Year 3 Monitoring Report for Stream Restoration of Bailey Fork

Burke County, NC
SCO # D04006-02

Prepared for:
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Ecosystem Enhancement PROGRAM

Submitted: November 2008

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I. EXECUTIVE SUMMARY

The Bailey Fork stream restoration project is located near Morganton in Burke County, North Carolina. Prior to restoration, the streambanks were denuded, actively eroding, and had a nearly vertical profiles. Vegetative cover was minimal along the stream. The project goal for the restoration, completed during early 2006, was to modify the dimension, pattern, and profile of the existing stream channels to stable and self-maintaining conditions by utilizing natural channel design techniques and procedures. Elements of the restoration design included improved bedform features, enhanced aquatic habitat diversity, establishment of riffle-pool sequences, in-stream grade control structures, rootwad bank stabilization, and establishment of a native forested riparian plant community. The following report documents the Year 3 Annual Monitoring for the project.

Monitoring of the vegetation was completed in September 2008 following the Carolina Vegetation Survey methodology. Stem counts completed in 10 vegetation plots show an average density of 373 stems per acre for the site, which meets the success criteria of 320 stems/acre after three years of monitoring. Four individual plots have stem densities below the minimum; these plots include one previously impacted by stream maintenance work, one previously infringed upon by pasture mowing, and one covered by the invasive *Sericea lespedeza*. Despite this, stem counts for Year 3 represent a net gain of 10 stems over the previous year, due to remedial plantings conducted in the spring of 2008. Further plantings will only be conducted as necessary to continue to maintain the required stem counts.

It is likely that the spread of *Sericea lespedeza* throughout much of the project corridor is hindering the growth and survival of woody vegetation. This species is a common component of pasture mixes and likely spread into the project area from the surrounding pasture lands. Management in 2008 included herbicide treatments, with spraying focused on targeted planted areas to minimize the impact of the invasive on woody survival. This spraying had minimal negative effect on the spread of this species. In addition, a very minor population of kudzu (*Pueraria montana*) was identified. Both species will be closely monitored, with further spraying conducted as deemed necessary to enhance survival of the planted species.

Previous monitoring of stream geomorphology identified some problem areas associated with channel stability. In Year 1, areas of streambank erosion, typically along outer meander bends, resulted in bank scour and/or bank failure at some locations. The banks at these locations were repaired and stabilized during Year 2, with extensive vegetation development contributing to streambank stability. Additionally, problem structures noted in previous monitoring years are not problem areas in Year 3, as project reaches have remained stable through the monitoring period, and show overall evidence the reaches are maintaining profile equilibrium. The indicators supporting this observation are parallel bankfull, water surface and channel slopes shown and noted on the longitudinal profiles. A few minor problem areas are noted in Year 3, but are limited to an isolated area of aggradation (mid-channel bar at profile station 1+75 on Lower Bailey Fork) and minimal bank scour (left bank at profile station 3+50 on Upper Bailey Fork) as summarized in Table Xc.

Bedform features continue to evolve along the restored reaches as shown on the long-term longitudinal profiles and monumented cross-sections. Riffle lengths and slopes are stable. Pool to pool spacings are representative of reference reach conditions, adjusted for drainage area and bankfull width. The pools have developed excellent glide features, with well sorted fine to medium gravels, providing good spawning habitat for native fishes. Riffle substrate compositions are conducive for benthic macro-invertebrate populations to re-emerge. Of interest is the change (median decrease) in pool to pool spacings from As-Built conditions to Year 3 as shown on the long-term monitoring profiles, and in tabular format on Table XII for each project reach. These

bedform adjustments represent an increase in channel stability. Comparison of As-Built, Year 1, Year 2 and Year 3 long-term stream monitoring data show successive increases in channel-floodplain connectivity and increasingly stable channel dimensions, interpreted from width/depth ratios, entrenchment ratios, and bank height ratios, as shown on the long-term monitoring profiles and cross-sections. The median bankfull dimensions, pattern, profile and substrate measurements presented in Table XII for each project reach, show transitions toward increased channel stability based upon bedform features, cross-section geometry, and planiform features. With channel geomorphologic data trends showing continual transition in increased stability, remedial stream maintenance work is not warranted at this time.

Pool substrate remains stable, with median particle sizes ranging from fine to coarse sand based on Year 3 substrate analysis. Constructed riffles remain stable, with a median particle sizes ranging from very coarse gravel to large cobble, with one anomaly from particle distributions collected at Riffle Cross-Section 5. Using the Year 3 particle distribution collected along this feature alone would indicate a Rosgen stream type substrate shift from C4 (coarse gravel) to a C3 (small to large cobble) dominated stream type (D50 = 110.1 mm; D84 = 163.8 mm). Sample interference is suspected due to the contribution of cobble-sized material introduced during construction of the cross-vane step structure at the sample location. Random substrate sample distributions collected at this location (with the exception of Year 0 "As-Built" sample) show C3, small to large cobble substrate composition. It is well documented, based on reference reach boundary conditions, pre-existing site substrate composition, and substrate readily available to the stream from the contribution drainage area, Upper Bailey Fork is a sand and gravel substrate system. To approximate a reach (Wolman, 1954) particle distribution, characteristic of Upper Bailey Fork, substrate particle distributions from Riffle Cross-Section 5 and Pool Cross-Section 7 were combined (n = 118 measurements). The D50 and D84 particle size for the approximated reach substrate particle distribution is 32.0 mm (coarse gravel) and 139.3 mm (large cobble), respectively, with fine to coarse sand comprising 37.3 percent of the sample composition. Based on Year 3 median pool lengths and spacings, the 800 l.f. long-term monitoring reach is 73.5 percent pools and glides and 26.5 riffles and runs. As a result, the combination of one pool and one riffle particle distribution will statistically skew (over-estimate) reach D50 and D84 median particle size distributions.

II. PROJECT BACKGROUND

A. Location and Setting

The project site is located approximately 2 miles southwest of Morganton, Burke County, North Carolina. The site is located 1.7 miles southwest of the I-40/US 64 interchange, as shown in Figure 1. The stream channels included in this project are the mainstem of Bailey Fork, and two unnamed tributaries to Bailey Fork, designated as UT1 and UT2. The project reach along the mainstem includes a portion upstream of Propst Road (hereafter referred to as Upper) and a portion downstream of that road (hereafter referred to as Lower).

The directions to the project site are as follows:

> From I-40, take US 64 south to Propst Road (SR 1112) and turn right. The project site is located on the north and south sides of Propst Road approximately 1,800 feet from the Propst Road and US 64 intersection.

B. Project Structure, Mitigation Type, Approach and Objectives

The primary, pre-existing land use within the immediate project site was agricultural. Based on photographic interpretation, the site has been historically utilized for agricultural row crop production and hayland. It is very likely the project site has been farmed since the Civil War era. The site was degraded by past land management practices including mechanical land clearing, straightening and dredging the stream channels. The project site was most recently utilized to produce hay for livestock feed. The stream banks were denuded, actively eroding, with vertical to undercut streambanks. Vegetative cover was minimal along the stream corridor, resulting in streambank erosion and lateral channel migration. The channels were deeply incised state and laterally confined. Prior to restoration, the floodplain was functioning as an abandoned terrace perched above the bankfull elevation.

The project restoration goal was to restore channel dimension, pattern, and profile to stable and self-maintaining conditions utilizing natural channel design techniques and procedures. Physical restoration and water quality improvements were accomplished by meeting the restoration goals and objectives below:

- Design channels with the appropriate cross-sectional dimension, pattern, and longitudinal profile based on reference reach boundary conditions.
- Improve and create bedform and aquatic habitat features (riffles, runs, pools, and glides)
- Integrate, in conjunction with the stream restoration, a nested floodplain (bankfull bench) connected to the bankfull channel elevation (Priority Level II restoration) or raise the bed elevation of the stream reconnecting the bankfull elevation to the existing floodplain elevation (Priority Level I restoration).
- Restore channel and streambank stability by integrating in-stream grade control structures, root wads, and native revetment while also creating stable and functional aquatic and terrestrial habitat.
- Establish a native forested riparian plant community within a minimum 30-feet buffer, measured horizontally from the left and right top of bank. Eradicate exotic vegetation and protect the riparian corridor with a perpetual conservation easement.
- Provide aesthetic and educational opportunities.

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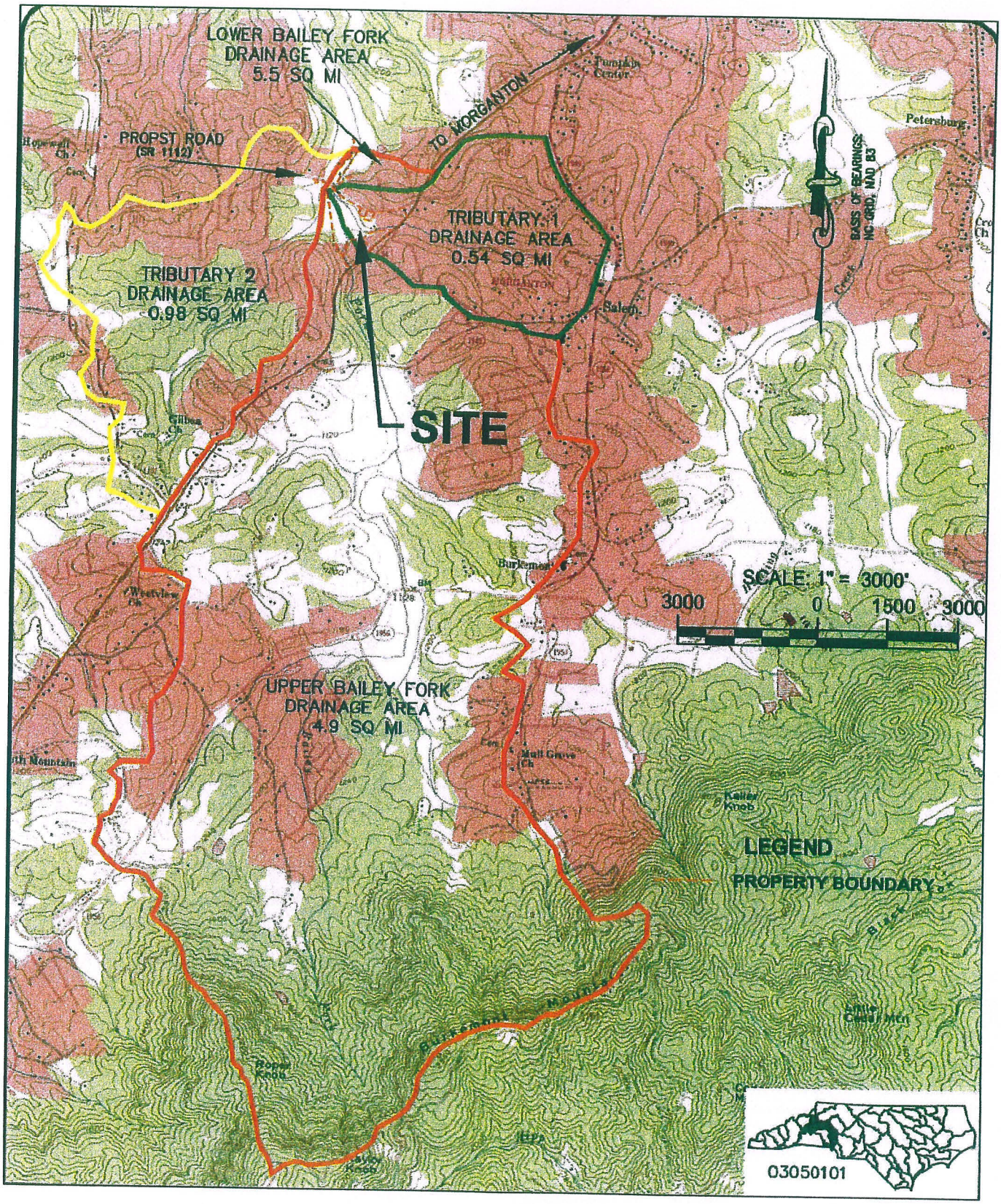
BAILEY FORK STREAM RESTORATION

FIGURE 1: SITE VICINITY MAP

N.C. ECOSYSTEM ENHANCEMENT PROGRAM

Date:	Job No.	Scale:
December, 2006	2006-1626	1" = 3000'



Restoration of the streams has met the objective of the project along both the mainstem of Thompsons Fork and the UT, providing the desired habitat and stability features required to improve and enhance the ecologic health of the streams for the long-term. Specifically, the completed restoration project has accomplished the items listed below.

Upper Bailey Fork:

- Reversed the effects of channelization using Priority Level II restoration techniques. The restoration has increased the median width/depth ratios from 7.59 to 12.80 after construction completion and 3 years of monitoring.
- Restored natural stream pattern, profile and dimension throughout the 1,543 l.f. stream reach, increasing channel sinuosity from 1.1 to 1.3, while creating a more stable relationship between the valley and bankfull slopes (the bankfull slope was greater than the valley slope under pre-existing conditions; the bankfull slope is now less than the valley slope).
- Stabilized eroding streambanks by providing an appropriately sized channel with stable streambank slopes using a combination of embedded stone, natural fabrics and aggressive native streamside and riparian revetment. The average Bank Height Ratio has been decreased from 1.95 (deeply incised) to 1.09 (stable) in Year 3.
- Provided a re-connection between the restored stream channel and a nested floodplain (bankfull bench) connected to the bankfull channel elevation (Priority Level II restoration). The completed restoration changed the average entrenchment ratio from <1.4 to 3.22, and restored the pre-existing unstable, incised and entrenched G4/F4 stream channel to a stable C4 stream type (Rosgen, 1994).
- Created instream aquatic habitat features including deep pools, rootwad streamside fish cover and streambank stabilization, constructed riffles, rock cross vanes and J-Hook vanes with deep pools and native streamside revetment to enhance outer meander bend stability, shade the pools, provide fish cover and lower water temperature to transition the channel thalweg of the restored stream to meet the culvert invert elevations at the three – 7.5 ft x 10.8 ft oval corrugated metal pipes (CMP) on the south side of Propst Road.
- Revegetated the streambanks and riparian corridor with indigenous trees, shrubs, herbaceous ground cover and preserved the riparian corridors within a perpetual conservation easement.

Lower Bailey Fork:

- Reversed the effects of channelization using Priority Level II restoration techniques. The restoration has increased the median width/depth ratios from 7.83 to 12.75 after construction completion and 3 years of monitoring.
- Restored natural stream pattern, profile and dimension throughout the 1,170 l.f. stream reach, increasing channel sinuosity from 1.1 to 1.3, while creating a more stable relationship between the valley and bankfull slopes (again, the bankfull slope was greater than the valley slope under pre-existing conditions; the bankfull slope is now less than the valley slope).
- Stabilized eroding streambanks by constructing an appropriately sized channel with stable streambank slopes using a combination of embedded stone, natural fabrics and aggressive native streamside and riparian revetment. The average Bank Height Ratio has been decreased from 1.95 (deeply incised) to 1.00 (stable).
- Provided a re-connection between the restored stream channel and a nested floodplain (bankfull bench) connected to the bankfull channel elevation (Priority Level II restoration). The completed restoration changed the average entrenchment ratio from <1.4 to 3.17, and restored the pre-existing unstable, incised and entrenched G4/F4 stream channel to a stable C4 stream type.

- Created instream aquatic habitat features including deep pools, rootwad streamside fish cover and streambank stabilization, constructed riffles, single arm log vanes, rock cross vanes and J-Hook vanes with deep scour pools and native streamside revetment to enhance outer meander bend stability, shade the pools, provide fish cover and lower water temperature.
- Revegetated the streambanks and riparian corridor with indigenous trees, shrubs, herbaceous ground cover and preserved the riparian corridors within a perpetual conservation easement.

Unnamed Tributary (UT-1):

- Reversed the effects of channelization utilizing natural channel design restoration techniques. The average width/depth ratio of the restored stream channel was increased from 5.40 to 17.08.
- Restored natural stream pattern, profile and dimension throughout the 1,758 l.f. stream reach, increasing channel sinuosity from 1.1 to 1.4, and providing a more stable relationship between the valley and bankfull slopes (the bankfull and valley slopes were essentially parallel under pre-existing condition. The bankfull slope is substantially less than the valley slope).
- Stabilized eroding streambanks by providing an appropriately sized channel with stable streambank slopes. The average Bank Height Ratio has been changed from 2.10 (extremely incised) to 1.01 (stable).
- Raised the streambed elevation reconnecting the bankfull elevation to the existing floodplain elevation (Priority Level I restoration).
- The completed restoration changed the average entrenchment ratio from 3.4 to 5.9.
- Created instream aquatic habitat features including deep pools, rootwad streamside fish cover and streambank stabilization, constructed riffles, rock sills, step cross vanes and J-Hook vanes with deep scour pools and native streamside revetment to enhance outer meander bend stability, shade the pools, provide fish cover and lower water temperature.
- Revegetated the streambanks and riparian corridor with indigenous trees, shrubs, herbaceous ground cover and preserved the riparian corridors within a perpetual conservation easement.

Unnamed Tributary (UT-2):

- Reversed the effects of channelization utilizing natural channel design restoration techniques. The average width/depth ratio of the restored stream channel was increased from 3.42 to 16.78.
- Restored natural stream pattern, profile and dimension throughout the 1,271 l.f. stream reach, increasing channel sinuosity from 1.1 to 1.4, and providing a more stable relationship between the valley and bankfull slopes (the bankfull slope was greater than the valley slope under pre-existing conditions; the bankfull slope is now less than the valley slope).
- Stabilized eroding streambanks by providing an appropriately sized channel with stable streambank slopes. The average Bank Height Ratio is 1.01 (stable) post-restoration and after 3 years of monitoring.
- Raised the streambed elevation reconnecting the bankfull elevation to the existing floodplain elevation (Priority Level I restoration).
- The completed restoration changed the average entrenchment ratio from <1.4 to 4.75.
- Created instream aquatic habitat features including deep pools, streambank stabilization, constructed riffles, rock sills, log sills, rock cross vanes and J-Hook vanes with deep scour pools and native streamside revetment to enhance outer

meander bend stability, shade the pools, provide fish cover and lower water temperature.

- Revegetated the streambanks and riparian corridor with indigenous trees, shrubs, herbaceous ground cover and preserved the riparian corridors within a perpetual conservation easement.

Information on the project structure and objectives is included in Tables I and II.

Table I. Project Structure Table
Bailey Fork Stream Restoration / EEP Project No. D04006-02

Project Segment/Reach ID	Linear Footage or Acreage
Upper	1,543.0 lf
Lower	1,170.4 lf
UT1	1,758.1 lf
UT2	1,271.0 lf
TOTAL	**5,742.5 lf**

Table II. Project Mitigation Objectives Table
Bailey Fork Stream Restoration / EEP Project No. D04006-02

Project Segment/ Reach ID	Mitigation Type	Approach	Linear Footage or Acreage	Comment
Upper	Restoration	Priority 2	1,543.0 lf	Restore dimension, pattern, and profile
Lower	Restoration	Priority 2	1,170.4 lf	Restore dimension, pattern, and profile
UT1	Restoration	Priority 1	1,758.1 lf	Restore dimension, pattern, and profile
UT2	Restoration	Priority 1	1,271.0 lf	Restore dimension, pattern, and profile
TOTAL			**5,742.5 lf**	

C. Project History and Background

Project activity and reporting history are provided in Table III. The project contact information is provided in Table IV. The project background history is provided in Table V.

Table III. Project Activity and Reporting History Bailey Fork Stream Restoration / EEP Project No. D04006-02			
Activity or Report	**Scheduled Completion**	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration plan	Jan 2005	Oct 2004	Mar 2005
Final Design - 90%[1]	Jan 2005	N/A	Mar 2005
Construction	Aug 2005	N/A	Sep 2005
Temporary S&E applied to entire project area[2]	Feb 2005	N/A	Feb 2005
Permanent plantings	Mar 2006	N/A	Mar 2006
Mitigation plan/As-built	Dec 2005	May 2006	Aug 2006
Year 1 monitoring	2006	Sep 2006 (vegetation) Apr 2007 (geomorphology)	May 2007
Remedial Stream Maintenance*	Aug 2007	N/A	Aug 2007
Year 2 monitoring	2007	Sep 2007 (vegetation) Oct 2007 (geomorphology)	Jan 2008
Year 3 monitoring	2008	Sep 2008 (vegetation) Oct 2008 (geomorphology)	Nov 2008
Year 4 monitoring	2009		
Year 5 monitoring	2010		

[1]Full-delivery project; 90% submittal not provided.
[2]Erosion and sediment control applied incrementally throughout the course of the project.
N/A: Data collection is not an applicable task to these project activities.
*Remedial Maintenance involved efforts to repair the degraded reaches of the channel along Upper and Lower Bailey Fork, improving channel bank stability by creating a more stable bank slope, as shown on the August 2007 maintenance plan sheet.

Table IV. Project Contact Table Bailey Fork Stream Restoration / EEP Project No. D04006-02	
Designer	Natural Systems Engineering* 3719 Benson Drive , Raleigh, NC 27609
Construction Contractor	Natural Systems Engineering* 3719 Benson Drive , Raleigh, NC 27609
Monitoring Performers	EMH&T, Inc. 5500 New Albany Road, Columbus, OH 43054
Stream Monitoring POC	Warren E. Knotts, P.G., EMH&T
Vegetation Monitoring POC	Holly Blunck, EMH&T
*Contact:	Jim Halley at The John R. McAdams Company, Inc 2905 Meridian Parkway, Durham, NC 27713

Table V. Project Background Table
Bailey Fork Stream Restoration / EEP Project No. D04006-02

Project County	Burke
Drainage Area-Upper	4.9 sq mi
Drainage Area-Lower	5.5 sq mi
Drainage Area-UT1	0.55 sq mi
Drainage Area-UT2	0.98 sq mi
Drainage Impervious Cover Estimate	10%
Stream Order	2nd
Physiographic Region	Inner Piedmont
Ecoregion	Northern Inner Piedmont
Rosgen Classification of As-built	E/C type
Dominant Soil Types	Colvard sandy loam
Reference Site ID	Sal's Branch, Whites Creek, S. Muddy Birchfield, S. Muddy Tributary 4
USGS HUC for Project and Reference	03050101
NCDWQ Sub-basin for Project and Reference	03-08-31
NCDWQ Classification for Project and Reference	C
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	No
Reason for 303d listing or stressor	N/A
% of project easement fenced	20%

*Data for Table V was derived from information from reports produced by Natural Systems Engineering.

D. Monitoring Plan View

The monitoring plan view is included as Figure 2. The information shown in Figure 2 is derived entirely from the As-Built stream plan provided with the approved Mitigation Plan report. In-stream structures shown on the plan view have been verified by the stream restoration designer/contractor based on field reconnaissance. The monitoring plan view also depicts the locations of each monumented cross-section, vegetation plot, crest gage and photo point that are part of the five year monitoring effort for this project.

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BAILEY FORK STREAM RESTORATION

FIGURE 2A - INDEX MAP

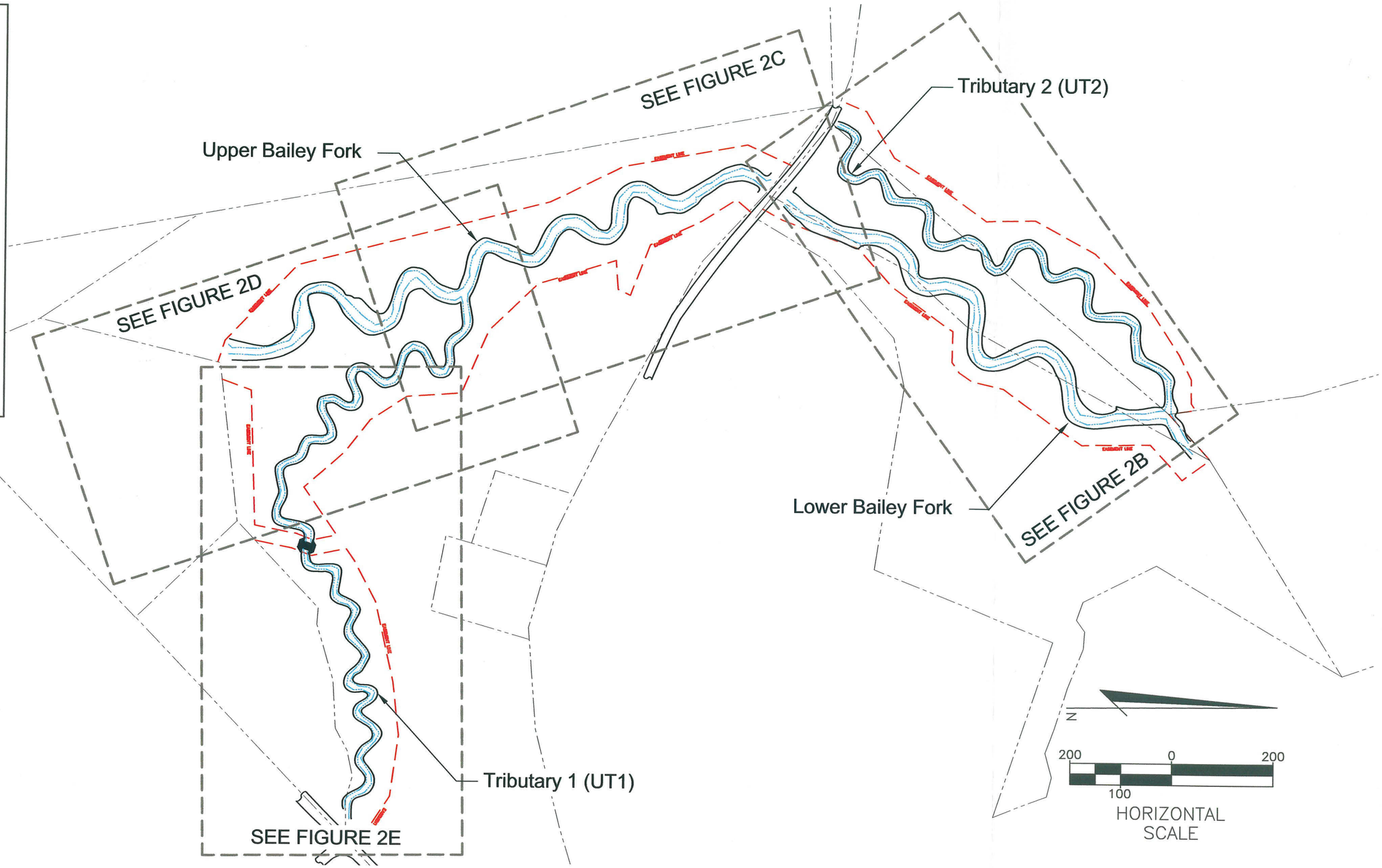
N.C. ECOSYSTEM ENHANCEMENT PROGRAM

Date:	December, 2007
Scale:	1" = 60'
Job No:	2006-1626

LEGEND

- Root Wad
- Step–Cross Vane
- "J" Hook
- Rock Channel Sill
- Log Channel Sill
- Riffle

Base map and structure locations are shown per the as–built plan completed by Natural Systems Engineering in Nov. 2007.



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BAILEY FORK STREAM RESTORATION

FIGURE 2B

N.C. ECOSYSTEM ENHANCEMENT PROGRAM

Date:	December, 2007
Scale:	1" = 60'
Job No:	2006-1626

LEGEND

- Vegetation Plot
- Photo Point
- Cross Section
- Crest Gauge

N/F
DAVID STROUP & WF
DB. 225 PG. 58

EASEMENT LINE

NEW FENCE LINE

VP-7

VP-8

VP-9

VP-10

PHOTO POINT 10 (PHOTO #10)

XSEC 10

PHOTO POINT 9 (PHOTO #9)

XSEC 9

PHOTO POINT 12 (PHOTO #12)

XSEC 12

PHOTO POINT 11 (PHOTO #11)

XSEC 11

PHOTO POINT 13 (PHOTO #13)

CG3

CG4

PROPOSED VANE

N/F
CHARLES TALBERT
DB. 1322 PG. 157
PB. 4 PG. 29

N

60 0 60
30
HORIZONTAL SCALE

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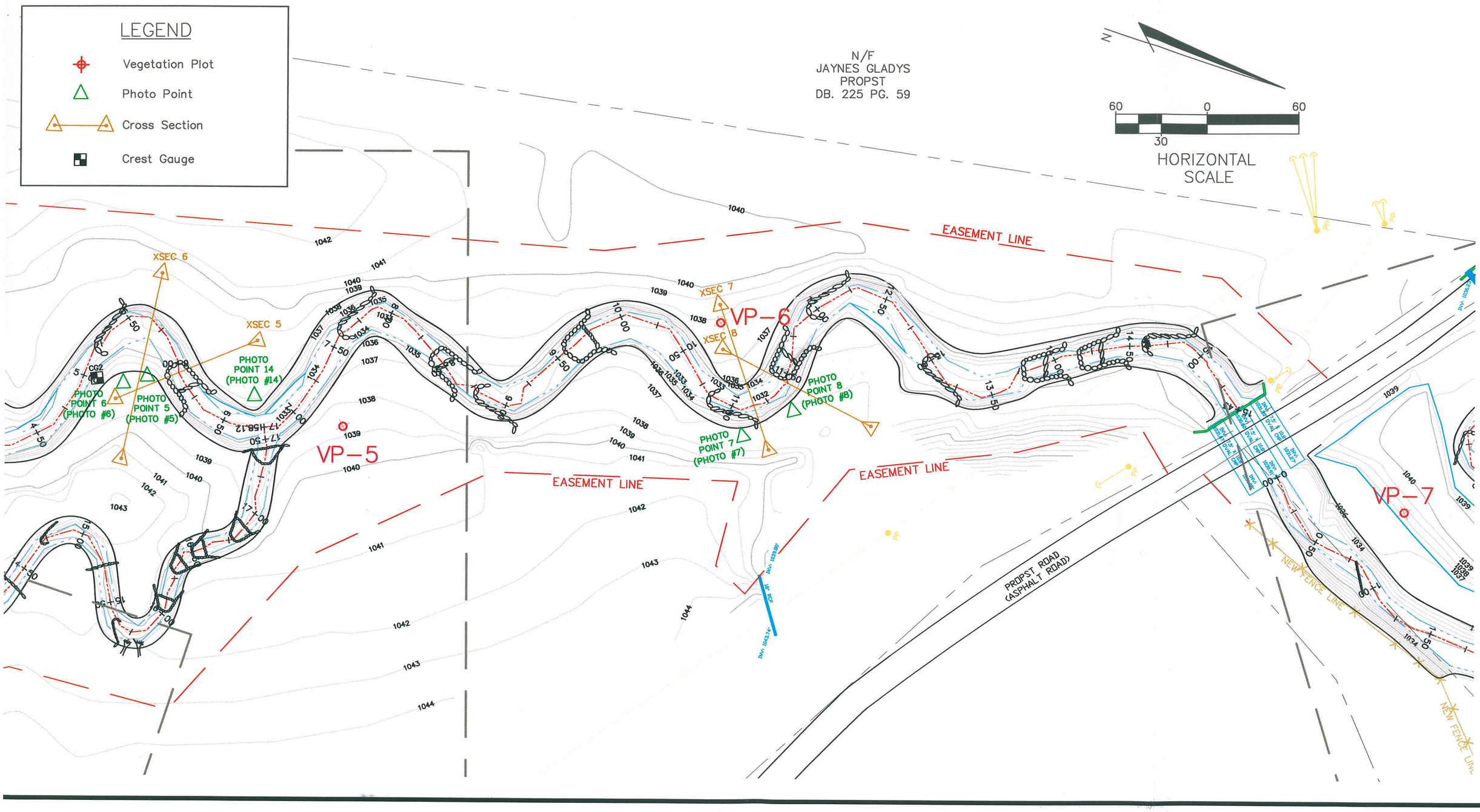
BAILEY FORK STREAM RESTORATION

FIGURE 2C

N.C. ECOSYSTEM ENHANCEMENT PROGRAM

Date:	December, 2007
Scale:	1" = 60'
Job No:	2006-1626



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BURKE COUNTY, NORTH CAROLINA

BAILEY FORK STREAM RESTORATION

FIGURE 2D

N.C. ECOSYSTEM ENHANCEMENT PROGRAM

Date:	December, 2007
Scale:	1" = 60'
Job No:	2006-1623

LEGEND

- Vegetation Plot
- Photo Point
- Cross Section
- Crest Gauge

N/F
CHARLIE DUVAL
DB. 841 PG. 1650

EASEMENT LINE

EASEMENT LINE

VP-2

VP-3

VP-4

VP-5

XSEC 6

XSEC 5

XSEC 4

XSEC 3

PHOTO POINT 6 (PHOTO #6)

PHOTO POINT 5 (PHOTO #5)

PHOTO POINT 14 (PHOTO #14)

PHOTO POINT 4 (PHOTO #4)

PHOTO POINT 3 (PHOTO #3)

CG2

N

60 0 60
30
HORIZONTAL SCALE

PERMANENT BENCHMARK
ELEVATION 1045.53 FT.

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BURKE COUNTY, NORTH CAROLINA

BAILEY FORK STREAM RESTORATION

FIGURE 2E

N.C. ECOSYSTEM ENHANCEMENT PROGRAM

Date:	December, 2007
Scale:	1" = 60'
Job No:	2006-1626

LEGEND

- Vegetation Plot
- Photo Point
- Cross Section
- Crest Gauge

EASEMENT LINE

VP-1

VP-2

VP-4

XSEC 1

XSEC 2

XSEC 3

XSEC 4

PHOTO POINT 1 (PHOTO #1)

PHOTO POINT 2 (PHOTO #2)

PHOTO POINT 3 (PHOTO #3)

PHOTO POINT 4 (PHOTO #4)

PHOTO POINT 15 (PHOTO #15)

CG1

HWY 64 (ASPHALT ROAD)

N/F
CRYSTAL & JIMMA
SMITH
DB. 592 PG. 164

N

60 0 60
30
HORIZONTAL SCALE

III. PROJECT CONDITION AND MONITORING RESULTS

A. Vegetation Assessment

1. Soil Data

Soils present in the riparian area adjacent to Bailey Fork are characteristic of those found in alluvial landforms within the Northern Inner Piedmont ecoregion of North Carolina. Colvard sandy loam soils are mapped within the floodplain and immediately adjacent to the stream channels on the project site. Colvard soils are formed in loamy alluvial deposits, and are nearly level, very deep, and well-drained or moderately well-drained.

Other soils within the project's vicinity include Fairview sandy clay loam and Unison fine sandy loam, which are mapped on adjacent slopes and terraces. No hydric soils were mapped within the project corridor.

Data on the soils series found within and near the project site is summarized in Table VI.

Table VI. Preliminary Soil Data
Bailey Fork Stream Restoration / EEP Project No. D04006-02

Series	Max. Depth (in.)	% Clay on Surface	K[1]	T[2]	% Organic Matter
Colvard sandy loam	60+	8-18	0.24	5	1-2
Fairview sandy clay loam	60+	20-35	0.24	5	0.5-1
Unison fine sandy loam	60+	12-20	0.24	5	0.5-1

Data for Table VI was derived from information from reports produced by Natural Systems Engineering.
[1]Erosion Factor K indicates the susceptibility of a soil to sheet and rill erosion, ranging from 0.05 to 0.69.
[2]Erosion Factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity, measured in tons per acre per year.

2. Vegetative Problem Areas

Vegetative Problem Areas are defined as areas either lacking vegetation or containing populations of exotic vegetation. Each problem area identified during each year of monitoring is summarized in Table VII. Photographs of the vegetative problem areas are shown in Appendix A. There are a few locations where the density of planted woody stems is not high enough to meet the required stem counts. Densities of planted woody species are discussed in the Stem Counts section of this report.

Table VII. Vegetative Problem Areas
Bailey Fork Stream Restoration / EEP Project No. D04006-02

Feature/Issue	Station # / Range	Probable Cause	Photo #
Invasive Population	Throughout: See VPA Plan View	*Sericea lespedeza*: encroachment from pasture	VPA 1, VPA 2

The most pervasive vegetative problem is the spread of an invasive species, *Sericea lespedeza.* This species is a common component of pasture mixes, and as this project is adjacent to pasture/hay lands, it likely spread into the project area from the surrounding landscape. The spread of the species is extensive throughout the project corridor, and has increased slightly over

the past year. Management in 2008 included herbicide treatments, with spraying focused on the areas most densely planted with trees in an attempt to minimize the impact of the invasive on woody survival. This spraying had minimal negative effect on the spread of this species. Further spraying will be conducted throughout the monitoring period as deemed necessary to enhance survival of the planted species. Management of the woody vegetation is discussed in the Stem Counts section of this report.

A very minor population of kudzu (*Pueraria montana*) was identified near Vegetation Plot #5. While the population of this species remains too small to have an impact on the desried vegetation at this time, it will be closely monitored to document and manage future spread of this invasive species.

An additional problem area noted in Year 2 included a section along Upper Bailey Fork where remedial maintenance activities along the stream banks impacted Vegetation Plot #6. The vegetation of the plot, along with much of the buffer vegetation along the top of the slope at this location, was damaged or destroyed by the construction activities. The streambanks were reseeded upon completion of maintenance activities, and new trees were planted in the spring of 2008. As this plot has become fully vegetated, it has been removed from consideration as a problem area for bare banks.

3. Vegetation Problem Area Plan View

The location of each vegetation problem area is shown on the vegetative problem area plan view included in Appendix A. Each problem area is color coded with yellow for areas of low concern (areas to be watched) or red for high concern (areas where maintenance is warranted).

4. Stem Counts

A summary of the stem count data for each species arranged by plot is shown in Table 8. This data was compiled from the information collected on each plot using the *CVS-EEP Protocol for Recording Vegetation, Version 4.0.* Additional data tables generated using the CVS-EEP format are included in Appendix A. All vegetation plots are labeled as VP in Figure 2.

Table VIII. Stem counts for each species arranged by plot.
Bailey Fork Stream Restoration / EEP Project No. D04006-02

Species	Plots										Year 1 Totals	Year 2 Totals	Year 3 Totals	Survival %
	1	2	3	4	5	6	7	8	9	10				
Shrubs														
Alnus serrulata	1										1	1	1	100
Cephalanthus occidentalis											3	3	0	0
Cornus amomum				6	1		1	3	3	2	9	9	16	100
Rosa palustris	2										2	2	2	100
Trees														
Fraxinus pennsylvanica					1						0	0		100
Liriodendron tulipifera				1		4	3				15	4	8	53
Malus sp.	1										0	0		100
Nyssa sylvatica	1										0	0		100
Platanus occidentalis	1	1	9	4			6			10	35	30	31	89
Quercus pagoda		8					4	9	2		31	28	23	74
Quercus phellos		1	1	2		1	1	2			9	5	8	89
Salix nigra											1	0	0	0
Totals	6	10	10	13	2	5	15	14	5	12	106	82	92	87
Live Stem Density	243	405	405	527	81	203	608	567	203	486				
Average Live Stem Density	373													

The average stem density for the site exceeds the minimum criteria of 320 stems per acre after three years. Four individual plots have stem densities below the minimum; however, eight seedlings have recruited in Plot #1, which would increase the stem count to exceed the minimum criteria. This is an increase over the seedling recruitment count of four found in 2007. Plot #6 was disturbed during remedial maintenance activity on the stream banks between monitoring in Years 1 and 2; two stems were planted in this plot in 2008, increasing the stem count in Year 3 over that found in Year 2. Plot #5 was damaged by pasture mowing in Year 1; two planted stems and one recruited seedling have subsequently been found in this plot, increasing the stem count over the original monitoring period. The final plot, Plot #9, is densely covered by *Sericea lespedeza*, which appears to have had a greater effect on both survival and recruitment in this plot than the others in the project corridor also affected by this invasive species.

It is likely that the spread of *Sericea lespedeza* throughout much of the project corridor has hindered the growth and survival of woody vegetation. Where present, this species is dominant, providing a thick coverage of growth approximately three feet high through which any species must break in order to receive sunlight or rainfall. A round of remedial tree plantings were conducted in 2008, which were intended to bring deficient areas of the site back into compliance with the 320 stems per acre minimum. Due to continued mortality of planted stems which is speculated to be due to the coverage of *Sericea lespedeza*, these plantings did not bring all areas of the site back to the minimum stem count. The remedial plantings did, however, result in a net

gain of woody stems for the entire site. The increase in total woody stems is considered a significant achievement, and further plantings will only be conducted as necessary to continue to maintain the required stem counts.

5. Vegetation Plot Photos

Vegetation plot photos are provided in Appendix A.

B. Stream Assessment

1. Hydrologic Criteria

One bankfull event was documented for the site, as reported in the Mitigation As-Built Report. Additional events were recorded in Year 2, and listed in Table IX. Photographs of the crest gages are shown in Appendix B.

Table IX. Verification of Bankfull Events

Date of Data Collection	Date of Occurrence	Method	Photo #
10/31/05	10/7/05-10/8/05	Photographs; Stream Gage Data	In Mitigation Plan
7/19/07	Unknown	Crest Gage 1 on UT1	BF 1
10/17/07	9/14/07-9/15/07*	Crest Gage 4 on Lower Bailey	BF 2

*Date is approximate; based on a review of recorded rainfall data

No additional bankfull events occurred during Year 3.

2. Stream Problem Areas

A summary of the areas of concern identified during the visual assessment of the stream for each year of monitoring is included in Tables Xa through Xc.

Table Xa. Stream Problem Areas – Year 1 Bailey Fork Stream Restoration / EEP Project No. D04006-02			
Feature Issue	**Station Numbers**	**Suspected Cause**	**Photo Number**
Aggradation	4+00 - 4+25 Upper	Lateral bar; bank material moving	SPA 1 (Year 1 Report)
	1+50 - 2+00 Upper	Lateral bar; bank material moving	
Bank failure	9+00 Lower	Rootwad causing reverse circulation leading to downstream bank scour and undercutting	SPA 2 (Year 1 Report)
	8+00 Lower	Large boulder fell out of bank; bank undercutting	
	11+50 Upper	Bank armor has fallen, undercutting	
Bank scour	11+80 - 12+50 Upper	Coir matting has fallen, bank erosion; deposition downstream	SPA 3 (Year 1 Report)
	10+25 Upper	Rootwad causing reverse circulation leading to downstream bank scour and undercutting	
	3+50 Upper	Channel is over widened, bank is slumping	
Stressed/failing structure	5+60 UT2	Embedded rock sill; channel is stable	SPA 4 (Year 1 Report)
	2+50 UT2	Embedded cross-vane; channel is stable	
	1+25 UT2	Embedded J-hook; channel is stable	
	14+75 Upper	Partially embedded J-hook; channel is stable	
	13+00 Upper	Embedded J-hook; channel is stable	
	10+60 UT1	Embedded rock sill ; channel is stable	
	3+25 UT1	Partially embedded J-hook; channel is stable	
	0+50 UT1	Embedded J-hook; channel is stable	
	0+25 UT1	Embedded rock sill ; channel is stable	
Other	7+00 UT1	Sinkhole adjacent to channel; piping water	SPA 5 (Year 1 Report)

Table Xb. Stream Problem Areas – Year 2 Bailey Fork Stream Restoration / EEP Project No. D04006-02			
Feature Issue	**Station Numbers**	**Suspected Cause**	**Photo Number**
Aggradation	1+50 - 2+00 Upper	Point bar; vegetated and stable	SPA 1, SPA 2
	1+75 Lower	Mid-channel bar	
Bank scour	3+50 Upper	Channel overwidened, left bank is slumping, W/D too high resulting in aggradation.	SPA 3, SPA 4
Stressed/failing structure	5+60 UT2	Embedded rock sill; channel is stable	SPA 5, SPA 6
	2+50 UT2	Embedded cross-vane; channel is stable	
	1+25 UT2	Embedded J-hook; channel is stable	
	14+75 Upper	Partially embedded J-hook; channel is stable	
	13+00 Upper	Embedded J-hook; channel is stable	
	2+50 Upper	Embedded J-hook; channel is stable	
	12+00 UT1	Embedded rock sill; channel is stable	
	10+60 UT1	Embedded rock sill ; channel is stable	
	3+25 UT1	Partially embedded J-hook; channel is stable	
	2+00 UT1	Embedded J-hook; channel is stable	
	0+50 UT1	Embedded J-hook; channel is stable	
Other	7+00 UT1	Sinkhole adjacent to channel; has improved since the previous year due to floodplain deposition	

Table Xc. Stream Problem Areas – Year 3 Bailey Fork Stream Restoration / EEP Project No. D04006-02			
Feature Issue	**Station Numbers**	**Suspected Cause**	**Photo Number**
Aggradation	1+50 - 2+00 Upper	Point bar; vegetated and stable	SPA 1, 2
	1+75 Lower	Mid-channel bar; vegetated and stable	
	6+30 UT1	Embedded rock sill; channel is stable	
	8+00 UT1	Embedded J-hook; channel is stable	
Bank scour	3+50 Upper	Slumping on left bank; heavily vegetated, channel is stable	SPA 3, 4, 5

Several features were removed from the stream problem areas table in Year 3. The majority of structures listed in the table in Year 2 were embedded throughout the monitoring period. However, the stream channels remain stable in these areas. Because the channel has remained stable throughout two consecutive years of monitoring, the structures are no longer considered problem areas and were removed from the Year 3 table. The remaining feature removed from the table was a sinkhole found along Tributary UT1. As no such sinkhole was identified in Year 3, likely due to deposition and subsequent heavy vegetative establishment, the feature has been removed from consideration as a problem area.

Five potential problem areas remain in Year 3, and are limited to isolated areas of aggradation and minimal bank scour. The bank scour noted near station 3+50 along Upper Bailey Fork in Years 1 and 2 has become heavily vegetated in Year 3, providing increases in root mass densities and streambank stability. The area noted as aggrading between profile stations 1+50 and 2+00 on Upper Bailey Fork is a point bar, an area of natural deposition in a sand and gravel dominated, C4 stream type. The mid-channel bar at profile station 1+75 on Lower Bailey Fork is of greater concern due to increases in near-bank shear stress associated with these types of mid-channel depositional features. Although the streambanks and channels are presently stable at the locations noted, theses areas will remain on the problem area table to ensure each is monitored through Year 4.

Two structures along UT1 were affected by aggradation in Year 3. Sand is the dominant streambed substrate in the project reaches, and as such, sediment deposition over the noted structures is attributed to high sediment supply readily available to UT1 upstream in the contribution watershed. Because the issue for these structures arises from depositional trends, rather than a concern with the physical structure, these areas are listed in the table as aggradation issues, not failed structures. It is noted that at both locations on UT1 (profile stations 6+30 and 8+00) where the two structures are embedded, the channel and streambanks are stable, with no bar formation.

During September 2008, EMH&T's Charlotte-based personnel surveyed the entire 1,759 l.f. UT1 reach, rather than picking up only the first 800 l.f. as approved in the as-built mitigation plan. This provided a unique opportunity to evaluate depositional trends, along the entire reach, by direct comparison of Year 3 to Year 0, as-built channel conditions.

The Year 0, as-built channel profile was overlaid with the Year 3 total station survey thalweg, water surface and bankfull indicator points and is included in Appendix B. Of interest, the best-fit trend line through the thalweg points for Year 0 and Year 3 cross near the reach midpoint, at profile station 9+50.6. Upstream from this profile station, the reach exhibits slight overall aggradation, ranging from 0.00 feet of deposition at station 9+50.6 to 0.48 feet of deposition at profile station 0+00 (i.e., the vertical difference between the best-fit thalweg trend lines for the two datasets). Conversely, there is 0.00 feet of degradation at profile station 9+50.6, and at profile

station 17+58 the vertical difference between to the best-fit trend lines is 0.40 feet of net degradation. There is only a infinitesimally small difference in channel slope from Year 0 to Year 3, with reach thalweg slopes of 0.0071 ft/ft and 0.0070 ft/ft, respectively. The evaluation of these subtle depositional trends was possible only by using the "zoom in" tool built into RiverMorph® v.4.1.1.

The conclusion drawn from this exercise is UT1 is approaching profile equilibrium post restoration. The observed depositional trends represents the stream's natural response to its realignment, grade control and aggressive riparian revetment associated with the stream mitigation project. These observations provide an understanding of both the cause and effect for the embedded conditions at the rock sill located at profile station 6+30 and J-Hook vane at profile station 8+00 upstream from the intersect point of the two best-fit streambed trend lines at station 9+50.6. The observed condition in the field are explained by natural and well understood fluvial geomorphic processes as natural streams entrain and deposit sediment in response to subtle shifts in base level and hydraulic controls (i.e., in-stream structures). Should the results from geomorphic stream surveys during monitoring Year 4 support depositional trends observed from Year 0 through September 26, 2008, the completion date of the Year 3 total station stream surveys on Bailey Fork and its two Unnamed Tributaries, these two problem areas will be removed from Table X in Year 4.

3. Stream Problem Areas Plan View

The location of each structural problem area is shown on the stream problem area plan view included in Appendix B. Each problem area is color coded with yellow for areas of low concern (areas to be watched) or red for high concern (areas where maintenance is warranted).

4. Stream Problem Areas Photos

Photographs of the stream problem areas noted in Table Xb are included in Appendix B.

5. Fixed Station Photos

Photographs were taken at each established photograph station on September 9, 2008. These photographs are provided in Appendix B.

6. Stability Assessment Table

The visual stream assessment was performed to determine the percentage of stream features remaining in a state of stability after the first year of monitoring. A summary of the visual assessment for each reach is included in Table XIa through Table XId. This summary was compiled from the more comprehensive Table B1, included in Appendix B. Each of the structures shown on the as-built plans were assessed during monitoring and reported in the tables.

Table XIa. Categorical Stream Feature Visual Stability Assessment Bailey Fork Stream Restoration / EEP Project No. D04006-02 Segment/Reach: Upper						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
A. Riffles[1]	100%	87%	87%	87%		
B. Pools[2]	100%	88%	88%	84%		
C. Thalweg	100%	100%	100%	100%		
D. Meanders	100%	91%	98%	98%		
E. Bed General	100%	98%	98%	98%		
F. Vanes / J Hooks etc. [3]	100%	97%	96%	96%		
G. Wads and Boulders[4]	N/A	N/A	N/A	N/A		

Table XIb. Categorical Stream Feature Visual Stability Assessment Bailey Fork Stream Restoration / EEP Project No. D04006-02 Segment/Reach: Lower						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
A. Riffles[1]	100%	100%	100%	100%		
B. Pools[2]	100%	100%	100%	100%		
C. Thalweg	100%	100%	100%	100%		
D. Meanders	100%	91%	100%	100%		
E. Bed General	100%	100%	99%	99%		
F. Vanes / J Hooks etc. [3]	100%	100%	100%	100%		
G. Wads and Boulders[4]	N/A	N/A	N/A	N/A		

Table XIc. Categorical Stream Feature Visual Stability Assessment Bailey Fork Stream Restoration / EEP Project No. D04006-02 Segment/Reach: UT1						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
A. Riffles[1]	100%	93%	92%	92%		
B. Pools[2]	100%	89%	87%	86%		
C. Thalweg	100%	100%	100%	100%		
D. Meanders	100%	100%	100%	100%		
E. Bed General	100%	100%	100%	98%		
F. Vanes / J Hooks etc. [3]	100%	97%	97%	95%		
G. Wads and Boulders[3]	100%	100%	100%	100%		

Table XId. Categorical Stream Feature Visual Stability Assessment Bailey Fork Stream Restoration / EEP Project No. D04006-02 Segment/Reach: UT2						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
A. Riffles[1]	100%	100%	89%	100%		
B. Pools[2]	100%	96%	86%	93%		
C. Thalweg	100%	100%	100%	100%		
D. Meanders	100%	100%	100%	100%		
E. Bed General	100%	100%	100%	100%		
F. Vanes / J Hooks etc. [3]	100%	95%	95%	95%		
G. Wads and Boulders[4]	N/A	N/A	N/A	N/A		

[1]Riffles are assessed using the longitudinal profile. A riffle is determined to be stable based on a comparison of location and elevation with respect to the as-built profile.
[2]Pools are assessed using the longitudinal profile. A pool is determined to be stable based on a comparison of location and elevation with respect to the as-built profile and a consideration of appropriate depth.
[3]Physical structures such as vanes, J-hooks, and root wads are assessed using the as-built plan sheets to define the location of such features. A structure is considered stable if the feature remains functional in the same location as shown in the as-built plan.
[4]Those features not included in the stream restoration were labeled N/A. This includes structures such as rootwads and boulders.

Identified problematic structures on Tributaries UT1 and UT2 were vanes/J-hooks. Each of the affected structures has become embedded in sand size sediment. However, the channel is stable at each location where aggradation has covered a structure. The percentage of embedded features has remained relatively the same for both tributaries from Year 1 to Year 3. (See discussion in Section B.2, the longitudinal profiles, cross-sections and the tabular geomorphic and hydraulic summary data for each reach in Table XII).

As a result of the streambank maintenance that occurred along Lower Bailey Fork in Year 2 during August 2007, each meander that was in an unstable state during Year 1 was repaired and remains stable in Year 3. At profile station 1+75 on Lower Bailey Fork, bed instability was noted in Year 2 where a mid-channel bar formed. This feature is still present in Year 3.Mid-channel bars form due to over widening of the channel (i.e., increase in width/depth ratio). During high flows and bankfull events, the hydraulics created by a longitudinal mid-channel bars divert stream power from the center of the channel and increases shear stress in the near-bank region along both sides of the channel. Left unchecked, mid-channel bars have a general tendency to enlarge over time and contribute to ongoing channel overwidening by eroding both the left and right banks. This location will continue to be monitored during channel stability assessments in future monitoring years.

Upper Bailey Fork had several categories where unstable features were noted. However, the stability percentages between Year 2 and 3 are very similar for the categories "bed general", "vanes/J-hooks", and the stability percentage improved or unchanged for the "meanders" category. As on Lower Bailey Fork, the eroding meanders were repaired and remain stable through Year 3. Noted structures are embedded by fine to coarse sand sediment along this reach. However, the channel remains stable at each location where sand entrainment and deposition has covered a structure.

Three of the four stream reaches were noted to have unstable pools and riffles during Year 2; in the tributaries, particularly UT2, the stability percentage decreased from Year 1 to Year 2.

Deposition was deemed the likely cause for those pools and riffles that differed in profile from as-built, Year 0 conditions. Some of the pools have become quite shallow, a few to the point of losing pool functions. In Year 3 UT2 shows considerable recovery with substantial percentage increases in both pool and riffle stability categories. The unstable riffles were typically areas where a structure had become covered by sediment. The decline in stability percentage from Year 1 to Year 2 was attributed to sedimentation, as aggradation was a visible trend throughout the profiles in Year 2. This bedform adjustment may be attributed to extended drought during the summer of 2007 and minimal flushing of sand-sized particles through the project reaches. During Year 3, the stability and integrity of pools and riffles on each of the project reaches remained essentially the same with minor gains and/or losses based on visual stability assessments. Despite slight aggradation in some locations, and degradation at other locations, the common theme drawn from the visual assessments, combined with detailed geomorphic and hydraulic assessment and analyses of Year 3 monitoring data show each of the reaches transitioning in the direction of increased stability, with improved channel-floodplain connectivity based on increasing trends in entrenchment ratios, decreasing trends in Bank Height Ratios, and stable width/depth ratios from analysis of the 12 monumented, long-term monitoring cross-sections on the project reaches. Each of the four reaches are stable in Year 3. Therefore, no maintenance is warranted based on qualitative and quantitative data analyses of Year 3 monitoring data for Bailey Fork and Tributaries.

7. Quantitative Measures

Graphic interpretations of cross-sections, profiles and pebble counts are provided in Appendix B. A summary of the baseline morphology for the site is included in Table XII for comparison with the monitoring data shown in the tables in the appendices. Geomorphic data in Table XII, except for Year 1 through Year 3 monitoring data, was provided by Natural Systems Engineering. Year 0 data presented in cross-sections and profiles, contained in Appendix B, were also provided by Natural Systems Engineering.

The stream pattern data provided for Year 1 and Year 2 is the same as the data provided from the As-Built survey, as pattern has not changed based on Year 1 and Year 2 stream surveys and visual field assessments.

Bedform features continue to evolve along the restored reaches as shown on the long-term longitudinal profiles. Riffle lengths and slopes are stable. Pool to pool spacings are representative of reference reach conditions, adjusted for drainage area and bankfull width. The pools have developed excellent glide features, providing spawning habitat for native fishes and riffle substrates conducive for benthic macro-invertebrate populations to re-emerge. Of interest, is the change (median decrease) in pool to pool spacings between Year 1, Year 2 and Year 3 on Upper and Lower Bailey Fork and UT-2. Pool to pool spacings have remained relatively the same from Year 0 through Year 3 as shown on the profiles and as summarized in Table XII. The bedform adjustments may be attributed to extended drought beginning during the summer of 2006 through 2008 (low flow conditions) and minimal flushing of sand-sized particles through the project reaches. Future monitoring may confirm this hypothesis. Comparison of As-Built, Year 1, Year 2 and Year 3 long-term stream monitoring data show successive increases in channel-floodplain connectivity and increasingly stable channel dimensions, interpreted from width/depth ratios, entrenchment ratios, and bank height ratios as shown on the long-term monitoring cross-sections, profiles and in tabular format in Table XII.

The constructed riffles remain stable, with a median particle size ranging from very coarse gravel to large cobble. The pools substrate remained stable, with median particle sizes ranging from fine to coarse sand based on Year 3 substrate analysis. Constructed riffles remain stable, with a median particle sizes ranging from very coarse gravel to large cobble, with one anomaly from

particle distributions collected at Riffle Cross-Section 5. Using the Year 3 particle distribution collected along this feature alone would indicate a Rosgen stream type substrate shift from C4 (coarse gravel) to a C3 (small to large cobble) dominated stream type (D50 = 110.1 mm; D84 = 163.8 mm). Sample interference is suspected due to the contribution of cobble-sized material introduced during construction of the cross-vane step structure at the sample location. Random substrate sample distributions collected at this location (with the exception of Year 0 "As-Built" sample) show C3, small to large cobble substrate composition. It is well documented, based on reference reach boundary conditions, pre-existing site substrate composition, and substrate readily available to the stream from the contribution drainage area, Upper Bailey Fork is a sand and gravel substrate system. To approximate a reach (Wolman, 1954) particle distribution, characteristic of Upper Bailey Fork, substrate particle distributions from Riffle Cross-Section 5 and Pool Cross-Section 7 were combined (n = 118 measurements). The D50 and D84 particle size for the approximated reach substrate particle distribution is 32.0 mm (coarse gravel) and 139.3 mm (large cobble), respectively, with fine to coarse sand comprising 37.3 percent of the sample composition. Based on Year 3 median pool lengths and spacings, the 800 l.f. long-term monitoring reach is 73.5 percent pools and glides and 26.5 riffles and runs. As a result, the combination of one pool and one riffle particle distribution will statistically skew (over-estimate) reach D50 and D84 median particle size distributions.

Table XII. Baseline Geomorphic and Hydraulic Summary

Bailey Fork Stream Restoration / EEP Project No. D04006-02

Station/Reach: Upper {Long-Term Monitoring Profile Station 0+00 to 8+00 (800 feet)}

Parameter	Regional Curve Data			Reference Reach			Pre-Existing Condition			Design			As-Built XSs 5 & 8			Year 1 Sta. 0+00 - 8+00			Year 2 Sta. 0+00 - 8+00			Year 3 Sta. 0+00 - 8+00		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Drainage Area (mi^2)			4.90	0.14	1.70	0.92			4.90			4.90			4.90			4.90			4.90			4.90
BF Width (ft)			25.10	7.35	10.80	9.08	19.90	26.47	23.19			28.00	28.20	37.70	32.95	29.07	30.94	30.01	28.89	36.63	32.76	28.77	36.74	32.76
Floodprone Width (ft)				43.00	150.00	96.50	180.00	180.00	180.00			280.00	100.00	109.00	104.50	99.20	109.50	104.35	99.84	109.52	104.68	99.72	109.00	104.36
BF Cross Sectional Area (ft^2)			63.62	9.10	20.70	14.90	67.37	71.69	69.53			65.00	71.70	81.80	76.75	77.68	102.22	89.95	77.14	89.37	83.26	76.82	90.98	83.90
BF Mean Depth (ft)			2.53	1.30	2.10	1.70	2.71	3.38	3.05			2.30	2.30	2.30	2.30	2.67	3.30	2.99	2.44	2.67	2.56	2.48	2.67	2.58
BF Max Depth (ft)				1.80	2.80	2.30	4.55	4.96	4.76			4.20	4.10	5.20	4.65	4.14	5.39	4.77	4.25	4.63	4.44	4.22	4.68	4.45
Width/Depth (ft)			9.92	5.65	5.14	5.40	7.34	7.83	7.59			12.20	12.26	16.39	14.33	9.38	10.89	10.14	10.82	15.01	12.92	10.78	14.81	12.80
Entrenchment Ratio				5.85	13.89	9.87	9.05	9.04	9.04			10.00	3.55	2.89	3.22	3.41	3.54	3.48	2.99	3.46	3.23	2.97	3.47	3.22
Bank Height Ratio				0.70	1.00	0.85	1.80	2.10	1.95			1.00	1.00	1.10	1.05	1.00	1.10	1.05	1.10	1.15	1.13	1.05	1.12	1.09
Wetted Perimeter (ft)			30.16	9.95	15.00	12.48	25.32	33.23	29.28			32.60	32.80	42.30	37.55	30.60	34.41	32.51	30.42	37.94	34.18	30.29	38.07	34.18
Hydraulic Radius (ft)			2.11	0.91	1.38	1.15	2.66	2.16	2.41			1.99	1.93	2.19	2.06	2.54	2.97	2.76	2.36	2.54	2.45	2.39	2.54	2.47
Pattern																								
*Channel Beltwidth (ft)				20.00	50.00	35.00	75.00	105.00	90.00	70.00	153.00	111.50	70.00	153.00	111.50	70.00	153.00	111.50	70.00	153.00	111.50	70.00	153.00	111.50
*Radius of Curvature (ft)				10.00	21.00	15.50	18.00	30.00	24.00	42.00	84.00	63.00	42.00	84.00	63.00	42.00	84.00	63.00	42.00	84.00	63.00	42.00	84.00	63.00
*Meander Wavelength (ft)				35.00	50.00	42.50	60.00	96.00	78.00	70.00	154.00	112.00	70.00	154.00	112.00	70.00	154.00	112.00	70.00	154.00	112.00	70.00	154.00	112.00
*Meander Width Ratio				2.00	21.80	11.90	3.20	3.60	3.40	2.50	5.50	4.00	2.50	5.50	4.00	2.41	4.95	3.72	2.42	4.18	3.40	2.43	4.16	3.40
Profile																								
Riffle Length (ft)				3.00	26.40	14.70	15.00	67.80	41.40	23.80	68.00	45.90	23.80	68.00	45.90	5.60	24.00	12.70	13.40	23.75	17.77	10.67	43.75	20.36
Riffle Slope (ft/ft)				0.0068	0.0700	0.0384	0.0086	0.0860	0.0473	0.0020	0.0035	0.0028	0.0020	0.0035	0.0028	0.0120	0.0456	0.0238	0.0045	0.0260	0.0173	0.0066	0.0247	0.0134
Pool Length (ft)				5.50	41.30	23.40	80.00	100.00	90.00	45.00	96.00	70.50	45.00	96.00	70.50	27.90	72.20	51.20	28.23	80.25	53.58	24.12	71.34	44.25
Pool Spacing (ft)				16.00	70.00	43.00	81.00	211.00	146.00	95.00	224.00	159.50	95.00	224.00	159.50	56.00	167.00	98.20	49.12	109.70	75.59	34.26	101.86	68.19
Substrate																								
**d50 (mm)				20.0	29.0	24.5	6.0	24.0	15.0				6.9	19.6	13.3			113.4			87.4			32.0
**d84 (mm)				38.0	76.0	57.0	7.0	50.0	28.5			55.0	121.0	154.0	137.5			178.3			115.0			139.3
Additional Reach Parameters																								
Valley Length (ft)				209	295	252.00			1108			1108			1108			550			550			550
Channel Length (ft)				406	479	442.50			1383.0			1410.4			1543.0			800			800			800
Sinuosity				1.9	1.6	1.8			1.1			1.3			1.3			1.5			1.5			1.5
Water Surface Slope (ft/ft)				0.0044	0.0219	0.0132			0.0024			0.0025			0.0027			0.0019			0.0019			0.0020
BF Slope (ft/ft)				0.0044	0.0219	0.0132			0.0035			0.0033			0.0020			0.0017			0.0024			0.0020
Rosgen Classification			E	E4	E4	E4			E-F-G			E4/C4			C4			E4			C4			C4
*Habitat Index																								
*Macrobenthos																								

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

Note: Blank fields = Historic project documentation necessary to provide these data were unavailable at the time of this report submission.

**Year 3 D50 and D84 are composite values from XS-5 & XS-7. This distribution best represents reach subtrate composition. Riffle XS-5 D50 and D84 subtrate composition (i.e., 110 mm & 164 mm) uncharacteristically classifies UBF as a large cobble, C3 stream type.

Note: Where only one measurement was taken, that value is posted in the "Med" column.

Table XII. Baseline Geomorphic and Hydraulic Summary

Bailey Fork Stream Restoration / EEP Project No. D04006-02

Station/Reach: Lower {Long-Term Monitoring Profile Station 0+00 to 8+00 (800 feet)}

Parameter	Regional Curve Data			Reference Reach			Pre-Existing Condition			Design			As-Built XS 12			Year 1 Sta 0+00 - 8+00			Year 2 Sta 0+00 - 8+00			Year 3 Sta 0+00 - 8+00		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Drainage Area (mi^2)			5.50	0.14	1.70	0.92			5.50			5.50			5.50			5.50			5.50			5.50
BF Width (ft)			26.02	7.35	10.80	9.08	19.90	37.42	28.66			30.00			31.50			32.36			32.71			32.89
Floodprone Width (ft)				43.00	150.00	96.50	70.00	143.33	70.00			250.00			106.00			104.21			104.81			104.22
BF Cross Sectional Area (ft^2)			67.85	9.10	20.70	14.90	78.11	95.26	86.69			75.00			81.40			81.42			83.19			85.00
BF Mean Depth (ft)			2.61	1.30	2.10	1.70	1.60	3.00	2.30			2.50			2.60			2.52			2.54			2.58
BF Max Depth (ft)				1.80	2.80	2.30	4.55	4.96	4.76			4.50			4.30			4.35			4.28			4.31
Width/Depth (ft)			9.97	5.65	5.14	5.40	5.88	9.77	7.83			12.00			12.12			12.84			12.88			12.75
Entrenchment Ratio				5.85	13.89	9.87	6.80	9.04	7.92			8.33			3.37			3.22			3.18			3.17
Bank Height Ratio				0.70	1.00	0.85	1.80	2.10	1.95			1.00			1.05			1.05			1.01			1.00
Wetted Perimeter (ft)			31.24	9.95	15.00	12.48	23.10	43.42	33.26			35.00			36.70			34.27			34.44			34.65
Hydraulic Radius (ft)			2.17	0.91	1.38	1.15	3.38	2.19	2.79			2.14			2.22			2.38			2.42			2.45
Pattern																								
*Channel Beltwidth (ft)				20.00	50.00	35.00	75.00	105.00	90.00	98.00	120.00	109.00	98.00	120.00	109.00	98.00	120.00	109.00	98.00	120.00	109.00	98.00	120.00	109.00
*Radius of Curvature (ft)				10.00	21.00	15.50	18.00	30.00	24.00	45.00	90.00	67.50	45.00	90.00	67.50	45.00	90.00	67.50	45.00	90.00	67.50	45.00	90.00	67.50
*Meander Wavelength (ft)				35.00	50.00	42.50	60.00	96.00	78.00	200.00	220.00	210.00	200.00	220.00	210.00	200.00	220.00	210.00	200.00	220.00	210.00	200.00	220.00	210.00
*Meander Width Ratio				2.00	21.80	11.90	3.20	3.60	3.40	3.27	4.00	3.63	3.11	3.81	3.46	3.03	3.71	3.37	3.00	3.67	3.33	2.98	3.65	3.31
Profile																								
Riffle Length (ft)				3.00	26.40	14.70	34.80	69.50	52.15	14.00	40.00	27.00	30.00	55.00	42.50	6.90	15.80	11.35	7.15	18.89	13.13	6.39	37.27	14.69
Riffle Slope (ft/ft)				0.0068	0.0700	0.0384	0.0070	0.0235	0.0153	0.0025	0.0070	0.0048	0.0013	0.0029	0.0021	0.0095	0.0447	0.0271	0.0021	0.0434	0.0196	0.0055	0.0426	0.0122
Pool Length (ft)				5.50	41.30	23.40	27.20	60.00	43.60	20.00	45.00	32.50	50.00	100.00	75.00	27.70	54.10	40.90	14.85	52.77	29.93	14.39	37.52	26.48
Pool Spacing (ft)				16.00	70.00	43.00	110.00	110.00	110.00	50.00	85.00	67.50	110.00	140.00	125.00	50.60	141.60	113.28	24.71	114.76	48.61	24.67	117.79	52.01
Substrate																								
**d50 (mm)				20.0	29.0	24.5	6.0	24.0	15.0				6.9	19.6	13.3			46.1			41.8			58.6
**d84 (mm)				38.0	76.0	57.0	7.0	50.0	28.5			80.0	121.0	154.0	137.5			96.7			86.5			153.4
Additional Reach Parameters																								
Valley Length (ft)				209	295	252.00			920			920			920			635			635			635
Channel Length (ft)				406	479	442.50			1125.3			1174.1			1170.4			800			800			800
Sinuosity				1.9	1.6	1.8			1.2			1.3			1.3			1.3			1.3			1.3
Water Surface Slope (ft/ft)				0.0044	0.0219	0.0132			0.0049			0.0025			0.0028			0.0018			0.0019			0.0017
BF Slope (ft/ft)				0.0044	0.0219	0.0132			0.0075			0.0033			0.0030			0.0018			0.0016			0.0015
Rosgen Classification			E	E4	E4	E4			G4/F4			E4/C4			C4			C4			C4			C4
*Habitat Index																								
*Macrobenthos																								

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

Note: Blank fields = Historic project documentation necessary to provide these data were unavailable at the time of this report submission.

**Year 1 data was derived using three riffle cross-sections out of the six total cross-sections from which pebble count data was collected. For this reach, XS 12 was the only riffle cross-section for which data was collected.

Note: Where only one measurement was taken, that value is posted in the "Med" column.

Table XII. Baseline Geomorphic and Hydraulic Summary

Bailey Fork Stream Restoration / EEP Project No. D04006-02

Station/Reach: UT1 {Long-Term Monitoring Profile Station 0+00 to 8+00 (800 feet)}

Parameter	Regional Curve Data			Reference Reach			Pre-Existing Condition			Design			As-Built XSs 1 & 3			Year 1 Sta. 0+00 - 8+00			Year 2 Sta. 0+00 - 8+00			Year 3 Sta. 0+00 - 8+00		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Drainage Area (mi^2)			0.54	0.14	1.70	0.92			0.54			0.54			0.54			0.54			0.54			0.54
BF Width (ft)			10.93	7.35	10.80	9.08	19.90	26.47	23.19			14.00	16.60	27.40	22.00	14.43	17.76	16.10	14.69	16.26	15.48	15.32	15.75	15.54
Floodprone Width (ft)				43.00	150.00	96.50	180.00	180.00	180.00	65.00	120.00	92.50	64.40	74.00	69.20	63.78	72.92	68.35	58.45	74.45	66.45	74.45	105.00	89.73
BF Cross Sectional Area (ft^2)			14.30	9.10	20.70	14.90	67.37	71.69	69.53			17.50	15.40	27.40	21.40	12.60	15.45	14.03	13.03	16.08	14.56	12.99	15.15	14.07
BF Mean Depth (ft)			1.30	1.30	2.10	1.70	2.71	3.38	3.05			1.30	0.56	1.73	1.15	0.87	0.87	0.87	0.89	0.99	0.94	0.85	0.96	0.91
BF Max Depth (ft)				1.80	2.80	2.30	4.55	4.96	4.76			1.80	1.80	3.00	2.40	1.66	1.98	1.82	1.66	2.03	1.85	1.70	1.98	1.84
Width/Depth (ft)			8.41	5.65	5.14	5.40	5.88	9.77	7.83			10.77	15.84	29.64	22.74	16.59	20.41	18.50	16.42	16.51	16.47	16.41	18.02	17.08
Entrenchment Ratio				5.85	13.89	9.87	6.80	9.04	7.92			6.61	2.70	3.88	3.29	3.59	5.05	4.32	3.59	5.07	4.33	4.86	6.67	5.77
Bank Height Ratio				0.70	1.00	0.85	2.05	2.15	2.10			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.05	1.03	1.00	1.02	1.01
Wetted Perimeter (ft)			13.53	9.95	15.00	12.48	25.32	33.23	29.28			16.60	17.72	30.86	24.29	15.20	19.06	17.13	15.45	17.34	16.40	15.97	16.67	16.32
Hydraulic Radius (ft)			1.06	0.91	1.38	1.15	2.66	2.16	2.41			1.05	0.87	0.89	0.88	0.81	0.83	0.82	0.84	0.93	0.89	0.81	0.91	0.86
Pattern																								
*Channel Beltwidth (ft)				20.00	50.00	35.00	30.00	40.00	35.00	30.00	80.00	55.00	30.00	80.00	55.00	30.00	80.00	55.00	30.00	80.00	55.00	30.00	80.00	55.00
*Radius of Curvature (ft)				10.00	21.00	15.50	9.00	18.00	13.50	15.00	35.00	25.00	15.00	35.00	25.00	15.00	35.00	25.00	15.00	35.00	25.00	15.00	35.00	25.00
*Meander Wavelength (ft)				35.00	50.00	42.50	48.00	60.00	54.00	55.00	100.00	77.50	55.00	100.00	77.50	55.00	100.00	77.50	55.00	100.00	77.50	55.00	100.00	77.50
*Meander Width Ratio				2.00	21.80	11.90	2.80	3.70	3.25	2.10	5.70	3.90	2.10	5.70	3.90	2.08	4.50	3.42	2.04	4.92	3.55	1.96	5.08	3.54
Profile																								
Riffle Length (ft)				3.00	26.40	14.70	34.80	69.50	52.15	14.00	40.00	27.00	4.00	37.00	14.22	4.70	28.60	15.70	5.02	26.34	14.17	9.28	25.32	18.00
Riffle Slope (ft/ft)				0.0068	0.0700	0.0384	0.0070	0.0235	0.0153	0.0025	0.0070	0.0048	0.0010	0.1830	0.0020	0.0046	0.0645	0.0254	0.0097	0.0559	0.0259	0.0151	0.0646	0.0376
Pool Length (ft)				5.50	41.30	23.40	27.20	60.00	43.60	20.00	45.00	32.50	3.00	37.00	20.00	8.40	56.90	30.80	7.44	54.86	27.36	10.67	44.74	23.21
Pool Spacing (ft)				16.00	70.00	43.00	110.00	110.00	110.00	50.00	85.00	67.50	22.00	88.00	50.00	39.77	120.50	64.00	27.83	81.86	55.23	17.11	106.45	55.93
Substrate																								
**d50 (mm)				20.0	29.0	24.5	6.0	24.0	15.0				16.7	22.4	19.6									
**d84 (mm)				38.0	76.0	57.0	7.0	50.0	28.5			65.0	31.0	50.0	40.5									
Additional Reach Parameters																								
Valley Length (ft)				209	295	252.00			1225			1225			1225			575			575			1225
Channel Length (ft)				406	479	442.50			1648.1			1707.3			1758.1			800			800			1759.2
Sinuosity				1.9	1.6	1.8			1.3			1.4			1.4			1.4			1.4			1.4
Water Surface Slope (ft/ft)				0.0044	0.0219	0.0132			0.0024			0.0025			0.0071			0.0047			0.0050			0.0069
BF Slope (ft/ft)				0.0044	0.0219	0.0132			0.0035			0.0033			0.0064			0.0046			0.0049			0.0069
Rosgen Classification			E	E4	E4	E4			G4/F4			E4/C4			C4			C4			C4			C4
*Habitat Index																								
*Macrobenthos																								

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

Note: Blank fields = Historic project documentation necessary to provide these data were unavailable at the time of this report submission.

**Years 1 through 3 data were derived using three riffle cross-sections out of the six total cross-sections where pebble count data are collected per the site mitigation plan.. No data is reported, as only substrate samples at pool cross-sections were collected.

Note: Where only one measurement was taken, that value is posted in the "Med" column.

Table XII. Baseline Geomorphic and Hydraulic Summary

Bailey Fork Stream Restoration / EEP Project No. D04006-02

Station/Reach: UT2 {Long-Term Monitoring Profile Station 0+00 to 6+00 (600 feet)}

Parameter	Regional Curve Data			Reference Reach			Pre-Existing Condition			Design			As-Built XS-10			Year 1 Sta. 0+00 - 6+00			Year 2 Sta. 0+00 - 6+00			Year 3 Sta. 0+00 - 6+00		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Drainage Area (mi^2)			0.98	0.14	1.70	0.92			0.98			0.98			0.98			0.98			0.98			0.98
BF Width (ft)			13.59	7.35	10.80	9.08			8.20			16.00			18.60			16.97			13.36			12.25
Floodprone Width (ft)				43.00	150.00	96.50	12.00	150.00	81.00	60.00	180.00	120.00			67.00			67.00			67.15			58.18
BF Cross Sectional Area (ft^2)			21.14	9.10	20.70	14.90			20.10			23.00			18.70			15.43			10.63			8.88
BF Mean Depth (ft)			1.55	1.30	2.10	1.70			2.40			1.40			1.00			0.91			0.80			0.73
BF Max Depth (ft)				1.80	2.80	2.30			3.50			2.00			1.90			1.55			1.28			1.20
Width/Depth (ft)			8.77	5.65	5.14	5.40			3.42			8.00			18.60			18.65			16.70			16.78
Entrenchment Ratio				5.85	13.89	9.87						7.50			3.60			3.95			5.03			4.75
Bank Height Ratio				0.70	1.00	0.85						1.00			1.00			1.00			1.14			1.03
Wetted Perimeter (ft)			16.69	9.95	15.00	12.48						18.80			20.60			17.41			13.98			12.68
Hydraulic Radius (ft)			1.27	0.91	1.38	1.15						1.22			0.91			0.89			0.76			0.70
Pattern																								
*Channel Beltwidth (ft)				20.00	50.00	35.00	30.00	33.00	31.50	34.00	91.20	62.60	34.00	91.20	62.60	34.00	91.20	62.60	34.00	91.20	62.60	34.00	91.20	62.60
*Radius of Curvature (ft)				10.00	21.00	15.50	15.00	18.00	16.50	24.00	40.00	32.00	24.00	40.00	32.00	24.00	40.00	32.00	24.00	40.00	32.00	24.00	40.00	32.00
*Meander Wavelength (ft)				35.00	50.00	42.50	66.00	78.00	72.00	56.00	104.00	80.00	56.00	104.00	80.00	56.00	104.00	80.00	56.00	104.00	80.00	56.00	104.00	80.00
*Meander Width Ratio				2.00	21.80	11.90	3.70	4.00	3.85	2.10	5.70	3.90	2.10	5.70	3.90	2.10	5.70	3.90	2.54	6.83	4.69	2.78	7.44	5.11
Profile																								
Riffle Length (ft)				3.00	26.40	14.70	16.00	24.00	20.00	16.00	44.80	30.40	16.00	44.80	30.40	3.60	13.10	8.90	7.71	22.58	14.81	3.78	31.26	14.13
Riffle Slope (ft/ft)				0.0068	0.0700	0.0384	0.0072	0.0650	0.0361	0.0020	0.0045	0.0033	0.0020	0.0045	0.0033	0.0080	0.0616	0.0259	0.0062	0.0108	0.0082	0.0048	0.0185	0.0087
Pool Length (ft)				5.50	41.30	23.40				22.40	48.00	35.20	22.40	48.00	35.20	12.50	53.10	29.00	14.10	48.32	31.78	12.38	47.41	24.26
Pool Spacing (ft)				16.00	70.00	43.00				55.00	85.00	70.00	55.00	85.00	70.00	37.20	80.10	63.70	37.56	102.04	61.42	21.13	79.53	49.71
Substrate																								
**d50 (mm)				20.0	29.0	24.5	6.0	24.0	15.0						2.0			45.0			38.5			4.9
**d84 (mm)				38.0	76.0	57.0	7.0	50.0	28.5			48.0			62.0			173.5			107.7			50.9
Additional Reach Parameters																								
Valley Length (ft)				209	295	252.00			860			860			860			425			425			425
Channel Length (ft)				406	479	442.50			898.9			1181.6			1271.0			600			600			600
Sinuosity				1.9	1.6	1.8			1.1			1.4			1.5			1.4			1.4			1.4
Water Surface Slope (ft/ft)				0.0044	0.0219	0.0132			0.0024			0.0025			0.0051			0.0024			0.0030			0.0029
BF Slope (ft/ft)				0.0044	0.0219	0.0132			0.0035			0.0033			0.0047			0.0026			0.0028			0.0029
Rosgen Classification			E	E4	E4	E4			G4/F4			E4/C4			C4			C4			C4			C4
*Habitat Index																								
*Macrobenthos																								

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

Note: Blank fields = Historic project documentation necessary to provide these data were unavailable at the time of this report submission.

**Years 1 through 3 data were derived using three riffle cross-sections out of the six total cross-sections where pebble count data are collected per the site mitigation plan. For this reach, XS-10 was the only riffle cross-section where data were collected.

Note: Where only one measurement was taken, that value is posted in the "Med" column.

IV. METHODOLOGY

Year 1 vegetation monitoring was conducted in September 2006 using the *CVS-EEP Protocol for Recording Vegetation, Version 4.0* (Lee, M.T., Peet, RK., Roberts, S.R., Wentworth, T.R. 2006). Year 3 vegetation monitoring was conducted in September 2008 using the same protocol as used in Years 1 and 2. Year 1 stream monitoring was conducted in April 2007 to provide adequate time between the as-built survey (completed in August 2006) and the Year 1 monitoring survey. Stream monitoring for Year 2 occurred in the fall of 2007, to provide six months between the Year 1 and Year 2 surveys. Year 3 monitoring occurred in the fall of 2008 to provide a full year between surveys. Subsequent stream monitoring will occur in the fall of Years 4 and 5 to continue to provide adequate time between surveys. Vegetation monitoring will continue to be conducted in the fall of each subsequent year of monitoring, providing a full year between vegetative surveys.

APPENDIX A

Vegetation Raw Data

1. Vegetation Problem Area Photos
2. Vegetation Problem Area Plan View
3. Vegetation Monitoring Plot Photos
4. Vegetation Data Tables

VPA 1
View of the dominance of *Sericea lespedeza* in Vegetation Plot 8, considered a problem area of high concern.
(EMH&T, Inc. 9/9/08)

VPA 2
Overview of the spread of *Sericea lespedeza* along Upper Bailey Fork, looking upstream along the left bank near station 7+00, considered a problem area of low concern.
(EMH&T, Inc. 9/9/08)

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BURKE COUNTY, NORTH CAROLINA

BAILEY FORK

MONITORING

APPENDIX A

VEGETATION PROBLEM AREA PLAN VIEW - YEAR 2

Date:	November, 2008
Scale:	1" = 200'
Job No:	2006-1626

Table 1. Vegetation Metadata	
Report Prepared By	Holly Blunck
Date Prepared	9/30/2007 9:09
database name	CVS_EEP_DataEntry_v202.mdb
database location	Q:\ENVIRONMENTAL\Monitoring\EEP Vegetation Database
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	This worksheet, which is a summary of the project and the project data.
Plots	List of plots surveyed.
Vigor	Frequency distribution of vigor classes.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Stem Count by Plot and Spp	Count of living stems of each species for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	D040062
project Name	Bailey Fork
Description	Restoration of Bailey Fork and unnamed tributaries
length (ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	10

Table 2. Vegetation Vigor by Species							
	Species	**4**	**3**	**2**	**1**	**0**	**Missing**
	Alnus serrulata	1					
	Cephalanthus occidentalis						1
	Cornus amomum	13	2	1			1
	Fraxinus pennsylvanica	1					
	Liriodendron tulipifera	6	1	1			7
	Malus	1					
	Nyssa sylvatica	1					
	Platanus occidentalis	18	11	2			8
	Quercus pagoda	20	3				9
	Quercus phellos	5	3				3
	Rosa palustris	1	1				
	Salix nigra						1
TOT:	**12**	**71**	**24**	**6**	**1**	**0**	**30**

Table 3. Vegetation Damage by Species												
	Species	All Damage Categories	(no damage)	_Enter other damage_	Deer	Diseased	Flood	Insects	Other/Unknown Animal	Site Too Dry	Unknown	(other damage)
	Alnus serrulata	1	1									
	Cornus amomum	16	15	1								
	Fraxinus pennsylvanica	1	1									
	Liriodendron tulipifera	8	8									
	Malus	1	1									
	Nyssa sylvatica	1	1									
	Platanus occidentalis	31	31									
	Quercus pagoda	23	22		1							
	Quercus phellos	8	8									
	Rosa palustris	2	2									
TOT:	**10**	**92**	**90**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Table 4. Vegetation Damage by Plot												
	plot	All Damage Categories	(no damage)	_Enter other damage_	Deer	Diseased	Flood	Insects	Other/Unknown Animal	Site Too Dry	Unknown	(other damage)
	D040062-01-0001 (year 3)	6	6									
	D040062-01-0002 (year 3)	10	10									
	D040062-01-0003 (year 3)	10	10									
	D040062-01-0004 (year 3)	13	13									
	D040062-01-0005 (year 3)	2	1	1								
	D040062-01-0006 (year 3)	5	5									
	D040062-01-0007 (year 3)	15	15									
	D040062-01-0008 (year 3)	14	14									
	D040062-01-0009 (year 3)	5	4		1							
	D040062-01-0010 (year 3)	12	12									
TOT:	**10**	**92**	**90**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Table 5. Stem Count by Plot and Species														
	Species	Total Stems	# plots	avg# stems	plot D040062-01-0001 (year 3)	plot D040062-01-0002 (year 3)	plot D040062-01-0003 (year 3)	plot D040062-01-0004 (year 3)	plot D040062-01-0005 (year 3)	plot D040062-01-0006 (year 3)	plot D040062-01-0007 (year 3)	plot D040062-01-0008 (year 3)	plot D040062-01-0009 (year 3)	plot D040062-01-0010 (year 3)
	Alnus serrulata	1	1	1	1									
	Cornus amomum	16	6	2.67				6	1		1	3	3	2
	Fraxinus pennsylvanica	1	1	1					1					
	Liriodendron tulipifera	8	3	2.67				1		4	3			
	Malus	1	1	1	1									
	Nyssa sylvatica	1	1	1	1									
	Platanus occidentalis	31	6	5.17	1	1	9	4			6			10
	Quercus pagoda	23	4	5.75		8					4	9	2	
	Quercus phellos	8	6	1.33		1	1	2		1	1	2		
	Rosa palustris	2	1	2	2									
TOT:	**10**	**92**	**10**		**6**	**10**	**10**	**13**	**2**	**5**	**15**	**14**	**5**	**12**

APPENDIX B

Geomorphologic Raw Data

1. Stream Problem Areas Plan View
2. Stream Problem Area Photos
3. Fixed Station Photos
4. Table B1. Qualitative Visual Stability Assessment
5. Cross Section Plots
6. Longitudinal Plots
7. Pebble Count Plots
8. Bankfull Event Photos

Vegetation Plot 1
Monitoring Year 3
(EMH&T, Inc. 9/9/08)

Vegetation Plot 2
Monitoring Year 3
(EMH&T, Inc. 9/9/08)

Vegetation Plot 3
Monitoring Year 3
(EMH&T, Inc. 9/9/08)

Vegetation Plot 4
Monitoring Year 3
(EMH&T, Inc. 9/9/08)

Vegetation Plot 5
Monitoring Year 3
(EMH&T, Inc. 9/9/08)

Vegetation Plot 6
Monitoring Year 3
(EMH&T, Inc. 9/9/08)

Vegetation Plot 7
Monitoring Year 3
(EMH&T, Inc. 9/9/08)

Vegetation Plot 8
Monitoring Year 3
(EMH&T, Inc. 9/9/08)

Vegetation Plot 9
Monitoring Year 3
(EMH&T, Inc. 9/9/08)

Vegetation Plot 10
Monitoring Year 3
(EMH&T, Inc. 9/9/08)

EMH&T
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STREAM PROBLEM AREA PLAN VIEW - YEAR 2

Date:	November, 2008
Scale:	1" = 200'
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SPA 1
Area of aggradation along Lower Bailey Fork near station 1+75. Bar is heavily vegetated and stable.
(EMH&T, Inc. 9/9/08)

SPA 2
Close-up view of aggradation over a rock sill in UT1 near station 6+30.
(EMH&T, Inc. 9/9/08)

SPA 3
Bank scour in Year 1 along Upper Bailey Fork at station 3+50.
(EMH&T, Inc. 4/13/07)

SPA 4
Bank scour in Year 2 along Upper Bailey Fork at station 3+50.
Bank is now vegetated. W/D ratio is too high resulting in aggradation.
(EMH&T, Inc. 10/22/07)

SPA 5
Bank scour in Year 3 along Upper Bailey Fork at station 3+50.
Close-up of bank shows the heavy vegetation; scour is no longer visible and bank is stable
(EMH&T, Inc. 9/9/08)

Fixed Station 1 (Photo Point 13)
Overview of the valley at the confluence of Lower Bailey Fork and UT2, near the downstream terminus of the project, facing upstream.
(EMH&T, Inc. 9/9/08)

Fixed Station 2 (Photo Point 14)
Overview of valley at confluence of Upper Bailey Fork and UT1, facing across the channel from the left to right bank.
(EMH&T, Inc. 9/9/08)

Fixed Station 3 (Photo Point 15)
Overview of valley along UT1 near the upstream terminus of the project, facing downstream.
(EMH&T, Inc. 9/9/08)

Table B1. Visual Morphological Stability Assessment
Bailey Fork Stream Restoration / EEP Project No. D04006-02
Segment/Reach: Upper

Feature Category	Metric (per As-built and reference baselines	(# Stable) Number Performing as Intended	Total number per As-built	Total Number / feet in unstable state	% Perform in Stable Condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	13	15	2	87	
	2. Armor stable (e.g. no displacement)?	13	15	2	87	
	3. Facet grade appears stable?	13	15	2	87	
	4. Minimal evidence of embedding/fining?	13	15	2	87	
	5. Length appropriate?	13	15	2	87	**87%**
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	14	16	2	88	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?)	12	16	4	75	
	3. Length appropriate?	14	16	2	88	**84%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	11	11	0	100	
	2. Downstream of meander (glide/inflection) centering?	11	11	0	100	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	10	11	1	91	
	2. Of those eroding, # w/concomitant point bar formation?	11	11	0	100	
	3. Apparent Rc within spec?	11	11	0	100	
	4. Sufficient floodplain access and relief?	11	11	0	100	**98%**
E. Bed General	1. Geveral channel bed aggradation areas (bar formation)	N/A	N/A	1/ 50 feet	97	
	2. Channel bed degradation - areas of increasing downcutting or headcutting?	N/A	N/A	0/ 0 feet	100	**98%**
F. Vanes	1. Free of back or arm scour?	16	16	0	100	
	2. Height appropriate?	16	16	0	100	
	3. Angle and geometry appear appropriate?	16	16	0	100	
	4. Free of piping or other structural failures?	16	16	0	100	
	5. Structure buried under aggraded material?	13	16	3	81	**96%**
G. Wads/ Boulders	1. Free of scour?	N/A	0	N/A	N/A	
	2. Footing stable?	N/A	0	N/A	N/A	N/A

Table B1. Visual Morphological Stability Assessment
Bailey Fork Stream Restoration / EEP Project No. D04006-02
Segment/Reach: Lower

Feature Category	Metric (per As-built and reference baselines	(# Stable) Number Performing as Intended	Total number per As-built	Total Number / feet in unstable state	% Perform in Stable Condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	9	9	0	100	
	2. Armor stable (e.g. no displacement)?	9	9	0	100	
	3. Facet grade appears stable?	9	9	0	100	
	4. Minimal evidence of embedding/fining?	9	9	0	100	
	5. Length appropriate?	9	9	0	100	**100%**
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	10	10	0	100	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?)	10	10	0	100	
	3. Length appropriate?	10	10	0	100	**100%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	6	6	0	100	
	2. Downstream of meander (glide/inflection) centering?	6	6	0	100	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	6	6	0	100	
	2. Of those eroding, # w/concomitant point bar formation?	6	6	0	100	
	3. Apparent Rc within spec?	6	6	0	100	
	4. Sufficient floodplain access and relief?	6	6	0	100	**100%**
E. Bed General	1. Geveral channel bed aggradation areas (bar formation)	N/A	N/A	1/ 25 feet	98	
	2. Channel bed degradation - areas of increasing downcutting or headcutting?	N/A	N/A	0/ 0 feet	100	**99%**
F. Vanes	1. Free of back or arm scour?	9	9	0	100	
	2. Height appropriate?	9	9	0	100	
	3. Angle and geometry appear appropriate?	9	9	0	100	
	4. Free of piping or other structural failures?	9	9	0	100	
	5. Structure buried under aggraded material?	9	9	0	100	**100%**
G. Wads/ Boulders	1. Free of scour?	N/A	0	N/A	N/A	
	2. Footing stable?	N/A	0	N/A	N/A	N/A

Table B1. Visual Morphological Stability Assessment
Bailey Fork Stream Restoration / EEP Project No. D04006-02
Segment/Reach: UT1

Feature Category	Metric (per As-built and reference baselines	(# Stable) Number Performing as Intended	Total number per As-built	Total Number / feet in unstable state	% Perform in Stable Condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	33	35	2	94	
	2. Armor stable (e.g. no displacement)?	33	35	2	94	
	3. Facet grade appears stable?	33	35	2	94	
	4. Minimal evidence of embedding/fining?	30	35	5	86	
	5. Length appropriate?	33	35	2	94	**92%**
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	33	35	2	94	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?)	25	35	10	71	
	3. Length appropriate?	33	35	2	94	**86%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	28	28	0	100	
	2. Downstream of meander (glide/inflection) centering?	28	28	0	100	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	28	28	0	100	
	2. Of those eroding, # w/concomitant point bar formation?	28	28	0	100	
	3. Apparent Rc within spec?	28	28	0	100	
	4. Sufficient floodplain access and relief?	28	28	0	100	**100%**
E. Bed General	1. Geveral channel bed aggradation areas (bar formation)	N/A	N/A	2/ 50 feet	97	
	2. Channel bed degradation - areas of increasing downcutting or headcutting?	N/A	N/A	0/ 0 feet	100	**98%**
F. Vanes	1. Free of back or arm scour?	31	31	0	100	
	2. Height appropriate?	31	31	0	100	
	3. Angle and geometry appear appropriate?	31	31	0	100	
	4. Free of piping or other structural failures?	31	31	0	100	
	5. Structure buried under aggraded material?	24	31	7	77	**95%**
G. Wads/ Boulders	1. Free of scour?	12	12	0	100	
	2. Footing stable?	12	12	0	100	**100%**

Table B1. Visual Morphological Stability Assessment
Bailey Fork Stream Restoration / EEP Project No. D04006-02
Segment/Reach: UT2

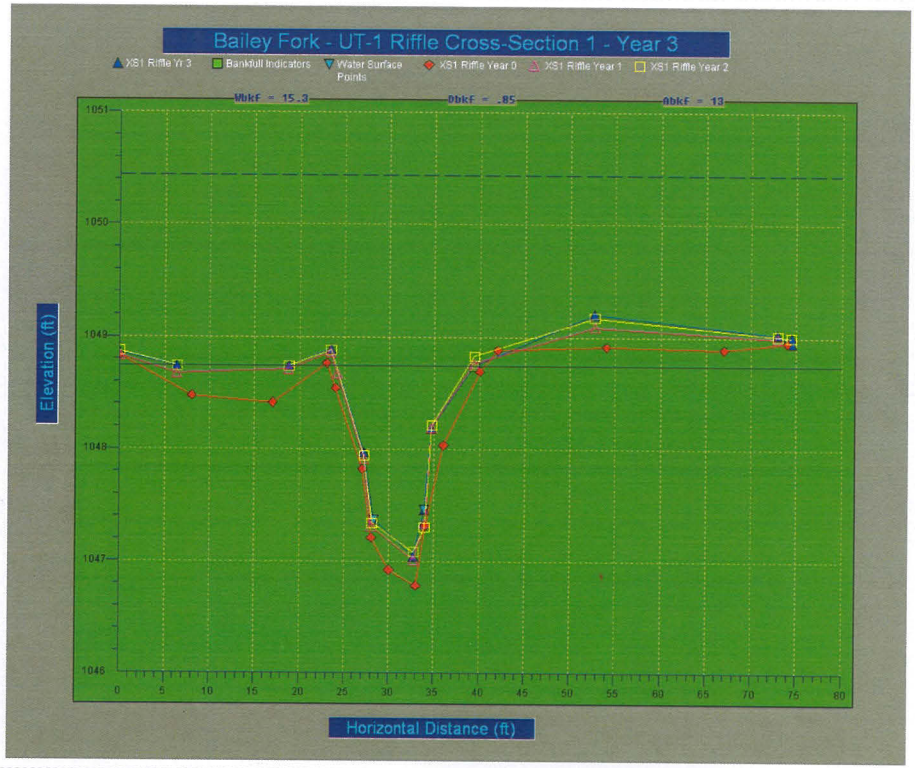
Feature Category	Metric (per As-built and reference baselines	(# Stable) Number Performing as Intended	Total number per As-built	Total Number / feet in unstable state	% Perform in Stable Condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	19	19	0	100	
	2. Armor stable (e.g. no displacement)?	19	19	0	100	
	3. Facet grade appears stable?	19	19	0	100	
	4. Minimal evidence of embedding/fining?	19	19	0	100	
	5. Length appropriate?	19	19	0	100	**100%**
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	19	19	0	100	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?)	15	19	4	79	
	3. Length appropriate?	19	19	0	100	**93%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	15	15	0	100	
	2. Downstream of meander (glide/inflection) centering?	15	15	0	100	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	15	15	0	100	
	2. Of those eroding, # w/concomitant point bar formation?	15	15	0	100	
	3. Apparent Rc within spec?	15	15	0	100	
	4. Sufficient floodplain access and relief?	15	15	0	100	**100%**
E. Bed General	1. Geveral channel bed aggradation areas (bar formation)	N/A	N/A	0/ 0 feet	100	
	2. Channel bed degradation - areas of increasing downcutting or headcutting?	N/A	N/A	0/ 0 feet	100	**100%**
F. Vanes	1. Free of back or arm scour?	11	11	0	100	
	2. Height appropriate?	11	11	0	100	
	3. Angle and geometry appear appropriate?	11	11	0	100	
	4. Free of piping or other structural failures?	11	11	0	100	
	5. Structure buried under aggraded material?	8	11	3	73	**95%**
G. Wads/ Boulders	1. Free of scour?	N/A	0	N/A	N/A	
	2. Footing stable?	N/A	0	N/A	N/A	N/A

Summary Data

Bankfull Area	12.99 ft^2
Bankfull Width	15.32 ft
Mean Depth	0.85 ft
Maximum Depth	1.7 ft
Width/Depth Ratio	18.02
Entrenchment Ratio	4.86
Classification	C

PROJECT	Bailey Fork
	D04006-2
	3-YEAR
TASK	Cross-Section
REACH	UT1
DATE	10/1/08
CROSS SECTION:	1
FEATURE:	Riffle

Cross-section photo – looking downstream
Channel is obscured by vegetation.



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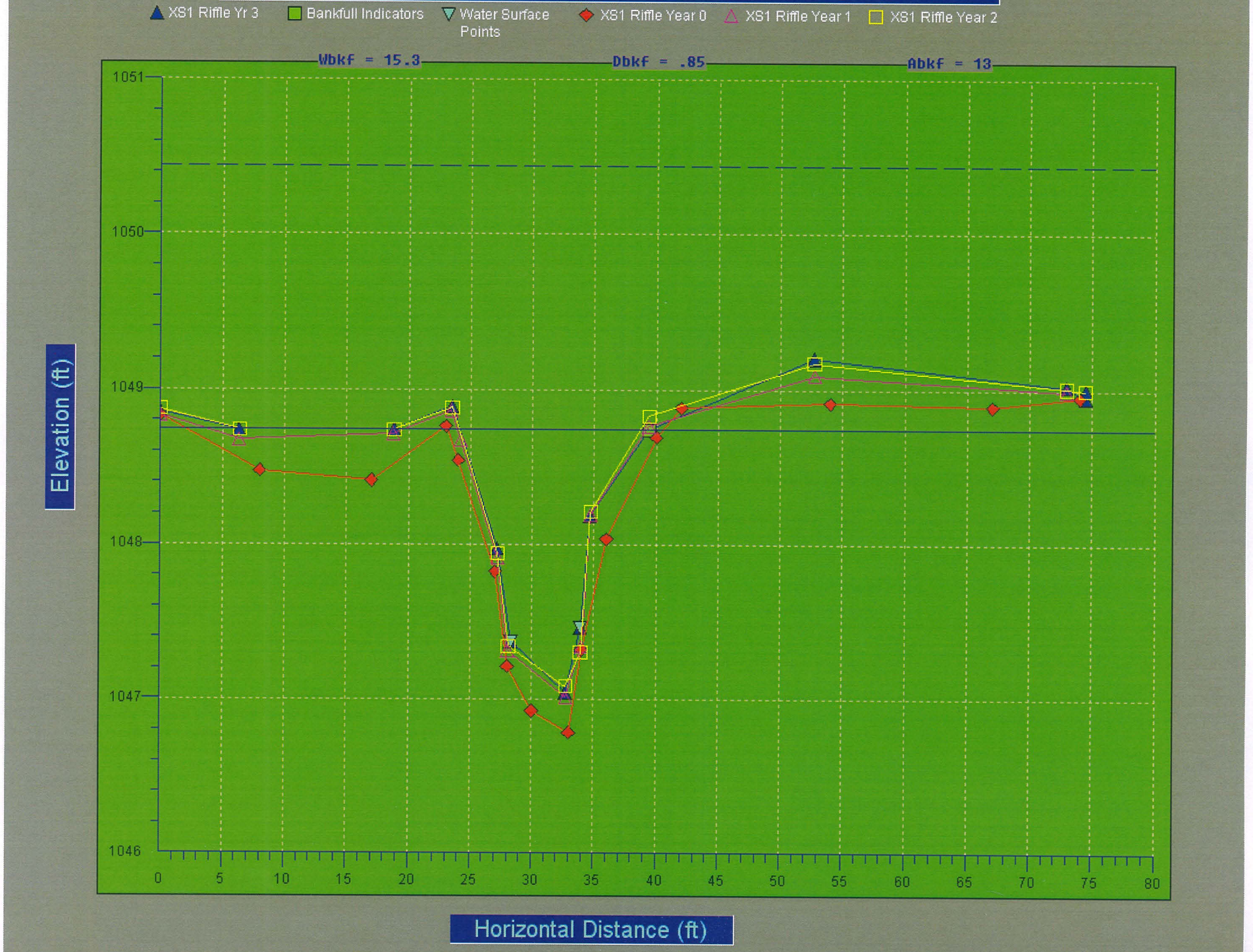
Bailey Fork - UT-1 Riffle Cross-Section 1 - Year 3

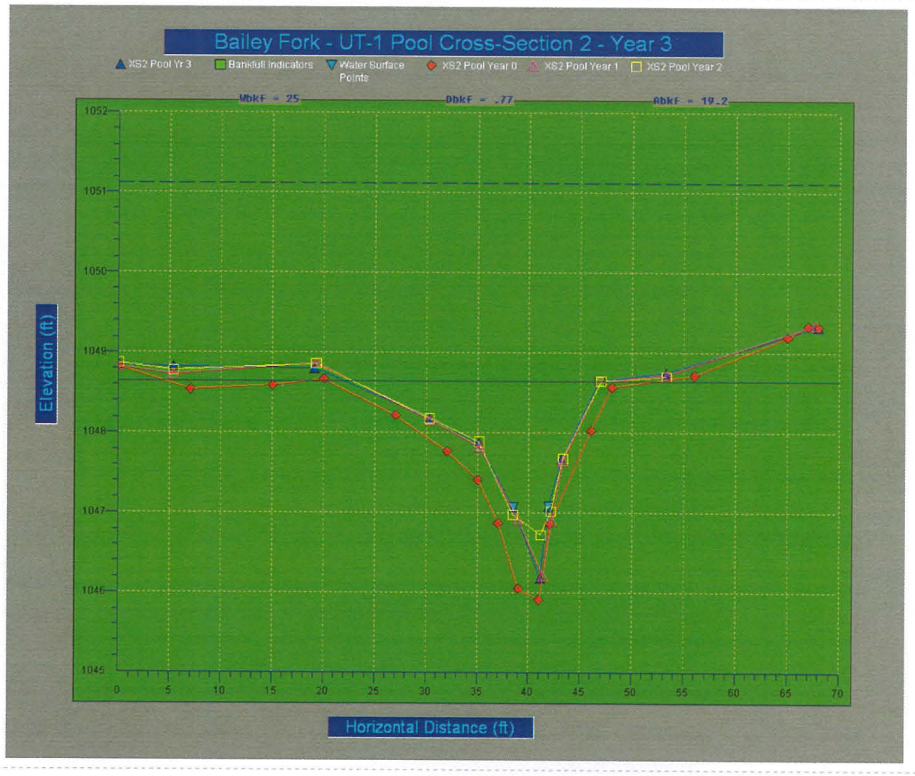


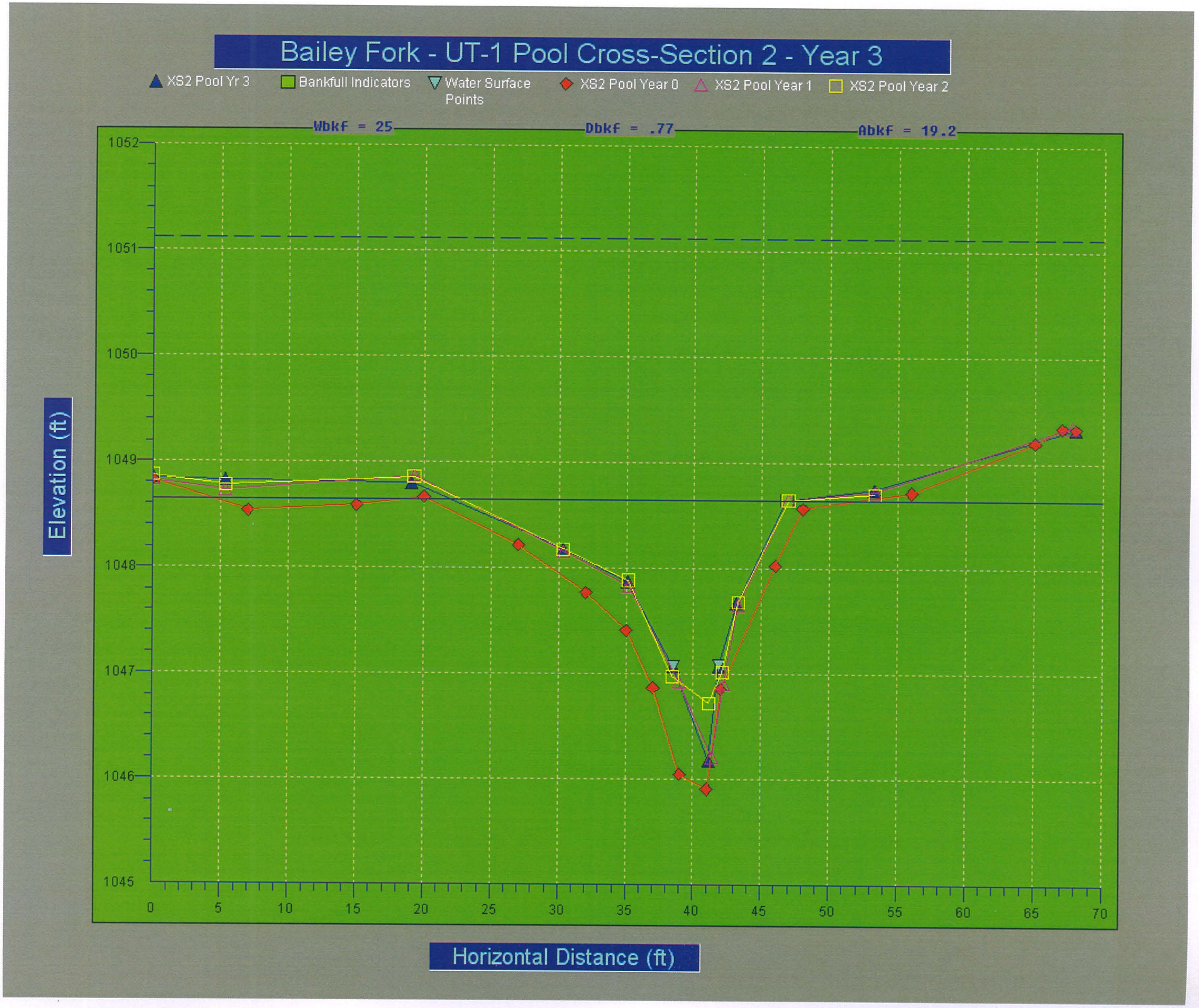
Summary Data

Bankfull Area	19.23 ft^2
Bankfull Width	25.01 ft
Mean Depth	0.77 ft
Maximum Depth	2.47 ft
Width/Depth Ratio	32.48
Entrenchment Ratio	4.2
Classification	C

PROJECT	Bailey Fork
	D04006-2
	3-YEAR
TASK	Cross-Section
REACH	UT1
DATE	10/1/08
CROSS SECTION:	2
FEATURE:	Pool

Cross-section photo – looking upstream
Channel is obscured by vegetation.



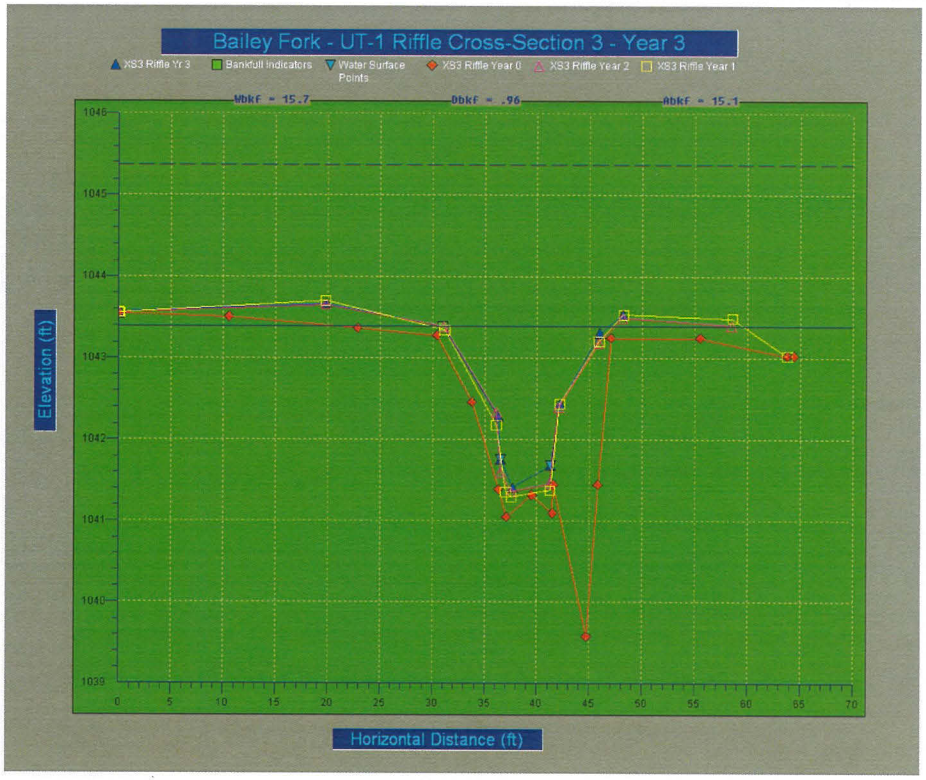

Bailey Fork - UT-1 Pool Cross-Section 2 - Year 3
XS2 Pool Yr 3
Bankfull Indicators
Water Surface Points
XS2 Pool Year 0
XS2 Pool Year 1
XS2 Pool Year 2
Wbkf = 25
Dbkf = .77
Abkf = 19.2
Elevation (ft)
1052
1051
1050
1049
1048
1047
1046
1045
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
Horizontal Distance (ft)

Summary Data

Bankfull Area	15.15 ft^2
Bankfull Width	15.75 ft
Mean Depth	0.96 ft
Maximum Depth	1.98 ft
Width/Depth Ratio	16.41
Entrenchment Ratio	6.67
Classification	C

PROJECT	Bailey Fork
	D04006-2
	3-YEAR
TASK	Cross-Section
REACH	UT1
DATE	10/1/08
CROSS SECTION:	3
FEATURE:	Riffle

Cross-section photo – looking downstream



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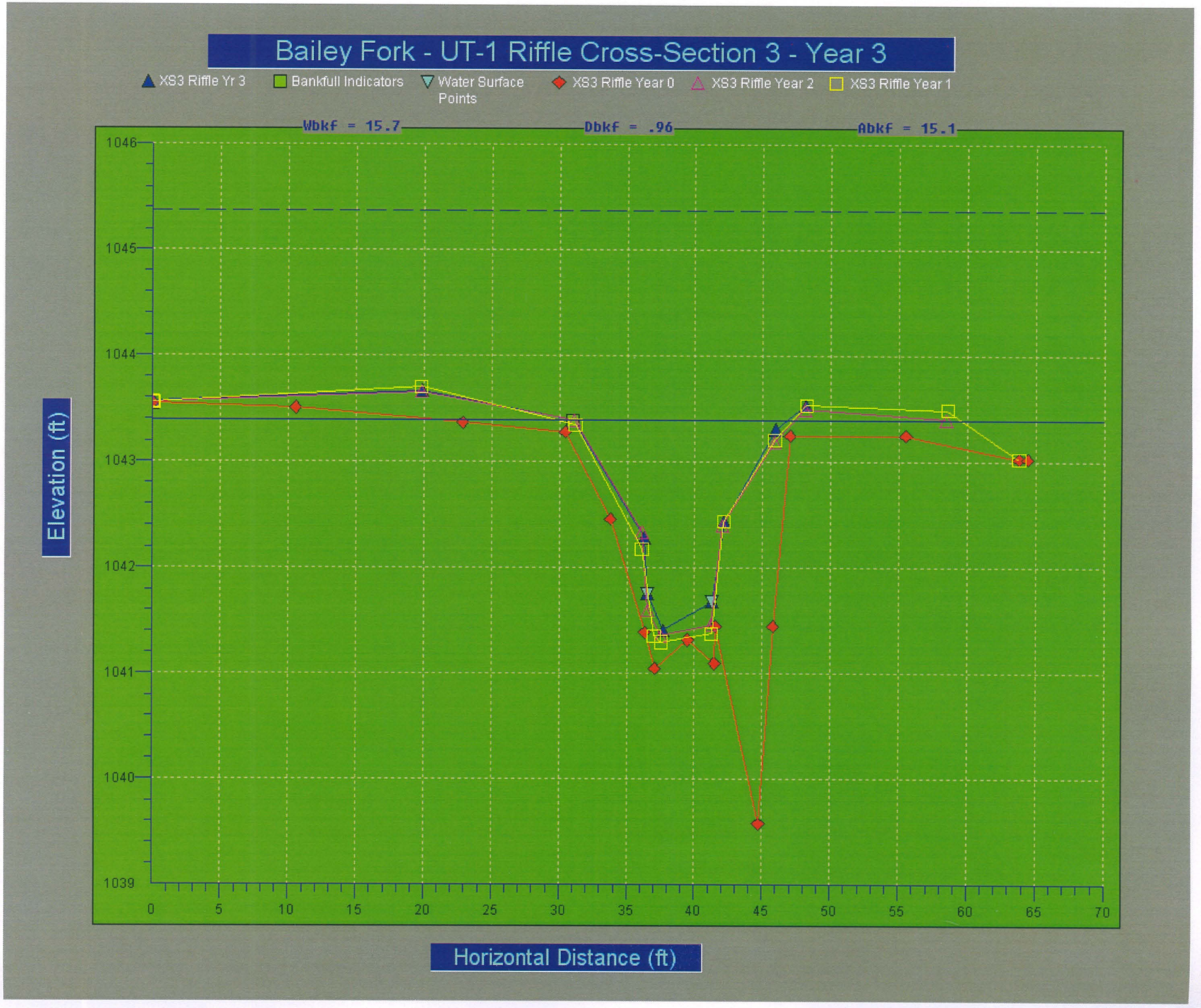
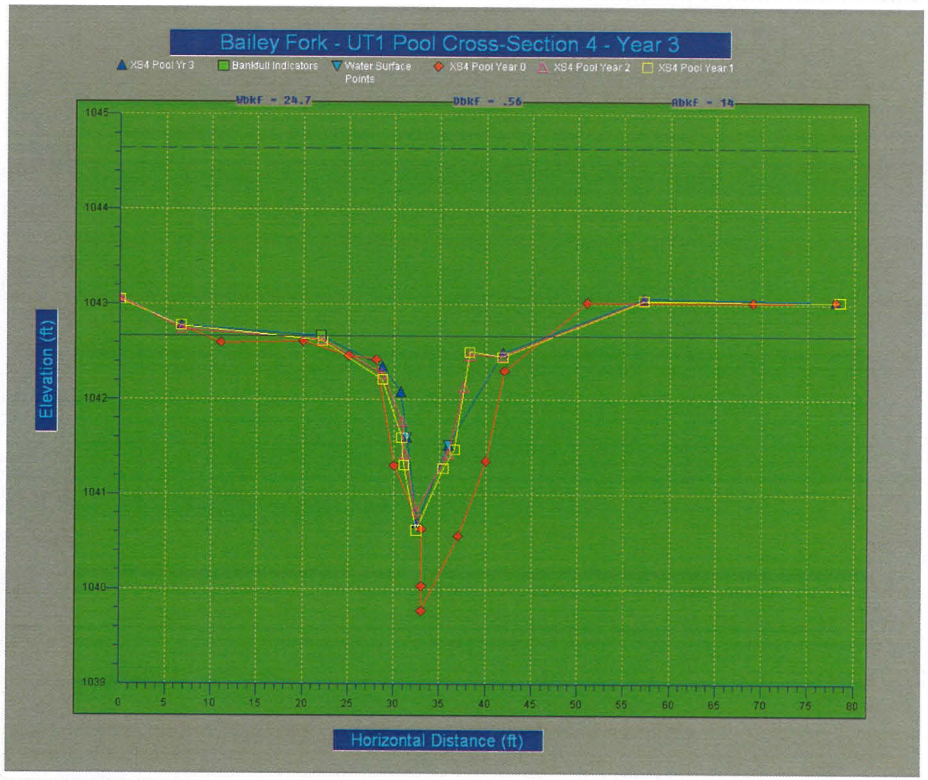

Bailey Fork - UT-1 Riffle Cross-Section 3 - Year 3
XS3 Riffle Yr 3
Bankfull Indicators
Water Surface Points
XS3 Riffle Year 0
XS3 Riffle Year 2
XS3 Riffle Year 1
Wbkf = 15.7
Dbkf = .96
Abkf = 15.1
Elevation (ft)
1046
1045
1044
1043
1042
1041
1040
1039
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
Horizontal Distance (ft)

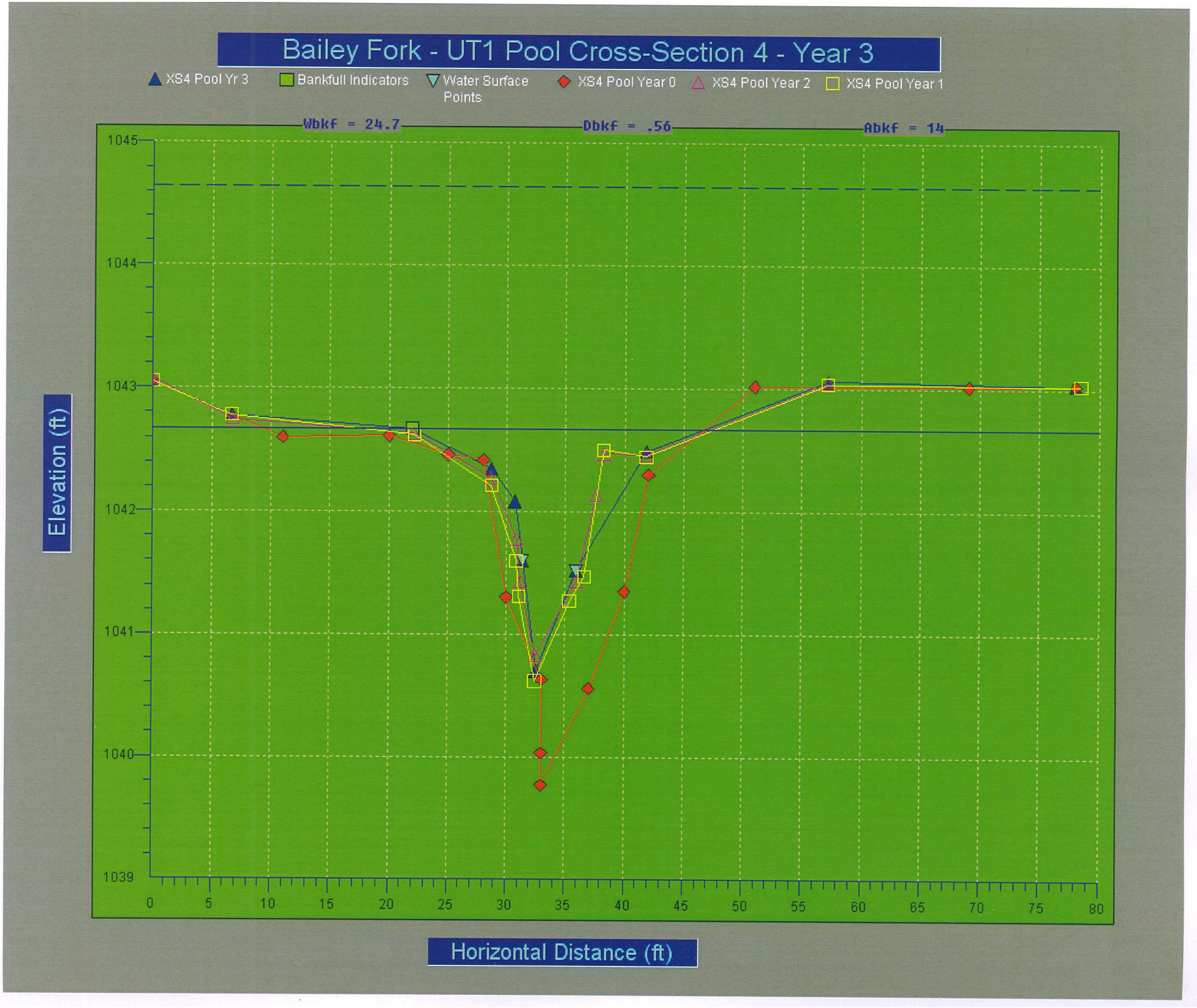
Summary Data

Bankfull Area	13.96 ft^2
Bankfull Width	24.73 ft
Mean Depth	0.56 ft
Maximum Depth	1.97 ft
Width/Depth Ratio	44.16
Entrenchment Ratio	3.15
Classification	C

PROJECT	Bailey Fork
	D04006-2
	3-YEAR
TASK	Cross-Section
REACH	UT1
DATE	10/1/08
CROSS SECTION:	4
FEATURE:	Pool

Cross-section photo – looking downstream
Channel is obscured by vegetation.



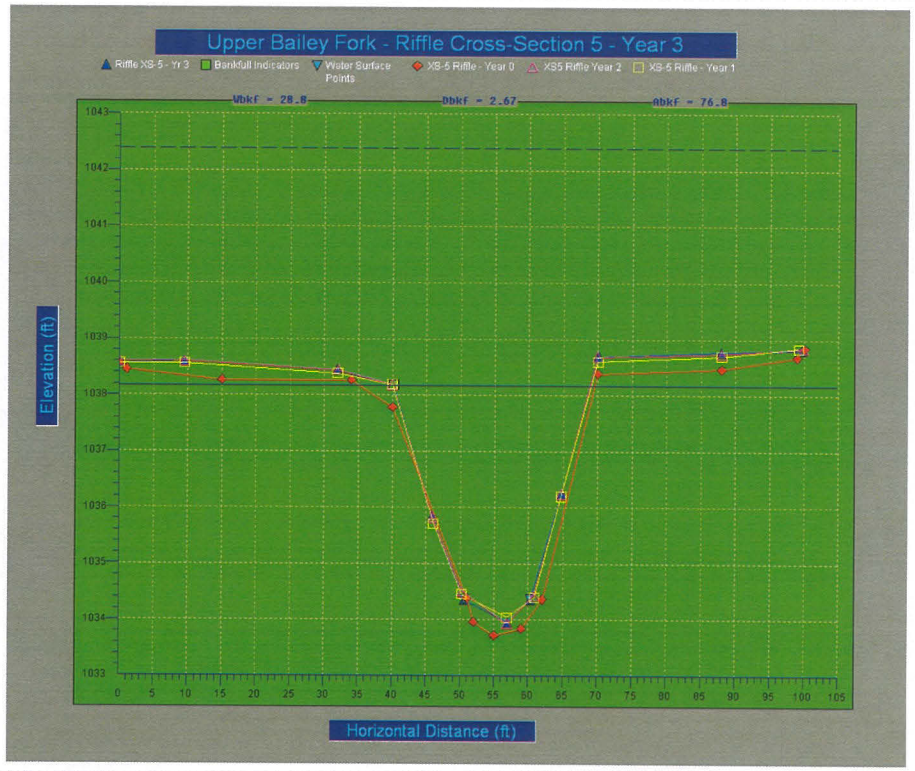

Bailey Fork - UT1 Pool Cross-Section 4 - Year 3
XS4 Pool Yr 3
Bankfull Indicators
Water Surface Points
XS4 Pool Year 0
XS4 Pool Year 2
XS4 Pool Year 1
Wbkf = 24.7
Dbkf = .56
Abkf = 14
Elevation (ft)
1045
1044
1043
1042
1041
1040
1039
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
Horizontal Distance (ft)

Summary Data

Bankfull Area	76.82 ft^2
Bankfull Width	28.77 ft
Mean Depth	2.67 ft
Maximum Depth	4.22 ft
Width/Depth Ratio	10.78
Entrenchment Ratio	3.47
Classification	E

PROJECT	Bailey Fork
	D04006-2
	3-YEAR
TASK	Cross-Section
REACH	Upper
DATE	10/1/08
CROSS SECTION:	5
FEATURE:	Riffle

Cross-section photo – looking downstream



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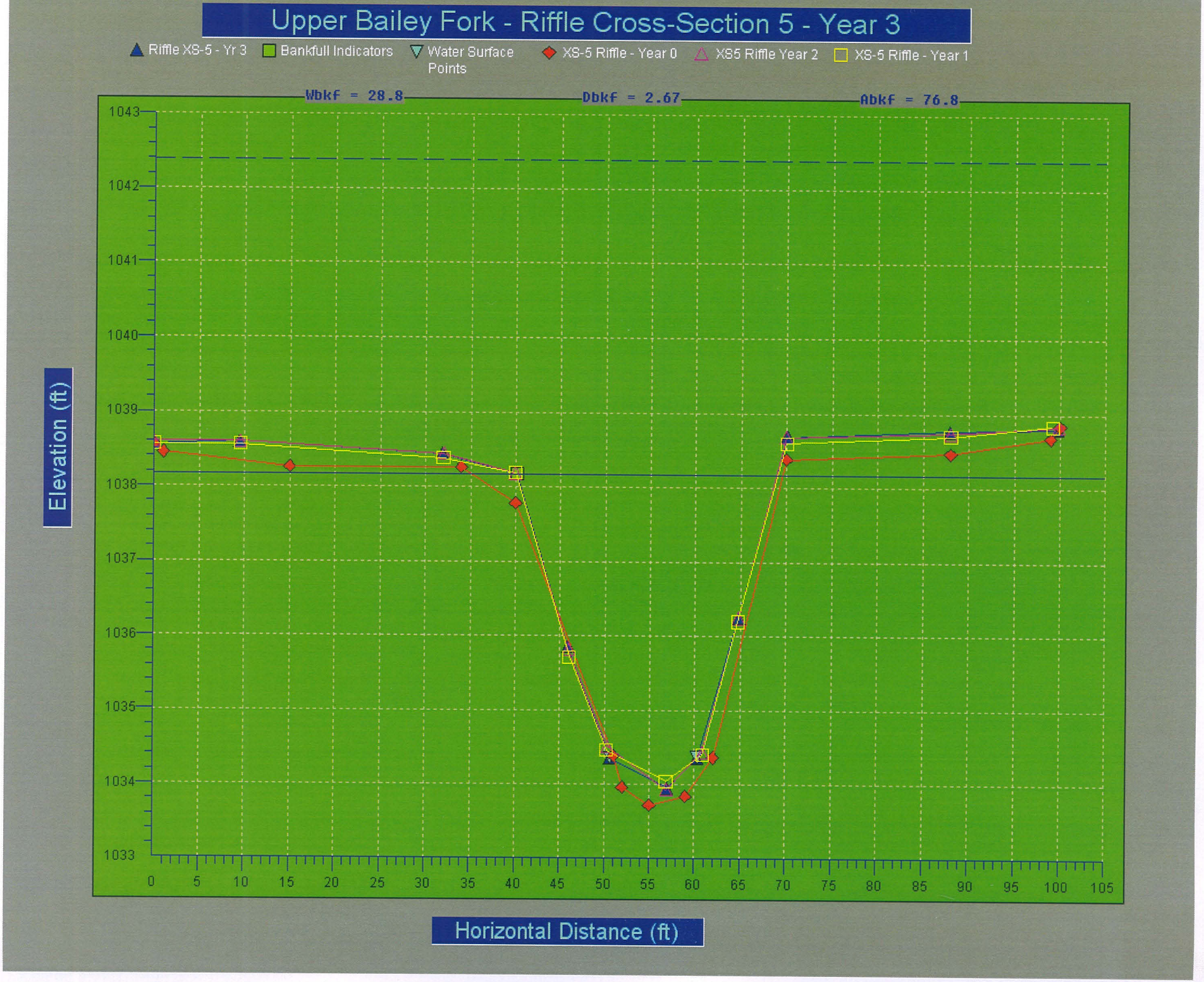
Upper Bailey Fork - Riffle Cross-Section 5 - Year 3



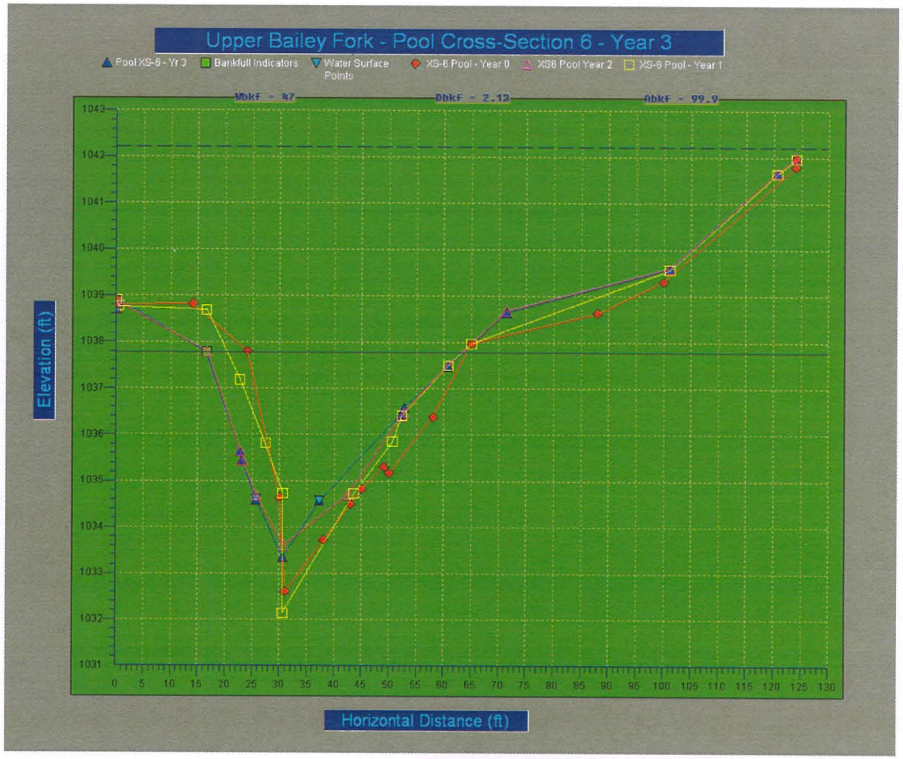
Summary Data

Bankfull Area	99.89 ft^2
Bankfull Width	47 ft
Mean Depth	2.13 ft
Maximum Depth	4.44 ft
Width/Depth Ratio	22.07
Entrenchment Ratio	2.64
Classification	C

PROJECT	Bailey Fork
	D04006-2
	3-YEAR
TASK	Cross-Section
REACH	Upper
DATE	10/1/08
CROSS SECTION:	6
FEATURE:	Pool

Ecosystem Enhancement

Cross-section photo – looking downstream



EMH&T

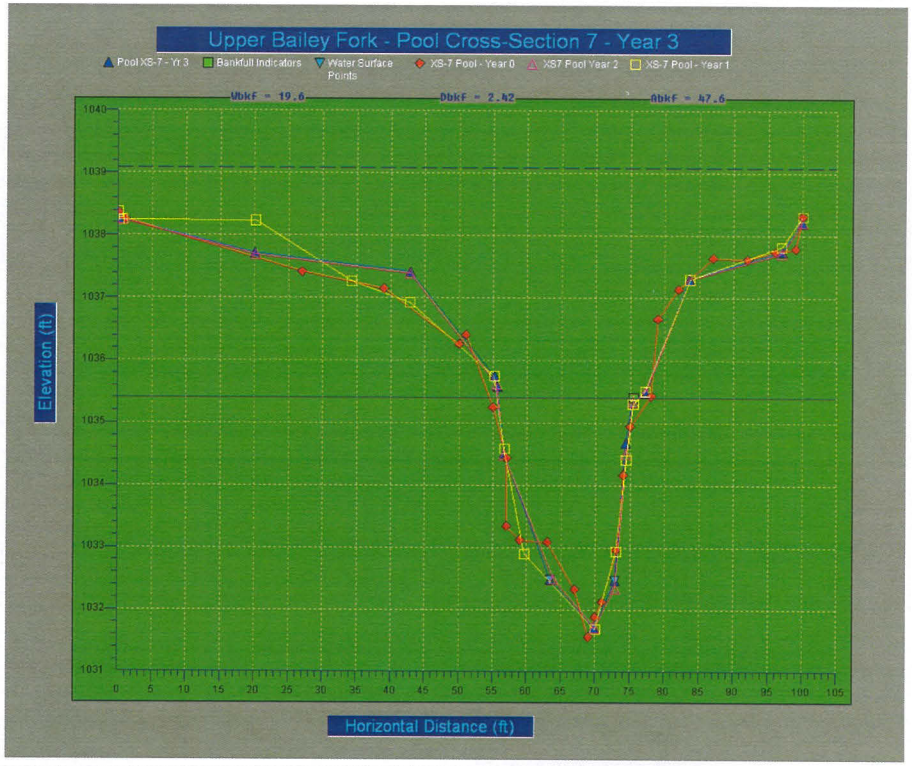
Upper Bailey Fork - Pool Cross-Section 6 - Year 3

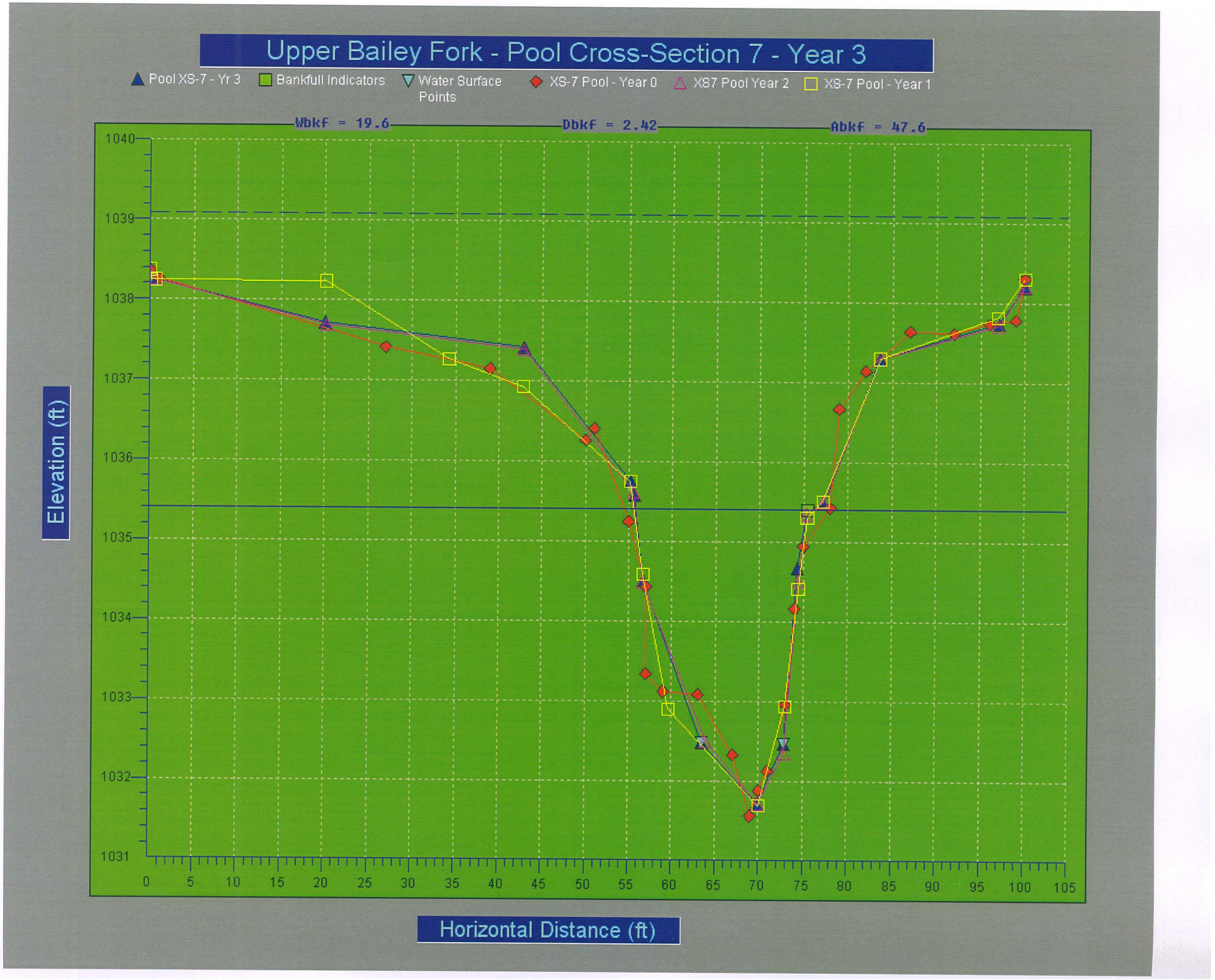
Summary Data

Bankfull Area	47.56 ft^2
Bankfull Width	19.63 ft
Mean Depth	2.42 ft
Maximum Depth	3.69 ft
Width/Depth Ratio	8.11
Entrenchment Ratio	5.09
Classification	E

PROJECT	Bailey Fork
	D04006-2
	3-YEAR
TASK	Cross-Section
REACH	Upper
DATE	10/1/08
CROSS SECTION:	7
FEATURE:	Pool

Cross-section photo – looking downstream



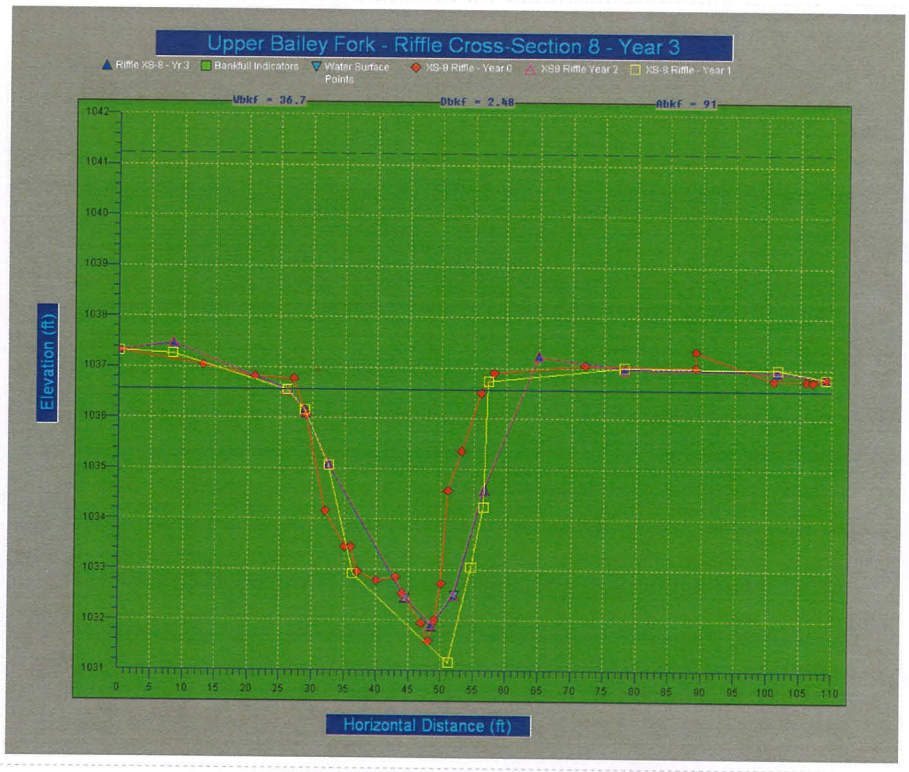

Upper Bailey Fork - Pool Cross-Section 7 - Year 3
Pool XS-7 - Yr 3
Bankfull Indicators
Water Surface Points
XS-7 Pool - Year 0
XS7 Pool Year 2
XS-7 Pool - Year 1
Wbkf = 19.6
Dbkf = 2.42
Abkf = 47.6
Elevation (ft)
1040
1039
1038
1037
1036
1035
1034
1033
1032
1031
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
Horizontal Distance (ft)

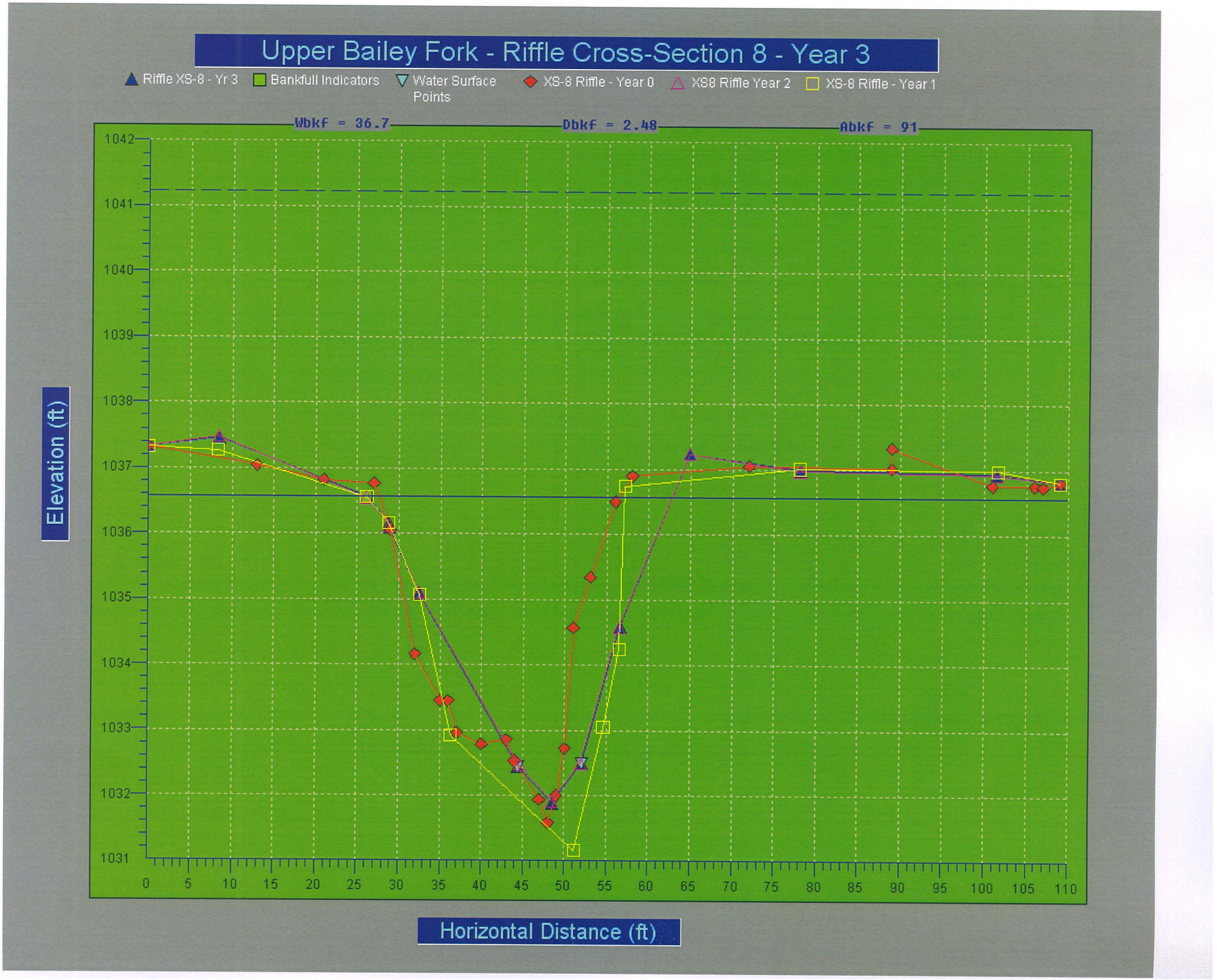
Summary Data

Bankfull Area	90.98 ft^2
Bankfull Width	36.74 ft
Mean Depth	2.48 ft
Maximum Depth	4.68 ft
Width/Depth Ratio	14.81
Entrenchment Ratio	2.97
Classification	E

PROJECT	Bailey Fork
	D04006-2
	3-YEAR
TASK	Cross-Section
REACH	Upper
DATE	10/1/08
CROSS SECTION:	8
FEATURE:	Riffle

Cross-section photo – looking downstream



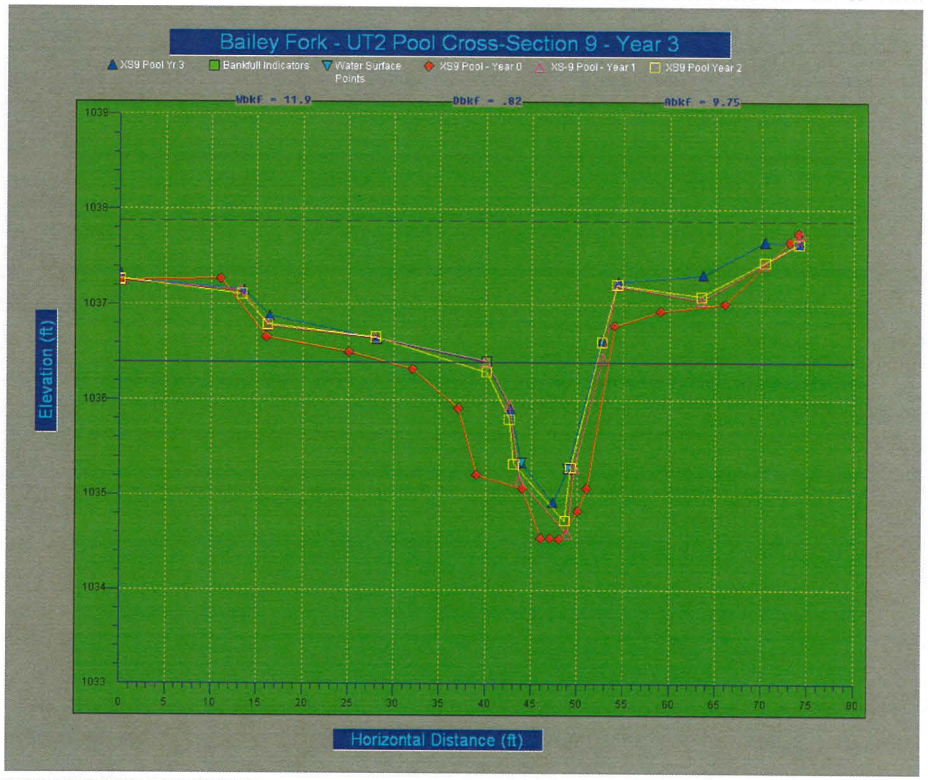

Upper Bailey Fork - Riffle Cross-Section 8 - Year 3
Riffle XS-8 - Yr 3
Bankfull Indicators
Water Surface Points
XS-8 Riffle - Year 0
XS8 Riffle Year 2
XS-8 Riffle - Year 1
Wbkf = 36.7
Dbkf = 2.48
Abkf = 91
Elevation (ft)
1042
1041
1040
1039
1038
1037
1036
1035
1034
1033
1032
1031
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
Horizontal Distance (ft)

Summary Data

Bankfull Area	9.75 ft^2
Bankfull Width	11.95 ft
Mean Depth	0.82 ft
Maximum Depth	1.48 ft
Width/Depth Ratio	14.57
Entrenchment Ratio	6.21
Classification	C

PROJECT	Bailey Fork
	D04006-2
	3-YEAR
TASK	Cross-Section
REACH	UT2
DATE	10/1/08
CROSS SECTION:	9
FEATURE:	Pool

Cross-section photo – looking downstream
Channel is obscured by vegetation.



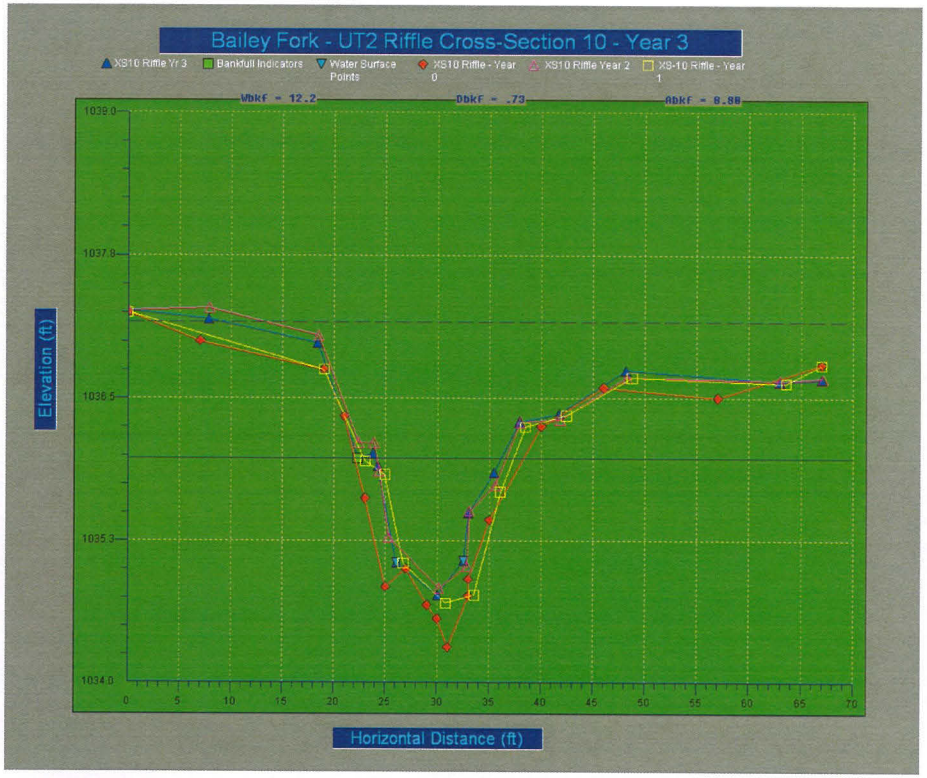
Bailey Fork - UT2 Pool Cross-Section 9 - Year 3

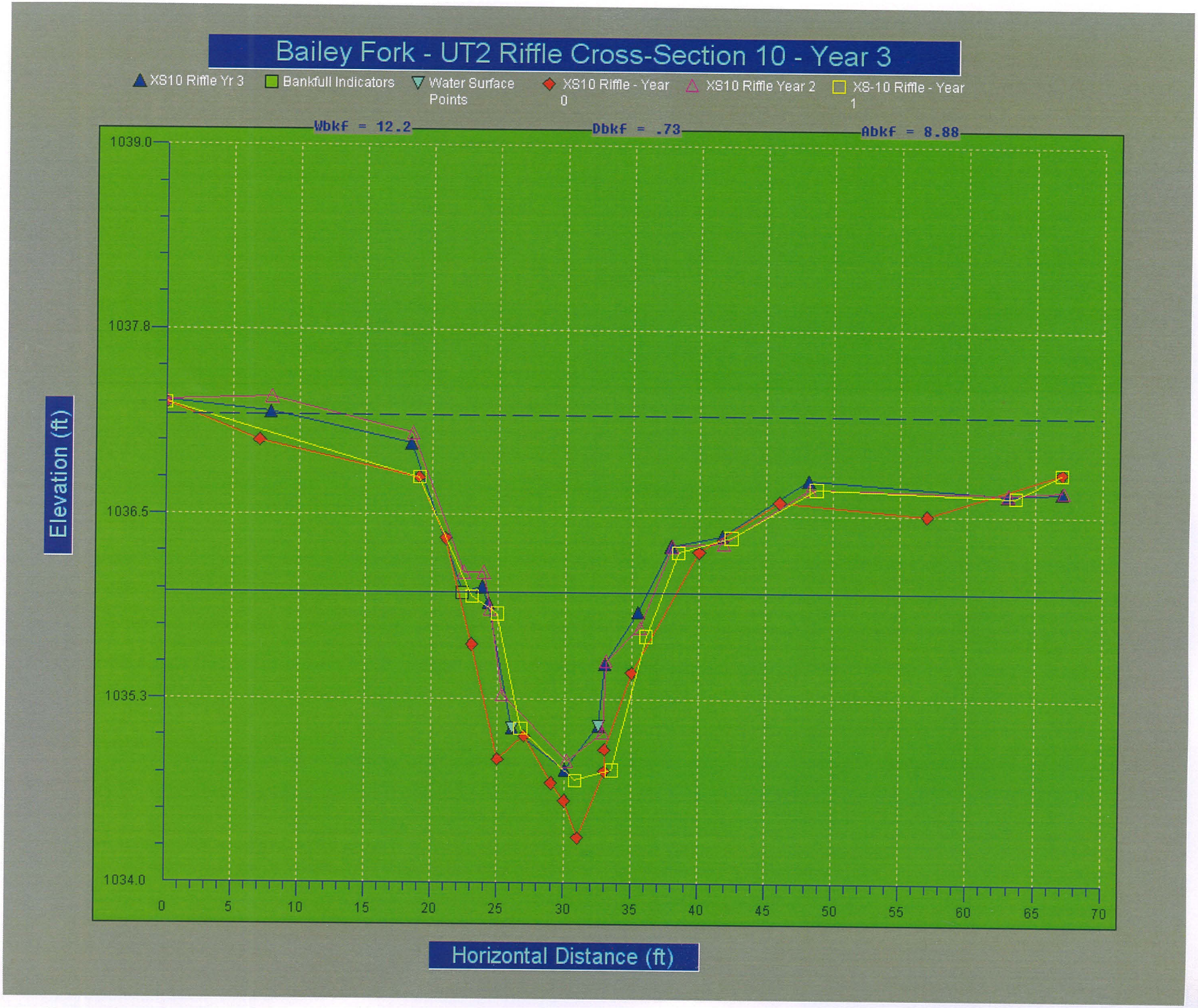
Summary Data

Bankfull Area	8.88 ft^2
Bankfull Width	12.25 ft
Mean Depth	0.73 ft
Maximum Depth	1.2 ft
Width/Depth Ratio	16.78
Entrenchment Ratio	4.75
Classification	C

PROJECT	Bailey Fork
	D04006-2
	3-YEAR
TASK	Cross-Section
REACH	UT2
DATE	10/1/08
CROSS SECTION:	10
FEATURE:	Riffle

Cross-section photo – looking downstream
Channel is obscured by vegetation.



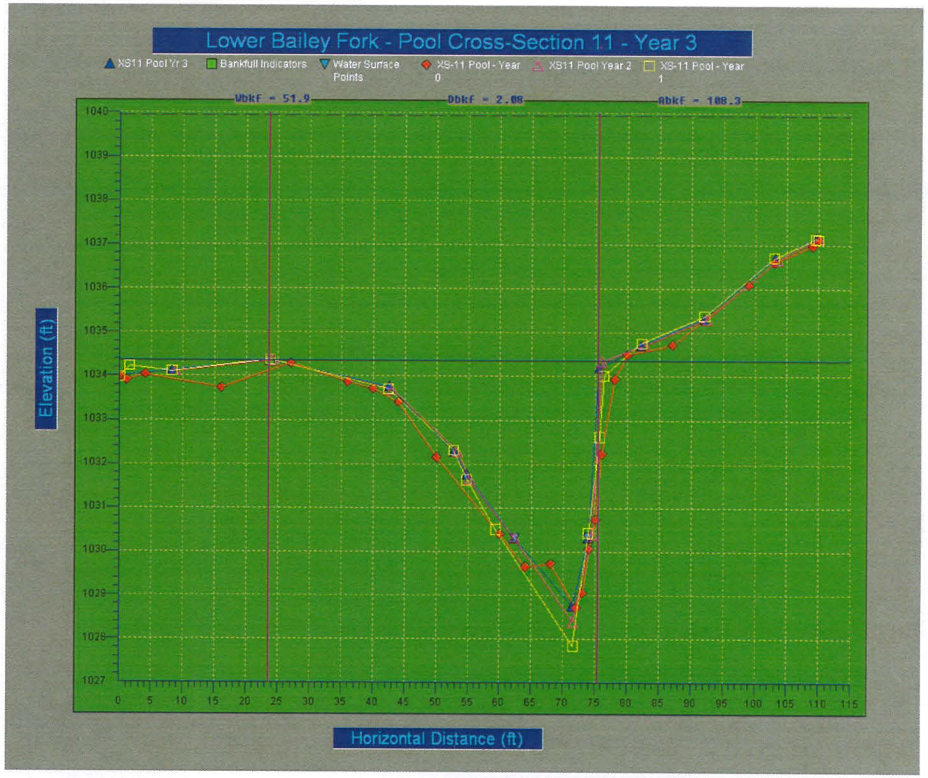

Bailey Fork - UT2 Riffle Cross-Section 10 - Year 3
XS10 Riffle Yr 3
Bankfull Indicators
Water Surface Points
XS10 Riffle - Year 0
XS10 Riffle Year 2
XS-10 Riffle - Year 1
Wbkf = 12.2
Dbkf = .73
Abkf = 8.88
1039.0
1037.8
1036.5
1035.3
1034.0
Elevation (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
Horizontal Distance (ft)

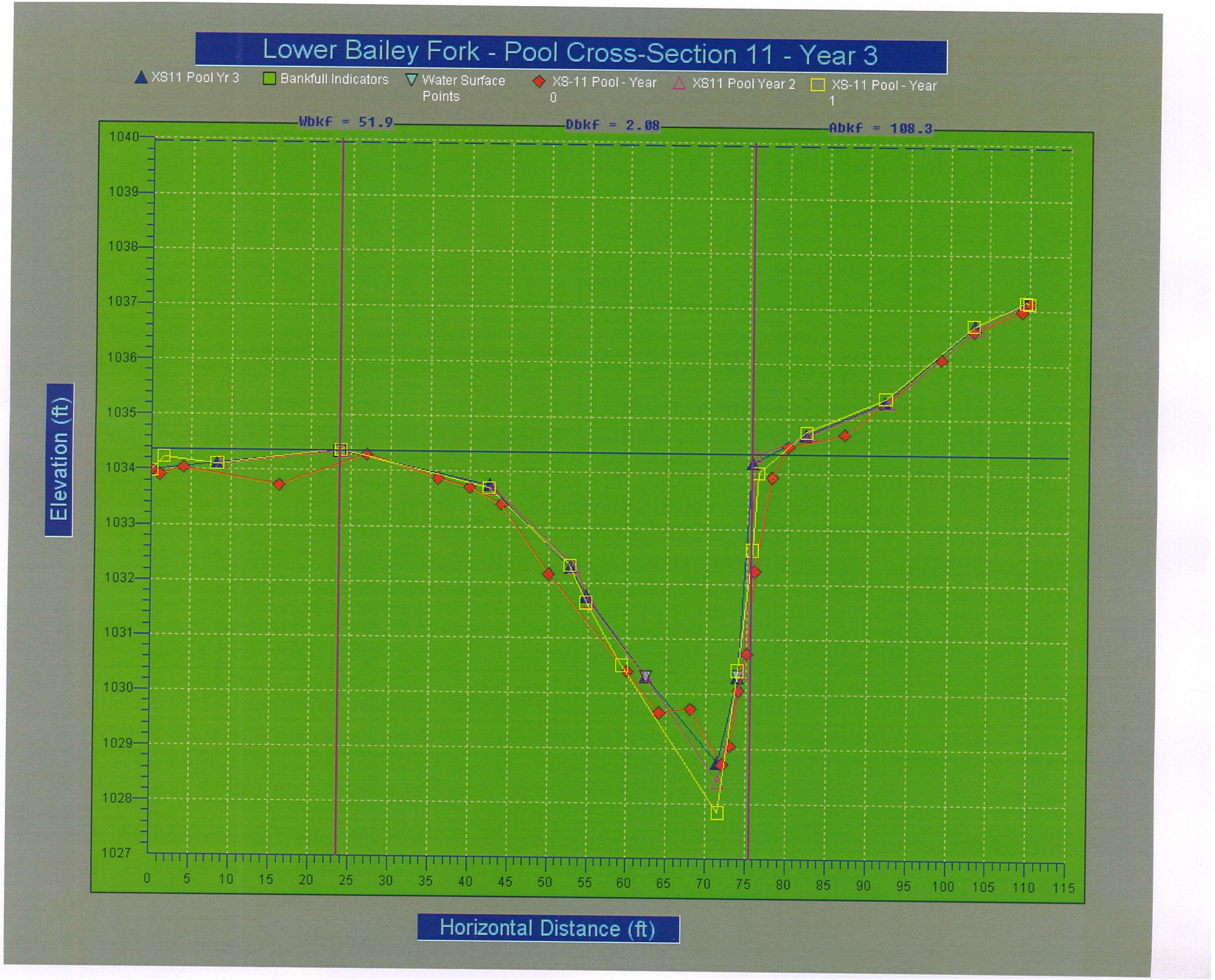
Summary Data

Bankfull Area	108.26 ft^2
Bankfull Width	51.94 ft
Mean Depth	2.08 ft
Maximum Depth	5.6 ft
Width/Depth Ratio	24.97
Entrenchment Ratio	2.31
Classification	C

PROJECT	Bailey Fork
	D04006-2
	3-YEAR
TASK	Cross-Section
REACH	Lower
DATE	10/1/08
CROSS SECTION:	11
FEATURE:	Pool

Cross-section photo – looking downstream




Lower Bailey Fork - Pool Cross-Section 11 - Year 3
XS11 Pool Yr 3
Bankfull Indicators
Water Surface Points
XS-11 Pool - Year 0
XS11 Pool Year 2
XS-11 Pool - Year 1
Wbkf = 51.9
Dbkf = 2.08
Abkf = 108.3
Elevation (ft)
1040
1039
1038
1037
1036
1035
1034
1033
1032
1031
1030
1029
1028
1027
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115
Horizontal Distance (ft)

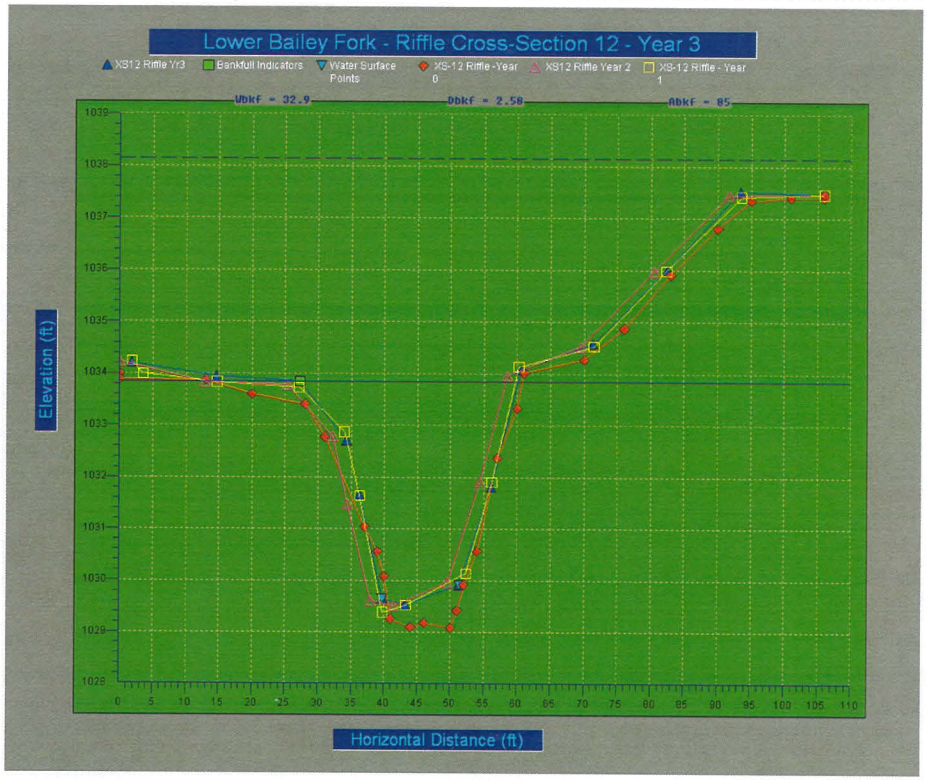
Summary Data

Bankfull Area	85 ft^2
Bankfull Width	32.89 ft
Mean Depth	2.58 ft
Maximum Depth	4.31 ft
Width/Depth Ratio	12.75
Entrenchment Ratio	3.17
Classification	C

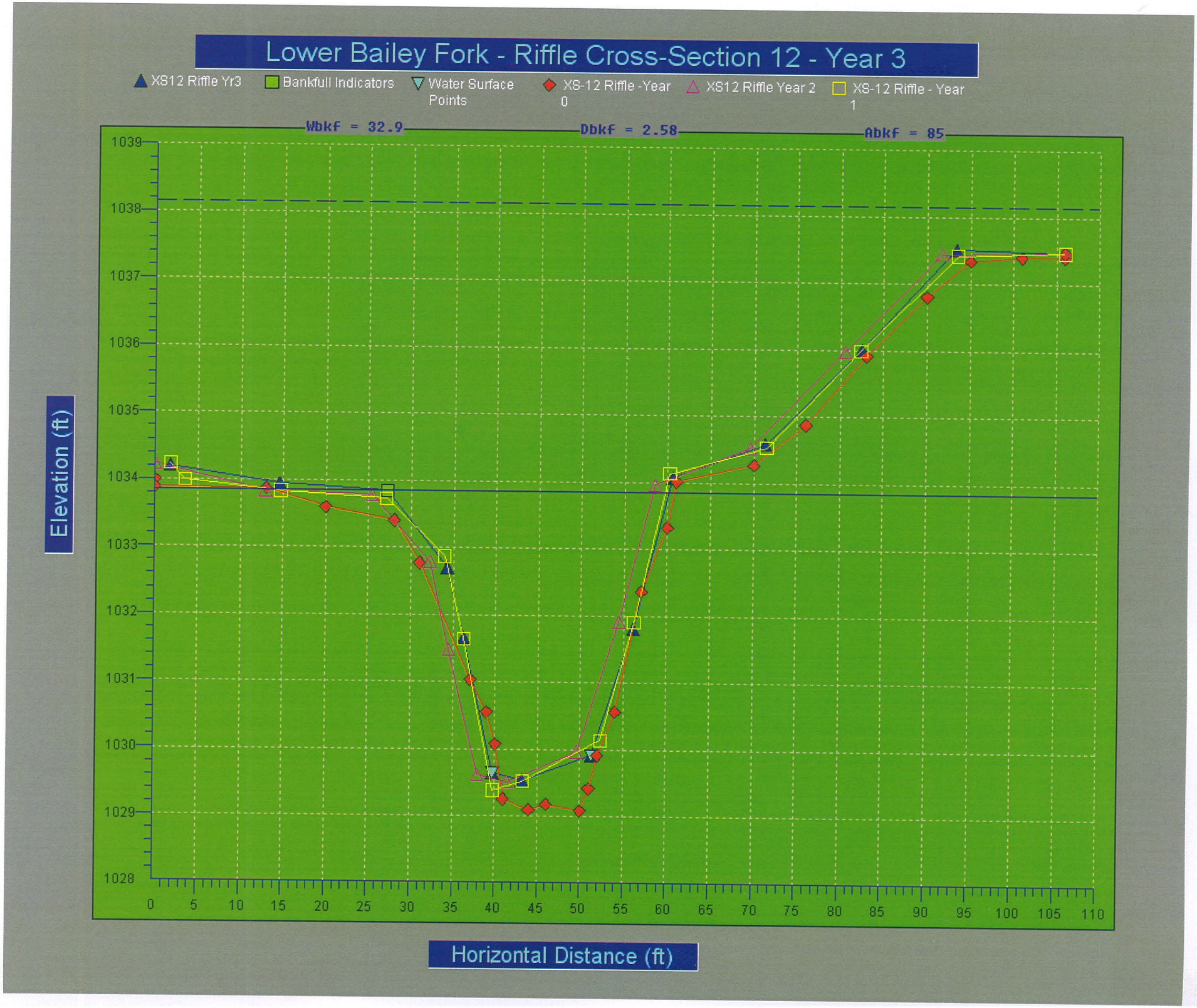
PROJECT	Bailey Fork
	D04006-2
	3-YEAR
TASK	Cross-Section
REACH	Lower
DATE	10/1/08
CROSS SECTION:	12
FEATURE:	Riffle

Ecosystem Enhancement

Cross-section photo – looking upstream



EMH&T


Lower Bailey Fork - Riffle Cross-Section 12 - Year 3
XS12 Riffle Yr3
Bankfull Indicators
Water Surface Points
XS-12 Riffle -Year 0
XS12 Riffle Year 2
XS-12 Riffle - Year 1
Wbkf = 32.9
Dbkf = 2.58
Abkf = 85
Elevation (ft)
1039
1038
1037
1036
1035
1034
1033
1032
1031
1030
1029
1028
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110
Horizontal Distance (ft)

Upper Bailey Fork - Long-Term Monitoring Profile - Year 3

Note:

While stable bedform features have evolved since Year 0 in this sand and gravel bed system, the channel bed slope in Year 3 approximates that of the "As-Built" condition.

With bankfull, water surface and channel slopes, for all practical purposes, being equal, the Upper Bailey Fork is stable and functioning as designed and constructed.

Pool XS-6 - Yr 3

Riffle XS-5 - Yr 3

UT-1 Confluence Sta. 6+70.64

Monitoring Year 3 Profile Summary

September 26, 2008 Profile Survey Points

▼ BKF

○ WS

● CH

September 26, 2008 Best-Fit Trendline Slopes

Sbkf = 0.0020 ft/ft

Sws = 0.0020 ft/ft

Sch = 0.0022 ft/ft

August 2006 "As-Built" Best-Fit Trendline Slopes

S low bnk = 0.0029 ft/ft

Sws = 0.0022 ft/ft

Sch = 0.0027 ft/ft

Elevation (ft)

1040 1039 1038 1037 1036 1035 1034 1033 1032 1031 1030

0 25 50 75 100 125 150 175 200 225 250 275 300 325 350 375 400 425 450 475 500 525 550 575 600 625 650 675 700 725 750 775 800 825

Distance along stream (ft)

Upper Bailey Fork - Long-Term Monitoring Profile - Year 3

Elevation (ft)

1037
1036
1035
1034
1033
1032
1031

Pool XS-6 - Yr 3
Riffle XS-5 - Yr 3
UT-1 Confluence Sta. 6+70.64

0 25 50 75 100 125 150 175 200 225 250 275 300 325 350 375 400 425 450 475 500 525 550 575 600 625 650 675 700 725 750 775 800 825

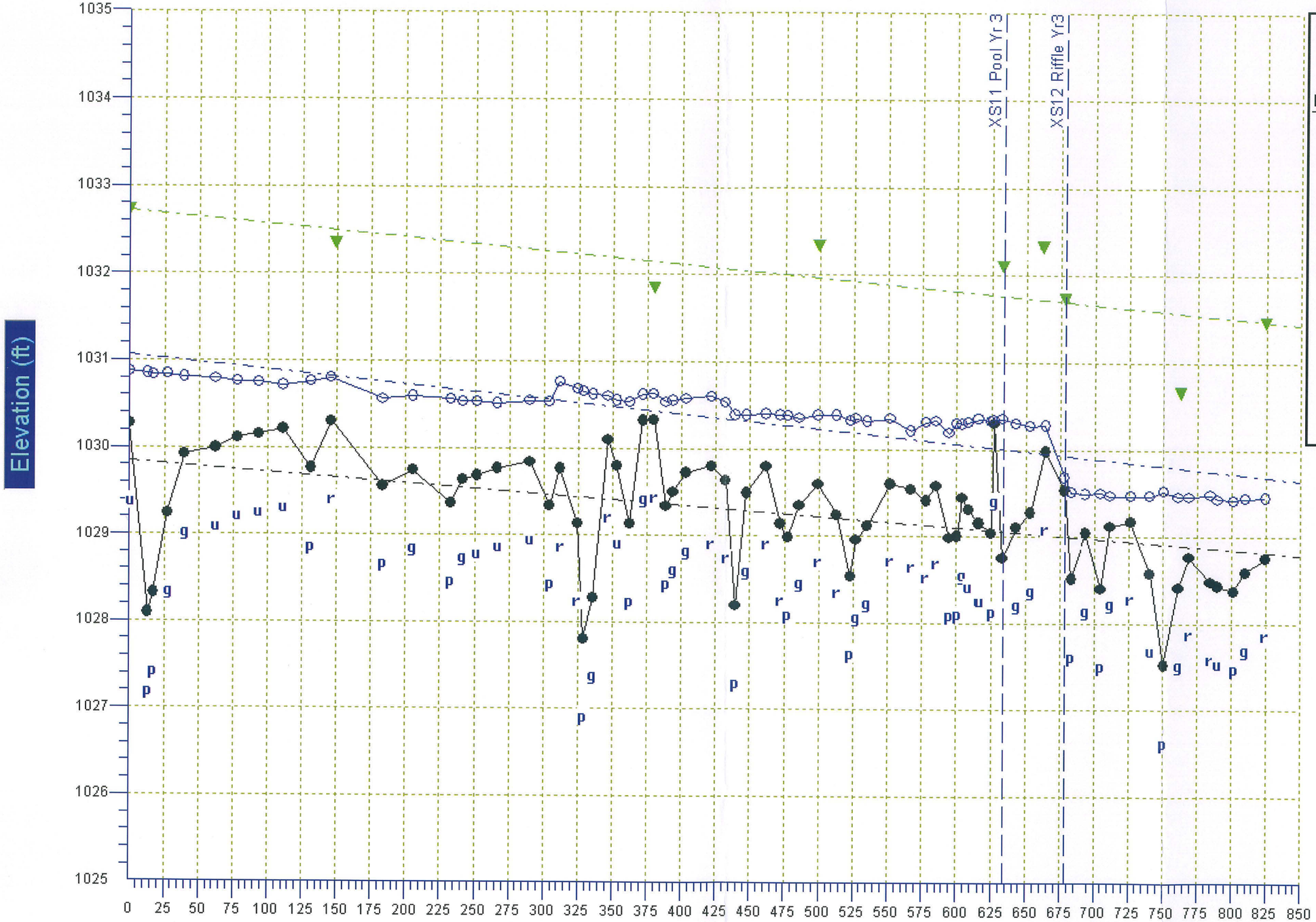
Distance along stream (ft)

Year 3 Profile Data Points

- BKF
- WS
- CH

- UBF LP YR 0
- UBF LP YR 2

Lower Bailey Fork - Long-Term Monitoring Profile - Year 3



Monitoring Year 3 Profile Summary

September 26, 2008 Profile Survey Points

▼ BKF

○ WS

● CH

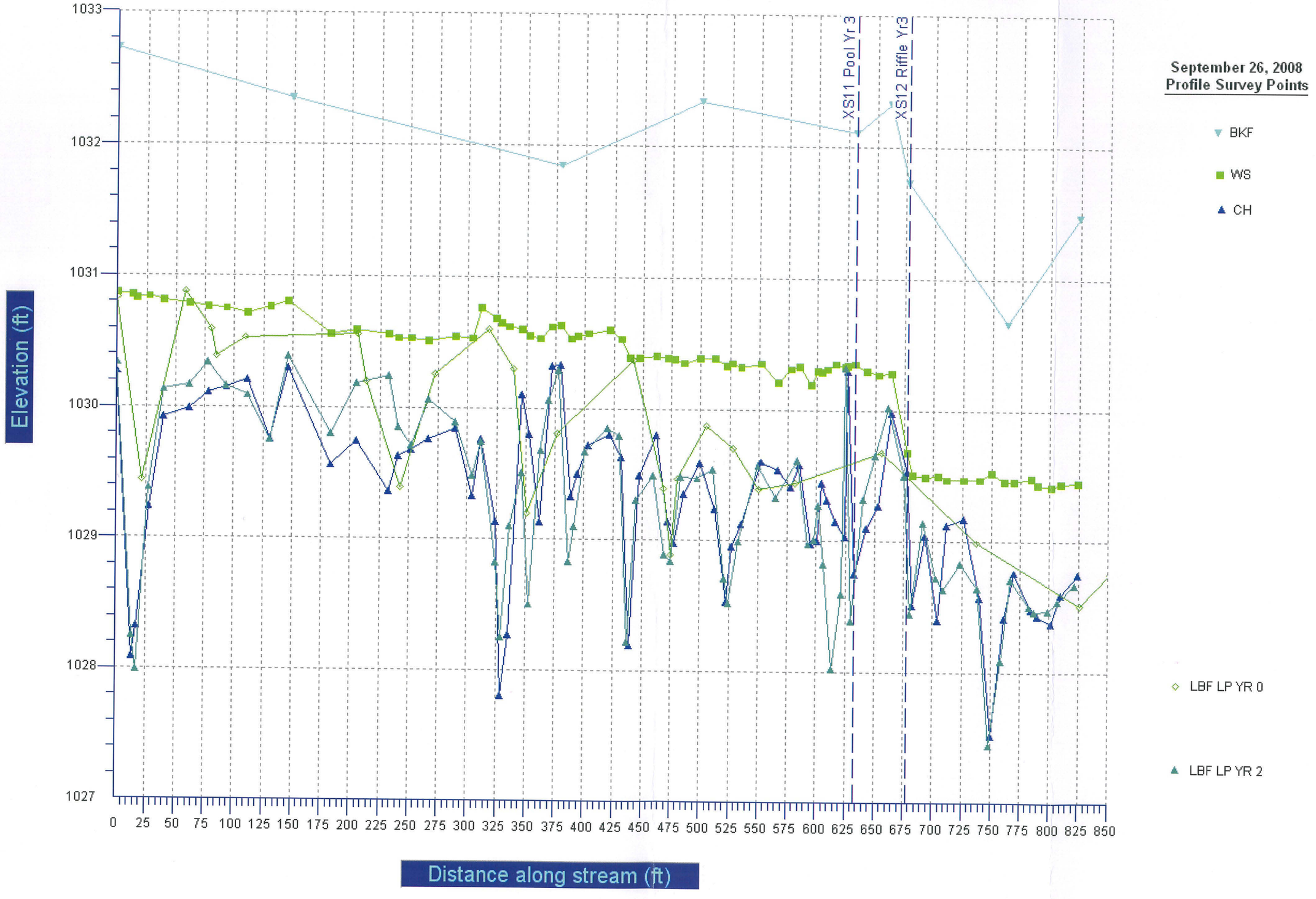
September 26, 2008 Best-Fit Trendline Slopes

Sbkf = 0.0015 ft/ft

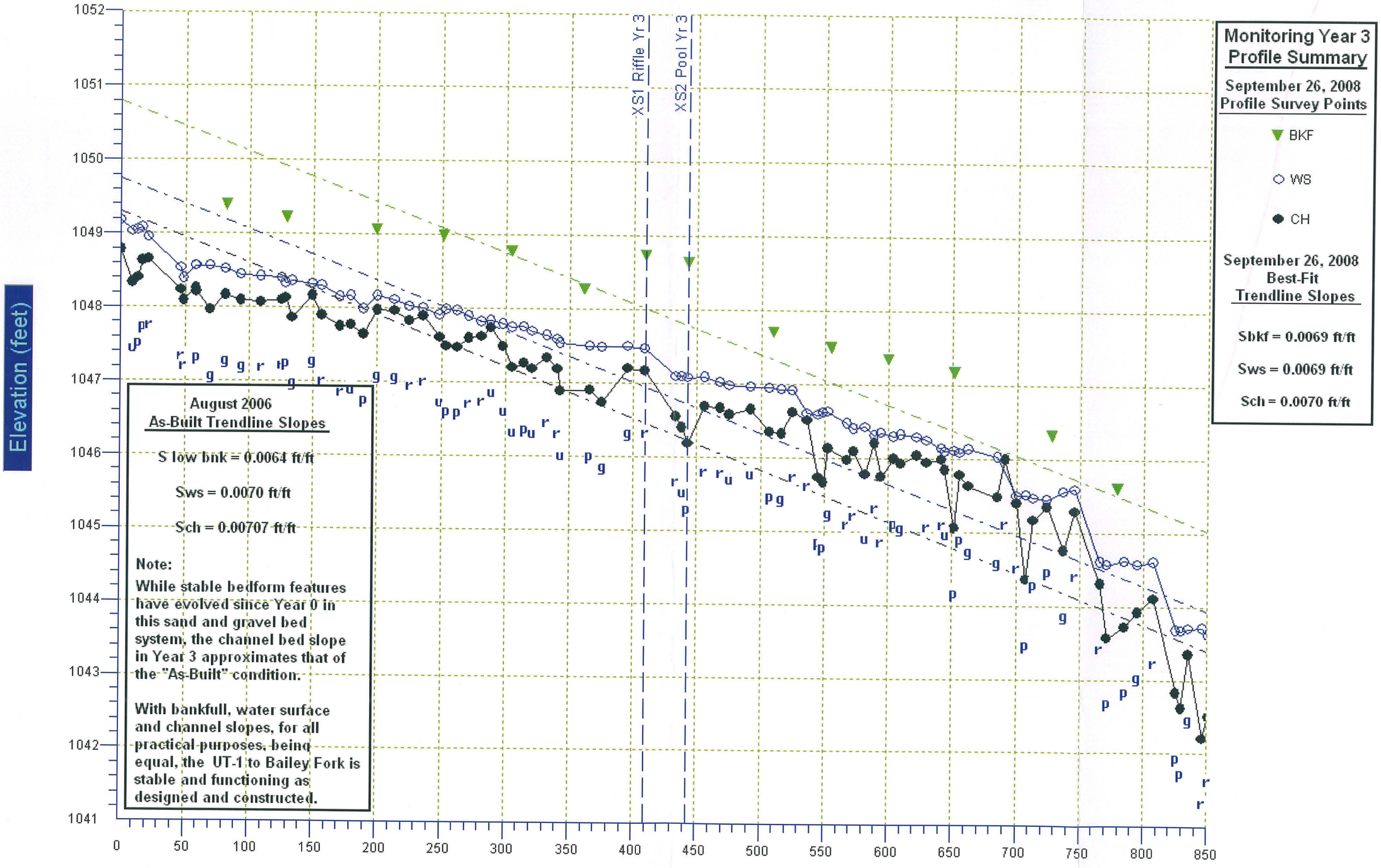
Sws = 0.0017 ft/ft

Sch = 0.0013 ft/ft

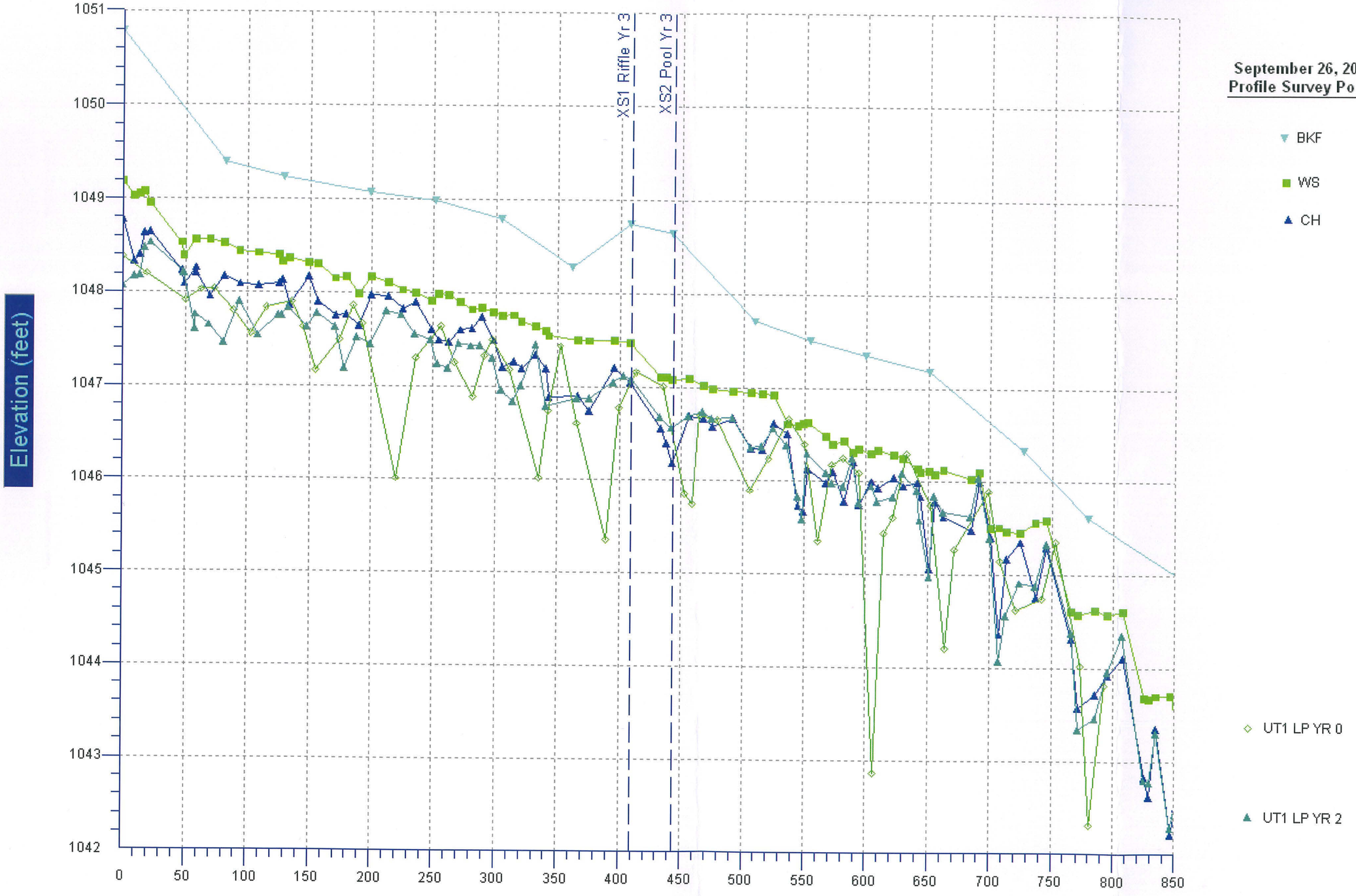
Lower Bailey Fork - Long-Term Monitoring Profile - Year 3



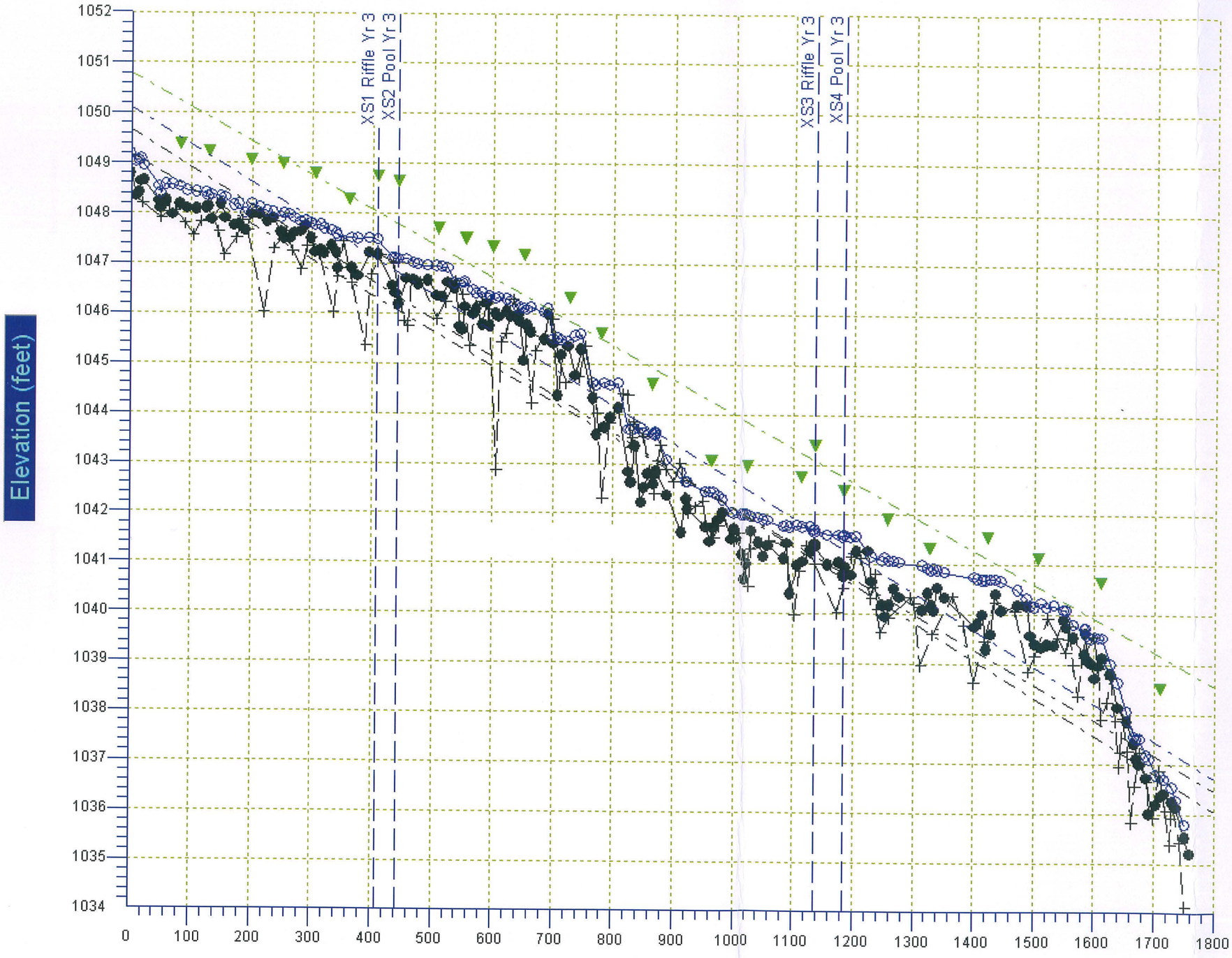
Bailey Fork - UT1 Long-Term Monitoring Profile - Year 3



Bailey Fork - UT1 Long-Term Monitoring Profile - Year 3 - 09/26/2008



Bailey Fork - UT1 Reach Monitoring Profile - Year 3 - 09/26/2008



Monitoring Year 3
TSS Profile Points
September 26, 2008

- CH
- WS
- BKF

September 26, 2008
Best-Fit Trendlines

Sbkf = 0.0069 ft/ft

Sws = 0.0069 ft/ft

Sch = 0.0070 ft/ft

August 2006
As-Built Trendline Slopes

S low bnk = 0.0064 ft/ft

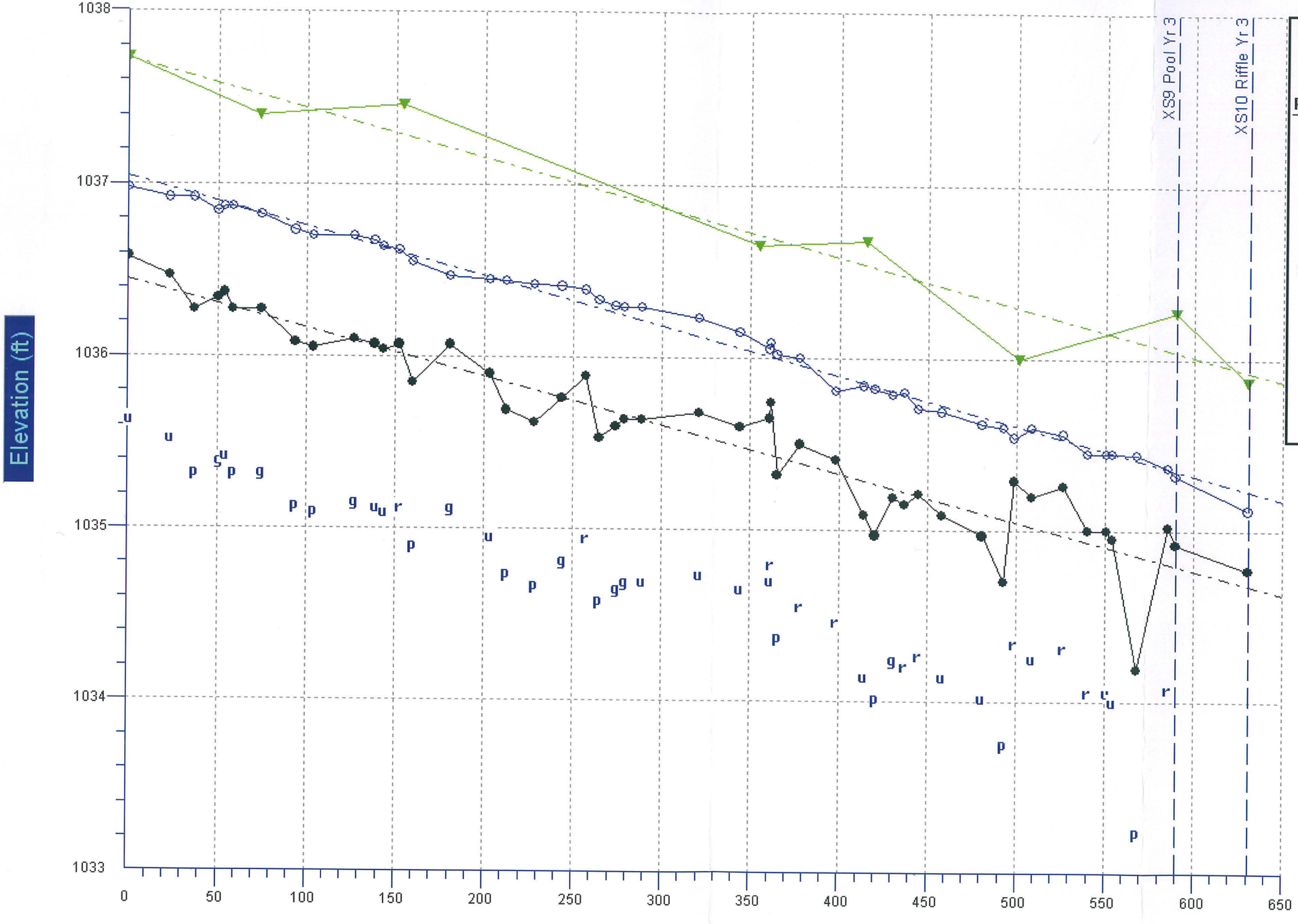
Sws = 0.0070 ft/ft

Sch = 0.00707 ft/ft

Note:
While stable bedform features have evolved since Year 0 in this sand and gravel bed system, the channel bed slope in Year 3 approximates that of the "As-Built" condition.

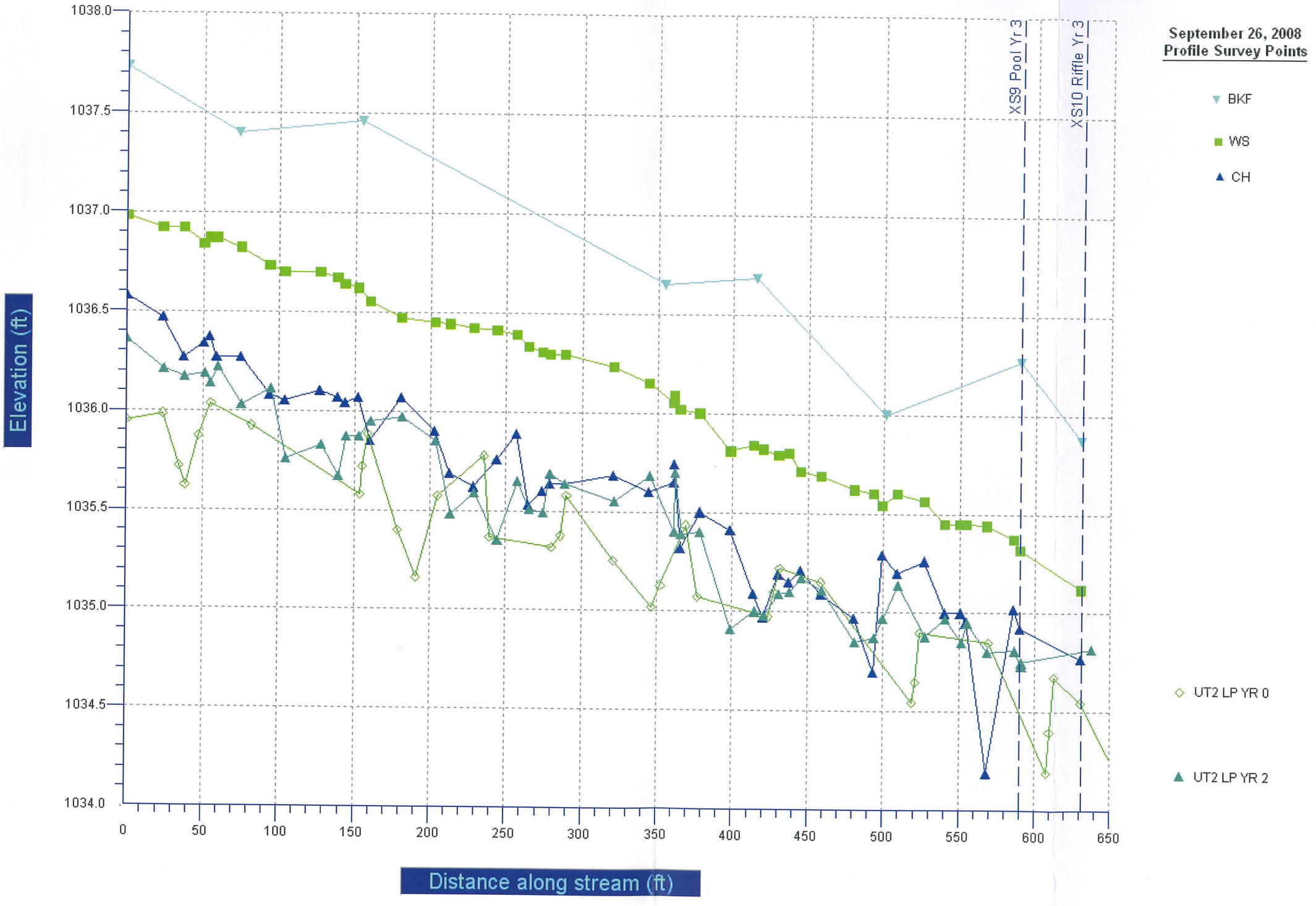
With bankfull, water surface and channel slopes, for all practical purposes, being equal, the UT-1 to Bailey Fork is stable and functioning as designed and constructed.

Bailey Fork UT-2 - Long-Term Monitoring Profile - Year 3 - 09/26/2008



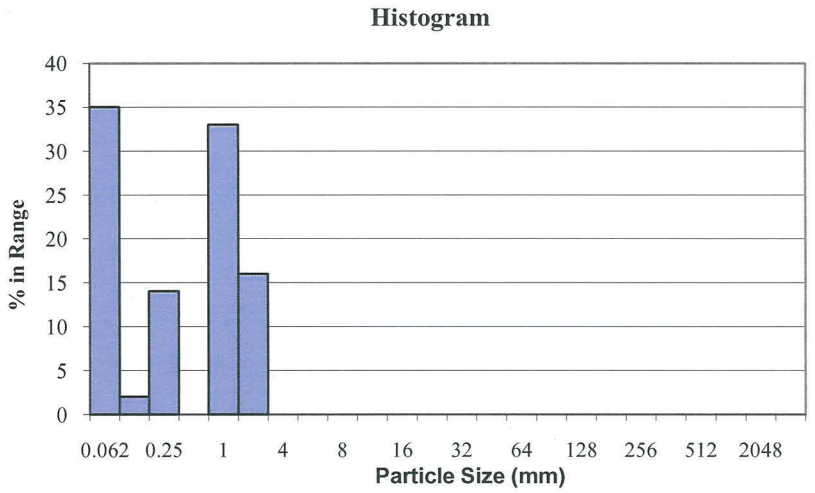
Distance along stream (ft)

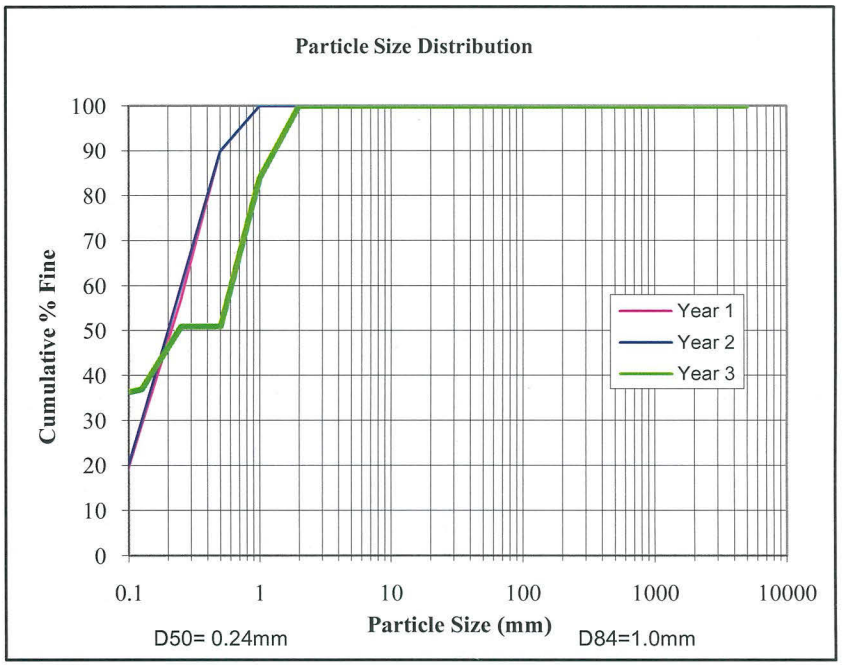
Bailey Fork UT-2 - Long-Term Monitoring Profile - Year 3 - 09/26/2008



Pebble Count – Pool				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	35	35	35
Very Fine Sand	0.062-0.125	2	2	37
Fine Sand	0.125-0.25	14	14	51
Medium Sand	0.25-0.5	0	0	51
Coarse Sand	0.5-1.0	33	33	84
Very Coarse Sand	1.0-2.0	16	16	100
Very Fine Gravel	2.0-4.0	0	0	100
Fine Gravel	4.0-5.7	0	0	100
Fine Gravel	5.7-8.0	0	0	100
Medium Gravel	8.0-11.3	0	0	100
Medium Gravel	11.3-16.0	0	0	100
Coarse Gravel	16.0-22.6	0	0	100
Coarse Gravel	22.6-32	0	0	100
Very Coarse Gravel	32-45	0	0	100
Very Coarse Gravel	45-64	0	0	100
Small Cobble	64-90	0	0	100
Small Cobble	90-128	0	0	100
Large Cobble	128-180	0	0	100
Large Cobble	180-256	0	0	100
Small Boulder	256-362	0	0	100
Small Boulder	362-512	0	0	100
Medium Boulder	512-1024	0	0	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		100	100	

Bailey Fork Stream Restoration EEP Project No. D04006-02			
Reach	UT1	**X Sec**	2
Date	9/9/08	**Sta No.**	4+50



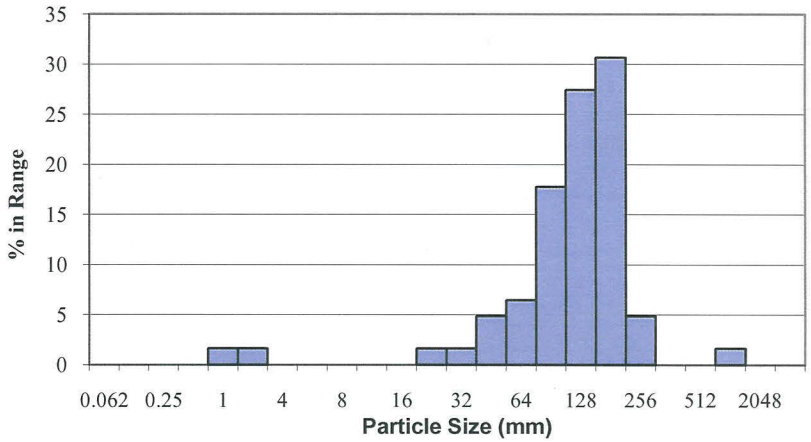


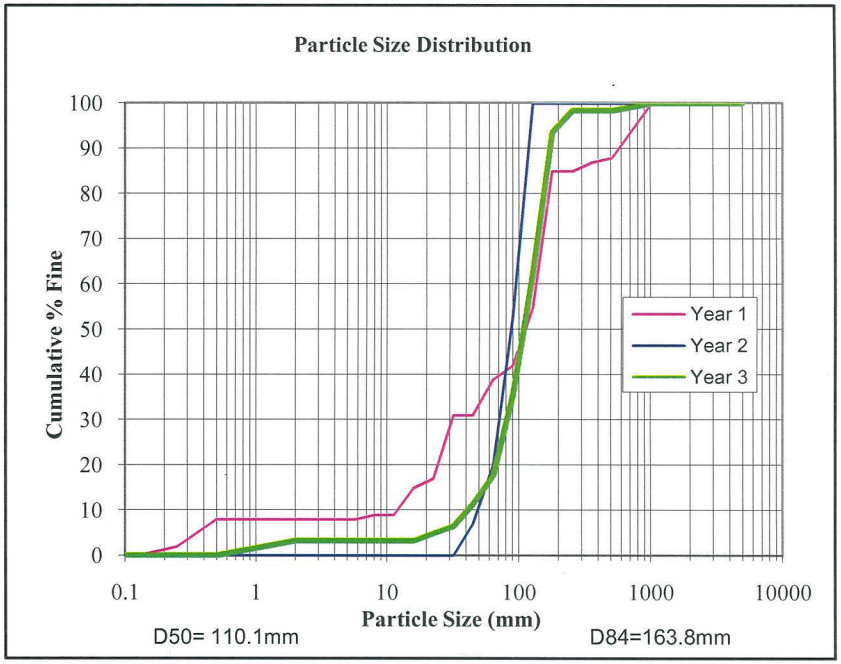
Pebble Count – Riffle

Material	Particle Size (mm)	Count	% in Range	% Cumulative
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	0	0	0
Medium Sand	0.25-0.5	0	0	0
Coarse Sand	0.5-1.0	1	2	2
Very Coarse Sand	1.0-2.0	1	2	3
Very Fine Gravel	2.0-4.0	0	0	3
Fine Gravel	4.0-5.7	0	0	3
Fine Gravel	5.7-8.0	0	0	3
Medium Gravel	8.0-11.3	0	0	3
Medium Gravel	11.3-16.0	0	0	3
Coarse Gravel	16.0-22.6	1	2	5
Coarse Gravel	22.6-32	1	2	6
Very Coarse Gravel	32-45	3	5	11
Very Coarse Gravel	45-64	4	6	18
Small Cobble	64-90	11	18	35
Small Cobble	90-128	17	27	63
Large Cobble	128-180	19	31	94
Large Cobble	180-256	3	5	98
Small Boulder	256-362	0	0	98
Small Boulder	362-512	0	0	98
Medium Boulder	512-1024	1	2	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		62	100	

Bailey Fork Stream Restoration EEP Project No. D04006-02			
Reach	Upper	**X Sec**	5
Date	9/9/08	**Sta No.**	6+00

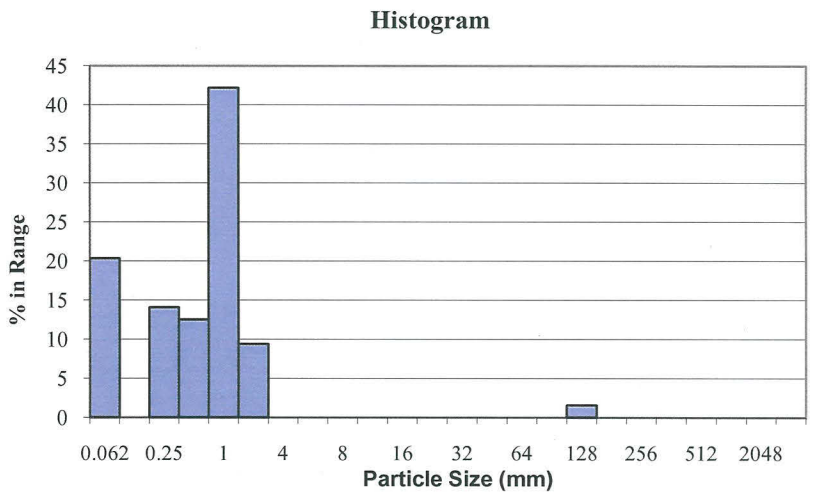
Histogram

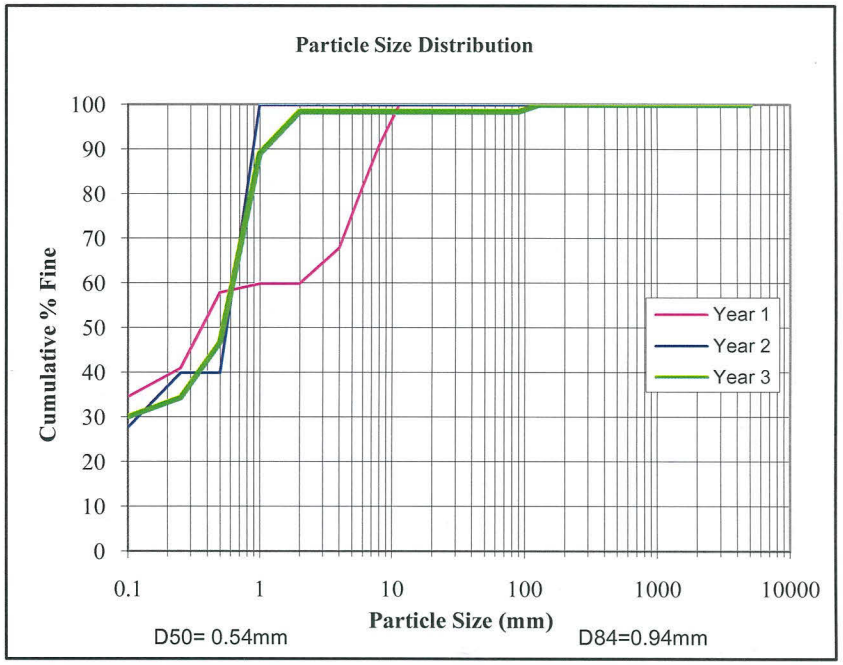




Pebble Count - Pool				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	13	20	20
Very Fine Sand	0.062-0.125	0	0	20
Fine Sand	0.125-0.25	9	14	34
Medium Sand	0.25-0.5	8	13	47
Coarse Sand	0.5-1.0	27	42	89
Very Coarse Sand	1.0-2.0	6	9	98
Very Fine Gravel	2.0-4.0	0	0	98
Fine Gravel	4.0-5.7	0	0	98
Fine Gravel	5.7-8.0	0	0	98
Medium Gravel	8.0-11.3	0	0	98
Medium Gravel	11.3-16.0	0	0	98
Coarse Gravel	16.0-22.6	0	0	98
Coarse Gravel	22.6-32	0	0	98
Very Coarse Gravel	32-45	0	0	98
Very Coarse Gravel	45-64	0	0	98
Small Cobble	64-90	0	0	98
Small Cobble	90-128	1	2	100
Large Cobble	128-180	0	0	100
Large Cobble	180-256	0	0	100
Small Boulder	256-362	0	0	100
Small Boulder	362-512	0	0	100
Medium Boulder	512-1024	0	0	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		64	100	

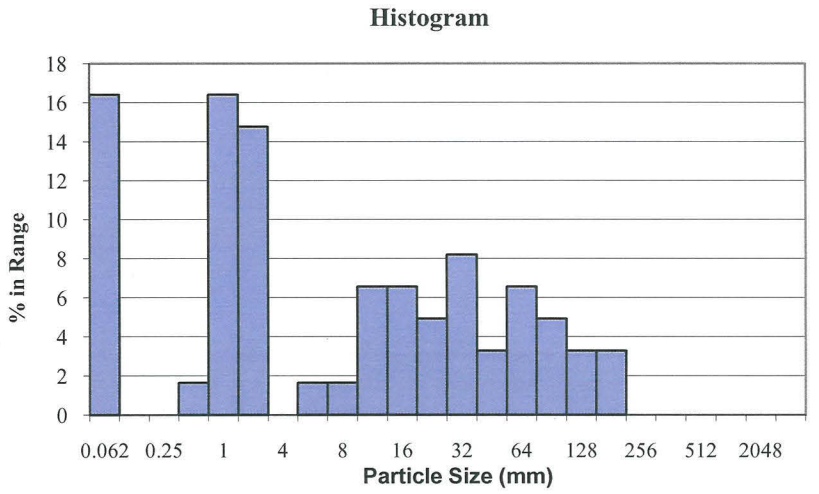
Bailey Fork Stream Restoration EEP Project No. D04006-02			
Reach	Upper	**X Sec**	7
Date	9/9/08	**Sta No.**	11+00

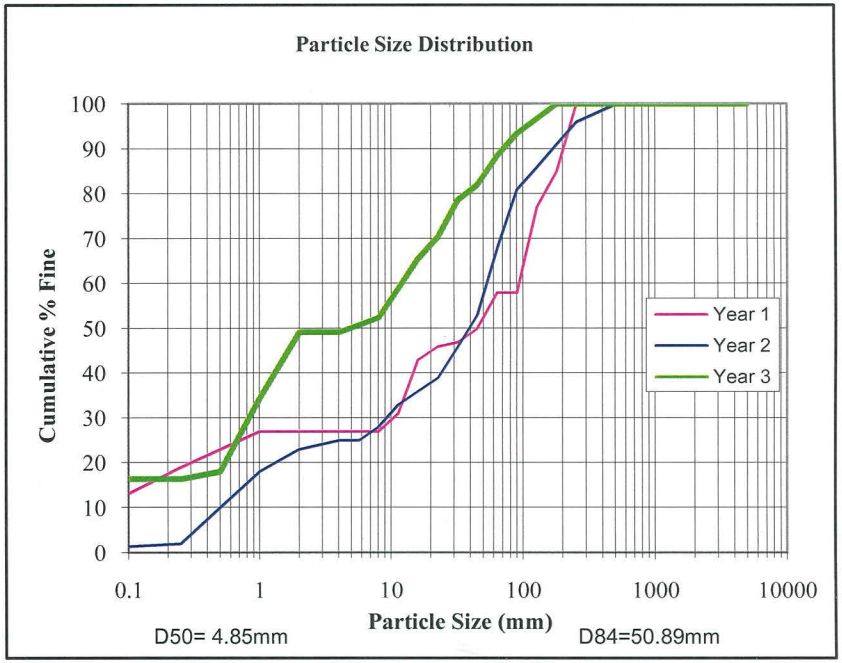




Pebble Count – Riffle				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	10	16	16
Very Fine Sand	0.062-0.125	0	0	16
Fine Sand	0.125-0.25	0	0	16
Medium Sand	0.25-0.5	1	2	18
Coarse Sand	0.5-1.0	10	16	34
Very Coarse Sand	1.0-2.0	9	15	49
Very Fine Gravel	2.0-4.0	0	0	49
Fine Gravel	4.0-5.7	1	2	51
Fine Gravel	5.7-8.0	1	2	52
Medium Gravel	8.0-11.3	4	7	59
Medium Gravel	11.3-16.0	4	7	66
Coarse Gravel	16.0-22.6	3	5	70
Coarse Gravel	22.6-32	5	8	79
Very Coarse Gravel	32-45	2	3	82
Very Coarse Gravel	45-64	4	7	89
Small Cobble	64-90	3	5	93
Small Cobble	90-128	2	3	97
Large Cobble	128-180	2	3	100
Large Cobble	180-256	0	0	100
Small Boulder	256-362	0	0	100
Small Boulder	362-512	0	0	100
Medium Boulder	512-1024	0	0	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		61	100	

Bailey Fork Stream Restoration EEP Project No. D04006-02			
Reach	UT2	**X Sec**	10
Date	9/9/08	**Sta No.**	6+50

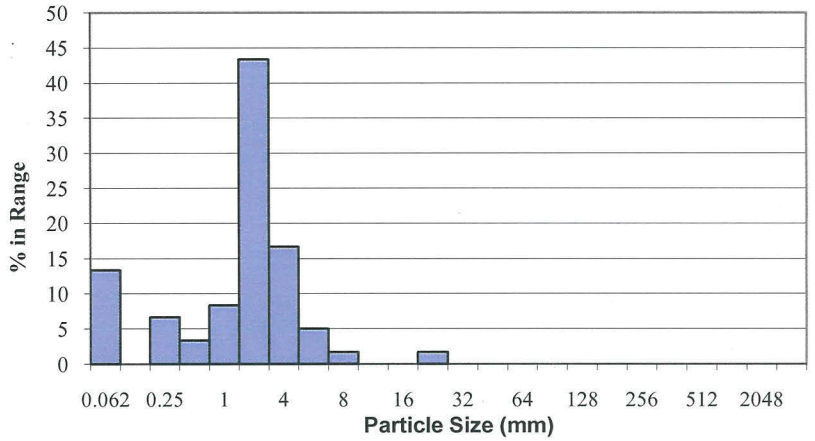




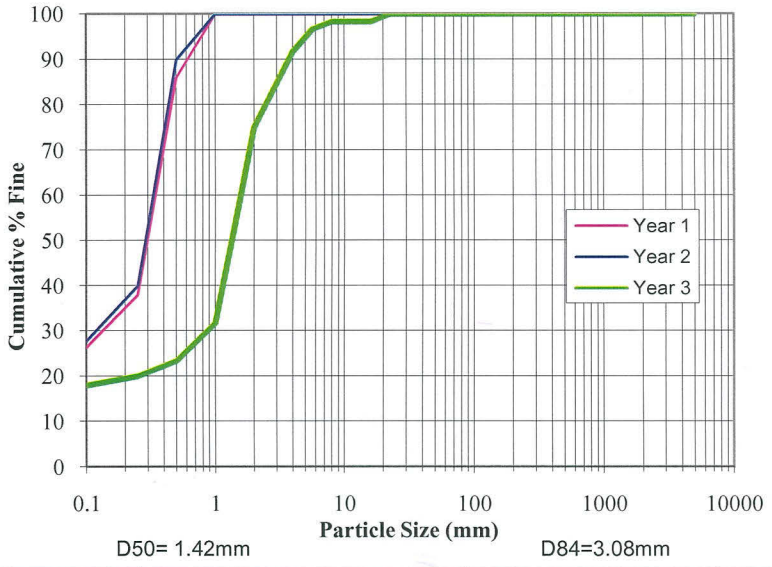
Pebble Count – Pool				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	8	13	13
Very Fine Sand	0.062-0.125	0	0	13
Fine Sand	0.125-0.25	4	7	20
Medium Sand	0.25-0.5	2	3	23
Coarse Sand	0.5-1.0	5	8	32
Very Coarse Sand	1.0-2.0	26	43	75
Very Fine Gravel	2.0-4.0	10	17	92
Fine Gravel	4.0-5.7	3	5	97
Fine Gravel	5.7-8.0	1	2	98
Medium Gravel	8.0-11.3	0	0	98
Medium Gravel	11.3-16.0	0	0	98
Coarse Gravel	16.0-22.6	1	2	100
Coarse Gravel	22.6-32	0	0	100
Very Coarse Gravel	32-45	0	0	100
Very Coarse Gravel	45-64	0	0	100
Small Cobble	64-90	0	0	100
Small Cobble	90-128	0	0	100
Large Cobble	128-180	0	0	100
Large Cobble	180-256	0	0	100
Small Boulder	256-362	0	0	100
Small Boulder	362-512	0	0	100
Medium Boulder	512-1024	0	0	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		60	100	

Bailey Fork Stream Restoration EEP Project No. D04006-02			
Reach	Lower	**X Sec**	11
Date	9/9/08	**Sta No.**	6+00

Histogram

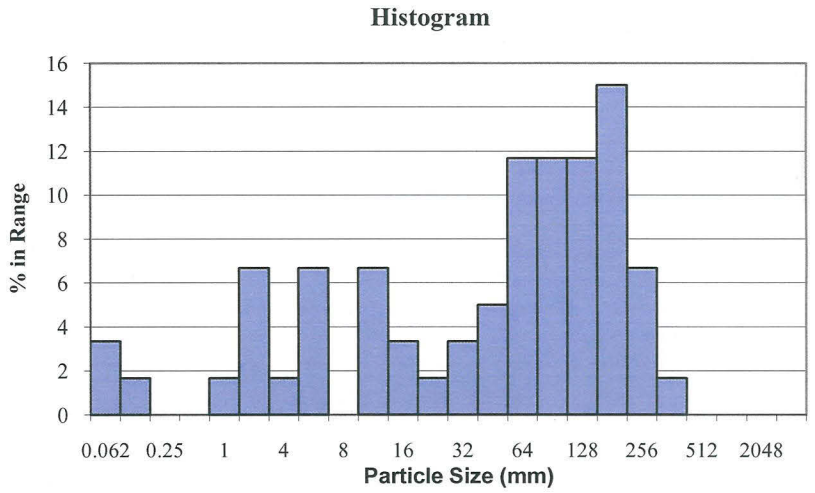


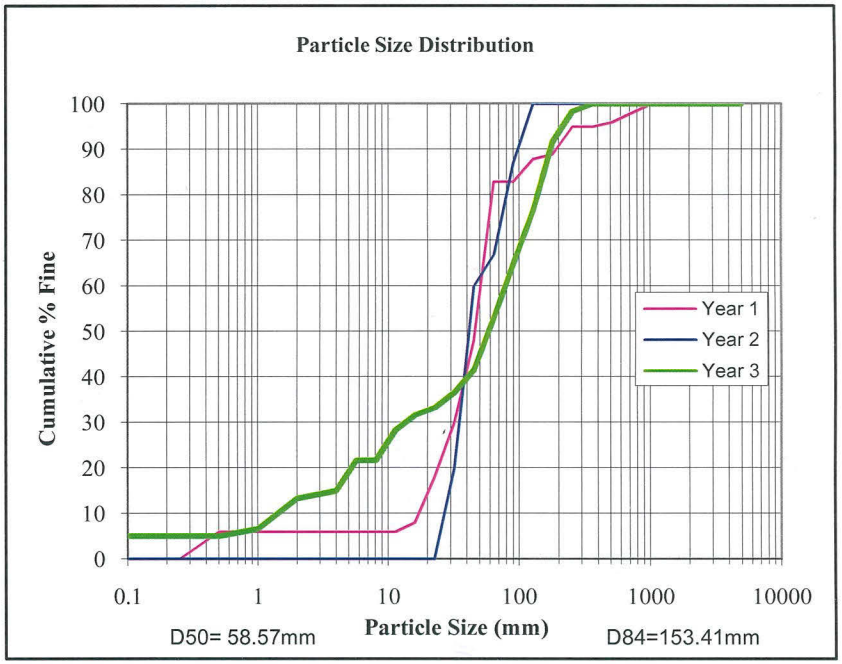
Particle Size Distribution



Pebble Count – Riffle				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	2	3	3
Very Fine Sand	0.062-0.125	1	2	5
Fine Sand	0.125-0.25	0	0	5
Medium Sand	0.25-0.5	0	0	5
Coarse Sand	0.5-1.0	1	2	7
Very Coarse Sand	1.0-2.0	4	7	13
Very Fine Gravel	2.0-4.0	1	2	15
Fine Gravel	4.0-5.7	4	7	22
Fine Gravel	5.7-8.0	0	0	22
Medium Gravel	8.0-11.3	4	7	28
Medium Gravel	11.3-16.0	2	3	32
Coarse Gravel	16.0-22.6	1	2	33
Coarse Gravel	22.6-32	2	3	37
Very Coarse Gravel	32-45	3	5	42
Very Coarse Gravel	45-64	7	12	53
Small Cobble	64-90	7	12	65
Small Cobble	90-128	7	12	77
Large Cobble	128-180	9	15	92
Large Cobble	180-256	4	7	98
Small Boulder	256-362	1	2	100
Small Boulder	362-512	0	0	100
Medium Boulder	512-1024	0	0	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		60	100	

Bailey Fork Stream Restoration EEP Project No. D04006-02			
Reach	Lower	**X Sec**	12
Date	9/9/08	**Sta No.**	6+50





BF 1
Crest Gage 1 on UT1.
(EMH&T, Inc. 7/19/07)

BF 2
Crest Gage 4 on Lower Bailey.
(EMH&T, Inc. 10/17/07)