

Freedom Park (Little Sugar Creek) Final Monitoring Report Year 2 of 5 (2006)

Mecklenburg County, North Carolina

USGS HUC: 03050103

Project ID No. 141



Prepared for:



NCDENR-Ecosystem Enhancement Program

1652 Mail Service Center

Raleigh, North Carolina 27699-1652

January 2007

Executive Summary

The Freedom Park Stream Restoration project falls within USGS hydrologic unit **03050103**. The project stream lies within an urban setting of the City of Charlotte that is comprised of predominantly residential and commercial uses. Prior to restoration work, the project stream (Little Sugar Creek) had been destabilized through historic channelization and dredging. Also, prior to restoration work, the channel consisted of a concrete lining.

HDR Engineering designed the restoration plans and restoration was completed in 2003. Kimley-Horn and Associates (KHA) performed stream and riparian monitoring during 2006 for this Year 2 Monitoring Report. During the late growing season, KHA assessed six (6) vegetation quads including two (2) newly installed quads. Combined stem count density for all the quads equaled approximately 587 stems per acre for planted stems; exceeding year 3 success criteria. Kudzu has invaded most of the channel reach and may interfere with vegetation goals if not managed.

A stream assessment including a visual assessment and geomorphic survey indicated that the project reaches were performing mostly within established success criteria ranges. Several isolated sections showed bank erosion and a few structures were stressed or failing. Most of the project reach continues to be stable. The geomorphic measurements are within the range of the design parameters.

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Appendix A: Vegetation Monitoring Data

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1.0 Project Background

The background information for this report references previous monitoring reports submitted by the Biological and Agricultural Engineering Department at North Carolina State University and Soil and Environmental Consultants, PA.

1.1 Location and Setting

The Little Sugar Creek stream restoration site lies within in the Catawba River Basin (HU No. 03050103) in Mecklenburg County, North Carolina. East Boulevard and Princeton Avenue bound the upper and lower endpoints of the stream reach and the site lies entirely within Freedom Park and the City of Charlotte. Freedom Park is part of the Mecklenburg County Park and Recreation Department public park system. (See Figure 1)

1.2 Project Structure, Mitigation Type, Approach and Objectives

Little Sugar Creek was dredged in 1917 to a minimum width of approximately 20 feet and a depth of 8 feet. Overall, the current alignment has existed since the early part of the 1900s. In the mid-1960s and early 1970s, the City initiated an erosion control system along the banks of Little Sugar Creek, as it flows through Freedom Park, using a combination of grouted riprap and concrete bank covering. In July 2002, the County removed the grouted riprap and concrete banking and temporarily stabilized the banks with erosion control matting. Additionally, the large flood control weir structure located approximately 450 feet upstream of Princeton Avenue was removed.

The restoration plan proposed to increase aquatic habitat diversity, improve on-site water quality, stabilize the stream banks, provide flood storage, and aesthetically enhance the stream setting.

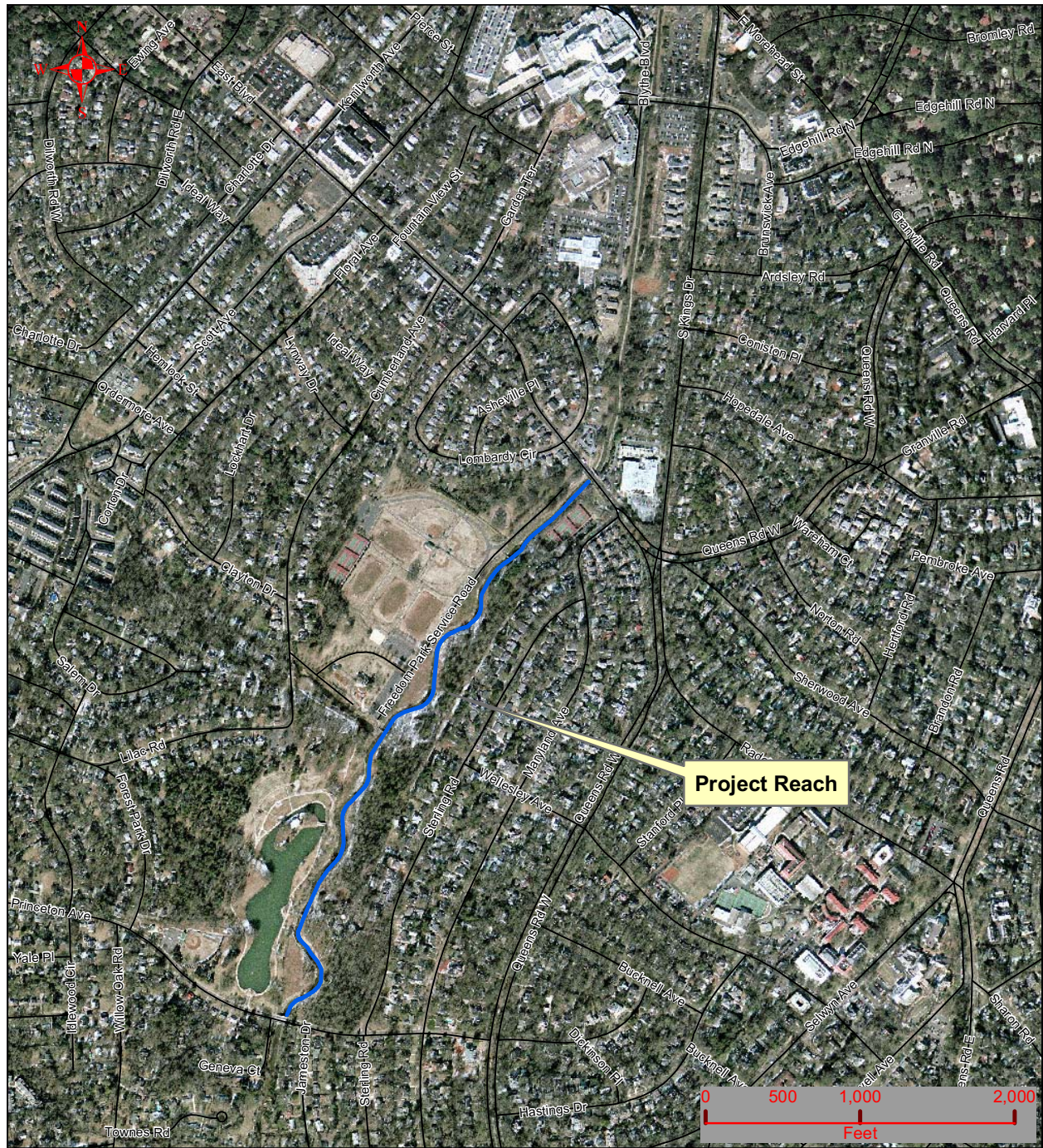
Table I provides project mitigation structure and objectives:



Table I: Project Restoration Components

Table I. Project Restoration Components									
Little Sugar Creek Stream Restoration Site (EEP Project #141)									
Project Segment or Reach ID	Existing Feet / Acres	Type	Approach	Footage or Acreage	Mitigation Ratio	Mitigation Units	Stationing	Comment	
Main	4,200	R	P2 / P3	4,450 lf	1:1	4,450	0+00.0 - 44+50.0		
Mitigation Unit Summaries									
Stream (lf)	Riparian Wetland (Ac.)	Non-Riparian Wetland (Ac.)	Total Wetland (Ac.)	Buffer (Ac.)	Comment				
4,450	--	--	--	--					

R = Restoration P1 = Priority I
 EI = Enhancement P2 = Priority II
 EII = Enhancement P3 = Priority III
 S = Stabilization SS = Stream Bank stabilization

Figure 1: Project Site Setting



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Project History and Background

Construction of the Little Sugar Creek Stream Restoration project began in mid-2003 and ended in September 2003. The As-built survey was completed in June 2004. Year 2 monitoring occurred during 2006. Table II provides additional details regarding the timeline of the project.

Table II: Project Activity and Reporting History

Table II. Project Activity and Reporting History				
Little Sugar Creek Stream Restoration Site (EEP Project #141)				
Activity or Report	Scheduled Completion	Data Collection Complete	Actual Completion or Delivery	Comments
Restoration Plan				
Final Design – 90%				
Construction	2003		Sept-03	
Temporary S&E mix applied to entire project area	2003		Sept-03	
Permanent seed mix applied	2003		Sept-03	
Containerized and B&B plantings for reach/segments 1&2	2004		June-04	
Mitigation Plan / As-built (Year 0 Monitoring – baseline)	2004		Spring 04	
Year 1 monitoring	2005	Oct-05	Nov-05	
Year 2 Monitoring	2006	Oct-06	Jan-07	
Year 3 Monitoring	2007			
Year 4 Monitoring	2008			
Year 5 Monitoring	2009			

The project was designed by HDR Engineering, Inc of the Carolinas. Construction was performed by SEI Environmental. Monitoring activities for Year 1 were performed by S&EC. Kimley-Horn and Associates performed monitoring for Year 2. Table III provides additional information regarding contractors.

Table III: Project Contact Table

Table III. Project Contact Table		
Little Sugar Creek Stream Restoration Site (EEP Project #141)		
Designer	128 South Tryon St., Suite 1400	
HDR Engineering, Inc. of the Carolinas	Charlotte, NC 28202	
Primary Designer POC		
Construction Contractor	5100 North I-85, Suite 7	
SEI Environmental	Charlotte, NC 28206	
Primary Contractor POC		
Planting Contractor		
Planting contractor POC		
Seeding Contractor		
Planting contractor POC		
Seed Mix Sources		
Nursery Stock Suppliers		
Monitoring Performers	PO Box 33068	
Kimley-Horn and Associates	Raleigh, NC 27636	
Stream Monitoring POC	Andrew Kiley	(919) 678-4150
Vegetation Monitoring POC	Andrew Kiley	(919) 678-4150

The project is located within Mecklenburg County, portions of which are located within the Charlotte Belt of the Piedmont of North Carolina. The site is located within a highly urbanized area. Table IV provides additional information regarding this stream.

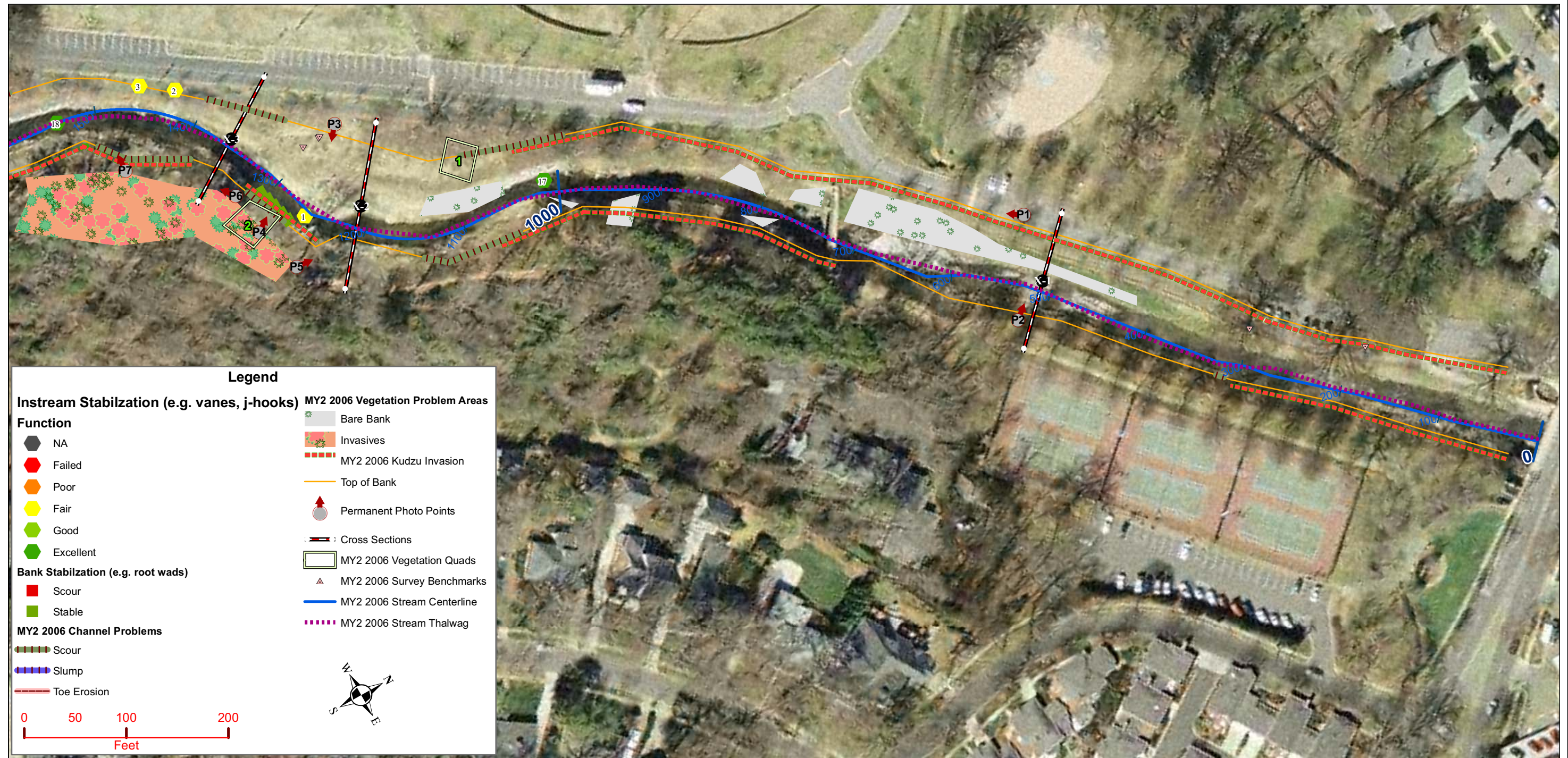
Table IV: Project Background Table

Table IV. Project Background Table Little Sugar Creek Stream Restoration Site (EEP Project #141)	
Project County	Mecklenburg
Drainage Area	13.6 square miles
Drainage impervious cover estimate (%)	75%
Stream Order	3
Physiographic Region	Piedmont
Ecoregion	Charlotte Belt
Rosgen Classification of As-built	C4
Cowardin Classification	N/A
Dominant soil types	Cecil, Monacan
Reference site ID	N/A
USGS HUC for Project and Reference	03050103
NCDWQ Sub-basin for Project and Reference	03-08-34
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
Reasons for 303d listing or stressor	No
% of project easement fenced	0%

1.3 Monitoring Plan View

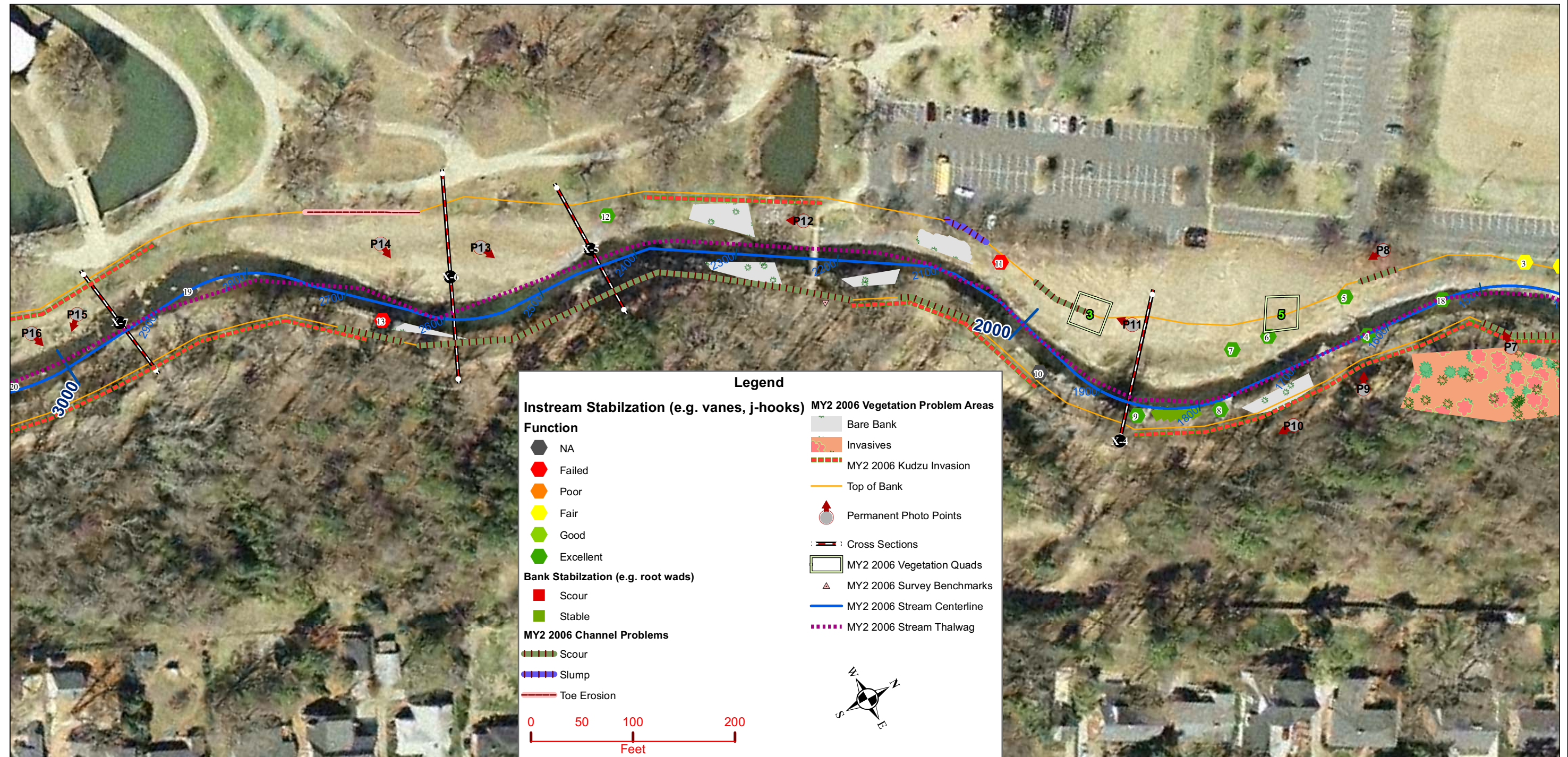
The monitoring plan assesses the project stream's geomorphology using a set of nine (9) cross sections located throughout the project reach. The longitudinal profile and pattern assessment covered the entire reach. Twenty-three (23) permanent photo points provide for a visual comparison of key site features through time. The monitoring plan uses six (6) randomly placed vegetation quads to assess riparian buffer restoration. Monitoring Plan View Sheets 1 to 3 show the locations of the monitoring features.

Figure 2: Monitoring Plan View Sheet 1



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Figure 3: Monitoring Plan View Sheet 2





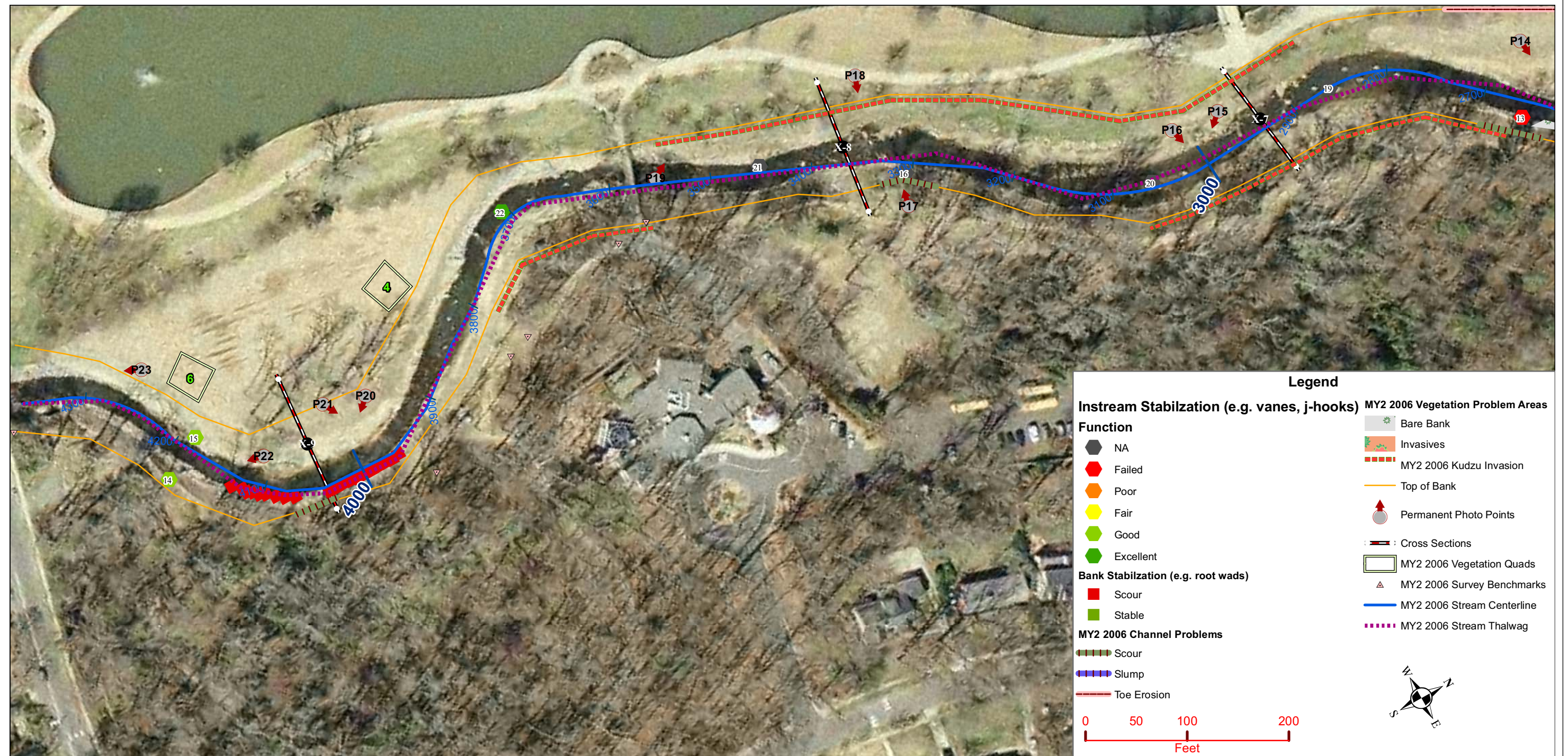


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Figure 4: Monitoring Plan View Sheet 3



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2.0 Project Conditions and Monitoring Results

2.1 Vegetation Assessment

Planted zones related to the stream restoration consisted of the riparian buffer zone and the stream banks. The riparian buffer zone begins at the top of the bank and continues out perpendicular from the stream. The planted stream bank begins at the normal base flow elevation and extends to the top of bank or interface with the flood plain.

KHA reassessed four (4) existing vegetation plots and established two (2) additional plots as directed by NC-EEP.

KHA assessed site vegetation in September and October, 2006. Kudzu has invaded much of the site. An interview with a park user suggests that a local community group within Charlotte has a program to combat invasives. Many sections of the reach exhibit bare banks. As noted in previous monitoring reports, the cause of the bare banks may be due to a lack of root development capable of withstanding stresses to during flood flows and/or compacted soils inhibiting vegetation growth. One section of floodplain appears to have been cleared and now exhibits early successional growth including invasives from areas surrounding the riparian buffer. Appendix A provides a summary of vegetative problem areas. Figures 2-4 show the problem areas.

KHA conducted a vegetation assessment during the early fall of 2006. The stem count table in appendix A summarizes the results of the vegetation sample. Each of the original four (4) plots and two (2) new plots meet success criteria for planted stem counts. The plot summary also shows that in several plots, species such as *Betula nigra*, *Acer negundo*, *Populus deltoids*, *Fraxinus pennsylvanicum*, and *Liquidambar styraciflua* are rapidly colonizing.

2.2 Stream Assessment

KHA assessed the stream channel during the spring and fall of 2006. Several isolated sections exhibited bank scour. Causes of scour may include lack of vegetative establishments; frequent flooding flows; unstable soils; and failed short-term protection such as coir fiber matting. Two areas utilizing boulder toe protection had pools developing behind them. Most structures seemed to remain in place and functional. Several structures previously mapped as J-Hooks appeared as rock vanes in the field. The headers were either missing or difficult to view because they may have been buried by sediment. One structure appeared to be missing completely; one structure appeared to be missing a header rock; and one structure had a collapse of boulders making up the arm. Several root wads were located in the field but were not previously mapped. A set of root wads near the bottom of the reach showed severe scour behind the root balls. Monitoring Plan View Sheets 1 through 3 show the location of the stream problem areas and table B1 in appendix B summarizes the stream problem areas.

KHA performed a database search and document review to locate information concerning measurement of bankfull events. The research found a functional gauge approximately 2,600 feet upstream of the project reach. The gage has a twelve (12) year period of record. This period is too short to estimate bankfull discharge based on peak discharges. A visit to the gage location is required to estimate bankfull hydraulic geometry relative to gage height or discharge. Table V provides a listing of probable bankfull events based on site observations and limited gage data.

Table V: Verification of Bankfull Events

Table V. Verification of Bankfull Events Little Sugar Creek Stream Restoration Site (EEP Project #141)			
Collection	Date of Occurrence	Method	Photo #
10/1/2006	Before 10/1/2006	Photographed On-Site	BE1

KHA did not find documentation of bank erosion estimates from previous site assessments. NC-EEP has scheduled a bank erosion assessment for a later date. Table VI that is intended to summarize sediment export estimates has no values but has been included in this section as a placeholder for future completion.

Table VI: BEHI and Sediment Export Estimates

Table VI. BEHI and Sediment Export Estimates																	
Little Sugar Creek Stream Restoration Site (EEP Project #141)																	
Time Point	Date of Assessment	Segment/ Reach	Linear Feet	Extreme		Very High		High		Moderate		Low		Very low		Sediment Export Ton/y	
				ft	%	ft	%	ft	%	ft	%	ft	%	ft	%		
Pre-Construction																	
Total																	
Post-Construction																	
Total																	

¹ Data missing or unavailable

² Assessment planned for later date

Table VII provides a categorical view of the stream visual stability assessment. The visual assessment shows an apparent decrease in stability related to meanders; in-stream stabilization (e.g. vanes, j-hooks); and bank stabilization (e.g. wads and boulders). Meander instability relates to floodplain relief and erosion of outer bends. Five (5) of the eleven (11) meander bends appear to have point bars that do not provide sufficient floodplain access. This may improve as the channel continues to adjust. KHA observed recent sediment deposition downstream of eroding outer banks that is likely a sign of adjustment. Table B2 in appendix B provides a breakdown of the visual assessment.

Table VII: Categorical Stream Features Visual Stability Assessment

Table VII. Categorical Stream Feature Visual Stability Assessment Little Sugar Creek Stream Restoration Site (EEP Project #141)						
Reach 1						
Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
A. Riffles	--	100%	100%	--	--	--
B. Pools	--	95%	98%	--	--	--
C. Thalweg	--	100%	100%	--	--	--
D. Meanders	--	85%	72%	--	--	--
E. Bed General	--	94%	100%	--	--	--
F. Bank Condition	--	92%	82%	--		
G. Vanes / J Hooks etc.	--	100%	80%	--	--	--
H. Wads and Boulders	--	100%	35%	--	--	--

Tables VII and IX summarize the site geomorphic assessment. KHA determined bankfull using a combination of upstream gage data, urban piedmont regional curves, and site indicators. Site indicators were not universally prominent throughout the reach likely due to the young age of the channel. KHA used gage data and regional curve data to verify the site indicators. This analysis led to new bankfull elevations that differed from previous elevations. All data from the previous surveys (i.e. the as-built and year 1 survey) was adjusted to match the year 2 bankfull elevations. The field investigators had difficulty identifying cross section benchmarks in the field; therefore some of the cross sections had a slightly different alignment than previous year's cross sections. The difference in alignment negates a very fine comparison between years for a cross section but does allow for the identification of significant changes in cross section. The cross sections did not show a significant change in the shape or area compared to earlier years. Appendix B provides raw data, photographs, and graphing for geomorphic data.

Table VIII: Baseline Morphology and Hydraulic Summary

Table VIII. Baseline Morphology and Hydraulic Summary																			
Little Sugar Creek Stream Restoration Site (EEP Project #141)																			
Reach																			
Parameter	Units	USGS Gage Data			Regional Curve			Pre-Existing Condition			Project Reference Stream			Design			As-built		
		Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Dimension																			
BF Width	ft	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	45.3	68.4	52.3
Floodprone Width	ft	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	60.2	85.9	75.7
BF Cross Sectional Area	ft ²	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	197.3	239.2	219.7
BF Mean Depth	ft	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	3.5	4.6	4.3
BF Max Depth	ft	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	4.8	6.9	5.5
Width/Depth Ratio		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	9.8	19.5	12.3
Entrenchment Ratio		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1.3	1.6	1.3
Bank Height Ratio																	1.5	2.2	1.9
Wetted Perimeter	ft	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	48.5	70.8	59.3
Hydraulic radius	ft	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	3.4	4.3	3.7
Pattern																			
Channel Beltwidth	ft	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	105	236	153
Radius of Curvature	ft	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	72	232	147.5
Meander Wavelength	ft	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	403	840	531
Meander Width ratio		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1.9	4.3	3
Profile																			
Riffle length	ft	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	15	207	66
Riffle slope	ft/ft	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	0.0027	0.0175	0.0115
Pool length	ft	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	76	252	132
Pool spacing	ft	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	171	587	294
Substrate¹																			
d50	mm	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	0.2	1.1	*
d84	mm	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	0.2	4.7	*
Additional Reach Parameters																			
Valley Length	ft		*			*			*			*			*				*
Channel Length	ft		*			*			*			*			*				*
Sinuosity			*			*			*			*			*				*
Water Surface Slope	ft/ft		*			*			*			*			*				0.0025
BF slope	ft/ft		*			*			*			*			*				*
Rosgen Classification			*			*			*			*			*				*
*Habitat Index			*			*			*			*			*				*
*Macrobenthos			*			*			*			*			*				*

¹Substrate collected at each cross section

Table IX: Morphology and Hydraulic Monitoring Summary

Table IX. Morphology and Hydraulic Monitoring Summary
Little Sugar Creek Stream Restoration Site (EEP Project #141)

Parameter		Cross Section 1						Cross Section 2					Cross Section 3						
		Riffle						Pool					Riffle						
Dimension	Units	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5
BF Width	ft	46.3	47.6	47.6	*	*	*	66.5	71.4	64.8	*	*	*	45.3	46.1	46.3	*	*	*
Floodprone Width	ft	67	71.3	69.5	*	*	*	106	109.6	110.3	*	*	*	60.2	61.3	58.3	*	*	*
BF Cross Sectional Area	ft	197.3	205.7	214.7	*	*	*	235.9	253.5	236	*	*	*	208.2	213	213	*	*	*
BF Mean Depth	ft	4.3	4.3	4.5	*	*	*	3.6	3.5	3.6	*	*	*	4.6	4.6	4.6	*	*	*
BF Max Depth	ft	5.5	5.6	5.8	*	*	*	6.5	7.1	7	*	*	*	6.7	6.3	6.5	*	*	*
Width/Depth Ratio		10.9	11	10.6	*	*	*	18.7	20.1	17.8	*	*	*	9.8	10	10	*	*	*
Entrenchment Ratio		1.5	1.5	1.5	*	*	*	1.6	1.5	1.7	*	*	*	1.3	1.3	1.3	*	*	*
Bank Height Ratio		1.9	1.9	1.8				1.9	1.8	1.8				1.5	1.6	1.3			
Wetted Perimeter	ft	50.1	50.5	50.9	*	*	*	68.8	74.3	68.5	*	*	*	48.5	49.2	49.5	*	*	*
Hydraulic radius	ft	*	4.1	4.2	*	*	*	3.4	3.4	3.5	*	*	*	4.3	4.3	4.3	*	*	*
Substrate																			
d50	mm	1.1	*	15.8	*	*	*	0.31	*	1.54	*	*	*	0.19	*	1.71	*	*	*
d84	mm	2.8	*	93.8	*	*	*	2.3	*	36.61	*	*	*	4.7	*	47.47	*	*	*
Parameter		Cross Section 4						Cross Section 5					Cross Section 6						
		Pool						Riffle					Pool						
Dimension	Units	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5
BF Width	ft	68.7	63.7	56.44	*	*	*	52.3	53.9	56	*	*	*	79.5	85.2	79.5	*	*	*
Floodprone Width	ft	100.7	104.8	88.4	*	*	*	81.3	81.06	92.6	*	*	*	140.4	145	131.2	*	*	*
BF Cross Sectional Area	ft	223.6	219.9	204.8	*	*	*	222.2	236.6	223.9	*	*	*	273.7	284.6	284.3	*	*	*
BF Mean Depth	ft	3.3	3.5	3.6	*	*	*	4.3	4.4	4	*	*	*	3.4	3.3	3.6	*	*	*
BF Max Depth	ft	6.6	6.8	6.5	*	*	*	6.9	7.2	7.4	*	*	*	7.8	8.2	7.7	*	*	*
Width/Depth Ratio		21.1	18.5	15.6	*	*	*	12.3	12.3	14	*	*	*	23.1	25.5	22.2	*	*	*
Entrenchment Ratio		1.5	1.7	1.6	*	*	*	1.6	1.5	1.7	*	*	*	1.8	1.7	1.7	*	*	*
Bank Height Ratio		2.0	2.0	1.8				1.7	1.6	1.4				2.1	2.0	1.9			
Wetted Perimeter	ft	72.8	67.9	59.9	*	*	*	59.3	58.1	60.1	*	*	*	83.2	88.1	82.3	*	*	*
Hydraulic radius	ft	3.1	3.2	3.4	*	*	*	3.8	4.1	3.7	*	*	*	3.3	3.2	3.5	*	*	*
Substrate																			
d50	mm	0.24	*	4.52	*	*	*	0.52	*	11.15	*	*	*	0.06	*	0.79	*	*	*
d84	mm	1.4	*	29.99	*	*	*	2	*	151.9	*	*	*	0.2	*	1.56	*	*	*

Parameter	Units	Cross Section 7						Cross Section 8						Cross Section 9					
		Rifle						Rifle						Pool					
Dimension		AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5
BF Width	ft	68.4	66.5	70	*	*	*	59.5	59.7	60.75	*	*	*	59.8	59.9	66.5	*	*	*
Floodprone Width	ft	85.9	84	91.1	*	*	*	75.7	76.6	82.1	*	*	*	96.4	96.5	95.3	*	*	*
BF Cross Sectional Area	ft	239.2	214.1	213.8	*	*	*	219.7	219.9	221.3	*	*	*	235.3	250.5	247.6	*	*	*
BF Mean Depth	ft	3.5	3.2	3.1	*	*	*	3.7	3.7	3.6	*	*	*	3.9	4.2	3.7	*	*	*
BF Max Depth	ft	5.02	5.02	4.3	*	*	*	4.8	5	4.9	*	*	*	9.6	9.5	9	*	*	*
Width/Depth Ratio		19.5	20.6	22.9	*	*	*	16.1	16.2	16.7	*	*	*	15.2	14.3	17.8	*	*	*
Entrenchment Ratio		1.3	1.3	1.3	*	*	*	1.3	1.3	1.4	*	*	*	1.6	1.6	1.4	*	*	*
Bank Height Ratio		2.1	2.1	2.3				2.2	2.2	1.5				1.7	1.7	1.7			
Wetted Perimeter	ft	70.8	68.2	71.5	*	*	*	61.3	61.4	62.3	*	*	*	66.6	67.3	70.2	*	*	*
Hydraulic radius	ft	3.4	3.1	3	*	*	*	3.6	3.6	3.6	*	*	*	3.5	3.7	3.5	*	*	*
Substrate																			
d50	mm	0.53	*	17.65	*	*	*	0.18	*	42.64	*	*	*	0.85	*	1.24	*	*	*
d84	mm	1.5	*	55.41	*	*	*	1.3	*	205.33	*	*	*	1.5	*	15.81	*	*	*
Parameter		AB (2004)			MY-01 (2005)			MY-02 (2006)			MY-03 (2007)			MY-04 (2008)			MY-05 (2009)		
Pattern		Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth	ft	105	236	153	103	304	184	118	225	150	*	*	*	*	*	*			
Radius of Curvature	ft	72	232	148	126	195	159	90	392	154	*	*	*	*	*	*			
Meander Wavelength	ft	403	840	531	523	837	634	411	852	501	*	*	*	*	*	*			
Meander Width ratio		1.9	4.3	2.8	1.9	5.5	3.3	2.1	4.1	2.7	*	*	*	*	*	*			
Profile																			
Rifle length	ft	15	207	66	*	*	*	26	192	54	*	*	*	*	*	*			
Rifle slope	ft/ft	0.0027	0.0175	0.0115	0.0021	0.0026	0.0023	0.0010	0.0240	0.0080	*	*	*	*	*	*			
Pool length	ft	76	252	132	83	413	168	34	296	126	*	*	*	*	*	*			
Pool spacing	ft	171	587	294	133	651	372	131	600	250	*	*	*	*	*	*			
Additional Parameters																			
Valley Length	ft	*	*	*	*	*	39.26	*	*	39.26	*	*	*	*	*	*			
Channel Length	ft	*	*	*	*	*	4437	*	*	4437	*	*	*	*	*	*			
Sinuosity		*	*	*	*	*	1.13	*	*	1.13	*	*	*	*	*	*			
Water Surface Slope	ft/ft	*	*	*	*	*	0.00234	0.0006	0.0095	0.0021	*	*	*	*	*	*			
BF slope	ft/ft	*	*	*	*	*	0.00234	*	*	0.0015	*	*	*	*	*	*			
Rosgen Classification		*	*	*	*	*	B5	*	*	B5	*	*	*	*	*	*			
Habitat Index*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
Macrobenthos*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			

3.0 Methodology

KHA adjusted some of the methodologies for data collection for monitoring year 2. Per NC-EEP's request, KHA added two additional vegetation plots and performed the vegetation survey using the EEP – Carolina Vegetation Survey (CVS) protocol. During the geomorphic survey, KHA added additional benchmarks and captured the location and elevation of new existing benchmarks. The new existing benchmarks are maintained by the City of Charlotte. Previous year's spatial data did not provide an indication of established benchmarks.

APPENDIX A
VEGETATION MONITORING DATA

Table VI. Vegetative Problem Areas
 Little Sugar Creek Stream Restoration Site (E/P Project #141)

Feature/Issue	Station # / Range	Probable Cause	Photo #
Bare Bank	410 - 1,140 (Both Banks)	Excessive bank stresses during yearly flooding events	VP 2
	1,690 - 1,750 (Left Bank)		
	2,065 - 2,350 (Both Banks)		
Bare Bench	--	--	--
Bare Flood Plain	1,250 - 1,580 (Left Floodplain)	Cleared area exhibiting successional growth including invasives from Local source colonization after bank scour	VP 4
	35 - 1,030 (Both Banks)		
Invasive/Exotic Populations	1,240 - 1,860 (Left Bank)		
	1,250 - 1,580 (Left Floodplain)	Cleared area exhibiting successional growth including invasives from local sources	VP 4
	1,950 - 2,190 (Left Bank)		VP 3
	2,210 - 2,380 (Right Bank)		VP 1
	2,680 - 3,065 (Left Bank)		
	2,690 - 3,555 (Right Bank)		
	3,555 - 3,790 (Left Bank)		

VQ1: Vegetation Quad 1 (2005)



VQ1: Vegetation Quad 1 (2006)

VQ2: Vegetation Quad 2 (2005)



VQ2: Vegetation Quad 2 (2006)

VQ3: Vegetation Quad 3 (2005)



VQ3: Vegetation Quad 3 (2006)

VQ4: Vegetation Quad 4 (2005)



VQ4: Vegetation Quad 4 (2006)



VQ5: Vegetation Quad 5 (2006)



VQ6: Vegetation Quad 6 (2006)



VP 1: Kudzu



VP 2: Bare Bank



VP 3: Bare Bank with dormant Kudzu



VP 4: Cleared floodplain

APPENDIX B
STREAM MONITORING DATA

Table B1. Stream Problem Areas					
Little Sugar Creek Stream Restoration Site (EEP Project #141)					
Feature Issue	Reach	Station numbers	Description	Suspected Cause	Photo number
Aggradation/Bar Formation		945 - 1,140	Bank Scour (Both Banks)	Excessive shear stresses	
		315 - 320	Bank Scour (Left Bank)	Stormwater Drain	
		1,260 - 1,330	Bank Scour (Left Bank)	Excessive shear stresses	
		1,310 - 1,390	Bank Scour (Right Bank)	Excessive shear stresses	
		1,395 - 1,500	Bank Scour (Left Bank)	Excessive shear stresses	SP 1
		1,570 - 1,620	Bank Scour (Right Bank)	Excessive shear stresses	
		1,940 - 2,015	Bank Scour (Right Bank)	Excessive shear stresses	
		2,040 - 2,140	Bank Scour (Left Bank)	Excessive shear stresses	SP 4
		2,190 - 2,700	Bank Scour (Left Bank)	Excessive shear stresses	SP 5
		2,625 - 2,740	Scour behind toe protect (Right Bank)	Excessive shear stresses	SP 2
		3,270 - 3,340	Bank Scour (Left Bank)	Excessive shear stresses	
		3450	Scour behind toe protection (Right Bank)	Excessive shear stresses	SP 6
		4,030 - 4,070	Scour (Left Bank) - Possibly displaced root wads	Excessive shear stresses	SP 7
Engineered structures - back or arm scour Etc.		1,260	Missing header rock	Excessive shear stresses	
		1,960	Missing structure	Excessive shear stresses	
		2,660	Arm boulder collapse	Excessive shear stresses	
		3,950 - 4,140	Scour behind root wads	Excessive shear stresses	SP 3



SP 1: Scout on left bank with failing rock stabilization



SP 2: Scour behind boulder toe protection



SP 3: Scour behind root wads



SP 4: Bare left bank



SP 5: Scour on left bank



SP 6: Scour on Right Bank



SP 7: Scour between root wads – possible displacement of root wads



BE 1: Indication of high flows – possibly bankfull



PS1 (2004)

PS1 (2005)



PS1 (2006)



PS2 (2004)

PS2 (2005)



PS2 (2006)



PS 3 (2004)

PS 3 (2005)



PS 3 (2006)



PS 4 (2004)

PS 4 (2005)



PS 4 (2006)



PS 5 (2004)

PS 5 (2005)



PS 5 (2006)



PS 6 (2004)

PS 6 (2005)



PS 6 (2006)



PS 7 (2004)

PS 7 (2005)



PS 7 (2006)



PS 8 (2004)

PS 8 (2005)



PS 8 (2006)



PS 9 (2004)

PS 9 (2005)



PS 9 (2006)



PS10 (2004)

PS10 (2005)



PS 10 (2006)



PS 11 (2004)

PS 11 (2005)



PS 11 (2006)



PS 12 (2004)

PS 12 (2005)



PS 12 (2006)



PS 13 (2004)

PS 13 (2005)

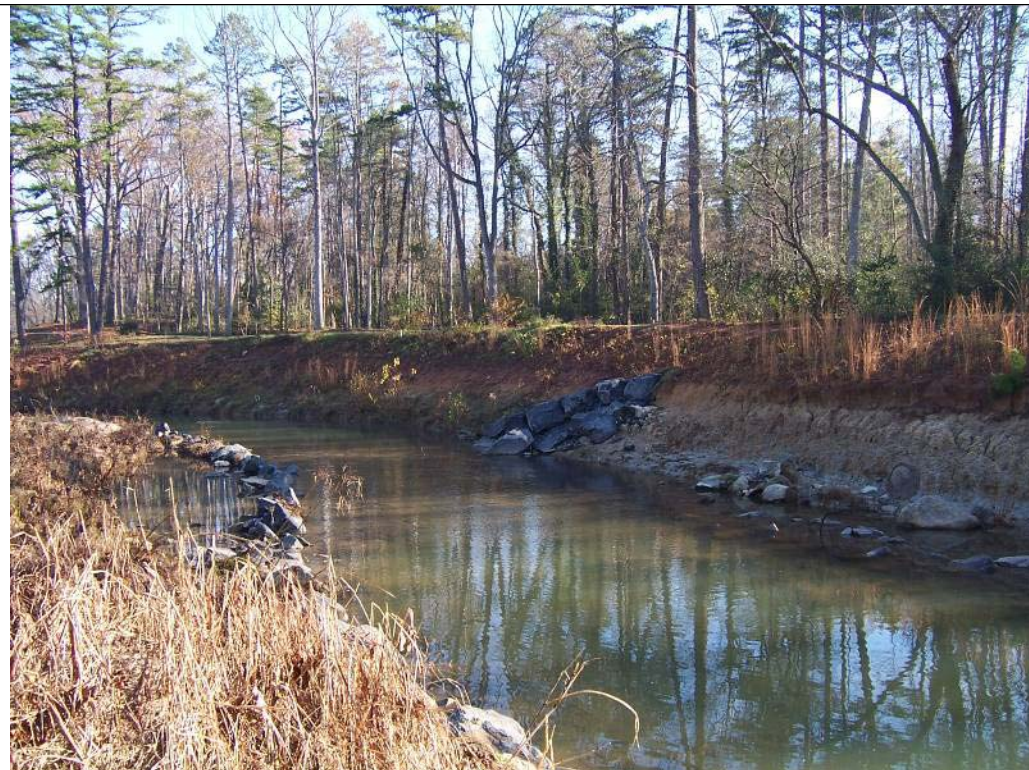


PS 13 (2006)



PS 14 (2004)

PS 14 (2005)



PS 14 (2006)



PS 15 (2004)

PS 15 (2005)



PS 15 (2006)



PS 16 (2004)

PS 16 (2005)



PS 16 (2006)



PS 17 (2004)

PS 17 (2005)



PS 17 (2006)



PS 18 (2004)

PS 18 (2005)



PS 18 (2006)



PS 19 (2004)

PS 19 (2005)



PS 19 (2006)



PS 20 (2004)

PS 20 (2005)



PS 20 (2006)



PS 21 (2004)

PS 21 (2005)



PS 21 (2006)



PS 22 (2004)

PS 22 (2005)



PS 22 (2006)



PS 23 (2004)

PS 23 (2005)

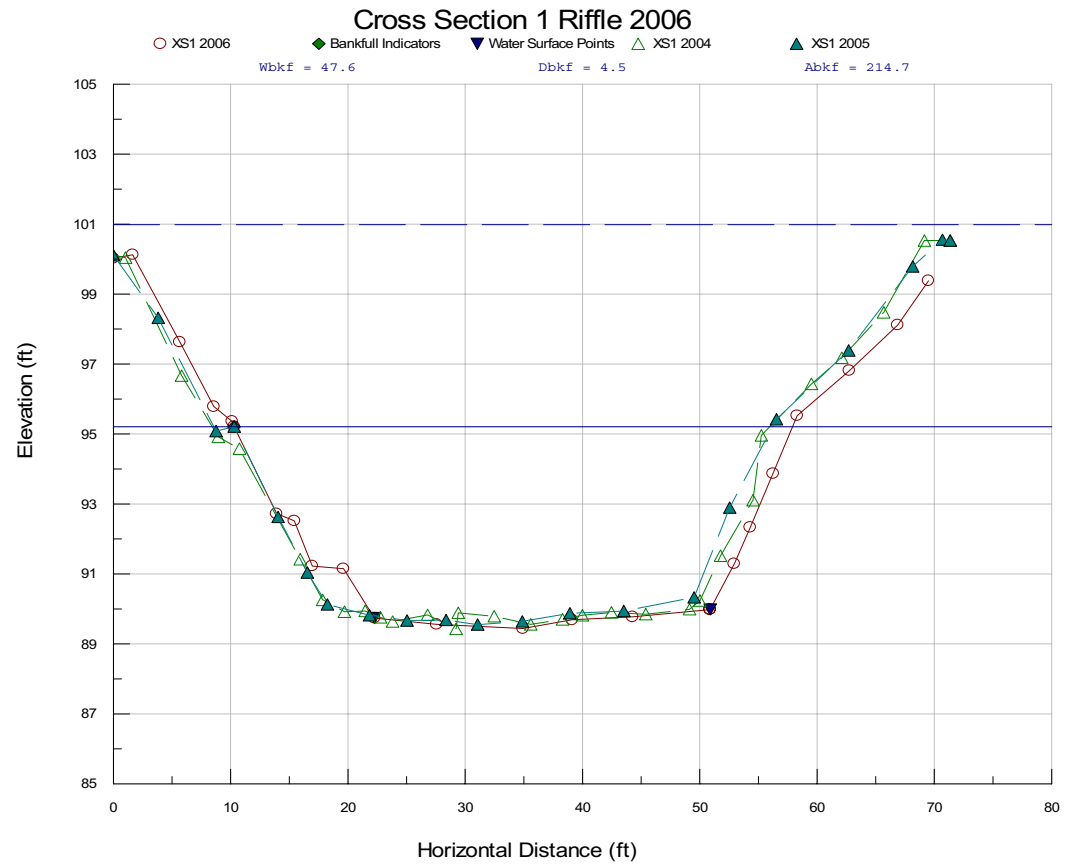


PS 23 (2006)

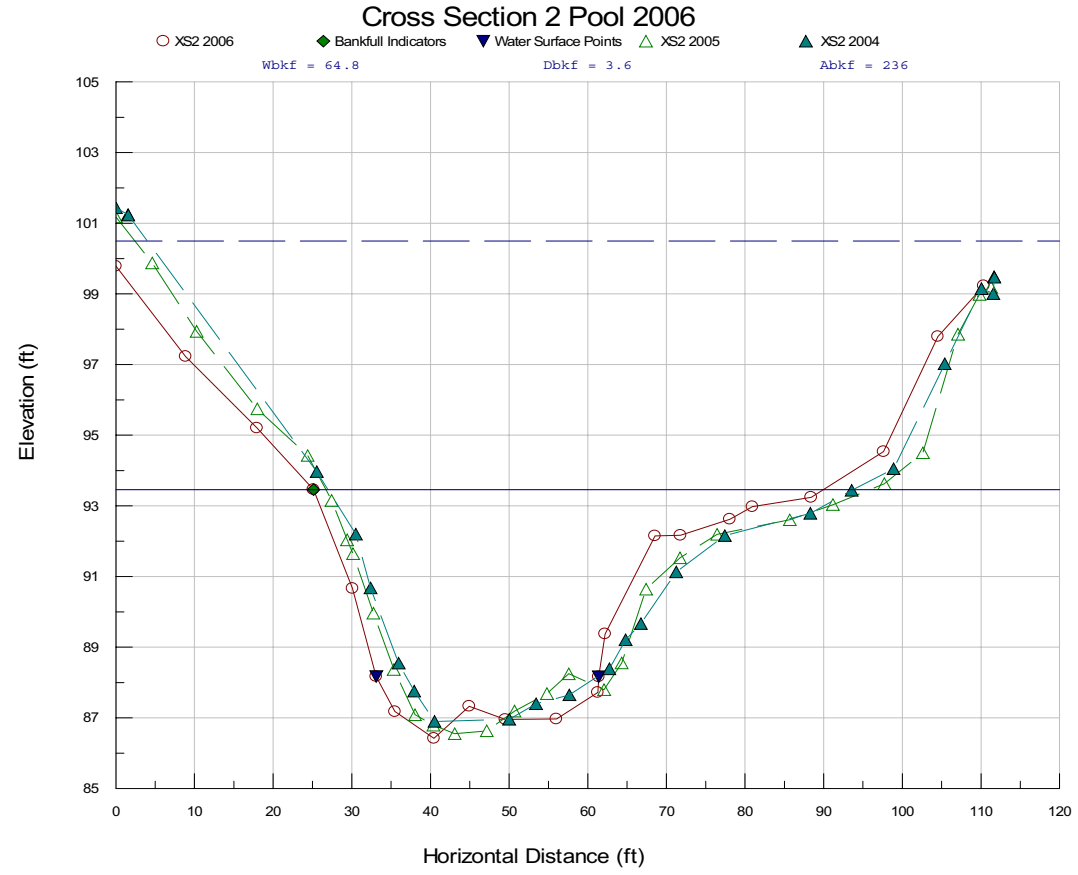
Table B2. Visual Morphological Stability Assessment
Little Sugar Creek Stream Restoration Site (EEP Project #141)

Reach							
Feature Category	Metric (per As-built and reference baselines)		(# Stable) Number Performing as Intended	Total number per As-built	Total Number / feet in unstable state	% Perform in Stable Condition	Feature Perform. Mean or Total
A. Riffles	1	Present?	15	15	NA	100%	100%
	2	Armor stable (e.g. no displacement)?	15	15	NA	100%	
	3	Facet grade appears stable?	15	15	NA	100%	
	4	Minimal evidence of embedding/fining?	15	15	NA	100%	
	5	Length appropriate?	15	15	NA	100%	
B. Pools	1	Present? (e.g not subject to severe aggrad. or migrat.?)	15	15	NA	100%	98%
	2	Sufficiently deep (Max Pool D:Mean Bkf >1.6?)	15	15	NA	100%	
	3	Length appropriate?	14	15	NA	93%	
C. Thalweg	1	Upstream of meander bend (run/inflection) centering?	11	11	NA	100%	100%
	2	Downstream of meander (glide/inflection) centering?	11	11	NA	100%	
D. Meanders	1	Outer bend in state of limited/controlled erosion?	9	11	NA	82%	72%
	2	Of those eroding, # w/concomitant point bar formation?	1	2	NA	50%	
	3	Apparent Rc within spec?	11	11	NA	100%	
	4	Sufficient floodplain access and relief?	6	11	NA	55%	
E. Bed General	1	General channel bed aggradation areas (bar formation)	--	--	0 / 0	100%	100%
	2	Channel bed degradation – areas of increasing down-cutting or head cutting?	--	--	0 / 0	100%	
F. Bank	2	Actively eroding, wasting, or slumping bank	--	--	13 / 1610	82%	82%
G. Vanes	1	Free of back or arm scour?	12	15	NA	80%	80%
	2	Height appropriate?	12	15	NA	80%	
	3	Angle and geometry appear appropriate?	12	15	NA	80%	
	4	Free of piping or other structural failures?	12	15	NA	80%	
H. Wads/ Boulders	1	Free of scour?	11	31	NA	35%	35%
	2	Footing stable?	11	31	NA	35%	

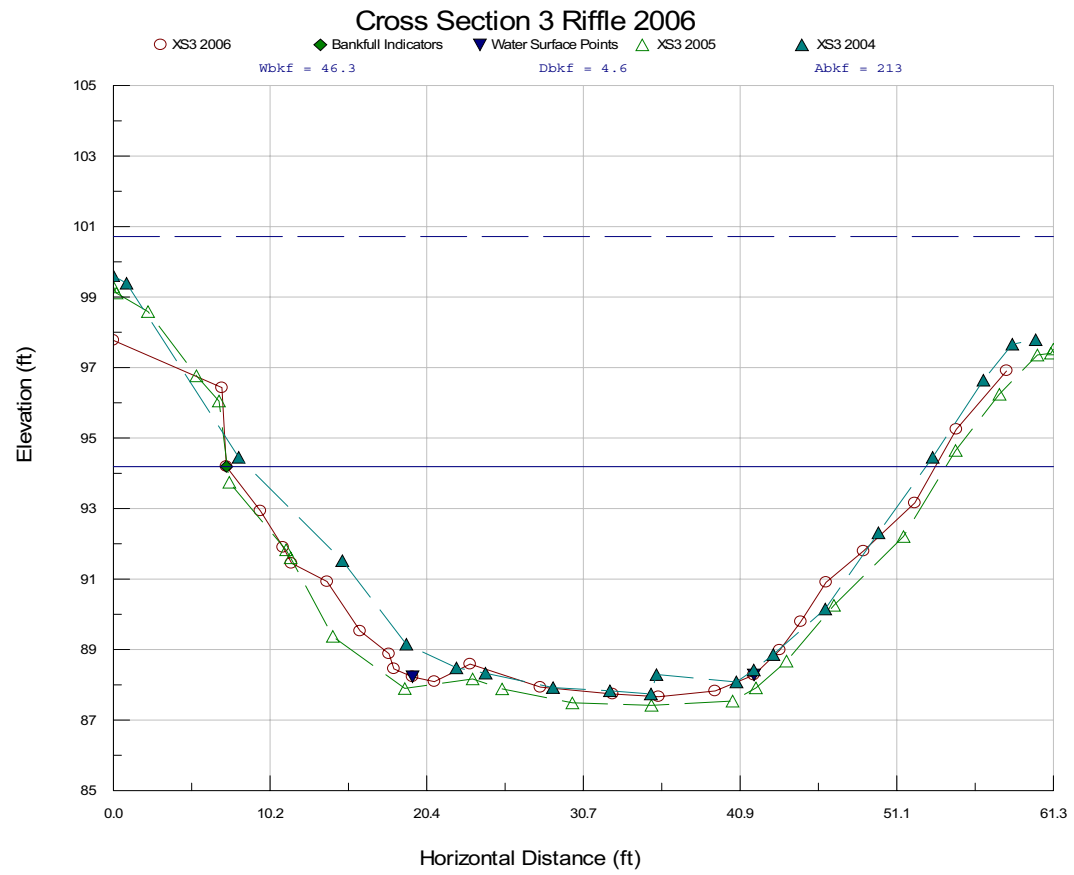
Cross Section XS1 Riffle November 2006		
Station	Elevation	Note
0	100.0	
1.65	100.1	
5.67	97.6	
8.56	95.8	
10.13	95.4	KHA BKF
10.3	95.2	BKF
13.92	92.7	
15.42	92.5	
16.95	91.2	
19.62	91.1	
22.26	89.7	LEW
27.57	89.6	
34.92	89.4	
39.12	89.7	
44.27	89.8	
50.86	90.0	
50.88	90.0	REW
52.94	91.3	
54.3	92.3	
56.25	93.9	
58.3	95.5	
62.75	96.8	
66.87	98.1	
69.5	99.4	



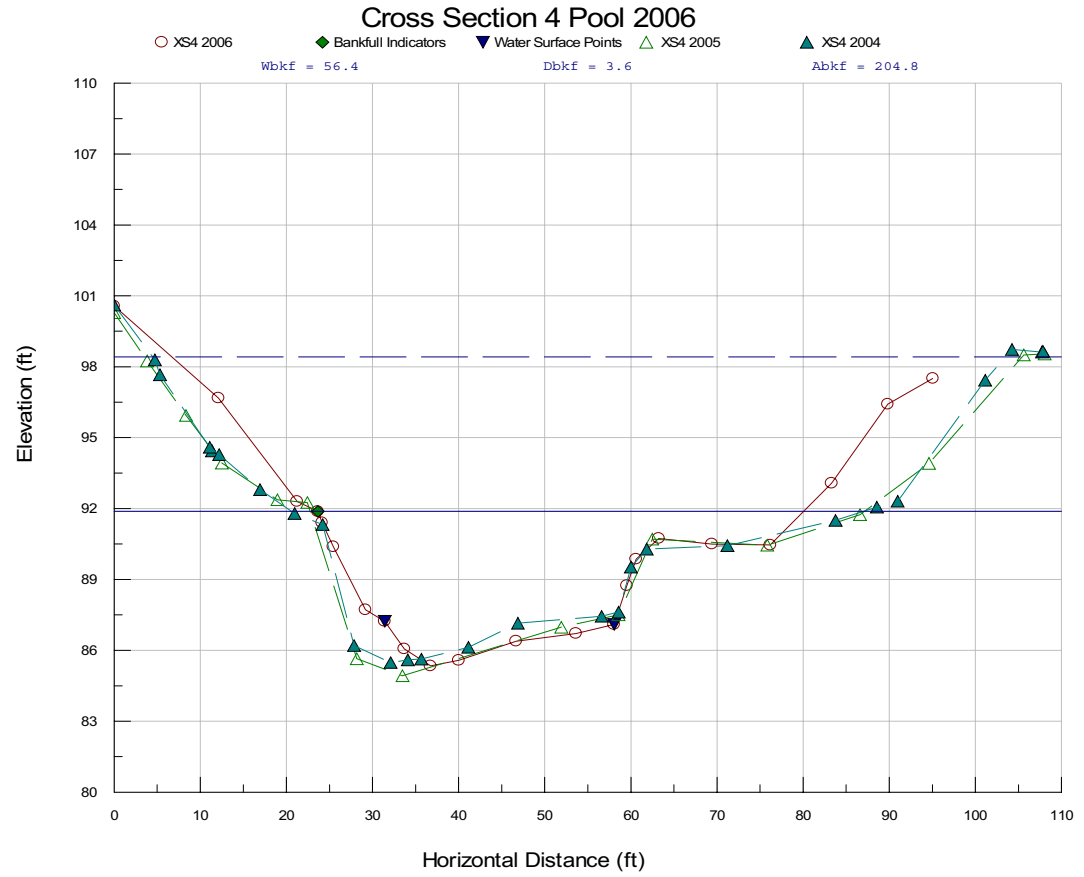
Cross Section XS2 Pool November 2006		
Station	Elevation	Note
110.34	99.23	
104.52	97.79	
97.62	94.54	
88.41	93.24	
80.94	92.98	
78.07	92.62	
71.79	92.17	
68.55	92.15	
62.2	89.38	
61.41	88.16	LEW
61.29	87.72	
56.03	86.97	
49.53	86.96	
44.93	87.33	
40.44	86.42	
35.48	87.18	
33.11	88.17	REW
30.09	90.66	
25.13	93.46	BKF
17.94	95.20	
8.87	97.23	
0	99.79	



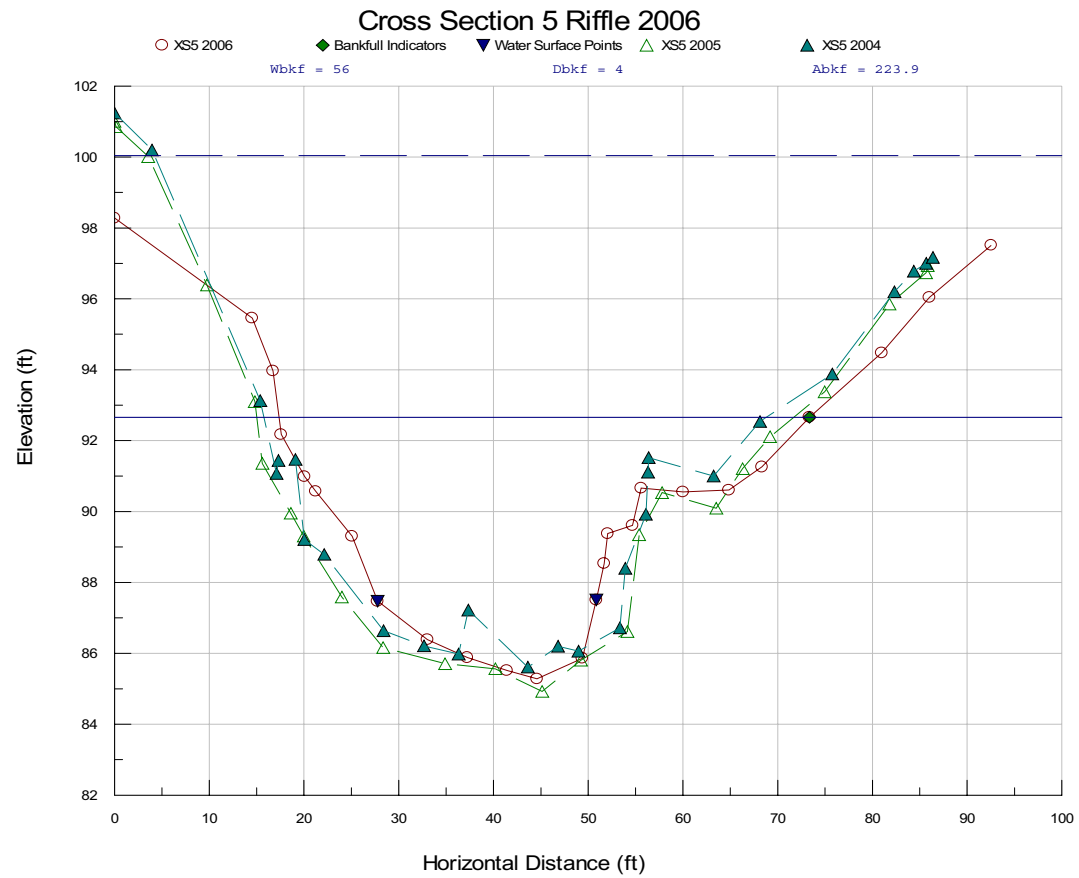
Cross Section XS3 Riffle November 2006		
Station	Elevation	Note
0	97.77	
7.09	96.43	
7.38	94.19	BKF
9.6	92.93	
11.08	91.90	
11.63	91.45	
13.95	90.93	
16.1	89.53	
17.99	88.88	
18.31	88.45	
19.52	88.23	LEW
20.95	88.09	
23.28	88.59	
27.87	87.93	
32.58	87.74	
35.59	87.66	
39.27	87.82	
41.8	88.28	REW
43.49	88.99	
44.86	89.79	
46.51	90.91	
48.95	91.79	
52.3	93.16	
55.01	95.25	
58.29	96.91	



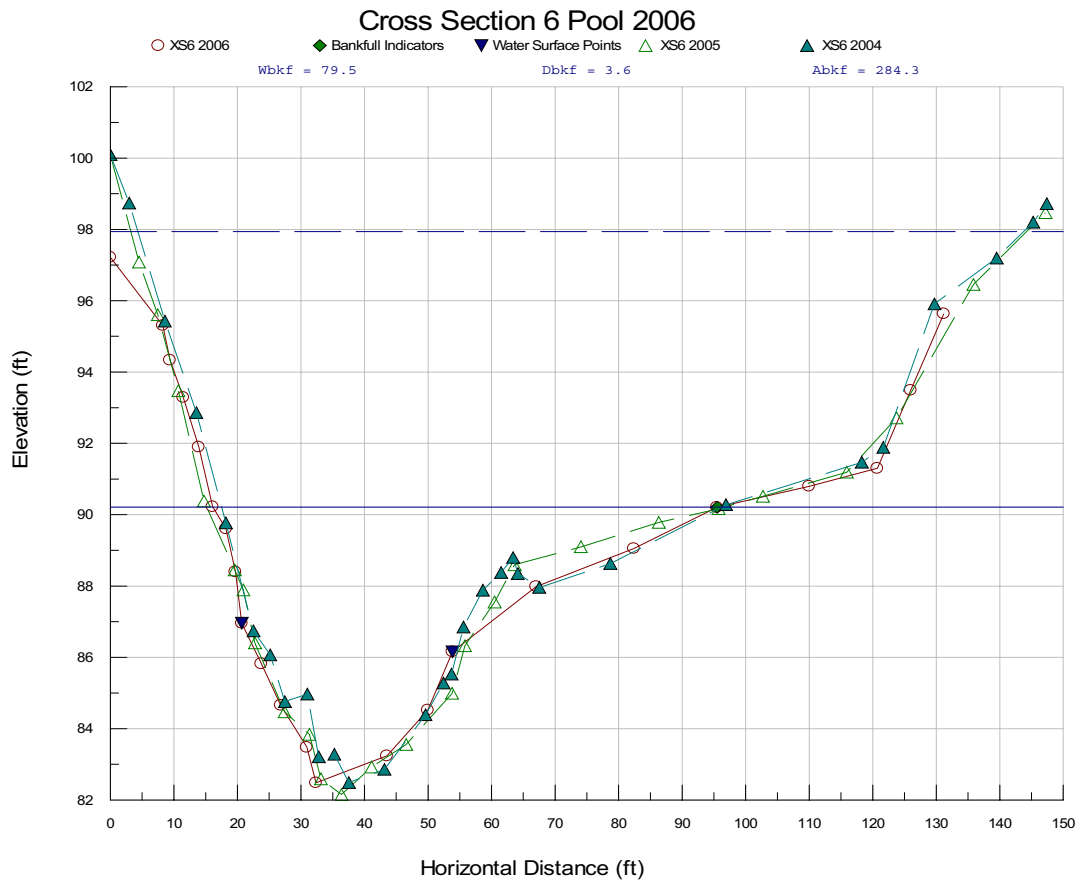
Cross Section XS4 Pool November 2006		
Station	Elevation	Note
0	98.28	
14.54	95.46	
16.73	93.97	
17.59	92.17	
20.07	90.99	
21.24	90.57	
25.08	89.30	
27.78	87.47	LEW
33.04	86.39	
37.25	85.88	
41.43	85.52	
44.6	85.28	
49.39	85.86	
50.86	87.51	REW
51.69	88.53	
52.07	89.38	
54.69	89.61	
55.6	90.66	
60.02	90.55	
64.86	90.60	
68.35	91.26	
73.36	92.66	BKF
80.99	94.48	
86.02	96.04	
92.55	97.51	



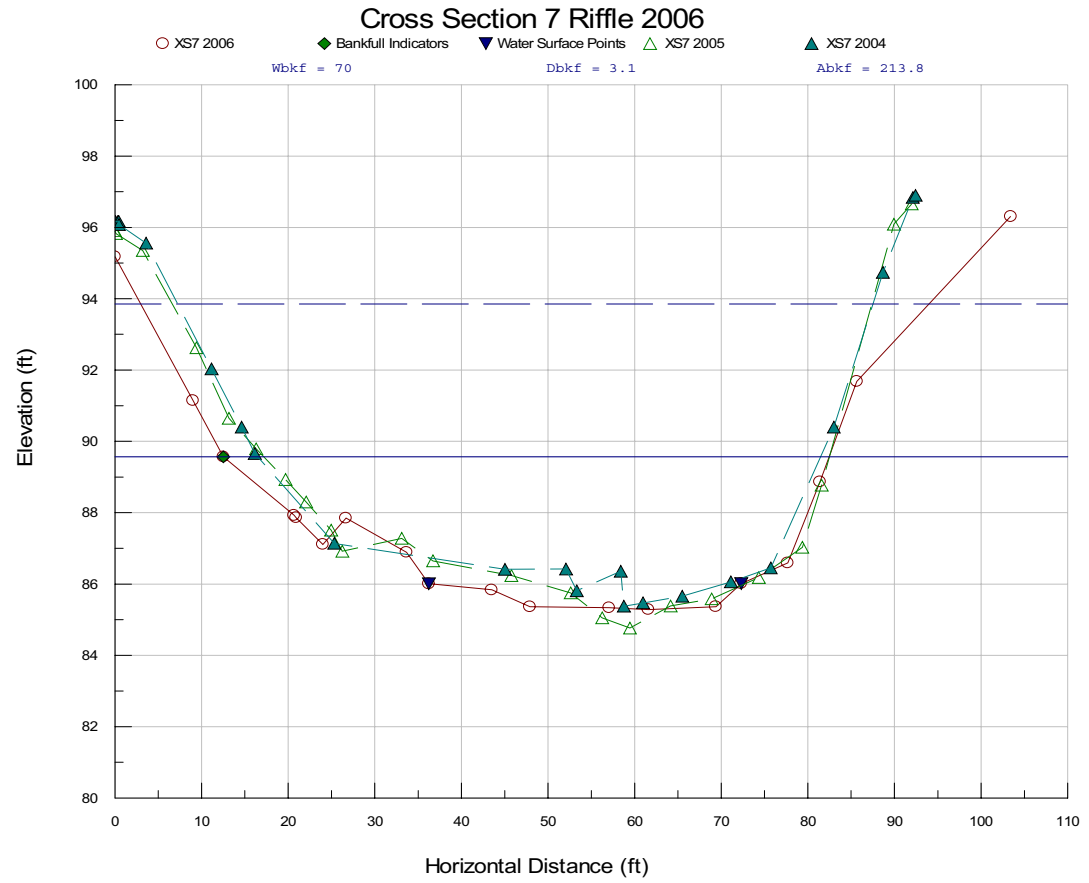
Cross Section XS5 Riffle November 2006		
Station	Elevation	Note
0	98.28	
14.54	95.46	
16.73	93.97	
17.59	92.17	
20.07	90.99	
21.24	90.57	
25.08	89.30	
27.78	87.47	LEW
33.04	86.39	
37.25	85.88	
41.43	85.52	
44.6	85.28	
49.39	85.86	
50.86	87.51	REW
51.69	88.53	
52.07	89.38	
54.69	89.61	
55.6	90.66	
60.02	90.55	
64.86	90.60	
68.35	91.26	
73.36	92.66	BKF
80.99	94.48	
86.02	96.04	
92.55	97.51	



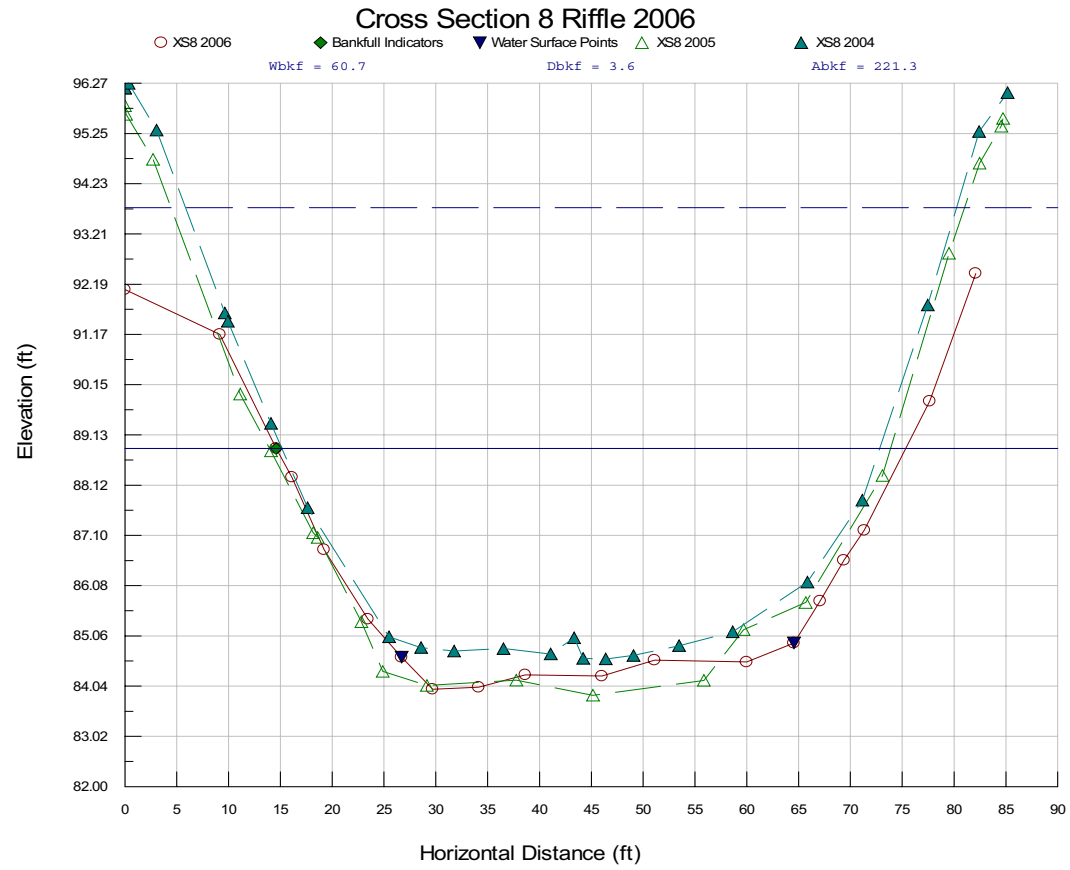
Cross Section XS6 Pool November 2006		
Station	Elevation	Note
0	97.22	
8.27	95.31	
9.39	94.33	
11.47	93.29	
13.92	91.90	
16.1	90.22	
18.2	89.61	
19.68	88.40	
20.69	86.96	LEW
23.77	85.82	
26.81	84.66	
30.92	83.48	
32.37	82.48	
43.55	83.24	
49.98	84.52	
53.86	86.16	REW
67.02	87.99	
82.4	89.05	
95.49	90.21	BKF
109.99	90.80	
120.72	91.300486	
125.98	93.489329	
131.17	95.637092	



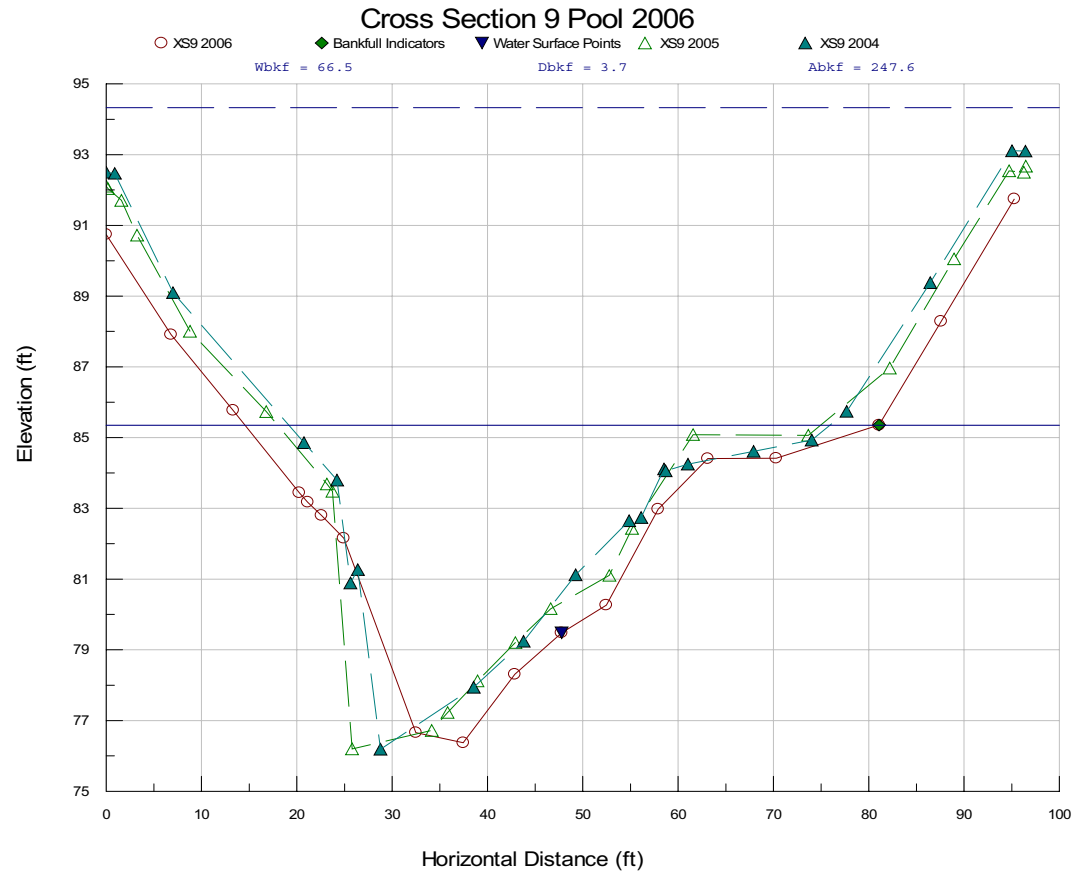
Cross Section XS7 Pool November 2006		
Station	Elevation	Note
0	95.18	
9.02	91.14	
12.52	89.57	BKF
20.68	87.93	
20.92	87.86	
24.01	87.11	
26.67	87.85	
33.66	86.89	
36.25	86.01	LEW
43.51	85.84	
47.92	85.36	
57.06	85.34	
61.59	85.28	
69.38	85.37	
72.31	86.01	REW
77.69	86.59	
81.41	88.87	
85.66	91.68	
103.44	96.31	FP



Cross Section XS8 Riffle November 2006		
Station	Elevation	Note
0	92.08	
9.16	91.17	
14.6	88.86	BKF
16.12	88.28	
19.22	86.81	
23.45	85.40	
26.71	84.63	LEW
29.69	83.97	
34.13	84.02	
38.63	84.27	
46.03	84.24	
51.11	84.56	
59.99	84.53	
64.56	84.91	REW
67.08	85.76	
69.37	86.59	
71.34	87.20	
77.66	89.82	
82.1	92.41	



Cross Section XS9 Pool November 2006		
Station	Elevation	Note
0	90.74	
6.8	87.91	
13.32	85.77	
20.26	83.44	
21.14	83.17	
22.59	82.80	
24.92	82.16	
32.48	76.66	
37.45	76.37	
42.87	78.31	
47.78	79.48	LEW
52.46	80.26	
57.91	82.98	
63.11	84.41	
70.29	84.42	
81.08	85.35	BKF
87.59	88.29	
95.27	91.75	





Freedom Park Cross Section XS1 Looking Downstream



Freedom Park Cross Section XS1 Looking Upstream



Freedom Park Cross Section XS1 Looking Right Bank



Freedom Park Cross Section XS1 Looking Left Bank



Freedom Park Cross Section XS4 Looking Downstream



Freedom Park Cross Section XS4 Looking Upstream



Freedom Park Cross Section XS4 Looking Right Bank



Freedom Park Cross Section XS4 Looking Left Bank



Freedom Park Cross Section XS5 Looking Downstream



Freedom Park Cross Section XS5 Looking Upstream



Freedom Park Cross Section XS5 Looking Left Bank



Freedom Park Cross Section XS5 Looking Right Bank



Freedom Park Cross Section XS6 Looking Right Bank



Freedom Park Cross Section XS6 Looking Left Bank



Freedom Park Cross Section XS6 Looking Downstream



Freedom Park Cross Section XS6 Looking Upstream



Freedom Park Cross Section XS7 Looking Downstream



Freedom Park Cross Section XS7 Looking Upstream



Freedom Park Cross Section XS7 Looking Left Bank



Freedom Park Cross Section XS7 Looking Right Bank



Freedom Park Cross Section XS8 Looking Downstream



Freedom Park Cross Section XS8 Looking Upstream



Freedom Park Cross Section XS8 Looking Left Bank



Freedom Park Cross Section XS8 Looking Right Bank



Freedom Park Cross Section XS9 Looking Downstream



Freedom Park Cross Section XS9 Looking Upstream

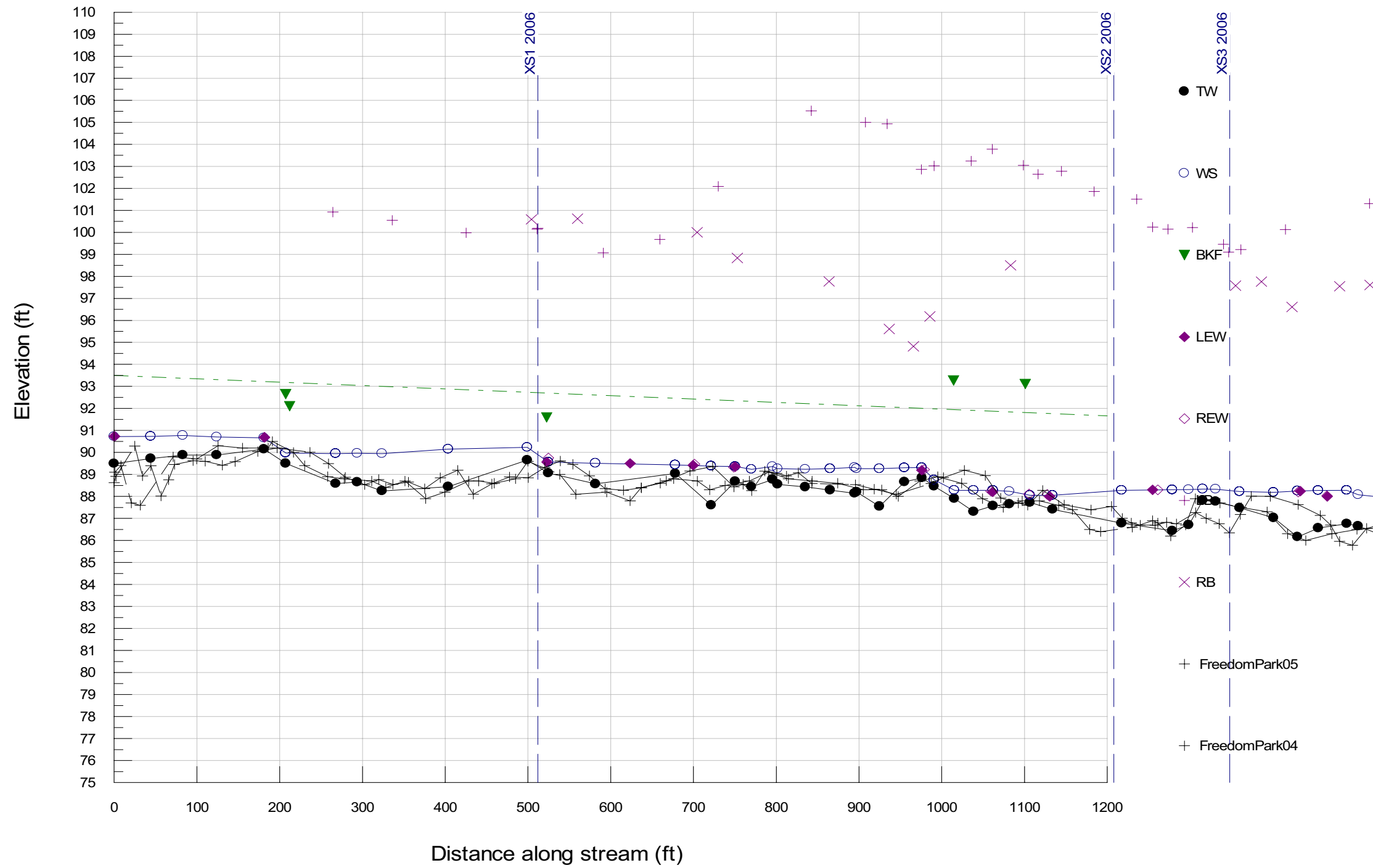


Freedom Park Cross Section XS9 Looking Left Bank

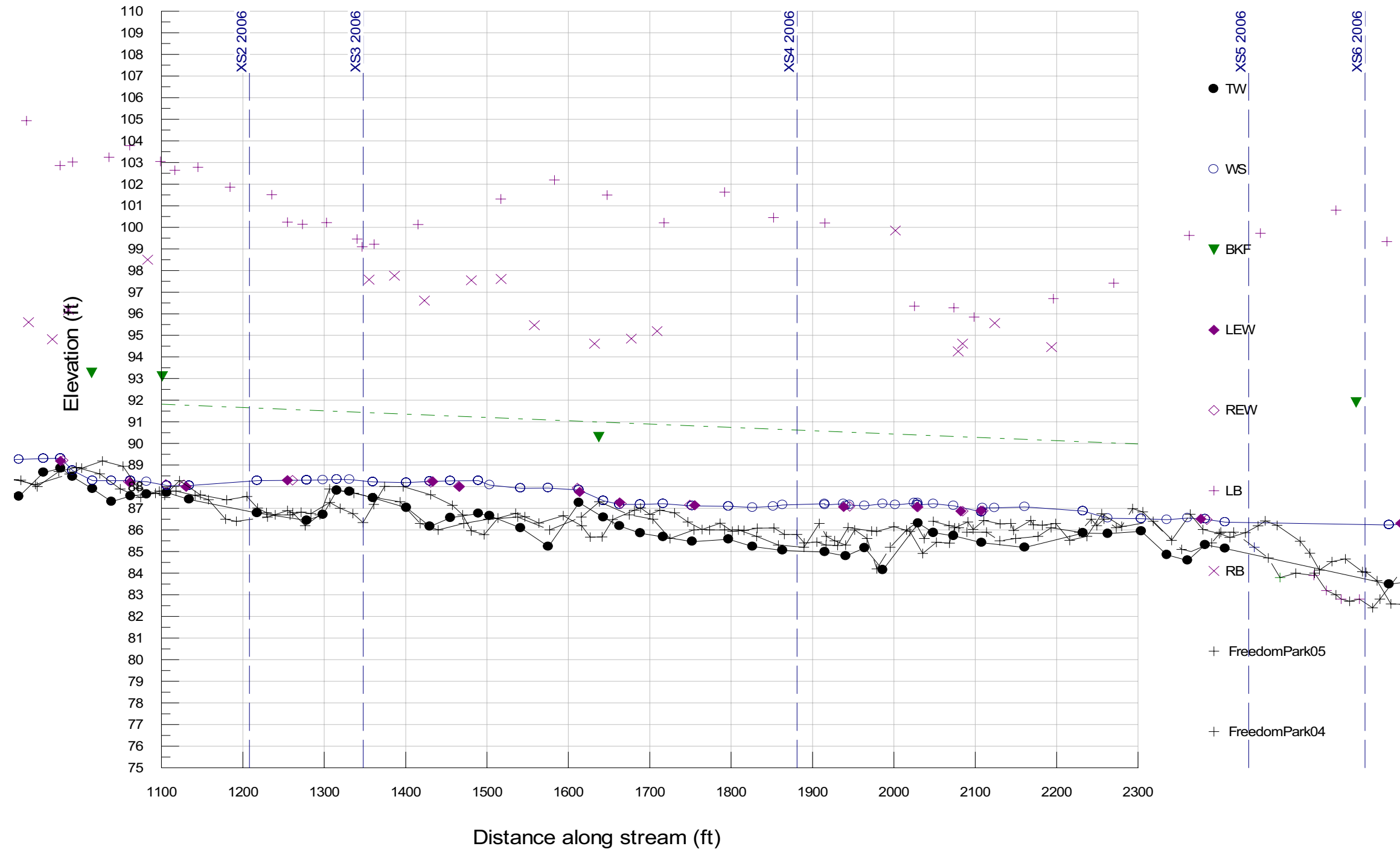


Freedom Park Cross Section XS9 Looking Right Bank

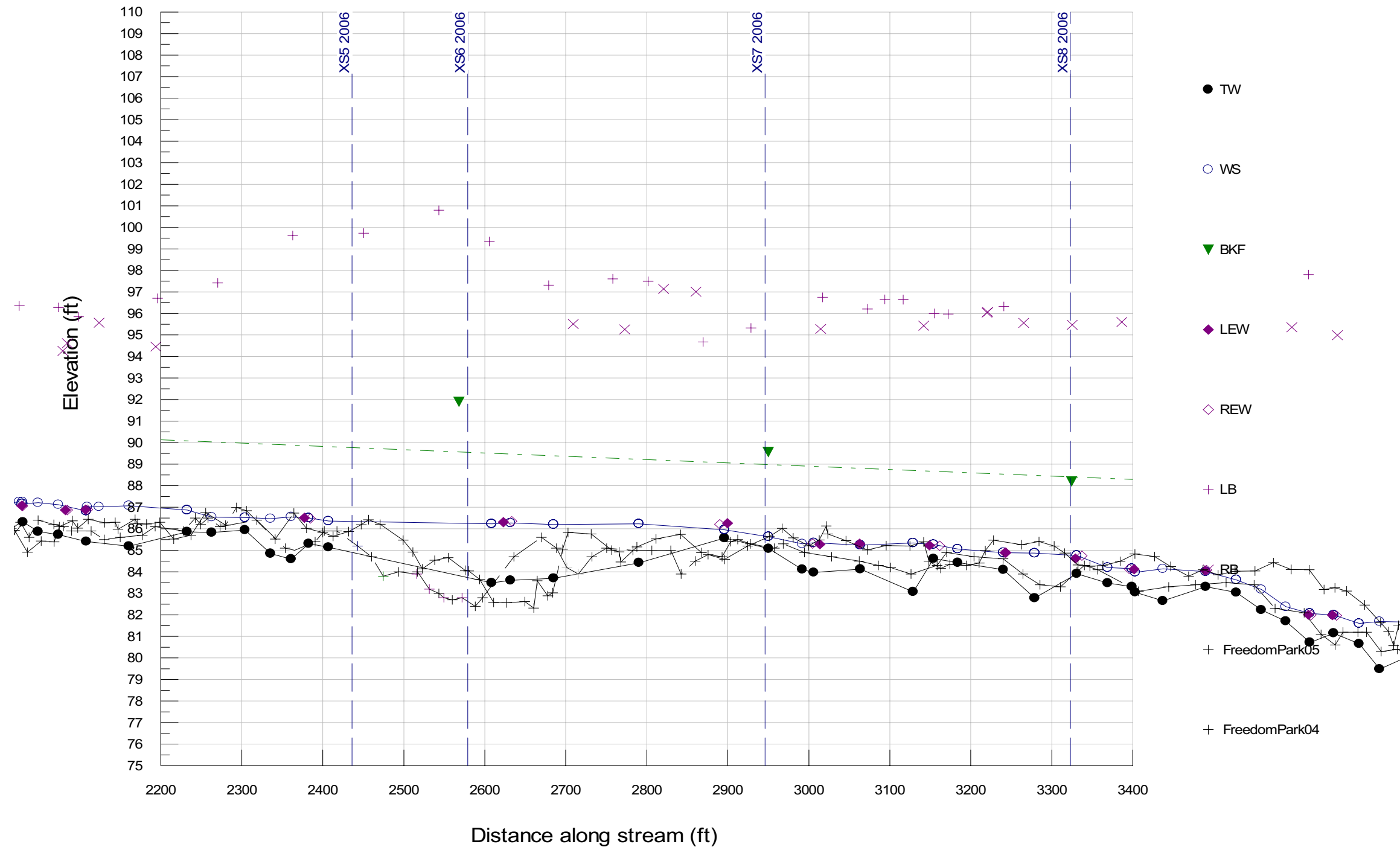
Freedom Park MY2 2006 Sheet 1



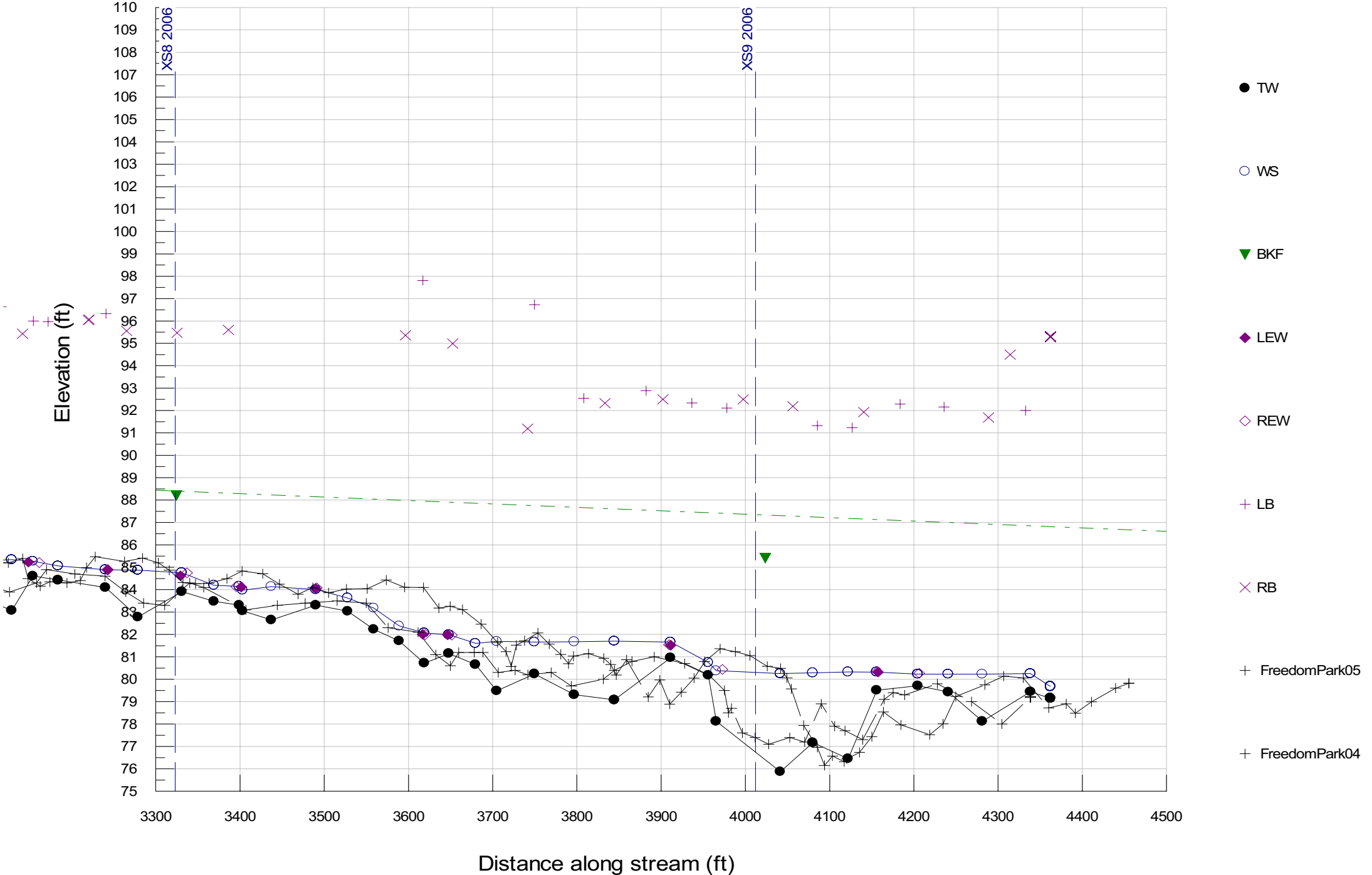
Freedom Park MY2 2006 Sheet 2



Freedom Park MY2 2006 Sheet 3



Freedom Park MY2 2006 Sheet 4



Profile Features						
Pro_ID	STA_BEG	STA_END	Feat_Type	Slope	Length	Dmax
2	268	416	Pool	0.0001	148	4.8
4	866	956	Pool	0.0001	90	4.5
6	1034	1072	Pool	0.0001	38	4.7
8	1250	1307	Pool	0.0001	57	5.2
10	1427	1599	Pool	0.0001	172	5.9
12	1828	2017	Pool	0.0001	189	6.3
14	2105	2231	Pool	0.0001	126	5.0
16	2331	2365	Pool	0.0001	34	5.2
18	2490	2786	Pool	0.0001	296	5.9
20	2997	3145	Pool	0.0001	148	5.6
22	3251	3314	Pool	0.0020	63	5.6
24	3411	3473	Pool	0.0001	62	5.6
26	3692	3895	Pool	0.0001	203	6.7
28	3977	4152	Pool	0.0001	175	9.2
30	4250	4326	Pool	0.0001	76	6.8
1	180	207	Riffle	0.0230	27	3.3
3	498	528	Riffle	0.0230	30	3.4
5	971	1014	Riffle	0.0240	43	3.4
7	1103	1133	Riffle	0.0080	30	4.2
9	1314	1403	Riffle	0.0010	89	3.9
11	1612	1666	Riffle	0.0160	54	4.4
13	2027	2103	Riffle	0.0040	76	4.5
15	2231	2307	Riffle	0.0040	76	4.1
17	2381	2407	Riffle	0.0050	26	4.6
19	2896	2952	Riffle	0.0059	56	3.8
21	3150	3238	Riffle	0.0050	88	4.3
23	3327	3403	Riffle	0.0100	76	4.9
25	3490	3682	Riffle	0.0120	192	4.8
27	3910	3958	Riffle	0.0194	48	5.1
29	4205	4241	Riffle	0.0010	36	5.3
Summary						
	Riffle			Pool		
	Slope	Length	Dmax	Slope	Length	Dmax
min	0.0010	26	3.3	0.0001	34	4.5
max	0.0240	192	5.3	0.0020	296	9.2
med	0.0080	54	4.3	0.0001	126	5.6
n	15	15	15.0	15	15	15

As Built	Riffle			Pool		
min	0.0027	15			76	
max	0.0175	207			252	
med	0.0115	66			132	

Profile Spacing and Water Surface Slopes					
Seg_ID	Pro_ID Beg	Pro_ID End	Spacing	Sws	Note
1	1	3	318	0.0014	
2	2	4	600	0.0016	Spacing includes Bridge
3	3	5	474	0.0019	
4	4	6	140	0.0070	
5	5	7	131	0.0095	
6	6	8	222	0.0010	
7	7	9	209		
8	8	10	299	0.0016	
9	9	11	287	0.0014	
10	10	12	424	0.0017	
11	11	13	417	0.0013	
12	12	14	175	0.0010	
13	13	15	203	0.0020	
14	14	16	201	0.0024	
15	15	17	153	0.0029	
16	16	18	293	0.0006	
17	17	19	516	0.0010	
18	18	20	499	0.0018	
19	19	21	256	0.0028	
20	20	22	155	0.0026	
21	21	23	176	0.0036	
22	22	24	162	0.0047	
23	23	25	165	0.0040	
24	24	26	405	0.0062	
25	25	27	421	0.0058	
26	26	28	244	0.0058	
27	27	29	300	0.0048	
28	28	30	210	0.0021	
Summary			Spacing	Sws	
Min			131	0.0006	
Max			600	0.0095	
Med			250	0.0021	
n			28	27	
As Built			Spacing		
Min			171		
Max			587		
Med			294		

Location of Pattern Features

Pat_ID	STA_BEG	STA_END	Feat_Type
1	10	750	Straight
2	750	1000	Meander
3	1000	1100	Straight
4	1100	1300	Meander
5	1300	1375	Straight
6	1375	1525	Meander
7	1525	1800	Straight
8	1800	1950	Meander
9	1950	2050	Straight
10	2050	2125	Meander
11	2125	2350	Straight
12	2350	2400	Meander
13	2400	2550	Straight
14	2550	2650	Meander
15	2650	2750	Straight
16	2750	2875	Meander
17	2875	3050	Straight
18	3050	3200	Meander
19	3200	3625	Straight
20	3625	3775	Meander
21	3775	4000	Straight
22	4000	4125	Meander
23	4125	4225	Straight
24	4225	4300	Meander
25	4300	4400	Straight

Meander Wavelengths

Seg_ID	Pat_ID Beg	Pat_ID End	Lm	Summary		
				Min	Max	n
1	2	6	520			411
2	4	8	626			852
3	6	10	588			501
4	8	12	447			10
5	10	14	480			
6	12	16	411			
7	14	18	482			
8	16	20	852			
9	18	22	832			
10	20	24	457			

Belth Widths and Meander Width Ratios						
Seg_ID	Pat_ID Beg	Pat_ID End	Wb	MWR	Summary	
					Min	Max
1	2	4	176	3.7		118
2	4	6	195	4.1		225
3	6	8	151	3.1		149.5
4	8	10	148	3.1		8
5	12	14	133	2.8		MWR Summary
6	16	18	143	3.0		2.5
7	20	22	225	4.7		4.7
8	22	24	118	2.5		3.1
					n	8

Radii of Curvature			
Pat_ID	Rc	Summary	
		min	max
2	392	90	
4	196.5	392	
6	158	154	
8	158	12	
10	135		
12	171		
14	97.5		
16	148.5		
18	165		
20	90		
22	150		
24	108		

RIVERMORPH PARTICLE SUMMARY

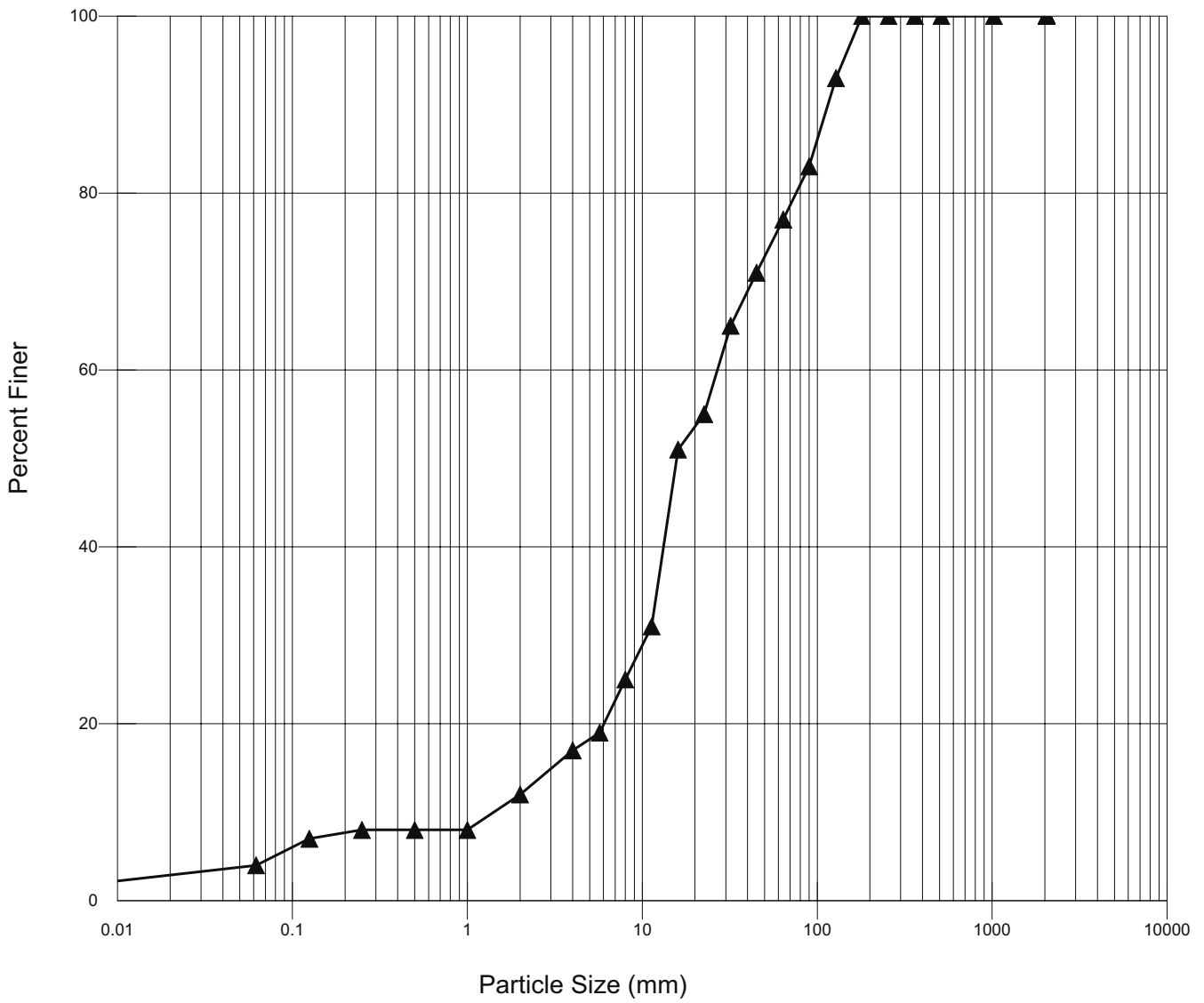
River Name: FreedomPark
 Reach Name: Main
 Sample Name: XS1 2006
 Survey Date: 11/28/06

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	4	4.00	4.00
0.062 - 0.125	3	3.00	7.00
0.125 - 0.25	1	1.00	8.00
0.25 - 0.50	0	0.00	8.00
0.50 - 1.0	0	0.00	8.00
1.0 - 2.0	4	4.00	12.00
2.0 - 4.0	5	5.00	17.00
4.0 - 5.7	2	2.00	19.00
5.7 - 8.0	6	6.00	25.00
8.0 - 11.3	6	6.00	31.00
11.3 - 16.0	20	20.00	51.00
16.0 - 22.6	4	4.00	55.00
22.6 - 32.0	10	10.00	65.00
32 - 45	6	6.00	71.00
45 - 64	6	6.00	77.00
64 - 90	6	6.00	83.00
90 - 128	10	10.00	93.00
128 - 180	7	7.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	3.6
D35 (mm)	12.24
D50 (mm)	15.77
D84 (mm)	93.8
D95 (mm)	142.86
D100 (mm)	180
Silt/Clay (%)	4
Sand (%)	8
Gravel (%)	65
Cobble (%)	23
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

XS1 2006



RIVERMORPH PARTICLE SUMMARY

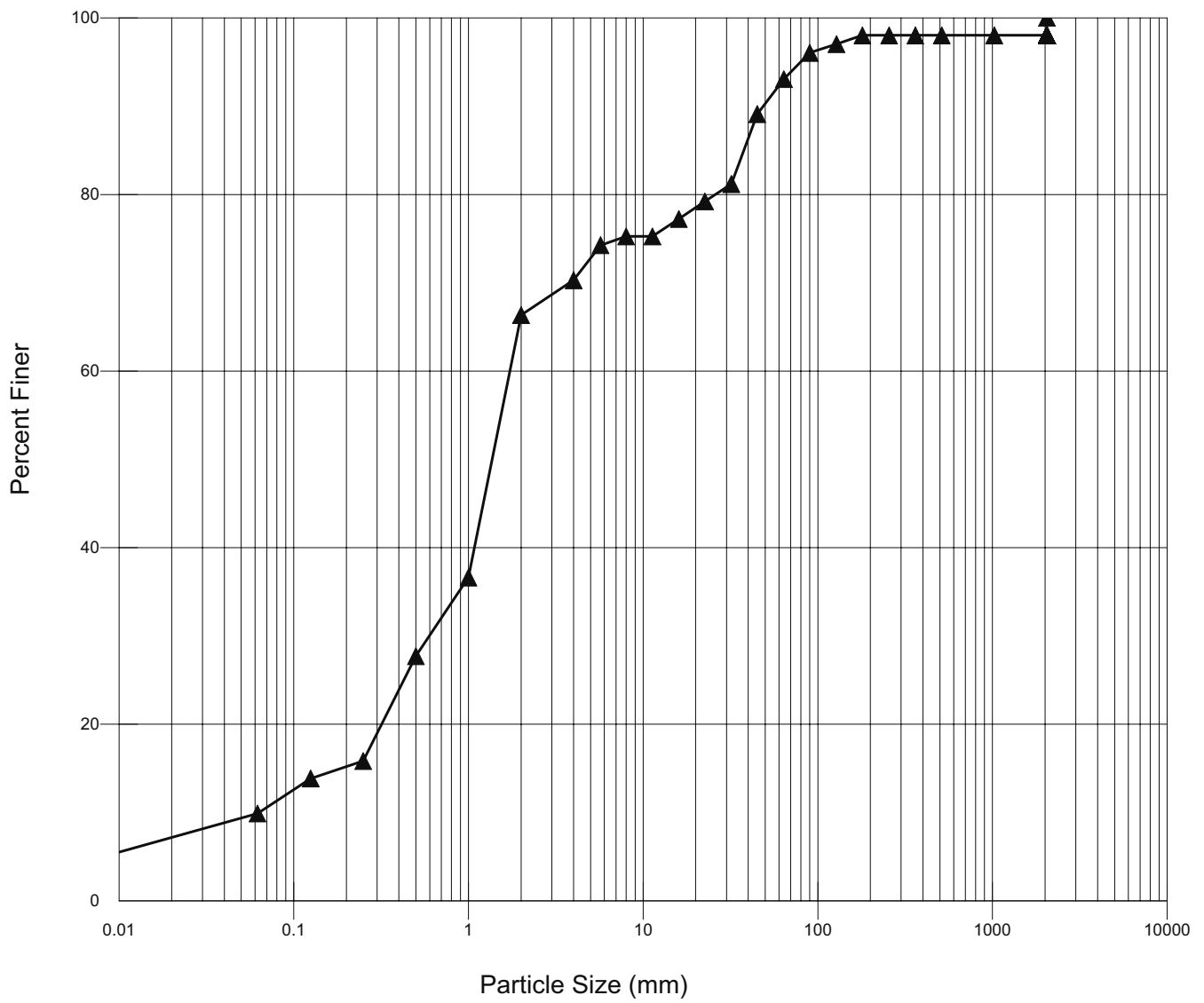
River Name: FreedomPark
 Reach Name: Main
 Sample Name: XS2 2006
 Survey Date: 11/28/06

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	10	9.90	9.90
0.062 - 0.125	4	3.96	13.86
0.125 - 0.25	2	1.98	15.84
0.25 - 0.50	12	11.88	27.72
0.50 - 1.0	9	8.91	36.63
1.0 - 2.0	30	29.70	66.34
2.0 - 4.0	4	3.96	70.30
4.0 - 5.7	4	3.96	74.26
5.7 - 8.0	1	0.99	75.25
8.0 - 11.3	0	0.00	75.25
11.3 - 16.0	2	1.98	77.23
16.0 - 22.6	2	1.98	79.21
22.6 - 32.0	2	1.98	81.19
32 - 45	8	7.92	89.11
45 - 64	4	3.96	93.07
64 - 90	3	2.97	96.04
90 - 128	1	0.99	97.03
128 - 180	1	0.99	98.02
180 - 256	0	0.00	98.02
256 - 362	0	0.00	98.02
362 - 512	0	0.00	98.02
512 - 1024	0	0.00	98.02
1024 - 2048	0	0.00	98.02
Bedrock	2	1.98	100.00

D16 (mm)	0.25
D35 (mm)	0.91
D50 (mm)	1.45
D84 (mm)	36.61
D95 (mm)	80.9
D100 (mm)	Bedrock
Silt/Clay (%)	9.9
Sand (%)	56.44
Gravel (%)	26.73
Cobble (%)	4.95
Boulder (%)	0
Bedrock (%)	1.98

Total Particles = 101.

XS2 2006



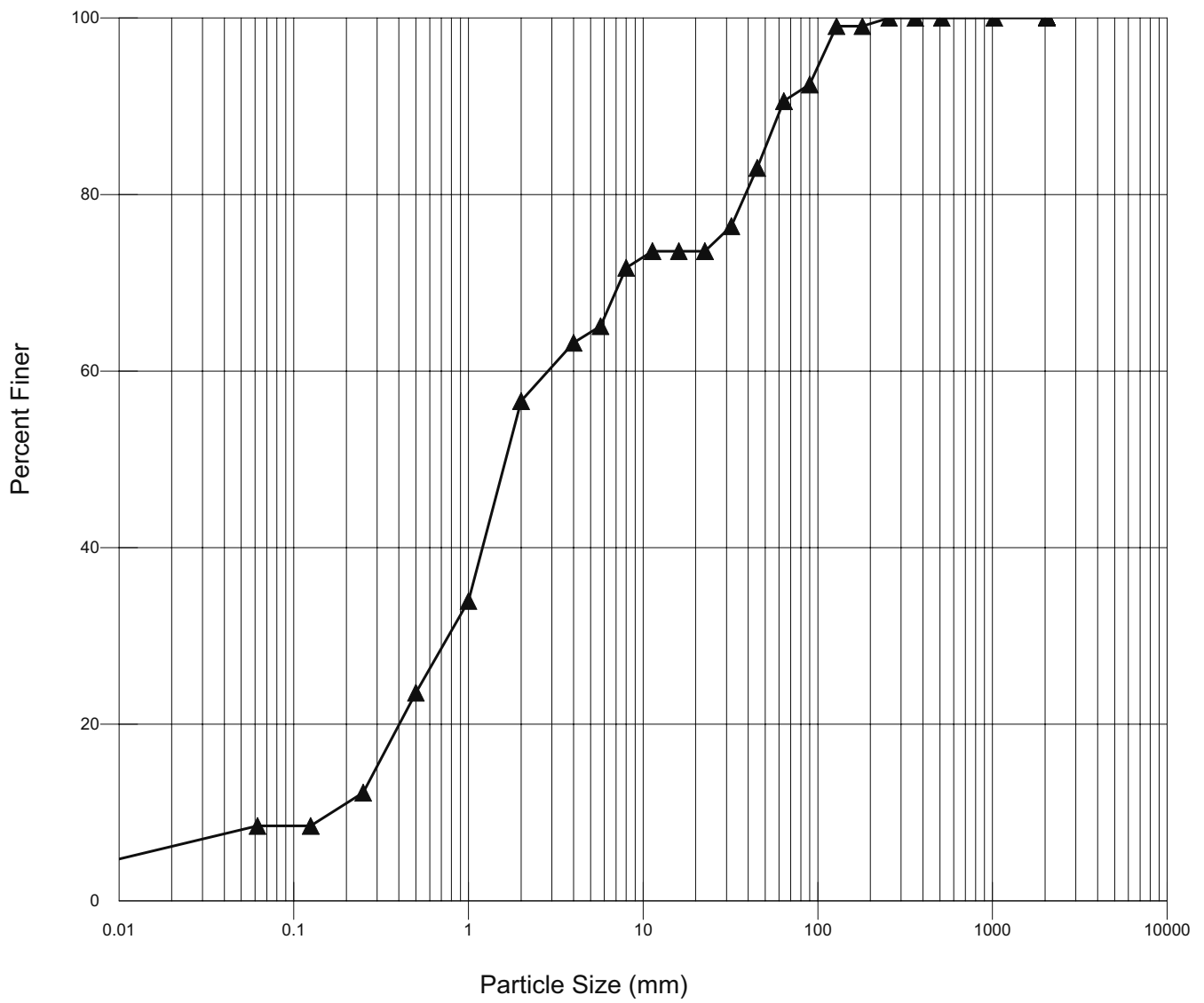
RIVERMORPH PARTICLE SUMMARY

River Name: FreedomPark
Reach Name: Main
Sample Name: XS3 2006
Survey Date: 11/28/06

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	9	8.49	8.49
0.062 - 0.125	0	0.00	8.49
0.125 - 0.25	4	3.77	12.26
0.25 - 0.50	12	11.32	23.58
0.50 - 1.0	11	10.38	33.96
1.0 - 2.0	24	22.64	56.60
2.0 - 4.0	7	6.60	63.21
4.0 - 5.7	2	1.89	65.09
5.7 - 8.0	7	6.60	71.70
8.0 - 11.3	2	1.89	73.58
11.3 - 16.0	0	0.00	73.58
16.0 - 22.6	0	0.00	73.58
22.6 - 32.0	3	2.83	76.42
32 - 45	7	6.60	83.02
45 - 64	8	7.55	90.57
64 - 90	2	1.89	92.45
90 - 128	7	6.60	99.06
128 - 180	0	0.00	99.06
180 - 256	1	0.94	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00
D16 (mm)	0.33		
D35 (mm)	1.05		
D50 (mm)	1.71		
D84 (mm)	47.47		
D95 (mm)	104.66		
D100 (mm)	255.99		
Silt/Clay (%)	8.49		
Sand (%)	48.11		
Gravel (%)	33.97		
Cobble (%)	9.43		
Boulder (%)	0		
Bedrock (%)	0		

Total Particles = 106.

XS3 2006



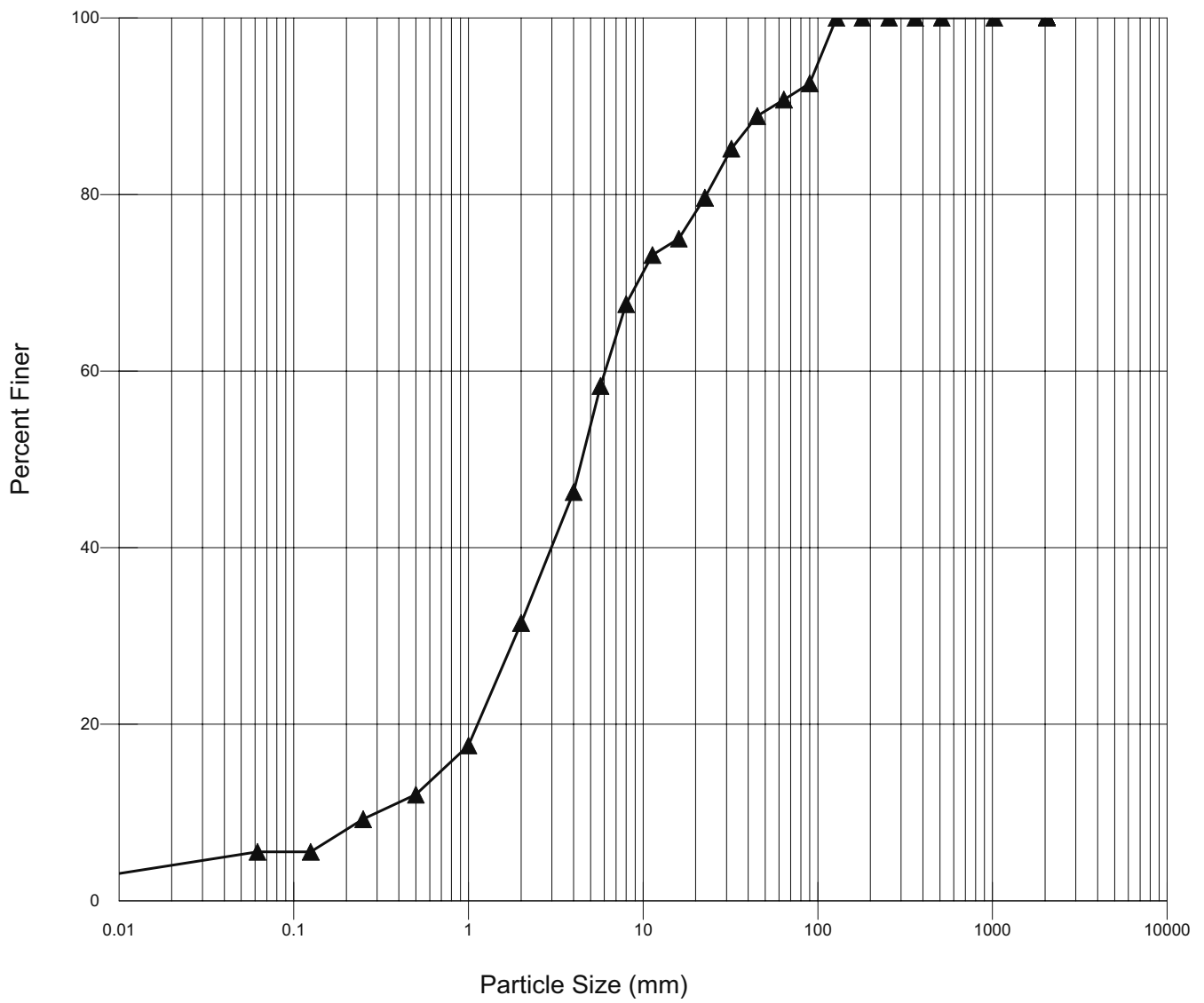
RIVERMORPH PARTICLE SUMMARY

River Name: FreedomPark
 Reach Name: Main
 Sample Name: XS4 2006
 Survey Date: 11/28/06

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	6	5.56	5.56
0.062 - 0.125	0	0.00	5.56
0.125 - 0.25	4	3.70	9.26
0.25 - 0.50	3	2.78	12.04
0.50 - 1.0	6	5.56	17.59
1.0 - 2.0	15	13.89	31.48
2.0 - 4.0	16	14.81	46.30
4.0 - 5.7	13	12.04	58.33
5.7 - 8.0	10	9.26	67.59
8.0 - 11.3	6	5.56	73.15
11.3 - 16.0	2	1.85	75.00
16.0 - 22.6	5	4.63	79.63
22.6 - 32.0	6	5.56	85.19
32 - 45	4	3.70	88.89
45 - 64	2	1.85	90.74
64 - 90	2	1.85	92.59
90 - 128	8	7.41	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00
D16 (mm)	0.86		
D35 (mm)	2.48		
D50 (mm)	4.52		
D84 (mm)	29.99		
D95 (mm)	102.36		
D100 (mm)	128		
Silt/Clay (%)	5.56		
Sand (%)	25.92		
Gravel (%)	59.26		
Cobble (%)	9.26		
Boulder (%)	0		
Bedrock (%)	0		

Total Particles = 108.

XS4 2006



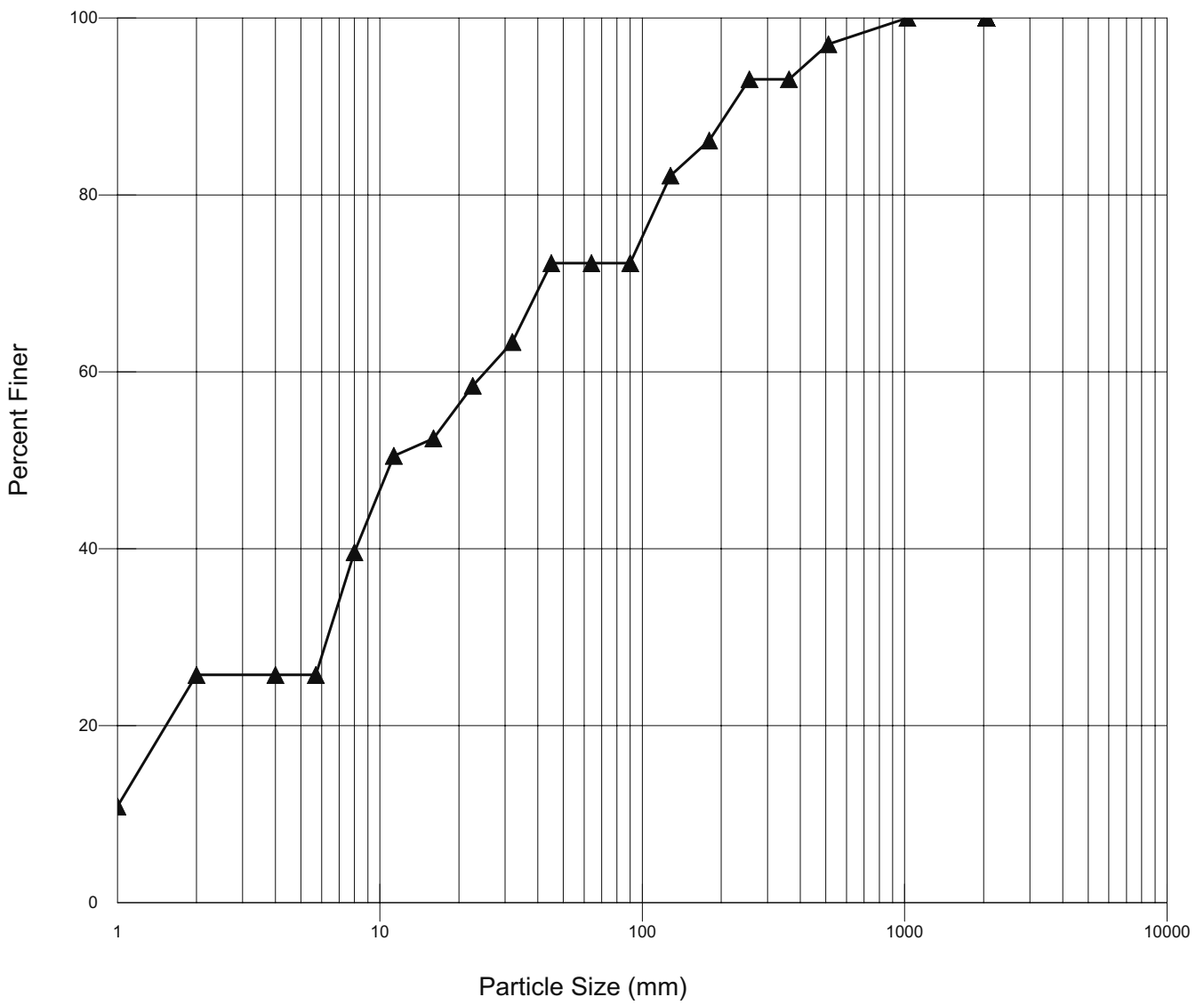
RIVERMORPH PARTICLE SUMMARY

River Name: FreedomPark
 Reach Name: Main
 Sample Name: XS5 2006
 Survey Date: 11/28/06

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	0	0.00	0.00
0.125 - 0.25	0	0.00	0.00
0.25 - 0.50	0	0.00	0.00
0.50 - 1.0	11	10.89	10.89
1.0 - 2.0	15	14.85	25.74
2.0 - 4.0	0	0.00	25.74
4.0 - 5.7	0	0.00	25.74
5.7 - 8.0	14	13.86	39.60
8.0 - 11.3	11	10.89	50.50
11.3 - 16.0	2	1.98	52.48
16.0 - 22.6	6	5.94	58.42
22.6 - 32.0	5	4.95	63.37
32 - 45	9	8.91	72.28
45 - 64	0	0.00	72.28
64 - 90	0	0.00	72.28
90 - 128	10	9.90	82.18
128 - 180	4	3.96	86.14
180 - 256	7	6.93	93.07
256 - 362	0	0.00	93.07
362 - 512	4	3.96	97.03
512 - 1024	3	2.97	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00
D16 (mm)	1.34		
D35 (mm)	7.24		
D50 (mm)	11.15		
D84 (mm)	151.9		
D95 (mm)	435.11		
D100 (mm)	1023.98		
Silt/Clay (%)	0		
Sand (%)	25.74		
Gravel (%)	46.54		
Cobble (%)	20.79		
Boulder (%)	6.93		
Bedrock (%)	0		

Total Particles = 101.

XS5 2006



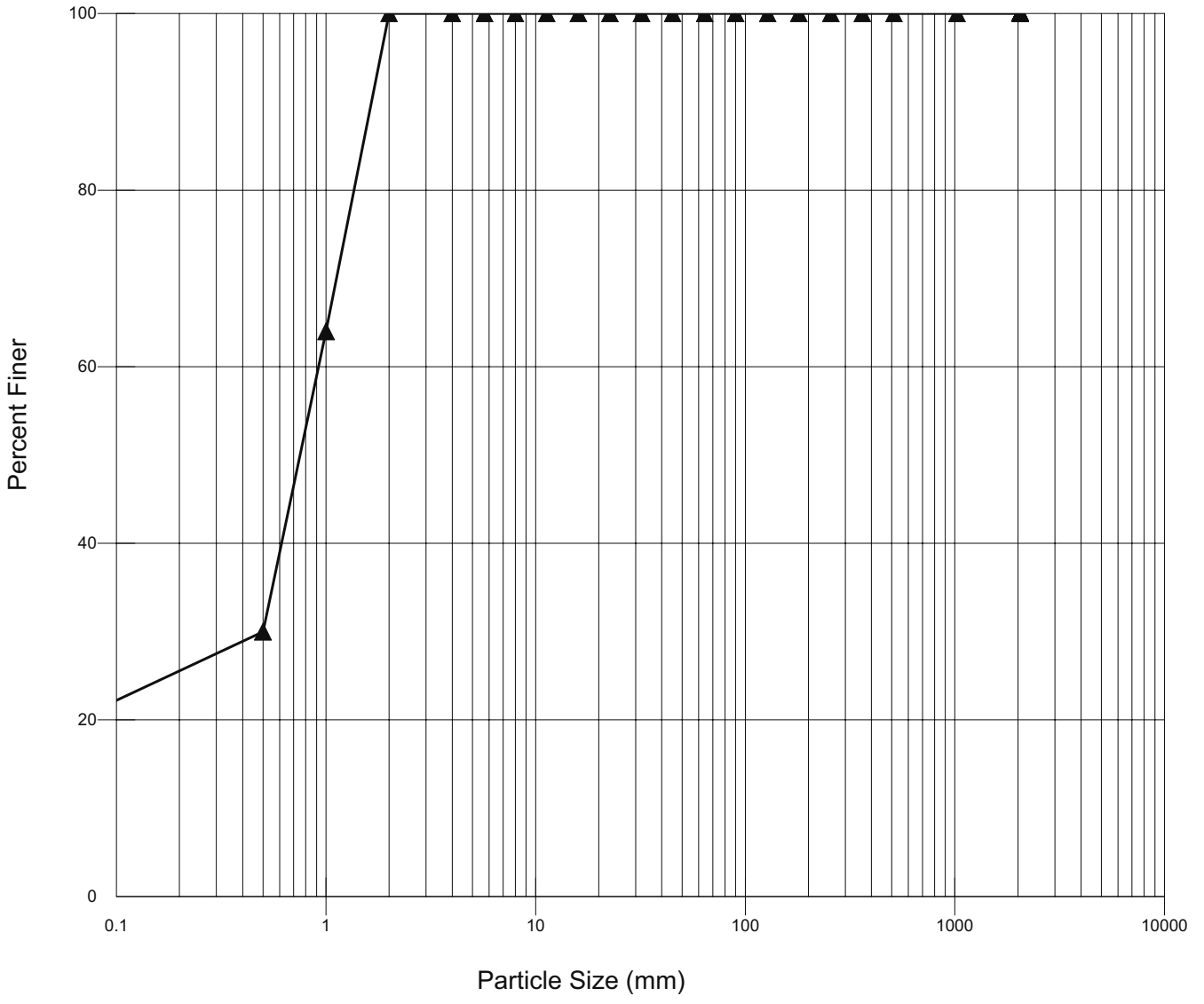
RIVERMORPH PARTICLE SUMMARY

River Name: FreedomPark
Reach Name: Main
Sample Name: XS6 2006
Survey Date: 11/28/06

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	0	0.00	0.00
0.125 - 0.25	0	0.00	0.00
0.25 - 0.50	30	30.00	30.00
0.50 - 1.0	34	34.00	64.00
1.0 - 2.0	36	36.00	100.00
2.0 - 4.0	0	0.00	100.00
4.0 - 5.7	0	0.00	100.00
5.7 - 8.0	0	0.00	100.00
8.0 - 11.3	0	0.00	100.00
11.3 - 16.0	0	0.00	100.00
16.0 - 22.6	0	0.00	100.00
22.6 - 32.0	0	0.00	100.00
32 - 45	0	0.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00
D16 (mm)	0.38		
D35 (mm)	0.57		
D50 (mm)	0.79		
D84 (mm)	1.56		
D95 (mm)	1.86		
D100 (mm)	2		
Silt/Clay (%)	0		
Sand (%)	100		
Gravel (%)	0		
Cobble (%)	0		
Boulder (%)	0		
Bedrock (%)	0		

Total Particles = 100.

XS6 2006



RIVERMORPH PARTICLE SUMMARY

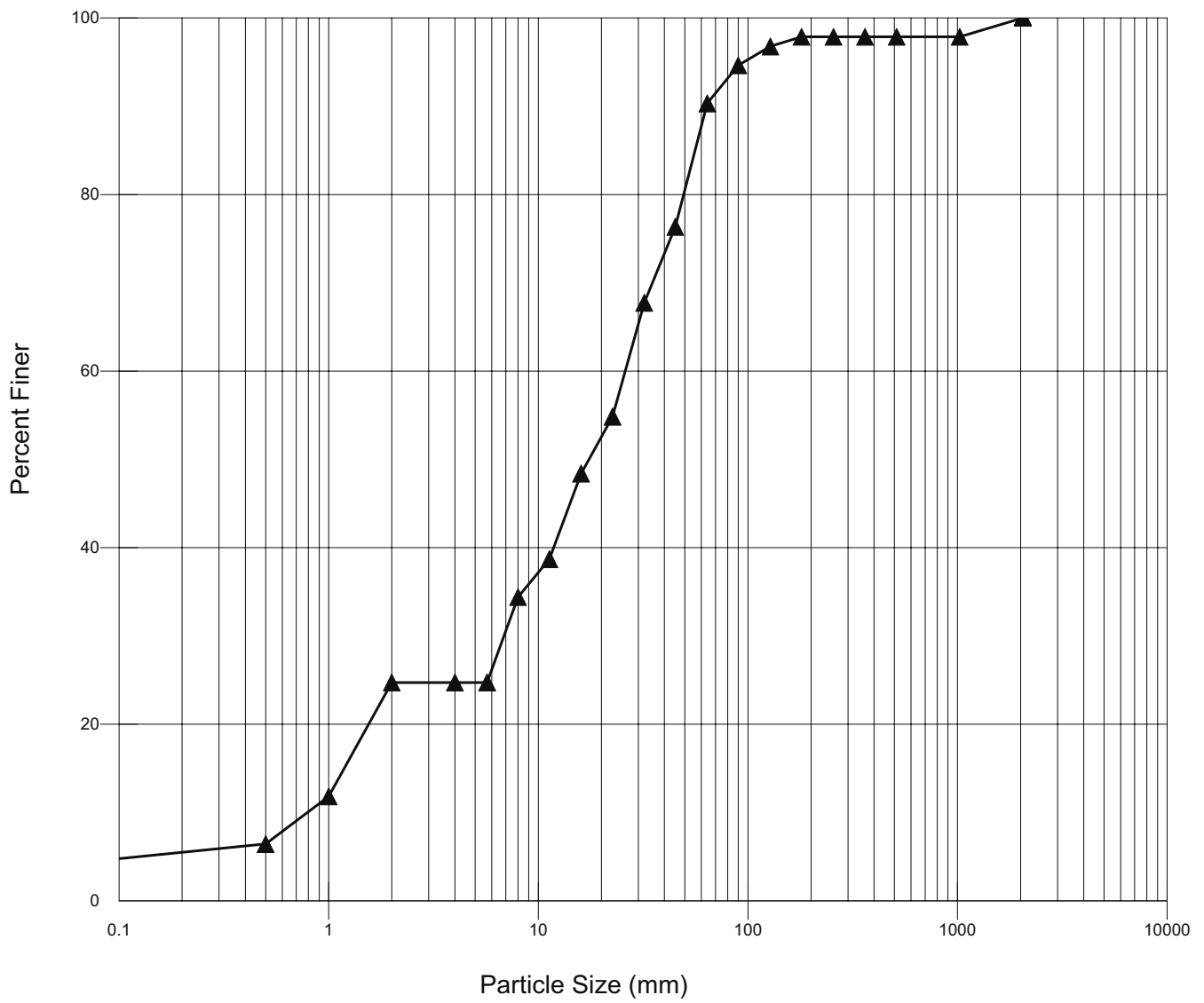
 River Name: FreedomPark
 Reach Name: Main
 Sample Name: XS7 2006
 Survey Date: 11/28/06

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	0	0.00	0.00
0.125 - 0.25	0	0.00	0.00
0.25 - 0.50	6	6.45	6.45
0.50 - 1.0	5	5.38	11.83
1.0 - 2.0	12	12.90	24.73
2.0 - 4.0	0	0.00	24.73
4.0 - 5.7	0	0.00	24.73
5.7 - 8.0	9	9.68	34.41
8.0 - 11.3	4	4.30	38.71
11.3 - 16.0	9	9.68	48.39
16.0 - 22.6	6	6.45	54.84
22.6 - 32.0	12	12.90	67.74
32 - 45	8	8.60	76.34
45 - 64	13	13.98	90.32
64 - 90	4	4.30	94.62
90 - 128	2	2.15	96.77
128 - 180	1	1.08	97.85
180 - 256	0	0.00	97.85
256 - 362	0	0.00	97.85
362 - 512	0	0.00	97.85
512 - 1024	0	0.00	97.85
1024 - 2048	2	2.15	100.00
Bedrock	0	0.00	100.00

D16 (mm)	1.32
D35 (mm)	8.45
D50 (mm)	17.65
D84 (mm)	55.41
D95 (mm)	96.72
D100 (mm)	2047.95
Silt/Clay (%)	0
Sand (%)	24.73
Gravel (%)	65.59
Cobble (%)	7.53
Boulder (%)	2.15
Bedrock (%)	0

Total Particles = 93.

XS7 2006



RIVERMORPH PARTICLE SUMMARY

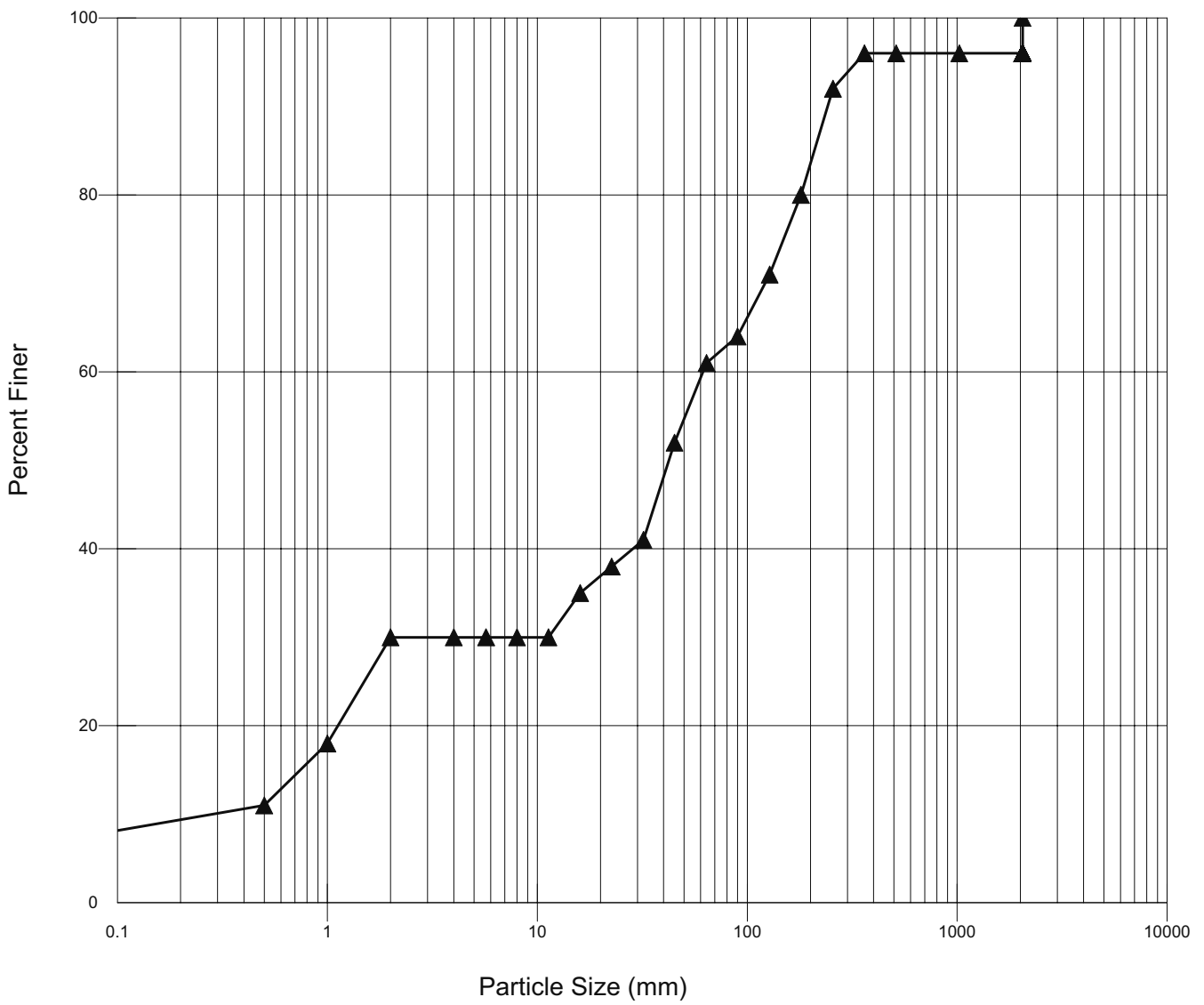
River Name: FreedomPark
Reach Name: Main
Sample Name: XS8 2006
Survey Date: 11/28/06

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	0	0.00	0.00
0.125 - 0.25	0	0.00	0.00
0.25 - 0.50	11	11.00	11.00
0.50 - 1.0	7	7.00	18.00
1.0 - 2.0	12	12.00	30.00
2.0 - 4.0	0	0.00	30.00
4.0 - 5.7	0	0.00	30.00
5.7 - 8.0	0	0.00	30.00
8.0 - 11.3	0	0.00	30.00
11.3 - 16.0	5	5.00	35.00
16.0 - 22.6	3	3.00	38.00
22.6 - 32.0	3	3.00	41.00
32 - 45	11	11.00	52.00
45 - 64	9	9.00	61.00
64 - 90	3	3.00	64.00
90 - 128	7	7.00	71.00
128 - 180	9	9.00	80.00
180 - 256	12	12.00	92.00
256 - 362	4	4.00	96.00
362 - 512	0	0.00	96.00
512 - 1024	0	0.00	96.00
1024 - 2048	0	0.00	96.00
Bedrock	4	4.00	100.00

D16 (mm)	0.86
D35 (mm)	16
D50 (mm)	42.64
D84 (mm)	205.33
D95 (mm)	335.5
D100 (mm)	Bedrock
Silt/Clay (%)	0
Sand (%)	30
Gravel (%)	31
Cobble (%)	31
Boulder (%)	4
Bedrock (%)	4

Total Particles = 100.

XS8 2006



RIVERMORPH PARTICLE SUMMARY

River Name: FreedomPark
Reach Name: Main
Sample Name: XS9 2006
Survey Date: 11/28/06

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	0	0.00	0.00
0.125 - 0.25	13	12.87	12.87
0.25 - 0.50	11	10.89	23.76
0.50 - 1.0	20	19.80	43.56
1.0 - 2.0	27	26.73	70.30
2.0 - 4.0	0	0.00	70.30
4.0 - 5.7	0	0.00	70.30
5.7 - 8.0	7	6.93	77.23
8.0 - 11.3	3	2.97	80.20
11.3 - 16.0	4	3.96	84.16
16.0 - 22.6	2	1.98	86.14
22.6 - 32.0	2	1.98	88.12
32 - 45	1	0.99	89.11
45 - 64	7	6.93	96.04
64 - 90	4	3.96	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00
D16 (mm)	0.32		
D35 (mm)	0.78		
D50 (mm)	1.24		
D84 (mm)	15.81		
D95 (mm)	61.15		
D100 (mm)	90		
Silt/Clay (%)	0		
Sand (%)	70.3		
Gravel (%)	25.74		
Cobble (%)	3.96		
Boulder (%)	0		
Bedrock (%)	0		

Total Particles = 101.

XS9 2006

