Brown Bark Park
Stream Restoration Monitoring Report
EEP Project # 52
Monitoring Year – 03
2007

Submitted to:

Ecosystem Enhancement PROGRAM

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

February 2008

Monitoring Firm

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Design Firm

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EXECUTIVE SUMMARY

In 2004, the North Carolina Ecosystem Enhancement Program (EEP) conducted stream restoration at Brown Bark Park within the Buffalo Creek Watershed in Greensboro, North Carolina. The 0.3-mi^2 watershed is located within the USGS 14-digit HUC 03030002020040 and the NCDWQ Sub-basin 03-06-02 of the Cape Fear River Basin. The project restored approximately 2,834 linear feet of channel. The design was developed to address vertical instability and the lack of bed variability. The restoration plan called for correcting these problems by stabilizing stream banks, installing in-stream structures, adjusting the stream planform, and replanting the riparian areas with native vegetation. Project construction occurred in 2004. This report describes the results from the third year of monitoring that took place in 2007.

The riparian buffer was planted with seven different species of bare root trees and four different species of live stakes. Three vegetation monitoring plots were established during the as-built survey; two buffer plots, each approximately 25' x 100', and one live stake plot, approximately 175' x 5'. The third year monitoring found an average of 305 stems per acre in the buffer plots, and 3,186 stems per acre in the live stake plot. The density of planted trees in the riparian buffer is low, but there is consistent vegetative cover for the majority of the buffer. Exotic vegetation was documented in the riparian buffer, but it does not warrant immediate corrective actions, but should continue to be monitored.

The stream assessment completed during the third year of monitoring found the stream to be functioning for the majority of the project. Channel dimensions have changed minimally from the as-built conditions. With the exception of a few places of deposition and erosion, the profile has changed little from previous monitoring. The majority of the in-stream structures are functioning. The third year of monitoring found that many previously documented areas of erosion have stabilized and have become well vegetated.

1.0 PROJECT BACKGROUND

1.1 Project Objectives

- Restore unstable stream channels to natural stable forms by modifying dimension, pattern, and/or profile based on reference reach parameters.
- Improve floodplain functionality by matching bankfull stage with floodplain elevation.
- Establish native floodplain vegetation through a forested riparian buffer.
- Improve the natural aesthetics of the stream corridor.
- Obtain mitigation credits for unavoidable impacts to streams within the same Hydrologic Unit Code (HUC).

1.2 Project Structure, Restoration Type, and Approach

A previously incised channel at Brown Bark Park was restored using channel dimension, pattern, and profile modifications and the establishment of a vegetated riparian zone adjacent to the creek. The new channel profile is maintained through the use of rock cross vanes and constructed riffles. Channel pattern is maintained through the use of cross vanes, root wads, and vegetation along the channel banks.

1.3 Location and Setting

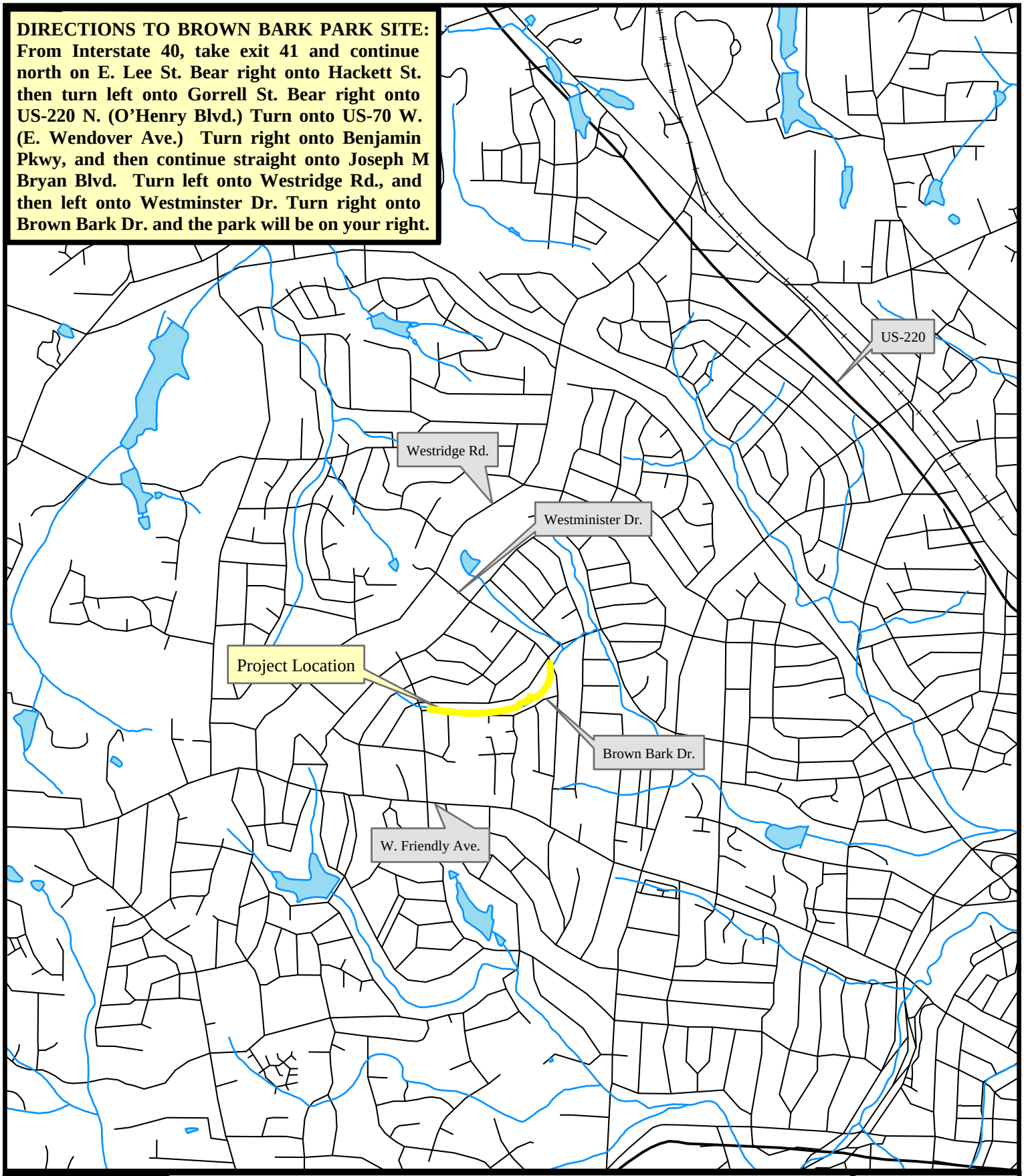
Brown Bark Park is located within the city limits of Greensboro, North Carolina. The land use of the 0.3-mi^2 watershed is urban residential development. The watershed is completely built out with little potential for future development.

1.4 Project History and Background

Table 1. Project Restoration Components
Project Number and Name: 52 - Brown Bark Park

Segment / Reach ID	Existing Linear Feet	Type	Approach	Linear Feet	Stationing	Comment
Reach I	635	EI	P2/3	635	10+00 - 16+35	
Reach II	324	R	P2/3	324	16+36 - 19+60	
Reach III	1,225	EI	P2/3	1,225	19+75 - 32+00	
Reach IV	474	R	P2/3	474	32+01 - 36+75	
Reach V	176	EI	P2/3	176	36+76 - 38+52	

DIRECTIONS TO BROWN BARK PARK SITE: From Interstate 40, take exit 41 and continue north on E. Lee St. Bear right onto Hackett St. then turn left onto Gorrell St. Bear right onto US-220 N. (O'Henry Blvd.) Turn onto US-70 W. (E. Wendover Ave.) Turn right onto Benjamin Pkwy, and then continue straight onto Joseph M Bryan Blvd. Turn left onto Westridge Rd., and then left onto Westminster Dr. Turn right onto Brown Bark Dr. and the park will be on your right.



Ecosystem Enhancement Program

Figure 1. Site Vicinity Map
Brown Bark Park, Guilford County, EEP Project # 52 - MY03

0.25 0.125 0 0.25 0.5 Miles

N

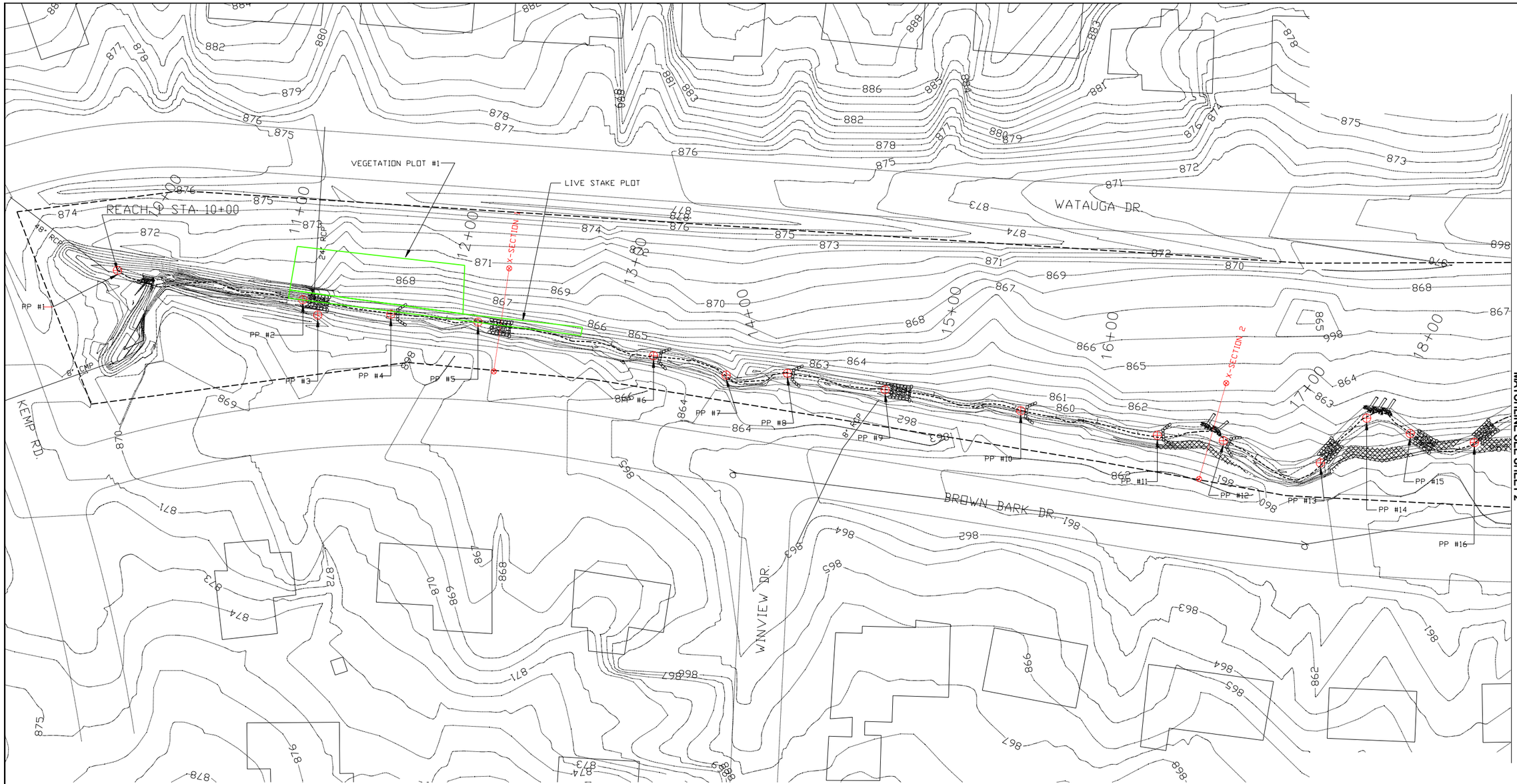
12/04/07

KCI Associates of NC

Table 2. Project Activity and Reporting History Project Number and Name: 52 - Brown Bark Park		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan		
Final Design - 90%		
Construction		Aug 04
Stream Repair and Maintenance Seeding		Apr 05
As-Built Report	2005	Jun 05
Year 1 Monitoring	Nov 05	Jan 06
Year 2 Monitoring	Sep 06	Jan 07
Year 3 Monitoring	Aug 07	Jan 08

Table 3. Project Contact Table Project Number and Name: 52 – Brown Bark Park	
Design Firm	Buck Engineering 8000 Regency Parkway, Suite 200 Cary, North Carolina 27511 Contact: Mr. Mike Rooney Phone: (919) 463-5488 Fax: (919) 463-5490
Construction Contractor	Shamrock Construction P.O. Box 14987 Greensboro, North Carolina 27415 Contact: Mr. Bill Wright Phone: (336) 375-1989 Fax: (336) 375-1801
Monitoring Performers	
MY-01	Buck Engineering 8000 Regency Parkway, Suite 200 Cary, North Carolina 27511 Contact: Mr. Mike Rooney Phone: (919) 463-5488 Fax: (919) 463-5490
MY-02, 03	KCI Associates of NC Landmark Center, II Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Contact: Mr. Adam Spiller Phone: (919) 783-9214 Fax: (919) 783-9266

Table 4. Project Background Table **Project Number and Name: 52 – Brown Bark Park**	
Project County	Guilford County
Drainage Area	0.3 sq. mi.
Drainage Impervious Cover Estimate (%)	N/A
Stream Order	First Order
Physiographic Region	Piedmont
Ecoregion	Southern Outer Piedmont
Rosgen Classification of As-built	B5/C5
Dominant Soil Types	Cecil-Urban land complex (Brown Bark)
Reference Site ID	N/A
USGS HUC for Project and Reference	03030002020040 (Brown Bark)
NCDWQ Sub-basin for Project and Reference	03-06-02 (Brown Bark)
NCDWQ Classification for Project and Reference	N/A (Brown Bark)
Any portion of the project segment 303(d) listed?	No - not rated
Any portion of the project segment upstream of a 303(d) listed segment?	N/A
Reasons for 303(d) Listing or Stressor	N/A
% of Project Easement Fenced	0%
% of Project Easement Demarcated with Bollards	approx. 100%



MATCHLINE SEE SHEET 2

CROSS-SECTION COORDINATES

	NORTHING	EASTING	ELEVATION
CROSS SECTION 1 LB	854764.00	1746575.78	868.72
RB	854702.75	1746566.80	867.17
CROSS SECTION 2 LB	854697.11	1747001.81	861.95
RB	854640.09	1746985.84	861.03
CROSS SECTION 3 LB	854720.10	1747301.05	860.12
RB	854670.41	1747312.08	859.03
CROSS SECTION 4 LB	854819.75	1748121.89	849.07
RB	854751.04	1748141.23	849.17
CROSS SECTION 5 LB	855254.33	1748454.35	843.60
RB	855166.17	1748509.37	845.77
CROSS SECTION 6 LB	855306.44	1748489.65	843.94
RB	855266.18	1748559.39	843.04

VEGETATION PLOT COORDINATES

	NORTHING	EASTING
VEGETATION PLOT #1	854776.63	1746449.92
	854765.69	1746549.34
	854736.87	1746548.45
	854750.71	1746445.55
VEGETATION PLOT #2	854759.56	1747969.16
	854784.70	1748070.71
	854751.50	1748085.79
	854730.74	1747972.89
LIVE STAKE PLOT, BEGIN -	854750.71	1746445.55
END -	854729.16	1746619.43

LEGEND

- PHOTO POINT
- THALWEG
- AS-BUILT VEGETATIVE BUFFER BOUNDARY
- CROSS-SECTION
- ROOT WAD
- ROCK CROSS VANE
- CONSTRUCTED RIFFLE

NAD 83

–60 –30 0 30 60

GRAPHIC SCALE

REVISIONS

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

BROWN BARK PARK
GUILFORD COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 52 - MY03
STATION 10+00 TO STATION 18+85

DATE: NOVEMBER 2007
SCALE: SEE SHEET

MONITORING PLAN VIEW

SHEET 1 OF 3

MATCHLINE SEE SHEET 1

MATCHLINE SEE SHEET 3

MATCHLINE SEE SHEET 3

EXISTING STREAM CROSSING

WATAUGA DR.

BROWN BARK DR.

LAUREL WOOD DR.

B-BALL COURT

PP #17
PP #18
PP #19A
PP #19B
PP #20A
PP #20B
PP #20C
PP #20D
PP #22
PP #23
PP #24
PP #25
PP #26
PP #27
PP #28

VEGETATION PLOT #2

24" RCP
18" RCP

SECTION 3

19+00
20+00
21+00
22+00
23+00
24+00
25+00
26+00
27+00
28+00

LEGEND

- PHOTO POINT
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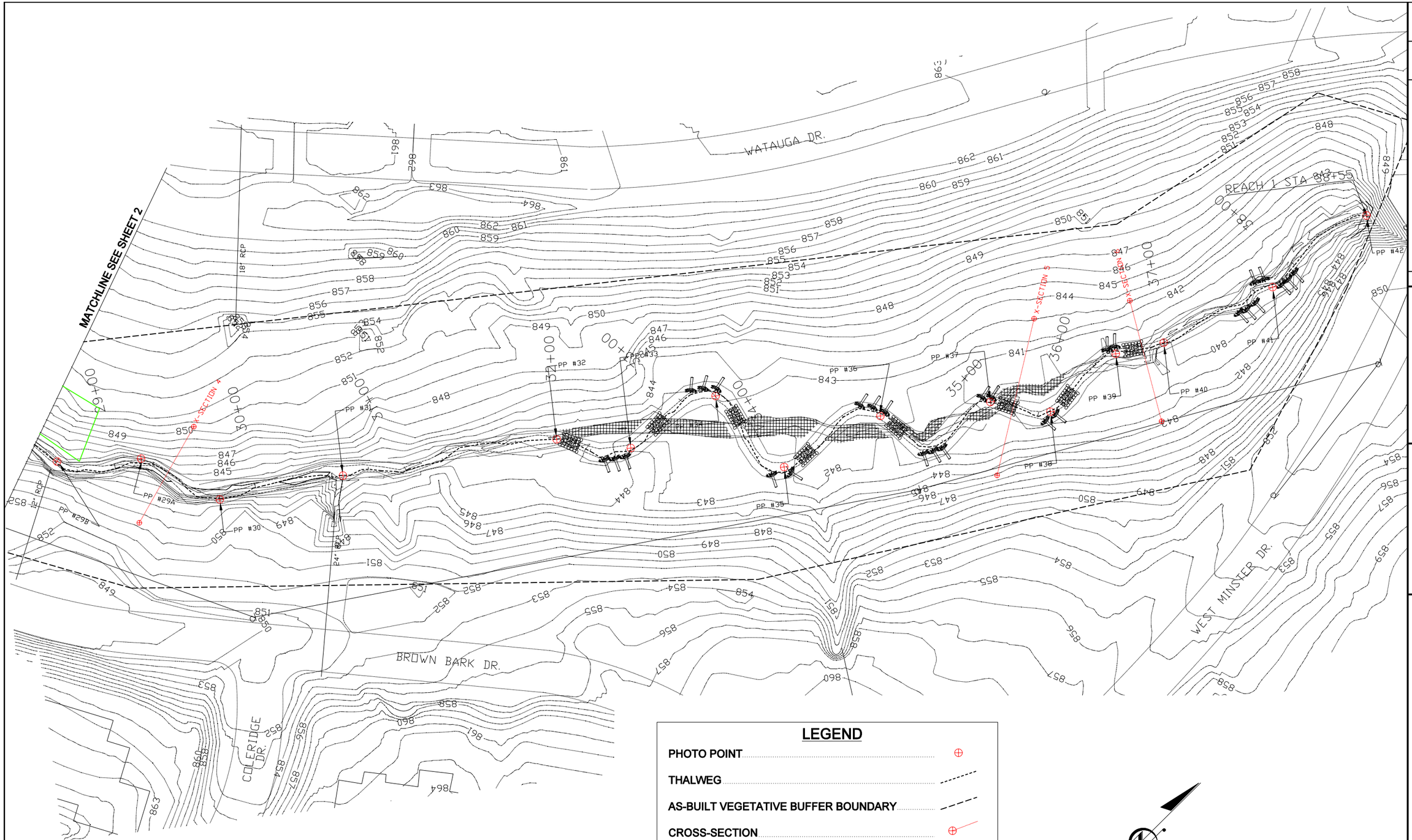
GUILFORD COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 52 - MY03

STATION 18+55 TO STATION 28+40

DATE: NOVEMBER 2007
SCALE: SEE SHEET

MONITORING PLAN VIEW



LEGEND

- PHOTO POINT
- THALWEG
- AS-BUILT VEGETATIVE BUFFER BOUNDARY
- CROSS-SECTION
- ROOT WAD
- ROCK CROSS VANE
- CONSTRUCTED RIFFLE

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BROWN BARK PARK

GUILFORD COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 52 - MY03

STATION 28+40 TO STATION 38+55

DATE: NOVEMBER 2007
SCALE: SEE SHEET

MONITORING PLAN VIEW

SHEET 3 OF 3

2.0 PROJECT CONDITIONS AND MONITORING RESULTS

2.1 Vegetation Assessment

See vegetation assessment in Appendix A and Current Conditions Plan View in Appendix C.

2.2 Stream Assessment

See stream assessment in Appendix A and Current Conditions Plan View in Appendix C.

2.2.1 Bankfull Event and Stability Assessment

2.2.1.a Verification of Bankfull Events Table

Table 5. Verification of Bankfull Events
Project Number and Name: 52 – Brown Bark Park

Date of Data Collection	Date of Occurrence	Method	Photo Number
9/18/2006	9/18/2006	On site	N/A
8/17/2007	unknown	Crest gauge	N/A
11/15/2007	unknown	Crest gauge	N/A

2.2.1.b BEHI and Sediment Export Table

Table 6. BEHI and Sediment Export Estimates
Project Number and Name: 52 – Brown Bark Park

To Be Conducted During Monitoring Year 05

2.2.2 Stability Assessment Table

Table 7. Categorical Stream Feature Visual Stability Assessment
Project Number and Name: 52 – Brown Bark Park

Feature	Initial	MY - 01	MY - 02	MY - 03	MY - 04	MY - 05
A. Riffles	100%	N/A	86%	83%		
B. Pools	100%	N/A	94%	93%		
C. Thalweg	100%	N/A	68%	82%		
D. Meanders	100%	N/A	60%	100%		
E. Bed General	100%	N/A	99%	100%		
F. Bank Condition	100%	N/A	93%	98%		
G. Vanes / J Hooks etc.	100%	N/A	100%	100%		
H. Wads and Boulders	100%	N/A	83%	83%		

2.2.3 Quantitative Measures Summary Tables

Table 8. Baseline Morphology and Hydraulic Summary
Project Number and Name: 52 – Brown Bark Park

Parameter	USGS Gage Data			Regional Curve Interval			Pre-Existing Condition			Project Reference Stream			Design			As-built		
Dimension	Min	Max	Mean	Min	Max	Med	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Median
Bankfull Width (ft)																13.5	19.4	16.7
Floodprone Width (ft)																23	59	49
Bankfull Cross-Sectional Area																12.2	23.2	14.2
Bankfull Mean Depth (ft)																0.8	1.2	0.9
Bankfull Maximum Depth (ft)																1.7	3.3	2.0
Width/Depth Ratio																15.0	23.4	16.1
Entrenchment Ratio																1.7	3.6	3.1
Bank Height Ratio																1.0	1.0	1.0
Wetted Perimeter (ft)																		
Hydraulic Radius (ft)																		
Pattern																		
Channel Beltwidth (ft)																		
Radius of Curvature (ft)																		
Meander Wavelength (ft)																		
Meander Width Ratio																		
Profile																		
Riffle Length (ft)																		
Riffle Slope (ft/ft)																		
Pool Length (ft)																		
Pool Spacing (ft)																		
Substrate																		
d50 (mm)																		
d84 (mm)																		
Additional Reach Parameters																		
Valley Length (ft)																		
Channel Length (ft)																		
Sinuosity																		
Water Surface Slope (ft/ft)																		
BF Slope (ft/ft)																		
Rosgen Classification																	B/C5c	

Table 9a. Morphology and Hydraulic Monitoring Summary
Project Number and Name: 52 – Brown Bark Park

Parameter	Cross-Section 1 Riffle						Cross-Section 2 Pool						Cross-Section 3 Riffle					
Dimension	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	14.9	10.9	5.7				15.9	15.3	17.3				19.2	19.0	9.8			
Floodprone Width (ft)	23	20	18				36	36	36				48	47	35			
Bankfull Cross Sectional Area (ft^2)	13.0	9.6	5.3				14.9	11.0	12.1				24.9	23.6	13.3			
Bankfull Mean Depth (ft)	0.9	0.9	0.9				0.9	0.7	0.7				1.3	1.2	1.4			
Bankfull Maximum Depth (ft)	2.0	1.8	1.3				2.8	1.7	1.9				3.8	3.3	2.7			
Width/Depth Ratio	17.2	12.4	6.2				17.0	21.3	24.7				14.9	15.3	7.2			
Entrenchment Ratio	1.6	1.9	3.2				3.3	2.4	2.1				2.6	2.5	3.5			
Bank Height Ratio	1.0	1.0	1.0				1.0	1.0	1.0				1.0	1.0	1.0			
Wetted Perimeter (ft)		11.9	6.8					16.0	18.2					20.7	12.0			
Hydraulic Radius (ft)		0.8	0.8					0.7	0.7					0.7	1.1			
Substrate																		
d50 (mm)		19.1	14.0					8.4	6.9					15.3	25.0			
d84 (mm)		56	53					18	17					101	110			

Table 9b. Morphology and Hydraulic Monitoring Summary
Project Number and Name: 52 – Brown Bark Park

Parameter	Cross-Section 4 Pool						Cross-Section 5 Riffle						Cross-Section 6 Riffle					
Dimension	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	13.5	12.2	5.9				15.7	9.8	10.0				19.7	11.7	8.7			
Floodprone Width (ft)	30	27	24				50	35	39				59	53	45			
Bankfull Cross Sectional Area (ft^2)	13.2	11.1	6.3				12.5	8.0	8.6				13.9	11.5	9.0			
Bankfull Mean Depth (ft)	1.0	0.9	1.1				0.8	0.8	0.9				0.7	1.0	1.0			
Bankfull Maximum Depth (ft)	2.4	2.3	1.8				1.6	1.3	1.4				1.8	1.8	1.6			
Width/Depth Ratio	13.8	13.4	5.6				19.6	12.0	11.5				28.7	11.9	8.4			
Entrenchment Ratio	2.1	2.2	4.0				3.3	3.7	3.9				2.6	4.6	5.1			
Bank Height Ratio	1.0	1.0	1.0				1.0	1.0	1.0				1.0	1.0	1.0			
Wetted Perimeter (ft)		13.7	7.4					10.3	10.8					12.5	9.6			
Hydraulic Radius (ft)		0.8	0.8					0.8	0.8					0.9	0.9			
Substrate																		
d50 (mm)		6.8	8.3					15.2	12.0					21.1	32.0			
d84 (mm)		31	42					70	140					83	150			

Table 9c. Morphology and Hydraulic Monitoring Summary continued Project Number and Name: 52 – Brown Bark Park															
Parameter	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
Channel Beltwidth (ft)				22	71	37	32	58	43						
Radius of Curvature (ft)				17	33	19	17	33	19						
Meander Wavelength (ft)				79	105	91	81	111	92						
Meander Width Ratio				1.7	5.5	2.9	2.4	4.4	3.2						
Profile															
Riffle Length (ft)				3	60	13	3	67	14						
Riffle Slope (ft/ft)				0.003	0.160	0.027	0.000	0.200	0.020						
Pool Length (ft)				4	64	14	3	44	8						
Pool Spacing (ft)				13	174	45	14	173	44						
Additional Reach Parameters															
Valley Length (ft)				2,623			2,623								
Channel Length (ft)				2,855			2,855								
Sinuosity				1.1			1.1								
Water Surface Slope (ft/ft)				0.009			0.0098								
Rosgen Classification	B/C5c			B/C4c			B/C4c								

The bankfull elevations for cross sections 1 and 3 were changed in Monitoring Year 03 from the elevations used to calculate bankfull dimensions in the previous monitoring years. This change is evident is Tables 9a and 9b, which shows large changes in bankfull dimensions for these two cross-sections. This is not a product of the stream dimensions changing or the formation of a bankfull indicating feature. The elevations were changed because those used previously were over the top of the bank, which is the intended bankfull elevation. Without other bankfull indicators, this elevation is the most accurate and best corresponds to the definition of bankfull. Future monitoring will continue to use these top of bank elevations unless other bankfull features develop over the course of monitoring.

Appendix A
Vegetation Data

Appendix A1: Vegetation Data Tables

Table A1. Stem Counts for Each Species Arranged by Plot
Project Number and Name: 52 – Brown Bark Park

Species	Buffer Plot 1	Buffer Plot 2	Live Stake Plot	Initial Totals	Year 1 Totals	Year 2 Totals	Year 3 Totals	Survival %*
Shrubs								
Cornus amomum			26			26	26	N/A
Sambucus canadensis			10			7	10	N/A
Trees								
Quercus phellos		1				1	1	N/A
Fraxinus pennsylvanica		4				4	4	N/A
Nyssa sylvatica	5	9				14	14	N/A
Betula nigra	1	3				5	4	N/A
Cornus florida	1					1	1	N/A
Hamamelis virginiana	11					11	11	N/A
Salix nigra			6			6	6	N/A
Salix sericea			22			25	22	N/A
Total	**18**	**17**	**64**	**179**	**127**	**100**	**99**	**55%**

*The survival percentage for each species is unknown because the as-built and first year monitoring results were not provided

Table A2. Stem Density By Plot
Project Number and Name: 52 – Brown Bark Park
Date : 8/10/07
Crew : B. Roberts

Plot #	Witch Hazel *Hamamelis virginiana*	Green Ash *Fraxinus pennsylvanica*	Black Gum *Nyssa sylvatica*	River Birch *Betula nigra*	Silky Dogwood *Cornus amomum*	Elderberry *Sambucus canadensis*	Flowering Dogwood *Cornus florida*	Willow Oak *Quercus phellos*	Silky Willow *Salix sericea*	Black Willow *Salix nigra*	Total (Year 2)	Density (Trees/Acre)
1	11		5	1			1				18	314
2		4	9	3				1			17	296
LS					26	10			22	6	64	3,186

Invasives Species Within the Site and Implications

There are some invasive species in the riparian buffer. These species include mimosa (*Albizia julibrissin*), white mulberry (*Morus alba*), Japanese honeysuckle (*Lonicera japonica*), Bradford pear (*Pyrus calleryana)*, multiflora rose (*Rosa multiflora*), and porcelainberry (*Ampelopsis brevipedunculata*). Most of the invasive species are scattered throughout the buffer and do not densely populate any one area more than others. Given the suburban park environment, there are many sources of invasive vegetation in close proximity to the project. Currently the invasive species do not warrant control efforts, but they should continue to be monitored.

Appendix A2 – Representative Vegetation Problem Area Photos

VP1 – Japanese honeysuckle (*Lonicera japonica*) and porcelainberry (*Ampelopsis brevipedunculata)*. Photo taken near Station 10+00. 11/19/07 - MY 03

VP2 – Banks with unvegetated coir matting. Photo taken near Station 10+75. 11/19/07 - MY 03

VP3 – The riparian buffer has been mowed along with the sewer line easement. Photo taken near Station 23+60. 11/19/07 - MY 03

VP4 – Bare floodplain/bank with exposed subsoil. Photo taken near Station 27+10. 11/19/06 - MY 03

Appendix A3 - Vegetation Monitoring Plot Photos

Plot 1 Photo – Taken from Photo Point #3, Buffer Plot #1 and the Live Stake Plot are on the left side of the stream. 11/27/07 - MY 03.

Plot 2 Photo – Taken from Photo Point #28, Buffer Plot #2 is on the left side of the stream. 11/27/07 - MY 03.

Appendix B
Geomorphologic Data

Appendix B1 – Representative Stream Problem Area Photos

SP1 –Scour behind rootwads under the streambank. Photo taken near Station 18+00. 11/19/07 - MY 03

SP2 – Base flow going around a header stone in cross vane. Photo taken near Station 19+20. 11/19/07 - MY 03

SP3 – Bank erosion. Photo taken near Station 31+50. 11/19/07 - MY 03

Appendix B2 –Stream Photo Station Photos

PP#1 – MY03 – 11/27/07

PP#2 – MY03 – 11/27/07

PP#3 – MY03 – 11/27/07

PP#4 – MY03 – 11/27/07

PP#5 – MY03 – 11/27/07

PP#6 – MY03 – 11/27/07

PP#7 – MY03 – 11/27/07

PP#8 – MY03 – 11/27/07

PP#9 – MY03 – 11/27/07

PP#10 – MY03 – 11/27/07

PP#11 – MY03 – 11/27/07

PP#12 – MY03 – 11/27/07

PP#13 – MY03 – 11/27/07

PP#14 – MY03 – 11/27/07

PP#15 – MY03 – 11/27/07

PP#16 – MY03 – 11/27/07

PP#17 – MY03 – 11/27/07

PP#18 – MY03 – 11/27/07

PP#19A – MY03 – 11/27/07

PP#19B – MY03 – 11/27/07

PP#20A – MY03 – 11/27/07

PP#20B – MY03 – 11/27/07

PP#21A – MY03 – 11/27/07

PP#21B – MY03 – 11/27/07

PP#22 – MY03 – 11/27/07

PP#23 – MY03 – 11/27/07

PP#24 – MY03 – 11/27/07

PP#25 – MY03 – 11/27/07

PP#26 – MY03 – 11/27/07

PP#27 – MY03 – 11/27/07

PP#28 – MY03 – 11/27/07

PP#29A – MY03 – 11/27/07

PP#29B – MY03 – 11/27/07

PP#30 – MY03 – 11/27/07

PP#31 – MY03 – 11/27/07

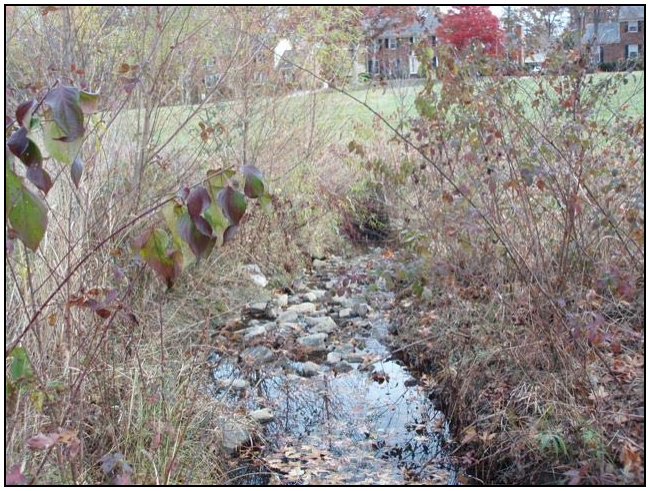
PP#32 – MY03 – 11/27/07

PP#33 – MY03 – 11/27/07

PP#34 – MY03 – 11/27/07

PP#35 – MY03 – 11/27/07

PP#36 – MY03 – 11/27/07



PP#37 – MY03 – 11/27/07

PP#38 – MY03 – 11/27/07

PP#39 – MY03 – 11/27/07

PP#40 – MY03 – 11/27/07

PP#41 – MY03 – 11/27/07

PP#42 – MY03 – 11/27/07

Appendix B3 – Qualitative Visual Stability Assessment

Table B2. Qualitative Visual Stability Assessment
Project Number and Name: 52 – Brown Bark Park

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?	45	52	N/A	87%	
	2. Armor stable (e.g. no displacement)?	43	52	N/A	83%	
	3. Facet grade appears stable?	45	52	N/A	87%	
	4. Minimal evidence of embedding/fining?	43	52	N/A	83%	
	5. Length appropriate?	38	52	N/A	73%	**83%**
B. Pools	1. Present? (e.g. no severe aggradation)	48	50	N/A	96%	
	2. Sufficiently deep (Dmax pool:Mean Bkf > 1.6?)	48	50	N/A	96%	
	3. Length appropriate?	43	50	N/A	86%	**93%**
C. Thalweg	1. Upstream of meander bend centering?	13	14	N/A	93%	
	2. Downstream of meander centering?	10	14	N/A	71%	**82%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	14	14	N/A	100%	
	2. Of those eroding, # w/ concomitant point bar formation?	0	0	N/A	-	
	3. Apparent Rc within spec?**			N/A		
	4. Sufficient floodplain access and relief?	14	14	N/A	100%	**100%**
E. Bed General	1.General channel bed aggradation areas (bar formation)	N/A	N/A	0/0		
	2. Channel bed degradation - areas of increasing down cutting or head cutting?	N/A	N/A	0/0		**100%**
F. Bank	1. Actively eroding, wasting, or slumping bank	N/A	N/A	4/60	98%	**98%**
G. Vanes	1. Free of back or arm scour?	6	6	N/A	100%	
	2. Height appropriate?	6	6	N/A	100%	
	3. Angle and geometry appear appropriate?	6	6	N/A	100%	
	4. Free of piping or other structural failures?	6	6	N/A	100%	**100%**
H. Wads / Boulders	1. Free of scour?	15	18	N/A	83%	
	2. Footing stable?	15	18	N/A	83%	**83%**

*Total number of features per as-built estimated from as-built profile and planview sheets.

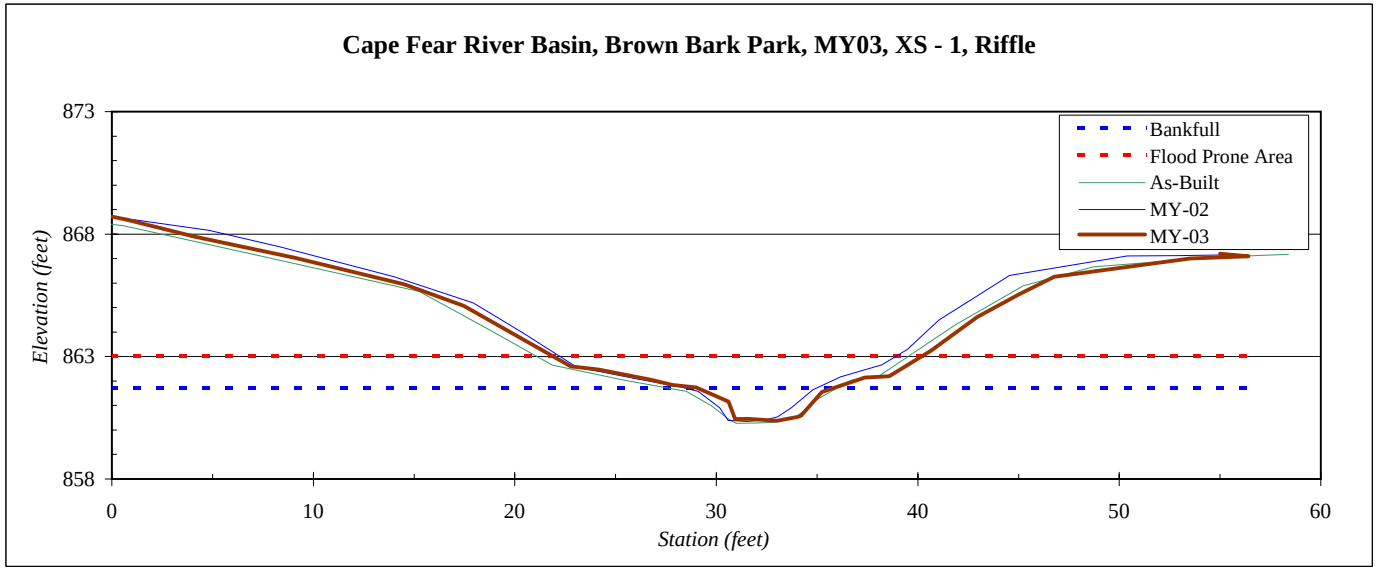
**Rc of design unknown

B4 - Cross Section Plots

River Basin:	Cape Fear
Watershed:	Brown Bark Park, MY03
XS ID	XS - 1, Riffle
Drainage Area (sq mi):	0.3
Date:	7/31/2007
Field Crew:	B. Roberts, Z. Mryncza

Station	Elevation
0.0	868.71
0.7	868.59
4.1	867.89
9.1	867.03
14.5	865.94
17.5	865.07
22.8	862.61
24.2	862.47
26.8	862.05
27.8	861.84
29.0	861.74
30.6	861.16
30.9	860.44
31.5	860.46
33.0	860.37
34.0	860.53
34.2	860.58
35.2	861.56
37.4	862.15
38.6	862.19
40.7	863.25
42.9	864.62
45.0	865.52
46.8	866.26
53.5	867.01
56.4	867.09
55.0	867.19

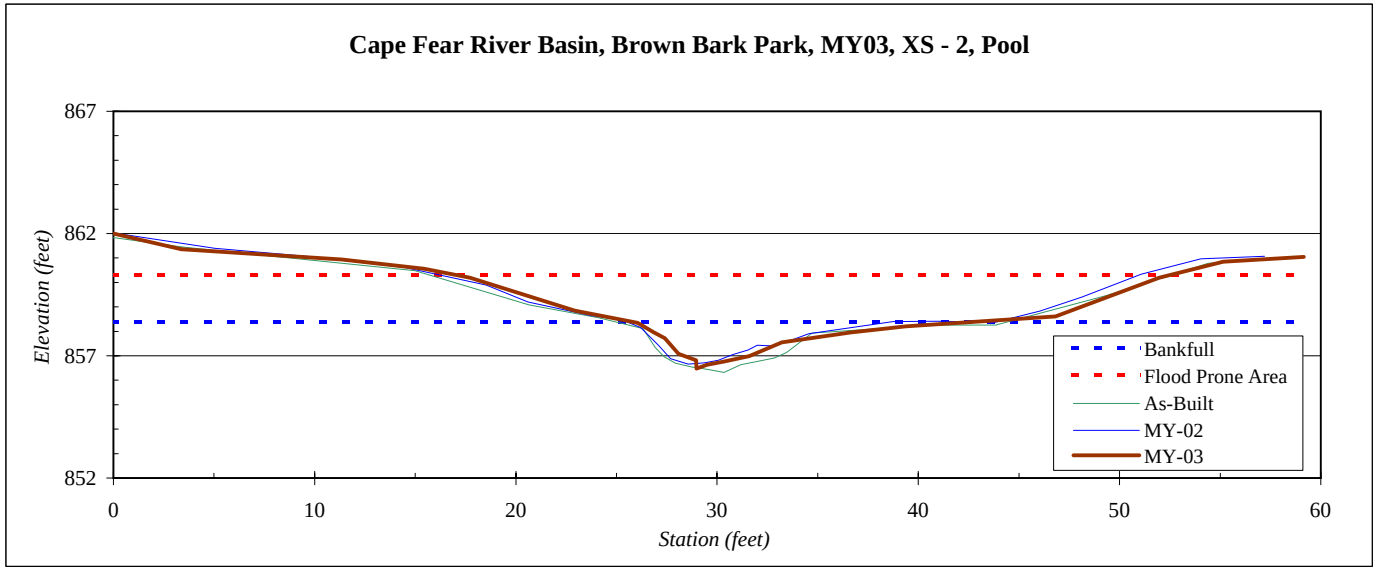
SUMMARY DATA	
Bankfull Elevation:	861.7
Bankfull Cross-Sectional Area:	5.3
Bankfull Width:	5.7
Flood Prone Area Elevation:	863.0
Flood Prone Width:	18.4
Max Depth at Bankfull:	1.3
Mean Depth at Bankfull:	0.9
W / D Ratio:	6.2
Entrenchment Ratio:	3.2
Bank Height Ratio:	1.0



River Basin:	Cape Fear
Watershed:	Brown Bark Park, MY03
XS ID	XS - 2, Pool
Drainage Area (sq mi):	0.3
Date:	7/31/2007
Field Crew:	B. Roberts, Z. Mryncza

Station	Elevation
0.00	862.00
3.38	861.35
11.34	860.94
15.45	860.56
17.72	860.19
22.93	858.84
26.06	858.35
26.87	857.95
27.41	857.72
28.09	857.08
28.96	856.81
28.98	856.47
29.50	856.63
30.34	856.76
31.60	856.99
33.23	857.55
36.64	857.96
39.37	858.20
46.82	858.61
51.97	860.19
55.15	860.85
59.16	861.04

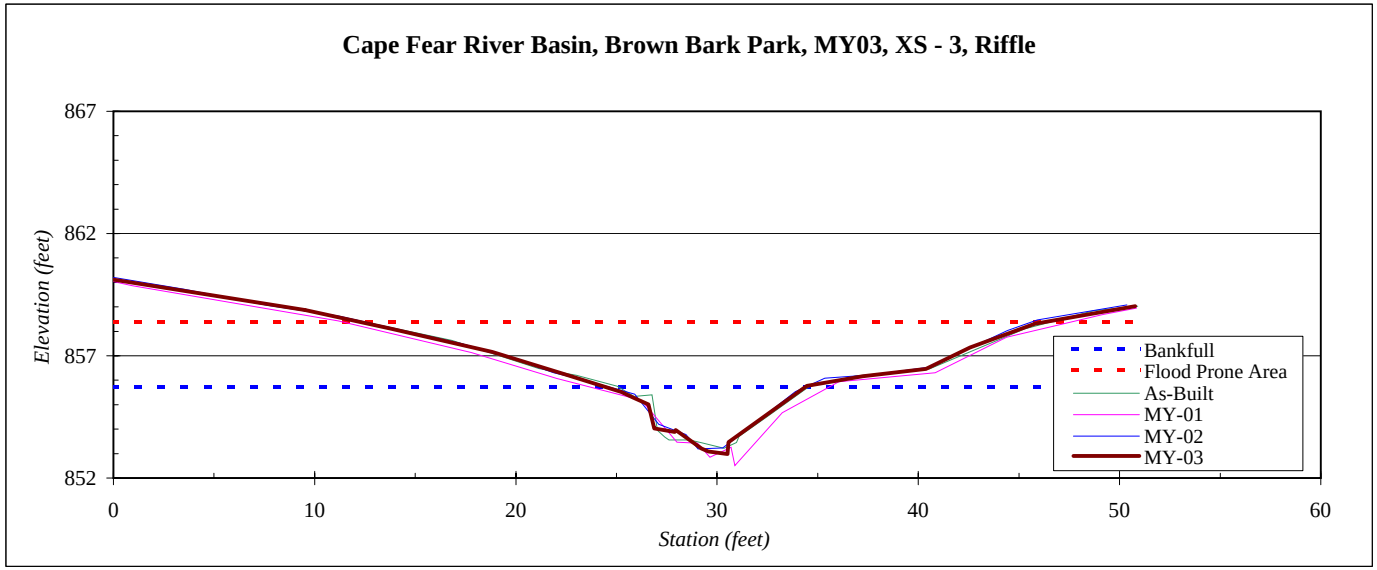
SUMMARY DATA	
Bankfull Elevation:	858.4
Bankfull Cross-Sectional Area:	12.1
Bankfull Width:	17.3
Flood Prone Area Elevation:	860.3
Flood Prone Width:	35.8
Max Depth at Bankfull:	1.9
Mean Depth at Bankfull:	0.7
W / D Ratio:	24.7
Entrenchment Ratio:	2.1
Bank Height Ratio:	1.0



River Basin:	Cape Fear
Watershed:	Brown Bark Park, MY03
XS ID	XS - 3, Riffle
Drainage Area (sq mi):	0.3
Date:	8/1/2007
Field Crew:	B. Roberts, Z. Mryncza

Station	Elevation
0.0	860.11
9.5	858.87
13.8	858.12
18.8	857.16
22.4	856.25
25.2	855.52
25.8	855.29
26.6	855.01
26.9	854.03
27.9	853.88
27.9	853.96
29.2	853.20
29.6	853.09
30.5	852.98
30.6	853.47
34.5	855.77
37.2	856.17
40.4	856.46
42.6	857.34
45.8	858.30
50.8	859.03

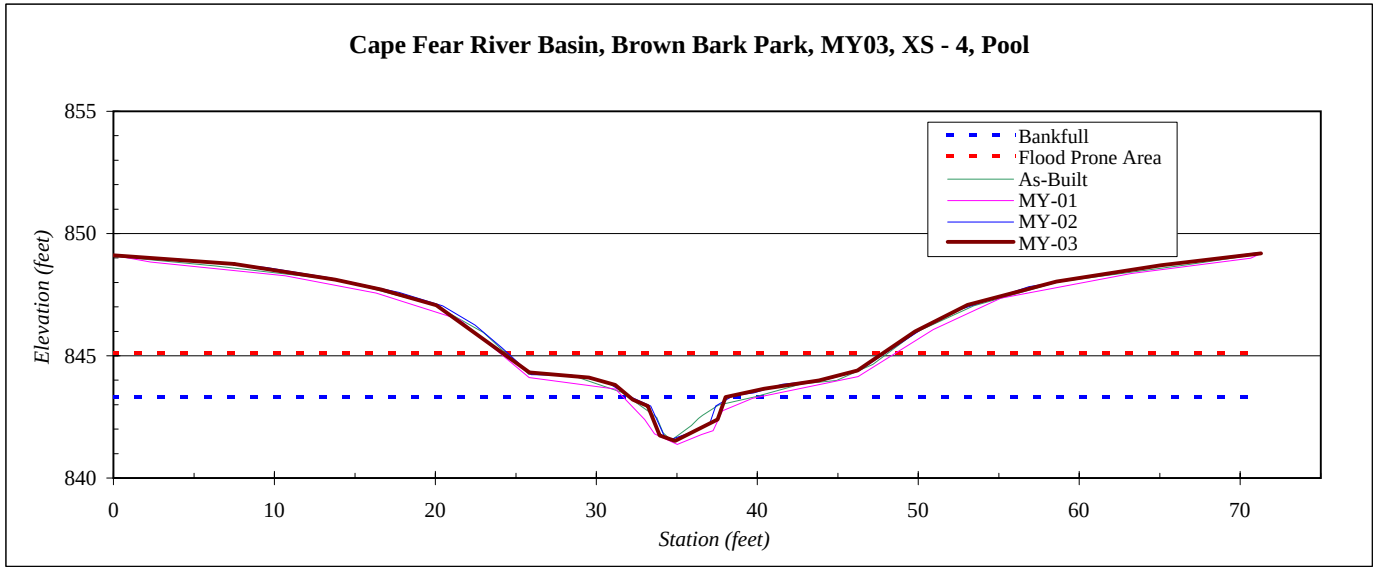
SUMMARY DATA	
Bankfull Elevation:	855.7
Bankfull Cross-Sectional Area:	13.3
Bankfull Width:	9.8
Flood Prone Area Elevation:	858.4
Flood Prone Width:	34.5
Max Depth at Bankfull:	2.7
Mean Depth at Bankfull:	1.4
W / D Ratio:	7.2
Entrenchment Ratio:	3.5
Bank Height Ratio:	1.0



River Basin:	Cape Fear
Watershed:	Brown Bark Park, MY03
XS ID	XS - 4, Pool
Drainage Area (sq mi):	0.3
Date:	8/1/2007
Field Crew:	B. Roberts, Z. Mryncza

Station	Elevation
0.0	849.10
7.5	848.76
13.8	848.12
16.6	847.70
20.1	847.07
25.8	844.32
29.5	844.12
31.2	843.81
32.3	843.21
33.2	842.95
33.9	841.74
34.9	841.52
37.5	842.39
38.0	843.31
40.4	843.65
43.8	843.99
46.2	844.40
49.8	846.00
53.0	847.09
58.6	848.04
65.1	848.70
71.3	849.18

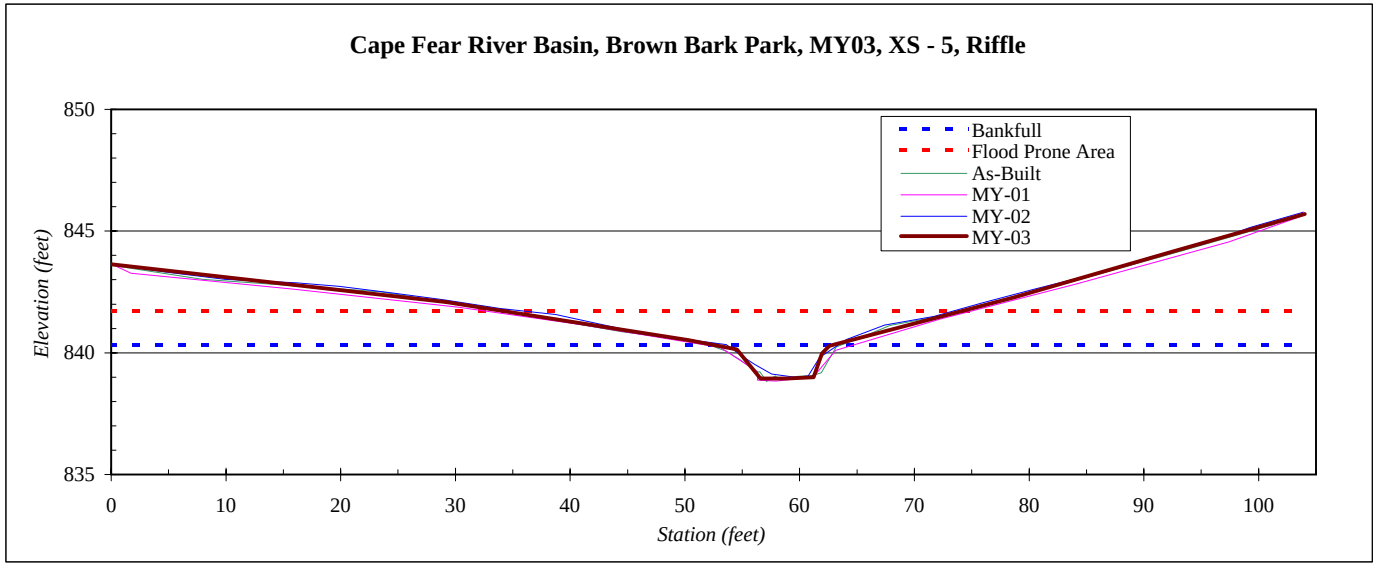
SUMMARY DATA	
Bankfull Elevation:	843.3
Bankfull Cross-Sectional Area:	6.3
Bankfull Width:	5.9
Flood Prone Area Elevation:	845.1
Flood Prone Width:	23.5
Max Depth at Bankfull:	1.8
Mean Depth at Bankfull:	1.1
W / D Ratio:	5.6
Entrenchment Ratio:	4.0
Bank Height Ratio:	1.0



River Basin:	Cape Fear
Watershed:	Brown Bark Park, MY03
XS ID	XS - 5, Riffle
Drainage Area (sq mi):	0.3
Date:	8/2/2007
Field Crew:	B. Roberts, Z. Mryncza

Station	Elevation
0	843.640238
29.1686895	842.080443
50.2999912	840.524337
54.5185345	840.14316
56.5977761	838.948465
58.9167321	838.948778
61.2140352	839.001964
61.939102	839.963453
62.5889978	840.28202
78.7299129	842.286199
92.7299657	844.185775
104.029771	845.700727

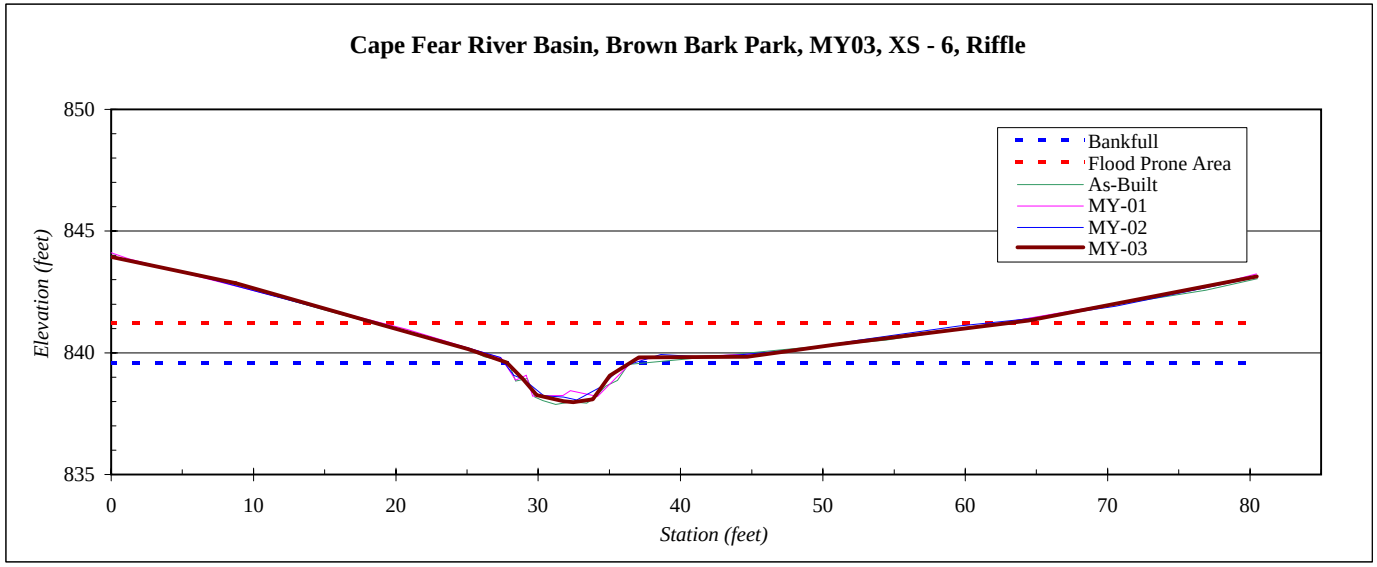
SUMMARY DATA	
Bankfull Elevation:	840.3
Bankfull Cross-Sectional Area:	8.6
Bankfull Width:	10.0
Flood Prone Area Elevation:	841.7
Flood Prone Width:	38.6
Max Depth at Bankfull:	1.4
Mean Depth at Bankfull:	0.9
W / D Ratio:	11.5
Entrenchment Ratio:	3.9
Bank Height Ratio:	1.0



River Basin:	Cape Fear
Watershed:	Brown Bark Park, MY03
XS ID	XS - 6, Riffle
Drainage Area (sq mi):	0.3
Date:	8/2/2007
Field Crew:	B. Roberts, Z. Mryncza

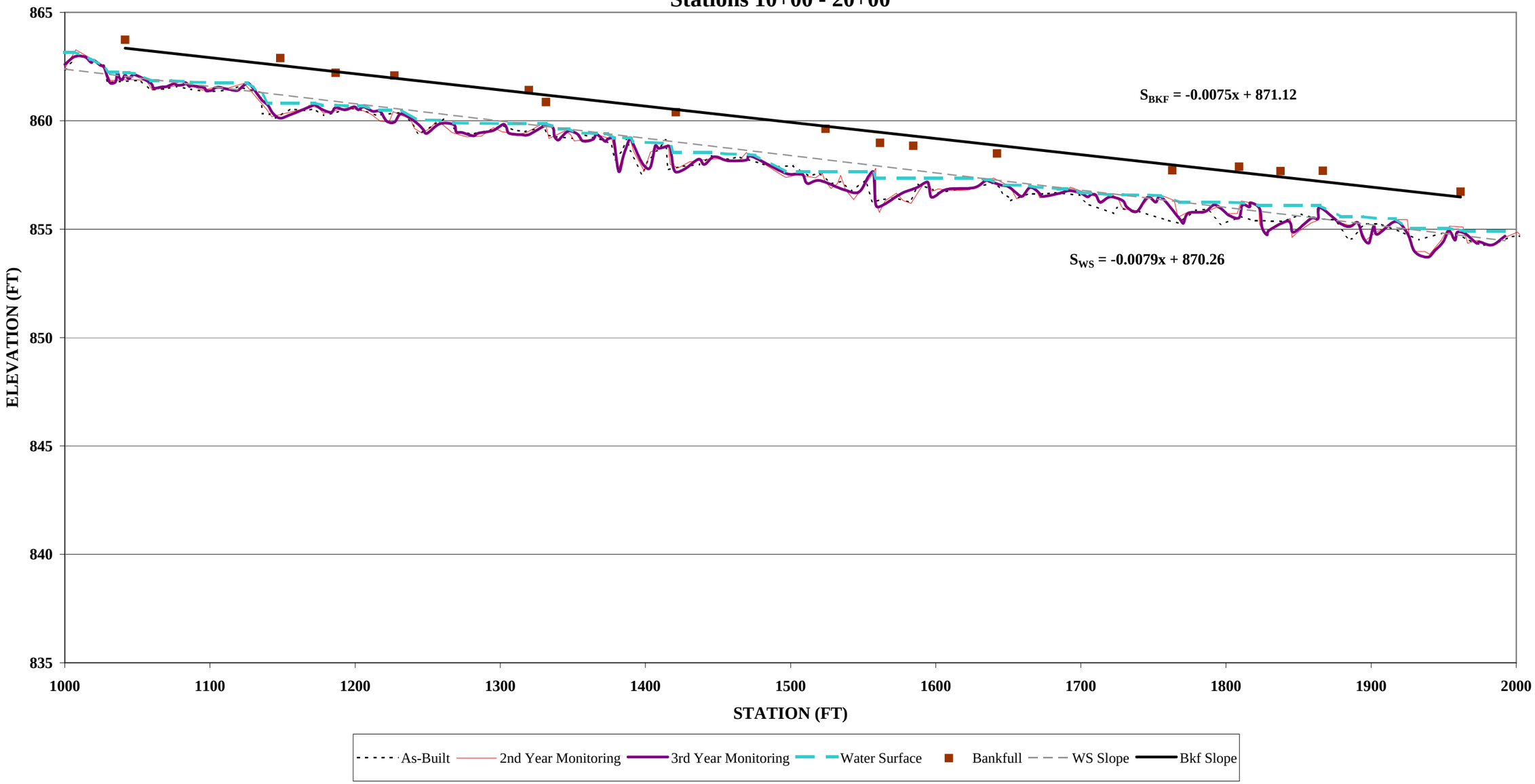
Station	Elevation
0.0	843.94
8.7	842.86
19.1	841.14
25.1	840.16
27.8	839.61
28.9	838.91
29.9	838.26
31.8	838.00
32.5	837.97
33.8	838.09
35.0	839.07
37.1	839.81
44.7	839.83
50.9	840.34
64.4	841.32
80.5	843.14

SUMMARY DATA	
Bankfull Elevation:	839.6
Bankfull Cross-Sectional Area:	9.0
Bankfull Width:	8.7
Flood Prone Area Elevation:	841.2
Flood Prone Width:	44.6
Max Depth at Bankfull:	1.6
Mean Depth at Bankfull:	1.0
W / D Ratio:	8.4
Entrenchment Ratio:	5.1
Bank Height Ratio:	1.0

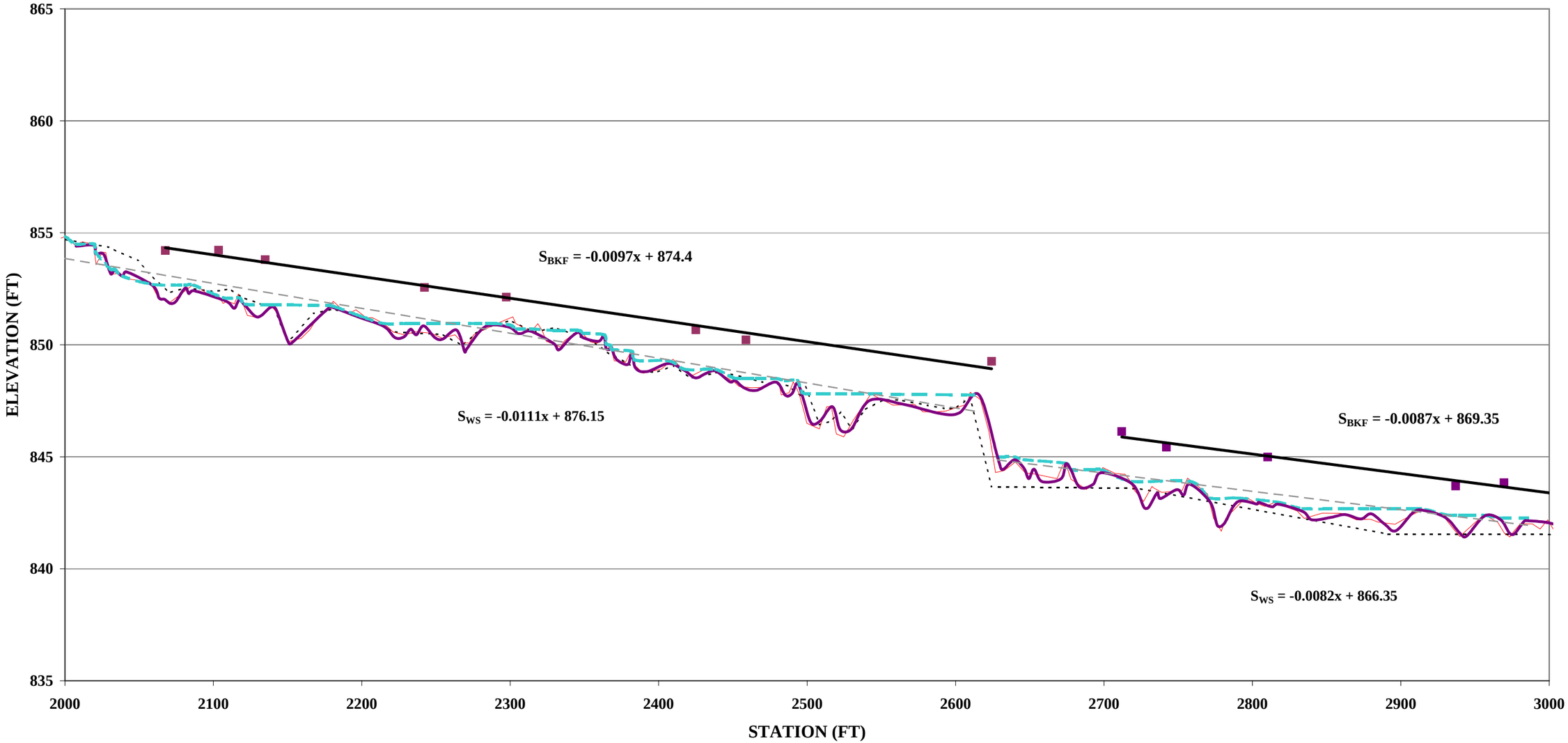


B5 -Longitudinal Plots

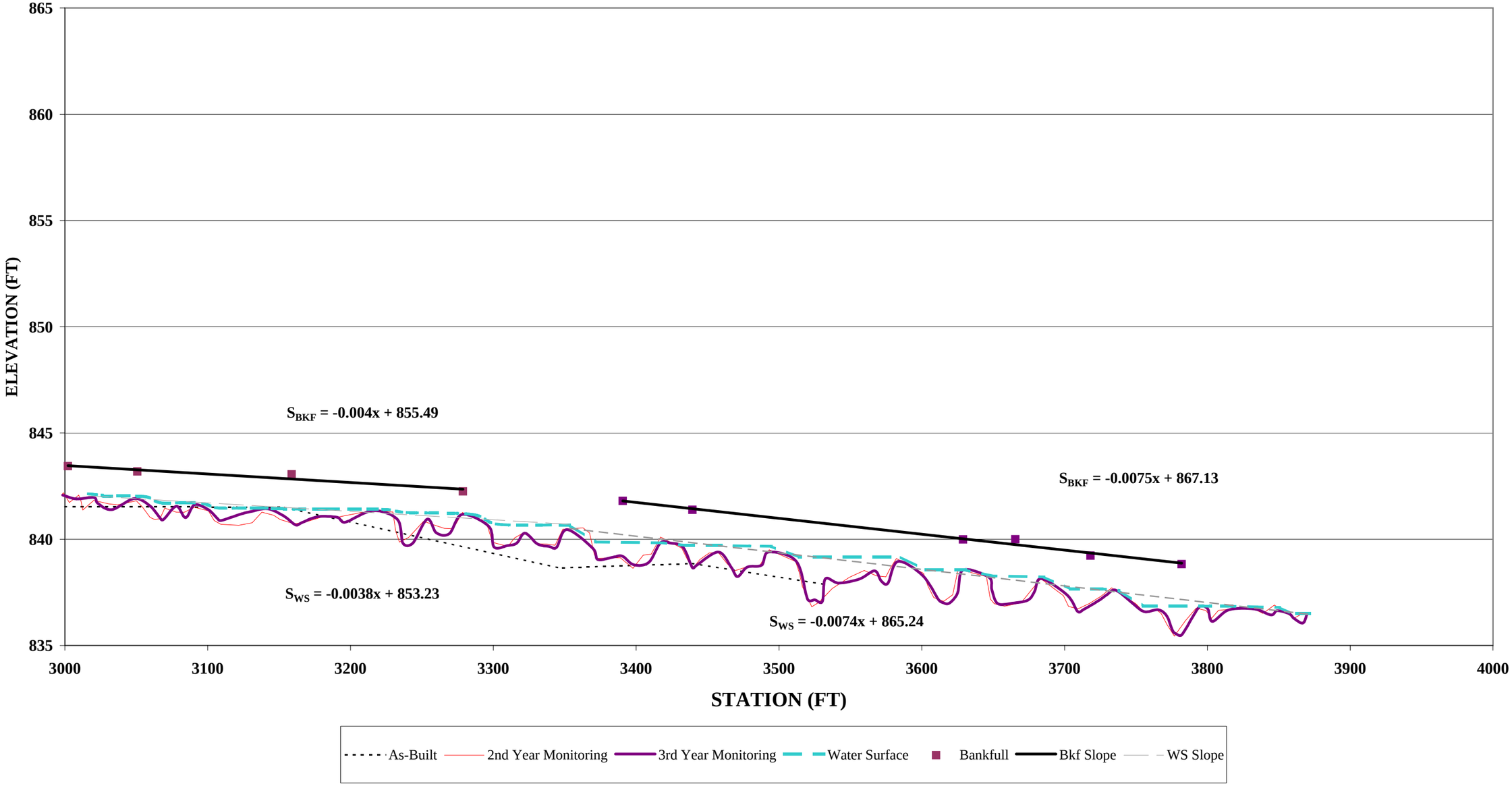
Longitudinal Profile
Brown Bark Park
EEP Project Number 52 - MY03
Stations 10+00 - 20+00



Longitudinal Profile
Brown Bark Park
EEP Project Number 52 - MY03
Stations 20+00 - 30+00



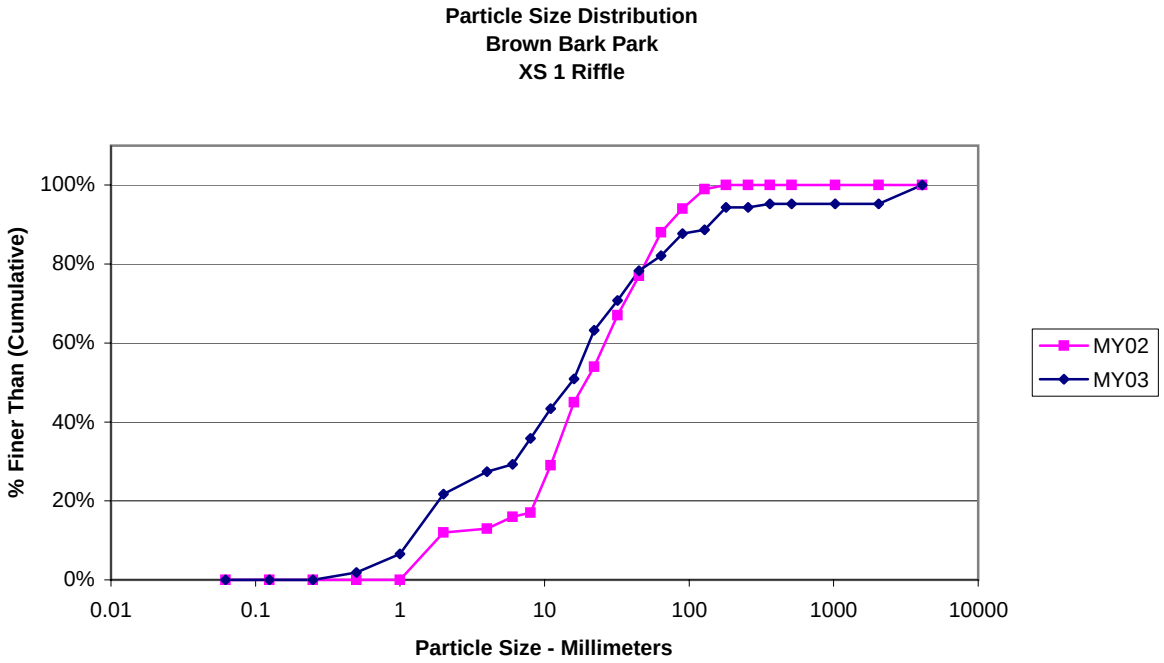
Longitudinal Profile
Brown Bark Park
EEP Project Number 52 - MY03
Stations 30+00 - 40+00



B6 - Pebble Count Plots

Cross Section 1 Riffle - MY03			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	2
Coarse	.50 - 1	D	5
Very Coarse	1 - 2	S	16
Very Fine	2 - 4		6
Fine	4 - 5.7	G	2
Fine	5.7 - 8	R	7
Medium	8 - 11.3	A	8
Medium	11.3 - 16	V	8
Coarse	16 - 22.6	E	13
Coarse	22.6 - 32	L	8
Very Coarse	32 - 45	S	8
Very Coarse	45 - 64		4
Small	64 - 90	C	6
Small	90 - 128	O	1
Large	128 - 180	B	6
Large	180 - 256	L	
Small	256 - 362	B	1
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	5
		Total	106

Note:



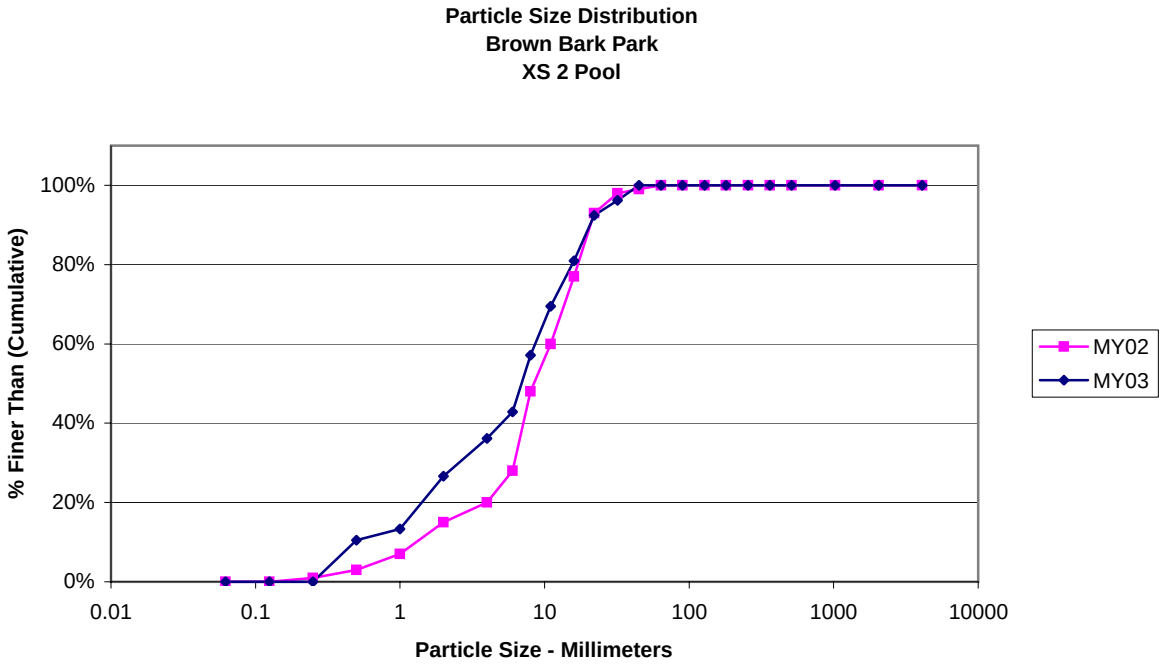
Size (mm)	
D16	1.5
D35	7.2
D50	14
D65	21
D84	53
D95	140

Size Distribution	
mean	8.9
dispersion	6.6
skewness	-0.16

Type	
silt/clay	0%
sand	22%
gravel	60%
cobble	12%
boulder	1%
bedrock	5%
hardpan	0%
wood/det	0%
artificial	0%

Cross Section 2 Pool - MY03			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	11
Coarse	.50 - 1	D	3
Very Coarse	1 - 2	S	14
Very Fine	2 - 4		10
Fine	4 - 5.7	G	7
Fine	5.7 - 8	R	15
Medium	8 - 11.3	A	13
Medium	11.3 - 16	V	12
Coarse	16 - 22.6	E	12
Coarse	22.6 - 32	L	4
Very Coarse	32 - 45	S	4
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	105

Note:



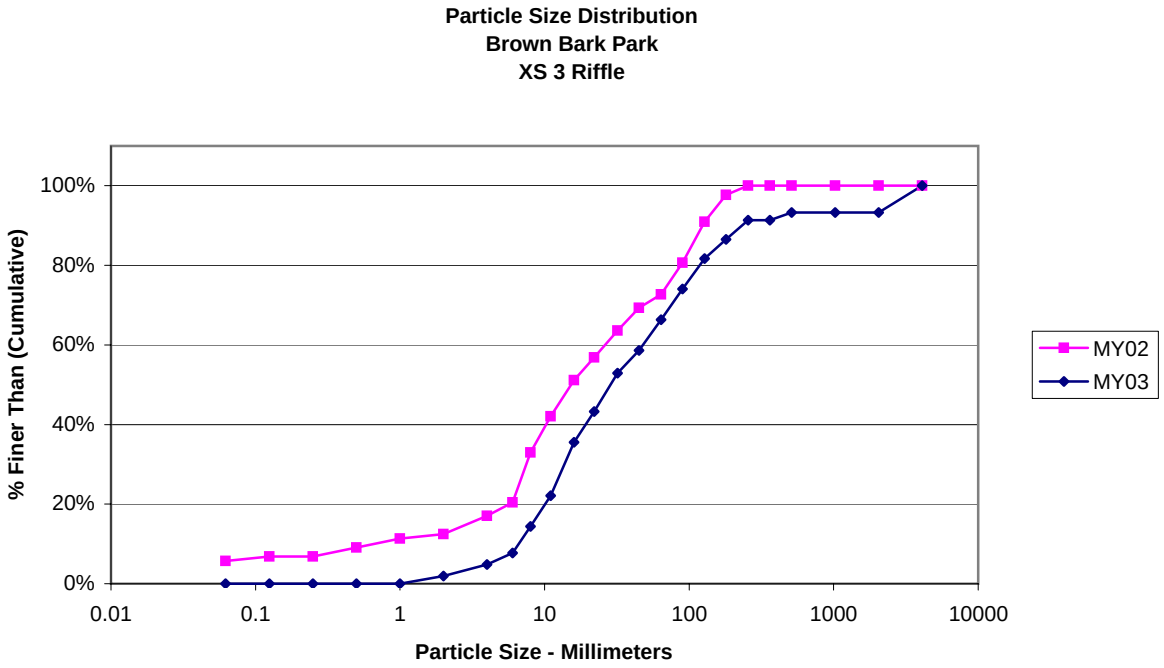
Size (mm)	
D16	1.1
D35	3.7
D50	6.9
D65	9.8
D84	17
D95	28

Size Distribution	
mean	4.3
dispersion	4.4
skewness	-0.19

Type	
silt/clay	0%
sand	27%
gravel	73%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross Section 3 Riffle - MY03			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	2
Very Fine	2 - 4		3
Fine	4 - 5.7	G	3
Fine	5.7 - 8	R	7
Medium	8 - 11.3	A	8
Medium	11.3 - 16	V	14
Coarse	16 - 22.6	E	8
Coarse	22.6 - 32	L	10
Very Coarse	32 - 45	S	6
Very Coarse	45 - 64		8
Small	64 - 90	C	8
Small	90 - 128	O	8
Large	128 - 180	B	5
Large	180 - 256	L	5
Small	256 - 362	B	
Small	362 - 512	L	2
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	7
		Total	104

Note:



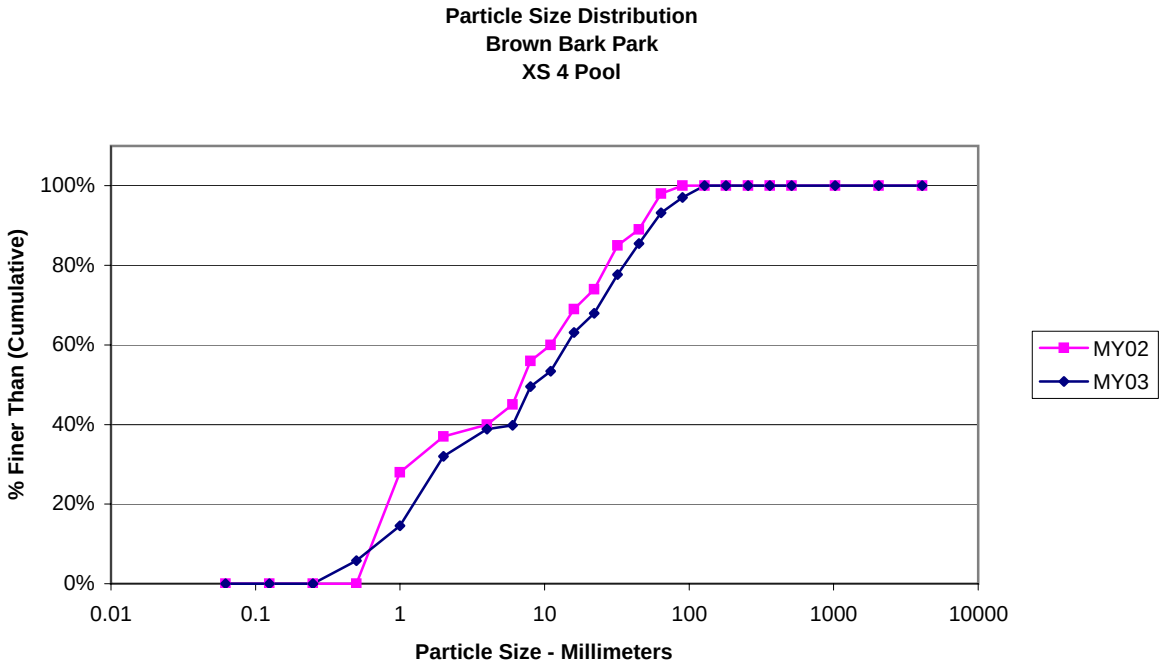
Size (mm)	
D16	8.2
D35	15
D50	25
D65	49
D84	110
D95	210

Size Distribution	
mean	30.0
dispersion	3.7
skewness	0.08

Type	
silt/clay	0%
sand	2%
gravel	64%
cobble	25%
boulder	2%
bedrock	7%
hardpan	0%
wood/det	0%
artificial	0%

Cross Section 4 Pool - MY03			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	6
Coarse	.50 - 1	D	9
Very Coarse	1 - 2	S	18
Very Fine	2 - 4		7
Fine	4 - 5.7	G	1
Fine	5.7 - 8	R	10
Medium	8 - 11.3	A	4
Medium	11.3 - 16	V	10
Coarse	16 - 22.6	E	5
Coarse	22.6 - 32	L	10
Very Coarse	32 - 45	S	8
Very Coarse	45 - 64		8
Small	64 - 90	C	4
Small	90 - 128	O	3
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	103

Note:



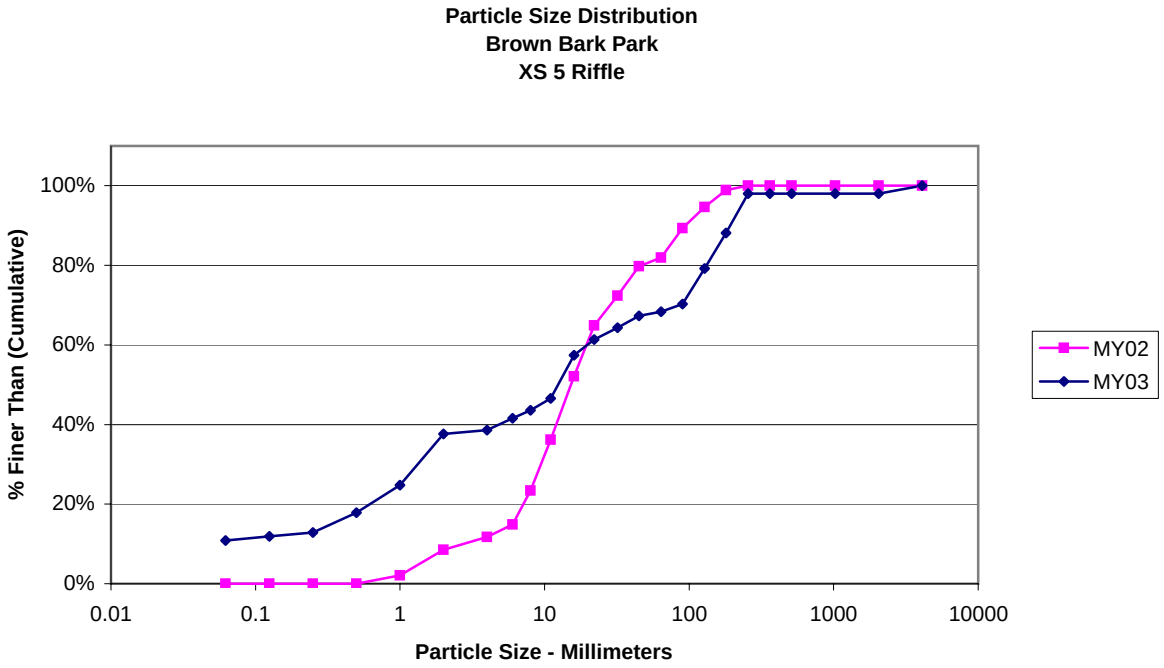
Size (mm)	
D16	1.1
D35	2.7
D50	8.3
D65	18
D84	42
D95	75

Size Distribution	
mean	6.8
dispersion	6.3
skewness	-0.07

Type	
silt/clay	0%
sand	32%
gravel	61%
cobble	7%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross Section 5 Riffle - MY03			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	11
Very Fine	.062 - .125	S	1
Fine	.125 - .25	A	1
Medium	.25 - .50	N	5
Coarse	.50 - 1	D	7
Very Coarse	1 - 2	S	13
Very Fine	2 - 4		1
Fine	4 - 5.7	G	3
Fine	5.7 - 8	R	2
Medium	8 - 11.3	A	3
Medium	11.3 - 16	V	11
Coarse	16 - 22.6	E	4
Coarse	22.6 - 32	L	3
Very Coarse	32 - 45	S	3
Very Coarse	45 - 64		1
Small	64 - 90	C	2
Small	90 - 128	O	9
Large	128 - 180	B	9
Large	180 - 256	L	10
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	2
		Total	101

Note:



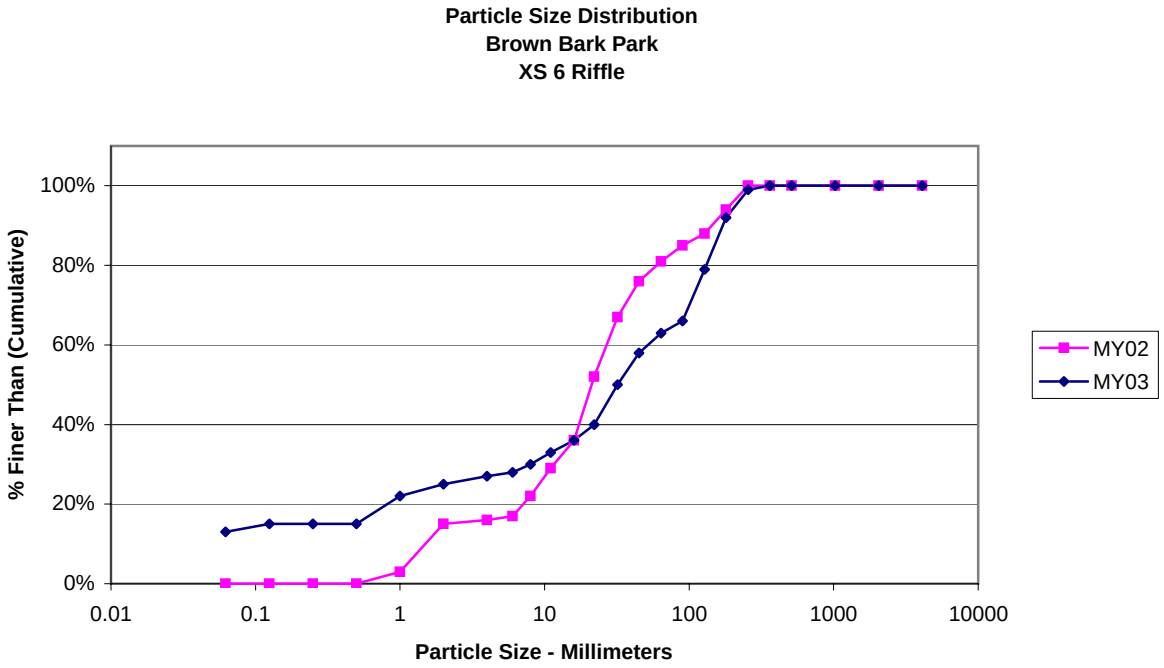
Size (mm)	
D16	0.37
D35	1.7
D50	12
D65	30
D84	140
D95	220

Size Distribution	
mean	7.2
dispersion	22.0
skewness	-0.14

Type	
silt/clay	11%
sand	27%
gravel	31%
cobble	30%
boulder	0%
bedrock	2%
hardpan	0%
wood/det	0%
artificial	0%

Cross Section 6 Riffle - MY03			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	13
Very Fine	.062 - .125	S	2
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	7
Very Coarse	1 - 2	S	3
Very Fine	2 - 4		2
Fine	4 - 5.7	G	1
Fine	5.7 - 8	R	2
Medium	8 - 11.3	A	3
Medium	11.3 - 16	V	3
Coarse	16 - 22.6	E	4
Coarse	22.6 - 32	L	10
Very Coarse	32 - 45	S	8
Very Coarse	45 - 64		5
Small	64 - 90	C	3
Small	90 - 128	O	13
Large	128 - 180	B	13
Large	180 - 256	L	7
Small	256 - 362	B	1
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



Size (mm)	
D16	0.55
D35	14
D50	32
D65	80
D84	150
D95	210

Size Distribution	
mean	9.1
dispersion	31.4
skewness	-0.35

Type	
silt/clay	13%
sand	12%
gravel	38%
cobble	36%
boulder	1%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Appendix C
Current Conditions Plan View

UNVEGETATED BANKS

FUNCTIONING CROSS VANES

FUNCTIONING CONSTRUCTED RIFFLE

FUNCTIONING ROOT WADS

FUNCTIONING CONSTRUCTED RIFFLES

STRESSED ROOT WADS

WATAUGA DR.

KEMP RD.

BROWN BARK DR.

WINVIEW DR.

FUNCTIONING CROSS VANE

FUNCTIONING CONSTRUCTED RIFFLE

HONEYSUCKLE AND PORCELAINBERRY

FUNCTIONING CROSS VANES

FUNCTIONING CROSS VANE

FUNCTIONING CONSTRUCTED RIFFLE

FUNCTIONING CONSTRUCTED RIFFLE

MATCH LINE SEE SHEET 2

MATCH LINE SEE SHEET 2

LEGEND

- THALWEG
- AS-BUILT VEGETATIVE BUFFER BOUNDARY
- ROOT WAD
- ROCK CROSS VANE
- CONSTRUCTED RIFFLE

NAD 83

–60 –30 0 30 60

GRAPHIC SCALE

REVISIONS

Ecosystem Enhancement

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

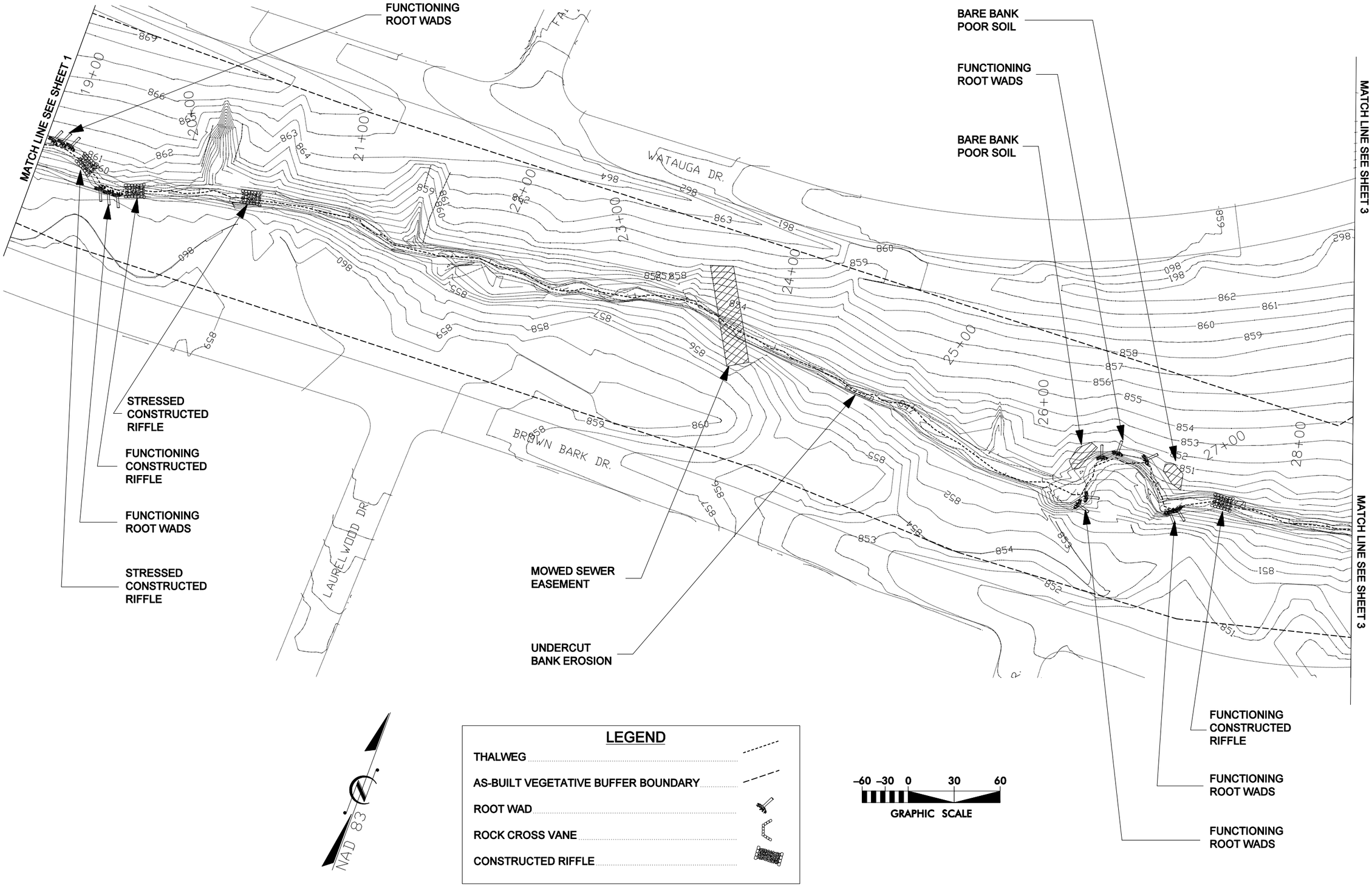
BROWN BARK PARK

GUILFORD COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 52 - MY03

STATION 10+00 TO STATION 18+85

DATE: NOVEMBER 2007
SCALE: SEE SHEET

CURRENT CONDITIONS PLAN VIEW



REVISIONS

Ecosystem Enhancement

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
460 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

BROWN BARK PARK
GUILFORD COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 52 - MY03
STATION 18+85 TO STATION 28+40

DATE: NOVEMBER 2007
SCALE: SEE SHEET

CURRENT CONDITIONS PLAN VIEW

SHEET 2 OF 3

MATCHLINE SEE SHEET 2

WATAUGA DR.

FUNCTIONING ROOT WADS

FUNCTIONING CONSTRUCTED RIFFLES

UNDERCUT BANK EROSION

FUNCTIONING ROOT WADS

FUNCTIONING CONSTRUCTED RIFFLE

FUNCTIONING CONSTRUCTED RIFFLES

FUNCTIONING ROOT WADS

FUNCTIONING CONSTRUCTED RIFFLE

FUNCTIONING ROOT WADS

MOWED BUFFER

FUNCTIONING ROOT WADS

FUNCTIONING ROOT WADS

FUNCTIONING CONSTRUCTED RIFFLE

FUNCTIONOING ROOT WADS

UNDERCUT BANK EROSION

FUNCTIONING ROOT WADS

FUNCTIONING CONSTRUCTED RIFFLE

WEST MINSTER DR.

BROWN BARK DR.

COLERIDGE DR.

NAD 83

LEGEND

THALWEG

AS-BUILT VEGETATIVE BUFFER BOUNDARY

ROOT WAD

ROCK CROSS VANE

CONSTRUCTED RIFFLE

–60 –30 0 30 60

GRAPHIC SCALE

REVISIONS

Ecosystem Enhancement

KCI ASSOCIATES OF NC

ENGINEERS • PLANNERS • SCIENTISTS

4601SW FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

BROWN BARK PARK

GUILFORD COUNTY, NORTH CAROLINA

EEP PROJECT NUMBER 52 - MY03

STATION 28+40 TO STATION 38+55

DATE: NOVEMBER 2007

SCALE: SEE SHEET

CURRENT CONDITIONS PLAN VIEW

SHEET 3 OF 3