Kentwood Park (Bushy Branch)
Stream Restoration Monitoring Report
EEP Project # 205
Monitoring Year – 04
2008

Submitted to:

Ecosystem Enhancement PROGRAM

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

March 2009

Monitoring Firm

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Design Firm

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EXECUTIVE SUMMARY

The North Carolina Wetlands Restoration Program identified Bushy Branch in Kentwood Park as a restoration project in 2000. The watershed of approximately 1.4 square miles is located within the USGS 14-digit HUC 03020201090010 and the NCDWQ Sub-basin 03-04-02 of the Neuse River Basin. The project restored approximately 1,400 linear feet of channel, 1,070 feet on Bushy Branch and 350 feet on an unnamed tributary to Bushy Branch (UT to Bushy Branch). The restoration was designed to correct various problems with the existing stream corridor including unstable channel configuration, poor water quality, minimal bed features, exotic and invasive vegetation, and poor stream and riparian habitat. The restoration plan was completed in 2002 and called for correcting these problems by stabilizing stream banks, installing in-stream structures, adjusting stream planform, and replanting the riparian areas with native vegetation. Project construction occurred in 2002. This report describes the findings of the fourth year of monitoring that took place in 2008.

The restoration plan called for the removal of all existing problem vegetation along the stream banks and within the riparian buffer. The as-built survey found the original planting of native vegetation to be unsuccessful. To correct the initial failure, a remedial vegetation plan was designed and implemented in 2004. Remedial vegetation was planted at a density of 4,840 stems per acre in the streamside community and 680 stems per acre in the bottomland hardwood community. The vegetation monitoring plots were established during the as-built survey. Three plots were surveyed and the corners marked with metal conduit for future monitoring. The fourth year of monitoring calculated an average of 1,840 planted stems per acre in the streamside community based on plots 1 and 2 and 1,240 stems per acre in the bottomland hardwood community based on plot 3. The use of the park's disc golf course continues to have a detrimental effect on the vegetation of UT to Bushy Branch and on the west bank of the upper 250 feet of Bushy Branch. The damage to the vegetation primarily consists of bare banks and plants being trampled due to foot traffic from disc golf players retrieving discs from the stream area. Some damage is due to direct impact of the flying discs on the planted vegetation. Microstegium (*Microstegium vimineum*) and kudzu (*Pueraria montana*) are prominent invasive plants that are present throughout the site. The kudzu has spread throughout the lower end of the stream and should be controlled as soon as possible. The fourth year monitoring found the vegetation component of the project, excluding these invasive populations, to be on track to meeting success criteria.

The stream assessment completed during the fourth year of monitoring found Bushy Branch to be functioning as designed. Channel dimensions based on repeat cross-sections have not changed significantly over the monitoring period. There was some localized bank erosion at one point or another during the monitoring period totaling 8% of the projects bank footage, but the majority of these localized, independent instances of bank erosion did not demonstrate advancement over the monitoring period. UT to Bushy Branch shows areas of bed degradation with the most significant problem being the fallen header stone near Station 02+20 that has begun to headcut further upstream, stressing the upstream rock sill. There has also been an increase in pedestrian footpaths along UT to Bushy Branch, creating more surface area devoid of vegetation and increasing rill erosion along these paths. Many of the in-stream structures are functioning across the project site, though several are experiencing stress evidenced by localized erosion on cross vane arms.

1.0 PROJECT BACKGROUND

1.1 Project Objectives

- Installation of in-stream structures to define additional bed features.
- Relocate a section of the stream in order to restore stream pattern.
- Grade severely eroding banks and excavate new bankfull benches.
- Install root wads to promote bank stability.
- Revegetate the adjacent banks to promote the establishment of native plant communities.

1.2 Project Structure, Restoration Type and Approach

A previously incised channel, Bushy Branch, and an unnamed tributary were restored using channel dimension, pattern, and profile modifications and the establishment of a vegetated riparian zone adjacent to the stream. Channel profile is maintained through the use of rock cross vanes. A new channel pattern was constructed through the use of single vanes, root wads, and vegetation along the channel banks. Due to heavy site use and low planting success, a corrective vegetation and stream maintenance plan was implemented since initial project completion.

1.3 Location and Setting

Bushy Branch and its unnamed tributary are located in Kentwood Recreational Park within the city limits of Raleigh, North Carolina. The 1.4-square mile watershed has a park setting surrounded by urban residential development with little potential for future development.

1.4 Project History and Background

Table 1. Project Restoration Components
Project Number and Name: 205 - Kentwood Park (Bushy Branch)

Segment / Reach ID	Existing Linear Feet	Type	Approach	Linear Feet	Stationing	Comment
Bushy Branch	N/A	R	P1/2/3	1,070	10+00 - 20+70	
UT to Bushy Branch	N/A	EII	P3	350	00+00 - 03+50	

R = Restoration P1/2/3 = Combination of Priority 1, 2, and 3
EII = Enhancement II P3 = Priority 3

DIRECTIONS TO KENTWOOD PARK SITE:
From Interstate 440 take exit 2A to Western Boulevard. From Western Boulevard, turn right (south) onto Kent Street. At a traffic light at the end of Kent Street, turn right (west) onto Kaplan Drive. Kentwood Park parking will be on the left (south) side of Kaplan Drive.

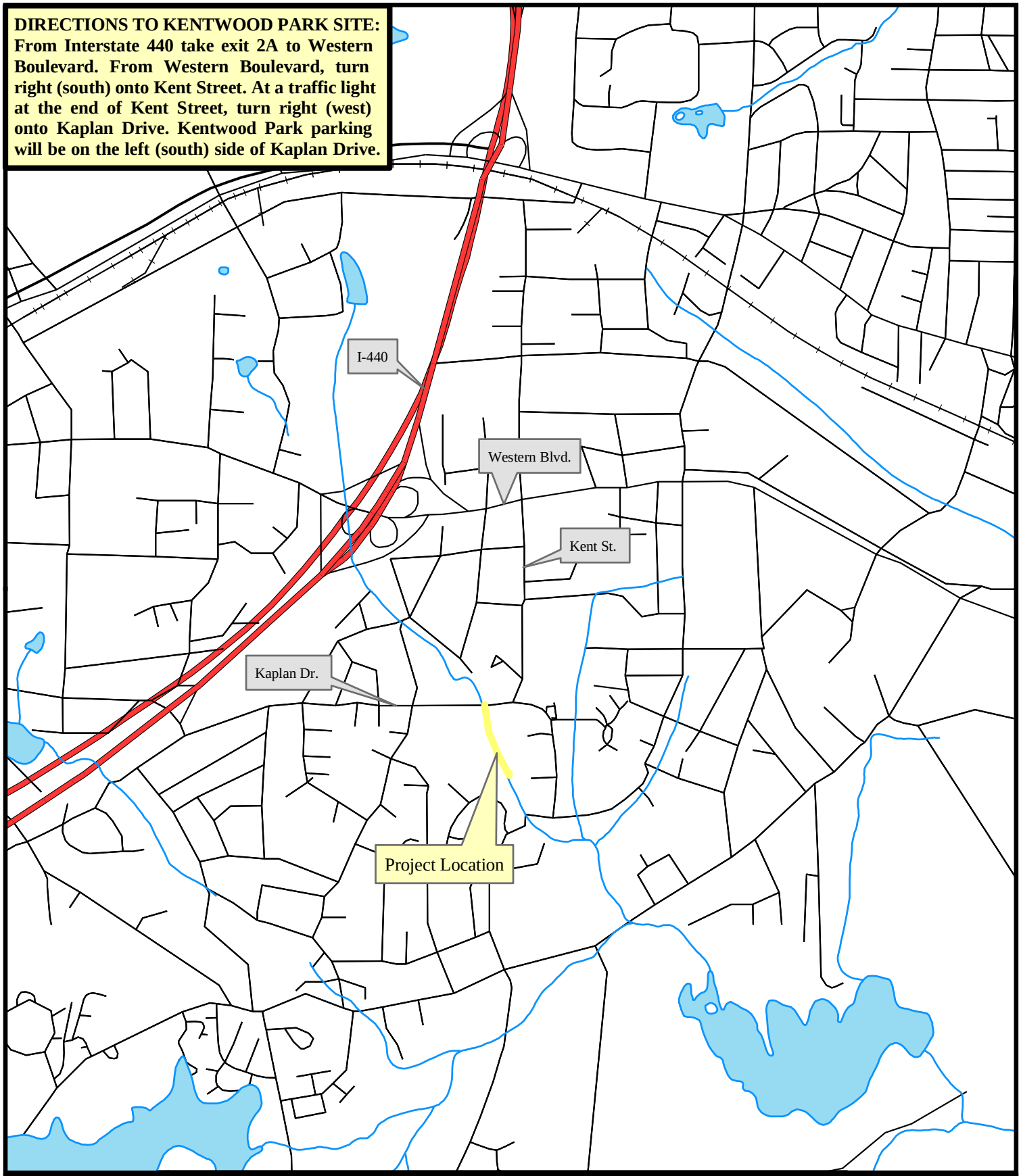


Figure 1. Site Vicinity Map
Kentwood Park, Wake County, EEP Project # 205

0.25 0.125 0 0.25 0.5
Miles

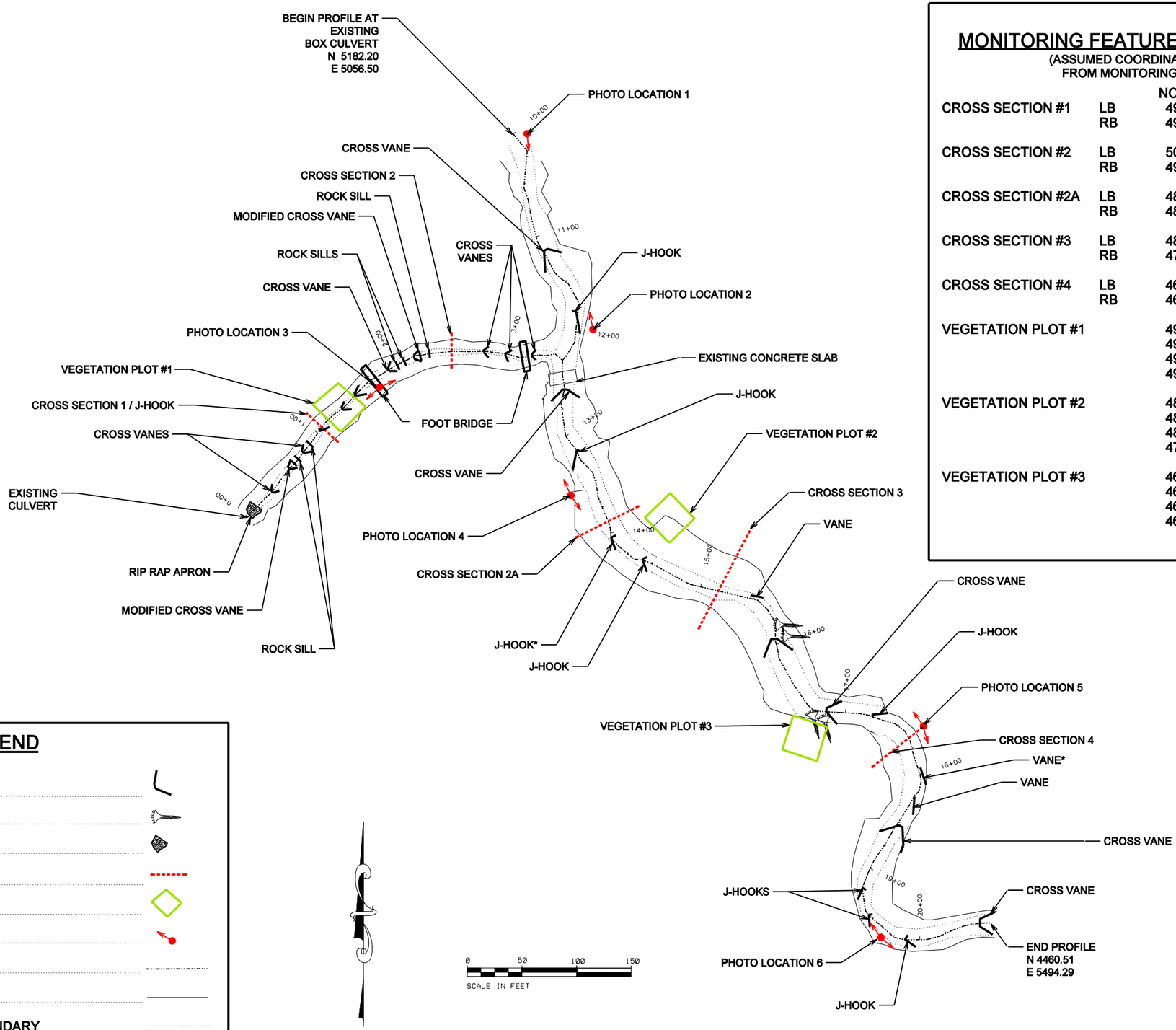
Ecosystem Enhancement Program

KCI ASSOCIATES OF NC

Table 2. Project Activity and Reporting History Project Number and Name: 205 - Kentwood Park (Bushy Branch)		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan	Apr-00	Mar-02
Final Design - 90%		
Construction		2002
Stream Maintenance Plan		Feb-04
Stream Repair and Maintenance Seeding		2004
As-Built Report		Feb-05
Year 1 Monitoring	Jul-05	Jan-06
Year 2 Monitoring	Jun-06	Jan-07
Year 3 Monitoring	Nov-07	Jan-08
Year 4 Monitoring	Oct-08	Jan-09

Table 3. Project Contact Table Project Number and Name: 205 - Kentwood Park (Bushy Branch)	
Design Firm	Arcadis G&M of North Carolina, Inc. 2301 Rexwoods Dr., Suite 102 Raleigh, North Carolina 27607 Contact: Mr. William Scott Hunt, III Phone: (919) 782-5511 Fax: (919) 782-5905
Construction Contractor	Shamrock Environmental Group 6106 Corporate Park Dr. Brown Summit, North Carolina 27214 Contact: Mr. Bill Wright Phone: (336) 375-1989 Fax: (336) 375-1801
Vegetation Design Firm (2004 Vegetation and Stream Maintenance Plan)	EcoScience Corporation 1101 Haynes St., Suite 101 Raleigh, North Carolina 27604 Contact: Mr. Jens Geratz Phone: (919) 828-3433 Fax: (919) 828-3518
Supplemental Vegetation and Structure Repair Contractor	Seal Brothers P.O. Box 86 Dobson, North Carolina 27017 Contact: Mr. Brian Seal Phone: (336) 710-3560
Monitoring Performer MY-01, 02, 03, 04	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: 205 – Kentwood Park (Bushy Branch)**	
Project County	Wake County
Drainage Area	1.4 sq. mi. (Bushy Branch)
	0.06 sq. mi. (UT to Bushy Branch)
Drainage Impervious Cover Estimate	45%
Stream Order	Second Order (Bushy Branch)
	First Order (UT to Bushy Branch)
Physiographic Region	Piedmont
Ecoregion	Northern Outer Piedmont
Rosgen Classification of As-built	C4/B4
Dominant Soil Types	Wehadkee and Bibb Soils (Bushy Branch)
	Wehadkee and Bibb Soils (UT to Bushy Branch)
Reference Site ID	UT to Lake Wheeler
	UT to Mine Creek
USGS HUC for Project and Reference	03020201090010 (Bushy Branch)
	03020201110010 (UT to Lake Wheeler)
	03020201080020 (UT to Mine Creek)
NCDWQ Sub-basin for Project and Reference	03-04-02 (Bushy Branch)
	03-04-02 (UT to Lake Wheeler)
	03-04-02 (UT to Mine Creek)
NCDWQ Classification for Project and Reference	C - NSW (Bushy Branch)
	N/A (UT to Lake Wheeler)
	N/A (UT to Mine Creek)
Any portion of the project segment 303d listed?	No
Any portion of the project segment upstream of a 303d listed segment?	N/A
Reasons for 303d Listing or Stressor	N/A
% of Project Easement Fenced	0%



MONITORING FEATURE COORDINATES

(ASSUMED COORDINATE SYSTEM FROM MONITORING SURVEY)

		NORTHING	EASTING
CROSS SECTION #1	LB	4926.60	4867.91
	RB	4900.65	4895.52
CROSS SECTION #2	LB	5000.00	5000.00
	RB	4968.67	5000.00
CROSS SECTION #2A	LB	4841.45	5170.71
	RB	4813.25	5114.21
CROSS SECTION #3	LB	4820.56	5259.23
	RB	4723.49	5219.47
CROSS SECTION #4	LB	4651.82	5430.88
	RB	4611.46	5389.46
VEGETATION PLOT #1		4931.15	4873.69
		4954.36	4896.34
		4909.86	4898.86
		4932.60	4921.73
VEGETATION PLOT #2		4819.84	5161.42
		4823.76	5206.52
		4844.74	5182.31
		4798.86	5185.63
VEGETATION PLOT #3		4619.82	5305.75
		4651.83	5312.74
		4644.35	5344.63
		4612.48	5338.48

LEGEND

- AS-BUILT STRUCTURE
- AS-BUILT ROOT WAD
- RIP RAP
- CROSS SECTION
- VEGETATION PLOT
- PHOTO LOCATION
- AS-BUILT THALWEG
- AS-BUILT TOP OF BANK
- AS-BUILT CHANNEL BOUNDARY

* INDICATES AS-BUILT STRUCTURE THAT WAS NOT ORIGINALLY INCLUDED IN THE AS-BUILT DRAWING

REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED

Ecosystem Enhancement Program

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

KENTWOOD PARK (BUSHY BRANCH)
WAKE COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 205 - MY04

DATE: NOVEMBER 2008
SCALE: SEE SHEET

MONITORING PLAN VIEW

SHEET 1 OF 1

2.0 PROJECT CONDITIONS AND MONITORING RESULTS

2.1 Vegetation Assessment

After the supplemental planting that took place in 2004, three vegetation monitoring plots were set up. Plots 1 and 2 were set up directly adjacent to the stream to monitor the plants in the streamside vegetative community. In monitoring year 04, a density of 1,840 stems/acre was calculated from these plots. Plot 3 was set up to monitor the bottomland hardwood vegetative community and calculated a density of 1,240 stems/acre in monitoring year 04. Overall, the planted vegetation has exhibited good survivability. Most of the vegetative problem areas associated with this site are caused by the project's park setting. With a disc golf course adjacent to the top half of the project, there is heavy foot traffic along the right bank of Bushy Branch from 10+00 to 12+75 and on both sides of UT to Bushy Branch. This foot traffic and the highly compacted soils have prevented vegetation from growing on the right bank of Bushy Branch from the beginning of the project until the confluence with the tributary. Along UT to Bushy Branch there are many foot paths crossing the easement and there is little vegetation on the terrace surrounding the stream. These areas appear to also have been mowed along with the rest of the park. Towards the end of this summer, a few signs demarcating the easement boundary were installed, which should prevent these areas from being mowed in the future.

There are many invasive exotic species present throughout the Kentwood Park conservation easement. The most prevalent species include English ivy (*Hedera helix*), microstegium (*Microstegium vimineum*), mimosa (*Albizia julibrissin*), kudzu (*Pueraria montana*), Japanese hops (*Humulus japonicus*) and Japanese honeysuckle (*Lonicera japonica*). In addition to these species, Chinese privet (*Ligustrum sinense*), multiflora rose (*Rosa multiflora*), and elaeagnus (*Elaeagnus pungens*) have also been observed in the riparian buffer. Due to the urban location of the park, there are many sources of invasive species close to the project and complete eradication of these plants is unlikely. Controlling the invasive species and removing larger individuals could help reduce the closest seed sources and decrease competition with the planted native species. It is especially important to control the kudzu population, which has already begun to cover a large portion of the easement and will continue to do so unless treated.

See vegetation data and photos in Appendix A and Current Conditions Plan View in Appendix C. The taxonomic standard being used for vegetation identifications is "Flora of the Carolinas, Virginia, Georgia, and surrounding areas by Alan S. Weakley.

2.2. Stream Assessment

The restored reach of Bushy Branch is predominately stable. This site is vertically controlled by bedrock and does not have any areas that are experiencing bed degradation or incision. There are portions of lateral instability throughout the project, though. In most of the cases the toe of the streambanks has washed out and many banks are experiencing slight undercut erosion. In a few of these cases, the bank vegetation is stabilizing these banks, but there are isolated areas that are suffering uncontrolled erosion. The in-stream structures are stable for the most part, but a few of the cross-vanes have suffered from significant back arm scour. One of the structures has fallen apart. The two sets of root wads that were installed have most of the root wad above the stream's baseflow. This has caused these root wads to begin to rot and they are also suffering from erosion behind the root wads. On UT to Bushy Creek, a scour hole downstream of a cross vane at Station 02+20 has caused the header boulder of the cross vane to fall into the hole. This headcut has begun to move upstream, stressing the structure just upstream of the affected cross vane. There are two other areas of note on the tributary: one is the small patch of concrete that was poured on

the bank and bed near Station 01+15 and the other is the outlet from a black drain pipe that has been put into the bank near Station 01+00. These issues are most likely related to the adjacent playground equipment that was replaced earlier this summer.

A repair assessment is recommended to investigate stabilizing and rebuilding the structure that has been affected by the headcut on UT to Bushy Creek. If left unstabilized, this vertical instability could continue to migrate upstream, affecting additional structures. Additional repair assessment is also recommended at the cross vane that has failed at Station 12+60. There is a pipe protected by concrete immediately upstream of this structure, which will control vertical instability, but further bank erosion could continue to take place in this location.

See additional stream assessment and photos in Appendix B and the 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: 205 - Kentwood Park (Bushy Branch)

Date of Data Collection	Date of Occurrence	Method	Photo Number
06/15/06	06/14/06	Site visit to evaluate stage indicators after storm event	N/A
07/11/07	06/03/07	Crest Gauge	N/A
11/12/07	07/17/07	Crest Gauge	N/A
10/28/2008	09/07/08	Crest Gauge	N/A

2.2.1.b BEHI and Sediment Export Table

Table 6. BEHI and Sediment Export Estimates
Project Number and Name: 205 – Kentwood Park (Bushy Branch)

N/A

2.2.2 Stability Assessment Table

Table 7a. Categorical Stream Feature Visual Stability Assessment
Project Number and Name: 205 – Kentwood Park (Bushy Branch)
Segment/Reach: Bushy Branch (1,070 ft.)

Feature	Initial	MY - 01	MY - 02	MY - 03	MY - 04	MY - 05
A. Riffles	100%	98%	75%	75%	75%	
B. Pools	100%	92%	94%	94%	89%	
C. Thalweg	100%	75%	75%	75%	75%	
D. Meanders	100%	75%	72%	81%	81%	
E. Bed General	100%	93%	94%	100%	100%	
F. Banks	100%	78%	77%	83%	92%	
G. Vanes / J Hooks etc.	100%	83%	82%	82%	82%	
H. Wads and Boulders	100%	80%	50%	50%	50%	

Table 7b. Categorical Stream Feature Visual Stability Assessment
Project Number and Name: 205 – Kentwood Park (Bushy Branch)
Segment/Reach: UT Bushy Branch (350 ft.)

Feature	Initial	MY - 01	MY - 02	MY - 03	MY - 04	MY - 05
A. Riffles	100%	92%	85%	85%	85%	
B. Pools	100%	90%	90%	90%	90%	
C. Thalweg	100%	100%	100%	100%	100%	
D. Bed General	100%	80%	80%	97%	93%	
E. Banks	100%	95%	95%	91%	91%	
F. Vanes / J Hooks etc.	100%	90%	90%	90%	90%	

2.2.3 Quantitative Measures Summary Tables

Table 8a. Baseline Morphology and Hydraulic Summary
Project Number and Name: 205 – Kentwood Park (Bushy Branch)
Segment Reach: Bushy Branch (1,070 ft.)

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	Mean
Bankfull Width (ft)			36.0				25.0	36.0	31.0	11.0	12.5	11.5			24.0			18.0
Floodprone Width (ft)			100				67	135	107	70	137	97	52	>100				43
Bankfull Cross Sectional Area (ft^2)			135.8				51.5	69.8	63.0	11.2	12.8	12.2			40.0			22.2
Bankfull Mean Depth (ft)			3.8				1.8	2.1	2.0	0.9	1.2	1.1			1.7			1.2
Bankfull Maximum Depth (ft)			5.5				2.8	3.1	2.9	1.4	1.8	1.6	2.2	2.7	2.4			1.8
Width/Depth Ratio							12	20	16	9	14	11			14			14.6
Bank Height Ratio							2.2	2.9	2.6	1.1	1.4	1.2						1.3
Entrenchment Ratio			2.2				1.9	4.8	3.6	6.4	12.5		2.2	>6				2.4
Wetted Perimeter (ft)																		19.8
Hydraulic Radius (ft)																		1.1
Pattern																		
Channel Beltwidth (ft)							40	95	77	50	110	69	103	230	144			
Radius of Curvature (ft)							32	204	138	7	66	25	15	137	53			
Meander Wavelength (ft)							180	380	269	45	120	74	94	250	156			
Meander Width Ratio							5.8	12.2	8.7	3.9	10.4	6.5	3.9	10.4	6.5			
Profile																		
Riffle Length (ft)																		
Riffle Slope (ft/ft)							0.001	0.028	0.016	0.013	0.042	0.028	0.017	0.056	0.04			
Pool Length (ft)							16	60.1	34.3	11	112	30	24	233	62			
Pool Spacing (ft)							47	141	111	22	148	57	46	310	120			
Substrate																		
d50 (mm)									12			4			12			6
d84 (mm)									45			17			45			44
Additional Reach Parameters																		
Valley Length (ft)																		
Channel Length (ft)																		
Sinuosity								1.16			1.57			1.3				
Water Surface Slope (ft/ft)																		
BF Slope (ft/ft)								0.009			0.006			0.008				
Rosgen Classification		E						C-E4/1			C-E4/1			C-E4/2			C-E4/2	

*As-built data is from a single cross section survey.

Table 8b. Baseline Morphology and Hydraulic Summary
Project Number and Name: 205 – Kentwood Park (Bushy Branch)
Segment Reach: UT to Bushy Branch (350 ft.)

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	Mean
Bankfull Width (ft)			36.0				6.0	6.3	6.2	10.1	10.5	10.4			8.0			6.5
Floodprone Width (ft)			100				8.0	8.5	8.3	12.3	23.0	16.3	12.0	18.0				16
Bankfull Cross Sectional Area (ft^2)			135.8				7.3	8.0	7.7	8.9	10.9	10.1			5			2.9
Bankfull Mean Depth (ft)			3.8				1.2	1.3	1.3	0.8	1.1	1.0			0.6			0.4
Bankfull Maximum Depth (ft)			5.5				1.6	1.8	1.7	1.5	1.7	1.6	0.9	1.0	1.0			0.8
Width/Depth Ratio									5.0	9.0	12.0	10.3			12.0			14.5
Entrenchment Ratio			2.2				1.3	1.4	1.35	1.2	2.2	1.6	1.5	2.2				2.5
Bank Height Ratio							1.8	2.1	1.9									1.0
Wetted Perimeter (ft)																		6.9
Hydraulic Radius (ft)																		0.4
Pattern																		
Channel Beltwidth (ft)							58	105	82	19	49	34	14	38	26			
Radius of Curvature (ft)							42	94	75	12	23.4	15.8	10	18	14			
Meander Wavelength (ft)									490			127			98			
Meander Width Ratio									79			12.2			12.2			
Profile																		
Riffle Length (ft)																		
Riffle Slope (ft/ft)										0.01	0.055	0.032	0.012	0.06	0.03			
Pool Length (ft)										3	14	6.7	2.4	10.4	6.4			
Pool Spacing (ft)										27	43	32	21	33	25			
Substrate																		
d50 (mm)									12			11			12			6.3
d84 (mm)									29			176			29			59
Additional Reach Parameters																		
Valley Length (ft)																		
Channel Length (ft)																		
Sinuosity								1.14			1.2			1.14				
Water Surface Slope (ft/ft)																		
BF Slope (ft/ft)								0.033			0.022			0.024				
Rosgen Classification		E						G4			B4/1			B4/2			B4/2	

*As-built data is from a single cross section survey.

Table 9a. Morphology and Hydraulic Monitoring Summary
Project Number and Name: 205 – Kentwood Park (Bushy Branch)
Segment Reach: Bushy Branch (1,070 ft.)

Parameter	Cross Section 2A						Cross Section 3						Cross Section 4					
	Riffle						Riffle						Pool					
Dimension	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)		26.5	26.0	23.9			20.3	21.4	20.8	21.6			23.3	23.2	21.6	22.2		
Floodprone Width (ft)		43	42	41			36	38	38	38			> 44	> 46	>46	>46		
Bankfull Cross Sectional Area (ft^2)		38.5	37.1	32.1			34.6	38.2	38.7	39.9			50.8	39.7	42.4	36.1		
Bankfull Mean Depth (ft)		1.5	1.4	1.3			1.7	1.8	1.9	1.8			2.2	1.7	2.0	1.6		
Bankfull Maximum Depth (ft)		2.0	2.0	1.7			2.3	2.6	2.4	2.4			3.2	3.0	3.0	3.0		
Width/Depth Ratio		18.2	18.2	17.8			11.9	12.0	11.2	11.7			10.6	13.6	11.0	13.7		
Entrenchment Ratio		1.6	1.6	1.7			1.8	1.8	1.8	1.8			>1.9	>2.0	>2.0	>2.0		
Bank Height Ratio		1.0	1.0	1.0			1.0	1.0	1.3	1.4			1.0	1.0	1.1	1.0		
Wetted Perimeter (ft)		27.8	27.6	24.9			21.8	23.4	22.5	22.9			25.4	25.0	23.6	24.6		
Hydraulic Radius (ft)		1.4	1.3	1.3			1.6	1.6	1.7	1.7			2.0	1.6	1.8	1.5		
Substrate																		
d50 (mm)		10	16	25			15	10	9	18			18.0	2.0	4.0	1.9		
d84 (mm)		41	41	74			38	35	24	68			59.0	32.0	49.0	26.0		

Table 9b. Morphology and Hydraulic Monitoring Summary
Project Number and Name: 205 – Kentwood Park (Bushy Branch)
Segment Reach: UT to Bushy Branch (350 ft.)

Parameter	Cross Section 1						Cross Section 2					
	Pool						Riffle					
Dimension	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	8.9	8.5	8.5	8.6			7.9	8.0	6.8	7.1		
Floodprone Width (ft)	20	19	20	20			14	15	15	15		
Bankfull Cross Sectional Area (ft^2)	10.8	9.7	9.4	8.4			4.1	3.3	3.3	4.2		
Bankfull Mean Depth (ft)	1.2	1.1	1.1	1.0			0.5	0.4	0.5	0.6		
Bankfull Maximum Depth (ft)	1.8	1.7	1.5	1.6			0.9	0.9	0.7	1.0		
Width/Depth Ratio	7.4	7.4	7.7	8.8			15.2	19.4	14.2	12.0		
Entrenchment Ratio	2.2	2.2	2.3	2.3			1.7	1.9	2.3	2.1		
Bank Height Ratio	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0		
Wetted Perimeter (ft)	10.1	12.1	10.1	9.3			8.2	8.2	7.1	7.5		
Hydraulic Radius (ft)	1.1	0.8	0.8	0.9			0.5	0.4	0.5	0.6		
Substrate												
d50 (mm)	30	39	23	2			30	38	21	5		
d84 (mm)	82	69	76	51			56	72	57	57		

Table 9c. Morphology and Hydraulic Monitoring Summary continued
Project Number and Name: 205 - Kentwood Park (Bushy Branch)
Segment Reach: Bushy Branch (1,070 ft.)

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)	26	83	34	36	93	38	36	93	38	36	93	38			
Radius of Curvature (ft)	60	100	90	32	96	60	32	96	60	32	96	60			
Meander Wavelength (ft)	138	219	194	170	210	195	170	210	195	170	210	195			
Meander Width Ratio	1.6	5.3	2.2	1.2	4.5	2.5	1.5	4.0	1.6	1.6	4.1	1.7			
Profile															
Riffle Length (ft)	9	35	16	9	40	23	6	43	19	9	92	18			
Riffle Slope (ft/ft)	0.008	0.049	0.025	0.003	0.036	0.019	0.002	0.090	0.022	0.009	0.046	0.025			
Pool Length (ft)	13	96	32	8	130	33	3	57	9	5	49	17			
Pool Spacing (ft)	5	103	35	43	136	74	27	144	83	7	148	70			
Additional Reach Parameters															
Valley Length (ft)	845			845			845			845					
Channel Length (ft)	1,070			1,070			1,070			1,070					
Sinuosity	1.27			1.27			1.27			1.27					
Water Surface Slope (ft/ft)	0.0080			0.0080			0.0086			0.0090					
Number of Bankfull Events	0			1			2			1					
Rosgen Classification	C4			C4			C4			C4					

Table 9d. Morphology and Hydraulic Monitoring Summary continued
Project Number and Name: 205 - Kentwood Park (Bushy Branch)
Segment Reach: UT to Bushy Branch (350 ft.)

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)			N/A			N/A			N/A			N/A			
Radius of Curvature (ft)			N/A			N/A			N/A			N/A			
Meander Wavelength (ft)			N/A			N/A			N/A			N/A			
Meander Width Ratio			N/A			N/A			N/A			N/A			
Profile															
Riffle Length (ft)	10	38	15	5	38	11	7	35	13	9	39	16			
Riffle Slope (ft/ft)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A			
Pool Length (ft)	6	46	10	6	36	10	2	15	6	3	11	6			
Pool Spacing (ft)	13	62	45	5	66	28	20	74	41	22	73	53			
Additional Reach Parameters															
Valley Length (ft)	318			318			318			318					
Channel Length (ft)	350			350			350			350					
Sinuosity	1.1			1.1			1.1			1.1					
Water Surface Slope (ft/ft)	N/A			N/A			N/A			N/A					
Number of Bankfull Events	0			1			2			1					
Rosgen Classification	B4			B4			B4			B4					

3.0 METHODOLOGY

The EEP 2004 Stem Counting Protocol was used to collect vegetation data from Kentwood Park this year, the fourth year of monitoring.

4.0 REFERENCES

Weakley, Alan S. 2006. Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas. (http://www.herbarium.unc.edu/FloraArchives/WeakleyFlora_2006-Jan.pdf)

Appendix A
Vegetation Data

A1 - Vegetation Data Tables

Table A1. Stem counts for each species arranged by plot
Project Number and Name: 205 – Kentwood Park (Bushy Branch)

Species	Plot			Initial Totals	Year 1 Totals	Year 2 Totals	Year 3 Totals	Year 4 Totals	Survival %
	1	2	3						
Shrubs									
Ilex verticillata	1	6		16	10	7	7	7	44%
Euonymus americana	1			6	3	4	3	1	17%
Lindera benzoin	2			4	4	4	3	2	50%
Sambucus canadensis				7	3	1	0	0	0%
Cornus amomum		17	2	34	24	20	19	19	56%
Alnus serrulata		6	1	14	11	7	7	7	50%
Trees									
Quercus michauxii	8		12	23	22	20	20	20	87%
Quercus phellos			5	4	5	5	5	5	125%
Quercus alba			2	2	2	2	2	2	100%
Fraxinus pennsylvanica	10			10	11	10	10	10	100%
Nyssa sylvatica	13			13	13	14	14	13	100%
Oxydendrum arboreum	3			8	4	3	3	3	38%
Betula nigra	8	12		18	16	21	20	20	111%
Cornus florida	1			1	1	1	1	1	100%
Platanus occidentalis		3		8	4	3	3	3	38%
Liriodendron tulipifera			4	6	4	4	4	4	67%
Acer negundo			3	4	4	3	3	3	75%
Ulmus americana			2	2	2	2	2	2	100%
Hamamelis virginiana	2			3	1	3	3	2	67%

Explanation of Probable Causes of Vegetation Mortality

- The *Euonymus americana* mortality can be attributed to the high foot traffic from the disc golf course in Vegetation Plot 1. Many paths cross through plot 1 and many plants (planted and unplanted) have been trampled.
- The decrease in *Lindera benzoin* in Plot 1 during Monitoring Year 04 could also be attributed the heavy foot traffic through the plot.
- There is over 100% survival for *Quercus phellos* in Plot 3. This is due to a miscount during the as-built stem count.
- There is also over 100% survival for *Betula nigra* in plots 1 and 2. This is due to either a miscount during the as-built and first year monitoring stem count or resprouts from the original plantings that were presumed dead.

Table A2. Stem Density By Plot
Project Number and Name: 205 -Kentwood Park (Bushy Branch)
Date : 7/13/08
Crew : B. Roberts

Plot #	Winterberry *Ilex verticillata*	Swamp Chestnut Oak *Quercus michauxii*	Green Ash *Fraxinus pennsylvanica*	Black Gum *Nyssa sylvatica*	Witch Hazel *Hamamelis virginiana*	Sourwood *Oxydendrum arboreum*	Hearts-a-busting *Euonymus americana*	Spice Bush *Lindera benzoin*	River Birch *Betula nigra*	Flowering Dogwood *Cornus florida*	Elderberry *Sambucus canadensis*	Silky Dogwood *Cornus amomum*	Sycamore *Platanus occidentalis*	Tag Alder *Alnus serrulata*	Willow Oak *Quercus phellos*	Tulip Poplar *Liriodendron tulipifera*	White Oak *Quercus alba*	Box Elder *Acer negundo*	American Elm *Ulmus americana*	Total (Year 2)	Density (Trees/Acre)
1	1	8	10	13	2	3	1	2	8	1										49	1,960
2	6								12			17	3	5						43	1,720
3		12										2		1	5	4	2	3	2	31	1,240
															Streamside Community (Plots 1 and 2)					1,840	
															Bottomland Hardwood Community (Plot 3)					1,240	

A2 – Representative Vegetation Problem Area Photos

VP1 - English ivy (*Hedera helix*) on stream bank. Photo taken near Station 10+25. 10/27/08 - MY 04

VP2 - Kudzu (*Pueraria montana*) along stream bank. Photo taken near Station 19+50. 10/27/08 - MY 04

VP3 - Bare terrace that is devoid of herbaceous vegetation. Photo taken near Station 12+80. 10/27/08 - MY 04

VP4 – Easement area mowed and worn by pedestrian traffic. Photo taken near Station 02+50. 10/27/08 - MY 04

VP5 - Erosion from path worn into stream bank from pedestrian access to the stream. Photo taken near Station 01+00. 10/27/08 - MY 04

A4 - Vegetation Monitoring Plot Photos

Vegetation Plot 1 Photo – Taken looking south from the north corner. 8/5/08 - MY 04

Vegetation Plot 1 Supplemental Photo – Taken looking upstream toward the center of the plot from established photo station #3. 8/5/08 - MY 04

Vegetation Plot 2 Photo – Taken looking south from the north corner. 8/5/08 - MY 04

Vegetation Plot 2 Supplemental Photo – Taken looking at center of plot from the top of the right bank across the stream from the vegetation plot. 8/5/08 - MY 04

Vegetation Plot 3 Photo – Taken looking east from the west corner. 8/5/08 - MY 04

Appendix B
Geomorphologic Data

B1 – Representative Stream Problem Area Photos

SP1 - Bank erosion. Photo taken near Station 17+80 on left bank. 10/28/08 - MY 04

SP2 - Back arm scour on arm of cross vane. Photo taken near Station 12+60. 10/28/08 - MY 04

SP3 - Failed cross vane in main stem. Photo taken near Station 12+60. 10/28/08 - MY 04

SP4 - Scour behind failed root wads. Photo taken near Station 16+00. 10/28/08 - MY 04

SP5 - Header stones of cross vane that have fallen into the pool; the stream is headcutting up from this point. Photo taken near Station 02+20. 10/28/08 - MY 04

SP6 – Cement discarded on bank and bed of tributary. Photo taken near Station 01+15. 10/28/08 - MY 04

B2 –Stream Photo Stations

Photo Point 1 – Taken looking downstream from bridge on Kaplan Drive. 10/28/08 - MY 04

Photo Point 1, supplemental – Taken looking downstream from streambed in front of bridge on Kaplan Drive. 10/28/08 - MY 04

Photo Point 2 – Taken looking upstream. 10/28/08 - MY 04

Photo Point 3 – Taken looking upstream. 10/28/08 - MY 04

Photo Point 3 – Taken looking downstream. 10/28/08 - MY 04

Photo Point 4 – Taken looking upstream. 10/28/08 - MY 04

Photo Point 4 – Taken looking downstream. 10/28/08 - MY 04

Photo Point 5 – Taken looking upstream. 10/28/08 - MY 04

Photo Point 5 – Taken looking downstream. 10/28/08 - MY 04

Photo Point 6 – Taken looking upstream. 10/28/08 - MY 04

Photo Point 6 – Taken looking downstream. 10/28/08 - MY 04

B3 –Qualitative Visual Stability Assessment Table

Table B2. Qualitative Visual Stability Assessment
Project Number and Name: 205 – Kentwood Park (Bushy Branch)
Segment/Reach: Bushy Branch (1,070 ft.)

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	12	N/A	75%	
	2. Armor stable (e.g. no displacement)?	9	12	N/A	75%	
	3. Facet grade appears stable?	9	12	N/A	75%	
	4. Minimal evidence of embedding/fining?	9	12	N/A	75%	
	5. Length appropriate?	9	12	N/A	75%	**75%**
B. Pools	1. Present? (e.g. no severe aggradation)	11	12	N/A	92%	
	2. Sufficiently deep (Dmax pool:Mean Bkf > 1.6?)	11	12	N/A	92%	
	3. Length appropriate?	10	12	N/A	83%	**89%**
C. Thalweg	1. Upstream of meander bend centering?	6	8	N/A	75%	
	2. Downstream of meander centering?	6	8	N/A	75%	**75%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	6	8	N/A	75%	
	2. Of those eroding, # w/ concomitant point bar formation?	2	2	N/A	100%	
	3. Apparent Rc within spec?	8	8	N/A	100%	
	4. Sufficient floodplain access and relief?	5	8	N/A	63%	**81%**
E. Bed General	1.General channel bed aggradation areas (bar formation)	N/A	N/A	0/0	100%	
	2. Channel bed degradation - areas of increasing down cutting or head cutting?	N/A	N/A	0/0	100%	**100%**
F. Bank	1. Actively eroding, wasting, or slumping bank	N/A	N/A	8/180	92%	**92%**
G. Vanes	1. Free of back or arm scour?	10	17	N/A	59%	
	2. Height appropriate?	15	17	N/A	88%	
	3. Angle and geometry appear appropriate?	15	17	N/A	88%	
	4. Free of piping or other structural failures?	16	17	N/A	94%	**82%**
H. Wads / Boulders	1. Free of scour?	1	2	N/A	50%	
	2. Footing stable?	1	2	N/A	50%	**50%**

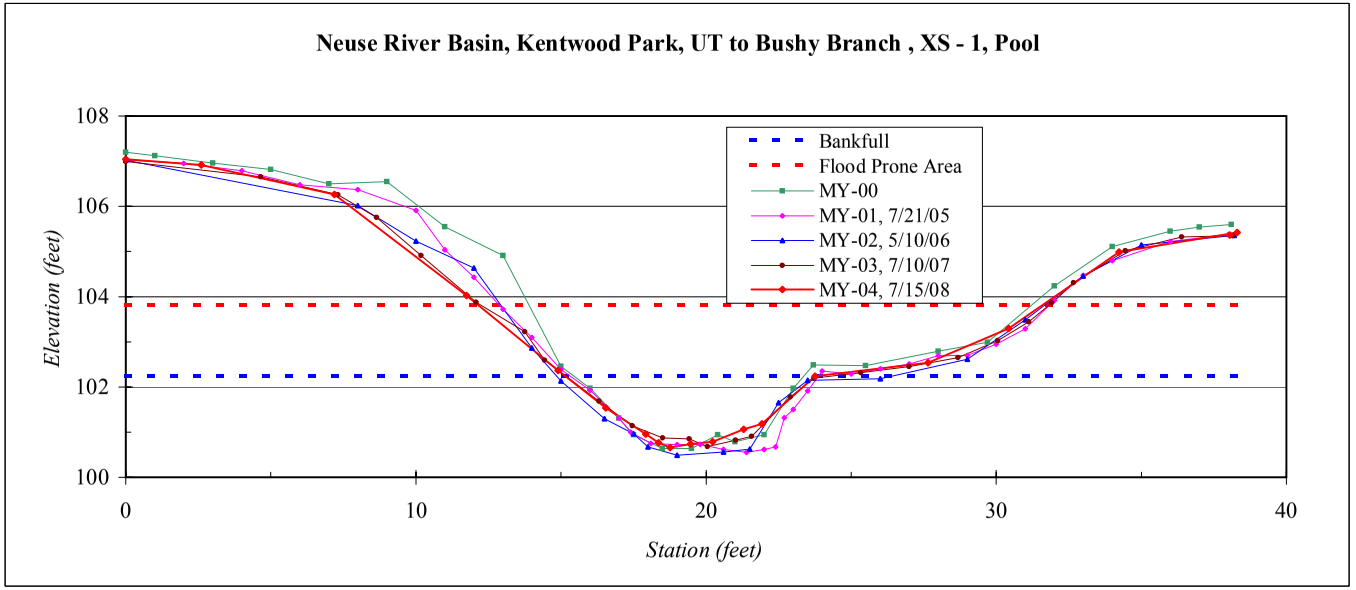
* Total number of features per as-built estimated from as-built profile and planview sheets.

B4 - Cross-Section Plots

River Basin:	Neuse
Watershed:	Kentwood Park, UT to Bushy Branch
XS ID	XS - 1, Pool
Drainage Area (sq mi):	0.06
Date:	7/15/2008
Field Crew:	B. Roberts, K. Vaughan

Station	Elevation
0.0	107.04
2.6	106.92
7.2	106.26
11.8	104.02
14.9	102.36
16.5	101.54
17.9	100.96
18.4	100.76
18.8	100.66
19.5	100.74
20.2	100.78
21.3	101.06
21.9	101.18
23.8	102.24
27.7	102.54
30.4	103.29
34.2	104.99
38.3	105.42
38.1	105.36

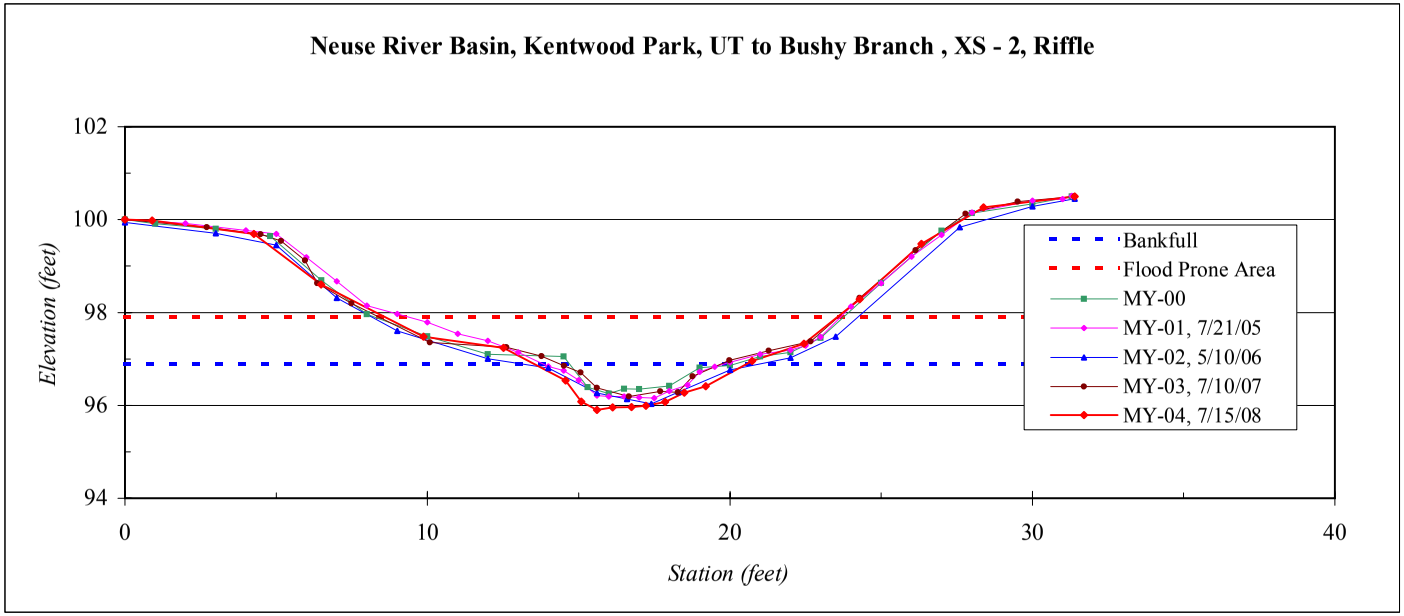
SUMMARY DATA	
Bankfull Elevation:	102.2
Bankfull Cross-Sectional Area:	8.4
Bankfull Width:	8.6
Flood Prone Area Elevation:	103.8
Flood Prone Width:	20
Max Depth at Bankfull:	1.6
Mean Depth at Bankfull:	1.0
W / D Ratio:	8.8
Entrenchment Ratio:	2.3
Bank Height Ratio:	1.0



River Basin:	Neuse
Watershed:	Kentwood Park, UT to Bushy Branch
XS ID	XS - 2, Riffle
Drainage Area (sq mi):	0.06
Date:	7/15/2008
Field Crew:	B. Roberts, K. Vaughan

Station	Elevation
0.0	100.00
0.9	99.98
4.3	99.69
6.5	98.61
9.9	97.48
12.5	97.24
14.6	96.54
15.1	96.08
15.6	95.90
16.1	95.96
16.7	95.97
17.2	95.99
17.9	96.08
18.5	96.28
19.2	96.41
20.7	96.96
22.5	97.33
24.3	98.29
26.3	99.48
28.4	100.26
31.4	100.50

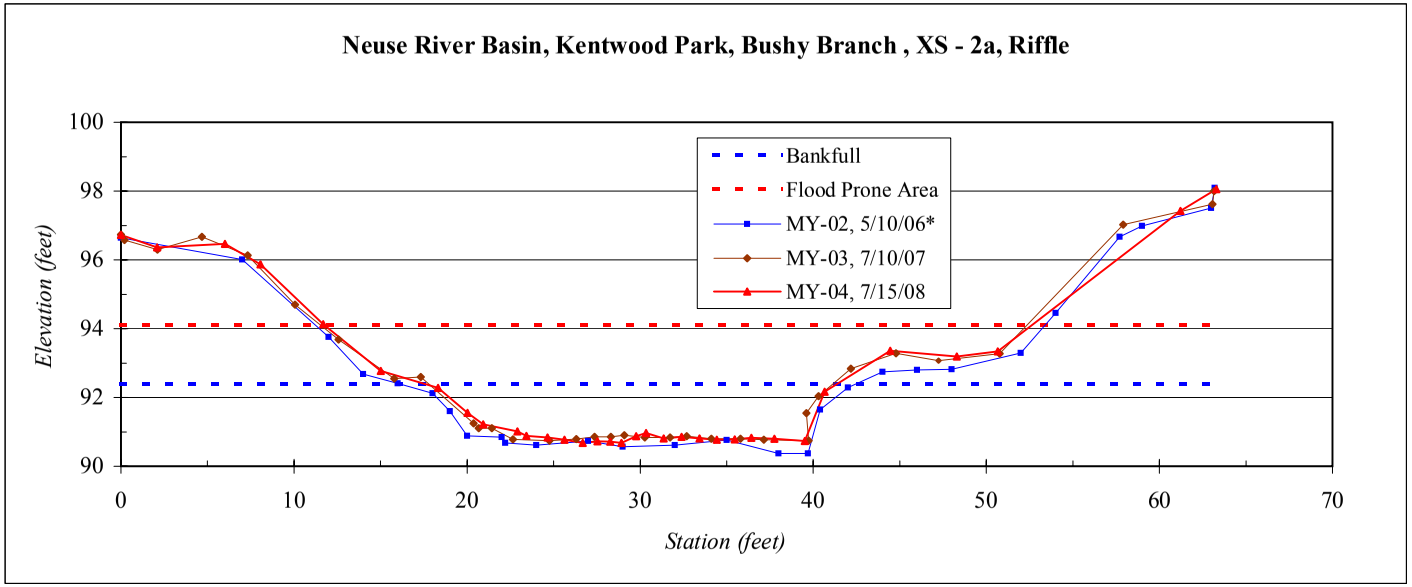
SUMMARY DATA	
Bankfull Elevation:	96.9
Bankfull Cross-Sectional Area:	4.2
Bankfull Width:	7.1
Flood Prone Area Elevation:	97.9
Flood Prone Width:	15
Max Depth at Bankfull:	1.0
Mean Depth at Bankfull:	0.6
W / D Ratio:	12.0
Entrenchment Ratio:	2.1
Bank Height Ratio:	1.0



River Basin:	Neuse
Watershed:	Kentwood Park, Bushy Branch
XS ID	XS - 2a, Riffle
Drainage Area (sq mi):	1.27
Date:	7/15/2008
Field Crew:	B. Roberts, K. Vaughan

Station	Elevation
0.0	96.73
2.1	96.36
6.0	96.46
8.1	95.87
11.7	94.13
15.0	92.77
18.3	92.28
20.0	91.55
20.9	91.21
22.9	91.01
23.4	90.88
24.6	90.84
25.6	90.77
26.7	90.68
27.5	90.73
28.3	90.72
28.9	90.68
29.8	90.87
30.3	90.97
31.4	90.81
32.4	90.86
33.4	90.81
34.4	90.77
35.5	90.78
36.4	90.83
37.8	90.80
39.5	90.73
40.7	92.17
44.4	93.36
48.3	93.19
50.7	93.34
61.2	97.43
63.3	98.05

SUMMARY DATA	
Bankfull Elevation:	92.4
Bankfull Cross-Sectional Area:	32.1
Bankfull Width:	23.9
Flood Prone Area Elevation:	94.1
Flood Prone Width:	41
Max Depth at Bankfull:	1.7
Mean Depth at Bankfull:	1.3
W / D Ratio:	17.8
Entrenchment Ratio:	1.7
Bank Height Ratio:	1.0

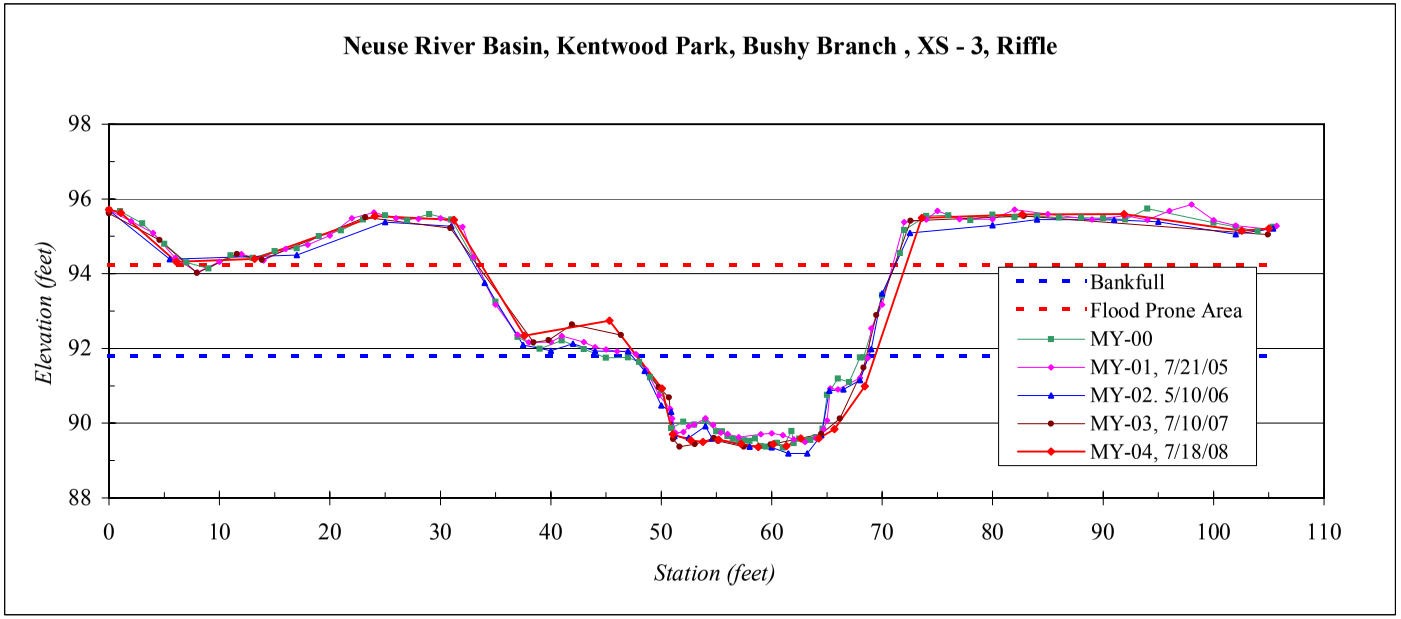


*Supplemental Cross Section, installed MY02

River Basin:	Neuse
Watershed:	Kentwood Park, Bushy Branch
XS ID	XS - 3, Riffle
Drainage Area (sq mi):	1.27
Date:	7/18/2008
Field Crew:	B. Roberts, K. Vaughan

Station	Elevation
0.0	95.71
1.1	95.63
6.1	94.32
13.2	94.40
24.1	95.55
31.2	95.44
37.6	92.34
45.3	92.75
50.1	90.92
51.0	89.70
52.7	89.55
53.8	89.50
55.2	89.56
57.2	89.45
58.8	89.36
60.1	89.44
61.3	89.38
62.6	89.59
64.3	89.59
65.7	89.84
68.4	90.99
73.6	95.49
82.7	95.59
91.9	95.60
102.6	95.15
105.0	95.21

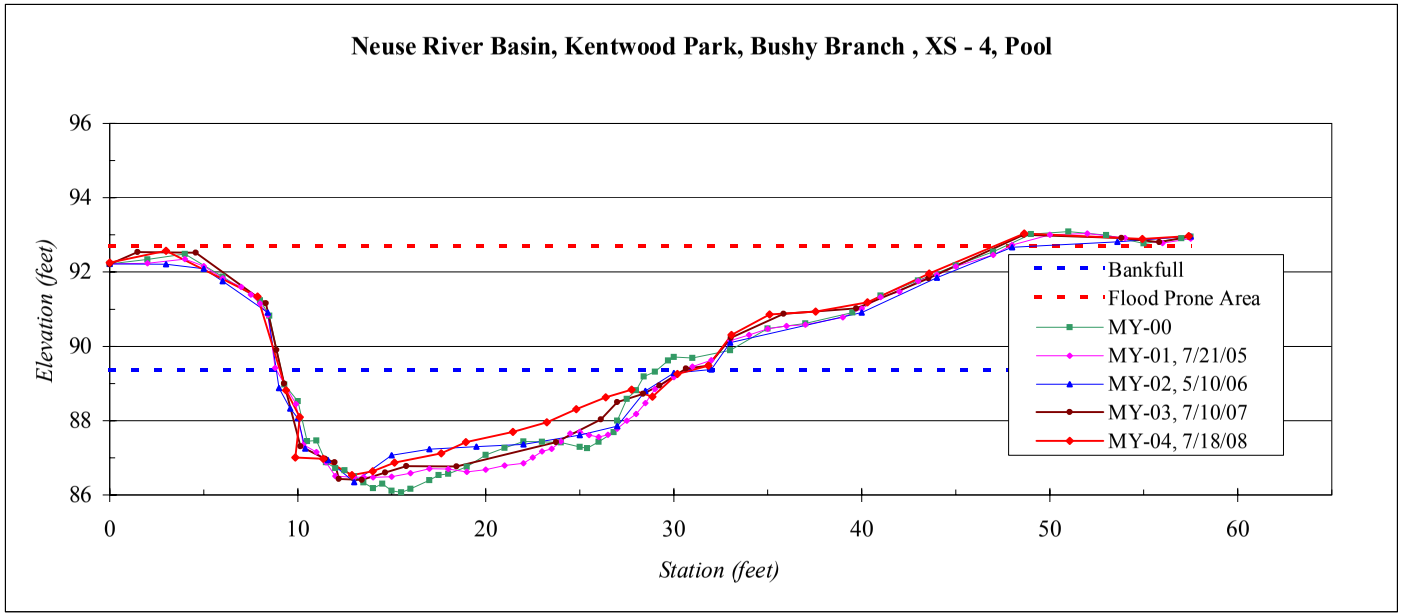
SUMMARY DATA	
Bankfull Elevation:	91.8
Bankfull Cross-Sectional Area:	39.9
Bankfull Width:	21.6
Flood Prone Area Elevation:	94.2
Flood Prone Width:	38
Max Depth at Bankfull:	2.4
Mean Depth at Bankfull:	1.8
W / D Ratio:	11.7
Entrenchment Ratio:	1.8
Bank Height Ratio:	1.4



River Basin:	Neuse
Watershed:	Kentwood Park, Bushy Branch
XS ID	XS - 4, Pool
Drainage Area (sq mi):	1.27
Date:	7/18/2008
Field Crew:	B. Roberts, K. Vaughan

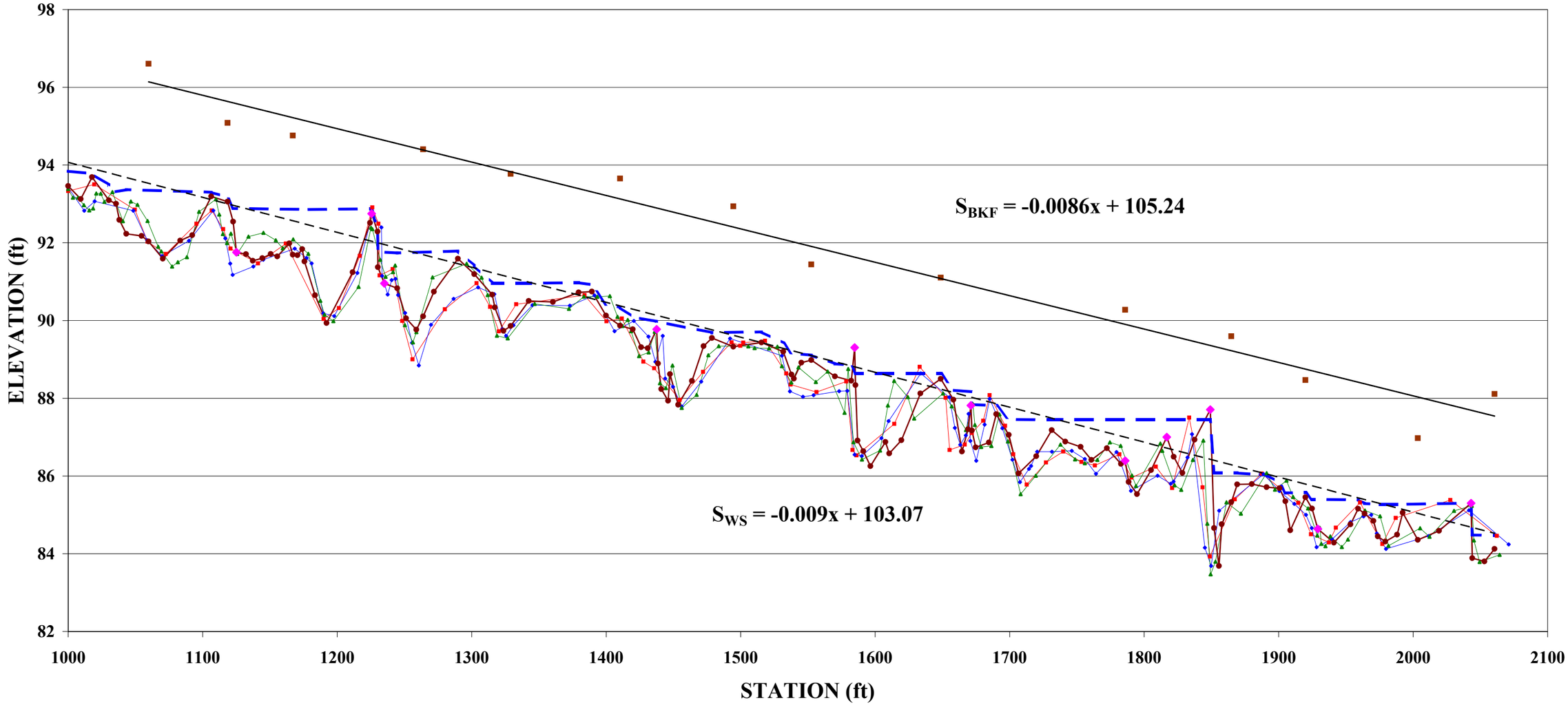
Station	Elevation
0.0	92.21
1.5	92.54
4.6	92.52
8.3	91.16
8.9	89.90
9.3	89.00
10.1	87.31
11.5	86.98
12.0	86.88
12.2	86.43
13.4	86.41
14.7	86.61
15.8	86.78
18.4	86.77
23.7	87.42
26.1	88.03
27.0	88.50
28.4	88.72
29.2	88.94
30.7	89.40
31.8	89.48
33.0	90.23
35.8	90.87
39.7	91.02
43.6	91.83
48.6	93.01
53.8	92.92
55.8	92.81
57.4	92.95

SUMMARY DATA	
Bankfull Elevation:	89.4
Bankfull Cross-Sectional Area:	36.1
Bankfull Width:	22.2
Flood Prone Area Elevation:	92.7
Flood Prone Width:	>46
Max Depth at Bankfull:	3.0
Mean Depth at Bankfull:	1.6
W / D Ratio:	13.7
Entrenchment Ratio:	>2.0
Bank Height Ratio:	1.0

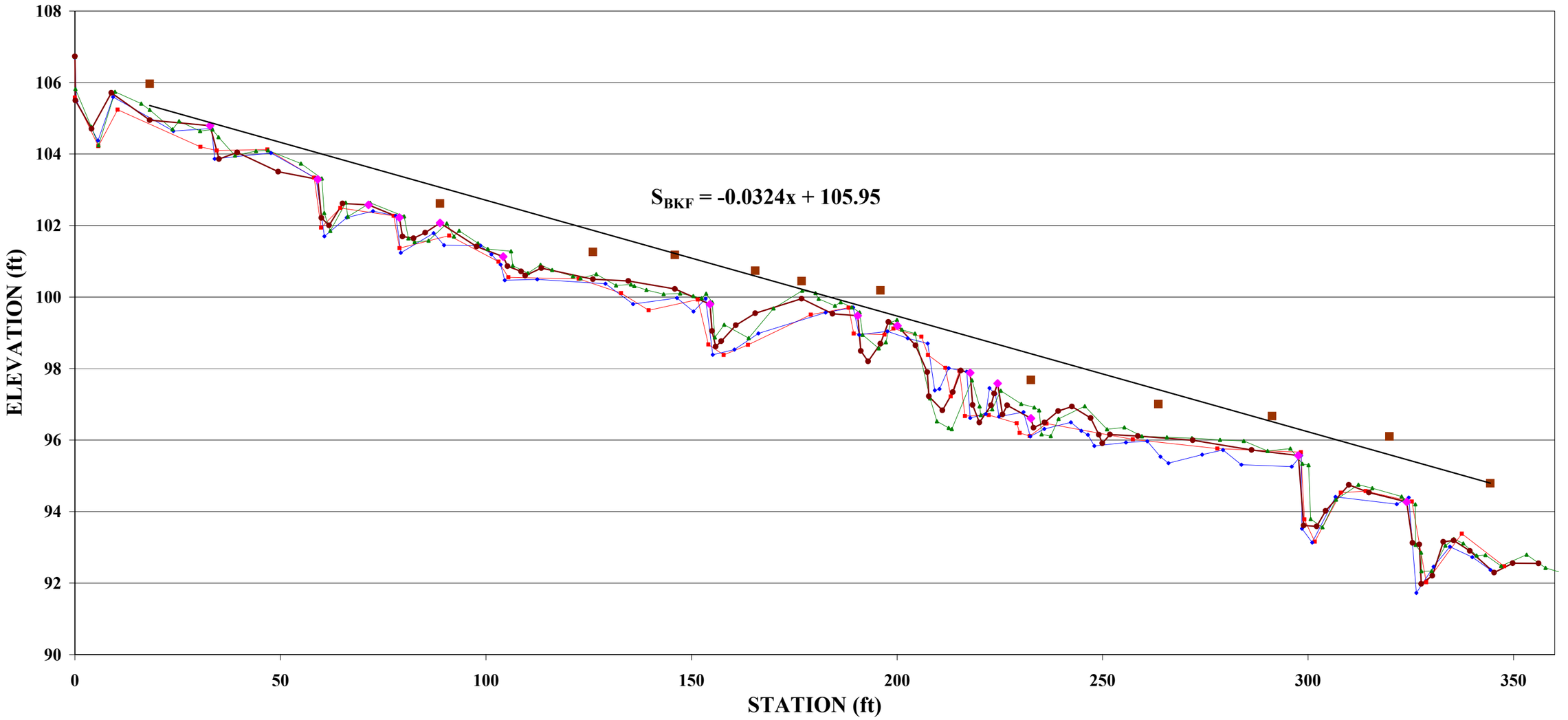


B5 - Longitudinal Plots

Longitudinal Profile for Bushy Branch
Kentwood Park, Wake County
EEP Project Number 205 - MY04



Longitudinal Profile for UT to Bushy Branch
Kentwood Park, Wake County
EEP Project Number 205 - MY04

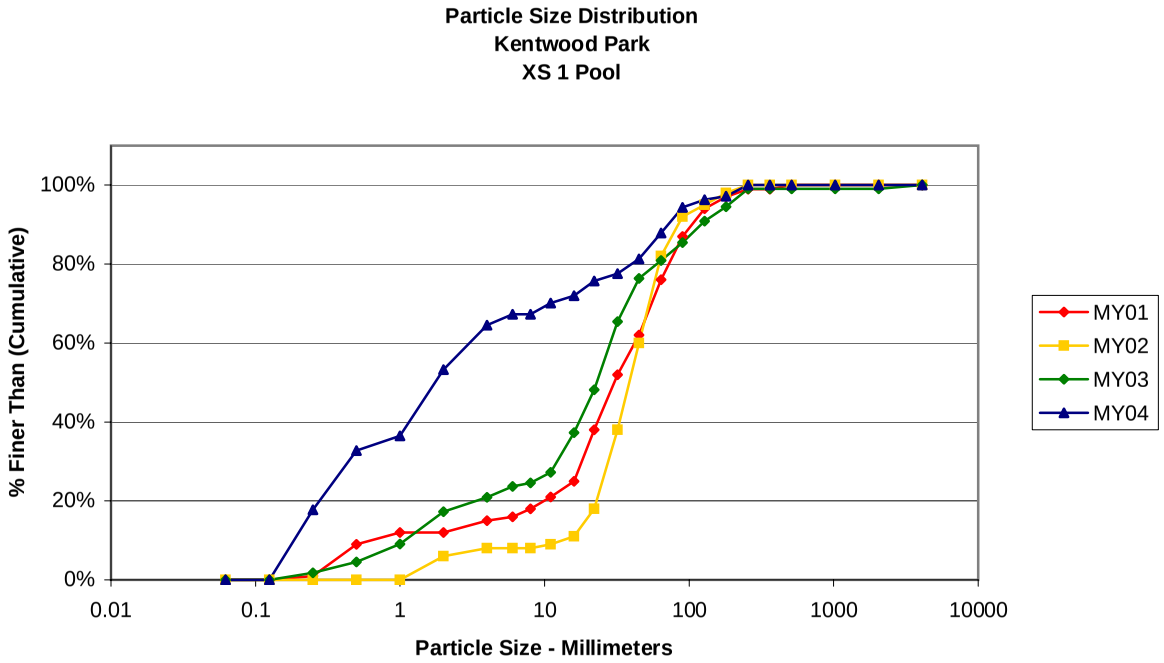


*No Water Surface due to no flow in channel

B6 - Pebble Count Plots

Cross Section 1 Pool - MY04			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	19
Medium	.25 - .50	N	16
Coarse	.50 - 1	D	4
Very Coarse	1 - 2	S	18
Very Fine	2 - 4		12
Fine	4 - 5.7	G	3
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	3
Medium	11.3 - 16	V	2
Coarse	16 - 22.6	E	4
Coarse	22.6 - 32	L	2
Very Coarse	32 - 45	S	4
Very Coarse	45 - 64		7
Small	64 - 90	C	7
Small	90 - 128	O	2
Large	128 - 180	B	1
Large	180 - 256	L	3
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	110

Note:



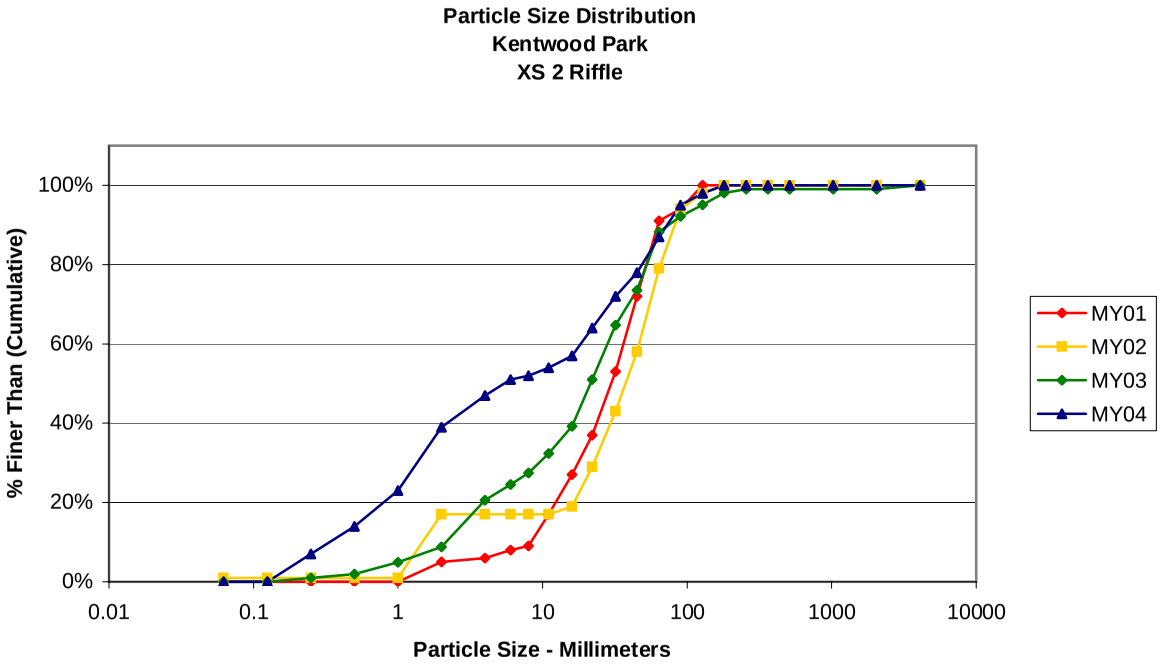
Size (mm)	
D16	0.24
D35	0.92
D50	1.9
D65	5.6
D84	51
D95	98

Size Distribution	
mean	3.5
dispersion	17.4
skewness	0.17

Type	
silt/clay	0%
sand	52%
gravel	36%
cobble	12%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross Section 2 Riffle - MY04			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	7
Medium	.25 - .50	N	7
Coarse	.50 - 1	D	9
Very Coarse	1 - 2	S	16
Very Fine	2 - 4		8
Fine	4 - 5.7	G	4
Fine	5.7 - 8	R	1
Medium	8 - 11.3	A	2
Medium	11.3 - 16	V	3
Coarse	16 - 22.6	E	7
Coarse	22.6 - 32	L	8
Very Coarse	32 - 45	S	6
Very Coarse	45 - 64		9
Small	64 - 90	C	8
Small	90 - 128	O	3
Large	128 - 180	B	2
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	100

Note:



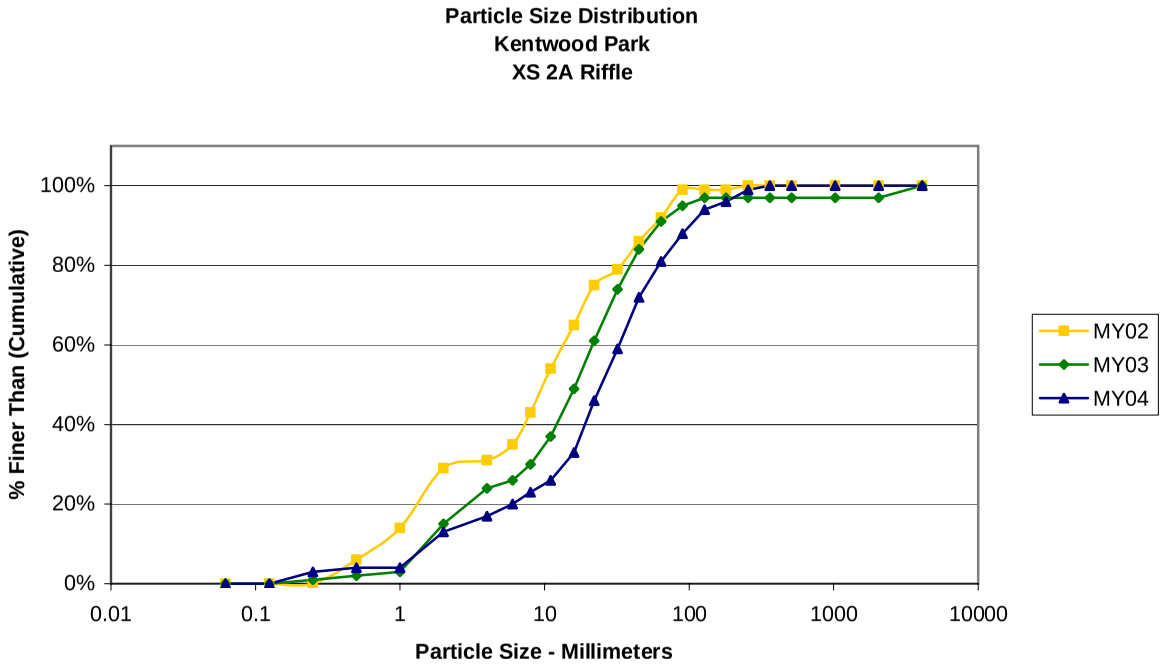
Size (mm)	
D16	0.58
D35	1.7
D50	5.4
D65	23
D84	57
D95	90

Size Distribution	
mean	5.7
dispersion	9.9
skewness	0.02

Type	
silt/clay	0%
sand	39%
gravel	48%
cobble	13%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross Section 2A Riffle - MY04			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	3
Medium	.25 - .50	N	1
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	9
Very Fine	2 - 4		4
Fine	4 - 5.7	G	3
Fine	5.7 - 8	R	3
Medium	8 - 11.3	A	3
Medium	11.3 - 16	V	7
Coarse	16 - 22.6	E	13
Coarse	22.6 - 32	L	13
Very Coarse	32 - 45	S	13
Very Coarse	45 - 64		9
Small	64 - 90	C	7
Small	90 - 128	O	6
Large	128 - 180	B	2
Large	180 - 256	L	3
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:



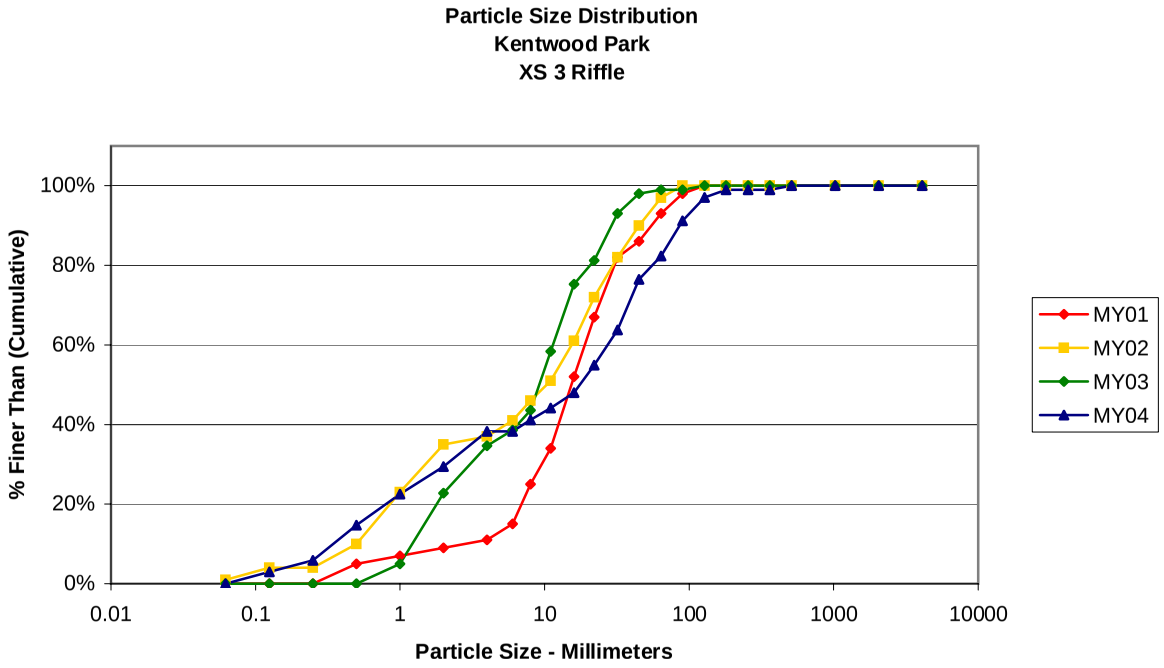
Size (mm)	
D16	3.4
D35	17
D50	25
D65	37
D84	74
D95	150

Size Distribution	
mean	15.9
dispersion	5.2
skewness	-0.17

Type	
silt/clay	0%
sand	13%
gravel	68%
cobble	18%
boulder	1%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross Section 3 Riffle - MY04			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	3
Medium	.25 - .50	N	3
Coarse	.50 - 1	D	9
Very Coarse	1 - 2	S	8
Very Fine	2 - 4		7
Fine	4 - 5.7	G	9
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	3
Medium	11.3 - 16	V	3
Coarse	16 - 22.6	E	4
Coarse	22.6 - 32	L	7
Very Coarse	32 - 45	S	9
Very Coarse	45 - 64		13
Small	64 - 90	C	6
Small	90 - 128	O	9
Large	128 - 180	B	6
Large	180 - 256	L	2
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	1
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	102

Note:



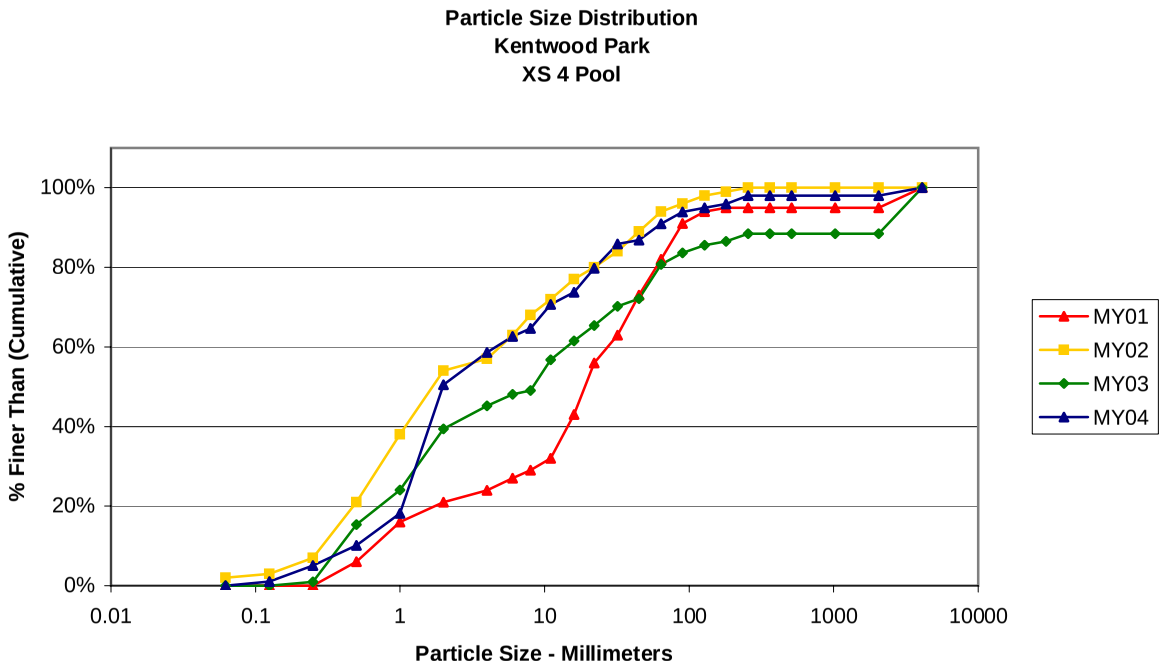
Size (mm)	
D16	0.56
D35	3.1
D50	18
D65	33
D84	68
D95	110

Size Distribution	
mean	6.2
dispersion	18.0
skewness	-0.32

Type	
silt/clay	0%
sand	29%
gravel	53%
cobble	17%
boulder	1%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross Section 4 Pool - MY04			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	1
Fine	.125 - .25	A	4
Medium	.25 - .50	N	5
Coarse	.50 - 1	D	8
Very Coarse	1 - 2	S	32
Very Fine	2 - 4		8
Fine	4 - 5.7	G	4
Fine	5.7 - 8	R	2
Medium	8 - 11.3	A	6
Medium	11.3 - 16	V	3
Coarse	16 - 22.6	E	6
Coarse	22.6 - 32	L	6
Very Coarse	32 - 45	S	1
Very Coarse	45 - 64		4
Small	64 - 90	C	3
Small	90 - 128	O	1
Large	128 - 180	B	1
Large	180 - 256	L	2
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	2
		Total	99

Note:

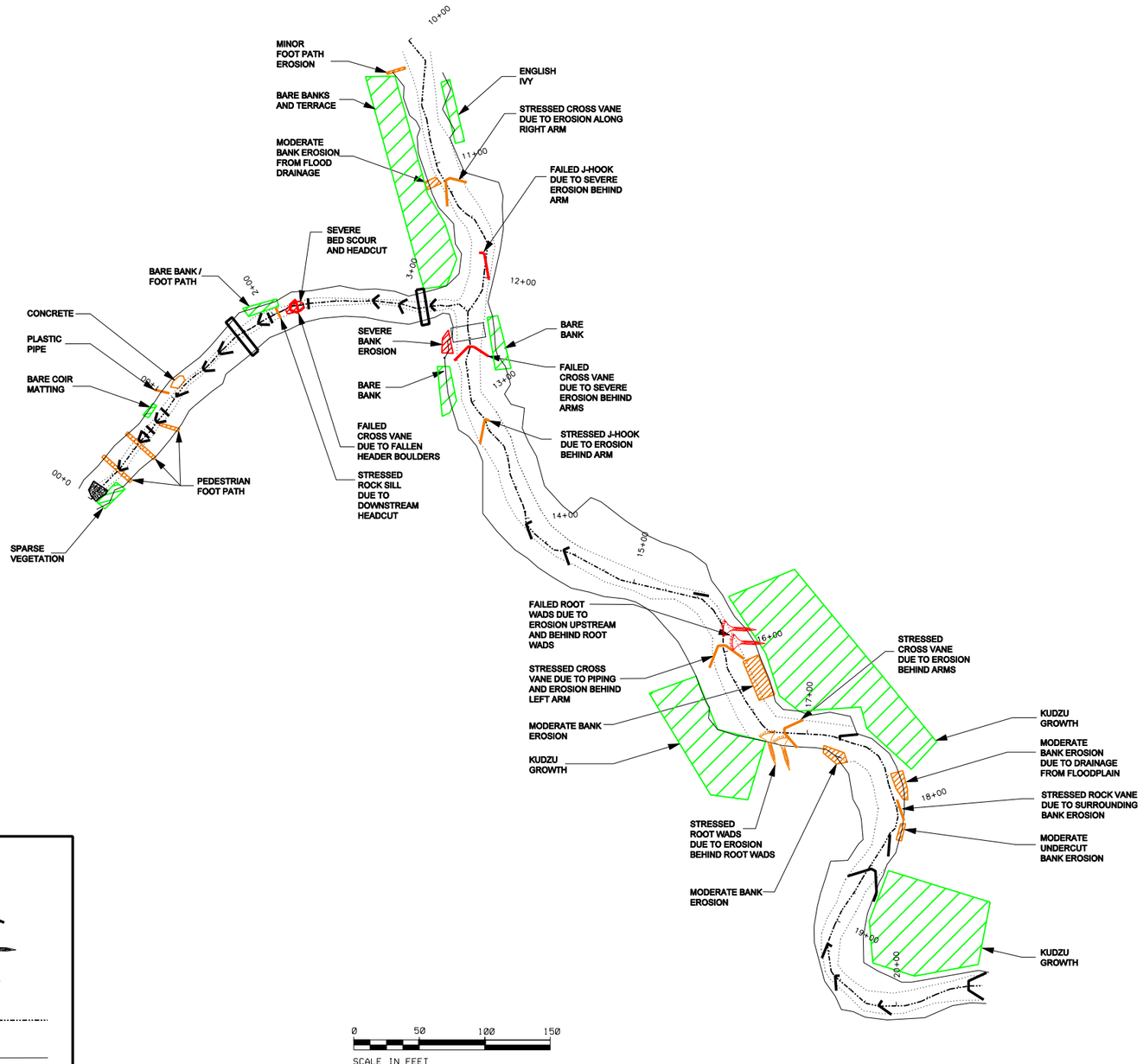


Size (mm)	
D16	0.81
D35	1.4
D50	1.9
D65	7
D84	26
D95	82

Size Distribution	
mean	4.6
dispersion	8.0
skewness	0.31

Type	
silt/clay	0%
sand	51%
gravel	40%
cobble	7%
boulder	0%
bedrock	2%
hardpan	0%
wood/det	0%
artificial	0%

Appendix C
Current Conditions Plan View



LEGEND

- AS-BUILT STRUCTURE
- AS-BUILT ROOT WAD
- RIP RAP
- AS-BUILT THALWEG
- AS-BUILT TOP OF BANK
- AS-BUILT CHANNEL BOUNDARY

* INDICATES AS-BUILT STRUCTURE THAT WAS NOT ORIGINALLY INCLUDED IN THE AS-BUILT DRAWING

REVISIONS

STM	DESCRIPTION	DATE	APPROVED

Ecosystem Enhancement Program

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

KENTWOOD PARK (BUSHY BRANCH)
WAKE COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 205 - MY04

DATE: NOVEMBER 2008
SCALE: SEE SHEET

CURRENT CONDITIONS PLAN VIEW

SHEET 1 OF 1