Chavis Park (Garner Branch) Stream Restoration Monitoring Report

EEP Project # 87

Monitoring Year – 02

2005

Submitted to:

Ecosystem Enhancement PROGRAM

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

Monitoring Firm

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Ecological Consultants

Natural Areas Ecosystem Management

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EXECUTIVE SUMMARY

The Wetlands Restoration Program identified the Garner Branch of Walnut Creek in Chavis Park as a restoration design project in 1999. The watershed of approximately 0.9 square miles is located within USGS 14-digit HUC 03020201090010 and NCDWQ Sub-basin 03-04-02 of the Neuse River Basin. The initial planning proposed to restore approximately 2,000 linear feet of channel. The restoration was designed to correct various problems with the existing stream corridor including unstable channel configuration, poor water quality, no 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 clearing and replanting the riparian areas with native vegetation. Project construction occurred in 2002. The first year monitoring was completed in 2004. This report is a description of the findings of the second year monitoring that took place in 2005.

The restoration plan called for removal of all existing vegetation along the stream banks and within the riparian buffer. The original planting of native vegetation was found to be unsuccessful during the first year monitoring. A remedial vegetation plan was designed in 2004 and planted in the same year. Vegetation was planted at a density of 680 and 890 stems per acre in the streamside and terrace slope communities, respectively. The wooden stakes marking the first year vegetation monitoring plot corners were not located during the second year. Four new plots were surveyed and the corners marked with metal conduit for second year monitoring. Second year monitoring counted an average of 739 stems per acre. Vegetation is extensive through the length of the project with minimal bare banks and slopes. Widespread microstegium growth is the most visible sign of exotic / invasive plants throughout the site. Other invasive vegetation has been noted as described within this report. The second year monitoring found the vegetation component of the project to be successful.

The stream assessment completed during the second year monitoring found the stream to be functioning and holding grade for the majority of the project. Channel dimensions have not changed drastically from the designed conditions with the exceptions of local areas of bank erosion. The stream profile does not have well defined features, but some features are discernible throughout the profile length. Most of the in-stream structures are functioning, though many are experiencing stress evidenced by localized erosion on cross vane arms. The most obvious stream problem occurs in the main channel immediately upstream of the confluence with the tributary. The cross vane directly upstream of the confluence directs flow into the downstream bank. This has resulted in severe bank erosion leaving a shear bank face of unconsolidated material that will continue to erode. This issue should be addressed to prevent further stream erosion. Other bank erosion issues of moderate concern are detailed in the report and should be monitored, but do not call for immediate action. Due to the nature of Chavis Park as an urban stream setting, it is expected that trash and urban debris will exist throughout the project site. Monitoring observed large amounts of trash in the riparian area and stream channel, including a shopping cart full of debris in one of the pools. The level of trash and debris should continue to be monitored to prevent debris from causing damaging blockages to flow or other problems.

1.0 PROJECT BACKGROUND

1.1 Location and Setting

This project is located within the city limits of Raleigh, North Carolina. From Interstate I-440 take exit 15 to Poole Road, west toward the City of Raleigh. Poole Road diverges into Martin Luther King Jr. Boulevard; continue on MLK Boulevard until you reach The City of Raleigh's Chavis Park on the north side of MLK Boulevard. Make a right and proceed north on Holmes Street; the site is on the left side (west) as soon as you turn onto Holmes Street. Refer to Figure 1.

1.2 Structure and Objectives

Before restoration, the channel of Garner Branch of Walnut Creek through Chavis Recreational Park was deeply incised and entrenched with heavy bank erosion due to urban storm runoff. The creek was restored using channel dimension, pattern, and profile modifications and the establishment of a riparian zone adjacent to the creek. Channel profile is maintained through the use of rock cross vanes. Channel pattern is maintained through the use of single vanes and vegetation along the channel banks. Due to multiple urban constraints, pattern modifications were limited throughout the project.

Table 1. Project Structure Table
Project Number and Name: 87 - Chavis Park (Garner Branch of Walnut Creek)

Segment/Reach ID	Linear Feet or Acerage
Garner Branch	1,765 feet
UT to Garner Branch	250 feet

Table 2. Project Objectives Table
Project Number and Name: 87 - Chavis Park (Garner Branch of Walnut Creek)

Segment/Reach ID	Objectives	Linear Feet or Acerage	Comment
Garner Branch	Restoration	1,765 feet	Priority 2 and Priority 3 Natural Channel Design with urban constraints
UT to Garner Branch	Restoration	250 feet	Priority 2 and Priority 3 Natural Channel Design with urban constraints
Garner Branch and UT – Riparian Areas	Establish / improve habitat	4.5 acres	Complete replanting and streamside stabilization

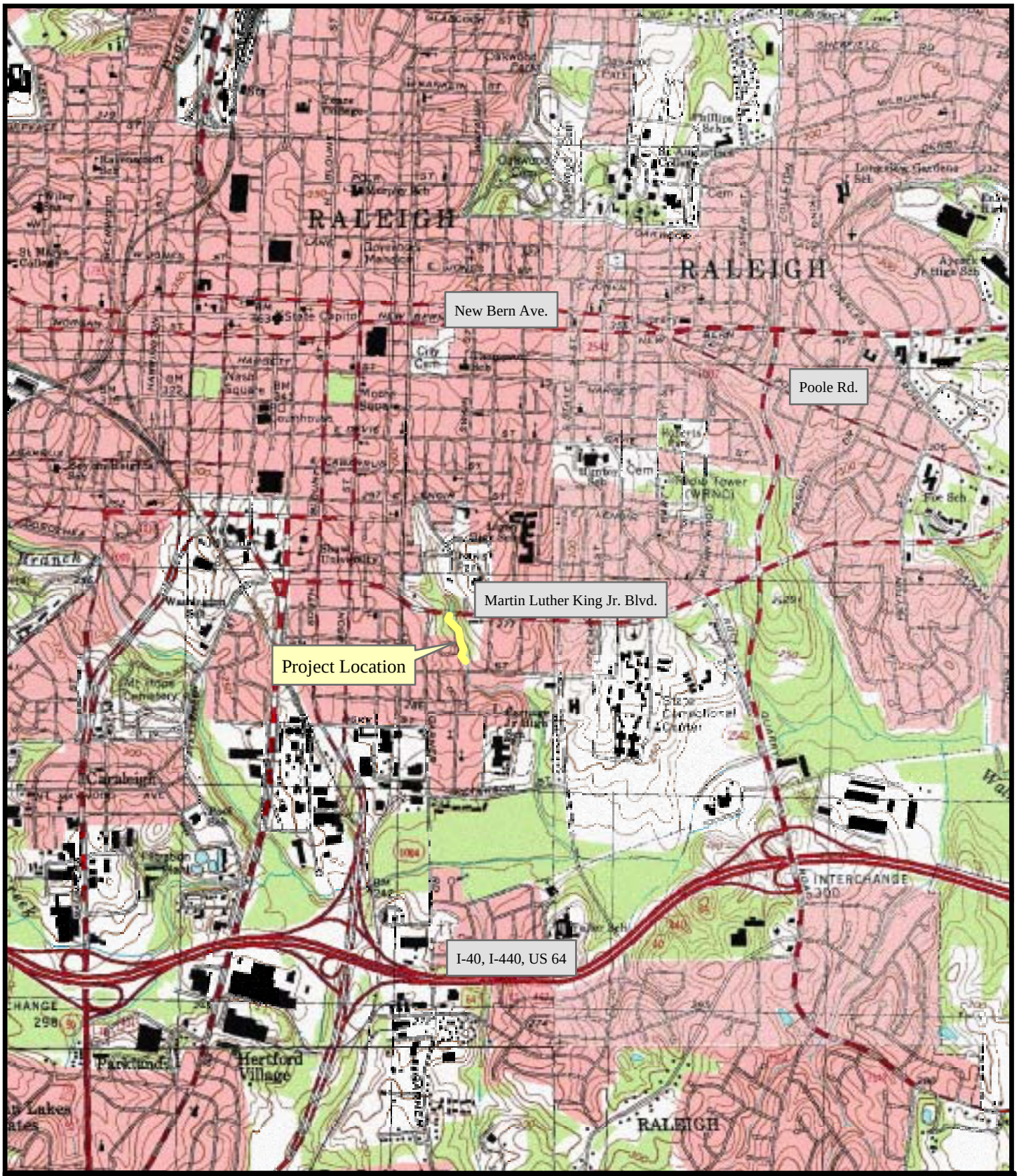

Figure 1. Site Vicinity Map
Chavis Park, Wake County, EEP Project # 87 - MY02

0.25 0.125 0 0.25 0.5 Miles

N

Date: 10/13/05
Source: USGS Topo Quads
Raleigh West, 1987
Raleigh East, 1981
Lake Wheeler, 1973
Garner, 1973.

Ecosystem Enhancement Program

KCI Associates of North Carolina, PA

1.3 Project History and Background

Table 3. Project Activity and Reporting History Project Number and Name: 87 - Chavis Park (Garner Branch of Walnut Creek)		
Activity or Report	**Calender Year of Completion or Planned Completion**	**Actual Completion Date**
Restoration Plan	2002	2002
Construction	2002	2002
As-built Report	2002	2002
Initial - Year 1 Monitoring	2003	2004
Vegetative Maintenance Plan	2004	2004
Vegetative Maintenance Planting	2004	2004
Year 2 Monitoring	2005	2005

Table 4. Project Contact Table Project Number and Name: 87 - Chavis Park (Garner Branch of Walnut Creek)
Design Firms
Becky L. Ward Consulting
1512 Eglantyne Ct.
Raleigh, NC 27613
Ecological Consultants
4216 Hope Valley Drive
Raleigh, NC 27278
Natural Areas Ecosystem Management
10015 Wright Road
Harvard, Illinois 60033
Contact: Mr. Randy Stowe
Phone: (815) 648-2253
Fax: (815) 648-2403
Construction Contractor
White Oak Construction Corporation
4020 Pea Ridge Road
New Hill, North Carolina 27562
Contact: Mr. Bruce Hollis
Phone: (919) 545-0442
Fax: (919) 545-2034
Planting and Vegetation Contractor
Tower Engineering Professionals
3703 Junction Boulevard
Raleigh, North Carolina 27603-5263
Contact: Mr. George T. Swearingen
Phone: (919) 661-6351
Fax: (919) 661-6350

Table 4. Project Contact Table cont.
Maintenance Planting and Plan Contractor
EcoScience
1101 Haynes Street, Suite 101
Raleigh, North Carolina 27604
Phone: (919) 828-3433
Monitoring Performers
MY-01
Biological & Agricultural Engineering
Water Resources Research Institute
North Carolina State University
Campus Box 7625
Raleigh, NC 27695
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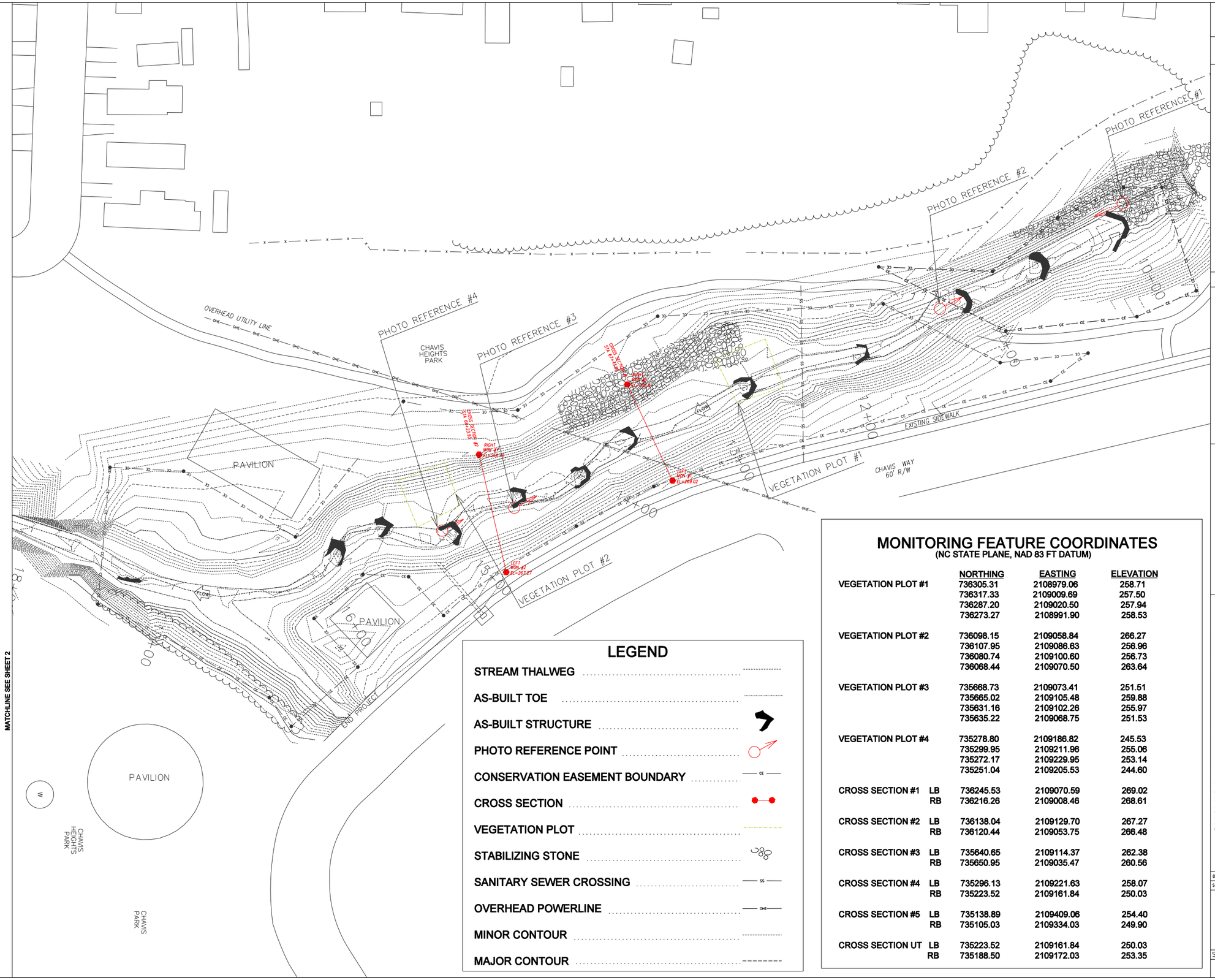
Phone: (919) 515-3723
MY-02
KCI Associates of NC
Suite 220
4602 Six Forks Rd.
Raleigh, NC 27609
Contact: Mr. Adam Spiller
Phone: (919) 783-9214
Fax: (919) 783-9266

Table 5. Project Background Table **Project Number and Name: 87 - Chavis Park (Garner Branch of Walnut Creek)**	
Project County	Wake County
Drainage Area	0.75 sq. mi. (Garner Branch)
	0.16 sq. mi. (UT)
Drainage Impervious Cover Estimate (%)	65% (Garner Branch)
	70% (UT)
Stream Order	First/Second Order (Garner Branch)
	First Order (UT)
Physiographic Region	Piedmont
Ecoregion	Northern Outer Piedmont
Rosgen Classification of As-built	C4
Dominant Soil Types	Wehadkee and Bibb Soils and Cecil Sandy Loam (Garner Branch)
	Cecil Sandy Loam (UT)
Reference Site ID	Brookhaven Park
USGS HUC for Project and Reference	03020201090010 (Garner Branch)
NCDWQ Sub-basin for Project and Reference	03-04-02 (Garner Branch)
NCDWQ Classification for Project and Reference	C - NSW (Garner Branch)
Any portion of the project segment 303d listed?	No - not rated
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%



LEGEND

- STREAM THALWEG
- AS-BUILT TOE
- AS-BUILT STRUCTURE
- PHOTO REFERENCE POINT
- CONSERVATION EASEMENT BOUNDARY
- CROSS SECTION
- VEGETATION PLOT
- STABILIZING STONE
- SANITARY SEWER CROSSING
- OVERHEAD POWERLINE
- MINOR CONTOUR
- MAJOR CONTOUR

GRAPHIC SCALE
–60 –30 0 30 60

MONITORING FEATURE COORDINATES
(NC STATE PLANE, NAD 83 FT DATUM)

		NORTHING	EASTING	ELEVATION
VEGETATION PLOT #1		736305.31	2108979.06	258.71
		736317.33	2109009.69	257.50
		736287.20	2109020.50	257.94
		736273.27	2108991.90	258.53
VEGETATION PLOT #2		736098.15	2109058.84	266.27
		736107.95	2109086.63	256.96
		736080.74	2109100.60	256.73
		736068.44	2109070.50	263.64
VEGETATION PLOT #3		735668.73	2109073.41	251.51
		735665.02	2109105.48	259.88
		735631.16	2109102.26	255.97
		735635.22	2109068.75	251.53
VEGETATION PLOT #4		735278.80	2109186.82	245.53
		735299.95	2109211.96	255.06
		735272.17	2109229.95	253.14
		735251.04	2109205.53	244.60
CROSS SECTION #1	LB	736245.53	2109070.59	269.02
	RB	736216.26	2109008.46	268.61
CROSS SECTION #2	LB	736138.04	2109129.70	267.27
	RB	736120.44	2109053.75	266.48
CROSS SECTION #3	LB	735640.65	2109114.37	262.38
	RB	735650.95	2109035.47	260.56
CROSS SECTION #4	LB	735296.13	2109221.63	258.07
	RB	735223.52	2109161.84	250.03
CROSS SECTION #5	LB	735138.89	2109409.06	254.40
	RB	735105.03	2109334.03	249.90
CROSS SECTION UT	LB	735223.52	2109161.84	250.03
	RB	735188.50	2109172.03	253.35

REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED

Ecosystem Enhancement Program

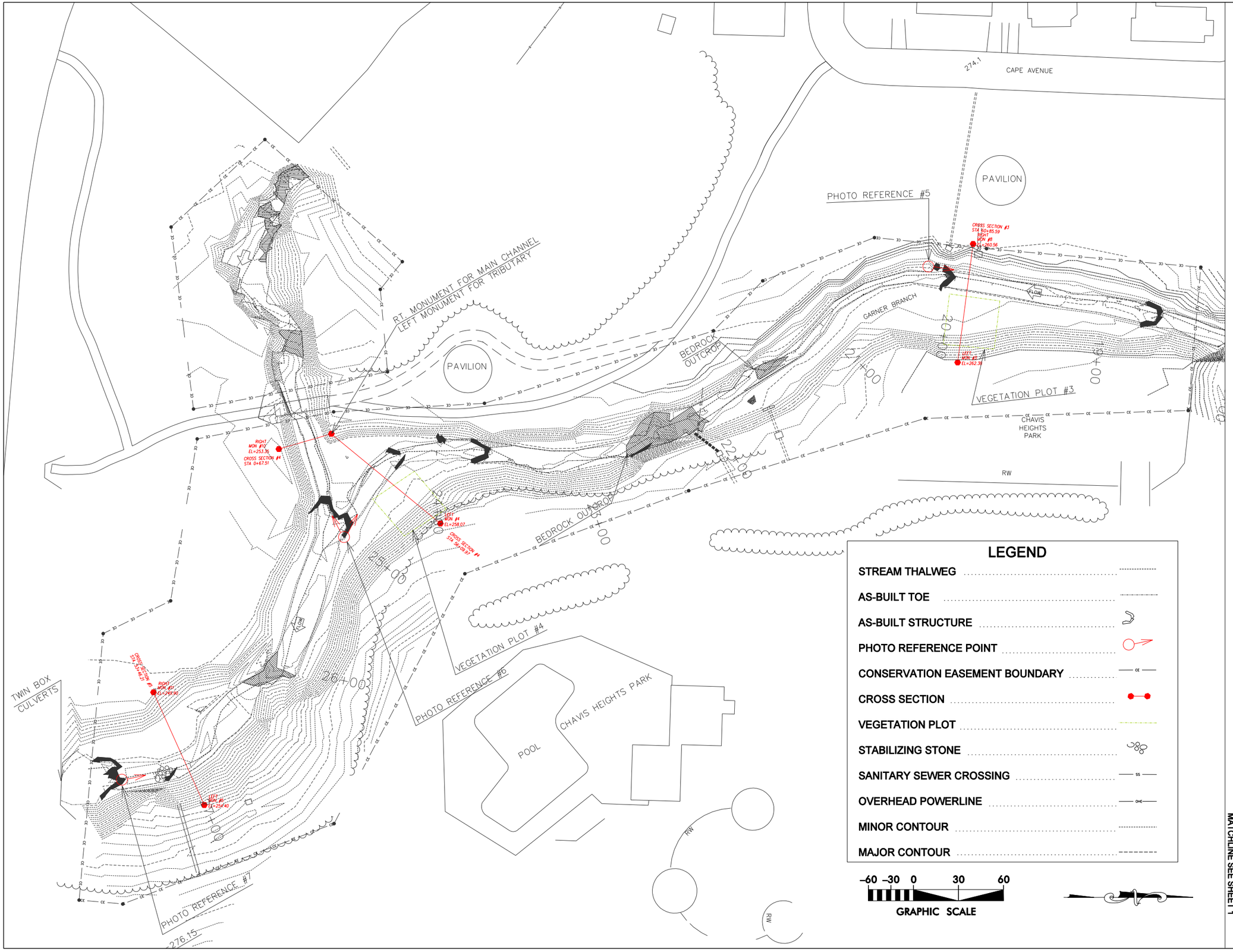
KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

CHAVIS PARK (GARNER BRANCH)
MONITORING PLAN VIEW
WAKE COUNTY
EEP PROJECT NUMBER 87 - MY02
STATION 00+00 TO STATION 17+64

DATE: JANUARY 2006
SCALE: SEE SHEET

MONITORING PLAN VIEW SHEET 1

SHEET 1 OF 2



LEGEND

- STREAM THALWEG
- AS-BUILT TOE
- AS-BUILT STRUCTURE
- PHOTO REFERENCE POINT
- CONSERVATION EASEMENT BOUNDARY
- CROSS SECTION
- VEGETATION PLOT
- STABILIZING STONE
- SANITARY SEWER CROSSING
- OVERHEAD POWERLINE
- MINOR CONTOUR
- MAJOR CONTOUR

–60 –30 0 30 60

GRAPHIC SCALE

MATCHLINE SEE SHEET 1

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVED

Ecosystem Enhancement Program

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

CHAVIS PARK (GARNER BRANCH) MONITORING PLAN VIEW WAKE COUNTY EEP PROJECT NUMBER 87 - MY02

STATION 00+00 TO STATION 17+64

DATE: JANUARY 2006
SCALE: SEE SHEET

MONITORING PLAN VIEW SHEET 2

SHEET 2 OF 2

2.0 PROJECT CONDITIONS AND MONITORING RESULTS

2.1 Vegetation Assessment

2.1.1 Soil Data

Table 6. Preliminary Soil Data
Project Number and Name: 87 - Chavis Park (Garner Branch of Walnut Creek)

Series	Max Depth (in.)	% Clay on Surface	K	T	% OM
Cecil (CeD)	75	5-20	0.28	4	0.5-2.0
Cecil (CeC2)	52	5-20	N/A	N/A	0.5-2.0
Wehadkee and Bibb (Wo)	36	5-20	N/A	N/A	2.0-5.0

2.1.2 Vegetative Problem Areas

Table 7. Vegetative Problem Areas
Project Number and Name: 87 - Chavis Park (Garner Branch of Walnut Creek)

Feature/Issue	Station # / Range	Probable Cause	Photo #
Invasive/Exotic Population	Scattered Throughout	Japanese Honeysuckle: previously established	VP1
	Scattered Throughout	Japanese Hops: unknown cause	VP2
	Sparse Throughout	Chinese Privet: previously established	VP3
	Scattered Throughout	English Ivy: previously established	VP4
	Heavy Throughout	Microstegium: upstream seed source	VP5

2.1.3 Vegetative Problem Area Plan View

See stream problem area plan view in Appendix A2.

2.1.4 Stem Counts

Table 8. Stem counts for each species arranged by plot

Project Number and Name: 87 - Chavis Park (Garner Branch of Walnut Creek)

Species	Plots				Initial Totals	Year 2 Totals	Survival %
	1	2	3	4			
Shrubs							
Viburnum nudum	2	1	2	5	N/A	10	N/A
Cornus amomum	6	4	4	3	N/A	17	N/A
Ilex verticillata	2	2			N/A	4	N/A
Ilex glabra		1			N/A	1	N/A
Myrica cerifera	2				N/A	2	N/A
Callicarpa americana		4		1	N/A	5	N/A
Alnus serrulata	1	1	3	1	N/A	6	N/A
Trees							
Platanus occidentalis	4	3	6	1	N/A	14	N/A
Hamamelis virginiana	1	5			N/A	6	N/A
Fraxinus pennsylvanica		3	3		N/A	6	N/A
Liriodendron tulipifera		1		2	N/A	3	N/A
Betula nigra			1		N/A	1	N/A

Monitoring year 01 revealed poor survival of planted species within the vegetation plots. The first year monitoring report recommended that the project area be replanted with larger containerized trees. Maintenance planting throughout the entire site was completed in 2004. The vegetation plot corners established during monitoring year 01 could not be found and new plots were established and permanently marked for monitoring year 02. The species indicated in Table 8 above are predominantly from the maintenance planting. A few species from the original planting are also included in the stem count.

2.1.5 Vegetation Plot Photos

See vegetation plot photos in Appendix A4.

2.2 Stream Assessment

2.2.1 Stream Problem Areas Plan View

See stream problem area plan view in Appendix B1.

2.2.2 Stream Problem Areas Table

Table 9. Stream Problem Areas
Project Number and Name: 87 - Chavis Park (Garner Branch of Walnut Creek)

Feature Issue	Station numbers	Suspected Cause	Photo #
Aggradation/Bar Formation	11+00	aggradation - unknown	SP1
	14+25	aggradation - sediment influx from upstream eroding bank	
	16+50	aggradation - unknown	
	18+80	aggradation - channel too wide	
	20+10	aggradation - unknown	
	20+25	aggradation - channel too wide	
	23+00	aggradation - unknown	
Bank Scour	11+25	unknown	SP2
	13+75	unknown	
	14+50	debris caused flow to damage banks	
	16+25	unknown	
	20+50	unknown	
	24+50	cross vane misdirected towards bank	
Engineered Structures - back or arm scour	14+40	unknown	SP3
	14+90	unknown	
	20+00	poor fill behind arm	
	24+25	installed at an incorrect angle to stream	
	24+90	poor fill behind arm	
	27+10	unknown	
Excessive Trash	throughout	typical of urban setting	SP4

2.2.3 Stream Issue Photos

Example issue photos can be found in Appendix B2

2.2.4 Fixed Station Photos

Stream photos from established photo stations can be found in Appendix B3

2.2.5 Stream Assessment Tables

Table 10a. Categorical Stream Feature Visual Stability Assessment
Project Number and Name: 87 - Chavis Park (Garner Branch of Walnut Creek)
Segment/Reach: Garner Branch (1750 ft.)

Feature	Initial	MY - 01	MY - 02	MY - 03	MY - 04	MY - 05
A. Riffles	100%	N/A	83%			
B. Pools	100%	N/A	83%			
C. Thalweg	100%	N/A	88%			
D. Meanders	100%	N/A	69%			
E. Bed General	100%	N/A	97%			
F. Channel General	100%	N/A	100%			
G. Banks	100%	N/A	97%			
H. Vanes / J Hooks etc.	100%	N/A	83%			

Table 10b. Categorical Stream Feature Visual Stability Assessment
Project Number and Name: 87 - Chavis Park (Garner Branch of Walnut Creek)
Segment/Reach: UT to Garner Branch (250 ft.)

Feature	Initial	MY - 01	MY - 02	MY - 03	MY - 04	MY - 05
A. Riffles	100%	N/A	95%			
B. Pools	100%	N/A	100%			
C. Thalweg	100%	N/A	100%			
D. Meanders	100%	N/A	100%			
E. Bed General	100%	N/A	100%			
F. Channel General	100%	N/A	100%			
G. Banks	100%	N/A	100%			
H. Vanes / J Hooks etc.	100%	N/A	100%			

2.2.6 Quantitative Measures Summary Tables

Table 11a. Baseline Morphology and Hydraulic Summary
Project Number and Name: 87 - Chavis Park (Garner Branch of Walnut Creek)
Segment Reach: Garner Branch (1,750 ft.)

Parameter	USGS Gage Data			Pre-Existing Condition			Project Reference Stream			Design			As-built		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Bankfull Width (ft)				12	24	16	10	15.6	12.8	21	25	23	16.4	44.8	35.8
Floodprone Width (ft)				52	57		19	33	27	40	63	52	35.5	74	49
Bankfull Cross Sectional Area (ft^2)						18.6	5.5	11.8	8.6			25	19.9	41	23.8
Bankfull Mean Depth (ft)				1.4	2	1.55	0.55	0.8	0.67	1.1	1.3	1.2	0.53	1.4	0.96
Bankfull Maximum Depth (ft)				3	3.8		1	1.2	1.1	1.7	2	1.8	1.54	3.06	2.01
Width/Depth Ratio						7.7	18.2	20.6	19.4	18	21	19	11.7	84.5	31.4
Entrenchment Ratio						4.5	1.9	3.3	2.6	1.9	2.5	2.2	1.51	3.1	1.93
Hydraulic Radius (ft)															
Pattern															
Channel Beltwidth (ft)				19	50	37	28	41	34.5	35	50	43			
Radius of Curvature (ft)				8	31	20	12	35	23.5	23	40	32			
Meander Wavelength (ft)						96			47	70	108	80			
Meander Width Ratio						3	2.2	3.2	2.7	1.5	2.2	1.9			
Profile															
Riffle Length (ft)															
Riffle Slope (ft/ft)															
Pool Length (ft)															
Pool Spacing (ft)				44	95	69	40	50	45	50	78	64			
Substrate															
d50 (mm)						3			16			3	1.04	19	9
d84 (mm)						11.5			70			11.5			
Additional Reach Parameters															
Valley Length (ft)															
Channel Length (ft)															
Sinuosity					1.05			1.7			1.1				
Water Surface Slope (ft/ft)															
BF Slope (ft/ft)															
Rosgen Classification					E4			C4			C4			C4	

Table 11b. Baseline Morphology and Hydraulic Summary
Project Number and Name: 87 - Chavis Park (Garner Branch of Walnut Creek)
Segment Reach: UT to Garner Branch (250 ft.)

Parameter	USGS Gage Data			Pre-Existing Condition			Project Reference Stream			Design			As-built		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Bankfull Width (ft)															17.1
Floodprone Width (ft)															24
Bankfull Cross Sectional Area (ft^2)															27
Bankfull Mean Depth (ft)															1.57
Bankfull Maximum Depth (ft)															2.57
Width/Depth Ratio															
Entrenchment Ratio															1.4
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)															17
d84 (mm)															
Additional Reach Parameters															
Valley Length (ft)															
Channel Length (ft)															
Sinuosity															
Water Surface Slope (ft/ft)															
BF Slope (ft/ft)															
Rosgen Classification															

Table 12. Morphology and Hydraulic Monitoring Summary
Project Number and Name: 87 - Chavis Park (Garner Branch of Walnut Creek)
Segment / Reach: Garner Branch (1,750 ft.)

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)	15.2	13.0					14.7	13.0					15.1	16.0				
Floodprone Width (ft)		33.0						42.0						51.0				
Bankfull Cross Sectional Area (ft^2)	12.8	15.2					22.1	18.3					15.8	18.3				
Bankfull Mean Depth (ft)	0.8	1.2					1.5	1.4					1.0	1.1				
Bankfull Maximum Depth (ft)	1.7	1.9					2.1	1.9					1.7	1.9				
Width/Depth Ratio	18.1	11.1					9.8	9.2					15.1	14.0				
Entrenchment Ratio		2.5						3.2						3.2				
Wetted Perimeter (ft)		14.1						14.1						16.8				
Hydraulic Radius (ft)		1.1						1.3						1.1				
Substrate																		
d50 (mm)	0.6	12.5					0.7	0.9					0.7	8.8				
d84 (mm)	9.5	28.0					10.5	39.0					10.5	20.0				

Table 12 cont. Morphology and Hydraulic Monitoring Summary
Project Number and Name: 87 - Chavis Park (Garner Branch of Walnut Creek)
Segment / Reach: Garner Branch (1,750 ft.) and UT to Garner Branch (250 ft.)

Parameter	Cross Section 4 Pool						Cross Section 5 Pool						Cross Section UT Riffle					
Dimension	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	19.2	20.5					25.5	21.2					14.6	12.0				
Floodprone Width (ft)		77.0						46.0						20.0				
Bankfull Cross Sectional Area (ft^2)	25.0	37.2					22.4	23.3					12.0	13.9				
Bankfull Mean Depth (ft)	1.3	1.8					0.9	1.1					0.8	1.2				
Bankfull Maximum Depth (ft)	2.3	3.3					1.6	1.8					1.3	1.7				
Width/Depth Ratio	14.8	11.3					28.3	19.3					18.3	10.4				
Entrenchment Ratio		3.8						2.2						1.7				
Wetted Perimeter (ft)		22.2						22.0						13.4				
Hydraulic Radius (ft)		1.7						1.1						1.0				
Substrate																		
d50 (mm)	0.9	2.1					1.0	0.9					1.3	17.0				
d84 (mm)	5.8	10.0					6.8	18.0					19.2	33.0				

Table 12. Morphology and Hydraulic Monitoring Summary continued

Project Number and Name: 87 - Chavis Park (Garner Branch of Walnut Creek)

Segment Reach: Garner Branch (1,750 ft.)

Parameter	MY - 01 (2004)			MY - 02 (2005)			MY - 03 (2006)			MY - 04 (2007)			MY - 05 (2008)		
Pattern*	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	24	56	33	13	44	29									
Radius of Curvature (ft)	28	87	66	15	80	50									
Meander Wavelength (ft)	83	104	100	72	113	84									
Meander Width Ratio	1.58	3.71	2.18	1.6	4.1	2.6									
Profile															
Riffle Length (ft)	22	71	31	4	52	20									
Riffle Slope (ft/ft)	0.62%	4.53%	1.49%	1.06%	12.50%	2.60%									
Pool Length (ft)	9	51	18	6	57	22									
Pool Spacing (ft)	19	402	61	9	404	44									
Additional Reach Parameters															
Valley Length (ft)				1,550											
Channel Length (ft)				1,773											
Sinuosity				1.15											
Number of Bankfull Events				0											
Extent of BF Floodplain (acres)															

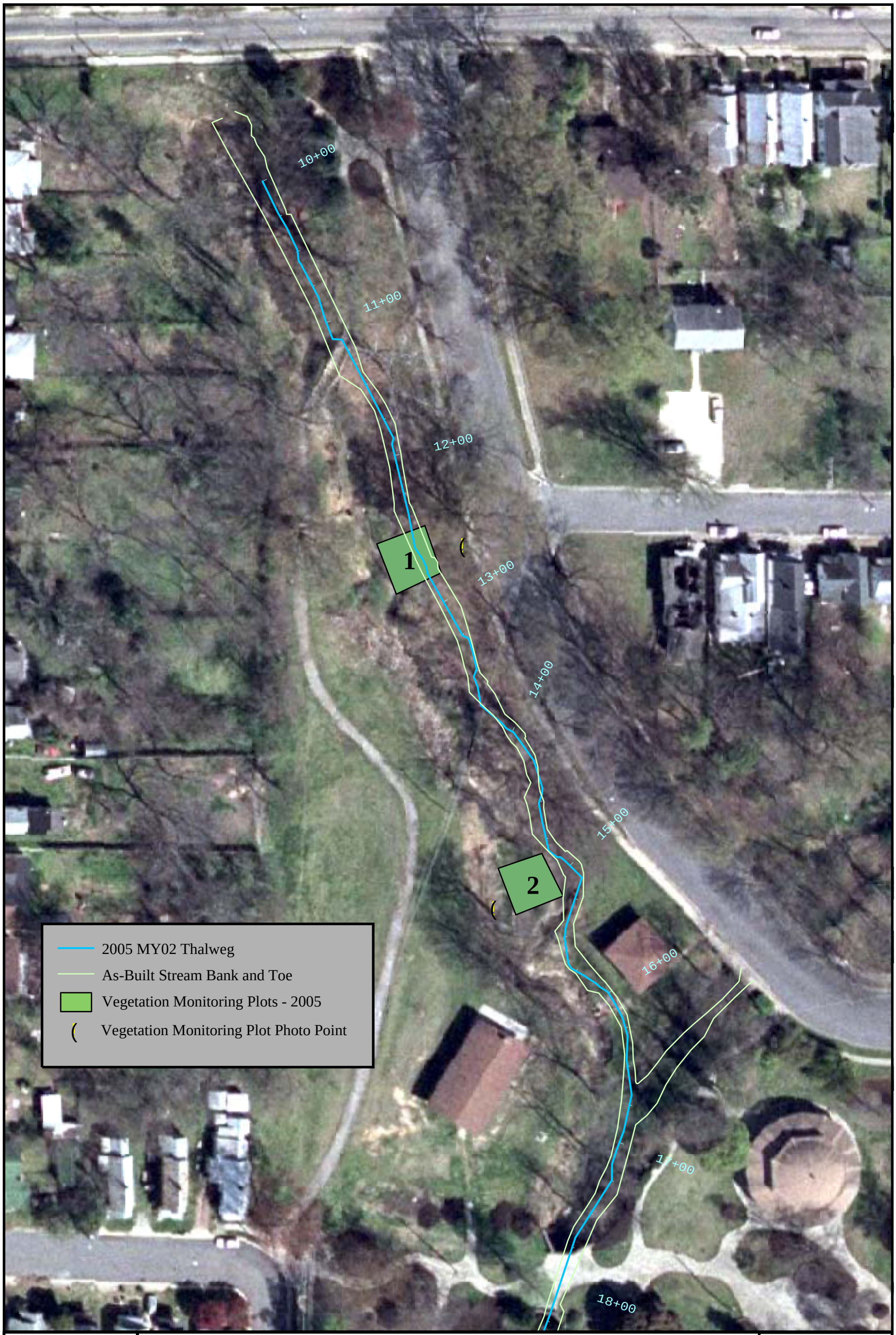
*Pattern measurements for MY - 02 calculated from approximately station 11+00 to 16+50, where the stream was re-meandered.

Appendix A
Vegetation Raw Data

App A1 - Vegetation Data Sheet

Chavis Park (Garner Branch) Stream Restoration
Date : 7/28/05
Crew : A. Spiller

Plot #	Winterberry *Ilex verticillata*	Silky Dogwood *Cornus amomum*	Green Ash *Fraxinus pennsylvanica*	Tag Alder *Alnus Serrulata*	Witch Hazel *Hamamelis virginiana*	Possum Haw *Viburnum nudum*	River Birch *Betula nigra*	Sycamore *Platanus occidentalis*	Tulip Poplar *Liriodendron tulipifera*	Beauty Berry *Callicarpa americana*	Wax Myrtle *Myrica cerifera*	Inkberry *Ilex glabra*	Total (Year 2)	**Density (Trees/Acre)**
1	2	6		1	1			4			2		16	648
2	2	4	3	1	5	1		3	1	4		1	25	1012
3		4	3	3		2	1	6					19	769
4		3		1		5		1	2	1			13	526
										Average Density			739	



Appendix A2a: Vegetative Problem Area Plan View
Chavis Park, Wake County, EEP Project Number 87 - MY02

30 15 0 30 60 Feet

1 inch = 60 feet

N

Date: 10-10-05

Note: No significant vegetative problem areas other than scattered invasive species.

Source: USGS High Resolution Orthoimage, Raleigh-Durham, NC, 2003.

Ecosystem Enhancement Program

KCI Associates of North Carolina, PA

Appendix A2b: Vegetative Problem Area Plan View
Chavis Park, Wake County, EEP Project Number 87 - MY02

30 15 0 30 60 Feet

1 inch = 60 feet

N

Date: 10-10-05

Note: No significant vegetative problem areas other than scattered invasive species.

Source: USGS High Resolution Orthoimage, Raleigh-Durham, NC, 2003.

Ecosystem Enhancement Program

KCI ASSOCIATES OF NORTH CAROLINA, PA

App A3 – Representative Vegetation Problem Area Photos

VP1 – Microstegium on stream bank continues sporadically throughout site. Photo taken near station 01+50. 8/16/05 - MY 02

VP2 – Japanese honeysuckle (*Lonicera japonica*) on stream bank and sewer pipe. Photo taken near station 22+00. 10/13/05 - MY 02

VP3 – Japanese hops (*Humulus japonicus*) on stream bank. Photo taken near station 23+50. 10/13/05 - MY 02

VP4 – Chinese privet (*Ligustrum sinense*) on stream bank. Photo taken near station 24+00. 10/13/05 - MY 02

VP5 – English ivy (*Hedera helix*) on stream bank. Photo taken near station 20+75. 10/13/05 - MY 02

App A4 - Vegetation Monitoring Plot Photos

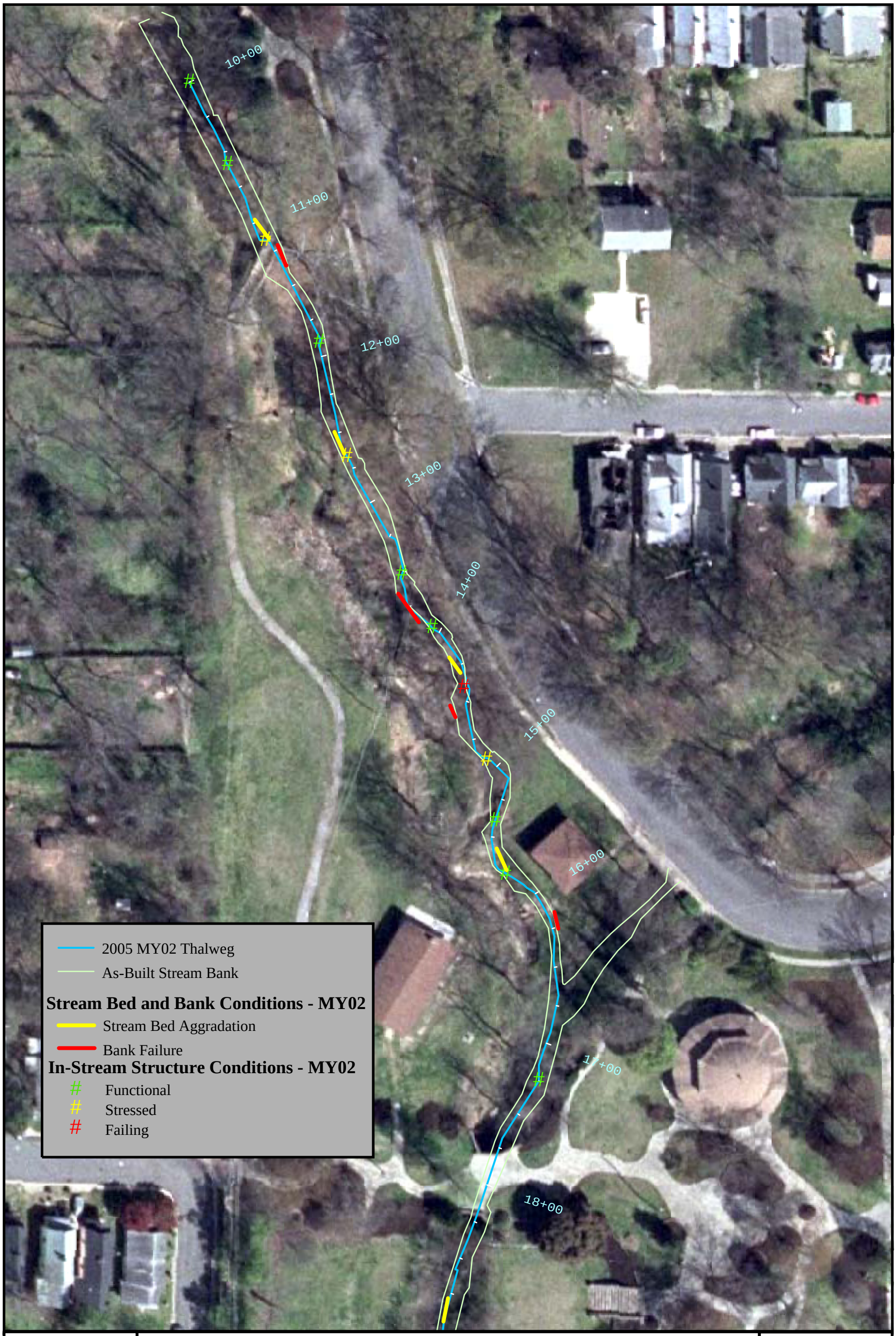
Plot 1 Photo – Taken looking at center of plot on right bank from top of left bank. 7/28/05 - MY 02.

Plot 2 Photo – Taken looking at center of plot from top of right bank. 7/28/05 - MY 02.

Plot 3 Photo – Taken looking at center of plot from top of left bank. 7/28/05 - MY 02.

Plot 4 Photo – Taken looking at center of plot from top of left bank. 7/28/05 - MY 02.

Appendix B
Geomorphologic Raw Data



Appendix B1a: Stream Problem Area Plan View
Chavis Park, Wake County, EEP Project Number 87 - MY02

30 15 0 30 60 Feet

1 inch = 60 feet

N

Date: 10-10-05

Note: Length of bank and aggradation problems approximated.

Source: USGS High Resolution Orthoimage, Raleigh-Durham, NC, 2003.

Ecosystem Enhancement Program

KCI Associates of North Carolina, PA

Appendix B1b: Stream Problem Area Plan View
Chavis Park, Wake County, EEP Project Number 87 - MY02

30 15 0 30 60 Feet

1 inch = 60 feet

N

Date: 10-10-05

Note: Length of bank and aggradation problems approximated.

Source: USGS High Resolution Orthoimage, Raleigh-Durham, NC, 2003.

Ecosystem Enhancement Program

KCI Associates of North Carolina, PA

App B2 – Representative Stream Problem Area Photos

SP1 – Mid-channel bar forming. Photo taken near station 18+90. 10/13/05 - MY 02

SP2 – Bank erosion/slumping. Photo taken near station 24+50. 8/16/05 - MY 02

SP3 – Back arm scour on cross vane. Photo taken near station 24+90. 10/13/05 - MY 02

SP4 – Excessive trash, shopping cart and caught trash and debris filling pool. Photo taken near station 14+40. 8/16/05 - MY 02

App B3 –Stream Photo-Station Photos

Photo Point 1 – 10/13/05 - MY 02

Photo Point 2 – 10/13/05 - MY 02

Photo Point 3 – 10/13/05 - MY 02

Photo Point 4 – 10/13/05 - MY 02

Photo Point 5 – 10/13/05 - MY 02

Photo Point 6 (Garner Branch) – 10/13/05 - MY 02

Photo Point 6 (UT) – 10/13/05 - MY 02

Photo Point 7 – 10/13/05 - MY 02

App B4 –Qualitative Visual Stability Assessment

Table B1. Qualitative Visual Stability Assessment
Project Number 87 - Chavis Park (Garner Branch of Walnut Creek)
Segment/Reach: Garner Branch (1,750 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?	17	18	N/A	94	
	2. Armor stable (e.g. no displacement)?	16	18	N/A	89	
	3. Facet grade appears stable?	16	18	N/A	89	
	4. Stable interval grade?	16	18	N/A	89	
	5. Feature spacing appropriate?	15	18	N/A	83	
	6. Minimal evidence of embedding/fining?	13	18	N/A	72	
	7. Depth appears appropriate for current discharge?	12	18	N/A	67	
	8. Length appropriate?	15	18	N/A	83	**83**
B. Pools	1. Present? (e.g. no severe aggradation)	24	28	N/A	86	
	2. Sufficiently deep (Dmax pool:Mean Bkf > 1.6?)	22	28	N/A	79	
	3. Thalweg located outer bend?	21	28	N/A	75	
	4. Feature spacing appropriate?	24	28	N/A	86	
	5. Non-aggrading?	24	28	N/A	86	
	6. Length appropriate?	24	28	N/A	86	**83**
C. Thalweg	1. Upstream of meander bend centering?	14	16	N/A	88	
	2. Downstream of meander centering?	14	16	N/A	88	**88**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	14	16	N/A	94	
	2. Of those eroding, # w/ concomitant point bar formation?	0	1	N/A	0	
	3. Apparent Rc within spec?	13	16	N/A	81	
	4. Sufficient floodplain access and relief?	16	16	N/A	100	**69**
E. Bed General	1.General channel bed aggradation areas (bar formation)	N/A	N/A	5/114	93	
	2. Channel bed degradation - areas of increasing down cutting or head cutting?	N/A	N/A	0/0	100	**97**
F. Channel Capac / Dimen.	1. Channel width:depth appears out of design/type spec?	N/A	N/A	0/0	100	**100**
G. Banks	1. Apparent scour points from channel processes	N/A	N/A	4/44	1.3	
	2. Apparent cut points from overland flow	N/A	N/A	0/0	0.0	
	3. Apparent cut or scour from flood water re-entry to channel (e.g. inadequate floodplain access?)	N/A	N/A	0/0	0.0	
	4. Tension cracks	N/A	N/A	2/20	0.6	
	5. Unstable cantilever blocks (e.g. height/undercut/soil type versus vegetation penetration and extent)	N/A	N/A	0/0	0.0	
	6. Collapse/slumping	N/A	N/A	3/40	1.1	
	7. Ratio of bank height: bankfull height elevated	N/A	N/A	0/0	0.0	**97**
H. Vanes	1. Free of back or arm scour?	13	19	N/A	68	
	2. Height appropriate?	16	19	N/A	84	
	3. Angle and geometry appear appropriate?	18	19	N/A	95	
	4. Free of piping or other structural failures?	16	19	N/A	84	**83**

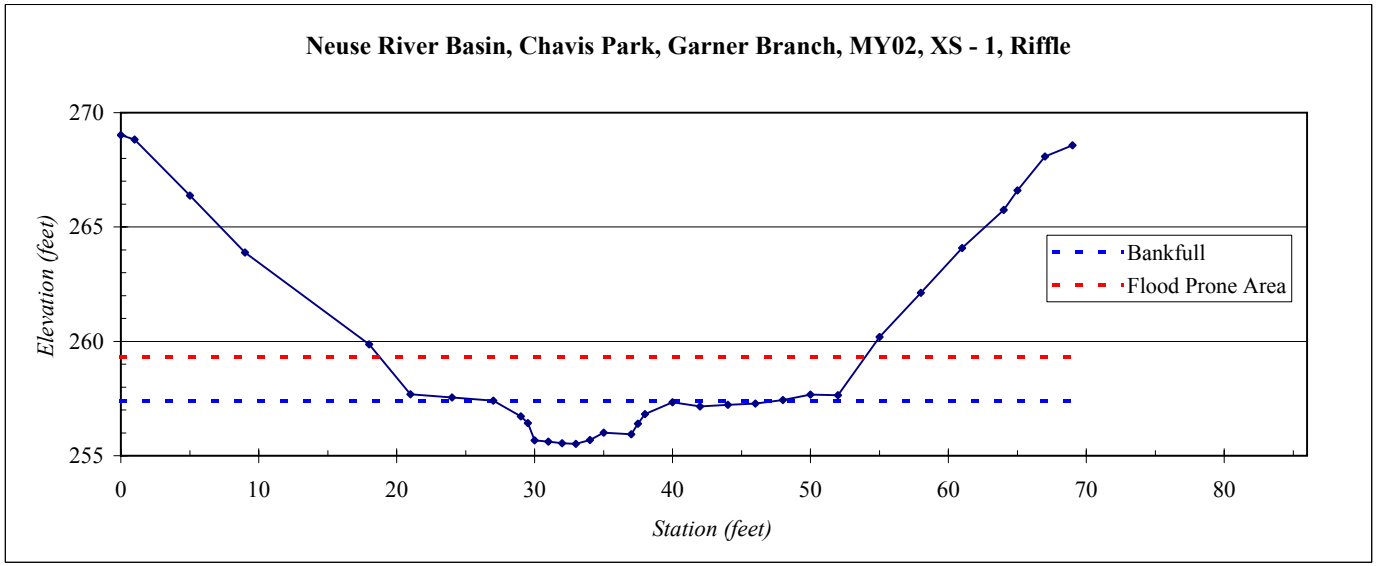
* Total number of features per as-built estimated from as-built profile and planview sheets.

App. B5 - Cross Section Plots and Data Tables

River Basin:	Neuse
Watershed:	Chavis Park, Garner Branch, MY02
XS ID	XS - 1, Riffle
Drainage Area (sq mi):	
Date:	8/2/2005
Field Crew:	A. Spiller, K. Knight

Station	Rod Ht.	Elevation
0	2.01	269.02
1	2.2	268.83
5	4.65	266.38
9	7.15	263.88
18	11.16	259.87
21	13.34	257.69
24	13.48	257.55
27	13.62	257.41
29	14.31	256.72
29.5	14.6	256.43
30	15.36	255.67
31	15.42	255.61
32	15.49	255.54
33	15.51	255.52
34	15.34	255.69
35	15.02	256.01
37	15.09	255.94
37.5	14.63	256.40
38	14.21	256.82
40	13.7	257.33
42	13.87	257.16
44	13.81	257.22
46	13.75	257.28
48	13.6	257.43
50	13.36	257.67
52	13.38	257.65
55	10.84	260.19
58	8.91	262.12
61	6.95	264.08
64	5.28	265.75
65	4.43	266.60
67	2.94	268.09
69	2.46	268.57

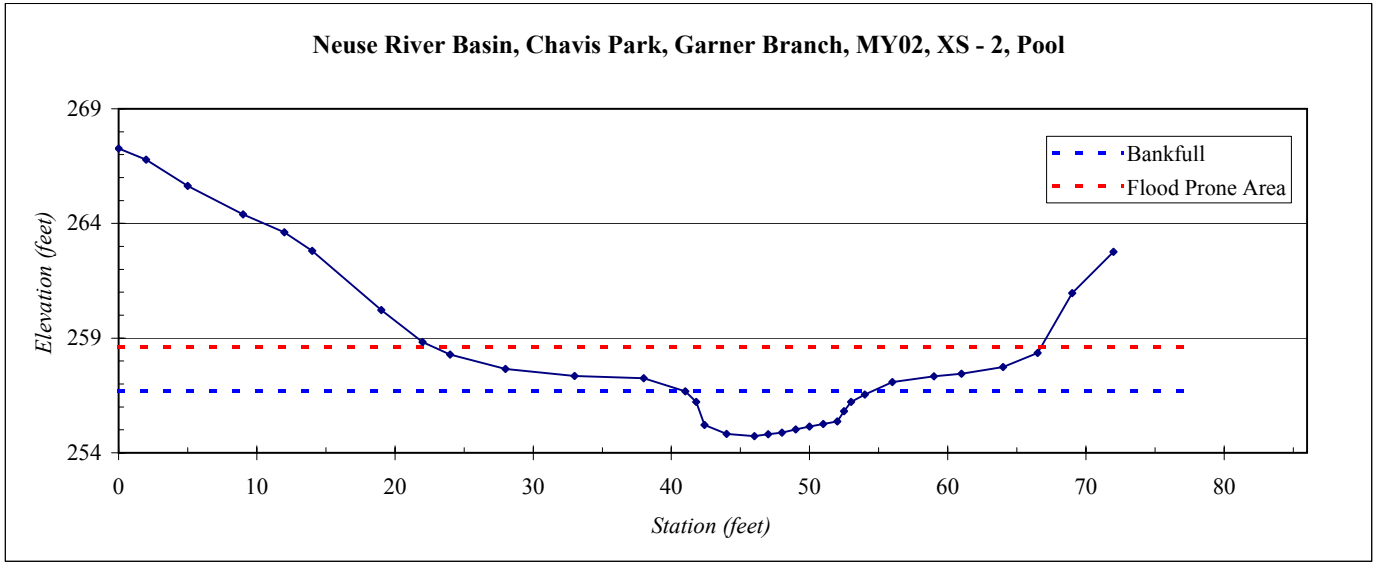
SUMMARY DATA	
Bankfull Elevation:	257.4
Bankfull Cross-Sectional Area:	15.2
Bankfull Width:	13.0
Flood Prone Area Elevation:	259.3
Flood Prone Width:	33.0
Max Depth at Bankfull:	1.9
Mean Depth at Bankfull:	1.2
W / D Ratio:	11.1
Entrenchment Ratio:	2.5
Bank Height Ratio:	0.8



River Basin:	Neuse
Watershed:	Chavis Park, Garner Branch, MY02
XS ID	XS - 2, Pool
Drainage Area (sq mi):	
Date:	8/2/2005
Field Crew:	A. Spiller, K. Knight

Station	Rod Ht.	Elevation
0	1.22	267.27
2	1.71	266.78
5	2.85	265.64
9	4.09	264.40
12	4.88	263.61
14	5.68	262.81
19	8.27	260.22
22	9.66	258.83
24	10.21	258.28
28	10.84	257.65
33	11.14	257.35
38	11.24	257.25
41	11.81	256.68
41.8	12.27	256.22
42.4	13.27	255.22
44	13.67	254.82
46	13.76	254.73
47	13.68	254.81
48	13.61	254.88
49	13.47	255.02
50	13.35	255.14
51	13.23	255.26
52	13.12	255.37
52.5	12.68	255.81
53	12.27	256.22
54	11.95	256.54
56	11.41	257.08
59	11.16	257.33
61	11.04	257.45
64	10.75	257.74
66.5	10.13	258.36
69	7.53	260.96
72	5.73	262.76
75	3.87	264.62
77	2.76	265.73
78	2.05	266.44

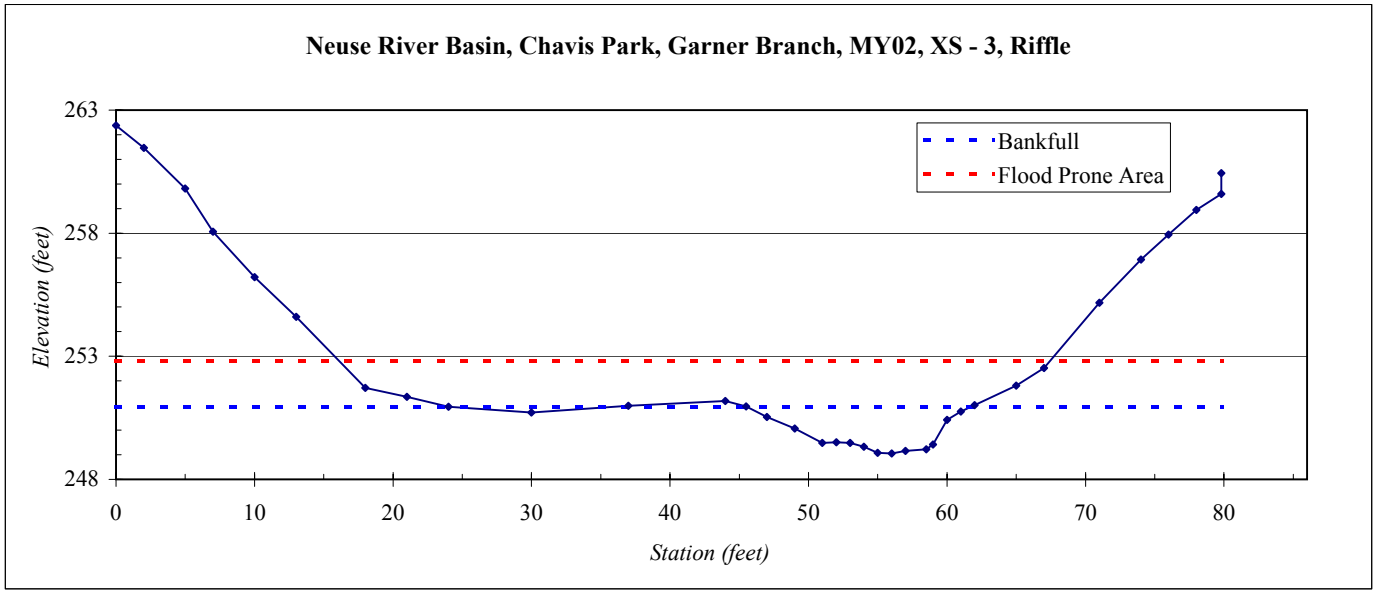
SUMMARY DATA	
Bankfull Elevation:	256.7
Bankfull Cross-Sectional Area:	18.3
Bankfull Width:	13.0
Flood Prone Area Elevation:	258.6
Flood Prone Width:	42.0
Max Depth at Bankfull:	2.0
Mean Depth at Bankfull:	1.4
W / D Ratio:	9.2
Entrenchment Ratio:	3.2
Bank Height Ratio:	0.7



River Basin:	Neuse
Watershed:	Chavis Park, Garner Branch, MY02
XS ID	XS - 3, Riffle
Drainage Area (sq mi):	
Date:	8/2/2005
Field Crew:	A. Spiller, K. Knight

Station	Rod Ht.	Elevation
0	1.44	262.38
2	2.36	261.46
5	4.01	259.81
7	5.76	258.06
10	7.6	256.22
13	9.22	254.60
18	12.1	251.72
21	12.47	251.35
24	12.87	250.95
30	13.1	250.72
37	12.83	250.99
44	12.63	251.19
45.5	12.86	250.96
47	13.29	250.53
49	13.75	250.07
51	14.34	249.48
52	14.31	249.51
53	14.34	249.48
54	14.5	249.32
55	14.74	249.08
56	14.77	249.05
57	14.66	249.16
58.5	14.6	249.22
59	14.4	249.42
60	13.4	250.42
61	13.06	250.76
62	12.81	251.01
65	12.01	251.81
67	11.3	252.52
71	8.65	255.17
74	6.89	256.93
76	5.88	257.94
78	4.87	258.95
79.8	4.23	259.59
79.8	3.38	260.44

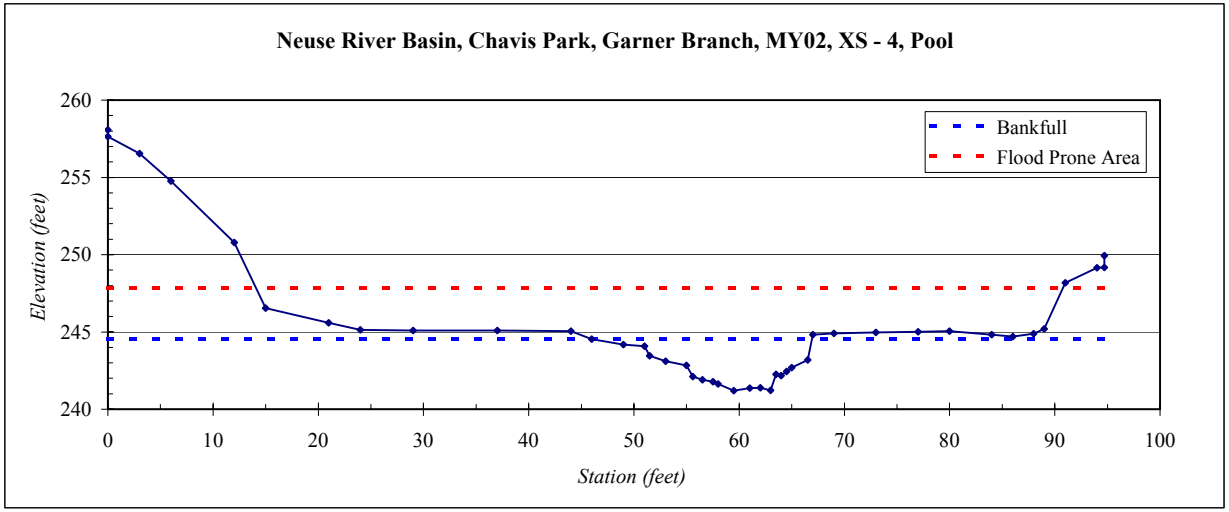
SUMMARY DATA	
Bankfull Elevation:	250.9
Bankfull Cross-Sectional Area:	18.3
Bankfull Width:	16.0
Flood Prone Area Elevation:	252.8
Flood Prone Width:	51.0
Max Depth at Bankfull:	1.9
Mean Depth at Bankfull:	1.1
W / D Ratio:	14.0
Entrenchment Ratio:	3.2
Bank Height Ratio:	1.0



River Basin:	Neuse
Watershed:	Chavis Park, Garner Branch, MY02
XS ID	XS - 4, Pool
Drainage Area (sq mi):	
Date:	8/2/2005
Field Crew:	A. Spiller, K. Knight

Station	Rod Ht.	Elevation
0	-1.39	258.07
0	-0.96	257.64
3	0.14	256.54
6	1.91	254.77
12	5.9	250.78
15	10.14	246.54
21	11.08	245.60
24	11.55	245.13
29	11.59	245.09
37	11.58	245.10
44	11.62	245.06
46	12.15	244.53
49	12.49	244.19
51	12.61	244.07
51.5	13.22	243.46
53	13.57	243.11
55	13.84	242.84
55.6	14.56	242.12
56.5	14.77	241.91
57.5	14.89	241.79
58	15.05	241.63
59.5	15.47	241.21
61	15.32	241.36
62	15.3	241.38
63	15.46	241.22
63.5	14.42	242.26
64	14.5	242.18
64.5	14.24	242.44
65	13.98	242.70
66.5	13.5	243.18
67	11.85	244.83
69	11.78	244.90
73	11.71	244.97
77	11.67	245.01
80	11.62	245.06
84	11.86	244.82
86	11.97	244.71
88	11.8	244.88
89	11.49	245.19
91	8.5	248.18
94	7.52	249.16
94.7	7.51	249.17
94.7	6.74	249.94

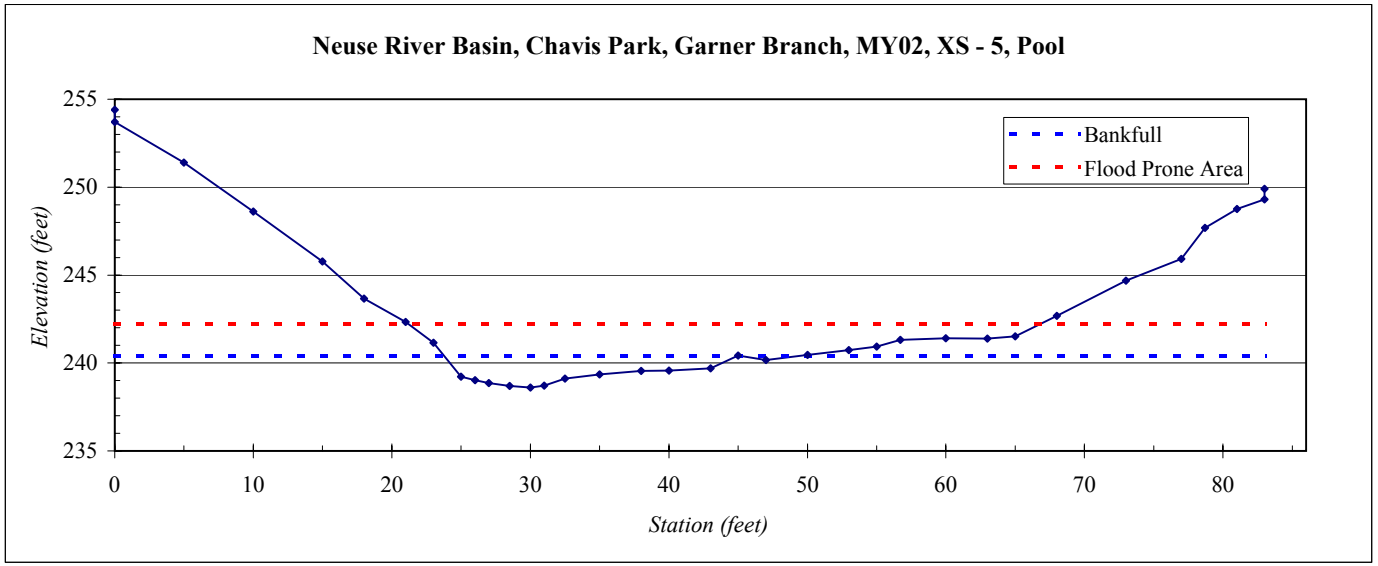
SUMMARY DATA	
Bankfull Elevation:	244.5
Bankfull Cross-Sectional Area:	37.2
Bankfull Width:	20.5
Flood Prone Area Elevation:	247.9
Flood Prone Width:	77.0
Max Depth at Bankfull:	3.3
Mean Depth at Bankfull:	1.8
W / D Ratio:	11.3
Entrenchment Ratio:	3.8
Bank Height Ratio:	0.8



River Basin:	Neuse
Watershed:	Chavis Park, Garner Branch, MY02
XS ID	XS - 5, Pool
Drainage Area (sq mi):	
Date:	8/2/2005
Field Crew:	A. Spiller, K. Knight

Station	Rod Ht.	Elevation
0	0.27	254.40
0	0.97	253.70
5	3.28	251.39
10	6.05	248.62
15	8.89	245.78
18	11.01	243.66
21	12.33	242.34
23	13.51	241.16
25	15.44	239.23
26	15.65	239.02
27	15.82	238.85
28.5	15.97	238.70
30	16.06	238.61
31	15.95	238.72
32.5	15.56	239.11
35	15.32	239.35
38	15.12	239.55
40	15.1	239.57
43	14.97	239.70
45	14.25	240.42
47	14.5	240.17
50	14.21	240.46
53	13.94	240.73
55	13.74	240.93
56.7	13.36	241.31
60	13.27	241.40
63	13.28	241.39
65	13.16	241.51
68	11.99	242.68
73	9.99	244.68
77	8.75	245.92
78.7	6.98	247.69
81	5.92	248.75
83	5.37	249.30
83	4.77	249.90

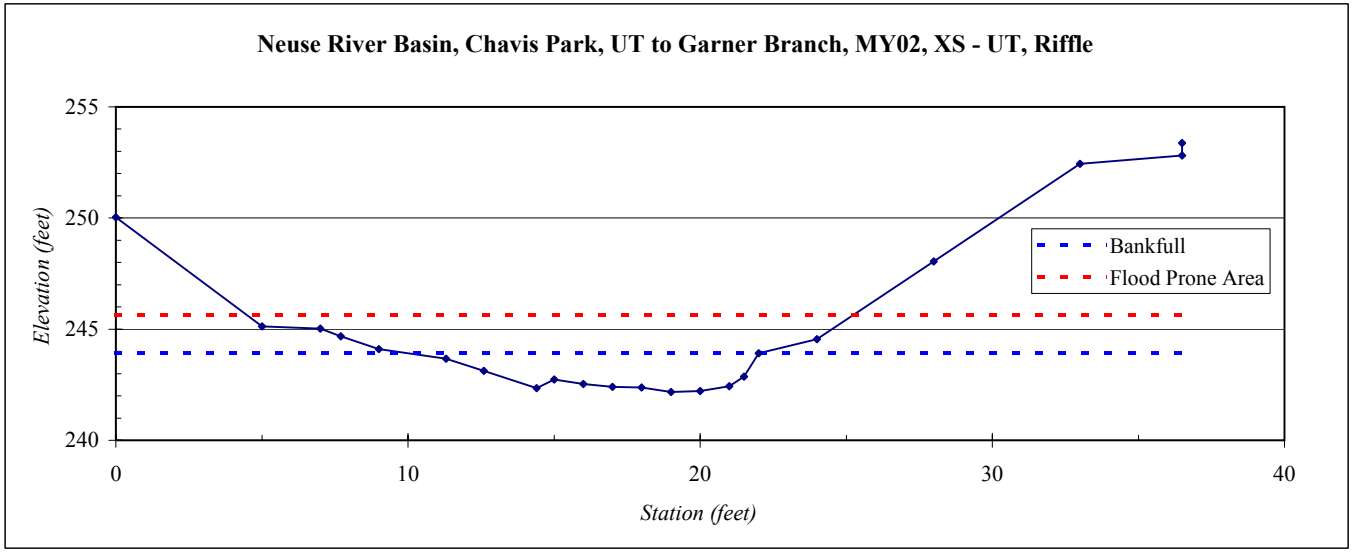
SUMMARY DATA	
Bankfull Elevation:	240.4
Bankfull Cross-Sectional Area:	23.3
Bankfull Width:	21.2
Flood Prone Area Elevation:	242.2
Flood Prone Width:	46.0
Max Depth at Bankfull:	1.8
Mean Depth at Bankfull:	1.1
W / D Ratio:	19.3
Entrenchment Ratio:	2.2
Bank Height Ratio:	0.8



River Basin:	Neuse
Watershed:	Chavis Park, UT to Garner Branch, MY02
XS ID	XS - UT, Riffle
Drainage Area (sq mi):	
Date:	8/2/2005
Field Crew:	A. Spiller, K. Knight

Station	Rod Ht.	Elevation
0	6.14	250.03
5	11.05	245.12
7	11.15	245.02
7.7	11.49	244.68
9	12.07	244.10
11.3	12.5	243.67
12.6	13.04	243.13
14.4	13.83	242.34
15	13.43	242.74
16	13.64	242.53
17	13.76	242.41
18	13.79	242.38
19	13.99	242.18
20	13.96	242.21
21	13.73	242.44
21.5	13.3	242.87
22	12.25	243.92
24	11.62	244.55
28	8.12	248.05
33	3.73	252.44
36.5	3.36	252.81
36.5	2.79	253.38

SUMMARY DATA	
Bankfull Elevation:	243.9
Bankfull Cross-Sectional Area:	13.9
Bankfull Width:	12.0
Flood Prone Area Elevation:	245.7
Flood Prone Width:	20.0
Max Depth at Bankfull:	1.7
Mean Depth at Bankfull:	1.2
W / D Ratio:	10.4
Entrenchment Ratio:	1.7
Bank Height Ratio:	0.9



Appendix B6 - Longitudinal Profile
Chavis Park (Garner Branch), Wake County
EEP Project Number 87 - MY02

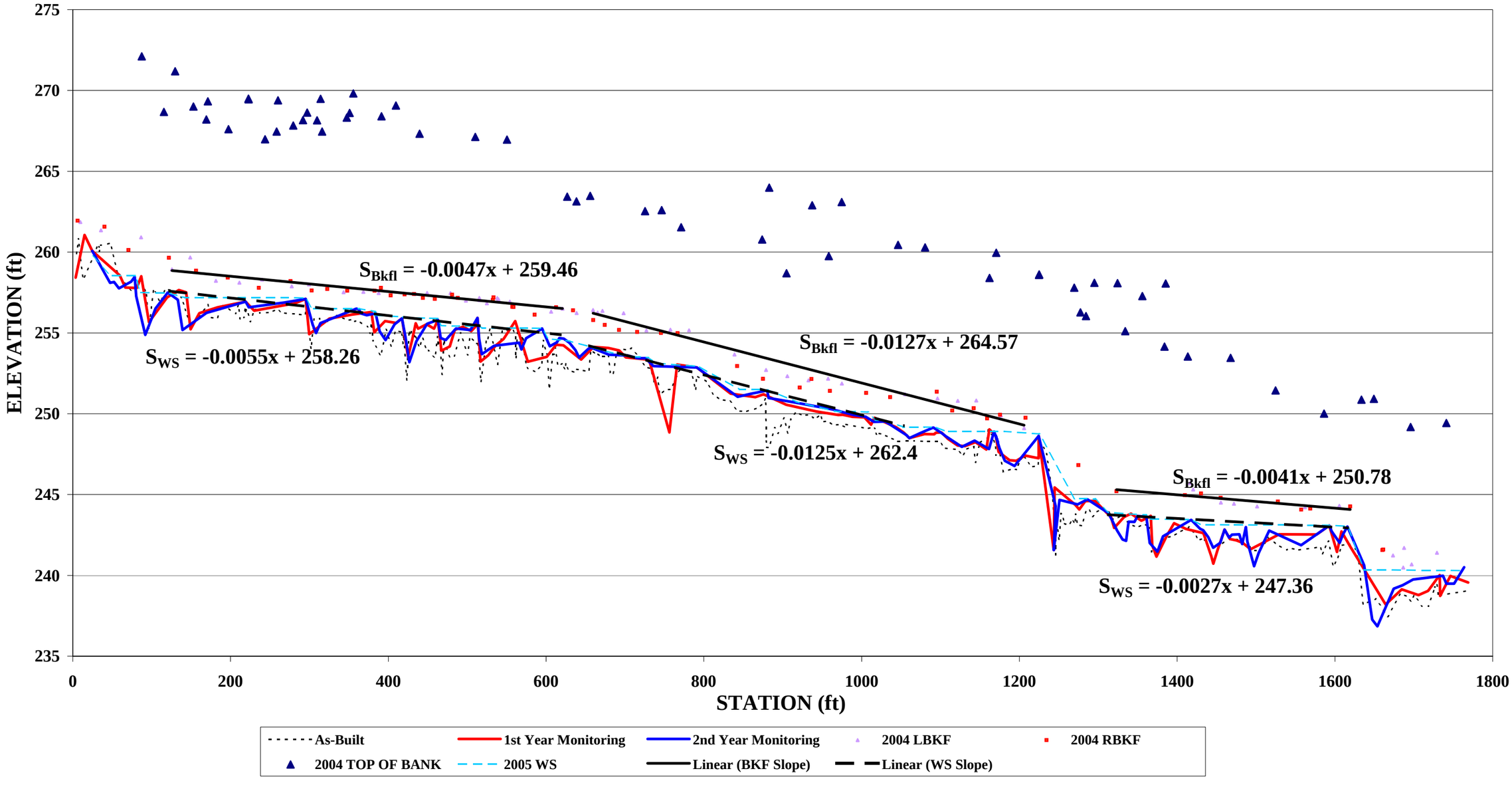


Table B2: Profile Points
Chavis Park (Garner Branch), Wake County
EEP Project number 87 - MY02

TW Station*	TW Elevation*	TW Station*	TW Elevation*	TW Station*	TW Elevation*	TW Station*	TW Elevation*
24.58	260.07	565.83	254.39	1174.74	247.88	1615.75	243.02
47.20	258.10	568.67	253.98	1181.42	247.09	1637.10	240.62
52.39	258.15	574.64	254.67	1193.90	246.77	1647.28	237.26
58.39	257.76	591.38	255.15	1224.54	248.63	1653.91	236.85
73.91	258.17	594.97	255.28	1246.04	244.30	1674.57	239.18
78.54	258.47	604.58	254.17	1243.59	241.56	1686.06	239.39
80.49	257.27	613.79	254.42	1250.84	244.67	1699.17	239.75
91.82	254.88	616.84	254.68	1273.88	244.39	1737.12	239.98
104.87	256.51	622.51	254.64	1286.45	244.70	1741.35	239.49
120.36	257.50	629.86	254.38	1312.83	243.86	1751.03	239.49
133.22	257.05	637.26	253.94	1317.41	243.42	1763.90	240.50
139.12	255.18	641.98	253.48	1323.50	242.80		
169.41	256.24	653.64	254.02	1330.89	242.22		
219.10	256.94	657.19	254.09	1335.26	242.14		
223.08	256.58	679.46	253.65	1338.46	243.32		
268.80	256.89	703.28	253.60	1345.82	243.31		
295.22	257.10	716.18	253.44	1349.77	243.67		
304.16	255.50	725.88	253.44	1361.08	243.62		
308.49	254.99	736.09	252.95	1365.23	242.00		
313.90	255.61	791.09	252.87	1374.95	241.47		
359.41	256.50	842.81	251.05	1382.07	242.42		
363.11	256.45	859.42	251.23	1417.77	243.43		
364.96	256.21	880.37	251.44	1428.99	242.88		
372.66	256.10	882.00	250.97	1433.17	242.79		
383.98	256.21	914.58	250.71	1439.57	242.36		
389.04	255.10	963.06	250.27	1445.57	241.71		
396.43	254.56	989.84	249.93	1454.59	242.01		
408.04	255.54	1005.23	249.81	1460.22	242.83		
417.31	255.90	1015.62	249.50	1465.77	242.33		
421.67	254.74	1030.01	249.52	1469.49	242.52		
426.72	253.19	1056.83	248.68	1478.88	242.54		
435.57	254.49	1060.58	248.49	1482.55	241.94		
449.28	255.57	1075.36	248.82	1487.21	242.99		
462.85	255.80	1090.87	249.15	1489.06	242.08		
466.51	254.68	1102.28	248.77	1497.47	240.57		
472.86	254.56	1106.52	248.62	1503.36	241.38		
485.81	255.28	1127.07	247.95	1516.78	242.77		
504.15	255.18	1143.11	248.34	1557.13	241.87		
513.11	255.93	1161.58	247.82	1592.94	243.08		
515.20	254.63	1167.84	248.90	1596.11	242.72		
518.50	253.69	1172.76	248.23	1606.06	242.01		
534.14	254.21	1170.00	248.65	1610.31	242.54		

*Stations and elevations adjusted to align with existing profile.

Table B3: Water Surface Points
Chavis Park (Garner Branch), Wake County
EEP Project number 87 - MY02

WS Station*	WS Elevation*
25.00	259.74
48.00	258.55
80.00	258.55
85.00	257.50
123.00	257.47
136.00	257.25
142.00	257.20
173.00	257.20
218.00	257.18
267.00	257.18
295.50	257.17
303.00	256.50
304.00	256.50
363.20	256.50
383.00	256.32
384.00	256.30
380.00	256.10
417.50	256.00
421.00	255.95
447.00	255.92
462.90	255.90
467.00	255.45
490.00	255.42
516.00	255.41
519.00	255.30
564.00	255.30
571.00	255.30
577.00	255.30
595.00	255.29
602.00	254.72
606.00	254.62
618.00	254.56
630.00	254.50
655.00	254.15
671.00	253.92
695.00	253.63
717.00	253.50
730.00	253.48
740.00	253.12
794.00	252.93
845.00	251.50
881.00	251.48

WS Station*	WS Elevation*
917.00	250.75
966.00	250.15
992.00	250.13
1008.00	250.10
1018.00	249.60
1032.00	249.54
1053.00	249.18
1059.00	249.18
1079.00	249.18
1095.00	249.16
1106.00	248.92
1110.00	248.92
1147.00	248.92
1172.00	248.91
1181.00	248.91
1225.00	248.75
1270.00	244.74
1285.00	244.74
1295.90	244.73
1313.00	243.90
1340.00	243.80
1361.00	243.75
1361.20	243.70
1363.00	243.48
1418.00	243.47
1429.00	243.15
1467.00	243.12
1593.00	243.10
1616.00	243.04
1637.00	240.35
1764.00	240.30

*Stations and elevations adjusted to align with existing profile.

Table B3: Riffle and Pool Measurements
Chavis Park (Garner Branch), Wake County
EEP Project number 87 - MY02

Riffle Measurements			
Station	Length	WS Elev	WS Slope
51	23	259.7	0.0526
73		258.6	
149	13	257.5	0.0288
162		257.1	
311	9	256.7	0.0134
320		256.5	
376	4	256.1	0.0108
379		256.0	
622	19	254.6	0.0234
641		254.1	
697	22	253.9	0.0202
719		253.5	
743	23	253.4	0.0106
765		253.2	
819	52	252.6	0.0286
871		251.1	
991	27	250.2	0.0205
1018		249.6	
1033	10	249.5	0.0318
1044		249.2	
1120	11	248.7	0.0149
1132		248.5	
1335	26	244.1	0.0337
1361		243.3	
1471	15	243.0	0.0370
1486		242.4	
1676	21	242.2	0.1251
1697		239.5	

Pool Measurements		
Station	Length	P-P Spacing
79	22	9
100		
109	24	34
134		
168	30	45
198		
243	46	31
289		
320	10	51
330		
381	19	96
400		
496	19	78
515		
593	3	61
596		
657	24	404
681		
1085	5	66
1090		
1157	16	18
1173		
1191	6	10
1197		
1207	57	22
1264		
1285	37	44
1322		
1366	21	32
1387		
1418	17	58
1435		
1493	15	25
1508		
1532	24	99
1557		
1656	14	27
1670		
1697	37	67
1735		
1801	23	
1824		

App B7 - Pebble Count Plots and Raw Data Tables

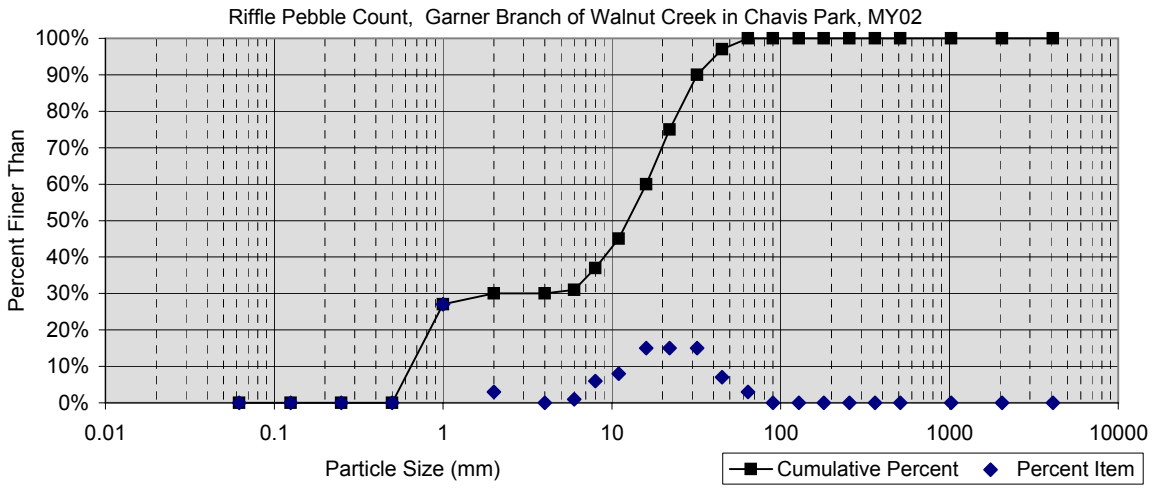
Riffle Pebble Count

Material	Size Range (mm)		Count
silt/clay	0	0.062	
very fine sand	0.062	0.13	
fine sand	0.13	0.25	
medium sand	0.25	0.5	
coarse sand	0.5	1	**27**
very coarse sand	1	2	**3**
very fine gravel	2	4	
fine gravel	4	6	**1**
fine gravel	6	8	**6**
medium gravel	8	11	**8**
medium gravel	11	16	**15**
coarse gravel	16	22	**15**
coarse gravel	22	32	**15**
very coarse gravel	32	45	**7**
very coarse gravel	45	64	**3**
small cobble	64	90	
medium cobble	90	128	
large cobble	128	180	
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
bedrock			
Total Particle Count:			100

Riffle Pebble Count,

	Garner Branch of Walnut Creek in Chavis Park, MY02
	Neuse

Note:	**XS 1**



Size percent less than (mm)				
D16	D35	D50	D84	D95
0.754	7.27	12.5	28	41

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
0%	30%	70%	0%	0%	0%

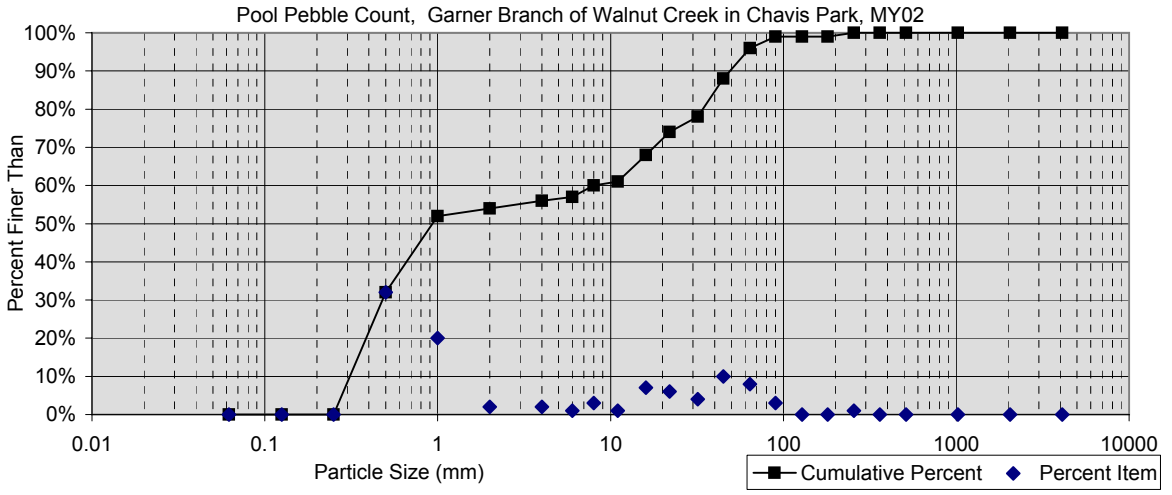
Pool Pebble Count

Pool Pebble Count,

Material	Size Range (mm)		Count	
silt/clay	0	0.062		# #
very fine sand	0.062	0.13		# #
fine sand	0.13	0.25		# #
medium sand	0.25	0.5	**32**	# #
coarse sand	0.5	1	**20**	# #
very coarse sand	1	2	**2**	# #
very fine gravel	2	4	**2**	# #
fine gravel	4	6	**1**	# #
fine gravel	6	8	**3**	# #
medium gravel	8	11	**1**	# #
medium gravel	11	16	**7**	# #
coarse gravel	16	22	**6**	# #
coarse gravel	22	32	**4**	# #
very coarse gravel	32	45	**10**	# #
very coarse gravel	45	64	**8**	# #
small cobble	64	90	**3**	# #
medium cobble	90	128		# #
large cobble	128	180		# #
very large cobble	180	256	**1**	# #
small boulder	256	362		# #
small boulder	362	512		# #
medium boulder	512	1024		# #
large boulder	1024	2048		# #
very large boulder	2048	4096		# #
bedrock				#
		Total Particle Count:	100	

	Garner Branch of Walnut Creek in Chavis Park, MY02
	Neuse

Note:	**XS 2**



Size percent less than (mm)				
D16	D35	D50	D84	D95
0.354	0.55	0.9	39	61

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
0%	54%	42%	4%	0%	0%

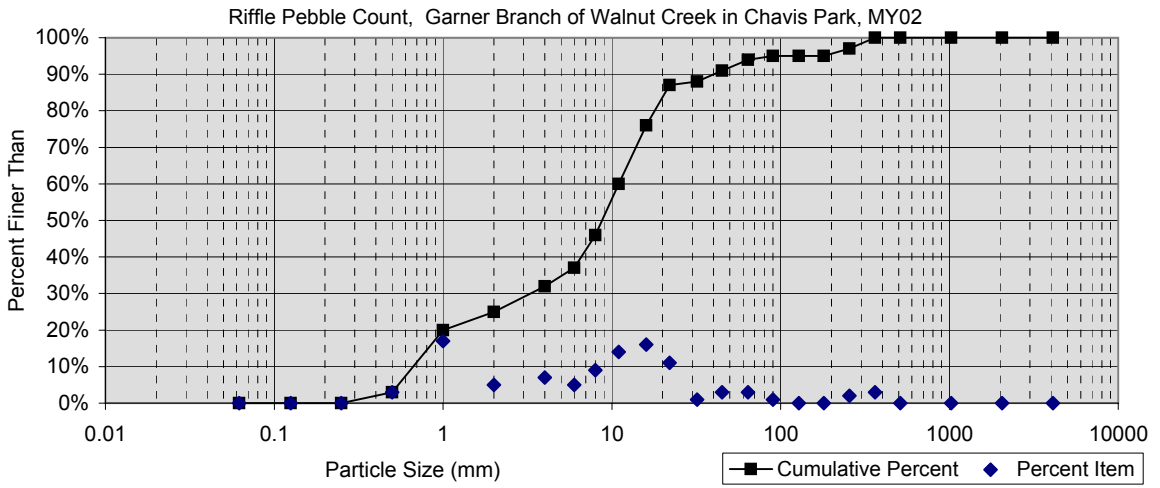
Riffle Pebble Count

Riffle Pebble Count,

Material	Size Range (mm)		Count	
silt/clay	0	0.062		# #
very fine sand	0.062	0.13		# #
fine sand	0.13	0.25		# #
medium sand	0.25	0.5	**3**	# #
coarse sand	0.5	1	**17**	# #
very coarse sand	1	2	**5**	# #
very fine gravel	2	4	**7**	# #
fine gravel	4	6	**5**	# #
fine gravel	6	8	**9**	# #
medium gravel	8	11	**14**	# #
medium gravel	11	16	**16**	# #
coarse gravel	16	22	**11**	# #
coarse gravel	22	32	**1**	# #
very coarse gravel	32	45	**3**	# #
very coarse gravel	45	64	**3**	# #
small cobble	64	90	**1**	# #
medium cobble	90	128		# #
large cobble	128	180		# #
very large cobble	180	256	**2**	# #
small boulder	256	362	**3**	# #
small boulder	362	512		# #
medium boulder	512	1024		# #
large boulder	1024	2048		# #
very large boulder	2048	4096		# #
bedrock				#
	Total Particle Count:		100	

	Garner Branch of Walnut Creek in Chavis Park, MY02
	Neuse

Note:	**XS 3**



Size percent less than (mm)				
D16	D35	D50	D84	D95
0.850	5.10	8.8	20	90

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
0%	25%	69%	3%	3%	0%

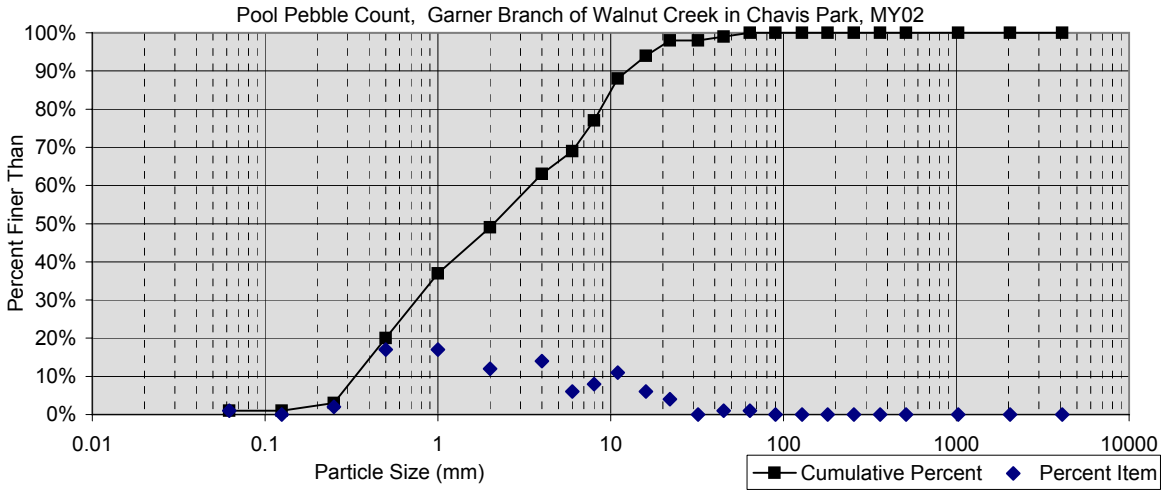
Pool Pebble Count

Pool Pebble Count,

Material	Size Range (mm)		Count	
silt/clay	0	0.062	**1**	# #
very fine sand	0.062	0.13		# #
fine sand	0.13	0.25	**2**	# #
medium sand	0.25	0.5	**17**	# #
coarse sand	0.5	1	**17**	# #
very coarse sand	1	2	**12**	# #
very fine gravel	2	4	**14**	# #
fine gravel	4	6	**6**	# #
fine gravel	6	8	**8**	# #
medium gravel	8	11	**11**	# #
medium gravel	11	16	**6**	# #
coarse gravel	16	22	**4**	# #
coarse gravel	22	32		# #
very coarse gravel	32	45	**1**	# #
very coarse gravel	45	64	**1**	# #
small cobble	64	90		# #
medium cobble	90	128		# #
large cobble	128	180		# #
very large cobble	180	256		# #
small boulder	256	362		# #
small boulder	362	512		# #
medium boulder	512	1024		# #
large boulder	1024	2048		# #
very large boulder	2048	4096		# #
bedrock				#
		Total Particle Count:	100	

	Garner Branch of Walnut Creek in Chavis Park, MY02
	Neuse

Note:	**XS 4**



Size percent less than (mm)				
D16	D35	D50	D84	D95
0.425	0.92	2.1	10	17

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
1%	48%	51%	0%	0%	0%

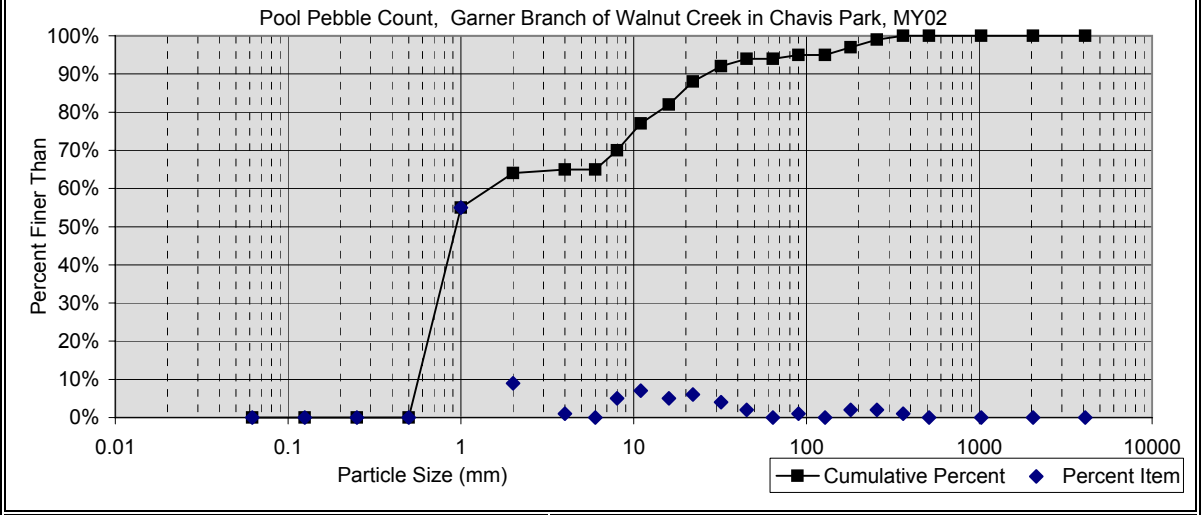
Pool Pebble Count

Pool Pebble Count,

Material	Size Range (mm)		Count	
silt/clay	0	0.062		# #
very fine sand	0.062	0.13		# #
fine sand	0.13	0.25		# #
medium sand	0.25	0.5		# #
coarse sand	0.5	1	**55**	# #
very coarse sand	1	2	**9**	# #
very fine gravel	2	4	**1**	# #
fine gravel	4	6		# #
fine gravel	6	8	**5**	# #
medium gravel	8	11	**7**	# #
medium gravel	11	16	**5**	# #
coarse gravel	16	22	**6**	# #
coarse gravel	22	32	**4**	# #
very coarse gravel	32	45	**2**	# #
very coarse gravel	45	64		# #
small cobble	64	90	**1**	# #
medium cobble	90	128		# #
large cobble	128	180	**2**	# #
very large cobble	180	256	**2**	# #
small boulder	256	362	**1**	# #
small boulder	362	512		# #
medium boulder	512	1024		# #
large boulder	1024	2048		# #
very large boulder	2048	4096		# #
bedrock				#
		Total Particle Count:	100	

	Garner Branch of Walnut Creek in Chavis Park, MY02
	Neuse

Note:	**XS 5**



Size percent less than (mm)				
D16	D35	D50	D84	D95
0.612	0.78	0.9	18	90

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
0%	64%	30%	5%	1%	0%

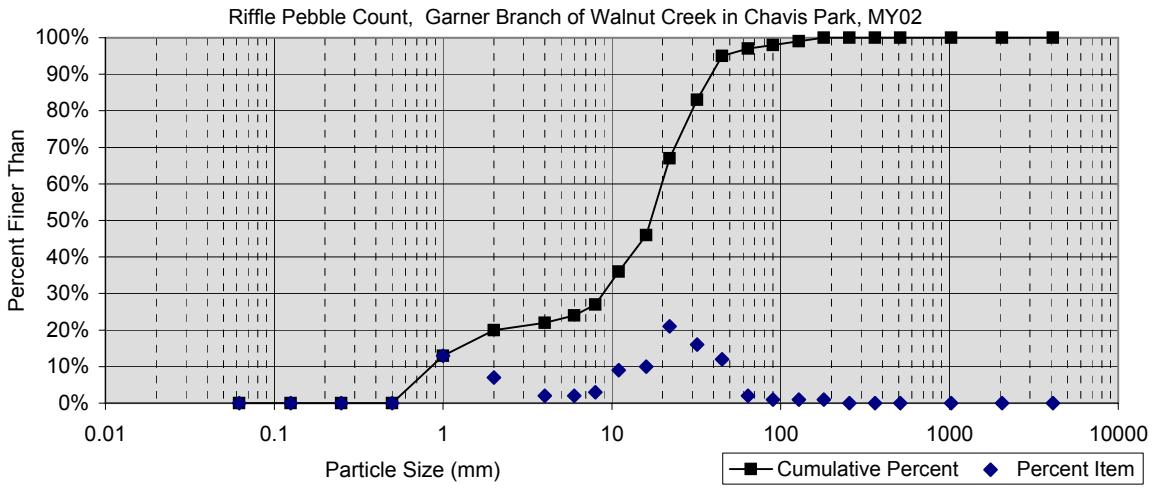
Riffle Pebble Count

Riffle Pebble Count,

Material	Size Range (mm)		Count	
silt/clay	0	0.062		# #
very fine sand	0.062	0.13		# #
fine sand	0.13	0.25		# #
medium sand	0.25	0.5		# #
coarse sand	0.5	1	**13**	# #
very coarse sand	1	2	**7**	# #
very fine gravel	2	4	**2**	# #
fine gravel	4	6	**2**	# #
fine gravel	6	8	**3**	# #
medium gravel	8	11	**9**	# #
medium gravel	11	16	**10**	# #
coarse gravel	16	22	**21**	# #
coarse gravel	22	32	**16**	# #
very coarse gravel	32	45	**12**	# #
very coarse gravel	45	64	**2**	# #
small cobble	64	90	**1**	# #
medium cobble	90	128	**1**	# #
large cobble	128	180	**1**	# #
very large cobble	180	256		# #
small boulder	256	362		# #
small boulder	362	512		# #
medium boulder	512	1024		# #
large boulder	1024	2048		# #
very large boulder	2048	4096		# #
bedrock				#
	Total Particle Count:		100	

	Garner Branch of Walnut Creek in Chavis Park, MY02
	Neuse

Note:	**XS UT**



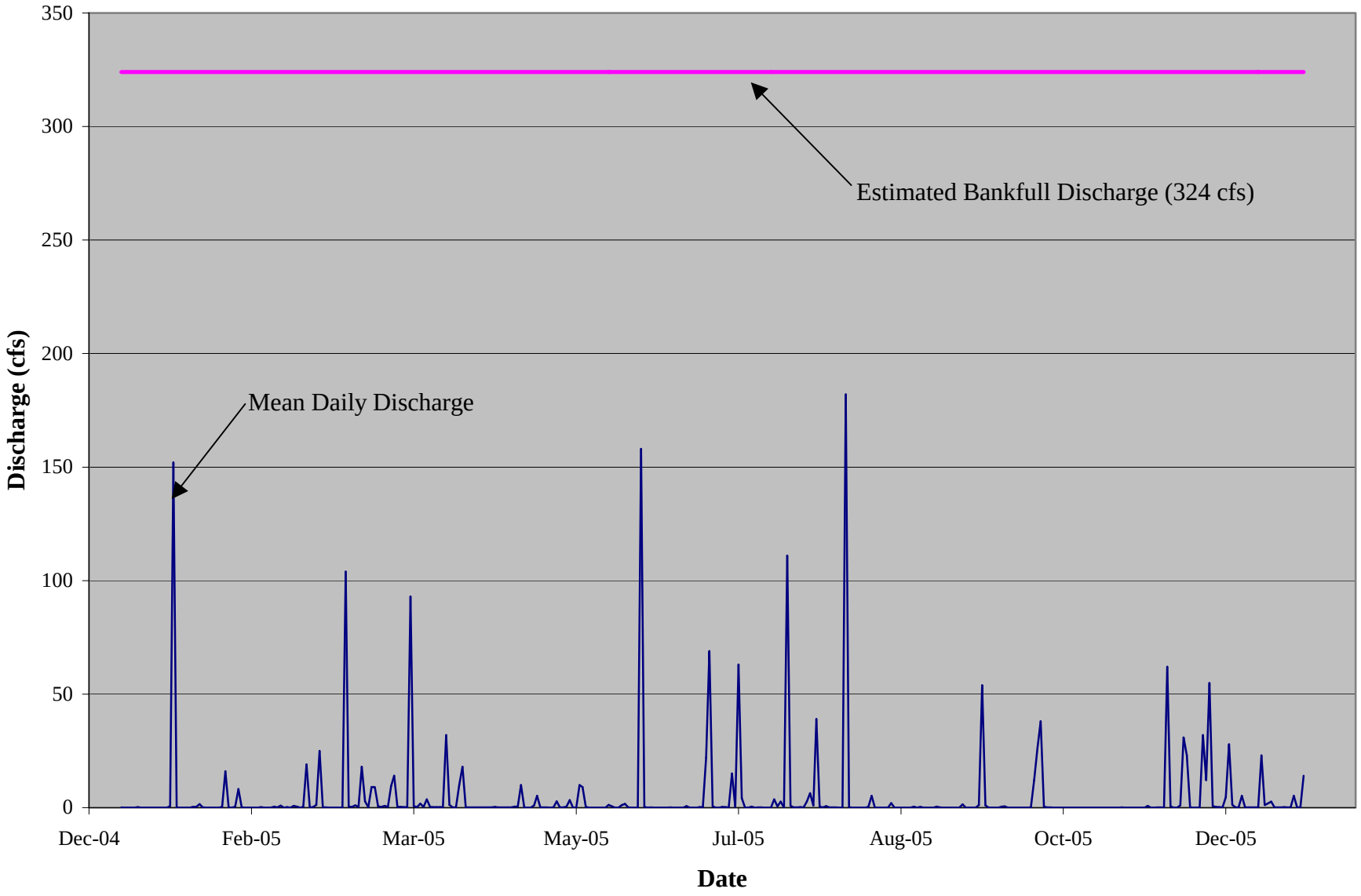
Size percent less than (mm)				
D16	D35	D50	D84	D95
1.346	10.62	17.0	33	45

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
0%	20%	77%	3%	0%	0%

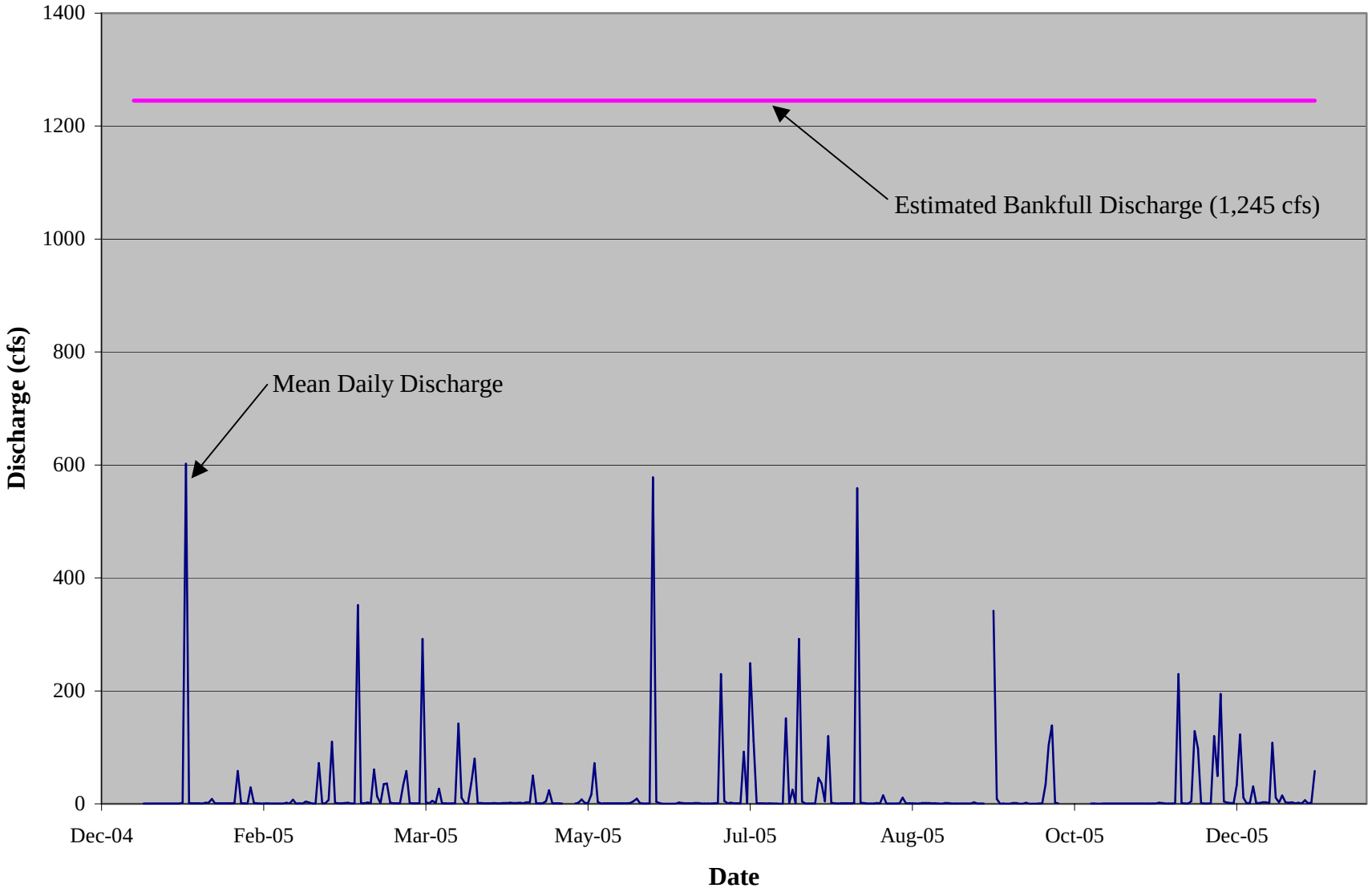
App B8 –USGS Gauge Discharge Plots

The Chavis Park Stream Restoration Site does not have a gauge installed to record bankfull events. In order to approximate the number of bankfull events, USGS gauge data has been used as a secondary surrogate. Three gauges, all within three miles of the Chavis Park Site, were used for this purpose. Since the bankfull discharge of the gauged streams is unknown, a flood frequency analysis was performed using an annual maximum series (AMS) for a period of 7 to 8 years to determine an approximate bankfull discharge. For this report it was assumed that the bankfull discharge is associated with a return period of 1.5 years. Due to the urban nature of the restoration site and its location outside the immediate drainages of the gauged streams, this data is not a substitute for an on-site recording device. The three streams and the gauges' approximate distance from Chavis Park are as follows: Pigeon House Creek, 1.7 miles; Rocky Branch, 2.4 miles; and Walnut Creek, 2.6 miles.

Pigeon House Creek - USGS Gauge 0208732534



Rocky Branch - USGS Gauge 0208735012



Walnut Creek - USGS Gauge 02087359