Chavis Park (Garner Branch)
Stream Restoration Monitoring Report
EEP Project # 87
Monitoring Year – 05
2008

Submitted to:

Ecosystem Enhancement PROGRAM

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

March 2009

Monitoring Firm

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Design Firms

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Ecological Consultants

Natural Areas Ecosystem Management

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EXECUTIVE SUMMARY

The North Carolina Wetlands Restoration Program identified the Garner Branch of Walnut Creek in Chavis Park as a restoration design project in 1999. The watershed of approximately 0.54-mi^2 is located within the USGS 14-digit HUC 03020201090010 and the NCDWQ Sub-basin 03-04-02 of the Neuse River Basin. The restoration plan 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 diversity, 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. Monitoring was completed for the first, second, third, and fourth years in 2004, 2005, 2006, and 2007, respectively. This report is a description of the findings from the fifth year of monitoring that took place in 2008.

The restoration plan called for removing all existing vegetation along the stream banks and within the riparian buffer and replanting the area with native vegetation. However, the original plantings were determined to be unsuccessful after the first year of monitoring. A remedial vegetation plan was designed in 2004 and implemented the same year. Vegetation was planted at densities 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 the remaining monitoring years. The fifth year of monitoring found an average of 600 stems per acre for all plots. Vegetative cover is extensive for the length of the project with minimal bare banks and slopes, but there are also large populations of exotic/invasive plants throughout the site. The most notable species are microstegium (*Microstegium vimineum*), Japanese honeysuckle (*Lonicera japonica*), and white mulberry (*Morus alba).* Excepting the site's invasive species, the project is on track to meet the vegetation success criteria.

The stream assessment completed during the fifth year of monitoring found the stream to be functioning as designed 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 lacks well defined pool and riffle features, but some are discernible along the profile length. Many of the in-stream structures are functioning, though several are experiencing stress as evidenced by localized erosion on cross vane arms. There are varying degrees of bank erosion throughout the project reach. Much of the stream has minimal toe erosion that is creating undercut banks; however, it is unlikely that these banks will continue to widen due to the high density of vegetation along the stream. 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 urban nature of Chavis Park trash and debris are common throughout the project site. 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 Project Objectives

- Reduce bank erosion by adjustment of the existing channel pattern or by bioengineered methods.
- Improve water quality by reducing erosion and by increasing the connectivity between the channel and floodplain.
- Stabilize the bankfull elevation along the reach.
- Enhance instream habitat by placing structures, overhanging vegetation and removal of aggressive species.
- Enhance riparian corridor with native vegetative species to improve the function and aesthetic value.
- Slope and vegetate the stream banks so that they are more resistant to flooding.
- Plant native trees, bushes and ground cover that will stabilize the stream banks, shade the stream, and provide wildlife cover and food.

1.2 Project Structure, Restoration Type, and Approach

Before restoration, the channel of Garner Branch of Walnut Creek through Chavis Recreational Park was deeply incised and entrenched with advanced bank erosion due to urban storm runoff. The creek was restored using channel dimension, pattern, and profile modifications and the establishment of a vegetated riparian zone adjacent to the creek. The new channel profile is maintained through the use of rock cross vanes. 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.

1.3 Location and Setting

Chavis Park is located within the city limits of Raleigh, North Carolina. The 0.54-mi.^{2} watershed is urban and fully developed. The current zoning and planimetric maps from the City of Raleigh show that three-quarters of the watershed consist primarily of residential high density properties. The upper northeastern quarter of the watershed is densely developed, and includes downtown businesses and industrial facilities. The watershed is completely built out with little potential for future development.

1.4 Project History and Background

Table I. Project Restoration Components
Project Number and Name: 87 - Chavis Park (Garner Branch of Walnut Creek)

Segment / Reach ID	Existing Linear Feet	Type	Approach	Linear Feet	Stationing	Comment
Garner Branch	N/A	R	P2/3	1,880	10+00 - 28+80	
UT to Garner Branch	N/A	R	P2/3	250	30+00 - 32+50	

DIRECTIONS TO CHAVIS PARK SITE: From 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) before the intersection with E. Lenoir Street.

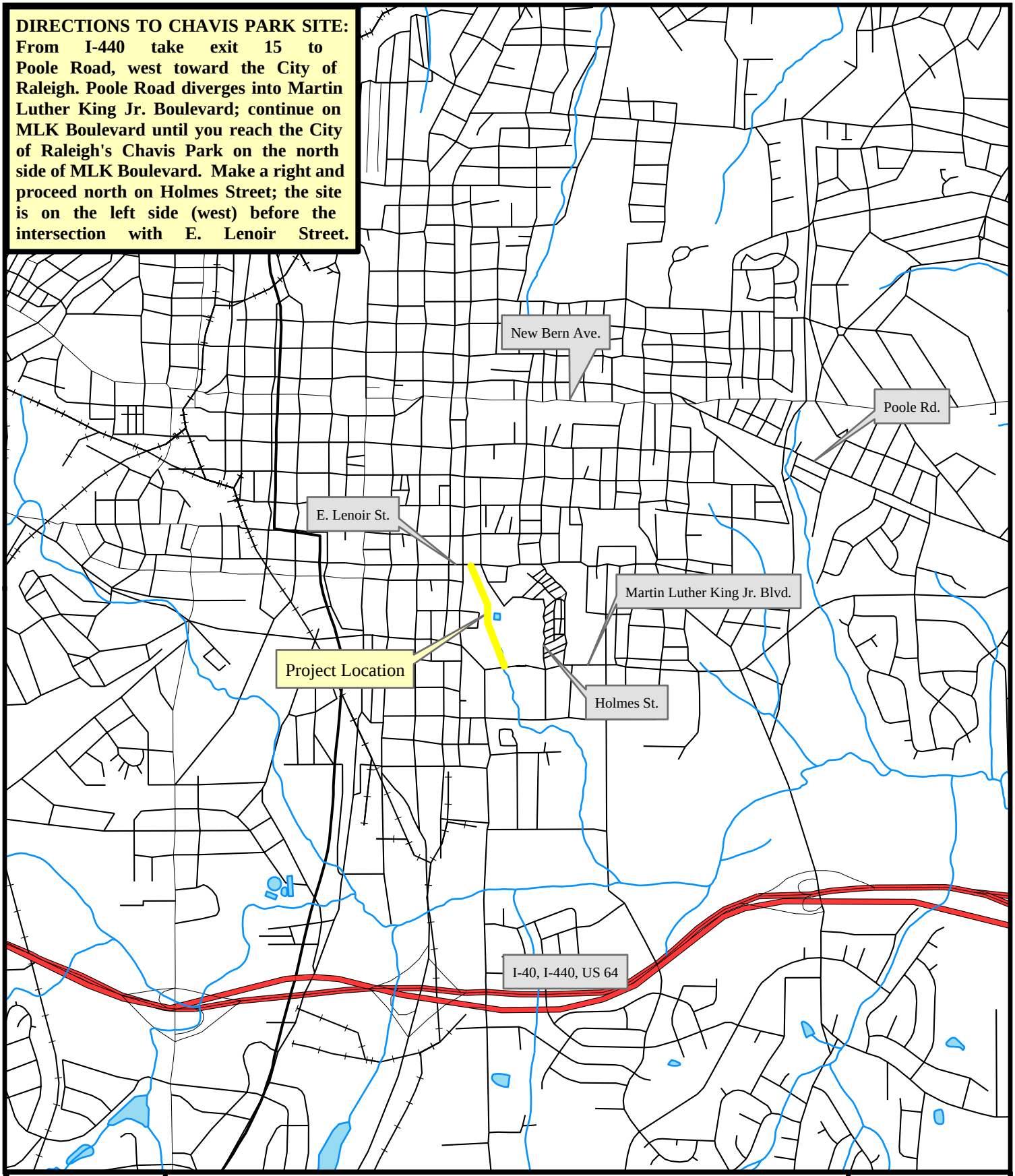


Figure 1. Site Vicinity Map
Chavis Park, Wake County, EEP Project # 87 - MY05

0.25 0.125 0 0.25 0.5 Miles

N

Date: 10/28/08

Ecosystem Enhancement Program

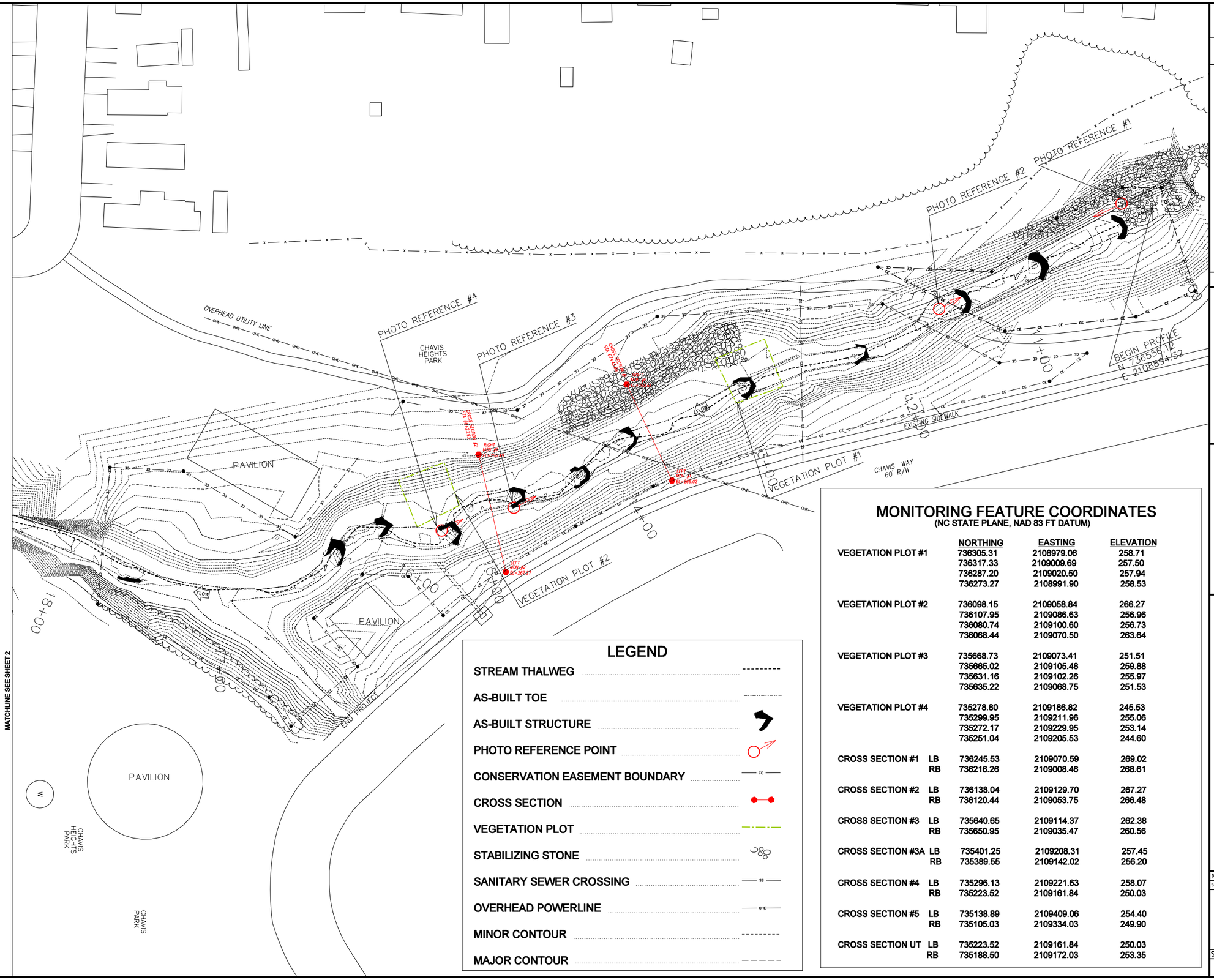
KCI Associates of NC

Table II. Project Activity and Reporting History Project Number and Name: 87 - Chavis Park (Garner Branch of Walnut Creek)		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan	2002	Feb 02
Final Design - 90%	N/A	N/A
Construction	2002	2002
As-built Report	Sep 02	2002
Year 1 Monitoring	Jun 04	Feb 05
Vegetative Maintenance Plan	2004	Mar 04
Vegetative Maintenance Planting	2004	Jun 05
Year 2 Monitoring	Aug 05	Jan 06
Year 3 Monitoring	Oct 06	Jan 07
Year 4 Monitoring	Sep 07	Jan 08
Year 5 Monitoring	Oct 08	Jan 09
Closeout		

Table III. 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 III cont. Project Contact Table	
Maintenance Planting and Plan Designer	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 Contact: Mr. Dan Clinton Phone: (919) 515-3723
MY-02 - MY-05	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 IV. Project Background Table **Project Number and Name: 87 - Chavis Park (Garner Branch of Walnut Creek)**	
Project County	Wake County
Drainage Area	0.54 sq. mi. (Garner Branch)
	0.20 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)
	03020201080020 (Brookhaven Park)
NCDWQ Sub-basin for Project and Reference	03-04-02 (Garner Branch)
	03-04-02 (Brookhaven Park)
NCDWQ Classification for Project and Reference	C - NSW (Garner Branch)
	Not listed (Brookhaven Park)
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%
% of Project Easement Demarcated with Plastic Lath Signs	90%



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

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 #3A	LB	735401.25	2109208.31	257.45
	RB	735389.55	2109142.02	256.20
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

STA.	DESCRIPTION	DATE	APPROVED

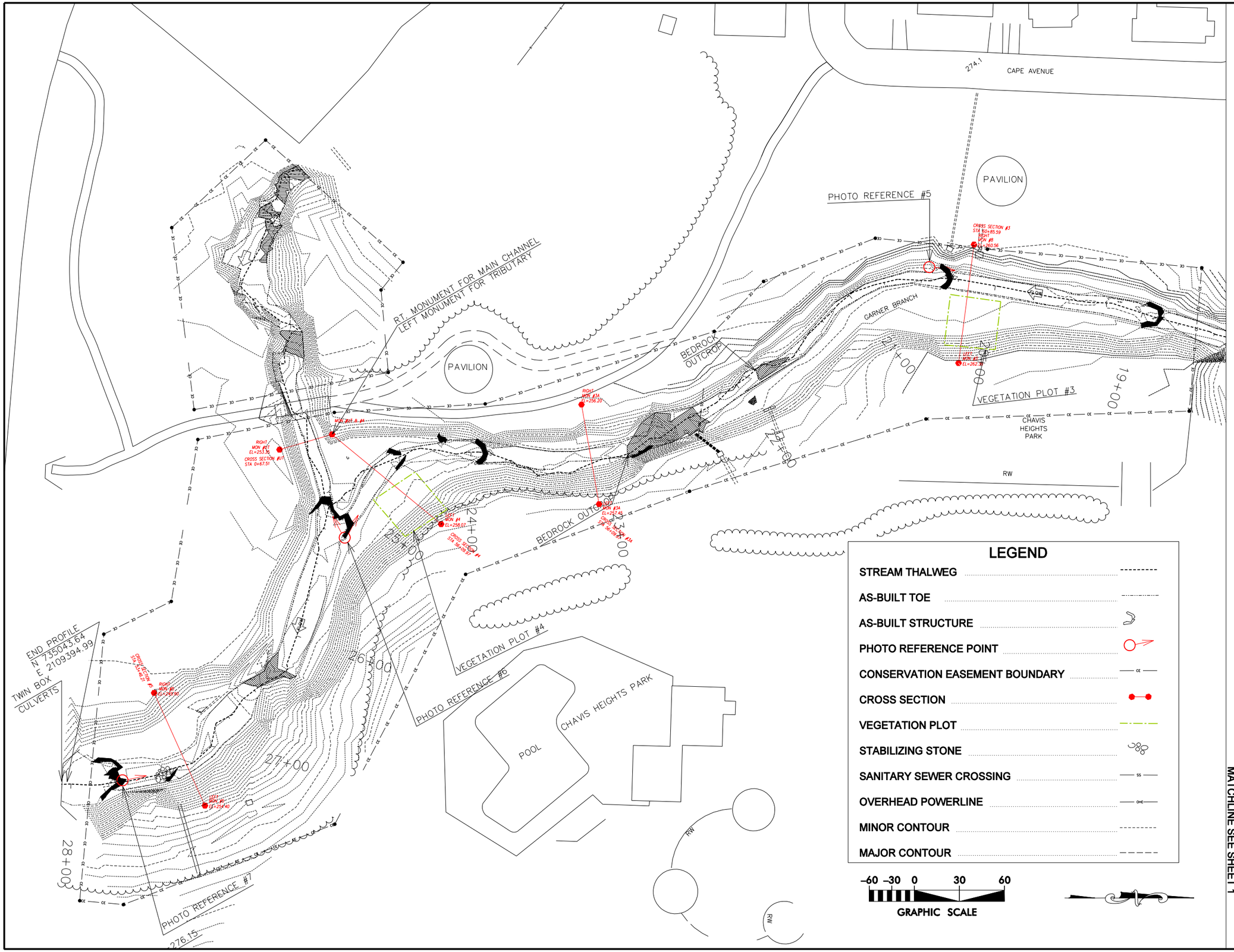
Ecosystem Enhancement Program

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

CHAVIS PARK (GARNER BRANCH)
WAKE COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 87 - MY05
STATION 10+00 TO STATION 18+40

DATE: NOVEMBER 2008
SCALE: SEE SHEET

MONITORING PLAN VIEW



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

STM.	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)
WAKE COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 87 - MY05

STATION 18+40 TO STATION 28+06

DATE: NOVEMBER 2008
SCALE: SEE SHEET

MONITORING PLAN VIEW

SHEET 2 OF 2

2.0 PROJECT CONDITIONS AND MONITORING RESULTS

2.1 Vegetation Assessment

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 and shrubs. Maintenance planting throughout the entire site was completed in 2004. The vegetation plot corners established during Monitoring Year 01 could not be found and four new plots were established and permanently marked during Monitoring Year 02.

This year's monitoring calculated densities of 680, 840, 760, and 120 stems/acre in plots 1, 2, 3, and 4, respectively. The average density for the entire site, based on these plots, is 600 stems/acre. While three out of four plots have high survival rates, the site's exotic invasive vegetation is having an obvious detrimental effect on the planted vegetation. Many of the planted stems within the plots were covered with strangling invasive vines. The low density within plot 4 is due to the large amounts of invasive vines that have covered that plot and overcome the planted vegetation. If allowed to continue unchecked, the invasive species could affect the other plots as well.

There are many invasive exotic species throughout the Chavis Park conservation easement. The most prevalent species include English ivy (*Hedera helix*), microstegium (*Microstegium vimineum*), mimosa (*Albizia julibrissin*), white mulberry (*Morus alba*), Japanese privet (*Ligustrum japonicum*), Japanese hops (*Humulus japonicus*) and Japanese honeysuckle (*Lonicera japonica*). In addition to these species, Chinese privet (*Ligustrum sinense*), Bradford pear (*Pyrus calleryana*), princess tree (*Paulownia tomentosa*), oriental bittersweet (*Celastrus orbiculatus*), osage orange (*Maclura pomifera*), multiflora rose (*Rosa multiflora*), lespedeza (*Lespedeza cuneata*), porcelainberry (*Ampelopsis brevipedunculata*), tree-of-heaven (*Ailanthus altissima*) and morning glory (*Ipomoea spp.*) 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 not possible. Controlling the invasive species and removing larger individuals could help reduce the closest seed sources and decrease competition with the planted native species.

See vegetation data and photos in Appendix A and the 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 stream in Chavis Park is predominately stable. Throughout most of the project the toe of the streambanks has washed out and many banks are undercutting slightly due to erosion. In many cases, bank vegetation is stabilizing these banks and there are very few areas that are suffering uncontrolled erosion. The sediment that is being transported through this system is sand. Most of the banks are made up of sand and there is sand deposition on the floodplain throughout the project. The instream structures are stable for the most part, but a few of the cross-vanes have suffered from significant back arm scour and the stream has cut around one of the arms. These problem areas are detailed on the Current Conditions Plan View.

See additional stream data and photos in Appendix B and the Current Conditions Plan View in Appendix C.

2.2.1 Bankfull Event and Stability Assessment

Table V. Verification of Bankfull Events
Project Number and Name: 87 - Chavis Park (Garner Branch of Walnut Creek)

Date of Data Collection	Date of Occurrence	Method	Photo Number
6/15/2006	6/14/2006	Site visit to evaluate stage indicators after storm event	N/A
8/20/2007	7/17/2007	Crest Gauge	N/A
11/12/2007	10/27/2007	Crest Gauge	N/A
7/8/2008	4/28/2008	Crest Gauge	N/A
10/27/2008	9/6/2008	Crest Gauge	N/A

Table VI. BEHI and Sediment Export Estimates
Project Number and Name: 87 - Chavis Park (Garner Branch of Walnut Creek)

Time Point	Segment/ Reach	Linear Footage	Extreme		Very High		High		Moderate		Low		Very Low		Sediment Export
			ft	%	ft	%	ft	%	ft	%	ft	%	ft	%	ton/yr
N/A															

2.2.2 Stability Assessment Table

Table VII a. Categorical Stream Feature Visual Stability Assessment
Project Number and Name: 87 - Chavis Park (Garner Branch of Walnut Creek)
Segment/Reach: Garner Branch (1,750 ft.)

Feature	Initial	MY - 01	MY - 02	MY - 03	MY - 04	MY - 05
A. Riffles	100%	N/A	83%	65%	68%	67%
B. Pools	100%	N/A	83%	58%	75%	73%
C. Thalweg	100%	N/A	88%	69%	75%	75%
D. Meanders	100%	N/A	69%	78%	84%	80%
E. Bed General	100%	N/A	97%	97%	99%	99%
F. Bank Condition	100%	N/A	97%	93%	93%	87%
G. Vanes / J Hooks etc.	100%	N/A	83%	83%	82%	82%

Table VII b. 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%	90%	90%	90%
B. Pools	100%	N/A	100%	100%	100%	100%
C. Thalweg	100%	N/A	100%	100%	100%	100%

2.2.3 Quantitative Measures Summary Tables

Table VIII a. 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)				12.0	24.0	16.0	10.0	15.6	12.8	21.0	25.0	23.0	16.4	44.8	35.8
Floodprone Width (ft)				52	57		19	33	27	40	63	52	36	74	49
Bankfull Cross Sectional Area (ft^2)						18.6	5.5	11.8	8.6			25.0	19.9	41.0	23.8
Bankfull Mean Depth (ft)				1.4	2.0	1.6	0.6	0.8	0.7	1.1	1.3	1.2	0.5	1.4	1.0
Bankfull Maximum Depth (ft)				3.0	3.8		1.0	1.2	1.1	1.7	2.0	1.8	1.5	3.1	2.0
Width/Depth Ratio						7.7	18.2	20.6	19.4	18.0	21.0	19.0	11.7	84.5	31.4
Entrenchment Ratio						4.5	1.9	3.3	2.6	1.9	2.5	2.2	1.5	3.1	1.9
Bank Height Ratio						1.2	0.9	1.1	1.0	0.9	1.1	1.0	1.0	1.0	1.0
Wetted Perimeter (ft)															
Hydraulic Radius (ft)															
Pattern															
Channel Beltwidth (ft)				19	50	37	28	41	35	35	50	43			
Radius of Curvature (ft)				8	31	20	12	35	24	23	40	32			
Meander Wavelength (ft)						96			47	70	108	80			
Meander Width Ratio						3.0	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 VIII b. 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
Bank Height Ratio															
Wetted Perimeter (ft)															
Hydraulic Radius (ft)															
Pattern															
Channel Beltwidth (ft)															
Radius of Curvature (ft)															
Meander Wavelength (ft)															
Meander Width Ratio															
Profile															
Riffle Length (ft)															
Riffle Slope (ft/ft)															
Pool Length (ft)															
Pool Spacing (ft)															
Substrate															
d50 (mm)															17
d84 (mm)															
Additional Reach Parameters															
Valley Length (ft)															
Channel Length (ft)															
Sinuosity															
Water Surface Slope (ft/ft)															
Bankfull Slope (ft/ft)															
Rosgen Classification															

Table IX. 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						Cross Section 2						Cross Section 3					
	Riffle						Pool						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	14.5	10.7	10.4		14.7	13.0	14.2	13.7	14.2		15.1	16.0	15.0	14.0	15.9	
Floodprone Width (ft)		33	36	34	35			42	44	41	42			51	50	51	52	
Bankfull Cross Sectional Area (ft^2)	12.8	15.2	12.8	11.2	11.4		22.1	18.3	19.4	20.6	20.5		15.8	18.3	17.0	17.6	18.1	
Bankfull Mean Depth (ft)	0.8	1.2	0.9	1.0	1.1		1.5	1.4	1.4	1.5	1.5		1.0	1.1	1.1	1.3	1.1	
Bankfull Maximum Depth (ft)	1.7	1.9	1.7	1.7	1.7		2.1	1.9	2.0	2.2	2.0		1.7	1.9	1.8	1.8	1.7	
Width/Depth Ratio	18.1	11.1	16.4	10.3	9.5		9.8	9.2	10.4	9.2	9.8		15.1	14.0	13.2	11.2	14.0	
Entrenchment Ratio		2.5	2.4	3.1	3.3			3.2	3.1	3.0	3.0			3.2	3.4	3.7	3.3	
Bank Height Ratio	1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	1.0	
Wetted Perimeter (ft)		14.1	15.1	11.9	11.9			14.1	15.2	14.9	15.4			16.8	15.9	15.2	16.5	
Hydraulic Radius (ft)		1.1	0.9	0.9	1.0			1.3	1.3	1.4	1.3			1.1	1.1	1.2	1.1	
Substrate																		
d50 (mm)	0.6	12.5	15.5	17.0	2.0		0.7	0.9	1.0	1.1	0.4		0.7	8.8	16.0	15.0	2.0	
d84 (mm)	9.5	28.0	36.0	29.0	19.0		10.5	39.0	27.0	3.8	5.9		10.5	20.0	39.0	45.0	22.0	

Table IX 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 3A						Cross Section 4					
	Riffle						Pool					
Dimension	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)			12.0	12.0	12.4		19.2	20.5	20.0	22.3	23.3	
Floodprone Width (ft)			30	30	31			77	75	74	74	
Bankfull Cross Sectional Area (ft^2)			20.5	20.9	23.6		25.0	37.2	36.9	36.2	32.2	
Bankfull Mean Depth (ft)			1.7	1.7	1.9		1.3	1.8	1.8	1.6	1.4	
Bankfull Maximum Depth (ft)			2.3	2.5	2.9		2.3	3.3	3.6	3.4	3.4	
Width/Depth Ratio			7.0	6.9	6.5		14.8	11.3	10.8	13.8	16.8	
Entrenchment Ratio			2.5	2.5	2.5			3.8	3.7	3.3	3.2	
Bank Height Ratio			1.0	1.0	1.0		1.0	1.0	1.0	1.0	1.0	
Wetted Perimeter (ft)			13.6	14.3	14.5			22.2	22.7	25.9	25.9	
Hydraulic Radius (ft)			1.5	1.5	1.6			1.7	1.6	1.4	1.2	
Substrate												
d50 (mm)			15.3	19.0	9.8		0.9	2.1	0.7	5.5	0.7	
d84 (mm)			38.0	58.0	47.0		5.8	10.0	6.0	28.0	8.7	

Table IX 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 5						Cross Section UT					
	Pool						Riffle					
Dimension	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	25.5	21.2	20.3	20.6	19.9		14.6	12.0	9.6	8.9	8.2	
Floodprone Width (ft)		46	46	41	46			20	17	16	15	
Bankfull Cross Sectional Area (ft^2)	22.4	23.3	23.3	20.6	23.2		12.0	13.9	10.3	8.3	7.6	
Bankfull Mean Depth (ft)	0.9	1.1	1.1	1.1	1.2		0.8	1.2	1.1	0.9	0.9	
Bankfull Maximum Depth (ft)	1.6	1.8	1.9	1.6	1.9		1.3	1.7	1.4	1.2	1.1	
Width/Depth Ratio	28.3	19.3	17.7	17.2	17.1		18.3	10.4	8.9	9.5	8.9	
Entrenchment Ratio		2.2	2.3	2.2	2.3			1.7	1.8	1.8	1.8	
Bank Height Ratio	1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.1	1.1	
Wetted Perimeter (ft)		22.0	21.2	19.4	21.0			13.4	10.7	9.9	9.3	
Hydraulic Radius (ft)		1.1	1.1	1.1	1.1			1.0	1.0	0.8	0.8	
Substrate												
d50 (mm)	1.0	0.9	1.6	3.1	1.9		1.3	17.0	13.0	5.2	1.6	
d84 (mm)	6.8	18.0	22.0	19.0	9.4		19.2	33.0	31.0	45.0	19.0	

Table IX cont. 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	20	45	26	21	44	26	21	52	24
Radius of Curvature (ft)	28	87	66	15	80	50	20	75	50	27	75	53	18	85	40
Meander Wavelength (ft)	83	104	100	72	113	84	77	118	96	83	119	92	73	105	95
Meander Width Ratio***	1.6	3.7	2.2	1.6	4.1	2.6	1.4	3.2	1.8	1.7	3.6	2.1	1.5	3.7	1.7
Profile															
Riffle Length (ft)	22	71	31	4	52	20	8	86	22	7	85	17	10	115	37
Riffle Slope (ft/ft)	0.62%	4.53%	1.49%	1.06%	12.50%**	2.60%	0.10%	3.54%	1.66%	0.20%	5.24%	1.90%	0.03%	3.71%	1.36%
Pool Length (ft)	9	51	18	6	57	22	11	90	22	4	52	16	6	51	16
Pool Spacing (ft)	19	402	61	9	404	44	34	673	61	32	189	55	38	275	78
Additional Reach Parameters															
Valley Length (ft)				1,550			1,550			1,550			1,550		
Channel Length (ft)				1,773			1,780			1,780			1,780		
Sinuosity				1.15			1.15			1.15			1.15		
Water Surface Slope (ft/ft)															
Bankfull Slope (ft/ft)															
Rosgen Classification				C4			C4			C4			C4		

*Pattern measurements for MY – 02, 03, 04, and 05 calculated from approximately station 11+00 to 16+50, where the stream was re-meandered.

**Max riffle slope from bedrock riffle, omitted from riffle calculations for other monitoring years.

***Meander Width Ratios calculated using average bankfull width from riffle cross sections

3.0 METHODOLOGY

The EEP 2004 Stem Counting Protocol was used to collect vegetation data from Chavis Park this year, the fifth 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: 87 - Chavis Park (Garner Branch of Walnut Creek)

Species	Plots				Initial Totals	Year 2 Totals	Year 3 Totals	Year 4 Totals	Year 5 Totals	Survival %
	1	2	3	4						
Shrubs										
Viburnum nudum	1	2	2		N/A	10	9	7	5	50%
Cornus amomum	6	4	5	1	N/A	17	18	16	16	94%
Ilex verticillata	2	1			N/A	4	4	3	3	75%
Ilex glabra		1			N/A	1	1	1	1	100%
Myrica cerifera	2				N/A	2	2	2	2	100%
Callicarpa americana		3		1	N/A	5	6	5	4	80%
Alnus serrulata	1	1	4		N/A	6	6	6	6	100%
Trees										
Platanus occidentalis	4	2	6	1	N/A	14	14	14	13	93%
Hamamelis virginiana	1	5			N/A	6	6	6	6	100%
Fraxinus pennsylvanica		1	2		N/A	6	4	4	3	50%
Liriodendron tulipifera		1			N/A	3	3	1	1	33%
Betula nigra					N/A	1	0	0	0	0%

Explanation of Probable Causes of Vegetation Mortality
The planted vegetation has experienced a moderate amount of mortality over the past year. Mortality of the five planted stems can most likely be attributed to competition with herbaceous vegetation, mainly invasive vines and other exotic vegetation.

Table A2. Stem Density By Plot
Project Number and Name: 87 - Chavis Park (Garner Branch) Stream Restoration
Date : 8/5/08
Crew : B. Roberts

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*	American Beautyberry *Callicarpa americana*	Wax Myrtle *Myrica cerifera*	Inkberry *Ilex glabra*	Total (Year 4)	**Density (Trees/Acre)**
1	2	6		1	1	1		4			2		17	680
2	1	4	1	1	5	2		2	1	3		1	21	840
3		5	2	4		2		6					19	760
4		1				0		1		1			3	120
											Average Density			600

A2 – Representative Vegetation Problem Area Photos

VP1 – English ivy (*Hedera helix*) on stream bank. Photo taken near Station 10+50. 10/27/08 - MY 05

VP2 – Japanese hops (*Humulus japonicus*) on stream bank and terrace. Photo taken near Station 24+50. 10/27/08 - MY 05

A3 - Vegetation Monitoring Plot Photos

Plot 1 Photo – Taken looking at center of plot on right bank from top of left bank. 8/5/08 - MY 05.

Plot 1 Supplemental Photo – Taken looking at the center of plot from southwest corner. 8/5/08 – MY 05.

Plot 2 Photo – Taken looking at center of plot from top of right bank. 8/5/08 - MY 05.

Plot 3 Photo – Taken looking at center of plot from top of left bank. 8/5/08 - MY 05.

Plot 4 Photo – Taken looking at center of plot from top of left bank. 8/5/08 - MY 05.

Appendix B
Geomorphologic Data

B1 – Representative Stream Problem Area Photos

SP1 – Mid-channel bar forming. Photo taken near station 14+30. 10/27/08 - MY 05

SP2 – Bank erosion/slumping. Photo taken near Station 20+75. 10/27/08 - MY 05

SP3 – Back arm scour, pool aggradation and debris in stream. Photo taken near station 14+75. 10/27/08 - MY 05

B2 –Stream Photo Station Photos

Photo Point 1 – 10/27/08 - MY 05

Photo Point 2 – 10/27/08 - MY 05

Photo Point 3 – 10/27/08 - MY 05

Photo Point 4 – 10/27/08 - MY 05

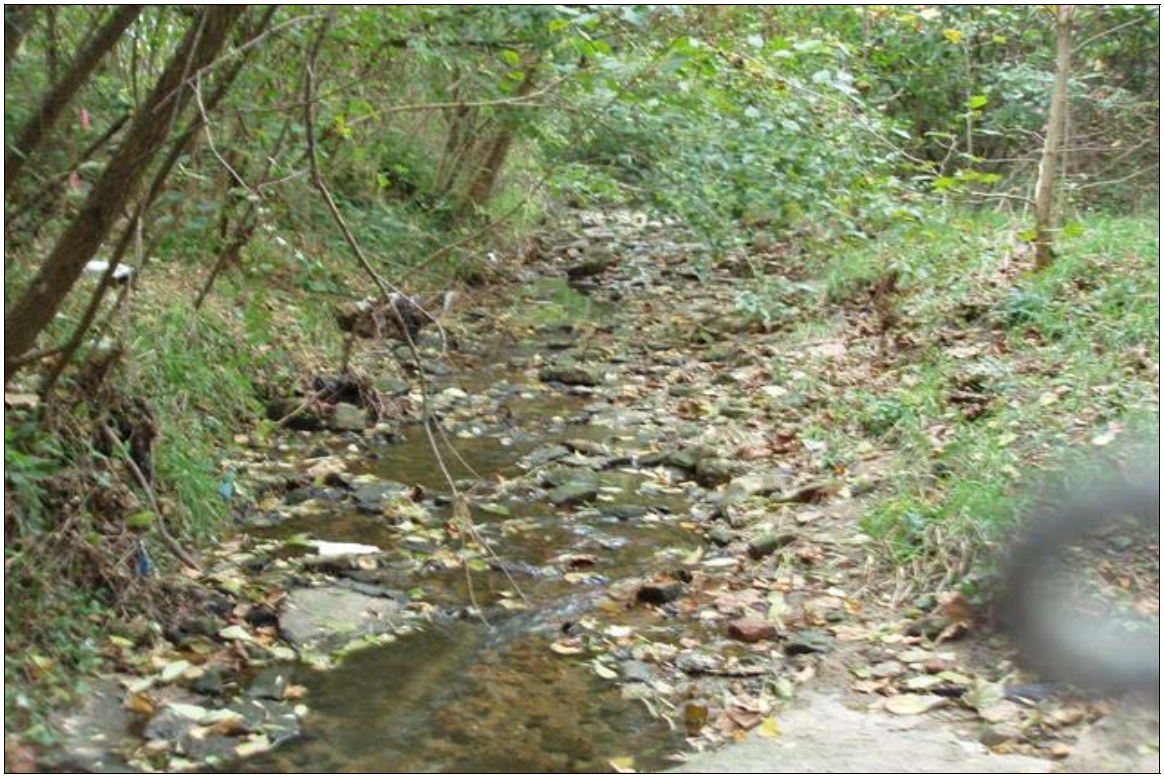


Photo Point 5 – 10/27/08 - MY 05

Photo Point 6 (Garner Branch) – 10/27/08 - MY 05

Photo Point 6 (UT) – 10/27/08 - MY 05

Photo Point 7 – 10/27/08 - MY 05

B3 – Qualitative Visual Stability Assessment

Table B2. 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?	12	18	N/A	67	
	2. Armor stable (e.g. no displacement)?	12	18	N/A	67	
	3. Facet grade appears stable?	12	18	N/A	67	
	4. Minimal evidence of embedding/fining?	12	18	N/A	67	
	5. Length appropriate?	12	18	N/A	67	**67%**
B. Pools	1. Present? (e.g. no severe aggradation or migration)	21	28	N/A	75	
	2. Sufficiently deep (Dmax pool:Mean Bkf > 1.6?)	21	28	N/A	75	
	3. Length appropriate?	18	28	N/A	64	**73%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	13	16	N/A	81	
	2. Downstream of meander (glide/inflection) centering?	11	16	N/A	69	**75%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	11	16	N/A	69	
	2. Of those eroding, # w/ concomitant point bar formation?	4	5	N/A	80	
	3. Apparent Rc within spec?	11	16	N/A	69	
	4. Sufficient floodplain access and relief?	16	16	N/A	100	**80%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	N/A	N/A	2/30	98	
	2. Channel bed degradation - areas of increasing down cutting or head cutting?	N/A	N/A	0/0	100	**99%**
F. Bank	1. Actively eroding, wasting, or slumping bank	N/A	N/A	10/235	87	**87%**
G. 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?	15	19	N/A	79	**82%**

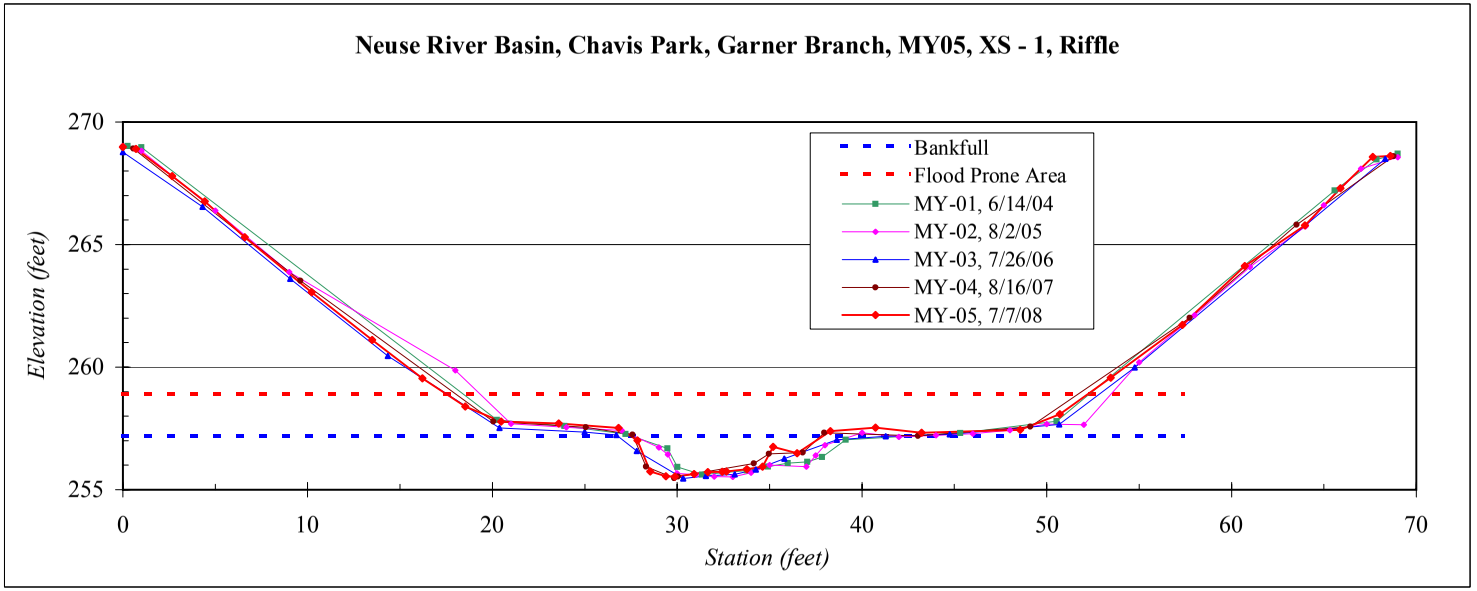
* Total number of features per as-built estimated from as-built profile and planview sheets.

B4 - Cross-Section Plots

River Basin:	Neuse
Watershed:	Chavis Park, Garner Branch, MY05
XS ID	XS - 1, Riffle
Drainage Area (sq mi):	0.54
Date:	7/7/2008
Field Crew:	B. Roberts, K. Vaughan

Station	Elevation
0.0	269.0
0.7	268.9
2.7	267.8
4.4	266.8
6.6	265.3
10.2	263.1
13.5	261.1
16.2	259.5
18.5	258.4
20.5	257.8
23.6	257.7
26.8	257.5
27.8	257.0
28.5	255.7
29.4	255.6
29.9	255.5
30.9	255.6
31.7	255.7
32.4	255.7
32.7	255.7
33.8	255.8
34.6	255.9
35.2	256.7
36.5	256.5
38.3	257.4
40.7	257.5
43.2	257.3
48.6	257.4
50.7	258.1
53.5	259.6
57.3	261.7

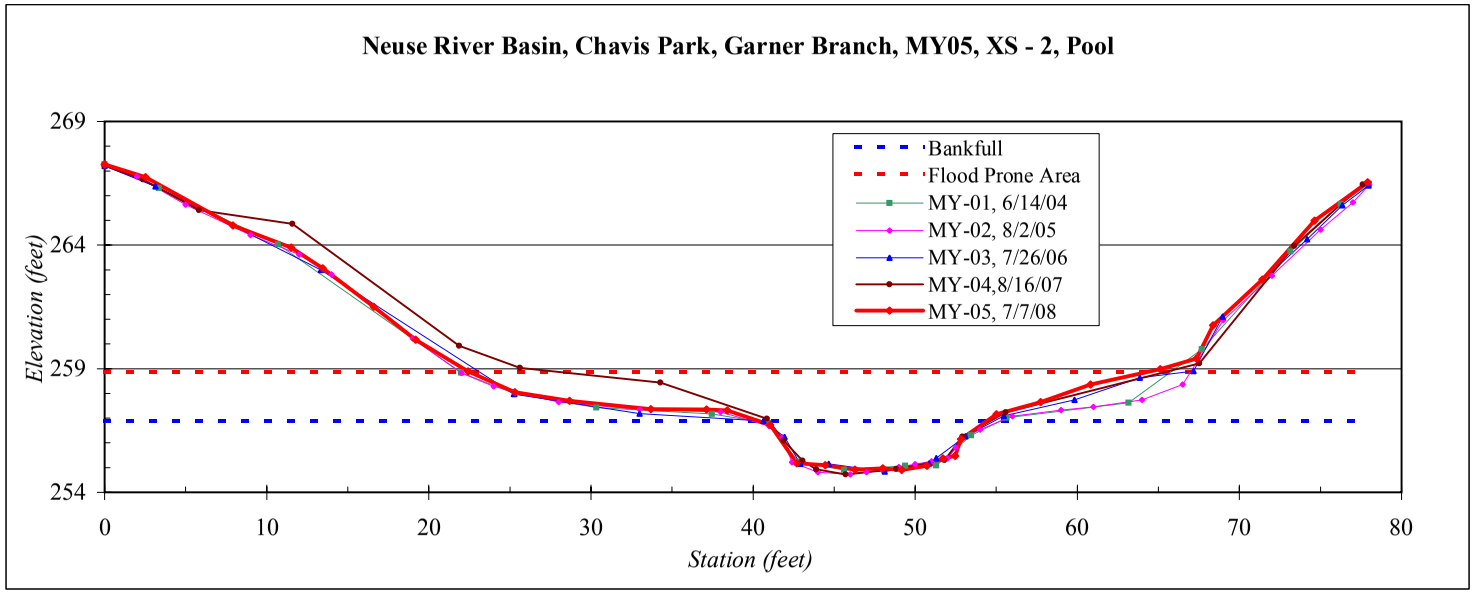
SUMMARY DATA	
Bankfull Elevation:	257.2
Bankfull Cross-Sectional Area:	11.4
Bankfull Width:	10.4
Flood Prone Area Elevation:	258.9
Flood Prone Width:	35
Max Depth at Bankfull:	1.7
Mean Depth at Bankfull:	1.1
W / D Ratio:	9.5
Entrenchment Ratio:	3.3
Bank Height Ratio:	1.0



River Basin:	Neuse
Watershed:	Chavis Park, Garner Branch, MY05
XS ID	XS - 2, Pool
Drainage Area (sq mi):	0.54
Date:	7/7/2008
Field Crew:	B. Roberts, K. Vaughan

Station	Elevation
0.0	267.3
2.5	266.7
7.9	264.8
11.5	263.9
13.5	263.1
16.6	261.5
19.2	260.2
22.4	258.9
25.3	258.0
28.7	257.7
33.7	257.4
37.1	257.3
38.4	257.3
41.1	256.7
42.7	255.2
44.5	255.1
46.3	254.9
48.0	255.0
49.2	254.9
50.7	255.1
51.7	255.4
52.5	255.5
52.8	256.2
55.0	257.2
57.7	257.7
60.8	258.4
65.1	259.0
67.3	259.4
68.4	260.8
71.4	262.6
74.6	265.0
77.9	266.5

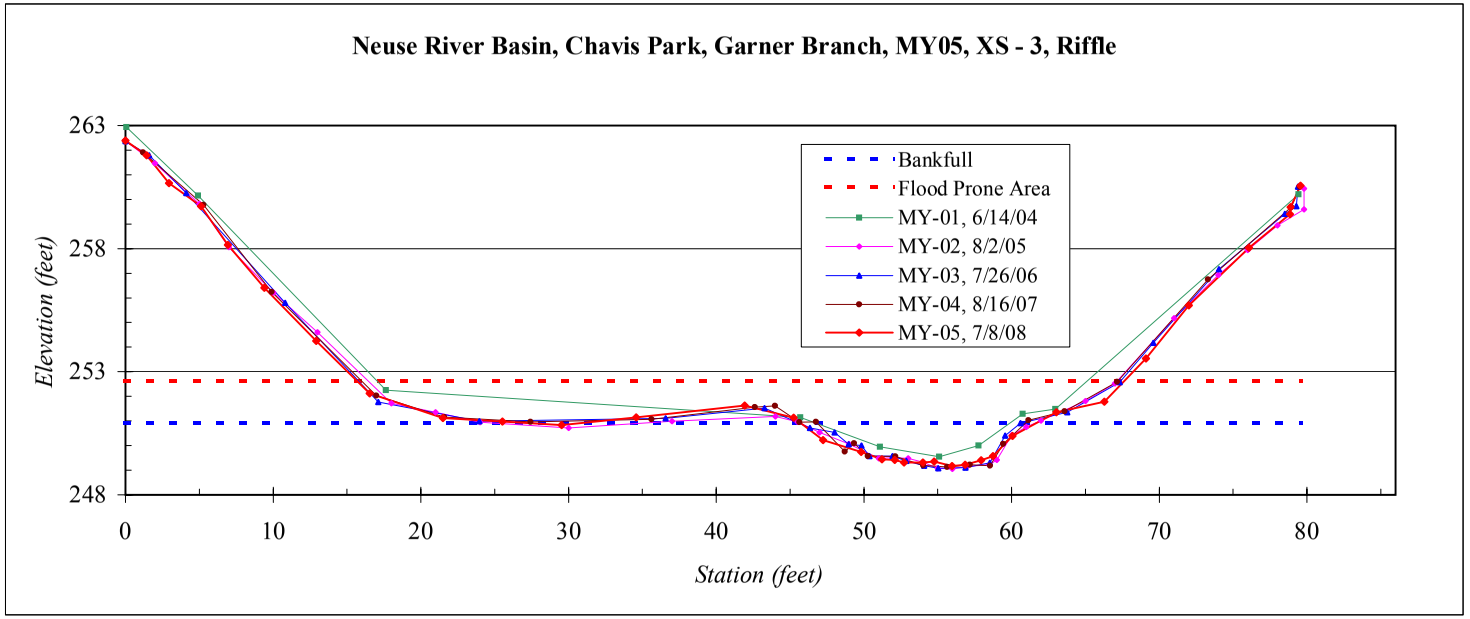
SUMMARY DATA	
Bankfull Elevation:	256.9
Bankfull Cross-Sectional Area:	20.5
Bankfull Width:	14.2
Flood Prone Area Elevation:	258.9
Flood Prone Width:	42
Max Depth at Bankfull:	2.0
Mean Depth at Bankfull:	1.5
W / D Ratio:	9.8
Entrenchment Ratio:	3.0
Bank Height Ratio:	1.0



River Basin:	Neuse
Watershed:	Chavis Park, Garner Branch, MY05
XS ID	XS - 3, Riffle
Drainage Area (sq mi):	0.54
Date:	7/8/2008
Field Crew:	B. Roberts, K. Vaughan

Station	Elevation
0.0	262.4
1.4	261.8
3.0	260.7
5.1	259.7
6.9	258.2
9.4	256.4
12.9	254.2
16.5	252.1
21.5	251.1
25.5	251.0
29.5	250.8
34.6	251.1
41.9	251.6
45.2	251.1
47.2	250.2
49.8	249.7
51.2	249.4
52.1	249.4
52.7	249.3
54.0	249.3
54.7	249.4
56.0	249.2
56.9	249.2
57.9	249.4
58.7	249.6
60.1	250.4
63.0	251.4
66.3	251.8
69.1	253.5
72.0	255.7
76.1	258.0
78.8	259.4
78.9	259.7
79.6	260.6

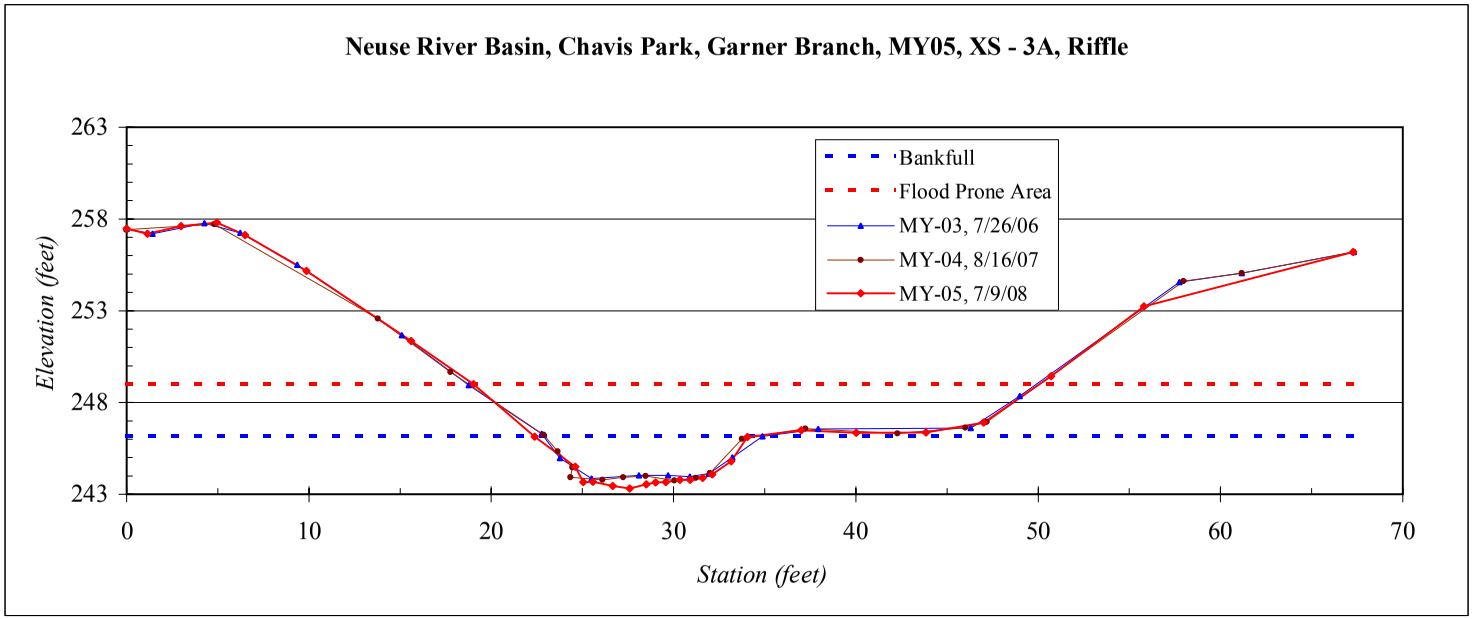
SUMMARY DATA	
Bankfull Elevation:	250.9
Bankfull Cross-Sectional Area:	18.1
Bankfull Width:	15.9
Flood Prone Area Elevation:	252.6
Flood Prone Width:	52
Max Depth at Bankfull:	1.7
Mean Depth at Bankfull:	1.1
W / D Ratio:	14.0
Entrenchment Ratio:	3.3
Bank Height Ratio:	1.0



River Basin:	Neuse
Watershed:	Chavis Park, Garner Branch, MY05
XS ID	XS - 3A, Riffle
Drainage Area (sq mi):	0.54
Date:	7/9/2008
Field Crew:	B. Roberts, K. Vaughan

Station	Elevation
0.0	257.5
1.1	257.2
3.0	257.6
4.9	257.8
6.5	257.1
9.9	255.2
15.6	251.3
19.0	249.0
22.4	246.1
24.6	244.5
25.0	243.7
25.6	243.7
26.7	243.4
27.6	243.3
28.5	243.5
29.0	243.6
29.6	243.7
30.3	243.8
30.9	243.8
31.6	243.9
32.1	244.1
33.1	244.8
34.1	246.1
37.0	246.5
40.0	246.3
43.9	246.4
47.0	246.9
50.7	249.4
55.8	253.2
67.3	256.2

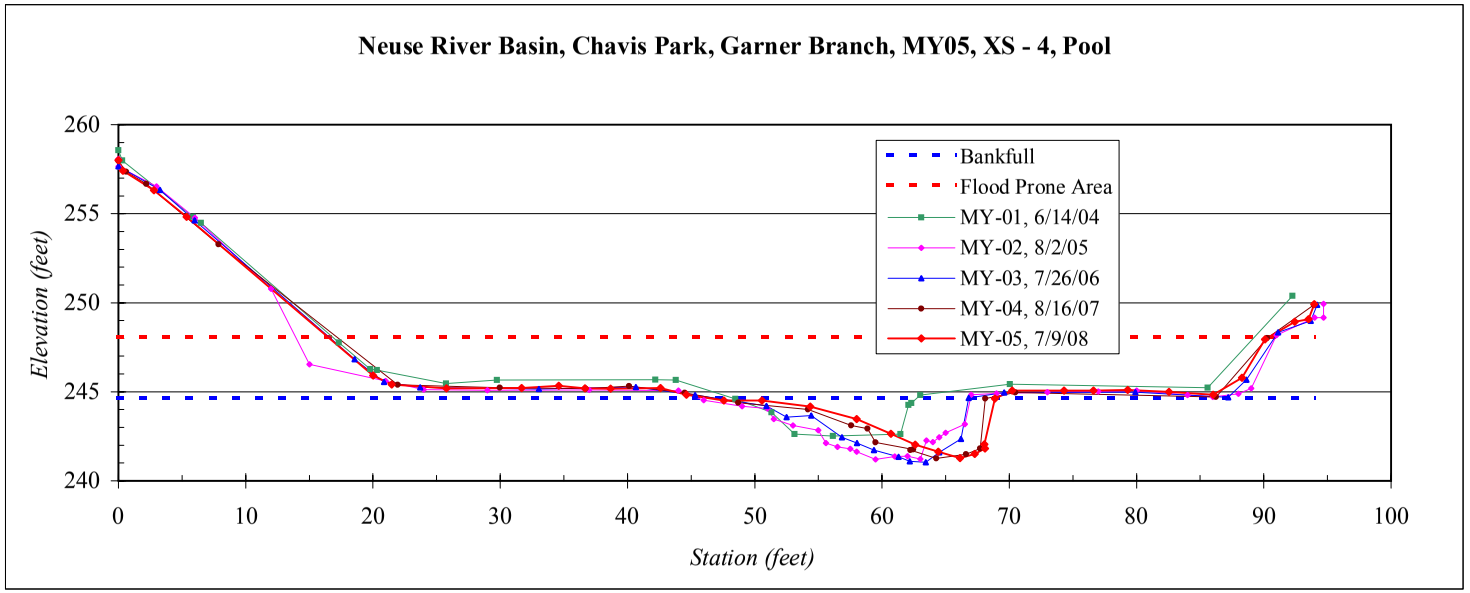
SUMMARY DATA	
Bankfull Elevation:	246.2
Bankfull Cross-Sectional Area:	23.6
Bankfull Width:	12.4
Flood Prone Area Elevation:	249.0
Flood Prone Width:	31
Max Depth at Bankfull:	2.9
Mean Depth at Bankfull:	1.9
W / D Ratio:	6.5
Entrenchment Ratio:	2.5
Bank Height Ratio:	1.0



River Basin:	Neuse
Watershed:	Chavis Park, Garner Branch, MY05
XS ID	XS - 4, Pool
Drainage Area (sq mi):	0.54
Date:	7/9/2008
Field Crew:	B. Roberts, K. Vaughan

Station	Elevation
0.0	258.0
0.3	257.4
2.8	256.3
5.4	254.8
20.0	245.9
21.5	245.4
25.8	245.2
31.7	245.2
34.6	245.3
36.7	245.2
38.7	245.2
42.6	245.2
44.6	244.8
47.6	244.5
50.6	244.5
54.4	244.2
58.0	243.5
60.7	242.6
62.6	242.0
64.4	241.6
66.1	241.3
67.3	241.5
68.1	241.8
68.0	242.0
68.9	244.6
70.2	245.1
74.3	245.1
76.6	245.1
79.3	245.1
82.5	245.0
86.0	244.8

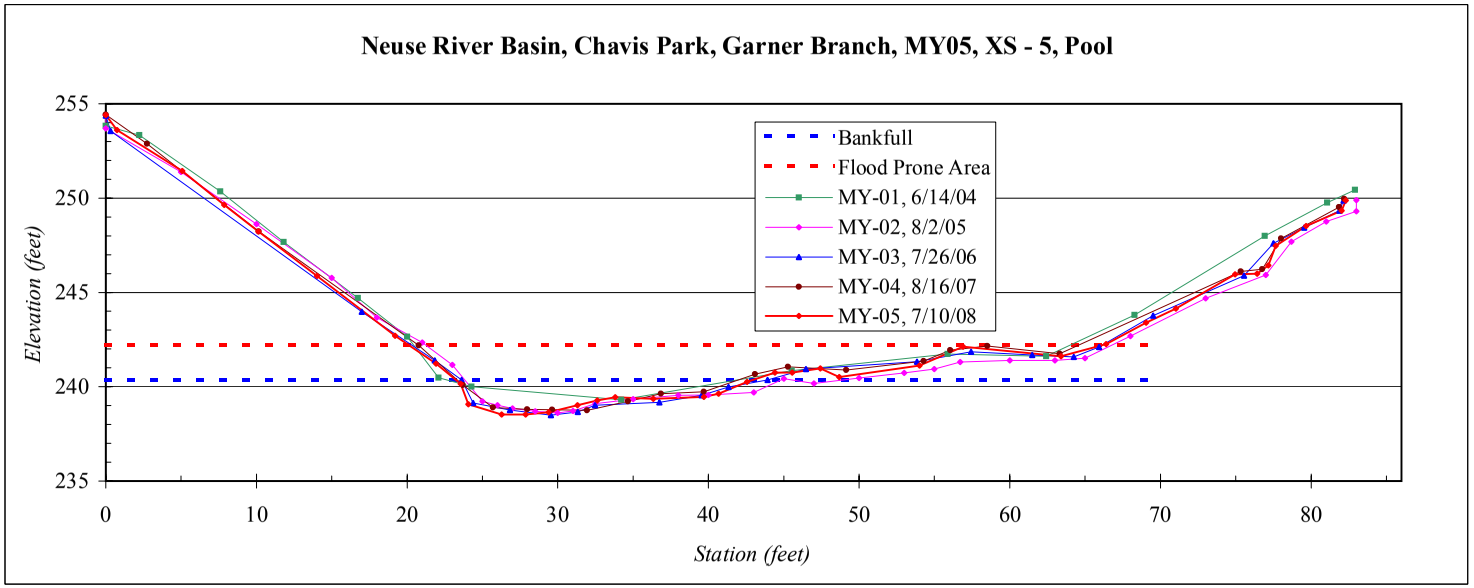
SUMMARY DATA	
Bankfull Elevation:	244.7
Bankfull Cross-Sectional Area:	32.2
Bankfull Width:	23.3
Flood Prone Area Elevation:	248.0
Flood Prone Width:	74
Max Depth at Bankfull:	3.4
Mean Depth at Bankfull:	1.4
W / D Ratio:	16.8
Entrenchment Ratio:	3.2
Bank Height Ratio:	1.0



River Basin:	Neuse
Watershed:	Chavis Park, Garner Branch, MY05
XS ID	XS - 5, Pool
Drainage Area (sq mi):	0.54
Date:	7/10/2008
Field Crew:	B. Roberts, K. Vaughan

Station	Elevation
0.0	254.4
0.7	253.6
5.1	251.4
7.9	249.6
10.1	248.2
14.0	245.9
19.2	242.7
21.9	241.2
23.6	240.2
24.1	239.1
26.3	238.5
27.9	238.5
29.4	238.7
31.3	239.0
32.6	239.3
33.8	239.4
36.4	239.4
39.7	239.5
40.7	239.6
42.6	240.3
44.4	240.8
45.6	240.8
47.4	241.0
48.7	240.5
54.0	241.1
56.9	242.1
63.4	241.6
66.4	242.3
69.1	243.4

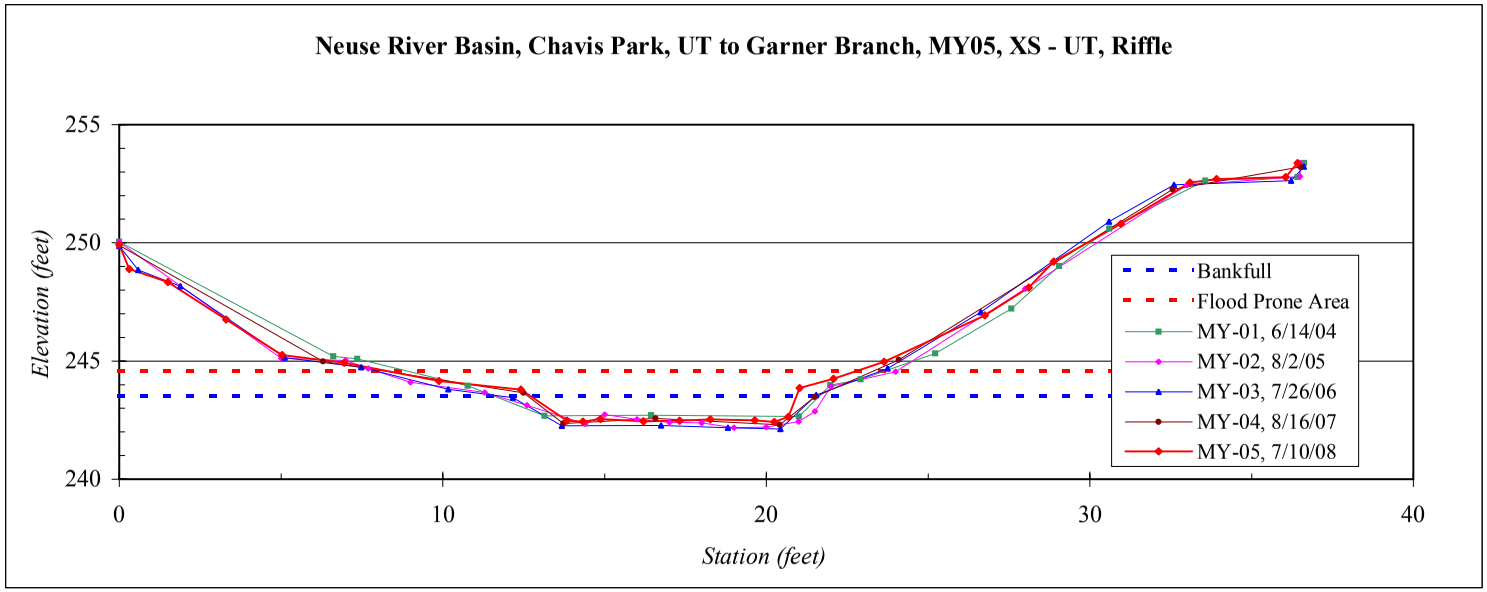
SUMMARY DATA	
Bankfull Elevation:	240.4
Bankfull Cross-Sectional Area:	23.2
Bankfull Width:	19.9
Flood Prone Area Elevation:	242.2
Flood Prone Width:	46
Max Depth at Bankfull:	1.9
Mean Depth at Bankfull:	1.2
W / D Ratio:	17.1
Entrenchment Ratio:	2.3
Bank Height Ratio:	1.0



River Basin:	Neuse
Watershed:	Chavis Park, UT to Garner Branch, MY05
XS ID	XS - UT, Riffle
Drainage Area (sq mi):	0.2
Date:	7/10/2008
Field Crew:	B. Roberts, K. Vaughan

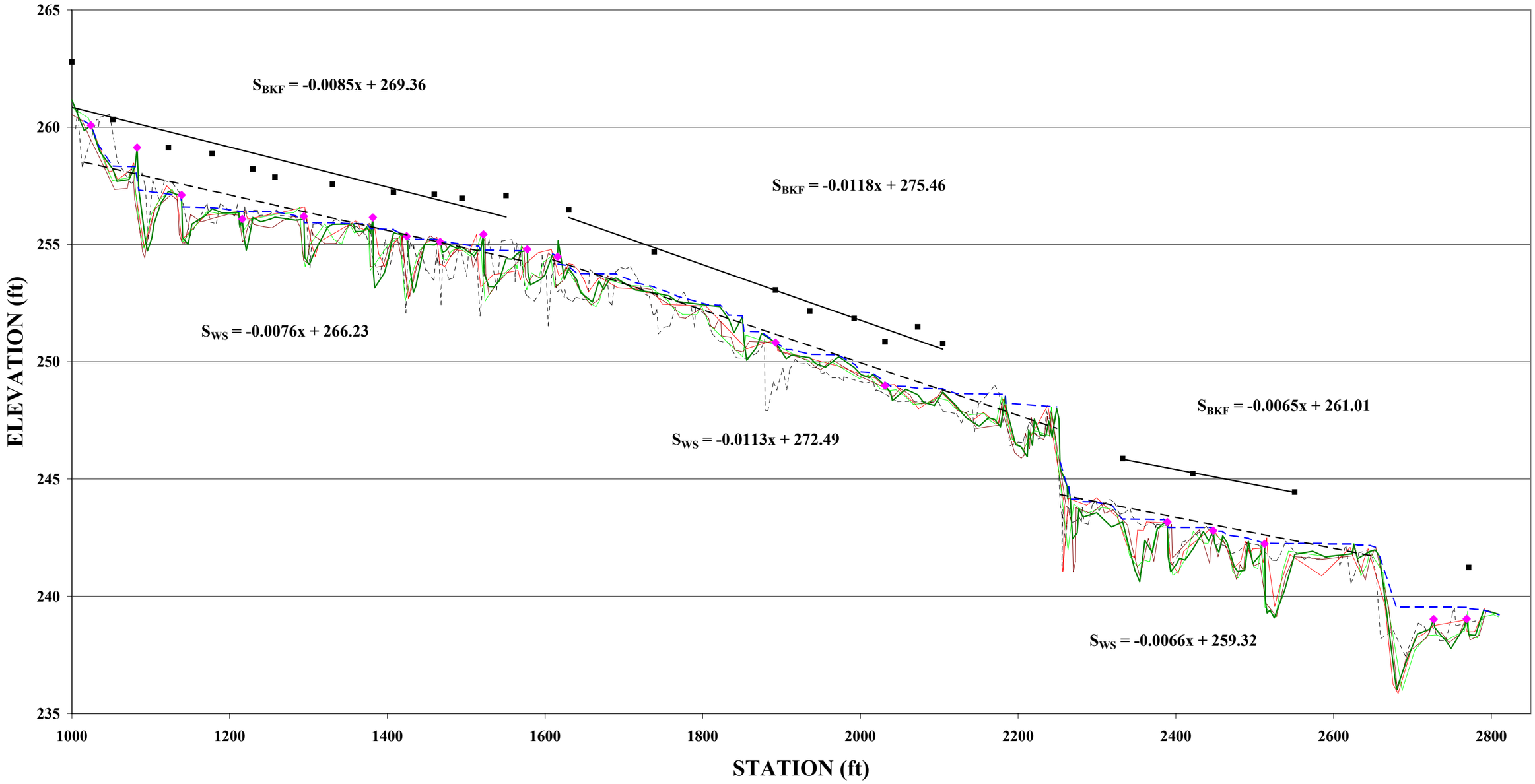
Station	Elevation
0.0	249.9
0.3	248.9
1.5	248.3
3.3	246.8
5.0	245.3
7.0	244.9
9.9	244.2
12.4	243.8
13.8	242.5
14.3	242.4
14.9	242.5
16.2	242.5
17.3	242.5
18.3	242.5
19.6	242.5
20.3	242.4
20.7	242.6
21.0	243.9
22.1	244.2
23.6	245.0
26.8	246.9
28.1	248.1
28.9	249.2
31.0	250.8
33.1	252.5
33.9	252.7
36.1	252.8
36.4	253.4

SUMMARY DATA	
Bankfull Elevation:	243.5
Bankfull Cross-Sectional Area:	7.6
Bankfull Width:	8.2
Flood Prone Area Elevation:	244.6
Flood Prone Width:	15
Max Depth at Bankfull:	1.1
Mean Depth at Bankfull:	0.9
W / D Ratio:	8.9
Entrenchment Ratio:	1.8
Bank Height Ratio:	1.1



B5 - Longitudinal Plot

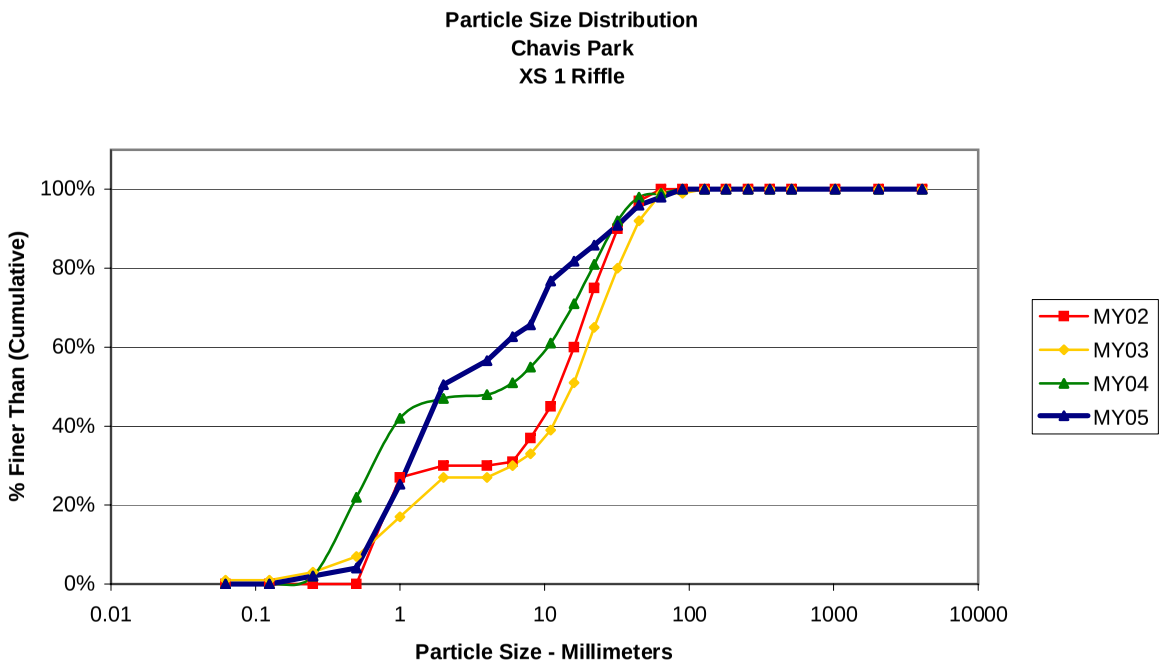
Chavis Park (Garner Branch), Wake County
EEP Project Number 87 - MY-05



B6 - Pebble Count Plots

Cross Section 1 Riffle - MY05			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	2
Medium	.25 - .50	N	2
Coarse	.50 - 1	D	21
Very Coarse	1 - 2	S	25
Very Fine	2 - 4		6
Fine	4 - 5.7	G	6
Fine	5.7 - 8	R	3
Medium	8 - 11.3	A	11
Medium	11.3 - 16	V	5
Coarse	16 - 22.6	E	4
Coarse	22.6 - 32	L	5
Very Coarse	32 - 45	S	5
Very Coarse	45 - 64		2
Small	64 - 90	C	2
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	99

Note:



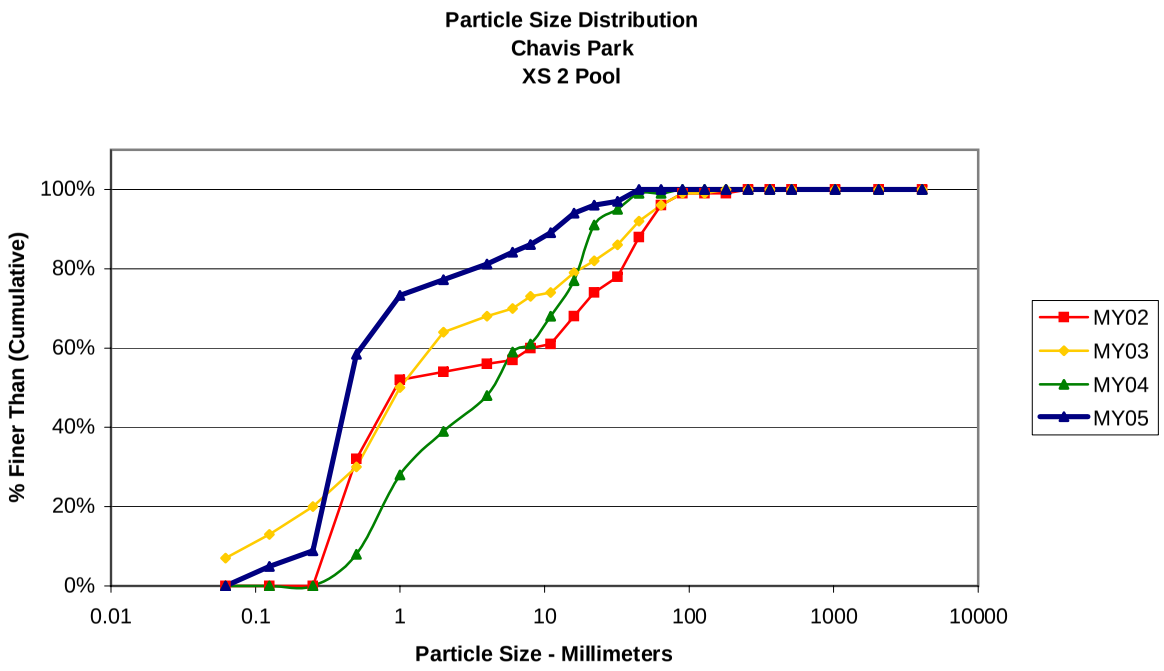
Size (mm)	
D16	0.74
D35	1.3
D50	2
D65	7.5
D84	19
D95	42

Size Distribution	
mean	3.7
dispersion	6.1
skewness	0.23

Type	
silt/clay	0%
sand	51%
gravel	47%
cobble	2%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross Section 2 Pool - MY05			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	5
Fine	.125 - .25	A	4
Medium	.25 - .50	N	50
Coarse	.50 - 1	D	15
Very Coarse	1 - 2	S	4
Very Fine	2 - 4		4
Fine	4 - 5.7	G	3
Fine	5.7 - 8	R	2
Medium	8 - 11.3	A	3
Medium	11.3 - 16	V	5
Coarse	16 - 22.6	E	2
Coarse	22.6 - 32	L	1
Very Coarse	32 - 45	S	3
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	101

Note:



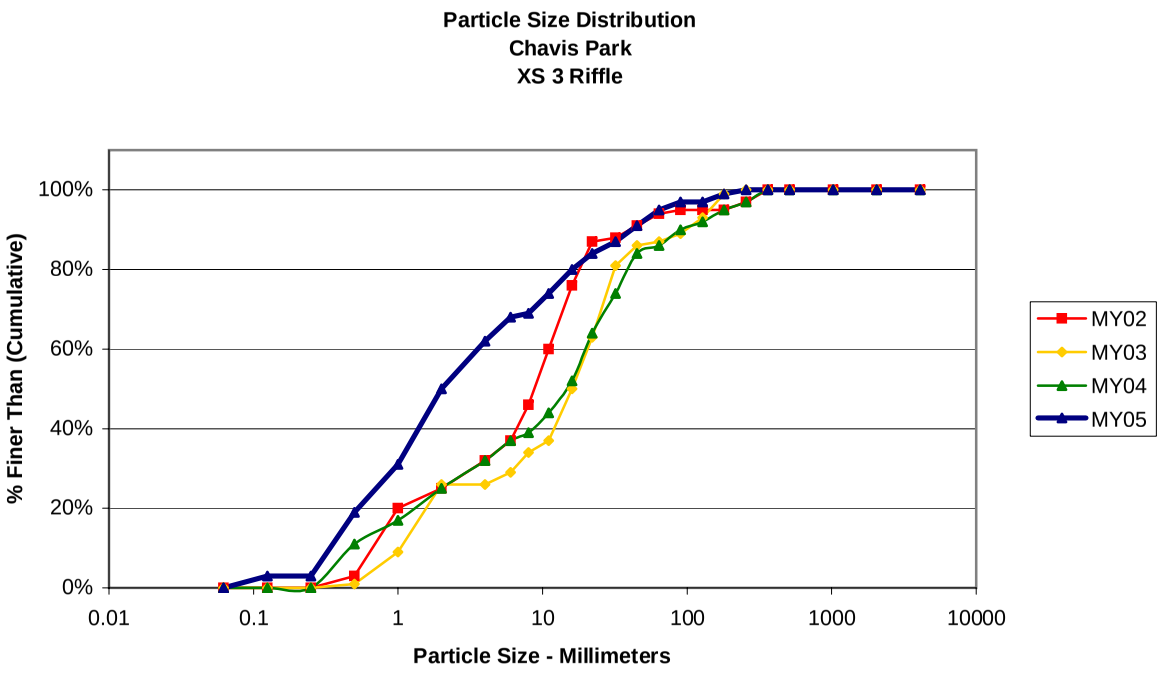
Size (mm)	
D16	0.28
D35	0.36
D50	0.44
D65	0.68
D84	5.9
D95	19

Size Distribution	
mean	1.3
dispersion	7.5
skewness	0.40

Type	
silt/clay	0%
sand	77%
gravel	23%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross Section 3 Riffle - MY05			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	3
Fine	.125 - .25	A	
Medium	.25 - .50	N	16
Coarse	.50 - 1	D	12
Very Coarse	1 - 2	S	19
Very Fine	2 - 4		12
Fine	4 - 5.7	G	6
Fine	5.7 - 8	R	1
Medium	8 - 11.3	A	5
Medium	11.3 - 16	V	6
Coarse	16 - 22.6	E	4
Coarse	22.6 - 32	L	3
Very Coarse	32 - 45	S	4
Very Coarse	45 - 64		4
Small	64 - 90	C	2
Small	90 - 128	O	
Large	128 - 180	B	2
Large	180 - 256	L	1
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



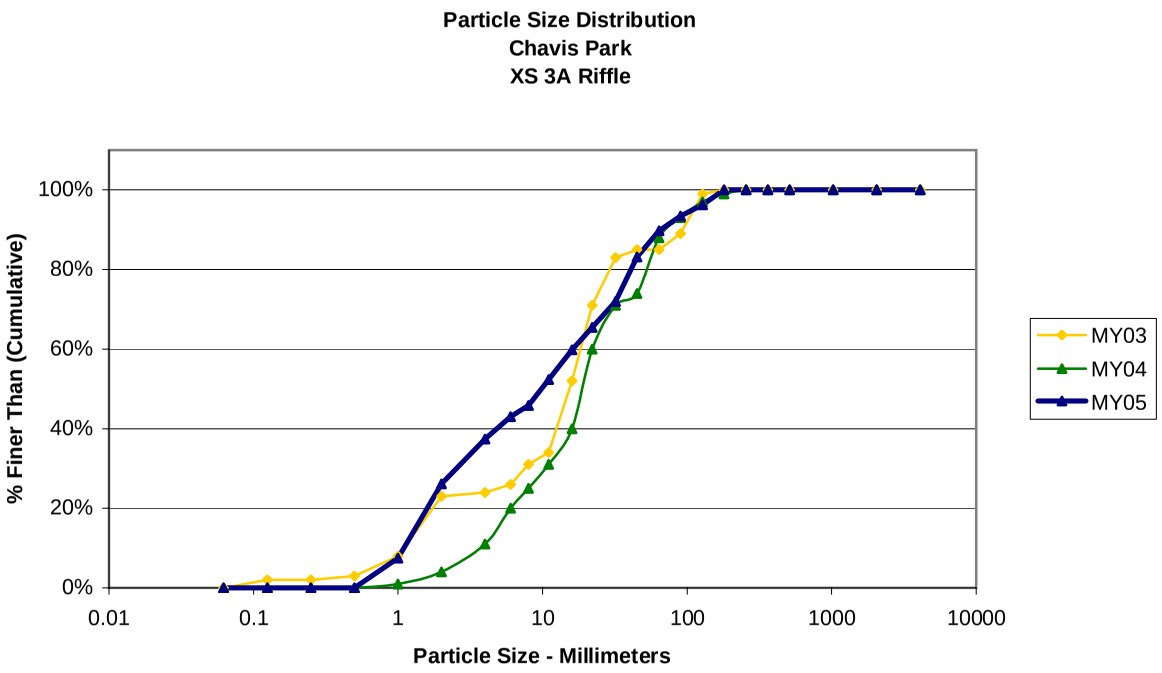
Size (mm)	
D16	0.44
D35	1.2
D50	2
D65	4.9
D84	22
D95	64

Size Distribution	
mean	3.1
dispersion	7.8
skewness	0.15

Type	
silt/clay	0%
sand	50%
gravel	45%
cobble	5%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross Section 3A Riffle - MY05			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	8
Very Coarse	1 - 2	S	20
Very Fine	2 - 4		12
Fine	4 - 5.7	G	6
Fine	5.7 - 8	R	3
Medium	8 - 11.3	A	7
Medium	11.3 - 16	V	8
Coarse	16 - 22.6	E	6
Coarse	22.6 - 32	L	7
Very Coarse	32 - 45	S	12
Very Coarse	45 - 64		7
Small	64 - 90	C	4
Small	90 - 128	O	3
Large	128 - 180	B	4
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	107

Note:



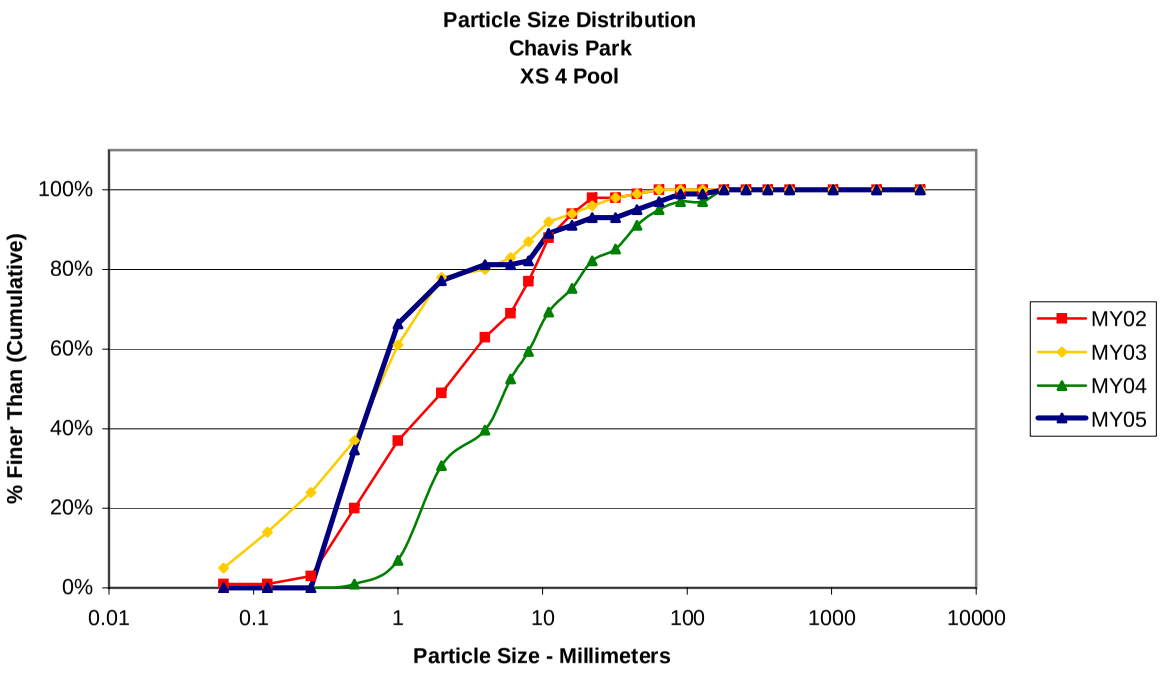
Size (mm)	
D16	1.4
D35	3.5
D50	9.8
D65	21
D84	47
D95	110

Size Distribution	
mean	8.1
dispersion	5.9
skewness	-0.07

Type	
silt/clay	0%
sand	26%
gravel	64%
cobble	10%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross Section 4 Pool - MY05			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	35
Coarse	.50 - 1	D	32
Very Coarse	1 - 2	S	11
Very Fine	2 - 4		4
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	1
Medium	8 - 11.3	A	7
Medium	11.3 - 16	V	2
Coarse	16 - 22.6	E	2
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	2
Very Coarse	45 - 64		2
Small	64 - 90	C	2
Small	90 - 128	O	
Large	128 - 180	B	1
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	101

Note:



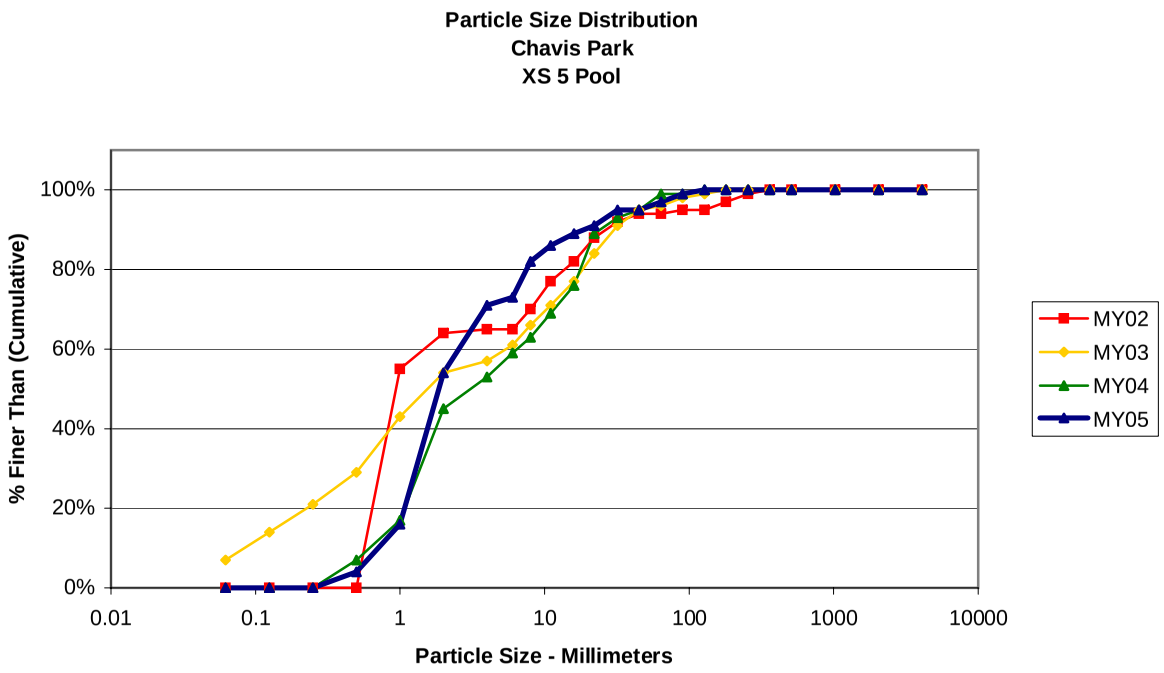
Size (mm)	
D16	0.34
D35	0.5
D50	0.7
D65	0.97
D84	8.7
D95	45

Size Distribution	
mean	1.7
dispersion	7.2
skewness	0.33

Type	
silt/clay	0%
sand	77%
gravel	20%
cobble	3%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross Section 5 Pool - MY05			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	4
Coarse	.50 - 1	D	12
Very Coarse	1 - 2	S	38
Very Fine	2 - 4		17
Fine	4 - 5.7	G	2
Fine	5.7 - 8	R	9
Medium	8 - 11.3	A	4
Medium	11.3 - 16	V	3
Coarse	16 - 22.6	E	2
Coarse	22.6 - 32	L	4
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		2
Small	64 - 90	C	2
Small	90 - 128	O	1
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



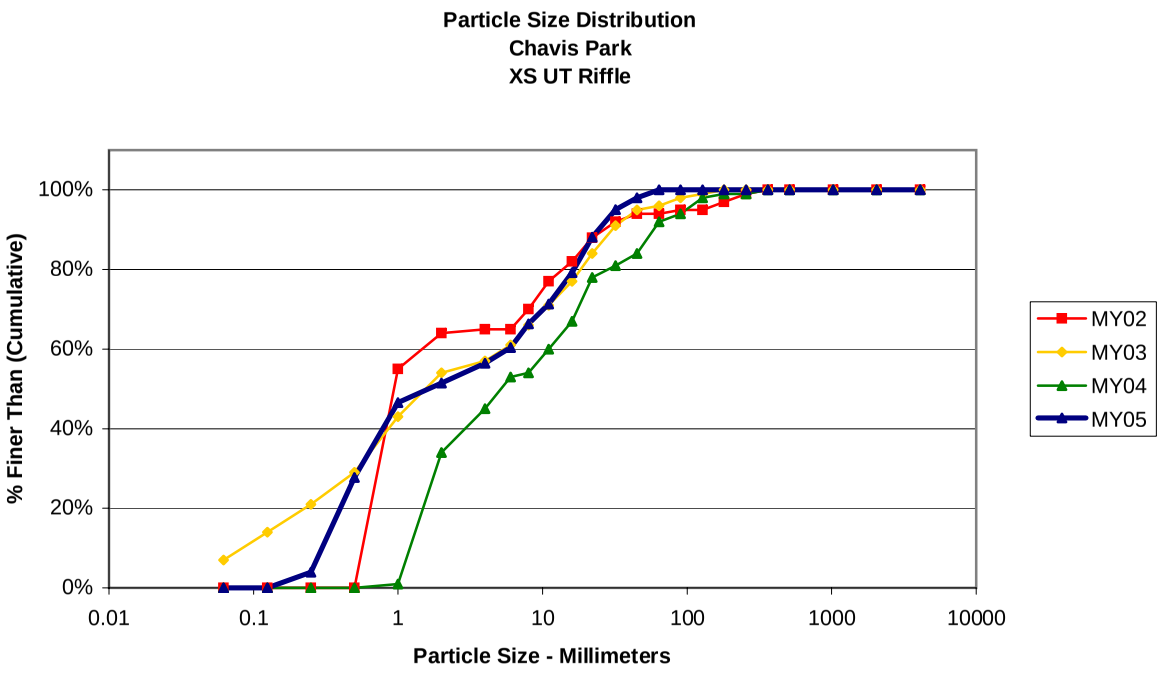
Size (mm)	
D16	1
D35	1.4
D50	1.9
D65	3.1
D84	9.4
D95	45

Size Distribution	
mean	3.1
dispersion	3.4
skewness	0.21

Type	
silt/clay	0%
sand	54%
gravel	43%
cobble	3%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross Section UT Riffle - MY05			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	4
Medium	.25 - .50	N	24
Coarse	.50 - 1	D	19
Very Coarse	1 - 2	S	5
Very Fine	2 - 4		5
Fine	4 - 5.7	G	4
Fine	5.7 - 8	R	6
Medium	8 - 11.3	A	5
Medium	11.3 - 16	V	8
Coarse	16 - 22.6	E	9
Coarse	22.6 - 32	L	7
Very Coarse	32 - 45	S	3
Very Coarse	45 - 64		2
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	101

Note:

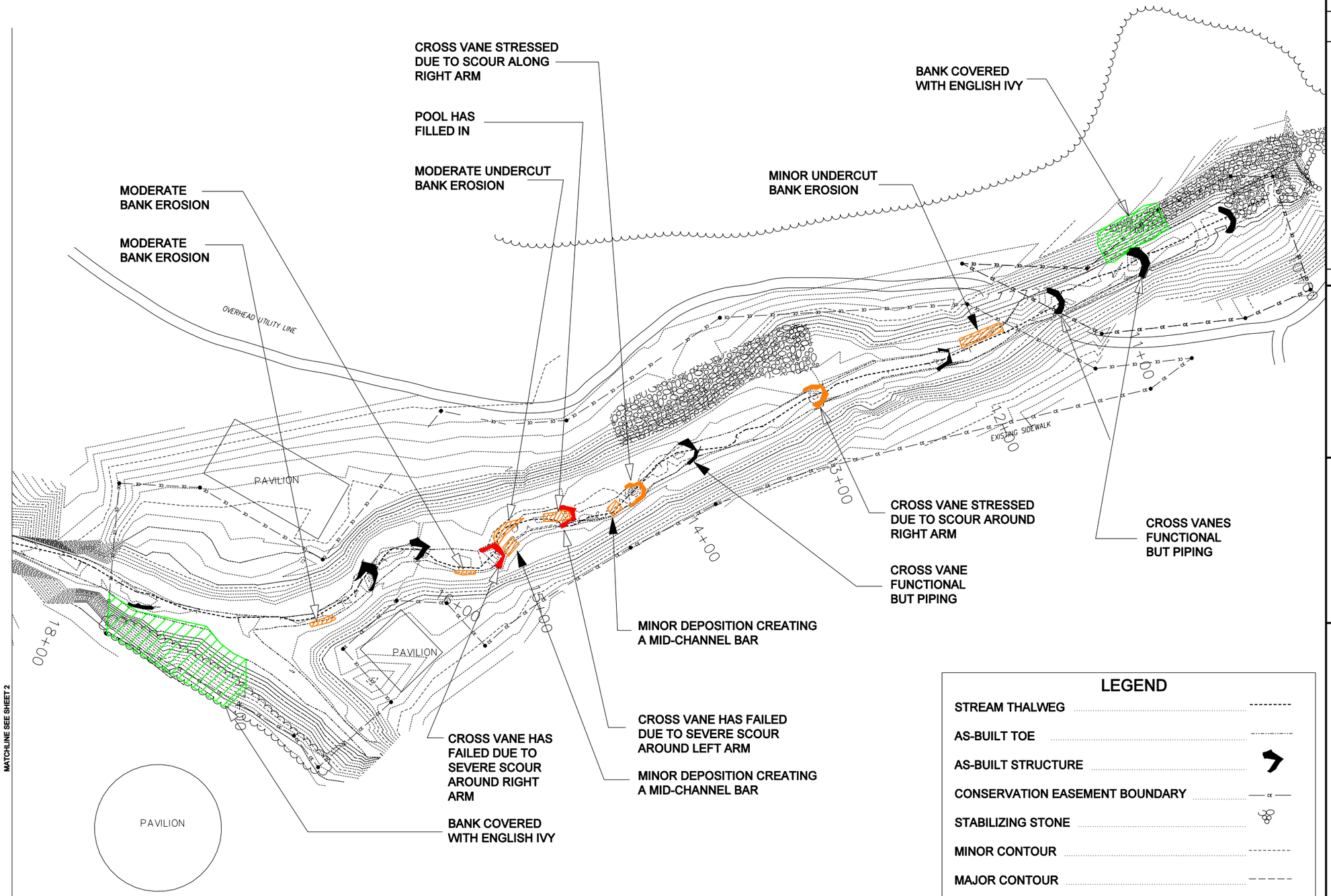


Size (mm)	
D16	0.36
D35	0.65
D50	1.6
D65	7.5
D84	19
D95	32

Size Distribution	
mean	2.6
dispersion	8.2
skewness	0.16

Type	
silt/clay	0%
sand	51%
gravel	49%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Appendix C
Current Conditions Plan View



LEGEND

- STREAM THALWEG
- AS-BUILT TOE
- AS-BUILT STRUCTURE
- CONSERVATION EASEMENT BOUNDARY — CE —
- STABILIZING STONE
- MINOR CONTOUR
- MAJOR CONTOUR

–60 –30 0 30 60

GRAPHIC SCALE

REVISIONS

STM	DESCRIPTION	DATE	APPROVED

Ecosystem Enhancement Program

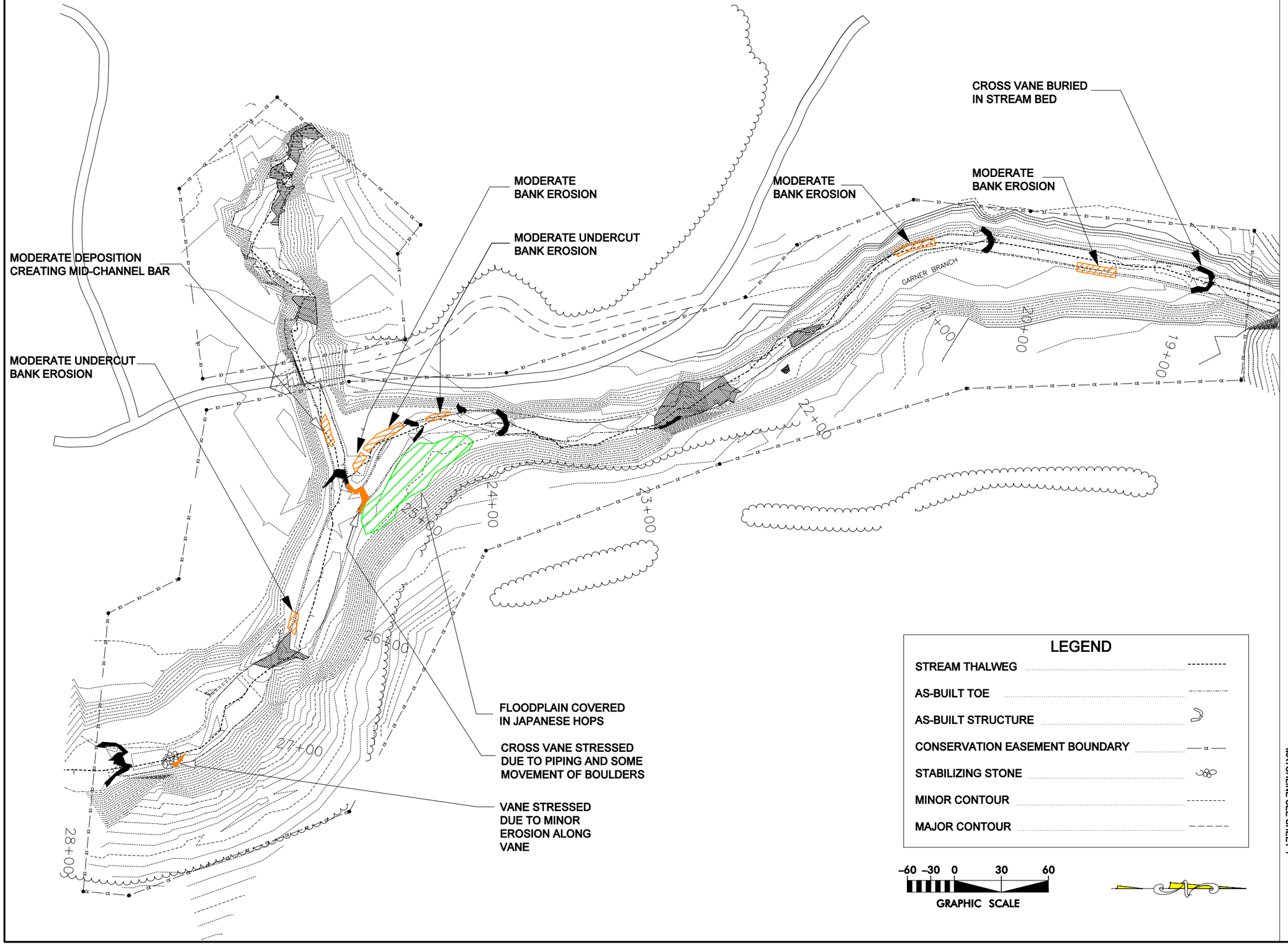
KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

CHAVIS PARK (GARNER BRANCH)
WAKE COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 87 - MY05

STATION 10+00 TO STATION 18+40

DATE: NOVEMBER 2008
SCALE: SEE SHEET

CURRENT CONDITIONS PLAN VIEW



LEGEND

- STREAM THALWEG
- AS-BUILT TOE
- AS-BUILT STRUCTURE
- CONSERVATION EASEMENT BOUNDARY
- STABILIZING STONE
- MINOR CONTOUR
- MAJOR CONTOUR

–60 –30 0 30 60

GRAPHIC SCALE

REVISIONS

STN.	DESCRIPTION	DATE	APPROVED

Ecosystem Enhancement Program

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4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

CHAVIS PARK (GARNER BRANCH)
WAKE COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 87 - MY05

STATION 18+40 TO STATION 28+06

DATE: NOVEMBER 2008
SCALE: SEE SHEET

CURRENT CONDITIONS PLAN VIEW

SHEET 2 OF 2