Bold Run
Stream/Buffer Restoration
Monitoring Report
EEP Project # 439
Monitoring Year - 01

Submitted to:

Ecosystem Enhancement PROGRAM

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

January 2008

Landmark Center II, Suite 220
4601 Six Forks Road
Raleigh, NC 27609
Phone: (919) 783-9214
Fax: (919) 783-9266

Project Manager: April Davis
Email: adavis@kci.com

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDIX A – VEGETATION DATA

APPENDIX B – GEOMORPHOLOGIC DATA

APPENDIX C – CURRENT CONDITIONS PLAN VIEW

EXECUTIVE SUMMARY

In 2007, the North Carolina Ecosystem Enhancement Program (EEP) conducted stream and buffer restoration on Bold Run Creek within Wake County, North Carolina. The 12 mi^2 watershed is located within the USGS 14-digit HUC 03020201065010 and the NCDWQ Sub-basin 03-04-08 of the Neuse River Basin. The project restored approximately 1,629 linear feet of channel, the first 175 feet using a Priority 4 approach and the remaining 1,454 feet using a Priority 2 approach. The design was developed to address vertical instability and lack of bed variability. The restoration plan called for correcting these problems by stabilizing stream banks, installing in-stream structures, adjusting the stream planform, and replanting the riparian areas with native vegetation. Project construction ended in early 2007. This report is a description of the findings of the first year monitoring that took place in 2007.

The riparian buffer was planted with thirteen different species of bare root trees and four different species of live stakes. Fifteen vegetation monitoring plots were established during the as-built survey. Five vegetation plots were established in the streamside riparian buffer and ten vegetation plots were established in the remaining riparian buffer. The first year monitoring counted an average of 483 stems per acre, which is on track to meet the success criteria of at least 320 stems per acre after five years. The invasive species Chinese lespedeza (*Lespedeza cuneata*) and Japanese stilt grass (*Microstegium vimineum*) are scattered throughout the buffer along the main channel and tropical soda apple (*Solanum viarium*) is found throughout the remaining buffer area. Japanese honeysuckle (*Lonicera japonica*) was observed on the edges of the downstream area of the project. These species are not yet prolific, but should continue to be monitored. The first year monitoring found the vegetation component of the project to be on track to meeting the success criteria.

The stream assessment completed during the first year of monitoring found the stream to be functioning well for nearly the entire project. Channel dimensions have changed minimally from the as-built conditions over the course of the first year monitoring. The stream channel between Stations 22+80 and 26+29 was built wider than designed. The dimensions surveyed at monitoring Cross-Section 5 illustrate this wider cross-section. This deviation from the design is due to a limitation during construction, because it was determined that it would not be stable to build up both banks to achieve the designed cross-section. A structure to constrict the base flow was added between Stations 23+15 and 23+60. Some lateral bars were observed throughout the project stream, but these did not appear to contribute to any channel instability. Small areas of bank erosion and patches of bare coir matting and bare terraces have been recorded in the following report. All of the in-stream structures are functioning with only one cross vane experiencing water piping around the header stone at low flow. Due to drought conditions causing low baseflow throughout the growing season, there has been extensive vegetative growth in the channel. This vegetative cover has created some minor aggradation in the channel, but overall has led to increased channel stability. Some of this vegetation is invasive and should continue to be monitored.

One bankfull event was recorded during the first year of monitoring. Other than the above mentioned minor issues, there are no stream problem areas that would warrant any corrective action. It is recommended that the silt fence remaining on-site from construction be removed. First year monitoring found the stream component of the project to be successful.

1.0 PROJECT BACKGROUND

1.1 Project Objectives

- Project success will be assessed utilizing measurements of stream dimension, pattern, and profile, site photographs, and vegetation sampling. These measurements should show little or no change from the as-built conditions.
- A stable channel is able to move the sediment supplied by its watershed without the channel aggrading or degrading. Through stream monitoring, the stability of the restored stream will be evaluated.
- Riparian vegetation must meet a minimum survival success rate of 320 stems/acre after five years.

1.2 Project Structure, Restoration Type, and Approach

Bold Run Creek became impaired through severe bank erosion resulting from poor grazing management. Sedimentation from bank erosion and stream bed degradation was widespread throughout the site. Restoration of 1,629 linear feet of channel was accomplished utilizing a combination of Priorities 2 and 4 (Table I). The riparian buffer was planted with native trees and shrubs. The stream dimension, pattern, and profile are based on the detailed morphological criteria and hydraulic geometry relationships developed from the reference stream.

1.3 Location and Setting

The Bold Run Stream/Buffer Restoration site is located 5 miles northwest of the Town of Wake Forest on Bold Run Hill Road, approximately 1.5 miles east of the intersection with Mangum Dairy Road in Wake County, North Carolina. The land use of the 12 mi^2 watershed is mainly forested and agricultural. The watershed has a high potential for future development. From Interstate 440, take the Six Forks Road Exit and head north for approximately 8.0 miles, then take a left to stay on Six Forks Road. Continue on Six Forks Road for approximately 3.0 miles, turn right onto Highway 98 and proceed for approximately 2.7 miles. Then, take a left onto Stony Hill Road and proceed 2.4 miles. Take a left on Purnell Road, followed by a right onto Mangum Dairy Road after approximately 0.1 mile. Turn right on Bold Run Hill Road after 1.8 miles on Mangum Dairy Road. The site will be on the right after approximately 1.5 miles (Figure 1).

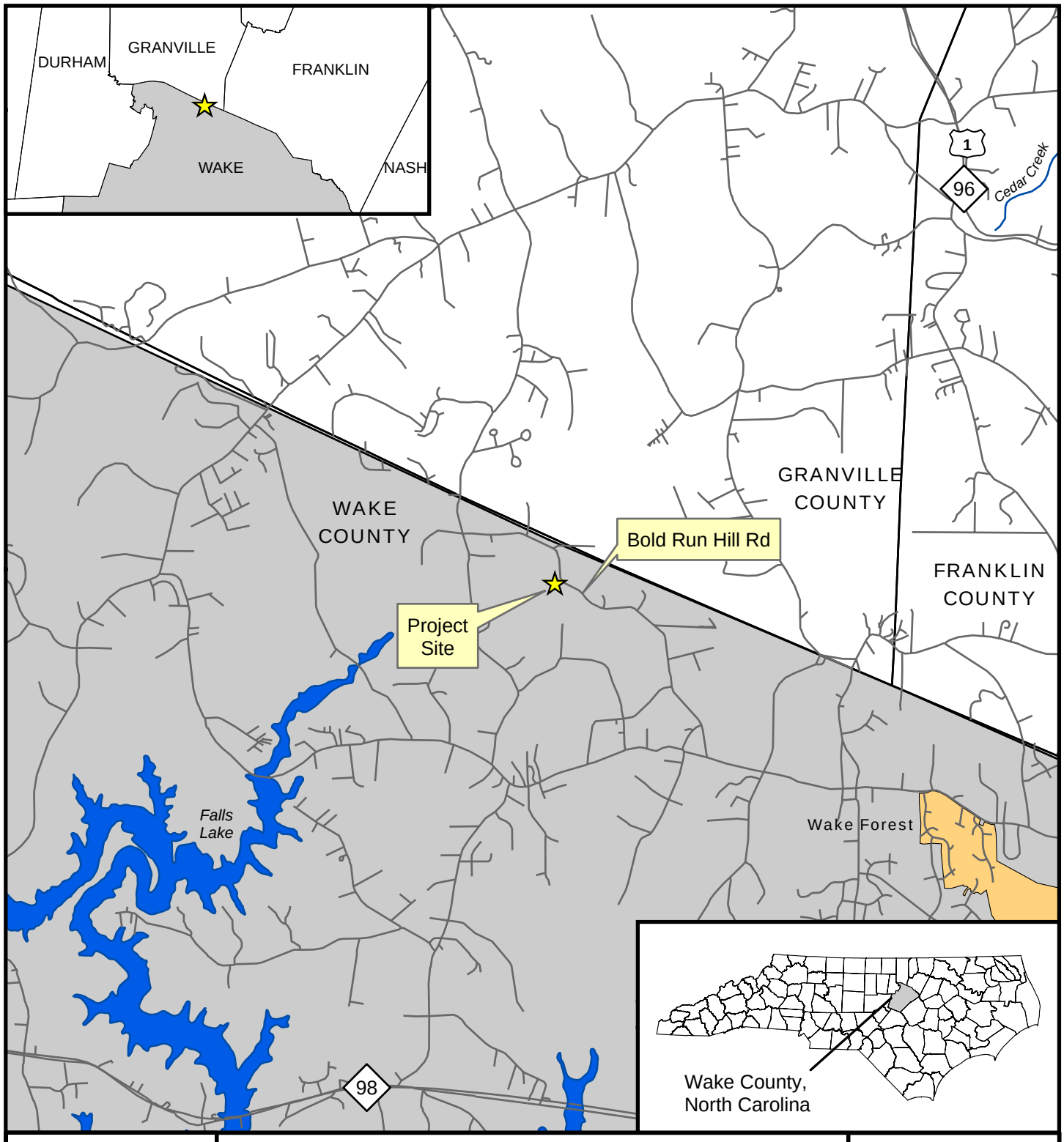


Figure 1. Project Site Vicinity Map

Restoration Site
Roads
Municipalities
County Boundaries
Major Rivers
Lakes and Reservoirs

N
W
E
S

1:63,360
1 inch equals 1 miles

1 0.5 0 1
Miles

KCI ASSOCIATES OF NC

Ecosystem Enhancement PROGRAM

1.4 Project History and Background

Table I. Project Restoration Components
Project Name and Number: Bold Run - 439

Project Segment / Reach ID	Existing Feet/Acres	Type	Approach	Footage or Acreage	Mitigation Ratio	Mitigation Units	Stationing	Comment
Reach I	175	R	P4	175 lf	1.0	175	10+00 - 11+75	
Reach II	1,296	R	P2	1,454 lf	1.0	1,454	11+75 - 26+29	
Riparian Buffer	27.1	R	-	27.1 ac	1.0	27.1	-	

Mitigation Unit Summations

Stream (lf)	Riparian Wetland	Nonriparian	Total Wetland	Buffer (Ac)	Comment
1,629	0	0	0	27.1	

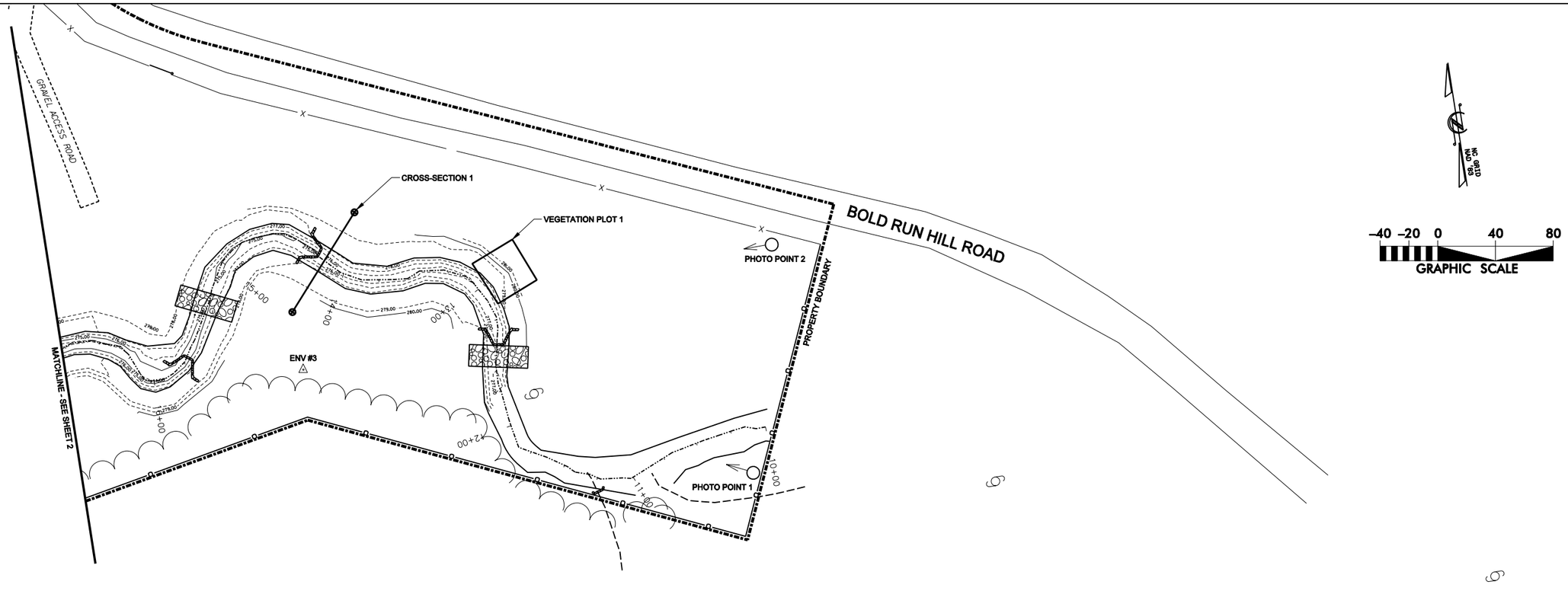
R = Restoration P2 = Priority 2
P4 = Priority 4

Table II. Project Activity and Reporting History
Project Name and Number: Bold Run - 439

Activity or Report	Data Collection Complete	Completion or Delivery
Restoration Plan	Nov 05	Feb 06
Final Design - Construction Plans	N/A	Jul 06
Construction	N/A	Feb 07
Temporary seed mix applied to entire project area	N/A	Feb 07
Permanent seed mix applied to entire project area	N/A	Feb 07
Tree plantings completed	N/A	Feb 07
Mitigation Plan / As-Built (Year 0 Monitoring - Baseline)	Mar 07	Mar 07
Year 1 Monitoring	Oct 07	Jan 08

Table III. Project Contacts Table Project Name and Number: Bold Run - 439	
Design Firm	KCI Associates of NC Landmark Center II, Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Contact: Ms. April Davis Phone: (919) 783-9214 Fax: (919) 783-9266
Construction Contractor	Vaughn Contracting Inc. P.O. Box 796 Wadesboro, North Carolina 28170 Contact: Mr. Don Vaughn Phone: (704) 694-6450 Fax: (704) 694-7401
Planting Contractor	Bruton Nurseries & Landscapes P.O. Box 1197 Freemont, NC 27830 Contact: Kelly Bruton Phone: (919) 524-5304
Seeding Contractor	Vaughn Contracting Inc. P.O. Box 796 Wadesboro, North Carolina 28170 Contact: Mr. Don Vaughn Phone: (704) 694-6450 Fax: (704) 694-7401
Seed Mix Sources	Evergreen Seed Company Phone: (919) 567-1333
Nursery Stock Suppliers	Bruton Nurseries & Landscapes Phone: (919) 524-5304
Monitoring Performers	
MY-00 & MY-01	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 Name and Number: Bold Run - 439**	
Project County	Wake County
Physiographic Region	Piedmont
Ecoregion	Northern Outer Piedmont
Project River Basin	Neuse
USGS HUC for Project and Reference	03020201065010 (Bold Run Creek) 03020201070060 (Richland Creek)
NCDWQ Sub-basin for Project and Reference	03-04-08 (Bold Run Creek) 03-04-02 (Richland Creek)
Drainage Area	1.6 sq. mi.
Stream Order	Second Order
Watershed Type (Rural, Urban, Developing, etc.)	Forested
Watershed LULC Distribution — Urban	<1%
Ag-Row Crop	13%
Ag-Livestock	6%
Forested	79%
Water/Wetlands	2%
Watershed impervious cover (%)	<1%
Rosgen Classification of As-built	C4
Cowardin Classification	N/A
Reference Site ID	Richland Creek
NCDWQ AU/Index Number	27-13-(0.1) New Light Creek
NCDWQ Classification for Project	WS-IV, NSW, CA
Within EEP Watershed Plan?	No
Any portion of the project segment upstream of a 303d listed segment?	No
Reasons for 303d Listing or Stressor	N/A
Total project acreage of easement	31.0 Acres
Total vegetated acreage within easement	30.7 Acres
Total planted acerage	28.7 Acres
WRC Class (Warm, Cool, Cold)	Warm
Trout Designation	N/A
Species of concern, endangered etc.	N/A
Pre-construction Beaver activity?	Historically, according to landowner
Dominant Soil Types	Chewacla, Chewacla variant, Chewacla-Riverview
Project soil characteristics	Chewacla variant with inclusions of Riverview, well to moderately well drained
% of Project Easement Fenced	100%



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

		NORTHING	EASTING	ELEVATION
CROSS-SECTION #1	LB	831093.83	2121155.51	280.06
	RB	831155.50	2121208.69	279.59
CROSS-SECTION #2	LB	831049.33	2120942.72	278.24
	RB	831114.72	2120951.23	278.62
CROSS-SECTION #3	LB	831006.43	2120791.65	276.76
	RB	831069.17	2120753.34	276.91
CROSS-SECTION #4	LB	830948.40	2120624.58	275.33
	RB	831008.85	2120590.40	275.80
CROSS-SECTION #5	LB	830890.96	2120332.42	274.47
	RB	830944.24	2120283.35	273.44

	NORTHING	EASTING
VEGETATION PLOT #1	831119.96	2121313.81
	831089.59	2121326.32
	831077.54	2121297.15
	831107.67	2121283.87
VEGETATION PLOT #2	831075.76	2120964.75
	831044.32	2120972.81
	831034.59	2120941.70
	831067.36	2120933.60
VEGETATION PLOT #3	831043.29	2120806.97
	831013.34	2120819.51
	830998.97	2120791.33
	831028.34	2120777.34
VEGETATION PLOT #4	831024.75	2120621.38
	830994.57	2120630.89
	830981.52	2120600.74
	831011.99	2120589.78
VEGETATION PLOT #5	830989.38	2120406.50
	830958.17	2120415.07
	830948.15	2120383.69
	830979.26	2120374.35
VEGETATION PLOT #6	831361.63	2120827.91
	831349.39	2120857.20
	831318.52	2120845.40
	831330.70	2120814.93
VEGETATION PLOT #7	831477.30	2120576.84
	831463.10	2120605.34
	831433.44	2120590.84
	831448.33	2120561.39
VEGETATION PLOT #8	831147.63	2120307.85
	831114.72	2120306.17
	831118.41	2120273.86
	831159.80	2120277.98
VEGETATION PLOT #9	831629.35	2120277.54
	831602.71	2120298.24
	831583.56	2120271.75
	831609.01	2120251.28
VEGETATION PLOT #10	831636.97	2120788.53
	831621.65	2120815.67
	831593.37	2120799.71
	831609.09	2120769.69
VEGETATION PLOT #11	831996.48	2120784.37
	831979.80	2120817.15
	831952.65	2120799.07
	831966.75	2120769.69
VEGETATION PLOT #12	832341.97	2120658.90
	832309.92	2120681.60
	832296.51	2120652.76
	832322.25	2120632.55
VEGETATION PLOT #13	832171.07	2120359.42
	832147.09	2120366.83
	832125.57	2120366.83
	832144.28	2120340.27
VEGETATION PLOT #14	831873.35	2120195.95
	831893.48	2120221.92
	831865.44	2120242.78
	831846.92	2120215.30
VEGETATION PLOT #15	831851.69	2120584.90
	831836.83	2120620.00
	831808.82	2120602.25
	831821.30	2120572.14

LEGEND

- STREAM THALWEG
- AS-BUILT TOP OF BANK
- AS-BUILT STRUCTURE
- RIFFLE ENHANCEMENT
- PHOTO REFERENCE POINT
- PROPERTY BOUNDARY
- CROSS-SECTION
- VEGETATION PLOT
- UTILITY POLE
- DRAINAGE DITCH
- FORD CROSSING
- CONTROL POINT (ENV #3)
- FENCE

REVISIONS

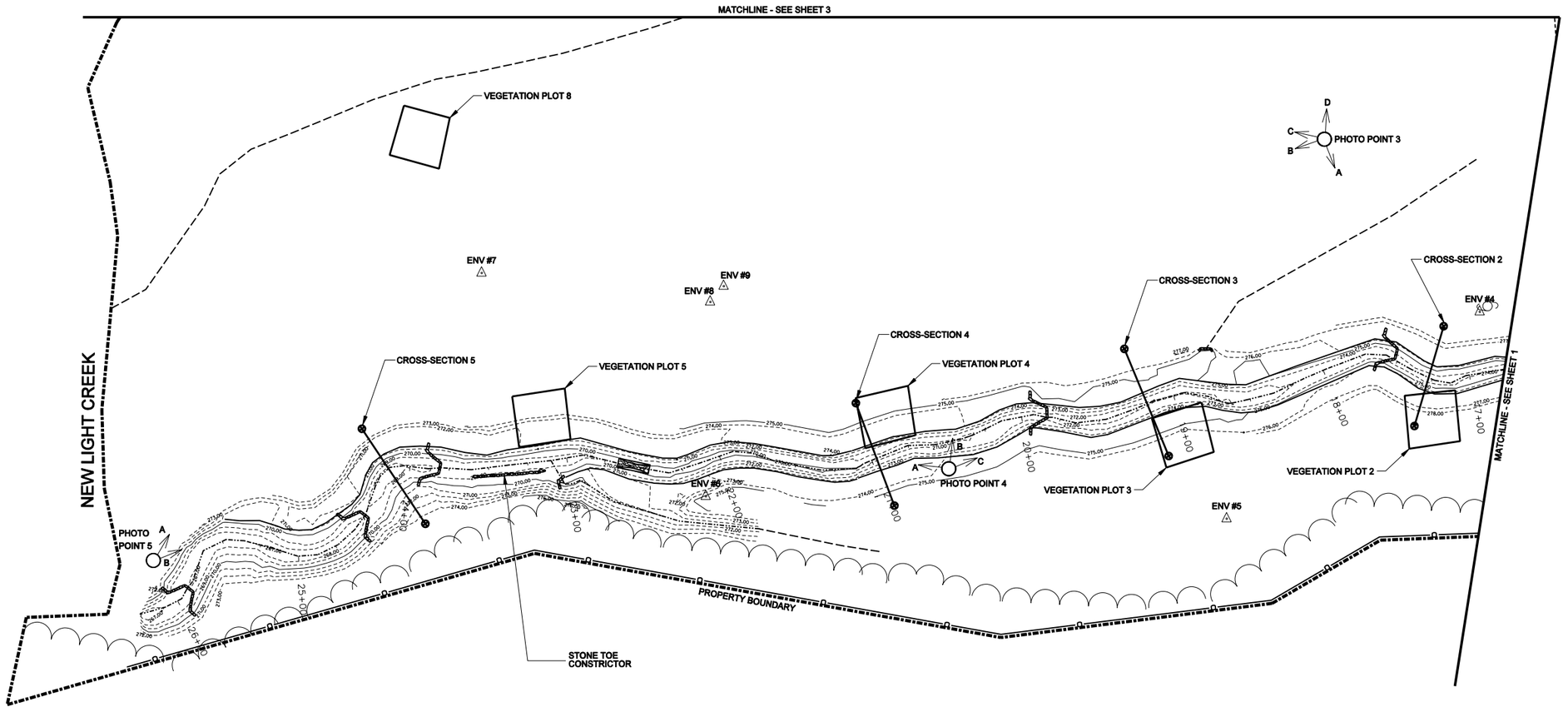
Ecosystem Enhancement

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

BOLD RUN CREEK
STREAM / BUFFER RESTORATION
WAKE FOREST, WAKE COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 439 - MY 01
STATION 10+00 TO STATION 16+77

DATE: NOV 2007
SCALE: SEE SHEET

MONITORING PLAN VIEW



LEGEND

- STREAM THALWEG
- AS-BUILT TOP OF BANK
- AS-BUILT STRUCTURE
- RIFFLE ENHANCEMENT
- PHOTO REFERENCE POINT
- PROPERTY BOUNDARY
- CROSS-SECTION
- VEGETATION PLOT
- UTILITY POLE
- DRAINAGE DITCH
- FORD CROSSING
- CONTROL POINT (ENV #3)
- FENCE

REVISIONS

Ecosystem Enhancement

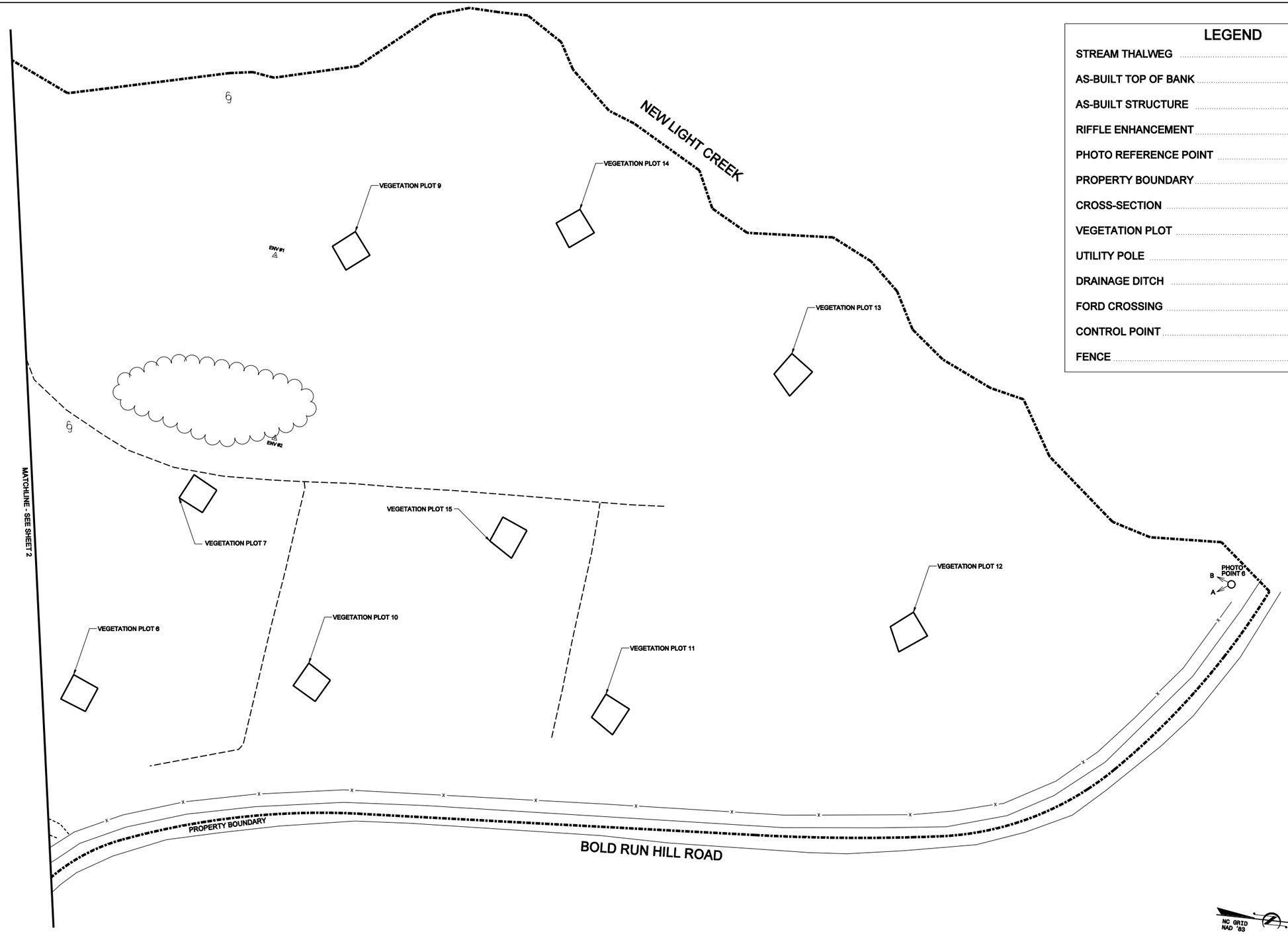
KCI
ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601-SW FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

BOLD RUN CREEK
STREAM / BUFFER RESTORATION
WAKE FOREST, WAKE COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 439 - MY 01
STATION 16+77 TO STATION 26+29

DATE: NOV 2007
SCALE: SEE SHEET

MONITORING PLAN VIEW

SHEET 2 OF 3



LEGEND

- STREAM THALWEG
- AS-BUILT TOP OF BANK
- AS-BUILT STRUCTURE
- RIFFLE ENHANCEMENT
- PHOTO REFERENCE POINT
- PROPERTY BOUNDARY
- CROSS-SECTION
- VEGETATION PLOT
- UTILITY POLE
- DRAINAGE DITCH
- FORD CROSSING
- CONTROL POINT (ENV #3)
- FENCE

REVISIONS

Ecosystem Enhancement

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

BOLD RUN CREEK
STREAM / BUFFER RESTORATION
WAKE FOREST, WAKE COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 439 - MY 01

DATE: NOV 2007
SCALE: SEE SHEET

MONITORING PLAN VIEW

SHEET 3 OF 3

2.0 PROJECT CONDITIONS AND MONITORING RESULTS

2.1 Vegetation Assessment

The planted vegetation on the site is growing well. Due to the baseline vegetation monitoring occurring while the plants were in dormancy, some of the plants could not be identified and their species was recorded as unknown. During the first year of monitoring, most of these plants were identified. A few previously unknown plants were damaged and could not be identified during the first year monitoring. These plants were again recorded as unknown.

The exceptional drought during the 2007 growing season caused the stream channel to have very low flows during most of the growing season. The lack of constant flow throughout the growing season allowed vegetation to become established in the stream channel and algae to grow in the stagnant pools. This vegetation included Asian dayflower (*Murdannia keisak*) and other invasives. While contributing to the overall stream stability, the invasive vegetation could out compete native species and contribute to aggradation in the channel by trapping sediment. In future, non-drought years, the normal flow through the stream should be enough to prevent the growth of algae and vegetation on the channel bottom. Further monitoring will determine if channel vegetation continues to be a problem.

The floodplain, stream banks, and riparian buffer have well-established vegetation. Some scattered populations of invasive species have been identified in the floodplain area, which included: Chinese lespedeza (*Lespedeza cuneata*), Japanese stilt grass (*Microstegium vimineum*), and tropical soda apple (*Solanum viarium*). Japanese honeysuckle (*Lonicera japonica*) was observed on the outer edges of the downstream area of the project. Although they are not a problem at this time, these populations should continue to be monitored to determine if invasive control is required in the future.

The monitored vegetation plots revealed that the planted vegetation is growing well with 483 stems/acre. The overall vegetation assessment found the site to be on track to meeting the vegetative success criteria.

The vegetative monitoring results are displayed in Appendix A and the Current Conditions Plan View in Appendix C.

2.2 Stream Assessment

During the drought in the 2007 growing season, the stream experienced very low flows throughout the summer. There were periods where the only water in the channel was found in stagnant pools. While these conditions did not cause stress on the stream banks, the lack of regular stream flows did not allow the fine sediment, which had accumulated in some pools immediately following construction, to clear out. The on-site crest gauge recorded a bankfull event sometime between August 31, 2007 and November 19, 2007.

The stream assessment found the stream to be generally stable. The stream banks were stable and showed only isolated areas of erosion. Some parts of the streambed were experiencing aggradation, especially in the wider, downstream portions of the project. The cross vanes at the site were not built exactly to standard specifications. Most of the cross vane's arms are not visible, because they are covered with coir matting and buried in the bank. However, there have not been any major problem areas associated with these structures. While these structures were not built correctly, they are serving as effective grade control and most are maintaining their downstream pools. There are minimal differences in both the longitudinal profile and the cross-

sections when compared to the as-built data. The cross vanes should receive special attention in future monitoring to track any problems that may occur.

The stream assessment monitoring is described 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 Name and Number: Bold Run - 439

Date of Data Collection	Date of Occurrence	Method	Photo Number
11/19/2007	Between 8/31/2007 and 11/19/2007	Crest Gauge	N/A

Table VI. BEHI and Sediment Export Estimates
Project Name and Number: Bold Run - 439

To Be Performed in Monitoring Year 05

2.2.2 Stability Assessment Tables

Table VII. Categorical Stream Feature Visual Stability Assessment
Project Name and Number: Bold Run - 439

Feature	MY-00	MY - 01	MY - 02	MY - 03	MY - 04	MY - 05
A. Riffles	100%	100%				
B. Pools	100%	100%				
C. Thalweg	100%	100%				
D. Meanders	100%	100%				
E. Bed General	100%	98%				
F. Bank Condition	100%	99%				
G. Vanes / J Hooks etc.	100%	94%				
H. Wads and Boulders	100%	100%				

2.2.3 Quantitative Measures Summary Tables

Table VIII. Baseline Morphology and Hydraulic Summary
Project Name and Number: Bold Run - 439

Parameter	USGS Gauge Data			Regional Curve			Pre-existing Conditions			Project Reference			Design		As-built		
Dimension	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Max	Min	Mean	Max
Bankfull Width (ft)							14.8	17	18.3	22.9	26.9	30.8	17.8		18.1	18.5	18.9
Floodprone Width (ft)							18.5	22.3	30	300	300	300	>100		>70		>80
Bankfull Cross-Sectional Area (ft2)							24.2	24.8	25.2	59.2	66.9	74.6	27.6		29.6	31.8	34.1
Bankfull Mean Depth (ft)							1.3	1.5	1.7	2.4	2.5	2.6	1.4		1.6	1.7	1.8
Bankfull Max Depth (ft)							1.9	2.0	2.3	3.7	3.8	3.9	2.2		2.6	2.8	3.1
Width/Depth Ratio							8.8	11.7	13.8	8.8	10.8	12.7	12.7		10.4	10.8	11.1
Entrenchment Ratio							1.1	1.3	1.7	9.7	11.4	13.1	>3.0		>2.2		>4.3
Bank Height Ratio							1.7	2.3	2.6	1.1	1.2	1.3	1.0		1.0	1.0	1.0
Wetted Perimeter (ft)																	
Hydraulic Radius (ft)																	
Pattern																	
Channel Beltwidth (ft)							20		75	300		300	160	195	32	76.3	136
Radius of Curvature (ft)							20		70	30		70	20	55	21	38	55
Meander Wavelength (ft)							68		150	110		200	60	180	96	117	142
Meander Width Ratio							1.1		4.3	9.3		10.7	9	11	5.2	6.3	7.7
Profile																	
Riffle Length (ft)															5	23	86
Riffle Slope (ft/ft)							0.0040		0.0210	0.0045		0.0090	0.0088	0.0158	0.0039	0.0170	0.0278
Pool Length (ft)							29		43	5		25	3	20	7	14	25
Pool Spacing (ft)							10		70	25		90	15	55	38	88	237
Substrate																	
d50 (mm)							11.7			7.1					11.2		
d84 (mm)							38								46.7		
Additional Reach Parameters																	
Valley Length (ft)													1,481		1,481		
Channel length (ft)							1,609			383			1,629		1,629		
Sinuosity							1.04			1.1			1.1		1.1		
Water Surface Slope (ft/ft)							0.007			0.004			0.007		0.007		
Bankfull slope (ft/ft)										0.004			0.007		0.006		
Rosgen Classification							B4c, F4, G4c			C4			C4		C4		

Table IXa. Morphology and Hydraulic Monitoring Summary
Project Name and Number: Bold Run - 439

Parameter	Cross-Section 1 Riffle						Cross-Section 2 Pool						Cross-Section 3 Riffle					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
Bankfull Width (ft)	18.1	20.1					19.3	19.0					18.9	18.9				
Floodprone Width (ft)	>80	>80					>65	>65					>74	>74				
Bankfull Cross-Sectional Area (ft^2)	29.6	30.6					30.8	29.3					34.1	34.5				
Bankfull Mean Depth (ft)	1.6	1.5					1.6	1.5					1.8	1.8				
Bankfull Max Depth (ft)	2.6	2.7					3	3.1					2.9	2.9				
Width/Depth Ratio	11.1	13.2					12.2	12.3					10.4	10.4				
Entrenchment Ratio	>4.4	>4.0					>3.4	>3.4					>3.9	>3.9				
Bank Height Ratio	1.0	1.0					0.9	0.9					1.0	1.0				
Wetted Perimeter (ft)	19.3	20.0					20.5	19.7					20.3	20.2				
Hydraulic Radius (ft)	1.5	1.6					1.5	1.5					1.7	1.7				
Substrate																		
d50 (mm)	20	18					0.65	9.3					7.3	12.0				
d84 (mm)	70	71					14	15					23	31				

Table IXb. Morphology and Hydraulic Monitoring Summary
Project Name and Number: Bold Run - 439

Parameter	Cross-Section 4 Riffle						Cross-Section 5 Pool					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
Bankfull Width (ft)	18.5	16.2					30.1	31.4				
Floodprone Width (ft)	>70	>70					>70	>70				
Bankfull Cross-Sectional Area (ft^2)	31.6	30.3					65.5	68.9				
Bankfull Mean Depth (ft)	1.7	1.9					2.2	2.2				
Bankfull Max Depth (ft)	2.9	2.9					3.5	3.9				
Width/Depth Ratio	10.8	8.7					13.8	13.6				
Entrenchment Ratio	>3.8	>4.3					>2.3	>2.2				
Bank Height Ratio	1.0	1.0					1.0	1.0				
Wetted Perimeter (ft)	20.2	19.7					31.5	32.8				
Hydraulic Radius (ft)	1.6	1.6					2.1	2.1				
Substrate												
d50 (mm)	6.4	18					0.12	1.0				
d84 (mm)	40	41					0.30	18				

Table IXc. Morphology and Hydraulic Monitoring Summary cont.
Project Name and Number: Bold Run - 439

Parameter	MY - 01 (2007)			MY - 02 (2008)			MY - 03 (2009)			MY - 04 (2010)			MY - 05 (2011)		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	139	29	71												
Radius of Curvature (ft)	20	55	38												
Meander Wavelength (ft)	96	142	109												
Meander Width Ratio	1.6	7.6	3.6												
Profile															
Riffle Length (ft)	6	66	16												
Riffle Slope (ft/ft)	0.0035	0.0604	0.0184												
Pool Length (ft)	8	43	17												
Pool Spacing (ft)	28	293	73												
Additional Reach Parameters															
Valley Length (ft)	1,792														
Channel Length (ft)	1,629														
Sinuosity	1.1														
Water Surface Slope (ft/ft)	0.0070														
Rosgen Classification	C4														

Appendix A
Vegetation Data

Appendix A1: Vegetation Data Tables

Table A1: Vegetation Metadata
Project Name and Number: Bold Run - 439

Report Prepared By	Brian Roberts
Date Prepared	11/5/2007 9:58
Database Name	CVS_EEP_EntryTool_v220.mdb
Database Location	M:\2005\12053743_EEP_OpenEnd_Design\B_BoldRun

PROJECT SUMMARY----------

Project Code	Project Name	Description	Length (ft)	Stream-to-Edge Width (ft)	Area (sq m)	Required Plots (calculated)	Sampled Plots
439	Bold Run	Stream and buffer restoration site in Wake County, NC.	1,629	N/A	12	15	15

Table A2: Vigor by Species
Project Name and Number: Bold Run - 439

	Species	4	3	2	1	0	Missing
	DONTKNOW: unsure record				4	4	2
	Betula nigra	1	1	1		1	3
	Celtis laevigata	4	3				
	Cornus amomum		2	3		1	
	Fraxinus pennsylvanica	2	25	5	1	1	
	Juglans nigra		2				
	Quercus lyrata	4	14	3			
	Quercus michauxii		5	6	1		
	Quercus pagoda	1	16	3	2		
	Quercus phellos	4	22	7			
	Salix nigra	1	6			1	
	Salix sericea		2	5			
	Sambucus canadensis			1		2	
	Quercus		1		1		
	Liriodendron tulipifera		2	3			
	Platanus occidentalis	13	5			1	1
TOT:	**16**	**30**	**106**	**37**	**9**	**11**	**6**

Table A3: Damage by Species
Project Name and Number: Bold Run - 439

	Species	All Damage Categories	(no damage)	_Enter other damage_	Deer	Diseased	Drought	Human Trampled	Insects	Unknown
	Betula nigra	7	4							3
	Celtis laevigata	7	7							
	Cornus amomum	6	1		4					1
	DONTKNOW: unsure record	10	5							5
	Fraxinus pennsylvanica	34	3		21	2			7	1
	Juglans nigra	2	2							
	Liriodendron tulipifera	5	2		1					2
	Platanus occidentalis	20	18						1	1
	Quercus	2					1			1
	Quercus lyrata	21	11		1			1	1	7
	Quercus michauxii	12	2		3		4		1	2
	Quercus pagoda	22	10				1		8	3
	Quercus phellos	33	18	2	4			1		8
	Salix nigra	8	7		1					
	Salix sericea	7			7					
	Sambucus canadensis	3			1					2
TOT:	**16**	**199**	**90**	**2**	**43**	**2**	**6**	**2**	**18**	**36**

Table A4: Damage by Plot
Project Name and Number: Bold Run - 439

	Plot	All Damage Categories	(no damage)	_Enter other damage_	Deer	Diseased	Drought	Human Trampled	Insects	Unknown
	BR-01-0001-year:1	17	4		13					
	BR-01-0002-year:1	14	4		7				1	2
	BR-01-0003-year:1	15	12		3					
	BR-01-0004-year:1	19	6		7	1			1	4
	BR-01-0005-year:1	14	5		3				4	2
	BR-01-0006-year:1	13	5				3			5
	BR-01-0007-year:1	8	2		3	1			2	
	BR-01-0008-year:1	11	3		1				4	3
	BR-01-0009-year:1	14	11						1	2
	BR-01-0010-year:1	13	9				1	2		1
	BR-01-0011-year:1	13	8		1				2	2
	BR-01-0012-year:1	12	8							4
	BR-01-0013-year:1	11	6							5
	BR-01-0014-year:1	12	5	1	2					4
	BR-01-0015-year:1	13	2	1	3		2		3	2
TOT:	**15**	**199**	**90**	**2**	**43**	**2**	**6**	**2**	**18**	**36**

Table A5: Stem Count by Plot and Project Name and Number: Bold Run - 439

	Species	Total Planted Stems	# plots	avg# stems	plot BR-01-0001-year:1	plot BR-01-0002-year:1	plot BR-01-0003-year:1	plot BR-01-0004-year:1	plot BR-01-0005-year:1	plot BR-01-0006-year:1	plot BR-01-0007-year:1	plot BR-01-0008-year:1	plot BR-01-0009-year:1	plot BR-01-0010-year:1	plot BR-01-0011-year:1	plot BR-01-0012-year:1	plot BR-01-0013-year:1	plot BR-01-0014-year:1	plot BR-01-0015-year:1
	Betula nigra	3	2	1.5				1	2										
	Celtis laevigata	7	3	2.33									2				3	2	
	Cornus amomum	5	4	1.25	1	1		1			2								
	DONTKNOW: unsure record	4	4	1						1		1	1		1				
	Fraxinus pennsylvanica	33	6	5.5	4	5	3	9	6		6								
	Juglans nigra	2	1	2									2						
	Liriodendron tulipifera	5	3	1.67						1		2		2					
	Platanus occidentalis	18	6	3	3	2	6	2	4					1					
	Quercus	2	2	1						1									1
	Quercus lyrata	21	4	5.25									6	4			7	4	
	Quercus michauxii	12	6	2	2				1	5				1	2	1			
	Quercus pagoda	22	6	3.67						1		7			6	2	1		5
	Quercus phellos	33	7	4.71						2			3	5	3	8		5	7
	Salix nigra	7	3	2.33	1		3	3											
	Salix sericea	7	2	3.5	6	1													
	Sambucus canadensis	1	1	1		1													
TOT:	**16**	**182**	**16**		**17**	**10**	**12**	**16**	**13**	**11**	**8**	**10**	**14**	**13**	**12**	**11**	**11**	**11**	**13**

Table A6. Vegetation Problem Areas
Project Name and Number: Bold Run - 439

Feature Issue	Station numbers	Suspected Cause	Photo #
Bare Bank	14+75	Unknown	VP1

Table A7. Planting Plan
Project Name and Number: Bold Run - 439

Planting Areas	Area (Ac)	Species	Common Name	Material	# of Plants
Levee	7.0	*Juglans nigra*	Black Walnut	Bare Root	770
		Quercus lyrata	Overcup Oak	Bare Root	610
		Quercus phellos	Willow Oak	Bare Root	920
		Celtis laevigata	Sugarberry	Bare Root	770
Streamside	1.4	*Betula nigra*	River Birch	Bare Root	210
		Fraxinus pennsylvanica	Green Ash	Bare Root	200
		Platanus occidentalis	Sycamore	Bare Root	200
Bottomland Hardwood	18.6	*Liriodendron tulipifera*	Tulip Poplar	Bare Root	1,622
		Quercus michauxii	Swamp Chestnut Oak	Bare Root	1,622
		Quercus pagoda	Cherrybark Oak	Bare Root	2,433
		Quercus phellos	Willow Oak	Bare Root	2,433
High Moisture	1.3	*Cornus amomum*	Silky Dogwood	Bare Root	190
		Fraxinus pennsylvanica	Green Ash	Bare Root	200
		Ulmus americana	American Elm	Bare Root	190
Stream Zone	0.34	*Cornus amomum*	Silky Dogwood	Live Stakes	1770*
		Salix nigra	Black Willow	Live Stakes	
		Salix sercia	Silky Willow	Live Stakes	
		Sambucus canadensis	Elderberry	Live Stakes	

*The numbers of individual species were not available, althought the planting plan stipulated that no species comprise greater than 40% of the total number of live stakes

Appendix A2 – Representative Vegetation Problem Area Photos

VP1 –Poorly vegetated banks and exposed coir matting. Photo taken near Station 14+75. 11/19/07 - MY 01

Appendix A3 – Vegetation Plot Photos

Vegetation Plot 1. 9/24/07 - MY 01

Vegetation Plot 2. 9/24/07 - MY 01

Vegetation Plot 3. 9/24/07 - MY 01

Vegetation Plot 4. 9/24/07 - MY 01

Vegetation Plot 5. 9/24/07 - MY 01

Vegetation Plot 6. 9/24/07 - MY 01

Vegetation Plot 7. 9/24/07 - MY 01

Vegetation Plot 8. 9/24/07 - MY 01

Vegetation Plot 9. 9/24/07 - MY 01

Vegetation Plot 10. 9/24/07 - MY 01

Vegetation Plot 11. 9/24/07 - MY 01

Vegetation Plot 12. 9/24/07 - MY 01

Vegetation Plot 13. 9/24/07 - MY 01

Vegetation Plot 14. 9/24/07 - MY 01

Vegetation Plot 15. 9/24/07 - MY 01

Appendix B
Geomorphologic Data

Appendix B1 – Representative Stream Problem Area Tables and Photos

Table B1. Stream Problem Areas
Project Name and Number: Bold Run - 439

Feature Issue	Station numbers	Suspected Cause	Photo #
Aggradation/Bar Formation	22+90	aggradation - - due to widened stream	SP1
Bed Degradation	13+85	unknown	SP2
	21+10	unknown	
Bank Scour	14+50	unknown	SP3
	21+10	unknown	
	24+10	unknown	
Engineered Structures - piping	19+85	poor head stone placement, structure still functional	SP4

SP1 – Aggradation due to overly wide as-built cross-section. Photo taken near Station 23+00 looking downstream. 11/19/07 - MY 01

SP2 – Bed degradation on the left with erosion downstream. Photo taken near Station 21+25. 11/19/07 - MY 01

SP3 – Bank erosion under coir matting. Photo taken near Station 24+10. 11/19/07 - MY 01

SP4 – Cross vane not built correctly with piping at low flow. Photo taken near Station 19+85. 11/19/07 – MY 01

Appendix B2 –Stream Photo Points Photos

Photo Point 1: View looking west near Station 11+00. 11/19/07 – MY01

Photo Point 2: View looking west toward Vegetation Plot #1. 11/19/07 – MY01

Photo Point 3a: View looking southeast toward Vegetation Plot #2. 11/19/07 – MY01

Photo Point 3b: View looking west toward Vegetation Plot #5. 11/19/07 – MY01

Photo Point 3c: View looking west toward Vegetation Plot #8. 11/19/07 – MY01

Photo Point 3d: View looking north with Vegetation Plot #6 in the foreground. 11/19/07 – MY01

Photo Point 4a: View looking west toward Vegetation Plot #5. 11/19/07 – MY01

Photo Point 4b: View looking north with Vegetation Plot #4 on the left. 11/19/07 – MY01

Photo Point 4c: View looking northeast with Vegetation Plot #3 on the right. 11/19/07 – MY01

Photo Point 5a: View looking northeast toward buffer area. 11/19/07 – MY01

Photo Point 5b: View looking east toward Vegetation Plot #5. 11/19/07 – MY01

Photo Point 6a: View looking southeast. 11/19/07 – MY01

Photo Point 6b: View looking southwest across the buffer restoration area. 11/19/07 – MY01

Appendix B3 – Qualitative Visual Stability Assessment

Table B3. Qualitative Visual Stability Assessment
Project Number and Name: 439 - Bold Run

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?	21	21		100%	
	2. Armor stable (e.g. no displacement)?	21	21		100%	
	3. Facet grade appears stable?	21	21		100%	
	4. Minimal evidence of embedding/fining?	21	21		100%	
	5. Length appropriate?	21	21		100%	**100%**
B. Pools	1. Present? (e.g. no severe aggradation)	15	15		100%	
	2. Sufficiently deep (Dmax pool:Mean Bkf > 2.2?)	15	15		100%	
	3. Length appropriate?	15	15		100%	**100%**
C. Thalweg	1. Upstream of meander bend centering?	14	14		100%	
	2. Downstream of meander centering?	14	14		100%	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	14	14		100%	
	2. Of those eroding, # w/ concomitant point bar formation?	0	0			
	3. Apparent Rc within spec?	14	14		100%	
	4. Sufficient floodplain access and relief?	14	14		100%	**100%**
E. Bed General	1.General channel bed aggradation areas (bar formation)	N/A	N/A	1/10	99%	
	2. Channel bed degradation - areas of increasing down cutting or head cutting?	N/A	N/A	2/20	99%	**99%**
F. Bank	1. Actively eroding, wasting, or slumping bank	N/A	N/A	3/30	98%	**98%**
G. Vanes	1. Free of back or arm scour?	8	8		100%	
	2. Height appropriate?	8	8		100%	
	3. Angle and geometry appear appropriate?	7	8		88%	
	4. Free of piping or other structural failures?	7	8		88%	**94%**
H. Wads / Boulders	1. Free of scour?	6	6		100%	
	2. Footing stable?	6	6		100%	**100%**

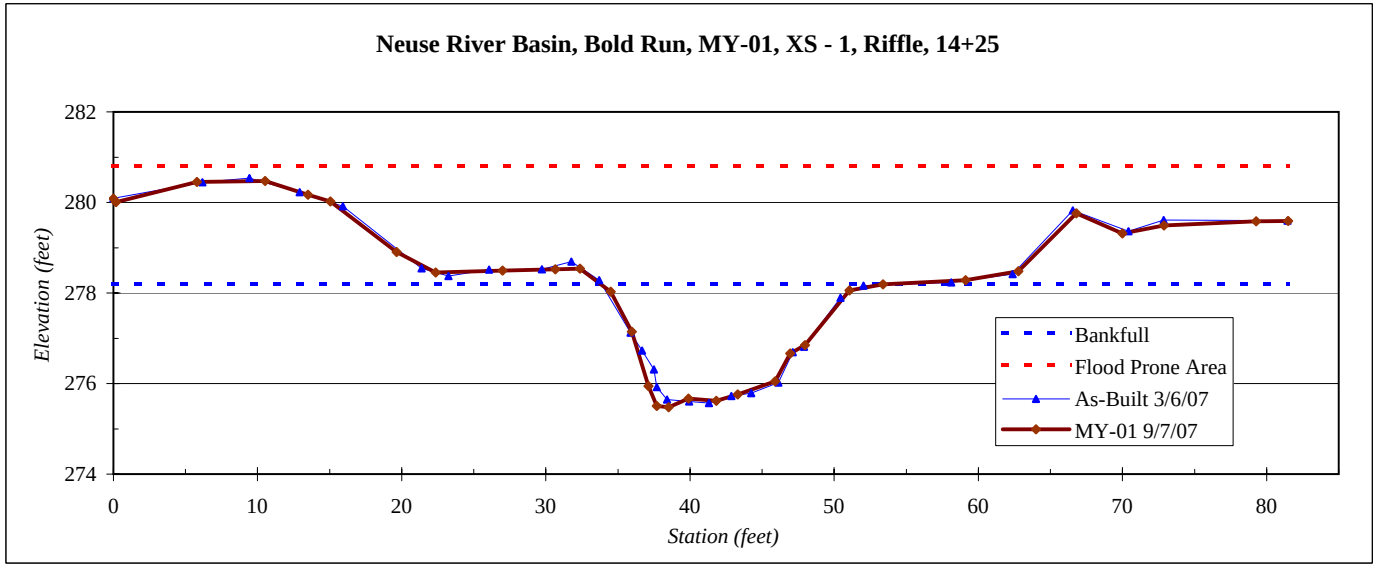
Appendix B4 - Cross-Section Plots

River Basin:	Neuse
Watershed:	Bold Run, MY-01
XS ID	XS - 1, Riffle, 14+25
Drainage Area (sq mi):	1.6
Date:	9/7/2007
Field Crew:	B. Roberts, J. Costante

Station	Elevation
0.0	280.1
0.2	280.0
5.8	280.5
10.5	280.5
13.5	280.2
15.1	280.0
19.6	278.9
22.4	278.5
27.0	278.5
30.7	278.5
32.4	278.5
34.5	278.0
36.0	277.1
37.1	275.9
37.7	275.5
38.5	275.5
39.9	275.7
41.8	275.6
43.3	275.8
45.9	276.0
46.9	276.7
48.0	276.8
51.1	278.1
53.4	278.2
59.1	278.3
62.8	278.5
66.8	279.8
70.0	279.3
72.9	279.5
79.3	279.6
81.5	279.6

SUMMARY DATA	
Bankfull Elevation:	278.2
Bankfull Cross-Sectional Area:	30.6
Bankfull Width:	20.1
Flood Prone Area Elevation:	280.8
Flood Prone Width:	>80
Max Depth at Bankfull:	2.7
Mean Depth at Bankfull:	1.5
W / D Ratio:	13.2
Entrenchment Ratio:	>4.0
Bank Height Ratio:	1.0

Stream Type	C4

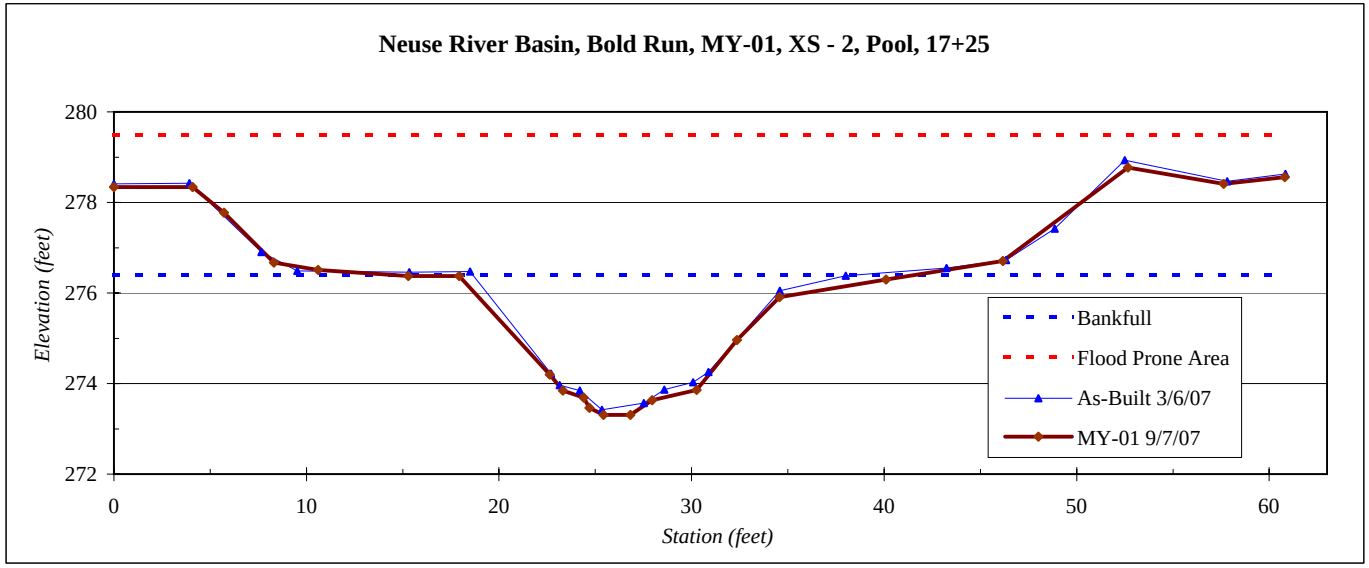


River Basin:	Neuse
Watershed:	Bold Run, MY-01
XS ID	XS - 2, Pool, 17+25
Drainage Area (sq mi):	1.6
Date:	9/7/2007
Field Crew:	B. Roberts, J. Costante

Station	Elevation
0.0	278.3
4.1	278.3
5.7	277.8
8.3	276.7
10.6	276.5
15.3	276.4
17.9	276.4
22.6	274.2
23.3	273.8
24.4	273.7
24.7	273.5
25.4	273.3
26.8	273.3
28.0	273.6
30.3	273.9
32.4	275.0
34.6	275.9
40.1	276.3
46.2	276.7
52.7	278.8
57.6	278.4
60.8	278.6

SUMMARY DATA	
Bankfull Elevation:	276.4
Bankfull Cross-Sectional Area:	29.3
Bankfull Width:	19.0
Flood Prone Area Elevation:	279.5
Flood Prone Width:	>65
Max Depth at Bankfull:	3.1
Mean Depth at Bankfull:	1.5
W / D Ratio:	12.3
Entrenchment Ratio:	>3.4
Bank Height Ratio:	0.9

Stream Type	C4

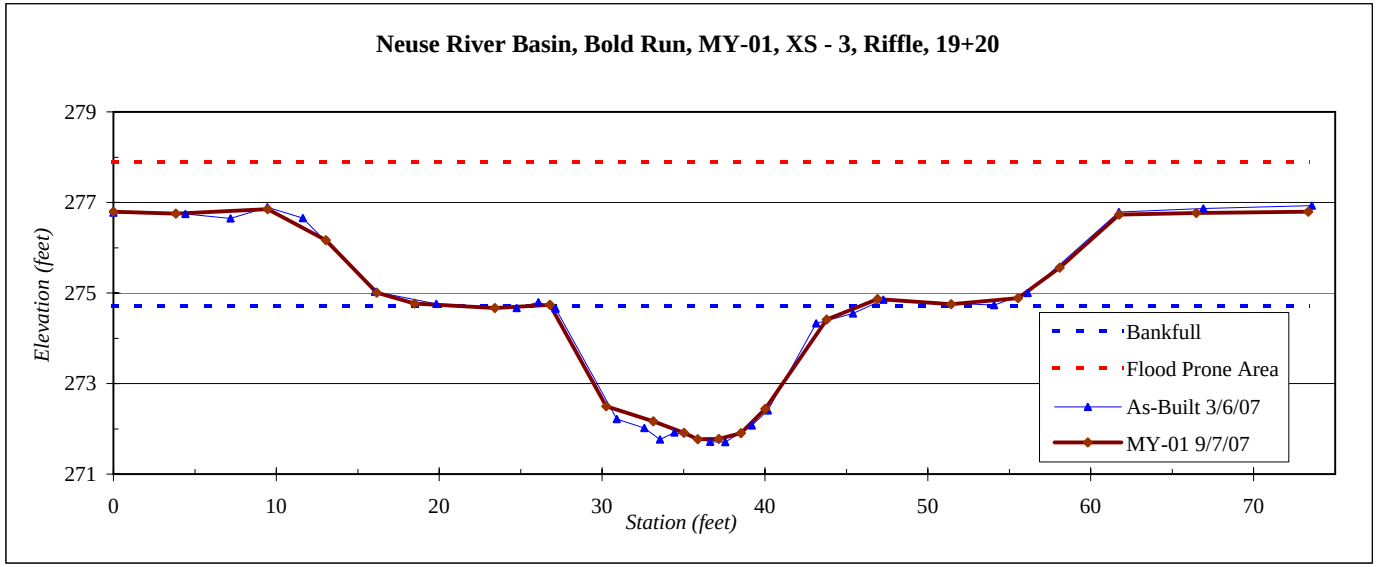


River Basin:	Neuse
Watershed:	Bold Run, MY-01
XS ID	XS - 3, Riffle, 19+20
Drainage Area (sq mi):	1.6
Date:	9/7/2007
Field Crew:	B. Roberts, J. Costante

Station	Elevation
0.0	276.8
3.8	276.8
9.5	276.8
13.0	276.2
16.2	275.0
18.5	274.8
23.4	274.7
26.8	274.7
30.2	272.5
33.1	272.2
35.0	271.9
35.9	271.8
37.2	271.8
38.5	271.9
40.0	272.4
43.8	274.4
46.9	274.9
51.4	274.8
55.5	274.9
58.1	275.6
61.7	276.7
66.5	276.8
73.4	276.8

SUMMARY DATA	
Bankfull Elevation:	274.7
Bankfull Cross-Sectional Area:	34.5
Bankfull Width:	18.9
Flood Prone Area Elevation:	277.9
Flood Prone Width:	>74
Max Depth at Bankfull:	2.9
Mean Depth at Bankfull:	1.8
W / D Ratio:	10.4
Entrenchment Ratio:	>3.9
Bank Height Ratio:	1.0

Stream Type	C4

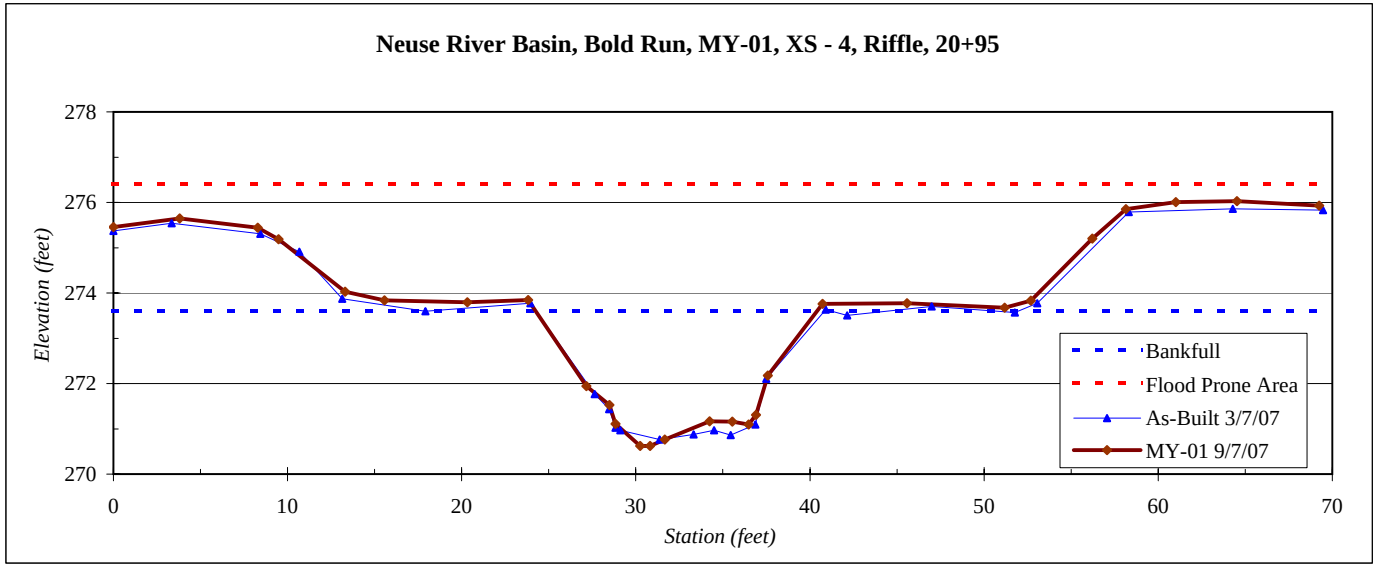


River Basin:	Neuse
Watershed:	Bold Run, MY-01
XS ID	XS - 4, Riffle, 20+95
Drainage Area (sq mi):	1.6
Date:	9/7/2007
Field Crew:	B. Roberts, J. Costante

Station	Elevation
0.0	275.45
3.8	275.65
8.3	275.44
9.5	275.19
13.3	274.03
15.6	273.84
20.3	273.79
23.8	273.85
27.2	271.94
28.5	271.52
28.8	271.11
30.2	270.62
30.8	270.62
31.7	270.76
34.2	271.16
35.5	271.16
36.5	271.10
36.9	271.30
37.6	272.18
40.7	273.76
45.6	273.77
51.2	273.68
52.7	273.83
56.2	275.20
58.1	275.85
61.0	276.01
64.5	276.03
69.2	275.93

SUMMARY DATA	
Bankfull Elevation:	273.6
Bankfull Cross-Sectional Area:	30.3
Bankfull Width:	16.2
Flood Prone Area Elevation:	276.4
Flood Prone Width:	>70
Max Depth at Bankfull:	2.9
Mean Depth at Bankfull:	1.9
W / D Ratio:	8.7
Entrenchment Ratio:	>4.3
Bank Height Ratio:	1.0

Stream Type	C4

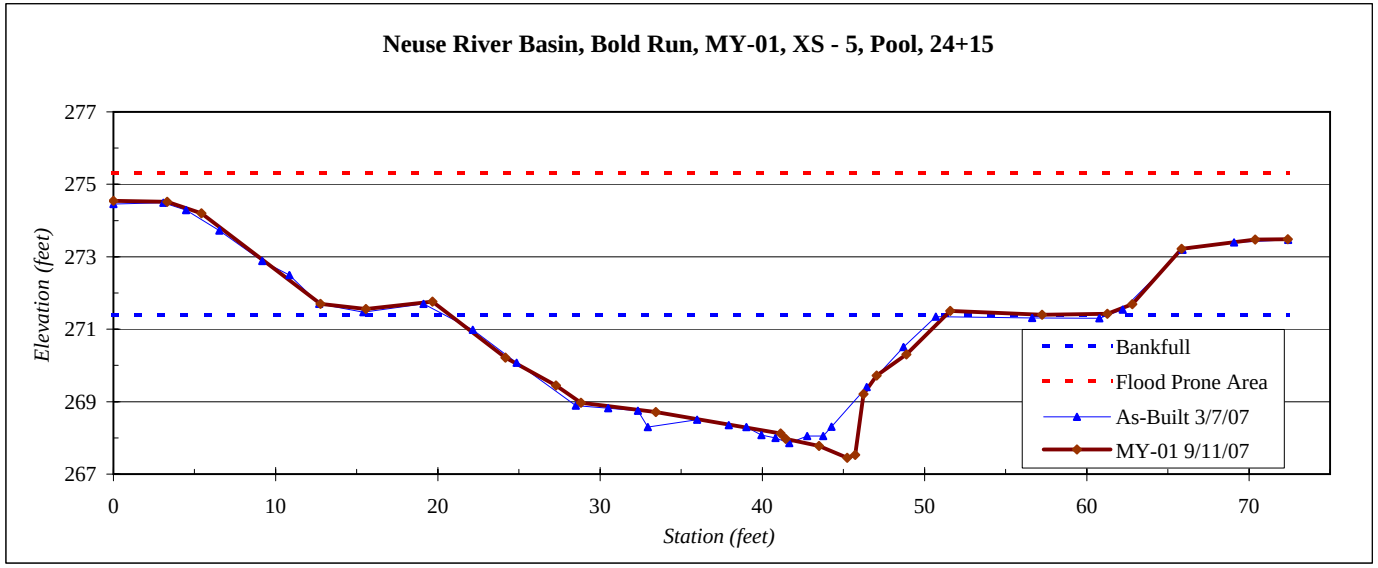


River Basin:	Neuse
Watershed:	Bold Run, MY-01
XS ID	XS - 5, Pool, 24+15
Drainage Area (sq mi):	1.6
Date:	9/11/2007
Field Crew:	B. Roberts, J. Costante

Station	Elevation
0.0	274.5
3.3	274.5
5.4	274.2
12.8	271.7
15.6	271.6
19.7	271.8
24.2	270.2
27.3	269.5
28.8	269.0
33.4	268.7
41.1	268.1
41.4	268.0
43.5	267.8
45.2	267.5
45.7	267.5
46.2	269.2
47.1	269.7
48.9	270.3
51.6	271.5
57.2	271.4
61.3	271.4
62.8	271.7
65.8	273.2
70.4	273.5
72.4	273.5

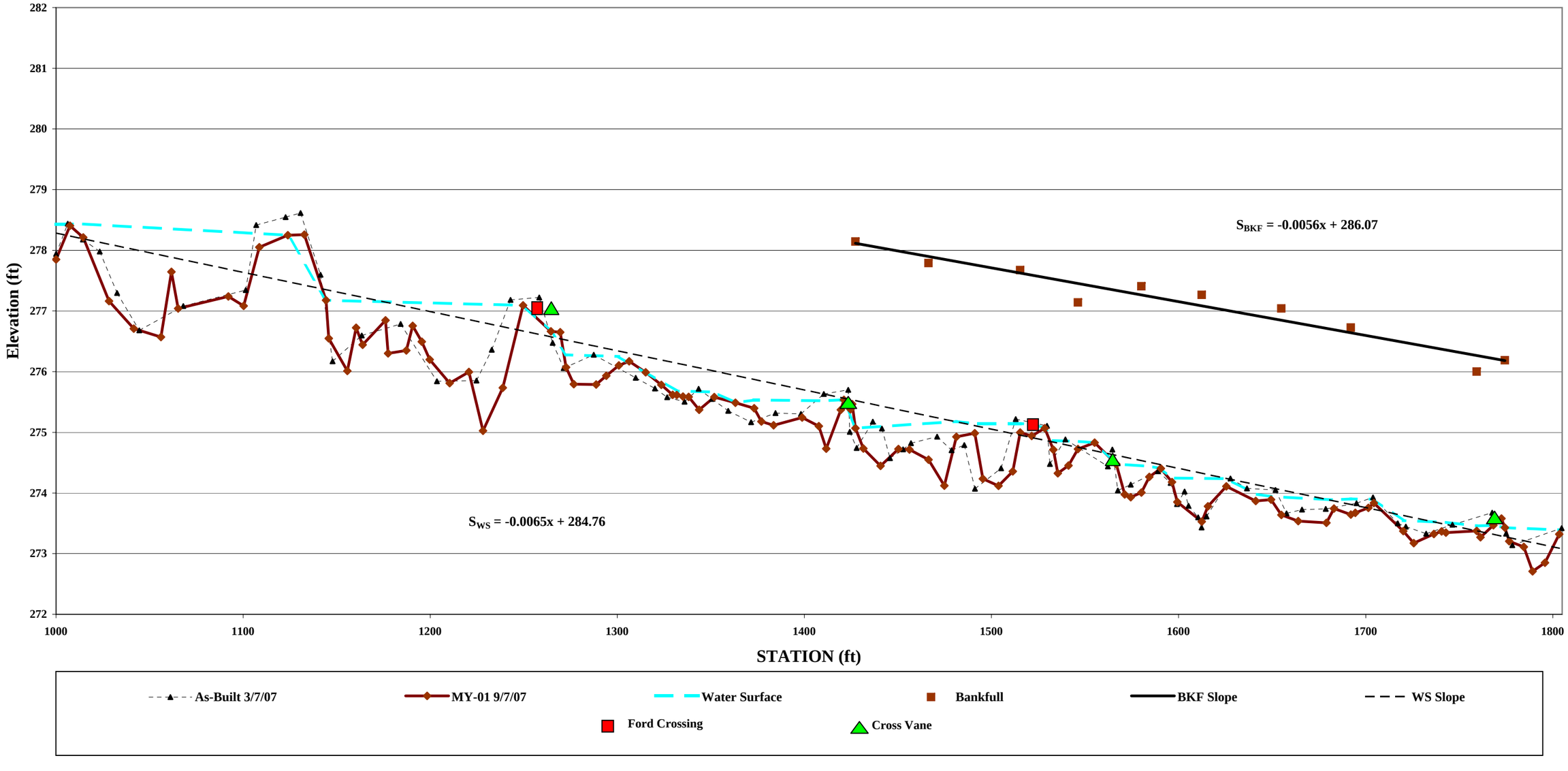
SUMMARY DATA	
Bankfull Elevation:	271.4
Bankfull Cross-Sectional Area:	68.9
Bankfull Width:	31.4
Flood Prone Area Elevation:	275.3
Flood Prone Width:	>70
Max Depth at Bankfull:	3.9
Mean Depth at Bankfull:	2.2
W / D Ratio:	13.6
Entrenchment Ratio:	>2.2
Bank Height Ratio:	1.0

Stream Type	C4

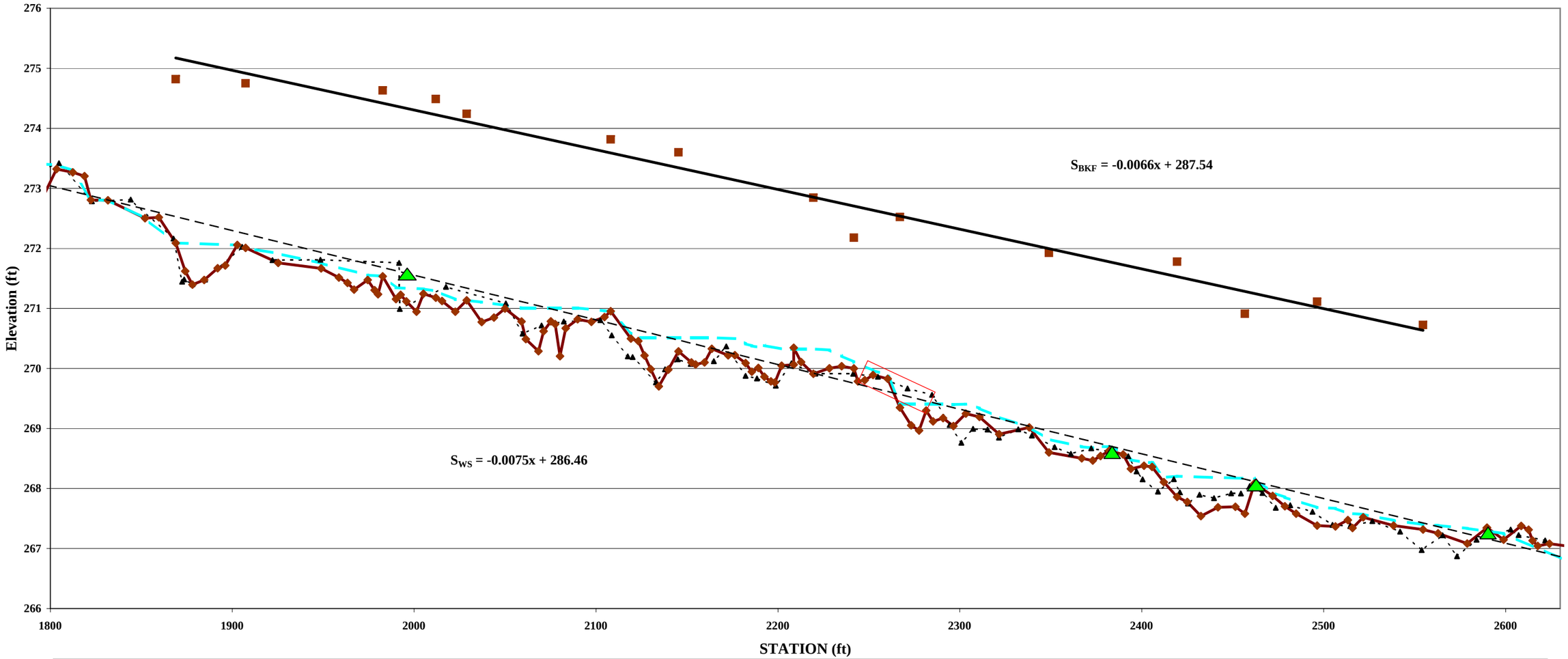


Appendix B5 - Longitudinal Plots

Longitudinal Profile
Bold Run Creek
EEP Project Number 439 MY-01
Stations 10+00 - 18+00



Longitudinal Profile
Bold Run Creek
EEP Project Number 439 MY-01
Stations 18+00 - 26+30

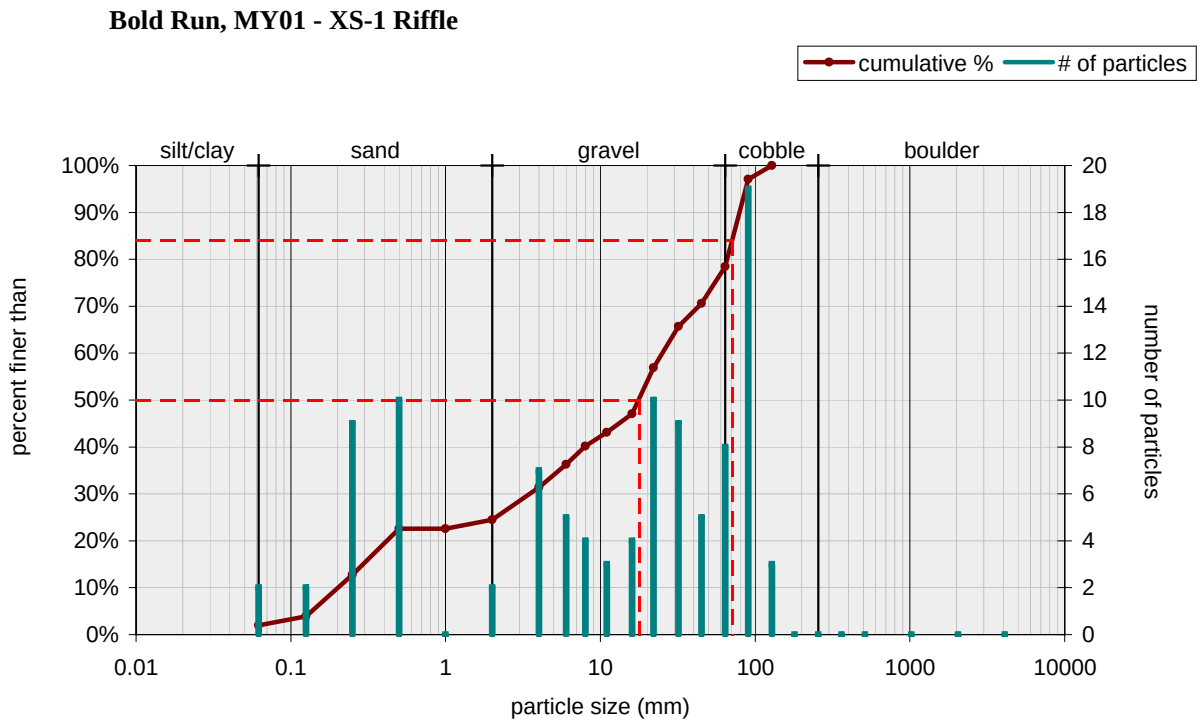


Appendix B6 - Pebble Count

Riffle Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**2**
very fine sand	0.062 - 0.125	**2**
fine sand	0.125 - 0.25	**9**
medium sand	0.25 - 0.5	**10**
coarse sand	0.5 - 1	**0**
very coarse sand	1 - 2	**2**
very fine gravel	2 - 4	**7**
fine gravel	4 - 6	**5**
fine gravel	6 - 8	**4**
medium gravel	8 - 11	**3**
medium gravel	11 - 16	**4**
coarse gravel	16 - 22	**10**
coarse gravel	22 - 32	**9**
very coarse gravel	32 - 45	**5**
very coarse gravel	45 - 64	**8**
small cobble	64 - 90	**19**
medium cobble	90 - 128	**3**
large cobble	128 - 180	**0**
very large cobble	180 - 256	**0**
small boulder	256 - 362	**0**
small boulder	362 - 512	**0**
medium boulder	512 - 1024	**0**
large boulder	1024 - 2048	**0**
very large boulder	2048 - 4096	**0**
total particle count:		102
bedrock ----------		
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		102

Note: XS-1



Size (mm)	
D16	0.31
D35	5.4
D50	18
D65	31
D84	71
D95	87

Size Distribution	
mean	4.7
dispersion	31.0
skewness	-0.38

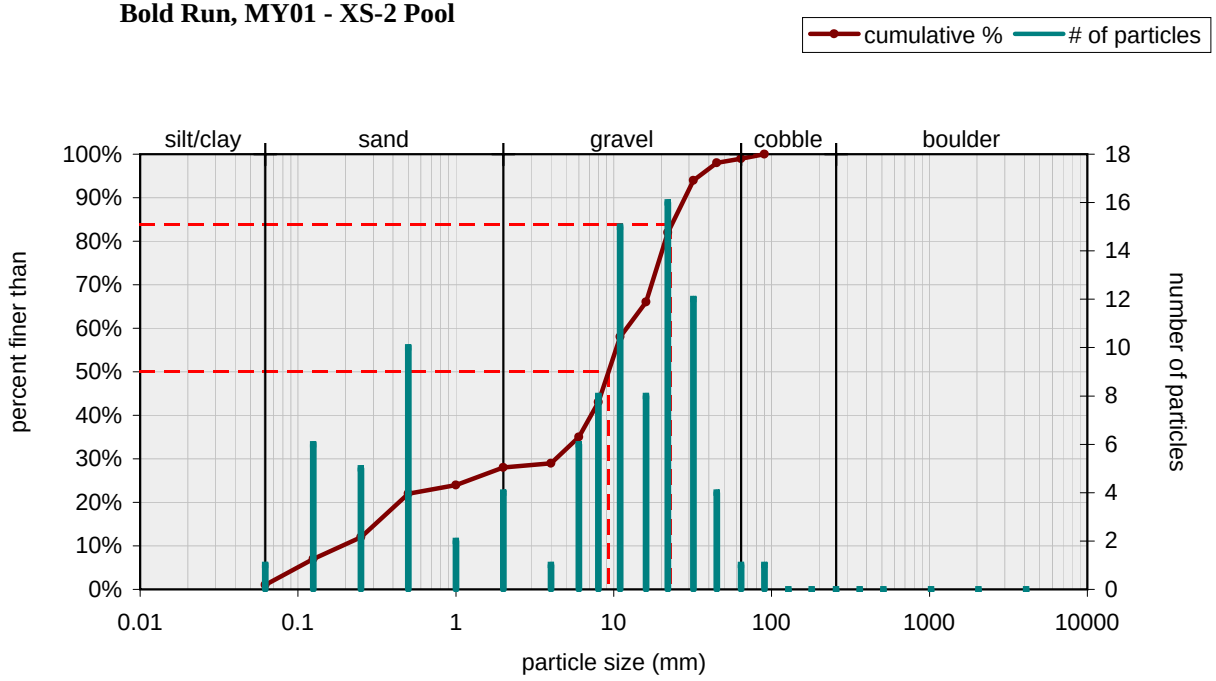
Type	
silt/clay	2%
sand	23%
gravel	54%
cobble	22%
boulder	0%

Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**1**
very fine sand	0.062 - 0.125	**6**
fine sand	0.125 - 0.25	**5**
medium sand	0.25 - 0.5	**10**
coarse sand	0.5 - 1	**2**
very coarse sand	1 - 2	**4**
very fine gravel	2 - 4	**1**
fine gravel	4 - 6	**6**
fine gravel	6 - 8	**8**
medium gravel	8 - 11	**15**
medium gravel	11 - 16	**8**
coarse gravel	16 - 22	**16**
coarse gravel	22 - 32	**12**
very coarse gravel	32 - 45	**4**
very coarse gravel	45 - 64	**1**
small cobble	64 - 90	**1**
medium cobble	90 - 128	**0**
large cobble	128 - 180	**0**
very large cobble	180 - 256	**0**
small boulder	256 - 362	**0**
small boulder	362 - 512	**0**
medium boulder	512 - 1024	**0**
large boulder	1024 - 2048	**0**
very large boulder	2048 - 4096	**0**
total particle count:		100
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
total count:		100

Note: XS-2

Bold Run, MY01 - XS-2 Pool



Size (mm)	
D16	0.33
D35	6
D50	9.3
D65	15
D84	23
D95	35

Size Distribution	
mean	2.8
dispersion	15.3
skewness	-0.39

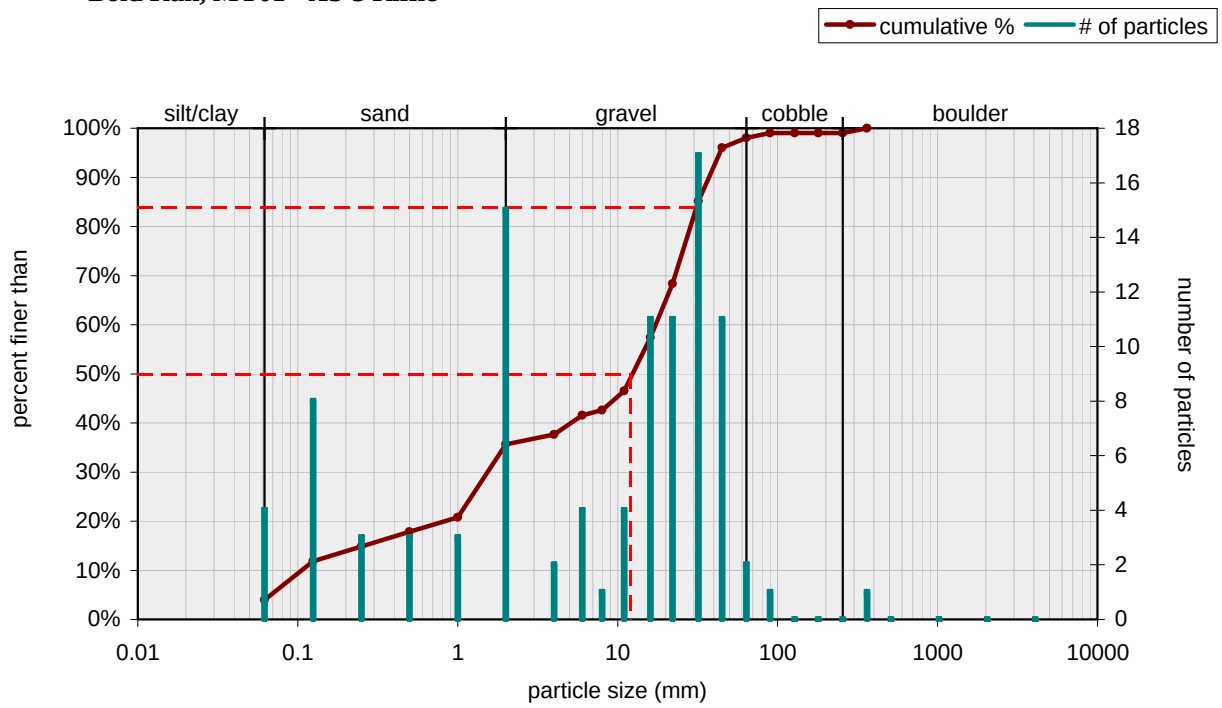
Type	
silt/clay	1%
sand	27%
gravel	71%
cobble	1%
boulder	0%

Riffle Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**4**
very fine sand	0.062 - 0.125	**8**
fine sand	0.125 - 0.25	**3**
medium sand	0.25 - 0.5	**3**
coarse sand	0.5 - 1	**3**
very coarse sand	1 - 2	**15**
very fine gravel	2 - 4	**2**
fine gravel	4 - 6	**4**
fine gravel	6 - 8	**1**
medium gravel	8 - 11	**4**
medium gravel	11 - 16	**11**
coarse gravel	16 - 22	**11**
coarse gravel	22 - 32	**17**
very coarse gravel	32 - 45	**11**
very coarse gravel	45 - 64	**2**
small cobble	64 - 90	**1**
medium cobble	90 - 128	**0**
large cobble	128 - 180	**0**
very large cobble	180 - 256	**0**
small boulder	256 - 362	**1**
small boulder	362 - 512	**0**
medium boulder	512 - 1024	**0**
large boulder	1024 - 2048	**0**
very large boulder	2048 - 4096	**0**
total particle count:		101
bedrock ----------		
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		101

Note: XS-3

Bold Run, MY01 - XS-3 Riffle



Size (mm)	
D16	0.33
D35	1.9
D50	12
D65	20
D84	31
D95	44

Size Distribution	
mean	3.2
dispersion	19.5
skewness	-0.41

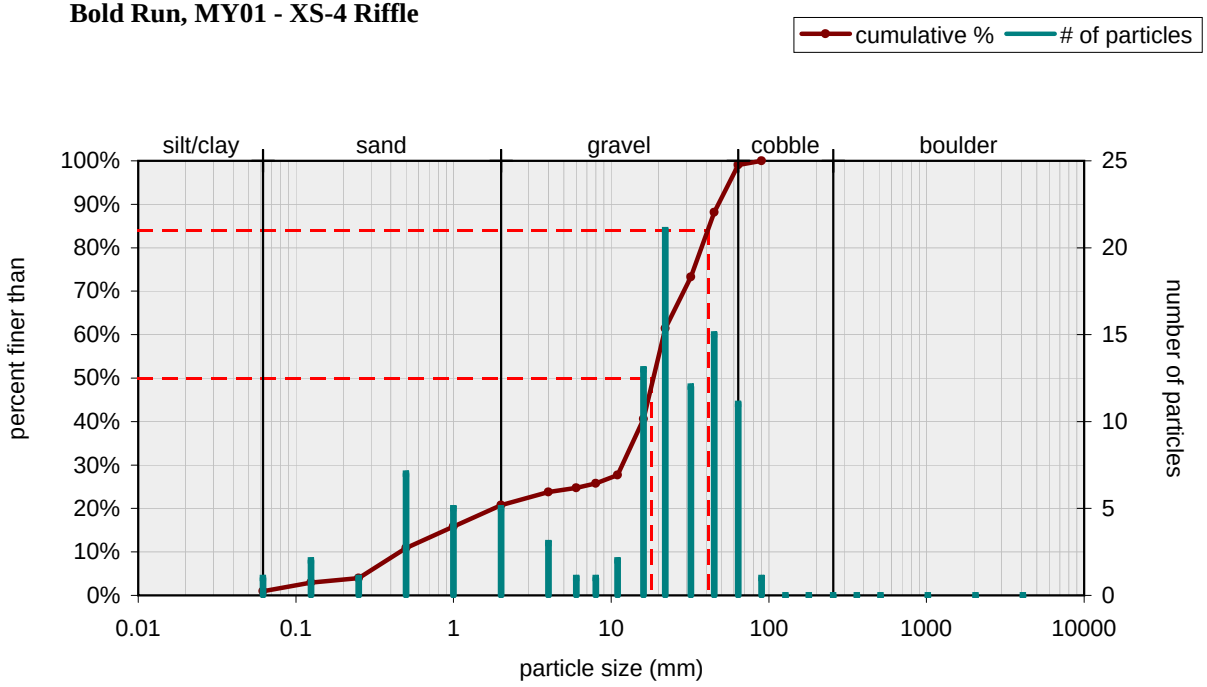
Type	
silt/clay	4%
sand	32%
gravel	62%
cobble	1%
boulder	1%

Riffle Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**1**
very fine sand	0.062 - 0.125	**2**
fine sand	0.125 - 0.25	**1**
medium sand	0.25 - 0.5	**7**
coarse sand	0.5 - 1	**5**
very coarse sand	1 - 2	**5**
very fine gravel	2 - 4	**3**
fine gravel	4 - 6	**1**
fine gravel	6 - 8	**1**
medium gravel	8 - 11	**2**
medium gravel	11 - 16	**13**
coarse gravel	16 - 22	**21**
coarse gravel	22 - 32	**12**
very coarse gravel	32 - 45	**15**
very coarse gravel	45 - 64	**11**
small cobble	64 - 90	**1**
medium cobble	90 - 128	**0**
large cobble	128 - 180	**0**
very large cobble	180 - 256	**0**
small boulder	256 - 362	**0**
small boulder	362 - 512	**0**
medium boulder	512 - 1024	**0**
large boulder	1024 - 2048	**0**
very large boulder	2048 - 4096	**0**
total particle count:		101
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
total count:		101

Note: XS-4

Bold Run, MY01 - XS-4 Riffle



Size (mm)		
D16	1	3.4
D35	14	12
D50	18	17
D65	25	20
D84	41	29
D95	56	39

Size Distribution	
mean	6.4
dispersion	10.1
skewness	-0.35

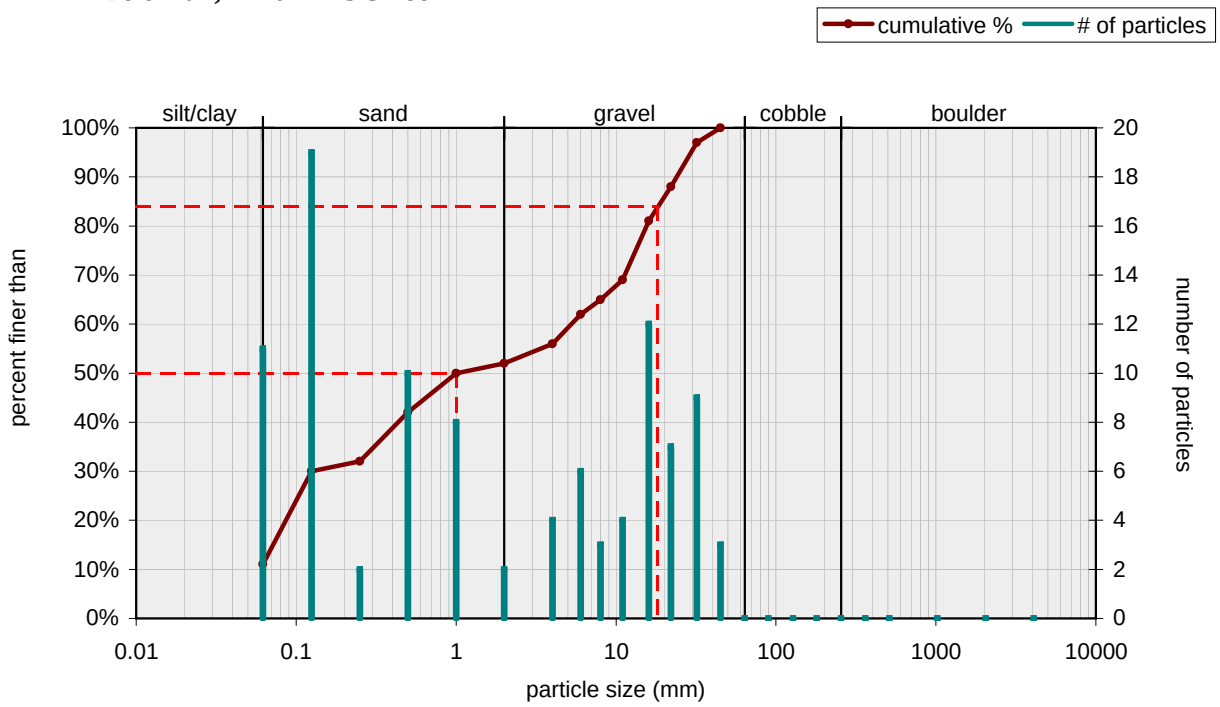
Type	
silt/clay	1%
sand	20%
gravel	78%
cobble	1%
boulder	0%

Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**11**
very fine sand	0.062 - 0.125	**19**
fine sand	0.125 - 0.25	**2**
medium sand	0.25 - 0.5	**10**
coarse sand	0.5 - 1	**8**
very coarse sand	1 - 2	**2**
very fine gravel	2 - 4	**4**
fine gravel	4 - 6	**6**
fine gravel	6 - 8	**3**
medium gravel	8 - 11	**4**
medium gravel	11 - 16	**12**
coarse gravel	16 - 22	**7**
coarse gravel	22 - 32	**9**
very coarse gravel	32 - 45	**3**
very coarse gravel	45 - 64	**0**
small cobble	64 - 90	**0**
medium cobble	90 - 128	**0**
large cobble	128 - 180	**0**
very large cobble	180 - 256	**0**
small boulder	256 - 362	**0**
small boulder	362 - 512	**0**
medium boulder	512 - 1024	**0**
large boulder	1024 - 2048	**0**
very large boulder	2048 - 4096	**0**
total particle count:		100
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
total count:		100

Note: XS-5

Bold Run, MY01 - XS-5 Pool

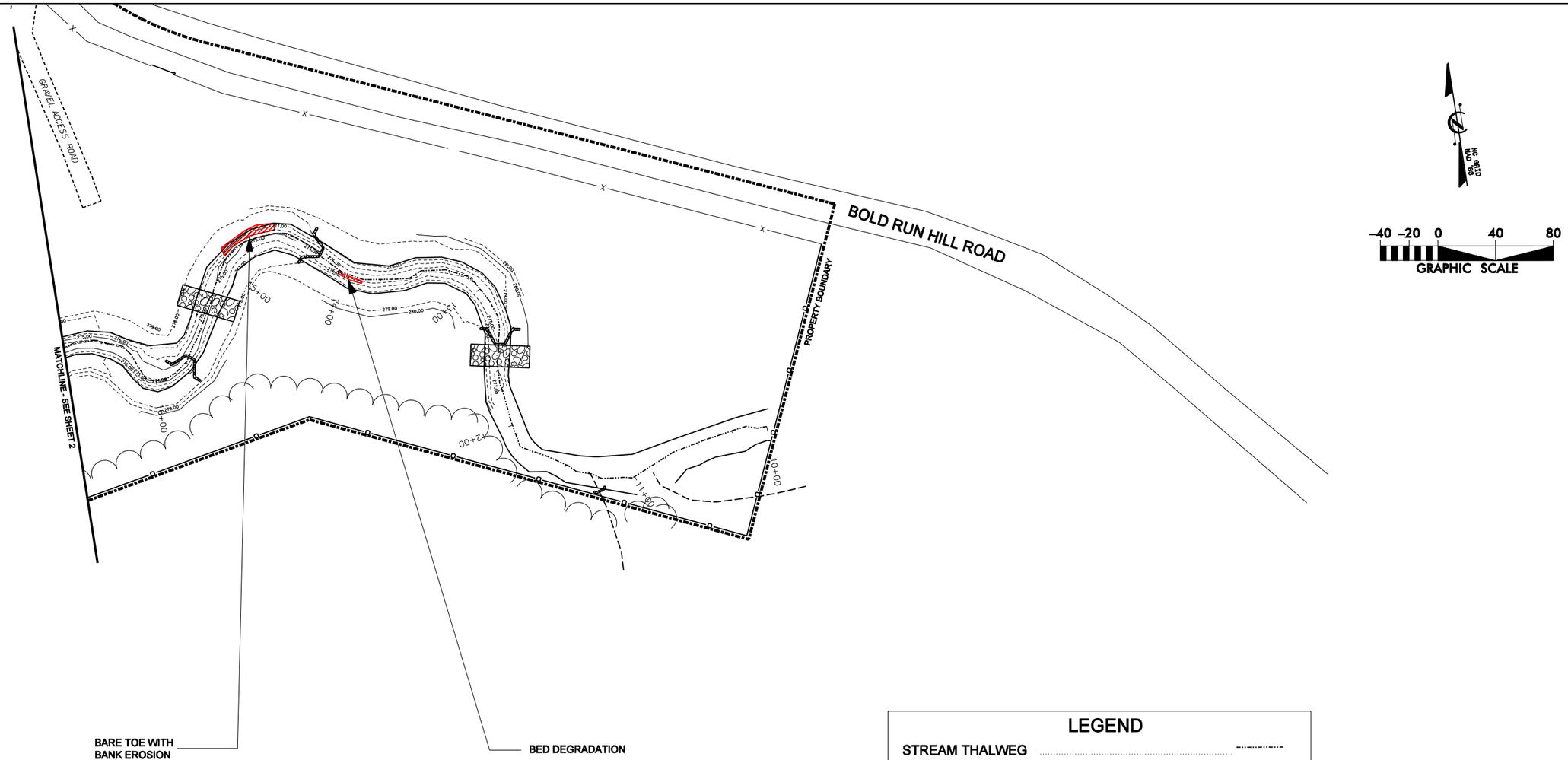


Size (mm)	
D16	0.075
D35	0.31
D50	1
D65	8
D84	18
D95	29

Size Distribution	
mean	1.2
dispersion	15.7
skewness	0.04

Type	
silt/clay	11%
sand	41%
gravel	48%
cobble	0%
boulder	0%

Appendix C
Current Conditions Plan View



NC GRID NAD 83

-40 -20 0 40 80

GRAPHIC SCALE

LEGEND

- STREAM THALWEG
- AS-BUILT TOP OF BANK
- AS-BUILT STRUCTURE
- RIFFLE ENHANCEMENT
- PROPERTY BOUNDARY
- DRAINAGE DITCH
- FORD CROSSING
- FENCE

REVISIONS

Ecosystem Enhancement

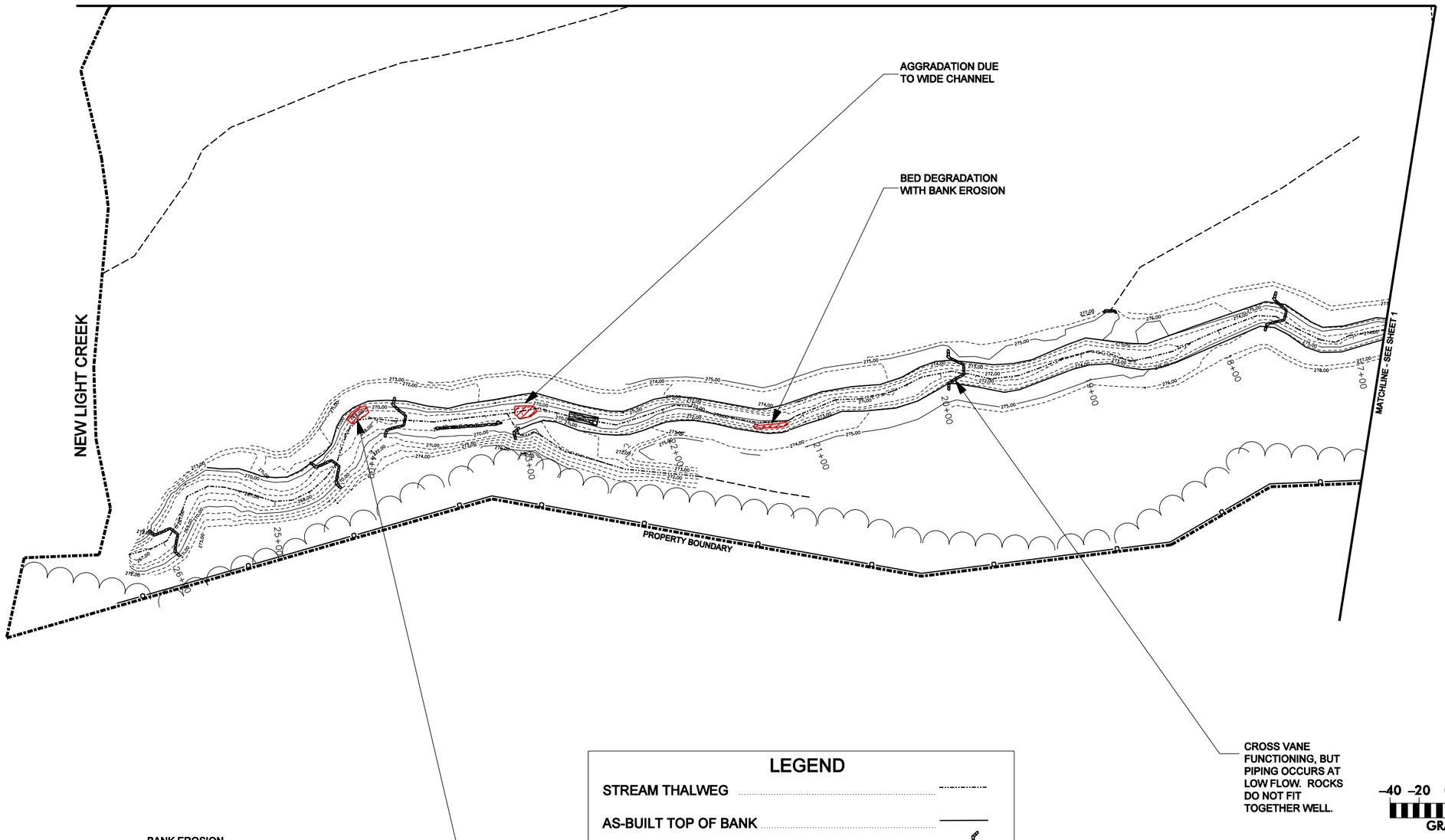
KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

BOLD RUN CREEK
STREAM / BUFFER RESTORATION
WAKE FOREST, WAKE COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 439 - MY 01
STATION 10+00 TO STATION 16+77

DATE: NOV 2007
SCALE: SEE SHEET

CURRENT CONDITIONS PLAN VIEW

SHEET 1 OF 2



LEGEND

- STREAM THALWEG
- AS-BUILT TOP OF BANK
- AS-BUILT STRUCTURE
- RIFFLE ENHANCEMENT
- PROPERTY BOUNDARY
- DRAINAGE DITCH
- FORD CROSSING
- FENCE

REVISIONS

Ecosystem Enhancement

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

BOLD RUN CREEK
STREAM / BUFFER RESTORATION
WAKE FOREST, WAKE COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 439 - MY 01
STATION 16+77 TO STATION 26+29

DATE: NOV 2007
SCALE: SEE SHEET

CURRENT CONDITIONS PLAN VIEW

SHEET 2 OF 2