Bold Run Stream/Buffer Restoration Mitigation Plan

EEP Project # 439

2007

Submitted to:

Ecosystem Enhancement PROGRAM

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EXECUTIVE SUMMARY

The Bold Run Creek Stream/Buffer Restoration Site is located within the Neuse River Basin. The goals of the project include restoring stable channel morphology, improving water quality, and enhancing aquatic and terrestrial habitat. The success of this project will be determined by using objectives set forth in the restoration plan. These objectives include little to no change from as-built conditions, moving sediment supplied by its watershed without the channel aggrading or degrading, and finally, riparian vegetation meeting a minimum survival success rate of 320 stems/acre after five years. Utilizing measurements of stream dimension, pattern, and profile, site photographs, and vegetation sampling, these criteria are assessed.

The project site is situated within the Neuse 01 watershed cataloging unit (8-digit HUC: 03020201), in a portion of the NCDWQ Priority Sub-basin 03-04-08. The North Carolina Ecosystem Enhancement Program (EEP) identifies this HUC as a Targeted Local Watershed. The site is part of a 31-acre parcel owned by the EEP, formerly owned by Mr. Douglas Darch. It is located 5 miles northwest of the Town of Wake Forest on Bold Hill Run Road, approximately 1.5 miles east of the intersection with Mangum Dairy Road in Wake County, North Carolina. The property was primarily used as rangeland for the former property owner's cattle. Bold Run Creek is a second order perennial stream that flows southwest through the subject property before joining New Light Creek.

Stream restoration included 1,629 linear feet of meandering channel based on Priority Level IV and II approaches. The Level IV restoration (Station 10+00 to 11+75) stabilized the bed and banks while maintaining the existing channel pattern. The Level II restoration (Station 11+75 to 26+29) established a bankfull channel with a new floodplain, a channel bed at the existing base level in the existing gravel layer, and the cross-section dimensions necessary to provide stable flow maintenance and sediment transport. In a modification to the plans, there were two additional grade control structures installed, one in the ephemeral channel to prevent headcutting near station 23+00. The second grade control structure was installed near station 18+75 where a ditch drains onto the floodplain. A rock constrictor was also installed from station 23+15 to 23+60 to narrow the constructed riffle at the convergence of the old and new channels. Bold Run Creek was restored to Rosgen stream type C4. Riparian buffers associated with the Bold Run Creek restoration extend between fifty (50) and two hundred (200) feet on both sides of the stream. To improve the water quality of Bold Run Creek, an approximate 200' buffer extends on either side of the small drainage features located throughout the project site. The as-built condition of the buffer follows the planting plan with the exception of approved substitutions for two tree species, which were unavailable at the time of planting.

The site will be monitored beginning in 2007 through 2011 or until the success criteria are achieved. Reports will be submitted to the EEP each year. Monitoring shall consist of the collection and analysis of stream stability and riparian/stream bank vegetation survivability data. Specifically, project success will be assessed utilizing measurements of stream dimension, pattern, profile, site photographs, and vegetation sampling. Cross-section and profile measurements should show little or no change from the as-built conditions. If changes do occur, they will be evaluated to determine whether they are minor adjustments associated with settling and increased stability or whether they indicate movement toward an unstable condition. Baseline monitoring of the as-built conditions was conducted in March 2007. This monitoring revealed that sedimentation has occurred in a few pools post-construction, following several storm events. Future monitoring will determine whether these pools will be capable of maintaining their design depth. Riparian vegetation must meet a minimum survival success rate of 320 stems/acre after five years. If monitoring indicates that the specified survival rate is not being met, corrective actions will be taken. Further baseline monitoring conditions are described in this report.

1.0 PROJECT BACKGROUND

The Bold Run Stream/Buffer Restoration site is located 5 miles northwest of the Town of Wake Forest on Bold Hill Run Road, approximately 1.5 miles east of the intersection with Mangum Dairy Road in Wake County, North Carolina. 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 then turn right onto Highway 98 and follow for approximately 2.7 miles. Then, take a left onto Stony Hill Road and proceed 2.4 miles. Take a left on Purnell Road, then take 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. Project Site Vicinity Map).

1.1 Project Goals and Objectives

Based on the existing and reference condition descriptions, the restoration goals and objectives for the Bold Run Creek Stream/Buffer Restoration project are as follows:

Restoration Goals:

- Restore a stable channel morphology that is capable of moving the flows and sediment provided by its watershed;
- Improve water quality and reduce land and riparian vegetation loss resulting from lateral erosion and bed degradation through the establishment of bank and riparian vegetation and,
- Enhance aquatic and terrestrial habitat through the improvements to the stream water quality (improved oxygen content, reduced sediment and nutrients, variable stream bed features).
- Improve water quality through approximately 27.1 acres of buffer restoration throughout the project site.

Restoration 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 IV and II (Table 1). The Priority IV restoration (Station 10+00 to 11+75) stabilized the bed and banks while maintaining the existing channel pattern. The Priority II restoration (Station 11+75 to 26+29) established a bankfull channel with a new floodplain, a channel bed at the existing base level in the existing gravel layer, and the cross-section dimensions necessary to provide stable flow maintenance and sediment transport. The design bankfull stage equals the floodplain elevation in the new channel (bank height ratio = 1.0). The stream dimension, pattern, and profile are based on the morphological criteria and hydraulic geometry relationships developed from the reference streams.

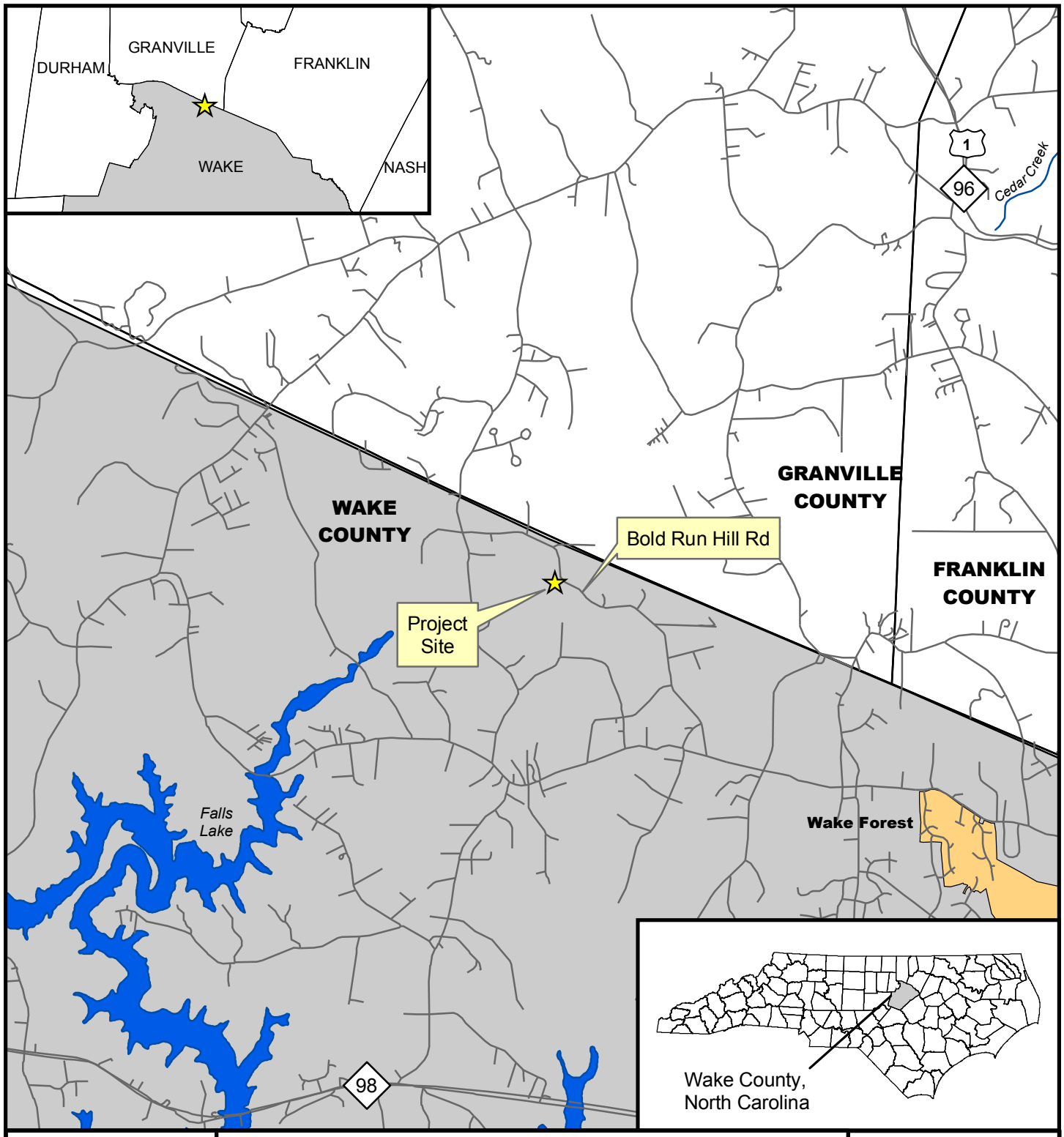


Figure 1. Project Site Vicinity Map

- Proposed 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

Table 1. 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 (Ac)	Nonriparian Wetland (Ac)	Total Wetland (Ac)	Buffer (Ac)	Comment
1,629	0	0	0	27.1	

R = Restoration P2 = Priority II
P4 = Priority IV

1.3 Project History, Contacts and Data

The project watershed containing the study area drains approximately 12 square miles (7,650 acres) and occupies the southwest corner of the headwaters of the Falls Lake Drainage area. The project watershed is located west off of US Highway 1 on the Wake and Granville County Line, with the majority of the watershed in Granville County. An Anderson Level I classification indicates that the contributing drainage area consists of: forest (79%), agriculture (13%), rangeland (6%), urban (<1%), and wetlands / open water (2%) land use / land cover. Design of the project was completed in July 2006 and construction began in November 2006. Construction was slowed by a wet winter season and ended in February 2007 (Tables 2 & 3). The site is located in a rural setting within the Northern Outer Piedmont ecoregion of the Piedmont physiographic province (Table 4).

Table 2. Project Activity and Reporting History
Project Name and Number: Bold Run - 439

Activity or Report	Data Collection	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	N/A	N/A

Table 3. Project Contact 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 Helms 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 4. 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	12 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%

2.0 MONITORING PLAN AND METHODOLOGY

2.1 Monitoring Features

Permanent monuments, marking monitoring feature locations, were established on-site. The beginning and end of each permanent cross-section were marked with rebar set in concrete monuments. Vegetation plots were installed with flagged metal conduit at each corner, and flagged PVC pipe at the photo corner. The locations of the permanent photo points are marked in the as-built plan. The crest gauge was installed to a steel fence post to monitor the occurrence of bankfull events.

2.2 Monitoring Guidelines

Five permanent cross-sections, three riffle and two pool, were established and will be used to evaluate stream dimension, with pebble counts being performed at each cross section. Cross-sections will be surveyed each year using a total station. Cross-sectional data such as area and width to depth ratio will be calculated for each cross-section. Longitudinal profile will be conducted on all 1,629 linear feet of stream. The profile will be surveyed with a total station and will record feature changes, water surface levels, and bankfull levels. This data will be used to obtain feature lengths and slopes, pool-to-pool spacing and other longitudinal measurements. The longitudinal profile will also be used to calculate planform measurements. Stem counts of planted trees and shrubs will be conducted in the 15 vegetation monitoring plots. Five plots were established along the project stream with four including live stakes, and ten plots are located in the buffer restoration area. All plots followed the latest EEP vegetation monitoring protocol. Visual monitoring of the site will be conducted with annual site walks and site photos taken from six permanent photo points located throughout the site.

2.3 As-Built Conditions

Baseline stream monitoring data was collected in March 2007. This data includes the detailed profile of all reaches and tributaries, five cross-sections and pebble counts with three riffles and two pools, fifteen 10m x 10m vegetation plot stem counts, the installation of a crest gauge, and six photo points throughout the site (Tables 5, 6, and 7).

The final design plans for Bold Run Creek, within the priority II restoration reach, consisted of 22 riffles and 22 pools. The baseline monitoring consisted of 21 riffles and 15 pools. The discrepancy between the number of pools stems from sedimentation post-construction before ground cover had stabilized the soils. Future monitoring will determine whether these pools will be capable of maintaining their design depth. The bankfull channel in the downstream section of the site is slightly larger than the design due to the location of the old channel. As-built riffle slope, belt width, and meander width ratios were adapted due to site conditions, which include a power line easement flanking the stream, a steep valley wall bordering the left bank of the stream, and riffles within the existing stream that were incorporated into the design to utilize existing bed material. The designed structures, which serve as grade control, are located as depicted in the plans.

Results of baseline vegetation monitoring include an average of 530 trees per acre (Table 7). An attempt to identify all trees was made; however, with the dormant conditions many were unidentifiable. All trees will be positively identified during first year monitoring. The planting plan was followed with the exception of approved substitutions of two tree species that were unavailable at the time of planting. Substitutions include Green Ash (*Fraxinus pennsylvanica*) for Box Elder (*Acer negundo*) in the streamside planting zone and Sugarberry (*Celtis laevigata*) for Slippery Elm (*Ulmus rubra*) in the Levee planting area.

3.0 SUCCESS CRITERIA

3.1 Channel Stability

Cross-section measurements should show little or no change from the as-built cross-sections. If changes do occur, they will be evaluated to determine whether they are minor adjustments associated with settling and increasing stability or whether they indicate movement toward an unstable condition. Annual measurements of the longitudinal profile should indicate stable bedform features with little change from the as-built survey. The pools should maintain their depth with lower water surface slopes, while the riffles should remain shallower with steeper water surface slopes. Sediment transport should remain relatively unchanged with respect to aggradation and deposition of sediments.

3.2 Vegetation

Riparian vegetation must meet a minimum survival success rate of 320 stems/acre after five years. If monitoring indicates that the specified survival rate is not being met, appropriate corrective actions will be developed, to include invasive species control, the removal of dead/dying plants, and replanting.

3.3 Hydrology

A minimum of two bankfull events must occur in separate years within the five-year monitoring period. If stream gauge data reveals that this criteria is not met, probable causes for this will be determined.

4.0 MAINTENANCE AND CONTINGENCY PLAN

Aspects of the restoration deemed problem areas will be dealt with accordingly based on the severity of the problem. Site maintenance may include reinstallation of coir matting, removal of debris from the channel, stabilization of bank erosion with protective structures, or adjustments to in-stream structures. All maintenance activities will be documented in the yearly monitoring reports and any major repairs will be completed after consultation with the EEP.

Table 5. Baseline Stream Summary
Project Name and Number: Bold Run - 439

Parameter	Pre-Existing Condition					Reference Reach(es) Data					Design		As-built				
Dimension -Riffle	Min	Mean	Med	Max	n	Min	Mean	Med	Max	n	Min	Max	Min	Mean	Med	Max	n
Bankfull Width (ft)	14.8	17	17.5	18.3	4	22.9	26.9	26.9	30.8	2	17.8		18.1	18.5	18.5	18.9	3
Floodprone Width (ft)	18.5	22.3	20.4	30	4	300	300	300	300	2	>100		>70			>80	3
Bankfull Mean Depth (ft)	1.3	1.5	1.5	1.7	4	2.4	2.5	2.5	2.6	2	1.4		1.6	1.7	1.7	1.8	3
Bankfull Max Depth (ft)	1.9	2.0	1.9	2.3	4	3.7	3.8	3.8	3.9	2	2.2		2.6	2.8	2.8	3.1	3
Bankfull Cross Sectional Area (ft^2)	24.2	24.8	24.9	25.2	4	59.2	66.9	66.9	74.6	2	27.6		29.6	31.8	31.6	34.1	3
Width/Depth Ratio	8.8	11.7	12.2	13.8	4	8.8	10.8	10.8	12.7	2	12.7		10.4	10.8	10.8	11.1	3
Entrenchment Ratio	1.1	1.3	1..3	1.7	4	9.7	11.4	11.4	13.1	2	>3.0		>2			>5	3
Bank Height Ratio	1.7	2.3	2.5	2.6	4	1.1	1.2	1.2	1.3	2	1.0		1.0	1.0	1.0	1.0	3
Bankfull Velocity (fps)	3.1			4.6	4	3.9	4.0	4.0	4.0	2							
Pattern																	
Channel Beltwidth (ft)	20			75		300			300		160	195	32	76.3	68.5	136	4
Radius of Curvature (ft)	20			70		30			70		20	55	21	38	38	55	12
Rc:Bankfull width (ft/ft)	1.1			4		1			2.5		1.1	3	1.1	2.0	2.1	3.0	12
Meander Wavelength (ft)	68			150		110			200		60	180	96	117	115	142	6
Meander Width Ratio	1.1			4.3		9.3			10.7		9	11	5.2	6.3	6.3	7.7	4
Profile																	
Riffle Length (ft)													5	23	15	86	21
Riffle Slope (ft/ft)	0.0040			0.0210	6	0.0045			0.0090	5	0.0088	0.0158	0.0039	0.0170	0.0155	0.0278	21
Pool Length (ft)	29			43	6	5			25	2	3	20	7	14	12	25	15
Pool Spacing (ft)	10			70	6	25			90		15	55	38	88	60	237	14
Substrate and Transport Parameters																	
SC% / Sa% / G% / C% / B% / Be%	14% / 2% / 76% / 8% / - / -					- / 11% / 89% / - / - / -							10% / 23.7% / 55.7% / 10.6% / -				
d16 / d35 / d50 / d84 / d95 / di^p / di^{sp} (mm)	2.0 / 7.4 / 11.7 / 38 / 74 / - /-					2.6 / 5.7 / 7.1 / - / 15 / - / -							0.9 / 5.9 / 11.2 / 46.7 / 69 / - / -				
Reach Shear Stress (competency) lb/ft^2																	
Additional Reach Parameters																	
Channel length (ft)	1,609					383					1,629		1,629				
Drainage Area (SM)	12					4.8					12		12				
Rosgen Classification	B4c, F4, G4c					C4					C4		C4				
Bankfull Discharge (cfs)	108					248							130				
Sinuosity	1.04					1.1					1.1		1.1				
Water Surface Slope (ft/ft)																	
BF slope (ft/ft)																	

Table 6. 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			Cross Section 4 Riffle			Cross Section 5 Pool		
Dimension	MY0	MY1	MY2	MY0	MY1	MY2	MY0	MY1	MY2	MY0	MY1	MY2	MY0	MY1	MY2
Current Bankfull Width (ft)	18.1			19.3			18.9			18.5			30.1		
Current Floodprone Width (ft)	>80			-			>74			>70			-		
Current Bankfull Mean Depth (ft)	1.6			1.6			1.8			1.7			2.2		
Current Bankfull Max Depth (ft)	2.6			3.0			2.9			2.9			3.5		
Current Bankfull Cross Sectional Area (ft^2)	29.6			30.8			34.1			31.6			65.5		
Current Bankfull Width/Depth Ratio	11.1			-			10.4			10.8			-		
Current Bankfull Entrenchment Ratio	>4			-			>4			>3			-		
Current Bankfull Bank Height Ratio	1			-			1			1			-		
As-built Bkf Elevation Width (ft)	18.1			19.3			18.9			18.5			30.1		
As-built Bkf Elevation Floodprone Width (ft)	>80			-			>74			>70			-		
As-built Bkf Elevation Mean Depth (ft)	1.6			1.6			1.8			1.7			2.2		
As-built Bkf Elevation Max Depth (ft)	2.6			3.0			2.9			2.9			3.5		
As-built Bkf Elevation Cross Sectional Area (ft^2)	29.6			30.8			34.1			31.6			65.5		
As-built Bkf Elevation Width/Depth Ratio	11.1			-			10.4			10.8			-		
As-built Bkf Elevation Entrenchment Ratio	>4			-			>4			>3			-		
As-built Bkf Elevation Bank Height Ratio	1			-			1			1			-		
Cross Sectional Area between cross-section end pins (ft^2)*	88.1			114.1			125.9			106.9			177.6		
Substrate															
d50 (mm)	20			0.65			7.3			6.4			0.12		
d84 (mm)	77			14			23			40			0.3		
Channel Length (ft)	1,629			1,629			1,629			1,629			1,629		
Sinuosity	1.1			1.1			1.1			1.1			1.1		
Water Surface Slope (ft/ft)	0.0069			0.0071			0.0070			0.0073			0.0071		
BF Slope (ft/ft)	0.0059			0.0059			0.0059			0.0059			0.0059		
Rosgen Classification	C4			C4			C4			C4			C4		

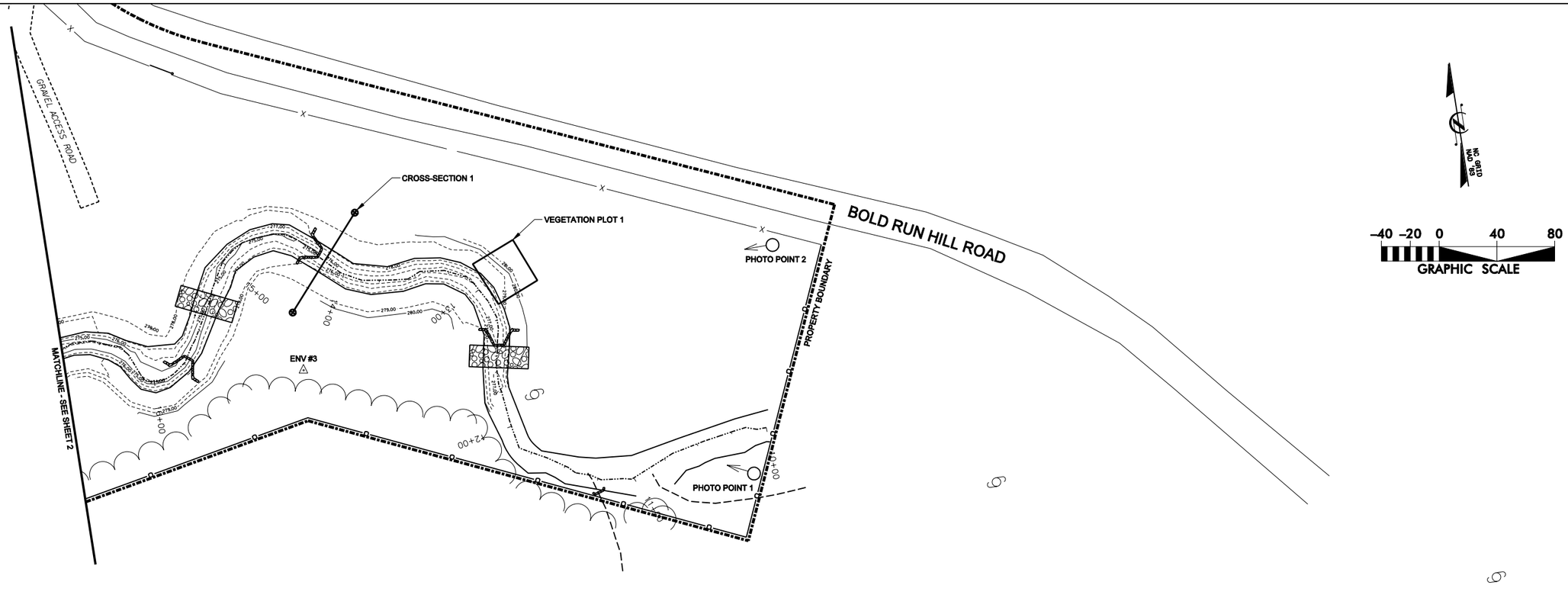
*Area taken from lowest pin elevation

Table 7: Stem counts arranged by plot.
Project Name and Number: Bold Run - 439

Species	Plots															Initial Totals	Year 1 Totals	Survival %
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
Trees																		
Betula nigra		2	2	1	2											7	-	-
Cornus amomum	1	1		2												4	-	-
Fraxinus pennsylvanica	4	6	3	9	6		6									34	-	-
Platanus occidentalis	3	3	6	2	6											20	-	-
Quercus spp.	2										1	2		1	1	7	-	-
Quercus phellos												1				1	-	-
Salix spp.	1		4	3												8	-	-
Sambucus canadensis		1		2												3	-	-
Unknown	6	1				13	2	11	14	13	12	9	11	11	12	115	-	-

Appendix A

Monitoring Plan View



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	
SUBMITTED WITH MITIGATION PLAN	JUNE 2007

Ecosystem Enhancement Program

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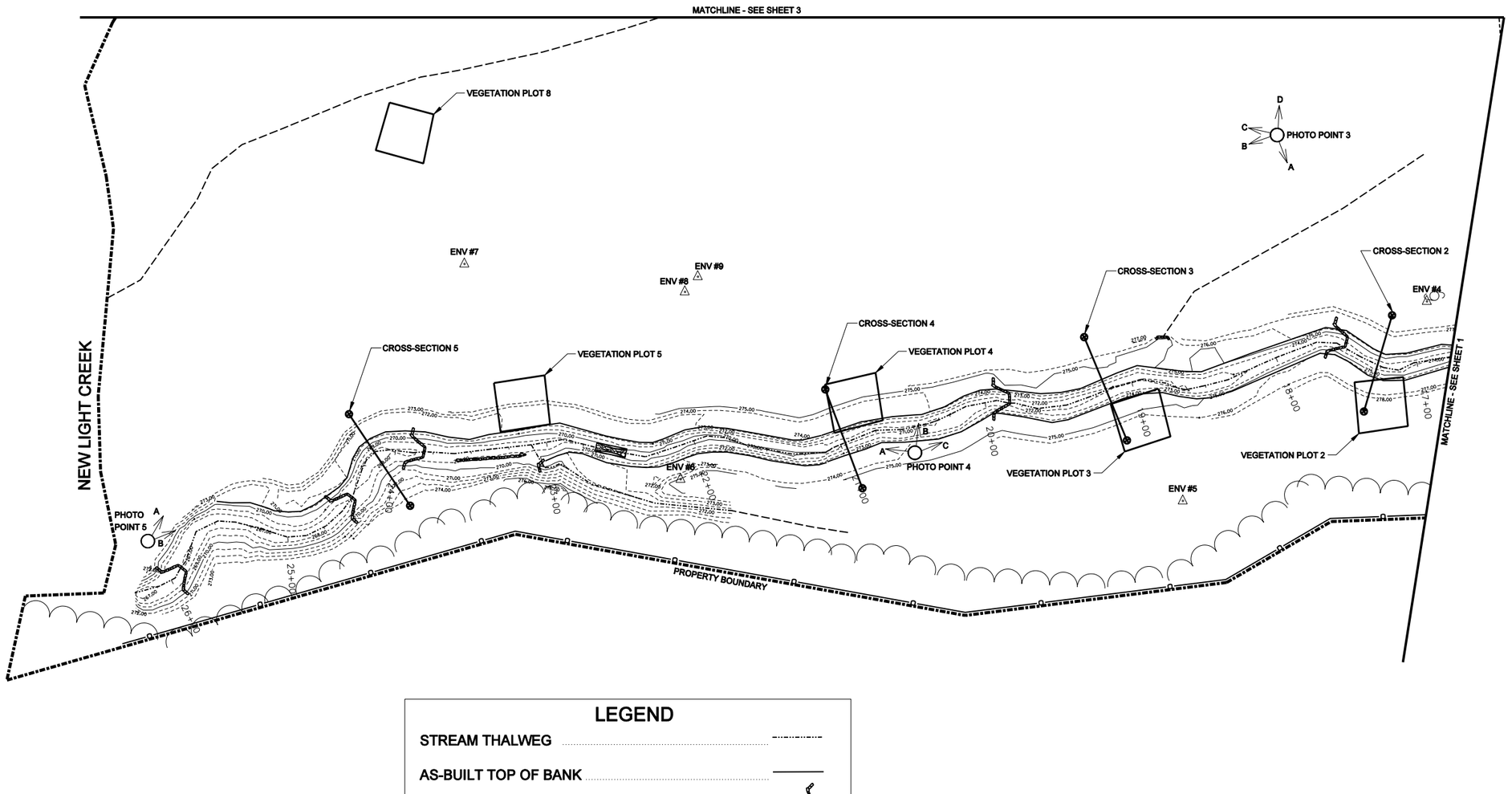
RALEIGH, NORTH CAROLINA 27609

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

DATE: 06/01/2007
SCALE: SEE SHEET

MONITORING PLAN VIEW

SHEET 1 OF 6



LEGEND

- STREAM THALWEG
- AS-BUILT TOP OF BANK
- AS-BUILT STRUCTURE
- RIFFLE ENHANCEMENT
- PHOTO REFERENCE POINT
- PROPERTY BOUNDARY
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- FENCE

REVISIONS								
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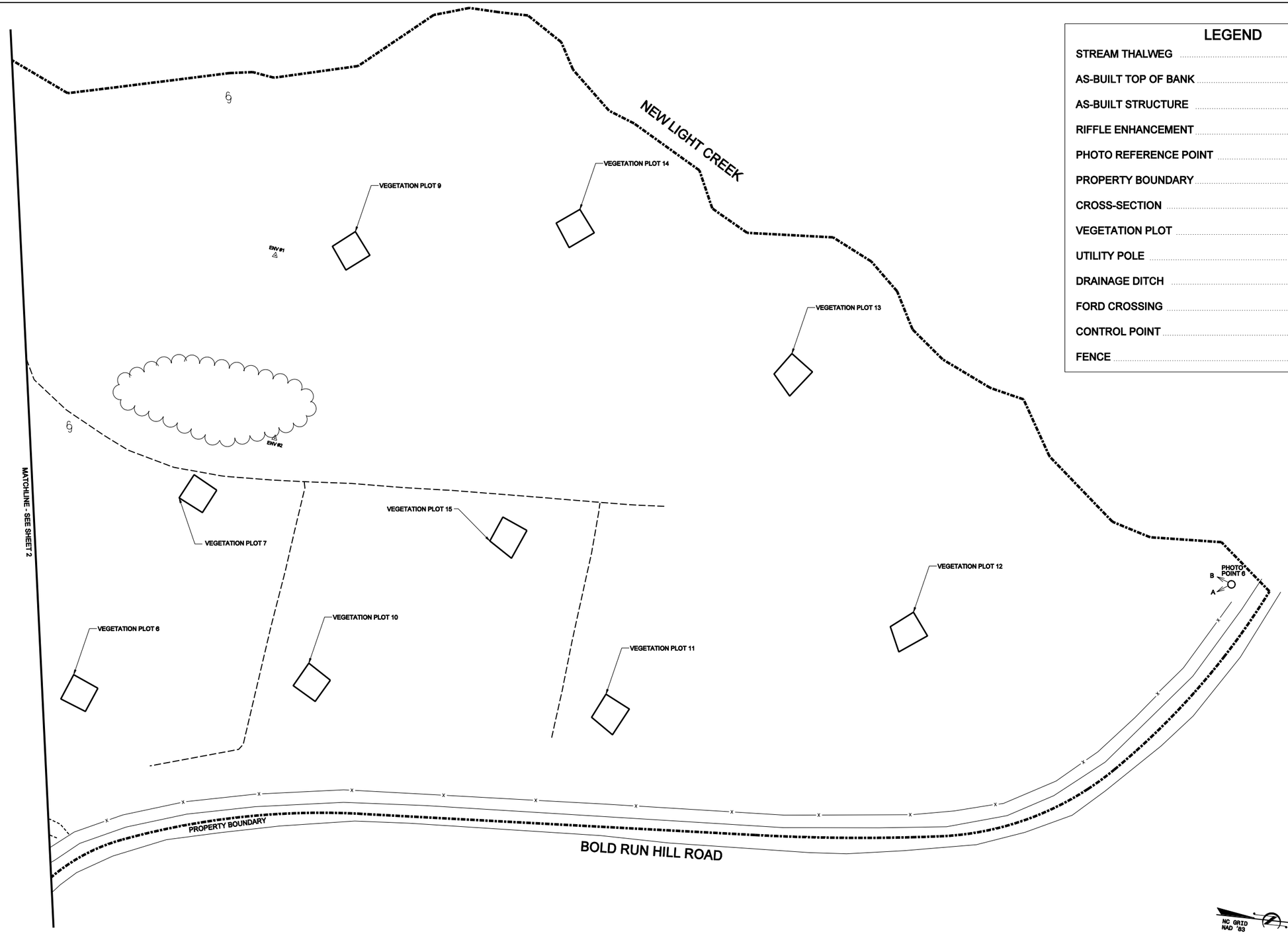
BOLD RUN CREEK
STREAM / BUFFER RESTORATION
WAKE FOREST, WAKE COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 439 - MY 00
STATION 16+77 TO STATION 26+29

DATE: 06/01/2007
SCALE: SEE SHEET

MONITORING PLAN VIEW

SHEET 2 OF 6



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
- FENCE

REVISIONS								
SUBMITTED WITH MITIGATION PLAN								JUNE 2007

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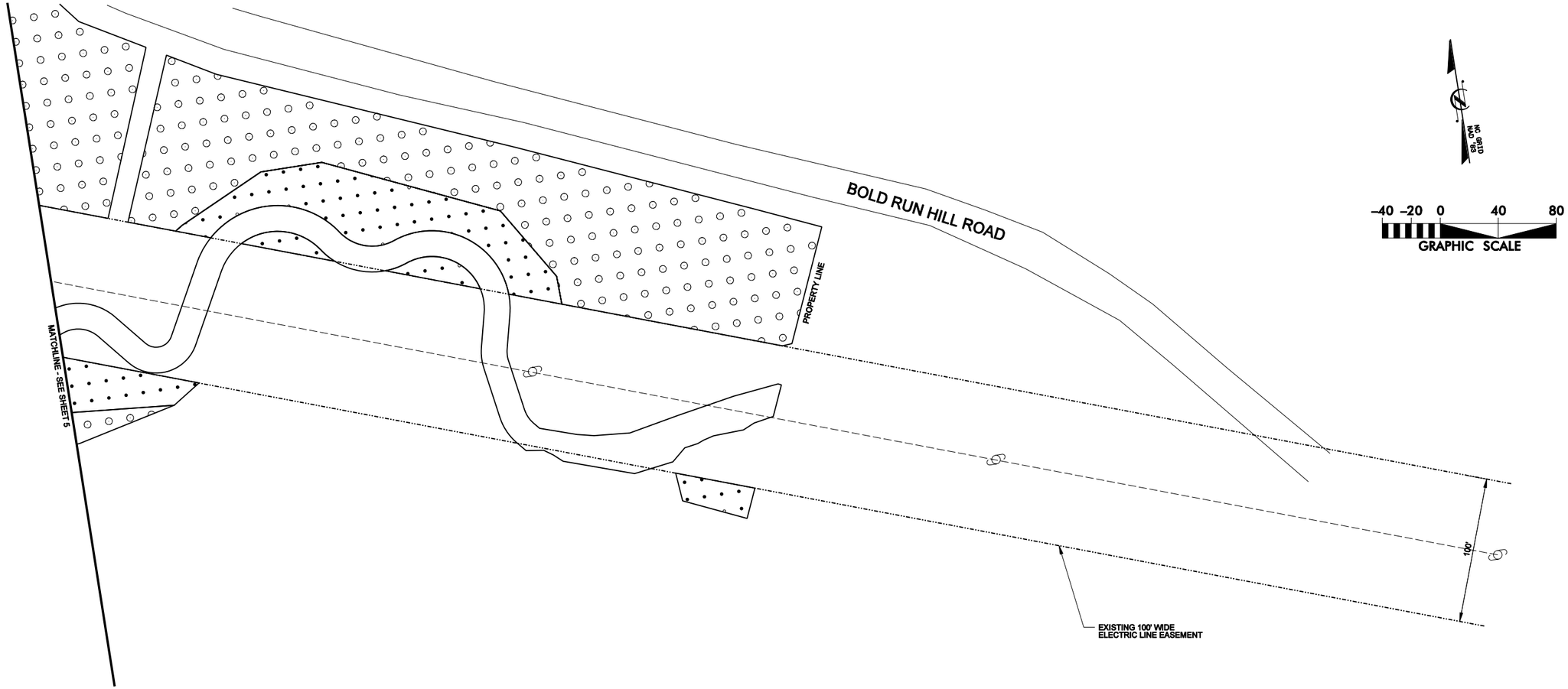
BOLD RUN CREEK
STREAM / BUFFER RESTORATION
WAKE FOREST, WAKE COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 439 - MY 00

DATE: 08/01/2007
SCALE: SEE SHEET

MONITORING PLAN VIEW

SHEET 3 OF 6



PLANTING PLAN AND SPECIES COMPOSITION

ZONE A

LEVEE PLANTING AREA = 7.0 ACRES

12" - 18" BARE ROOT MATERIAL
436 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

SCIENTIFIC NAME	COMMON NAME	% OF TOTAL	# OF PLANTS
JUGLANS NIGRA	BLACK WALNUT	25	770
QUERCUS PHELLOS	WILLOW OAK	20	610
QUERCUS LYRATA	OVERCUP OAK	30	920
CELTIS LAEVIGATA	SUGARBERRY	25	770
		100	3,070

* UNDISTURBED FORESTED AREAS WITHIN PLANTING ZONE WILL NOT BE PLANTED

ZONE B

STREAMSIDE PLANTING AREA = 1.4 ACRES

12" - 18" BARE ROOT MATERIAL
436 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

SCIENTIFIC NAME	COMMON NAME	% OF TOTAL	# OF PLANTS
BETULA NIGRA	RIVER BIRCH	34	210
FRAXINUS PENNSYLVANICA	GREEN ASH	33	200
PLATANUS OCCIDENTALIS	AMERICAN SYCAMORE	33	200
		100	610

* UNDISTURBED FORESTED AREAS WITHIN PLANTING ZONE WILL NOT BE PLANTED

ZONE B

BOTTOMLAND HARDWOOD PLANTING AREA = 18.6 ACRES

12" - 18" BARE ROOT MATERIAL
436 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

SCIENTIFIC NAME	COMMON NAME	% OF TOTAL	# OF PLANTS
LIRIODENDRON TULIPIFERA	TULIP POPLAR	20	1,622
QUERCUS PAGODA	CHERRYBARK OAK	30	2,433
QUERCUS PHELLOS	WILLOW OAK	30	2,433
QUERCUS MICHAUXII	SWAMP CHESTNUT OAK	20	1,622
		100	8,110

* UNDISTURBED FORESTED AREAS WITHIN PLANTING ZONE WILL NOT BE PLANTED

ZONE B

HIGH MOISTURE PLANTING AREA = 1.3 ACRES

12" - 18" BARE ROOT MATERIAL
436 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

SCIENTIFIC NAME	COMMON NAME	% OF TOTAL	# OF PLANTS
FRAXINUS PENNSYLVANICA	GREEN ASH	34	200
ULMUS AMERICANA	AMERICAN ELM	33	190
CORNUS AMOMUM	SILKY DOGWOOD	33	190
		100	580

* UNDISTURBED FORESTED AREAS WITHIN PLANTING ZONE WILL NOT BE PLANTED

ZONE B

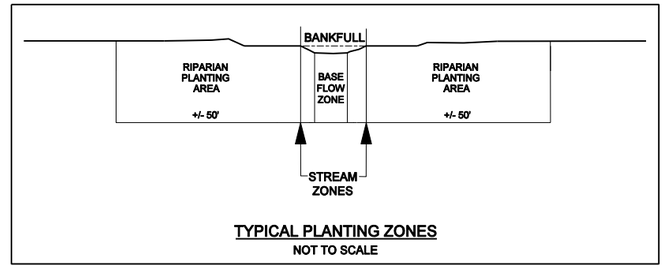
STREAM ZONE = 0.34 ACRES (1,629 LF x 9.2 FT BANK)

LIVE STAKES: 1.5' TO 2' LENGTHS, 1/2' TO 2" DIAMETER
3' CENTER SPACING, RANDOM SPECIES PLACEMENT

SCIENTIFIC NAME	COMMON NAME
SALIX NIGRA	BLACK WILLOW
SALIX SERICEA	SILKY WILLOW
CORNUS AMOMUM	SILKY DOGWOOD
SAMBUCUS CANADENSIS	ELDERBERRY

NOTE: NO SINGLE LIVE STAKING SPECIES SHALL COMPOSE MORE THAN 40% OF THE 1,770 TOTAL NUMBER OF LIVE STAKES TO BE INSTALLED

EXISTING TREE LINE



TYPICAL PLANTING ZONES
NOT TO SCALE

REVISIONS								
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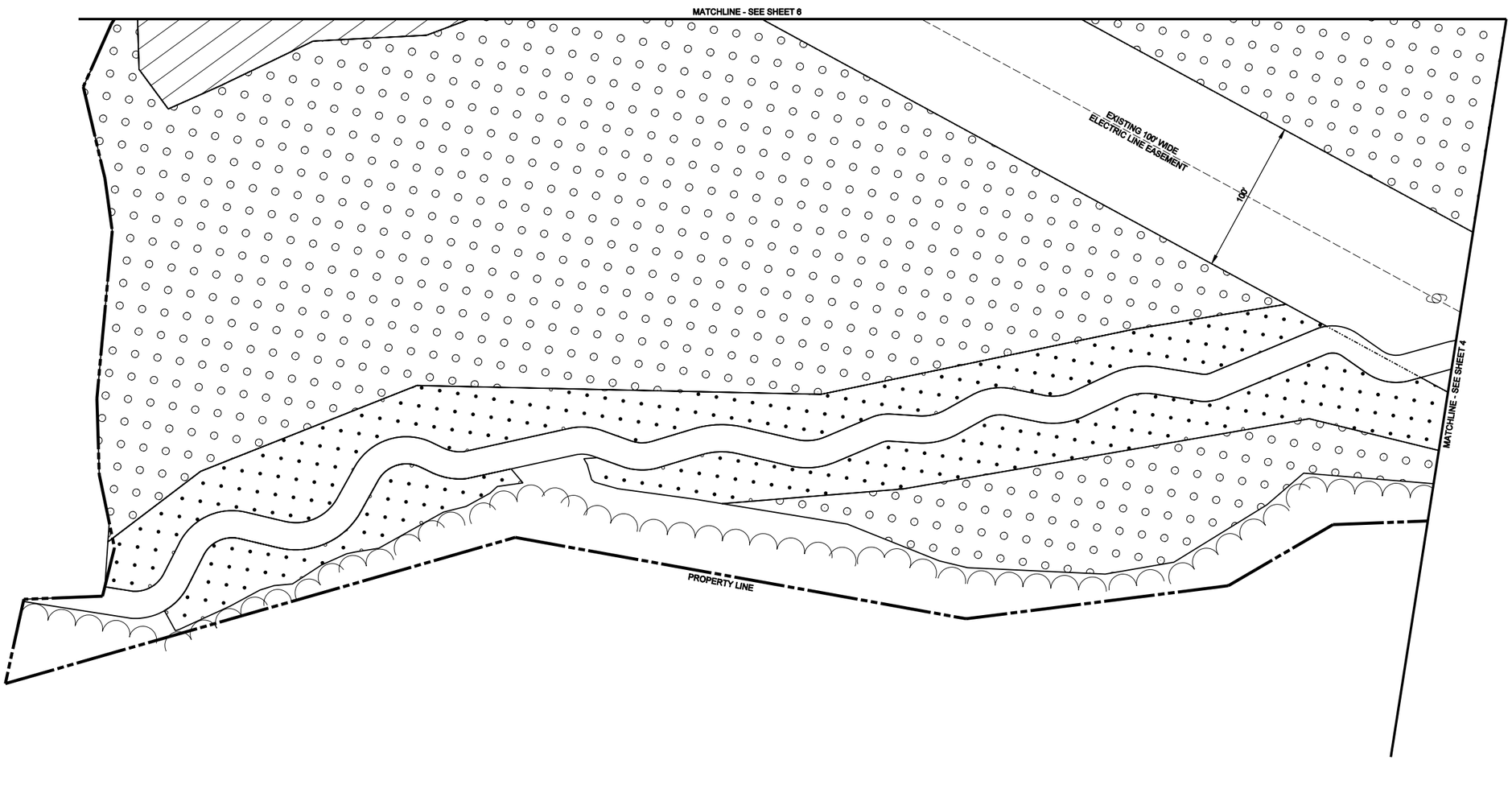
BOLD RUN CREEK
STREAM / BUFFER RESTORATION
WAKE FOREST, WAKE COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 439 - MY 00

DATE: 06/01/2007
SCALE: SEE SHEET

PLANTING PLAN

SHEET 4 OF 6



–40 –20 0 40 80
GRAPHIC SCALE

TEMPORARY SEED MIX

THE CONTRACTOR SHALL UTILIZE THE FOLLOWING SEED/FERTILIZER MIX IN SEEDING ALL DISTURBED AREAS WITHIN THE PROJECT LIMITS:

PEARL MILLET	20LBS./ACRE
ANNUAL RYE	10LBS./ACRE
FERTILIZER	500LBS./ACRE
LIMESTONE	4000LBS./ACRE

FERTILIZER SHALL BE 10-20-20 ANALYSIS. UPON WRITTEN APPROVAL OF THE SITE SUPERVISOR, A DIFFERENT ANALYSIS OF FERTILIZER MAY BE USED PROVIDED THE 1-2-2 RATIO IS MAINTAINED AND THE RATE OF APPLICATION ADJUSTED TO PROVIDE THE SAME AMOUNT OF PLANT FOOD AS A 10-20-20 ANALYSIS.

PERMANENT SEED MIX

THE CONTRACTOR SHALL UTILIZE THE FOLLOWING SEED MIX AND FERTILIZER SPECIFICATION IN ALL AREAS INSIDE THE RIPARIAN BUFFER ZONES, INCLUDING THE STREAM BANKS:

WINTER MIX (OCTOBER 15 – APRIL 15)

	APPLICATION RATE (IN MIX)	
SPECIES	% OF MIX	LBS./ACRE
ORCHARDGRASS – DACTYLIS GLOMERATA	5	1.5
BLUESTEM – ANDROPOGON GLOMERATUS	5	1.5
VIRGINIA – WILDRYE ELYMUS VIRGINICUS	5	1.5
RIVER OATS – CHASMANTHIUM LATIFOLIUM	5	1.5
PURPLE LOVE GRASS – ERAGROSTIS SPECTABILIS	5	1.5
DEERTONGUE – PANICUM CLANDESTINUM	25	7.5
SWITCHGRASS – PANICUM VIRGATUM	25	7.5
RYE GRAIN – SECALE CEREALE	25	7.5
TOTALS	100	30

SUMMER MIX (APRIL 15 – OCTOBER 15)

	APPLICATION RATE (IN MIX)	
SPECIES	% OF MIX	LBS./ACRE
ORCHARDGRASS – DACTYLIS GLOMERATA	5	1.5
BLUESTEM – ANDROPOGON GLOMERATUS	5	1.5
VIRGINIA WILDRYE – ELYMUS VIRGINICUS	5	1.5
RIVER OATS – CHASMANTHIUM LATIFOLIUM	5	1.5
PURPLE LOVE GRASS – ERAGROSTIS SPECTABILIS	5	1.5
DEERTONGUE – PANICUM CLANDESTINUM	25	7.5
SWITCHGRASS – PANICUM VIRGATUM	25	7.5
PEARL MILLET – PENNISETUM GLAUCOMA	25	7.5
TOTALS	100	30

FERTILIZER AND LIMESTONE SHALL BE APPLIED AT THE RATE OF 500LBS./ACRE AND 4000LBS./ACRE, RESPECTIVELY. FERTILIZER SHALL BE 10-20-20 ANALYSIS. UPON WRITTEN APPROVAL OF THE SITE SUPERVISOR, A DIFFERENT ANALYSIS OF FERTILIZER MAY BE USED PROVIDED THE 1-2-2 RATIO IS MAINTAINED AND THE RATE OF APPLICATION ADJUSTED TO PROVIDE THE SAME AMOUNT OF PLANT FOOD AS A 10-20-20 ANALYSIS.

MULCHING

SEEDED AREAS ARE TO BE PROTECTED BY SPREADING STRAW MULCH UNIFORMLY TO FORM A CONTINUOUS BLANKET (75% COVERAGE = 2 TONS/ACRE) OVER SEEDED AREAS. CONTRACTOR MAY PROPOSE ALTERNATE METHODS OF SEED, FERTILIZER AND LIMING (HYDRO-SEEDING) UPON SUBMISSION TO THE ENGINEER OF CALCULATIONS SHOWING THE EQUIVALENCY OF THE PROPOSED METHOD.

ZONE A — RIPARIAN BUFFER - LEVEE PLANTING AREA

ZONE B — RIPARIAN BUFFER - HIGH MOISTURE PLANTING ZONE

ZONE B — RIPARIAN BUFFER - STREAMSIDE PLANTING AREA

ZONE B — RIPARIAN BUFFER - STREAM ZONE PLANTING AREA

ZONE B — RIPARIAN BUFFER - BOTTOMLAND HARDWOOD PLANTING AREA

EXISTING TREE LINE

SUBMITTED WITH MITIGATION PLAN	JUNE 2007
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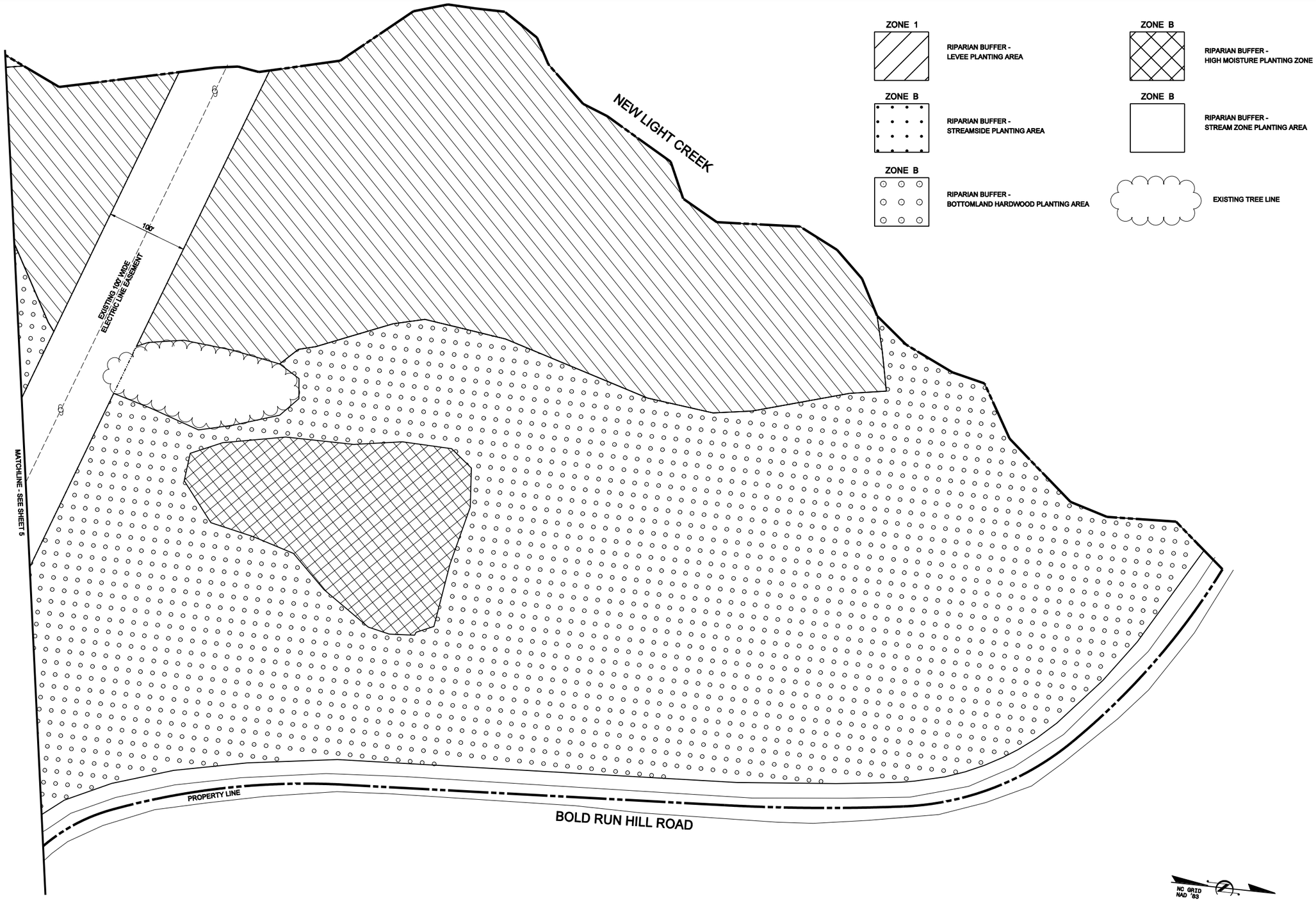
BOLD RUN CREEK
STREAM / BUFFER RESTORATION
WAKE FOREST, WAKE COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 439 - MY 00

DATE: 06/01/2007
SCALE: SEE SHEET

PLANTING PLAN

SHEET 5 OF 6



REVISIONS

SUBMITTED WITH MITIGATION PLAN	JUNE 2007

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RALEIGH, NORTH CAROLINA 27609

BOLD RUN CREEK
STREAM / BUFFER RESTORATION
WAKE FOREST, WAKE COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 439 - MY 00

DATE: 06/01/2007
SCALE: SEE SHEET

PLANTING PLAN

SHEET 6 OF 6

Appendix B

Vegetation Plot Photos

Vegetation Plot 1. (3/8/07)

Vegetation Plot 2. (3/8/07)

Vegetation Plot 3. (3/8/07)

Vegetation Plot 4. (3/8/07)

Vegetation Plot 5. (3/8/07)

Vegetation Plot 6. (3/8/07)

Vegetation Plot 7. (3/8/07)

Vegetation Plot 8. (3/8/07)

Vegetation Plot 9. (3/8/07)

Vegetation Plot 10. (3/8/07)

Vegetation Plot 11. (3/8/07)

Vegetation Plot 12. (3/8/07)

Vegetation Plot 13. (3/8/07)

Vegetation Plot 14. (3/8/07)

Vegetation Plot 15. (3/8/07)

Appendix C

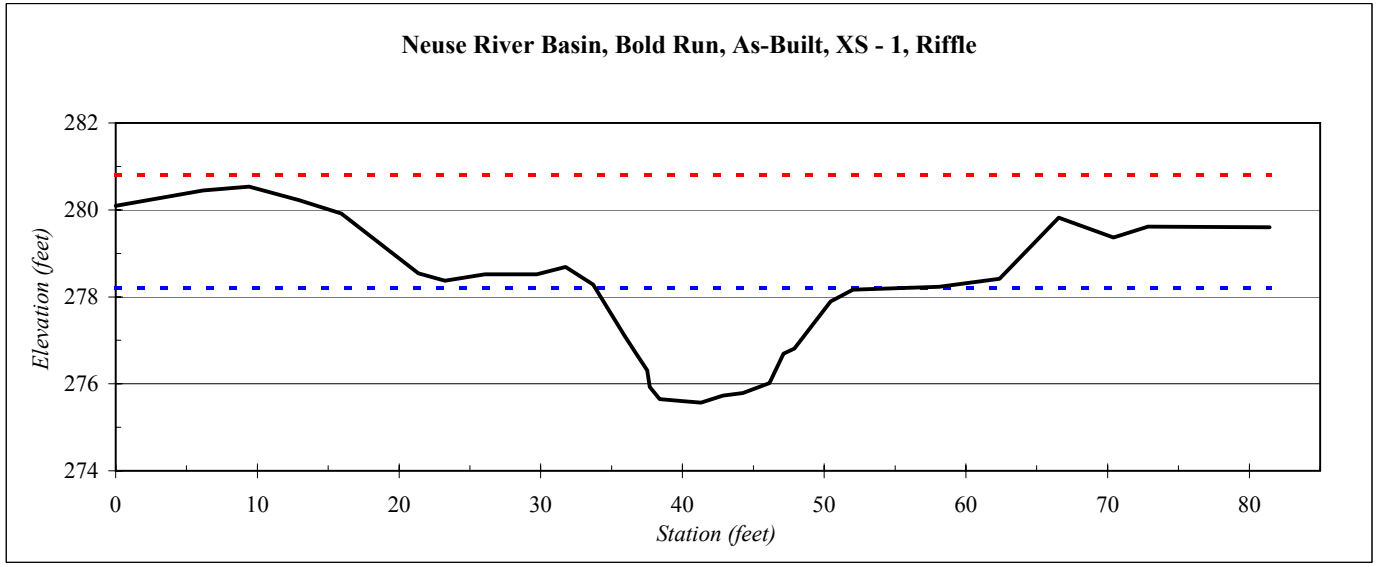
Cross-Section Plots and Pebble Counts

River Basin:	Neuse
Watershed:	Bold Run, As-Built
XS ID	XS - 1, Riffle
Drainage Area (sq mi):	12
Date:	3/6/2007
Field Crew:	A. Spiller, B. Roberts, H. Miller

Station	Elevation
0.00	280.1
6.17	280.4
9.43	280.5
12.92	280.2
15.92	279.9
21.37	278.5
23.23	278.4
26.06	278.5
29.73	278.5
31.76	278.7
33.69	278.3
35.88	277.1
36.67	276.7
37.50	276.3
37.70	275.9
38.40	275.6
39.94	275.6
41.30	275.6
42.86	275.7
44.25	275.8
46.13	276.0
47.13	276.7
47.91	276.8
50.44	277.9
52.03	278.2
58.11	278.2
62.38	278.4
66.56	279.8
70.41	279.4
72.85	279.6
81.44	279.6

SUMMARY DATA	
Bankfull Elevation:	278.2
Bankfull Cross-Sectional Area:	29.6
Bankfull Width:	18.1
Flood Prone Area Elevation:	280.8
Flood Prone Width:	>80
Max Depth at Bankfull:	2.6
Mean Depth at Bankfull:	1.6
W / D Ratio:	11.1
Entrenchment Ratio:	>5
Bank Height Ratio:	1.0
Slope:	0.0069
Discharge:	116

Stream Type	C4

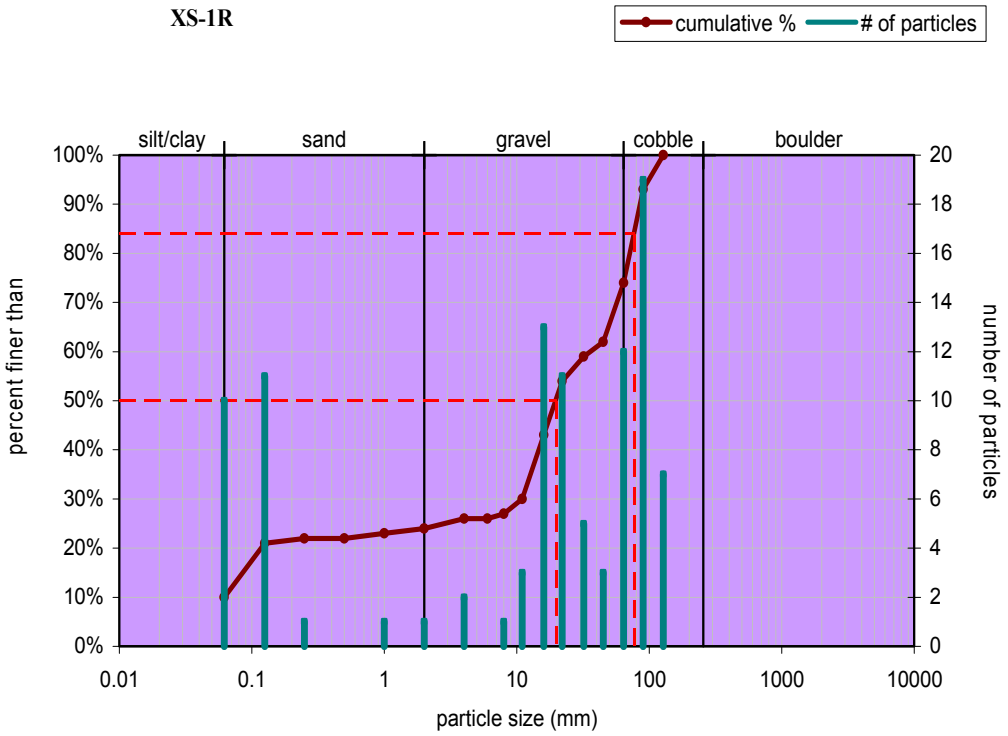


Riffle

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	10
very fine sand	0.062 - 0.125	11
fine sand	0.125 - 0.25	1
medium sand	0.25 - 0.5	
coarse sand	0.5 - 1	1
very coarse sand	1 - 2	1
very fine gravel	2 - 4	2
fine gravel	4 - 6	
fine gravel	6 - 8	1
medium gravel	8 - 11	3
medium gravel	11 - 16	13
coarse gravel	16 - 22	11
coarse gravel	22 - 32	5
very coarse gravel	32 - 45	3
very coarse gravel	45 - 64	12
small cobble	64 - 90	19
medium cobble	90 - 128	7
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
	total particle count:	100
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
	total count:	100

Note: XS-1 Riffle

Bold Run, As Built
XS-1R



Size (mm)	
D16	0.091
D35	13
D50	20
D65	49
D84	77
D95	100

Size Distribution	
mean	2.6
dispersion	111.8
skewness	-0.51

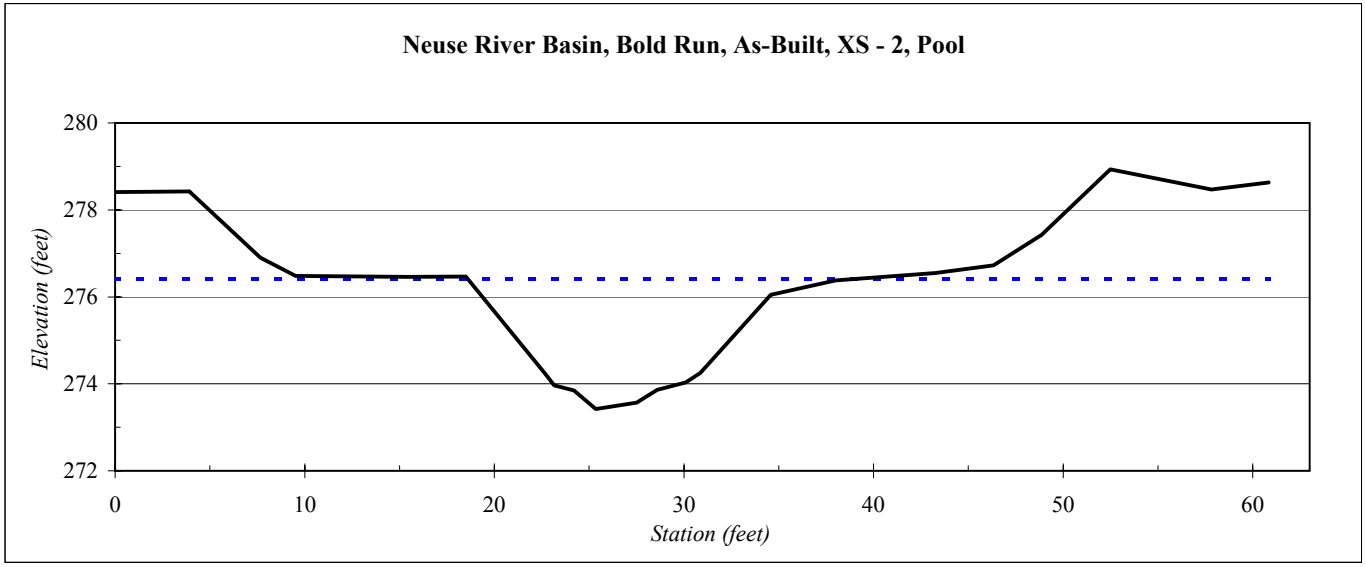
Type	
silt/clay	10%
sand	14%
gravel	50%
cobble	26%
boulder	0%

River Basin:	Neuse
Watershed:	Bold Run, As-Built
XS ID	XS - 2, Pool
Drainage Area (sq mi):	12
Date:	3/6/2007
Field Crew:	A. Spiller, B. Roberts, H. Miller

Station	Elevation
0.00	278.4
3.92	278.4
7.66	276.9
9.52	276.5
15.33	276.5
18.49	276.5
22.70	274.2
23.15	274.0
24.20	273.8
25.34	273.4
27.51	273.6
28.58	273.9
30.08	274.0
30.87	274.3
34.59	276.0
38.00	276.4
43.25	276.6
46.33	276.7
48.86	277.4
52.49	278.9
57.82	278.5
60.84	278.6

SUMMARY DATA	
Bankfull Elevation:	276.4
Bankfull Cross-Sectional Area:	30.8
Bankfull Width:	18.9
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	3.0
Mean Depth at Bankfull:	1.6
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-
Slope:	-
Discharge:	-

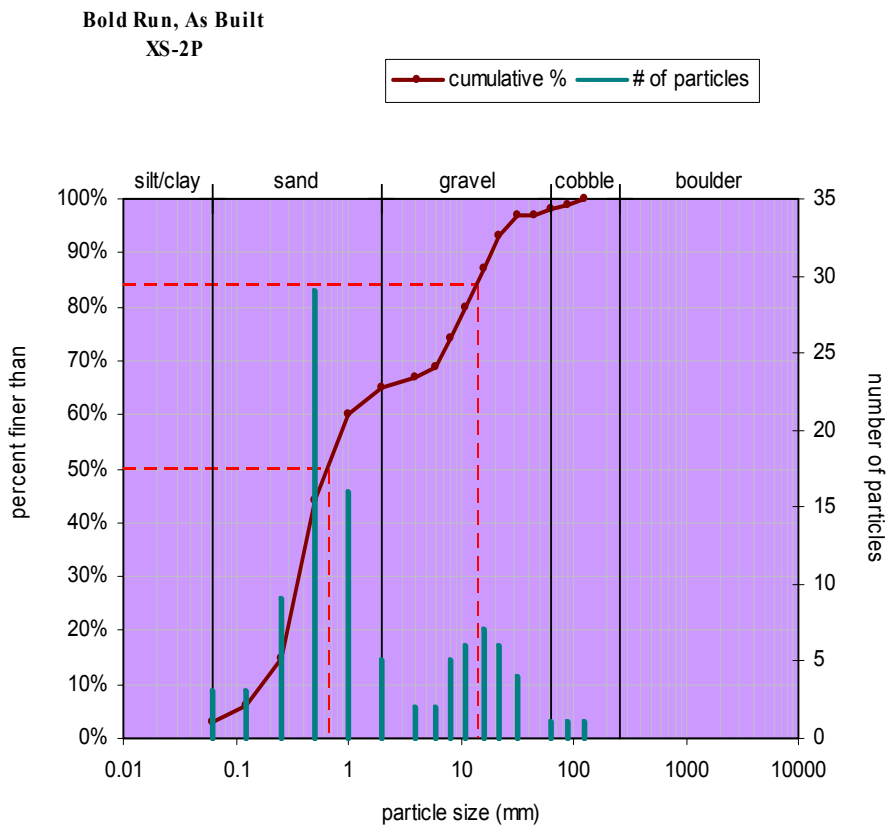
Stream Type	C4



Pool

Material	Size Range (mm)		Count
silt/clay	0 -	0.062	3
very fine sand	0.062 -	0.125	3
fine sand	0.125 -	0.25	9
medium sand	0.25 -	0.5	29
coarse sand	0.5 -	1	16
very coarse sand	1 -	2	5
very fine gravel	2 -	4	2
fine gravel	4 -	6	2
fine gravel	6 -	8	5
medium gravel	8 -	11	6
medium gravel	11 -	16	7
coarse gravel	16 -	22	6
coarse gravel	22 -	32	4
very coarse gravel	32 -	45	
very coarse gravel	45 -	64	1
small cobble	64 -	90	1
medium cobble	90 -	128	1
large cobble	128 -	180	
very large cobble	180 -	256	
small boulder	256 -	362	
small boulder	362 -	512	
medium boulder	512 -	1024	
large boulder	1024 -	2048	
very large boulder	2048 -	4096	
	total particle count:		100
bedrock	----------		
clay hardpan	----------		
detritus/wood	----------		
artificial	----------		
	total count:		100

Note: XS-2 Pool



Size (mm)		
D16	0.26	3.4
D35	0.4	12
D50	0.65	17
D65	2	20
D84	14	29
D95	27	39

Size Distribution	
mean	1.9
dispersion	12.0
skewness	0.36

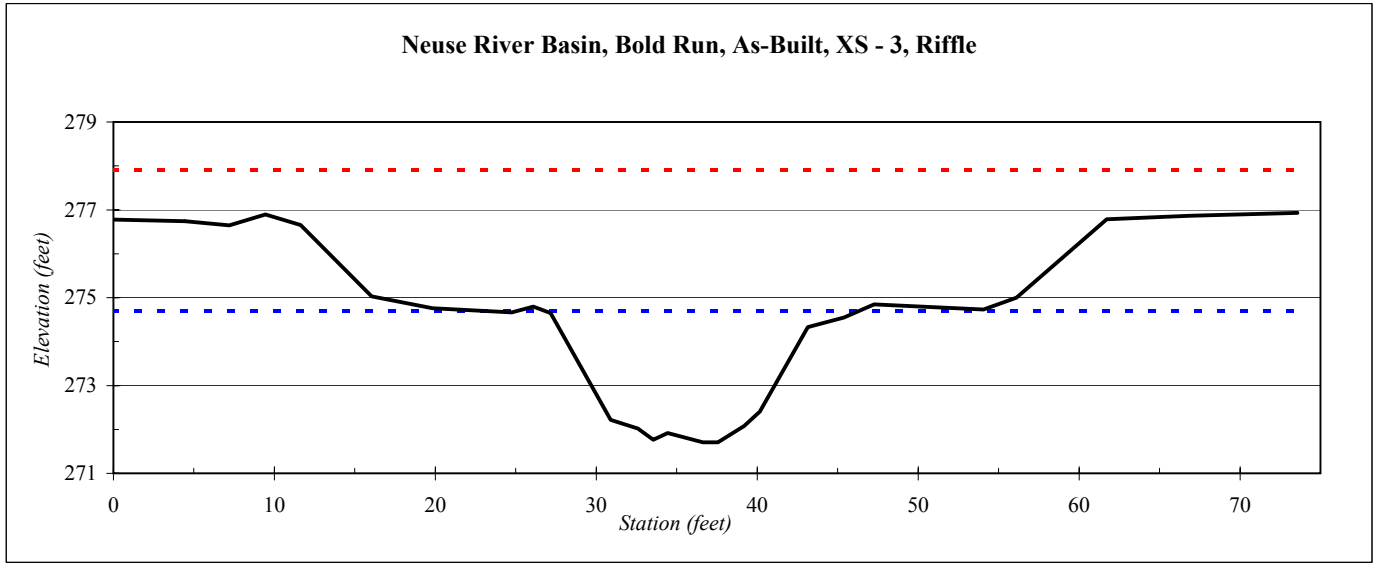
Type	
silt/clay	3%
sand	62%
gravel	33%
cobble	2%
boulder	0%

River Basin:	Neuse
Watershed:	Bold Run, As-Built
XS ID	XS - 3, Riffle
Drainage Area (sq mi):	12
Date:	3/6/2006
Field Crew:	A. Spiller, B. Roberts, H. Miller

Station	Elevation
0.00	276.8
4.43	276.7
7.19	276.6
9.45	276.9
11.63	276.7
16.04	275.0
19.82	274.8
24.76	274.7
26.08	274.8
27.15	274.7
30.90	272.2
32.58	272.0
33.54	271.8
34.43	271.9
36.63	271.7
37.56	271.7
39.18	272.1
40.17	272.4
43.14	274.3
45.39	274.6
47.27	274.8
54.06	274.7
56.12	275.0
61.72	276.8
66.91	276.9
73.6	276.9

SUMMARY DATA	
Bankfull Elevation:	274.7
Bankfull Cross-Sectional Area:	34.1
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:	>2
Bank Height Ratio:	1.1
Slope:	0.007
Discharge:	150

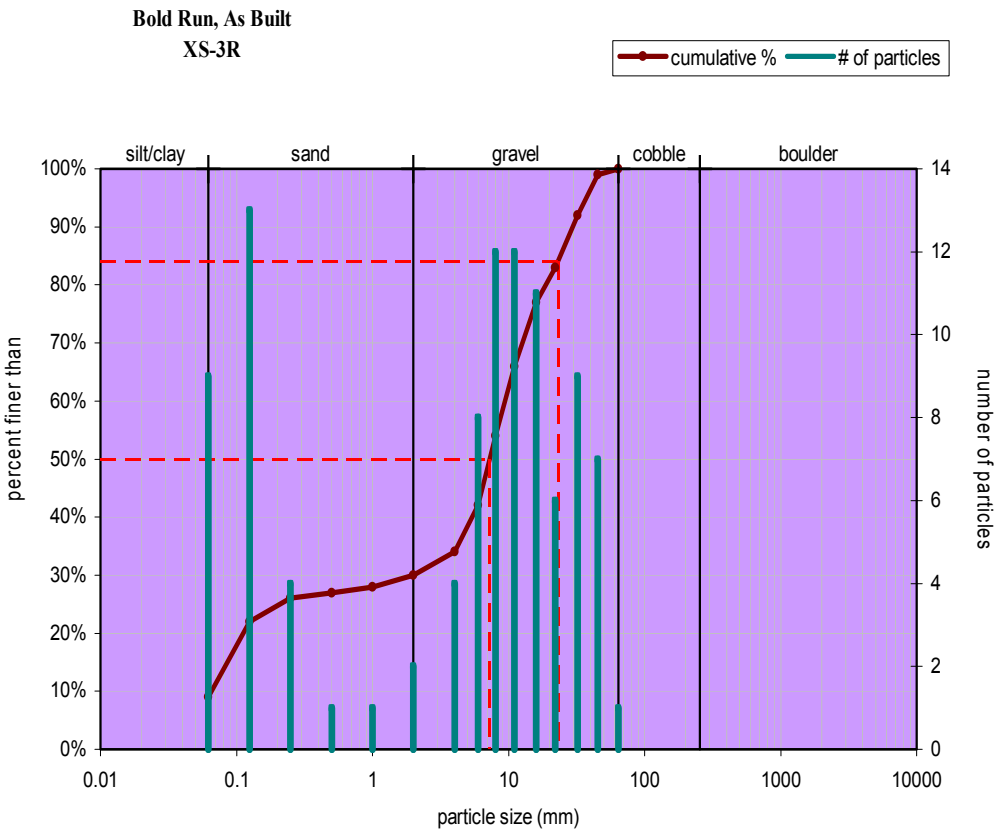
Stream Type	C4



Riffle

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	9
very fine sand	0.062 - 0.125	13
fine sand	0.125 - 0.25	4
medium sand	0.25 - 0.5	1
coarse sand	0.5 - 1	1
very coarse sand	1 - 2	2
very fine gravel	2 - 4	4
fine gravel	4 - 6	8
fine gravel	6 - 8	12
medium gravel	8 - 11	12
medium gravel	11 - 16	11
coarse gravel	16 - 22	6
coarse gravel	22 - 32	9
very coarse gravel	32 - 45	7
very coarse gravel	45 - 64	1
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
	total particle count:	100
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
	total count:	100

Note: XS-3 Riffle



Size (mm)	
D16	0.09
D35	4.2
D50	7.3
D65	11
D84	23
D95	37

Size Distribution	
mean	1.4
dispersion	42.1
skewness	-0.45

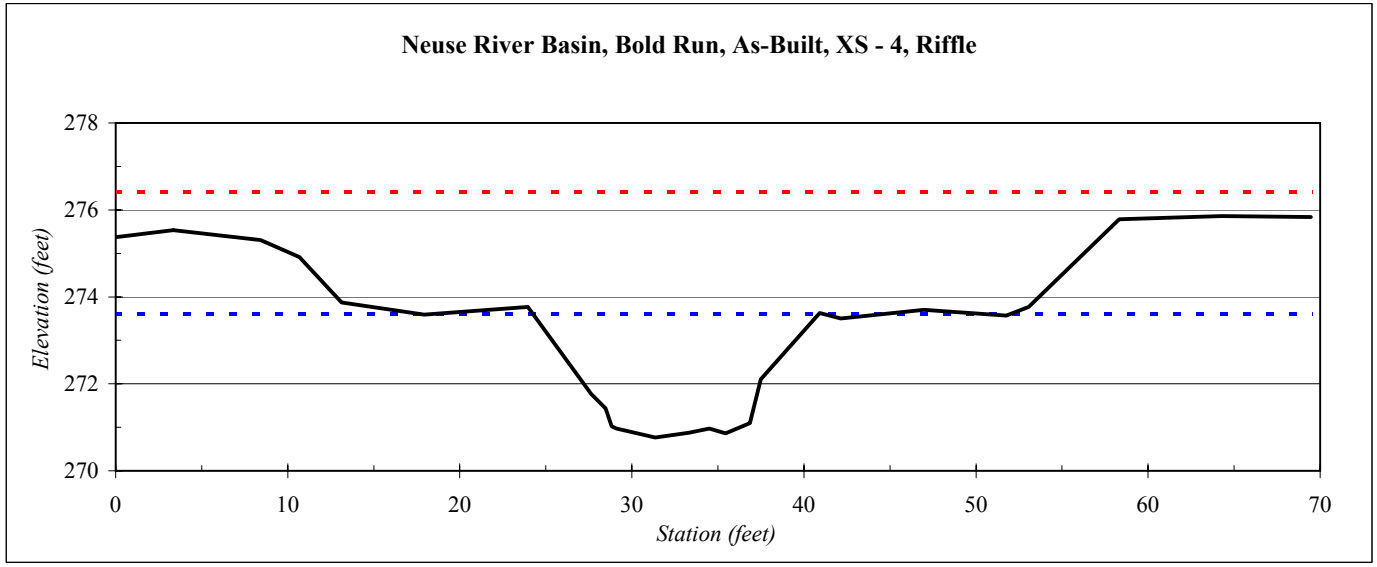
Type	
silt/clay	9%
sand	21%
gravel	70%
cobble	0%
boulder	0%

River Basin:	Neuse
Watershed:	Bold Run, As-Built
XS ID	XS - 4, Riffle
Drainage Area (sq mi):	12
Date:	3/7/2007
Field Crew:	A. Spiller, K. Knight, B. Roberts

Station	Elevation
0.0	275.37
3.4	275.54
8.4	275.30
10.7	274.91
13.1	273.87
17.9	273.59
23.9	273.77
27.6	271.77
28.5	271.43
28.8	271.02
29.1	270.97
31.4	270.76
33.3	270.88
34.5	270.97
35.5	270.86
36.9	271.10
37.5	272.10
40.9	273.63
42.1	273.50
47.0	273.70
51.8	273.57
53.1	273.77
58.3	275.79
64.3	275.86
69.5	275.83

SUMMARY DATA	
Bankfull Elevation:	273.6
Bankfull Cross-Sectional Area:	31.6
Bankfull Width:	18.5
Flood Prone Area Elevation:	276.4
Flood Prone Width:	>70
Max Depth at Bankfull:	2.9
Mean Depth at Bankfull:	1.7
W / D Ratio:	10.8
Entrenchment Ratio:	>3
Bank Height Ratio:	1.0
Slope:	0.0073
Discharge:	123

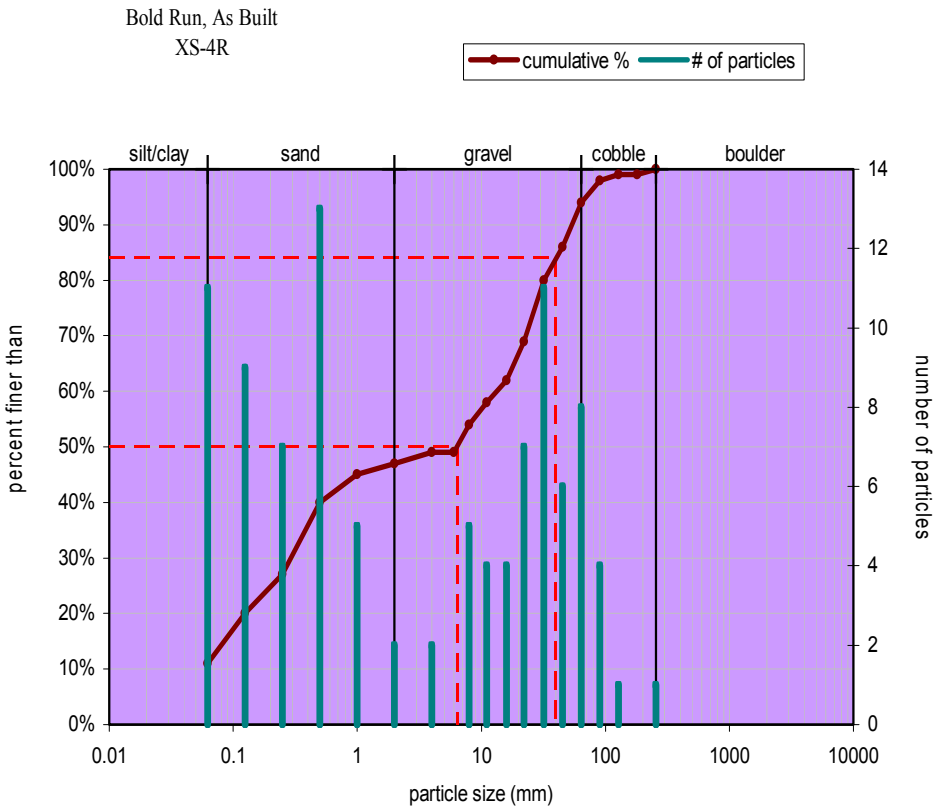
Stream Type	C4



Riffle

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	11
very fine sand	0.062 - 0.125	9
fine sand	0.125 - 0.25	7
medium sand	0.25 - 0.5	13
coarse sand	0.5 - 1	5
very coarse sand	1 - 2	2
very fine gravel	2 - 4	2
fine gravel	4 - 6	
fine gravel	6 - 8	5
medium gravel	8 - 11	4
medium gravel	11 - 16	4
coarse gravel	16 - 22	7
coarse gravel	22 - 32	11
very coarse gravel	32 - 45	6
very coarse gravel	45 - 64	8
small cobble	64 - 90	4
medium cobble	90 - 128	1
large cobble	128 - 180	
very large cobble	180 - 256	1
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
	total particle count:	100
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
	total count:	100

Note: XS-4 Riffle



Size (mm)		
D16	0.092	3.4
D35	0.38	12
D50	6.4	17
D65	18	20
D84	40	29
D95	70	39

Size Distribution	
mean	1.9
dispersion	37.9
skewness	-0.32

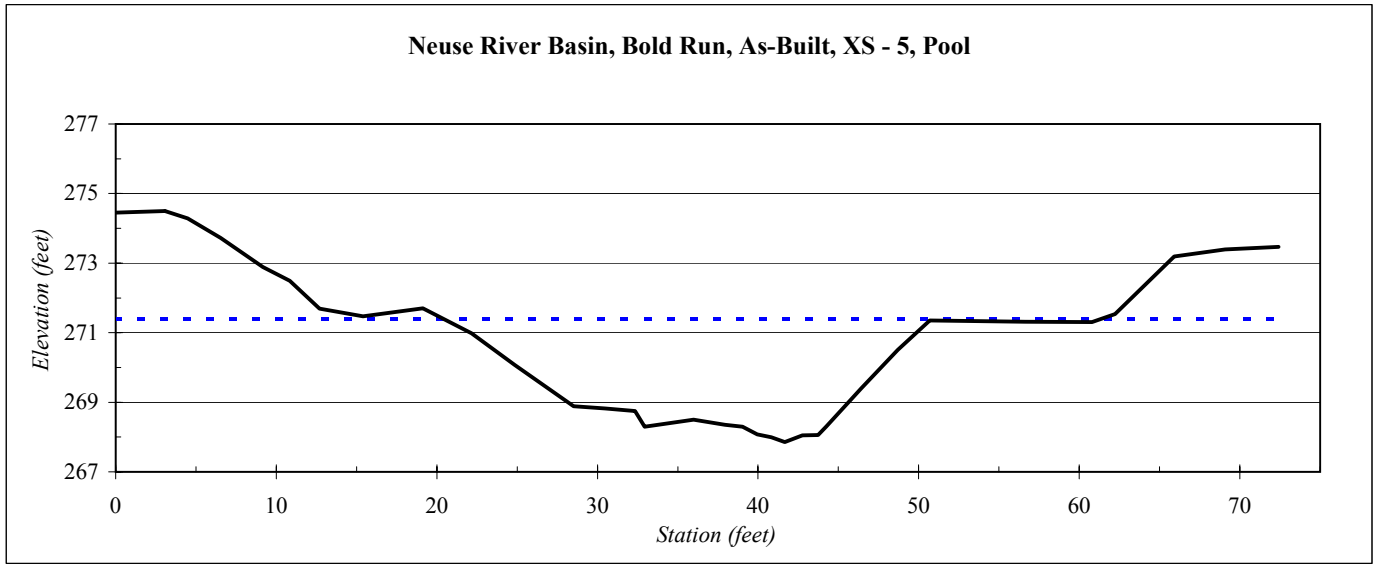
Type	
silt/clay	11%
sand	36%
gravel	47%
cobble	6%
boulder	0%

River Basin:	Neuse
Watershed:	Bold Run, As-Built
XS ID	XS - 5, Pool
Drainage Area (sq mi):	12
Date:	3/7/2007
Field Crew:	A. Spiller, K. Knight, B. Roberts

Station	Elevation
0.0	274.5
3.1	274.5
4.5	274.3
6.5	273.7
9.2	272.9
10.8	272.5
12.7	271.7
15.4	271.5
19.1	271.7
22.2	271.0
24.9	270.1
28.5	268.9
30.5	268.8
32.3	268.7
32.9	268.3
36.0	268.5
37.9	268.3
39.0	268.3
39.9	268.1
40.8	268.0
41.7	267.9
42.8	268.1
43.7	268.1
44.3	268.3
46.4	269.4
48.7	270.5
50.7	271.4
56.6	271.3
60.8	271.3
62.2	271.5
65.9	273.2
69.1	273.4
72.4	273.5

SUMMARY DATA	
Bankfull Elevation:	271.4
Bankfull Cross-Sectional Area:	65.5
Bankfull Width:	30.1
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	3.5
Mean Depth at Bankfull:	2.2
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-
Slope:	-
Discharge:	-

Stream Type	C4

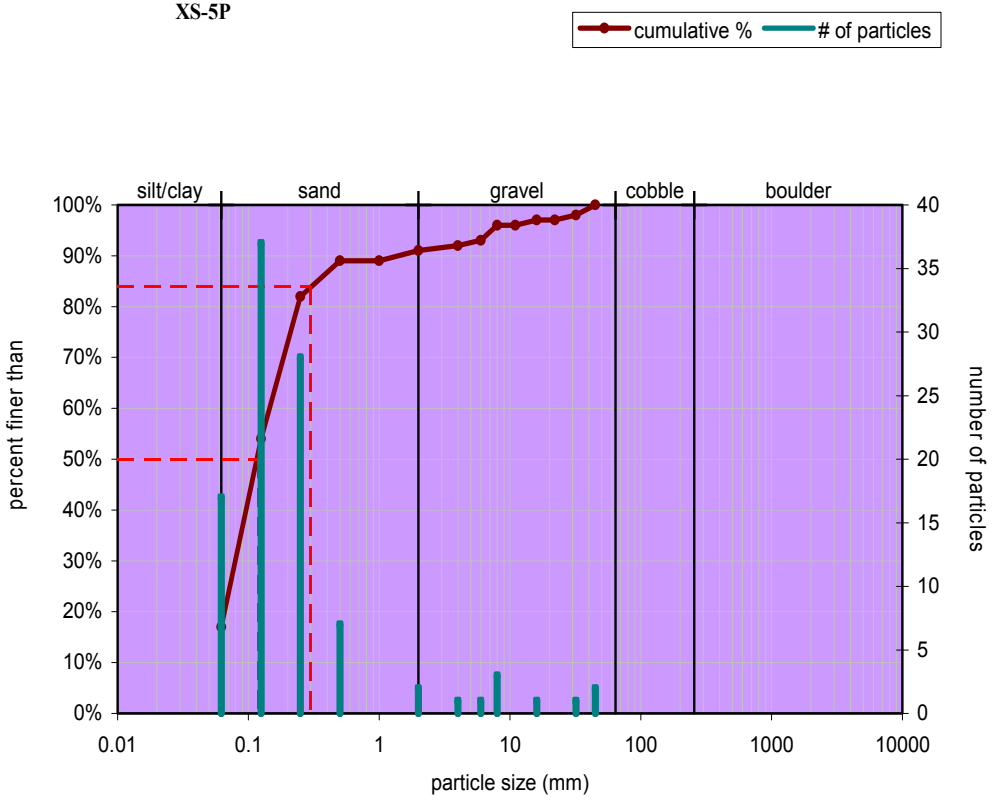


Pool

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	17
very fine sand	0.062 - 0.125	37
fine sand	0.125 - 0.25	28
medium sand	0.25 - 0.5	7
coarse sand	0.5 - 1	
very coarse sand	1 - 2	2
very fine gravel	2 - 4	1
fine gravel	4 - 6	1
fine gravel	6 - 8	3
medium gravel	8 - 11	
medium gravel	11 - 16	1
coarse gravel	16 - 22	
coarse gravel	22 - 32	1
very coarse gravel	32 - 45	2
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
	total particle count:	100
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
	total count:	100

Note: XS-5 Pool

Bold Run, As Built
XS-5P



Size (mm)	
D16	0.062
D35	0.087
D50	0.12
D65	0.16
D84	0.3
D95	7.3

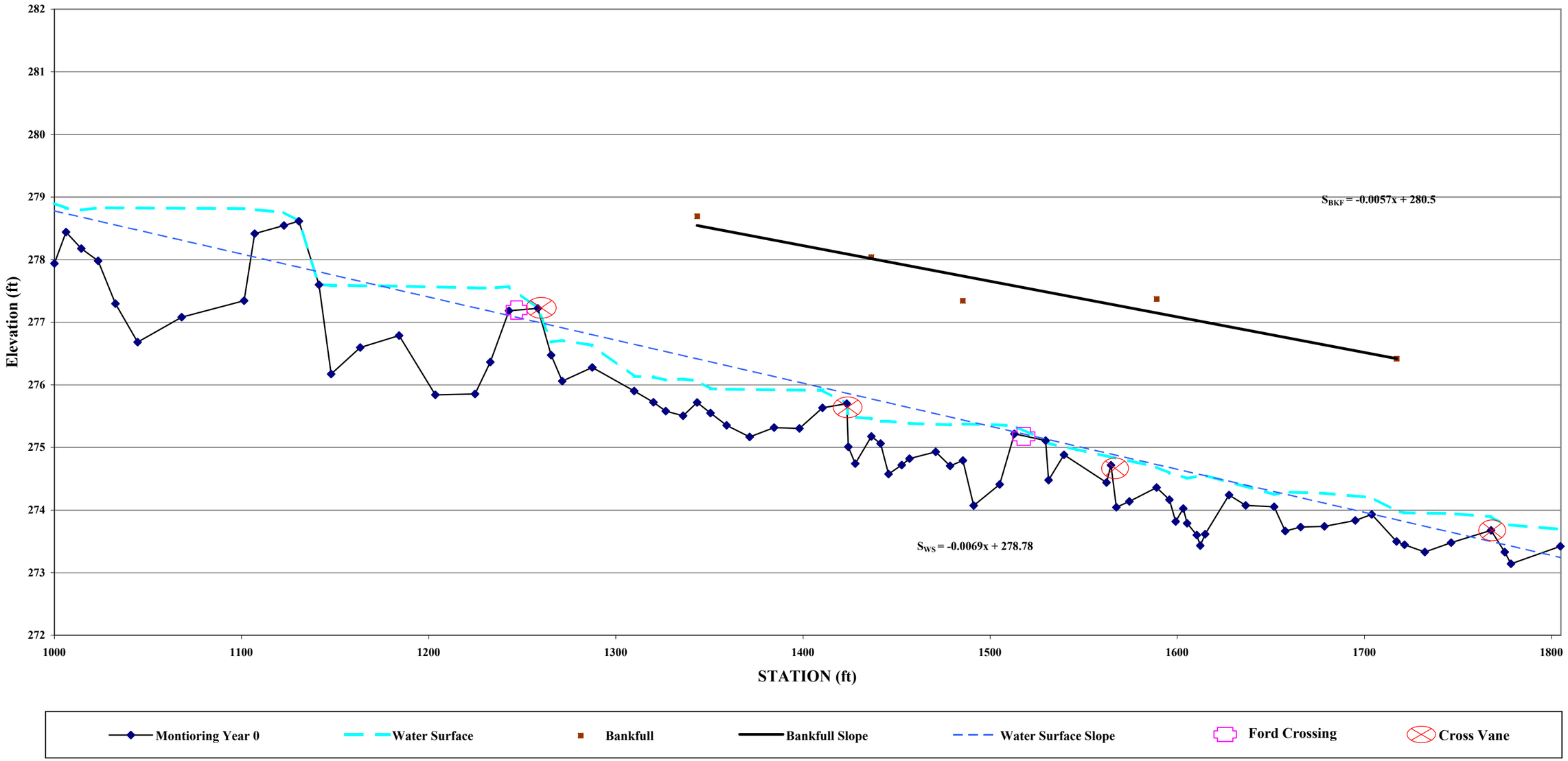
Size Distribution	
mean	0.1
dispersion	2.2
skewness	0.07

Type	
silt/clay	17%
sand	74%
gravel	9%
cobble	0%
boulder	0%

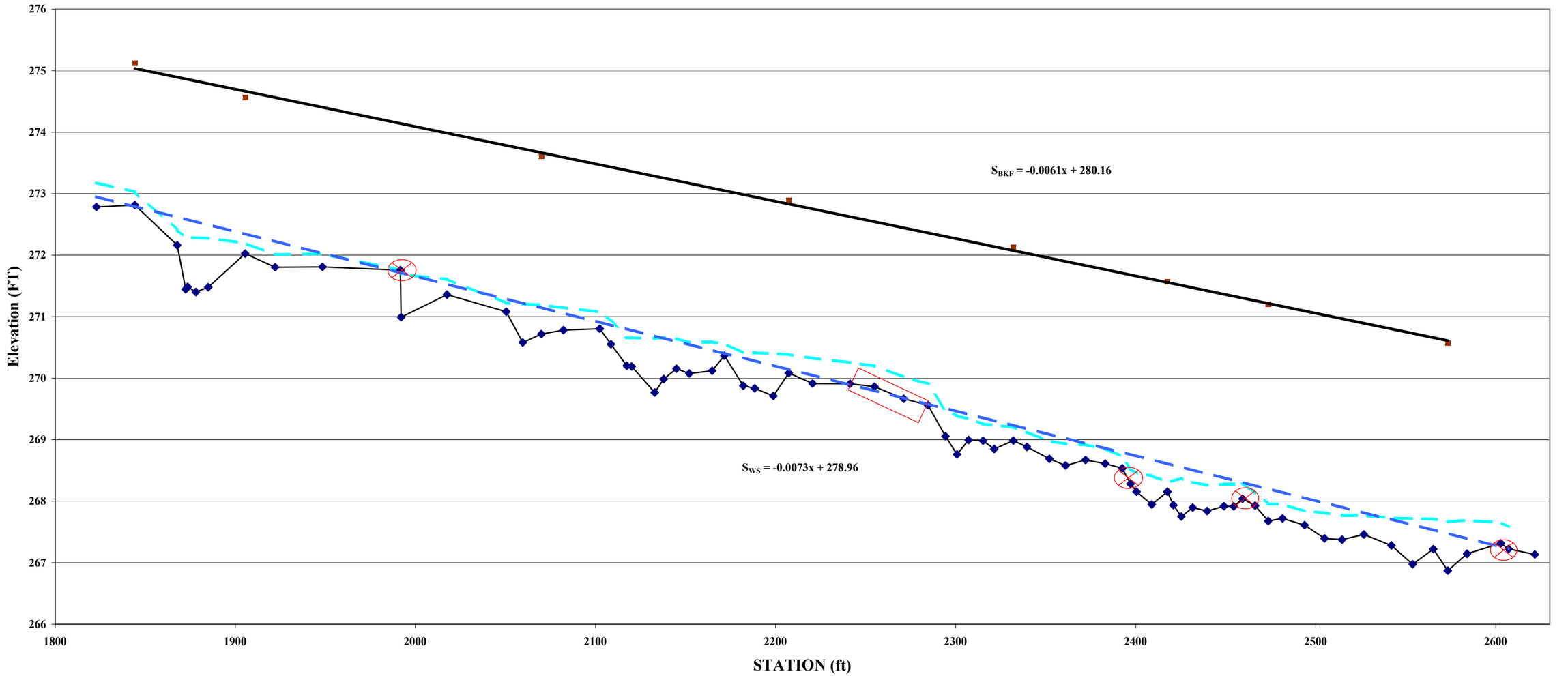
Appendix D

Detailed Profile

Longitudinal Profile
Bold Run Creek
EEP Project Number 439 As-Built
Stations 10+00 - 18+00



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



Appendix E

Permanent Photo Station Photos

Photo Point 1: View looking west, near station 11+00. 3/9/07 – As-Built

Photo Point 2: View looking west, toward vegetation plot #1. 3/9/07 – As-Built

Photo Point 3a: View looking south, toward vegetation plot #2. 3/9/07 – As-Built

Photo Point 3b: View looking west, toward vegetation plot #5. 3/9/07 – As-Built

Photo Point 3c: View looking west, toward vegetation plot #8. 3/9/07 – As-Built

Photo Point 3d: View looking north, with vegetation plot #6 in the foreground. 3/9/07 – As-Built

Photo Point 4a: View looking west, toward vegetation plot #5. 3/9/07 – As-Built

Photo Point 4b: View looking north, with vegetation plot #4 on the left. 3/9/07 – As-Built

Photo Point 4c: View looking east, with vegetation plot #3 on the right. 3/9/07 – As-Built

Photo Point 5a: View looking northeast, toward buffer area. 3/9/07 – As-Built

Photo Point 5b: View looking east, toward vegetation plot #5. 3/9/07 – As-Built

Photo Point 6a: View looking southwest. 3/9/07 – As-Built

Photo Point 6b: View looking southeast. 2/5/07 – As-Built