Baseline Monitoring Report
McCain Stream Restoration Site - Project # 443
Randolph County

Submitted to:

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EXECUTIVE SUMMARY

The McCain Stream Restoration Site restored a total of 2,470 linear feet of stream in the Lower Yadkin River Basin. The goals of the project are to: restore a stable channel morphology to the project stream that is capable of moving the flows and sediment provided by its watershed; restore riparian buffer habitat and functions; improve water quality to the receiving watershed by reducing bank erosion and bed degradation; and improve aquatic habitat. In order to achieve these goals, the project objectives included building an appropriate C4 channel with stable channel dimensions; planting a functional Bottomland Hardwood Forest community; and excluding livestock from the riparian area.

The project site is situated in Randolph County in the Piedmont physiographic province of North Carolina and is in the Carolina Slate Belt ecoregion. The site is located on the McCain farm, which is used for livestock feeding and grazing. The stream valley is primarily cleared and contains several small ephemeral channels that drain the surrounding valley. The project stream is an Unnamed Tributary to Back Creek (UTBC). From the confluence with UTBC, Back Creek flows approximately one mile to Lake Lucas / Back Creek Reservoir. Before the restoration project, the stream was heavily impacted by cattle and contained no riparian buffer. Even though most of the project was not highly incised, the pre-project stream suffered from substantial erosion as the stream was laterally unstable.

The stream restoration utilized a Priority Level 2 approach. Two reference reaches were used in the design process, with one of them being a reach of UTBC on an adjacent property and the other one located in Moore County. The stream design separated UTBC into four reaches based on slope changes across the site. Reaches 2, 3, and 4 have very similar as-built conditions and have been combined for monitoring purposes. A bankfull bench/floodplain was constructed along all of the reaches, creating a B4c channel at the top of the site and a C4 channel throughout the rest of the project. Rock cross-vanes were built to stabilize pools and provide grade control to the new channel. The unvegetated parts of the easement were planted with bare root trees and shrubs and live stakes were planted along the stream banks. A cattle exclusion fence keeps cattle out of the newly restored stream. An easement exception due to an overhead utility line bisects the middle of the stream and will be maintained by Randolph Electric Membership Corporation. The stream restoration was built as designed and, with the exception of a few species substitutions, the riparian area was planted as designed as well.

The baseline monitoring in May 2009 established the stream and vegetation monitoring components. The stream monitoring consists of a full survey of the longitudinal profile and six cross-sections, four in riffles and two in pools. Seven vegetation monitoring plots were established throughout the planted riparian buffer. These plots will be monitored every year according to the latest CVS-EEP vegetation monitoring protocol. The site will be monitored for at least five years or until the success criteria are met. The first year of monitoring will be in 2009.

1.0 Project Goals, Background and Attributes

1.1 Location and Setting

The McCain Stream Restoration site is located on a 71-acre parcel located approximately one mile southeast of the intersection of Lake Lucas Road (SR 1518) and Spero Road (SR1504) in Randolph County, North Carolina. The property is an active livestock farm, and is surrounded by a mix of hardwood forests, row crops, and other livestock operations. See Figure 1 Vicinity Map in Appendix A.

1.2 Project Goals and Objectives

Project Goals:

- Restore a stable channel morphology that is capable of moving the flows and sediment provided by its watershed.
- Restore riparian buffer habitat and functions.
- Improve water quality to the receiving watershed by reducing bank erosion and bed degradation.
- Improve aquatic habitat.

Project Objectives:

- Build an appropriate C4 channel with stable channel dimensions.
- Plant a functional Bottomland Hardwood Forest community to create an effective riparian buffer.
- Exclude livestock from the riparian areas.

1.3 Project Structure, Restoration Type and Approach

The pre-restoration stream was highly impacted by cattle. There was poor definition to the streambed features and many of the banks were actively eroding. The riparian buffer was in poor condition. There were isolated trees along the stream however, most of the buffer was used as pasture. The completed project has greater than 50 feet of buffer between the stream and the conservation easement boundary throughout most of the project. Some mature forest is included in the easement on the edges of the project. The conservation easement has one easement exception through the middle of the project where there is a utility line crossing. The 2,470-foot project stream has been divided into four reaches. These reaches were separated during the design phase based on differences in slope and the gradually increasing drainage area. For future monitoring the stream has been separated into two reaches. The reaches were restored to B4c and C4 type streams based on a Priority Level 2 approach. The stream's planform, dimension, and profile were all changed for this restoration. See Table 1 for the reach station breaks.

1.4 Project History, Contacts and Attribute Data

The project was initiated by the North Carolina Department of Transportation in April 2003. In that same year, a feasibility study was conducted for the site. After the feasibility study was completed, the site was transferred to the EEP and the restoration plan was produced. Construction began in late October 2008 and was completed in March 2009, with planting taking place in the same month.

The project stream, UT to Back Creek, is a tributary to Back Creek, which drains to Back Creek Lake. The site is in the Lower Yadkin watershed (8-digit HUC – 03040103) in the

Piedmont physiographic province. The 0.88 square mile watershed is predominately forested with some row crops and pastures.

2.0 Success Criteria

2.1 Dimension

The dimensional data from the yearly cross-section survey should show minimal change over the course of the monitoring period. However, some change is natural and expected, indicating that the site is becoming more stable. Changes that may indicate destabilizing conditions include significant widening or deepening of the riffle section or a consistent trend of change over the course of the monitoring. For a pool cross-section, deepening is frequently a positive change while consistent filling of the pool may indicate destabilization.

2.2 Pattern and Profile

For the profile, the reach under assessment should not demonstrate any trends in thalweg aggradation or degradation over any significant continuous portion of its length. The profile should also demonstrate contrasting bedform diversity against the pre-existing condition. Bedform distributions, riffle/pool lengths and slopes will vary, but should do so around design distributions. The majority of pools should be maintained at greater depths with lower water surface slopes while riffles should be shallow with greater water surface slopes. Pattern features should show little adjustment over the monitoring period.

2.3 Substrate

Substrate measurements should indicate the progression towards, or the maintenance of, the known distributions from the design phase. While stream projects are designed to transport bedload in equilibrium and carry overall sediment loads at bankfull, fines can be transported even at low discharges and upstream instability beyond design projections can also lead to deposition as storm events recede in areas of energy dissipation such as restoration reaches. This can have the effect of obscuring bedform and fining of riffles especially in the first few years after the implementation of a stream project. In many cases subsequent narrowing and reduction of W/D ratios as a project develops/stabilizes can then increase transport efficiency and return bedform to intended distributions, but some fining can persist due to upstream disturbance.

2.4 Sediment Transport

Maintenance of sediment transport will be evident by the monitored cross-sections and profile. From these two indicators there should be no evidence of any significant trend in aggradation or degradation throughout the channel.

2.5 Vegetation

Vegetation success is based on the criteria established in the USACE Stream Mitgation Guidelines (2003). This document states that vegetation monitoring results indicate the following planted stem density minimums in the corresponding monitoring years: 320 stems/acre through year three, 288 stems/acre in year four, and 260 stems/acre in year five.

2.6 Hydrology

A minimum of two bankfull events, occurring in separate years, must be documented within the monitoring period.

3.0 Monitoring Plan

3.1 Dimension

Six permanent monitoring cross-sections have been established on the site. One riffle cross-section has been established in Reach 1 and the rest are spread throughout Reach 2. Permanent monuments of rebar in concrete have been established at each end of these cross-sections. These cross-sections will be surveyed each year, with measurements occurring at bankfull, top of bank, edge of water, and other significant breaks in slope.

3.2 Profile

The entire profile of the restored stream will be surveyed each monitoring year. The profile will be surveyed in detail, documenting the elevations of the thalweg, water surface, and bankfull. Pool and riffle features will be called out to calculate feature slopes and lengths.

3.3 Pattern

Pattern measurements have been taken for the as-built condition and are documented in this report. Future pattern measurements will not be taken unless there is evidence that significant geomorphological adjustments have occurred.

3.4 Visual Assessment

A visual assessment of the stream, to include an assessment of bank (lateral stability), bed (vertical stability), the easement boundary, and site vegetation will be completed each year to document the necessary parameters required for the EEP monitoring report.

3.5 Vegetation

Seven vegetation plots were set up and assessed for the baseline vegetation monitoring. Vegetation data collection must follow the CVS-EEP Protocol for Recording Vegetation (Lee et al. 2006, http://cvs.bio.unc.edu/methods.htm). The baseline vegetation monitoring was conducted as a Level 1: Inventory of Planted Stems, as will the first year monitoring. Beginning in year two and continuing throughout the rest of the monitoring period, the site will be monitored using the Level 2 protocol.

3.6 Digital Photos

Ten permanent photo stations have been established as part of the baseline monitoring. Five of these photo stations have two photos assigned to them, so there will be a total of 20 photos taken from these photo stations. Starting in the first monitoring year, these photos will be taken in late October / early November, so that vegetative conditions are similar at the site between monitoring years.

3.7 Watershed Conditions

Yearly monitoring will document any evident changes in the watershed. Any large hydrologic events in the watershed, such as tropical storms or hurricanes, will also be documented in the yearly monitoring reports.

4.0 Baseline Conditions

A detailed baseline survey was conducted post-construction by KCI in May 2009. This survey and site evaluation found that the site was built as designed, with the exceptions noted on the record drawings. The baseline survey revealed that the cross-sections were built slightly larger than designed. The difference between the design and the as-built cross-sections is minimal and is not expected to lead to future problems or instability.

To verify that the differences between the baseline and design conditions are minor and are not expected to cause problems, the largest particle size capable of being moved by the stream were calculated for each reach. Using Shields' equation, it was determined that Reach 1 and 2 could move particles 34mm and 44mm, respectively. This reveals that the stream is capable of moving the particles that are currently in the channel. It is expected that gravel from upstream sources will continue to wash into the streams riffles and create a balanced sediment transport regime.

After the baseline monitoring was completed in May 2009, a large rain event occurred during the week of June 15th. The rain event exceeded two inches and flooded the entire site. A site visit was conducted on June 18th to document the site conditions. At the upstream end of the site, the storm pulled up four wooden posts and the fence crossing the stream. Near Stations 13+25 and 15+90, small headcuts developed in parts of the riffles, but they are being partially stabilized by weathered bedrock. Two other small headcuts have begun around Stations 19+00 and 25+25. At the rock ford crossing/emergency cattle access at Station 24+00 and at the end of the project, the fence crossing the stream was knocked down and is covered with debris. Particular attention will be paid to these riffles during monitoring and the fence will be repaired in the future.

There were some species from the designed planting plan that were unavailable at the time of planting and approved substitutions were made. These changes included substituting willow oak (*Quercus phellos*) for the two elm species (*Ulmus spp.*), persimmon (*Diospyros virginiana*) for spicebush (*Lindera benzoin*), and American beautyberry (*Callicarpa americana*) for the witch hazel (*Hamemelis virginiana*). Other than these changes, the site was planted per the designed planting plan.

5.0 Maintenance and Contingency Plans

Problem areas at the McCain site will be dealt with accordingly based on the severity of the problem and at the discretion of the EEP. 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.

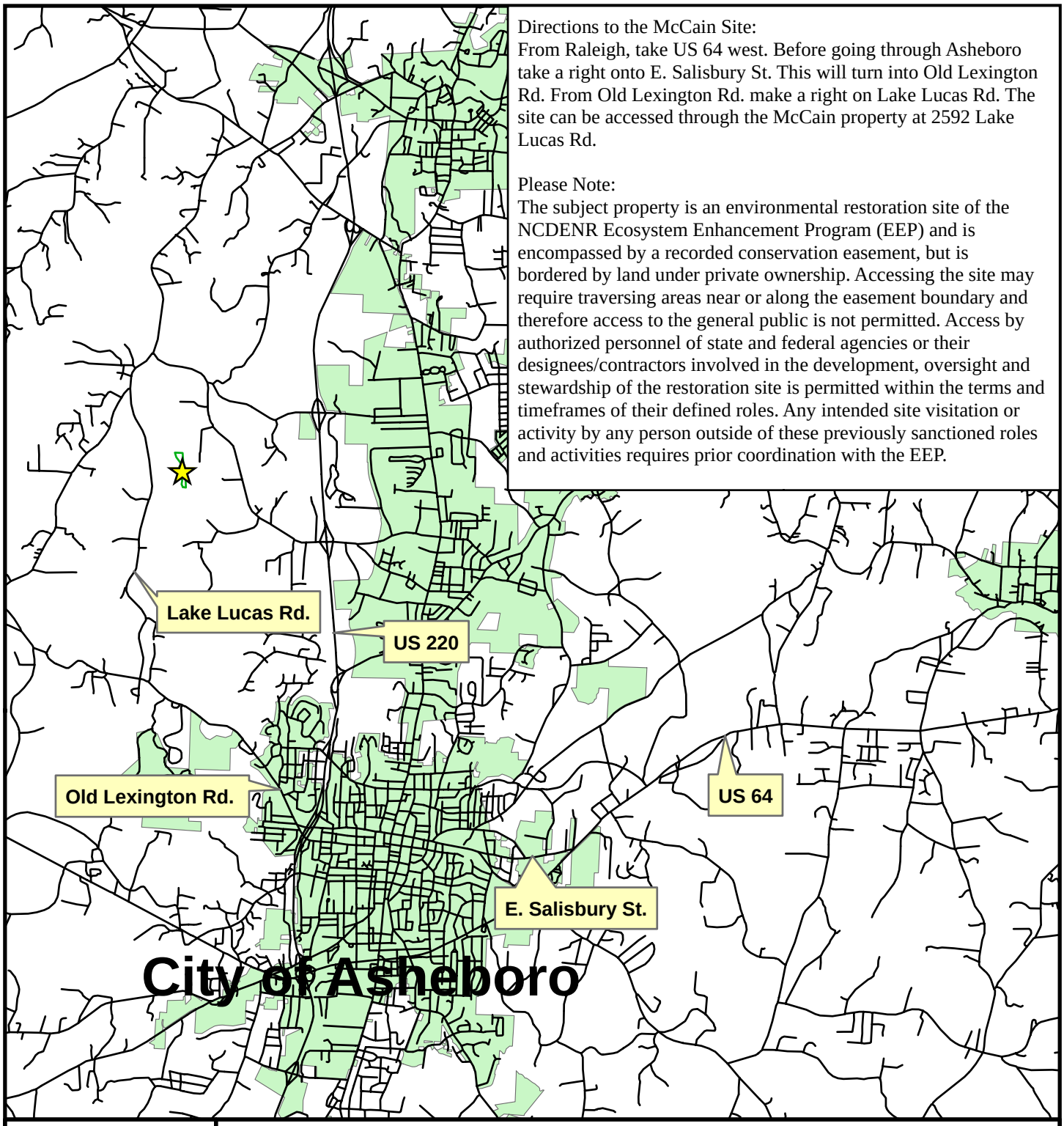
6.0 References

Lee, Michael T., R.K. Peet, S.D. Roberts, and T.R. Wentworth, 2006. CVS-EEP Protocol for Recording Vegetation, Version 4.0 (http://cvs.bio.unc.edu/methods.htm)

USACOE (2003) *Stream Mitigation Guidelines*. USACOE, NCDENR-DWQ, USEPA, NCWRC.

APPENDIX A

General Figures and Tables



Directions to the McCain Site:
From Raleigh, take US 64 west. Before going through Asheboro take a right onto E. Salisbury St. This will turn into Old Lexington Rd. From Old Lexington Rd. make a right on Lake Lucas Rd. The site can be accessed through the McCain property at 2592 Lake Lucas Rd.

Please Note:
The subject property is an environmental restoration site of the NCDENR Ecosystem Enhancement Program (EEP) and is encompassed by a recorded conservation easement, but is bordered by land under private ownership. Accessing the site may require traversing areas near or along the easement boundary and therefore access to the general public is not permitted. Access by authorized personnel of state and federal agencies or their designees/contractors involved in the development, oversight and stewardship of the restoration site is permitted within the terms and timeframes of their defined roles. Any intended site visitation or activity by any person outside of these previously sanctioned roles and activities requires prior coordination with the EEP.

Figure 1. Vicinity Map

Ecosystem Enhancement Program

★ Project Site

N
W E
S

1 inch equals 1.5 miles

3 1.5 0 3
Miles

Figure 2. Site Map

Designed Top of Bank

Designed Thalweg - Reach 1

Designed Thalweg - Reach 2

Access Easement Boundary

Conservation Easement Boundary

N

W E

S

1:2,400

1 inch = 200 feet

200 100 0 200

Feet

Ecosystem Enhancement PROGRAM

Table 1. Project Restoration Components
Project Name and Number: McCain - 443

Project Segment / Reach ID	Existing Footage	Restoration Level	Approach	Project Footage	Stationing	Mitigation Ratio	Mitigation Units	Comment
Reach 1	490	R	P2	286	10+00 - 12+86	1:1	286	Stream was realigned and two cross vanes were installed.
Reach 2	1,955	R	P2	2,184	12+87 - 34+70	1:1	2,131	Stream was realigned and six cross vanes were installed. A 53' length of channel through an easement exception has been excluded from the mitigation unit calculation.

Component Summations

Restoration Level	Riparian Wetland (Ac)	Nonriparian Wetland (Ac)	Buffer (Ac)	Stream (lf)	Comment
Restoration	0	0	0	2,417	

R = Restoration P2 = Priority 2

Table 2. Project Activity and Reporting History
Project Name and Number: McCain - 443

Activity or Report	Data Collection	Completion or Delivery
Restoration Plan	2003/2004	Jun 05
Final Design - Construction Plans	N/A	May 06
Construction	N/A	Mar 09
Temporary seed mix applied to entire project area	N/A	Mar 09
Permanent seed mix applied to reach/segments1-4	N/A	Mar 09
Mitigation Plan / As-Built (Year 0 Monitoring - Baseline)	May 09	Jan 10
Year 1 Monitoring		
Year 2 Monitoring		
Year 3 Monitoring		
Year 4 Monitoring		
Year 5 Monitoring		
Closeout		

Table 3. Project Contact Table Project Name and Number: McCain - 443	
Design Firm	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
Construction Contractor	Carolina Environmental Contracting, Inc. PO Box 1905 Mount Airy, NC 27030 Contact: Mr. Stephen James Phone: (336) 320-3849 Fax: (336) 320-3854
Planting Contractor	Carolina Environmental Contracting, Inc. PO Box 1905 Mount Airy, NC 27030 Contact: Mr. Stephen James Phone: (336) 320-3849 Fax: (336) 320-3854
Nursery Stock Suppliers	Viginia Department of Forestry PO Box 160 Crimora, VA 24431 Phone: (504) 363-5732
Monitoring Performers	
MY-00	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 Attribute Table Project Name and Number: McCain - 443		
Project County	Randolph County	
Physiographic Region	Piedmont	
Ecoregion	Carolina Slate Belt	
Project River Basin	Yadkin	
USGS HUC for Project (14 digit)	03040103050050	
NCDWQ Sub-basin for Project	03-07-09	
Within extent of EEP Watershed Plan?	No	
WRC Class (Warm, Cool, Cold)	Warm	
% of project easement fenced or demarcated	100%	
Beaver activity observed during design phase?	No	
Restoration Component Attribute Table		
	Reach 1	Reach 2
Drainage Area	0.88 sq.mi.	0.88 sq.mi.
Stream Order	First	First
Restored length (feet)	286	2,184
Perennial or Intermittent	Perennial	Perennial
Watershed Type (Rural, Urban, Developing, etc.)	Rural	
Watershed LULC Distribution (e.g.)		
Urban	4%	
Ag-Row Crop	16%	
Ag-Livestock	12%	
Forested	67%	
Water/Wetlands	<1%	
Watershed impervious cover (%)	2%	
NCDWQ AU/Index Number	13-2-3-3 (UT Back Creek)	
NCDWQ Classification	C	
303d listed?	No	
Upstream of a 303d listed segment?	No	
Reasons for 303d Listing or Stressor	N/A	
Total acreage of easement	12.9 Acres	
Total vegetated acreage within the easement	4.8 Acres	
Total planted acreage as part of the restoration	7.6 Acres	
Rosgen Classification of pre-existing	B4c	C5/E5/C4
Rosgen Classification of As-built	B4c	C4
Valley Type	U	U
Valley Slope	0.0066	0.0066
Valley side slope range (e.g. 2-3%)	U	U
Valley toe slope range (e.g. 2-3%)	U	U
Trout waters designation	No	
Species of concern, endangered etc.? (Y/N)	No	
Dominant soil series and characteristics		
Series	Dogue Sandy Loam	
Depth Clay%	U	U
K	U	U
T	U	U

"N/A" is for items that do not apply.
"-" is for items that are unavailable.
"U" is for items that are unknown.

APPENDIX B

Morphological Summary Data and Plots

Table 5a. Baseline Stream Data Summary: Reach 1
Project Name and Number: McCain - 443

Parameter	Gauge	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			As-built					
Dimension and Substrate - Riffle		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Med	Max	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)					14.6	18.7	25.9	29.3		4	10.4			27.1				18.0			16.9				
Floodprone Width (ft)					34	95	125	125		3	150			200							35				
Bankfull Mean Depth (ft)					1.1	1.4	1.4	1.7		4	0.8			1.5				1.4			1.1				
Bankfull Max Depth (ft)					1.7	2.7	2.8	3.5		4	1.4			2.0				2.0			1.5				
Bankfull Cross-Sectional Area (ft^2)					21.3	25.6	25.9	29.3		4	12.5			22.3				24.6			18.6				
Width/Depth Ratio					8.3	14.0	15.0	17.6		4	11.6			18.5				13.2			15.4				
Entrenchment Ratio					1.8	5.6	6.4	8.5		3	7.4			14.4							2.1				
Bank Height Ratio					1.0	1.2	1.1	1.7		4	1.0			1.0				1.0			1.0				
d50 (mm)					0.2	7.9	4.7	22.0		4	23.0			70.0				26.0			21.0				
Profile																									
Riffle Length (ft)											9			108				58		54	63	63	72	12	2
Riffle Slope (ft/ft)											0.0100			0.0756				0.0068		0.0048	0.0059	0.0059	0.0070	0.0016	2
Pool Length (ft)											28			108				38		16	21	22	25	4	3
Pool Max Depth											1.8			3.1				3.0							
Pool Spacing (ft)											38			181				95		107	113	113	119	8	2
Pool Volume (ft^2)																									
Pattern																									
Channel Beltwidth (ft)											75			135							78				
Radius of Curvature (ft)											14.5			26.8			30		35	35	38	38	40		2
Rc:Bankfull width (ft/ft)											1.0			1.6			1.7		1.9	2.1	2.2	2.2	2.4		
Meander Wavelength (ft)											70			148				190			204				1
Meander Width Ratio											3.6			13.0							4.6				
Substrate, bed and transport parameters																									
Ri%/Ru%/P%/G%/S%																									
SC% / Sa% / G% / C% / B% / Be%																									
d16 / d35 / d50 / d84 / d95 / di^p / di^{sp} (mm)																									
Reach Shear Stress (competency) lb/ft^2																									
Max part size (mm) mobilized at bankfull																									
Stream Power (transport capacity) W/m^2																									
Additional Reach Parameters																									
Drainage Area (SM)							0.88						0.70 - 0.9									0.88			
Impervious cover estimate							2%															2%			
Rosgen Classification							B4c/E4/C4-5						B4c/C3/C4				B4c			B4c					
Bankfull Velocity (fps)													4.7 - 6.3				3.9								
Bankfull Discharge (cfs)													63 - 137				95								
Valley length (ft)							2,155															218			
Channel thalweg length (ft)							2,475										285					286			
Sinuosity							1.15						1.50 - 1.70				1.17					1.30			
Water Surface Slope (Channel) (ft/ft)													0.0070 - 0.0120				0.0067					0.0068			
BF slope (ft/ft)													0.0070 - 0.0120				0.0067					0.0065			
Bankfull Floodplain Area (acres)																									
Proportion over wide (%)																									
Entrenchment Class (ER Range)																									
Incision Class (BHR Range)																									
BEHI VL% / L% / M% / H% / VH% / E%																									
Channel Stability or Habitat Metric																									
Biological or Other																									

Data Source Notes: Pre-Existing Data – Dimension and Additional Reach Parameter data are from the entire site.
Reference Reach Data – The data are a combination from the two reference reaches used in this project.
Design Data – The data are specific to each reach.
As-Built Data – Dimension data are from the baseline monitoring riffle cross-sections in each reach. Profile and Pattern data are from the baseline monitoring longitudinal profile of each reach. The drainage area, % impervious, channel slope, and bankfull slope data are from the entire site. The valley length, channel length, and sinuosity are from each reach.

Table 5b. Baseline Stream Data Summary: Reach 2
Project Name and Number: McCain - 443

Parameter	Gauge	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			As-built					
Dimension and Substrate - Riffle		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Med	Max	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)					14.6	18.7	25.9	29.3		4	10.4			27.1			18.0	20.0	24.0	20.6	22.8	23.3	24.6	0.9	3
Floodprone Width (ft)					34	95	125	125		3	150			200						47	54	51	63	6.2	3
Bankfull Mean Depth (ft)					1.1	1.4	1.4	1.7		4	0.8			1.5			1.0	1.3	1.4	1.3	1.4	1.4	1.5	0.1	3
Bankfull Max Depth (ft)					1.7	2.7	2.8	3.5		4	1.4			2.0			1.3	1.7	2.0	1.8	1.9	1.8	2.1	0.2	3
Bankfull Cross-Sectional Area (ft^2)					21.3	25.6	25.9	29.3		4	12.5			22.3			25.0	25.5	26.0	30.8	31.9	31.2	33.7	1.3	3
Width/Depth Ratio					8.3	14.0	15.0	17.6		4	11.6			18.5			12.7	15.6	23.0	13.8	16.4	17.4	18.0	0.8	3
Entrenchment Ratio					1.8	5.6	6.4	8.5		3	7.4			14.4						2.0	2.3	2.5	2.5	0.1	3
Bank Height Ratio					1.0	1.2	1.1	1.7		4	1.0			1.0				1.0		1.0	1.0	1.0	1.0	0.0	3
d50 (mm)					0.2	7.9	4.7	22.0		4	23.0			70.0				26.0		11.0	15.7	17.0	19.0	1.7	3
Profile																									
Riffle Length (ft)											9			108			59	67	88	20	68	76	97	23	13
Riffle Slope (ft/ft)											0.0100			0.0756			0.0080	0.0080	0.0104	0.0028	0.0087	0.0075	0.0199	0.0040	13
Pool Length (ft)											28			108			47	52	59	12	22	23	33	6	13
Pool Max Depth											1.8			3.1			2.3	2.8	3.3	2.2	2.5		2.8		2
Pool Spacing (ft)											38			181			106	118	147	56	117	123	150	25	12
Pool Volume (ft^2)																									
Pattern																									
Channel Beltwidth (ft)											75			135						20	66	62	97	24	10
Radius of Curvature (ft)											14.5			26.8			35		60	35	49	43	80	14	12
Rc:Bankfull width (ft/ft)											1.0			1.6			1.8		3.1	1.5	2.2	2.2	3.3		
Meander Wavelength (ft)											70			148			212	236	294	158	221	229	261	36	10
Meander Width Ratio											3.6			13.0						1.9	3.1	2.7	4.8		
Substrate, bed and transport parameters																									
Ri%/Ru%/P%/G%/S%																									
SC% / Sa% / G% / C% / B% / Be%																									
d16 / d35 / d50 / d84 / d95 / di^p / di^{sp} (mm)																									
Reach Shear Stress (competency) lb/ft^2																									
Max part size (mm) mobilized at bankfull																									
Stream Power (transport capacity) W/m^2																									
Additional Reach Parameters																									
Drainage Area (SM)							0.88							0.70 - 0.9								0.88			
Impervious cover estimate							2%															2%			
Rosgen Classification							B4c/E4/C4-5							B4c/C3/C4			C4					C4			
Bankfull Velocity (fps)														4.7 - 6.3			3.9-4.0								
Bankfull Discharge (cfs)														63 - 137			99-101								
Valley length (ft)							2,155															1,845			
Channel thalweg length (ft)							2,475										2,162					2,182			
Sinuosity							1.15							1.50 - 1.70			1.17					1.18			
Water Surface Slope (Channel) (ft/ft)														0.0070 - 0.0120			0.0051-0.0084					0.0068		
BF slope (ft/ft)														0.0070 - 0.0120			0.0051-0.0054					0.0065		
Bankfull Floodplain Area (acres)																									
Proportion over wide (%)																									
Entrenchment Class (ER Range)																									
Incision Class (BHR Range)																									
BEHI VL% / L% / M% / H% / VH% / E%																									
Channel Stability or Habitat Metric																									
Biological or Other																									

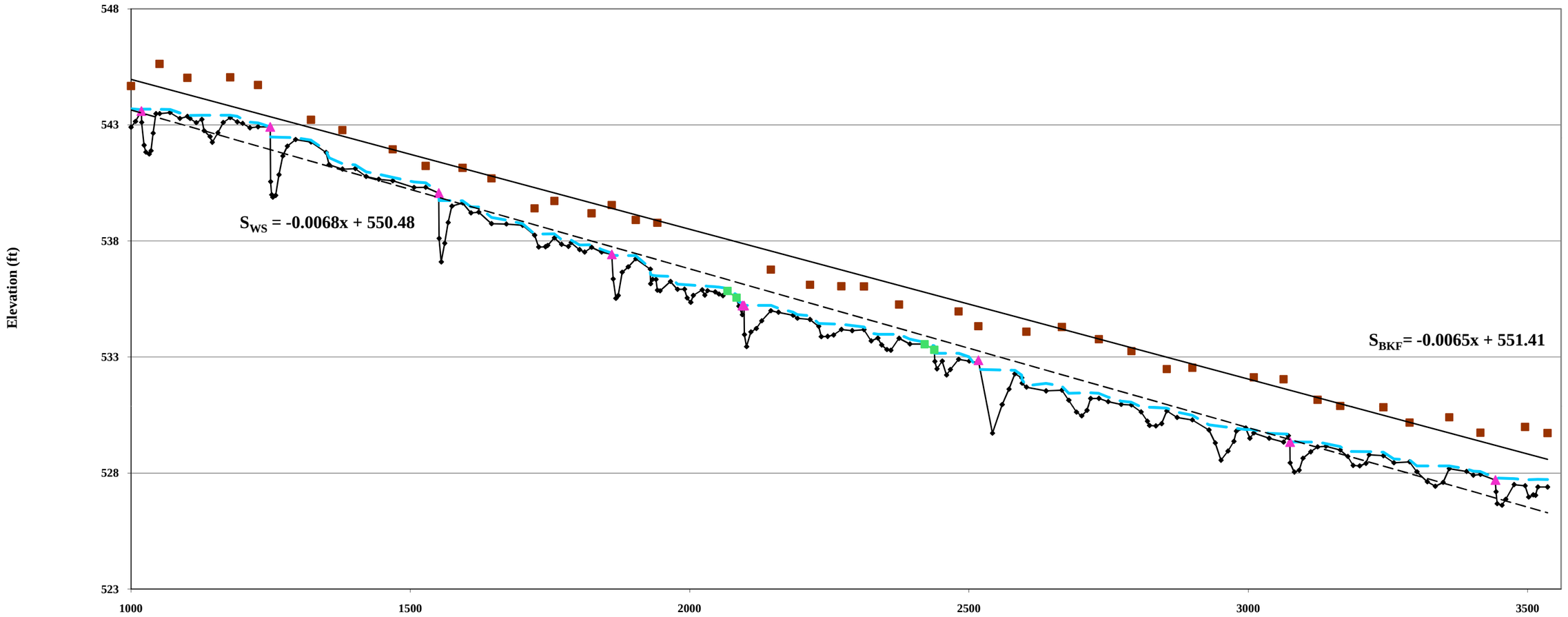
Data Source Notes: Pre-Existing Data – Dimension and Additional Reach Parameter data are from the entire site.
Reference Reach Data – The data are a combination from the two reference reaches used in this project.
Design Data – For monitoring purposes design Reaches 2-4 have been combined to create Reach 2, this column is a combination of the design data.
As-Built Data – Dimension data are from the baseline monitoring riffle cross-sections in each reach. Profile and Pattern data are from the baseline monitoring longitudinal profile of each reach. The drainage area, % impervious, channel slope, and bankfull slope data are from the entire site. The valley length, channel length, and sinuosity are from each reach.

Table 6. Morphology and Hydraulic Monitoring Summary (Dimensional Parameters - Cross-Sections)
Project Name and Number: McCain - 443

Dimension and Substrate	Cross-Section 1 (Reach 1, Riffle)							Cross-Section 2 (Reach 2, Riffle)							Cross-Section 3 (Reach 2, Pool)							Cross-Section 4 (Reach 2, Riffle)							Cross-Section 5 (Reach 2, Pool)						
Based on fixed baseline elevation	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	16.9							24.6							22.6							23.3							18.1						
Floodprone Width (ft)	35							63							-							47							-						
Bankfull Mean Depth (ft)	1.1							1.4							1.5							1.3							1.2						
Bankfull Max Depth (ft)	1.5							1.8							2.2							1.8							2.8						
Bankfull Cross-Sectional Area (ft^2)	18.6							33.7							33.6							31.2							22.2						
Bankfull Width/Depth Ratio	15.4							18.0							-							17.4							-						
Bankfull Entrenchment Ratio	2.1							2.5							-							2.0							-						
Bankfull Bank Height Ratio	1.0							1.0							-							1.0							-						
Cross-Sectional Area Between End Pins (ft^2)	174							119							97							103							146						
d50 (mm)	21.0							19.0							8.1							17.0							0.6						

	Cross-Section 6 (Reach 2, Riffle)						
Based on fixed baseline elevation	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	20.6						
Floodprone Width (ft)	51						
Bankfull Mean Depth (ft)	1.5						
Bankfull Max Depth (ft)	2.1						
Bankfull Cross-Sectional Area (ft^2)	30.8						
Bankfull Width/Depth Ratio	13.8						
Bankfull Entrenchment Ratio	2.5						
Bankfull Bank Height Ratio	1.0						
Cross-Sectional Area Between End Pins (ft^2)	133						
d50 (mm)	11.0						

Longitudinal Profile
McCain Site - Unnamed Tributary to Back Creek
EEP Project Number - 443
Station 10+00 - 35+50

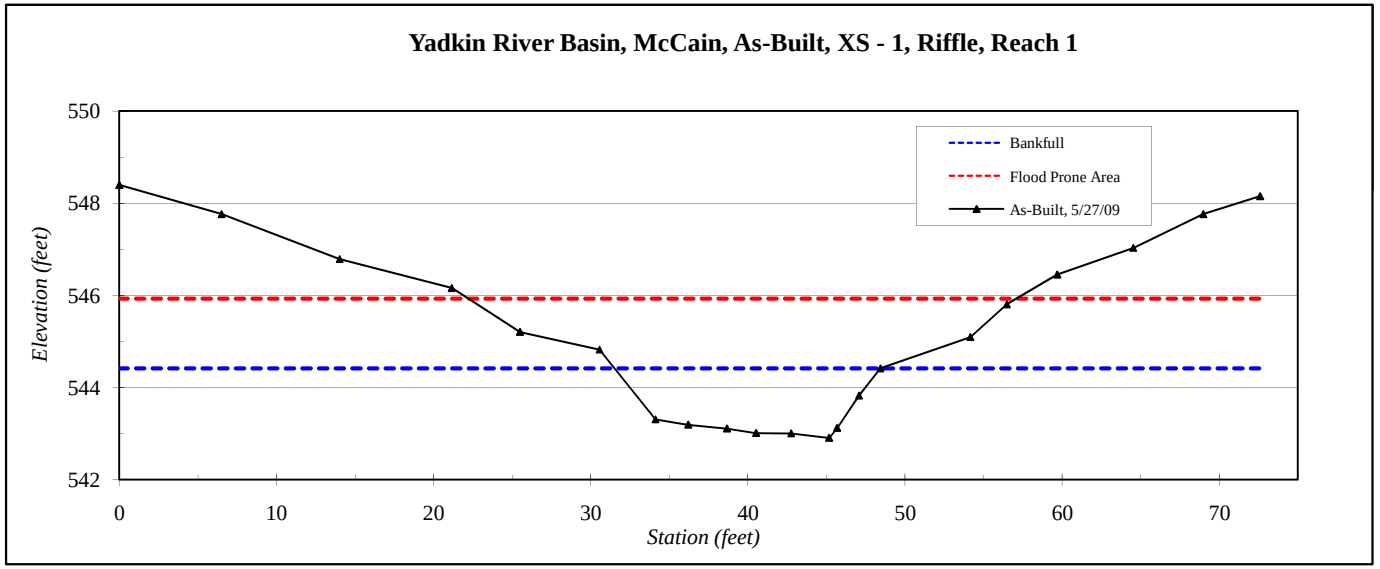


River Basin:	Yadkin
Watershed:	McCain, As-Built
XS ID	XS - 1, Riffle, Reach 1
Drainage Area (sq mi):	0.88
Date:	5/27/2009
Field Crew:	B. Roberts, C. Carter

Station	Elevation
0.0	548.39
6.5	547.76
14.0	546.79
21.1	546.16
25.5	545.21
30.6	544.82
34.1	543.31
36.2	543.19
38.7	543.11
40.5	543.01
42.8	543.01
45.2	542.91
45.7	543.12
47.1	543.83
48.4	544.42
54.2	545.10
56.5	545.81
59.7	546.45
64.5	547.03
69.0	547.76
72.6	548.15

SUMMARY DATA	
Bankfull Elevation:	544.4
Bankfull Cross-Sectional Area:	18.6
Bankfull Width:	16.9
Flood Prone Area Elevation:	545.9
Flood Prone Width:	34.9
Max Depth at Bankfull:	1.5
Mean Depth at Bankfull:	1.1
W / D Ratio:	15.4
Entrenchment Ratio:	2.1
Bank Height Ratio:	1.0

Stream Type	B4c

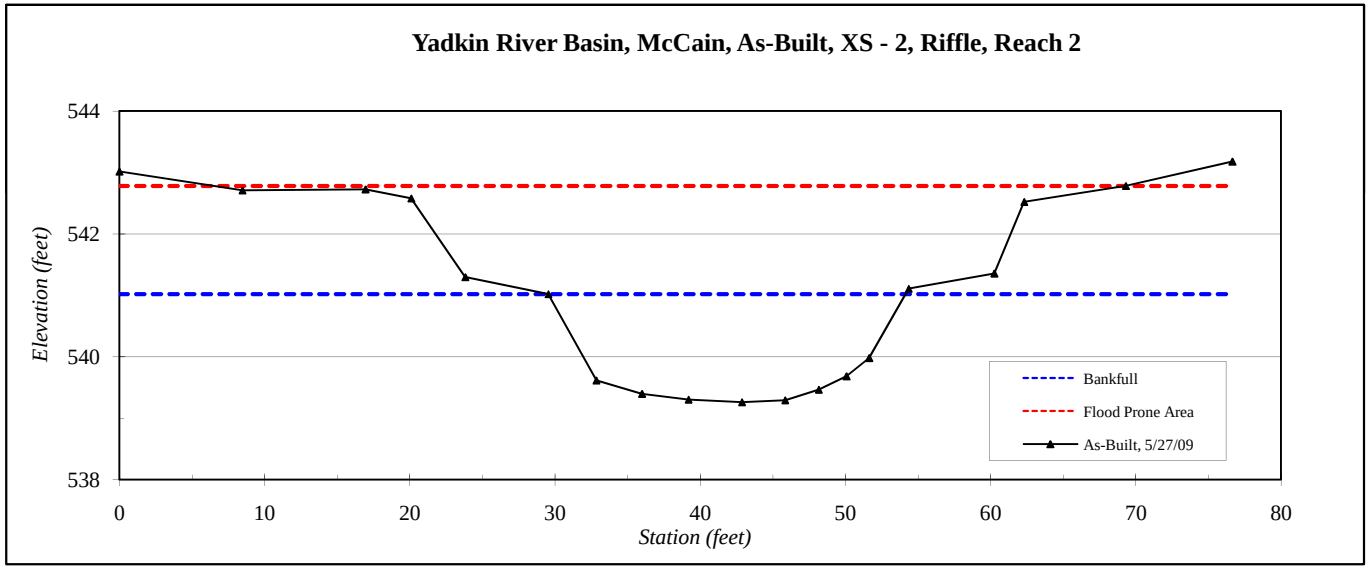


River Basin:	Yadkin
Watershed:	McCain, As-Built
XS ID	XS - 2, Riffle, Reach 2
Drainage Area (sq mi):	0.88
Date:	5/27/2009
Field Crew:	B. Roberts, C. Carter

Station	Elevation
0.0	543.01
8.5	542.71
16.9	542.73
20.1	542.57
23.8	541.30
29.5	541.02
32.9	539.61
36.0	539.40
39.2	539.30
42.9	539.26
45.9	539.29
48.2	539.47
50.1	539.68
51.6	539.98
54.4	541.11
60.3	541.36
62.3	542.52
69.3	542.78
76.7	543.18

SUMMARY DATA	
Bankfull Elevation:	541.0
Bankfull Cross-Sectional Area:	33.7
Bankfull Width:	24.6
Flood Prone Area Elevation:	542.8
Flood Prone Width:	62.7
Max Depth at Bankfull:	1.8
Mean Depth at Bankfull:	1.4
W / D Ratio:	18.0
Entrenchment Ratio:	2.5
Bank Height Ratio:	1.0

Stream Type	C4

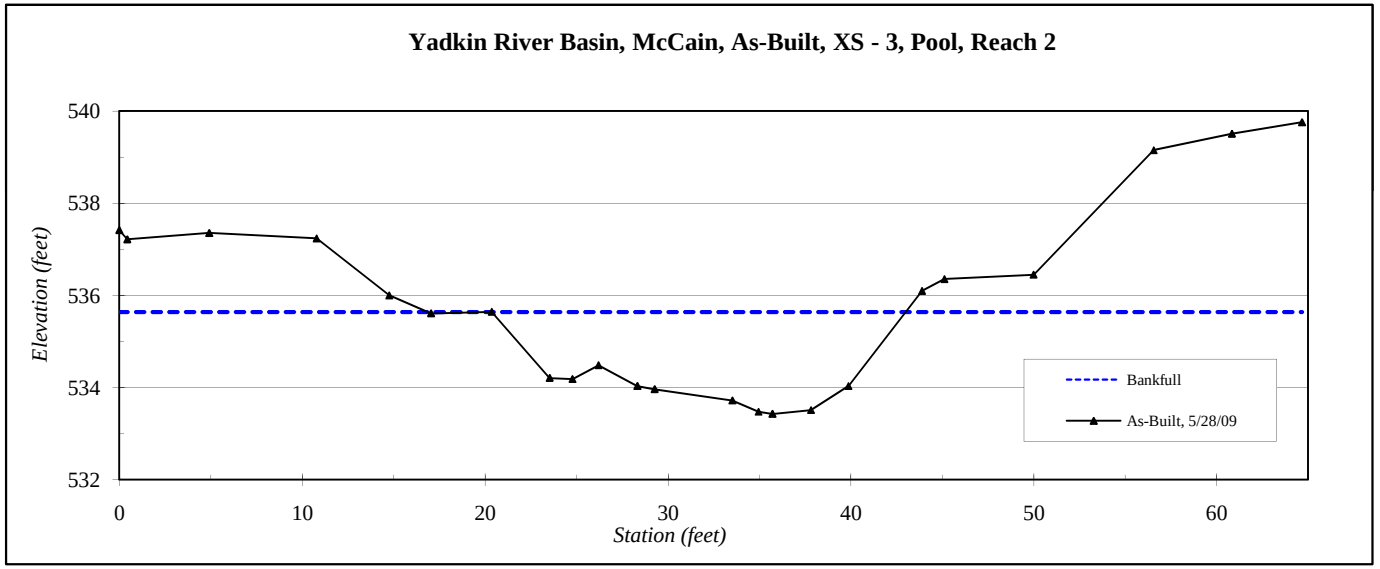


River Basin:	Yadkin
Watershed:	McCain, As-Built
XS ID	XS - 3, Pool, Reach 2
Drainage Area (sq mi):	0.88
Date:	5/28/2009
Field Crew:	B. Roberts, C. Carter

Station	Elevation
0.0	537.42
0.4	537.22
4.9	537.35
10.8	537.23
14.8	536.00
17.0	535.61
20.4	535.64
23.5	534.21
24.8	534.18
26.2	534.48
28.3	534.03
29.3	533.96
33.5	533.72
35.0	533.47
35.7	533.43
37.8	533.51
39.9	534.03
43.9	536.10
45.1	536.35
50.0	536.45
56.6	539.15
60.8	539.51
64.7	539.76

SUMMARY DATA	
Bankfull Elevation:	535.6
Bankfull Cross-Sectional Area:	33.6
Bankfull Width:	22.6
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.2
Mean Depth at Bankfull:	1.5
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	C4

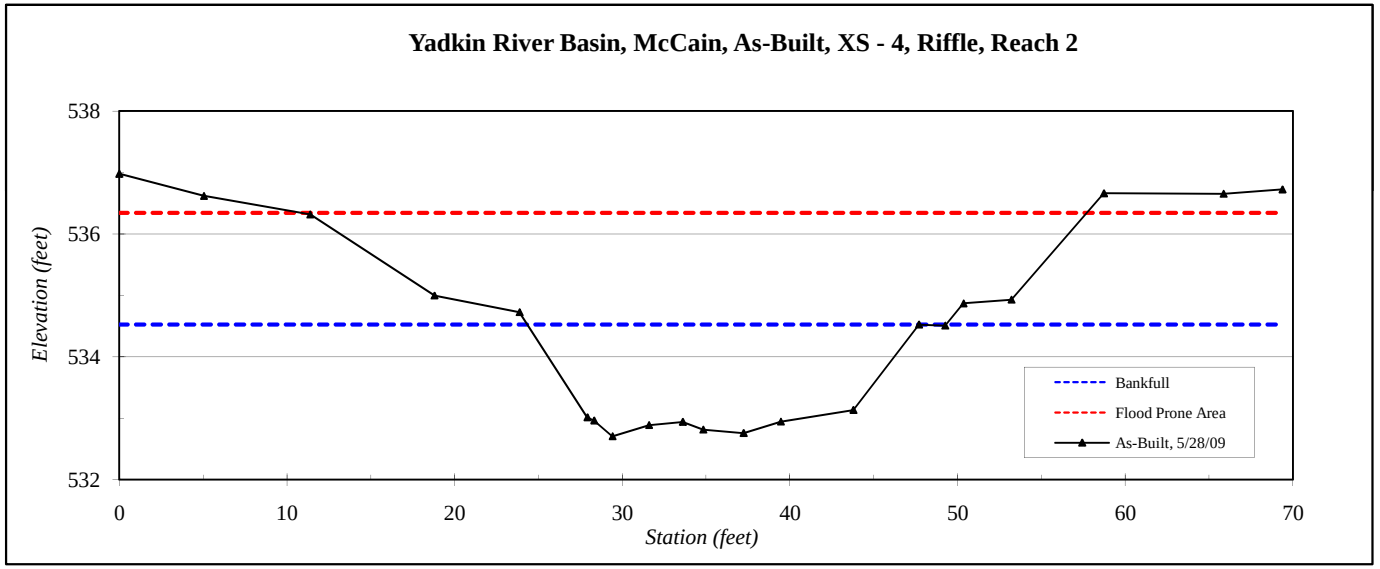


River Basin:	Yadkin
Watershed:	McCain, As-Built
XS ID	XS - 4, Riffle, Reach 2
Drainage Area (sq mi):	0.88
Date:	5/28/2009
Field Crew:	B. Roberts, C. Carter

Station	Elevation
0.0	536.98
5.0	536.62
11.4	536.32
18.8	535.00
23.9	534.73
27.9	533.01
28.3	532.96
29.4	532.71
31.6	532.89
33.6	532.94
34.8	532.81
37.2	532.76
39.5	532.94
43.8	533.13
47.7	534.52
49.3	534.51
50.4	534.87
53.2	534.93
58.7	536.66
65.9	536.65
69.4	536.72

SUMMARY DATA	
Bankfull Elevation:	534.5
Bankfull Cross-Sectional Area:	31.2
Bankfull Width:	23.3
Flood Prone Area Elevation:	536.3
Flood Prone Width:	46.9
Max Depth at Bankfull:	1.8
Mean Depth at Bankfull:	1.3
W / D Ratio:	17.4
Entrenchment Ratio:	2.0
Bank Height Ratio:	1.0

Stream Type	C4

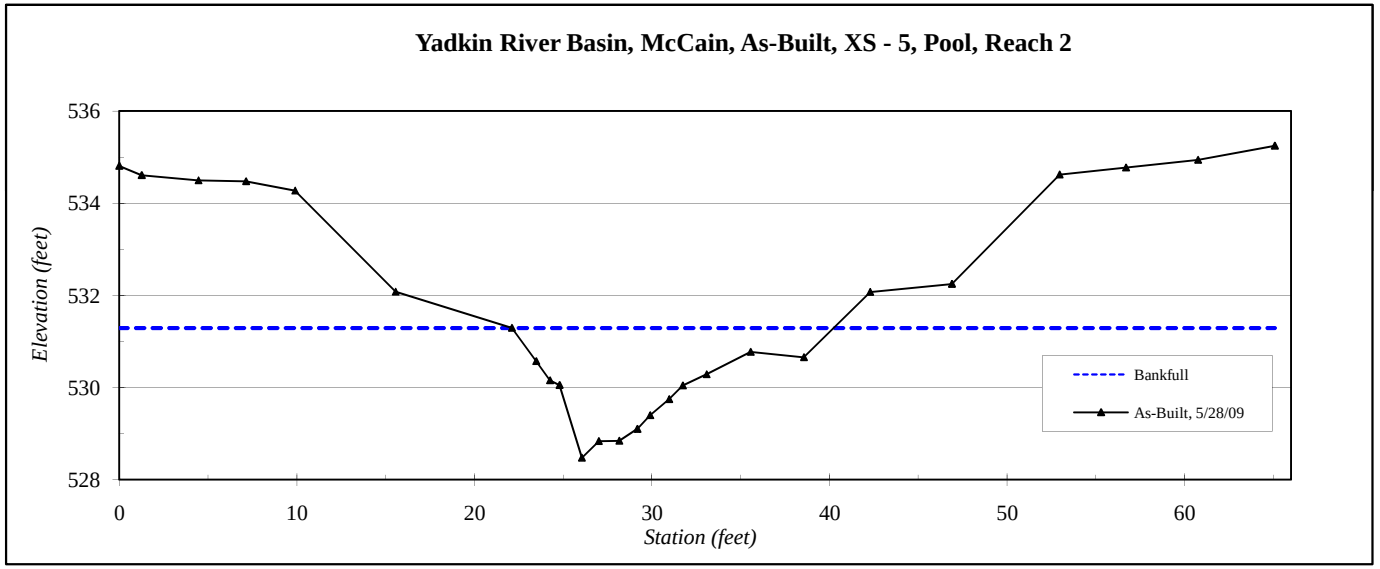


River Basin:	Yadkin
Watershed:	McCain, As-Built
XS ID	XS - 5, Pool, Reach 2
Drainage Area (sq mi):	0.88
Date:	5/28/2009
Field Crew:	B. Roberts, C. Carter

Station	Elevation
0.0	534.81
1.3	534.61
4.5	534.49
7.1	534.47
9.9	534.27
15.6	532.08
22.1	531.29
23.5	530.57
24.3	530.15
24.8	530.05
26.1	528.48
27.0	528.84
28.2	528.85
29.2	529.10
29.9	529.40
31.0	529.75
31.7	530.04
33.1	530.28
35.6	530.77
38.6	530.66
42.3	532.07
46.9	532.25
53.0	534.62
56.7	534.8
60.8	534.9
65.1	535.2

SUMMARY DATA	
Bankfull Elevation:	531.3
Bankfull Cross-Sectional Area:	22.2
Bankfull Width:	18.1
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.8
Mean Depth at Bankfull:	1.2
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	C4

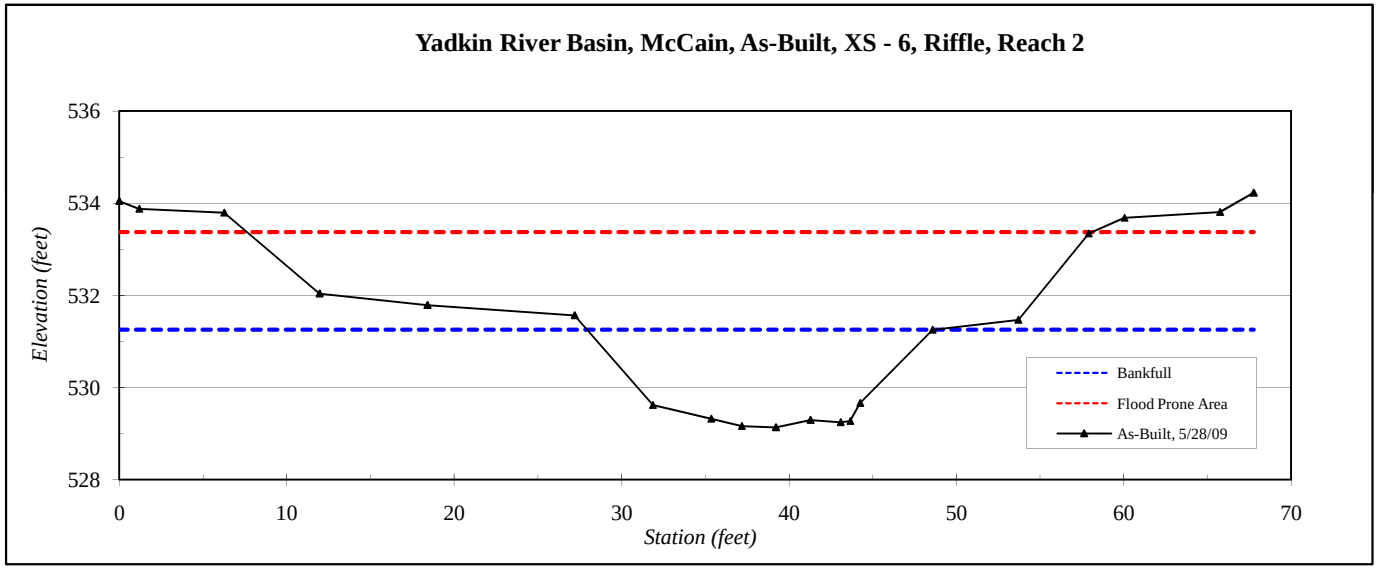


River Basin:	Yadkin
Watershed:	McCain, As-Built
XS ID	XS - 6, Riffle, Reach 2
Drainage Area (sq mi):	0.88
Date:	5/28/2009
Field Crew:	B. Roberts, C. Carter

Station	Elevation
0.0	534.05
1.2	533.88
6.3	533.79
12.0	532.04
18.4	531.79
27.2	531.57
31.9	529.62
35.4	529.32
37.2	529.17
39.2	529.13
41.3	529.29
43.1	529.25
43.7	529.27
44.3	529.66
48.6	531.25
53.7	531.47
57.9	533.34
60.0	533.68
65.8	533.81
67.8	534.22

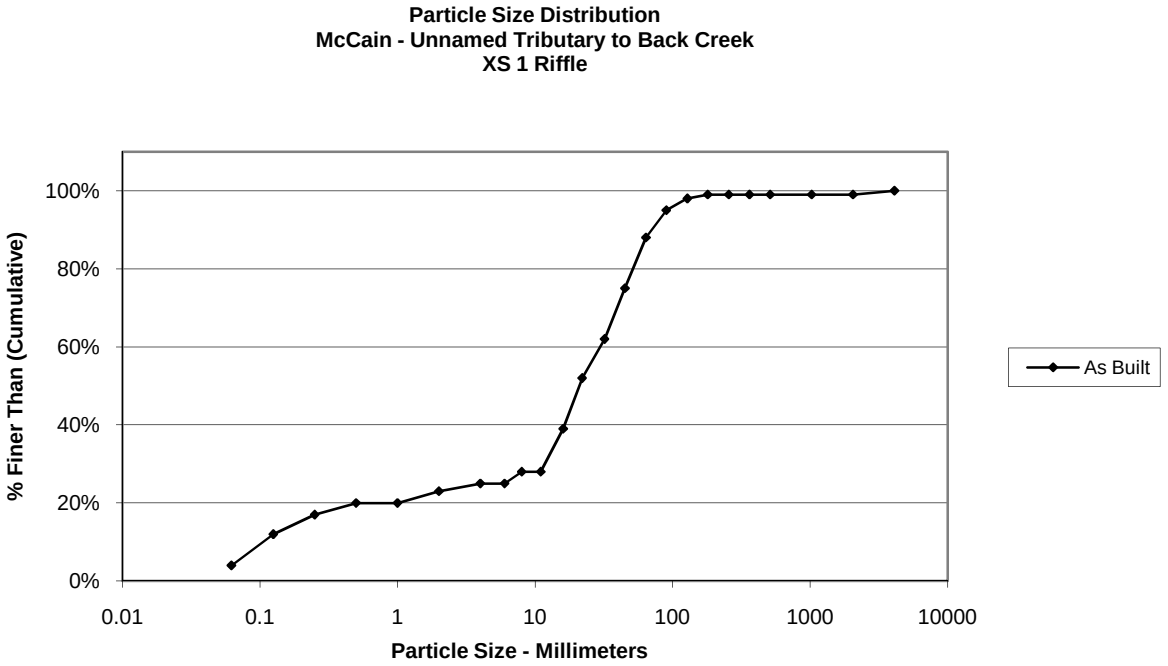
SUMMARY DATA	
Bankfull Elevation:	531.3
Bankfull Cross-Sectional Area:	30.8
Bankfull Width:	20.6
Flood Prone Area Elevation:	533.4
Flood Prone Width:	50.5
Max Depth at Bankfull:	2.1
Mean Depth at Bankfull:	1.5
W / D Ratio:	13.8
Entrenchment Ratio:	2.5
Bank Height Ratio:	1.0

Stream Type	C4



Cross-Section 1 Riffle - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	4
Very Fine	.062 - .125	S	8
Fine	.125 - .25	A	5
Medium	.25 - .50	N	3
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	3
Very Fine	2 - 4		2
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	3
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	11
Coarse	16 - 22.6	E	13
Coarse	22.6 - 32	L	10
Very Coarse	32 - 45	S	13
Very Coarse	45 - 64		13
Small	64 - 90	C	7
Small	90 - 128	O	3
Large	128 - 180	B	1
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	1
		Total	100

Note:



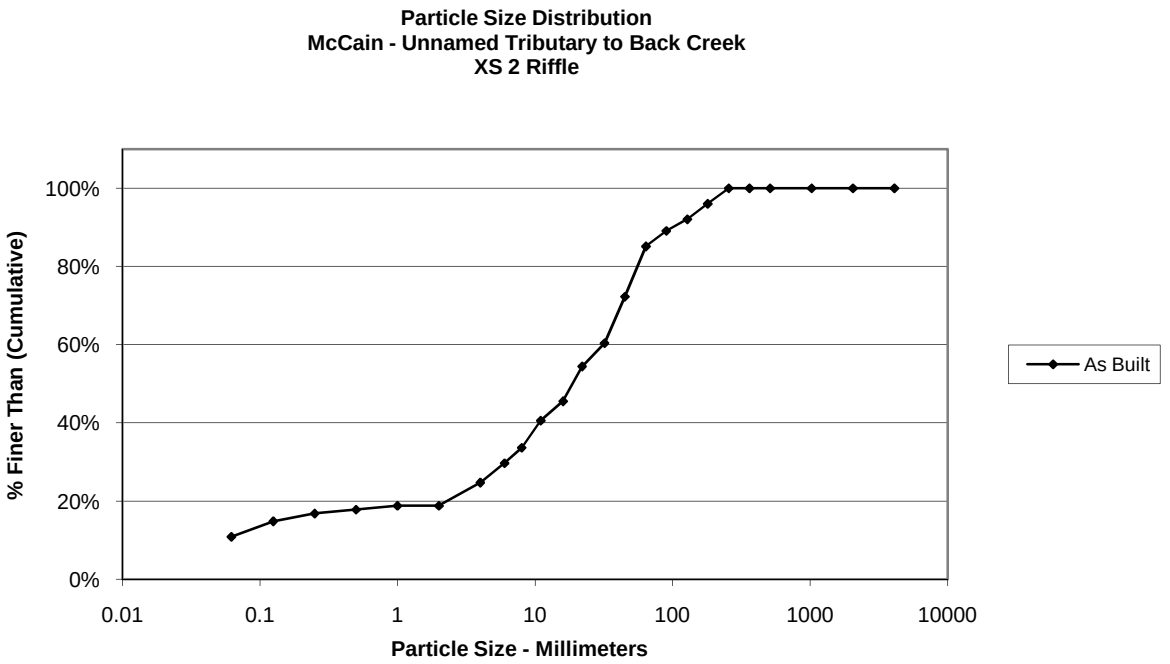
Size (mm)	
D16	0.21
D35	14
D50	21
D65	34
D84	56
D95	86

Size Distribution	
mean	3.4
dispersion	51.3
skewness	-0.51

Type	
silt/clay	4%
sand	19%
gravel	65%
cobble	11%
boulder	0%
bedrock	1%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 2 Riffle - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	11
Very Fine	.062 - .125	S	4
Fine	.125 - .25	A	2
Medium	.25 - .50	N	1
Coarse	.50 - 1	D	1
Very Coarse	1 - 2	S	
Very Fine	2 - 4		6
Fine	4 - 5.7	G	5
Fine	5.7 - 8	R	4
Medium	8 - 11.3	A	7
Medium	11.3 - 16	V	5
Coarse	16 - 22.6	E	9
Coarse	22.6 - 32	L	6
Very Coarse	32 - 45	S	12
Very Coarse	45 - 64		13
Small	64 - 90	C	4
Small	90 - 128	O	3
Large	128 - 180	B	4
Large	180 - 256	L	4
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	101

Note:



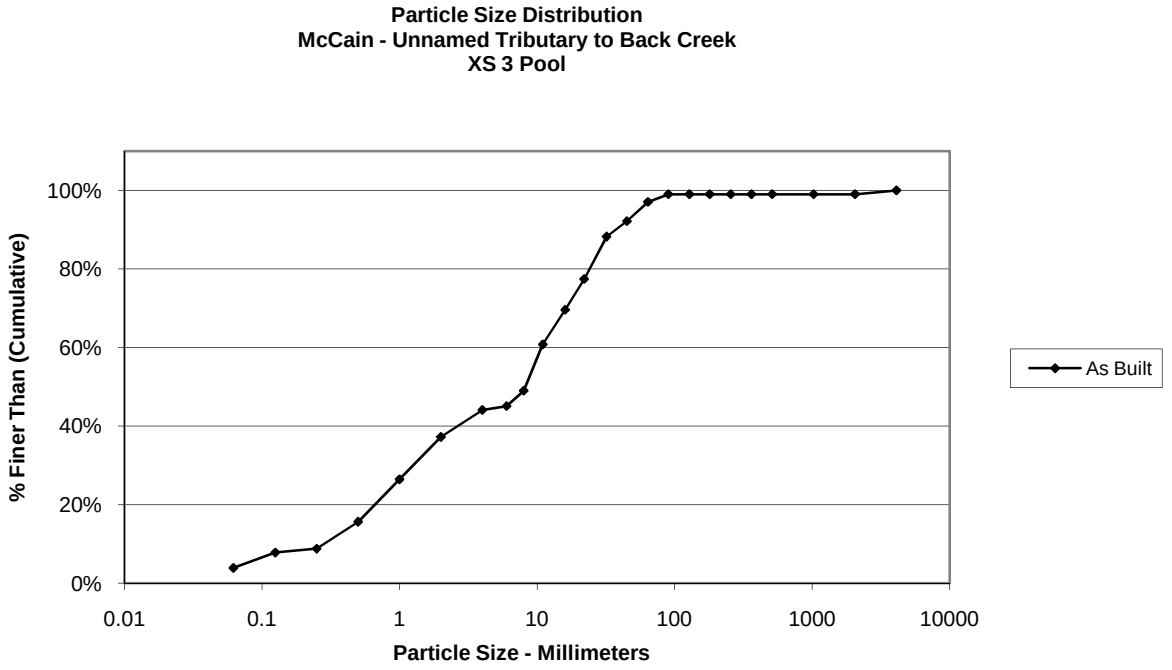
Size (mm)	
D16	0.19
D35	8.5
D50	19
D65	37
D84	62
D95	160

Size Distribution	
mean	3.4
dispersion	51.6
skewness	-0.47

Type	
silt/clay	11%
sand	8%
gravel	66%
cobble	15%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 3 Pool - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	4
Very Fine	.062 - .125	S	4
Fine	.125 - .25	A	1
Medium	.25 - .50	N	7
Coarse	.50 - 1	D	11
Very Coarse	1 - 2	S	11
Very Fine	2 - 4		7
Fine	4 - 5.7	G	1
Fine	5.7 - 8	R	4
Medium	8 - 11.3	A	12
Medium	11.3 - 16	V	9
Coarse	16 - 22.6	E	8
Coarse	22.6 - 32	L	11
Very Coarse	32 - 45	S	4
Very Coarse	45 - 64		5
Small	64 - 90	C	2
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	1
		Total	102

Note:



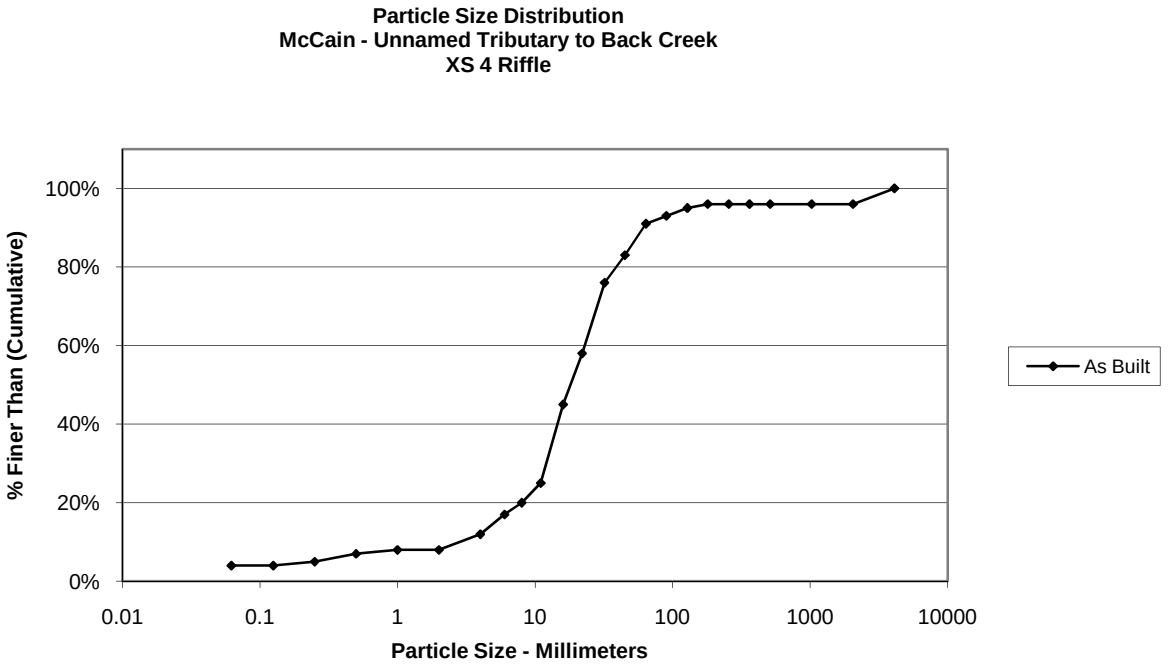
Size (mm)	
D16	0.51
D35	1.7
D50	8.1
D65	13
D84	27
D95	52

Size Distribution	
mean	3.7
dispersion	9.6
skewness	-0.26

Type	
silt/clay	4%
sand	33%
gravel	60%
cobble	2%
boulder	0%
bedrock	1%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 4 Riffle - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	4
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	1
Medium	.25 - .50	N	2
Coarse	.50 - 1	D	1
Very Coarse	1 - 2	S	
Very Fine	2 - 4		4
Fine	4 - 5.7	G	5
Fine	5.7 - 8	R	3
Medium	8 - 11.3	A	5
Medium	11.3 - 16	V	20
Coarse	16 - 22.6	E	13
Coarse	22.6 - 32	L	18
Very Coarse	32 - 45	S	7
Very Coarse	45 - 64		8
Small	64 - 90	C	2
Small	90 - 128	O	2
Large	128 - 180	B	1
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	4
		Total	100

Note:



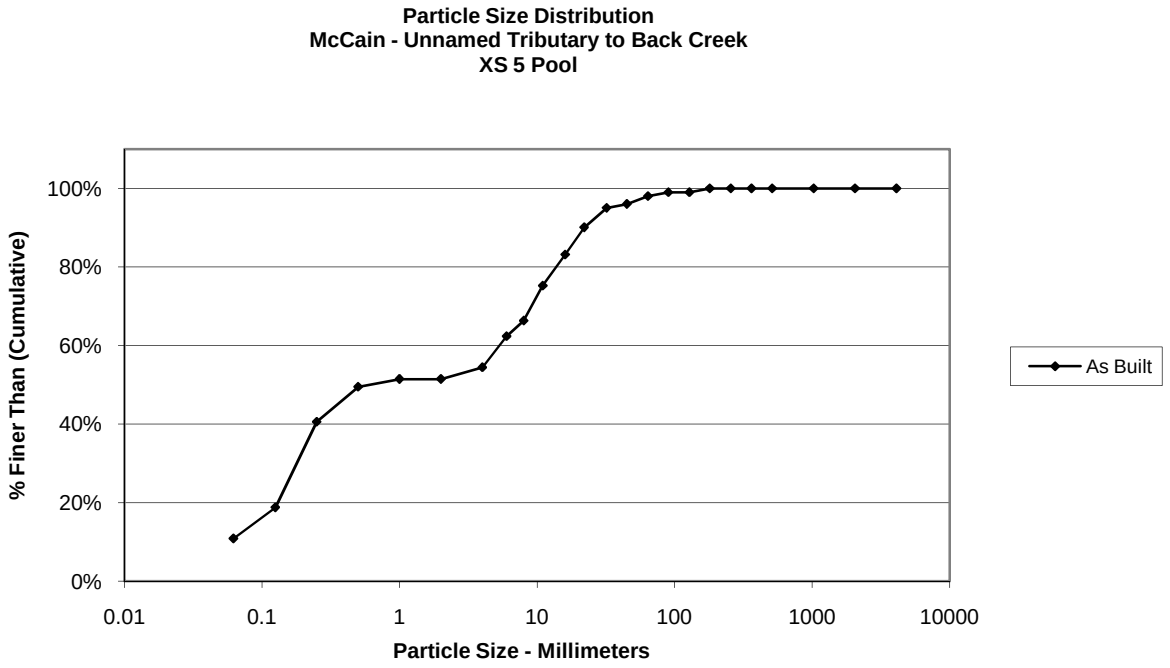
Size (mm)	
D16	5.3
D35	13
D50	17
D65	24
D84	40
D95	66

Size Distribution	
mean	14.6
dispersion	2.8
skewness	-0.07

Type	
silt/clay	4%
sand	4%
gravel	83%
cobble	5%
boulder	0%
bedrock	4%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 5 Pool - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	11
Very Fine	.062 - .125	S	8
Fine	.125 - .25	A	22
Medium	.25 - .50	N	9
Coarse	.50 - 1	D	2
Very Coarse	1 - 2	S	
Very Fine	2 - 4		3
Fine	4 - 5.7	G	8
Fine	5.7 - 8	R	4
Medium	8 - 11.3	A	9
Medium	11.3 - 16	V	8
Coarse	16 - 22.6	E	7
Coarse	22.6 - 32	L	5
Very Coarse	32 - 45	S	1
Very Coarse	45 - 64		2
Small	64 - 90	C	1
Small	90 - 128	O	
Large	128 - 180	B	1
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	101

Note:



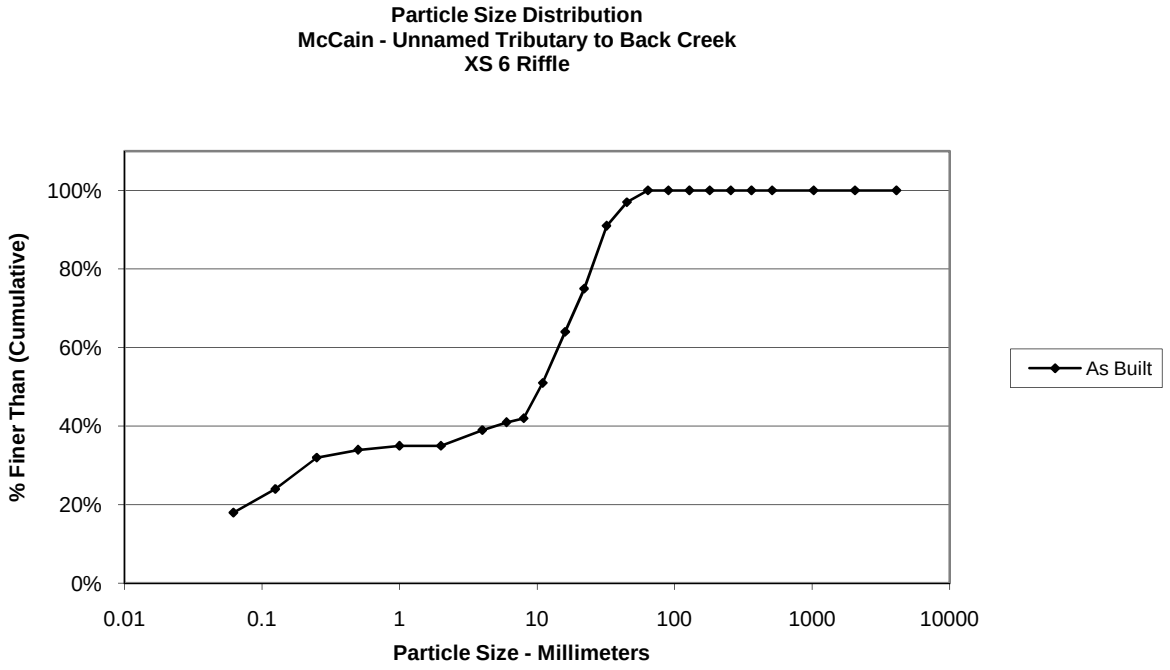
Size (mm)	
D16	0.097
D35	0.21
D50	0.59
D65	7.3
D84	17
D95	32

Size Distribution	
mean	1.3
dispersion	17.4
skewness	0.23

Type	
silt/clay	11%
sand	41%
gravel	47%
cobble	2%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 6 Riffle - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	18
Very Fine	.062 - .125	S	6
Fine	.125 - .25	A	8
Medium	.25 - .50	N	2
Coarse	.50 - 1	D	1
Very Coarse	1 - 2	S	
Very Fine	2 - 4		4
Fine	4 - 5.7	G	2
Fine	5.7 - 8	R	1
Medium	8 - 11.3	A	9
Medium	11.3 - 16	V	13
Coarse	16 - 22.6	E	11
Coarse	22.6 - 32	L	16
Very Coarse	32 - 45	S	6
Very Coarse	45 - 64		3
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



Size (mm)	
D16	0.062
D35	2
D50	11
D65	16
D84	27
D95	40

Size Distribution	
mean	1.3
dispersion	89.9
skewness	-0.57

Type	
silt/clay	18%
sand	17%
gravel	65%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

APPENDIX C

Vegetation Data

Table 7. Vegetation Plot Attribute Table Project Name and Number: McCain - 443				
Plot ID	Community Type	Planting Zone ID	Reach ID	CVS Level
443-A-0001	Piedmont Bottomland Hardwood	Bare Root	2	1
443-A-0002	Piedmont Bottomland Hardwood	Bare Root/Live Stake	2	1
443-A-0003	Piedmont Bottomland Hardwood	Bare Root	2	1
443-A-0004	Piedmont Bottomland Hardwood	Bare Root	2	1
443-A-0005	Piedmont Bottomland Hardwood	Bare Root/Live Stake	2	1
443-A-0006	Piedmont Bottomland Hardwood	Bare Root	2	1
443-A-0007	Piedmont Bottomland Hardwood	Bare Root/Live Stake	2	1

Report Prepared By	Brian Roberts
Date Prepared	7/8/2009 10:24

database name	KCI_2008.mdb
database location	M:\2007\12071067_2007 EEP OPEN END\Veg_database
computer name	12-2R926J1

DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------

Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.

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

Project Code	443
project Name	McCain
Description	Stream restoration site located in the Yadkin River Basin
River Basin	
length(ft)	2450
stream-to-edge width (ft)	50
area (sq m)	22758.94
Required Plots (calculated)	7
Sampled Plots	7

Living planted stems, excluding live stakes, per acre: Negative (red) numbers indicate the project failed to reach requirements in a particular year.

Project Code	Project Name	River Basin	Year 0 (baseline)
443	McCain	Yadkin	335.31

Total stems, including planted stems of all kinds (including live stakes) and natural/volunteer stems:

Project Code	Project Name	River Basin	Year 0 (baseline)
443	McCain	Yadkin	566.5599002

vigor	Count	Percent
1	16	16.3
2	18	18.4
3	28	28.6
4	36	36.7

	Species	4	3	2	1	0	Missing	Unknown
	Betula nigra	2	10	6	2			
	Cornus amomum	15	5	2	4			
	Fraxinus pennsylvanica	1	2	1				
	Quercus falcata		3	1				
	Quercus phellos		1	1				
	Salix nigra	8	1					
	Salix sericea	7	1					
	Sambucus				1			
	Quercus				7			
	Liriodendron tulipifera		1	5				
	Platanus occidentalis	3	4	2				
	Unknown				2			
TOT:	**12**	**36**	**28**	**18**	**16**			

Damage	Count	Percent Of Stems
(no damage)	98	100

	Species	All Damage Categories	(no damage)
	Betula nigra	20	20
	Cornus amomum	26	26
	Fraxinus pennsylvanica	4	4
	Liriodendron tulipifera	6	6
	Platanus occidentalis	9	9
	Quercus	7	7
	Quercus falcata	4	4
	Quercus phellos	2	2
	Salix nigra	9	9
	Salix sericea	8	8
	Sambucus	1	1
	Unknown	2	2
TOT:	**12**	**98**	**98**

	plot	All Damage Categories	(no damage)
	443-A-0001	7	7
	443-A-0002	24	24
	443-A-0003	20	20
	443-A-0004	10	10
	443-A-0005	14	14
	443-A-0006	8	8
	443-A-0007	15	15
TOT:	**7**	**98**	**98**

plot	Plot Level	Year	Latitude/ Northing	Longitude/ Easting	Zone	Datum	Date Sampled	Planted Living Stems	Planted Living Stems EXCLUDING Live Stakes	Dead/ Missing Stems	Natural (Volunteer) Stems	Total Living Stems	Total Living Stems EXCLUDING Live Stakes	Planted Living Stems per ACRE	Planted Living Stems EXCLUDING Live Stakes PER ACRE	Natural (Volunteer) Stems PER ACRE	Total Living Stems PER ACRE	Total Living Stems EXCLUDING Live Stakes PER ACRE	# species
443-A-0001	1	0	734720.5835	1746458.3211	17	NAD83/WGS84	5/26/2009 to 6/5/2009	7	7	0	0	7	7	283.2799501	283.2799501	0	283.27995	283.2799501	3
443-A-0002	1	0	734493.4077	1746543.0044	17	NAD83/WGS84	5/26/2009 to 6/5/2009	24	4	0	0	24	4	971.2455432	161.8742572	0	971.245543	161.8742572	6
443-A-0003	1	0	734162.6573	1746572.2892	17	NAD83/WGS84	5/26/2009 to 6/5/2009	20	20	0	0	20	20	809.371286	809.371286	0	809.371286	809.371286	8
443-A-0004	1	0	733829.9902	1746523.9181	17	NAD83/WGS84	5/26/2009 to 6/5/2009	10	10	0	0	10	10	404.685643	404.685643	0	404.685643	404.685643	6
443-A-0005	1	0	733565.1648	1746579.5309	17	NAD83/WGS84	5/26/2009 to 6/5/2009	14	5	0	0	14	5	566.5599002	202.3428215	0	566.5599	202.3428215	7
443-A-0006	1	0	733365.1116	1746621.9527	17	NAD83/WGS84	5/26/2009 to 6/5/2009	8	8	0	0	8	8	323.7485144	323.7485144	0	323.748514	323.7485144	3
443-A-0007	1	0	733124.4687	1746641.0621	17	NAD83/WGS84	5/26/2009 to 6/5/2009	15	4	0	0	15	4	607.0284645	161.8742572	0	607.028465	161.8742572	7

	Species	Total Planted Stems	# plots	avg# stems	plot 443-A-0001	plot 443-A-0002	plot 443-A-0003	plot 443-A-0004	plot 443-A-0005	plot 443-A-0006	plot 443-A-0007
	Betula nigra	20	7	2.86	2	1	6	3	2	5	1
	Cornus amomum	26	6	4.33		11	1	1	4	2	7
	Fraxinus pennsylvanica	4	3	1.33		2	1	1			
	Liriodendron tulipifera	6	3	2			3	2			1
	Platanus occidentalis	9	5	1.8		1	5		1	1	1
	Quercus	7	4	1.75	4		1	1	1		
	Quercus falcata	4	2	2			2	2			
	Quercus phellos	2	2	1	1				1		
	Salix nigra	9	2	4.5		8			1		
	Salix sericea	8	3	2.67		1			4		3
	Sambucus	1	1	1							1
	Unknown	2	2	1			1				1
TOT:	**12**	**98**	**12**		**7**	**24**	**20**	**10**	**14**	**8**	**15**

Vegetation Plot 1: 5/29/09 – As-Built

Vegetation Plot 2: 5/29/09 – As-Built

Vegetation Plot 3: 5/29/09 – As-Built

Vegetation Plot 4: 5/29/09 – As-Built

Vegetation Plot 5: 5/29/09 – As-Built

Vegetation Plot 6: 5/29/09 – As-Built

Vegetation Plot 7: 5/29/09 – As-Built

APPENDIX D

Stream Photos

Photo Point 1u: View looking immediately upstream of the project. 5/29/08 – As-Built

Photo Point 1d: View looking downstream near Station 10+00. 5/29/09 – As-Built

Photo Point 2u: View looking upstream taken near Station 11+50. 5/29/09 – As-Built

Photo Point 2d: View looking downstream taken near Station 11+50. 5/29/09 – As-Built

Photo Point 3u: View looking upstream near Station 14+30. 5/29/09 – As-Built

Photo Point 3d: View looking downstream near Station 14+30. 5/29/09 – As-Built

Photo Point 4u: View looking upstream near Station 17+35. 5/29/09 – As-Built

Photo Point 4d: View looking downstream near Station 17+35. 5/29/09 – As-Built

Photo Point 5u: View looking upstream near Station 21+00. 5/29/09 – As-Built

Photo Point 5d: View looking downstream near Station 21+00. 5/29/09 – As-Built

Photo Point 6u: View looking upstream near Station 23+00. 5/29/09 – As-Built

Photo Point 6d: View looking downstream near Station 23+00. 5/29/09 – As-Built

Photo Point 7u: View looking upstream near Station 25+25. 5/29/09 – As-Built

Photo Point 7d: View looking downstream near Station 25+25. 5/29/09 – As-Built

Photo Point 8u: View looking upstream near Station 27+75. 5/29/09 – As-Built

Photo Point 8d: View looking downstream near Station 27+75. 5/29/09 – As-Built

Photo Point 9u: View looking upstream near Station 30+30. 5/29/09 – As-Built

Photo Point 9d: View looking downstream near Station 30+30. 5/29/09 – As-Built

Photo Point 10u: View looking upstream near Station 34+25. 5/29/09 – As-Built

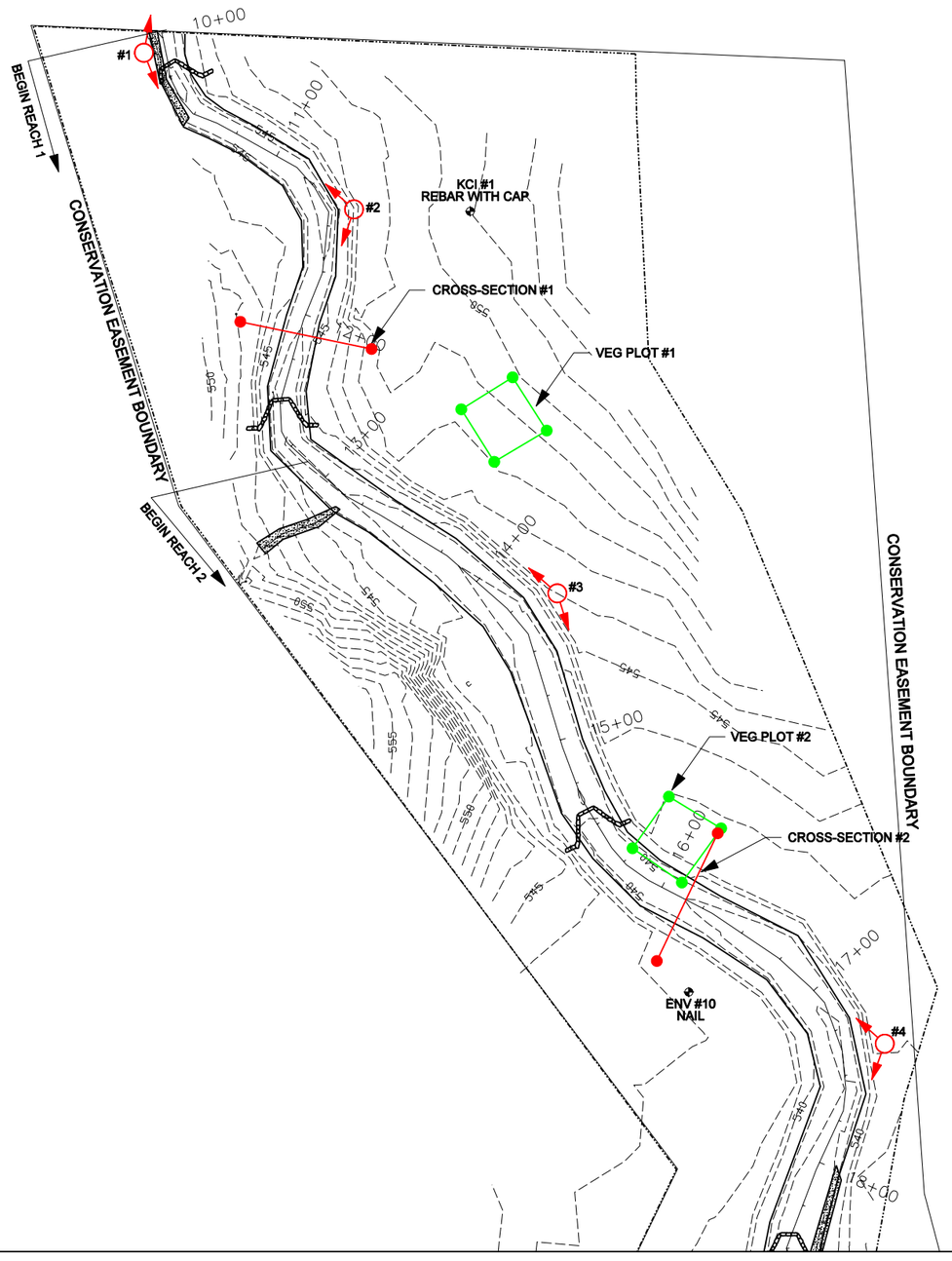
Photo Point 10d: View looking downstream towards the end of the project. 5/29/09 – As-Built

APPENDIX E

Monitoring Plan View

LEGEND

- Thalweg, Stationing, and Top of Bank
- Rock Cross Vane
- Rock Ford Crossing
- Stone Stabilization
- Minor Contour Line
- Major Contour Line
- Fence
- Control Point — McCAIN #1
- Utility Pole
- Overhead Utility Line — P
- Cross–Section
- Veg Plot
- Photo Point — #1



MATCHLINE SEE SHEET 2

MATCHLINE SEE SHEET 2

–40 –20 0 40 80

GRAPHIC SCALE

NC GRID
NAD '83

REVISIONS

NO.	DESCRIPTION	DATE	APPROVED

Ecosystem Enhancement Program

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

McCAIN PROPERTY - UT TO BACK CREEK STREAM RESTORATION PROJECT

SOPHIA, RANDOLPH COUNTY, NORTH CAROLINA

STATION 10+00 TO STATION 18+52

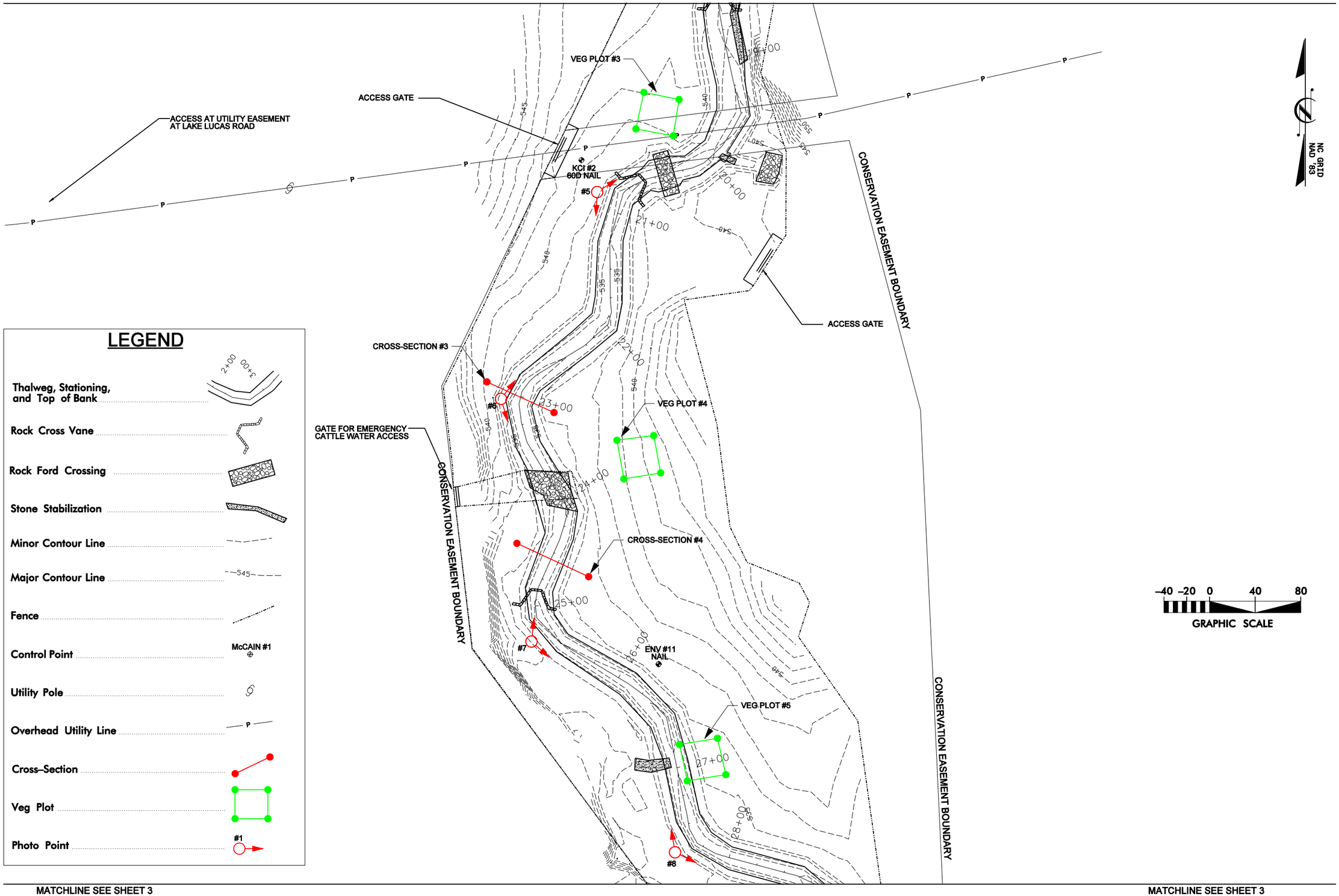
DATE: APRIL 2009

SCALE: 1" = 40'

MONITORING PLAN VIEW

MATCHLINE SEE SHEET 1

MATCHLINE SEE SHEET 1



LEGEND

- Thalweg, Stationing, and Top of Bank
- Rock Cross Vane
- Rock Ford Crossing
- Stone Stabilization
- Minor Contour Line
- Major Contour Line
- Fence
- Control Point (McCAIN #1)
- Utility Pole
- Overhead Utility Line
- Cross–Section
- Veg Plot
- Photo Point (#1)

MATCHLINE SEE SHEET 3

MATCHLINE SEE SHEET 3

REVISIONS

DESCRIPTION	DATE	APPROVED

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

McCAIN PROPERTY - UT TO BACK CREEK STREAM RESTORATION PROJECT

SOPHIA, RANDOLPH COUNTY, NORTH CAROLINA

STATION 18+52 TO STATION 28+80

DATE: APRIL 2009

SCALE: 1" = 40'

MONITORING PLAN VIEW

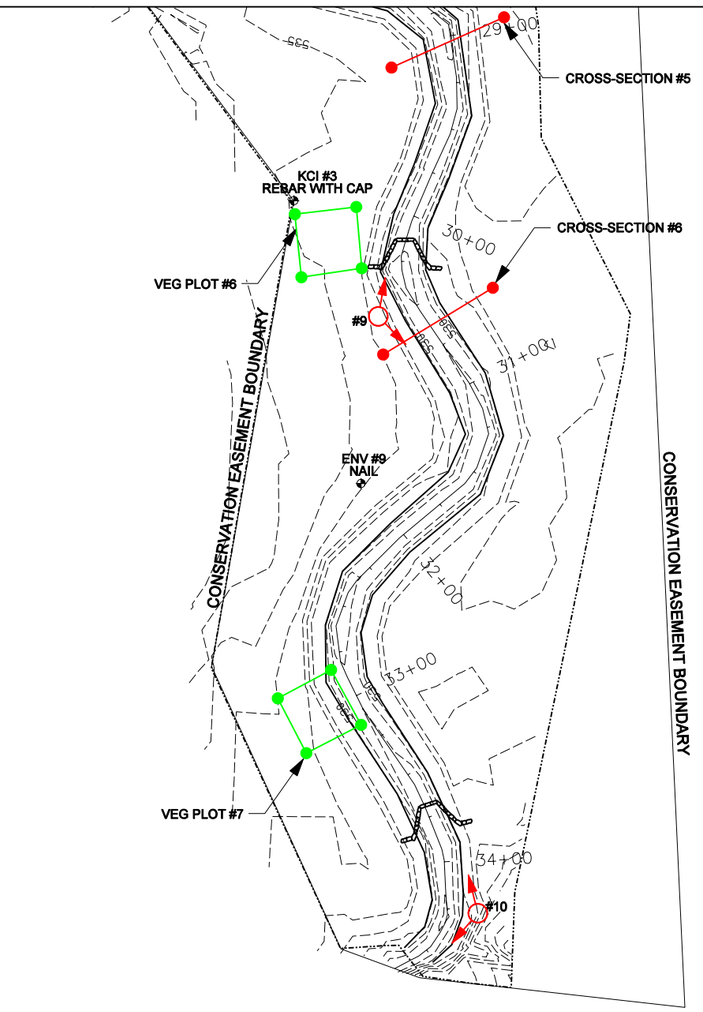
SHEET 2 OF 3

MATCHLINE SEE SHEET 2

MATCHLINE SEE SHEET 2

LEGEND

- Thalweg, Stationing, and Top of Bank
- Rock Cross Vane
- Rock Ford Crossing
- Stone Stabilization
- Minor Contour Line
- Major Contour Line (545)
- Fence
- Control Point (McCAIN #1)
- Utility Pole
- Overhead Utility Line (P)
- Cross-Section
- Veg Plot
- Photo Point (#1)



GRAPHIC SCALE: –40 –20 0 40 80

NC GRID NAD 83

CROSS-SECTION COORDINATES

	NORTHING	EASTING	ELEVATION
CROSS-SECTION 1 LB	734735.9381	1746381.8929	548.39
RB	734750.6724	1746310.7986	548.15
CROSS-SECTION 2 LB	734473.5603	1746569.4449	543.01
RB	734404.3635	1746536.4518	543.18
CROSS-SECTION 3 LB	733888.1215	1746462.6269	537.42
RB	733914.9934	1746403.7981	539.76
CROSS-SECTION 4 LB	733744.2532	1746493.0029	536.98
RB	733773.4611	1746430.0640	536.72
CROSS-SECTION 5 LB	733469.0412	1746732.3871	534.81
RB	733442.4984	1746672.9621	536.24
CROSS-SECTION 6 LB	733326.2237	1746726.4775	534.05
RB	733290.9942	1746668.5976	534.22

VEGETATION PLOT COORDINATES

	NORTHING	EASTING
VEGETATION PLOT #1	734720.5835	1746458.3211
	734703.2431	1746430.4921
	734674.8052	1746448.3808
	734691.7336	1746476.7933
VEGETATION PLOT #2	734493.4077	1746543.0044
	734476.2316	1746571.3042
	734446.8668	1746550.0446
	734465.3995	1746523.2910
VEGETATION PLOT #3	734162.6573	1746572.2892
	734168.8762	1746541.4157
	734136.8391	1746534.4487
	734130.7241	1746567.2099
VEGETATION PLOT #4	733829.9902	1746523.9181
	733863.9420	1746517.8217
	733868.0456	1746550.0363
	733835.2289	1746556.1683
VEGETATION PLOT #5	733565.1648	1746579.5309
	733597.1084	1746572.6516
	733602.5131	1746606.0003
	733570.6933	1746613.3063
VEGETATION PLOT #6	733365.1116	1746621.9527
	733331.7960	1746625.4098
	733336.5329	1746657.2544
	733368.8913	1746654.3806
VEGETATION PLOT #7	733124.4687	1746641.0621
	733095.4500	1746656.9404
	733080.5213	1746628.0131
	733109.4479	1746612.9452

REVISIONS

NO.	DESCRIPTION	DATE	APPROVED

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

McCAIN PROPERTY - UT TO BACK CREEK STREAM RESTORATION PROJECT

SOPHIA, RANDOLPH COUNTY, NORTH CAROLINA

STATION 28+80 TO STATION 34+70

DATE: APRIL 2009

SCALE: 1" = 40'

MONITORING PLAN VIEW

SHEET 3 OF 3