THIRD FORK/FOREST HILLS CREEK STREAM RESTORATION–Project #139
Fifth Annual Monitoring Report – 2009 – FINAL

January 2010

Submitted to:

North Carolina Department of
Environment and Natural Resources
Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, NC 27699-1652

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1.0 Executive Summary

The Third Fork Creek stream restoration project is located in southwest-central Durham, North Carolina, in the headwaters of the Third Fork Creek watershed (US Geological Survey 14-digit Hydrologic Unit Code 03030002060120) within the New Hope Creek Sub-basin of the Upper Cape Fear River (NC Division of Water Quality Sub-basin 03-06-05). The project has restored approximately 3,025 linear feet of perennial stream in the Cape Fear River Basin. Evaluation and design were initiated during the summer of 2002. Construction was completed in January 2005.

According to the 2003 Restoration Plan (KCI 2003), the stream restoration project's goals and objectives are to:

- Restore stable channel morphology that is capable of moving the flows and sediment provided by its watershed;
- Reduce sediment-related water quality impacts resulting from lateral bank erosion and bed degradation;
- Improve aquatic habitat diversity through the reestablishment of riffle-pool bed variability and the use of in-stream structures;
- Restore vegetative riparian buffers utilizing native plant species; and,
- Improve natural aesthetics in an urban park setting.

In June 2009 RJG&A staff used the CVS-EEP monitoring protocol, level 2, to evaluate the planted woody stem survival in eight permanent vegetation plots. The average live planted woody stem density (829 live stems per acre) has exceeded the vegetation success criteria (260 live stems per acre in Year 5) by 218 percent. Throughout the riparian buffer restoration area, planted woody stem survival and vigor are high. Non-native invasive species are scattered throughout the site, including *Reynoutria japonica* (Japanese knotweed), *Ampelopsis brevipedunculata* (porcelainberry), *Albizia julibrissin* (mimosa), *Melia azedarach* (chinaberry), *Pyrus calleryana* (callery pear), *Triadica sebifera* (Chinese tallow tree), and *Humulus japonicus* (Japanese hops).

RJG&A staff collected cross-section, longitudinal, and pebble data in June 2009. Overall, the site is maintaining its as-built dimension, pattern, and profile. Several areas of bank slump/undercut that were identified during past visits have stabilized and are no longer considered problem areas, however new areas of scour and slumping have developed. Despite these problem areas, the qualitative evaluation performed in July 2009, indicates that 90% of the banks in the upper reach and 91% of the banks in the lower reach are performing as intended. The bank scour and slumping may be due, in part, to the site's location in an urbanized watershed where rapid drainage during storm events results in high flows and velocities that cause bank erosion.

2.0 Project Background

2.1. Project Goals and Objectives

According to the 2003 Restoration Plan (KCI 2003), the stream restoration project's goals and objectives are to:

- Restore stable channel morphology that is capable of moving the flows and sediment provided by its watershed;
- Reduce sediment-related water quality impacts resulting from lateral bank erosion and bed degradation;
- Improve aquatic habitat diversity through the reestablishment of riffle-pool bed variability and the use of in-stream structures;
- Restore vegetative riparian buffers utilizing native plant species; and,
- Improve natural aesthetics in an urban park setting.

2.2. Project Structure, Mitigation Type, and Approach

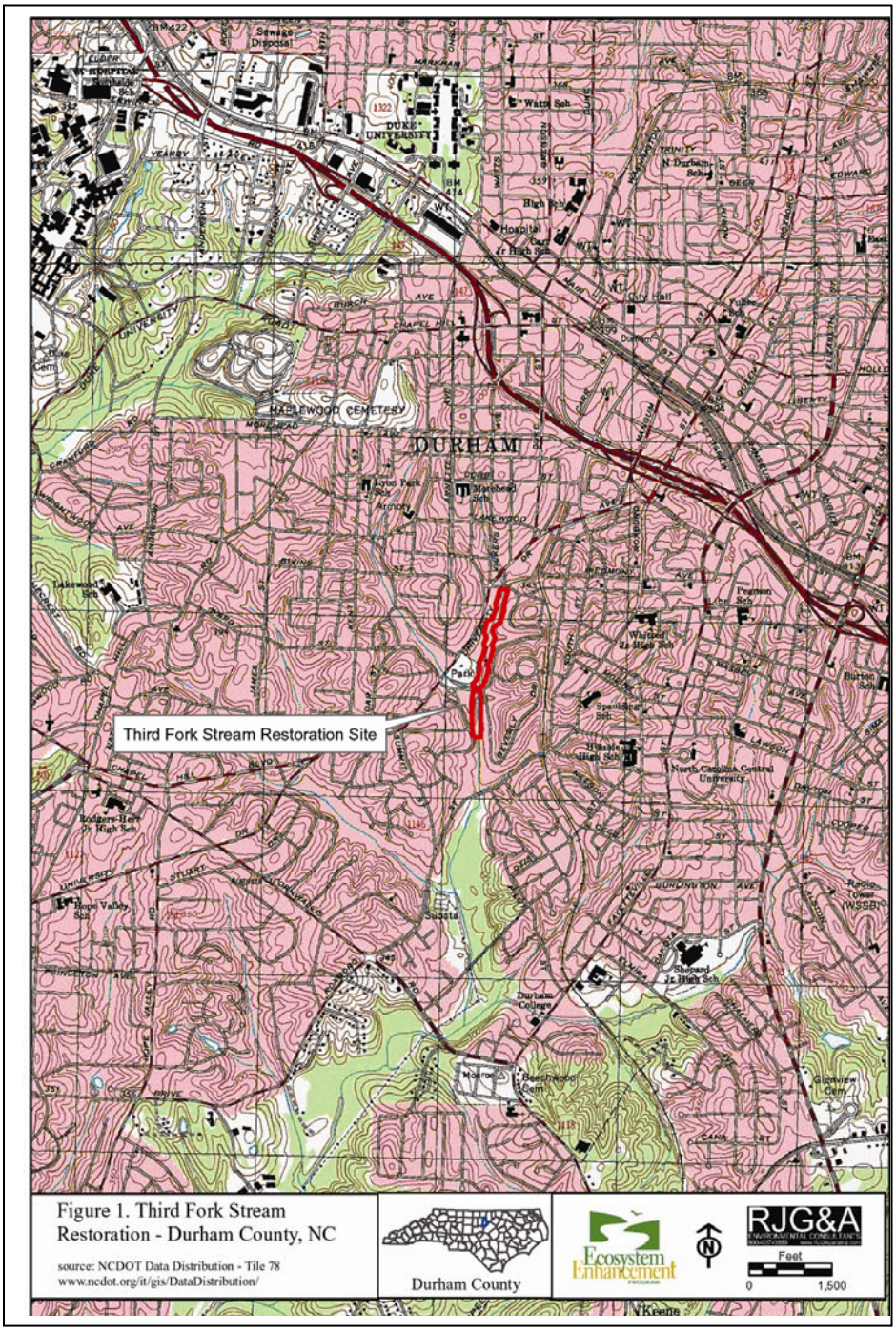
A priority 2 stream restoration approach was used to design and reestablish approximately 3,025 linear feet of meandering, bankfull channel and a new floodplain along Third Fork Creek. The project restored riffle-pool sequencing and used cross-vane and j-hook in-stream structures to provide grade control. The unnamed tributary that enters from the upper reach's left bank (station 20+33) was incorporated and stabilized with a grade control structure to match the grade of the restored channel. Coir fiber matting and live staking were installed/planted to help stabilize the graded stream banks. Native species were planted in a 50-foot wide buffer on both sides the restored stream.

2.3 Location and Setting

The entire restoration site is contained within Forest Hills Park, which is owned by the City of Durham. To get to the Third Fork Creek restoration site from NC 147, take exit 12C. At the end of the off-ramp, drive north on Duke Street. At the first light, take a left on Jackson and then a left on to Vickers. Take Vickers to the intersection with University Drive (US 15/501 Business). Forest Hills Park will be directly in front of you. Take a right on to University and park in the parking lot across from West Forest Hills Boulevard (Figure 1).

The upstream boundary of the restoration project is downstream from where Third Fork Creek emerges from the box culvert under the northern stretch East Forest Hills Boulevard. The stream restoration extends downstream along the main channel from this point to the southern edge of the Forest Hills Park. The double box culvert under the southern stretch of the East Forest Hills Boulevard loop divides the restoration into upper and lower reaches. An unnamed tributary to Third Fork Creek joins the lower reach on the downstream end of the culvert. The lower reach therefore has a significantly larger watershed.

Forest Hills Park is dominated by lawn/open space with relatively little mature canopy cover (less than 25 percent). A playground and other facilities with impervious cover (e.g swimming pool, tennis courts, and picnic shelter) are located near the southern portion of the restoration's upper reach. The surrounding area is highly urbanized. The majority of the land use is dedicated to residential and commercial development and secondary roads. Prior to the restoration, both project reaches were incised and had active bed degradation and channel widening characterized by severe bank erosion.



2.4. History and Background

KCI Associates of North Carolina designed the Third Fork (Forest Hills Park) stream restoration. The restoration plan was completed in February 2003 and construction was completed approximately two years later. As-built data collection occurred in March 2005 and the as-built and year one monitoring reports were submitted in December 2005. Robert J. Goldstein and Associates collected monitoring data and submitted the Year 2 report in December 2006, the Year 3 report in October 2007, and the Year 4 report in November 2008. Year 5 monitoring data were collected in June and July 2009.

Exhibit Table I. Project Restoration Components
Third Fork Creek Stream Restoration – EEP Project #139

Reach ID	Pre-existing Feet/Acres	Mitigation Type	Approach	Footage	Stationing	Comment
Upstream	2,900	R	P2	1,600	10+00-26+00	Realigned channel with restored floodplain to convey stormflow/ sediment and restore aquatidc habitat
Downstream		R	P2	1,525	26+00 – 40+25	

Exhibit Table II. Activity and Reporting History
Third Fork Creek Stream Restoration – EEP Project #139

Activity or Report	Data Collection	Completion
Restoration Plan	2002	February 2003
Construction	NA	January 2005
Temporary S&E mix applied	NA	NA
Permanent seed mix applied	NA	NA
Bare Root Planting	NA	NA
Mitigation Plan	NA	December 2005 (report date)
As-built	March 2005	December 2005 (report date)
Year 1 Monitoring		December 2005 (report date)
Vegetation	September 2005	
Geomorphological	September 2005	
Year 2 Monitoring		December 2006 (report date)
Vegetation	September 2006	
Geomorphological	October 2006	

Exhibit Table II. Activity and Reporting History Third Fork Creek Stream Restoration – EEP Project #139		
Year 3 Monitoring		October 2007 (report date)
Vegetation	July 2007	
Geomorphological	July 2007	
Year 4 Monitoring		November 2008 (report date)
Vegetation	July 2008	
Geomorphological	September 2008	
Year 5 Monitoring		July 2009 (report date)
Vegetation	June 2009	
Geomorphological	June 2009	

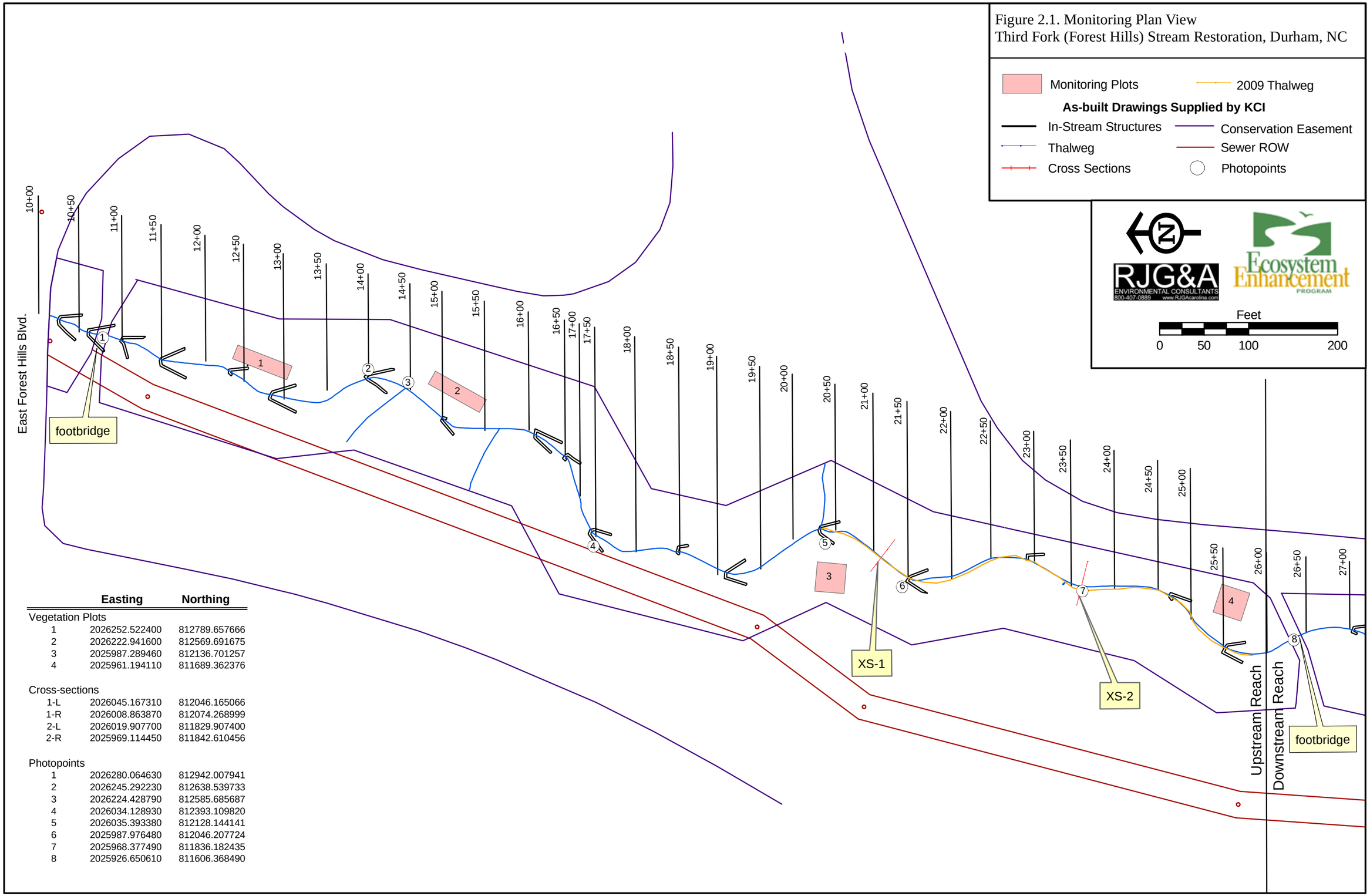
Exhibit Table III. Project Contacts Third Fork Creek Stream Restoration – EEP Project #139	
Design:	KCI Associates of North Carolina, P.A. Landmark Center II, Suite 220 4601 Six Forks Road Raleigh, North Carolina 27609 Mr. Joe Pfeiffer (919) 783-9214
Construction Contractor:	Not Provided
Planting Contractor:	Not Provided
Seeding Contractor:	Not Provided
Seed Mix Sources:	Not Provided
Nursery Stock Suppliers:	Not Provided
Monitoring Performers (2005):	KCI Associates of North Carolina, P.A. Landmark Center II, Suite 220 4601 Six Forks Road Raleigh, North Carolina 27609 Mr. Joe Pfeiffer (919) 783-9214
Monitoring Performers (2006 - 2009):	RJG&A 1221 Corporation Parkway, Suite 100 Raleigh, NC 27616 Mr. Sean Doig (919) 872-1174

Exhibit Table IV. Project Background Third Fork Creek Stream Restoration – EEP Project #139	
County	Durham
Drainage Area	1,126.4 acres (1.76 square miles)
Drainage Impervious Cover Estimate (%)	44%
Stream Order	Second Order
Physiographic Region	Piedmont
Ecoregion	Triassic Basins
Rosgen Classification of As-built	
Upper Reach	F5, G5, E5
Lower Reach	C5
Dominant Soil Types	
Upstream Reach	Congaree
Downstream Reach	Congaree
Reference Site ID	North Prong Creek
USGS HUC for Project and Reference	03030002060120, 0303002060140
NCDWQ Sub-basin for Project and Reference	03-06-05, 03-06-05
NCDWQ Classification for Project and Reference	C
Any portion of the project segment 303d listed?	Yes
Any portion of the project segment upstream of a 303d listed segment?	Yes
Reasons for 303d Listing or Stressor	Turbidity, low dissolved oxygen, fecal coliform bacteria
% of Project Easement Fenced	0%

2.5. Monitoring Plan View

See Figure 2.1 and 2.2 for the Monitoring Plan View.

Figure 2.1. Monitoring Plan View
Third Fork (Forest Hills) Stream Restoration, Durham, NC



	Easting	Northing
Vegetation Plots		
1	2026252.522400	812789.657666
2	2026222.941600	812569.691675
3	2025987.289460	812136.701257
4	2025961.194110	811689.362376
Cross-sections		
1-L	2026045.167310	812046.165066
1-R	2026008.863870	812074.268999
2-L	2026019.907700	811829.907400
2-R	2025969.114450	811842.610456
Photopoints		
1	2026280.064630	812942.007941
2	2026245.292230	812638.539733
3	2026224.428790	812585.685687
4	2026034.128930	812393.109820
5	2026035.393380	812128.144141
6	2025987.976480	812046.207724
7	2025968.377490	811836.182435
8	2025926.650610	811606.368490

	Easting	Northing
Vegetation Plots		
5	2025825.804140	811325.105992
6	2025751.559070	810836.827402
7	2025773.300850	810651.892462
8	2025829.725470	810411.548741
Cross-sections		
3-L	2025870.880914	810673.554871
3-R	2025770.851314	810650.406271
4-L	2025798.603914	810554.818971
4-R	2025759.096714	810575.310971
Photopoints		
9	2025883.659280	811374.025644
10	2025782.503210	811250.741684
11	2025792.618820	811001.328751
12	2025781.870990	810914.081641
13	2025766.697570	810688.630051
14	2025800.837750	810416.773115

Figure 2.2. Monitoring Plan View
Third Fork (Forest Hills) Stream Restoration Durham, NC

Monitoring Plots
2009 Thalweg

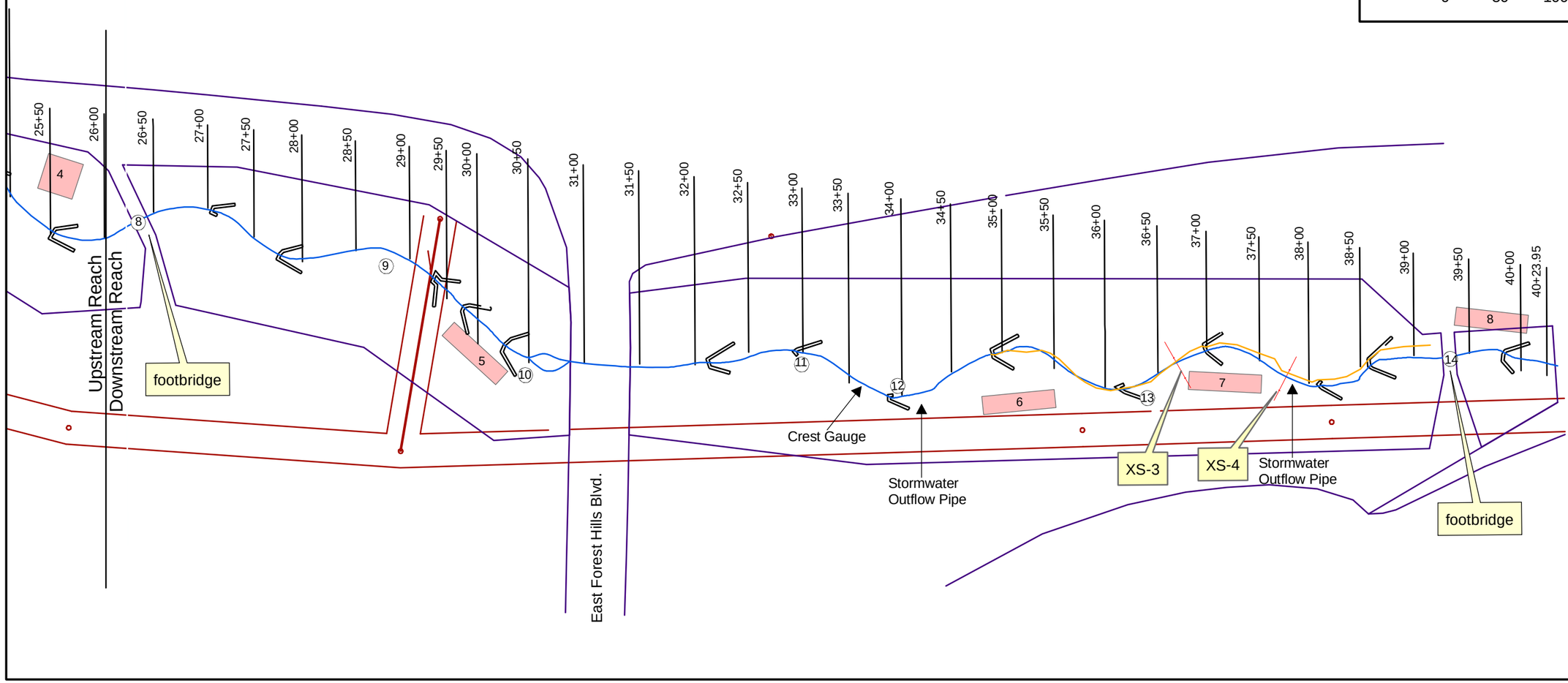
As-built Drawings Supplied by KCI

In-Stream Structures
Conservation Easement
Thalweg
Sewer ROW
Cross Sections
Photopoints

RJG&A ENVIRONMENTAL CONSULTANTS 800-407-0889 www.RJGAcarolina.com

Ecosystem Enhancement PROGRAM

Feet
0 50 100 200



3.0 Project Conditions and Monitoring Results

RJG&A's 2009 initial assessment was completed on 6 March. Quantitative vegetation and geomorphologic data were collected between 1 and 10 June. Another qualitative evaluation was conducted on 3 July and 17 July 2009.

3.1 . Vegetation Assessment

RJG&A staff evaluated the planted woody stem survival in June and July 2009. The average live planted woody stem density (829 live stems per acre) has exceeded the vegetation success criteria (260 live stems per acre in Year 5) by 218 percent. Throughout the riparian buffer restoration area, planted woody stem survival and vigor are high. Non-native invasive species are scattered throughout the site, including *Reynoutria japonica* (Japanese knotweed), *Ampelopsis brevipedunculata* (porcelainberry), *Albizia julibrissin* (mimosa), *Melia azedarach* (chinaberry), *Pyrus calleryana* (callery pear), *Triadica sebifera* (Chinese tallow tree), and *Humulus japonicus* (Japanese hops). Due to its prevalence and its habitat of growing over other vegetation, Japanese hops may represent the greatest threat to the success of planted stems on the site.

Summary vegetation data and monitoring plot photos are located in Appendix A.

3.1.1. Vegetation Problem Areas

See Appendix A.1. Table 6, Appendix A.2. Vegetation Problem Area Photos, and Appendix B.1. Current Conditions Plan View.

3.1.2. Current Conditions Plan View

The Current Conditions Plan View may be found in Appendix B.1.

3.2. Stream Assessment

3.2.1. Procedural Items

3.2.1.1. Morphometric Criteria

RJG&A personnel collected cross section, pebble, and longitudinal profile data in June 2009. Survey data were collected at four cross-sections and along approximately 350 linear feet of both the upstream and downstream reaches. Photographs were taken at the four cross sections and at the 14 permanent photo locations that were established by KCI. The site was also qualitatively assessed and the crest gauge evaluated in July 2009.

3.2.1.2. Hydrologic Criteria

A crest gauge with granulated cork was installed along the right bank at station 33+75 on 13 June 2007. The evaluation of Third Fork Creek in 2009 indicates that at least two storm events resulted in flows over the designed/built bankfull elevation. The crest gauge was evaluated on 6 March 2009 and the only cork remaining inside the gauge was stuck around the cap, indicating that a bankfull storm event had occurred. This conclusion was supported by evidence of rack and drift lines on the bankfull benches throughout the restoration. After this evaluation, the gauge was re-filled with approximately five cubic

inches of ground cork. The gauge was again evaluated on 17 July 2009. Granulated cork was found on the top rim of the crest gauge, indicating that at least one bankfull event had occurred since 6 March. Details about hydrologic evaluations of the site can be found below in Exhibit Table V.

Exhibit Table V. Verification of Bankfull Events
Third Fork Stream Restoration – EEP Project #139

Date of Data Collection	Date of Occurrence	Method	Photo # (if available)
1 November 2006	Based on USGS Gage Data: 22 November 2006	Observed Rack and Drift Lines; Proximal USGS Gage	NA
16 July 2007	13 June 2007 (crest gauge installation date) – 16 July 2007 CRONOS data suggest 14 June or 11 July 2007	Crest Gauge Evaluation	NA
12 October 2007	16 July 2007 – 12 October 2007 CRONOS data suggest 28 July, 15 August, or 23 August 2007	Crest Gauge Evaluation	NA
6 May 2008	12 October 2007 – 5 May 2008 CRONOS data suggest 4 March 2008 or 27-28 April 2008	Crest Gauge Evaluation	NA
28 October 2008	6 May – 28 October 2008 CRONOS data suggest 5 July, 28 August, 6 September, and 26 September 2008	Crest Gauge Evaluation	NA
6 March 2009	29 October 2008 – 6 March 2009 CRONOS data suggests 2 March 2009	Crest Gauge Evaluation	NA
17 July 2009	7 March 2009 – 17 July 2009 CRONOS data suggest 5 June and 10 June 2009	Crest Gauge Evaluation	NA

Table VI BEHI and Sediment Export Estimates. Based on a conversation with the EEP project manager, BEHI was not assessed in Monitoring Year 5 due to a lack of pre-construction and as-built BEHI data.

3.2.2. Current Conditions Plan View

The Current Conditions Plan View can be found in Appendix B.1.

3.2.3. Problem Areas Table

Overall, the site is maintaining its as-built dimension, pattern, and profile. Several areas of bank slump/undercut that were identified in the past have stabilized and are no longer considered problem areas, however new areas of scour and slumping have developed. These problem areas may in part develop due to the fact that the site is located in a highly

urbanized watershed and storm events result in high flows containing a lot of sediment. The problem area table and associated photographs can be found in Appendix B.2. and B.3.

3.2.4. Numbered Issue Photo Section

Representative problem area photos listed in Table B.1. are located in Appendix B.3.

3.2.5. Fixed Station Photos

Permanent photopoint images are located in Appendix B.4.

3.2.6. Stability Assessment Table

The visual stability assessment was conducted in July 2009 and the findings are summarized below. More detailed information can be found in Appendix B.5. Low scores for certain features are due to the accumulation of fine sediment at the site, which is creating filled-in pools, mid-stream bars, off-center thalwegs, overly-active eroding meanders, and slumping banks. This fine sediment is both transported from upstream and off-site into the project area and also enters the stream due to scour and bank slump in the project area. Secondarily, debris build-up in certain stream segments has aggravated this problem. Specific examples of these problems are detailed Appendices B.2. and B.3.

Exhibit Table VII. Categorical Stream Feature Visual Stability Assessment
Third Fork Creek Stream Restoration – EEP Project #139

Feature	Initial*	MY-01	MY-02	MY-03	MY-04	MY-05
Upstream Reach (1600 Feet)						
A. Riffles	100%	NA	92%	86%	78%	82%
B. Pools	100%	NA	87%	87%	80%	80%
C. Thalweg	100%	NA	69%	97%	100%	100%
D. Meanders	100%	NA	90%	98%	98%	92%
E. Bed General	100%	NA	100%	100%	95%	98%
F. Bank	100%	NA	NA	98%	98%	90%
G. Vanes/J Hooks, etc.	100%	NA	93%	96%	96%	96%
H. Wads and Boulders	NA	NA	NA	NA	NA	NA
Downstream Reach (1425 Feet)						
A. Riffles	100%	NA	56%	56%	82%	84%
B. Pools	100%	NA	56%	56%	64%	81%
C. Thalweg	100%	NA	57%	57%	57%	71%
D. Meanders	100%	NA	67%	67%	82%	81%
E. Bed General	100%	NA	100%	100%	100%	99%
F. Bank	100%	NA	NA	NA	81%	91%
F. Vanes/J Hooks, etc.	100%	NA	89%	94%	92%	95%
G. Wads and Boulders	100%	NA	NA	NA	NA	NA

*These percentages are assumed. Neither the As-built Monitoring Report nor the First Year Monitoring Report contained any visual stability assessment data.

Exhibit Table VIII. Baseline Morphology and Hydraulic Summary - Third Fork Creek Stream Restoration– EEP Project #139 – Upstream Reach																		
Parameters	**USGS Data**			**Regional Curve Int.**			**Pre-Existing Condition**			**Reference Reach**			**Design**			**As-Built**		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Bankfull Width (ft)	NA	NA	NA	NA	NA	NA	21.8	26.8	NA	NA	NA	17.8	NA	NA	27	NA	NA	NA
Floodprone Width (ft)	NA	NA	NA	NA	NA	NA	29.2	400.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bankfull Area (sq ft)	NA	NA	NA	NA	NA	NA	45.1	57.2	NA	NA	NA	26.2	NA	NA	60	NA	NA	NA
Mean Depth (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5	NA	NA	2.2	NA	NA	NA
Maximum Depth (ft)	NA	NA	NA	NA	NA	NA	NA	NA	4.7	NA	NA	3.0	NA	NA	4.0	NA	NA	NA
Width/Depth Ratio	NA	NA	NA	NA	NA	NA	8.3	15.9	NA	NA	NA	12.1	NA	NA	12.1	NA	NA	NA
Entrenchment Ratio	NA	NA	NA	NA	NA	NA	1.1	18.3	NA	NA	NA	33.7	2.3	14.8	NA	NA	NA	NA
Bank Height Ratio	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wetted Perimeter (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hydraulic Radius (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pattern																		
Channel Beltwidth (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	158	NA	NA	120.0	NA	NA	NA
Radius of Curvature (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	37.0	40.0	NA	60.0	75.0	NA	NA	NA	NA
Meander Wavelength	NA	NA	NA	NA	NA	NA	NA	NA	NA	94.0	143.0	NA	160	190	NA	NA	NA	NA
Meander Width ratio	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.9	NA	NA	4.4	NA	NA	NA
Profile																		
Riffle length (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Riffle slope (ft/ft)	NA	NA	NA	NA	NA	NA	0.2	0.6	NA	0.2	2.1	NA	0.3	0.3	NA	NA	NA	NA
Pool length (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.0	30.0	NA	27.0	40.0	NA	NA	NA	NA
Pool spacing (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	40.0	85.5	NA	60.0	125.0	NA	NA	NA	NA
Substrate																		
d50 (mm)	NA	NA	NA	NA	NA	NA	0.3	0.4	NA	NA	NA	0.2	0.3	0.4	NA	NA	NA	NA
d84 (mm)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Additional Reach Parameters																		
Valley Length (ft)	NA			NA			NA			NA			NA			NA		
Channel Length (ft)	NA			NA			1890			407			2083			NA		
Sinuosity	NA			NA			1.03			1.28			1.13			NA		
Water Surface Slope (ft/ft)	NA			NA			0.25			0.24			0.25			NA		
BF slope (ft/ft)	NA			NA			NA			NA			NA			NA		
Rosgen Classification	NA			NA			F5, G5, E5			C5			C5			NA		
Habitat Index	NA			NA			NA			NA			NA			NA		
Macrobenthos	NA			NA			NA			NA			NA			NA		

Exhibit Table VIII. Baseline Morphology and Hydraulic Summary - Third Fork Creek Stream Restoration– EEP Project #139 – Downstream Reach																		
Parameters	**USGS Data**			**Regional Curve Int.**			**Pre-Existing Condition**			**Reference Reach**			**Design**			**As-Built**		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Bankfull Width (ft)	NA	NA	NA	NA	NA	NA	NA	NA	29.5	NA	NA	17.8	NA	NA	30.0	NA	NA	NA
Floodprone Width (ft)	NA	NA	NA	NA	NA	NA	62.0	400.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bankfull Area (sq ft)	NA	NA	NA	NA	NA	NA	NA	NA	71.4	NA	NA	26.2	NA	NA	75.0	NA	NA	NA
Mean Depth (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5	NA	NA	NA	NA	2.5	NA	NA	NA
Maximum Depth (ft)	NA	NA	NA	NA	NA	NA	NA	NA	5.8	3.0	NA	NA	NA	NA	4.3	NA	NA	NA
Width/Depth Ratio	NA	NA	NA	NA	NA	NA	NA	NA	12.2	NA	NA	12.1	NA	NA	12.0	NA	NA	NA
Entrenchment Ratio	NA	NA	NA	NA	NA	NA	NA	NA	6.8	NA	NA	33.7	NA	NA	6.7	NA	NA	NA
Bank Height Ratio	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wetted Perimeter (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hydraulic Radius (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pattern																		
Channel Beltwidth (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	158	NA	NA	90.0	NA	NA	NA	NA	NA
Radius of Curvature (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	37.0	40.0	NA	60.0	80.0	NA	NA	NA	NA
Meander Wavelength	NA	NA	NA	NA	NA	NA	NA	NA	NA	94.0	143.0	NA	180	200.0	NA	NA	NA	NA
Meander Width ratio	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.9	NA	NA	3.0	NA	NA	NA
Profile																		
Riffle length (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Riffle slope (ft/ft)	NA	NA	NA	NA	NA	NA	0.3	0.3	NA	0.2	2.1	NA	NA	NA	0.3	NA	NA	NA
Pool length (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.0	30.0	NA	30.0	45.0	NA	NA	NA	NA
Pool spacing (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA	40.0	85.5	NA	70.0	140.0	NA	NA	NA	NA
Substrate																		
d50 (mm)	NA	NA	NA	NA	NA	NA	0.4	0.4	NA	NA	NA	0.2	NA	NA	0.4	NA	NA	NA
d84 (mm)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Additional Reach Parameters																		
Valley Length (ft)	NA			NA			NA			NA			NA			NA		
Channel Length (ft)	NA			NA			900			407			925			NA		
Sinuosity	NA			NA			1.01			1.28			1.10			NA		
Water Surface Slope (ft/ft)	NA			NA			0.20			0.24			0.20			NA		
BF slope (ft/ft)	NA			NA			NA			NA			NA			NA		
Rosgen Classification	NA			NA			C5			C5			C5			NA		
Habitat Index	NA			NA			NA			NA			NA			NA		
Macrobenthos	NA			NA			NA			NA			NA			NA		

Table IX. Morphology and Hydraulic Monitoring Summary - Third Fork Creek Stream Restoration - EEP Project #139 Upstream Reach												
	XS 1-Riffle						XS 2-Pool					
Dimension	As-built	MY1	MY2	MY3	MY4	MY5	As-built	MY1	MY2	MY3	MY4	MY5
Floodprone Width (ft)	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00
Bankfull Width (ft)	27.66	27.11	28.63	27.46	27.35	27.71	26.43	26.39	27.62	27.39	34.54	37.40
Bankfull Area (sq ft)	61.64	61.37	62.47	61.28	63.29	62.64	70.07	72.88	76.71	77.42	83.22	83.64
Mean Depth (ft)	2.23	2.26	2.18	2.23	2.31	2.26	2.65	2.76	2.78	2.83	2.41	2.24
Maximum Depth (ft)	3.96	3.95	4.19	4.23	4.36	4.50	4.81	5.11	5.45	5.59	6.00	5.85
Width/Depth Ratio	12.41	12.00	13.12	11.8	11.82	12.26	9.97	NA	9.94	9.69	14.34	16.72
Entrenchment Ratio	8.68	8.85	8.38	8.74	8.78	8.66	9.08	NA	8.69	8.67	6.95	6.42
Bank Height Ratio	1.00	1.00	1.03	1.02	1.04	1.03	1.00	1.03	1.03	1.03	1.00	1.00
Wetted Perimeter (ft)	NA	NA	30.91	30.12	30.25	30.91	NA	NA	31.70	31.14	38.72	41.16
Hydraulic Radius (ft)	NA	NA	2.02	NA	2.09	2.03	NA	NA	2.42	2.49	2.15	2.03
Substrate												
d50 (mm)	NA	0.06	0.04	0.36	0.04	0.04	NA	0.06	0.09	0.14	0.05	0.17
d84 (mm)	NA	0.06	0.06	1.88	0.09	0.40	NA	0.10	0.78	1.63	0.93	1.56
Pattern		**As-built**		**MY1**		**MY2**		**MY3**		**MY4**		**MY5**
Channel Beltwidth (ft)		NA		NA		33.88		29.28		40.36		40.39
Radius of Curvature (ft)		NA		NA		69.42		60.58		46.09		39.79
Meander Wavelength		NA		NA		177.65		182.45		181.68		181.61
Meander Width ratio		NA		NA		1.20		2.12		1.17		1.29
Profile												
Riffle length (ft)		NA		NA		51.43		55.57		43.37		52.00
Riffle slope (ft/ft)		NA		NA		0.002		0.002		0.002		-0.001
Pool length (ft)		NA		NA		28.60		47.39		54.80		52.75
Pool spacing (ft)		NA		NA		35.95		21.96		43.76		46.00
Additional Reach Parameters												
Valley Length (ft)		NA		NA		310		310		310		310
Channel Length (ft)		NA		NA		350		350		343		341
Sinuosity		NA		NA		1.13		1.13		1.11		1.10
Water Surface Slope (ft/ft)		NA		NA		0.0018		0.0018		0.0016		0.0012
BF slope (ft/ft)		NA		NA		0.0007		0.0007		0.0035		0.0016
Rosgen Classification		NA		NA		C5		C5		C5		C5
Habitat Index		NA		NA		NA		NA		NA		NA
Macrobenthos		NA		NA		NA		NA		NA		NA

Table IX. Morphology and Hydraulic Monitoring Summary - Third Fork Creek Stream Restoration - EEP Project #139 Downstream Reach

	XS 3-Riffle						XS 4-Pool					
Dimension	As-built	MY1	MY2	MY3	MY4	MY5	As-built	MY1	MY2	MY3	MY4	MY5
Floodprone Width (ft)	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00	240.00
Bankfull Width (ft)	30.33	29.00	28.65	32.07	30.28	27.40	24.03	23.29	23.94	24.28	24.69	24.82
Bankfull Area (sq ft)	54.61	53.46	51.94	64.17	69.49	73.68	59.65	60.40	60.73	68.79	63.78	63.55
Mean Depth (ft)	1.80	1.84	1.81	2.17	2.29	2.69	2.48	2.59	2.79	2.83	2.58	2.56
Maximum Depth (ft)	3.28	3.48	3.64	4.59	4.73	5.29	5.00	4.97	4.72	4.77	4.73	4.87
Width/Depth Ratio	16.85	15.70	15.80	13.64	13.19	10.19	9.68	NA	7.81	8.57	9.56	9.69
Entrenchment Ratio	7.91	8.28	8.38	8.11	7.93	8.76	9.99	NA	11.01	9.89	9.72	9.67
Bank Height Ratio	1.08	1.04	1.13	1.15	1.07	1.04	1.11	1.12	1.05	1.09	1.13	1.09
Wetted Perimeter (ft)	NA	NA	31.23	32.35	32.93	31.36	NA	NA	25.36	27.91	28.20	27.91
Hydraulic Radius (ft)	NA	NA	1.66	1.98	2.11	2.35	NA	NA	2.39	2.46	2.26	2.28
Substrate												
d50 (mm)		0.49	6.27	0.76	0.76	0.06		1.00	0.85	0.78	1.14	0.76
d84 (mm)		1.50	16.60	9.65	9.65	0.45		2.00	11.30	3.17	4.42	4.85
Pattern		**As-built**		**MY1**		**MY2**		**MY3**		**MY4**		**MY5**
Channel Beltwidth (ft)		NA		NA		35.77		47.47		47.53		46.95
Radius of Curvature (ft)		NA		NA		57.96		56.59		40.69		41.74
Meander Wavelength		NA		NA		162.56		183.76		176.63		171.17
Meander Width ratio		NA		NA		1.54		1.61		1.48		1.42
Profile												
Riffle length (ft)		NA		NA		14.24		8.45		35.67		41.00
Riffle slope (ft/ft)		NA		NA		0.02		0.03		0.02		0.02
Pool length (ft)		NA		NA		101.45		51.15		53.00		61.33
Pool spacing (ft)		NA		NA		23.28		30.45		57.00		47.00
Additional Reach Parameters												
Valley Length (ft)		NA		NA		308		310		310		310
Channel Length (ft)		NA		NA		350		350		353		345
Sinuosity		NA		NA		1.14		1.13		1.14		1.11
Water Surface Slope (ft/ft)		NA		NA		0.0009		0.001		0.0008		0.0018
BF slope (ft/ft)		NA		NA		0.0003		0.0046		0.0021		0.0029
Rosgen Classification		NA		NA		C5b		E5		E5		E5
Habitat Index		NA		NA		NA		NA		NA		NA
Macrobenthos		NA		NA		NA		NA		NA		NA

IV. Methodology

Monitoring methodologies follow the current EEP-provided templates and guidelines (Lee *et al* 2006). Photographs were taken digitally. A Trimble Geo XT handheld mapping-grade unit was used to collect cross section, vegetation corner, photopoint, and problem area locations. Additional notations were written on the spring 2009 versions of the CCPV.

4.1. Stream Methodology

Methods employed were a combination those specified in the Mitigation Plan, the First Annual Monitoring Report, and standard regulatory guidance and procedures documents. Stream monitoring data was collected using the techniques described in US ACE Stream Mitigation Guidelines, US Forest Service's Stream Channel Reference Sites, and Applied River morphology (USACE, 2003; Harrelson et al., 1994; Rosgen, 1996). A South Total Station and Nikon automatic level were used for collecting all geomorphic data. Photographs facing downstream were taken at each cross section.

4.2. Vegetation Methodology

Eight representative vegetation survey plots were selected and installed in the upstream and downstream reaches during September 2006. Where appropriate, the new monitoring plots were co-located with the first year monitoring plots. All plots measure 100 square meters in area and are either 10 meters by 10 meters, or five meters by 20 meters. Pursuant to the guidelines, the four corners of each plot (e.g. 0,0; 0,10; 10,0; and 10,10; or 0,0; 0,20; 5,0; and 5,20.) marked with 18 inch long one half inch diameter galvanized steel conduit were relocated in 2008. Within each plot, each planted woody stem location (x and y) recorded in 2006 was relocated. No mortality was observed.

Level 1 (planted woody stems) and Level 2 (volunteer woody stems) data collection was performed in all plots, pursuant to the most recent CVS/EEP protocol (Lee *et al* 2006). Within each plot, each planted woody stem location (x and y) was recorded, and height and live stem diameter were recorded for each stem location. All planted stems were identified with pink flagging. Vegetation was identified using Weakley (Weakley 2007). Photos were taken of each vegetation plot from the 0,0 corner. Because the dimensions of the plots installed in 2006 are different than the first annual vegetation monitoring plots, direct comparison with the first year data is inappropriate.

Tables 1 through 5 in Appendix A contain the data from the vegetation monitoring. Monitoring plot photos can also be found in Appendix A.

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Appendix A Vegetation Data

A.1. Table 1. Vegetation Metadata - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

Report Prepared By	sean doig
Date Prepared	7/21/2009 13:40
database name	ThirdFork.mdb
database location	C:\Documents and Settings\Owner\Desktop\EEP 2009
computer name	GATELAP
file size	42991616

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.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.

PROJECT SUMMARY	
Project Code	139
project Name	Forest Hills
Description	Stream Restoration
River Basin	Cape Fear
length(ft)	3025
stream-to-edge width (ft)	50
area (sq m)	35948
Required Plots (calculated)	8
Sampled Plots	8

A.1. Table 2. Vigor by Species - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

	Species	4	3	2	1	0	Missing	Unknown
	Alnus serrulata	15				1		
	Amelanchier arborea	1						
	Betula nigra	12						
	Callicarpa americana	21		1	1	1		
	Cephalanthus occidentalis	1				1		
	Clethra alnifolia	1						
	Cornus amomum	15						
	Fraxinus pennsylvanica	16					1	
	Itea virginica	11	1		1	1		
	Salix nigra	2						
	Sambucus canadensis	4						
	Symphoricarpos orbiculatus	15		1				
	Viburnum nudum	2						
	Morella cerifera	9						
	Viburnum dentatum	6	1					
	Ilex decidua	3						
	Ilex opaca	3						
	Cercis canadensis	1						
	Hamamelis virginiana	8						
	Platanus occidentalis	16		1			1	
TOT:	**20**	**162**	**2**	**3**	**2**	**4**	**2**	

A.1. Table 3. Damage by Species - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

	Species	All Damage Categories	(no damage)	(other damage)
	Alnus serrulata	16	16	
	Amelanchier arborea	1	1	
	Betula nigra	12	12	
	Callicarpa americana	24	23	1
	Cephalanthus occidentalis	2	2	
	Cercis canadensis	1	1	
	Clethra alnifolia	1	1	
	Cornus amomum	15	15	
	Fraxinus pennsylvanica	17	17	
	Hamamelis virginiana	8	8	
	Ilex decidua	3	3	
	Ilex opaca	3	3	
	Itea virginica	14	13	1
	Morella cerifera	9	9	
	Platanus occidentalis	18	18	
	Salix nigra	2	2	
	Sambucus canadensis	4	4	
	Symphoricarpos orbiculatus	16	16	
	Viburnum dentatum	7	6	1
	Viburnum nudum	2	2	
TOT:	**20**	**175**	**172**	**3**

A.1. Table 4. Damage by Plot - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

	plot	All Damage Categories	(no damage)	(other damage)
	E139-jo,sd-0005-year:3	10	10	
	E139-jo,sd-0007-year:3	17	17	
	E139-sd-0008-year:3	10	10	
	E139-wjs-0001-year:3	35	33	2
	E139-WJS-0002-year:3	29	29	
	E139-wjs-0003-year:3	32	31	1
	E139-wjs-0004-year:3	12	12	
	E139-WM-0006-year:3	30	30	
TOT:	**8**	**175**	**172**	**3**

A.1. Table 5. Planted Stems by Plot and Species - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

	Species	Total Planted Stems	# plots	avg# stems	Plot 5	Plot 7	Plot 8	Plot 1	Plot 2	Plot 3	Plot 4	Plot 6
	Alnus serrulata	15	7	2.14	1	2		4	1	3	1	3
	Amelanchier arborea	1	1	1			1					
	Betula nigra	12	7	1.71	1	2	1		2	1	2	3
	Callicarpa americana	23	6	3.83		2	1	5	8	4		3
	Cephalanthus occidentalis	1	1	1						1		
	Cercis canadensis	1	1	1				1				
	Clethra alnifolia	1	1	1				1				
	Cornus amomum	15	8	1.88	2	1	1	3	3	2	1	2
	Fraxinus pennsylvanica	16	6	2.67	2		2		3	3	2	4
	Hamamelis virginiana	8	6	1.33		1	2	1	1	1		2
	Ilex decidua	3	3	1	1			1	1			
	Ilex opaca	3	2	1.5				1			2	
	Itea virginica	13	5	2.6		2		5	1	4		1
	Morella cerifera	9	4	2.25		3		2		1		3
	Platanus occidentalis	17	7	2.43		2	1	6	2	1	2	3
	Salix nigra	2	1	2	2							
	Sambucus canadensis	4	3	1.33		1		1				2
	Symphoricarpos orbiculatus	16	8	2	1	1	1	2	3	4	2	2
	Viburnum dentatum	7	2	3.5					3	4		
	Viburnum nudum	2	2	1					1			1
TOT:	**20**	**169**	**20**		**10**	**17**	**10**	**33**	**29**	**29**	**12**	**29**

Appendix A.1.

A.1. Table 6. Vegetation Problem Area Table - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139			
Feature/Issue	**Station/ Range**	**Probable Cause**	**Photo #**
Reynoutria japonica (Japanese knotweed), *Ampelopsis brevipedunculata* (porcelainberry), *Albizia julibrissin* (mimosa), *Melia azedarach* (chinaberry), *Pyrus calleryana* (callery pear), *Triadica sebifera* (Chinese tallow tree)	1000-4024	Introduction of waterborne seeds from offsite	VP1-shows Japanese hops and Japanese knotweed
Japanese hops (*Humulus japonicus*)	1145-1215	Introduction of waterborne seeds from offsite	VP1-VP4
Japanese hops (*Humulus japonicus*)	1205-1255	Introduction of waterborne seeds from offsite	VP1-VP4
Japanese hops (*Humulus japonicus*)	1235-1380	Introduction of waterborne seeds from offsite	VP1-VP4
Japanese hops (*Humulus japonicus*)	1335-1360	Introduction of waterborne seeds from offsite	VP1-VP4
Japanese hops (*Humulus japonicus*)	1340-1355	Introduction of waterborne seeds from offsite	VP1-VP4
Japanese hops (*Humulus japonicus*)	1600-1650	Introduction of waterborne seeds from offsite	VP1-VP4
Japanese hops (*Humulus japonicus*)	1750-1800	Introduction of waterborne seeds from offsite	VP1-VP4
Japanese hops (*Humulus japonicus*)	1930-2000	Introduction of waterborne seeds from offsite	VP1-VP4
Japanese hops (*Humulus japonicus*)	2180-2205	Introduction of waterborne seeds from offsite	VP1-VP4
Japanese hops (*Humulus japonicus*)	2480-2585	Introduction of waterborne seeds from offsite	VP1-VP4
Japanese hops (*Humulus japonicus*)	2940-2955	Introduction of waterborne seeds from offsite	VP1-VP4
Japanese hops (*Humulus japonicus*)	3070-3090	Introduction of waterborne seeds from offsite	VP1-VP4
Japanese hops (*Humulus japonicus*)	3145-3200	Introduction of waterborne seeds from offsite	VP1-VP4
Japanese hops (*Humulus japonicus*)	3150-3205	Introduction of waterborne seeds from offsite	VP1-VP4
Japanese hops (*Humulus japonicus*)	3260-3320	Introduction of waterborne seeds from offsite	VP1-VP4

A.1. Table 6. Vegetation Problem Area Table - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139			
Feature/Issue	**Station/ Range**	**Probable Cause**	**Photo #**
Japanese hops (*Humulus japonicus*)	3380-3465	Introduction of waterborne seeds from offsite	VP1-VP4
Japanese hops (*Humulus japonicus*)	3515-3540	Introduction of waterborne seeds from offsite	VP1-VP4
Japanese hops (*Humulus japonicus*)	3565-3580	Introduction of waterborne seeds from offsite	VP1-VP4
Japanese hops (*Humulus japonicus*)	3750-3780	Introduction of waterborne seeds from offsite	VP1-VP4

A.1. Table 7. Stem Count Total and Planted by Plot and Species - Forest Hills/Third Fork Creek
EEP Project Code 139. Project Name: Forest Hills

			Current Plot Data (MY3 2009)																							
			E139-jo,sd-0005			E139-jo,sd-0007			E139-sd-0008			E139-wjs-0001			E139-WJS-0002			E139-wjs-0003			E139-wjs-0004			E139-WM-0006		
Scientific Name	Common Name	Species Type	P-LS	P-all	T	P-LS	P-all	T	P-LS	P-all	T	P-LS	P-all	T	P-LS	P-all	T	P-LS	P-all	T	P-LS	P-all	T	P-LS	P-all	T
Acer negundo	boxelder	Tree						2																		
Acer rubrum	red maple	Tree																								
Albizia julibrissin	silktree	Shrub Tree																								
Alnus serrulata	hazel alder	Shrub Tree		1	1		2	2					4	4		1	1		3	3		1	1		3	3
Amelanchier arborea	common serviceberry	Shrub Tree								1	1															
Baccharis halimifolia	eastern baccharis	Shrub Tree																								
Betula nigra	river birch	Tree		1	1		2	2		1	1					2	2		1	1		2	2		3	3
Callicarpa americana	American beautyberry	Shrub					2	2		1	1		5	5		8	8		4	4					3	3
Catalpa speciosa	northern catalpa	Tree			2			3						3									1			1
Cephalanthus occidentalis	common buttonbush	Shrub Tree																	1	1						
Cercis canadensis	eastern redbud	Shrub Tree											1	1												
Clethra alnifolia	coastal sweetpepperbu	Shrub											1	1												
Cornus amomum	silky dogwood	Shrub	2	2	2		1	1		1	1		3	3		3	3		2	2	1	1	1		2	2
Fraxinus pennsylvanica	green ash	Tree		2	2			4		2	2					3	3		3	3		2	2		4	23
Hamamelis virginiana	American witchhazel	Shrub Tree					1	1		2	2		1	1		1	1		1	1					2	2
Ilex decidua	possumhaw	Shrub Tree		1	1								1	1		1	1									
Ilex opaca	American holly	Shrub Tree											1	1								2	2			1
Itea virginica	Virginia sweetspire	Shrub					2	2					5	5		1	1		4	4					1	1
Juniperus virginiana	eastern redcedar	Tree																								3
Liquidambar styraciflua	sweetgum	Tree						7												1			18			8
Morella cerifera	wax myrtle	Shrub Tree					3	3					2	2					1	1					3	3
Paulownia tomentosa	princesstree	Tree																								
Pinus taeda	loblolly pine	Tree																		5						9
Platanus occidentalis	American sycamore	Tree					2	3		1	1		6	8		2	2		1	1		2	3		3	5
Prunus	plum	Shrub Tree																								
Prunus serotina	black cherry	Shrub Tree																								2
Quercus phellos	willow oak	Tree																		1						
Salix nigra	black willow	Tree	2	2	3																					
Sambucus canadensis	Common Elderberry	Shrub Tree					1	1					1	1											2	3
Symphoricarpos orbiculatus	coralberry	Shrub		1	1		1	1		1	1		2	2		3	3		4	4		2	2		2	2
Taxodium distichum	bald cypress	Tree																		1						
Ulmus	elm	Tree												1												
Ulmus alata	winged elm	Tree																					2			
Ulmus americana	American elm	Tree																								
Ulmus rubra	slippery elm	Tree						1																		
Vaccinium	blueberry	Shrub Vine Tree																								
Viburnum dentatum	southern arrowwood	Shrub Tree														3	3		4	4						
Viburnum nudum	possumhaw	Shrub Tree														1	1								1	1
	Stem count		4	10	13	0	17	35	0	10	10	0	33	39	0	29	29	0	29	37	1	12	34	0	29	75
	size (ares)		1			1			1			1			1			1			1			1		
	size (ACRES)		0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
	Species count		2	7	8	0	10	15	0	8	8	0	13	15	0	12	12	0	12	16	1	7	10	0	12	18
	Stems per ACRE		161.9	404.7	526.1	0	688	1416	0	404.7	404.7	0	1335	1578	0	1174	1174	0	1174	1497	40.47	485.6	1376	0	1174	3035

A.1. Table 7. Stem Count Total and Planted by Plot and Species
EEP Project Code 139. Project Name: Forest Hills

			Annual Means											
			MY3 (2009)			MY2 (2008)			MY1 (2007)			MY0 (2006)		
Scientific Name	Common Name	Species Type	P-LS	P-all	T	P-LS	P-all	T	P-LS	P-all	T	P-LS	P-all	T
Acer negundo	boxelder	Tree			2						1			
Acer rubrum	red maple	Tree									1			13
Albizia julibrissin	silktree	Shrub Tree									3		1	3
Alnus serrulata	hazel alder	Shrub Tree		15	15		16	16		17	19		17	17
Amelanchier arborea	common serviceberry	Shrub Tree		1	1		1	1		1	2		1	3
Baccharis halimifolia	eastern baccharis	Shrub Tree												1
Betula nigra	river birch	Tree		12	12		12	12		12	13		12	12
Callicarpa americana	American beautyberry	Shrub		23	23		24	24		23	25		25	25
Catalpa speciosa	northern catalpa	Tree			10									
Cephalanthus occidentalis	common buttonbush	Shrub Tree		1	1		2	2			2			
Cercis canadensis	eastern redbud	Shrub Tree		1	1		1	1		1	1		2	2
Clethra alnifolia	coastal sweetpepperbu	Shrub		1	1		1	1		1	1			
Cornus amomum	silky dogwood	Shrub	3	15	15	3	15	15	3	15	15	3	16	16
Fraxinus pennsylvanica	green ash	Tree		16	39		18	18		23	30		23	23
Hamamelis virginiana	American witchhazel	Shrub Tree		8	8		8	8		7	8		7	7
Ilex decidua	possumhaw	Shrub Tree		3	3		3	3		4	4		4	4
Ilex opaca	American holly	Shrub Tree		3	4		4	4		4	4		4	4
Itea virginica	Virginia sweetspire	Shrub		13	13		14	14		13	15		14	14
Juniperus virginiana	eastern redcedar	Tree			3									
Liquidambar styraciflua	sweetgum	Tree			34						47			11
Morella cerifera	wax myrtle	Shrub Tree		9	9		9	9		9	11		9	9
Paulownia tomentosa	princesstree	Tree									5			9
Pinus taeda	loblolly pine	Tree			14						6			3
Platanus occidentalis	American sycamore	Tree		17	23		18	18		18	26		18	30
Prunus	plum	Shrub Tree												1
Prunus serotina	black cherry	Shrub Tree			2						3			1
Quercus phellos	willow oak	Tree			1						2			4
Salix nigra	black willow	Tree	2	2	3	2	2	2	2	2	2	2	2	3
Sambucus canadensis	Common Elderberry	Shrub Tree		4	5		4	4		4	5		3	4
Symphoricarpos orbiculatus	coralberry	Shrub		16	16		17	17		16	17		17	17
Taxodium distichum	bald cypress	Tree			1						1			2
Ulmus	elm	Tree			1									6
Ulmus alata	winged elm	Tree			2									1
Ulmus americana	American elm	Tree												3
Ulmus rubra	slippery elm	Tree			1						6			
Vaccinium	blueberry	Shrub Vine Tre									1			
Viburnum dentatum	southern arrowwood	Shrub Tree		7	7		7	7		7	7		7	7
Viburnum nudum	possumhaw	Shrub Tree		2	2		2	2		2	2		1	1
		Stem count	5	169	272	5	178	178	5	179	285	5	183	256
		size (ares)		8			8			8			8	
		size (ACRES)		0.20			0.20			0.20			0.20	
		Species count	2	20	31	2	20	20	2	19	31	2	19	31
		Stems per ACRE	25.29	854.9	1376	25.29	900.4	900.4	25.29	905.5	1442	25.29	925.7	1295

A.2. Representative Vegetation Problem Photos - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

VP1 (7/17/2009)

VP2 (7/17/2009)

VP3 (7/17/2009)

VP4 (7/17/2009)

A.3. Vegetation Monitoring Plot Photographs - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

Plot 1 (September 21, 2006)

Plot 1 (June 1, 2009)

Plot 2 (September 21, 2006)

Plot 2 (June 1, 2009)

A.3. Vegetation Monitoring Plot Photographs - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

Plot 3 (September 21, 2006)

Plot 3 (June 1, 2009)

Plot 4 (July 20, 2007)

Plot 4 (June 1, 2009)

A.3. Vegetation Monitoring Plot Photographs - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

Plot 5 (July 20, 2007)

Plot 5 (June 1, 2009)

Plot 6 (July 20, 2007)

Plot 6 (June 2, 2009)

A.3. Vegetation Monitoring Plot Photographs - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

Plot 7 (September 21, 2006)

Plot 7 (June 2, 2009)

Plot 8 (September 22, 2006)

Plot 8 (June 2, 2009)

Appendix B Geomorphologic Raw Data

Figure B1. Current Conditions Plan View

B2. Stream Problem Areas Table

B3. Representative Stream Problem Area Photos

B4. Stream Photo-station Photos

B5. Qualitative Visual Stability Assessment Table

B6. Cross section Plots and Raw Data Tables

B7. Longitudinal Plots and Raw Data Tables

B8. Pebble Counts

B.1.1. Current Condition Plan View - Upstream - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

2009 Thalweg (6/3/2009)

Stream Problem Areas

Aggradation (Pool)

UT/Stormwater Headcut

Bank Undercut/Slump

Vegetation Problem Areas

Japanese Hops

As-built Drawings Supplied by KCI

In-Stream Structures

Thalweg

Cross Sections

Photopoints

Conservation Easement

Sewer ROW

Monitoring Plots

East Forest Hills Blvd.

10+00 10+50 11+00 11+50 12+00 12+50 13+00 13+50 14+00 14+50 15+00 15+50 16+00 16+50 17+00 17+50 18+00 18+50 19+00 19+50 20+00 20+50 21+00 21+50 22+00 22+50 23+00 23+50 24+00 24+50 25+00 25+50 26+00 26+50 27+00

footbridge

1 2 3 4 5 6 7 8

1 2 3 4

XS-1

XS-2

Upstream Reach

Downstream Reach

footbridge

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Ecosystem Enhancement PROGRAM

N

Feet

0 25 50 100 150 200

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Ecosystem Enhancement PROGRAM

N

Feet
0 50 100 200

B.1.2. Current Condition Plan View - Downstream - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

2009 Thalweg (6/4/2009)

Stream Problem Areas

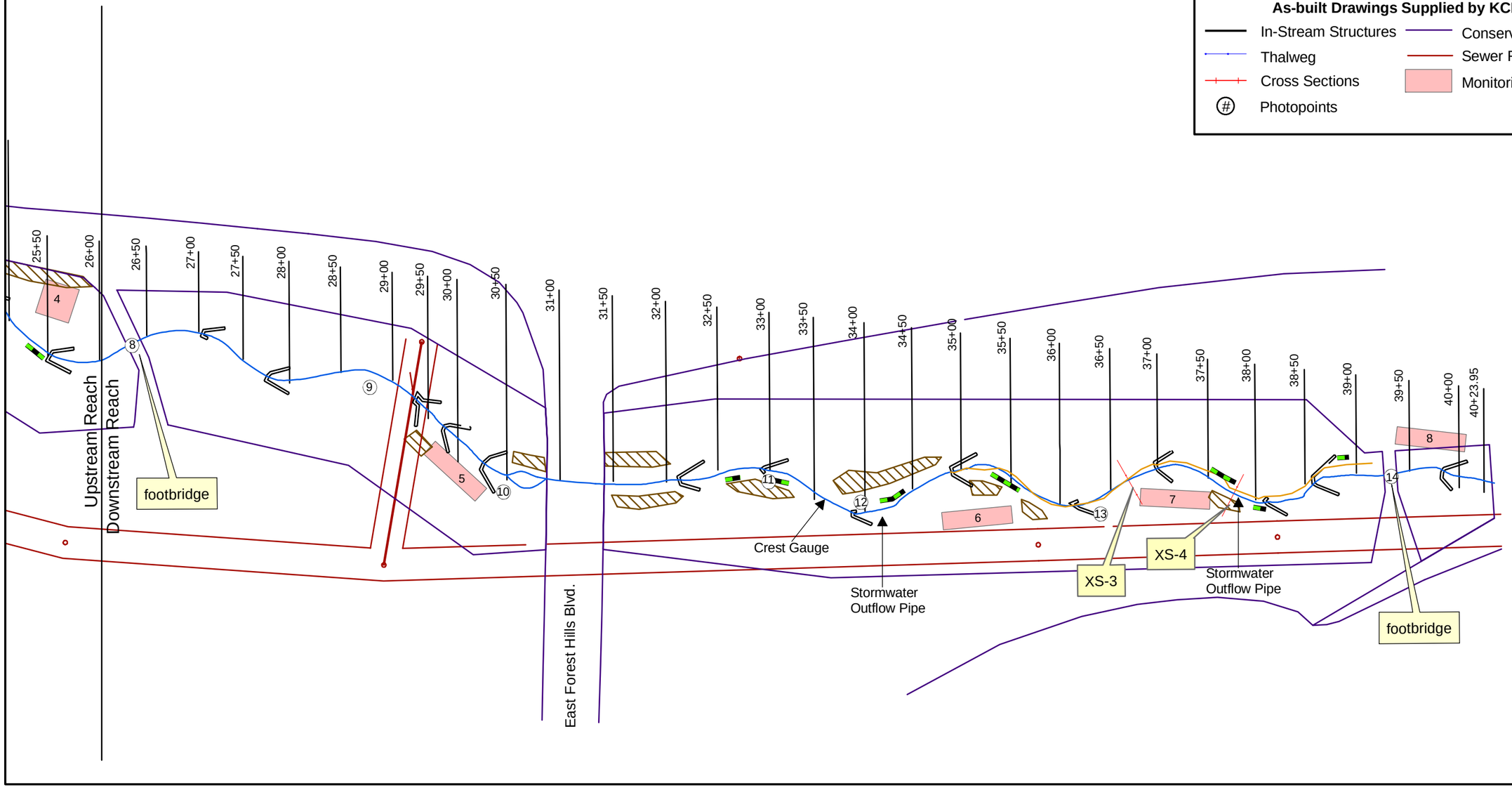
Aggradation (Pool)
UT/Stormwater Headcut
Bank Undercut/Slump

Vegetation Problem Areas

Japanese Hops

As-built Drawings Supplied by KCI

In-Stream Structures
Thalweg
Cross Sections
Photopoints
Conservation Easement
Sewer ROW
Monitoring Plots



B.2. Stream Problem Areas Table - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

Feature/Issue	Station	Suspected Cause	Photo #
Aggradation (pool)	1025	Sediment from offsite/upstream	SP1
Aggradation (pool)	1110	Sediment from offsite/upstream	SP1
Aggradation (pool)	1158	Sediment from offsite/upstream	SP1
Right Bank Scour/Slump	1190-1205	No armor/rootwad	SP3 & SP4
Aggradation (pool)	1290	Sediment from offsite/upstream	SP1
Right Bank Scour/Slump	1345-1360	No armor/rootwad	SP3 & SP4
Left Bank Scour/Slump	1355-1367	No armor/rootwad	SP3 & SP4
Headcut at UT/stormwater	1443	Insufficient armor	SP2
Right Bank Scour/Slump	1900-1910	No armor/rootwad	SP3 & SP4
Right Bank Scour/Slump	1930-1960	No armor/rootwad	SP3 & SP4
Right Bank Scour/Slump	1940-1960	No armor/rootwad	SP3 & SP4
Right Bank Scour/Slump	2180-2186	No armor/rootwad	SP3 & SP4
Left Bank Scour/Slump	2222-2234	No armor/rootwad	SP3 & SP4
Right Bank Scour/Slump	2480-2485	No armor/rootwad	SP3 & SP4
Right Bank Scour/Slump	2530-2548	No armor/rootwad	SP3 & SP4
Right Bank Scour/Slump	3270-3285	No armor/rootwad	SP3 & SP4
Right Bank Scour/Slump	3410-3430	No armor/rootwad	SP3 & SP4
Left Bank Scour/Slump	3415-3440	No armor/rootwad	SP3 & SP4
Right Bank Scour/Slump	3525-3555	No armor/rootwad	SP3 & SP4
Left Bank Scour/Slump	3750-3780	No armor/rootwad	SP3 & SP4
Right Bank Scour/Slump	3800-3810	No armor/rootwad	SP3 & SP4
Left Bank Scour/Slump	3850-3863	No armor/rootwad	SP3 & SP4

B.3. Stream Problem Photos - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

SP1-Aggradation (pool) (7/6/2009)

SP2-Headcut in UT/Stormwater (7/17/2009)

SP3-Bank slump (7/6/2009)

SP4-Bank scour (7/17/2009)

B.4. Permanent Photopoint Photographs - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

PP #1 – Looking Upstream (11/20/06)

PP #1 – Looking Upstream (03/06/09)

PP #2 – Looking Upstream (11/20/06)

PP #2 – Looking Upstream (03/06/09)

B.4. Permanent Photopoint Photographs - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

PP #3 – Ditch Entering Stream (11/20/06)

PP #3 – Ditch Entering Stream (03/11/09)

PP #4 – Looking Downstream (11/20/06)

PP #4 – Looking Downstream (03/06/09)

B.4. Permanent Photopoint Photographs - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

PP #5 – UT Entering Stream (11/20/06)

PP #5 – UT Entering Stream (03/06/09)

PP #6 – Looking Downstream (11/20/06)

PP #6 – Looking Downstream (03/06/09)

B.4. Permanent Photopoint Photographs - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

PP #7 – Looking Downstream (11/20/06)

PP #7 – Looking Downstream (03/06/09)

PP #8 – Looking Upstream (07/16/07)

PP #8 – Looking Upstream (03/06/09)

B.4. Permanent Photopoint Photographs - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

PP #9 – Looking Upstream (11/20/06)

PP #9 – Looking Upstream (7/23/09)

PP #10 – Looking Downstream (07/16/07)

PP #10 – Looking Downstream (03/06/09)

B.4. Permanent Photopoint Photographs - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

PP #11 – Looking Upstream (11/20/06)

PP #11 – Looking Upstream (03/11/09)

PP #12 – Looking Upstream (11/20/06)

PP #12 – Looking Upstream (03/11/09)

B.4. Permanent Photopoint Photographs - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

PP #13 – Looking Upstream (11/20/06)

PP #13 – Looking Upstream (03/11/09)

PP #14 – Looking Upstream (11/20/06)

PP #14 – Looking Upstream (03/11/09)

B.5. Qualitative Visual Stability Assessment Table - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

Upstream Reach (1600 feet)

Feature Category	Metric (per As-built and reference baselines)	(# Stable) Number Performing as Intended	Total Number per As-built	Total Number/ feet in Unstable State	Percent Performing in Stable Condition	Feature Performing Mean (%)
A. Riffles	1. Present	10	10	NA	100	
	2. Armor stable	10	10	NA	100	
	3. Facet grade appears stable	10	10	NA	100	
	4. Minimal evidence of embedding/fining	3	10	NA	30	
	5. Length appropriate	8	10	NA	80	**82**
B. Pools	1. Present	13	15	NA	87	
	2. Sufficiently deep	12	15	NA	80	
	3. Length appropriate	11	15	NA	73	**80**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering	16	16	NA	100	
	2. Downstream of meander (glide/inflection) centering	16	16	NA	100	**100**
D. Meanders	1. Outer bend in state of limited/controlled erosion	12	16	NA	75	
	2. Of those eroding, # w/concomitant point bar formation	0	4	NA		
	3. Apparent Rc within spec	16	16	NA	100	
	4. Sufficient floodplain access and relief	16	16	NA	100	**92**
E. Bed (General)	1. General channel bed aggradation areas (bar formation)	NA	NA	0/0	100	
	2. Channel bed degradation – areas of increasing downcutting or head cutting	NA	NA	2/60	96	**98**
F. Bank	1. Actively eroding, wasting, or slumping bank	NA	NA	10/161	90	**90**
G. Vanes	1. Free of back or arm scour	15	18	NA	83	
	2. Height appropriate	18	18	NA	100	
	3. Angle and geometry appear appropriate	18	18	NA	100	
	4. Free of piping or other structural failures	18	18	NA	100	**96**
H. Wads/ Boulders	1. Free of scour	NA	NA	NA	NA	
	2. Footing stable	NA	NA	NA	NA	**NA**

B.5. Qualitative Visual Stability Assessment Table - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

Downstream Reach (1525 feet)

Feature Category	Metric (per As-built and reference baselines)	(# Stable) Number Performing as Intended	Total Number per As-built	Total Number/ feet in Unstable State	Percent Performing in Stable Condition	Feature Performing Mean (%)
A. Riffles	1. Present	10	10	NA	100	
	2. Armor stable	10	10	NA	100	
	3. Facet grade appears stable	10	10	NA	100	
	4. Minimal evidence of embedding/fining	5	10	NA	50	
	5. Length appropriate	7	10	NA	70	**84**
B. Pools	1. Present	11	12	NA	92	
	2. Sufficiently deep	10	12	NA	83	
	3. Length appropriate	8	12	NA	67	**81**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering	5	7	NA	71	
	2. Downstream of meander (glide/inflection) centering	5	7	NA	71	**71**
D. Meanders	1. Outer bend in state of limited/controlled erosion	5	7	NA	71	
	2. Of those eroding, # w/concomitant point bar formation	0	2	NA		
	3. Apparent Rc within spec	5	7	NA	71	
	4. Sufficient floodplain access and relief	7	7	NA	100	**81**
E. Bed (General)	1. General channel bed aggradation areas (bar formation)	NA	NA	0	100	
	2. Channel bed degradation – areas of increasing downcutting or head cutting	NA	NA	2/30	98	**99**
F. Bank	1. Actively eroding, wasting, or slumping bank	NA	NA	7/140	91	**91**
G. Vanes	1. Free of back or arm scour	12	14	NA	86	
	2. Height appropriate	13	14	NA	93	
	3. Angle and geometry appear appropriate	14	14	NA	100	
	4. Free of piping or other structural failures	14	14	NA	100	**95**
H. Wads/ Boulders	1. Free of scour	NA	NA	NA	NA	
	2. Footing stable	NA	NA	NA	NA	**NA**

B.6. Cross Section Plots with Annual Overlays - Forest Hills/Third Fork Stream Restoration - MY5 (2009) - Project #139

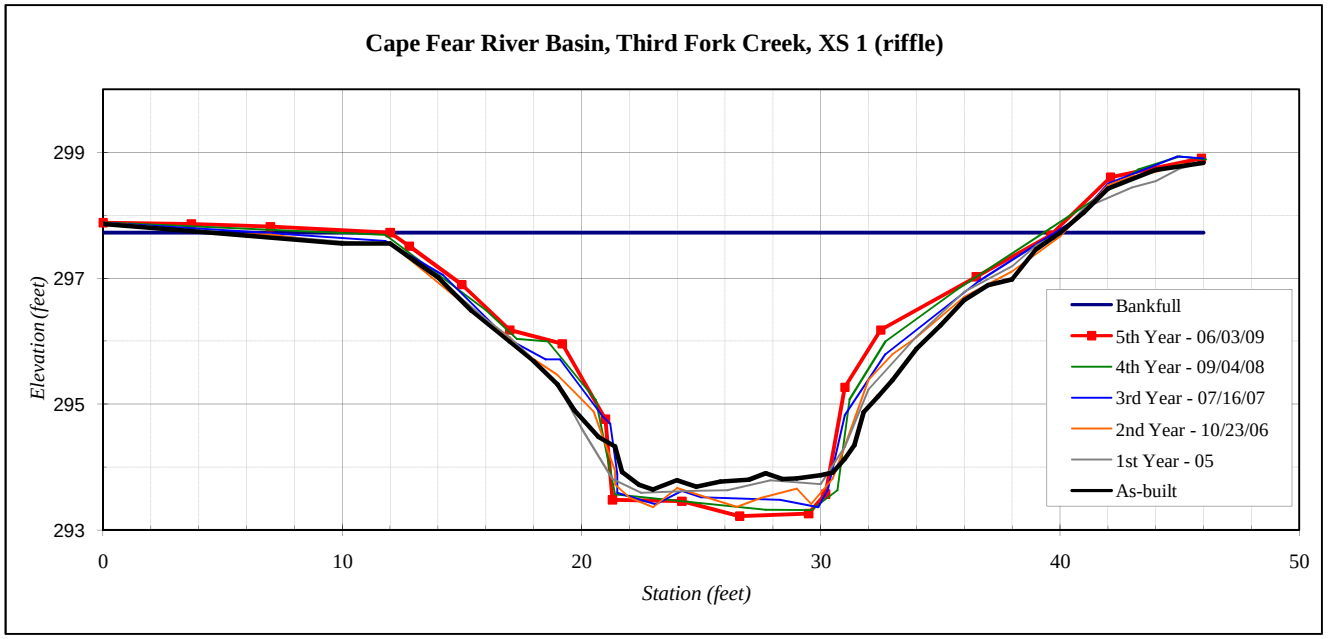
River Basin:	Cape Fear
Watershed:	Third Fork Creek
XS ID	XS 1 (riffle)
Reach:	Upstream
Date:	6/3/2009
Field Crew:	J. O'Neal, S. Doig

Station	Elevation
0	297.88
3.7	297.86
7	297.82
12	297.72
12.8	297.51
15	296.9
17	296.18
19.2	295.96
21	294.76
21.3	293.48
24.2	293.46
26.6	293.22
29.5	293.26
30.2	293.57
31	295.27
32.5	296.18
36.5	297.02
39.60	297.68
42.1	298.6
45.9	298.9

SUMMARY DATA	
Floodprone Elevation (ft)	302.22
Bankfull Elevation (ft)	297.72
Floodprone Width (ft)	240.00
Bankfull Width (ft)	27.71
Entrenchment Ratio	8.66
Mean Depth (ft)	2.26
Maximum Depth (ft)	4.50
Width/Depth Ratio	12.26
Bankfull Area (sq ft)	62.64
Wetted Perimeter (ft)	30.91
Hydraulic Radius (ft)	2.03

View of cross-section #1 looking downstream

Stream Type:	C5



B.6. Cross Section Plots with Annual Overlays - Forest Hills/Third Fork Stream Restoration - MY5 (2009) - Project #139

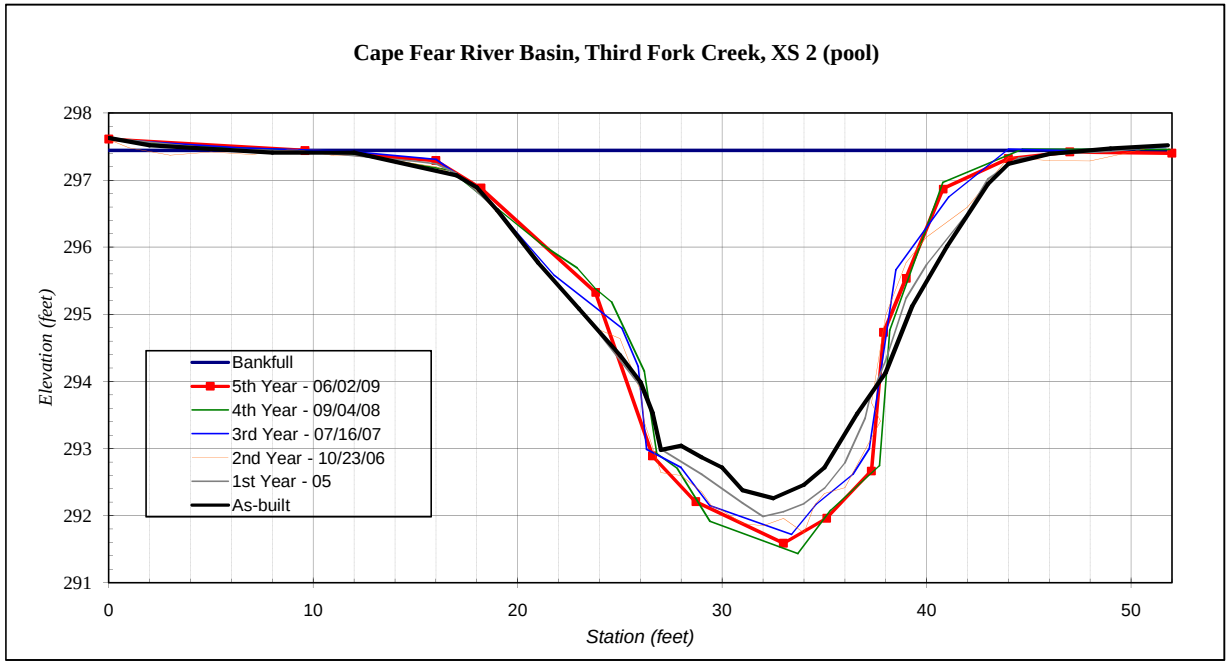
River Basin:	Cape Fear
Watershed:	Third Fork Creek
XS ID	XS 2 (pool)
Reach:	Upstream
Date:	6/2/2009
Field Crew:	J. O'Neal, S. Doig

Station	Elevation
0.00	297.61
9.60	297.44
16.00	297.29
18.20	296.88
23.80	295.33
26.60	292.89
28.70	292.21
33.00	291.59
35.10	291.96
37.30	292.67
37.90	294.73
39.00	295.54
40.80	296.87
44.00	297.32
47.00	297.42
52.00	297.4

SUMMARY DATA	
Floodprone Elevation (ft)	303.29
Bankfull Elevation (ft)	297.44
Floodprone Width (ft)	240
Bankfull Width (ft)	37.4
Entrenchment Ratio	6.42
Mean Depth (ft)	2.24
Maximum Depth (ft)	5.85
Width/Depth Ratio	16.72
Bankfull Area (sq ft)	83.64
Wetted Perimeter (ft)	41.16
Hydraulic Radius (ft)	2.03

View of cross-section #2 looking downstream

Stream Type:	C5c



B.6. Cross Section Plots with Annual Overlays - Forest Hills/Third Fork Stream Restoration - MY5 (2009) - Project #139

River Basin:	Cape Fear
Watershed:	Third Fork Creek
XS ID	XS 3 (riffle)
Reach:	Downstream
Date:	9/5/2008
Field Crew:	J. O'Neal, S. Doig

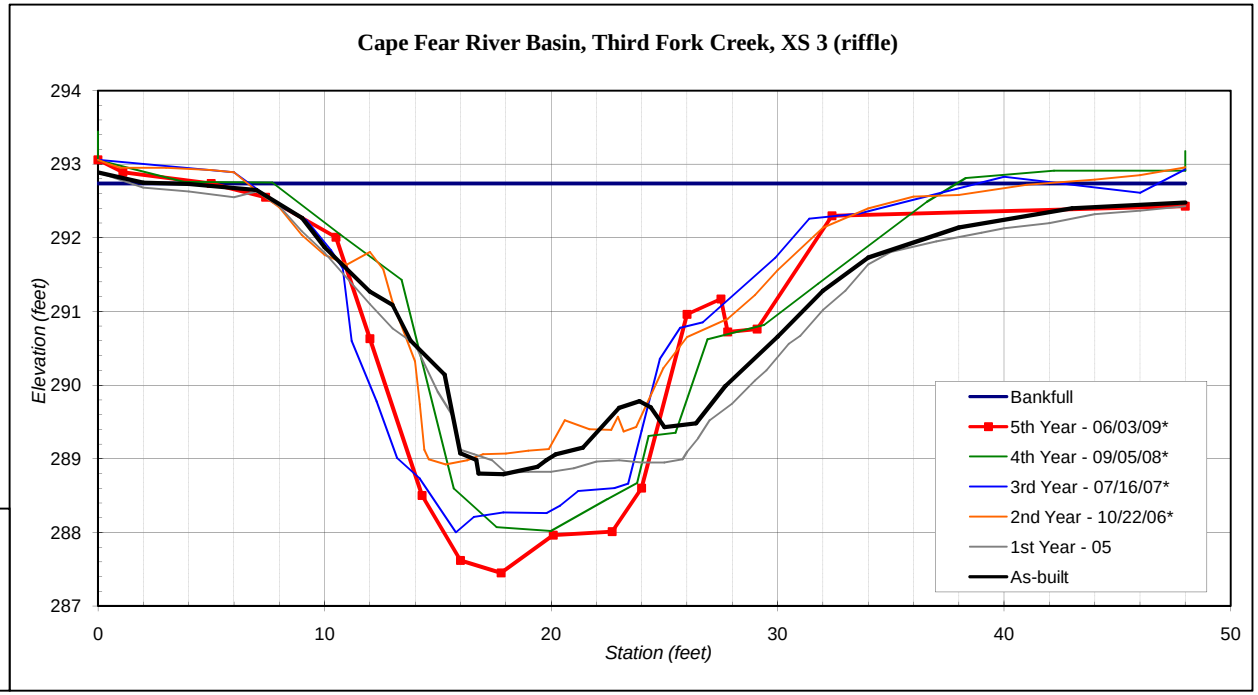
Station	Elevation
0	293.06
1.1	292.89
5	292.74
7.4	292.55
10.5	292.01
12	290.63
14.3	288.5
16	287.62
17.8	287.45
20.1	287.96
22.7	288.01
24	288.6
26	290.96
27.5	291.17
27.8	290.72
29.1	290.76
32.4	292.3
48	292.43

SUMMARY DATA

Floodprone Elevation (ft)	298.03
Bankfull Elevation (ft)	292.74
Floodprone Width (ft)	240.00
Bankfull Width (ft)	27.40
Entrenchment Ratio	8.76
Mean Depth (ft)	2.69
Maximum Depth (ft)	5.29
Width/Depth Ratio	10.19
Bankfull Area (sq ft)	73.68
Wetted Perimeter (ft)	31.36
Hydraulic Radius (ft)	2.35

View of cross-section #3 looking downstream

Stream Type: E5



*the original (as-built and 1st year) cross section was not relocated in 2006. Subsequent years' data represent relocation based best professional judgment, which appropriately approximates the original location.

B.6. Cross Section Plots with Annual Overlays - Forest Hills/Third Fork Stream Restoration - MY5 (2009) - Project #139

River Basin:	Cape Fear
Watershed:	Third Fork Creek
XS ID	XS 4 (pool)
Reach:	Downstream
Date:	6/2/2009
Field Crew:	J. O'Neal, S. Doig

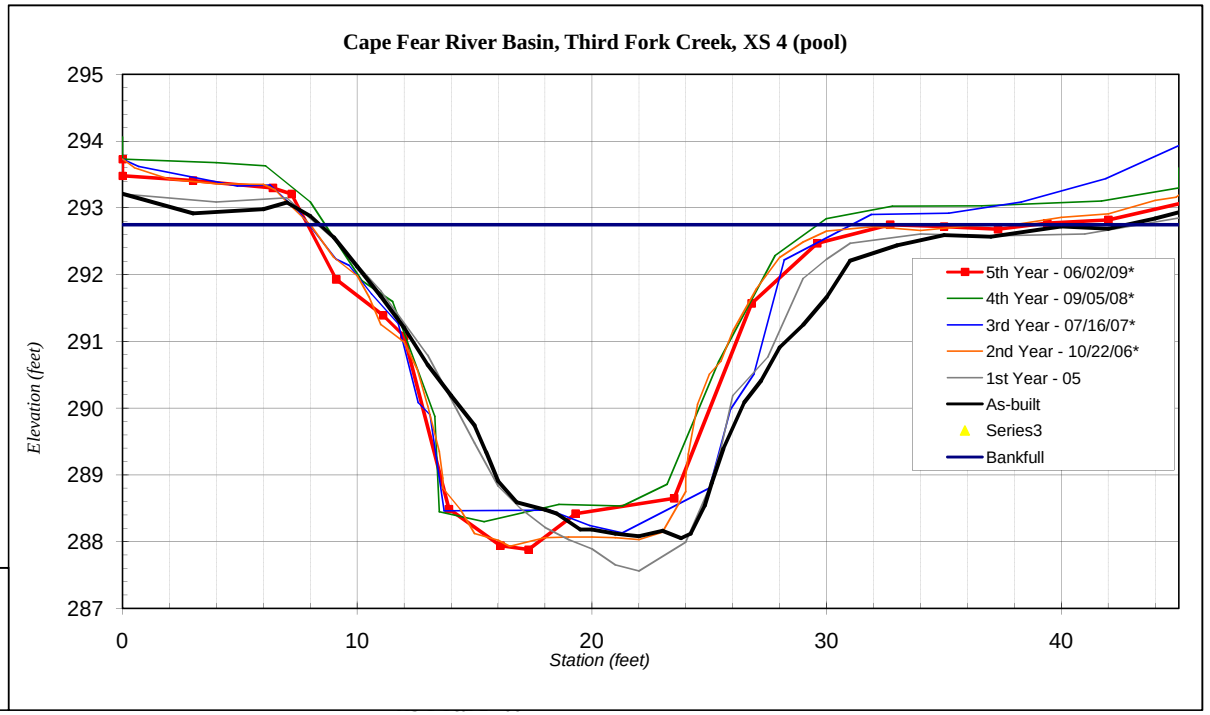
Station	Elevation
0	293.73
0	293.48
3	293.41
6.4	293.3
7.2	293.21
9.1	291.93
11.1	291.39
12	291.08
13.9	288.49
16.1	287.94
17.3	287.88
19.3	288.42
23.5	288.65
26.8	291.57
29.6	292.47
32.7	292.75
35	292.72
37.30	292.68
39.4	292.77
42	292.82
45.1	293.07
45.1	293.28

SUMMARY DATA

Floodprone Elevation (ft)	297.62
Bankfull Elevation (ft)	292.75
Floodprone Width (ft)	240.00
Bankfull Width (ft)	24.82
Entrenchment Ratio	9.67
Mean Depth (ft)	2.56
Maximum Depth (ft)	4.87
Width/Depth Ratio	9.69
Bankfull Area (sq ft)	63.55
Wetted Perimeter (ft)	27.91
Hydraulic Radius (ft)	2.28

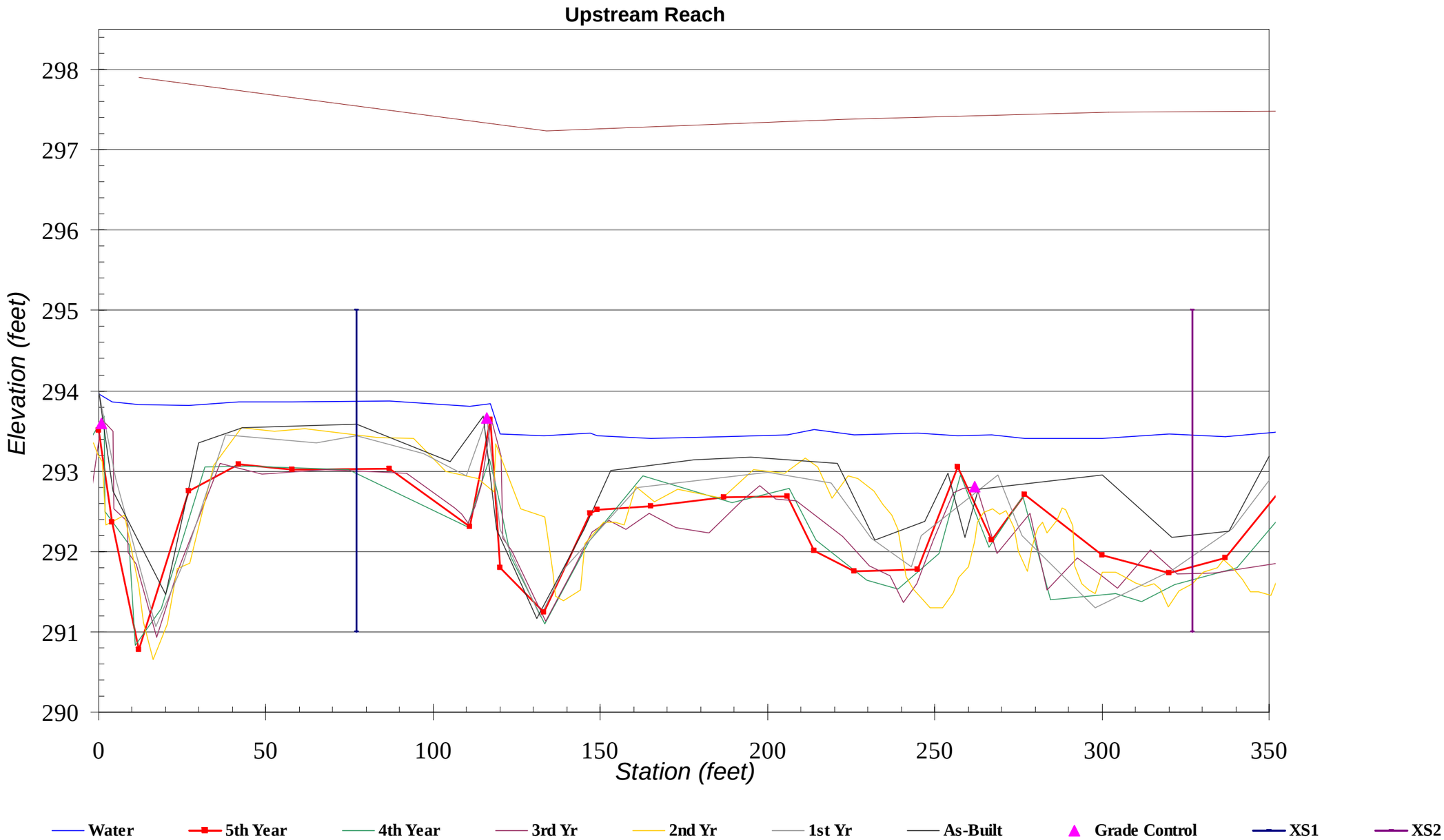
View of cross-section #4 looking downstream

Stream Type: E5

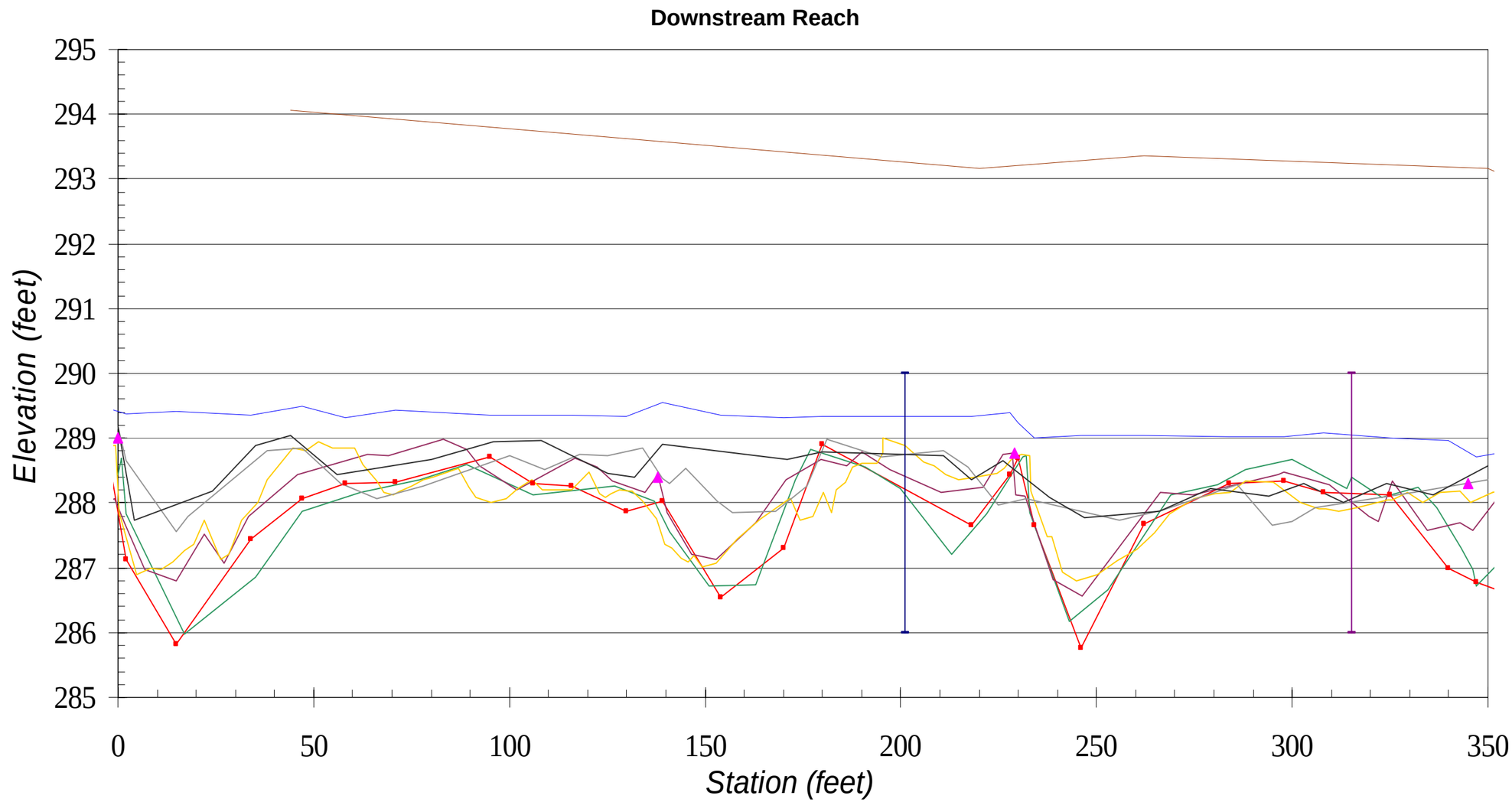


*the original (as-built and 1st year) cross section was not relocated in 2006. Subsequent years' data represent relocation based best professional judgment, which appropriately approximates the original location.

B.7. Longitudinal Profile with Annual Overlays - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139



B.7. Longitudinal Profile with Annual Overlays - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139



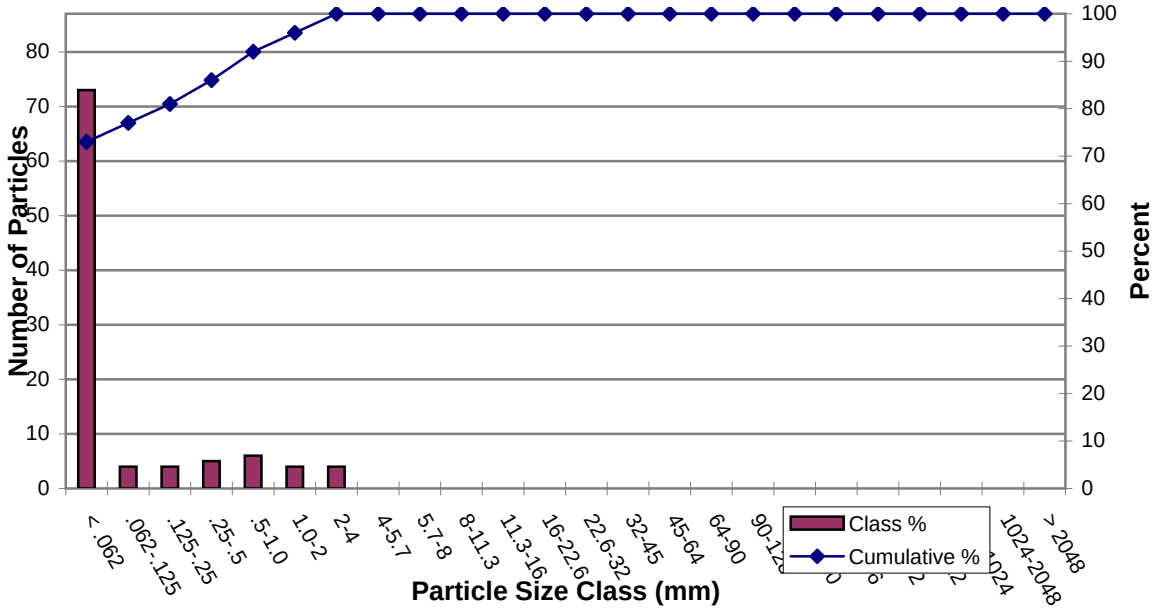
B.8. Pebble Counts - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

Cross Section One

	Particle	Size Range (mm)	Total #	Class %	Cumulative %
S/C	Silt/Clay	< .062	73	73	73
Sand	Very Fine Sand	.062-.125	4	4	77
	Fine Sand	.125-.25	4	4	81
	Medium Sand	.25-.5	5	5	86
	Coarse Sand	.5-1.0	6	6	92
	Very Course Sand	1.0-2	4	4	96
Gravel	Very Fine Gravel	2-4	4	4	100
	Fine Gravel	4-5.7		0	100
	Fine Gravel	5.7-8		0	100
	Medium Gravel	8-11.3		0	100
	Medium Gravel	11.3-16		0	100
	Coarse Gravel	16-22.6		0	100
	Coarse Gravel	22.6-32		0	100
	Very Course Gravel	32-45		0	100
	Very Course Gravel	45-64		0	100
Cobble	Small Cobble	64-90		0	100
	Small Cobble	90-128		0	100
	Medium Cobble	128-180		0	100
	Large Cobble	180-256		0	100
Boulder	Small Boulders	256-362		0	100
	Small Boulders	362-512		0	100
	Medium Boulders	512-1024		0	100
	Large Boulders	1024-2048		0	100
	Bedrock	> 2048		0	100
	Total		100		

d_{50} = 0.04 mm

d_{84} = 0.40 mm



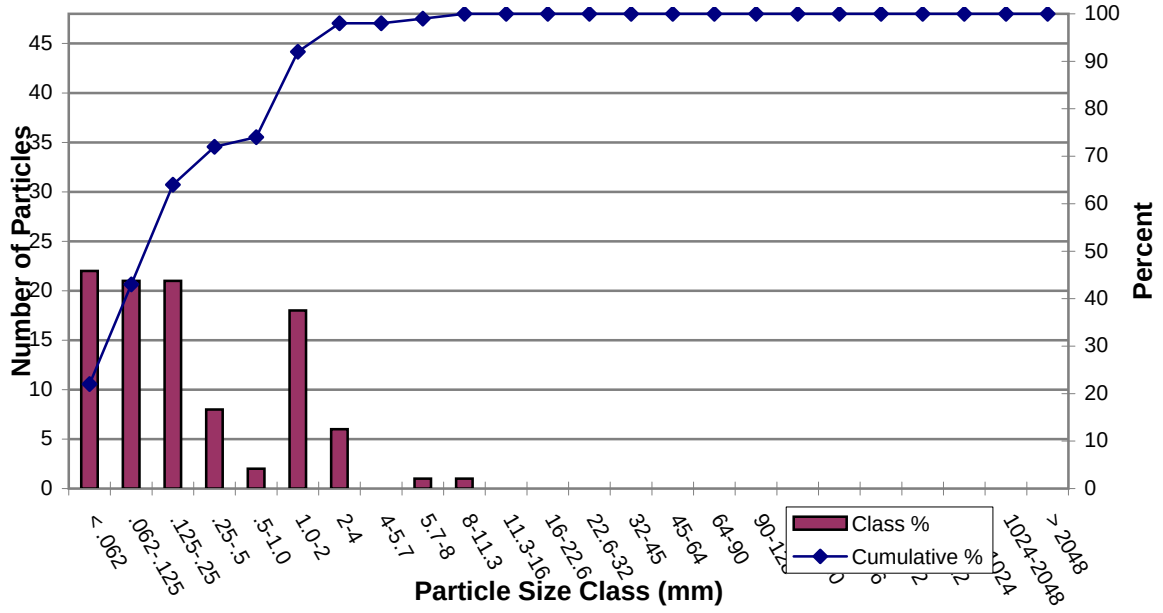
B.8. Pebble Counts - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

Cross Section Two

	Particle	Size Range (mm)	Total #	Class %	Cumulative %
S/C	Silt/Clay	< .062	22	22	22
Sand	Very Fine Sand	.062-.125	21	21	43
	Fine Sand	.125-.25	21	21	64
	Medium Sand	.25-.5	8	8	72
	Coarse Sand	.5-1.0	2	2	74
	Very Course Sand	1.0-2	18	18	92
Gravel	Very Fine Gravel	2-4	6	6	98
	Fine Gravel	4-5.7		0	98
	Fine Gravel	5.7-8	1	1	99
	Medium Gravel	8-11.3	1	1	100
	Medium Gravel	11.3-16		0	100
	Coarse Gravel	16-22.6		0	100
	Coarse Gravel	22.6-32		0	100
	Very Course Gravel	32-45		0	100
	Very Course Gravel	45-64		0	100
Cobble	Small Cobble	64-90		0	100
	Small Cobble	90-128		0	100
	Medium Cobble	128-180		0	100
	Large Cobble	180-256		0	100
Boulder	Small Boulders	256-362		0	100
	Small Boulders	362-512		0	100
	Medium Boulders	512-1024		0	100
	Large Boulders	1024-2048		0	100
	Bedrock	> 2048		0	100
	Total		100		

d_{50} = 0.17 mm

d_{84} = 1.56 mm



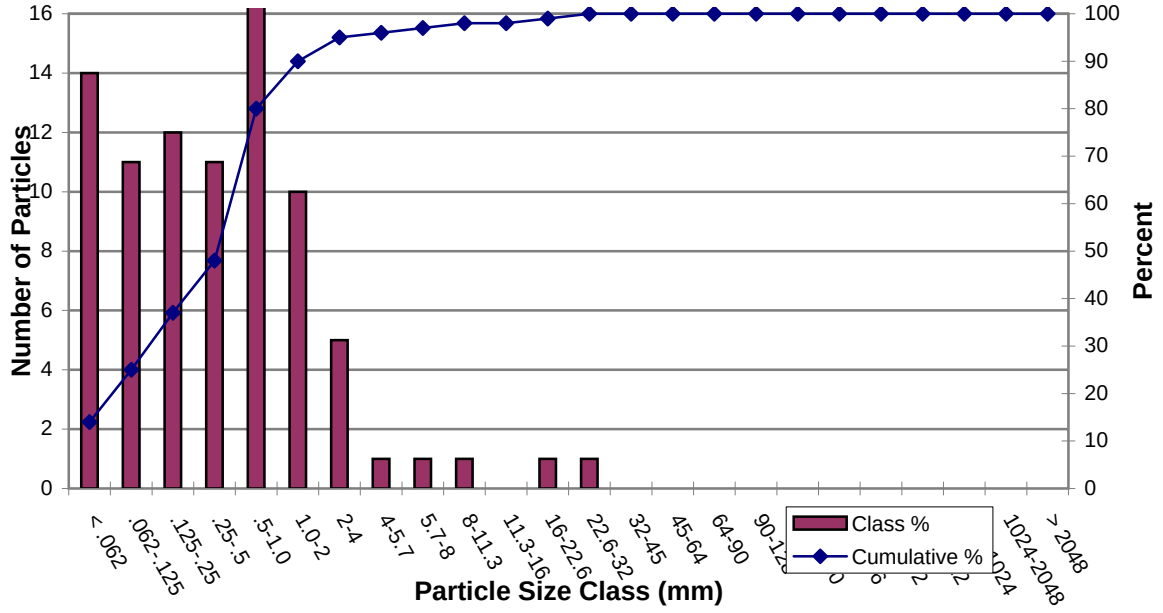
B.8. Pebble Counts - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

Cross Section Three

	Particle	Size Range (mm)	Total #	Class %	Cumulative %
S/C	Silt/Clay	< .062	14	14	14
Sand	Very Fine Sand	.062-.125	11	11	25
	Fine Sand	.125-.25	12	12	37
	Medium Sand	.25-.5	11	11	48
	Coarse Sand	.5-1.0	32	32	80
	Very Course Sand	1.0-2	10	10	90
Gravel	Very Fine Gravel	2-4	5	5	95
	Fine Gravel	4-5.7	1	1	96
	Fine Gravel	5.7-8	1	1	97
	Medium Gravel	8-11.3	1	1	98
	Medium Gravel	11.3-16		0	98
	Coarse Gravel	16-22.6	1	1	99
	Coarse Gravel	22.6-32	1	1	100
	Very Course Gravel	32-45		0	100
	Very Course Gravel	45-64		0	100
Cobble	Small Cobble	64-90		0	100
	Small Cobble	90-128		0	100
	Medium Cobble	128-180		0	100
	Large Cobble	180-256		0	100
Boulder	Small Boulders	256-362		0	100
	Small Boulders	362-512		0	100
	Medium Boulders	512-1024		0	100
	Large Boulders	1024-2048		0	100
	Bedrock	> 2048		0	100
	Total		100		

d_{50} = 0.06 mm

d_{84} = 0.45 mm



B.8. Pebble Counts - Forest Hills/Third Fork Creek Stream Restoration - MY5 (2009) - Project #139

Cross Section Four

	Particle	Size Range (mm)	Total #	Class %	Cumulative %
S/C	Silt/Clay	< .062	11	11	11
Sand	Very Fine Sand	.062-.125	8	8	19
	Fine Sand	.125-.25	2	2	21
	Medium Sand	.25-.5	17	17	38
	Coarse Sand	.5-1.0	23	23	61
	Very Course Sand	1.0-2	17	17	78
Gravel	Very Fine Gravel	2-4	5	5	83
	Fine Gravel	4-5.7	2	2	85
	Fine Gravel	5.7-8	2	2	87
	Medium Gravel	8-11.3	1	1	88
	Medium Gravel	11.3-16	8	8	96
	Coarse Gravel	16-22.6	2	2	98
	Coarse Gravel	22.6-32	1	1	99
	Very Course Gravel	32-45	1	1	100
	Very Course Gravel	45-64		0	100
Cobble	Small Cobble	64-90		0	100
	Small Cobble	90-128		0	100
	Medium Cobble	128-180		0	100
	Large Cobble	180-256		0	100
Boulder	Small Boulders	256-362		0	100
	Small Boulders	362-512		0	100
	Medium Boulders	512-1024		0	100
	Large Boulders	1024-2048		0	100
	Bedrock	> 2048		0	100
	Total		100		

d_{50} = 0.76 mm

d_{84} = 4.85 mm