EEP Project Closeout Summary

Project ID and Status		Project Setting and Background		Project Timeline	
Project Name:	Ellerbe Creek	**Basin:**	Neuse	**Restoration Plan:**	March 2003
EEP ID:	127	**Physiographic Region:**	Piedmont	**Construction Complete:**	March 2005
County:	Durham	**Ecoregion:**	Triassic Basin	**Monitoring Year 1:**	Oct2005
Project Type:	Stream Restoration	**14-Digit HUC:**	03020201050010	**Monitoring Year 2:**	Sept 2006
Current Status:	5 years of monitoring complete	**NCDWQ Sub-basin:**	03-04-01	**Monitoring Year 3:**	Sept 2007
		Thermal Regime:	Warm	**Monitoring Year 4:**	Sept 2008
		Trout Water:	No	**Monitoring Year 5:**	July 2009
		Designer:	Stantec Consulting		
		Monitoring:	Stantec Consulting Robert J. Goldstein & Associates		

Table 1. Project Restoration Components and Mitigation Assets

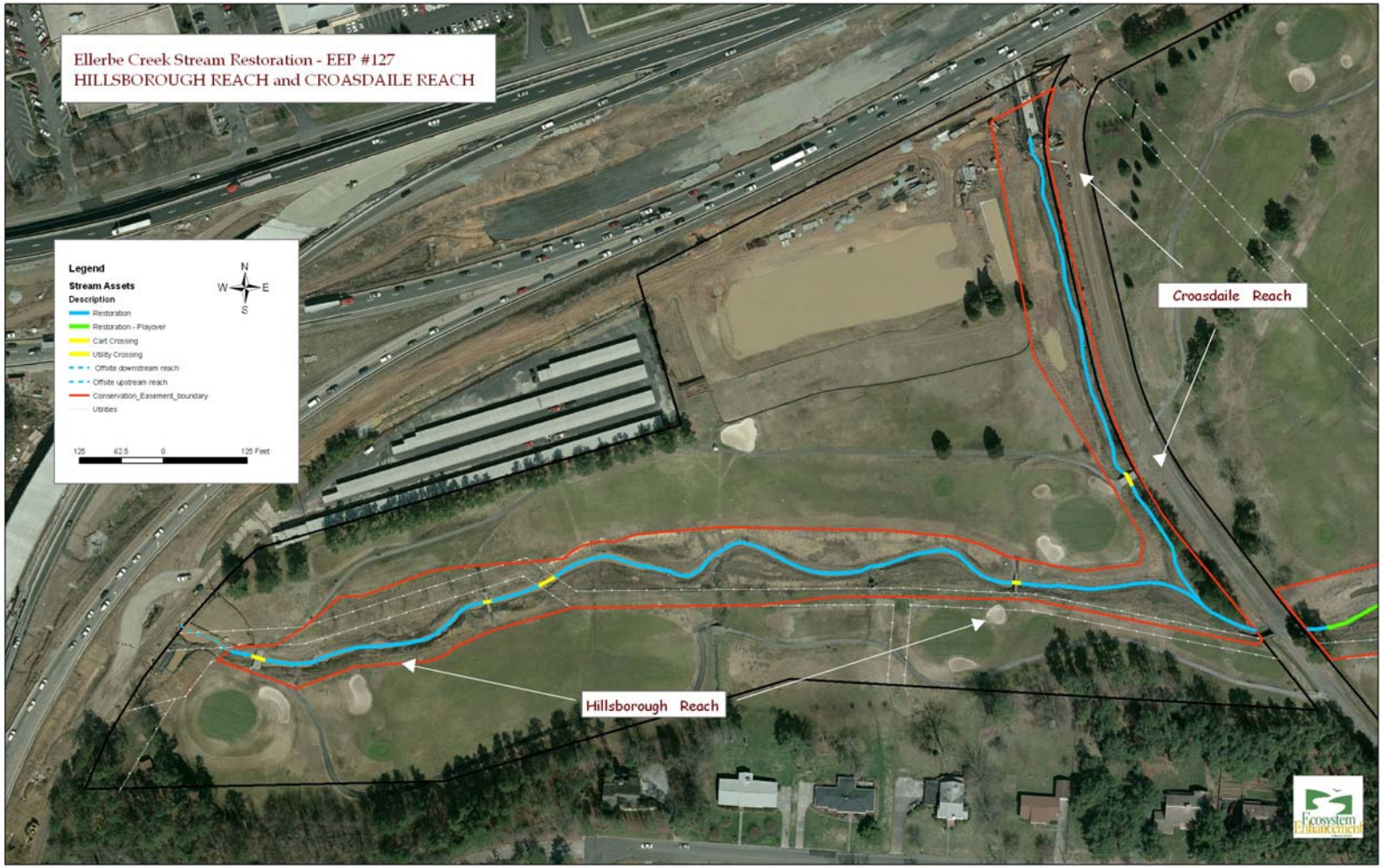
Drainage/Hydrology Component	Stationing	Asset Map #	Approach	Level	Ratio	Ratio Multiplier	Feet	SMU	Acres	Buffer Credit	BMP Credit
Stream Assets											
Hillsborough Reach: Ellerbe Creek from culvert under I-85 to bridge over Bellevue Avenue.	1000-2663	1	P2	R	1.00	1.00	1,640	1,564			
Croasdaile Reach: UT to Ellerbe from culvert under I-85 to confluence with Ellerbe Creek	CR 1000-1703	2	P2	R	1.00	1.00	761	737			

Drainage/Hydrology Component	Stationing	Asset Map #	Approach	Level	Ratio	Ratio Multiplier	Feet	SMU	Acres	Buffer Credit	BMP Credit
Stream Assets (con't)											
Hillandale Reach: Ellerbe Creek downstream of bridge to culvert at Hillandale Road	2663-4602	3	P2	R	1.00 and 0.75	1.00 and 0.75	1,847	1,512			
Albany Reach: Ellerbe Creek downstream of Hillandale Road to eastern edge of easement	4602-6217	4	P2	R	1.00 and 0.75	1.00 and 0.75	1,880	1,584			
Riparian Buffer											
Eligible Buffer		1-15		R	1.00	1.00			2.44	2.44	
Additional Assets											
Stormwater Wetland BMP		20									1

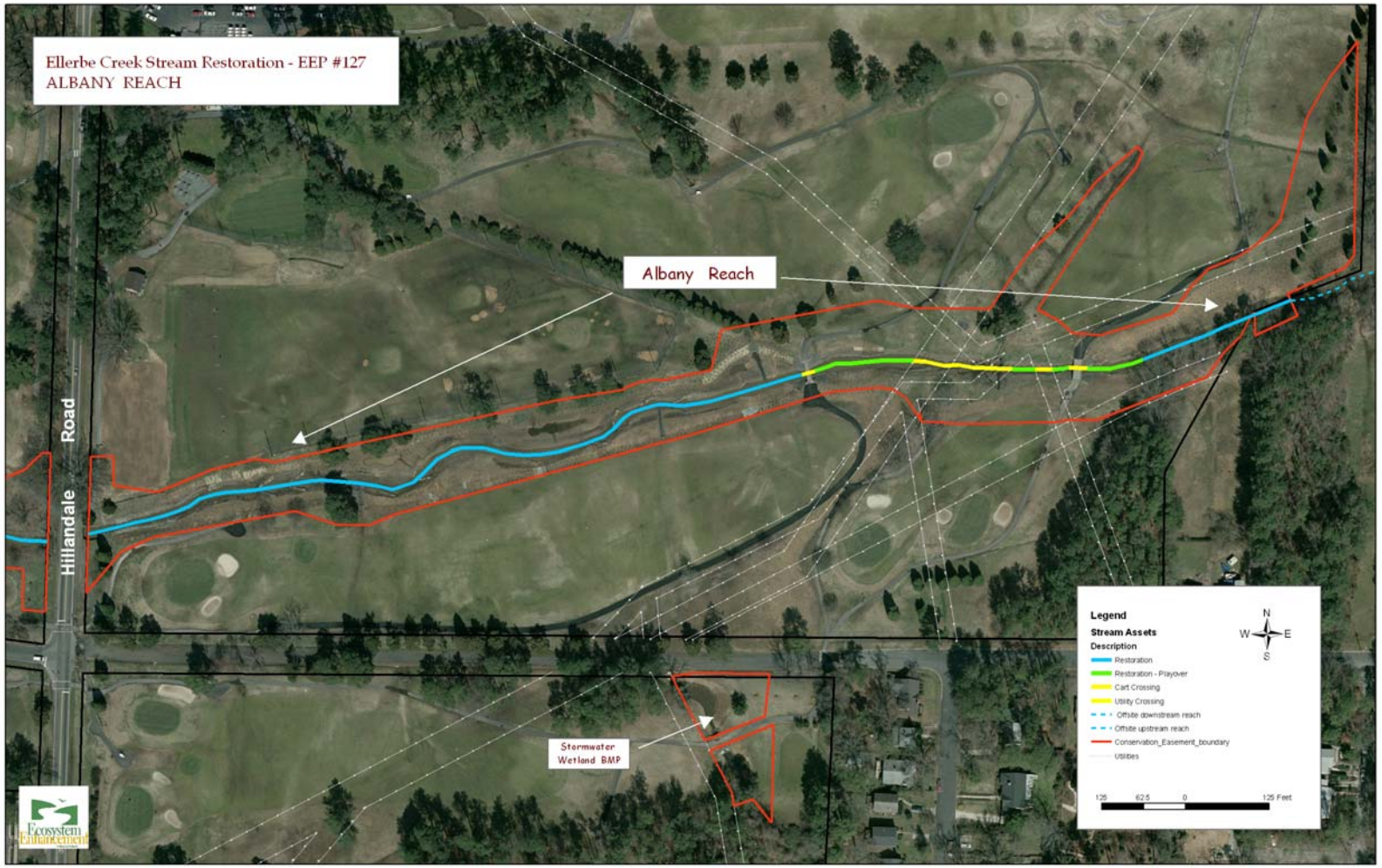
Asset Summary

Level	Feet	SMU	Buffer Credit	Stormwater Wetland BMP
R	6,128	5,397	2.44 (106,286 Sq. Ft.)	1
TOTAL	**6,128**	**5,397**	**2.44 (106,286 Sq. Ft.)**	**1**

Figure 1. Project Asset Maps.




Ellerbe Creek Stream Restoration - EEP #127
HILLANDALE REACH
Bellvue Street
Hillandale Road
Hillandale Reach
Legend
Stream Assets
Description
Restoration
Restoration - Playover
Cart Crossing
Utility Crossing
Offsite downstream reach
Offsite upstream reach
Conservation_Easement_boundary
Utilities
N
W
E
S
125
62.5
0
125 Feet
Ecosystem Enhancement


Ellerbe Creek Stream Restoration - EEP #127
ALBANY REACH
Albany Reach
Hillandale Road
Stormwater Wetland BMP
Legend
Stream Assets
Description
Restoration
Restoration - Playover
Cart Crossing
Utility Crossing
Offsite downstream reach
Offsite upstream reach
Conservation_Easement_boundary
Utilities
N
W
E
S
125
62.5
0
125 Feet
Ecosystem Enhancement

Ellerbe Creek Buffer Credit Areas Final
28 May 2010

Buffer Area ID	Acres
1	0.078
2	0.161
3	0.058
4	0.063
5	0.154
6	0.505
7	0.027
8	0.115
9	0.399
10	0.120
11	0.065
12	0.129
13	0.189
14	0.149
15	0.223
Sum	2.435

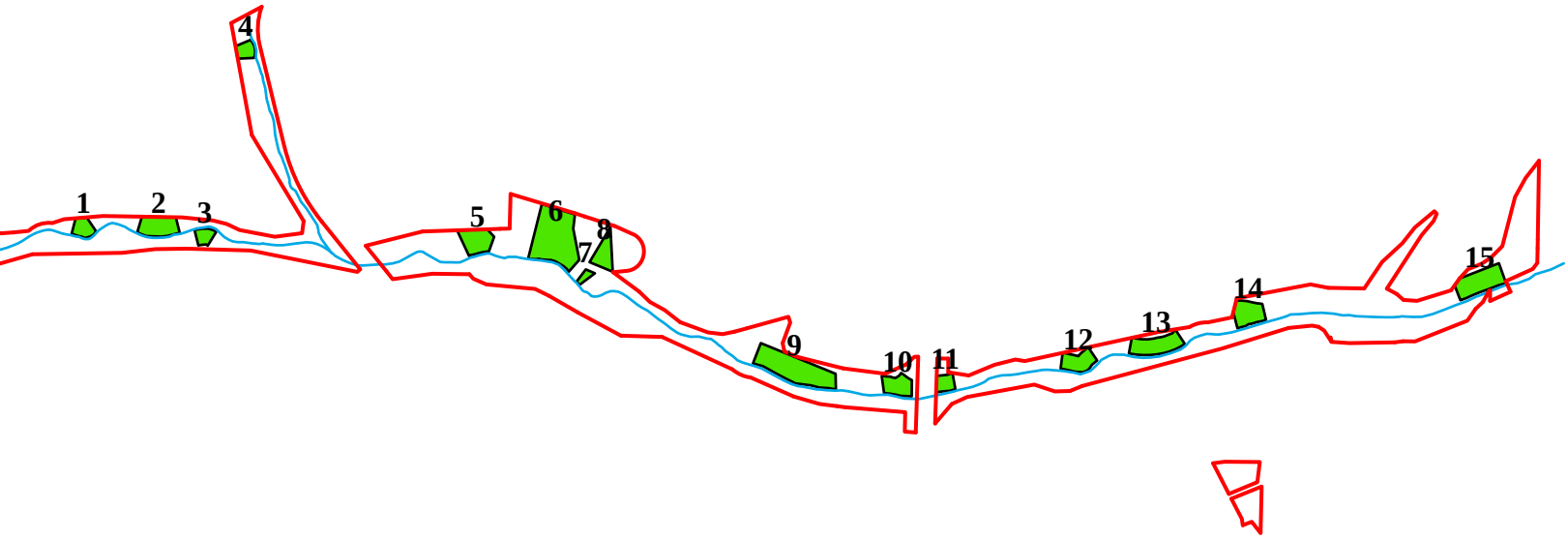


Figure 2. Example Pre-existing Condition Photos

Top of Hillsborough Reach (HB-P02)

Hillsborough Reach (approximately at HB-P04)

Top of Hillandale Reach (HD-P01)

Top of Albany Reach (AL-P01)

Figure 3. As-built and Monitoring Year 5 Comparison Photos

HB-P04 facing downstream

MY 1 (2005)

Closeout (04/19/10)

HB-P10 facing downstream

MY 1 (2005)

Closeout (04/19/10)

CR-P03 facing downstream

MY 1 (2005)

HD-P01 facing downstream

MY 1 (2005)

Closeout (04/19/10)

MY 5 (Summer 2009)

AL-P01 facing downstream

MY 1 (2005)

Closeout (04/15/10)

AL-P07 facing downstream

MY 1 (2005)

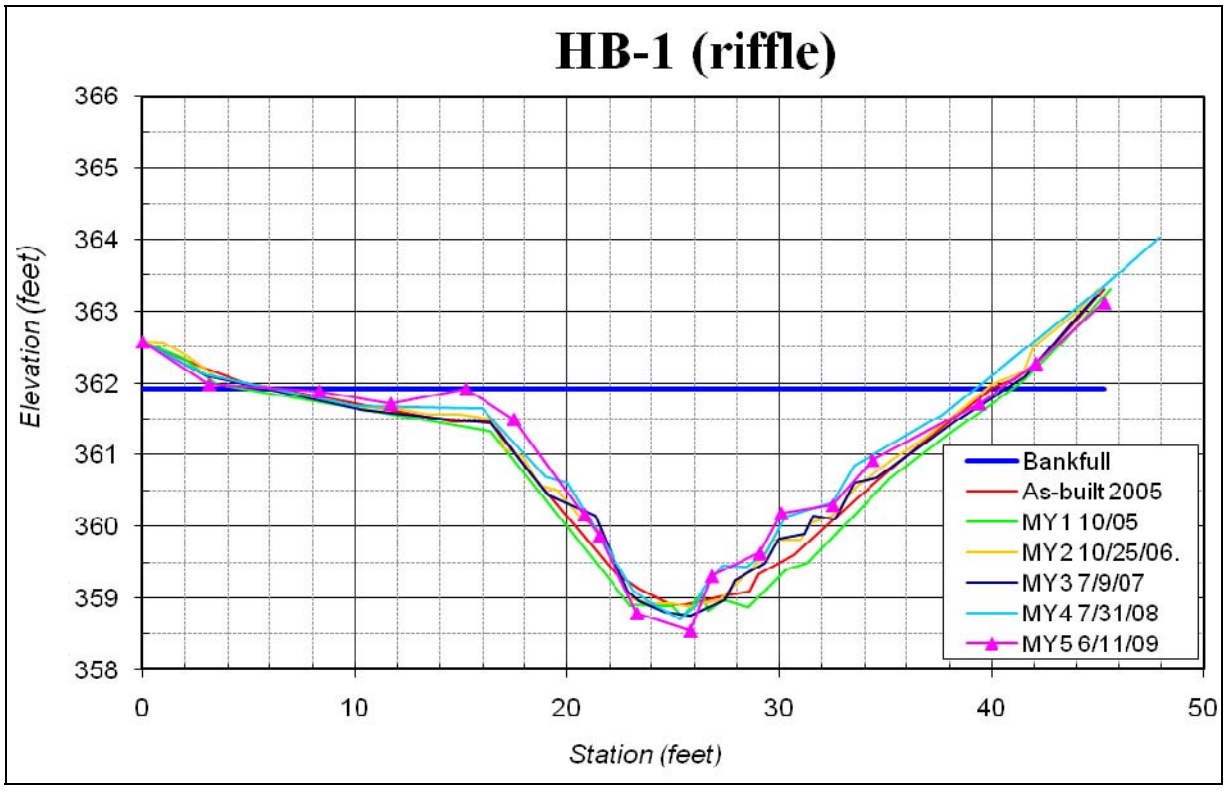
Closeout (04/19/10)

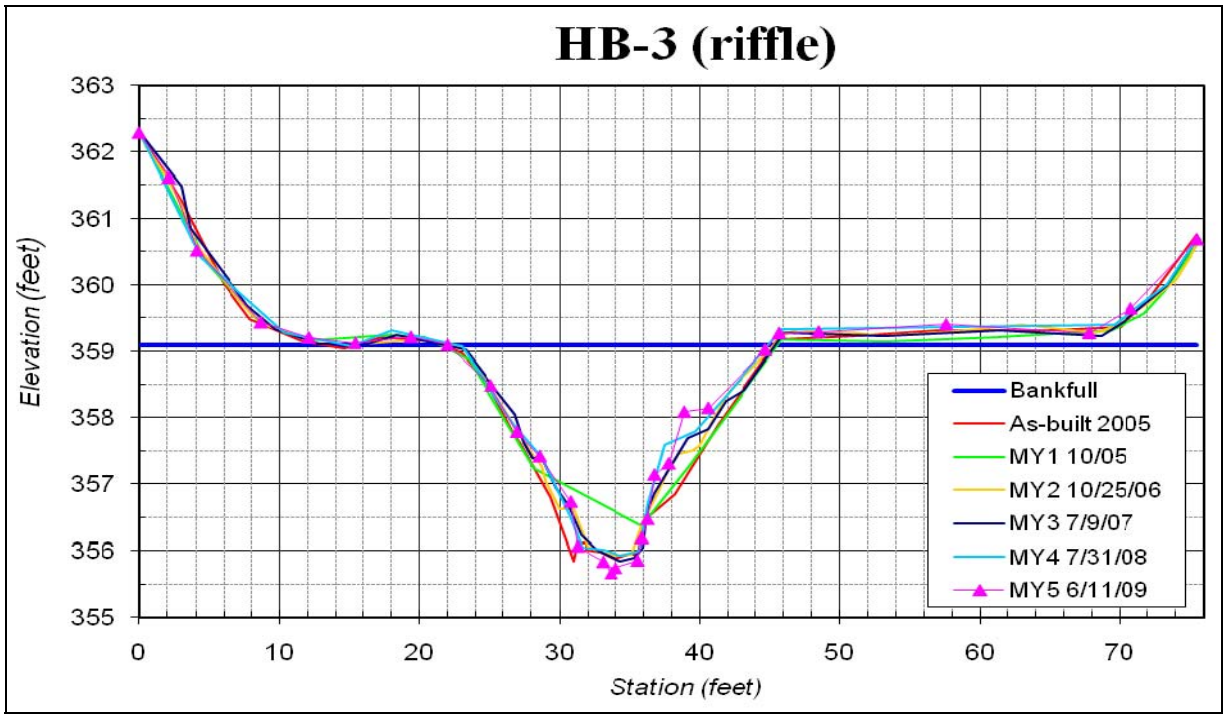
Channel Stability

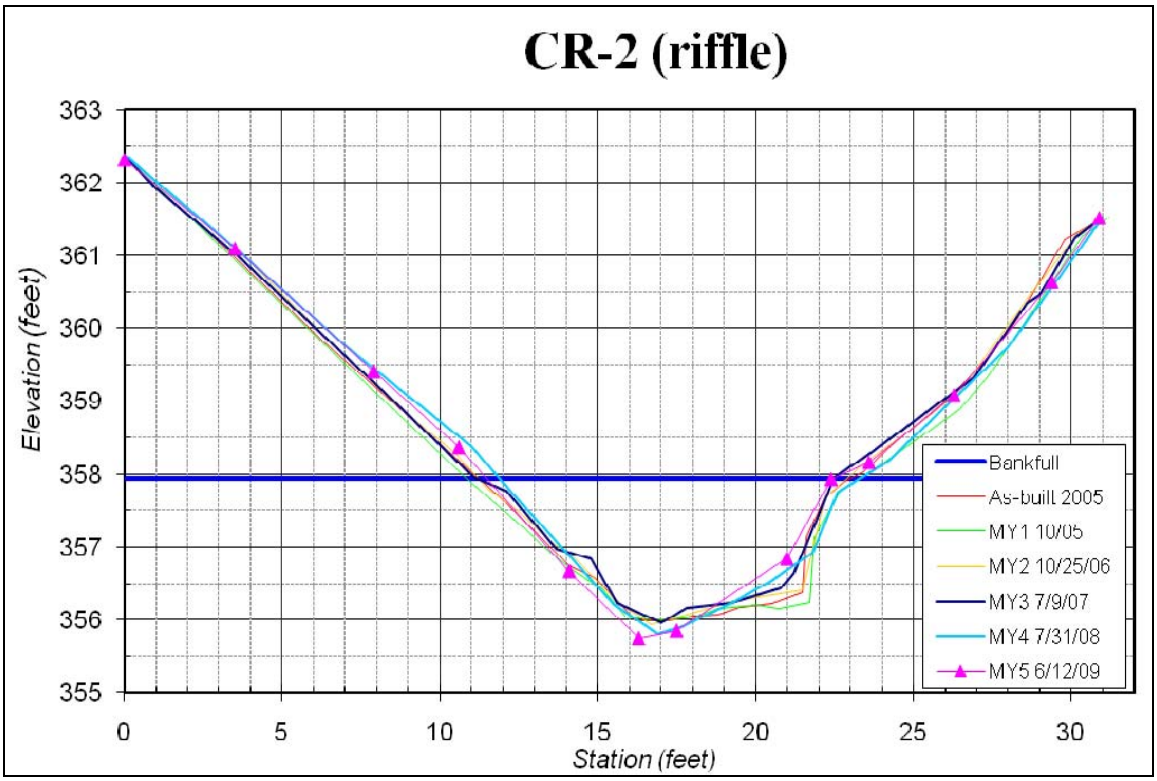
Dimension

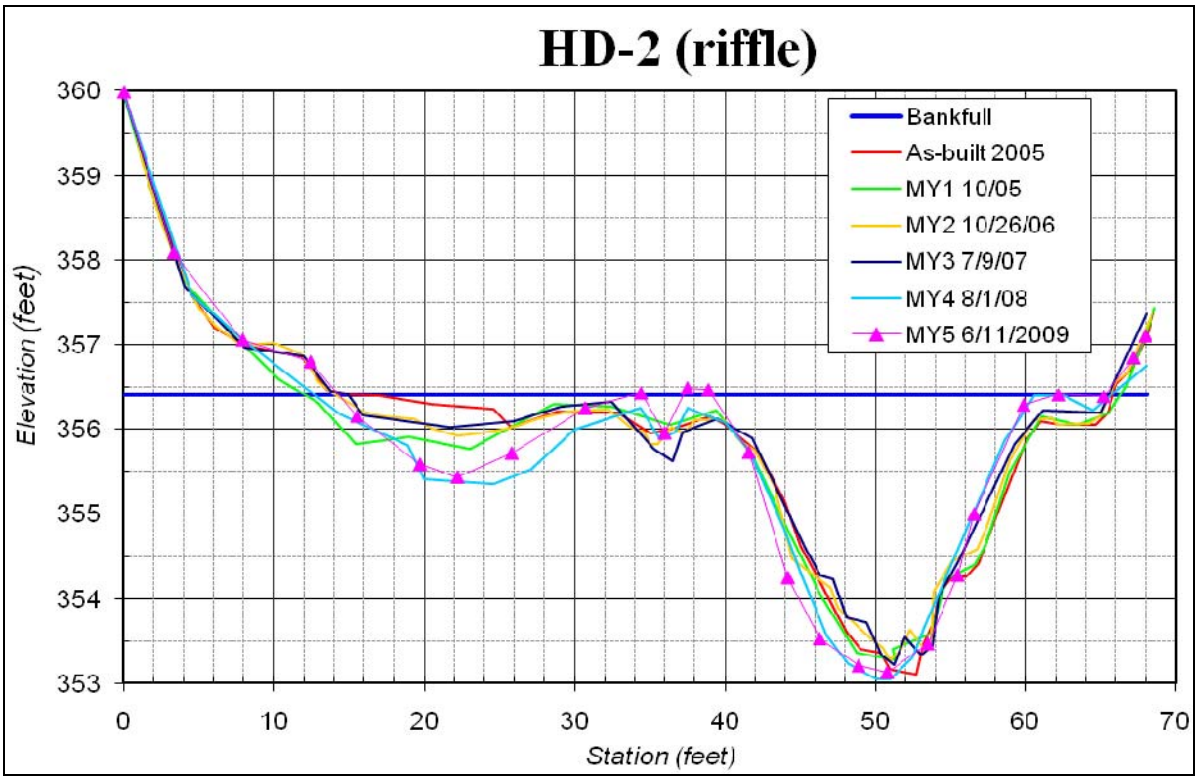
Repeat X-section surveys indicate that the restored channels' dimensions were stable and changes were within expected parameters. Fourteen X-sections were installed on the site during the as-built survey and surveyed for all 5 monitoring years. The Hillsborough, Hillandale, and Albany reaches each contained 4 X-sections consisting of two paired riffle and pool X-sections. The Croasdaile Reach included two X-sections—one riffle and one pool. As might be expected, growth of stream bank vegetation caused the channels to decrease slightly in width and deposition slightly increased the bankfull elevation. Repeated beaver activity in the Hillsborough and Hillandale reaches appeared to have had little effect on overall channel dimension. All riffle X-section plots are depicted in Figure 4 below.

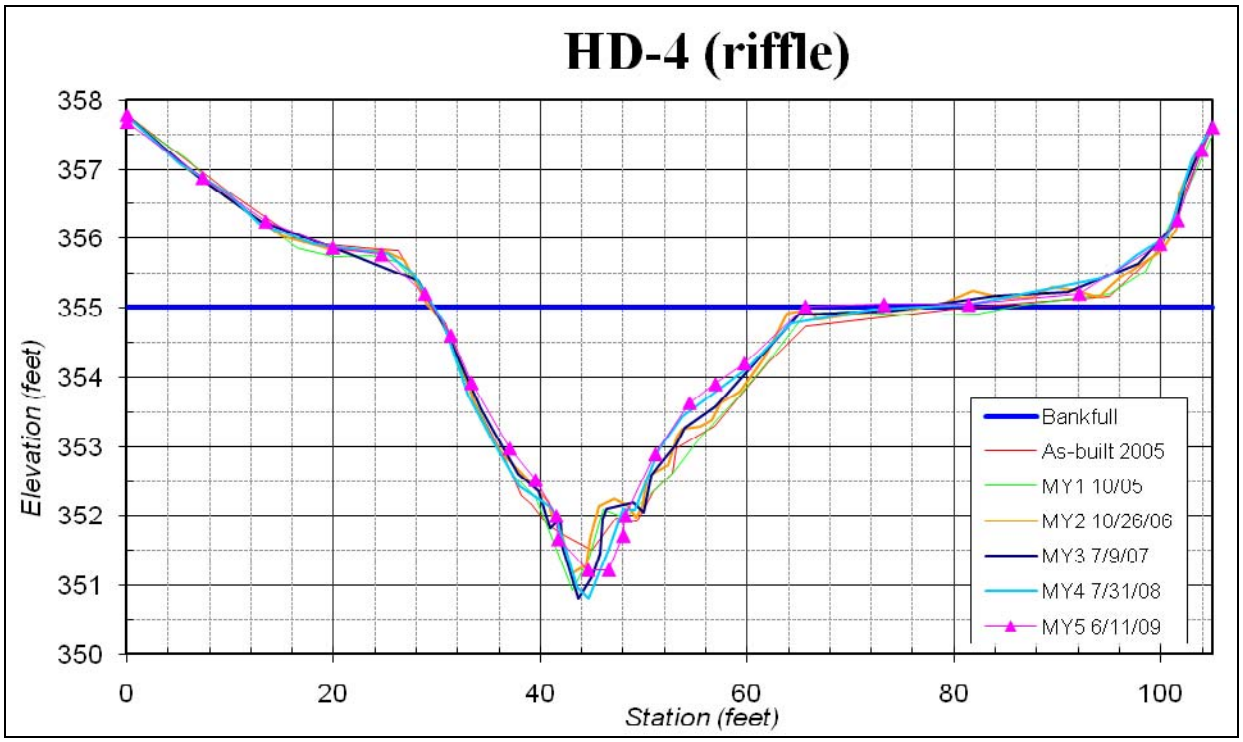
Figure 4. Annual Cross-Section Plots

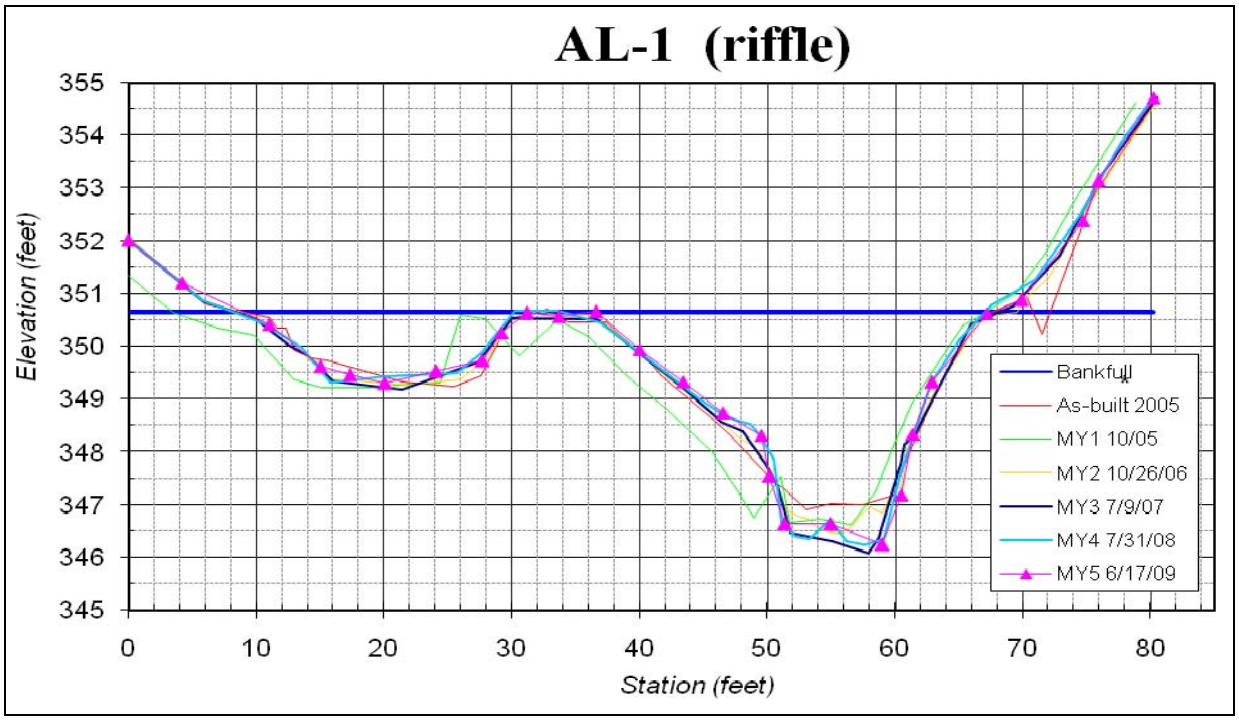


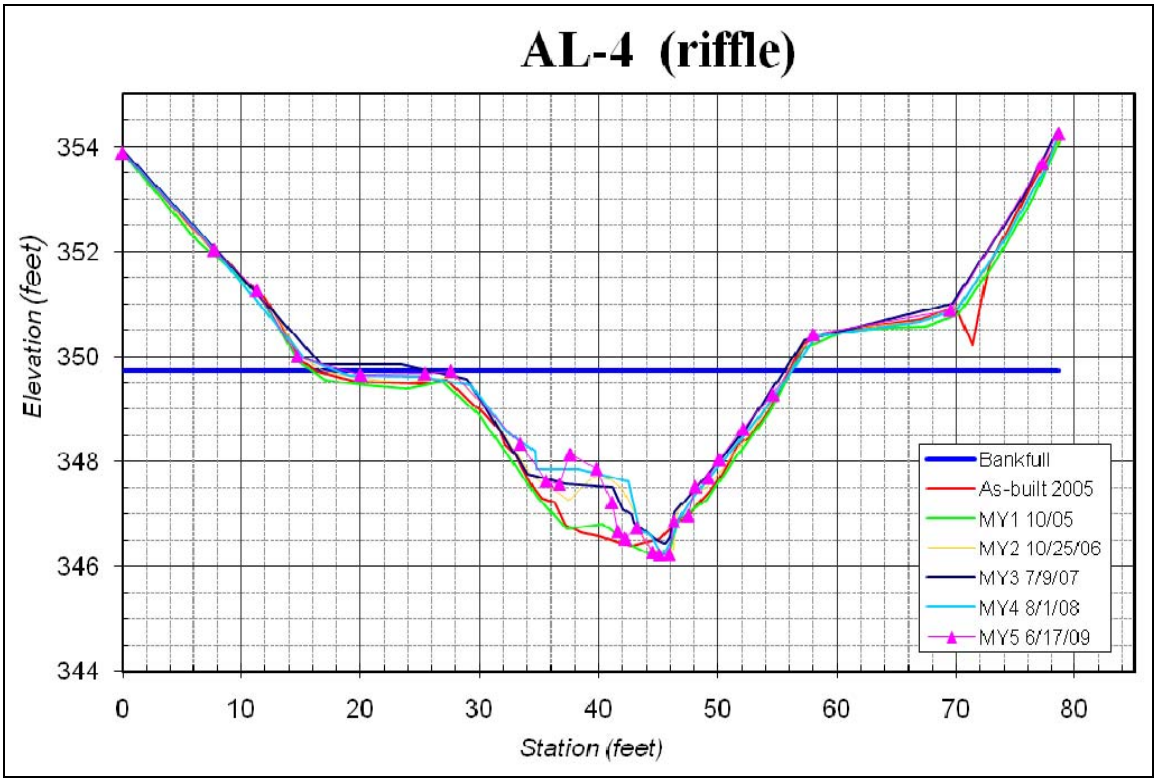

HB-3 (riffle)
Elevation (feet)
Station (feet)
363
362
361
360
359
358
357
356
355
0
10
20
30
40
50
60
70
Bankfull
As-built 2005
MY1 10/05
MY2 10/25/06
MY3 7/9/07
MY4 7/31/08
MY5 6/11/09


CR-2 (riffle)
Elevation (feet)
Station (feet)
363
362
361
360
359
358
357
356
355
0
5
10
15
20
25
30
Bankfull
As-built 2005
MY1 10/05
MY2 10/25/06
MY3 7/9/07
MY4 7/31/08
MY5 6/12/09


HD-2 (riffle)
Elevation (feet)
Station (feet)
Bankfull
As-built 2005
MY1 10/05
MY2 10/26/06
MY3 7/9/07
MY4 8/1/08
MY5 6/11/2009
360
359
358
357
356
355
354
353
0
10
20
30
40
50
60
70


HD-4 (riffle)
Elevation (feet)
Station (feet)
Bankfull
As-built 2005
MY1 10/05
MY2 10/26/06
MY3 7/9/07
MY4 7/31/08
MY5 6/11/09
358
357
356
355
354
353
352
351
350
0
20
40
60
80
100

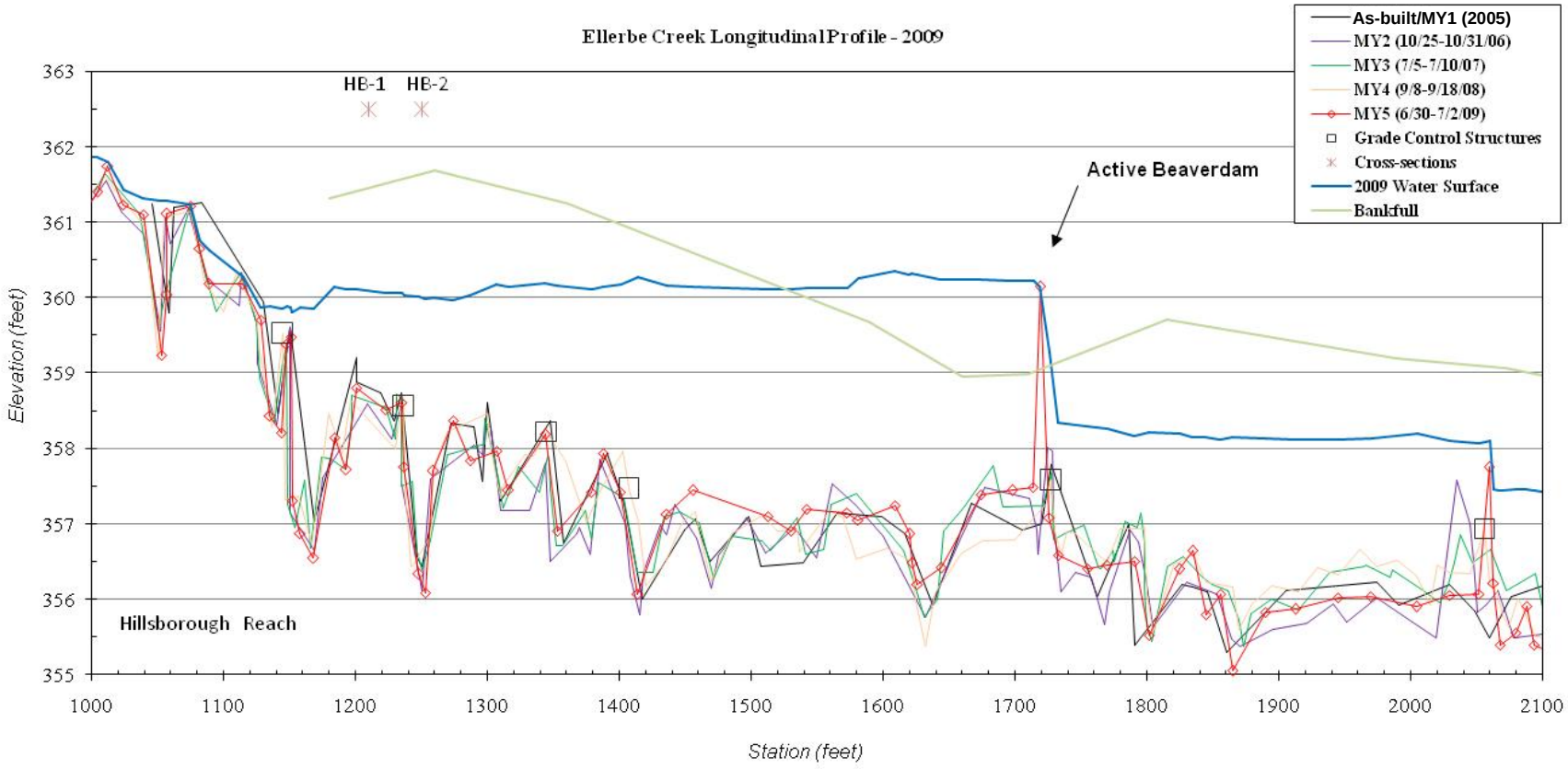

AL-1 (riffle)
Elevation (feet)
355
354
353
352
351
350
349
348
347
346
345
0
10
20
30
40
50
60
70
80
Station (feet)
Bankfull
As-built 2005
MY1 10/05
MY2 10/26/06
MY3 7/9/07
MY4 7/31/08
MY5 6/17/09

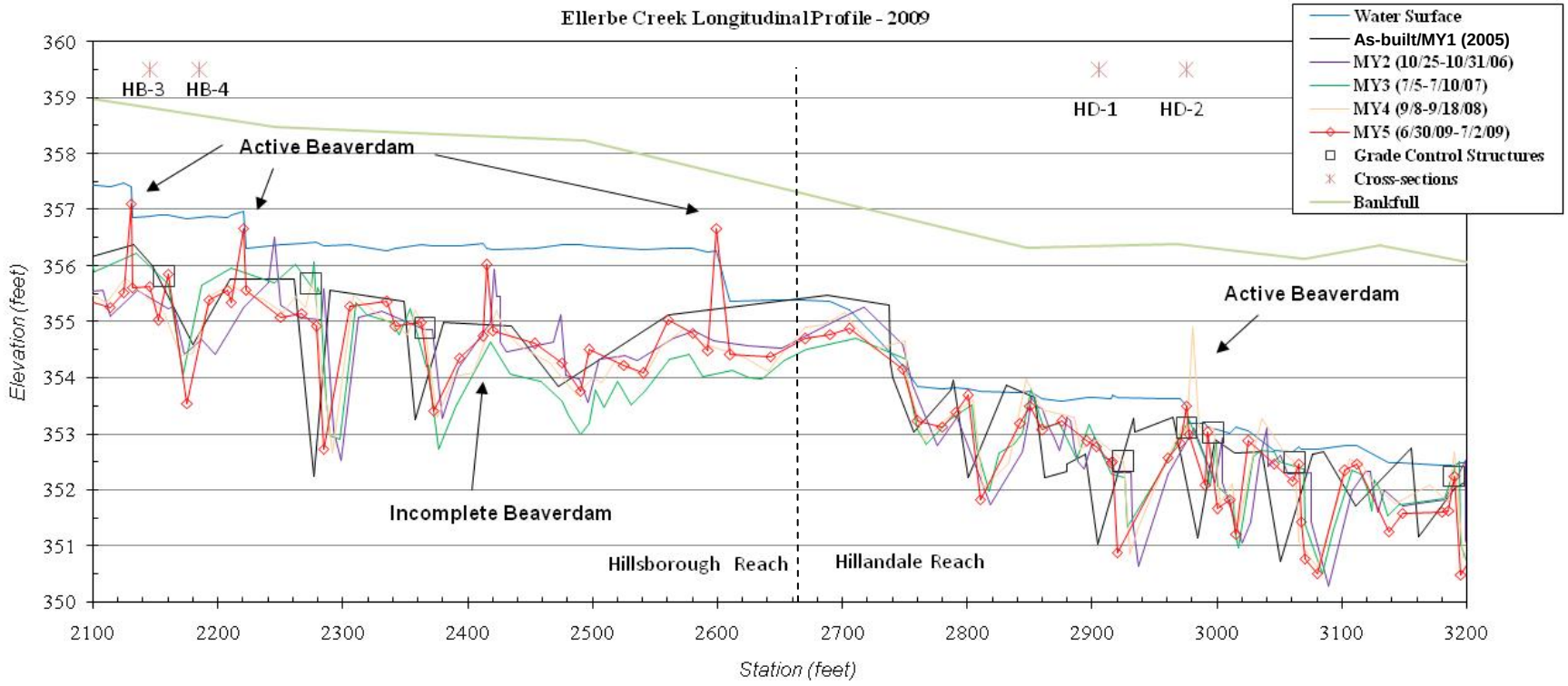

AL-4 (riffle)
Elevation (feet)
354
352
350
348
346
344
0
10
20
30
40
50
60
70
80
Station (feet)
Bankfull
As-built 2005
MY1 10/05
MY2 10/25/06
MY3 7/9/07
MY4 8/1/08
MY5 6/17/09

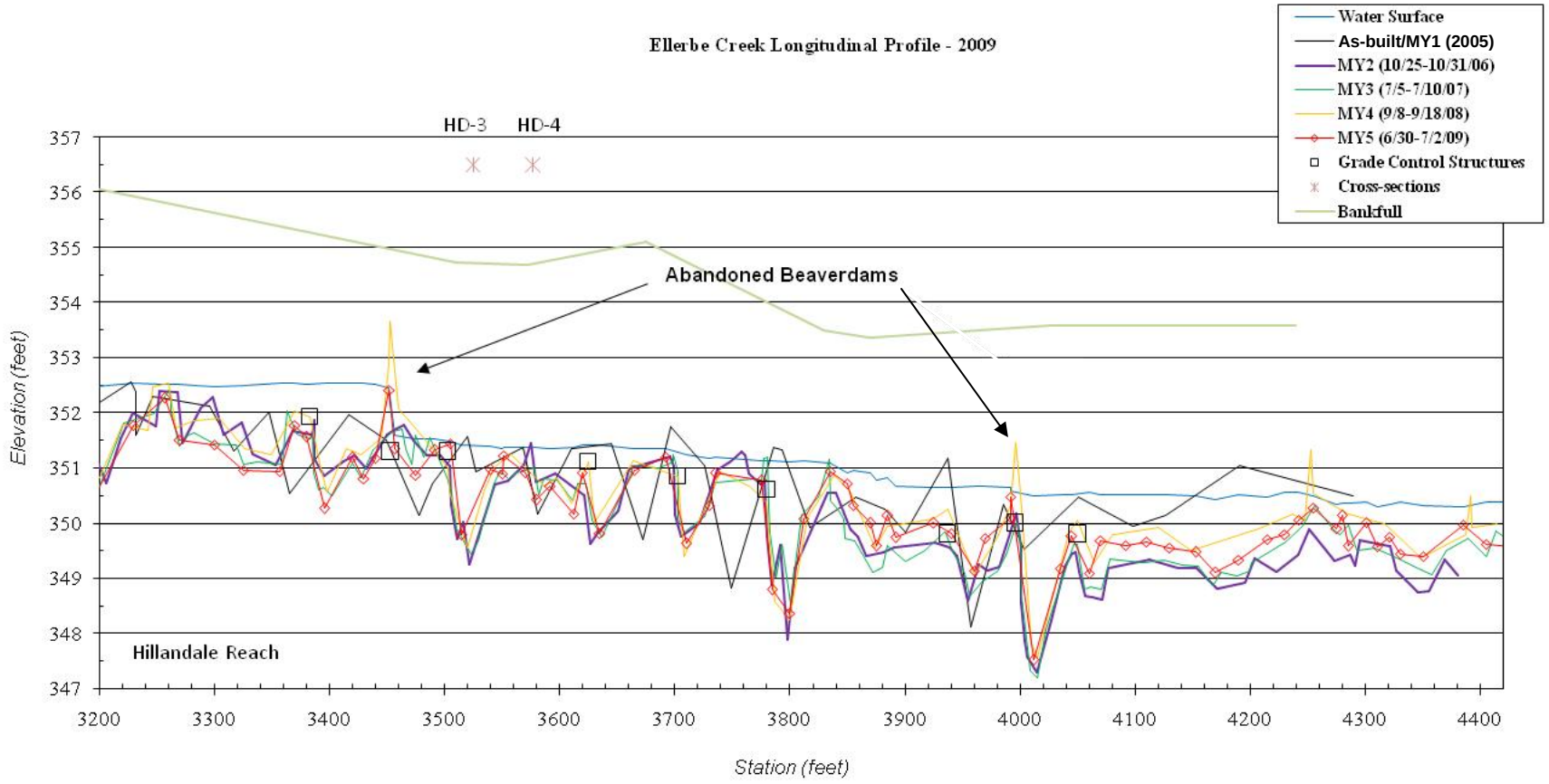
Profile

Repeat longitudinal profile surveys indicate that riffle-pool morphology was maintained and in-stream structures and the project profile are stable. Project reaches experienced some bed degradation, but this stabilized as the site matured. Approximately 3,000 feet of the project was surveyed for all five monitoring years, including the entirety of the Hillsborough Reach and a portion of the Hillandale Reach. Longitudinal profile, channel beltwidth, and sinuosity data all indicated that the channel established a slightly longer and more sinuous pattern over the five year period. Beaver activity caused some isolated bed aggradation upstream of the dams, but this did not create project instability.

Figure 5. Annual Longitudinal Profile




Ellerbe Creek Longitudinal Profile - 2009
Water Surface
As-built/MY1 (2005)
MY2 (10/25-10/31/06)
MY3 (7/5-7/10/07)
MY4 (9/8-9/18/08)
MY5 (6/30/09-7/2/09)
Grade Control Structures
Cross-sections
Bankfull
HB-3
HB-4
HD-1
HD-2
Active Beaverdam
Active Beaverdam
Incomplete Beaverdam
Hillsborough Reach
Hillandale Reach
Elevation (feet)
Station (feet)
360
359
358
357
356
355
354
353
352
351
350
2100
2200
2300
2400
2500
2600
2700
2800
2900
3000
3100
3200


Ellerbe Creek Longitudinal Profile - 2009
Water Surface
As-built/MY1 (2005)
MY2 (10/25-10/31/06)
MY3 (7/5-7/10/07)
MY4 (9/8-9/18/08)
MY5 (6/30-7/2/09)
Grade Control Structures
Cross-sections
Bankfull
HD-3
HD-4
Abandoned Beaverdams
Hillandale Reach
Elevation (feet)
Station (feet)
357
356
355
354
353
352
351
350
349
348
347
3200
3300
3400
3500
3600
3700
3800
3900
4000
4100
4200
4300
4400

Substrate
Repeat pebble count data indicate that median riffle particles have ranged from very fine sand to medium gravels. As the As-built d50 for mainstem riffles ranged from very fine sand to fine gravel, the project has generally demonstrated stability. Riffles have fined somewhat over the monitoring period and some of this fining can be attributed to beaver activity. However, it is not an indication of project instability.

Table 2. Project Bedform Substrate Means for Riffle Cross-Sections

Cross Section	MY1	MY2	MY3	MY4	MY5	Average
HB-1	12.00 Medium gravel	4.00 Fine gravel	5.70 Fine gravel	14.00 Medium gravel	0.30 Medium Sand	7.20 Fine gravel
HB-3	0.06 Very fine sand	0.04 Very fine sand	6.60 Fine gravel	0.05 Very fine sand	0.05 Very fine sand	1.36 Very coarse sand
HD-2	0.06 Very fine sand	0.10 Very fine sand	0.10 Very fine sand	0.69 Coarse sand	0.20 Fine sand	0.23 Fine sand
HD-4	0.06 Very fine sand	0.10 Very fine sand	6.90 Fine gravel	1.88 Very coarse sand	0.30 Medium sand	1.85 Very coarse sand
AL-1	0.06 Very fine sand	2.30 Very fine gravel	0.20 Fine sand	0.60 Coarse sand	1.40 Very coarse sand	0.91 Coarse sand
AL-3	9.20 Medium gravel	7.00 Fine gravel	0.60 Coarse sand	0.20 Fine sand	0.70 Coarse sand	3.54 Very fine gravel
CR-2	12.00 Medium gravel	9.50 Medium gravel	8.30 Medium gravel	6.70 Fine gravel	0.06 Very fine sand	7.31 Fine gravel

Status of Engineered Structures and Stream Bank Stability
Grade control structures (rock cross vanes, j-hooks, and rootwads) were functioning as intended and none were experiencing any active erosion or backcutting.

There were limited areas of stream bank scour and slumping over the monitoring period, and banks under several of the golf cart bridges experienced scour. The Albany Reach had two areas of scour, each about 50 feet in length, and one slumped section just downstream of the golf cart bridge at station 6290. Even with these identified areas, less than 2% of the total bank length was identified as erosional in the monitoring year 5 visual assessment. Some amount of channel bank scour is expected in alluvial systems and the year-5 percentages are considered a success, particularly in comparison with pre-project conditions (Figure 2). It is anticipated that continued buffer vegetation growth will further influence project channel banks.

Bankfull Hydrology Data

Onsite observations and evaluation of a crest gauge installed on 13 June 2007 indicated that the site experienced at least one bankfull event during each monitoring year, exceeding the success criteria of two bankfull events in separate years over the five-year monitoring period. Table 3 outlines bankfull verification for the site.

Table 3. Verification of Bankfull Events

Date of Data Collection	Date of Occurrence	Method
4/30/06	Late April 2006*	On-site high water indicators observed
6/28/06	Mid-June 2006*	On-site high water indicators
9/19/06	Early-September 2006*	On-site high water indicators
4/11/07	Between 7 December 2006 and 11 April 2007*	On-site high water indicators
10/02/07	Between 13 June 2007 and 02 October 2007*	crest gauge
4/16/08	4 March 2008[+]	On-site high water indicators AND crest gauge
9/18/08	28 August, 6 September 2008[+]	On-site high water indicators AND crest gauge
3/6/2009	Possible Dates: 3/2/2009 (1.36") [+]	All cork at bottom of crest gauge; occurrence of bankfull event deemed inconclusive

*Based on dates of on-site visits

[+]Based on data from State Climate Office of North Carolina NC CRONOS database (http://www.nc-climate.ncsu.edu/cronos/) for COOP station 312515 and ECONET station DURH.

Vegetative Performance

Planted buffer vegetation is successful along the project. All 11 established vegetation plots exceeded 320 planted stems per acre in monitoring year 5 and had an average planted density of 699 stems per acre.

Table 4. Planted Live Stem Counts per Acre by Monitoring Year and Plot

Vegetation Plot ID	Monitoring Year					
	As-Built	MY1	MY2	MY3	MY4	MY5
HB1	2,266	1,902	890	809	769	769
HB2	1,538	1,133	1,133	809	769	688
HB3	809	1,093	890	890	728	728
CR1	2,752	728	728	769	769	728
CR2	1,012	1,781	1,376	1,174	1,214	1,174
HD1	486	486	324	324	324	324
HD2	1,497	1,052	890	769	688	688
HD3	1,497	769	688	688	688	526
AL1	1,700	648	486	728	688	567
AL2	2,752	1,700	1,295	850	769	688
AL3	2,550	1,983	1,659	1,457	1,376	809
Average	**1,714**	**1,207**	**942**	**843**	**798**	**699**

Several small areas of bare soil persisted on the site, primarily due to erosion of the terrace riser slopes immediately adjacent to the golf course. As can be seen in Figure 6, herbaceous species have begun to establish themselves and these areas are expected to decrease over time. Several stands of mimosa (*Albizia julibrissin*) were found on the site, along with some other scattered invasive species. The project is scheduled for invasive vegetation treatment in 2010 and 2011, which should address this problem.

Figure 6. Bare soil associated with rill and gully erosion

Project Goals, Outcomes, and Conclusions

This report summarizes the key information provided in the project's mitigation plan and monitoring reports. Further details can be found in those materials, which may be accessed on the NCEEP website (http://www.nceep.net/eep_projects.html). According to the 2005 Restoration Plan, the project's objectives were to (a) establish a new floodplain at a lower elevation and connecting the stream to the new floodplain; (b) reduce erosion and sedimentation; (c) provide wildlife habitat through the creation of a more natural riparian buffer; (d) improve aquatic habitat with the use of natural material stabilization structures and a riparian buffer; and (e) improve water quality within Ellerbe Creek.

Data collected over the last five years indicates that the restoration project has resulted in a stable stream channel that has floodplain access and a thriving native riparian buffer. The riffle-pool structure remained intact and improved the quality and distribution of in-stream habitat and erosion and sedimentation on the site has been significantly decreased.

The project's assets and their measured performance yield the ratios listed in Table 1. Buffer credit is only proposed for those areas that were planted as part of the restoration project and that are at least 50 feet wide from the stream edge. As the restoration project has met and exceeded the success criteria EEP considers the project to be successful and seeks regulatory closure on the assets detailed in Table 1.