Chapel Creek Stream Restoration Project
Orange County, North Carolina
EEP Project #77

MY-01 Monitoring Report - Final
Data Collected: September 2009
Submitted: December 1, 2009

Prepared for:
North Carolina Department of Environment and Natural Resources
Ecosystem Enhancement Program
Parker Lincoln Building
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Chapel Creek Stream Restoration
EEP Project #77
Chapel Hill, North Carolina
Orange County

MY-01 Monitoring Report - Final
Prepared By:

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APPENDICES

I. Executive Summary

The North Carolina Ecosystem Enhancement Program (EEP) has completed a stream restoration project along approximately 1,350 linear feet of Chapel Creek, located on University of North Carolina property in Chapel Hill, Orange County, North Carolina. The project is located in the Morgan Creek Local Watershed planning area, within the 14-digit HUC 03030002060080. The drainage area for Chapel Creek is approximately 0.42 square miles at the downstream limit of the project where a drainage channel through the A.E. Finley Golf Course flows into Chapel Creek. The land use in the watershed consists of University of North Carolina facilities, single family residential, elementary schools, roadways, and forested land. The Morgan Creek LWP noted water quality degradation and impaired biological community in the watershed and identified major watershed stressors as: streambank erosion, excess stormwater runoff, and disturbed riparian buffers. The goals of the restoration project are to improve water quality in Chapel Creek and the Cape Fear river basin by:

- Channel restoration of pattern, profile, and dimension for approximately 960 linear feet of Chapel Creek.
- Channel enhancement/stabilization for approximately 330 feet with a Priority Two restoration approach, bankfull bench and stream bank repairs.
- Restore reach to a stable stream channel, capable of transporting flows and sediment load efficiently.
- Improve aquatic habitat by planting trees along the banks in the cleared section to increase shade and adding more sinuosity to create more pool and riffle sections.
- Reduce sediment inputs to the stream from bank erosion by re-vegetating the banks.

The new CVS-EEP protocol was not administered for monitoring year one. Four vegetation monitoring plots were monitored and only planted stems were counted to monitor success criteria. Currently, 769 planted stems per acre are succeeding within the conservation easement. The success criteria of the planted woody species are the survival of 320 stems/acre after monitoring year three (MY3). A mortality rate of ten percent will be allowed after MY4 (288 stems/acre), with another ten percent mortality rate allowed after MY5 requiring a minimum of 260 stems/acre. Herbaceous species such as dog fennel (*Eupatorium capillifolium*), horseweed (*Erigeron canadensis*), tickseed (*Bidens* sp.), seedbox (*Ludwigia* sp.), smartweed (*Persicaria* sp.), common rush (*Juncus* sp.), sedges (*Carex* sp.), and various grasses, are present throughout the conservation easement. Woody species observed that were not planted include easterm red cedar (*Juniperus virginiana*), loblolly pine (*Pinus taeda*), silverling (*Baccharis halimifolia*), sycamore (*Platanus occidentalis*), green ash (*Fraxinus pennsylvanica*), tulip poplar (*Liriodendron tulipifera*), sweetgum (*Liquidambar styraciflua),* hickory (*Carya* sp.), hazelnut (*Corylus americana*), willow oak (*Quercus phellos*), black willow (*Salix nigra*), and tag alder (*Alnus serrulata*).

Invasive exotics observed include Japanese honeysuckle (*Lonicera japonica*), Japanese stiltgrass (*Microstegium vimineum*), autumn olive (*Elaeagnus umbellata*), multiflora rose (*Rosa multiflora*), and Chinese privet (*Ligustrum sinense*). According to the NC Native Plant Society all of these species are classified as Rank 1 "Severe Threat" species which is defined as exotic plant species that have invasive characteristics and spread readily into native plant communities,

displacing native vegetation. Although these species have been given this rank, the functionality of the project is not expected to be impaired significantly. The vegetation problem areas consist of invasive exotic species present within the conservation easement. See Table - for vegetation problem area descriptions and figure – for their locations. See section - of Appendix - for representative photos of the vegetation problem areas observed within the conservation easement of Chapel Creek.

The channel and banks of the restoration project are stable when compared to MY-00. There are not any negligible changes in pattern, profile or dimension between the monitoring years. The riffle pebble counts are trending slightly finer, but this is to be expected as the larger substrate in constructed riffles picks up some sediment deposition. A few problem areas were noted in the banks, but these do not appear to be further degrading and will likely continue to stabilize as vegetation is established.

Summary information/data related to the occurrence of items and statistics related to performance of various project and monitoring elements, can be found in the tables and figures in the report appendices. Narrative background and supporting information formally found in these reports can be found in the mitigation and restoration plan documents available on EEP's website. All raw data supporting the tables and figures in the appendices is available from EEP upon request.

II. Methodology

Methodologies follow EEP monitoring report template Version 1.2.1 (06/01/09) and guidelines (Lee et al 2008). Photos were taken with a digital camera. A Trimble Geo XT handheld unit with sub-meter accuracy was used to collect vegetation monitoring plot origins, and problem area locations. Cross sectional and longitudinal surveys were conducted using total station survey equipment. Data was entered into AutoCAD Civil3D to obtain dimensions of the cross sections and parameters applicable to the longitudinal profile. Reports were then generated to display summaries of the stream survey.

A. Vegetation Methodologies

A total of four 100m² vegetation monitoring plots were established during as built data collection. VP1, VP3, and VP4 are 20m x 5m plots and VP2 is a 10m x 10m plot. Planted stems within each plot were identified and counted to determine the number of stems/acre. Data collected for these plots are in Appendix C. The CVS-EEP protocol was not implemented for this project

B. Stream Methodologies

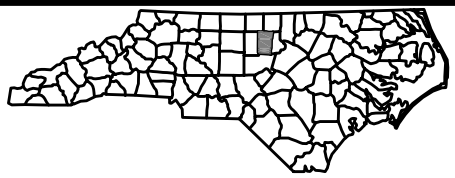
Stream profile and cross-sections were surveyed using total station equipment and methods. The survey data was plotted using AutoCAD Civil3D. The longitudinal profile was generated using the MY-02 alignment. Cross sectional data was extracted based on a linear alignment between the end pins.

III. References

Miller, James H. 2003. Nonnative invasive plants of southern forests: a field guide for identification and control. Gen. Tech. Rep. SRS–62. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 93 p.

Weakley, Alan (2006). *Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas*. http://www.herbarium.unc.edu/flora.htm.

Appendix A. General Figures and Plan Views



Ecosystem Enhancement PROGRAM

North Carolina – Ecosystem Enhancement Program

Chapel Creek Stream Reference Site
Orange County, North Carolina
SCO ID #050645701

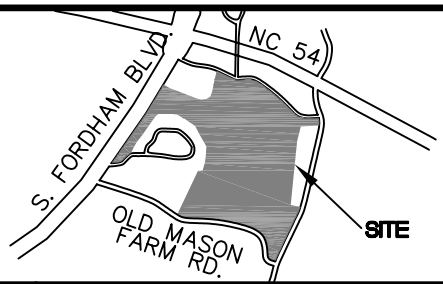


FIGURE 1-A
RESTORATION SITE
CHAPEL CREEK
AERIAL VICINITY MAP

DATE: JULY 25, 2006

N

500 250 0 500

APPROXIMATE SCALE

WARD CONSULTING ENGINEERS, PC

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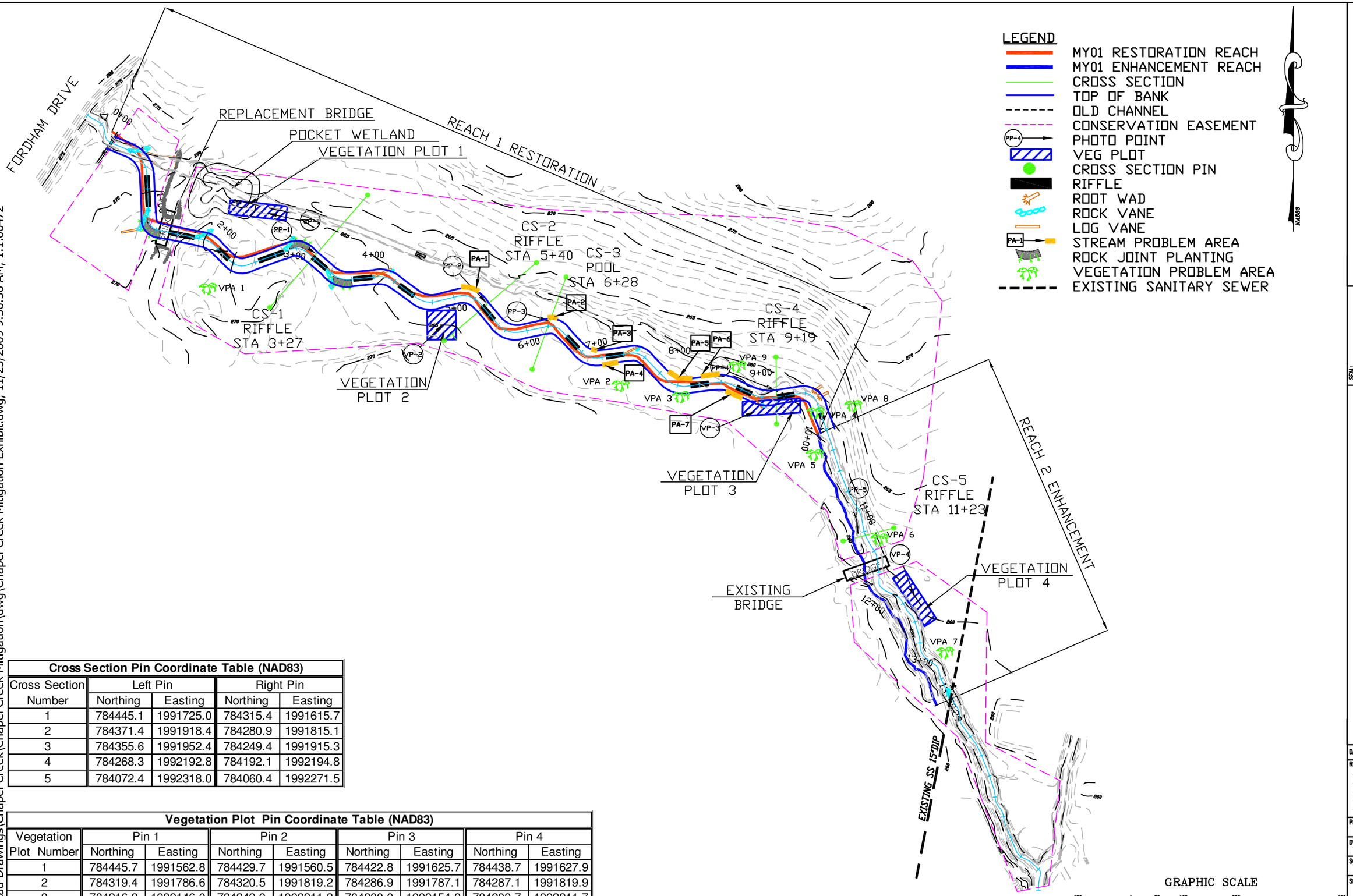

Cross Section Pin Coordinate Table (NAD83)

Cross Section Number	Left Pin		Right Pin	
	Northing	Easting	Northing	Easting
1	784445.1	1991725.0	784315.4	1991615.7
2	784371.4	1991918.4	784280.9	1991815.1
3	784355.6	1991952.4	784249.4	1991915.3
4	784268.3	1992192.8	784192.1	1992194.8
5	784072.4	1992318.0	784060.4	1992271.5

Vegetation Plot Pin Coordinate Table (NAD83)

Vegetation Plot Number	Pin 1		Pin 2		Pin 3		Pin 4	
	Northing	Easting	Northing	Easting	Northing	Easting	Northing	Easting
1	784445.7	1991562.8	784429.7	1991560.5	784422.8	1991625.7	784438.7	1991627.9
2	784319.4	1991786.6	784320.5	1991819.2	784286.9	1991787.1	784287.1	1991819.9
3	784216.3	1992146.0	784249.9	1992211.3	784200.0	1992154.8	784203.7	1992211.7
4	784015.2	1992316.7	784024.2	1992330.8	783969.2	1992366.4	783960.4	1992353.1

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SEAL:

CHAPEL CREEK CONSOLIDATED CURRENT CONDITIONS PLAN VIEW

CHAPEL HILL, NORTH CAROLINA

DATE: 25 NOVEMBER 2009

REVISIONS:

PROJECT NAME: CHAPEL CREEK

DWG NAME: Mitigation Plan

SCALE: 1" = 100'

SHEET NO.

FIGURE 2

Appendix B. General Projects Tables

Table 1. Project Restoration Components

Table 1. Project Restoration Components Chapel Creek Stream Restoration-Project No. 77								
Project Segment Reach I.D.	**Existing Feet**	**Mitigation Type**	**Approach**	**Linear Feet**	**Mitigation Ratio**	**Mitigation Units**	**Stationing**	**Comments**
Reach I	957	Restoration	Priority 1	961	1	961	0+00 to 9+94	Includes 900 lf of channel relocation
Reach II	356	Enhancement II	Priority 3	330	1.5	220	9+94 to 13+50	Instream Structure and Vegetated Buffers
Mitigation Unit Summations								
Stream (lf)	**Riparian Wetland (Ac)**	**Nonriparian Wetland (Ac)**		**Total Wetland(Ac)**			**Buffer (Ac)**	**Comment**
1181	0	0		0			1.2	

Table 2. Project Activity and Reporting History

Table 2. Project Activity and Reporting History Chapel Creek Stream Restoration-Project No. 77		
Activity or Reporting	**Data Collection Complete**	**Actual Completion Date**
Restoration Plan		Aug-06
Final Design – Construction Plans		Jun-07
Construction		Jul-08
Temporary S&E mix applied to entire project area		Jul-08
Permanent seed mix applied to enitre project area		Jul-08
Repairs to stream due to damages from storm events		Mar-09
Temporary S&E mix applied to area disturbed by repairs		Mar-09
Permanent seed mix applied to area disturbed by repairs		Mar-09
Containerized and B&B plantings for entire reach		Mar-09
Mitigation Plan / As-built (Year 0 Monitoring – baseline)	Mar-09	Mar-09
Year 1 Monitoring	Sept-09	Nov-09
Year 2 Monitoring		
Year 3 Monitoring		
Year 4 Monitoring		
Year 5 Monitoring		
Year 5+ Monitoring		

Table 3. Project Contacts Table

Table 3. Project Contacts Table Chapel Creek Stream Restoration - Project No. 77	
Designer	Ward Consulting Engineers, P.C. 8386 Six Forks Road Suite 101 Raleigh, NC 27615-5088
Primary project design POC	Becky Ward 919-870-0526
Construction Contractor	River Works, Inc. 800 Regency Parkway, Suite 200 Cary, NC 27518
Construction contractor POC	Will Pederson 919-459-9001
Survey Contractor	Level Cross Surveying, PLLC (all surveying) 668 Marsh County Lane Randleman, NC 27317
Survey contractor POC	Sherie Willard 336-495-1713
Planting Contractor	River Works, Inc. 800 Regency Parkway, Suite 200 Cary, NC 27518
Planting contractor POC	Will Pederson 919-459-9001
Seeding Contractor	River Works, Inc. 800 Regency Parkway, Suite 200 Cary, NC 27518
Contractor point of contact	Will Pederson 919-459-9001
Seed Mix Sources	Green Resource 336-855-6363
Nursery Stock Suppliers	Mellow Marsh Farm, Inc. 919-742-1200 Cure Nursery 919-542-6186
Monitoring Performers	Ward Consulting Engineers, P.C. 8386 Six Forks Road Suite 101 Raleigh, NC 27615-5088
Stream Monitoring POC	Robert Langager 919-870-0526
Vegetation Monitoring POC	Chris Sheats - The Catena Group - 919-732-1300

Table 4. Project Attribute Table

Table 4. Project Background Table Chapel Creek Stream Restoration Site-Project No. 77	
Project County	Orange
Drainage Area	0.42 square miles
Drainage impervious surface cover estimate (%)	< 5%
Stream Order	2
Physiographic Region	Piedmont (Triassic Basin)
Ecoregion	Central Piedmont
Rosgen Classification of As-Built	C4
Cowardin Classification	Riverine
Dominant Soil Types	Chewacla
Reference Site ID	Cabin Branch
USGS HUC for Project	03030002
USGS HUC for Reference	03020201
NCDWQ Sub-basin for Project	03-06-06
NCDWQ Sub-basin for Reference Reach	03-04-01
NCDWQ Classification for Project	WS-IV;NSW
NCDWQ Classification for Reference	WS-IV;NSW
Is any portion of any project segment 303D listed?	No
Is any portion of any project segment upstream of a 303D listed segment?	Yes
Reasons for 303D listing or stressor	Standard Violation
% of project easement fenced	0%

Appendix C. Vegetation Assessment Data

Vegetation Monitoring Plots Photos

Photo 1. Vegetation Plot 1

Photo 2. Vegetation Plot 2

Photo 3. Vegetation Plot 3

Photo 4. Vegetation Plot 4

Table 5. Chapel Creek MY-01 Vegetation Plot Stem Counts							
Scientific Name	**Common Name**	Plot*				**Total**	
		1	**2**	**3**	**4**		
Magnolia virginiana	Sweetbay Magnolia	3				**3**	
Rosa palustris	Swamp Rose	5				**5**	
Rhododendron viscosum	Swamp Azalea					**0**	
Viburnum cassinoides	Northern Wild Raisin					**0**	
Hibiscus moscheutos	Eastern Rose Mallow	2				**2**	
Vaccinium corymbosum	Highbush Blueberry	1				**1**	
Diospyros virginiana	American Persimmon	1	3	3		**7**	
Lindera benzoin	Spicebush			5	2	**7**	
Quercus nigra	Water Oak		1		2	**3**	
Carpinus caroliniana	Ironwood				3	**3**	
Betula nigra	River Birch		2	5	6	**13**	
Fraxinus pennsylvanica	Green Ash		4	2	5	**11**	
Platanus occidentalis	Sycamore		3			**3**	
Calycanthus floridus	Sweet-shrub			1	3	**4**	
Hamamelis virgniniana	Witch-hazel					**0**	
Viburnum dentatum	Mapleleaf Viburnum	1	2	4		**7**	
Viburnum nudum	Possumhaw					**0**	
Cornus amomum	Silky Dogwood			4		**4**	
Xanthorhiza simplicissima	Brook-feather			2		**2**	
Cephalanthus occidentalis	Buttonbush			1		**1**	
		13	***15***	***27***	***21***	***76***	***Total***

Table 5. Stem Count Total and Planted by Plot and Species

Appendix D. Stream Assessment Data

Stream Station Photos

Photo 5. Looking downstream at XS-1

Photo 6. Looking downstream at XS-2

Photo 7. Looking downstream at XS-3

Photo 8. Looking downstream at XS-4

Photo 9. Looking downstream at XS-5

Table 6. Visual Morphological Stability Assessment

Table 6. Visual Morphological Stability Assessment Chapel Creek Stream Restoration-Project N0. 77 Reach 1 (Restoration): (961 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	% Perform in Stable Condition	Feature Perform Mean or Total
A. Riffles	1. Present?	18	18	NA	100%	
	2. Armor stable (e.g.no displacement?)	18	18	NA	100%	
	3. Facet grade appears stable?	17	18	NA	94%	
	4. Minimal evidence of embedding/fining?	18	18	NA	100%	
	5. Length appropriate?	17	18	NA	94%	**98%**
B. Pools	1. Present? (e.g. not subject to severe aggrad. Or migrat.?)	17	17	NA	100%	
	2. Sufficiently deep (Max. Pool D:Mean Bkf>1.6?)	17	17	NA	100%	
	3. Length appropriate?	17	17	NA	100%	**100%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	18	18	NA	100%	
	2. Downstream of meander (glide/inflection) centering?	18	18	NA	100%	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	12	17	NA	71%	
	2. Of those eroding, # w/concomitant point bar formation?	1	5	NA	20%	
	3. Apparent Rc within spec?	17	17	NA	100%	
	4. Sufficient floodplain access and relief?	17	17	NA	100%	**73%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	NA	NA	0	100%	
	2. Channel bed degradation-areas of increasing downcutting of head cutting?	NA	NA	0	100%	**100%**
F. Bank	1. Actively eroding, wasting, or slumping bank?	NA	NA	7/70	96%	**96%**
G. Cross vanes, sills, single wing vanes	1. Free of back or arm scour?	8	8	NA	100%	
	2. Height appropriate?	8	8	NA	100%	
	3. Angle and geometry appear appropriate?	8	8	NA	100%	
	4. Free of piping or other structural failures?	8	8	NA	100%	**100%**
H. Wads/ Boulders	1. Free of scour?	1	1	NA	100%	
	2. Footing stable?	1	1	NA	100%	**100%**

Table 7. Verification of Bankfull Events

Table 7. Verification of Bankfull Events Chapel Creek Stream Restoration-Project No. 77			
Date of Data Collection	**Date of Occurrence**	**Method**	**Photo #**
September 2008	August 27, 2008	4.25 inches of rain.	N/A
September 2008	September 6, 2008	Tropical Storm Hanna: 4.8 inches of rain in 8 hours.	N/A

Figure 3. Cross Section 1

Project:	Chapel Creek
Cross Section:	Cross Section 1
Feature	Riffle
Station:	3+27
Date:	9/17/09
Crew:	RL,BW,SV,RW

Summary (bankfull)

	MY0	MY1	MY2	MY3	MY4	MY5
A (BKF)	30.6	29.2				
W (BKF)	19.9	19.2				
Max d	2.4	2.3				
Mean d	1.5	1.5				
W/D	12.9	12.6				

MY0-2008			MY1-2009			MY3-2010			MY4-2011		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0	266.3	CS1LP	0.00	266.32	CS1LP						
0.64	266.18		18.18	265.11							
17.02	265.02		29.77	265.02							
44.5	265.04		44.34	265.24							
60.68	265.73		61.77	265.73							
82.33	266.29	BKF	72.92	265.96							
86.28	264.74		78.71	266.05							
89.1	264.37		82.59	266.26	BKF						
89.64	264.12		84.02	265.61							
91.09	264.07		86.10	264.76							
92.6	263.89	TW	88.63	264.47							
94.63	264.11		89.44	264.21							
95.18	264.28		91.09	264.06							
96.67	264.35		92.55	263.95	TW						
99.42	265.03		94.36	264.05							
102.61	266.48	BKF	95.80	264.36							
110.65	266.69		97.38	264.54							
122.07	267.18		98.88	264.98							
129.16	267.75		102.19	266.45	BKF						
162.74	269.39		111.02	266.62							
169.8	269.71	CS1RP	125.08	267.42							
			138.99	268.25							
			155.50	268.91							
			169.83	269.68	CS1RP						

Photo of XS-1, looking in the downstream direction

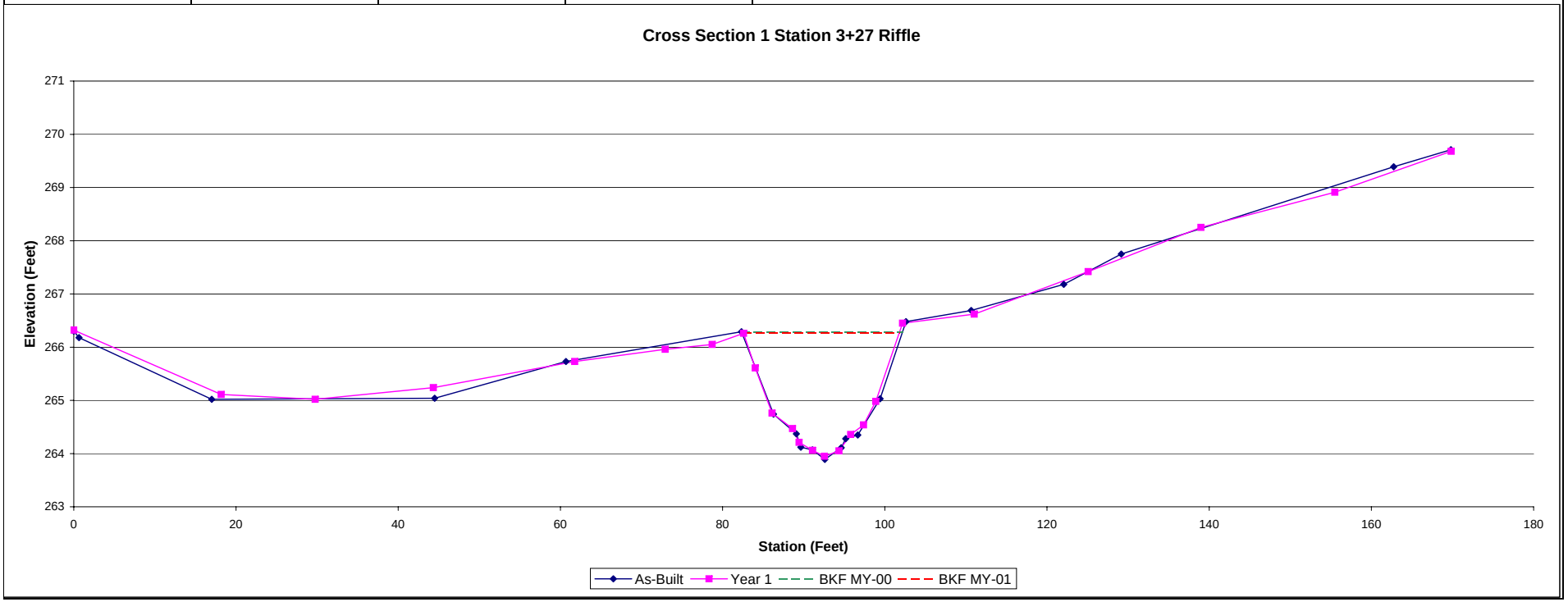

Figure 4. Cross Section 2

Project:	Chapel Creek
Cross Section:	Cross Section 2
Feature	Riffle
Station:	5+40
Date:	9/17/09
Crew:	RL,BW,SV,RW

Summary (bankfull)

	MY0	MY1	MY2	MY3	MY4	MY5
A (BKF)	22.7	24.6				
W (BKF)	20.5	18.7				
Max d	2.3	2.0				
Mean d	1.1	1.3				
W/D	18.5	14.2				

MY0-2008			MY1-2009			MY3-2010			MY4-2011		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0.00	266.03	CS2LP	0.00	266.03	CS2LP						
0.38	265.94		16.68	264.81							
4.75	265.69		30.81	264.21							
6.82	265.45		50.86	263.75							
11.04	265.10		62.35	263.95							
14.64	264.94		73.58	264.03	BKF						
25.70	264.37		75.25	263.28							
31.04	264.08		76.14	262.76							
36.34	263.85		77.41	262.75							
37.06	263.79		78.13	262.40							
41.50	263.61		78.89	262.12							
47.31	263.69		81.12	262.01							
51.71	263.65		82.79	262.02							
57.67	263.84		84.67	262.01							
67.59	263.84		85.80	262.44							
73.72	264.10	BKF	87.54	262.61	TW						
74.13	263.99		89.21	263.11							
76.20	262.67		90.31	263.48							
76.90	262.52		91.93	263.98	BKF						
77.98	262.33		93.46	264.08							
78.59	262.25		97.93	264.12							
79.00	261.99		104.58	264.45							
80.33	261.96		112.83	264.51							
82.32	261.66	TW	113.42	264.73							
82.76	261.71		122.91	265.04							
83.77	261.84		127.37	265.29							
85.02	261.98		130.38	265.47							
85.73	262.23										
86.10	262.20										
86.17	262.20										
87.25	262.49										
88.04	262.58										
89.18	262.81										
90.27	263.14										
92.52	263.89	BKF									
97.87	264.16										
99.91	264.11										
106.72	264.39										
113.11	264.53										
117.44	264.77										
120.77	264.77										
128.39	265.23										
131.96	265.41										
136.68	265.82										
137.13	265.80										
137.60	265.91	CS2RP									

Photo of XS-2, looking in the downstream direction

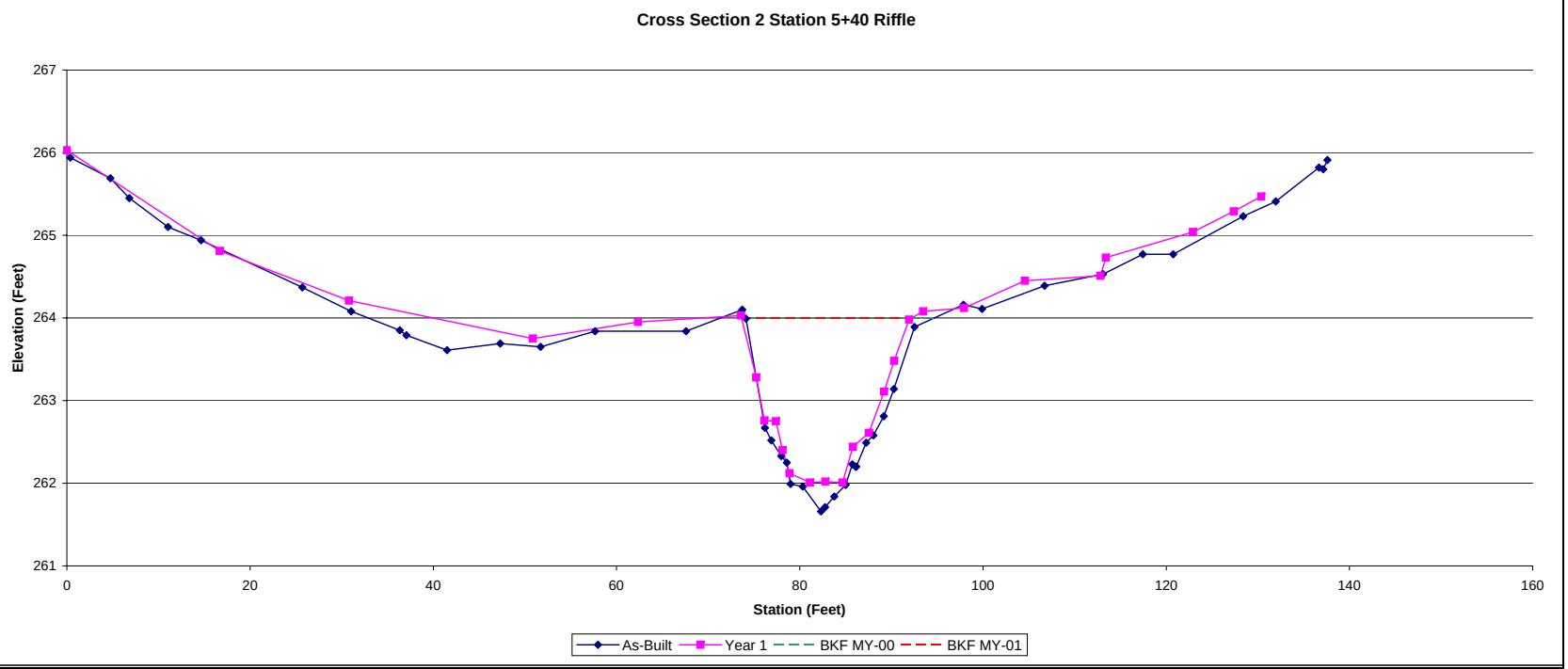

Figure 5. Cross Section 3

Project:	Chapel Creek
Cross Section:	Cross Section 3
Feature	Riffle
Station:	6+28
Date:	9/17/09
Crew:	RL,BW,SV,RW

Summary (bankfull)

	MY0	MY1	MY2	MY3	MY4	MY5
A (BKF)	30.7	31.1				
W (BKF)	24.2	27.1				
Max d	3.2	3.2				
Mean d	1.3	1.1				
W/D	19.1	23.6				

MY0-2008			MY1-2009			MY3-2010			MY4-2011		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0	265.48	CS3LP	0.00	265.48	CS3LP						
0.52	265.42		10.55	264.11							
2.73	265.16		18.73	263.26							
9.49	264.18		31.24	262.68							
14.9	263.52		35.17	262.69							
20.47	263.1		41.14	262.60							
23.77	263.1		46.79	262.78							
28.58	262.56		49.43	262.79	BKF						
35.48	262.64		51.32	262.31							
42.42	262.7		51.38	262.31							
48.6	262.78		54.13	260.47							
50.14	262.71		54.31	260.46							
50.34	262.67	BKF	54.51	259.75							
52.36	261.47		55.46	259.59	TW						
53.15	260.86		57.44	259.89							
53.53	260.37		58.64	260.51							
55.64	259.43	TW	59.48	260.78							
55.72	259.62		60.26	261.17							
56.04	259.6		62.56	261.58							
57.72	259.89		66.21	262.10							
60.4	260.93		71.54	262.42							
61.16	261.44		75.60	262.70							
62.34	261.53		83.12	263.41							
64.14	261.8		83.12	263.41							
67.47	262.07		95.56	263.56							
72.39	262.29		103.84	263.66							
73.32	262.54	BKF	112.64	263.65	CS3RP						
78.3	263.05										
81.32	263.2										
86.02	263.42										
95.12	263.6										
97.05	263.61										
112.14	263.62	CS3RP									
112.14	263.62										

Photo of XS-3, looking in the downstream direction

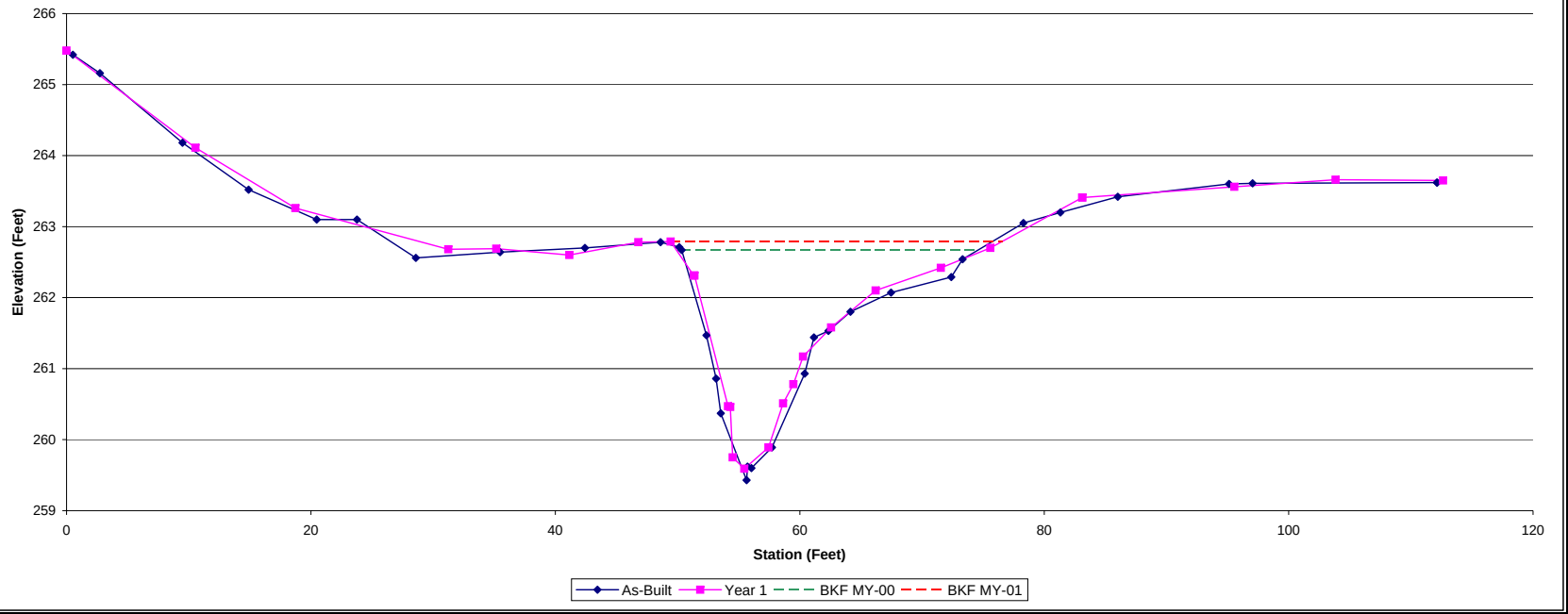

Figure 6. Cross Section 4

Project:	Chapel Creek
Cross Section:	Cross Section 4
Feature	Riffle
Station:	9+19
Date:	9/17/09
Crew:	RL,BW,SV,RW

Summary (bankfull)

	MY0	MY1	MY2	MY3	MY4	MY5
A (BKF)	18.9	20.8				
W (BKF)	21.6	19.9				
Max d	1.8	1.9				
Mean d	0.9	1.0				
W/D	24.7	19.0				

MY0-2008			MY1-2009			MY3-2010			MY4-2011		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0	262.82	CS4LP	0.00	262.81	CS4LP						
0.37	262.73		10.20	261.64							
11.25	261.64		21.56	260.50							
21	260.46		30.04	260.05							
27.2	260.07		35.61	259.72							
33.42	259.81		37.48	259.64	BKF						
37.4	259.78		38.96	259.13							
37.36	259.79	BKF	40.32	258.63							
42.23	258.51		42.50	258.28							
43.48	258.4		44.02	258.01							
46.99	258.07	TW	45.06	257.93	TW						
48.79	258.22		45.75	258.01							
49.47	258.56		48.42	258.06							
51.67	258.79		48.64	258.18							
54.33	259.9	BKF	49.13	258.54							
59.33	260.18		49.42	258.54							
61.93	260.17		51.39	258.65							
66.89	260.72		54.59	259.95	BKF						
75.89	262.24		62.38	260.15							
76.23	262.27	CS4RP	68.60	260.95							
			68.64	260.92							
			76.18	262.35	CS4RP						

Photo of XS-4, looking in the downstream direction

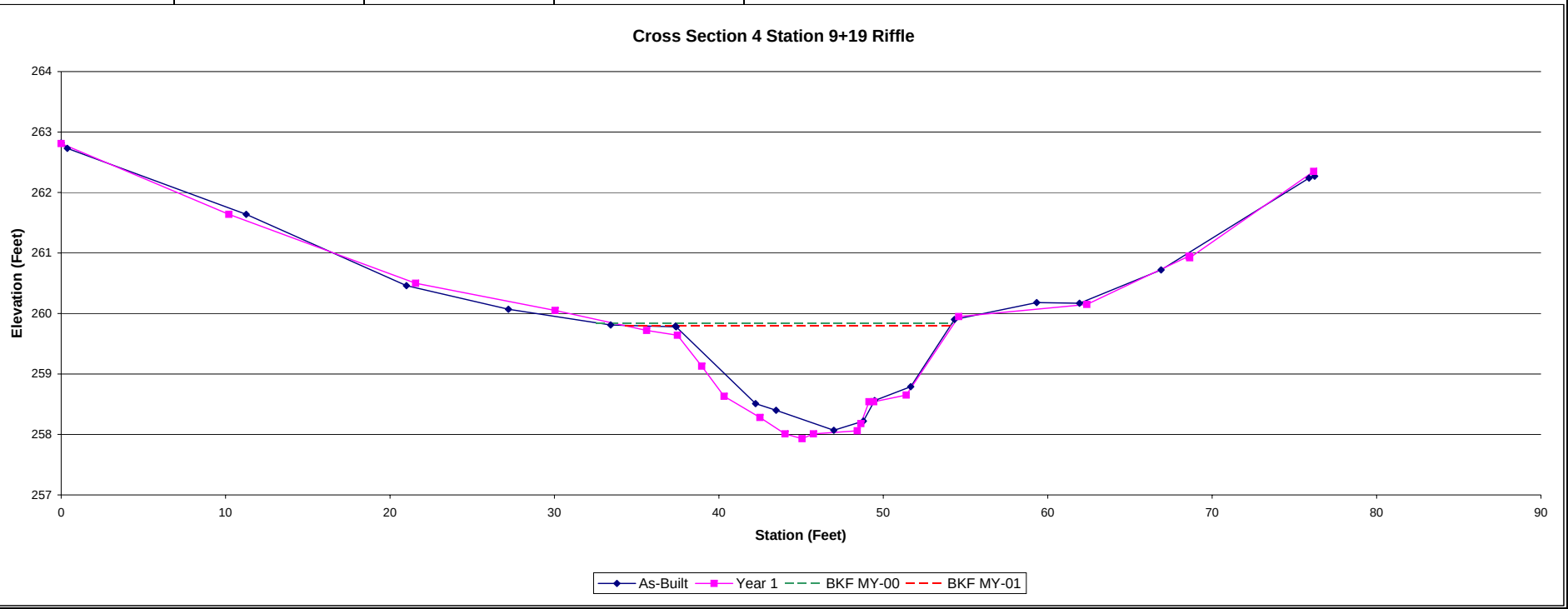

Figure 7. Cross Section 5

Project:	Chapel Creek
Cross Section:	Cross Section 5
Feature	Riffle
Station:	11+23
Date:	9/17/09
Crew:	RL,BW,SV,RW

Summary (bankfull)

	MY0	MY1	MY2	MY3	MY4	MY5
A (BKF)	28.9	29.8				
W (BKF)	15.4	16.3				
Max d	2.9	2.7				
Mean d	1.9	1.8				
W/D	8.2	8.9				

MY0-2008			MY1-2009			MY3-2010			MY4-2011		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0	263.84		11.46	263.25	X5LP						
11.46	263.25	CS5LP	18.59	261.67	X5						
11.9	263.17		25.70	260.34	X5						
14.29	262.76		32.76	259.76	X5						
17.16	262.06		34.95	259.71	X5						
21.29	261.07		37.85	259.29	ıkfull Left TOBL						
24.94	260.4		40.42	258.00	X5						
29.43	260.09		41.37	257.54	X5TOE						
38.04	259.37	BKF	43.11	257.21	X5						
40.27	258.13		45.35	256.92	X5						
41.78	257.51		47.47	256.79	X5						
43.14	257.19		49.40	256.63	TW						
43.92	257.16		50.91	256.66	X5TOE						
46.07	256.88		56.60	261.24	TOBR						
47.81	256.84		59.41	261.60	X5RP						
49.84	256.71										
50.92	256.5	TW									
51.32	256.53										
51.55	256.86										
51.59	257.39										
51.85	257.89										
52.29	258.83	BKF									
53.88	259.61										
55.53	260.82										
57.29	261.32										
59.48	261.63	CS5RP									
70.78	263										

Photo of XS-5, looking in the downstream direction

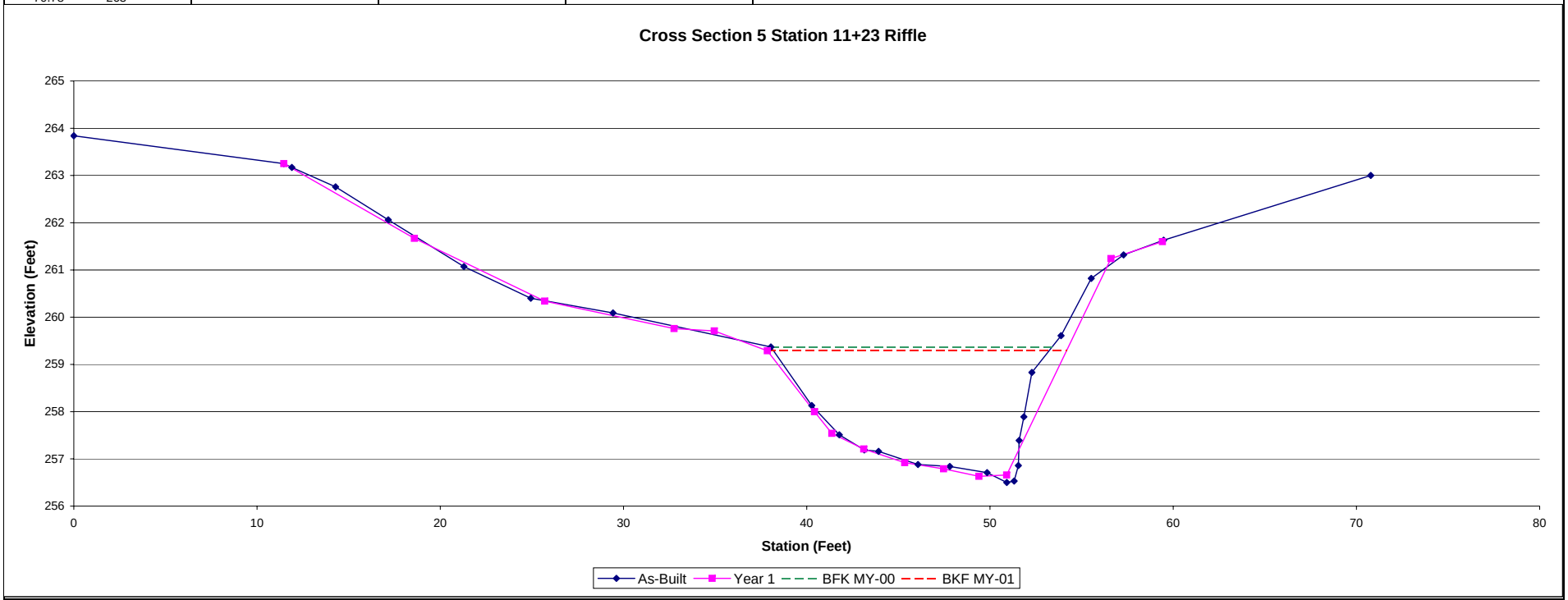

Figure 8. Chapel Creek MY-01 Longitudinal Profile

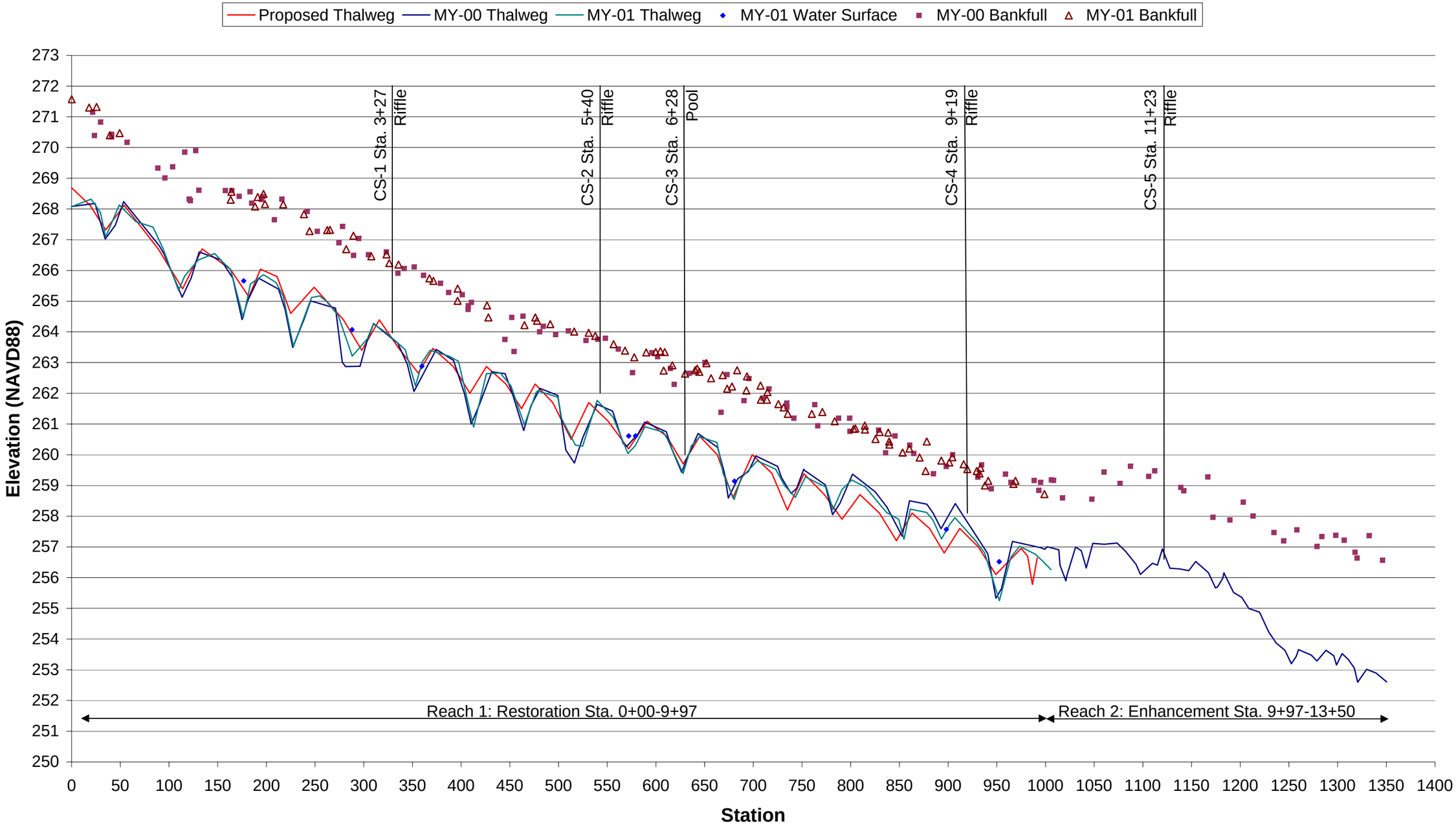

Figure 9. Pebble Count-Cross Section 1

Project: Chapel Creek, Chapel Hill, NC **Date:** 9/17/2009

Location: CS-1

				Particle Counts				
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	0	0	0	0%	0%
	Very Fine	.062 - .125	S	0	0	0	0%	0%
	Fine	.125 - .25	A	0	0	0	0%	0%
	Medium	.25 - .50	N	0	0	0	0%	0%
	Coarse	.50 - 1.0	D	2	0	2	2%	2%
.04 -.08	Very Coarse	1.0 - 2.0	S	1	0	1	1%	3%
.08 - .16	Very Fine	2.0 - 4.0		0	0	0	0%	3%
.16 - .22	Fine	4.0 - 5.7	G	0	0	0	0%	3%
.22 - .31	Fine	5.7 - 8.0	R	1	0	1	1%	4%
.31 - .44	Medium	8.0 - 11.3	A	0	0	0	0%	4%
.44 - .63	Medium	11.3 - 16.0	V	0	0	0	0%	4%
.63 - .89	Coarse	16.0 - 22.6	E	2	0	2	2%	6%
.89 - 1.26	Coarse	22.6 - 32.0	L	9	0	9	9%	14%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	18	0	18	17%	32%
1.77 - 2.5	Very Coarse	45.0 - 64.0		34	0	34	33%	64%
2.5 - 3.5	Small	64 - 90	C	22	0	22	21%	86%
3.5 - 5.0	Small	90 - 128	O	8	0	8	8%	93%
5.0 - 7.1	Large	128 - 180	B	4	0	4	4%	97%
7.1 - 10.1	Large	180 - 256	L	2	0	2	2%	99%
10.1 - 14.3	Small	256 - 362	B	1	0	1	1%	100%
14.3 - 20	Small	362 - 512	L	0	0	0	0%	100%
20 - 40	Medium	512 - 1024	D	0	0	0	0%	100%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0	0	0	0%	100%
	Bedrock		BDRK	0	0	0	0%	100%
			Totals	**104**	**0**	**104**	**100%**	**100%**

d16	d35	d50	d84	d95
33.2	46.9	55.6	88.1	151.4

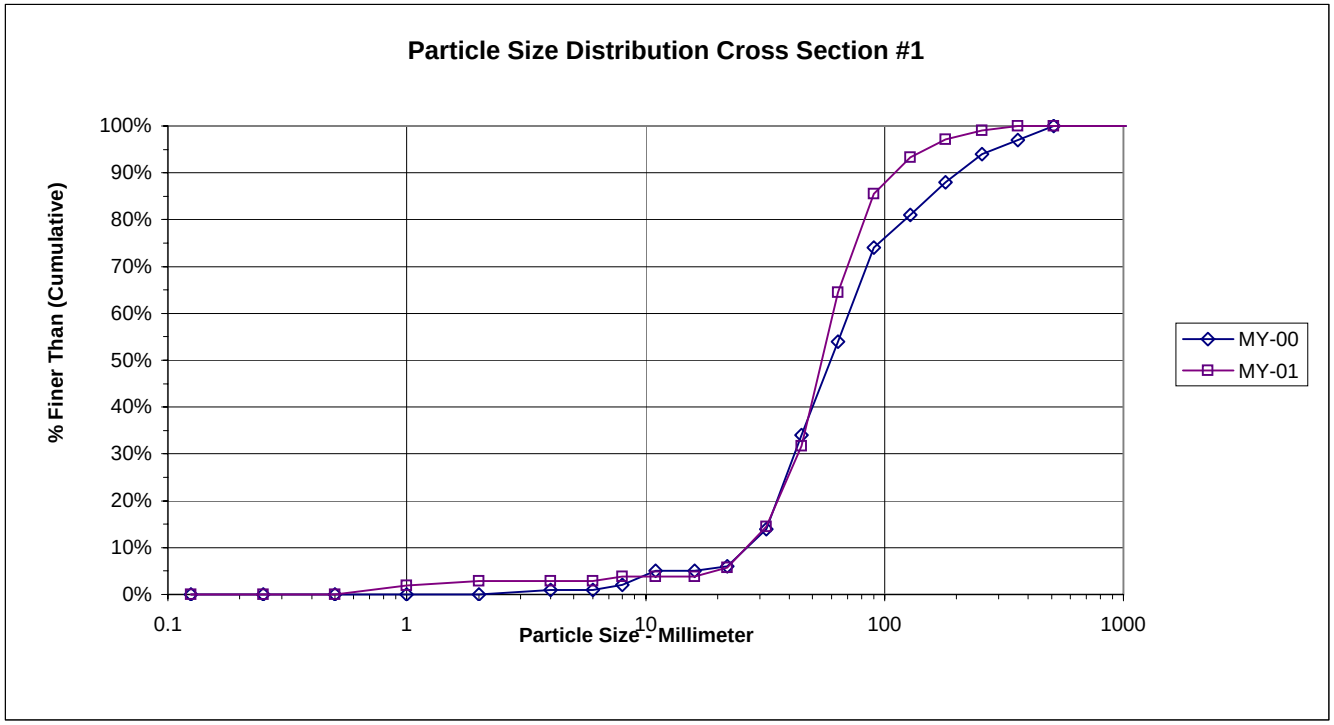

Figure 10. Pebble Count-Cross Section 2

Project: Chapel Creek, Chapel Hill, NC **Date:** 9/17/2009

Location: CS-2

				Particle Counts				
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	0	0	0	0%	0%
	Very Fine	.062 - .125	S	0	0	0	0%	0%
	Fine	.125 - .25	A	0	0	0	0%	0%
	Medium	.25 - .50	N	1	0	1	1%	1%
	Coarse	.50 - 1.0	D	6	0	6	6%	7%
.04 -.08	Very Coarse	1.0 - 2.0	S	6	0	6	6%	13%
.08 - .16	Very Fine	2.0 - 4.0		0	0	0	0%	13%
.16 - .22	Fine	4.0 - 5.7	G	0	0	0	0%	13%
.22 - .31	Fine	5.7 - 8.0	R	0	0	0	0%	13%
.31 - .44	Medium	8.0 - 11.3	A	0	0	0	0%	13%
.44 - .63	Medium	11.3 - 16.0	V	0	0	0	0%	13%
.63 - .89	Coarse	16.0 - 22.6	E	3	0	3	3%	16%
.89 - 1.26	Coarse	22.6 - 32.0	L	2	0	2	2%	17%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	18	0	18	17%	35%
1.77 - 2.5	Very Coarse	45.0 - 64.0		29	0	29	28%	63%
2.5 - 3.5	Small	64 - 90	C	25	0	25	24%	87%
3.5 - 5.0	Small	90 - 128	O	6	0	6	6%	93%
5.0 - 7.1	Large	128 - 180	B	3	0	3	3%	96%
7.1 - 10.1	Large	180 - 256	L	2	0	2	2%	98%
10.1 - 14.3	Small	256 - 362	B	1	0	1	1%	99%
14.3 - 20	Small	362 - 512	L	0	0	0	0%	99%
20 - 40	Medium	512 - 1024	D	1	0	1	1%	100%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0	0	0	0%	100%
	Bedrock		BDRK	0	0	0	0%	100%
			Totals	**103**	**0**	**103**	**100%**	**100%**

d16	d35	d50	d84	d95
24.4	45.0	55.2	86.4	160.1

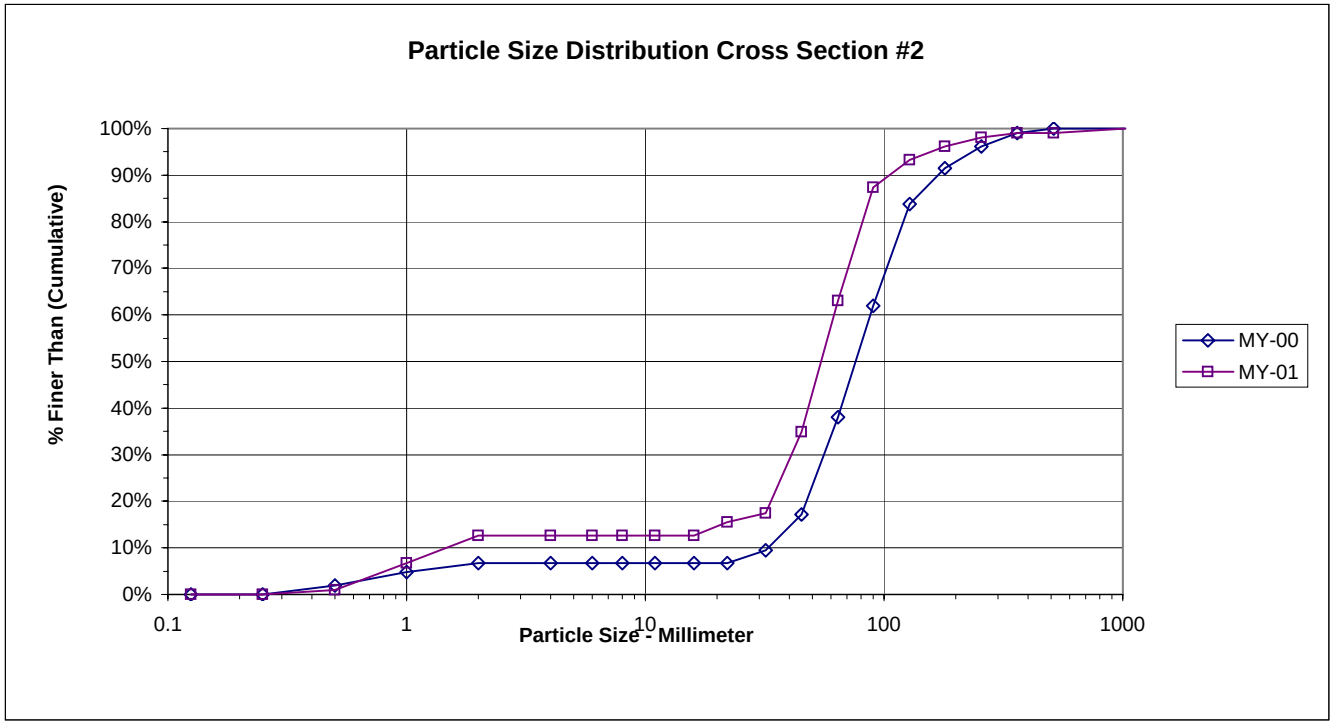

Figure 11. Pebble Count-Cross Section 4

Project: Chapel Creek, Chapel Hill, NC **Date:** 9/17/2009

Location: CS-4

				Particle Counts				
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	0	0	0	0%	0%
	Very Fine	.062 - .125	S	0	0	0	0%	0%
	Fine	.125 - .25	A	0	0	0	0%	0%
	Medium	.25 - .50	N	2	0	2	2%	2%
	Coarse	.50 - 1.0	D	1	0	1	1%	3%
.04 -.08	Very Coarse	1.0 - 2.0	S	0	0	0	0%	3%
.08 - .16	Very Fine	2.0 - 4.0		0	0	0	0%	3%
.16 - .22	Fine	4.0 - 5.7	G	0	0	0	0%	3%
.22 - .31	Fine	5.7 - 8.0	R	0	0	0	0%	3%
.31 - .44	Medium	8.0 - 11.3	A	0	0	0	0%	3%
.44 - .63	Medium	11.3 - 16.0	V	0	0	0	0%	3%
.63 - .89	Coarse	16.0 - 22.6	E	0	0	0	0%	3%
.89 - 1.26	Coarse	22.6 - 32.0	L	2	0	2	2%	5%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	8	0	8	8%	13%
1.77 - 2.5	Very Coarse	45.0 - 64.0		37	0	37	37%	50%
2.5 - 3.5	Small	64 - 90	C	31	0	31	31%	80%
3.5 - 5.0	Small	90 - 128	O	8	0	8	8%	88%
5.0 - 7.1	Large	128 - 180	B	4	0	4	4%	92%
7.1 - 10.1	Large	180 - 256	L	6	0	6	6%	98%
10.1 - 14.3	Small	256 - 362	B	1	0	1	1%	99%
14.3 - 20	Small	362 - 512	L	1	0	1	1%	100%
20 - 40	Medium	512 - 1024	D	0	0	0	0%	100%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0	0	0	0%	100%
	Bedrock		BDRK	0	0	0	0%	100%
			Totals	**101**	**0**	**101**	**100%**	**100%**

d16	d35	d50	d84	d95
46.6	56.5	64.4	108.2	217.4

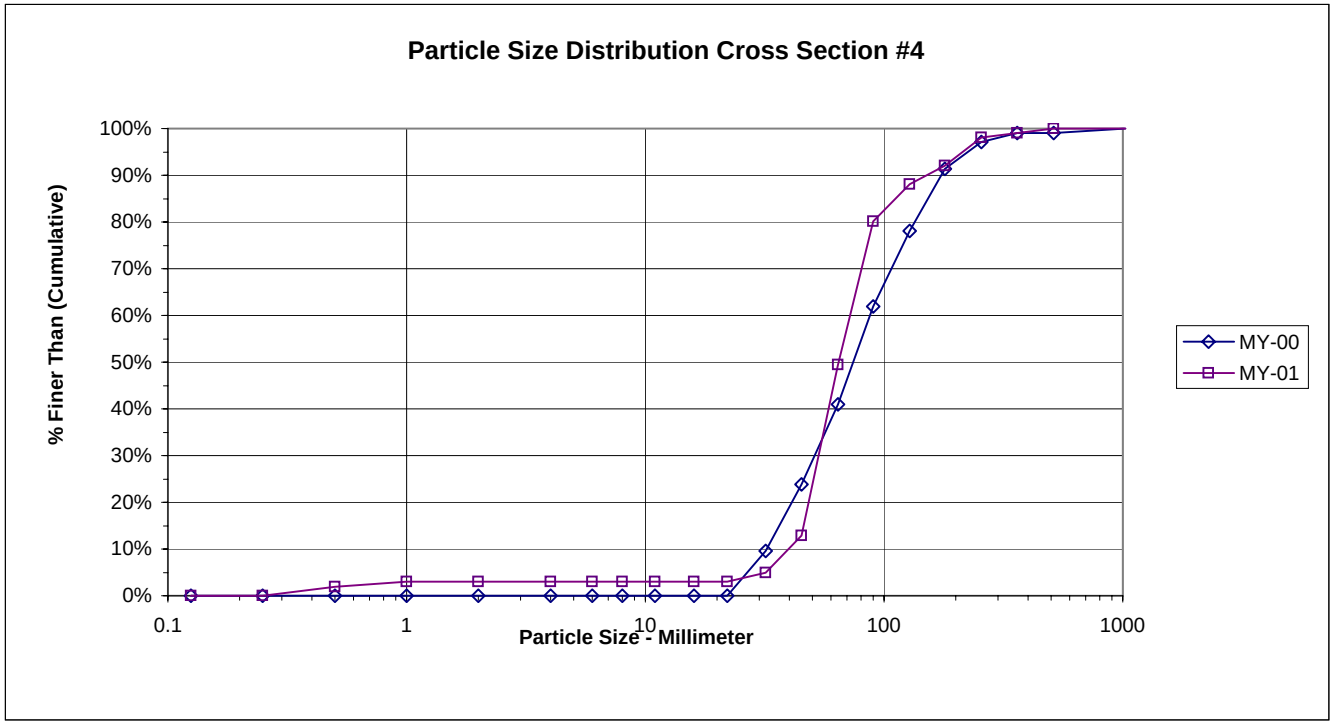

Figure 12. Pebble Count-Cross Section 5

Project: Chapel Creek, Chapel Hill, NC **Date:** 9/17/2009

Location: CS-5

				Particle Counts				
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	0	0	0	0%	0%
	Very Fine	.062 - .125	S	0	0	0	0%	0%
	Fine	.125 - .25	A	0	0	0	0%	0%
	Medium	.25 - .50	N	7	0	7	7%	7%
	Coarse	.50 - 1.0	D	13	0	13	13%	19%
.04 -.08	Very Coarse	1.0 - 2.0	S	11	0	11	11%	30%
.08 - .16	Very Fine	2.0 - 4.0		0	0	0	0%	30%
.16 - .22	Fine	4.0 - 5.7	G	1	0	1	1%	31%
.22 - .31	Fine	5.7 - 8.0	R	1	0	1	1%	32%
.31 - .44	Medium	8.0 - 11.3	A	1	0	1	1%	33%
.44 - .63	Medium	11.3 - 16.0	V	8	0	8	8%	41%
.63 - .89	Coarse	16.0 - 22.6	E	9	0	9	9%	50%
.89 - 1.26	Coarse	22.6 - 32.0	L	18	0	18	17%	67%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	8	0	8	8%	75%
1.77 - 2.5	Very Coarse	45.0 - 64.0		13	0	13	13%	87%
2.5 - 3.5	Small	64 - 90	C	6	0	6	6%	93%
3.5 - 5.0	Small	90 - 128	O	3	0	3	3%	96%
5.0 - 7.1	Large	128 - 180	B	3	0	3	3%	99%
7.1 - 10.1	Large	180 - 256	L	1	0	1	1%	100%
10.1 - 14.3	Small	256 - 362	B	0	0	0	0%	100%
14.3 - 20	Small	362 - 512	L	0	0	0	0%	100%
20 - 40	Medium	512 - 1024	D	0	0	0	0%	100%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0	0	0	0%	100%
	Bedrock		BDRK	0	0	0	0%	100%
			Totals	**103**	**0**	**103**	**100%**	**100%**

d16	d35	d50	d84	d95
0.9	12.3	22.3	58.9	113.4