

**Paschal Golf Course (Richland Creek)
Stream Restoration Monitoring Report
EEP Project #276
Monitoring Year 01**



Submitted to:



NCEEP, 1652 Mail Service Center, Raleigh, NC 27699-1652

**Construction Completed: May 2010
Data Collection: July 2011
Submitted: December 2011**

Monitoring Firm



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Table of Contents

1.0	Executive Summary/Project Abstract	1
2.0	Methodology	2
3.0	References	2

Appendix A – Project Vicinity Map and Background Tables

Figure 1.	Vicinity Map.....	4
Figure 2.	Site Map.....	5
Table 1a –	Project Components	6
Table 1b –	Component Summations.....	6
Table 2 –	Project Activity and Reporting History	7
Table 3 –	Project Contacts	7
Table 4 –	Project Attributes	8

Appendix B – Visual Assessment Data

Figure 3.	Current Condition Plan View	10
Table 5 –	Visual Stream Morphology Stability Assessment	12
Table 6 –	Vegetation Condition Assessment	13
Stream Station	Photos	14
Vegetation Plot	Photos.....	19

Appendix C – Vegetation Plot Data

Table 7 –	Vegetation Plot Criteria Attainment	22
Table 8 –	CVS Vegetation Plot Metadata.....	22
Table 9 –	CVS Stem Count Total and Planted by Plot and Species	23

Appendix D – Stream Survey Data

Cross Section	Plots	25
Longitudinal	Profile Plots	31
Pebble Count	Plots.....	34
Table 10 –	Baseline-Stream Data Summary Table.....	40
Table 11a.	Monitoring - Cross-Section Morphology Data Table	41
Table 11b.	Monitoring - Stream Reach Morphology Data Table	42

Appendix E – Hydrology Data

Table 12 –	Verification of Bankfull Events	44
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1.0 EXECUTIVE SUMMARY / PROJECT ABSTRACT

The Paschal Golf Course (Richland Creek) Stream Restoration Site, completed in May 2010, restored a total of 2,919 linear feet of stream in the Neuse River Basin. The project is located in the USGS Hydrologic Unit 03020201-07-0060. This HU is within the EEP's Neuse River Basin Local Watershed Plan and is also listed as a Targeted Local Watershed (TLW) in EEP's *Neuse River Basin Restoration Priorities 2010*. The project goals and objectives are listed below.

Project Goals

- Restore a stable channel morphology and floodplain to the project stream that is capable of moving the flows and sediment provided by its watershed.
- Improve water quality by reducing bank erosion and bed degradation.
- Provide a riparian management zone that is compatible with the surrounding uses (golf course and electrical transmission corridor) and yet retains the ecological function of the riparian zone.
- Enhance aquatic and terrestrial habitat in the stream corridor.

Project Objectives

- Restore 2,919 linear feet of stable stream channel with the appropriate pattern, profile, and dimension that can support efficient sediment transport.
- Plant native trees and shrubs throughout the site.
- Grade a floodplain adjacent to the stream.

The vegetation monitoring success criterion for the planted stream riparian zone is a density of 320 stems/acre after the third year of monitoring and an allowance for 10% mortality in the fourth and fifth years with a final density of 260 stems/acre. The first-year vegetation monitoring was based on the Level 2 CVS-EEP vegetation monitoring protocol. The site's average density for this monitoring period was 642 planted stems/acre, including live stakes, and 457 planted stems/acre, excluding live stakes (N = 7). Including volunteers, the site averaged 815 total stems/acre (N=7). Of the vegetation monitoring plots in the streamside planting area (Plots 1 and 6), only Plot 1 had a planted stem density below the five-year success criterion of 260 stems/acre. All of the vegetation monitoring plots in the buffer restoration areas (Plots 2, 3, 4, 5, and 7) had a planted stem density above the five-year success criterion of 320 stems/acre. The 2011 monitoring found an overall low vigor and live stake survivability throughout the site. Due to the fact that the planted vegetation is still young, the low vigor areas have not been quantified. There were many pine and river birch volunteers throughout the easement. The site will be re-evaluated in Monitoring Year Two to determine if any further recommendations are needed.

First-year monitoring found Richland Creek to be mostly stable, with only minor changes from the baseline conditions. The stream has had areas of localized bank erosion since construction (1% of all banks), with one section (Station 5+05) displaying signs of mass wasting (1% of all banks). These areas will continue to be watched closely in Monitoring Year Two. The longitudinal and cross-sectional data also reflect the overall stability in the project streams. As a part of the stream success criterion, the stream must experience at least two bankfull events, each in separate monitoring years. The site has experienced multiple bankfull events since construction.

Summary information/data related to the occurrence of items such as beaver or encroachment 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 formerly found in these reports can be found in the Baseline Monitoring Report and in the Mitigation Plan (formerly the Restoration Plan) documents available on the EEPs website. All raw data supporting the tables and figures in the appendices are available from EEP upon request.

2.0 METHODOLOGY

The survey data were collected with a total station instrument.

The stationing for the longitudinal profile is based on the thalweg stationing and has been adjusted to match grade control structures from previous longitudinal profiles. The stationing was adjusted by changing the stationing between grade control structures to match the stationing from previous surveys.

The CVS-EEP protocol, Level 2 (<http://cvs.bio.unc.edu/methods.htm>) was used to collect vegetation data from the site.

3.0 REFERENCES

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

NCEEP. 2010. DRAFT - Neuse River Basin Restoration Priorities. (http://www.nceep.net/services/restplans/DRAFT_RBRP_Neuse_201007.pdf)

USACE. 2003. Stream Mitigation Guidelines. USACE, NCDENR-DWQ, USEPA, NCWRC.

Appendix A

Project Vicinity Map and Background Tables

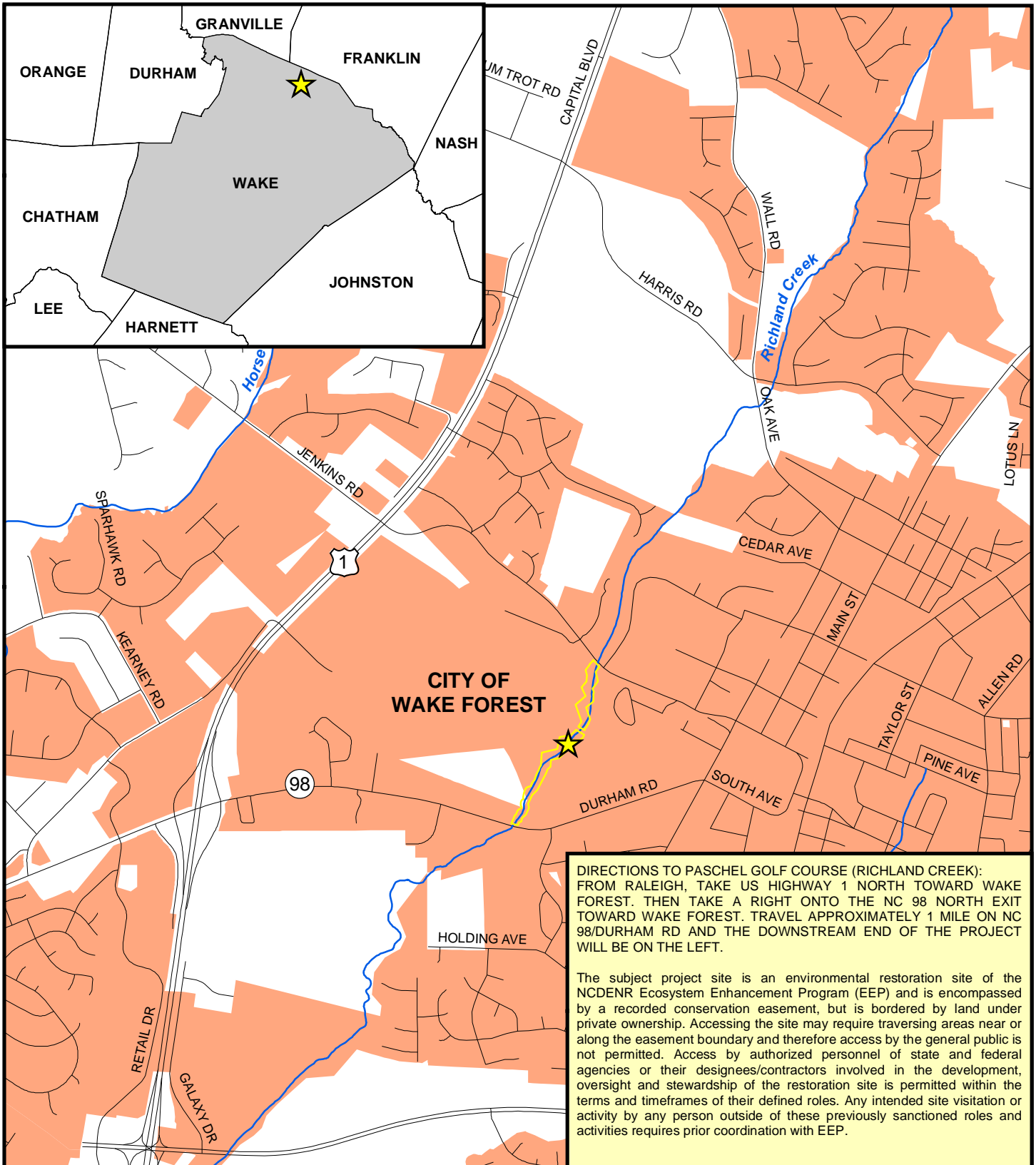







Figure 1. Vicinity Map - Paschal Golf Course (Richland Creek), Project No. 276



-  Project Location
-  Roads
-  Major Streams and Rivers
-  Municipalities
-  Project Easement

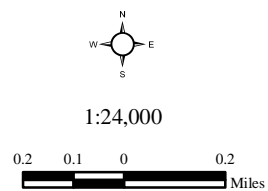









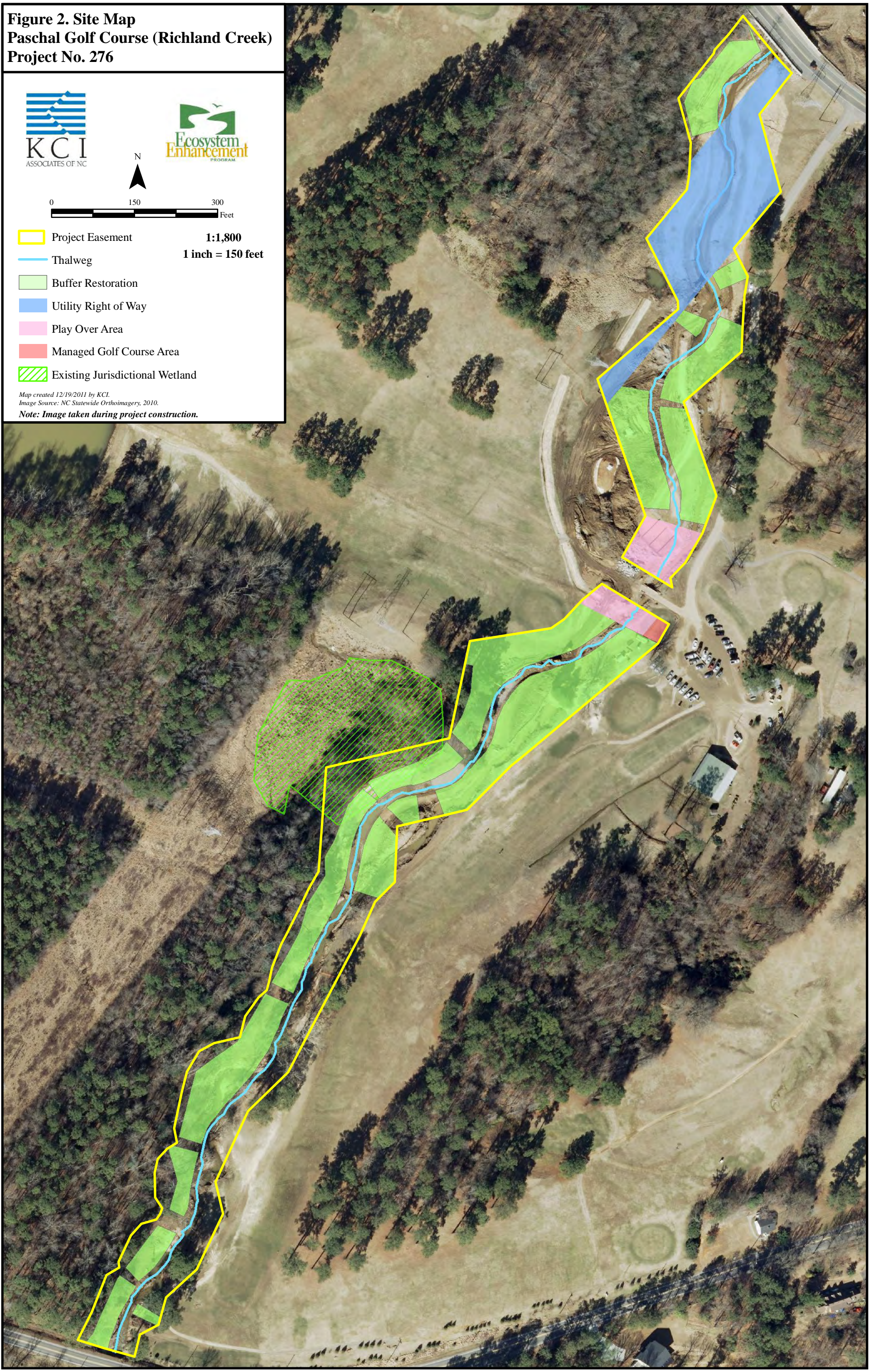
Figure 2. Site Map
Paschal Golf Course (Richland Creek)
Project No. 276



0 150 300
Feet

-  Project Easement
 -  Thalweg
 -  Buffer Restoration
 -  Utility Right of Way
 -  Play Over Area
 -  Managed Golf Course Area
 -  Existing Jurisdictional Wetland
- 1:1,800**
1 inch = 150 feet

Map created 12/19/2011 by KCI.
Image Source: NC Statewide Orthoimagery, 2010.
Note: Image taken during project construction.



**Table 1a. Project Components
Paschal Golf Course (Richland Creek) / Project No. 276**

Project Component or Reach ID	Existing Feet/Acres	Restoration Level	Approach	Linear Footage or Square Feet*	Stationing	Mitigation Ratio	Mitigation Credits ⁺	BMP Elements	Comment
Richland Creek	N/A	R	P2	2,919	10+00 - 39+80	1:1	2,766		In-stream structures, including offset rock cross vanes, riffle grade controls, and rock sills, were used to stabilize restored channel. Planted a riparian buffer.
Buffer		R		167,092.2		1:1	167,092.2		Buffer was planted with native vegetation.

*Linear footage does not include the stream length that runs under a golf cart bridge through an easement exception. Square feet of buffer are limited to the areas of the buffer that meet the regulatory criteria for buffer restoration credit. See Figure 2 for the locations of the creditable buffer.

⁺The credits have been reduced to account for areas where the stream flows through vegetation management zones within the easement. These management areas are depicted on Figure 2. They include a utility right of way and a play over area for the golf course. Under the utility right of way the buffer will be allowed to grow to a height of 12'. Due to this restriction the 309 mitigation credits that would be generated by the stream in the right of way is reduced by 25% to 231 stream credits. The vegetation in the play over area will be trimmed to a few feet high. Due to this restriction, the 151 mitigation credits that would be generated by the stream in the play over area are reduced by 50% to 76 stream credits. There is 2,459 lf of stream that does not have any reductions and will generate 2,459 credits.

**Table 1b. Component Summations
Paschal Golf Course (Richland Creek) / Project No. 276**

Restoration Level	Stream (lf)	Riparian Wetland (Ac)		Non-Ripar (Ac)	Upland (Ac)	Buffer (Ac)	BMP
		Riverine	Non-Riverine				
Restoration	2,919					3.84	
Enhancement							
Enhancement I							
Enhancement II							
Creation							
Preservation							
HQ Preservation							
		0	0				
Totals (Feet/Acres)	2,919	0	0	0	0	3.84	0
MU Totals	2,766	0	0	0	0	3.84	0

Table 2. Project Activity & Reporting History Paschal Golf Course (Richland Creek) / Project No. 276		
Elapsed Time Since Grading Complete: 1 yr 7 months Elapsed Time Since Planting Complete: 1 yr 7 months Number of Reporting Years: 1		
Activity or Report	Data Collection Complete	Actual Completion or Delivery
Restoration Plan	2004	June 2007
Final Design - Construction Plans		Sept 2007
Construction		May 2010
Planting		May 2010
Baseline Monitoring/Report	Aug 2010	Dec 2010
Year 1 Monitoring	Aug 2011	Dec 2011

Table 3. Project Contacts Paschal Golf Course (Richland Creek) / Project No. 276	
Designer	EcoLogic Associates, P.C. 3808 Clifton Road Greensboro, NC 27407
Primary Project Design POC	Mark Taylor, PE (336) 632-4441
Construction Contractor	River Works 8000 Regency Parkway, Suite 200 Cary, NC 27518
Construction Contractor POC	William Pedersen (919) 459-9034
Planting Contractor	H + J Forest Service
Planting Contractor POC	Matt Hitch (910) 264-1612
Monitoring Performers	KCI Associates of North Carolina 4601 Six Forks Road, Suite 220 Raleigh, NC 27609
Monitoring POC	Adam Spiller (919) 278-2514

**Table 4. Project Attributes
Paschal Golf Course (Richland Creek) / Project No. 276**

Project County	Wake County
Physiographic Region	Piedmont
Ecoregion	Northern Outer Piedmont
River Basin	Neuse
USGS HUC	03020201
NCDWQ Sub-Basin	03-04-02
Within Extent of EEP Watershed Plan	Yes - Draft - Neuse River Basin Restoration Priorities 2010
WRC Class	Warm
% of Project Easement Demarcated	70%, with wooden bollards
Beaver Activity Observed During Design Phase	Yes
Restoration Component Attributes	
Drainage Area (sq.mi.)	7.8
Stream Order	Second
Restored Length (feet)	2,919
Perennial or Intermittent	Perennial
Watershed Type	Suburban
Watershed LULC Distribution	
Forest/Wetland	35%
Agricultural/Managed Herbaceous	35%
Developed	30%
Watershed Impervious Cover	10%
NCDWQ AU/Index Number	27-21
NCDWQ Classification	C; NSW
303d Listed	U
Upstream of 303d Listed Segment	U
Reasons for 303d Listing or Stressor	U
Total Acreage of Easement	8.5
Total Vegetated Acreage within Easement	1.3
Total Planted Acreage as Part of Restoration	7.2
Rosgen Classification of Pre-Existing	C4/F4
Rosgen Classification of As-Built	C4
Valley Type	-
Valley Slope	0.002
Valley Side Slope Range	-
Valley Toe Slope Range	-
Cowardin Classification	-
Trout Waters Designation	No
Species of Concern, Endangered, Etc.	None
Dominant Soil Series and Characteristics	
Series	Chewacla
Depth	Deep
Clay%	-
K	-
T	-

"N/A" is for items that do not apply.

"-" is for items that are unavailable.

"U" is for items that are unknown.

Appendix B

Visual Assessment Data



LEGEND

- EASEMENT BOUNDARY.....
- AS-BUILT STATIONED CENTERLINE, TOP OF BANK, AND TOP OF TERRACE.....
- PHOTO POINT.....
- CROSS-SECTION.....
- OLD STREAM CHANNEL.....

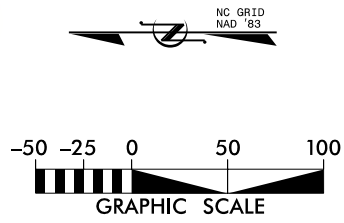
PROJECT CONDITION

- STREAM BED DEGRADATION.....
- BANK EROSION.....
- MASS WASTING OF BANK.....
- VEG PLOT ACHIEVING DENSITY CRITERION.....
- VEG PLOT BELOW DENSITY CRITERION.....

PROJECT CONDITION DETAILS

- VEG PLOT TOTAL / PLANTED STEM DENSITY **1100/550**
- STRUCTURE PIPING..... **P**
- STRUCTURE NOT PROTECTING BANK..... **B**

IMAGE SOURCE: NC 2010 STATEWIDE ORTHOIMAGERY
 NOTE: IMAGE TAKEN DURING PROJECT CONSTRUCTION



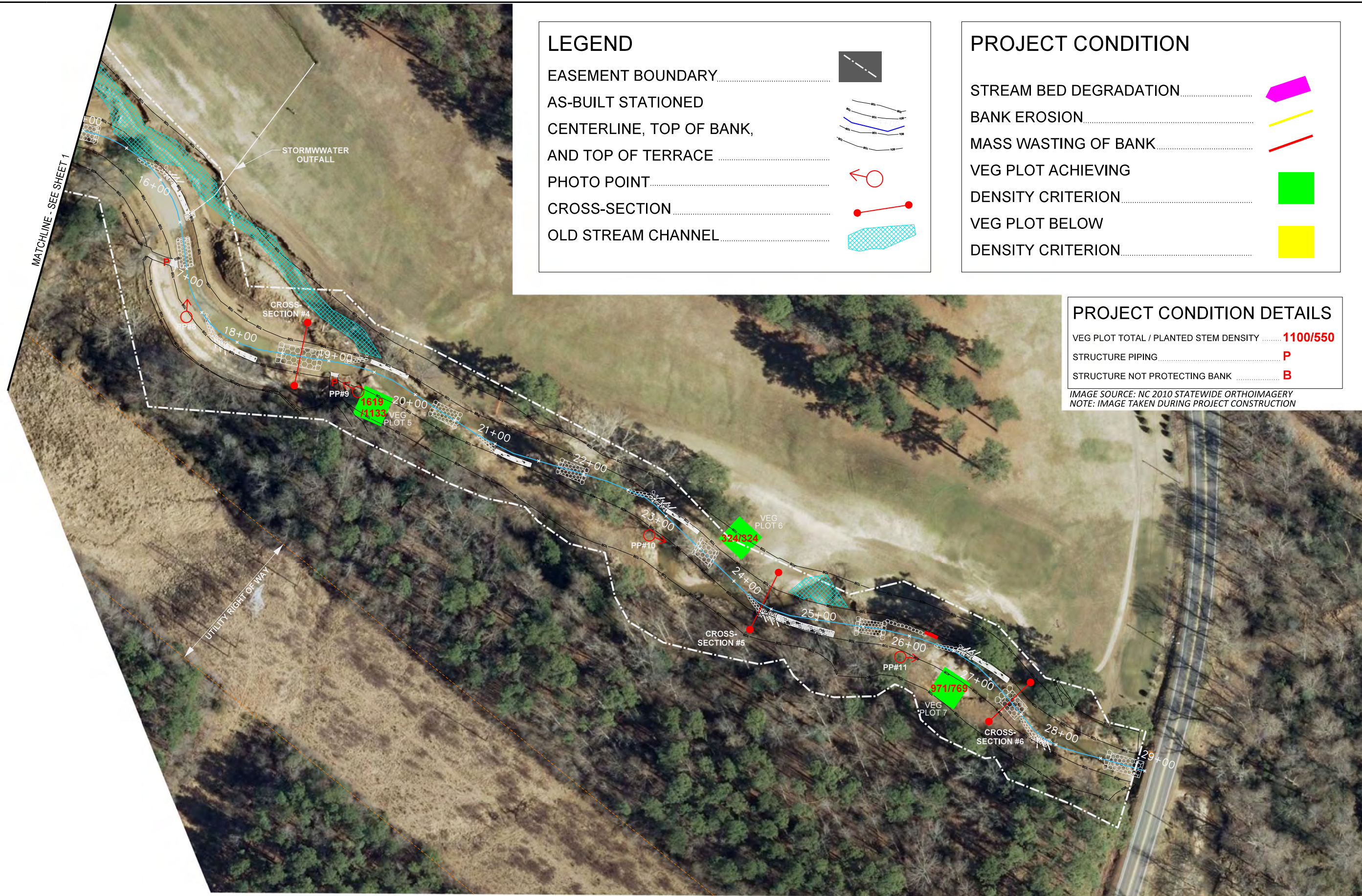
NO.	DESCRIPTION	DATE	APPROVED



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PASCHAL GOLF COURSE (RICHLAND CREEK)
 PROJECT #276 - MONITORING YEAR 1
 WAKE FOREST, WAKE COUNTY, NORTH CAROLINA

DATE: NOV 2011
 SCALE: 1" = 100'
 FIGURE 3
 CURRENT CONDITION PLAN VIEW
 SHEET 1 OF 2



LEGEND

- EASEMENT BOUNDARY.....
- AS-BUILT STATIONED CENTERLINE, TOP OF BANK, AND TOP OF TERRACE
- PHOTO POINT.....
- CROSS-SECTION.....
- OLD STREAM CHANNEL.....

PROJECT CONDITION

- STREAM BED DEGRADATION.....
- BANK EROSION.....
- MASS WASTING OF BANK.....
- VEG PLOT ACHIEVING DENSITY CRITERION.....
- VEG PLOT BELOW DENSITY CRITERION.....

PROJECT CONDITION DETAILS

VEG PLOT TOTAL / PLANTED STEM DENSITY **1100/550**

STRUCTURE PIPING..... **P**

STRUCTURE NOT PROTECTING BANK..... **B**

IMAGE SOURCE: NC 2010 STATEWIDE ORTHOIMAGERY
NOTE: IMAGE TAKEN DURING PROJECT CONSTRUCTION

NO.	DESCRIPTION	DATE	APPROVED



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PROJECT #276 - MONITORING YEAR 1
WAKE FOREST, WAKE COUNTY, NORTH CAROLINA

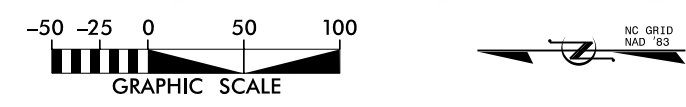


Table 5. Visual Stream Morphology Stability Assessment												
Project Number and Name: 276 - Paschal Golf Course (Richland Creek)												
Assessed Length 2,919												
Reach - Richland Creek												
Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation		
1. Bed	1. Vertical Stability (Riffle and Run units)	1. <u>Aggradation</u> - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%					
		2. <u>Degradation</u> - Evidence of downcutting			0	0	100%					
	2. Riffle Condition	1. <u>Texture/Substrate</u> - Riffle maintains coarser substrate	17	17			100%					
		3. Meander Pool Condition	1. <u>Depth</u> Sufficient (Max Pool Depth : Mean Bankfull Depth \geq 1.6)	13	13						100%	
	2. <u>Length</u> appropriate (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)		13	13			100%					
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	17	17			100%					
2. Thalweg centering at downstream of meander (Glide)		17	17			100%						
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			4	65	99%	0	0	99%		
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does <u>NOT</u> include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%		
	3. Mass Wasting	Bank slumping, calving, or collapse			2	35	99%	0	0	99%		
					Totals		6	100	98%	0	0	98%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	16	16			100%					
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	15	15			100%					
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	1	2			50%					
	3. Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. (See guidance for this table in EEP monitoring guidance document)	14	16			88%					
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio \geq 1.6 Rootwads/logs providing some cover at base-flow.	16	16			100%					

Table 6. Vegetation Condition Assessment						
Project Number and Name: 276 - Paschal Golf Course (Richland Creek)						
Planted Acreage 7.2			Easement Acreage 8.5			
Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	0.1 acre	Pattern and Color*	1	0.14	1.9%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acre	Pattern and Color ⁺	2	0.30	4.2%
Total				3	0.44	6.1%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acre	Pattern and Color	0	0.00	0.0%
Cumulative Total				3	0.44	6.1%
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	1,000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	none	Pattern and Color	0	0.00	0.0%

*These areas were not depicted on the CCPV. Generally, the floodplain of Richland Creek has many small scattered bare areas that are below the mapping threshold, but are significant when combined.

⁺These areas were not depicted on the CCPV. Generally, the floodplain of Richland Creek has many scattered areas of noticable low stem densities that are below the mapping threshold, but are significant when combined.

Stream Station Photos



Photo Point #1 – Looking upstream at fish ramp 8/6/2010



Photo Point #1 – Looking upstream at fish ramp 11/16/2011



Photo Point #2 – Looking downstream 8/6/2010



Photo Point #2 – Looking downstream 11/16/2011



Photo Point #2 – Looking upstream 8/6/2010



Photo Point #2 – Looking upstream 11/16/2011



Photo Point #3 – Looking downstream 8/6/2010



Photo Point #3 – Looking downstream 11/16/2011



Photo Point #3 – Looking upstream 8/6/2010



Photo Point #3 – Looking upstream 11/16/2011



Photo Point #4 – Looking downstream 8/6/2010



Photo Point #4 – Looking downstream 11/16/2011



Photo Point #4 – Looking upstream 8/6/2010



Photo Point #4 – Looking upstream 11/16/2011



Photo Point #5 – Looking upstream from bridge 8/6/2010



Photo Point #5 – Looking upstream from bridge 11/16/2011



Photo Point #6 – 8/6/2010



Photo Point #6 – 11/16/2011



Photo Point #7 – 8/6/2010



Photo Point #7 – 11/16/2011



Photo Point #8 – 8/6/2010



Photo Point #8 – 11/16/2011



Photo Point #9 – 8/6/2010



Photo Point #9 – 11/16/2011



Photo Point #10 – 8/6/2010



Photo Point #10 – 11/16/2011



Photo Point #11 – 8/6/2010



Photo Point #11 – 11/16/2011

Vegetation Plot Photos



Veg Plot #1 – 8/15/2011



Veg Plot #2 – 8/15/2011



Veg Plot #3 – 8/15/2011



Veg Plot #4 – 8/15/2011



Veg Plot #5 – 8/15/2011



Veg Plot #6 – 8/15/2011



Veg Plot #7 – 8/15/2011

Appendix C

Vegetation Plot Data

Vegetation Plot ID	Vegetation Survival Threshold Met?
1	No
2	Yes
3	Yes
4	Yes
5	Yes
6	Yes
7	Yes

Report Prepared By	April Helms
Date Prepared	12/5/2011 10:01
database name	KCI-2011-RC.mdb
database location	M:\2007\12071067_2007 EEP OPEN END\Veg_database
computer name	12-CV76KF1
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT-----	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
PROJECT SUMMARY-----	
Project Code	304
project Name	Richland Creek
Description	
River Basin	Neuse
length(ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	

Table 9. CVS Stem Count Total and Planted by Plot and Species

		Current Plot Data (MY1 2011)																					Annual Means									
Scientific Name	Common Name	Species Type	E304-01-0001			E304-01-0002			E304-01-0003			E304-01-0004			E304-01-0005			E304-01-0006			E304-01-0007			MY1 (2011)			MY0 (2010)					
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T			
<i>Alnus serrulata</i>	hazel alder	Shrub Tree				4	4	4	2	2	2																6	6	6	8	8	8
<i>Aronia arbutifolia</i>	Red Chokeberry	Shrub							1	1	1	2	2	2				4	4	4							7	7	7			
<i>Betula nigra</i>	river birch	Tree															1									1						
<i>Celtis</i>	hackberry											2	2	2	1	1	1										3	3	3	3	3	3
<i>Celtis occidentalis</i>	common hackberry	Shrub Tree																														
<i>Cephalanthus occidentalis</i>	common buttonbush	Shrub Tree				1	1	1	1	1	1				1	1	1										3	3	3	5	5	5
<i>Clethra alnifolia</i>	coastal sweetpepperbush	Shrub	1	1	1	2	2	2																			3	3	3	3	3	3
<i>Cornus amomum</i>	silky dogwood	Shrub	5	5	5	1	2	2	1	1	1	1	1	1		4	4				1	6	6				9	19	19	18	54	54
<i>Diospyros virginiana</i>	common persimmon	Tree										1	1	1	1	1	1										2	2	2	4	4	4
<i>Fraxinus pennsylvanica</i>	green ash	Tree							2	2	2	2	2	2	2	2	2				2	2	2				8	8	8	8	8	8
<i>Liquidambar styraciflua</i>	sweetgum	Tree															1									1			2			
<i>Liriodendron tulipifera</i>	tuliptree	Tree																					2						2			
<i>Nyssa sylvatica</i>	blackgum	Tree				1	1	4	1	1	1				1	1	1	1	1	1							4	4	7	5	5	5
<i>Pinus taeda</i>	loblolly pine	Tree									1						9												10			
<i>Platanus occidentalis</i>	American sycamore	Tree			3	4	4	9	5	5	5	5	5	6			1	2	2	2	3	3	5				19	19	31	20	20	20
<i>Quercus michauxii</i>	swamp chestnut oak	Tree																1	1	1							1	1	1	1	1	1
<i>Quercus nigra</i>	water oak	Tree																														
<i>Quercus phellos</i>	willow oak	Tree													4	4	4										4	4	4	6	6	6
<i>Salix sericea</i>	silky willow	Shrub Tree				1	7	7								8	8							5	5		1	20	20	1	21	21
<i>Sambucus canadensis</i>	Common Elderberry	Shrub Tree					1	1																				1	1	1	12	12
<i>Unknown</i>		unknown										1	1	1	5	6	6				2	3	3				8	10	10	28	40	40
<i>Viburnum dentatum</i>	southern arrowwood	Shrub Tree										1	1	1													1	1	1	1	1	1
Stem count			6	6	9	14	22	31	13	13	13	15	15	16	15	28	40	8	8	8	8	19	24	79	111	141	114	193	193			
size (ares)			1			1			1			1			1			1			1			7			7					
size (ACRES)			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.17			0.17					
Species count			2	2	3	7	8	9	7	7	7	8	8	8	7	9	13	4	4	4	4	5	7	15	16	20	17	17	17			
Stems per ACRE			243	243	364	567	890	1255	526	526	526	607	607	647	607	1133	1619	324	324	324	324	769	971	457	642	815	659	1116	1116			

Appendix D

Stream Survey Data

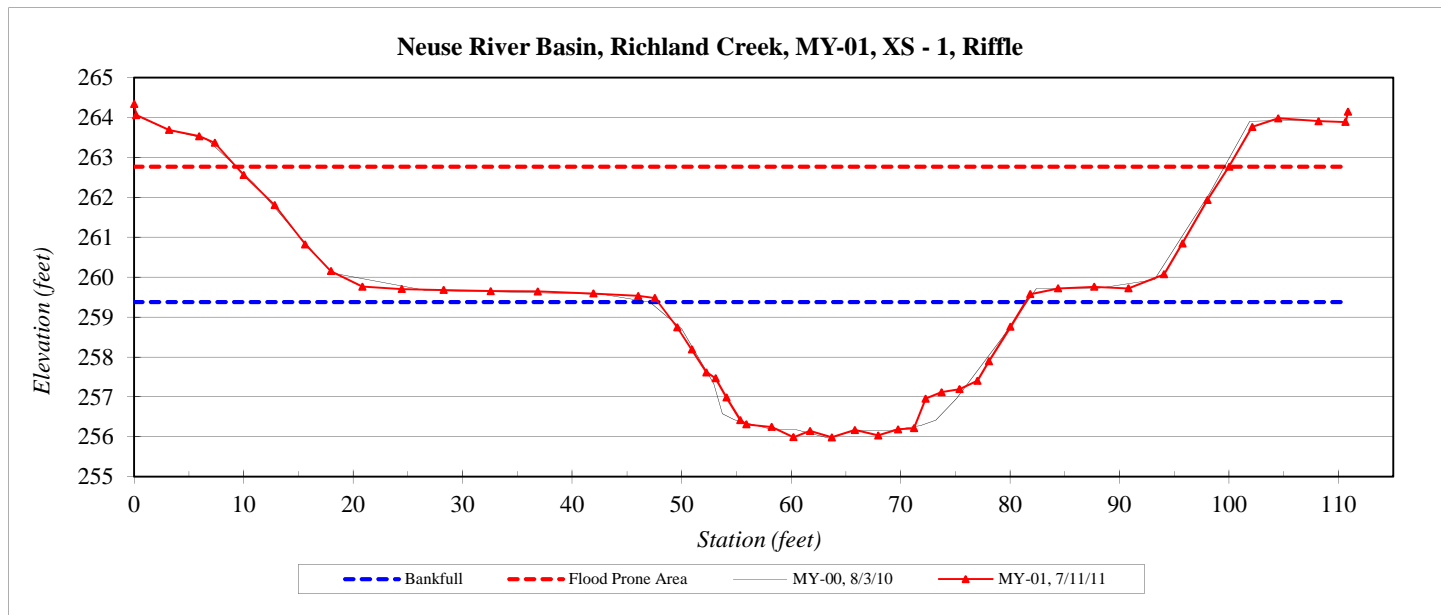
Cross-Section Plots

River Basin:	Neuse
Watershed:	Richland Creek, MY-01
XS ID	XS - 1, Riffle
Drainage Area (sq mi):	7.8
Date:	7/11/2011
Field Crew:	A. French, J. Anders



Station	Elevation
0.0	264.34
0.2	264.06
3.2	263.69
5.9	263.53
7.4	263.37
10.0	262.56
12.8	261.80
15.6	260.82
18.0	260.15
20.8	259.77
24.4	259.70
28.3	259.68
32.6	259.65
36.9	259.64
42.0	259.59
46.0	259.53
47.6	259.48
49.6	258.75
50.9	258.19
52.3	257.62
53.1	257.47
54.1	256.99
55.4	256.42
55.9	256.31
58.2	256.25
60.2	255.99
61.7	256.15
63.7	255.99
65.8	256.17
68.0	256.03
69.8	256.19
71.2	256.22
72.3	256.96
73.7	257.12
75.4	257.19

SUMMARY DATA	
Bankfull Elevation:	259.4
Bankfull Cross-Sectional Area:	79.9
Bankfull Width:	33.6
Flood Prone Area Elevation:	262.8
Flood Prone Width:	91
Max Depth at Bankfull:	3.4
Mean Depth at Bankfull:	2.4
W / D Ratio:	14.1
Entrenchment Ratio:	2.7
Bank Height Ratio:	1.0



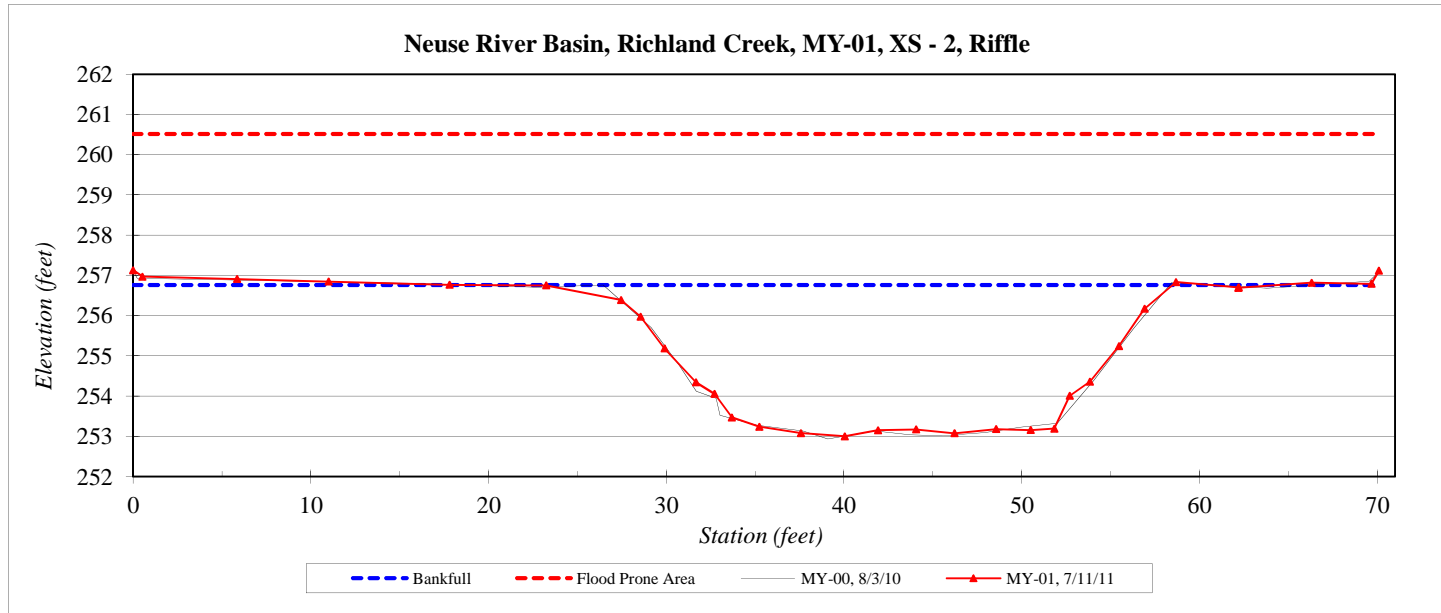
*Other shots not included due to space

River Basin:	Neuse
Watershed:	Richland Creek, MY-01
XS ID	XS - 2, Riffle
Drainage Area (sq mi):	7.8
Date:	7/11/2011
Field Crew:	A. French, J. Anders



Station	Elevation
0.0	257.13
0.5	256.97
5.8	256.91
11.0	256.85
17.8	256.77
23.3	256.75
27.5	256.39
28.6	255.98
29.9	255.18
31.7	254.34
32.7	254.06
33.7	253.47
35.2	253.24
37.6	253.08
40.0	253.00
41.9	253.15
44.1	253.17
46.2	253.08
48.6	253.18
50.5	253.16
51.8	253.19
52.7	254.01
53.8	254.36
55.5	255.25
56.9	256.17
58.7	256.84
62.2	256.70
62.2	256.69
66.3	256.82
69.7	256.79
70.1	257.12

SUMMARY DATA	
Bankfull Elevation:	256.8
Bankfull Cross-Sectional Area:	88.5
Bankfull Width:	35.2
Flood Prone Area Elevation:	260.5
Flood Prone Width:	>70
Max Depth at Bankfull:	3.8
Mean Depth at Bankfull:	2.5
W / D Ratio:	14.0
Entrenchment Ratio:	>1.8
Bank Height Ratio:	1.0



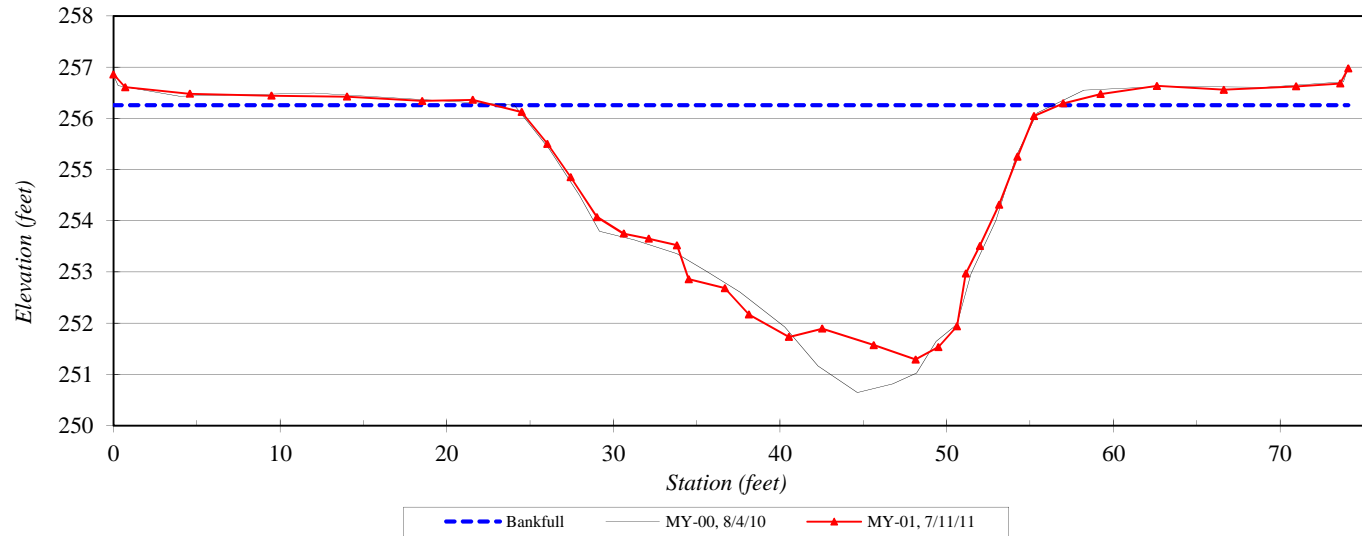
River Basin:	Neuse
Watershed:	Richland Creek, MY-01
XS ID	XS - 3, Pool
Drainage Area (sq mi):	7.8
Date:	7/11/2011
Field Crew:	A. French, J. Anders



Station	Elevation
0.0	256.86
0.7	256.61
4.6	256.48
9.5	256.44
14.0	256.43
18.5	256.34
21.6	256.36
24.5	256.12
26.0	255.50
27.4	254.85
29.0	254.07
30.6	253.75
32.1	253.65
33.8	253.52
34.5	252.86
36.7	252.69
38.1	252.17
40.5	251.73
42.5	251.89
45.6	251.57
48.1	251.29
49.5	251.54
50.6	251.94
51.1	252.97
52.0	253.51
53.1	254.31
54.3	255.25
55.2	256.05
57.0	256.29
59.2	256.47
62.6	256.64
66.6	256.56
71.0	256.63
73.6	256.68
74.1	256.98

SUMMARY DATA	
Bankfull Elevation:	256.3
Bankfull Cross-Sectional Area:	99.2
Bankfull Width:	33.9
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	5.0
Mean Depth at Bankfull:	2.9
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	1.0

Neuse River Basin, Richland Creek, MY-01, XS - 3, Pool

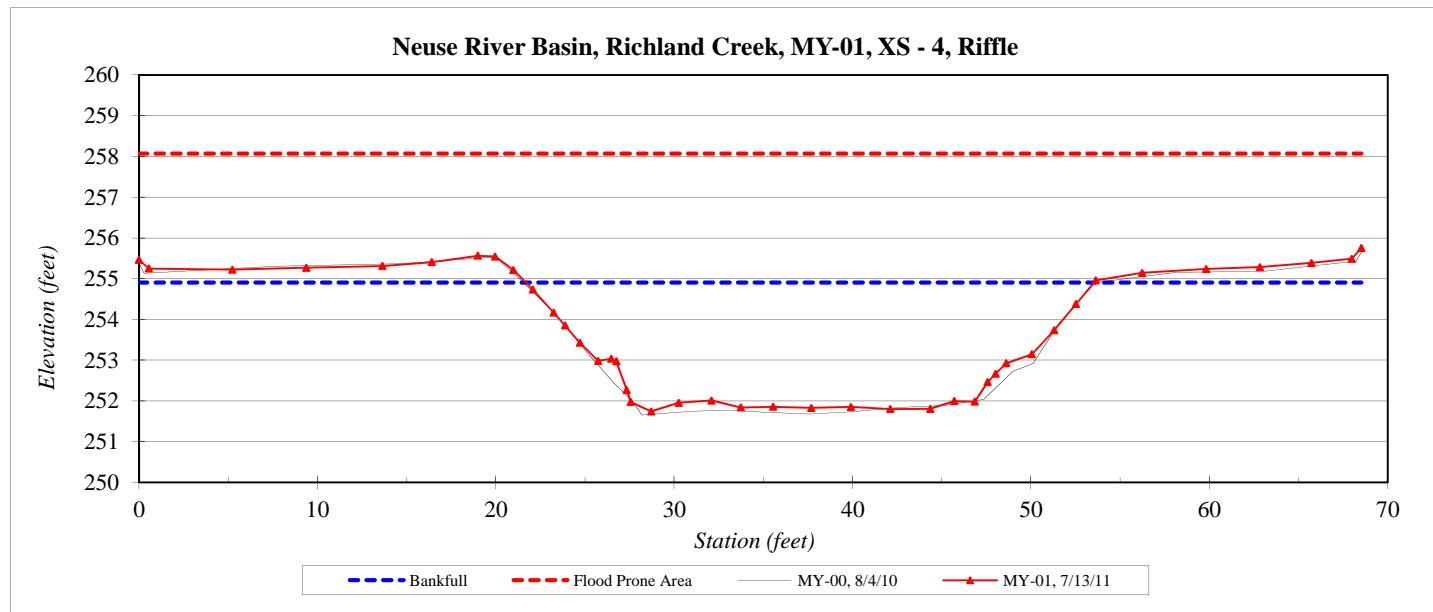


River Basin:	Neuse
Watershed:	Richland Creek, MY-01
XS ID	XS - 4, Riffle
Drainage Area (sq mi):	7.8
Date:	7/13/2011
Field Crew:	A. French, J. Anders



Station	Elevation
0.0	255.46
0.6	255.25
5.2	255.22
9.4	255.27
13.6	255.31
16.4	255.41
19.0	255.56
20.0	255.54
21.0	255.21
22.1	254.73
23.2	254.17
23.9	253.85
24.7	253.43
25.7	252.98
26.5	253.03
26.8	252.97
27.3	252.27
27.6	251.97
28.7	251.74
30.3	251.95
32.1	252.01
33.7	251.84
35.6	251.85
37.7	251.83
39.9	251.85
42.1	251.80
44.4	251.80
45.7	251.99
46.9	251.98
47.6	252.46
48.0	252.66
48.6	252.92
50.1	253.14
51.3	253.73
52.5	254.38

SUMMARY DATA	
Bankfull Elevation:	254.9
Bankfull Cross-Sectional Area:	76.5
Bankfull Width:	31.9
Flood Prone Area Elevation:	258.1
Flood Prone Width:	>68
Max Depth at Bankfull:	3.2
Mean Depth at Bankfull:	2.4
W / D Ratio:	13.3
Entrenchment Ratio:	>2.1
Bank Height Ratio:	1.0



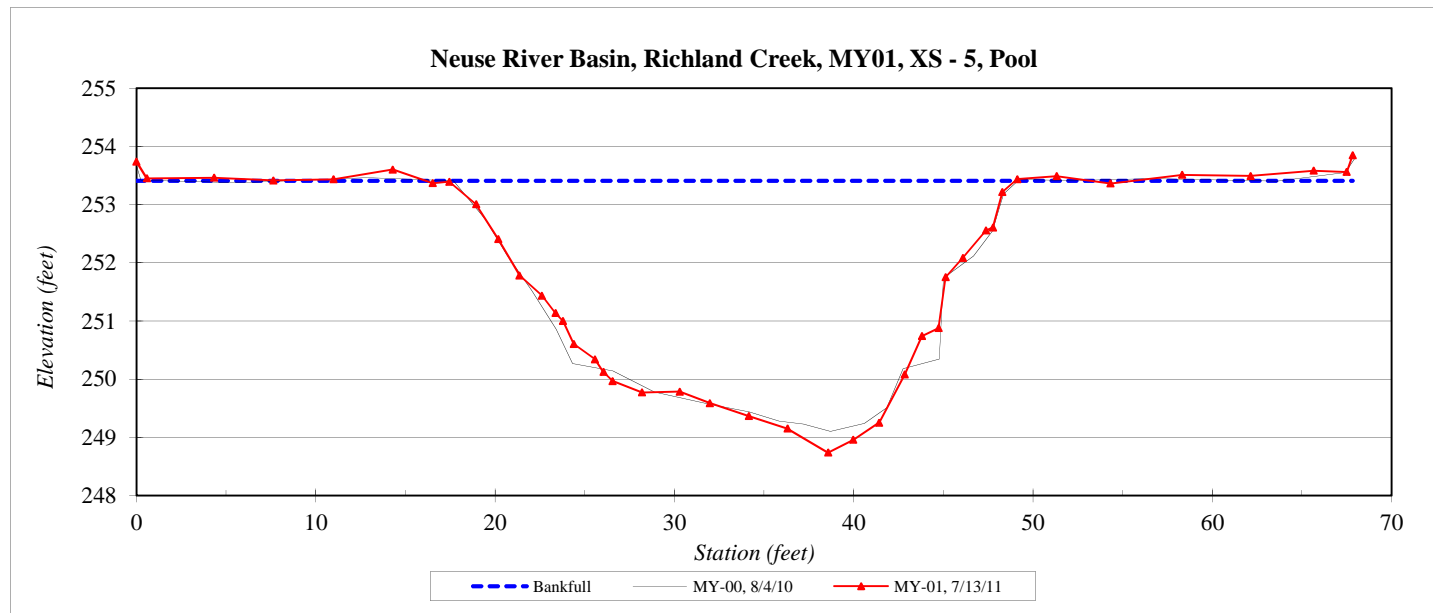
*Other shots not included due to space

River Basin:	Neuse
Watershed:	Richland Creek, MY-01
XS ID	XS - 5, Pool
Drainage Area (sq mi):	7.8
Date:	7/13/2011
Field Crew:	A. French, J. Anders



Station	Elevation
0.0	253.74
0.6	253.45
4.3	253.46
7.6	253.41
11.0	253.44
14.3	253.60
16.5	253.37
17.4	253.39
18.9	253.00
20.2	252.41
21.4	251.78
22.6	251.43
23.4	251.14
23.8	251.00
24.4	250.61
25.6	250.34
26.0	250.12
26.6	249.97
28.2	249.77
30.3	249.78
32.0	249.59
34.2	249.36
36.3	249.15
38.6	248.74
40.0	248.96
41.4	249.25
42.9	250.08
43.8	250.74
44.7	250.88
45.1	251.75
46.1	252.09
47.4	252.55
47.8	252.61
48.3	253.22
49.1	253.44

SUMMARY DATA	
Bankfull Elevation:	253.4
Bankfull Cross-Sectional Area:	90.6
Bankfull Width:	32.5
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	4.7
Mean Depth at Bankfull:	2.8
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	1.0



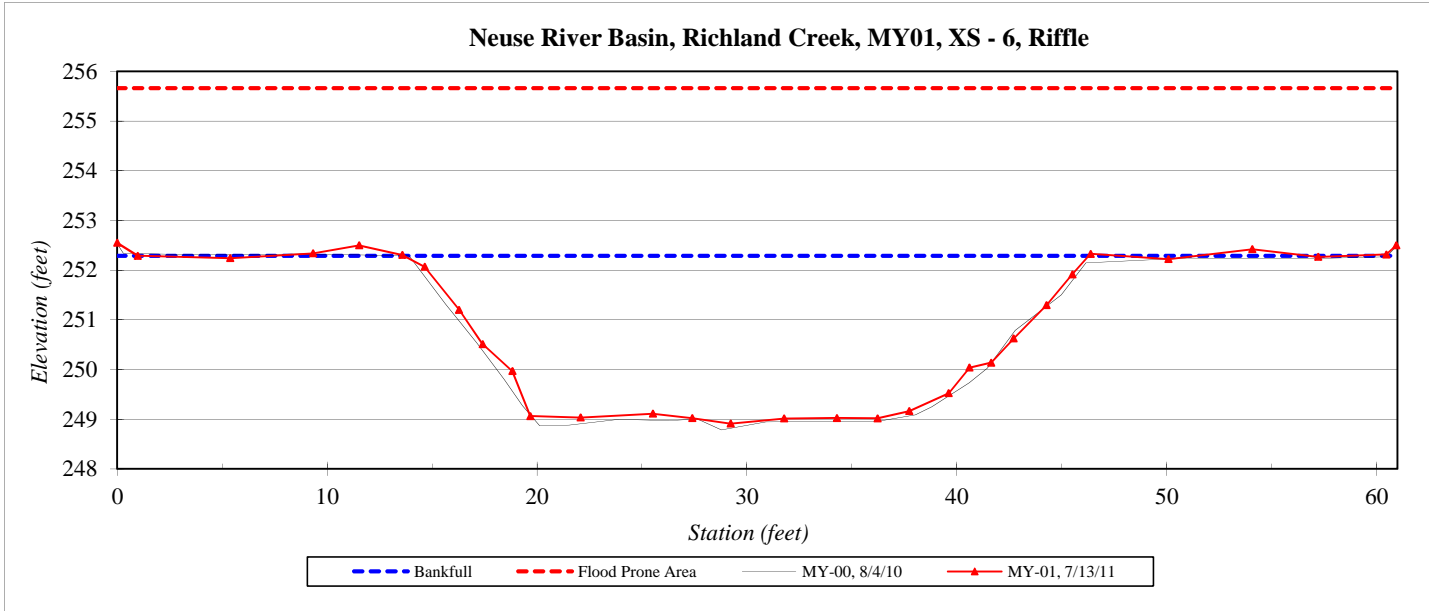
*Other shots not included due to space

River Basin:	Neuse
Watershed:	Richland Creek, MY-01
XS ID	XS - 6, Riffle
Drainage Area (sq mi):	7.8
Date:	7/13/2011
Field Crew:	A. French, J. Anders

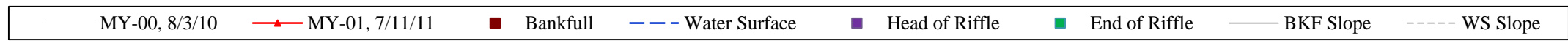
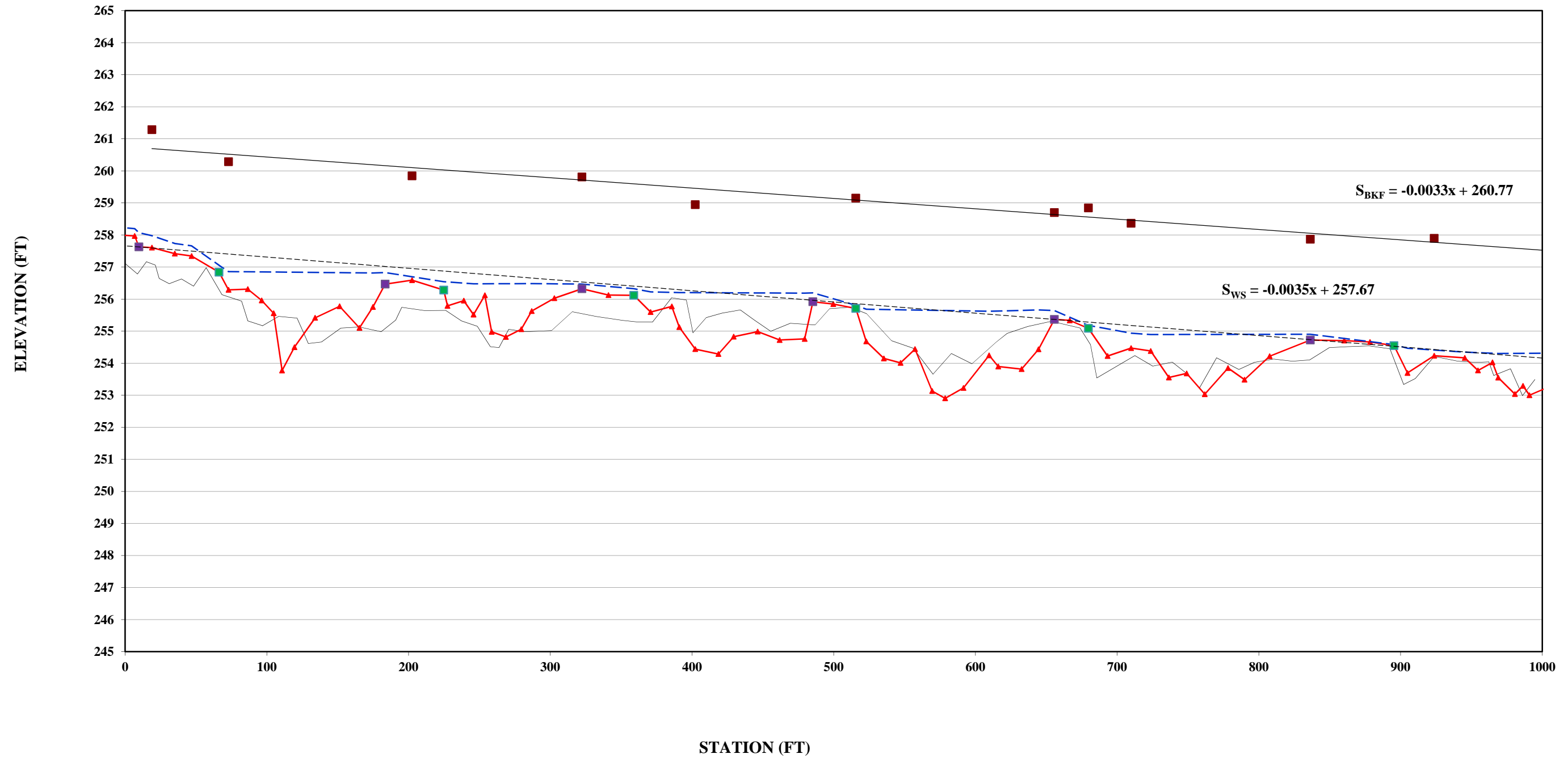


Station	Elevation
0.0	252.55
1.0	252.29
5.4	252.24
9.3	252.34
11.5	252.50
13.6	252.31
14.7	252.07
16.3	251.20
17.4	250.51
18.8	249.97
19.7	249.06
22.1	249.03
25.5	249.11
27.4	249.02
29.2	248.91
31.8	249.01
34.3	249.02
36.2	249.02
37.7	249.16
39.6	249.52
40.6	250.04
41.6	250.14
42.7	250.63
44.3	251.30
45.5	251.92
46.4	252.33
50.1	252.22
54.1	252.42
57.2	252.27
60.5	252.31
60.9	252.50

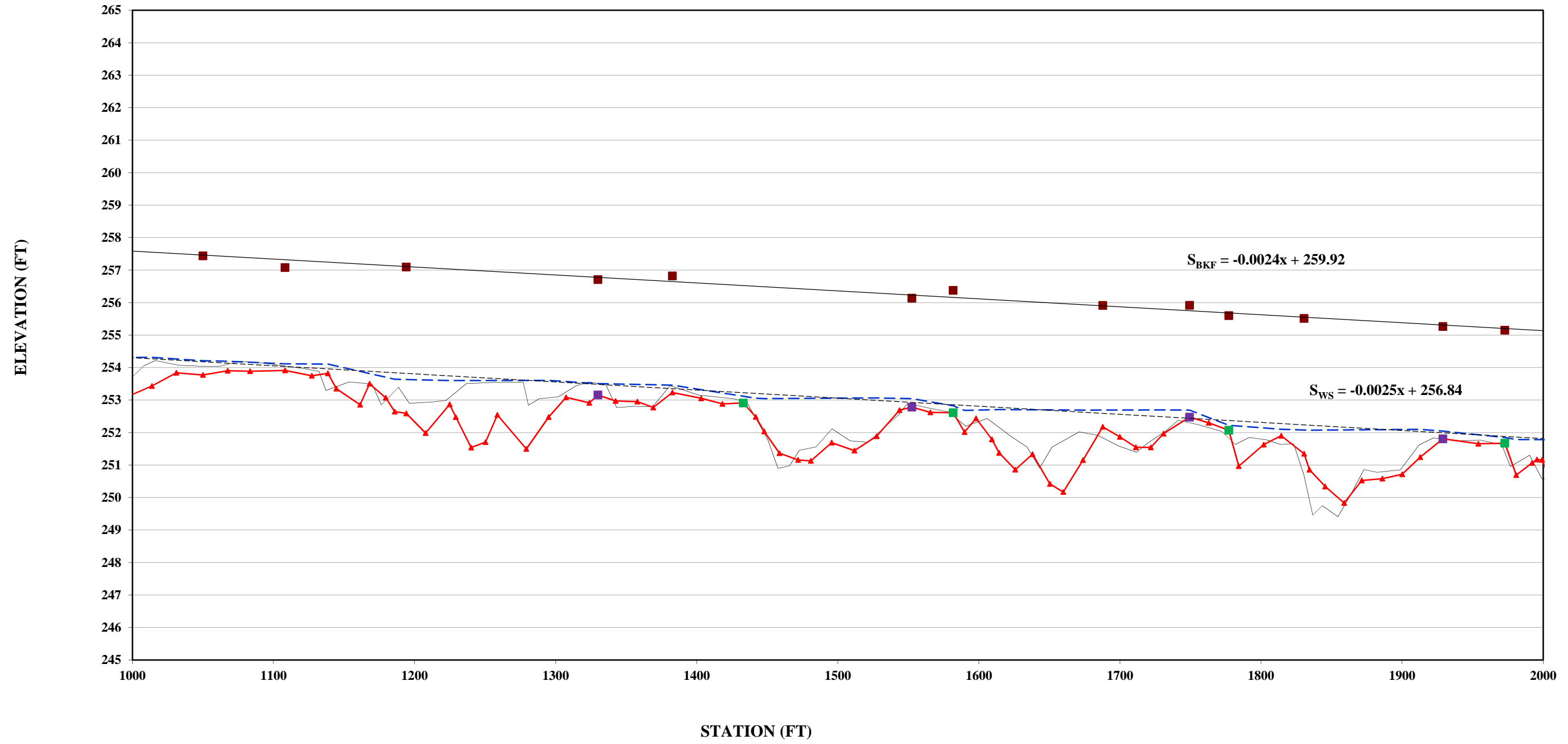
SUMMARY DATA	
Bankfull Elevation:	252.3
Bankfull Cross-Sectional Area:	82.2
Bankfull Width:	32.6
Flood Prone Area Elevation:	255.7
Flood Prone Width:	>60
Max Depth at Bankfull:	3.4
Mean Depth at Bankfull:	2.5
W / D Ratio:	12.9
Entrenchment Ratio:	>1.8
Bank Height Ratio:	1.0



**Longitudinal Profile
Richland Creek
EEP Project Number 304- MY-01
Stations 0+00 - 10+00**

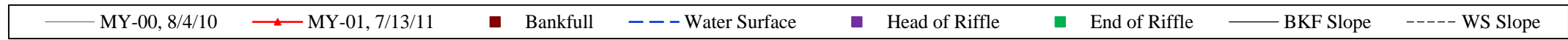
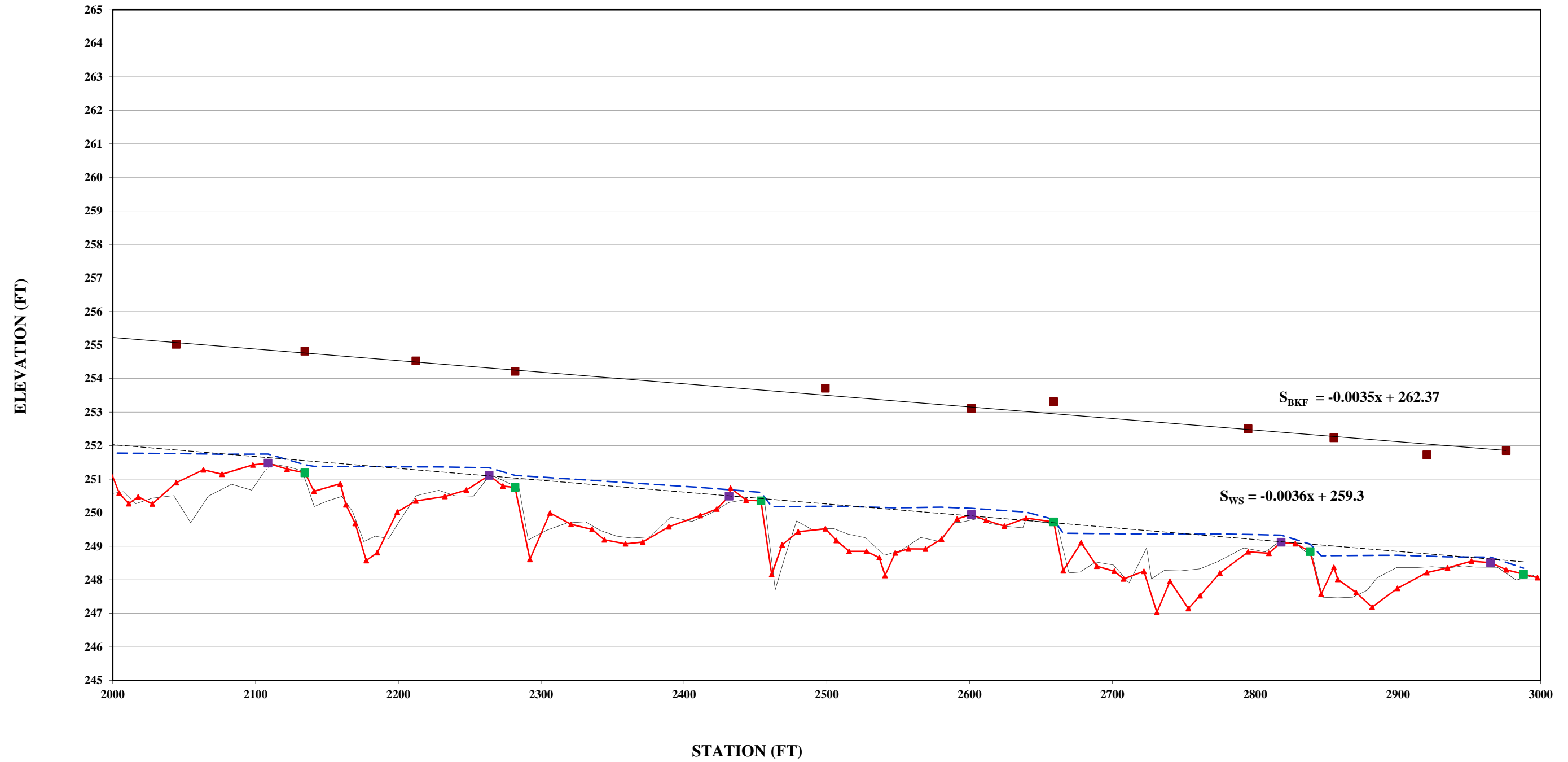


**Longitudinal Profile
Richland Creek
EEP Project Number 304- MY-01
Stations 10+00 - 20+00**



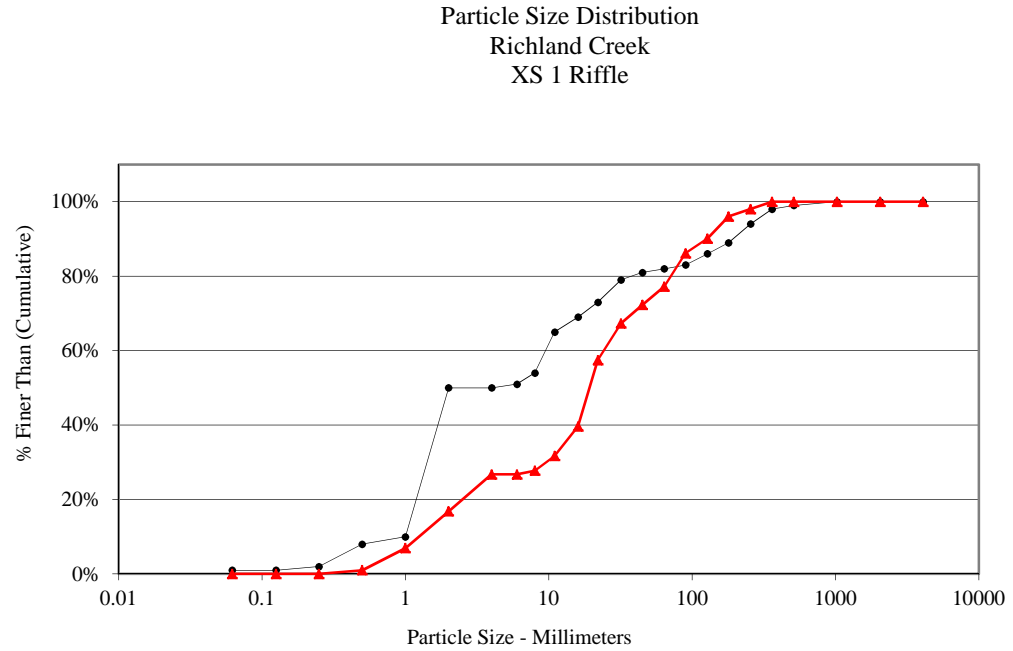
— MY-00, 8/3/10
—▲— MY-01, 7/11/11
■ Bankfull
- - - Water Surface
■ Head of Riffle
■ End of Riffle
— BKF Slope
- - - WS Slope

**Longitudinal Profile
Richland Creek
EEP Project Number 304- MY-01
Stations 20+00 - 30+00**



Pebble Count Plots

Cross-Section 1 Riffle - MY-01			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	1
Coarse	.50 - 1	D	6
Very Coarse	1 - 2	S	10
Very Fine	2 - 4		10
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	1
Medium	8 - 11.3	A	4
Medium	11.3 - 16	V	8
Coarse	16 - 22.6	E	18
Coarse	22.6 - 32	L	10
Very Coarse	32 - 45	S	5
Very Coarse	45 - 64		5
Small	64 - 90	C	9
Small	90 - 128	O	4
Large	128 - 180	B	6
Large	180 - 256	L	2
Small	256 - 362	B	2
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	101
Note:			

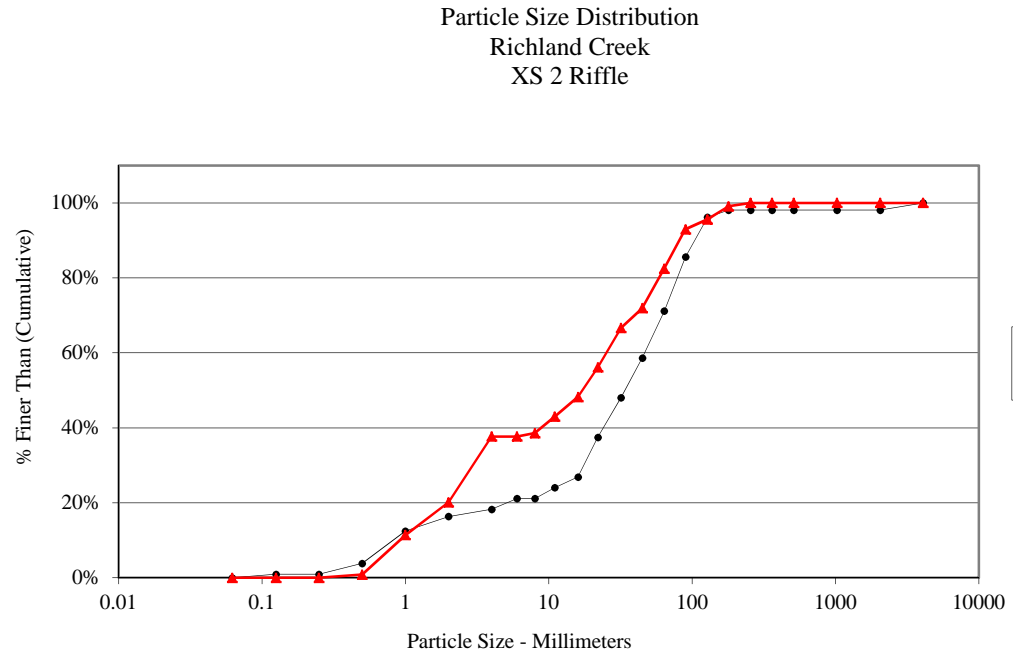


Size (mm)	
D16	1.9
D35	13
D50	19
D65	29
D84	83
D95	170

Size Distribution	
mean	12.6
dispersion	7.2
skewness	-0.14

Type	
silt/clay	0%
sand	17%
gravel	60%
cobble	21%
boulder	2%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 2 Riffle - MY-01			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	1
Coarse	.50 - 1	D	12
Very Coarse	1 - 2	S	10
Very Fine	2 - 4		20
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	1
Medium	8 - 11.3	A	5
Medium	11.3 - 16	V	6
Coarse	16 - 22.6	E	9
Coarse	22.6 - 32	L	12
Very Coarse	32 - 45	S	6
Very Coarse	45 - 64		12
Small	64 - 90	C	12
Small	90 - 128	O	3
Large	128 - 180	B	4
Large	180 - 256	L	1
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
	Total		114
Note:			

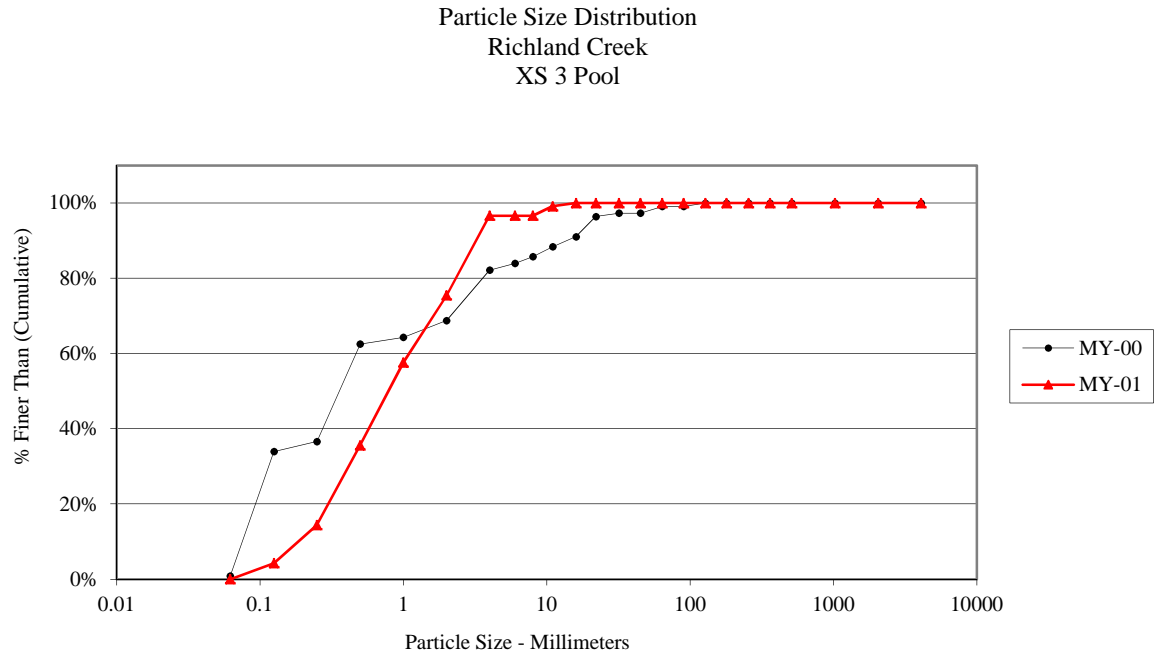


Size (mm)	
D16	1.4
D35	3.6
D50	17
D65	30
D84	67
D95	120

Size Distribution	
mean	9.7
dispersion	8.0
skewness	-0.19

Type	
silt/clay	0%
sand	20%
gravel	62%
cobble	18%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 3 Pool - MY-01			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	5
Fine	.125 - .25	A	12
Medium	.25 - .50	N	25
Coarse	.50 - 1	D	26
Very Coarse	1 - 2	S	21
Very Fine	2 - 4		25
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	3
Medium	11.3 - 16	V	1
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
	Total		118
Note:			

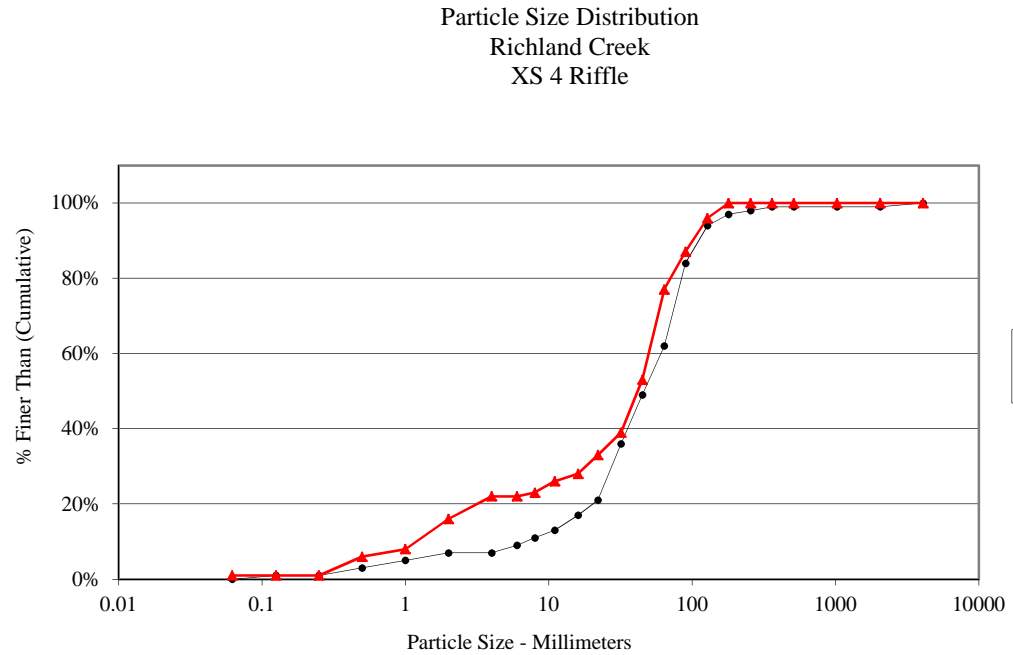


Size (mm)	
D16	0.26
D35	0.49
D50	0.79
D65	1.3
D84	2.6
D95	3.8

Size Distribution	
mean	0.8
dispersion	3.2
skewness	0.02

Type	
silt/clay	0%
sand	75%
gravel	25%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 4 Riffle - MY-01			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	1
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	5
Coarse	.50 - 1	D	2
Very Coarse	1 - 2	S	8
Very Fine	2 - 4		6
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	1
Medium	8 - 11.3	A	3
Medium	11.3 - 16	V	2
Coarse	16 - 22.6	E	5
Coarse	22.6 - 32	L	6
Very Coarse	32 - 45	S	14
Very Coarse	45 - 64		24
Small	64 - 90	C	10
Small	90 - 128	O	9
Large	128 - 180	B	4
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100
Note:			

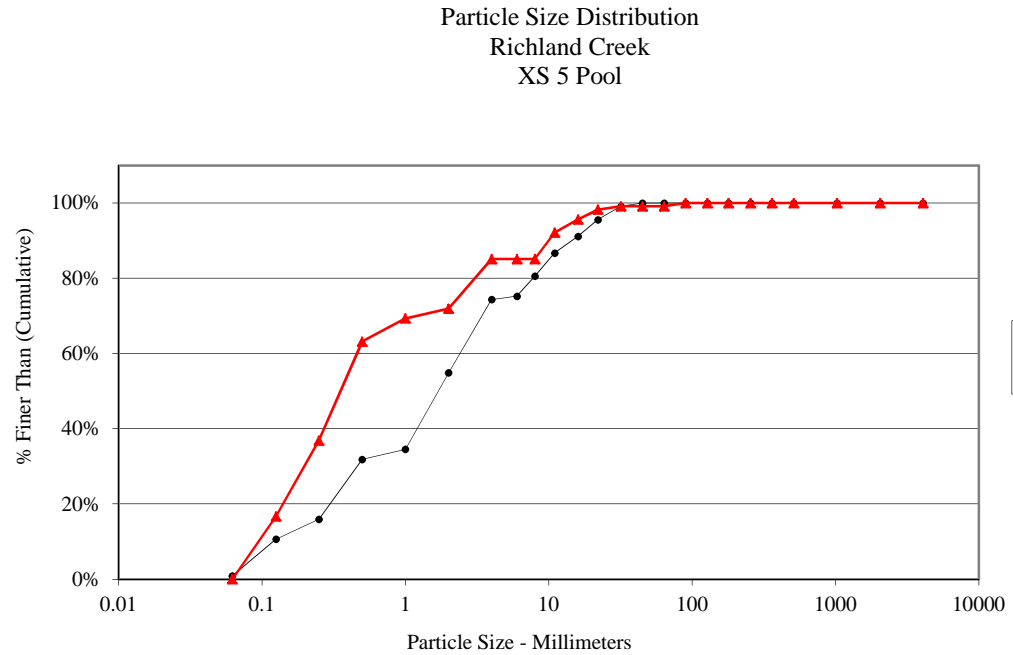


Size (mm)	Count
D16	2
D35	25
D50	42
D65	54
D84	81
D95	120

Size Distribution	
mean	12.7
dispersion	11.5
skewness	-0.41

Type	
silt/clay	1%
sand	15%
gravel	61%
cobble	23%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 5 Pool - MY-01			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	19
Fine	.125 - .25	A	23
Medium	.25 - .50	N	30
Coarse	.50 - 1	D	7
Very Coarse	1 - 2	S	3
Very Fine	2 - 4		15
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	8
Medium	11.3 - 16	V	4
Coarse	16 - 22.6	E	3
Coarse	22.6 - 32	L	1
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	1
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
	Total		114
Note:			

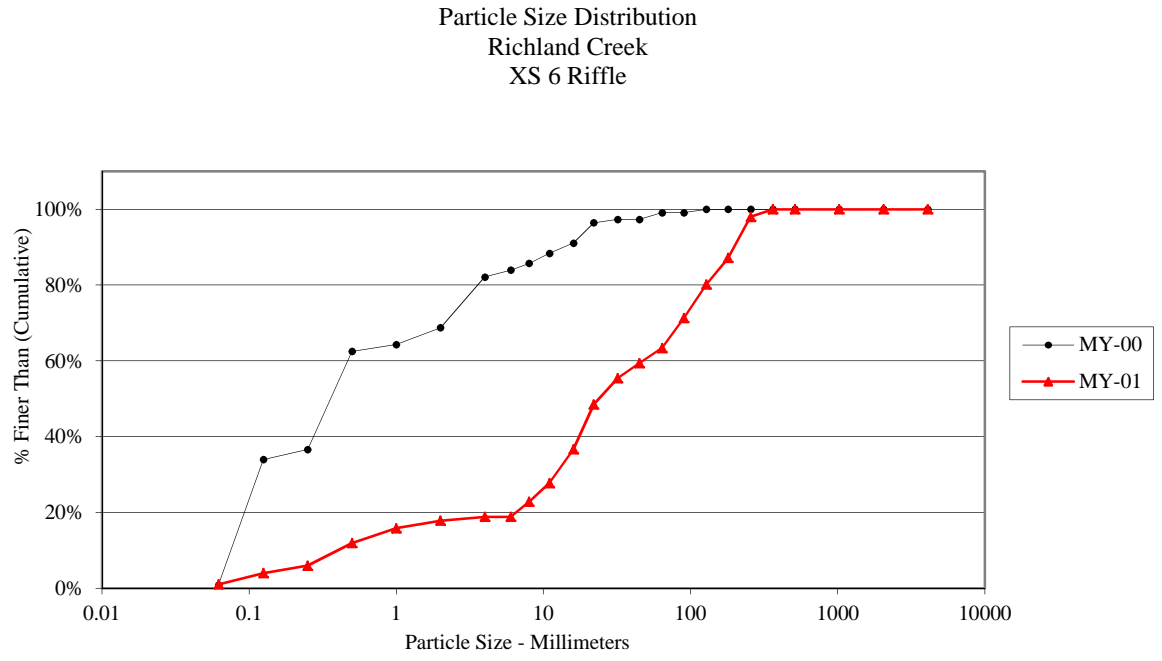


Size (mm)	
D16	0.12
D35	0.23
D50	0.35
D65	0.62
D84	3.8
D95	15

Size Distribution	
mean	0.7
dispersion	6.9
skewness	0.23

Type	
silt/clay	0%
sand	72%
gravel	27%
cobble	1%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 6 Riffle - MY-01			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	1
Very Fine	.062 - .125	S	3
Fine	.125 - .25	A	2
Medium	.25 - .50	N	6
Coarse	.50 - 1	D	4
Very Coarse	1 - 2	S	2
Very Fine	2 - 4		1
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	4
Medium	8 - 11.3	A	5
Medium	11.3 - 16	V	9
Coarse	16 - 22.6	E	12
Coarse	22.6 - 32	L	7
Very Coarse	32 - 45	S	4
Very Coarse	45 - 64		4
Small	64 - 90	C	8
Small	90 - 128	O	9
Large	128 - 180	B	7
Large	180 - 256	L	11
Small	256 - 362	B	2
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
	Total		101
Note:			



Size (mm)	
D16	1.1
D35	15
D50	24
D65	69
D84	150
D95	230

Size Distribution	
mean	12.8
dispersion	14.0
skewness	-0.19

Type	
silt/clay	1%
sand	17%
gravel	46%
cobble	35%
boulder	2%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

**Table 10. Baseline Stream Data Summary: Richland Creek - 2,919 lf
Paschal Golf Course (Richland Creek) / Project No. 276**

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach Data (Upper Richland Creek)						Design			As-built					
	LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Med	Max	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle																								
Bankfull Width (ft)				22			35.0			28.0			32.0				33.0		31.9	32.7	32.2	34.4	1.2	4
Floodprone Width (ft)				28			60				>100						100		>60	>72	>69	>90	12.8	4
Bankfull Mean Depth (ft)				1.4			2.8			2.3			2.4				2.6		2.4	2.6	2.6	2.8	0.2	4
Bankfull Max Depth (ft)				3.4			3.8				3.75						3.4		3.3	3.5	3.5	3.8	0.2	4
Bankfull Cross-Sectional Area (ft ²)				48			72			67			75				85.0		80.2	84.2	83.7	89.3	4.1	4
Width/Depth Ratio				12.0			13.8			12.2			13.3				12.1		11.4	12.7	12.5	14.5	1.3	4
Entrenchment Ratio				1.7			1.9			3.1			3.6				3.0		>1.9	>2.0	>2.0	>2.0	0.0	4
Bank Height Ratio					1.2						1.1						1.0		1.0	1.0	1.0	1.0	0.0	4
d50 (mm)					12.0												12.0		4.1	12.7	14.0	20.0	8.0	4
Profile																								
Riffle Length (ft)																			14	48	30	177	42	20
Riffle Slope (ft/ft)				0.0200			0.0370			0.0050			0.0090				0.0056		0.0011	0.0089	0.0075	0.0212	0.0067	20
Pool Length (ft)				23			96			5			25				41		8	74	82	150	42	19
Pool Max Depth					4.0						4.6						5.5		4.3	5.0		5.6	0.92	2
Pool Spacing (ft)				38			258			25			90			150		230	63	153	155	216	49	19
Pool Volume (ft ³)																								
Pattern																								
Channel Beltwidth (ft)				22			71			100			300			60		300	37	78	83	116	25	9
Radius of Curvature (ft)				32			98			37			70			80		100	80	90	90	100	10	14
Rc:Bankfull width (ft/ft)					1.34					1.1			2.1				2.4		2.5	2.8	2.8	3.1		
Meander Wavelength (ft)				110			300			110			200			220		330	259	321	312	395	45	11
Meander Width Ratio					1.59					9.3			10.7				9.0		1.1	2.4	2.5	3.5		
Substrate, bed and transport parameters																								
Ri%/Ru%/P%/G%/S%																								
SC% / Sa% / G% / C% / B% / Be%																			0% / 16% / 55% / 27% / 2% / 0%					
d16 / d35 / d50 / d84 / d95 / di ^p / di ^{sp} (mm)				1.5 / 7.3 / 12 / 35 / 49 / - / -															1.9 / 20 / 34 / 54 / 87 / 120 / - / -					
Reach Shear Stress (competency) lb/ft ²							0.35										0.40					0.40		
Max part size (mm) mobilized at bankfull							20-80										20-90					31		
Stream Power (transport capacity) W/m ²																								
Additional Reach Parameters																								
Drainage Area (SM)						7.8						4.8					7.8				7.8			
Impervious cover estimate						10%											10%				10%			
Rosgen Classification						F4/1						C4					C4/1				C4/1			
Bankfull Velocity (fps)						3.1 - 7.0						3.6 - 5.0					5.0							
Bankfull Discharge (cfs)						305 - 400						260 - 280					425							
Valley length (ft)						2,710																2,710		
Channel thalweg length (ft)																						2,919		
Sinuosity						1.22						1.1					1.20				1.10			
Water Surface Slope (Channel) (ft/ft)						0.0028						0.0040					0.0028				0.0028			
BF slope (ft/ft)																	0.0028				0.0027			
Bankfull Floodplain Area (acres)																								
Proportion over wide (%)																								
Entrenchment Class (ER Range)																								
Incision Class (BHR Range)																								
BEHI VL% / L% / M% / H% / VH% / E%																								
Channel Stability or Habitat Metric																								
Biological or Other																								

**Table 11a. Monitoring - Cross-Section Morphology Data
Paschal Golf Course (Richland Creek) / Project No. 276**

Dimension and Substrate	Cross-Section 1 (Riffle)							Cross-Section 2 (Riffle)							Cross-Section 3 (Pool)							Cross-Section 4 (Riffle)							Cross-Section 5 (Pool)						
	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline elevation																																			
Bankfull Width (ft)	34.4	33.6						31.9	35.2						31.4	33.9						32.1	31.9						31.5	32.5					
Floodprone Width (ft)	>90	>90						>70	>70						-	-						>68	>68						-	-					
Bankfull Mean Depth (ft)	2.4	2.4						2.8	2.5						3.3	2.9						2.5	2.4						2.9	2.8					
Bankfull Max Depth (ft)	3.4	3.4						3.8	3.8						5.6	5.0						3.3	3.2						4.3	4.7					
Bankfull Cross-Sectional Area (ft ²)	81.7	79.9						89.3	88.5						104.0	99.2						80.2	76.5						90.8	90.6					
Bankfull Width/Depth Ratio	14.5	14.1						11.4	14.0						-	-						12.8	13.3						-	-					
Bankfull Entrenchment Ratio	>2.0	>2.0						>2.0	>1.8						-	-						>2.0	>2.1						-	-					
Bankfull Bank Height Ratio	1.0	1.0						1.0	1.0						-	-						1.0	1.0						-	-					
Cross-Sectional Area Between End Pins (ft ²)	477.5	478.0						111.4	108.6						135.7	134.2						100.1	100.6						106.4	110.6					
d50 (mm)	2.0	19.0						34.0	17.0						0.4	0.79						46.0	42.0						1.7	0.35					
	Cross-Section 6 (Riffle)																																		
Based on fixed baseline elevation																																			
Bankfull Width (ft)	32.2	32.6																																	
Floodprone Width (ft)	>60	>60																																	
Bankfull Mean Depth (ft)	2.7	2.5																																	
Bankfull Max Depth (ft)	3.5	3.4																																	
Bankfull Cross-Sectional Area (ft ²)	85.6	82.2																																	
Bankfull Width/Depth Ratio	12.1	12.9																																	
Bankfull Entrenchment Ratio	>1.9	>1.8																																	
Bankfull Bank Height Ratio	1.0	1.0																																	
Cross-Sectional Area Between End Pins (ft ²)	94.3	94.1																																	
d50 (mm)	44.0	24.0																																	

Table 11b. Monitoring - Stream Reach Morphology Data Table
Paschal Golf Course (Richland Creek) / Project No. 276
Richland Creek (2,919 ft.)

Parameter	MY01 (2011)						MY02 (2012)						MY03 (2013)						MY04 (2014)						MY05 (2015)					
	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension																														
Bankfull Width (ft)	31.9	34.2	33.1	35.2	3.031	4																								
Floodprone Width (ft)	68	72	69	90	12.754	4																								
Bankfull Mean Depth (ft)	2.3	2.4	2.4	2.5	0.082	4																								
Bankfull Max Depth (ft)	3.2	3.5	3.4	3.8	0.252	4																								
Bankfull Cross-Sectional Area (ft ²)	76.5	81.8	81.1	88.6	5.102	4																								
Width/Depth Ratio	12.9	14.3	13.7	16.8	1.756	4																								
Entrenchment Ratio	1.8	1.9	1.9	2.1	0.150	4																								
Bank Height Ratio	1.0	1.0	1.0	1.0	0.000	4																								
Pattern																														
Channel Beltwidth (ft)	37	78	83	116	25	9																								
Radius of Curvature (ft)	80	91.1	90	100	9	9																								
Rad. of Curv. : Bankfull Width (ft/ft)	2.5	2.7	2.7	2.6																										
Meander Wavelength (ft)	259	321	312	395	45	11																								
Meander Width Ratio	1.2	2.3	2.5	3.0																										
Profile																														
Riffle Length (ft)	18	41	30	103	23	17																								
Riffle Slope (ft/ft)	0.001	0.010	0.008	0.019	0.006	17																								
Pool Length (ft)	31	72	74	122	24	17																								
Pool Max Depth (ft)	1.5	1.5		1.5		1																								
Pool Spacing (ft)	86	172	169	262	45	16																								
Additional Reach Parameters																														
Valley Length (ft)				2,710																										
Channel Thalweg Length (ft)				2,919																										
Sinuosity				1.1																										
Water Surface Slope (ft/ft)				0.0032																										
Bankfull Slope (ft/ft)				0.0029																										
Rosgen Classification				C4																										
SC% / Sa% / G% / C% / B% / Be%				0.33%/36%/47%/16%/0.67%																										
d16 / d35 / d50 / d84 / d95				1.1/10/17/65/110																										
% of Reach with Eroding Banks				1%																										

Appendix E

Hydrology Data

Table 12. Verification of Bankfull Events			
Paschal Golf Course (Richland Creek) / Project No. 276			
Date of Data Collection	Date of Occurrence	Method	Photo #
5/17/2010	5/17/2010	Photographed on site	1, See Below
9/28/2011	9/16/2011	Crest gauge	None



Photo #1 - Bankfull Event, 5/17/2010