MCDONALDS POND RESTORATION SITE
2010 Annual Monitoring Report (Year 5)

Richmond County, North Carolina
EEP Project No. D04020-2
Design Firm: International Paper

Prepared for: **NCDENR – ECOSYSTEM ENHANCEMENT PROGRAM**
1652 Mail Service Center
Raleigh, North Carolina 27699-1619

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2010 Annual Monitoring Report (Year 5)

RICHMOND COUNTY, NORTH CAROLINA

PREPARED BY:

RESOURCE MANAGEMENT SERVICE, LLC
PROJECT MANAGER: TONY DOSTER
2704-C Exchange Drive
Wilmington, NC 28405

AND

PBS&J, an Atkins company
PROJECT MANAGER: JENS GERATZ
1616 East Millbrook Road, Suite 310
Raleigh, NC 27609

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EXECUTIVE SUMMARY

Introduction

In response to a Request for Proposal (RFP, No. 16-D04016) issued in December of 2003, International Paper Company (IP) proposed the establishment of the McDonalds Pond Restoration Site (hereafter referred to as the "Site") located in Richmond County, approximately two (2) miles northeast of the town of Hamlet and three (3) miles east of the town of Rockingham. In order to provide stream channel restoration and riverine wetland restoration, IP has removed the McDonalds Pond Dam (Dam) located on Falling Creek. The Site comprises approximately 128 acres, and includes the 17.7 acre McDonalds Pond (a.k.a Shepards Lake), portions of Falling Creek, numerous headwater tributaries and over 80 acres of forested riparian wetlands, seepage wetlands, and marsh wetlands.

The Dam was removed in a manner to minimize potential impacts to water resources. Gradual dewatering and phased dam removal were undertaken to avoid introducing sediments and pollutants into the receiving Falling Creek reaches downstream. Heavy equipment operated from or within the footprint of the former Dam during dam removal operations, thereby minimizing the impact to the adjacent intact forest and wetland soil. Dam removal began with the dewatering (lowering) of the pond in the fall of 2005, followed by the clearing of trees and small bushes from the former earthen dam in February 2006. Excavation activities continued for approximately two weeks until dam removal was complete in mid-March 2006.

PBS&J initiated beaver management and minor grading activities on the former Dam location during Year 4 monitoring. Beaver management was performed by the USDA wildlife service, and grading was then performed in order to remove the existing beaver dam and further lower the elevation of the former Dam footprint. Once grading activities were complete, an approximate 2-acre area was replanted.

Monitoring Plan

Monitoring activities began in March 2006 (Year 1), and were performed for five years. Project success is based on a comparison of post removal monitoring data collected from 2006-2010 to reference sites as well as biological baseline values collected in September 2004. Primary success criteria of the project include: 1) the successful classification of restored/enhanced stream reaches as functioning systems, 2) channel stability indicative of a stable stream system, 3) development of characteristic lotic aquatic communities, 4) establishment of wetland hydrology (as defined in the U.S. Army Corps of Engineers [USACE] Wetlands Delineation Manual) within the former pond footprint, and 5) vegetative success of 320 stems/acre after the third year of monitoring and 260 stems/acre after the fifth and final year of monitoring. The following monitoring report describes the results of the final year of monitoring activities completed during (2010) Year 5 monitoring.

Year 5 Monitoring Results (2010)

Stream Assessment

Following five years of passive stream restoration on the Site, Falling Creek now contains braided, anastomosed, bifurcated, and single-threaded channels characteristic of the area. Restored and enhanced

stream segments across the Site have stream pattern, profile, and dimension similar to that of reference reaches. In addition, stream banks have stabilized with native planted and volunteer vegetation.

Aquatic community assemblages within the former pond have maintained characteristics of a natural lotic system. Fifty percent (50%) of the macroinvertebrate samples taken in October 2010 (Year 5) from restored segments of Falling Creek (within the former pond) consisted of macroinvertebrate genera predominantly found in lotic systems. Genera predominantly found in lentic systems represented only five percent (5%) of species collected within the former pond from the Year 5 samples. A comparison of aquatic community assemblages from 2006-2010 indicates the successful development of a characteristic lotic aquatic community.

North Carolina Division of Water Quality (NCDWQ) Habitat Assessment Forms (HAFs) were completed at multiple locations along the restored and enhanced segments of Falling Creek. The HAF scores quantitatively increased in each of the five monitoring years and indicate that the restored and enhanced stream segments contain in-stream habitat characteristic of reference reaches.

Wetland Vegetation Assessment
Vegetation monitoring was performed based on the Carolina Vegetation Survey (CVS) Levels 1 and 2 at eight (8) 10 x 10 meter plots. Based on Year 5 monitoring, the average count of surviving planted species is 491 stems per acre, which exceeds the established success criteria of 260 stems/acre. If volunteer species are included, the total survival increases to 4,467 stems per acre. Vegetation success criteria were met in each of the five monitoring years indicating the establishment of an appropriate vegetative community.

Wetland Hydrology Assessment
All four groundwater gauges (Gauges 1-4) located on-Site have registered water levels within the upper 12 inches of the soil surface for at least 28 consecutive days (Richmond County, NRCS) or 12.5 percent (12.5%) of the growing season. With the exception of 2009 (gauge 3 malfunction), all groundwater gauges on the Site achieved success criteria within each of the five monitoring years indicating the establishment of wetland hydrology in the former pond footprint.

Summary
Following the fifth year of monitoring, restored streams within the former pond have developed stable, lotic conditions typical of reference systems. Pattern, profile, and dimension data obtained from channel surveys indicate that stream geomorphology continues to shift toward that of reference reaches. Groundwater gauge data within the former pond indicates restored wetland hydrology and closely resembles that of the upstream reference gauge. Vegetation surveys support the establishment of a Streamhead Pocosin/Atlantic White Cedar forest community with thriving planted and volunteer species. Stream, wetland vegetation, and wetland hydrology success criteria were met in all monitoring years (2006-2010). All primary project goals and objectives have been met or exceeded for this project.

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1.0 PROJECT BACKGROUND

1.1 Location and Setting

The North Carolina Ecosystem Enhancement Program (EEP) is currently developing stream and wetland restoration strategies for the Yadkin-Pee Dee River Basin, Cataloging Unit 03040201. As a part of this effort, International Paper (IP) was selected to complete the McDonalds Pond Restoration Project located in Richmond County. The McDonalds Pond Restoration Site ('hereafter referred to as the "Site") is located approximately two (2) miles northeast of the town of Hamlet and three (3) miles east of the town of Rockingham between NC Route 1 and NC Route 177 (Figure 1, Appendix A).

1.2 Restoration Structure and Objectives

Falling Creek, the major drainage feature on-Site, was previously impounded by the McDonalds Pond Dam (Dam), constructed over 70 years ago. Approximately 3,700 linear feet of Falling Creek and tributaries were impacted by the construction of the Dam including streams contained within the pond footprint, as well as stream sections located both up and downstream of the pond. In addition, approximately 17.7 acres of riverine wetland were inundated with the construction of the Dam. Approximately 4.2 acres of the floodplain immediately upstream of the pond were impacted by the "backwater effect" (the backing-up of water), creating marsh wetlands with saturated conditions unsuitable for historic wetland communities. An eroded pond outfall channel located at the northern extent of the Dam drained adjacent wetlands and redirected historic flows away from the Falling Creek floodplain.

Stream restoration efforts were achieved through the removal of the Dam resulting in the restoration of 2,969 linear feet of stream. The former Dam was excavated to the approximate level of the pre-existing valley contours, allowing the stream unrestricted flow through the Site. Stream restoration efforts were designed to utilize passive stream channel restoration processes, allowing the channel to reestablish naturally following the removal of the Dam. Stream enhancement (Level I) was achieved through the removal of the Dam and the filling of the northern outfall channel, which returned the historic hydrologic characteristics (stream volume and velocity) to 770 feet of impacted stream channel downstream of the former Dam. Riverine wetland restoration was accomplished within the former 17.7 acre pond footprint through the excavation of the Dam and the establishment of native Streamhead Pocosin and Atlantic White Cedar forest communities. Additionally, the Site includes the preservation of 5,800 linear feet of stream, 77.8 acres of wetland, and 25.6 acres of upland/wetland ecotone buffer.

1.3 Project Objectives

The primary project goals include 1) the restoration of a stable, meandering stream channel through the areas impacted by the Dam, 2) the restoration of historic lotic aquatic communities that represent the Site's natural range in variation, 3) the restoration of historic wetland conditions within the pond footprint, and 4) the restoration of natural wetland plant communities within their historic locations.

Additional potential benefits of the project include the restoration of wildlife functions associated with a riparian corridor and stable stream and the enhancement of water quality function in the on-Site, upstream, and downstream segments of Falling Creek and tributaries.

The specific goals of this project are to:

- Restore approximately 2,969 linear feet of historic stream course, flow volumes, and patterns through the marsh wetlands, McDonalds Pond footprint, and immediately downstream of the existing dam.

- Enhance an additional approximate 770 linear feet of Falling Creek downstream of the restored stream channel extending into the gas line easement (Figure 2, Appendix A)

- Protect the headwaters of Falling Creek that are located within the Site through preservation of approximately 5,800 linear feet of Falling Creek and associated tributaries.

- Restore approximately 17.7 acres of forested riverine wetlands within the McDonalds Pond footprint.

- Enhance 4.2 acres of forested riverine wetlands within the marsh wetlands located at the head of McDonalds Pond.

- Preserve 77.8 acres of forested riverine wetlands adjacent to Falling Creek and associated tributaries.

- Restore and enhance habitat for vegetation and wildlife species, characteristic of Streamhead Pocosin and Atlantic White Cedar Forest (Schafale and Weakley 1990).

- Enhance the function and value of the Falling Creek wetland community through the preservation of 25.6 acres of buffer along the Falling Creek stream/wetland complex.

Table 1. Summary of Stream and Wetland Mitigation Units

Restoration Activities	Linear feet	Acres	Mitigation Ratios	Percentage of Mitigation Units	Mitigation Units
Stream Restoration	1,784	N/A	1:1	75	1,784
Stream Restoration (undefined channel)	1,185	N/A	1:1		1,185
Stream Enhancement (Level I)	770	N/A	1:1.5		513
Stream Preservation	5,800	N/A	1:5	25	1,160
Total Stream Mitigation Units (SMUs) Provided					**4,642**
Total SMUs Under Contract					**4,364**
Wetlands Restoration	N/A	17.7	1:1	75	17.7
Wetland Enhancement	N/A	4.2	1:2	25	2.1
Wetlands Preservation	N/A	19	1:5		3.8
Total Wetland Mitigation Units (WMUs) Provided					**23.6**
Total WMUs Under Contract					**23.4**

1.4 Project History and Background

Table 2. Project Activity and Reporting History			
Activity Report	**Scheduled Completion**	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan	*NA	July 2005	August 2005
Final Design (90%)	*NA	July 2005	August 2005
Construction	*NA	N/A	March 2006
Temporary S&E mix applied to entire project area	*NA	N/A	March 2006
Bare Root Seedling Installation	*NA	N/A	March 2006
Mitigation Plan	*NA	June 2006	July 2006
Final Report	*NA	Oct 2006	Oct 2006
Year 1 Vegetation Monitoring	Dec 2006	Oct 2006	Dec 2006
Year 1 Stream Monitoring	Dec 2006	Oct 2006	Dec 2006
Year 2 Vegetation Monitoring	Dec 2007	Oct 2007	February 2008
Year 2 Stream Monitoring	Dec 2007	Oct 2007	February 2008
Year 3 Vegetation Monitoring	Dec 2008	Oct 2008	Dec 2008
Year 3 Stream Monitoring	Dec 2008	Oct 2008	Dec 2008
Year 4 Vegetation Monitoring	Dec 2009	Oct 2009	Feb 2010
Year 4 Stream Monitoring	Dec 2009	Oct 2009	Feb 2010
Remedial Earthwork and Supplemental Planting	Sep 2009	Sep 2009	Sep 2009
Year 5 Vegetation Monitoring	Dec 2010	Sep 2010	Dec 2010
Year 5 Stream Monitoring	Dec 2010	Sep 2010	Dec 2010

*NA – Scheduled completion dates unknown due to unanticipated project delays.

Table 3. Project Contacts	
Designer International Paper	6400 Poplar Avenue Memphis, TN 38197 (901) 419-1854
Construction Contractor Environmental Repair, Inc.	28723 Marston Road Marston, NC 28363 (910) 280-6043
Planting Contractor Garcia Forest Service, Inc. Resource Management Service, LLC (Supplemental Planting)	 PO Box 789 Rockingham, NC 28379 (910) 997-5011 2704-C Exchange Drive Wilmington, NC 28405 910-790-1074
Seeding Contactor Environmental Repair, Inc.	 28723 Marston Road Marston, NC 28363 (910) 280-6043
Nursery Stock Suppliers International Paper North Carolina Division of Forest Resources ArborGen	 5594 Highway 38 South Blenheim, SC 29516 (843) 528-3203 726 Claridge Nursery Road Goldsboro, NC 27530 (919) 731-7988 P.O. Box 840001 Summerville, SC 29484 (843) 851-4129
Monitoring Performers PBS&J an Atkins company	 1616 East Millbrook Road, Suite 310 Raleigh, NC 27609 (919) 876-6888
Stream and Wetland Monitoring POC	Jens Geratz

Table 4. Project Background	
Project County	Richmond
Drainage Area	2.5 square miles
Impervious cover estimate (%)	<5 percent
Stream Order	3rd order
Physiographic Region	Southeastern Plains
Ecoregion (Griffith and Omernik)	Sandhills
Rosgen Classification of As-built	DA5/E5
Cowardin Classification	Stream (R2UB2)
Dominant soil types	Johnston (JmA)
	Ailey (AcB, AcC)
	Candor-Wakulla Complex (CaC, WcB)
Reference Site ID	Falling Creek
USGS HUC for Project and Reference	03040201
NCDWQ Sub-basin for Project and Reference	03-07-16
NCDWQ classification for Project and Reference	WSIII
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	Yes
Reasons for 303d listing or stressor	Aquatic weeds
Percent of project easement fenced	NA

2.0 PROJECT CONDITION AND MONITORING RESULTS

The monitoring results described herein document the Year 5 (2010) monitoring activities. Stream monitoring activities continued at two (2) stream reaches that were established in April 2006. Each monitoring reach is approximately 150 feet in length and is comprised of one (1) stream cross-section where stream profile and dimension are monitored. Another 575 feet of stream channel profile and eight (8) cross-sections were added to the Site monitoring activities in October 2006 (Figure 2, Appendix A). Wetland vegetation monitoring activities were conducted in September 2010 and consist of an inventory of planted and volunteer species within eight (8) plots located throughout the former pond (Figure 4, Appendix A). Wetland hydrology monitoring activities include groundwater gauge monitoring conducted throughout the growing season (March 27 - November 5) (NRCS 1999) at four (4) gauges located within the former pond (Figure 5, Appendix A).

2.1 Stream Assessment

2.1.1 Stream Channel Morphology

Stream channel cross-sectional surveys were performed at ten (10) on-site monitoring locations in September 2010 [XS1-8 and XSR2-3] (Figure 2, Appendix 2). Bankfull channel geometry for surveyed cross-sections are presented in Tables 5, 6, 6a, and 6b. Cross-section parameters were not generated for XS2, XS7, or XS8 where stream braiding has resulted in multiple active channels. Some parameters including width/depth ratio, entrenchment ratio, wetted perimeter, and hydraulic radius were generated for riffles only. Stream pattern parameters including channel beltwidth, radius of curvature, meander wavelength, and meander width ratio were also re-evaluated during Year 5 monitoring. Cross-section plots are represented in Figures B1-B10 in Appendix B. Bankfull elevations depicted in cross-section plots were adjusted as needed.

In general, bankfull channel parameters indicate minor change compared to conditions assessed during Year 4 monitoring. Scouring and transportation of bank and bed material was detected at some monitoring cross-sections where restored channels continue to migrate toward reference conditions. Soil subsidence has diminished as herbaceous and woody vegetation further stabilize the soil and begin to provide shading to the developing forest floor.

Stream longitudinal profile was surveyed for approximately 900 feet within the restored channel, including the section of stream between on-Site Reach 3 and on-Site Reach 2 (Figure 2, Appendix A). Longitudinal profile data for this portion of the stream is plotted along with previous years conditions in Figure B-11, Appendix B. The Site's natural low gradient and the large amount of coarse woody debris present within the channel has produced numerous depositional features (traverse and diagonal bars) scattered among scour pools of varying sizes. As a result, longitudinal profile parameters were not generated for the stream due to the complexity and irregularity of the channel bed.

The stream channel substrate is naturally comprised of more than 90 percent (90%) sand throughout the Site. As a result, substrate sampling was not conducted at the cross-sections and is not included with the summarized cross-sectional parameters in Tables 5-6b.

Table 5. Baseline Morphology and Hydrologic Summary															
Parameter	Regional Curve Interval			Reference Stream Reach 1 (233 linear feet)			Reference Stream Reach 4 (175 linear feet)			As-Built On-Site Reach 2 (186 linear feet)			As-Built On-Site Reach 3 (293 linear feet)		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
BF Width (ft)	9.6	13.5	12.7	N/A	N/A	13.0	N/A	N/A	9.1	N/A	N/A	7.9	N/A	N/A	11.3
Floodprone Width (ft)	300.0	600.0	400.0	N/A	N/A	500.0	N/A	N/A	300.0	N/A	N/A	450.0	N/A	N/A	400.0
BF Cross Sectional Area (ft^2)	9.4	18.1	16.1	N/A	N/A	14.3	N/A	N/A	9.0	N/A	N/A	7.6	N/A	N/A	10.8
BF Mean Depth (ft)	1.0	1.3	1.3	N/A	N/A	1.1	N/A	N/A	1.0	N/A	N/A	1.0	N/A	N/A	1.0
BF Max Depth (ft)	N/A	N/A	N/A	N/A	N/A	1.9	N/A	N/A	2.0	N/A	N/A	1.3	N/A	N/A	1.5
Width/Depth Ratio	9.8	10.0	9.9	N/A	N/A	11.4	N/A	N/A	9.2	N/A	N/A	8.3	N/A	N/A	11.7
Entrenchment Ratio	28.4	49.7	32.2	N/A	N/A	38.6	N/A	N/A	33.0	N/A	N/A	57.0	N/A	N/A	35.5
Wetted Perimeter (ft)	N/A	N/A	N/A	N/A	N/A	14.9	N/A	N/A	10.9	N/A	N/A	9.4	N/A	N/A	12.4
Hydraulic Radius (ft)	N/A	N/A	N/A	N/A	N/A	1.0	N/A	N/A	0.8	N/A	N/A	0.8	N/A	N/A	0.9
Pattern															
Channel Beltwidth (ft)	N/A	N/A	N/A	18.2	35.5	22.1	12.6	18.5	14.0	19.3	22.6	21.0	8.9	20.9	11.0
Radius of Curvature (ft)	N/A	N/A	N/A	18.6	46.3	21.1	4.2	27.7	6.8	10.3	24.3	15.8	4.1	18.2	13.4
Meander Wavelength	N/A	N/A	N/A	61.2	88.1	78.9	17.5	44.6	21.6	39.1	59.9	47.9	19.1	49.2	28.0
Meader Width Ratio	N/A	N/A	N/A	1.4	2.8	1.7	1.5	2.2	1.6	1.6	1.9	1.7	1.5	2.2	1.9
Profile															
Riffle Length (ft)	N/A	N/A	N/A	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*
Riffle Slope (ft)	N/A	N/A	N/A	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*
Pool Length (ft)	N/A	N/A	N/A	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*
Pool Spacing (ft)	N/A	N/A	N/A	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*
Substrate															
d50 (mm)	N/A	N/A	N/A	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*
d84 (mm)	N/A	N/A	N/A	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*
Additional Reach Parameters															
Valley Length (ft)		N/A			N/A			N/A			N/A			N/A	
Channel Length (ft)		N/A			N/A			N/A			N/A			N/A	
Sinuosity		N/A			1.3			1.1			1.1			1.1	
Water Surface Slope (ft/ft)		N/A			0.003			0.005			0.004			0.004	
BF Slope (ft/ft)		N/A			0.003			0.005			0.004			0.004	
Rosgen Classification		N/A			E5			E5			E5			E5	
Habitat Index		N/A			NA*			NA*			NA*			NA*	
Macrobenthos		N/A			NA*			NA*			NA*			NA*	

*See document text for details.

Table 6. Morphology and Hydraulic Monitoring Summary																		
Parameter	Cross-Section XS1 - Pool						Cross-Section XS2 – Braided Channels						Cross-Section XS3 - Riffle					
Dimension	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
BF Width (ft)	11.8	11.8	9.5	10.9	8.8		NA*	NA*	NA*	NA*	NA*		8.4	8.8	8.3	8.7	8.7	
Floodprone Width (ft)	400.0	400.0	400.0	400.0	400.0		NA*	NA*	NA*	NA*	NA*		400.0	400.0	400.0	400.0	400.0	
BF Cross Sectional Area (ft^2)	4.9	4.9	5.3	6.4	4.2		NA*	NA*	NA*	NA*	NA*		4.2	6.3	4.7	6.0	8.3	
BF Mean Depth (ft)	0.4	0.4	0.6	0.6	0.5		NA*	NA*	NA*	NA*	NA*		0.5	0.7	0.6	0.7	1.0	
BF Max Depth (ft)	0.8	0.8	0.8	0.9	0.7		NA*	NA*	NA*	NA*	NA*		1.0	1.2	0.9	1.2	1.6	
Width/Depth Ratio	NA*	NA*	NA*	NA*	NA*		NA*	NA*	NA*	NA*	NA*		16.7	12.4	14.8	12.4	8.7	
Entrenchment Ratio	NA*	NA*	NA*	NA*	NA*		NA*	NA*	NA*	NA*	NA*		47.9	45.4	48.3	45.9	46.0	
Wetted Perimeter (ft)	NA*	NA*	NA*	NA*	NA*		NA*	NA*	NA*	NA*	NA*		9.3	8.7	8.6	8.6	9.5	
Hydraulic Radius (ft)	NA*	NA*	NA*	NA*	NA*		NA*	NA*	NA*	NA*	NA*		0.4	0.7	0.5	0.7	0.9	
Substrate																		
d50 (mm)	NA*	NA*	NA*	NA*	NA*		NA*	NA*	NA*	NA*	NA*		NA*	NA*	NA*	NA*	NA*	
d84 (mm)	NA*	NA*	NA*	NA*	NA*		NA*	NA*	NA*	NA*	NA*		NA*	NA*	NA*	NA*	NA*	

Parameter	MY-01 (2006)			MY-02 (2007)			MY-03 (2008)			MY-04 (2009)			MY-05 (2010)					
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	8.9	22.6	15.6	NA*	NA*	NA*	6.9	32.3	15.5	NA*	NA*	NA*	7.2	28.9	15.2			
Radius of Curvature (ft)	4.1	24.3	13.4	NA*	NA*	NA*	5.6	29.2	21.0	NA*	NA*	NA*	5.1	27.2	19.4			
Meander Wavelength	19.1	59.9	38.0	NA*	NA*	NA*	18.4	70.4	49.0	NA*	NA*	NA*	18.9	63.8	41.0			
Meader Width Ratio	1.5	2.2	1.9	NA*	NA*	NA*	0.8	2.5	1.5	NA*	NA*	NA*	1.0	2.1	1.8			
Profile																		
Riffle Length (ft)	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*			
Riffle Slope (ft)	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*			
Pool Length (ft)	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*			
Pool Spacing (ft)	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*			
Additional Reach Parameters																		
Valley Length (ft)	N/A			N/A			N/A			N/A			N/A					
Channel Length (ft)	N/A			N/A			N/A			N/A			N/A					
Sinuosity	1.1			1.1			1.1			1.1			1.1					
Water Surface Slope (ft/ft)	0.004			0.004			0.004			0.004			0.004					
BF Slope (ft/ft)	0.004			0.004			0.004			0.004			0.004					
Rosgen Classification	DA5/E5			DA5/E5			DA5/E5			DA5/E5			DA5/E5					
Habitat Index	NA*			NA*			NA*			NA*			NA*					
Macrobenthos	NA*			NA*			NA*			NA*			NA*					

*See document text for details.

Table 6a. Morphology and Hydraulic Monitoring Summary (*Cont.*)																		
Parameter	Cross-Section XS4 - Riffle						Cross-Section XSR2 - Riffle						Cross-Section XS5 - Pool					
Dimension	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
BF Width (ft)	25.1	29.8	37.3	25.0	19.3		7.9	8.9	10.8	8.8	9.5		6.4	19.2	23.5	25.4	28.2	
Floodprone Width (ft)	500.0	500.0	500.0	500.0	500.0		450.0	450.0	450.0	450.0	450.0		400.0	400.0	400.0	400.0	400.0	
BF Cross Sectional Area (ft^2)	6.7	14.0	24.3	25.8	12.9		7.6	8.7	11.4	9.3	9.5		3.9	6.9	12.6	16.7	14.0	
BF Mean Depth (ft)	0.3	0.5	0.7	1.0	0.7		1.0	1.0	1.0	1.1	1.0		0.6	0.4	0.5	0.7	0.5	
BF Max Depth (ft)	0.9	1.9	1.6	1.9	1.6		1.3	1.6	1.6	1.6	1.7		1.9	2.2	1.3	2.0	1.7	
Width/Depth Ratio	96.7	64.8	57.3	25.0	27.6		8.2	9.1	10.5	8.0	9.5		NA*	NA*	NA*	NA*	NA*	
Entrenchment Ratio	19.9	16.8	13.4	20.0	25.9		57.0	50.6	41.4	51.1	47.4		NA*	NA*	NA*	NA*	NA*	
Wetted Perimeter (ft)	25.2	30.4	26.8	25.2	20.1		9.4	10.3	9.0	9.4	10.5		NA*	NA*	NA*	NA*	NA*	
Hydraulic Radius (ft)	0.3	0.5	0.9	1.0	0.6		0.8	0.9	1.3	1.0	0.9		NA*	NA*	NA*	NA*	NA*	
Substrate																		
d50 (mm)	NA*	NA*	NA*	NA*	NA*		NA*	NA*	NA*	NA*	NA*		NA*	NA*	NA*	NA*	NA*	
d84 (mm)	NA*	NA*	NA*	NA*	NA*		NA*	NA*	NA*	NA*	NA*		NA*	NA*	NA*	NA*	NA*	
Parameter	Cross-Section XSR3 - Riffle						Cross-Section XS6 - Pool						Cross-Section XS7 – Braided Channels					
Dimension	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
BF Width (ft)	11.3	16.1	15.5	11.3	16.4		13.9	21.7	23.7	22.1	25.1		NA*	NA*	NA*	NA*	NA*	
Floodprone Width (ft)	400.0	400.0	400.0	400.0	400.0		350.0	350.0	350.0	350.0	350.0		NA*	NA*	NA*	NA*	NA*	
BF Cross Sectional Area (ft^2)	10.8	11.4	12.7	8.8	12.1		8.1	13.1	12.7	15.4	13.1		NA*	NA*	NA*	NA*	NA*	
BF Mean Depth (ft)	1.0	0.7	0.8	0.8	0.7		0.6	0.6	0.5	0.7	0.5		NA*	NA*	NA*	NA*	NA*	
BF Max Depth (ft)	1.5	1.8	1.5	1.4	1.8		2.5	3.3	1.9	1.9	2.0		NA*	NA*	NA*	NA*	NA*	
Width/Depth Ratio	11.7	22.9	20.7	14.1	23.4		NA*	NA*	NA*	NA*	NA*		NA*	NA*	NA*	NA*	NA*	
Entrenchment Ratio	35.5	24.9	24.2	35.4	24.4		NA*	NA*	NA*	NA*	NA*		NA*	NA*	NA*	NA*	NA*	
Wetted Perimeter (ft)	12.4	16.7	8.9	12.4	17.4		NA*	NA*	NA*	NA*	NA*		NA*	NA*	NA*	NA*	NA*	
Hydraulic Radius (ft)	0.9	0.7	1.4	0.7	0.7		NA*	NA*	NA*	NA*	NA*		NA*	NA*	NA*	NA*	NA*	
Substrate																		
d50 (mm)	NA*	NA*	NA*	NA*	NA*		NA*	NA*	NA*	NA*	NA*		NA*	NA*	NA*	NA*	NA*	
d84 (mm)	NA*	NA*	NA*	NA*	NA*		NA*	NA*	NA*	NA*	NA*		NA*	NA*	NA*	NA*	NA*	

*See document text for details.

Table 6b. Morphology and Hydraulic Monitoring Summary (*Cont.*)																		
Parameter	Cross-Section XS8 - Braided Channels																	
Dimension	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
BF Width (ft)	NA*	NA*	NA*	NA*	NA*													
Floodprone Width (ft)	NA*	NA*	NA*	NA*	NA*													
BF Cross Sectional Area (ft^2)	NA*	NA*	NA*	NA*	NA*													
BF Mean Depth (ft)	NA*	NA*	NA*	NA*	NA*													
BF Max Depth (ft)	NA*	NA*	NA*	NA*	NA*													
Width/Depth Ratio	NA*	NA*	NA*	NA*	NA*													
Entrenchment Ratio	NA*	NA*	NA*	NA*	NA*													
Wetted Perimeter (ft)	NA*	NA*	NA*	NA*	NA*													
Hydraulic Radius (ft)	NA*	NA*	NA*	NA*	NA*													
Substrate																		
d50 (mm)	NA*	NA*	NA*	NA*	NA*													
d84 (mm)	NA*	NA*	NA*	NA*	NA*													

*See document text for details.

2.1.2 Stream Problem Areas

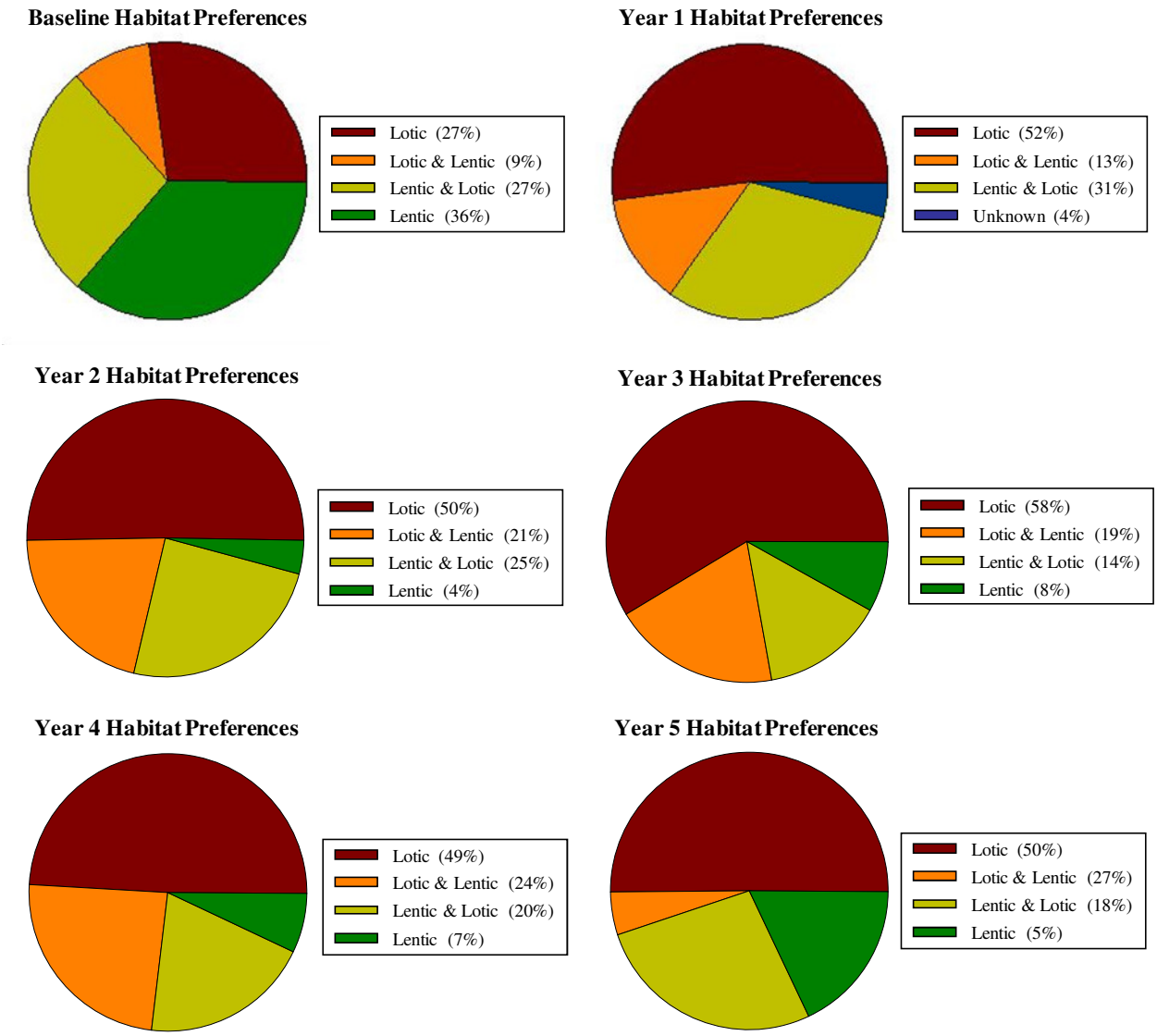
No stream problem areas were observed during Year 5 monitoring. During Year 4 monitoring, PBS&J initiated beaver management and minor grading activities on the former Dam location. Grading efforts have successfully reduced the opportunity for beavers to re-construct dams on-Site and no further beaver activity has been observed.

2.1.3 Aquatic Communities

Benthic macroinvertebrates were sampled within Falling Creek during Year 5 monitoring in late September 2010. Aquatic community data, located in Appendix C, are based on laboratory identifications of benthic macroinvertebrate taxa by Pennington and Associates, Inc., a NCDWQ-certified lab. A temporal comparison between collected benthic habitat and their preferences are provided in Graph 1.

Fifty percent (50%) of the macroinvertebrate samples collected during Year 5 monitoring from restored segments of Falling Creek (within the former pond) consisted of macroinvertebrate genera predominantly found in lotic systems. Genera found in both lotic and lentic systems (with a preference for lotic) increased three percent within Falling Creek, while genera favoring lentic and lotic (with a preference for lentic) decreased. Genera predominantly found in lentic systems made up only five percent of taxa collected from Falling Creek. Overall, the Year 5 data indicates an aquatic community assemblage that continues to transition from lentic to lotic as favorable habitat increases within Falling Creek.

Graph 1. Comparisons between collected benthic macroinvertebrates and their habitat preferences (Source: Merritt and Cummins 1984).



In addition to benthic macroinvertebrate habitat preference comparisons, other comparative metrics including the total number of organisms collected, the total taxa represented in the collection, the richness (diversity) of EPT taxa, and the biotic index can be used to evaluate aquatic habitat restoration. Table 7 summarizes the mean values for all these metrics from benthic macroinvertebrates collected within Falling Creek prior to dam removal and all subsequent monitoring years.

Table 7. Benthic Macroinvertebrate Metric Summary				
Monitoring Year	**Total Organisms**	**Total Taxa**	**EPT Richness**	**Biotic Index***
Baseline (2005)	32	15	2	7.42
Year 1 (2006)	209	35	16	5.33
Year 2 (2007)	187	38	12	4.95
Year 3 (2008)	73	24	8	5.21
Year 4 (2009)	148	37	12	5.43
Year 5 (2010)	150	33	10.5	4.27
*The biotic index is derived from North Carolina Tolerance Values that are assigned to each collected species. These Tolerance Values range from 0 for organisms intolerant of organic wastes to 10 for organisms very tolerant of organic wastes.				

Data from 2006-2007 monitoring suggests that there may have been an initial colonization spike of opportunistic species during the early successional stages of stream development. While the total number of organisms collected in 2006 has not been surpassed in subsequent monitoring years, the Year 5 data represents the lowest biotic index recorded during project monitoring. A decrease (improvement) in the biotic index indicates a macroinvertebrate community less tolerant of organic wastes (analogous to improved water quality). Compared to baseline (2005) values, Year 5 summary data represents a continued progression towards a restored aquatic community composition.

2.1.4 Habitat Assessment

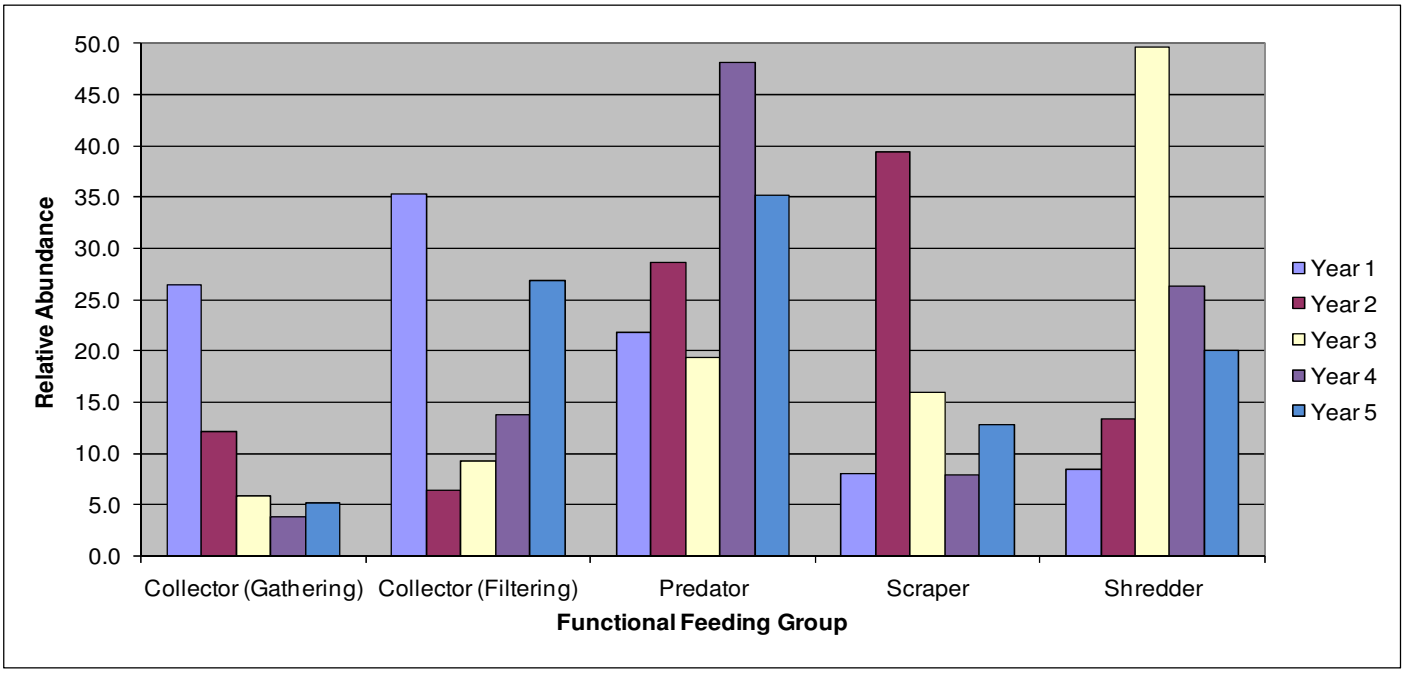
North Carolina Division of Water Quality (NCDWQ) Habitat Assessment Forms (HAFs) were completed at each cross-section location across the Site (Appendix D). Minor improvements in HAF scores were observed during Year 5 monitoring. This improvement is largely due to the favorable prevalence of in-stream habitat including sticks, snags, logs, leafpacks, and macrophytic vegetation as well as an increase in stream shading. The HAF mean score from restored and enhanced stream segments quantitatively increased in each of the five monitoring years. The HAF scores are summarized in Table 8.

Table 8. NCDWQ Habitat Assessment Form Scores					
Cross-section	**Score**				
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
XSR1 (Reference)	98	98	96	98	98
XSR4 (Reference)	97	97	96	95	96
Mean (Reference)	**97.5**	**97.5**	**96**	**96.5**	**97**
XS1	78	95	91	93	93
XS2	80	80	82	89	88
XS3	84	98	93	93	93
XS4	63	66	75	83	84
XSR2	88	93	88	88	91
XS5	69	80	83	83	83
XSR3	85	90	88	87	88
XS6	65	71	74	77	75
XS7	74	76	82	77	80
XS8	86	90	91	90	90
Mean	**81.9**	**87.0**	**87.3**	**88.4**	**88.9**

Stream habitat characterizations depicting aquatic in-stream habitat composition were completed using plan-view drawings derived from total station surveys of the stream monitoring reaches. Drawings were updated in the field through visual observation and habitat composition was transcribed onto each drawing by hand. Drawings were digitized using GIS technology to determine rough estimates of habitat type representation. Representative habitat includes adjacent stream bank trees, root mats/balls, stumps, coarse woody debris, and undercut banks. Figure 3 (Appendix A) depicts the Year 5 stream habitat composition. Compared to previous monitoring years, Reaches 2 and 3 show both an increase in habitat quantity, and habitat type, particularly with regards to in stream woody debris. Reaches 2 and 3 still contain an abundance of macrophytic vegetation compared to the reference reaches (1 and 4). The macrophytic vegetation is expected to diminish as the riparian community continues developing, and shading increases.

During Year 5 benthic macroinvertebrate monitoring, an increase in the number of collectors (both gathering and filtering) and scrapers was observed. The increased abundance of collectors and scrapers suggests a possible increase in their available food source, macrophytes and fine particle organic matter respectively. This may be attributed to an increase in riparian litterfall and organic input from the surrounding floodplain. Year 5 monitoring also indicates a decrease in the number of predators and shredders, although predators still make up the largest relative abundance. The following graph displays functional feeding group composition following dam removal at the Site.

Graph 2. Functional Feeding Group Composition



2.2 Wetland Assessment

2.2.1 Vegetation Assessment

Eight (8) 10 x 10 meter plots (VP 2-7 and VP 9-10) were sampled in accordance with the Carolina Vegetation Survey Protocol (Figure 4, Appendix A). Vegetation plots 9 and 10 were installed last year following the remedial grading activities performed on the footprint of the former dam. Success criteria for vegetation requires that at least 320 stems per acre must survive after the completion of the third growing season. The required survival criterion will decrease by 10 percent per year after the third year of vegetation monitoring (i.e. for an expected 260 stems per acre for Year 5). The Site is currently meeting the established success criteria for vegetation based on the survival of the planted species with an average density of 491 stems per acre. Including all volunteer species raises the vegetation survival within the Site to 4,467 stems per acre.

Both plots 9 and 10 are exceeding the required survival criterion with an average density of 607 stems per acre and 647 stems per acre respectively (average density of 627 stems per acre). As discussed with EEP, if vegetation success of remedial planted stems within plots 9 and 10 are on target at the end of Year 5, then no additional vegetative monitoring will be required

An inventory of planted stems within plots 2-7 are given in Table 9, and an inventory of planted stems within new plots 9-10 are given in Table 9a. The Site met the density requirement for success in all monitoring years. A tally of volunteer woody species is listed in Table 9b. Year 5 photographs of vegetation plots are provided in Appendix E.

Table 9. Stem Counts for Planted Species Arranged by Plot

Species	Year 5 Plots*						Initial Totals		Year 1 Totals		Year 2 Totals		Year 3 Totals		Year 4 Totals**		Year 5 Totals**	
	2	3	4	5	6	7	Stems/ Plot	Stems/ Acre	Stems/ Plot	Stems/ Acre	Stems/ Plot	Stems/ Acre	Stems/ Plot	Stems/ Acre	Stems/ Plot	Stems/ Acre	Stems/ Plot	Stems/ Acre
Chamaecyparis thyoides	2	3	2	2	6	5	32	162	31	157	31	157	30	152	23	155	20	135
Liriodendron tulipifera	0	1	0	0	0	0	6	30	6	30	3	15	1	5	1	7	1	7
Magnolia virginiana	1	3	0	0	0	0	10	51	10	51	11	56	5	25	5	34	4	27
Nyssa biflora	4	3	6	0	2	5	29	147	29	147	28	142	30	152	20	135	20	135
Persea borbonia	0	0	0	0	0	0	1	5	1	5	1	5	0	0	0	0	0	0
Pinus serotina	1	3	6	6	4	1	32	162	32	162	30	152	36	182	26	175	21	142
Pinus taeda	0	0	0	0	0	0	12	61	12	61	12	61	4	20	1	7	0	0
Site Total							**122**	**618**	**121**	**613**	**116**	**588**	**106**	**536**	**76**	**513**	**66**	**446**

*Plots 1 and 8 were replaced following on-Site grading. See Table 9b.

** Total values differ from previous years because Plots 1 and 8 were replaced.

Table 9a. Stem Counts for Planted Species at New Plots						
Species	**Year 5 Plots**		**Year 4 Totals**		**Year 5 Totals**	
	9	**10**	**Stems/ Plot**	**Stems/ Acre**	**Stems/ Plot**	**Stems/ Acre**
Chamaecyparis thyoides	2	3	6	121	5	101
Liriodendron tulipifera	3	0	3	61	3	61
Magnolia virginiana	3	3	6	121	6	121
Nyssa biflora	7	10	18	364	17	344
Site Total			**33**	**667**	**31**	**627**

Table 9b. Stem Counts for Volunteer Species Arranged by Plot																		
Species	**Year 5 Plots**								**Year 1 Totals**		**Year 2 Totals**		**Year 3 Totals**		**Year 4 Totals****		**Year 5 Totals****	
	2	**3**	**4**	**5**	**6**	**7**	**9***	**10***	**Stems/ Plot**	**Stems/ Acre**	**Stems/ Plot**	**Stems/ Acre**	**Stems/ Plot**	**Stems/ Acre**	**Stems/ Plot**	**Stems/ Acre**	**Stems/ Plot**	**Stems/ Acre**
Acer rubrum	11	11	21	1	3	30	21	0	12	61	16	81	25	126	24	121	98	496
Betula nigra	0	0	0	0	0	0	0	1	0	0	5	25	0	0	0	0	1	5
Chamaecyparis thyoides	2	0	1	0	12	3	0	0	0	0	4	20	13	66	7	35	18	91
Cyrilla racemifllora	0	2	0	0	22	0	0	0	1	5	0	0	4	20	5	25	24	121
Liquidambar stryaciflua	2	2	0	1	0	0	0	0	0	0	1	5	1	5	2	10	5	25
Liriodendron tulipifera	2	0	0	0	16	1	2	6	14	71	7	35	5	25	4	20	27	137
Magnolia virginiana	3	2	0	0	1	0	0	1	2	10	1	5	8	40	6	30	7	35
Nyssa biflora	1	0	0	0	0	0	0	0	0	0	1	5	0	0	1	5	1	5
Pinus serotina	71	171	16	63	283	24	32	31	105	531	168	850	532	2691	339	1715	691	3495
Pinus taeda	0	0	0	0	0	0	0	0	0	0	29	147	6	30	0	0	0	0
Salix nigra	1	0	0	0	0	2	0	0	7	35	1	5	1	5	2	10	3	15
Clethra alnifolia	0	0	0	0	0	0	0	0	1	5	1	5	0	0	0	0	0	0
Baccharis halimifolia	0	0	0	0	0	0	0	0	1	5	0	0	1	5	0	0	0	0
Kalmia angustifolia	0	0	0	0	0	0	0	0	1	5	0	0	0	0	0	0	0	0
Vaccinium corymbosum	0	0	0	0	1	0	0	1	0	0	2	10	0	0	0	0	2	10
Lyonia lucida	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	5
Ilex glabra	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	5	25
Site Total									**144**	**728**	**236**	**1193**	**596**	**3013**	**390**	**1971**	**883**	**4465**

*New vegetation plot established following on-Site grading. See previous Table 9a.

** Total values differ from previous years because Plots 1 and 8 were replaced.

2.2.2 Groundwater Hydrology

Success criteria for groundwater hydrology on the Site requires that wetland mitigation areas be inundated or saturated (within 12 inches of the surface) by surface or groundwater for at least 28 consecutive days (Richmond County, NRCS) or 12.5 percent of the growing season (March 27 - November 5). Groundwater gauge locations (Gauges 1- 4) are depicted in Figure 5 (Appendix A). Groundwater gauge hydrographs are plotted on Figure F-1 in (Appendix F). All four groundwater gauges located on-Site are currently meeting the wetland hydrologic success criteria. Gauge 3 likely recorded groundwater within 12 inches of the surface longer than the reported 75 days, but gauge malfunction resulted in data loss from July 20 through September 2. With the exception of 2009 (gauge 3 malfunction), all groundwater gauges on the Site achieved success criteria within each of the last five monitoring years indicating the establishment of wetland hydrology in the former pond footprint.

2.2.3 Wetland Criteria Attainment

Table 10. Wetland Criteria Attainment					
Year	**Gauge ID**	**Gauge Hydrology Threshold Met?**		**Vegetation Plot ID**	**Vegetation Survival Threshold Met?**
2006 (Year 1)	Gauge1	Yes	201 days (89% of growing season)	1	Yes
				2	Yes
	Gauge2	Yes	98 days (44% of growing season)	3	Yes
				4	Yes
	Gauge3	Yes	216 days (96% of growing season)	5	Yes
				6	Yes
	Gauge4	Yes	205 days (91% of growing season)	7	Yes
				8	Yes
2007 (Year 2)	Gauge1	Yes	105 days (47% of growing season)	1	Yes
				2	Yes
	Gauge2	Yes	96 days (43% of growing season)	3	Yes
				4	Yes
	Gauge3	Yes	212 days (94% of growing season)	5	Yes
				6	Yes
	Gauge4	Yes	131 days (58% of growing season)	7	Yes
				8	Yes
2008 (Year 3)	Gauge1	Yes	58 days (26% of growing season)	1	Yes
				2	Yes
	Gauge2	Yes	58 days (26% of growing season)	3	Yes
				4	Yes
	Gauge3	Yes	74 days (33% of growing season)	5	Yes
				6	Yes
	Gauge4	Yes	72 days (32% of growing season)	7	Yes
				8	Yes
2009 (Year 4)	Gauge1	Yes	42 days (19% of growing season)	2	Yes
				3	Yes
	Gauge2	Yes	38 days (17% of growing season)	4	Yes
				5	Yes
	Gauge3	NA	Gauge Malfunction	6	Yes
				7	Yes
	Gauge4	Yes	47 days (21% of growing season)	9	Yes
				10	Yes
2010 (Year 5)	Gauge1	Yes	85 days (38% of growing season)	2	Yes
				3	Yes
	Gauge2	Yes	78 days (35% of growing season)	4	Yes
				5	Yes
	Gauge3	Yes	75 days (33% of growing season)	6	Yes
				7	Yes
	Gauge4	Yes	85 days (38% of growing season)	9	Yes
				10	Yes

REFERENCES

Natural Resources Conservation Service (NRCS). 1999. Soil Survey of Richmond County, North Carolina. United States Department of Agriculture.

Rosgen, D. 1994. Applied Fluvial Geomorphology. Wildland Hydrology: Pagosa Springs, CO.

Schafale, M.P. and A.S. Weakley. 1990. Classification of the Natural Communities of North Carolina: Third Approximation. North Carolina Natural Heritage Program, Division of Parks and Recreation, N.C. Department of Environment, Health, and Natural Resources. Raleigh, North Carolina.

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APPENDIX A: FIGURES

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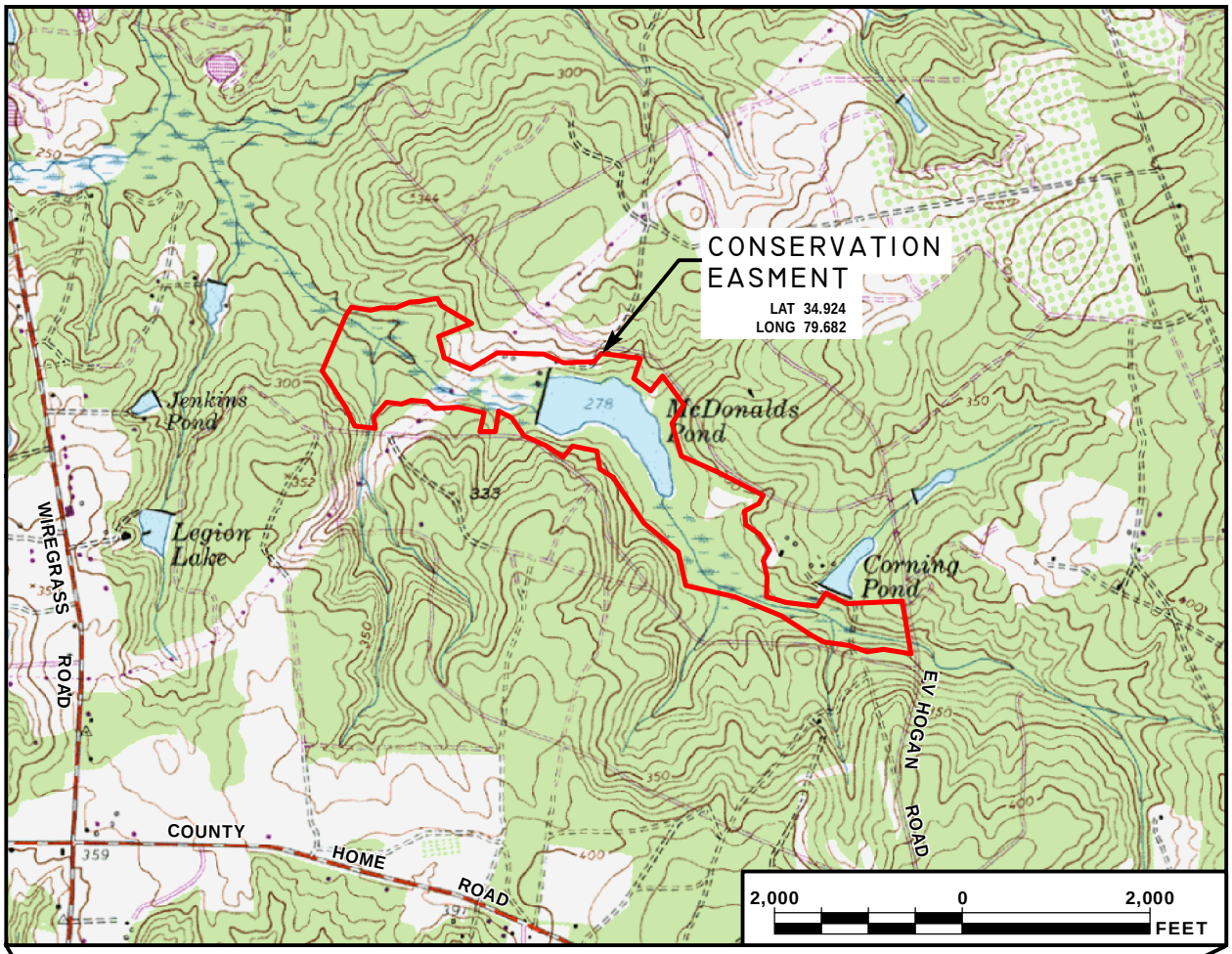

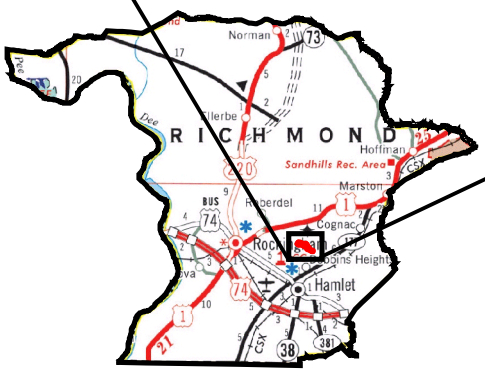

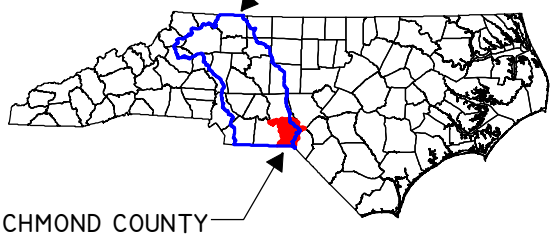

NAD 83

INTERNATIONAL PAPER

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Ecosystem Enhancement Program

SITE LOCATION

McDONALDS POND RESTORATION SITE

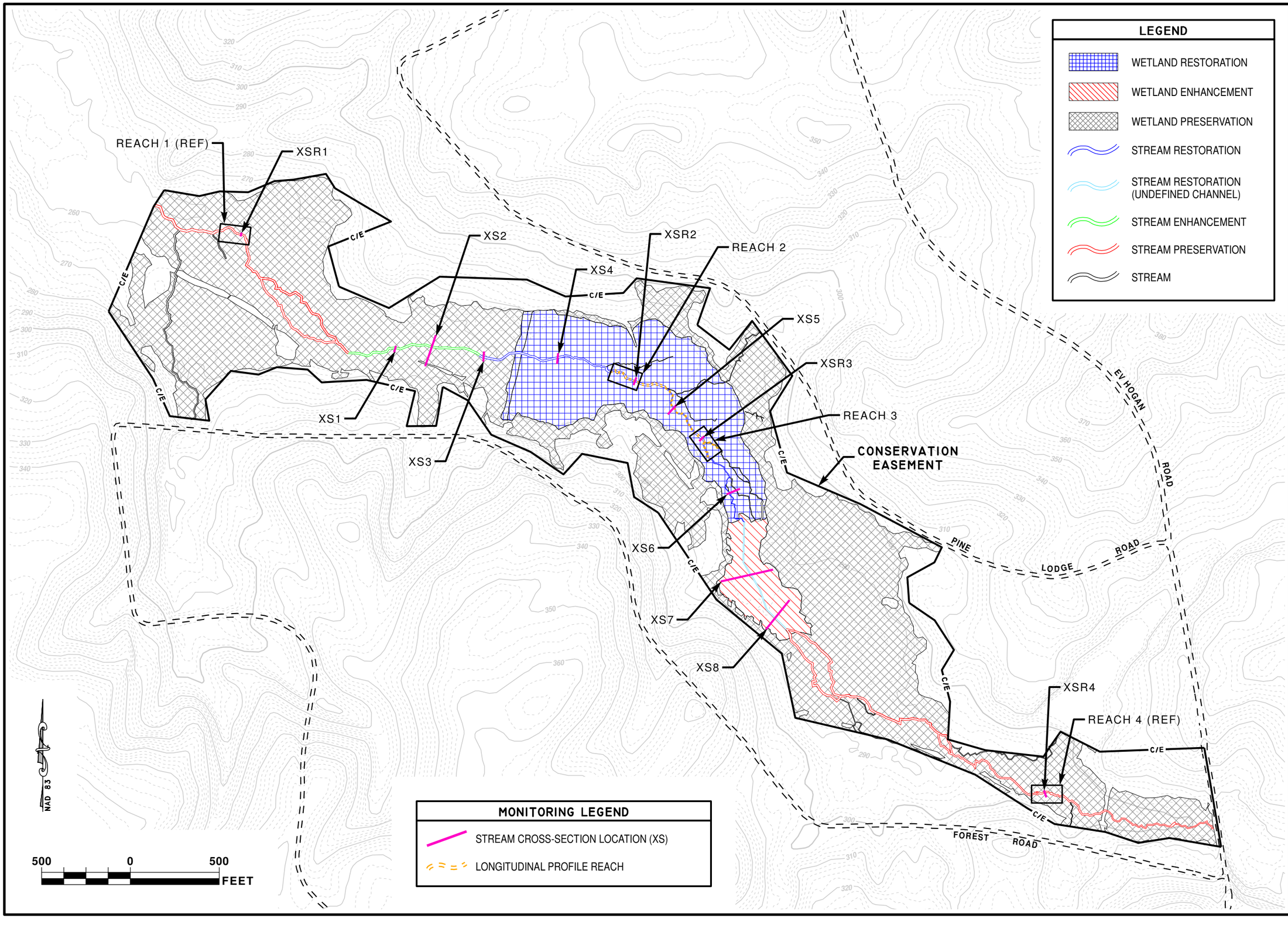
EEP Project No. D04020-2

RICHMOND COUNTY, NORTH CAROLINA

DWN BY:	MCG
CKD BY:	JWG
DATE:	NOV 2010
PROJECT NO:	100004932

FIGURE

1



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REVISIONS

INTERNATIONAL PAPER

CLIENT:
Ecosystem Enhancement PROGRAM

PROJECT:

McDONALDS POND RESTORATION SITE

EEP Project No. D04020-2

RICHMOND COUNTY, NORTH CAROLINA

TITLE:

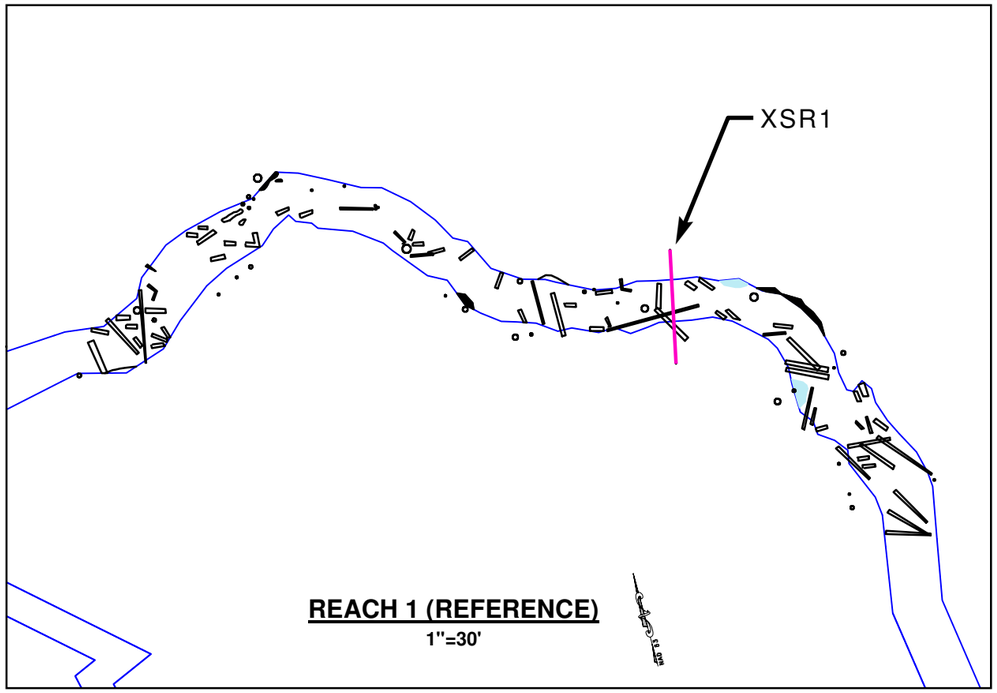
STREAM MONITORING PLAN VIEW

DWN BY:	DATE:
MCG	FEB 2010
CKD BY:	SCALE:
JWG	1" = 500'

ESC PROJECT NO.: 100004932

FIGURE

2



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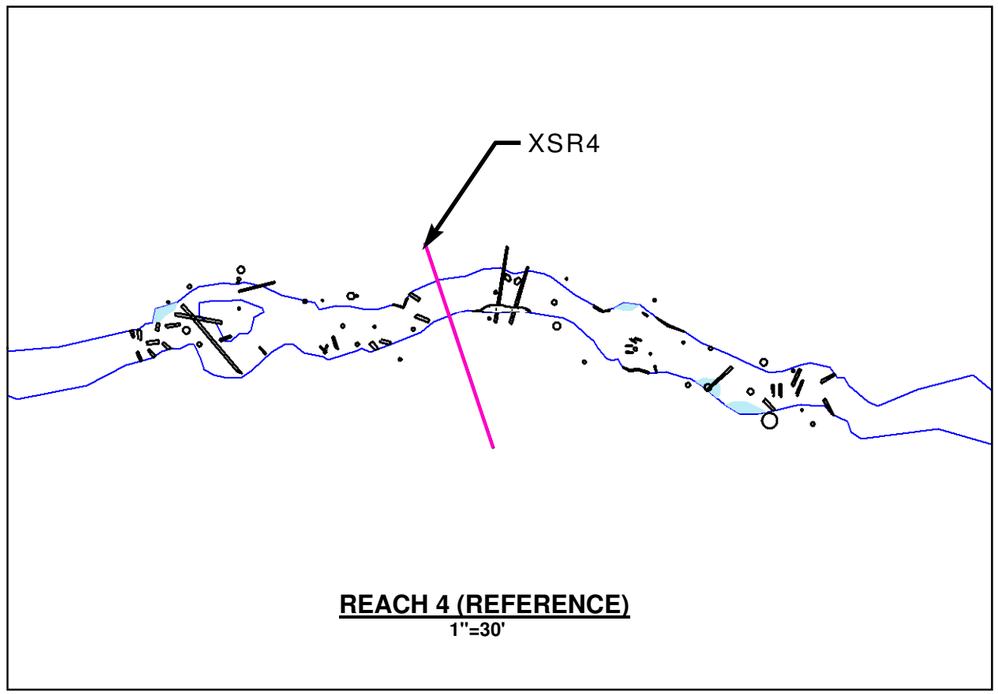

REACH 4 (REFERENCE)
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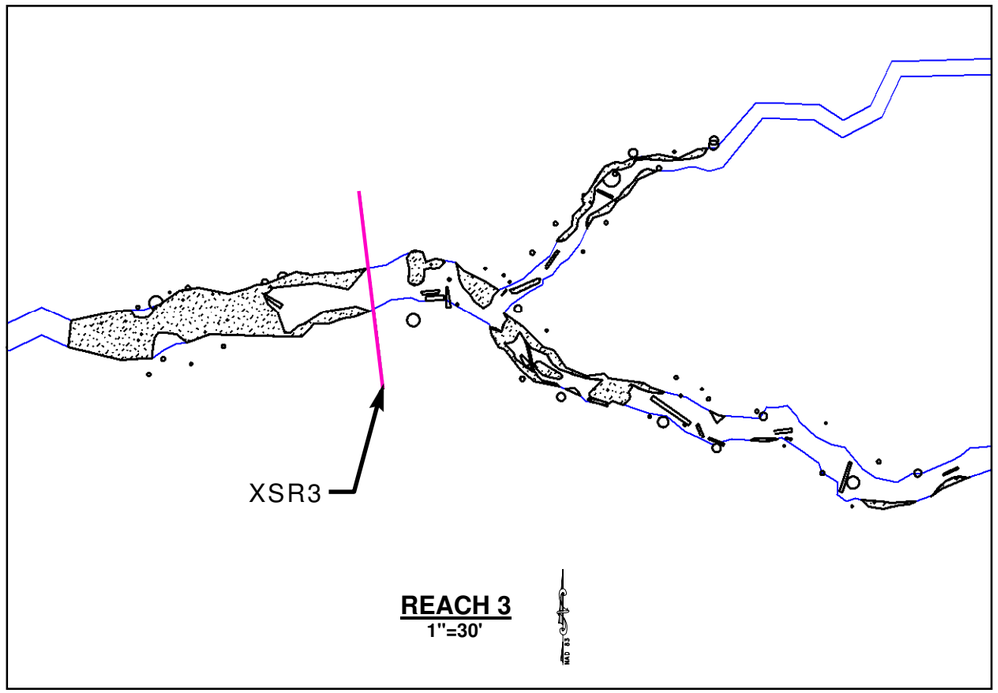
STREAM
STREAM CROSS-SECTION LOCATION (XS)
POOL
STUMP / LOG
TREE / ROOT
UNDERCUT BANK
MACROPHYTIC VEGETATION



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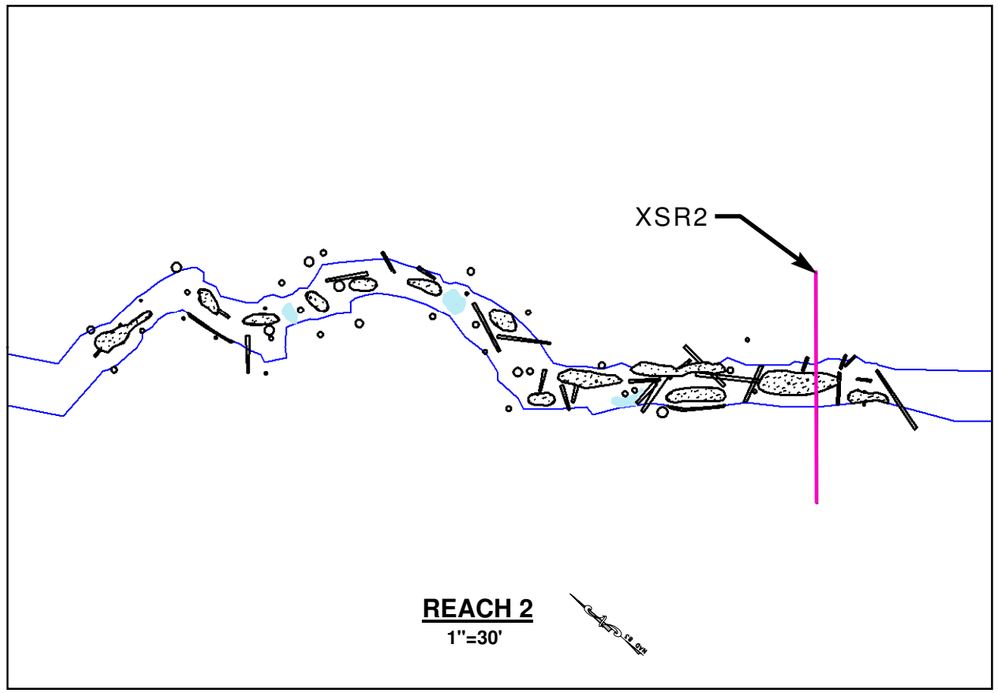

REACH 2
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CLIENT:
Ecosystem Enhancement Program

PROJECT:

McDONALDS POND RESTORATION SITE

EEP Project No. D04020-2

RICHMOND COUNTY, NORTH CAROLINA

TITLE:

STREAM HABITAT COMPOSITION

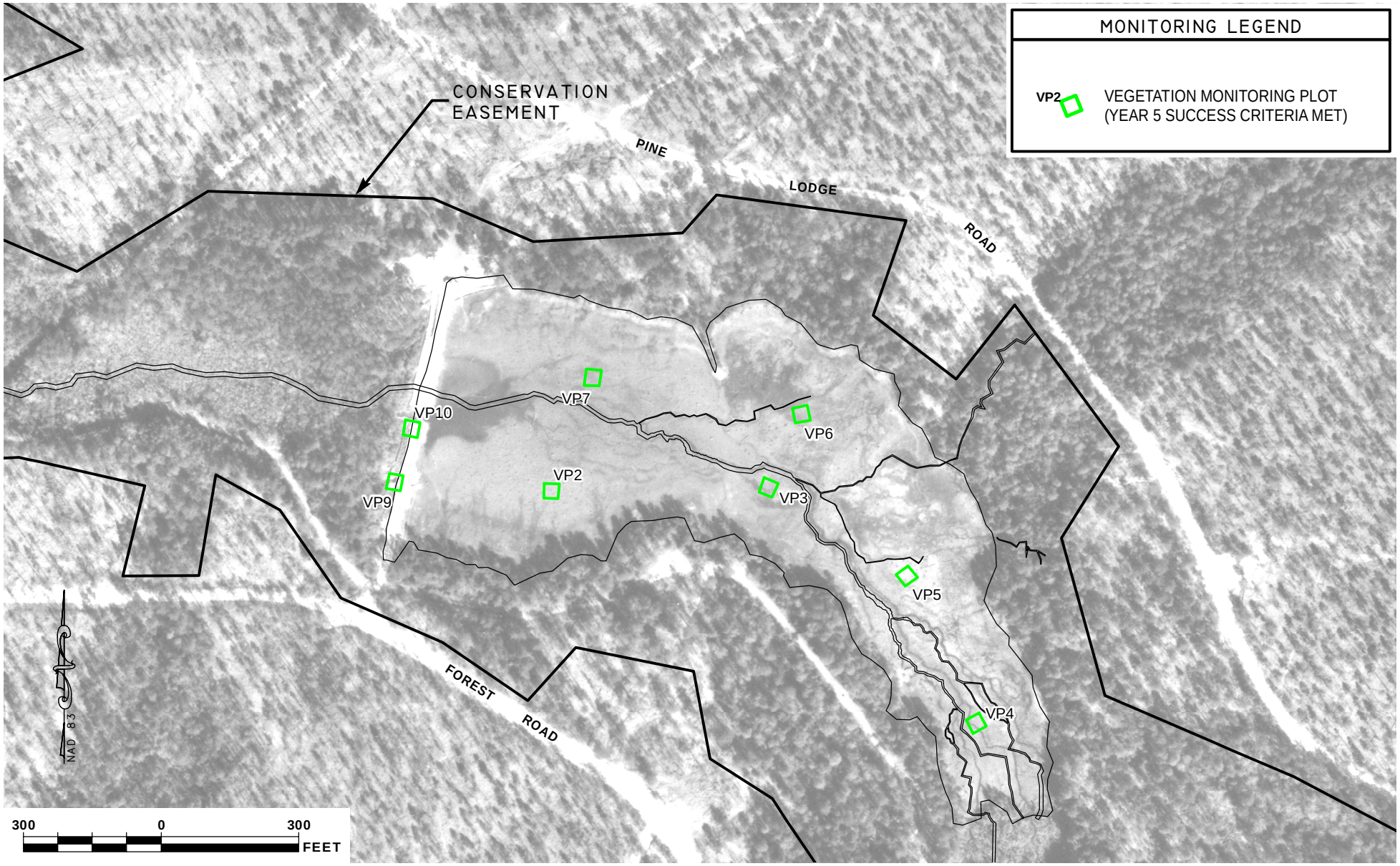
2010 YEAR 5 MONITORING

DWN BY:	DATE:
MCG	SEP 2010
CKD BY:	SCALE:
JWG	AS SHOWN

ESC PROJECT NO.: 07-330.00

FIGURE

3



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CLIENT:
Ecosystem Enhancement Program

VEGETATION MONITORING PLOTS

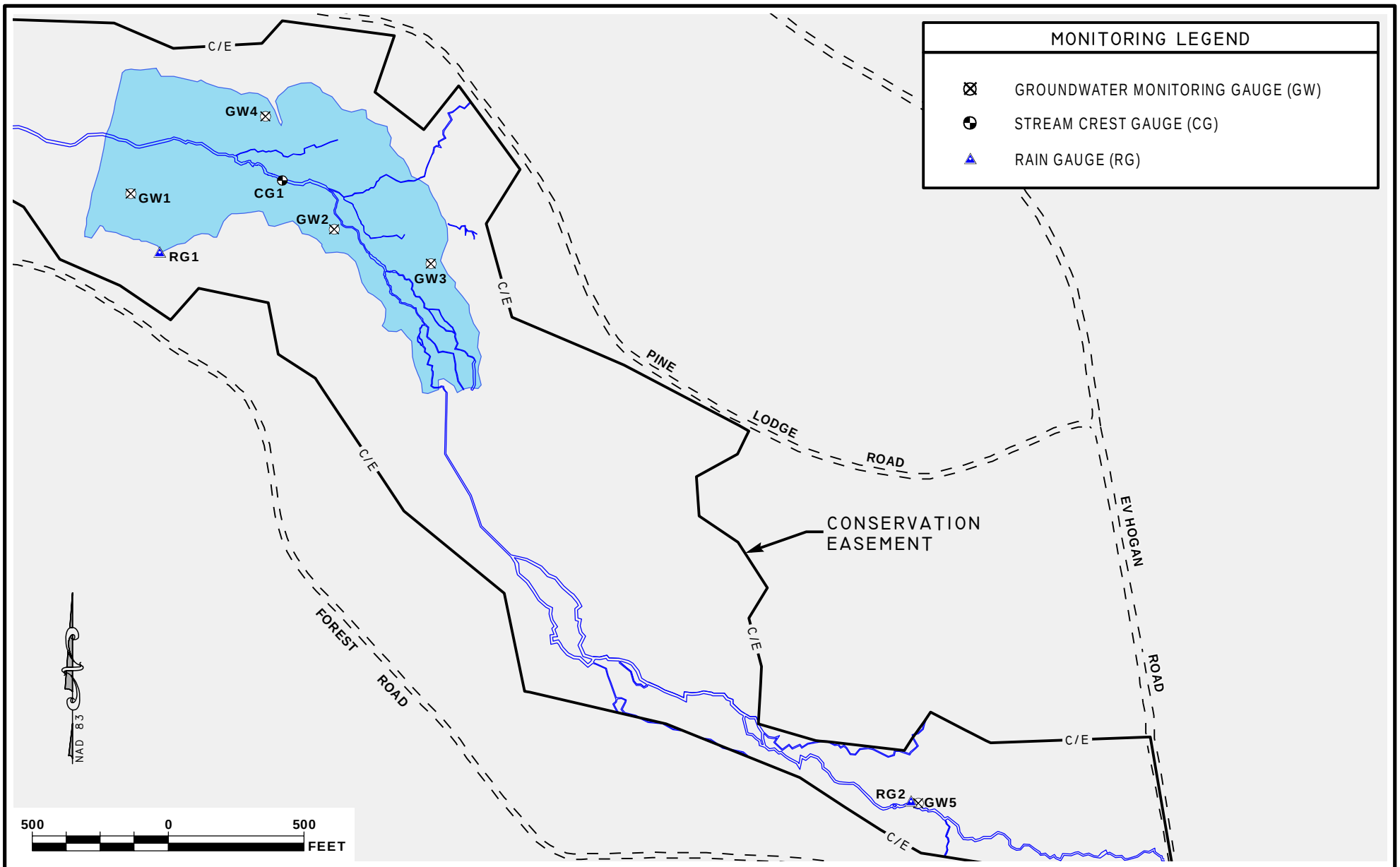
McDONALDS POND RESTORATION SITE

EEP Project No. D04020-2

RICHMOND COUNTY, NORTH CAROLINA

DWN BY:	MCG
CKD BY:	JWG
DATE:	NOV 2010
ESC PROJECT:	100004932

FIGURE
4



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INTERNATIONAL PAPER

CLIENT:
Ecosystem Enhancement Program

MONITORING GAUGES

McDONALDS POND RESTORATION SITE

EEP Project No. D04020-2

RICHMOND COUNTY, NORTH CAROLINA

DWN BY:	MCG
CKD BY:	JWG
DATE:	NOV 2010
ESC PROJECT:	100004932

FIGURE 5

APPENDIX B: STREAM GEOMORPHOLOGY DATA

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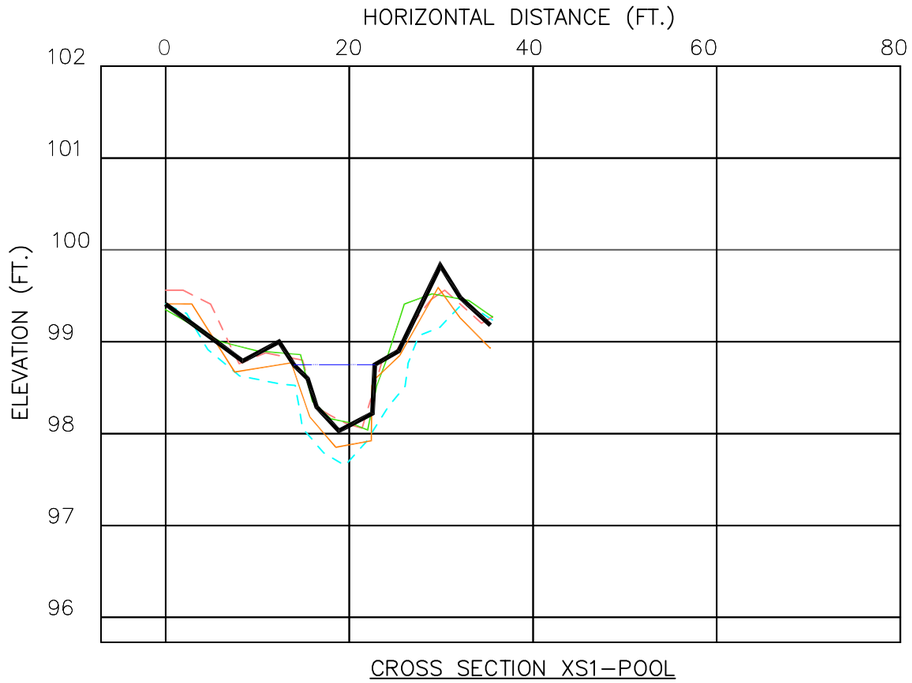

CROSS SECTION XS1–POOL

GRADE ELEVATION (2006)
GRADE ELEVATION (2007)
GRADE ELEVATION (2008)
GRADE ELEVATION (2009)
GRADE ELEVATION (2010)
BANKFULL ELEVATION

SURVEY DATA

STATION	ELEVATION	FEATURE
0.01	100.13	blpi
8.4	99.51	
12.36	99.72	
14.05	99.46	
15.46	99.32	
16.45	99.01	
18.89	98.75	
22.54	98.94	
22.78	99.47	
25.41	99.62	
29.92	100.55	
32.11	100.2	
35.38	99.9	brpi

SUMMARY DATA

BANKFULL CROSS SECTIONAL AREA	4.2 SQ. FT.
BANKFULL WIDTH	8.8 FT.
BANKFULL MEAN DEPTH	0.5 FT.
BANKFULL MAX DEPTH	0.7 FT.
WIDTH–DEPTH RATIO	N/A
ENTRENCHMENT RATIO	N/A
CLASSIFICATION	N/A

NOTES:

1. All cross–sections facing the downstream direction
2. Cross–section stationing represents approximate field locations.
3. Elevations based on relative benchmark; left pin elevation=100.0 ft.

Survey Date	SEPT. 2010
Survey Weather	Sunny
Field Team	Schmid, Geratz
Location	XS1

XS1 LEFT BANK LOOKING RIGHT BANK

XS1 LOOKING DOWNSTREAM

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RMS Resource Management Service, LLC

Client: Ecosystem Enhancement PROGRAM

Project:

McDONALDS POND RESTORATION SITE

EEP Project No. D04020–2

RICHMOND COUNTY, NORTH CAROLINA

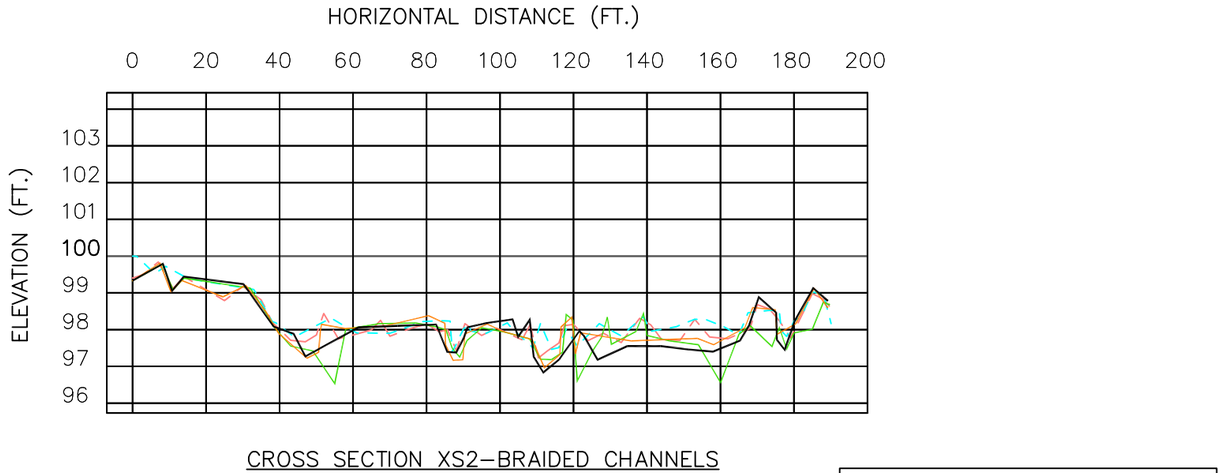
Title:

CROSS SECTION XS1–POOL

Dsn. By: JWC	Dwn. By: RLG
Ckd. By: MCG	Date: OCT 2010
Scale: NO SCALE	
Project No.: 100004932	

SHEET

B1



CROSS SECTION XS2–BRAIDED CHANNELS

XS2 RIGHT BANK LOOKING LEFT BANK

XS2 LOOKING DOWNSTREAM

SURVEY DATA

STATION	ELEVATION	FEATURE
0	99.73	blpi
8.24	100.19	
10.73	99.45	
13.91	99.84	
30.18	99.64	
38.4	98.48	
43.79	98.29	
47.03	97.67	
50.97	97.89	
61.43	98.46	
72.11	98.5	
82.6	98.54	
85.65	97.79	
88.09	97.78	
90.21	98.19	
91.13	98.46	
96.04	98.57	
103.4	98.68	
104.92	98.2	
108.04	98.67	
109.16	97.66	
111.78	97.23	
116.09	97.59	
121.57	98.36	
122.76	98.24	
126.53	97.58	
134.61	97.95	
143.67	97.95	
151.32	97.86	
157.99	97.8	
165.32	98.1	
167.77	98.52	eo
170.4	99.28	
175.12	98.86	
175.35	98.12	
177.48	97.85	
180.17	98.63	
185.24	99.53	
189.25	99.18	brpi

SUMMARY DATA

BANKFULL CROSS SECTIONAL AREA	N/A*
BANKFULL WIDTH	N/A*
BANKFULL MEAN DEPTH	N/A*
BANKFULL MAX DEPTH	N/A*
WIDTH–DEPTH RATIO	N/A*
ENTRENCHMENT RATIO	N/A*
CLASSIFICATION	DA5

* See document text for details

NOTES:

1. All cross–sections facing the downstream direction
2. Cross–section stationing represents approximate field locations.
3. Elevations based on relative benchmark; left pin elevation=100.0 ft.

Survey Date	SEPT. 2010
Survey Weather	Sunny
Field Team	Schmid, Geratz
Location	XS2

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REVISIONS

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Client: Ecosystem Enhancement PROGRAM

Project:

McDONALDS POND RESTORATION SITE

EEP Project No. D04020–2

RICHMOND COUNTY, NORTH CAROLINA

Title:

CROSS SECTION XS2–BRAIDED CHANNELS

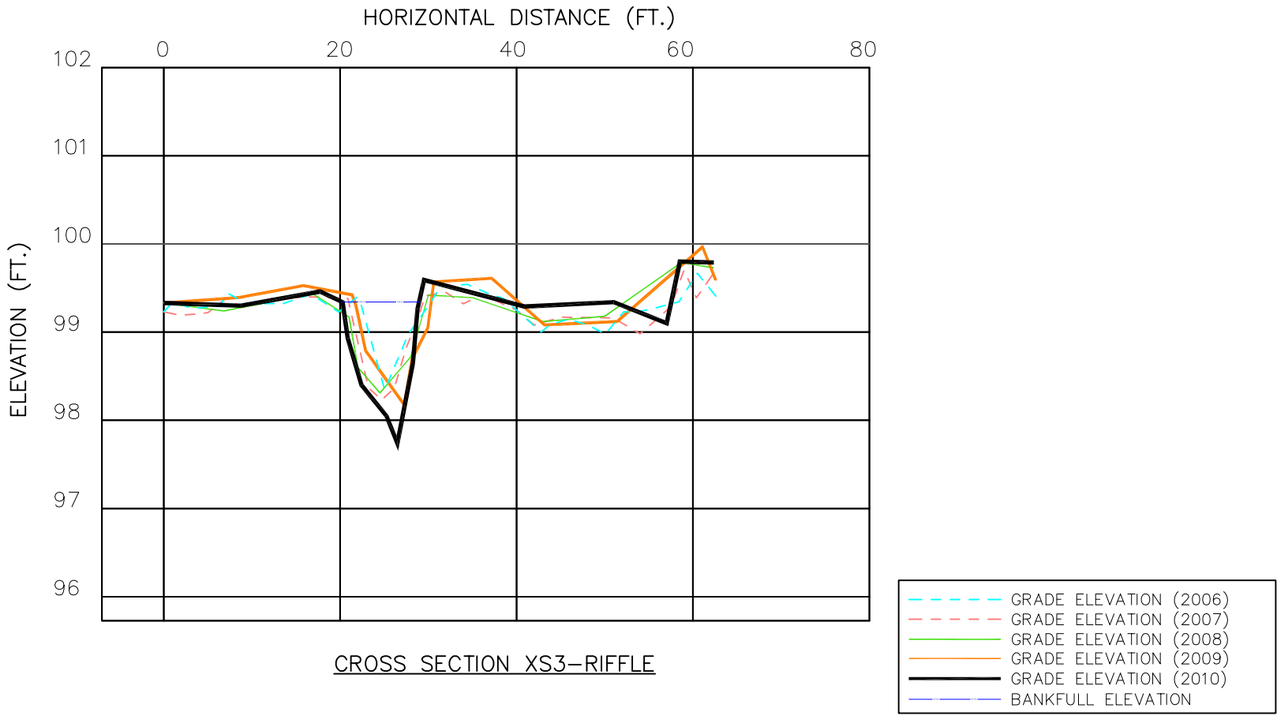
Dsn. By:	Dwn. By:
JWC	RLG
Ckd. By:	Date:
MCG	OCT 2010

Scale: NO SCALE

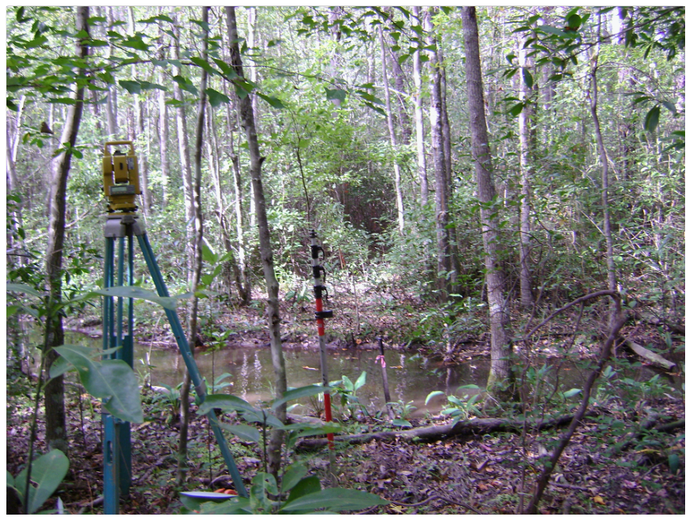
Project No.: 100004932

SHEET

B2



CROSS SECTION XS3–RIFFLE



XS3 LEFT BANK LOOKING RIGHT BANK

XS3 LOOKING DOWNSTREAM

SURVEY DATA

STATION	ELEVATION	FEATURE
0	99.77	blpi
8.76	99.74	
17.73	99.9	
20.27	99.78	
20.85	99.37	
22.43	98.84	
25.25	98.49	
26.49	98.18	
28.24	99.09	
28.77	99.7	eo
29.5	100.03	
40.91	99.73	
51.03	99.78	
57.04	99.54	
58.52	100.24	
62.37	100.23	brpi

SUMMARY DATA

BANKFULL CROSS SECTIONAL AREA	8.3 SQ. FT.
BANKFULL WIDTH	8.7 FT.
BANKFULL MEAN DEPTH	1.0 FT.
BANKFULL MAX DEPTH	1.6 FT.
WIDTH–DEPTH RATIO	8.7
ENTRENCHMENT RATIO	46.0
CLASSIFICATION	C5

NOTES:

1. All cross–sections facing the downstream direction
2. Cross–section stationing represents approximate field locations.
3. Elevations based on relative benchmark; left pin elevation=100.0 ft.

Survey Date	SEPT. 2010
Survey Weather	Sunny
Field Team	Schmid, Geratz
Location	XS3

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RICHMOND COUNTY, NORTH CAROLINA

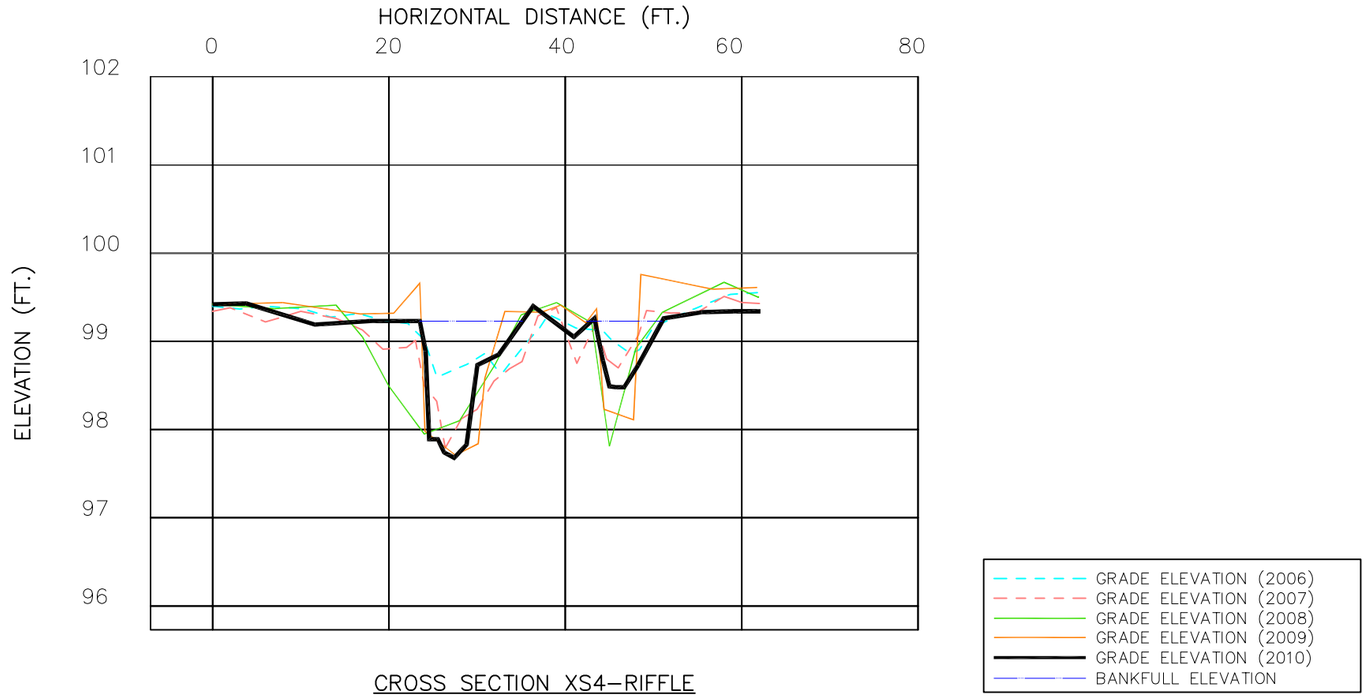
Title:

CROSS SECTION XS3–RIFFLE

Dsn. By: JWC	Dwn. By: RLG
Ckd. By: MCG	Date: OCT 2010
Scale: NO SCALE	
Project No.: 100004932	

SHEET

B3



CROSS SECTION XS4–RIFFLE

XS4 LEFT BANK LOOKING RIGHT BANK

XS4 LOOKING DOWNSTREAM

SURVEY DATA

STATION	ELEVATION	FEATURE
0	90.24	blpin
3.1	90.24	
6.65	90.23	
10.96	90.16	
13.88	89.63	
15.44	89.38	
16.36	89.38	
17.12	89.39	
17.84	89.68	
18.81	90.16	
21.14	89.95	
25.76	90.3	
29.66	89.75	
32.1	89.63	
33.32	88.73	
34.72	88.58	
35.87	88.64	
36.59	88.79	
37.56	88.79	
37.97	89.79	
38.62	90.13	
40.17	90.13	
44.28	90.13	
50.52	90.09	
58.31	90.33	
62.12	90.32	brpin

SUMMARY DATA

BANKFULL CROSS SECTIONAL AREA	12.9 FT.
BANKFULL WIDTH	19.3 FT.
BANKFULL MEAN DEPTH	0.7 FT.
BANKFULL MAX DEPTH	1.6 FT.
WIDTH–DEPTH RATIO	27.6
ENTRENCHMENT RATIO	25.9
CLASSIFICATION	DA5/C5

NOTES:

1. All cross–sections facing the downstream direction
2. Cross–section stationing represents approximate field locations.
3. Elevations based on relative benchmark; left pin elevation=100.0 ft.

Survey Date	SEPT. 2010
Survey Weather	Sunny
Field Team	Schmid, Geratz
Location	XS4

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McDONALDS POND RESTORATION SITE

EEP Project No. D04020–2

RICHMOND COUNTY, NORTH CAROLINA

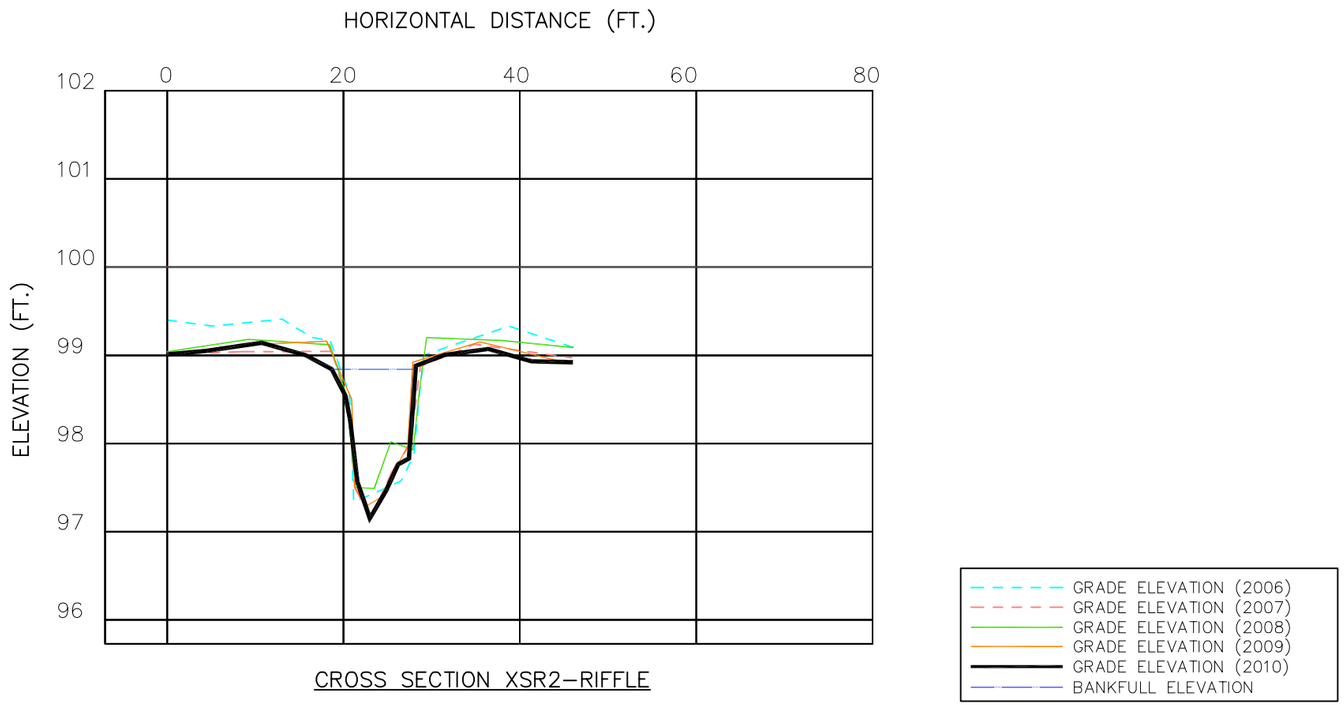
Title:

CROSS SECTION XS4–RIFFLE

Dsn. By: JWC	Dwn. By: RLG
Ckd. By: MCG	Date: OCT 2010
Scale: NO SCALE	
Project No.: 100004932	

SHEET

B4



CROSS SECTION XSR2–RIFFLE

SURVEY DATA

STATION	ELEVATION	FEATURE
0.01	99.72	blpin
4.46	99.76	
10.61	99.85	
15.6	99.71	
18.56	99.55	
20.11	99.25	
20.62	98.99	
21.49	98.27	
22.89	97.86	
24.77	98.18	
26.09	98.47	
27.33	98.54	
28.11	99.59	
31.33	99.71	
36.29	99.78	
41.24	99.64	
45.92	99.63	brpin

SUMMARY DATA

BANKFULL CROSS SECTIONAL AREA	9.5 SQ. FT.
BANKFULL WIDTH	9.5 FT.
BANKFULL MEAN DEPTH	1.0 FT.
BANKFULL MAX DEPTH	1.7 FT.
WIDTH–DEPTH RATIO	9.5
ENTRENCHMENT RATIO	47.4
CLASSIFICATION	E5

XSR2 LEFT BANK LOOKING RIGHT BANK

XSR2 LOOKING DOWNSTREAM

NOTES:

1. All cross–sections facing the downstream direction
2. Cross–section stationing represents approximate field locations.
3. Elevations based on relative benchmark; left pin elevation=100.0 ft.

Survey Date	SEPT. 2010
Survey Weather	Sunny
Field Team	Schmid, Geratz
Location	XSR2

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Project:

McDONALDS POND RESTORATION SITE

EEP Project No. D04020–2

RICHMOND COUNTY, NORTH CAROLINA

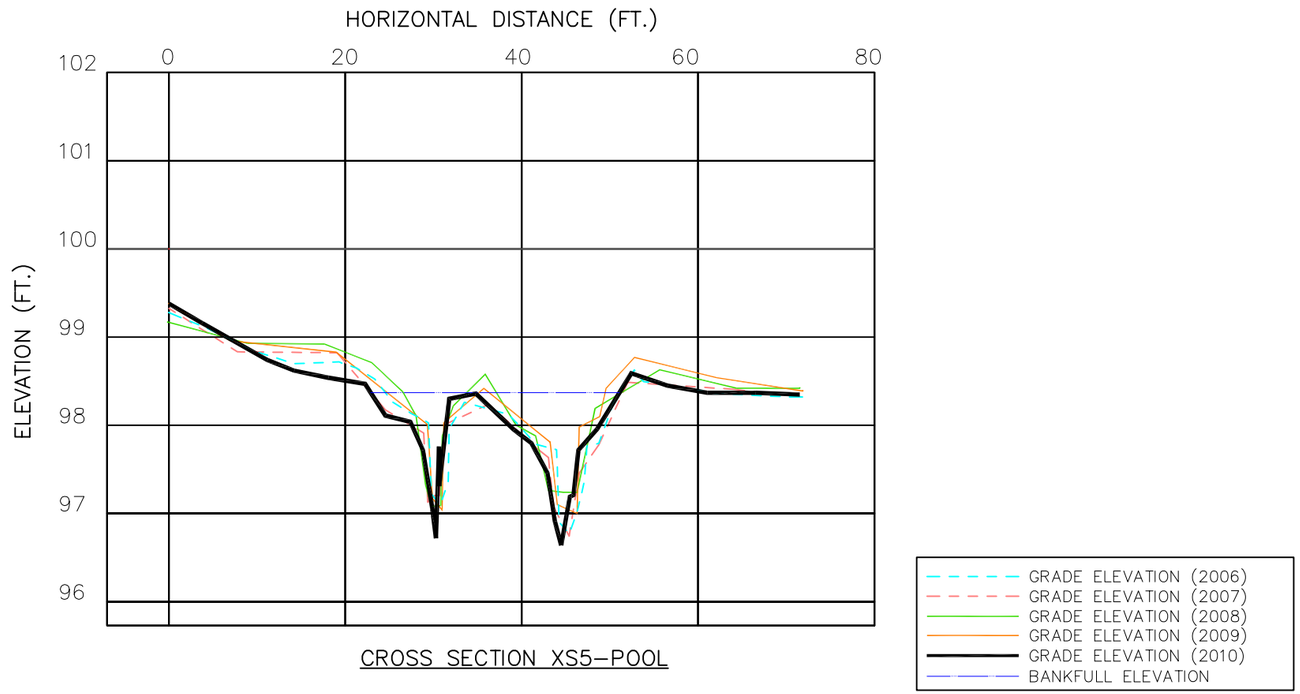
Title:

CROSS SECTION XSR2–RIFFLE

Dsn. By: JWC	Dwn. By: RLG
Ckd. By: MCG	Date: OCT 2010
Scale: NO SCALE	
Project No.: 100004932	

SHEET

B5



CROSS SECTION XS5–POOL

SURVEY DATA

STATION	ELEVATION	FEATURE
0.26	94.19	blpin
4.02	93.97	
11.44	93.55	
14.48	93.43	
18.35	93.35	
22.5	93.28	
24.81	92.92	
27.63	92.85	
29.07	92.53	
30.1	91.89	
30.54	91.53	
30.88	92.57	
30.9	92.12	
32.05	93.11	
35.06	93.17	
39.4	92.76	
41.35	92.61	
43.19	92.27	
44.04	91.72	
44.76	91.45	
45.72	92	
46.13	92.02	
46.7	92.53	
48.84	92.77	
52.7	93.4	
56.83	93.26	
61.32	93.18	
66.82	93.18	
71.8	93.16	brpin

SUMMARY DATA

BANKFULL CROSS SECTIONAL AREA	14.0 SQ. FT.
BANKFULL WIDTH	28.2 FT.
BANKFULL MEAN DEPTH	0.5 FT.
BANKFULL MAX DEPTH	1.7 FT.
WIDTH–DEPTH RATIO	N/A
ENTRENCHMENT RATIO	N/A
CLASSIFICATION	N/A

XS5 LEFT BANK LOOKING RIGHT BANK

XS5 LOOKING DOWNSTREAM

NOTES:

1. All cross–sections facing the downstream direction
2. Cross–section stationing represents approximate field locations.
3. Elevations based on relative benchmark; left pin elevation=100.0 ft.

Survey Date	SEPT. 2010
Survey Weather	Sunny
Field Team	Schmid, Geratz
Location	XS5

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Client: Ecosystem Enhancement PROGRAM

Project:

McDONALDS POND RESTORATION SITE

EEP Project No. D04020–2

RICHMOND COUNTY, NORTH CAROLINA

Title:

CROSS SECTION XS5–POOL

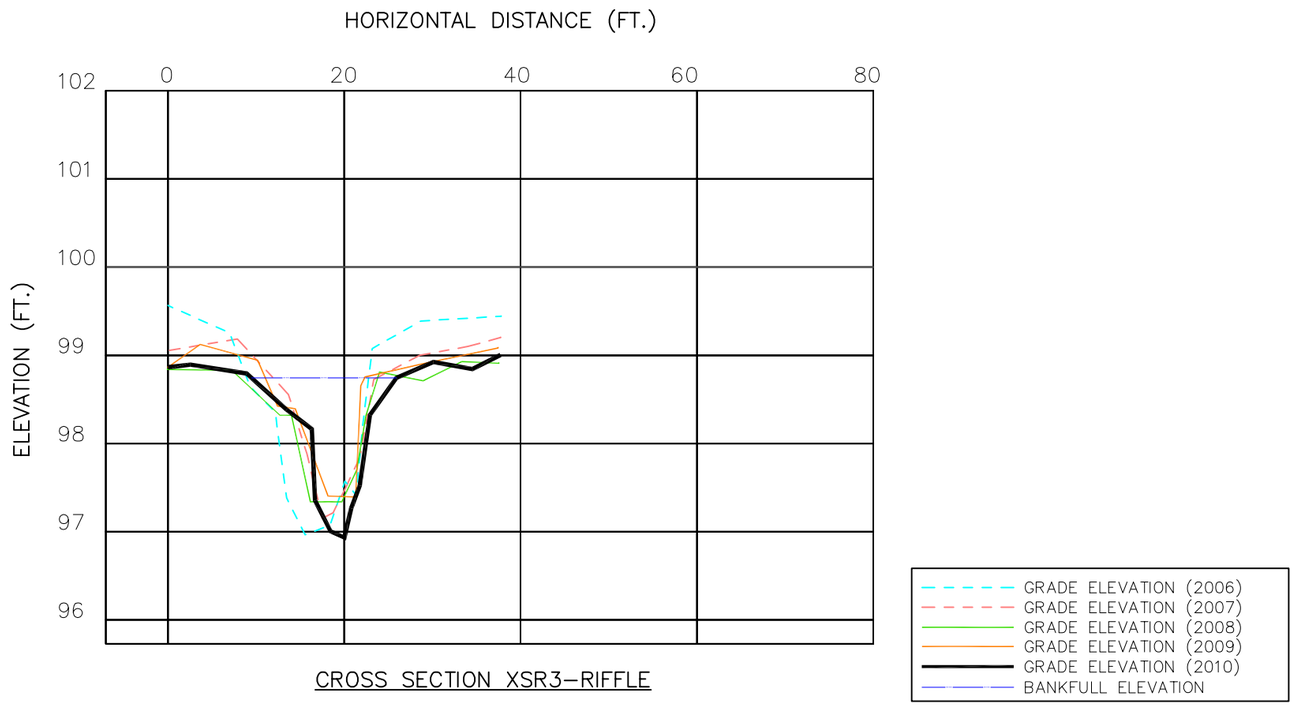
Dsn. By:	Dwn. By:
JWC	RLG
Ckd. By:	Date:
MCG	OCT 2010

Scale: NO SCALE

Project No.: 100004932

SHEET

B6



CROSS SECTION XSR3–RIFFLE

SURVEY DATA

STATION	ELEVATION	FEATURE
0	100.47	blpin
2.55	100.5	
8.93	100.4	
13.46	99.99	
16.32	99.77	
16.68	98.96	
18.45	98.61	
20.01	98.54	
20.78	98.87	
21.75	99.13	
22.92	99.93	
25.91	100.35	
30.12	100.53	
34.53	100.45	
37.73	100.61	brpin

SUMMARY DATA

BANKFULL CROSS SECTIONAL AREA	12.1 SQ. FT.
BANKFULL WIDTH	16.4 FT.
BANKFULL MEAN DEPTH	0.7 FT.
BANKFULL MAX DEPTH	1.8 FT.
WIDTH–DEPTH RATIO	23.4
ENTRENCHMENT RATIO	24.4
CLASSIFICATION	C5

XSR3 LEFT BANK LOOKING RIGHT BANK

XSR3 LOOKING DOWNSTREAM

NOTES:

1. All cross–sections facing the downstream direction
2. Cross–section stationing represents approximate field locations.
3. Elevations based on relative benchmark; left pin elevation=100.0 ft.

Survey Date	SEPT. 2010
Survey Weather	Sunny
Field Team	Schmid, Geratz
Location	XSR3

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REVISIONS

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Client: Ecosystem Enhancement PROGRAM

Project:

McDONALDS POND RESTORATION SITE

EEP Project No. D04020–2

RICHMOND COUNTY, NORTH CAROLINA

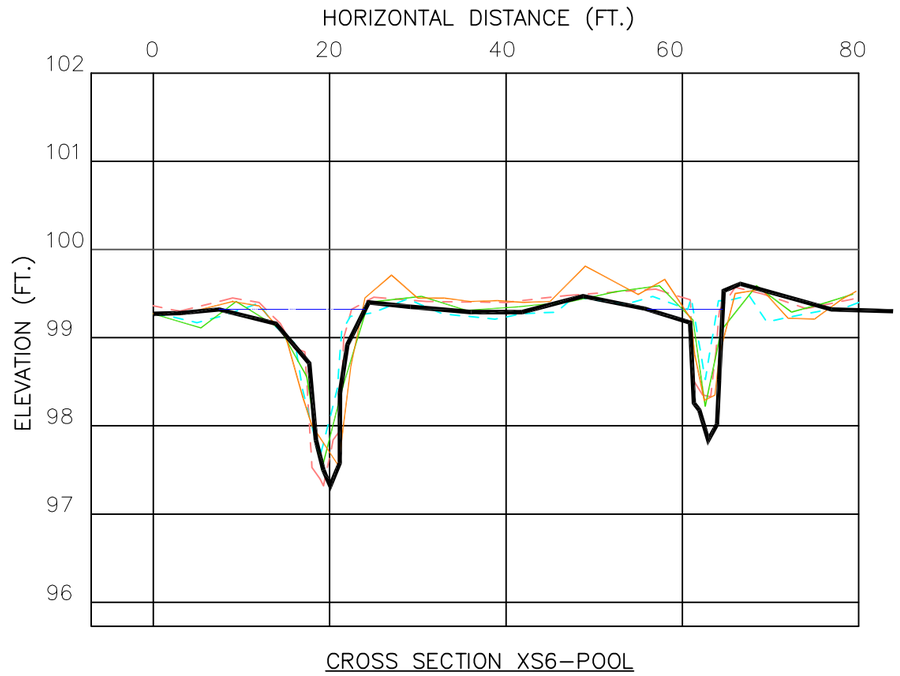
Title:

CROSS SECTION XSR3–RIFFLE

Dsn. By: JWC	Dwn. By: RLG
Ckd. By: MCG	Date: OCT 2010
Scale: NO SCALE	
Project No.: 100004932	

SHEET

B7



CROSS SECTION XS6–POOL

XS6 LEFT BANK LOOKING RIGHT BANK

XS6 LOOKING DOWNSTREAM

SURVEY DATA

STATION	ELEVATION	FEATURE
0	99.32	blpin
3.16	99.33	
7.46	99.37	
13.89	99.21	
17.68	98.76	
18.45	97.89	
19.29	97.55	
20.07	97.37	
21.17	98.42	
21.16	97.63	
22.01	98.97	
24.42	99.45	
29.17	99.4	
36.05	99.34	
41.83	99.34	
48.74	99.52	
55.71	99.38	
60.88	99.22	
61.3	98.31	
61.91	98.23	
62.93	97.89	
63.93	98.07	
64.17	98.57	
64.68	99.58	
66.58	99.66	
76.95	99.37	
83.9	99.35	brpin

SUMMARY DATA

BANKFULL CROSS SECTIONAL AREA	13.1 SQ. FT.
BANKFULL WIDTH	25.1 FT.
BANKFULL MEAN DEPTH	0.5 FT.
BANKFULL MAX DEPTH	2.0 FT.
WIDTH–DEPTH RATIO	N/A
ENTRENCHMENT RATIO	N/A
CLASSIFICATION	N/A

NOTES:

1. All cross–sections facing the downstream direction
2. Cross–section stationing represents approximate field locations.
3. Elevations based on relative benchmark; left pin elevation=100.0 ft.

Survey Date	SEPT. 2010
Survey Weather	Sunny
Field Team	Schmid, Geratz
Location	XS6

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Client: Ecosystem Enhancement PROGRAM

Project:

McDONALDS POND RESTORATION SITE

EEP Project No. D04020–2

RICHMOND COUNTY, NORTH CAROLINA

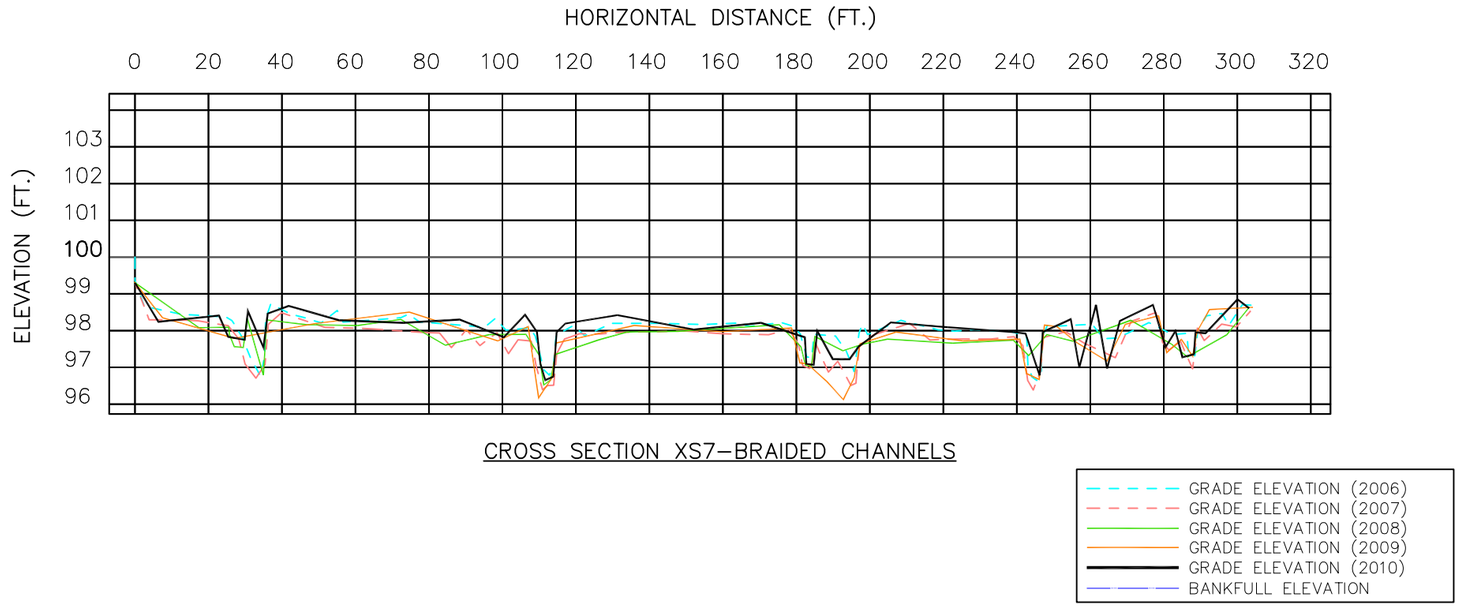
Title:

CROSS SECTION XS6–POOL

Dsn. By: JWC	Dwn. By: RLG
Ckd. By: MCG	Date: OCT 2010
Scale: NO SCALE	
Project No.: 100004932	

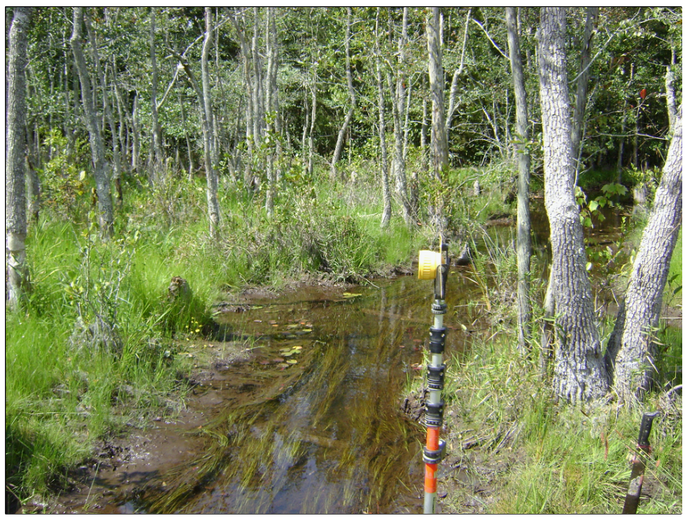
SHEET

B8



CROSS SECTION XS7–BRAIDED CHANNELS

XS7 LEFT BANK LOOKING RIGHT BANK



XS7 LOOKING DOWNSTREAM

SURVEY DATA

STATION	ELEVATION	FEATURE	STATION	ELEVATION	FEATURE
0.25	99.74	blpi	185.02	97.51	
6.63	98.68		185.93	98.43	
23.13	98.85		190.2	97.66	
25.66	98.27		194.79	97.66	
30.13	98.19		197.18	98	
30.99	98.97		205.95	98.66	
35.26	97.98		221.56	98.53	
36.36	98.9		239.27	98.4	
42.08	99.11		242.66	98.36	eo
55.87	98.72		246.48	97.22	
73.42	98.65		247.31	98.4	
88.6	98.74		254.95	98.75	
100.66	98.26		257.27	97.44	
106.44	98.87		261.79	99.14	
109.65	98.41		264.84	97.41	
110.63	97.53		268.33	98.7	
111.95	97.09		277.33	99.14	
114.15	97.19		280.79	97.99	
115.01	98.39		283.42	98.43	
117.35	98.63		285.36	97.71	
131.55	98.86		288.46	97.8	
152.38	98.47		288.86	98.39	
170.59	98.65		291.63	98.37	
182.54	98.26		300.31	99.29	
182.96	97.53		303.51	99.05	brpi

SUMMARY DATA

BANKFULL CROSS SECTIONAL AREA	N/A*
BANKFULL WIDTH	N/A*
BANKFULL MEAN DEPTH	N/A*
BANKFULL MAX DEPTH	N/A*
WIDTH–DEPTH RATIO	N/A*
ENTRENCHMENT RATIO	N/A*
CLASSIFICATION	DA5

* See document text for details

NOTES:

1. All cross–sections facing the downstream direction
2. Cross–section stationing represents approximate field locations.
3. Elevations based on relative benchmark; left pin elevation=100.0 ft.

Survey Date	SEPT. 2010
Survey Weather	Sunny
Field Team	Schmid, Geratz
Location	XS7

PBS&J an Atkins company

REVISIONS

RMS Resource Management Service, LLC

Client: Ecosystem Enhancement PROGRAM

Project:

McDONALDS POND RESTORATION SITE

EEP Project No. D04020–2

RICHMOND COUNTY, NORTH CAROLINA

Title:

CROSS SECTION XS7–BRAIDED CHANNELS

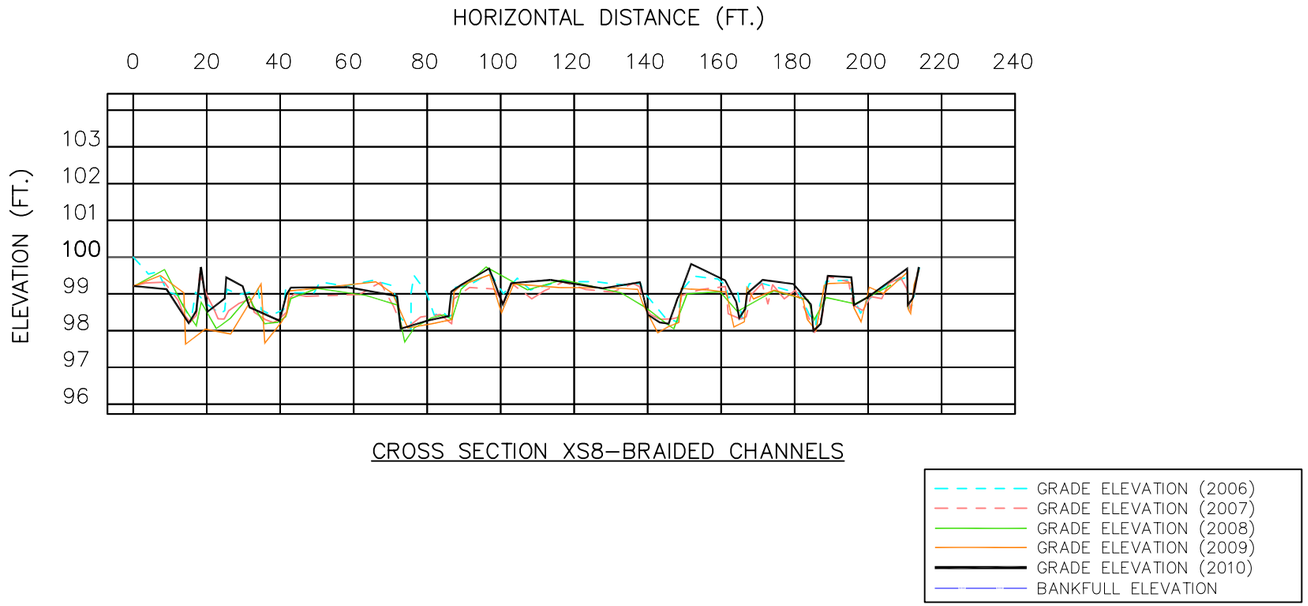
Dsn. By:	Dwn. By:
JWC	RLG
Ckd. By:	Date:
MCG	OCT 2010

Scale: NO SCALE

Project No.: 100004932

SHEET

B9



CROSS SECTION XS8–BRAIDED CHANNELS

XS8 LEFT BANK LOOKING RIGHT BANK

XS8 LOOKING DOWNSTREAM

SURVEY DATA

STATION	ELEVATION	FEATURE	STATION	ELEVATION	FEATURE
0.18	100.17	blpi	137.89	100.28	
9.02	100.09		140.08	99.39	
15.13	99.16		143.33	99.18	
17.17	99.5		145.73	99.15	
18.41	100.69		148.05	99.82	eo
20.2	99.47		149.18	100.04	
24.89	99.84		151.83	100.77	
25.28	100.41		161.08	100.33	
29.77	100.17		164.11	99.75	
31.7	99.59		164.95	99.3	
39.81	99.23		166.55	99.56	
41.67	99.94		167.01	99.97	
42.9	100.13		171.25	100.34	
58.34	100.14		179.65	100.23	
71.76	99.9		184.43	99.67	
72.8	99.01		185.11	98.95	
79.99	99.23		187.08	99.15	
85.88	99.36		189	100.45	
86.53	100.02		195.41	100.41	
88.96	100.19		196.18	99.65	
96.82	100.65		200.27	99.89	
100.6	99.67		210.62	100.65	
102.88	100.25		210.81	99.66	
113.51	100.34		212.21	99.85	
127.74	100.11		213.81	100.69	brpi

SUMMARY DATA

BANKFULL CROSS SECTIONAL AREA	N/A*
BANKFULL WIDTH	N/A*
BANKFULL MEAN DEPTH	N/A*
BANKFULL MAX DEPTH	N/A*
WIDTH–DEPTH RATIO	N/A*
ENTRENCHMENT RATIO	N/A*
CLASSIFICATION	DA5

* See document text for details

NOTES:

1. All cross–sections facing the downstream direction
2. Cross–section stationing represents approximate field locations.
3. Elevations based on relative benchmark; left pin elevation=100.0 ft.

Survey Date	SEPT. 2010
Survey Weather	Sunny
Field Team	Schmid, Geratz
Location	XS8

PBS&J an Atkins company

REVISIONS

RMS Resource Management Service, LLC

Client: Ecosystem Enhancement PROGRAM

Project:

McDONALDS POND RESTORATION SITE

EEP Project No. D04020–2

RICHMOND COUNTY, NORTH CAROLINA

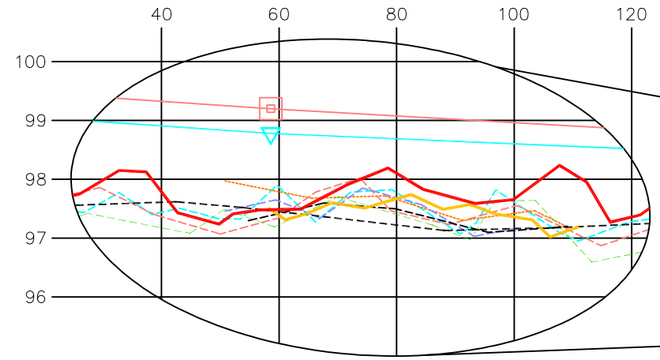
Title:

CROSS SECTION XS8–BRAIDED CHANNELS

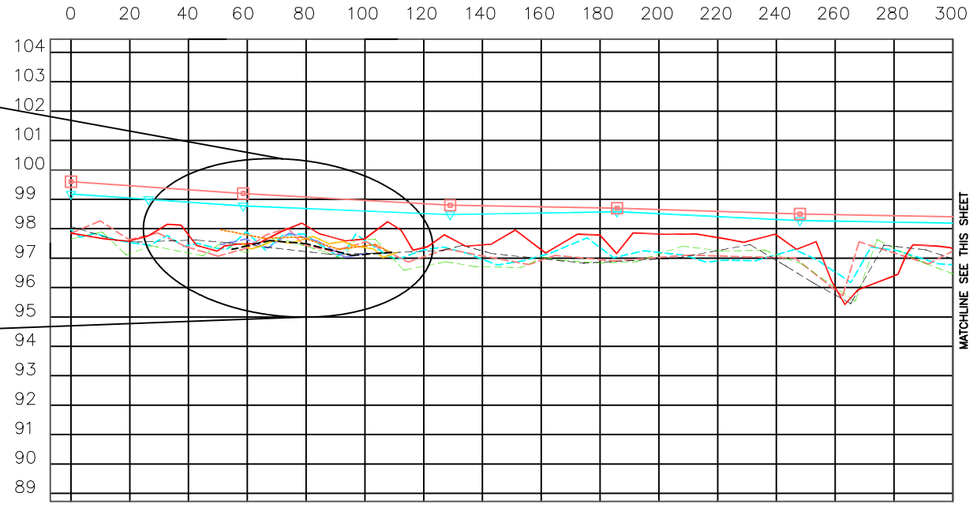
Dsn. By: JWC	Dwn. By: RLG
Ckd. By: MCG	Date: OCT 2010
Scale: NO SCALE	
Project No.: 100004932	

SHEET

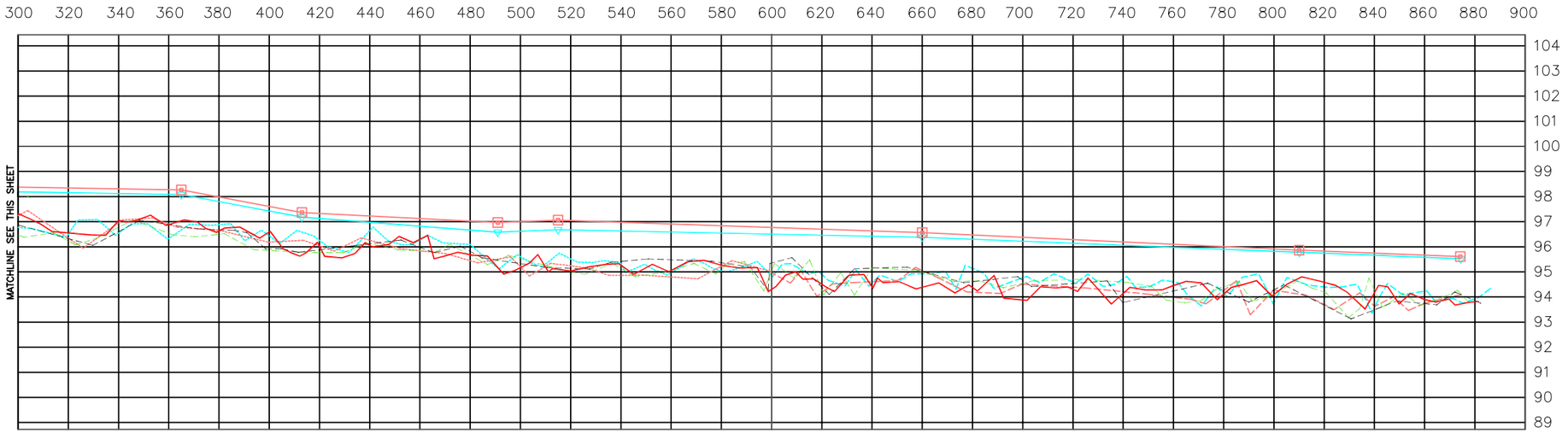
B10



RIGHT BRAID INSET



LONGITUDINAL PROFILE SECTION 1



LONGITUDINAL PROFILE SECTION 2

BANKFULL SLOPE: 0.0046

WATER SURFACE SLOPE: 0.0042

GRADE ELEVATION THALWEG (2006)
GRADE ELEVATION THALWEG (2007)
GRADE ELEVATION THALWEG (2008)
GRADE ELEVATION THALWEG (2009)
GRADE ELEVATION THALWEG (2010)
RIGHT BRAID THALWEG (2007)
RIGHT BRAID THALWEG (2008)
RIGHT BRAID THALWEG (2009)
RIGHT BRAID THALWEG (2010)
WATER SURFACE ELEVATION
BANKFULL

PBS&J
an **Atkins** company

REVISIONS

RMS
Resource Management Service, LLC

Client:
Ecosystem Enhancement PROGRAM

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McDONALDS POND RESTORATION SITE

EEP Project No. D04020-2

RICHMOND COUNTY, NORTH CAROLINA

Title:
LONGITUDINAL PROFILE

Dsn. By:	Dwn. By:
JWC	RLG
Ckd. By:	Date:
MCG	OCT 2010

Scale: NO SCALE

Project No.: 100004932

SHEET
B11

McDonalds Pond Restoration Site: Longitudinal Profile Data (2010)											
Station	TWG	WS	BKF	Station	TWG	WS	BKF	Station	TWG	WS	BKF
0.0	98.0	99.0	99.6	358.1	97.0			620.0	94.5		
11.8	97.8			365.2	97.2	97.9	98.3	623.4	94.4		
19.6	97.7			370.4	97.1			629.3	95.0		
26.2	97.9			373.9	96.9			635.1	95.0		
32.7	98.3			378.2	96.7			638.7	94.5		
37.4	98.3			381.2	96.9			640.4	94.9		
42.7	97.6			387.3	96.9			642.7	94.7		
49.8	97.4			392.7	96.6			649.1	94.8		
52.1	97.6			395.3	96.5			655.8	94.5		
58.6	97.6	98.6	99.2	399.5	96.8			660.0	94.6	96.2	96.6
56.4	97.6			404.7	96.1			664.8	94.7		
63.6	97.6			408.3	95.9			671.3	94.3		
71.4	98.0			411.3	95.8			676.7	94.6		
78.4	98.3			413.0	95.8	97.0	97.4	680.2	94.4		
84.5	98.0			413.7	95.9			686.7	95.0		
93.3	97.7			418.2	96.3			690.5	94.1		
99.8	97.8			421.1	95.8			699.8	94.0		
107.6	98.4			428.0	95.7			705.1	94.6		
112.2	98.1			433.1	95.9			711.3	94.5		
116.2	97.4			437.1	96.3			716.0	94.5		
121.3	97.5			440.0	96.1			719.9	94.4		
126.8	97.9			446.6	96.2			724.0	94.9		
129.0	97.7	98.3	98.8	450.6	96.6			733.2	93.9		
134.1	97.6			456.3	96.3			740.6	94.5		
142.7	97.6			462.0	96.6			747.1	94.4		
150.9	98.1			464.4	95.7			753.6	94.4		
161.2	97.3			469.3	95.8			757.0	94.6		
172.0	98.0			473.7	95.9			762.9	94.8		
179.6	97.9			479.9	95.8			769.0	94.7		
185.4	97.3	98.4	98.7	485.6	95.8			775.3	94.0		
190.9	98.0			491.0	95.4	94.4	97.0	780.9	94.5		
202.0	98.0			492.1	95.1			785.6	94.6		
212.1	98.0			496.7	95.2			790.9	94.8		
221.2	97.8			502.4	95.5			797.1	94.2		
228.5	97.7			505.6	95.8			803.1	94.7		
239.2	98.0			509.8	95.1			810.0	94.8	95.6	95.9
246.5	97.4			511.3	95.3			808.8	95.0		
248.0	97.5	98.1	98.5	515.0	95.1	96.5	97.1	815.3	94.8		
253.1	97.7			518.8	95.2			822.2	94.6		
258.2	96.4			525.8	95.3			826.8	94.3		
262.6	95.6			532.7	95.4			834.1	93.7		
267.0	96.1			537.8	95.5			839.3	94.6		
280.7	96.6			543.8	95.0			843.0	94.6		
283.3	97.2			551.1	95.4			847.4	93.9		
285.6	97.6			557.7	95.2			851.9	94.3		
293.8	97.6			565.2	95.6			857.8	94.0		
298.3	97.5			571.6	95.6			862.2	93.9		
303.2	97.3			579.1	95.4			867.3	94.1		
307.9	97.1			586.1	95.3			869.8	93.8		
312.8	96.8			592.9	95.3			874.8	93.9		
328.7	96.6			597.2	94.4			880.1	93.9		
334.1	96.6			600.3	94.6						
339.2	97.2			603.9	95.0			Units=Feet			
342.6	97.1			607.9	95.2			TWG=Thalweg			
346.1	97.2			610.9	94.9			WS=Water Surface			
351.8	97.4			615.1	94.9			BKF=Bankfull			

APPENDIX C: AQUATIC COMMUNITY DATA

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SPECIES	T.V.	F.F.G.	Reach 1 (Reference)	Reach 2	Reach 3	Reach 4 (Reference)
ANNELIDA						
Oligochaeta		**CG**				
Tubificida						
Naididae	**6.1**	**CG**	2			
Nais sp.	**8.9**	**CG**				2
Pristina leidyi	**9.6**	**CG**	1			
Tubificidae w.o.h.c.	**9.5**	**CG**	1			
Lumbriculida						
Lumbriculidae	**7**	**CG**	1			
ARTHROPODA						
Arachnoidea						
Acariformes					1	
Crustacea						
Cladocera						
Chydoridae					1	
Isopoda						
Asellidae		**SH**				
Caecidotea sp.	**9.1**	**CG**			1	
Decapoda						
Cambaridae	**7.5**		1			1
Insecta						
Ephemeroptera						
Baetidae	**6.1**	**CG**		1	1	
Acerpenna pygmaea	**3.7**			1		
Plauditus sp.	**4.5**	**CG**			1	
Pseudocloeon sp.		**CG**	2	2		
Maccaffertium (Stenonema) sp.	**3.5**	**SC**	7	14	8	9
Paraleptophlebia sp.	**0.9**	**CG**	2	2	3	1
Odonata						
Boyeria vinosa	**6**	**P**	13	6	5	20
Calopteryx sp.	**7.8**	**P**	5	2	18	7
Argia sp.	**8.2**	**P**	7	2		
Cordulegaster sp.	**5.7**	**P**	2			4
Gomphidae	**5**	**P**				
Dromogomphus spinosus	**5.9**	**P**	1	1	4	
Gomphus sp.	**5.8**	**P**	9		2	15
Hagenius brevistylus	**4**	**P**		3		
Progomphus obscurus	**8.2**	**P**	3	1		
Libellulidae	**6.7**	**P**	1			
Macromia sp.	**6.2**	**P**			1	
Macromia illinoensis					1	
Neurocordulia sp.	**5**		2	10	14	3
Neurocordulia virginiensis	**5**					1
Plecoptera						
Leuctridae	**0.2**	**SH**				
Leuctra sp.	**0.7**	**SH**	12	16	26	27

SPECIES	T.V.	F.F.G.	Reach 1 (Reference)	Reach 2	Reach 3	Reach 4 (Reference)
Acroneuria sp.	**1.5**	**P**	7			2
Perlesta sp.	**4.7**	**P**		1		1
Perlinella sp.	**0.6**	**P**	1			
Hemiptera						
Nepidae		**-**				
Ranatra sp.	**7.8**	**P**		1		
Veliidae	**6**	**P**				
Rhagovelia obesa	**6**	**P**	1			1
Megaloptera						
Corydalidae	**6.5**	**P**				
Nigronia serricornis	**5.3**	**P**	6	4	1	2
Sialidae		**P**				
Sialis sp.	**7.2**	**P**				1
Trichoptera						
Hydropsychidae	**4**	**FC**				
Cheumatopsyche sp.	**6.2**	**FC**	2	1		
Diplectrona modesta	**2.2**	**FC**	10	1		23
Hydropsyche sp.	**4.3**	**FC**	6	14	48	1
Hydroptilidae	**4**	**PI**				
Oxyethira sp.	**2.2**	**PI**			1	
Leptoceridae	**2.7**	**CG**				
Oecetis sp.	**4.7**	**P**			4	
Odontoceridae		**SC**				
Psilotreta sp.	**0**	**SC**		3	3	1
Philopotamidae		**FC**				
Chimarra sp.	**2.8**	**FC**	6		1	
Coleoptera						
Elmidae	**6**	**CG**				
Ancyronyx variegata	**6.5**	**SC**	3	5	1	
Promoresia elegans	**2.4**	**SC**	1	1	1	
Stenelmis sp.	**5.1**	**SC**	8		1	
Staphylinidae	**8**	**P**	1			
Diptera						
Chironomidae						
Ablabesmyia mallochi	**7.2**	**P**			1	
Ablabesmyia rhamphe gp.	**7.2**	**P**	1			
Apsectrotanypus johnsoni	**0.1**		2		2	3
Conchapelopia sp.	**4.5**	**P**	8	3	15	4
Corynoneura sp.	**6**	**CG**	2			
Cricotopus bicinctus				1		
Cryptochironomus sp.	**6.4**	**P**			1	
Microtendipes pedellus gp.	**5.5**	**CG**		1	1	
Parachaetocladius sp.	**0**	**CG**				1
Paramerina sp.	**4.3**	**P**	1			
Parametriocnemus sp.	**3.7**	**CG**	8			
Polypedilum flavum (convictum)	**5.7**	**SH**	1	2	6	

Polypedilum illinoense	**5.7**	**SH**			1	
SPECIES	**T.V.**	**F.F.G.**	**Reach 1 (Reference)**	**Reach 2**	**Reach 3**	**Reach 4 (Reference)**
Psectrocladius sp.	**3.6**	**SH**			7	
Rheocricotopus tuberculatus	**7.3**	**CG**			2	
Rheosmittia arcuota	**7**					1
Rheotanytarsus exiguus gp.	**5.9**		1	1	8	
Tanytarsus sp.	**6.8**	**FC**			1	
Thienemanniella sp.	**5.9**		1			
Thienemanniella xena	**5.9**	**CG**				1
Tvetenia paucunca	**3.7**	**CG**			1	1
Simuliidae	**3.5**	**FC**				
Simulium sp.	**4**	**FC**	2		4	
Tipulidae	**4.9**	**SH**				
Hexatoma sp.	**4.3**	**P**	1			
Tipula sp.	**7.3**	**SH**	1			1
TOTAL NO. OF ORGANISMS			**153**	**100**	**199**	**134**
TOTAL NO. OF TAXA			**42**	**27**	**38**	**26**
EPT			**10**	**11**	**10**	**8**
BIOTIC INDEX			**4.54**	**4.03**	**4.51**	**4.07**

APPENDIX D: NCDWQ HABITAT ASSESSMENT FORM - COASTAL PLAIN

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3/06 Revision 7

Habitat Assessment Field Data Sheet
Coastal Plain Streams

TOTAL SCORE_____

Biological Assessment Unit, DWQ
Directions for use: The observer is to survey a **minimum of 100 meters with 200 meters preferred** of stream, preferably in an **upstream** direction starting above the bridge pool and the road right-of-way. The segment which is assessed should represent average stream conditions. To perform a proper habitat evaluation the observer needs to get into the stream. To complete the form, select the description which best fits the observed habitats and then circle the score. If the observed habitat falls in between two descriptions, select an intermediate score. A final habitat score is determined by adding the results from the different metrics.

Stream_____Location/road: _____(Road Name_____)County_____

Date_____**CC#**_____Basin_____Subbasin_____

Observer(s)_____ Type of Study: ☐ Fish ☐Benthos ☐ Basinwide ☐Special Study (Describe) _____

Latitude _____Longitude _____Ecoregion: ☐ CA ☐ SWP ☐ Sandhills ☐ CB

Water Quality: Temperature_____^{0}C DO _____mg/l Conductivity (corr.) _____µS/cm pH _____

Physical Characterization: Visible land use refers to immediate area that you can see from sampling location. Check off what you observe driving thru the watershed in watershed land use.

Visible Land Use: _____%Forest _____%Residential _____%Active Pasture _____% Active Crops
_____%Fallow Fields _____% Commercial _____%Industrial _____%Other - Describe:_____

Watershed land use ☐ Forest ☐ Agriculture ☐Urban ☐ Animal operations upstream

Width: (meters) Stream_____ Channel (at top of bank)_____ **Stream Depth**: (m) Avg_____Max ____
☐ **Width variable** ☐**Braided channel** ☐**Large river >25m wide**
Bank Height (from deepest part of channel to top of bank): (m)_____

Flow conditions : ☐High ☐Normal ☐Low
Channel Flow Status
Useful especially under abnormal or low flow conditions.
A. Water reaches base of both banks, minimal channel substrate exposed ..... ☐
B. Water fills >75% of available channel, or <25% of channel substrate is exposed..... ☐
C. Water fills 25-75% of available channel, many logs/snags exposed..... ☐
D. Root mats out of water..... ☐
E. Very little water in channel, mostly present as standing pools..... ☐

Turbidity: ☐Clear ☐ Slightly Turbid ☐Turbid ☐Tannic ☐Milky ☐Colored (from dyes) ☐Green tinge
Good potential for Wetlands Restoration Project?? ☐ YES ☐ NO
Details_____

☐Channelized ditch
☐Deeply incised-steep, straight banks ☐Both banks undercut at bend ☐Channel filled in with sediment
☐Recent overbank deposits ☐Bar development ☐Sewage smell
☐Excessive periphyton growth ☐Heavy filamentous algae growth

Manmade Stabilization: ☐N ☐Y: ☐Rip-rap, cement, gabions ☐ Sediment/grade-control structure ☐Berm/levee
Weather Conditions:_____**Photos:** ☐N ☐Y ☐Digital ☐35mm

Remarks:_____
TYPICAL STREAM CROSS SECTION DIAGRAM ON BACK

I. Channel Modification

	Score
A. Natural channel-minimal dredging.....	15
B. Some channelization near bridge, or historic (>20 year old), and/or bends beginning to reappear..	10
C. Extensive channelization, straight as far as can see, channelized ditch.....	5
D. Banks shored with hard structure, >80% of reach disrupted, instream habitat gone.....	0

Remarks_____ Subtotal____

II. Instream Habitat: Consider the percentage of the reach that is favorable for benthos colonization or fish cover. If >50% of the reach is snags, and 1 type is present, circle the score of 16. Definition: leafpacks consist of older leaves that are packed together and have begun to decay (not piles of leaves in pool areas). Mark as **R**are, **C**ommon, or **A**bundant.

____Sticks ____Snags/logs ____Undercut banks or root mats ____Macrophytes ____Leafpacks

AMOUNT OF REACH FAVORABLE FOR COLONIZATION OR COVER

	>50% Score	30-50% Score	10-30% Score	<10% Score
4 or 5 types present.....	20	15	10	5
3 types present.....	18	13	8	4
2 types present.....	17	12	7	3
1 type present.....	16	11	6	2
No substrate for benthos colonization and no fish cover.....0				

☐ No woody vegetation in riparian zone Remarks_____ Subtotal_____

III. Bottom Substrate (silt, clay, sand, detritus, gravel) look at entire reach for substrate scoring.

	Score
A. Substrate types mixed	
1. gravel dominant.....	15
2. sand dominant.....	13
3. detritus dominant.....	7
4. silt/clay/muck dominant.....	4
B. Substrate homogeneous	
1. nearly all gravel.....	12
2. nearly all sand	7
3. nearly all detritus.....	4
4. nearly all silt/clay/muck.....	1

Remarks_____Subtotal_____

IV. Pool Variety Pools are areas of deeper than average maximum depths with little or no surface turbulence. Water velocities associated with pools are always slow.

	Score
A. Pools present	
1. Pools Frequent (>30% of 100m length surveyed)	
a. variety of pool sizes.....	10
b. pools about the same size (indicates pools filling in).....	8
2. Pools Infrequent (<30% of the 100m length surveyed)	
a. variety of pool sizes.....	6
b. pools about the same size.....	4
B. Pools absent	
1. Deep water/run habitat present.....	4
2. Deep water/run habitat absent.....	0
	Subtotal_____

Remarks_____ Page Total_____

V. Bank Stability and Vegetation	Score	Score
A. Banks stable or no banks, just flood plain		
1. little or no evidence of erosion or bank failure, little potential for erosion	10	10
B. Erosion areas present		
1. diverse trees, shrubs, grass; plants healthy with good root systems.....	9	9
2. few trees or small trees and shrubs; vegetation appears generally healthy.....	7	7
3. sparse vegetation; plant types and conditions suggest poorer soil binding.....	4	4
4. mostly grasses, few if any trees and shrubs, high erosion and failure potential at high flow	2	2
5. little or no bank vegetation, mass erosion and bank failure evident.....0	0	

Total_____

Remarks_____

VI. Light Penetration (Canopy is defined as tree or vegetative cover directly above the stream's surface. Canopy would block out sunlight when the sun is directly overhead).

	Score
A. Stream with **good** canopy with some breaks for light penetration	10
B. Stream with **full canopy** - breaks for light penetration absent.....	8
C. Stream with **partial** canopy - sunlight and shading are essentially equal.....	7
D. Stream with **minimal** canopy - full sun in all but a few areas.....	2
E. **No canopy** and no shading.....	0

Subtotal____

Remarks_____

VII. Riparian Vegetative Zone Width

Definition: A break in the riparian zone is any area which allows sediment to enter the stream. Breaks refer to the near-stream portion of the riparian zone (banks); places where pollutants can directly enter the stream.

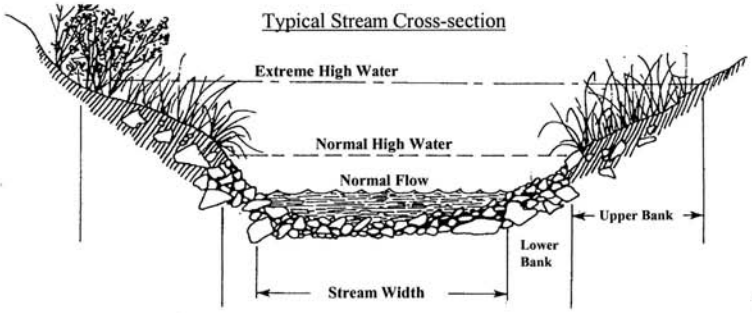
	Lft. Bank Score	Rt. Bank Score
A. Riparian zone **intact** (no breaks)		
1. zone width > 18 meters.....	5	5
2. zone width 12-18 meters.....	4	4
3. zone width 6-12 meters.....	3	3
4. zone width < 6 meters.....	2	2
B. Riparian zone **not intact** (breaks)		
1. breaks rare		
a. zone width > 18 meters.....	4	4
b. zone width 12-18 meters.....	3	3
c. zone width 6-12 meters.....	2	2
d. zone width < 6 meters.....	1	1
2. breaks common		
a. zone width > 18 meters.....	3	3
b. zone width 12-18 meters.....	2	2
c. zone width 6-12 meters.....	1	1
d. zone width < 6 meters.....	0	0

Total_____

Remarks_____

Page Total_____

TOTAL SCORE _____


Typical Stream Cross-section
Extreme High Water
Normal High Water
Normal Flow
Upper Bank
Lower Bank
Stream Width
This side is 45° bank angle.

APPENDIX E: VEGETATION MONITORING PLOT PHOTOS

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Vegetation Plot 2

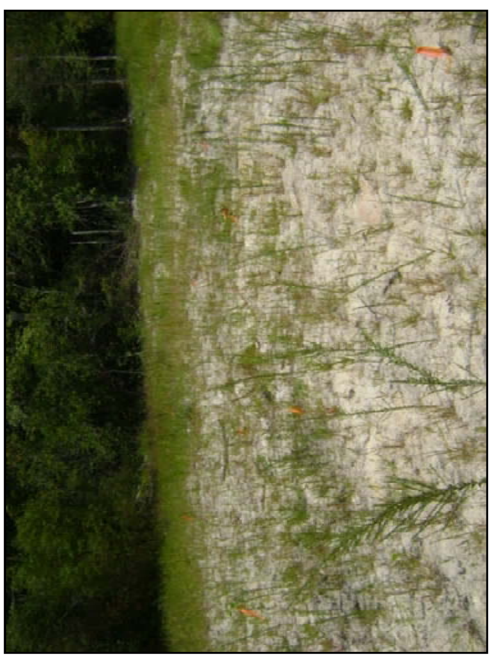
Vegetation Plot 3

Vegetation Plot 4

Vegetation Plot 5

Vegetation Plot 6

Vegetation Plot 7



Vegetation Plot 9

Vegetation Plot 10

McDonalds Pond Restoration Site Vegetation Monitoring Summary Data

2006 - Year 1 Monitoring								
Species	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**	**Plot 6**	**Plot 7**	**Plot 8**
Chamaecyparis thyoides	4	4	3	2	2	7	7	4
Liriodendron tulipifera	2	0	1	0	0	2	0	1
Magnolia virginiana	0	6	3	0	0	1	0	0
Nyssa biflora	4	6	3	6	0	2	6	2
Persea borbonia	0	0	0	0	0	0	1	0
Pinus taeda	1	2	0	3	0	0	0	6
Pinus serotina	3	3	4	1	9	2	3	7
TOTAL	14	21	14	12	11	14	17	20
DENSITY (trees/acre)	**567**	**850**	**567**	**486**	**445**	**567**	**688**	**809**
2007 - Year 2 Monitoring								
Species	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**	**Plot 6**	**Plot 7**	**Plot 8**
Chamaecyparis thyoides	4	4	2	2	2	7	7	3
Liriodendron tulipifera	0	0	1	0	0	2	0	0
Magnolia virginiana	0	6	3	0	0	1	1	0
Nyssa biflora	4	5	3	6	0	2	6	2
Persea borbonia	0	0	0	0	0	0	1	0
Pinus taeda	1	2	0	3	0	0	0	6
Pinus serotina	4	3	4	1	8	2	3	5
TOTAL	13	20	13	12	10	14	18	16
DENSITY (trees/acre)	**526**	**809**	**526**	**486**	**405**	**567**	**728**	**647**
2008 - Year 3 Monitoring								
Species	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**	**Plot 6**	**Plot 7**	**Plot 8**
Chamaecyparis thyoides	3	5	3	2	2	6	7	2
Liriodendron tulipifera	0	0	1	0	0	0	0	0
Magnolia virginiana	0	1	3	0	0	1	0	0
Nyssa biflora	4	7	4	6	0	2	5	2
Persea borbonia	0	0	0	0	0	0	0	0
Pinus taeda	1	0	0	0	1	0	0	2
Pinus serotina	6	3	3	7	7	5	1	4
TOTAL	14	16	14	15	10	14	13	10
DENSITY (trees/acre)	**567**	**647**	**567**	**607**	**405**	**567**	**526**	**405**
2009 - Year 4 Monitoring								
Species	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**	**Plot 6**	**Plot 7**	**Plot 9***	**Plot 10***
Chamaecyparis thyoides	4	3	2	2	6	6	3	3
Liriodendron tulipifera	0	1	0	0	0	0	3	0
Magnolia virginiana	1	3	0	0	1	0	3	3
Nyssa biflora	4	3	6	0	2	5	7	11
Persea borbonia	0	0	0	0	0	0	0	0
Pinus taeda	0	0	0	1	0	0	0	0
Pinus serotina	3	3	7	7	5	1	0	0
TOTAL	12	13	15	10	14	12	16	17
DENSITY (trees/acre)	**486**	**526**	**607**	**405**	**567**	**486**	**647**	**688**
2010 - Year 5 Monitoring								
Species	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**	**Plot 6**	**Plot 7**	**Plot 9***	**Plot 10***
Chamaecyparis thyoides	2	3	2	2	6	5	2	3
Liriodendron tulipifera	0	1	0	0	0	0	3	0
Magnolia virginiana	1	3	0	0	0	0	3	3
Nyssa biflora	4	3	6	0	2	5	7	10
Persea borbonia	0	0	0	0	0	0	0	0
Pinus taeda	0	0	0	0	0	0	0	0
Pinus serotina	1	3	6	6	4	1	0	0
TOTAL	8	13	14	8	12	11	15	16
DENSITY (trees/acre)	**324**	**526**	**567**	**324**	**486**	**445**	**607**	**647**

*Plots 1 and 8 were replaced with new plots 9 and 10 following remedial work at the Site

APPENDIX F: GROUNDWATER GAUGE HYDROGRAPH

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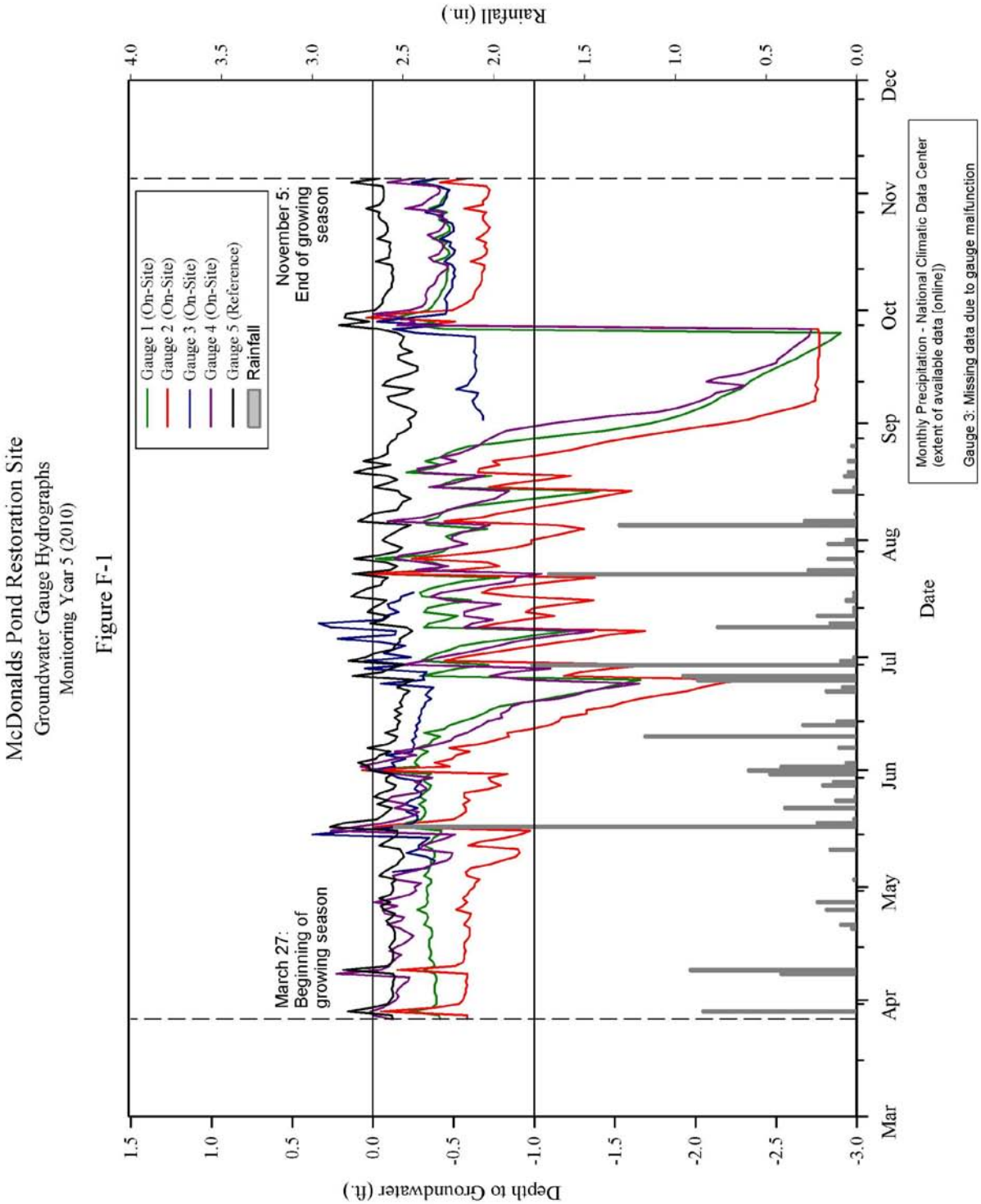
McDonalds Pond Restoration Site
Groundwater Gauge Hydrographs
Monitoring Year 5 (2010)
Figure F-1
Gauge 1 (On-Site)
Gauge 2 (On-Site)
Gauge 3 (On-Site)
Gauge 4 (On-Site)
Gauge 5 (Reference)
Rainfall
March 27: Beginning of growing season
November 5: End of growing season
Depth to Groundwater (ft.)
Rainfall (in.)
Date
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Monthly Precipitation - National Climatic Data Center (extent of available data [online])
Gauge 3: Missing data due to gauge malfunction