MCDONALDS POND RESTORATION SITE
2009 Annual Monitoring Report (Year 4)

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

March 2010

Prepared for: **NCDENR – ECOSYSTEM ENHANCEMENT PROGRAM**
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2009 Annual Monitoring Report (Year 4)

RICHMOND COUNTY, NORTH CAROLINA

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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 both upstream and downstream of the dam. 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 lower the elevation of the former Dam. Once grading activities were complete, an approximate 2-acre area was replanted.

Monitoring Plan

Monitoring activities began in March 2006 (Year 1), and will be performed for at least five-years or until success criteria are achieved. Post removal monitoring data will be compared 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 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 monitoring activities completed during (2009) Year 4 monitoring.

Year 4 Monitoring Results (2009)

Stream Assessment

Restored and enhanced segments of Falling Creek contain braided, anastomosed, bifurcated, and single-threaded channels characteristic of the area. Restored and enhanced stream segments across the Site have

further developed stream pattern, profile, and dimension similar to that of reference reaches. Cross-sections located within the former pond indicate that deposited pond sediment continues to be transported downstream, as evidenced by increased bankfull areas. In addition, stream banks have further stabilized with native planted vegetation.

Aquatic community assemblages within the former pond have maintained characteristics of a natural lotic system. Forty-nine percent (49%) of the macroinvertebrate samples taken in October 2009 (Year 4) 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 seven percent (7%) of species collected within the former pond from the Year 4 samples.

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 indicate that the restored and enhanced stream segments contain in-stream habitat characteristic of reference reaches.

Wetland Vegetation Assessment
Vegetation monitoring for Year 4 was performed based on the Carolina Vegetation Survey (CVS) Levels 1 and 2 at eight (8) 10 x 10 meter plots. Following the remedial grading and supplemental planting activities performed at the site of the former dam, two new vegetation monitoring plots were established. Based on Year 4 monitoring, the average count of surviving planted species is 552 stems per acre. If volunteer species are included, the total survival increases to 2,526 stems per acre. The Site exceeds the established success criteria of 320 stems/acre and is on track to exceed the success criteria of 260 stems/acre after the fifth and final year.

Wetland Hydrology Assessment
Three of the four groundwater gauges (Gauges 1, 2, and 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. Due to the malfunction of Gauge 3, the frequency for which groundwater was within 12 inches cannot be determined. PBS&J installed new gauges on-Site in advance of the final year of monitoring. Based on previous and current year gauge data, as well as visual observations of inundation, wetland hydrology at the Site is meeting the required success criteria.

Summary
Following the third year of monitoring, restored streams within the former pond have continued to develop 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. Stable single-threaded (E-channel) and braided (DA-channel) streams have developed at the Site. 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 Year 4 monitoring.

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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 of 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

*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

Table 3. Project Contacts (*Cont.*)	
Nursery Stock Suppliers	
International Paper	5594 Highway 38 South Blenheim, SC 29516 (843) 528-3203
North Carolina Division of Forest Resources	726 Claridge Nursery Road Goldsboro, NC 27530 (919) 731-7988
ArborGen	P.O. Box 840001 Summerville, SC 29484 (843) 851-4129
Monitoring Performers	
PBS&J	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 4 (2009) 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 2009 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 2009 [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. Stream pattern parameters including channel beltwidth, radius of curvature, meander wavelength, and meander width ratio were not generated from this year's survey data, but will be 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 were largely unchanged compared to conditions assessed during Year 3 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 Year 1 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.

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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						Cross-Section XS2						Cross-Section XS3					
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			NA*	NA*	NA*	NA*			8.4	8.8	8.3	8.7		
Floodprone Width (ft)	400.0	400.0	400.0	400.0			NA*	NA*	NA*	NA*			400.0	400.0	400.0	400.0		
BF Cross Sectional Area (ft^2)	4.9	4.9	5.3	6.4			NA*	NA*	NA*	NA*			4.2	6.3	4.7	6.0		
BF Mean Depth (ft)	0.4	0.4	0.6	0.6			NA*	NA*	NA*	NA*			0.5	0.7	0.6	0.7		
BF Max Depth (ft)	0.8	0.8	0.8	0.9			NA*	NA*	NA*	NA*			1.0	1.2	0.9	1.2		
Width/Depth Ratio	28.9	28.8	17.3	18.2			NA*	NA*	NA*	NA*			16.7	12.4	14.8	12.4		
Entrenchment Ratio	33.8	33.9	42.0	36.7			NA*	NA*	NA*	NA*			47.9	45.4	48.3	45.9		
Wetted Perimeter (ft)	12.1	11.1	9.8	9.8			NA*	NA*	NA*	NA*			9.3	8.7	8.6	8.6		
Hydraulic Radius (ft)	0.4	0.4	0.5	0.6			NA*	NA*	NA*	NA*			0.4	0.7	0.5	0.7		
Substrate																		
d50 (mm)	NA*	NA*	NA*				NA*	NA*	NA*	NA*			NA*	NA*	NA*	NA*		
d84 (mm)	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)			MY+ (2011)		
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*						
Radius of Curvature (ft)	4.1	24.3	13.4	NA*	NA*	NA*	5.6	29.2	21.0	NA*	NA*	NA*						
Meander Wavelength	19.1	59.9	38.0	NA*	NA*	NA*	18.4	70.4	49.0	NA*	NA*	NA*						
Meader Width Ratio	1.5	2.2	1.9	NA*	NA*	NA*	0.8	2.5	1.52	NA*	NA*	NA*						
Profile																		
Riffle Length (ft)	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*						
Pool Length (ft)	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*						
Additional Reach Parameters																		
Valley Length (ft)	N/A			N/A			N/A			N/A								
Channel Length (ft)	N/A			N/A			N/A			N/A								
Sinuosity	1.1			1.1			1.1			1.1								
Water Surface Slope (ft/ft)	0.004			0.004			0.004			0.004								
BF Slope (ft/ft)	0.004			0.004			0.004			0.004								
Rosgen Classification	DA5/E5			DA5/E5			DA5/E5			DA5/E5								
Habitat Index	NA*			NA*			NA*			NA*								
Macrobenthos	NA*			NA*			NA*			NA*								

*See document text for details.

Table 6a. Morphology and Hydraulic Monitoring Summary (*Cont.*)																		
Parameter	Cross-Section XS4						Cross-Section XSR2						Cross-Section XS5					
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			7.9	8.9	10.8	8.8			6.4	19.2	23.47	25.4		
Floodprone Width (ft)	500.0	500.0	500.0	500.0			450.0	450.0	450.0	450.0			400.0	400.0	400.0	400.0		
BF Cross Sectional Area (ft^2)	6.7	14.0	24.3	25.8			7.6	8.7	11.4	9.3			3.9	6.9	12.6	16.7		
BF Mean Depth (ft)	0.3	0.5	0.7	1.0			1.0	1.0	1.0	1.1			0.6	0.4	0.5	0.7		
BF Max Depth (ft)	0.9	1.9	1.6	1.9			1.3	1.6	1.6	1.6			1.9	2.2	1.3	2.0		
Width/Depth Ratio	96.7	64.8	57.3	25.0			8.2	9.1	10.5	8.0			10.6	53.3	43.5	38.8		
Entrenchment Ratio	19.9	16.8	13.4	20.0			57.0	50.6	41.4	51.1			62.9	20.9	21.3	15.7		
Wetted Perimeter (ft)	25.2	30.4	26.8	25.2			9.4	10.3	9.0	9.4			8.6	21.0	9.6	8.6		
Hydraulic Radius (ft)	0.3	0.5	0.9	1.0			0.8	0.9	1.3	1.0			0.5	0.3	1.3	1.9		
Substrate																		
d50 (mm)	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*		

Parameter	Cross-Section XSR3						Cross-Section XS6						Cross-Section XS7					
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			13.9	21.7	23.7	22.1			NA*	NA*	NA*	NA*		
Floodprone Width (ft)	400.0	400.0	400.0	400.0			350.0	350.0	350.0	350.0			NA*	NA*	NA*	NA*		
BF Cross Sectional Area (ft^2)	10.8	11.4	12.7	8.8			8.1	13.1	12.7	15.4			NA*	NA*	NA*	NA*		
BF Mean Depth (ft)	1.0	0.7	0.8	0.8			0.6	0.6	0.5	0.7			NA*	NA*	NA*	NA*		
BF Max Depth (ft)	1.5	1.8	1.5	1.4			2.5	3.3	1.9	1.9			NA*	NA*	NA*	NA*		
Width/Depth Ratio	11.7	22.9	20.7	14.1			24.0	36.2	44.7	31.6			NA*	NA*	NA*	NA*		
Entrenchment Ratio	35.5	24.9	24.21	35.4			25.1	16.1	21.1	15.8			NA*	NA*	NA*	NA*		
Wetted Perimeter (ft)	12.4	16.7	8.9	12.4			15.0	24.8	16.3	15.0			NA*	NA*	NA*	NA*		
Hydraulic Radius (ft)	0.9	0.7	1.4	0.7			0.5	0.5	0.8	1.0			NA*	NA*	NA*	NA*		
Substrate																		
d50 (mm)	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*		

*See document text for details.

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

*See document text for details.

2.1.2 Stream Problem Areas

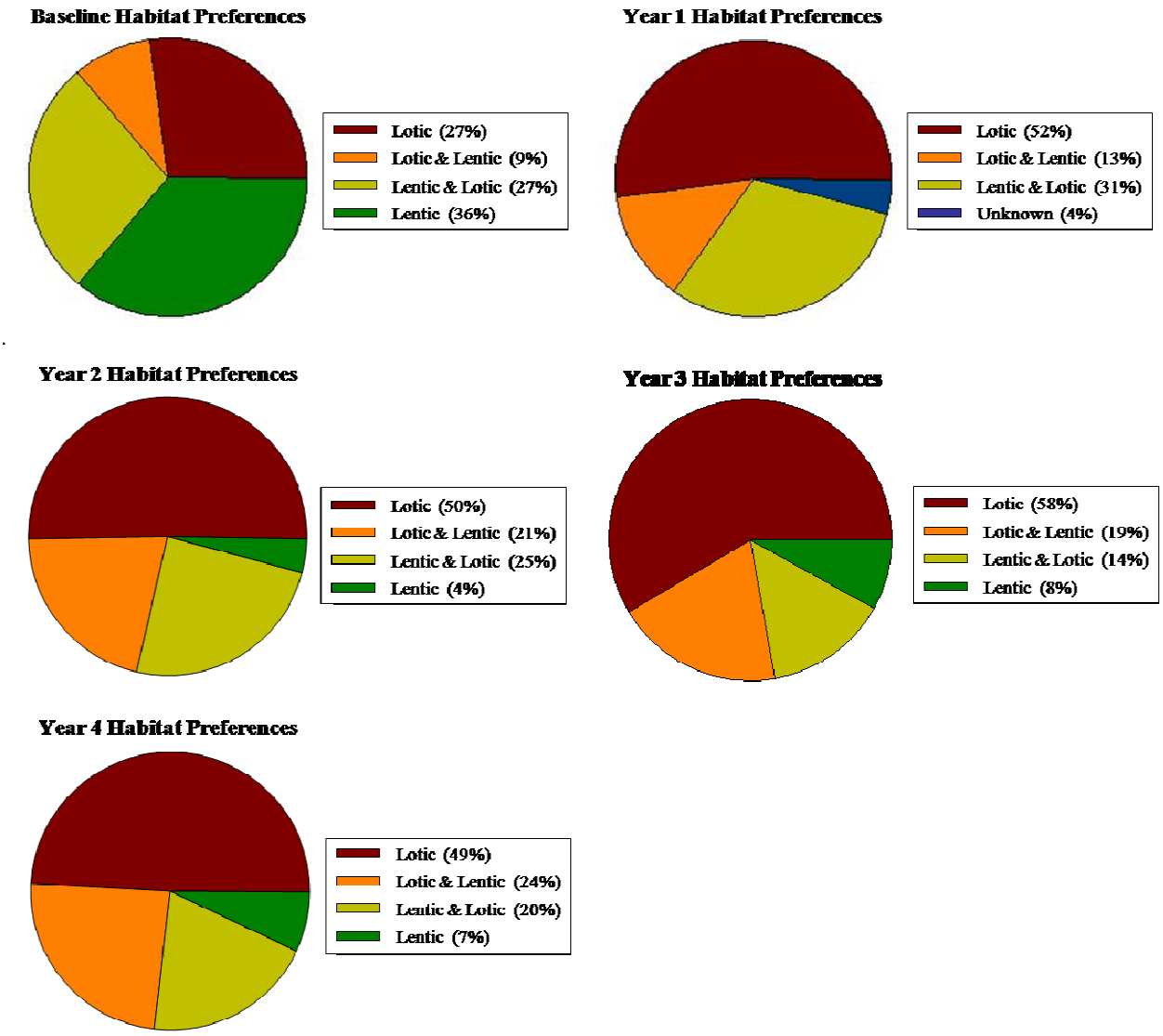
During Year 4 monitoring, PBS&J initiated beaver management and minor grading activities on the former Dam location in September 2009. Beaver management was performed by the USDA Wildlife Service within the beaver impoundment established at the former dam footprint. Grading was then performed in order to remove all components of the existing beaver dam. Minor grading was also targeted at lowering the elevation of the former Dam in areas where the residual footprint was above adjacent floodplain elevations. Grading will reduce opportunities for beavers to re-construct dams during the remaining project monitoring. Once grading activities were complete, an approximate 2-acre area (including 1.5 acres of inundation from beaver activity) was replanted according to reference plant communities at agency required stocking levels (Jan 2010). Subsequent beaver management was also performed in the upstream reference reaches after PBS&J staff observed beaver dam construction during stream channel cross-sectional surveys. Additional beaver management will be implemented as necessary in the final year of monitoring. A remedial grading as-built letter of completion is provided in Appendix G.

2.1.3 Aquatic Communities

Benthic macroinvertebrates were sampled within Falling Creek during Year 4 monitoring in late September 2009. 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.

Forty-nine percent (49%) of the macroinvertebrate samples collected during Year 4 monitoring from restored segments of Falling Creek (within the former pond) consisted of macroinvertebrate genera predominantly found in lotic systems. This is a decrease since Year 3 monitoring; however, macroinvertebrate genera favoring lotic systems have increased 22 percent compared to baseline samples collected prior to dam removal. Genera found in both lotic and lentic systems (with a preference for lotic) increased five percent within Falling Creek, while genera favoring lentic and lotic (with a preference for lentic) also increased. Genera predominantly found in lentic systems made up only seven percent of taxa collected from 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
*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.				

As seen in Table 7, comparative metrics from Year 4 monitoring have greatly improved from Year 3 and have returned to values closer to those of 2006-2007. Exceptional drought conditions ([D4] highest ranking drought classification) within the Falling Creek watershed throughout the Year 3 monitoring season likely contributed to degraded benthic macroinvertebrate collections. Data obtained from the North Carolina Drought Management Advisory Council indicates that drought conditions in Richmond County did not exceed the Moderate classification (D1) during the 2009 growing season. This improvement in drought conditions during Year 4 monitoring is a likely cause of the resulting increases in the total number of organisms, total taxa, and overall species diversity (richness). The slight increase in biotic index values (following a decrease in 2006 and 2007 indicative of improved water quality) shows that some variability between years may be present.

Data from 2006 monitoring suggests that there may have been an initial colonization spike of opportunistic species during the early successional stages of stream development. While values from 2006 (total organisms and EPT richness) have not been surpassed in subsequent monitoring years, the data indicates a substantial increase from baseline (2005) values for all comparative metrics. As the restored stream continues shifting towards reference reach conditions, it is expected that macroinvertebrate communities will further migrate more towards assemblages typical of the region.

2.1.4 Habitat Assessment

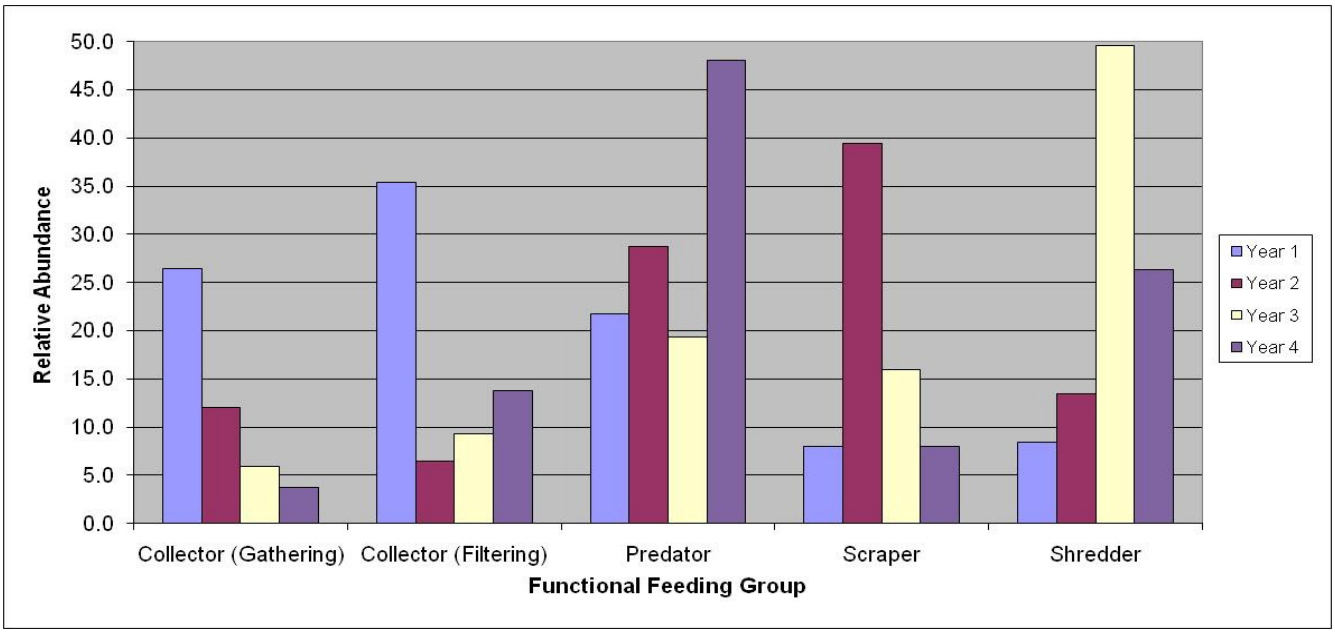
North Carolina Division of Water Quality (NCDWQ) Habitat Assessment Forms (HAFs) were completed at each cross-section location across the Site (Appendix D). Several HAF scores increased during Year 3 monitoring demonstrating an increased availability and quality of aquatic habitat at those locations. This improvement is largely due to the favorable prevalence of in stream habitat including sticks, snags, logs, leafpacks, and macrophytic vegetation. Limitations to habitat scores result from the lack of canopy trees within the former pond that would otherwise provide stream shading and allochthonous input for in-stream habitat. The HAF scores are summarized in Table 8.

Table 8. NCDWQ Habitat Assessment Form Scores						
Cross-section	Score					
	MY1	MY2	MY3	MY4	MY5	MY+
XSR1 (Reference)	98	98	96	98		
XSR4 (Reference)	97	97	96	95		
XS1	78	95	91	93		
XS2	80	80	82	89		
XS3	84	98	93	93		
XS4	63	66	75	83		
XSR2	88	93	88	88		
XS5	69	80	83	83		
XSR3	85	90	88	87		
XS6	65	71	74	77		
XS7	74	76	82	77		
XS8	86	90	91	90		

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 4 stream habitat composition. Compared to previous monitoring years, Reaches 2 and 3 show both an increase in habitat quantity, and habitat type. The abundance of macrophytic vegetation within Reaches 2 and 3 compared to the reference reaches (1 and 4) is likely due to the lack of canopy trees and resulting sunlight within the former pond. The macrophytic vegetation is expected to diminish as the riparian community continues developing, and shading increases.

During Year 4 benthic macroinvertebrate monitoring, a decrease in the number of collector/gatherers, scrapers and shredders was observed. Year 4 monitoring also indicates a substantial increase in the number of predators. This trend may suggest that predator populations have increased as a result of an increased food source (shredders) during Year 3 monitoring. The shredder population increase during Year 3 monitoring may be directly linked to drought conditions that led to an increased abundance of organic matter within the stream channel (due to reduced flow and transport). The link between shredders and predators is supported by the fact that both feeding groups share the same aquatic habits of sprawling and borrowing. Year 4 monitoring indicates a continued progression towards a stable aquatic community with a continued shift from early successional composition. 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 were sampled in accordance with the Carolina Vegetation Survey Protocol (Figure 4, Appendix A). Six of the vegetation plots (VP 2-7) were sampled in the same locations as previous years. Vegetation plots 1 and 8 were relocated this year following the remedial grading activities (new plots VP 9-10). As discussed with EEP, if vegetation success of remedial planted stems is on target at the end of Year 5, then no additional vegetative monitoring will be required. Planted stems (woody) were marked with flagging and the species, height, diameter, vigor and coordinate location within each plot was recorded. Volunteer species where noted and placed into height classes.

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 290 stems per acre for Year 4, and 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 552 trees per acre. Some large volunteer species may have been included in the planted species inventory, for instances in which the yearly monitoring species totals exceed the initial totals. Including all volunteer species raises the vegetation survival within the Site to 2,526 trees per acre.

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. A tally of volunteer woody species is listed in Table 9b. Year 3 photographs are provided in Appendix E.

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Table 9. Stem Counts for Planted Species Arranged by Plot											
Species	**Plots***						**Initial Totals**	**Year 1 Totals**	**Year 2 Totals**	**Year 3 Totals**	**Year 4 Totals****
	2	**3**	**4**	**5**	**6**	**7**					
Trees											
Chamaecyparis thyoides	4	3	2	2	6	6	32	31	31	30	23
Liriodendron tulipifera	0	1	0	0	0	0	6	6	3	1	1
Magnolia virginiana	1	3	0	0	1	0	10	10	11	5	5
Nyssa biflora	4	3	6	0	2	5	29	29	28	30	20
Persea borbonia	0	0	0	0	0	0	1	1	1	0	0
Pinus serotina	3	3	7	7	5	1	32	32	30	36	26
Pinus taeda	0	0	0	1	0	0	12	12	12	4	1

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

**Totals lower due to loss of Plots 1 and 8.

Table 9a. Stem Counts for Planted Species at New Plots			
Species	**Plots**		**2009 Totals**
	9	**10**	
Trees			
Chamaecyparis thyoides	3	3	6
Liriodendron tulipifera	3	0	3
Magnolia virginiana	3	3	6
Nyssa biflora	7	11	18

Table 9b. Stem Counts for Volunteer Species Arranged by Plot												
Species	**Plots**								**Year 1 Totals**	**Year 2 Totals**	**Year 3 Totals**	**Year 4 Totals****
	2	**3**	**4**	**5**	**6**	**7**	**9***	**10***				
Trees												
Acer rubrum	5	4	11	0	0	4			12	16	25	24
Betula nigra	0	0	0	0	0	0			0	5	0	0
Chamaecyparis thyoides	0	0	2	0	3	2			0	4	13	7
Cyrilla racemifllora	0	3	0	0	2	0			1	0	4	5
Liquidambar stryaciflua	1	1	0	0	0	0			0	1	1	2
Liriodendron tulipifera	0	0	0	0	4	0			14	7	5	4
Magnolia virginiana	6	0	0	0	0	0			2	1	8	6
Nyssa biflora	0	0	0	0	1	0			0	1	0	1
Pinus serotina	45	89	9	62	122	12			105	168	532	339
Pinus taeda	0	0	0	0	0	0			0	29	6	0
Salix nigra	1	0	0	0	0	1			7	1	1	2
Shrubs												
Clethra alnifolia	0	0	0	0	0	0			1	1	0	0
Baccharis halimifolia	0	0	0	0	0	0			1	0	1	0
Kalmia angustifolia	0	0	0	0	0	0			1	0	0	0
Vaccinium corymbosum	0	0	0	0	0	0			0	2	0	0

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

**Totals lower due to loss of Plots 1 and 8.

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. Groundwater gauge locations are depicted in Figure 5 (Appendix A). Groundwater gauge hydrographs are plotted on Figure F-1 (2008) (Appendix F). Three of the four groundwater gauges (Gauges 1, 2, and 4) located on-Site are currently meeting the wetland hydrologic success criteria. The hydrologic success of Gauge 3 may be inferred based on visual observations of inundation. However, due to gauge malfunction and data loss, the frequency for which groundwater was within 12 inches cannot be determined.

Due to numerous groundwater gauge malfunctions and data loss during Year 4 monitoring, PBS&J staff installed new gauges directly beside the existing gauges. The new gauges will ensure complete data collection in support of continued hydrologic success in the final year of monitoring.

2.2.3 Wetland Criteria Attainment

Table 10. Wetland Criteria Attainment

Gauge ID	Gauge Hydrology Threshold Met?	Vegetation Plot ID	Vegetation Survival Threshold Met?
Gauge1	Yes (19% of growing season)	2	Yes
		3	Yes
Gauge2	Yes (17% of growing season)	4	Yes
		5	Yes
Gauge3	N/A (gauge malfunction)	6	Yes
		7	Yes
Gauge4	Yes (21% of growing season)	9	N/A*
		10	N/A*

* Vegetation success of remedial planted stems will be evaluated during Year 5 monitoring

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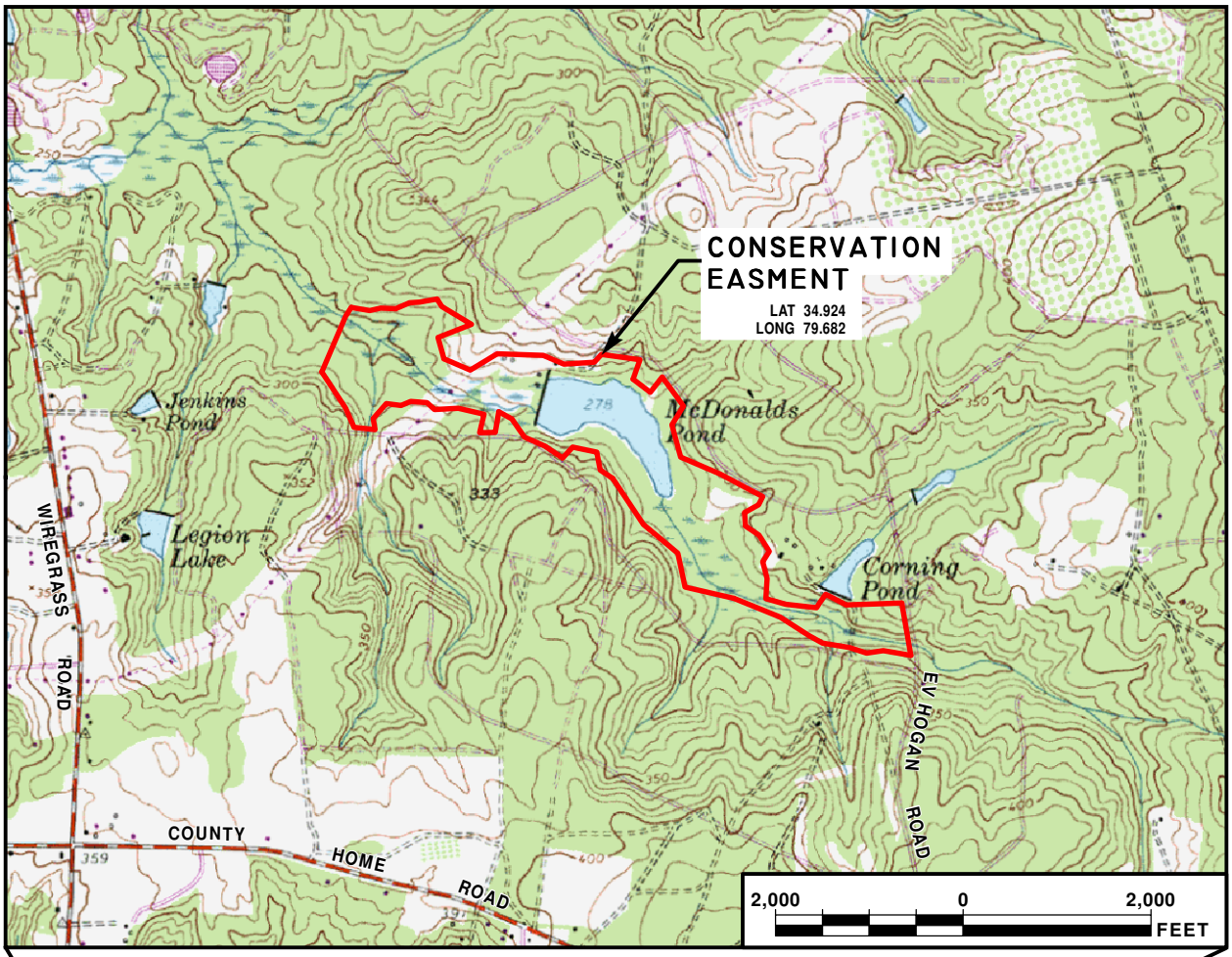
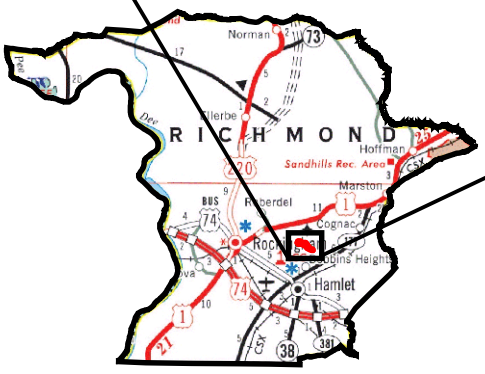
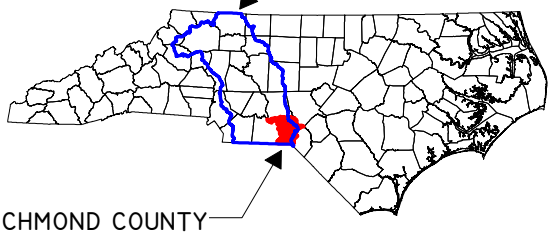
APPENDIX A: FIGURES







NAD 83

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Ecosystem Enhancement Program

SITE LOCATION

McDONALDS POND RESTORATION SITE

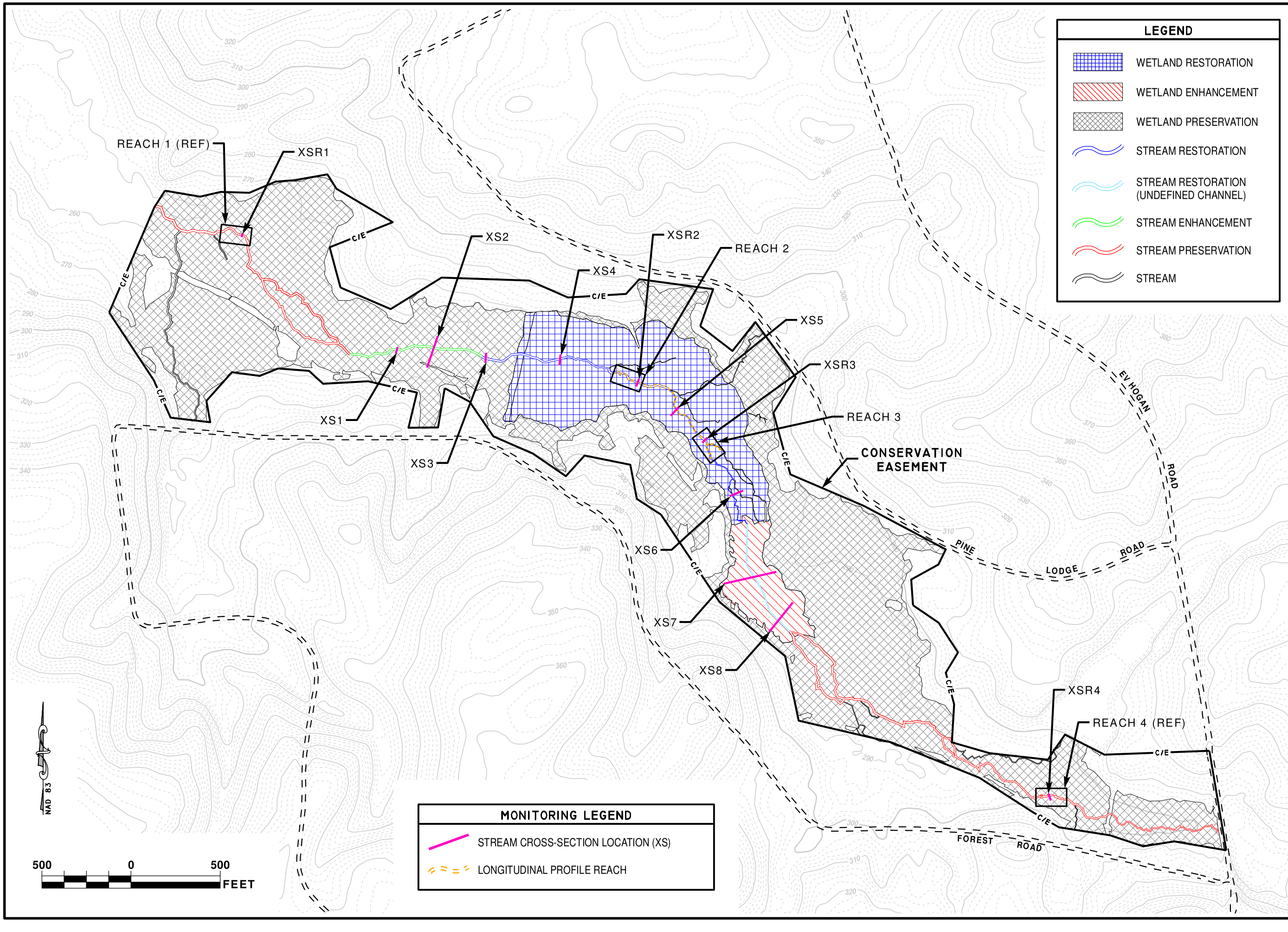
EEP Project No. D04020-2

RICHMOND COUNTY, NORTH CAROLINA

Dwn By:	MCG
Ckd By:	JWG
Date:	FEB 2010
Project No:	100004932

FIGURE

1



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CLIENT:

Ecosystem Enhancement PROGRAM

PROJECT:

McDONALDS POND RESTORATION SITE

EEP Project No. D04020-2

RICHMOND COUNTY, NORTH CAROLINA

TITLE:

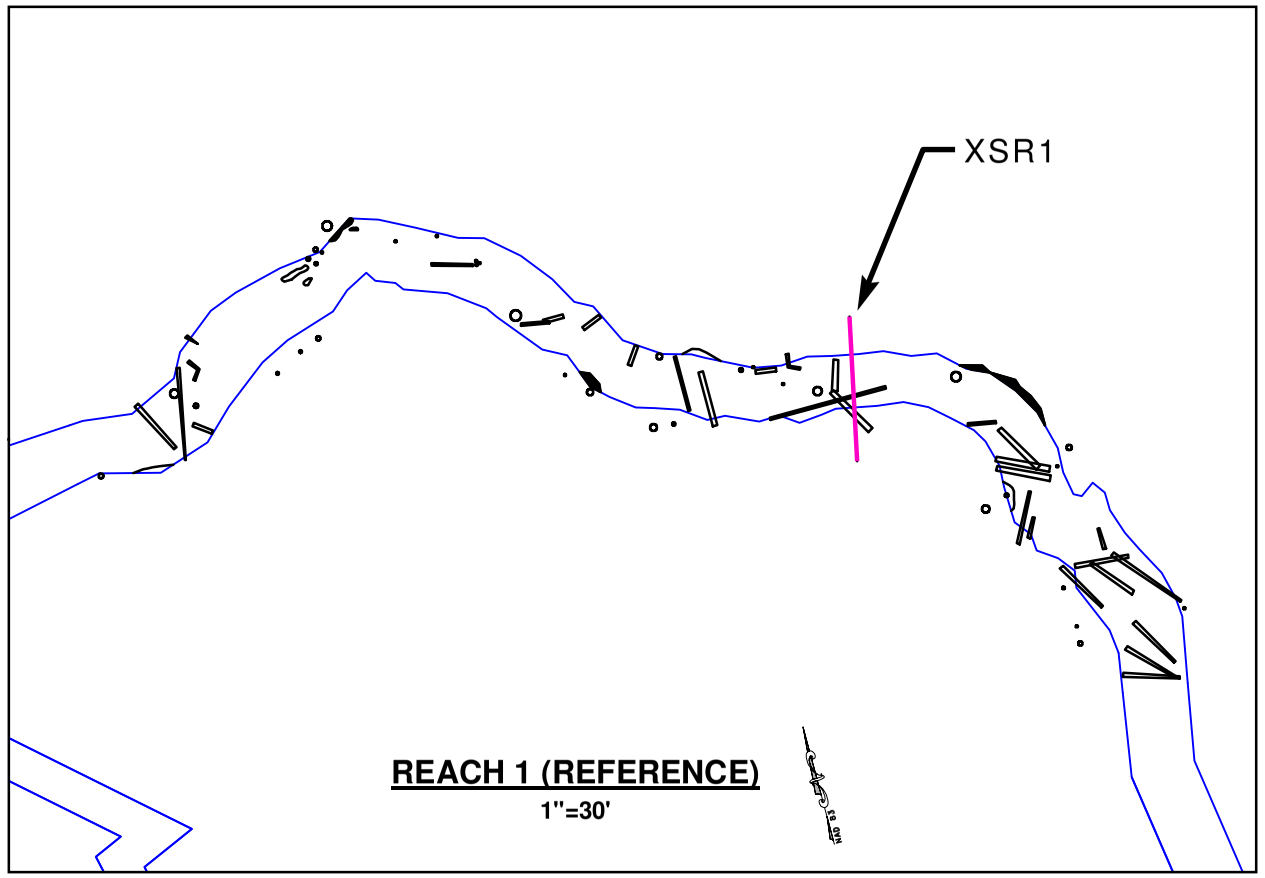
STREAM MONITORING PLAN VIEW

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

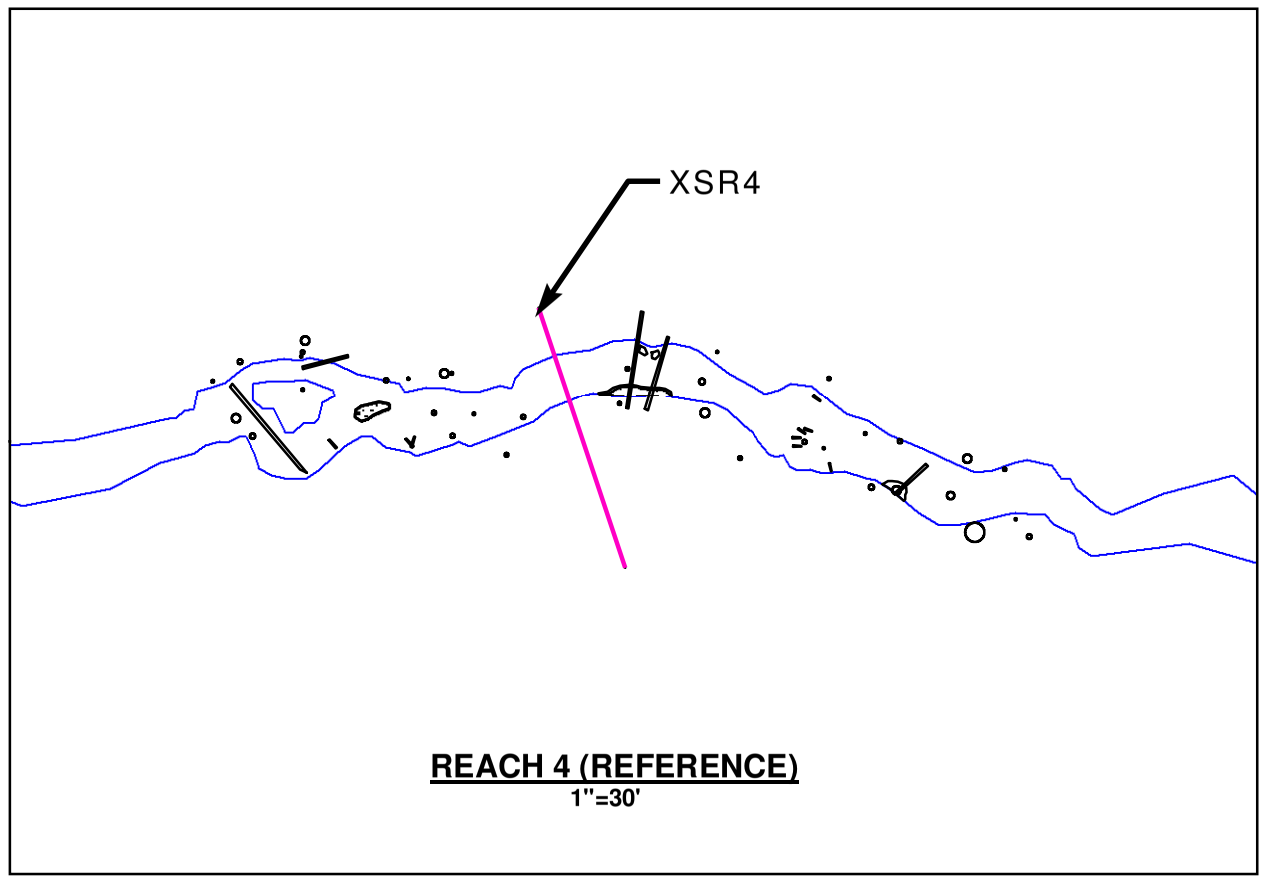
ESC PROJECT NO.: 100004932

FIGURE

2



REACH 1 (REFERENCE)
1"=30'

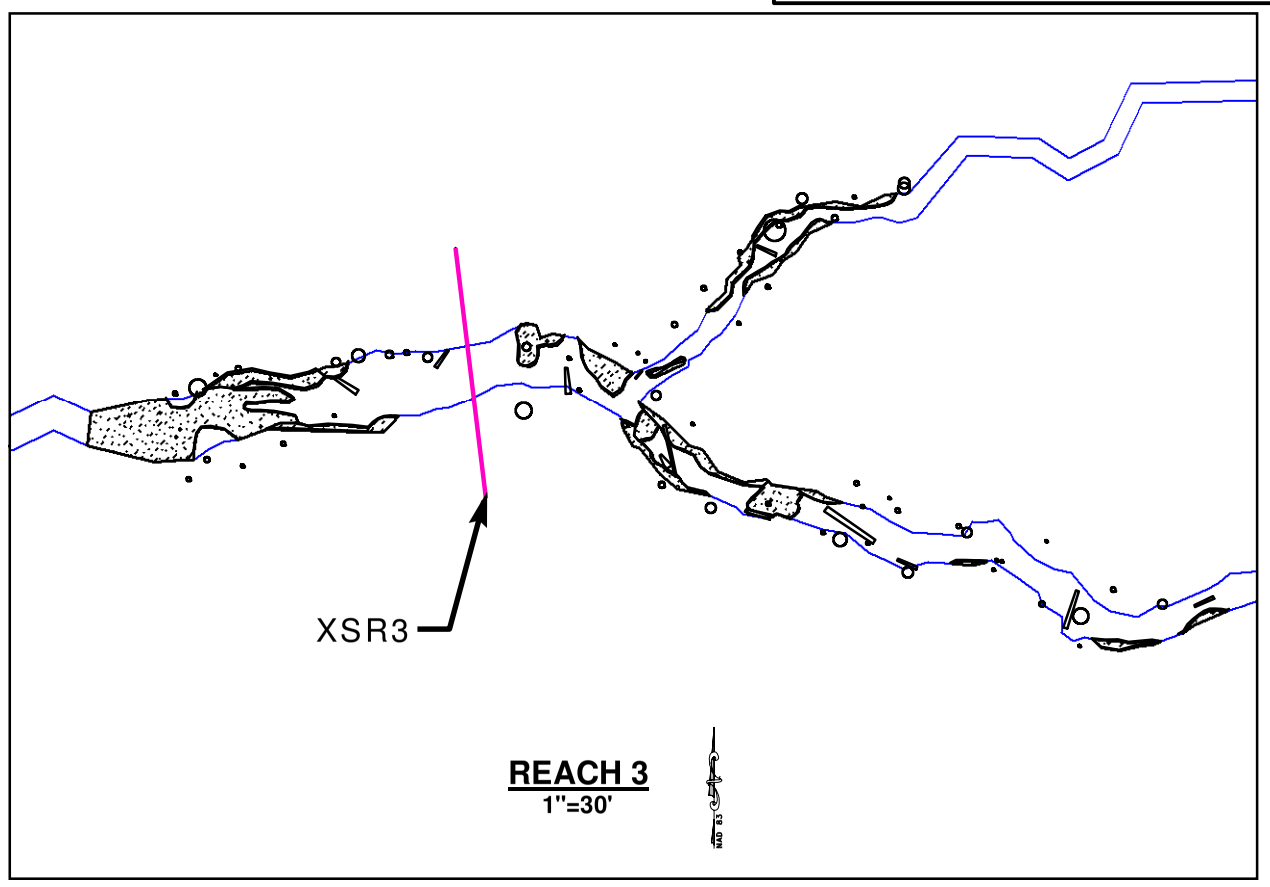


REACH 4 (REFERENCE)
1"=30'

STREAM
STREAM CROSS-SECTION LOCATION (XS)

NOTE: REACH AND CROSS-SECTION LOCATIONS SHOWN ON FIGURE 2

STUMP / LOG (2009)
TREE / ROOT (2009)
UNDERCUT BANK (2009)
MACROPHYTIC VEGETATION (2009)



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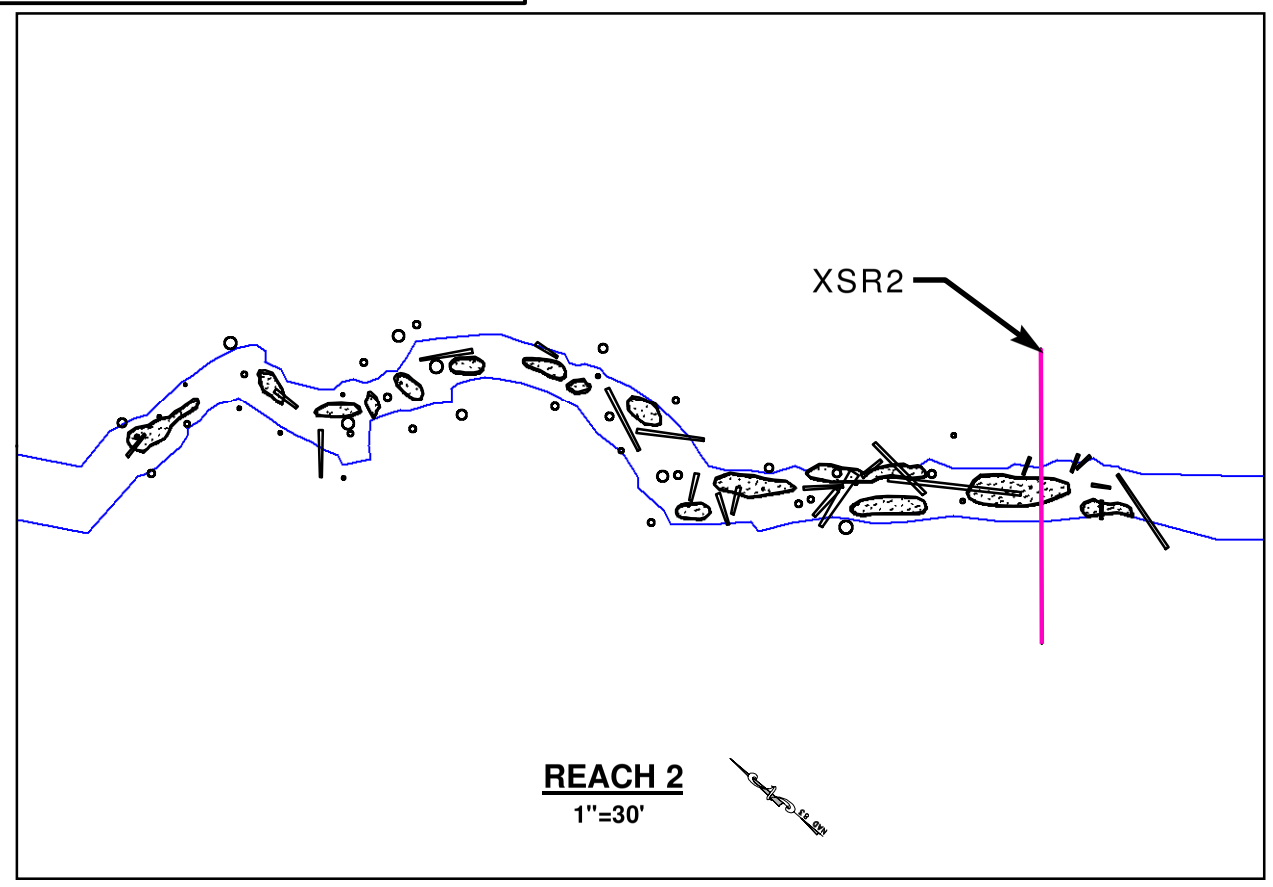

REACH 2
1"=30'

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Ecosystem Enhancement Program

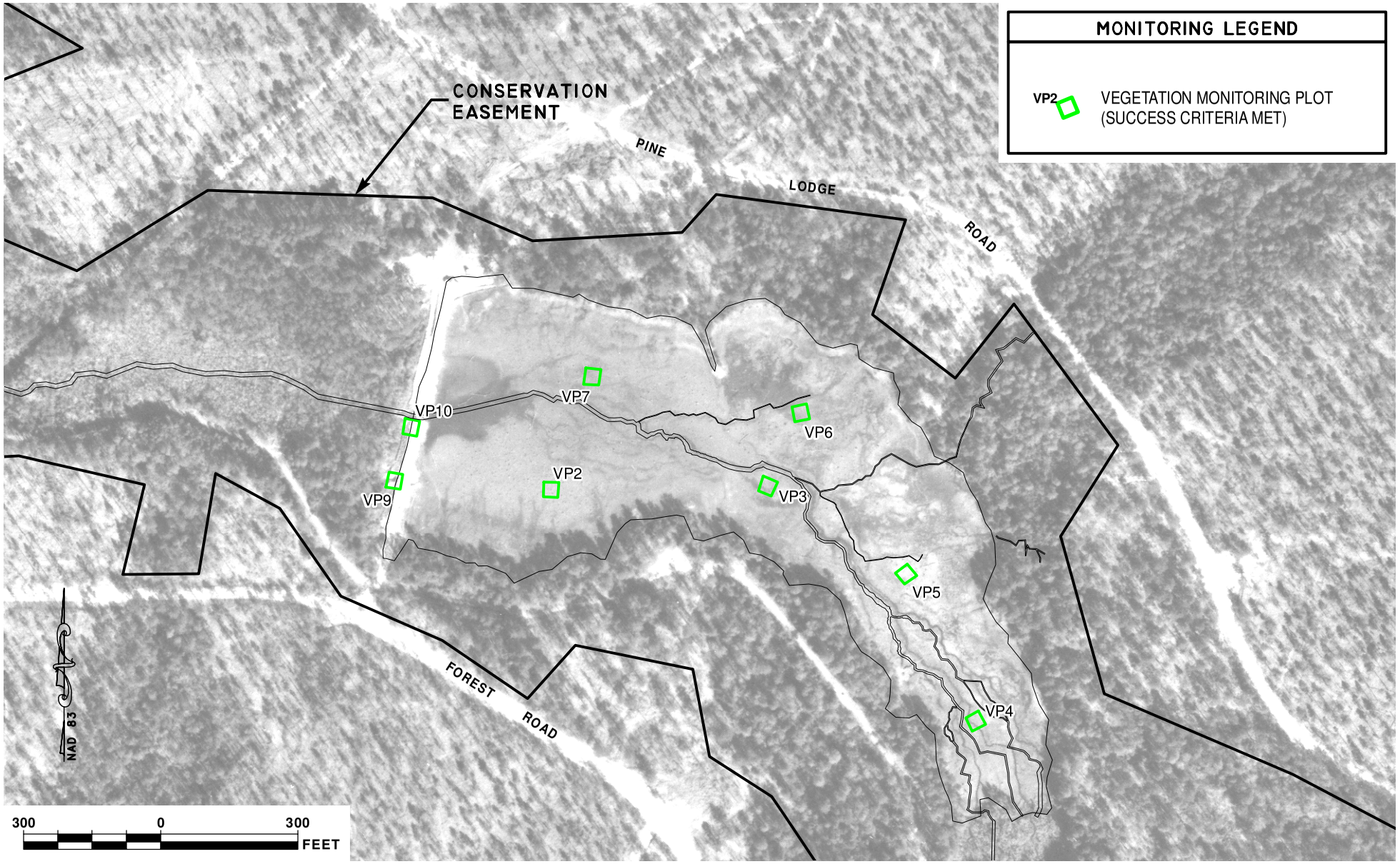
PROJECT:
McDONALDS POND RESTORATION SITE
EEP Project No. D04020-2
RICHMOND COUNTY, NORTH CAROLINA

TITLE:
STREAM HABITAT COMPOSITION

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

ESC PROJECT NO.: 07-330.00

FIGURE
3



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VEGETATION MONITORING PLOTS

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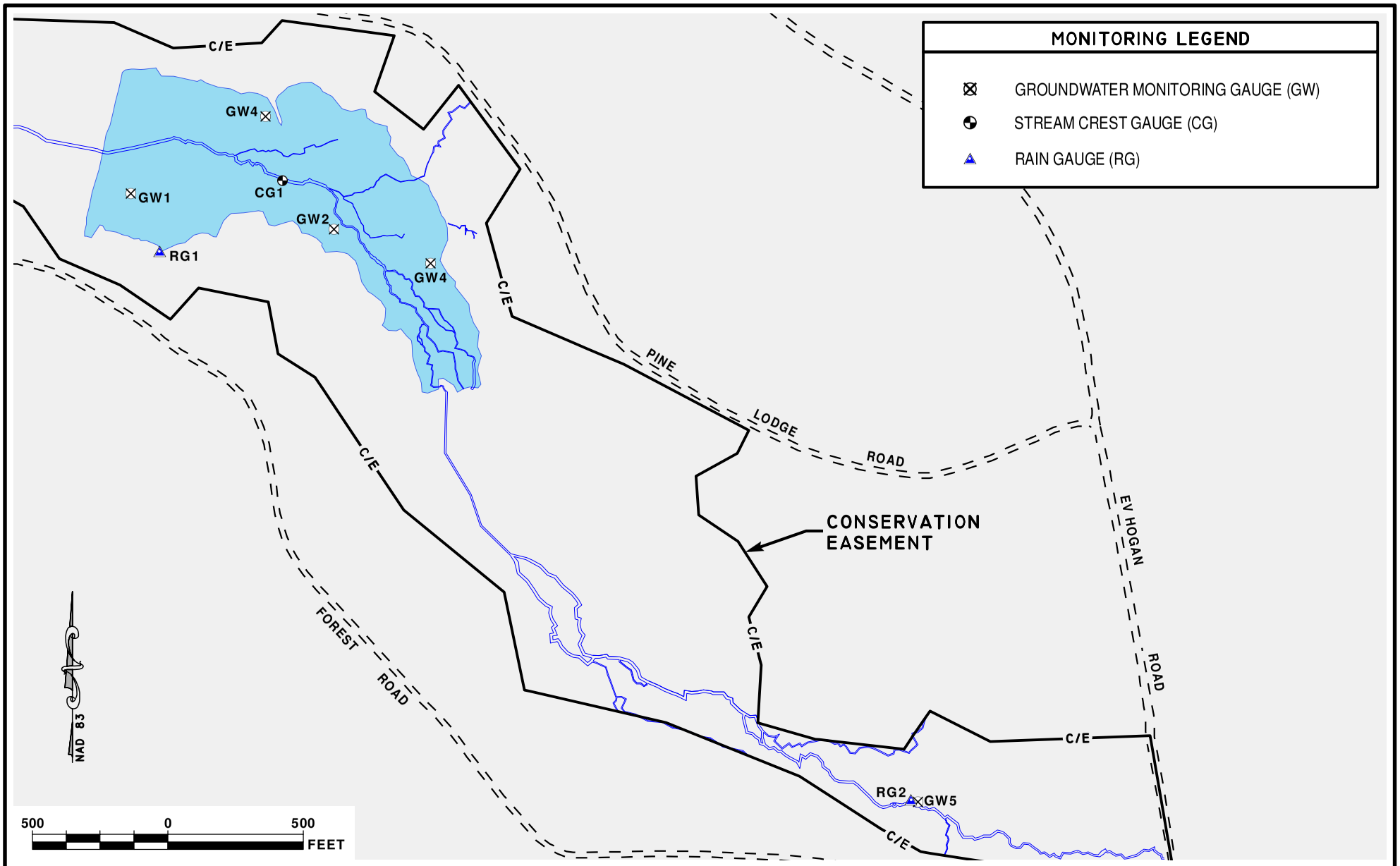
CKD BY:	JWG
DATE:	FEB 2010
ESC PROJECT:	100004932

FIGURE

4



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MONITORING GAUGES

McDONALDS POND RESTORATION SITE

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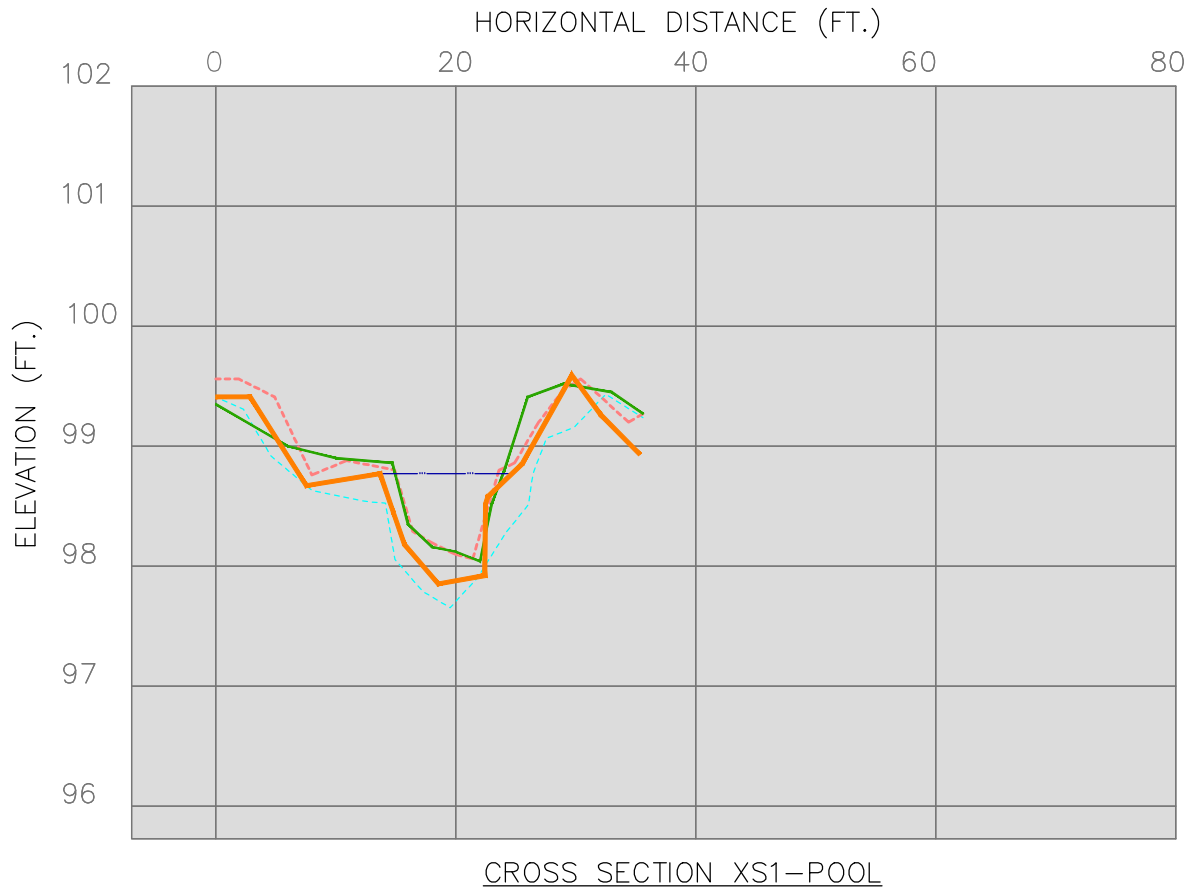
CKD BY:	JWG
DATE:	FEB 2010
ESC PROJECT:	100004932

FIGURE 5

APPENDIX B: STREAM GEOMORPHOLOGY DATA



CROSS SECTION XS1–POOL

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

SURVEY DATA		
STATION	ELEVATION	FEATURE
2.86	99.41	BLPIN
7.54	98.67	
13.70	98.77	
14.79	98.45	
15.73	98.18	
18.56	97.85	
22.42	97.92	
22.49	98.52	
22.69	98.58	
25.53	98.85	
29.70	99.59	
32.10	99.26	BRPIN

SUMMARY DATA	
BANKFULL CROSS SECTIONAL AREA	6.4 SQ. FT.
BANKFULL WIDTH	10.9 FT.
BANKFULL MEAN DEPTH	0.6 FT.
BANKFULL MAX DEPTH	0.9 FT.
WIDTH–DEPTH RATIO	18.2
ENTRENCHMENT RATIO	36.7
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	OCT. 2009
Survey Weather	Sunny
Field Team	Schmid, Geratz
Location	XS1

XS1 LEFT BANK LOOKING RIGHT BANK

XS1 LOOKING DOWNSTREAM

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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

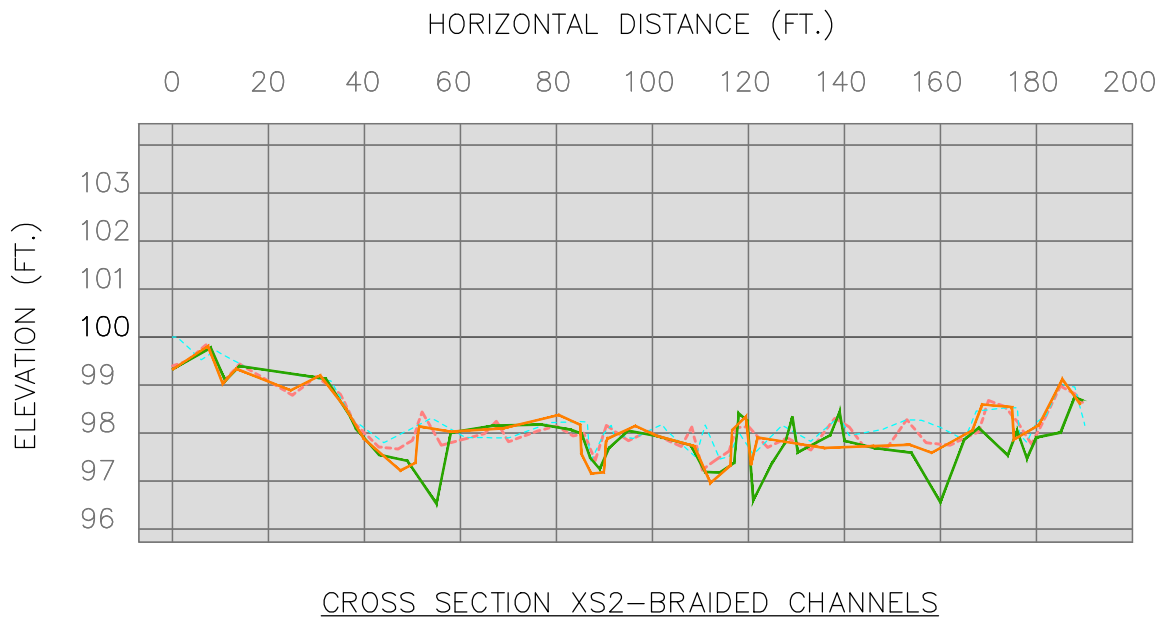
Title:

CROSS SECTION XS1–POOL

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

SHEET

B1



CROSS SECTION XS2–BRAIDED CHANNELS

XS2 LEFT BANK LOOKING RIGHT BANK

XS2 LOOKING DOWNSTREAM

SURVEY DATA		
STATION	ELEVATION	FEATURE
0.04	99.19	BLPIN
7.49	99.67	
10.48	98.89	
13.35	99.20	
24.63	98.75	
30.84	99.06	
36.29	98.35	EOW
39.82	97.75	
47.51	97.08	
50.65	97.24	
51.14	97.81	
51.45	98.00	
57.91	97.89	
68.83	97.96	
80.53	98.24	EOW
85.00	98.03	
85.23	97.44	
87.28	97.02	
89.92	97.04	
90.40	97.69	
90.70	97.75	
96.50	98.01	
100.74	97.81	
108.77	97.59	
112.11	96.82	
116.31	97.18	
116.65	97.93	
119.54	98.20	
120.55	97.20	
121.96	97.77	
135.77	97.55	
146.19	97.59	
153.72	97.62	
158.19	97.45	
166.66	97.91	
168.78	98.46	
174.93	98.40	
175.35	97.73	
180.49	98.02	
185.50	98.98	
189.20	98.46	BRPIN

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	OCT. 2009
Survey Weather	Sunny
Field Team	Schmid, Geratz
Location	XS2

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INTERNATIONAL PAPER

Client: Ecosystem Enhancement PROGRAM

Project:

McDONALDS POND RESTORATION SITE

EEP Project No. D04020–2

RICHMOND COUNTY, NORTH CAROLINA

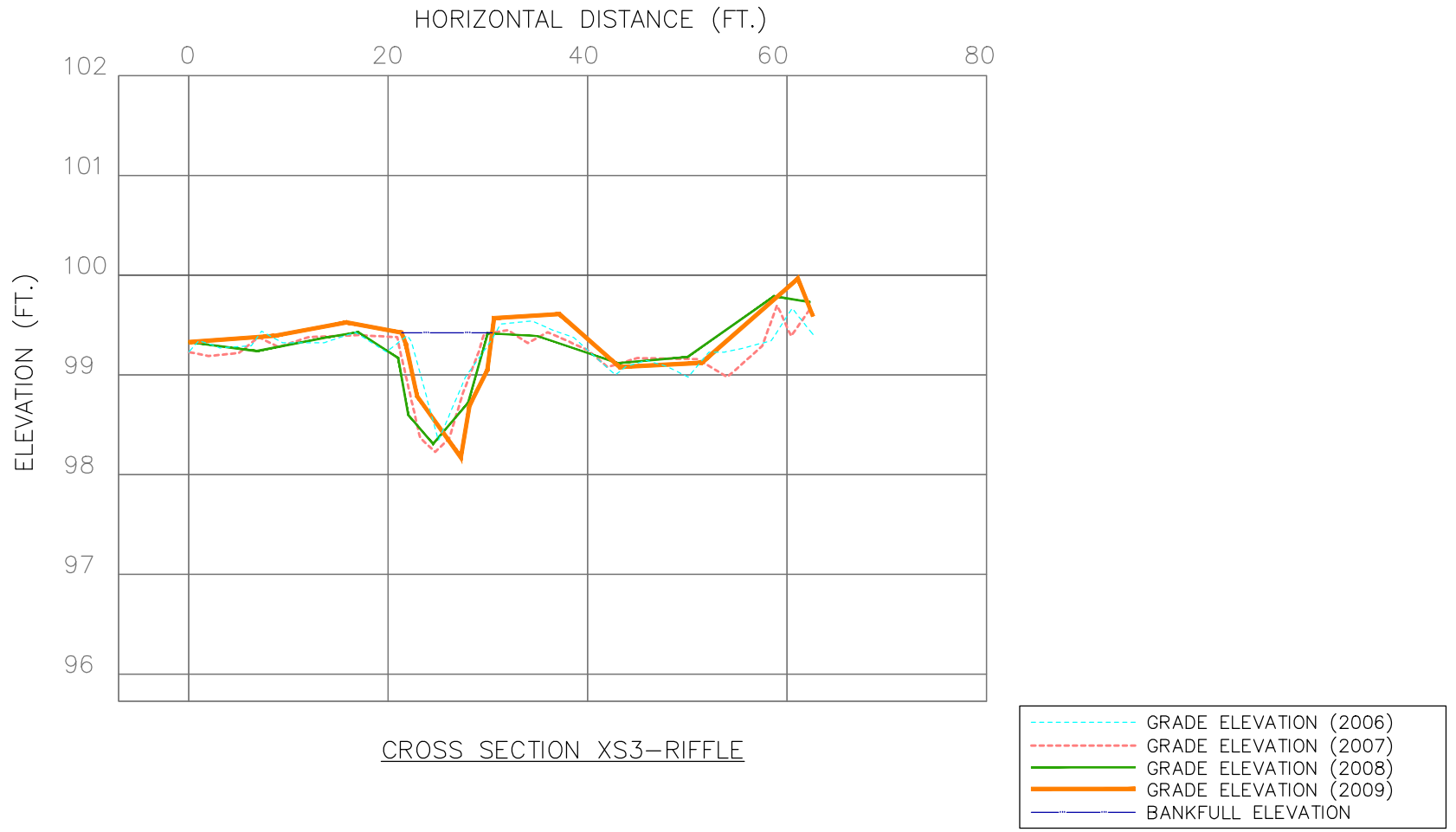
Title:

CROSS SECTION XS2–BRAIDED CHANNELS

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

SHEET

B2

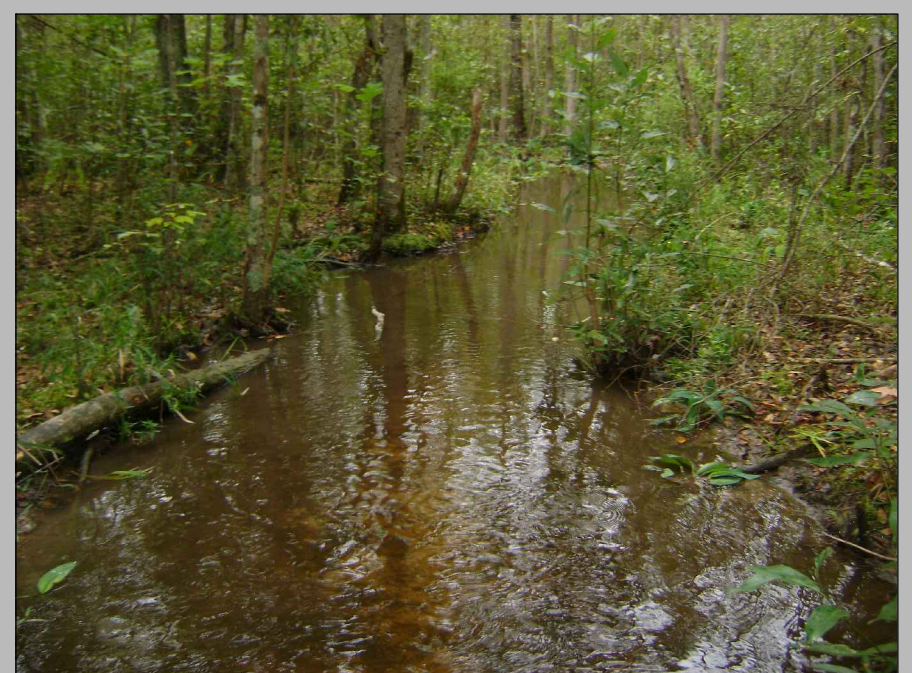


CROSS SECTION XS3–RIFFLE

SURVEY DATA		
STATION	ELEVATION	FEATURE
0.06	99.12	BLPIN
8.29	99.18	
15.24	99.31	
20.55	99.21	
20.95	99.10	EOW
22.04	98.60	
26.25	98.01	
27.09	98.51	
28.80	98.85	
29.45	99.35	
35.74	99.39	
41.52	98.88	
49.42	98.92	
58.70	99.73	
60.15	99.37	
62.45	99.37	BRPIN

SUMMARY DATA	
BANKFULL CROSS SECTIONAL AREA	6.0 SQ. FT.
BANKFULL WIDTH	8.7 FT.
BANKFULL MEAN DEPTH	0.7 FT.
BANKFULL MAX DEPTH	1.2 FT.
WIDTH–DEPTH RATIO	12.4
ENTRENCHMENT RATIO	45.9
CLASSIFICATION	C5

XS3 LEFT BANK LOOKING RIGHT BANK



XS3 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	OCT. 2009
Survey Weather	Sunny
Field Team	Schmid, Geratz
Location	XS3

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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 XS3–RIFFLE

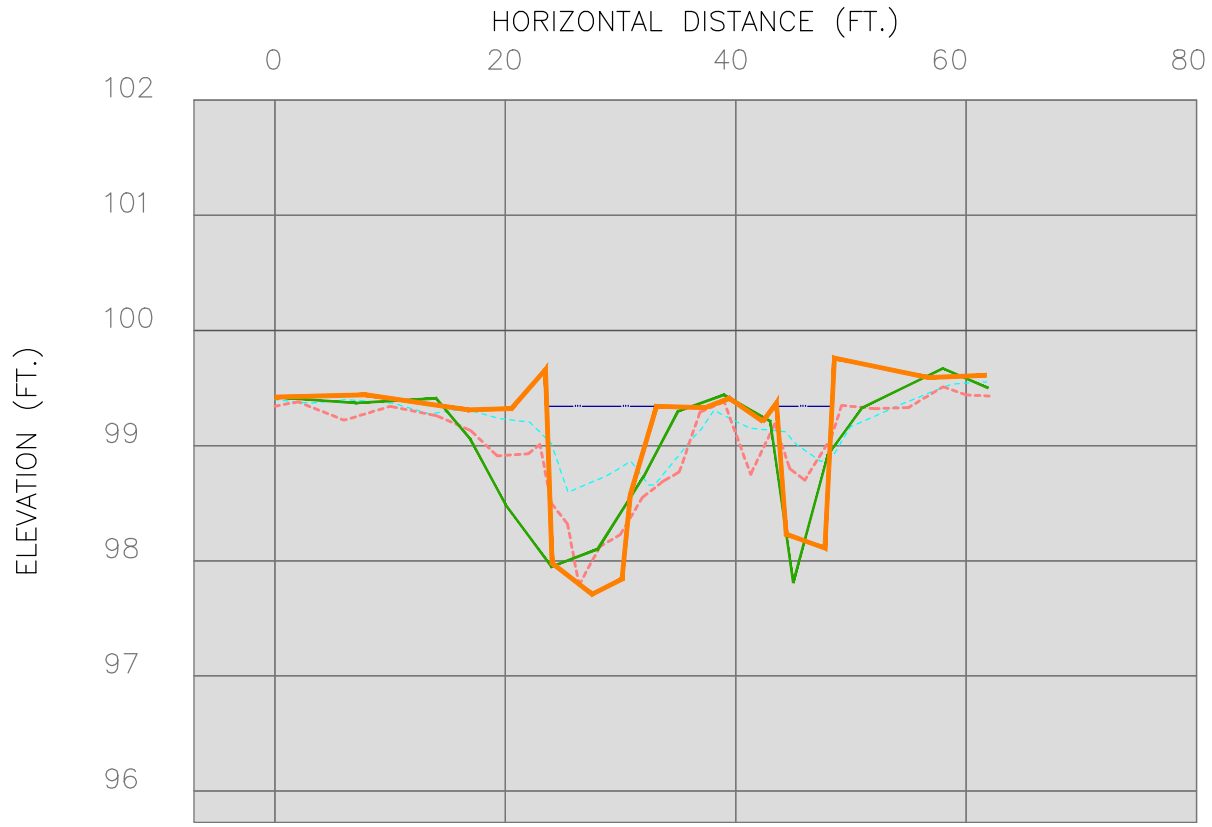
Dsn. By:	Dwn. By:
JWC	JWC
Ckd. By:	Date:
MCG	FEB 2010

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
0.11	99.02	BLPIN
8.05	99.04	
16.88	98.91	
20.65	98.92	
23.61	99.26	
24.18	97.58	
27.64	97.31	
30.24	97.44	
30.97	98.18	
33.25	98.94	
37.44	98.93	
39.57	99.01	
40.95	97.72	
42.46	98.81	
43.66	98.97	
44.49	97.83	
47.84	97.71	
48.68	99.36	
56.82	99.19	
61.86	99.21	BRPIN

SUMMARY DATA	
BANKFULL CROSS SECTIONAL AREA	25.8 FT.
BANKFULL WIDTH	25.0 FT.
BANKFULL MEAN DEPTH	1.0 FT.
BANKFULL MAX DEPTH	1.9 FT.
WIDTH–DEPTH RATIO	25.0
ENTRENCHMENT RATIO	20.0
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	OCT. 2009
Survey Weather	Sunny
Field Team	Schmid, Geratz
Location	XS4

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Project:

McDONALDS POND RESTORATION SITE

EEP Project No. D04020–2

RICHMOND COUNTY, NORTH CAROLINA

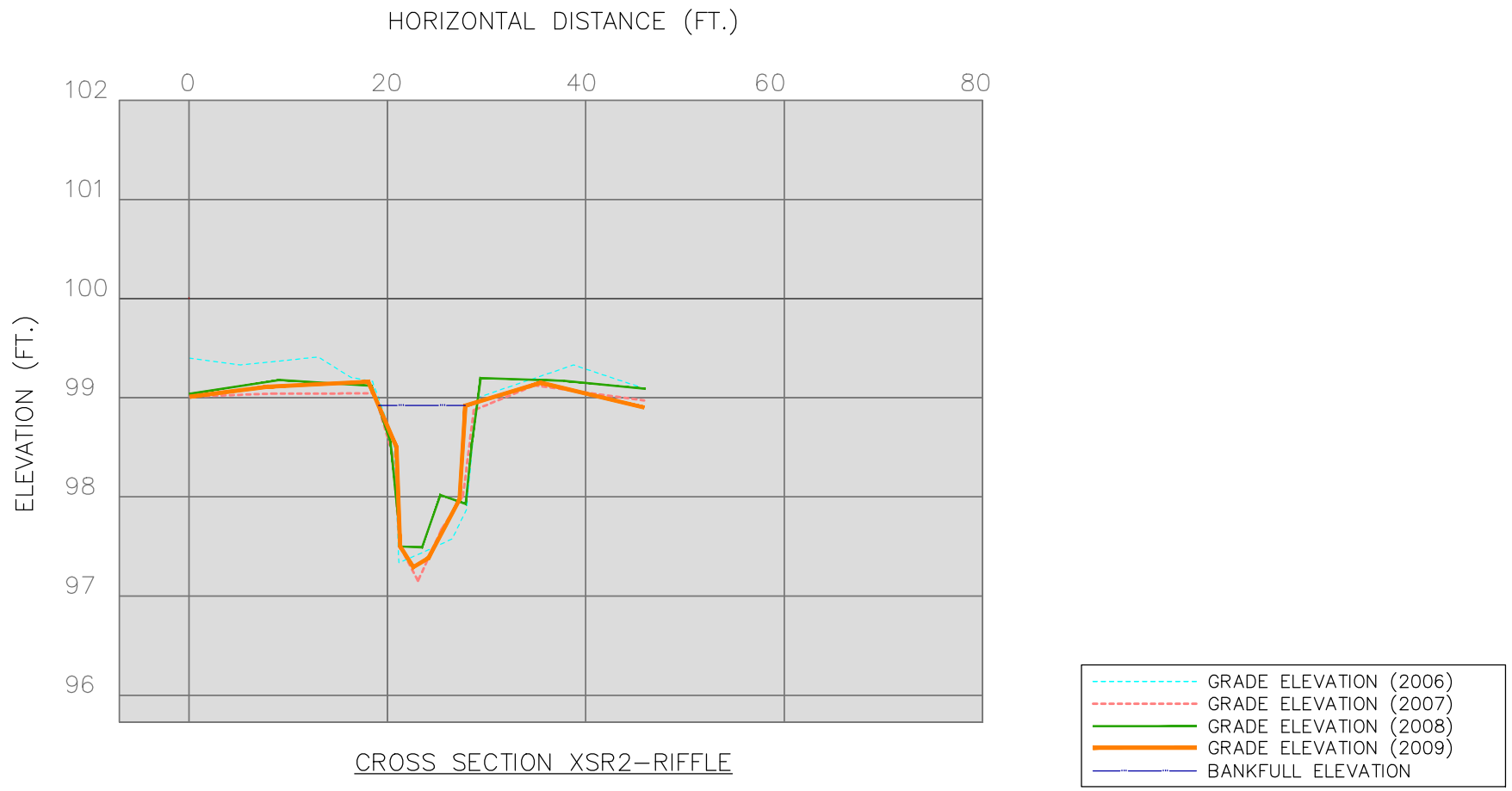
Title:

CROSS SECTION XS4–RIFFLE

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

SHEET

B4



CROSS SECTION XSR2–RIFFLE

SURVEY DATA		
STATION	ELEVATION	FEATURE
7.86	100.10	BLPIN
17.97	100.15	
20.81	99.49	
21.18	98.49	
22.50	98.28	
24.03	98.37	
27.16	98.96	
27.75	99.91	
35.36	100.14	
45.78	99.89	BRPIN

SUMMARY DATA	
BANKFULL CROSS SECTIONAL AREA	9.3 SQ. FT.
BANKFULL WIDTH	8.8 FT.
BANKFULL MEAN DEPTH	1.1 FT.
BANKFULL MAX DEPTH	1.6 FT.
WIDTH–DEPTH RATIO	8.0
ENTRENCHMENT RATIO	51.1
CLASSIFICATION	E5

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	OCT. 2009
Survey Weather	Sunny
Field Team	Schmid, Geratz
Location	XSR2

XSR2 LEFT BANK LOOKING RIGHT BANK

XSR2 LOOKING DOWNSTREAM

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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 XSR2–RIFFLE

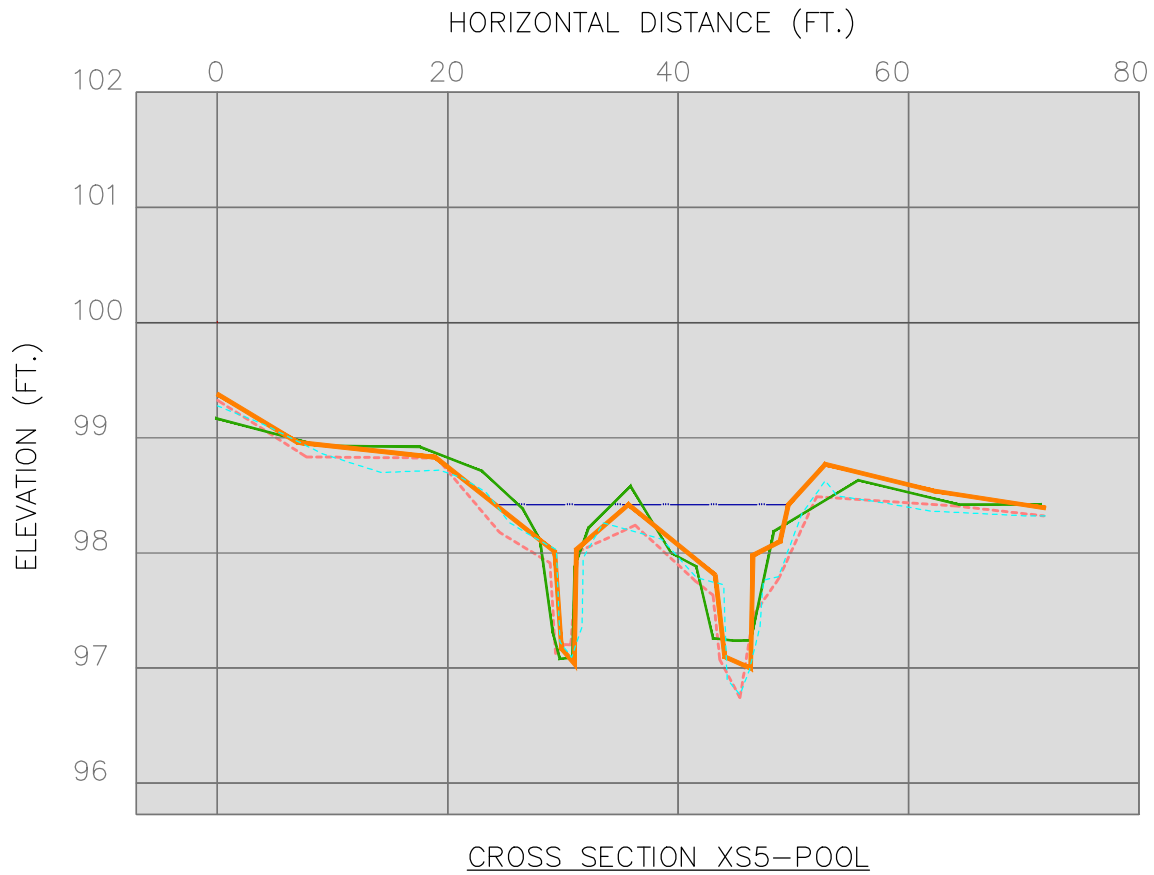
Dsn. By:	Dwn. By:
JWC	JWC
Ckd. By:	Date:
MCG	FEB 2010

Scale: NO SCALE

Project No.: 100004932

SHEET

B5



CROSS SECTION XS5–POOL

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

SURVEY DATA		
STATION	ELEVATION	FEATURE
0.08	99.19	BLPIN
7.04	98.77	
19.03	98.64	
29.38	97.82	
29.96	96.98	
31.07	96.85	
31.25	97.84	
35.78	98.23	
43.26	96.23	
43.30	97.62	
44.12	96.91	
46.38	96.81	
46.60	97.79	
48.93	97.91	
49.65	98.23	
52.87	98.58	
62.23	98.35	
71.97	98.20	
72.02	98.95	BRPIN

SUMMARY DATA	
BANKFULL CROSS SECTIONAL AREA	16.7 SQ. FT.
BANKFULL WIDTH	25.4 FT.
BANKFULL MEAN DEPTH	0.07 FT.
BANKFULL MAX DEPTH	2.00 FT.
WIDTH–DEPTH RATIO	38.8
ENTRENCHMENT RATIO	15.7
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	OCT. 2009
Survey Weather	Sunny
Field Team	Schmid, Geratz
Location	XS5

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Project:

McDONALDS POND RESTORATION SITE

EEP Project No. D04020–2

RICHMOND COUNTY, NORTH CAROLINA

Title:

CROSS SECTION XS5–POOL

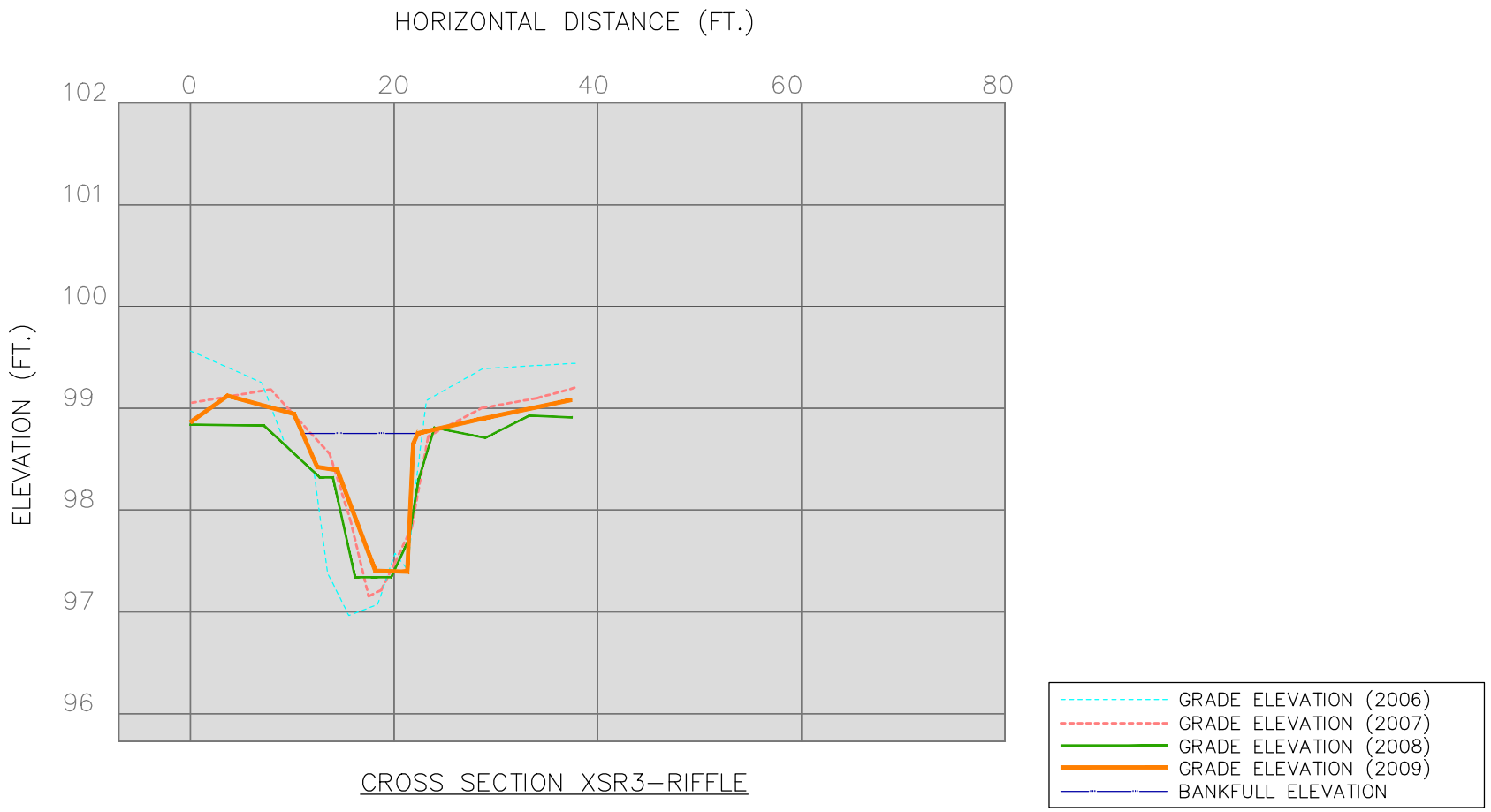
Dsn. By: JWC	Dwn. By: JWC
Ckd. By: MCG	Date: FEB 2010

Scale: NO SCALE

Project No.: 100004932

SHEET

B6



CROSS SECTION XSR3–RIFFLE

SURVEY DATA		
STATION	ELEVATION	FEATURE
0.26	98.98	BLPIN
3.92	99.24	
10.44	99.06	
12.70	98.54	
14.70	98.51	
18.42	97.52	
21.55	97.51	
22.14	98.77	
22.60	98.87	
28.73	99.01	
37.71	99.20	
37.82	99.97	BRPIN

SUMMARY DATA	
BANKFULL CROSS SECTIONAL AREA	8.8 SQ. FT.
BANKFULL WIDTH	11.3 FT.
BANKFULL MEAN DEPTH	0.8 FT.
BANKFULL MAX DEPTH	1.4 FT.
WIDTH–DEPTH RATIO	14.1
ENTRENCHMENT RATIO	35.4
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	OCT. 2009
Survey Weather	Sunny
Field Team	Schmid, Geratz
Location	XSR3

XSR3 LEFT BANK LOOKING RIGHT BANK

XSR3 LOOKING DOWNSTREAM

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Project:

McDONALDS POND RESTORATION SITE

EEP Project No. D04020–2

RICHMOND COUNTY, NORTH CAROLINA

Title:

CROSS SECTION XSR3–RIFFLE

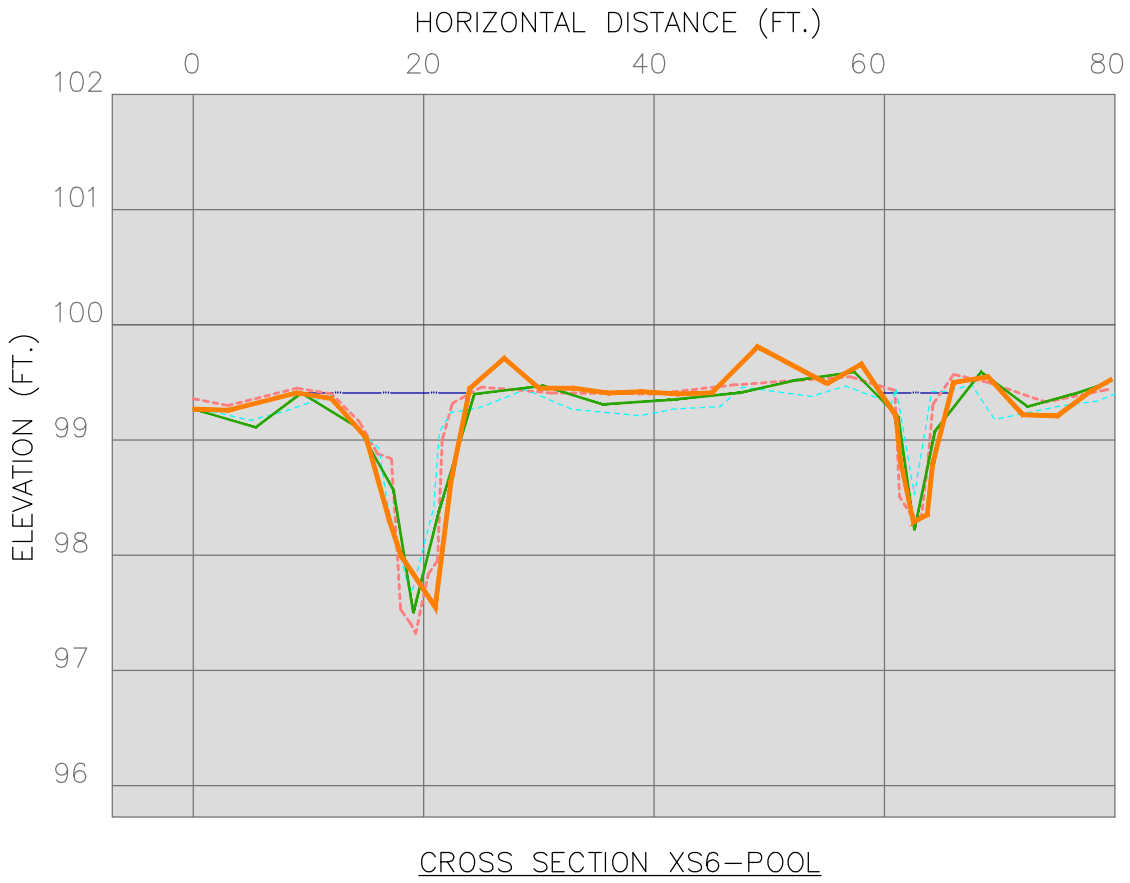
Dsn. By:	Dwn. By:
JWC	JWC
Ckd. By:	Date:
MCG	FEB 2010

Scale: NO SCALE

Project No.: 100004932

SHEET

B7



CROSS SECTION XS6-POOL

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

SURVEY DATA		
STATION	ELEVATION	FEATURE
0.00	99.19	BLPIN
3.00	99.18	
6.00	99.92	
9.00	99.33	
12.00	99.28	
15.00	98.94	
17.00	98.23	
18.00	97.92	
21.00	97.47	
22.4	98.59	
24.0	99.37	
27.0	99.63	
30.0	99.37	
33.0	99.37	
36.0	99.33	
39.0	99.34	
42.0	99.32	
45.0	99.33	
49.0	99.73	
52.0	98.56	
55.0	99.41	
58.0	99.58	
61.0	99.13	
61.4	98.73	
62.5	98.21	
63.7	98.27	
64.2	98.72	
66.0	99.42	
69.0	99.47	
72.0	99.14	
75.0	99.13	
78.0	99.35	
81.0	99.52	
83.0	99.24	
83.9	99.28	BRPIN

SUMMARY DATA	
BANKFULL CROSS SECTIONAL AREA	15.4 SQ. FT.
BANKFULL WIDTH	22.1 FT.
BANKFULL MEAN DEPTH	0.7 FT.
BANKFULL MAX DEPTH	1.9 FT.
WIDTH-DEPTH RATIO	31.6
ENTRENCHMENT RATIO	15.8
CLASSIFICATION	DA5/C5

XS6 LEFT BANK LOOKING RIGHT BANK

XS6 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	OCT. 2009
Survey Weather	Sunny
Field Team	Schmid, Geratz
Location	XS6

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Project:

McDONALDS POND RESTORATION SITE

EEP Project No. D04020-2

RICHMOND COUNTY, NORTH CAROLINA

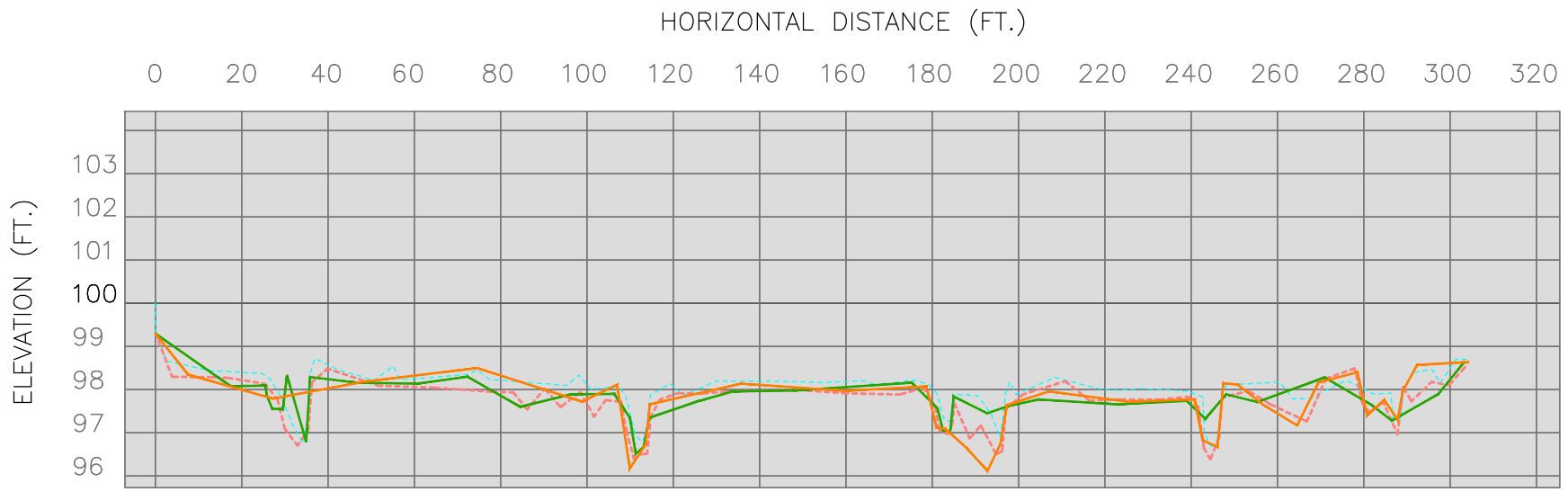
Title:

CROSS SECTION XS6-POOL

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

SHEET

B8



CROSS SECTION XS7–BRAIDED CHANNELS

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

XS7 LEFT BANK LOOKING RIGHT BANK

XS7 LOOKING DOWNSTREAM

SURVEY DATA					
STATION	ELEVATION	FEATURE	STATION	ELEVATION	FEATURE
0.06	99.05	BLPIN			
7.59	98.10				
27.19	97.54				
48.97	97.94				
74.74	98.25				
98.84	97.47				
107.06	97.86				
109.96	95.92				
113.68	96.48				
114.66	97.41				
135.91	97.89				
159.66	97.72				
178.78	97.82				
181.04	96.87				
183.12	96.84				
188.32	96.37				
192.87	95.87				
195.82	96.47				
197.38	97.39				
207.20	97.71				
225.42	97.47				
240.92	97.52				
242.72	96.58				
246.17	96.42				
247.56	97.90				
250.93	97.86				
256.58	97.41				
262.72	98.43				
264.63	96.92				
269.61	97.92				
278.62	98.15				
280.85	97.15				
284.84	97.51				
287.94	97.05				
289.08	97.71				
292.48	98.32				
303.56	98.75	BRPIN			

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	OCT. 2009
Survey Weather	Sunny
Field Team	Schmid, Geratz
Location	XS7

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Ecosystem Enhancement PROGRAM

Project:

McDONALDS POND RESTORATION SITE

EEP Project No. D04020–2

RICHMOND COUNTY, NORTH CAROLINA

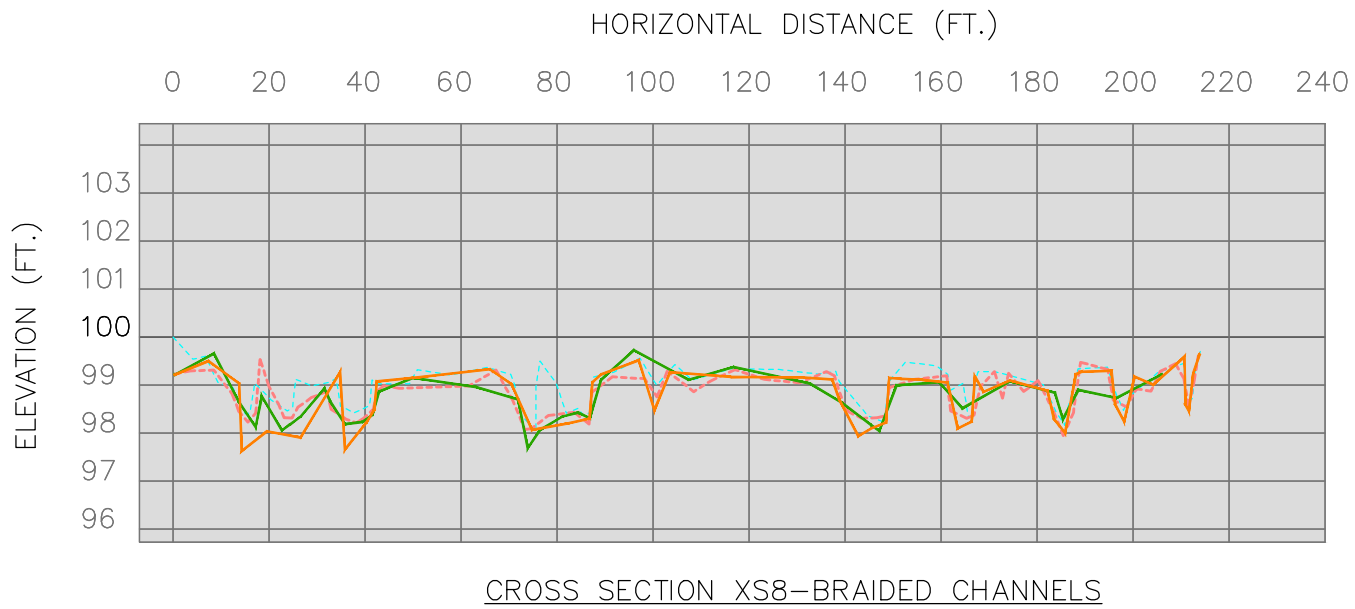
Title:

CROSS SECTION XS7–BRAIDED CHANNELS

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

SHEET

B9



CROSS SECTION XS8–BRAIDED CHANNELS

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

XS8 LEFT BANK LOOKING RIGHT BANK

XS8 LOOKING DOWNSTREAM

SURVEY DATA

STATION	ELEVATION	FEATURE	STATION	ELEVATION	FEATURE
0.09	99.63	BLPIN	182.09	99.30	
7.28	99.92		183.36	98.72	
13.67	99.45		185.74	98.42	
14.17	98.05		187.99	99.65	
19.47	98.46		189.09	99.70	
26.41	98.33		195.37	99.72	
34.66	99.69		196.11	99.03	
35.69	98.08		198.02	98.66	
40.16	98.64		200.20	99.60	
41.76	98.90		204.07	99.43	
42.33	99.50		210.61	100.01	
49.88	99.57		210.77	99.01	
65.91	99.75		211.51	98.88	
70.43	99.44		212.46	99.68	BRPIN
74.62	98.49				
81.91	98.62				
86.62	98.72				
87.24	99.48				
89.09	99.65				
96.89	99.94				
100.14	98.90				
103.44	99.69				
116.08	99.59				
131.29	99.58				
137.20	99.54				
138.65	99.13				
142.64	98.36				
145.56	98.53				
148.40	98.64				
149.09	99.57				
151.51	99.55				
156.00	99.53				
161.29	99.47				
163.36	98.52				
166.23	98.66				
166.93	99.60				
167.10	99.58				
168.71	99.28				
174.26	99.52				

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	OCT. 2009
Survey Weather	Sunny
Field Team	Schmid, Geratz
Location	XS8

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Client: Ecosystem Enhancement PROGRAM

Project:

McDONALDS POND RESTORATION SITE

EEP Project No. D04020–2

RICHMOND COUNTY, NORTH CAROLINA

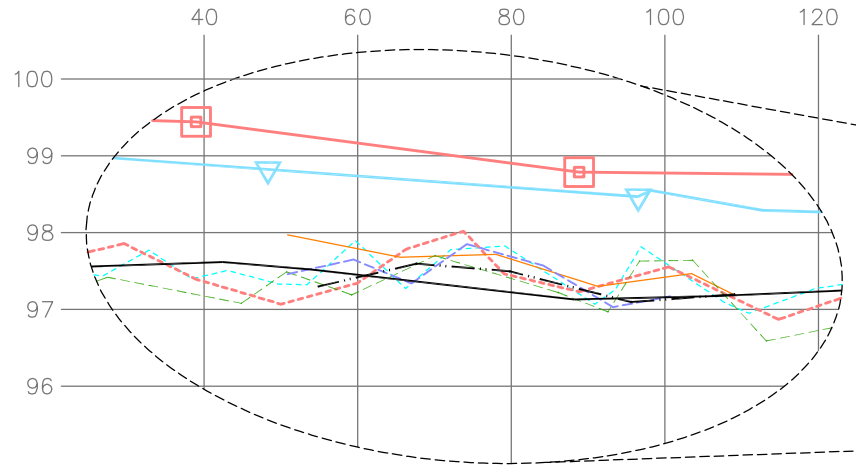
Title:

CROSS SECTION XS8–BRAIDED CHANNELS

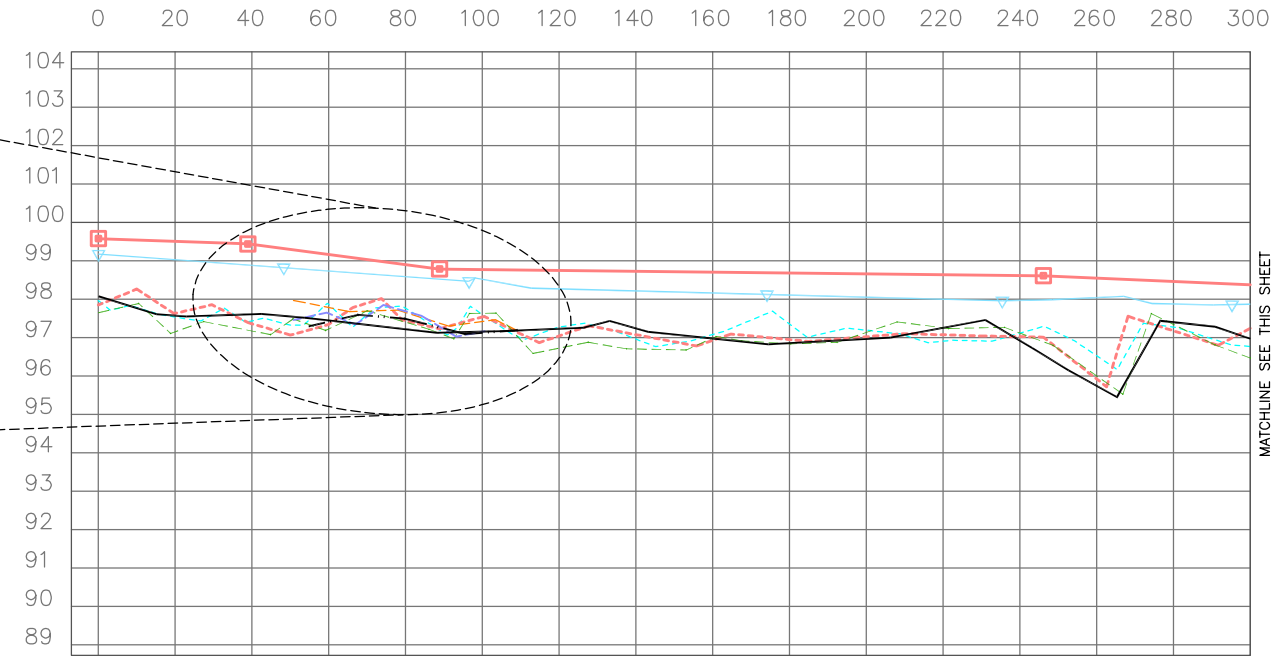
Dsn. By: JWC	Dwn. By: JWC
Ckd. By: MCG	Date: FEB 2010
Scale: NO SCALE	
Project No.: 100004932	

SHEET

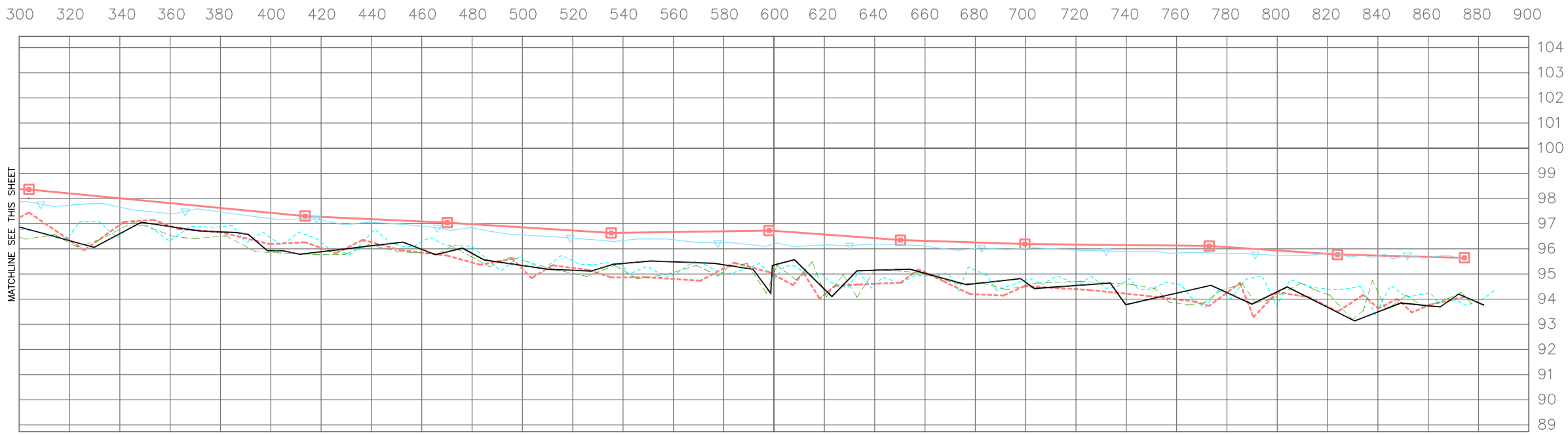
B10



RIGHT BRAID INSET



LONGITUDINAL PROFILE SECTION 1



LONGITUDINAL PROFILE SECTION 2

BANKFULL SLOPE: 0.0044

WATER SURFACE SLOPE: 0.0041

GRADE ELEVATION THALWEG (2006)
GRADE ELEVATION THALWEG (2007)
GRADE ELEVATION THALWEG (2008)
GRADE ELEVATION THALWEG (2009)

RIGHT BRAID THALWEG (2007)
RIGHT BRAID THALWEG (2008)
RIGHT BRAID THALWEG (2009)

WATER SURFACE ELEVATION

BANKFULL

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Client: Ecosystem Enhancement PROGRAM

Project:

McDONALDS POND RESTORATION SITE

EEP Project No. D04020-2

RICHMOND COUNTY, NORTH CAROLINA

Title:

LONGITUDINAL PROFILE

Dsn. By: JWC	Dwn. By: JWC
Ckd. By: MCG	Date: FEB 2010

Scale: NO SCALE

Project No.: 100004932

SHEET

B11

McDonalds Pond Restoration Site: Longitudinal Profile Data (Oct 2009)							
Station	TWG Elevation	WS Elevation	BKF Elevation	Station	TWG Elevation	WS Elevation	BKF Elevation
0.0	98.2	99.1	99.7	452.4	96.2		
15.0	97.6			466.3	95.8		
22.8	97.5			471.3	96.0		
41.6	97.6			484.4	95.5		
54.2	97.4			510.0	95.2	96.5	96.8
87.7	97.1			527.5	95.1		
108.1	97.2			535.1	95.3		
124.5	97.2			551.8	95.1		
133.2	97.5			574.7	95.4		
141.4	97.1	92.2	98.8	591.7	95.3		
176.5	96.9			595.0	94.2		
209.3	97.0			599.8	95.4		
231.1	97.5			614.2	95.5		
242.2	96.8	98.0	98.7	626.4	94.1		
257.1	96.1			636.0	95.1	96.2	96.5
265.4	95.7			647.0	95.3		
278.4	97.4			678.4	94.6		
290.2	97.4			696.3	94.7		
302.5	96.8			716.0	94.5		
330.1	96.1	97.8	98.1	728.3	94.7		
343.6	97.2			766.6	93.9		
355.1	91.2			778.9	94.4		
370.7	96.6			790.2	93.1	95.8	96.0
384.7	96.6			809.9	94.1		
390.7	96.4			830.9	93.2		
397.5	95.9			850.9	93.8		
402.7	95.9	97.2	97.3	864.4	93.7		
416.3	95.8			872.1	94.3		
434.1	96.3			881.8	93.8		

APPENDIX C: AQUATIC COMMUNITY DATA

SPECIES	T.V.	F.F.G.	Reach 1 (Reference)	Reach 2	Reach 3	Reach 4 (Reference)
ANNELIDA						
Oligochaeta	***10**	**CG**				
Tubificida						
Tubificidae w.o.h.c.	**7.1**	**CG**				1
Lumbriculida						
Lumbriculidae	**7**	**CG**	1		1	1
ARTHROPODA						
Crustacea						
Amphipoda		**CG**				
Crangonyctidae						
Crangonyx sp.	**7.9**	**CG**				2
Decapoda						
Palaemonidae						
Palaemonetes sp.	**7.1**	**CG**	1			
Insecta						
Ephemeroptera						
Baetidae		**CG**				
Acerpenna pygmaeus	**3.9**			2		
Procloeon sp.	**5**			4	1	
Ephemerellidae		**SC**				1
Eurylophella sp.	**4.3**	**SC**		5	1	
Ephemeridae		**CG**				
Hexagenia sp.	**4.9**	**CG**		1	1	1
Heptageniidae		**SC**				
Maccaffertium (Stenonema) sp.		**SC**		6	2	3
Leptophlebiidae		**CG**	1	1	2	
Paraleptophlebia sp.	**0.9**	**CG**			1	
Odonata						
Aeshnidae		**P**				
Boyeria vinosa	**5.9**	**P**	8	16	2	4
Calopterygidae		**P**				
Calopteryx sp.	**7.8**	**P**	1	16	1	3
Coenagrionidae		**P**				
Argia sp.	**8.2**	**P**	1	7	2	
Cordulegastridae		**P**				
Cordulegaster sp.	**5.7**	**P**		1		8
Gomphidae		**P**	4	2	7	
Dromogomphus armatus				2		
Gomphus sp.	**5.8**	**P**	1	2		3
Hagenius brevistylus	**4**	**P**		1		
Progomphus obscurus	**8.2**	**P**	2			3
Libellulidae		**P**		1		1
Helocordulia sp.	**4.8**	**P**			1	
Ladona sp.				1	1	
Macromia sp.	**6.2**	**P**	1	2	1	
Neurocordulia alabamensis			9	8	2	
Neurocordulia sp.	**5**				1	

SPECIES	T.V.	F.F.G.	Reach 1 (Reference)	Reach 2	Reach 3	Reach 4 (Reference)
Plecoptera						
Leuctridae		**SH**				
Leuctra sp.	**2.5**	**SH**	15	34	6	49
Perlidae		**P**	1			
Acroneuria sp.		**P**	9			
Acroneuria lycorias	**2.1**	**P**	1			
Eccoptura xanthenes	**3.7**	**P**	1			7
Perlesta placida sp. gp.	**4.7**	**P**				2
Hemiptera						
Veliidae		**P**				
Microvelia sp.		**P**				1
Rhagovelia obesa		**P**				2
Megaloptera						
Corydalidae		**P**				
Nigronia serricornis	**5**	**P**	5	2	1	3
Trichoptera						
Calamoceratidae		**SH**				
Anisocentropus pyraloides	**0.9**	**SH**				1
Hydropsychidae		**FC**	2			
Diplectrona modesta	**2.2**	**FC**	2	1		50
Hydropsyche sp.		**FC**	4	9		
Hydroptilidae		**PI**				
Hydroptila sp.	**6.2**	**PI**		1		
Lepidostomatidae		**SH**				
Lepidostoma sp.	**0.9**	**FC**		1	1	3
Leptoceridae		**CG**				
Oecetis sp.	**4.7**	**P**		2	1	
Triaenodes sp.	**4.5**	**SH**			1	
Odontoceridae		**SC**				
Psilotreta sp.	**0**	**SC**		1		2
Philopotamidae		**FC**				
Chimarra aterrima	**2.8**	**FC**		10		
Wormaldia sp.	**0.7**	**FC**				3
Psychomyiidae		**CG**				
Lype diversa	**4.1**	**SC**				1
Coleoptera						
Elmidae		**CG**				
Optioservus sp.	**2.4**	**SC**		1		
Promoresia elegans	**2.2**	**SC**	1	1		
Stenelmis sp.	**5.1**	**SC**	2	1	1	1
Hydrophilidae		**P**				
Sperchopsis tesselatus	**6.1**	**CG**		1		1
Diptera						
Ceratopogonidae		**P**				4
Chironomidae						
Ablabesmyia mallochi	**7.2**	**P**	1	1	4	1
Clinotanypus sp.		**P**			2	1

SPECIES	T.V.	F.F.G.	Reach 1 (Reference)	Reach 2	Reach 3	Reach 4 (Reference)
Conchapelopia sp.	**8.4**	**P**	7	21	6	9
Corynoneura sp.	**6**	**CG**	1			
Cryptochironomus sp.	**6.4**	**P**	1			
Lopescladius sp.			1			
Microtendipes rydalensis gp.			1	5	6	7
Nilotanypus sp.	**3.9**	**P**	2			
Parachaetocladius sp.	**0**	**CG**	2			2
Parametriocnemus sp.	**3.7**	**CG**			1	3
Pentaneura inconspicua				6	1	2
Polypedilum flavum (convictum)	**4.9**	**SH**	1			2
Procladius sp.	**9.1**	**P**		4	7	
Psectrocladius sp.	**3.6**	**SH**	1	15	6	12
Rheotanytarsus exiguus gp.	**5.9**		1	11	6	2
Stenochironomus sp.	**6.5**	**SH**	1			1
Tanytarsus sp.	**6.8**	**FC**		6		7
Tribelos jucundum	**6.3**					1
Xylotopus par	**6**	**SH**				7
Empididae	**7.6**	**P**				
Neoplasta sp.		**P**				3
Simuliidae		**FC**				
Simulium sp.	**6**	**FC**		4	1	
Tipulidae		**SH**				
Hexatoma sp.	**4.3**	**P**	2	1		2
Tipula sp.	**7.3**	**SH**		1		2

TOTAL NO. OF ORGANISMS	**95**	**218**	**78**	**225**
TOTAL NO. OF TAXA	**35**	**42**	**32**	**44**
NC BIOTIC INDEX assigned values	**4.81**	**5.34**	**5.52**	**4.36**

APPENDIX D: NCDWQ HABITAT ASSESSMENT FORM - COASTAL PLAIN

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.

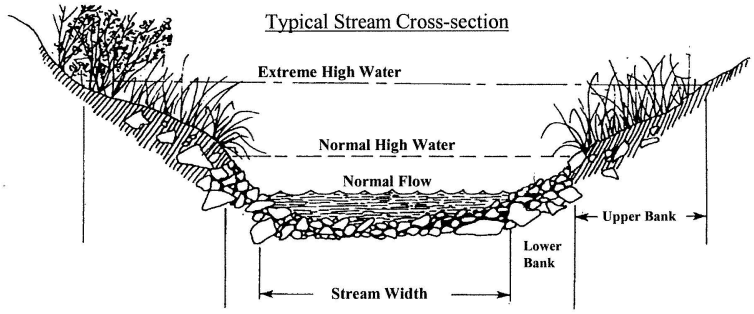
	Lft. Bank Score	Rt. Bank Score
A. Riparian zone **intact** (no breaks)		
1. zone width > 18 meters.....	5	5
2. zone width 12-18 meters.....	4	4
3. zone width 6-12 meters.....	3	3
4. zone width < 6 meters.....	2	2
B. Riparian zone **not intact** (breaks)		
1. breaks rare		
a. zone width > 18 meters.....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

Vegetation Plot 2

Vegetation Plot 3

Vegetation Plot 4

Vegetation Plot 5

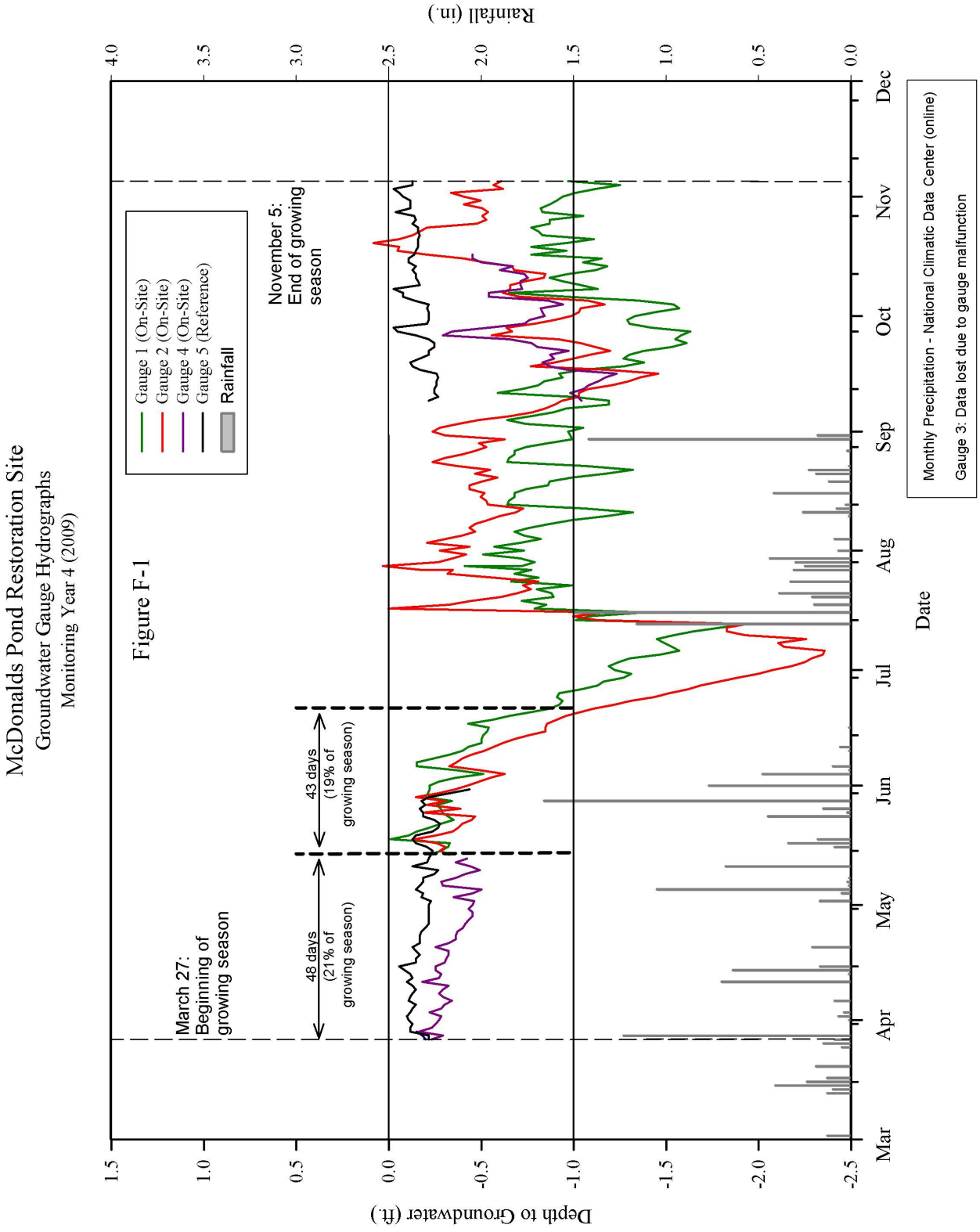
Vegetation Plot 6

Vegetation Plot 7

Vegetation Plot 9

Vegetation Plot 10

APPENDIX F: GROUNDWATER GAUGE HYDROGRAPH


McDonalds Pond Restoration Site
Groundwater Gauge Hydrographs
Monitoring Year 4 (2009)
Figure F-1
Gauge 1 (On-Site)
Gauge 2 (On-Site)
Gauge 4 (On-Site)
Gauge 5 (Reference)
Rainfall
March 27:
Beginning of
growing season
November 5:
End of growing
season
48 days
(21% of
growing season)
43 days
(19% 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 (online)
Gauge 3: Data lost due to gauge malfunction

APPENDIX G. REMEDIAL GRADING AS-BUILT LETTER OF COMPLETION

PBS&J®

An employee-owned company

September 16, 2009

Tony Doster, RF CF
North Carolina Region Manager
Resource Management Service, LLC
2704-C Exchange Drive
Wilmington, NC 28405

RE: Completion of Remedial Grading 100009505
McDonalds Pond Restoration Site, Richmond County, NC

Dear Tony:

PBS&J is pleased to notify you of the initiation of nuisance species management and completion of remedial grading at the McDonalds Pond Restoration Site (Site). Grading activities were targeted at lowering the elevation of the former dam in areas where the residual footprint remained above adjacent floodplain elevations. Grading activities also reduced the opportunity for beavers to re-construct dams along elevated areas of the former dam. Grading was carried out following initial nuisance species management by APHIS Wildlife Services. The following text, photos, and As-Built survey (Sheet 1) document the completed tasks.

Approximately 2 feet of surface material was removed from the former dam footprint (As-Built, Sheet 1). The compacted surface material of the former dam was removed and hauled away to an off-Site stock pile. The beaver dam was removed to restore flow, and the muck and sediment that was trapped behind the dam was spread across the newly graded surfaces to stimulate plant growth and enhance water retention. Rip-rap that was placed in the stream channel following the removal of McDonalds Pond (2005) was removed and the channel was re-shaped through the newly graded area. All graded areas within the former pond footprint were ripped for microtopography and enhanced water holding capacity. Grading was carried out near the southern Site boundary (As-Built Contour 277) in order to direct surface water from an adjacent seepage slope wetland onto the former dam footprint. Finally, a deep trench and spoil pile was created near the southern Site boundary to deter ATV travel onto the Site.

Plant survivorship was assessed within the limits of the former beaver dam impoundment. Mortality of plant species was found to be near 100 percent. Nearly all planted and volunteer species within the limits of the impoundment succumbed to inundation and/or were felled/uprooted by beaver. PBSJ suggests that inundated and graded areas be replanted. Site planting will be require a supplemental contract to be initiated in Winter/Spring 2010 (or sooner based on seedling availability). Planting should be performed within all graded areas, as well as within areas affected by beaver activity (total area approximately 2.0 acres). Plant species will be selected according to reference plant communities at the required stocking levels (680 trees/acre). Once planting is complete, an immediate inventory of planted stems will be taken.

We look forward to providing continued services at the McDonalds Pond Restoration Site. A supplemental contract can be initiated once seedling availability and the subsequent timeline for Site planting can be determined.

Please feel free to call me if you have any questions or concerns.

Sincerely,
PBSJ

Jens Geratz
Senior Scientist

Attachments

Completion of Remedial Grading - Site Photos

Dam surface prior to grading activities

Beaver impoundment prior to grading activities

Dewatering the beaver impoundment

Removing beaver dam and beginning grading activities

Grading the former dam surface

Grading the former dam surface

Completion of Remedial Grading - Site Photos

Following grading, the former dam elevation now matches the surrounding floodplain

Stream channel flowing through newly graded area

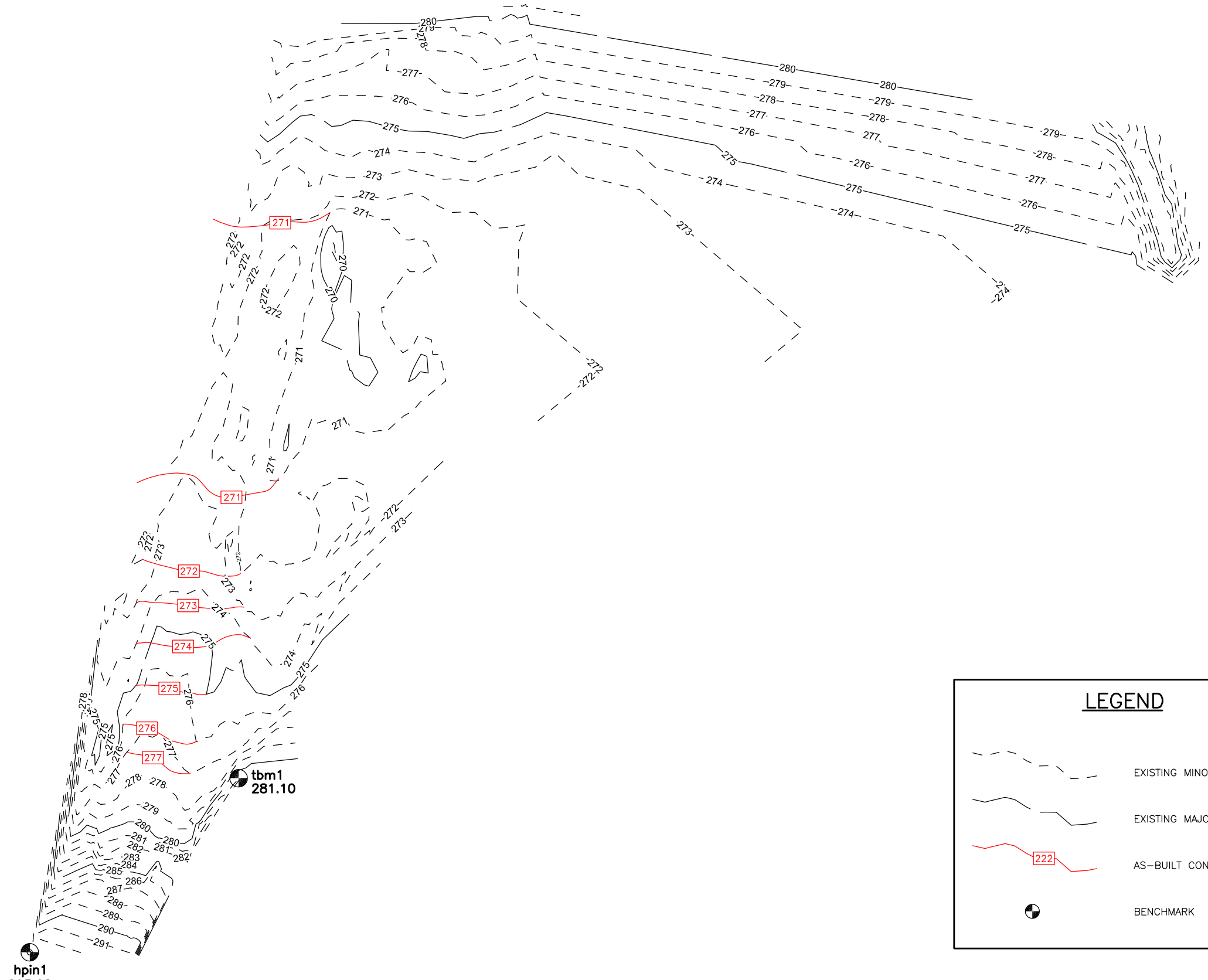
Confluence of existing channel with newly reshaped channel

Finished grade near wetland boundary

Finished grade of former dam from southern Site boundary

Trench and soil pile at southern Site boundary

NAD 83



80' 0 80'

SCALE: 1"=80'

LEGEND

- EXISTING MINOR CONTOURS
- EXISTING MAJOR CONTOURS
- 222 AS-BUILT CONTOURS
- BENCHMARK

PBS&J

REVISIONS

Client:

RESOURCE MANAGEMENT SERVICE, LLC

Project:

McDONALDS POND REMEDIAL GRADING

RICHMOND COUNTY NORTH CAROLINA

Title:

AS-BUILT

Dwn. By:	Ckd. By:
TAL	JG
Date:	Scale:
SEP 2009	AS SHOWN

Project No.: 100009505

SHEET 1