MITIGATION REPORT

FULL DELIVERY PROJECT TO PROVIDE WETLAND AND STREAM RESTORATION
YADKIN RIVER BASIN CATALOGUING UNIT 03040201

MCDONALDS POND RESTORATION SITE
Richmond County, North Carolina

PREPARED FOR:

NCDENR - ECOSYSTEM ENHANCEMENT PROGRAM
1652 Mail Service Center
Raleigh, North Carolina 27699-16152

JULY 2006

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MCDONALDS POND RESTORATION SITE
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 2 miles northeast of the town of Hamlet and 3 miles east of the town of Rockingham. IP was selected as a contractor to provide **4,364 stream mitigation units (SMUs) and 23.4 wetland mitigation units (WMUs)** (EEP Contract No. D04020-2). In order to provide stream channel restoration and riverine wetland restoration, IP has removed the McDonalds Pond Dam located on Falling Creek in Richmond County, North Carolina.

Falling Creek, the major drainage feature on-Site, was previously impounded by the McDonalds Pond Dam, constructed over 70 years ago. Approximately 3,700 linear feet of Falling Creek and tributaries were impacted by the construction of the pond 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.

Dam Removal

The McDonalds Pond 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 off of or within the footprint of the former dam during dam removal operations, thereby minimizing the impact to the adjacent intact forest and wetland soil.

Numerous Best Management Practices (BMPs) were undertaken to avoid impacts to aquatic species in the vicinity of the dam site. Silt fence and hay bale arrays were constructed to avoid sediment fluxes downstream during and after dam removal. The dam and adjacent staging area were seeded with appropriate temporary herbaceous vegetation and later planted with appropriate tree species.

Mitigation Goals

The primary goals of the McDonalds Pond Dam removal are to (see Table 1 for details):

- **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.

- **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 Forests (Schafale and Weakely, 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.

Monitoring Plan

To ensure the Site meets regulatory stream and wetland restoration monitoring criteria, each parameter on-Site will be monitored annually for five (5) years or until success criteria has been achieved. Primary success criteria of the project include: 1) 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) wetland hydrology as defined in the US Army Corp of Engineers Wetland Delineation Manual, 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.

Four (4) permanent stream monitoring reaches have been established to monitor stream restoration success (one upstream of the former pond, two within the former pond footprint, and one downstream of the former pond). Success criteria for stream restoration will include 1) successful classification of restored/enhanced reaches as functioning systems, 2) channel stability indicative of a stable stream system, and 3) development of characteristic lotic aquatic communities native to the area.

Site groundwater hydrology will be monitored by four (4) auto-logging monitoring gauges. Gauges will be downloaded as needed throughout the growing season. Hydrologic success criteria will be achieved by gauges registering groundwater levels within the upper 12 inches of the soil surface for a minimum number of consecutive days corresponding to at least 12.5 percent of the growing season in Richmond County under normal annual precipitation. Under drought conditions, off-Site groundwater reference data from one (1) nearby gauge will be used to evaluate Site groundwater hydrologic success.

Eight (8) 10 X 10m^2 vegetation monitoring plots have been established to monitor Site vegetation. Stem counts of planted and volunteer species as well as an assessment of planted stem survivability will be performed annually. Vegetative monitoring success criteria will be achieved by plot data indicating an average number of planted stems per acre exceeding 320 stems/acre after the third year of monitoring and 260 stems/acre after the fifth and final year of project monitoring.

If vegetative success criteria are not achieved, supplemental plantings will be performed with native species approved by the appropriate regulatory agencies. Supplemental plantings will be performed as needed until success criteria are achieved.

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**

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Photo of *Semotilus lumbee* (sandhills chub) captured downstream from McDonalds Pond in Falling Creek on 20 September 2004. (MHH 04-039). Copyrighted by International Paper Company.

MITIGATION REPORT

FULL DELIVERY PROJECT TO PROVIDE WETLAND AND STREAM RESTORATION YADKIN RIVER BASIN CATALOGUING UNIT 03040201

MCDONALDS POND RESTORATION SITE

1.0 INTRODUCTION

The North Carolina Department of Environment and Natural Resources, 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 (Figure 1, Appendix A). In order to successfully accomplish the goals of the project, IP enlisted the services of EcoScience Corporation (ESC), which provide additional scientific and engineering expertise.

1.1 Project Location

The McDonalds Pond Restoration Site (‘hereafter referred to as the “Site”) is located approximately 2 miles northeast of the town of Hamlet and 3 miles east of the town of Rockingham between NC Route 1 and NC Route 177. The Site comprises 127.86 acres, and is situated along Falling Creek 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.

1.2 Pre-existing Conditions

1.2.1 Watershed Characteristics

The Site is located in the Coastal Plain Physiographic Province of North Carolina within the Yadkin-Pee Dee River Basin in the United States Geologic Survey (USGS) Hydrologic Unit 03040201 (North Carolina Division of Water Quality [DWQ] Subbasin 03-07-16) (Figure 1, Appendix A). Annual precipitation within the project vicinity is approximately 47.4 inches per year distributed evenly throughout the year (NRCS 1999). This subbasin of the Yadkin-Pee Dee River Basin is almost entirely contained within Richmond County and consists of the last segment of the Pee Dee River main stem from Blewett Falls Lake to the border of North Carolina and South Carolina.

Physiography within the region is characterized as dissected irregular plains with moderate to steep side slopes. Seepage and groundwater support steady stream flows and some small, saturated wetlands (Griffith *et al.* 2002). The ecoregion is characterized by low- to moderate-gradient streams with sandy bottoms. Elevations range from a high of 310 feet National Geodetic Vertical Datum (NGVD) on adjacent upland slopes to a low of approximately 260 feet NGVD at the Site outlet (USGS Hamlet, NC quadrangle).

Falling Creek, a third-order stream, encompasses a drainage area of approximately 2.5 square miles at the western Site boundary. Falling Creek flows through a relatively wide, low-sloped (approximately 0.02 rise/run) alluvial valley with a floodplain width ranging from approximately 300 to 600 feet. The

upstream drainage basin is characterized by managed forest land, agricultural land, and sparse industrial/residential development.

1.2.2 Pond and Stream Characteristics

1.2.2.1 McDonalds Pond

McDonalds Pond was a 17.7 acre pond approximately 2,000 feet long and approximately 630 feet wide at its widest point near the dam. McDonalds Pond Dam was an earthen dam that stretched approximately 630 feet across the center of the Falling Creek floodplain constructed of native sand to sandy clay loam over 70 years ago (est. early 1930's). The dam was constructed with several water level control structures, including a brick and mortar riser structure at the northern extent of the dam, a flash board riser/gate valve system located near the center of the dam, and an emergency spillway located at the southern extent of the dam.

The brick and mortar riser structure at the northern extent of the former dam channeled high water through multiple culverts and into an excavated/eroded ditch (hereafter referred to as the "northern outfall channel") (Photos 1 and 2). The northern outfall channel extended parallel to the main channel of Falling Creek for approximately 500 feet before merging into overland flow through the center of the floodplain. The change in elevation from the outlet pipe to the bottom of the outfall channel was approximately 3 feet. The drop in elevation caused erosion and scouring of the outfall channel and subsequent deposition of excess sediment onto the floodplain down valley. This brick and mortar riser was serving as the primary discharge for the pond prior to dam removal.

Photo 1: Pond Drainage Inlet – Brick and mortar riser structure at the northern outfall channel located within the pond at the northern extent of the dam.
Source: International Paper Company 2004

Photo 2: Pond Drainage Outlet – Concrete culverts located at the northern outfall channel and adjacent eroded soil.
Source: International Paper Company 2004

The flash board riser/gate valve system formerly located near the center of the dam historically served as the primary water control structure for the pond (Photo 3). However, the gate valves were not operating immediately prior to dam removal due to infrequent use. This structure was comprised of three 8 inch diameter outlet pipes with traditional gate valves attached to each pipe outlet. The gate valves are denoted with red arrows in Photo 4.

Photo 3: Pond Drainage Inlet – Brick flash board riser leading to gate valve structures located near the center of the dam.

Source: International Paper Company 2005

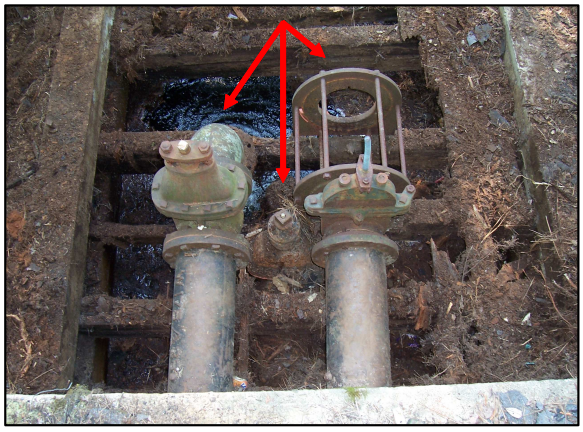

Photo 4: Pond Drainage Outlet – Three gate valves attached to 8 inch diameter pipes near the center of the dam.

Source: International Paper Company 2005

The emergency spillway formerly located at the southern extent of the dam consisted of a small excavated channel that carried pond discharge during high flow events.

1.2.2.2 Stream Characteristics

Portions of the on-Site reach of Falling Creek, immediately above and below McDonalds Pond, are characterized as braided, anastomosed streams without well-defined channels. During winter and spring, and during periods of high flow, water travels overland and inundates wide areas of the riverine forest community. Observations at various points in time indicate that water depths within the floodplain downstream of the dam are frequently greater than one foot. The associated downstream floodplain, which is characterized by braided channels, is approximately 300 to 600 feet in width. Based on USGS quadrangles, channel elevations drop approximately 5 feet over the approximate 2,000 feet immediately downstream of McDonalds Pond, resulting in a valley slope of approximately 0.0025 (rise/run).

Reference stream reaches in the area (both on-Site and off-Site) include both sinuous, single threaded E-type and braided, D-type streams (Rosgen 1996). Streams that occur in low-gradient valleys, as observed on-Site, are prone to perturbation (i.e., beaver and tree fall) and easily revert to braided systems. A combination of stream types (both E- and D-types) appear to be stable and represent the objective for restoration of natural stream processes in the footprint of McDonalds Pond (Photos 5 and 6).

Photo 5: Braided D-type stream section located upstream of the former pond near stream reference reach.
Source: EcoScience Corporation 2005

Photo 6: Single threaded E-type stream section located upstream of the former pond within stream reference reach.
Source: EcoScience Corporation 2006

1.2.3 Water Resources

1.2.3.1 Water Quality

The project segment of Falling Creek [NCDWQ Index 13-39-12-(1)] provides water quality functions to approximately 2.5-square mile watershed upstream of the Site. A secondary water supply intake for the City of Rockingham is located at Old City Pond, located directly above Hinson Lake and approximately 3.6 stream miles downstream of the Site. Highway runoff enters the Site from the NC 177 highway corridor and a Seaboard Coast Line railway yard located at the headwaters of Falling Creek.

There are seven permitted National Pollutant Discharge Elimination System (NPDES) Dischargers and two permitted NPDES Individual Stormwater Dischargers in subbasin 03-07-16. The nearest permitted discharger is greater than 10 miles downstream of the project. No permitted discharges occur upstream of the Site. The majority of water quality impacts in the subbasin were due to nonpoint source pollution, including stormwater runoff. The Hitchcock Creek watershed is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NCWRP/EEP as an area with the greatest need and opportunity for stream and wetland restoration efforts (NCWRP 2003).

1.2.3.2 Best Usage Classifications

Falling Creek has a Best Usage Classification of WS III, designating it as water supply waters. The stream does not have a Use Support Rating. Falling Creek drains into Hitchcock Creek approximately 7.0 stream miles west of the Site. Hitchcock Creek has a Best Usage Classification of C, and is rated Supporting. Hitchcock Creek drains into the Pee Dee River which has a Best Usage Classification of C,

and is Supporting (NCDWQ 2004, 2003a). Class C waters are suitable for aquatic life propagation and survival, fishing, wildlife, secondary recreation, and agriculture.

1.3 Restoration Summary

1.3.1 Stream Restoration

Stream restoration was achieved through the removal of the McDonalds Pond Dam. 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.

Currently, sections of Falling Creek have developed braided, ponded, and anastomosed conditions. These sections are located for short distances immediately upstream and downstream of the former dam as well as immediately upstream of the former pond. It is anticipated that some of these stream sections will develop more defined channels as the historic hydrologic patterns return to the Site, while other sections will remain with these conditions, similar to reference streams in the region. For those sections of Falling Creek with braided, ponded, or anastomosed conditions, a single braid or a straight line distance will be used to determine stream length.

See attached as-built drawing illustrating the dam cross sections before and after dam removal (Figure X1, Appendix B). The total stream channel length restored by the dam removal is 2,969 linear feet (Figure 2, Appendix A).

1.3.2 Stream Enhancement

Stream enhancement was achieved through the removal of the dam and the filling of the northern outfall channel, returning the historic hydrologic characteristics (stream volume and velocity) to a section of impacted stream channel downstream of the former dam. Sections of this stream exhibit anastomosed conditions characteristic of reference streams in the region. The total stream channel length enhanced is 770 linear feet (Figure 2, Appendix A).

1.3.3 Stream Preservation

In addition to the stream restoration and enhancement, 5,800 linear feet of Falling Creek (both up- and downstream of the former pond) and numerous tributaries to Falling Creek are provided as preservation within the Site (Figure 2, Appendix A). Stream preservation will provide protection and habitat to the headwaters of Falling Creek.

1.3.4 Riverine Wetland Restoration

Riverine wetland restoration was accomplished through the excavation of the McDonalds Pond Dam and the establishment of native Streamhead Pocosin and Atlantic White Cedar forest communities. The former pond was planted with an assortment of wetland trees characteristic of the reference forest ecosystem. See attached as-built drawing illustrating the planting plan for the Site (Figure X2, Appendix B). Wetlands within the former pond footprint are expected to retain hydrologic regimes suitable for the survival of indigenous hydrophytic vegetation. The total area of riverine wetland restoration is 17.7 acres (Figure 2, Appendix A).

1.3.5 Riverine Wetland Enhancement

Riverine wetland enhancement was accomplished through the removal of the dam and subsequent restoration of the historic water table to the section of floodplain immediately upstream of the pond where the backwater effects of the dam had altered and degraded the wetland community. The increased water table height associated with the backwater effects of the dam killed the floodplain forest canopy and converted the area to an open canopy marsh wetland. With the removal of the dam and the restoration of the historic water table height, this area will reestablish the characteristic hydrology for the historic riverine plant communities. The total area of riverine wetland enhancement is 4.2 acres (Figure 2, Appendix A).

1.3.6 Riverine Wetland Preservation

In support of the wetland restoration and enhancement activities, 77.8 acres of wetland preservation are provided within the Site (Figure 2, Appendix A). The wetland preservation areas will provide connectivity for wildlife use and provide for valuable contiguous regional corridors along major stream courses in the region. Additionally, these preserved areas will assist to ensure that water quality benefits realized by the stream and wetland restoration activities are not negated by adjacent changes in land use.

1.3.7 Buffer Preservation

In addition to the creditable restoration activities performed on-Site, 25.6 acres of upland/wetland ecotone buffer are provided for within the Site (Figure 2, Appendix A). These buffer areas support various plant and animal communities associated with the different stages of forest succession along various physical and hydrologic gradients. Along the toe of the slope and adjacent to existing wetlands, vegetation resembles pocosin-like vegetation. Upslope communities in the buffer zone include historically managed loblolly (*Pinus taeda*), slash (*Pinus elliottii*), and longleaf pine (*Pinus palustris*) forests. These areas will also provide connectivity for wildlife communities and further buffer the restored stream and wetland areas.

1.4 Project Mitigation Goals

The primary project goals include 1) the restoration of a stable, meandering stream channel through the areas impacted by the McDonalds Pond 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.

- **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 Forests (Schafale and Weakely, 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.

2.0 DAM REMOVAL

2.1 Pre-Removal Surveys

2.1.1 Pre-Removal Aquatic Species Surveys

Pre-removal baseline aquatic species surveys were performed at multiple locations downstream of the former pond, within the pond, and upstream of the former pond by IP biologists in September of 2004. Surveys were performed to catalogue species expected to re-colonize the stream sections impacted by the former pond. Sampling methodologies for macroinvertebrates, fish, and mussels are outlined in Section 3.1.2. Table 2 displays aquatic species identified during pre-removal monitoring surveys at the Site.

Table 2: McDonalds Pond Restoration Site: Pre-removal Survey Results

Scientific Name	Common Name
Freshwater Mussels	~
None	~
Freshwater Clams	~
Sphaerium sp.	fingernail clam
Freshwater Fish	~
Esox americanus	redfin pickerel
Notropis cummingsae	dusky shiner
Semotilus lumbee	sandhills chub
Ameiurus platycephalus	flat bullhead
Noturus insignis	margined madtom
Aphredoderus sayanus	pirate perch
Fundulus lineolatus	lined topminnow

Gambusia sp.	mosquitofish
Enneacanthus chaetodon	black-banded sunfish
Enneacanthus gloriosus	blue-spotted sunfish
Lepomis gulosus	warmouth
Lepomis macrochirus	bluegill
Lepomis marginatus	dollar sunfish
Aquatic Salamanders	~
None	~

2.1.2 Pre-Removal Water and Sediment Analyses

Two water samples (one downstream of the former pond, one within the former pond) and one sediment sample (within the former pond) were collected at the Site in late 2004. The purpose of these analyses was to ensure that toxic materials potentially hazardous to aquatic resources would not be released with the removal of the pond dam.

Water sample results indicated that there was no water quality toxicity at the Site and all parameters were within the allowable state limits. Also, the sediment sample did not exceed the probable effects concentrations (PECs, concentrations above which adverse effects to sediment dwelling organisms may be expected) for any elemental contaminant analyzed as a part of the study (Appendix C). Thus, potential contamination of the water or sediments present within the former pond Site is unlikely to be of concern, either in-situ or upon mobilization.

2.2 Dewatering

Prior to dam removal, the former pond was dewatered. Dewatering was conducted in order to 1) begin normalized sediment transport from the upper reaches of the former pond through Falling Creek, 2) avoid/mitigate high hazard conditions at the Site, and 3) allow natural riparian recruitment within the footprint of the former pond to mitigate potential surface soil erosion.

The former pond was dewatered beginning in the late summer – early fall of 2005. Initial dewatering was accomplished through the opening of two of the three gate valves located near the center of the dam (Photo 7). In addition, a 4 inch PVC siphon was installed to assist with the rise in the pond pool elevation following storm events (Photo 8). By late January – early February 2006, the normal pond pool elevation of approximately 281 feet above mean sea level (MSL) (equaling approximately 18 acres) was lowered to approximately 275 feet above MSL (equaling approximately 5 acres). In early – mid February, the third and final gate valve was removed, which allowed for the pond pool elevation to be reduced to approximately 273 feet above MSL or approximately 3 acres by the end of late February 2006.

Photo 7: Removal of two gate valves using an acetylene torch.
Source: International Paper Company 2005

Photo 8: 4 inch siphon system installed to assist with the control of pond pool elevation following storm events.
Source: International Paper Company 2005

2.3 Dam Removal

Dam removal activities began in late February 2006, when IP and contractors began removing planted pine trees and small bushes from the former earthen dam (Photo 9). Equipment gained access to the north side of the dam via IP forest roads and a staging area was established directly adjacent in an upland pine stand. Forest harvesting conducted on-Site was done in a manner that protected adjacent resources, e.g., intact forest and wetland soil, outside of the dam footprint. A small grapple skidder and bull dozer worked in tandem to remove trees and bushes from the dam.

Photo 9: Grapple skidder (background) and bull dozer (foreground) working in tandem to remove trees from the former dam.
Source: International Paper Company 2006

Following the clearing of vegetation from the dam, heavy equipment operated off of or within the footprint of the former dam during excavation activities, thereby minimizing the impact to adjacent intact forest and wetland soil. A portion of the excavated dam material was deposited into a segment of the northern outfall channel, moderately compacted, and graded to the elevation of the adjacent undisturbed soil. The remaining fill material was either graded onto existing IP dirt roads (upland sections outside of the easement area) or hauled to the nearest appropriate landfill.

2.4 Site Stabilization

Numerous Best Management Practices (BMPs) were undertaken to avoid impacts to aquatic resources in the vicinity of the former dam throughout the removal process, including: 1) the construction of silt fence and hay bale arrays to avoid sediment fluxes downstream during and after dam removal (Photos 10 and 11), 2) the placement of rip-rap directly below the former dam within the newly developed stream channel to stabilize soil and streambed (Photo 10), 3) the strategic placement of logging debris outside of the floodplain on slope soils to assist with site stabilization and to prevent trespass into the restoration area (Photo 11), and 4) the seeding of the dam and adjacent staging area with appropriate temporary herbaceous vegetation, which was later planted with appropriate tree species.

Photo 10: Temporary silt fence, spread hay, and rip-rap located adjacent to new stream channel.
Source: EcoScience Corporation 2006

Photo 11: View of former dam from south-side looking north at erosion control measures including logging debris, silt fence, and hay bales.
Source: EcoScience Corporation 2006

3.0 MONITORING PLAN

To ensure the Site meets regulatory stream and wetland restoration monitoring criteria, each parameter on-Site will be monitored annually for five (5) years or until success criteria has been achieved. Primary success criteria of the project include: 1) successful classification of restored/enhanced reaches as functioning systems (Rosgen 1996), 2) channel stability indicative of a stable stream system, 3) development of characteristic lotic aquatic communities, 4) wetland hydrology as defined in the US Army Corp of Engineers Wetland Delineation Manual, 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.

3.1 Stream Monitoring

3.1.1 Stream Channel

Four (4) permanent stream monitoring reaches have been established to monitor stream restoration success (one upstream of the former pond, two within the former pond footprint, and one downstream of the former pond). Stream reaches 1 and 4 will serve as reference reaches and stream reaches 2 and 3 will serve for on-Site monitoring (Figure 3, Appendix A). Each monitoring reach is comprised of approximately 150 foot section of stream with one (1) stream cross-section. Each sampling reach has been described using total station survey equipment in order to characterize stream pattern, profile, and dimension. Cross-sections will be surveyed in the first, third, and fifth years of project monitoring in

order to assess changes in the channel dimensions as the natural, unimpeded hydrologic regime returns to the stream.

3.1.2 Aquatic Species Sampling

Changes in the aquatic community within the former pond are anticipated as the restoration of the natural lotic flow regime to Falling Creek and its previously impounded tributaries diversifies the aquatic habitat. In order to track these changes, benthic macroinvertebrate and fish sampling will be conducted annually within each stream monitoring reach. During pre-removal monitoring, aquatic species sampling was conducted at multiple locations downstream, within, and upstream of the pond. These data will serve as baseline data for subsequent monitoring within the established stream monitoring reaches. Benthic macroinvertebrate sampling will be conducted using the North Carolina Division of Water Quality (NCDWQ) protocols outlined for the Standard Qualitative Method in the Standard Operating Procedures for Benthic Macroinvertebrates (NCDWQ 2003b). Fish sampling will be conducted using the NCDWQ Standard Operation Procedure for Stream Fish Community Assessment & Fish Tissue collection methods (NCDWQ 2001).

Benthic macroinvertebrate samples collected from each stream monitoring reach will be shipped to a NCDWQ-certified lab for processing and identification. The lab will provide standard community data including total number of organisms, total number of taxa, Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa, EPT: Chironomidae (midge) ratio, and biotic index assigned values (BIAV). Fish species observed while conducting surveys will be recorded and assigned a relative abundance value based on the number of individuals observed at the stream monitoring reach.

3.1.3 Habitat Assessment

NCDWQ Habitat Assessment Forms (HAFs) (most recent version), which evaluate the quality, character, and abundance of habitat niches, will be completed to provide a score that describes the habitat availability and quality at each stream monitoring reach. Habitat Assessment Forms will be completed annually at all stream monitoring reaches throughout the five-year monitoring period. Improvements in Habitat Assessment Form scores are anticipated as the restoration of the natural lotic flow regime to Falling Creek and its previously impounded tributaries diversifies aquatic habitat.

In addition, stream habitat characterizations including habitat composition and percentage representation will be completed using plan-view drawings derived from total station surveys of the stream monitoring reaches (Figure 3, Appendix A). Drawings will be updated annually with regard to habitat composition (e.g. adjacent streambank trees, root mats/balls, stumps, coarse woody debris, leaf packs, undercut banks, etc.) and percentage representation will be recorded through ocular estimates. Habitat diversity is expected to approximate the natural range of lotic conditions at the Site as the historic lotic flow regime returns to Falling Creek and its previously impounded tributaries.

3.2 Photography and Videography

Digital photography and videography will be used to qualitatively assess improvements in aquatic community habitat, stream channel stability, and wetland forest establishment. Photography and videography is proposed annually throughout the five-year monitoring period at each stream monitoring reach and at three (3) permanent photo points.

At each stream monitoring reach, a minimum of four photographs will be taken: one facing upstream from the downstream extent of the reach (channel thalweg), one facing downstream from the upstream extent of the reach, one from the left bank towards the right bank at the cross-section, and one from the right bank towards the left bank at the cross-section. Videography will consist of a brief narrated panorama at each stream monitoring reach.

In addition to photography and videography proposed at the stream monitoring reaches, three (3) permanent photo points have been established to document changes in the former pond. Multiple photos and one brief narrated panorama will be conducted at each of the three photo points.

3.3 Groundwater Hydrology

Four (4) auto-logging monitoring gauges have been installed to monitor Site groundwater hydrology. Gauges will be downloaded as needed throughout the growing season. Under drought conditions, off-Site groundwater reference data from one (1) nearby gauge will be used to evaluate Site groundwater hydrologic conditions. See Figure 4, Appendix A for gauge locations.

3.4 Vegetation

Eight (8) 10 X 10m^2 vegetation monitoring plots have been established to monitor Site vegetation. Stem counts of planted and volunteer species as well as an assessment of planted stem survivability will be performed in late summer or early fall of each monitoring year. See Figure 5, Appendix A for vegetation plot locations.

4.0 MITIGATION SUCCESS CRITERIA

4.1 Stream Restoration

Success criteria for stream restoration will include 1) successful classification of restored/enhanced reaches as functioning systems (Rosgen 1996), 2) channel stability indicative of a stable stream system, and 3) development of characteristic lotic aquatic communities native to the area.

Biotic indices will be used to support success evaluation for stream restoration. Macroinvertebrate species are assigned biotic index values based on their tolerance of water quality conditions. Therefore, it is expected that macroinvertebrate species with lower biotic index values will begin to colonize stream sections within the former impounded reaches of Falling Creek, indicating that water quality conditions have shifted from a characteristic lentic system to a more historically natural lotic system.

In order to evaluate anticipated improvements in characteristic lotic aquatic communities, the average biotic indices of macroinvertebrate samples collected at stream monitoring reaches within the former pond will be compared with the average biotic indices of samples collected in reference stream monitoring reaches. Success criteria will be achieved by comparing the means of the biotic indices from data collected at stations within the former pond with the means of the reference stations.

Fish sampling data will be used to support success evaluation for stream restoration. Annual migration of two targeted rare endemics including the pinewoods darter (*Etheostoma mariae*) and the sandhills chub (*Semotilus lumbee*) will be tracked throughout the five-year monitoring period. Success criteria will be achieved by the documented presence of the targeted species within the former Site pond. See Appendix D for a list of fish species that could establish within the restored reaches of Falling Creek.

Habitat assessment data (see Section 3.1.3) will be used to support success evaluation for the improved aquatic community. As the conditions within the former Site pond transition from lentic, impeded flow to those typical of a free-flowing, lotic system, it is anticipated that the NCDWQ Habitat Assessment Form scores will qualitatively increase. Habitat Assessment Form scores at stream monitoring reaches within the former pond will be compared with reference stream monitoring reaches to assess habitat improvement throughout the five-year monitoring period. Habitat characterizations of stream monitoring reaches within the former pond using plan-view drawings will be compared to reference stream monitoring reaches in order to evaluate habitat composition and percentage representation development within the former impounded reaches of Falling Creek. These data are expected to correspond with lotic aquatic species development as characteristic habitat establishes with the former impounded reaches of Falling Creek. Photography and videography (see Section 3.2), performed at each stream monitoring reach, will also be used to facilitate assessing improvements in aquatic species habitat.

4.2 Wetland Restoration

Wetland hydrologic success criteria will be achieved by groundwater gauges registering levels within the upper 12 inches of the soil surface for a minimum number of consecutive days corresponding to at least 12.5 percent of the growing season [March 27th – November 5th] in Richmond County under normal annual precipitation (NRCS 1999). However, if drought conditions prevent the Site from achieving hydrologic success criteria, the on-Site gauge hydroperiods must meet or exceed 75 percent of the hydroperiods exhibited by the nearby reference gauge.

Wetland vegetative monitoring success criteria will be achieved by plot data indicating an average number of planted stems per acre exceeding 320 stems/acre after the third year of monitoring and 260 stems/acre after the fifth and final year of project monitoring.

4.3 Bonus Factors

4.3.1 Biodiversity and Protected Species

Located within the Sand Hills ecoregion of North Carolina, the McDonalds Pond Restoration Site harbors a diverse biota. Both aquatic and terrestrial biodiversity in and around the former McDonalds Pond is significant due to the unique physiography and associated aquatic and terrestrial habitat. International Paper Company scientists have prepared a summary of the potential benefits associated with the restoration, enhancement, and preservation efforts on-Site to plants and animals associated with rivers, streams, ponds, bogs, and seepage heads. The removal of the McDonalds Pond Dam could benefit the following:

- 48 species of fishes which include:
  - Two critically imperiled species, that are proposed Endangered (State)
  - Two Special Concern (State), endemic to Carolina Sandhills

- 16 species of freshwater mussels including,
  - One Endangered (Federal)
  - Three Endangered (State)
  - Four Threatened (State)
  - One Special Concern (State)
  - One Significantly Rare (State)

- 6 aquatic insects that are Significantly Rare (State)

- 2 state listed mammals
  - One Threatened
  - One Special Concern

- 1 Significantly Rare amphibian

- 22 rare, threatened, or endangered species of plants including
  - 1 Endangered (Federal)
  - 8 Special Concern (Federal)
  - 4 Endangered (State)
  - 5 Threatened (State)
  - 17 Significantly Rare (State)

Summary tables are provided in Appendix D.

5.0 MAINTENANCE AND CONTINGENCY PLAN

If vegetation success criteria are not achieved by on average planted stem/acre density calculations from combined sample plot data, supplemental plantings will be performed with native tree species approved by the appropriate regulatory agencies. Supplemental plantings will be performed as needed until vegetative success criteria are achieved.

Historically, beaver activity has been observed within the Site upstream of the former pond. Throughout the five-year monitoring period, the Site will be periodically monitored for beaver activity encroachment into the restored/enhanced stream sections and appropriate remedial measures will be pursued on an as needed basis.

6.0 REFERENCES

Griffith, G.E., Omernik, J.M., Comstock, J.A., Schafale, M.P., McNab, W.H., Lenat, D.R., MacPherson, T.F., Glover, J.B., and Shelburne, V.B. 2002. Ecoregions of North Carolina and South Carolina, (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,500,000).

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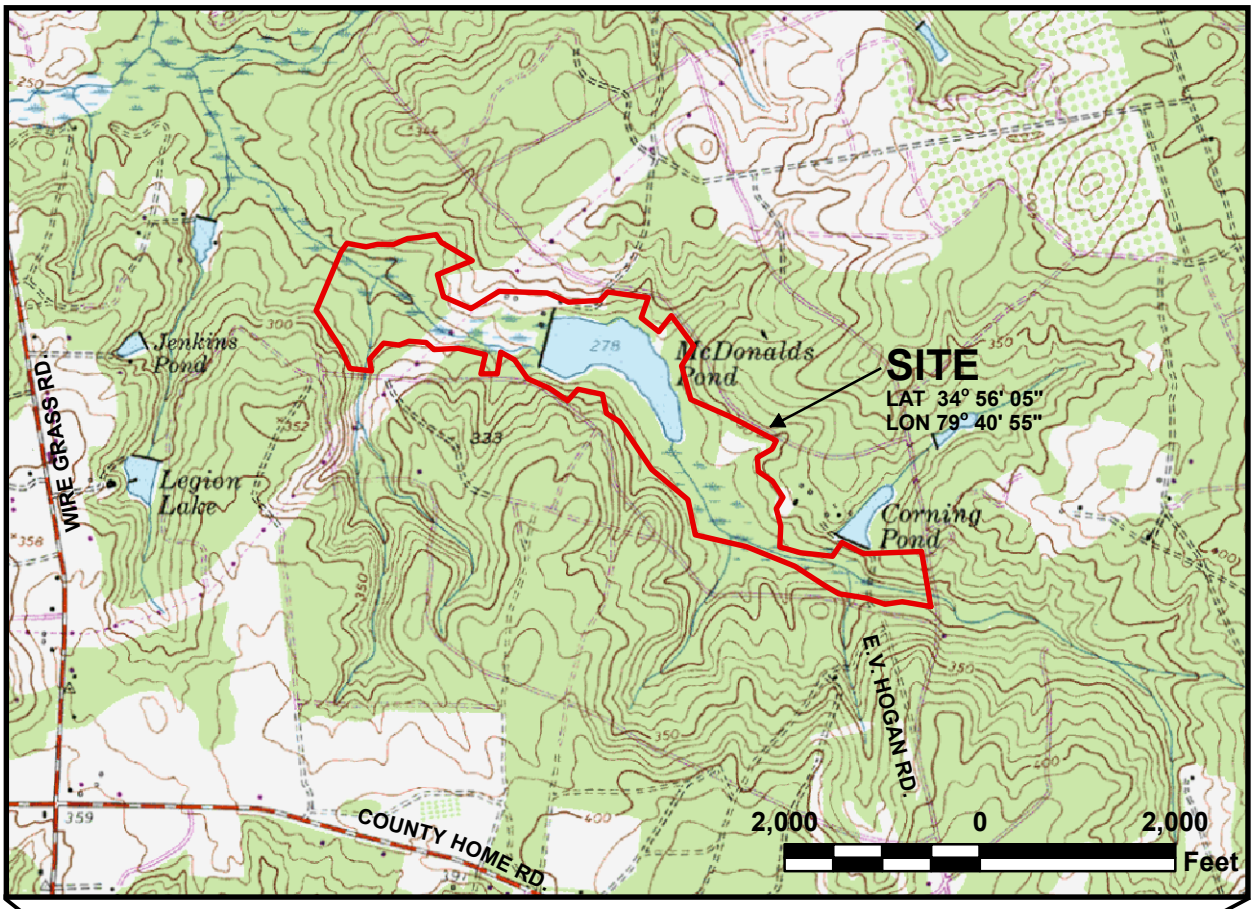
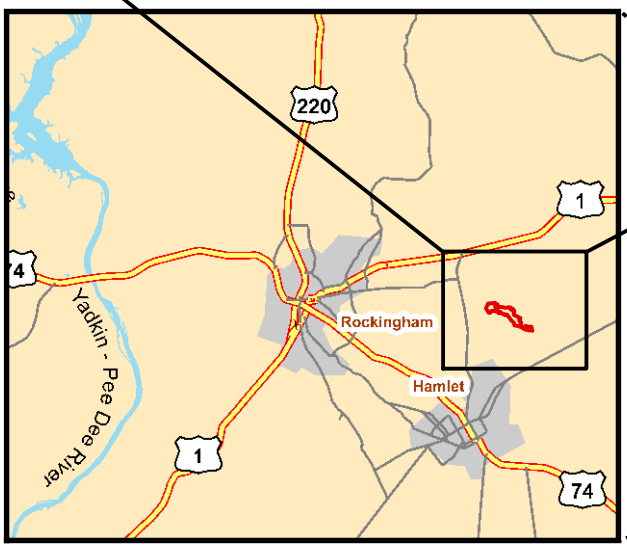
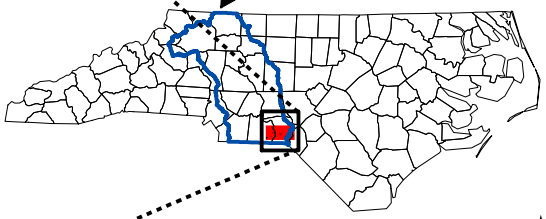
Rosgen, D. 1996. Applied Fluvial Geomorphology. Wildland Hydrology: Pagosa Springs, CO.

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.

APPENDIX A: Figures







EcoScience Corporation
Raleigh, North Carolina 27605

Client: Ecosystem Enhancement Program

Project:

SITE LOCATION MAP

McDONALDS POND RESTORATION SITE

Richmond County, North Carolina

Dwn By:	Ckd By:
DGJ	JWG

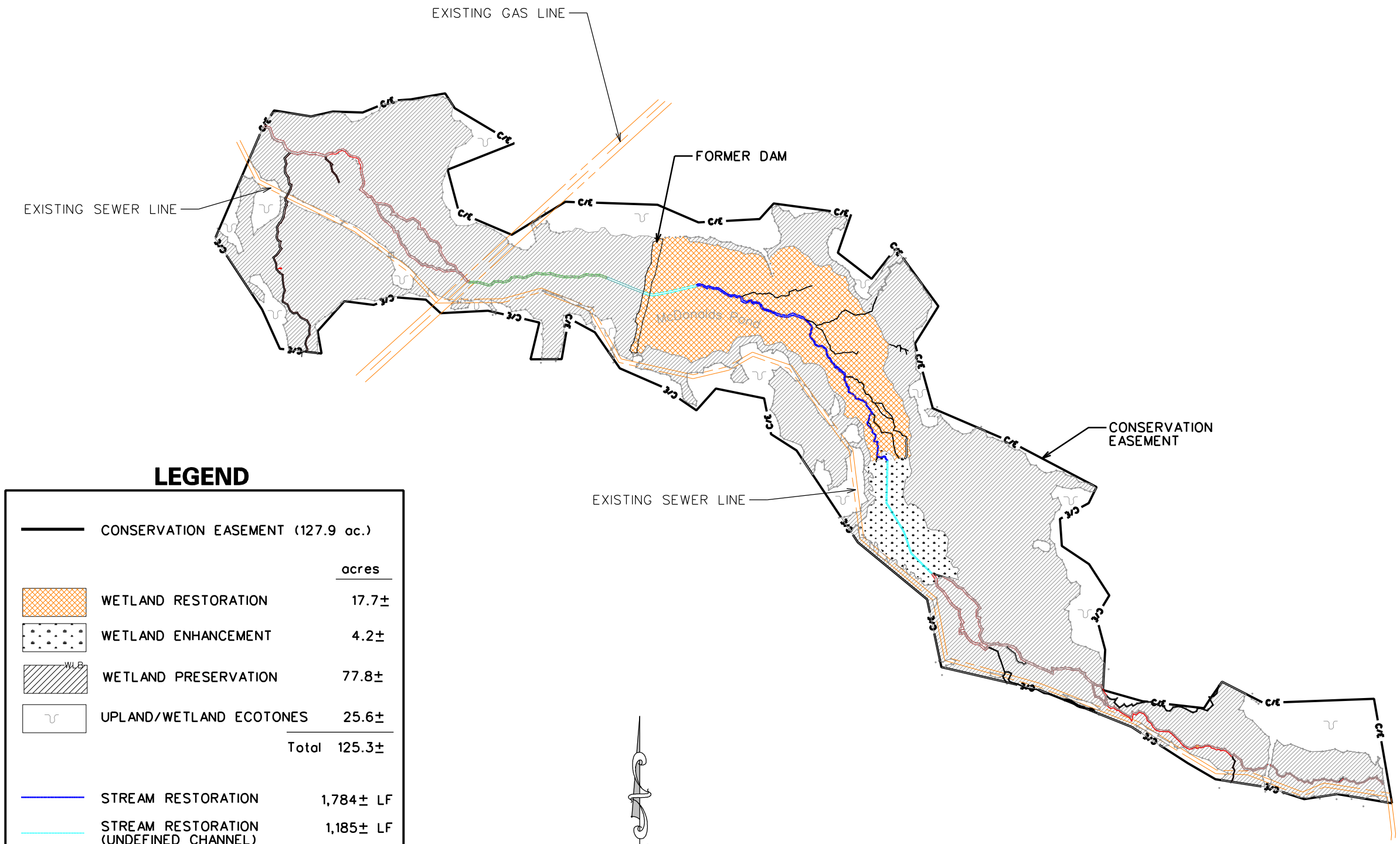
Date: JUL 2006

Scale: AS SHOWN

ESC Project No.: 04-177.05

FIGURE

1



LEGEND

	CONSERVATION EASEMENT (127.9 ac.)	
		acres
	WETLAND RESTORATION	17.7±
	WETLAND ENHANCEMENT	4.2±
WLB	WETLAND PRESERVATION	77.8±
	UPLAND/WETLAND ECOTONES	25.6±
	Total	125.3±
	STREAM RESTORATION	1,784± LF
	STREAM RESTORATION (UNDEFINED CHANNEL)	1,185± LF
	STREAM ENHANCEMENT	770± LF
	STREAM PRESERVATION	5,800± LF
	STREAM	

EcoScience Corporation
Raleigh, North Carolina

REVISIONS

INTERNATIONAL PAPER

Client:
Ecosystem Enhancement Program

Project:

McDONALDS POND STREAM & WETLAND RESTORATION

RICHMOND COUNTY, NORTH CAROLINA

Title:

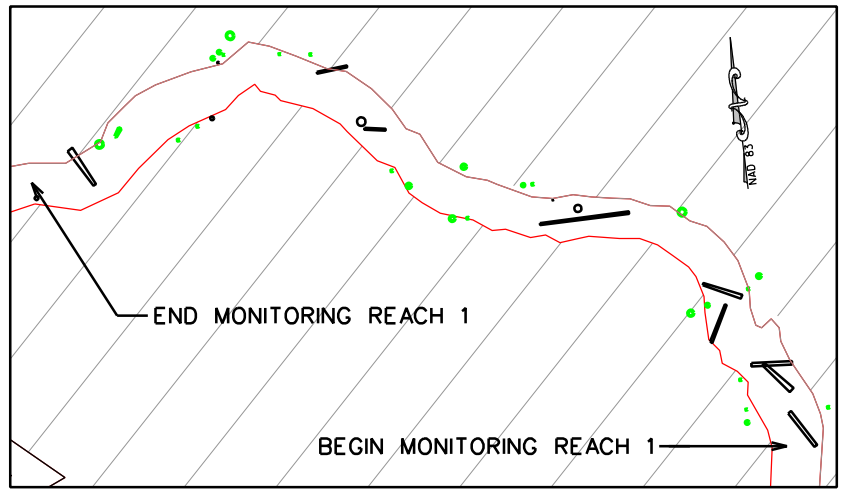
STREAM & WETLAND MITIGATION UNITS

Dwn By:	Date:
JDG	JUL 2006
Ckd By:	Scale:
JWG	1"=600'

ESC Project No.: 04-177.05

FIGURE

2



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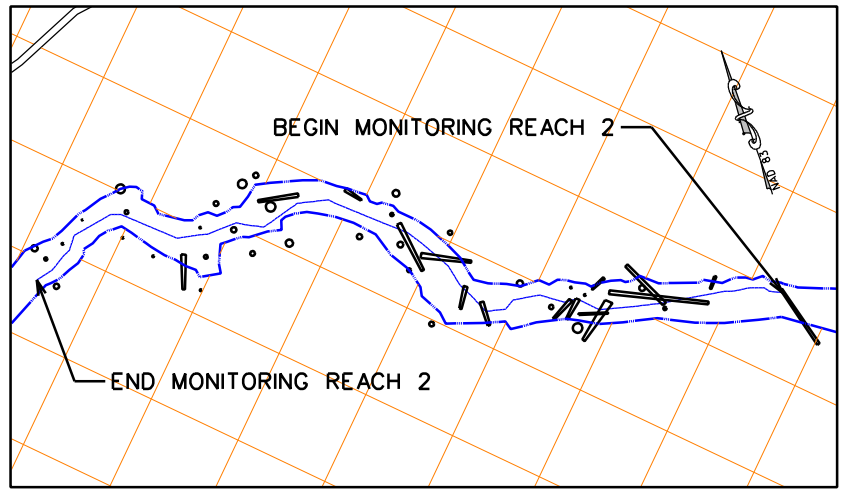

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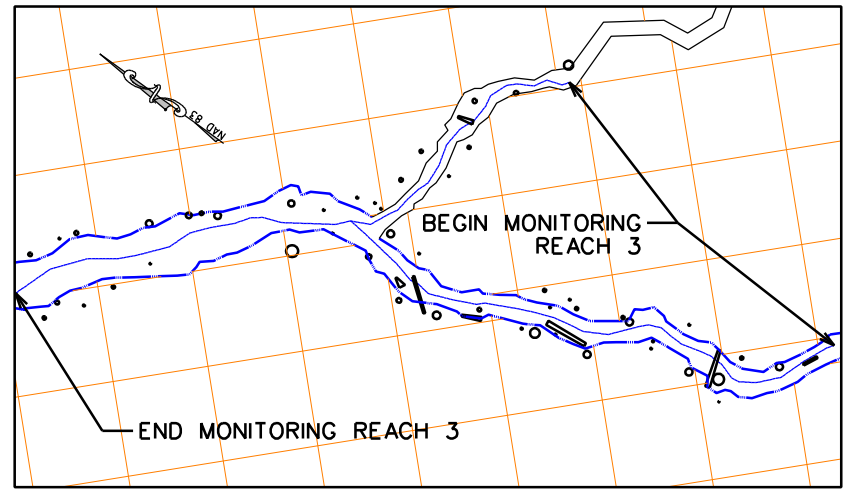

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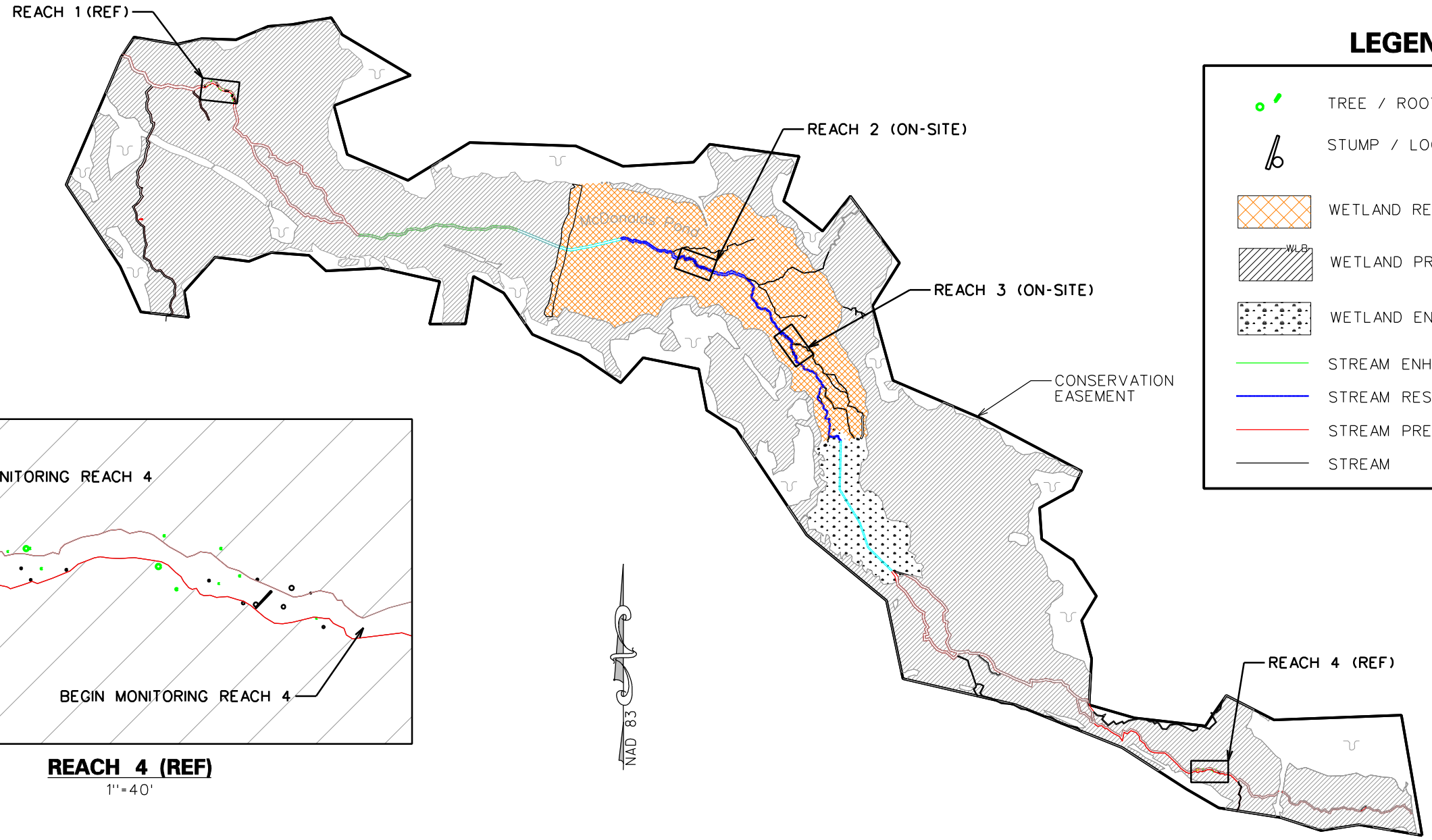


LEGEND

- TREE / ROOT
- STUMP / LOG
- WETLAND RESTORATION
- WETLAND PRESERVATION
- WETLAND ENHANCEMENT
- STREAM ENHANCEMENT
- STREAM RESTORATION
- STREAM PRESERVATION
- STREAM

REACH 4 (REF)
1"=40'

EcoScience Corporation
Raleigh, North Carolina

REVISIONS

INTERNATIONAL PAPER

Client: Ecosystem Enhancement Program

Project:

McDONALDS POND STREAM & WETLAND RESTORATION

RICHMOND COUNTY, NORTH CAROLINA

Title:

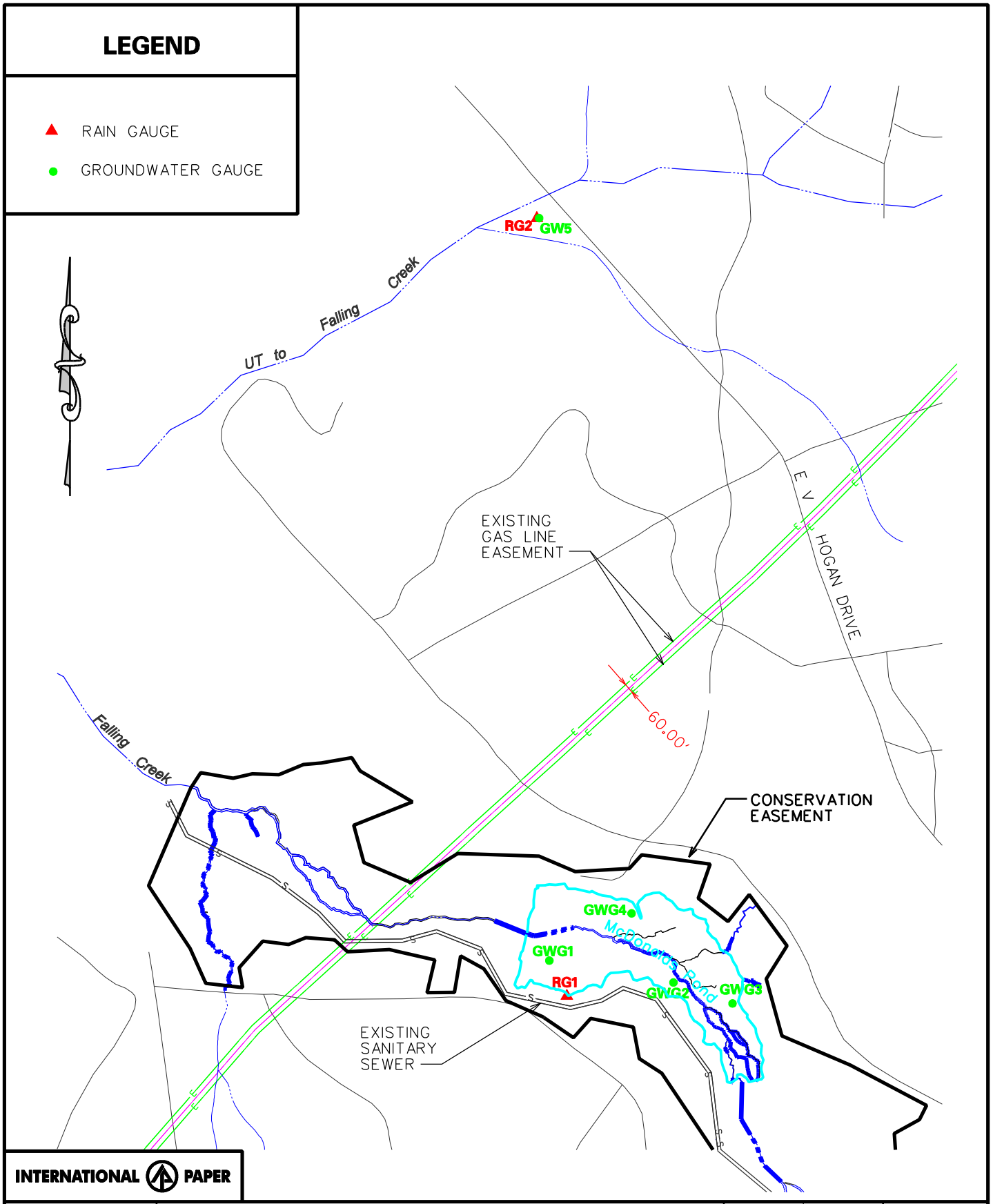
STREAM MONITORING REACHES

Dwn By:	Date:
JDG	JUL 2006
Ckd By:	Scale:
JWG	AS SHOWN

ESC Project No.: 04-177.05

FIGURE

3



INTERNATIONAL PAPER

EcoScience Corporation
Raleigh, North Carolina

Project:

McDONALDS POND MONITORING GAUGES

RICHMOND COUNTY, NORTH CAROLINA

Dwn By:	Ckd By:
JDG	JWG

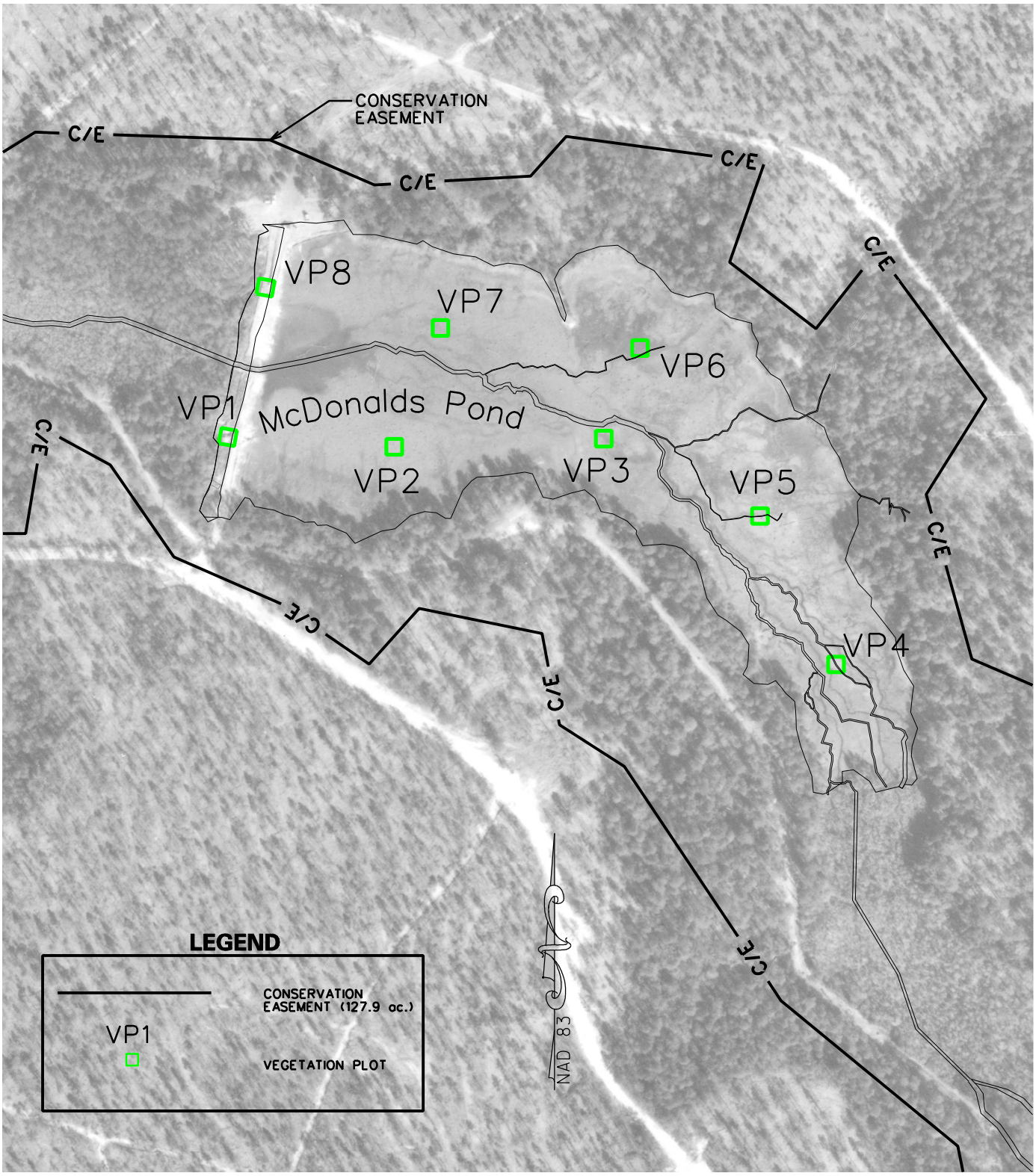
Date: JUL 2006

Scale: 1"=800'

ESC Project No.: 04-177.05

FIGURE

4



INTERNATIONAL PAPER

EcoScience Corporation
Raleigh, North Carolina

Project:

McDONALDS POND VEGETATION MONITORING PLOTS

RICHMOND COUNTY, NORTH CAROLINA

Dwn By:	Ckd By:
JDG	JWG

Date: JUL 2006

Scale: 1"=300'

ESC Project No.: 04-177.05

FIGURE 5

APPENDIX B: As-Built Drawings

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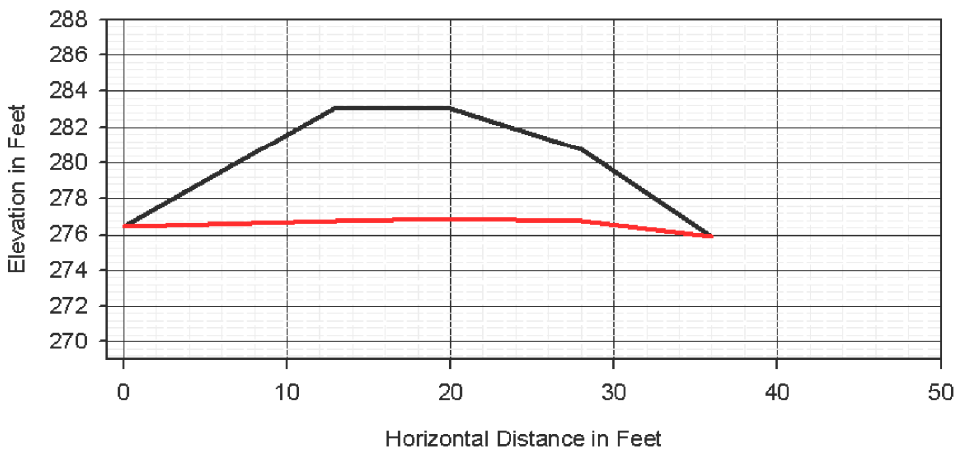

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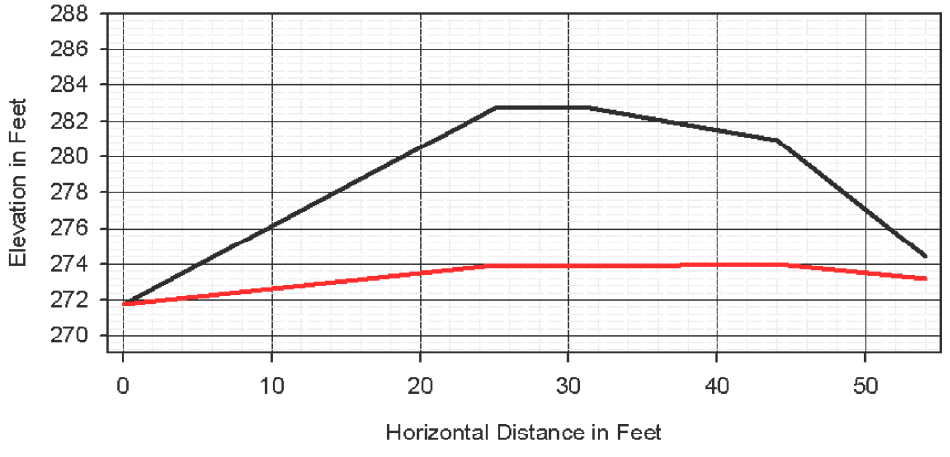
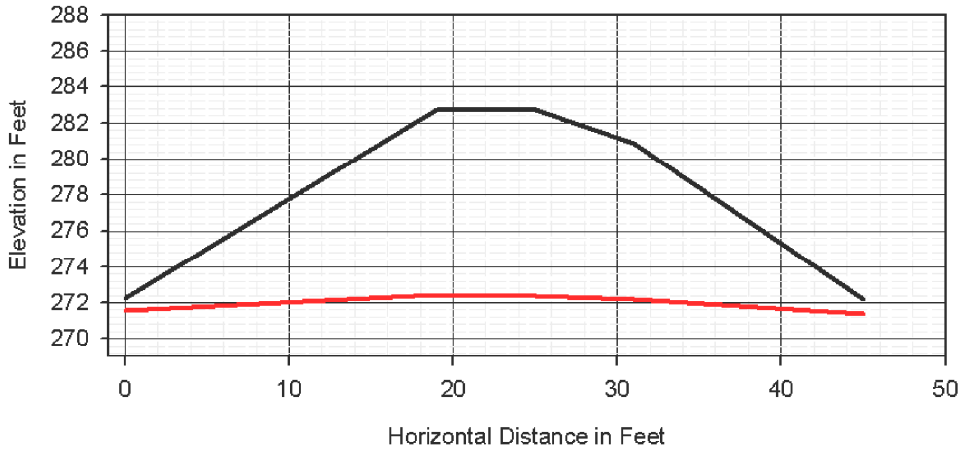
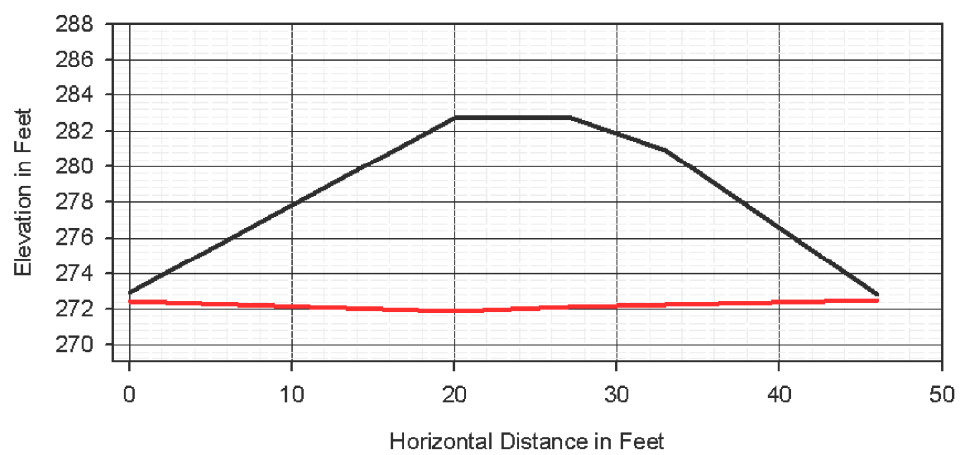


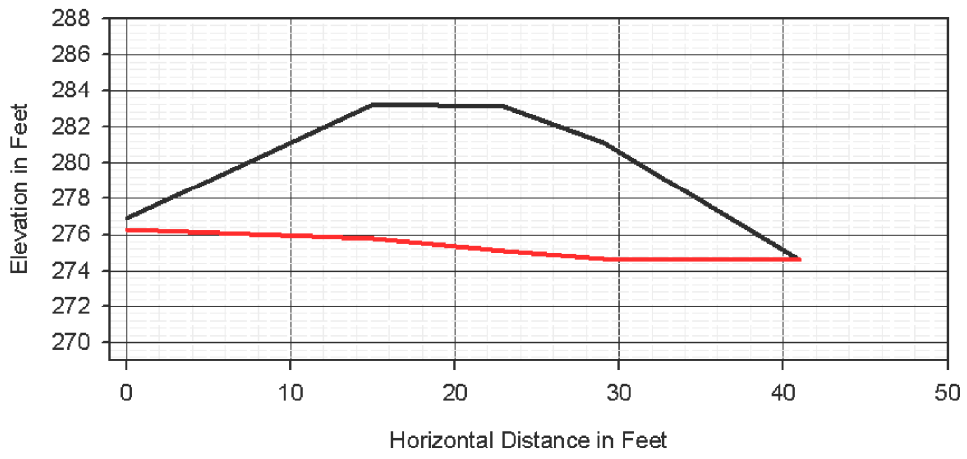
CROSS-SECTION 3+17



CROSS-SECTION 4+34



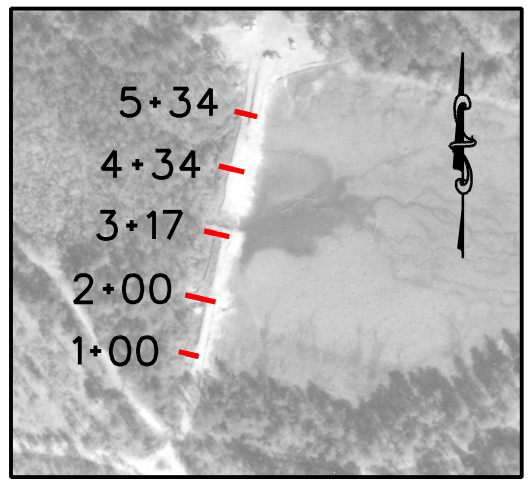
CROSS-SECTION 5+34



LEGEND

PRE-EXISTING GROUND SURFACE

AS-BUILT GROUND SURFACE



CROSS SECTION LOCATIONS
(N.T.S.)

EcoScience Corporation
Raleigh, North Carolina

REVISIONS

INTERNATIONAL PAPER

Client:
Ecosystem Enhancement Program

Project:

McDONALDS POND STREAM & WETLAND RESTORATION

RICHMOND COUNTY, NORTH CAROLINA

Title:

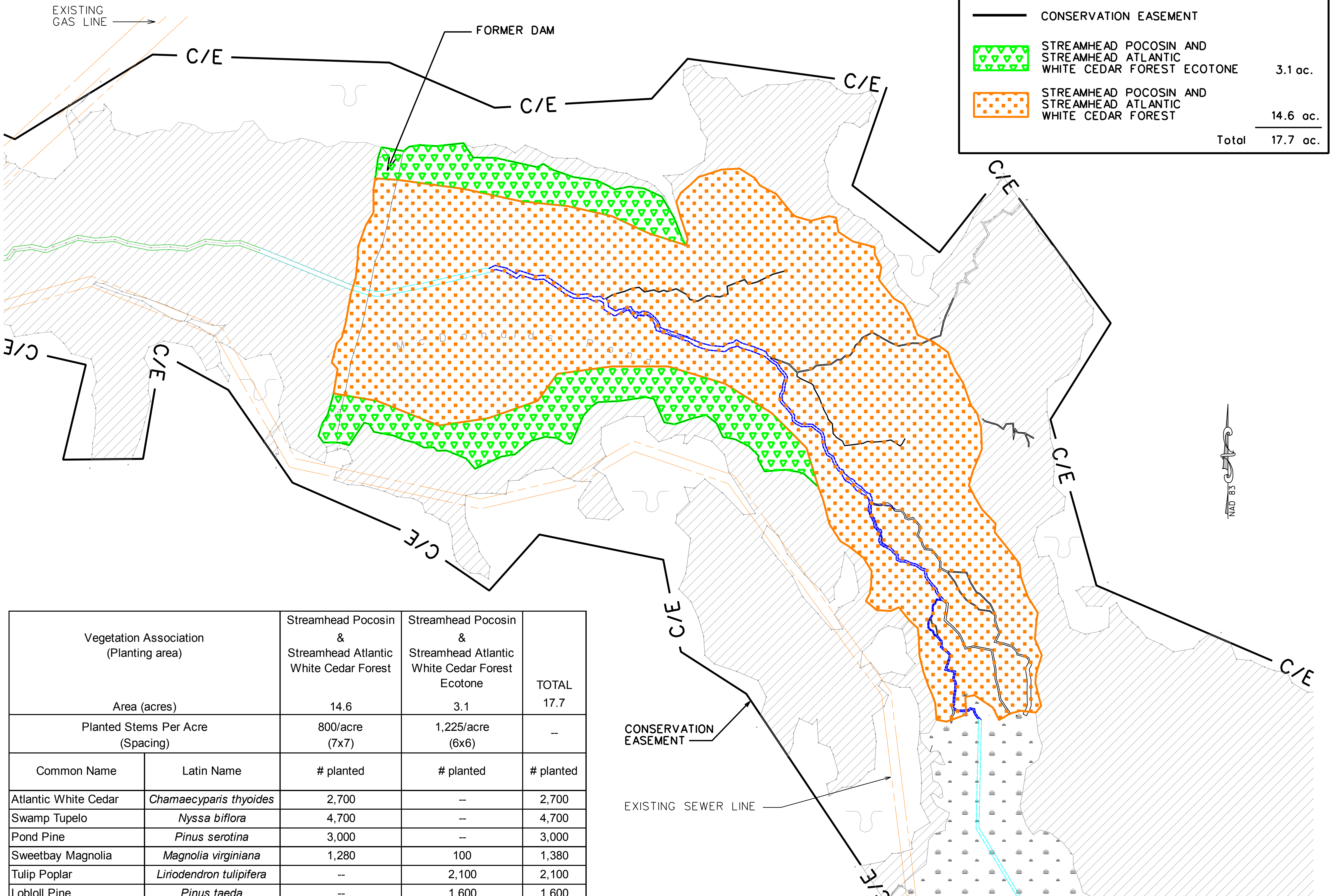
DAM AS–BUILT

Dwn By:	Date:
JDG	JUL 2006
Ckd By:	Scale:
JWG	AS SHOWN

ESC Project No.: 04-177.05

FIGURE

X1



LEGEND

CONSERVATION EASEMENT		
STREAMHEAD POCOSIN AND STREAMHEAD ATLANTIC WHITE CEDAR FOREST ECOTONE	3.1 ac.	
STREAMHEAD POCOSIN AND STREAMHEAD ATLANTIC WHITE CEDAR FOREST	14.6 ac.	
Total	17.7 ac.	

Vegetation Association (Planting area)		Streamhead Pocosin & Streamhead Atlantic White Cedar Forest	Streamhead Pocosin & Streamhead Atlantic White Cedar Forest Ecotone	TOTAL
Area (acres)		14.6	3.1	17.7
Planted Stems Per Acre (Spacing)		800/acre (7x7)	1,225/acre (6x6)	--
Common Name	Latin Name	# planted	# planted	# planted
Atlantic White Cedar	*Chamaecyparis thyoides*	2,700	--	2,700
Swamp Tupelo	*Nyssa biflora*	4,700	--	4,700
Pond Pine	*Pinus serotina*	3,000	--	3,000
Sweetbay Magnolia	*Magnolia virginiana*	1,280	100	1,380
Tulip Poplar	*Liriodendron tulipifera*	--	2,100	2,100
Lobloll Pine	*Pinus taeda*	--	1,600	1,600
	TOTAL	11,680	3,800	15,480

EcoScience Corporation
Raleigh, North Carolina

REVISIONS

INTERNATIONAL PAPER

Client: Ecosystem Enhancement Program

Project:
McDONALDS POND STREAM & WETLAND RESTORATION
RICHMOND COUNTY, NORTH CAROLINA

Title:
PLANTING PLAN

Dwn By: JDG
Date: JUL 2006
Ckd By: JWG
Scale: 1"=200'
ESC Project No.: 04-177.05

FIGURE
X2

APPENDIX C: Water & Sediment Sampling Results

TRiTEST
6701 Conference Drive
Raleigh, NC 27607
Telephone: (919) 834-4984
Fax: (919) 834-6497

NC/WW Cert. #: 067
NC/DW Cert. #: 37731

Laboratory Report

--- Prepared for ---

Jerry McCrain
EcoScience Corp.
1101 Haynes St.
Suite 101
Raleigh, NC 27604

Report Date: **11/9/2004**
Date Received: **10/18/2004**
Work Order #: **0410-00711**

Project No.:
Project ID: **SOIL/WATER TESTING**
Cust. Code: **EC3433**
Cust. P.O.#:

No.	Sample ID	Date Sampled	Time Sampled	Matrix	Sample Type	Condition
001	MCDONALD POND	10/18/2004	12:00	Soil	Grab	4 +/- 2 deg C

Test Performed	Method	Results	Analyzed Date	Analyzed Time	Qualifier
Total Kjeldahl Nitrogen	EPA 351.2	1020 mg/kg	10/29/04	11:00	
Nitrate-Nitrite	EPA 353.2	91.3 mg/kg	10/27/04	9:29	
Total Nitrogen Calculation		1111 mg/kg	10/29/04	11:00	
Total Phosphorus	EPA 365.4	50.4 mg/kg	11/2/04	12:02	
Ammonia	EPA 350.1	12.6 mg/kg	10/26/04	12:15	
MS/ICP METALS				0:00	
Beryllium	EPA 200.8	<0.248# ug/kg	11/3/04	8:25	
Aluminum	SM 3111D	1020# ug/kg	11/3/04	8:25	
Vanadium	EPA 200.8	1.69 ug/kg	11/3/04	8:25	
Chromium	EPA 200.8	1.19# ug/kg	11/3/04	8:25	
Manganese	EPA 200.8	1.57# ug/kg	11/3/04	8:25	
Cobalt	EPA 200.8	<0.248# ug/kg	11/3/04	8:25	
Nickel	EPA 200.8	0.327# ug/kg	11/3/04	8:25	
Copper	EPA 200.8	1.46# ug/kg	11/3/04	8:25	
Zinc	EPA 200.8	9.28# ug/kg	11/3/04	8:25	
Arsenic	EPA 200.8	<0.248# ug/kg	11/3/04	8:25	
Selenium	EPA 200.8	<0.248# ug/kg	11/3/04	8:25	
Molybdenum	EPA 200.8	<0.248# ug/kg	11/3/04	8:25	
Silver	EPA 200.8	<0.099# ug/kg	11/3/04	8:25	
Cadmium	EPA 200.8	<0.099# ug/kg	11/3/04	8:25	
Antimony	EPA 200.8	<0.248# ug/kg	11/3/04	8:25	
Tin	EPA 200.8	<0.248# ug/kg	11/3/04	8:25	
Barium	EPA 200.8	4.52# ug/kg	11/3/04	8:25	
Thallium	EPA 200.8	<0.248# ug/kg	11/3/04	8:25	
Lead	EPA 200.8	11.9# ug/kg	11/3/04	8:25	
Iron	SM 3111B	504# ug/kg	10/28/04	8:25	
Diesel Range Organics	EPA 3550	60.4 mg/kg	11/1/04	12:00	
Gas Range Organics	EPA 5030	8.11 mg/kg	11/1/04	13:42	
Fecal Coliforms/MPN	SM 9221 E	<1800 MPN/100mL	10/19/04	15:38	
Percent Dry Weight	SM 2540B	41.5 %	10/25/04	13:30	
Fecal Coliform in Solids		<43.4 MPN/g,TS	10/25/04	13:30	
Extr., Diesel Range, Soils	EPA 3550	DONE.	11/1/04	12:00	

TRiTEST

3909 Beryl Road
Raleigh, NC 27607

Telephone: (919) 834-4984
Fax: (919) 834-6497

NC/WW Cert. #: 067
NC/DW Cert. #: 37731

Laboratory Report

Work Order #: **0410-00711**

No.	Sample ID	Date Sampled	Time Sampled	Matrix	Sample Type	Condition
002	**MCDONALD POND**	**10/18/2004**	**12:00**	**WW**	**Grab**	**4 +/- 2 deg C**

Test Performed	Method	Results	Analyzed Date	Analyzed Time	Qualifier
Total Kjeldahl Nitrogen	**EPA 351.2**	**0.52 mg/L**	**10/29/04**	**11:00**	
Nitrate-Nitrite	**EPA 353.2**	**0.83 mg/L as N**	**10/27/04**	**9:29**	
Total Nitrogen Calculation		**1.35 mg/L**	**10/29/04**	**11:00**	
Total Phosphorus	**EPA 365.4**	**<0.05 mg/L**	**11/2/04**	**12:03**	
Ammonia	**EPA 350.1**	**<0.02 mg/L as N**	**10/20/04**	**11:00**	
ICP/MS METAL SCAN			**10/20/04**	**8:53**	
Beryllium	**EPA 200.8**	**<0.001 mg/L**	**10/20/04**	**8:53**	
Aluminum	**EPA 200.8**	**0.381 mg/L**	**10/20/04**	**8:53**	
Vanadium	**EPA 200.8**	**<0.010 mg/L**	**10/20/04**	**8:53**	
Chromium	**EPA 200.8**	**<0.005 mg/L**	**10/20/04**	**8:53**	
Manganese	**EPA 200.8**	**<0.010 mg/L**	**10/20/04**	**8:53**	
Cobalt	**EPA 200.8**	**<0.005 mg/L**	**10/20/04**	**8:53**	
Nickel	**EPA 200.8**	**<0.005 mg/L**	**10/20/04**	**8:53**	
Copper	**EPA 200.8**	**0.002 mg/L**	**10/20/04**	**8:53**	
Zinc	**EPA 200.8**	**0.015 mg/L**	**10/20/04**	**8:53**	
Arsenic	**EPA 200.8**	**<0.003 mg/L**	**10/20/04**	**8:53**	
Selenium	**EPA 200.8**	**<0.002 mg/L**	**10/20/04**	**8:53**	
Molybdenum	**EPA 200.8**	**<0.005 mg/L**	**10/20/04**	**8:53**	
Silver	**EPA 200.8**	**<0.005 mg/L**	**10/20/04**	**8:53**	
Cadmium	**EPA 200.8**	**<0.002 mg/L**	**10/20/04**	**8:53**	
Antimony	**EPA 200.8**	**<0.003 mg/L**	**10/20/04**	**8:53**	
Tin	**EPA 200.8**	**<0.002 mg/L**	**10/20/04**	**8:53**	
Barium	**EPA 200.8**	**0.010 mg/L**	**10/20/04**	**8:53**	
Thallium	**EPA 200.8**	**<0.001 mg/L**	**10/20/04**	**8:53**	
Lead	**EPA 200.8**	**<0.005 mg/L**	**10/20/04**	**8:53**	
Iron	**EPA 200.8**	**1.20 mg/L**	**10/21/04**	**9:43**	
Diesel Range Organics	**EPA MOD. 8015**	**<10 mg/L**	**10/25/04**	**14:45**	
Gas Range Organics	**EPA MOD. 8015**	**<10 mg/L**	**11/1/04**	**13:42**	
Fecal Coliforms/MF	**SM 9222D**	**11 e CFU/100mL**	**10/18/04**	**14:14**	
Extr., Diesel Range	**EPA 3510**	**-**	**10/25/04**	**14:45**	

Reviewed by:

for Tritest, Inc.

APPENDIX D: Aquatic and Terrestrial Biodiversity

Bioiversity of Falling Creek
When the biodiversity of aquatic species in the southeast is considered, four groups typically come to mind: crayfish, aquatic insects, mussels, and fish. The latter three are diverse in the Carolina Sandhills in the vicinity of Falling Creek in Richmond County, NC.

Aquatic Insects
Six significantly rare, aquatic insects have been confirmed from Richmond County, NC, in the last 20 years, according to NC NHP (Table 1, Appendix B)

Mussels
In all, 25 distinct taxa of freshwater mussels have been identified from the Pee Dee River system (Bogan 2002). Sixteen of those mussels could occur in Falling Creek (Table 2; Appendix B). This includes three state endangered mussels (Barrel Floater, Savannah Lilliput, and Carolina Creekshell), four state Threatened mussels (Triangular Floater, Eastern Lampmussel, Eastern Pondmussel, and the Creeper), one Significantly Rare mussel (Pod lance), and the one Special Concern (Notched Rainbow) that could occur in Falling Creek.

One of the state's Endangered mussels, the Carolina heelsplitter (*Lasmigona decorata*), is also a federally Endangered mussel. It occurs in small creeks and rivers, as well as ponds. The closest extant population in the Pee Dee is the Goose Creek watershed of Union County. The US Fish and Wildlife Service's List of Threatened and Endangered Species of North Carolina include the Carolina heelsplitter in the fauna of Richmond County, NC (http://nc-es.fws.gov/es/countyfr.html). The service's Recovery Plan for the Carolina heelsplitter recommends that suitable habitat within the historic range of this mussel should be marked for reintroduction. This action item is an essential part of recovery for this species. Also, they recommend the *establishment of mussel sanctuaries, protective water quality designations, stream buffer zones, and other protection strategies as a means of protecting present and reintroduced populations*.

Fishes
Out of 72 species of fishes that occur in the vicinity of Hitchcock Creek, 48 might occur in the Falling Creek watershed (Table 3; Appendix B).

Two of the rare, endemics the pinewoods darter (*Etheostoma mariae*) and the sandhills chub (*Semotilus lumbee*) are restricted to the Carolina Sandhills of North and South Carolina in the upper reaches of the Pee Dee River system. They have both been collected in the last 20 years within Richmond County, according to the NC NHP.

The critically imperiled robust redhorse (*Moxostoma robustum*) and Carolina redhorse (*Moxostoma* sp.) are proposed Endangered species by NC. Although, these fish are not anadromous, they behave in a similar manner, spending much of their time in larger rivers and entering small rivers and creeks to spawn. Adults of these extremely rare fishes are found in the Pee Dee River near the mouth of Hitchcock Creek. Removal of ponds on Falling Creek would provide access to additional breeding habitat for these two.

Mammals
Condylura cristata (the Star nosed mole) is of Special Concern to NC (Table 4; Appendix B). It benefits from bogs, a preferred habitat. Additionally, *Corynorhinus rafinesquii* (Rafinesque's big-eared bat) requires intact riparian areas with den trees such as gum and cypress. Rafinesque's big-eared bat is Threatened in NC and federally tracked as a species of Special Concern (FSC).

Ampibians
The Significantly Rare pine barrens treefrog occurs in Richmond County, NC, in pocosins, bay forests, and boggy areas, according to the NC NHP (Table 4; Appendix B).

Plants
At least 22 rare, threatened, or endangered species of plants that depend on wet areas such as bogs, riparian areas, and sandhill seeps have been observed in Richmond County in the last 20 years (Table 5; Appendix B).

This includes the federally and state Endangered rough-leaved loosestrife, *Lysimachia asperulifolia,* which occupies the ecotone between long-leaf pine savannahs and pocosins. Three other species are listed as state Endangered: the Georgia indigo-bush, sandhills bog lily, and the southern white beaksedge. These three species occur in moist sandhill areas, peaty bogs, and seepage bogs, respectively.

Five state Threatened species (bog oatgrass, piedmont Aster, roughleaf yellow-eyed-grass, and Chapman's yellow-eyed-grass, and bog spicebush) live in the following respective habitats: seepage bogs, bottomlands, sandhill seeps and bogs, mucky sandhill seeps, and bogs. Of these five species all but Chapman's yellow-eyed grass are listed federally as species of Special Concern.

Another 10 of the Significantly Rare species found in the bogs, seepage areas, and riparian zones are proposed for changes in state status. These include: conferva pondweed, southern water grass, hairy smartweed, scale-leaf Gerardia, silvery sedge, water purslane, sarvis holly, feather-bristle beaksedge, Canby's bulrush, and swaying bulrush.

One species, the white wicky, is known from one occurrence in South Carolina and over forty occurrences in a restricted area of south-central North Carolina, but seems to be threatened by development. Due to its status, *limited to North Carolina*, conservation responsibilities for this species should be high. This plant is known from recent observations in Richmond County, NC.

Ecological Communities
The ecological community that would be of most interest in this area would be the Sandhills seep, a G2 Natural Community that has been observed in Richmond County, NC, sometime in the past 20 years.

NatureServe's Global Ranking Classification
http://www.natureserve.org/explorer/granks.htm

GX - **Presumed Extinct** (species)—Believed to be extinct throughout its range. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.

- **Eliminated** (ecological communities)—Eliminated throughout its range, with no restoration potential due to extinction of dominant or characteristic species.

GH - **Possibly Extinct** (species)—Known from only historical occurrences, but may nevertheless still be extant; further searching needed.

- **Presumed Eliminated** (Historic, ecological communities)—Presumed eliminated throughout its range, with no or virtually no likelihood that it will be rediscovered, but with the potential for restoration, for example, American chestnut (Forest).

G1 - Critically Imperiled—Critically imperiled globally because of extreme rarity or because of some factor(s) making it especially vulnerable to extinction. Typically 5 or fewer occurrences or very few remaining individuals (<1,000) or acres (<2,000) or linear miles (<10).

G2 - Imperiled—Imperiled globally because of rarity or because of some factor(s) making it very vulnerable to extinction or elimination. Typically 6 to 20 occurrences or few remaining individuals (1,000 to 3,000) or acres (2,000 to 10,000) or linear miles (10 to 50).

G3 - Vulnerable—Vulnerable globally either because very rare and local throughout its range, found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extinction or elimination. Typically 21 to 100 occurrences or between 3,000 and 10,000 individuals.

G4 - Apparently Secure—Uncommon but not rare (although it may be rare in parts of its range, particularly on the periphery), and usually widespread. Apparently not vulnerable in most of its range, but possibly cause for long-term concern. Typically more than 100 occurrences and more than 10,000 individuals.

G5 - Secure—Common, widespread, and abundant (although it may be rare in parts of its range, particularly on the periphery). Not vulnerable in most of its range. Typically with considerably more than 100 occurrences and more than 10,000 individuals.

Variant Global Ranks Rank

G#G# -Range Rank—A numeric range rank (e.g., G2G3) is used to indicate uncertainty about the exact status of a taxon. Ranges cannot skip more than one rank (e.g., GU should be used rather than G1G4).

GU - Unrankable—-Currently unrankable due to lack of information or due to substantially conflicting information about status or trends. NOTE: Whenever possible, the most likely rank is assigned and the question mark qualifier is added (e.g., G2?) to express uncertainty, or a range rank (e.g., G2G3) is used to delineate the limits (range) of uncertainty.

G? - Unranked—Global rank not yet assessed.

HYB - Hybrid—(species elements only) Element not ranked because it represents an interspecific hybrid and not a species. (Note, however, that hybrid-derived species are ranked as species, not as hybrids.)

Rank Qualifiers Rank

? - Inexact Numeric Rank—Denotes inexact numeric rank

Q- Questionable taxonomy that may reduce conservation priority— Distinctiveness of this entity as a taxon at the current level is questionable; resolution of this uncertainty may result in change from a species to a subspecies or hybrid, or inclusion of this taxon in another taxon, with the resulting taxon having a lower-priority (numerically higher) conservation status rank.

C - Captive or Cultivated Only—Taxon at present is extant only in captivity or cultivation, or as a reintroduced population not yet established.

Natural Heritage Program State Status Codes:

State Status: E = Endangered; T = Threatened; SC = Special Concern;
P = Proposed (E, T, or SC); SR = Significantly Rare;

USFWS Federal Status:
Federal Status: E = Endangered; T = Threatened; C = Candidate (with categories similar to others); FSC = proposed for federal special concern

Table 1. List of six significantly rare, aquatic insects that have been confirmed from Richmond County, NC, in the last 20 years, according to NC NHP (http://www.ncsparks.net/nhp/elements2.fm)

State (State Status): SR = Significantly Rare
Fed (Federal Status): None for these species.
NatureServe Global Ranking:
Grank (Global Rank):

G? -	Unranked	Global rank not yet assessed.
G4 -	Apparently Secure	Uncommon but not rare and usually widespread.
G5 -	Secure	Common, widespread, and abundant

Group	Scientific Name	Common Name	Habitat	GRank	State	Fed
Stonefly	*Attaneuria ruralis*			G4	SR	
Caddisfly	*Ceraclea cancellata*			G?	SR	
Caddisfly	*Triaenodes marginata*			G?	SR	
Mayfly	*Choroterpes basalis*			G5	SR	
Mayfly	*Ephemerella argo*			G4	SR	
Dragonfly	*Neurocordulia molesta*			G4	SR	

Table 2. List of Freshwater Mussels (Unionidae) in the Pee Dee River system (Bogan 2002) that may occur in Falling Creek, Richmond County, NC.

[P=Possibly occurs in Falling Creek; X=species extant in Pee Dee R; ?=species in strict sense may not occur in the Pee Dee system].

State (State Status): E = Endangered; T = Threatened; SC = Special Concern.
SR = Significantly Rare.
Federal (Federal Status): E = Endangered
NatureServe Global Ranking:
Grank (Global Rank):

G?	Unranked	Global rank not yet assessed.
GU	Unrankable	Currently unrankable due to lack of information
G1	Critically Imperiled	Especially vulnerable to extinction
G2	Imperiled	Very vulnerable to extinction or elimination.
G3	Vulnerable	Very rare and local throughout its range
G4	Apparently Secure	Uncommon but not rare and usually widespread.
G5	Secure	Common, widespread, and abundant
G#G#	Range Rank	A numeric range rank (e.g., G2G3)
Q	Questionable taxonomy	May reduce conservation priority

Scientific Name	Common Name	Presence	NatureServe	State	Federal
Alasmidonta undulata	Triangular Floater	PX	G4	T	
Alasmidonta varicose	Brook Floater	PX	G3	E	
Anodonta couperiana	Barrel Floater	?	G4	E	
Elliptio angustata	Carolina lance	?	G4		
Elliptio cistellaeformis	Box Spike	PX	G4Q		
Elliptio complanata	Eastern Elliptio	PX	G5		
Elliptio congaraea	Carolina Slabshell	PX	G4		
Elliptio folliculata	Pod Lance	X	G2G3Q	SC	
Elliptio icterina	Variable Spike	PX	G4Q		
Elliptio producta	Atlantic Spike	?	G4Q		
Elliptio raveneli	Carolina Spike	?	GU		
Elliptio roanokensis	Roanoke Slabshell	X	G2G3	T	
Fusconaia masoni	Atlantic Pigtoe	X	G2	E	
Lampsilis cariosa	Yellow Lampmussel	X	G3G4	E	
Lampsilis radiata	Eastern Lampmussel	PX	G5	T	
Lasmigona decorata	Carolina heelsplitter	X	G1	E	E
Ligumia nasuta	Eastern Pondmussel	PX	G4G5	T	
Pyganodon cataracta	Eastern Floater	PX	G5		
Strophitus undulates	Creeper	PX	G5	T	
Toxolasma pullus	Savannah Lilliput	PX	G2	E	
Uniomerus caroliniana	Florida Pondhorn	PX	G4		
Utterbackia imbecillis	Paper Pondshell	PX	G5		
Villosa constricta	Notched Rainbow	PX	G3	SC	
Villosa delumbis	Eastern Rainbow	PX	G4	SR	
Villosa vaughaniana	Carolina Creekshell	PX	G2	E	

Table 3. Fishes Known to Occur in the Pee Dee River system (Menhinick 1991) in the vicinity of Hitchcock Creek and may occur in Falling Creek, Richmond County, NC.

[P=Possibly occurs in Falling Creek; X=species extant in Pee Dee R; ?=species in strict sense may not occur in the Pee Dee system].

State (State Status): E = Endangered; T = Threatened; SC = Special Concern; P = Proposed (E, T, or SC);
SR = Significantly Rare.
Federal (Federal Status): E = Endangered, T = Threatened
NatureServe Global Ranking:
Grank (Global Rank):

G?	Unranked	Global rank not yet assessed.
GU	Unrankable	Currently unrankable due to lack of information
G1	Critically Imperiled	Especially vulnerable to extinction
G2	Imperiled	Very vulnerable to extinction or elimination.
G3	Vulnerable	Very rare and local throughout its range
G4	Apparently Secure	Uncommon but not rare and usually widespread.
G5	Secure	Common, widespread, and abundant
G#G#	Range Rank	A numeric range rank (e.g., G2G3)
Q	Questionable taxonomy	May reduce conservation priority

Scientific Name	Common Name	Occurs	GRank	State	Fed
Acipenser oxyrinchus	Atlantic sturgeon	X	G3	T	T
Acipenser brevirostrum	Shortnose sturgeon	X	G3	E	E
Lepisosteus osseus	Longnose gar	PX	G5		
Amia calva	Bowfin	PX	G5		
Anguilla rostrata	American eel	X	G5		
Dorosoma cepedianum	Gizzard Shad	PX	G5		
Dorosoma petenense	Threadfin Shad	X	G5		
Alosa sapidissima	American shad	X	G5		
Umbra pygmaea	Eastern mudminnow	X	G5		
Esox niger	Chain pickerel	PX	G5		
Esox americanus	Redfin pickerel	PX	G5		
Cyprinus carpio	carp	X	G5		
Carassius auratus	Goldfish	X	G5		
Notemigonus crysoleucas	Golden shiner	PX	G5		
Clinostomus funduloides	Rosyside dace	PX	G5		
Ctenopharyngodon idella	Grass carp	PX	G5		
Hybognathus regius	Eastern silvery minnow	X	G5		
Cyprinella labrosa	Thicklip chub	X	G4		
Nocomis leptocephalus	Bluehead chub	PX	G5		
Cyprinella analostana	Satinfin shiner	X	G5		
Cyprinella nivea	Whitefin shiner	PX	G4		
Notropis pyrrhomelas	Fieryback shiner	X	G4		
Notropis petersoni	Coastal shiner	X	G5		

Scientific Name	Common Name	Occurs	GRank	State	Fed
Notropis hudsonius	Spottail shiner	PX	G5		
Notropis chiliticus	Redlip shiner	X	G4		
Notropis cummingsae	Dusky shiner	PX	G5		
Notropis altipinnis	Highfin shiner	X	G5		
Notropis photogenis	Silver shiner	X	G5		
Semotilus lumbee	Sandhills chub	PX	G3	SC	
Minytrema melanops	Spotted sucker	PX	G5		
Erimyzon oblongus	Creek chubsucker	PX	G5		
Ictiobus bubalus	Smallmouth buffalo	X	G5		
Moxostoma robustum	Robust redhorse	PX	G1	PE	
Moxostoma anisurum	Silver redhorse	PX	G5		
Moxostoma macrolepidotum	Shorthead redhorse	PX	G5		
Moxostoma carinatum	River redhorse	X	G4		
Moxostoma sp.	Carolina redhorse	PX	G1G2Q	PE	
Pylodictis olivaris	Flathead catfish	PX	G5		
Ictalurus furcatus	Blue catfish	PX	G5		
Ameiurus natalis	Yellow bullhead	PX	G5		
Ameiurus platycephalus	Flat bullhead	PX	G5		
Ameiurus nebulosus	Brown bullhead	PX	G5		
Ictalurus punctatus	Channel catfish	PX	G5		
Ictalurus furcatus	Blue catfish	X	G5		
Ictalurus catus	White Catfish	PX	G5		
Noturus insignis	Margined madtom	PX	G5		
Noturus gyrinus	Tadpole madtom	PX	G5		
Aphredoderus sayanus	Pirate perch	PX	G5		
Fundulus lineolatus	Lined topminnow	PX	G5		
Gambusia holbrooki	Eastern mosquitofish	PX	G5		
Morone americana	White perch	X	G5		
Morone saxatilis	Striped bass	X	G5		
Morone chrysops	White bass	X	G5		
Centrarchus macropterus	Flier	PX	G5		
Acantharchus pomotis	Mud sunfish	PX	G5		
Enneacanthus gloriosus	Blue-spotted sunfish	PX	G5		
Lepomis cyanellus	Green sunfish	PX	G5		
Lepomis auritus	Redbreast sunfish	PX	G5		
Lepomis gulosus	Warmouth	PX	G5		
Lepomis macrochirus	Bluegill	PX	G5		
Lepomis gibbosus	Pumpkinseed	PX	G5		
Lepomis microlophus	Redear sunfish	PX	G5		
Micropterus salmoides	Largemouth bass	PX	G5		
Pomoxis annularis	White crappie	X	G5		
Pomoxis nigromaculatus	Black crappie	X	G5		
Perca flavescens	Yellow perch	PX	G5		
Etheostoma flabellare	Fantail darter	PX	G5		

Scientific Name	Common Name	Occurs	GRank	State	Fed
Etheostoma mariae	Pinewoods darter	PX	G3	SC	
Etheostoma olmstedi	Tessellated darter	PX	G5		
Etheostoma serriferum	Sawcheek darter	PX	G5		
Etheostoma fusiforme	Swamp darter	PX	G5		
Percina crassa	Piedmont darter	PX	G4		

Table 4. Groups of terrestrial animals that utilize bogs, open wet areas, and/or riparian wetlands that have been observed in the Carolina Sandhills of Richmond County in the last 20 years, according to the NC Natural Heritage Program (http://www.ncsparks.net/nhp/elements2.fm).

State Status: E = Endangered; T = Threatened; SC = Special Concern;
P = Proposed (E, T, or SC); SR = Significantly Rare; W = Watch List.
Federal Status: E = Endangered; T = Threatened; C = Candidate (with categories similar to others); FSC = proposed for federal special concern

Group	Scientific Name	Common Name	Habitat	State	Fed
Mammal	*Condylura cristata*	Star nosed mole	Bogs	SC	
Mammal	Corynorhinus rafinesquii	Rafinesque's big-eared bat	Gum and cypress trees near water	T	FSC
Amphibian	*Hyla andersonii*	Pine Barrens Treefrog	Breeds in bogs	SR	

Table 5. Twenty-two terrestrial plants located in bogs, open wet areas, and/or riparian wetlands. All of these species have been observed in the Carolina Sandhills of Richmond County in the last 20 years, according to the NC Natural Heritage Program database on 12 March 2004. (www.ncsparks.net/nhp/county.html).

State Status: E = Endangered; T = Threatened; SC = Special Concern;
P = Proposed (E, T, or SC); SR = Significantly Rare; L = Limited (endemic or nearly endemic to NC. Conservation in NC is critical to survival of species).
Federal Status: E = Endangered; T = Threatened; C = Candidate (with categories similar to others); FSC = proposed for federal special concern

Scientific Name	Common Name	Habitat	State	Fed
Agalinis aphylla	Scale-leaf Gerardia	Pocosin ecotones	SR-P	
Amorpha georgiana var georgiana	Georgia Indigo-bush	Moist sandhill areas	E	FSC
Carex canescens ssp disjuncta	Silvery Sedge	Open wet areas	SR-P	
Danthonia epilis	Bog oatgrass	Seepage bogs.	SR-T	FSC
Didiplis diandra	Water Purslane	Sluggish streams	SR-P	
Eurybia mirabilis	Piedmont Aster	Bottomlands	SR-T	FSC
Ilex amelanchier	Sarvis Holly	Riverbanks.	SR-P	
Kalmia cuneata	White Wicky	Pocosins.	SR-L	
Lilium pyrophilum	Sandhills Bog Lily	Peaty bogs.	E-SC	
Lindera subcoriacea	Bog Spicebush	Bogs.	T	FSC
Ludwigia sphaerocarpa	Globe-fruit Seedbox	Bogs	SR	
Luziola fluitans	Southern Water Grass	Pools, lakes, streams.	SR-P	
Lysimachia asperulifolia	Rough-leaf Loosestrife	Pocosins.	E	E
Polygonum hirsutum	Hairy Smartweed	Drawdowns zones blackwater rivers.	SR-P	
Potamogeton confervoides	Conferva Pondweed	Blackwater creeks.	SR-P	FSC
Rhynchospora macra	Southern White Beaksedge	Seepage bogs	E	
Rhynchospora oligantha	Feather-bristle Beaksedge	Seepage bogs.	SR-P	
Schoenoplectus etuberculatus	Canby's Bulrush	Blackwater creeks.	SR-P	
Schoenoplectus subterminalis	Swaying Bulrush	Blackwater creeks.	SR-P	
Solidago verna	Spring-flowering Goldenrod	Pocosin ecotones.	SR-L	FSC
Xyris chapmanii	Chapman's Yellow-eyed-grass	Mucky sandhill seeps.	SR-T	
Xyris scabrifolia	Roughleaf Yellow-eyed-grass	Sandhill seeps and bogs.	SR-T	FSC

MITIGATION REPORT - ADDENDUM

FULL DELIVERY PROJECT TO PROVIDE WETLAND AND STREAM RESTORATION
YADKIN RIVER BASIN CATALOGUING UNIT 03040201

MCDONALDS POND RESTORATION SITE
Richmond County, North Carolina

PREPARED FOR:

NCDENR - ECOSYSTEM ENHANCEMENT PROGRAM
1652 Mail Service Center
Raleigh, North Carolina 27699-16152

OCTOBER 2006

MITIGATION REPORT – ADDENDUM

FULL DELIVERY PROJECT TO PROVIDE WETLAND AND STREAM RESTORATION YADKIN RIVER BASIN CATALOGUING UNIT 03040201

MCDONALDS POND RESTORATION SITE

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 2 miles northeast of the town of Hamlet and 3 miles east of the town of Rockingham. IP was selected as a contractor to provide **4,364 stream mitigation units (SMUs) and 23.4 wetland mitigation units (WMUs)** (EEP Contract No. D04020-2). In order to provide stream channel restoration and riverine wetland restoration, IP has removed the McDonalds Pond Dam located on Falling Creek in Richmond County, North Carolina.

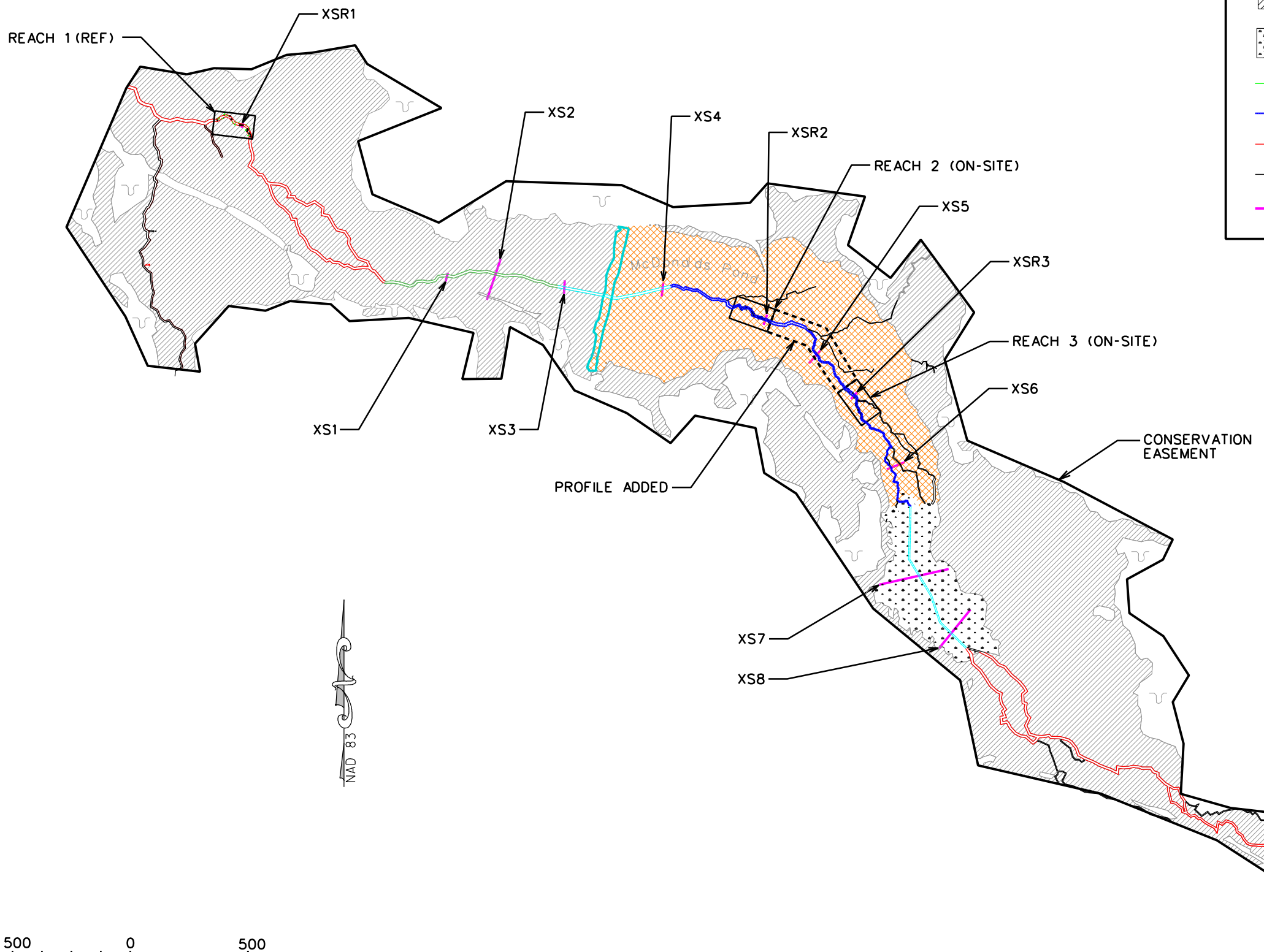
The following is an addendum to the McDonalds Pond Restoration Project Mitigation Plan submitted in July 2006. This addendum was prepared in response to the North Carolina Ecosystem Enhancement Program's (EEP) comments (dated August 24, 2006, see attached) concerning the McDonalds Pond Restoration Project Mitigation Plan.

The EEP requests the following revisions to Section 3.0 Monitoring Plan of the Mitigation Plan and additional information to be submitted as addenda to the mitigation plan:

1. Increase longitudinal profile monitoring length within restored and enhanced stream segments.
Longitudinal profile monitoring will be added to the section of restored stream between stream monitoring reaches 2 and 3 totaling approximately 940 feet of profile monitoring. These data will be presented in the first year monitoring report. See Figure A1 for details.

2. Increase the number of permanent cross-section locations within restored and enhanced stream segments.
Eight (8) permanent cross-sections have been added to the site monitoring activities (Oct 2006). The cross-sections have been placed on average approximately 350 feet apart through the restored and enhanced stream segments. There are (12) total cross-sections now at the Site; (1) downstream of the restored/enhanced segments serving as a reference, (1) upstream of the restored/enhanced segments serving as a reference, and (10) located within the restored/enhanced portions of Falling Creek. Figure A1 illustrates the location of the newly established cross-sections. Cross-sectional surveys and photo documentation have been completed at these locations and will be provided in the first year monitoring report.

3. Provide As-Built drawings depicting the restored stream as it now exists.
The cross-sectional and longitudinal profile data for the site monitoring reaches presented in the Mitigation Plan are illustrated in Figures R1-R4 and Figure P1. These data were collected in April 2006 following the dam removal and represent site "as-built" conditions.



LEGEND

- WETLAND RESTORATION
- WETLAND PRESERVATION (WLP)
- WETLAND ENHANCEMENT
- STREAM ENHANCEMENT
- STREAM RESTORATION
- STREAM PRESERVATION
- STREAM
- CROSS-SECTION LOCATIONS

EcoScience Corporation
Raleigh, North Carolina

REVISIONS

INTERNATIONAL PAPER

Client: Ecosystem Enhancement Program

Project:

McDONALDS POND MITIGATION PLAN ADDENDUM

RICHMOND COUNTY, NORTH CAROLINA

Title:

STREAM MONITORING PLAN

Dwn By: MAF	Date: OCT 2006
Ckd By: JWG	Scale: AS SHOWN
ESC Project No.: 06-311	

FIGURE

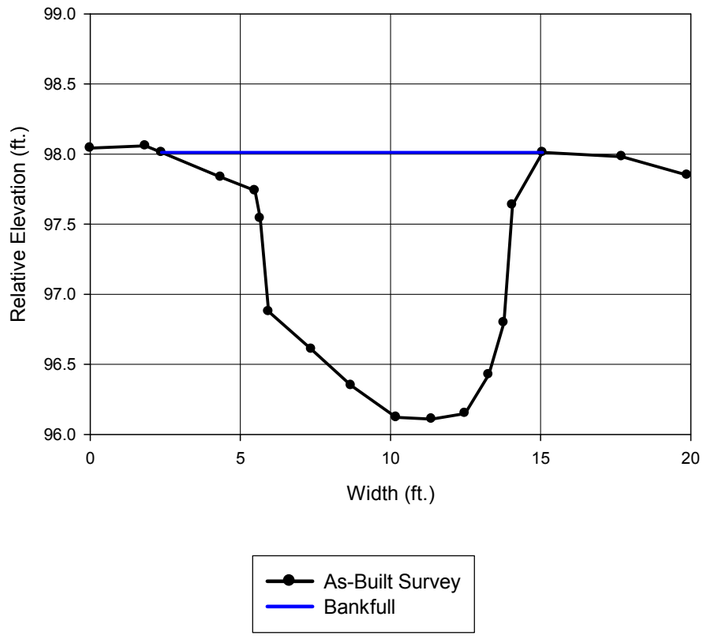
A1

Survey Data		
Reach 1 Cross-Section: Riffle		
Station	Elevation	Feature
0.00	98.04	LPIN
1.84	98.06	
4.36	97.84	
5.49	97.74	
5.66	97.54	
5.94	96.88	
7.37	96.61	
8.69	96.35	
10.19	96.12	
11.37	96.11	
12.48	96.15	
13.28	96.43	
13.78	96.80	
14.07	97.64	
15.07	98.01	BKF
17.71	97.98	
19.89	97.85	RPIN

Summary Data	
Bankfull Cross-Sectional Area	14.7 sq. ft.
Bankfull Width	12.7 ft.
Bankfull Mean Depth	1.2 ft.
Bankfull Max. Depth	1.9
Width/Depth Ratio	10.9
Entrenchment Ratio	> 30
Classification	E5

Cross-Section

Cross-Section Plot - Looking Downstream



Cross-Section Photos

Reach 1 Cross-Section upstream looking downstream

Reach 1 Cross-Section downstream looking upstream

Survey Date	Survey Weather	Field Team	Location
Apr 06	Sunny	David Jones, Michael Gloden	Reference Reach 1 (XSR1)

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RICHMOND COUNTY, NORTH CAROLINA

Title:

STREAM REACH 1 CROSS-SECTION

Dwn By:	Date:
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JWG	As Shown

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FIGURE

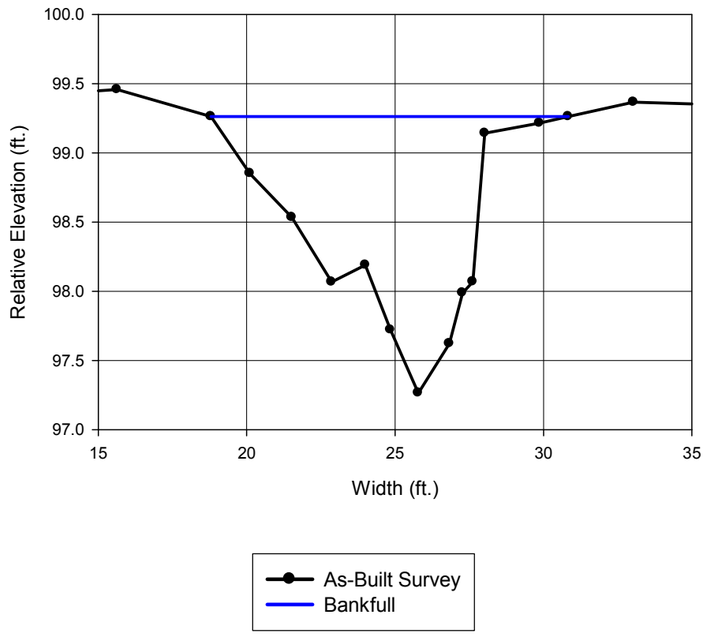
R1

Survey Data		
Reach 2 Cross-Section: Riffle		
Station	Elevation	Feature
0.00	99.34	LPIN
3.48	99.34	
9.15	99.38	
15.63	99.46	
18.80	99.26	BKF
20.11	98.85	
21.52	98.53	
22.86	98.07	
24.00	98.19	
24.85	97.72	
25.78	97.27	
26.83	97.62	
27.27	97.99	
27.62	98.07	
28.03	99.14	
29.87	99.22	
33.03	99.37	
37.60	99.34	
43.82	99.25	
46.10	99.26	RPIN

Summary Data	
Bankfull Cross-Sectional Area	11.1 sq. ft.
Bankfull Width	12.0 ft.
Bankfull Mean Depth	1.0 ft.
Bankfull Max. Depth	2.0 ft.
Width/Depth Ratio	11.8
Entrenchment Ratio	> 30
Classification	E5

Cross-Section

Cross-Section Plot - Looking Downstream



Cross-Section Photos

Reach 2 Cross-Section upstream looking downstream

Reach 2 Cross-Section downstream looking upstream

Survey Date	Survey Weather	Field Team	Location
Apr 06	Sunny	David Jones, Michael Gloden	On-Site Reach 2 (XSR2)

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STREAM REACH 2 CROSS-SECTION

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FIGURE

R2

Survey Data

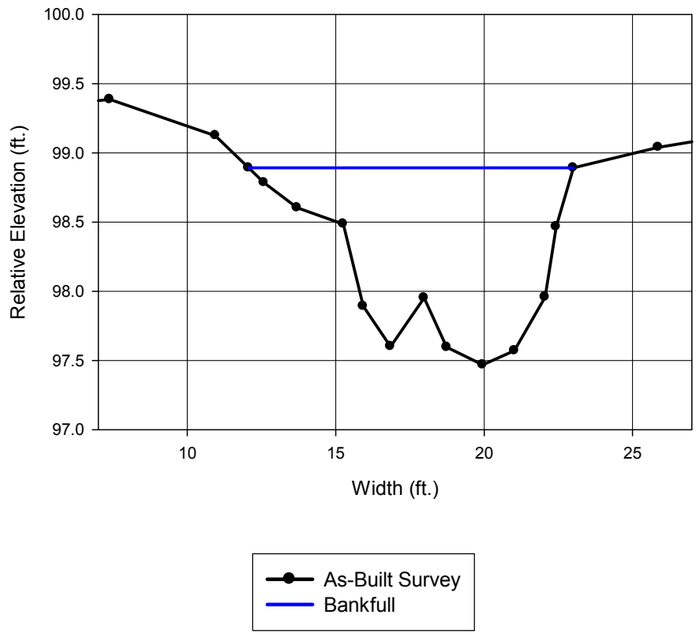
Reach 3 Cross-Section: Riffle

Station	Elevation	Feature
0.00	99.19	LPIN
3.63	99.30	
7.38	99.39	
10.94	99.12	
12.58	98.79	
13.70	98.60	
15.26	98.49	
15.93	97.89	
16.85	97.60	
17.98	97.95	
18.74	97.60	
19.96	97.47	
21.02	97.57	
22.05	97.96	
22.43	98.47	
23.01	98.89	BKF
25.87	99.04	
30.92	99.22	
32.51	99.33	
33.71	99.20	
37.91	99.18	RPIN

Summary Data	
Bankfull Cross-Sectional Area	10.2 sq. ft.
Bankfull Width	10.9 ft.
Bankfull Mean Depth	0.8 ft.
Bankfull Max. Depth	1.4 ft.
Width/Depth Ratio	12.7
Entrenchment Ratio	> 30
Classification	E5

Cross-Section

Cross-Section Plot - Looking Downstream



Cross-Section Photos

Reach 3 Cross-Section upstream looking downstream

Reach 3 Cross-Section downstream looking upstream

Survey Date	Survey Weather	Field Team	Location
Apr 06	Sunny	David Jones, Michael Gloden	On-Site Reach 3 (XSR3)

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STREAM REACH 3 CROSS-SECTION

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Ckd By:	Scale:
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FIGURE

R3

Survey Data

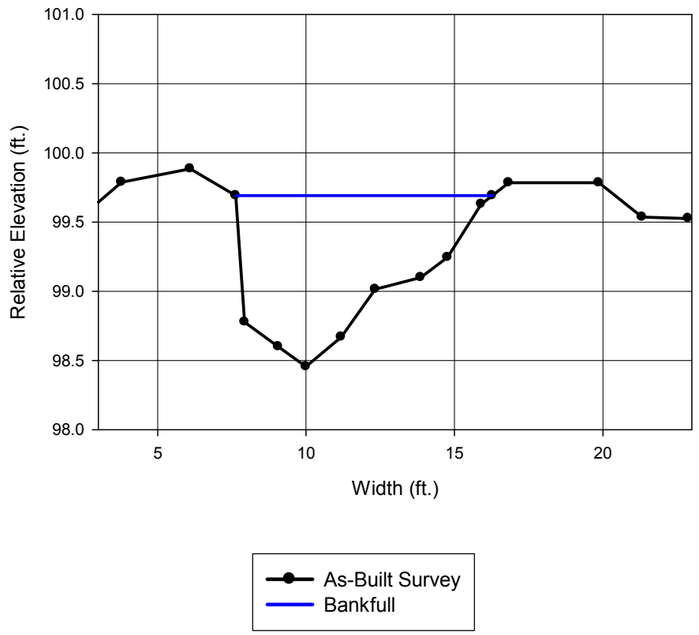
Reach 4 Cross-Section: Riffle

Station	Elevation	Feature
0.00	99.55	LPIN
2.45	99.54	
3.79	99.79	
6.10	99.89	
7.63	99.69	BKF
7.93	98.78	
9.07	98.60	
10.00	98.46	
11.19	98.67	
12.33	99.01	
13.86	99.10	
14.77	99.25	
15.90	99.63	
16.83	99.78	
19.87	99.78	
21.33	99.54	
22.88	99.53	RPIN

Summary Data	
Bankfull Cross-Sectional Area	7.7 sq. ft.
Bankfull Width	8.6 ft.
Bankfull Mean Depth	0.8 ft.
Bankfull Max. Depth	1.2 ft.
Width/Depth Ratio	11.5
Entrenchment Ratio	> 40
Classification	E5

Cross-Section

Cross-Section Plot - Looking Downstream



Cross-Section Photos

Reach 4 Cross-Section upstream looking downstream

Reach 4 Cross-Section downstream looking upstream

Survey Date	Survey Weather	Field Team	Location
Apr 06	Sunny	David Jones, Michael Gloden	Reference Reach 4 (XSR4)

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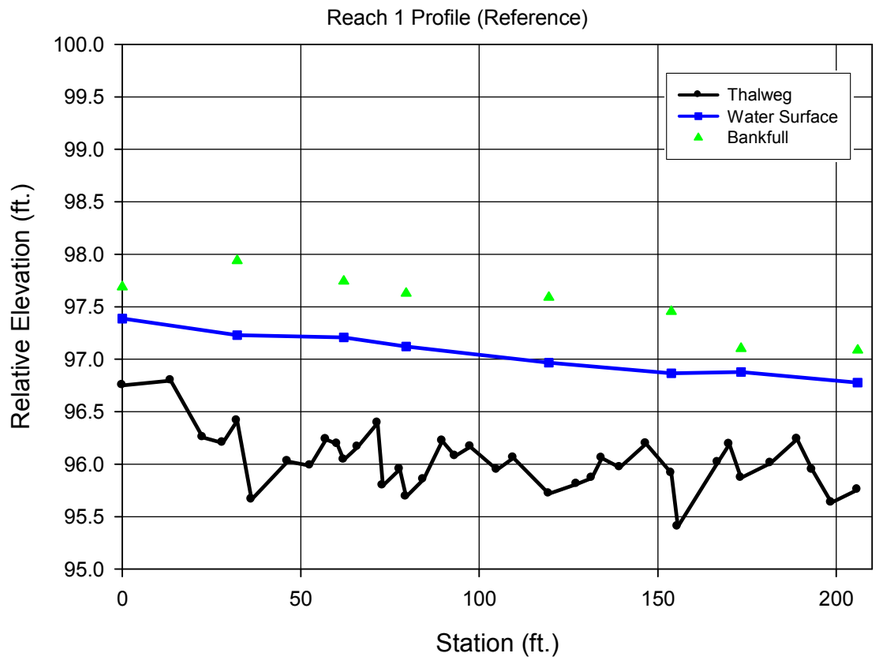
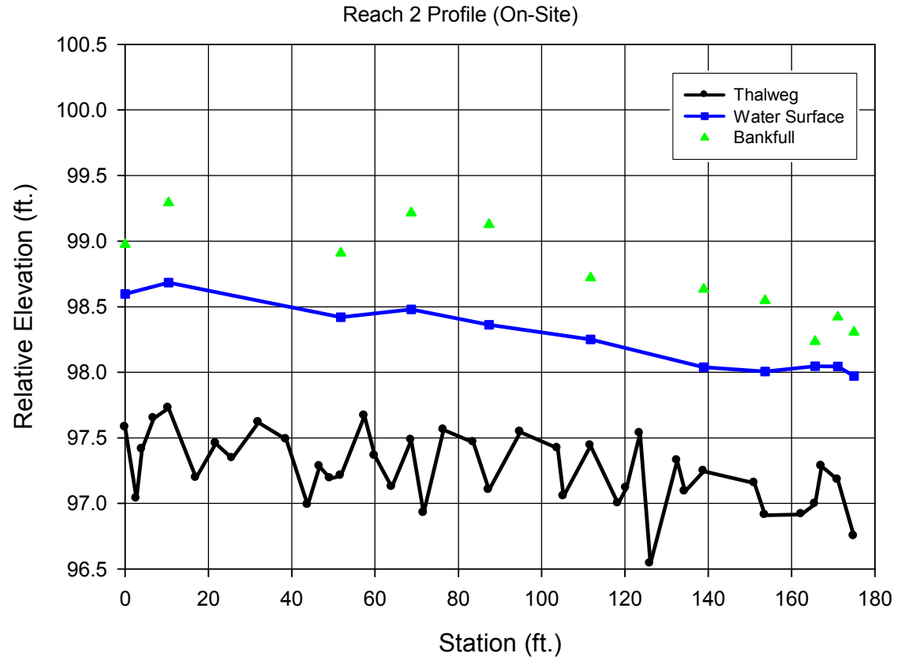
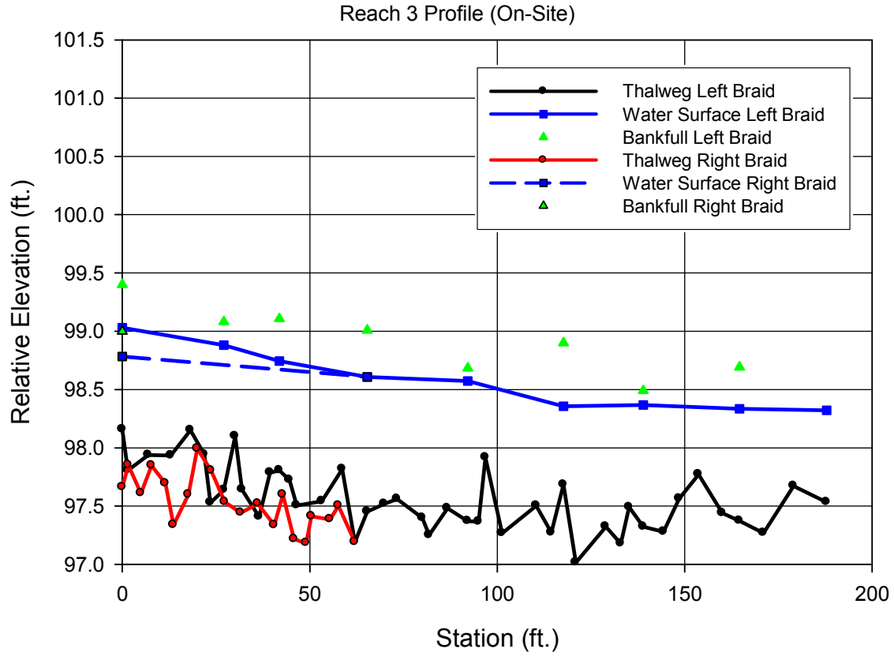
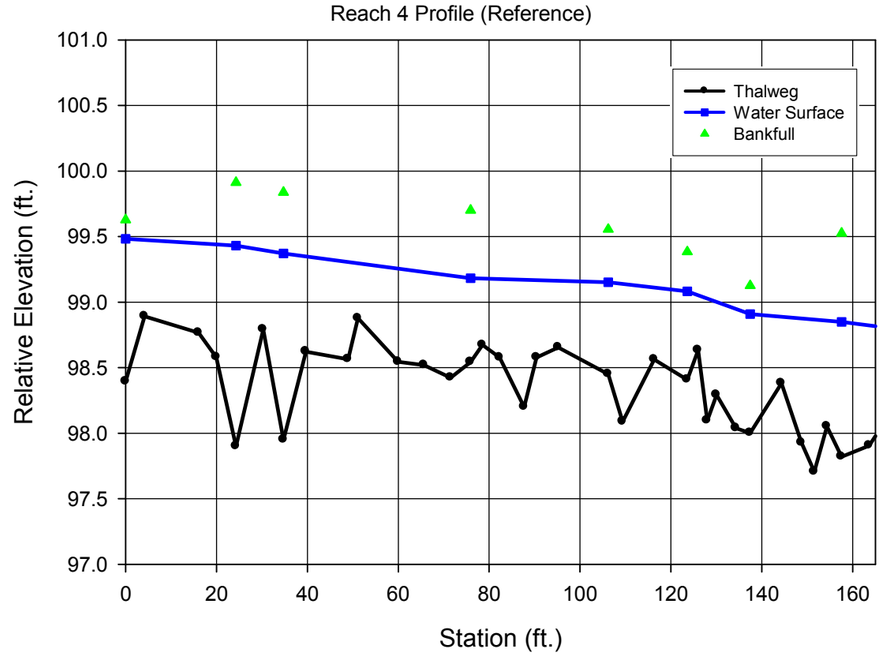
FIGURE

R4









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STREAM REACH PROFILES

Dwn By:	Date:
DGJ	OCT 2006
Ckd By:	Scale:
JWG	As Shown

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FIGURE

P1