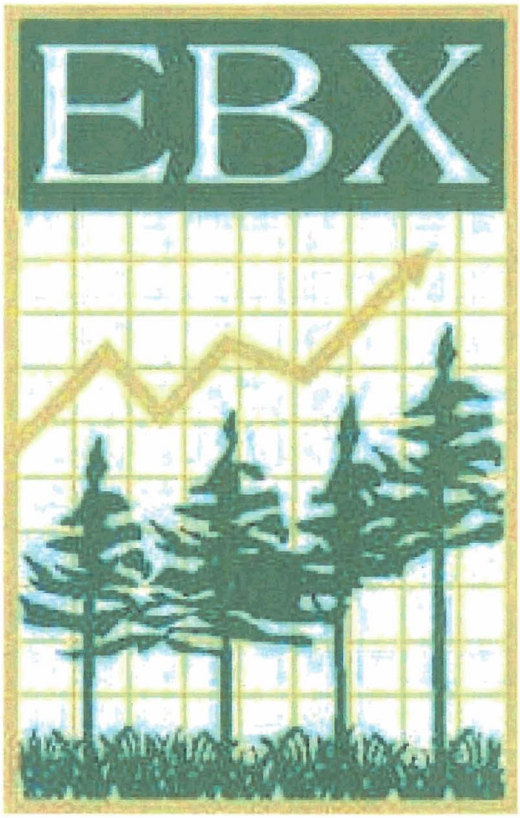
#114

GREGORY WETLAND AND STREAM RESTORATION SITE

Annual Monitoring Report for 2005 (Year 1)



Environmental Banc & Exchange, LLC
Managers, Bankers, and Traders of Environmental Rights

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ANNUAL REPORT FOR 2005 (YEAR 1)
Gregory Mitigation Site

1.0 SUMMARY

This Annual Report details the monitoring activities during the 2005 growing season on the Gregory Mitigation Site. Construction of the site, including planting of trees, was completed in January 2005. The 2005 data represents results from the first year of hydrologic and vegetation monitoring for both wetlands and streams.

Restoration of the Gregory site involved the restoration of a "small stream swamp" with associated "bottomland hardwood" and "cypress swamp" communities as described by Schafale and Weakley (1990). Restoration of the site involved the restoration of one stable meandering channel across the hydric farm fields on the site. The channel was designed and constructed using natural channel design techniques. Restoration also involved raising the local water table by filling the drainage ditches on-site and scarification of the fields and breaking of the local plow pan to provide increased surface storage of water. After construction, it was determined that 6,757 feet of stream and 85.8 acres of wetland hydrology were restored.

This Annual Report presents the data from 11 hydrologic monitoring stations, 7 vegetation monitoring stations, and stream monitoring, as required by the approved Mitigation Plan for the site. Four of the hydrologic stations are equipped with manual groundwater gauges and seven stations are equipped with automated gauges and a manual calibration gauge. Additionally, the gauges are used as points from which photographs are taken over time.

Weather station data from the Enfield and Halifax were used in conjunction with a manual rain gauge located on the site to document precipitation amounts. The manual gauge is used to validate observations made at the automated station. During the 2005 growing season, the rainfall total through the end of September was 8.1 inches below normal. In addition, the distribution of rainfall throughout the period was very irregular with very little rain occurring during the first month of the growing season.

In 2005, 5 of 11 hydrology monitoring gauges recorded hydroperiods of at least 12.5 percent of the growing season. Of the remaining gauges, 4 exhibited a hydroperiod greater than 9 percent of the growing season. The 2 remaining gauges exhibited conditions drier than expected but, at approximately 5 percent these areas were within the range expected in a wetland system. An additional well will be installed in the northwestern corner of the site to verify that the hydroperiod is accurately documented in this area. Based on these results, it was concluded that the site is performing as designed. It is important to note that the hydrology of the targeted restored wetland system (Coastal Plain, small stream swamp) is highly variable across a given site, supporting the ecological and functional diversity that makes these systems so valuable.

Seven monitoring plots 0.1 acre in size were used to predict survivability of the woody vegetation planted on site. The vegetation monitoring indicated a survivability range of 540 stems per acre to 697 stems per acre with an overall average of 623 stems per acre. Overall, the site is on track for meeting the initial vegetation survival criteria of 320 stems per acre surviving after the third growing season.

2.0 INTRODUCTION

2.1 Project Description

The Gregory wetland and stream restoration site is located near the town of Halifax in Halifax County, North Carolina (see Figure 1). The site has a past history of agricultural use consisting primarily of row crop agriculture. Ditches on the site were used to increase subsurface drainage when the land was under agricultural production. The Gregory site involved the restoration of a "small stream swamp" with associated "bottomland hardwood" and "cypress swamp" communities as described by Schafale and Weakley (1990). Construction of the site, including planting of trees, was completed in January 2005. Groundwater, surface water, and rain gauges were functional beginning February 1, 2005. The 2005 monitoring season represents the first year of monitoring for the site. As-built sheets for the project are shown in Figures 2, 2A, and 2B and in Appendix A.

2.2 Purpose

Monitoring of the Gregory Site is required to demonstrate successful restoration based on the criteria found in the Restoration Plan and through a comparison to reference site conditions. Hydrologic, vegetation, and stream monitoring are conducted on an annual basis. Success criteria must be met for five consecutive years. This Annual Report details the results of the monitoring efforts for 2005 (Year 1) at the Gregory Mitigation Site.

2.3 Project History

May 2004	Reference Monitoring Gauges Installed
June 2004	Approved Restoration Plan
October 2004	Construction Began
January 2005	Construction Completed
January 2005	Planting Completed
February 2005	Post-restoration Monitoring Begins
November 2005	1st Annual Monitoring Report
November 2006 (scheduled)	2nd Annual Monitoring Report
November 2007 (scheduled)	3rd Annual Monitoring Report
November 2008 (scheduled)	4th Annual Monitoring Report
November 2009 (scheduled)	5th Annual Monitoring Report

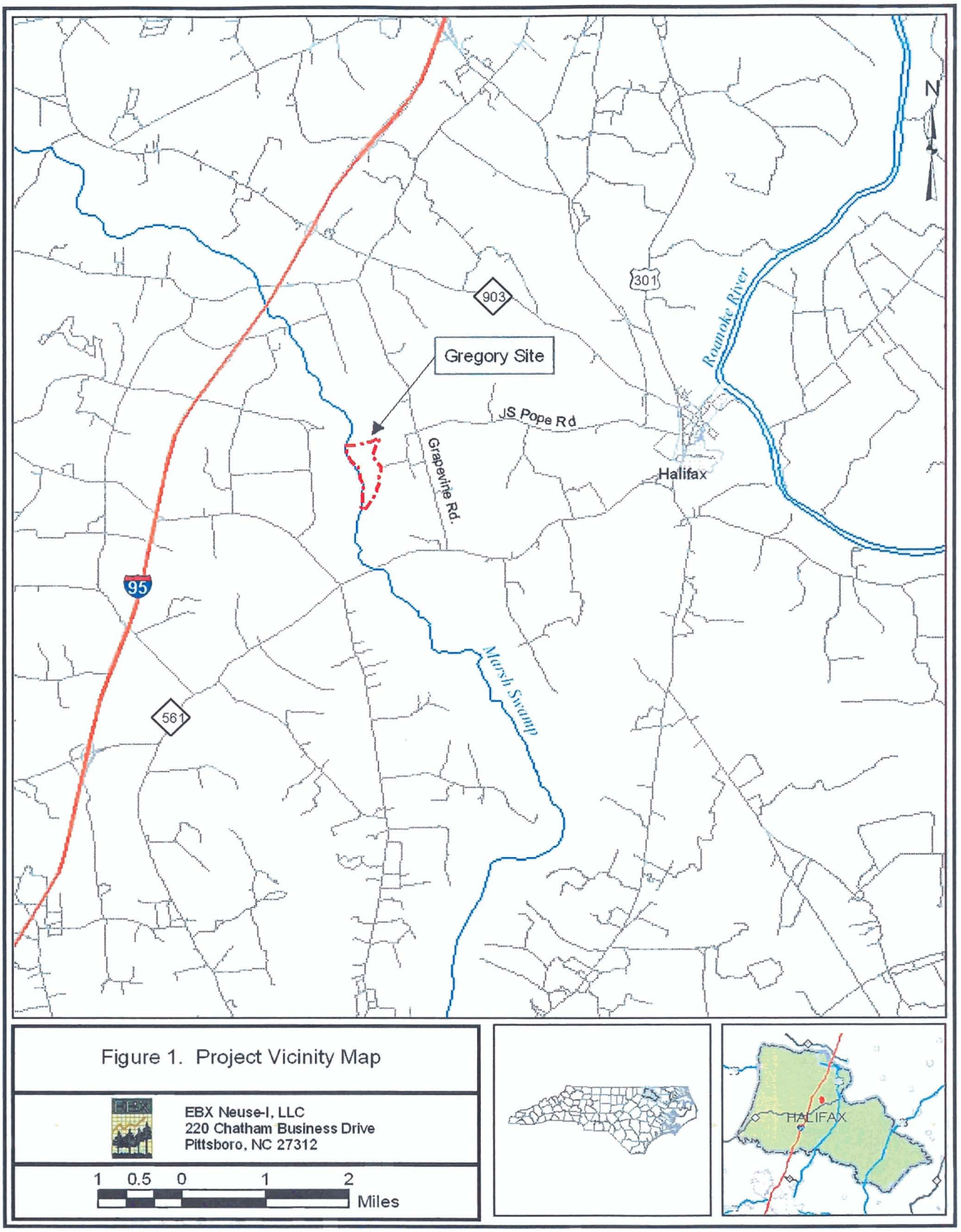


Figure 1. Location of Gregory Wetland and Stream Restoration Site.

GREGORY SITE

PROJECT: 170

WETLAND & STREAM RESTORATION PROJECT
EBX NEUSE - I , LLC
GREGORY SITE

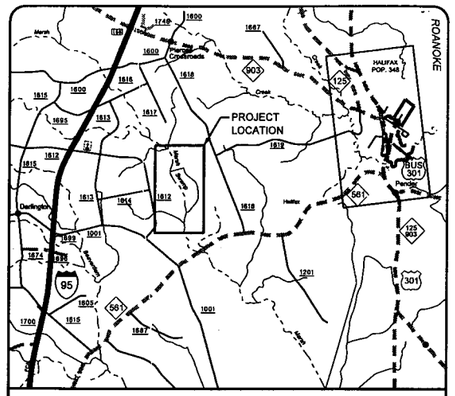
HALIFAX COUNTY

LOCATION: OFF NCSR 561 NEAR HALIFAX

TYPE OF WORK: AS-BUILT

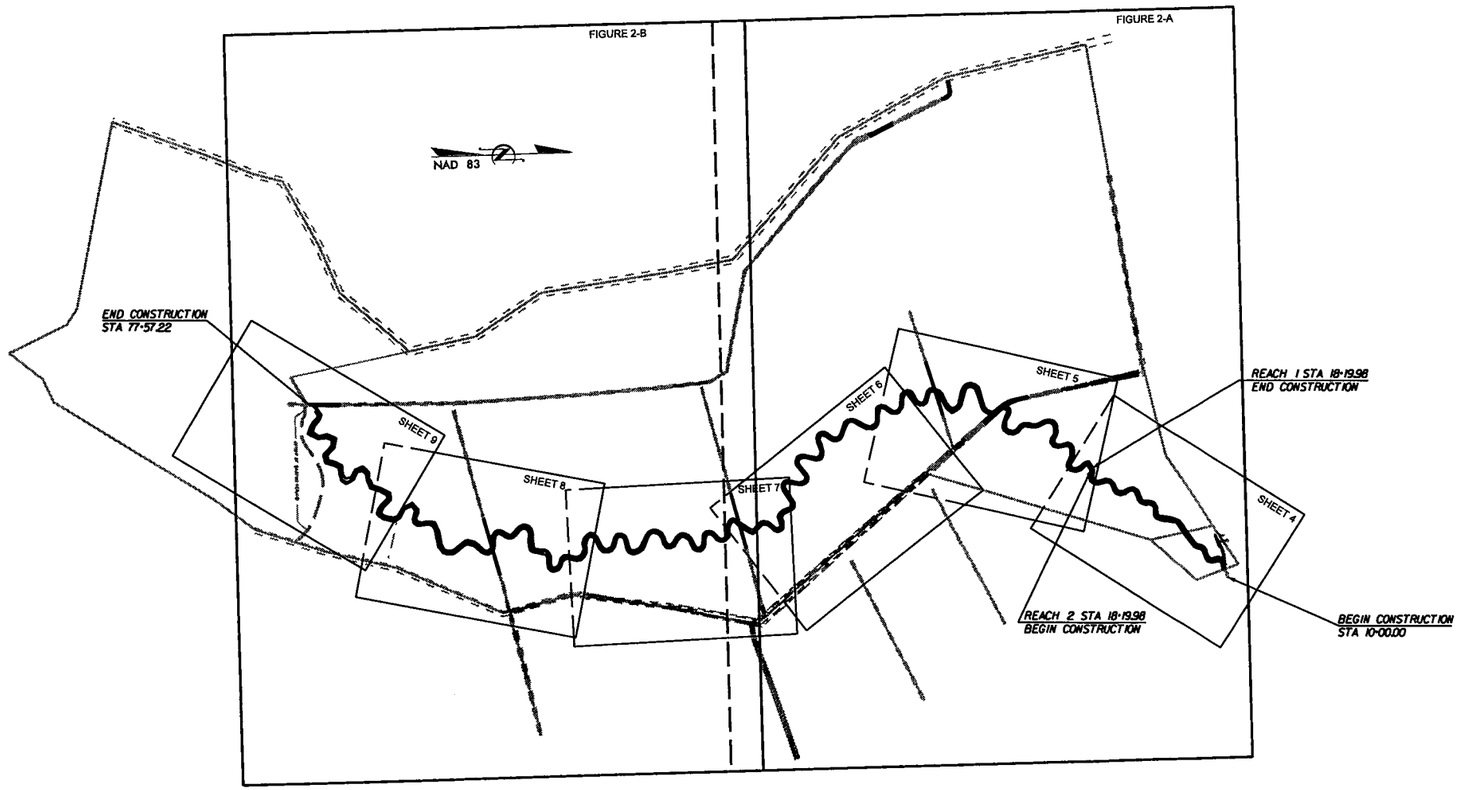
STATE	PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
NC	170	1	12

NO.	DATE	CHECKED BY	APPROVED BY
1	06/05/06	JOHN HUTTON	KEVIN TWEEDY
1	06/10/06	DANIEL TAYLOR	DANIEL TAYLOR



VICINITY MAP

INDEX OF SHEETS



NOTE:
SEE APPENDIX FOR SHEETS 4 - 9

GRAPHIC SCALES

30 15 0 30 60
PLANS

PROJECT SUMMARY

AS-BUILT STREAM LENGTH = 6757 FEET

AS-BUILT RESTORED WETLAND = 85.8 AC

PREPARED FOR THE OFFICE OF:

EBX NEUSE - I , LLC

220 CHATHAM BUSINESS DRIVE
PITTSBORO, NC 27312

EBX

EBX CONTACT:
TARA DISY ALLDEN
PROJECT MANAGER

PREPARED IN THE OFFICE OF:

BUCK ENGINEERING

8000 Regency Parkway Suite 200
Cary, North Carolina 27511
Phone: 919-463-5488
Fax: 919-463-5490

JAN. 2005
COMPLETION DATE:

JOHN HUTTON
PROJECT MANAGER

KEVIN TWEEDY, PE
PROJECT ENGINEER

PROJECT ENGINEER

THIS DOCUMENT ORIGINALLY ISSUED AND SEALED BY:

KEVIN L. TWEEDY
027337
MAY 25, 2005

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SIGNATURE: ***P.E.***

2/26/03

PROJECT REFERENCE NO.	SHEET NO.
170	10

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Fax: 919-463-5490

NAD 83

PROPERTY BOUNDARY

GRADING LIMITS

CONSTRUCTED BERM

AS-BUILT WETLAND RESTORATION BOUNDARY

REACH 1 STA 10+00.00
BEGIN CONSTRUCTION

REACH 1 STA 18+19.98
END CONSTRUCTION

REACH 2 STA 18+19.98
BEGIN CONSTRUCTION

VEGETATION MONITORING PLOT
WETLAND 1

VEGETATION MONITORING PLOT
WETLAND 2

VEGETATION MONITORING PLOT
WETLAND 3

VEGETATION MONITORING PLOT
STREAM 1

CREST GAGE #1

RAIN GAGE #1

MANUAL MONITORING WELL #3

MANUAL MONITORING WELL #4

MANUAL MONITORING WELL #6

AUTOMATIC MONITORING WELL #1

AUTOMATIC MONITORING WELL #2

AUTOMATIC MONITORING WELL #5

AUTOMATIC MONITORING WELL #7

AS-BUILT WETLAND AREA

CHANNEL BLOCK

FILLED CHANNEL AREA

MATCHLINE SHEET 11

NOTE:
AS-BUILT CONTOURS ARE ACCURATE
TO WITHIN +/- 5 INCHES

GREGORY SITE
AS-BUILT PLANS

100 50 0 100 200
SCALE (FT)

11/10/2005
I:\0170R\Design\Plans\0170R_EBX_psh_AB_10.dgn

2/26/03

MATCHLINE SHEET 10

PROJECT REFERENCE NO.	SHEET NO.
170	11

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NAD 83

VEGETATION MONITORING PLOT STREAM 2

AUTOMATIC MONITORING WELL #9

AUTOMATIC MONITORING WELL #8

POST GAGE

CONSTRUCTED BERM

AS-BUILT WETLAND RESTORATION BOUNDARY

GRADING LIMITS

MANUAL MONITORING WELL #11

VEGETATION MONITORING PLOT STREAM 3

VEGETATION MONITORING PLOT WETLAND 4

AUTOMATIC MONITORING WELL #10

EXTENT OF EXISTING WETLAND

REACH 2 STA 17+57.23 END CONSTRUCTION

AS-BUILT WETLAND AREA

FILLED CHANNEL AREA

CHANNEL BLOCK

NOTE:
AS-BUILT CONTOURS ARE ACCURATE TO WITHIN +/- 5 INCHES

GREGORY SITE
AS-BUILT PLANS

100 50 0 100 200
SCALE (FT)

11/10/2005
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3.0 HYDROLOGY

3.1 Success Criteria

As stated in the approved Restoration Plan, to meet the hydrologic success criteria, the monitoring data must show that for each normal year of rainfall within the monitoring period, the site has been inundated or saturated within 12 inches of the soil surface for a minimum of 12.5 percent of the growing season (28 consecutive days). As specified in the approved Restoration Plan, data are collected from seven automated and four manual groundwater gauges.

The day counts are based on the growing season for Halifax County. The NRCS does not publish temperature data in the Wetlands Determination Tables (WETS) for Halifax County, therefore the growing season was determined by averaging the beginning and ending dates from two east/west adjacent counties, Warren and Bertie. NRCS calculates that the Warren County growing season covers 219 days, beginning on March 30 and ending November 4. The Bertie County growing season covers at 231 days, beginning on March 22 and ending November 8. The average of the two growing seasons is 225 days, beginning on March 26 and ending November 6.

The Restoration Plan further specified that WETS tables for Halifax County would be compared to observed rainfall to determine whether the year would be considered normal for rainfall. During the 2005 growing season, the rainfall total through the end of September was 8.1 inches below normal. In addition, the distribution of rainfall throughout the period was very irregular.

3.2 Description of Hydrologic Monitoring Efforts

Four manual groundwater gauges, seven automated Infinities groundwater gauges, and two manual stream crest gauges were installed prior to the beginning of the first growing season (Figure 2). Groundwater gauges, both manual and automated, were installed to a minimum depth of at least 40 inches below the ground surface. The monitoring protocol for the site specifies that automated monitoring stations will be downloaded and checked for malfunctions on a monthly basis. During monthly site visits, manual groundwater gauges are read and rainfall totals are collected from the on-site rain gauge. During the 2005 growing season, all three automated loggers performed well and no periods of missing data were incurred.

3.3 Results of Hydrologic Monitoring

3.3.1 Site Data

The following hydroperiod statistics were calculated for each monitoring station during the growing season: 1) most consecutive days that the water table was within twelve inches of the soil surface; 2) cumulative number of days that the water table was within twelve inches of the soil surface; and 3) number of times that the water table rose to within twelve inches of the soil surface. The results of these calculations are presented in Table 1. Figure 3 provides a chart of the water depth for each of the monitoring gauges on the site. Precipitation is shown at the top of the graph. This graph illustrates the reaction at each monitoring location of the groundwater level to specific rainfall events. Raw hydrograph data collected from the monitoring gauges are provided in Appendix B.

As stated in the approved Restoration Plan, to meet the hydrologic success criteria, the monitoring data must show that for each normal year of rainfall within the monitoring period, the site has been inundated or saturated within 12 inches of the soil surface for a minimum of 12.5 percent of the growing season (28 consecutive days). Monitoring has thus far demonstrated that much of the site is functioning as designed, with varying degrees of wetness and saturation across the site. Gauges MW4, AW5, AW9, AW10, and MW11 have exceeded the 12.5 percent hydrologic success criteria. Gauges AW2, MW3, AW7, and AW8 document wet conditions. These gauges have all exhibited water tables within 12 inches of the soil surface in excess of 9 percent of the growing season continuously and 20 percent of the growing season cumulatively. Gauges AW1 and MW6 are exhibiting continuously saturated conditions of approximately 5 percent during the 2005 season.

Table 1. Site Hydrologic Monitoring Results for 2005 (Year 1).

Monitoring Station	Most Consecutive Days Meeting Criteria[1]	Cumulative Days Meeting Criteria[2]	Number of Instances Meeting Criteria[3]
G-AW1	11 (4.9%)	28 (12.4%)	7
G-AW2	23 (10.2%)	111 (49.3%)	7
G-MW3 [4]	~23 (10.2%)	~111 (49.3%)	~7
G-MW4 [4]	~30 (13.3%)	~111 (49.3%)	~7
G-AW5	30 (13.3%)	111 (49.3%)	7
G-MW6 [4]	~11 (4.9%)	~28 (12.4%)	~7
G-AW7	24 (10.7%)	105 (46.7%)	8
G-AW8	21 (9.3%)	46 (20.4%)	5
G-AW9	30 (13.3%)	109 (48.4%)	8
G-AW10	30 (13.3%)	101 (44.9%)	7
G-MW11 [4]	~30 (13.3%)	~101 (44.9%)	~7

Notes:

Percentage indicates percent of the growing season.

1. Indicates the most consecutive number of days within the monitored growing season with a water table less than 12 inches from the soil surface.
2. Indicates the cumulative number of days within the monitored growing season with a water table less than 12 inches from the soil surface.
3. Indicates the number of instances within the monitored growing season when the water table rose to less than 12 inches from the soil surface.
4. Groundwater gauges G-MW3, G-MW4, G-MW6, and G-MW11 are manual gauges. Hydrologic parameters are estimated based on data from automated gauges at G-AW2, G-AW5, G-AW1, and G-AW10 respectively.

3.3.2 Reference Data

The approved Restoration Plan provides that if the rainfall data for any given year during the monitoring period is not normal, the reference wetland data can be used to determine if there is a positive correlation between the performance of the restoration site and the natural hydrology of the reference site.

The same hydroperiod statistics were calculated for each reference monitoring station during the growing season as were calculated for the site monitoring stations (Section

2.3.1). The results of these calculations are presented in Table 2. Figure 4 shows a comparison of the Gregory site with the reference monitoring station data.

Both reference wells far exceed the 12.5 percent hydroperiod established as success criteria for the site. The reference wells are located within the floodplain for Marsh Swamp near the southern end of the restoration site. Beaver activity in Marsh Swamp has kept the entire floodplain in this area inundated for much of the growing season. This is evidenced by the fact that the water surface remained above ground level for much of the year, particularly in RW2 (Appendix B).

Table 2. Reference Wetland Hydrologic Monitoring Results for 2005 (Year 1).

Monitoring Station	Most Consecutive Days Meeting Criteria[1]	Cumulative Days Meeting Criteria[2]	Number of Instances Meeting Criteria[3]
G-RW1	54 (24.0%)	76 (33.8%)	7
G-RW2	85 (37.8%)	125 (55.6%)	5

Notes:

Percentage indicates percent of the growing season.

1. Indicates the most consecutive number of days within the monitored growing season with a water table less than 12 inches from the soil surface.
2. Indicates the cumulative number of days within the monitored growing season with a water table less than 12 inches from the soil surface.
3. Indicates the number of instances within the monitored growing season when the water table rose to less than 12 inches from the soil surface.

3.3.3 Climate Data

Table 3 and Figure 5 are a comparison of the 2005 monthly rainfall to historical precipitation (collected between 1971 and 2000) for Halifax County (NRCS WETS Tables NC2827 for Enfield). Halifax County has an average annual rainfall of 45.4 inches. Observed precipitation data were collected from an automated weather station in Halifax. For the period of record in which on-site rainfall measurements were collected (March 9 through August 31), the rainfall total from the Halifax gauge (21.3 inches) correlates well with data collected from the onsite manual rain gauge (22.6 inches). In general, the Halifax gauge indicates that monthly rainfall amounts for the area were much lower than normal for the months of April, June, August and September and near or above average for the months of May and July. Table 3 gives an indication of how 2005 compares to historical data in terms of average rainfall. For the 2005 period of record shown, total rainfall was 11.3 inches below the long-term average. Monthly rainfall for October (missing data), November, and December 2005 were not available at the time this report was compiled.

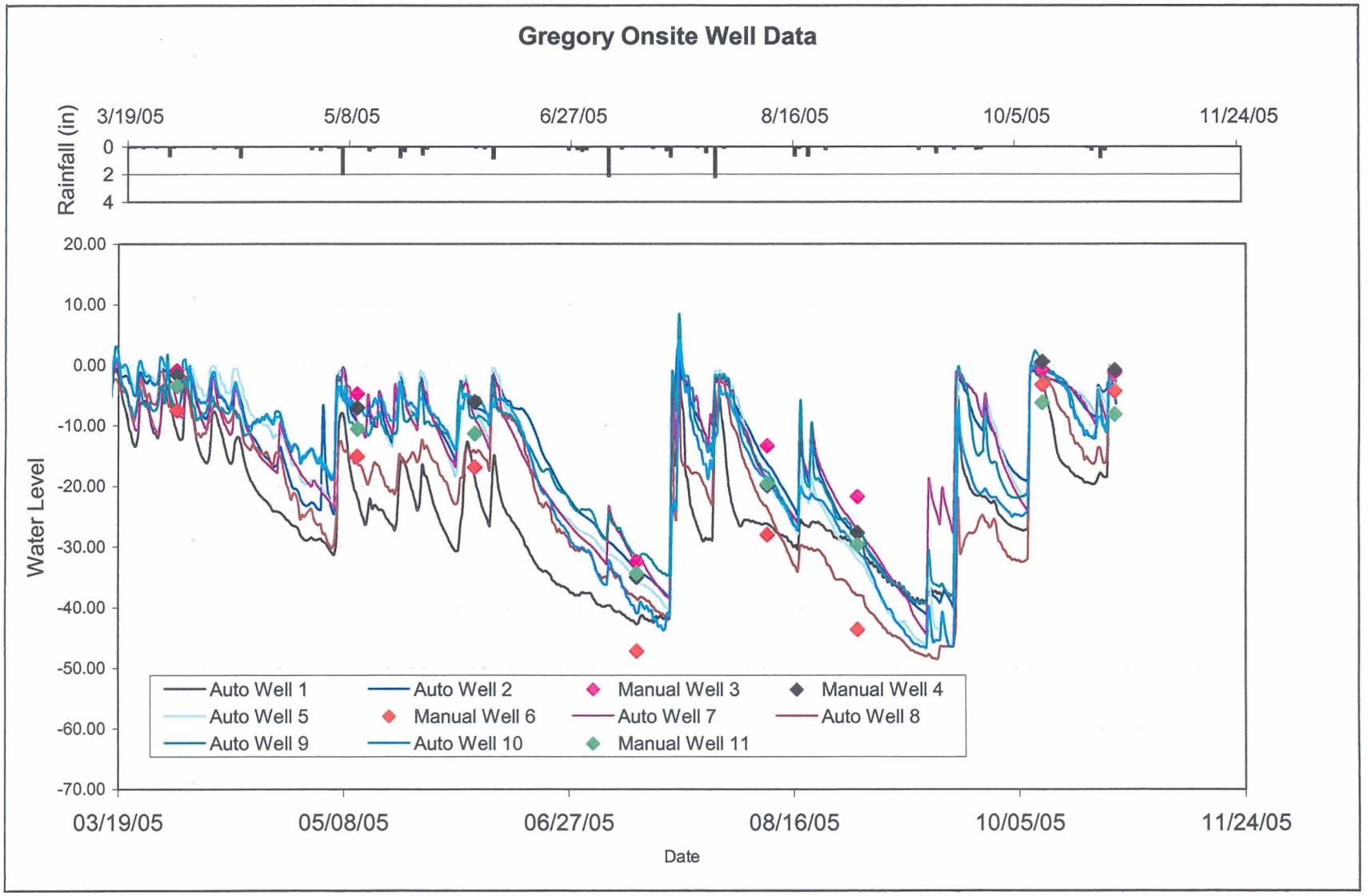

Figure 3. 2005 Onsite Groundwater Gauge Data Graph.

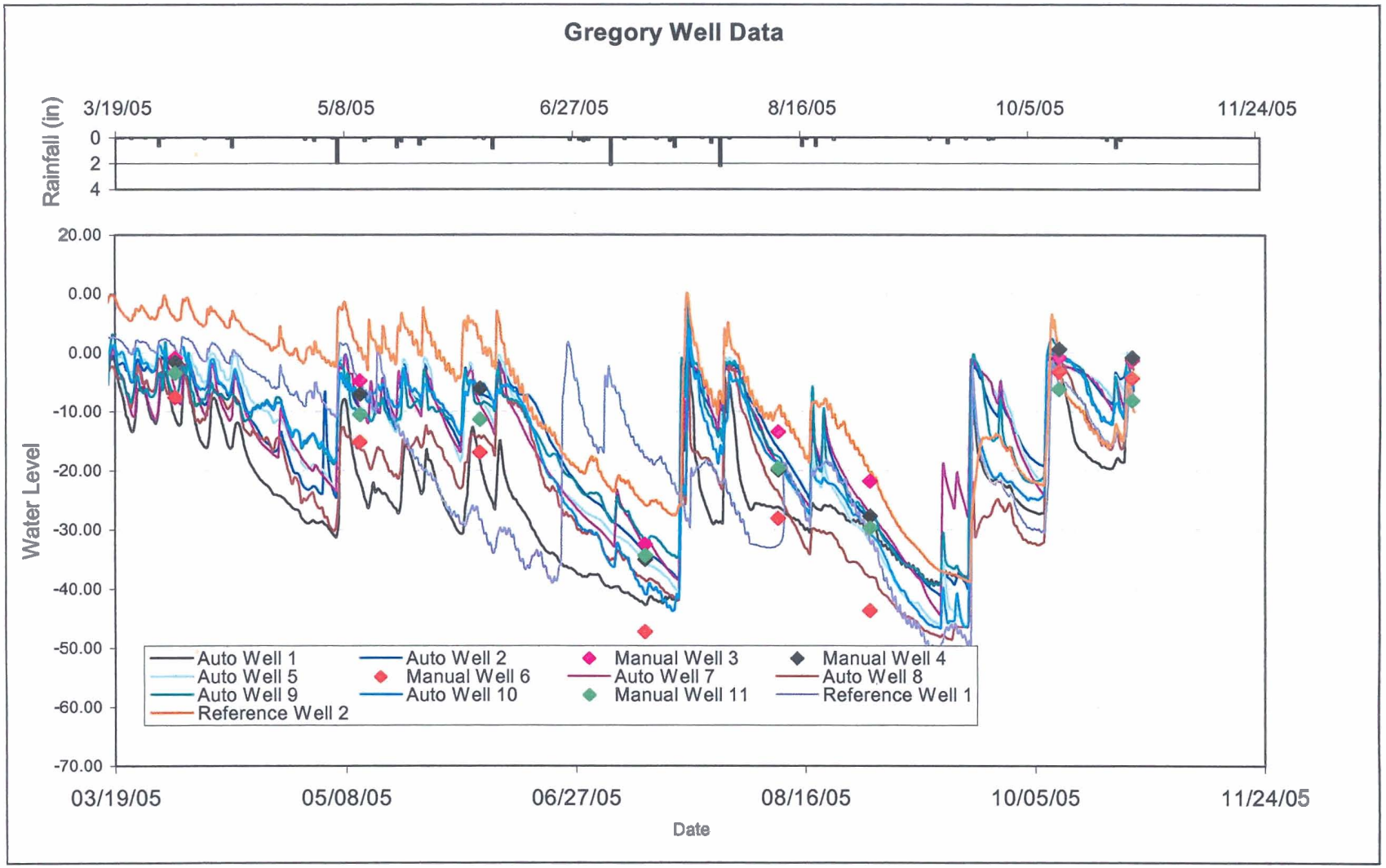

Figure 4. Comparison of Reference Site Data to Restoration Site Data.

Table 3. Comparison of Historic Average Rainfall to Observed Rainfall (Inches).

				Observed Precipitation, P (in)	
Month	**Average**	**30%**	**70%**	**Month**	**P**
October	3.33	2.01	4.35	**October 2004**	2.8
November	3.04	1.86	3.59	**November 2004**	1.53
December	3.26	2.29	4.06	**December 2004**	1.9
January	4.23	3.2	5.01	**January 2005**	3.17
February	3.47	2.37	4.29	**February 2005**	2.49
March	4.22	3.12	4.95	**March 2005**	4.04
April	3.16	2.14	3.94	**April 2005**	1.05
May	3.94	2.58	4.77	**May 2005**	4.28
June	3.62	2.48	4.25	**June 2005**	1.83
July	4.25	2.76	5.07	**July 2005**	6.01
August	4.26	2.6	5.62	**August 2005**	1.56
September	4.58	2.19	5.52	**September 2005**	0.97
October	3.33	2.01	4.35	**October 2005**	**N/A**
November	3.04	1.86	3.59	**November 2005**	**N/A**
December	3.26	2.29	4.06	**December 2005**	**N/A**

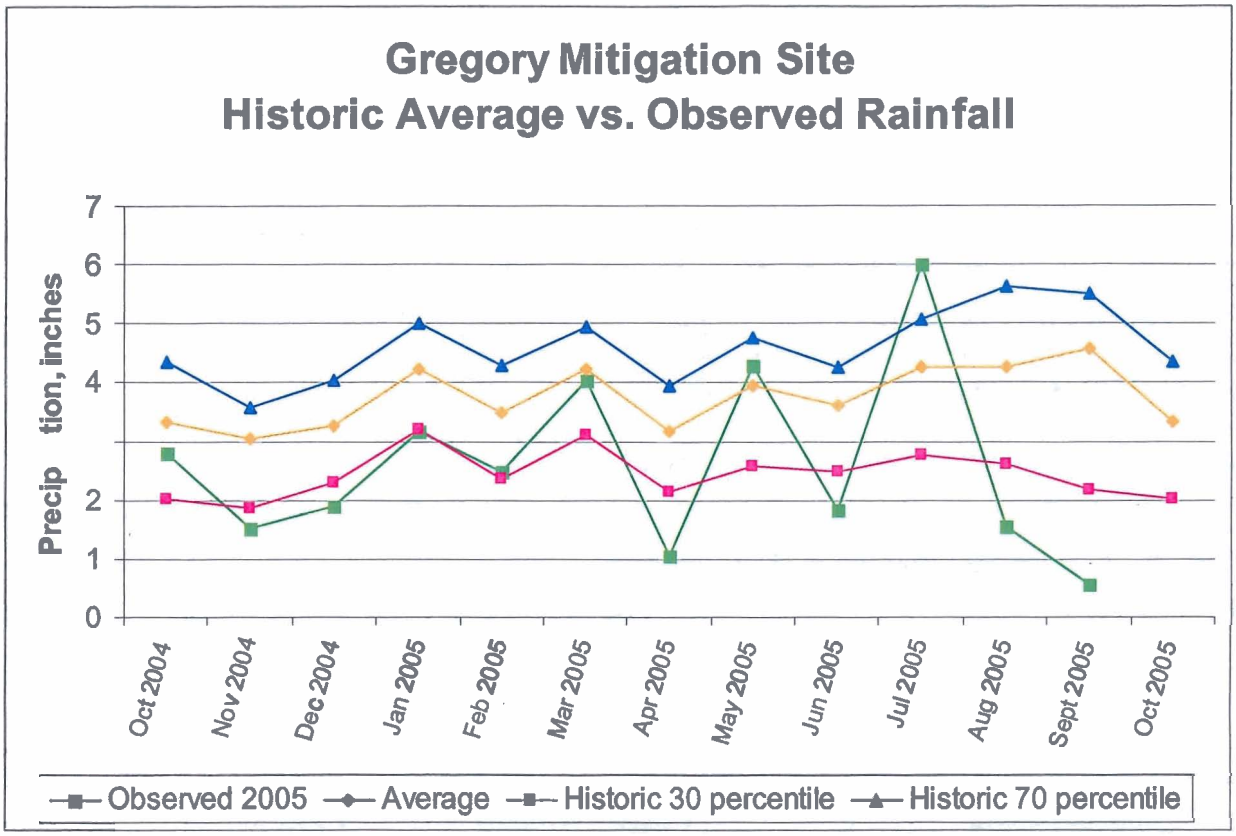

Figure 5. Comparison of Historic Average Rainfall to Observed Rainfall.

3.4 Hydrologic Conclusions

Data collected from all the groundwater monitoring gauges on Gregory Mitigation Site indicate that five of eleven hydrology monitoring recorded hydroperiods of at least 12.5 percent of the growing season. Four of the remaining gauges exhibited a hydroperiod greater than 9 percent of the growing season. The remaining two gauges exhibited conditions drier than expected, but, at 5 percent were within the range expected for a wetland system.

Rainfall data indicates that the 2005 growing season was unusually dry compared to average rainfall totals. Of particular concern was the low rainfall during April. This is the first month of the growing season and is historically the period when the water table is closest to the surface for the longest continuous period.

Based on the generally positive results from the monitoring wells and the extremely low rainfall totals, it was concluded that most of the site is performing as designed. The northwestern portion of the showed the driest conditions, however, visual observations of the site indicate that this area has a comparable hydroperiod to the more southern portions of the site. An additional automated well will be installed north of AW1 to better represent this area. Particular attention will be paid to these wells in subsequent monitoring seasons.

4.0 VEGETATION

4.1 Success Criteria

The interim measure of vegetative success for the Gregory Mitigation Plan will be the survival of at least 320, 3-year-old planted trees per acre at the end of Year 3 of the monitoring period. The final vegetative success criteria will be the survival of 260, 5-year-old planted trees per acre at the end of Year 5 of the monitoring period.

Up to 20 percent of the site species composition may be comprised of volunteer species. Remedial action may be required should these (i.e. loblolly pine, red maple, sweet gum, etc.) present a problem and/or exceed 20 percent of the total species composition.

4.2 Description of Species and Monitoring Protocol

Table 4 shows the tree species planted as part of the Gregory Wetland Restoration project.

Table 4. Tree Species Planted in the GregoryWetland Restoration Area.

ID	Scientific Name	Common Name	FAC Status
1	*Nyssa biflora*	Swamp Tupelo	OBL
2	*Nyssa sylvatica*	Blackgum	FAC
3	*Quercus lyrata*	Overcup Oak	OBL
4	*Quercus michauxii*	Swamp Chestnut Oak	FACW-
5	*Quercus phellos*	Coastal Willow Oak	FACW-
6	*Quercus laurifolia*	Laurel Oak	FACW
7	*Taxodium distichum*	Bald Cypress	OBL
8	*Fraxinus pennsylvanica*	Green Ash	FACW

The following monitoring protocol was designed to predict vegetative survivability. Seven plots were established on the Gregory Mitigation Site, to monitor approximately 0.65 percent of the site. The three stream bank vegetation monitoring plots were designed to be 1/10th of an acre in size, or 50' x 87.5' dimensionally. Four other plots are designed to be 25' x 100' dimensionally. The plots were randomly located and randomly oriented within the wetland restoration area.

Plot construction involved using metal fence posts at each of the four corners to clearly and permanently establish the area that was to be sampled. Then ropes were hung connecting all four corners to help in determining if trees close to the plot boundary were inside or outside of the plot. Trees right on the boundary and trees just outside of the boundary that appear to have greater than 50 percent of their canopy inside the boundary were counted inside the plot. A piece of white PVC pipe ten feet tall was placed over the metal post on one corner to facilitate visual location of site throughout the five-year monitoring period.

All of the planted stems inside the plot were flagged with orange flagging and marked with a 3-foot tall piece of half-inch PVC to mark them as the planted stems (vs. any colonizers) and to help in locating them in the future. Each stem was then tagged with a permanent numbered aluminum tag.

4.3 Results of Vegetative Monitoring

Table 5 shows stem count data for each of the monitoring plot. Each planted tree species is identified across the top row, and each plot is identified down the left column. The numbers on the top row correlate to the ID number in Table 4. Trees are flagged in the field on a quarterly basis before the flags degrade. Flags are utilized, because they will not interfere with the growth of the tree. Volunteers are also flagged during this process. Volunteer species for the Gregory Site are summarized in Table 6.

Table 5. 2005 Vegetation Monitoring Plot Species Composition.

Plot	1	2	3	4	5	6	7	8	Total	Stem/ac
G1	7	1	12	2	2	1	0	11	36	627
G2	0	9	5	11	2	5	0	4	36	627
G3	0	4	4	2	20	3	0	7	40	697
G4	15	0	0	0	0	0	23	0	38	662
GS-1	0	3	22	0	6	3	0	26	60	600
GS-2	0	4	22	6	14	2	0	6	54	540
GS-3	20	0	0	0	0	0	41	0	61	610

Average Stems/Acre: 623

Volunteer species will also be monitored throughout the five-year monitoring period. Below is a table of the most commonly found woody volunteer species.

Volunteer woody species were observed in most all of the vegetation plots, but were deemed too small to tally. If these trees persist into the next growing season, they will be flagged and added to the overall stems per acre assessment of the site. Sweetgum (Liquidambar styraciflua) is the most common volunteer, though Red Maple (Acer rubrum) and River Birch (Betula nigra) were also observed.

Table 6. Volunteer Tree Species Identified within in the Wetland Restoration Area.

ID	Species	Common Name	FAC Status
A	*Liquidambar styraciflua*	Sweetgum	FAC+
B	*Acer rubrum*	Red Maple	FAC
C	*Betula nigra*	River Birch	FACW

4.4 Vegetation Observations and Conclusions

After construction of the mitigation site, a permanent ground cover seed mixture of Virginia wild rye (Elymus virginicus), switch grass (Panicum virgatum), and fox sedge (Carex vulpinoidea) was broadcast on the site at a rate of 10 pounds per acre. These species are present on the site. Hydrophytic herbaceous vegetation, including rush (Juncus effusus), spike-rush (Eleocharis obtusa), Boxseed (Ludwigia sp.), and sedge (Carex sp.), are observed across the site, particularly in areas of periodic inundation. The presence of these herbaceous wetland plants helps to confirm the presence of wetland hydrology on the site.

There are quite a few weedy species occurring on the site, though none seem to effect the woody or herbaceous hydrophytic vegetation. The majority of the weedy species are annuals and seem

to pose very little threat to survivability on site. Commonly observed weedy vegetation includes ragweed (Ambrosia artemisiifolia) and wild dill (Foeniculum vulgare). Any threatening weedy vegetation found in the future will be documented and discussed in quarterly reports.

The site was planted in nonriverine wet hardwoods and Coastal Plain swamp species in February 2005. There were seven vegetation-monitoring plots established throughout the planting areas. We feel that the overall site is on trajectory to meet the minimum success interim criteria of 320 trees per acre by the end of Year 3 and the final success criteria of 260 trees per acre by the end of Year 5.

5.0 STREAM MONITORING

5.1 Success Criteria

As stated in the approved Mitigation Plan, the stream restoration success criteria for the site include the following:

- *Bankfull Events*: Two bankfull flow events must be documented within the five-year monitoring period.
- *Cross-sections*: There should be little change in as-built cross-sections. Cross-sections shall be classified using the Rosgen stream classification method and all monitored cross-sections should fall within the quantitative parameters defined for "E" or "C" type channels.
- *Longitudinal Profiles*: The longitudinal profiles should show that the bedform features are remaining stable, e.g. they are not aggrading or degrading. Bedforms observed should be consistent with those observed in "E" and "C" type channels.
- *Photo Reference Stations*: Photographs will be used to subjectively evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation and effectiveness of erosion control measures (see Appendix C).
- *Benthic Macroinvertebrate*: Sampling of benthic macroinvertebrates within the restored stream channel shall be conducted for the first three years of post-restoration monitoring. No success criteria are applied to the sampling data that will be collected.

5.2 Description of Stream Monitoring

To document the stated success criteria, the following monitoring program was instituted following construction completion on the Gregory Site:

Bankfull Events: Two crest gauges were installed on the site to document bankfull events. The gauge is checked each month, and records the highest out-of-bank flow event that occurred during the past month. See as-built plans for gauge locations (Figure 2).

Cross-sections: Two permanent cross-sections were installed per 1,000 linear feet of stream restoration work, with one of the locations being a riffle cross-section and one location being a pool cross-section. A total of 14 permanent cross-sections were established across the mitigation site. Each cross-section was marked on both banks with permanent pins to establish the exact transect used. Permanent cross-section pins were surveyed and located relative to a common benchmark to facilitate easy comparison of year-to-year data. The annual cross-section surveys include points measured at all breaks in slope, including top of bank, bankfull, inner berm, edge of water, and thalweg. Riffle cross-sections are classified using the Rosgen stream classification system. Permanent cross-sections for 2005 (Year 1) were surveyed in September 2005.

Longitudinal Profiles: A complete longitudinal profile was completed for each restoration and enhancement level I reach. The longitudinal survey will take place in Years 3 and 5 as well. Measurements include thalweg, water surface, inner berm, bankfull, and top of low bank. Each of these measurements is taken at the head of each feature, e.g. riffle, run, pool, and glide, and the max pool depth. A common benchmark will be used each year to facilitate comparison of year-to-year data. The longitudinal survey for 2005 (Year 1) was conducted during September 2005.

Photo Reference Stations: Photographs are used to visually document restoration success. Reference stations are marked with wooden stakes and Global Positioning Satellite (GPS) coordinates have been determined for each location. Reference photos are taken at each permanent cross-section from both streambanks. The survey tape is centered in the photographs of the bank, and the water line is located in the lower edge of the frame with as much of the bank as possible included in each photo. In-stream structures (e.g., rock vanes, cross vanes, and constructed riffles) are also photographed. Photo reference stations will be photographed at least once per year for at least 5 years following construction.

Benthic Macroinvertebrates: Benthic macroinvertebrate data will be collected from the reference reach (upstream of project reach) and within the project reach. Pre-restoration data were collected on September 15, 2004, prior to initiation of stream restoration practices upstream of the restoration reach. Prior to construction, the water level was too high in McCulloch's Ditch to sample the restoration reach. Post-restoration sampling will begin at least one year after construction activities have been completed, and annually thereafter for a total of three years. Sampling will be conducted each year between September and October to be consistent with the pre-construction sampling. Sample collection follows protocols described in the standard operating procedures of the Biological Assessment Unit of the North Carolina Division of Water Quality (NCDWQ). The Qual-4 collection method is used for the collection of macroinvertebrate samples, and a North Carolina-certified laboratory performs the identification of the macroinvertebrate samples. The metrics calculated include total and Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa richness, EPT abundance and biotic index values.

Year 1 biological sampling will be conducted in September 2006 (more than one year following completion of construction). Results for Year 1 biological sampling will be included in the Year 2 report.

5.3 Results of Stream Monitoring

Two crest gages were installed along Black Spring Creek following site construction. During 2005, bankfull events on the site were documented during at least two site visits through the use of the onsite crest gauge and visual evidence of out-of-bank flow. The largest stream flow documented by the downstream crest gauge was a flow that occurred during the month of August and was approximately 0.3 feet above the bankfull stage at the crest gauge. Based on observations of ponded water, debris lines, and deposited sediment on the floodplain, the bankfull event spread over much of the restored wetland areas adjacent to the stream. Stream monitoring data is provided in Appendix D.

Year 1 cross-section monitoring data for stream stability were collected during September 2005 and compared to baseline data collected in February 2005. A longitudinal profile survey was conducted along the entire stream length. The longitudinal profile information documents the elevations and locations of streambed features and in-stream grade control structures (see Appendix A). The longitudinal profile also documents that the overall design stream slope was achieved in the completed stream. Permanent cross-sections document the stream dimension at eleven locations (six riffles and five pools, see Appendix A). The profile and cross-sections show that there has been very little adjustment to stream profile or dimension since construction. Several pool cross-sections indicate the development of point bar features, which is expected. All monitored cross-sections fell within the quantitative parameters defined for "E" or "C" type channels.

In-stream structures installed within the restored stream included constructed riffles, log vanes, log weirs, and root wads. Visual observations of structures throughout the past growing season have indicated that nearly all structures are functioning as designed. Log vanes placed in meander pool areas have provided scour to keep pools deep and provide cover for fish. Log weirs placed in riffle areas have maintained riffle elevations and provided a downstream scour hole that provides habitat. Bank scour downstream of the log weirs was minimized through the use of notches in the logs that keep the stream flow centered. Root wads placed on the outside of meander bends have provided bank stability and in-stream cover for fish and other aquatic organisms. The constructed riffles were all installed on the upper end of the site where slopes are significantly higher than the lower end. The constructed riffles have maintained riffle elevations and kept bank height ratios at 1.0 as shown in the longitudinal profile and cross-sections. Some minor piping of water around the boulders has been observed and will be monitored over the coming years to determine whether maintenance action is needed.

Photographs have been taken throughout the monitored season to document the evolution of the restored stream channel (see Appendix C). The most observable change to the stream during 2005 has been the prevalence of native hydrophytic vegetation along the restored streambanks. Herbaceous vegetation is dense along the restored stream, making it difficult to take photographs of the stream channel itself in some locations. Pools have maintained a variety of depths and habitat qualities, depending on the location and type of scour features (logs, root wads, transplants, etc.).

5.4 Stream Benthic Macroinvertebrates

Year 1 biological sampling will be conducted in September 2006 (one year following completion of construction). Results for Year 1 biological sampling will be included in the Year 2 report.

6.0 OVERALL CONCLUSIONS AND RECOMMENDATIONS

- First year hydrologic monitoring has shown that suitable minimum wetland hydrology criteria have been achieved on most of the site despite low rainfall conditions. Of the 11 hydrology monitoring gauges, 5 recorded consecutive hydroperiods for at least 12.5 percent of the growing season. Four of the remaining gauges exhibited a hydroperiod greater than 9 percent of the growing season. The remaining two gauges exhibited conditions drier than expected, but, at approximately 5 percent, were within the range found in other wetland systems.
- An additional well will be installed in the northwestern corner of the site to verify that the hydroperiod is accurately documented in this area.
- The restored stream channel has remained stable and is providing the intended habitat and hydrologic functions. All monitoring cross-sections for 2005 showed very little adjustment in stream dimension.
- Vegetation monitoring efforts have calculated the average number of stems per acre on site to be 623, which is a survival rate of greater than 90 percent based on the initial planting count of 672 stems per acre. We feel that vegetation survivability should remain excellent on site and vegetative success criteria will easily be met.
- Monitoring of vegetation and groundwater and surface water levels will continue.

7.0 WILDLIFE OBSERVATIONS

Observations of deer and deer tracks are common on the Gregory site. During certain times of the year, frogs have been very prevalent across the site. Birds, turtles and black snakes have also been observed on the site.

APPENDICES

(APPENDIX MATERIALS ARE INCLUDED ON ENCLOSED CD)