

ANNUAL REPORT FOR 2004



**Mashoes Road Mitigation Site
Dare County
Project No. 8.T051402
TIP No. R-2551WM**



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North Carolina Department of Transportation
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SUMMARY

The following report summarizes the monitoring activities that have occurred in the past year at the Mashoes Road Mitigation Site. Construction began on this site in 1998. The west side of Mashoes Road was completed in early 1999 and was planted with trees; this area was replanted in the Winter of 2000-01. The east side of Mashoes Road was completed in the fall of 1999 but was not planted due to attempts to control *Phragmites*. The east side of the site was planted with marsh grass in the spring of 2001. The site must demonstrate hydrologic and vegetation success for a minimum of five years or until the project is deemed successful.

The site contains nine groundwater-monitoring gauges on the west side, ten surface gauges on the east side and one rain gauge. On the east side, there are a total of 167 random vegetation plots and the west side has five permanent vegetation plots.

The daily rainfall data depicted on the monitoring gauge graphs is recorded from an on-site rain gauge. Historical rainfall data used for the 30-70 percentile was recorded at the Manteo Rain Gauge, maintained by the NC State Climate Office.

Hydrologic monitoring indicated that the site is continuing toward success. Under average conditions for 2004, all nine of the groundwater gauges exceeded the jurisdictional hydrologic success for at least 12.5% of the growing season. All ten of the surface gauges showed steady tidal influence that maintained a water elevation above zero under normal conditions for at least 25% of the growing season.

Vegetation monitoring on the west side (tree area) of the restoration area yielded 482 trees per acre, which is above the 290-tree requirement. A frequency of 73.1% for the targeted vegetative species was found on the east side (marsh grasses area) of the site. A vegetative scale value of 4.6 was recorded.

Per the letter from the Ecosystem Enhancement Program (EEP) to NCDOT dated August 25, 2004, the EEP has accepted the transfer of all off-site mitigation projects. The EEP will be responsible for fulfilling the remaining monitoring requirements and future remediation for this project.

1.0 INTRODUCTION

1.1 Project Description

The Mashoes Road Wetland Mitigation Site is located north of Manns Harbor in Dare County (Figure 1). It is bounded by US 64-264 to the south, the Alligator River National Wildlife Refuge to the west, the Croatan Sound to the east, and is bisected into east/west by SR 1113 (Mashoes Road).

A significant portion of the site (254 acres) was classified as a coastal marsh and fell under the jurisdiction of the N.C. Division of Coastal Management. Another portion (107 acres) was classified as forested wetlands. The remainder of the site consisted of a 15-acre pond, borrow pits and cleared uplands from a sand mining operation, as well as some forested uplands.

The site encompasses approximately 399 acres and is designed as a mitigation site primarily for the new Croatan Sound Bridge between Manns Harbor and Manteo; TIP Projects R-2551 and K-4003 (USACE Action ID No. 199502334).

1.2 Purpose

In order to demonstrate successful mitigation, hydrologic and vegetative monitoring must be conducted for a minimum of five years or until success criteria are fulfilled. Success criteria are based on federal guidelines for wetland mitigation. These guidelines stipulate criteria for both hydrologic conditions and vegetation survival. The following report details the results of hydrologic and vegetative monitoring during 2004 at the Mashoes Road Mitigation Site.

Included in this report are analyses of both hydrologic and vegetative monitoring results, as well as local climate conditions throughout the growing season.

1.3 Project History

Winter 1999	West Side Construction Complete
Spring 1999	Wetland Trees Planted (West Side)
Spring 1999	East Side Construction Complete
March 1999	Monitoring Gauges Installed (Entire Site)
March – November 1999	Hydrologic Monitoring (Entire Site, Year 1)
October 1999	Vegetation Monitoring (West Side, Year 1)
March – November 2000	Hydrologic Monitoring (Entire Site, Year 2)
October 2000	Vegetation Monitoring (West Side, Year 2)
October 2000	Phragmites Treated
March – November 2001	Hydrologic Monitoring (Entire Site, (Restart Year 1)
April 2001	Phragmites Treated
May 2001	Marsh Grasses Planted
August 2001	Tree Vegetation Monitoring (Restart Year 1)
August 2001	Marsh Vegetation Monitoring (Year 1)
March – November 2002	Hydrologic Monitoring (Year 2)
July 2002	Tree Vegetation Monitoring (Year 2)
July 2002	Marsh Vegetation Monitoring (Year 2)
November 2002	Phragmites Treated
March – November 2003	Hydrologic Monitoring (Year 3)
October 2003	Phragmites Treated
October 2003	Tree Vegetation Monitoring (3 yr.)
October 2003	Marsh Vegetation Monitoring (3 yr.)
March – November 2004	Hydrologic Monitoring (Year 4)
September 2004	Tree Vegetation Monitoring (Year 4)
September 2004	Marsh Vegetation Monitoring (Year 4)

2.0 HYDROLOGY

2.1 Success Criteria

In accordance with federal guidelines for wetland mitigation, the success criteria for hydrology in the forested wetland (west side) state that the area must be inundated or saturated (within 12 inches of the surface) by surface or ground water for at least 12.5% of the growing season. Areas inundated less than 5% of the growing season are always classified as non-wetlands. Areas inundated between 5% - 12.5% of the growing season can be classified as wetlands depending upon other factors, such as the presence of hydrophytic vegetation and hydric soils.

In the coastal marsh wetland (east side), success criteria include saturation or inundation within 12 inches of the surface for at least 25% of the growing season, or statistically the same as the reference ecosystem.

The growing season in Dare County begins March 13 and ends November 25. The dates correspond to a 50% probability that temperatures will drop to 28° F or lower after March 13 and before November 25.¹ The growing season is 258 days; therefore the optimum duration for wetland hydrology is 32 days. Also, local climate must represent average conditions for the area.

2.2 Hydrologic Description

Historically, the wetlands on this tract were part of the coastal marsh of the surrounding area. The primary sources of hydrology are tidal flushing of the system and groundwater. After an extensive study of the site's hydrology, it was concluded that filling of the ponds, and grading down of the upland areas would elevate soils to a level that would saturate the soil stratum within the required twelve inches or even flood the area during high tides. It was predicted that this would be sufficient to restore wetland hydrology.

Six groundwater-monitoring gauges, eight surface gauges, and one rain gauge were installed in 1999 (Figure 2). Three more groundwater-monitoring gauges were installed during 2001 to evaluate potential drainage by the side canal. Also, two additional surface gauges were added to the coastal marsh wetland area. The rain gauge and monitoring gauges recorded daily readings of rainfall and depth to groundwater, respectively. The surface gauges record tidal conditions eight times daily; however, only one representative reading was used for graphing and statistical purposes in this report.

¹ Natural Resources Conservation Service, Soil Survey of Dare County, North Carolina, p.69.

**MASHOES ROAD MITIGATION SITE
DARE COUNTY**

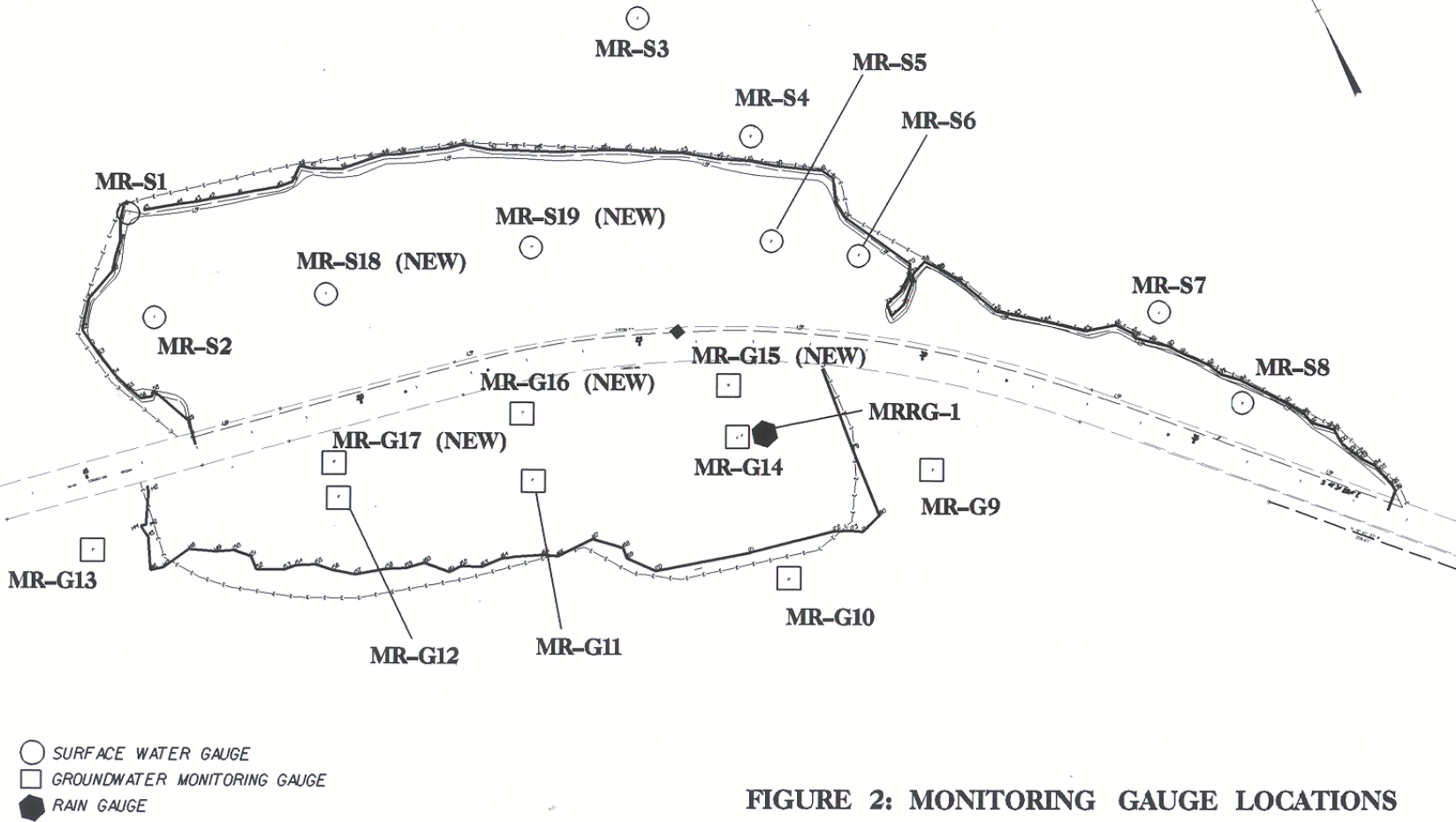


FIGURE 2: MONITORING GAUGE LOCATIONS

2.3 Results of Hydrologic Monitoring

2.3.1 Site Data

For groundwater monitoring gauges on the west side of the mitigation site, the maximum number of consecutive days that the groundwater was within twelve inches of the surface was determined for each gauge. For surface gauges, the ground surface was used (elevation zero) to give a better representation that the east side of Mashoes Road was receiving daily tidal flooding. This number was converted into a percentage of the 256-day growing season. Table 1 presents the 2004 results. In the table, "MR" refers to Mashoes Road Mitigation Site, "S" refers to surface gauges, and "G" refers to groundwater gauges. Reference gauges and new gauges are indicated.

In order to meet the success criteria for hydrology, the surface water gauges need to maintain a water elevation above 0 for at least 25% of the growing season. Since the criteria in the mitigation plan were unclear whether hydrology should be met in maximum consecutive days or total days, the table (Table 1) shows both sets of data (All ten gauges met the hydrology criteria using maximum consecutive and total days in 2004).

Appendix A contains a plot of the groundwater depth for each monitoring gauge. The maximum number of consecutive days that the gauge met success above the 12-inch depth is noted on each graph. Data determined to be erroneous was omitted; therefore, some gaps appear in the plots. Precipitation events are included on each graph as bars.

Table 1. 2004 HYDROLOGIC MONITORING RESULTS

Monitoring Gauge	< 5%	5 - 8%	8 – 12.5%	> 12.5%	Maximum Consecutive Days >25%	Total Days	Success Dates
MR-S1 (ref)					100	100	
MR-S2					29.5	61.7	
MR-S3 (ref)					100	100	
MR-S4 (ref)					100	100	
MR-S5					73.7	99.7	
MR-S6					100	100	
MR-S7 (ref)					100	100	
MR-S8					100	100	
MR-G9 (ref)+				×	100		March 13-Nov 25
MR-G10 (ref)+				×	44.2		March 13-July 4 Aug 19-Nov 25
MR-G11+				×	100		March 13-Nov 25
MR-G12+				×	35.7		March 13-May 17 May 19-Aug 18 Sept 17-Nov 25
MR-G13 (ref)+				×	83.7		March 13-Oct 14
MR-G14+				×	100		March 13-Nov 25
MR-G15+				×	100		March 13-Nov 25
MR-G16+				×	100		March 13-Nov 25
MR-G17+				×	81		May 1-Nov 25
MS-S18				×	100	100	March 13-Nov 25
MS-S19				×	90.4	100	March 13-Nov 25

+Gauge met success criterion during an average rainfall month (February, April, May, July, and November).

Notes: “MR” denotes Mashoes Road Site gauges.
 “S” denotes surface gauges.
 “G” denotes groundwater gauges.
 “ref” denotes gauges in reference wetlands.

Figure 3 provides a graphical representation of the hydrologic results. Gauges highlighted in blue indicate wetland hydrology for more than 12.5% of the growing season. Gauges highlighted in red show hydrology between 8% and 12.5% of the season, while those in green indicate hydrology between 5% and 8% of the season.

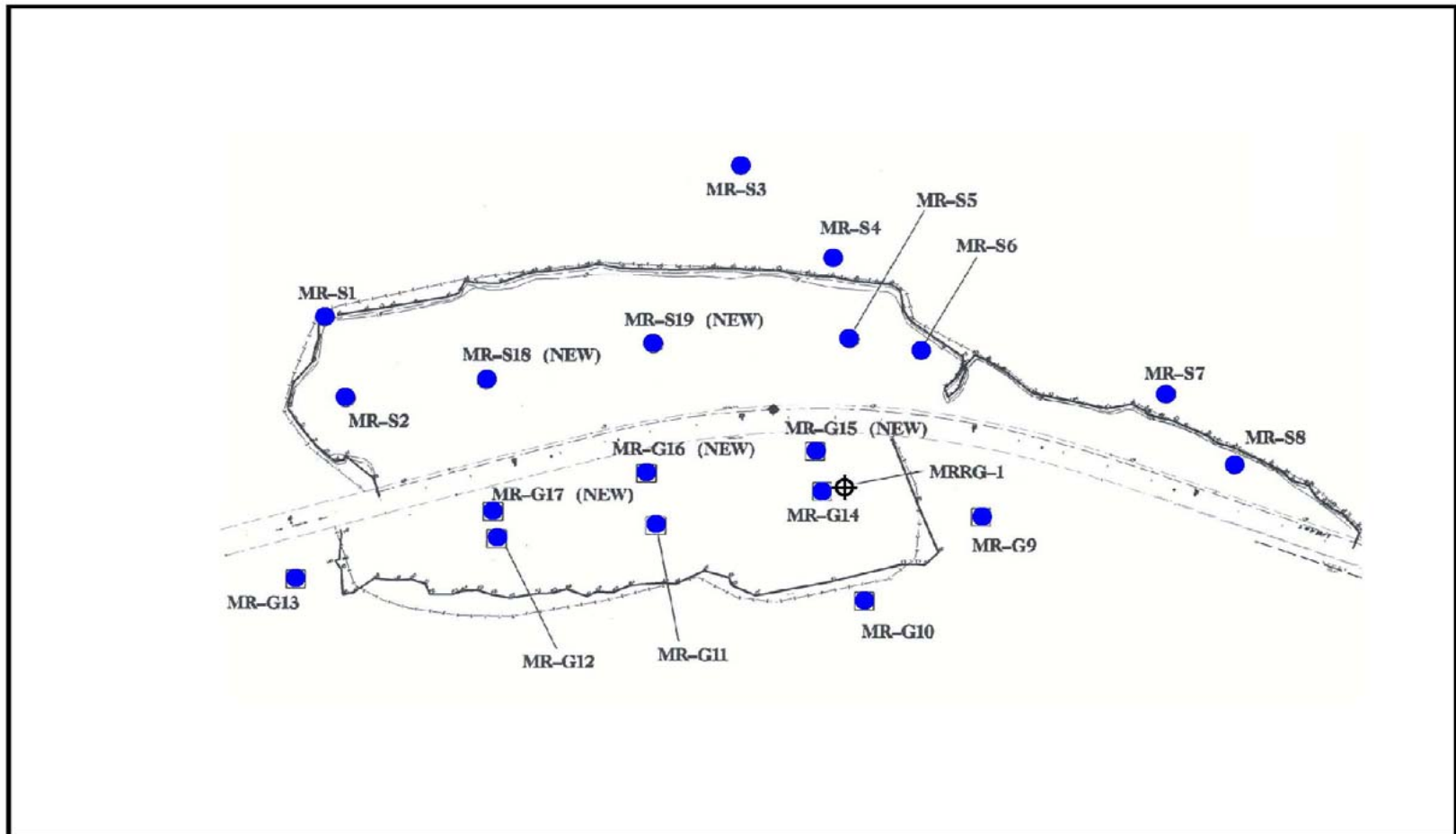


Figure 3. 2004 Hydrologic Monitoring Gauge Results



Hydrology Results

- < 5%
- 5 - 8%
- 8 - 12.5%
- > 12.5%

- ⊕ Rain Gauge
- Surface Gauge

Not to Scale

2.3.2 Climatic Data

Figure 4 provides an examination of the local climate in comparison with historical data in order to determine whether 2004 was “average” in terms of climate conditions. The two lines represent the 30th and 70th percentiles of monthly precipitation for Manteo, NC. The bars are monthly rainfall totals for 2003 and 2004. The historical data was collected from the State Climate Office of North Carolina.

For the 2004-year, November (03’), January, March, and October experienced below average rainfall. The months of February, April, May, July, and November all recorded average rainfall for the site. December (03’), June, August, and September experienced above average rainfall. The rainfall data from the onsite rain gauge was used for the months of September-November. Overall, 2004 experienced an average rainfall year.

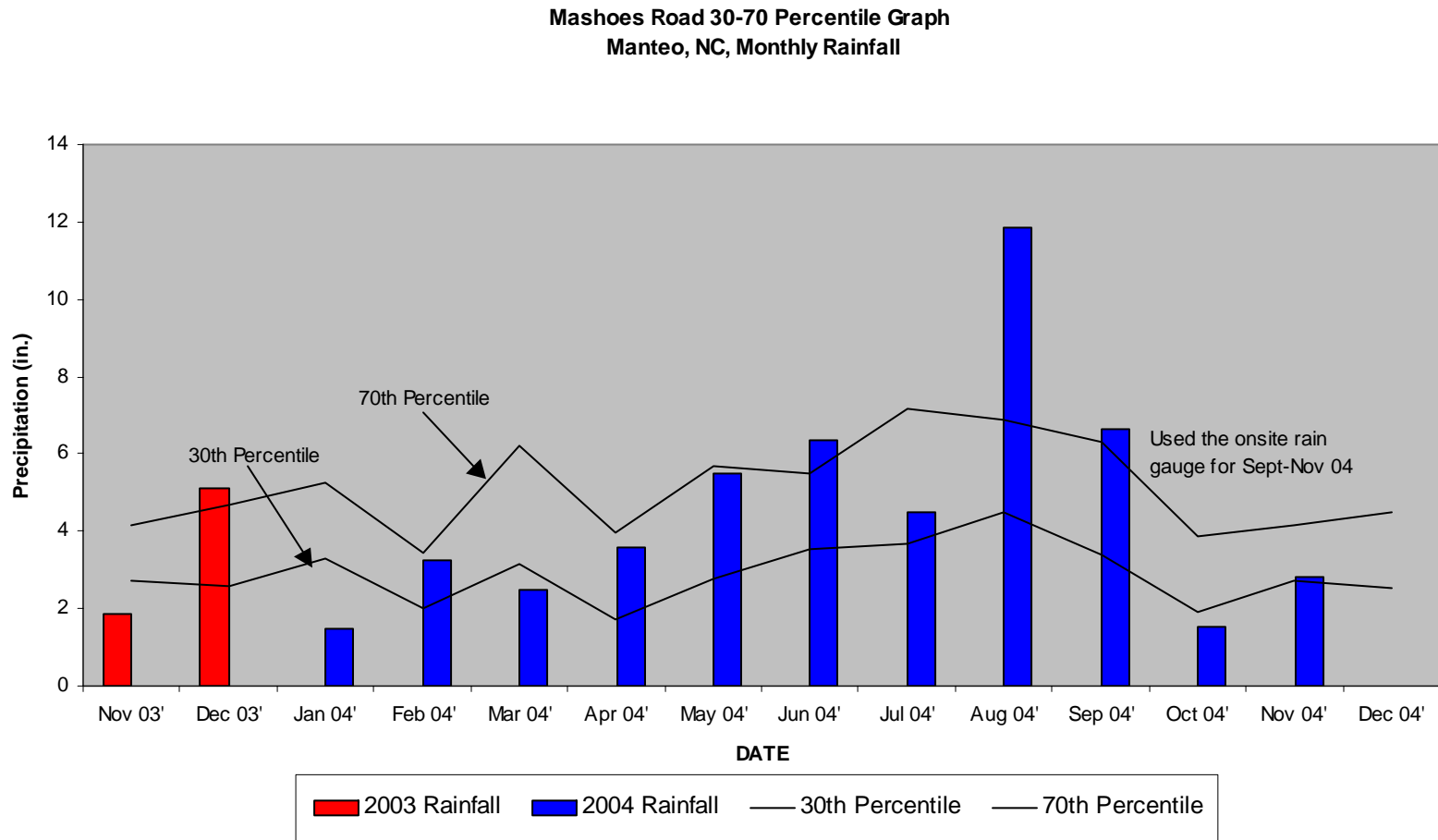
2.4 Conclusions

For the 2004 monitoring year, all nine of the groundwater gauges exceeded the jurisdictional hydrologic success for at least 12.5% of the growing season. All ten of the surface gauges showed steady tidal influence that maintained a water elevation above zero under normal conditions for at least 25% of the growing season.

The overall monitoring results show that the site performed successfully from a hydrological standpoint in 2004.

EEP will begin monitoring the hydrology at the Mashoes Road Mitigation Site in 2005.

FIGURE 4. 30-70 Percentile Graph



3.0 VEGETATION: MASHOES ROAD MITIGATION SITE (YEAR 4 MONITORING)

3.1A Success Criteria (Trees)

NCDOT will monitor the site for five years or until success criteria are met. A 320-stems per acre survival criterion for planted seedlings will be used to determine success for the first three years. The required survival criterion will decrease by 10% per year after the third year of vegetation monitoring (i.e., for an expected 290 stems per acre for year 4, and 260 stems per acre for year 5). The number of plants of one species will not exceed 20% of the total number of plants of all species planted.

3.1B Success Criteria (Marsh Grasses)

The vegetative marsh success of the wetland site will be determined in accordance with NMFS Guidelines. Monitoring plots found to be located within the open water channel will not count to the final count of plots. The vegetation component of the wetland site will be deemed successful if the following criteria are met.

1. At year five, the average of all plots should have a scale value of 5 (75% vegetative cover) consisting of wetland herbaceous species, not including any invasive species.
2. A minimum of 70% of the plots shall contain the target (planted) species.

3.2A Description of Species

The following species were planted in the Wetland Restoration Area:

Zone 1: Wetland Tree Reforestation (2.7 acres)

Taxodium distichum, Baldcypress
Quercus phellos, Willow Oak
Nyssa sylvatica var. *sylvatica*, Blackgum
Fraxinus pennsylvanica, Green Ash
Quercus nigra, Water Oak

Zone 2: Wetland Tree Reforestation (4.3 acres)

Taxodium distichum, Baldcypress
Fraxinus pennsylvanica, Green Ash
Quercus nigra, Water Oak
Quercus phellos, Willow Oak

3.2B Description of Species

The following plant communities were planted in the Marsh Grass Area:

Zone 1: (approximately 11.92 acres)

Cladium jamaicense, Sawgrass

Zone 2: (approximately 0.42 acres)

Juncus roemerianus, Black Needle Rush

3.3A Results of Vegetation Monitoring

TABLE 2: 2004 VEGETATIVE MONITORING RESULTS (TREE AREA, WEST SIDE)

ZONE	Plot #	Green Ash	Willow Oak	Baldcypress	Blackgum	Water Oak	Total (4 year)	Total (at planting)	Density (trees/acre)
1	1	11	1	5	3		20	40	340
	2	17	4	10	4		35	40	595
ZONE 1 AVERAGE									468
2	3	8	1	27			36	49	500
	4	10		12		2	24	32	510
	5	4	7	12	1		24	35	466
ZONE 2 AVERAGE									492
TOTAL AVERAGE									482

Site Notes: Other species noted: *Scirpus americanus*, sawgrass, black needle rush, *Bidens* sp., ragweed, *Baccharis halimifolia*, fennel, phragmites, redbay, cattail, golden rod, wax myrtle, Atlantic white cedar, red maple, big cordgrass, broomsedge, pine, and *Pluchea* sp.

TABLE 3: 2004 VEGETATIVE MONITORING RESULTS (MARSH GRASS AREA, EAST SIDE)

49					Out of Bounds
50	5.0		☐	☐	
51	5.0				
52	5.0				
53	4.0		☐	☐	
54	5.0		☐	☐	
55	3.0				
56	5.0		☐	☐	
57	5.0				
58	5.0				
59	4.0		☐	☐	
60					Out of Bounds
61	4.0		☐	☐	
62	5.0		☐	☐	
63	5.0		☐	☐	
64					Out of Bounds
65	5.0		☐	☐	
66	5.0		☐	☐	
67	5.0		☐	☐	
68	4.0				
69	4.0		☐	☐	
70	5.0		☐	☐	
71	4.0		☐	☐	
72	5.0		☐	☐	
73	0.0				Bare Ground
74	5.0		☐	☐	
75	5.0		☐	☐	
76	4.0		☐	☐	
77	5.0		☐	☐	
78	5.0				
79	5.0		☐	☐	
80	5.0				
81	5.0		☐	☐	
82	5.0		☐	☐	
83	5.0				
84	5.0		☐	☐	
85	4.0				
86	4.0				
87	5.0		☐	☐	
88	3.0		☐	☐	
89	5.0		☐	☐	
90	4.0		☐	☐	
91	5.0		☐	☐	
92	4.0				

ZONE	Plot #	Scale Factor	Black Needle Rush	Sawgrass	Frequency	Notes
	93	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	94	4.0		<input type="checkbox"/>	<input type="checkbox"/>	
	95	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	96	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	97					Out of Bounds
	98	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	99	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	100					Out of Bounds
	101	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	102	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	103	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	104	5.0				
	105	4.0		<input type="checkbox"/>	<input type="checkbox"/>	
	106					Out of Bounds
	107	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	108	4.0				
	109	5.0				
	110	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	111	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	112	5.0				
	113	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	114	0.0				Bare Ground
	115	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	116	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	117	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	118	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	119	4.0		<input type="checkbox"/>	<input type="checkbox"/>	
	120	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	121	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	122	5.0				
	123	4.0		<input type="checkbox"/>	<input type="checkbox"/>	
	124	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	125	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	126	4.0		<input type="checkbox"/>	<input type="checkbox"/>	
	127	5.0				
	128	4.0		<input type="checkbox"/>	<input type="checkbox"/>	
	129	4.0				
	130	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	131	4.0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	132	5.0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	133	4.0				
	134	5.0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	135	5.0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	136	4.0	<input type="checkbox"/>		<input type="checkbox"/>	
	137	5.0		<input type="checkbox"/>	<input type="checkbox"/>	
	138	3.0	<input type="checkbox"/>		<input type="checkbox"/>	

ZONE	Plot #	Scale Factor	Black Needle Rush	Sawgrass	Frequency	Notes
	139	4.0	☐		☐	
	140	5.0	☐	☐	☐	
	141	3.0	☐		☐	
	142	4.0	☐		☐	
	143	5.0	☐	☐	☐	
	144	4.0				
	145	5.0	☐	☐	☐	
	146	3.0				
	147	3.0	☐		☐	
	148	5.0	☐		☐	
	149	5.0	☐	☐	☐	
	150	4.0	☐		☐	
	151	3.0	☐		☐	
	152	5.0	☐		☐	
	153	4.0	☐		☐	
	154	5.0	☐	☐	☐	
	155	4.0	☐		☐	
	156	5.0		☐	☐	
	157	5.0	☐		☐	
	158	5.0	☐	☐	☐	
	159	5.0	☐		☐	
	160	5.0	☐		☐	
	161	5.0	☐		☐	
	162	5.0	☐		☐	
	163	5.0	☐	☐	☐	
	164	5.0	☐		☐	
	165	5.0	☐	☐	☐	
	166	5.0	☐	☐	☐	
	167	5.0	☐		☐	
Frequency/Percentage Plots						
with Desired Species					73.1%	
Sum Scale Value					743	
Total # of Plots					160	
Vegetative Cover (Scale Value)					4.6	

Site Notes: The following species were also noted in the monitoring plots. The number of plots the species was found in is following the species in parentheses (i.e. 58 plots contain *Scirpus* sp.)

Scirpus sp. (58), phragmites (108), *Juncus* sp. (23), goldenrod (9), *Spartina patens* (6), nutsedge (15), *Polygonum* sp. (11), *Aster* sp. (3), *Panicum* sp. (3), broomsedge (1), pennywort (3), *Baccharis* sp. (1), fennel (3), *Pluchea* sp. (1), and big cordgrass (1).

3.4A Conclusions (Tree Area)

Of the 399 acres on this site, approximately 7 acres involved tree planting. The west side of the site has become well vegetated with marsh grasses. There were five plots established throughout the planting areas, encompassing all plant communities. The 2004 vegetation monitoring revealed an average density of 482 trees per acre, which is well above the 290 trees per acre required by the success criteria.

3.4B Conclusions (Marsh Area)

- Percent Frequency of Target Species **73.1%**
Frequency of 70% required.
- Vegetative Cover Scale Value **4.6**
Scale Value of 5 required for year 5.

Of the 399 acres on this site, approximately 12.34 acres involved marsh grass planting. There were 167 random plots established throughout the planting areas, encompassing all plant communities. These plots were located with GPS. The vegetative coverage and frequency appear to be on track for year four.

EPP will begin monitoring the vegetation at the Mashoes Mitigation Site in 2005.

4.0 OVERALL CONCLUSIONS/ RECOMMENDATIONS

The 2004-year represents the sixth full growing season (the fourth official season) that the hydrologic data has been examined. All nine groundwater-monitoring gauges exceeded the jurisdictional wetland hydrology for 12.5% of the growing season. When considering maximum cumulative days, all ten surface gauges met the 25% requirement of daily flooding onsite during this same period. The overall monitoring results show that the site performed successfully from a hydrology standpoint.

Vegetation monitoring on the west side (tree area) of the restoration area yielded 482 trees per acre, which is well above the 290-tree requirement. A frequency of 73.1% for the targeted vegetative species was found on the east side (marsh grasses area) of the site. A frequency of 70% is required. A vegetative scale value of 4.6 was recorded (scale value of 5 is required by year 5).

Per the letter from the Ecosystem Enhancement Program (EEP) to NCDOT dated August 25, 2004, the EEP has accepted the transfer of all off-site mitigation projects. The EEP will be responsible for fulfilling the remaining monitoring requirements and future remediation for this project.

APPENDIX A
GAUGE DATA GRAPHS



APPENDIX B

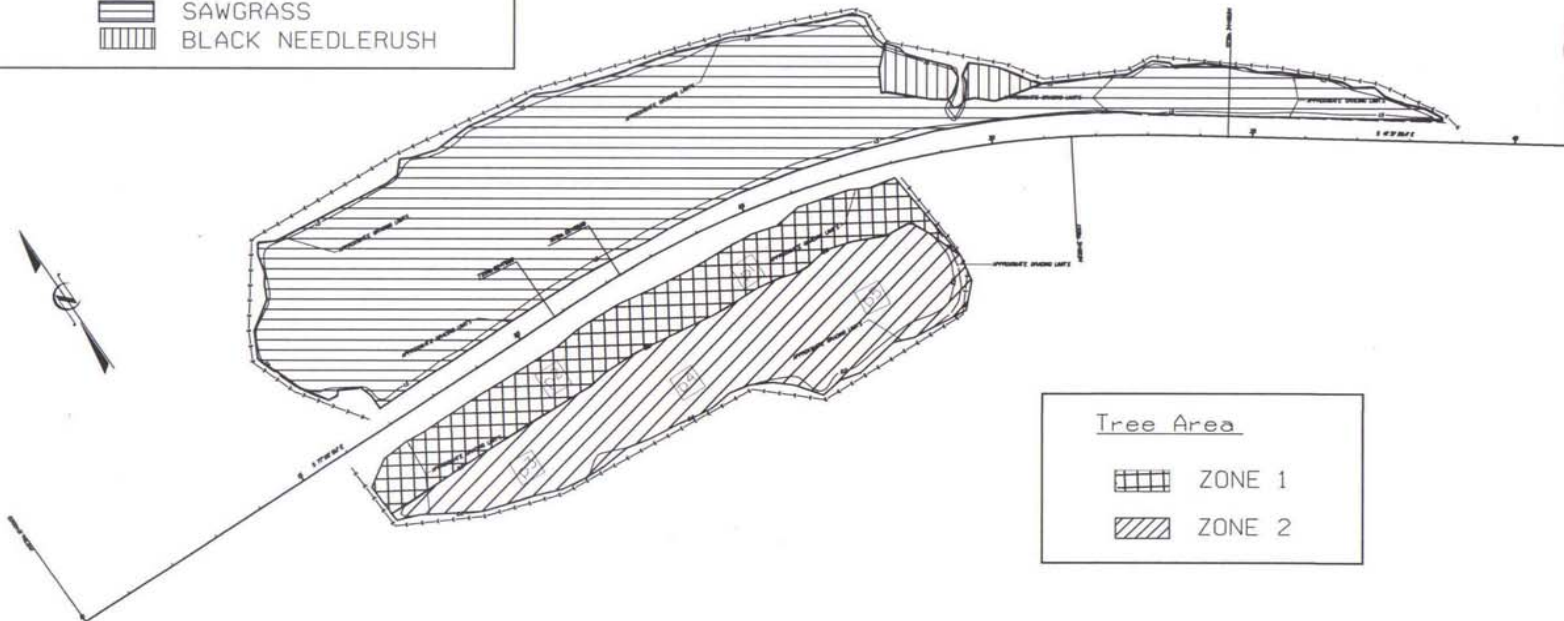
PHOTO AND VEGETATION PLOT LOCATIONS, SITE PHOTOS

Dare County, North Carolina
Mashoes Road Mitigation Site
Planting Plan



PROJ. REFERENCE NO.	SHEET NO.	TOTAL SHEETS
8-2551WM	WM-1	
STATE PROJECT NO.	F.A. PROJ. NO.	DESCRIPTION

Marsh Area

	SAWGRASS
	BLACK NEEDLERUSH

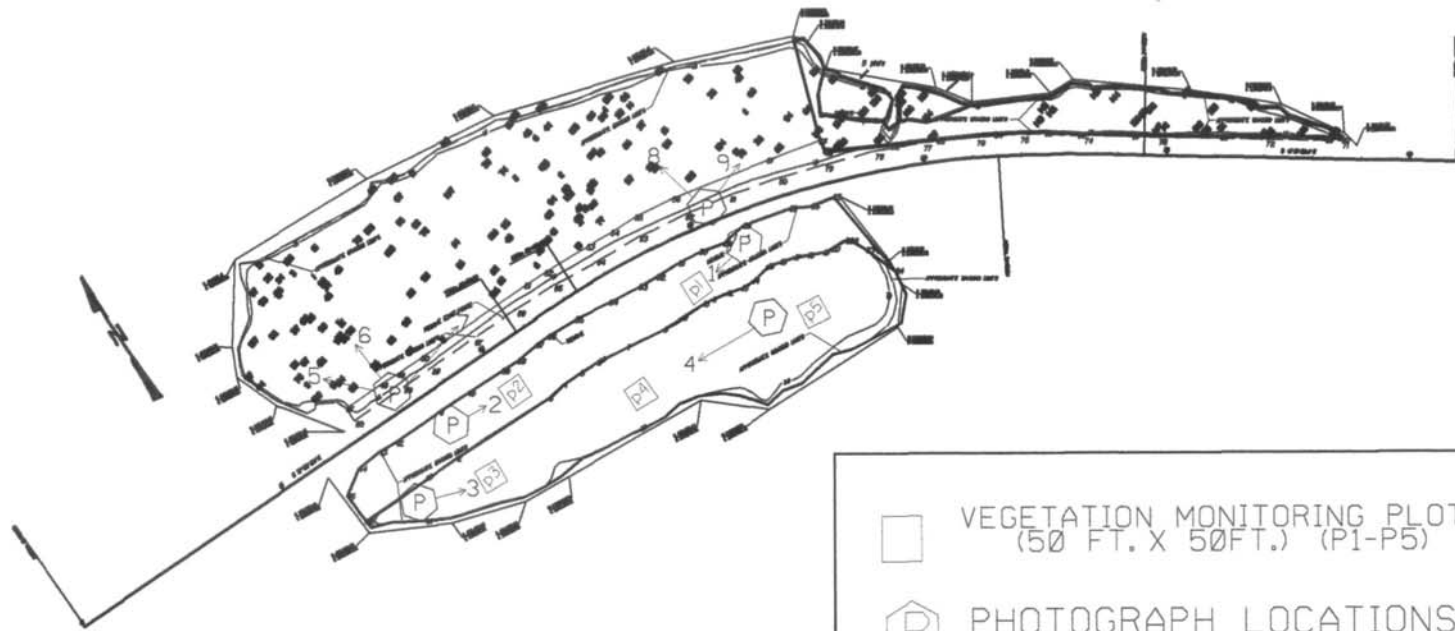


Tree Area

	ZONE 1
	ZONE 2

PROJ. REFERENCE NO.	SHEET NO.	TOTAL SHEETS
8-205170M	10M-1	
STATE PROJECT NO.	F.A. PROJ. NO.	DESCRIPTION

DARE COUNTY, NORTH CAROLINA
 MASHOES ROAD MITIGATION SITE
 Photo and Vegetation Plot Locations



-  VEGETATION MONITORING PLOTS
(50 FT. X 50FT.) (P1-P5)
-  PHOTOGRAPH LOCATIONS

MASHOES ROAD



Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Photo 6



Photo 7



Photo 8



Photo 9