ANNUAL REPORT FOR 2004

Croatan Wetland Mitigation Bank

Craven County

Project No. 8.T170702

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Natural Systems Unit & Roadside Environmental Unit
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SUMMARY

The following report summarizes the monitoring and construction activities that have occurred prior to and during 2004 at the 4035-acre Croatan Wetland Mitigation Bank (CWMB). The CWMB site is expected to provide compensatory wetland mitigation for several NCDOT projects in the Neuse River Basin (Hydrologic Unit 03020204). This site was designed and implemented in two phases, Phase I (1469.3 acres) and Phase II (2565.3 acres). Phase I construction was completed in the winter of 2001 and Phase II construction was completed in the spring of 2002. Each Phase has been divided into Management Units (MU) to aid in the report presentation. In 2004, hydrologic and vegetative monitoring in Phase II (MU 1-11) continued into the second year and monitoring in Phase I (MU 12A-18) continued into the third year.

The CWMB contains both non-riverine mitigation areas and riverine mitigation areas; non-riverine and riverine mitigation areas are tracked separately. In addition, per request of the Mitigation Banking Review Team (MBRT), there are separate hydrologic monitoring success criteria for the non-riverine mineral and organic soils. Non-riverine mineral soils are expected to make jurisdictional hydrology for a minimum of 12.5 percent (%) of the growing season (Success Criterion 1) and be within 50% of the Reference Range for years one through three [and 20% of the Reference Range for years four and five (Success Criterion 2)]. Non-riverine organic soils and riverine restoration/enhancement areas are expected to make jurisdictional hydrology for a minimum of 25% of the growing season and be within 50% of the reference range for years one through three (and 20% of the Reference Range for years four and five).

Prior to the beginning of the 2004 growing season 286 ground water monitoring gauges were installed throughout Phase I and II for monitoring success. A total of 33 reference gauges were installed either onsite or offsite in areas of minimal disturbance to provide a range of reference conditions for the ten hydric soil mapping units present on the CWMB. Two rain gauges spaced across the site were used for hydrologic analysis; a third rain gauge malfunctioned several times and was not used for data analyses. Hydrologic monitoring was conducted by Environmental Services, Inc. (ESI).

The majority of the gauges in the CWMB showed that groundwater levels dropped below 12 inches below ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). Analyzing the data during the initial draw down (pre-hurricane events) under normal rainfall conditions would be a better indication of how the CWMB is responding to mitigation measures. Therefore, ESI analyzed the data two ways: 1) the entire growing season [longest number of consecutive days < 12 inches below the ground surface between March 18 and November 30 (pre or post hurricane events)] and 2) the early part of the growing season prior to the initial draw down [longest number of consecutive days < 12 inches below the ground surface between March and June (pre-hurricane events)] (Appendix D).

Entire Growing Season (March-November)
Hydrologic monitoring in 2004 showed 270 of 286 (94.4%) monitoring gauges in the CWMB met both respective hydrologic success criteria established for years one through three [≥ 12.5 % (mineral soils) or ≥ 25 % (organic/riverine soils) of the growing season and within 50% of Reference Range] (Figures 3a and 3b). Of the 16 gauges that did not meet both respective

success criteria, nine made jurisdictional hydrology for ≥ 12.5% of the growing season, six made jurisdictional hydrology 5 – 12.5% of the growing season and only one (Gauge 75) did not make jurisdictional hydrology for at least 5% of the growing season.

Of the 204 monitoring gauges in non-riverine mineral soils, 191 met both hydrologic success criteria and six did not meet either hydrologic success criterion; the remaining seven gauges met Success Criterion 1 only. Of the 62 monitoring gauges in non-riverine organic soils, all 62 met both hydrologic success criteria. Of the 12 monitoring gauges in riverine organic soils, 10 met both hydrologic success criteria and the remaining two gauges met Success Criterion 1 only. Of the eight monitoring gauges in riverine mineral soils seven met both hydrologic success criteria and the remaining gauge did not meet either hydrologic success criterion.

Of the 286 monitoring gauges, 250 (87.%) that met both of their respective hydrologic success criteria established for years one through three also met the hydrologic success criteria established for years four and five [≥ 12.5 % (mineral soils) or ≥ 25 % (organic/riverine soils) of the growing season and within 20% of Reference Range] under normal rainfall conditions.

March-June (Initial draw down)

Of the 286 monitoring gauges, 262 (91.6%) met both respective hydrology success criteria established for years one through three [≥ 12.5 % (mineral soils) or ≥ 25 % (organic/riverine soils) of the growing season and within 50% of Reference Range], under normal rainfall conditions, during the initial draw down [March-June (pre-hurricane events) (Figures 5a and 5b in Appendix C). Of the 24 gauges that did not meet both respective success criteria, two made jurisdictional hydrology for ≥ 12.5% of the growing season, seven made jurisdictional hydrology 5 – 12.5% of the growing season and 15 did not make jurisdictional hydrology for at least 5% of the growing season.

Of the 204 monitoring gauges in non-riverine mineral soils, 183 (89.7%) met both hydrologic success criteria and 18 did not meet either hydrologic success criterion; one gauge met Success Criterion 1 only, and two gauges met Success Criterion 2 only. Of the 62 monitoring gauges in non-riverine organic soils, 61 met both hydrologic success criteria and one (Gauge 133) did not meet Success Criterion 1 for organic soils (≥ 25% of the growing season). All 12 of the monitoring gauges in riverine organic soils met both hydrologic success criteria. Of the eight monitoring gauges in riverine mineral soils seven met both hydrologic success criteria and the remaining gauge did not meet either hydrologic success criterion.

Of the 286 monitoring gauges, 243 (85.0%) that met both of their respective hydrologic success criteria established for years one through three also met the hydrologic success criteria established for years four and five [≥ 12.5 % (mineral soils) or ≥ 25 % (organic/riverine soils) of the growing season and within 20% of Reference Range] under normal rainfall conditions, during the initial draw down [March-June (pre-hurricane events).

Rainfall

Overall, the rainfall for the 2004 growing season was normal (50.35 to 52.94 inches onsite compared to normal 49.98 to 57.89 inches). Rainfall between November 2003 and February 2004 varied from below normal to above normal, but trended towards the high side of normal overall (16.18 to 16.21 inches onsite compared to normal 10.19 to 18.37 inches). Rainfall from March through June 2004, the early part of the growing season and pre-hurricane events,

trended towards the low side of normal (13.54 to 14.17 inches onsite compared to normal 12.07 to 20.27 inches). Rainfall from July through September, coinciding with the hurricanes, was substantially above normal (26.68 to 27.62 inches onsite compared to normal 12.96 to 22.18 inches). Rainfall from October through November trended towards the low side of normal (3.85 to 4.56 inches onsite compared to normal 3.61 to 7.49 inches).

Vegetation

The vegetative success criterion states that there must be a minimum of 320 trees per acre surviving for three consecutive years. NCDOT has agreed to monitor this site for 5 years or until success criteria are met. 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).

Of the 4,035 acres on this site, approximately 224.5 acres involved tree planting for Phase I and 466.0 acres involved tree planting for Phase II. Vegetation monitoring was conducted by Mulkey Engineering, Inc. There were 25 vegetation monitoring plots established throughout the Phase I planting areas, and 23 vegetation monitoring plots established throughout the Phase II planting areas. The 2004 vegetation monitoring of the Phase I portion of the site revealed an average tree density of 413 trees per acre while the vegetation monitoring of the Phase II portion of the site revealed an average tree density of 327 trees per acre. These averages are above the minimum success criteria of 320 trees per acre.

Recommendations

NCDOT recommends that monitoring of Phase I and II continue into 2005. ESI documented that many of the gauges along transects 258-260 (MU 3/4A), 286-287 (MU 10C), 181-183 (MUs 12B /16), and 188-191 (MU 12B/18) did not meet both of their expected hydrologic success criteria. Additional gauges may need to be installed along these transects in order to capture the zone of influence that may remain adjacent to the open areas of the ditch. It is also recommended that additional areas in MU 2B, 5, and 6 (for example Gauges 241, 240, 242 and 251) be re-evaluated for riverine function. These areas showed prolonged surface flooding and flowing water throughout much of the growing season and may be considered riverine wetland due to the surface connection with the unnamed tributary to East Prong Brice Creek.

Due to the high rate of hydrologic success under normal rainfall conditions, it is recommended to the MBRT that selected interior gauges that have met success criteria for years one and two as well as already meeting success criteria for years four and five be removed from monitoring. Gauge sites adjacent to roads, point plugged ditches, areas where riverine credit may be gained, areas that are not meeting the success criteria established for years four and five, and representative areas across the CWMB should continue to be monitored through years four and five.

It is recommended that Rain Gauge 4 be replaced due to repeated malfunction and unreliable data collected during late 2003 through 2004. For 2005 and subsequent years, it is recommended that additional follow-up trips be scheduled after routine gauge downloads to check gauges that malfunction, particularly reference gauges, and take appropriate measures to avoid extended and frequent data gaps, especially for Ecotone gauges. Ecotone gauges tended to have frequent gauge malfunctions, including dead batteries, chewed external wires, and broken battery connections.

Per the letter from 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 Croatan Wetland Mitigation Bank (CWMB) is located in Craven County, North Carolina approximately 3.6 miles northwest of Havelock. The site is situated west of US 70 and south of Catfish Lake Road (SR 1100) (Figure 1). The CWMB was created to provide compensatory mitigation for several projects in the Neuse River Basin (Hydrologic Unit 03020204). The site encompasses approximately 4,035 acres and was designed and implemented in two phases (Phase I and Phase II). Each phase was divided into Management Units (MU) to aid in planning, and this is continued for presentation of monitoring results. Phase I is approximately 1469.3 acres and contains approximately 1446.5 acres targeted for a combination of non-riverine wetland restoration (311.6 acres), enhancement (1026.9 acres) and preservation (108.0 acres). The remaining 22.8 acres of Phase I consists of non-hydric soils (3.9 acres) and areas considered non-restorable (18.9 acres). Phase II is approximately 2565.3 acres and contains approximately 2333.5 acres targeted for a combination of non-riverine wetland restoration (1123.6 acres), enhancement (956.9 acres) and preservation (253.0 acres). Approximately 179 acres are targeted for a combination of riverine restoration (49.6 acres), enhancement (91.6 acres), and preservation (37.8 acres). The remaining 52.8 acres of Phase II consists of non-hydric soils (25.7 acres) and areas considered non-restorable (27.1 acres). In 2004, hydrologic and vegetative monitoring continued for a second year in Phase II and continued for a third year in Phase I.

1.2 Purpose

In order to demonstrate successful mitigation, vegetative and hydrologic monitoring will be conducted for a minimum of five years. Success criteria were established by the Mitigation Bank Review Team (MBRT). The following report describes the results of the hydrologic and vegetation monitoring for Phase I and II during the 2004 growing season at the CWMB. Included in this report are analyses of both hydrologic and vegetative monitoring results, as well as local climate conditions throughout the growing season and site photographs.

1.3 Project History

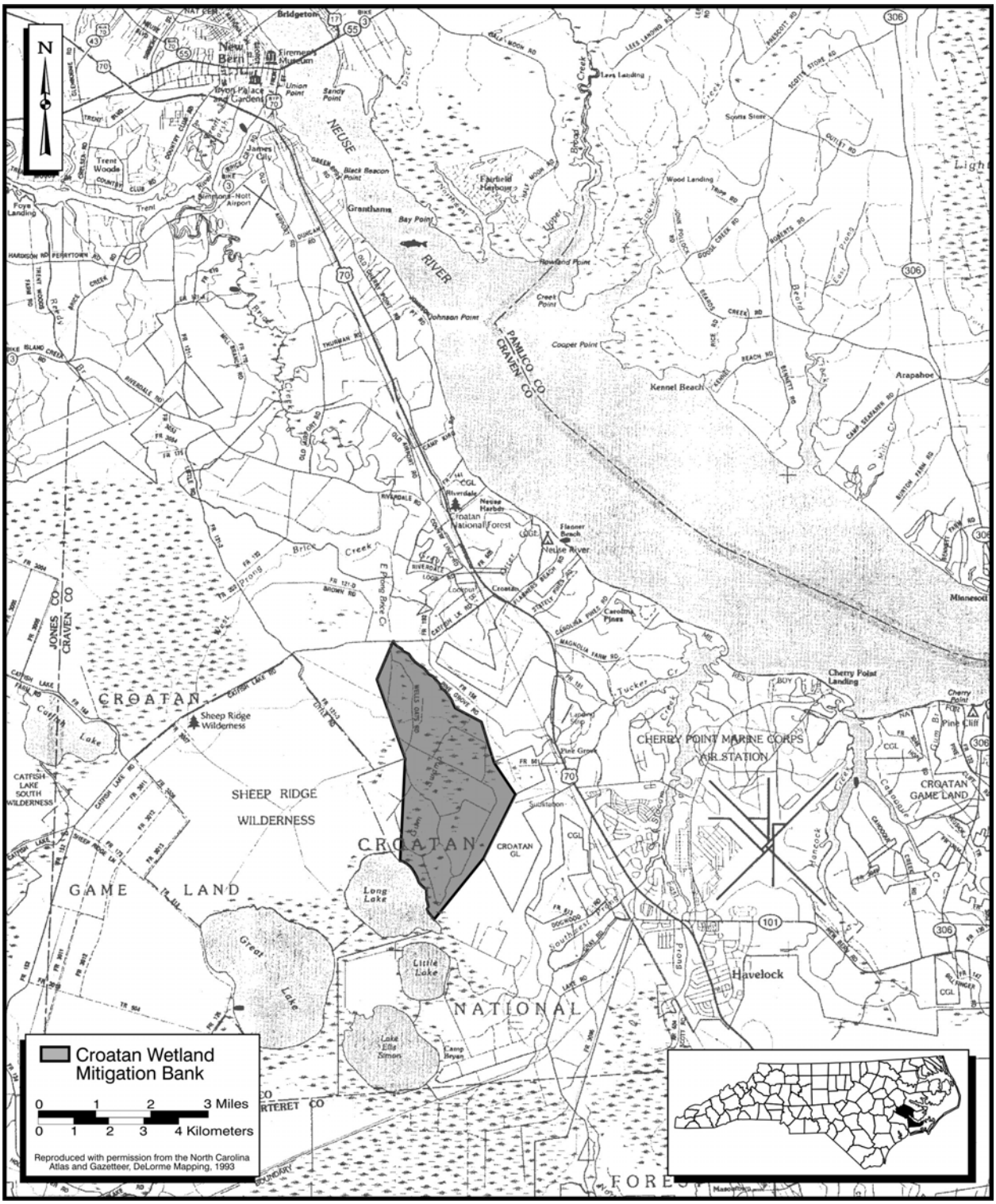
Phase I

1998-2000	Gauges Installed to Aid Delineation
November 2000	Drum-chopping of Phase I Planting Areas
December 2000	Herbicide of Phase I Planting Areas
February 2001	Planting of Phase I
September 2001 – February 2002	Construction of Phase I
February 2002	Additional Monitoring Gauges Installed
March – November 2002	Hydrologic Monitoring (1 yr.)
July 2002	Vegetation Monitoring (1 yr.)
March – November 2003	Hydrologic Monitoring (2 yr.)
August 2003	Vegetation Monitoring (2 yr.)
March – November 2004	Hydrologic Monitoring (3 yr.)
August 2004	Vegetation Monitoring (3 yr.)

Phase II

1999-2000	Gauges Installed to Aid Delineation
August 2001	Drum-chopping of Phase II Planting Areas
December 2001 – June 2002	Construction of Phase II
July 2002	Herbicide of Phase II Planting Areas
February –March 2003	Additional Monitoring Gauges Installed
February 2003	Tree Planting
March - November 2003	Hydrologic Monitoring (1 yr.)
August 2003	Vegetative Monitoring (1 yr.)
March - November 2004	Hydrologic Monitoring (2 yr.)
August 2004	Vegetative Monitoring (2 yr.)

Figure 1. Site Location Map



2.0 HYDROLOGY

2.1 Success Criteria

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

The MBRT required additional conditions to the hydrologic monitoring requirements for the CWMB beyond the minimum established by the federal guideline for wetland mitigation success criteria.

Hydrologic success criteria will include both of the following:

> 1) inundation or saturation within 12 inches of the surface for at least 12.5% of the growing season for mineral soils and 25% of the growing season for organic soils and riverine restoration/enhancement areas (**Success Criterion 1**); and
>
> 2) the hydroperiod for restoration/enhancement areas shall be within 50% of reference saturation or inundation depth, duration and frequency for the first three years and shall be within 20% for years four and five (**Success Criterion 2**).

If the 50% and 20% reference goals are not attained, a site visit will be conducted by the MBRT to determine the viability of the site.

The growing season in Craven County begins March 18 and ends November 14. These dates correspond to a 50% probability that air temperatures will drop to 28° F or lower after March 18 and before November 14. Thus, the growing season is 242 days. A jurisdictional hydroperiod of 12.5% of the growing season is approximately 30 days. A jurisdictional hydroperiod of 25% of the growing season is approximately 60 days. However, the site must also experience average climatic conditions for the data to be valid. Use of reference gauge data collected concurrently with site data for evaluating success is expected to provide more meaningful means for evaluating success following initial site re-hydration regardless of rainfall conditions. Table 1 provides a summary of hydrologic success criteria.

Table 1. Expected Wetland Conditions 2004

Wetland Type	Soil Mapping Unit	Success Criterion 1	Success Criterion 2	MUs with Representative Gauges
Non-riverine, Mineral	Bayboro (Ba)	≥ 12.5 %	14.9 – 68.2 %	1, 2A, 2B, 3, 4A, 4B, 5, 6, 7, 8, 9, 10A, 10B, 11, 12A, 13A, 13B, 14, 15, 17
	Leaf (La)	≥ 12.5 %	21.9 – 73.1 %	1, 2A, 2B, 3, 5, 6
	Leon (Ln)	≥ 12.5 %	11.6 – 45.9 %	13B, 16, 18
	Murville (Mu)	≥ 12.5 %	22.7 – 100 %	12A, 12B, 13A, 13B, 15, 16
	Pantego (Pa)	≥ 12.5 %	16.9 – 78.1 %	1, 2B, 4B, 5, 6, 7, 8, 10B, 10C, 11, 12A, 12B, 13A, 13B, 14, 15, 16, 17, 18
	Rains (Ra)	≥ 12.5 %	15.3 – 71.1 %	5, 6, 10B, 10C, 12A
Non-riverine, Organic	Croatan (CT)	≥ 25.0 %	26.0 – 100 %	4B, 6, 8, 9, 10A, 10B, 10C, 11, 12B, 13A, 15, 16, 17, 18
	Dare (DA)	≥ 25.0 %	50.0 – 100 %	16, 17
Riverine, Organic	Dorovan (DO)	≥ 25.0 %	50.0 – 100 %	6
	Masontown/Muckalee (MM)	≥ 25.0 %	50.0 – 100 %	5, 6

2.2 Hydrologic Description

Phase I construction was completed prior to the onset of the 2002 growing season. Phase I began monitoring for hydrologic success in 2002 and continued into 2004. Phase II construction was completed in the spring of 2002 and hydrologic monitoring began in the spring of 2003. Hydrologic monitoring was conducted in 2004 by Environmental Services, Inc. (ESI). In 2004, 286 monitoring gauges were monitored (Figures 2a and 2b). Gauges consist of a combination of Remote Data Systems (RDS) WL-20, WL-40, and Ecotone monitoring gauges. In addition, three to four monitoring gauges were monitored per soil mapping unit in areas of minimal disturbance to provide reference conditions for the CWMB (a total of 33 reference monitoring gauges located onsite and offsite); reference gauges are also either RDS WL-20, WL-40, or Ecotone monitoring gauges. Three rain gauges are spaced across the site; however, one (Rain Gauge 4) malfunctioned repeatedly in 2004 and its data could not be used. The rain gauges are Infinity rain gauges. The automatic monitoring gauges record the depth to the groundwater level and duration of jurisdictional hydrology. Daily readings were taken throughout the growing season.

The CWMB is being tracked by riverine and non-riverine wetland restoration (R), enhancement (E) and preservation (P) areas (Figures 2a and 2b). The monitoring gauges installed throughout the CWMB between 1998 and 2000 were used to collect data in support of jurisdictional determinations and to assist in mitigation planning. The additional gauges installed in Phase I in 2002 and Phase II in 2003 after mitigation construction activities were used to supplement the previous gauges for monitoring success.

Gauges established in Phase II in 2003 were installed in transects across the different mitigation treatments in order to monitor the success of these treatments in the major soil types present. These treatments can be summarized as areas where: 1) ditches have been reach-plugged and the road remains; 2) ditches have been point-plugged and the road remains; 3) ditches have been reach-plugged and the road removed; and 4) ditches have been point-plugged and the road removed. Reach-plugging is the back-filling of the entire ditch or extensive section of the ditch. Point-plugging involves shorter plugs of fill spaced along the length of the ditch to render the drainage system inoperable. Six additional gauges were installed in Phase I in 2003 to document hydrologic changes resulting from the removal of the road and/or ditch along the phase boundary during Phase II construction.

In 2004, one additional gauge (Gauge 321) was installed to document the jurisdictional hydrology between Gauges 84/85 and Gauge 196 was removed due to safety concerns (alligator).

Table 2 provides a list of gauge locations within each MU and the number of gauges within each mitigation type.

Figure 2a. Hydrologic Monitoring Gauge Location Map, Phase II

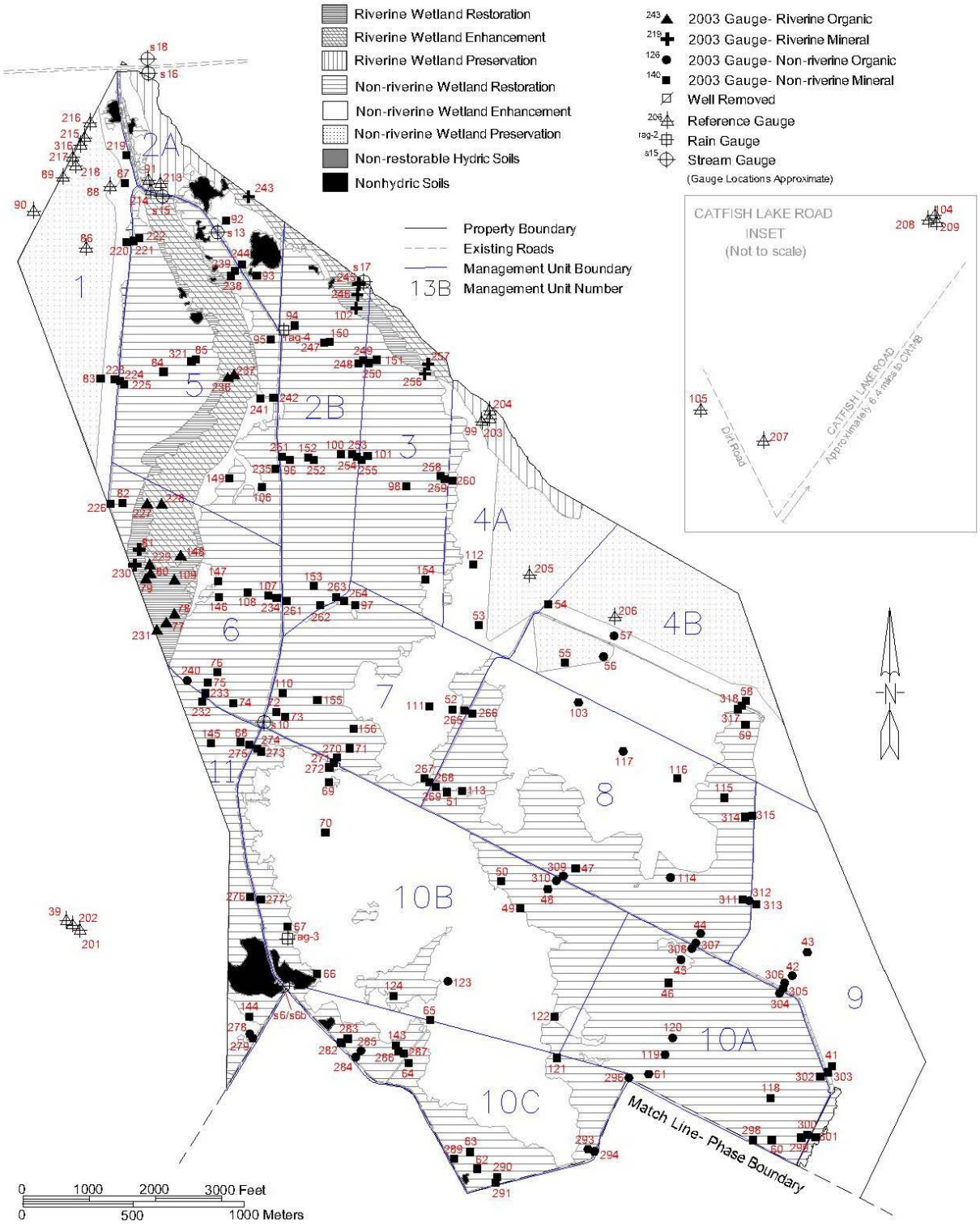


Figure 2b. Hydrologic Monitoring Gauge Location Map, Phase I

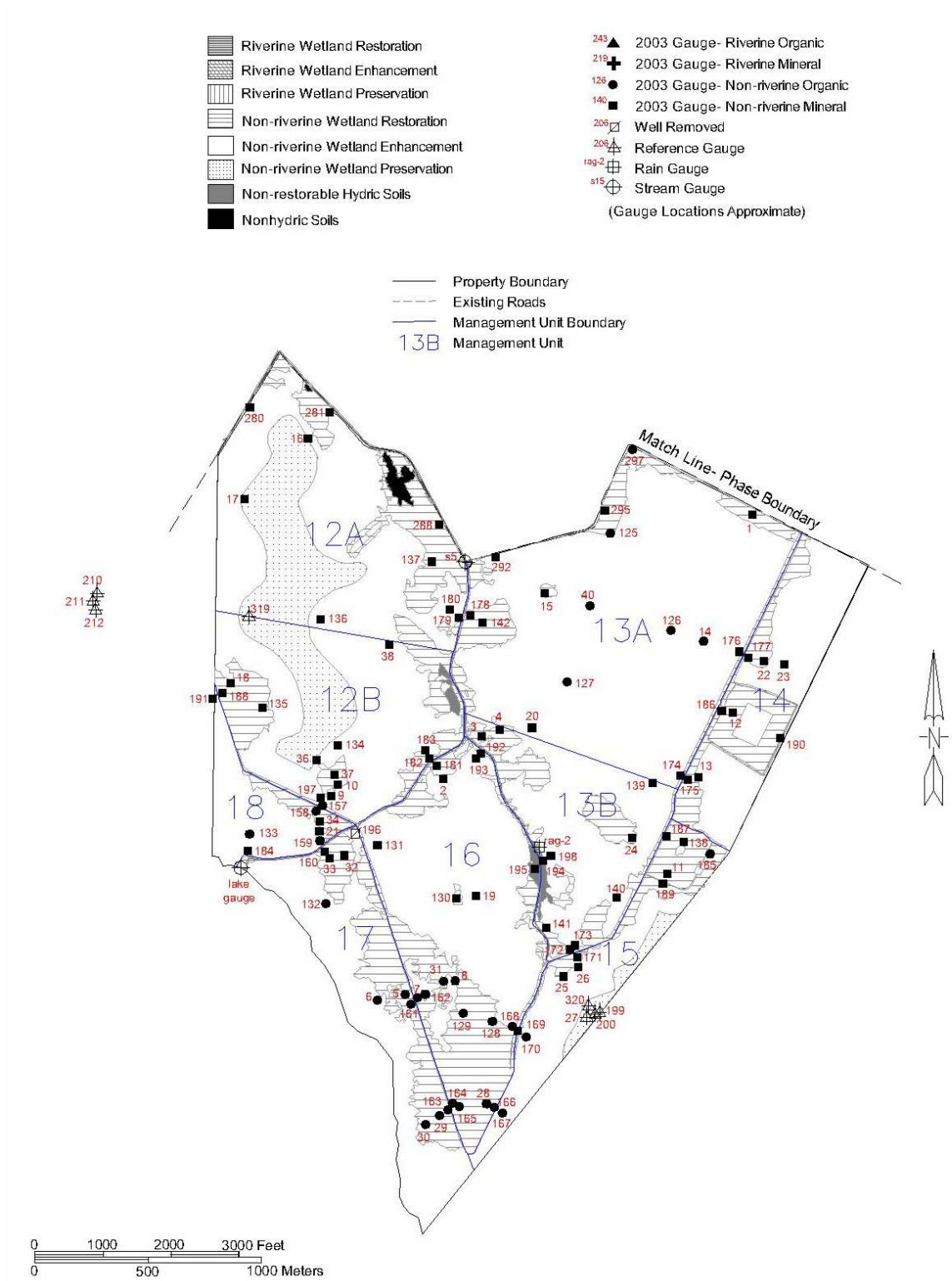


Table 2. Phase II (MU: 1-11) and I (MU: 12A-18) Gauge Locations

Phase II			
MU	**Location**	**Total # of Gauges**	**# of Gauges per Mitigation Type (NR, NE, NP,RR, RE, RP)[a]**
1	Northwestern portion of Phase II along western boundary	5 (+ 8 Reference)	NE–4, NP-1 + 8*
2A	Northern portion of Phase II adjacent to Catfish Lake Rd. and East Prong Brice Creek	4 (+3 Reference)	NR-1, NE-2, RE-1, and RP-3*
2B	North-central portion of Phase II east of 2A and west of 3	19	NR-17, RE-2
3	North-central portion of Phase II east of 2B and west of 4A	10	NR-7, NE-1, RE-1, RR-1
4A	North-central portion of Phase II east of 3 and west of 4B	3 (+4 Reference)	NR-1, NE-2, NP-1*, and RP-3*
4B	Northeastern portion of Phase II along the boundary north of transmission line	8 (+ 1 Reference)	NR-3, NE-3, and NP-2 + 1*
5	Northwestern portion of Phase II east of 1 and north of transmission line	17	NR-13[b], NE-2, RR-1, RE-1
6	West-central portion of Phase II south of the transmission lime along the western boundary	24	NR-11, NE-1 RR-8, RE-4
7	Central portion of Phase II east of 6 and west of 8	14	NR-11, NE-3
8	Central portion of Phase II east of 7 and west of 9	17	NR-11, NE-6
9	Southeastern portion of Phase II along the eastern boundary	8	NR-3, NE-5
10A	Southeastern portion of Phase II, along Phase boundary	14	NR-14
10B	Southern portion of Phase II, east of 11 and north of 10C	17	NR-13, NE-4
10C	Southern portion of Phase II, south of 10B and north of 13A	16	NR-16
11	Southwestern portion of Phase II, along western boundary	8	NR-7, NE-1
Table 2 Continues.			

Table 2 Concluded.			
Phase I			
MU	**Location**	**Total # of Gauges**	**# of Gauges per Mitigation Type (R, E, P)[a]**
12A	Northwestern portion of Phase I along western boundary	9 (+1 Reference)	NR-4, NE-5, NP-1
12B	Western portion of Phase I south of 12A	13	NR-9, NE-4
13A	Center of Phase I adjacent to the northern Phase I Boundary	15	NR-9, NE-6
13B	Center of Phase I south of 13A	10	NR-4, NE-6
14	Northeastern portion of Phase I along eastern boundary	8	NR-7, NE-1
15	Southeastern portion of Phase I south of 14	10 (+ 4 Reference)	NR-8, NE-2, and NP-4*
16	Center of Phase I south of 13B	20	NR-17, NE-3
17	Southeastern portion of Phase I adjacent to the Lake	10	NR-8, NE-2[c]
18	Southwestern portion of Phase I adjacent to the Lake	7	NR-3, NE-4
Off-site	Catfish Lake Road	5 Reference	N/A
Off-site	Forest Service Land adjacent to the Croatan WMB western boundary	7 Reference	N/A

[a] Mitigation Type: NR = Non-riverine Restoration, NE = Non-riverine Enhancement, NP = Non-riverine Preservation, RR = Riverine Restoration, RE = Riverine Enhancement, RP = Riverine Preservation (* = Reference)
[b] Gauge 321 was installed in 2004.
[c] Gauge 196 in MU 17 was removed due to safety concerns (alligator).
* Onsite Reference gauges

Appendix A contains a numerical list of all monitoring and references gauges monitored in 2004. Appendix A also contains a plot of the water depth for each of the monitoring gauges. Due to the number of gauges within the CWMB some gauges have been plotted on the same graph. The gauges that are plotted on the same graph are within the same MU and soil series. Reference gauges are plotted individually in the Reference section of Appendix A. Precipitation events are included on each graph as bars. Historical precipitation data used for establishing rainfall normalcy were obtained from the North Carolina State Climate Office rain gauge in New Bern, Craven County, North Carolina. Rainfall data for 2004 came from three onsite rain gauges.

2.3 Results of Hydrologic Monitoring

2.3.1 Site Data

As described previously, each monitoring gauge must meet both of its respective hydrologic success criteria based on soil type in order to achieve hydrologic success. In order to achieve Success Criterion 1 monitoring gauges in mineral soils must have jurisdictional hydrology for 12.5% of the growing season and monitoring gauges in riverine or organic soils must have jurisdictional hydrology for 25% of the growing season. In order to achieve Success Criterion 2 each monitoring gauge must be within 50% of the Reference Range for its respective soil series for years one through three and within 20% of the Reference Range for its respective soil series for years four and five.

Reference Gauges

Overall, the reference gauges met or exceeded the number of days and time of year for the high water table values published for each soil type in the Craven County soil survey (pre and post hurricane events). The reference gauges for Leon soils did not meet the published values for the high water table during the early part of the growing season (pre-hurricane events), but exceeded the published values for the high water table during the later part of the growing season (post hurricane events).

Appendix A contains a table with the reference gauges within each soils series, the maximum number of consecutive days that jurisdictional hydrology was met and the percentage of the 242-day growing season that jurisdictional hydrology was met. These reference gauges have been used to establish a reference range. Table 1 provides the 50% range from reference conditions in days and percentage of the growing season. This is the number of days in which each soil series must have jurisdictional hydrology in order to achieve Success Criterion 2. Success Criterion 2 is based on restoring the jurisdictional hydroperiod for each soil series to within 50% of the Reference Range for years one through three and 20% of the Reference Range for years four and five (Appendix D).

For example, in 2004 all monitoring gauges within the Bayboro (mineral) soil series must have jurisdictional hydrology for 12.5% of the growing season in order to achieve Success Criterion 1. However, a gauge must also have jurisdictional hydrology between 36 and 165 days (14.9% to 68.2%) of the growing season to achieve Success Criterion 2. Thus, a gauge could achieve success for overall percentage of the growing season (Criterion 1), but not achieve 50% of the Reference Range (Criterion 2).

Monitoring Gauges

Phase II is broken into fifteen MUs, identified as MU 1 through 11 and Phase I is broken into nine MUs, identified as MU 12A through MU 18. Tables 3 through 26 and Figures 3a and 3b provide overviews of which monitoring gauges achieved hydrologic success. Each table lists gauges within each MU, the soil series in which the gauge is installed, mitigation type, expected jurisdictional hydroperiod, actual jurisdictional hydroperiod and whether the gauge met both respective hydrologic success criteria.

Portions of the site exhibited hydroperiods that exceeded 50% above the Reference Range (Success Criterion 2). These gauge sites were considered to have met Success Criterion 2 and considered to be hydrologically successful. The gauges exceeding 50% above Reference Range have been noted in the report and in Appendix D.

Several of the monitoring gauges have missing data due to gauge malfunction. ESI extrapolated the missing data for each gauge by using reference gauges, nearby gauges in the same soil type, rainfall events and adjacent data points. ESI analyzed the hydrographic response to rainfall events prior to and subsequent to the missing data gap and then extrapolated the missing data based on comparison to data for a comparable gauge that exhibited similar groundwater levels and hydrographic responses to precipitation events. Missing data is discussed in the report as it relates to the largest number of consecutive days $\geq$ 12.5% of the growing season.

Non-riverine minerals soils, such as Bayboro, Pantego, Leaf, and Rains, occupy a large portion of the CWMB. These soils types typically have a high water table that is within 12 inches of the ground surface during the winter and early spring. The water table tends to drop below 12 inches of the ground surface in late spring or early summer. Therefore these soil types should meet the jurisdictional hydrology requirement in the spring and early summer (the critical defining hydroperiod for many wetlands in eastern North Carolina).

The majority of the gauges in the CWMB showed that groundwater levels dropped below 12 inches below the ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). Analyzing the data during the initial draw down (pre-hurricane events) under normal rainfall conditions would be a better indication of how the CWMB is responding to mitigation measures. Therefore, ESI analyzed the data two ways: 1) the entire growing season [longest number of consecutive days < 12 inches below the ground surface between March 18 and November 14 (pre or post hurricane events)] and 2) the early part of the growing season prior to the initial draw down [longest number of consecutive days < 12 inches below the ground surface between March and June (pre-hurricane events)] (Appendix D).

Figure 3a. Hydrologic Monitoring Results, Phase II

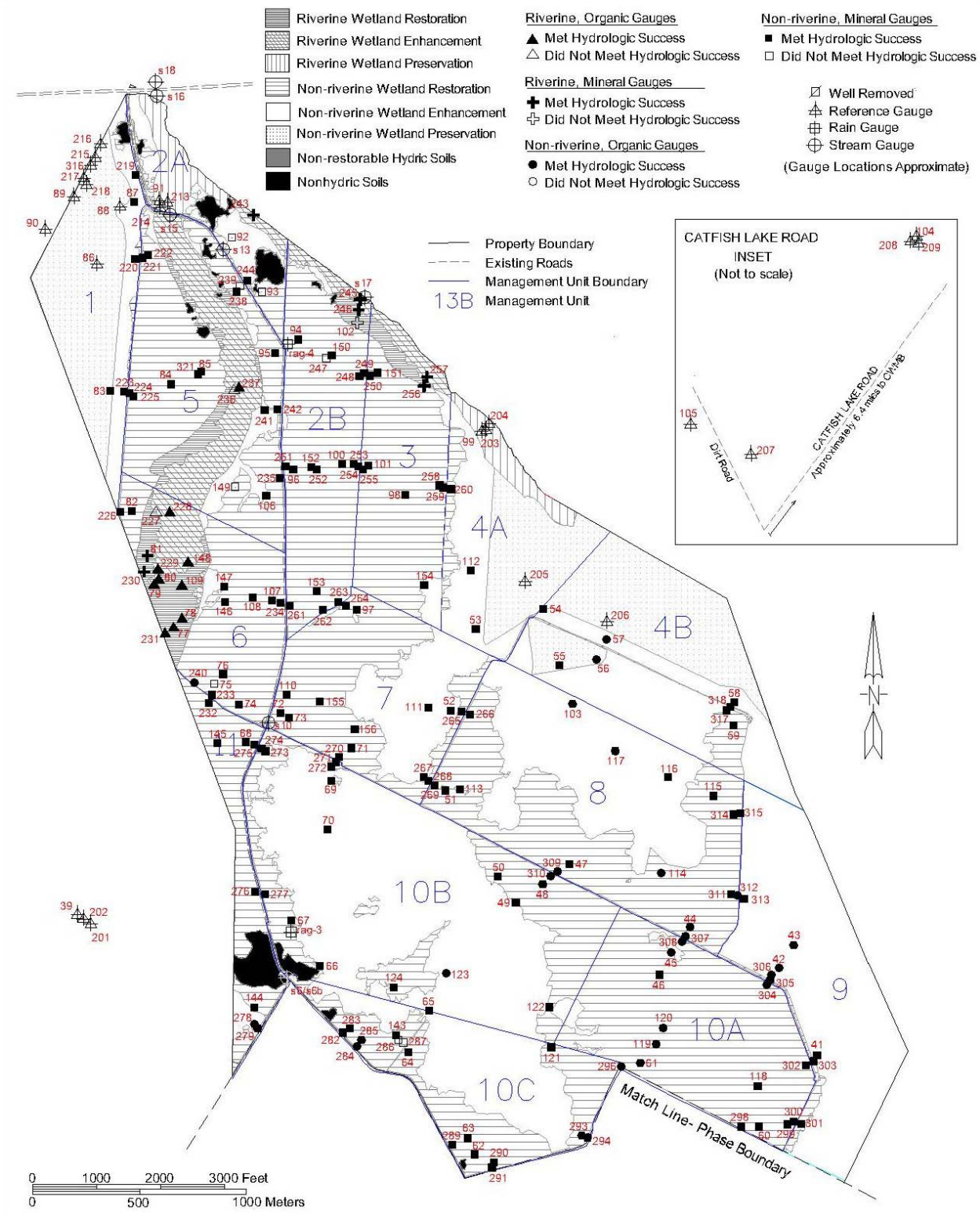


Figure 3b. Hydrologic Monitoring Results, Phase I

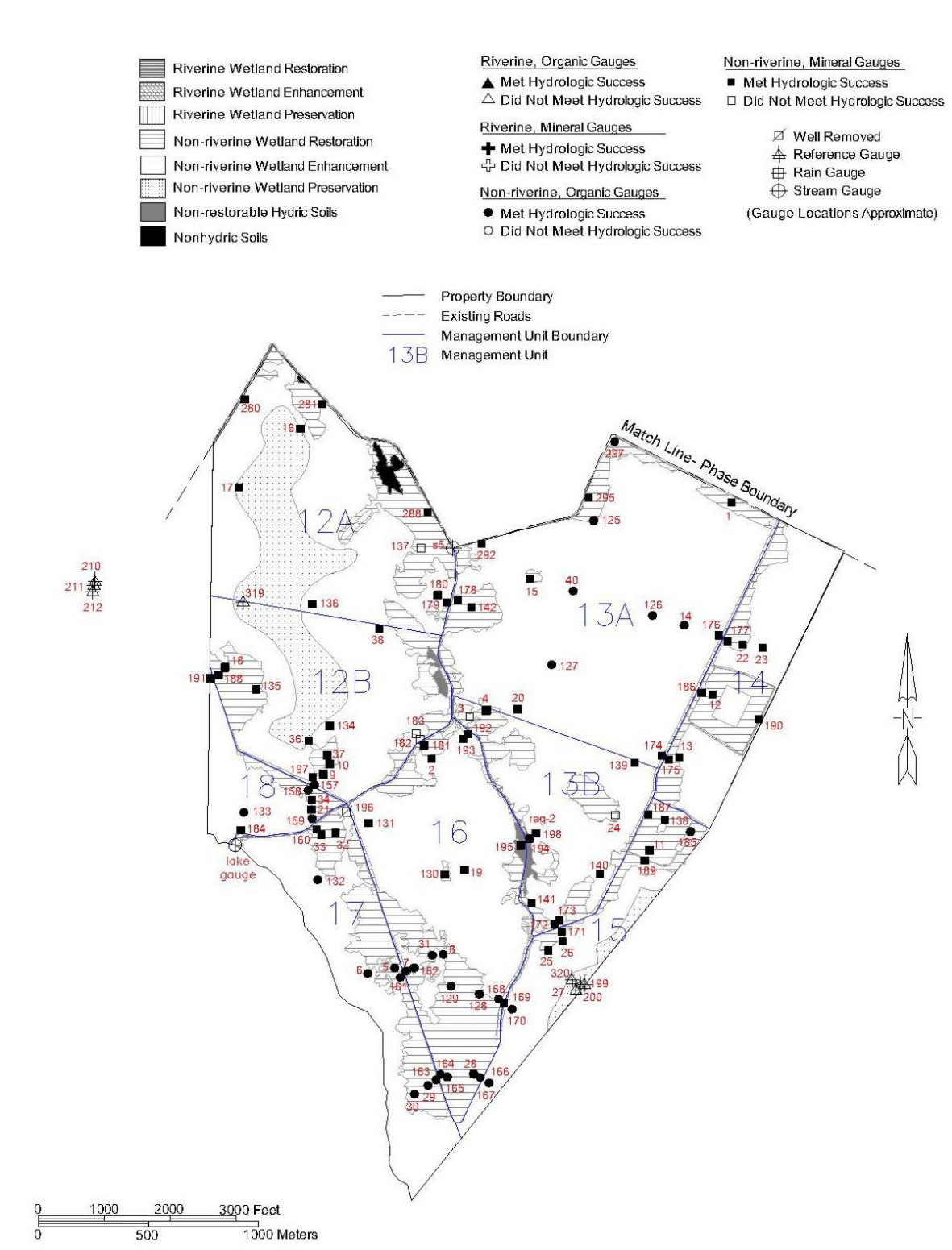


Table 3. Hydrologic Monitoring Results – MU 1

Gauge	Soil Series and Mitigation Type[a]	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥12.5% of Growing Season; ≤ 50% of Reference Range)					
83	Pa/NP	52.1	√	√	√[c]
87	La/NE	46.7	√	√	√[c]
219	Ra/NE	48.8	√	√	√[c]
220	La/NE	40.5	√	√	√[c]
223	Pa/NE	100	√	√[b]	√[c]

[a] Soils: Pa – Pantego, La – Leaf, and Ra – Rains.
Mitigation Types: Non-riverine Enhancement – NE, and Non-riverine Preservation – NP.
[b] Gauge exceeded Hydrologic Success Criterion 2.
[c] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table 3 MU 1 Discussion
March-November
All five monitoring gauges in MU 1 met both of their expected hydrologic success criteria for Year 2. In addition, all five gauges met the hydrologic success criteria established for years one through three (≥ 12.5 % of the growing season and within 50% of Reference Range) and the success criteria established for years four and five (≥ 12.5 % of the growing season and within 20% of Reference Range). Gauge 223 made jurisdictional hydrology for 100% of the growing season which exceeded the hydrologic success criteria established for the Pantego soil series.

Gauge 220 has missing data due to gauge malfunction. Gauge 220 has recorded data for a minimum of 98 consecutive days (40.5%) and two data gaps. The minimum number of consecutive days (98 days) was used for data analysis, but the actual number of consecutive days could have been 98 to 113 days based on extrapolation of hydrographic response in comparison to reference and adjacent gauges.

March-June (Initial draw down)
Gauges 83, 87, 219, and 220 all showed that groundwater levels dropped below 12 inches below ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). However, in a year with overall normal rainfall, all five gauges met the hydrologic success criteria established for years one through three and the success criteria established for years four and five during the initial draw down period (pre-hurricane events) (Appendix D). Gauge 223 exceeded the success criteria established for years four and five for the Pantego soil series during the initial draw down period (pre-hurricane events).

Table 4. Hydrologic Monitoring Results – MU 2A

Gauge	Soil Series and Mitigation Type[a]	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥12.5% of Growing Season; ≤ 50% of Reference Range)					
92	La/NE	11.6	–	–	–
93	La/NR	17.8	√	–	–
244	La/NE	32.1 [b]	√	√	√
Riverine, Mineral (Success = Saturation/inundation ≥ 25% of Growing Season; ≤ 50% of Reference Range)					
243	Ba/RE	38.0 [b]	√	√	√ [c]

[a] Soils: Ba – Bayboro and La – Leaf.
Mitigation Types: Non-riverine Restoration – NR, Non-riverine Enhancement – NE, and Riverine Enhancement – RE.
[b] Actual %: Missing data extrapolated from comparable gauges.
[c] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table 4 MU 2A Discussion
March-November

Two of the four monitoring gauges in MU 2A met both of their expected hydrologic success criteria for Year 2. Only Gauge 243 met the hydrologic success criteria established for years one through three and met the success criteria established for years four and five. Gauges 243 and 244 have missing data due to gauge malfunction.

Gauge 243 has recorded data for 71 consecutive days (29.4% of the growing season) and two data gaps. Using Reference Gauges 99 and 203 to extrapolate missing data, it can be assumed that Gauge 243 would have made jurisdictional hydrology for approximately 38.0% of the growing season.

Gauge 244 has recorded data for 65 consecutive days (26.9% of the growing season) and two data gaps. Using Reference Gauge 217 to extrapolate missing data, it can be assumed that Gauge 244 would have made jurisdictional hydrology for approximately 32.1% of the growing season.

Gauge 92 did not meet either of its expected hydrologic success criteria. In a year with normal rainfall, Gauge 92 did not make jurisdictional hydrology. Additional mitigative measures may need to be addressed if jurisdictional hydrology is not restored in years three through five.

Gauge 93 made jurisdictional hydrology for 17.8% of the growing season, and therefore met Success Criterion 1. However, this gauge did not meet Success Criterion 2 (50% of Reference Range) for the Leaf soil series (21.9 –73.1% of the growing season). Mitigative measures appear to be successful at returning jurisdictional hydrology to Gauge 93, but were not

successful at returning the gauge site to within 50% of reference conditions under the normal rainfall conditions in 2004.

March-June (Initial draw down)

The gauges in MU 2A showed that groundwater levels dropped below 12 inches below the ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). Gauges 243 and 244 met the hydrologic success criteria established for years one through three and years four and five for their respective soil series during the initial draw down period (pre-hurricane events). Gauges 92 and 93 did not meet either of the expected hydrologic success criteria during the initial draw down period.

Table 5. Hydrologic Monitoring Results – MU 2B

Gauge	Soil Series and Mitigation Type[a]	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥12.5% of Growing Season; ≤ 50% of Reference Range)					
94	Pa/NR	32.2	√	√	√[d]
96	La/NR	48.8	√	√	√[d]
100	La/NR	43.0	√	√	√[d]
150	La/NR	22.7	√	√	√
152	Ba/NR	28.9	√	√	√[d]
153	Ba/NR	45.5[b]	√	√	√[d]
247	La/NR	18.2	√	–	–
248	La/NR	26.9	√	√	√
249	La/NR	42.2	√	√	√[d]
251	Ba/NR	52.1	√	√	√[d]
252	Ba/NR	48.8	√	√	√[d]
253	Ba/NR	42.6	√	√	√[d]
254	Ba/NR	52.1[b]	√	√	√[d]
261	Ba/NR	48.8	√	√	√[d]
262	Ba/NR	100	√	√[c]	√[d]
263	Ba/NR	45.5	√	√	√[d]
Riverine, Mineral (Success = Saturation/inundation ≥ 25% of Growing Season; ≤ 50% of Reference Range)					
102	Ba/RR	10.3	–	–	–
245	Ba/RE	100	√	√[c]	√[d]
246	La/RE	43.4[b]	√	√	√[d]

[a] Soils: Pa – Pantego, Ba – Bayboro, and La – Leaf.
Mitigation Types: Non-riverine Restoration – NR, Riverine Restoration – RR, and Riverine Enhancement – RE.
[b] Actual %: Missing data extrapolated from comparable gauges.
[c] Gauge exceeded Hydrologic Success Criterion 2.
[d] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table 5 MU 2B Discussion

March-November

Seventeen of the nineteen monitoring gauges in MU 2B met both of their expected hydrologic success criteria for Year 2. Fifteen gauges that met the hydrologic success criteria established for years one through three, also met the success criteria established for years four and five. Gauges 150 and 248 met the hydrologic success criteria established for years one through three, but did not met the success criteria established for years four and five. Gauges 245 and 262 made jurisdictional hydrology for 100% of the growing season which exceeded the hydrologic success criteria established for the Bayboro soil series. Gauges 153, 246 and 254 have missing data due to gauge malfunction.

Gauge 153 has recorded data for 79 consecutive days (32.6% of the growing season) and two data gaps. Using nearby Gauges 261, 262, and 263 to extrapolate missing data, it can be assumed that Gauge 153 would have made jurisdictional hydrology for approximately 45.5% of the growing season.

Gauge 246 has recorded data for 93 consecutive days (38.4% of the growing season) and one data gap. Using Reference Gauges 216, 217, and 218 to extrapolate missing data, it can be assumed that Gauge 246 would have made jurisdictional hydrology for approximately 43.4% of the growing season.

Gauge 254 has recorded data for 79 consecutive days (32.6% of the growing season) and one data gap. Using Gauge 253, it can be assumed that Gauge 254 would have made jurisdictional hydrology for approximately 52.1% of the growing season.

Gauge 102 did not meet either of its expected hydrologic success criteria. In a year with normal rainfall the areas around Gauge 102 did not make jurisdictional hydrology. This gauge is located on the upper edge of the floodplain and may be on a topographic high. Additional measures may need to be addressed if jurisdictional hydrology is not restored in years 3-5.

Gauge 247 made jurisdictional hydrology for 18.2% of the growing season, and therefore met Success Criterion 1. However, this gauge did not meet Success Criterion 2 (50% of Reference Range) for the Leaf soil series (21.9 –73.1% of the growing season). Mitigative measures appear to be successful at returning jurisdictional hydrology to Gauge 247, but were not successful at returning the gauge site to within 50% of reference conditions under the normal rainfall conditions in 2004.

March-June (Initial draw down)

The gauges in MU 2B showed that groundwater levels dropped below 12 inches below the ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). Only Gauge 102 did not meet the hydrologic success criteria established for years one through three for the Bayboro soil series during the initial draw down period (pre-hurricane events). Gauges 102, 150 and 247 did not meet the hydrologic success criteria for years four and five for their respective soil series during the initial draw down period (pre-hurricane events). During the initial draw down Gauges 150 and 247 met jurisdictional hydrology for 18.2% of the growing season and would be considered jurisdictional under normal rainfall conditions.

Table 6. Hydrologic Monitoring Results – MU 3

Gauge	Soil Series and Mitigation Type[a]	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥12.5% of Growing Season; ≤ 50% of Reference Range)					
98	Ba/NR	39.7	√	√	√[c]
101	Ba/NR	40.1	√	√	√[c]
151	La/NR	37.6	√	√	√[c]
154	Ba/NE	45.9	√	√	√[c]
250	La/NR	45.9 [b]	√	√	√[c]
255	Ba/NR	42.2	√	√	√[c]
258	Ba/NR	24.0 [b]	√	√	√[c]
259	Ba/NR	18.2	√	√	√
Riverine, Mineral (Success = Saturation/inundation ≥ 25% of Growing Season; ≤ 50% of Reference Range)					
256	Ba/RR	38.8	√	√	√[c]
257	Ba/RE	52.1	√	√	√[c]

[a] Soils: Ba – Bayboro and La – Leaf.
Mitigation Types: Non-riverine Restoration – NR, Non-riverine Enhancement – NE, Riverine Restoration – RR, and Riverine Enhancement – RE.
[b] Actual %: Missing data extrapolated from comparable gauges.
[c] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table 6 MU 3 Discussion

March-November

All ten of the monitoring gauges in MU 3 met both of their expected hydrologic success criteria for Year 2. Nine of the ten gauges met the hydrologic success criteria established for years one through three and met the success criteria established for years four and five. Only Gauge 259 met the hydrologic success criteria for years one through three, but did not met the success criteria established for years four and five. Gauges 250 and 258 have missing data due to gauge malfunction.

Gauge 250 has recorded data for 83 consecutive days (34.3% of the growing season) and one data gap. Using nearby Gauge 151 to extrapolate missing data, it can be assumed that Gauge 250 would have made jurisdictional hydrology for approximately 45.9% of the growing season.

Table 6 MU 3 Discussion Continued

Gauge 258 has recorded data for 37 consecutive days (15.3% of the growing season) and one data gap. Using nearby Gauge 259 to extrapolate missing data, it can be assumed that Gauge 258 would have made jurisdictional hydrology for approximately 24.0% of the growing season.

March-June (Initial draw down)

The gauges in MU 3 showed that groundwater levels dropped below 12 inches below the ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). Gauges 256, 258 and 259 did not meet Success Criterion 1 under normal rainfall conditions. Only Gauge 259 did not meet Success Criteria 2 established for years one through three and Gauges 258 and 259 did not meet the hydrologic success criteria established for years four and five for the Bayboro soil series during the initial draw down period (pre-hurricane events).

Gauges 258 and 259 are located adjacent to the north-south ditch that divides MU 3 from MU 4A. These gauges were placed in non-jurisdictional areas within the zone of influence of the ditch. The point-plugs were successful at returning jurisdictional hydrology within the zone of influence off the former ditch during the later part of the growing season (post-hurricane events). However, during the initial drawn down period (pre-hurricane events) these gauges made jurisdictional hydrology for 5 - 12.5% of the growing season. Jurisdictional hydrology ($\geq$ 12.5% of the growing season) may not be restored within the zone of influence off the former ditch between MU 3 and 4A under normal rainfall conditions. The ditch adjacent to 258 and 259 may still have a zone of influence extending a greater distance off the ditch than can be measured with existing gauges. Another gauge installed along the same transect may capture the zone of influence.

Table 7. Hydrologic Monitoring Results – MU 4A

Gauge	Soil Series and Mitigation Type[a]	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥12.5% of Growing Season; ≤ 50% of Reference Range)					
53	Ba/NE	43.0[b]	√	√	√[c]
112	Ba/NE	43.0	√	√	√[c]
260	Ba/NR	37.6[b]	√	√	√[c]

[a] Soils: Ba – Bayboro.
Mitigation Types: Non-riverine Restoration – NR, and Non-riverine Enhancement – NE.
[b] Actual %: Missing data extrapolated from comparable gauges.
[c] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table 7 MU 4A Discussion
March-November
All three of the monitoring gauges in MU 4A met both of their expected hydrologic success criteria for Year 2. All of the gauges met the hydrologic success criteria established for years one through three and met the success criteria established for years four and five for the Bayboro soil series. Gauges 53 and 260 have missing data due to gauge malfunction.

Gauge 53 has recorded data for 78 consecutive days (32.2% of the growing season) and two large data gaps. Using nearby Gauge 112 and Reference Gauges 99 and 203 to extrapolate missing data, it can be assumed that Gauge 53 would have made jurisdictional hydrology for approximately 43.0% of the growing season.

Gauge 260 has recorded data for 38 consecutive days (15.7% of the growing season) and three data gaps. Using nearby Gauge 259 and Reference Gauges 99 and 204 to extrapolate missing data, it can be assumed that Gauge 260 would have made jurisdictional hydrology for approximately 37.6% of the growing season.

March-June (Initial draw down)
The gauges in MU 4A showed that groundwater levels dropped below 12 inches below the ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). During the initial draw down period, Gauges 53 and 112 met the hydrologic success criteria established for years one through three and met the hydrologic success criteria established for years four and five. During the initial draw down period (pre-hurricane events), Gauge 260 made jurisdictional hydrology for 11.2% of the growing season and did not meet Success Criterion 1 or the hydrologic success criteria for years four and five for the Bayboro soil series. The ditch adjacent to 258, 259, and 260 may still have a zone of influence extending a greater distance off the ditch than can be measured with existing gauges. Another gauge installed along the same transect may capture the zone of influence.

Table 8. Hydrologic Monitoring Results – MU 4B

Gauge	Soil Series and Mitigation Type[a]	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥12.5% of Growing Season; ≤ 50% of Reference Range)					
54	Pa/NP	45.0	√	√	√[d]
55	Ba/NE	100	√	√[c]	√[d]
58	Ba/NE	43.8	√	√	√[d]
59	Ba/NR	45.5	√	√	√[d]
317	Ba/NR	45.5	√	√	√[d]
318	Ba/NR	45.5	√	√	√[d]
Non-riverine, Organic (Success = Saturation/inundation ≥ 25% of Growing Season; ≤ 50% of Reference Range)					
56	CT/NP	100	√	√	√[d]
57	CT/NE	56.2[b]	√	√	√[d]

[a] Soils: Ba – Bayboro, CT – Croatan, and Pa - Pantego.
Mitigation Types: Non-riverine Restoration – NR, Non-riverine Enhancement – NE, and Non-riverine Preservation – NP.
[b] Actual %: Missing data extrapolated from comparable gauges.
[c] Gauge exceeded Hydrologic Success Criterion 2.
[d] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table 8 MU 4B Discussion

March-November

All eight monitoring gauges in MU 4B met both of their expected hydrologic success criteria for Year 2. In addition, these monitoring gauges met the hydrologic success criteria established for years one through three and met the success criteria established for years four and five. Gauge 55 made jurisdictional hydrology for 100% of the growing season which exceeded the hydrologic success criteria established for the Bayboro soil series. Gauge 57 has missing data due to gauge malfunction.

Gauge 57 has recorded data for 97 consecutive days (40.1% of the growing season) and one data gap. Using nearby Gauge 56 and Reference Gauge 206 to extrapolate missing data, it can be assumed that Gauge 57 would have made jurisdictional hydrology for approximately 56.2% of the growing season.

Table 8 MU 4B Discussion Continued

March –June (Initial draw down)

The majority of the gauges in MU 4B showed that groundwater levels dropped below 12 inches below the ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). However, all of the gauges met the hydrologic success criteria for years four and five for their respective soil series during the initial draw down period (pre-hurricane events).

Table 9. Hydrologic Monitoring Results – MU 5

Gauge	Soil Series and Mitigation Type[a]	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥12.5% of Growing Season; ≤ 50% of Reference Range)					
84	Ra/NR	46.7	√	√	√[d]
85	Pa/NR	18.2	√	√	√
95	La/NR	22.7	√	√	√
106	Ba/NE	64.9[b]	√	√	√[d]
149	Pa/NR	16.5	√	–	–
221	La/NR	52.1	√	√	√[d]
222	La/NR	40.9	√	√	√[d]
224	Pa/NR	56.6[b]	√	√	√[d]
225	Pa/NR	56.6[b]	√	√	√[d]
235	Ba/NR	100	√	√[c]	√[d]
238	Ra/NR	17.8	√	√	√
239	Ra/NR	10.7	–	–	–
241	Ra/NE	100	√	√[c]	√[d]
242	La/NR	64.9	√	√	√[d]
321	Pa/NR	23.1	√	√	√
Riverine, Organic (Success = Saturation/inundation ≥ 25% of Growing Season; ≤ 50% of Reference Range)					
236	MM/RR	47.1	√	–	–
237	MM/RE	100	√	√	√[d]

[a] Soils: Ra – Rains, Pa – Pantego, Ba – Bayboro, La –Leaf, and MM –Masontown/Muckalee.
Mitigation Types: Non-riverine Restoration – NR, Non-riverine Enhancement – NE, Riverine Restoration – RR, and Riverine Enhancement – RE.
[b] Actual %: Missing data extrapolated from comparable gauges.
[c] Gauge exceeded Hydrologic Success Criterion 2.
[d] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table 9 MU 5 Discussion

March-November

Fourteen of the seventeen monitoring gauges in MU 5 met both of their expected hydrologic success criteria for Year 2. Ten monitoring gauges met the hydrologic success criteria established for years one through three and met the success criteria established for years four and five. Gauges 235 and 241 made jurisdictional hydrology for 100% of the growing season which exceeded the hydrologic success criteria established for their respective soil series. Gauges 106, 224, and 225 have missing data due to gauge malfunction.

Gauge 106 has recorded data for 147 consecutive days (60.7% of the growing season) and two data gaps. Using nearby Gauge 235 to extrapolate missing data, it can be assumed that Gauge 106 would have made jurisdictional hydrology for approximately 64.9% of the growing season.

Gauges 224 and 225 have recorded data for 81 consecutive days (33.5% of the growing season) and one large data gap. Using nearby Gauges 223 and 83 to extrapolate missing data, it can be assumed that Gauges 224 and 225 would have made jurisdictional hydrology for approximately 56.6% of the growing season.

Gauge 149 made jurisdictional hydrology for 16.5% of the growing season, and therefore met Success Criterion 1. However, this gauge did not meet Success Criterion 2 (50% of Reference Range) for the Pantego soil series (16.9 – 78.1% of the growing season). Mitigative measures appear to be successful at returning jurisdictional hydrology to Gauge 149, but were not successful at returning the gauge site to within 50% of reference conditions under the normal rainfall conditions in 2004 by one day.

Gauge 236 made jurisdictional hydrology for 47.1% of the growing season, and therefore met Success Criterion 1 for Riverine, Organic soils. However, this gauge did not meet Success Criterion 2 (50% of reference) for the Masontown/Muckalee soil series (50.0 - 100% of the growing season). Mitigative measures appear to be successful at returning jurisdictional hydrology to Gauge 236, but were not successful at returning the gauge site to within 50% of reference conditions under the normal rainfall conditions in 2004.

Gauge 239 did not meet either of its expected hydrologic success criteria. In a year with normal rainfall, Gauge 239 did not make jurisdictional hydrology. This gauge is located on the upper edge of the floodplain and may be on a topographic high. Additional measures may need to be addressed if jurisdictional hydrology is not restored in years three through five.

March-June (Initial draw down)

The majority of the gauges in MU 5 showed that groundwater levels dropped below 12 inches below the ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). Only Gauges 149 and 239 did not meet the hydrologic success criteria established for years one through three for their respective soil series during the initial draw down period (pre-hurricane events). Gauges 85, 95, 149, 236, 238, and 239 did not meet the hydrologic success criteria established for years four and five for their respective soil series during the initial draw down period (pre-hurricane events). However, during the initial drawn down (pre-hurricane events), all gauges except Gauges 149 and 239 met jurisdictional hydrology for $\geq$ 12.5% of the growing season.

Table 10. Hydrologic Monitoring Results – MU 6

Gauge	Soil Series and Mitigation Type[a]	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥12.5% of Growing Season; ≤ 50% of Reference Range)					
74	Ba/NR	40.1	√	√	√[d]
75	Ba/NR	2.5	–	–	–
76	Ba/NR	16.5	√	√	√
82	Pa/NR	100	√	√[c]	√[d]
107	Ba/NR	100	√	√[c]	√[d]
108	Ba/NR	100	√	√[c]	√[d]
146	La/NR	36.4	√	√	√[d]
147	Ba/NE	100	√	√[c]	√[d]
226	Pa/NR	100[b]	√	√[c]	√[d]
233	Ra/NR	43.0	√	√	√[d]
234	Ba/NR	100[b]	√	√[c]	√[d]
Non-riverine, Organic (Success = Saturation/inundation ≥ 25% of Growing Season; ≤ 50% of Reference Range)					
240	CT/NR	100	√	√	√[d]
Riverine, Mineral (Success = Saturation/inundation ≥ 25% of Growing Season; ≤ 50% of Reference Range)					
81	Ba/RR	100	√	√[c]	√[d]
230	Ba/RR	100	√	√[c]	√[d]

Table 10 Continues

Table 10 Concluded.

Riverine, Organic (Success = Saturation/inundation ≥ 25% of Growing Season; ≤ 50% of Reference Range)					
Gauge	**Soil Series and Mitigation Type[a]**	**Actual %**	**Criterion 1 Met (% of Growing Season)**	**Criterion 2 Met (% of Reference Range)**	**Hydrologic Success Met**
77	CT/RE	100	√	√	√[d]
78	MM/RR	100	√	√	√[d]
79	DO/RR	100[b]	√	√	√[d]
80	DO/RR	100	√	√	√[d]
109	MM/RR	100	√	√	√[d]
148	MM/RE	100[b]	√	√	√[d]
227	MM/RR	38.8[b]	√	–	–
228	MM/RE	100	√	√	√[d]
229	CT/RE	100[b]	√	√	√[d]
231	CT/RR	100	√	√	√[d]

[a] Soils: Ra – Rains, Pa – Pantego, Ba – Bayboro, La –Leaf, MM –Masontown/Muckalee, CT – Croatan, and DO - Dorovan.
Mitigation Types: Non-riverine Restoration – NR, Non-riverine Enhancement – NE, Riverine Restoration – RR, and Riverine Enhancement – RE.
[b] Actual %: Missing data extrapolated from comparable gauges.
[c] Gauge exceeded Hydrologic Success Criterion 2.
[d] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table 10 MU 6 Discussion

March-November

Twenty-two of the twenty-four monitoring gauges in MU 6 met both of their expected hydrologic success criteria for Year 2. Twenty-one of the twenty-two monitoring gauges that met the hydrologic success criteria established for years one through three also met the success criteria established for years four and five. Gauges 75 and 227 did not meet hydrologic success. Eight gauges made jurisdictional hydrology for 100% of the growing season which exceeded the hydrologic success criteria established for their respective soil series. Gauges 79, 148, 226, 227, 229, and 234 have missing data due to gauge malfunction.

Gauge 79 has recorded data for 165 consecutive days (68.2% of the growing season) and one large data gap. Using nearby Gauges 80, 81, 229, and 230 to extrapolate missing data, it can be assumed that Gauge 79 would have made jurisdictional hydrology for approximately 100% of the growing season.

Gauge 148 has recorded data for 189 consecutive days (78.1% of the growing season) and one data gap. Using nearby Gauge 109 to extrapolate missing data, it can be assumed that Gauge 148 would have made jurisdictional hydrology for approximately 100% of the growing season.

Gauge 226 has recorded data for 161 consecutive days (66.5% of the growing season) and one data gap. Using nearby Gauge 82 to extrapolate missing data, it can be assumed that Gauge 226 would have made jurisdictional hydrology for approximately 100% of the growing season.

Gauge 227 has recorded data for 81 consecutive days (33.5% of the growing season) and one data gap. Using nearby Gauge 228 and the rainfall data to extrapolate missing data, it can be assumed that Gauge 227 would have made jurisdictional hydrology for approximately 38.8% of the growing season.

Gauge 229 has recorded data for 216 consecutive days (89.3% of the growing season) and one data gap. Using nearby Gauge 231 to extrapolate missing data, it can be assumed that Gauge 229 would have made jurisdictional hydrology for approximately 100% of the growing season.

Gauge 234 has recorded data for 134 consecutive days (55.4% of the growing season) and multiple data gaps. Using nearby Gauges 107 and 230 to extrapolate missing data, it can be assumed that Gauge 234 would have made jurisdictional hydrology for approximately 100% of the growing season.

Gauge 227 made jurisdictional hydrology for 38.8% of the growing season, and therefore met Success Criterion 1. However, this gauge did not meet Success Criterion 2 (50% of Reference Range) for the Masontown/Muckalee soil series (50.0 - 100% of the growing season). Mitigative measures appear to be successful at exceeding jurisdictional hydrology to Gauge 227, but were not successful at returning the gauge site to within 50% of reference conditions under the normal rainfall conditions in 2004. Gauge 227 may be on a topographic high compared to the surrounding landscape. Adjacent Gauge 228 showed 7 to 20 inches of surface water for the entire year and Gauge 82 showed 5 to 7 inches of surface water for extended periods during the beginning and later parts of the growing season. Due to its location in the landscape, Gauge 227 may not meet Success Criterion 2 in years with normal rainfall.

Gauge 75 did not meet either of its expected hydrologic success criteria. In a year with normal rainfall Gauge 75 did not make jurisdictional hydrology. This gauge is located on the upper edge of the floodplain and may be on a topographic high. Additional measures may need to be addressed if jurisdictional hydrology is not restored in years three through five.

March- June (Initial draw down)

The remaining monitoring gauges in MU 6 showed that groundwater levels dropped below 12 inches below the ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). Gauges 74, 75, and 76 did not meet the hydrologic success criteria established for years one through three for their respective soil series during the initial draw down period (pre-hurricane events). Gauges 74, 75, 76, 227, and 233 did not meet the hydrologic success criteria for years four and five for their respective soil series during the initial draw down period (pre-hurricane events). During the initial draw down, Gauge 227 met jurisdictional hydrology for 26.0% of the growing season and Gauge 233 met jurisdictional hydrology for 15.3% of the growing season. Gauges 74, 75, 76, and 233 are surrounded by

loblolly pine (*Pinus taeda*) and bracken fern (*Pteridium aquilinum*) which may be an indication that the topography may be a little higher than the surrounding landscape. These gauge sites may not be returned to within 20% of reference during years with normal rainfall.

Table 11. Hydrologic Monitoring Results – MU 7

Gauge	Soil Series and Mitigation Type[a]	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥12.5% of Growing Season; ≤ 50% of Reference Range)					
52	Ba/NE	45.5	√	√	√[d]
71	Ba/NR	45.5	√	√	√[d]
72	Ba/NR	52.1	√	√	√[d]
73	Pa/NR	45.5	√	√	√[d]
97	Ba/NR	52.1	√	√	√[d]
110	Pa/NR	45.5	√	√	√[d]
111	Ba/NE	45.5	√	√	√[d]
155	Ba/NR	45.5	√	√	√[d]
156	Ba/NR	45.5[b]	√	√	√[d]
264	Ba/NR	100	√	√[c]	√[d]
265	Ba/NR	47.1	√	√	√[d]
267	Ba/NE	45.5	√	√	√[d]
268	Ba/NR	45.5	√	√	√[d]
270	Ba/NR	100	√	√[c]	√[d]

[a] Soils: Pa – Pantego and Ba – Bayboro.
Mitigation Types: Non-riverine Restoration – NR and Non-riverine Enhancement – NE.
[b] Actual %: Missing data extrapolated from comparable gauges.
[c] Gauge exceeded Hydrologic Success Criterion 2.
[d] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table 11 MU 7 Discussion

March-November

All fourteen of the monitoring gauges in MU 7 met both of their expected hydrologic success criteria for Year 2. In addition, all fourteen monitoring gauges that met the hydrologic success criteria established for years one through three also met the success criteria established for years four and five. Gauges 264 and 270 made jurisdictional hydrology for 100% of the growing season which exceeded the hydrologic success criteria for the Bayboro soil series. Gauge 156 has missing data due to gauge malfunction.

Gauge 156 has recorded data for 78 consecutive days (28.5% of the growing season) and two data gaps. Using nearby Gauges 71 and 155 to extrapolate missing data, it can be assumed that Gauge 156 would have made jurisdictional hydrology for approximately 45.5% of the growing season.

March-June (Initial draw down)

The majority of the gauges in MU 7 showed that groundwater levels dropped below 12 inches below the ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). However, all of the gauges in MU 7 met the hydrologic success criteria established for years one through three during the initial draw down period (pre-hurricane events) and met hydrologic success criteria established for years four and five for their respective soil series during the initial draw down period (pre-hurricane events).

Table 12. Hydrologic Monitoring Results – MU 8

Gauge	Soil Series and Mitigation Type[a]	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥12.5% of Growing Season; ≤ 50% of Reference Range)					
47	Ba/NR	46.3	√	√	√[d]
51	Ba/NE	100[b]	√	√[c]	√[d]
113	Ba/NE	52.1[b]	√	√	√[d]
115	Pa/NR	45.5	√	√	√[d]
116	Pa/NE	45.5	√	√	√[d]
266	Ba/NR	52.1	√	√	√[d]
269	Ba/NE	52.1	√	√	√[d]
311	Ba/NR	45.5	√	√	√[d]
314	Ba/NR	45.5	√	√	√[d]
315	Ba/NR	45.5	√	√	√[d]
Non-riverine, Organic (Success = Saturation/inundation ≥ 25% of Growing Season; ≤ 50% of Reference Range)					
44	CT/NR	45.5	√	√	√[d]
103	CT/NE	100[b]	√	√	√[d]
114	CT/NR	45.0	√	√	√[d]
117	CT/NE	100	√	√	√[d]
307	CT/NR	45.5	√	√	√[d]
309	CT/NR	45.9	√	√	√[d]
312	CT/NR	45.5[b]	√	√	√[d]

[a] Soils: Pa – Pantego, Ba – Bayboro, and CT - Croatan.
Mitigation Types: Non-riverine Restoration – NR and Non-riverine Enhancement – NE.
[b] Actual %: Missing data extrapolated from comparable gauges.
[c] Gauge exceeded Hydrologic Success Criterion 2.
[d] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table 12 MU 8 Discussion

March-November

All seventeen monitoring gauges in MU 8 met both of their expected hydrologic success criteria for Year 2. All of the monitoring gauges that met the hydrologic success criteria established for years one through three also met the success criteria established for years four and five. Gauge 51 made jurisdictional hydrology for 100% of the growing season which exceeded the hydrologic success criteria established for the Bayboro soil series. Gauges 51, 103, 113, and 312 have missing data due to gauge malfunction.

Gauge 51 has recorded data for a minimum of 108 consecutive days (44.6%) and one data gap. Using nearby Gauges 113 and 266 to extrapolate the missing data, it can be assumed that Gauge 51 would have made jurisdictional hydrology for 100% of the growing season.

Gauge 103 has recorded data for a minimum of 208 consecutive days (85.9%) and one data gap. Using nearby Gauges 56 and 117 to extrapolate the missing data, it can be assumed that Gauge 103 would have made jurisdictional hydrology for 100% of the growing season.

Gauge 113 has recorded data for a minimum of 107 consecutive days (44.2%) and two data gaps. Using nearby Gauge 266 to extrapolate the missing data, it can be assumed that Gauge 113 would have made jurisdictional hydrology for 52.1% of the growing season.

Gauge 312 has recorded data for a minimum of 96 consecutive days (39.7%) and two data gaps. Using nearby Gauges 311 and 313 to extrapolate the missing data, it can be assumed that Gauge 312 would have made jurisdictional hydrology for 45.5% of the growing season.

March-June (Initial draw down)

The majority of the gauges in MU 8 showed that groundwater levels dropped below 12 inches below the ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). However, all of the gauges in MU 8 met the hydrologic success criteria established for years one through three also met the success criteria established for years four and five during the initial draw down period (pre-hurricane events).

Table 13. Hydrologic Monitoring Results – MU 9

Gauge	Soil Series and Mitigation Type[a]	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥12.5% of Growing Season; ≤ 50% of Reference Range)					
41	Ba/NE	45.5	√	√	√[c]
301	Ba/NR	45.5[b]	√	√	√[c]
303	Ba/NR	45.5[b]	√	√	√[c]
313	Ba/NE	45.5[b]	√	√	√[c]
Non-riverine, Organic (Success = Saturation/inundation ≥ 25% of Growing Season; ≤ 50% of Reference Range)					
42	CT/NE	45.5	√	√	√[c]
43	CT/NE	45.5	√	√	√[c]
305	CT/NR	45.5	√	√	√[c]
306	CT/NE	45.5	√	√	√[c]

[a] Soils: Ba – Bayboro and CT - Croatan.
Mitigation Types: Non-riverine Restoration – NR and Non-riverine Enhancement – NE.
[b] Actual %: Missing data extrapolated from comparable gauges.
[c] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table 13 MU 9 Discussion

March-November

All eight of the monitoring gauges in MU 9 met both of their expected hydrologic success criteria for Year 2. All eight of the monitoring gauges met the hydrologic success criteria established for years one through three and met the success criteria established for years four and five. Gauges 301, 303, and 313 have missing data due to gauge malfunction.

Gauge 301 has recorded data for a minimum of 96 consecutive days (39.7%) and two data gaps. Using nearby Gauges 299 and 300 to extrapolate the missing data, it can be assumed that Gauge 301 would have made jurisdictional hydrology for 45.5% of the growing season.

Gauge 303 has recorded data for a minimum of 81 consecutive days (33.5%) and one data gap. Using nearby Gauges 41 and 302 to extrapolate the missing data, it can be assumed that Gauge 303 would have made jurisdictional hydrology for 45.5% of the growing season.

Gauge 313 has recorded data for a minimum of 92 consecutive days (38.0%) and one data gap. Using nearby Gauges 311 and 312 to extrapolate the missing data, it can be assumed that Gauge 313 would have made jurisdictional hydrology for 45.5% of the growing season.

March-June (Initial draw down)
The gauges in MU 9 showed that groundwater levels dropped below 12 inches below the ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). However, all of the gauges in MU 9 met the hydrologic success criteria established for years one through three also met the success criteria established for years four and five during the initial draw down period (pre-hurricane events).

Table 14. Hydrologic Monitoring Results – MU 10A

Gauge	Soil Series and Mitigation Type[a]	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥12.5% of Growing Season; ≤ 50% of Reference Range)					
60	Ba/NR	100 [b]	√	√ [c]	√ [d]
118	Ba/NR	46.7	√	√	√ [d]
298	Ba/NR	100	√	√ [c]	√ [d]
299	Ba/NR	100 [b]	√	√ [c]	√ [d]
300	Ba/NR	100	√	√ [c]	√ [d]
302	Ba/NR	100	√	√ [c]	√ [d]
Non-riverine, Organic (Success = Saturation/inundation ≥ 25% of Growing Season; ≤ 50% of Reference Range)					
45	CT/NR	100	√	√	√ [d]
46	CT/NR	45.0	√	√	√ [d]
61	CT/NR	45.5	√	√	√ [d]
119	CT/NR	45.0	√	√	√ [d]
120	CT/NR	45.5	√	√	√ [d]
296	CT/NR	46.7[b]	√	√	√ [d]
304	CT/NR	45.0	√	√	√ [d]
308	CT/NR	100	√	√	√ [d]

[a] Soils:, Ba – Bayboro and CT – Croatan.
Mitigation Types: Non-riverine Restoration – NR.
[b] Actual %: Missing data extrapolated from comparable gauges.
[c] Gauge exceeded Hydrologic Success Criterion 2.
[d] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table 14 MU 10A Discussion

March-November

All fourteen monitoring gauges in MU 10A met both of their expected hydrologic success criteria for Year 2. All fourteen of the monitoring gauges met the hydrologic success criteria established for years one through three and met the success criteria established for years four and five. Gauges 60, 298, 299, 300,and 302 made jurisdictional hydrology for 100% of the growing season which exceeded the hydrologic success criteria established for the Bayboro soil series. Gauges 60, 296, and 299 have missing data due to gauge malfunction.

Gauge 60 has recorded data for a minimum of 216 consecutive days (89.3%) and one data gap. Using nearby Gauges 298 and 299 to extrapolate the missing data, it can be assumed that Gauge 60 would have made jurisdictional hydrology for 100% of the growing season.

Gauge 296 has recorded data for a minimum of 111 consecutive days (45.9%) and one data gap. Using nearby Gauge 297 to extrapolate the missing data, it can be assumed that Gauge 296 would have made jurisdictional hydrology for 46.7% of the growing season.

Gauge 299 has recorded data for a minimum of 136 consecutive days (56.2%) and one data gap. Using nearby Gauge 298 to extrapolate the missing data, it can be assumed that Gauge 299 would have made jurisdictional hydrology for 100% of the growing season.

March-June (Initial draw down)

Gauges 46, 61, 118, 119, 120, 296, and 304 showed that groundwater levels dropped below 12 inches below the ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). However, all of the gauges in MU 10A met the hydrologic success criteria established for years one through three as well as the success criteria established for years four and five during the initial draw down period (pre-hurricane events).

Table 15. Hydrologic Monitoring Results – MU 10B

Gauge	Soil Series and Mitigation Type[a]	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥12.5% of Growing Season; ≤ 50% of Reference Range)					
49	Ba/NR	46.3	√	√	√[d]
50	Ba/NR	50.0	√	√	√[d]
65	Pa/NE	45.5	√	√	√[d]
66	Ra/NE	45.5	√	√	√[d]
67	Pa/NR	45.5	√	√	√[d]
69	Ba/NR	45.0	√	√	√[d]
70	Ba/NE	45.5	√	√	√[d]
122	Pa/NR	43.0	√	√	√[d]
124	Pa/NR	31.0	√	√	√[d]
271	Ba/NR	100	√	√[c]	√[d]
272	Ba/NR	100	√	√[c]	√[d]
273	Ba/NR	45.5	√	√	√[d]
274	Ba/NR	45.5[b]	√	√	√[d]
277	Ra/NR	30.2	√	√	√[d]
Non-riverine, Organic (Success = Saturation/inundation ≥ 25% of Growing Season; ≤ 50% of Reference Range)					
48	CT/NR	50.4	√	√	√[d]
123	CT/NE	45.0	√	√	√[d]
310	CT/NR	46.3	√	√	√[d]

[a] Soils:, Ba – Bayboro, CT – Croatan, Ra – Rains, and Pa - Pantego.
Mitigation Types: Non-riverine Restoration – NR and Non-riverine Enhancement – NE.
[b] Actual %: Missing data extrapolated from comparable gauges.
[c] Gauge exceeded Hydrologic Success Criterion 2.
[d] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table15 MU 10B Discussion

March-November

All seventeen monitoring gauges in MU 10B met both of their expected hydrologic success criteria for Year 2. In addition, all seventeen of the monitoring gauges met the hydrologic success criteria established for years one through three and met the success criteria established for years four and five. Gauges 271 and 272 made jurisdictional hydrology for 100% of the growing season which exceeded the hydrologic success criteria established for the Bayboro soil series. Gauge 274 has missing data due to gauge malfunction.

Gauge 274 has recorded data for a minimum of 95 consecutive days (39.3%) and one data gap. Using nearby Gauge 273 to extrapolate the missing data, it can be assumed that Gauge 274 would have made jurisdictional hydrology for 45.5% of the growing season.

March-June (Initial draw down)

The majority of the gauges in MU 10B showed that groundwater levels dropped below 12 inches below the ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). However, only Gauge 277 did not meet the hydrologic success criteria established for years one through three and did not meet the success criteria established for years four and five during the initial draw down period (pre-hurricane events).

Table 16. Hydrologic Monitoring Results – MU 10C

Gauge	Soil Series and Mitigation Type[a]	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥12.5% of Growing Season; ≤ 50% of Reference Range)					
62	Ra/NR	23.1	√	√	√
63	Pa/NR	45.5	√	√	√[c]
64	Ra/NR	45.5	√	√	√[c]
121	Pa/NR	45.5	√	√	√[c]
143	Pa/NR	45.0	√	√	√[c]
282	Pa/NR	45.0	√	√	√[c]
283	Pa/NR	45.0	√	√	√[c]
286	Ra/NR	6.2	–	–	–
287	Ra/NR	6.2	–	–	–
289	Pa/NR	37.6	√	√	√[c]
290	Pa/NR	45.5	√	√	√[c]
291	Pa/NR	24.8	√	√	√
Non-riverine, Organic (Success = Saturation/inundation ≥ 25% of Growing Season; ≤ 50% of Reference Range)					
284	CT/NR	45.5	√	√	√[c]
285	CT/NR	47.5[b]	√	√	√[c]
293	CT/NR	50	√	√	√[c]
294	CT/NR	100	√	√	√[c]

[a] Soils:, Pa - Pantego, CT – Croatan, and Ra – Rains.
Mitigation Types: Non-riverine Restoration – NR.
[b] Actual %: Missing data extrapolated from comparable gauges.
[c] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table 16 MU 10C Discussion

March-November

Fourteen of the sixteen monitoring gauges in MU 10C met both of their expected hydrologic success criteria for Year 2. Twelve of the fourteen monitoring gauges that met the hydrologic success criteria established for years one through three also met the success criteria established for years four and five. Gauge 285 has missing data due to gauge malfunction.

Gauge 285 has recorded data for a minimum of 113 consecutive days (46.7%) and one data gap. Using nearby Gauge 284 to extrapolate the missing data, it can be assumed that Gauge 285 would have made jurisdictional hydrology for 47.5% of the growing season.

Gauges 286 and 287 did not meet either of their expected hydrologic success criteria. These gauges are located on either side of the ditch adjacent to the removed roadbed. Point-plugs instead of reach plugs were used to fill this ditch. The point plugs do not appear to be successful at returning jurisdictional hydrology within the zone of influence off the western side of the former ditch.

March-June (Initial draw down)

The majority of the gauges in MU 10C showed that groundwater levels dropped below 12 inches below the ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). Gauges 62, 286, and 287 did not meet the hydrologic success criteria for years one through three and did not meet the success criteria established for years four and five during the initial draw down period (pre-hurricane events). However, during the initial draw down, Gauge 62 met jurisdictional hydrology for 18.2% of the growing season. Gauges 286 and 287 met jurisdictional hydrology for < 5.0% of the growing season and did not meet either expected hydrologic success criterion during the initial draw down.

Table 17. Hydrologic Monitoring Results – MU 11

Gauge	Soil Series and Mitigation Type[a]	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥12.5% of Growing Season; ≤ 50% of Reference Range)					
68	Ba/NR	45.5	√	√	√[c]
144	Pa/NR	24.8	√	√	√
145	Ba/NR	45.5[b]	√	√	√[c]
232	Ra/NR	45.0	√	√	√[c]
275	Ba/NR	52.1	√	√	√[c]
276	Ra/NR	30.2[b]	√	√	√[c]
Non-riverine, Organic (Success = Saturation/inundation ≥ 25% of Growing Season; ≤ 50% of Reference Range)					
278	CT/NE	100	√	√	√[c]
279	CT/NR	100	√	√	√[c]

[a] Soils: Pa – Pantego, Ba – Bayboro, Ra – Rains, and CT - Croatan.
Mitigation Types: Non-riverine Restoration – NR and Non-riverine Enhancement – NE.
[b] Actual %: Missing data extrapolated from comparable gauges.
[c] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table 17 MU 11 Discussion

March-November

All eight of the monitoring gauges in MU 11 met both of their expected hydrologic success criteria for Year 2. Seven of the eight monitoring gauges met the hydrologic success criteria established for years one through three and met the success criteria established for years four and five Gauge 144 did not meet the success criteria established for years four and five for the Pantego soil series. Gauges 145 and 276 have missing data due to gauge malfunction.

Gauge 145 has recorded data for a minimum of 81 consecutive days (33.5%) and one data gap. Using nearby Gauge 68 to extrapolate the missing data, it can be assumed that Gauge 145 would have made jurisdictional hydrology for 45.5% of the growing season.

Gauge 276 has recorded data for a minimum of 49 consecutive days (20.2%) and two data gaps. Using nearby Gauges 232 and 277 to extrapolate the missing data, it can be assumed that Gauge 276 would have made jurisdictional hydrology between 30.2 and 45.0% of the growing season, so the minimum 30.2% was used for data analysis.

March-June (Initial draw down)
The majority of the gauges in MU 11 showed that groundwater levels dropped below 12 inches below the ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). All eight gauges met the hydrologic success criteria established for years one through three. Only Gauge 144 did not meet the success criteria established for years four and five during the initial draw down period (pre-hurricane events). However, during the initial draw down, Gauge 144 met jurisdictional hydrology for 20.2% of the growing season and would be considered jurisdictional under normal rainfall conditions.

Table 18. Hydrologic Monitoring Results – MU 12A

Gauge	Soil Series and Mitigation Type[a]	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥12.5% of Growing Season; ≤ 50% of Reference Range)					
16	Pa/NE	45.5	√	√	√[b]
17	Pa/NP	45.0	√	√	√[b]
136	Mu/NE	35.5	√	√	√
137	Mu/NR	17.8	√	–	–
179	Pa/NR	47.5	√	√	√[b]
180	Ba/NE	31.4	√	√	√[b]
280	Pa/NE	50.0	√	√	√[b]
281	Ra/NE	45.0	√	√	√[b]
288	Ra/NR	36.0	√	√	√[b]

[a] Soils: Pa – Pantego, Mu – Murville, Ba – Bayboro, and Ra - Rains.
Mitigation Types: Non-riverine Restoration – NR, Non-riverine Enhancement – NE, and Non-riverine Preservation – NP.
[b] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table 18 MU 12A Discussion

March-November

Eight of the nine monitoring gauges in MU 12A met both of their expected hydrologic success criteria for Year 3. Seven monitoring gauges met the hydrologic success criteria established for years one through three and met the success criteria established for years four and five. Gauge 136 met the hydrologic success criteria established for years one through three, but did not meet the success criteria established for years four and five. Gauge 137 did not meet both of the hydrologic success criteria established for the Murville soil series for Year 3. These gauges exceeded Success Criterion 1 ($\geq$ 12.5% of the growing season) and would be considered jurisdictional.

Gauge 137 made jurisdictional hydrology for 17.8% of the growing season, and therefore met Success Criterion 1. However, this gauge did not meet Success Criterion 2 (50% of Reference Range) for the Murville soil series (22.7 - 100% of the growing season).

March-June (Initial draw down)

The gauges in MU 12A showed that groundwater levels dropped below 12 inches below the ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). During the initial draw down, Gauge 137 made jurisdictional hydrology for < 5.0% if the growing season and did not meet either of its hydrologic success criteria. The remaining eight gauges met the hydrologic success criteria established for years one through three. Seven monitoring gauges met the hydrologic success criteria established for years one through three and met the success criteria established for years four and five during the initial draw down period (pre-hurricane events). Gauge 135 met the hydrologic success criteria established for years one through three, but did not meet the success criteria for years four and five for the Murville soil series. Gauges 16, 179, 280, and 288 met the hydrologic success criteria established for years one through three and exceeded the success criteria established for years four and five.

Table 19. Hydrologic Monitoring Results – MU 12B

Gauge	Soil Series and Mitigation Type[a]	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥ 12.5% of Growing Season; ≤ 50% of Reference Range)					
9	Pa/NR	43.4	√	√	√[b]
10	Pa/NR	45.5	√	√	√[b]
18	Pa/NR	29.8	√	√	√[b]
36	Pa/NE	45.0	√	√	√[b]
37	Pa/NR	35.1	√	√	√[b]
38	Mu/NE	49.6	√	√	√[b]
134	Pa/NE	35.1	√	√	√[b]
135	Pa/NR	29.3	√	√	√[b]
182	Mu/NR	9.9	–	–	–
183	Mu/NR	17.8	√	–	–
188	Pa/NR	31.8	√	√	√[b]
197	Pa/NE	45.5	√	√	√[b]
Non-riverine, Organic (Success = Saturation/inundation ≥ 25% of Growing Season; ≤ 50% of Reference Range)					
157	CT/NR	50.0	√	√	√[b]

[a] Soils: Pa – Pantego, Mu – Murville, and CT – Croatan.
Mitigation Types: Non-riverine Restoration – NR and Non-riverine Enhancement – NE.
[b] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table 19 MU 12B Discussion

March-November

Eleven of the thirteen monitoring gauges in MU 12B met both of their expected hydrologic success criteria for Year 3. All eleven of the monitoring gauges that met the hydrologic success criteria established for years one through three also met the success criteria established for years four and four.

Gauge 182 did not meet either of its expected hydrologic success criteria. Gauge 183 made jurisdictional hydrology for 17.8% of the growing season, and therefore met Success Criterion 1. However, this gauge did not meet Success Criterion 2 (50% of Reference Range) for the Murville soil series (22.7 - 100% of the growing season).

March-June (Initial draw down)

The gauges in MU 12B showed that groundwater levels dropped below 12 inches below the ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). Nine of the gauges in MU 12B met the hydrologic success criteria established for years one through three and met the success criteria established for years four and five during the initial draw down period (pre-hurricane events). Gauges 18 and 135 met the hydrologic success criteria established for years one through three, but did not meet the success criteria established for years four and five. During the initial draw down, Gauges 182 and 183 made jurisdictional hydrology for < 5.0% of the growing season and did not meet either of its hydrologic success criteria.

Gauges 182 and 183 are located adjacent to the north-south ditch that maintains the main access road. Point-plugs instead of reach plugs were used to fill this ditch. The point plugs may be successful at returning jurisdictional hydrology to some areas within the zone of influence of the ditch and not in others. The ditch adjacent to 182 and 183 may still have a zone of influence extending a greater distance off the ditch than can be measured with existing gauges. Another gauge installed along the same transect may capture the zone of influence.

Table 20. Hydrologic Monitoring Results – MU 13A

Gauge	Soil Series and Mitigation Type[a]	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥ 12.5% of Growing Season; ≤ 50% of Reference Range)					
1	Ba/NR	100	√	√[c]	√[d]
15	Pa/NR	46.3	√	√	√[d]
20	Pa/NE	45.5	√	√	√[d]
142	Pa/NR	41.7	√	√	√[d]
174	Ba/NR	100	√	√[c]	√[d]
176	Ba/NR	100[b]	√	√[c]	√[d]
178	Mu/NR	45.5	√	√	√[d]
292	Pa/NE	45.0	√	√	√[d]
295	Pa/NR	100	√	√[c]	√[d]
Non-riverine, Organic (Success = Saturation/inundation ≥ 25% of Growing Season; ≤ 50% of Reference Range)					
14	CT/NE	100	√	√	√[d]
40	CT/NE	49.6	√	√	√[d]
125	CT/NR	54.1	√	√	√[d]
126	CT/NE	52.5	√	√	√[d]
127	CT/NE	50.0	√	√	√[d]
297	CT/NR	50.0	√	√	√[d]

[a] Soils: Ba – Bayboro, Pa – Pantego, Mu – Murville, and CT – Croatan.
Mitigation Types: Non-riverine Restoration – NR and Non-riverine Enhancement – NE.
[b] Actual %: Missing data extrapolated from comparable gauges.
[c] Gauge exceeded Hydrologic Success Criterion 2.
[d] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table 20 MU 13A Discussion

March-November

All fifteen monitoring gauges in MU 13A met both of their expected hydrologic success criteria for Year 3. All fifteen of the monitoring gauges that met the hydrologic success criteria established for years one through three also met the success criteria established for years four and five. Gauges 1, 174, 176, and 295 made jurisdictional hydrology for 100% of the growing season which exceeded the hydrologic success criteria established for their respective soil series. Gauge 176 has missing data due to gauge malfunction.

Gauge 176 has recorded data for a minimum of 158 consecutive days (65.3%) and two data gaps. Using Gauge 175 to extrapolate the missing data, it can be assumed that Gauge 176 would have made jurisdictional hydrology for 100% of the growing season.

March-June (Initial draw down)

The gauges in MU 13A showed that groundwater levels dropped below 12 inches below the ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). All fifteen of the monitoring gauges in MU 13A met the hydrologic success criteria established for years one through three and met the success criteria established for years four and five during the initial draw down period (pre-hurricane events). During the initial draw down period, Gauges 15, 20 and 295 not only met the hydrologic success criteria established for years one through three, but exceeded the success criteria established for years four and five.

Table 21. Hydrologic Monitoring Results – MU 13B

Gauge	Soil Series and Mitigation Type[a]	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥ 12.5% of Growing Season; ≤ 50% of Reference Range)					
3	Mu/NR	17.4	√	–	–
4	Mu/NR	25.2	√	√	√
24	Mu/NR	13.2	√	–	–
139	Ba/NE	52.5	√	√	√[d]
140	Pa/NE	53.7	√	√	√[d]
141	Pa/NE	36.8	√	√	√[d]
172	Ba/NR	45.5	√	√	√[d]
173	Ba/NE	100	√	√[c]	√[d]
194	Mu/NE	31.0	√	√	√[d]
198	Ln/NE	39.7	√	√[c]	√[d]

[a] Soils: Ba – Bayboro, Pa – Pantego, Mu – Murville, and Ln - Leon.
Mitigation Types: Non-riverine Restoration – NR and Non-riverine Enhancement – NE.
[b] Actual %: Missing data extrapolated from comparable gauges.
[c] Gauge exceeded Hydrologic Success Criterion 2.
[d] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table 21 MU 13B Discussion

March-November

Eight of the ten monitoring gauges in MU 13B met both of their expected hydrologic success criteria for Year 3. Gauges 139, 140, 141,172, 173, and 198 met the hydrologic success criteria established for years one through three and also met the success criteria established for years four and five. In addition, Gauges 173 and 198 made jurisdictional hydrology for 100% of the growing season which exceeds hydrologic success criteria for their respective soil series.

Gauges 3 and 24 made jurisdictional hydrology for at least 12.5% of the growing season, and therefore met Success Criterion 1. Neither of the gauges met Success Criterion 2 (50% of reference) for the Murville soil series (22.7 to 100% of the growing season).

March-June (Initial draw down)

The majority of the gauges in MU 13B showed that groundwater levels dropped below 12 inches below the ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). Five gauges met the hydrologic success criteria established for years one through three and met the success criteria established for years four and five during the initial draw down period (pre-hurricane events). During the initial draw down period, Gauges 140, 173, and 198 met the hydrologic success criteria established for years one through three, but exceeded the success criteria established for years four and five. During the initial draw down period, Gauges 3, 24, and 141 did not meet jurisdictional hydrology for at least 12.5% of the growing season.

Gauges 3, 24, and 141 did not meet either of their expected hydrologic success criteria during the initial draw down period (pre-hurricane events). Bracken fern dominates the area adjacent to these gauge sites which may be an indication that the topography may be a little higher than the surrounding landscape.

Table 22. Hydrologic Monitoring Results – MU 14

Gauge	Soil Series and Mitigation Type[a]	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥ 12.5% of Growing Season; ≤ 50% of Reference Range)					
12	Pa/NR	100[b]	√	√[c]	√[d]
13	Ba/NR	100	√	√[c]	√[d]
22	Pa/NR	100	√	√[c]	√[d]
23	Pa/NE	100	√	√[c]	√[d]
175	Ba/NR	52.5[b]	√	√	√[d]
177	Pa/NR	53.7	√	√	√[d]
186	Pa/NR	100	√	√[c]	√[d]
190	Pa/NR	100[b]	√	√[c]	√[d]

[a] Soils: Ba – Bayboro and Pa – Pantego.
Mitigation Types: Non-riverine Restoration – NR and Non-riverine Enhancement – NE.
[b] Actual %: Missing data extrapolated from comparable gauges.
[c] Gauge exceeded Hydrologic Success Criterion 2.
[d] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table 22 MU 14 Discussion
March-November

All eight monitoring gauges in MU 14 met both of their expected hydrologic success criteria for Year 3. Gauges 12, 13, 22, 23, 186 and 190 made jurisdictional hydrology for 100% of the growing season which exceeded the hydrologic success criteria established for their respective soil series. Most of the gauges had between 2 to 15 inches of surface water for the majority of the growing season. Gauges 12, 175 and 190 have missing data due to gauge malfunction.

Gauge 12 has recorded data for a minimum of 233 consecutive days (96.3%) and one data gap. Using nearby Gauge 177 to extrapolate the missing data, it can be assumed that Gauge 12 would have made jurisdictional hydrology for 100% of the growing season.

Gauge 175 has recorded data for a minimum of 110 consecutive days (45.5%) and multiple data gaps. Using nearby Gauge 174 to extrapolate the missing data, it can be assumed that Gauge 175 would have made jurisdictional hydrology for 52.5% of the growing season.

Gauge 190 has recorded data for a minimum of 145 consecutive days (59.9%) and one data gap. Using nearby Gauges 12 and 177 to extrapolate the missing data, it can be assumed that Gauge 190 would have made jurisdictional hydrology for 100% of the growing season.

March-June (Initial draw down)
The majority of the gauges in MU 14 showed that surface water levels began to drop near 12 inches below the ground surface in July and then rose again in August due to numerous hurricane events. All of the gauges met the hydrologic success criteria established for years one through three and Gauges 12, 22, 23, 177, 186, and 190 exceeded the success criteria established for years four and five during the initial draw down period (pre-hurricane events).

Table 23. Hydrologic Monitoring Results – MU 15

Gauge	Soil Series and Mitigation Type[a]	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥ 12.5% of Growing Season; ≤ 50% of Reference Range)					
11	Pa/NR	17.4	√	√	√
25	Pa/NR	43.4	√	√	√[c]
26	Mu/NR	43.0	√	√	√[c]
138	Pa/NR	45.5	√	√	√[c]
171	Ba/NR	43.0	√	√	√[c]
187	Ba/NR	54.1	√	√	√[c]
189	Pa/NR	45.5	√	√	√[c]
Non-riverine, Organic (Success = Saturation/inundation ≥ 25% of Growing Season; ≤ 50% of Reference Range)					
167	CT/NE	100[b]	√	√	√[c]
170	CT/NE	100	√	√	√[c]
185	CT/NR	52.1	√	√	√[c]

[a] Soils: Ba – Bayboro, CT – Croatan, Mu – Murville, and Pa – Pantego.
Mitigation Types: Non-riverine Restoration – NR and Non-riverine Enhancement – NE.
[b] Actual %: Missing data extrapolated from comparable gauges.
[c] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table 23 MU 15 Discussion

March-November

All ten of the monitoring gauges in MU 15 met both of their expected hydrologic success criteria for Year 3. Nine of the ten gauges met the hydrologic success criteria established for years one through three and met the success criteria established for years four and five. Only Gauge 11 met the hydrologic success criteria established for years one through three, but did not meet the success criteria established for years four and five. Gauge 167 has missing data due to gauge malfunction.

Gauge 167 has recorded data for a minimum of 129 consecutive days (53.3%) and two data gaps. Using nearby Gauges 165 and 170 to extrapolate the missing data, it can be assumed that Gauge 167 would have made jurisdictional hydrology for 100% of the growing season.

March-June (Initial draw down)

The majority of the gauges in MU 15 showed that groundwater levels dropped below 12 inches below the ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). Nine gauges met the hydrologic success criteria established for years one through three and eight of these met the success criteria established for years four and five during the initial draw down period (pre-hurricane events). During the initial draw down period, Gauge 138 met the hydrologic success criteria established for years one through three, but exceeded the success criteria established for years four and five. During the initial draw down period, Gauge 11 met jurisdictional hydrology for < 5.0% of the growing season.

Table 24. Hydrologic Monitoring Results – MU 16

Gauge	Soil Series and Mitigation Type[a]	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥ 12.5% of Growing Season; ≤ 50% of Reference Range)					
2	Mu/NE	45.5	√	√	√[c]
19	Pa/NE	100	√	√[c]	√[c]
130	Pa/NR	52.1	√	√	√[c]
131	Mu/NE	100	√	√	√[c]
169	Pa/NR	100	√	√[c]	√[c]
181	Mu/NR	37.2	√	√	√[c]
192	Mu/NR	43.0	√	√	√[c]
193	Mu/NR	45.5	√	√	√[c]
195	Ln/NR	18.2	√	√	√[c]
Non-riverine, Organic (Success = Saturation/inundation ≥ 25% of Growing Season; ≤ 50% of Reference Range)					
7	CT/NR	100	√	√	√[c]
8	CT/NR	100	√	√	√[c]
28	DA/NR	100	√	√	√[c]
31	CT/NR	100	√	√	√[c]
128	CT/NR	100	√	√	√[c]
129	CT/NR	100	√	√	√[c]
162	CT/NR	100	√	√	√[c]
164	CT/NR	100	√	√	√[c]
165	CT/NR	100	√	√	√[c]
166	DA/NR	100	√	√	√[c]
168	CT/NR	100	√	√	√[c]

[a] Soils: DA – Dare, CT – Croatan, Ln – Leon, Mu – Murville, and Pa – Pantego.
Mitigation Types: Non-riverine Restoration – NR and Non-riverine Enhancement – NE.
[b] Actual %: Missing data extrapolated from comparable gauges.
[c] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table 24 MU 16 Discussion

March-November

All twenty of the monitoring gauges in MU 16 met both of their expected hydrologic success criteria for Year 3. In addition, all of the monitoring gauges (except Gauge 195) met both hydrologic success criteria established for years one through three and the success criteria for years four and five. Gauges 19 and 169 made jurisdictional hydrology for 100% of the growing season which exceeded the hydrologic success criteria established for the Pantego soil series. Gauge 195 met the hydrologic success criteria established for years one through three, but did not meet the success criteria established for years four and five.

March-June (Initial draw down)

Gauges 2, 130, 181, 192, 193, and 195 showed that groundwater levels dropped below 12 inches below the ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). Nineteen gauges in MU 16 met the hydrologic success criteria established for years one through three and fifteen of these met the success criteria established for years four and five during the initial draw down period (pre-hurricane events). Of the fifteen gauges, Gauges 19, 130, and 169 met the hydrologic success criteria established for years one through three, but exceeded the success criteria established for years four and five. During the initial draw down period, Gauge 195 met jurisdictional hydrology for < 5.0% of the growing season.

Table 25. Hydrologic Monitoring Results – MU 17

Gauge	Soil Series and Mitigation Type[a]	Actual %	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥ 12.5% of Growing Season; ≤ 50% of Reference Range)					
32	Ba/NR	100	√	√[b]	√[c]
33	Ba/NR	45.5	√	√	√[c]
160	Ba/NR	53.7	√	√	√[c]
Non-riverine, Organic (Success = Saturation/inundation ≥ 25% of Growing Season; ≤ 50% of Reference Range)					
5	DA/NR	100	√	√	√[c]
6	DA/NE	100	√	√	√[c]
29	CT/NR	100	√	√	√[c]
30	DA/NR	100	√	√	√[c]
132	CT/NE	45.5	√	√	√[c]
161	CT/NR	100	√	√	√[c]
163	CT/NR	100	√	√	√[c]

[a] Soils: Ba – Bayboro, DA – Dare, and CT – Croatan.
Mitigation Types: Non-riverine Restoration – NR and Non-riverine Enhancement – NE.
[b] Gauge exceeded Hydrologic Success Criterion 2.
[c] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table 25 MU 17 Discussion

March-November

All ten of the monitoring gauges in MU 17 met both of their expected hydrologic success criteria for Year 3. In addition, all ten gauges met the hydrologic success criteria established for years one through three and the success criteria established for years four and five. Gauge 32 made jurisdictional hydrology for 100% of the growing season which exceeded the hydrologic success criteria established for the Bayboro soil series. Gauge 196 was removed from monitoring due to safety concerns (alligator). Gauge 196 is in a semi-permanently ponded area.

March-June (Initial draw down)

The majority of the gauges in MU 17 showed that surface water levels began to drop in July and then rose again in August due to numerous hurricane events. All ten of the monitoring gauges met the hydrologic success criteria established for years one through three and met the success criteria established for years four and five during the initial draw down period (pre-hurricane events).

Table 26. Hydrologic Monitoring Results – MU 18

Gauge	Soil Series and Mitigation Type[a]	Actual %[b]	Criterion 1 Met (% of Growing Season)	Criterion 2 Met (% of Reference Range)	Hydrologic Success Met
Non-riverine, Mineral (Success = Saturation/inundation ≥ 12.5% of Growing Season; ≤ 50% of Reference Range)					
21	Pa/NE	54.1[b]	√	√	√[c]
34	Pa/NR	45.5	√	√	√[c]
184	Ln/NE	29.3	√	√	√[c]
191	Pa/NE	24.8	√	√	√
Non-riverine, Organic (Success = Saturation/inundation ≥ 25% of Growing Season; ≤ 50% of Reference Range)					
133	CT/NE	30.6	√	√	√
158	CT/NR	47.5	√	√	√[c]
159	CT/NR	45.5	√	√	√[c]

[a] Soils: CT – Croatan, Ln – Leon, and Pa – Pantego.
Mitigation Types: Non-riverine Restoration – NR and Non-riverine Enhancement – NE.
[b] Actual %: Missing data extrapolated from comparable gauges.
[c] Gauge meets or exceeds both Hydrologic Success Criteria for years four and five.

Table 26 MU 18 Discussion

March-November

All seven of the monitoring gauges in MU 18 met both of their expected hydrologic success criteria for Year 3. Five of the gauges that met the hydrologic success criteria established for years one through three also met the success criteria established for years four and five. Only Gauges 133 and 191 met the hydrologic success criteria established for years one through three, but did not meet the success criteria established for years four and five. Gauge 21 has missing data due to gauge malfunction.

Gauge 21 has recorded data for a minimum of 111 consecutive days (45.9%) and one data gap. Using nearby Gauge 34 to extrapolate the missing data, it can be assumed that Gauge 21 would have made jurisdictional hydrology for 54.1% of the growing season.

March-June (Initial draw down)

The gauges in MU 18 showed that groundwater levels dropped below 12 inches below the ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). All but Gauges 133 and 191 met the hydrologic

success criteria established for years one through three during the initial draw down period (pre-hurricane events). Gauges 34, 133, and 159 met the hydrologic success criteria established for years one through three and met the success criteria established for years four and five during the initial draw down period (pre-hurricane events). Gauge 21 met the hydrologic success criteria established for years one through three, but exceeded the success criteria established for years four and five. Gauge 184 exceeded hydrologic success criteria established for years one through three and exceeded the success criteria established for years four and five. During the initial draw down period, Gauge 191 did not meet jurisdictional hydrology for at least 12.5% of the growing season during the initial draw down. Gauge 133 did not meet jurisdictional hydrology for at least 25% of the growing season during the initial draw down.

2.3.2 Climatic Data

Figure 4 is a comparison of 2004 monthly rainfall to historical precipitation for the area. The two lines represent the 30th and 70th percentiles of monthly precipitation for Craven County, North Carolina. The bars are monthly rainfall totals for the 2004 growing season as well as the rainfall for November and December of 2003. The historical data were collected from the North Carolina State Climate Office rain gauge in Craven County, North Carolina. Three onsite rain gauges provided 2004 rainfall data.

Rain Gauge 4 malfunctioned throughout much of 2003 and the beginning of 2004. The data collected from Rain Gauge 4 in August and September 2004 is unreliable when compared to the data collected from the other on-site rain gauges during the hurricane events. Rain Gauge 4 was not used to determine normal rainfall, due to the malfunctions and unreliable data.

Overall, the rainfall for the 2004 growing season was normal (50.35 to 52.94 inches onsite compared to normal 49.98 to 57.89 inches). Rainfall between November 2003 and February 2004 varied from below normal to above normal, but trended towards the high side of normal overall (16.18 to 16.21 inches onsite compared to normal 10.19 to 18.37 inches). Rainfall from March through June 2004, the early part of the growing season and pre-hurricane events, trended towards the low side of normal (13.54 to 14.17 inches onsite compared to normal 12.07 to 20.27 inches). Rainfall from July through September, coinciding with the hurricanes, was substantially above normal (26.68 to 27.62 inches onsite compared to normal 12.96 to 22.18 inches). Rainfall from October through November trended towards the low side of normal (3.85 to 4.56 inches onsite compared to normal 3.61 to 7.49 inches).

2.4 Conclusions

The majority of the monitoring gauges showed that groundwater levels dropped below 12 inches below the ground surface at the end of May/beginning of June and then rose to within 12 inches of the ground surface in July/August due to numerous hurricane events. Therefore, the longest number of consecutive days reported for success criteria occurred in the later part of the growing season (post hurricane events). The critical defining hydroperiod occurs in late spring and early summer for many of the non-riverine minerals soils that occupy a large portion of the CWMB. To analyze the data during the initial draw down (pre-hurricane events) under normal rainfall conditions would be a better indication of how the CWMB is responding to mitigation measures. Therefore, ESI analyzed the data two ways: 1) the entire growing season [longest number of consecutive days < 12 inches below the surface (pre or post hurricane)] and 2) the early part of the growing season prior to the initial draw down [longest number of consecutive

days < 12 inches below the ground surface between March and June (pre-hurricane events)] (Appendix D).

Several of the monitoring gauges in the Bayboro and Pantego soil series exhibited hydroperiods that exceeded 50% above Reference Range (Success Criterion 2). These gauge sites were considered to have met Success Criterion 2 and considered to be hydrologically successful.

Entire Growing Season (March-November)

Hydrologic monitoring in 2004 showed 270 of 286 (94.4%) monitoring gauges in the CWMB met both respective hydrologic success criteria established for years one through three [≥ 12.5 % (mineral soils) or ≥ 25 % (organic/riverine soils) of the growing season and within 50% of Reference Range] (Figures 3a and 3b). Of the 16 gauges that did not meet both of its respective success criteria, nine made jurisdictional hydrology for ≥ 12.5% of the growing season, six made jurisdictional hydrology 5 – 12.5% of the growing season and only one (Gauge 75) did not make jurisdictional hydrology for at least 5% of the growing season.

Of the 204 monitoring gauges in non-riverine mineral soils, 191 met both hydrologic success criteria and six did not meet either hydrologic success criterion; the remaining seven gauges met Success Criterion 1 only. Of the 62 monitoring gauges in non-riverine organic soils, all 62 met both hydrologic success criteria. Of the 12 monitoring gauges in riverine organic soils, 10 met both hydrologic success criteria and the remaining two gauges met Success Criterion 1 only. Of the eight monitoring gauges in riverine mineral soils seven met both hydrologic success criteria and the remaining gauge did not meet either hydrologic success criterion.

Hydrologic monitoring in 2004 showed 97 of 102 (95.1%) monitoring gauges in Phase I met both respective hydrologic success criteria. Of the 71 monitoring gauges in non-riverine mineral soils, 66 met both hydrologic success criteria and one did not meet either hydrologic success criterion; the remaining four gauges met Success Criterion 1 only. All five of the monitoring gauges in Phase I that did not meet both hydrologic success criteria are in Murville soils. Gauges 3, 24, 137, and 183 made jurisdictional hydrology ≥ 12.5% of the growing season. Gauge 182 made jurisdictional hydrology for 9.9% of the growing season. All 31 of the monitoring gauges in Phase I in non-riverine organic soils met both hydrologic success criteria.

Hydrologic monitoring in 2004 showed 173 of 184 (94.0%) monitoring gauges in Phase II met both respective hydrologic success criteria. Of the 133 monitoring gauges in non-riverine mineral soils, 125 met both hydrologic success criteria and five did not meet either hydrologic success criterion; the remaining three gauges met Success Criterion 1 only. Of the 31 of the monitoring gauges in non-riverine organic soils, all 31 met both hydrologic success criteria. Of the 12 monitoring gauges in riverine organic soils, 10 met both hydrologic success criteria and the remaining two gauges met Success Criterion 1 only. Gauges 227 and 236 made jurisdictional hydrology for 38.8% and 47.1% of the growing season, but did not make within 50% of the Reference Range. Of the eight monitoring gauges in riverine mineral soils seven met both hydrologic success criteria and the remaining gauge did not meet either hydrologic success criterion.

Of the 16 monitoring gauges that did not meet both of their respective hydrologic success criteria, nine met Success Criterion 1 and the remaining seven did not meet either of their respective hydrologic success criteria. Nine of the monitoring gauges that did meet both of their respective hydrologic success criteria are located adjacent to ditches that remain partially open where point-plugs were used to fill the ditch. The remaining seven monitoring gauges appear to

be located on topographic highs compared to the surrounding landscape. In years with normal rainfall these areas may not be returned to jurisdictional hydrology. The non-jurisdictional areas around these monitoring gauges may need to be delineated and removed from mitigation credits if they are not returned to jurisdictional hydrology in years four and five.

Of the 286 monitoring gauges, 250 (87.4%) met both of their respective hydrologic success criteria established for years one through three and met the hydrologic success criteria established for years four and five [≥ 12.5 % (mineral soils) or ≥ 25 % (organic/riverine soils) of the growing season and within 20% of Reference Range] under normal rainfall conditions.

Initial Draw Down [March-June (pre-hurricane events)]
Of the 286 monitoring gauges, 262 (91.6%) met both of their respective hydrology success criteria established for years one through three [≥ 12.5 % (mineral soils) or ≥ 25 % (organic/riverine soils) of the growing season and within 50% of Reference Range], under normal rainfall conditions, during the initial draw down [March-June (pre-hurricane events)] (Figures 5a and 5b in Appendix C). Of the 24 gauges that did not meet both of its respective success criteria, two made jurisdictional hydrology for ≥ 12.5% of the growing season, seven made jurisdictional hydrology 5 – 12.5% of the growing season and 15 did not make jurisdictional hydrology for at least 5% of the growing season.

Of the 204 monitoring gauges in non-riverine mineral soils, 183 (89.7%) met both hydrologic success criteria and 18 did not meet either hydrologic success criterion; one gauge met Success Criterion 1 only, and two gauges met Success Criterion 2 only. Of the 62 monitoring gauges in non-riverine organic soils, 61 met both hydrologic success criteria and one (Gauge 133) did not meet Success Criterion 1 for organic soils (≥ 25% of the growing season). All 12 of the monitoring gauges in riverine organic soils met both hydrologic success criteria. Of the eight monitoring gauges in riverine mineral soils seven met both hydrologic success criteria and the remaining gauge did not meet either hydrologic success criterion.

Hydrologic monitoring in 2004 showed 93 of 102 (91.2%) monitoring gauges in Phase I met both their respective hydrologic success criteria. Of the 71 monitoring gauges in non-riverine mineral soils, 63 met both hydrologic success criteria and seven did not meet either hydrologic success criterion; the remaining one gauges met Success Criterion 1 only. Of the 31 monitoring gauges in non-riverine organic soils, 30 met both hydrologic success criteria and one (Gauge 133) did not meet Success Criterion 1 for organic soils (≥ 25% of the growing season). Gauge 133 made jurisdictional hydrology for 24.4% of the growing season.

Hydrologic monitoring in 2004 showed 169 of 184 (91.8%) monitoring gauges in Phase II met both their respective hydrologic success criteria. Of the 133 monitoring gauges in non-riverine mineral soils, 120 met both hydrologic success criteria and 11 did not meet either hydrologic success criterion; the remaining two gauges met Success Criterion 2 only. All 31 of the monitoring gauges in non-riverine organic soils met both hydrologic success criteria. All 12 of the monitoring gauges in riverine organic soils met both hydrologic success criteria. Of the eight monitoring gauges in riverine mineral soils six met both hydrologic success criteria, one gauge (Gauge 256) met Success Criterion 2 only and the remaining gauge (Gauge 102) did not meet either hydrologic success criterion.

Of the 24 monitoring gauges that did not meet both of their respective hydrologic success criteria, four met Success Criterion 2 (50% of Reference Range) and the remaining 20 did not meet either of their respective hydrologic success criteria. Sixteen of the monitoring gauges

that did meet both of their respective hydrologic success criteria are located adjacent to ditches that remain partially open where point plugs were used to fill the ditch. The remaining eight monitoring gauges appear to be located on topographic highs compared to the surrounding landscape. In years with normal rainfall these areas may not be returned to jurisdictional hydrology. The non-jurisdictional areas around these monitoring gauges may need to be delineated and removed from mitigation credits if they are not returned to jurisdictional hydrology in years four and five.

Of the 286 monitoring gauges, 243 (85.0%) met both of their respective hydrologic success criteria established for years one through three and met the hydrologic success criteria established for years four and five [≥ 12.5 % (mineral soils) or ≥ 25 % (organic/riverine soils) of the growing season and within 20% of Reference Range] under normal rainfall conditions, during the initial draw down [March-June (pre-hurricane events)].

Areas of Concern

Gauges 92, 93, 102, 149, 239, 75, 286, 287, 137, 182, 183, 3, and 24 did not meet both of their hydrologic success criteria during the initial draw down or the later part of the growing season (post hurricane events). Gauges 258, 259, 260, 247, 74, 76, 277, 11, 141, 195, 133, and 191 did not meet both of their hydrologic success criteria during the initial draw down under normal rainfall conditions, but did not meet overall hydrologic success criteria for 2004.

Gauges 92, 93, 286, 287, 137, 182, 183, 3, 277, 141, 195, and 191 occur adjacent to ditches that remain partially open where point plugs were used to fill the ditch. These gauges were placed in non-jurisdictional areas within the zone of influence of the ditch. The point plugs were successful at returning jurisdictional hydrology within the zone of influence off the former ditch during the later part of the growing season (post-hurricane events). However, jurisdictional hydrology (≥ 12.5% of the growing season) may not be restored within the zone of influence off the former ditch under normal rainfall conditions. These partially open ditches may still have a zone of influence extending a greater distance off the ditch than can be measured with existing gauges. Another gauge installed along the same transect may capture the zone of influence or measures should be taken to remove these non-jurisdictional areas around these monitoring gauges (may need to be delineated) from mitigation credits if they are not returned to jurisdictional hydrology in years four and five.

Gauges 102, 149, 239, 74, 75, 76, 24, 133, 11 appear to be located on topographic highs compared to the surrounding landscape. In years with normal rainfall these areas may not be returned to jurisdictional hydrology. The non-jurisdictional areas around these monitoring gauges may need to be delineated and removed from mitigation credits if they are not returned to jurisdictional hydrology in years four and five.

Gauges 227, 236, and 247 met both of their hydrologic success criteria during the initial draw down, but only met Success Criterion 1 for the later part of the growing season. Gauge 247 made jurisdictional hydrology for 18.2% of the growing season. Gauge 227 made jurisdictional hydrology for 38.8 of the growing season and Gauge 236 made jurisdictional hydrology for 47.1% of the growing season. Mitigative measures have been successful at returning jurisdictional hydrology to these areas, but may not be enough to return these gauge sites to within 50 or 20% of reference conditions due to their location in the landscape.

Of the 20 monitoring gauges in riverine areas, two (Gauges 102 and 227) did not show evidence of surface water throughout much of the growing season. These gauge sites may be

too high in the landscape to function as riverine influenced wetlands. However, additional areas in MU 6, 5, and 2B (for example Gauges 241, 240, 242, and 251) showed prolonged surface flooding and flowing water throughout much of the growing season. These areas are headwater wetlands that have a surface connection to the unnamed tributary to East Prong Brice Creek and should be re-evaluated for riverine function.

Rainfall

The high rate of hydrologic success criteria achievement during the 2004 growing season is attributed to the continued re-hydration of the site under the normal rainfall conditions in the spring of 2004 and the hurricane events in the summer and early fall of 2004. Overall, the rainfall for the 2004 growing season was normal (50.35 to 52.94 inches onsite compared to normal 49.98 to 57.89 inches). Rainfall between November 2003 and February 2004 varied from below normal to above normal, but trended towards the high side of normal overall (16.18 to 16.21 inches onsite compared to normal 10.19 to 18.37 inches). Rainfall from March through June 2004, the early part of the growing season and pre-hurricane events, trended towards the low side of normal (13.54 to 14.17 inches onsite compared to normal 12.07 to 20.27 inches). Rainfall from July through September, coinciding with the hurricanes, was substantially above normal (26.68 to 27.62 inches onsite compared to normal 12.96 to 22.18 inches). Rainfall from October through November trended towards the low side of normal (3.85 to 4.56 inches onsite compared to normal 3.61 to 7.49 inches). Phase I and II have shown trends towards re-hydration compared to baseline conditions (1998-2000 data). Assuming normal rainfall conditions, this trend is expected to continue into the 2005 growing season as the surficial aquifer continues to recharge.

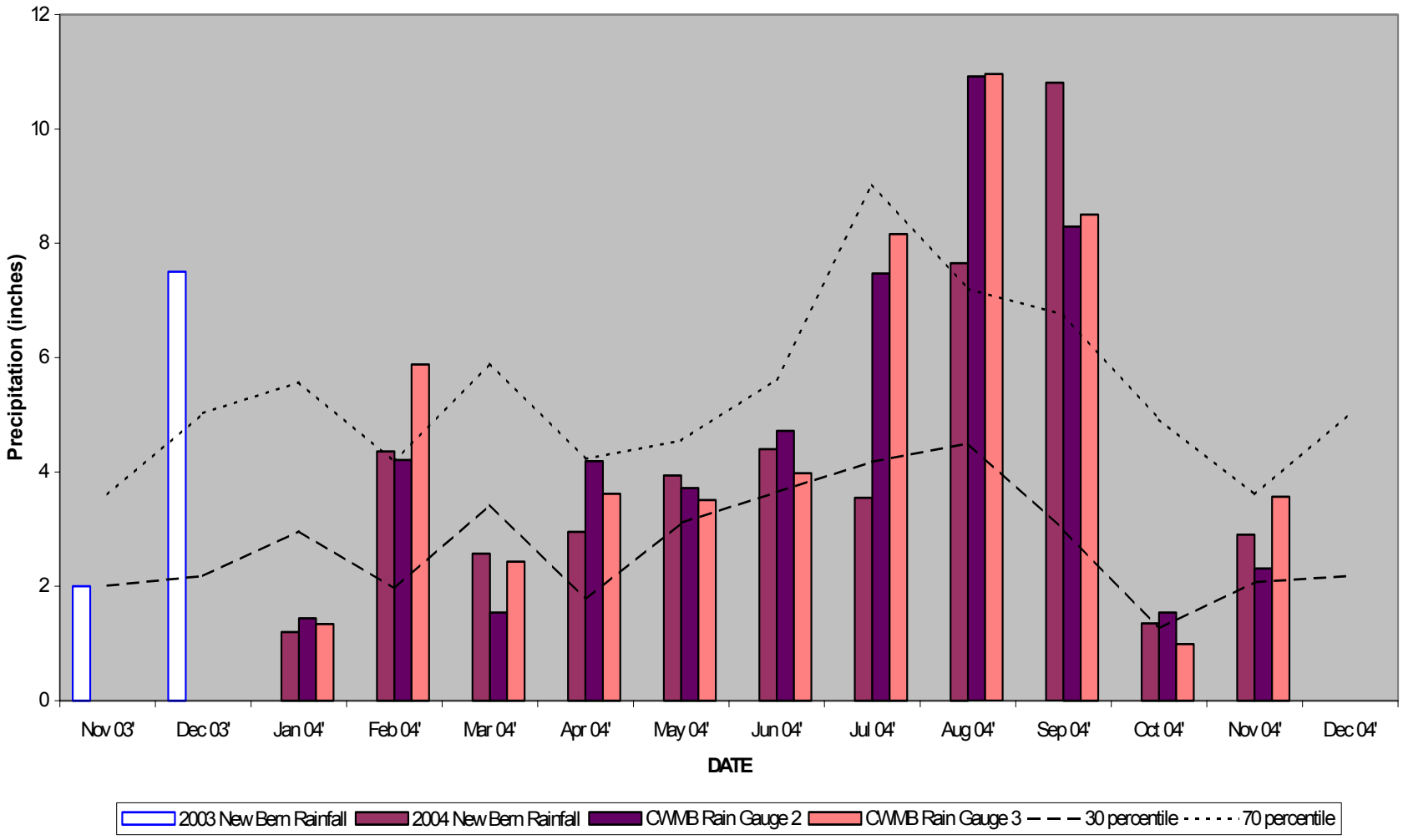
Recommendations

It is recommended that monitoring of Phase I and II continue into 2005. ESI documented that many of the gauges along transects 258-260 (MU 3/4A), 286-287 (MU 10C), 181-183 (MUs 12B /16), and 188-191 (MU 12B/18) did not meet both of their expected hydrologic success criteria. Additional gauges may need to be installed along these transects in order to capture the zone of influence that may remain adjacent to the open areas of the ditch. ESI also recommends that additional areas in MU 6, 5, and 2B (for example Gauges 241, 240, 242, and 251) be re-evaluated for riverine function. These areas showed prolonged surface flooding and flowing water throughout much of the growing season and may be considered riverine wetland due to the surface connection with the unnamed tributary to East Prong Brice Creek.

Due to the high rate of hydrologic success under normal rainfall conditions, ESI would suggest that selected interior gauges that are meeting success criteria for years four and five be removed from monitoring. Gauges sites adjacent to roads, point plugged ditches, areas where riverine credit may be gained, areas that are not meeting the success criteria established for years four and five and representative areas across the CWMB continued to be monitored through years four and five.

It is recommended that Rain Gauge 4 be replaced due to repeated malfunction and unreliable data collected during late 2003 through 2004. For 2005 and subsequent years, It is recommended that additional follow-up trips be scheduled after routine gauge downloads to check gauges that malfunction, particularly reference gauges, and take appropriate measures to avoid extended and frequent data gaps, especially for Ecotone gauges. Ecotone gauges tended to have frequent gauge malfunctions, including dead batteries, chewed external wires, and broken battery connections.

Figure 4. Croatan WMB 30-70 Percentile Graph



3.0 VEGETATION: CROATAN MITIGATION SITE

3.1 Success Criteria

Success Criteria state that there must be a minimum of 320 trees per acre surviving for three consecutive 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).

3.2 Description of Species

The listing below provides a listing of tree species that were planted in each mitigation area. Specific information regarding tree counts in each plot is provided in Tables 27 and 28 associated with Section 3.3. Other observations concerning each zone are presented in Section 3.4.

<u>Phase I</u>

Zone 1: Wet Pine Flat (63.2 acres)
Pinus taeda, Loblolly Pine
Pinus palustris, Longleaf Pine
Pinus serotina, Pond Pine

Zone 2: Pond Pine Woodland (89.3 acres)
Pinus taeda, Loblolly Pine
Pinus serotina, Pond Pine

Zone 3: Non-Riverine Wet Hardwood (60.6 acres)
Quercus falcata var. *pagodifolia*, Cherrybark Oak
Quercus laurifolia, Laurel Oak
Quercus lyrata, Overcup Oak
Nyssa aquatica, Water Tupelo
Quercus michauxii, Swamp Chestnut Oak
Quercus nigra, Water Oak
Quercus phellos, Willow Oak

Zone 4: Non-Riverine Swamp Forest (11.4 acres)
Taxodium distichum, Bald Cypress
Fraxinus pennsylvanica, Green Ash
Nyssa aquatica, Water Tupelo
Pinus serotina, Pond Pine
Chamaecyparis thyoides, Atlantic White Cedar

Phase II

Zone 1: Wet Pine Flat

Pinus taeda, Loblolly Pine
Pinus palustris, Longleaf Pine
Pinus serotina, Pond Pine

Zone 2: Mesic Pine Flat

Pinus palustris, Longleaf Pine

Zone 3: Non-Riverine Wet Hardwood Forest (Type A)

Quercus falcata var. *pagodifolia*, Cherrybark Oak
Quercus laurifolia, Laurel Oak
Quercus lyrata, Overcup Oak
Nyssa sylvatica var. *biflora,* Swamp Blackgum
Quercus nigra, Water Oak
Quercus phellos, Willow Oak

Zone 4: Non-Riverine Wet Hardwood Forest (Type B)

Quercus falcata var. *pagodifolia*, Cherrybark Oak
Quercus laurifolia, Laurel Oak
Quercus lyrata, Overcup Oak
Nyssa sylvatica var. *biflora,* Swamp Blackgum
Quercus nigra, Water Oak
Quercus phellos, Willow Oak
Pinus serotina, Pond Pine

Zone 5: Coastal Plain Small Stream Swamp

Nyssa sylvatica var. *biflora,* Swamp Blackgum
Pinus serotina, Pond Pine
Quercus laurifolia, Laurel Oak
Taxodium distichum, Bald Cypress
Fraxinus pennsylvanica, Green Ash

3.3 Results of Vegetation Monitoring

Vegetation monitoring was conducted in 2004 by Mulkey Engineering, Inc.

Table 27. Phase I Vegetation Monitoring Statistics 2004, by Plot

Table 1. Phase I Vegetation Monitoring Statistics 2004, by Plot

	Plot No.	Cherrybark Oak	Laurel Oak	Overcup Oak	Water Tupelo	Swamp Chestnut Oak	Water Oak	Willow Oak	Oak sp. (no leaves)	Pond Pine	Longleaf Pine	Baldcypress	Green Ash	Pond/Loblolly Pine	Atlantic White Cedar	Total 2004 (Year 3)	Total 2003 (Year 2)	Total 2002 (Year 1)	Total (at planting)	Current Density (Trees/Acre)
Zone 1	6													26		26	26	29	36	491
	8										7			33		40	40	42	42	647
	10													27		27	28	28	30	612
	12													22		22	22	30	31	483
	14													14		14	15	16	28	340
	19													32		32	35	35	35	622
	20													27		27	28	30	33	556
	25													15		15	40	40	44	232
Zone 2	3													16		16	17	17	24	453
	4													8		8	7	10	22	247
	5													6		6	6	7	12	340
	7													15		15	15	18	21	483
	9													24		23	24	27	36	434
	11													14		13	14	14	30	295
	13													30		30	30	32	40	510
	15													23		23	23	21	23	680
	18													31		30	31	31	32	638
Zone 3	16	2		9		1	3	9								24	26	26	30	544
	17	3		3		3	3									12	11	13	16	510
	21			3		4										7	7	8	27	176
	22			11	1		1	10								19	23	28	30	431
	23	4		14		19	1	5	2							44	55	74	76	394
	24					1	1	1						1		4	8	11	40	68
Zone 4	1											1				1	4	25	40	17
	2									2		3	1			6	7	23	37	110
														Total Average Density						**413**

Notes: The counts for pond pine and loblolly pine have been combined due to the difficulty in differentiating between the two species at such an early age. Longleaf pine was only planted in the higher areas of Zone 1. Density calculations were completed by taking the number of trees

counted in 2004, dividing by the total number of trees planted in the plot, and multiplying by 680. Specific information regarding each zone is presented after the tables.

Table 28. Phase II Vegetation Monitoring Statistics 2004, by Plot

	Table 2. Phase II Vegetation Monitoring Statistics 2004, by Plot																		
	Plot No.	Cherrybark Oak	Laurel Oak	Overcup Oak	Water Tupelo	Swamp Chestnut Oak	Water Oak	Willow Oak	Oak sp. (no leaves)	Pond Pine	Longleaf Pine	Baldcypress	Green Ash	Pond/Loblolly Pine	Atlantic White Cedar	Total 2004 (Year 2)	Total 2003 (Year 1)	Total (at planting)	Current Density (Trees/Acre)
Zone 1	26													36		36	36	39	627
	34			1								1		11		13	18	39	227
	47										4			52		56	60	39	680
Zone 3	31	3			11			1						3		18	23	39	314
	33			3												3	4	39	52
	45			4	6									2		9	10	39	157
	46			5	9											14	18	39	244
Zone 4	27		1	4						4			9			18	22	39	314
	28	8		17				3		10			2			40	49	39	680
	29	5		4	2		1					2	4			18	25	39	314
	30	1		6	1		1	3		11			1			24	32	39	418
	35									10						10	18	39	174
	36	1	1	3	5					24			3			37	49	39	645
	37	1	1	1				2					1			6	6	39	105
	38		2		5					7			3			19	17	39	331
	39			1						1			2			4	11	39	70
	40				20											20	41	39	348
	41				2			1								3	6	39	52
	42															0	11	39	0
	43				6								2			8	9	39	139
	44		1	2	5					7						15	19	39	261
Zone 5	32				6					17		22	2			47	48	39	680
	48			29						12	17					58	59	39	680
													Total Average Density						327

Notes: The counts for pond pine and loblolly pine have been combined due to the difficulty in differentiating between the two species at such an early age. Longleaf pine was only planted in the higher areas of Zone 1. Density calculations were completed by taking the number of trees counted in 2004, dividing by the total number of trees planted in the plot, and multiplying by 680. Specific information regarding each zone is presented after the tables. No "at-planting counts" were conducted for Phase II since no consultants were under contract during that period. Therefore, it is assumed that 39 total stems were planted in each plot. Any counts above 39 stems are represented by a maximum density of 680 trees per acre.

3.4 Plot Descriptions

The Phase I assessment included third year vegetation surveys associated with the existing 25 total plots. Standing water was commonly observed scattered within and immediately outside the areas of nearly all of the plots. Water levels averaging one to three feet deep were noted in Plot Nos. 1, 2, 24, and 25. Commonly observed species in addition to the planted species were sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), wax myrtle (*Myrica cerifera*), American holly (*Ilex opaca*), redbay (*Persea borbonia*), titi (*Cyrilla racemiflora*), winged sumac (*Rhus copallina*), Johnson grass (*Sorghum halepense*), bracken fern (*Pteridium aquilinum*), dog fennel (*Eupatorium* sp.), greenbrier (*Smilax* sp.), and blackberry (*Rubus* sp.). Other site specific species included: volunteer pines (*Pinus taeda* and *P. serotina*), giant cane (*Arundinaria gigantea*), wiregrass (*Aristida* sp.), fetterbush (*Lyonia* sp.), meadow beauty (*Rhexia* sp.) and cinnamon fern (*Osmunda cinnamomea*) in Zone 1; volunteer pines, blueberry (*Vaccinium* sp.), sedge (*Carex* sp.), and grape (*Vitis* sp.) in Zone 2; volunteer oaks (*Quercus* spp.), aster (*Aster* sp.), and huckleberry (*Gaylussacia* sp.) in Zone 3; and plume grass (*Erianthus giganteus*) in Zone 4.

The Phase II assessment included second year vegetation surveys associated with 23 established plots covering four of five planted zones. Standing water was also commonly observed within the majority of these plots. Water levels exceeding one foot were noted in Plot Nos. 34, 36, 39, 41, 42, and 43. Commonly observed species in addition to the planted species were sweetgum, red maple, wax myrtle, American holly, redbay, titi, winged sumac, Johnson grass, bracken fern, dog fennel, greenbrier, velvet panic grass (*Dicanthelium scoparium*), and blackberry. Other site specific species included: volunteer pines, bulrush (*Scirpus* sp.), spike-rush (*Eleocharis* sp.), and sphagnum moss (*Sphagnum* sp.) in Zone 1; pepperbush (*Clethra alnifolia*), fetterbush, lambkill (*Kalmia angustifolia*), iris (*Iris* sp.) in Zone 3; rush (*Juncus* sp.), plume grass, sedge, ragweed (*Ambrosia artemisiifolia*), aster, bulrush, iris, horse nettle (*Solanum carolinense*), and smartweed (*Polygonum* sp.) in Zone 4; and, bulrush, bluestem (*Andropogon* sp.), pepperbush, iris, giant cane, and huckleberry in Zone 5.

3.5 Conclusions

Of the 4,035 acres on this site, approximately 224.5 acres involved tree planting for Phase I and 466.0 acres involved in tree planting for Phase II. There were 25 vegetation monitoring plots established throughout the Phase I planting areas, and 23 vegetation monitoring plots established throughout the Phase II planting areas. The 2004 vegetation monitoring of the Phase I portion of the site revealed an average tree density of 413 trees per acre while the vegetation monitoring of the Phase II portion of the site revealed an average tree density of 327 trees per acre. These averages are above the minimum success criteria of 320 trees per acre.

4.0 OVERALL CONCLUSIONS/RECOMMENDATIONS

Per the letter from 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.

Monitoring of Phase I hydrology and vegetation should continue in 2005 (Year 4) and Phase II hydrology and vegetation will continue in 2005 (Year 3). Monitoring may continue for a minimum of 5 years in each phase. However, due to the high rate of hydrologic success under normal rainfall conditions, it is recommended to the MBRT that selected interior gauges that are already meeting success criteria for years four and five be removed from monitoring. Gauges sites adjacent to roads, point plugged ditches, areas where riverine credit may be gained, areas that are not meeting the success criteria established for years four and five, and representative areas across the CWMB should continue to be monitored through years four and five.

It is recommended that Rain Gauge 4 be replaced due to repeated malfunction and unreliable data collected during late 2003 through 2004. For 2005 and subsequent years, it is recommended that additional follow-up trips be scheduled after routine gauge downloads to check gauges that malfunction, particularly reference gauges, and take appropriate measures to avoid extended and frequent data gaps, especially for Ecotone gauges. Ecotone gauges tended to have frequent gauge malfunctions, including dead batteries, chewed external wires, and broken battery connections.