

ANNUAL REPORT FOR 2006



Croatan Wetland Mitigation Bank Craven County, North Carolina

Prepared for:

**The Ecosystem Enhancement Program
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I. Background Data

A. Goals and Objectives

The Croatan Wetland Mitigation Bank (CWMB) was created to provide in-kind compensatory mitigation for unavoidable wetland impacts to several projects in the Neuse River Basin (Hydrologic Unit 03020204). The 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 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. Approximately 224.5 acres of low quality, secondary growth successional areas were cleared and replanted with woody species more representative of target communities including pond pine woodland, wet pine flats, non-riverine wet hardwood forest, and non-riverine swamp forest. Remaining forested areas in Phase I were not altered vegetatively due to the presence of reasonably intact community structure of desired forested communities.

In order to assist in the return of site hydrology to a more natural condition, sections of the existing road and ditch network were removed or modified. Ditches were either “point” plugged to stop longitudinal flow while limiting the volume of fill required, or “reach” plugged, which required significantly more fill ranging from hundreds to thousands of feet. Additional hydrological modifications included removal of roads and scarification of consolidated soils, installation of surface water conveyances at remaining road crossings, addition of surface water diversions in selected areas, and installation of subsurface aggregate drains.

Phase I mitigation construction activities were completed in February 2002 and monitoring initiated in March 2002 for the 2002 monitoring season. In 2006, hydrologic and vegetative monitoring were completed for the fifth year in Phase I. The following report summarizes the overall hydrologic and vegetative trends during the 5-year monitoring period, demonstrates mitigative success, and provides basis for the closeout of Phase I of the CWMB.

The Mitigation Banking Review Team (MBRT) approved the Mitigation Plan and Mitigation Banking Instrument prepared by the N. C. Department of Transportation and its consultant. The MBRT established specific goals for vegetative and hydrologic success.

Vegetation success criteria established by the MBRTstate:

- 1) that there must be a minimum of 320 trees per acre surviving for three consecutive years.
- 2) the required survival criterion will decrease by 10% per year after the third year of vegetation monitoring (i.e., for an expected 288 trees/acre for Year 4, and 260 trees/acre for Year 5), such that at the end of Year 5, there are at least 260 5-year old trees per acre.

Hydrologic success criteria established by the MBRT 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, the MBRT requested that a site visit be conducted to determine the viability of the site.

B. Summary

Overall, Phase I planting areas cumulatively exceed the minimum success criteria of 260 trees/acre for Year 5. Individual plots within Zones (Target Communities) may not meet minimum success criteria, but the overall average for Zones 1 (Wet Pine Flat), 2 (Pond Pine Woodland), and 3 (Non-Riverine Wet Hardwood Forest) exceed the 260 stems/acre requirement for Year 5. Zone 4, the Non-Riverine Swamp Forest Target Community, does not meet minimum success criteria.

All of the vegetative monitoring plots in Phase I should be removed and credits released. A contingency plan should be developed for the Non-Riverine Swamp Forest Target Community which is not meeting the minimum success criteria of 260 stems/acre at the end of the 5-year monitoring period, but which is dominated by hydrophytic vegetation and achieving hydrologic success criteria.

The majority of the monitoring gauges (78.4%) in Phase I of the CWMB met both respective hydrologic success criteria [$\geq 12.5\%$ (mineral soils) or $\geq 25\%$ (organic/riverine soils) of the growing season and within 20% of Reference Range] consistently throughout the five year monitoring period. Of the remaining gauges that did not meet both respective success criteria consistently, 14.7% made jurisdictional hydrology for $\geq 12.5\%$ of the growing season and should be evaluated for success credits, and only 6.9% (Gauges 3, 11, 24, 137, 182, 183, and 191) did not meet jurisdictional hydrology for $\geq 12.5\%$ of the growing season.

All of the gauges in Phase I should be removed and credits released based on the contingency plan developed for the areas that have not been successfully enhanced and/or restored.

Due to the high rate of hydrologic and vegetative success and completion of five years of monitoring, Phase I should be considered for success and closeout.

Overall, Phase I hydrologic modifications have resulted in restoration and/or enhancement as expected over most of the site, with 93.1% of the gauges documenting hydroperiods exceeding 12.5% of the growing season.

Figure 1. Site Location Map, Croatan Wetland Mitigation Bank

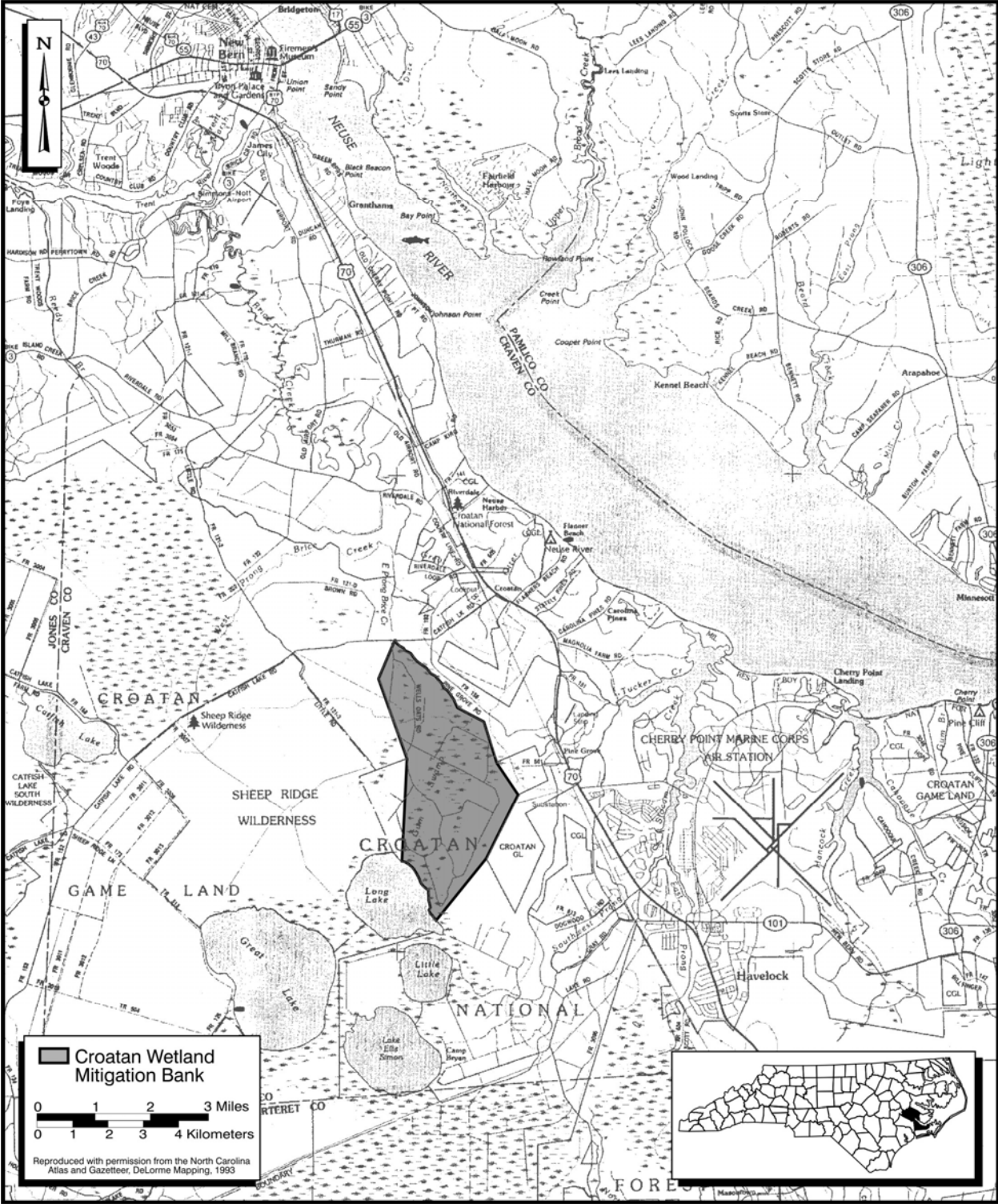
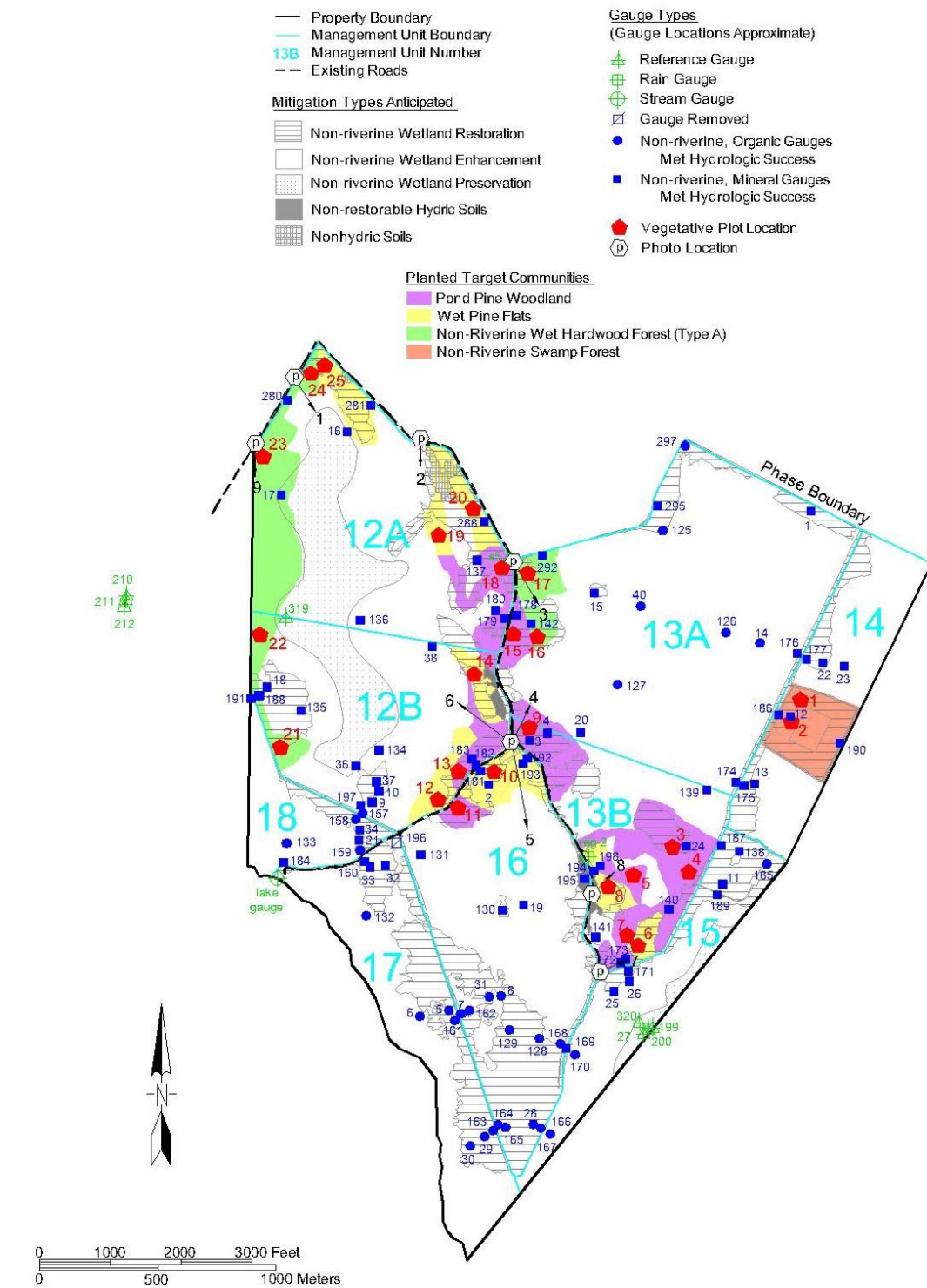
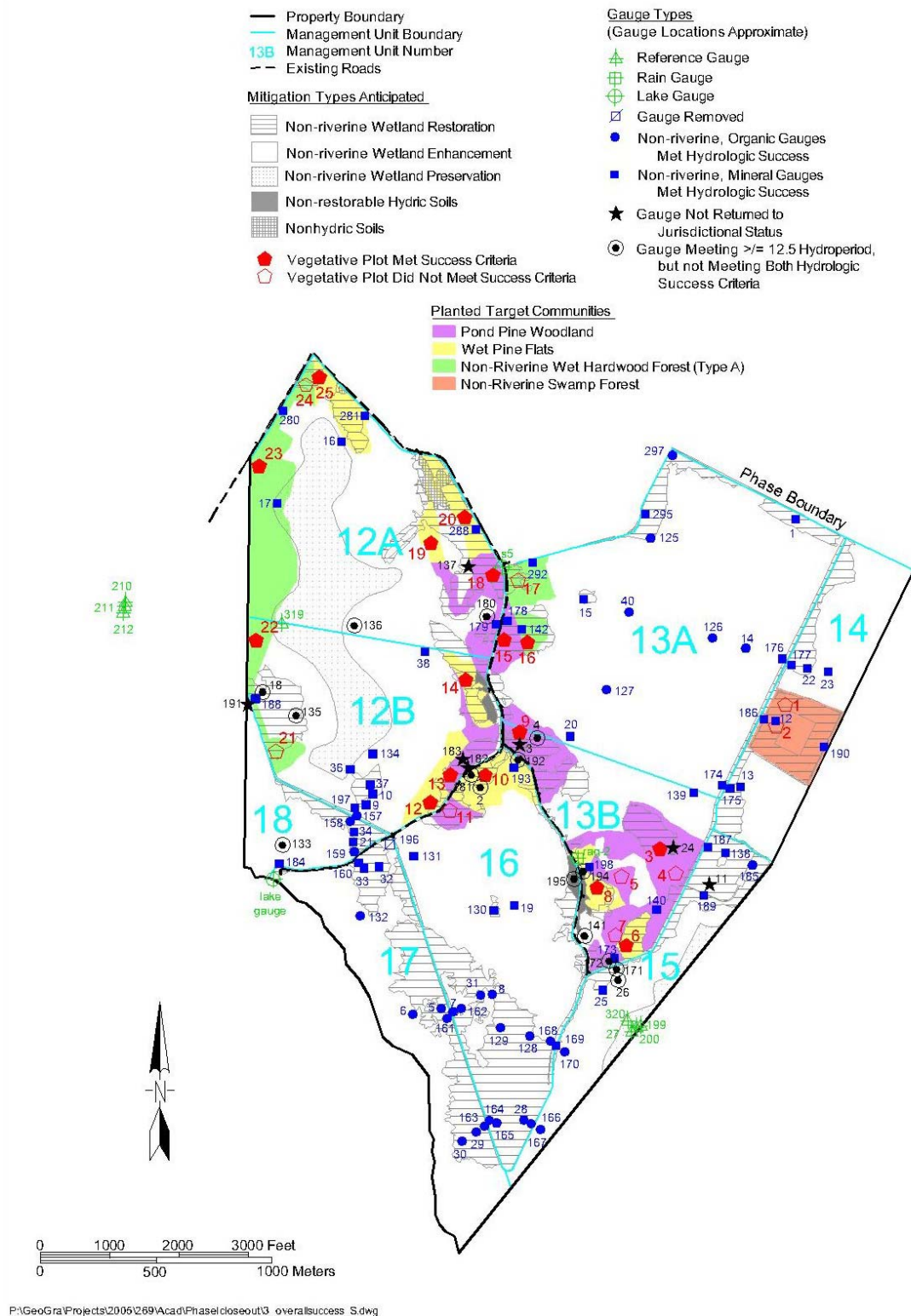


Figure 2. Hydrologic Monitoring Gauge and Vegetation Plots, Croatan WMB, Phase I



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Figure 3. Summary of 5 Years Monitoring, Croatan WMB, Phase I



II. Conclusions

A. Vegetation Summary

Table 1 depicts the monitoring results for the vegetation plots and overall Target Communities by Plot for each of the 5 years of monitoring. These results are shown in Appendix A along with photo pages that depict the changing vegetation patterns from years 2003 to 2006.

Sixteen plots (64.0%) in Phase I met the established success criteria for Year 5. Individual plots within Zones (Target Communities) may not meet minimum success criteria, but the overall average for Zones 1 (Wet Pine Flat), 2 (Pond Pine Woodland, and 3 (Non-Riverine Wet Hardwood Forest) exceed the 260 stems/acre requirement for Year 5. Zone 4, the Non-Riverine Swamp Forest Target Community, does not meet minimum success criteria. Zone 4 (Plots 1 and 2) comprises an area that was once used as an impoundment area for duck hunting which now may be too wet to support the minimum success criteria of 260 trees/acre.

The majority of the stem loss occurred between Years 1 and 2. The viability of remaining stems appears to have stabilized with only minimal loss between Years 2 through 5.

The Phase I assessment included vegetation surveys associated with 25 plots to identify naturally recruited herbaceous and woody vegetation. Detailed lists are provided in the 2005 and 2006 monitoring reports. Naturally recruited vegetation considered common in assessment plots consist of hydrophytic species.

Overall the Wet Pine Flat Target Community meets the average success criteria for Year 5 with an average density of 463 trees/acre, all plots met success criteria. Commonly observed species in the Wet Pine Flat Target Community, in addition to the planted species, included grey inkberry (*Ilex glabra*).

Overall the Pond Pine Woodland Target Community meets the average success criteria for Year 5 with an average density of 323 trees/acre, although plots 4, 5, 7, and 11 individually do not meet success criteria. Commonly observed species in Pond Pine Woodland Target Community, in addition to the planted species, included coastal bluestem (*Andropogon glaucopsis*), grey inkberry, shinyleaf (*Lyonia lucida*), and swamp bay (*Persea palustris*). Of those four plots not meeting success criteria, plot 5 was not originally planted dense enough to meet the success criteria.

Overall the Non-Riverine Wet Hardwood (Type A) Target Community meets the average success criteria for Year 5 with an average density of 337 trees/acre, plots 17, 21, and 24 do not meeting success criteria. Commonly observed species in the Non-Riverine Wet Hardwood (Type A) Target Community, in addition to the planted species, included sweetgum (*Liquidambar styraciflua*).

The Non-Riverine Swamp Forest Target Community with an average density of 79 trees/acre falls well below the success criteria of 260 trees/acre for Year 5, with neither plot 1 or 2 meeting success criteria. Commonly observed species in the Non-Riverine Swamp Forest Target Community, in addition to the planted species, included Canadian rush (*Juncus canadensis*), giant plume grass (*Saccharum giganteum*), lamp rush (*Juncus effusus*), cottongrass bulrush (*Scirpus cyperinus*), red maple (*Acer rubrum*), Virginia chain fern (*Woodwardia virginica*), and

Virginia Marsh St. John's-Wort (*Triadenum virginicum*). Plots 1 and 2 are located in an area that remains inundated year round and contains dense, emergent, hydrophytic vegetation. These two factors may be preventing the success of planted species.

Phase I exceeds the minimum success criteria of 260 trees/acre for Year 5 for planted areas and should be considered successful overall by the established vegetation success criterion. Individual plots within Zones (Target Communities) may not meet minimum success criteria, but the overall average for Zones 1 (Wet Pine Flat), 2 (Pond Pine Woodland), and 3 (Non-Riverine Wet Hardwood Forest) exceed the 260 stems/acre requirement for Year 5. Zone 4, the Non-Riverine Swamp Forest Target Community, does not meet minimum success criteria.

All of the vegetative monitoring plots in Phase I should be removed and credits released based on the contingency plan for the Non-Riverine Swamp Forest Target Community which is not meeting the minimum success criteria of 260 stems/acre at the end of the 5-year monitoring period, but which is dominated by hydrophytic herbaceous vegetation and meeting hydrologic success criteria.

B. Hydrology Summary

The majority of Phase I met both hydrologic success criteria, consistently throughout the 5-year monitoring period. The overall monitoring trends and results are discussed below for each MU in Phase I. In areas that did not meet both hydrologic success criteria consistently throughout the 5-year monitoring period, many should be evaluated for mitigation credits based on the increased critical hydroperiods, when compared to the available baseline (pre-construction) data (Appendix B).

Point plugs were used in areas where the roads were to remain open and where the groundwater flow was perpendicular to the ditch in order to compensate for the lack of available fill material. Groundwater models that were run to support the mitigation plan predicted that there would be a 3-meter zone of influence adjacent to point plugged ditches that would not be restored per hydrological success criteria. As predicted, monitoring showed there are areas adjacent to the point plugged ditches that were not returned to jurisdictional hydrology. The zone of influence appears to be wider than predicted in some areas and much less in other areas.

Hydrologic monitoring showed 80 of 102 (78.4%) monitoring gauges in the CWMB met both respective hydrologic success criteria [$\geq 12.5\%$ (mineral soils) or $\geq 25\%$ (organic/riverine soils) of the growing season and within 20% of Reference Range] consistently throughout the five year monitoring period (**Figure 3**). Of the 22 gauges that did not meet both respective success criteria consistently, 15 made jurisdictional hydrology for $\geq 12.5\%$ of the growing season, and only seven (Gauges 3, 11, 24, 137, 182, 183, and 191) did not meet jurisdictional hydrology for $\geq 12.5\%$ of the growing season.

Five of the seven gauges (Gauges 3, 11, 182, 183, and 191) that did not meet jurisdictional hydrology for $\geq 12.5\%$ of the growing season are located adjacent to point plugged ditches and as predicted these gauges were not returned to jurisdictional status. The zone of influence in these areas may be greater than 3 meters. Gauges along other transects confirmed the predicted zone of influence or indicated that the zone of influence is less than predicted. The remaining two gauges (Gauges 24 and 137) are located on topographic highs. These gauges should be reviewed to determine the extent of the non-jurisdictional areas around these gauges

sites and a contingency plan developed for addressing the areas that have not been successfully enhanced and/or restored.

MU 12A Discussion

Six of the nine monitoring gauges in MU 12A consistently met both expected hydrologic success criteria during the 5-year monitoring period. Gauge 136 met both success criteria in 2003 and 2004 (years 2 and 3), and was close to achieving success in 2006 (jurisdictional hydrology cumulatively greater than 98% of the growing season, interrupted by two minor, brief falls below 12 inches). Gauge 180 met both success criteria in 2003 through 2005 (years 2 through 4). Both gauges are in enhancement areas and should be compared against baseline data, which documents increased hydroperiods. Gauge 137 has failed to meet hydrologic success during any of the five years of monitoring.

The only area of concern in MU 12A is the area represented by Gauge 137. This gauge site should be reviewed to determine the extent of the non-jurisdictional area surrounding Gauge 137 and a contingency plan developed for the area that has not been returned to jurisdictional status.

MU 12B Discussion

Nine of the thirteen monitoring gauges in MU 12B consistently met both expected hydrologic success criteria during the 5-year monitoring period. The areas of concern in MU 12B are the areas where gauges (Gauges 18, 135, 182, and 183) are located adjacent to ditches that maintain the access roads. Point-plugs instead of reach-plugs were used to fill these ditches. Mitigative measures appear to be successful at returning jurisdictional hydrology to Gauges 18 and 135, which are in restoration areas, but were not successful at returning these gauge sites to within 20% of reference conditions under the normal rainfall conditions. Gauges 182 and 183 have failed to meet jurisdictional hydrology.

Gauges 182 and 183 should be reviewed to determine the extent of the non-jurisdictional area surrounding these gauge sites and a contingency plan developed for the areas that have not been returned to jurisdictional status. Credit should be evaluated for restoring jurisdictional status to the previously non-jurisdictional area around Gauges 18 and 135.

MU 13A Discussion

All fifteen monitoring gauges in MU 13A consistently met both expected hydrologic success criteria during the 5-year monitoring period.

MU 13B Discussion

Four of the ten monitoring gauges in MU 13B met both expected hydrologic success criteria during the 5-year monitoring period. Mitigative measures have been successful at restoring and enhancing jurisdictional hydrology to within 20% of the Reference Range for portions of MU 13B, which is a complex of sandy areas interspersed with sloughs. Mitigative measures appear to be successful at returning jurisdictional hydrology for four other gauges (Gauges 4, 141, 172, and 194), but have not successful at returning these gauge sites to within 20% of reference conditions under the normal rainfall conditions. Gauge 172 met both success criteria from 2002 through 2004 (years 1 through 3) and was close to achieving success in 2006 (jurisdictional hydrology cumulatively greater than 99% of the growing season, interrupted by two minor, brief falls to or below 12 inches). Gauge 172 should be considered for success. The areas of concern in MU 13B are the areas where gauges are located adjacent to ditches that maintain the access roads. Point-plugs instead of reach-plugs were used to fill these ditches. Gauges 3

and 24 should be reviewed to determine the extent of the non-jurisdictional area surrounding these gauge sites and the contingency plan for the areas that have not been returned to jurisdictional status.

Due to the completion of five years of monitoring, the gauges in MU 13B should be considered for removal following resolution of how to address the unsuccessfully restored areas. The lower end of the road spur remaining along the southwestern boundary of MU 13B may be evaluated for remedial actions to determine whether removal of roadbed or addition of drains may facilitate transport of surface or groundwater into the southern and eastern portions of MU 13B.

MU 14 Discussion

All eight monitoring gauges in MU 14 consistently met both expected hydrologic success criteria during the 5-year monitoring period.

MU 15 Discussion

Seven of the ten monitoring gauges in MU 15 consistently met both expected hydrologic success criteria during the 5-year monitoring period.

Mitigative measures have been successful at restoring and enhancing jurisdictional hydrology to within 20% of the Reference Range for the majority of MU 15. Areas of concern in MU 15 are the areas represented by Gauges 11, 26, and 171. These gauges are located adjacent to ditches that maintain the access roads. Point-plugs instead of reach-plugs were used to fill these ditches. Mitigative measures appear to be successful at returning jurisdictional hydrology to these gauge sites, but were not successful at returning this gauge site to within 20% of reference conditions under the normal rainfall conditions.

Gauges 26 and 171 met both success criteria from 2002 through 2004 (years 1 through 3) and were close to achieving success in 2006 (jurisdictional hydrology cumulatively greater than 98% of the growing season, both interrupted by two slight, brief drops below 12 inches). Gauges 26 and 171 should be considered for success. Gauge 11 did not achieve expected hydrologic success criteria, but did exhibit increased hydroperiods to 5-12.5% of the growing season from baseline conditions <5%.

Gauge 11 should be reviewed to determine the extent of the non-jurisdictional area surrounding this gauge site and a contingency plan developed for the area that has not been returned to jurisdictional status.

MU 16 Discussion

Sixteen of the twenty monitoring gauges in MU 16 consistently met both expected hydrologic success criteria during the 5-year monitoring period.

The areas of concern in MU 16 are the areas where gauges are located adjacent to ditches that maintain the access roads. Point-plugs instead of reach-plugs were used to fill these ditches. Mitigative measures appear to be successful at returning jurisdictional hydrology to Gauges 2, 181, 192, and 195 but were not successful at consistently returning these gauge sites to within 20% of reference conditions under the normal rainfall conditions.

Gauges 2 and 192 met both success criteria from 2002 through 2004 (years 1 through 3) and were close to achieving success in 2006 (jurisdictional hydrology cumulatively greater than 97% and 98%, respectively, interrupted by few minor, brief falls below 12 inches). Gauges 181 and

195 met both success criteria from 2003 through 2005 (years 2 through 4) and were close to achieving success in 2006. These gauges should be considered for success.

MU 17 Discussion

All ten monitoring gauges in MU 17 consistently met both expected hydrologic success criteria for during the 5-year monitoring period. Gauge 196 was removed from monitoring due to safety concerns (alligator). Gauge 196 was in a semi-permanently ponded area.

MU 18 Discussion

Five of the seven monitoring gauges in MU 18 consistently met both expected hydrologic success criteria during the 5-year monitoring period.

Mitigative measures have been successful at restoring jurisdictional and enhancing jurisdictional hydrology to within 20% of the Reference Range for the majority of MU 18. The area of concern in MU 18 is the area represented by Gauges 191 and 133, both located in enhancement areas. Gauge 191 is located near the final point plug on the property in a ditch that remains open on the adjacent Forest Service property. Point-plugs instead of reach-plugs were used to fill this ditch. When compared to baseline conditions, mitigative measures do not appear to be successful at enhancing the jurisdictional hydrology to the areas represented by Gauges 133 and 191. However, Gauge 133 met both success criteria in 2004 and 2005 (years 3 and 4) and Gauge 191 met both success criteria in year 2004 (year 3). Mitigative measures have been successful at enhancing the jurisdictional hydrology to the areas around Gauge 133, but not to within 20% of the Reference Range. Gauge 133 should be considered for success. The area around Gauge 191 should be reviewed and a contingency plan developed for the areas that have not been successfully enhanced.

Overall Summary

All of the gauges in Phase I should be removed and credits released based on the contingency plan developed for the areas that have not been successfully enhanced and/or restored.

Due to the high rate of hydrologic and vegetative success and completion of five years of monitoring, Phase I should be considered for success and closeout.

C. Photographs

Photo points are identified on Figure 4. Photographs taken 2003-2006 at the nine photo points are presented in the following photo pages. Aerial photos of the CWMB are provided for 1998 (pre-construction) and 2003 (post-construction).

Phase I



Figure 4. CWMB Photostation 1, facing southeast.



Figure 5. CWMB Photostation 2, facing south.



Figure 6. CWMB Photostation 3, facing south-southeast.



Figure 7. CWMB Photostation 4, facing north-northeast.



Figure 8. CWMB Photostation 5, facing south.



Figure 9. CWMB Photostation 6, facing northwest.



Figure 10. CWMB Photostation 7, facing east-northeast.



Figure 11. CWMB Photostation 8, facing northeast.

Phase II



Figure 12. CWMB Photostation 9, facing south.



Figure 13. CWMB Photostation 10, facing east.

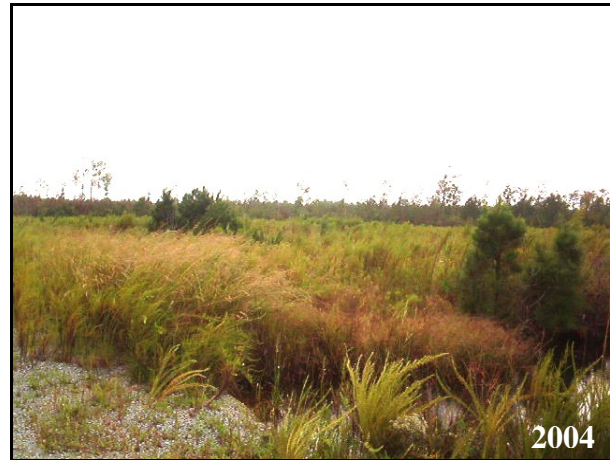
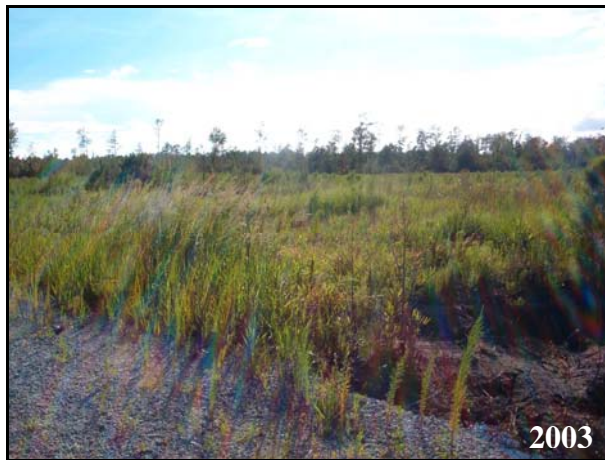


Figure 14. CWMB Photostation 11, facing west.



Figure 15. CWMB Photostation 12, facing east-northeast.



Figure 16. CWMB Photostation 13, facing west.



Figure 17. CWMB Photostation 14, facing south.



Figure 18. CWMB Photostation 15, facing north.



Figure 19. CWMB Photostation 16, facing west-southwest.



Figure 20. CWMB Photostation 17, facing north.

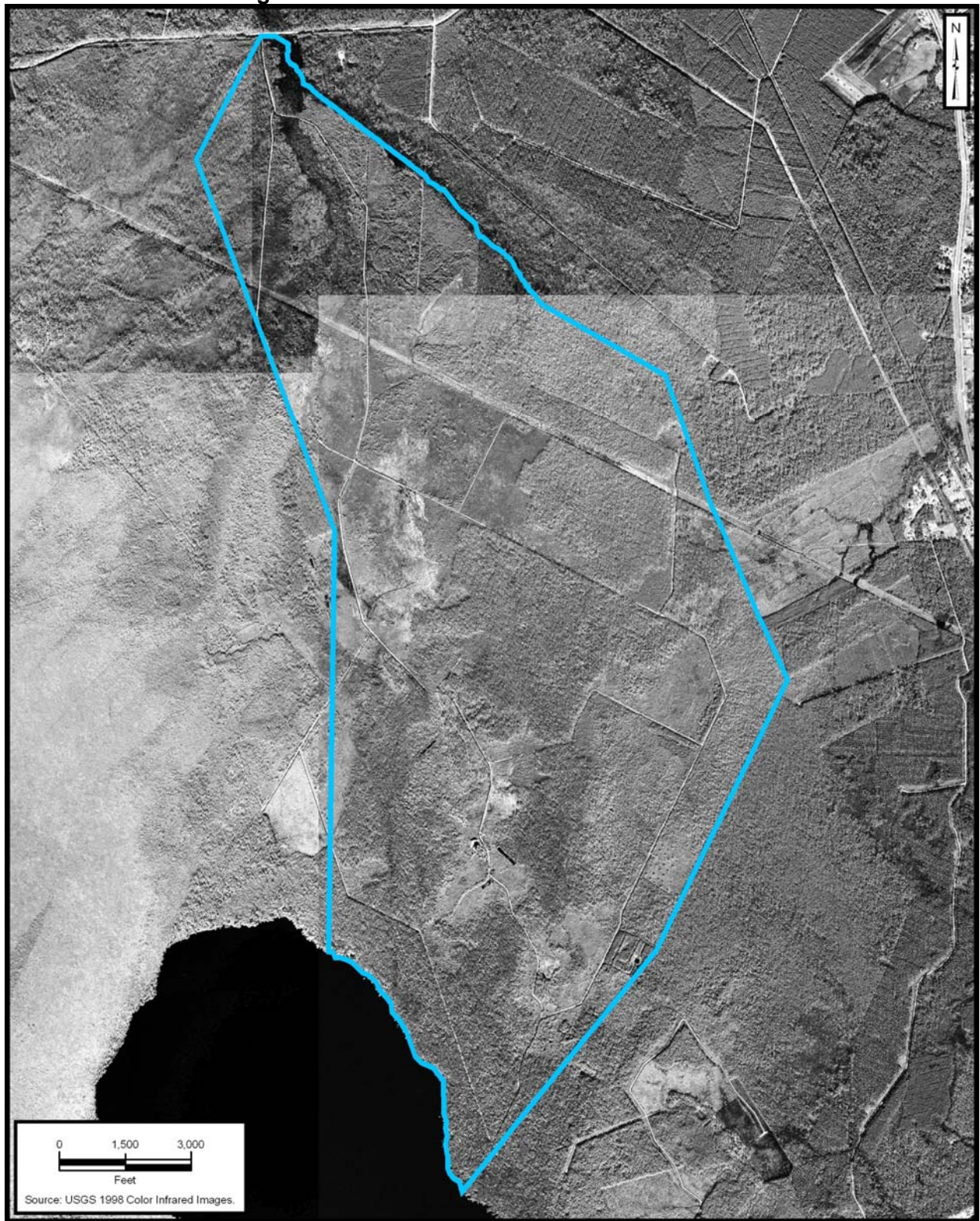


Figure 21. CWMB Photostation 18, facing east-northeast.



Figure 22. CWMB Photostation 19, facing west-southwest.

Figure 23. 1998 Aerial Photo Pre-Construction



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Figure 24. 2003 Aerial Photo Post-Construction



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