

# **FINAL PHASE II CLOSEOUT REPORT**



## **Croatan Wetland Mitigation Bank Craven County, North Carolina**

Prepared for:

**The Ecosystem Enhancement Program  
EEP Project No. 103**

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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. The Phase I Closeout report was submitted in January 2007. This present report summarizes the closeout out of Phase II.

Phase II consists of approximately 2,565.3 acres and is divided into 15 MUs (1-11). Approximately 466.0 acres of low quality, secondary growth successional areas were cleared and replanted with woody species more representative of target communities including Wet Pine Flat, Coastal Plain Small Stream Swamp, Non-Riverine Wet Hardwood Forest (Type A), and Non-riverine Wet Hardwood Forest (Type B). Remaining forested areas in Phase II 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 II mitigation construction activities were completed in June 2002 and monitoring initiated in March 2003 for the 2003 monitoring season. In 2007, hydrologic and vegetative monitoring were completed for the fifth year in Phase II. 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 II wetland hydrologic and vegetative monitoring for 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 MBRT state:

- 1) that there must be a minimum of 320 trees per acre surviving for three consecutive years.

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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 II planting areas cumulatively exceed the minimum success criteria of 260 trees/acre for Year 5. Individual plots within Target Communities and overall Target Communities may not meet minimum success criteria. The overall average for Wet Pine Flat and Coastal Plain Small Stream Swamp Target Communities exceed the 260 stems/acre requirement for Year 5. Type A and Type B of the Non-Riverine Wet Hardwood Forest Target Community have an average of 248 and 243 trees/acre, respectively, and do not meet minimum success criteria.

All of the vegetative monitoring plots in Wet Pine Flat and Coastal Plain Small Stream Swamp Target Communities should be removed and credits released. A contingency plan should be developed for the Non-Riverine Wet Harwood Forest Target Communities (Type A and B) which are not meeting the minimum success criteria of 260 stems/acre at the end of the 5-year monitoring period, but which are dominated by hydrophytic vegetation and achieving hydrologic success criteria.

The majority of the monitoring gauges [158 (85.9%)] in Phase II 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 ( $\geq 4$  years out of 5) throughout the five year monitoring period (**Figure 3**). Of the remaining 26 gauges, 16 consistently made jurisdictional hydrology for  $\geq 12.5\%$  of the growing season and only ten gauges did not meet jurisdictional hydrology for  $\geq 12.5\%$  of the growing season consistently throughout the 5-year monitoring period.

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

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Overall, Phase II hydrologic modifications have resulted in restoration and/or enhancement as expected over most of the site, with 94.6% of the gauges documenting hydroperiods consistently exceeding 12.5% of the growing season.

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

Figure 1. Site Location, Croatan Wetland Mitigation Bank

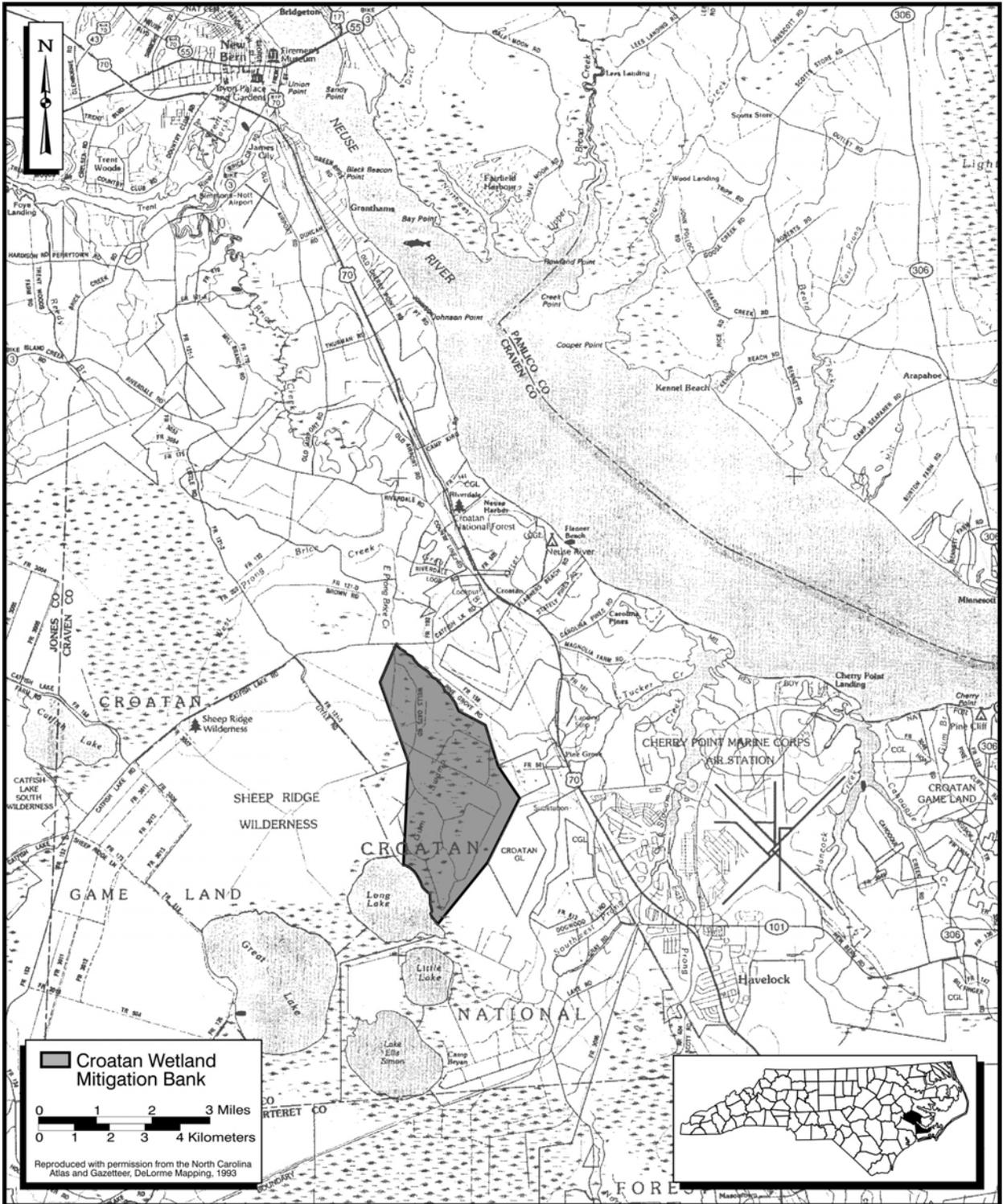
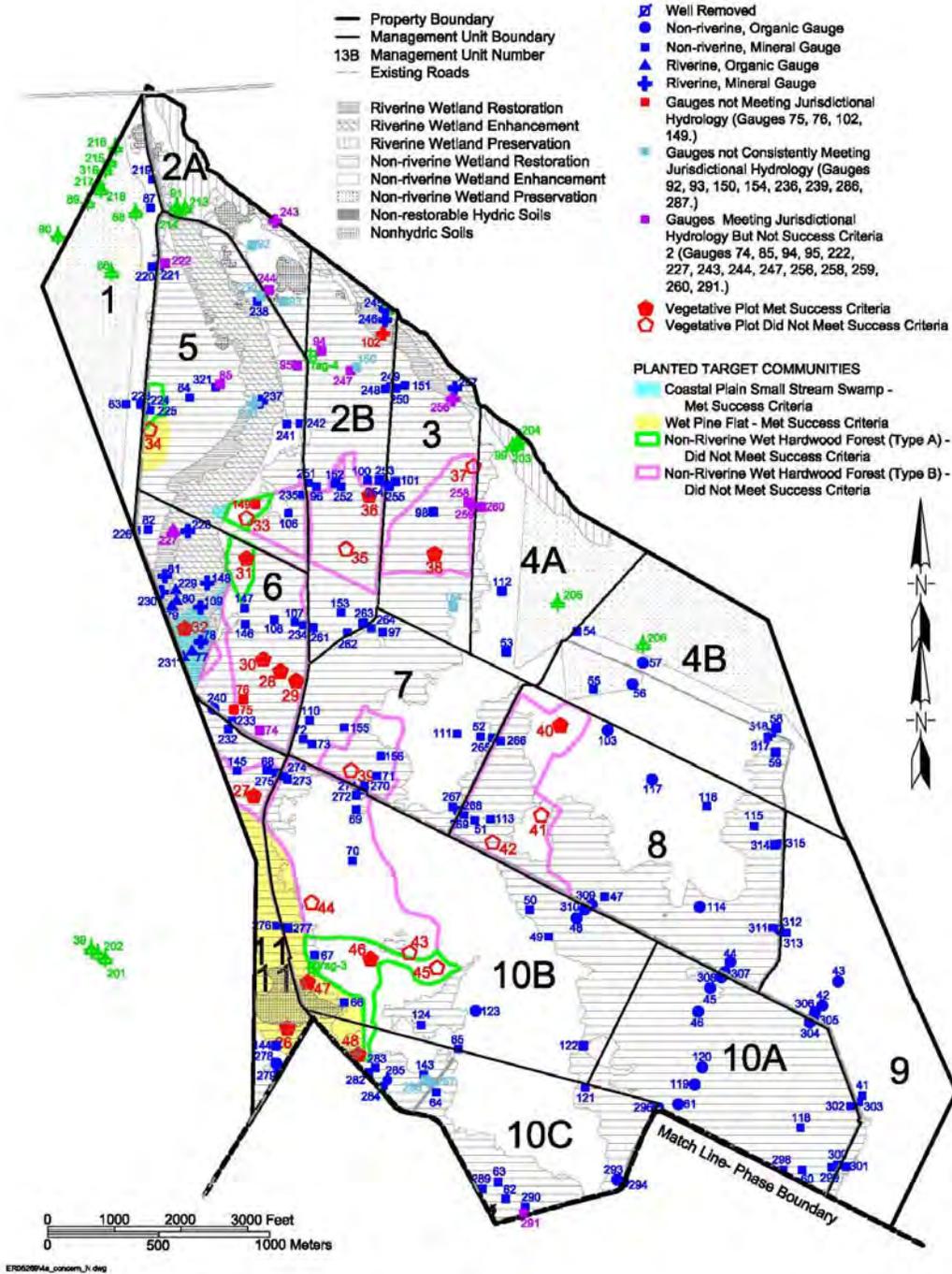




Figure 3. Summary of 5 Years Monitoring, Croatan WMB, Phase II



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## II. Conclusions

### A. Vegetation Summary

Tables A-1 and A-2 depict the monitoring results for the vegetation plots and overall Target Communities by Plot for the fifth year of monitoring.

In 2007, 13 of the 23 plots (56.5%) in Phase II met the established success criteria for Year 5 (**Figure A-1**). Individual plots within Target Communities may not meet minimum success criteria, but the overall average for Wet Pine Flat and Coastal Plain Small Stream Swamp Target Communities exceed the 260 stems/acre requirement for Year 5. The Non-Riverine Wet Hardwood Forest (Type A and B) Target Communities do not meet minimum success criteria.

The Phase II assessment included vegetation surveys associated with 23 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.

The Wet Pine Flat Target Community meets the average success criteria for Year 5 with an average density of 675 trees/acre, although plot 34 individually does not meet success criteria. Commonly observed species in the Wet Pine Flat Target Community, in addition to the planted species, included grey inkberry (*Ilex glabra*), swamp titi (*Cyrtilla racemiflora*), and Maryland meadow-beauty (*Rhexia mariana*).

The Coastal Plain Small Stream Swamp Target Community meets the average success criteria for Year 5 with an average density of 697 trees/acre. Commonly observed species in Coastal Plain Small Stream Swamp Target Community, in addition to the planted species, included coastal bluestem (*Andropogon glaucopsis*), red maple (*Acer rubrum*), pine barren goldenrod (*Solidago fistulosa*), slender goldentop (*Euthamia caroliniana*), small dog-fennel (*Eupatorium capillifolium*), and swamp bay (*Persea palustris*).

The Non-Riverine Wet Hardwood Forest (Type A) Target Community does not meet the average success criteria for Year 5 with an average density of 248 trees/acre; specifically, plots 33 and 45 are not meeting success criteria. Commonly observed species in the Non-Riverine Wet Hardwood Forest (Type A) Target Community, in addition to the planted species, include giant plume grass (*Saccharum giganteum*), red maple, pine-barren goldenrod, slender goldentop, southern waxy sedge (*Carex glaucescens*), swamp bay, and Virginia chain fern (*Woodwardia virginica*). Additional investigation may be needed to determine why this Target Community is not meeting minimum success criterion and if further action is needed.

The Non-Riverine Wet Hardwood Forest (Type B) Target Community does not meet the average success criteria for Year 5 with an average density of 243 trees/acre; specifically, plots 35, 37, 39, 41, 42, 43, and 44 are not meeting success criteria. Commonly observed species in the Non-Riverine Wet Hardwood Forest (Type B) Target Community, in addition to the planted species, included giant plume grass, Maryland meadow-beauty, red maple, and cottongrass bulrush (*Scirpus cyperinus*). The Non-

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Riverine Wet Hardwood Forest (Type B) Target Community, with 14 plots, is the largest Target Community in Phase II. Further investigation may be needed to determine why the seven plots failed to meet the Year 5 success criterion.

Overall, due to the high rate of success in individual plots and individual Target Communities, Phase II 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.

All of the vegetative monitoring plots in Phase II should be removed and credits released based on the contingency plan for the Non-Riverine Wet Hardwood Forest (Type A and B) Target Communities which are 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 II 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 II. 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 jurisdictional hydroperiod (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.

The majority of the monitoring gauges [158 (85.9%)] in Phase II 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 ( $\geq 4$  years out of 5) throughout the five year monitoring period (**Figures 3 and B-1**). Of the remaining 26 gauges, 16 consistently made jurisdictional hydrology for  $\geq 12.5\%$  of the growing season and only ten gauges did not meet jurisdictional hydrology for  $\geq 12.5\%$  of the growing season consistently throughout the 5-year monitoring period.

The areas of concern in Phase II are the areas represented by the following (**Figure B-2**):

- Gauges 74, 85, 94, 95, 154, 222, 227, 236, 243, 244, 247, 256, 258, 259, 260, and 291 have consistently met jurisdictional hydrology, but have not consistently met Success Criterion 2 (20% of Reference Range).
- Gauges 75, 76, 102, and 149 which have not met jurisdictional hydrology ( $\geq 12.5\%$  of the growing season).
- Gauges 92, 93, 150, 239, 286, 287 which have not consistently met jurisdictional hydrology ( $\geq 12.5\%$  of the growing season  $\geq 4$  years out of 5).

### **MU 1 Discussion**

All five monitoring gauges in MU 1 consistently met both expected hydrologic success criteria during the 5-year monitoring period. Mitigative measures have been successful at restoring jurisdictional hydrology to within 20% of the Reference Range for the majority of MU 1.

Due to the high rate of hydrologic success and completion of five years of monitoring, the gauges in MU 1 should be considered for removal.

### **MU 2A Discussion**

None of the four monitoring gauges in MU 2A 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 portions of MU 2A. The areas of concern in MU 2A include 92, 93, 243, and 244. These gauges appear to be on topographic highs and/or adjacent to point-plugged ditches.

Gauges 243 and 244 failed to consistently meet Hydrologic Success, but have met jurisdictional hydrology in each year of monitoring. Mitigative measures appear to be successful at returning jurisdictional hydrology to Gauges 243 and 244 but were not successful at consistently returning these gauge sites to within 20% of reference conditions. These gauges should be considered for success.

Gauges 92 and 93 failed to consistently meet jurisdictional hydrology throughout the 5-year monitoring period. These gauges 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 2A should be considered for removal following resolution of how to address the unsuccessfully restored areas.

### **MU 2B Discussion**

Fifteen of the nineteen monitoring gauges in MU 2B consistently met both expected hydrologic success criteria during the 5-year monitoring period. Mitigative measures have been successful at restoring jurisdictional hydrology to within 20% of the Reference Range for the majority of MU 2B. The areas of concern in MU 2B include 94, 102, 150, 247. These gauges appear to be on topographic highs or adjacent to point-plugged ditches.

Gauges 94 and 247 failed to consistently meet Hydrologic Success, but have met jurisdictional hydrology in each year of monitoring. Mitigative measures appear to be successful at returning jurisdictional hydrology to Gauges 94 and 247, but were not successful at consistently returning these gauge sites to within 20% of reference conditions. These gauges should be considered for success.

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Gauge 102 failed to meet jurisdictional hydrology during the 5-year monitoring period.

Gauge 150 failed to meet Hydrologic Success in 2005 through 2007 (year 3 through 5). Gauge 150 failed to consistently meet jurisdictional hydrology  $\geq 12.5\%$  of the growing season.

Gauges 102 and 150 should be reviewed to determine the extent of the non-jurisdictional area surrounding these gauges 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 2B should be considered for removal following resolution of how to address the unsuccessfully restored areas.

### **MU 3 Discussion**

Six of the ten monitoring gauges in MU 3 consistently met both expected hydrologic success criteria during the 5-year monitoring period. Mitigative measures have been successful at restoring jurisdictional hydrology to within 20% of the Reference Range for the majority of MU 3. The areas of concern in MU 3 include 154, 256, 258, and 259. These gauges appear to be on topographic highs or adjacent to point-plugged ditches.

Gauges 154, 256, 258, and 259 failed to consistently meet Hydrologic Success, but have met jurisdictional hydrology in each year of monitoring. Mitigative measures appear to be successful at returning jurisdictional hydrology to Gauges 154, 256, 258, and 259, but were not successful at consistently returning these gauge sites to within 20% of reference conditions. These gauges should be considered for success.

Due to the completion of five years of monitoring, the gauges in MU 3 should be considered for removal following resolution of how to address the unsuccessfully restored areas.

### **MU 4A Discussion**

Two of three monitoring gauges in MU 4A consistently met both expected hydrologic success criteria during the 5-year monitoring period. Mitigative measures have been successful at restoring jurisdictional hydrology to within 20% of the Reference Range for the majority of MU 4A. The area of concern in MU 4A includes Gauge 260. This gauge appears to be adjacent to point-plugged ditches.

Gauge 260 failed to consistently meet Hydrologic Success, but has met jurisdictional hydrology in each year of monitoring. Mitigative measures appear to be successful at returning jurisdictional hydrology to Gauge 260, but were not successful at consistently returning this gauge site to within 20% of reference conditions. This gauge should be considered for success.

Due to the completion of five years of monitoring, the gauges in MU 4A should be considered for removal following resolution of how to address the unsuccessfully restored areas.

#### **MU 4B Discussion**

All eight monitoring gauges in MU 4B consistently met both expected hydrologic success criteria during the 5-year monitoring period.

Due to the high rate of hydrologic success and completion of five years of monitoring, the gauges in MU 4B should be considered for removal.

#### **MU 5 Discussion**

Eleven of the seventeen monitoring gauges in MU 5 consistently met both expected hydrologic success criteria during the 5-year monitoring period. Mitigative measures have been successful at restoring jurisdictional hydrology to within 20% of the Reference Range for the majority of MU 5. The areas of concern in MU 5 include 85, 95, 149, 222, 236, and 239. These gauges appear to be on topographic highs.

Gauges 85, 95, 222, and 236 failed to consistently meet Hydrologic Success, but have met jurisdictional hydrology in each year of monitoring. Mitigative measures appear to be successful at returning jurisdictional hydrology to Gauges 85, 95, 222, and 236, but were not successful at consistently returning these gauge sites to within 20% of reference conditions. These gauges should be considered for success.

Gauges 149 and 239 failed to consistently meet jurisdictional hydrology during the 5-year monitoring period. These gauges should be reviewed to determine the extent of the non-jurisdictional area surrounding these gauges 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 5 should be considered for removal following resolution of how to address the unsuccessfully restored areas.

#### **MU 6 Discussion**

Twenty of the twenty-four monitoring gauges in MU 6 consistently met both expected hydrologic success criteria during the 5-year monitoring period. Mitigative measures have been successful at restoring jurisdictional hydrology to within 20% of the Reference Range for the majority of MU 6. The areas of concern in MU 6 include 74, 75, 76, and 227. These gauges appear to be on topographic highs.

Gauges 74 and 227 failed to consistently meet Hydrologic Success, but have met jurisdictional hydrology in each year of monitoring. Mitigative measures appear to be successful at returning jurisdictional hydrology to Gauges 74 and 227, but were not successful at consistently returning these gauge sites to within 20% of reference conditions. These gauges should be considered for success.

Gauges 75 and 76 failed to meet jurisdictional hydrology during the 5-year monitoring period. These gauges should be reviewed to determine the extent of the non-jurisdictional area surrounding these gauges and the contingency plan for the areas that have not been returned to jurisdictional status.

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Due to the completion of five years of monitoring, the gauges in MU 6 should be considered for removal following resolution of how to address the unsuccessfully restored areas.

### **MU 7 Discussion**

All fourteen monitoring gauges in MU 7 consistently met both expected hydrologic success criteria during the 5-year monitoring period.

Due to the high rate of hydrologic success and completion of five years of monitoring, the gauges in MU 7 should be considered for removal.

### **MU 8 Discussion**

All seventeen monitoring gauges in MU 8 consistently met both expected hydrologic success criteria during the 5-year monitoring period.

Due to the high rate of hydrologic success and completion of five years of monitoring, the gauges in MU 8 should be considered for removal.

### **MU 9 Discussion**

All eight monitoring gauges in MU 9 consistently met both expected hydrologic success criteria during the 5-year monitoring period.

Due to the high rate of hydrologic success and completion of five years of monitoring, the gauges in MU 9 should be considered for removal.

### **MU 10A Discussion**

All fourteen monitoring gauges in MU 10A consistently met both expected hydrologic success criteria during the 5-year monitoring period.

Due to the high rate of hydrologic success and completion of five years of monitoring, the gauges in MU 10A should be considered for removal.

### **MU 10B Discussion**

All seventeen monitoring gauges in MU 10B consistently met both expected hydrologic success criteria during the 5-year monitoring period.

Due to the high rate of hydrologic success and completion of five years of monitoring, the gauges in MU 10B should be considered for removal.

### **MU 10C Discussion**

Thirteen of the sixteen monitoring gauges in MU 10C consistently met both expected hydrologic success criteria during the 5-year monitoring period. Mitigative measures have been successful at restoring jurisdictional hydrology to within 20% of the Reference Range for the majority of MU 6. The areas of concern in MU 10C include 286, 287, and 291. Gauges 286 and 287 are located in the old roadbed adjacent to point-plugged ditches. Gauge 291 is located in the old roadbed and may be on a topographic high.

Gauge 291 failed to consistently meet Hydrologic Success, but has met jurisdictional hydrology in each year of monitoring. Mitigative measures appear to be successful at returning jurisdictional hydrology to Gauge 291, but were not successful at consistently

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returning this gauge site to within 20% of reference conditions. This gauge should be considered for success.

Gauges 286 and 287 failed to meet jurisdictional hydrology during the 5-year monitoring period. These gauges should be reviewed to determine the extent of the non-jurisdictional area surrounding these gauges 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 10C should be considered for removal following resolution of how to address the unsuccessfully restored areas.

### **MU 11 Discussion**

All eight monitoring gauges in MU 11 consistently met both expected hydrologic success criteria during the 5-year monitoring period.

Due to the high rate of hydrologic success and completion of five years of monitoring, the gauges in MU 11 should be considered for removal.

### **Overall Summary**

The majority of the monitoring gauges [158 (85.9%)] in Phase II 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 ( $\geq 4$  years out of 5) throughout the five year monitoring period (**Figure 3**).

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

The mitigative measures for areas represented by Gauges 74, 85, 94, 154, 95, 154, 222, 227, 236, 243, 244, 247, 256, 258, 259, 260, and 291 have been successful at returning jurisdictional hydrology to these areas, but these gauges may never meet Success Criterion 2 (20% of reference) for their respective soil series because of their location adjacent to existing roads and point-plugged ditches or on topographic highs. These gauges should be considered for success.

Gauges 75, 76, 102, 149, and 150 appear to be located on topographic highs. The areas represented by these gauges should be reviewed to determine the extent of the non-jurisdictional areas and a contingency plan developed for the areas that have not been returned to jurisdictional status.

Gauges 92, 93, 239, 286, and 287 are located adjacent to point plugged ditches. 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 or these gauges may be installed in residual spoil material. The areas represented by these gauges should be reviewed to determine the zone of influence and a contingency plan developed for the areas that have not been returned to jurisdictional status.

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

### **C. Potential Riverine Wetland and Stream Credits**

#### **Riverine Wetland Credit**

Additional areas in MU 6, 5, and 2B (for example Gauges 241, 240, 242, and 251) have shown prolonged surface flooding and flowing water throughout much of the growing season in years with normal rainfall. 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 wetland function and credit.

#### **Stream Credit**

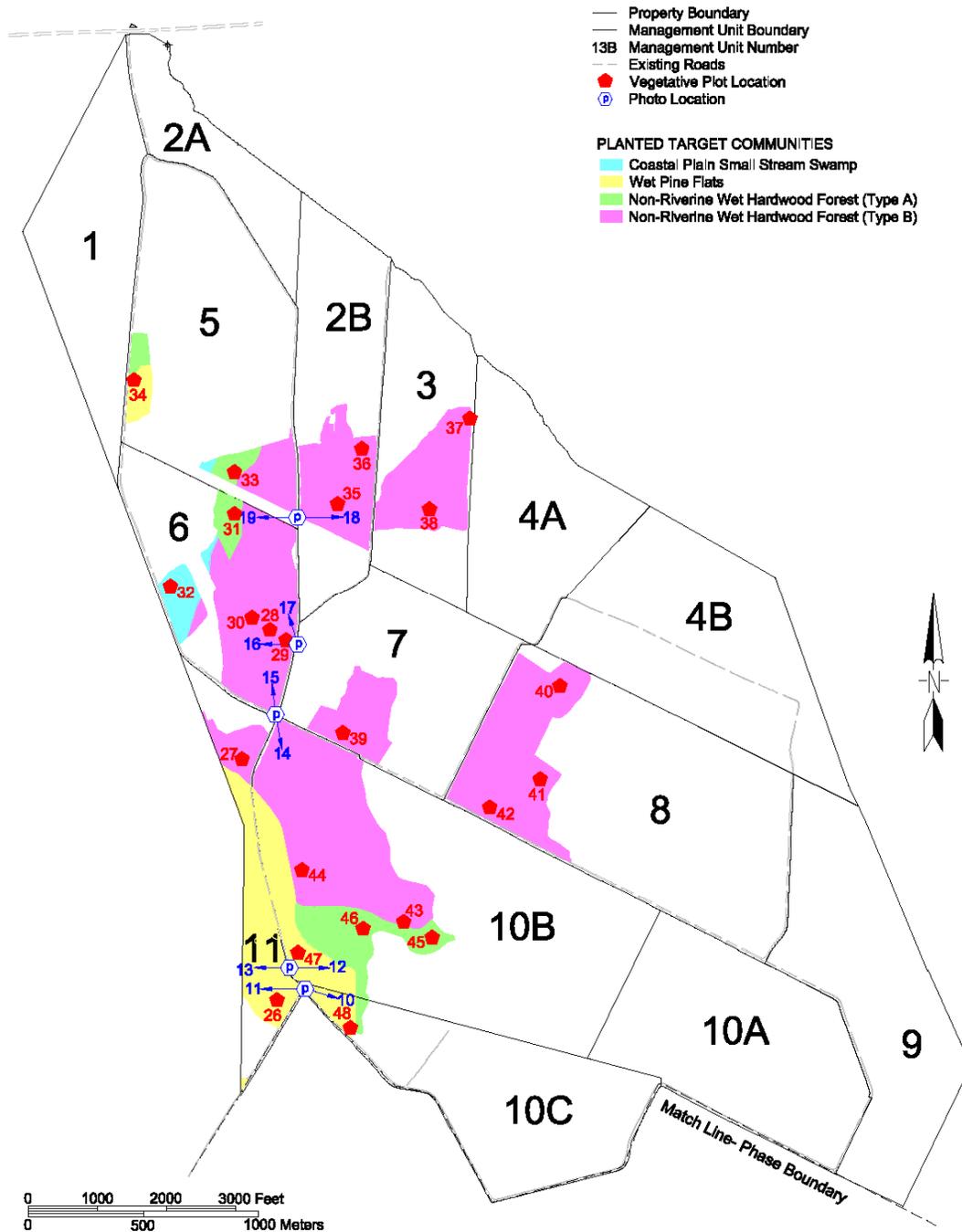
The U.S. Army Corps of Engineers (COE) and N.C. Division of Water Quality (DWQ) have recently revised their interpretation for stream restoration in the outer coastal plain of North Carolina. The preferred method is now what was done at CWMB, taking headwater surface flow intercepted by ditches and restoring the flow to natural drainage features. Stream credits available in Phase II of the CWMB should be documented prior to closing out the mitigation site monitoring.

Should EEP decide to pursue the additional riverine wetland and/or stream credits available in Phase II, it will be included as an addendum to the Phase II Closeout report.

### **D. Photographs**

Photo points are identified on Figure 4. Photographs taken 2003-2007 at the ten photo points are presented in the following photo pages (**Figures 5-14**). Aerial photos of the CWMB are provided for 1998 (pre-construction) and 2003 (post-construction).

Figure 4. Target Communities, Vegetative Plot, and Photostation Locations, Phase II



**Figure 5. Croatan WMB Photostation 10, facing east.**



**Figure 6. Croatan WMB Photostation 11, facing west.**



**Figure 7. Croatan WMB Photostation 12, facing east-northeast.**



**Figure 8. Croatan WMB Photostation 13, facing west.**



**Figure 9. Croatan WMB Photostation 14, facing south.**



**Figure 10. Croatan WMB Photostation 15, facing north.**



Figure 11. Croatan WMB Photostation 16, facing west-southwest.



**Figure 12. Croatan WMB Photostation 17, facing north.**



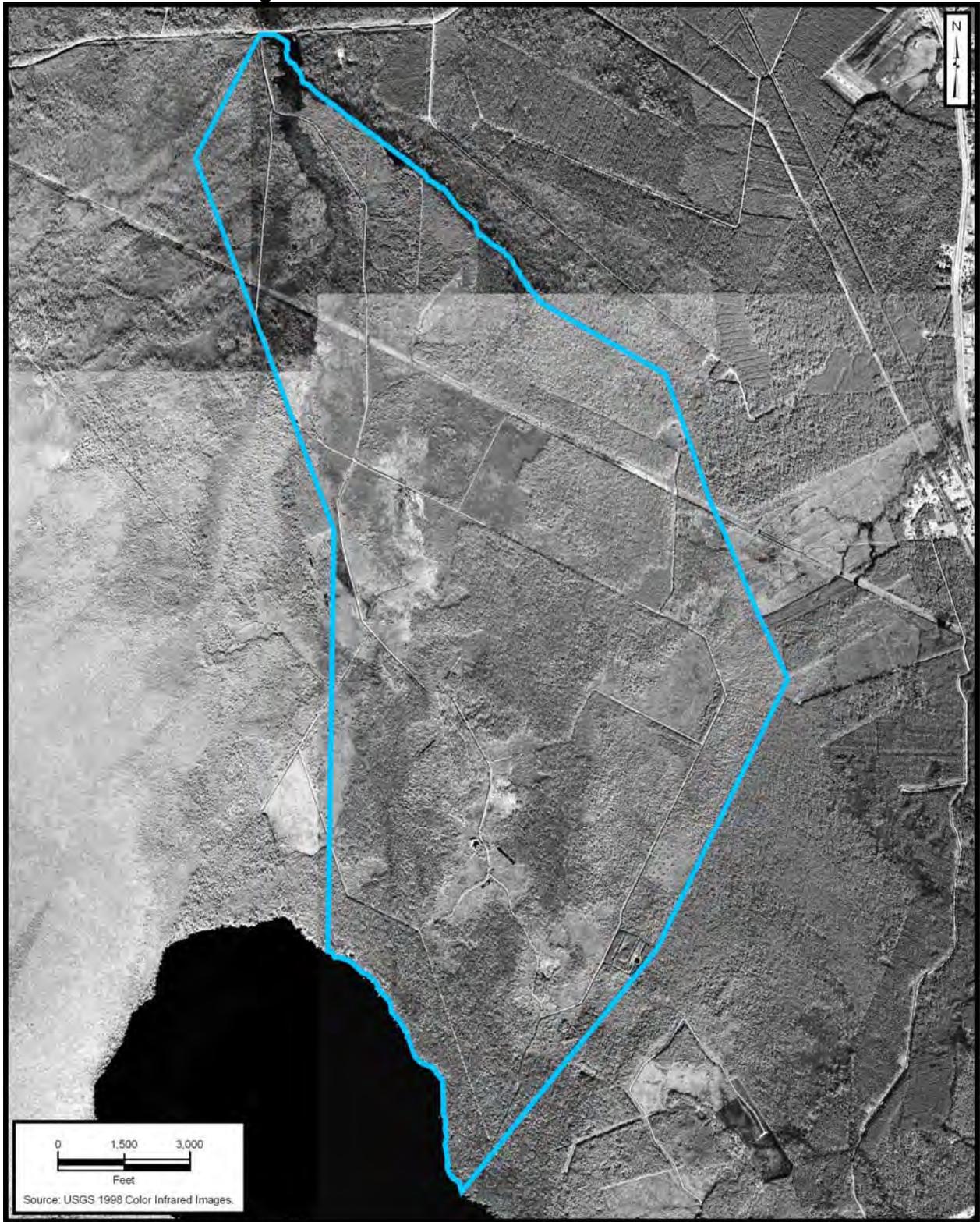
**Figure 13. Croatan WMB Photostation 18, facing east-northeast.**



**Figure 14. Croatan WMB Photostation 19, facing west-southwest.**



Figure 15. 1998 Aerial Photo Pre-Construction



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Figure 16. 2003 Aerial Photo Post-Construction



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