

**Eagle Brunswick Tract  
Year Five Monitoring Report**

Brunswick County, NC

Prepared for:  
ECOBANK  
Winter Park, FL

Prepared by:  
Land Management Group, Inc.  
Wilmington, NC

January 2006

## Table of Contents

<b>1.0 Introduction.....</b>	<b>1</b>
<b>2.0 Hydrology .....</b>	<b>2</b>
2.1 <u>Success Criteria</u> .....	2
2.2 <u>Methods</u> .....	2
2.3 <u>Results</u> .....	3
<b>3.0 Vegetation .....</b>	<b>5</b>
3.1 <u>Success Criteria</u> .....	5
3.2 <u>Methods</u> .....	5
3.3 <u>Results</u> .....	6
<b>4.0 Conclusions.....</b>	<b>6</b>

## Tables, Figures, and Appendices

Table 1. Groundwater monitoring results for Eagle Brunswick gauges .....	4
Table 2. Dominant vegetation at the reference area of Eagle Brunswick.....	5
Table 3. Number of pond pine and loblolly bay trees found at Eagle Brunswick...	6
Figure 1. Vicinity map .....	9
Figure 2. Location of monitoring gauges and vegetation monitoring plots at site.....	10

### Appendix A. Hydrographs

Figure A.1. Hydrology Monitoring, Gauge A1	
Figure A.2. Hydrology Monitoring, Gauge A2	
Figure A.3. Hydrology Monitoring, Gauge A3	
Figure A.4. Hydrology Monitoring, Gauge A4	
Figure A.5. Hydrology Monitoring, Gauge A5	
Figure A.6. Hydrology Monitoring, Gauge A6	
Figure A.7. Hydrology Monitoring, Gauge B1	
Figure A.8. Hydrology Monitoring, Gauge B2	
Figure A.9. Hydrology Monitoring, Gauge B3	
Figure A.10. Hydrology Monitoring, Gauge C1	
Figure A.11. Hydrology Monitoring, Gauge C2	
Figure A.12. Hydrology Monitoring, Gauge C3	
Figure A.13. Hydrology Monitoring, Gauge E1	
Figure A.14. Hydrology Monitoring, Gauge E2	
Figure A.15. Hydrology Monitoring, Gauge E3	
Figure A.16. Hydrology Monitoring, Gauge D1	
Figure A.17. Hydrology Monitoring, Gauge D2	
Figure A.18. Hydrology Monitoring, Gauge D3	
Figure A.19. Hydrology Monitoring, Gauge F1	
Figure A.20. Hydrology Monitoring, Gauge F2	
Figure A.21. Hydrology Monitoring, Gauge F3	
Figure A.22. Hydrology Monitoring, Reference Gauge R1	
Figure A.23. Hydrology Monitoring, Reference Gauge R2	
Figure A.24. Rainfall Analysis for Year 2005	
Figure A.25. Hydrology Monitoring, Pre-Construction Gauges G, A, B, C, H	
Figure A.26. Hydrology Monitoring, Pre-Construction Gauges G, D, E, F, H	

### Appendix B. Pictures of site

**Eagle Brunswick Tract  
Year Five Monitoring Report  
Brunswick County, NC**

**1.0 Introduction**

As part of mitigation for unavoidable wetland impacts associated with the construction of the Wilmington Bypass by the North Carolina Department of Transportation, ECOBANK proposed to utilize restoration, enhancement, and preservation mitigation at the 451-acre Eagle Brunswick tract, located in Brunswick County, North Carolina (Figure 1) as described in Revised Compensatory Mitigation Plan for the Eagle Brunswick Tract dated July 21, 2000. This tract historically consisted of pine flat and pocosin habitats, much of which was ditched and drained due to silvicultural purposes.

In order to restore wetland hydrology at the Eagle Brunswick tract, all on-site ditches were filled in December of 1999. Automated groundwater monitoring gauges were then placed in transects throughout the site to collect hydrology data. Although the mitigation efforts did not include planting wetland vegetation within the pocosin and pine flats, six monitoring plots were located within the site and existing vegetation was analyzed to verify that the ditch-filling has not negatively affected species composition or numbers.

In addition to the pocosin and pine flats mitigation, approximately four acres (~1700 linear feet of stream) of stream/headwater riverine wetlands were restored at the northern end of the tract by filling a ditch, reestablishing wider slopes and natural sinuosity, and planting 2000 seedlings along the bank. Because this area was not counted towards the mitigation credits, neither hydrologic nor vegetation monitoring were conducted here.

The hydrology and vegetation data collected throughout the past twelve months are presented in this document. The mitigation plan for the Eagle Brunswick Tract

required the site to be monitored for at least a total of five years, or until the project is deemed successful. As determined in the four previous monitoring reports for this site, Eagle Brunswick has achieved both the vegetative and hydrological success criteria in year five. This is the fifth and final monitoring report.

## **2.0 Hydrology**

### **2.1 Success Criteria**

According to the Eagle Brunswick Tract Mitigation Plan, the wetland hydrology success criterion for this site is the establishment of a static water table at or within 12” of the soil surface, ponded or flooded for 12.5% of the growing season during normal precipitation conditions. The growing season in Brunswick County extends 265 days, between March 7 and November 28. Normal precipitation is defined as total monthly precipitation falling within the 30<sup>th</sup> and 70<sup>th</sup> percentiles of a 30-year period. Therefore, to meet the success criterion, the water table should remain at or within 12” of the soil surface for at least 33 consecutive days between March 7 and November 28. However, because of awareness in the scientific community that undisturbed pocosin/pine flat wetlands do not always meet this 12.5% threshold, this criterion is subject to redefinition based on groundwater results from the reference gauges, as stated on page 16 of the mitigation plan. A redefinition of the hydrological success criterion is not requested in this monitoring report.

### **2.2 Methods**

In December of 1999, several ditches that transected the Eagle Brunswick Tract were filled to restore wetland hydrology to the 451-acre site. As stated in the mitigation plan, a total of 23 automated groundwater monitoring gauges were installed throughout the site to monitor groundwater hydrology for at least five years. Fifteen of these gauges were located in restored wetlands, six gauges were installed in enhanced wetlands, and two gauges were placed in reference wetlands

located on site (Figure 2). Hydrology data from the gauges located in restored and enhanced areas have been compared to data from the two reference gauges.

At the Eagle Brunswick site, four gauges were installed within restored wetlands at the end of 1999. The remaining gauges in restored areas and reference areas were installed in the summer of 2000. Finally, six gauges were installed within enhancement areas at the end of October, 2000.

### 2.3 Results

Of the 21 gauges located within the restored and enhanced wetlands, 19 met the hydrology success criterion in 2005 (Table 1), which is a water table within 12" of the soil surface for 12.5% of the growing season (33 days). In fact, most gauges documented wetland hydrology for significantly longer than 33 days. Gauge A6 fell slightly short of the criterion and documented 28 continuous days. Gauge C3 malfunctioned for most of the growing season and was unable to meet the hydrology success criterion. The well at this location was replaced but still malfunctioned, likely because it was inundated with water. The reference gauges (R1 and R2) located within the tract reflected the same patterns as the other gauges, and documented wetland hydrology for 76 and 47 days, respectively.

The 30-day running total for 2005 shows normal rainfall for most of the year, except for late summer and early fall, which documented above normal rainfall (Appendix A).

Table 1. Groundwater monitoring results for gauges located within the Eagle Brunswick Tract.

Type	Gauge #	Serial Number	2001 # of Days above 12"	2002 # of Days above 12"	2003 # of Days above 12"	2004 # of Days above 12"	2005 # of Days above 12"
Restoration	A1	S320479	89	35	123	80	107
	A2	S342F37	89	*	123	80	107
	A3	S353973	89	35	123	80	54
	B1	S35398E	90	36	123	85	98*
	B2	S2C7D36	89	24*	122	81	98*
	B3	S37851A	91	35	124	83	99*
	C1	S2C7EE9	128	16*	193	108	126
	C2	S35387C	57	35	190	73*	123
	C3	S353B90	128	35	193	23*	9*
	E1	S126F5F	85	25	71	58	60
	E2	S2EACFA	85	25	48	59	50
	E3	S214018	83	19	68	56	36
	F1	S2D44E2	98	35	114	86	110
	F2	S2EA974	gauge stolen	35	124	81	108
	F3	S353A85	77	*	26*	85	100
Enhancement	A4	S353BOE	*	35	123	80	108
	A5	S353ADE	*	35	77	79	106
	A6	S144FBA	*	*	39	42	28
	D1	S3697DA	53	39	125	108	122
	D2	S3783F2	*	39	189	108	123
	D3	S1271FD	28	39	190	108	124
Reference	R1	S378395	9	36	124	62	76
	R2	S3174D3	11	35	75	80	47

\* Gauge stopped reading during growing season.

### 3.0 Vegetation

#### 3.1 Success Criterion

As established in the mitigation plan, the vegetation success criterion for the Eagle Brunswick site was a minimum of 320 trees per acre, specifically of pond pine (*Pinus serotina*) and loblolly bay (*Gordonia lasianthus*).

#### 3.2 Methods

Although no wetland vegetation was planted within the pocosin or pine flats restoration and enhancement areas at Eagle Brunswick, vegetation monitoring was included as a part of the mitigation plan in order to evaluate whether the ditch-filling activities had any negative consequences on existing vegetation and if vegetation within these restored and enhanced areas resembled the wet pine flat reference area (Table 2).

Table 2. Dominant vegetation at the pine flat reference area of the Eagle Brunswick Tract.

<b>Dominant Overstory</b>	<b>Dominant Shrub/Sapling</b>	<b>Dominant Herbaceous</b>
<i>Pinus serotina</i>	<i>Gordonia lasianthus</i> <i>Lyonia lucida</i> <i>Cyrilla racemiflora</i> <i>Ilex glabra</i>	<i>Ilex glabra</i> <i>Lyonia lucida</i>

Six circular plots were randomly located within restoration and enhancement areas throughout the site (Figure 2). All species within these plots were noted, however only pond pine and loblolly bay stems were counted towards the total. Each plot surveyed had a 10' radius and, therefore, contained 314 ft<sup>2</sup>. Because six plots were counted, the total area surveyed was 1884 ft<sup>2</sup>. To extrapolate the vegetation to one acre, the total number of pond pine and loblolly bay trees in the six plots was multiplied by 23.1.



### 3.3 Results

Based on data from the six vegetation plots, the Eagle Brunswick site contained an average of 577.5 pond pine and loblolly bay trees per acre. This is well above the 320 trees per acre criterion established in the mitigation plan. Therefore, the vegetation criterion for 2005 has been met.

Table 3. Number of pond pine and loblolly bay trees found in each plot at the Eagle Brunswick Tract in 2005.

<b>Plot #</b>	<b>Pond Pine (<i>Pinus serotina</i>)</b>	<b>Loblolly Bay (<i>Gordonia lasianthus</i>)</b>
1	1	4
2	2	4
3	1	3
4	2	-
5	3	-
6	4	1
<b>Total</b>	<b>10</b>	<b>15</b>

As in previous years, other vegetation observed at Eagle Brunswick included titi (*Cyrilla racemiflora*), sweet pepperbush (*Clethra alnifolia*), fetterbush (*Lyonia lucida*), gallberry (*Ilex glabra*), and catbrier (*Smilax spp.*), which were mainly found in the shrub and herbaceous layers. Exact counts of these species were not made since they did not factor into the vegetation criterion.

It should be noted that a fire spread through sections of Eagle Brunswick in the spring of 2005. This thinned out the younger shrub vegetation, including some of the loblolly bay, but most of the pond pines appeared to survive. The cause of the fire is unknown.

### 4.0 Conclusions

Hydrology data from 2005 revealed that 19 of 21 monitoring gauges throughout the restored and enhanced areas of Eagle Brunswick met the 12.5% wetland hydrology criterion established in the mitigation plan. Gauge A6 fell slightly short of the criterion and documented 28 continuous days of water 12" from the soil surface in October. Gauge C3 malfunctioned for most of the growing season and was unable to meet the hydrology success criterion. The gauge at this location was replaced midseason, but this replacement

gauge malfunctioned as well. The hydrology data collected from this transect show that the water level appears to reach the upper edge of the reading, approximately three inches above ground, for most of the year. It is likely that the gauges at C3 failed because they were inundated with water.

Hydrology data collected from the past five years documented that most of the 21 gauges consistently achieved the wetland hydrology success criterion (15 in 2001; 15 in 2002; 20 in 2003; 20 in 2004; 19 in 2005). When a gauge failed to meet this criterion, it was usually because it malfunctioned and stopped reading during the growing season. This was especially evident during the first two years of monitoring, which were plagued with vandalism. Several gauges were broken or stolen, creating gaps in the data.

As stated on page 10 of the mitigation plan, several gauges were installed throughout the tract in 1997 to evaluate the effects of the ditches on hydrology (Figure 2). It was determined from these data that the ditches had a 300' drainage effect, which was used to establish restoration and enhancement boundaries. The mitigation plan did not require a direct comparison of pre-project and post-project data and all but two of the gauges (D1 and D2; see Figure 2) were in different locations. However, a general comparison of data from these gauges revealed that the ditches had a considerable drainage effect. Gauges as far as 500' away from a ditch measured water levels that were routinely 2-3' below the surface (Appendix A: Figures A.11 & A.12). After the ditches were filled, groundwater levels rose to within 12" of the soil surface for most of the growing season and reflected wetland hydrology. Even gauges located in enhanced areas resulted in wetter hydrology after the ditches were filled (Gauges F & H compared to Gauges D1-D3 and A4-A6). This is evident throughout the five years of hydrology monitoring.

Vegetation monitoring in 2005 found the Eagle Brunswick Tract to contain thick stands of wet pine flat plant species such as gallberry, fetterbush, and sweet pepperbush (Appendix B). In addition, an average of 577.5 trees per acre of pond pine and loblolly bay were observed in the canopy and shrub layer throughout the tract. This is similar to results from 2001 (462 trees/acre), 2002 (508.2 trees/acre), 2003 (646.8 trees/acre), and

2004 (600.6 trees/acre) and well above the 320 trees per acre criterion established in the mitigation plan. Although no vegetation planting occurred within the Eagle Brunswick tract, these data show that filling of the ditches did not harm the existing wetland vegetation.

Because both hydrology and vegetation criteria were achieved during these five years of monitoring, wetland mitigation at the Eagle Brunswick site can be considered a success. This is the fifth and final monitoring report.