Ballance Site Riparian Buffer Restoration Project Monitoring Report (Year 3)

Wayne County, North Carolina

Monitoring Firm: Michael Baker Engineering, Inc

Monitoring Firm POC: Kevin Tweedy, PE

EEP Project Manager: Guy Pearce

Prepared for: **NC Ecosystem Enhancement Program**

Report Prepared By: **Michael Baker Engineering, Inc.**

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Cary, NC 27518

Date Submitted: **November 2008**

EXECUTIVE SUMMARY

The Ballance Site Riparian Buffer Restoration Project was designed by Baker Engineering, formerly Buck Engineering, and constructed by River Works, Inc. The goals and objectives of this project were as follows:

- Restore 52 acres of riparian buffer along Nahunta Swamp and eleven of its tributaries
- Enhance 4 acres of riparian buffer
- Restore riparian buffers at least 50 feet in width to areas that historically supported hardwood forest, bottomland ecosystems
- Restore a "Coastal Plain, Bottomland Hardwood Forest" vegetation community, as described by Schafale and Weakley (1990).

This report is being submitted to document completion of the Year 3 (2008) monitoring period.

TABLE OF CONTENTS

Tables and Figures

Appendices

1.0 BACKGROUND INFORMATION

The Ballance properties border approximately 5,000 linear feet (LF) of the northern bank of Nahunta Swamp. Nahunta Swamp flows in a general west-to-east direction along and through the property boundaries. There are approximately 11,826 LF of streams and ditches within the 56 acres of the conservation easement. The properties are bounded to the south by Nahunta Swamp and to the west, east, and north by adjacent landowners.

The Ballance Site Riparian Buffer Restoration Project ("Site") is part of a privately-owned farm that is used primarily for row crop agricultural, hog production, and pasture. The streams on the Site were channelized, and riparian vegetation had been cleared in the field areas such that cattle grazing pastures and row crops extended up to the top of the stream banks. Drainage ditches were excavated in parts of the Site to provide additional drainage for agricultural production.

A summary of the project background information is provided in Table 1.

Table 1. **Background Information**		
Project	Ballance Site Riparian Buffer Restoration Project	
Designer	Michael Baker Engineering, Inc. 8000 Regency Parkway, Cary, NC, 27518 (919) 463-5488	
Contractor	River Works, Inc.	
Project County	Wayne County	
Directions to Project Site	Travel on US-64 E / US-264 E. toward Wilson / Rocky Mount. Merge onto US-264 E toward NC-97 / Wilson / Greenville. Merge onto US-301 N. Turn Right onto US-117. Travel US-222 East. Turn right onto Benton Pond Road. Site is on the right.	
USGS Hydro Unit	03020203-060020	
NCDWQ Sub-basin	03-04-07	
Project Length/Acres	N/A	56 Acres
Restoration Approach	Enhance riparian functions to 4 acres along Nahunta Swamp	
	Restore riparian functions to 52 acres along Nahunta Swamp	
Date of Completion	Planting completed on February 15, 2006; Fencing completed on March 10, 2006.	
Monitoring Dates	Seasonally through each growing season for 5 years	

1.1 Project Goals and Objectives

This riparian buffer restoration project provides numerous ecological benefits within the Neuse River basin. While many of these benefits are limited to the project area, others, such as pollutant removal and improved aquatic and terrestrial habitat, have more far-reaching effects. Expected improvements to water quality, hydrology, and habitat are as follows:

- Nutrient removal
- Increased dissolved oxygen concentrations
- Improved stream bank stability
- Reduced water temperature by increasing shading
- Restoration of terrestrial habitat
- Improved aesthetics.

1.2 Project Location

The Ballance site is located in northeast Wayne County, near the Wayne-Greene-Wilson county lines. The site is approximately 3.0 miles east of the Town of Fremont, and 9.0 miles northeast of the City of Goldsboro, and west of the intersection of NC 222 and NC 111 in Wayne County, North Carolina (Figure 1).

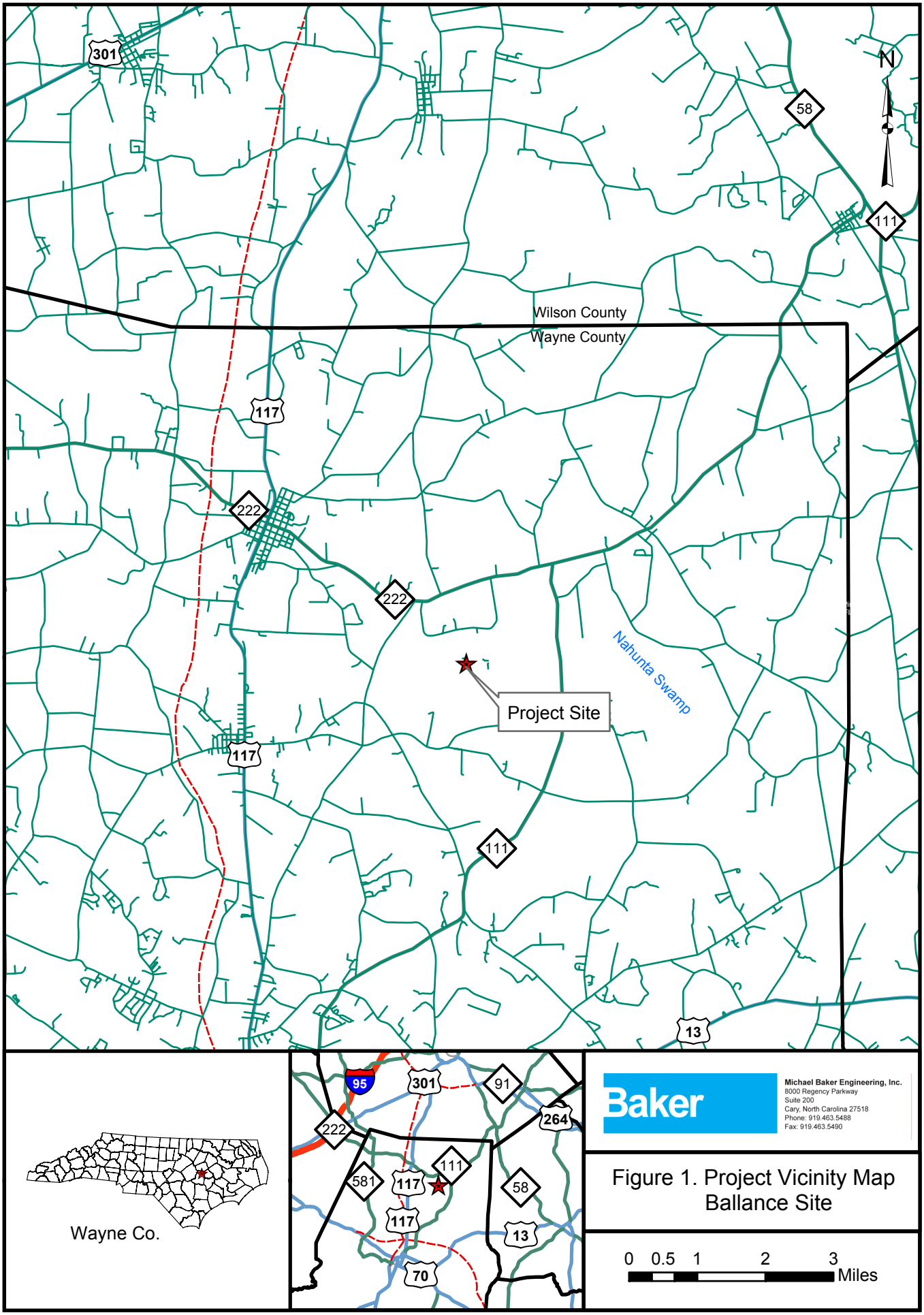
1.3 Project Description

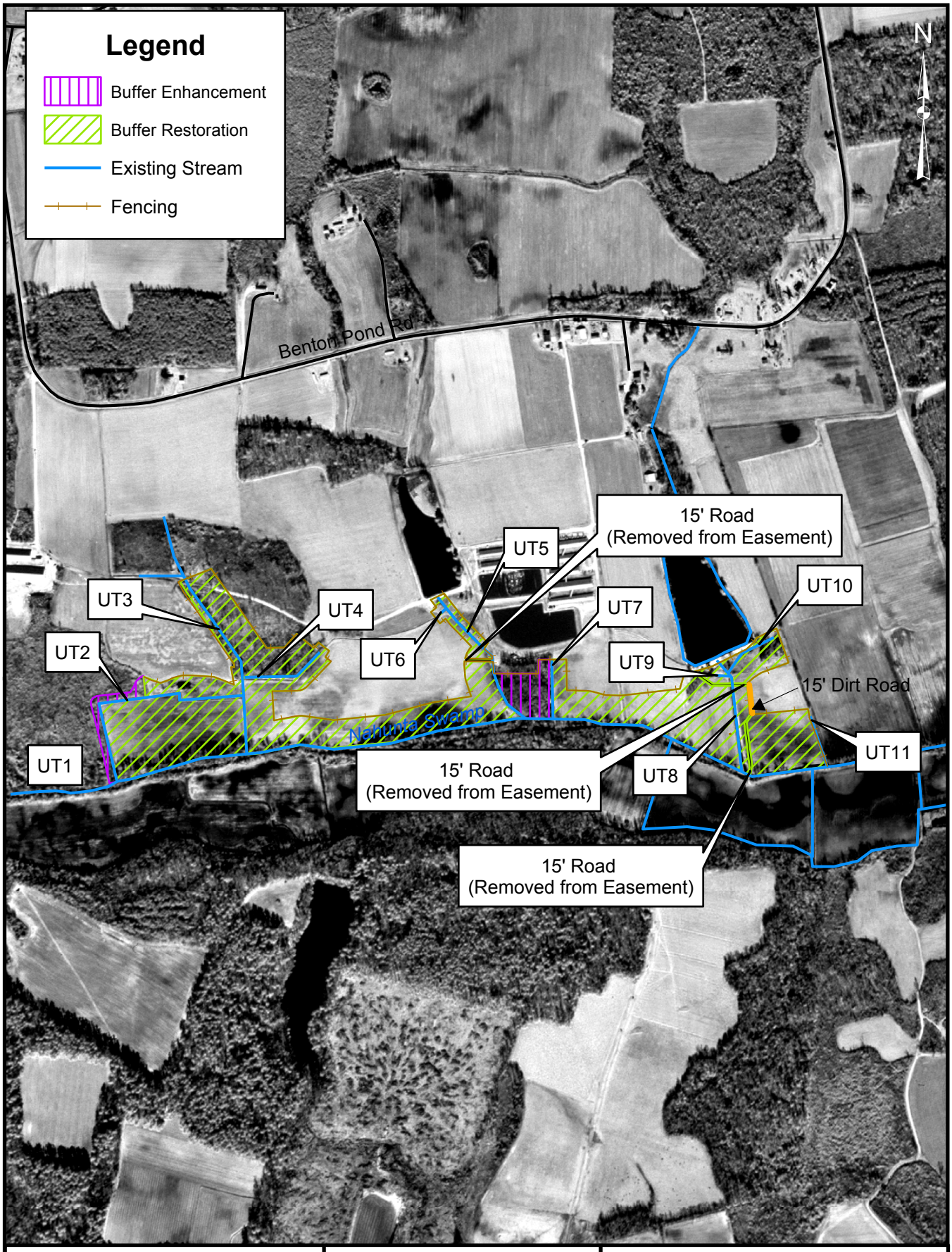
Prior to restoration, land use within the Site consisted of pastureland for cattle grazing, hog production, and row crop agricultural production. The majority of the floodplain vegetation had been removed and fields had been created for crop production and pastureland. The landowner currently has an active hog operation on the Site. Prior to restoration, the landowner used these fields for the spray application of swine lagoon effluent. Effluent was spread across the field areas in close proximity to the ditches and streams on the site. The landowner has now discontinued the use of these fields for application of effluent and the buffer areas have been placed under a conservation easement.

For analysis and design purposes, the on-site streams were divided into eleven reaches. The reach locations are shown in Figure 2. The reaches were numbered sequentially, moving from west to east, with unnamed tributaries carrying a "UT" designation.

Eleven UTs to Nahunta Swamp (UT1 through UT11) drain the majority of the Site. Nahunta Swamp lies along the southern boundary of the Site and flows in a general west-to-east direction along the property boundaries. In most areas, only herbaceous species were present along the stream and ditch banks, and fields were maintained to the top of the streambanks. The lack of riparian vegetation left the channelized systems open to sunlight and without adequate filtration of agricultural runoff and nutrient loading. Along reaches that were not regularly maintained, woody riparian vegetation was sparse, existing only in narrow buffer widths adjacent to the channels. As a result, filamentous algae and other aquatic plants were common in the channels.

Nahunta Swamp and the smaller channels throughout the Site originate in rural and agricultural areas. These areas are considered to be at least intermittent channels. The stream lengths of Nahunta Swamp and the UTs, with restoration approaches are provided in Table 2. The primary objective of the restoration was to enhance areas of existing riparian buffer vegetation and to reforest the cleared floodplain with native species along Nahunta Swamp and eleven UTs within the conservation easement. Primary activities within the Site are designed to preserve plant community assemblages and to enhance and restore native floodplain vegetation through site preparation and subsequent plantings.


301
58
111
Wilson County
Wayne County
117
222
222
Nahunta Swamp
Project Site
117
111
13
95
301
91
264
222
581
117
111
58
117
13
70
Wayne Co.
Michael Baker Engineering, Inc.
8000 Regency Parkway
Suite 200
Cary, North Carolina 27518
Phone: 919.463.5488
Fax: 919.463.5490
Figure 1. Project Vicinity Map
Ballance Site
0 0.5 1 2 3
Miles



Baker
Michael Baker Engineering, Inc.
8000 Regency Parkway
Suite 200
Cary, North Carolina 27518
Phone: 919.463.5488
Fax: 919.463.5490

0 500 1,000 Feet

Figure 2.
Hydrography and Restoration Plan
Ballance Site

Table 2.
Summary of As-built Lengths and Restoration Approaches

Stream Designation	Project Stream Length (LF)	Restoration Approach
Nahunta Swamp	5,070	Riparian planting
UT1	550	Riparian planting
UT2	1,053	Riparian planting
UT3	1,339	Riparian planting
UT4	591	Riparian planting
UT5	1,077	Riparian planting
UT6	47	Riparian planting
UT7	402	Riparian planting
UT8	814	Riparian planting
UT9	107	Riparian planting
UT10	410	Riparian planting
UT11	366	Riparian planting

1.4 Construction

Prior land use and clearing had already removed the majority of the native floodplain vegetative communities along Nahunta Swamp and within the associated floodplain. However, prior to plant community restoration, remaining invasive vegetation such as privet (*Ligustrum sinense*), which existed in small quantities along the stream banks, was cleared by bush-hogging, mowing and cutting with bush axes and saws. Cleared areas were then disked to further prepare the soil for planting. Care was taken to avoid exposure of surficial soils.

Bare-root seedlings of tree species were planted at a density of 680 stems per acre on 8-foot centers for buffer restoration areas. To ensure meeting vegetation success criteria, enhancement areas were also planted at 680 stems per acre. Table 3 depicts the total number of stems and percent of species planted. Planting was performed in February 2006 to allow plants to stabilize during the dormant period and establish root systems during the spring season. A total number of 36,950 tree seedlings were planted during restoration activities. One substitution from the proposed species took place because Hackberry (*Celtis laevigata*) seedlings were not available. Overcup Oak (*Quercus lyrata)* was planted as a substitute. This species is appropriate for the locale, site conditions, and target community. Overcup Oak comprised 10 percent of the overall planting. This further necessitated a reduction in laurel oak (*Quercus laurifolia*) from the originally proposed 10 percent composition to a 5 percent composition.

Certain opportunistic species that may dominate the early successional forests within bottomland hardwood forests have been excluded from riparian buffer restoration efforts with the anticipation that natural regeneration will occur from existing local species. Opportunistic species consist primarily of red maple (*Acer rubrum*), box elder (*Acer negundo*), and sweet-gum (*Liquidambar styraciflua*).

Table 3.
Planting Species for Ballance Buffer Restoration

Scientific Name	Common Name	Percent	Number of Species
Nyssa sylvatica var biflora	Swamp Black Gum	15%	5,550
Quercus phellos	Willow oak	10%	3,700
Morus rubra	Red mulberry	5%	1,850
Platanus occidentalis	Sycamore	15%	5,550
Quercus laurifloia	Laurel oak	5%	1,850
Quercus michauxii	Swamp Chestnut oak	5%	1,850
Quercus falcata var. pogodifolia	Cherrybark oak	5%	1,850
Quercus lyrata	Overcup oak	10%	3,700
Fraxinus pennsylvanica	Green Ash	20%	7,350
Asimina triloba	Paw Paw	10%	3,700
TOTAL		**100%**	**36,950**

Notes: 1. Planting density for restoration, as well as enhancement, was 680 trees per acre.

2.0 MONITORING RESULTS – YEAR 3 (2008) DATA

The five-year monitoring plan for the Site includes criteria to evaluate the success of the vegetation components of the project. The specific locations of vegetation plots are shown on the As-built drawing sheets included in Appendix 1. Two photo point stations are located at each of the six vegetation plots. The first photo point is for the entire vegetation plot and the second photo point is for the herbaceous plot at the corner of each quadrant. Site photographs of all photo points are included in Appendix 2.

2.1 Vegetation

The success of this buffer restoration project is dependent upon active planting of preferred canopy species and volunteer regeneration of the native plant community. In order to determine if the success criteria have been met, vegetation monitoring quadrants were installed across the Site, as directed by North Carolina Ecosystem Enhancement Program (NCEEP) monitoring guidance. Six vegetation monitoring plots were installed on the Site. The number of quadrants required was based on the species/area curve method, as per NCEEP guidelines. The sizes of individual quadrants are 100 square meters for woody tree species and 1 square meter for herbaceous vegetation. No plots were established for shrubs since all planted species were considered tree species. At the end of the growing season, species composition, density, and survival are evaluated each year.

The density within each of the vegetation monitoring plots for Year 3 is given in Table 4. The initial density of planted bare root stems, based on the data from the six monitoring plots, was 561 stems per acre. The average density of bare root stems for monitoring Year 3 is 452 stems per acre. The locations of the vegetation plots are shown on the as-built plan sheets. Individual quadrant data that includes diameter, height, density and herbaceous coverage quantities are provided in Appendix 3.

Table 4.
Density of Vegetation Sampling Plots (Initial, Years 1, 2 and 3)

Sampling Plot No.	Counted Stems per Plot				Stems per Acre (extrapolated)			
	Initial	Year 1	Year 2	Year 3	Initial	Year 1	Year 2	Year 3
1	13	13	13	13	526	526	526	526
2	16	15	15	14	640	607	607	567
3	15	11	11	11	600	445	445	445
4	13	10	7	5	520	405	283	202
5	16	16	15	15	640	647	607	607
6	11	10	10	9	440	405	405	364
Total	**84**	**75**	**71**	**67**	**561**	**506**	**479**	**452**

2.2 Areas of Concern

Maintenance requirements vary from site to site and are generally driven by the following conditions:

- Trees planted during wet weather may have difficulty rooting
- Extreme hot, cold, wet, or dry weather during and after construction can limit vegetation growth, particularly temporary and permanent seed
- The presence and aggressiveness of invasive species can affect the extent to which a native buffer can be established
- The larvae of herbivorous insects can destroy the trees; so infestations can be extremely damaging.

Monitoring plot 4 had a lower than expected survivability rate for Year 3. The density for Plot 4 was 202 stems per acre, which is below the survivability rate of 320 stems per acre after Year 3. The area has been inspected and it has been determined that approximately 2 acres surrounding Plot 4 would benefit from supplemental planting. Supplemental planting in this area will be completed with approximately 200 stems per acre during December 2008 and February 2009, using species that were approved as part of the restoration plan.

During the monitoring event, morning glory was observed within plots 1 and 3. The morning glory was not profuse within these plots and was not exhibiting stress on the planted stems at the time of the Site visit.

Privet was also observed within plots 1 and 2. Only one privet stem on each plot was noted at the time of the Site visit. However, there is a significant amount of privet established along the banks of Nahunta Swamp within the project area. To avoid future impacts to planted vegetation from privet, the areas of privet on the site will be treated during December 2008 and February 2009 to knock the stands back and provide more time for the planted species to reach heights that will overtop any future privet.

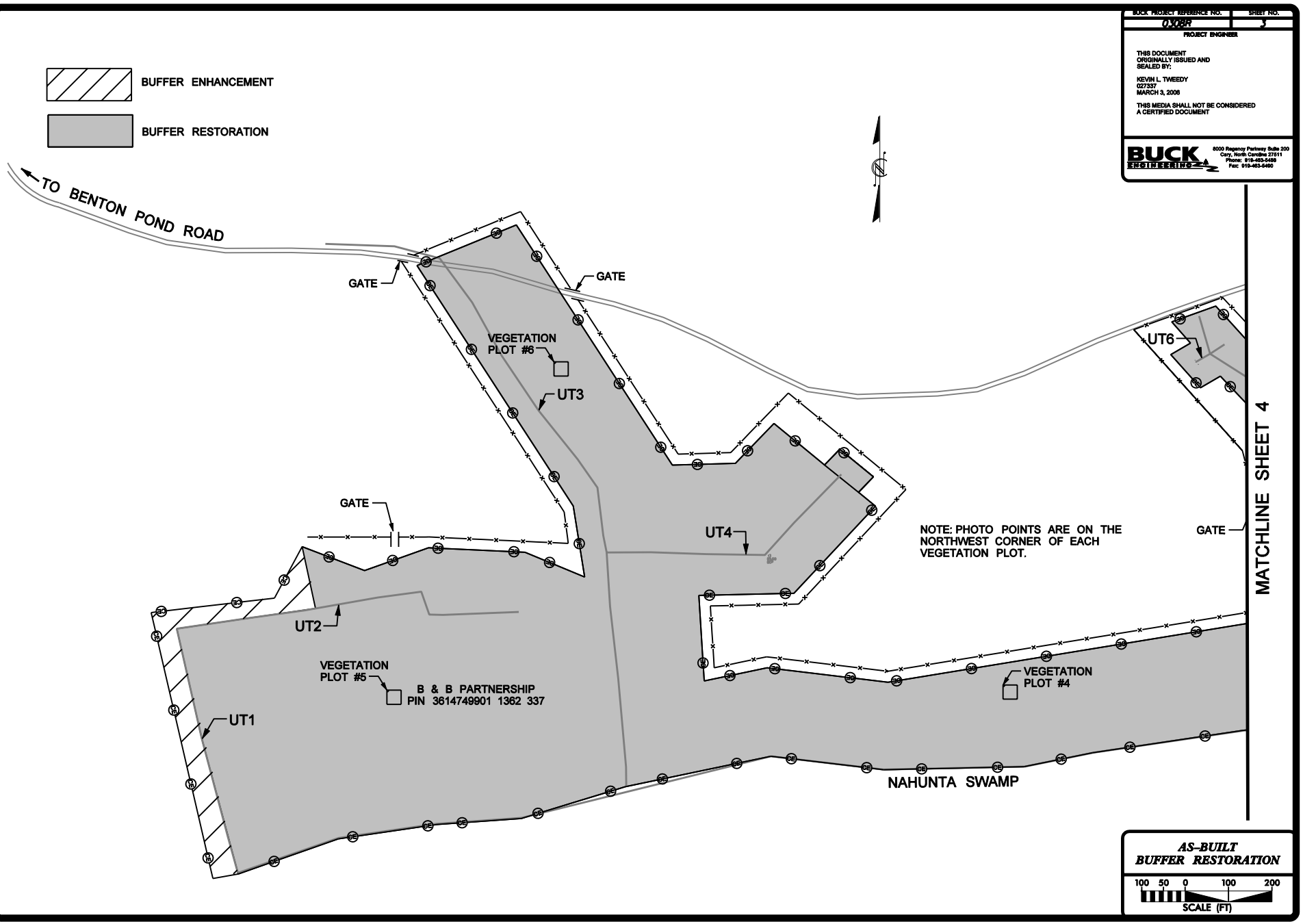
In the future, privet may become a concern due to its former presence along lengths of stream channel adjacent to the restoration areas. Rivercane and morning glory may also prove problematic as they may hinder growth of some of the trees due to competition. These potential concerns will be monitored as the project progresses and matures.

3.0 REFERENCES

Schafale, M.P. and A.S. Weakley. 1990. Classification of the Natural Communities of North Carolina: Third Approximation. North Carolina Natural Heritage Program, Division of Parks and Recreation, N.C. Department of Environment, Health, and Natural Resources. Raleigh, North Carolina.

APPENDIX 1

AS-BUILT PLAN SHEETS


BUFFER ENHANCEMENT
BUFFER RESTORATION
TO BENTON POND ROAD
GATE
GATE
GATE
GATE
VEGETATION PLOT #6
UT3
UT6
UT4
UT2
VEGETATION PLOT #5
B & B PARTNERSHIP
PIN 3614749901 1362 337
UT1
VEGETATION PLOT #4
NAHUNTA SWAMP
NOTE: PHOTO POINTS ARE ON THE NORTHWEST CORNER OF EACH VEGETATION PLOT.
MATCHLINE SHEET 4
BUCK PROJECT REFERENCE NO.
0308R
SHEET NO.
3
PROJECT ENGINEER
THIS DOCUMENT ORIGINALLY ISSUED AND SEALED BY:
KEVIN L. TWEEDY
027337
MARCH 3, 2006
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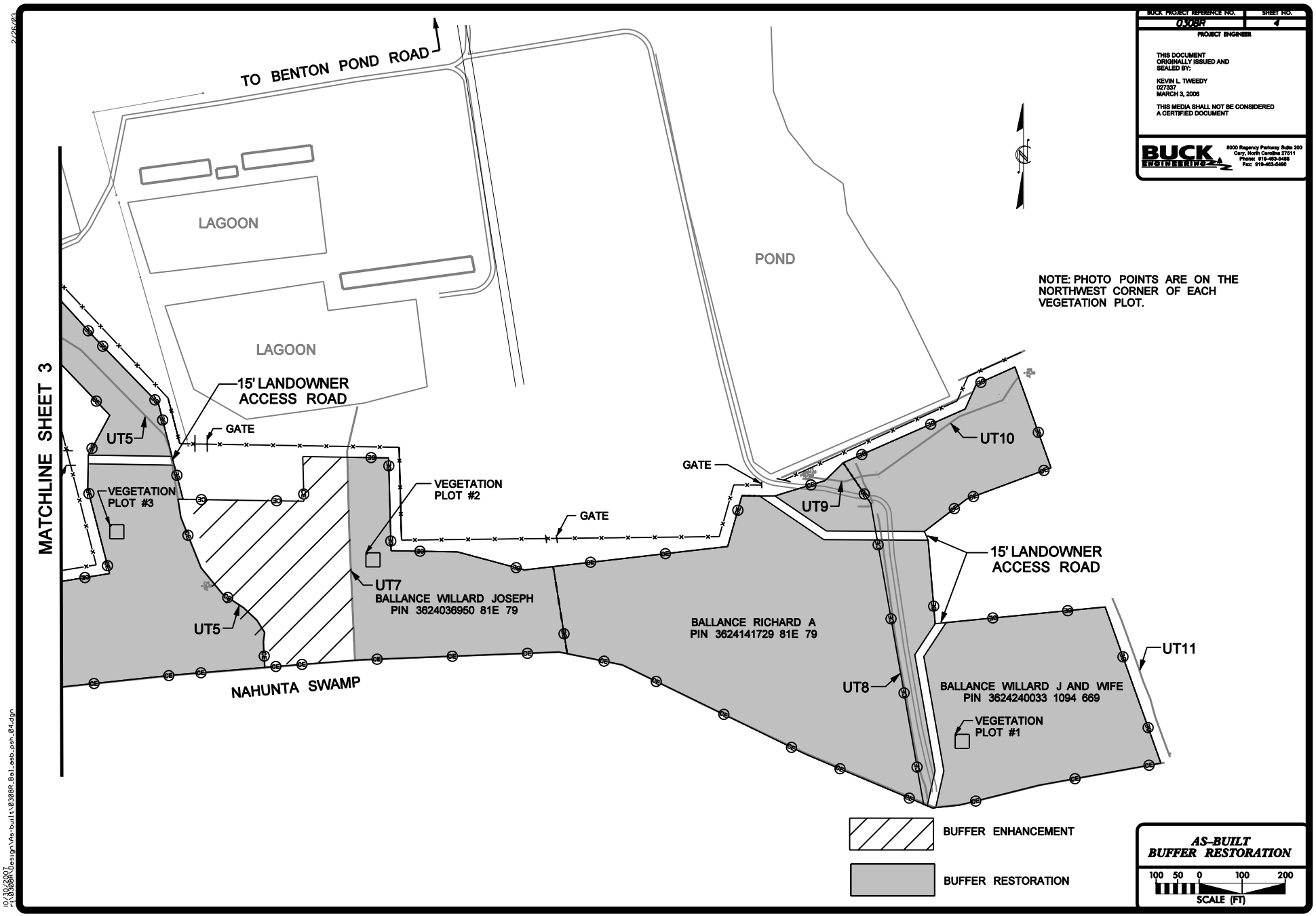
Cary, North Carolina 27511
Phone: 919-463-5488
Fax: 919-463-5490
AS-BUILT
BUFFER RESTORATION
100 50 0 100 200
SCALE (FT)


TO BENTON POND ROAD
LAGOON
LAGOON
POND
MATCHLINE SHEET 3
15' LANDOWNER ACCESS ROAD
GATE
UT5
VEGETATION PLOT #3
VEGETATION PLOT #2
GATE
GATE
UT10
UT9
15' LANDOWNER ACCESS ROAD
UT7
BALLANCE WILLARD JOSEPH
PIN 3624036950 81E 79
UT5
BALLANCE RICHARD A
PIN 3624141729 81E 79
UT11
UT8
BALLANCE WILLARD J AND WIFE
PIN 3624240033 1094 669
VEGETATION PLOT #1
NAHUNTA SWAMP
NOTE: PHOTO POINTS ARE ON THE NORTHWEST CORNER OF EACH VEGETATION PLOT.
BUFFER ENHANCEMENT
BUFFER RESTORATION
AS-BUILT
BUFFER RESTORATION
100 50 0 100 200
SCALE (FT)
BUCK PROJECT REFERENCE NO.
0308R
SHEET NO.
4
PROJECT ENGINEER
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BUCK PROJECT REFERENCE NO.	SHEET NO.
0308R	5

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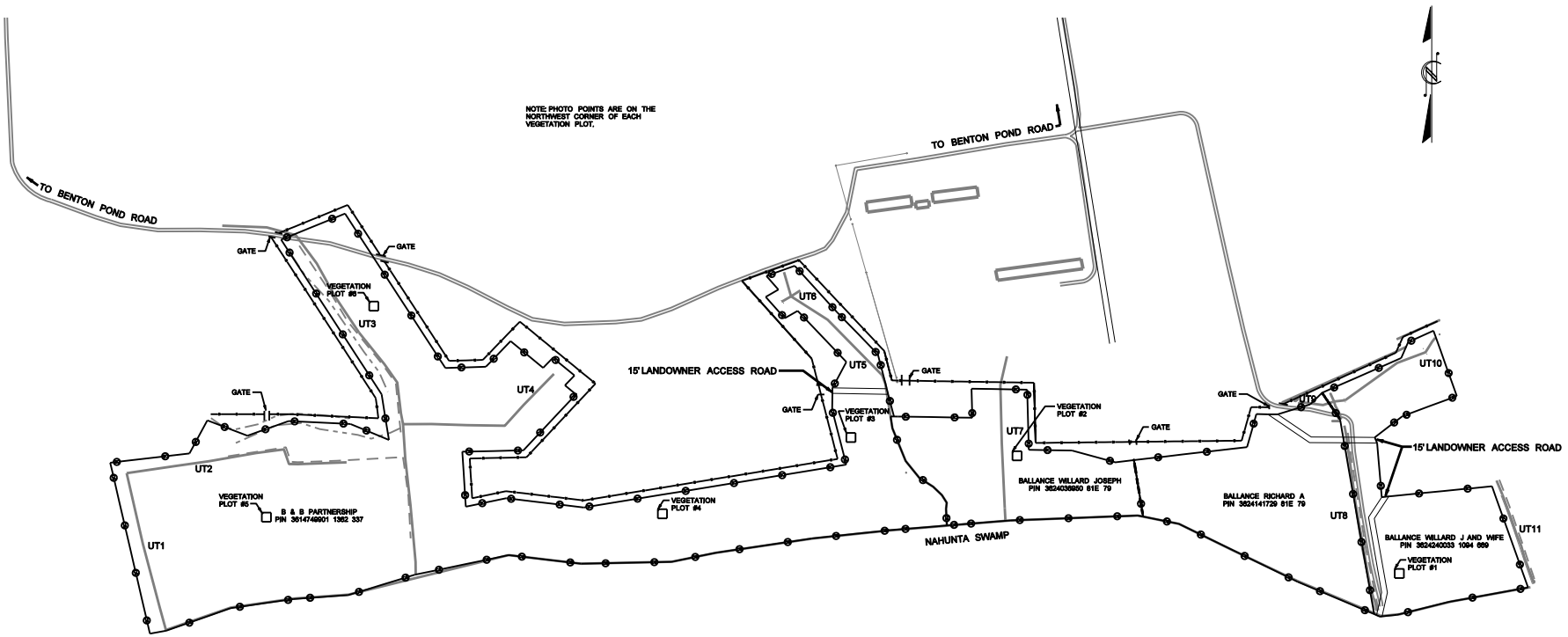

AS-BUILT SITE OVERVIEW AND FENCING

200 100 0 200 400
SCALE (FT)

APPENDIX 2

PHOTO LOG

1. Veg Plot 1 Herbaceous Plot.

2. Veg Plot 1 NW Looking SE.

3. Veg Plot 2 Herbaceous Plot.

4. Veg Plot 2 NW Looking SE.

5. Veg Plot 3 Herbaceous Plot.

6. Veg Plot 3 NW Looking SE.

7. Veg Plot 4 Herbaceous Plot.

8. Veg Plot 4 NW Looking SE.

9. Veg Plot 5 Herbaceous Plot.

10. Veg Plot 5 NW Looking SE.

11. Veg Plot 6 Herbaceous Plot.

12. Veg Plot 6 NW Looking SE.

APPENDIX 3

INDIVIDUAL QUADRANT DATA

YEAR 3 Monitoring **Ballance Site** **Baker Project # 108353**

Date: Oct. 13, 2008 Monitored By: D. Huneycutt

Veg Plot 1		Herbaceous Plot % Coverage	80%
Tree #	Species	Height (cm)	Diameter (mm)
1-1	NS	159	10
1-2	NS	112	15
1-3	QL	254	35
1-4	QL	232	37
1-5	QL	282	26
1-6	QL	89	8
1-7	QL	285	35
1-8	QH	186	14
1-9	QH	>300	26
1-10	QP	228	25
1-11	QL	>300	32
1-12	QL	274	34
1-13	QL	294	34
	Total Surviving Stems		13
	Density (Stems per Acre)		526

Veg Plot 2		Herbaceous Plot % Coverage	90%
Tree #	Species	Height (cm)	Diameter (mm)
2-1	PO	>300	54
2-2	QF	93	9
2-3	QP	82	3
2-4	QP	227	21
2-5	QH	84	9
2-6	QP	274	11
2-7	NS	Missing	--
2-8	NS	199	17
2-9	NS	150	10
2-10	NS	83	6
2-11	NS	124	11
2-12	QL	219	22
2-13	PO	DEAD	--
2-14	QH	209	12
2-15	QH	139	12
2-16	QF	171	11
	Total Surviving Stems		14
	Density (Stems per Acre)		567

Veg Plot 3		Herbaceous Plot % Coverage	80%
Tree #	Species	Height (cm)	Diameter (mm)
3-1	NS	41	8
3-2	NS	26	3
3-3	PO	>300	29
3-4	NS	DEAD	--
3-5	PO	>300	27
3-6	QF	20	3
3-7	QL	DEAD	--
3-8	NS	64	6
3-9	QF	41	6
3-10	PO	>300	35
3-11	QF	33	4
3-12	QP	DEAD	--
3-13	AT	50	7
3-14	PO	>300	32
3-15	QP	DEAD	--
	Total Surviving Stems		11
	Density (Stems per Acre)		445

Veg Plot 4		Herbaceous Plot % Coverage	95%
Tree #	Species	Height (cm)	Diameter (mm)
4-1	NS	58	13
4-2	QF	Missing	--
4-3	PO	>300	44
4-4	NS	29	16
4-5	NS	DEAD	--
4-6	MR	39	6
4-7	QL	DEAD	--
4-8	NS	Missing	--
4-9	QL	DEAD	--
4-10	QF	63	8
4-11	QF	DEAD	--
4-12	QP	DEAD	--
4-13	QP	DEAD	--
	Total Surviving Stems		5
	Density (Stems per Acre)		202

Veg Plot 5		Herbaceous Plot % Coverage	85%
Tree #	Species	Height (cm)	Diameter (mm)
5-1	FP	100	23
5-2	FP	78	15
5-3	FP	117	20
5-4	FP	151	24
5-5	PO	>300	19
5-6	PO	>300	27
5-7	PO	DEAD	--
5-8	PO	>300	20
5-9	PO	>300	20
5-10	MR	71	11
5-11	MR	56	9
5-12	MR	74	15
5-13	MR	47	11
5-14	FP	123	20
5-15	FP	120	17
5-16	PO	>300	21
	Total Surviving Stems		15
	Density (Stems per Acre)		607

Veg Plot 6		Herbaceous Plot % Coverage	80%
Tree #	Species	Height (cm)	Diameter (mm)
6-1	NS	DEAD	--
6-2	NS	59	10
6-3	FP	62	9
6-4	FP	71	8
6-5	NS	70	8
6-6	NS	61	9
6-7	FP	37	4
6-8	QL	91	6
6-9	QM	DEAD	--
6-10	FP	45	4
6-11	NS	61	7
	Total Surviving Stems		9
	Density (Stems per Acre)		364

Average Stems Per Acre = **452**

= Plot density criteria not meet or stem dead

Species Code	Common Name	Scientific Name
NS	Swamp Black Gum	*Nyssa sylvatica var biflora*
QP	Willow Oak	*Quercus phellos*
MR	Red Mulberry	*Morus rubra*
PO	Sycamore	*Platanus occidentalis*
QH	Laurel Oak	*Quercus laurifolia*
QM	Swamp Chestnut Oak	*Quercus michauxii*
QF	Cherrybark Oak	*Quercus falcata var. pogodifolia*
QL	Overcup Oak	*Quercus lyrata*
FP	Green Ash	*Fraxinus pennsylvanica*
AT	Paw Paw	*Asimina triloba*