

**THIRD ANNUAL MONITORING REPORT – 2007 GROWING SEASON**

**Little Contentnea Creek Riparian Buffer Restoration – Phase 3  
(EEP Contract: 005020)**



**November 2007**

**Submitted to:**



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North Carolina Ecosystem Enhancement  
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**Submitted for:**



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## **INTRODUCTION AND BACKGROUND**

On 27 June 2005 the NC Ecosystem Enhancement Program awarded Greene Environmental Services a contract to restore 54.16 acres of riparian buffer along Little Contentnea Creek and its unnamed tributaries in southeastern Greene County, NC (Figure 1) (Phase 3). The project was a continuation of the successful Phase 1 and Phase 2 projects that restored a total of 87.1 acres of riparian buffers along unnamed tributaries to Little Contentnea Creek and Contentnea Creek. The Little Contentnea Creek Riparian Buffer Restoration Plan Phase 3 was implemented in 2005 with site preparation, the planting of 28,000 saplings of 11 species, and the establishment of 60 monitoring quadrats in 17 sampling units, as specified in the project's Mitigation Plan (GES, 2005) (Figure 2).

Woody stem density, diameter, and height measurements were recorded in October 2007 within each of the 60 100-square meter quadrats, as detailed in the Mitigation Plan. The monitoring results, management activities to date, and planned management activities are presented below.

## **RESULTS**

During the October 2007 monitoring, 600 planted woody stems were recorded within the 60 quadrats, resulting in an average density of 405 planted woody stems per acre (Figure 2, Table 1). Additionally, a total of 4,462 native *volunteers* were recorded (3,572 *Acer rubrum* and 791 *Liquidambar styraciflua*) within the monitoring quadrats. All recorded stems combined (i.e. planted + *volunteer*) results in 5,062 total live stems observed (average density of 3,414 woody stems per acre). Average densities for planted woody stems and all live woody stems both indicate that the project has exceeded the success criterion of 320 live woody stems per acre by 27 percent and 967 percent, respectively.

Monitoring data for planted stems indicate that *Fraxinus pennsylvanica* is the most abundant tree species (39.5 percent relative density). *Platanus occidentalis* had the highest relative diameter (17.6 percent relative to all planted species). The average of relative diameter and relative density was calculated for planted species and is presented here as the importance value. Based on this calculation, in 2007 *F. pennsylvanica* replaced *P. occidentalis* as the most important planted species in the project area with a value of 23.2 (Table 1). *P. occidentalis* was the species with the greatest average height (2.36 meters) and the second-highest importance value (17.7). Other important species included *Quercus phellos* (9.1) and *Taxodium distichum* (8.3). Considered collectively, the oaks were first in importance (39.6).

## **MAINTENANCE (COMPLETED AND PLANNED) AND QUALITATIVE OBSERVATIONS**

As reported in the First Annual Monitoring Report (GES, 2005), herbicide application performed early in 2005 to control weedy vegetation resulted in significant mortality among planted stems. As observed in 2005, areas that had a moderately dense canopy of early successional vegetation (e.g. *Conyza canadensis* and *Eupatorium capillifolium*, 60-80 percent foliar cover) experienced a lower planted woody stem mortality. The herbaceous annual, biennial and short-lived perennial *pioneer* species appear to be maintaining soil moisture, which increases available water uptake by the planted individuals and reduces their evapotranspiration. Because planted species success quantitatively and qualitatively appears to be higher in areas with a moderately dense early successional herbaceous overstory, these areas were not sprayed or cut in 2006 or 2007.

Qualitative evaluation in late spring/early summer will identify locations with invasive, exotic woody species, including vines. Manual removal/control of the identified populations will involve machete

and/or gasoline powered string trimmers, and, if necessary, very limited glyphosphate herbicide (Roundup) application, using hand pump or backpack sprayers with nose cone-tipped nozzles. *L. styraciflua* and *A. rubrum*, which are by far the dominant *volunteer* woody stems counted or observed, are both native to southeastern Greene County and will not be removed. No other native woody stems that have colonized the restoration site will be removed, unless it's a necessary and unavoidable part of exotic invasive woody stem removal/management.

During December 2006-January 2007, approximately 6,000 native bare root seedlings were planted including *Fraxinus pennsylvanica*, *Liriodendron tulipifera*, and *Nyssa bicolor*. This, along with several resprouted trees, resulted in an increase in total planted stems from 517 to 600 (16% increase) and led to an increase in average planted stems per acre from 349 to 405.

Although the majority of the planted woody stem high mortality *problem* areas indicated in the 2006 monitoring report were remedied due to the winter 2006-2007 re-plantings, high mortality of re-planted stems was observed in four of those areas (Figure 2). Most of the problem areas are on ridges and mortality of the re-planted stems is most likely due to the severe, on going drought in the area. In early 2008, remedial plantings will occur in the identified problem areas.

Soil fertility/chemistry may also need to be addressed in the problem areas. Representative soil samples will be taken from the identified areas and sent to the NCSU soil laboratory for evaluation. Based on the results, nutrient/organic material application and/or planted species selection will be modified.

Table 1A. Importance Values for Planted Individuals - Little Contentnea Creek Riparian Buffer Restoration - Phase 3 - Greene County, NC

Species	Total Living	Total Dead	Average Height (cm)	Average Diameter (cm)	Relative Diameter (%)	Relative Density (%)	Importance Value
<i>Fraxinus pennsylvanica</i>	237	30	43	0.74	6.94	39.50	23.22
<i>Liriodendron tulipifera</i>	53	76	47	0.68	6.35	8.83	7.59
<i>Nyssa bicolor</i>	20	11	43	0.47	4.44	3.33	3.89
<i>Platanus occidentalis</i>	107	1	236	1.88	17.57	17.83	17.70
<i>Quercus falcata</i>	1	0	46	0.68	6.37	0.17	3.27
<i>Quercus lyrata</i>	11	0	55	0.70	6.57	1.83	4.20
<i>Quercus nigra</i>	40	5	60	0.71	6.66	6.67	6.66
<i>Quercus pagoda</i>	9	0	62	0.75	7.05	1.50	4.28
<i>Quercus phellos</i>	75	8	52	0.62	5.84	12.50	9.17
<i>Quercus rubra</i>	1	0	48	0.59	5.52	0.17	2.85
<i>Quercus virginiana</i>	8	0	79	0.56	5.20	1.33	3.26
<i>Quercus spp.</i>	1	14	36	1.19	11.14	0.17	5.65
<i>Taxodium distichum</i>	37	5	122	1.11	10.35	6.17	8.26

**Total Planted**                600                150  
**Total Volunteers**            4462  
**Total Stems**                    5062  
**Average Planted Stems/Acre**    405  
**Average Stems/Acre**            3414

Table 1B. Volunteer Woody Stems Summary - Little Contentnea Creek - Phase 3

Species	SEEDLING HT CLASS			SAPLINGS DBH		TREES - DBH										Total by Species
	10-50cm	50-100cm	100-137cm	0-1 cm	1-2.5	2.5	5	10	15	20	25	30	35	40		
<i>Acer rubrum</i>	3510	60	1	1	0	0	0	0	0	0	0	0	0	0	0	3572
<i>Baccharis halimifolia</i>	9	6	20	3	0	0	0	0	0	0	0	0	0	0	0	38
<i>Crataegus spp.</i>	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	8
<i>Ilex opaca</i>	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	4
<i>Ligustrum sinensis</i>	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
<i>Liquidambar styraciflua</i>	598	113	35	16	25	0	2	2	0	0	0	0	0	0	0	791
<i>Nyssa biflora</i>	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
<i>Pinus taeda</i>	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
<i>Platanus occidentalis</i>	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
<i>Quercus michauxii</i>	11	5	0	0	0	0	0	0	0	0	0	0	0	0	0	16
<i>Rhus copallinum</i>	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
<i>Salix sp.</i>	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	2
<i>Ulmus americana</i>	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10

Total by Size Class                4162                190                59                21                26                0                2                2                0                0                0                0                0                0

**Total Volunteers**                4462

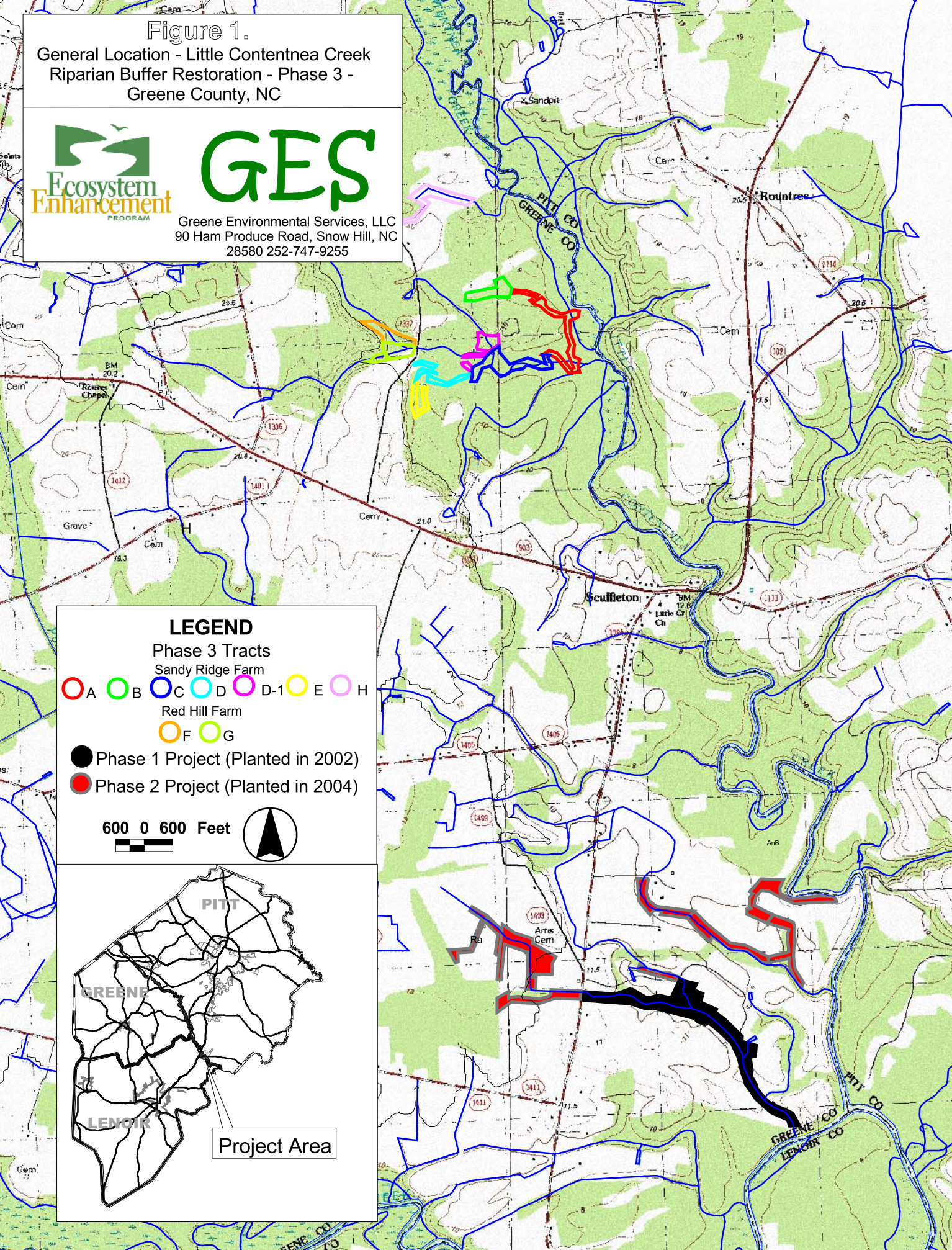
Figure 1.

General Location - Little Contentnea Creek  
Riparian Buffer Restoration - Phase 3 -  
Greene County, NC



# GES

Greene Environmental Services, LLC  
90 Ham Produce Road, Snow Hill, NC  
28580 252-747-9255



### LEGEND

Phase 3 Tracts  
Sandy Ridge Farm

● A ● B ● C ● D ● D-1 ● E ● H

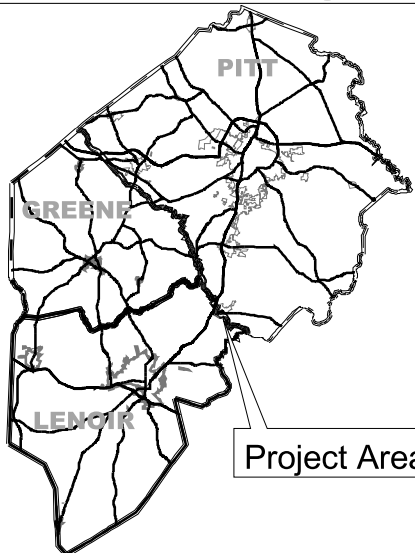
Red Hill Farm

● F ● G

● Phase 1 Project (Planted in 2002)

● Phase 2 Project (Planted in 2004)

600 0 600 Feet



Project Area

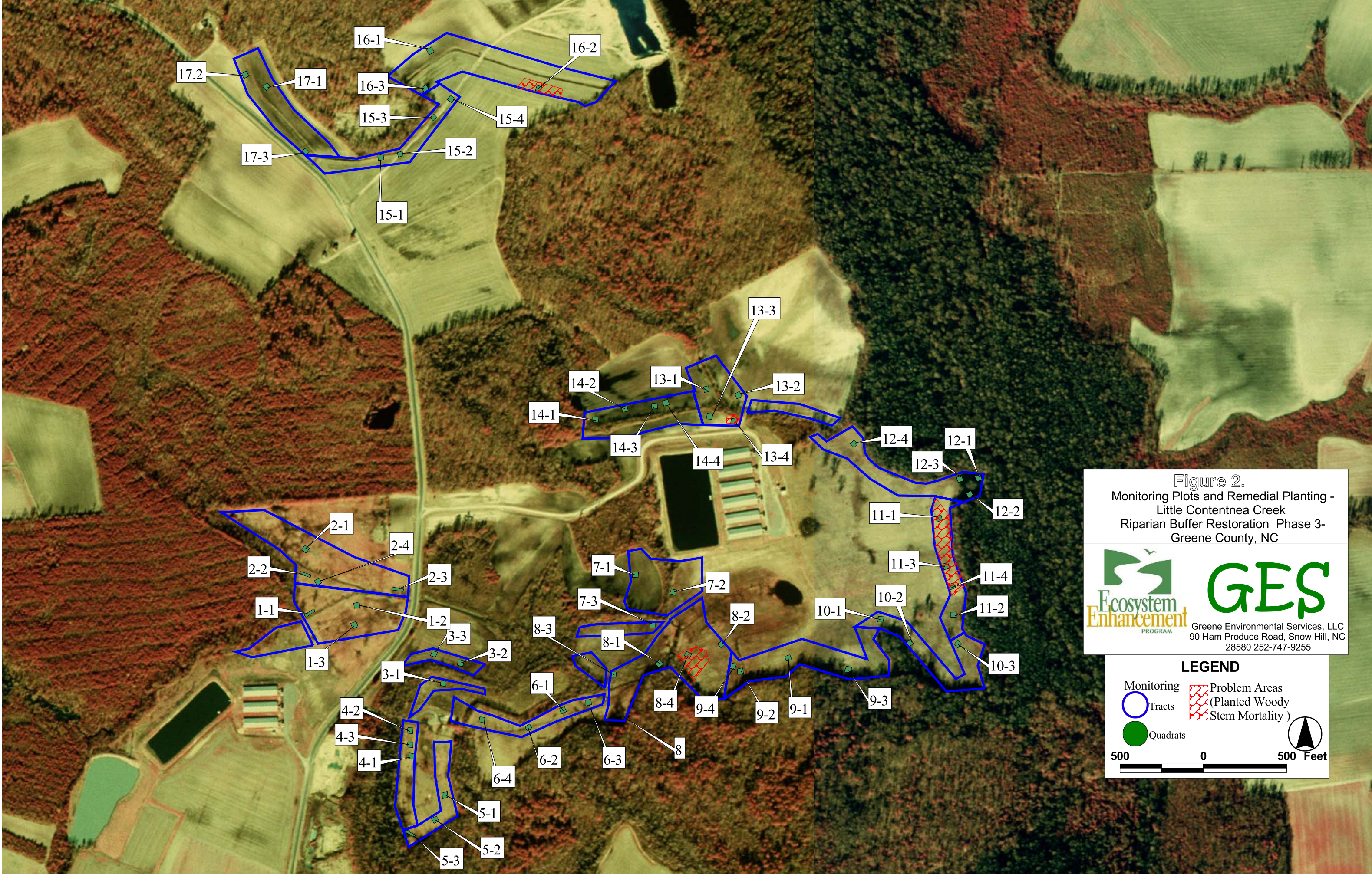


Figure 2.  
 Monitoring Plots and Remedial Planting -  
 Little Contentnea Creek  
 Riparian Buffer Restoration Phase 3-  
 Greene County, NC

**Ecosystem Enhancement PROGRAM**

**GES**  
 Greene Environmental Services, LLC  
 90 Ham Produce Road, Snow Hill, NC  
 28580 252-747-9255

**LEGEND**

- Monitoring Tracts (Blue outline)
- Quadrats (Green circle)
- Problem Areas (Planted Woody Stem Mortality) (Red hatched area)

500 0 500 Feet

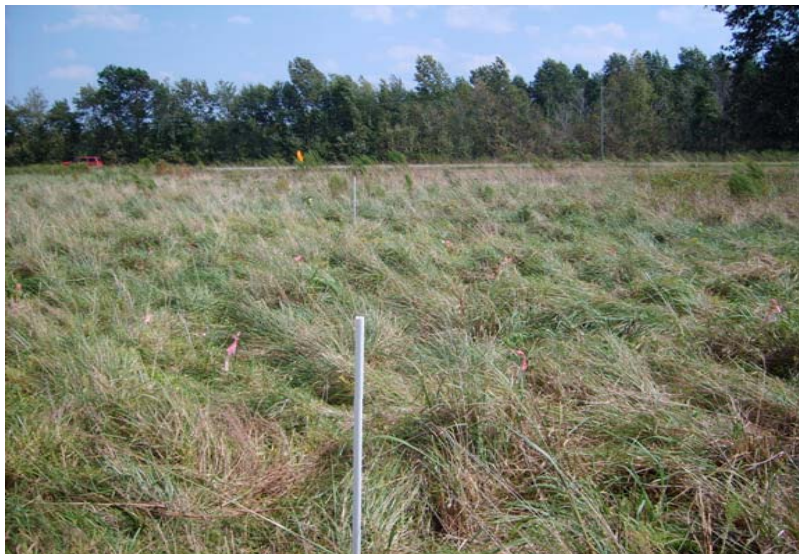
**Permanent Quadrat Photographs - 2007 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3**



**Quadrat 1-1**



**Quadrat 1-2**



**Quadrat 1-3**



**Quadrat 2-1**

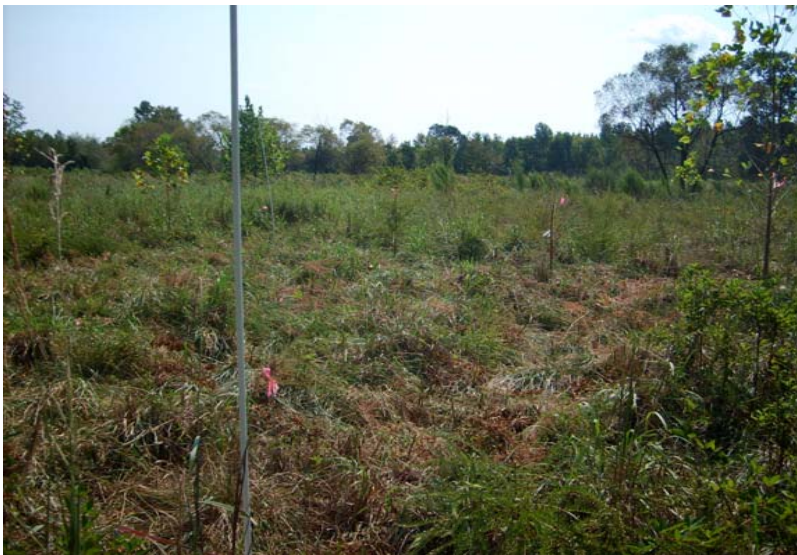
Permanent Quadrat Photographs - 2007 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3



Quadrat 2-2



Quadrat 2-3



Quadrat 2-4



Quadrat 3-1



**Permanent Quadrat Photographs - 2007 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3**



**Quadrat 3-2**



**Quadrat 3-3**



**Quadrat 4-1**



**Quadrat 4-2**

**Permanent Quadrat Photographs - 2007 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3**



**Quadrat 4-3**



**Quadrat 5-1**



**Quadrat 5-2**



**Quadrat 5-3**

**Permanent Quadrat Photographs - 2007 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3**



**Quadrat 6-1**



**Quadrat 6-2**



**Quadrat 6-3**



**Quadrat 6-4**

Permanent Quadrat Photographs - 2007 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3



Quadrat 7-1



Quadrat 7-2



Quadrat 7-3



Quadrat 8-1

Permanent Quadrat Photographs - 2007 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3



Quadrat 8-2



Quadrat 8-3



Quadrat 8-4



Quadrat 9-1

Permanent Quadrat Photographs - 2007 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3



Quadrat 9-2



Quadrat 9-3



Quadrat 9-4



Quadrat 10-1

Permanent Quadrat Photographs - 2007 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3



Quadrat 10-2



Quadrat10-3



Quadrat 11-1



Quadrat 11-2

**Permanent Quadrat Photographs - 2007 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3**



**Quadrat 11-3**



**Quadrat 11-4**



**Quadrat 12-1**



**Quadrat 12-2**



**Permanent Quadrat Photographs - 2007 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3**



**Quadrat 12-3**



**Quadrat 12-4**



**Quadrat 13-1**



**Quadrat 13-2**

**Permanent Quadrat Photographs - 2007 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3**



**Quadrat 13-3**



**Quadrat 13-4**



**Quadrat 14-1**



**Quadrat 14-2**

Permanent Quadrat Photographs - 2007 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3



Quadrat 14-3



Quadrat 14-4



Quadrat 15-1



Quadrat 15-2

**Permanent Quadrat Photographs - 2007 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3**



**Quadrat 15-3**



**Quadrat 15-4**



**Quadrat 16-1**



**Quadrat 16-2**

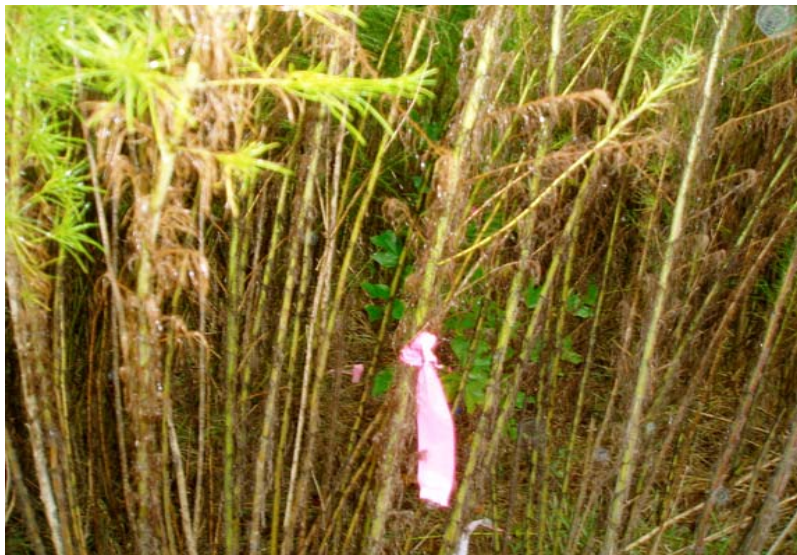
**Permanent Quadrat Photographs - 2007 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3**



**Quadrat 16-3**



**Quadrat 17-1**



**Quadrat 17-2**



**Quadrat 17-3**

































































































































































**Table 36. Plot 11-1 2007 Monitor**

<b>Volunteer woody stems</b>
<i>Acer rubrum</i>
<i>Baccharis halimifolia</i>
<i>Cornus amomum</i>
<i>Crataegus spp.</i>
<i>Ilex opaca</i>
<i>Ligustrum sinensis</i>
<i>Liquidambar styraciflua</i>
<i>Nyssa biflora</i>
<i>Pinus taeda</i>
<i>Platanus occidentalis</i>
<i>Quercus michauxii</i>
<i>Quercus nigra</i>
<i>Rhus copallinum</i>
<i>Salix sp.</i>
<i>Ulmus americana</i>
<b>Total volunteer stems per plot</b>



































## SEEDLING HT CLASS

## SAPLINGS

<b>Volunteer woody stems</b>	10-50cm	50-100cm	100-137cm	0-1 cm
<i>Acer rubrum</i>				
<i>Baccharis halimifolia</i>				
<i>Cornus amomum</i>				
<i>Crataegus spp.</i>				
<i>Ilex opaca</i>				
<i>Ligustrum sinensis</i>				
<i>Liquidambar styraciflua</i>				
<i>Nyssa biflora</i>				
<i>Pinus taeda</i>				
<i>Platanus occidentalis</i>				
<i>Quercus michauxii</i>				
<i>Quercus nigra</i>				
<i>Rhus copallinum</i>				
<i>Salix sp.</i>				
<i>Ulmus americana</i>				
<b>Total volunteer stems per plot</b>		no 0 volunteers		

















































**Table 53. Plot 15-2 2007 Monitoring Data - Little Contentnea Creek Riparian Table 53. Plot 15-2 2007 Monitoring Data - Lit**

<b>Volunteer woody stems</b>	SEEDLING HT CLASS			SAPLINGS
	10-50cm	50-100cm	100-137cm	0-1 cm
<i>Acer rubrum</i>	1			
<i>Baccharis halimifolia</i>		1	1	1
<i>Cornus amomum</i>				
<i>Crataegus spp.</i>				
<i>Ilex opaca</i>				
<i>Ligustrum sinensis</i>				
<i>Liquidambar styraciflua</i>	7	1		
<i>Nyssa biflora</i>				
<i>Pinus taeda</i>				
<i>Platanus occidentalis</i>				
<i>Quercus micheauxii</i>				
<i>Quercus nigra</i>				
<i>Rhus copallinum</i>				
<i>Salix sp.</i>				
<i>Ulmus americana</i>				
<b>Total volunteer stems per plot</b>	12			







**Table 54. Plot 15-3 2007 Monitoring Data - Little Contentnea Creek Riparian Table 54. Plot 15-3 2007 Monitoring Data - Lit**

<b>Volunteer woody stems</b>	SEEDLING HT CLASS			SAPLINGS
	10-50cm	50-100cm	100-137cm	0-1 cm
<i>Acer rubrum</i>				
<i>Baccharis halimifolia</i>			2	1
<i>Cornus amomum</i>				
<i>Crataegus spp.</i>				
<i>Ilex opaca</i>				
<i>Ligustrum sinensis</i>				
<i>Liquidambar styraciflua</i>	8	2	2	
<i>Nyssa biflora</i>				
<i>Pinus taeda</i>				
<i>Platanus occidentalis</i>				
<i>Quercus micheauxii</i>				
<i>Quercus nigra</i>				
<i>Rhus copallinum</i>				
<i>Salix sp.</i>				
<i>Ulmus americana</i>				
<b>Total volunteer stems per plot</b>	15			































