

SECOND ANNUAL MONITORING REPORT – 2006 GROWING SEASON

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



December 2006

Submitted to:



**Guy Pearce
North Carolina Ecosystem Enhancement
Program
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Submitted for:



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90 Ham Produce Road
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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 2006 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 2006 monitoring, 517 planted woody stems were recorded within the 60 quadrats, resulting in an average density of 349 planted woody stems per acre (Figure 2, Table 1). Additionally, a total of 5,111 native *volunteers* were recorded (3,533 *Acer rubrum* and 1,488 *Liquidambar styraciflua*) within the monitoring quadrats. When all recorded stems are combined (i.e. planted + *volunteer*) 5,628 live stems were observed (3,796 stems per acre average, all quadrats). 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 nine percent and 1,186 percent, respectively.

Monitoring data for planted stems indicate that *Fraxinus pennsylvanica* is the most abundant tree species (42.0 percent relative density). *Platanus occidentalis* had the highest relative diameter (41.1 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, *P. occidentalis* was the most important planted species in the project area with a value of 28.5. *P. occidentalis* was also the species with the greatest average height (2.12 meters). *F. pennsylvanica*'s importance value was the second-highest at 24.0 (Table 1).

Taxodium distichum was the third-most important planted tree (10.7). Other important species included *Quercus phellos* (8.6) and *Q. nigra* (7.9). Considered collectively, the oaks were second in importance (25.8).

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. Like 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 will not be sprayed or cut in 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

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(Roundup) application, using hand pump or backpack sprayers with nose cone-tipped nozzles. *L. styraciflua* and *A. negundo*, 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.

Several planted woody stem high mortality *problem* areas were identified during the June 2006 qualitative evaluation, and the October 2006 monitoring. Most of these areas are very close to the mortality areas identified during the 2005 evaluation and monitoring. To offset the planted woody stem mortality in these areas, approximately 6,000 native bare root seedlings will be planted during January and/or February 2007. Additionally, because a more than one full growing season, including dozens of significant precipitation events, has passed since the 2005 herbicide application, soil fertility/chemistry may need to be addressed. 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.

Browsing evidence was observed in a small number of monitoring units during 2006, but is much less common or threatening than in 2005. Threats to planted woody stem success from browsing will continue to be monitored, but the negative impact on stem success is expected continue to lessen as the trees age.

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

Species	Total Live Stems	Total Dead	Average Height (cm)	Average Diameter (cm)	Relative Diameter (%)	Relative Density (%)	Importance Value (%)
Fraxinus americana	2	0	40.4	0.7	5.3	0.4	2.8
Fraxinus pennsylvanica	217	23	44.0	0.7	6.0	42.0	24.0
Liriodendron tulipifera	24	23	41.6	0.7	5.9	4.6	5.3
Platanus occidentalis	82	5	212.0	5.0	41.1	15.9	28.5
Quercus nigra	57	3	52.9	0.6	4.8	11.0	7.9
Quercus pagoda	2	0	57.7	0.7	5.3	0.4	2.8
Quercus phellos	69	8	41.9	0.5	3.9	13.3	8.6
Quercus rubra	9	0	61.6	0.7	5.4	1.7	3.6
Quercus spp.	7	13	60.1	0.5	4.4	1.4	2.9
Taxodium distichum	43	0	88.9	1.6	13.1	8.3	10.7
Nyssa bicolor	5	0	43.6	0.6	4.7	1.0	2.8

Total Planted 517 75
Total Volunteers 5111
Total Stems 5628
Ave/Acre (planted) 349
Ave/Acre (all) 3796

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		
Acer rubrum	3482	51	0	0	0	0	0	0	0	0	0	0	0	0	0	3533
Alnus serrulata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baccharis halimifolia	20	15	5	2	0	0	0	0	0	0	0	0	0	0	0	42
Carpinus caroliniana	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Cornus amomum	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Crataegus spp.	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
Diospyros virginiana	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Ligustrum sinensis	8	8	3	0	0	0	0	0	0	0	0	0	0	0	0	19
Lindera benzoin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Liquidambar styraciflua	1197	252	28	10	0	0	1	0	0	0	0	0	0	0	0	1488
Myrica cerifera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pinus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Quercus micheauxii	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Quercus nigra	3	7	0	0	0	0	0	0	0	0	0	0	0	0	0	10
Rhus copallinum	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Salix sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Vitus spp.	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Total by Size Class	4724	337	37	12	0	0	1	0	0	0	0	0	0	0	0	5111

Total Volunteers 5111

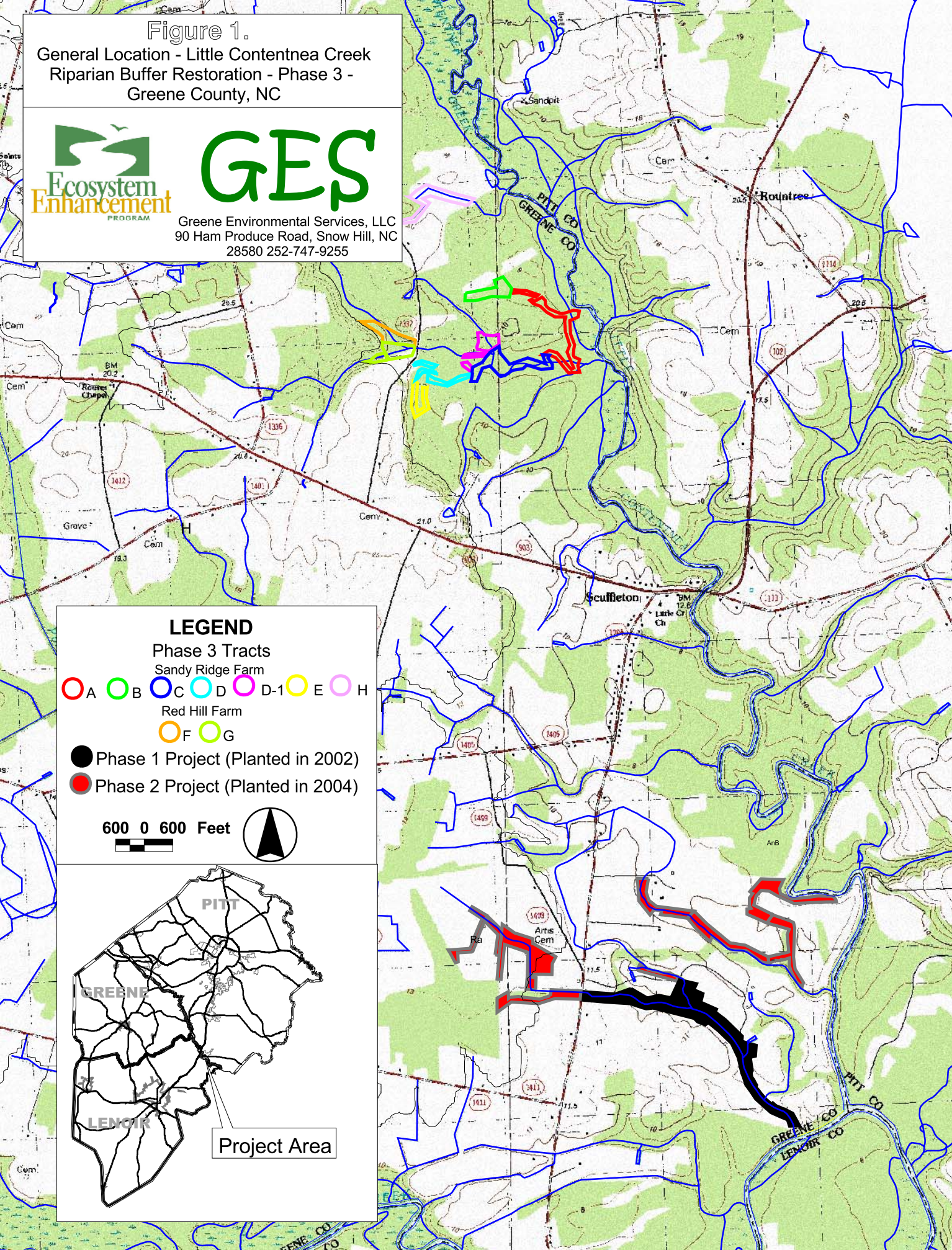
Figure 1.

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



GES

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LEGEND

Phase 3 Tracts
Sandy Ridge Farm

A B C D D-1 E H

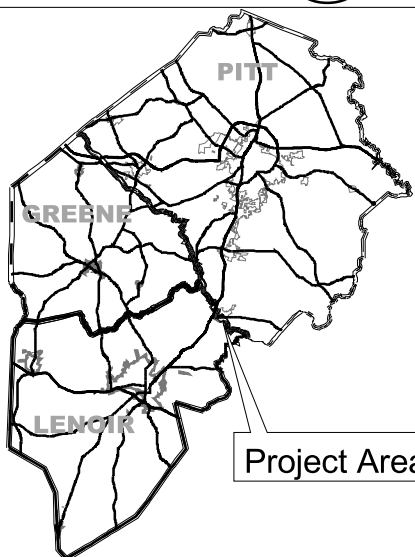
Red Hill Farm

F G

● Phase 1 Project (Planted in 2002)

● Phase 2 Project (Planted in 2004)

600 0 600 Feet



Project Area

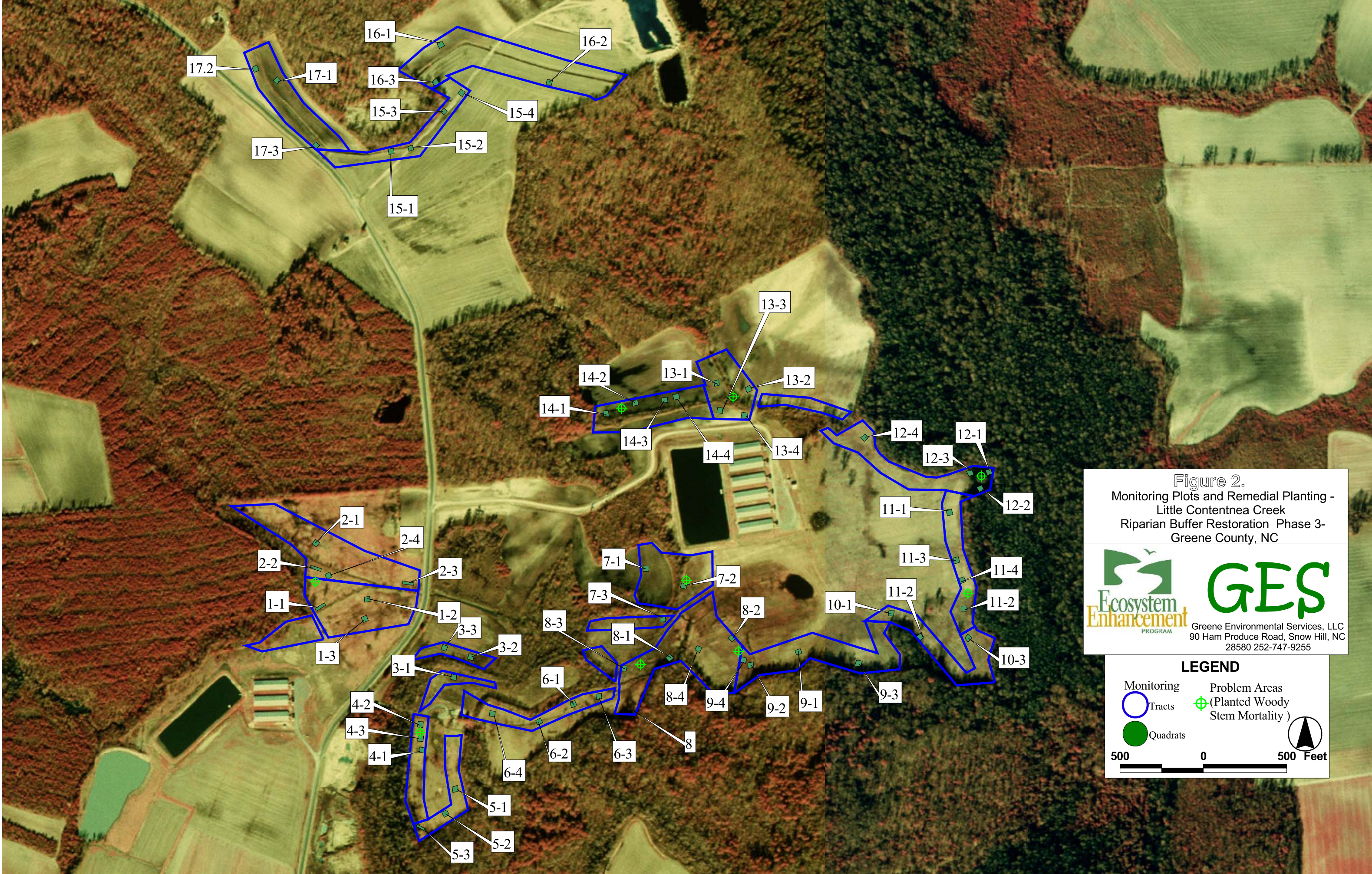


Figure 2.
 Monitoring Plots and Remedial Planting -
 Little Contentnea Creek
 Riparian Buffer Restoration Phase 3-
 Greene County, NC

Ecosystem Enhancement PROGRAM

GES
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LEGEND

Monitoring	Problem Areas
○ Tracts	⊕ (Planted Woody Stem Mortality)
● Quadrats	

500 0 500 Feet

Permanent Quadrat Photographs - 2006 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3



Quadrat 1-1



Quadrat 1-2



Quadrat 1-3



Quadrat 2-1

Permanent Quadrat Photographs - 2006 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3



Quadrat 2-2



Quadrat 2-3



Quadrat 2-4



Quadrat 3-1

Permanent Quadrat Photographs - 2006 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3



Quadrat 3-2



Quadrat 3-3



Quadrat 4-1



Quadrat 4-2

Permanent Quadrat Photographs - 2006 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3



Quadrat 4-3



Quadrat 5-1



Quadrat 5-2



Quadrat 5-3

Permanent Quadrat Photographs - 2006 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3



Quadrat 6-1



Quadrat 6-2



Quadrat 6-3



Quadrat 6-4

Permanent Quadrat Photographs - 2006 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3



Quadrat 7-1



Quadrat 7-2



Quadrat 7-3



Quadrat 8-1

Permanent Quadrat Photographs - 2006 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3



Quadrat 8-2



Quadrat 8-3



Quadrat 8-4



Quadrat 9-1

Permanent Quadrat Photographs - 2006 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3



Quadrat 9-2



Quadrat 9-3



Quadrat 9-4



Quadrat 10-1

Permanent Quadrat Photographs - 2006 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3



Quadrat 10-2



Quadrat 10-3



Quadrat 11-1



Quadrat 11-2

Permanent Quadrat Photographs - 2006 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3



Quadrat 11-3



Quadrat 11-4



Quadrat 12-1



Quadrat 12-2

Permanent Quadrat Photographs - 2006 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3



Quadrat 12-3



Quadrat 12-4



Quadrat 13-1



Quadrat 13-2

Permanent Quadrat Photographs - 2006 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3



Quadrat 13-3



Quadrat 13-4



Quadrat 14-1



Quadrat 14-2

Permanent Quadrat Photographs - 2006 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3



Quadrat 14-3



Quadrat 14-4



Quadrat 15-1



Quadrat 15-2

Permanent Quadrat Photographs - 2006 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3



Quadrat 15-3



Quadrat 15-4



Quadrat 16-1



Quadrat 16-2

Permanent Quadrat Photographs - 2006 - Little Contentnea Creek Riparian Buffer Restoration - Phase 3



Quadrat 16-3



Quadrat 17-1



Quadrat 17-2



Quadrat 17-3

Table 7. Plot 2-3. 2006 Monitoring Data - Little Contentnea Creek Riparian Buffer Restoration - Phase 3 - Greene County, NC.

Species	Average Diameter (cm)	Average Height (cm)	Total Live Stems	Total Dead	Diameter (cm)	Height (cm)	Diameter (cm)	Height (cm)
<i>Fraxinus americana</i>			0.00	0.00				
<i>Fraxinus pennsylvanica</i>	0.59	56.00	8.00	0.00	0.6	50.6	0.8	51.2
<i>Liriodendron tulipifera</i>			0.00	0.00				
<i>Platanus occidentalis</i>			0.00	0.00				
<i>Quercus nigra</i>	1.05	63.63	4.00	0.00				
<i>Quercus pagoda</i>			0.00	0.00				
<i>Quercus phellos</i>	0.50	47.20	1.00	0.00				
<i>Quercus rubra</i>			0.00	0.00				
<i>Quercus spp.</i>			0.00	1.00				
<i>Taxodium distichum</i>			0.00	0.00				
<i>Nyssa bicolor</i>			0.00	0.00				
Total planted stems per plot			13.00	1.00				
Total planted stems per acre			526.11					

Table 10. Plot 3-2. 2006 Monitoring Data - Little Contentnea Creek Riparian Buffer Restoration - Phase 3 - Greene County, NC.

Species	Average Diameter (cm)	Average Height (cm)	Total Live Stems	Total Dead	Diameter (cm)	Height (cm)	Diameter (cm)	Height (cm)	Diameter (cm)	Height (cm)
<i>Fraxinus americana</i>			0.00	0.00						
<i>Fraxinus pennsylvanica</i>	0.60	49.18	9.00	0.00	0.5	67.1	0.6	42.7	0.5	39.6
<i>Liriodendron tulipifera</i>			0.00	0.00						
<i>Platanus occidentalis</i>			0.00	0.00						
<i>Quercus nigra</i>	0.77	56.90	3.00	0.00						
<i>Quercus pagoda</i>			0.00	0.00						
<i>Quercus phellos</i>			0.00	0.00						
<i>Quercus rubra</i>			0.00	0.00						
<i>Quercus spp.</i>			0.00	0.00						
<i>Taxodium distichum</i>	1.35	101.35	2.00	0.00						
<i>Nyssa bicolor</i>			0.00	0.00						
Total planted stems per plot			14.00	0.00						
Total planted stems per acre			566.58							

Table 22. Plot 7-1. 2006 Monitoring Data - Little Contentnea Creek Riparian Buffer Restoration - Phase 3 - Greene County, NC.

Species	Average Diameter (cm)	Average Height (cm)	Total Live Stems	Total Dead	Diameter (cm)	Height (cm)	Diameter (cm)	Height (cm)	Diameter (cm)	Height (cm)
<i>Fraxinus americana</i>			0.00	0.00						
<i>Fraxinus pennsylvanica</i>	0.81	31.16	9.00	0.00	0.8	22.9	0.7	27.4	0.5	33.5
<i>Liriodendron tulipifera</i>	0.50	14.80	2.00	2.00						
<i>Platanus occidentalis</i>			0.00	0.00						
<i>Quercus nigra</i>			0.00	0.00						
<i>Quercus pagoda</i>			0.00	0.00						
<i>Quercus phellos</i>			0.00	0.00						
<i>Quercus rubra</i>			0.00	0.00						
<i>Quercus spp.</i>			0.00	0.00						
<i>Taxodium distichum</i>			0.00	0.00						
<i>Nyssa bicolor</i>			0.00	0.00						
Total planted stems per plot			11.00	2.00						
Total planted stems per acre			445.17							

Table 24. Plot 7-3. 2006 Monitoring Data - Little Contentnea Creek Riparian Buffer Restoration - Phase 3 - Greene County, NC.

Species	Average Diameter (cm)	Average Height (cm)	Total Live Stems	Total Dead	Diameter (cm)	Height (cm)	Diameter (cm)	Height (cm)
<i>Fraxinus americana</i>			0.00	0.00				
<i>Fraxinus pennsylvanica</i>	1.00	30.50	1.00	0.00				
<i>Liriodendron tulipifera</i>			0.00	0.00				
<i>Platanus occidentalis</i>	1.30	185.18	8.00	0.00	1.7	125	0.5	24.4
<i>Quercus nigra</i>			0.00	0.00				
<i>Quercus pagoda</i>			0.00	0.00				
<i>Quercus phellos</i>			0.00	0.00				
<i>Quercus rubra</i>			0.00	0.00				
<i>Quercus spp.</i>			0.00	0.00				
<i>Taxodium distichum</i>			0.00	0.00				
<i>Nyssa bicolor</i>			0.00	0.00				
Total planted stems per plot			9.00	0.00				
Total planted stems per acre			364.23					

Table 53. Plot 15-2. 2006 Monitoring Data - Little Contentnea Creek Riparian Buffer Restoration - Phase 3 - Greene County, NC.

Species	Average Diameter (cm)	Average Height (cm)	Total Live Stems	Total Dead	Diameter (cm)	Height (cm)	Diameter (cm)	Height (cm)	Diameter (cm)	Height (cm)
<i>Fraxinus americana</i>			0.00	0.00						
<i>Fraxinus pennsylvanica</i>			0.00	0.00						
<i>Liriodendron tulipifera</i>			0.00	0.00						
<i>Platanus occidentalis</i>			0.00	0.00						
<i>Quercus nigra</i>	0.56	49.79	9.00	0.00	1.1	36.6	0.2	18.3	0.2	21.3
<i>Quercus pagoda</i>			0.00	0.00						
<i>Quercus phellos</i>	0.38	32.38	4.00	0.00						
<i>Quercus rubra</i>	0.70	54.90	1.00	0.00						
<i>Quercus spp.</i>	1.10	140.20	1.00	0.00						
<i>Taxodium distichum</i>			0.00	0.00						
<i>Nyssa bicolor</i>			0.00	0.00						
Total planted stems per plot			15.00	0.00						
Total planted stems per acre			607.05							

Table 57. Plot 16-2. 2006 Monitoring Data - Little Contentnea Creek Riparian Buffer Restoration - Phase 3 - Greene County, NC.

Species	Average Diameter (cm)	Average Height (cm)	Total Live Stems	Total Dead	Diameter (cm)	Height (cm)	Diameter (cm)	Height (cm)	Diameter (cm)	Height (cm)
<i>Fraxinus americana</i>			0.00	0.00						
<i>Fraxinus pennsylvanica</i>	0.69	48.80	10.00	5.00	d	d	d	d	d	d
<i>Liriodendron tulipifera</i>			0.00	1.00						
<i>Platanus occidentalis</i>			0.00	0.00						
<i>Quercus nigra</i>			0.00	0.00						
<i>Quercus pagoda</i>			0.00	0.00						
<i>Quercus phellos</i>			0.00	0.00						
<i>Quercus rubra</i>			0.00	0.00						
<i>Quercus spp.</i>			0.00	1.00						
<i>Taxodium distichum</i>			0.00	0.00						
<i>Nyssa bicolor</i>			0.00	0.00						
Total planted stems per plot			10.00	7.00						
Total planted stems per acre			404.7							

