



# **Fifth Annual Monitoring Report – 2010 Growing Season**

## **Moccasin Creek Riparian Buffer Restoration (EEP Contract: 005015)**

**December 2010**



**Submitted to:**

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## Introduction and Background

On 27 June 2005 the NC Ecosystem Enhancement Program awarded Greene Environmental Services a contract to restore 20.2 acres of riparian buffer along un-named tributaries to Moccasin Creek in southeastern Johnston County, NC (Figure 1). The project area is approximately 2.75 miles south of Princeton along Moccasin Creek's western bank. The unnamed tributary that the buffer surrounds confluent Moccasin Creek immediately to the southeast of the restoration site, approximately 7.5 stream miles north of its confluence with the Neuse River (Figure 1). The entire project lies on the Danny Kornegay Farm in USGS Hydrologic Unit 03020201160010. Hay fields and cattle pastures adjacent to the buffers receive liquid hog waste from the farm and typically have 65 cow/calf pairs rotating between fields.

The Moccasin Creek Riparian Buffer Restoration Plan was implemented in February 2006 with site preparation and the planting of approximately 9,700 bare root hardwood saplings of six species and 2,000 bald cypress saplings. Planted woody stem density, location, diameter, and height monitoring was conducted in November 2010 inside 17, 100 square meter (10m x 10m ) quadrats, pursuant to the 2006 CVS-EEP protocol for monitoring vegetation. The monitoring results, management activities to date, identified problem areas, and planned management activities are presented below.

## Results

During the 2010 monitoring, eight planted species with a total of 233 stems and five volunteer species with a total of 592 stems were recorded in the 17 monitoring plots (Table 1). Of the planted species, *Fraxinus pennsylvanica* was the most dominant, with a calculated Importance Value of 91.6 (Table 1). *Taxodium distichum* and *Platanus occidentalis* were the second and third most dominant planted species with Importance Values of 83.1 and 51.3, respectively. When calculating Importance Values inclusive of both planted and volunteer species, *Liquidambar styraciflua* superseded the above species with a value of 107.0 followed by *Fraxinus pennsylvanica* (42.3) *Taxodium distichum* (42.0) and *Liriodendron tulipifera* (39.0).

An average of 13 planted stems per plot was recorded among the 17 plots, thus an average of 531 planted stems per acre (Table 2). Tract B had the highest average planted stems per plot, 14 stems per plot or 557 planted stems per acre and Tract C had the lowest average planted stems per plot, 11 stems or 482 planted stems per acre (Table 2). Inclusive of both planted and volunteer species, Tract D had the highest number of total stems per acre, 3725 total stems per

acre, and Tract B had the lowest, 759 total stems per acre. The calculated stems per acre based on plot totals indicated that all 17 plots exceeded the required 320 stems per acre minimum; the highest plot value was Plot D-2 with 243 total stems per plot or 9838 total stems per acre. Plot C-4 had the lowest total stems per plot 10, or 405 total stems per acre (Tables 2 and 3).

A comparison of the 2009 to the 2010 annual monitoring data indicated no change in the total number of planted stems recorded but number of volunteer stems more than doubled, 272 in 2009 compared to 592 in 2010; this may be consequence of new volunteer recruits (colonizers) and/or sampling error associated with recording seedlings (Table 4). Additionally, in 2010, *Platanus occidentalis* replaced *Liriodendron tulipifera* as the third highest ranking planted species based on importance value calculations.

### **Qualitative Observations and Maintenance**

During the 2010 growing season, all major planted tree species increased in height relative to the previous year. The average increase in height for *Platanus occidentalis* was approximately 2 m, and *Liriodendron tulipifera*, approximately 1.5 m, and *Fraxinus pennsylvanica* and *Taxodium distichum*, approximately 1 m (Table 1). Grazing by deer appeared lighter than previous years, especially for *Fraxinus pennsylvanica*, however, beavers removed some planted trees in the vicinity of plots C-4, C-5 and D-4. To reduce excessive flooding on adjacent farmland, periodic beaver control and ditch maintenance will be undertaken. During December 2010, approximately 100 *Nyssa sylvatica* bareroot seedlings and 10 containerized *Quercus virginiana* were planted in areas affected by beavers.

### **Five Year Summary**

Table 6 provides a summary of plots stem counts and calculated stems per acre for planted and combined planted and volunteer stem for each of the five monitoring year beginning in 2006 and completed in 2010. Plot B-2 had the greatest increase in planted stems from the first to fifth year; per plot, 10 stems or 405 stems per acre. Plot D-1 had the greatest loss of planted stems over the five year period; a loss of 9 stems or 364 stems per acre (Table 6). A combined planted and volunteer stems count indicated that the greatest increase was in plot A-2; 165 new stems or 6680 stems per acre. Plot D-2 experienced the greatest loss in total stems; 101 stems or 4089 stems per acre. Table 7 provides a summary of the average number of planted and total stems per plot as well as the calculated stems per acre for each monitoring year. Over the five year monitoring period the average number of planted stems in all 17 plots was very consistent; 14 stems per plot (548 stems per acre) for the first year and 13 stems per plot (average, 539 stems per acre) for the remaining four years (Table 7). Combining planted and volunteer stems among the 17 plots for each of the five years indicates that the fifth monitoring year (2010) had the highest number of stems per plot, 48 stems or 1939 stems per acre. The lowest average total stem count was for the third monitoring year (2008) with an average of 29 total stems per plot or 1184 stems per acre.

Table 1. Summary Data by Species – 2010 Vegetation Monitoring, Year 5. Moccasin Creek Riparian Buffer Restoration – Johnston County, NC.  
Greene Environmental Services, LLC.

Species	Total Number of Stems	Average Height ± Std dev. (cm)	Average DBH/DGH ± Std dev. (cm)	Average Status* ± Std dev.	Planted Species Relative Frequency (RFrq)	Planted Species Relative Density (RDen)	Planted Species Relative Dominance (RDom)	Planted Species Importance Value (RFrq+RDen+RDom) (Ranked)	Combined Planted and Volunteer Species Importance Value (RFrq+RDen+RDom) (Ranked)
<b>Planted Species</b>									
<i>Fraxinus pennsylvanica</i>	77	312±141	3.0±1.6	1.1±0.3	30.4	34.5	26.7	91.6 (1)	42.3 (2)
<i>Liriodendron tulipifera</i>	39	453±183	4.2±2.5	1.0±0.0	13.0	17.5	19.0	49.5 (4)	23.0 (6)
<i>Nyssa sp.</i>	7	267±125	2.4±1.6	1.0±0.0	4.3	3.1	1.9	9.3 (5)	4.5 (8)
<i>Platanus occidentalis</i>	30	534±193	5.9±3.1	1.0±0.0	17.4	13.5	20.4	51.3 (3)	25.3 (5)
<i>Quercus michauxii</i>	3	123±75	1.7±0.6	1.3±0.6	4.3	1.3	0.6	6.2 (6)	3.3 (9)
<i>Quercus pagoda</i>	1	60±0	1.0±0.0	2.0±0.0	2.2	0.4	0.1	2.7 (8)	1.5 (12t)
<i>Quercus rubra</i>	3	167±115	1.2±0.3	1.0±0.0	4.3	1.3	0.4	6 (7)	3.2 (10)
<i>Taxodium distichum</i>	63	361±129	4.2±2.0	1.0±0.1	23.9	28.3	30.9	83.1 (2)	39.0 (3)
Totals	223	----	----	----	100.0	100.0	100.0	300	----
<b>Volunteer Species</b>									
					Volunteer Species Relative Frequency (RFrq)	Volunteer Species Relative Density (RDen)	Volunteer Species Relative Dominance (RDom)	Volunteer Species Importance Value (RFrq+RDen+RDom) (Ranked)	----
<i>Acer rubrum</i>	142	103±96	0.6±0.6	1.0±0.0	38.7	24.0	12.8	75.5 (2)	38.8 (4)
<i>Carya sp.</i>	2	250±100	1.5±0.5	1.0±0.0	6.5	0.3	0.4	7.2 (4)	3.0 (11)
<i>Liquidambar styraciflua</i>	437	192±124	1.4±0.4	1.0±0.0	38.7	73.8	83.8	196.3 (1)	107.0 (1)
<i>Pinus taeda</i>	10	171±94	2.0±1.3	1.0±0.0	12.9	1.7	2.7	17.3 (3)	7.7 (7)
<i>Prunus serotina</i>	1	300±0	2.0±0.0	1.0±0.0	3.2	0.2	0.3	3.7 (5)	1.5 (12t)
Totals	592	----	----	----	100.0	100.0	100.0	300	300.0

\*Status was a determined by a visual assessment of plant vigor; 1 = good, 2 = intermediate, 3 = poor.

Table 2. Summary Data by Plot - 2010 Vegetation Monitoring, Year 5. Moccasin Creek Riparian Buffer Restoration – Johnston County, NC.  
Greene Environmental Services, LLC.

<b>Plot</b>	<b>Planted Stems/Plot</b>	<b>Planted Stems/Acre</b>	<b>Volunteer Stems/Plot</b>	<b>Volunteer Stems/Acre</b>	<b>Total Stems/Plot</b>	<b>Total Stems/Acre</b>
A-1	13	526	0	0	13	526
A-2	12	486	153	6194	165	6680
A-3	10	405	3	121	13	526
A-4	18	729	17	688	35	1417
<b>M<sub>x</sub> for A</b>	<b>13</b>	<b>537</b>	<b>43</b>	<b>1751</b>	<b>57</b>	<b>2287</b>
B-1	10	405	7	283	17	688
B-2	15	607	1	40	16	648
B-3	15	607	10	405	25	1012
B-4	15	607	2	81	17	688
<b>M<sub>x</sub> for B</b>	<b>14</b>	<b>557</b>	<b>5</b>	<b>202</b>	<b>19</b>	<b>759</b>
C-1	16	648	0	0	16	648
C-2	10	405	3	121	13	526
C-3	13	526	8	324	21	850
C-4	9	364	1	40	10	405
C-5	13	526	73	2955	86	3482
<b>M<sub>x</sub> for C</b>	<b>11</b>	<b>428</b>	<b>15</b>	<b>602</b>	<b>25</b>	<b>1013</b>
D-1	10	405	56	2267	66	2672
D-2	13	526	230	9312	243	9838
D-3	19	769	25	1012	44	1781
D-4	12	486	3	121	15	607
<b>M<sub>x</sub> for D</b>	<b>14</b>	<b>547</b>	<b>79</b>	<b>3178</b>	<b>92</b>	<b>3725</b>
<b>Overall Average (<math>\bar{x}</math>)</b>	<b>13</b>	<b>531</b>	<b>35</b>	<b>1410</b>	<b>48</b>	<b>1941</b>



Table 3. Species Counts by Plot - 2010 Vegetation Monitoring, Year 5. Moccasin Creek Riparian Buffer Restoration – Johnston County, NC.  
Greene Environmental Services, LLC.

<b>Species (Common name)</b>	<b>A-1</b>	<b>A-2</b>	<b>A-3</b>	<b>A-4</b>	<b>B-1</b>	<b>B-2</b>	<b>B-3</b>	<b>B-4</b>	<b>C-1</b>	<b>C-2</b>	<b>C-3</b>	<b>C-4</b>	<b>C-5</b>	<b>D-1</b>	<b>D-2</b>	<b>D-3</b>	<b>D-4</b>
<b>Planted Species</b>																	
<i>Fraxinus pennsylvanica</i> (Green ash)		8	1		4	11	5	7	7	9	3	4	3	8		5	2
<i>Liriodendron tulipifera</i> (Tulip poplar)	7			8					3				4		7	10	
<i>Nyssa sp.</i> (Black gum)								2				5					
<i>Platanus occidentalis</i> (Sycamore)	2			9	6			1	5					2	3	2	
<i>Quercus michauxii</i> (Swamp chestnut oak)	2		1														
<i>Quercus pagoda</i> (Cherrybark oak)				1													
<i>Quercus rubra</i> (Red oak)	2												1				
<i>Taxodium distichum</i> (Bald cypress)		4	8			4	10	5	1	1	10		5		3	2	10
<b>Totals (Planted)</b>	<b>13</b>	<b>12</b>	<b>10</b>	<b>18</b>	<b>10</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>16</b>	<b>10</b>	<b>13</b>	<b>9</b>	<b>13</b>	<b>10</b>	<b>13</b>	<b>19</b>	<b>12</b>
<b>Volunteer Species</b>																	
<i>Acer rubrum</i> (Red maple)		52		1	2		10	1		1	1	1	23	20	25	4	
<i>Carya sp.</i> (Hicckory)				1													
<i>Liquidambar styraciflua</i> (Sweetgum)		100	3	15	5			1		2	7		50	31	200	20	3
<i>Pinus taeda</i> (Loblolly pine)		1												3	5	1	
<i>Prunus serotina</i> (Black cherry)						1											
<b>Totals (Volunteer)</b>	<b>0</b>	<b>153</b>	<b>3</b>	<b>17</b>	<b>7</b>	<b>1</b>	<b>10</b>	<b>2</b>	<b>0</b>	<b>3</b>	<b>8</b>	<b>1</b>	<b>73</b>	<b>55</b>	<b>230</b>	<b>25</b>	<b>3</b>
<b>Combined Totals</b>	<b>13</b>	<b>165</b>	<b>13</b>	<b>35</b>	<b>17</b>	<b>16</b>	<b>25</b>	<b>17</b>	<b>16</b>	<b>13</b>	<b>21</b>	<b>10</b>	<b>86</b>	<b>65</b>	<b>243</b>	<b>44</b>	<b>15</b>



Table 4. Comparison of Key Parameters from 2009 to 2010 Annual Monitoring Data. 2010 Vegetation Monitoring, Year 5. Moccasin Creek Riparian Buffer Restoration – Johnston County, NC. Greene Environmental Services, LLC.

<b>Parameter</b>	<b>Monitoring Year 2009</b>	<b>Monitoring Year 2010</b>
Total number of planted stems (17 plots)	233	223
Total number of volunteer stems (17 plots)	272	592
Average number of planted stems per acre	555	531
Average number of planted and volunteer stems combined per acre	1203	1941
Average number of planted stems per acre in Tract A	536	537
Average number of planted stems per acre in Tract B	587	557
Average number of planted stems per acre in Tract C	461	428
Average number of planted stems per acre in Tract D	607	547
Importance value three most abundant planted species	<i>Fraxinus pennsylvanica</i> (91.2) <i>Taxodium distichum</i> (71.3) <i>Liriodendron tulipifera</i> (58.2)	<i>Fraxinus pennsylvanica</i> (91.6) <i>Taxodium distichum</i> (83.1) <i>Platanus occidentalis</i> (51.3)
Importance value of three most abundant volunteer species	<i>Liquidambar styraciflua</i> (207.3) <i>Acer rubrum</i> (49.4) <i>Pinus taeda</i> (27.0)	<i>Liquidambar styraciflua</i> (196.3) <i>Acer rubrum</i> (75.5) <i>Pinus taeda</i> (17.3)
Importance value of three most abundant planted and volunteer species combined	<i>Liquidambar styraciflua</i> (88.5) <i>Fraxinus pennsylvanica</i> (53.3) <i>Taxodium distichum</i> (42.0)	<i>Liquidambar styraciflua</i> (107.0) <i>Fraxinus pennsylvanica</i> (42.3) <i>Taxodium distichum</i> (39.0)











A-4	<i>Liquidambar styraciflua</i>	700	2	1
A-4	<i>Liquidambar styraciflua</i>	700	2	1
A-4	<i>Liquidambar styraciflua</i>	700	2	1
A-4	<i>Liquidambar styraciflua</i>	700	2	1
A-4	<i>Liquidambar styraciflua</i>	700	2	1
A-4	<i>Liquidambar styraciflua</i>	700	2	1
A-4	<i>Platanus occidentalis</i>	600	7	1
A-4	<i>Platanus occidentalis</i>	700	8.5	1
A-4	<i>Platanus occidentalis</i>	700	10	1
A-4	<i>Platanus occidentalis</i>	650	9	1
A-4	<i>Platanus occidentalis</i>	600	7	1
A-4	<i>Platanus occidentalis</i>	650	6	1
A-4	<i>Platanus occidentalis</i>	650	5.5	1
A-4	<i>Platanus occidentalis</i>	800	10	1
A-4	<i>Platanus occidentalis</i>	500	7.5	1
B-1	<i>Fraxinus pennsylvanica</i>	600	8	1
B-1	<i>Fraxinus pennsylvanica</i>	400	3.5	1
B-1	<i>Fraxinus pennsylvanica</i>	200	1	1
B-1	<i>Fraxinus pennsylvanica</i>	450	4	1
B-1	<i>Acer rubrum</i>	50	0.5	1
B-1	<i>Acer rubrum</i>	50	0.2	1
B-1	<i>Liquidambar styraciflua</i>	300	1	1
B-1	<i>Liquidambar styraciflua</i>	300	1	1
B-1	<i>Liquidambar styraciflua</i>	300	1	1
B-1	<i>Liquidambar styraciflua</i>	300	1	1
B-1	<i>Liquidambar styraciflua</i>	400	3.5	1
B-1	<i>Platanus occidentalis</i>	700	7.5	1
B-1	<i>Platanus occidentalis</i>	800	10	1
B-1	<i>Platanus occidentalis</i>	900	11	1
B-1	<i>Platanus occidentalis</i>	850	10	1
B-1	<i>Platanus occidentalis</i>	600	9	1
B-1	<i>Platanus occidentalis</i>	700	8	1
B-2	<i>Fraxinus pennsylvanica</i>	350	5	1
B-2	<i>Fraxinus pennsylvanica</i>	200	1	1
B-2	<i>Fraxinus pennsylvanica</i>	350	5	1
B-2	<i>Fraxinus pennsylvanica</i>	300	3	1
B-2	<i>Fraxinus pennsylvanica</i>	450	6	1
B-2	<i>Fraxinus pennsylvanica</i>	450	6	1
B-2	<i>Fraxinus pennsylvanica</i>	400	5	1
B-2	<i>Fraxinus pennsylvanica</i>	450	4	1

B-2	<i>Fraxinus pennsylvanica</i>	400	5	1
B-2	<i>Fraxinus pennsylvanica</i>	500	4	1
B-2	<i>Fraxinus pennsylvanica</i>	400	5	1
B-2	<i>Prunus serotina</i>	300	2	1
B-2	<i>Taxodium distichum</i>	150	1	1
B-2	<i>Taxodium distichum</i>	400	4	1
B-2	<i>Taxodium distichum</i>	400	4.5	1
B-2	<i>Taxodium distichum</i>	150	1	1
B-3	<i>Fraxinus pennsylvanica</i>	285	3	1
B-3	<i>Fraxinus pennsylvanica</i>	300	2.5	1
B-3	<i>Fraxinus pennsylvanica</i>	250	2	1
B-3	<i>Fraxinus pennsylvanica</i>	220	3	1
B-3	<i>Fraxinus pennsylvanica</i>	240	1.5	1
B-3	<i>Taxodium distichum</i>	400	5.5	1
B-3	<i>Taxodium distichum</i>	300	3	1
B-3	<i>Taxodium distichum</i>	320	4	1
B-3	<i>Taxodium distichum</i>	450	5.5	1
B-3	<i>Taxodium distichum</i>	300	3	1
B-3	<i>Taxodium distichum</i>	300	4	1
B-3	<i>Taxodium distichum</i>	400	5.5	1
B-3	<i>Taxodium distichum</i>	400	5	1
B-3	<i>Taxodium distichum</i>	400	7	1
B-3	<i>Taxodium distichum</i>	400	5	1
B-3	<i>Acer rubrum</i>	270	1.5	1
B-3	<i>Acer rubrum</i>	155	0.5	1
B-3	<i>Acer rubrum</i>	150	0.5	1
B-3	<i>Acer rubrum</i>	140	0.5	1
B-3	<i>Acer rubrum</i>	230	2	1
B-3	<i>Acer rubrum</i>	150	0.5	1
B-3	<i>Acer rubrum</i>	120	0.5	1
B-3	<i>Acer rubrum</i>	80	0.5	1
B-3	<i>Acer rubrum</i>	120	0.5	1
B-3	<i>Acer rubrum</i>	120	0.5	1
B-4	<i>Fraxinus pennsylvanica</i>	165	2	1
B-4	<i>Fraxinus pennsylvanica</i>	450	5	1
B-4	<i>Fraxinus pennsylvanica</i>	400	3	1
B-4	<i>Fraxinus pennsylvanica</i>	400	2	1
B-4	<i>Fraxinus pennsylvanica</i>	300	3.5	1
B-4	<i>Fraxinus pennsylvanica</i>	400	5	1
B-4	<i>Fraxinus pennsylvanica</i>	350	4	1



B-4	<i>Nyssa sp.</i>	300	2	1
B-4	<i>Nyssa sp.</i>	170	1	1
B-4	<i>Taxodium distichum</i>	350	4	1
B-4	<i>Taxodium distichum</i>	450	8	1
B-4	<i>Taxodium distichum</i>	450	8	1
B-4	<i>Taxodium distichum</i>	350	5.5	1
B-4	<i>Taxodium distichum</i>	325	4	1
B-4	<i>Acer rubrum</i>	100	0.5	1
B-4	<i>Liquidambar styraciflua</i>	150	1	1
B-4	<i>Platanus occidentalis</i>	300	2.5	1
C-1	<i>Fraxinus pennsylvanica</i>	200	1.5	1
C-1	<i>Fraxinus pennsylvanica</i>	200	1	1
C-1	<i>Fraxinus pennsylvanica</i>	300	2	1
C-1	<i>Fraxinus pennsylvanica</i>	250	2	1
C-1	<i>Fraxinus pennsylvanica</i>	300	4	1
C-1	<i>Fraxinus pennsylvanica</i>	350	3	1
C-1	<i>Fraxinus pennsylvanica</i>	250	3	1
C-1	<i>Taxodium distichum</i>	150	1	1
C-1	<i>Liriodendron tulipifera</i>	150	1	1
C-1	<i>Liriodendron tulipifera</i>	250	1.5	1
C-1	<i>Liriodendron tulipifera</i>	300	3	1
C-1	<i>Platanus occidentalis</i>	500	4	1
C-1	<i>Platanus occidentalis</i>	550	5.5	1
C-1	<i>Platanus occidentalis</i>	550	7	1
C-1	<i>Platanus occidentalis</i>	400	2.5	1
C-1	<i>Platanus occidentalis</i>	110	1	1
C-2	<i>Fraxinus pennsylvanica</i>	450	5	1
C-2	<i>Fraxinus pennsylvanica</i>	450	3	1
C-2	<i>Fraxinus pennsylvanica</i>	550	7	1
C-2	<i>Fraxinus pennsylvanica</i>	550	4	1
C-2	<i>Fraxinus pennsylvanica</i>	400	3	1
C-2	<i>Fraxinus pennsylvanica</i>	450	6	1
C-2	<i>Fraxinus pennsylvanica</i>	250	2	1
C-2	<i>Fraxinus pennsylvanica</i>	550	4	1
C-2	<i>Fraxinus pennsylvanica</i>	550	6	1
C-2	<i>Taxodium distichum</i>	500	6	1
C-2	<i>Acer rubrum</i>	400	3	1
C-2	<i>Liquidambar styraciflua</i>	250	3	1
C-2	<i>Liquidambar styraciflua</i>	200	2	1

C-3	<i>Fraxinus pennsylvanica</i>	150	1	1
C-3	<i>Fraxinus pennsylvanica</i>	150	1	1
C-3	<i>Fraxinus pennsylvanica</i>	150	2	1
C-3	<i>Taxodium distichum</i>	350	5	1
C-3	<i>Taxodium distichum</i>	300	4	1
C-3	<i>Taxodium distichum</i>	600	8	1
C-3	<i>Taxodium distichum</i>	400	5	1
C-3	<i>Taxodium distichum</i>	350	4	1
C-3	<i>Taxodium distichum</i>	300	2.5	1
C-3	<i>Taxodium distichum</i>	500	7	1
C-3	<i>Taxodium distichum</i>	400	6	1
C-3	<i>Taxodium distichum</i>	400	6	1
C-3	<i>Taxodium distichum</i>	450	5	1
C-3	<i>Acer rubrum</i>	200	1	1
C-3	<i>Liquidambar styraciflua</i>	150	1	1
C-3	<i>Liquidambar styraciflua</i>	200	2	1
C-3	<i>Liquidambar styraciflua</i>	250	2	1
C-3	<i>Liquidambar styraciflua</i>	200	2	1
C-3	<i>Liquidambar styraciflua</i>	220	1.5	1
C-3	<i>Liquidambar styraciflua</i>	50	0.5	1
C-3	<i>Liquidambar styraciflua</i>	150	1	1
C-4	<i>Fraxinus pennsylvanica</i>	550	4	1
C-4	<i>Fraxinus pennsylvanica</i>	500	4	1
C-4	<i>Fraxinus pennsylvanica</i>	600	5	1
C-4	<i>Fraxinus pennsylvanica</i>	500	3	1
C-4	<i>Nyssa sp.</i>	50	0.5	1
C-4	<i>Nyssa sp.</i>	400	5	1
C-4	<i>Nyssa sp.</i>	300	2	1
C-4	<i>Nyssa sp.</i>	400	4	1
C-4	<i>Nyssa sp.</i>	250	2	1
C-4	<i>Acer rubrum</i>	50	0.5	1
C-5	<i>Fraxinus pennsylvanica</i>	200	3	1
C-5	<i>Fraxinus pennsylvanica</i>	200	1	1
C-5	<i>Fraxinus pennsylvanica</i>	250	1.5	1
C-5	<i>Taxodium distichum</i>	400	6	1
C-5	<i>Taxodium distichum</i>	350	3	1
C-5	<i>Taxodium distichum</i>	450	7	1
C-5	<i>Taxodium distichum</i>	350	2.5	1
C-5	<i>Taxodium distichum</i>	600	8	1





















D-3	<i>Fraxinus pennsylvanica</i>	250	1.5	1
D-3	<i>Fraxinus pennsylvanica</i>	250	1	1
D-3	<i>Taxodium distichum</i>	220	1.5	1
D-3	<i>Taxodium distichum</i>	150	1	1
D-3	<i>Pinus taeda</i>	50	0.5	1
D-3	<i>Liriodendron tulipifera</i>	700	8	1
D-3	<i>Liriodendron tulipifera</i>	500	3	1
D-3	<i>Liriodendron tulipifera</i>	700	6.5	1
D-3	<i>Liriodendron tulipifera</i>	750	6	1
D-3	<i>Liriodendron tulipifera</i>	700	7	1
D-3	<i>Liriodendron tulipifera</i>	600	5	1
D-3	<i>Liriodendron tulipifera</i>	650	5	1
D-3	<i>Liriodendron tulipifera</i>	500	3	1
D-3	<i>Liriodendron tulipifera</i>	450	2.5	1
D-3	<i>Liriodendron tulipifera</i>	600	4	1
D-3	<i>Acer rubrum</i>	70	0.5	1
D-3	<i>Acer rubrum</i>	50	0.2	1
D-3	<i>Acer rubrum</i>	50	0.2	1
D-3	<i>Acer rubrum</i>	50	0.2	1
D-3	<i>Liquidambar styraciflua</i>	300	2	1
D-3	<i>Liquidambar styraciflua</i>	300	2	1
D-3	<i>Liquidambar styraciflua</i>	300	2	1
D-3	<i>Liquidambar styraciflua</i>	300	2	1
D-3	<i>Liquidambar styraciflua</i>	300	2	1
D-3	<i>Liquidambar styraciflua</i>	300	2	1
D-3	<i>Liquidambar styraciflua</i>	300	2	1
D-3	<i>Liquidambar styraciflua</i>	300	2	1
D-3	<i>Liquidambar styraciflua</i>	300	2	1
D-3	<i>Liquidambar styraciflua</i>	300	2	1
D-3	<i>Liquidambar styraciflua</i>	300	2	1
D-3	<i>Liquidambar styraciflua</i>	300	2	1
D-3	<i>Liquidambar styraciflua</i>	300	2	1
D-3	<i>Liquidambar styraciflua</i>	300	2	1
D-3	<i>Liquidambar styraciflua</i>	300	2	1
D-3	<i>Liquidambar styraciflua</i>	300	2	1
D-3	<i>Liquidambar styraciflua</i>	300	2	1
D-3	<i>Liquidambar styraciflua</i>	300	2	1
D-3	<i>Liquidambar styraciflua</i>	300	2	1
D-3	<i>Liquidambar styraciflua</i>	300	2	1
D-3	<i>Platanus occidentalis</i>	600	6	1
D-3	<i>Platanus occidentalis</i>	500	3	1
D-4	<i>Fraxinus pennsylvanica</i>	600	4	1

D-4	<i>Fraxinus pennsylvanica</i>	250	3	1
D-4	<i>Taxodium distichum</i>	300	2	1
D-4	<i>Taxodium distichum</i>	550	5	1
D-4	<i>Taxodium distichum</i>	600	7	1
D-4	<i>Taxodium distichum</i>	550	6	1
D-4	<i>Taxodium distichum</i>	500	5	1
D-4	<i>Taxodium distichum</i>	500	5	1
D-4	<i>Taxodium distichum</i>	550	5.5	1
D-4	<i>Taxodium distichum</i>	200	2	2
D-4	<i>Taxodium distichum</i>	550	3	1
D-4	<i>Taxodium distichum</i>	300	3	1
D-4	<i>Liquidambar styraciflua</i>	500	3	1
D-4	<i>Liquidambar styraciflua</i>	150	1	1
D-4	<i>Liquidambar styraciflua</i>	220	1	1

Table 6. Summary table of stem counts by plot for five monitoring years, 2006-2010. Data for the final year of monitoring is in bold and the change in stem counts from the first to the last monitoring effort is in italics. Moccasin Creek Riparian Buffer Restoration, 2010 Annual Report – Johnston County, NC. Greene Environmental Services, LLC.

Plot Number	Monitoring Year – Growing Season	Number of Planted Stems Per Plot	Number of Planted Stems Per Acre	Number of Volunteer Stems Per Plot	Total Planted and Volunteer Stems Per Plot	Total Planted and Volunteer Stems Per Acre
A-1	1-2006	9	364	0	9	364
A-1	2-2007	6	243	0	6	243
A-1	3-2008	10	405	0	10	405
A-1	4-2009	16	648	0	16	648
<b>A-1</b>	<b>5-2010</b>	<b>13</b>	<b>526</b>	<b>0</b>	<b>13</b>	<b>526</b>
<i>Δ Monitoring Year 1 to 5</i>		<i>4</i>	<i>162</i>	<i>0</i>	<i>4</i>	<i>162</i>
A-2	1-2006	14	567	75	89	3603
A-2	2-2007	10	405	83	93	3765
A-2	3-2008	11	445	30	41	1660
A-2	4-2009	8	324	55	63	2551
<b>A-2</b>	<b>5-2010</b>	<b>12</b>	<b>486</b>	<b>153</b>	<b>165</b>	<b>6680</b>
<i>Δ Monitoring Year 1 to 5</i>		<i>-2</i>	<i>-81</i>	<i>78</i>	<i>76</i>	<i>3077</i>
A-3	1-2006	10	405	0	10	405
A-3	2-2007	10	405	0	10	405
A-3	3-2008	11	445	2	13	526
A-3	4-2009	14	567	2	16	648
<b>A-3</b>	<b>5-2010</b>	<b>10</b>	<b>405</b>	<b>3</b>	<b>13</b>	<b>526</b>
<i>Δ Monitoring Year 1 to 5</i>		<i>0</i>	<i>0</i>	<i>3</i>	<i>3</i>	<i>121</i>
A-4	1-2006	16	648	2	18	729
A-4	2-2007	12	486	3	15	607
A-4	3-2008	14	567	14	28	1134
A-4	4-2009	15	607	20	35	1417
<b>A-4</b>	<b>5-2010</b>	<b>18</b>	<b>729</b>	<b>17</b>	<b>35</b>	<b>1417</b>
<i>Δ Monitoring Year 1 to 5</i>		<i>2</i>	<i>81</i>	<i>15</i>	<i>17</i>	<i>688</i>
B-1	1-2006	17	688	0	17	688
B-1	2-2007	14	567	5	19	769
B-1	3-2008	14	567	3	17	688
B-1	4-2009	18	729	0	18	729
<b>B-1</b>	<b>5-2010</b>	<b>10</b>	<b>405</b>	<b>7</b>	<b>17</b>	<b>688</b>
<i>Δ Monitoring Year 1 to 5</i>		<i>-7</i>	<i>-283</i>	<i>7</i>	<i>0</i>	<i>0</i>
B-2	1-2006	5	202	3	8	324
B-2	2-2007	13	526	5	18	729
B-2	3-2008	14	567	7	21	850
B-2	4-2009	12	486	3	15	607
<b>B-2</b>	<b>5-2010</b>	<b>15</b>	<b>607</b>	<b>1</b>	<b>16</b>	<b>648</b>
<i>Δ Monitoring Year 1 to 5</i>		<i>10</i>	<i>405</i>	<i>-2</i>	<i>8</i>	<i>324</i>

Table 6. Continued. Summary table of stem counts by plot for five monitoring years, 2006-2010.

B-3	1-2006	17	688	0	17	688
B-3	2-2007	17	688	2	19	769
B-3	3-2008	17	688	0	17	688
B-3	4-2009	15	607	0	15	607
<b>B-3</b>	<b>5-2010</b>	<b>15</b>	<b>607</b>	<b>10</b>	<b>25</b>	<b>1012</b>
<i>Δ Monitoring Year 1 to 5</i>		-2	-81	10	8	324
B-4	1-2006	15	607	3	18	729
B-4	2-2007	16	648	2	18	729
B-4	3-2008	12	486	3	15	607
B-4	4-2009	13	526	2	15	607
<b>B-4</b>	<b>5-2010</b>	<b>15</b>	<b>607</b>	<b>2</b>	<b>17</b>	<b>688</b>
<i>Δ Monitoring Year 1 to 5</i>		0	0	-1	-1	-40
C-1	1-2006	17	688	0	17	688
C-1	2-2007	18	729	0	18	729
C-1	3-2008	15	607	7	22	891
C-1	4-2009	10	405	0	10	405
<b>C-1</b>	<b>5-2010</b>	<b>16</b>	<b>648</b>	<b>0</b>	<b>16</b>	<b>648</b>
<i>Δ Monitoring Year 1 to 5</i>		-1	-40	0	-1	-40
C-2	1-2006	8	324	3	11	445
C-2	2-2007	10	405	3	13	526
C-2	3-2008	11	445	6	17	688
C-2	4-2009	10	405	3	13	526
<b>C-2</b>	<b>5-2010</b>	<b>10</b>	<b>405</b>	<b>3</b>	<b>13</b>	<b>526</b>
<i>Δ Monitoring Year 1 to 5</i>		2	81	0	2	81
C-3	1-2006	12	486	3	15	607
C-3	2-2007	11	445	2	13	526
C-3	3-2008	11	445	6	17	688
C-3	4-2009	11	445	2	13	526
<b>C-3</b>	<b>5-2010</b>	<b>13</b>	<b>526</b>	<b>8</b>	<b>21</b>	<b>850</b>
<i>Δ Monitoring Year 1 to 5</i>		1	40	5	6	243
C-4	1-2006	10	405	3	13	526
C-4	2-2007	15	607	3	18	729
C-4	3-2008	14	567	0	14	567
C-4	4-2009	12	486	1	13	526
<b>C-4</b>	<b>5-2010</b>	<b>9</b>	<b>364</b>	<b>1</b>	<b>10</b>	<b>405</b>
<i>Δ Monitoring Year 1 to 5</i>		-1	-40	-2	-3	-121
C-5	1-2006	13	526	3	16	648
C-5	2-2007	13	526	16	29	1174
C-5	3-2008	13	526	28	41	1660
C-5	4-2009	14	567	45	59	2389
<b>C-5</b>	<b>5-2010</b>	<b>13</b>	<b>526</b>	<b>73</b>	<b>86</b>	<b>3482</b>
<i>Δ Monitoring Year 1 to 5</i>		0	0	70	70	2834

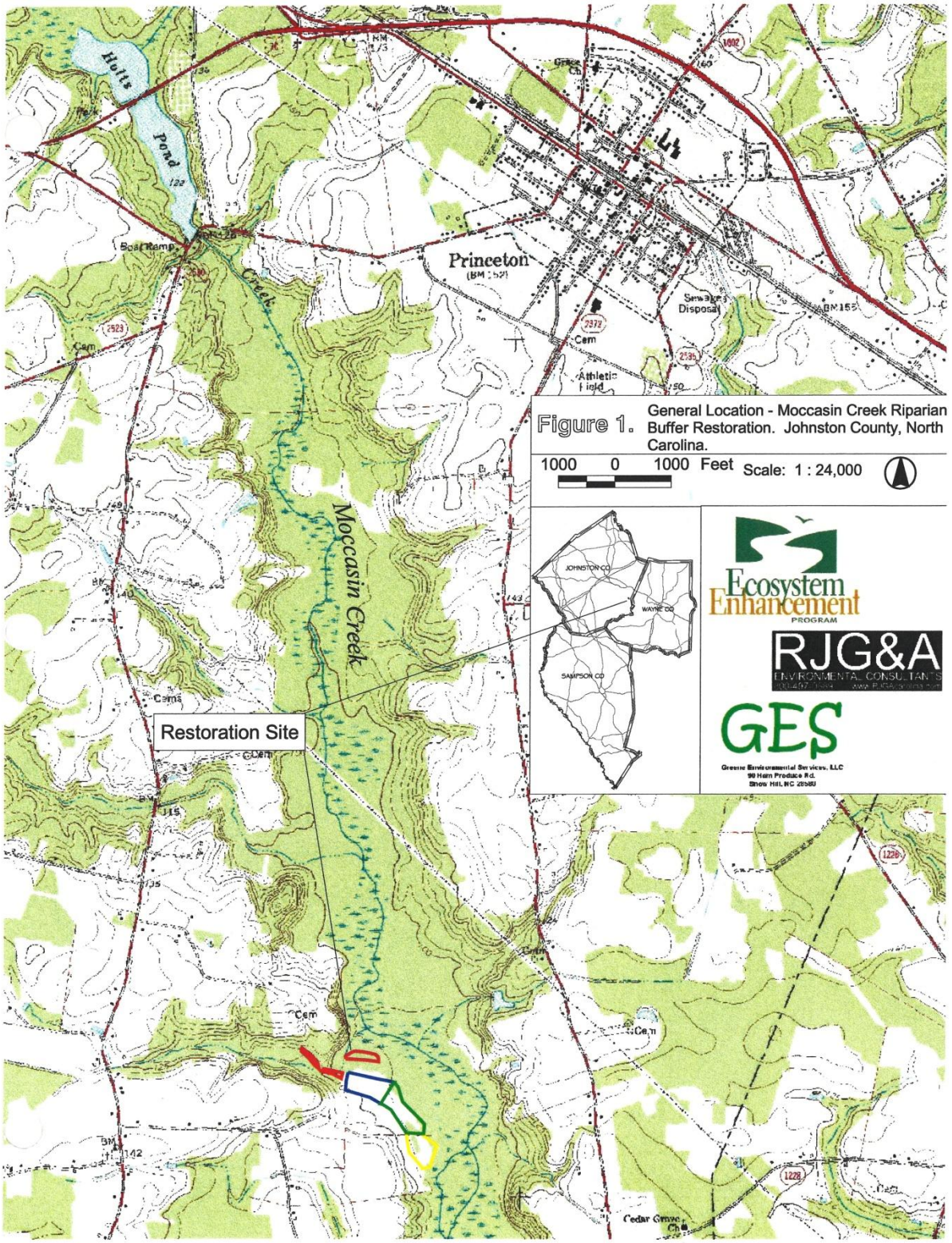
Table 6. Continued. Summary table of stem counts by plot for five monitoring years, 2006-2010.

D-1	1-2006	19	769	43	62	2510
D-1	2-2007	17	688	18	35	1417
D-1	3-2008	17	688	17	34	1377
D-1	4-2009	16	648	20	36	1457
<b>D-1</b>	<b>5-2010</b>	<b>10</b>	<b>405</b>	<b>55</b>	<b>65</b>	<b>2632</b>
<i>Δ Monitoring Year 1 to 5</i>		-9	-364	12	3	121
D-2	1-2006	18	729	326	344	13927
D-2	2-2007	19	769	158	177	7166
D-2	3-2008	18	729	137	155	6275
D-2	4-2009	15	607	107	122	4939
<b>D-2</b>	<b>5-2010</b>	<b>13</b>	<b>526</b>	<b>230</b>	<b>243</b>	<b>9838</b>
<i>Δ Monitoring Year 1 to 5</i>		-5	-202	-96	-101	-4089
D-3	1-2006	15	607	13	28	1134
D-3	2-2007	17	688	8	25	1012
D-3	3-2008	15	607	7	22	891
D-3	4-2009	16	648	12	28	1134
<b>D-3</b>	<b>5-2010</b>	<b>19</b>	<b>769</b>	<b>25</b>	<b>44</b>	<b>1781</b>
<i>Δ Monitoring Year 1 to 5</i>		4	162	12	16	648
D-4	1-2006	15	607	19	34	1377
D-4	2-2007	10	405	5	15	607
D-4	3-2008	10	405	3	13	526
D-4	4-2009	13	526	0	13	526
<b>D-4</b>	<b>5-2010</b>	<b>12</b>	<b>486</b>	<b>3</b>	<b>15</b>	<b>607</b>
<i>Δ Monitoring Year 1 to 5</i>		-3	-121	-16	-19	-769




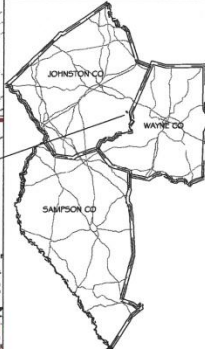
Table 7. Summary table of average stem count for all plots by monitoring year 2006-2010. Moccasin Creek Riparian Buffer Restoration – Johnston County, NC. Greene Environmental Services, LLC. Annual Report 2010.

<b>Monitoring Year – Growing Season</b>	<b>Parameters for All Plots by Year</b>	<b>Number of Planted Stems Per Plot</b>	<b>Number of Planted Stems Per Acre</b>	<b>Number of Volunteer Stems Per Plot</b>	<b>Total Planted and Volunteer Stems Per Plot</b>	<b>Total Planted and Volunteer Stems Per Acre</b>
1-2006	Average	14	548	29	43	1729
	Standard Deviation	4	160	79	80	3257
	Plot Count	17	17	17	17	17
2-2007	Average	13	543	18	32	1288
	Standard Deviation	4	147	41	42	1706
	Plot Count	17	17	17	17	17
3-2008	Average	13	541	16	29	1184
	Standard Deviation	3	102	32	34	1366
	Plot Count	17	17	17	17	17
4-2009	Average	13	543	16	29	1191
	Standard Deviation	3	107	29	29	1164
	Plot Count	17	17	17	17	17
5-2010	Average	13	531	35	48	1939
	Standard Deviation	3	118	64	64	2582
	Plot Count	17	17	17	17	17
	Highest Average During Five year Monitoring	14	548	35	48	1939
	Lowest Average During Five year Monitoring	13	531	16	29	1184
	Change in Stem Average Stems from First to Fifth Monitoring Year	-1	-17	6	5	210



**Figure 1.** General Location - Moccasin Creek Riparian Buffer Restoration. Johnston County, North Carolina.

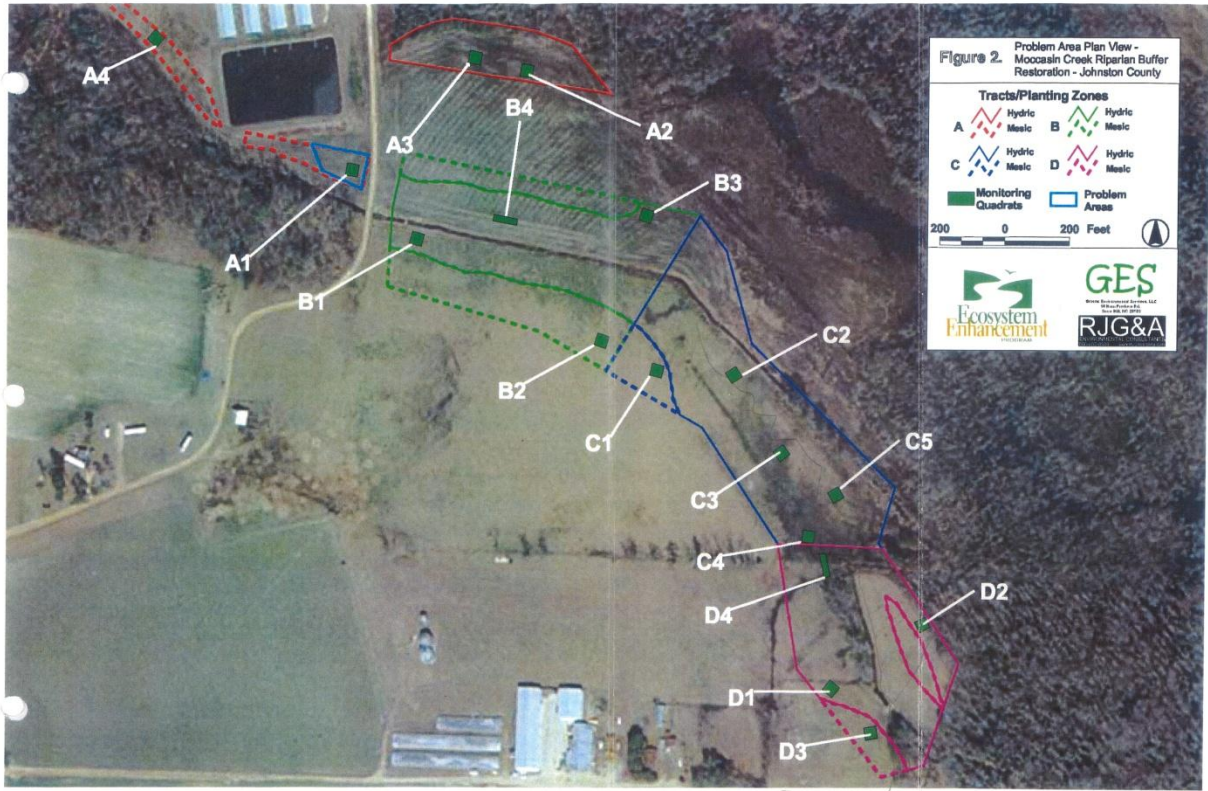
1000 0 1000 Feet Scale: 1 : 24,000 



  
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 Snow Hill, NC 28580





**Plot A-1**



**Plot A-2**



**Plot A-3**



**Plot A-4**



**Plot B-1**



**Plot B-2**



**Plot B-3**



**Plot B-4**



**Plot C-1**



**Plot C-2**



**Plot C-3**



**Plot C-4**



**Plot C-5**



**Plot D-1**



**Plot D-2**



**Plot D-3**



**Plot D-4**



**Greene Environmental Services, LLC**  
**90 Ham Produce Rd.**  
**Snow Hill, NC 28580**

DATE	INVOICE #
10 December 2010	005

<b>BILL TO</b>
North Carolina Ecosystem Enhancement Program 1652 Mail Service Center Raleigh, NC 27699-1652 Attn: Jeff Jurek

		PROJECT NAME	CONTRACT #
		Moccasin Creek Riparian Buffer Restoration	005015
Description	QTY	Contract Percent	AMOUNT
Fifth Annual Monitoring Report	1	5	\$21,390.75

TOTAL DUE: \$21,390.7

