Daniels Farm #1
Wetland Restoration Site
Franklin County, North Carolina

Tar-Pam 03020101
Contract # AW03005

Monitoring Report
Year 4

Submitted to:

North Carolina
Department of Environment and
Natural Resources
Ecosystem Enhancement Program

Submitted by:

KCI Associates of North Carolina, P.A.
KCI Environmental Technologies & Construction, Inc.
Landmark Center II, Suite 220
4601 Six Forks Road
Raleigh, North Carolina 27609

November 2007

ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.

EXECUTIVE SUMMARY

The Daniels Farm Wetland Restoration Project is located on the Clyde Daniels Farm, south-southeast of Louisburg in Franklin County, North Carolina. The restoration of 31.72 acres of non-riverine wetlands was completed following construction in March 2004. The site will be monitored for five years or until the success criteria are met.

This monitoring report presents the data and findings developed in 2007 following the fourth growing season. Included in this report are analyses of both hydrologic and vegetation monitoring results as well as local climatic conditions throughout the growing season. Monitoring activities included sampling vegetation survivability at nine locations, monitoring groundwater elevations at eight locations and documenting general site conditions at five permanent photograph points within the wetland restoration area. In addition daily precipitation was recorded at the site. These data were evaluated and verified using climatic data for Louisburg, North Carolina. Field investigations were conducted in May and November 2007. Supporting data and site photographs are included in the report appendices.

The 31.72-acre wetland restoration site was initially planted at a density of 436 trees per acre. Supplemental planting occurred during the winter of 2004-2005. There were nine vegetation monitoring plots established throughout the planting areas instead of the eight originally discussed in the as-built. The additional plot was established to monitor the survival and growth of the bald cypress and water tupelo area. The 2007 vegetation monitoring of the planted areas revealed an average density of 622 trees per acre, which is well above the minimum requirement of 260 trees per acre needed to meet the success criteria. After four years, the average density for the Low Elevation Seep species (Zone 1) was 540 trees per acre and the Non-Riverine Wet Hardwood Forest species (Zone 2) had a density of 646 trees per acre.

During the 2007 monitoring year, wetland hydrology was achieved at all eight wells on the site. Groundwater was within 12 inches of the soil surface in excess of 12 consecutive days (5% of the growing season) at each well. The hydrologic monitoring also showed that the water table was within 12 inches of the soil surface for greater than 12.5% of the growing season at five wells.

The daily rainfall data depicted on the gauge data graphs were obtained from the on-site precipitation gauge. The precipitation gauge was installed on the site in 2003 prior to project implementation. Daily rainfall data from the project site were compared to historic precipitation data for Louisburg, North Carolina in order to determine whether the monitoring year experienced below average, average, or above average rainfall. This analysis showed that 2007 was a below average year. The piedmont of North Carolina experienced an exceptional drought during the 2007 growing season. This is reflected in the shorter hydroperiod for the site when compared to previous monitoring data. The fact that the project site maintained wetland hydrology during this drought illustrates how strong the groundwater influence is.

Soils in the restoration portion of the site were determined to be Roanoke and Toisnot. Since these soils are already considered hydric, no success criteria or monitoring is required.

Site photographs were taken from five permanent photograph points established along the property boundary. Photograph documentation facilitates the qualitative evaluation of the conditions or changes in the restored wetland. The photo point locations were selected in order to document representative site conditions.

TABLE OF CONTENTS

Tables

Appendices

1.0 SUMMARY

1.1 Vegetation

The 31.72-acre wetland restoration site was originally planted at a density of 436 trees per acre. Supplemental planting occurred during the winter of 2004-2005. Originally there were eight vegetation monitoring plots established throughout the planting areas covering two vegetative communities, a Low-Elevation Seep and the Non-Riverine Wet Hardwood Forest. However, a ninth plot was established in 2004 to monitor the bald cypress and water tupelo community. The 2007 vegetation monitoring of the planted areas revealed an average density of 622 trees per acre, which is well above the minimum requirement of 260 trees per acre (Appendix A). After four years the average density for the Low Elevation Seep species (Zone 1) was 540 trees per acre and the Non-Riverine Wet Hardwood Forest species (Zone 2) had 646 trees per acre. A total of 6.5 trees per vegetation monitoring plot are needed to meet the 260 trees per acre minimum requirement and the average number of trees per plot in 2007 was 16.

Table 1: Vegetation Monitoring Results

Planting Zone	Plot #	Willow Oak	Swamp Chestnut Oak	Laurel Oak	Yellow Poplar	Swamp Blackgum	Water Tupelo	Bald Cypress	Overcup Oak	Green Ash	Cherrybark Oak	Total (Year 4)	Total (at planting)	Density-(Year 4 (Trees/Acres)
1	1	3	7	1							2	13	16	520
	8	3	6	4	1							14	17	560
												Zone 1 Average		540
2	2	1	5	2					6	2	1	17	22	680
	3		3				4		3	5	1	16	19	640
	4	1	5				3		2		2	13	14	520
	5		3			5			4	5	3	20	21	800
	6	4	4	1		4			4	1	2	20	22	800
	7		10						3		3	16	20	640
	9						3	7	1			11	11	440
												Zone 2 Average		646
												Total Average		622

Table 2: Vegetation History (Trees/Acre)

Plot #	Year 1	Year 2	Year 3	Year 4	Year 5
1	360	520	520	520	
2	360	720	680	680	
3	320	640	680*	640	
4	320	480	520*	520	
5	320	760	800*	800	
6	520	760	800*	800	
7	560	560	640*	640	
8	520	560	560	560	
9	360	440	440	440	

* More trees/acre recorded in Year 3 because of either a resprout from a tree that was previously counted as dead or a missed tree from previous monitoring.

1.2 Hydrology

Site climatic data for the 2007 growing season were analyzed in comparison to historical data to determine whether 2007 was a normal year in terms of climatic conditions. This step is as a precursor to validating the results of the wetland monitoring. The historical data were collected from the NRCS, Water and Climate Center, "Climate Analysis for Wetlands by County" website. This evaluation concluded that 2007 was a below average year for rainfall during the growing season. The rainfall data from 2007 indicates that every month was below the 30th percentile of average rainfall for each month (Appendix B). The piedmont of North Carolina experienced an exceptional drought during the 2007 growing season. This is reflected in the shorter hydroperiod for the site when compared to previous monitoring data. The fact that the project site maintained wetland hydrology during this drought illustrates how strong the groundwater influence is.

Wetland hydrology was achieved at all eight wells on the site. Groundwater was within 12 inches of the soil surface in excess of 12 consecutive days (5% of the growing season) at each well (Table 3). Based upon these data, even though there were drought conditions, the site has exceeded the minimum duration of near surface saturation of 12 consecutive days with the water table within 12 inches of the soil surface for the 2007 growing season (Appendix B). The results of this monitoring also indicate that the water table was within 12 inches of the soil surface for greater than 12.5% of the growing season at five wells. The maximum number of consecutive days that the groundwater was within 12 inches of the surface was determined for each groundwater gauge. This number was converted into a percentage of the 235-day growing season from March 20th to November 11th. Table 3 presents the hydrological monitoring results for 2007 and Table 4 presents the hydroperiod history of each well over the course of the monitoring.

Table 3: 2007 Hydrologic Monitoring Results

	Hydroperiod					
Well #	**<5%**	**5% - 8%**	**8% -12.5%**	**>12.5%**	**Maximum Number of Consecutive Days**	**Dates Meeting Success**
1				X	67	3/20-5/25; 5/3-6/19; 7/11-7/29; 10/25-11/11
2				X	112	3/20-7/9; 7/11-7/27; 10/25-11/11
3				X	36	3/20-4/24
4		X			15	3/20-4/5; 4/12-4/25
5		X			16	3/20-4/4; 4/12-4/26
6				X	43	3/20-5/1; 10/27-11/10
7			X		20	3/20-4/8; 4/12-4/24
8				X	43	3/20-5/1

Table 4. Hydroperiod History

Well #	**Pre-Restoration**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
1	<5%	>12.5%	>12.5%	>12.5%	>12.5%	
2	<5%	>12.5%	>12.5%	>12.5%	>12.5%	
3	<5%	>12.5%	>12.5%	>12.5%	>12.5%	
4	<5%	>12.5%	>12.5%	>12.5%	5%-8%	
5	<5%	>12.5%	>12.5%	>12.5%	5%-8%	
6	<5%	>12.5%	>12.5%	>12.5%	>12.5%	
7	<5%	>12.5%	>12.5%	>12.5%	8%-12.5%	
8	<5%	>12.5%	>12.5%	>12.5%	>12.5%	

2.0 DATA ANALYSIS

2.1 Vegetation

Vegetation monitoring in 2007 found that most of the trees are tall enough that the site's dense herbaceous vegetation is not having a detrimental effect on the trees.

2.2 Hydrology

Wetland restoration on the site focused on the removal of hydrologic alterations and included filling the primary ditches and grassed waterways, plugging the lateral ditches, removing ditch spoil to restore natural seepage areas, placing water diversion features to redistribute the surface hydrology, installing restrictive berms to reduce runoff and enhance infiltration, and recreating microtopography across the site to enhance surface water retention and storage. Based on the hydrological results, this site has met and exceeded the groundwater criteria outlined in the wetland restoration plan. Ditch plugging, filling and the other hydrologic restoration methods have resulted in increased short-term surface and subsurface water storage and subsequent increase in the duration and elevation of the seasonally high water table.

2.3 Soils

Soils in the restoration portion of the site were determined to be Roanoke and Toisnot, both hydric soils on the state and federal hydric soils lists. NRCS verified the limits of hydric soils and confirmed their status as Prior Converted wetland. As the soils are already considered hydric, no success criteria or monitoring are required.

3.0 MAINTENANCE/MANAGEMENT ACTIONS

No Maintenance/Management actions were necessary in 2007.

4.0 CONCLUSIONS

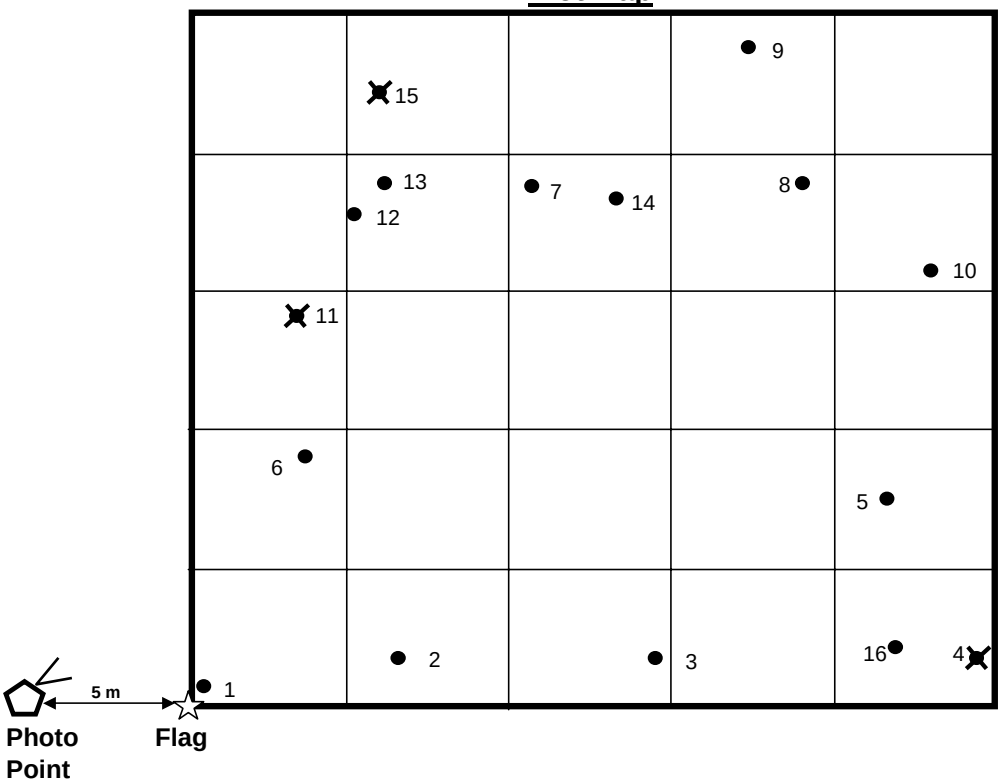
Findings from this monitoring year indicate that the project is meeting the success criteria set for the site. The criterion for the survival of the planted species is 260 stems/acre at the end of five years of monitoring. The 2007 vegetation monitoring of the planted areas revealed an average density of 622 trees per acre, which is above the minimum requirement of 260 trees per acre. Non-target species do not constitute more than 20 percent of the woody vegetation based on permanent monitoring plots. For the 2007 monitoring year, all eight gauges met the hydrologic success criteria of at least 5% saturation during the growing season and five were saturated for more than 12.5%.

Appendix A
Vegetation Monitoring Plot Data Sheets

Vegetation Monitoring Worksheet

Site: Daniels **Plot:** 1 **Date:** 5/30/2007

Plot Map



ID	Species	Height (m)	Collar Diameter (cm)	Comments (insect damage, disease, browsing)
1	Swamp Chestnut Oak (*Quercus michauxii*)	0.7	0.7	healthy
2	Willow Oak (*Quercus phellos*)	0.7	0.9	healthy
3	Swamp Chestnut Oak (*Quercus michauxii*)	0.8	1.2	healthy
4	Swamp Chestnut Oak (*Quercus michauxii*)			dead
5	Swamp Chestnut Oak (*Quercus michauxii*)	0.8	1.2	healthy
6	Swamp Chestnut Oak (*Quercus michauxii*)	1.0	1.8	healthy
7	Swamp Chestnut Oak (*Quercus michauxii*)	1.7	2.5	healthy
8	Swamp Chestnut Oak (*Quercus michauxii*)	1.1	1.8	healthy
9	Willow Oak (*Quercus phellos*)	0.8	1.5	healthy
10	Cherrybark Oak (*Quercus pagoda*)	0.4	0.8	resprout from base
11	Willow Oak (*Quercus phellos*)			dead
12	Swamp Chestnut Oak (*Quercus michauxii*)	0.3	0.9	top died back
13	Laurel Oak (*Quercus laurifolia*)	0.3	0.4	resprout from base
14	Cherrybark Oak (*Quercus pagoda*)	1.2	1.4	healthy
15	Cherrybark Oak (*Quercus pagoda*)			dead
16	Willow Oak (*Quercus phellos*)	0.9	1.0	healthy

Species	Percent of Total
Swamp Chestnut Oak (*Quercus michauxii*)	54%
Willow Oak (*Quercus phellos*)	23%
Cherrybark Oak (*Quercus pagoda*)	15%
Laurel Oak (*Quercus laurifolia*)	8%

Density:

Total Number of Trees **13** / **0.025 acres** = **520** **trees / acre**

Survivability:

Total Number of Trees **13** / **16 trees** x **100** = **81** **% survivability**

Number of New Recruits : 0

Note : Flag located AZ. 72°, 16 feet from monitoring well

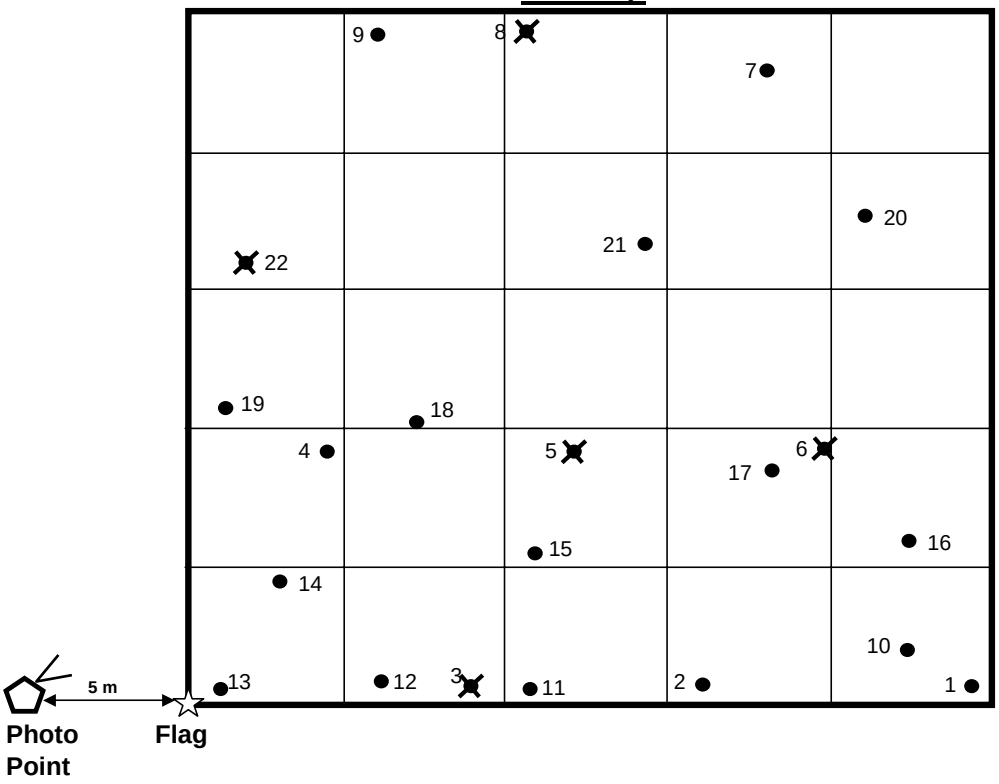
3rd Year Monitoring

4th Year Monitoring

Vegetation Monitoring Worksheet

Site: Daniels **Plot:** 2 **Date:** 5/30/2007

Plot Map



ID	Species	Height (m)	Collar Diameter (cm)	Comments (insect damage, disease, browsing)
1	Laurel Oak (*Quercus laurifolia*)	1.5	1.8	healthy
2	Swamp Chestnut Oak (*Quercus michauxii*)	1.6	3.5	healthy
3	Swamp Black Gum (*Nyssa sylvatica*)			dead
4	Swamp Chestnut Oak (*Quercus michauxii*)	2.0	2.9	healthy
5	Swamp Black Gum (*Nyssa sylvatica*)			dead
6	Swamp Chestnut Oak (*Quercus michauxii*)			dead
7	Laurel Oak (*Quercus laurifolia*)	1.4	1.6	healthy
8	Laurel Oak (*Quercus laurifolia*)			dead
9	Laurel Oak (*Quercus laurifolia*)	0.8	0.9	healthy
10	Green Ash (*Fraxinus pennsylvanica*)	1.7	2.1	healthy
11	Swamp Chestnut Oak (*Quercus michauxii*)	1.3	1.0	healthy
12	Swamp Chestnut Oak (*Quercus michauxii*)	1.5	1.9	healthy
13	Cherrybark Oak (*Quercus pagoda*)	1.5	1.5	healthy
14	Overcup Oak (*Quercus lyrata*)	1.6	2.6	healthy
15	Overcup Oak (*Quercus lyrata*)	1.7	2.4	healthy
16	Green Ash (*Fraxinus pennsylvanica*)	1.7	2.2	healthy
17	Overcup Oak (*Quercus lyrata*)	1.7	3.7	healthy
18	Overcup Oak (*Quercus lyrata*)	1.5	2.5	healthy
19	Swamp Chestnut Oak (*Quercus michauxii*)	0.3	0.3	resprout from the base
20	Overcup Oak (*Quercus lyrata*)	1.7	3.3	healthy
21	Overcup Oak (*Quercus lyrata*)	1.9	2.6	healthy
22	Overcup Oak (*Quercus lyrata*)			dead

Species	Percent of Total
Swamp Chestnut Oak (*Quercus michauxii*)	29%
Laurel Oak (*Quercus laurifolia*)	12%
Swamp Black Gum (*Nyssa sylvatica*)	0%
Green Ash (*Fraxinus pennsylvanica*)	12%
Overcup Oak (*Quercus lyrata*)	35%
Cherrybark Oak (*Quercus pagoda*)	6%
Willow Oak (*Quercus phellos*)	6%

Density:

Total Number of Trees **17** / **0.025 acres** = **680** **trees / acre**

Survivability:

Total Number of Trees **17** / **22 trees** x **100** = **77.3** **% survivability**

Number of New Recruits : 0

Note : Flag located AZ. 104°, 43 feet from monitoring well

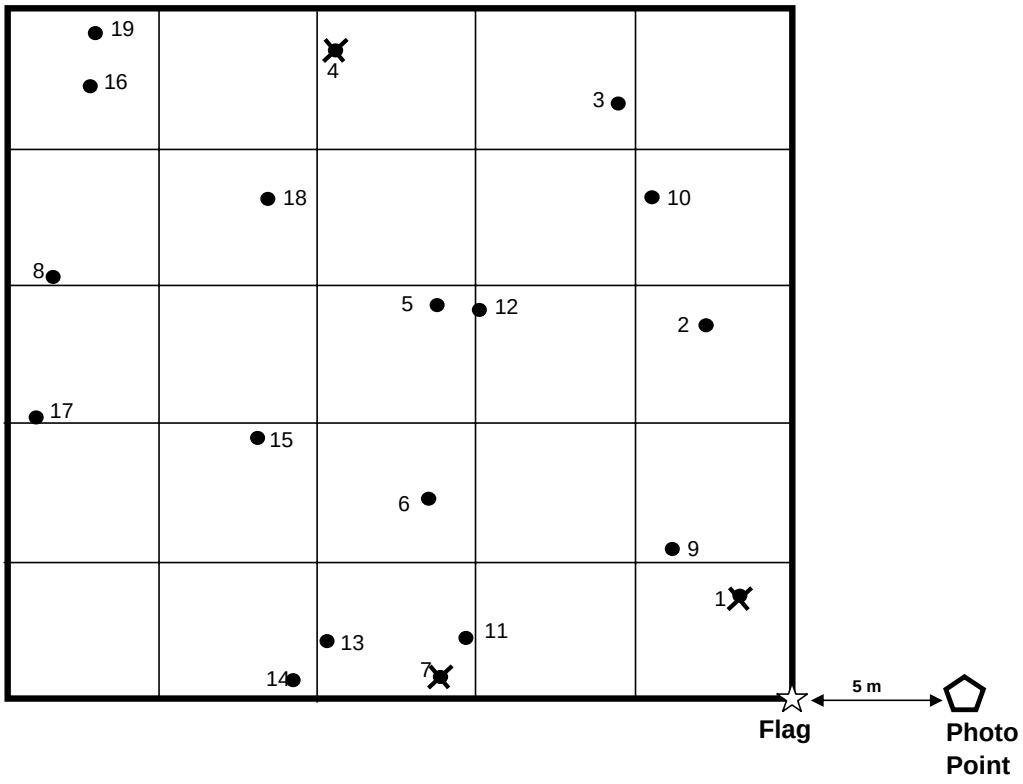
3rd Year Monitoring

4th Year Monitoring

Vegetation Monitoring Worksheet

Site: Daniels **Plot:** 3 **Date:** 5/30/2007

Plot Map



ID	Species	Height (m)	Collar Diameter (cm)	Comments (insect damage, disease, browsing)
1	Water Tupelo (*Nyssa sylvatica* var. *biflora*)			dead
2	Water Tupelo (*Nyssa sylvatica* var. *biflora*)	0.9	0.9	healthy
3	Swamp Chestnut Oak (*Quercus michauxii*)	1.2	1.7	healthy
4	Water Tupelo (*Nyssa sylvatica* var. *biflora*)			dead
5	Water Tupelo (*Nyssa sylvatica* var. *biflora*)	0.7	1.5	healthy
6	Water Tupelo (*Nyssa sylvatica* var. *biflora*)	0.9	2.8	healthy
7	Water Tupelo (*Nyssa sylvatica* var. *biflora*)			dead
8	Swamp Chestnut Oak (*Quercus michauxii*)	1.4	2.1	healthy
9	Overcup Oak (*Quercus lyrata*)	1.7	2.8	healthy
10	Green Ash (*Fraxinus pennsylvanica*)	2.1	3.1	healthy
11	Overcup Oak (*Quercus lyrata*)	1.9	2.5	healthy
12	Green Ash (*Fraxinus pennsylvanica*)	1.9	2.7	healthy
13	Overcup Oak (*Quercus lyrata*)	1.6	2.4	healthy
14	Swamp Chestnut Oak (*Quercus michauxii*)	0.7	1.2	healthy
15	Green Ash (*Fraxinus pennsylvanica*)	1.8	3.1	healthy
16	Cherrybark Oak (*Quercus pagoda*)	1.5	2.5	healthy
17	Green Ash (*Fraxinus pennsylvanica*)	1.7	2.3	healthy
18	Water Tupelo (*Nyssa sylvatica* var. *biflora*)	1.3	1.6	healthy
19	Green Ash (*Fraxinus pennsylvanica*)	1.9	3.0	healthy

Species	Percent of Total
Swamp Chestnut Oak (*Quercus michauxii*)	19%
Water Tupelo (*Nyssa sylvatica* var. *biflora*)	25%
Green Ash (*Fraxinus pennsylvanica*)	31%
Overcup Oak (*Quercus lyrata*)	19%
Cherrybark Oak (*Quercus pagoda*)	6%

Density:

Total Number of Trees **16** / **0.025 acres** = **640** **trees / acre**

Survivability:

Total Number of Trees **16** / **19 trees** x **100** = **84** **% survivability**

Number of New Recruits : 0

Note : Flag located AZ. 220°, 63 feet from monitoring well

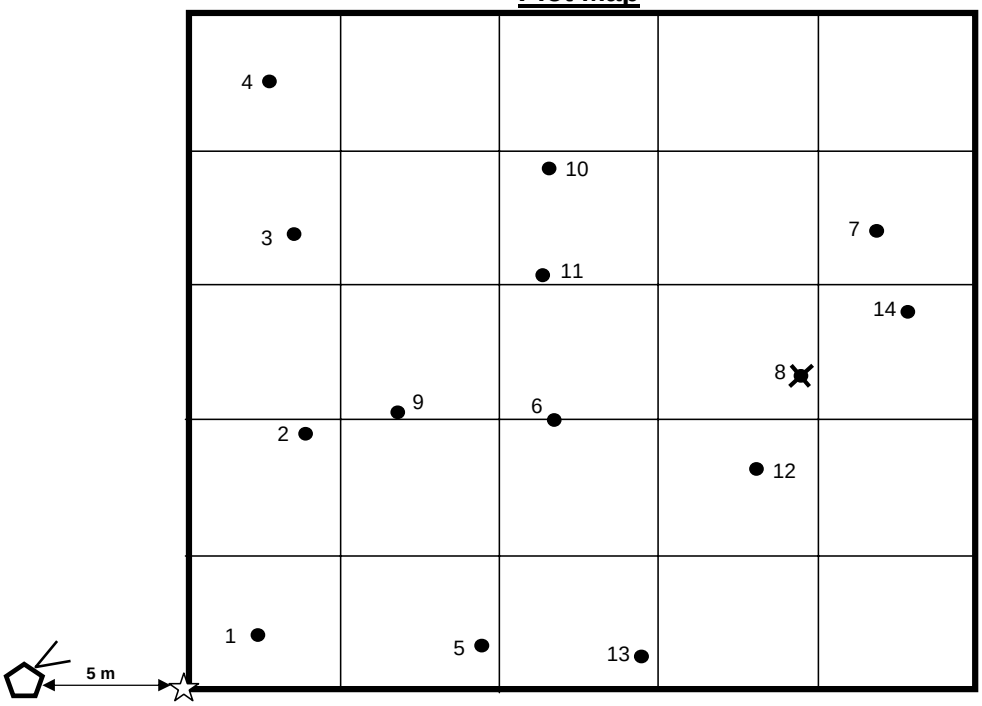
3rd Year Monitoring

4th Year Monitoring

Vegetation Monitoring Worksheet

Site: Daniels **Plot:** 4 **Date:** 5/30/2007

Plot Map



ID	Species	Height (m)	Collar Diameter (cm)	Comments (insect damage, disease, browsing)
1	Swamp Chestnut Oak (*Quercus michauxii*)	1.2	1.4	healthy
2	Water Tupelo (*Nyssa sylvatica* var. *biflora*)	1.2	1.7	healthy
3	Swamp Chestnut Oak (*Quercus michauxii*)	0.6	0.8	healthy
4	Willow Oak (*Quercus phellos*)	1.2	1.8	healthy
5	Water Tupelo (*Nyssa sylvatica* var. *biflora*)	1.0	1.4	healthy
6	Swamp Chestnut Oak (*Quercus michauxii*)	1.1	1.0	healthy
7	Water Tupelo (*Nyssa sylvatica* var. *biflora*)	0.9	2.0	healthy
8	Water Tupelo (*Nyssa sylvatica* var. *biflora*)			dead
9	Overcup Oak (*Quercus lyrata*)	1.2	1.4	healthy
10	Overcup Oak (*Quercus lyrata*)	1.2	2.7	healthy
11	Swamp Chestnut Oak (*Quercus michauxii*)	0.5	0.4	resprout from the base
12	Swamp Chestnut Oak (*Quercus michauxii*)	1.3	1.5	healthy
13	Cherrybark Oak (*Quercus pagoda*)	1.1	1.5	healthy
14	Cherrybark Oak (*Quercus pagoda*)	1.1	1.2	healthy

Species	Percent of Total
Swamp Chestnut Oak (*Quercus michauxii*)	38%
Willow Oak (*Quercus phellos*)	8%
Water Tupelo (*Nyssa sylvatica* var. *biflora*)	23%
Overcup Oak (*Quercus lyrata*)	15%
Cherrybark Oak (*Quercus pagoda*)	15%

Density:

Total Number of Trees **13** / **0.025 acres** = **520** **trees / acre**

Survivability:

Total Number of Trees **13** / **14 trees** x **100** = **93** **% survivability**

Number of New Recruits : 0

Note : Flag located AZ. 45°, 99' feet from monitoring well

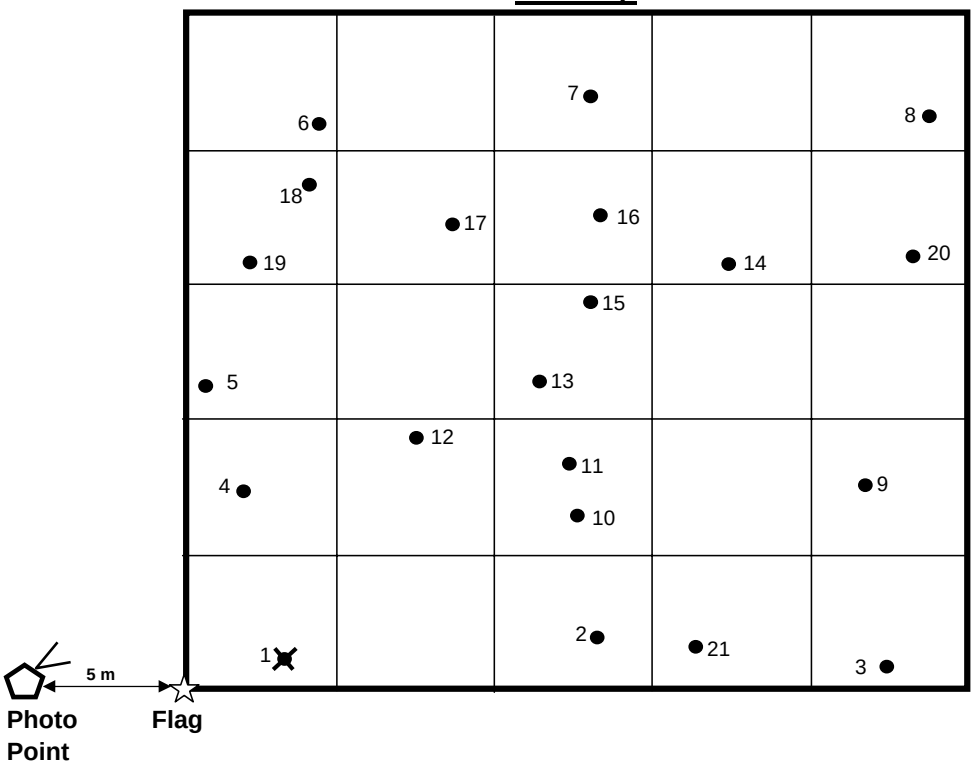
3rd Year Monitoring

4th Year Monitoring

Vegetation Monitoring Worksheet

Site: Daniels **Plot:** 5 **Date:** 5/30/2006

Plot Map



ID	Species	Height (m)	Collar Diameter (cm)	Comments (insect damage, disease, browsing)
1	Swamp Black Gum (*Nyssa sylvatica*)			dead
2	Swamp Black Gum (*Nyssa sylvatica*)	0.7	1.3	healthy
3	Swamp Black Gum (*Nyssa sylvatica*)	1.5	1.8	healthy
4	Swamp Chestnut Oak (*Quercus michauxii*)	1.1	1.2	healthy
5	Swamp Black Gum (*Nyssa sylvatica*)	0.7	1.1	healthy
6	Swamp Chestnut Oak (*Quercus michauxii*)	0.3	0.2	resprout from base
7	Swamp Black Gum (*Nyssa sylvatica*)	0.6	1.5	healthy
8	Swamp Chestnut Oak (*Quercus michauxii*)	1.3	2.3	healthy
9	Green Ash (*Fraxinus pennsylvanica*)	1.9	3.2	healthy
10	Green Ash (*Fraxinus pennsylvanica*)	1.5	2.2	healthy
11	Green Ash (*Fraxinus pennsylvanica*)	1.6	1.8	healthy
12	Cherrybark Oak (*Quercus pagoda*)	0.8	1.1	healthy
13	Swamp Black Gum (*Nyssa sylvatica*)	0.5	1.1	healthy
14	Green Ash (*Fraxinus pennsylvanica*)	1.0	1.6	healthy
15	Overcup Oak (*Quercus lyrata*)	0.7	1.3	healthy
16	Cherrybark Oak (*Quercus pagoda*)	0.7	0.9	healthy
17	Green Ash (*Fraxinus pennsylvanica*)	1.3	2.2	healthy
18	Cherrybark Oak (*Quercus pagoda*)	0.3	0.3	resprout from root
19	Overcup Oak (*Quercus lyrata*)	0.9	1.5	healthy
20	Overcup Oak (*Quercus lyrata*)	0.9	1.1	healthy
21	Overcup Oak (*Quercus lyrata*)	1.0	1.2	healthy

Species	Percent of Total
Swamp Chestnut Oak (*Quercus michauxii*)	15%
Swamp Black Gum (*Nyssa sylvatica*)	25%
Overcup Oak (*Quercus lyrata*)	20%
Green Ash (*Fraxinus pennsylvanica*)	25%
Cherrybark Oak (*Quercus pagoda*)	15%

Density:

Total Number of Trees **20** / **0.025 acres** = **800** **trees / acre**

Survivability:

Total Number of Trees **20** / **21 trees** **x** **100** = **95.2** **% survivability**

Number of New Recruits : 0

Note : Flag located AZ. 38°, 27 feet from monitoring well

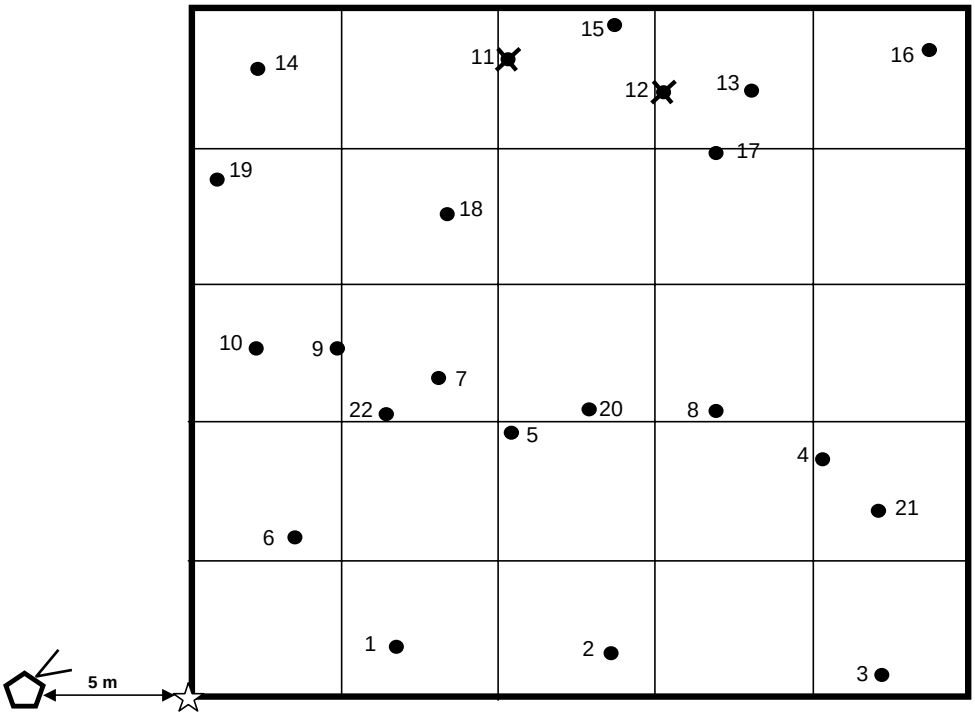
3rd Year Monitoring

4th Year Monitoring

Vegetation Monitoring Worksheet

Site: Daniels **Plot:** 6 **Date:** 5/30/2007

Plot Map



ID	Species	Height (m)	Collar Diameter (cm)	Comments (insect damage, disease, browsing)
1	Willow Oak (*Quercus phellos*)	0.9	1.7	healthy
2	Willow Oak (*Quercus phellos*)	0.8	1.2	healthy
3	Willow Oak (*Quercus phellos*)	1.0	1.4	healthy
4	Swamp Black Gum (*Nyssa sylvatica*)	0.6	1.2	healthy
5	Swamp Chestnut Oak (*Quercus michauxii*)	0.7	0.8	healthy
6	Swamp Black Gum (*Nyssa sylvatica*)	0.8	1.3	healthy
7	Swamp Chestnut Oak (*Quercus michauxii*)	1.9	2.1	healthy
8	Willow Oak (*Quercus phellos*)	2.6	3.4	healthy
9	Swamp Chestnut Oak (*Quercus michauxii*)	2.1	2.4	healthy
10	Swamp Black Gum (*Nyssa sylvatica*)	0.8	2.1	healthy
11	Swamp Black Gum (*Nyssa sylvatica*)			dead
12	Swamp Chestnut Oak (*Quercus michauxii*)			dead
13	Swamp Black Gum (*Nyssa sylvatica*)	0.9	2.6	healthy
14	Laurel Oak (*Quercus laurifolia*)	0.5	0.8	healthy
15	Swamp Chestnut Oak (*Quercus michauxii*)	1.6	1.9	healthy
16	Overcup Oak (*Quercus lyrata*)	1.7	2.8	healthy
17	Green Ash (*Fraxinus pennsylvanica*)	2.1	3.1	healthy
18	Overcup Oak (*Quercus lyrata*)	1.9	4.2	healthy
19	Overcup Oak (*Quercus lyrata*)	1.4	1.9	healthy
20	Cherrybark Oak (*Quercus pagoda*)	0.9	1.0	healthy
21	Cherrybark Oak (*Quercus pagoda*)	0.4	0.7	healthy
22	Overcup Oak (*Quercus lyrata*)	0.9	1.1	healthy

Species	Percent of Total
Swamp Chestnut Oak (*Quercus michauxii*)	20%
Willow Oak (*Quercus phellos*)	20%
Swamp Black Gum (*Nyssa sylvatica*)	20%
Cherrybark Oak (*Quercus pagoda*)	10%
Overcup Oak (*Quercus lyrata*)	20%
Green Ash (*Fraxinus pennsylvanica*)	5%
Laurel Oak (*Quercus laurifolia*)	5%

Density:

Total Number of Trees **20** / **0.025 acres** = **800** **trees / acre**

Survivability:

Total Number of Trees **20** / **22 trees** x **100** = **91** **% survivability**

Number of New Recruits : 0

Note : Flag located AZ. 174°, 150 feet from monitoring well

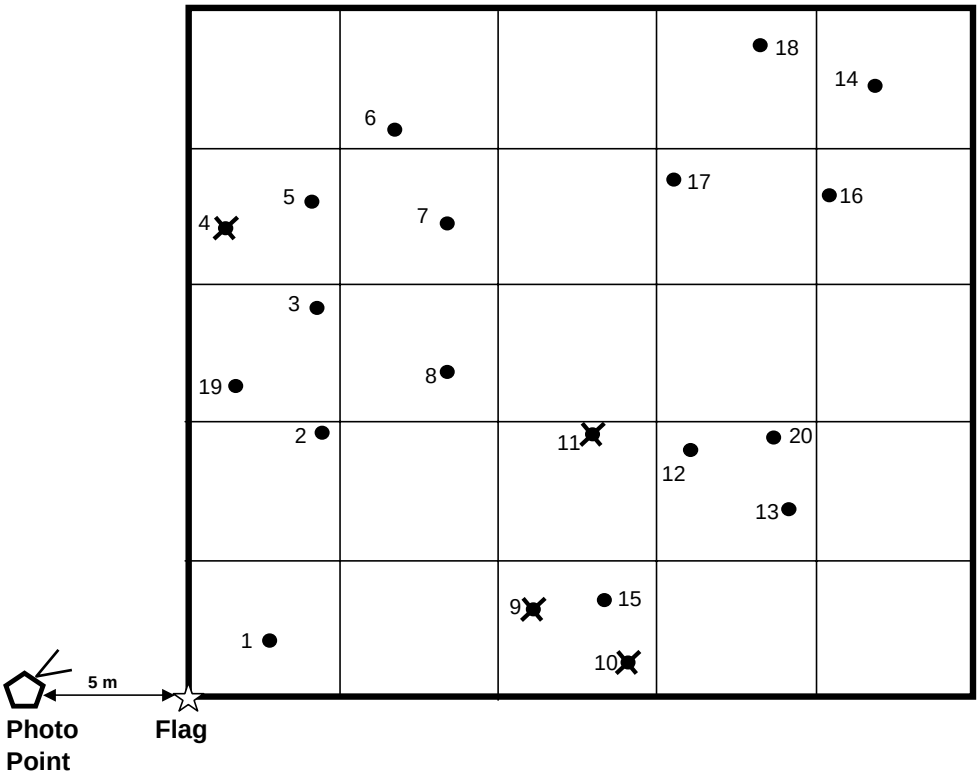
3rd Year Monitoring

4th Year Monitoring

Vegetation Monitoring Worksheet

Site: Daniels **Plot:** 7 **Date:** 5/30/2007

Plot Map



ID	Species	Height (m)	Collar Diameter (cm)	Comments (insect damage, disease, browsing)
1	Swamp Chestnut Oak (*Quercus michauxii*)	1.5	2.1	healthy
2	Swamp Chestnut Oak (*Quercus michauxii*)	1.7	2.3	healthy
3	Swamp Chestnut Oak (*Quercus michauxii*)	0.7	0.9	healthy
4	Swamp Chestnut Oak (*Quercus michauxii*)			dead
5	Swamp Chestnut Oak (*Quercus michauxii*)	1.2	2.0	healthy
6	Swamp Chestnut Oak (*Quercus michauxii*)	1.0	1.6	healthy
7	Swamp Chestnut Oak (*Quercus michauxii*)	0.8	0.9	healthy
8	Swamp Chestnut Oak (*Quercus michauxii*)	1.5	1.9	healthy
9	Swamp Chestnut Oak (*Quercus michauxii*)			dead
10	Swamp Black Gum (*Nyssa sylvatica*)			dead
11	Swamp Black Gum (*Nyssa sylvatica*)			dead
12	Swamp Chestnut Oak (*Quercus michauxii*)	1.0	1.3	healthy
13	Swamp Chestnut Oak (*Quercus michauxii*)	1.2	1.4	healthy
14	Swamp Chestnut Oak (*Quercus michauxii*)	0.9	1.4	healthy
15	Cherrybark Oak (*Quercus pagoda*)	0.7	0.9	healthy
16	Overcup Oak (*Quercus lyrata*)	1.1	1.8	healthy
17	Cherrybark Oak (*Quercus pagoda*)	1.0	1.4	healthy
18	Cherrybark Oak (*Quercus pagoda*)	0.3	0.5	healthy
19	Overcup Oak (*Quercus lyrata*)	1.3	2.3	healthy
20	Overcup Oak (*Quercus lyrata*)	0.4	0.4	healthy

Species	Percent of Total
Swamp Chestnut Oak (*Quercus michauxii*)	63%
Cherrybark Oak (*Quercus pagoda*)	19%
Overcup Oak (*Quercus lyrata*)	19%

Density:

Total Number of Trees **16** / **0.025 acres** = **640** **trees / acre**

Survivability:

Total Number of Trees **16** / **20 trees** x **100** = **80** **% survivability**

Number of New Recruits : 0

Note : Flag located AZ. 12°, 42 feet from monitoring well

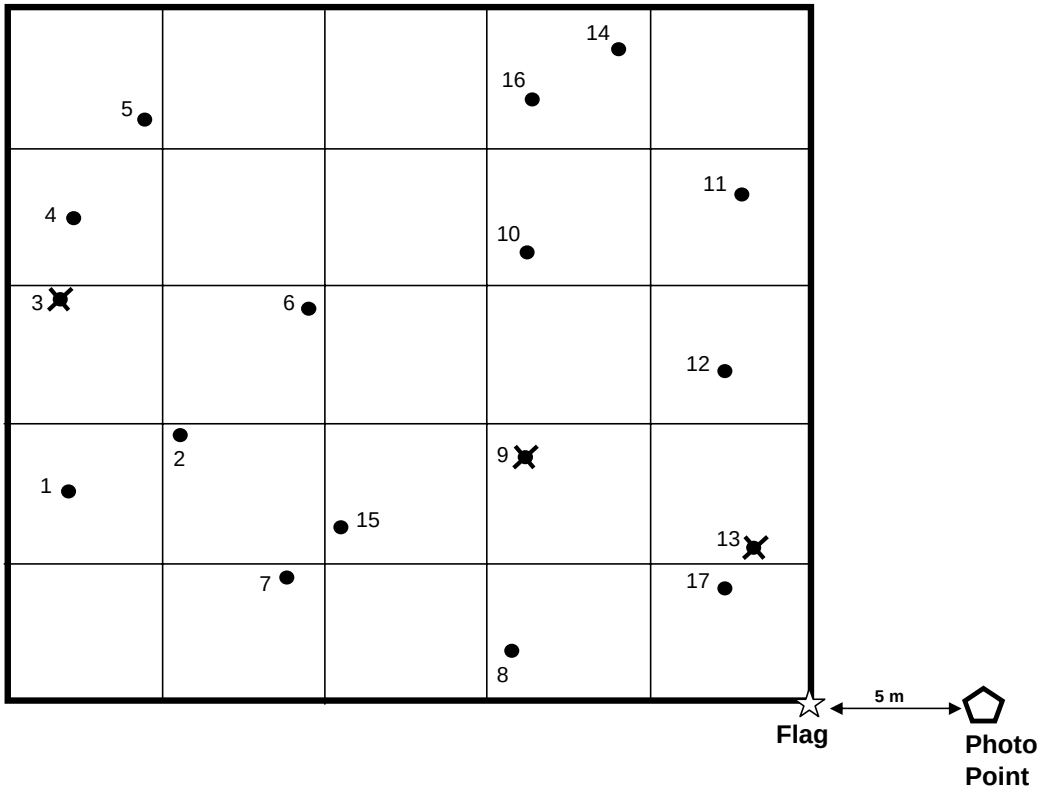
3rd Year Monitoring

4th Year Monitoring

Vegetation Monitoring Worksheet

Site: Daniels **Plot:** 8 **Date:** 5/30/2007

Plot Map



ID	Species	Height (m)	Collar Diameter (cm)	Comments (insect damage, disease, browsing)
1	Willow Oak (*Quercus phellos*)	0.9	1.2	healthy
2	Swamp Chestnut Oak (*Quercus michauxii*)	1.6	3.0	healthy
3	Yellow Poplar (*Liriodendron tulipifera*)			dead
4	Yellow Poplar (*Liriodendron tulipifera*)	0.5	1.0	healthy
5	Laurel Oak (*Quercus laurifolia*)	1.8	2.8	healthy
6	Swamp Chestnut Oak (*Quercus michauxii*)	1.7	2.1	healthy
7	Swamp Chestnut Oak (*Quercus michauxii*)	2.0	2.0	healthy
8	Swamp Chestnut Oak (*Quercus michauxii*)	2.2	2.9	healthy
9	Yellow Poplar (*Liriodendron tulipifera*)			dead
10	Swamp Chestnut Oak (*Quercus michauxii*)	0.8	0.9	healthy
11	Laurel Oak (*Quercus laurifolia*)	2.7	3.2	healthy
12	Swamp Chestnut Oak (*Quercus michauxii*)	1.7	2.6	healthy
13	Yellow Poplar (*Liriodendron tulipifera*)			dead
14	Laurel Oak (*Quercus laurifolia*)	1.8	1.7	healthy
15	Laurel Oak (*Quercus laurifolia*)	1.3	1.4	healthy
16	Willow Oak (*Quercus phellos*)	1.2	1.5	healthy
17	Willow Oak (*Quercus phellos*)	1.7	1.5	healthy

Species	Percent of Total
Swamp Chestnut Oak (*Quercus michauxii*)	43%
Willow Oak (*Quercus phellos*)	21%
Laurel Oak (*Quercus laurifolia*)	29%
Yellow Poplar (*Liriodendron tulipifera*)	7%

Density:

Total Number of Trees **14** / **0.025 acres** = **560** **trees / acre**

Survivability:

Total Number of Trees **14** / **17 trees** x **100** = **82.4** **% survivability**

Number of New Recruits : 0

Note : Flag located AZ. 328°, 27 feet from monitoring well

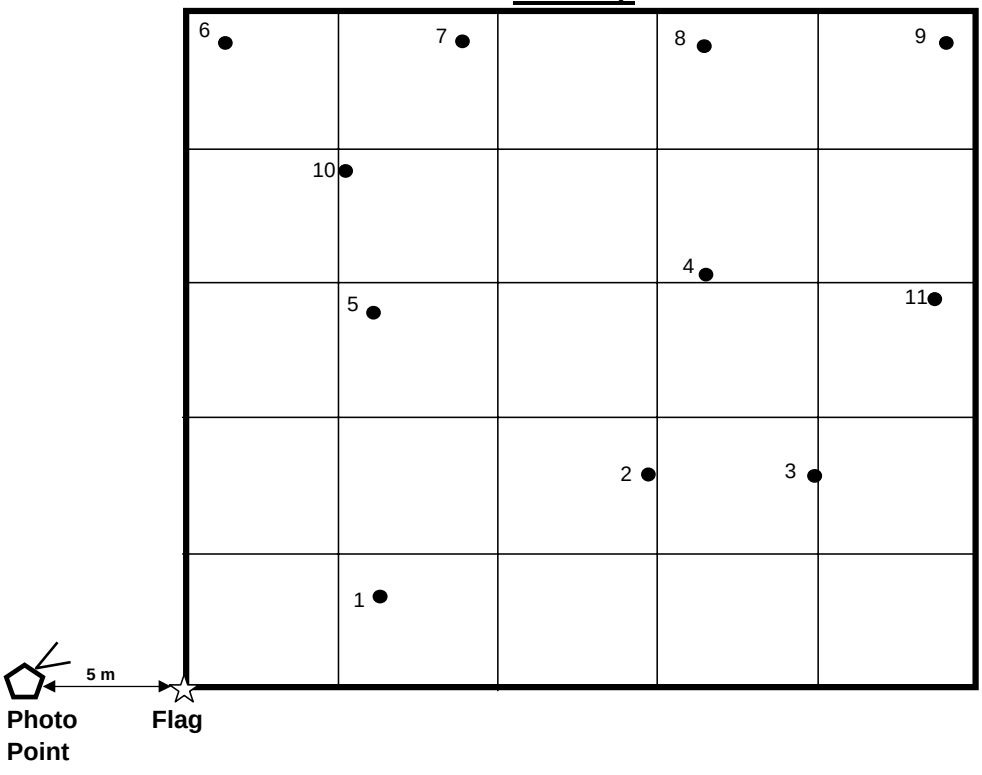
3rd Year Monitoring

4th Year Monitoring

Vegetation Monitoring Worksheet

Site: Daniels **Plot:** 9 **Date:** 5/30/2007

Plot Map



ID	Species	Height (m)	Collar Diameter (cm)	Comments (insect damage, disease, browsing)
1	Water Tupelo (*Nyssa sylvatica* var. *biflora*)	1.1	2.0	healthy
2	Bald Cypress (*Taxodium distichum*)	1.5	3.4	healthy
3	Bald Cypress (*Taxodium distichum*)	1.3	2.6	healthy
4	Bald Cypress (*Taxodium distichum*)	1.2	2.5	healthy
5	Bald Cypress (*Taxodium distichum*)	1.7	2.9	healthy
6	Bald Cypress (*Taxodium distichum*)	1.3	3.1	healthy
7	Bald Cypress (*Taxodium distichum*)	1.4	3.3	healthy
8	Bald Cypress (*Taxodium distichum*)	1.2	2.6	healthy
9	Water Tupelo (*Nyssa sylvatica* var. *biflora*)	0.9	1.6	healthy
10	Overcup Oak (*Quercus lyrata*)	1.5	1.8	healthy
11	Water Tupelo (*Nyssa sylvatica* var. *biflora*)	0.9	1.7	healthy

Species	Percent of Total
Water Tupelo (*Nyssa sylvatica* var. *biflora*)	27%
Bald Cypress (*Taxodium distchum*)	64%
Overcup Oak (*Quercus lyrata*)	9%

Density:

Total Number of Trees **11** / **0.025 acres** = **440** **trees / acre**

Survivability:

Total Number of Trees **11** / **11 trees** **x** **100** = **100** **% survivability**

Number of New Recruits : 0

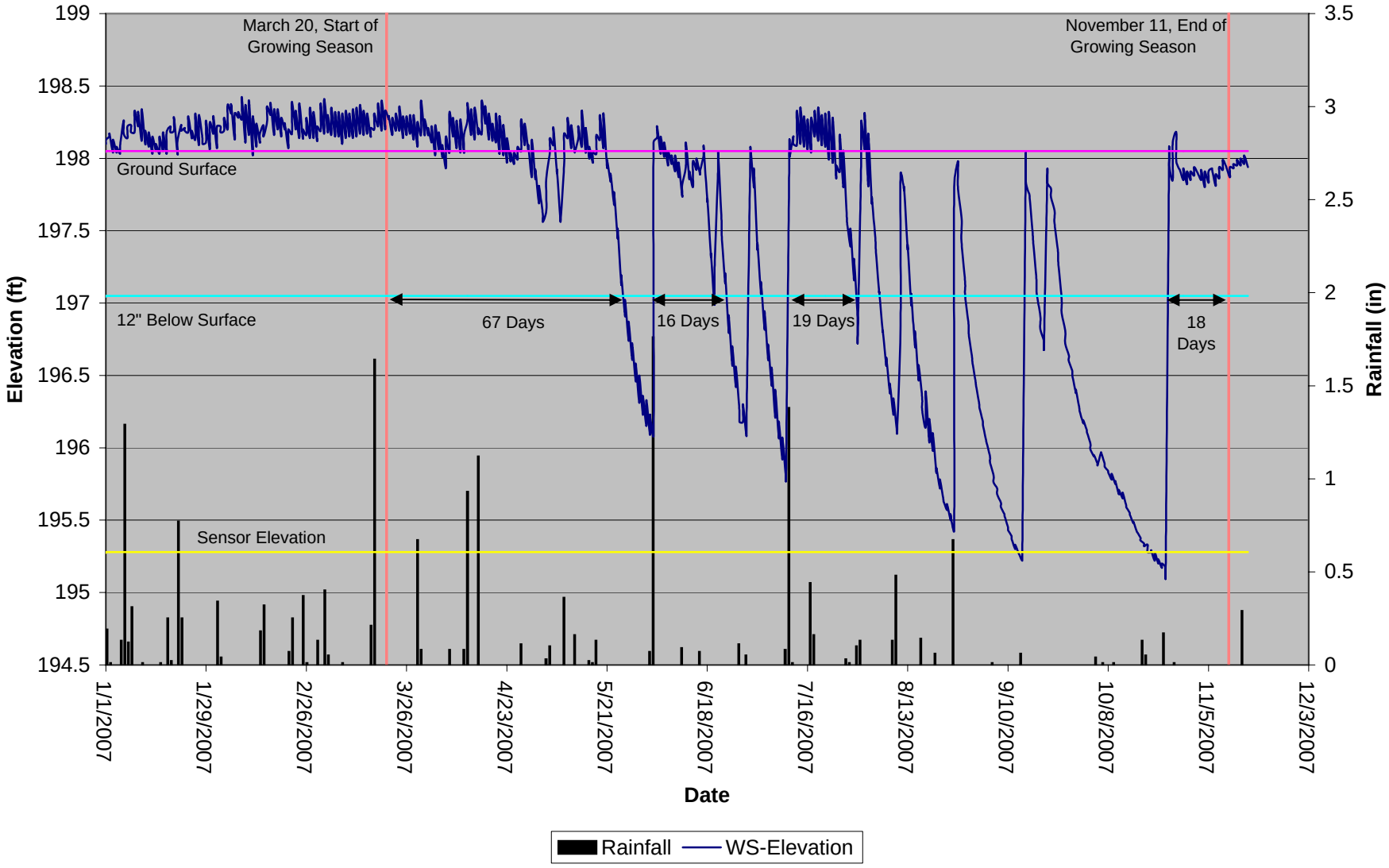
Note : Flag located AZ. 72°, 16 feet from monitoring well

3rd Year Monitoring

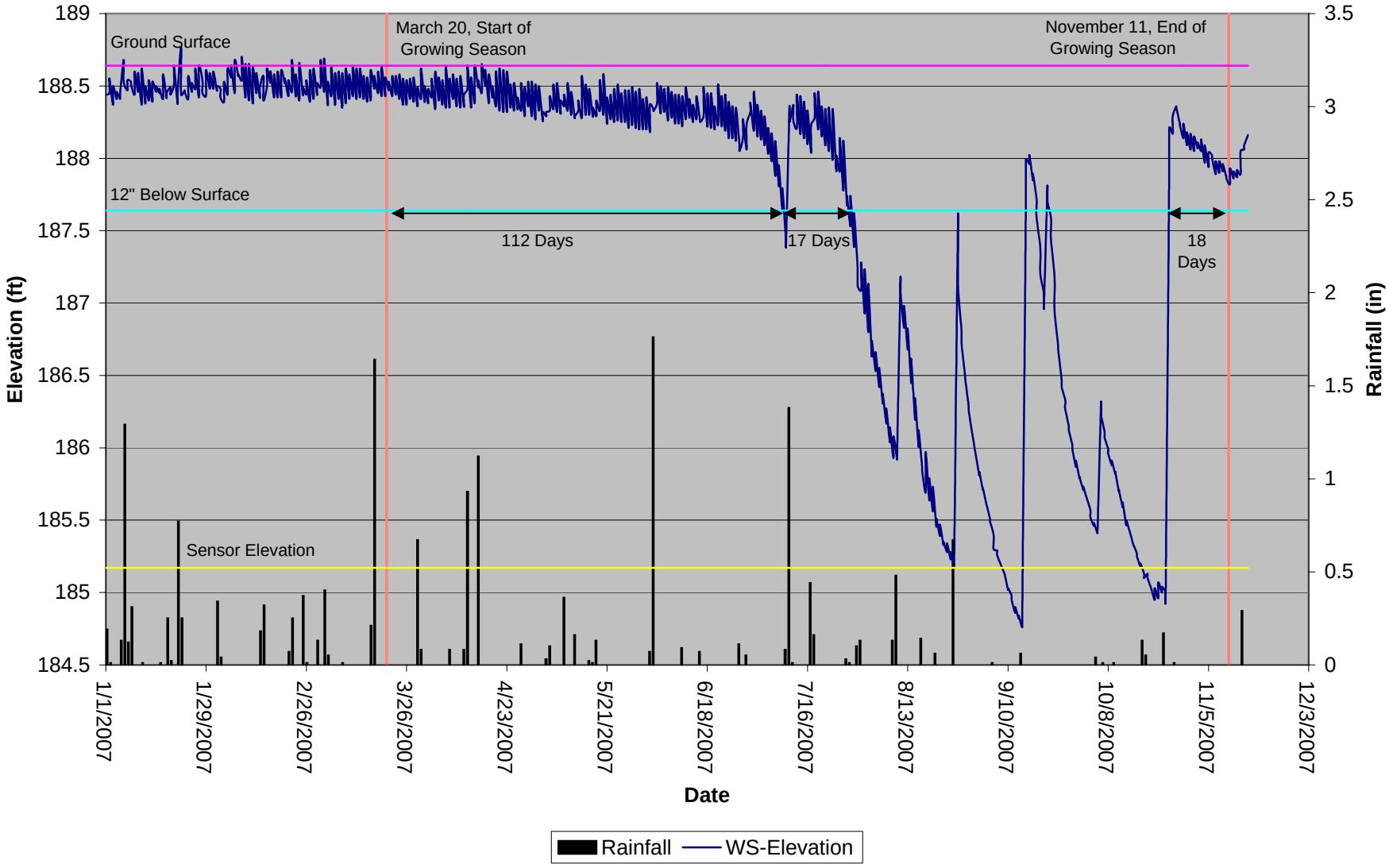
4th Year Monitoring

Appendix B
Hydrologic Monitoring and Hydroperiod

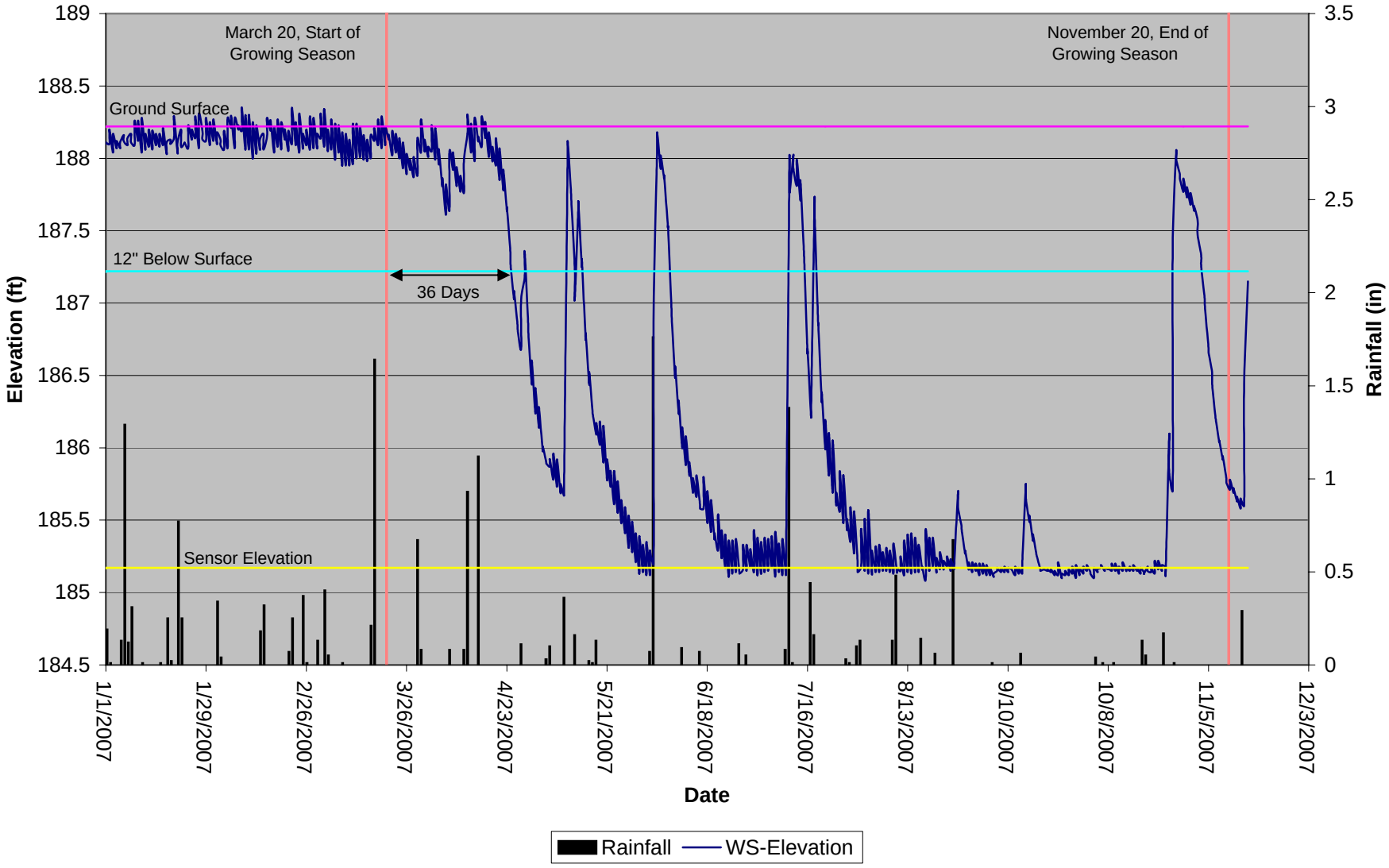
Daniels Farm Gauge 1 Hydrograph



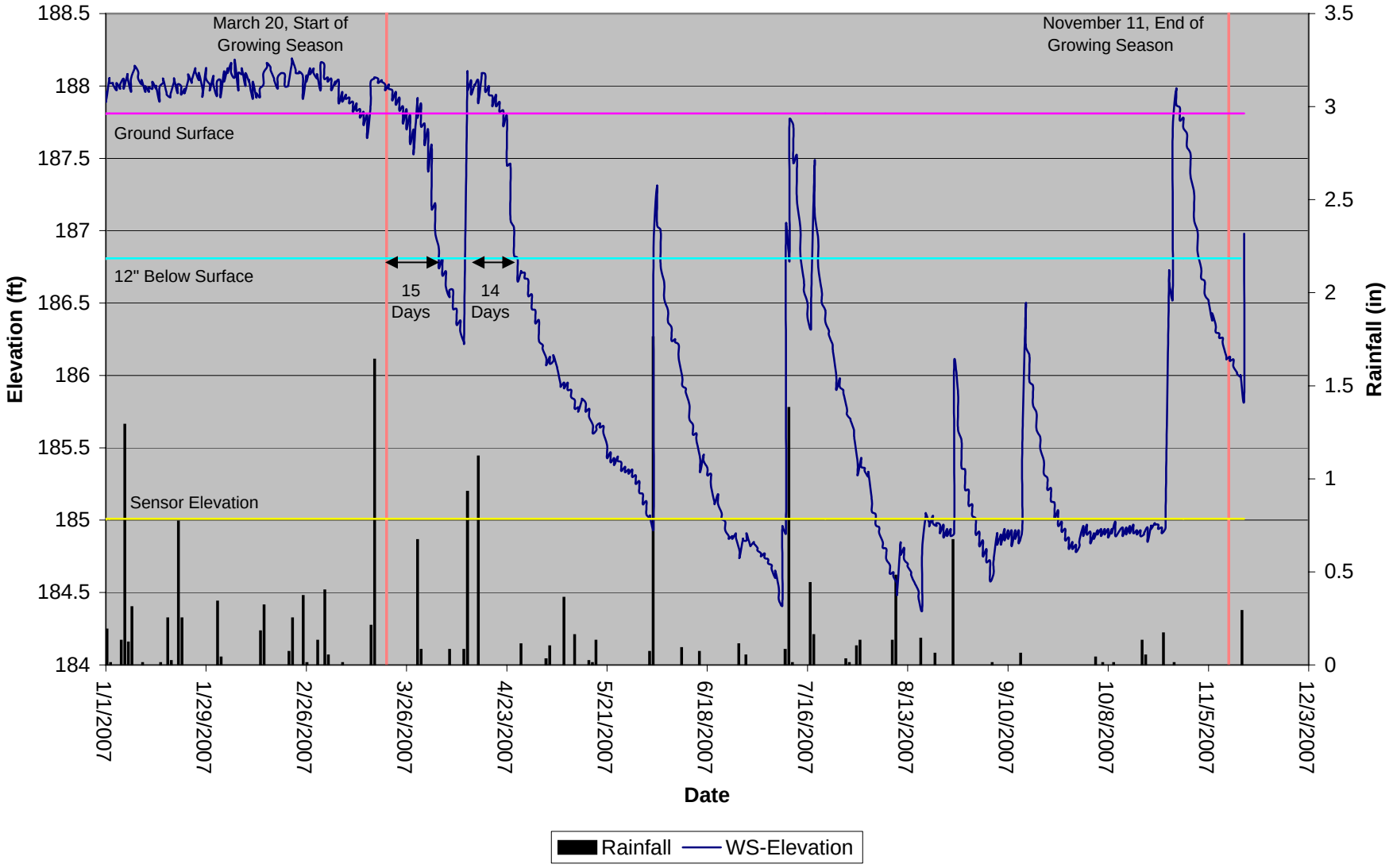
Daniels Farm Gauge 2 Hydrograph



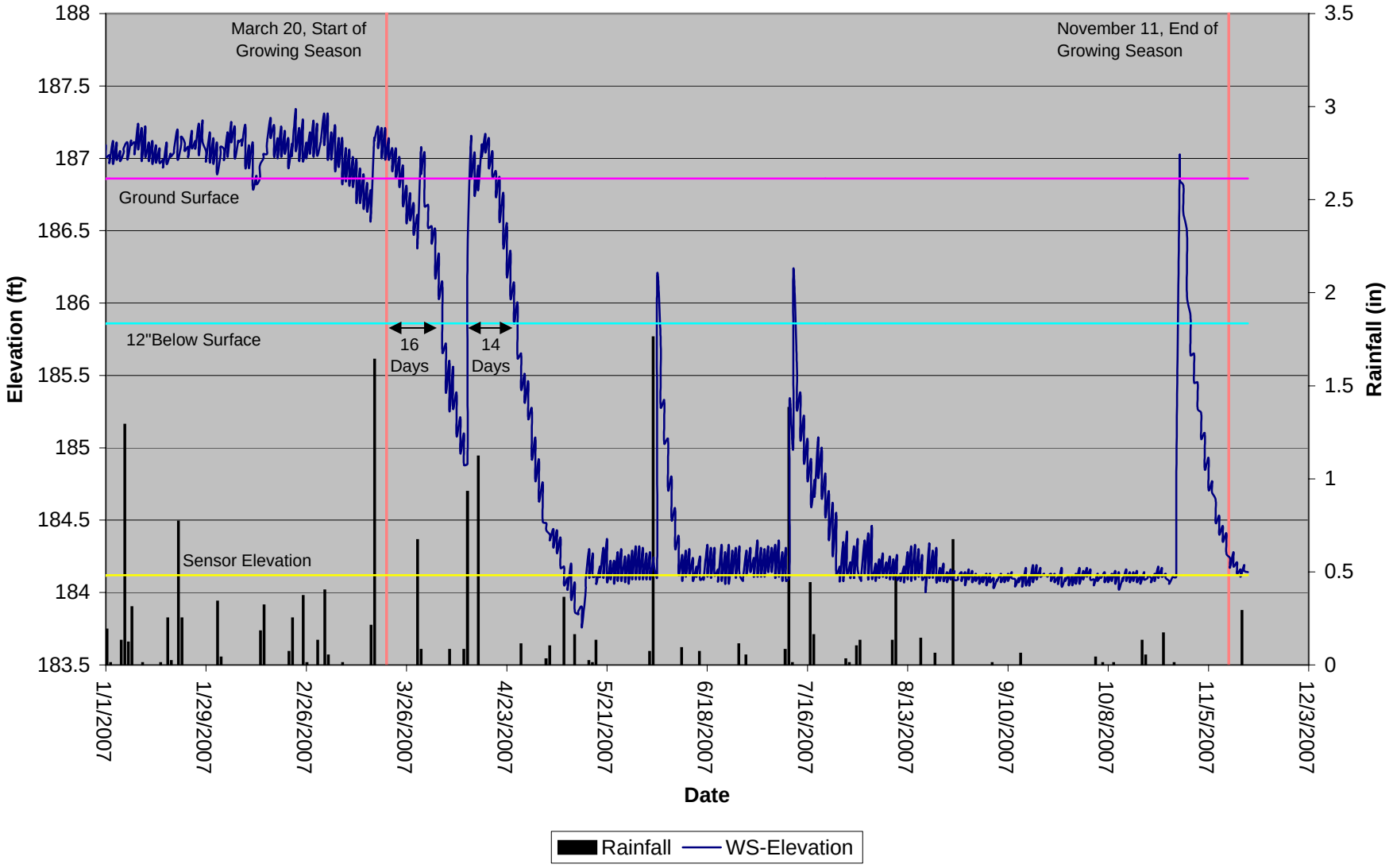
Daniels Farm Gauge 3 Hydrograph



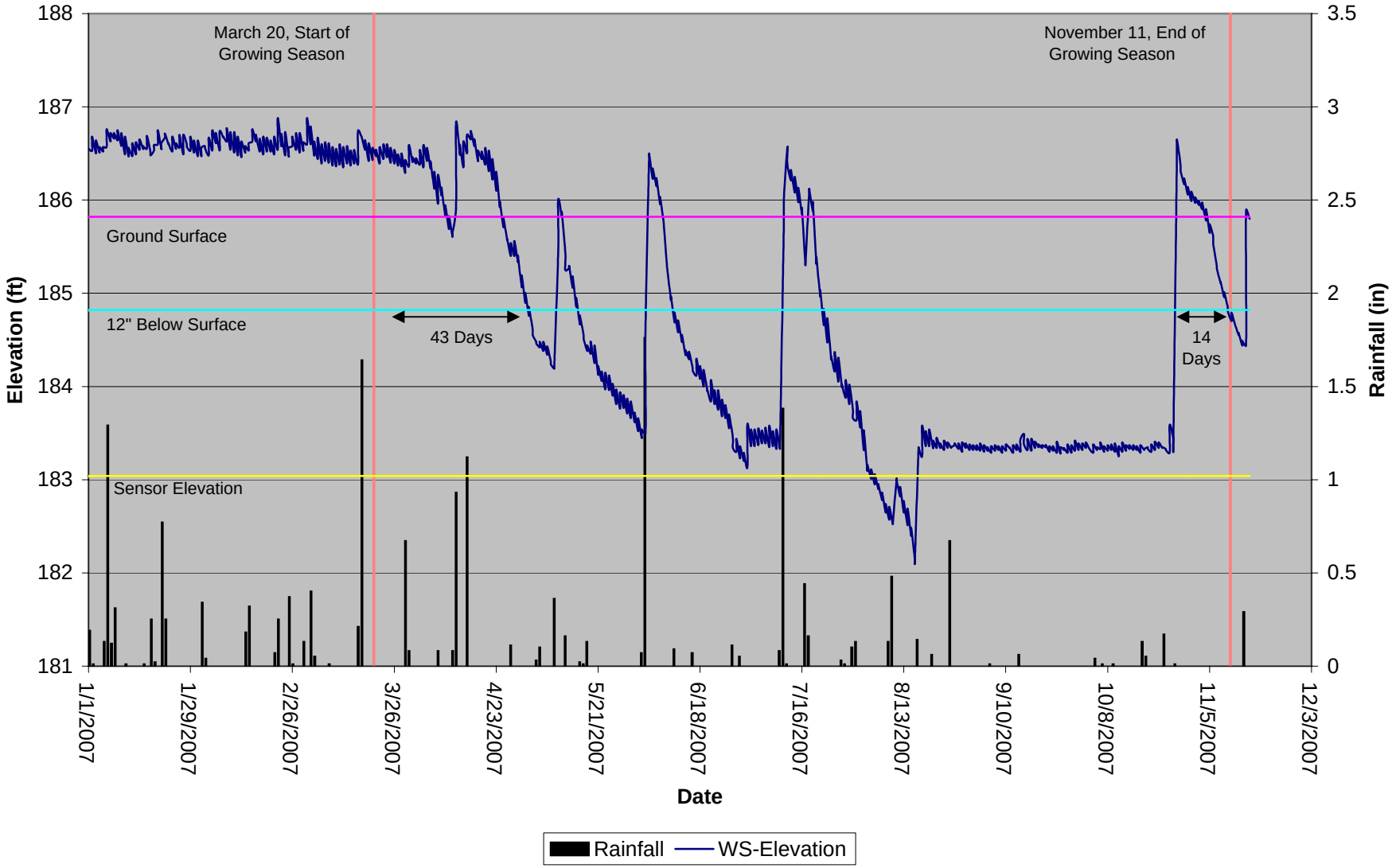
Daniels Farm Gauge 4 Hydrograph



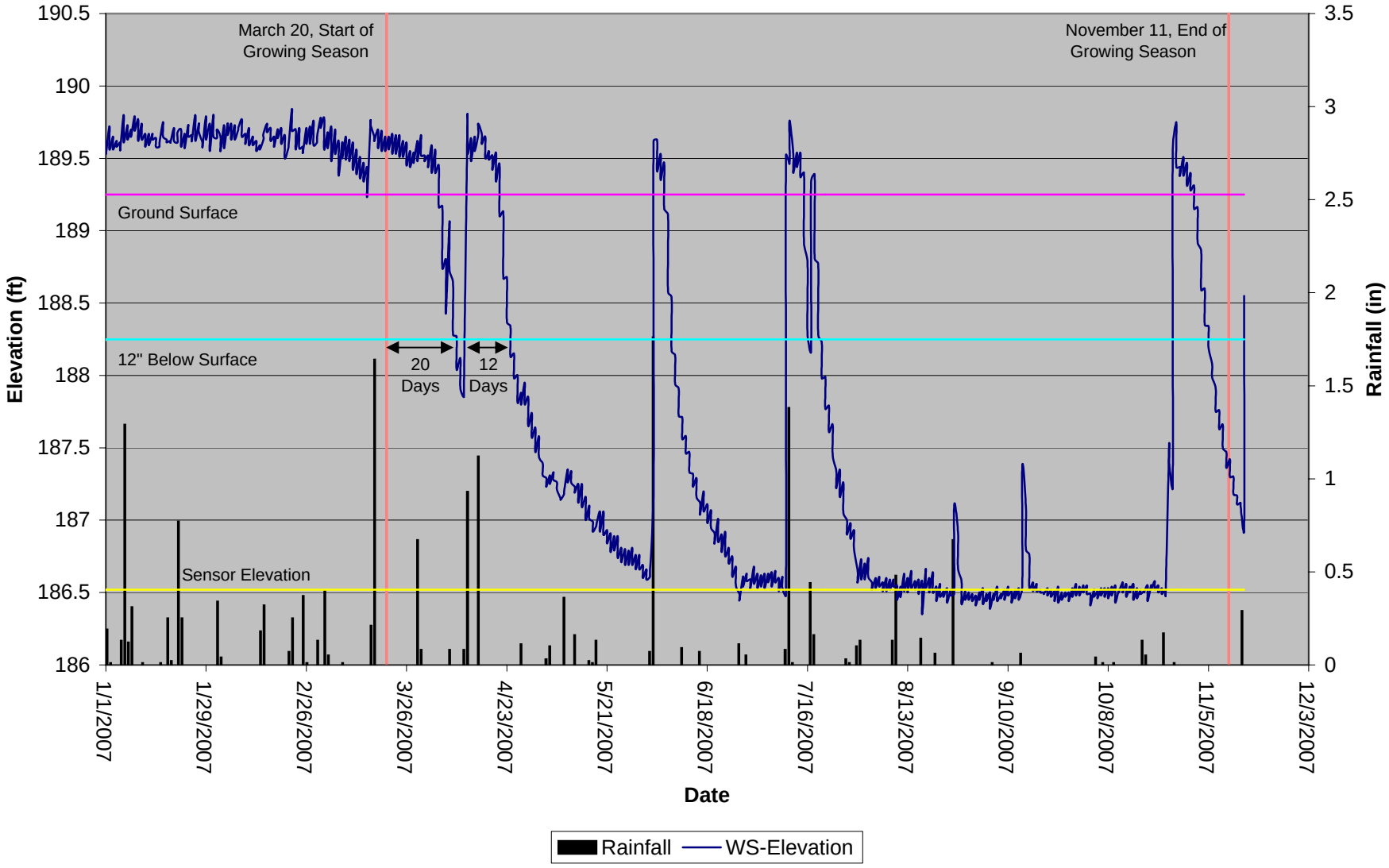
Daniels Farm Gauge 5 Hydrograph



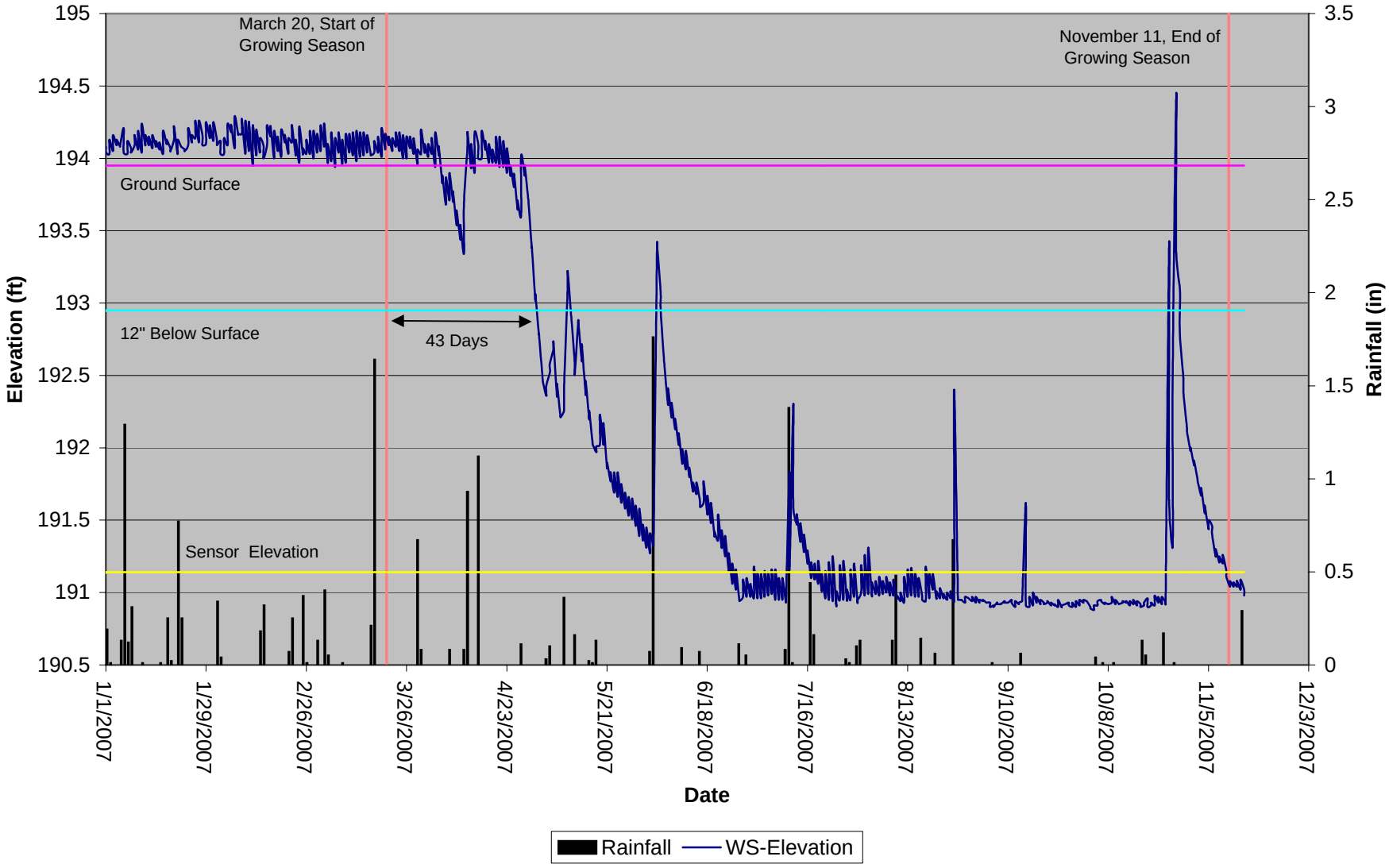
Daniels Farm Gauge 6 Hydrograph



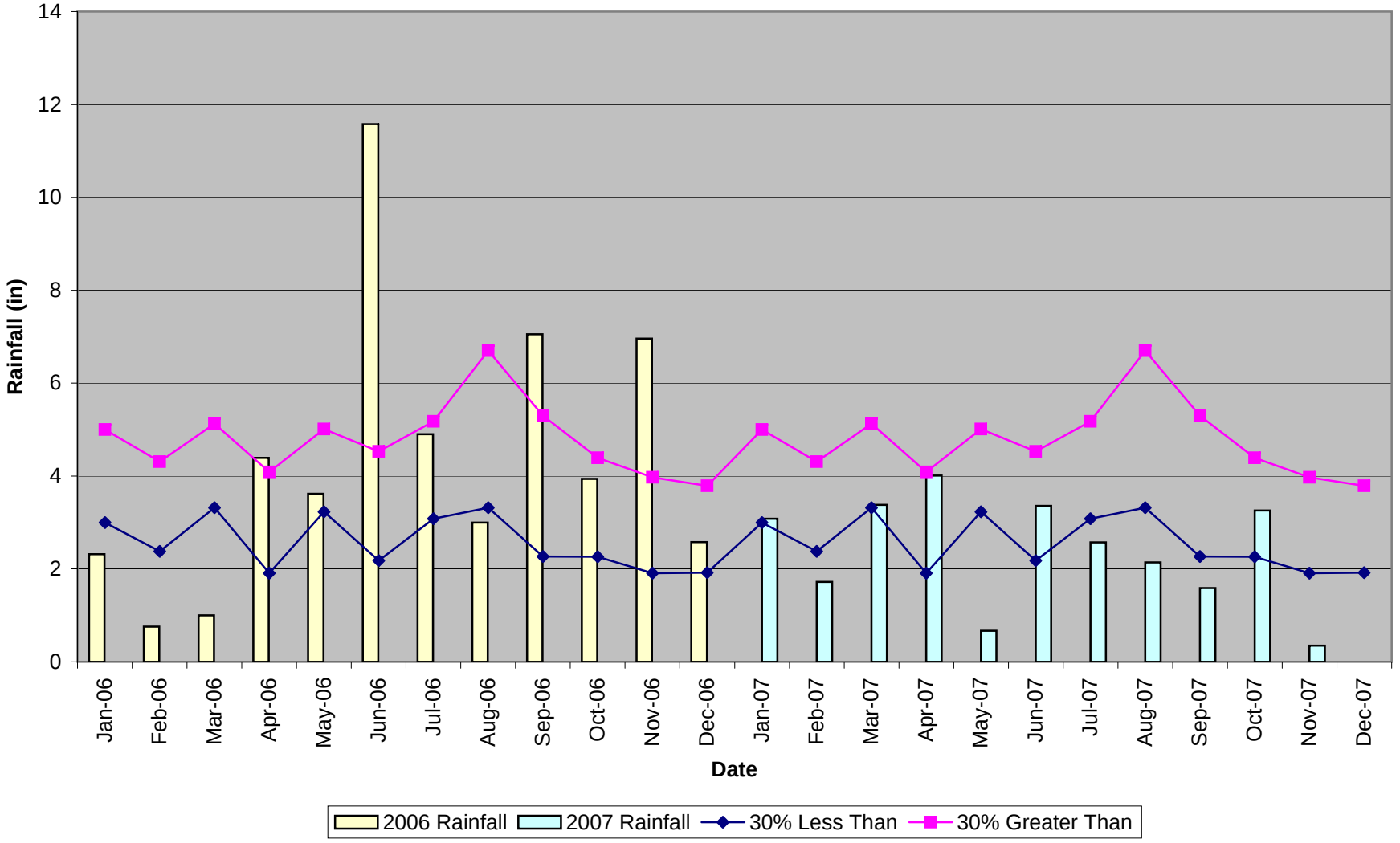
Daniels Farm Gauge 7 Hydrograph



Daniels Farm Gauge 8 Hydrograph



Daniels Property 30-70 Percentile Graph 2006-2007
Louisburg, NC Monthly Rainfall



Appendix C
Permanent Photo Documentation Points

Photo Location 1: View looking toward vegetation plot #8 identified by flag. 5/30/07 - MY04

Photo Location 2: View looking toward vegetation plot #1. 5/30/07 - MY04

Photo Location 3: View looking toward vegetation plot #4. 5/30/07 - MY04

Photo Location 4: View looking toward vegetation plot #5. 5/30/07 - MY04

Photo Location 5: View looking toward vegetation plot #6 identified by the yellow flag. The upland area shown to the left of the yellow flag is non-wetland. 5/30/07 - MY04