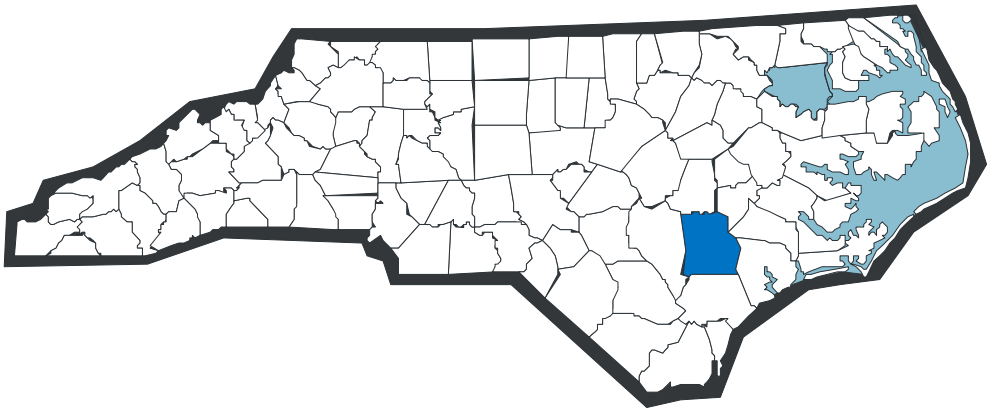
ANNUAL MONITORING REPORT FOR 2009
GROVE CREEK



GROVE CREEK MITIGATION SITE
DUPLIN COUNTY, NORTH CAROLINA
TIP No. R-2204 WM
NCDOT Project No. 8.1241801
(EEP Project Number .00038)
2009 Annual Monitoring Report (Year 4 of 5)

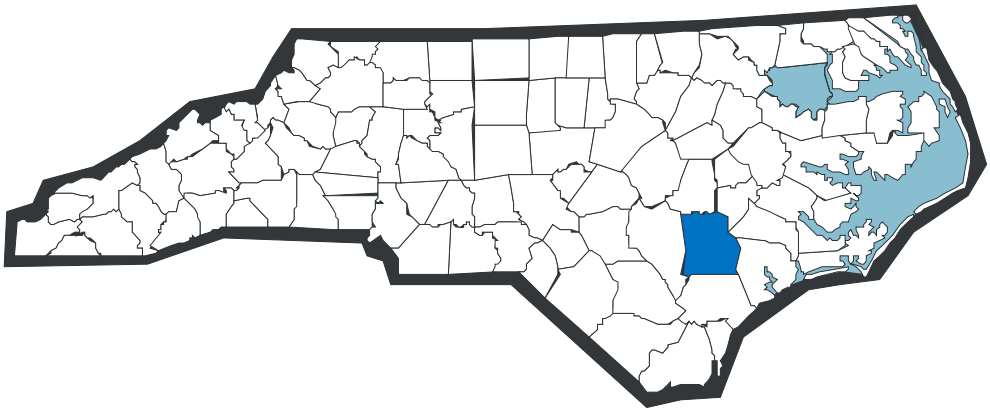
Submitted to:
North Carolina Department of Environment and Natural Resources
Ecosystem Enhancement Program
Raleigh, North Carolina

Prepared by:
Axiom Environmental, Inc.
20 Enterprise Street, Suite 7
Raleigh, North Carolina 27607

Design Firm:
Office of Natural Environment & Roadside Environmental Unit
North Carolina Department of Transportation
Raleigh, North Carolina

November 2009

ANNUAL MONITORING REPORT FOR 2009
GROVE CREEK



GROVE CREEK MITIGATION SITE
DUPLIN COUNTY, NORTH CAROLINA
TIP No. R-2204 WM
NCDOT Project No. 8.1241801
(EEP Project Number .00038)
2009 Annual Monitoring Report (Year 4 of 5)

Axiom Environmental, Inc.

Ecosystem Enhancement PROGRAM

Submitted to:
North Carolina Department of Environment and Natural Resources
Ecosystem Enhancement Program
Raleigh, North Carolina

Prepared by:
Axiom Environmental, Inc.
20 Enterprise Street, Suite 7
Raleigh, North Carolina 27607

Design Firm:
Office of Natural Environment & Roadside Environmental Unit
North Carolina Department of Transportation
Raleigh, North Carolina

November 2009

EXECUTIVE SUMMARY

The Grove Creek Wetland Mitigation Site (Site) is located within the United States Geological Survey (USGS) Hydrologic Unit 03030007 (North Carolina Division of Water Quality [NCDWQ] subbasin 03-06-22) of the Cape Fear River Basin. The Site includes an approximately 549-acre tract, located 5 miles east of Kenansville in central Duplin County. This document serves as the 2009 Fourth Year Annual Monitoring Report.

Eleven gauges were maintained and monitored for the year 4 (2009) growing season. Groundwater hydrology within 12 inches of the soil surface occurred for greater than 12.5 percent of the growing season at all gauges except Gauge GW3, which is located along an upland margin, and Gauges GW4 and GW11. Rainfall for the growing season was on average slightly lower than normal. Based on the available gauge and rain data, as a whole the Site should be considered successful for the year 4 (2009) monitoring period.

Seven 10-meter square vegetation plots were monitoring for the year 4 (2009) monitoring season. Based on the number of stems counted, the average plot density monitored at this Site is greater than 290 stems per acre and is considered successful for 2009 (year 4) monitoring. The average plot density was measured at 665 planted stems per acre. The stems per acre totals have increased from year to year due to resprouts from plants heavily grazed by deer (mostly smaller green ash stems) or with previous dieback for unknown causes.

Vegetation problem areas within the Site are depicted on Figure 5. Several areas of poor planted stem survival have been observed throughout the Site during monitoring, especially near vegetation plot 5; however, natural recruits are beginning to colonize these areas. Poor survival may have resulted from drought during planting followed by excessive inundation and subsequent drought.

In summary, Grove Creek Mitigation Site was successful for hydrology and vegetation for the Fourth Annual Monitoring Year (2009) period.

Table of Contents

List of Figures

List of Tables

Appendices

1.0 PROJECT BACKGROUND

1.1 Project Description

The Grove Creek Wetland Mitigation Site (Site) is located within the United States Geological Survey (USGS) Hydrologic Unit 03030007 (North Carolina Division of Water Quality [NCDWQ] subbasin 03-06-22) of the Cape Fear River Basin. The Site includes an approximately 549-acre tract, located 5 miles east of Kenansville in central Duplin County (Figure 1).

Directions to the Site:
From Raleigh take Interstate 40 East to Exit 373

- Travel east on Highway 24 through Kenansville
- Travel approximately 6 miles further east on Highway 24 (if you reach the Cape Fear River, you have gone too far) to a left onto Dobson Chapel Road
- Road surface becomes gravel and intersects another gravel road in about 0.3 mile. The Site is straight ahead

1.2 Purpose

In order to demonstrate successful mitigation, hydrologic and vegetative monitoring must be conducted for five years or until success criteria are achieved. Success criteria are based on federal guidelines for wetland mitigation. These guidelines stipulate criteria for both hydrologic conditions and vegetation survival. The following report details the results of hydrologic and vegetative monitoring for the 2009 (year 4) growing season at the Grove Creek Mitigation Site.

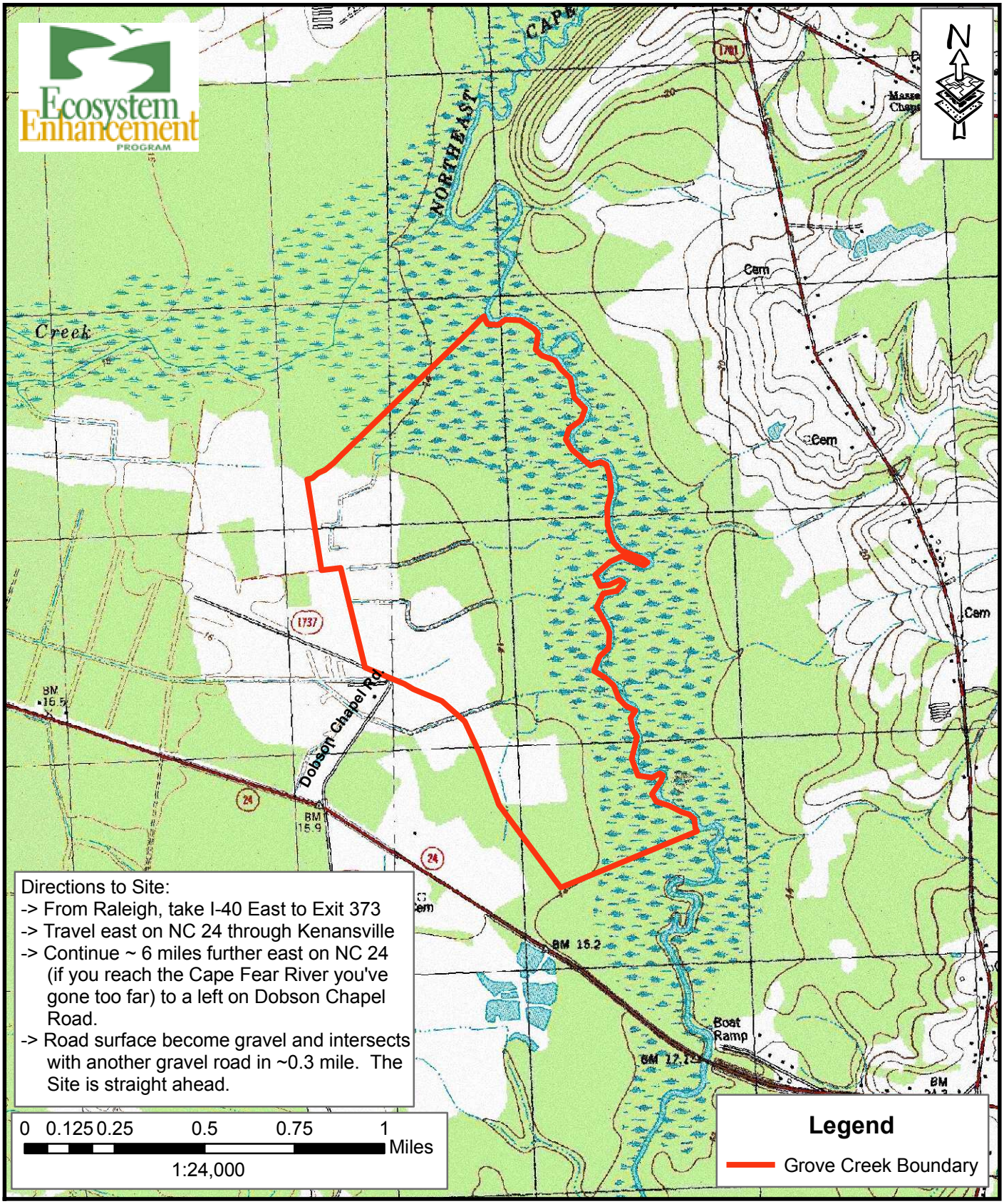
1.3 Project History

January 2004	Mitigation Plan
September 2004	Final Design (90%)
2005	Site Construction
2005	Planting
November 2006	Vegetation Monitoring (Year 1)
March-November 2006	Hydrologic Monitoring (Year 1)
July 2007	Vegetation Monitoring (Year 2)
March-November 2007	Hydrologic Monitoring (Year 2)
July 2008	Vegetation Monitoring (Year 3)
March-November 2008	Hydrologic Monitoring (Year 3)
July 2009	Vegetation Monitoring (Year 4)
March-November 2009	Hydrologic Monitoring (Year 4)

1.4 Mitigation Structure and Objectives

Prior to implementation of wetland restoration activities, the Site was characterized by active agricultural fields, mixed hardwood forests, and a large Bottomland Hardwood/Cypress-Gum Swamp wetland system located adjacent to the Northeast Cape Fear River. Historical land use activities included ditching within hydric soils and timber harvesting within wetlands.

The primary mitigation activities at the Site included restoration of previously ditched and filled riverine wetlands, creation of riverine wetlands within existing agricultural fields, hydrological enhancement of previously ditched riverine wetlands, preservation of the existing Coastal Plain Bottomland Hardwoods/Cypress-Gum Swamp Forest wetlands, restoration of a previously drained nonriverine wetland area, and preservation of existing upland hardwood forests.



Axiom Environmental, Inc
20 Enterprise Street
Suite 7
Raleigh, NC 27607
(919) 215-1693
Axiom Environmental, Inc.

SITE LOCATION
GROVE CREEK WETLAND RESTORATION SITE
EEP Project Number .00038
Year 4 (2009) Annual Monitoring Report
Duplin County, North Carolina

CLF

Date: Nov 2009

Project: 08-002

FIGURE 1

Wetland restoration and creation at the Site entailed 1) ditch cleaning prior to backfill, 2) impervious ditch plug construction, 3) ditch/canal backfilling, and 4) removal of fill material from wetlands.

According to the January 2004 Mitigation Plan, the primary goals of the project include 1) maximize the area returned to historic wetland function; 2) expand, enhance, and preserve 549 acres of the Northeast Cape Fear River riparian ecosystem; 3) protect the Site within a conservation easement in perpetuity; 4) provide valuable habitat to a diverse assemblage of flora and fauna; 5) serve as a wildlife corridor along the Northeast Cape Fear river; and 6) provide numerous wetland values including water storage, shoreline stabilization, pollutant removal, aquatic/wildlife habitat, recreation, and education. Project structures and objectives are summarized in Table 1 and depicted in Figure 2.

Table 1. Project Mitigation Structures and Objectives

Grove Creek (EEP Project Number .00038)

Project Segment or Reach ID	Mitigation Type*	Approach	Acreage	Stationing	Comment
Bottomland Hardwood	R	---	3.0 acres	---	Previously ditched and filled riverine wetlands
Bottomland Hardwood	E	---	18.4 acres	---	Ditched riverine wetlands
Cypress-Gum Swamp/Bottomland Hardwood	P	---	375.9 acres	---	Existing riverine wetlands
Bottomland Hardwood	C	---	9.2 acres	---	Existing upland agricultural fields to be graded to riverine wetlands
Headwater Forest	E	---	1.9 acres	---	Existing agricultural fields to be converted to nonriverine wetlands
Headwater Forest	C	---	1.4 acres	---	Existing agricultural fields upland to be graded to nonriverine wetlands
Headwater Forest	R	---	7.3 acres	---	Previously drained nonriverine wetlands
TOTAL			**417.1 acres**		

* R = Restoration; E = Enhancement; C = Creation; P = Preservation

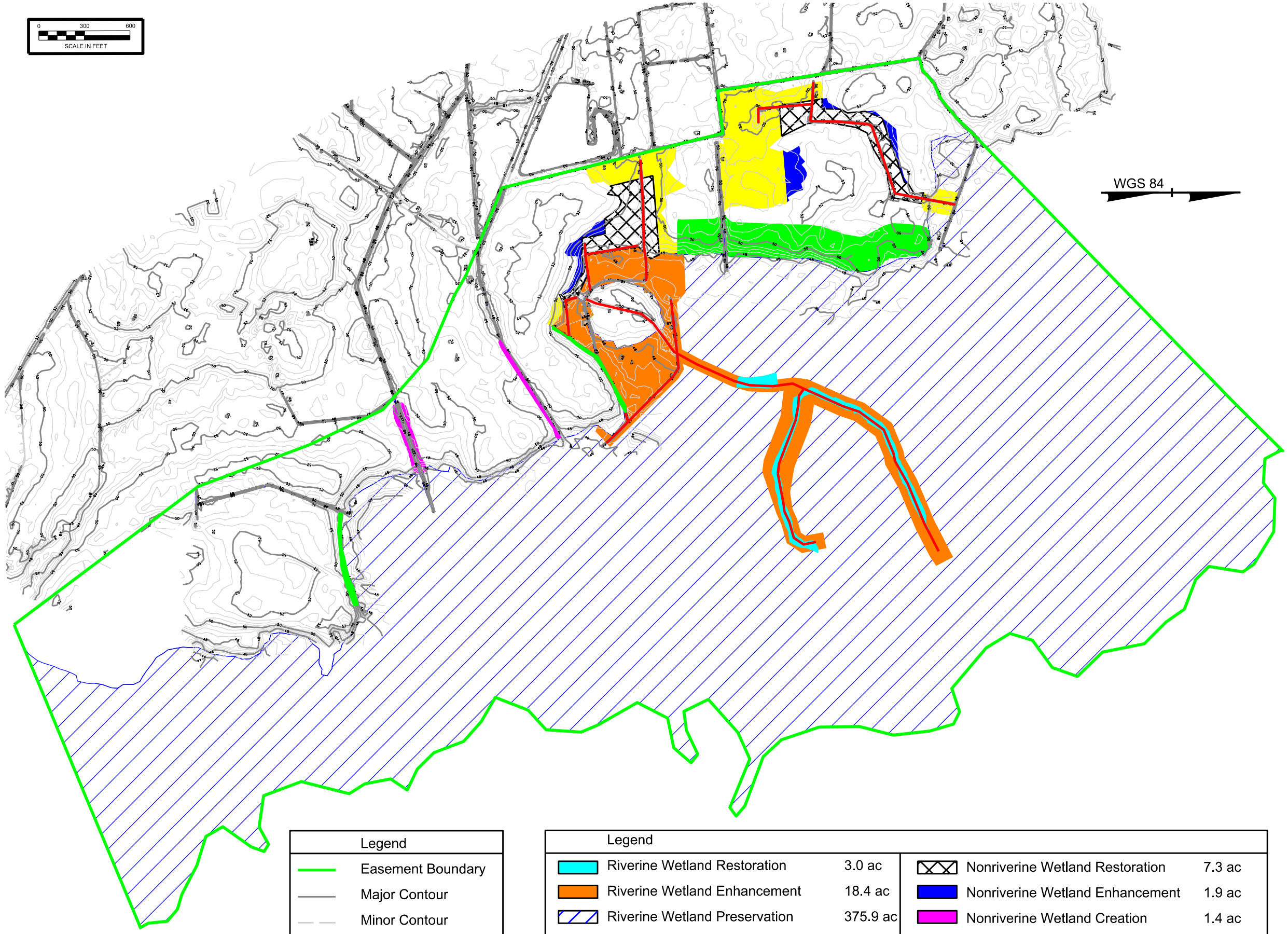
2.0 HYDROLOGY

2.1 Success Criteria

Success criteria for wetland hydrology at Grove Creek require inundation or saturation within 12 inches of the ground surface for a consecutive period of 12.5 percent of the growing season. The soil survey for Duplin County does not contain growing season data; therefore, due to its close proximity, the Sampson County soil survey was used. The estimated growing season begins March 18 and ends November 4 (239 days). In order to attain hydrologic success, saturation within 12 inches of the ground surface is required for at least 30 consecutive days (12.5 percent of the growing season).

2.2 Hydrologic Description

Seven groundwater monitoring gauges and four surfacewater monitoring gauges were maintained and monitored throughout the year 4 (2009) growing season (Figure 3).



Axiom Environmental, Inc.

Ecosystem Enhancement PROGRAM

NOTES/REVISIONS

Project:

Grove Creek Restoration Site

Project No. .00038
Year 4 (2009) Monitoring Report
Duplin County
North Carolina

Title:

As-Built Wetland Restoration Plan

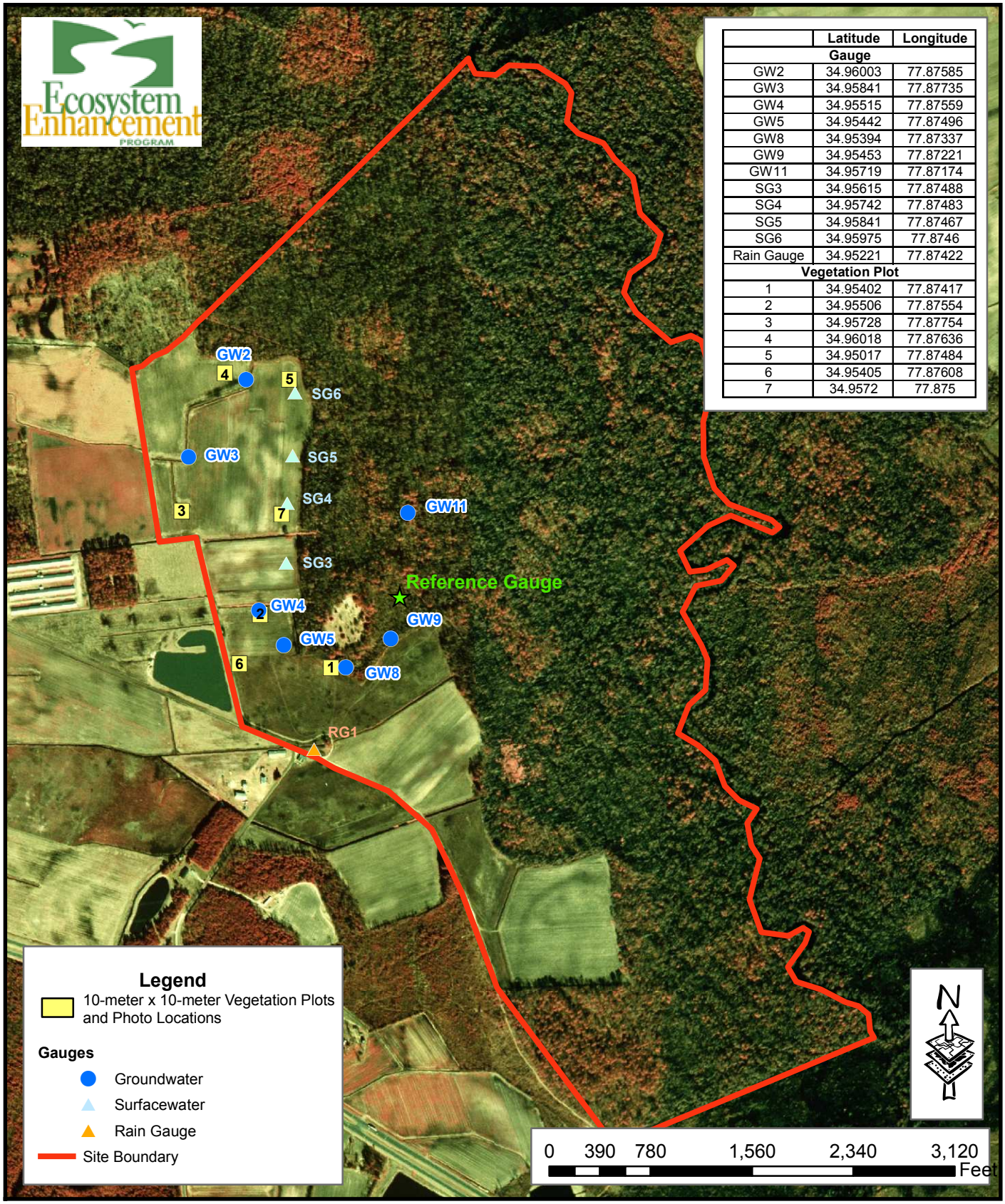
Scale: 1" = 655 '

Date: NOV 2009

Project No.: 08-002

FIGURE NO.

2



	Latitude	Longitude
Gauge		
GW2	34.96003	77.87585
GW3	34.95841	77.87735
GW4	34.95515	77.87559
GW5	34.95442	77.87496
GW8	34.95394	77.87337
GW9	34.95453	77.87221
GW11	34.95719	77.87174
SG3	34.95615	77.87488
SG4	34.95742	77.87483
SG5	34.95841	77.87467
SG6	34.95975	77.8746
Rain Gauge	34.95221	77.87422
Vegetation Plot		
1	34.95402	77.87417
2	34.95506	77.87554
3	34.95728	77.87754
4	34.96018	77.87636
5	34.95017	77.87484
6	34.95405	77.87608
7	34.9572	77.875

Axiom Environmental, Inc
20 Enterprise Street
Suite 7
Raleigh, NC 27607
(919) 215-1693
Axiom Environmental, Inc.

MONITORING PLAN
GROVE CREEK WETLAND RESTORATION SITE
EEP Project Number .00038
Year 4 of 5 (2009) Monitoring Report
Duplin County, North Carolina

CLF

Date: Nov 2009

Project: 08-002

FIGURE 3

Graphs of groundwater/surfacewater hydrology and precipitation from an onsite rain gauge for year 4 (2009) are included in Appendix A. Rain data from a nearby station in Kenansville was used at the beginning and end of the growing season due to malfunctions of the onsite rain gauge.

2.3 Results of Hydrologic Monitoring

2.3.1 Site Data

Eleven gauges were maintained and monitored for the year 4 (2009) growing season. Groundwater hydrology within 12 inches of the soil surface occurred for greater than 12.5 percent of the growing season at all gauges except Gauge GW3, which is located along an upland margin, and Gauges GW4 and GW11. Table 2 summarizes success criteria achievement for Site gauges.

Table 2. Summary of Groundwater/Surfacewater Gauge Results for Years 1 through 5
Grove Creek (EEP Project Number .00038)

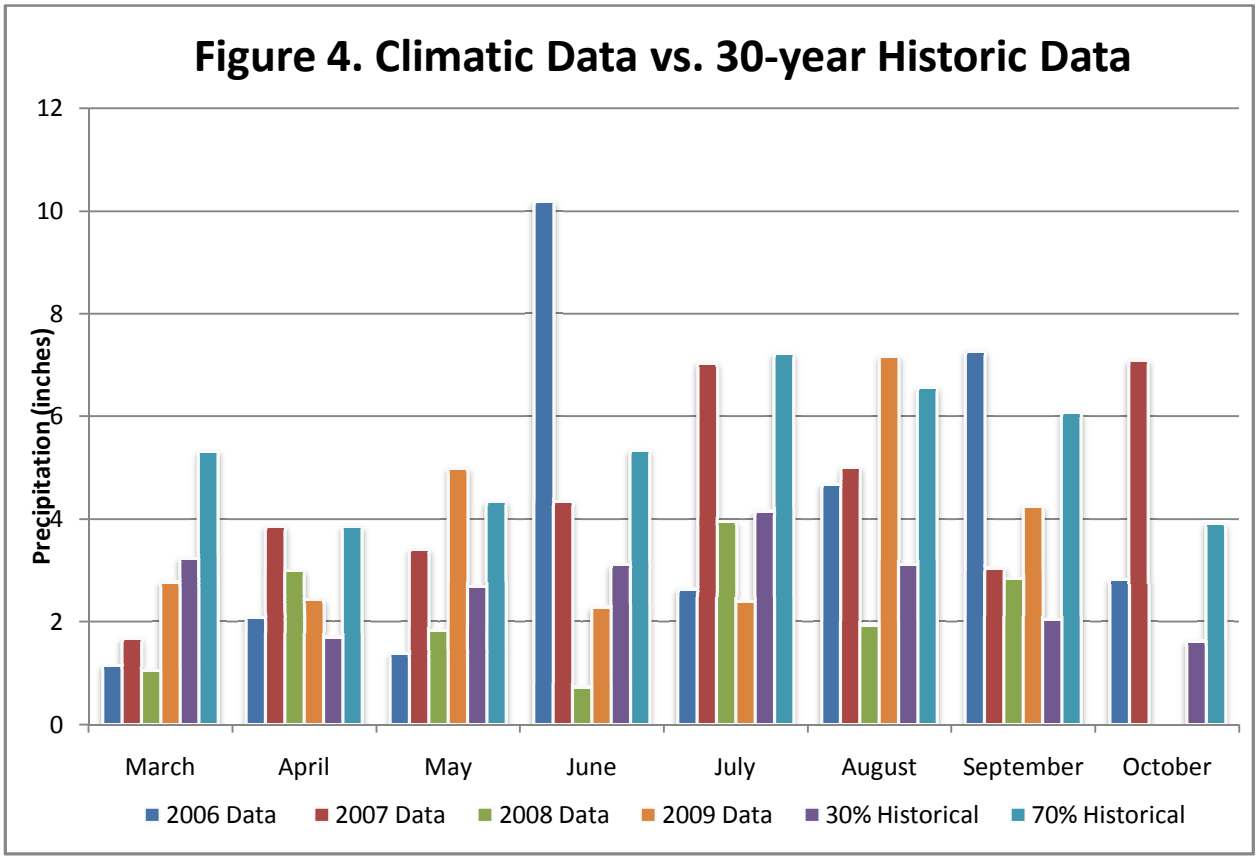
Gauge	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)				
	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)
GW2	Yes/98 days (41 percent)	Yes/60 days (25 percent)	Yes/32 days (13.4 percent)	Yes/48 days (20.1 percent)	
GW3	No/14 days (5.9 percent)	No/8 days (3.3 percent)	No/13 days (5.4 percent)	No/14 days (5.9 percent)	
GW4	Yes/46 days (19.2 percent)	No/13 days (5.4 percent)	Yes/33 days (13.8 percent)	No/21 days (8.8 percent)	
GW5	Yes/98 days (41 percent)	No/18 days (7.5 percent)	Yes/88 days (36.8 percent)	Yes/42 days (17.6 percent)	
GW8	Yes/239 days (100 percent)	Yes/69 days (28.9 percent)	Yes/87 days (36.4 percent)	Yes/37 days (15.5 percent)	
GW9	Yes/239 days (100 percent)	Yes/89 days (37.2 percent)	Yes/82 days (34.3 percent)	Yes/102 days (42.7 percent)	
GW11	Yes/31 days (13.0 percent)	No/9 days (3.8 percent)	Yes/39 days (16.3 percent)	Yes/7 days (2.9 percent)	
SG3	Yes/239 days (100 percent)	Yes/239 days (100 percent)	Yes/239 days (100 percent)	Yes/239 days (100 percent)	
SG4	Yes/239 days (100 percent)	Yes/213 days (89.1 percent)	Yes/239 days (100 percent)	Yes/239 days (100 percent)	
SG5	Yes/239 days (100 percent)	Yes/239 days (100 percent)	Yes/239 days (100 percent)	Yes/239 days (100 percent)	
SG6	Yes/239 days (100 percent)	Not able to determine*	Not able to determine*	Yes/239 days (100 percent)	
Reference**	--	--	Yes/67 days (28.0 percent)	Yes/97 days (40.6 percent)	

*This gauge does not monitor groundwater levels below the soil surface; therefore, it is not possible determine the number of days the groundwater level was within 12 inches of the soil surface. However, it is expected that the groundwater level remains near the soil surface.

**Reference was not installed prior to the 2008 (Year 3) monitoring season.

2.3.2 Climatic Data

Climatic data for the year 4 (2009) growing season has been compared to 30-year historical data from the station in Clinton, North Carolina (Figure 4) (NOAA 2004). The Site experienced slightly lower than average rainfall for the entire growing season with 26.3 inches of rain between March and September 2009 compared to the average historic rainfall of 29.4 inches for the same period between March and September.



2.4 Hydrologic Conclusions

Eleven gauges were maintained and monitored for the year 4 (2009) growing season. Groundwater hydrology within 12 inches of the soil surface occurred for greater than 12.5 percent of the growing season at all gauges except Gauge GW3, which is located along an upland margin, and Gauges GW4 and GW11. Rainfall for the growing season was on average slightly lower than normal. Based on the available gauge and rain data, as a whole the Site should be considered successful for the year 4 (2009) monitoring period.

3.0 VEGETATION

3.1 Success Criteria

Wetland vegetation success criteria at Grove Creek will require an average across the Site of 320 stems per acre of approved target species surviving for the first three years of monitoring, 290 stems per acre in year four, and 260 stems per acre in year five.

3.2 Description of Planted Areas

According to the 2004 *Grove Creek Mitigation Plan*, seedlings were to be planted at a minimum density of 680 stems per acre and included:

1. water oak (*Quercus nigra*)
2. willow oak (*Quercus phellos*)
3. laurel oak (*Quercus laurifolia*)
4. swamp chestnut oak (*Quercus michauxii*)
5. green ash (*Fraxinus pennsylvanica*)
6. river birch (*Betula nigra*)
7. bald cypress (*Taxodium distichum* var. *distichum*)
8. water tupelo (*Nyssa biflora*)

3.3 Results of Vegetation Monitoring

Seven 10-meter square vegetation plots were established as depicted in Figure 2 in November 2006. These plots were surveyed in July 2009 for the year 4 (2009) monitoring season using the *CVS-EEP Protocol for Recording Vegetation, Version 4.0* (Lee et al. 2006) (http://cvs.bio.unc.edu/methods.htm); results are included in Table 3 and pictures are included in Appendix B. The taxonomic standard for vegetation used for this document was *Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas* (Weakley 2007). No reference area was studied; therefore, no comparisons could be made to reference conditions.

Based on the number of stems counted, the average plot density monitored at this Site is greater than 290 stems per acre and is considered successful. The average plot density has been measured at 665 planted stems per acre for 2009 (year 4) monitoring. The dominant species identified at the Site were bald cypress (*Taxodium distichum*), green ash (*Fraxinus pennsylvanica*), and water oak (*Quercus nigra*). Five out of the seven individual vegetation plots were well above the success criteria with 728 to 1093 planted stems per acre. Vegetation plots 5 and 7 were low with 121 and 243 planted stems per acre, respectively as the result of previous high water levels; however, when including natural recruits, the stem counts increase well above 290 stems per acre.

Table 3. Stem Counts for Planted Species Arranged by Plot

Grove Creek (EEP Project Number .00038)

	Year 4 (2009) Individual Plots (0.0247 acre each)							Year 4 (2009)	Year 3 (2008)	Year 2 (2007)	Year 1 (2006)
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Totals**	**Totals**	**Totals**	**Totals**
Betula nigra	-	-	-	5	2	5	-	12	12	10	9
Fraxinus pennsylvanica	-	4	10	3	1	7	-	25	24	19	11
Nyssa sp.	-	-	1	1	-	-	-	2	2	-	-
Quercus sp.	-	-	-	1	-	-	-	1	2	2	2
Quercus lyrata	5	1	-	3	-	2	-	11	11	11	11
Quercus michauxii	2	1	2	5	-	-	-	10	9	8	7
Quercus nigra	7	3	-	4	-	2	-	16	15	14	14
Quercus phellos	4	-	-	1	-	-	-	5	5	5	5
Taxodium distichum	-	11	7	4	-	4	6	32	33	33	27
Ulmus sp.	-	1	-	-	-	-	-	1			
Total Stems Per Plot	**18**	**21**	**20**	**27**	**3**	**20**	**6**	**115**	**113**	**102**	**86**
Stems Per Acre	**728**	**850**	**809**	**1093**	**121**	**809**	**243**	**665**	**654**	**560**	**497**

3.4 Conclusions

Based on the number of stems counted, the average plot density monitored at this Site is greater than 290 stems per acre and is considered successful for 2009 (year 4) monitoring. The average plot density was measured at 665 planted stems per acre. The stems per acre totals have increased from year to year due to resprouts from plants heavily grazed by deer (mostly smaller green ash stems) or with previous dieback for unknown causes.

Vegetation problem areas within the Site are depicted on Figure 5. Several areas of poor planted stem survival have been observed throughout the Site during monitoring, especially near vegetation plot 5; however, natural recruits are beginning to colonize these areas. Poor survival may have resulted from drought during planting followed by excessive inundation and subsequent drought.

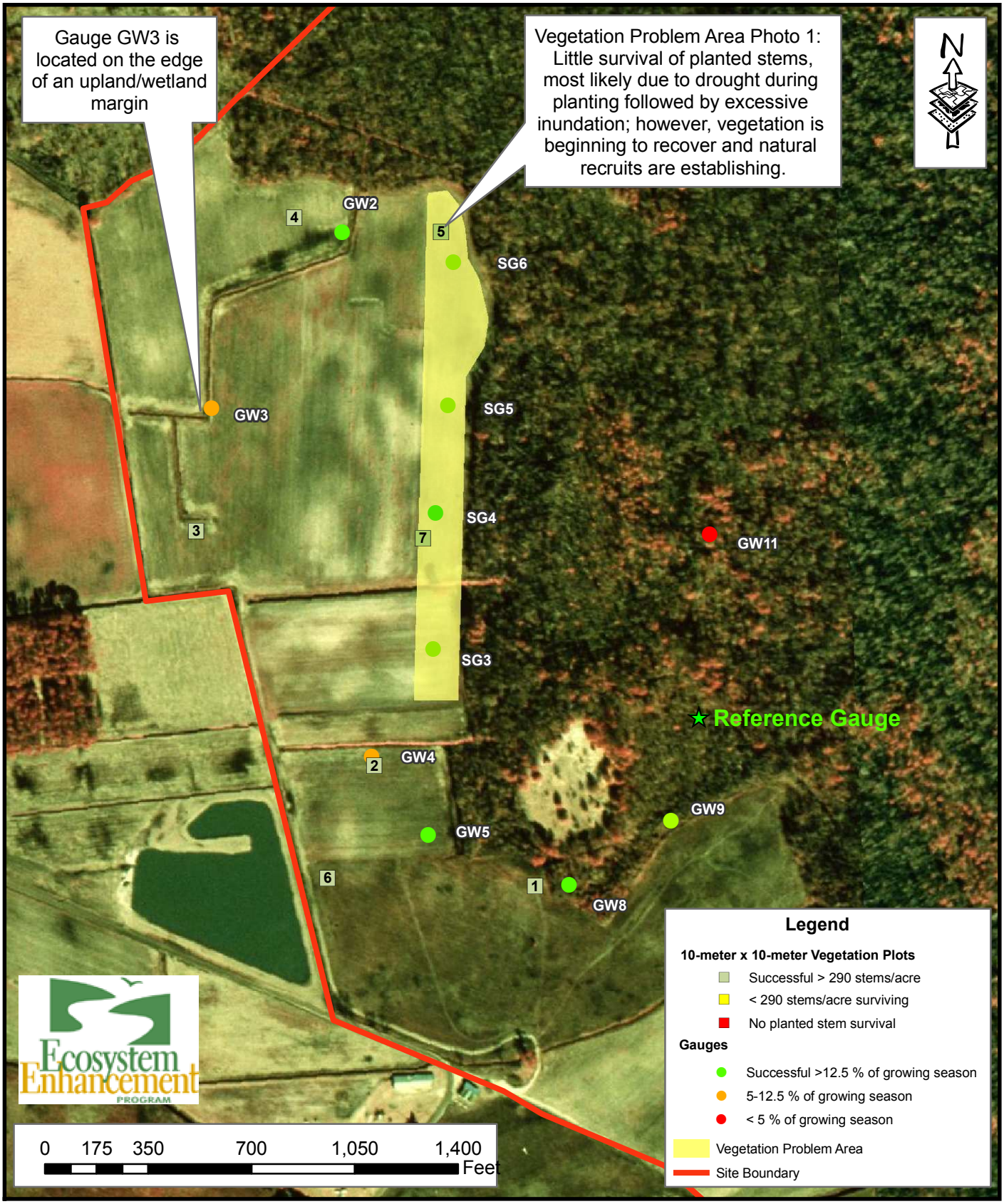
4.0 OVERALL CONCLUSIONS/RECOMMENDATIONS

Eleven gauges were maintained and monitored for the year 4 (2009) growing season. Groundwater hydrology within 12 inches of the soil surface occurred for greater than 12.5 percent of the growing season at all gauges except Gauge GW3, which is located along an upland margin, and Gauges GW4 and GW11. Rainfall for the growing season was on average slightly lower than normal. Based on the available gauge and rain data, as a whole the Site should be considered successful for the year 4 (2009) monitoring period.

Based on the number of stems counted, the average plot density monitored at this Site is greater than 290 stems per acre and is considered successful for 2009 (year 4) monitoring. The average plot density was measured at 665 planted stems per acre. The stems per acre totals have increased from year to year due to resprouts from plants heavily grazed by deer (mostly smaller green ash stems) or with previous dieback for unknown causes.

Vegetation problem areas within the Site are depicted on Figure 5. Several areas of poor planted stem survival have been observed throughout the Site during monitoring, especially near vegetation plot 5; however, natural recruits are beginning to colonize these areas. Poor survival may have resulted from drought during planting followed by excessive inundation and subsequent drought.

In summary, Grove Creek Mitigation Site was successful for hydrology and vegetation for the Fourth Annual Monitoring Year (2009) period.



Axiom Environmental, Inc
0 Enterprise Street
uite 7
aleigh, NC 27607
)19) 215-1693
Axiom Environmental, Inc.

YEAR 4 (2009) MONITORING RESULTS
GROVE CREEK WETLAND RESTORATION SITE
EEP Project Number .00038
Year 4 of 5 (2009) Monitoring Report
Duplin County, North Carolina

CLF

Date: Nov 2009

Project: 08-002

FIGURE 5

5.0. REFERENCES

Lee, Michael T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2006. CVS-EEP Protocol for Recording Vegetation, Version 4.0. (online). Available: http://cvs.bio.unc.edu/methods.htm.

National Oceanic and Atmospheric Administration (NOAA). 2004. Climatography of the United States No. 20; Monthly Station Climate Summaries, 1971-2000. National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Service, National Climatic Data Center, Asheville, North Carolina.

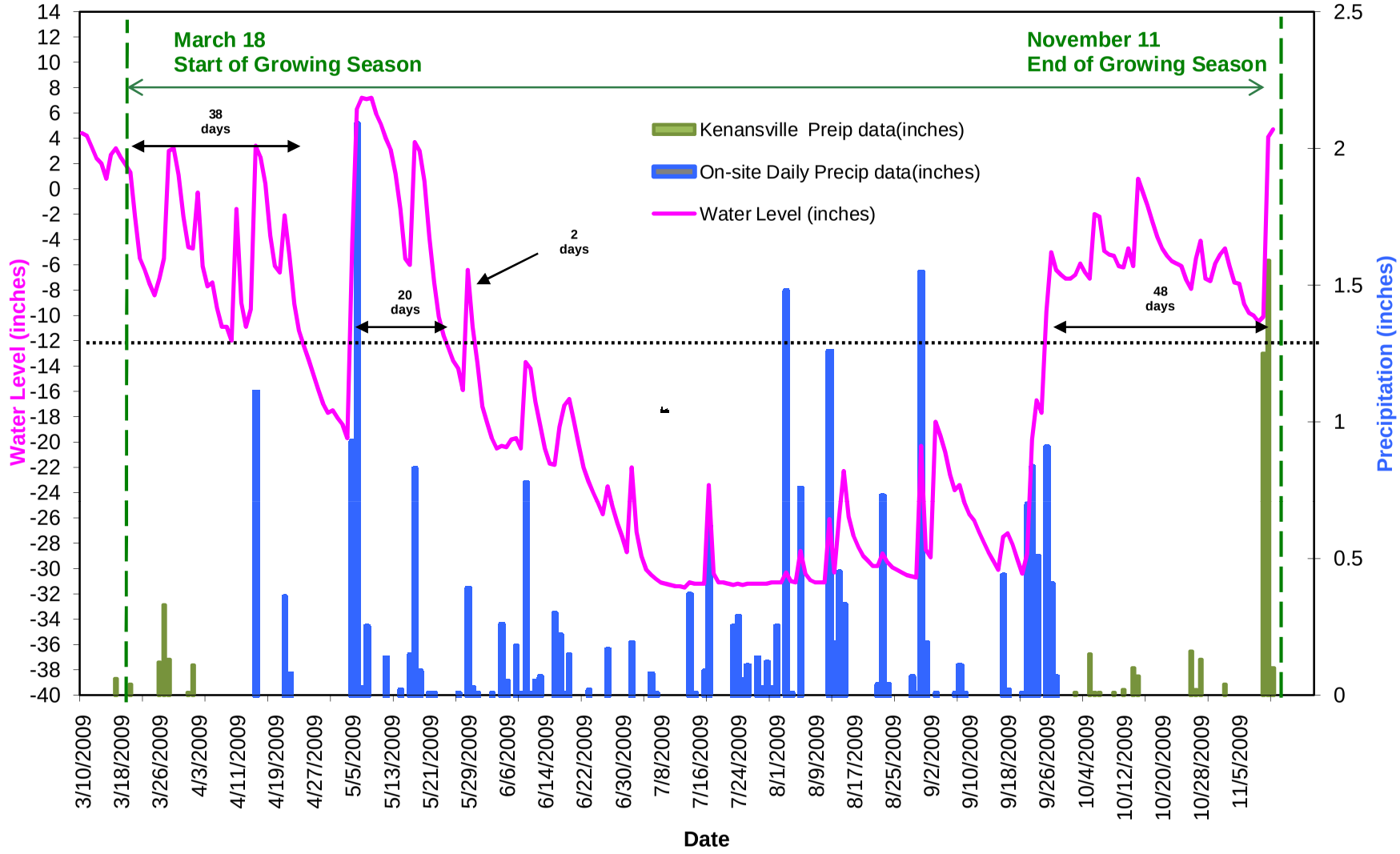
North Carolina Department of Transportation (NCDOT). 2004. Grove Creek Mitigation Plan, Duplin County, North Carolina, TIP No. R-2204 WM. Office of Natural Environment & Roadside Environmental Unit.

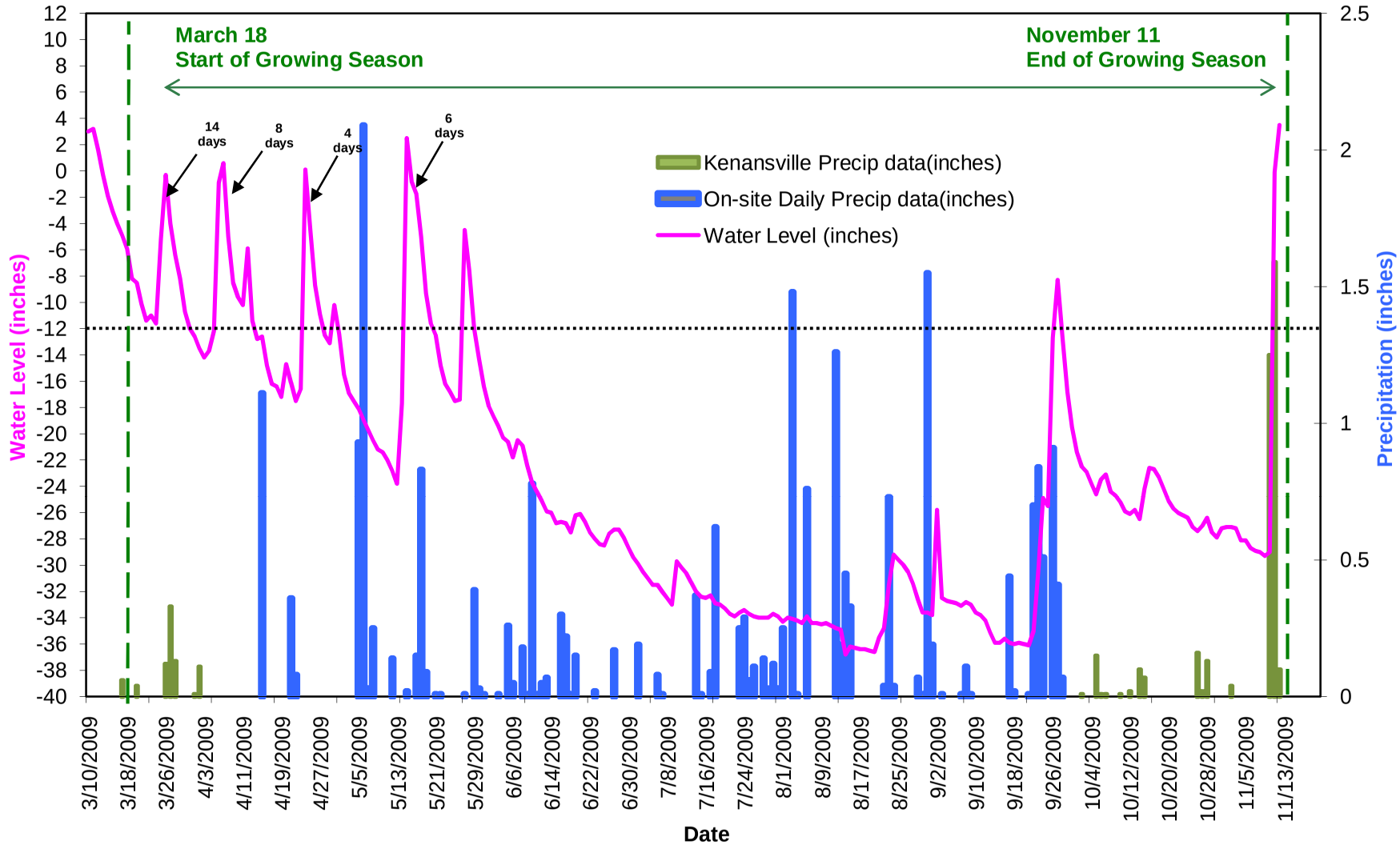
United States. Department of Agriculture (USDA). 1985. Soil Survey of Sampson County, North Carolina. United States Department of Agriculture.

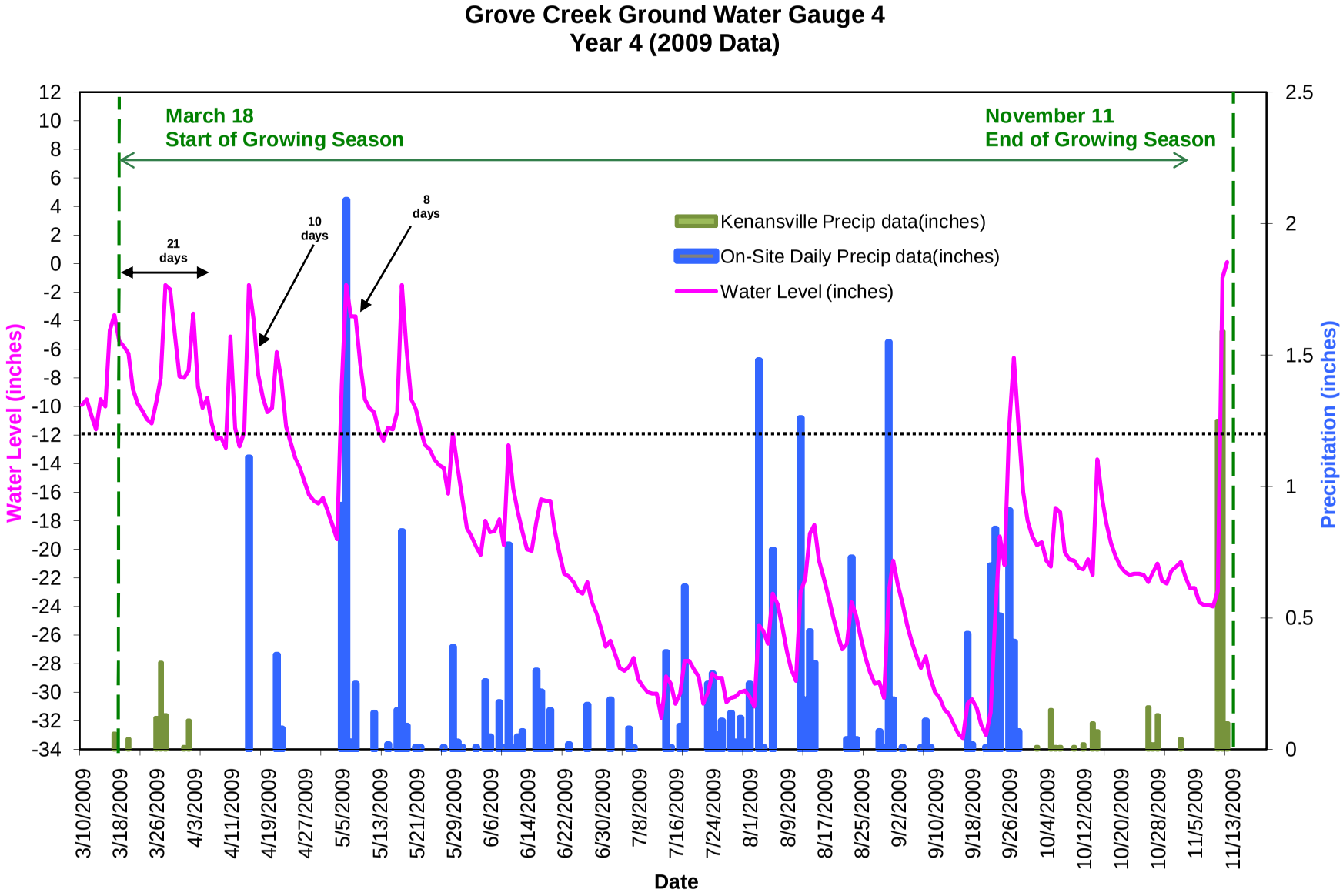
Weakley, Alan S. 2007. Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas (online). Available: http://www.herbarium.unc.edu/WeakleysFlora.pdf [February 1, 2008]. University of North Carolina Herbarium, North Carolina Botanical Garden, University of North Carolina, Chapel Hill, North Carolina.

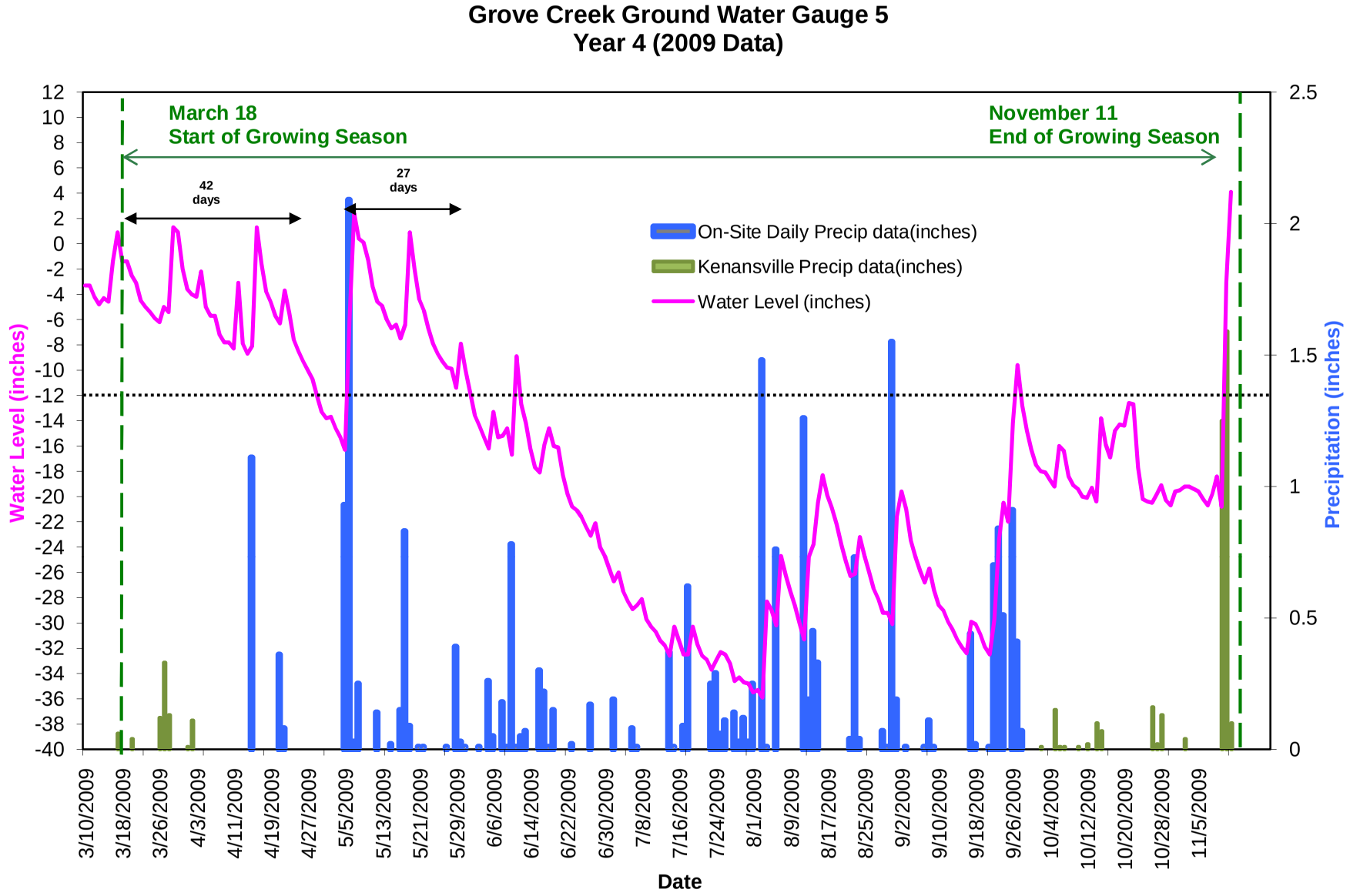
APPENDIX A

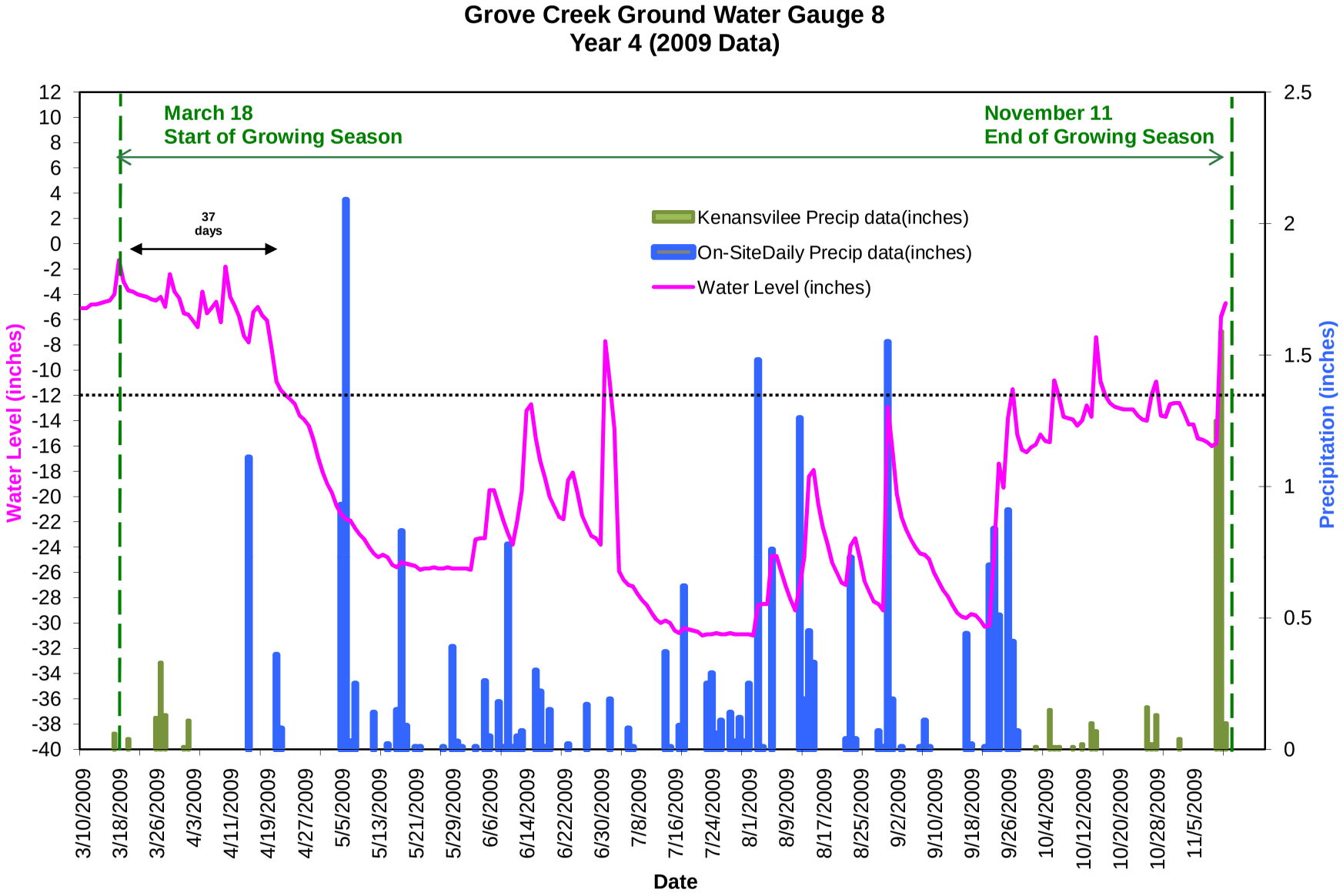
YEAR 4 (2009) GROUNDWATER/SURFACEWATER GAUGE GRAPHS

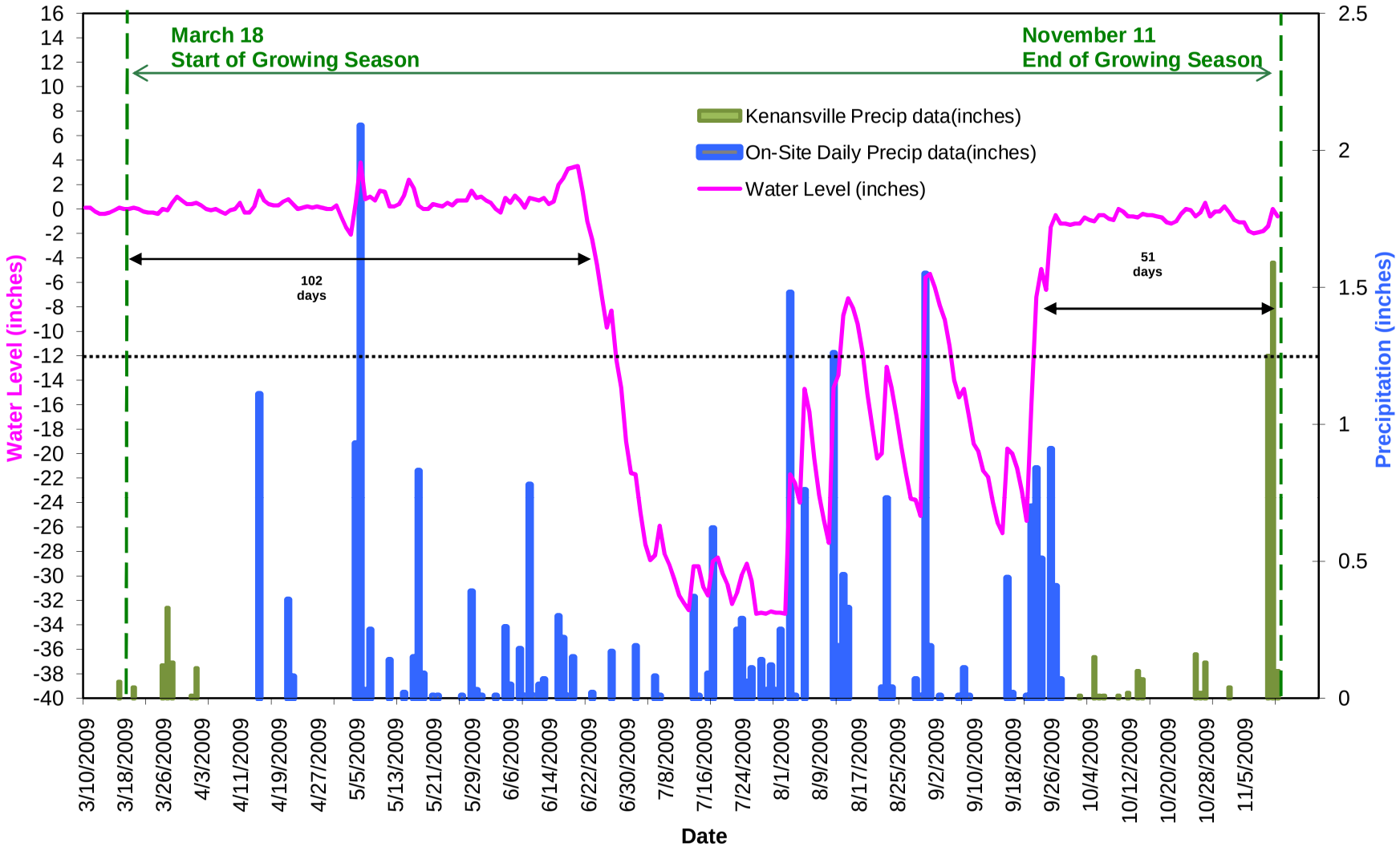

Grove Creek Ground Water Gauge 2
Year 4 (2009 Data)
March 18
Start of Growing Season
November 11
End of Growing Season
38 days
20 days
2 days
48 days
Kenansville Preip data(inches)
On-site Daily Precip data(inches)
Water Level (inches)
Water Level (inches)
Precipitation (inches)
Date
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
2.5
2
1.5
1
0.5
0
3/10/2009
3/18/2009
3/26/2009
4/3/2009
4/11/2009
4/19/2009
4/27/2009
5/5/2009
5/13/2009
5/21/2009
5/29/2009
6/6/2009
6/14/2009
6/22/2009
6/30/2009
7/8/2009
7/16/2009
7/24/2009
8/1/2009
8/9/2009
8/17/2009
8/25/2009
9/2/2009
9/10/2009
9/18/2009
9/26/2009
10/4/2009
10/12/2009
10/20/2009
10/28/2009
11/5/2009

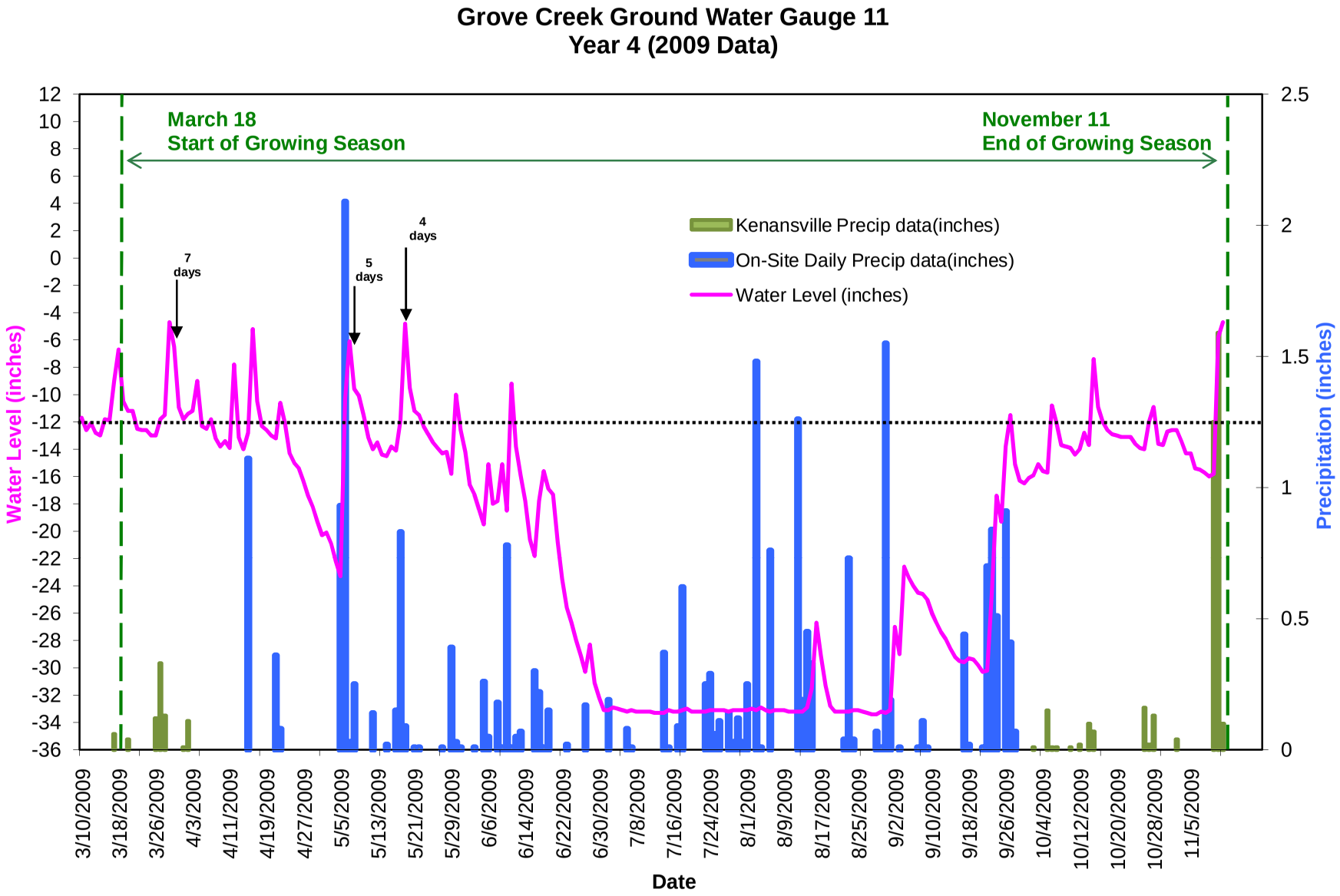

Grove Creek Ground Water Gauge 3
Year 4 (2009 Data)
March 18
Start of Growing Season
November 11
End of Growing Season
14 days
8 days
4 days
6 days
Kenansville Precip data(inches)
On-site Daily Precip data(inches)
Water Level (inches)
Water Level (inches)
Precipitation (inches)
Date
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
2.5
2
1.5
1
0.5
0
3/10/2009
3/18/2009
3/26/2009
4/3/2009
4/11/2009
4/19/2009
4/27/2009
5/5/2009
5/13/2009
5/21/2009
5/29/2009
6/6/2009
6/14/2009
6/22/2009
6/30/2009
7/8/2009
7/16/2009
7/24/2009
8/1/2009
8/9/2009
8/17/2009
8/25/2009
9/2/2009
9/10/2009
9/18/2009
9/26/2009
10/4/2009
10/12/2009
10/20/2009
10/28/2009
11/5/2009
11/13/2009

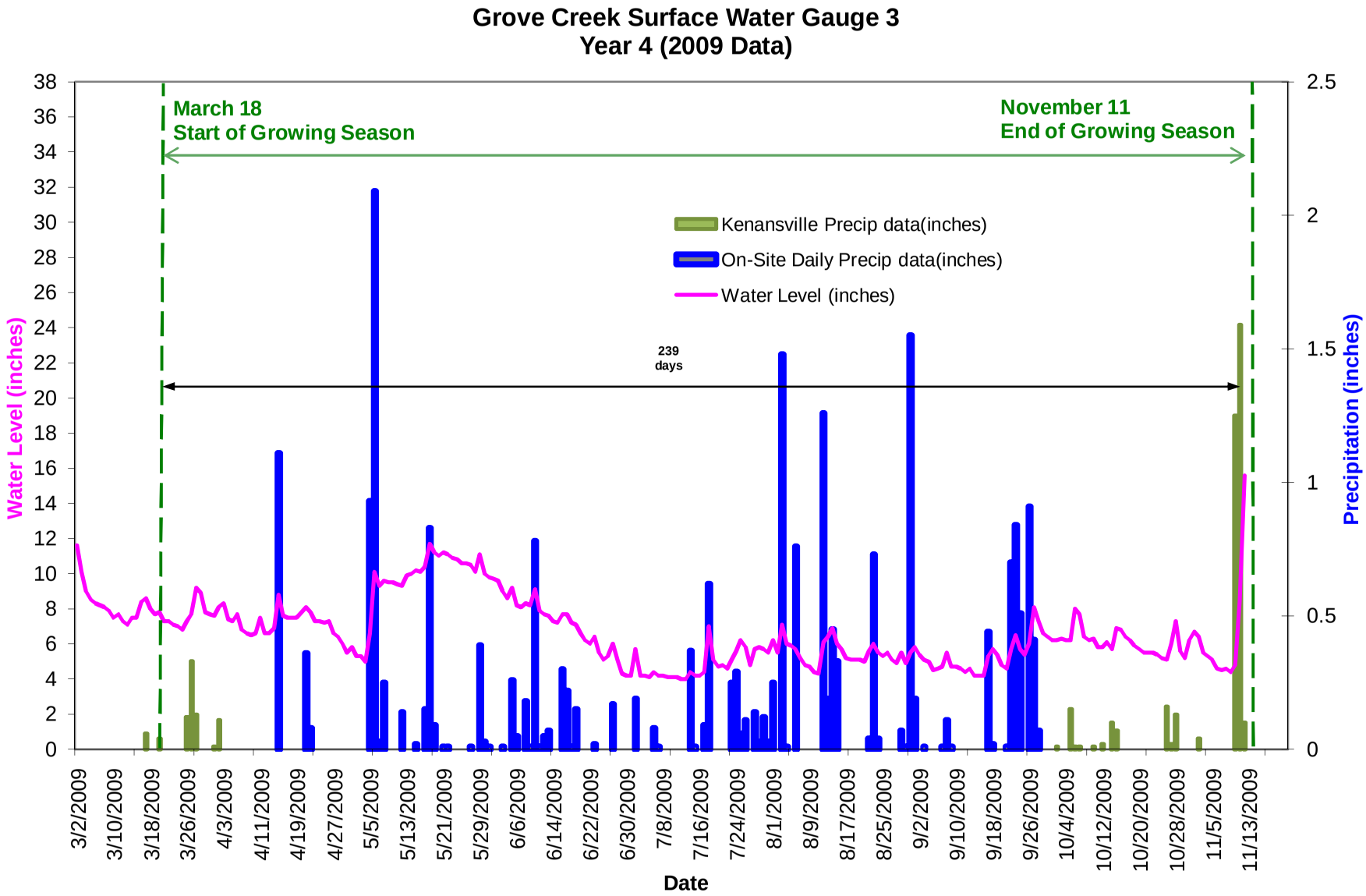

Grove Creek Ground Water Gauge 4
Year 4 (2009 Data)
March 18
Start of Growing Season
November 11
End of Growing Season
21 days
10 days
8 days
Kenansville Precip data(inches)
On-Site Daily Precip data(inches)
Water Level (inches)
Water Level (inches)
Precipitation (inches)
Date
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
2.5
2
1.5
1
0.5
0
3/10/2009
3/18/2009
3/26/2009
4/3/2009
4/11/2009
4/19/2009
4/27/2009
5/5/2009
5/13/2009
5/21/2009
5/29/2009
6/6/2009
6/14/2009
6/22/2009
6/30/2009
7/8/2009
7/16/2009
7/24/2009
8/1/2009
8/9/2009
8/17/2009
8/25/2009
9/2/2009
9/10/2009
9/18/2009
9/26/2009
10/4/2009
10/12/2009
10/20/2009
10/28/2009
11/5/2009
11/13/2009

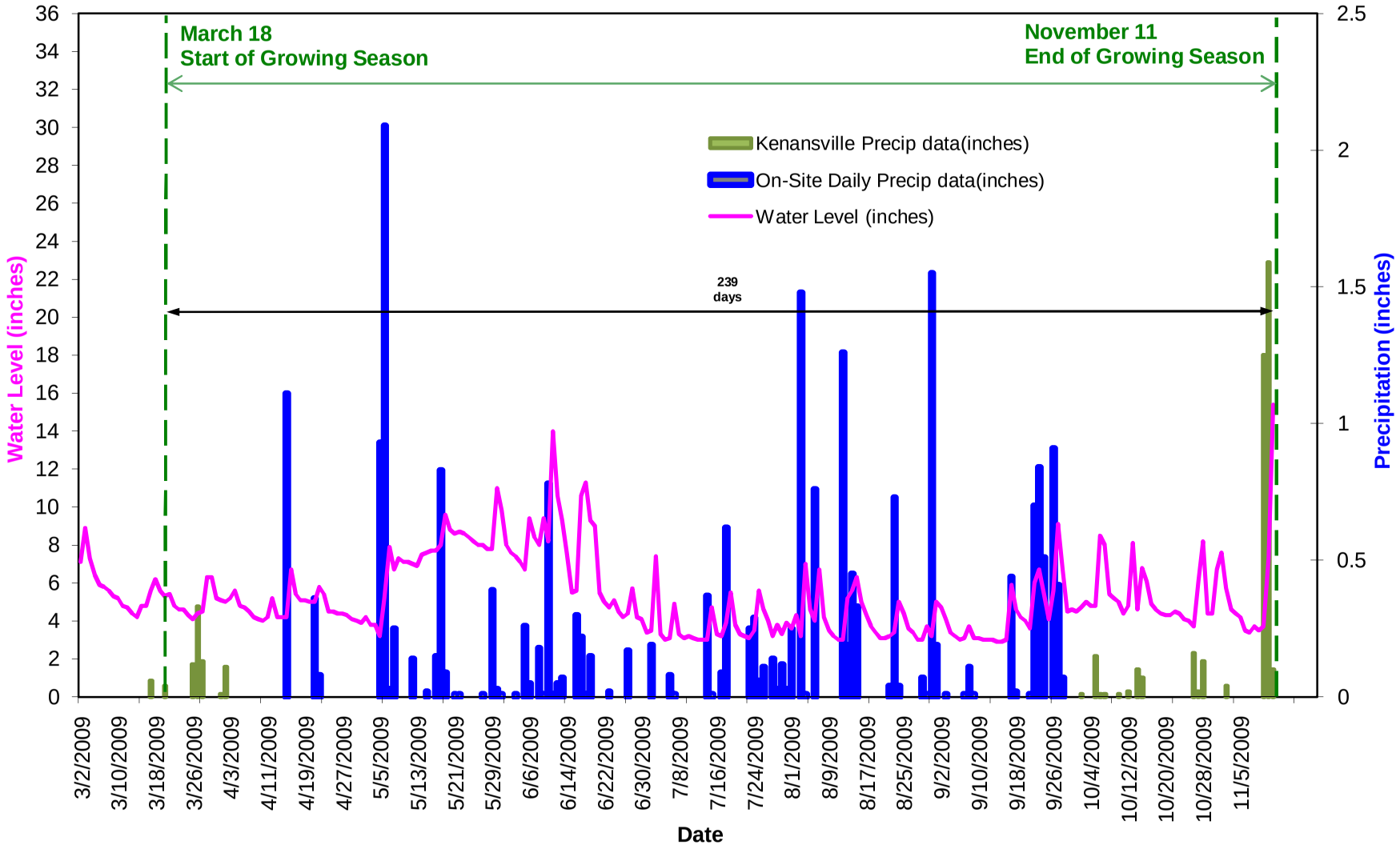

Grove Creek Ground Water Gauge 5
Year 4 (2009 Data)
March 18
Start of Growing Season
November 11
End of Growing Season
42
days
27
days
On-Site Daily Precip data(inches)
Kenansville Precip data(inches)
Water Level (inches)
Water Level (inches)
Precipitation (inches)
Date
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
2.5
2
1.5
1
0.5
0
3/10/2009
3/18/2009
3/26/2009
4/3/2009
4/11/2009
4/19/2009
4/27/2009
5/5/2009
5/13/2009
5/21/2009
5/29/2009
6/6/2009
6/14/2009
6/22/2009
6/30/2009
7/8/2009
7/16/2009
7/24/2009
8/1/2009
8/9/2009
8/17/2009
8/25/2009
9/2/2009
9/10/2009
9/18/2009
9/26/2009
10/4/2009
10/12/2009
10/20/2009
10/28/2009
11/5/2009

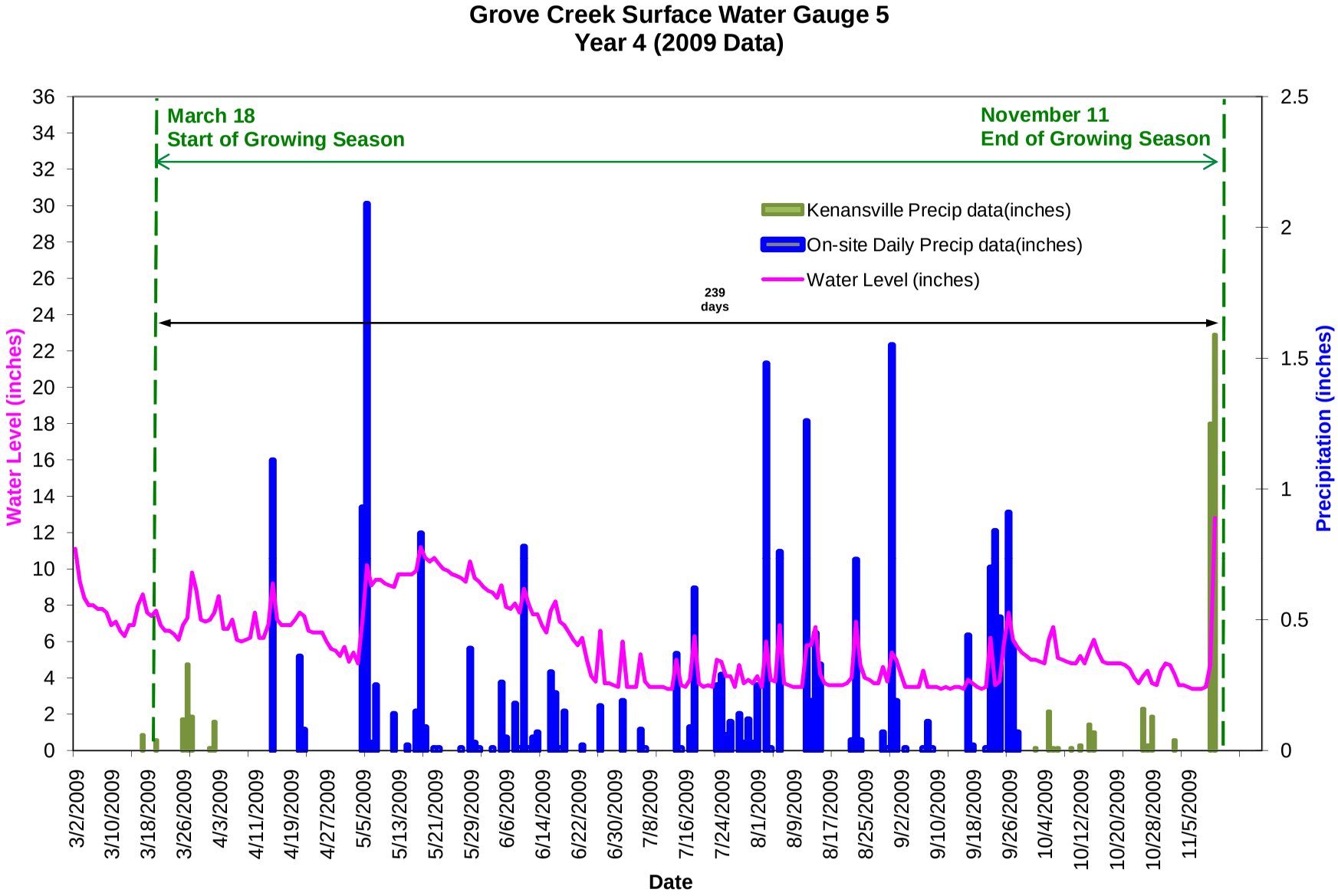

Grove Creek Ground Water Gauge 8
Year 4 (2009 Data)
March 18
Start of Growing Season
November 11
End of Growing Season
37
days
Kenansvilee Precip data(inches)
On-SiteDaily Precip data(inches)
Water Level (inches)
Water Level (inches)
Precipitation (inches)
Date
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
2.5
2
1.5
1
0.5
0
3/10/2009
3/18/2009
3/26/2009
4/3/2009
4/11/2009
4/19/2009
4/27/2009
5/5/2009
5/13/2009
5/21/2009
5/29/2009
6/6/2009
6/14/2009
6/22/2009
6/30/2009
7/8/2009
7/16/2009
7/24/2009
8/1/2009
8/9/2009
8/17/2009
8/25/2009
9/2/2009
9/10/2009
9/18/2009
9/26/2009
10/4/2009
10/12/2009
10/20/2009
10/28/2009
11/5/2009

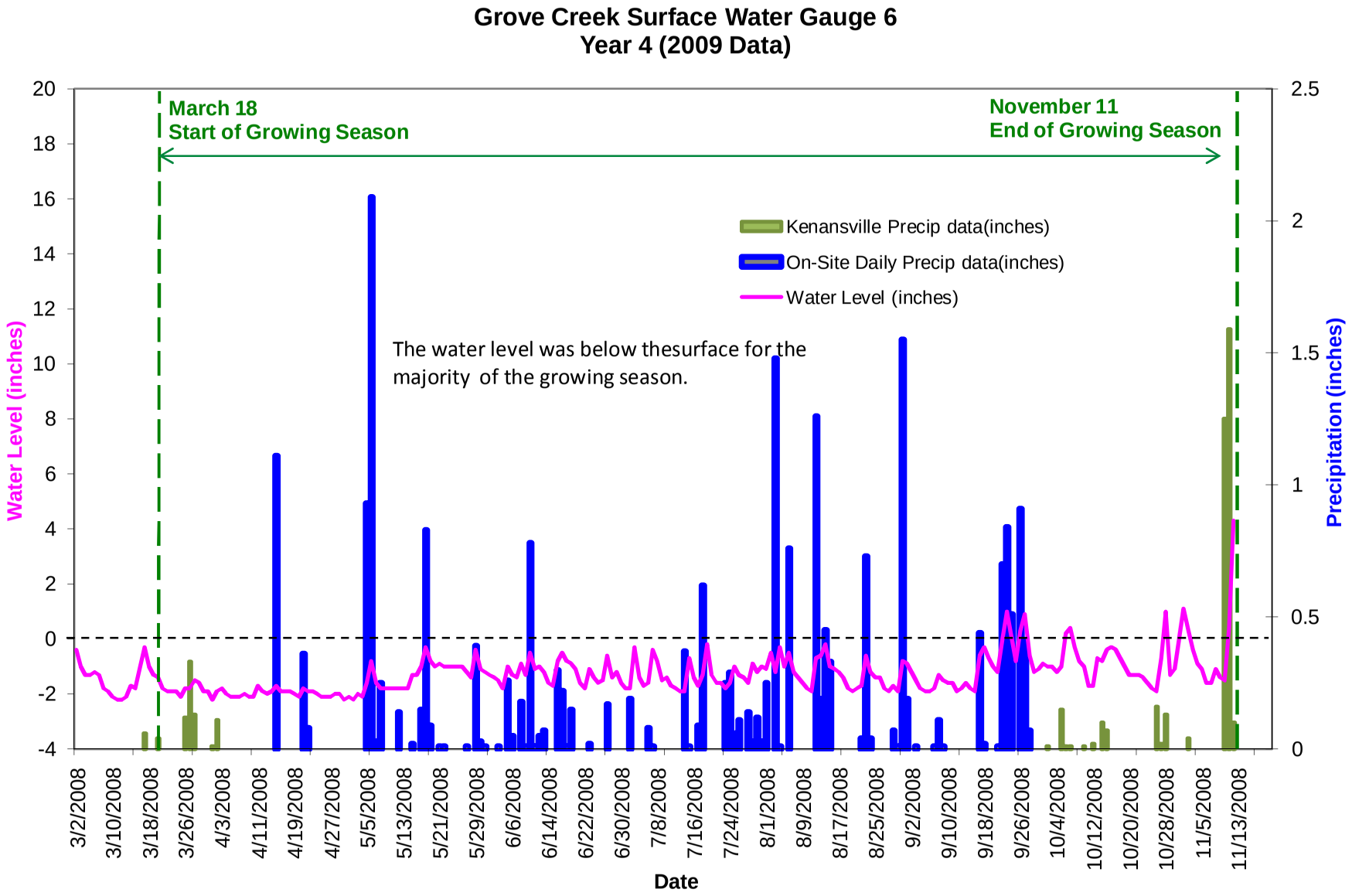

Grove Creek Ground Water Gauge 9
Year 4 (2009 Data)
March 18
Start of Growing Season
November 11
End of Growing Season
Kenansville Precip data(inches)
On-Site Daily Precip data(inches)
Water Level (inches)
102
days
51
days
Water Level (inches)
Precipitation (inches)
Date
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
2.5
2
1.5
1
0.5
0
3/10/2009
3/18/2009
3/26/2009
4/3/2009
4/11/2009
4/19/2009
4/27/2009
5/5/2009
5/13/2009
5/21/2009
5/29/2009
6/6/2009
6/14/2009
6/22/2009
6/30/2009
7/8/2009
7/16/2009
7/24/2009
8/1/2009
8/9/2009
8/17/2009
8/25/2009
9/2/2009
9/10/2009
9/18/2009
9/26/2009
10/4/2009
10/12/2009
10/20/2009
10/28/2009
11/5/2009

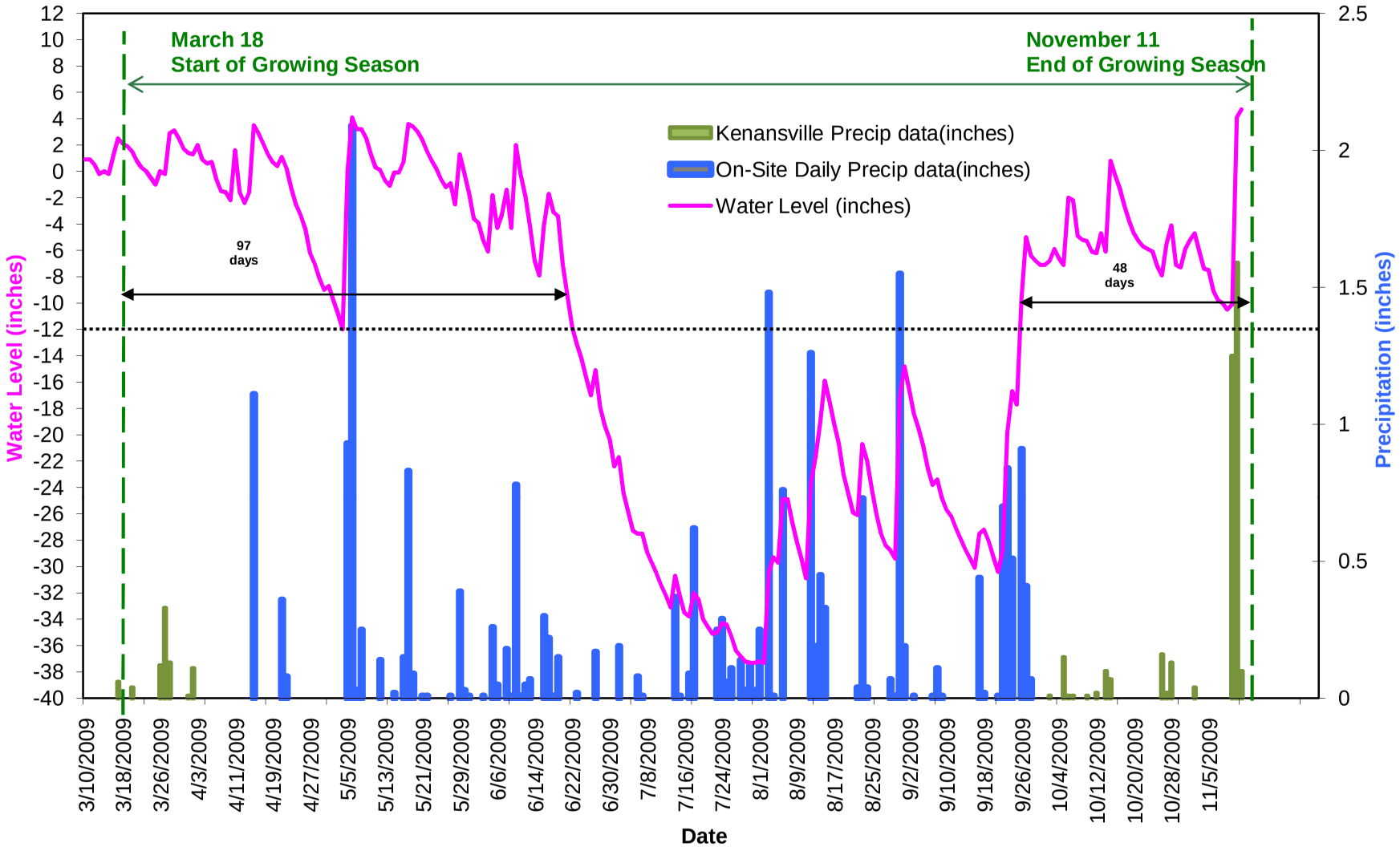

Grove Creek Ground Water Gauge 11
Year 4 (2009 Data)
March 18
Start of Growing Season
November 11
End of Growing Season
7 days
5 days
4 days
Kenansville Precip data(inches)
On-Site Daily Precip data(inches)
Water Level (inches)
Water Level (inches)
Precipitation (inches)
Date
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
2.5
2
1.5
1
0.5
0
3/10/2009
3/18/2009
3/26/2009
4/3/2009
4/11/2009
4/19/2009
4/27/2009
5/5/2009
5/13/2009
5/21/2009
5/29/2009
6/6/2009
6/14/2009
6/22/2009
6/30/2009
7/8/2009
7/16/2009
7/24/2009
8/1/2009
8/9/2009
8/17/2009
8/25/2009
9/2/2009
9/10/2009
9/18/2009
9/26/2009
10/4/2009
10/12/2009
10/20/2009
10/28/2009
11/5/2009


Grove Creek Surface Water Gauge 3
Year 4 (2009 Data)
March 18
Start of Growing Season
November 11
End of Growing Season
Kenansville Precip data(inches)
On-Site Daily Precip data(inches)
Water Level (inches)
239
days
Water Level (inches)
Precipitation (inches)
Date
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
0
0.5
1
1.5
2
2.5
3/2/2009
3/10/2009
3/18/2009
3/26/2009
4/3/2009
4/11/2009
4/19/2009
4/27/2009
5/5/2009
5/13/2009
5/21/2009
5/29/2009
6/6/2009
6/14/2009
6/22/2009
6/30/2009
7/8/2009
7/16/2009
7/24/2009
8/1/2009
8/9/2009
8/17/2009
8/25/2009
9/2/2009
9/10/2009
9/18/2009
9/26/2009
10/4/2009
10/12/2009
10/20/2009
10/28/2009
11/5/2009
11/13/2009


Grove Creek Surface Water Gauge 4
Year 4 (2009 Data)
March 18
Start of Growing Season
November 11
End of Growing Season
Kenansville Precip data(inches)
On-Site Daily Precip data(inches)
Water Level (inches)
239
days
Water Level (inches)
Precipitation (inches)
Date
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
0
0.5
1
1.5
2
2.5
3/2/2009
3/10/2009
3/18/2009
3/26/2009
4/3/2009
4/11/2009
4/19/2009
4/27/2009
5/5/2009
5/13/2009
5/21/2009
5/29/2009
6/6/2009
6/14/2009
6/22/2009
6/30/2009
7/8/2009
7/16/2009
7/24/2009
8/1/2009
8/9/2009
8/17/2009
8/25/2009
9/2/2009
9/10/2009
9/18/2009
9/26/2009
10/4/2009
10/12/2009
10/20/2009
10/28/2009
11/5/2009


Grove Creek Surface Water Gauge 5
Year 4 (2009 Data)
March 18
Start of Growing Season
November 11
End of Growing Season
239
days
Kenansville Precip data(inches)
On-site Daily Precip data(inches)
Water Level (inches)
Water Level (inches)
Precipitation (inches)
Date
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
0
0.5
1
1.5
2
2.5
3/2/2009
3/10/2009
3/18/2009
3/26/2009
4/3/2009
4/11/2009
4/19/2009
4/27/2009
5/5/2009
5/13/2009
5/21/2009
5/29/2009
6/6/2009
6/14/2009
6/22/2009
6/30/2009
7/8/2009
7/16/2009
7/24/2009
8/1/2009
8/9/2009
8/17/2009
8/25/2009
9/2/2009
9/10/2009
9/18/2009
9/26/2009
10/4/2009
10/12/2009
10/20/2009
10/28/2009
11/5/2009


Grove Creek Surface Water Gauge 6
Year 4 (2009 Data)
March 18
Start of Growing Season
November 11
End of Growing Season
Kenansville Precip data(inches)
On-Site Daily Precip data(inches)
Water Level (inches)
The water level was below thesurface for the majority of the growing season.
Water Level (inches)
Precipitation (inches)
Date
20
18
16
14
12
10
8
6
4
2
0
-2
-4
2.5
2
1.5
1
0.5
0
3/2/2008
3/10/2008
3/18/2008
3/26/2008
4/3/2008
4/11/2008
4/19/2008
4/27/2008
5/5/2008
5/13/2008
5/21/2008
5/29/2008
6/6/2008
6/14/2008
6/22/2008
6/30/2008
7/8/2008
7/16/2008
7/24/2008
8/1/2008
8/9/2008
8/17/2008
8/25/2008
9/2/2008
9/10/2008
9/18/2008
9/26/2008
10/4/2008
10/12/2008
10/20/2008
10/28/2008
11/5/2008
11/13/2008


Grove Creek Ground Water Reference Gauge
Year 4 (2009 Data)
March 18
Start of Growing Season
November 11
End of Growing Season
Kenansville Precip data(inches)
On-Site Daily Precip data(inches)
Water Level (inches)
97
days
48
days
Water Level (inches)
Precipitation (inches)
Date
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
2.5
2
1.5
1
0.5
0
3/10/2009
3/18/2009
3/26/2009
4/3/2009
4/11/2009
4/19/2009
4/27/2009
5/5/2009
5/13/2009
5/21/2009
5/29/2009
6/6/2009
6/14/2009
6/22/2009
6/30/2009
7/8/2009
7/16/2009
7/24/2009
8/1/2009
8/9/2009
8/17/2009
8/25/2009
9/2/2009
9/10/2009
9/18/2009
9/26/2009
10/4/2009
10/12/2009
10/20/2009
10/28/2009
11/5/2009

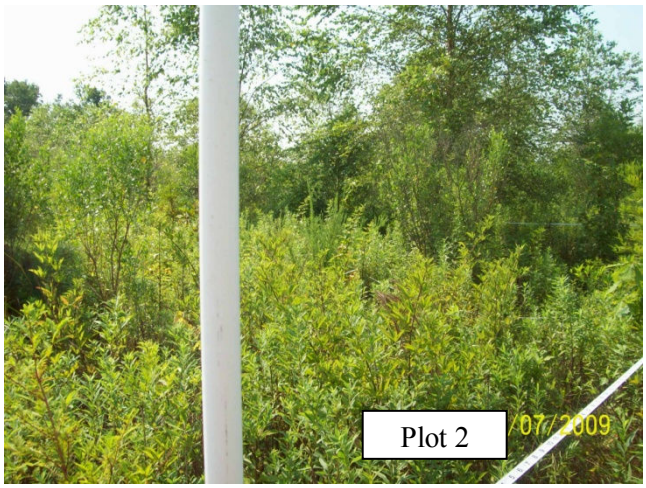
APPENDIX B

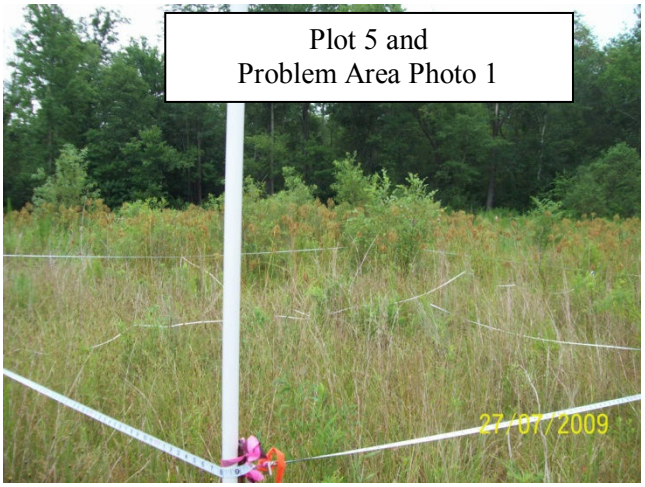
VEGETATION MONITORING PHOTOGRAPHS

Appendix B

Vegetation Plot and Problem Area Photographs

Taken July 2009





Appendix B (continued)

Vegetation Plot and Problem Area Photographs

Taken July 2009