ANNUAL MONITORING REPORT
WILSON BAY (STURGEON CITY) PHASE II

WETLAND RESTORATION
ONSLOW COUNTY, NORTH CAROLINA
(EEP Project Number 367)

Monitoring Year 4 of 5 (2007)

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

February 2008

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Submitted to:
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Prepared by:
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BLUE Land, Water, Infrastructure, PA
1271 Old US Highway 1 South
Southern Pines, North Carolina 28387

Axiom Environmental, Inc.

Ecosystem Enhancement PROGRAM

February 2008

EXECUTIVE SUMMARY

The Wilson Bay (Surgeon City) Wetland Restoration Phase II Site (Site) is located within the United States Geological Survey (USGS) Hydrologic Unit 03030001 (North Carolina Division of Water Quality [NCDWQ] subbasin 03-05-02) of the White Oak River Basin. The Site includes 2.5 acres of brackish marsh restoration, located at Sturgeon City in Jacksonville, North Carolina in Onslow County. The Site is located adjacent to Thompson School Creek and Sturgeon City Park at an inactive municipal wastewater treatment plant. This report summarizes data for year 4 (2007) monitoring.

The primary goals of the project include the following.

1. Reduce nutrient and stormwater inputs to adjacent estaurine waters.
2. Stabilize the shoreline through restoration of native vegetation.
3. Improve the aesthetics to that of a natural estuarine marsh.
4. Enhance wildlife habitat.
5. Educate visitors about the importance of coastal wetlands.

Five vegetation plots had been previously established and were surveyed for herbaceous coverage in late January 2008 for the 2007 (year 4) monitoring season. Vegetative growth has been excellent in the brackish marsh, with many native volunteer salt marsh species; in addition an organic mat typical of a coastal salt marsh is continuing to develop.

One vegetation problem area identified last year (year 3) occurred along the northernmost and westward trending creek where a small colony of cattail (*Typha latifolia*) was growing within the area of *Spartina cynosuroides*. This may have resulted due to freshwater runoff from the adjacent parking area. However, there are very few cattail remaining, the area is recovering naturally, and is no longer considered a problem area.

No wetland problem areas have been identified during the year-4 (2007) monitoring year. Site hydrology supports a coastal marsh as evidenced by sufficient flooding to support the growth of brackish marsh vegetation, the establishment of native volunteer salt marsh species, and the continued development of a native coastal marsh vegetative community structure.

In summary, the Site is stable, the desired plant communities are developing, the plants are healthy, and the marsh has an aesthetic appeal.

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1.0 PROJECT BACKGROUND

1.1 Location and Setting

The Wilson Bay (Surgeon City) Wetland Restoration Phase II Site (Site) is located within the United States Geological Survey (USGS) Hydrologic Unit 03030001 (North Carolina Division of Water Quality [NCDWQ] subbasin 03-05-02) of the White Oak River Basin. The Site includes 2.5 acres of brackish marsh restoration, located at Sturgeon City in Jacksonville, North Carolina in Onslow County (Figure 1). The Site is located adjacent to Thompson School Creek and Sturgeon City Park at an inactive municipal wastewater treatment plant.

Directions to the Site:
From Raleigh:

- Travel east on Interstate 40 to Exit 373 (NC24/903 east)
- Follow NC 24 to Jacksonville
- In Jacksonville, veer right onto Old Bridge Street to cross over the New River
- Turn right on Court Street
- At the end of Court Street take a left into the inactive wastewater treatment plant
- The Site is adjacent to Wilson Bay at the far end of the property

The Site is located in the Middle Atlantic Coastal Plain Physiographic Province, within the Carolina Flatwoods ecoregion.

1.2 Mitigation Structure and Objectives

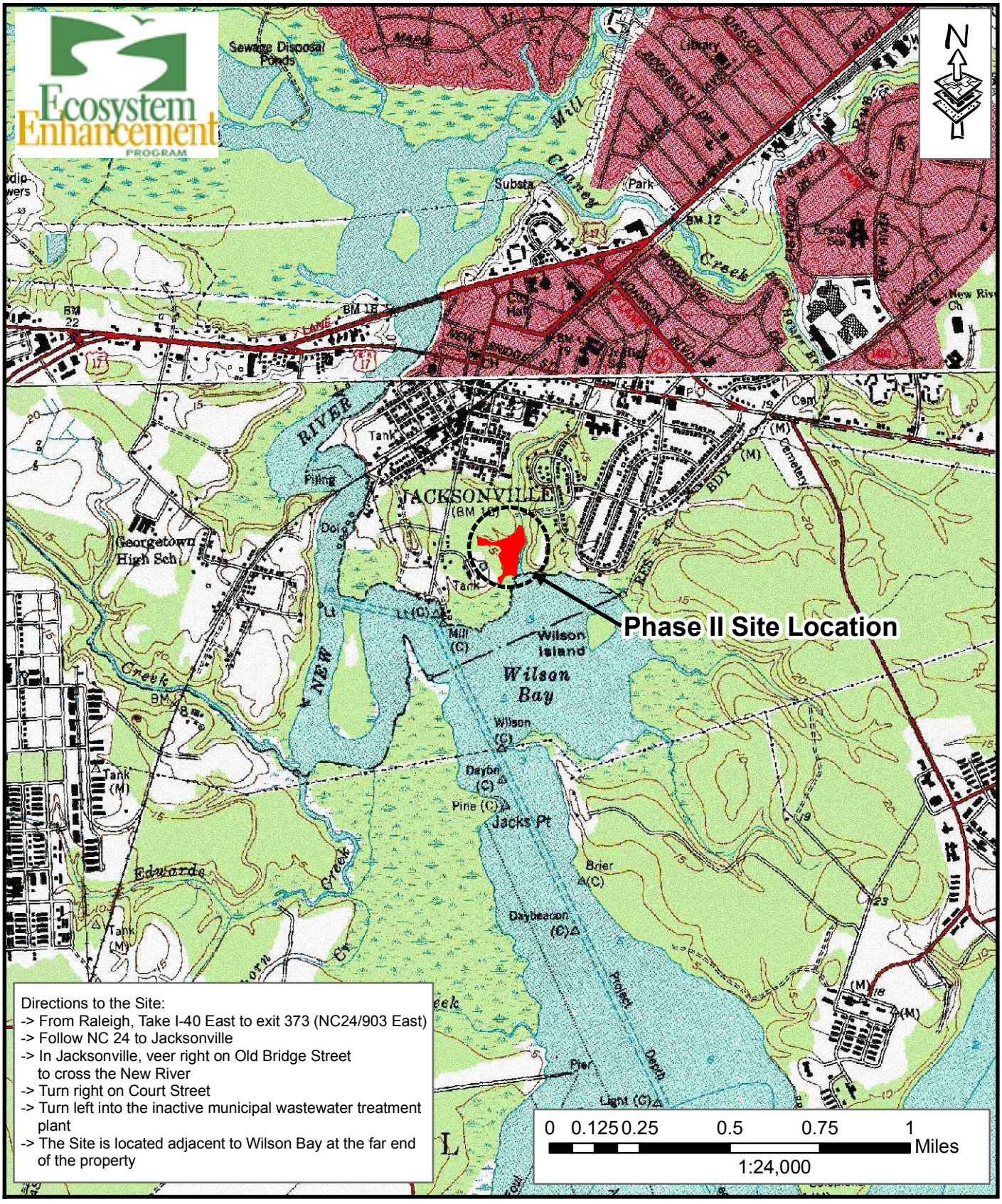
Prior to implementation of wetland restoration activities, the Site was used as a municipal wasterwater treatment plant.

Restoration at the Site entailed 1) removal of trash laden fill material, 2) grading the Site to the desired elevations to restore wetland hydrology, and 3) planting the Site. The primary goals of this project were to reduce nutrient and stormwater inputs to adjacent estaurine waters, stabilize the shoreline through restoration of native vegetation, improve the aesthetics to that of a natural estuarine marsh, enhance wildlife habitat, and educate visitors about the importance of coastal wetlands. Project structures and objectives are summarized in Table 1.

Table 1. Project Mitigation Structures and Objectives

Wilson Bay (Sturgeon City) Wetland Restoration Phase II (EEP Project Number 367)

Project Segment or Reach ID	Mitigation Type	Approach	Linear Footage or Acreage	Stationing	Comment
Brackish Marsh	Restoration	---	2.50 acres	---	Planted with *Spartina cynosuroides* in the lower elevations and *Spartina patens* in the higher elevations.



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SITE LOCATION
WILSON BAY (STURGEON CITY) PHASE II
EEP Project Number 367
2007 Annual Monitoring Year 4 of 5
Onslow County, North Carolina

CLF

Date: January 2008

Project: 08-001

FIGURE 1

1.3 Project History and Background

Completed project activities, reporting history, and completion dates are summarized in Table 2.

Table 2. Project Activity and Reporting History

Wilson Bay (Sturgeon City) Wetland Restoration Phase II (EEP Project Number 367)

Activity or Report	Scheduled Completion	Data Collection Completion	Actual Completion or Delivery
Restoration Plan	2002	---	Mar. 24, 2003
Final Design – 90%	Unknown	---	Unknown
Construction	June 2003	---	October 2003
Temporary Sediment & Erosion Mix Applied	Not Applicable	Not Applicable	Not Applicable
Permanent Seed Mix Applied	Not Applicable	Not Applicable	Not Applicable
Brackish Marsh Planting	August 2003	---	June 2004
Containerized and B&B Plantings	Not Applicable	Not Applicable	Not Applicable
As-built Report (Year 0 Monitoring – map only)	2005	---	Unknown
Year 1 Monitoring (2004)	Fall 2004	---	Oct. 12, 2004
Year 2 Monitoring (2005)	Fall 2005	---	Sept. 22, 2005
Year 3 Monitoring (2006)	Fall 2006	---	Feb. 2007
Year 4 Monitoring (2007)	Fall 2007	---	Feb. 2008

Contact information regarding project designer, construction, planting contractor, and monitoring personnel are summarized in Table 3 and relevant project background information is summarized in Table 4.

Table 3. Project Contact Table

Wilson Bay (Sturgeon City) Wetland Restoration Phase II (EEP Project Number 367)

Designer	BLUE: Land, Water, Infrastructure, PA 1271 Old Highway 1 Southern Pines, NC 28387 Thomas Blue (910) 692-6461
Property Owner	City of Jacksonville PO Box 128 Jacksonville, North Carolina 28541 Glenn Hargett (910) 938-5200
Construction Contractor	Trader Construction Company 2500 Highway 70 East New Bern, North Carolina 28560 Carl Huddle (252) 633-2424

Table 3. Project Contact Table (continued)	
Planting Contractor	BLUE: Land, Water, Infrastructure, PA 1271 Old Highway 1 Southern Pines, NC 28387 Larry Hobbs (919)306-2410 Thomas Blue (910) 692-6461
Seeding Contractor	Unknown
Temporary Seed Mix Sources	Unknown
Nursery Stock Suppliers (marsh plants)	Campbells Greenhouse Raleigh, North Carolina Street Address and Point of Contact: Unknown
Monitoring Performers	Axiom Environmental, Inc. 2126 Rowland Pond Dr. Willow Spring, NC 27592 Grant Lewis 919-215-1693

Table 4. Project Background Table

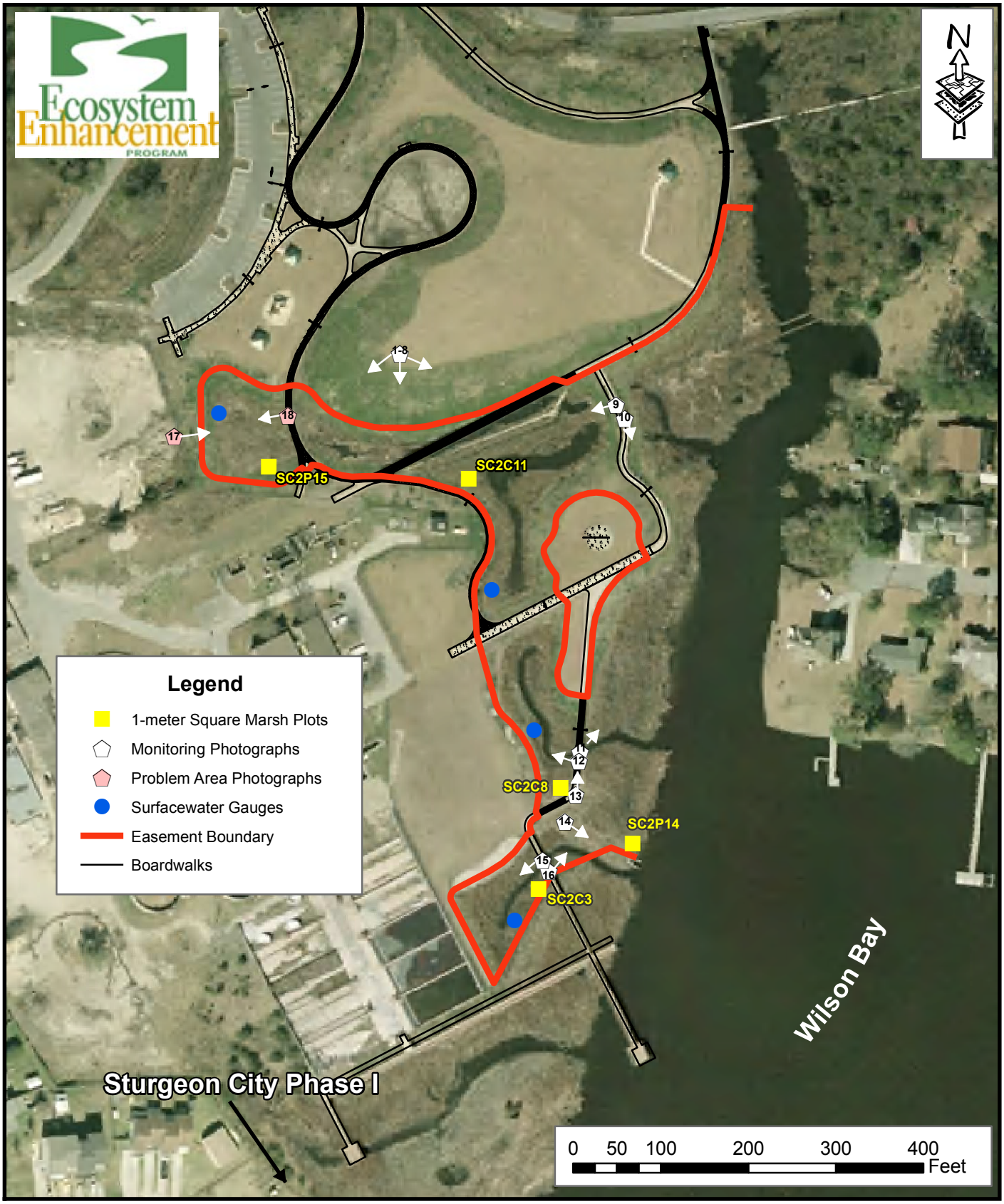
Wilson Bay (Sturgeon City) Wetland Restoration Phase II (EEP Project Number 367)

Project County	Onslow County, North Carolina
Drainage Area	~ 115 acres
Drainage impervious cover estimate (%)	~ 35 percent
Stream Order	First
Physiographic Region	Coastal Plain
Ecoregion	Carolina Flatwoods
Rosgen Classification of As-built	Not Applicable
Cowardin Classification	Estaurine Intertidal Emergent Persistant Irregularly Flooded (E21P)
Dominant Soil Types	Wando fine sand
Reference Site ID	No Reference
USGS HUC for Project and Reference	Project – 03030001
NCDWQ Subbasin for Project and Reference	Project – 03-05-02
NCDWQ Classification for Project and Reference	Project – SC HQW NSW
Any portion of any project segment 303d listed?	No (Stream Index #19-14)
Any portion of any project segment upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor	Not Applicable
% of project easement fenced	None

1.4 Monitoring Plan View

Monitoring activities for the Site, including relevant structures and utilities, project features, specific project structures, and monitoring features are detailed in Figure 2.

Site features have been monitored with five 1-meter square marsh grass vegetation plots, four continuous recording surfacewater gauges, and photographic documentation.



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MONITORING PLAN
WILSON BAY (STURGEON CITY) PHASE II
EEP Project Number 367
2007 Annual Monitoring Year 4 of 5
Onslow County, North Carolina

CLF

Date: January 2008

Project: 08-001

FIGURE 2

2.0 PROJECT CONDITION AND MONITORING RESULTS

2.1 Vegetation Assessment

During late January 2008, five 1-meter square plots were sampled for herbaceous cover. Two plots were located in the *Spartina cynosuroides* area of the marsh, and three were located in the *Spartina patens* area. Plant height, numbers, and percent cover were measured and recorded in each plot. Plots were located as close as possible to the corresponding plot designation from the previous monitoring reports. In addition, the methodology from previous monitoring reports was followed and stems were not counted in the *Spartina patens* plots. The general condition of the marsh was assessed, and potential problem areas were also examined and photographed.

2.1.1 Soil Data

General soil conditions found onsite, including level of erosion and percentage of organic matter, are summarized in Table 5.

Table 5. Preliminary Soil Data

Wilson Bay (Sturgeon City) Wetland Restoration Phase II (EEP Project Number 367)

Series	Max Depth (inches)	% Clay on Surface	K	T	OM %
Wando	85	1	0.1	5	<1
Pactolus	72	2-12	0.1	5	0.5-2

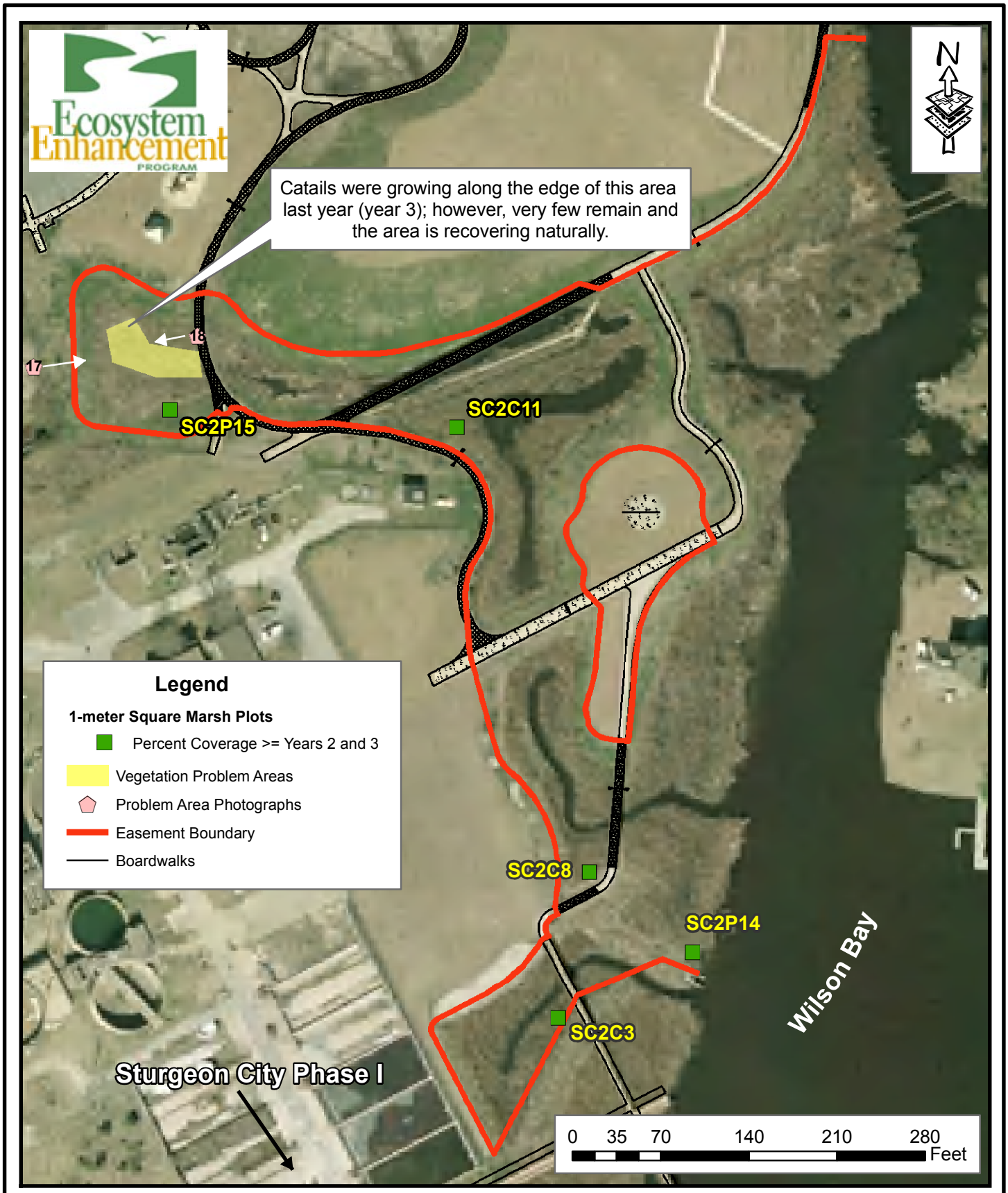
2.1.2 Vegetative Problem Areas

Recovering vegetation problem areas within the Site are depicted on Figure 3 and are outlined in Table 6. Last year (year 3) an area along the northernmost and westward trending creek contained a small colony of cattail (*Typha latifolia*) growing within the area of *Spartina cynosuroides*. This may have resulted due to freshwater runoff from the adjacent parking area. However, there are very few cattail remaining, the area is recovering naturally, and is no longer considered a problem area.

Table 6. Vegetation Problem Areas

Wilson Bay (Sturgeon City) Wetland Restoration Phase II (EEP Project Number 367)

Feature/Issue	Location	Probable Cause	Photo
Recovering area of volunteer *Typha latifolia*	Northwestern portion of the Site	Freshwater runoff from the adjacent parking area	Recovering Problem Area Photos 17 and 18 (Appendix A)



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VEGETATION PROBLEM AREAS
WILSON BAY (STURGEON CITY) PHASE II
EEP Project Number 367
2007 Annual Monitoring Year 4 of 5
Onslow County, North Carolina

CLF

Date: January 2008

Project: 08-001

FIGURE 3

2.1.3 Stem Counts

Marsh vegetation was assessed by sampling five 1-meter by 1-meter plots using the *CVS-EEP Protocol for Recording Vegetation, Version 4.0* (Lee et al. 2006) (http://cvs.bio.unc.edu/methods.htm); two plots are located in the *Spartina cynosuroides* area of the marsh and three in the *Spartina patens* area. Percent cover from year 4 (2007) are summarized in Table 7 and vegetation trends for the first four monitoring years are summarized in Table 8. 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.

Table 7. Marsh Stem Counts

Wilson Bay (Sturgeon City) Wetland Restoration Phase II (EEP Project Number 367)

Desired Species	Plot	Stem Count	Height (meters)	Percent Coverage of Desired Species	Notes Other Plants within Plots
Spartina cynosuroides	C3	NA	2.4	80	--
	C8	NA	2.6	100	--
	C11	NA	2.8	70	*Juncus effusus* -10% cover, *Ipomomea* sp.
Spartina patens	P14	NA	0.7	40	*S. cynosuroides* - <1% cover, *Solidago* sp., *Andropogon* sp.
	P15	NA	1.0	80	*S. cynosuroides* - 10% cover, *Paspalum urvillei* - 3% cover), *Aster* - 1% cover

Table 8. Vegetation Trends

Wilson Bay (Sturgeon City) Wetland Restoration Phase II (EEP Project Number .00091)

Lower Marsh (*Spartina cynosuroides*) Data Range				
Monitoring Year	**Firm**	**Stem Count**	**Height (meters)**	**Percent Cover**
2004 (year 1)	No measurements taken			
2005 (year 2)	BLWI	47-78	1.4-3.3	45-60
2006 (year 3)	AXE	48-71	2.2-2.4	30-60
2007 (year 4)	AXE	Not applicable	2.4-2.8	70-100
Upper Marsh (*Spartina patens*) Data Range				
Monitoring Year	**Firm**	**Stem Count**	**Height (meters)**	**Percent Cover**
2004 (year 1)	No measurements taken			
2005 (year 2)	BLWI	Not applicable	0.45-1.3	40-50
2006 (year 3)	AXE	Not applicable	0.9-2.3	50-70
2007 (year 4)	AXE	Not applicable	0.7-1.0	40-80

Site vegetation success will be determined based on year-to-year comparisons of the stem counts, plant heights, and will require 75 percent coverage of marsh species at the end of the five-year monitoring period.

The average percent coverage within the lower marsh (*Spartina cynosuroides*) was between 70 and 100 percent coverage with *Spartina cynosuroides* and within the upper marsh (*Spartina patens*) was between 40 and 80 percent coverage with *Spartina patens* for year 4 (2006) monitoring. The average percent coverage across the Site appears to be increasing especially within the lower marsh/*Spartina cynosuroides* areas.

2.1.4 Vegetation Plot Photos

Photographs taken in the vegetation monitoring area are included in Appendix A; locations of each are depicted on Figure 2. The photographs show that the marsh grasses are growing well and the Site is functioning as a brackish marsh wetland system.

2.2 Wetland Assessment

Four surfacewater monitoring gauges have been maintained and monitored throughout the year 4 (2007) growing season. The gauges are located within the *Spartina cynosuroides* area between the 1 and 1.5-foot contours and record daily readings of the groundwater levels. Daily rainfall data recorded from a rain gauge maintained and monitored at the nearby New River Station in Jacksonville, North Carolina was used for seasonal comparison (Weather Underground 2008). The graphs of groundwater hydrology and precipitation are included in Appendix B.

No specific success criteria were established for this project; however, hydrologic success is based on sufficient Site flooding to support the marsh vegetation. General success criteria for wetland groundwater hydrology require inundation or saturation within 12 inches of the ground surface for a consecutive period of 12.5 percent of the growing season. The growing season in Onslow County begins April 8 and ends November 5 (212 days).

Surfacewater gauges provided unreliable data during year 2 (2005) monitoring and no gauge data is available for years 1 and 2 (2004 and 2005) monitoring. The gauge graphs for years 3 and 4 (2006 and 2007) are included in Appendices B and C. The following table summarizes success criteria achievement for surfacewater gauges over the three-year monitoring period.

Groundwater hydrology within 12 inches of the soil surface occurred for greater than 12.5 percent of the growing season for the year 4 (2007) growing season. In addition, the ground surface is sufficiently flooded to support the brackish marsh vegetation.

Table 9. Summary of Groundwater Gauge Results for Years 1 through 4

Wilson Bay (Sturgeon City) Wetland Restoration Phase II (EEP Project Number 367)

Gauge	Success Criteria Achieved/Max Consecutive Days During Growing Season Saturated or Inundated within 12 inches of the Ground Surface (Percentage)			
	Year 1 (2004)	Year 2 (2005)	Year 3 (2006)	Year 4 (2007)
1	No Data*	No Data*	Yes/212 days (100 %)	Yes/212 days (100 %)
2	No Data*	No Data*	Yes/36 days (17.0 %)	Yes/37 days (17.5 %)
3	No Data*	No Data*	Yes/69 days (32.5 %)	Yes/176 days (83.0 %)
4	No Data*	No Data*	Yes/212 days (100 %)	Yes/212 days (100 %)

Gauge	Percentage of Growing Season the Ground Surface was Inundated			
	Year 1 (2004)	Year 2 (2005)	Year 3 (2006)	Year 4 (2007)
1	No Data*	No Data*	71	92
2	No Data*	No Data*	11	23
3	No Data*	No Data*	33	40
4	No Data*	No Data*	58	95

* - The surfacewater gauges provided unreliable data during year 2 (2005) monitoring and no data is available for years 1 or 2 (2004 or 2005).

2.2.1 Wetland Problem Area Plan View

No wetland problem areas have been identified during the year 4 (2007) monitoring year.

2.2.2 Wetland Criteria Attainment

All monitored gauges within restoration areas were inundated/saturated within 12 inches of the surface for greater than 12.5 percent of the growing season with sufficient flooding to support brackish marsh vegetation (Table 10). Hydrographs containing precipitation data for each gauge can be found in Appendix B. Percent coverage of planted species is increasing since year 2 (2005) monitoring. Photographs within the Site can be found in Appendix A.

Table 10. Wetland Criteria Attainment for Year 4 (2007)

Wilson Bay (Sturgeon City) Wetland Restoration Phase II (EEP Project 367)

Gauge ID	Hydrology Threshold Met?	Hydrophytic Vegetation Criteria Met?	Site Mean	Vegetation Plot ID	Vegetation Survival Threshold Met?	Site Mean
1	Yes	Yes	100 %	C3	Yes	100 %
2	Yes	Yes		C8	Yes	
3	Yes	Yes		C11	Yes	
4	Yes	Yes		P14	Yes	
				P15	Yes	

4.0. 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.

United States. Department of Agriculture (USDA). 1992. Soil Survey of Onslow 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.

Weatherground. 2008. New River MCAS Station in Jacksonville, North Carolina. (online). Available: http://www.wunderground.com/cgi-bin/findweather/getForecast?query=jacksonville%2C+nc [January 21, 2008]. Weather Underground.

APPENDIX A

VEGETATION PHOTOGRAPHS

1. Vegetation Monitoring Photographs
2. Vegetation Problem Area Photographs

Appendix A

1. Vegetation Monitoring Photographs

Taken January 21, 2008

Photographs 1-8: Panoramic from east to south to west looking towards the Site.

Picture 9

Picture 10

Picture 11

Picture 12

Picture 13

Picture 14

Picture 15

Picture 16

Appendix A

2. Recovering Vegetation Problem Area Photographs

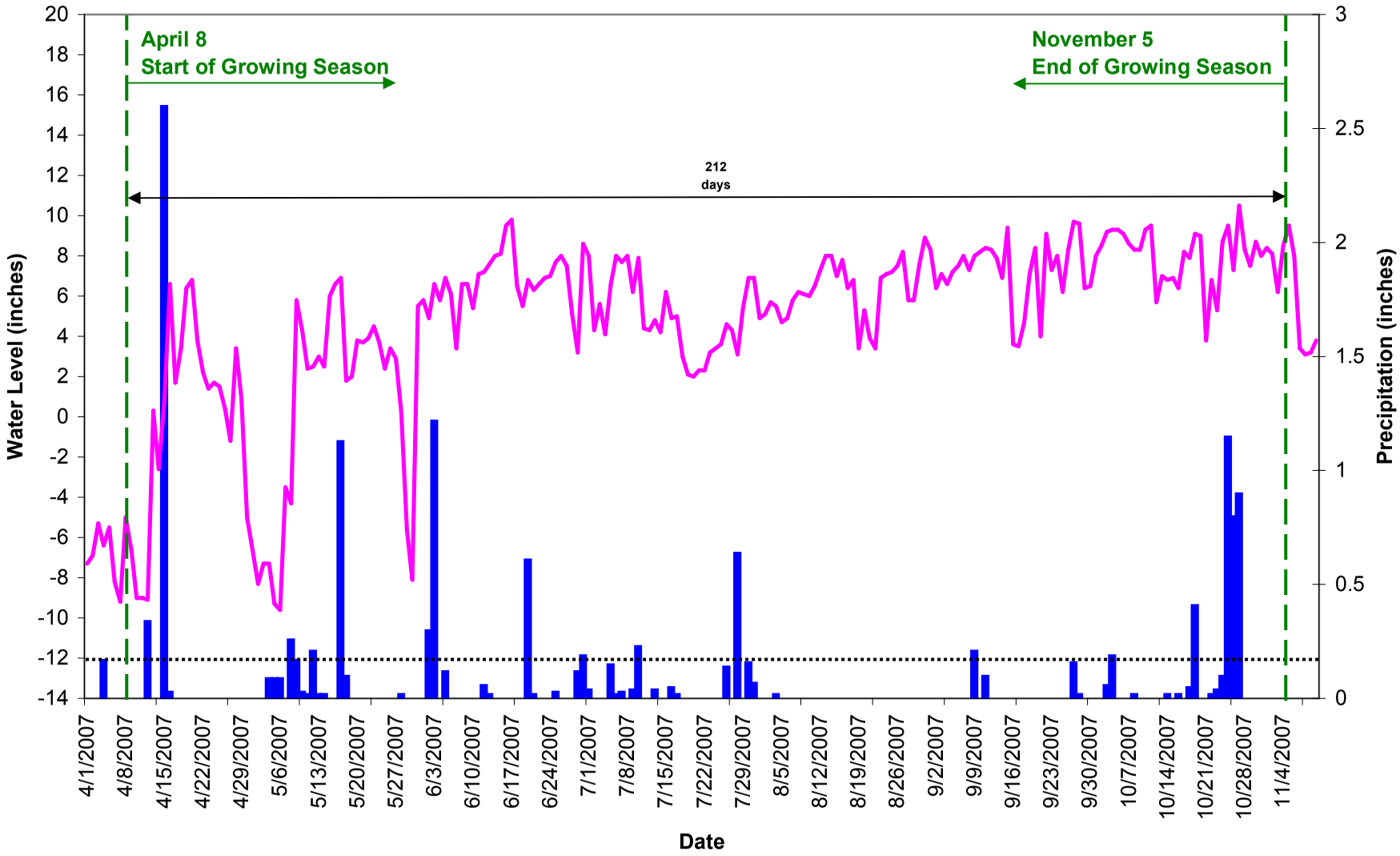
Taken January 21, 2008

Picture 17: Cattails along edge of marsh vegetation

Picture 18: Cattails along edge of marsh vegetation, taken from boardwalk

APPENDIX B

YEAR 4 (2007) GROUNDWATER GAUGE GRAPHS


SC II 1 (2007 Gauge Data)
April 8
Start of Growing Season
November 5
End of Growing Season
212
days
Water Level (inches)
Precipitation (inches)
Date
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
3
2.5
2
1.5
1
0.5
0
4/1/2007
4/8/2007
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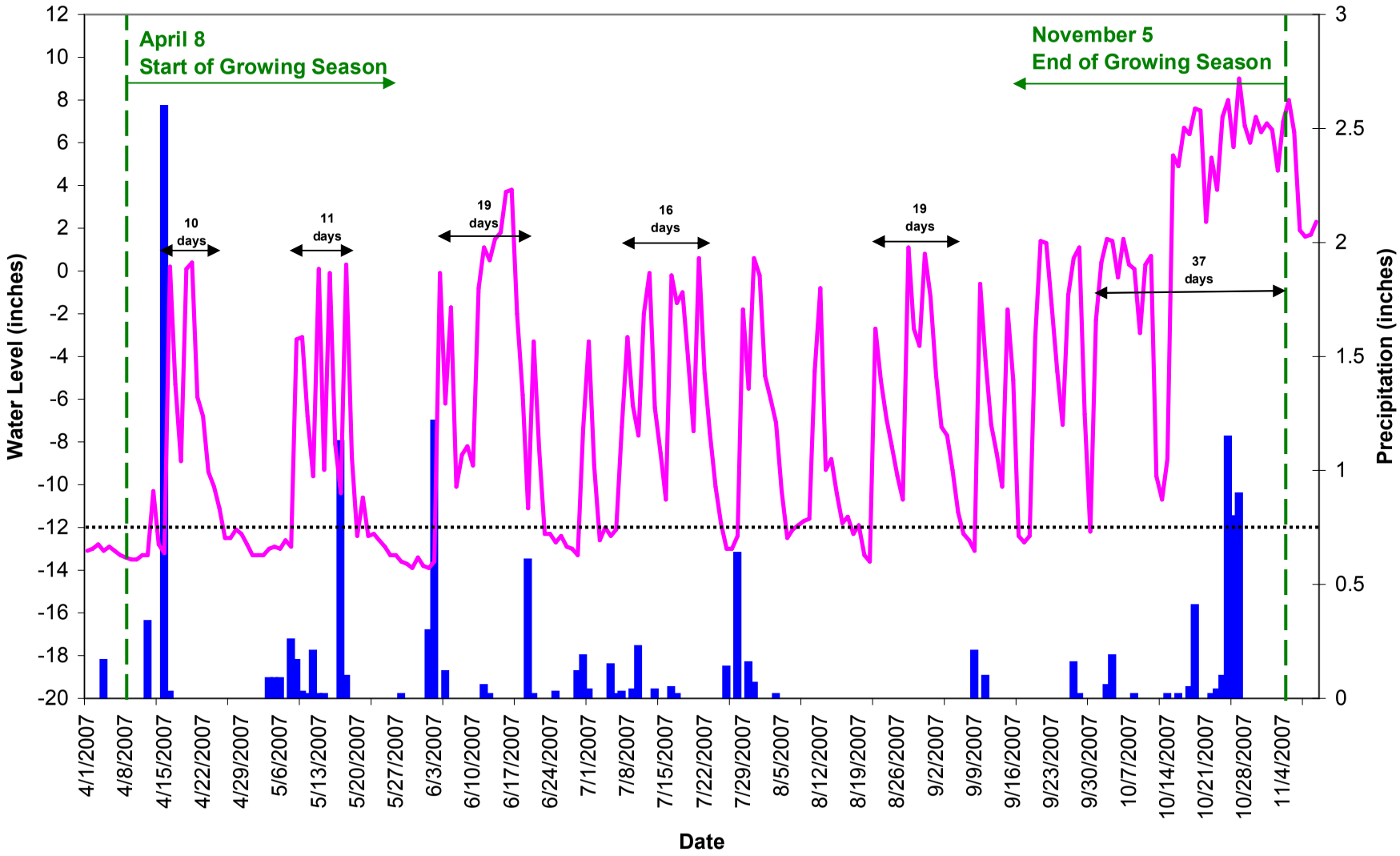
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April 8
Start of Growing Season
November 5
End of Growing Season
10 days
11 days
19 days
16 days
19 days
37 days
Water Level (inches)
Precipitation (inches)
Date
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
3
2.5
2
1.5
1
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0
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4/8/2007
4/15/2007
4/22/2007
4/29/2007
5/6/2007
5/13/2007
5/20/2007
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6/3/2007
6/10/2007
6/17/2007
6/24/2007
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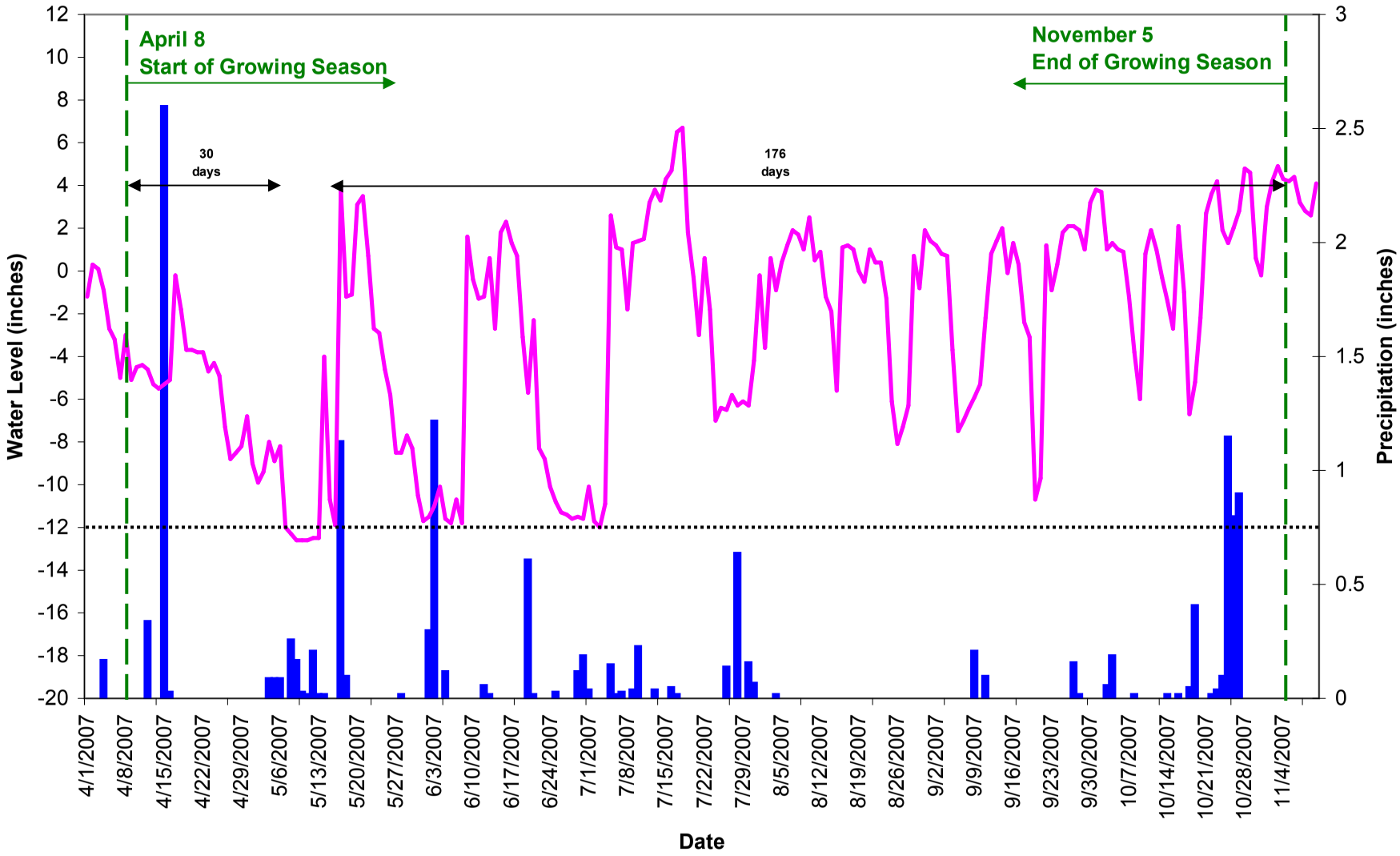
SC II 3 (2007 Gauge Data)
April 8
Start of Growing Season
November 5
End of Growing Season
30
days
176
days
Water Level (inches)
Precipitation (inches)
Date
12
10
8
6
4
2
0
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-6
-8
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-12
-14
-16
-18
-20
3
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2
1.5
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0.5
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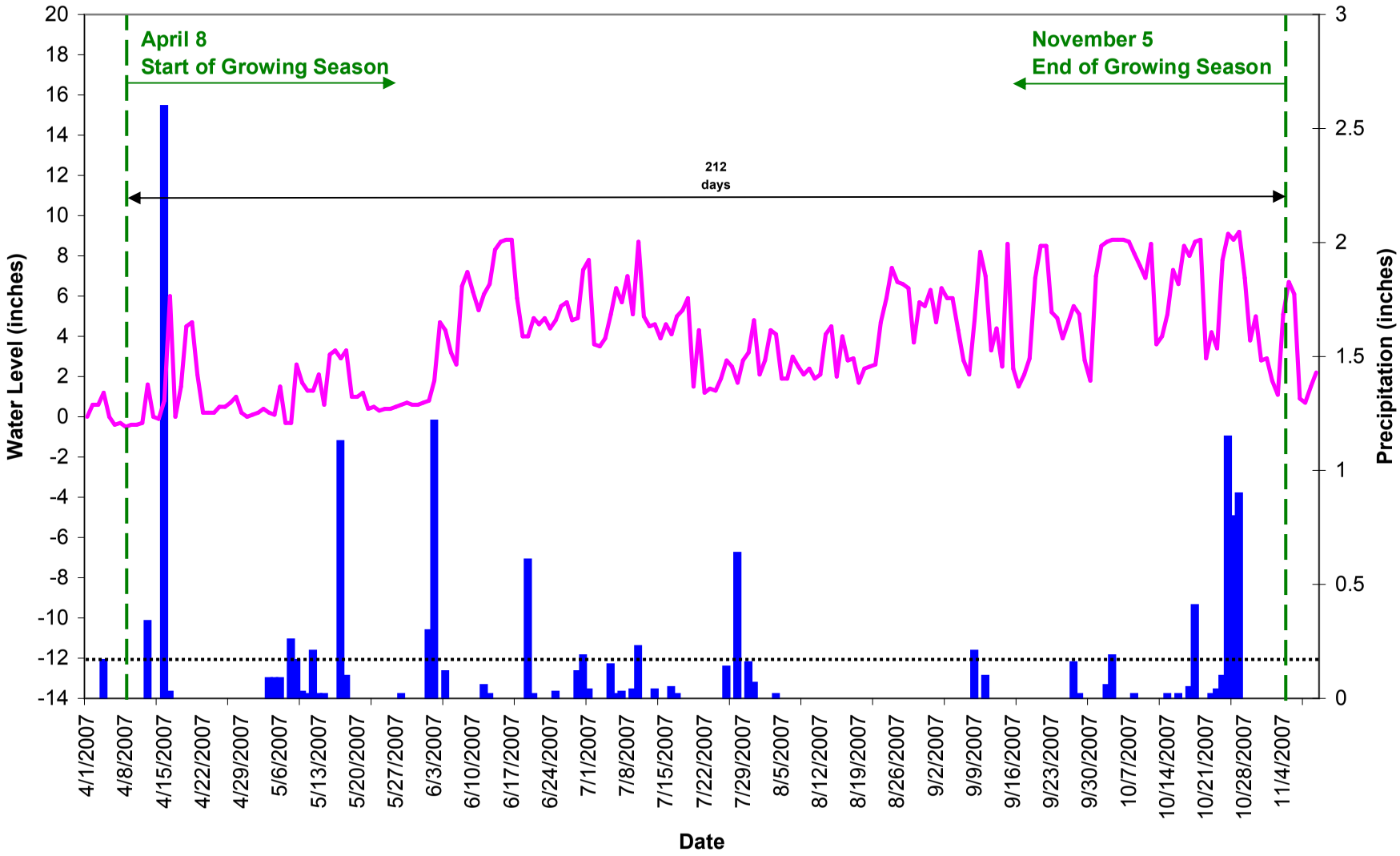
SC II 4 (2007 Gauge Data)
April 8
Start of Growing Season
November 5
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212
days
Water Level (inches)
Precipitation (inches)
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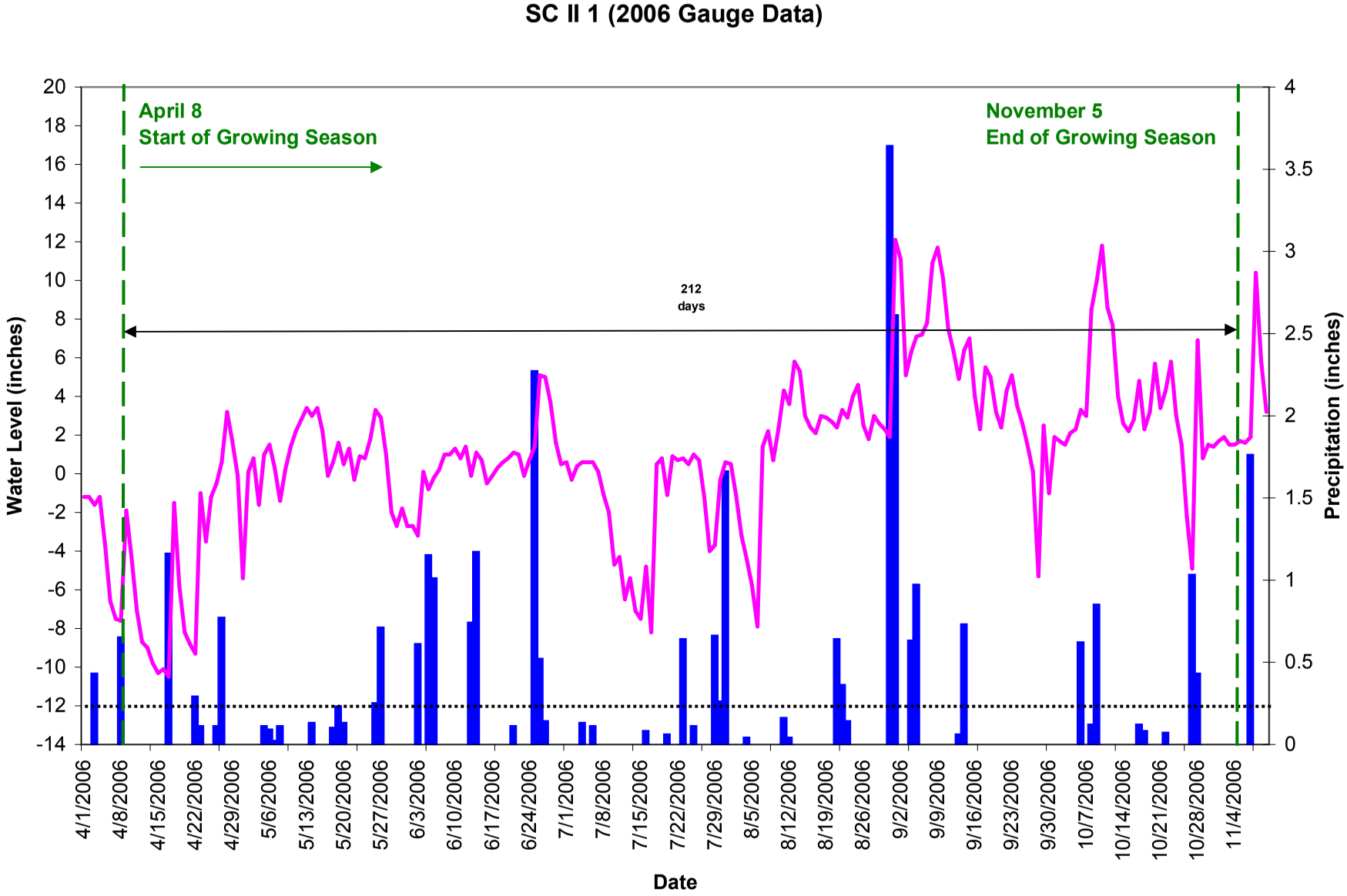
11/4/2007

APPENDIX C

YEAR 3 (2006) GROUNDWATER GAUGE GRAPHS


SC II 1 (2006 Gauge Data)
April 8
Start of Growing Season
November 5
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days
Water Level (inches)
Precipitation (inches)
Date
20
18
16
14
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10
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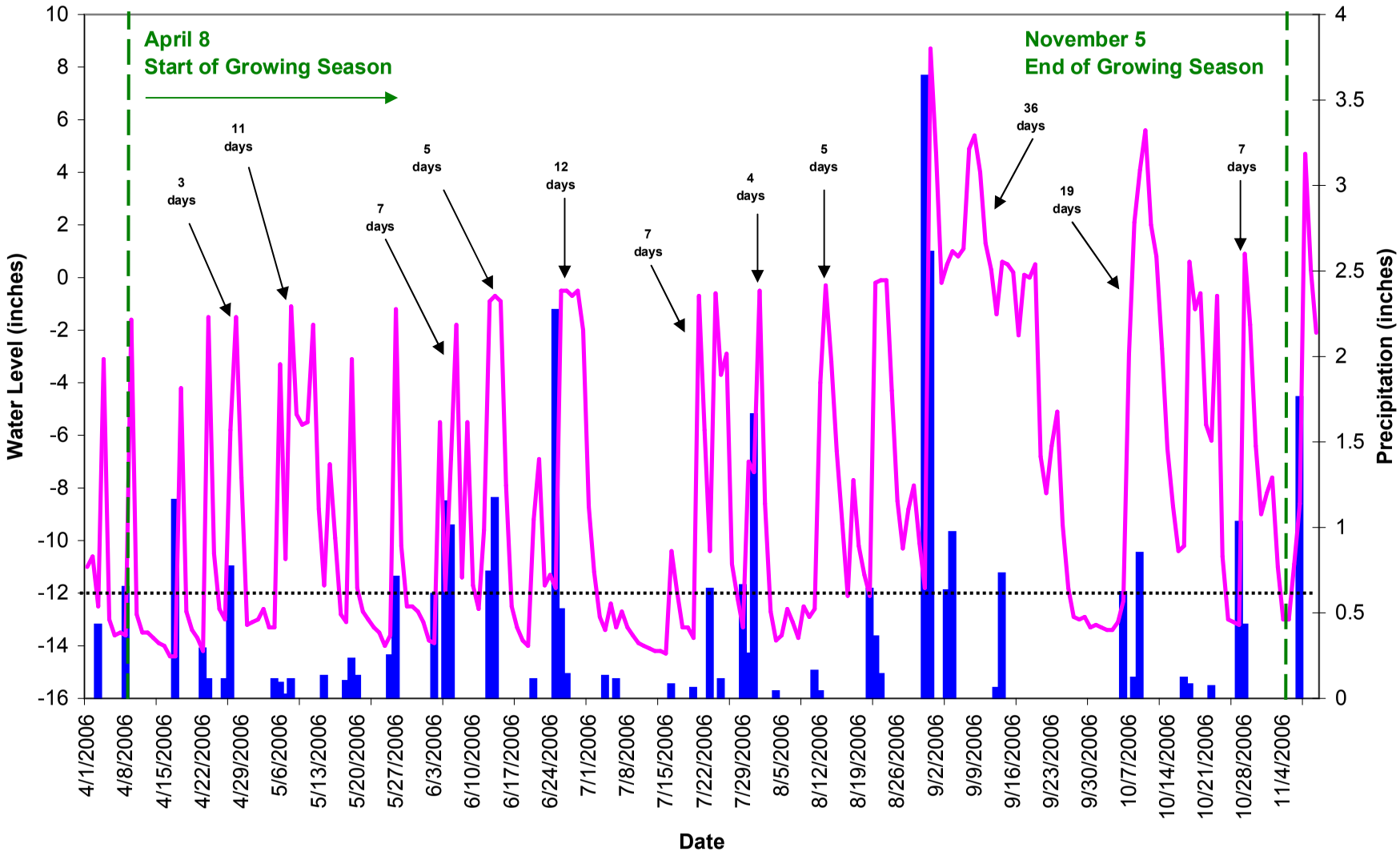
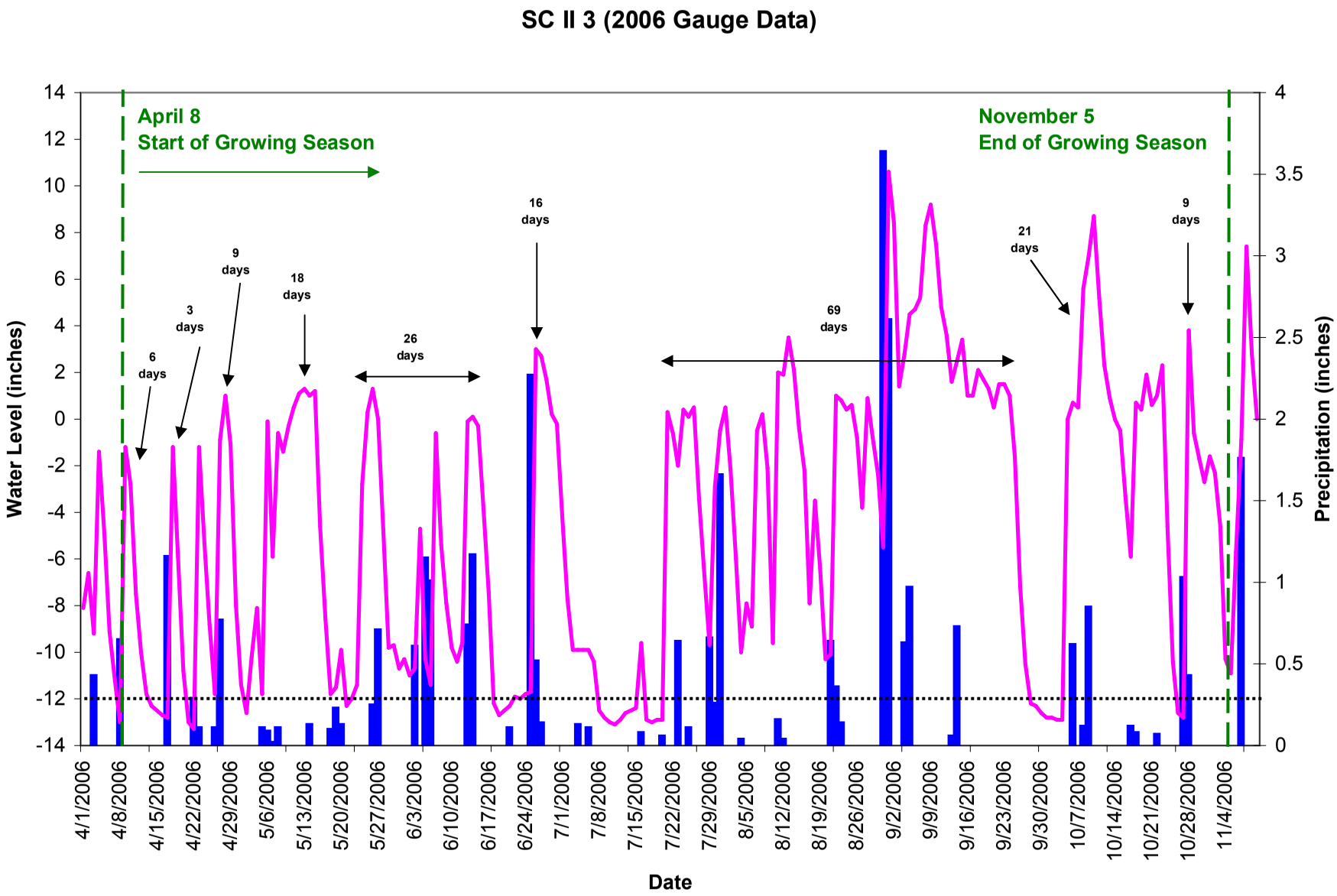
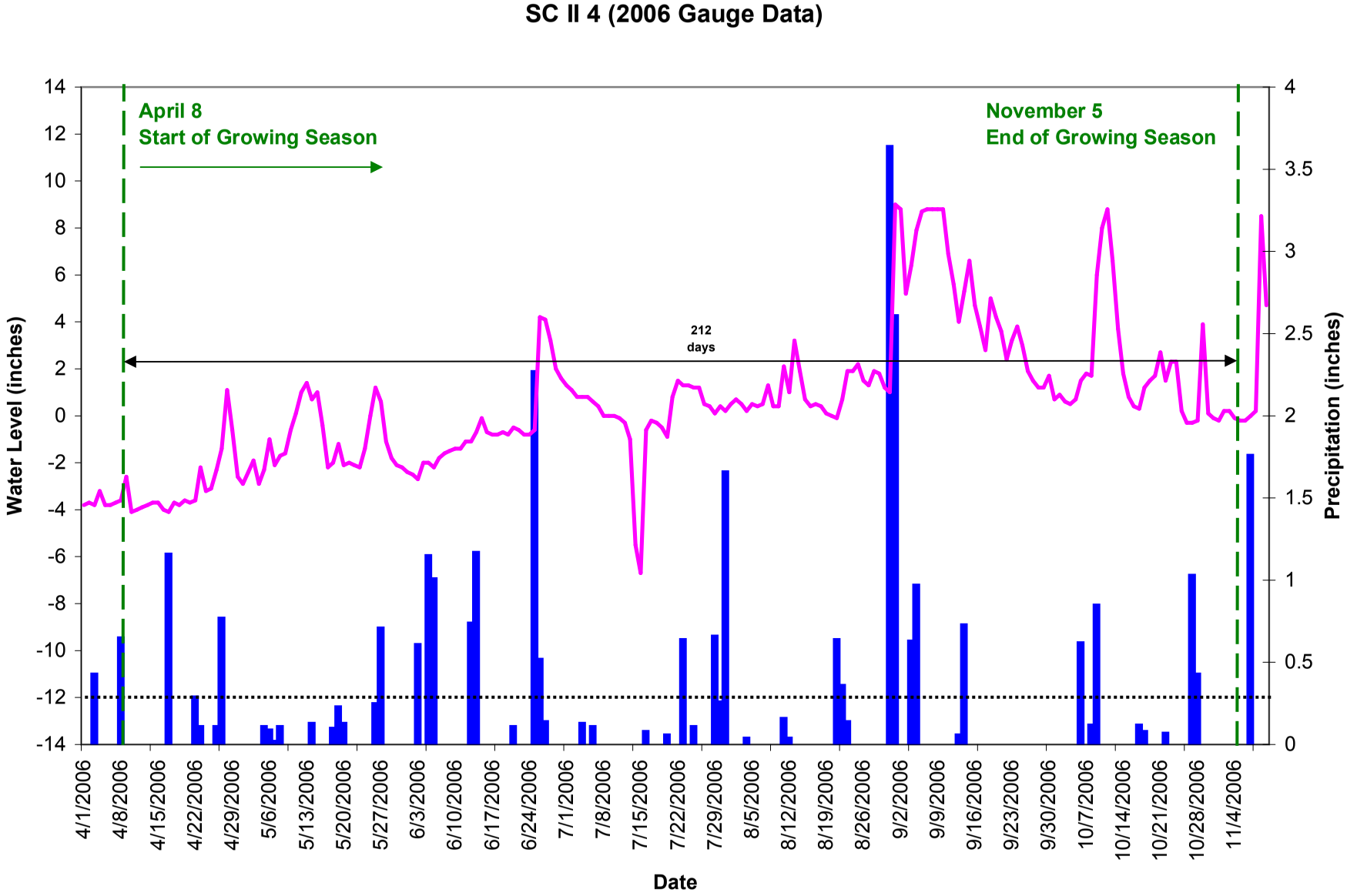
0.5
0
4/1/2006
4/8/2006
4/15/2006
4/22/2006
4/29/2006
5/6/2006
5/13/2006
5/20/2006
5/27/2006
6/3/2006
6/10/2006
6/17/2006
6/24/2006
7/1/2006
7/8/2006
7/15/2006
7/22/2006
7/29/2006
8/5/2006
8/12/2006
8/19/2006
8/26/2006
9/2/2006
9/9/2006
9/16/2006
9/23/2006
9/30/2006
10/7/2006
10/14/2006
10/21/2006
10/28/2006
11/4/2006


SC II 2 (2006 Gauge Data)
April 8
Start of Growing Season
November 5
End of Growing Season
3 days
11 days
7 days
5 days
12 days
7 days
4 days
5 days
36 days
19 days
7 days
Water Level (inches)
Precipitation (inches)
Date
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
4
3.5
3
2.5
2
1.5
1
0.5
0
4/1/2006
4/8/2006
4/15/2006
4/22/2006
4/29/2006
5/6/2006
5/13/2006
5/20/2006
5/27/2006
6/3/2006
6/10/2006
6/17/2006
6/24/2006
7/1/2006
7/8/2006
7/15/2006
7/22/2006
7/29/2006
8/5/2006
8/12/2006
8/19/2006
8/26/2006
9/2/2006
9/9/2006
9/16/2006
9/23/2006
9/30/2006
10/7/2006
10/14/2006
10/21/2006
10/28/2006
11/4/2006


SC II 3 (2006 Gauge Data)
April 8
Start of Growing Season
November 5
End of Growing Season
6 days
3 days
9 days
18 days
26 days
16 days
69 days
21 days
9 days
Water Level (inches)
Precipitation (inches)
Date
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
4
3.5
3
2.5
2
1.5
1
0.5
0
4/1/2006
4/8/2006
4/15/2006
4/22/2006
4/29/2006
5/6/2006
5/13/2006
5/20/2006
5/27/2006
6/3/2006
6/10/2006
6/17/2006
6/24/2006
7/1/2006
7/8/2006
7/15/2006
7/22/2006
7/29/2006
8/5/2006
8/12/2006
8/19/2006
8/26/2006
9/2/2006
9/9/2006
9/16/2006
9/23/2006
9/30/2006
10/7/2006
10/14/2006
10/21/2006
10/28/2006
11/4/2006


SC II 4 (2006 Gauge Data)
April 8
Start of Growing Season
November 5
End of Growing Season
212
days
Water Level (inches)
Precipitation (inches)
Date
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
4
3.5
3
2.5
2
1.5
1
0.5
0
4/1/2006
4/8/2006
4/15/2006
4/22/2006
4/29/2006
5/6/2006
5/13/2006
5/20/2006
5/27/2006
6/3/2006
6/10/2006
6/17/2006
6/24/2006
7/1/2006
7/8/2006
7/15/2006
7/22/2006
7/29/2006
8/5/2006
8/12/2006
8/19/2006
8/26/2006
9/2/2006
9/9/2006
9/16/2006
9/23/2006
9/30/2006
10/7/2006
10/14/2006
10/21/2006
10/28/2006
11/4/2006