

**Juniper Bay Wetland Mitigation Site
Robeson County, NC**

**2006 Annual Monitoring Report
Year 1 of 5**



NCEEP Project Number 201

Submitted To:
NCDENR/Ecosystem Enhancement Program
1619 Mail Service Center
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Monitoring:
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Executive Summary

The Juniper Bay Mitigation Site (JBMS) is a Carolina bay located in Robeson County, North Carolina comprising 728.5 acres. The site was constructed by the North Carolina Department of Transportation and is managed by the North Carolina Ecosystem Enhancement Program in order to provide compensatory wetland mitigation credits in the Lumber River Basin. The site previously was used for agricultural production with a drainage ditch network constructed to drain the site. The goal of the mitigation plan is to restore the hydrologic functions and re-vegetate the site with wetland forest vegetation. The two community types planned for establishment are Peatland Atlantic White Cedar Forest/Bay Forest and Pond Pine Woodland/Bay Forest.

The site was monitored for two primary wetland parameters: hydrology and vegetation. Forty-three automated groundwater monitoring gauges are installed across the site. The hydrologic success criterion requires the soil to be ponded, flooded, or saturated within 12 inches of the surface for a least 12.5% of the growing season during years with normal precipitation. The growing season extends from March 25th to November 4th in Robeson County (225 days). Vegetation success criterion is monitored using 20 (10 meter X 10 meter) vegetative plots. Species composition and density are noted. The minimum survival rates for vegetative success are as follows: 320 stems/acre of target species at end of Year 3, 290 stems/acre at end of Year 4, and 260 stems/acre at end of Year 5.

In 2006, nine of the 20 plots did not meet the success criterion of the total 320 stems/acre that would be required after Year 3. Plots 4, 19, and 20 had water levels greater than one foot. ESI would have to review more data provided by EEP to study this.

During the 2006 monitoring period, 29 of the 43 monitoring gauges met the hydrology success criterion (Table VI.), a 67.4% success rate. However, based on the JBMS Mitigation Plan, there are 13 gauges located adjacent to the perimeter ditch, which are not expected to be restored to jurisdictional status. Only 3 of the 13 perimeter gauges met jurisdictional hydrology. Of the remaining 30 interior gauges, 26 met the hydrology success criterion, an 86.6% success rate.

I. Project Background

1.0 Project Objectives

The goal of the Juniper Bay Mitigation Site (JBMS) is to restore natural wetland functions, processes, structure, and species composition to the site for compensatory wetland mitigation due to highway construction impacts in the Lumber River Basin. The objectives for this site entail restoring the predicted conditions which existed on site prior to human disturbance. The mitigation plan is accomplished through elimination of the drainage ditch network, grading the land surface to eliminate field crowns and promote microtopography, and establishing wetland forest vegetation on site. The pre-disturbance site conditions are based upon reference system analysis, hydrology monitoring and modeling, soil investigations, and published literature.

2.0 Project Structure, Restoration Type, and Approach

This 728.5 ac site was constructed to provide compensatory mitigation for several projects including Transportation Improvement Projects (TIP) R-513, R-2593, and R-3333 in the Lumber River Basin (Hydrologic Unit 03040203). Initially, only 1.6 percent of the Juniper Bay property was jurisdictional due to the extensive drainage. Therefore, the majority of the compensatory mitigation will qualify as nonriverine wetland restoration.

The site was originally cleared and ditched over a period of 15 years beginning between 1966 and 1972 to facilitate agricultural production. A drainage ditch network running in a north-south direction was initially established. This system was established along the western third of the site. As of 1981, the entire site had been cleared, and the current northwest to southeast ditch network had been established. Additionally, another drainage ditch runs along the entire perimeter of the site. In 1994, longleaf pine was planted in three large fields on the southern portion of the property. The site was used for agricultural production until being purchased by the North Carolina Department of Transportation (NCDOT) in January 2000. The site was constructed by the North Carolina Department of Transportation and is managed by the North Carolina Ecosystem Enhancement Program (EEP).

The site is a Carolina bay comprising 728.5 acres of which 567.7 acres are part of the mitigation component where jurisdictional hydrology is to be enhanced or restored. The remaining 160.8 acres are considered to be non-restorable areas due to the perimeter ditch that has been left open in order to avoid hydrologic trespass issues. Mitigative measures are not expected to return jurisdictional hydrology to these areas.

The hydrologic restoration plan involves systematically plugging and backfilling the interior ditch network to increase surface and subsurface water storage capacity and to increase the retention of water onsite. The wetland vegetation restoration plan is to establish two natural community types: Peatland Atlantic White Cedar Forest/Bay Forest and Pond Pine Woodland/Bay Forest. The Peatland Atlantic White Cedar Forest/Bay Forest community was planted in low lying areas dominated by organic soils and the Pond Pine Woodland/Bay Forest community was planted in areas with higher elevation dominated by sandy soils.

Table I lists the estimated wetland acreage by community type to be restored or enhanced on the JBMS. The proposed mitigation plan provides for the restoration and enhancement of 567.7 acres of nonriverine wetlands.

Table I. Project Restoration Components Juniper Bay Wetland Mitigation Site-EEP # 201		
Community Type	Mitigation Type	Acreage
Peatland Atlantic White Cedar Forest	Restoration	264.8
Peatland Atlantic White Cedar Forest	Enhancement	11.8
Pond Pine Woodland	Restoration	291.1
	Total	567.7
Non-restorable areas	Total	160.8
Juniper Bay Mitigation Site	Total	728.5

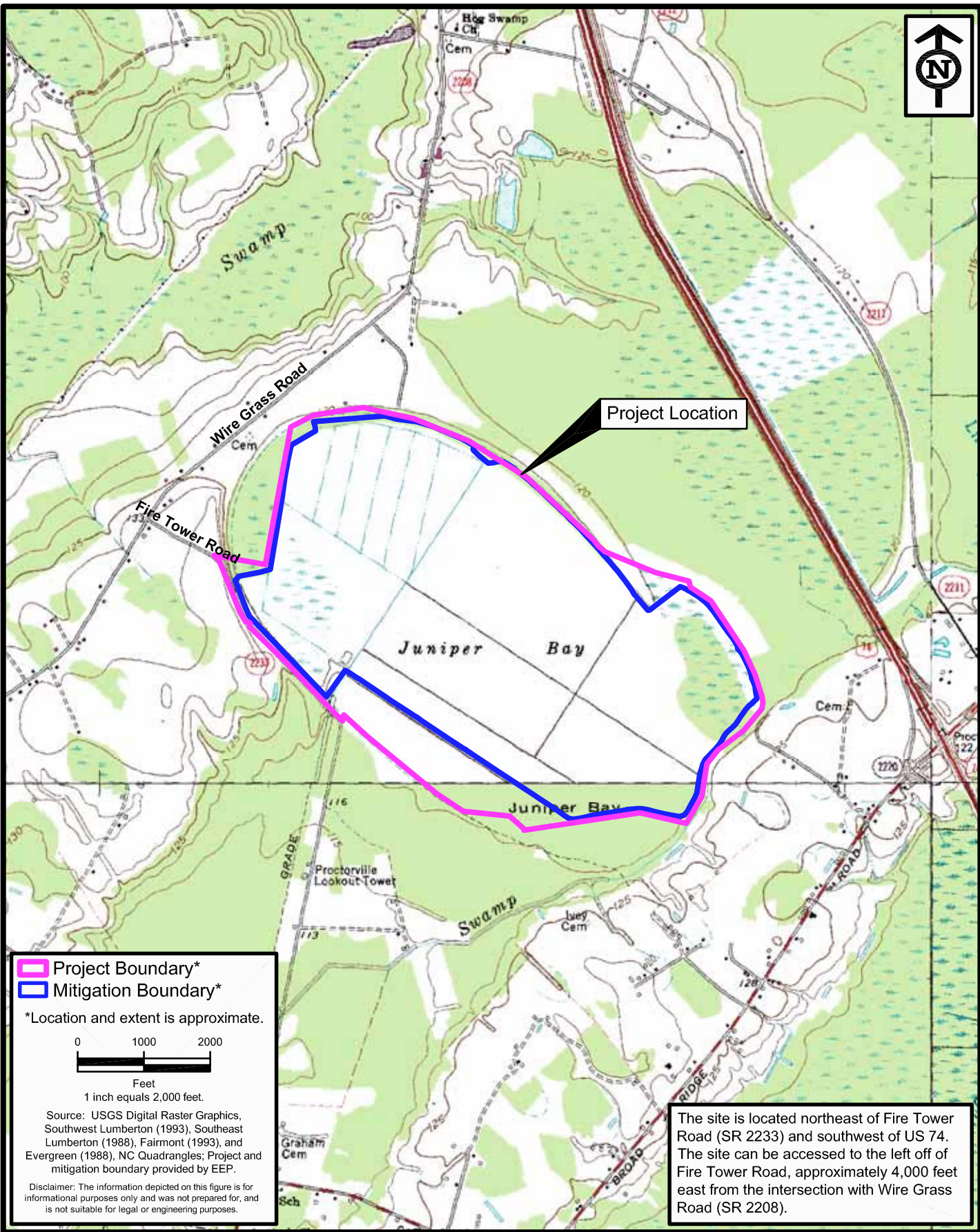
In order to demonstrate successful mitigation, hydrologic and vegetation monitoring is to be conducted for a minimum of five years. Relic hydric soils are present at the site negating the necessity for soil monitoring. Successful hydrological criterion requires the soil be ponded, flooded, or saturated within 12 inches of the surface for at least 12.5% of the growing season during a year with normal precipitation levels. The growing season for Robeson County is from March 25th to November 4th (225 days), therefore in order to demonstrate success, a gauge must have saturated conditions for a minimum of 28 consecutive days during the growing season.

According to the JBMS Mitigation Plan, the appropriate species mixes were planted at a rate of 680 stems/acre. Success criterion for vegetation restoration states there must be a minimum of 320 stems/acre of target species at the end of the third year of monitoring. Vegetation success criterion for Year 4 requires 290 stems/acre and for the end of Year 5, 260 stems/acre. Using EEP guidelines developed by the Carolina Vegetation Survey, the vegetation plots will be monitored for success criterion for a minimum of five years. Photographs of the vegetation plots from the same viewpoints annually will provide a visual record of plot growth. Vegetative data will be correlated with the appropriate hydrologic data from the groundwater monitoring gauges to determine if success criteria are being met.

Planted seedlings and natural recruitment of the target species are included in the survival criterion. Survival and density of planted tree stock and natural recruitment will be reported and evaluated relative to the success criterion. At least six different representative tree species should be present on the entire site. If vegetation success criterion is not met, the reasons for failure will be examined and appropriate corrective action will be taken.

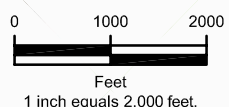
3.0 Location and Setting

The Juniper Bay Wetland Mitigation Site is located in eastern Robeson County, North Carolina approximately 7.5 miles south of Lumberton, NC and 4.5 miles east of Fairmont, North Carolina in the Coastal Plain physiographic region. The site is located in an interstream divide between two streams, Hog Swamp and Big Branch. The surrounding land use consists primarily of managed forest and agricultural production. Few residential properties are located along Wiregrass Road and Fire Tower Road.



- Project Boundary*
- Mitigation Boundary*

*Location and extent is approximate.



Source: USGS Digital Raster Graphics, Southwest Lumberton (1993), Southeast Lumberton (1988), Fairmont (1993), and Evergreen (1988), NC Quadrangles; Project and mitigation boundary provided by EEP.

Disclaimer: The information depicted on this figure is for informational purposes only and was not prepared for, and is not suitable for legal or engineering purposes.

The site is located northeast of Fire Tower Road (SR 2233) and southwest of US 74. The site can be accessed to the left off of Fire Tower Road, approximately 4,000 feet east from the intersection with Wire Grass Road (SR 2208).



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Ecosystem Enhancement

Composite Vicinity Map
Juniper Bay
 Robeson County, North Carolina
 Monitoring Report Year 1

Project:	ER06040.00
Date:	Dec 2006
Drwn/Chkd:	AJS/GT
Figure:	1

4.0 Project History and Background

Table II provides the timeline for data collection completion and for actual completion of various construction and monitoring milestones of JBMS. The dates for several of these activities were unavailable at the time of report submission.

Table II. Project Activity and Reporting History Juniper Bay Wetland Mitigation Site-EEP # 201		
Activity or Report	Data Collection Complete	Actual Completion
Restoration Plan	N/A	N/A
Final Design-90%	N/A	N/A
Construction	N/A	Phase I Feb 2004; Phase II Jan 2006
Temporary S&E mix applied to entire site	N/A	N/A
Permanent Seed mix applied	N/A	N/A
Mitigation Plan/ As-built (Year 0 Monitoring- baseline)	N/A	Feb 2006
Year 1 Monitoring	Nov 2006	Dec 2006
Year 2 Monitoring	N/A	N/A
Year 3 Monitoring	N/A	N/A
Year 4 Monitoring	N/A	N/A
Year 5 Monitoring	N/A	N/A

The point of contact for various phases and for the monitoring of the JBMS are provided in Table III.

Table III. Project Contacts Juniper Bay Wetland Mitigation Site-EEP # 201	
Designer Primary project design POC	N.C. Department of Transportation Natural Environment Unit Arcadis
Construction Contractor Construction contractor POC	NCDOT Division 6 Robeson County Maintenance Eugene McKeithan, Highway Maintenance Engineer
Planting Contractor Planting contractor POC	Professional Consolidated, LLC Henry Rozo
Seeding Contractor Seeding contractor POC	NCDOT Division 6 Roadside Environmental Unit James Barnes, Division Roadside Environmental Engineer
Nursery Stock Suppliers	NC Forestry Service (hardwoods); Coastal Plain Conservation Nursery (bays); Hillis Nursery (bays)
Monitoring Performers Wetland and Vegetation POC	Environmental Service, Inc. 524 S. New Hope Road Raleigh, North Carolina 27610 Gail Tyner (919) 212-1760

Relevant project background information for JBMS is provided in Table IV. The Cowardin classification is based upon a typical Carolina bay system. The current U.S. Fish and Wildlife Service National Wetlands Inventory mapping for the site is based upon the previous drained status of the site. The NCDWQ classification for Project and Reference was unavailable at the time of report submission.

Table IV. Project Background Juniper Bay Wetland Mitigation Site-EEP # 201	
Project County	Robeson County
Drainage Area	904 Acres; 756 acres within the site perimeter
Drainage impervious cover estimate (%)	1%
Physiographic Region	Coastal Plain
Ecoregion	651 Atlantic Southern Loam Plain
Cowardin Classification	PFOB4/6
Dominant soil types	Ponzer Muck, Leon sand, Rutledge loamy sand, Pantego fine sandy loam
Reference site ID	Tatum Millpond Bay, Bladen County, NC
USGS HUC for Project and Reference	03040203
NCDWQ Sub-basin for Project and Reference	03-07-54
NCDWQ classification for Project and Reference	N/A
Any portion of the project 303d listed?	No
Any upstream portion 303d listed?	No
% of project easement fenced	Gate at access road

5.0 Monitoring Plan View

In 2006, hydrologic monitoring was initiated across the site. Environmental Services, Inc. installed 43 groundwater gauges. Gauges GW-15 and GW-22 were not installed due to high water conditions. There are 30 gauges installed within the Pond Pine Woodland/ Bay Forest community, and 13 gauges installed within the Peatland Atlantic White Cedar Forest/Bay Forest community. Groundwater monitoring is conducted onsite to determine if the hydrologic success criterion for a wetland mitigation site is being met.

One rain gauge is installed onsite. This precipitation data will be compared to data from the National Oceanic & Atmospheric Administration (NOAA) gauge station in Lumberton, North Carolina to determine the reliability of the onsite data.

The vegetation monitoring is conducted using 20 plots as representative samples of the entire site. The vegetation plots are 10 meters by 10 meters. For each plot, species composition and density are recorded to determine if vegetative success criterion is met.

Figures 2a-d provide plan views of the site showing the location of all monitoring features including groundwater gauges, vegetation plots, photo points, and the rain gauge.

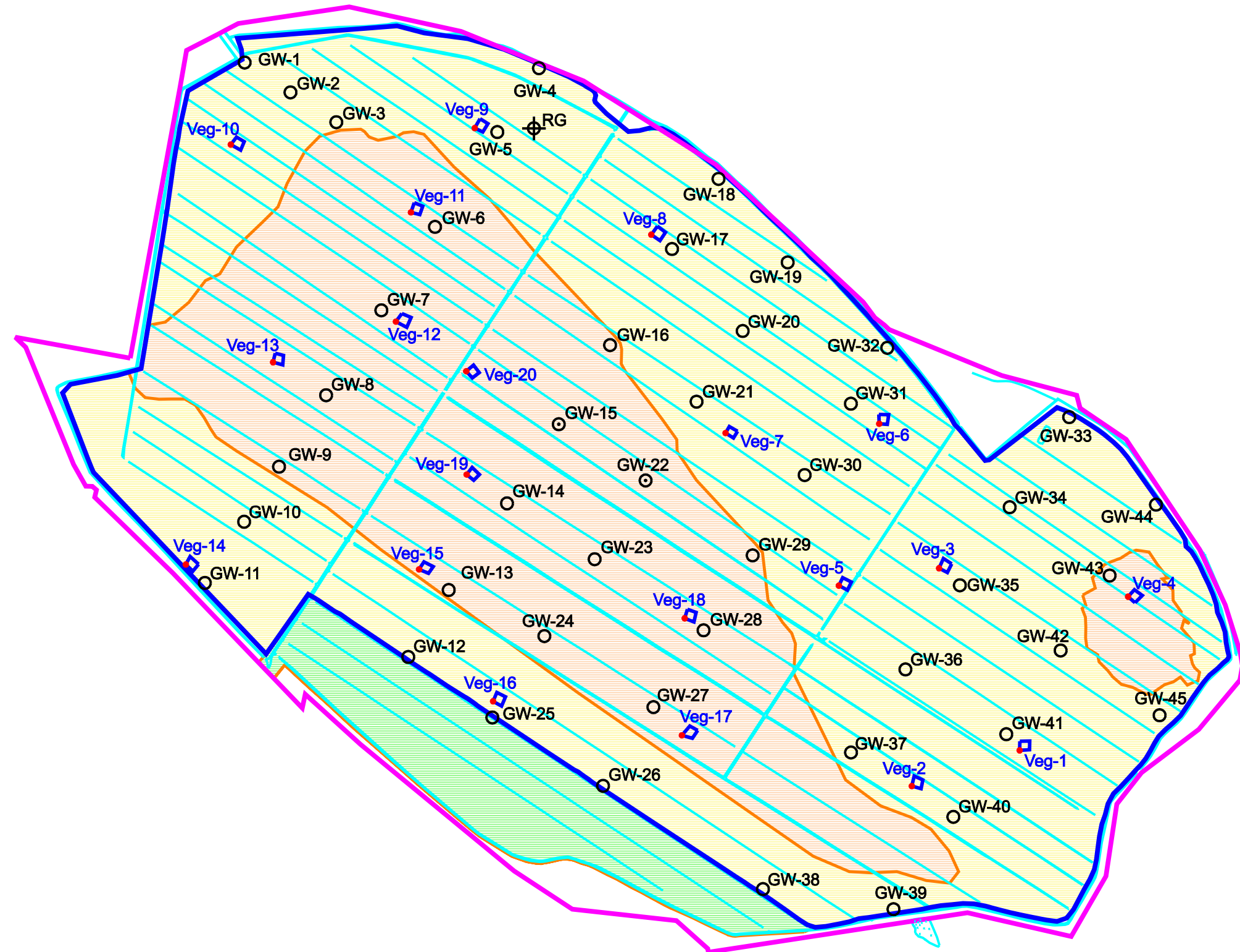


Project: ER06040.00
 Date: Feb 2007
 Drwn/Chkd: AJS/GT
 Figure: 2a

Monitoring Plan View - Monitoring Gauges and Vegetation Plots
Juniper Bay
 Robeson County, North Carolina
 Monitoring Report Year 1

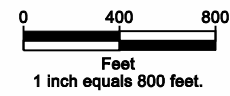


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- Project Boundary*
- Mitigation Boundary*
- Pond Pine Woodland / Bay Forest*
- Peatland Atlantic White Cedar Forest / Bay Forest*
- Long Leaf Pine Stand*
- Ditch*
- Vegetation Plot*
- Photo Location*
- Monitoring Well - Installed*
- Monitoring Well - Not Installed*
- Rain Gauge*

*Location and extent is approximate.



Source: Ecosystem Enhancement Program.

Disclaimer: The information depicted on this figure is for informational purposes only and was not prepared for, and is not suitable for legal or engineering purposes. This information presented is not for regulatory review and is intended for use only by a Professional Land Surveyor prior to regulatory review.



Project: ER06040.00
 Date: Feb 2007
 Drwn/Chkd: AJS/GT
 Figure: 2b

Monitoring Plan View - NRCS Soils and Contours
Juniper Bay
 Robeson County, North Carolina
 Monitoring Report Year 1



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Project Boundary*
 Mitigation Boundary*
 NRCS Soil Boundary*
 NRCS Water Boundary*
 Ditch*
 5' Contour*
 1' Contour*

Soil Mapping Units

Hydric Soils

- Le** Leon sand
- Pm** Plummer and Osier soils
- Pr** Ponzer muck
- Ru** Rutlege loamy sand

Non-Hydric Soils

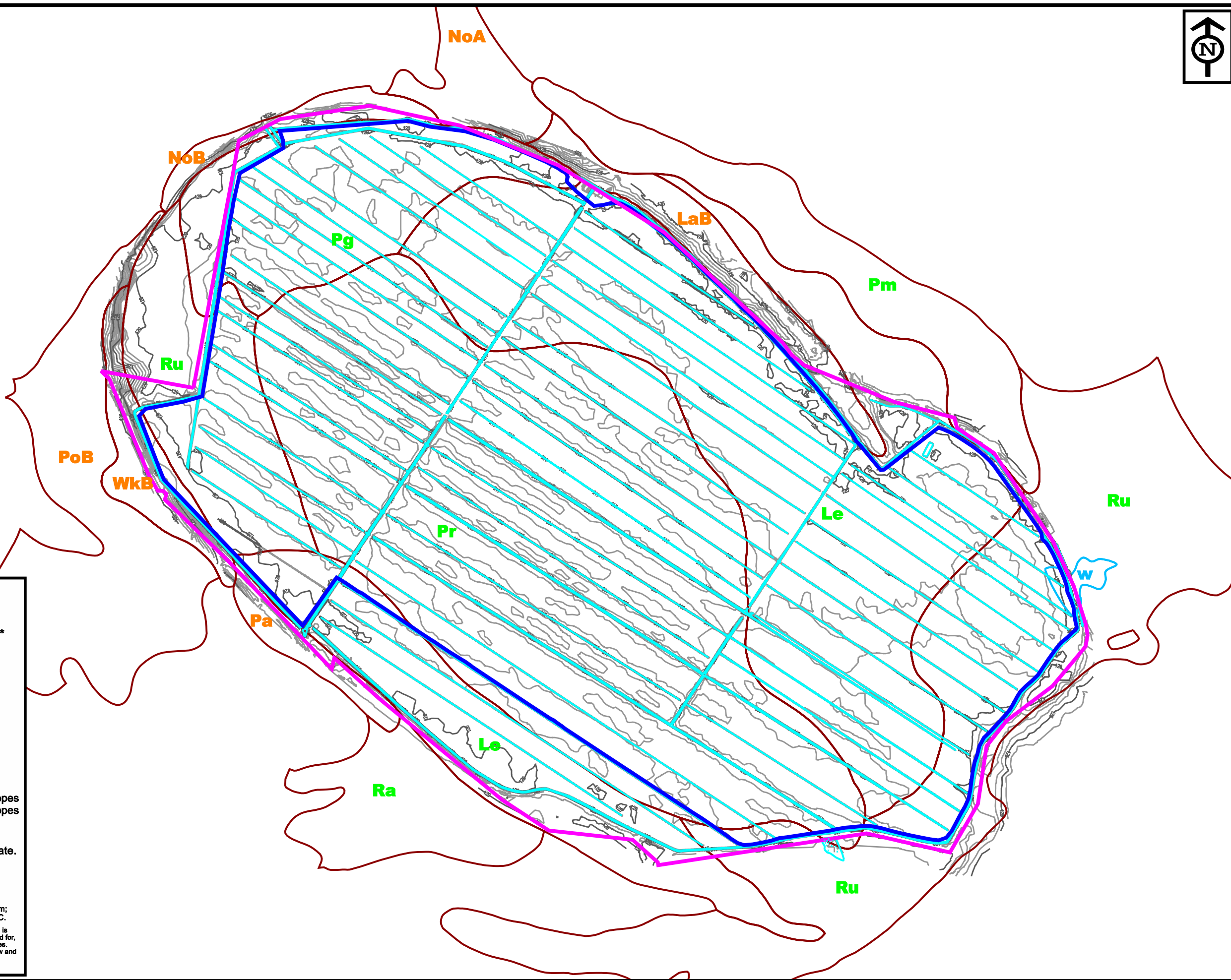
- LaB** Lakeland sand, 0-6% slopes
- NoA** Norfolk loamy sand, 0-2% slopes
- NoB** Norfolk loamy sand, 2-6% slopes
- Pa** Pactolus loamy sand
- WkB** Wakulla sand, 0-6% slopes

*Location and extent is approximate.

0 400 800
 Feet
 1 inch equals 800 feet.

Source: Ecosystem Enhancement Program;
 NRCS Soil Survey of Robeson County, NC.

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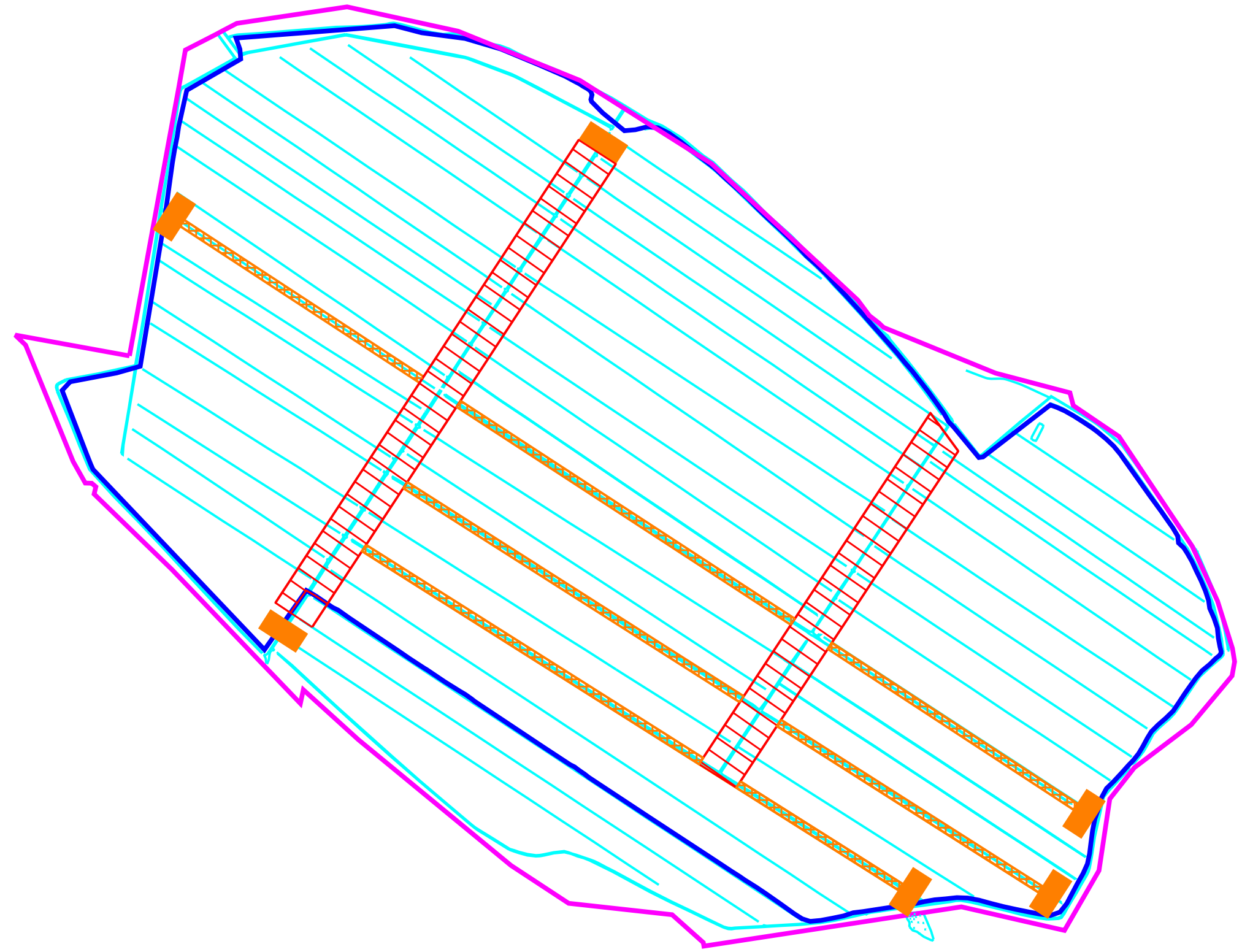


Project: ER06040.00
 Date: Feb 2007
 Drwn/Chkd: AJS/GT
 Figure: 2c

Monitoring Plan View - Ditch Network and Application
Juniper Bay
 Robeson County, North Carolina
 Monitoring Report Year 1



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Project Boundary*
 Mitigation Boundary*
 Ditch Backfilling*
 Grading Area*
 Ditch Plug*
 Ditch*

*Location and extent is approximate.

0 400 800
 Feet
 1 inch equals 800 feet.

Source: Ecosystem Enhancement Program.

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Project: ER06040.00
Date: Dec 2006
Drwn/Chkd: AJS/GT
Figure: 2d

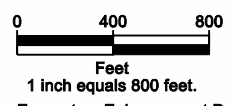
Monitoring Plan View - Plant Communities
Juniper Bay
Robeson County, North Carolina
Monitoring Report Year 1



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-  Project Boundary*
-  Mitigation Boundary*
-  Pond Pine Woodland / Bay Forest*
-  Peatland Atlantic White Cedar Forest / Bay Forest*
-  Long Leaf Pine Stand*
-  Ditch*



Source: Ecosystem Enhancement Program;
NRCS Soil Survey of Robeson County, NC.
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II. Project Condition and Monitoring Results

1.0 Vegetation Assessment

The vegetation success criteria were developed in accordance with Environmental Protection Agency guidelines detailed in Mitigation Site Type documentation and U.S. Army Corps of Engineers Compensatory Hardwood Mitigation Guidelines. Two community types were planned at the site: Peatland Atlantic White Cedar Forest/Bay Forest and Pond Pine Woodland/Bay Forest. The target species are based on the Tatum Millpond Bay reference site and NCNHP community descriptions. The appropriate species mix was planted in the two specified communities at a rate of 680 stems/acre (Table V).

Table V. Species for Each Community Type		
Peatland Atlantic White Cedar Forest/ Bay Forest		
Atlantic white cedar	<i>Chamaecypari thyoides</i>	OBL
Loblolly bay	<i>Gordonia lasianthus</i>	FACW
Swamp tupelo	<i>Nyssa sylvatica</i> var. <i>biflora</i>	OBL
Bald cypress	<i>Taxodium distichum</i>	OBL
Sweetbay	<i>Magnolia virginiana</i>	FACW+
Pond pine	<i>Pinus serotina</i>	FACW+
Swamp red bay	<i>Persea palustris</i>	FACW
Pond Pine Woodland/ Bay Forest		
Pond pine	<i>Pinus serotina</i>	FACW+
Loblolly bay	<i>Gordonia lasianthus</i>	FACW
Sweetbay	<i>Magnolia virginiana</i>	FACW+
Atlantic white cedar	<i>Chamaecyparis thyoides</i>	OBL
Loblolly pine	<i>Pinus taeda</i>	FAC
Swamp red bay	<i>Persea palustris</i>	FACW

Using EEP guidelines developed by the Carolina Vegetation Survey, 20 (10 meter X 10 meter) plots were designated across the site based on proximity to groundwater gauges and representative conditions for the site as a whole. Stem counts by species were conducted for each plot, including vigor and damage estimates. Volunteer trees were not included in the stem counts, although natural recruitment of target species are included. The 2006 monitoring event for JBMS represents the first year of monitoring. There is no vegetative success criterion for Years 1 and 2. However, the third year success criterion is 320 stems/acre of target species. Therefore, any plots with stem counts less than 320 stems/acre will not be considered to have met the vegetative success criterion.

1.1 Vegetative Problem Areas

Eleven of the 20 vegetation plots met the Year 3 success criteria of 320 stems/acre after this first years monitoring event. Four of the 9 plots in the Peatland Atlantic White Cedar Forest/ Bay Forest community met the vegetative success criterion (44.4%). Seven of the 11 plots in the Pond Pine Woodland/ Bay Forest community met the vegetative success criterion (63.6%) (Table VI).

Figure 3a depicts a hand-drawn approximation of the areas that are permanently flooded. These areas account for approximately 115 acres, which includes plots 4, 19, and 20. These

plots had water levels greater than one foot, which could negatively affect species survival. These three plots are located in the Peatland Atlantic White Cedar Forest/Bay Forest community. This community type occupies the wetter portions of the site thereby increasing the likelihood of high water contributing to sapling mortality. Plot 4 is located in a topographic depression underlain by a clayey subsoil and is located too far from a primary ditch outlet to receive drainage increasing potential high water conditions.

Plots, 7, 9, 14, and 16 are located in the Pond Pine Woodland/Bay Forest community. The soils within this community type are sandy soils with low organic matter content, which may inhibit survival.

Plots, 13 and 15 are located in the Peatland Atlantic White Cedar Forest/Bay Forest community. These plots may be adversely affected by the dense growth of pioneer herbaceous vegetation, primarily dog fennel (*Eupatorium capillifolium*) and goldenrod (*Solidago* spp.). This herbaceous growth may result in competition-induced mortality or may block sunlight to the saplings due to the dense midstory.

The overall vegetation success rate is low and is not expected to increase in the upcoming monitoring years. The areas not meeting the vegetative success criterion warrant further investigation.

Representative photographs of submergence and herbaceous problem areas are identified in Table 6 of Appendix A.

1.2 Vegetative Problem Area Plan View

Figure 3A in Appendix A provides an overview of all vegetative problem areas with regard to the scale and layout of the entire project.

Refer to Appendix A for additional vegetation related data and information.

2.0 Wetland Assessment

In accordance with federal guidelines for wetland mitigation, the success criterion for hydrologic restoration states that the soil must be ponded, flooded, or saturated within 12 inches of the surface for at least 12.5% of the growing season during years with normal precipitation. The growing season for this site extends from March 25th to November 4th (225 days). Therefore, in order to demonstrate success, a gauge must have saturated conditions within 12 inches of the surface for a minimum of 28 consecutive days during the growing season.

There are a total of 43 automated groundwater monitoring gauges installed across the site. The gauges are installed in each community type in accordance with federal guidelines. Precipitation data was collected by an onsite rain gauge. For comparative purposes, precipitation data is also obtained from a NOAA gauge station in Lumberton, NC.

2.1 Wetland Problem Areas

During the 2006 monitoring period, 29 of the 43 monitoring gauges met the hydrology success criteria (Table VI.), a 67.4% success rate. However, based on the JBMS Mitigation Plan, there are 13 gauges located adjacent to the perimeter ditch that area not expected to be restored to jurisdictional status. Only three of the 13 perimeter gauges met jurisdictional hydrology. Of the remaining 30 interior gauges 26 met the hydrology success criterion, an 86.6% success rate. Hydrographs for the individual monitoring gauges can be found in Appendix B.

There are 13 perimeter gauges that are located adjacent the perimeter ditch in the Pond Pine Woodland/ Bay Forest community. The perimeter ditch remains open in order to avoid hydrologic trespass issues. The location of these 13 gauges represents portions of the site which are not expected to meet the wetland criterion due to the adjacent ditch's zone of influence. Additionally, Carolina bay topography is somewhat bowl shaped. The center of the mitigation site has a lower elevation, but slopes outward to a dry sand ridge, which encloses the bay. These 13 gauges are all located in this drier sand ridge area. Ten of the 13 perimeter gauges did not meet the hydrologic success criterion.

Of the 17 remaining gauges in the Pond Pine Woodland/ Bay Forest community, 13 (76.5%) met the hydrological success criterion. Gauges GW-10, GW-34, GW-36, and GW-42 did not meet the hydrologic success criterion. The soils within this community type are sandy with higher infiltration rates than those in the Peatland Atlantic White Cedar Forest/ Bay Forest community. Additionally, the Pond Pine Woodland/ Bay Forest community was designated for areas of the site with higher elevations in the bay. The sandy soils and higher elevations may explain why these gauges did not meet the success criteria, although further observation is warranted.

Of the 13 gauges in the Peatland Atlantic White Cedar Forest/ Bay Forest community, 13 (100%) met the hydrological success criterion. The Peatland Atlantic White Cedar Forest/ Bay Forest community was designated for areas of the site with the lowest elevations and often wetter conditions. The soils in this community type are primarily poorly drained organic soils.

Gauges GW-5 and GW-14 malfunctioned for short periods of the growing season and were replaced. These two gauges met the hydrologic success criterion regardless of the periods of missing data. The missing data for Gauge GW-5 does not affect the longest consecutive hydroperiod. Gauge GW-14 recorded 156 consecutive days of jurisdictional hydrology with one data gap. Using adjacent data points to extrapolate missing data, it can be assumed that Gauge GW-14 would have made jurisdictional hydrology for 100% of the growing season.

2.2. Problem Areas Plan View (Wetland)

Figure 4 in Appendix B provides an overview of all hydrologic problem areas with regard to the scale and layout of the entire project.

Refer to Appendix A for additional vegetation related data and information. Gauges are identified in terms of meeting hydrologic success criteria.

Table VI. Wetland Criteria Attainment by Community Type Juniper Bay Wetland Mitigation Site-EEP# 201					
Peatland Atlantic White Cedar Forest/ Bay Forest					
Gauge	Hydrology Success Met	Community Type Mean	Vegetation Plot	Vegetative Success Met	Community Type Mean
GW-6	Y	100%	Veg-4	N	44.40%
GW-7	Y		Veg-11	Y	
GW-8	Y		Veg-12	Y	
GW-9	Y		Veg-13	N	
GW-13	Y		Veg-15	N	
GW-14	Y		Veg-17	Y	
GW-15	Not Installed		Veg-18	Y	
GW-16	Y		Veg-19	N	
GW-22	Not Installed		Veg-20	N	
GW-23	Y				
GW-24	Y				
GW-27	Y				
GW-28	Y				
GW-29	Y				
GW-43	Y				
Pond Pine Woodland/Bay Forest					
Perimeter Gauges					
Gauge	Hydrology Success Met	Community Type Mean	Vegetation Plot	Vegetative Success Met	Community Type Mean
GW-1	N	23.1%			N/A
GW-4	N				
GW-11	N				
GW-12	N				
GW-18	Y				
GW-25	N				
GW-26	N				
GW-32	Y				
GW-33	N				
GW-38	Y				
GW-39	N				
GW-44	N				
GW-45	N				

Table VI. (continues)

Table VI. (concluded) Wetland Criteria Attainment by Community Type Juniper Bay Wetland Mitigation Site-EEP# 201					
Pond Pine Woodland/Bay Forest					
Interior Ditches					
Gauge	Hydrology Success Met	Community Type Mean	Vegetation Plot	Vegetative Success Met	Community Type Mean
GW-2	Y	76.5%	Veg-1	Y	63.60%
GW-3	Y		Veg-2	Y	
GW-5	Y		Veg-3	Y	
GW-10	N		Veg-5	Y	
GW-17	Y		Veg-6	Y	
GW-19	Y		Veg-7	N	
GW-20	Y		Veg-8	Y	
GW-21	Y		Veg-9	N	
GW-30	Y		Veg-10	Y	
GW-31	Y		Veg-14	N	
GW-34	N		Veg-16	N	
GW-35	Y				
GW-36	N				
GW-37	Y				
GW-40	Y				
GW-41	Y				
GW-42	N				

III. Methodology Section

The first year of monitoring for JBMS occurred in 2006. Monitoring and vegetative sampling measures were established and no deviations regarding sampling procedures occurred.

Appendix A
Vegetation Data Tables
Vegetation Photos

1. Vegetation Data Tables

Table 1. Vegetation Metadata	
Report Prepared By	Gail Tyner
Date Prepared	12/13/2006 14:38
database name	CVS_EEP_DataEntry_v202.mdb
database location	P:\Common\Projects\2006\ER06-040
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT-----	
Metadata	This worksheet, which is a summary of the project and the project data.
Plots	List of plots surveyed.
Vigor	Frequency distribution of vigor classes.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Stem Count by Plot and Spp	Count of living stems of each species for each plot; dead and missing stems are excluded.
PROJECT SUMMARY-	
Project Code	201
project Name	Juniper Bay
Description	A Carolina bay mitigation site
length (ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	20

Table 2. Vegetation Vigor by Species							
	Species	4	3	2	1	0	Missing
	Chamaecyparis thyoides			2			
	Liquidambar styraciflua						
	Nyssa aquatica		11	3		1	
	Persea palustris				7		
	Pinus serotina	6	14				
	Pinus taeda	36	14	2			
	Quercus lyrata	21	7				
	Salix nigra						
	Taxodium distichum	11	43	4			
	Baccharis						
	Magnolia virginiana	2	6				
	Myrica sp.						
	Acer rubrum						
Tot:	13	76	95	11	7	1	

Table 3. Vegetation Damage by Species					
	Species	All Damage Categories	(no damage)	_Enter other damage_	Unknown
	Acer rubrum	1	1		
	Baccharis	1	1		
	Chamaecyparis thyoides	2	2		
	Liquidambar styraciflua	2	2		
	Magnolia virginiana	8	8		
	Myrica sp.	1	1		
	Nyssa aquatica	16	15	1	
	Persea palustris	7	2		5
	Pinus serotina	20	20		
	Pinus taeda	52	52		
	Quercus lyrata	28	28		
	Salix nigra	1	1		
	Taxodium distichum	58	58		
Tot:	13	197	191	1	5

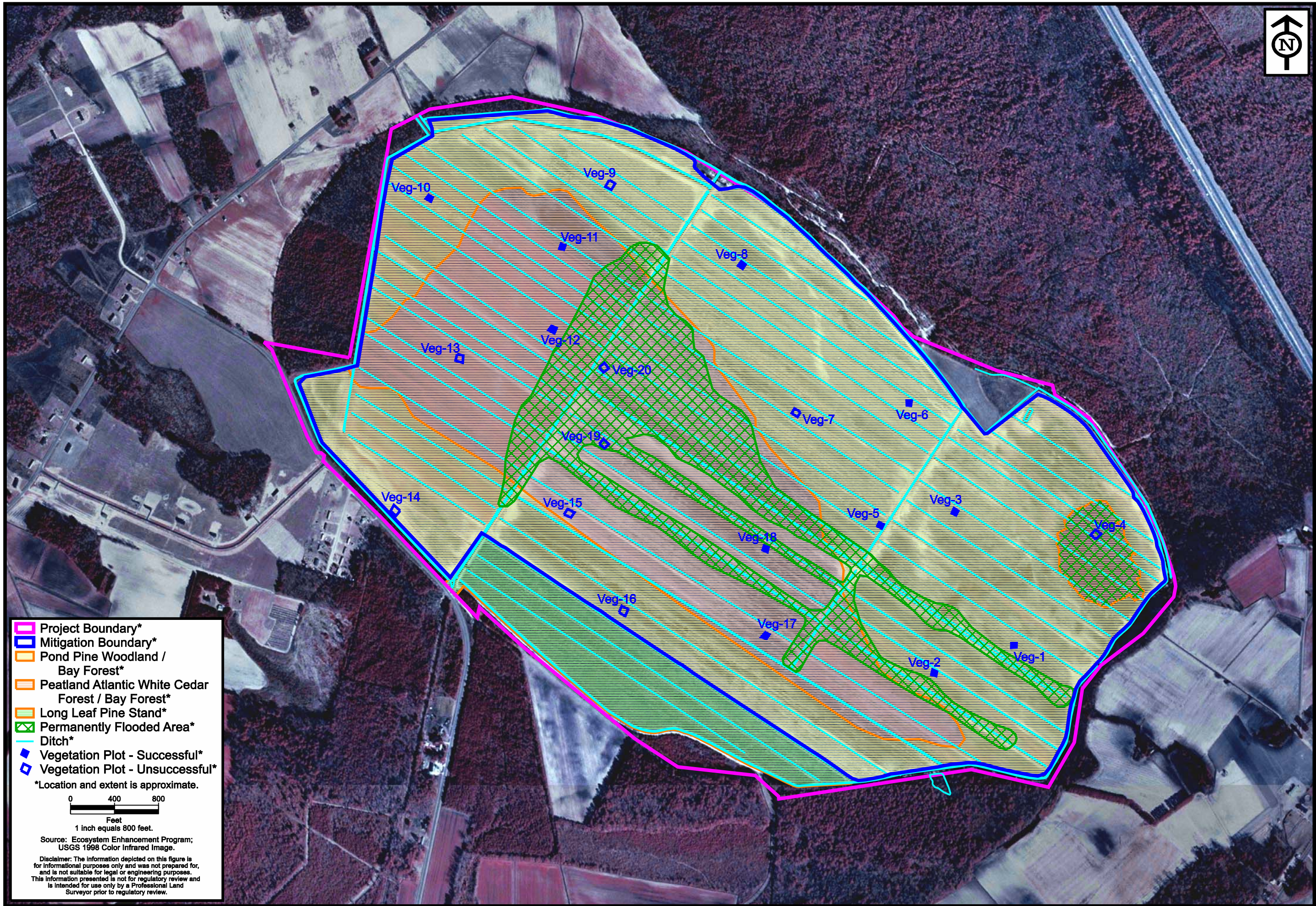
Table 4. Vegetation Damage by Plot

	plot	All Damage Categories	(no damage)	_Enter other damage_	Unknown
	00201-01-0001	10	10		
	00201-01-0002	9	9		
	00201-01-0003	16	16		
	00201-01-0004	7	7		
	00201-01-0005	43	37	1	5
	00201-01-0006	10	10		
	00201-01-0007	7	7		
	00201-01-0008	11	11		
	00201-01-0009	6	6		
	00201-01-0010	10	10		
	00201-01-0011	8	8		
	00201-01-0012	9	9		
	00201-01-0013	7	7		
	00201-01-0014	7	7		
	00201-02-0015	6	6		
	00201-02-0016	7	7		
	00201-02-0017	11	11		
	00201-02-0018	8	8		
	00201-02-0019	4	4		
	00201-02-0020	1	1		
Tot:	20	197	191	1	5

Table 5. Stem Count by Plot and Species

					plot	plot	plot	plot	plot	plot	plot	plot	plot	plot	plot	plot	plot	plot	plot	plot	plot	plot	plot	
	Species	Total Stems	# plots	avg# stems	00201- 01- 0001	00201- 01- 0002	00201- 01- 0003	00201- 01- 0004	00201- 01- 0005	00201- 01- 0006	00201- 01- 0007	00201- 01- 0008	00201- 01- 0009	00201- 01- 0010	00201- 01- 0011	00201- 01- 0012	00201- 01- 0013	00201- 01- 0014	00201- 02- 0015	00201- 02- 0016	00201- 02- 0017	00201- 02- 0018	00201- 02- 0019	00201- 02- 0020
	Chamaecyparis thyoides	2	1	2																2				
	Magnolia virginiana	8	3	2.67													2	3				3		
	Nyssa aquatica	14	6	2.33			1	7	1	1										1		3		
	Persea palustris	7	1	7				7																
	Pinus serotina	20	6	3.33			4							6						1	7	1		1
	Pinus taeda	52	12	4.33	6	5			2	5	2	3	10		5	7	5	1				1		
	Quercus lyrata	28	7	4	3		13		5	1		2	1							3				
	Taxodium distichum	58	13	4.46	1	4	3	1	22	4	1	6			2	4				2		4		4
Total	8	189	8		10	9	16	6	41	8	7	10	4	10	8	9	7	7	6	7	11	8	4	1

Table 6. Vegetative Problem Areas			
Feature/Issue	Plot	Probable Cause	Photo #
Submerged	19	Adjacent to drainage ditch with overtopped bank. >25% of plot submerged > 1ft.	VPA 1
Submerged	20	Low area in center of site adjacent to drainage ditch. 40% of plot submerged > 1ft.	VPA 2
Submerged	4	Low area in eastern portion of site. Approximately 1 ft. water across plot.	VPA 3
Herbaceous growth	15	Dense herbaceous midstory.	VPA 4



Project: ER06040.00
 Date: Dec 2006
 Drwn/Chkd: AJS/GT
 Figure: 3a

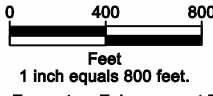
Vegetation Problem Areas
Juniper Bay
 Robeson County, North Carolina
 Monitoring Report Year 1



ENVIRONMENTAL SERVICES, INC.
 524 S. New Hope Road
 Raleigh, North Carolina 27610
 (919) 212-1780 FAX
 (919) 212-1707 FAX
 www.environmentalservicesinc.com

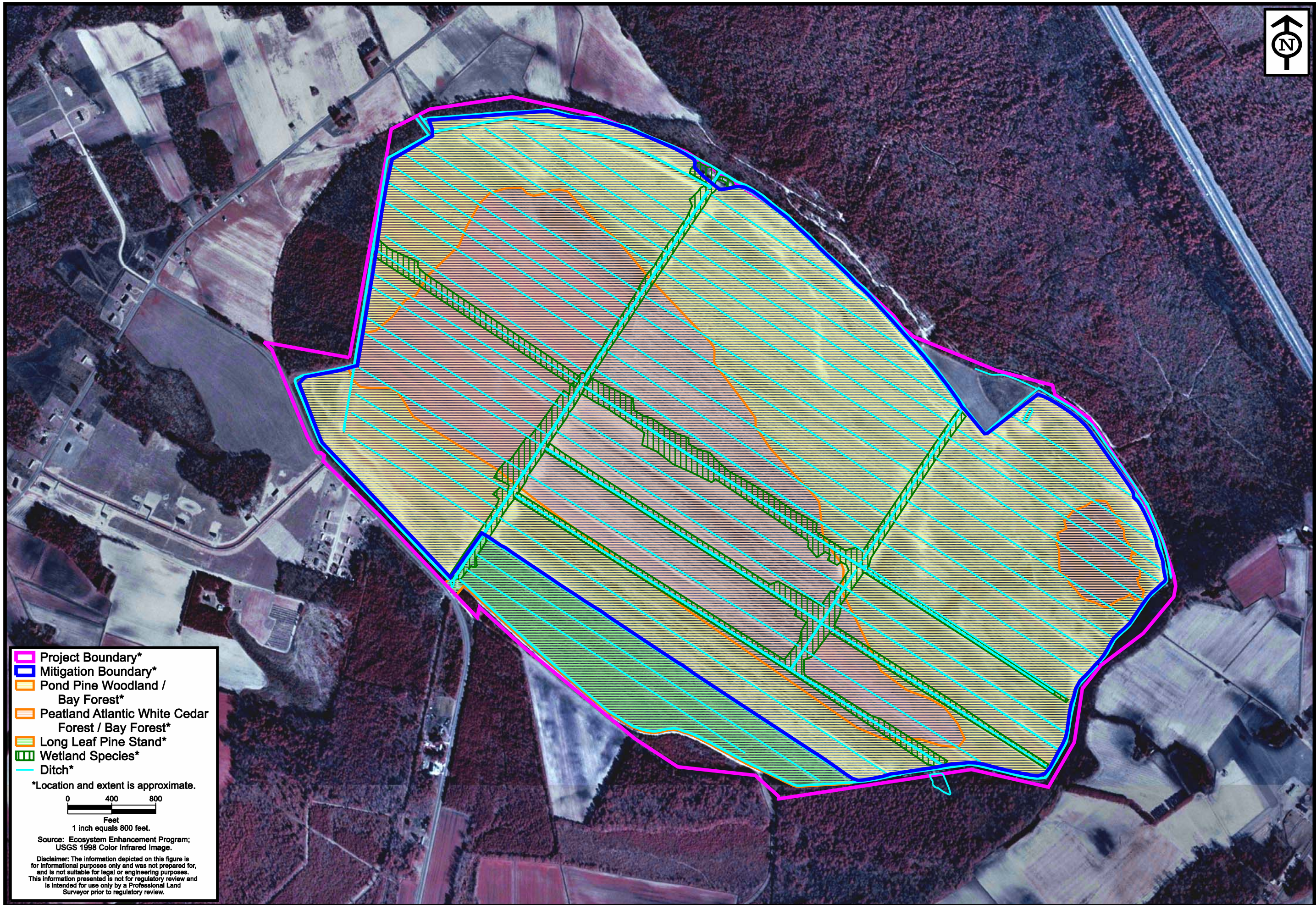
- Project Boundary*
- Mitigation Boundary*
- Pond Pine Woodland / Bay Forest*
- Peatland Atlantic White Cedar Forest / Bay Forest*
- Long Leaf Pine Stand*
- Permanently Flooded Area*
- Ditch*
- ◆ Vegetation Plot - Successful*
- ◇ Vegetation Plot - Unsuccessful*

*Location and extent is approximate.



Source: Ecosystem Enhancement Program;
 USGS 1998 Color Infrared Image.

Disclaimer: The information depicted on this figure is for informational purposes only and was not prepared for, and is not suitable for legal or engineering purposes. This information presented is not for regulatory review and is intended for use only by a Professional Land Surveyor prior to regulatory review.



Project: ER06040.00
 Date: Feb 2007
 Drwn/Chkd: AJS/GT
 Figure: 3b

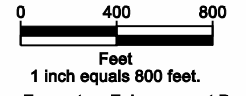
Planting Plan
Juniper Bay
 Robeson County, North Carolina
 Monitoring Report Year 1



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 Raleigh, North Carolina 27610
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 (919) 212-1707 FAX
www.environmentalservicesinc.com

- Project Boundary*
- Mitigation Boundary*
- Pond Pine Woodland / Bay Forest*
- Peatland Atlantic White Cedar Forest / Bay Forest*
- Long Leaf Pine Stand*
- Wetland Species*
- Ditch*

*Location and extent is approximate.



Source: Ecosystem Enhancement Program; USGS 1996 Color Infrared Image.

Disclaimer: The information depicted on this figure is for informational purposes only and was not prepared for, and is not suitable for legal or engineering purposes. This information presented is not for regulatory review and is intended for use only by a Professional Land Surveyor prior to regulatory review.

1. Vegetation Problem Area Photos

VPA-1
Plot 19



VPA-2
Plot 20



VPA-3
Plot-4



VPA-4
Plot 15



3. Vegetation Monitoring Plot Photos

Plot1



Plot2



Plot 3



Plot 4



Plot 5



Plot 6



Plot 7



Plot 8



Plot 9



Plot 10



Plot 11



Plot 12



Plot 13



Plot 14



Plot 15



Plot 16



Plot 17



Plot 18



Plot 19



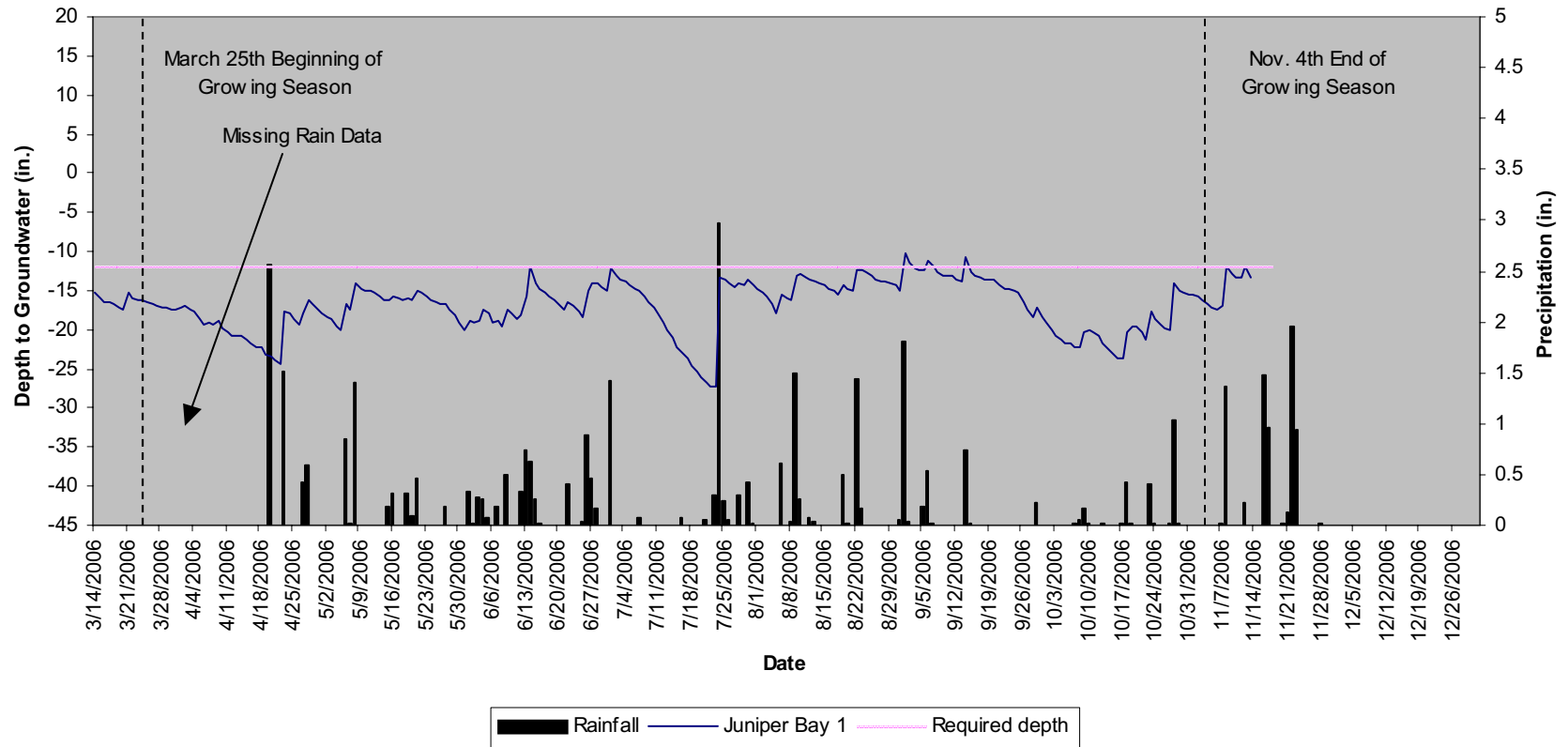
Plot 20



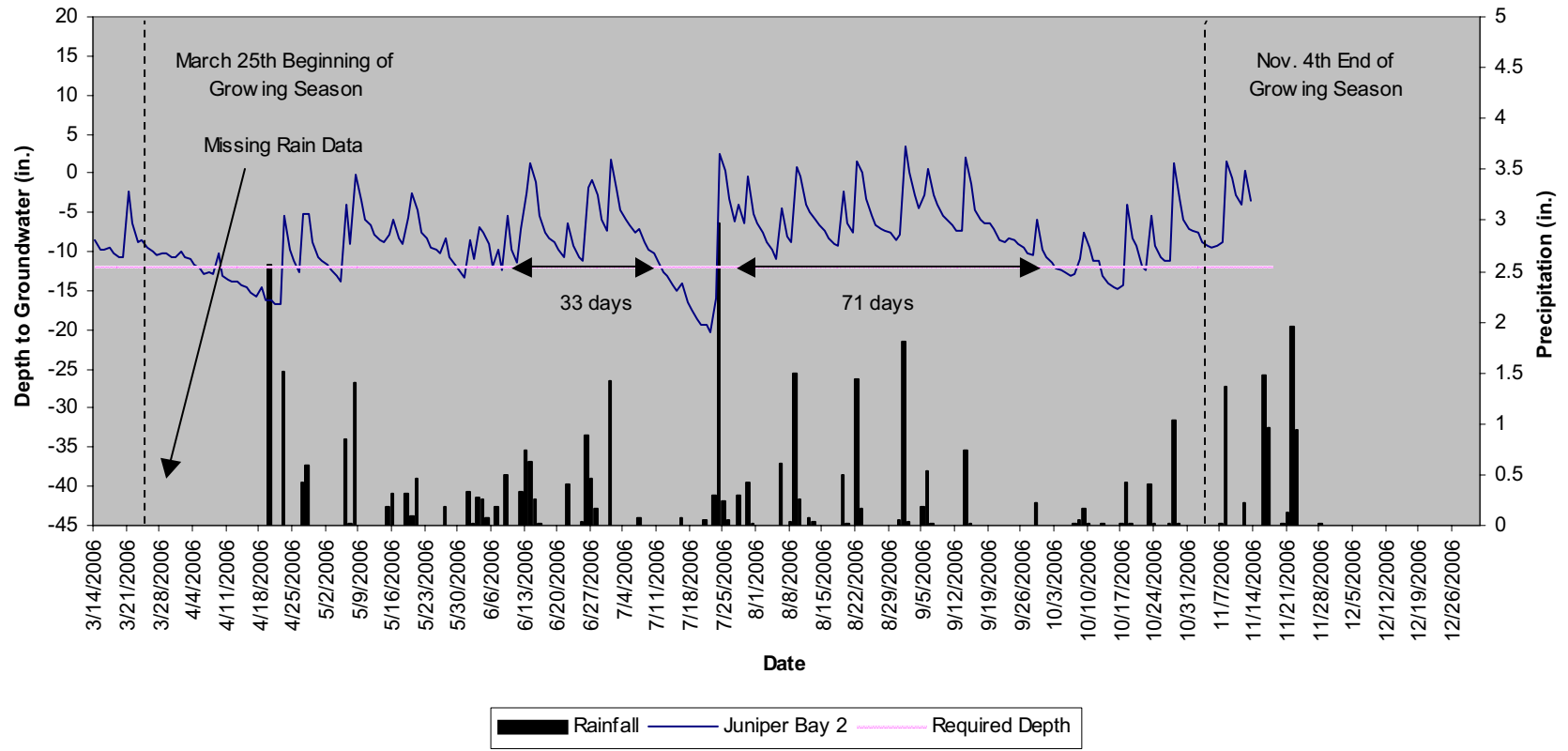
Appendix B

Data Tables for Hydrological Data

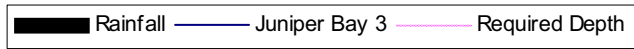
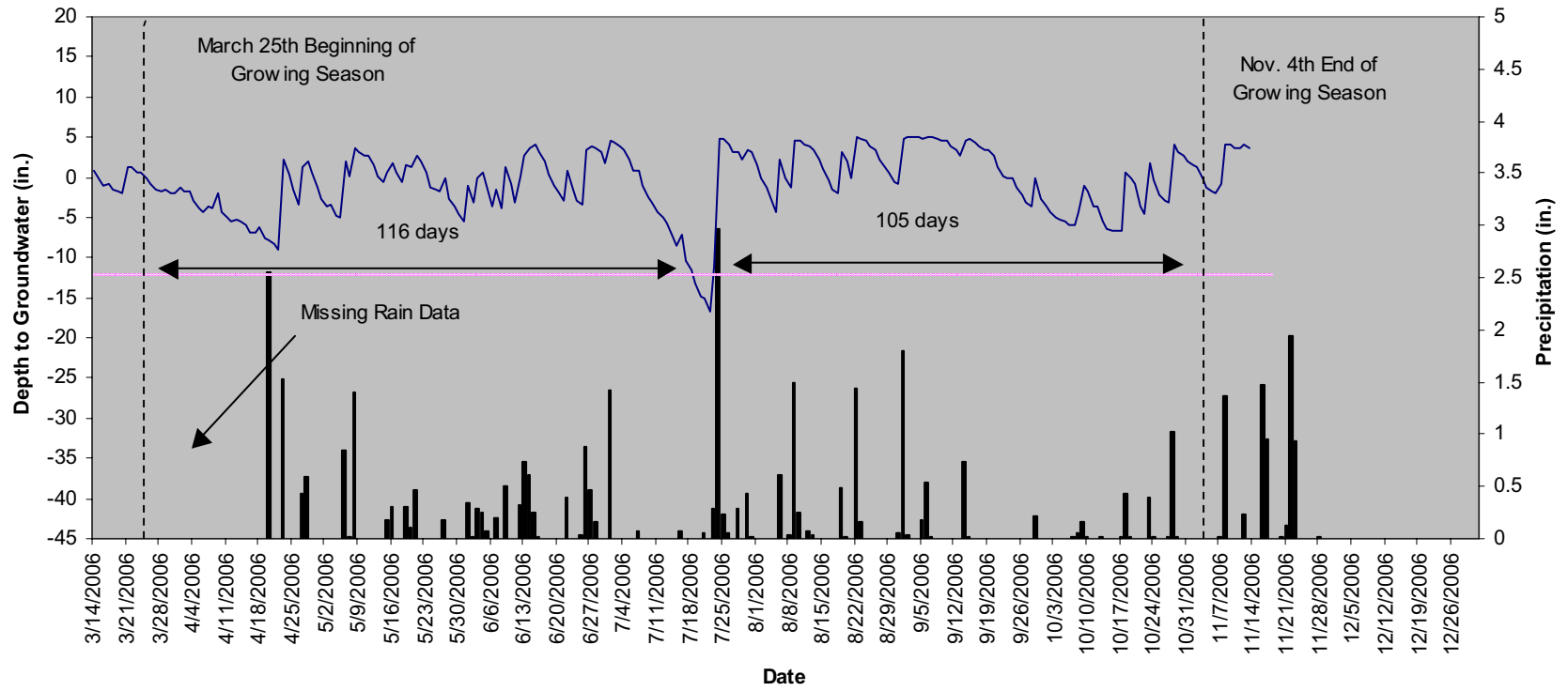
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40" Groundwater



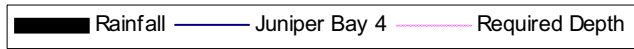
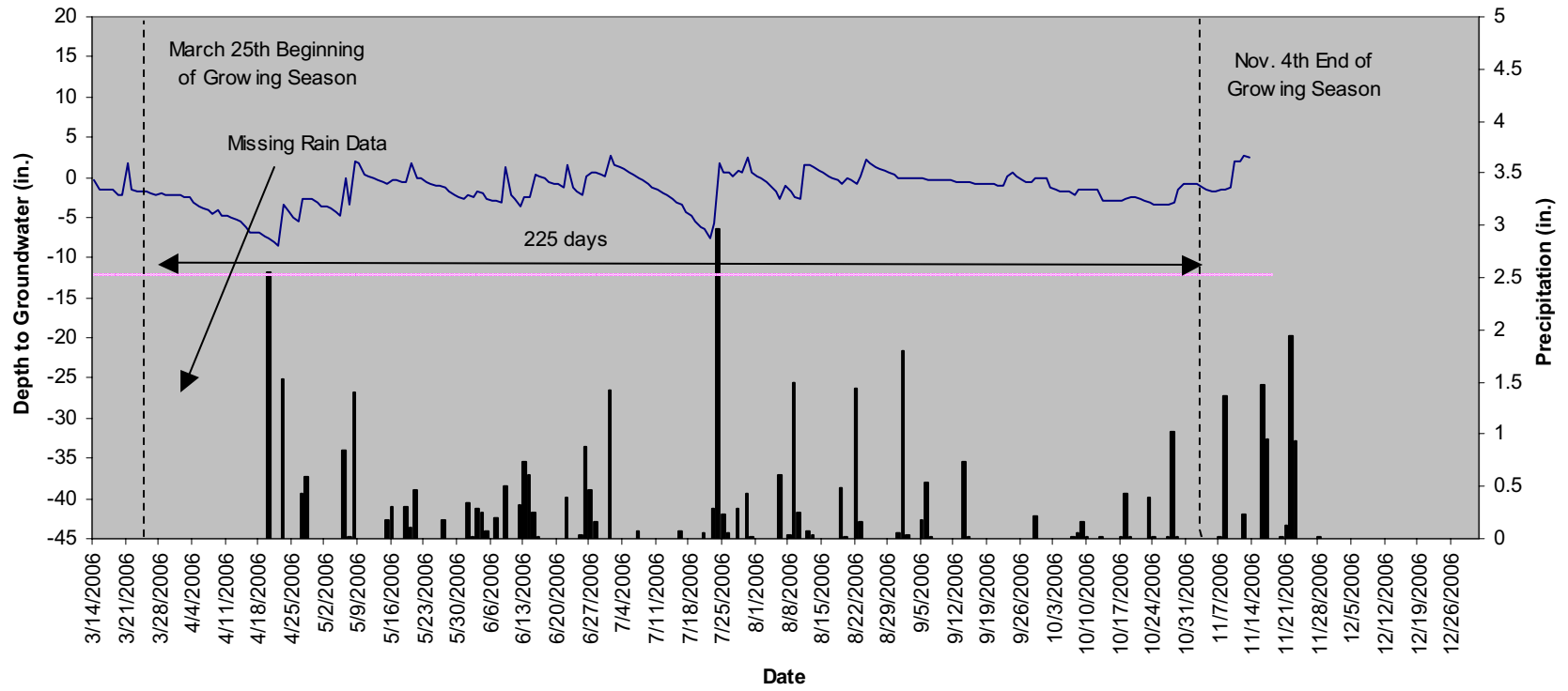
**Juiper Bay
2
40" Groundwater**



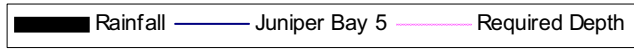
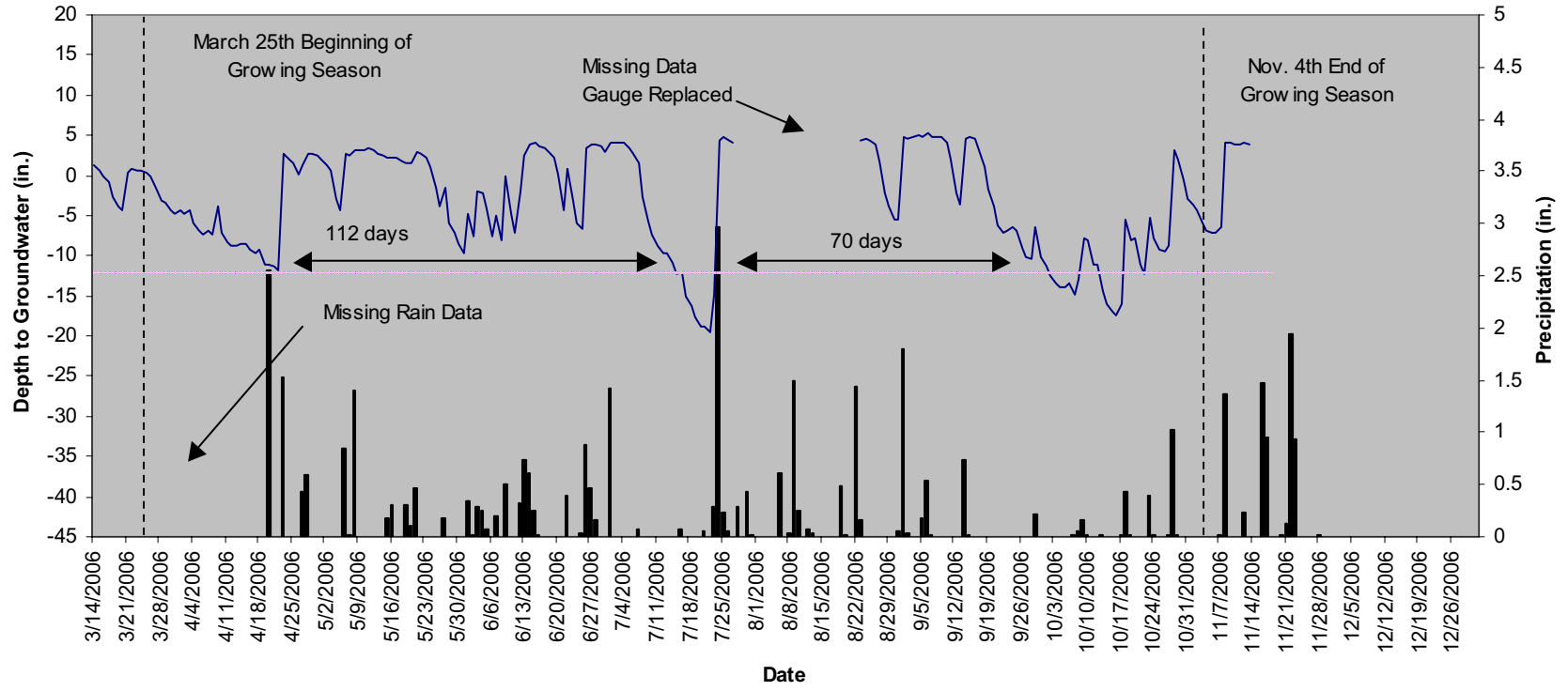
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3
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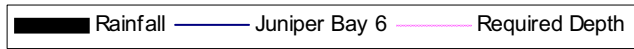
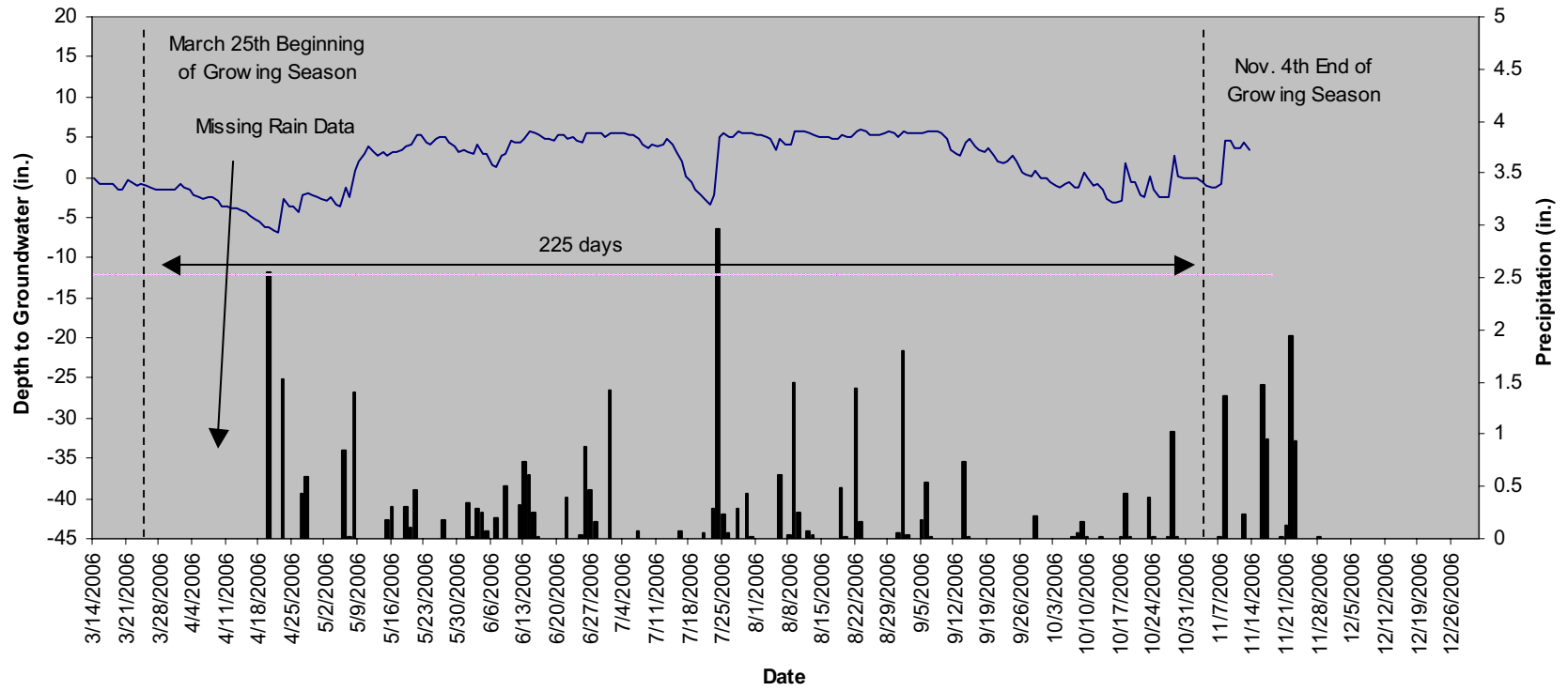
Juniper Bay
4
40" Groundwater



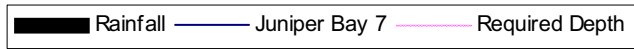
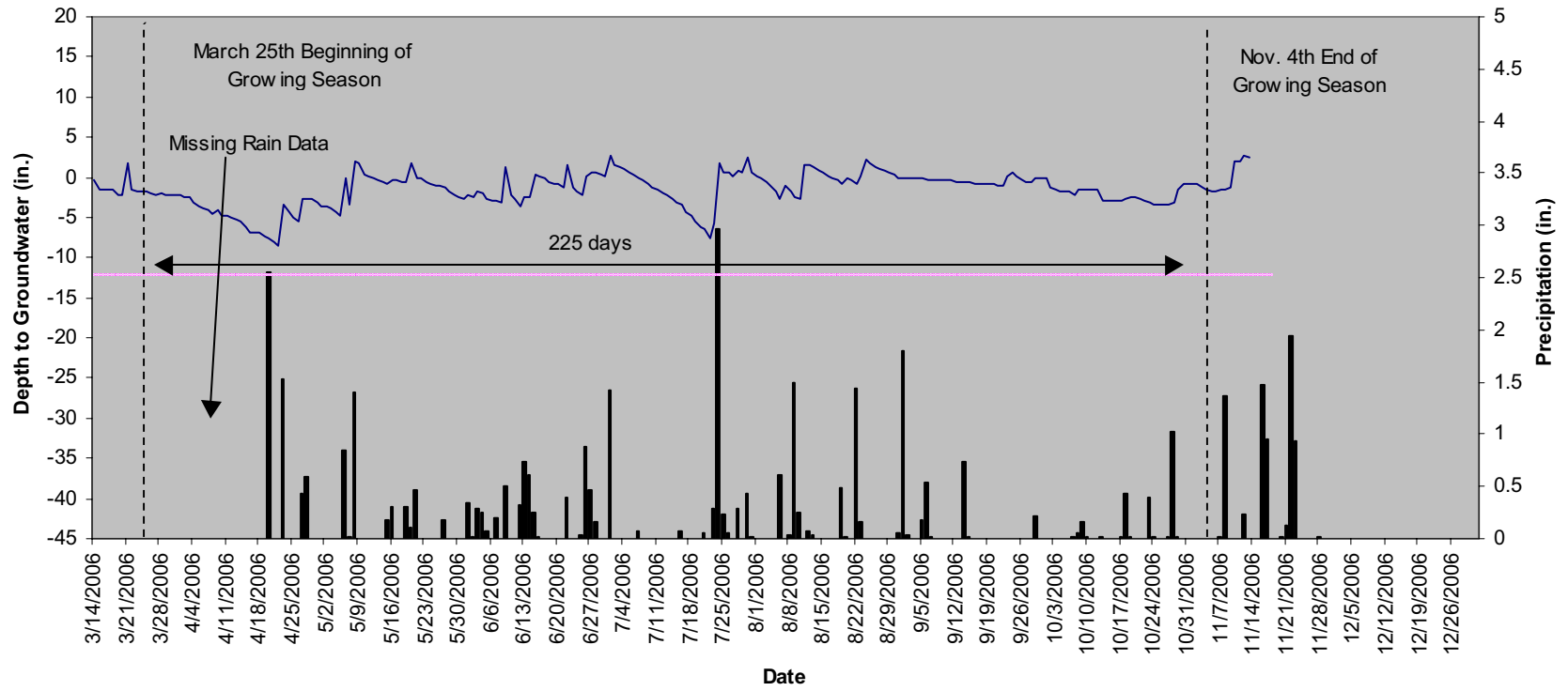
**Juniper Bay
5
40" Groundwater**



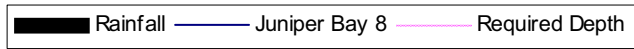
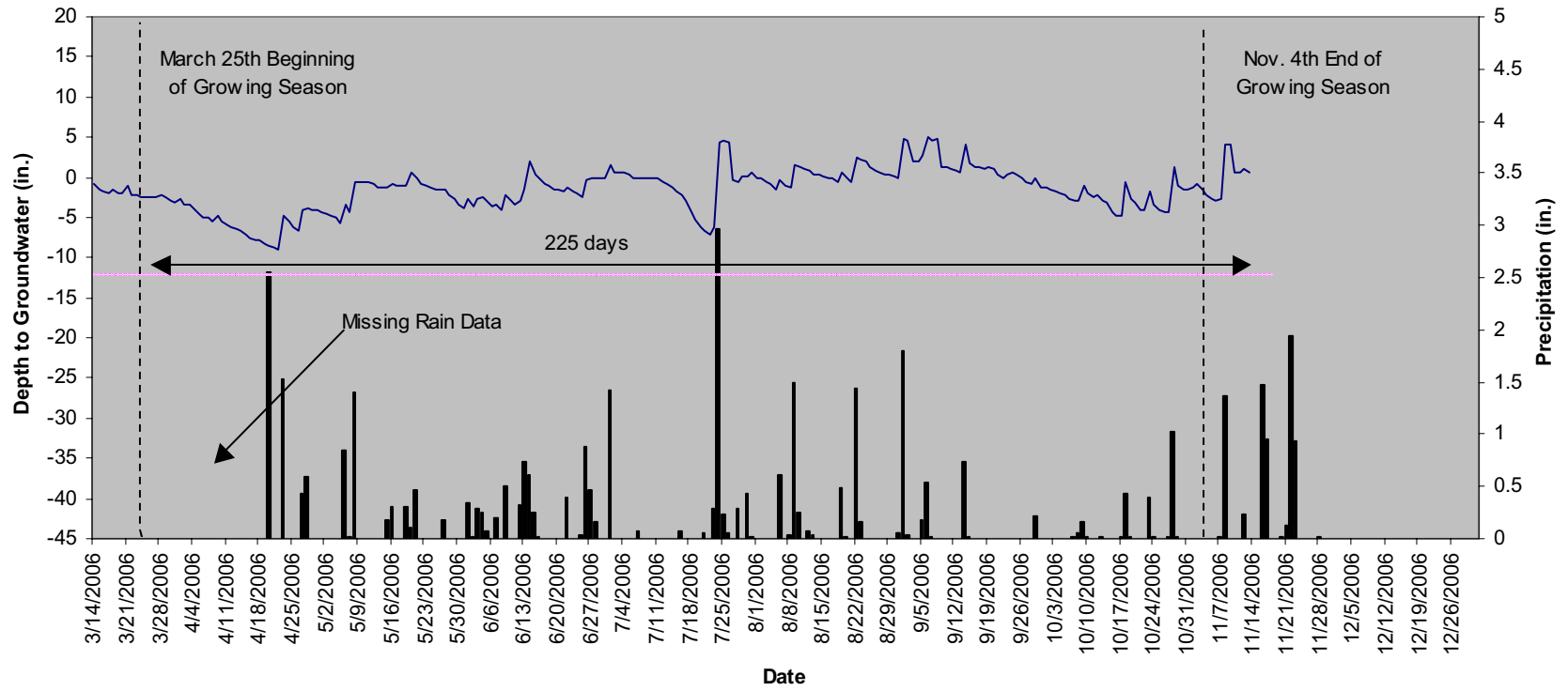
Juniper Bay
6
40" Groundwater



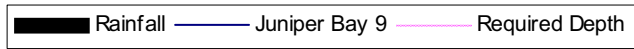
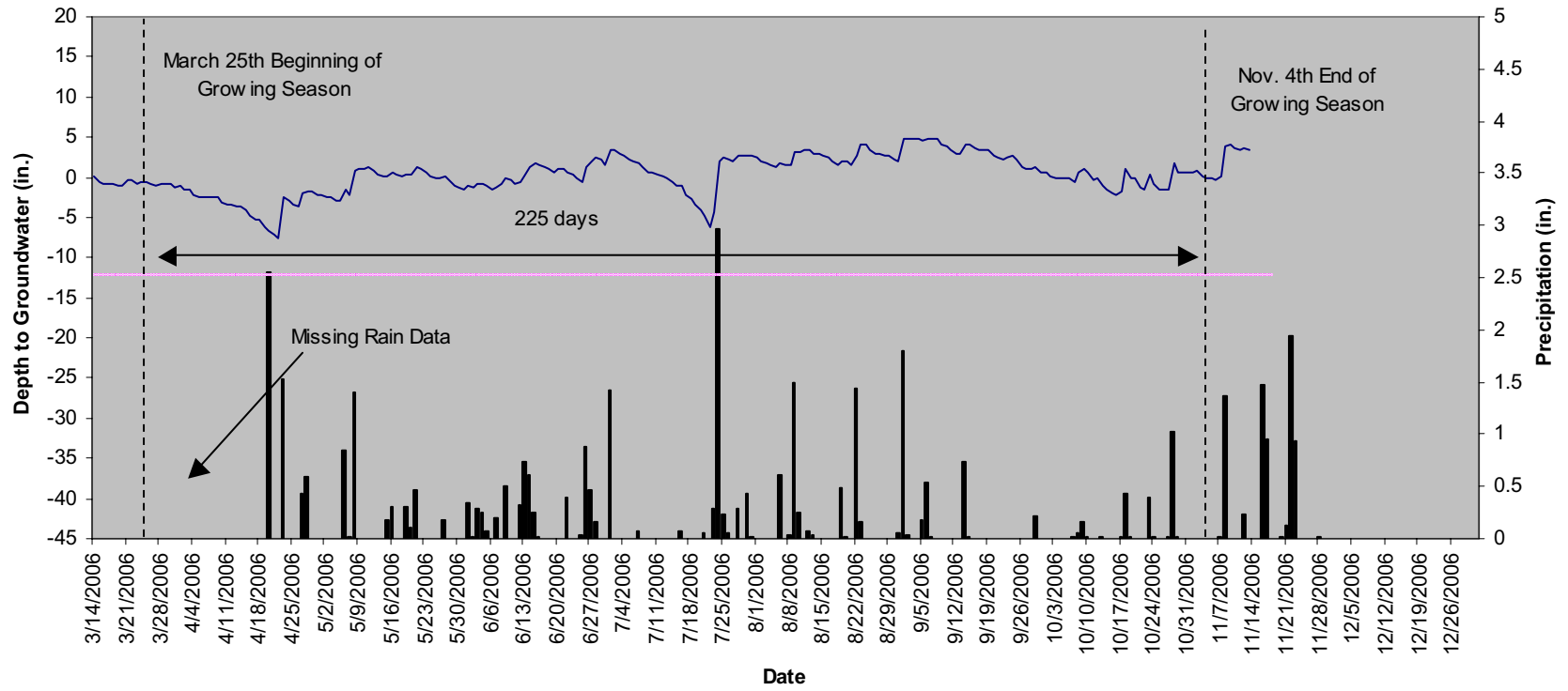
Juniper Bay
7
40" Groundwater



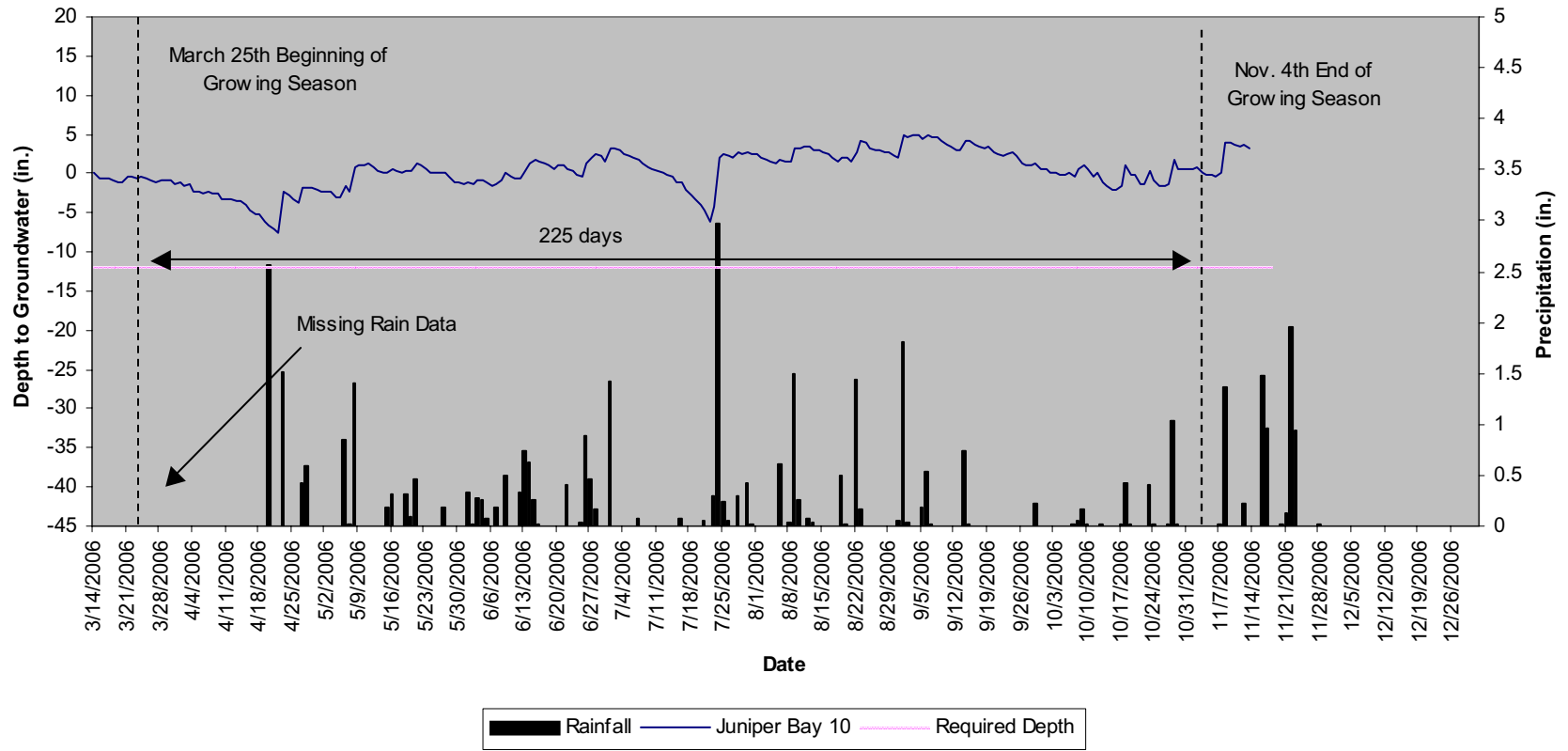
**Juniper Bay
8
40" Groundwater**



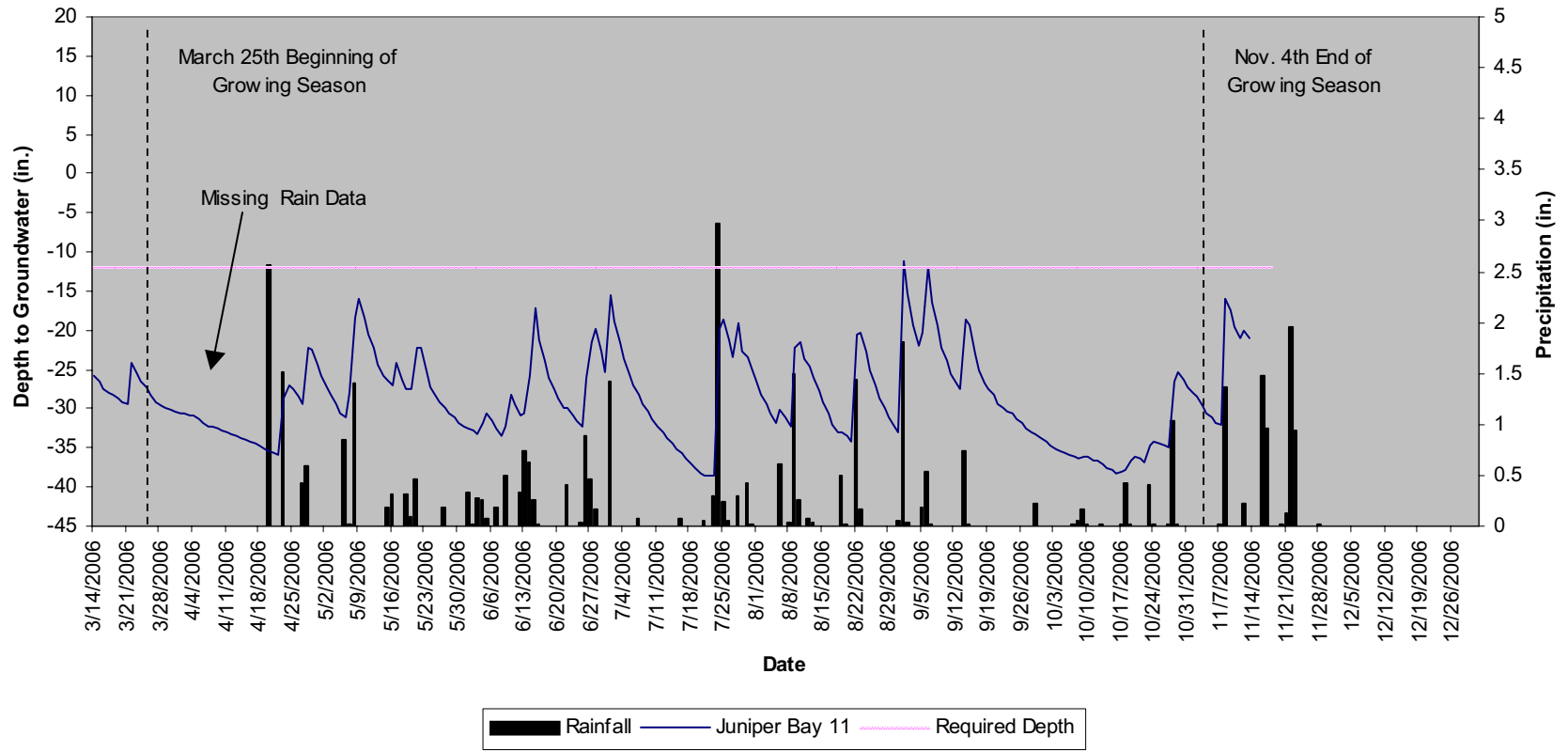
**Juniper Bay
9
40" Groundwater**



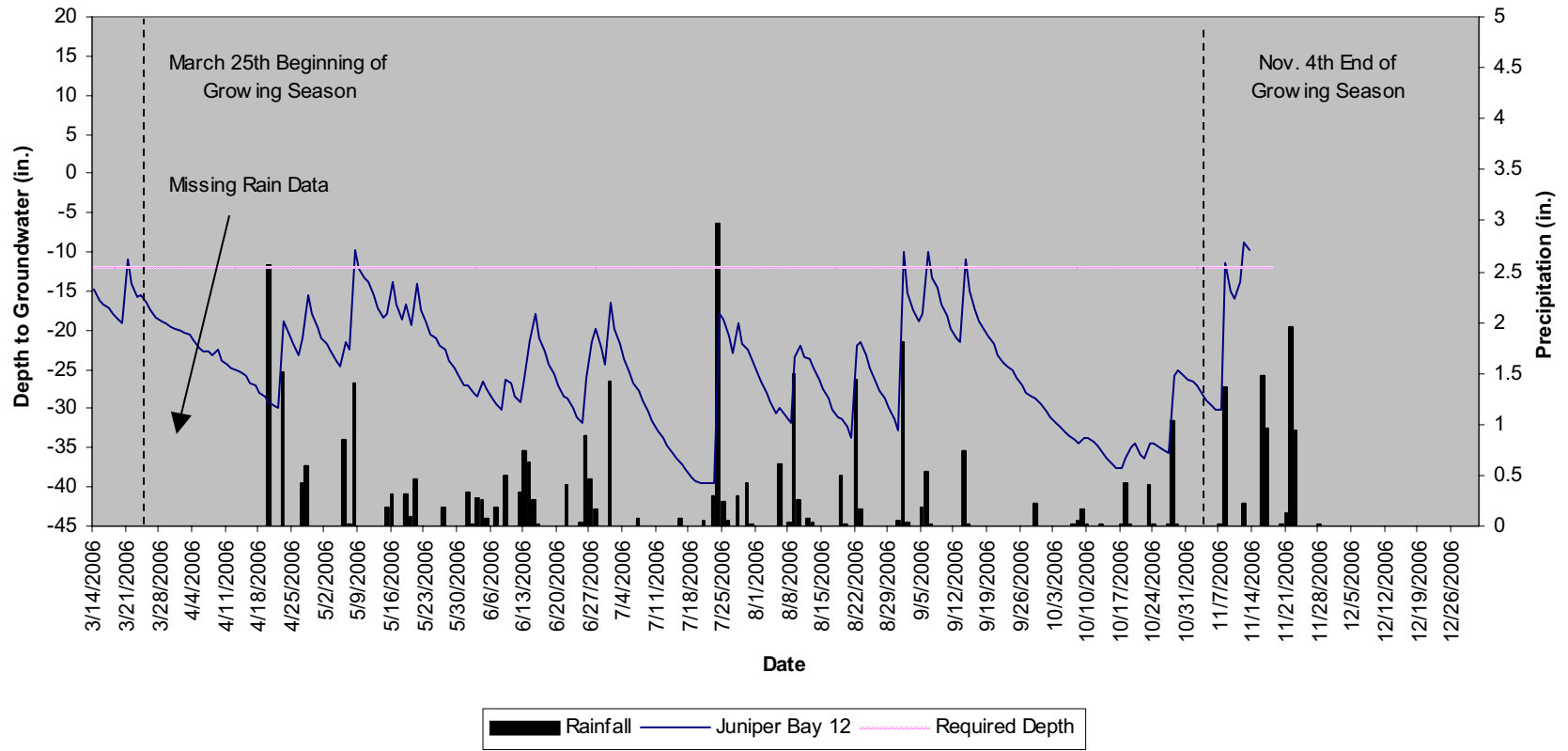
**Juniper Bay
10
40" Groundwater**



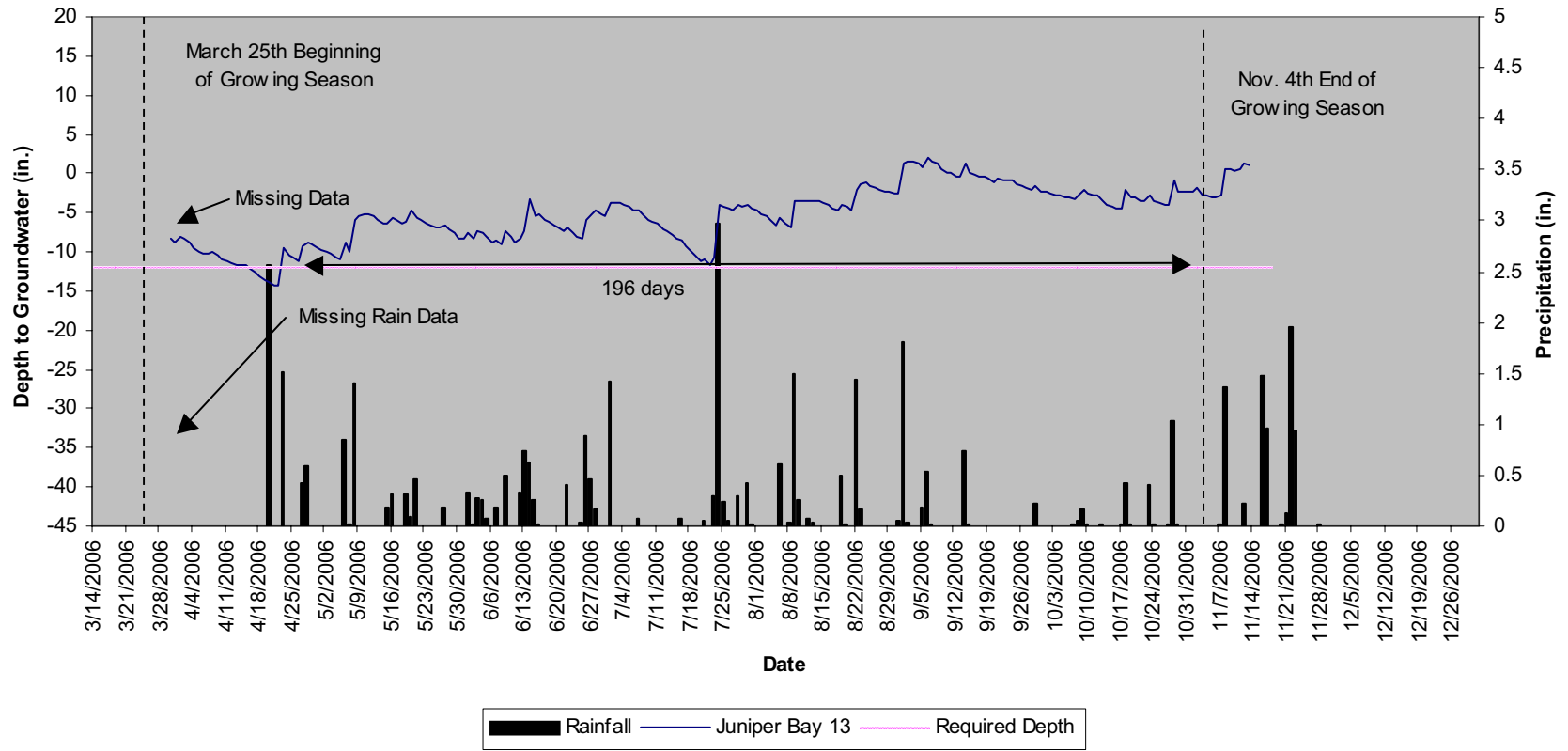
Juniper Bay
11
40" Groundwater



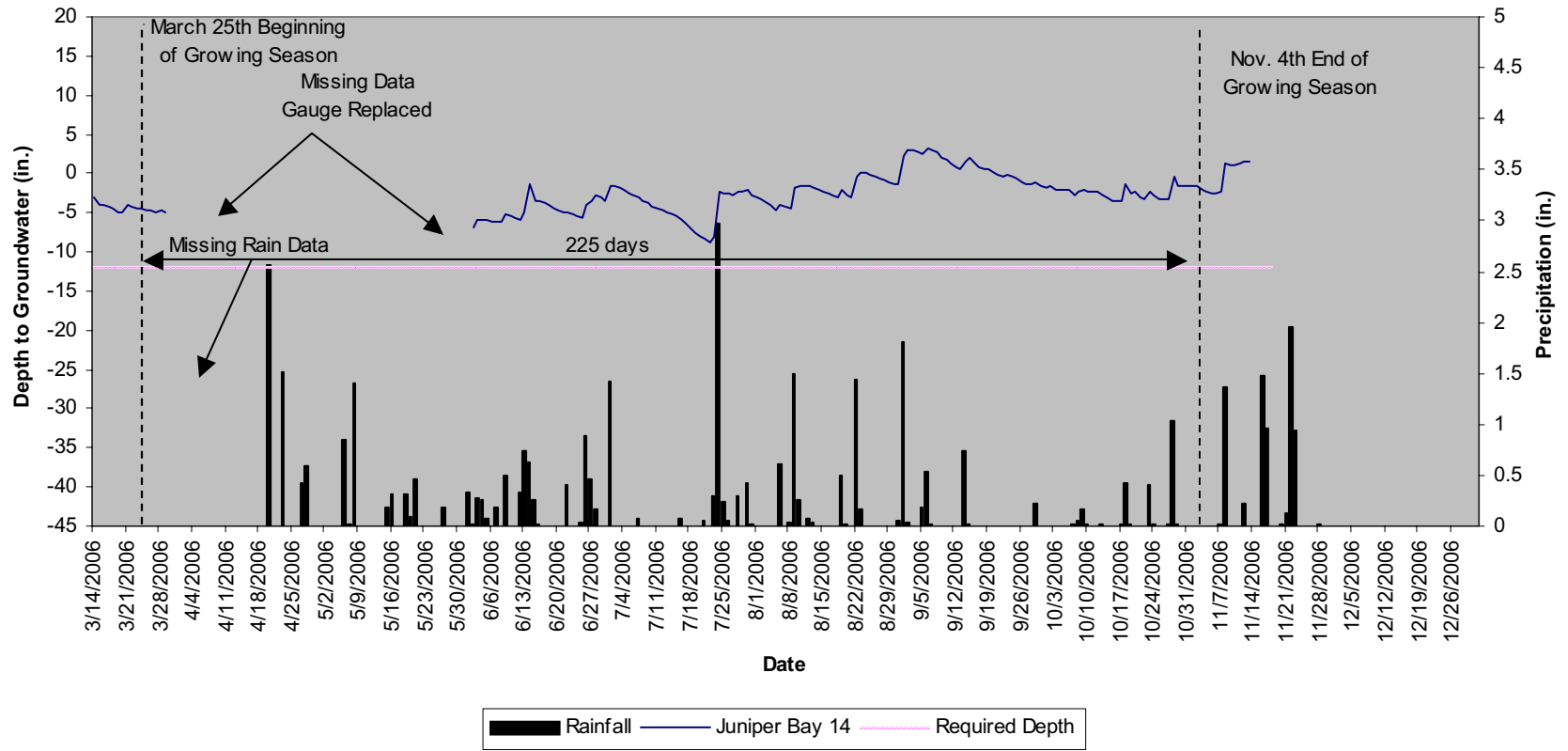
Juniper Bay
12
40" Groundwater



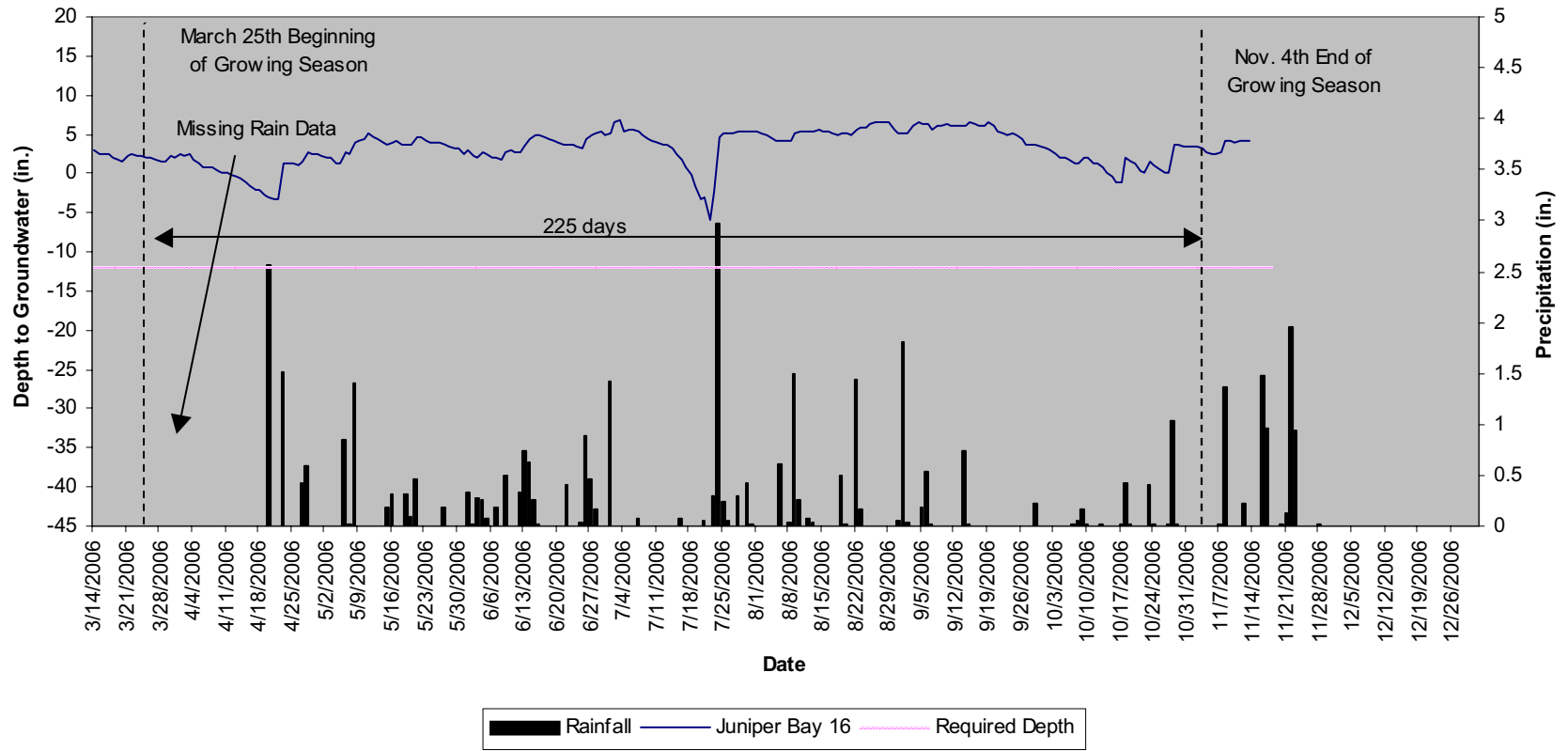
Juniper Bay
13
40" Groundwater



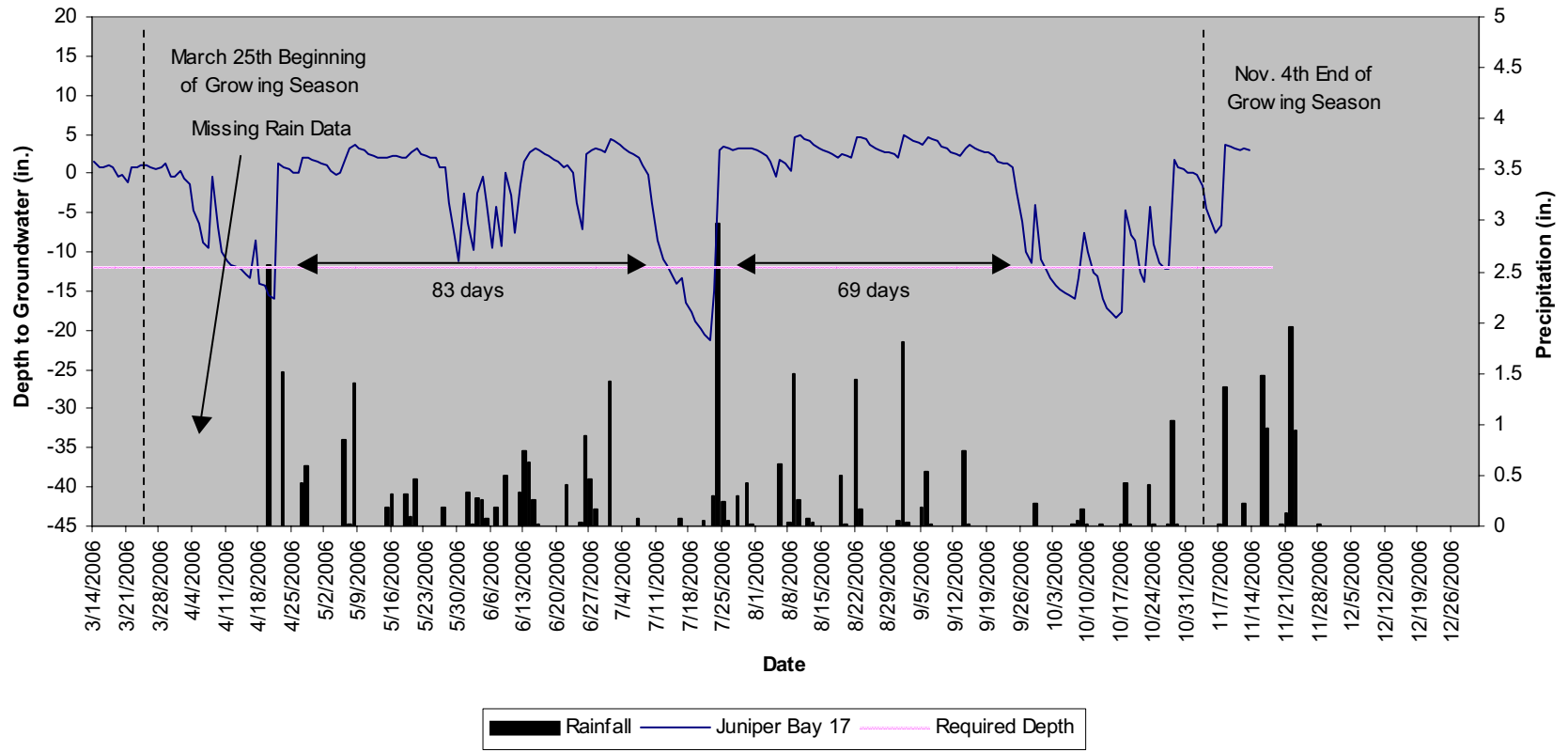
**Juniper Bay
14
40" Groundwater**



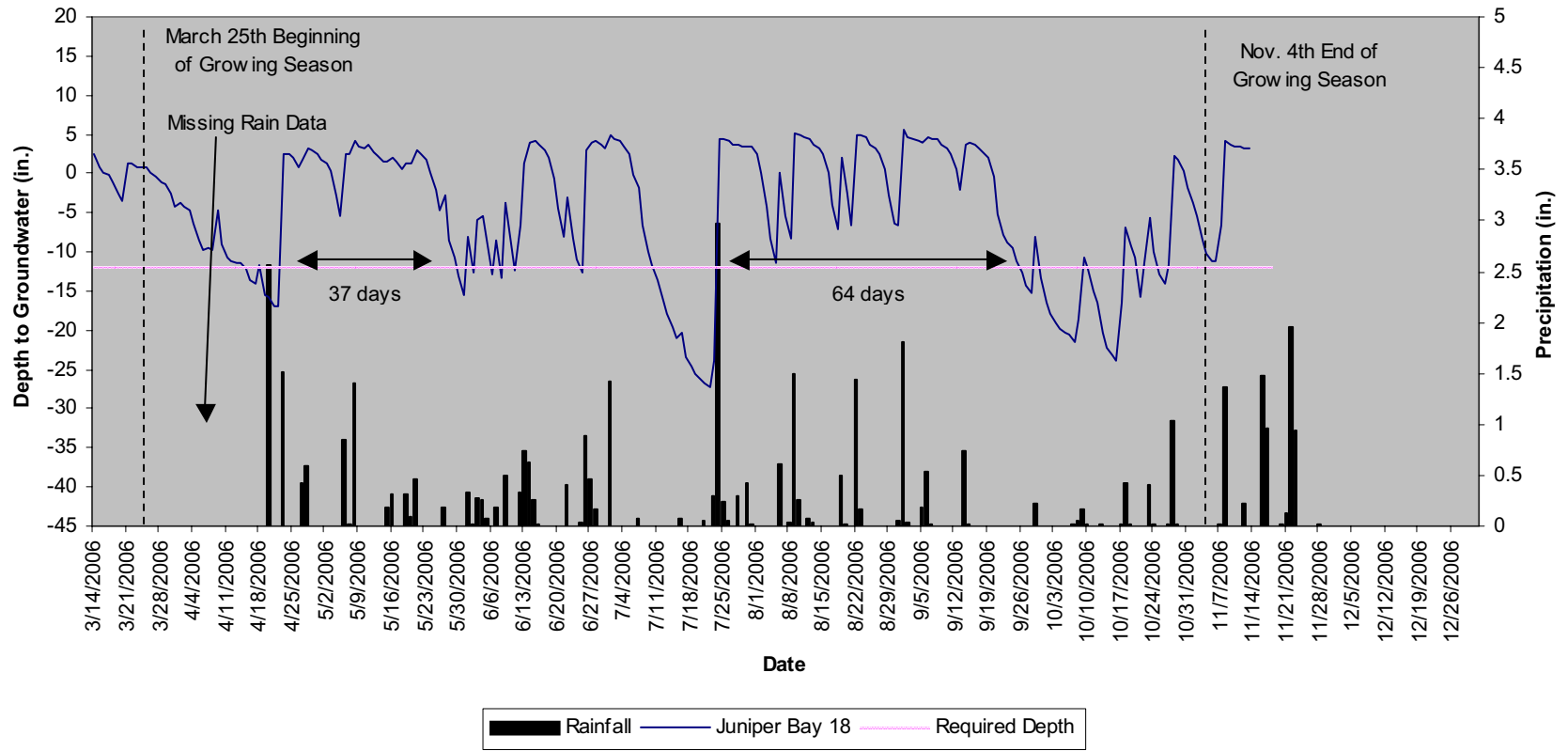
Juniper Bay
16
40" Groundwater



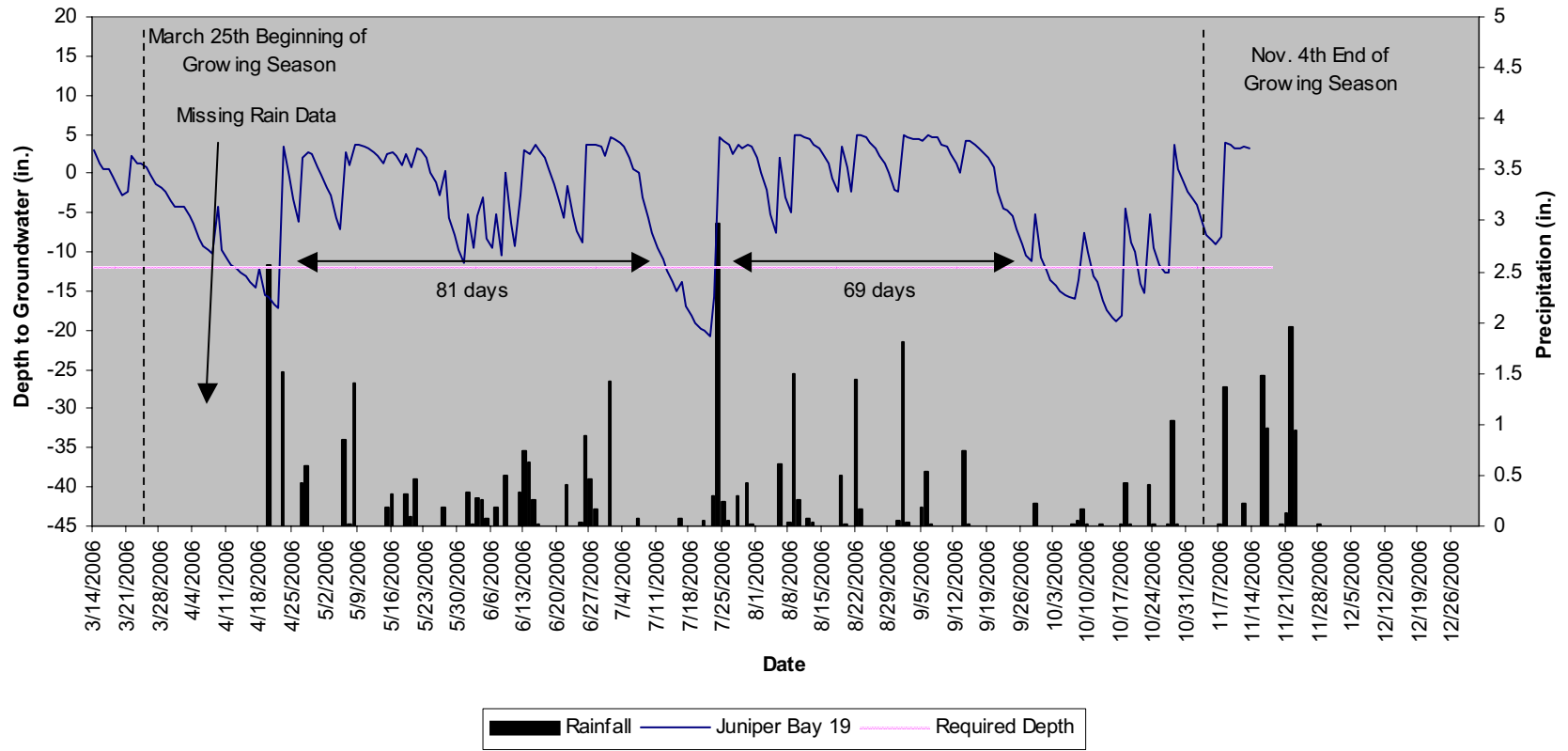
**Juniper Bay
17
40" Groundwater**



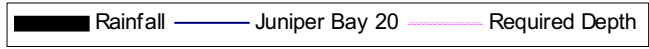
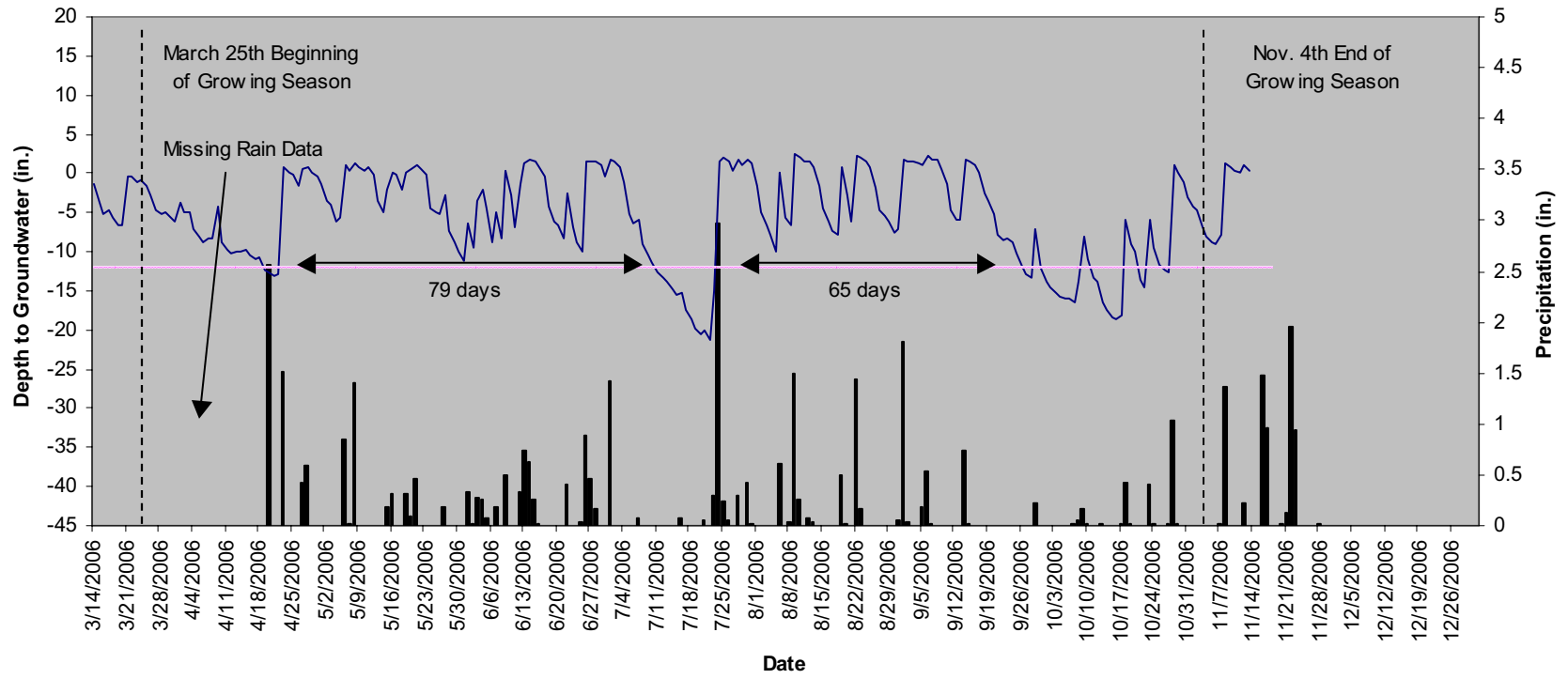
**Juniper Bay
18
40" Groundwater**



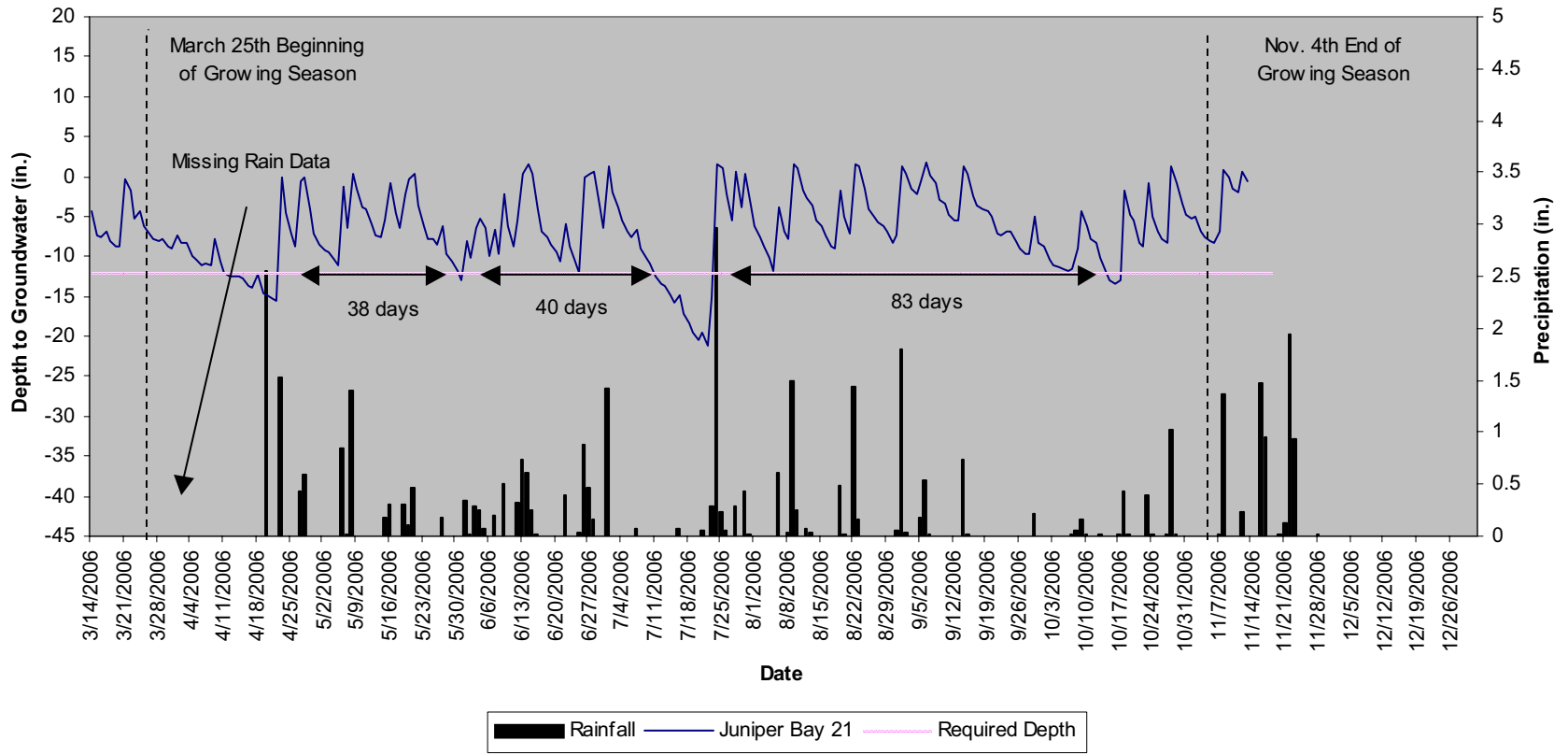
Juniper Bay
19
40" Groundwater



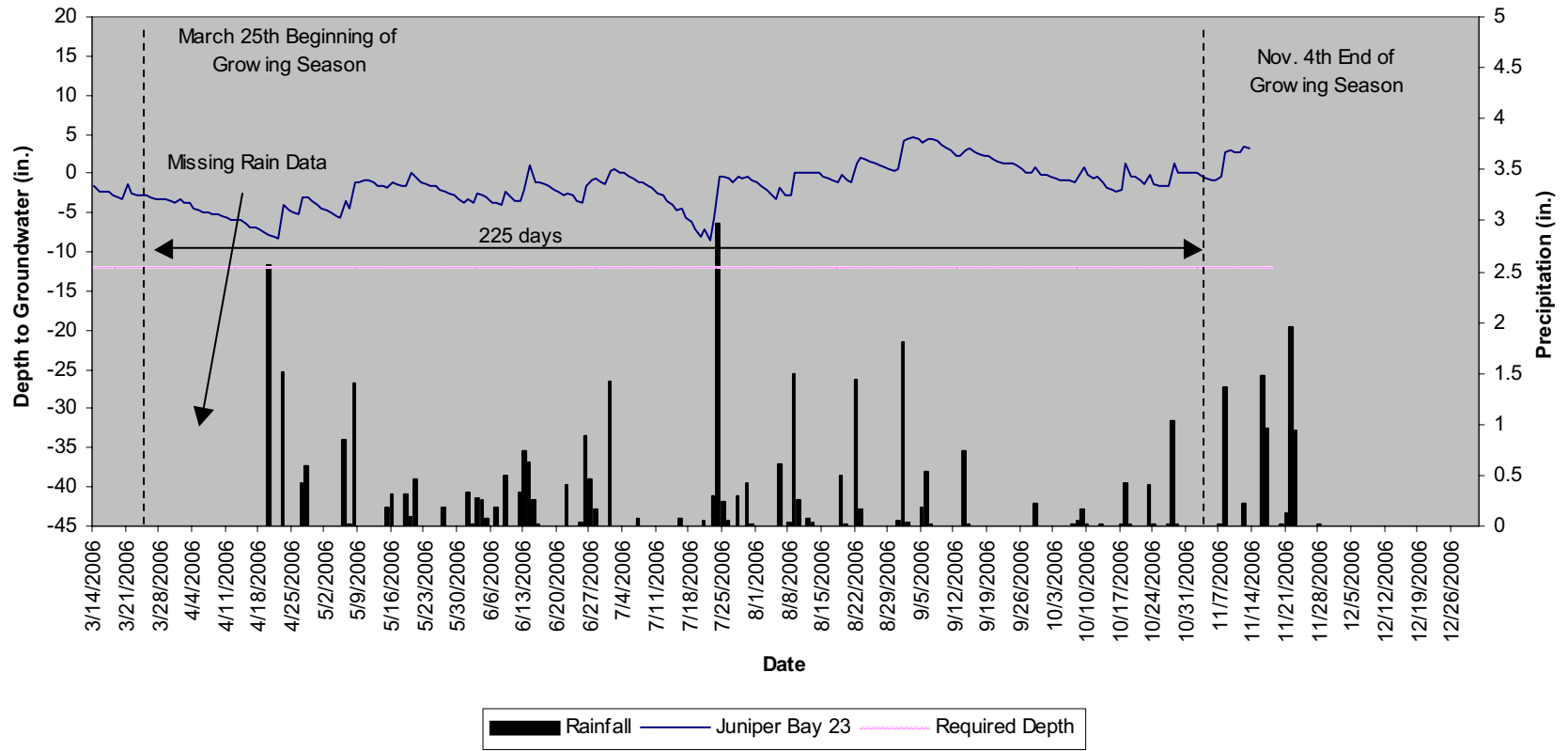
Juniper Bay
20
40" Groundwater



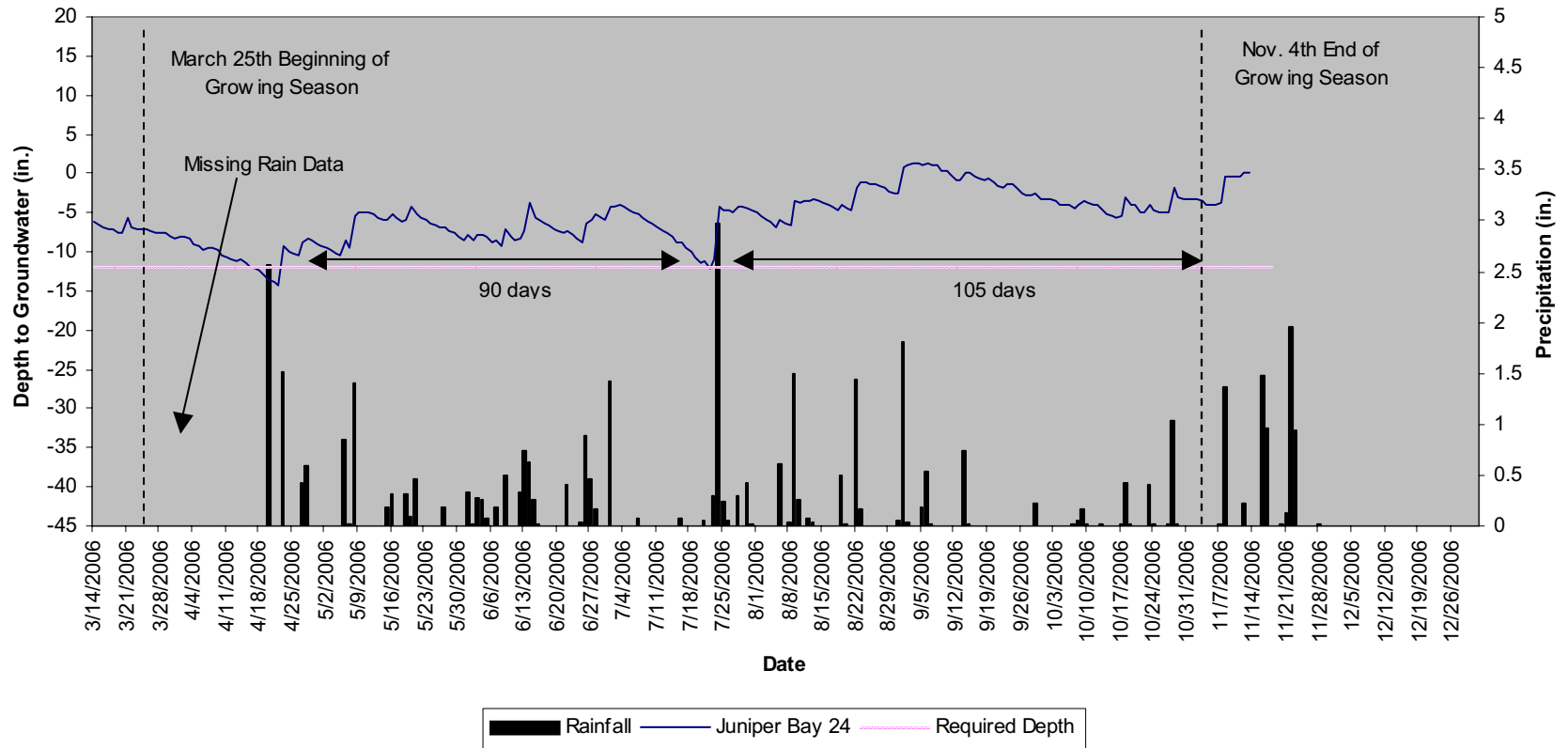
**Juniper Bay
21
40" Groundwater**



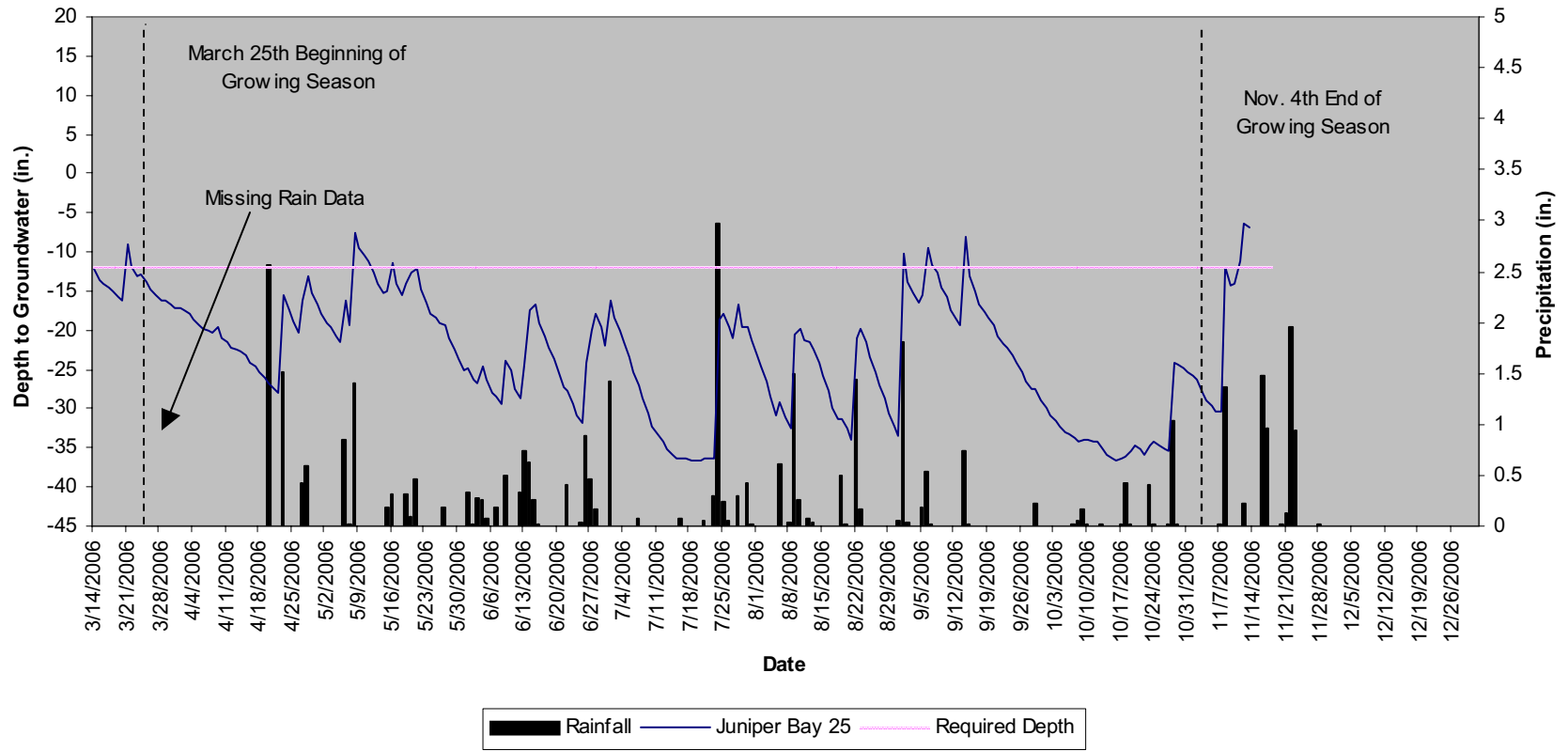
**Juniper Bay
23
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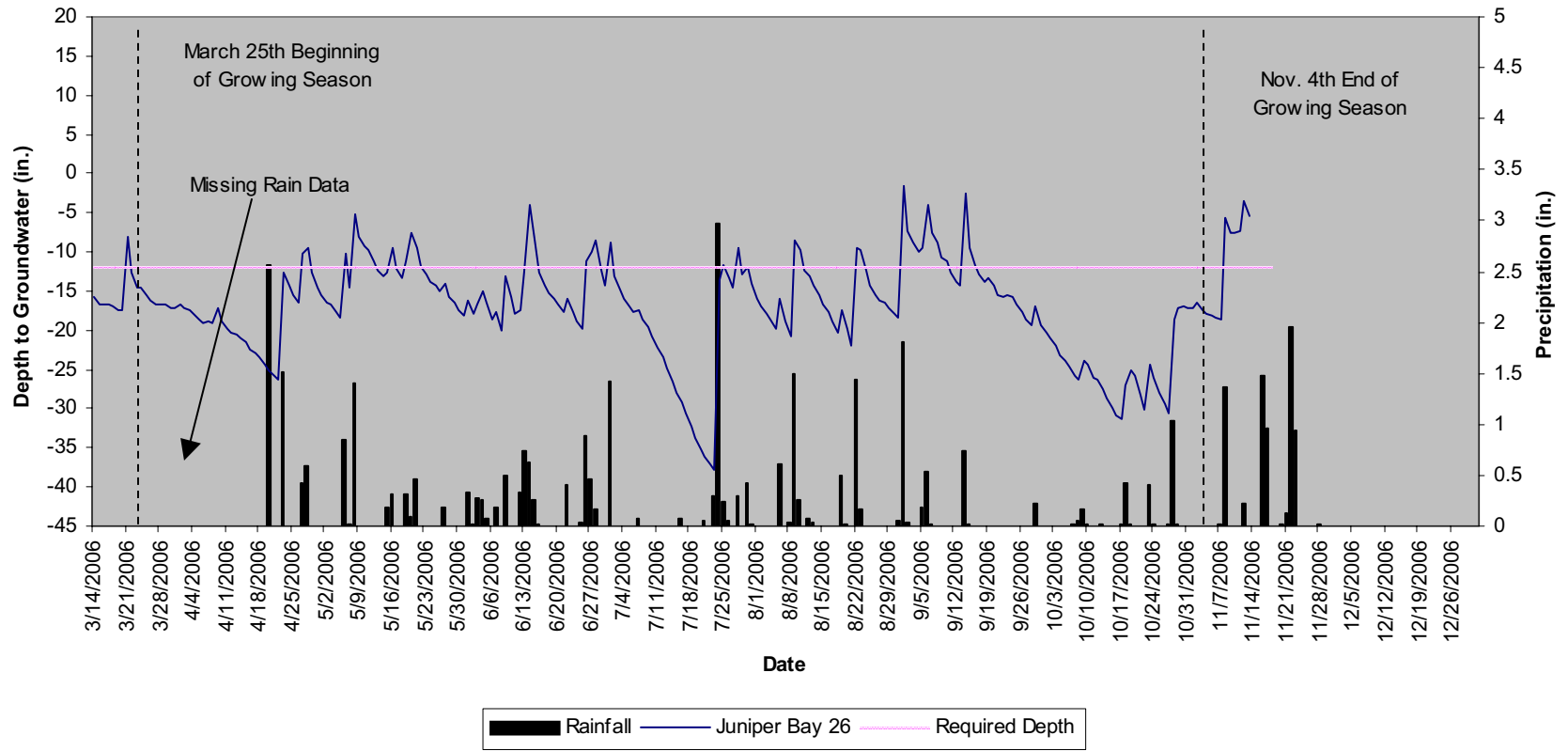
**Juniper Bay
24
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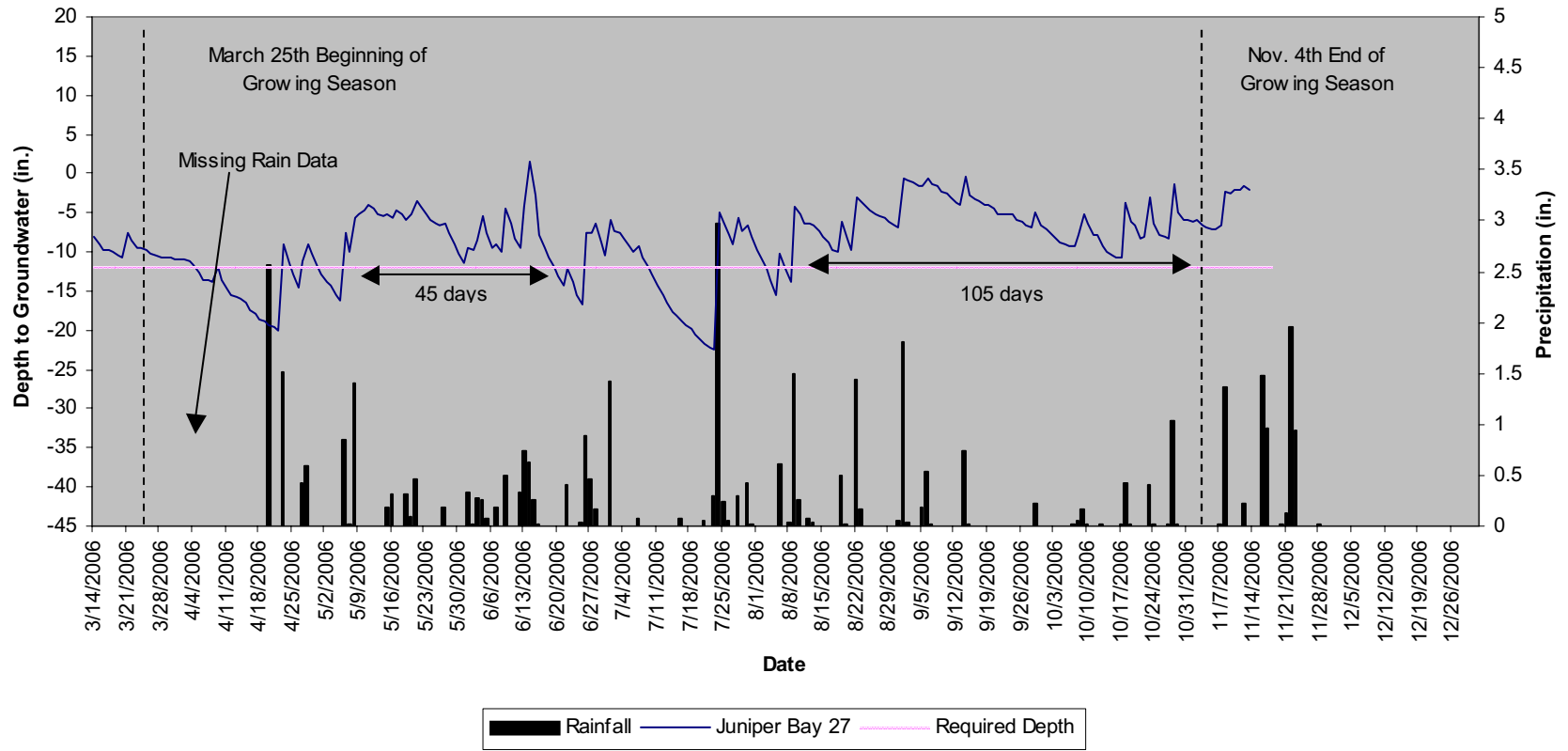
**Juniper Bay
25
40" Groundwater**



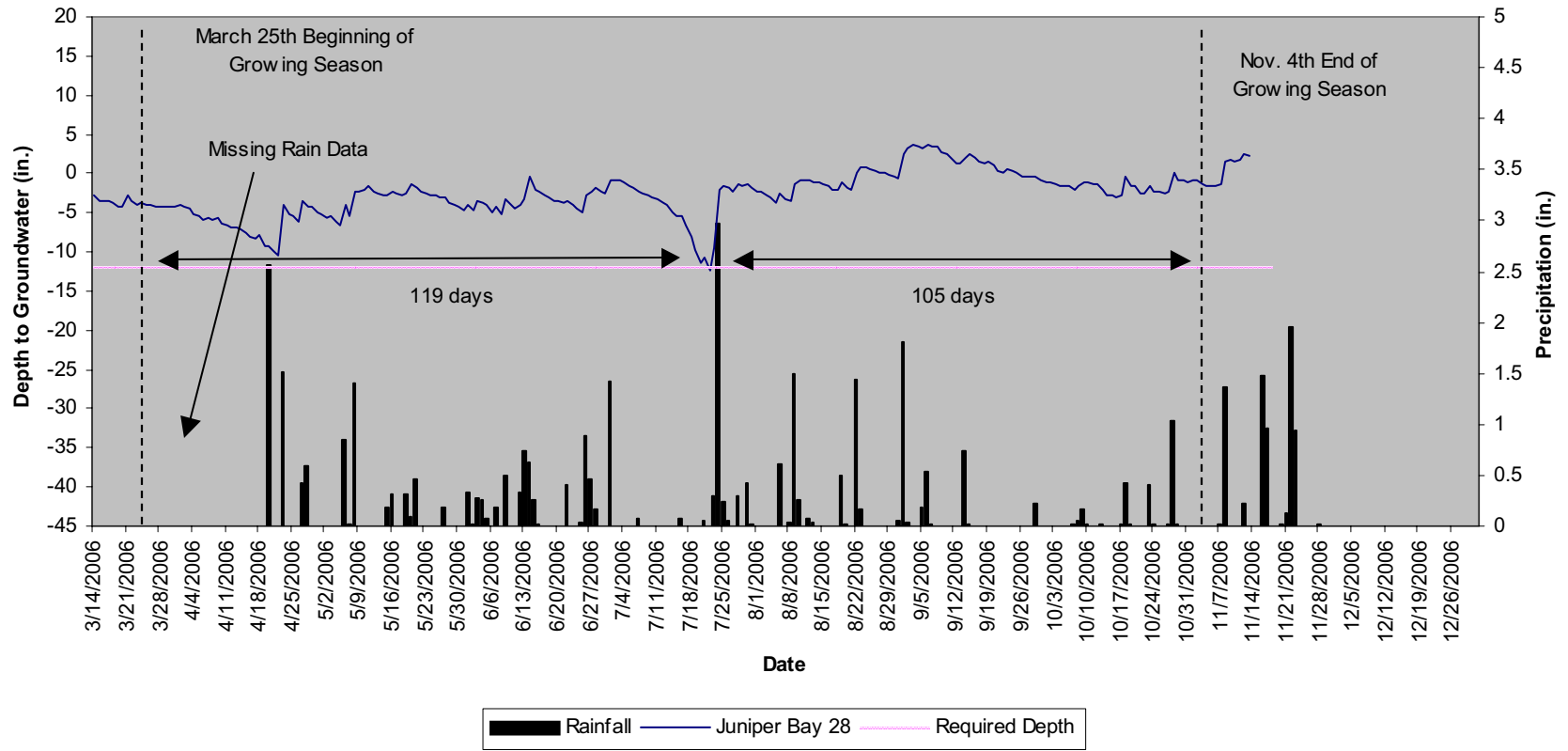
Juniper Bay
26
40" Groundwater



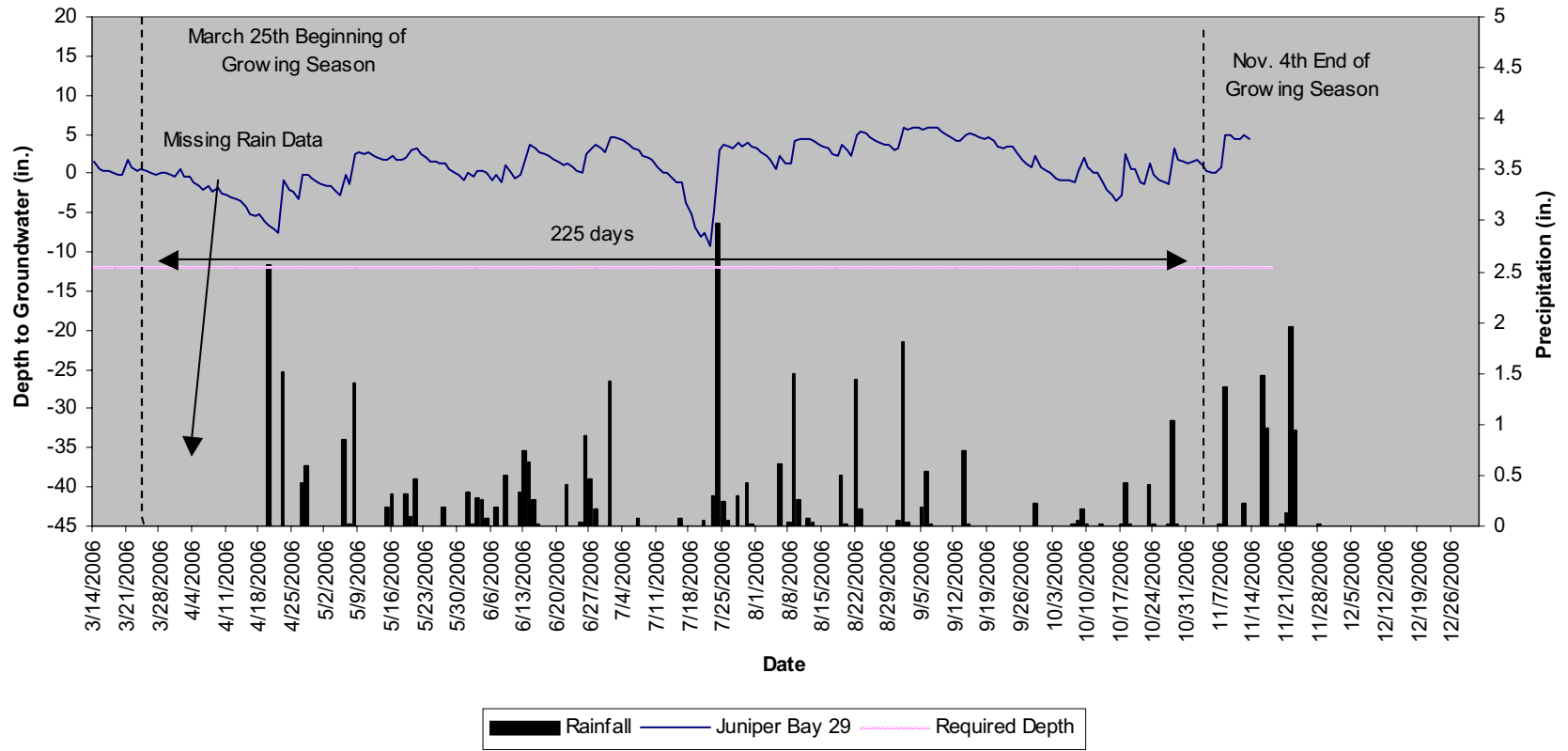
Juniper Bay
27
40" Groundwater



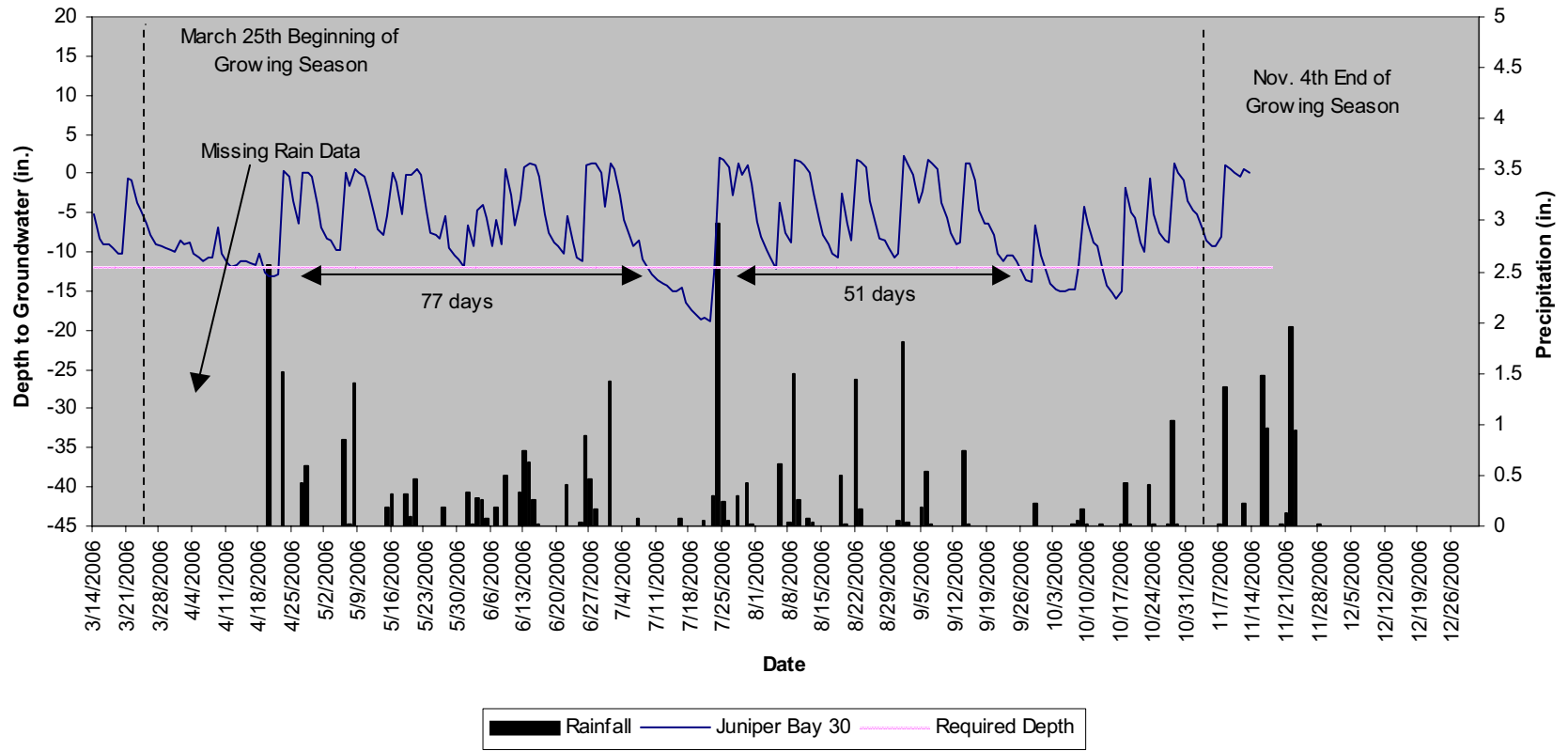
Juniper Bay
28
40" Groundwater



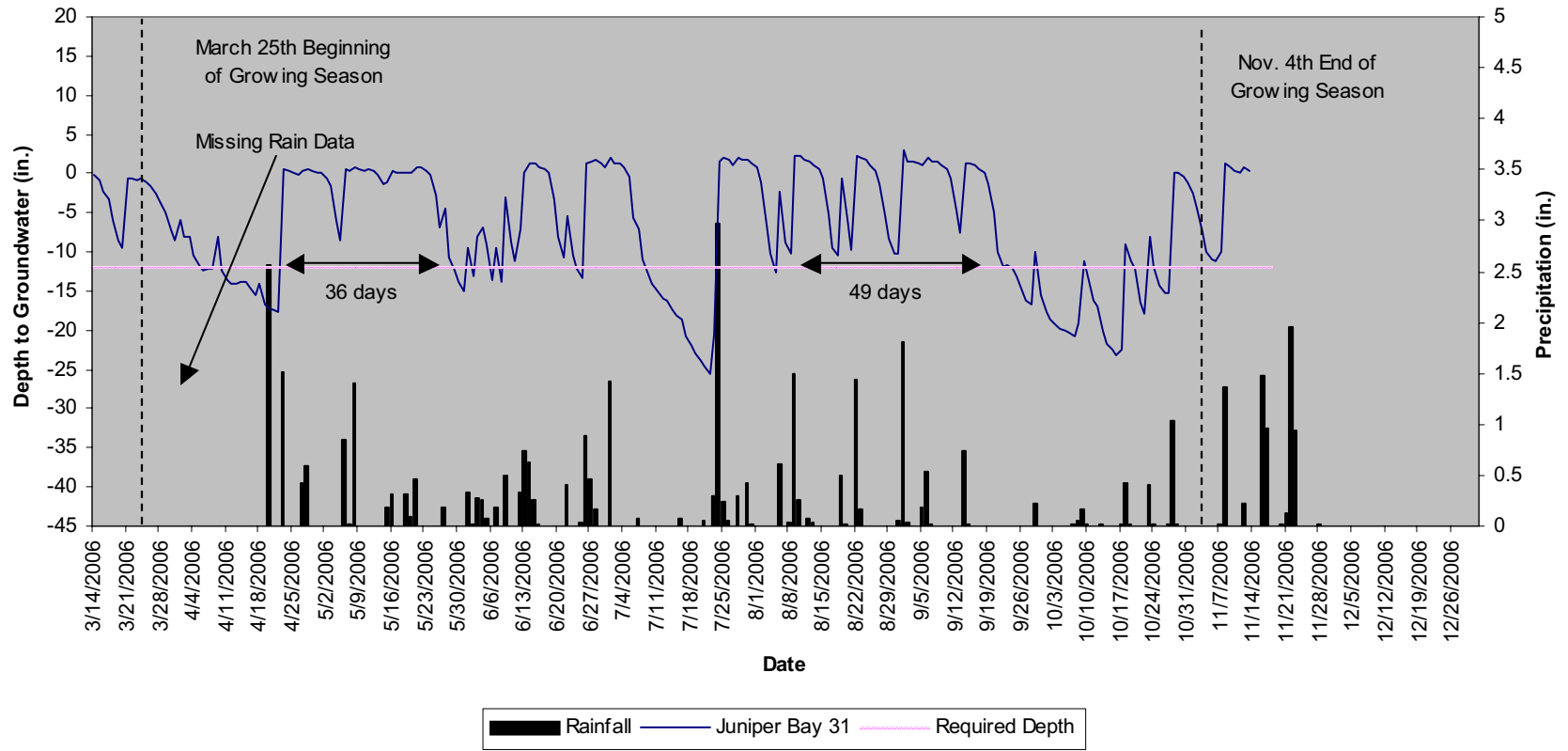
**Juniper Bay
29
40" Groundwater**



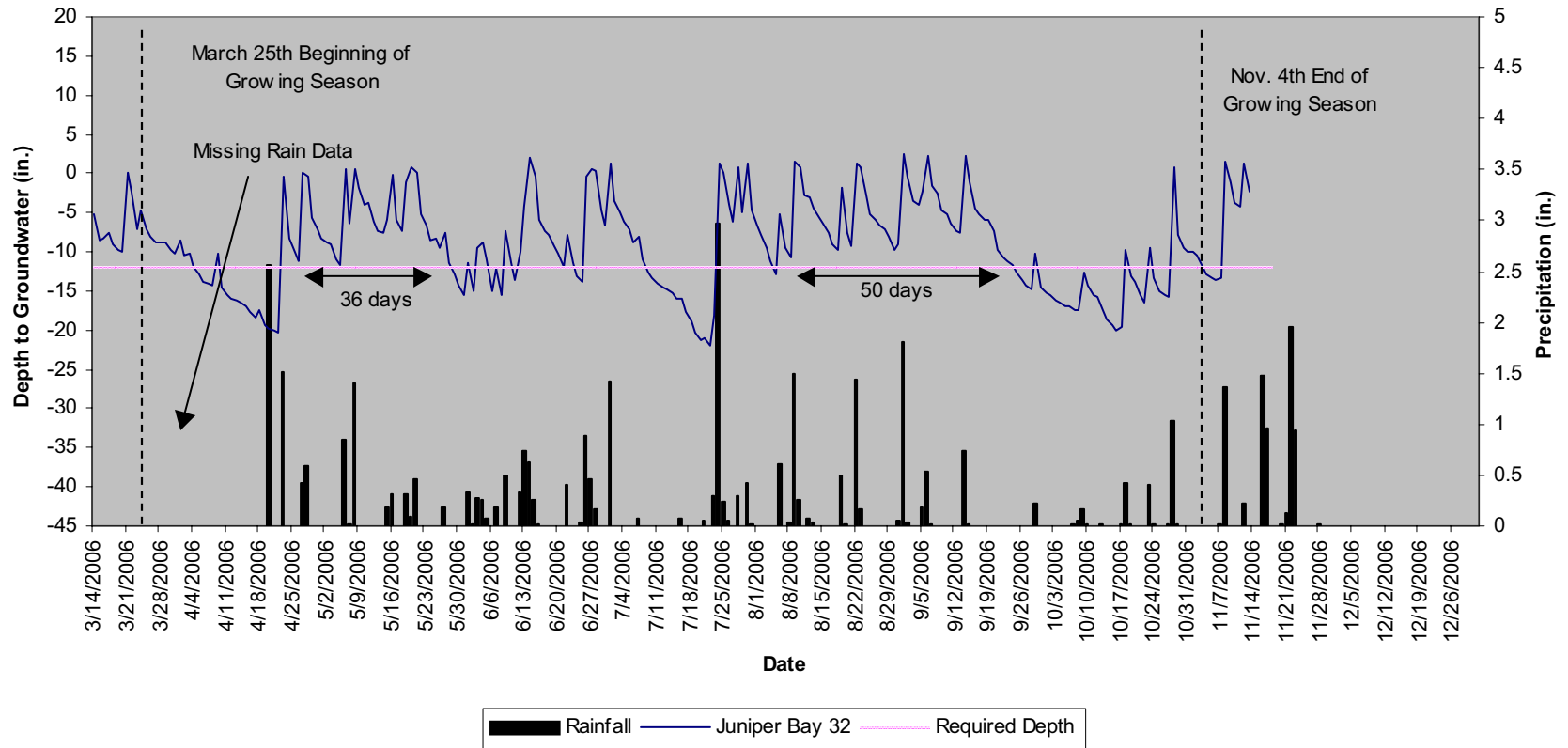
Juniper Bay
30
40" Groundwater



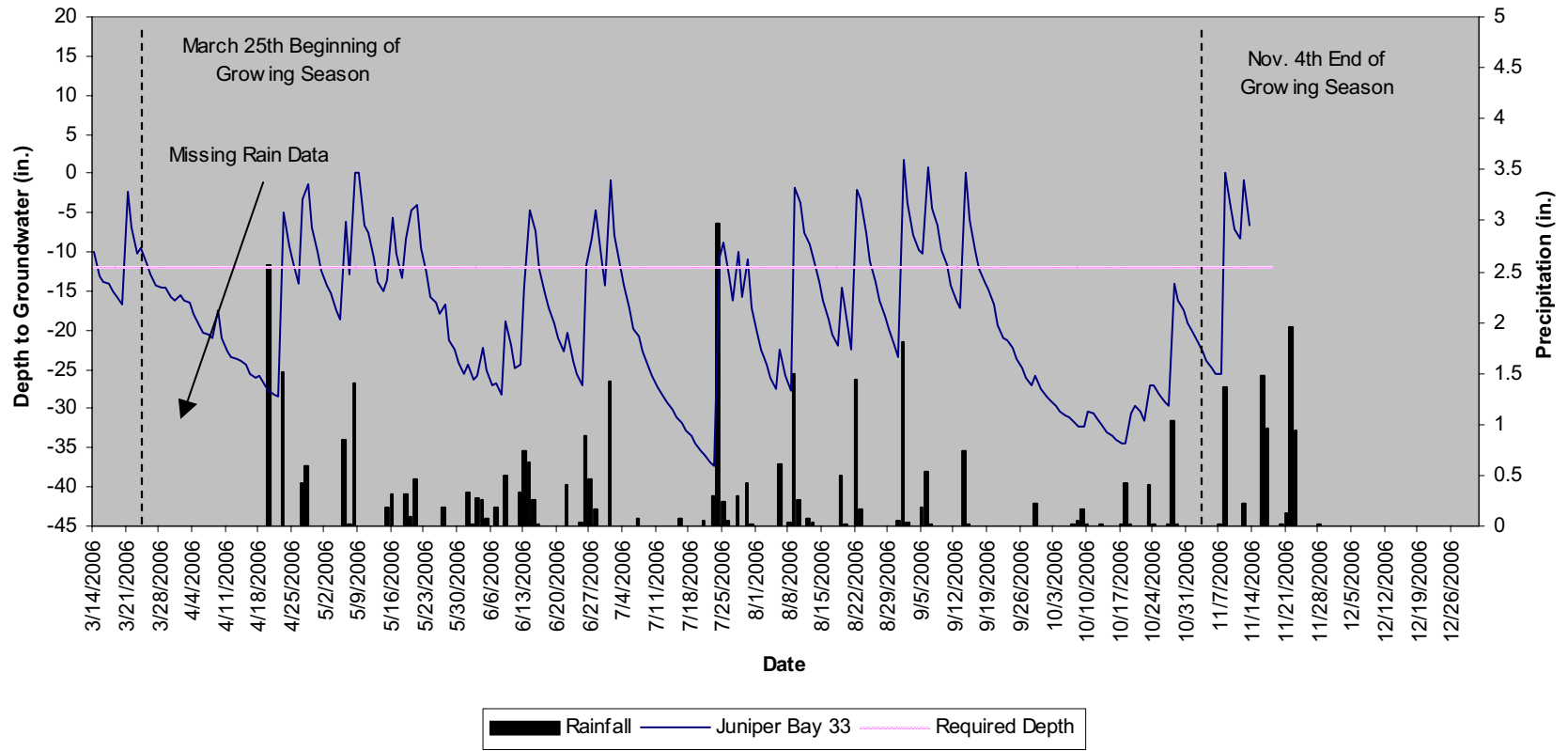
Juniper Bay
31
40" Groundwater



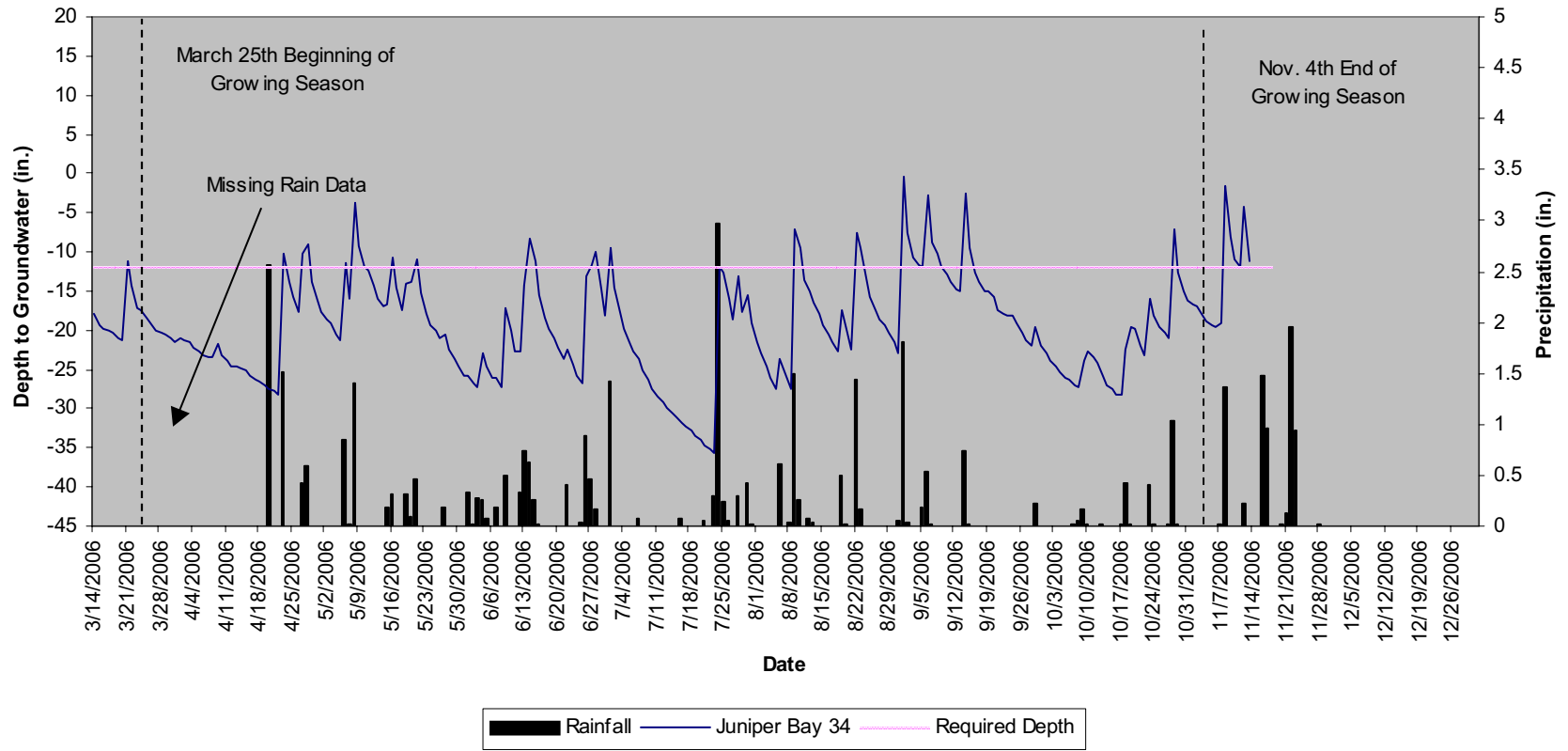
**Juniper Bay
32
40" Groundwater**



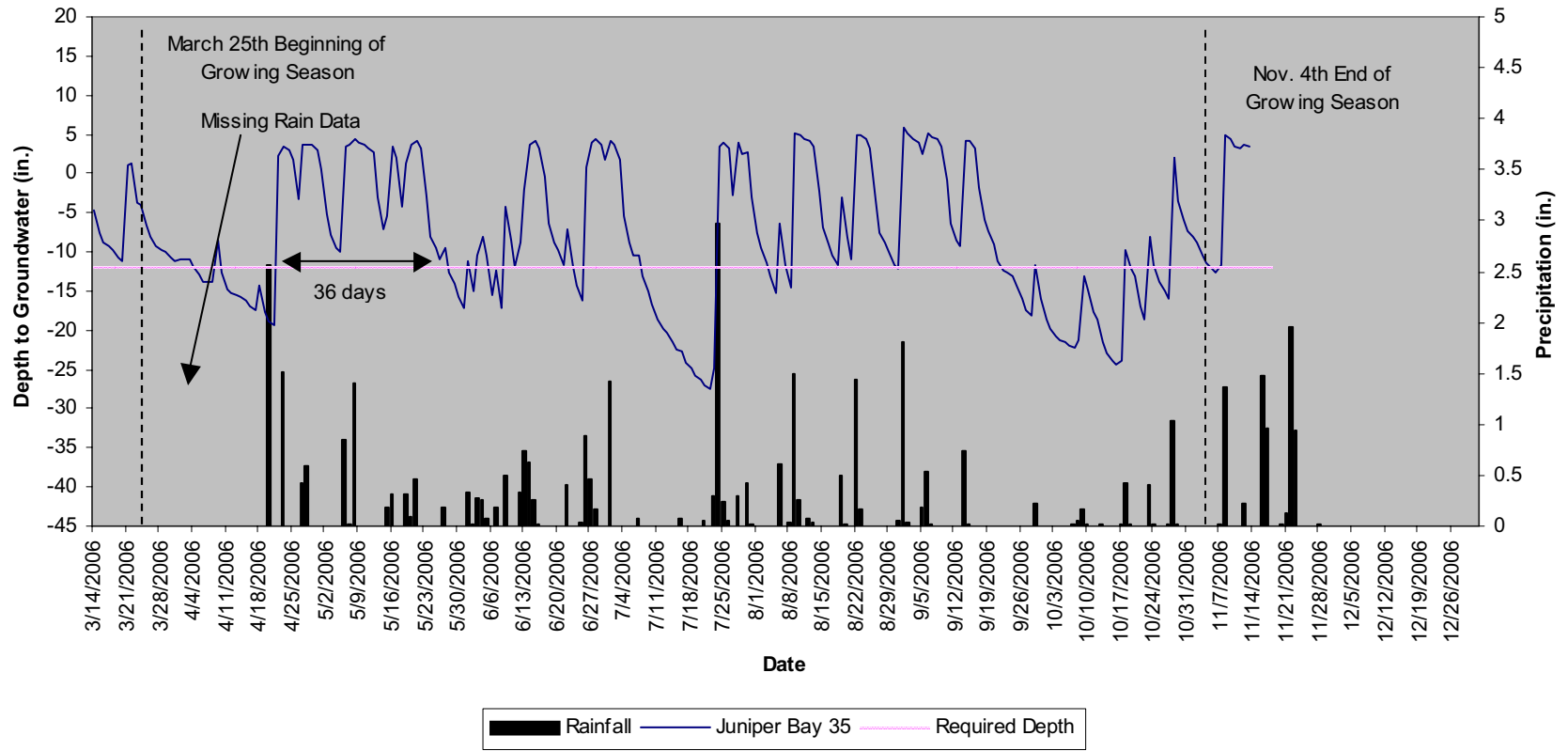
**Juniper Bay
33
40" Groundwater**



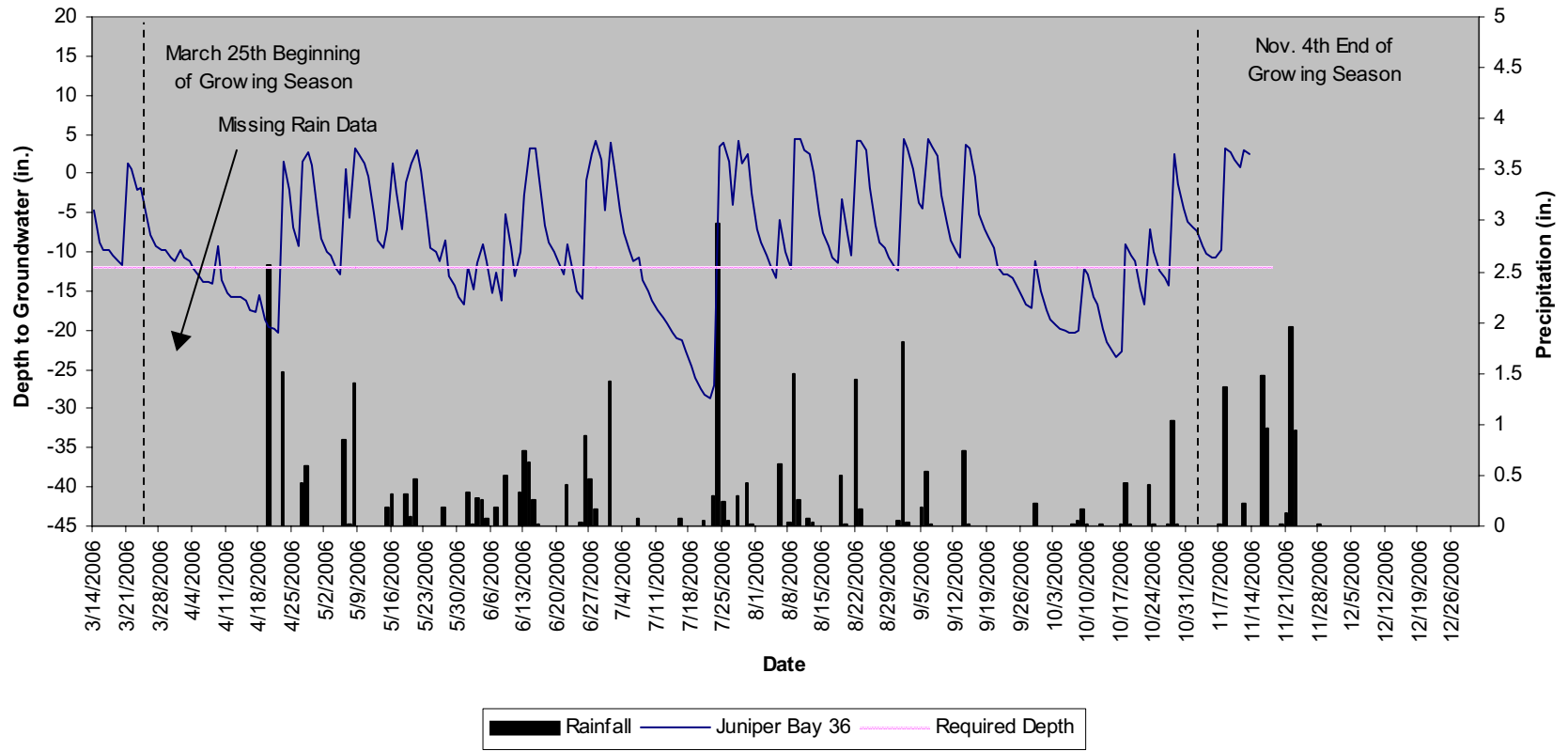
**Juniper Bay
34
40" Groundwater**



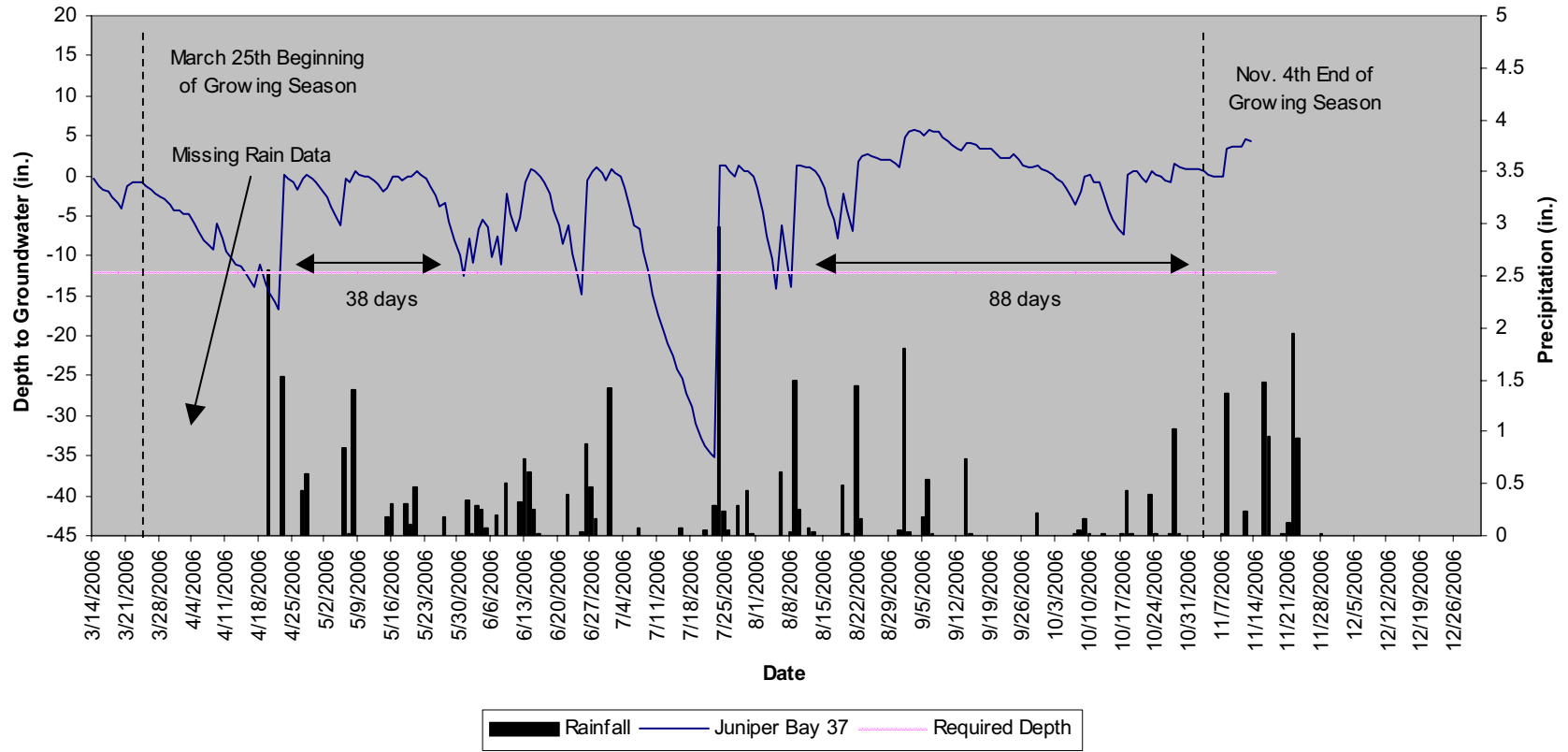
Juniper Bay
35
40" Groundwater



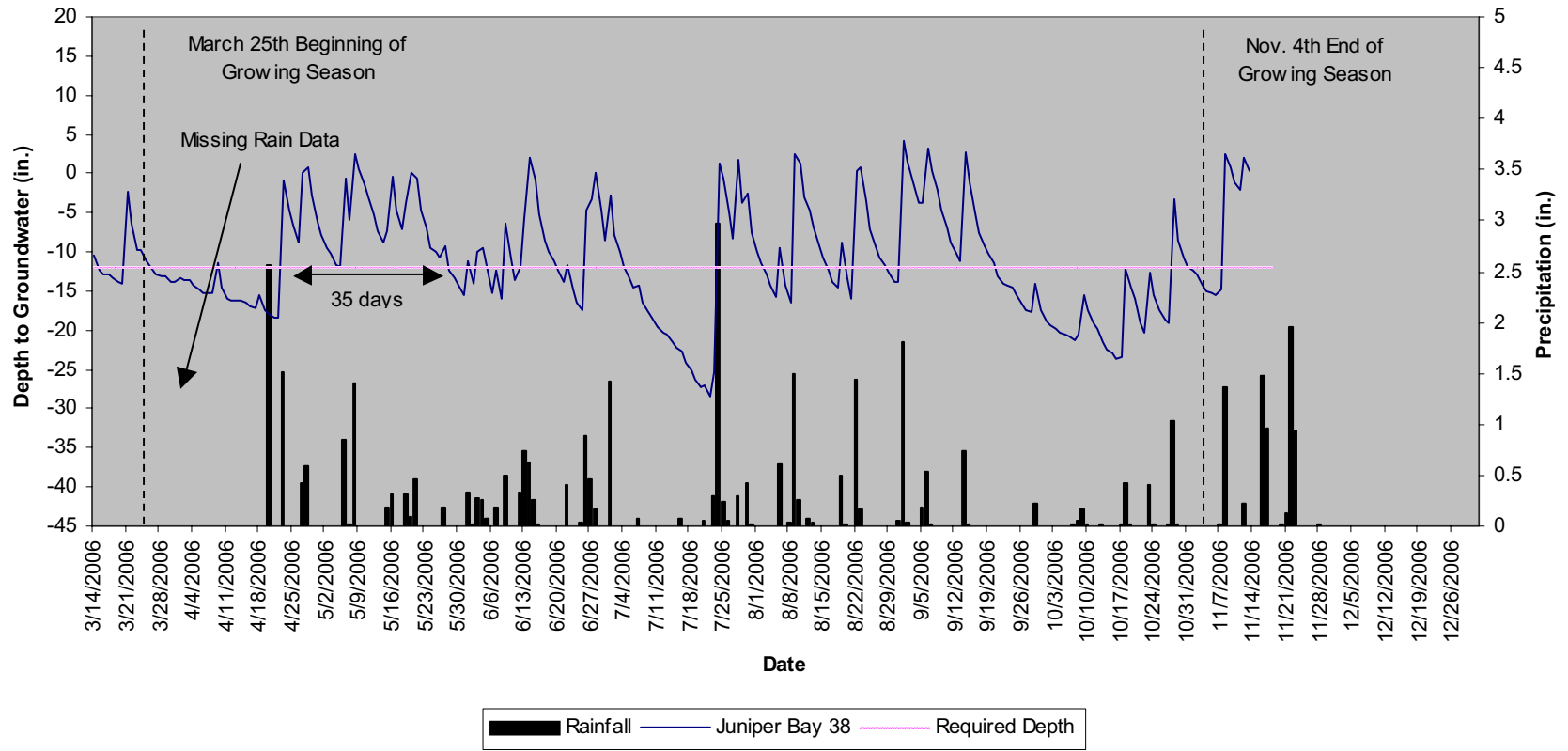
Juniper Bay
36
40" Groundwater



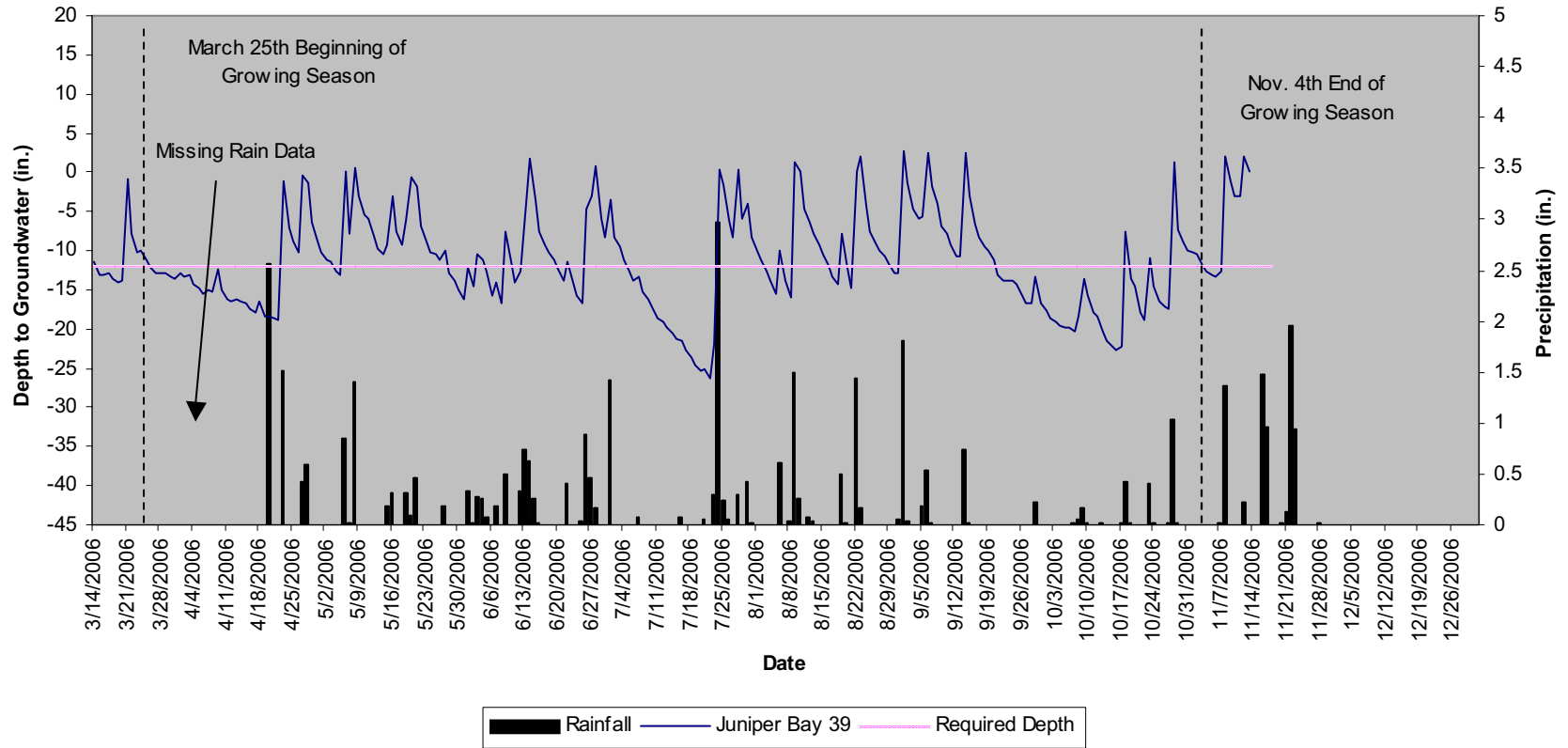
Juniper Bay
37
40" Groundwater



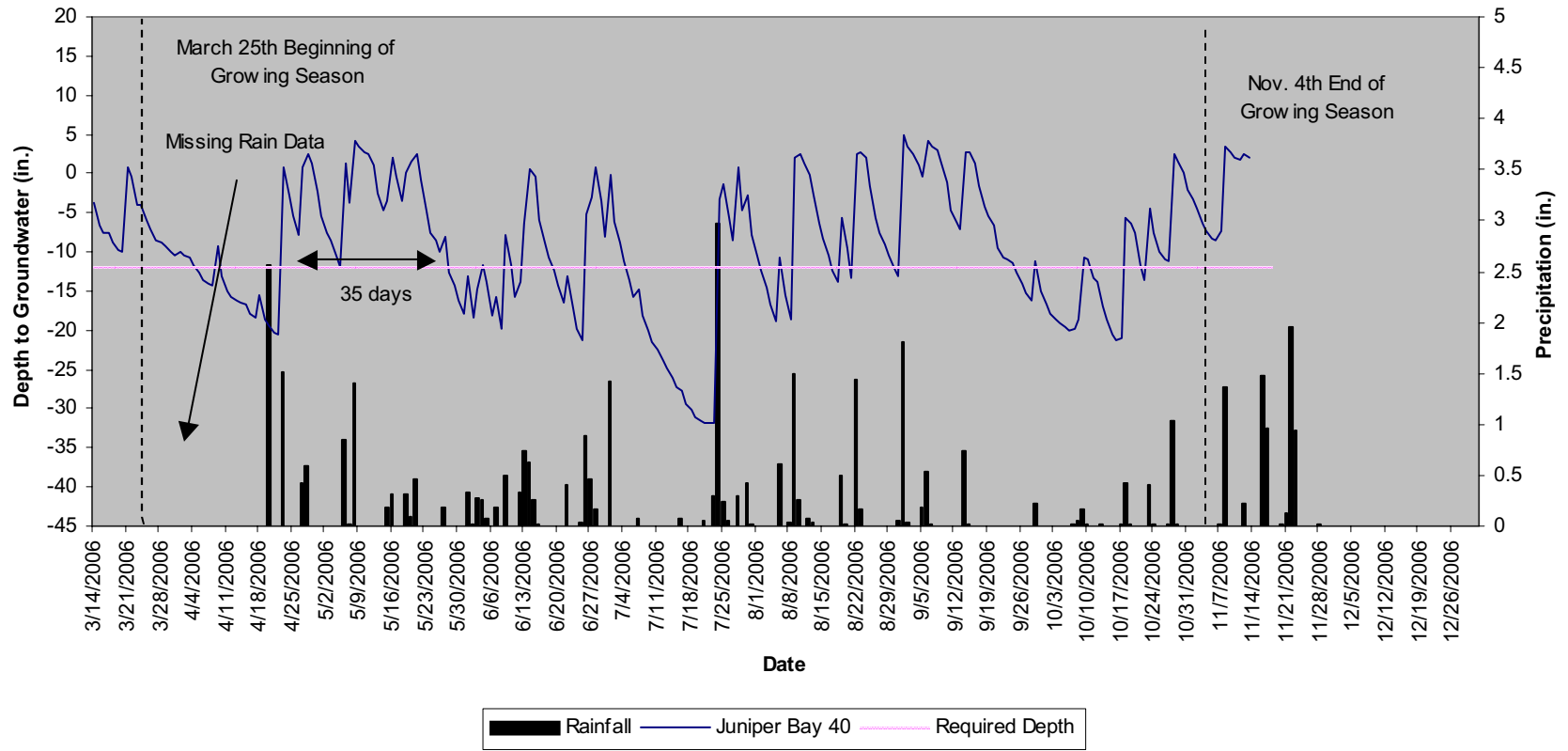
Juniper Bay
38
40" Groundwater



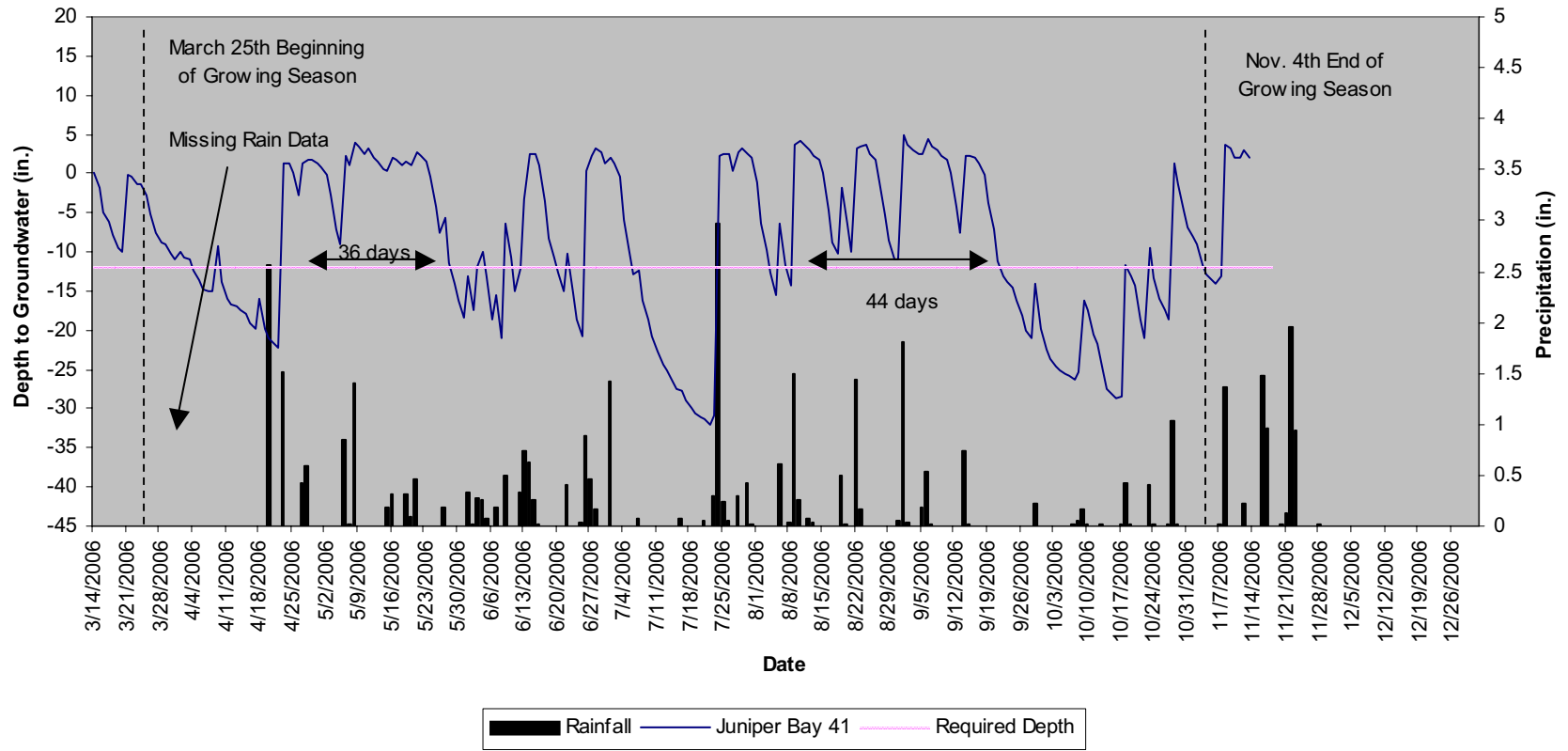
Juniper Bay
39
40" Groundwater



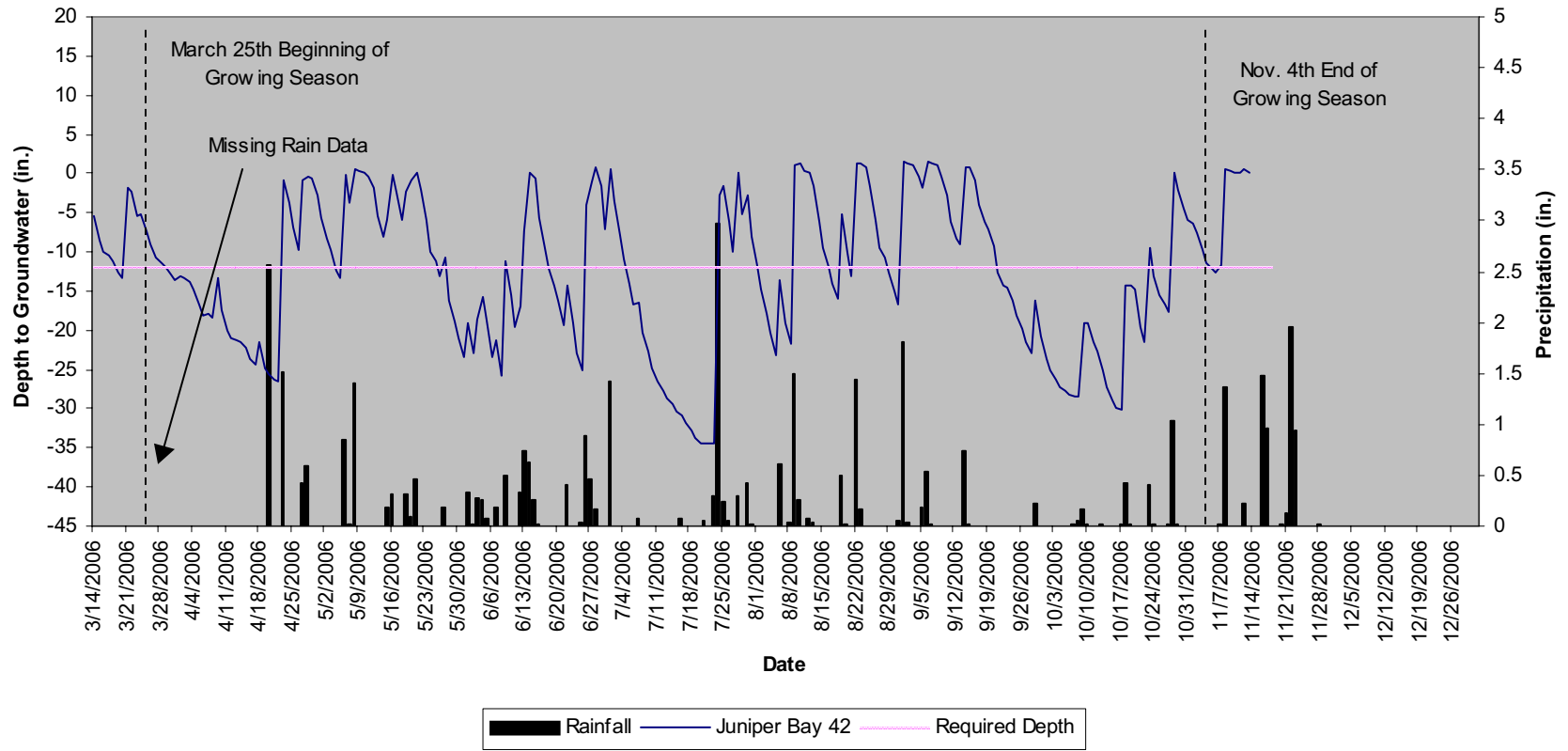
**Juniper Bay
40
40" Groundwater**



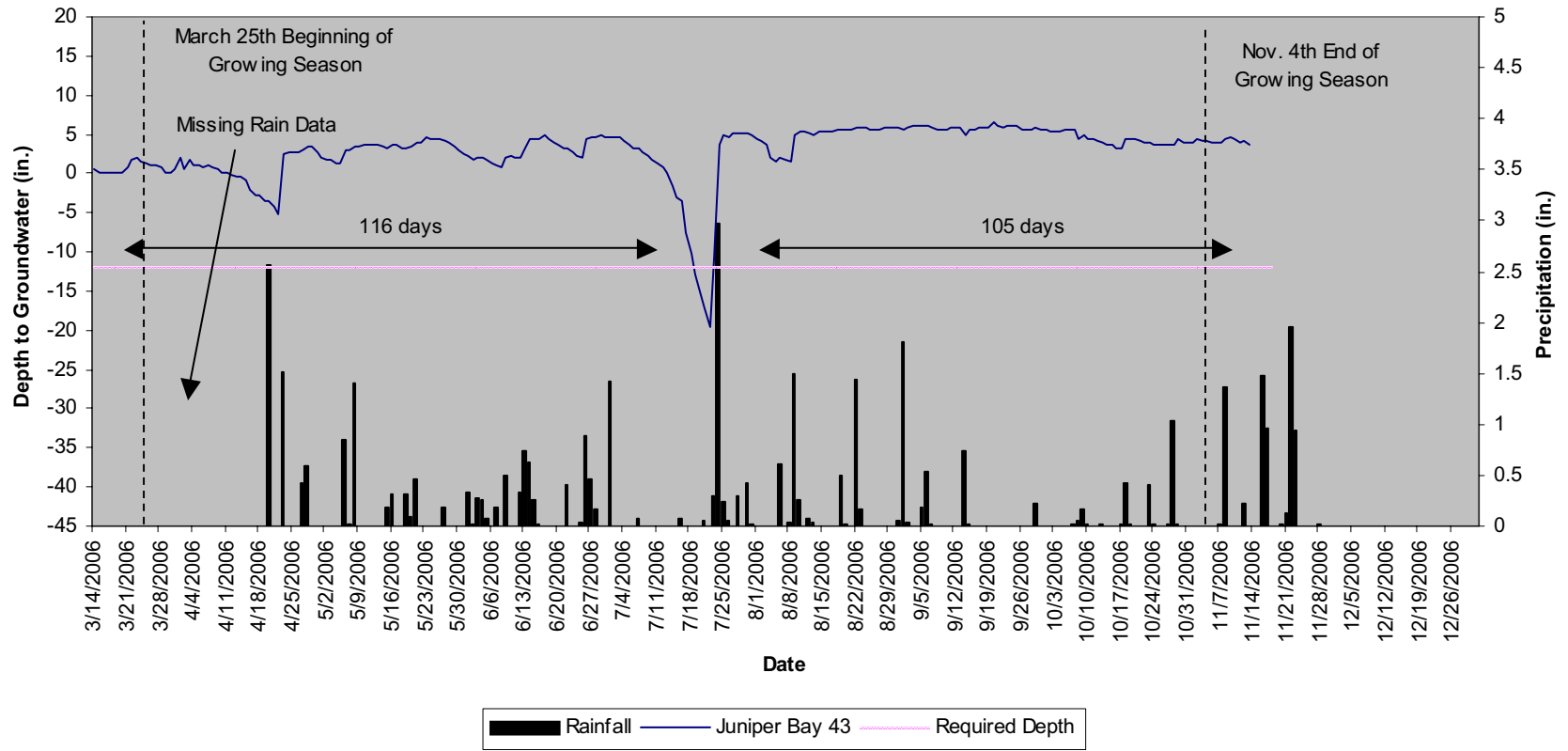
**Juniper Bay
41
40" Groundwater**



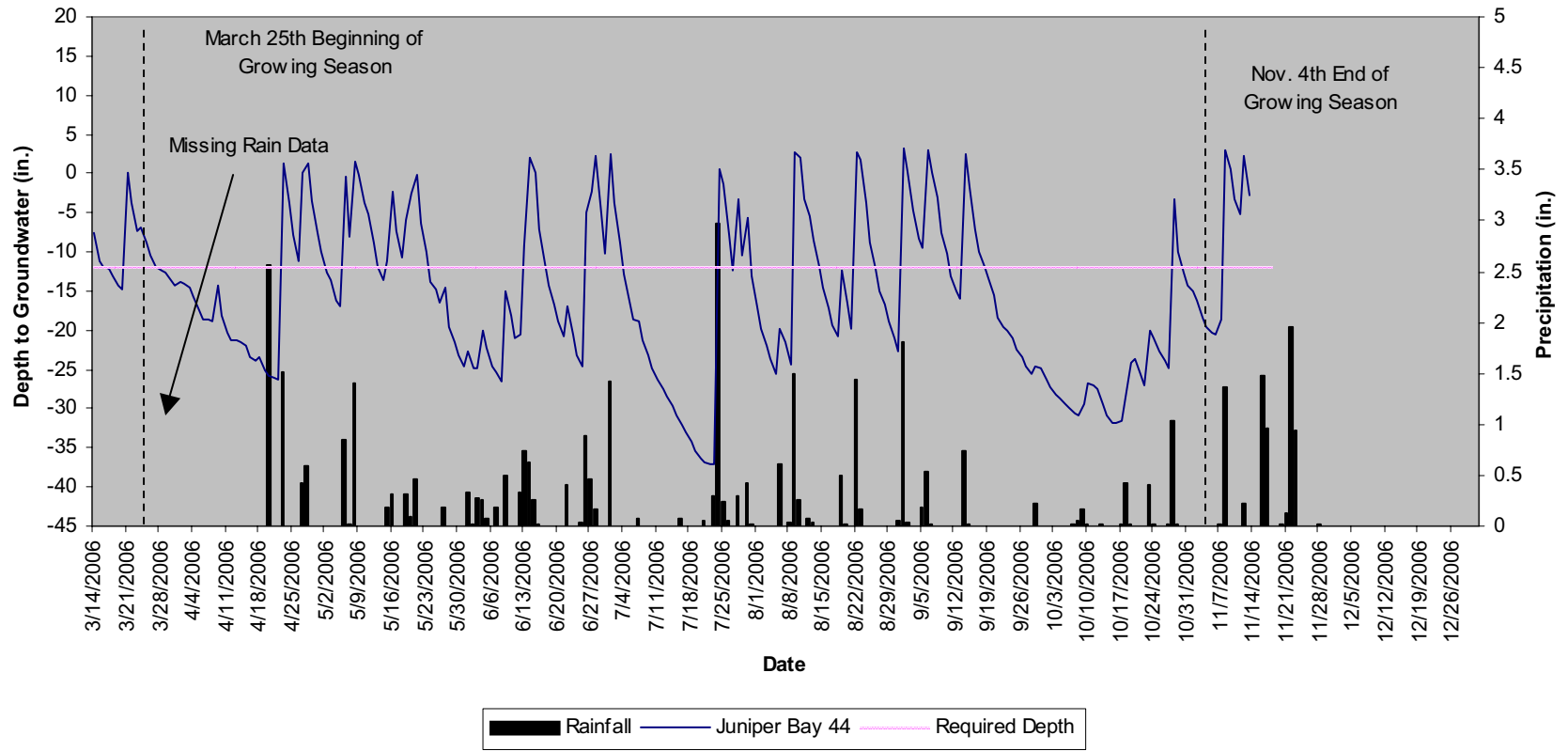
Juniper Bay
42
40" Groundwater



**Juniper Bay
43
40" Groundwater**



**Juniper Bay
44
40" Groundwater**



Juniper Bay
45
40" Groundwater

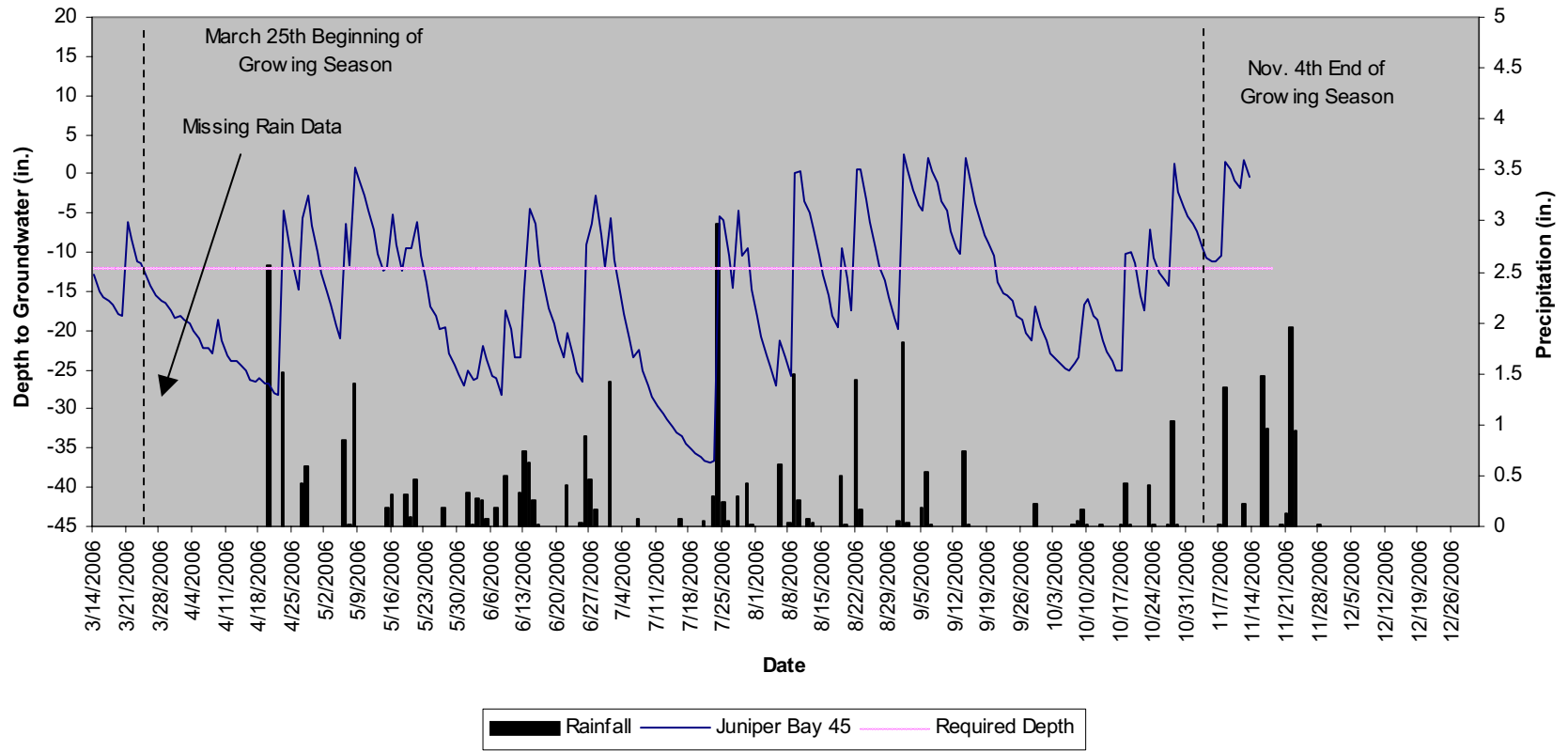


Table B-1. 2006 Hydrologic Monitoring Results				
Gauge	Community Type^a	Status % of Growing Season	No. Days <12" March 25-November 4	Hydrologic Success
GW-1	PPW/BF	<5%	2	No
GW-2	PPW/BF	>12.5%	71	Yes
GW-3	PPW/BF	>12.5%	116	Yes
GW-4	PPW/BF	5-12.5%	18	No
GW-5	PPW/BF	>12.5%	112 ^b	Yes
GW-6	PAWCF/BF	>12.5%	225	Yes
GW-7	PAWCF/BF	>12.5%	225	Yes
GW-8	PAWCF/BF	>12.5%	225	Yes
GW-9	PAWCF/BF	>12.5%	225	Yes
GW-10	PPW/BF	<5%	10	No
GW-11	PPW/BF	<5%	1	No
GW-12	PPW/BF	<5%	1	No
GW-13	PAWCF/BF	>12.5%	196	Yes
GW-14	PAWCF/BF	>12.5%	156 (225) ^c	Yes
GW-15	PAWCF/BF	N/A	Not Installed	N/A
GW-16	PAWCF/BF	>12.5%	225	Yes
GW-17	PPW/BF	>12.5%	83	Yes
GW-18	PPW/BF	>12.5%	64	Yes
GW-19	PPW/BF	>12.5%	81	Yes
GW-20	PPW/BF	>12.5%	79	Yes
GW-21	PPW/BF	>12.5%	83	Yes
GW-22	PAWCF/BF	N/A	Not Installed	N/A
GW-23	PAWCF/BF	>12.5%	225	Yes
GW-24	PAWCF/BF	>12.5%	105	Yes
GW-25	PPW/BF	<5%	4	No
GW-26	PPW/BF	<5%	10	No
GW-27	PAWCF/BF	>12.5%	88	Yes
GW-28	PAWCF/BF	>12.5%	119	Yes
GW-29	PAWCF/BF	>12.5%	225	Yes
GW-30	PPW/BF	>12.5%	77	Yes
GW-31	PPW/BF	>12.5%	49	Yes
GW-32	PPW/BF	>12.5%	50	Yes
GW-33	PPW/BF	<5%	10	No
GW-34	PPW/BF	<5%	9	No
GW-35	PPW/BF	>12.5%	36	Yes
GW-36	PPW/BF	5-12.5%	22	No
GW-37	PPW/BF	>12.5%	88	Yes
GW-38	PPW/BF	>12.5%	35	Yes
GW-39	PPW/BF	5-12.5%	22	No
GW-40	PPW/BF	>12.5%	35	Yes
GW-41	PPW/BF	>12.5%	44	Yes

Table B-1 continues.

Table B-1 concluded.

Gauge	Community Type^a	Status % of Growing Season	No. Days <12" March 25-November 4^b	Hydrologic Success
GW-42	PPW/BF	5-12.5%	20	No
GW-43	PAWCF/BF	>12.5%	116	Yes
GW-44	PPW/BF	<5%	10	No
GW-45	PPW/BF	5-12.5%	20	No

^a Community Types: PPW/BF-Pine Pond Woodland/Bay Forest, PAWCF/BF- Peatland Atlantic White Cedar Forest/Bay Forest.

^b Missing data: data does not affect longest hydroperiod.

^c Missing data: status shown in parenthesis was extrapolated from comparable gauges.

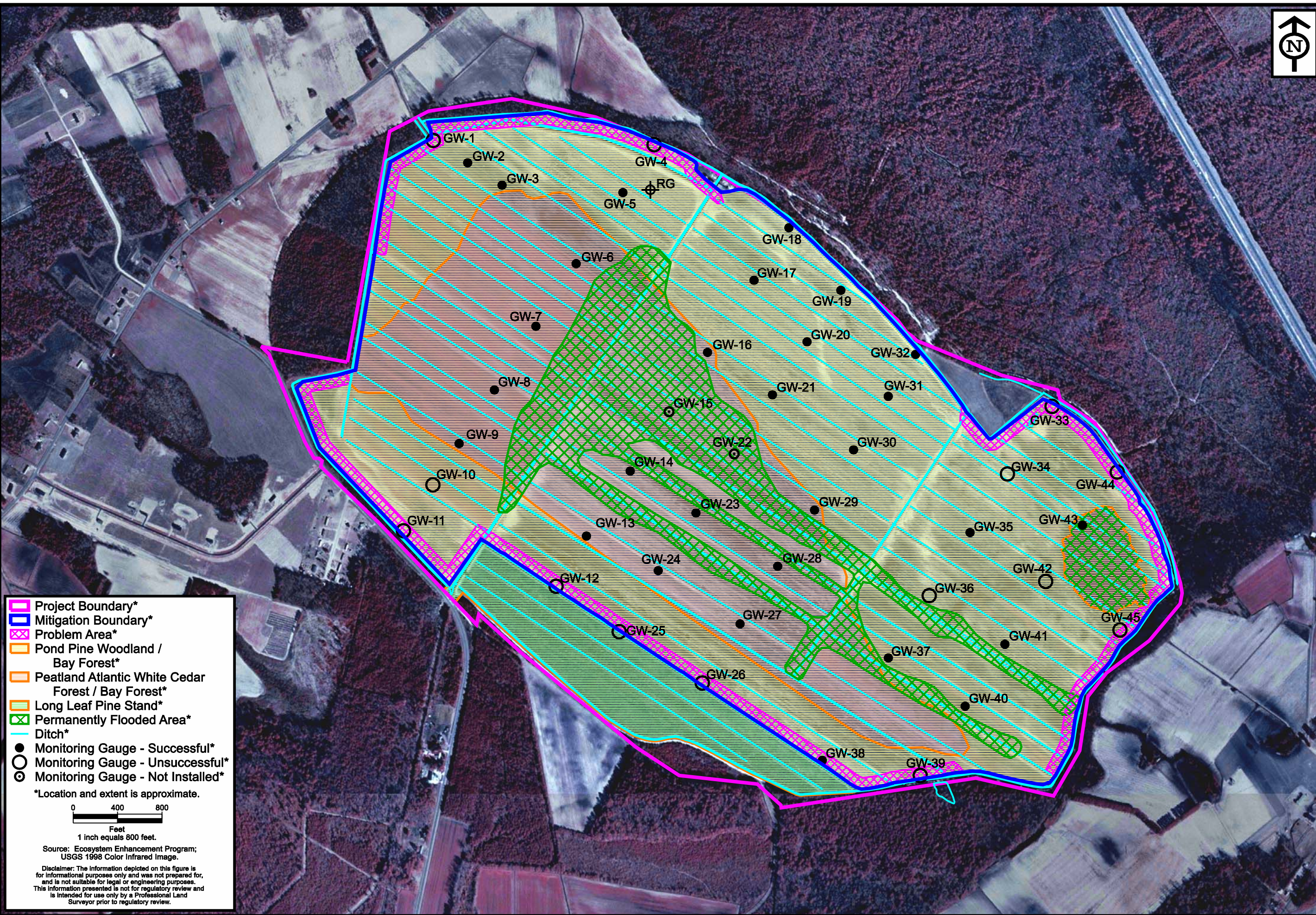


Project: ER06040.00
 Date: Dec 2006
 Drwn/Chkd: AJS/GT
 Figure: 4

Monitoring Gauge Problem Areas
Juniper Bay
 Robeson County, North Carolina
 Monitoring Report Year 1

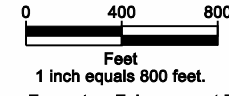


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- Project Boundary*
- Mitigation Boundary*
- Problem Area*
- Pond Pine Woodland / Bay Forest*
- Peatland Atlantic White Cedar Forest / Bay Forest*
- Long Leaf Pine Stand*
- Permanently Flooded Area*
- Ditch*
- Monitoring Gauge - Successful*
- Monitoring Gauge - Unsuccessful*
- Monitoring Gauge - Not Installed*

*Location and extent is approximate.



Source: Ecosystem Enhancement Program;
 USGS 1998 Color Infrared Image.

Disclaimer: The information depicted on this figure is for informational purposes only and was not prepared for, and is not suitable for legal or engineering purposes. This information presented is not for regulatory review and is intended for use only by a Professional Land Surveyor prior to regulatory review.

Appendix C
Integrated Overview

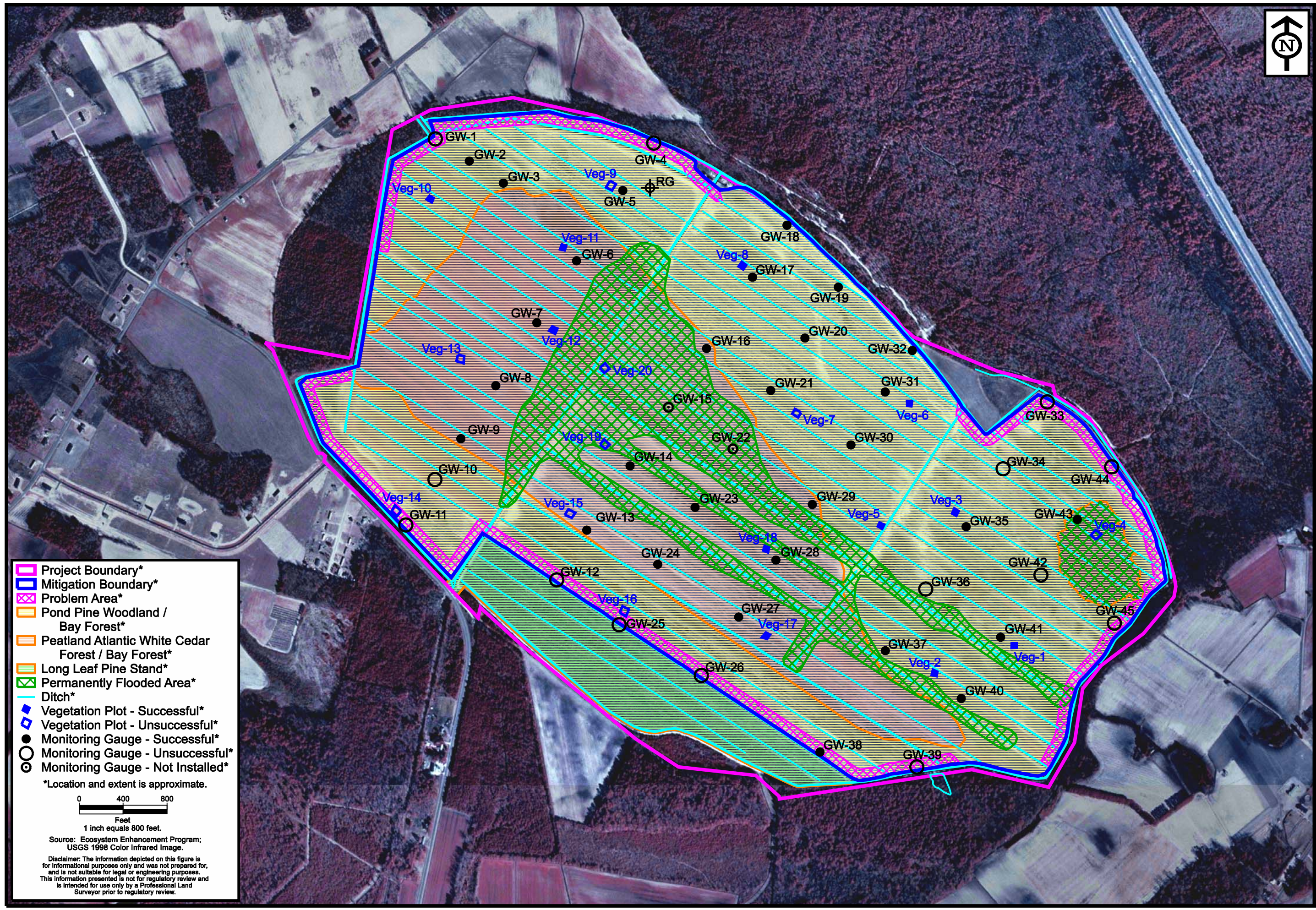


Project: ER06040.00
 Date: Feb 2007
 Drwn/Chkd: AJS/GT
 Figure: 5

Overall Problem Areas
Juniper Bay
 Robeson County, North Carolina
 Monitoring Report Year 1



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- Project Boundary*
- Mitigation Boundary*
- Problem Area*
- Pond Pine Woodland / Bay Forest*
- Peatland Atlantic White Cedar Forest / Bay Forest*
- Long Leaf Pine Stand*
- Permanently Flooded Area*
- Ditch*
- Vegetation Plot - Successful*
- Vegetation Plot - Unsuccessful*
- Monitoring Gauge - Successful*
- Monitoring Gauge - Unsuccessful*
- Monitoring Gauge - Not Installed*

*Location and extent is approximate.

0 400 800
 Feet
 1 inch equals 800 feet.

Source: Ecosystem Enhancement Program;
 USGS 1998 Color Infrared Image.

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