

ANNUAL REPORT FOR 2005



ABC Wetland Mitigation Site
Beaufort County
Project No. 8.T221801
TIP No. R-2510WM
Monitoring Year 5 of 5



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SUMMARY

The following report summarizes the monitoring activities that have occurred in the past year at the ABC Mitigation Site. The site must be monitored to show successful mitigation and must demonstrate both vegetation and hydrologic success for a minimum of five years or until the site is deemed successful. Completed in January 2001, the 187-acre site will serve as mitigation for wetland impacts within the coastal plain region of the Tar-Pamlico River Basin and provides non-riverine wet hardwood forest restoration. In order to restore wetland conditions, the existing site was altered by constructing depressions and installing ditch plugs as well as by backfilling material and scarifying wetland soil surfaces. Trees were planted to facilitate establishment of natural communities.

Twenty-nine groundwater-monitoring gauges are used to record daily hydrologic conditions. Eight of these gauges are situated within an offsite reference area; data from these reference gauges are used as a comparison if data from the restored area does not meet jurisdictional success criteria. An onsite rain gauge records daily rainfall events to monitor the site's response to rainfall. Monthly rainfall data, measured at the closest official weather station, was compared to historical rainfall totals in order to determine relative climate conditions during the growing season.

For the 2005 monitoring year, all of the twenty-nine groundwater gauges showed saturation in excess of the 12.5% hydrologic success criterion. Overall, onsite gauges exhibited similar results or exceeded the saturation periods recorded in the reference community.

Approximately 140.7 acres of the site were planted with wetland vegetation. Thirteen permanent vegetation plots are used in annual vegetation monitoring; success criteria state that at least 320 trees/acre must be surviving after three years, with at least 260 trees/ acre surviving at the end of year five. For 2005, the thirteen permanent vegetation plots revealed an average density of 488 trees per acre, which is well above the minimum success criteria of 260 trees per acre.

The 2005 monitoring year represents the fifth and final year of monitoring for the ABC Wetland Mitigation Site. The site has met all required monitoring success criteria. It is recommended that EEP review this information with associated government agencies and close out the ABC Wetland Mitigation Site.

1.0 INTRODUCTION

1.1 Project Description

The North Carolina Department of Transportation (NCDOT) established the ABC Wetland Mitigation Site to provide up-front wetland mitigation for unavoidable transportation-related wetland impacts in the coastal plain region of the Tar-Pamlico River Basin. The 75-hectare (184-acre) tract is situated northeast of Washington in Beaufort County, North Carolina (Figure 1).

The site had been cleared, ditched, and drained, with wetlands effectively removed to facilitate agricultural production and to convey runoff into Acre Swamp located along the southeastern border of the site. Wetland mitigation activities were designed to restore wetland features and functions similar to those exhibited by reference wetlands in the region. Site alterations, designed to restore characteristic wetland soil features and groundwater wetland hydrology, include depression construction (B-horizon contouring), impervious ditch plug construction, ditch backfilling, field crown removal, and ripping/scarification of wetland soil surfaces. Following construction, the site was planted with native vegetation characteristic of the target ecosystem.

Pre-construction investigations suggested that the site would support the following communities: 37 hectares (92 acres) of restored non-riverine forested wetlands; 7 hectares (19 acres) of enhanced non-riverine wetland systems; and approximately 1,252 meters (4,107 feet) of stream enhancement (including streamside plantings and riparian forest buffer restoration). In addition, groundwater recharge was expected to improve within the remaining 31 hectares (76 acres) of uplands and streamside management areas. These areas were estimated based on soil types, local topographic features, elevation and slope, landscape position, and groundwater model forecast (DRAINMOD).

1.2 Purpose

In order to demonstrate successful mitigation, a site must be monitored for at least five years or until success criteria are met. Monitoring is conducted by installing both groundwater and surface water gauges to establish a hydrologic record, by placing permanent vegetation sampling plots to record establishment of woody vegetation, and by utilizing photographs as visual documentation of the site. This document summarizes the results of the monitoring program activities at the ABC Wetland Mitigation Site for the 2005 growing season, the fifth year that monitoring has been conducted on the site.

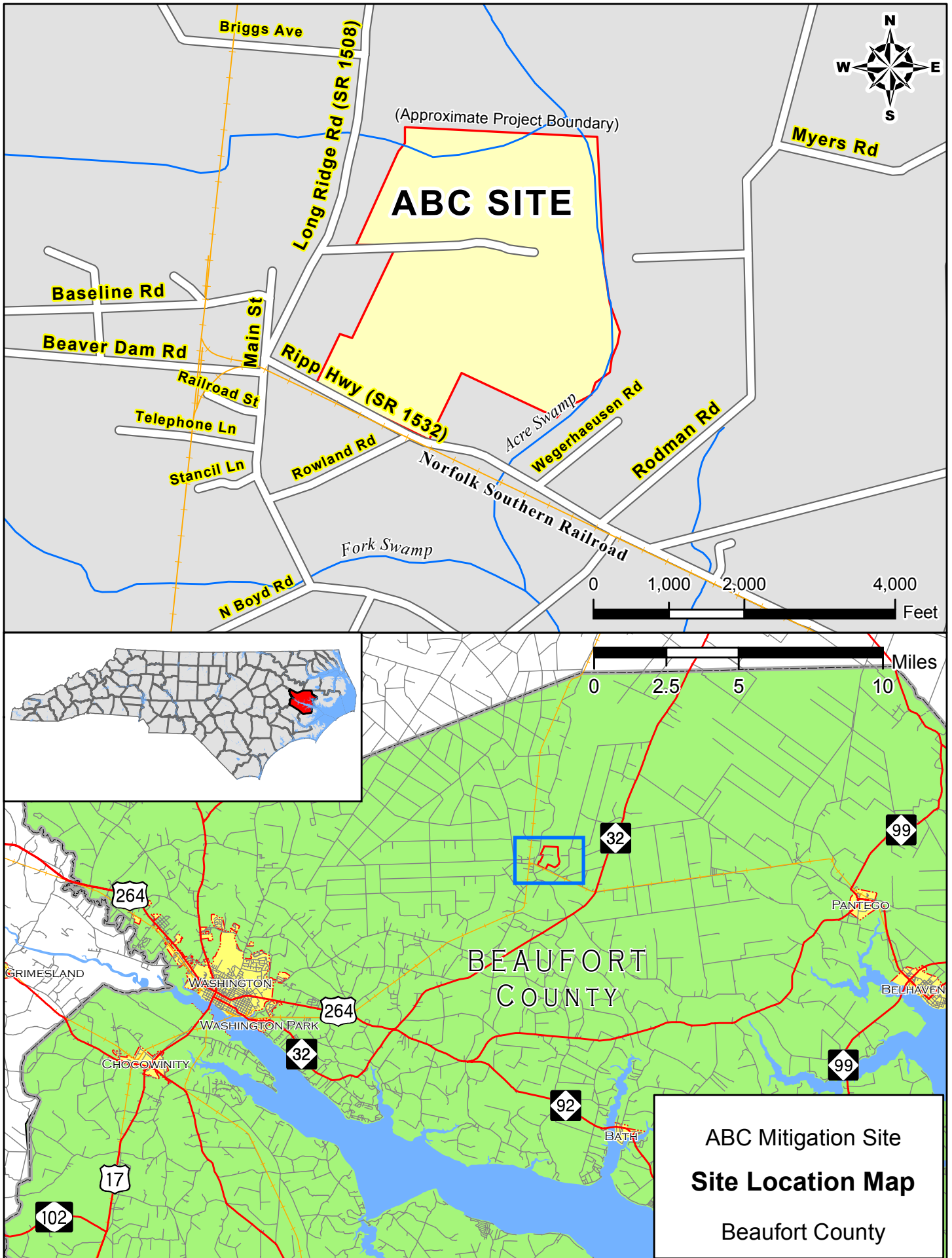


Figure 1

1.3 Project History

Date	Task Accomplished
1997	
January	Site Identification
1999	
June	Detailed Mitigation Design Study
2000	
September 2000-January 2001	Site Construction
2001	
March	Site Planted
March-November	Hydrologic Monitoring (1 yr.)
August	Vegetation Monitoring (1 yr.)
2002	
March-November	Hydrologic Monitoring (2 yr.)
August	Vegetation Monitoring (2 yr.)
2003	
March-November	Hydrologic Monitoring (3 yr.)
June 10	Agency Site Visit
August	Vegetation Monitoring (3 yr.)
2004	
March-November	Hydrologic Monitoring (4 yr.)
September	Vegetation Monitoring (4 yr.)
2005	
March-November	Hydrologic Monitoring (5 yr.)
June	Vegetation Monitoring (5 yr.)

2.0 HYDROLOGY

2.1 Success Criteria

Hydrologic success criteria for the ABC Mitigation Site are based on federal guidelines for mitigation as described in the 1987 U.S. Army Corps of Engineers (COE) Wetlands Delineation manual. These guidelines suggest that an area must be inundated or saturated (within 12 inches of the surface) by surface or groundwater for 12.5% of the growing season (32 consecutive days). However, areas inundated between 5% and 12.5% of the growing season may warrant jurisdictional classification depending upon factors such as the presence of hydrophytic vegetation and hydric soils.

The average wetland hydroperiod for this site is expected to exhibit a gradual increase from 8% of the growing season, immediately after the farm land is abandoned and the drainage structures are removed, to as much as 20% under steady state forest conditions. Evaluation of success criteria will be supplemented by sampling and data comparison between reference wetland sites. One reference community was monitored during 2005 and is located approximately 0.20 miles north of the site.

The growing season for Beaufort County is defined in the Beaufort County Soil Survey as the period between March 13 and November 25 (256 days, USDA 1995). In order to meet minimum hydrologic regulatory success (12.5% of the growing season), the groundwater table must remain within 12 inches of the surface for 32 consecutive days. In the event that the site does not meet jurisdictional success criteria, the hydrologic data from the site will be compared to that from the reference wetland.

2.2 Hydrologic Description

Following construction, twenty-one groundwater gauges were placed on the site in accordance with the specifications in U.S. Army Corps of Engineers', Installing Monitoring Recorders/Piezometers in Wetlands (WRP Technical Note HY-IA-3.1, August 1993). Sixteen monitoring gauges were installed in 2001 to provide representative coverage within each of the wetland physiographic landscape areas on the site. In 2002, eight additional groundwater gauges were installed on site; three of those gauges were installed in the reference wetland. Currently, eight of the twenty-nine groundwater-gauges are located within the reference wetland, approximately 0.2 miles north of the mitigation site (Figure 2). The groundwater gauges record daily groundwater levels across the site. In addition, an onsite rain gauge records daily rainfall totals; this data is used to see how the groundwater table responds to rainfall events.

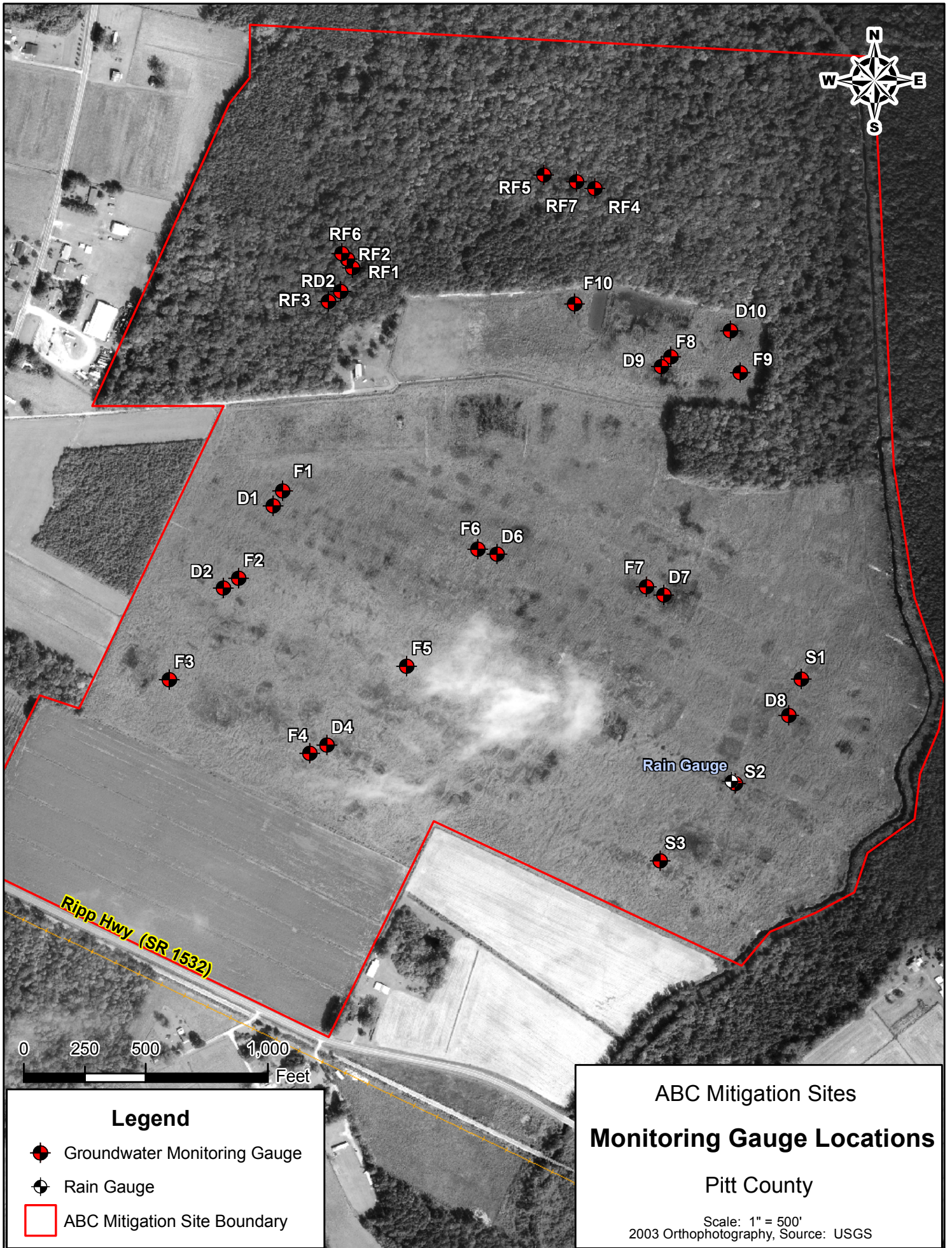


Figure 2

Micro-topographical features, such as semi-permanently inundated/saturated depressions and swales of various sizes, were created for the purpose of water storage, as well as habitat diversity. Eleven gauges (D1, D2, D4, D6, D7, D8, D9, D10, S1, S2, and S3) were placed within saturated depressions, while nine gauges (F1, F2, F3, F4, F5, F6, F7, F8, and F9) were placed in non-depressional areas throughout the site at ground elevation. Eight gauges were placed in similar landscape positions within the reference community. Reference gauges RD1, RD2, RD3, RD4, and RD5 were placed in depressions while gauges RF1, RF2, and RF3 were placed at base elevation.

2.3 Results of Hydrologic Monitoring

2.3.1 Site Data

The maximum number of consecutive days that the groundwater was within twelve inches of the surface was determined for each gauge. This number was converted into a percentage of the 256-day growing season. Table 1 shows the hydrologic results for the 2005 growing season; these results are illustrated in Figure 3.

Appendix A contains a plot of the groundwater depth readings at each monitoring gauge location. The maximum number of consecutive days that the gauge met success above the 12-inch depth is noted on each graph. Data determined to be erroneous was omitted; therefore, some gaps appear in the plots. Precipitation events, recorded at the onsite rain gauge, are included on each graph as bars.

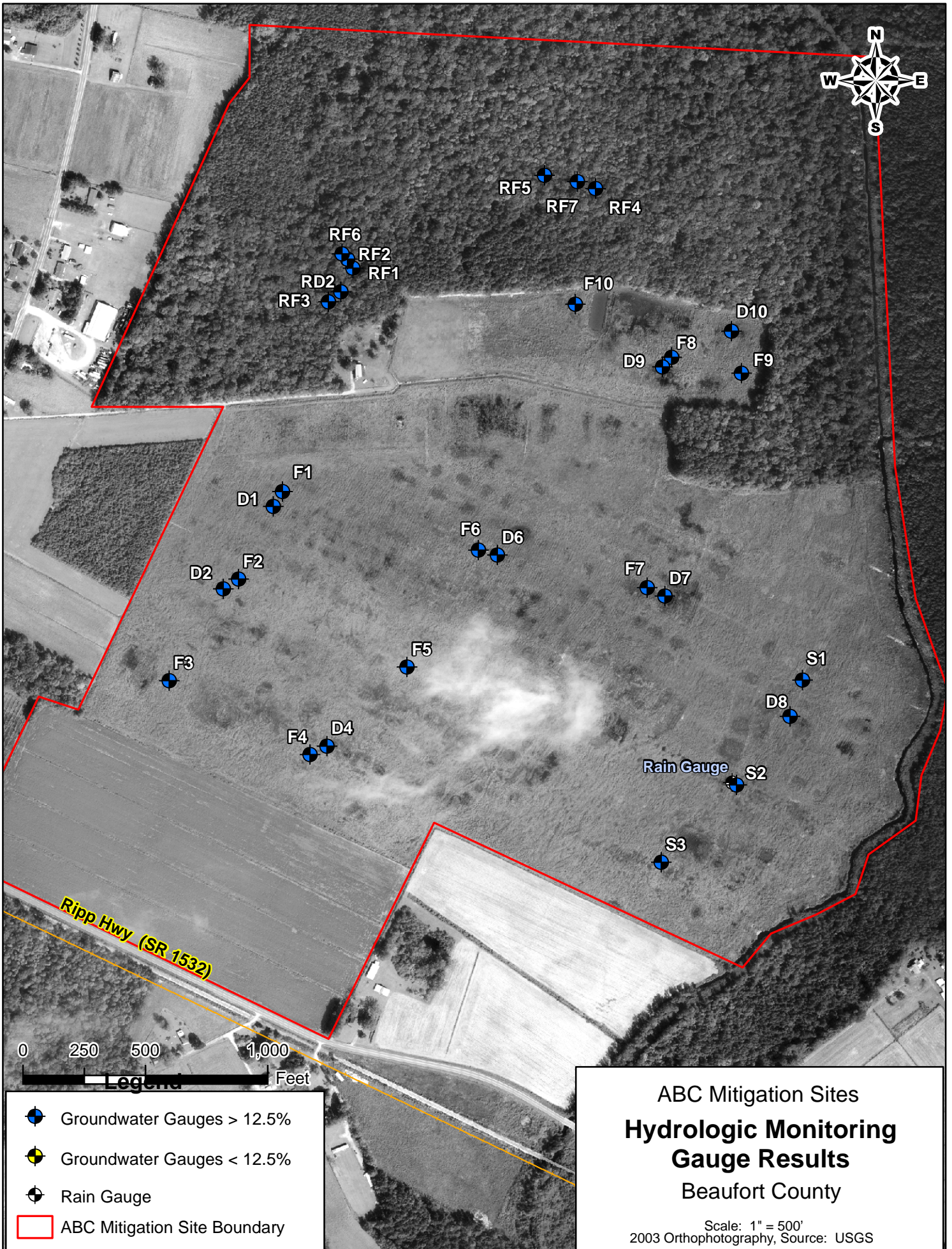
Table 1. 2005 Hydrologic Monitoring Results

Monitoring Gauge	< 5%	5 – 8%	8 – 12%	> 12.5%	Actual %	Success Dates
Depressions	D1+			x	62.1	March 13-June 26 July 3-August 24
	D2+			x	82.8	March 13-July 27 June 30-August 24 October 8-November 25
	D4+			x	72.7	March 13-August 30 October 8-November 25
	D6+			x	55.5	March 13-May 4 July 7-August 15 October 8-November 25
	D7+			x	83.6	March 13-June 22 June 30-August 30 October 8-November 25
	D8+			x	34.0	March 13-April 27 October 8-November 17
	D9+			x	37.1	March 13-May 3 October 8-November 19
	D10			x	39.3	June 30-August 19 October 7-November 25
	S1+			x	100	March 13-November 25
	S2+			x	100	March 13-November 25

Monitoring Gauge		< 5%	5 – 8%	8 – 12%	> 12.5%	Actual %	Success Dates
	S3+				x	100	March 13-November 25
Base Elevation	F1+				x	98.0	March 13-October 17 October 25-November 25
	F2+				x	71.5	March 13-May 30 June 29-August 21 October 7-November 25
	F3+				x	31.1	March 13-April 25 October 8-November 12
	F4+				x	72.3	March 13-May 31 June 29-August 21 October 7-November 25
	F5+				x	100	March 13-November 25
	F6+				x	70.7	March 13-May 28 June 29-August 21 October 7-November 25
	F7+				x	88.3	March 13-September 2 October 5-November 25
	F8+				x	30.5	March 13-April 25 October 7-November 10
	F9+				x	15.6	March 13-April 21
	F10+				x	32.8	March 13-April 27 October 8-November 14
Reference	RD2+				x	16.8	March 13-April 23
	RF1+				x	32.4	March 13-April 28 October 8-November 12
	RF2+				x	36.3	March 13-May 3 October 8-November 17
	RF3				x		October 8-November 25
	RF4				x		October 8-November 25
	RF5+				x	44.9	March 13-May 29 October 12-November 17
	RF6+				x	46.1	March 13-May 28 October 8-November 17
RF7+				x	36.3	March 13-May 3 October 8-November 17	

+ Gauge met the success criterion during an average rainfall month March, April, May, and September.

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ABC Mitigation Sites
**Hydrologic Monitoring
 Gauge Results**
 Beaufort County

Scale: 1" = 500'
 2003 Orthophotography, Source: USGS

Figure 3

2.3.2 Climatic Data

The majority of the ABC Site is characterized as a precipitation driven system; the wetland hydroperiod is completely dependent upon local weather patterns. Figure 4 is a comparison of monthly rainfall for the period of November 2004 through September 2005 to historical precipitation (collected between 1973 and 2004) for Washington, North Carolina. The rainfall data was collected from the onsite rain gauge and the NC State Climate Office provided the historical rainfall information. This comparison gives an indication of how 2005 relates to historical data in terms of climate conditions.

For 2005, average rainfall occurred in March, April, May and September. January, February and August were below average while June, July and October were above average.

2.4 Conclusions

Hydrologic data for 2005 indicates that all of the twenty-nine monitoring gauges (both onsite and reference) exceeded the success criteria of 12.5% of the growing season during an average rainfall year. The site data also correlated well with similar data collected on the reference wetland.

ABC 30-70 Percentile Graph
Washington, NC

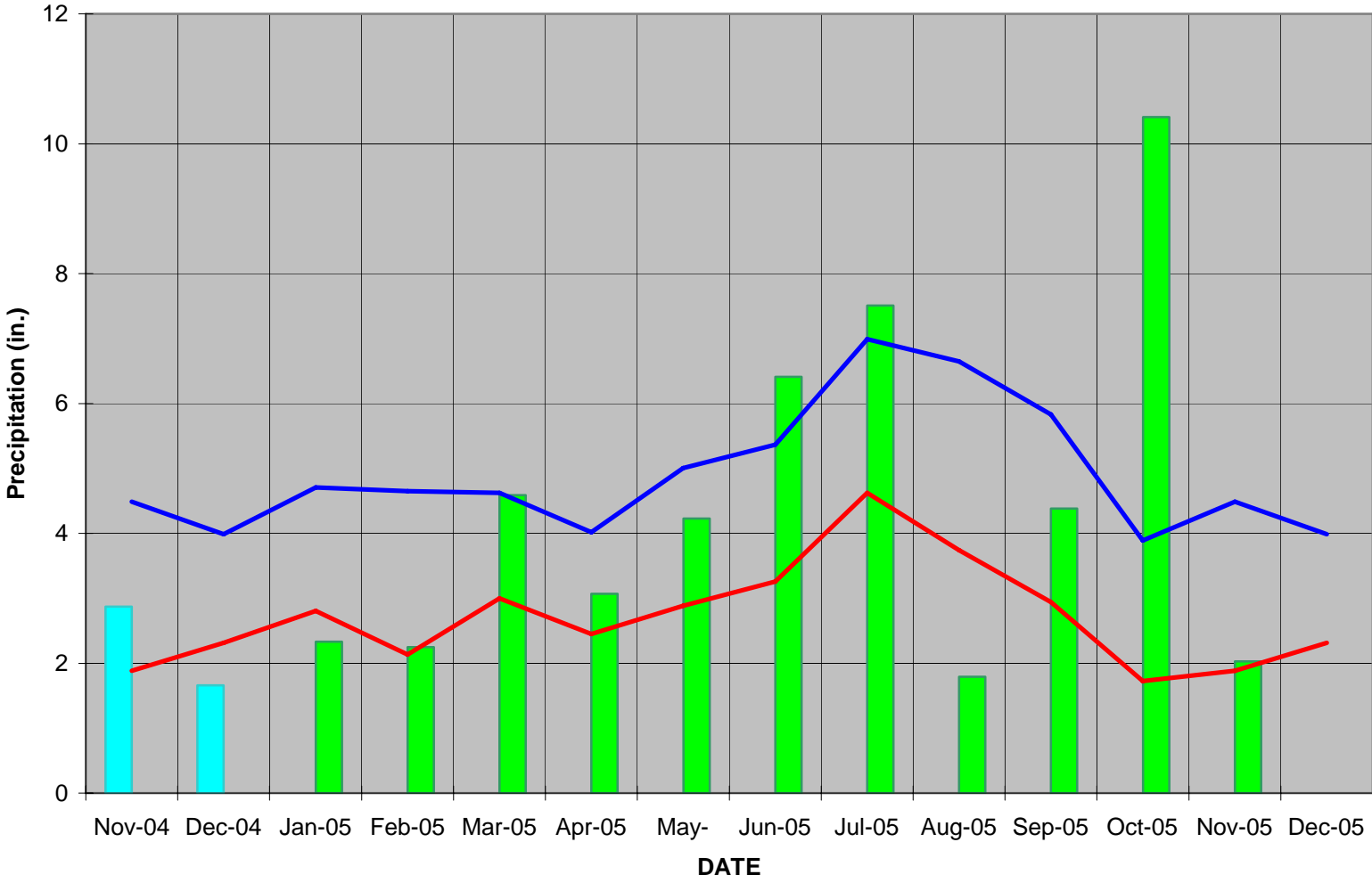


Figure 4

2004 Rainfall 2005 Rainfall 30th Percentile 70th Percentile

3.0 VEGETATION (YEAR 5 MONITORING)

3.1 Success Criteria

The success criteria state that there must be a minimum of 320 trees per acre living for at least three consecutive years. A minimum of 290 trees per acre must be living at year 4 and a minimum of 260 trees per acre must be living at year 5.

3.2 Description of Species

The following tree species were planted in the Wetland Restoration Area:

Zone 1: Levee/Streambank Forest

Taxodium distichum, Baldcypress
Nyssa sylvatica var. *biflora*, Swamp Blackgum
Quercus laurifolia, Laurel Oak
Quercus lyrata, Overcup Oak
Quercus phellos, Willow Oak
Betula nigra, River Birch

Zone 2: Riverine Swamp Forest

Taxodium distichum, Baldcypress
Quercus laurifolia, Laurel Oak
Quercus lyrata, Overcup Oak
Quercus phellos, Willow Oak
Fraxinus pennsylvanica, Green Ash
Quercus michauxii, Swamp Chestnut Oak

Zone 3: Mesic Hardwood Forest

Fraxinus pennsylvanica, Green Ash
Quercus michauxii, Swamp Chestnut Oak
Quercus falcata var. *pagodaefolia*, Cherrybark Oak
Liriodendron tulipifera, Tulip Poplar
Quercus rubra, Northern Red Oak
Quercus alba, White Oak

Zone 4: Non-Riverine Wet Hardwood Forest

Nyssa sylvatica var. *biflora*, Swamp Blackgum
Quercus laurifolia, Laurel Oak
Quercus lyrata, Overcup Oak
Quercus phellos, Willow Oak
Fraxinus pennsylvanica, Green Ash

Quercus michauxii, Swamp Chestnut Oak

Zone 5: Dry Mesic Oak/Hickory Forest

Quercus rubra, Northern Red Oak

Quercus alba, White Oak

Carya tomentosa, Mockernut Hickory

Nyssa sylvatica var. *sylvatica*, Blackgum

Carya glabra var. *glabra*, Pignut Hickory

Quercus falcata var. *falcata*, Southern Red Oak

3.3 Results of Vegetation Monitoring

Table 2. 2005 Vegetation Monitoring Results

ZONE	Plot #	Baldcypress	Swp. Blackgum	Laurel Oak	Overcup Oak	Willow Oak	River Birch	Green Ash	Swp. Chestnut Oak	Cherrybark Oak	Tulip Poplar	Northern Red Oak	White Oak	Mockernut Hickory	Blackgum	Pignut Hickory	Southern Red Oak	Total (5 year)	Total (at planting)	Density (Tree/Acre)
1	12	12			1		1		16				3					32	32	680
	13			7	11	4			7									29	35	563
ZONE 1 AVERAGE DENSITY																			621	
2	10	1			11	5				1		2						20	32	425
	11	16			6			10										32	35	659
ZONE 2 AVERAGE DENSITY																			542	
3	8							6		2		3	7					18	33	371
	9									12		3						15	31	329
ZONE 3 AVERAGE DENSITY																			350	
4	1		1		7	20		1										29	31	636
	2		3			5		2	16									26	34	520
	3	5			7	6		1	6									25	31	548
	4	1			18	4		13	1									37	39	645
	5				10	1		18										29	35	563
ZONE 4 AVERAGE DENSITY																			582	
5	6											1	0				11	12	31	263
	7					3						1	3					7	32	148
ZONE 5 AVERAGE DENSITY																			205	
TOTAL AVERAGE DENSITY																			488	

Site Notes:

Zone 1: Other species noted: Goldenrod and fennel.

Zone 2: Other species noted: smartweed, foxtail, fennel, *Aster* sp., ragweed, *Juncus* sp., and *Scirpus* sp.

Zone 3: Other species noted: pine, lespedeza, fennel, briars, and broomsedge.

Zone 4: Other species noted: goldenrod, briars, woolgrass, foxtail, black willow, smartweed, lespedeza, blackberry, fennel, ragweed, *Juncus* sp., *Aster* sp., *Baccharis* sp., *Panicum* sp., and *Eleocharis* sp.

Zone 5: Other species noted: fennel, broomsedge, and ragweed.

3.4 Conclusions

Of the 187 acres that comprise this site, approximately 140.7 acres involved tree planting. There were thirteen vegetation-monitoring plots established throughout the planting areas. The 2005 vegetation monitoring of the planted areas revealed an average density of 488 trees per acre. This is well above the minimum success criteria of 260 trees per acre.

4.0 OVERALL CONCLUSIONS/ RECOMMENDATIONS

All of the twenty-nine groundwater gauges showed saturation in excess of the 12.5% hydrologic success criterion. Overall, onsite gauges exhibited similar results or exceeded the saturation periods recorded in the reference community.

For the 2005 vegetation-monitoring year, the thirteen permanent vegetation plots revealed an average density of 488 trees per acre, which is well above the minimum success criteria of 260 trees per acre.

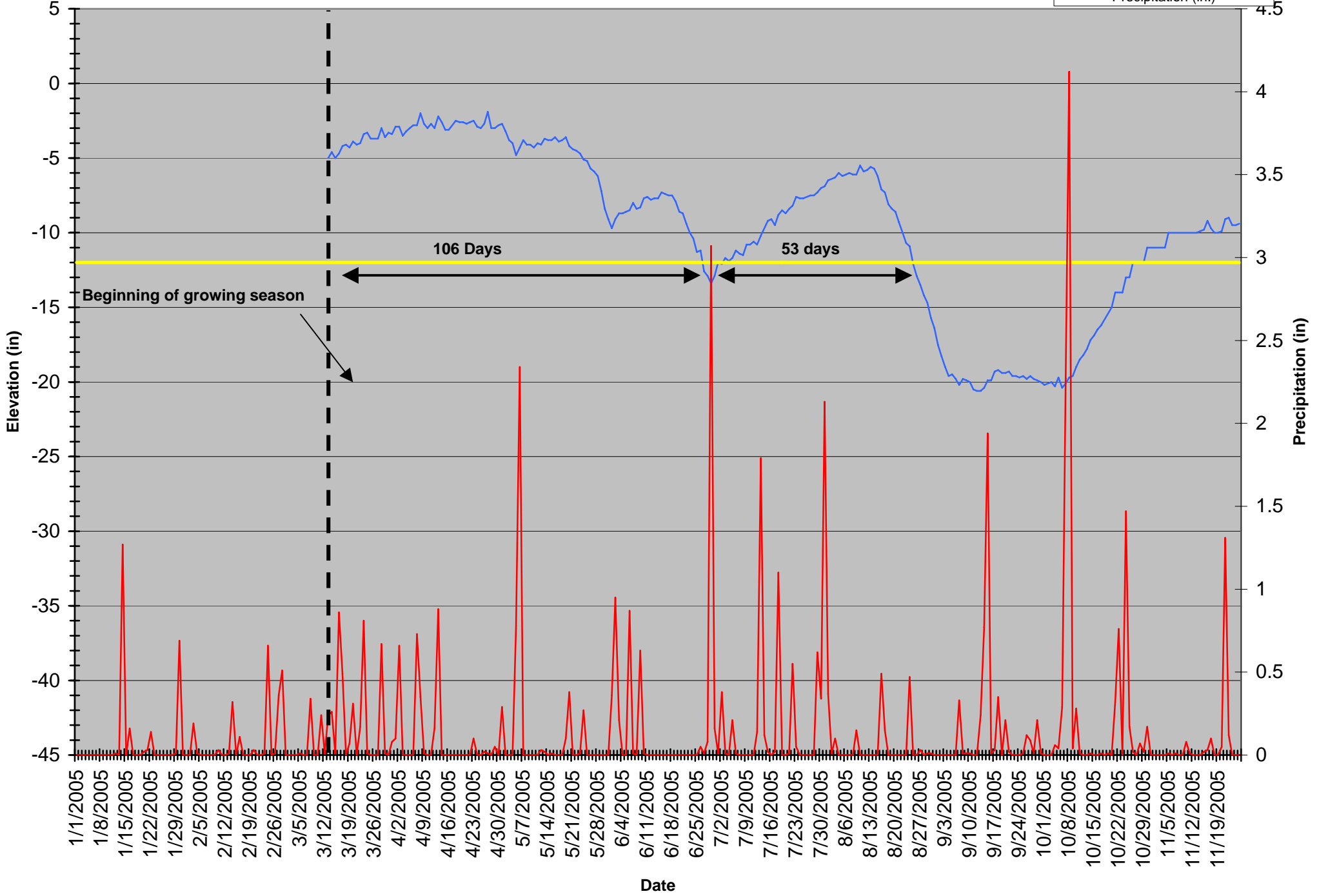
In summary, the ABC Mitigation Site met the success criteria for hydrology at 100% of the onsite monitoring locations, as well as the vegetation criteria in the 2005-monitoring year. The site also exhibits wetland characteristics similar to those in the reference wetland.

The 2005 monitoring year represents the fifth and final year of monitoring for the ABC Wetland Mitigation Site. The site has met all required monitoring success criteria. It is recommended that EEP review this information with associated government agencies and close out the ABC Wetland Mitigation Site.

APPENDIX A
Gauge Data Graphs

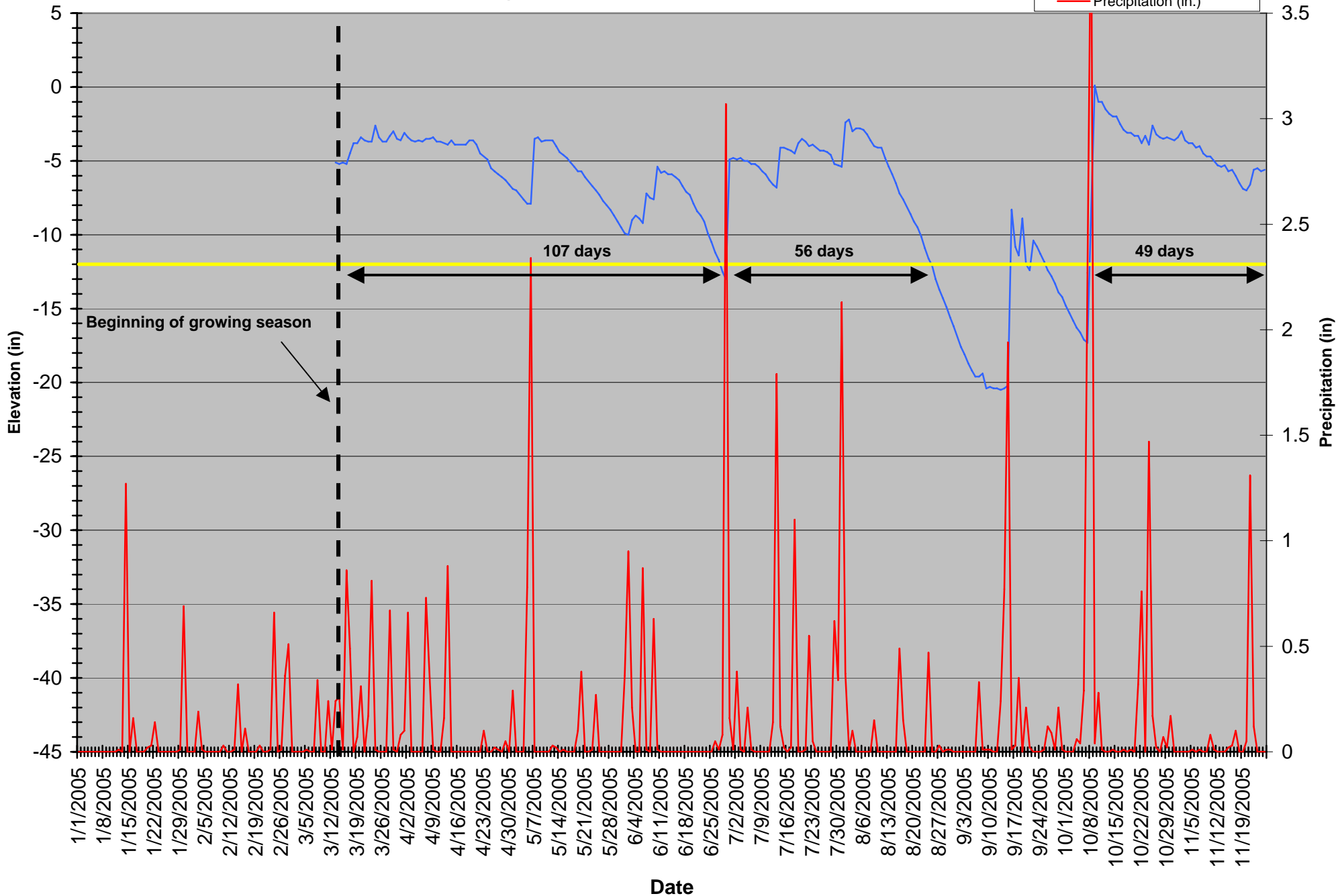
Gauge D1 (S320671)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)

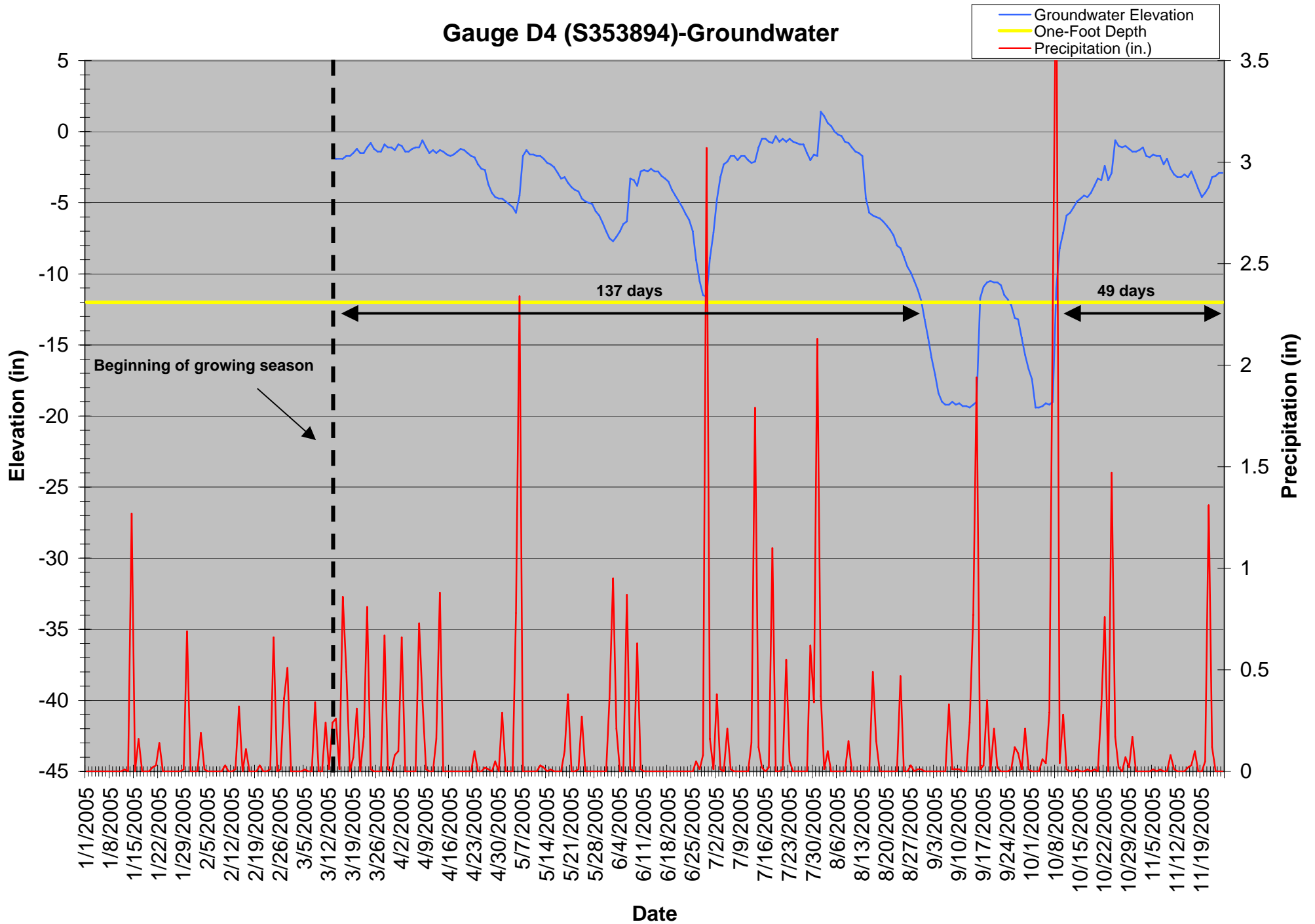


Gauge D2 (S3538FF)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)

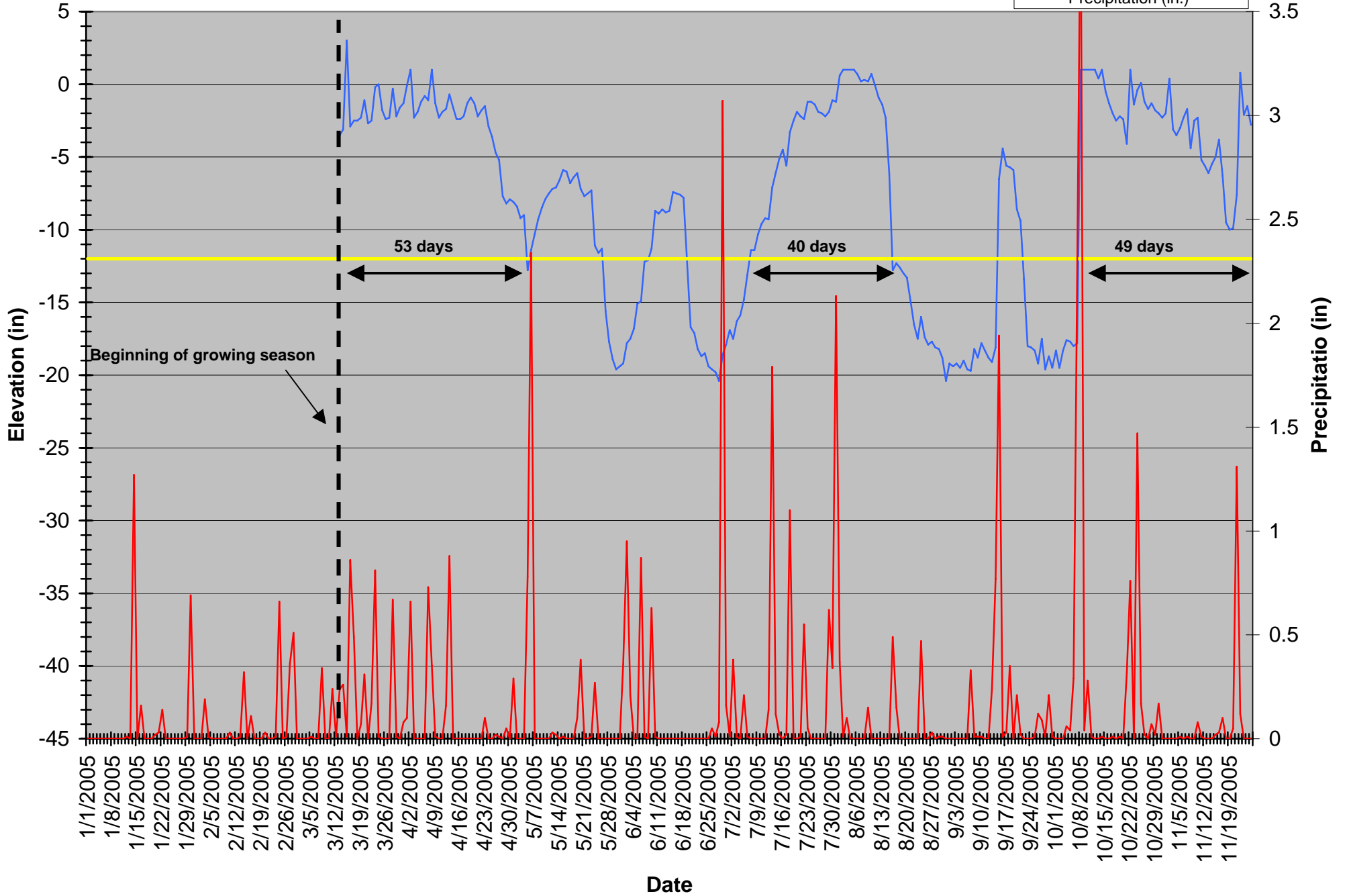


Gauge D4 (S353894)-Groundwater



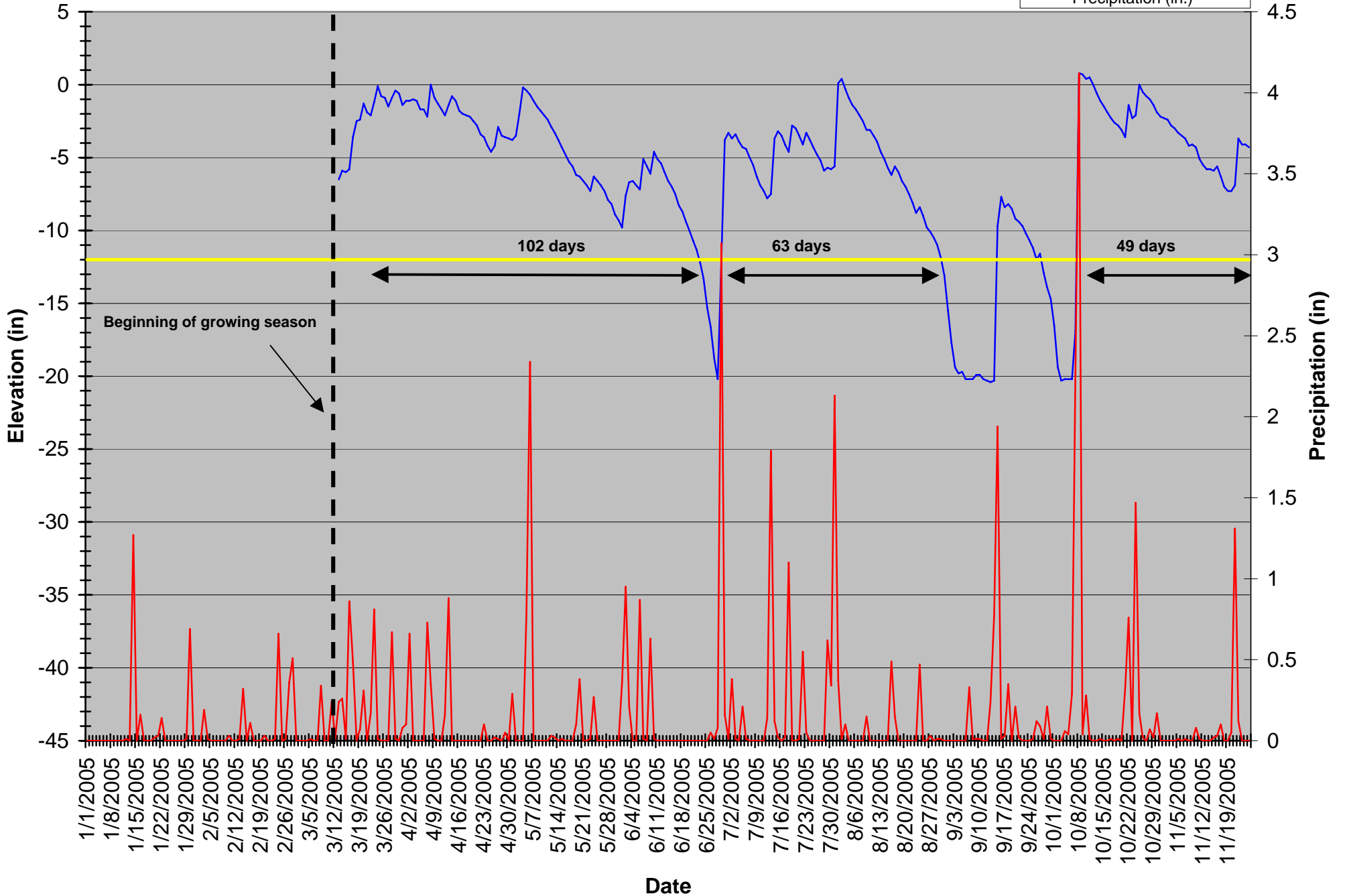
Gauge D6 (S353954)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)



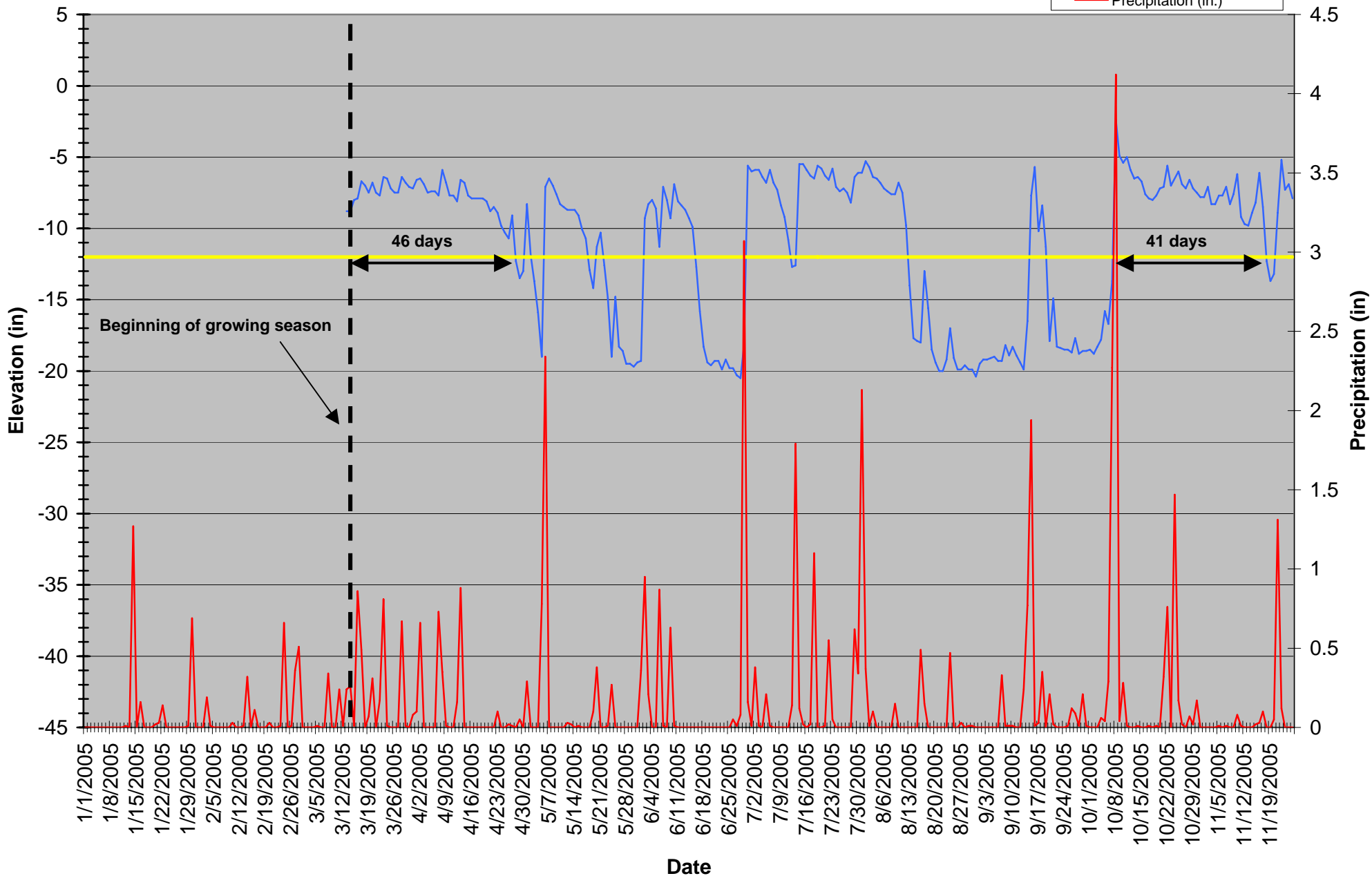
Gauge D7 (S2EAB45)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)



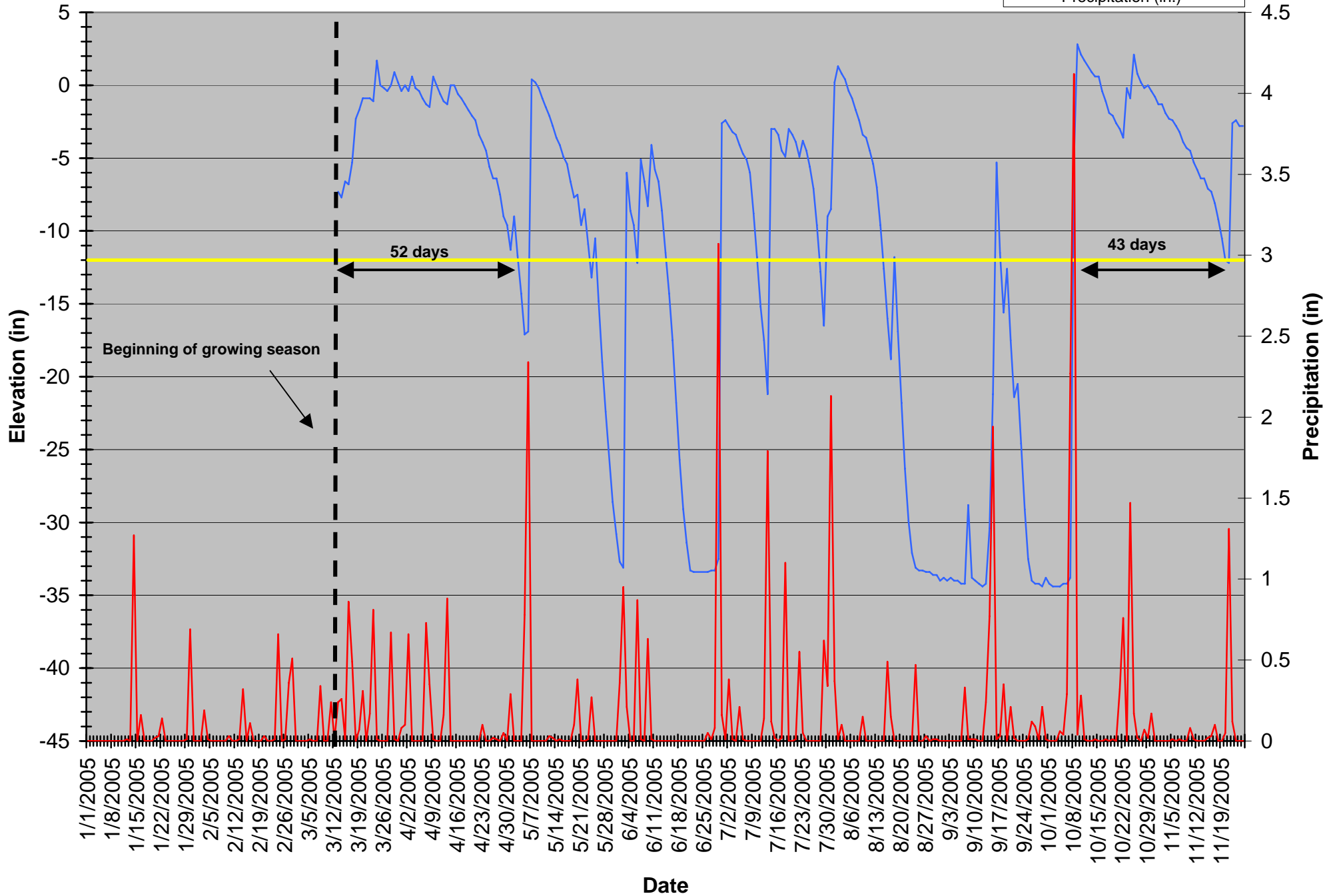
Gauge D8 (S213DAD)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)



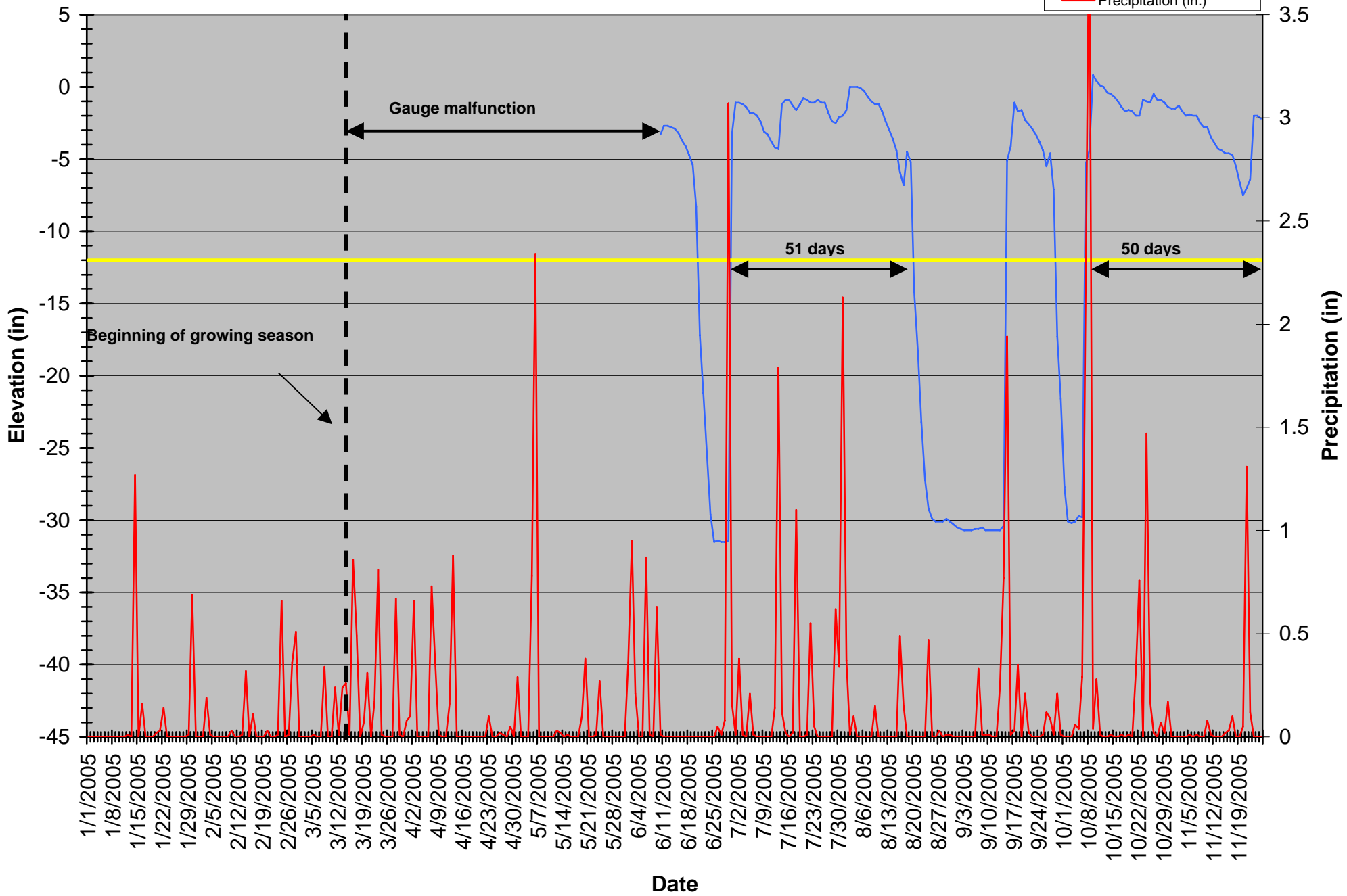
Gauge D9 (S4F53E5)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)



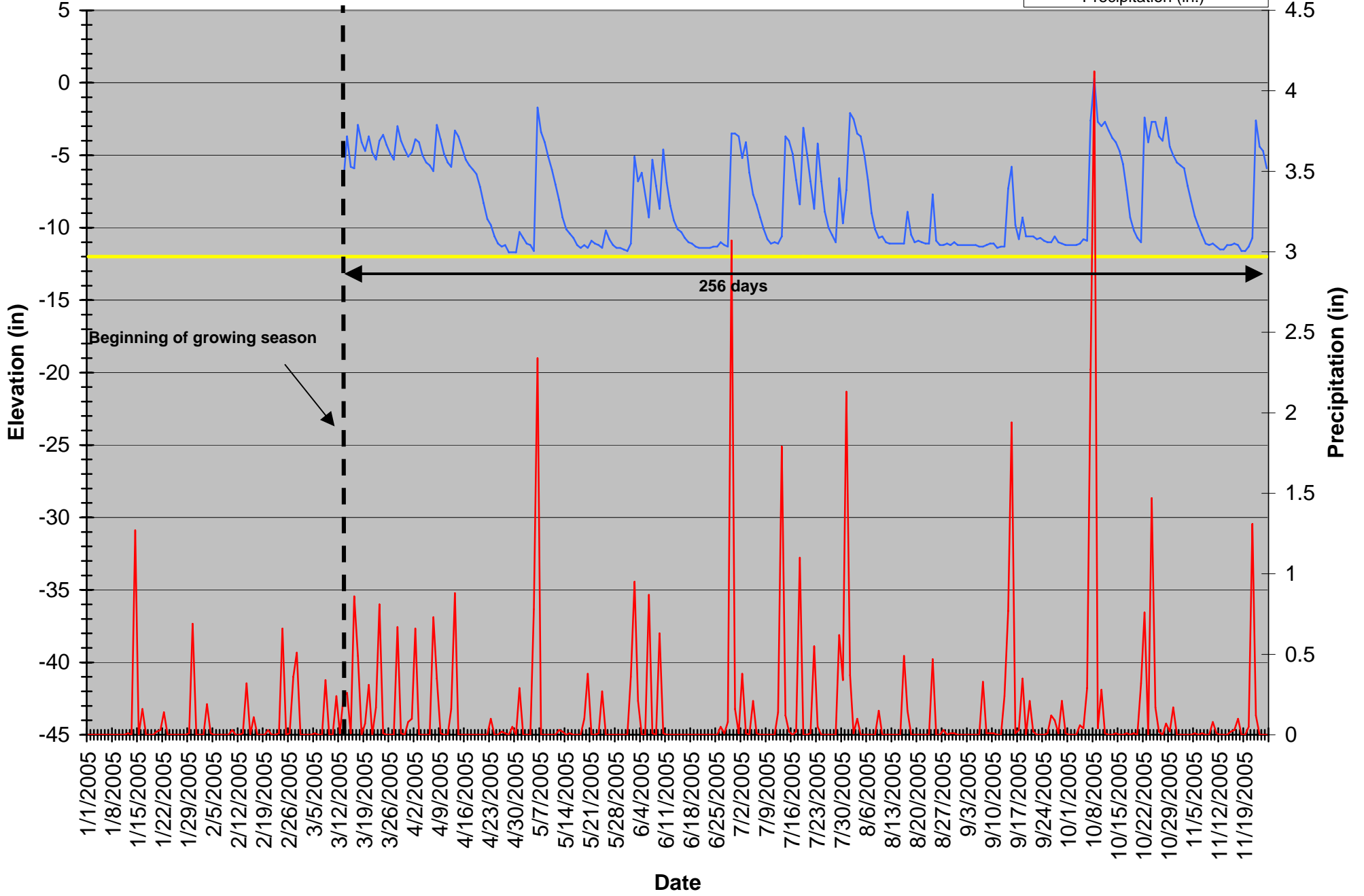
Gauge D10 (B6B7968)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)



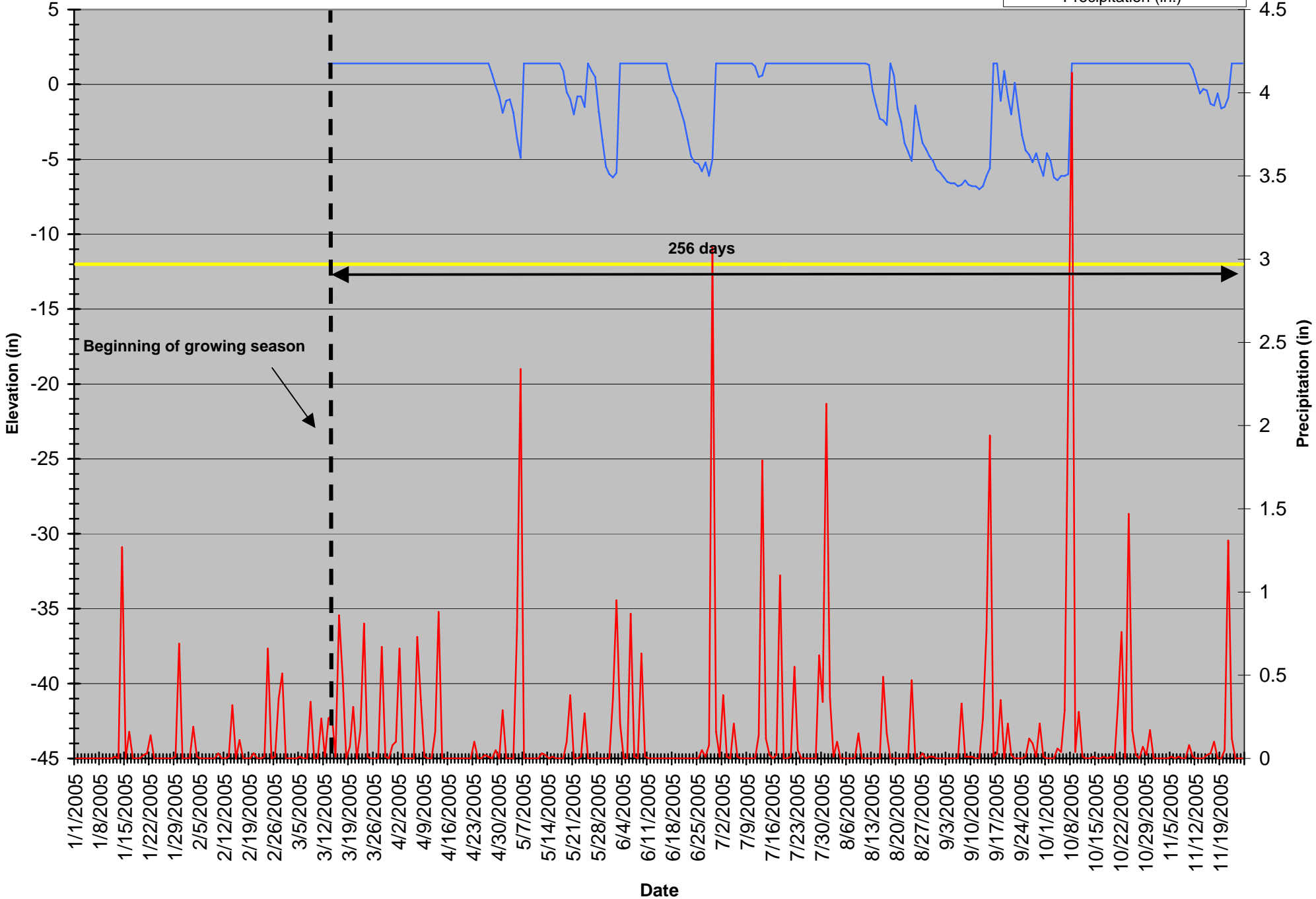
Gauge S1 (S3539DA)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)



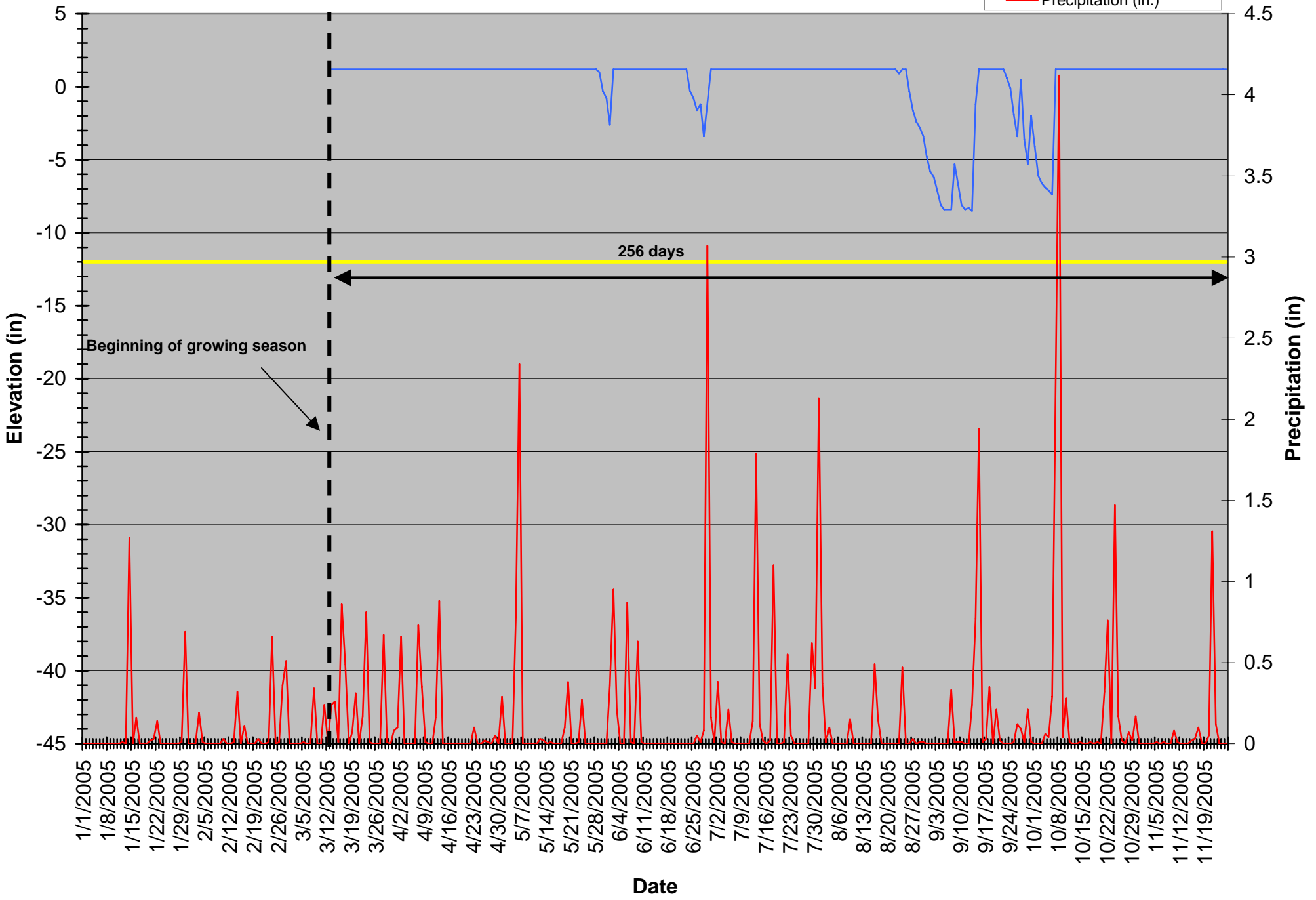
Gauge S2 (S320691)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)



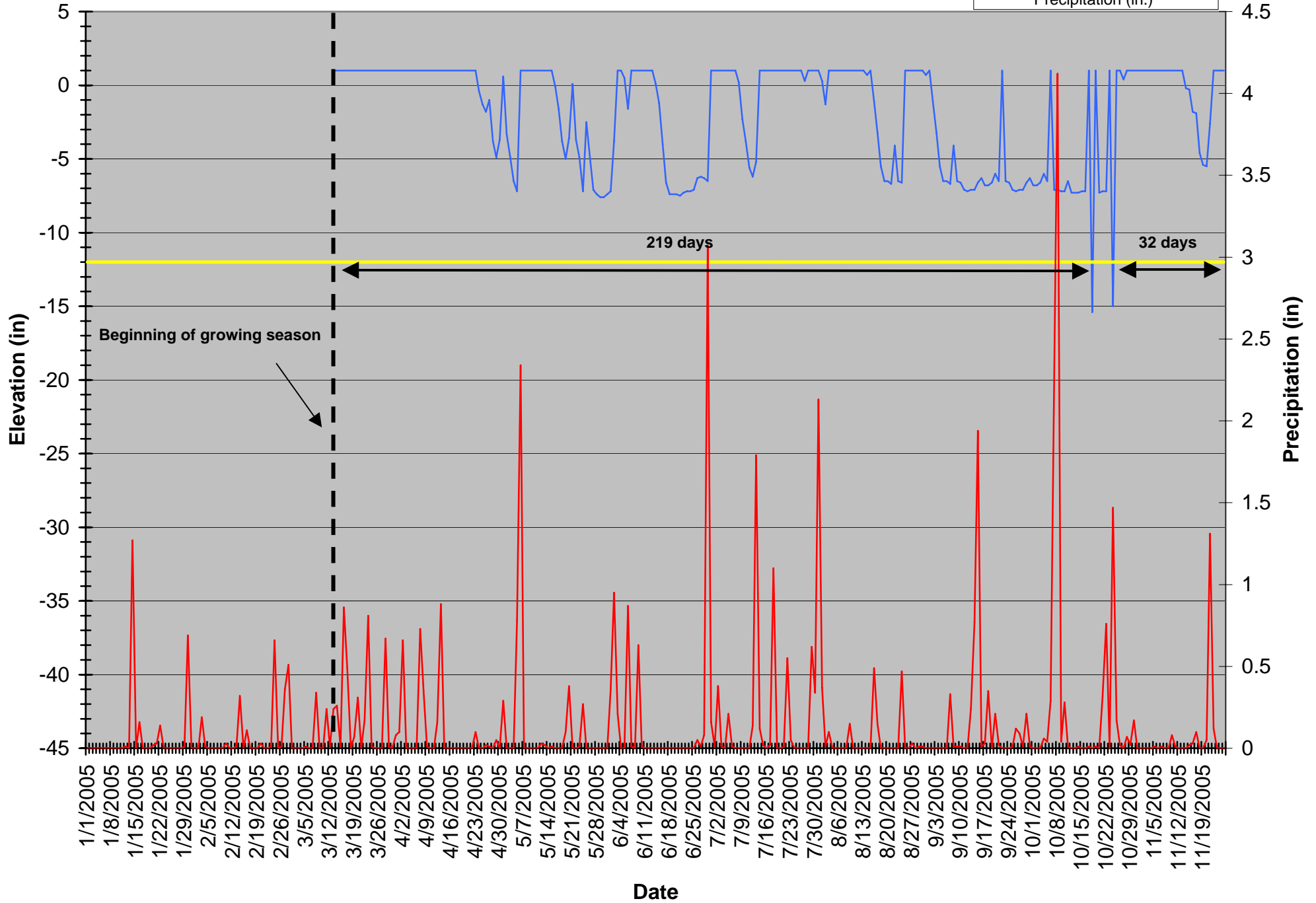
Gauge S3 (S353B52)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)



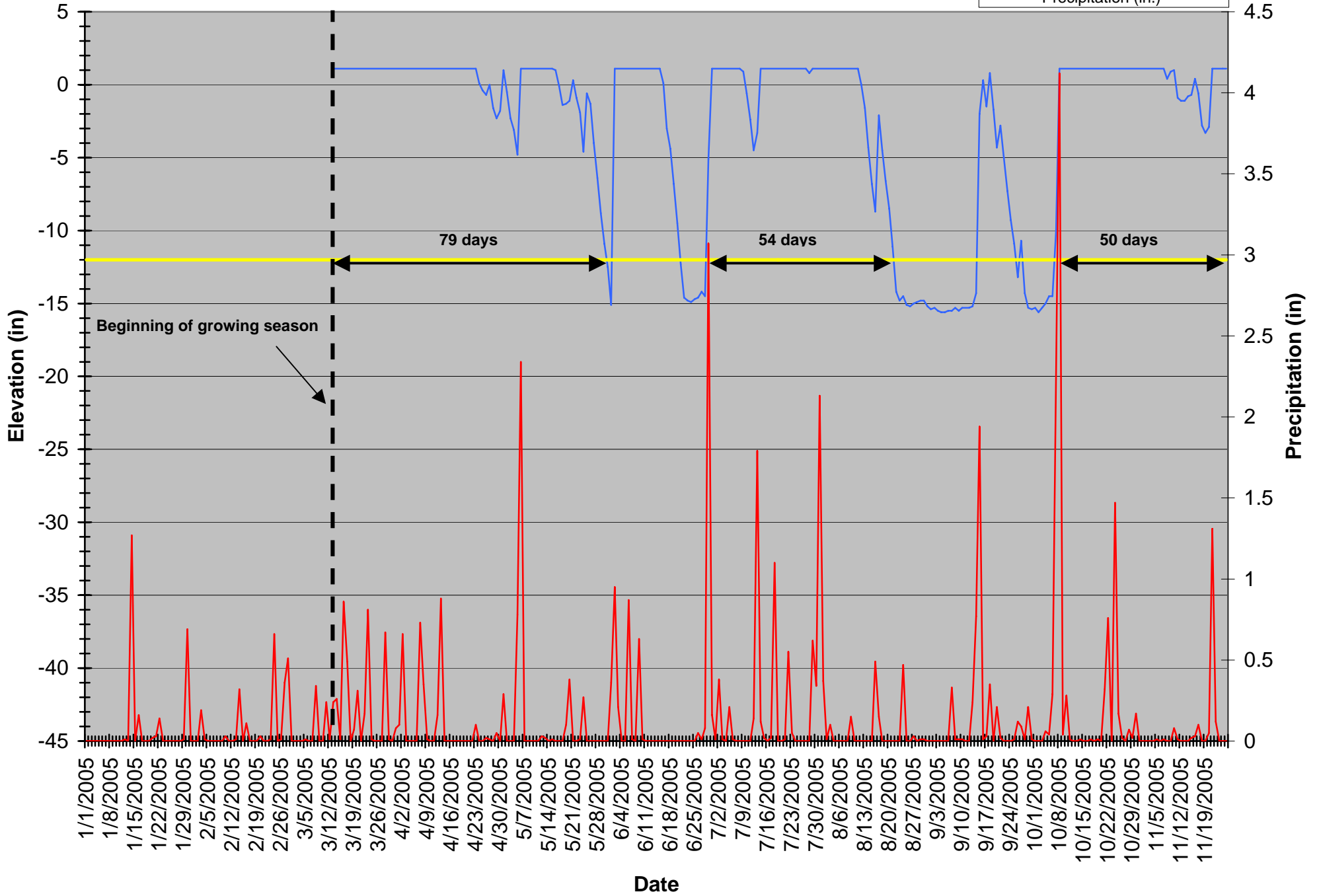
Gauge F1 (S4F5659)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)



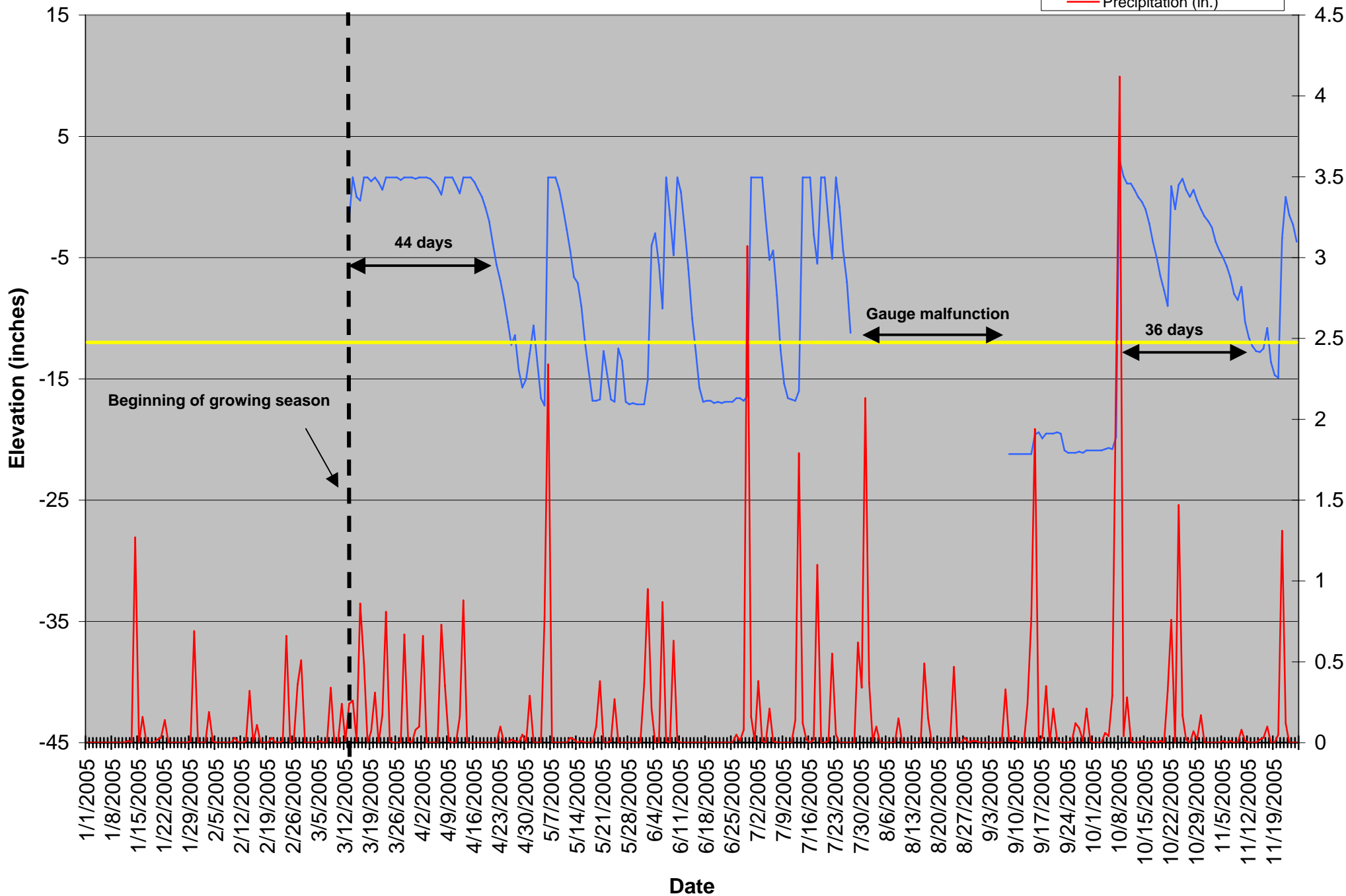
Gauge F2 (S2EAAF1)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)



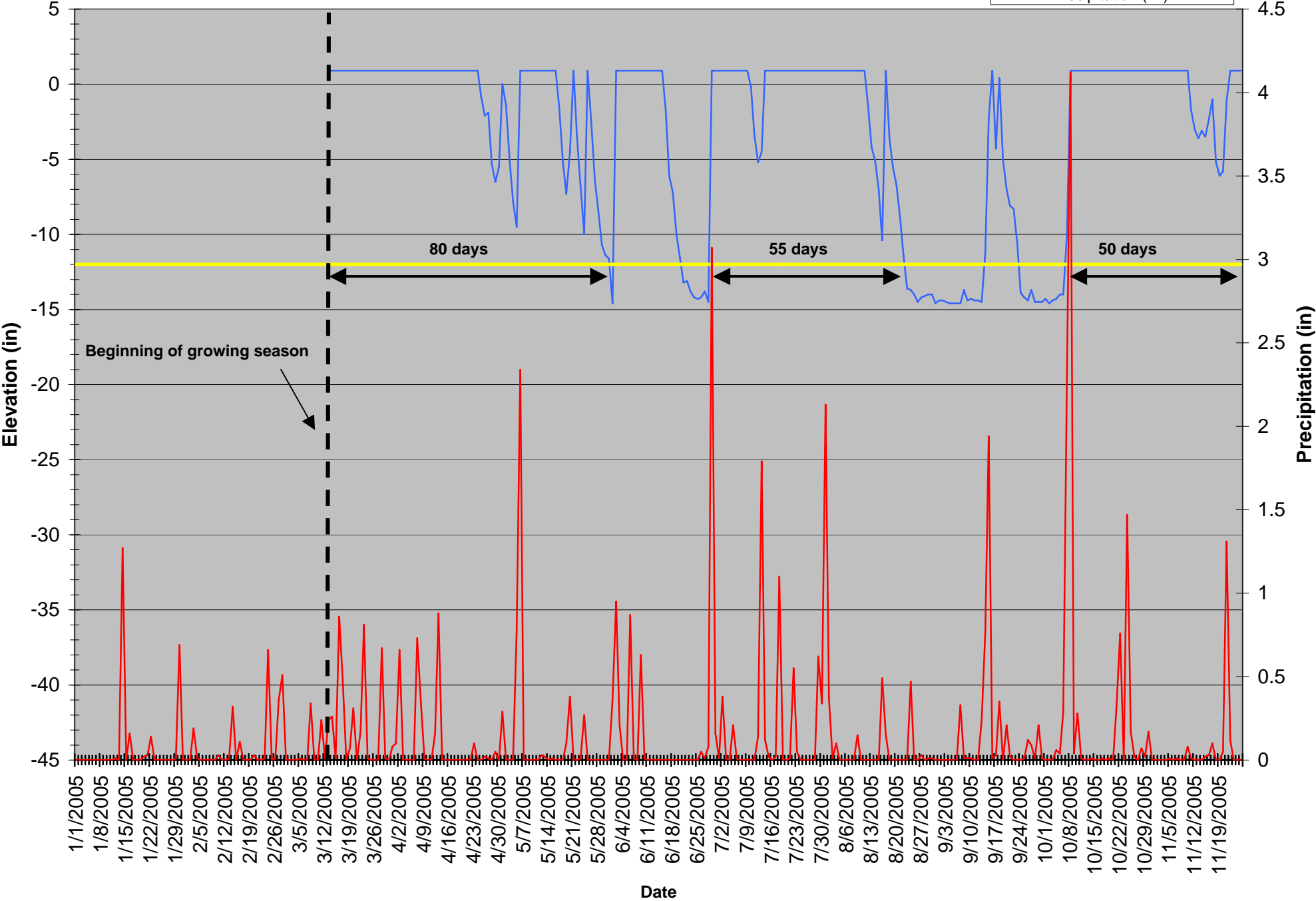
Gauge F3 (S32062A) Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)



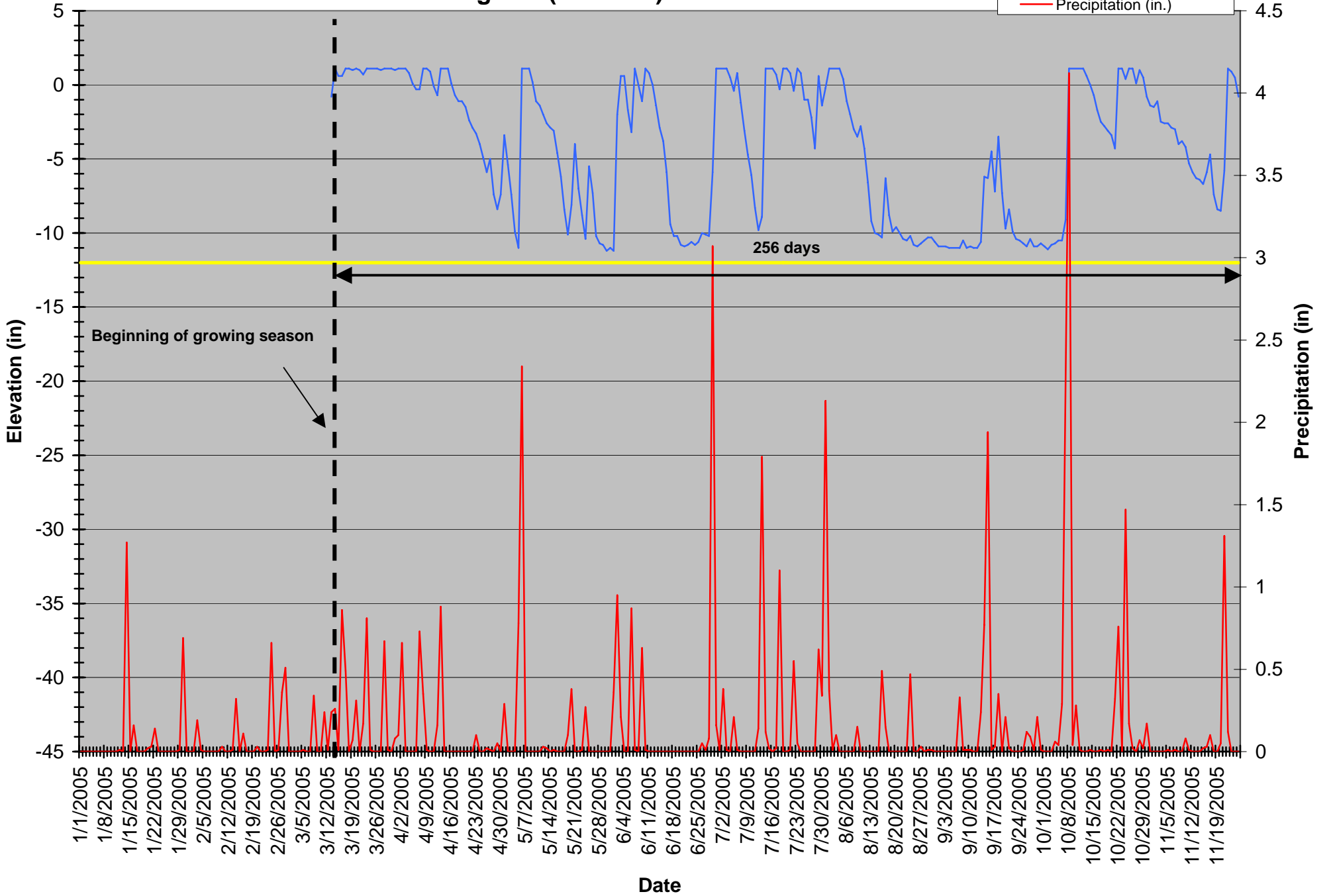
Gauge F4 (S3288CE)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)



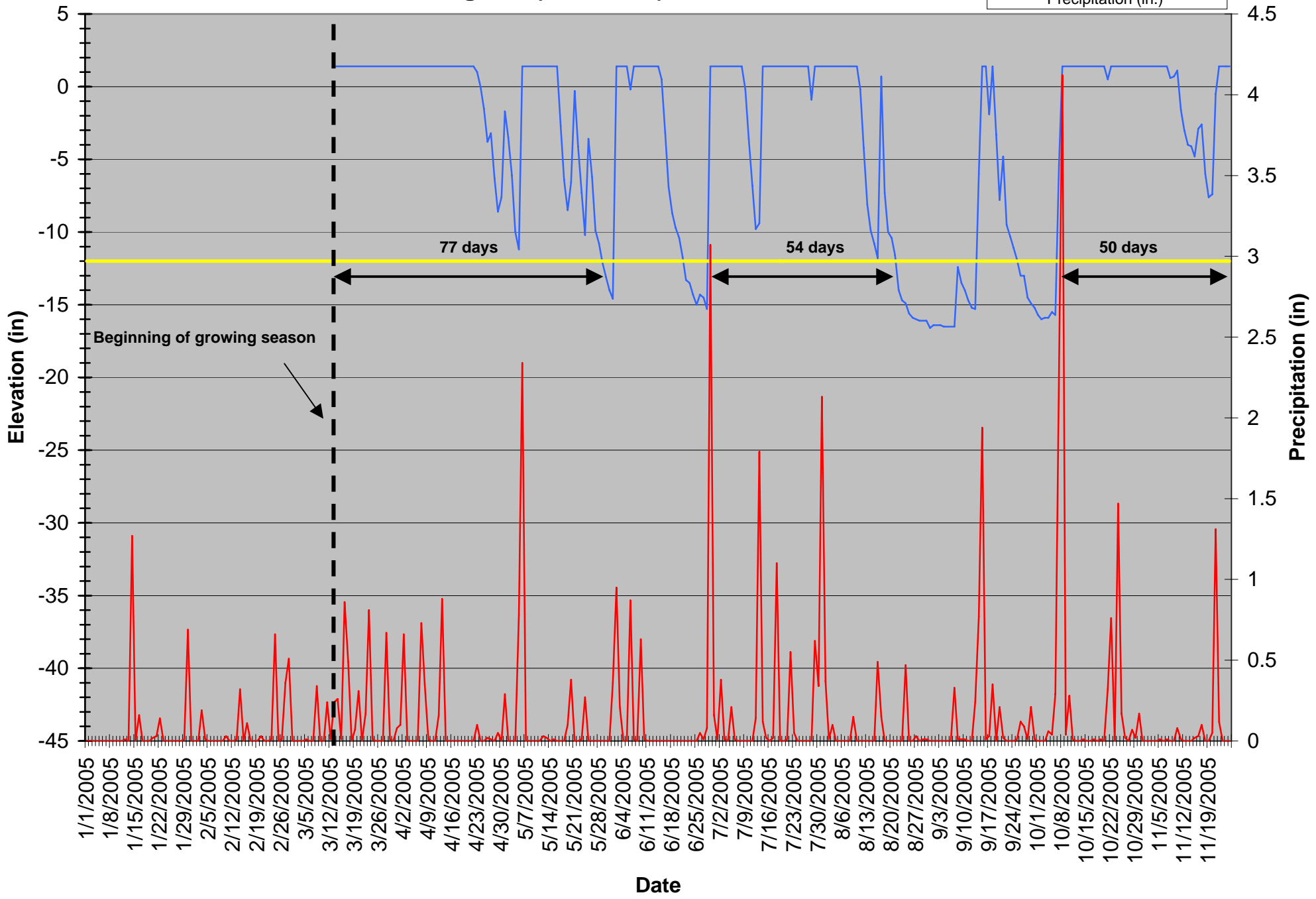
Gauge F5 (S320615)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)



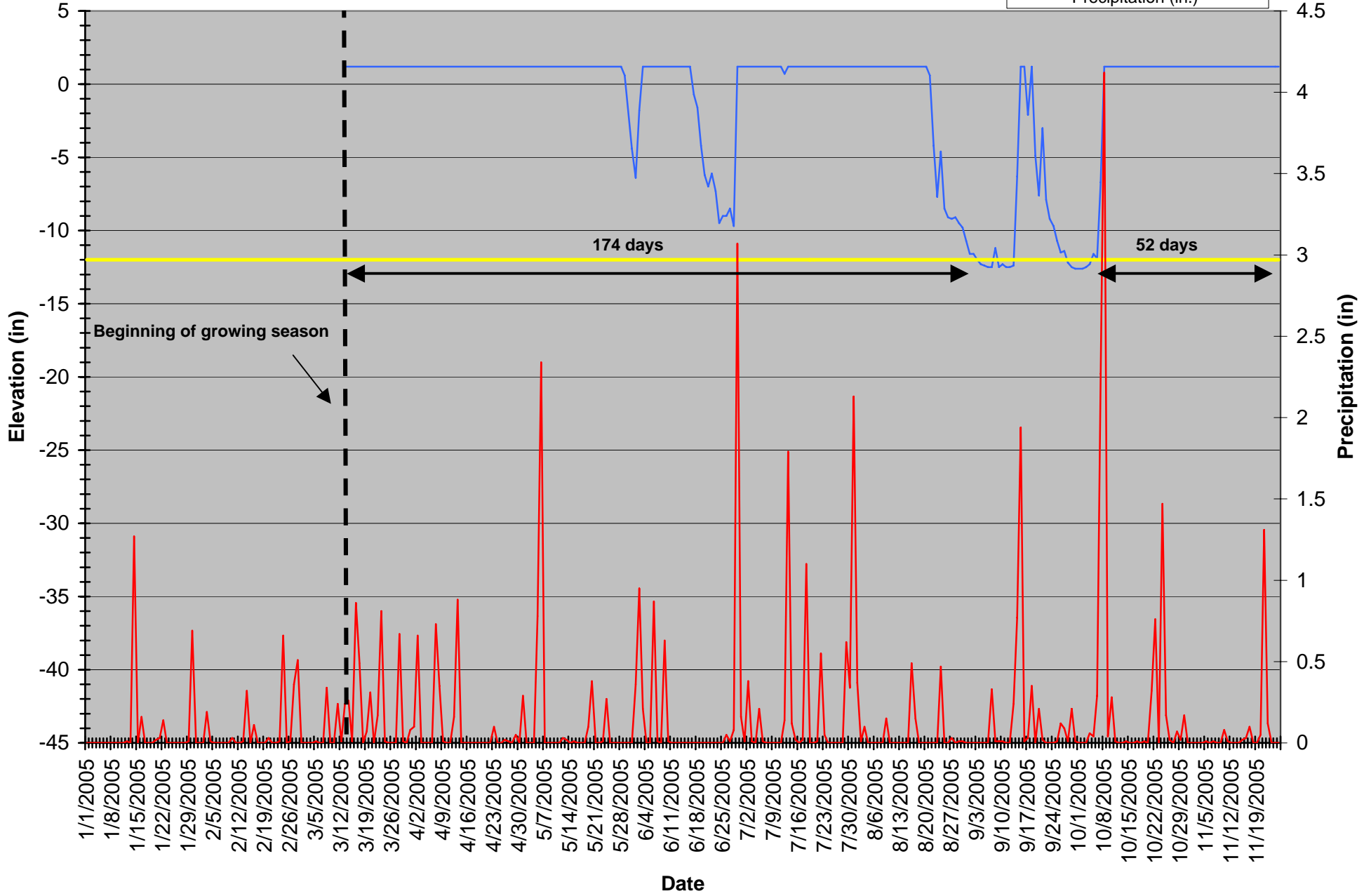
Gauge F6 (S2EAAB1)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)



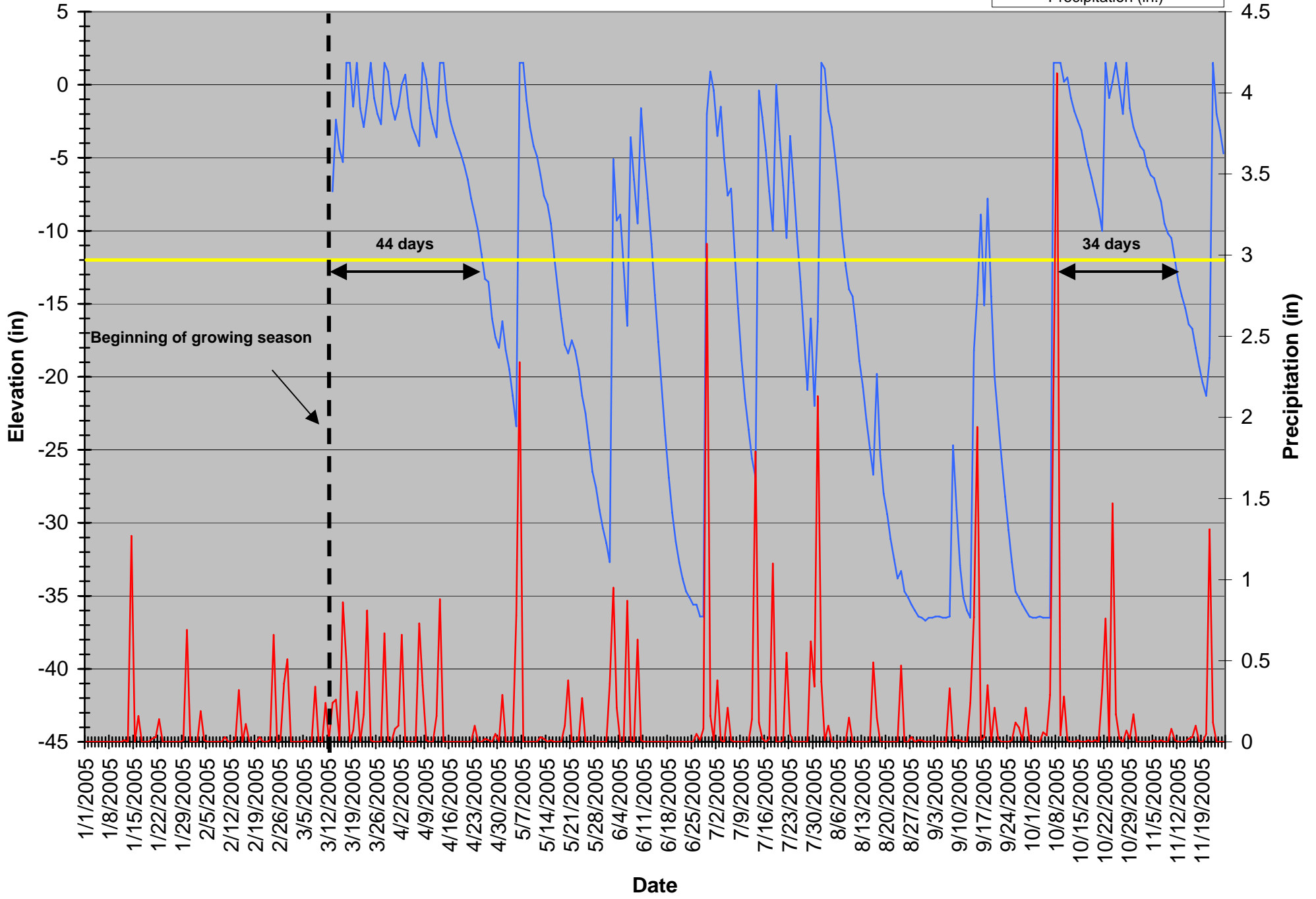
Gauge F7 (S353A93)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)



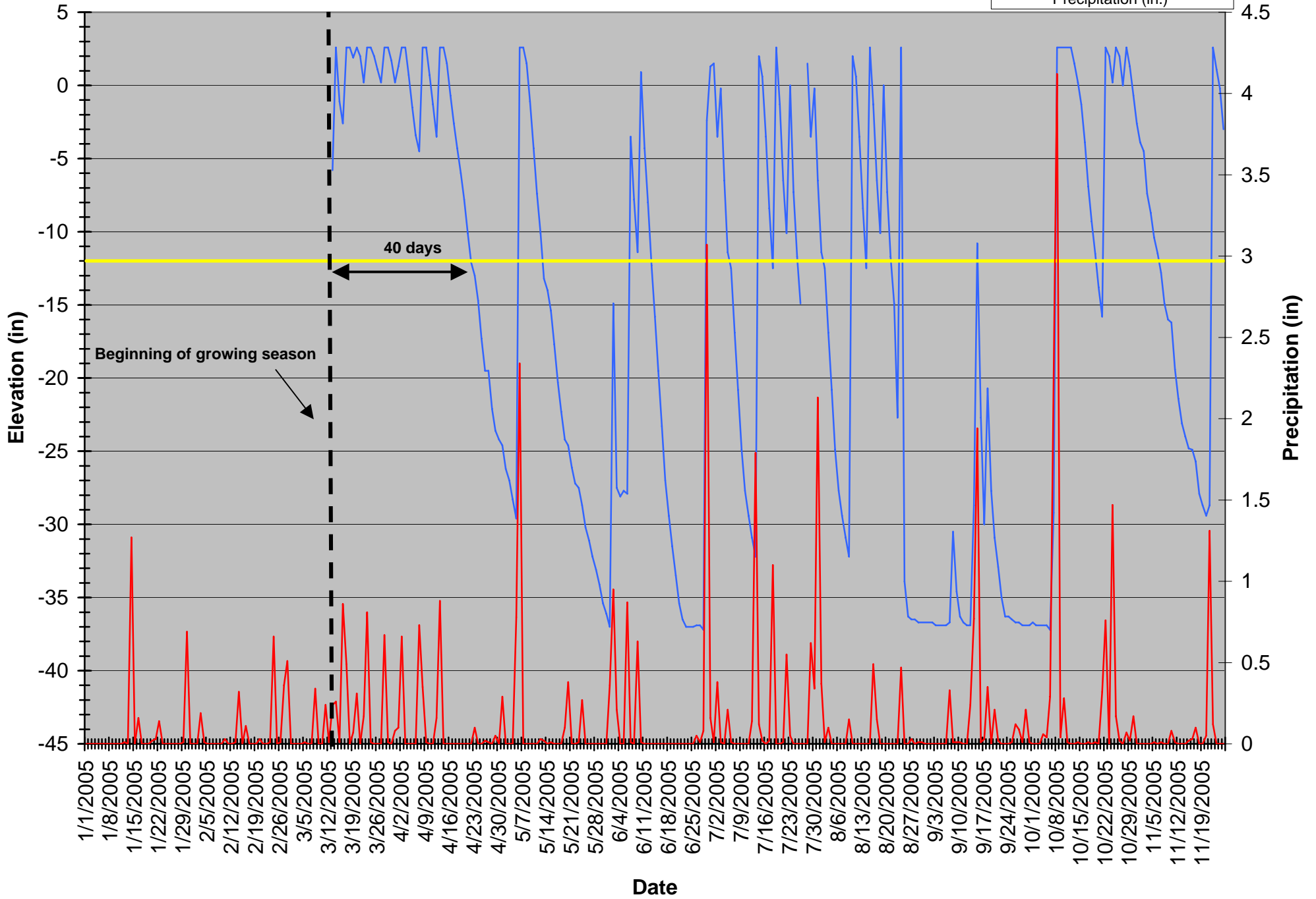
Gauge F8 (S213DA1)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)



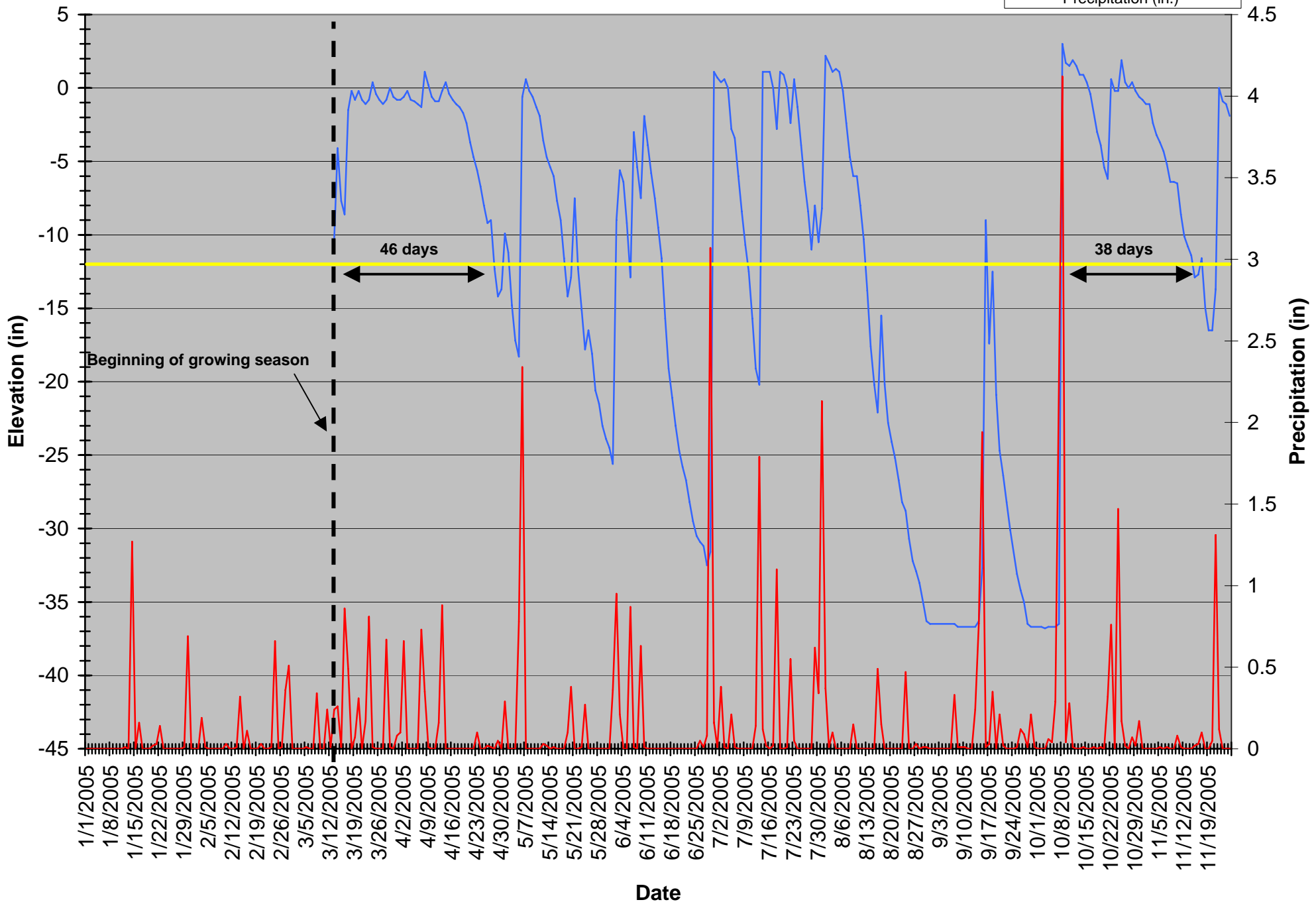
Gauge F9 (S517639)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)



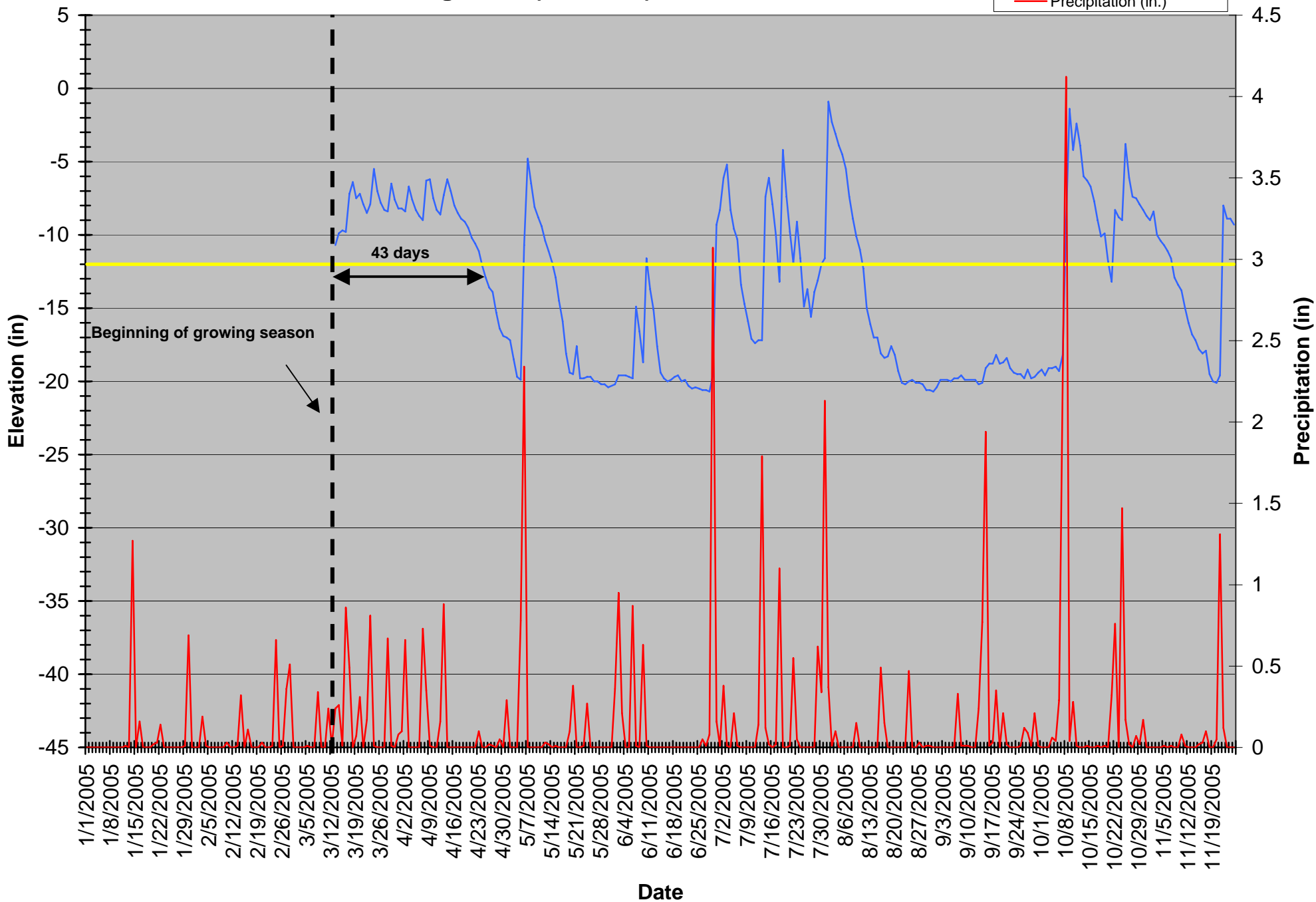
Gauge F10 (S4F5836)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)



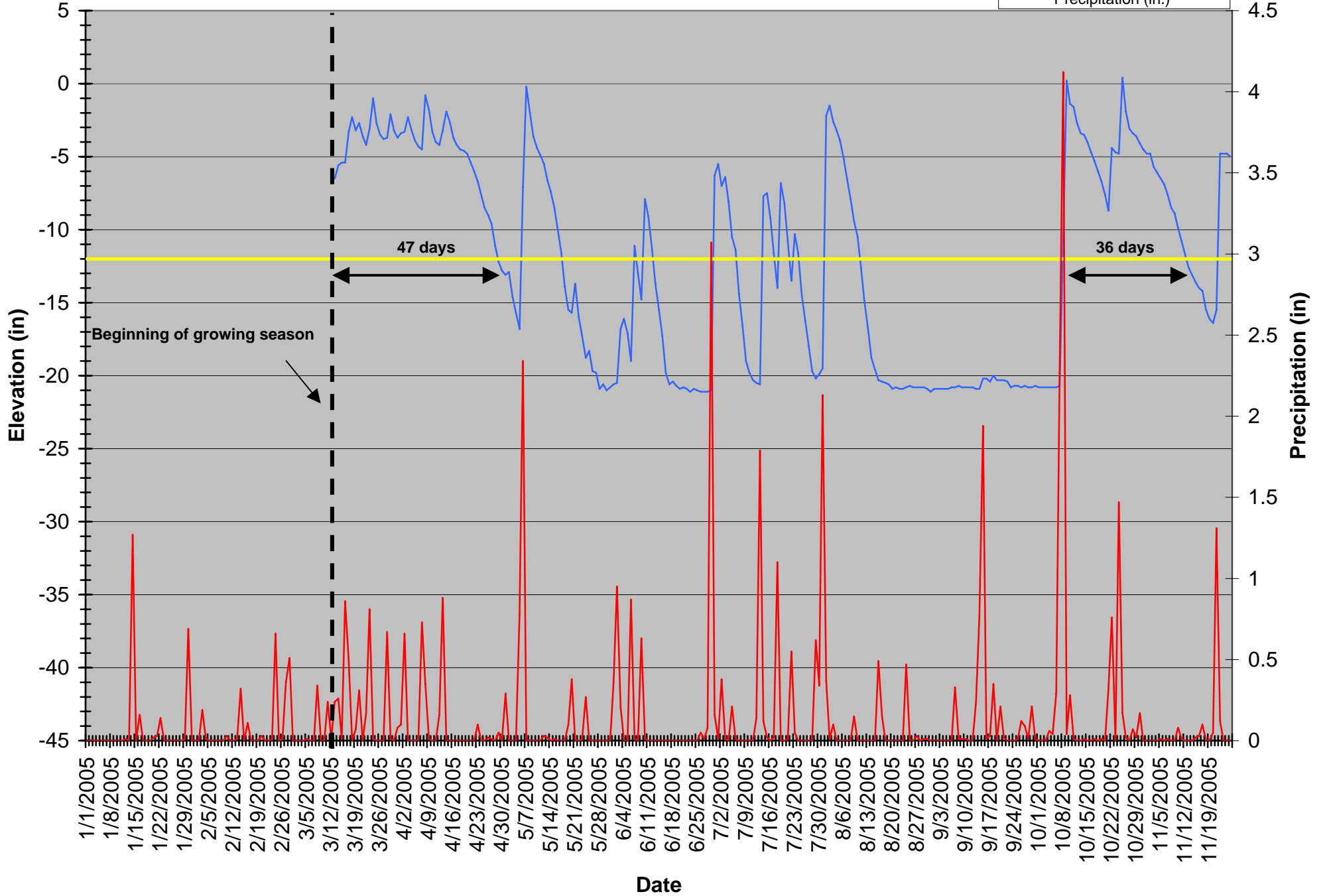
Gauge RD2 (S353B94)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)

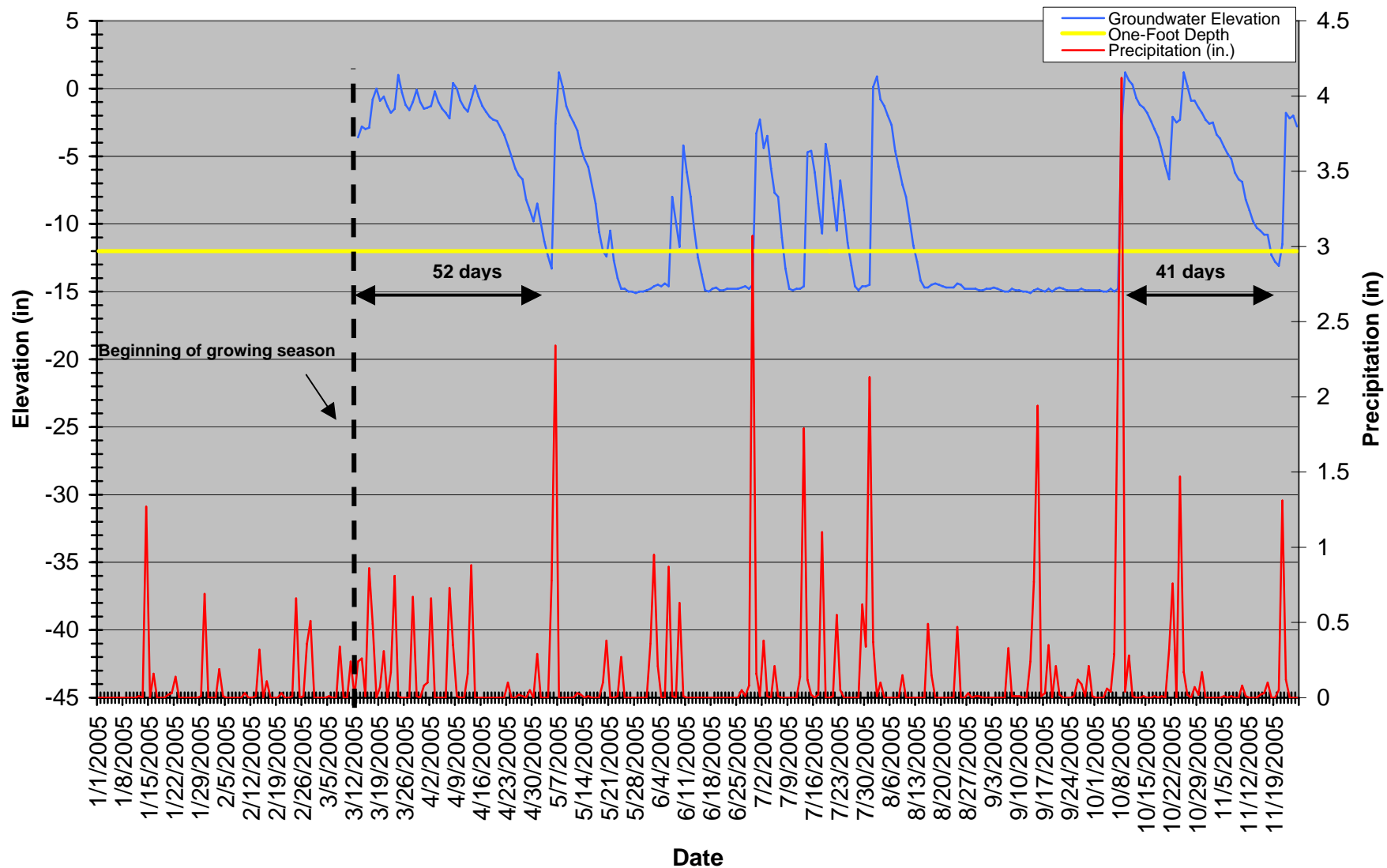


Gauge RF1 (S353A5C)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)

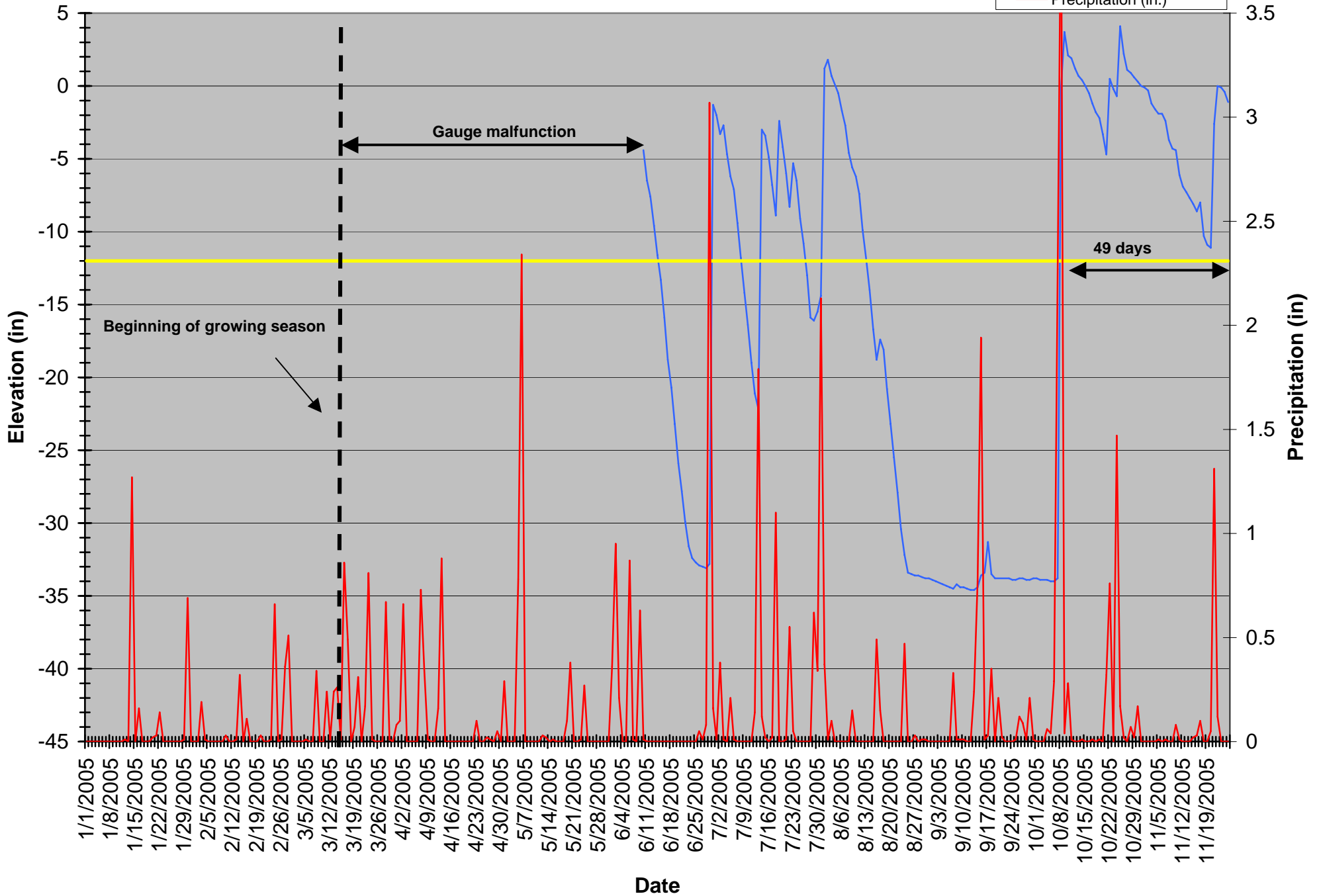


Gauge RF2 (S353AB8)-Groundwater



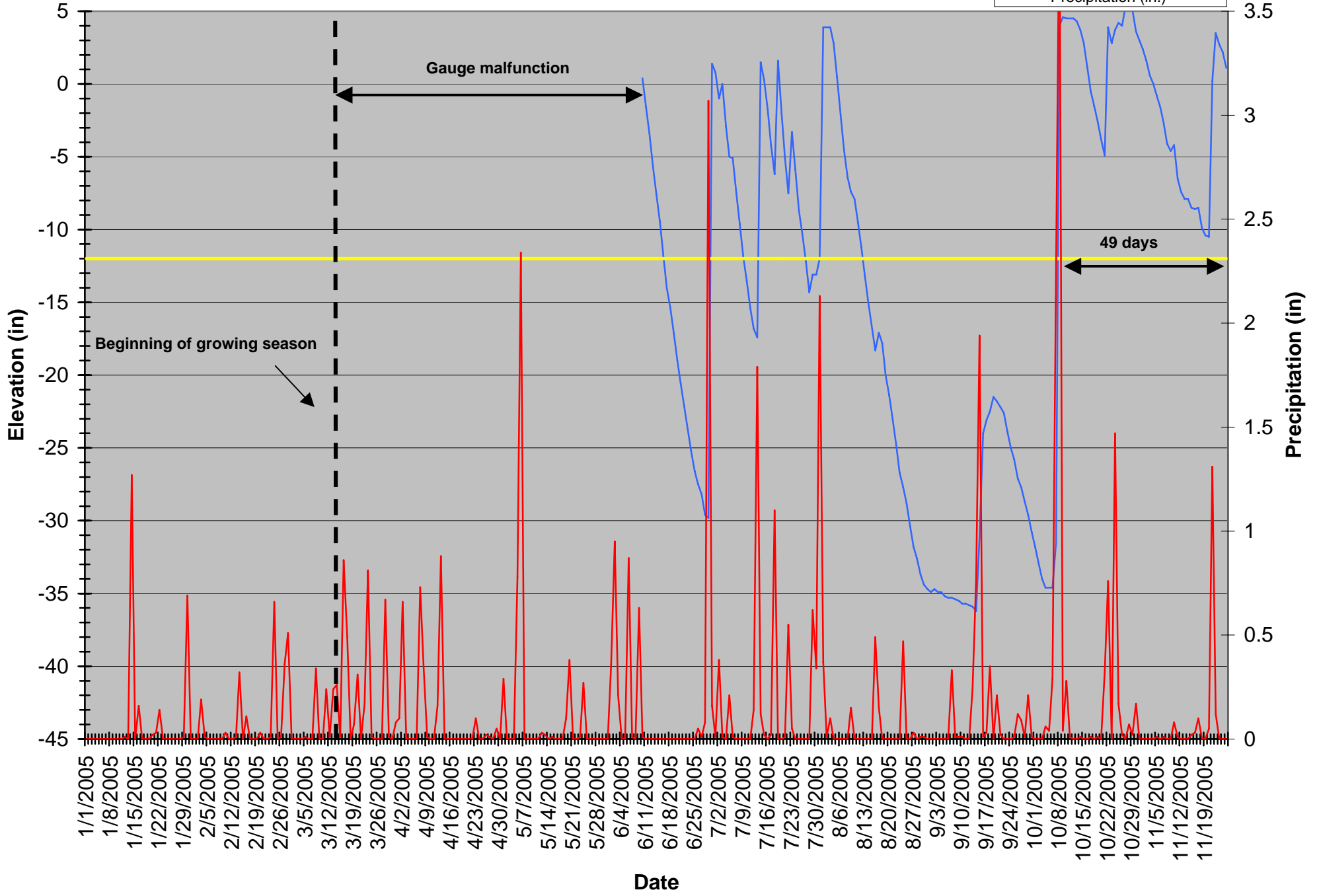
Gauge RF3 (SB6B65A7)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)



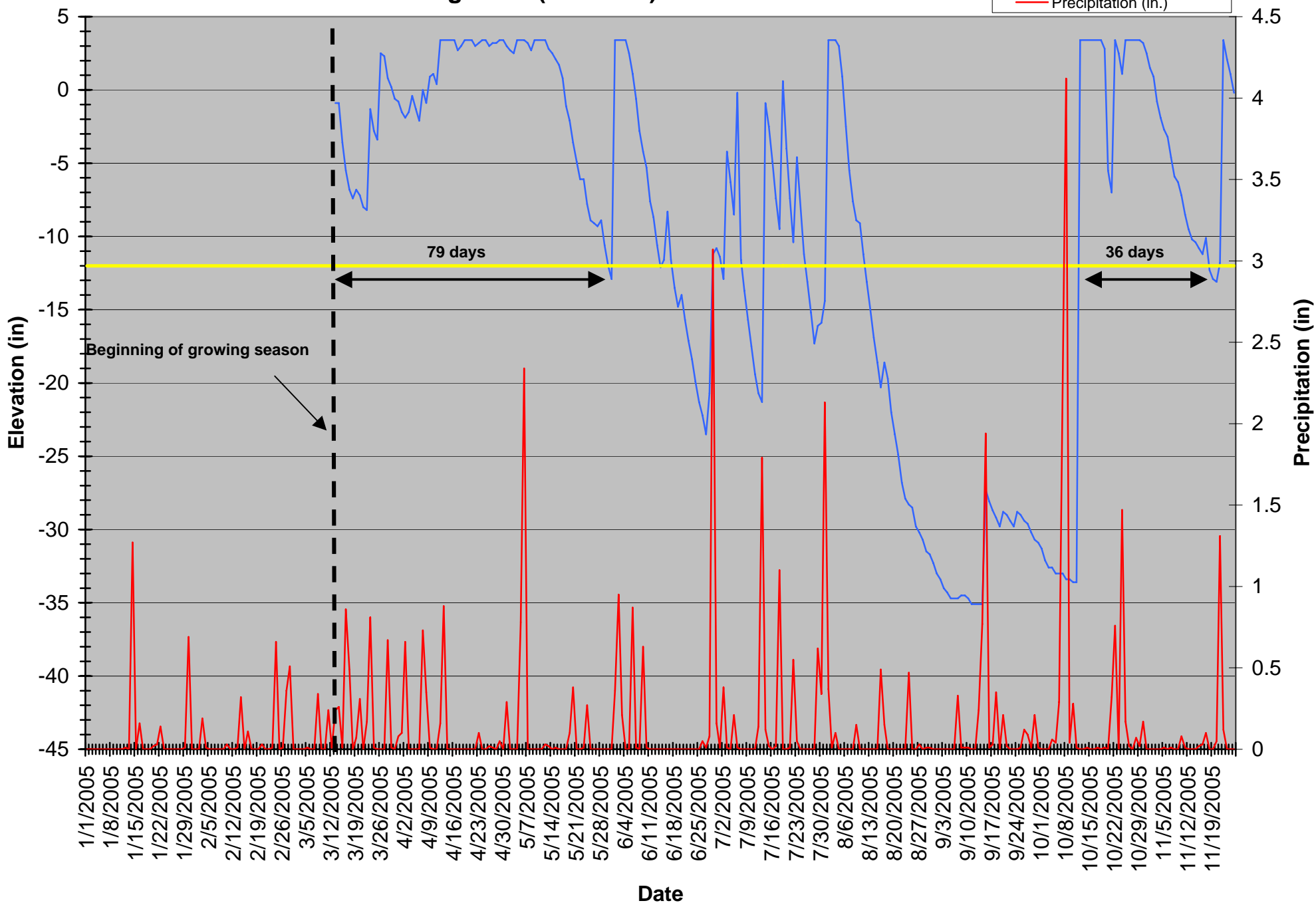
Gauge RF4 (SB6B787E) Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)



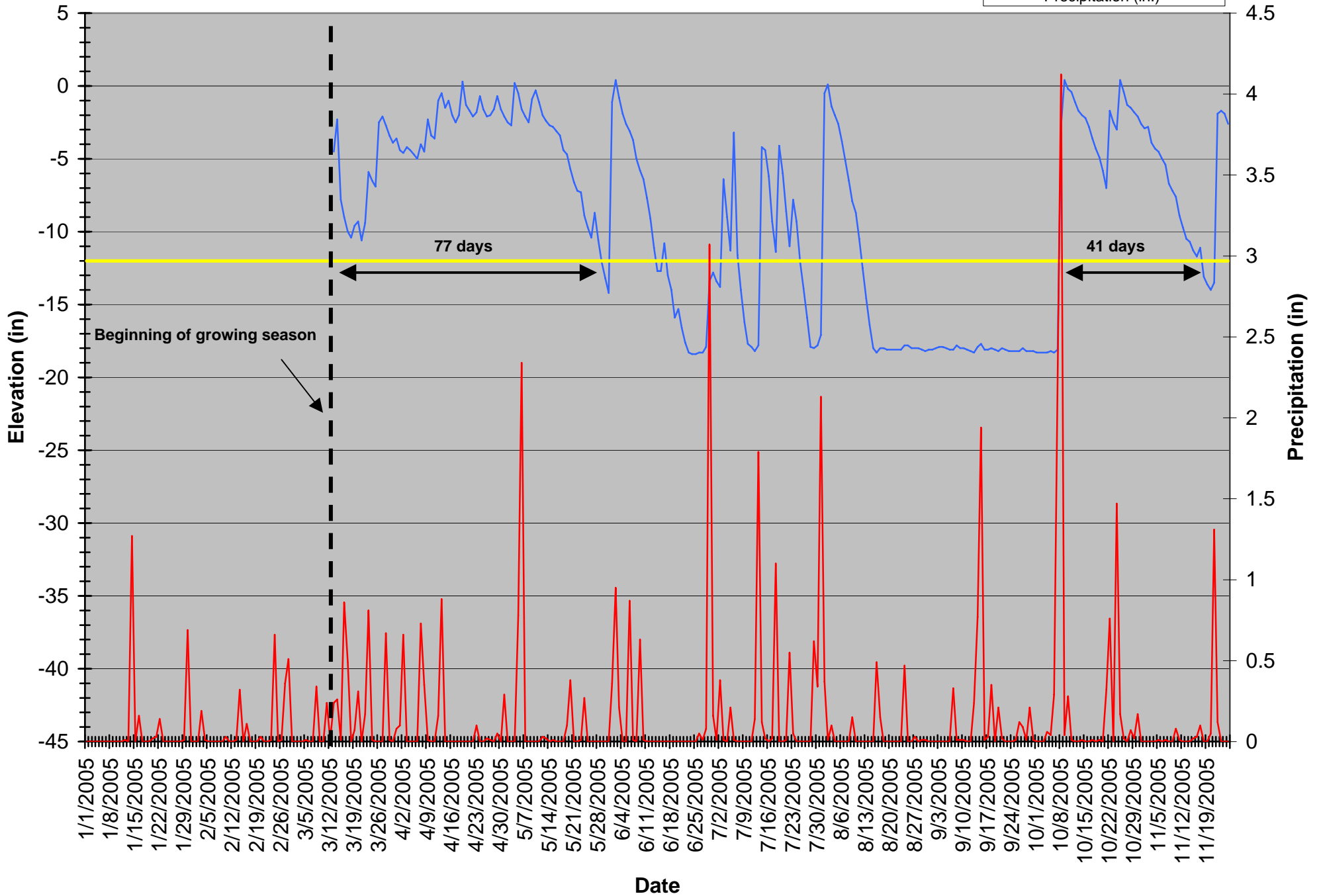
Gauge RF5 (S51751C)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)



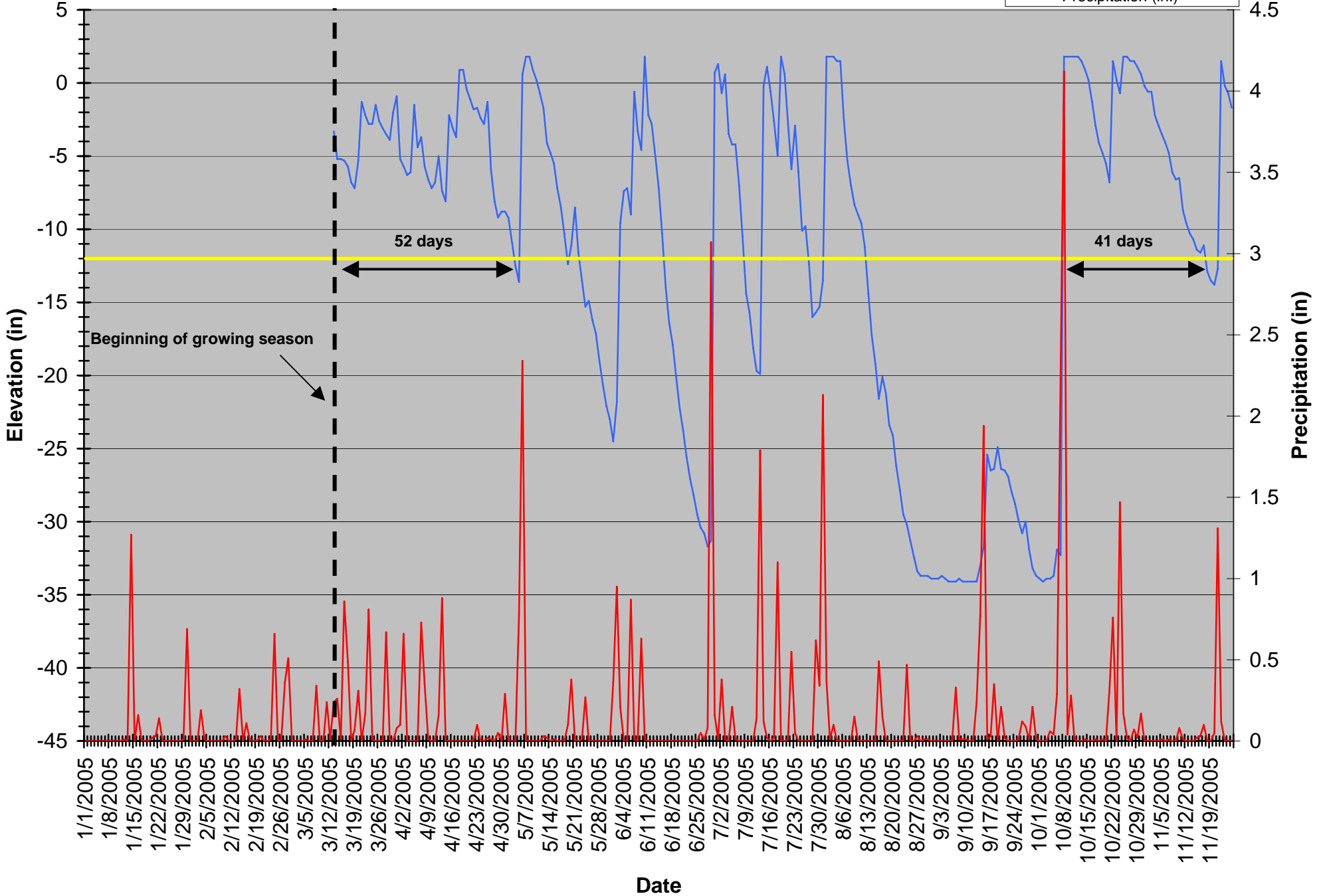
Gauge RF6 (S126F99)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)



Gauge RF7 (S214059)-Groundwater

- Groundwater Elevation
- One-Foot Depth
- Precipitation (in.)



APPENDIX B
Site Photos & Vegetation Plot Map

ABC Wetland Mitigation Site



Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Photo 6












Photo 7



Photo 8

ABC MITIGATION SITE

PLANT COMMUNITIES	
	LEVEE/STREAMBANK FOREST
	RIVERINE SWAMP FOREST
	MESIC HARDWOOD FOREST
	NON-RIVERINE WET HARDWOOD
	DRY MESIC OAK/HICKORY FOREST
	EXISTING FORESTED COMMUNITY
	NON-RIVERINE SWAMP FOREST
	VEGETATION MONITORING PLOTS
	PHOTO LOCATIONS

