UT to Lilliput Creek (Hog Branch Ponds) Stream and Wetland Restoration Project

SCO No. 04-06351-01A
DENR Contract No. D05053S-1
EEP Project No. 290
Brunswick County
North Carolina

Year 1 of 5 Monitoring Report
Data Collection: March through December 2010
Submission Date: September 16, 2011

Prepared for:

North Carolina Department of Environment and Natural Resources
Ecosystem Enhancement Program
2728 Capital Boulevard, Suite 1H-103
Raleigh, NC 27606

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Prepared by:

Rummel, Klepper & Kahl, LLP
900 Ridgefield Drive
Suite 350
Raleigh, NC 27609

2.0 Table of Contents

3.0 EXECUTIVE SUMMARY/PROJECT ABSTRACT

The UT to Lilliput Creek (Hog Branch Ponds) Stream and Wetland Restoration Site is located in Boiling Spring Lakes, Brunswick County. The restoration project is located on a 516.73 acre tract purchased (fee simple) by the State of North Carolina (Ecosystem Enhancement Program) in December 2004. The UT Lilliput Stream and Wetland Restoration Site was previously owned by International Paper and used in rotation as a pine plantation. Pine plantations in southeastern North Carolina are typically characterized by major site alterations constructed to provide sufficient surface and groundwater drainage in wet conditions which allows planted pine trees to grow and cultivate. Site alterations also destroy ecological function, decrease water quality and disrupts habitat for wildlife, including federally threatened and endangered species.

The goal for the UT to Lilliput Creek (Hog Branch Ponds) Stream and Wetland Restoration Site is to restore ecological function, improve overall water quality, and enhance native wildlife habitat. This goal will be accomplished by two main objectives. The first objective is restoration of channelized tributaries to the headwater outer coastal plain stream type, as described in the "Information Regarding Stream Restoration in the Outer Coastal Plain of North Carolina" guidance document (COE 2005). The stream restoration will re-establish the riparian vegetation zone, re-connect flood plain areas, and enhance wildlife habitat. These ecological functions have been non-existent for decades due to the previous ditch and drainage regime. The second objective is to restore and enhance the altered wetlands. The restoration and enhancement of wetlands onsite will generate longer soil saturation periods and the result is improved water quality. Restoring the native hydrologic characteristics will also restore the conditions that are beneficial for the long-leaf pine community type that previously dominated the site before human intervention. The long-leaf pine forest will also restore native habitat for the red-cockaded woodpecker.

The UT to Lilliput Creek (Hog Branch Ponds) Stream and Wetland Restoration Site was previously a pine plantation. Pine plantations in southeastern North Carolina are typically characterized by major site alterations that were made to eliminate much of the wet conditions. When modified, these sites provide sufficient surface and groundwater drainage that allow planted loblolly pine (*Pinus taeda*) and long-leaf pine (*Pinus palustris*) trees to grow be cultivated. Foresters typically perform two major site alterations in preparation for a pine plantation: channelization of natural stream channels and bedding. These site alterations were utilized extensively throughout the project site. Restoring these alterations back to natural condition were key in both project design and implementation.

Stream Restoration and Stream Preservation are both components of this project (Table 1). Stream restoration for UT to Lilliput Creek (Hog Branch Ponds) Stream and Wetland Restoration Site is divided into two tributaries. The North Tributary (**1,535 linear feet**) and South Tributary (**1,703 linear feet**) were constructed utilizing the previous referenced guidance entitled "Information Regarding Stream Restoration in the Outer Coastal Plain of North Carolina" (COE 2005). The referenced document states that restoration of dimension, pattern and profile in accordance with the typical natural channel design is often not appropriate in environments similar to the project site. For zero to first order headwater stream restoration, a width of 100 feet centered along the resulting valley will determine the area that can be considered for stream restoration (COE 2005). A total of **3,238 linear feet** of stream restoration will be provided in accordance with the enclosed plans. Stream Preservation areas will consist of **5,332 linear feet** (See Table 1 for Project Components and Figure 1a for Component Location).

The wetland component of the UT to Lilliput Creek (Hog Branch Ponds) Stream and Wetland Restoration Site consists of non-riparian wetland preservation, restoration, enhancement, and riparian preservation. The non-riparian wetland preservation areas total **87.74 acres** and riparian wetland preservation areas total **20.45 acres**. These areas were delineated using guidelines described in the Corps of Engineers 1987 Manual (COE 1987). Non-riparian wetland enhancement totaling **96.46 acres** makes up the bulk of the project effort. Non-riparian wetland restoration totals **7.83 acres**. Vegetative enhancement was utilized by planting with native species and the hydrology enhanced through the stream restoration process. (See Table 1 for Project Components and Figure 1a for Component Location)

Fifteen (15) permanent vegetation plots and one (1) total stem count for Site 6 were established and used in annual vegetation monitoring. The vegetative success criteria are based on the US Army Corps of Engineers Stream Mitigation Guidelines (USACE, 2003). Currently, the site is meeting the minimum success requirements with 639 stems per acre overall. As per the mitigation plan, the final vegetative success criteria will be the survival of 260 5-year old planted woody stems per acre at the end of the year 5 monitoring period. Vegetation plot locations are identified in Figure 2.

Overall, the UT to Lilliput Creek (Hog Branch Ponds) Stream and Wetland Restoration Site restored channel dimension and pattern are similar to as-built conditions. Visual and survey evidence exhibit the "braided" stream type featured in the Zero to First Order outer coastal plain stream morphology. The longitudinal profile is holding grade and flow disrupters are performing as designed. There are no areas of significant degradation or rill erosion. For MY1 2010, UT Lilliput Stream and Wetland Restoration Project experienced several major rain events that demonstrated a wide range of surface flow conditions. The hydrologic graphs showing these events are found in Appendix E.

The UT to Lilliput Creek (Hog Branch Ponds) Stream and Wetland Restoration Site is currently being monitored for hydrology using thirty (30) water level monitoring gauges (20 groundwater monitoring gauges, 8 surface flow monitoring gauges, and 2 reference gauges). For Monitoring Year 1 (MY1) 2010, all groundwater monitoring gauges showed saturation in excess of the 12% hydrologic success criterion and all surface flow monitoring gauges exhibited extended periods of above ground flow and matched reference conditions.

A comparison between pre-construction monitoring data and post-construction monitoring data demonstrated an increase in hydroperiod within the enhancement areas also. Gauge 11 had 57 consecutive days (22% of the growing season) by comparison; the pre-construction monitoring (2005) gauge location in this area had 14 consecutive days (6% of the growing season). Gauge 17 had 43 consecutive days (16% of the growing season) in 2010 MY1 while 2005 pre-construction monitoring data showed 11 consecutive days (5% of the growing season) in the same location.

Eight (8) additional ground water monitoring gauges were installed in December 2010 and will be included in the MY2 monitoring report. These gauges were installed perpendicular to the restored headwater stream channel and utilized as transects to effectively monitory the hydrologic improvement along and outward from the restored stream channel. These gauges will also be used in comparison with preconstruction monitoring data to document improved hydrologic conditions. Three (3) additional reference gauges were installed in June 2011. These gauges will be included for 2011 MY2.

As per the monitoring success criteria, surface water monitoring gauges must exhibit similar conditions to the onsite reference gauge and clearly show fluctuation in flow. For MY1 2010, all surface water monitoring gauges met said criteria. Please see Figure 2 for gauge locations.

Summary information/data related to the occurrence of items such as beaver or encroachment and statistics related to performance of various project and monitoring elements can be found in the tables and figures in the report appendices. Narrative background and supporting information formerly found in these reports can be found in the mitigation and restoration plan documents available on EEP's website. All raw data supporting the tables and figures in the appendices is available from EEP upon request.

4.0 METHODOLOGY

Stream monitoring was completed by utilizing total station survey to determine stream geomorphology, stability, and performance. The annual cross-sectional survey included points surveyed at all elevation changes and included surface water (if present). A longitudinal profile survey was conducted for the restored centerline for both the Northern and Southern tributaries. Measurements included channel centerline, water surface, and water depth. All surveys utilized existing onsite benchmarks.

Fifteen (15) permanent vegetation plots and one (1) total stem count for Site 6 are used for vegetation monitoring. All vegetation monitoring was completed in October 2010 utilizing the Carolina Vegetation Survey (CVS) – EEP protocol Level 1 (version 4.1) for fifteen (15) vegetation monitoring plots and a total stem count was utilized for Site 6.

For MY1 2010, hydrology was monitored through a series of thirty (30) water level monitoring gauges (20 groundwater monitoring gauges, 8 surface flow monitoring gauges, and 2 reference gauges). All gauges, including reference, were downloaded monthly utilizing Remote Data Systems data loggers and software.

Photo monitoring was conducted by walking the entire site. A digital camera was used to take photos at each predetermined photo point location.

5.0 References

Harrelson, C.C., C.L. Rawlins and J.P. Potyondy. 1994. Stream Channel Reference Sites: An Illustrated Guide to Field Technique. United States Department of Agriculture, Fort Collins, CO.

NCEEP. 2006. UT to Lilliput Stream and Wetland Restoration Project Restoration Plan. North Carolina Department of Environment and Natural Resources, Ecosystem Enhancement Program. Raleigh, NC. Version 3, October 16, 2006.

NCEEP. 2010. Content, Format and Data Requirements for EEP Baseline Monioring Report. North Carolina Department of Environment and Natural Resources, Ecosystem Enhancement Program. Raleigh, NC. Version 2.0 October 14, 2010.

NCEEP. 2008. CVS-EEP Vegetation Sampling Protocol. North Carolina Department of Environment and Natural Resources, Ecosystem Enhancement Program. Raleigh, NC. Version 4.2, 2008.

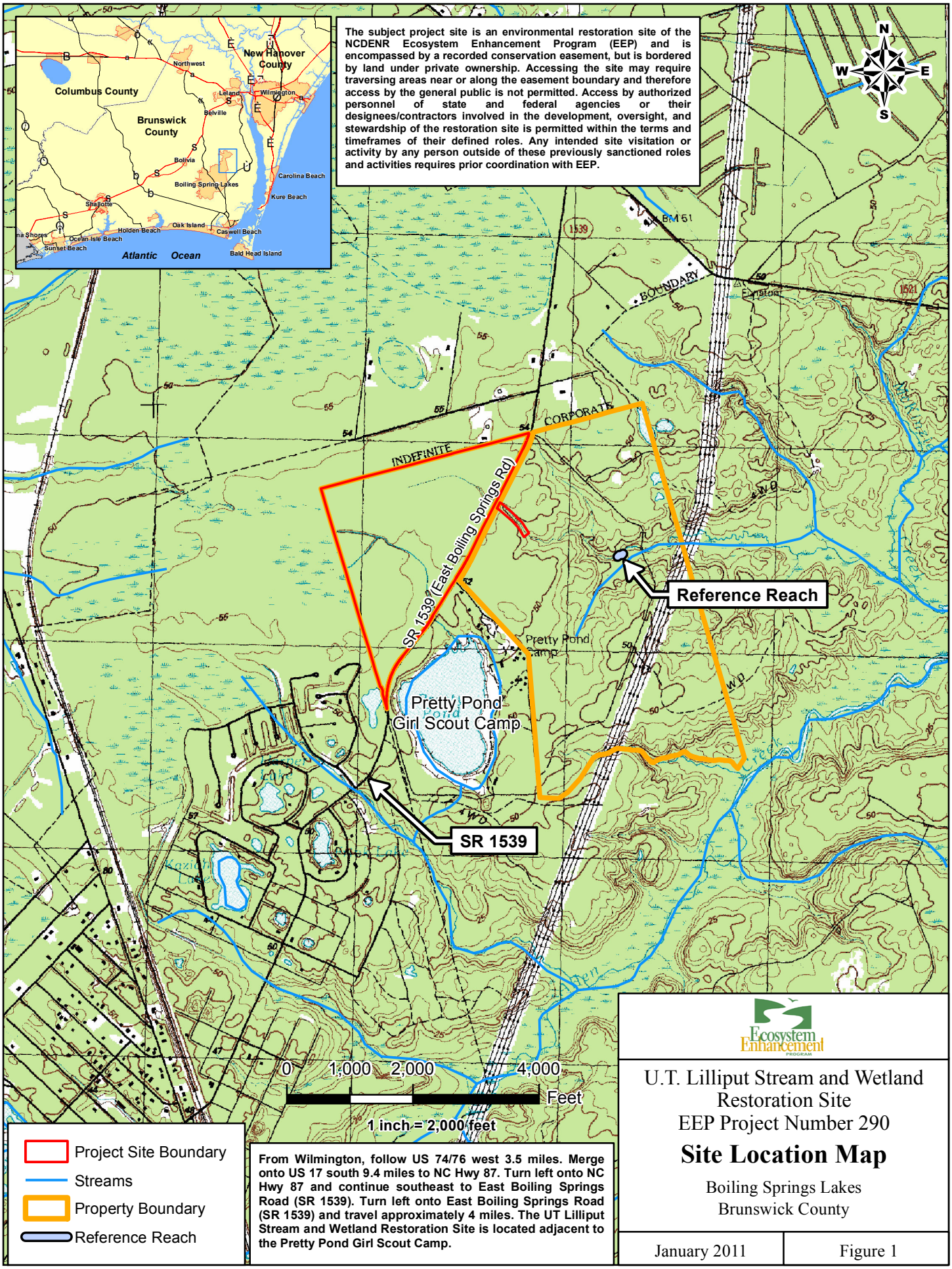
Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, CO.

U.S. Army Corps. Of Engineers. 1987. U.S. Army Corps. of Engineers. Tech Report Y-87-1, 1987 Wetland Delineation Manual, Washington, DC. AD/A176.

U.S. Army Corps. Of Engineers. 2005. U.S. Army Corps. of Engineers. Information Regarding Stream Restoration in the Outer Coastal Plain of North Carolina, Wilmington Regulatory Field Office.

6.0 Project Condition and Monitoring Data Appendices

APPENDIX A



Ecosystem Enhancement Program

U.T. Lilliput Stream and Wetland Restoration Site
EEP Project Number 290

Site Location Map

Boiling Springs Lakes
Brunswick County

January 2011 | Figure 1

Source: USGS 7.5 Minute Quadrangle, Funston, NC

FIGURE 1a.

Project Components

U.T. to Lilliput Creek
(Hog Branch Ponds)
Stream and Wetland Restoration Site
Project No: D05053S
EEP No. 290

Brunswick County

Legend

Restoration Plan Component

- Property Boundary
- Stream Restoration (7.23 Ac., 3238 LF.)
- Wetland Restoration (7.83 Ac.)
- Wetland Enhancement (96.46 Ac.)
- Wetland Preservation (87.74 Ac.)
- Riverine Wetland Preservation (20.45 Ac.)
- Wetland in Powerline ROW (4.54 Ac.)
- Stream Preservation (100' buffer, 8.67 Ac., 5332 LF)

N
W E
S

0 250 500 1,000
Feet

Ecosystem Enhancement Program

September 2011

Table 1. Project Components and Mitigation Credits
UT Lilliput Stream and Wetland Restoration Project, EEP No. 290

Mitigation Credits

	Stream (LF)		Riparian Wetland		Non-Riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	3,238	1,066.4		4.09	7.83	65.72			

Project Components

Project Component	Stationing/Location	Existing Footage/Acreage	Approach	Restoration or Restoration Equivalent	Restoration Footage or Acreage	Mitigation Ratio
0 to 1st Order Stream Restoration	Northern Tributary	1,535 LF	0 to 1st Order Stream Restoration	Restoration	1,535 LF	1:1
0 to 1st Order Stream Restoration	Southern Tributary	1,703 LF	0 to 1st Order Stream Restoration	Restoration	1,703 LF	1:1
Stream Preservation	See Figure 1a	5,332 LF	Preservation	Preservation (RE)	5,332 LF	5:1
Non-riparian Wetland Restoration	See Figure 1a	7.83 acres	Restoration	Restoration	7.83 acres	1:1
Non-riparian Wetland Enhancement	See Figure 1a	96.46 acres	Enhancement	Enhancement (RE)	96.46 acres	2:1
Non-riparian Wetland Preservation	See Figure 1a	87.74 acres	Preservation	Preservation (RE)	87.74 acres	5:1
Riparian Wetland Preservation	See Figure 1a	20.45 acres	Preservation	Preservation (RE)	20.45 acres	5:1

Component Summation

Restoration Level	Stream (Linear Feet)	Riparian Wetland (acres)	Non-riparian Wetland (acres)	Buffer (acres)	Upland (acres)
Restoration	3,238 LF		7.83 acres		
Enhancment			96.46 acres		
Enhancement I					
Enhancement II					
Creation					
Preservation	5,332 LF	20.45 acres	87.74 acres		
High Quality Preservation					

BMP Elements*

Element	Location	Purpose/Function	Notes

*BMP Elements are not part of the UT Lilliput Project

Table 2. Project Activity and Reporting History UT Lilliput Stream and Wetland Restoration Project - EEP Project No. 290		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan	NA	October 2006
Final Design – Construction Plans	NA	April 2008
Construction	NA	February 2010
Temporary S&E mix applied to entire project area	NA	March 2009
Permanent seed mix applied to entire project area	NA	March 2009
Containerized and B&B plantings	NA	February 2010
Baseline Monitoring Document (Year 0 Monitoring - baseline)	December 2010	December 2010
Year 1 Monitoring	December 2010	January 2011
Year 2 Monitoring		
Year 3 Monitoring		
Year 4 Monitoring		
Year 5 Monitoring		

Table 3. Project Contacts Table UT Lilliput Stream and Wetland Restoration Project - EEP Project No. 290	
Designer Primary project design POC	RK&K Engineers 900 Ridgefield Drive Suite 350 Raleigh, NC 27609 Pete Stafford (919)-878-9560
Construction Contractor Construction contractor POC	River Works Inc. 8000 Regency Parkway Cary, NC 27518 Mike Pedersen (919)-459-9001
Planting Contractor Planting Contractor POC	River Works Inc. 8000 Regency Parkway Cary, NC 27518 Mike Pedersen (919)-459-9001
Seeding Contractor Seeding Contractor POC	River Works Inc. 8000 Regency Parkway Cary, NC 27518 Mike Pedersen (919)-459-9001
Seed Mix Sources	Contact River Works Inc.
Nursery Stock Suppliers	Contact River Works Inc.
Monitoring Performers (MY1)	Rummel, Klepper, and Kahl, LLP 900 Ridgefield Drive Suite 250 Raleigh, NC 27609
Stream Monitoring POC Vegetation Monitoring POC Wetland Monitoring POC	Pete Stafford (919)878-9560 Pete Stafford (919)878-9560 Pete Stafford (919)878-9560

Table 4. Project Baseline Information and Attributes UT Lilliput Stream and Wetland Restoration Project - EEP Project No. 290		
Project Information		
Project Name	UT Lilliput Stream and Wetland Restoration Project	
Project County	Brunswick	
Project Area	600 acres	
Project Coordinates (Lat and Long)	34.078043,-78.026662	
Project Watershed Summary Information		
Physiographic Region	Coastal Plain	
River Basin	Cape Fear	
USGS HUC 8 Digit 03020103	USGS HUC 14 Digit 03030005070010	
NCDWQ Subbasin	03-06-17	
Project Drainage Area	N/A	
Project Drainage impervious cover estimate (%)	< 5%	
CGIA Land Use Classification		
Reach Summary Information		
Parameters	**North Tributary**	**South Tributary**
Length of Reach	1,535 LF	1,703 LF
Valley Classification	0 to 1st order	0 to 1st order
Drainage Area	52.49 acres	66.94 acres
NCDWQ Stream Identification Score	N/A	N/A
NCDWQ Water Quality Classification	CNSW	CNSW
Morphological Description (stream type)	0 to 1st order	0 to 1st order
Evolutionary Trend	N/A	N/A
Underlying Mapped Soils	Leon	Murville
Drainage Class	Poorly Drained	Poorly Drained
Soil Hydric Status	Hydric A	Hydric A
Slope	.001	.001
FEMA Classification	Zone X	Zone X
Native Vegetation Community	N/A	N/A
Percent Composition Exotic Invasive Vegetation	< 1%	< 1%

Wetland Summary Information		
Parameter	**Wetland 1**	**Wetland 2**
Size (acres)	87.74	22.45
Wetland Type	Non-Riparian	Riparian
Mapped Soils Series	Murville and Leon	Muckalee
Drainage Class	Very Poorly Drained, Poorly drained	Very poorly drained
Soil Hydric Status	A	A
Source of Hydrology	Groundwater	Groundwater
Hydrologic Impairment	N/A	N/A
Native Vegetation Community	Long Leaf Pine	Coastal Plain Blackwater Small Stream
Percent of Exotic/Invasive Veg	<1%	<1%

Table 4. Continued UT Lilliput Stream and Wetland Restoration Project - EEP Project No. 290			
Regulatory Considerations			
Regulation	**Applicable?**	**Resolved?**	**Supporting Documentation**
Waters of the United States – Section 404	Yes	Yes	Upon Request
Waters of the United States – Section 401	Yes	Yes	Upon Request
Endangered Species Act	Yes	Yes	Upon Request
Historic Preservation Act	Yes	Yes	Upon Request
Coastal Zone Management Act (CZMA) Coastal Area Management Act (CAMA)	Yes	Yes	Upon Request
FEMA Floodplain Compliance	Yes	Yes	Upon Request
Essential Fisheries Habitat	No		

APPENDIX B

FIGURE 2

Current Conditions Plan View

U.T. to Lilliput Creek
(Hog Branch Ponds)
Stream and Wetland
Restoration Site
Project No: D05053S
EEP No. 290

Brunswick County

Legend

Vegetation Monitoring Counts

- Less Than 320 Stems per Acre
- More Than 320 Stems per Acre

Gauge Success Criteria

- < 12%
- > 12%

Restoration Plan Component

- Stream Restoration (7.23 Ac., 3238 LF.)
- Wetland Restoration (7.83 Ac.)
- Wetland Enhancement (96.46 Ac.)
- Property Boundary
- Wetland Preservation (87.74 Ac.)
- Riverine Wetland Preservation (20.45 Ac.)
- Wetland in Powerline ROW (4.54 Ac.)
- Stream Preservation (100' buffer, 8.67 Ac., 5332 LF)

N W E S

0 200 400 800 Feet

Ecosystem Enhancement PROGRAM

January 2011

SR 1539 (East Boiling Springs Rd)

Pretty Pond
Girl Scout Camp

Table 5 - Visual Stream Morphological Stability Assessment
Reach ID – Northern Tributary
Assessed Length – 1535 LF

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run Units)	1. Aggradation			NA	NA	NA			
		2. Degradation			NA	NA	NA			
	2. Riffle Condition	1. Texture/Substrate	NA	NA			NA			
	3. Meander Pool Condition	1. Depth	NA	NA			NA			
		2. Length	NA	NA			NA			
	4. Thalweg Condition	1. Thalweg at upstream of meander bend	NA	NA			NA			
		2. Thalweg centering at downstream of meander	NA	NA			NA			
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover from poor growth and/or scour and erosion			0	0	100%	NA	NA	100%
	2. Undercut	Banks undercut/overhanging			NA	NA	NA	NA	NA	NA
	3. Mass Wasting	Bank slumping, caving, or collapse			0	0	100%	NA	NA	100%
				Totals	0	0	100%	NA	NA	100%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	9	9			100%			
	2. Grade Control	Grade Control exhibiting maintenance of grade across the s ill	1	1			100%			
	2a. Piping	Structures Lacking any substantial flow underneath sills or arms	NA	NA			NA			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	NA	NA			NA			
	4. Habitat	Pool forming structures maintaining – Max Pool Depth: Mean Bankfull Depth Ratio $\geq$ 1.6 Rootwads/logs providing some cover at base flow.	NA	NA			NA			

Table 5a - Visual Stream Morphological Stability Assessment
Reach ID – Southern Tributary
Assessed Length – 1703 LF

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run Units)	1. Aggradation			NA	NA	NA			
		2. Degradation			NA	NA	NA			
	2. Riffle Condition	1. Texture/Substrate	NA	NA			NA			
	3. Meander Pool Condition	1. Depth	NA	NA			NA			
		2. Length	NA	NA			NA			
	4. Thalweg Condition	1. Thalweg at upstream of meander bend	NA	NA			NA			
		2. Thalweg centering at downstream of meander	NA	NA			NA			
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover from poor growth and/or scour and erosion			0	0	100%	NA	NA	100%
	2. Undercut	Banks undercut/overhanging			NA	NA	NA	NA	NA	NA
	3. Mass Wasting	Bank slumping, caving, or collapse			0	0	100%	NA	NA	100%
				Totals	0	0	100%	NA	NA	100%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	9	9			100%			
	2. Grade Control	Grade Control exhibiting maintenance of grade across the sill	1	1			100%			
	2a. Piping	Structures Lacking any substantial flow underneath sills or arms	NA	NA			NA			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	NA	NA			NA			
	4. Habitat	Pool forming structures maintaining – Max Pool Depth: Mean Bankfull Depth Ratio $\geq$ 1.6 Rootwads/logs providing some cover at base flow.	NA	NA			NA			

Table 6 – Vegetation Condition Assessment
Planted Acreage - NA

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very Limited Cover of both woody and herbaceous material	No bare areas located onsite for MY1 2010	NA	NA	NA	0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria	No low stem density areas onsite for MY1 2010	NA	NA	NA	0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year	No areas of poor growth rates or vigor onsite for MY1 2010	NA	NA	NA	0%

Stream Problem Areas UT Lilliput Stream and Wetland Restoration Site EEP Project No. 290			
Feature Issue	**Station Number**	**Suspected Cause**	**Photo Number**
No Issues			

Vegetation Problem Areas UT Lilliput Stream and Wetland Restoration Site EEP Project No. 290			
Feature Category	**Station Number**	**Suspected Cause**	**Photo Number**
No Issues			

Appendix B - Stream and Cross Section Photos (all photos recorded on December 6, 2010)

Photo Station 1. Southern Tributary Station 15+00 – Looking upstream

Photo Station 2. Southern Tributary Station 15+00 – SCX4 - Looking downstream

Photos recorded on December 6, 2010

Photo Station 3. Southern Tributary Station 23+00 – SCX3 - Looking upstream

Photo Station 4. Southern Tributary Station 23+00 – SCX2 - Looking downstream

Photos recorded on December 6, 2010

Photo Station 5. Southern Tributary Station 29+00 – Looking upstream

Photo Station 6. Southern Tributary Station 29+00 – SCX1 - Looking downstream

Photos recorded on December 6, 2010

Photo Station 7. Northern Tributary Station 14+00 – NCX4 - Looking downstream

Photo Station 8. Northern Tributary Station 21+00 – NCX3 - Looking upstream

Photos recorded on December 6, 2010

Photo Station 9. Northern Tributary Station 21+00 – NCX2 - Looking downstream

Photo Station 10. Northern Tributary Station 28+25 – Looking upstream

Photos recorded on December 6, 2010

Photo Station 11. Northern Tributary Station 28+25 –NCX1 - Looking downstream

Photos recorded on December 6, 2010

Appendix B - Wetland and General Site Photos (all photos recorded on December 6, 2010)

Photo Station 12. Site 1 – Looking west

Photo Station 13. Site 2 - Looking west

Photos recorded on December 6, 2010

Photo Station 14. Site 3 - Looking west

Photo Station 15. Site 4 - Looking north

Photos recorded on December 6, 2010

Photo Station 16. Site 5 – Looking northeast

Photo Station 17. Site 6 –northeast

Photos recorded on December 6, 2010

Photo Station 18. Site 7 - Looking west

Photo Station 19. Northern Headwater Wetland – North Prong.

Photos recorded on December 6, 2010

Photo Station 20. Northern Headwater Wetland – South Prong.

Photo Station 21. Southern Headwater Wetland – North Prong.

Photos recorded on December 6, 2010

Photo Station 22. Southern Headwater Wetland – South Prong.

Photo Station 23. General Site View – Wetland Enhancement Area.

Photos recorded on December 6, 2010

Photo Station 24. General Site View – Wetland Enhancement Area.

Photo Station 25. General Site View – Wetland Enhancement Area.

Photos recorded on December 6, 2010

Vegetation Plot Photos (all photos recorded on October 18, 2010)

Vegetation Plot 1

Vegetation Plot 2

All photos recorded on October 18, 2010

Vegetation Plot 3

Vegetation Plot 4

Vegetation Plot 5

Vegetation Plot 6

Vegetation Plot 7

Vegetation Plot 8

Vegetation Plot 9

Vegetation Plot 10

Vegetation Plot 11

Vegetation Plot 12

Vegetation Plot 13

Vegetation Plot 14

All photos recorded on October 18, 2010

Vegetation Plot 15

Site 6 – Total Stem Count

APPENDIX C

Table 7. Vegetation Plot Criteria Attainment			
Tract	**Vegetation Plot ID**	**Vegetation Survival Threshold Met?**	**Tract Mean**
Southern Tributary	VP1	Y	100%
Southern Tributary	VP2	Y	
Southern Tributary	VP3	Y	
Southern Headwater Wetland	VP4	Y	
Site 2	VP5	Y	
Northern Tributary	VP6	Y	
Northern Tributary	VP7	Y	
Northern Tributary	VP8	Y	
Northern Headwater Wetland	VP9	Y	
Wetland Enhancement	VP10	Y	
Wetland Enhancement	VP11	Y	
Site 1	VP12	Y	
Wetland Enhancement	VP13	Y	
Wetland Enhancement	VP14	Y	
Wetland Enhancement	VP15	Y	
Site 6	Site 6 (Total Count)	Y	

Table 8. CVS Vegetation Plot Metadata East Tarboro Canal EEP No: 123	
Report Prepared By	William (Pete) Stafford
Date Prepared	12/4/2010 10:49
Database Name	UTLilliput_290_101910_MY1.mdb
Database Location	C:\Documents and Settings\pstafford\Desktop\CVS Veg Data
Computer Name	STAFFORDP
Description Worksheets In This Document	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
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.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
Project Summary	
Project Code	290
Project Name	UT Lilliput
Description	Stream and Wetland Restoration Project
River Basin	Cape Fear
Length(ft)	3238
Stream-to-edge width (ft)	
Area (sq m)	
Required Plots (calculated)	

Table 9. Planted and Total Stem Counts (Species by Plot with Annual Means)

			CURRENT DATA (Baseline 2010)																												ANNUAL MEANS	
			Plot 1		Plot 2		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		Current Means MY1 2010	
Scientific Name	Common Name	Type	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T
Magnolia virginiana	sweetbay	Tree	6	6	2	2	2	2							6	6	3	3	2	2											21	21
Nyssa biflora	swamp tupelo	Tree															1	1													1	1
Pinus palustris	longleaf pine	Tree									7	6	8	7							20	20	18	16	12	10	18	16	17	17	18	17	118	109
Pinus serotina	pond pine	Tree	7	5	7	6	7	7	3	2	6	5	12	12	6	6	12	10	4	4					9	9							73	66
Quercus sp.	oak sp.	Tree	4		5		9	1	9						7	2	7	6	6	2													47	11
Quercus laurifolia	laurel oak	Tree				2		3		1						1																		7
Quercus lyrata	overcup oak	Tree		3		3		4		7						2			3	3													3	22
	Plot Area (acres)		0.025		0.025		0.025		0.025		0.025		0.025		0.025		0.025		0.025		0.025		0.025		0.025		0.025		0.025					
* *Not Applicable for Baseline*	Species Count		3	3	3	4	3	5	2	3	2	2	2	2	3	5	4	4	4	4	1	1	1	1	2	2	1	1	1	1	1	1	6	7
Type = Tree or Shrub	Stem Count		17	14	14	13	18	17	12	10	13	11	20	19	19	17	23	20	15	11	20	20	18	16	21	19	18	16	17	17	18	17	263	237
P = Planted, T = Total	Stems/Acre		687.48	566.16	566.16	525.72	727.92	687.48	485.28	404.4	525.72	444.84	808.8	768.36	768.36	687.48	930.12	808.8	606.6	444.84	808.8	808.8	727.92	647.04	849.24	768.36	727.92	647.04	687.48	687.48	727.92	687.48	709	639

Site	Species	Planted	MY1 Total
Site 6	*Taxodium distichum*	40	27

APPENDIX D

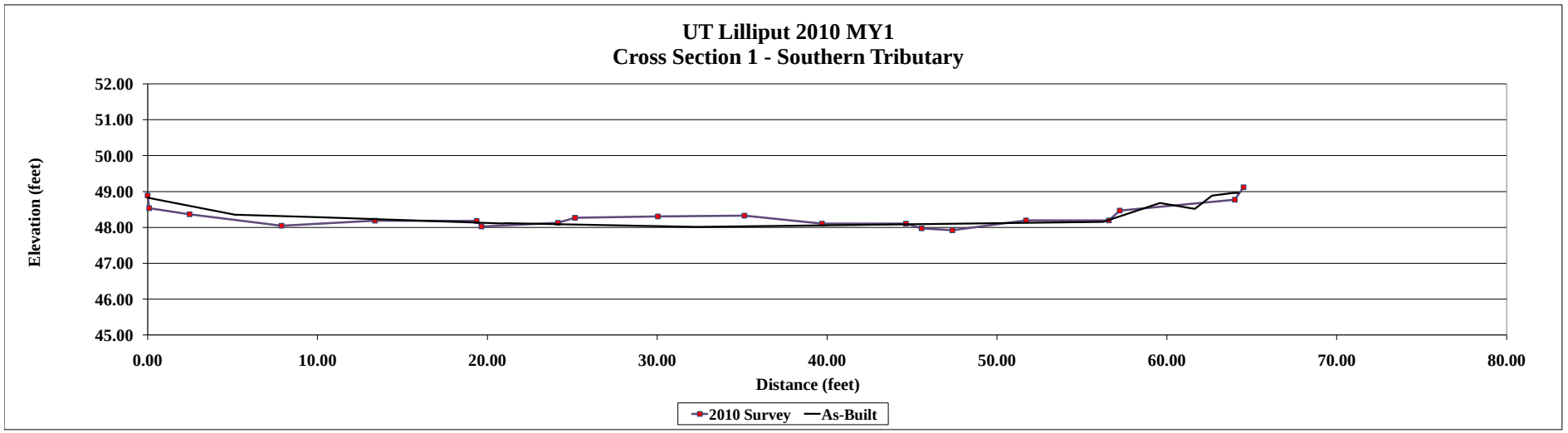
Project Name	UT Lilliput
Watershed	Lilliput, MY1
Cross Section	1
Drainage Area	66.94 acres
Date	Dec-10
Crew	Tutt, Stafford

Photo of Cross-Section #1 - Looking Downstream

Picture Taken December 6, 2010

As-Built Survey As-Built Survey			2010 2010 Survey			2011 2011 Survey			2012 2012 Survey			2013 2013 Survey			2014 2014 Survey		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0.00	48.83		0.00	48.89													
5.13	48.35		0.09	48.53													
10.36	48.28		2.48	48.37													
20.86	48.11		7.88	48.05													
21.10	48.12		13.38	48.19													
32.36	48.01		19.37	48.18													
56.25	48.16		19.65	48.02													
59.59	48.68		24.16	48.13													
61.65	48.52		25.16	48.27													
62.67	48.89		30.04	48.30													
63.92	48.96		35.14	48.33													
64.23	48.96		39.71	48.10													
			44.64	48.11													
			45.56	47.97													
			47.38	47.92													
			51.71	48.19													
			56.59	48.19													
			57.23	48.47													
			64.00	48.77													
			64.52	49.12													

Summary Data	
Bankfull Elv.	
BF Area	
BF Width	
Flood Prone Elv.	
Flood Prone Width	
Max Depth	
Mean Depth	
W/D Ratio	
ER	
Bank Height Ratio	
Stream Type	Zero



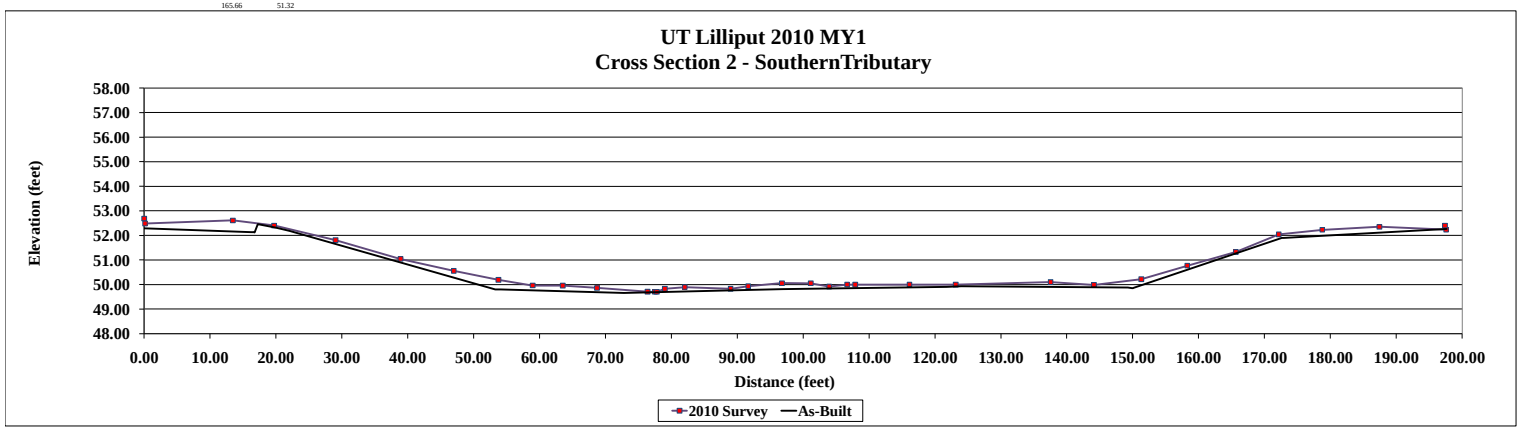
Project Name	UT Lilliput
Watershed	Lilliput, MY1
Cross Section	2
Drainage Area	66.94 acres
Date	Dec-10
Crew	Tutt, Stafford

Photo of Cross-Section #2 - Looking Downstream

Picture Taken December 6, 2010

As-Built Survey As-Built Survey			2010 2010 Survey			2011 2011 Survey			2012 2012 Survey			2013 2013 Survey			2014 2014 Survey		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0.00	52.28		0.00	52.68													
16.25	52.13		0.14	52.48													
16.73	52.13		13.46	52.61													
16.75	52.12		19.73	52.40													
16.75	52.12		29.04	51.80													
17.26	52.46		38.91	51.04													
20.00	52.32		47.00	50.55													
22.07	52.18		53.77	50.19													
53.26	49.80		58.97	49.96													
53.29	49.79		63.53	49.95													
53.99	49.80		68.72	49.86													
54.12	49.80		76.40	49.70													
72.82	49.66		77.52	49.70													
96.93	49.81		77.81	49.70													
121.79	49.90		79.02	49.82													
124.01	49.92		82.05	49.89													
149.28	49.87		88.99	49.83													
149.91	49.85		91.67	49.93													
150.07	49.85		96.79	50.05													
150.16	49.86		101.16	50.05													
172.65	51.89		103.95	49.91													
172.69	51.90		106.66	50.00													
172.91	51.90		107.92	50.00													
197.64	52.26		116.14	50.00													
			123.16	50.00													
			137.55	50.10													
			144.13	49.98													
			151.32	50.21													
			158.29	50.77													
			165.66	51.32													

Summary Data	
Bankfull Elv.	
BF Area	
BF Width	
Flood Prone Elv.	
Flood Prone Width	
Max Depth	
Mean Depth	
W/D Ratio	
ER	
Bank Height Ratio	
Stream Type	Zero



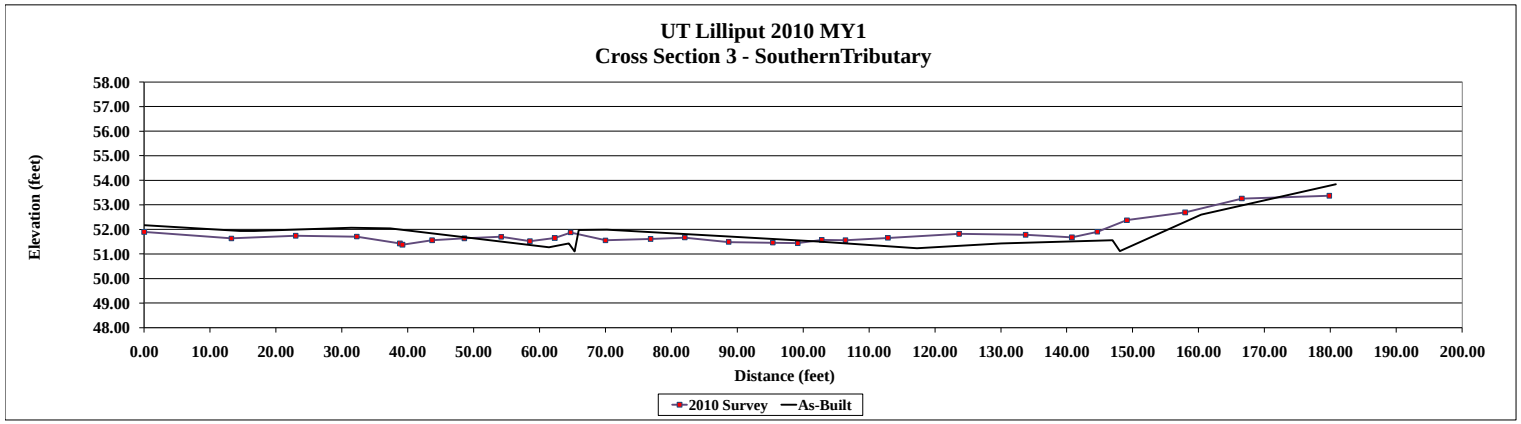
Project Name	UT Lilliput
Watershed	Lilliput, MY1
Cross Section	3
Drainage Area	66.94 acres
Date	Dec-10
Crew	Tutt, Stafford

Photo of Cross-Section #3 - Looking Upstream

Picture Taken December 6, 2010

As-Built Survey As-Built Survey			2010 2010 Survey			2011 2011 Survey			2012 2012 Survey			2013 2013 Survey			2014 2014 Survey		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0.00	52.17		0.00	51.90													
14.60	51.94		13.24	51.63													
16.72	51.93		23.01	51.74													
31.45	52.07		32.28	51.71													
37.34	52.05		38.82	51.43													
61.46	51.27		39.20	51.38													
64.43	51.42		43.69	51.56													
65.32	51.10		48.60	51.63													
65.95	51.97		54.17	51.70													
70.21	51.99		58.55	51.52													
102.27	51.50		62.30	51.65													
117.25	51.23		64.72	51.87													
130.06	51.43		70.01	51.55													
146.95	51.56		76.86	51.61													
148.06	51.12		82.04	51.67													
160.40	52.60		88.70	51.48													
180.84	53.84		95.41	51.46													
			99.19	51.44													
			102.84	51.57													
			106.43	51.56													
			112.85	51.65													
			123.66	51.82													
			133.77	51.78													
			140.78	51.67													
			144.63	51.90													
			149.13	52.37													
			157.97	52.69													
			166.56	53.26													
			179.84	53.37													

Summary Data	
Bankfull Elv.	
BF Area	
BF Width	
Flood Prone Elv.	
Flood Prone Width	
Max Depth	
Mean Depth	
W/D Ratio	
ER	
Bank Height Ratio	
Stream Type	Zero



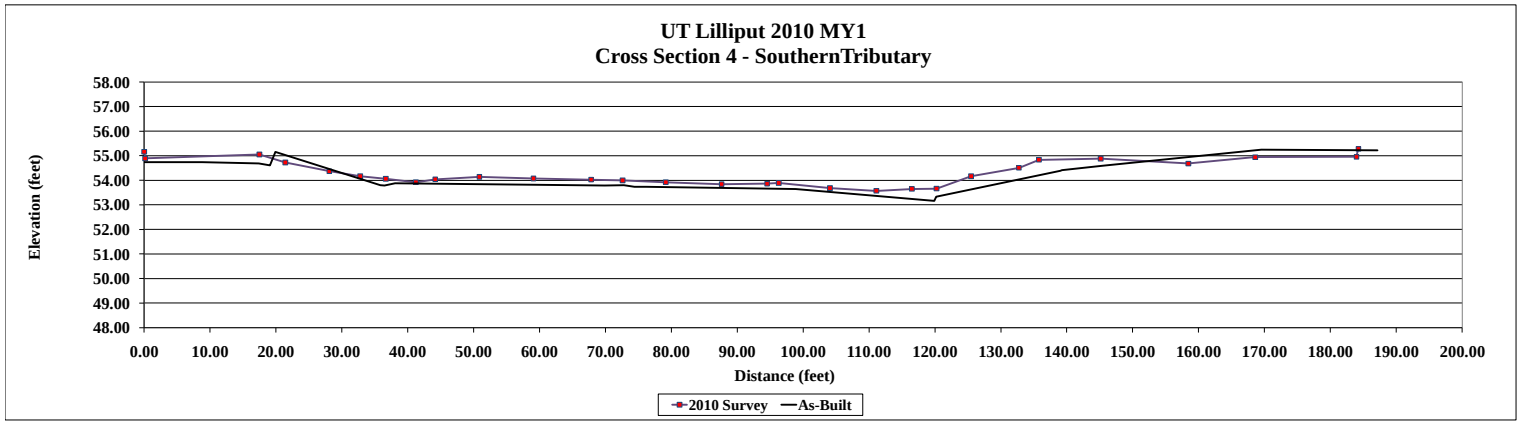
Project Name	UT Lilliput
Watershed	Lilliput, MY1
Cross Section	4
Drainage Area	66.94 acres
Date	Dec-10
Crew	Tutt, Stafford

Photo of Cross-Section #4 - Looking Downstream

Picture Taken December 6, 2010

As-Built Survey As-Built Survey			2010 2010 Survey			2011 2011 Survey			2012 2012 Survey			2013 2013 Survey			2014 2014 Survey		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0.00	54.74		0.00	55.16													
8.78	54.73		0.15	54.89													
15.36	54.69		17.50	55.05													
17.37	54.68		21.43	54.72													
19.10	54.61		28.11	54.37													
19.91	55.16		32.80	54.16													
35.85	53.80		36.68	54.06													
36.47	53.79		41.24	53.92													
38.08	53.88		44.17	54.04													
69.90	53.79		50.87	54.14													
72.79	53.79		59.07	54.08													
74.41	53.73		67.83	54.03													
76.19	53.73		72.61	54.00													
98.88	53.64		79.17	53.92													
119.88	53.16		87.63	53.84													
120.20	53.33		94.53	53.86													
139.03	54.39		96.31	53.89													
139.26	54.41		104.06	53.68													
145.55	54.60		111.12	53.57													
169.51	55.24		116.50	53.65													
187.17	55.22		120.25	53.66													
			125.49	54.17													
			132.75	54.51													
			135.77	54.83													
			145.16	54.88													
			158.45	54.68													
			168.60	54.94													
			183.97	54.95													
			184.25	55.28													

Summary Data	
Bankfull Elv.	
BF Area	
BF Width	
Flood Prone Elv.	
Flood Prone Width	
Max Depth	
Mean Depth	
W/D Ratio	
ER	
Bank Height Ratio	
Stream Type	Zero



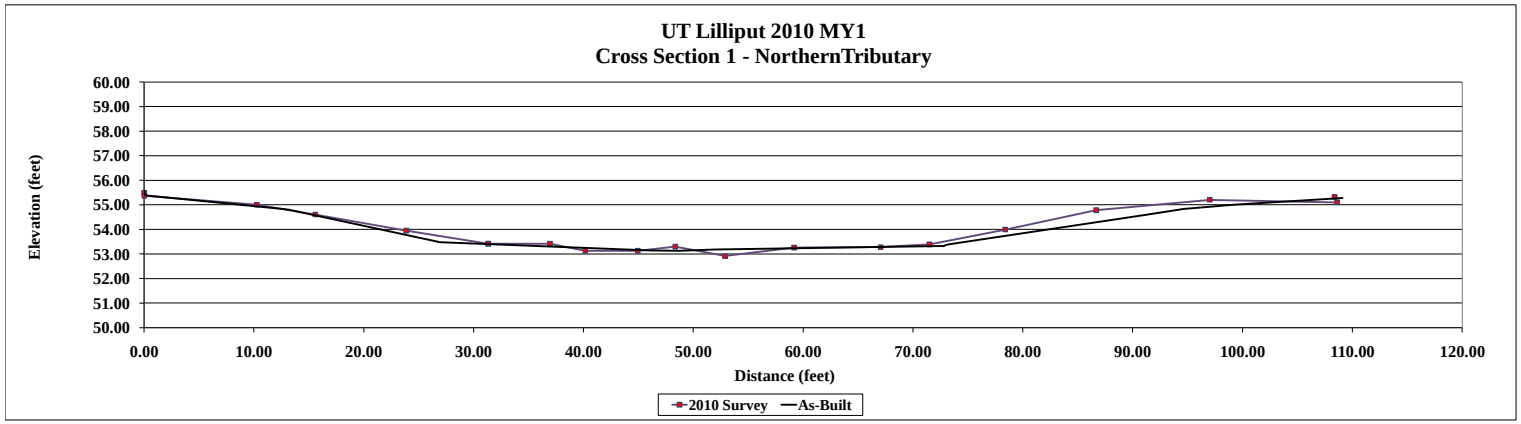
Project Name	UT Lilliput
Watershed	Lilliput, MY1
Cross Section	1
Drainage Area	52.49
Date	Dec-10
Crew	Tutt, Stafford

Photo of Cross-Section #1 - Looking Downstream

Picture Taken December 6, 2010

As-Built Survey As-Built Survey			2010 2010 Survey			2011 2011 Survey			2012 2012 Survey			2013 2013 Survey			2014 2014 Survey		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0.00	55.56		0.00	55.49													
0.07	55.39		0.02	55.37													
0.44	55.37		10.28	55.00													
12.86	54.82		15.58	54.61													
13.11	54.80		23.87	53.95													
13.14	54.81		31.33	53.41													
13.23	54.79		31.33	53.42													
13.25	54.79		36.95	53.42													
13.25	54.79		40.17	53.13													
26.79	53.49		44.95	53.13													
26.80	53.48		48.35	53.29													
46.12	53.15		52.89	52.91													
48.76	53.13		59.18	53.26													
51.88	53.18		67.07	53.28													
72.69	53.33		71.50	53.39													
72.80	53.31		78.40	53.99													
72.91	53.35		86.69	54.78													
73.23	53.38		97.03	55.20													
91.32	54.60		108.62	55.10													
94.69	54.84		108.38	55.32													
94.73	54.84																
99.22	55.00																
109.11	55.28																

Summary Data	
Bankfull Elv.	
BF Area	
BF Width	
Flood Prone Elv.	
Flood Prone Width	
Max Depth	
Mean Depth	
W/D Ratio	
ER	
Bank Height Ratio	
Stream Type	Zero



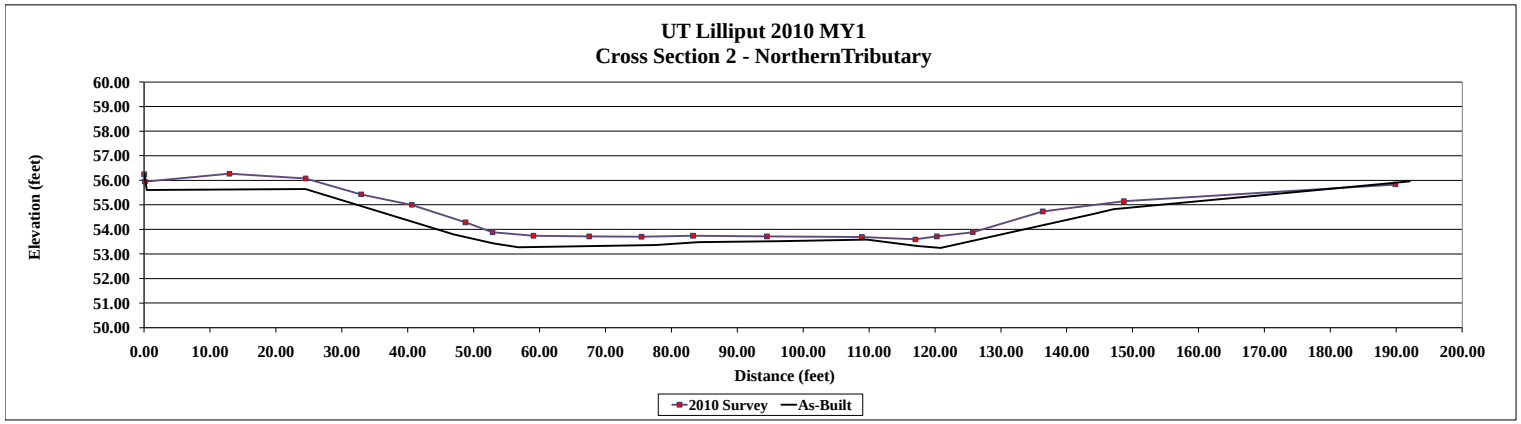
Project Name	UT Lilliput
Watershed	Lilliput, MY1
Cross Section	2
Drainage Area	52.49
Date	Dec-10
Crew	Tutt, Stafford

Photo of Cross-Section #2 - Looking Downstream

Picture Taken December 6, 2010

As-Built Survey As-Built Survey			2010 2010 Survey			2011 2011 Survey			2012 2012 Survey			2013 2013 Survey			2014 2014 Survey		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0.00	56.28		0.00	56.24													
0.40	55.61		0.10	55.95													
24.51	55.64		12.95	56.26													
47.03	53.79		24.50	56.07													
53.04	53.43		32.94	55.43													
56.82	53.28		40.64	55.00													
77.60	53.37		48.75	54.29													
84.09	53.48		52.86	53.88													
96.35	53.52		59.07	53.74													
109.63	53.59		67.53	53.71													
117.34	53.32		75.47	53.70													
120.85	53.25		83.29	53.74													
144.04	54.63		94.51	53.72													
147.08	54.82		108.93	53.69													
192.06	55.96		117.04	53.59													
			120.29	53.71													
			125.76	53.88													
			136.35	54.73													
			148.67	55.15													
			189.88	55.83													

Summary Data	
Bankfull Elv.	
BF Area	
BF Width	
Flood Prone Elv.	
Flood Prone Width	
Max Depth	
Mean Depth	
W/D Ratio	
ER	
Bank Height Ratio	
Stream Type	Zero



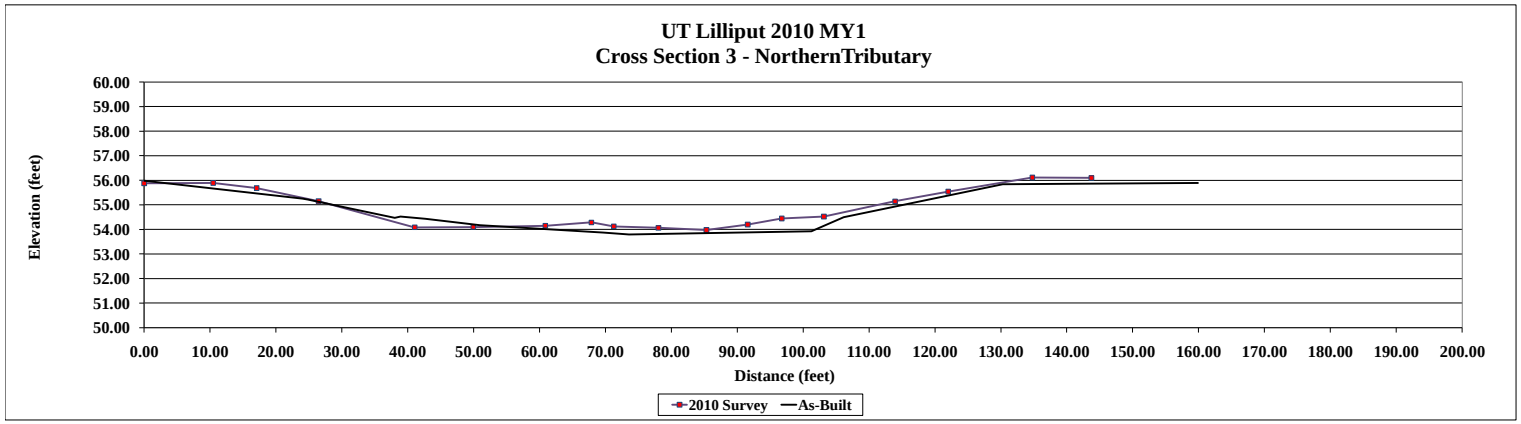
Project Name	UT Lilliput
Watershed	Lilliput, MY1
Cross Section	3
Drainage Area	52.49
Date	Dec-10
Crew	Tutt, Stafford

Photo of Cross-Section #3 - Looking Upstream

Picture Taken December 6, 2010

As-Built Survey As-Built Survey			2010 2010 Survey			2011 2011 Survey			2012 2012 Survey			2013 2013 Survey			2014 2014 Survey		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0.00	55.98		0.00	55.88													
24.05	55.25		10.48	55.89													
24.89	55.21		17.07	55.68													
38.04	54.48		26.47	55.15													
38.91	54.52		41.07	54.08													
42.70	54.43		49.96	54.10													
50.97	54.17		60.88	54.15													
69.64	53.88		67.88	54.28													
73.57	53.79		71.28	54.12													
101.27	53.92		78.04	54.06													
106.16	54.50		85.34	53.98													
130.28	55.84		91.58	54.20													
159.93	55.89		96.76	54.45													
			103.14	54.52													
			113.94	55.14													
			122.02	55.54													
			134.77	56.11													
			143.73	56.09													

Summary Data	
Bankfull Elv.	
BF Area	
BF Width	
Flood Prone Elv.	
Flood Prone Width	
Max Depth	
Mean Depth	
W/D Ratio	
ER	
Bank Height Ratio	
Stream Type	Zero



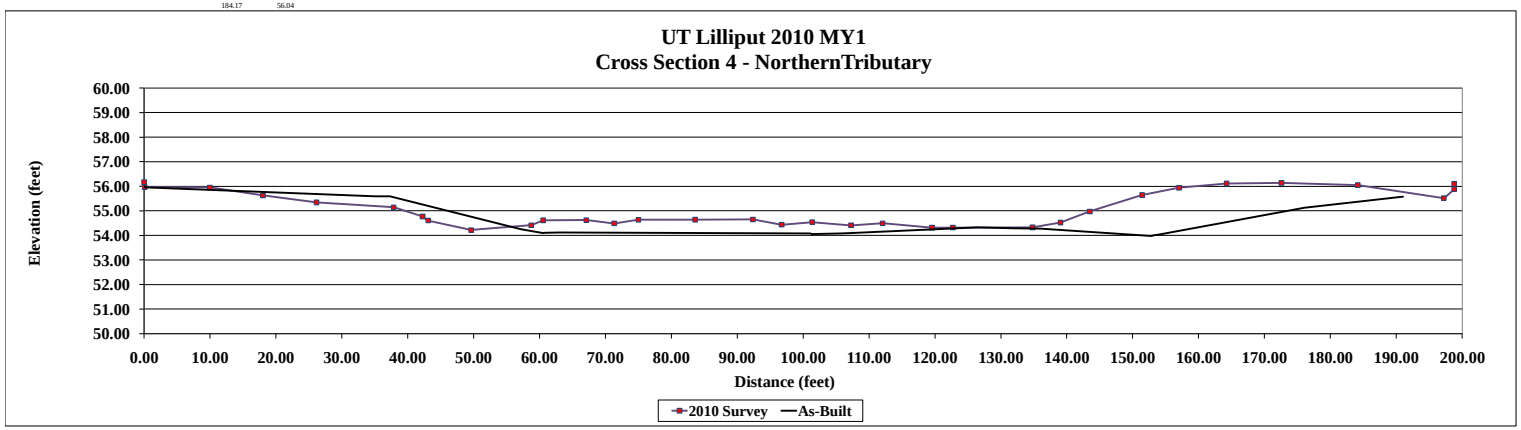
Project Name	UT Lilliput
Watershed	Lilliput, MY1
Cross Section	4
Drainage Area	52.49
Date	Dec-10
Crew	Tutt, Stafford

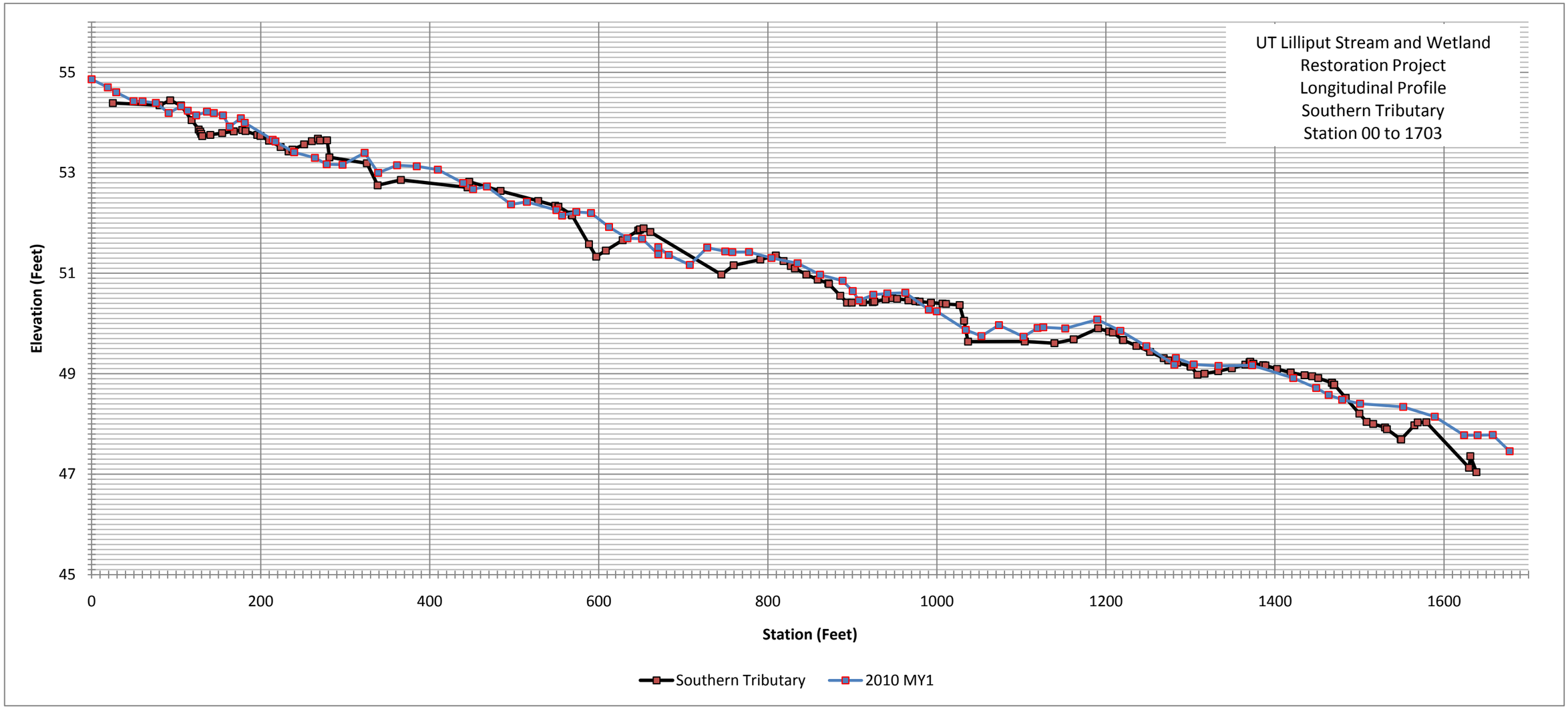
Photo of Cross-Section #4 - Looking Downstream

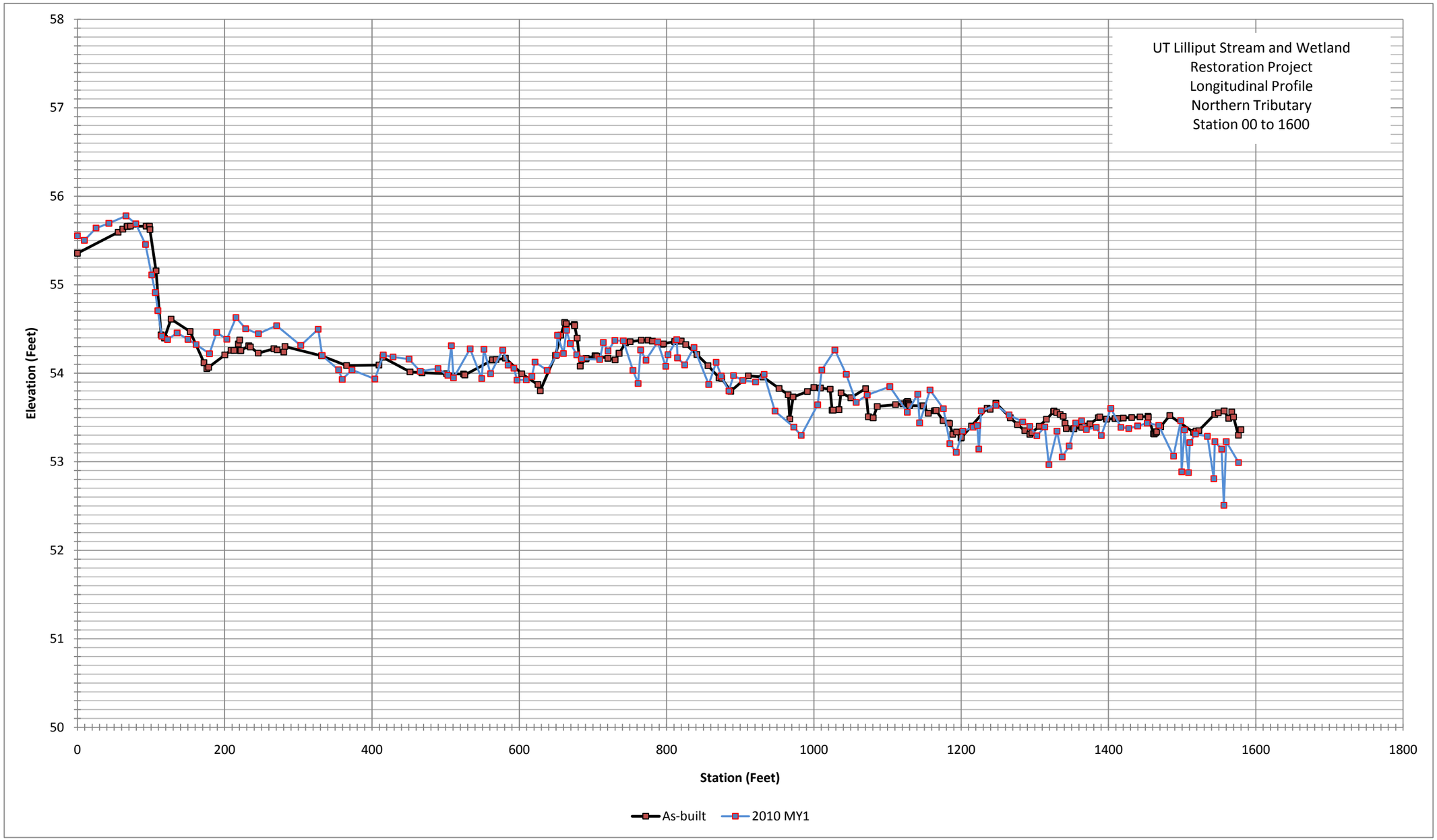
Picture Taken December 6, 2010

As-Built Survey As-Built Survey			2010 2010 Survey			2011 2011 Survey			2012 2012 Survey			2013 2013 Survey			2014 2014 Survey		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0.00	56.02		0.00	56.16													
0.18	55.96		0.09	55.97													
35.09	55.59		9.96	55.95													
37.17	55.59		18.02	55.63													
37.20	55.59		26.17	55.34													
37.30	55.59		37.86	55.14													
57.19	54.25		42.25	54.77													
60.55	54.09		43.10	54.61													
60.72	54.11		49.61	54.22													
63.06	54.12		58.74	54.41													
100.42	54.08		60.54	54.61													
101.05	54.08		67.09	54.62													
101.29	54.05		71.34	54.49													
105.71	54.07		75.01	54.63													
107.01	54.09		83.61	54.64													
126.47	54.33		92.39	54.65													
132.17	54.29		96.75	54.43													
136.00	54.28		101.36	54.54													
152.86	53.98		107.27	54.41													
152.86	53.98		112.06	54.49													
154.15	54.04		119.55	54.32													
176.01	55.12		122.71	54.32													
176.22	55.13		134.82	54.33													
176.36	55.13		139.05	54.52													
191.03	55.58		143.49	54.97													
			151.43	55.64													
			157.04	55.94													
			164.26	56.11													
			172.58	56.14													
			184.17	56.04													

Summary Data	
Bankfull Elv.	
BF Area	
BF Width	
Flood Prone Elv.	
Flood Prone Width	
Max Depth	
Mean Depth	
W/D Ratio	
ER	
Bank Height Ratio	
Stream Type	Zero




UT Lilliput Stream and Wetland
Restoration Project
Longitudinal Profile
Southern Tributary
Station 00 to 1703
Elevation (Feet)
55
53
51
49
47
45
0
200
400
600
800
1000
1200
1400
1600
Station (Feet)
Southern Tributary
2010 MY1


UT Lilliput Stream and Wetland
Restoration Project
Longitudinal Profile
Northern Tributary
Station 00 to 1600
Elevation (Feet)
58
57
56
55
54
53
52
51
50
0
200
400
600
800
1000
1200
1400
1600
1800
Station (Feet)
As-built
2010 MY1

APPENDIX E

Figure 3. UT Lilliput Stream and Wetland Restoraton Project 30 to 70 Percentile Graph for Rainfall in 2010. Brunswick County, NC.

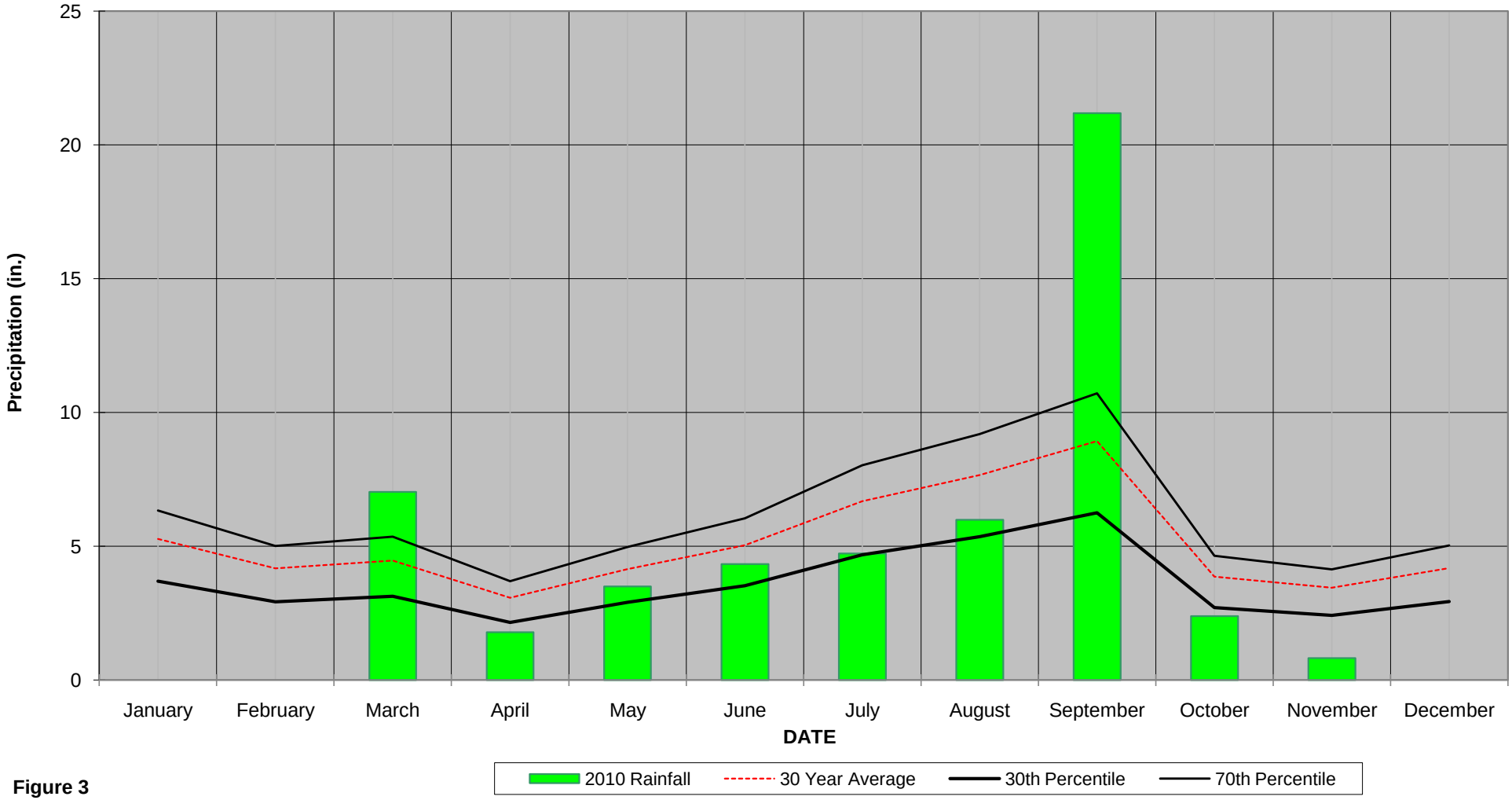
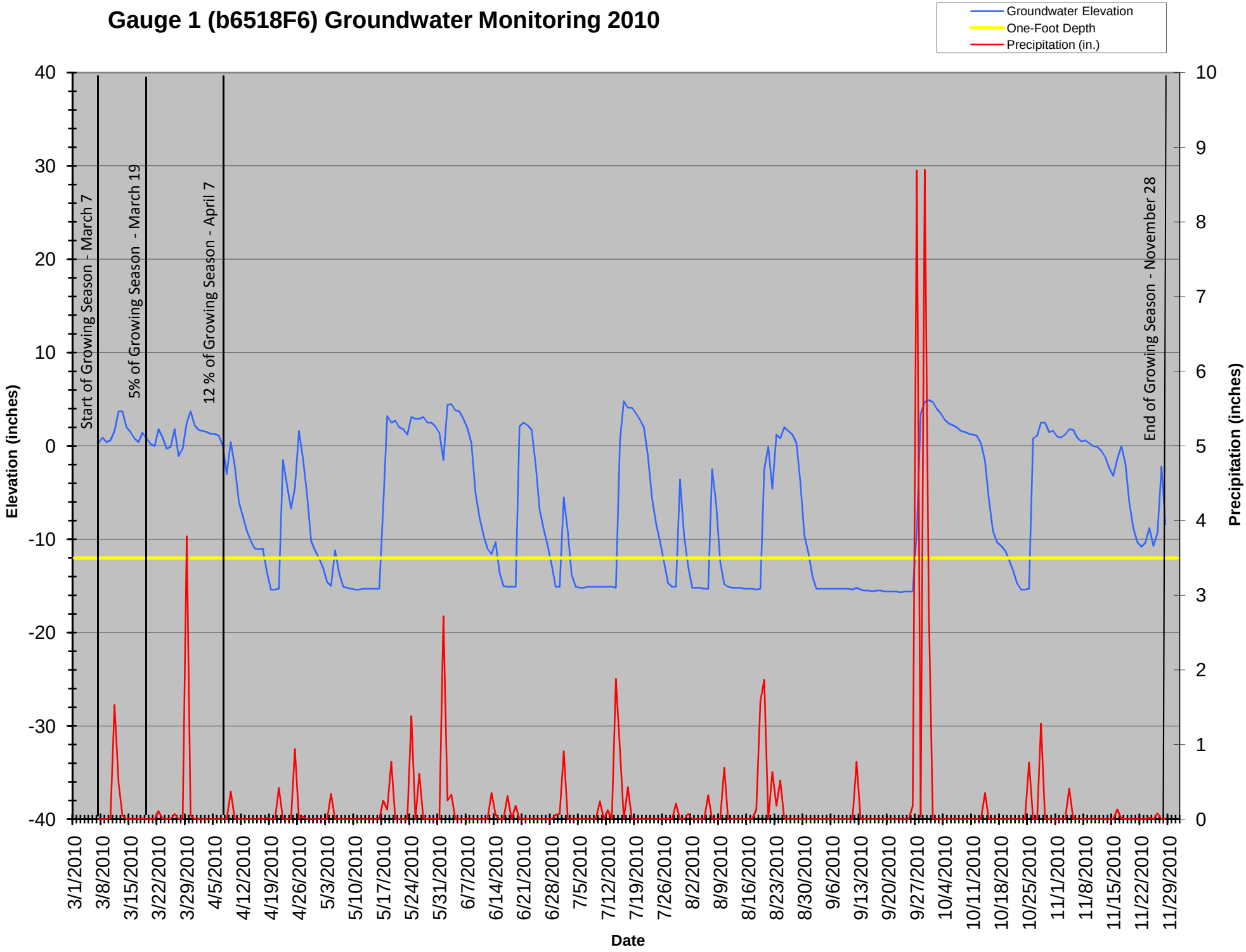
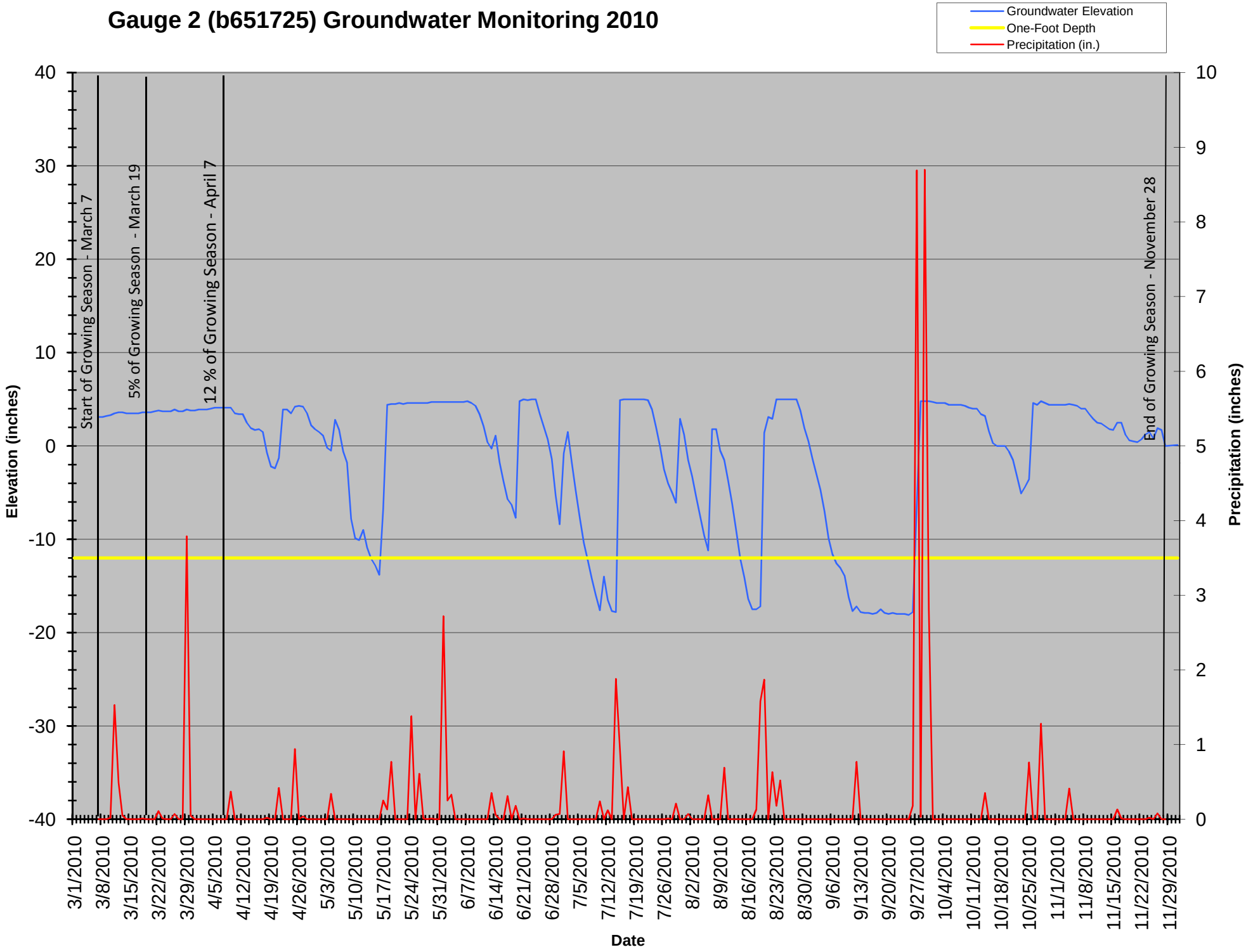


Figure 3

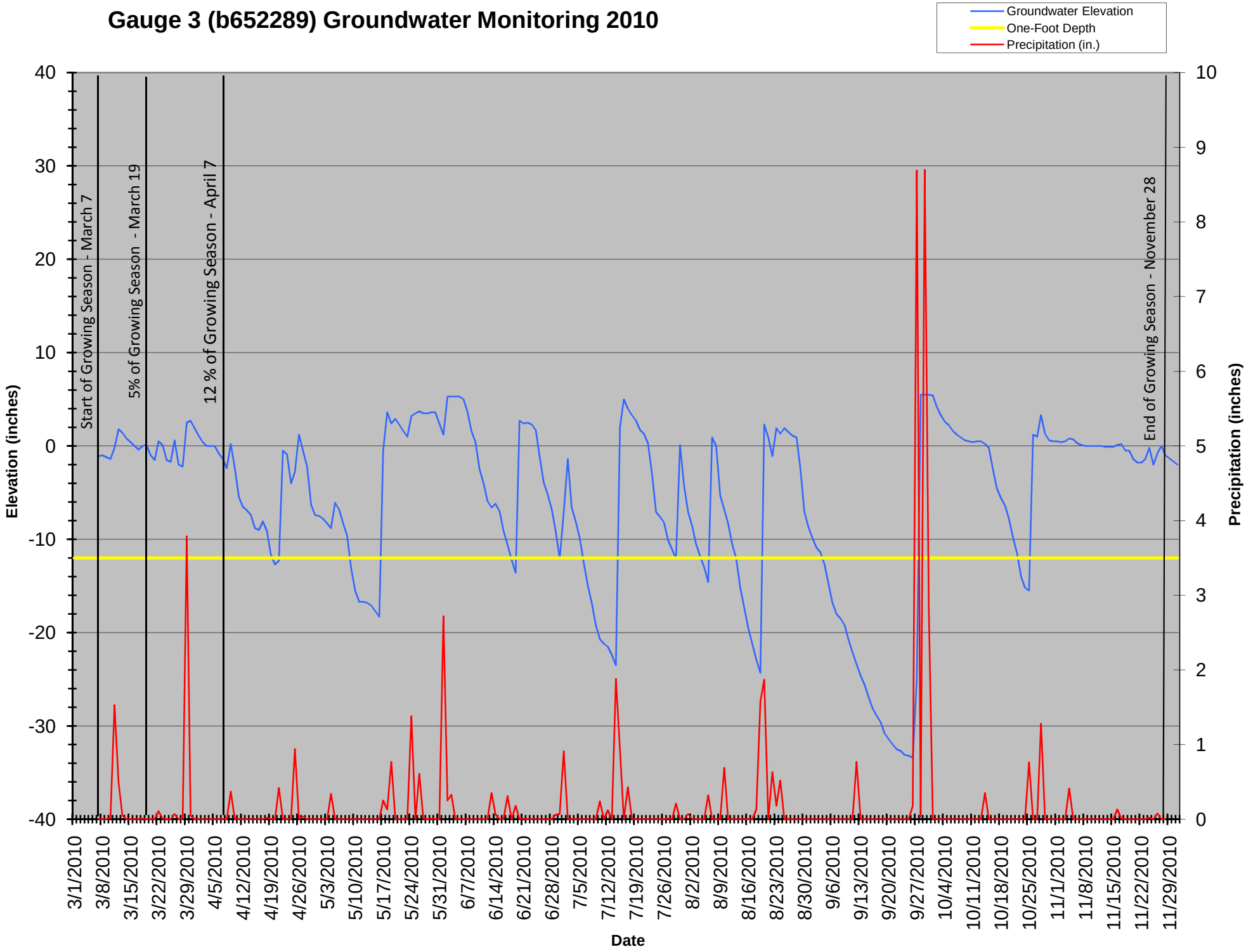
Gauge 1 (b6518F6) Groundwater Monitoring 2010



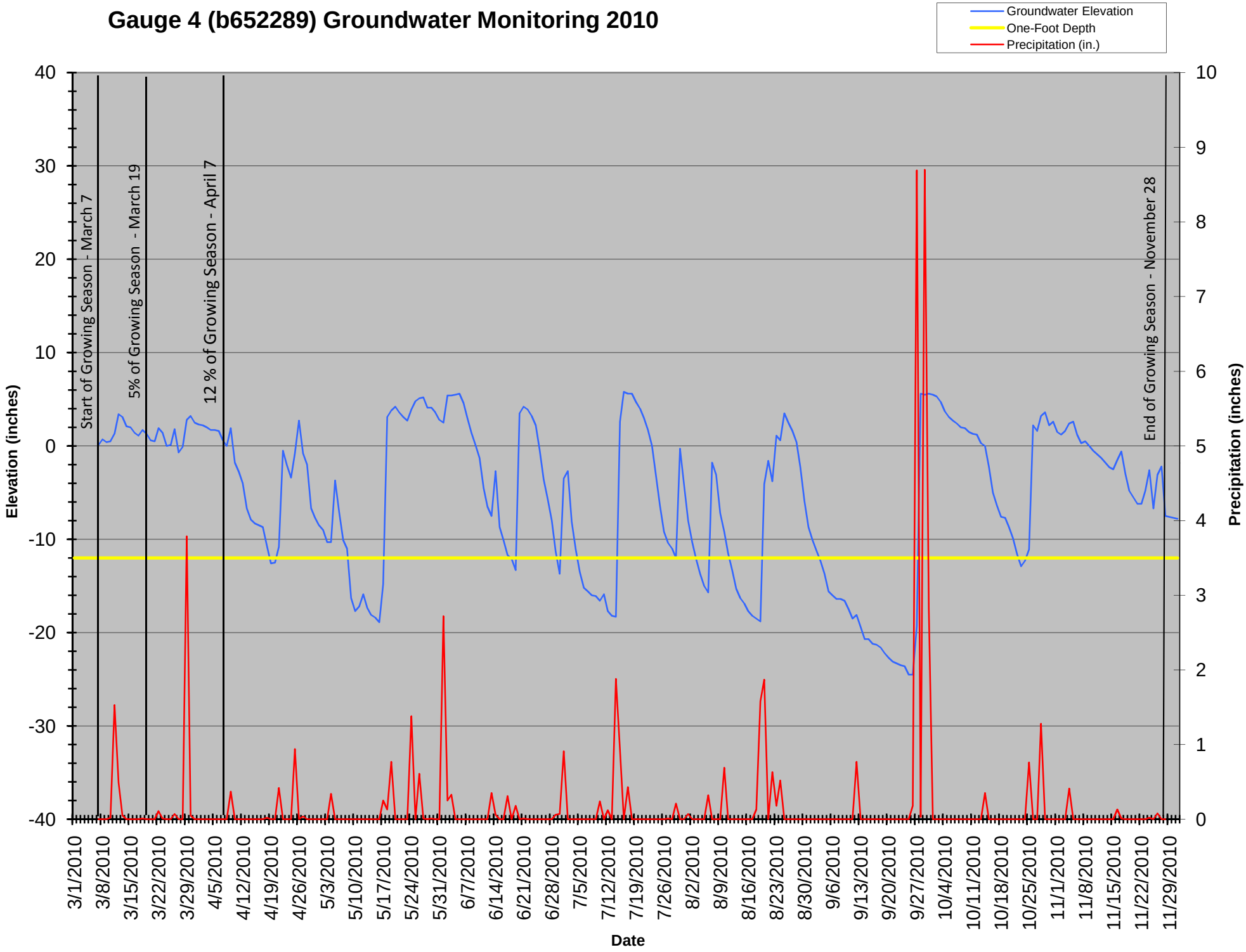
Gauge 2 (b651725) Groundwater Monitoring 2010



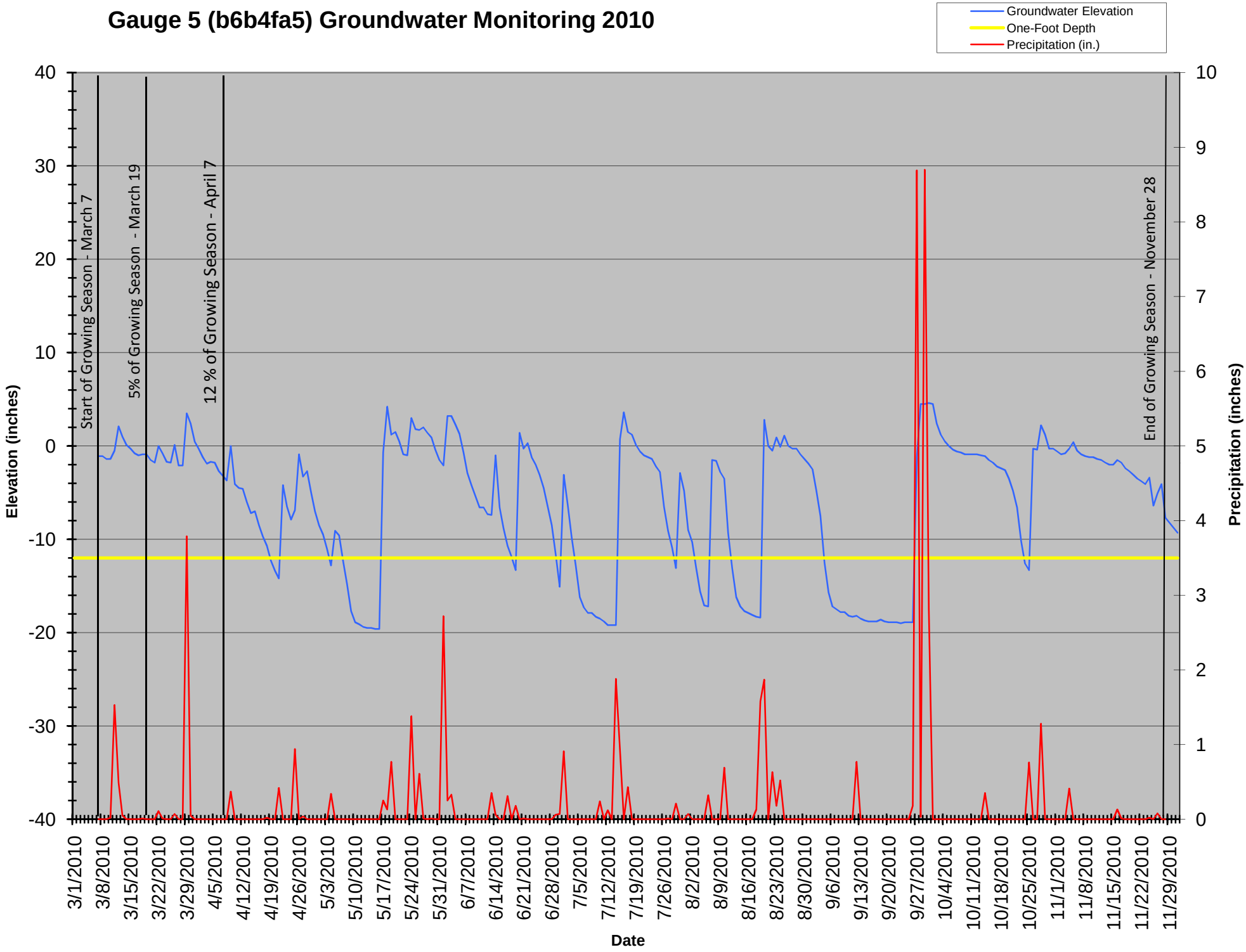
Gauge 3 (b652289) Groundwater Monitoring 2010

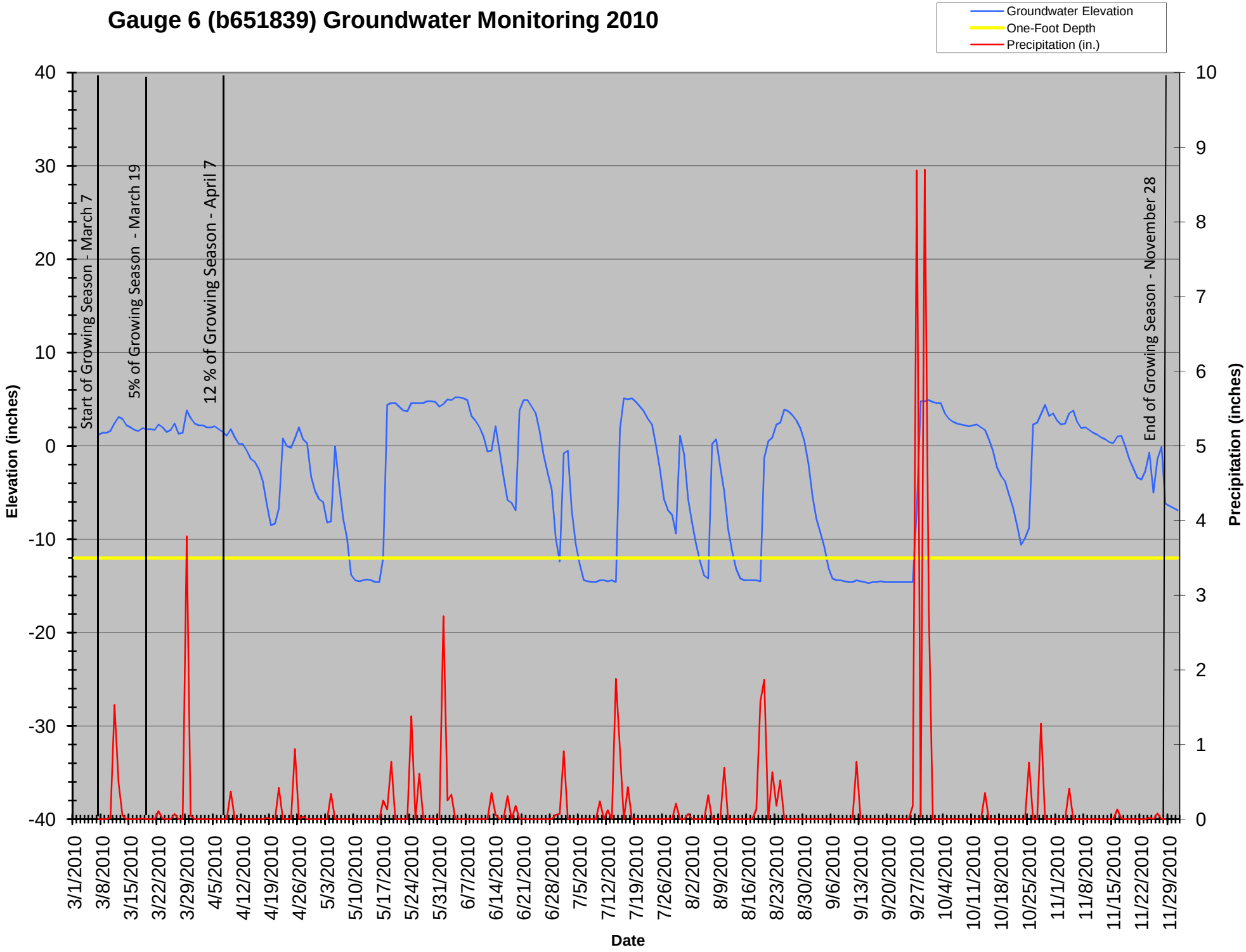


Gauge 4 (b652289) Groundwater Monitoring 2010



Gauge 5 (b6b4fa5) Groundwater Monitoring 2010




Gauge 6 (b651839) Groundwater Monitoring 2010
Groundwater Elevation
One-Foot Depth
Precipitation (in.)
Start of Growing Season - March 7
5% of Growing Season - March 19
12 % of Growing Season - April 7
End of Growing Season - November 28
Elevation (inches)
Precipitation (inches)
Date
40
30
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5/17/2010
5/24/2010
5/31/2010
6/7/2010
6/14/2010
6/21/2010
6/28/2010
7/5/2010
7/12/2010
7/19/2010
7/26/2010
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8/9/2010
8/16/2010
8/23/2010
8/30/2010
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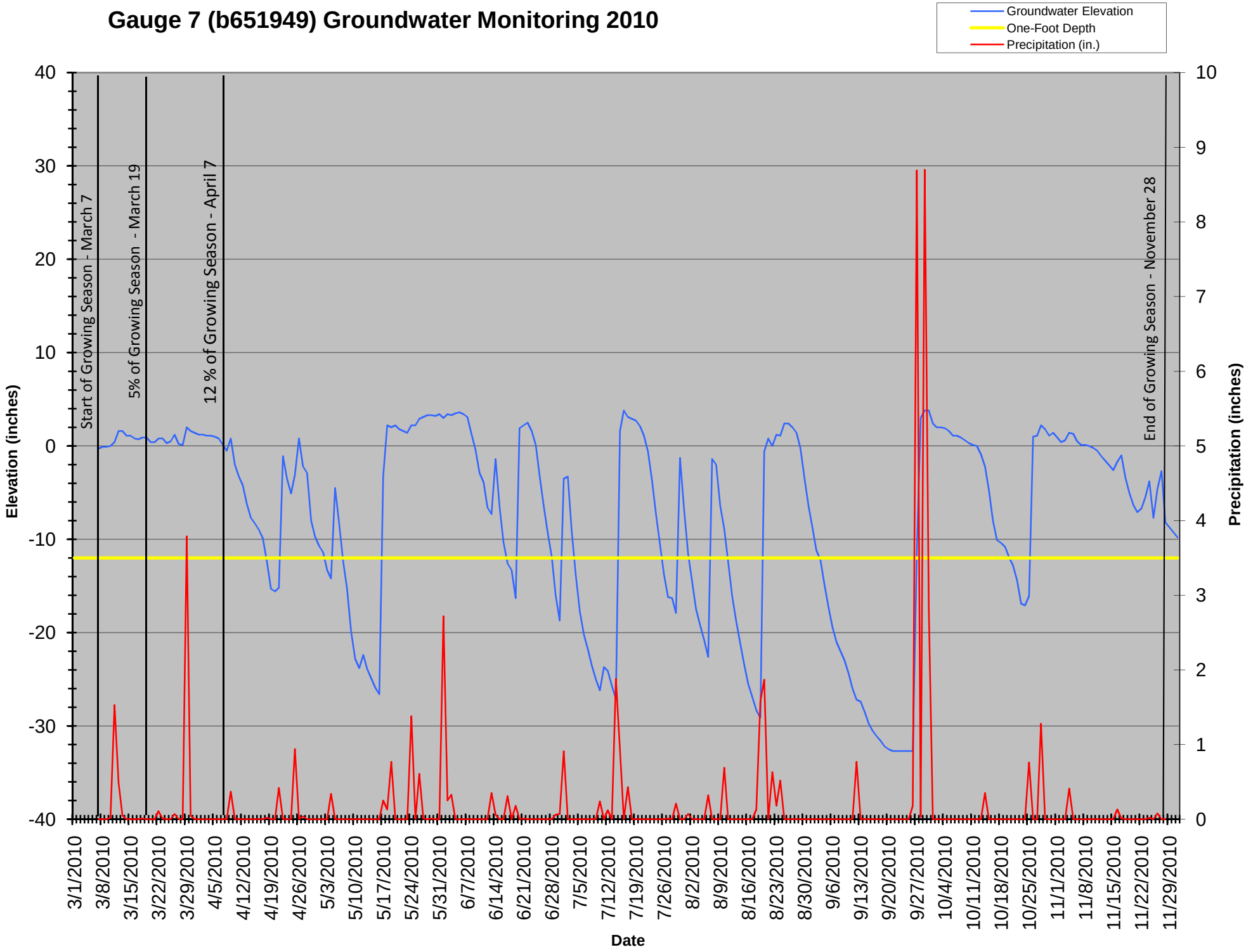
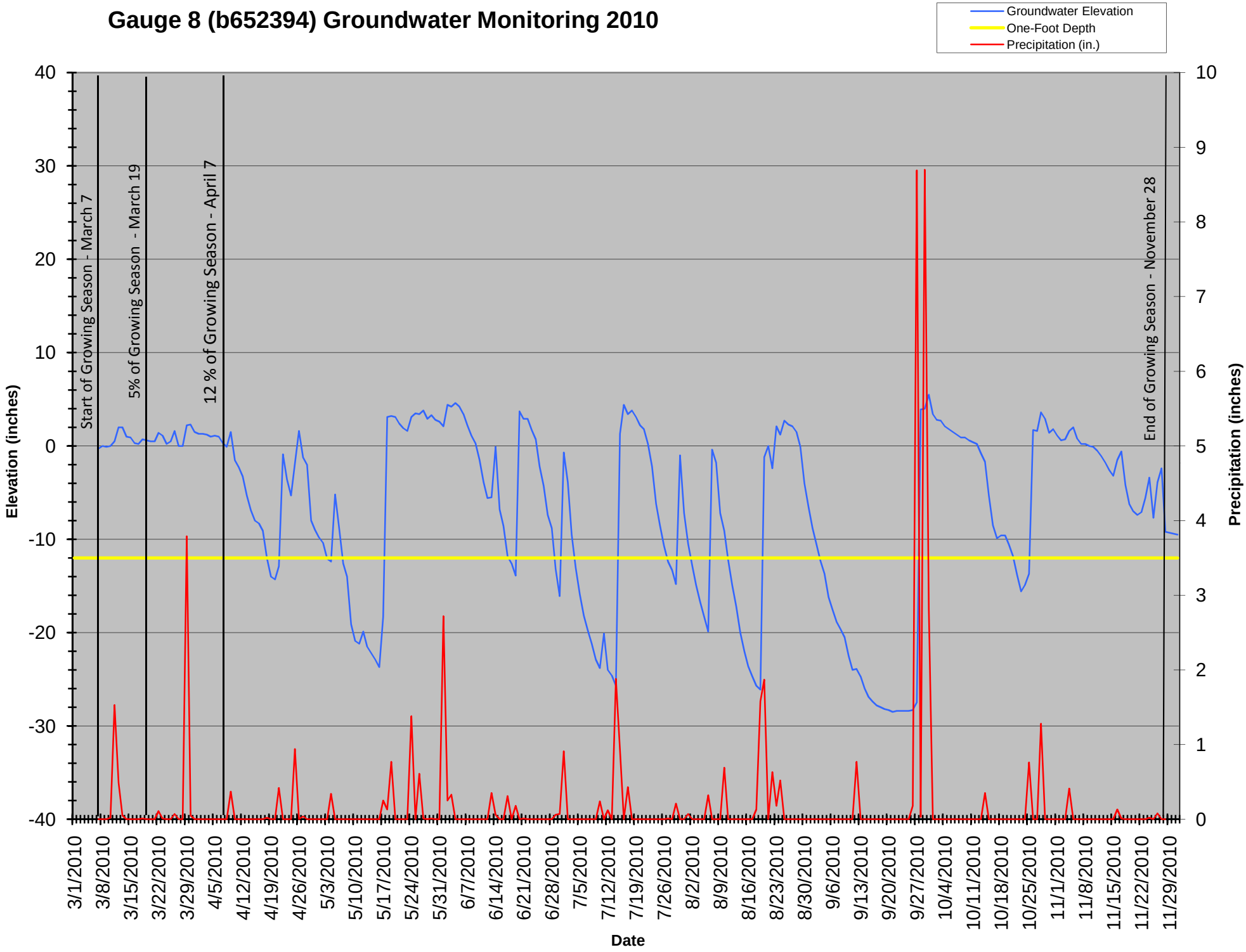
11/15/2010
11/22/2010
11/29/2010

Gauge 7 (b651949) Groundwater Monitoring 2010




Gauge 8 (b652394) Groundwater Monitoring 2010
Groundwater Elevation
One-Foot Depth
Precipitation (in.)
Start of Growing Season - March 7
5% of Growing Season - March 19
12 % of Growing Season - April 7
End of Growing Season - November 28
Elevation (inches)
Precipitation (inches)
Date
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5/10/2010
5/17/2010
5/24/2010
5/31/2010
6/7/2010
6/14/2010
6/21/2010
6/28/2010
7/5/2010
7/12/2010
7/19/2010
7/26/2010
8/2/2010
8/9/2010
8/16/2010
8/23/2010
8/30/2010
9/6/2010
9/13/2010
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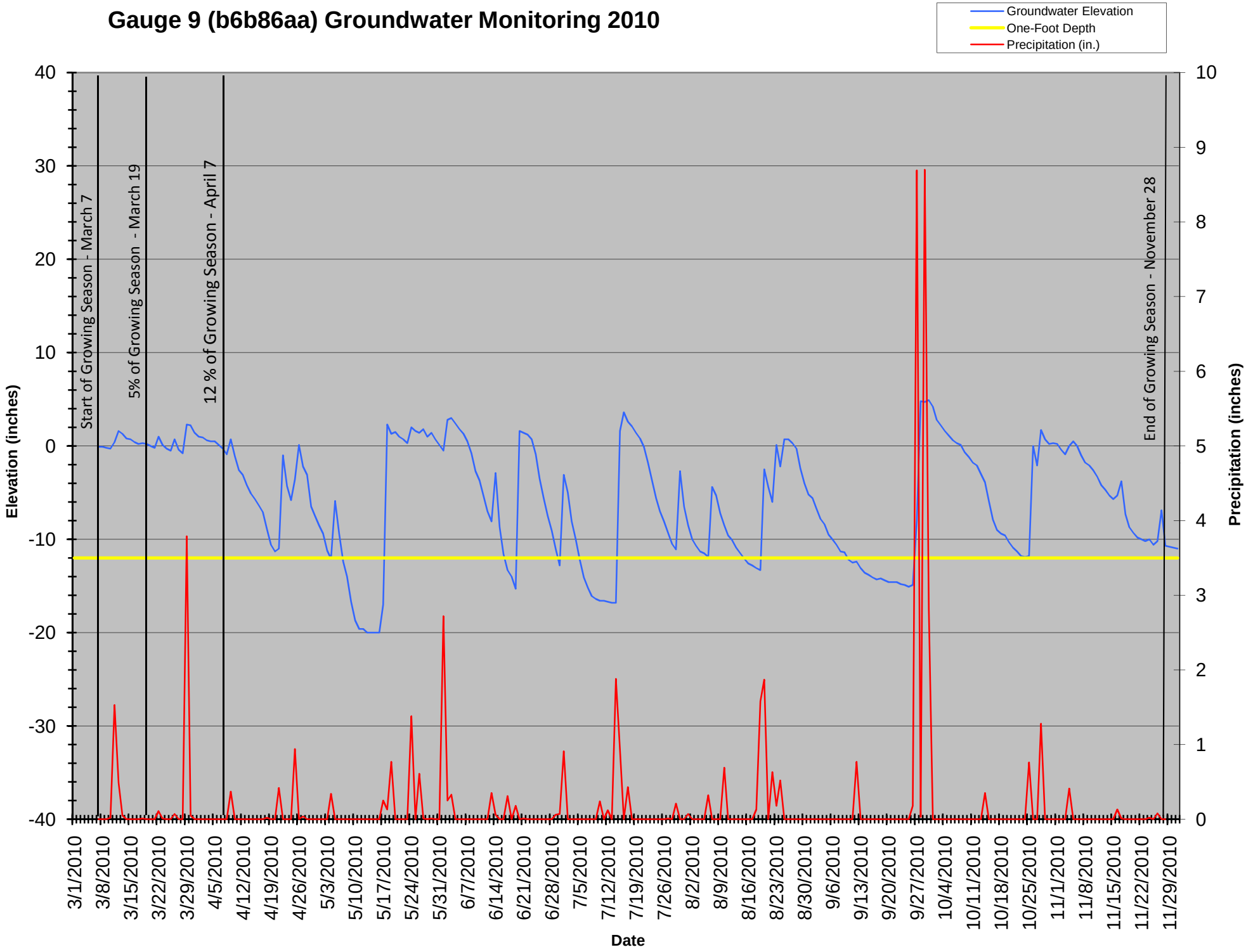
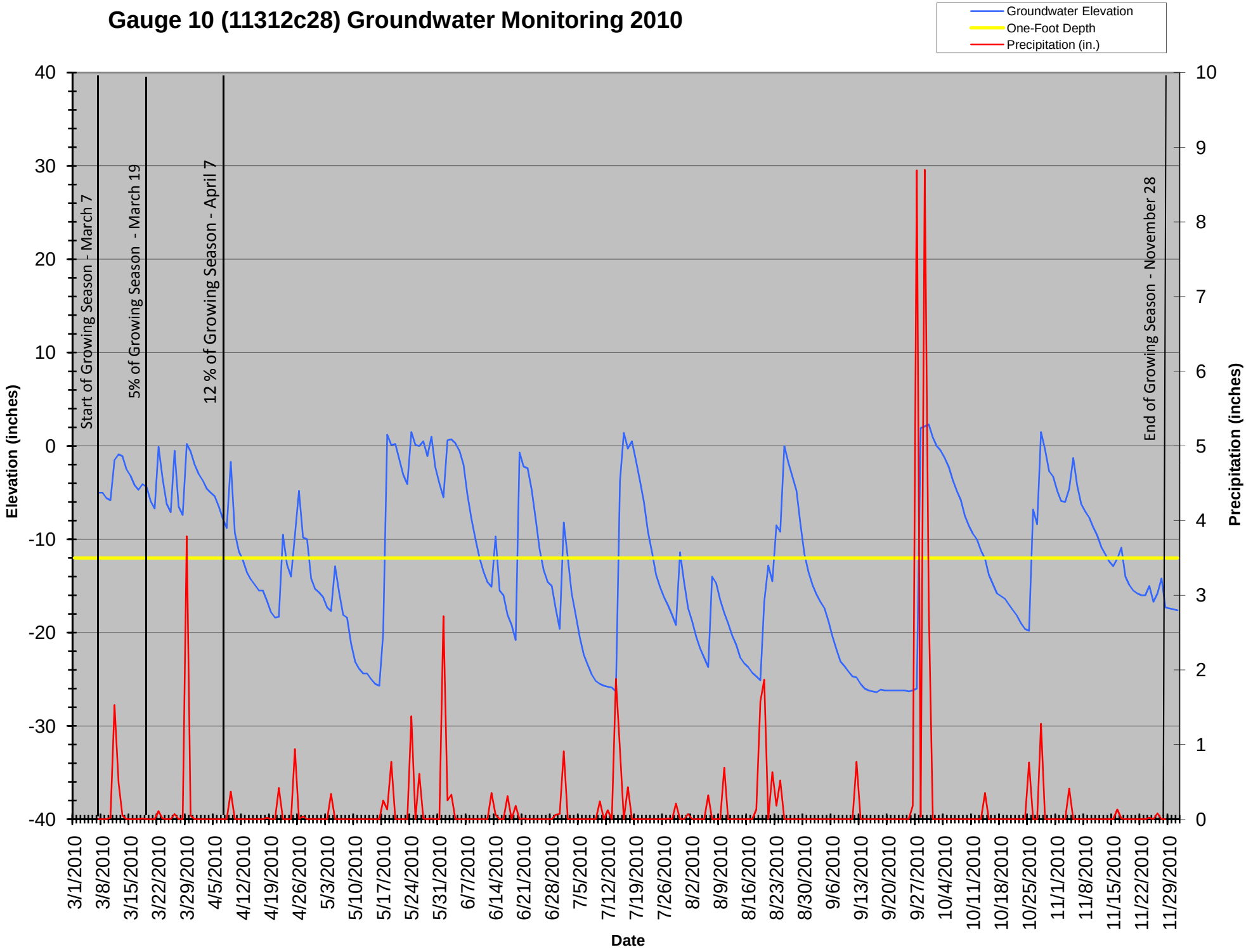
11/29/2010

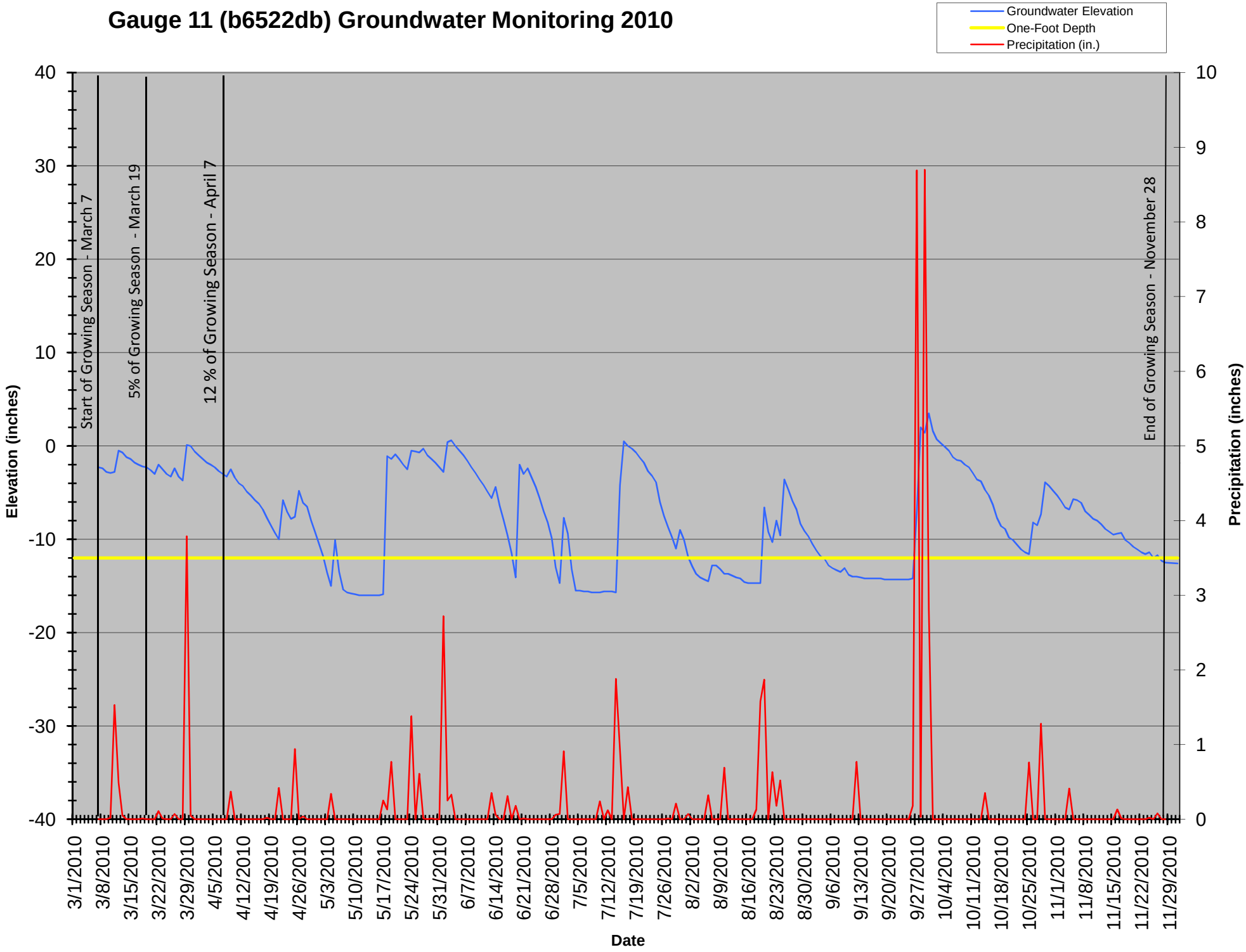
Gauge 9 (b6b86aa) Groundwater Monitoring 2010



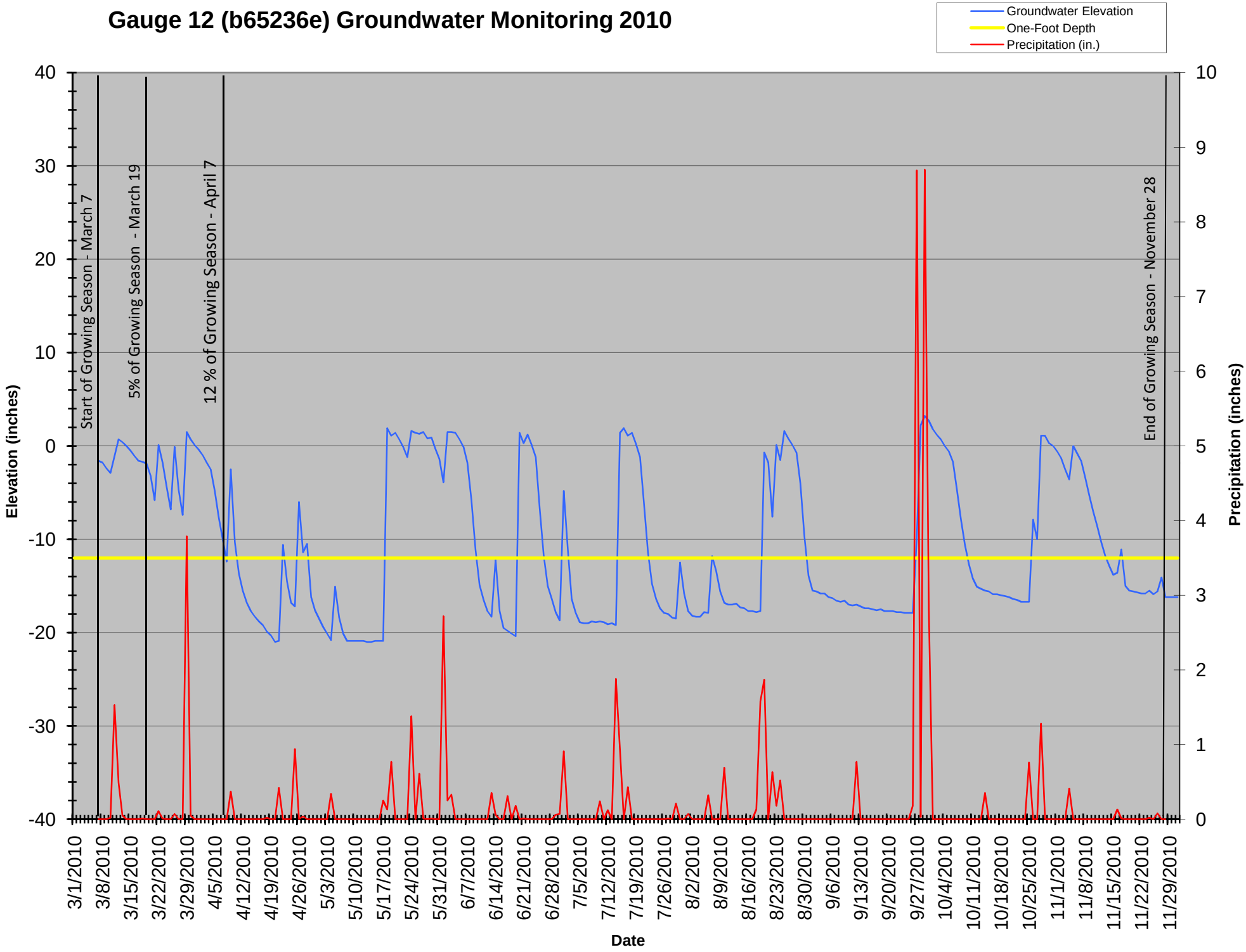
Gauge 10 (11312c28) Groundwater Monitoring 2010



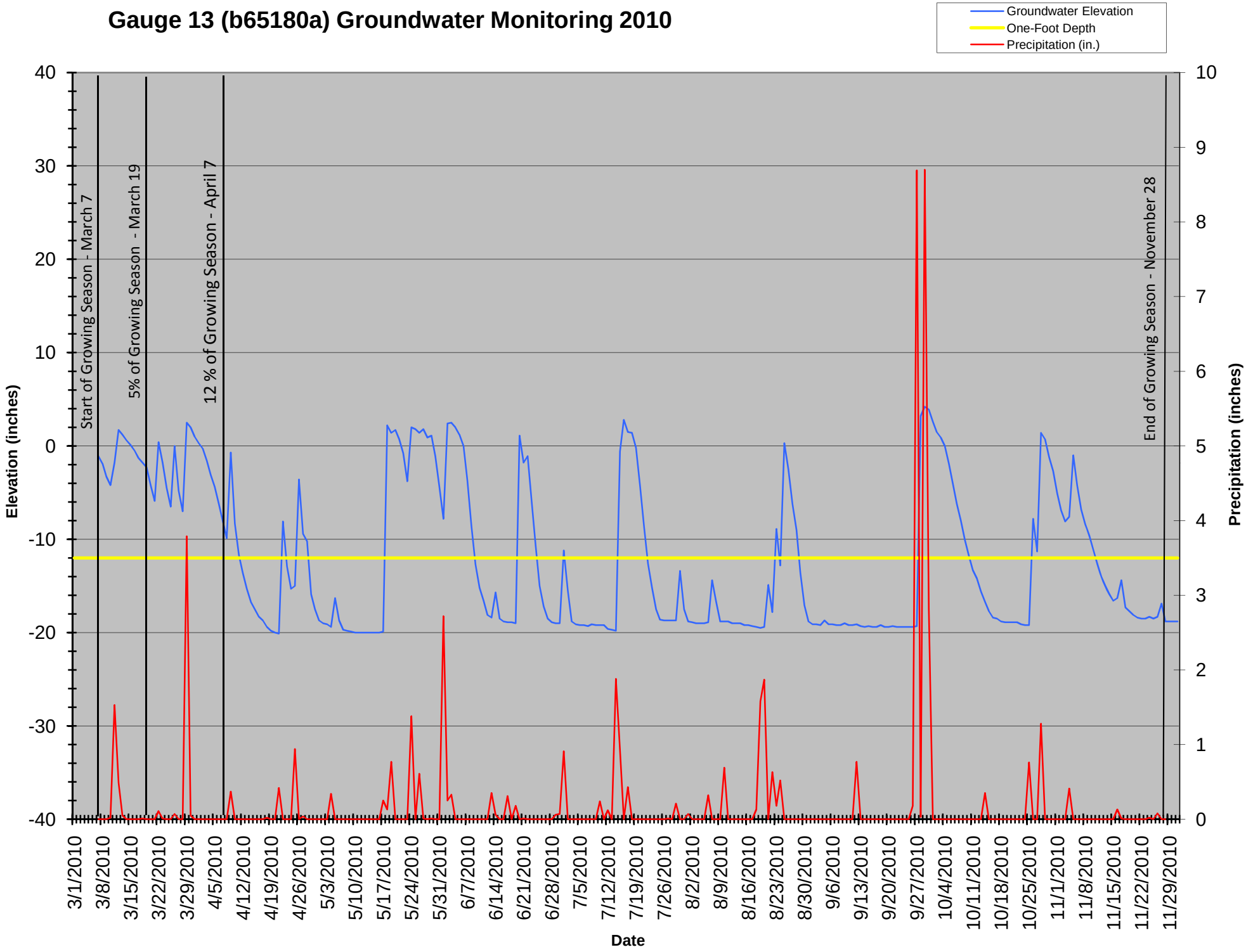
Gauge 11 (b6522db) Groundwater Monitoring 2010



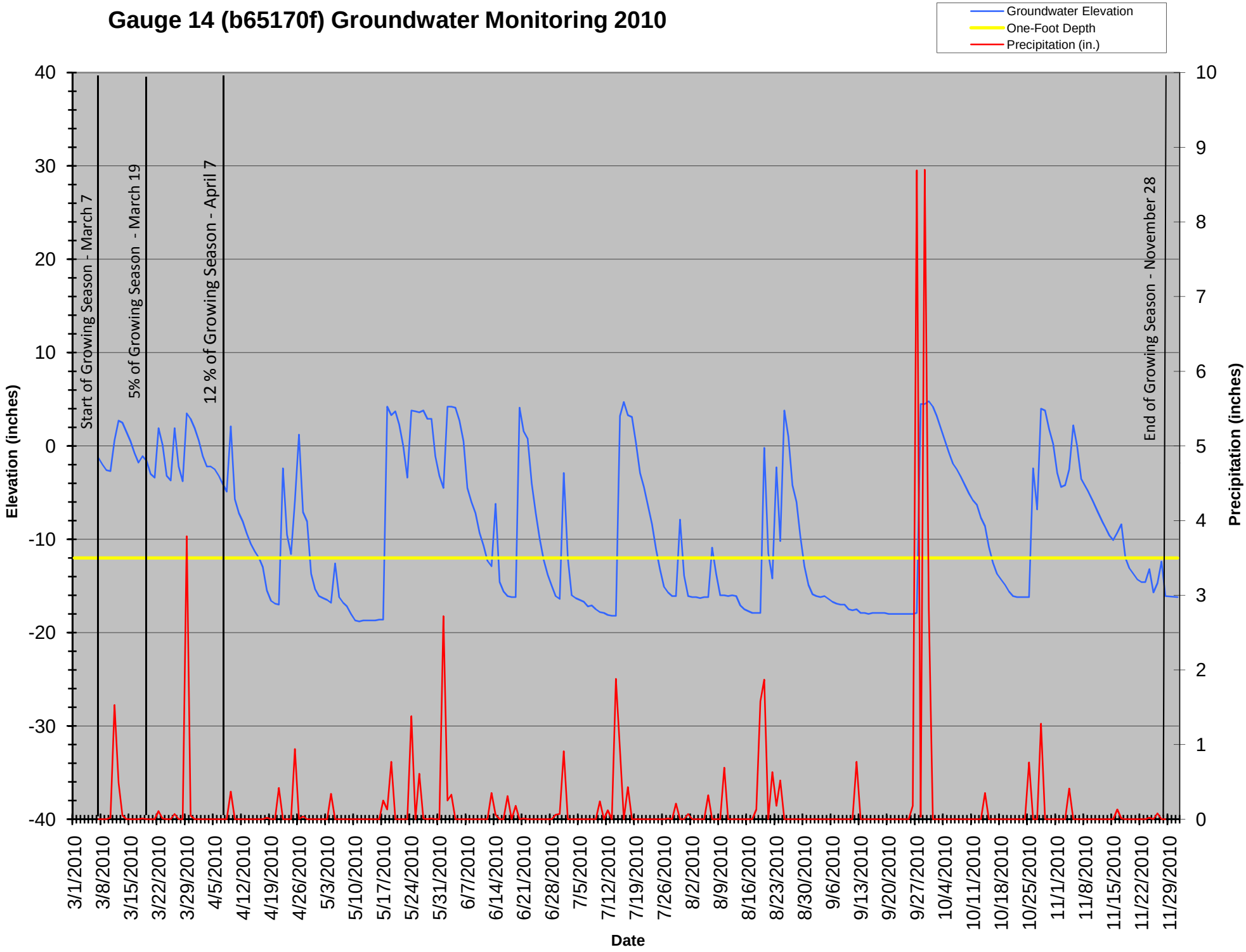
Gauge 12 (b65236e) Groundwater Monitoring 2010



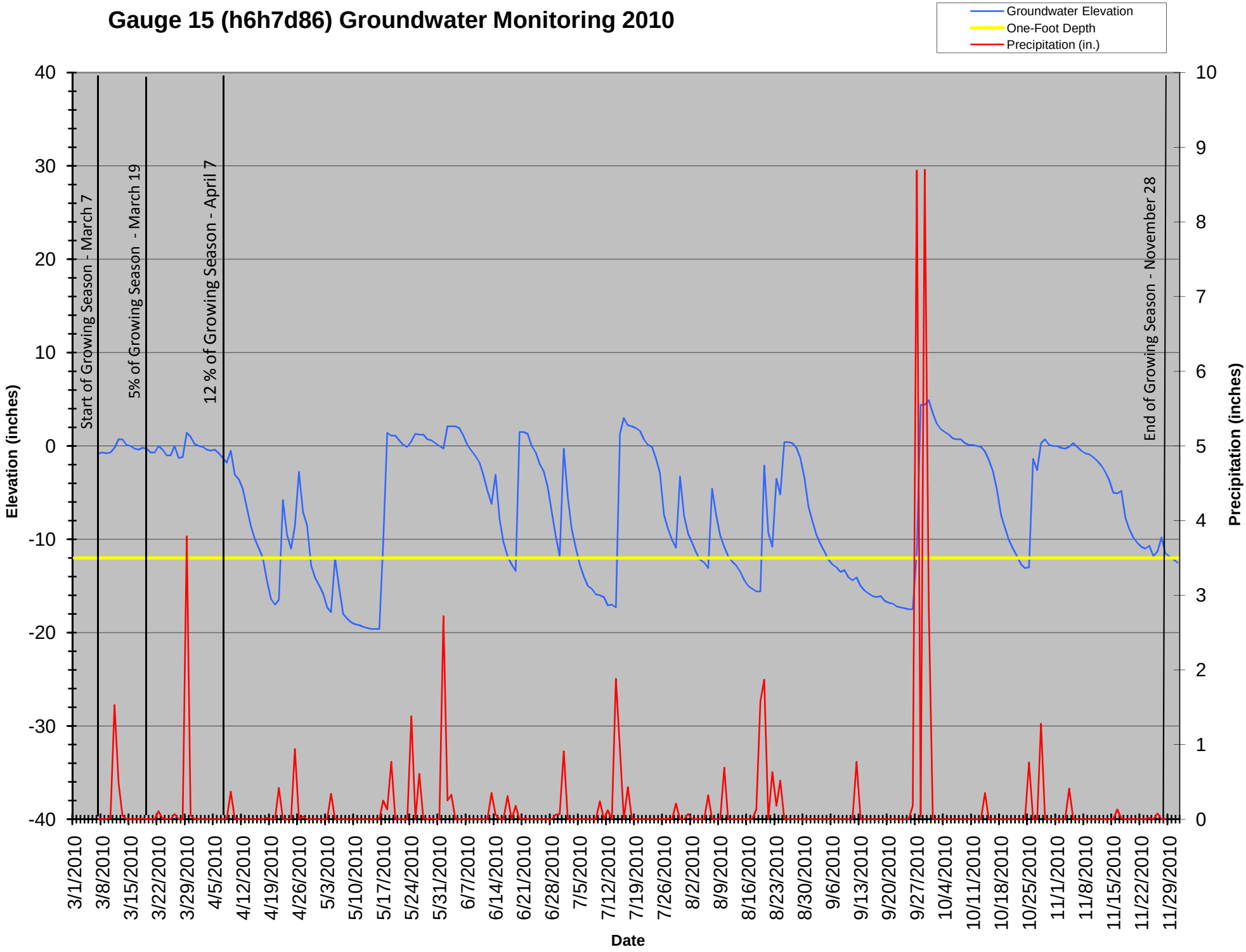
Gauge 13 (b65180a) Groundwater Monitoring 2010



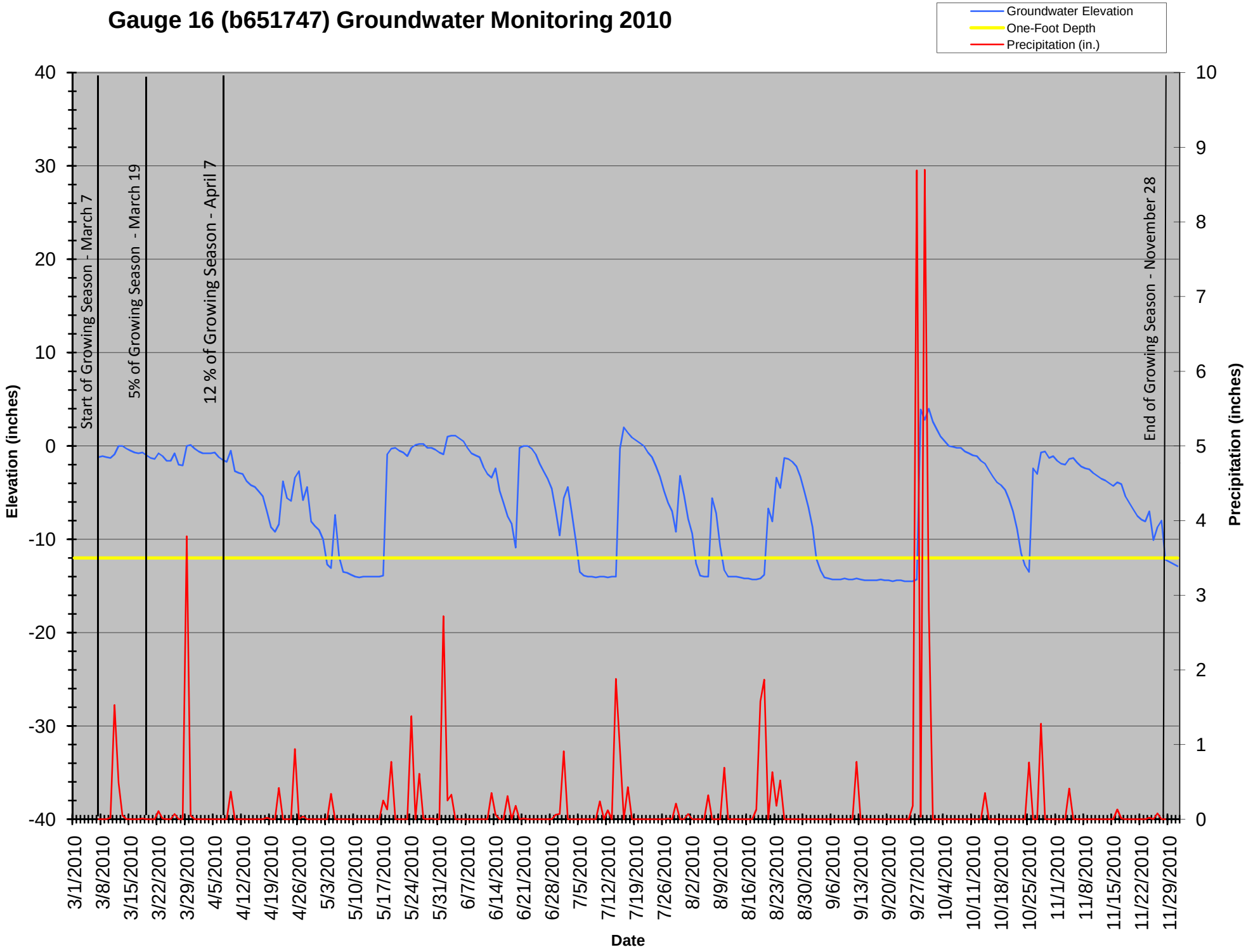
Gauge 14 (b65170f) Groundwater Monitoring 2010



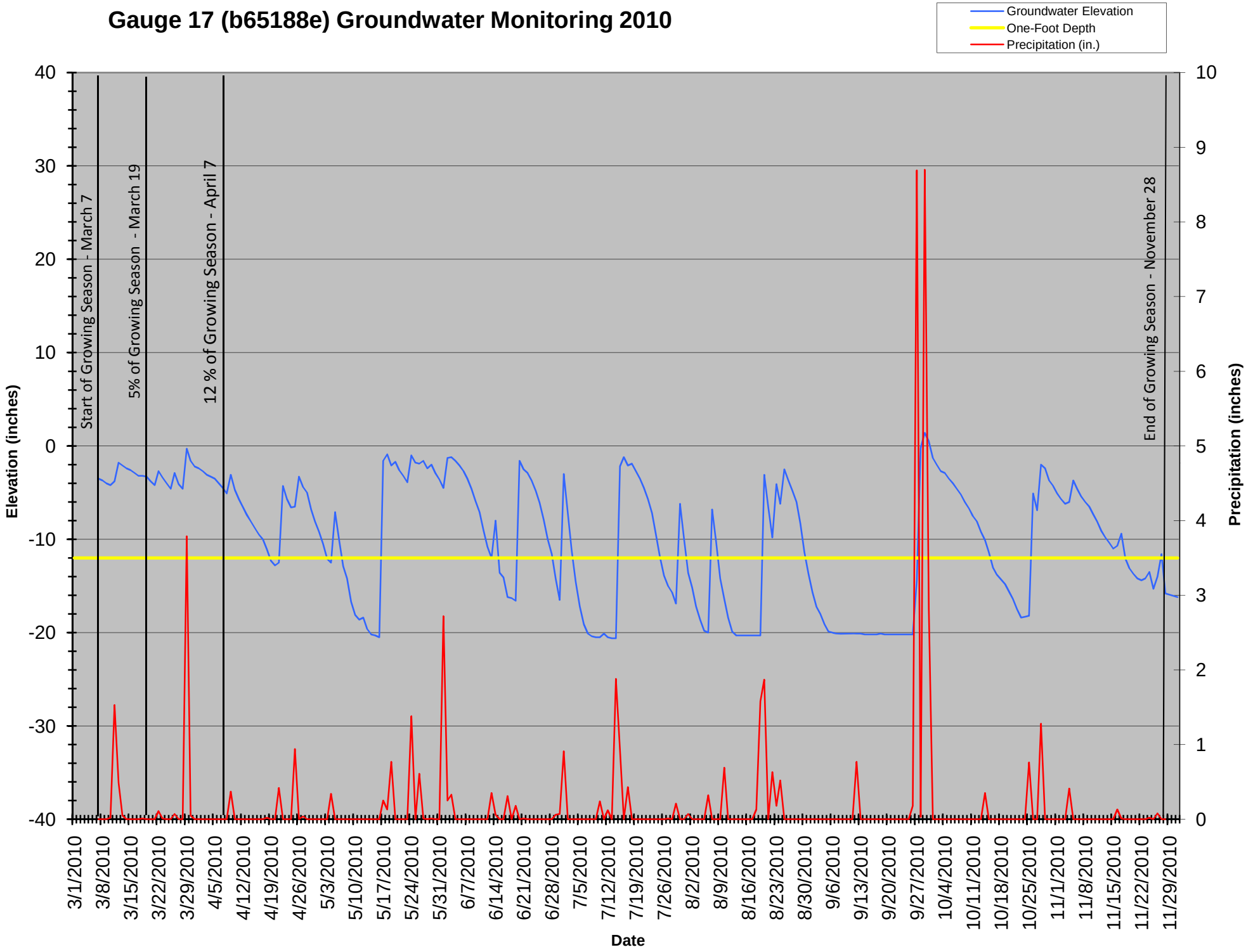
Gauge 15 (h6h7d86) Groundwater Monitoring 2010

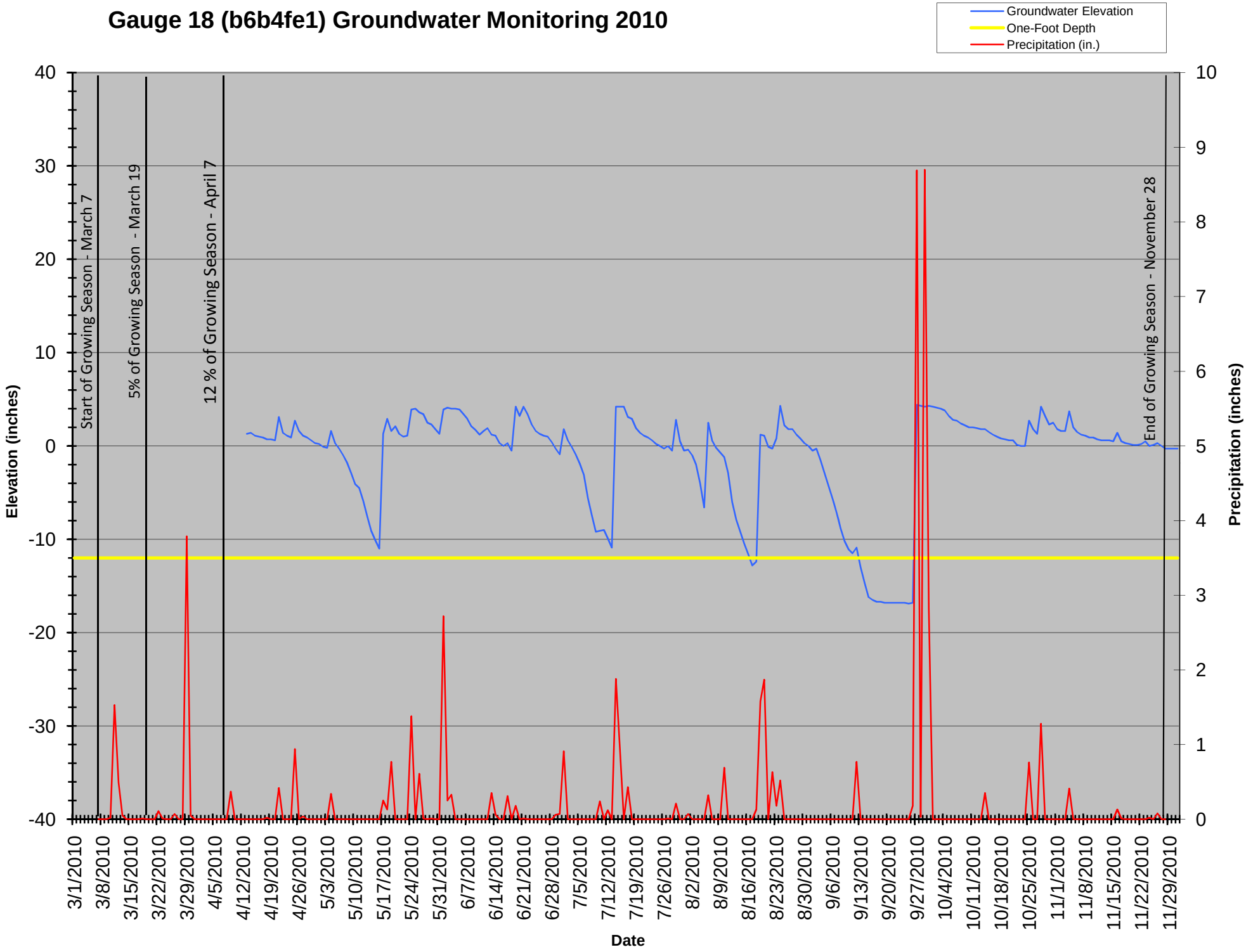


Gauge 16 (b651747) Groundwater Monitoring 2010



Gauge 17 (b65188e) Groundwater Monitoring 2010




Gauge 18 (b6b4fe1) Groundwater Monitoring 2010
Groundwater Elevation
One-Foot Depth
Precipitation (in.)
Start of Growing Season - March 7
5% of Growing Season - March 19
12 % of Growing Season - April 7
End of Growing Season - November 28
Elevation (inches)
Precipitation (inches)
Date
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5/17/2010
5/24/2010
5/31/2010
6/7/2010
6/14/2010
6/21/2010
6/28/2010
7/5/2010
7/12/2010
7/19/2010
7/26/2010
8/2/2010
8/9/2010
8/16/2010
8/23/2010
8/30/2010
9/6/2010
9/13/2010
9/20/2010
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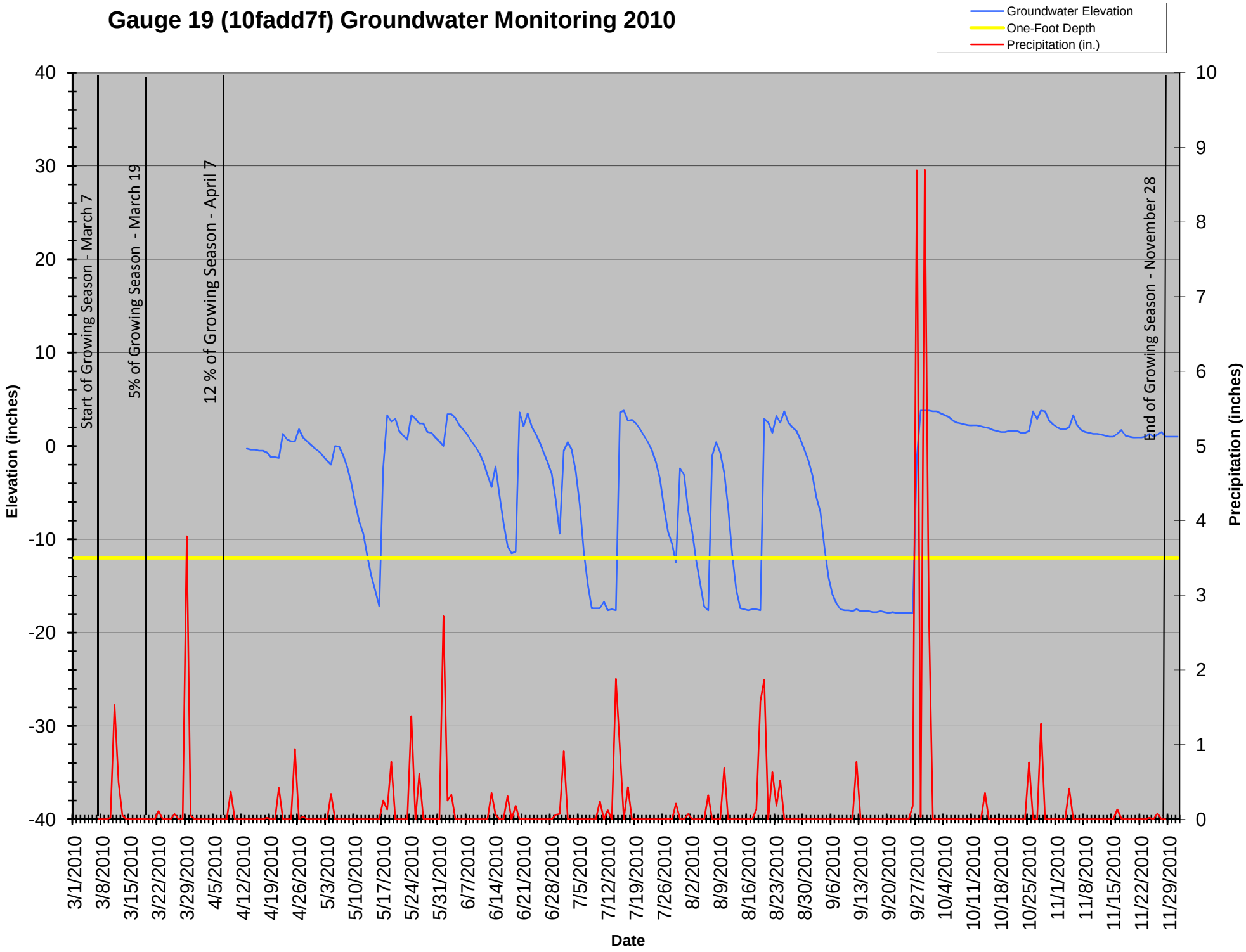
Gauge 19 (10fadd7f) Groundwater Monitoring 2010
Groundwater Elevation
One-Foot Depth
Precipitation (in.)
Start of Growing Season - March 7
5% of Growing Season - March 19
12 % of Growing Season - April 7
End of Growing Season - November 28
Elevation (inches)
Precipitation (inches)
Date
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3/22/2010
3/29/2010
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4/19/2010
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5/3/2010
5/10/2010
5/17/2010
5/24/2010
5/31/2010
6/7/2010
6/14/2010
6/21/2010
6/28/2010
7/5/2010
7/12/2010
7/19/2010
7/26/2010
8/2/2010
8/9/2010
8/16/2010
8/23/2010
8/30/2010
9/6/2010
9/13/2010
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9/27/2010
10/4/2010
10/11/2010
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10/25/2010
11/1/2010
11/8/2010
11/15/2010
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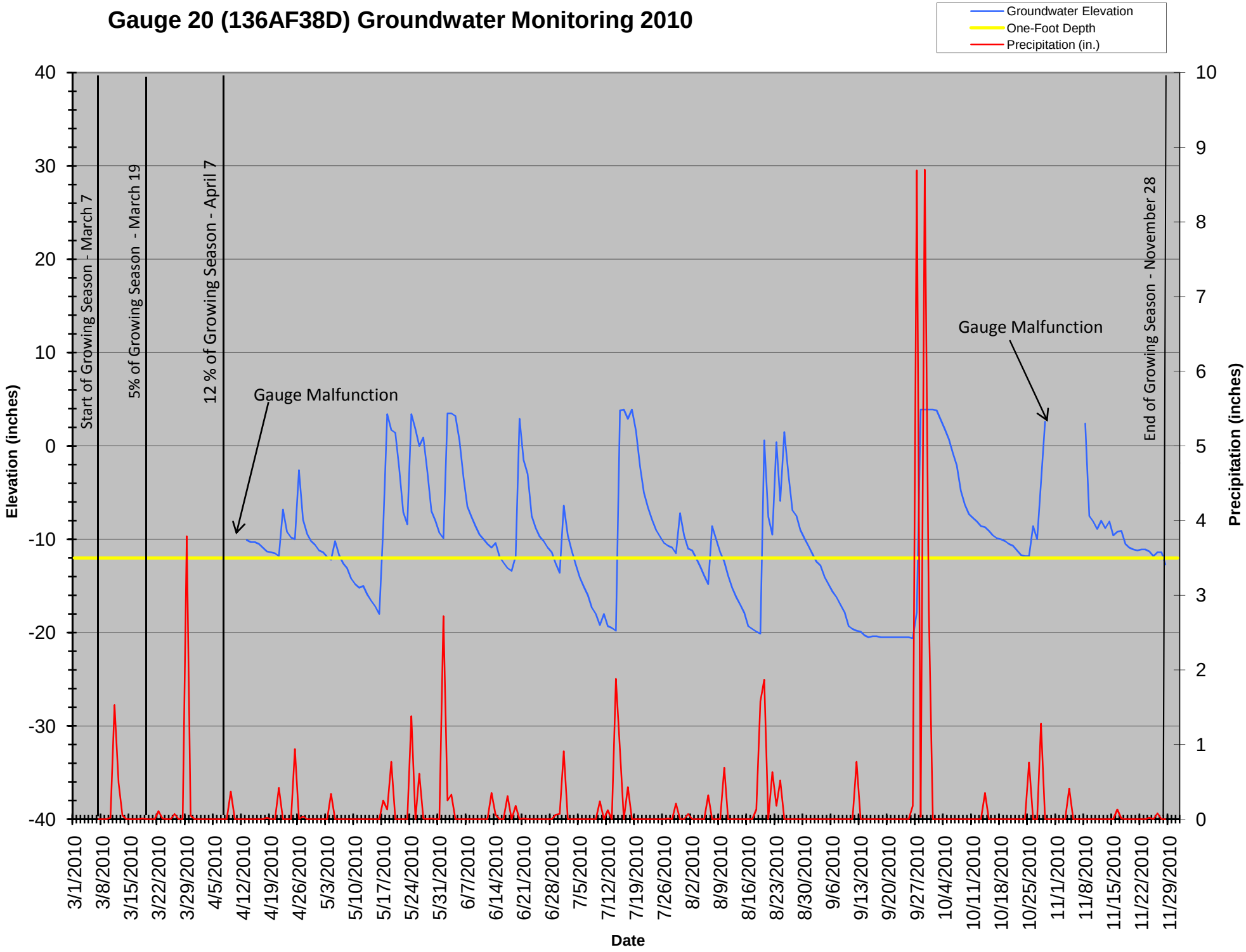
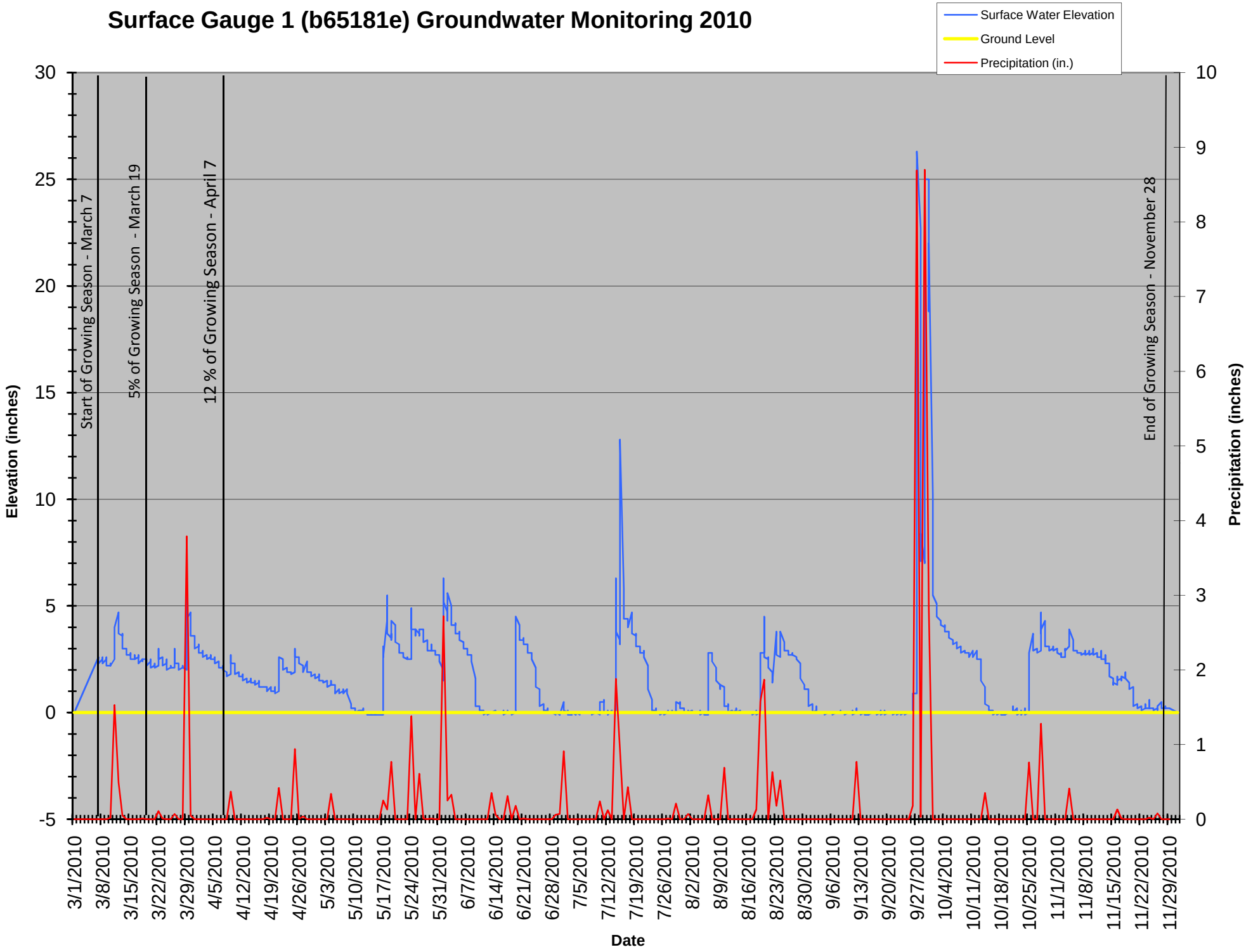
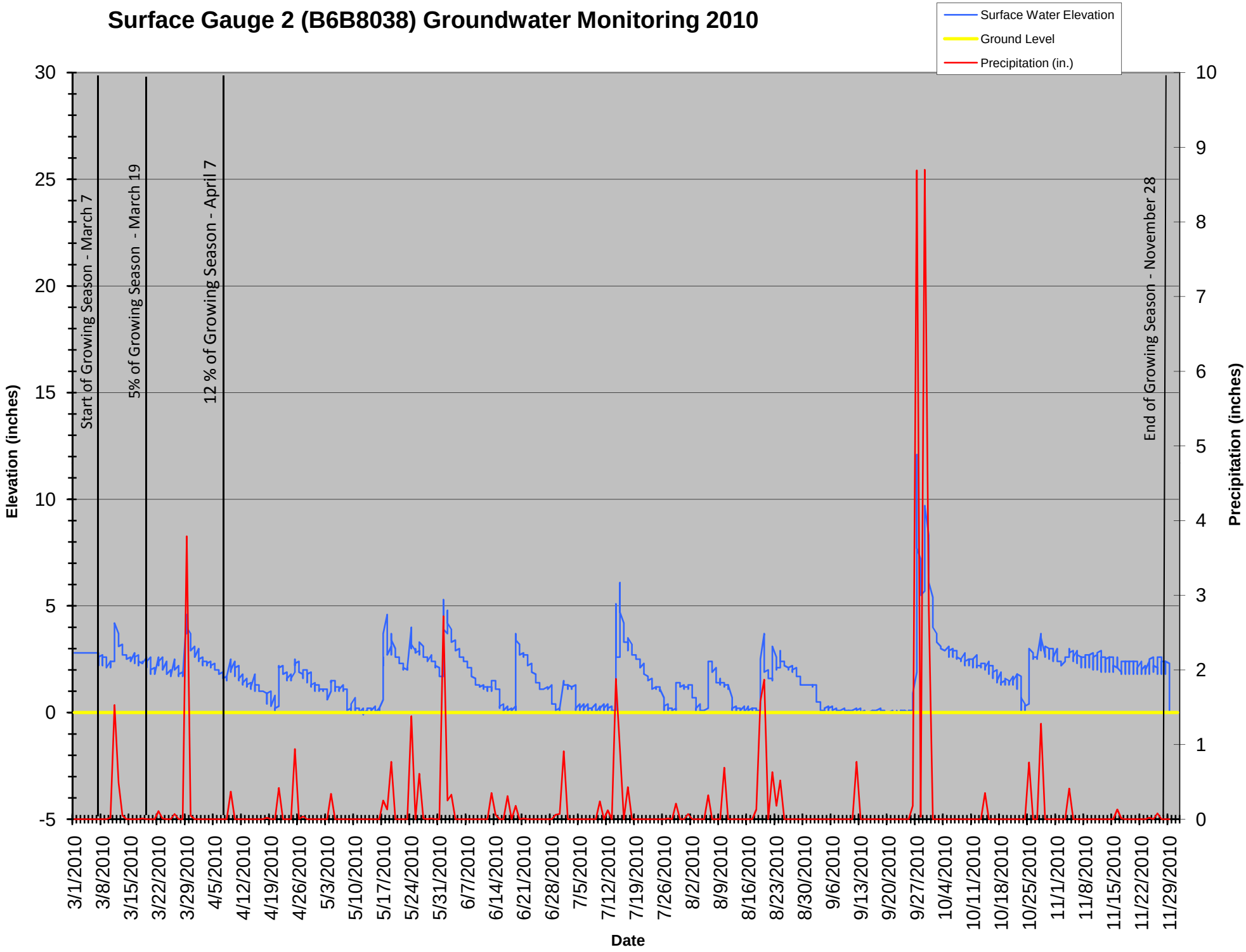
Gauge 20 (136AF38D) Groundwater Monitoring 2010



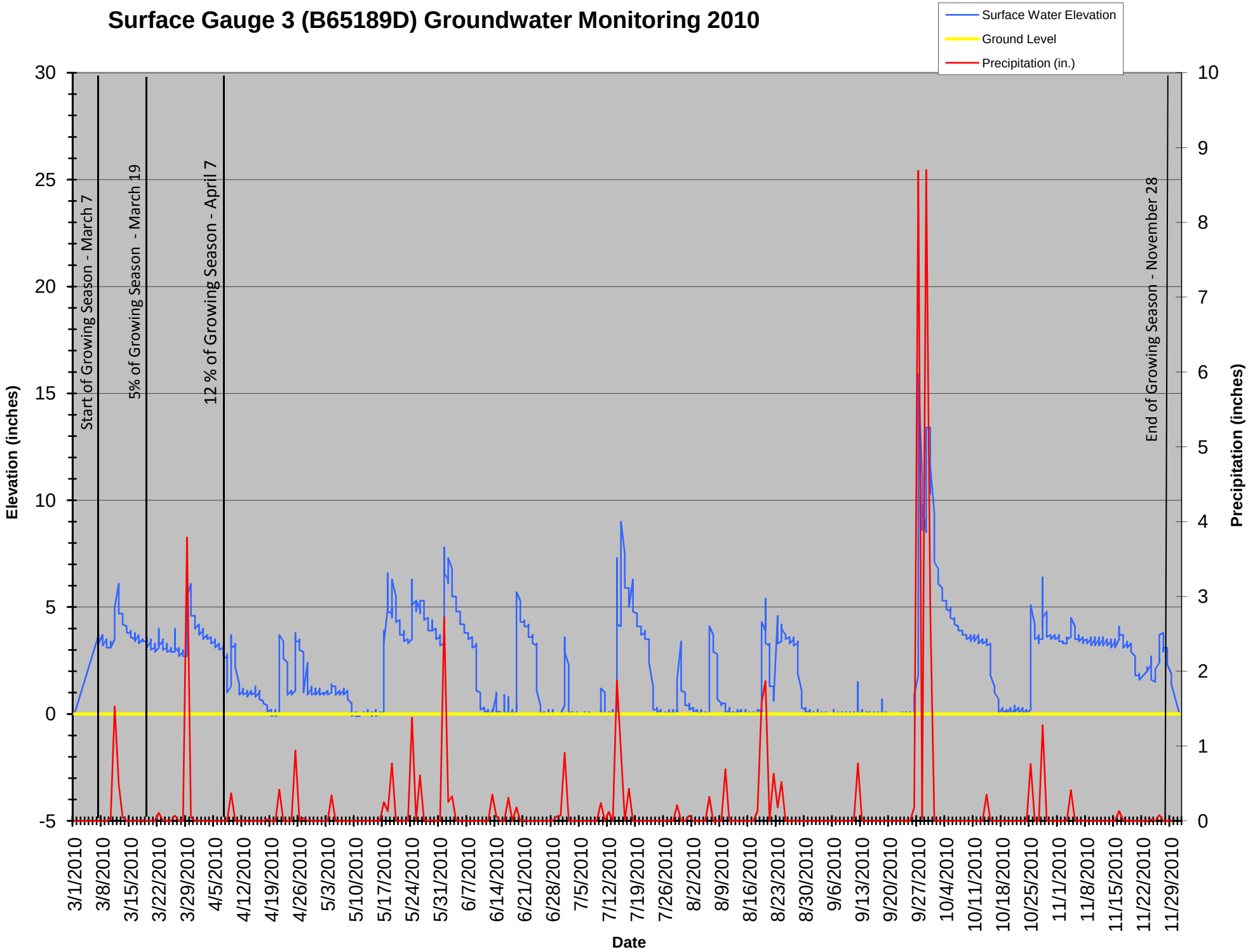
Surface Gauge 1 (b65181e) Groundwater Monitoring 2010



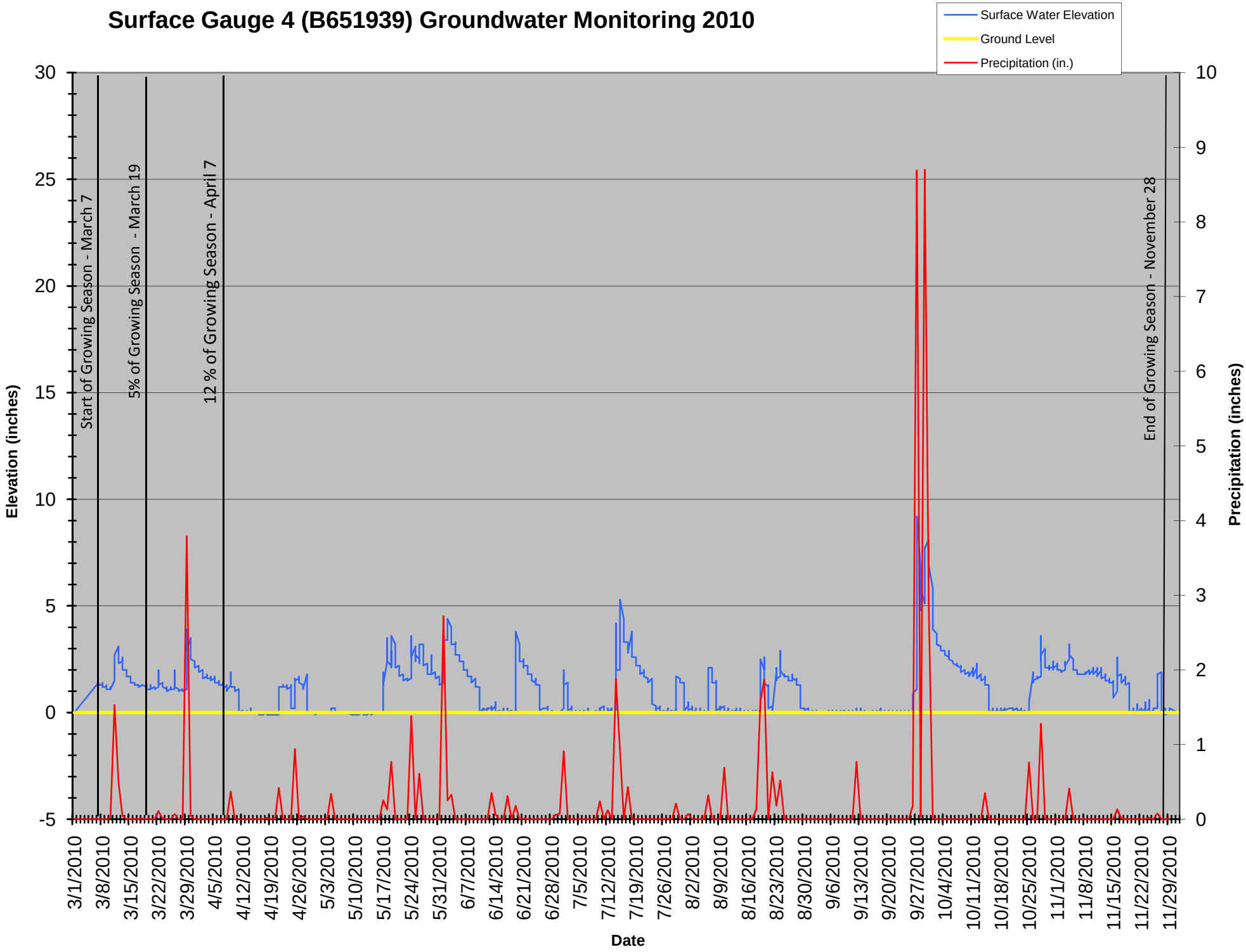
Surface Gauge 2 (B6B8038) Groundwater Monitoring 2010



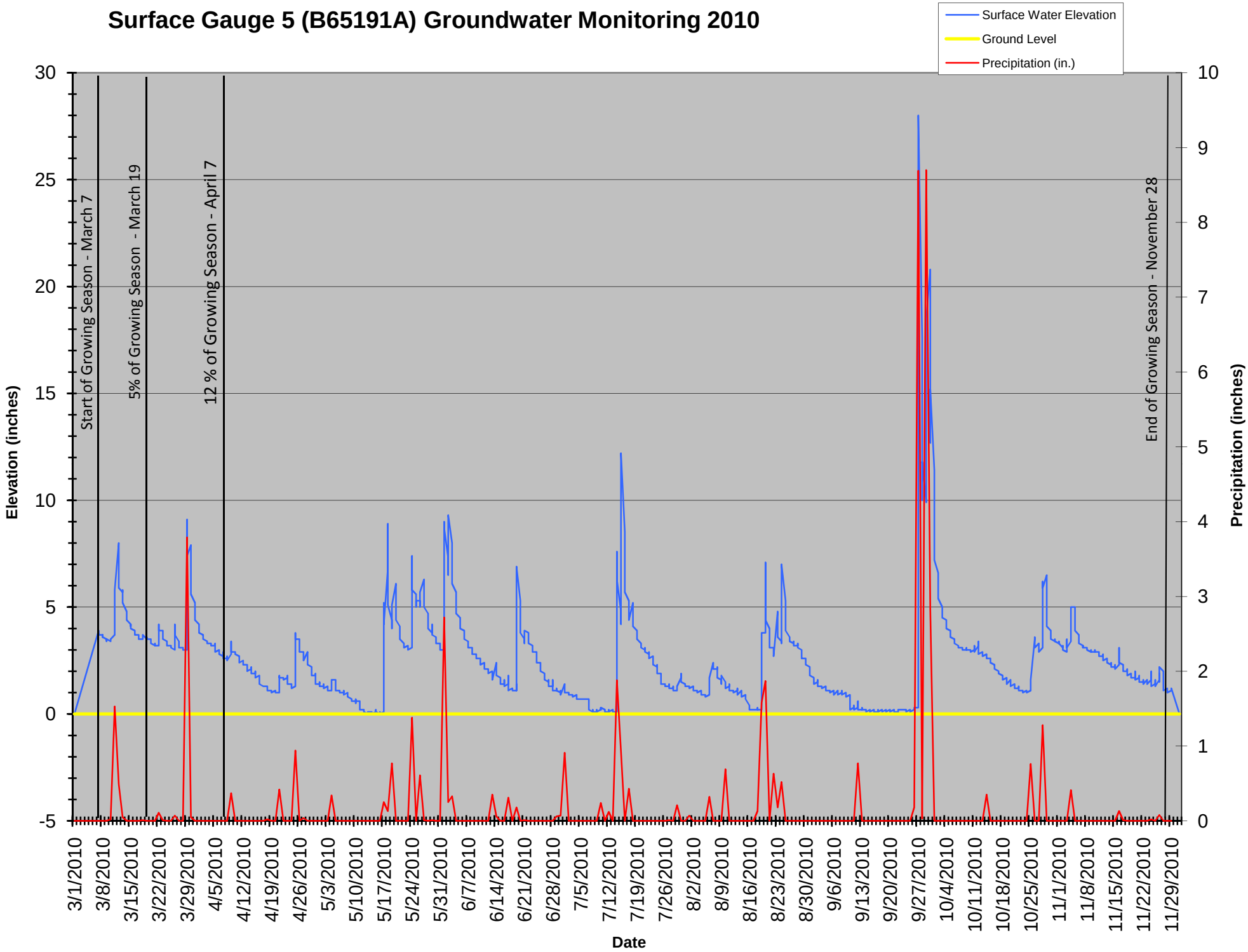
Surface Gauge 3 (B65189D) Groundwater Monitoring 2010

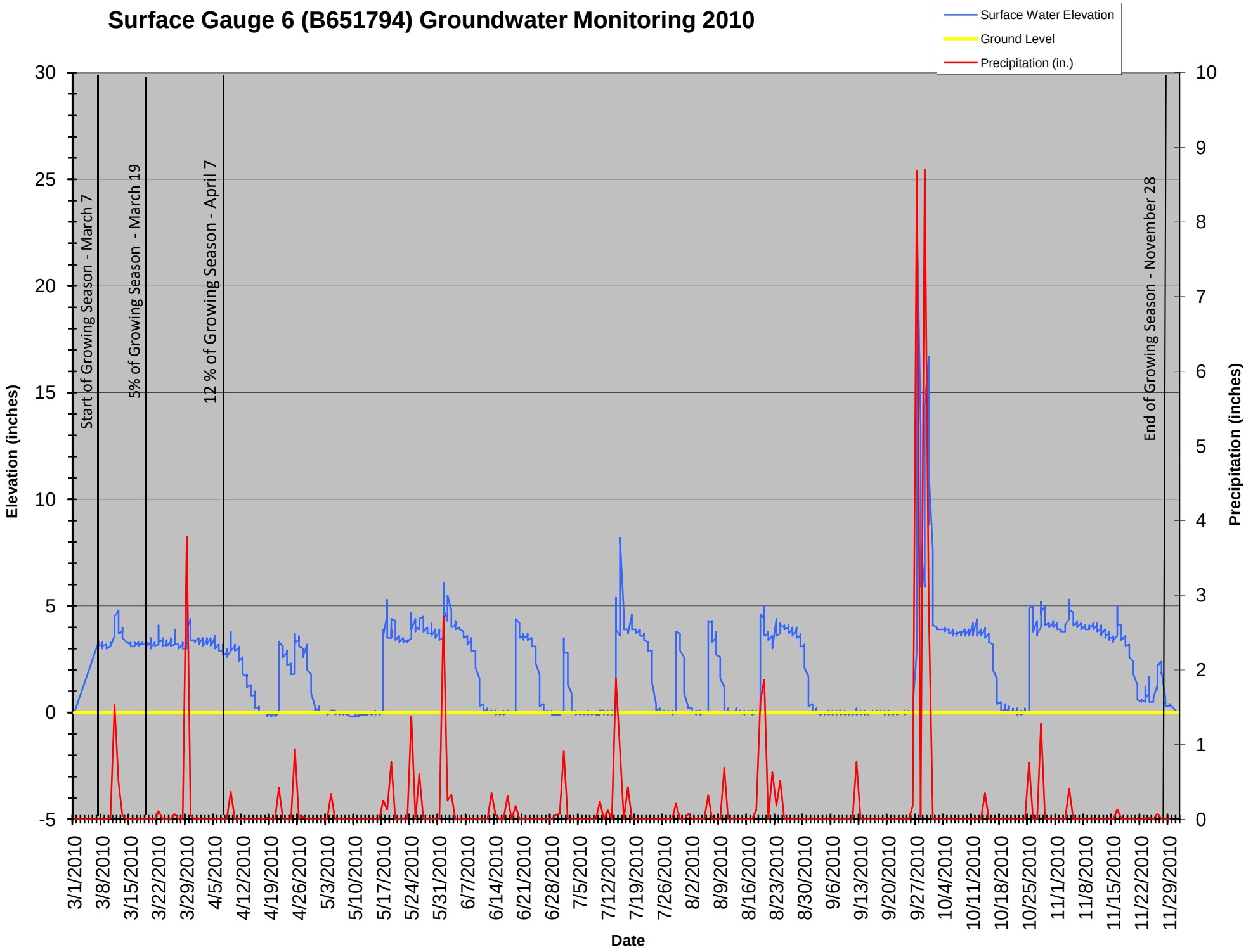


Surface Gauge 4 (B651939) Groundwater Monitoring 2010



Surface Gauge 5 (B65191A) Groundwater Monitoring 2010




Surface Gauge 6 (B651794) Groundwater Monitoring 2010
Surface Water Elevation
Ground Level
Precipitation (in.)
Start of Growing Season - March 7
5% of Growing Season - March 19
12 % of Growing Season - April 7
End of Growing Season - November 28
Elevation (inches)
Precipitation (inches)
Date
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5/17/2010
5/24/2010
5/31/2010
6/7/2010
6/14/2010
6/21/2010
6/28/2010
7/5/2010
7/12/2010
7/19/2010
7/26/2010
8/2/2010
8/9/2010
8/16/2010
8/23/2010
8/30/2010
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10/18/2010
10/25/2010
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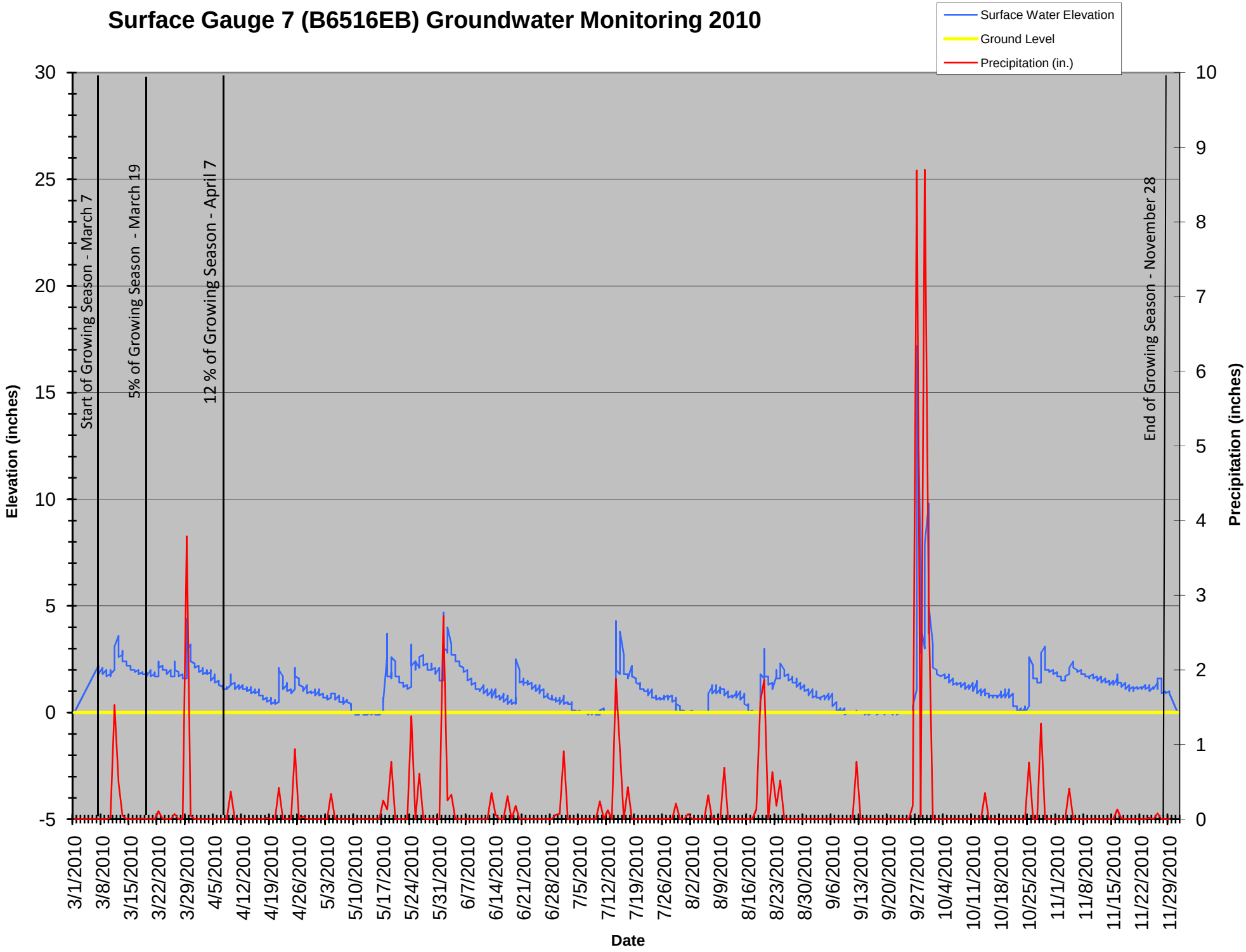
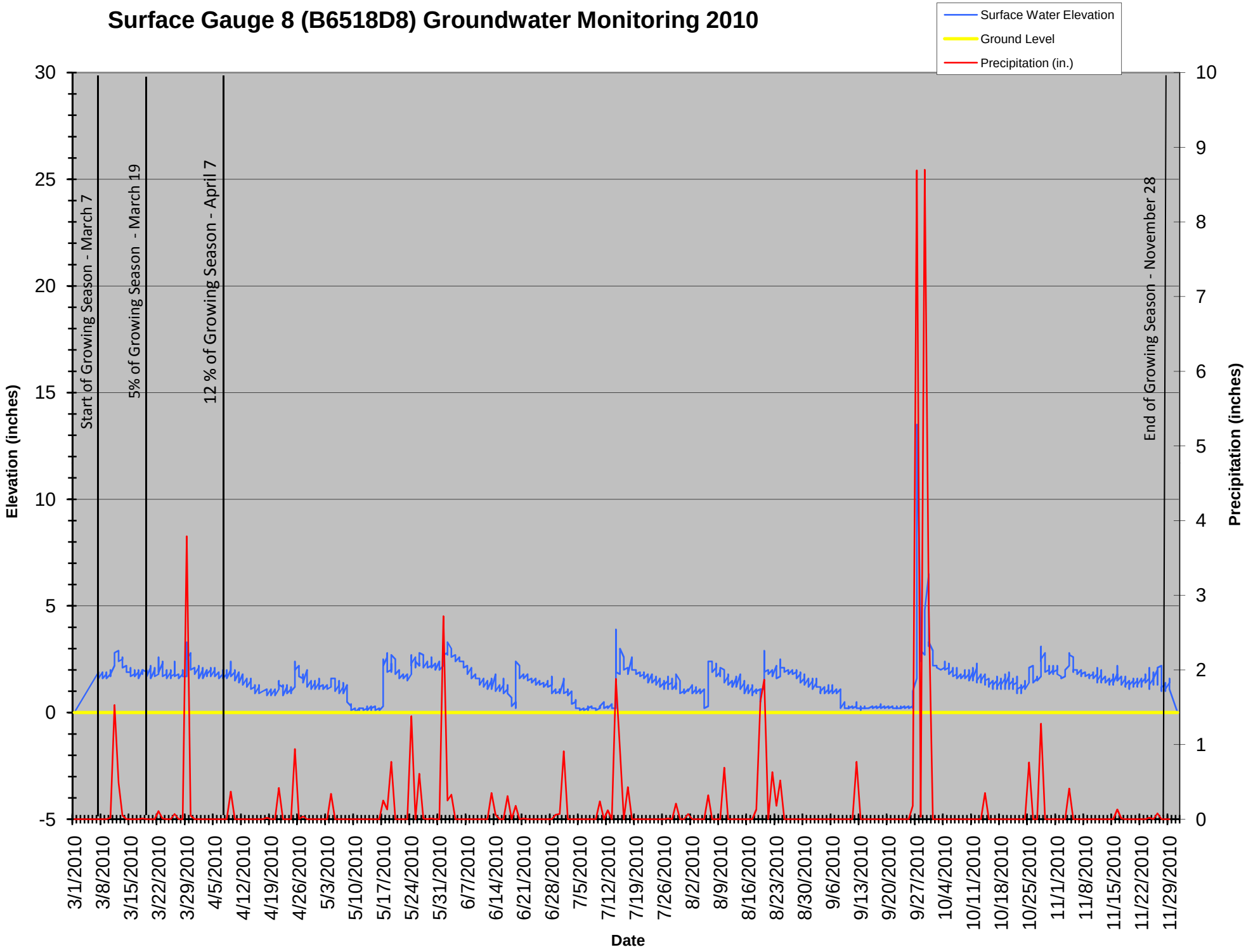
Surface Gauge 7 (B6516EB) Groundwater Monitoring 2010




Surface Gauge 8 (B6518D8) Groundwater Monitoring 2010
Surface Water Elevation
Ground Level
Precipitation (in.)
Start of Growing Season - March 7
5% of Growing Season - March 19
12 % of Growing Season - April 7
End of Growing Season - November 28
Elevation (inches)
Precipitation (inches)
Date
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6/14/2010
6/21/2010
6/28/2010
7/5/2010
7/12/2010
7/19/2010
7/26/2010
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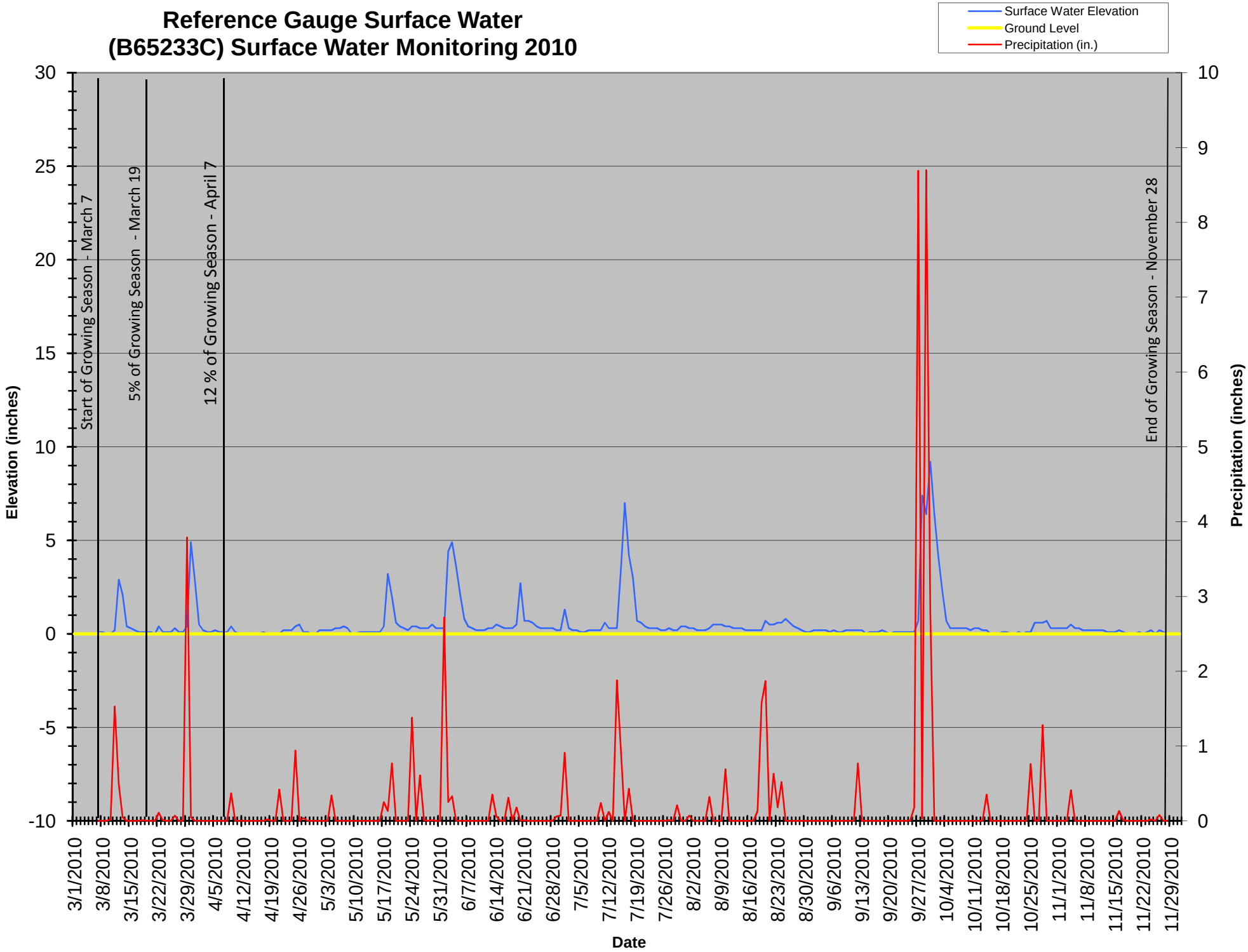
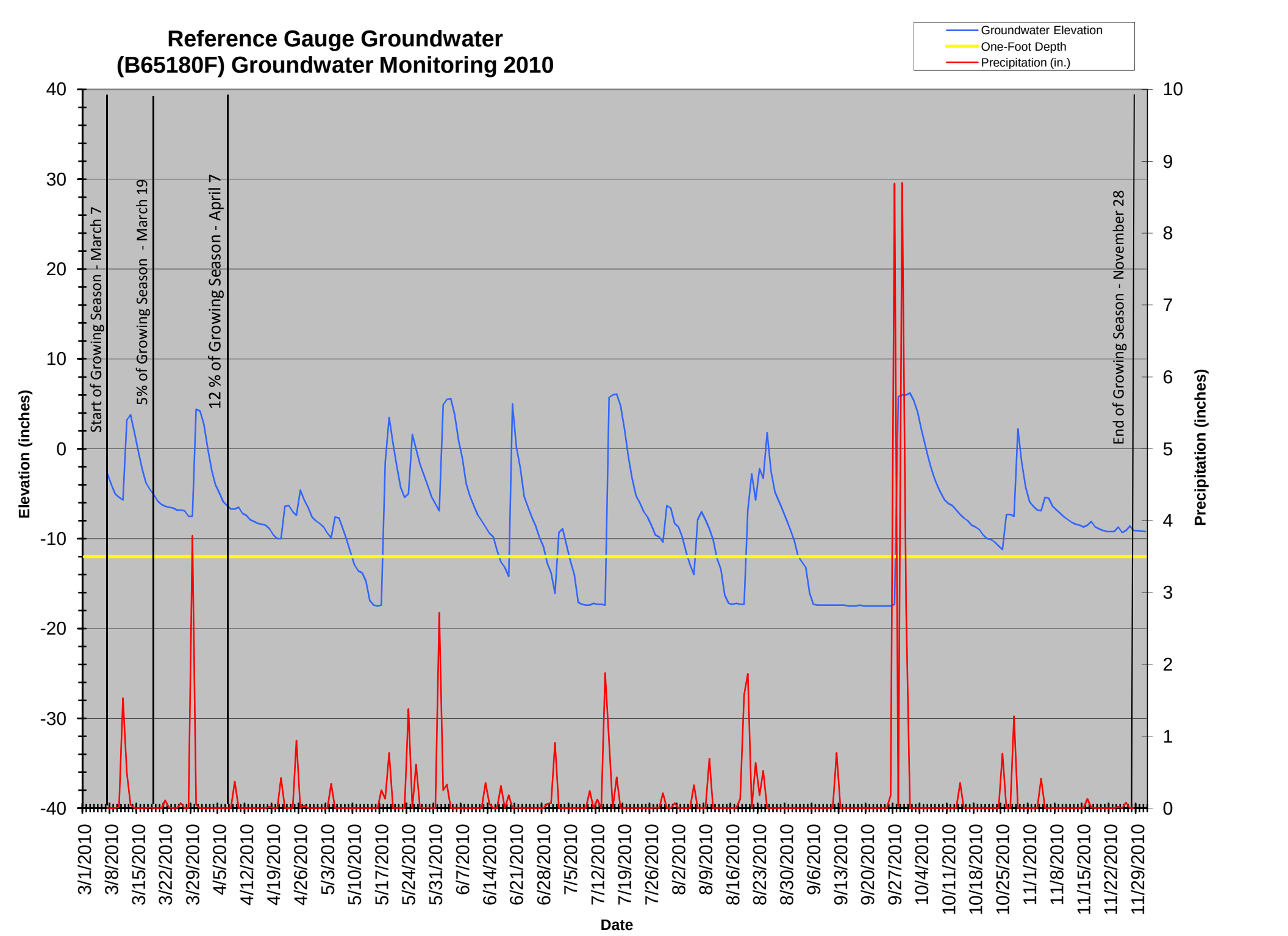
Reference Gauge Surface Water (B65233C) Surface Water Monitoring 2010




Reference Gauge Groundwater
(B65180F) Groundwater Monitoring 2010
Groundwater Elevation
One-Foot Depth
Precipitation (in.)
Start of Growing Season - March 7
5% of Growing Season - March 19
12 % of Growing Season - April 7
End of Growing Season - November 28
Elevation (inches)
Precipitation (inches)
Date
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5/24/2010
5/31/2010
6/7/2010
6/14/2010
6/21/2010
6/28/2010
7/5/2010
7/12/2010
7/19/2010
7/26/2010
8/2/2010
8/9/2010
8/16/2010
8/23/2010
8/30/2010
9/6/2010
9/13/2010
9/20/2010
9/27/2010
10/4/2010
10/11/2010
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Table 13. Wetland Gauge Attainment Data					
Summary of Groundwater Gauge Results for Year 1 through 5					
Gauge	**Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)**				
	Year 1 (2010)	**Year 2 (2011)**	**Year 3 (2012)**	**Year 4 (2013)**	**Year 5 (2014)**
1	Yes/43 days (16%)				
2	Yes/68 days (25%)				
3	Yes/44 days (16 %)				
4	Yes/43 days (16 %)				
5	Yes/43 days (16 %)				
6	Yes/63 days (24 %)				
7	Yes/42 days (16 %)				
8	Yes/42 days (16 %)				
9	Yes/58 days (22 %)				
10	Yes/36 days (14 %)				
11	Yes/57 days (22 %)				
12	Yes/33 days (13 %)				
13	Yes/36 days (13 %)				
14	Yes/40 days (16 %)				
15	Yes/41 days (16 %)				
16	Yes/57 days (22 %)				
17	Yes/43 days (16 %)				
18	Yes/126 days (47 %)				
19	Yes/63 days (24 %)				
20	Yes/32 days (13 %)				