Armstrong Property Wetland and Stream Mitigation Project
Hyde County, NC

2014 Annual Monitoring Report Supplemental to Closeout Report
Year 7

NCEEP Project Number D06012-A
Tar-Pamlico River Basin 03020104

Submitted to
NCDENR/Ecosystem Enhancement Program
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Executive Summary

The Armstrong Property Wetland Mitigation Site went to closeout in the spring of 2013. Tree survival and evidence of stream flow were adequate but hydrology success was insufficient to meet the success criterion of 8% during the growing season. The site was trending toward success and as a result, the Interagency Review Team recommended that hydrology be monitored through mid-2014. The 2014 hydrology monitoring results can be seen in Table ES-1. The site showed successful hydrology due to adequate rainfall during the critical months of March and April.

The Armstrong Property Wetland Mitigation Site is a headwater riverine wetland and stream mitigation project located just east of State Route 45 near its intersection with State Route 264, in Hyde County, North Carolina. It was constructed by Albemarle Restorations, LLC, under contract with EEP to provide compensatory wetland mitigation credits in the Tar-Pamlico River Basin. Construction activities, in accordance with the approved restoration plan, began October 1, 2007, and were completed on November 30, 2007. Tree and shrub planting on the project site occurred on January 28 and 29, 2008.

Five water level monitoring gauges are located at varying elevations throughout riverine wetland areas of the site to measure subsurface water elevations. Two additional gauges are located in the headwater stream (swamp run) to help monitor flow and water level within the stream. Two more gauges are installed at the reference site.

Table ES-1 shows the levels of success attained by each of the water level monitoring gauges and the vegetation plots since monitoring began. Success criterion for hydrology is 8% of the growing season (21 days). All gauges in the project site showed a successful hydroperiod in 2014.

Table ES-1.

Longest hydrologic period in days (and % of Growing Season)														
Gauge	Year 1		Year 2		Year 3		Year 4		Year 5		Year 6		Year 7	
	Days	%	Days	%	Days	%	Days	%	Days	%	Days	%	Days	%
1	9	3	19	7	14	5	19	7	29	11	32	12	58	22
2	4	2	17	7	9	3	12	4	26	10	35	13	26	10
3	12	5	17	7	13	5	12	4	12	4	34	13	33	13
4	8	3	13	5	30	12	18	7	14	5	35	13	32	12
5	18	7	27	10	51	20	67	26	58	22	67	26	58	22
6 (Ref)	100	38	98	38	99	38	108	41	119	46	79	30	58	22
7 (Ref)	14	5	17	7	28	11	19	7	19	7	37	14	7	3
Run 1	35	13	124	48	49	19	65	25	54	21	80	31	58	22
Run 2	140	54	261	100	92	35	93	36	261	100	248	100	23	9

5% of growing season is 13 days, 8% is 21 days

I. Project Background

1.0 Project Objectives

The goal of the Armstrong Property Mitigation Project was to create a riverine wetland system typically found in the middle to upper reaches of first or zero order tributary systems. The project is to serve as compensation for wetland loss in the Tar-Pamlico River Basin. The restoration plan was developed and implemented to eliminate pattern drainage and restore topography and hydrology that more closely resembled that of similar undisturbed land. Construction resulted in the development of a broad, frequently flooded swamp run following a historical path as evidenced by archived aerial photographs and signature topography. Subsequent planting was designed to restore a wetland forest ecosystem that is typically found in the immediate area characteristic of similar soils, topography and hydrology.

Ecological benefits of the restored riparian headwater system and its associated riverine wetlands are the following:

1. Water quality improvements, including nutrient, toxicant and sediment retention and reduction, increasing dissolved oxygen levels, as well as reducing excessive algae growth, and reducing surface water temperatures in receiving waters by providing permanent shading in the form of a shrub/scrub and forested headwater wetland system.
2. Wildlife habitat enhancement by adding to the existing adjacent forested areas creating a continuous travel corridor between habitat blocks and providing a wide range of habitat areas (open water, emergent, shrub/scrub and forested) for amphibians, reptiles, birds, insects and mammals.
3. Flood flow attenuation during storm events which reduces sedimentation and erosion downstream, and improves long term water quality within the Pungo River.
4. Passive outdoor recreation and educational opportunities for the landowner and the surrounding community.

2.0 Project Structure, Restoration Type, and Approach

Table I lists the estimated wetland acreage to be restored on the Armstrong Property. The mitigation plan provides for the restoration of 20.0 acres of riverine wetlands and 2,200 linear feet of stream (swamp run) restoration. Prior to construction, the easement area was used entirely for row crop agriculture, primarily soy beans, corn and cotton. The agricultural fields were drained by several ditches that traversed the site with outfall into Clark Mill Creek. Construction activities, in accordance with the approved restoration plan, began in October, 2007 and were completed in November of 2007. Native tree and shrub species were planted in January of 2008. The resulting riverine system is designed to emulate natural swamp run systems found within the Pungo River Basin.

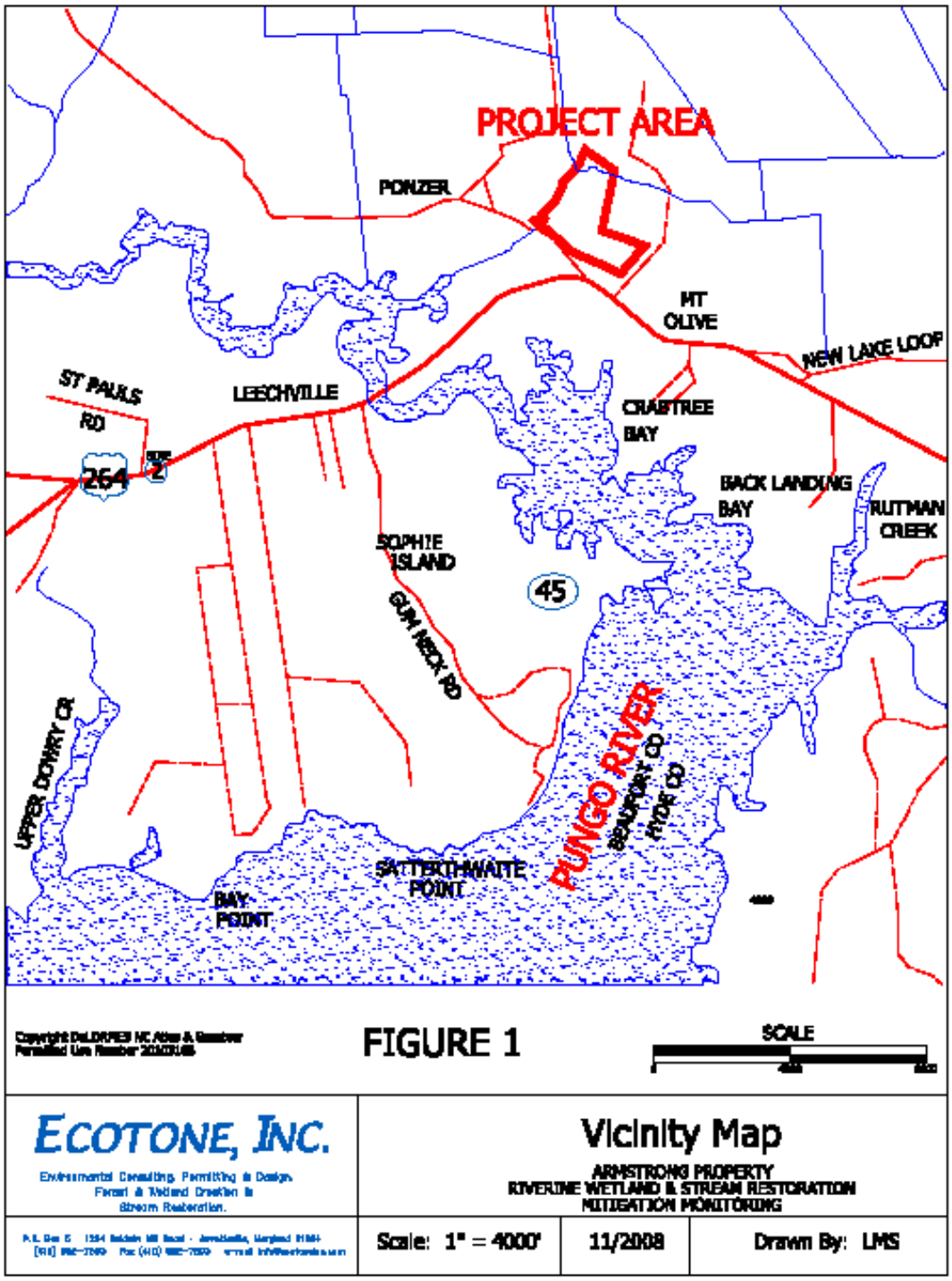
Table 1. Project Restoration Components

Restoration Type	Pre-Existing Acres/Linear Feet	Post Construction Acres/ Linear Feet	Credit Ratio (Restoration : WMU)	Total WMUs/ SMUs
Riverine Wetland	0.0 acres	20.0 acres	1:1	20.0 WMUs
Stream (Swamp Run)	0.0 linear feet	2,200 linear feet	1:1	2,200 SMUs

3.0 Location and Setting

The Armstrong Property Mitigation Site is located in Hyde County, between Ponzer and Mt. Olive on the north side of State Route 45 near its intersection with US Hwy 264. The easement area is situated in the middle of the Armstrong property and adds contiguous swamp run and forested wetlands to those of Clark Mill Creek, a tributary of the Pungo River which is less than a mile to the south. The surrounding area is primarily forest and agricultural land with residential properties as a minor component.

Figure 1 is a location map for the project site. Directions to the site are as follows: from Belhaven, travel east on US Hwy 264 approximately 10 miles and turn left (north) on State Route 45. Access to the site is approximately .25 miles north of the intersection on right.


PROJECT AREA
PONZER
MT OLIVE
NEW LAKE LOOP
ST PAULS RD
LEECHVILLE
CRABTREE BAY
264
BACK LANDING BAY
RUTMAN CREEK
SOPHIE ISLAND
45
GUM NECK RD
UPPER DOWRY CR
PUNGO RIVER
BEAUFORT CO
HYDE CO
SATTERTHWAITE POINT
BAY POINT
FIGURE 1
SCALE
ECOTONE, INC.
Environmental Consulting, Permitting & Design.
Forest & Wetland Creation &
Stream Restoration.
Vicinity Map
ARMSTRONG PROPERTY
RIVERINE WETLAND & STREAM RESTORATION
MITIGATION MONITORING
Scale: 1" = 4000'
11/2008
Drawn By: LMS

4.0 Project History and Background

Table II provides the history of data collection and actual completion of various milestones of the Armstrong Property Wetland Mitigation Site.

Table II. Project Activity and Reporting History
Armstrong Property Wetland Mitigation Project/EEP #D06012-A

Activity or Report	Data Collection Complete	Actual Completion or Delivery
Restoration Plan	June 2007	July 2007
Final Design -90%	June 2007	July 2007
Construction	N/A	November 2007
Temporary S & E mix applied to entire project area	N/A	February 2008
Permanent seed mix applied to entire project area	N/A	February 2008
Containerized and Bare Root Planting	N/A	January 2008
Mitigation Plan/As-built/Year 1 monitoring	March 2008	December 2008
Year 2 monitoring	September 2009	January 2010
Year 3 monitoring	September 2010	November 2010
Year 4 monitoring	September 2011	December 2011
Year 5 monitoring	September 2012	December 2012
Year 6 monitoring	November 2013	December 2013
Year 7 monitoring	May 2014	June 2014

Figure 2 provides a plan view of the site showing the location of all monitoring gauges.

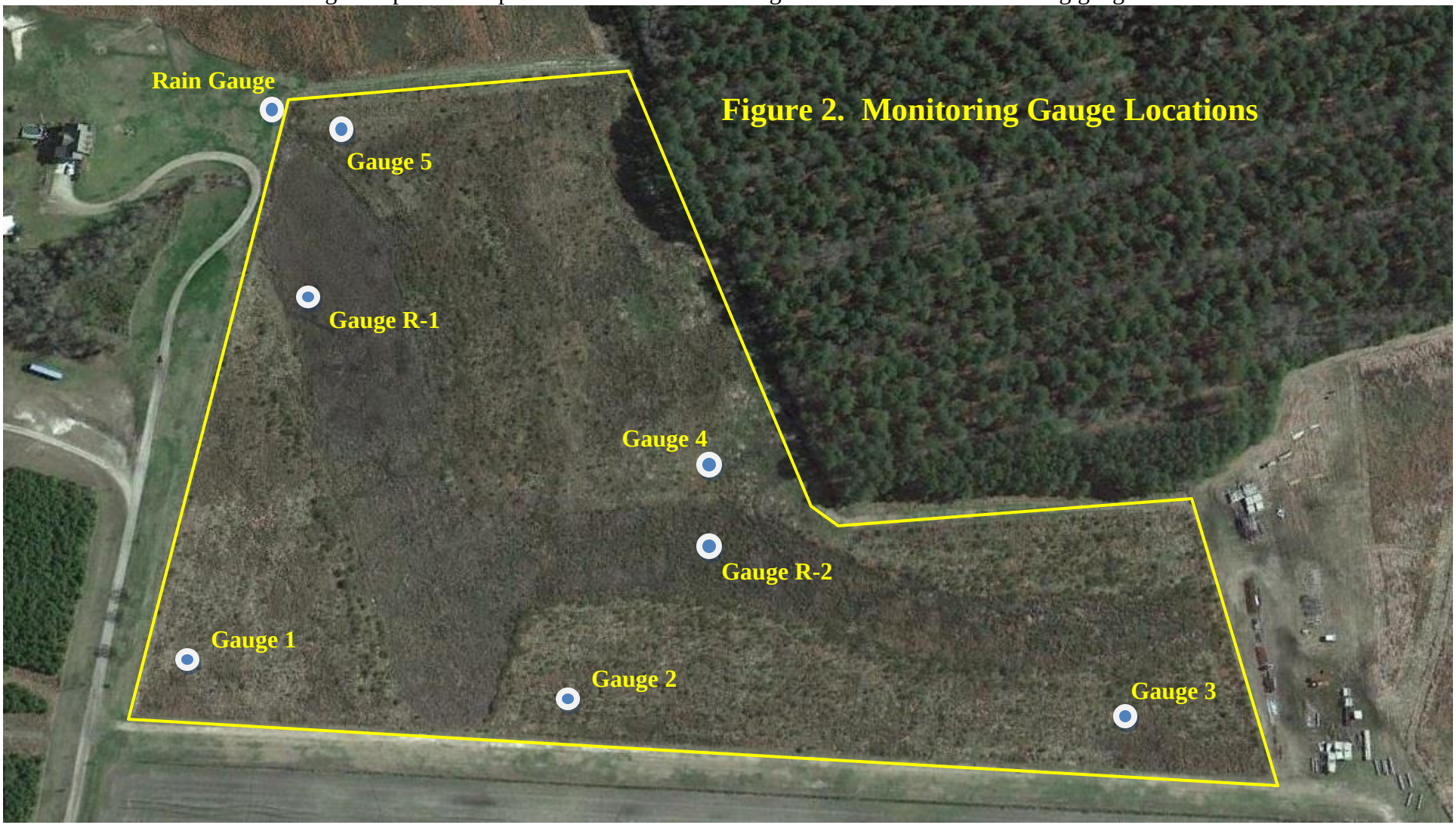


Figure 2. Monitoring Gauge Locations

II. Project Condition and Monitoring Results

1.0 Wetland Assessment

The hydrologic success criterion is to achieve a minimum of 21 consecutive days where the groundwater level is within 12 inches of the soil surface during the growing season. The growing season for this site is from March 11 to November 27, a period of 261 days (WETS Table for Belhaven, NC). Success for any particular monitoring location is to show soil saturation to within 12 inches of the surface for 21 consecutive days during that period.

There are five continuous water level monitoring gauges deployed across the riverine portion of the site (Gauges 1 through 5) to monitor fluctuations in the water table and to determine if wetland hydrology is present. A rain gauge is also kept onsite and its data are compared to that collected at the NOAA cooperator site in Aurora, NC. To further monitor the affect of seasonal and annual variations in precipitation in restored wetlands, hydrologic success of the site is assessed in relation to the reference wetland site where two more monitoring gauges are installed (Gauge 6 as a Swamp Run reference & Gauge 7 as a Riverine Wetland reference).

The data logger in Reference Gauge 7 and the one in Run Gauge 2 had to be sent back to the manufacturer for data retrieval. The data from Reference Gauge 7 is probably questionable since that gauge has always performed similar to Gauge 4 and in 2014 it did not. The data from Run Gauge 2 appears to be accurate although it stopped logging data in mid-April. That portion of the site around Run Gauge 2 had approximately 12 inches of standing water on May 8 when the data was collected, suggesting the hydroperiod should have been much longer than the recorded 23 days.

The rainfall data collected on-site and shown in Figure 3 appears to be exceptionally low though the rain gauge appeared to be functioning properly. As a comparison, Figure 4 shows precipitation data from a cooperator in Aurora, the closest site that had complete data. It too is well below normal so it is probably a safe prediction that true rainfall on-site was below normal to some extent. This suggests the hydrology on the Armstrong site has fully recovered given the length of the hydroperiods.

Figure 3

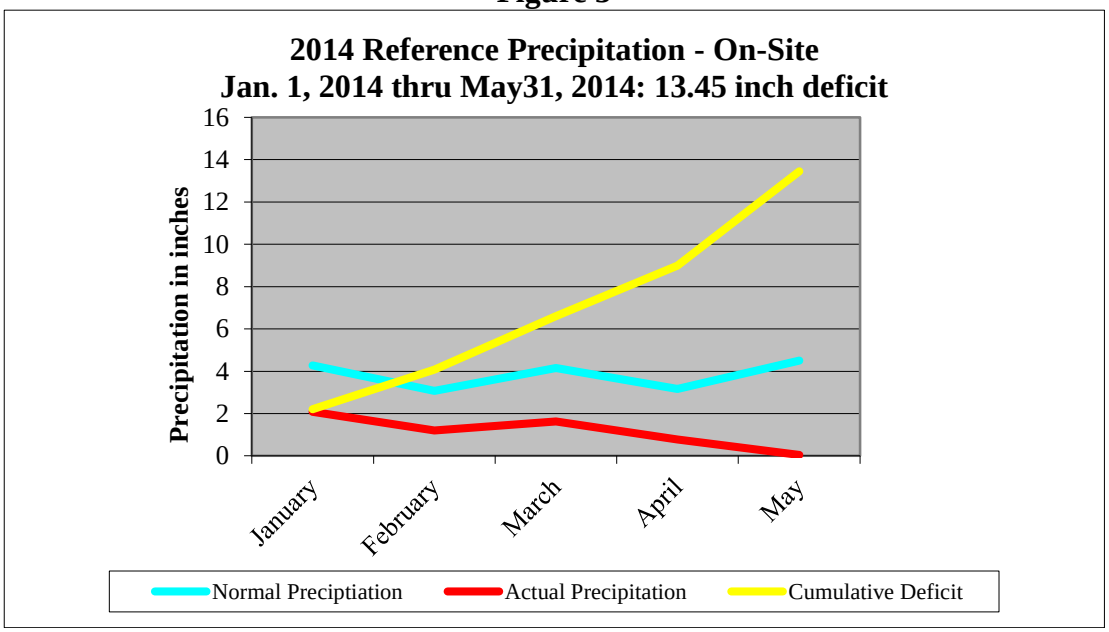
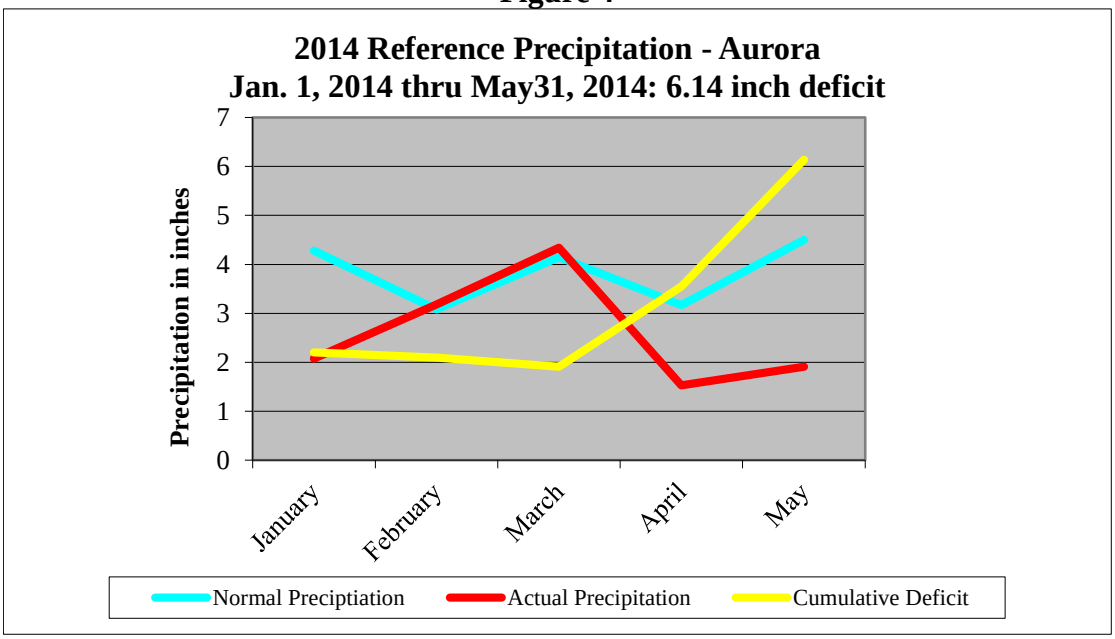
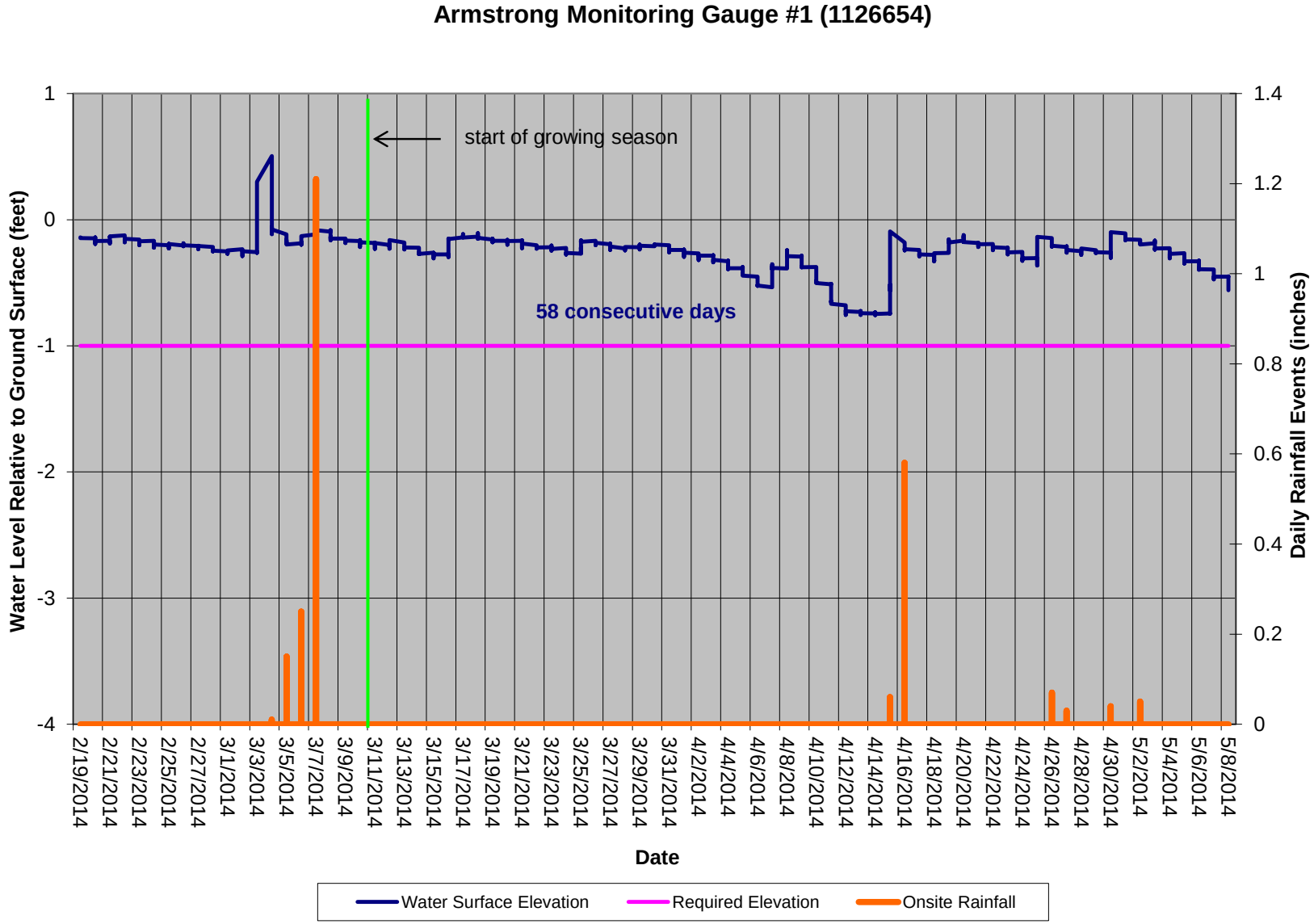


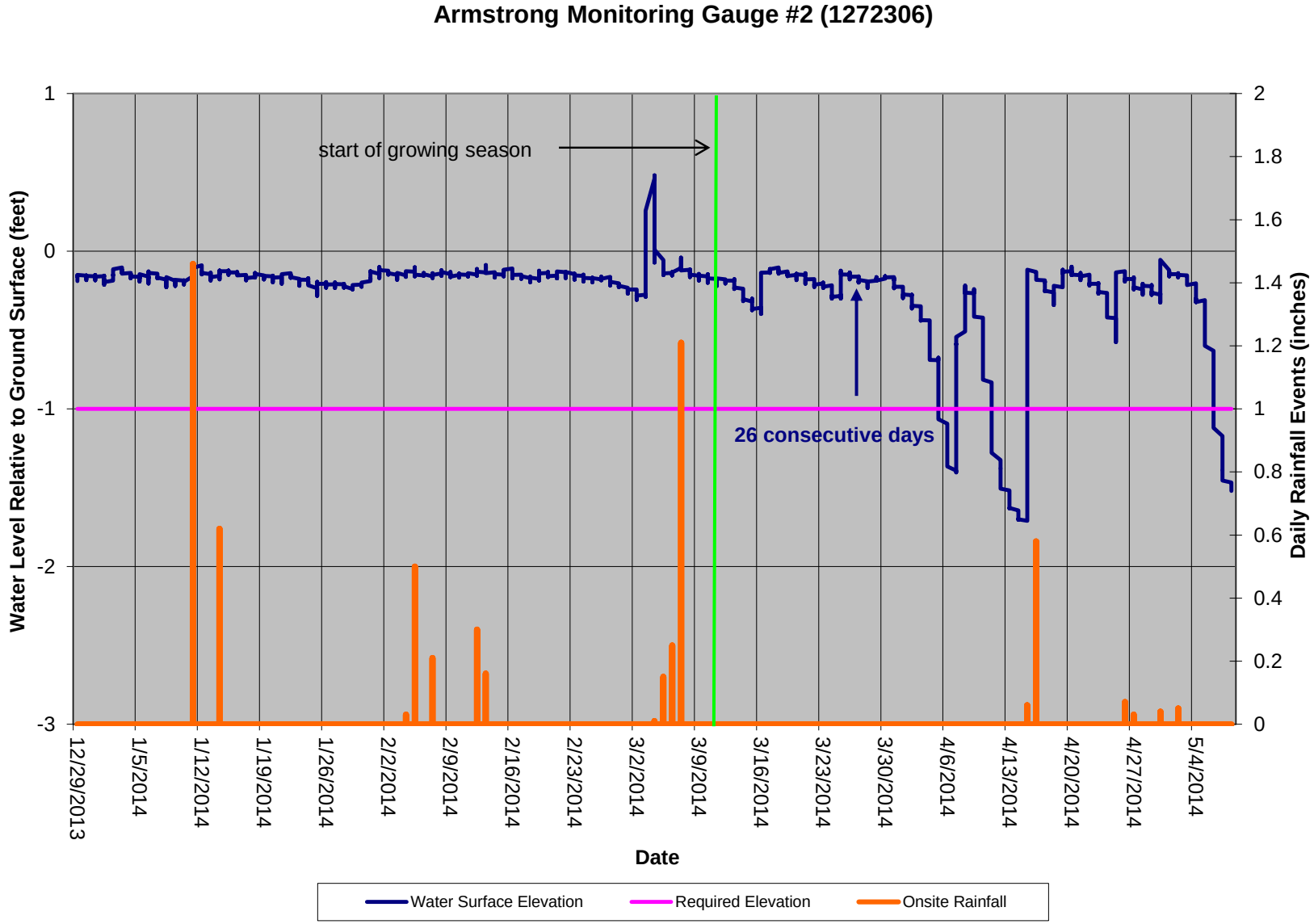
Figure 4

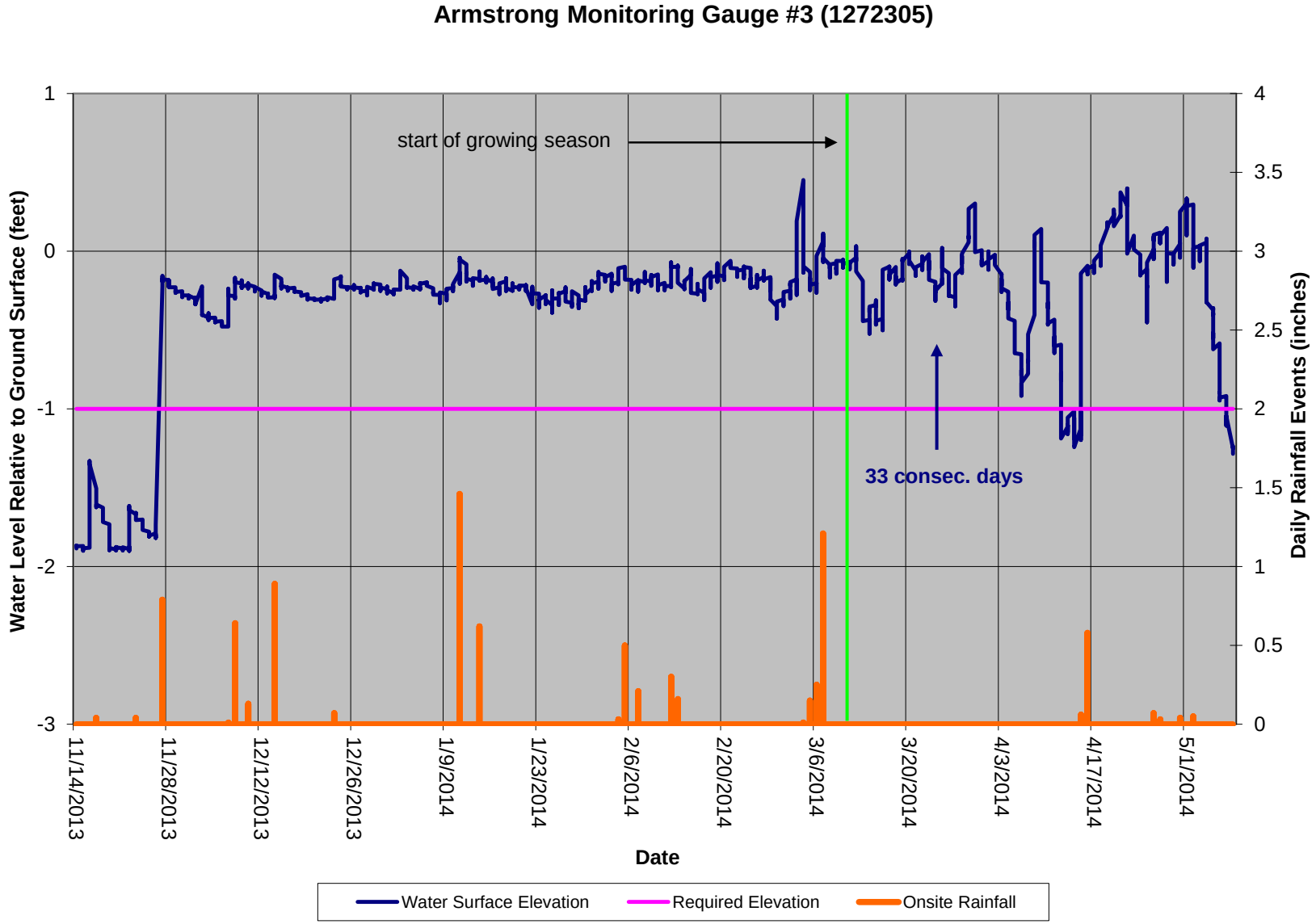


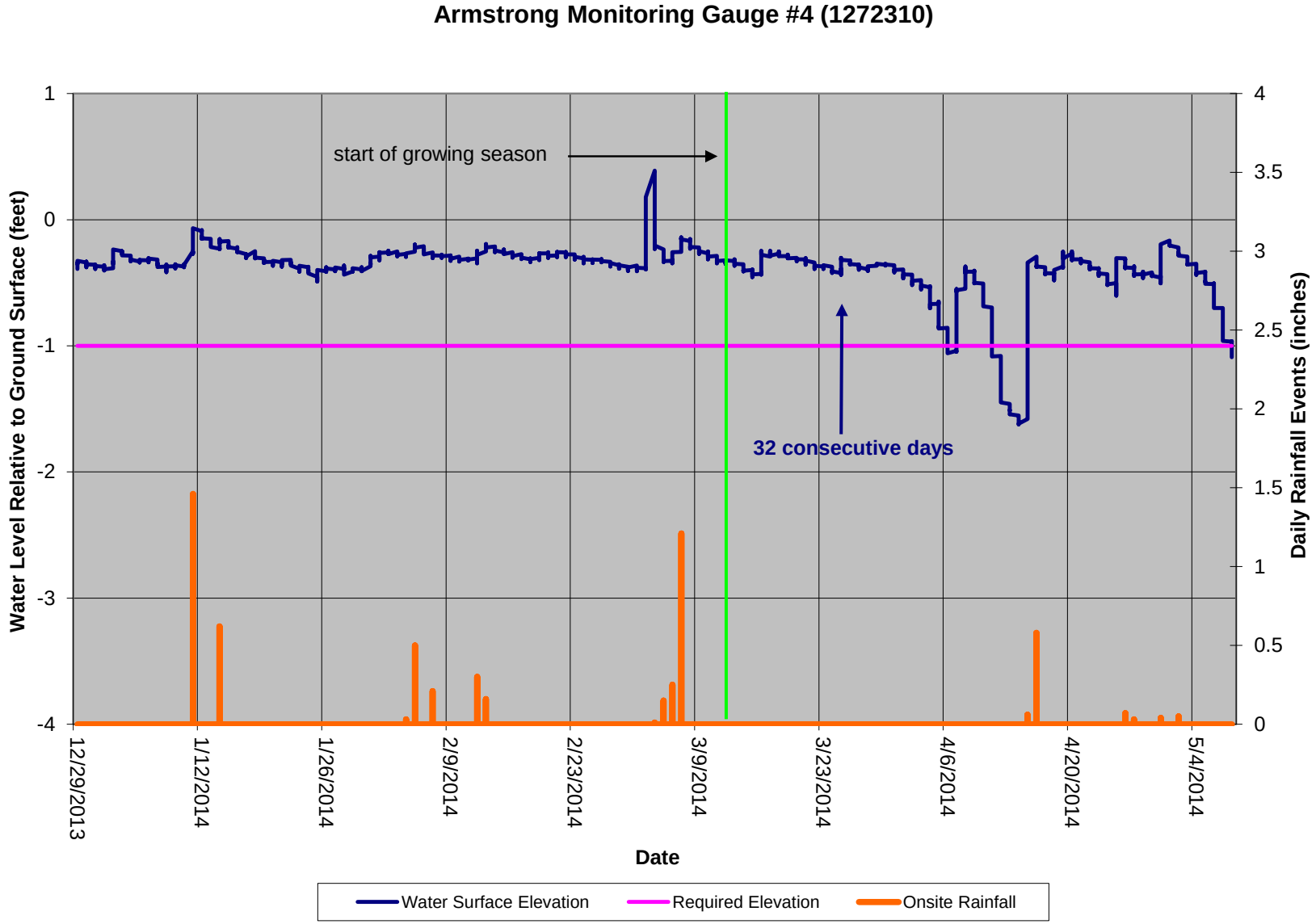
Appendix A

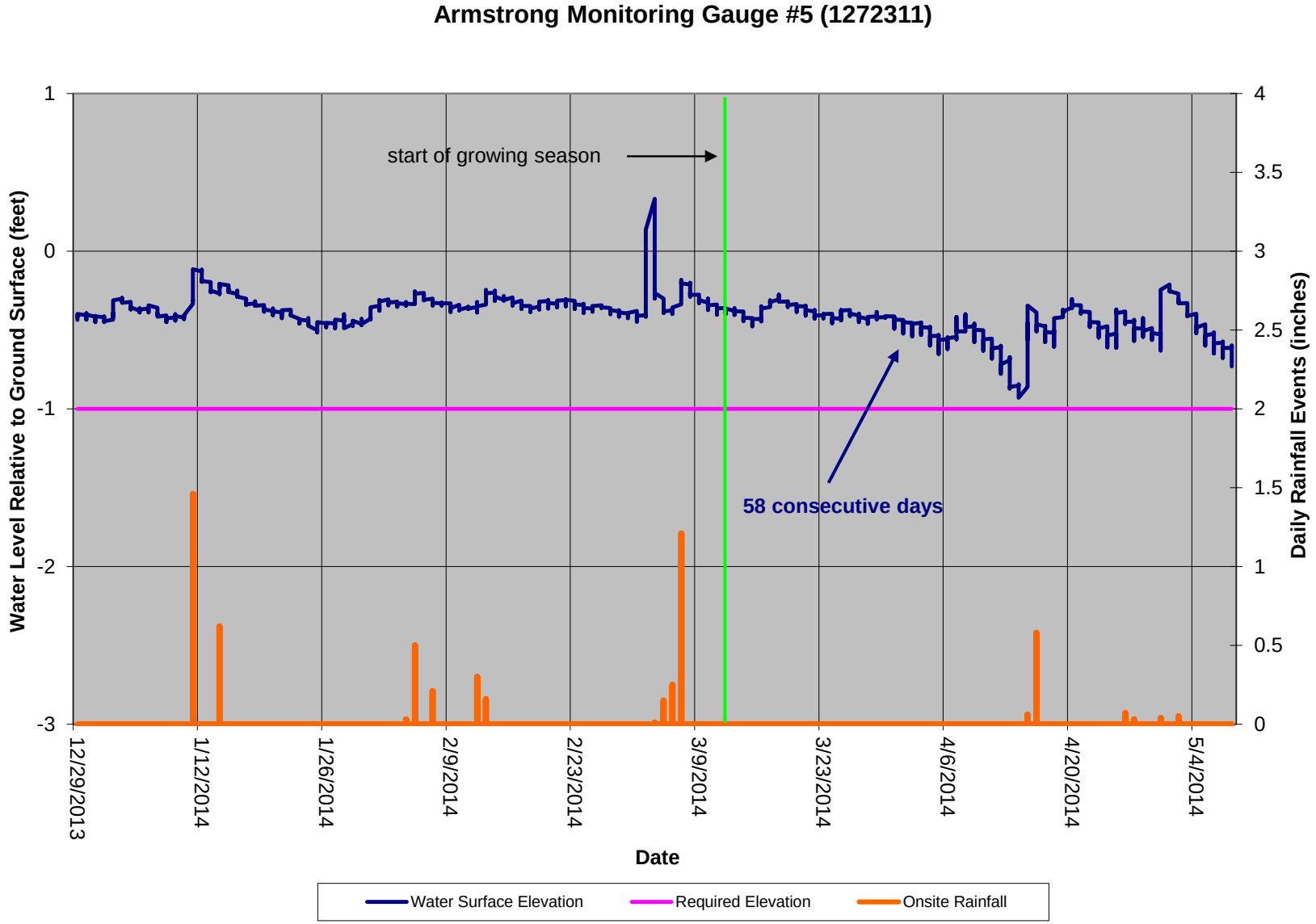
Hydrologic Data Tables

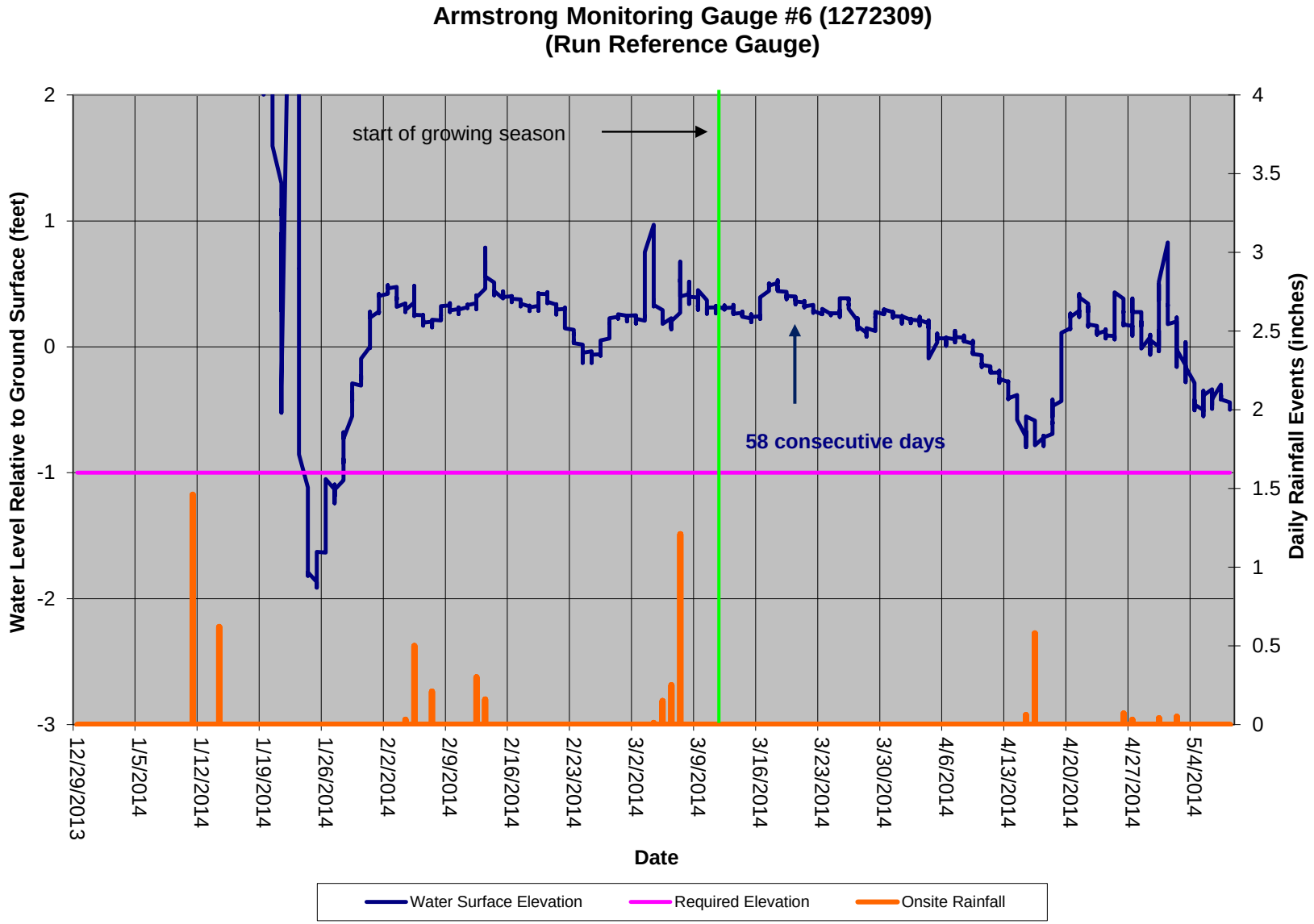

Armstrong Monitoring Gauge #1 (1126654)
start of growing season
58 consecutive days
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall

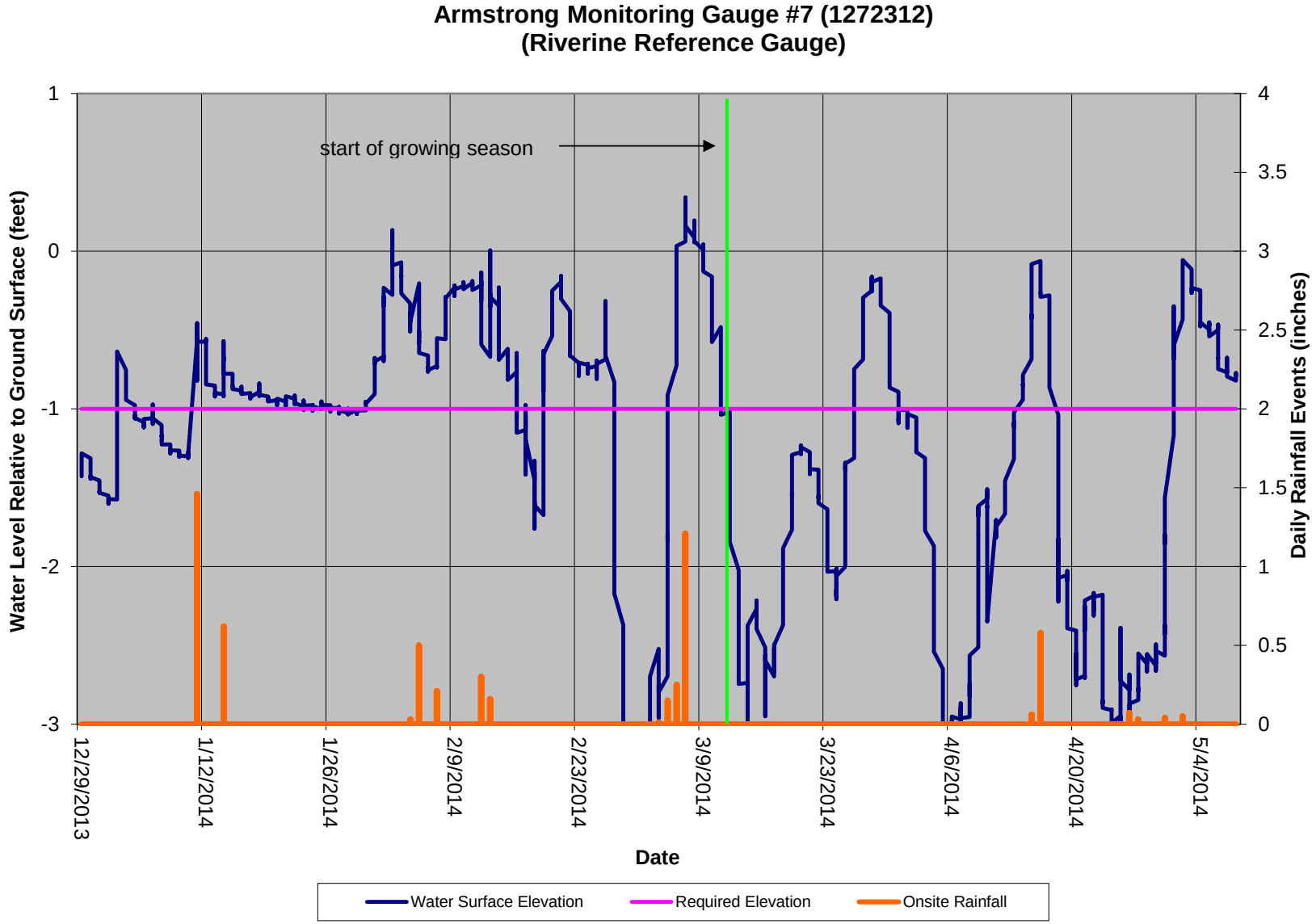

Armstrong Monitoring Gauge #2 (1272306)
start of growing season
26 consecutive days
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
Date
1
0
-1
-2
-3
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
12/29/2013
1/5/2014
1/12/2014
1/19/2014
1/26/2014
2/2/2014
2/9/2014
2/16/2014
2/23/2014
3/2/2014
3/9/2014
3/16/2014
3/23/2014
3/30/2014
4/6/2014
4/13/2014
4/20/2014
4/27/2014
5/4/2014
Water Surface Elevation
Required Elevation
Onsite Rainfall

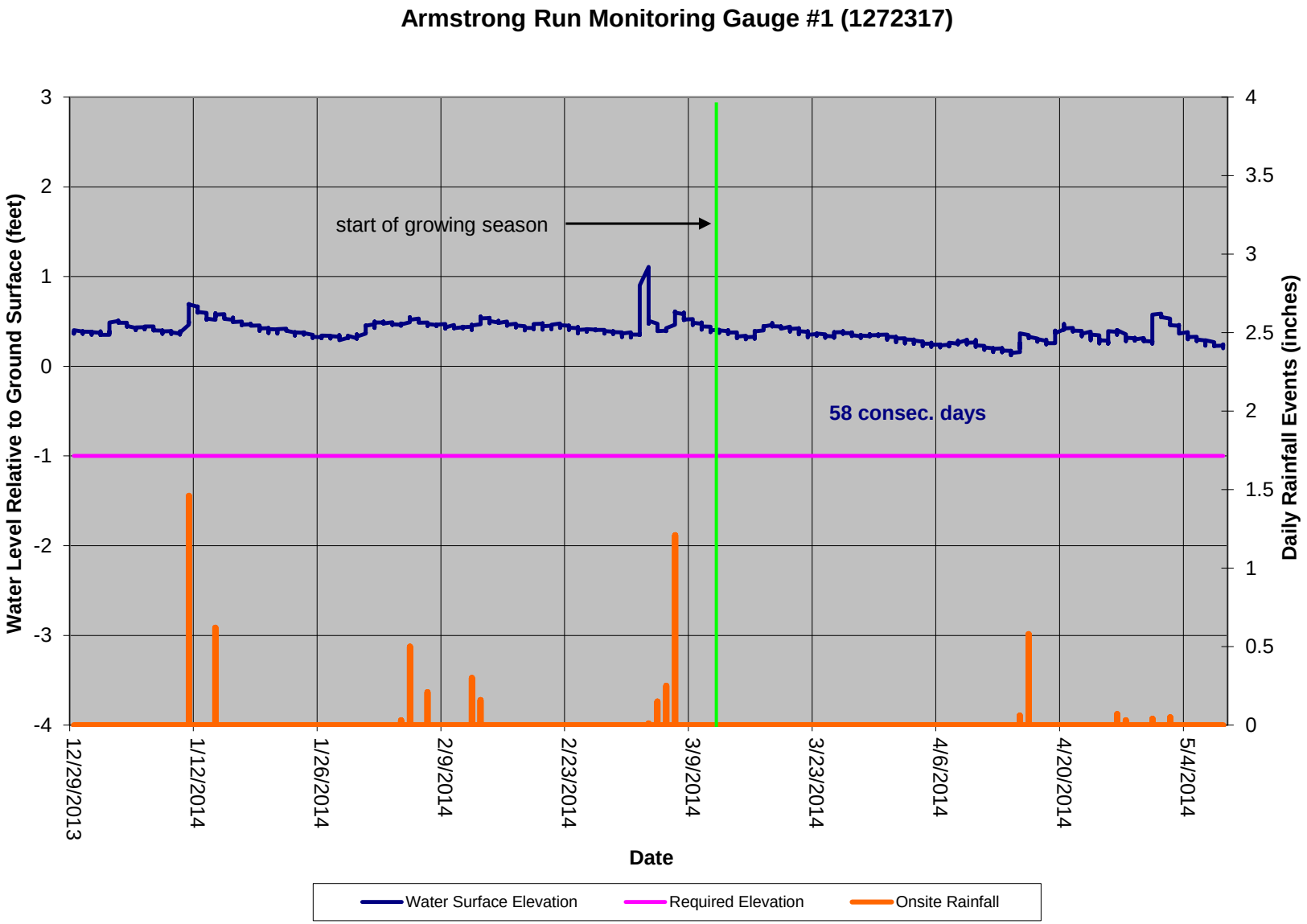

Armstrong Monitoring Gauge #3 (1272305)
start of growing season
33 consec. days
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
Date
1
0
-1
-2
-3
4
3.5
3
2.5
2
1.5
1
0.5
0
11/14/2013
11/28/2013
12/12/2013
12/26/2013
1/9/2014
1/23/2014
2/6/2014
2/20/2014
3/6/2014
3/20/2014
4/3/2014
4/17/2014
5/1/2014
Water Surface Elevation
Required Elevation
Onsite Rainfall

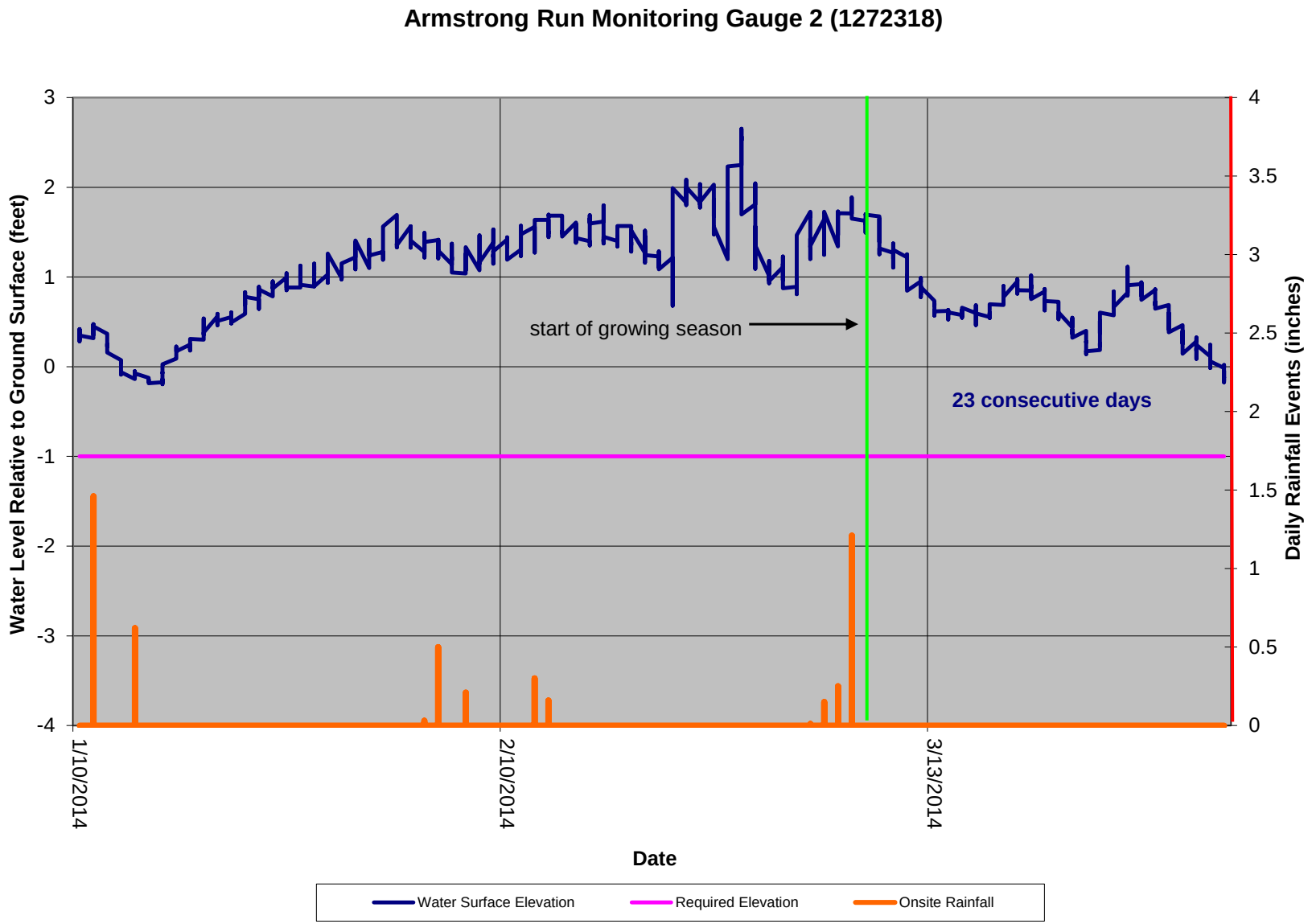

Armstrong Monitoring Gauge #4 (1272310)
start of growing season
32 consecutive days
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
1
0
-1
-2
-3
-4
4
3.5
3
2.5
2
1.5
1
0.5
0
12/29/2013
1/12/2014
1/26/2014
2/9/2014
2/23/2014
3/9/2014
3/23/2014
4/6/2014
4/20/2014
5/4/2014
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall


Armstrong Monitoring Gauge #5 (1272311)
start of growing season
58 consecutive days
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
1
0
-1
-2
-3
4
3.5
3
2.5
2
1.5
1
0.5
0
12/29/2013
1/12/2014
1/26/2014
2/9/2014
2/23/2014
3/9/2014
3/23/2014
4/6/2014
4/20/2014
5/4/2014
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall


Armstrong Monitoring Gauge #6 (1272309)
(Run Reference Gauge)
start of growing season
58 consecutive days
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
Date
2
1
0
-1
-2
-3
4
3.5
3
2.5
2
1.5
1
0.5
0
12/29/2013
1/5/2014
1/12/2014
1/19/2014
1/26/2014
2/2/2014
2/9/2014
2/16/2014
2/23/2014
3/2/2014
3/9/2014
3/16/2014
3/23/2014
3/30/2014
4/6/2014
4/13/2014
4/20/2014
4/27/2014
5/4/2014
Water Surface Elevation
Required Elevation
Onsite Rainfall


Armstrong Monitoring Gauge #7 (1272312)
(Riverine Reference Gauge)
start of growing season
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
1
0
-1
-2
-3
4
3.5
3
2.5
2
1.5
1
0.5
0
12/29/2013
1/12/2014
1/26/2014
2/9/2014
2/23/2014
3/9/2014
3/23/2014
4/6/2014
4/20/2014
5/4/2014
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall


Armstrong Run Monitoring Gauge #1 (1272317)
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
start of growing season
58 consec. days
3
2
1
0
-1
-2
-3
-4
4
3.5
3
2.5
2
1.5
1
0.5
0
12/29/2013
1/12/2014
1/26/2014
2/9/2014
2/23/2014
3/9/2014
3/23/2014
4/6/2014
4/20/2014
5/4/2014
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall


Armstrong Run Monitoring Gauge 2 (1272318)
Water Level Relative to Ground Surface (feet)
Daily Rainfall Events (inches)
3
2
1
0
-1
-2
-3
-4
4
3.5
3
2.5
2
1.5
1
0.5
0
start of growing season
23 consecutive days
1/10/2014
2/10/2014
3/13/2014
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall