Powell Property Wetland and Stream Mitigation Project
Bertie County, NC

2012 Annual Monitoring Report
Year 4

NCEEP Project Number D06065-B
Chowan River Basin
USGS Catalog Unit 03010203
IMS #92548

Submitted to
NCDENR/Ecosystem Enhancement Program
2728 Capital Blvd.
Raleigh, NC 27604

Date: December, 2012

Monitoring:
Albemarle Restorations, LLC
P. O. Box 176
Fairfield, NC 27826

Ecosystem Enhancement PROGRAM

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Executive Summary

The Powell Property Wetland and Stream Mitigation Site is a headwater riverine wetland and stream mitigation project located southeast of Powellsville, in Bertie County, North Carolina. It was constructed by Albemarle Restorations, LLC, under contract with EEP to provide 48.4 acres of riverine wetland mitigation credits and 3,310 linear feet of stream mitigation credits in the Chowan River Basin. Construction activities, in accordance with the approved restoration plan, began in June of 2008, and were completed in January of 2009. Planting took place in January of 2009.

Ten of the twelve gauges on the project site indicated successful wetland hydrology for a minimum of 5% of the growing season. Hydrology around gauges 7A and 7B continues to develop. Those two gauges, which are situated higher in the landscape than any of the other gauges are more sensitive to interrupted rainfall patterns. Two separate flow events were documented during 2012.

A total of ten vegetation monitoring plots are located on the site, seven in the riverine wetland areas and three more situated to monitor the swamp run vegetation. One plot is entirely within the boundaries of the swamp run and two more are located so as to share both land forms. Each plot is a 10m X 10m square, as recommended by the CVS-EEP protocol for recording vegetation sampling. All ten plots met the fourth year survival success criterion which is a minimum of 260 stems per acre.

Table ES-1 shows the levels of success attained by each of the water level monitoring gauges and the vegetation plots. The success criterion for hydrology is maintained groundwater levels within 12 inches of the soil surface for 5% to 8% of the growing season (12 to 19 consecutive days). Table C-1 in Appendix C has a detailed breakdown of hydrologic success.

Table ES-1. Project Success Summary

Gauges show longest hydroperiod as % of growing season, Plots show Stems per Acre														**Percent**
Success		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**7A**	**7B**	**8**	**9**	**10**	**Success**
Year 1 2009	**Gauges %**	6	15	6	2	15	2	3	Not Installed		39	24	14	70%
	Plot SPA	577	412	495	454	412	371	371			701	454	454	100%
Year 2 2010	**Gauges %**	8	11	7	6	15	3	2			16	17	12	80%
	Plot SPA	526	364	405	445	405	405	324			647	364	405	100%
Year 3 2011	**Gauges %**	13	26	26	9	26	26	8	6	8	26	26	21	100%
	Plot SPA	495	330	330	371	495	371	330	No Plot		577	371	454	100%
Year 4 2012	**Gauges %**	8	12	12	7	12	8	6	3	3	37	38	13	83%
	Plot SPA	454	371	289	371	454	371	371	No Plot		577	371	412	100%
Year 5 2013	**Gauges %**													
	Plot SPA								No Plot					

Gauge values shown in red did not meet minimum of 5% of the growing season

I. Project Background

1.0 Project Objectives

The goal of the Powell 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 Chowan 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, branched, 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 Chowan 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 Powell Property. The mitigation plan provides for the restoration of 48.4 acres of riverine wetlands and 3,310 linear feet of stream (swamp run) restoration. Prior to construction, the easement area was used entirely for row crop agriculture, primarily soy beans, corn, cotton and tobacco. The agricultural fields were drained by several ditches that traversed the site and one main drainage ditch that emptied into Quioccosin Swamp. Construction was done in accordance with the approved restoration plan and completed in January of 2009. Native tree and shrub species were planted in January of 2009 and the resulting riverine system is designed to emulate natural swamp run systems found within the Chowan River Basin.

Table I. Project Restoration Components Powell Wetland and Stream Mitigation Site/EEP #D06065-B				
Restoration Type	**Pre-Existing Acres/Linear Feet**	**Post Construction Acres/ Linear Feet**	**Credit Ratio (Restoration : WMU)**	**Total WMU's/SMU's**
Riverine Wetland	0.0 acres	48.4 acres	1:1	48.4 WMUs
Stream (Swamp Run)	0.0 linear feet	3,310 linear feet	1:1	3,310 SMUs

3.0 Location and Setting

The Powell Property Mitigation Site is located in Bertie County, just north of Buzzard's Crossroads on Meadow Road (approximately 4.6 miles southeast of Powellsville). The easement area is situated on the eastern portion of the Powell farm and adds contiguous swamp run and forested wetlands to Quioccosin Swamp which flows to the Wiccacon River, a tributary of the Chowan River. 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 Powellsville (Hwy. 42), travel south on Sally Freeman Rd., turn left on Dilday Rd., right on Luther Brown Rd., then right on Meadow Rd. Access to the site is approximately 2 miles from this intersection, on the right.

VICINITY MAP

POWELL PROPERTY

RIVERINE WETLAND RESTORATION
48.4 ACRES (48.4 WMU'S)

STREAM RESTORATION
3,310 LINEAR FEET (3,310 SMU'S)

BERTIE COUNTY, NORTH CAROLINA
CONTRACT # 16-006065-3

Scale: 1" = 4000'

4/ 2008

Drawn By: LMS

PREPARED FOR:

ALBEMARLE RESTORATIONS, LLC

WETLAND RESTORATION,
STREAM RESTORATION,
& WILDLIFE HABITAT CREATION

404 COURT STREET • GATESVILLE, NC 27938
(252) 333-9249 • FAX (252) 357-4892

SCALE

0 4,000' 8,000'

4.0 Project History and Background

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

Table II. Project Activity and Reporting History Powell Wetland and Stream Mitigation Project/EEP #D06065-B		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan	January 2008	May 2008
Final Design -90%	January 2008	May 2008
Construction	N/A	January 2009
Temporary S & E mix applied to entire project area	N/A	January 2009
Permanent seed mix applied to entire project area	N/A	January 2009
Containerized and Bare Root Planting	N/A	January 2009
Mitigation Plan/As-built	April 2009	June 2009
Year 1 monitoring	September 2009	March 2010
Year 2 monitoring	August 2010	August 2010
Year 3 monitoring	September 2011	December 2011
Year 4 monitoring	September 2012	December 2012
Year 5 monitoring		

Points of contact for the various phases of the Powell Project are provided in Table III.

Table III. Project Contacts Powell Wetland and Stream Mitigation Site/EEP #D06065-B	
Designer Primary Project design POC	Ecotone, Inc. (Scott McGill 410-692-7500) 1204 Baldwin Mill Road Jarrettsville, MD 21804
Construction Contractor Construction contractor POC	Armstrong, Inc. (Tink Armstrong 252-943-2082) P. O. Box 96 25852 US Hwy 64 Pantego, NC 27860
Planting Contractor Planting contractor POC	Carolina Silvics, Inc. 908 Indian Trail Road Edenton, NC 27932 Mary-Margaret McKinney (252-482-8491)
Seeding Contractor Seed planting contractor POC	Armstrong, Inc. (Tink Armstrong 252-943-2082) P. O. Box 96 25852 US Hwy 64 Pantego, NC 27860
Seed mix sources	Ernst Conservation Seeds, LLP, Meadville, PA
Nursery stock suppliers	Arborgen, Blenheim, SC, Native Roots, Clinton, NC
Monitoring Performers Wetland and Vegetation POC	Woods, Water and Wildlife, Inc. (Ashby Brown 757-651-3162) P. O. Box 176 Fairfield, NC 27826

Project background information for the Powell project is provided in Table IV.

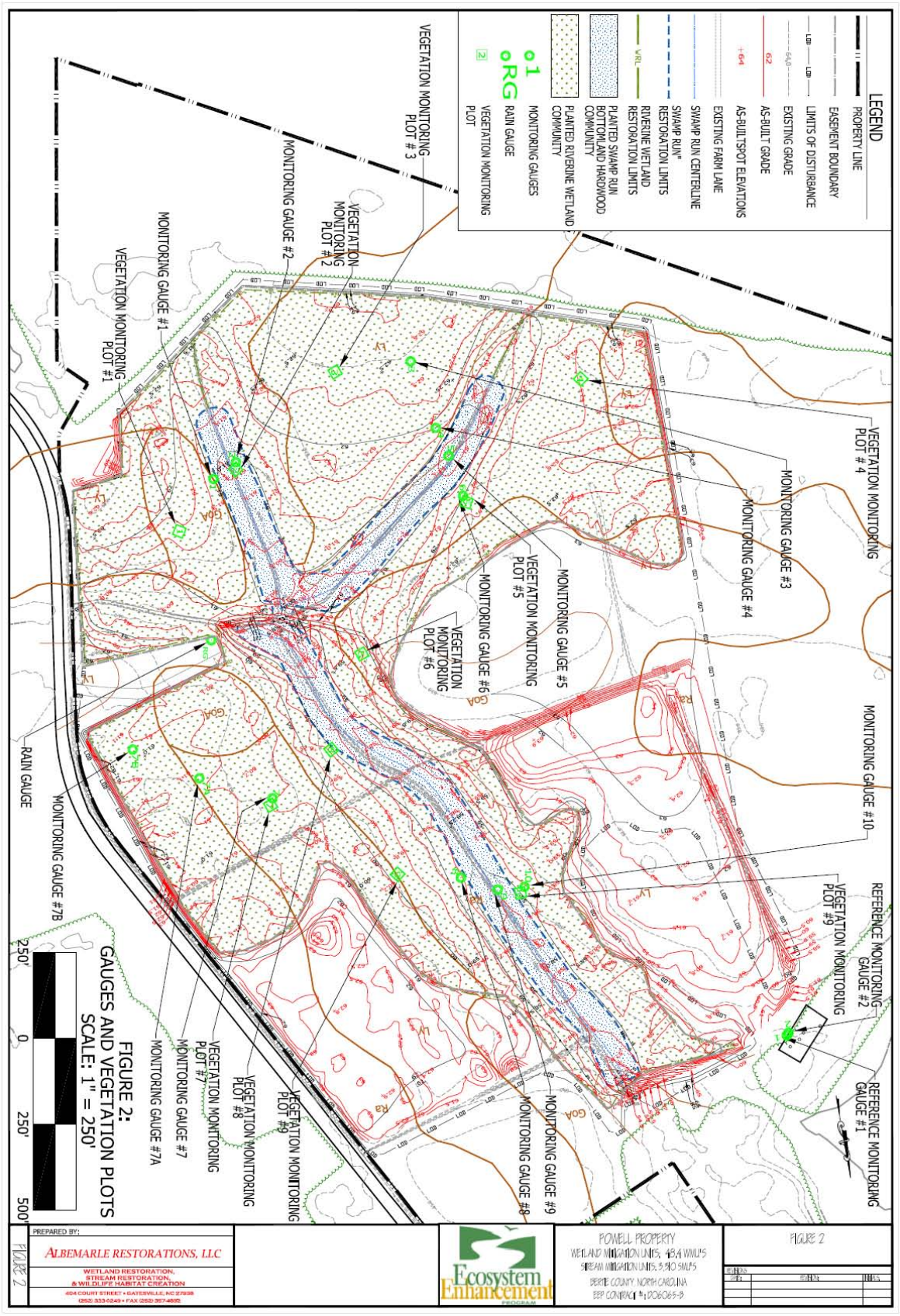
Table IV. Project Background Powell Wetland and Stream Mitigation Site/EEP #D06065-B	
Project County	Bertie County
Drainage Area	Approximately 871 Acres
Drainage impervious cover estimate (%)	0
Physiographic Region	Coastal Plain
Ecoregion	8.3.5 Southeastern Plains
Rosgen Classification of As-built	N/A
Cowardin Classification	PSS, PFO
Dominant Soil Types	Goldsboro, Lynchburg
Reference site ID	Quioccosin Swamp
USGS HUC for Project and Reference	03010203
NCDWQ Sub-basin for Project and Reference	03-01-01
NCDWQ classification for Project and Reference	C
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	Yes, Wiccacon River
Reasons for 303d listing or stressor?	Non-Point Source
% of project easement fenced	None

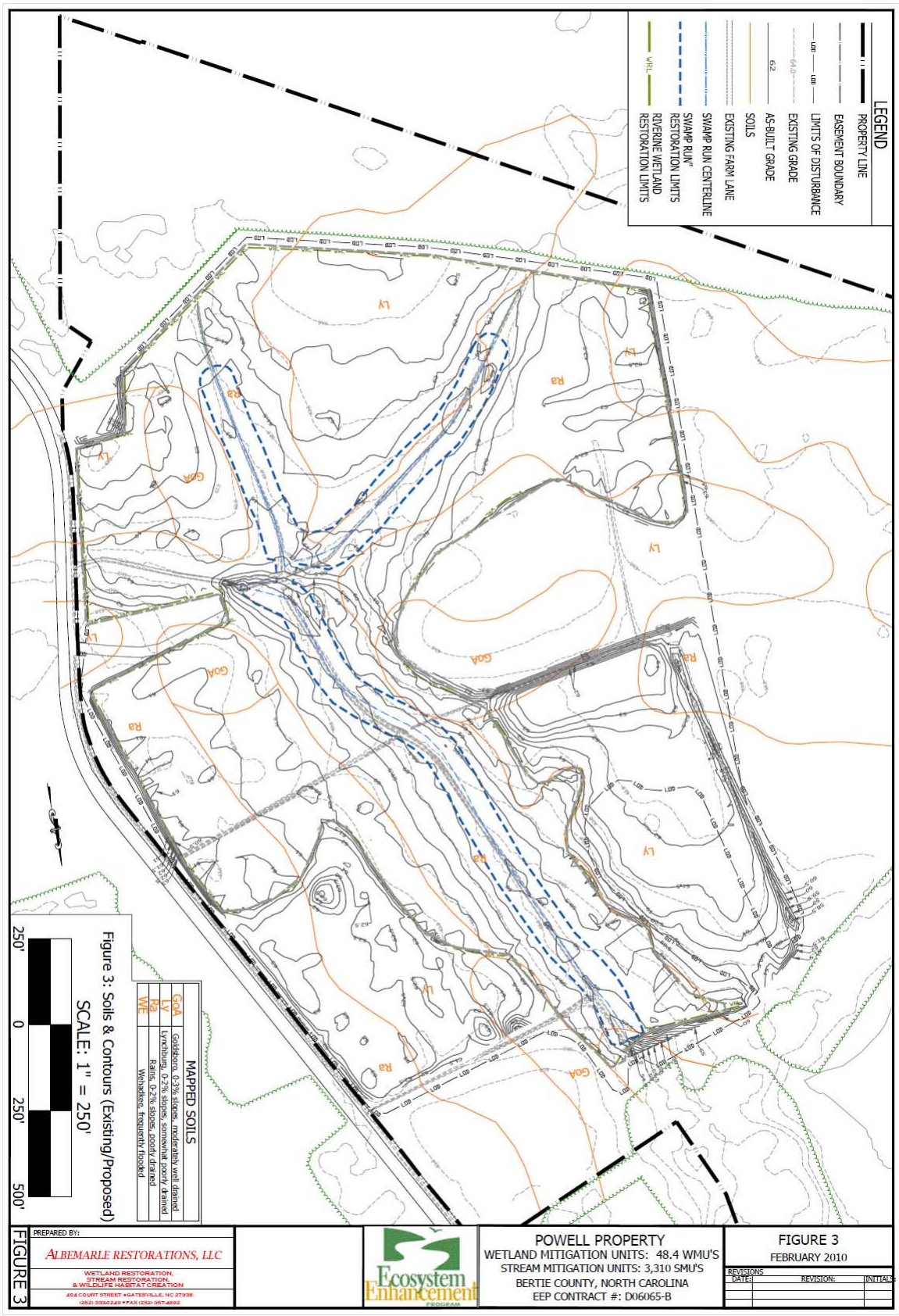
5.0 Monitoring Plan View

A total of twelve water level monitoring gauges are installed across the site. These gauges are suspended in two-inch pvc pipe that is set from two to four feet vertically in the ground. The gauges have been located to assess the groundwater levels throughout the year at various elevations and topographies within the site. Two more gauges are installed in an offsite riverine wetland area to serve as references for a naturally functioning riverine wetland and headwater swamp run. In addition, there is a rain gauge onsite to capture and record precipitation.

Vegetation monitoring is accomplished by surveying the ten permanent sampling plots. The plots are ten meters square and are situated to give an accurate sample of the planted and natural woody vegetation in both the riverine and swamp run communities. For each site, the data recorded matches that required of the *CVS-EEP Protocol for Recording Vegetation, v 4.0, 2006,* level 1-2.

Figures 2 and 3 provide plan views of the site showing the location of all monitoring features including gauges, sampling plots and the rain gauge as well as the vegetative communities.


LEGEND
PROPERTY LINE
EASEMENT BOUNDARY
LIMITS OF DISTURBANCE
EXISTING GRADE
AS-BUILT GRADE
AS-BUILTSPOT ELEVATIONS
EXISTING FARM LANE
SWAMP RUN CENTERLINE
SWAMP RUN" RESTORATION LIMITS
RIVERINE WETLAND RESTORATION LIMITS
PLANTED SWAMP RUN BOTTOMLAND HARDWOOD COMMUNITY
PLANTED RIVERINE WETLAND COMMUNITY
MONITORING GAUGES
RAIN GAUGE
VEGETATION MONITORING PLOT
VEGETATION MONITORING PLOT # 3
VEGETATION MONITORING PLOT #2
VEGETATION MONITORING PLOT #1
MONITORING GAUGE #2
MONITORING GAUGE #1
VEGETATION MONITORING PLOT # 4
MONITORING GAUGE #3
MONITORING GAUGE #4
VEGETATION MONITORING PLOT #5
MONITORING GAUGE #5
VEGETATION MONITORING PLOT #6
MONITORING GAUGE #6
MONITORING GAUGE #10
VEGETATION MONITORING PLOT #9
REFERENCE MONITORING GAUGE #2
REFERENCE MONITORING GAUGE #1
RAIN GAUGE
MONITORING GAUGE #7B
MONITORING GAUGE #7A
VEGETATION MONITORING PLOT #7
MONITORING GAUGE #7
VEGETATION MONITORING PLOT #8
VEGETATION MONITORING PLOT #9
MONITORING GAUGE #8
MONITORING GAUGE #9
250' 0 250' 500'
FIGURE 2:
GAUGES AND VEGETATION PLOTS
SCALE: 1" = 250'
PREPARED BY:
ALBEMARLE RESTORATIONS, LLC
WETLAND RESTORATION, STREAM RESTORATION, & WILDLIFE HABITAT CREATION
404 COURT STREET • GATESVILLE, NC 27938
(252) 333-0249 • FAX (252) 357-4693
Ecosystem Enhancement PROGRAM
POWELL PROPERTY
WETLAND MITIGATION UNITS: 48.4 WMU'S
STREAM MITIGATION UNITS: 3,910 SMU'S
BERTIE COUNTY, NORTH CAROLINA
EEP CONTRACT #: D06069-B
FIGURE 2


LEGEND
PROPERTY LINE
EASEMENT BOUNDARY
LIMITS OF DISTURBANCE
EXISTING GRADE
AS-BUILT GRADE
SOILS
EXISTING FARM LANE
SWAMP RUN CENTERLINE
SWAMP RUN" RESTORATION LIMITS
RIVERINE WETLAND RESTORATION LIMITS
MAPPED SOILS
GoA Goldsboro, 0-3% slopes, moderately well drained
Ly Lynchburg, 0-2% slopes, somewhat poorly drained
Ra Rains, 0-2% slopes, poorly drained
WE Wehadkee, frequently flooded
250' 0 250' 500'
SCALE: 1" = 250'
Figure 3: Soils & Contours (Existing/Proposed)
FIGURE 3
PREPARED BY:
ALBEMARLE RESTORATIONS, LLC
WETLAND RESTORATION, STREAM RESTORATION, & WILDLIFE HABITAT CREATION
404 COURT STREET • GATESVILLE, NC 27938
(252) 330-2281 • FAX (252) 357-2892
Ecosystem Enhancement Program
POWELL PROPERTY
WETLAND MITIGATION UNITS: 48.4 WMU'S
STREAM MITIGATION UNITS: 3,310 SMU'S
BERTIE COUNTY, NORTH CAROLINA
EEP CONTRACT #: D06065-B
FIGURE 3
FEBRUARY 2010
REVISIONS
DATE: REVISION: INITIALS

II. Project Condition and Monitoring Results

1.0 Vegetation Assessment

The vegetation success criterion was developed in accordance with the CVS-EEP protocol. The Powell project was designed to include both riverine and bottomland hardwood plant communities. The project was planted with a mixture of tree and shrub species that would resemble that of naturally occurring swamp runs and adjacent riverine wetlands in the local area. The run and area immediately adjacent were planted heavily with cypress, willow and tupelo. The riverine wetland zone beyond the swamp run is populated by a broader mix of native hydrophytic tree and shrub species. The species mix was based on the vegetation noted at the reference site and all species are classified from FAC to OBL (Table V). The site was planted at a rate of 600 stems per acre in January of 2009.

Table V. Species by Community Type
Powell Wetland and Stream Mitigation Project/EEP #D06065-B
Total Forested Wetland 55.9 Acres

Common Name	Scientific Name	Wetland Indicator Status
Trees		
Bald Cypress	Taxodium distichum	OBL
Water tupelo	Nyssa aquatica	OBL
Swamp Black Gum	Nyssa biflora	FAC
Willow Oak	Quercus phellos	FACW-
Swamp White Oak	Quercus bicolor	FACW+
Pin Oak	Quercus palustris	FACW
Water Oak	Quercus nigra	FAC
Swamp Chestnut Oak	Quercus michauxii	FACW-
Shrubs		
Staggerbush	Lyonia mariana	FAC
Tag Alder	Alnus serrulata	FACW+
Highbush Blueberry	Vaccinium corymbosum	FACW
Sweet Pepperbush	Clethra alnifolia	FACW
Virginia Sweetspire	Itea virginica	FACW+
Button Bush	Cephalanthus occidentalis	OBL
Swamp Bay	Persea palustris	FACW
Inkberry	Ilex glabra	FACW
Wax Myrtle	Myrica cerifera	FAC+
Black Willow	Salix nigra	OBL
Sweetbay Magnolia	Magnolia virginiana	FACW+

1.1 Vegetation Discussion and Problem Areas

All ten plots met the Year 5 success criterion of a minimum of 260 stems per acre. Over the entire project, the survival rate averaged 404 live stems per acre. Annual mortality continues to be light; the survival rate in 2010 averaged 429 stems per acre. Growth continues to be very good as well as is the overall health of the forested community.

2.0 Wetland Assessment

The hydrologic success criterion for any gauge is to achieve a minimum of 12 to 19 consecutive days where the groundwater level is within 12 inches of the soil surface during the growing season. This represents 5% to 8% of the growing season which for this site runs from March 22 to November 8, a period of 231 days (WETS Table for Lewiston, NC). All but two gauges, 7A and 7B, measured a successful hydroperiod during the year. Gauges 7A and 7B both measured a 3% hydroperiod.

2.1 Wetland Discussion and Problem Areas

The deficiency shown at Gauges 7A and 7B is directly linked to the rainfall patterns at the beginning and end of the growing season when successful hydrology is most likely to occur. There was a cumulative rainfall deficit of .99" from January through April. From April 1 through April 19, only .4 inches total were recorded on site. Since these two gauges are located highest in the landscape, the rainfall pattern must show some continuity during this critical time in order for them to record successful hydrology. The same pattern of sporadic rainfall occurred at the end of the growing season. Rainfall in October was nearly twice normal, but most of that fell during Hurricane Sandy at the end of October. Total rainfall from November 1st through the 26th totaled only .65". All of the gauges that indicated successful hydrology did so at the beginning of the growing season this year. Gauges 1 and 4 showed the same patterns as 7A and 7B but due to their location in the landscape they showed successful hydrology at 8% and 7% respectively.

Because of concerns about soil compaction around Gauges 6 and 7 in 2009 and 2010, those areas of the project were subsoiled in September of 2010 and replanted in January of 2011. Gauges 7A and 7B were added to enhance the accuracy of data collection. Gauge 6 showed a 26% hydroperiod in 2011, but only an 8% hydroperiod in 2012, indicating the subsoiling successfully corrected any compaction problems in that area, but rainfall patterns continue to have a greater effect on success. Again, location in the landscape appears to be the issue as Gauge 6 sits a foot lower in elevation and closer to the swamp run than either 7A or 7B. Gauge 7 also sits at the same elevation as Gauge 6 and is also nearer the swamp run than 7A and 7B and Gauge 7 showed an 8% hydroperiod this year. The relative positions of these gauges serve to further affirm that adequately timed rainfall at the beginning and end of the growing season is necessary in order for Gauges 7A and 7B to show successful hydrology.

2.15 Flow

Refer to Figures F1and F2 which are composite charts for Gauges 2, 5 & 9, for the following discussion of evidence of flow within the swamp runs. Figure F1 is a composite chart showing a period of flow in March, 2012. Figure F2 is a composite chart showing flow in late October, 2012 after Hurricane Sandy produced enough rainfall to briefly recharge the watershed. As can be seen on the hydrographs, prior to that storm, the site was very dry. Both flow events were video documented and those files are included on the CD accompanying this report.

By comparison, Reference Gauge 11, which is in the center of the reference swamp run, showed no water flowing in October. This was confirmed during a site visit in November; the reference run was found to be dry and both reference gauges were empty. The project area appears to be more sensitive to rainfall, producing flow patterns that may be shorter lived, but more frequent than the reference area which may take longer to recharge, but continues to flow for longer periods.

Figure F1.
Monitoring Gauges 2, 5 & 9
Indicating Flow in March, 2012

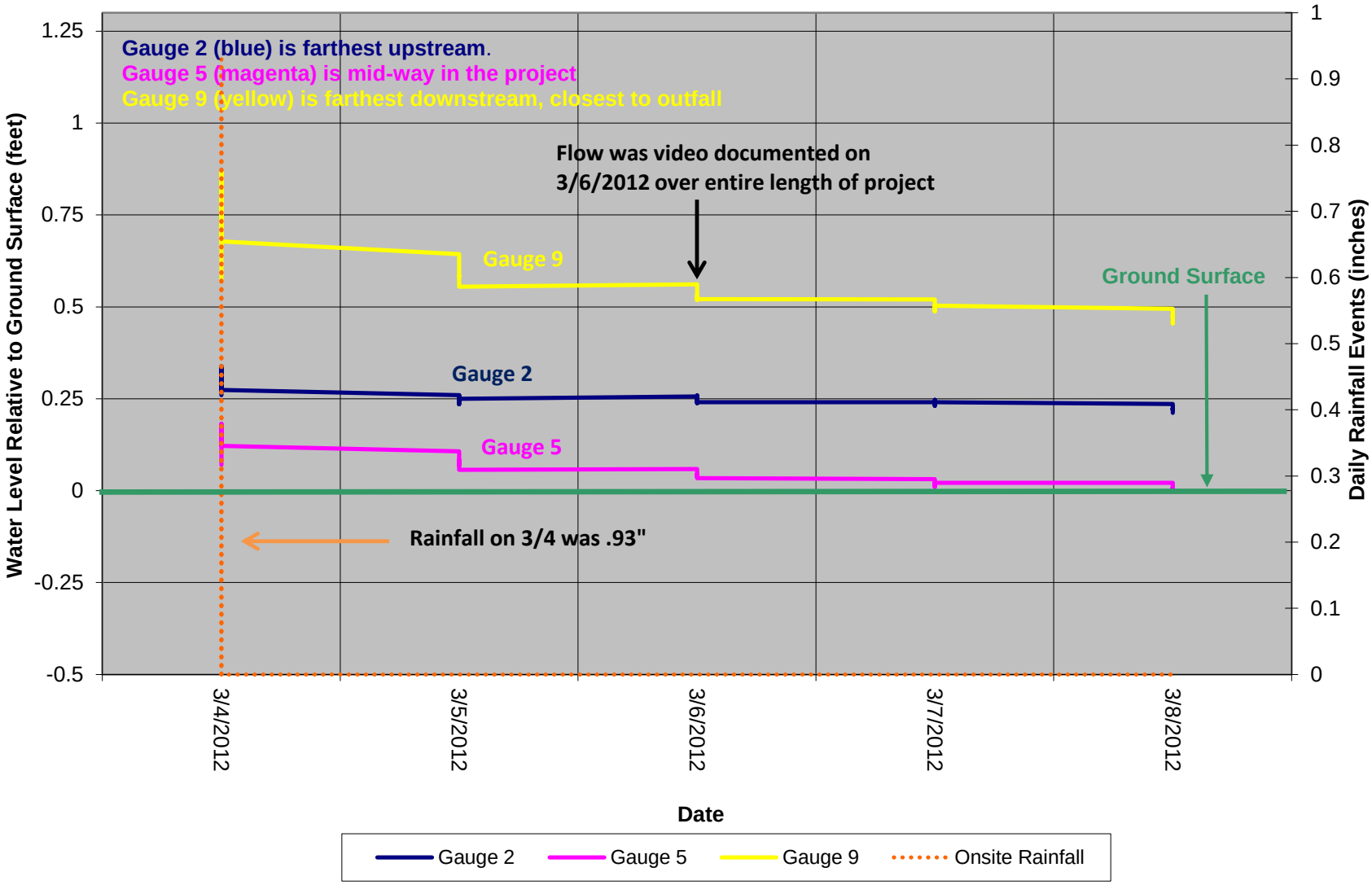
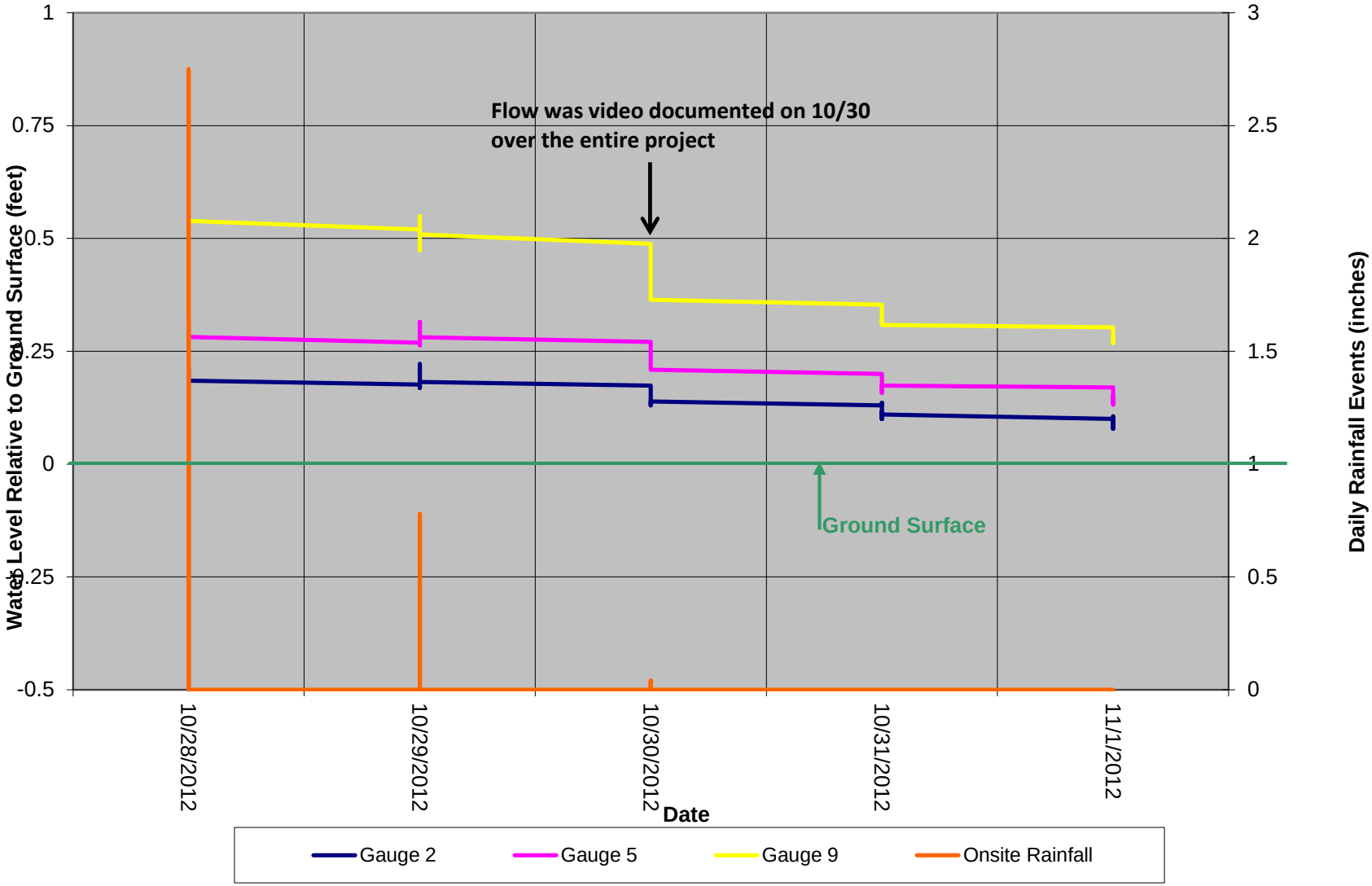


Figure F2.
Monitoring Gauges 2, 5 & 9
Indicating Flow in October 2012



2.2 Wetland Monitoring Plan View (Integrated)

Figure 4 in Appendix D provides an overview of the areas where hydrology is still developing.

Table VI. 2012 Hydrology and Vegetation Criteria Success by Plot
Powell Wetland and Stream Mitigation Project/EEP #D06065-B

Gauge	Hydrology Success Met (% hydroperiod)	Hydrology Mean	Vegetation Plot	Vegetation Success Met (Stems/Acre)	Vegetation Mean
1	Y (8%)	83%	1	Y (454)	100%
2	Y (12%)		2	Y (371)	
3	Y (12%)		3	Y (289)	
4	Y (7%)		4	Y (371)	
5	Y (12%)		5	Y (454)	
6	Y (8%)		6	Y (371)	
7	Y (6%)		7	Y (371)	
7A	N (3%)		No Plot		
7B	N (3%)		No Plot		
8	Y (37%)		8	Y (577)	
9	Y (38%)		9	Y (371)	
10	Y (13%)		10	Y (412)	
11 (Ref)*	39%		No Plot		
12 (Ref)*	11%		No Plot		

* Gauges 11 & 12 are reference gauges and not included in the hydrology mean

3.0 Project Success Discussion

After the fourth year of monitoring and corrective action in the form of subsoiling to correct hydrology issues, the wetland hydrology on the Powell project shows indications of successful restoration. Specifically, the hydrology within the swamp run has been restored and the project is functioning like a natural riparian headwater system. Flow of water across the site was successfully measured and documented on two separate occasions in 2012.

The reference gauges are measuring very similar above- and below-ground water patterns at the reference site as those measured on the project, confirming that the site is functioning like a natural system. Overall tree survival and growth is good.

Listed below are the field indicators from the approved mitigation plan that are to be used to help substantiate flow. Those shown in ***blue*** were observed and/or video or photo documented since 2009.

- A natural line impressed on the bank
- Shelving
- Changes in soil characteristics
- **Destruction of terrestrial vegetation**
- **Presence of litter and debris**
- **Wracking**
- **Vegetation matted down or absent**
- **Sediment sorting**
- Leaf litter disturbed or washed away
- **Scour**
- Deposition
- **Bed and bank formation**
- **Water staining**
- **Change in plant community**

High water marks on bank vegetation were noted and photographed during December of 2009 after heavy rainfall. Matted vegetation was noted and photographed in April of 2010, the remnants of winter flooding. Further evidence of flow is deposition of small detritus after flow events as well as some scouring in the mid portion of the project. Wracking can be seen among the vegetation downstream after heavy rains. Sediment sorting can also be seen after heavy rains. Channelization at the midpoint of the project continues to develop.

III. Methodology Section

Year 4 monitoring for the Powell project occurred in September of 2012. Monitoring and vegetation sampling procedures were established in the mitigation plan for this project and no deviations were made.

Appendix A

Vegetation Data Tables

Site Photos

1. Vegetation Data Tables

Table 1. Project Metadata

Report Prepared By	Ashby Brown
Date Prepared	10/6/2012 16:19
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	D06065B
project Name	Powell
Description	Powell wetland and stream mitigation
River Basin	Chowan
Sampled Plots	10

Table 2. Vegetation Vigor by Species

	Species	CommonName	4	3	2	1	0	Missing
	Alnus serrulata	hazel alder	1					
	Celtis occidentalis	common hackberry		1				
	Cephalanthus occidentalis	common buttonbush	4	1				
	Itea virginica	Virginia sweetspire		3	1			2
	Nyssa biflora	swamp tupelo	1	5	3			1
	Quercus bicolor	swamp white oak	3	1				
	Quercus michauxii	swamp chestnut oak	5	3				1
	Quercus palustris	pin oak	1		1			
	Quercus phellos	willow oak	16	4				1
	Salix nigra	black willow	5					
	Taxodium distichum	bald cypress	16	13	4			3
	Magnolia virginiana	sweetbay			1			
	Myrica	wax myrtle	5					
TOT:	**13**	**13**	**57**	**31**	**10**			**8**

Table 3. Vegetation Damage by Species

	Species	CommonName	Count of Damage Categories	(no damage)
	Alnus serrulata	hazel alder	0	1
	Celtis occidentalis	common hackberry	0	1
	Cephalanthus occidentalis	common buttonbush	0	5
	Itea virginica	Virginia sweetspire	0	6
	Magnolia virginiana	sweetbay	0	1
	Myrica	wax myrtle	0	5
	Nyssa biflora	swamp tupelo	0	10
	Quercus bicolor	swamp white oak	0	4
	Quercus michauxii	swamp chestnut oak	0	9
	Quercus palustris	pin oak	0	2
	Quercus phellos	willow oak	0	21
	Salix nigra	black willow	0	5
	Taxodium distichum	bald cypress	0	36
TOT:	**13**	**13**	**0**	**106**

Table 4. Vegetation Damage by Plot

	plot	Count of Damage Categories	(no damage)
	D06065B-AB-0001-year:4	0	12
	D06065B-AB-0002-year:4	0	9
	D06065B-AB-0003-year:4	0	8
	D06065B-AB-0004-year:4	0	9
	D06065B-AB-0005-year:4	0	16
	D06065B-AB-0006-year:4	0	9
	D06065B-AB-0007-year:4	0	9
	D06065B-AB-0008-year:4	0	14
	D06065B-AB-0009-year:4	0	9
	D06065B-AB-0010-year:4	0	11
TOT:	**10**	**0**	**106**

Table 5. All Stems by Plot and Species

					Plot									
Species	**CommonName**	**Total Stems**	**# plots**	**avg# stems**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Alnus serrulata	hazel alder	1	1	1			1							
Celtis occidentalis	common hackberry	1	1	1								1		
Cephalanthus occidentalis	common buttonbush	5	2	2.5	3							2		
Itea virginica	Virginia sweetspire	4	4	1	1		1	1				1		
Magnolia virginiana	sweetbay	1	1	1					1					
Myrica	wax myrtle	5	2	2.5					2		3			
Nyssa biflora	swamp tupelo	9	4	2.25		2		1		2		4		
Quercus bicolor	swamp white oak	4	2	2						3	1			
Quercus michauxii	swamp chestnut oak	8	3	2.67		1			3					4
Quercus palustris	pin oak	2	1	2		2								
Quercus phellos	willow oak	20	5	4	7	4	3			4	2			
Salix nigra	black willow	5	1	5								5		
Taxodium distichum	bald cypress	33	7	4.71			2	7	5		3	1	9	6
Totals: 13	**13**	**98**	**13**		**11**	**9**	**7**	**9**	**11**	**9**	**9**	**14**	**9**	**10**
Average stems per acre					**454**	**371**	**289**	**371**	**454**	**371**	**371**	**577**	**371**	**412**

2012 overall project average stems per acre: 404

Near Gauge 6 looking across project toward midpoint March 2012

Stream center at midpoint March 2012

Outflow end looking upstream toward midpoint March 2012. Note low water level.

Outflow volume March 2012 relatively low.

Reference area flow volume in March 2012 similar to project flow volume

Outflow volume after Hurricane Sandy is relatively light.

Table C-1

Longest consecutive successful hydrologic period in days (and % of Growing Season) and success at 5% and 8% of the growing season

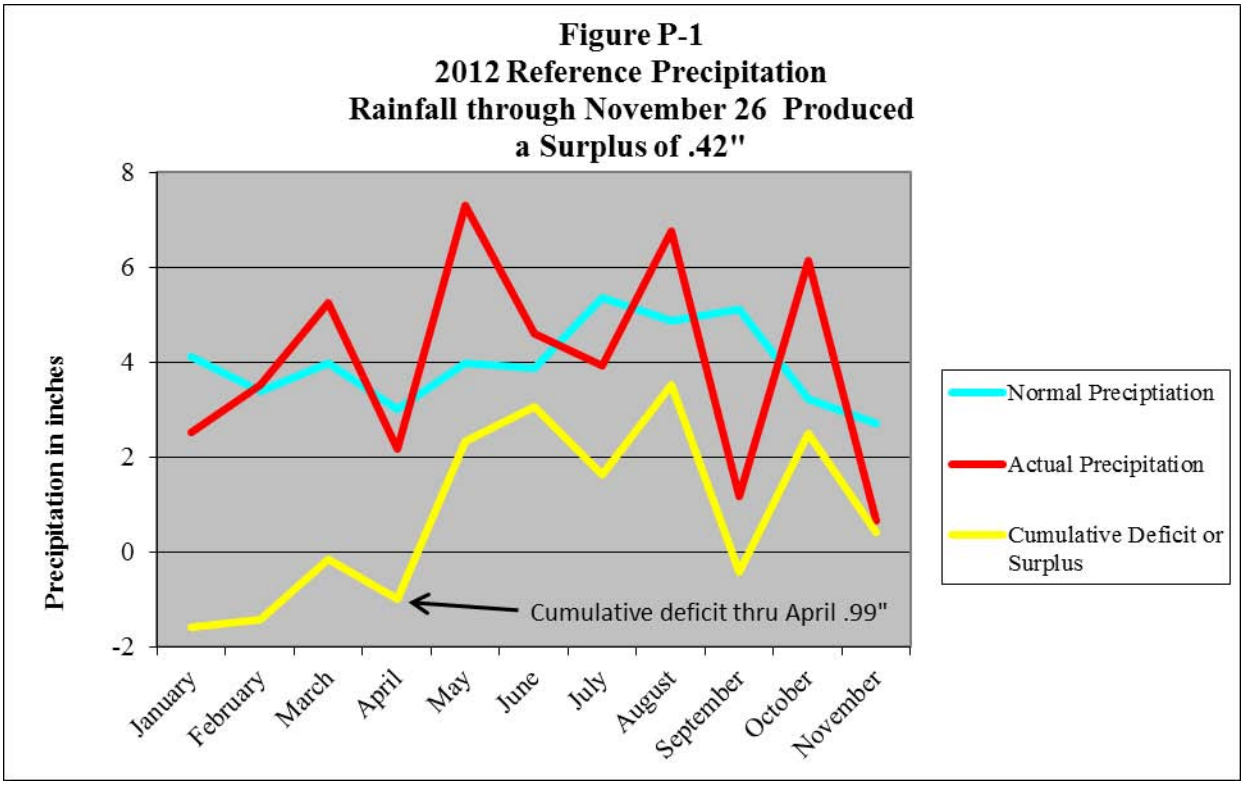
Living Stems Per Acre at the end of the growing season for plots 1-10

Gauge	Year 1					Year 2					Year 3					Year 4					Year 5				
(Plot)	Days	%	5%	8%	SPA	Days	%	5%	8%	SPA	Days	%	5%	8%	SPA	Days	%	5%	8%	SPA	Days	%	5%	8%	SPA
1	14	6	Y	N	577	18	8	Y	N	526	30	13	Y	Y	495	18	8	Y	N	454					
2	34	15	Y	Y	412	25	11	Y	Y	364	59	26	Y	Y	330	27	12	Y	Y	371					
3	15	6	Y	N	495	17	7	Y	N	405	59	26	Y	Y	330	27	12	Y	Y	289					
4	4	2	N	N	454	15	6	Y	N	445	21	9	Y	Y	371	16	7	Y	N	371					
5	35	15	Y	Y	412	34	15	Y	Y	405	59	26	Y	Y	495	28	12	Y	Y	454					
6	4	2	N	N	371	7	3	N	N	405	59	26	Y	Y	371	18	8	Y	N	371					
7	7	3	N	N	371	4	2	N	N	324	19	8	Y	Y	330	13	6	Y	N	371					
7A											13	6	Y	N		6	3	N	N						
7B											18	8	Y	Y		6	3	N	N						
8	39	17	Y	Y	701	38	16	Y	Y	647	59	26	Y	Y	577	85	37	Y	Y	577					
9	24	10	Y	Y	454	39	17	Y	Y	364	59	26	Y	Y	371	87	38	Y	Y	371					
10	14	6	Y	N	454	28	12	Y	Y	405	48	21	Y	Y	454	30	13	Y	Y	412					
11 (Ref)	53	23	Y	Y		38	16	Y	Y		59	26	Y	Y		89	39	Y	Y						
12 (Ref)	39	17	Y	Y		36	16	Y	Y		59	26	Y	Y		25	11	Y	Y						

5% of growing season is 12 days, 8% is 19 days

Hydrology is deemed successful if longest consecutive hydrologic period meets minimum of 5% of the growing season

Gauges 7A and 7B were installed in Year 3 (2011)



Cumulative rainfall deficit through April 2012 was .99". Late spring and summer rainfall was good, but due to timing did not help maintain hydrology. Except for Hurricane Sandy late in October, fall rainfall was very light.

Appendix B

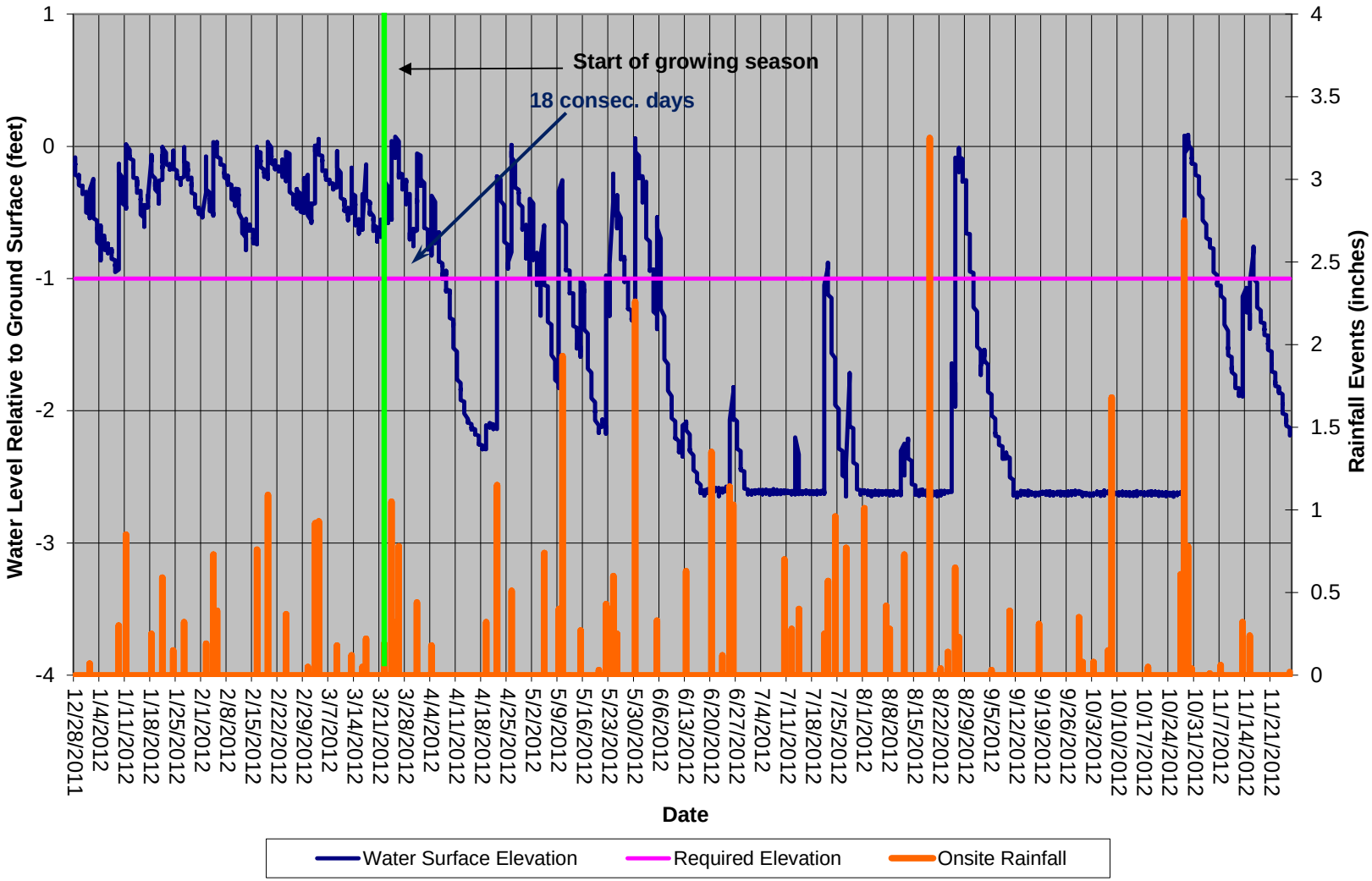
Geomorphologic Raw Data

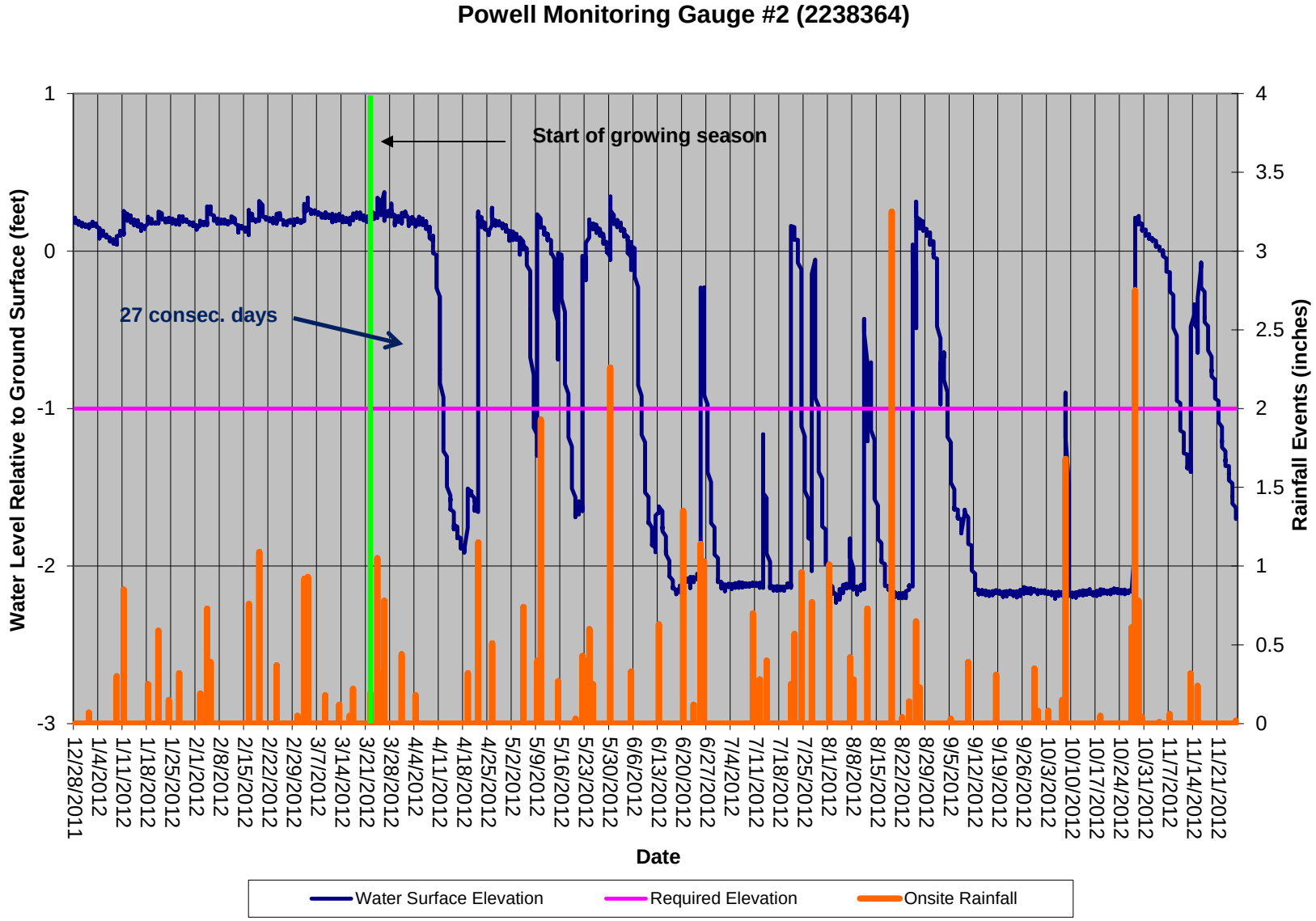
Not used in this report

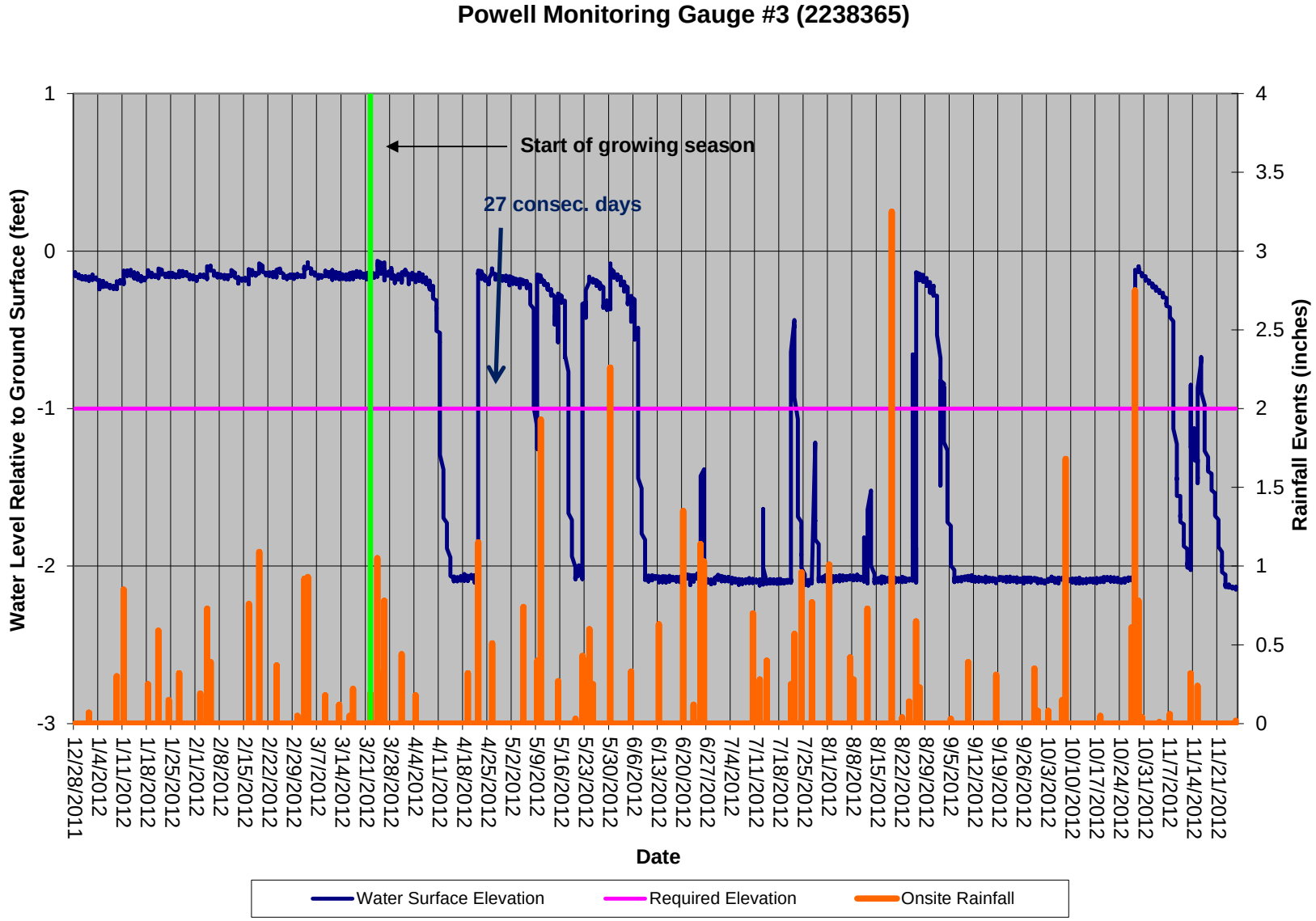
Appendix C

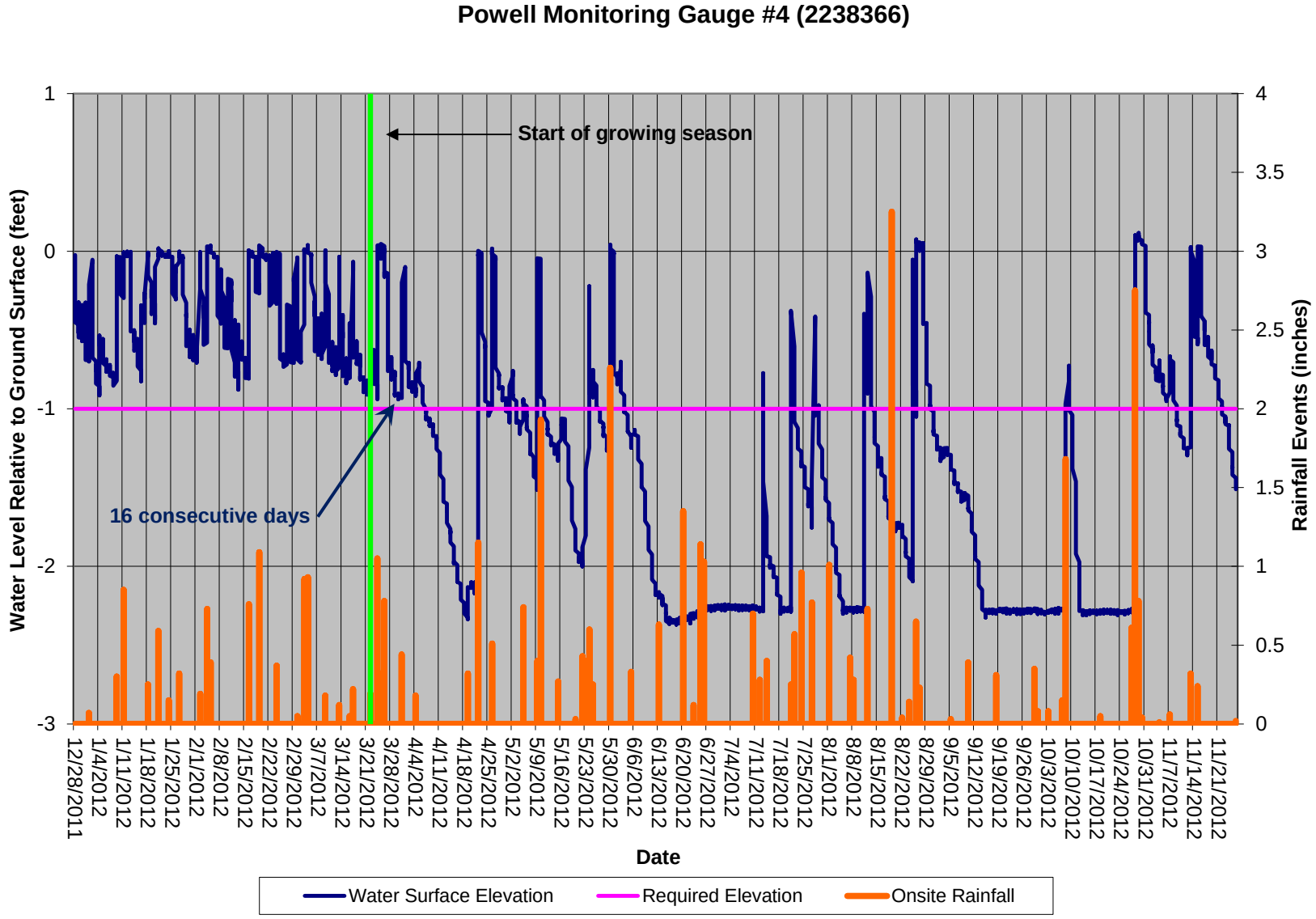
Hydrologic Data Tables

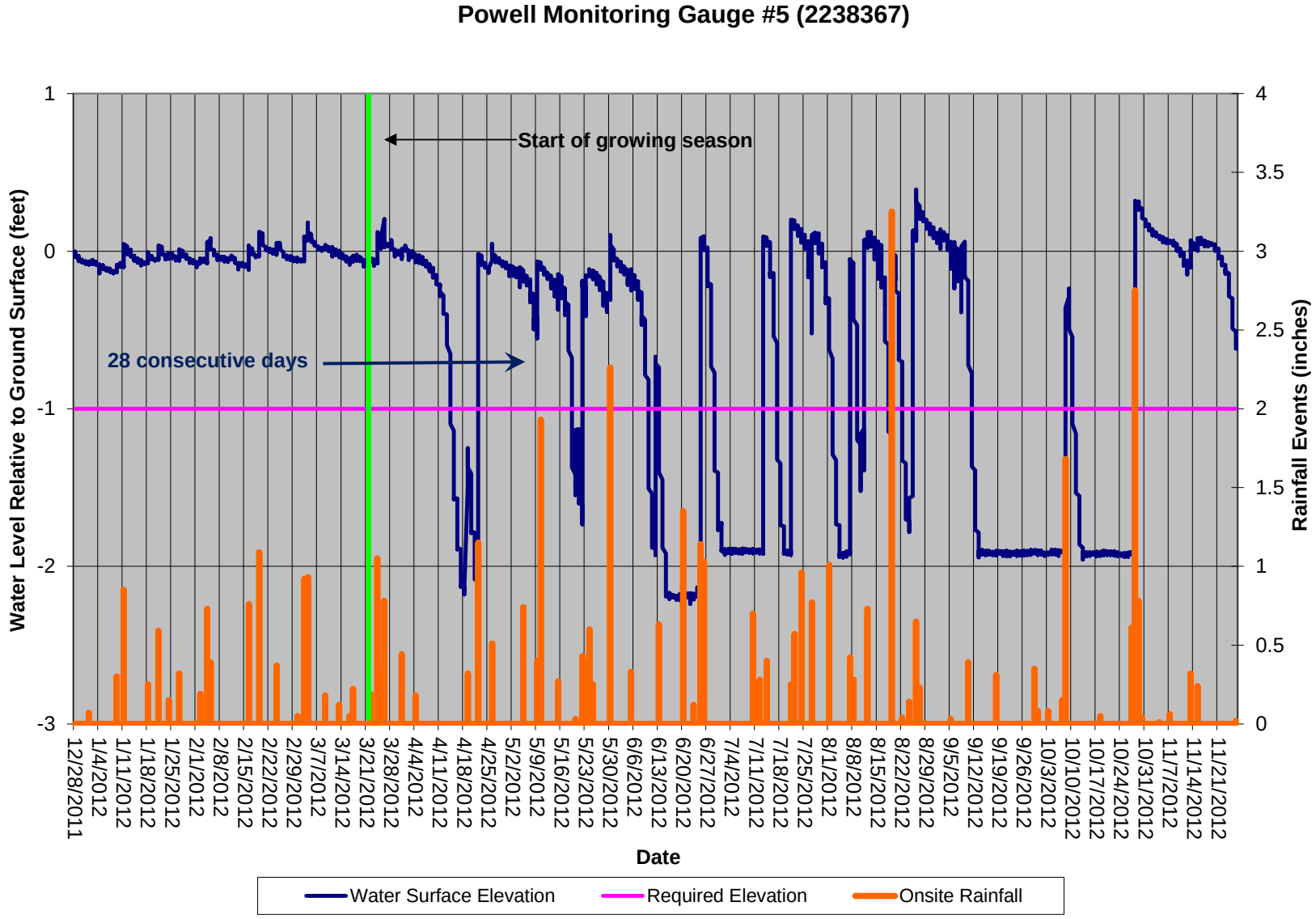
Powell Monitoring Gauge #1 (2238363)

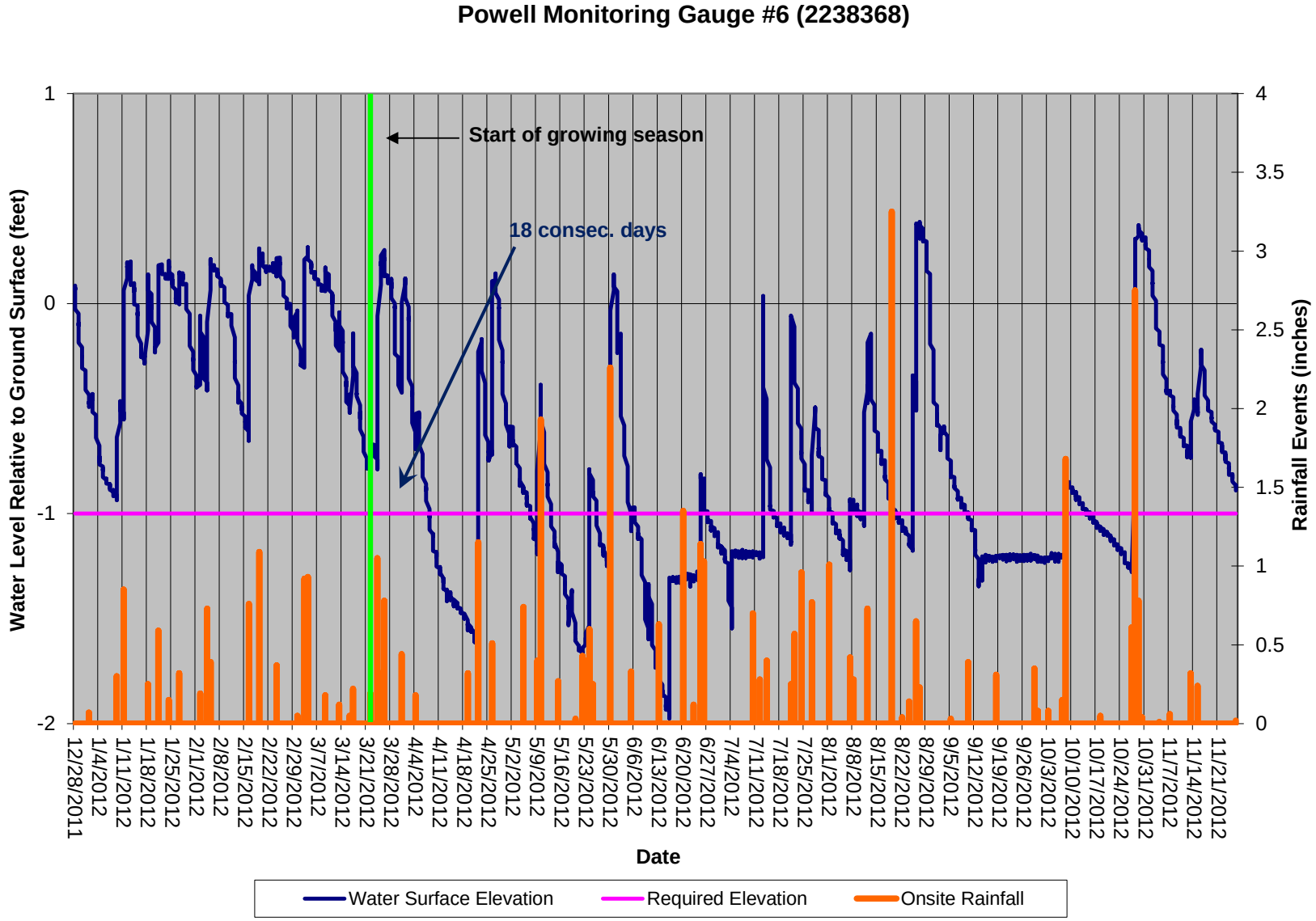


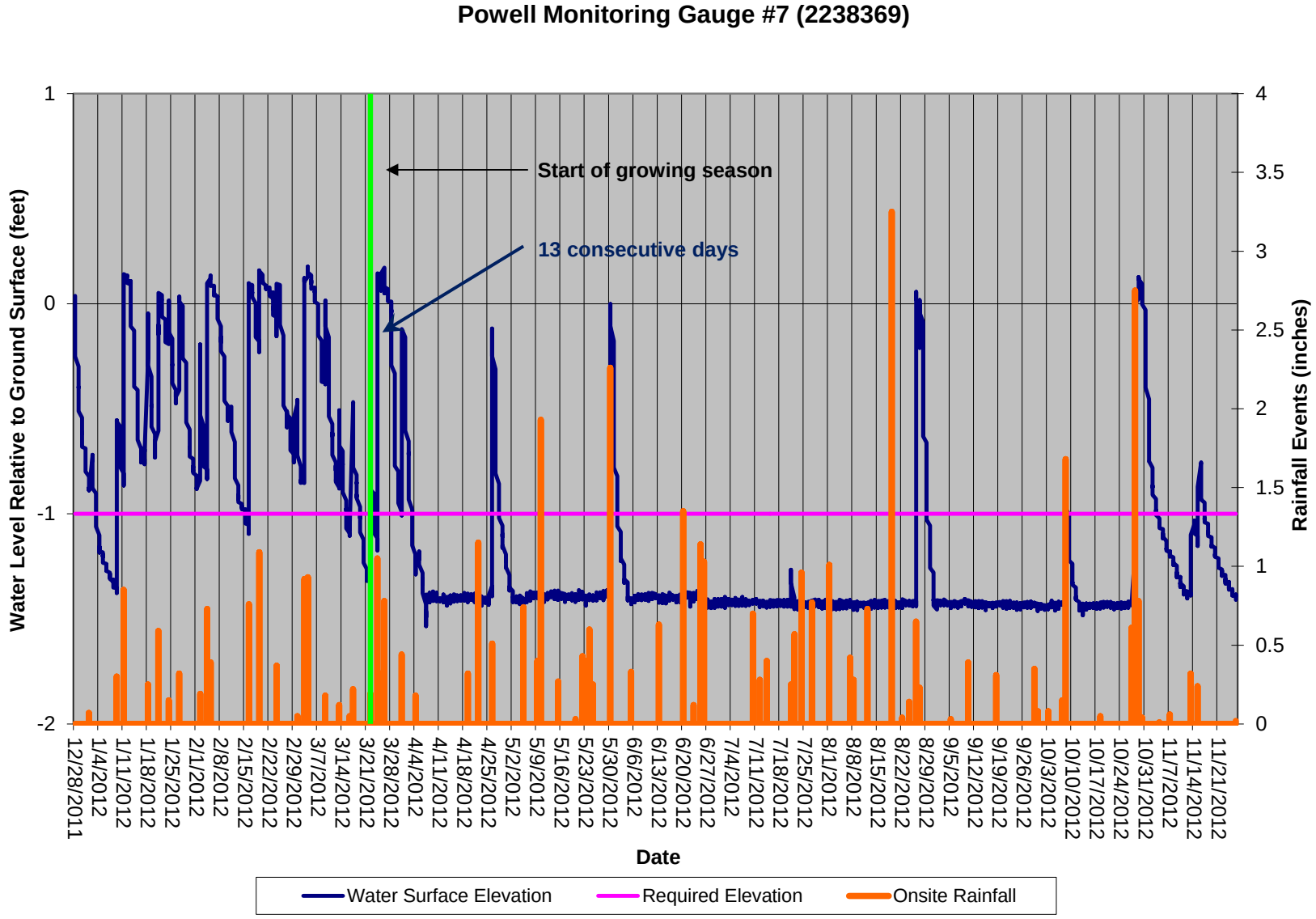

Powell Monitoring Gauge #2 (2238364)
Start of growing season
27 consec. days
Water Level Relative to Ground Surface (feet)
Rainfall Events (inches)
Date
1
0
-1
-2
-3
4
3.5
3
2.5
2
1.5
1
0.5
0
12/28/2011
1/4/2012
1/11/2012
1/18/2012
1/25/2012
2/1/2012
2/8/2012
2/15/2012
2/22/2012
2/29/2012
3/7/2012
3/14/2012
3/21/2012
3/28/2012
4/4/2012
4/11/2012
4/18/2012
4/25/2012
5/2/2012
5/9/2012
5/16/2012
5/23/2012
5/30/2012
6/6/2012
6/13/2012
6/20/2012
6/27/2012
7/4/2012
7/11/2012
7/18/2012
7/25/2012
8/1/2012
8/8/2012
8/15/2012
8/22/2012
8/29/2012
9/5/2012
9/12/2012
9/19/2012
9/26/2012
10/3/2012
10/10/2012
10/17/2012
10/24/2012
10/31/2012
11/7/2012
11/14/2012
11/21/2012
Water Surface Elevation
Required Elevation
Onsite Rainfall

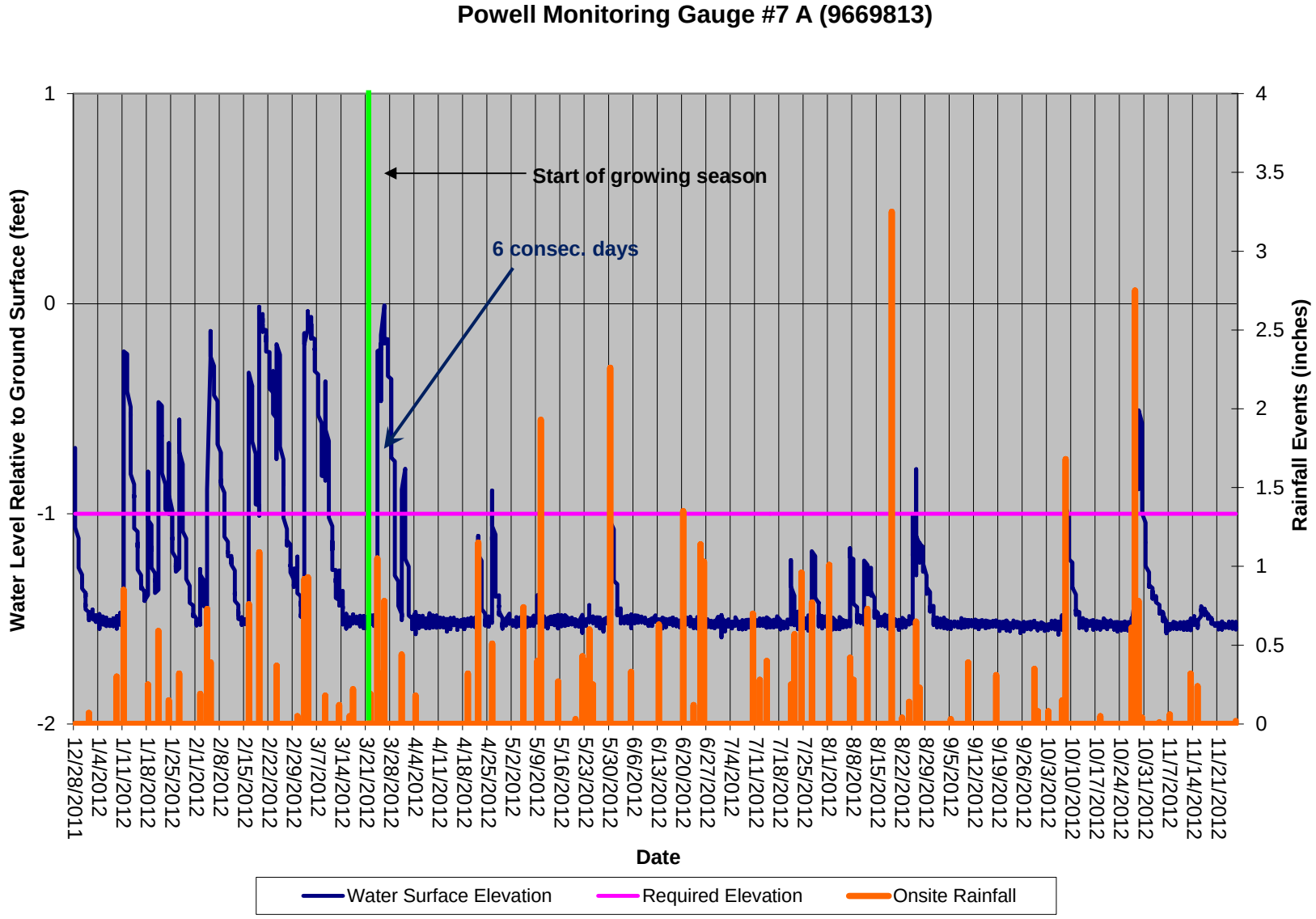

Powell Monitoring Gauge #3 (2238365)
Start of growing season
27 consec. days
Water Level Relative to Ground Surface (feet)
Rainfall Events (inches)
Date
1
0
-1
-2
-3
4
3.5
3
2.5
2
1.5
1
0.5
0
12/28/2011
1/4/2012
1/11/2012
1/18/2012
1/25/2012
2/1/2012
2/8/2012
2/15/2012
2/22/2012
2/29/2012
3/7/2012
3/14/2012
3/21/2012
3/28/2012
4/4/2012
4/11/2012
4/18/2012
4/25/2012
5/2/2012
5/9/2012
5/16/2012
5/23/2012
5/30/2012
6/6/2012
6/13/2012
6/20/2012
6/27/2012
7/4/2012
7/11/2012
7/18/2012
7/25/2012
8/1/2012
8/8/2012
8/15/2012
8/22/2012
8/29/2012
9/5/2012
9/12/2012
9/19/2012
9/26/2012
10/3/2012
10/10/2012
10/17/2012
10/24/2012
10/31/2012
11/7/2012
11/14/2012
11/21/2012
Water Surface Elevation
Required Elevation
Onsite Rainfall


Powell Monitoring Gauge #4 (2238366)
Start of growing season
16 consecutive days
Water Level Relative to Ground Surface (feet)
Rainfall Events (inches)
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall
1
0
-1
-2
-3
4
3.5
3
2.5
2
1.5
1
0.5
0
12/28/2011
1/4/2012
1/11/2012
1/18/2012
1/25/2012
2/1/2012
2/8/2012
2/15/2012
2/22/2012
2/29/2012
3/7/2012
3/14/2012
3/21/2012
3/28/2012
4/4/2012
4/11/2012
4/18/2012
4/25/2012
5/2/2012
5/9/2012
5/16/2012
5/23/2012
5/30/2012
6/6/2012
6/13/2012
6/20/2012
6/27/2012
7/4/2012
7/11/2012
7/18/2012
7/25/2012
8/1/2012
8/8/2012
8/15/2012
8/22/2012
8/29/2012
9/5/2012
9/12/2012
9/19/2012
9/26/2012
10/3/2012
10/10/2012
10/17/2012
10/24/2012
10/31/2012
11/7/2012
11/14/2012
11/21/2012


Powell Monitoring Gauge #5 (2238367)
Start of growing season
28 consecutive days
Water Level Relative to Ground Surface (feet)
Rainfall Events (inches)
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall


Powell Monitoring Gauge #6 (2238368)
Start of growing season
18 consec. days
Water Level Relative to Ground Surface (feet)
Rainfall Events (inches)
1
0
-1
-2
4
3.5
3
2.5
2
1.5
1
0.5
0
12/28/2011
1/4/2012
1/11/2012
1/18/2012
1/25/2012
2/1/2012
2/8/2012
2/15/2012
2/22/2012
2/29/2012
3/7/2012
3/14/2012
3/21/2012
3/28/2012
4/4/2012
4/11/2012
4/18/2012
4/25/2012
5/2/2012
5/9/2012
5/16/2012
5/23/2012
5/30/2012
6/6/2012
6/13/2012
6/20/2012
6/27/2012
7/4/2012
7/11/2012
7/18/2012
7/25/2012
8/1/2012
8/8/2012
8/15/2012
8/22/2012
8/29/2012
9/5/2012
9/12/2012
9/19/2012
9/26/2012
10/3/2012
10/10/2012
10/17/2012
10/24/2012
10/31/2012
11/7/2012
11/14/2012
11/21/2012
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall


Powell Monitoring Gauge #7 (2238369)
Start of growing season
13 consecutive days
Water Level Relative to Ground Surface (feet)
Rainfall Events (inches)
1
0
-1
-2
4
3.5
3
2.5
2
1.5
1
0.5
0
12/28/2011
1/4/2012
1/11/2012
1/18/2012
1/25/2012
2/1/2012
2/8/2012
2/15/2012
2/22/2012
2/29/2012
3/7/2012
3/14/2012
3/21/2012
3/28/2012
4/4/2012
4/11/2012
4/18/2012
4/25/2012
5/2/2012
5/9/2012
5/16/2012
5/23/2012
5/30/2012
6/6/2012
6/13/2012
6/20/2012
6/27/2012
7/4/2012
7/11/2012
7/18/2012
7/25/2012
8/1/2012
8/8/2012
8/15/2012
8/22/2012
8/29/2012
9/5/2012
9/12/2012
9/19/2012
9/26/2012
10/3/2012
10/10/2012
10/17/2012
10/24/2012
10/31/2012
11/7/2012
11/14/2012
11/21/2012
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall


Powell Monitoring Gauge #7 A (9669813)
Start of growing season
6 consec. days
Water Level Relative to Ground Surface (feet)
Rainfall Events (inches)
1
0
-1
-2
4
3.5
3
2.5
2
1.5
1
0.5
0
12/28/2011
1/4/2012
1/11/2012
1/18/2012
1/25/2012
2/1/2012
2/8/2012
2/15/2012
2/22/2012
2/29/2012
3/7/2012
3/14/2012
3/21/2012
3/28/2012
4/4/2012
4/11/2012
4/18/2012
4/25/2012
5/2/2012
5/9/2012
5/16/2012
5/23/2012
5/30/2012
6/6/2012
6/13/2012
6/20/2012
6/27/2012
7/4/2012
7/11/2012
7/18/2012
7/25/2012
8/1/2012
8/8/2012
8/15/2012
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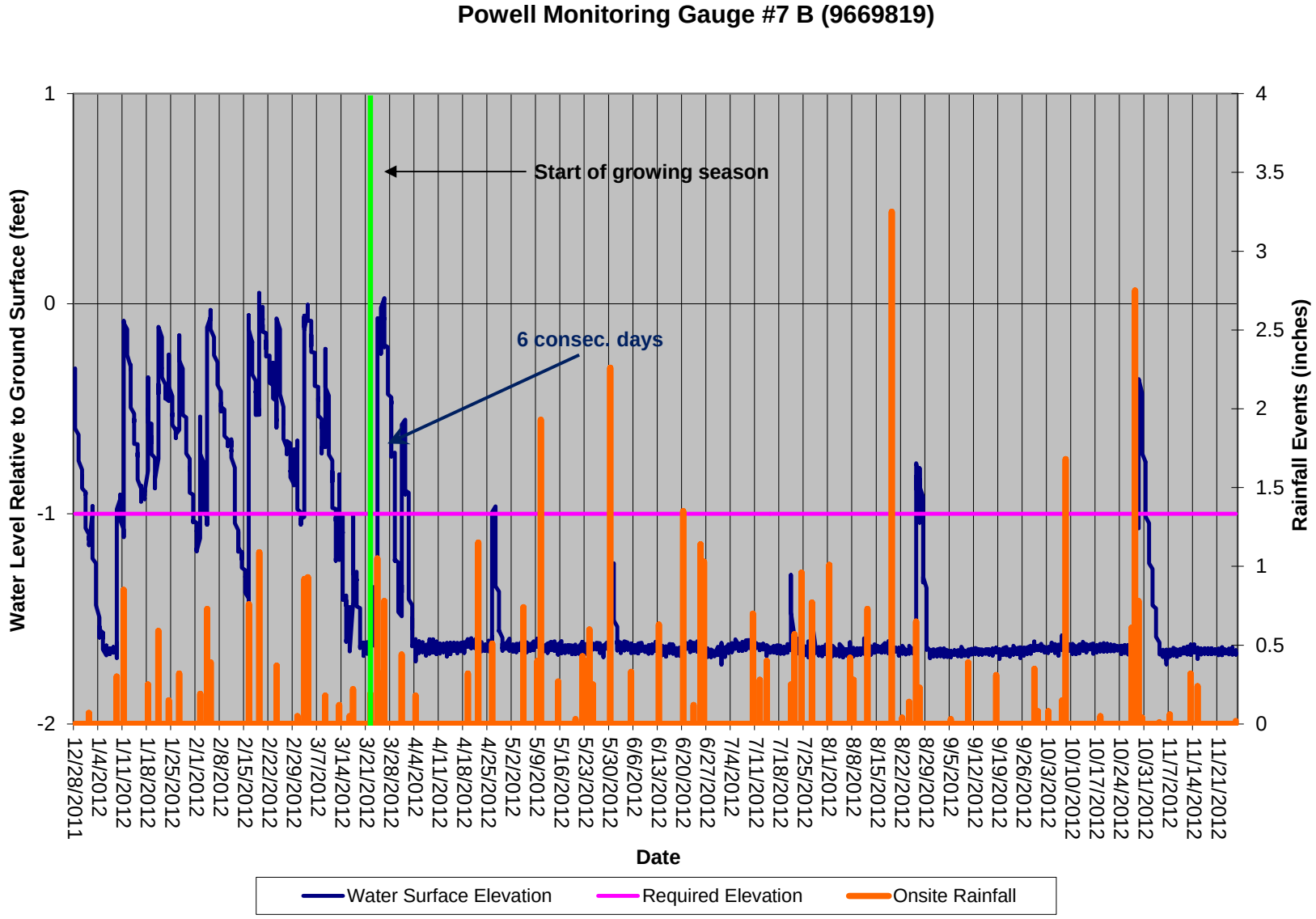
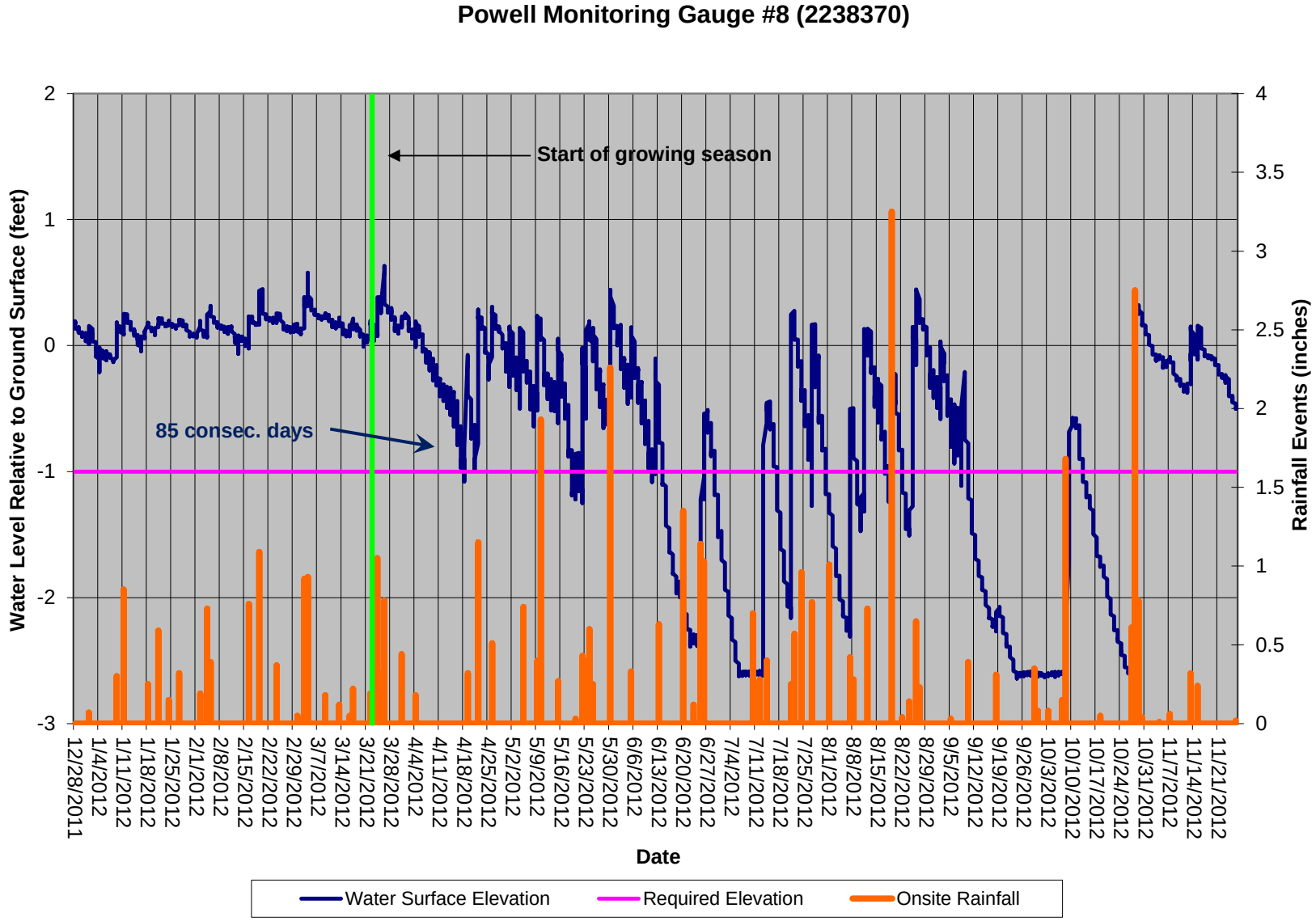
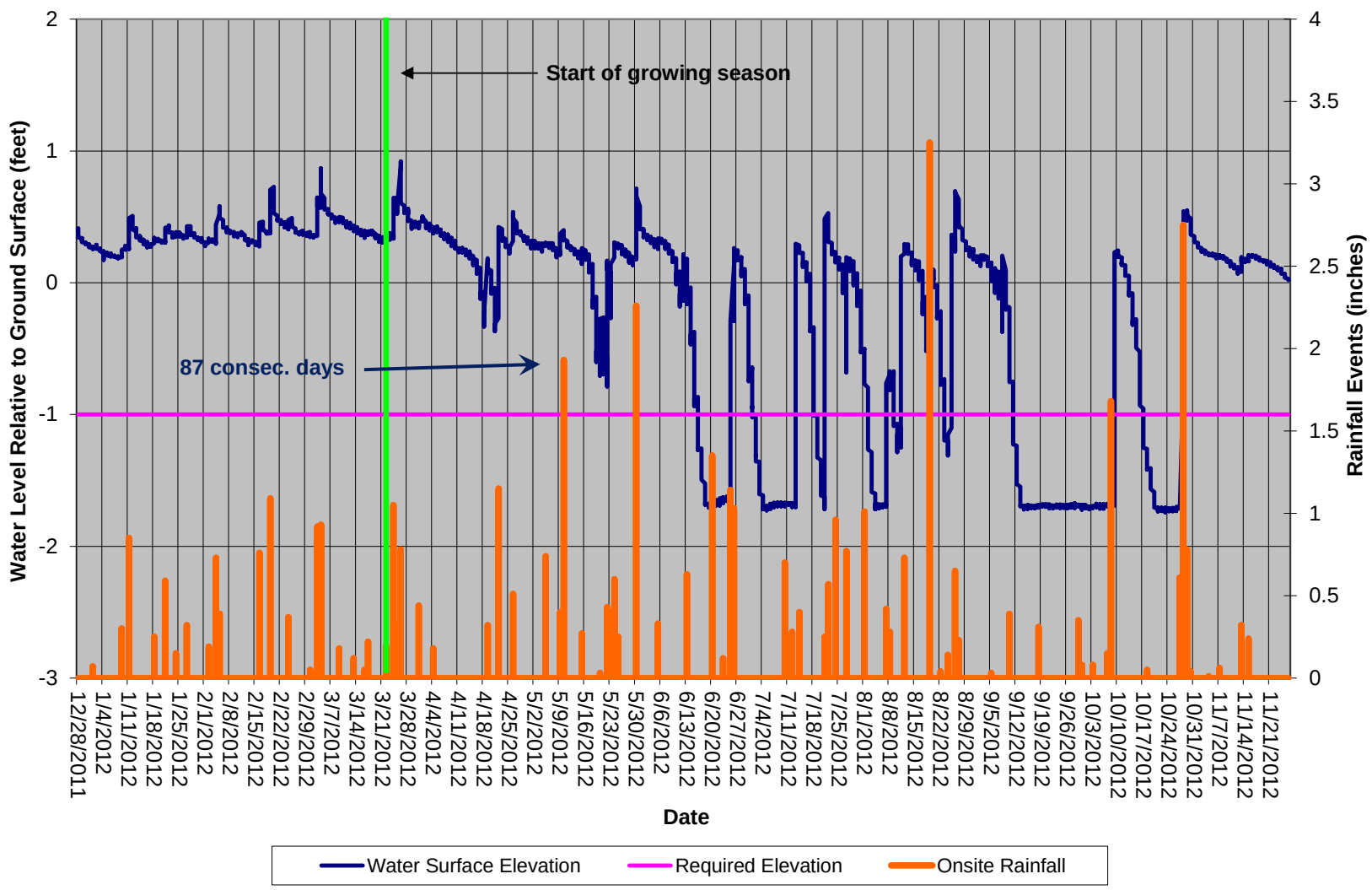
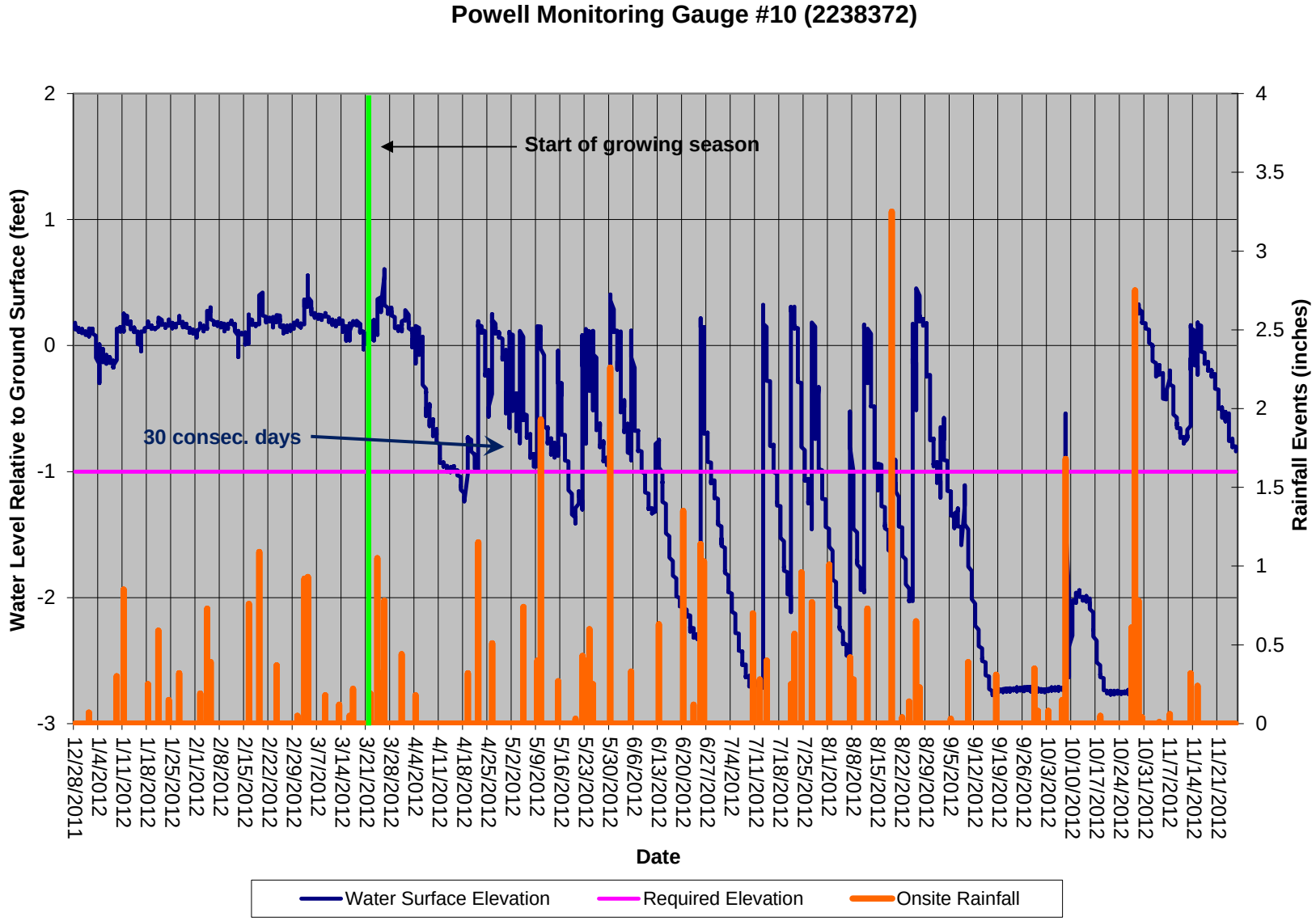
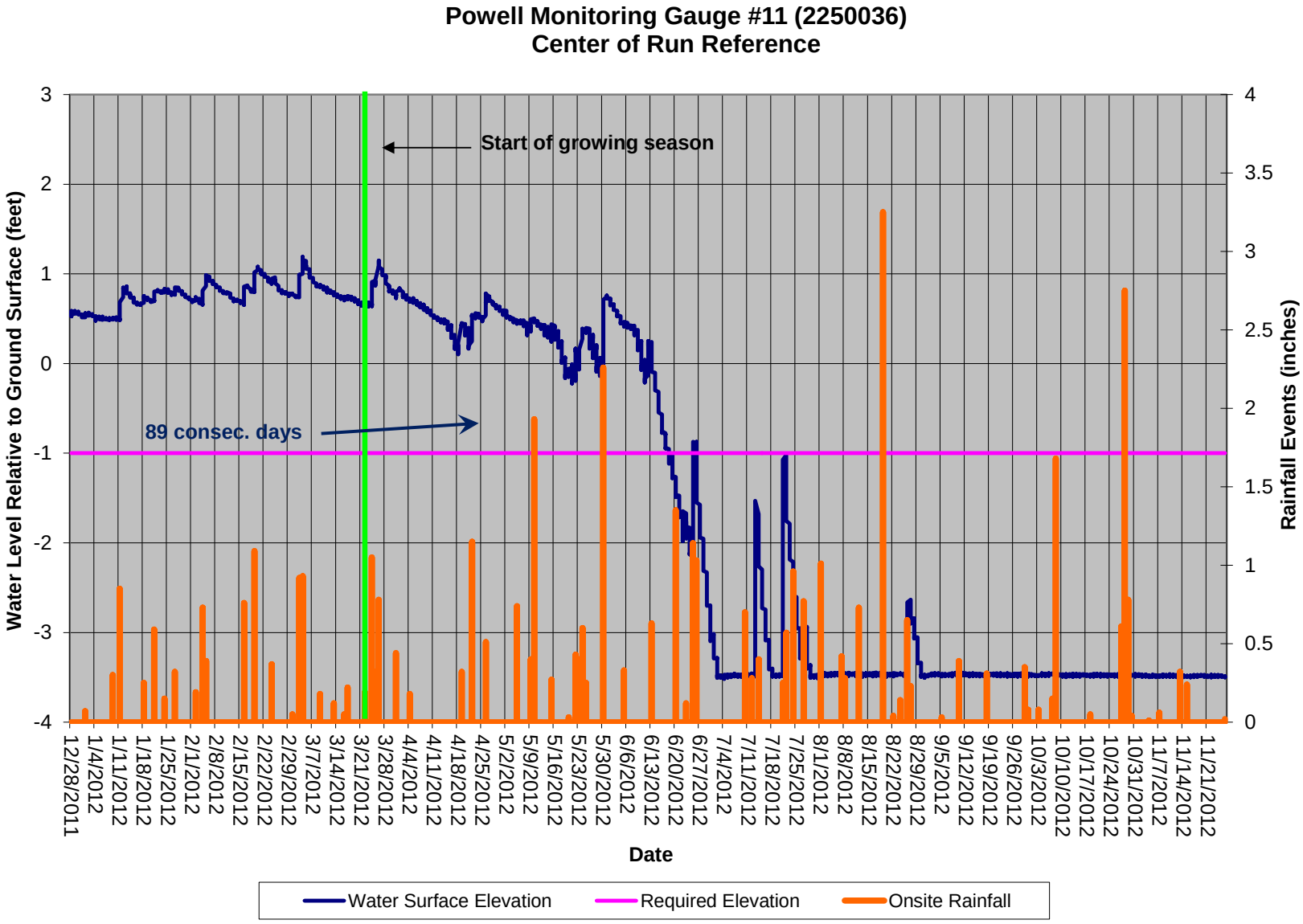
8/29/2012
9/5/2012
9/12/2012
9/19/2012
9/26/2012
10/3/2012
10/10/2012
10/17/2012
10/24/2012
10/31/2012
11/7/2012
11/14/2012
11/21/2012
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall

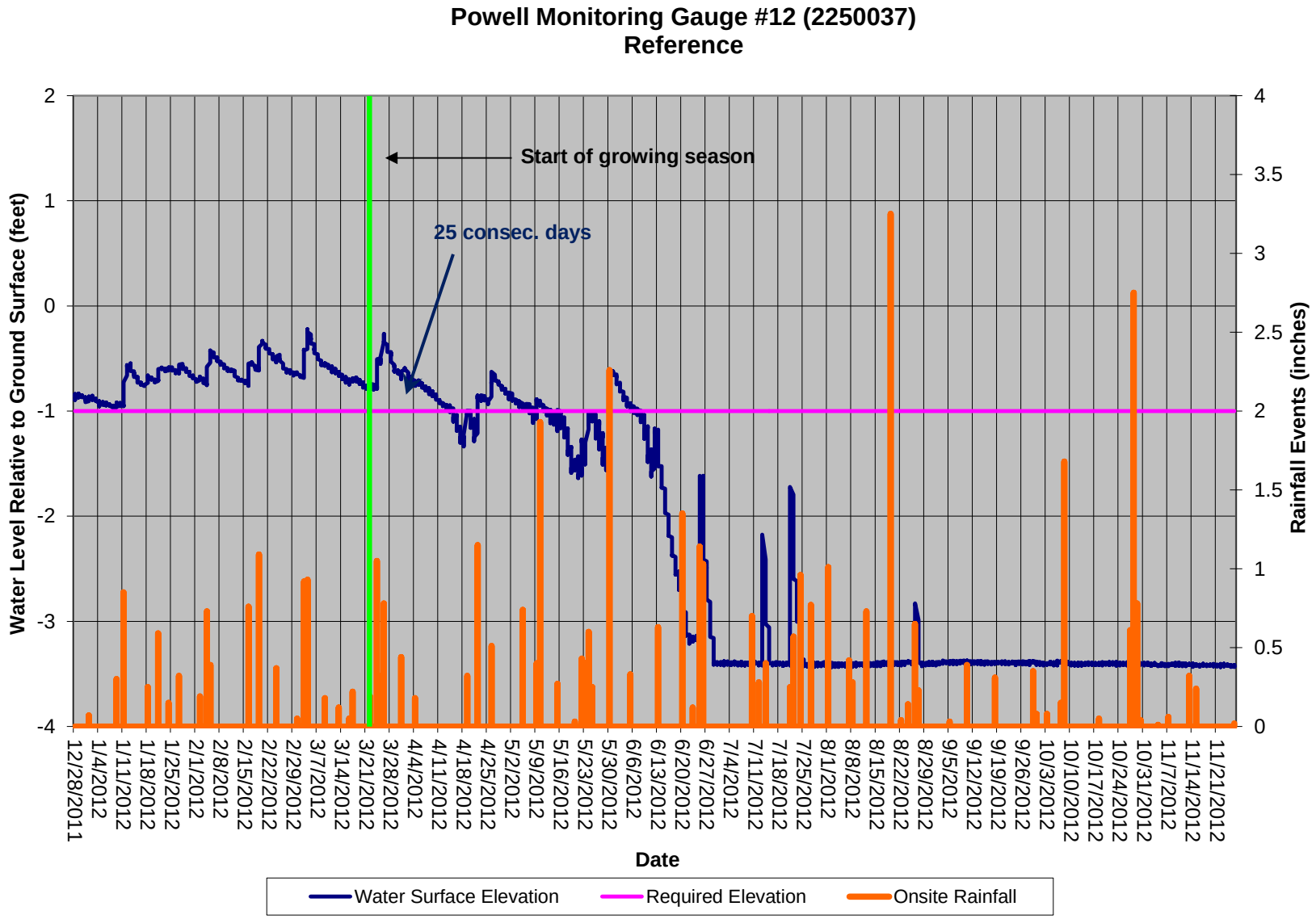

Powell Monitoring Gauge #7 B (9669819)
Start of growing season
6 consec. days
Water Level Relative to Ground Surface (feet)
Rainfall Events (inches)
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall


Powell Monitoring Gauge #8 (2238370)
Start of growing season
85 consec. days
Water Level Relative to Ground Surface (feet)
Rainfall Events (inches)
Date
2
1
0
-1
-2
-3
4
3.5
3
2.5
2
1.5
1
0.5
0
12/28/2011
1/4/2012
1/11/2012
1/18/2012
1/25/2012
2/1/2012
2/8/2012
2/15/2012
2/22/2012
2/29/2012
3/7/2012
3/14/2012
3/21/2012
3/28/2012
4/4/2012
4/11/2012
4/18/2012
4/25/2012
5/2/2012
5/9/2012
5/16/2012
5/23/2012
5/30/2012
6/6/2012
6/13/2012
6/20/2012
6/27/2012
7/4/2012
7/11/2012
7/18/2012
7/25/2012
8/1/2012
8/8/2012
8/15/2012
8/22/2012
8/29/2012
9/5/2012
9/12/2012
9/19/2012
9/26/2012
10/3/2012
10/10/2012
10/17/2012
10/24/2012
10/31/2012
11/7/2012
11/14/2012
11/21/2012
Water Surface Elevation
Required Elevation
Onsite Rainfall


Powell Monitoring Gauge #9 (2238371)
Start of growing season
87 consec. days
Water Level Relative to Ground Surface (feet)
Rainfall Events (inches)
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall

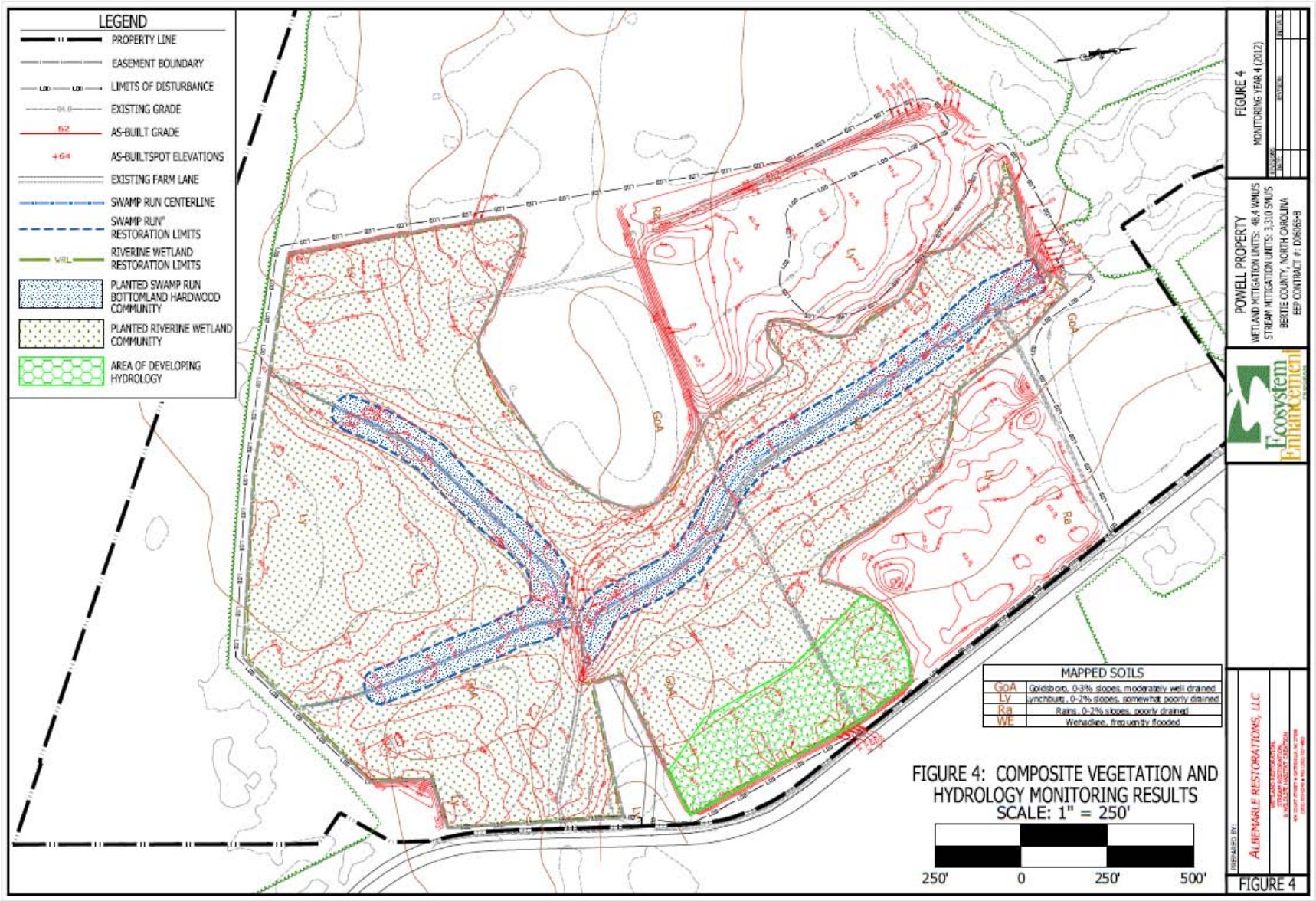

Powell Monitoring Gauge #10 (2238372)
Start of growing season
30 consec. days
Water Level Relative to Ground Surface (feet)
Rainfall Events (inches)
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall
2
1
0
-1
-2
-3
4
3.5
3
2.5
2
1.5
1
0.5
0
12/28/2011
1/4/2012
1/11/2012
1/18/2012
1/25/2012
2/1/2012
2/8/2012
2/15/2012
2/22/2012
2/29/2012
3/7/2012
3/14/2012
3/21/2012
3/28/2012
4/4/2012
4/11/2012
4/18/2012
4/25/2012
5/2/2012
5/9/2012
5/16/2012
5/23/2012
5/30/2012
6/6/2012
6/13/2012
6/20/2012
6/27/2012
7/4/2012
7/11/2012
7/18/2012
7/25/2012
8/1/2012
8/8/2012
8/15/2012
8/22/2012
8/29/2012
9/5/2012
9/12/2012
9/19/2012
9/26/2012
10/3/2012
10/10/2012
10/17/2012
10/24/2012
10/31/2012
11/7/2012
11/14/2012
11/21/2012


Powell Monitoring Gauge #11 (2250036)
Center of Run Reference
Start of growing season
89 consec. days
Water Level Relative to Ground Surface (feet)
Rainfall Events (inches)
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall


Powell Monitoring Gauge #12 (2250037)
Reference
Start of growing season
25 consec. days
Water Level Relative to Ground Surface (feet)
Rainfall Events (inches)
Date
Water Surface Elevation
Required Elevation
Onsite Rainfall
2
1
0
-1
-2
-3
-4
4
3.5
3
2.5
2
1.5
1
0.5
0
12/28/2011
1/4/2012
1/11/2012
1/18/2012
1/25/2012
2/1/2012
2/8/2012
2/15/2012
2/22/2012
2/29/2012
3/7/2012
3/14/2012
3/21/2012
3/28/2012
4/4/2012
4/11/2012
4/18/2012
4/25/2012
5/2/2012
5/9/2012
5/16/2012
5/23/2012
5/30/2012
6/6/2012
6/13/2012
6/20/2012
6/27/2012
7/4/2012
7/11/2012
7/18/2012
7/25/2012
8/1/2012
8/8/2012
8/15/2012
8/22/2012
8/29/2012
9/5/2012
9/12/2012
9/19/2012
9/26/2012
10/3/2012
10/10/2012
10/17/2012
10/24/2012
10/31/2012
11/7/2012
11/14/2012
11/21/2012

Appendix D

Problem Areas Plan View (Integrated)


LEGEND
PROPERTY LINE
EASEMENT BOUNDARY
LIMITS OF DISTURBANCE
EXISTING GRADE
AS-BUILT GRADE
AS-BUILTSPOT ELEVATIONS
EXISTING FARM LANE
SWAMP RUN CENTERLINE
SWAMP RUN" RESTORATION LIMITS
RIVERINE WETLAND RESTORATION LIMITS
PLANTED SWAMP RUN BOTTOMLAND HARDWOOD COMMUNITY
PLANTED RIVERINE WETLAND COMMUNITY
AREA OF DEVELOPING HYDROLOGY
MAPPED SOILS
GoA Goldsboro, 0-3% slopes, moderately well drained
Ly Lynchburg, 0-2% slopes, somewhat poorly drained
Ra Rains, 0-2% slopes, poorly drained
We Wehadkee, frequently flooded
FIGURE 4: COMPOSITE VEGETATION AND HYDROLOGY MONITORING RESULTS
SCALE: 1" = 250'
250' 0 250' 500'
FIGURE 4
MONITORING YEAR 4 (2012)
POWELL PROPERTY
WETLAND MITIGATION UNITS: 48.4 WMUS
STREAM MITIGATION UNITS: 3,310 SMUS
BERTIE COUNTY, NORTH CAROLINA
EEP CONTRACT #: D06863-4
Ecosystem Enhancement
ALBEMARLE RESTORATIONS, LLC