

# **SANDY CREEK**

Durham County, North Carolina  
EEP Project No. 322  
Contract No. D08039S

2013 Annual Monitoring Report  
(Measurement Year-8 – MY8 (2013) – 4<sup>th</sup> year post-repair)  
Site Constructed 2003/Repaired 2008-2009/Replanted 2011



November 2013

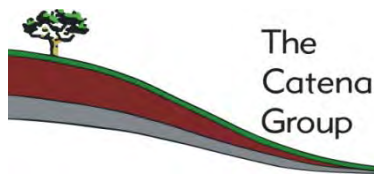
Prepared for:



NCDENR-EEP

1619 Mail Service Center  
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Prepared by:



The  
Catena  
Group

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## TABLE OF CONTENTS

1.0	EXECUTIVE SUMMARY-----	1
1.1	Goals and Objectives -----	1
1.2	Vegetative Assessment-----	1
1.3	Stream Assessment-----	2
1.4	Wetland Assessment-----	2
1.5	Annual Monitoring Summary -----	2
2.0	Methodology-----	3
3.0	References-----	3
	Appendix A -----	1
	Appendix B-----	7
	Appendix C-----	16
	Appendix D -----	19
	Appendix E-----	24

## 1.0 EXECUTIVE SUMMARY

Sandy Creek is a wetland restoration and stream enhancement mitigation site located in Durham County, North Carolina. The project consists of 3.13 acres of wetland restoration and 2,461 linear feet of Level II stream enhancement. The conservation easement encompasses 22.6 acres and includes an additional 7.1 acres of preserved existing wetlands. Wetland and stream construction originally took place in 2003. Wetlands restoration consisted of grading activities and planting wetland vegetation. Stream enhancement consisted of the installation of log vanes to create pool features to enhance habitat and water quality along 2,461 linear feet of stream. The wetland restoration area was again re-graded between December 2009 and February 2010 to correct final grade elevations to establish proper wetland hydrology. Topsoil was added to improve soil fertility for plant growth and the graded areas were replanted with native plant species. This monitoring report represents the 4<sup>th</sup> year of wetland monitoring after site maintenance and re-grading. Stream monitoring has been conducted annually since original restoration activities completed in 2003.

### 1.1 Goals and Objectives

#### Project Goals:

- Improve water quality by incorporating log vanes within the stream channel and planting the stream buffer
- Improve wetland hydrology with the removal of fill material and the sludge drying beds
- Improve in-stream habitat with the installation of log vanes to enhance pool depths
- Restore wetland function with the incorporation of woody and herbaceous wetland plant species

#### Project Objectives:

- The Level II stream enhancement of 2,461 linear feet of Sandy Creek
- Restoration of 3.13 acres of wetlands through the removal of fill material and the sludge drying beds to improve wetland hydrology
- Establishment of a 22.6 acres conservation easement

### 1.2 Vegetative Assessment

Currently the vegetation is meeting the success criterion with 677 total woody stems/acre. The success criterion for vegetation is 260 total woody stems/acre at the end of the monitoring period. Based on the CVS vegetation data there are 313 planted woody stems/acre and 677 total woody stems/acre. As a result of the wetland re-grading in December 2009, the vegetation in monitoring plots 2, 3, and 4 was removed, leaving only vegetation monitoring plot 1 intact. The site was replanted and plots 2, 3, and 4, were re-established in February 2010. Warranty planting was conducted in February 2011 to replace trees that did not survive initial replanting after the

wetland was re-graded. Level II of the CVS-EEP protocol was administered for plots 1, 2, 3, and 4, which accounts for natural and planted woody stems. Some planted stems are still exhibiting evidence of being smothered by the herbaceous vegetation (i.e. *Juncus effuses*, *Lespedeza cuneata*). Vegetation problem areas mainly consist of invasive exotic species. Chinese lespedeza (*Lespedeza cuneata*), continues to thrive in patches along the adjacent forest margin and throughout the wetland in the vicinity of plots 3 and 4. These areas along the woodland margin have remained undisturbed throughout the monitoring period.

### **1.3 Stream Assessment**

In general the stream banks are well vegetated and stable. The majority of the log vanes are stable, providing bank protection as intended, and generating scour pools providing habitat. The cross section shows little change in stream dimension as compared to previous monitoring data. Some erosion was observed at station 4+00 on the upstream portion of the log vane. The log structure and the adjacent banks are stable. Some localized bank erosion and log jams were observed near stations 23+00 and 13+50. Debris is located at the upstream face of the culverts at US 15-501. Notification to NCDOT regarding the current blockage is recommended so that maintenance can be preformed.

### **1.4 Wetland Assessment**

The site was re-graded between December 2009 and February 2010. New groundwater gauges were installed in the spring of 2010 at three locations – the reference wetland gauge, gauge A, and gauge C. The reference gauge was installed in its original location and Gauge B remained undisturbed in its original location. On May 23, 2013 four addition gauges (D, E, F, &G) were installed. Gauges D, E, F were installed within the wetland restoration area to capture a more accurate depiction of the groundwater levels. Gauge G was installed within the adjacent alluvial forest along Sandy Creek as supplemental reference gauge. Gauges A, B, and C exhibited saturation within 12 inches of the ground surface for more than 12.5% of the growing season. Gauges D, E, F, and G did not collect data for a complete growing season however these wetland areas have exhibited evidence of wetland hydrology (Table 13). The average annual growing season for Durham County is 222 days (March 24 to November 1).

### **1.5 Annual Monitoring Summary**

Summary information/data related to the occurrence of items such as beaver or encroachment, and statistics related to performance of various projects 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 are available from EEP upon request.

## 2.0 METHODOLOGY

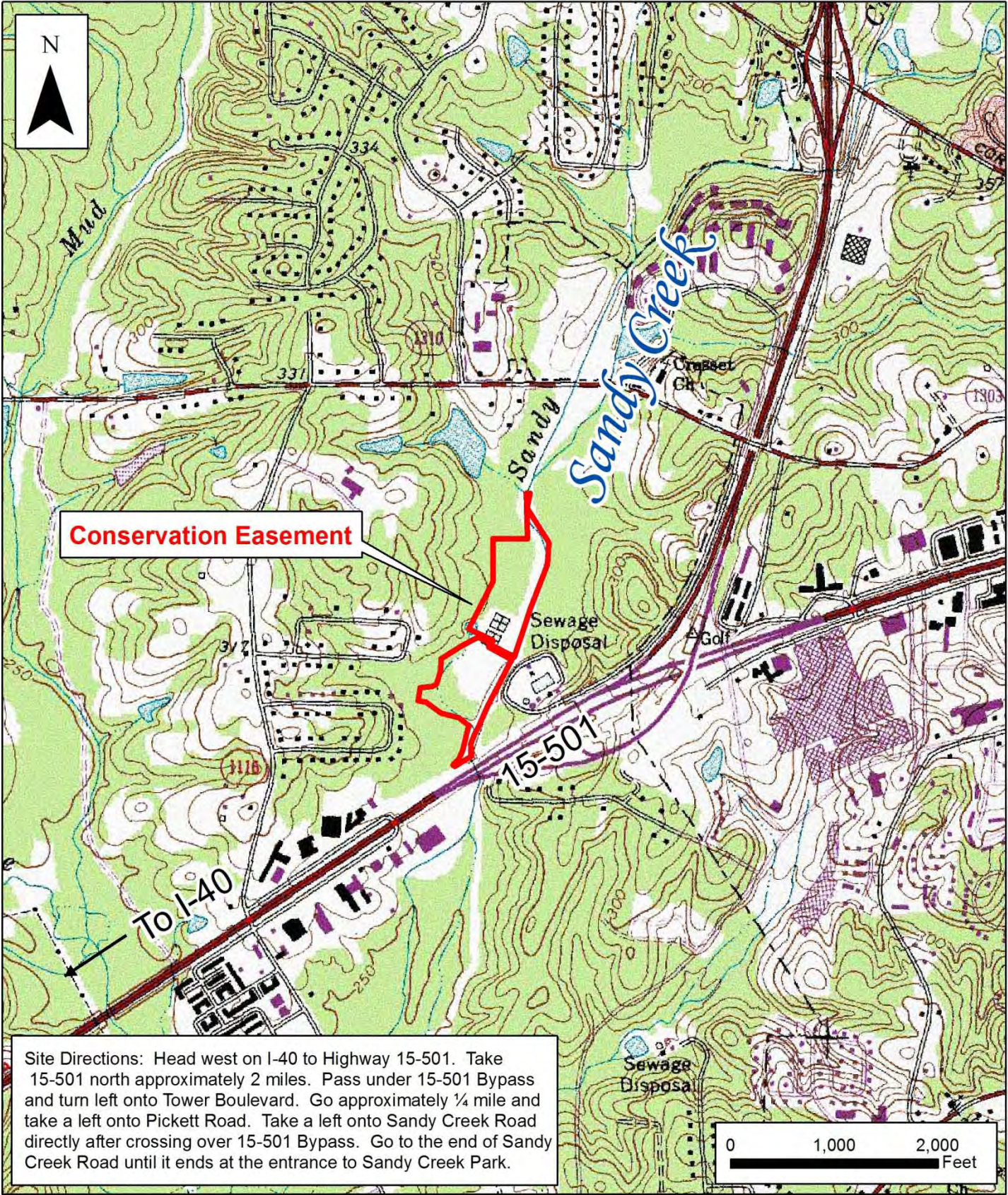
All monitoring methodologies are a combination of current NCEEP templates and guidelines and previous monitoring reports (EEP template version 1.4 11/07/2011). Level II of the CVS –EEP Protocol for Recording Vegetation (Lee et al. 2008) was used for vegetation data collection. Photos were taken with a digital camera. A Trimble Geo XT handheld unit with sub-meter accuracy was used to collect monitoring feature locations and vegetation problem areas. Stream assessments followed methodologies outlined in *Applied River Morphology* (Rosgen 1996). Precipitation data were obtained from the State Climate Office of North Carolina (<http://www.nc-climate.ncsu.edu/services/request.php>) (State Office of North Carolina 2013). *Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas* was the taxonomic standard used throughout vegetation data collection (Weakley 2012). Vegetation monitoring data was collected on August 16, 2013. Stream monitoring was conducted on June 5, 2013.

## 3.0 REFERENCES

- Lee, Michael T., R. K. Peet, S. D. Roberts, and T. R. Wentworth. 2008. CVS-EEP Protocol for Recording Vegetation, Version 4.2 (<http://cvs.bio.unc.edu/methods.htm>)
- Rosgen, D. 1996. *Applied River Morphology*. Wildland Hydrology, Pagosa Springs, CO.
- State Climate Office of North Carolina. 2012. North Durham Water Reclamation Facility Precipitation Data (*Jan 1, 2010 – Oct 31, 2012; Daily Totals*). <http://www.nc-climate.ncsu.edu/services/request.php>.
- Weakley, A.S. 2011. *Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas*. Working draft of May 2011. University of North Carolina Herbarium, North Carolina Botanical Garden, University of North Carolina. 1015pp.

## **Appendix A**

### **Project Vicinity Map and Background Tables**



**Conservation Easement**

Site Directions: Head west on I-40 to Highway 15-501. Take 15-501 north approximately 2 miles. Pass under 15-501 Bypass and turn left onto Tower Boulevard. Go approximately ¼ mile and take a left onto Pickett Road. Take a left onto Sandy Creek Road directly after crossing over 15-501 Bypass. Go to the end of Sandy Creek Road until it ends at the entrance to Sandy Creek Park.



The  
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Sandy Creek  
Stream Enhancement and Wetland Restoration Site  
Site Location Map  
Durham County, North Carolina  
USGS 7.5-Minute Topographic Quadrangle Map

EPP Project No. 322

Date:  
November 2013



Figure  
**1**



**Table 1. Project Components and Mitigation Credits**

Sandy Creek Stream Enhancement and Wetland Restoration Site/ EEP Project No. 322					
<b>Project Segment or Reach ID</b>	<b>Mitigation Type *</b>	<b>Approach **</b>	<b>Linear Footage or Acreage</b>	<b>Stationing</b>	<b>Comments</b>
Reach I	EII	BFI	2,461 linear feet	00+00 to 27+00	Primarily achieved with placement of log vanes
Wetland Restoration	R	~	3.13 acres	N/A	Wetland site re-graded and replanted in Dec 2009
Wetland Preservation	P	~	7.1 acres	N/A	7.1 acres of preserved wetlands are within the 22.63 acre conservation easement.

\* EII = Enhancement II, R = Restoration. \*\* BFI = Bed form Improvement, P=Preservation

\*\*\* Stationing begins at downstream end of project and increases upstream

**Table 2. Project Activity and Reporting History**

Sandy Creek Stream Enhancement and Wetland Restoration Site / EEP Project No. 322			
Elapsed Time Since Grading Complete: 4 years			
Elapsed Time Since Planting: 31 Months			
Number of Reporting Years <sup>1</sup> : 8			
<b>Activity Report</b>	<b>Scheduled Completion</b>	<b>Data Collection Complete</b>	<b>Actual Completion or Delivery</b>
Restoration Plan	N/A*	N/A*	Aug 2002
Final Design (90%)	N/A*	N/A*	Dec 2002
Construction	N/A*	N/A*	Jun 2003
Temporary S&E mix applied to entire project area	N/A*	N/A*	Jun 2003
Permanent seed mix applied to reach/segments	N/A*	N/A*	Jun 2003
Bare root seedling installation	N/A*	N/A*	Jun 2003
Mitigation Plan/As-builts (Year 0 Monitoring – baseline)	N/A*	Jun 2003	Oct 2003
Year 1 Monitoring	N/A*	May 2004	Dec 2004
<b>Site Replanting (portions of Zone 3)</b>	~	~	Mid 2004
Year 1 Monitoring re-sampling	N/A*	Sep 2004	Dec 2004
Year 2 Monitoring (Vegetation)	Dec 2005	Oct 2005	Dec 2005
Year 2 Monitoring (Groundwater Gauges)	Dec 2005	Oct 2005	Dec 2005
Year 3 Monitoring (Vegetation)	Dec 2006	Oct 2006	Dec 2006
Year 3 Monitoring (Groundwater Gauges)	Dec 2006	Oct 2006	Dec 2006
Year 4 Monitoring (Vegetation)	Dec 2007	Oct 2007	Dec 2007
Year 4 Monitoring (Groundwater Gauges)	Dec 2007	Oct 2007	Dec 2007
<b>Site Repair Period (Re-grading)</b>	~	~	Nov 2009
<b>Site Replanting</b>	Dec 2009	~	Dec 2009
Year 5 Monitoring (Vegetation)	Nov 2010	Oct 2010	Nov 2010
Year 5 Monitoring (Groundwater Gauges)	Nov 2010	Oct 2010	Nov 2010
<b>Warranty Planting</b>	Feb 2011	~	Feb 2011
Year 6 Monitoring (Vegetation)	Aug 2011	Aug 2011	Dec 2011
Year 6 Monitoring (Groundwater Gauges)	Nov 2011	Nov 2011	Dec 2011
Year 7 Monitoring (Vegetation)	Aug 2012	Aug 2012	Aug 2012
Year 7 Monitoring (Groundwater Gauges)	Nov 2012	Nov 2012	Nov 2012
Year 8 Monitoring (Vegetation)	Aug 2013	Aug 2013	Aug 2013
Year 8 Monitoring (Groundwater Gauges)	Nov 2013	Nov 2013	Nov 2013

Bold items represent those events of deliverables that are variable. Plain-font items represent events that are standard over the course of a typical project.

\*N/A –Data not available.

1-Equals the number of reports or data points produced excluding the baseline

**Table 3. Project Contacts Table**

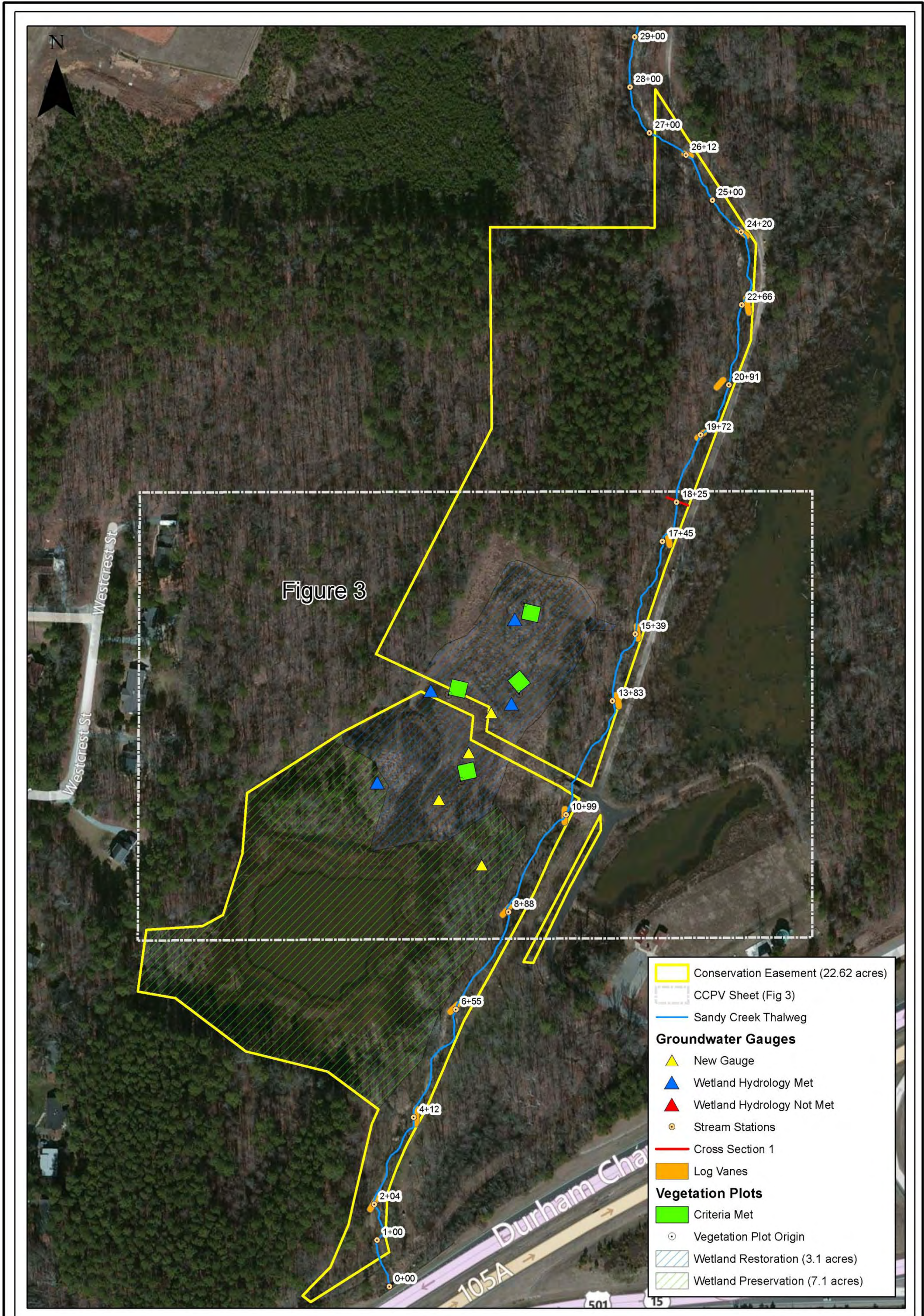
<b>Sandy Creek Stream Enhancement and Wetland Restoration Site / EEP Project No. 322</b>	
<b>Designer:</b> Ward Consulting Engineers, P.C.	8368 Six Forks Road, Suite 104 Raleigh, NC 27615-5083 (919) 870-0526 email: bward@wce-corp.com
<b>Construction Contractor:</b> Shamrock Environmental, Inc.	Mr. Greg Kiser 6106 Corporate Park Drive Browns Summit, NC 27214 (336) 375-1989
<b>Planting Contractor:</b> Shamrock Environmental, Inc.	Mr. Greg Kiser 6106 Corporate Park Drive Browns Summit, NC 27214 (336) 375-1989
<b>Seeding Contactor:</b> Shamrock Environmental, Inc.	Mr. Greg Kiser 6106 Corporate Park Drive Browns Summit, NC 27214 (336) 375-1989
Seed Mix Sources	N/A*
Nursery Stock Suppliers	N/A*
<b>Monitoring Performers (MY-01-04):</b> EcoScience Corporation	1101 Haynes Street, Ste. 101 Raleigh, NC 27604 (919) 828-3433
<b>Re-Designer:</b> Ward Consulting Engineers, P.C.	8368 Six Forks Road, Suite 104 Raleigh, NC 27615-5083 (919) 870-0526 email: bward@wce-corp.com
<b>Re-Construction:</b> Environmental Quality Resources, LLC	1405 Benson Court, Suite C Arbutus, MD 21227 Tel: (443) 304-3310
<b>Re-Planting:</b> Bruton Natural Systems, Inc.	P.O. Box 1197 Freemont, NC 27830 (919) 242-6555
<b>Re-Seeding:</b> Erosion Supply Company	P.O. Box 91208 Raleigh, NC 27675 (919) 787-0334
<b>Monitoring Performers (MY-05+):</b> The Catena Group	410B Millstone Drive Hillsborough, NC 27278 (919)732-1300

**Table 4. Project Baseline Information and Attributes**

<b>Sandy Creek Stream Enhancement and Wetland Restoration Site / EEP Project No. 322</b>	
Project County	Durham
Drainage Area	7.3 square miles to culvert at Bypass 15-501
Impervious cover estimate (%)	10 percent
Stream Order	3 <sup>rd</sup> order
Physiographic Region	Piedmont
Ecoregion (Griffith and Omernik)	Triassic Basin
Rosgen Classification of As-built	NA (Enhancement only)
Cowardin Classification	Stream (R3UB2)
	Wetlands (PFO1)
Dominant soil types	Stream - Chewacla and Wehadkee soils (Ch)
	Wetlands - Urban Land (Ur)
SCO #ID 0	10542301
USGS HUC for Project and Reference	03030002060110 / N/A
NCDWQ Sub-basin for Project and Reference	03-06-05 / N/A
NCDWQ classification for Project and Reference	C, NSW / N/A
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor	N/A
Percent of project easement fenced	None

## **Appendix B**

### Visual Assessment Data



	Conservation Easement (22.62 acres)
	CCPV Sheet (Fig 3)
	Sandy Creek Thalweg
<b>Groundwater Gauges</b>	
	New Gauge
	Wetland Hydrology Met
	Wetland Hydrology Not Met
	Stream Stations
	Cross Section 1
	Log Vanes
<b>Vegetation Plots</b>	
	Criteria Met
	Vegetation Plot Origin
	Wetland Restoration (3.1 acres)
	Wetland Preservation (7.1 acres)



The  
Catena  
Group

**Sandy Creek: Wetland Restoration  
and Stream Enhancement Site**

MY-08 CCPV Sheet Index

EEP Project No. 322  
2010 Aerial Photography

Durham County, North Carolina

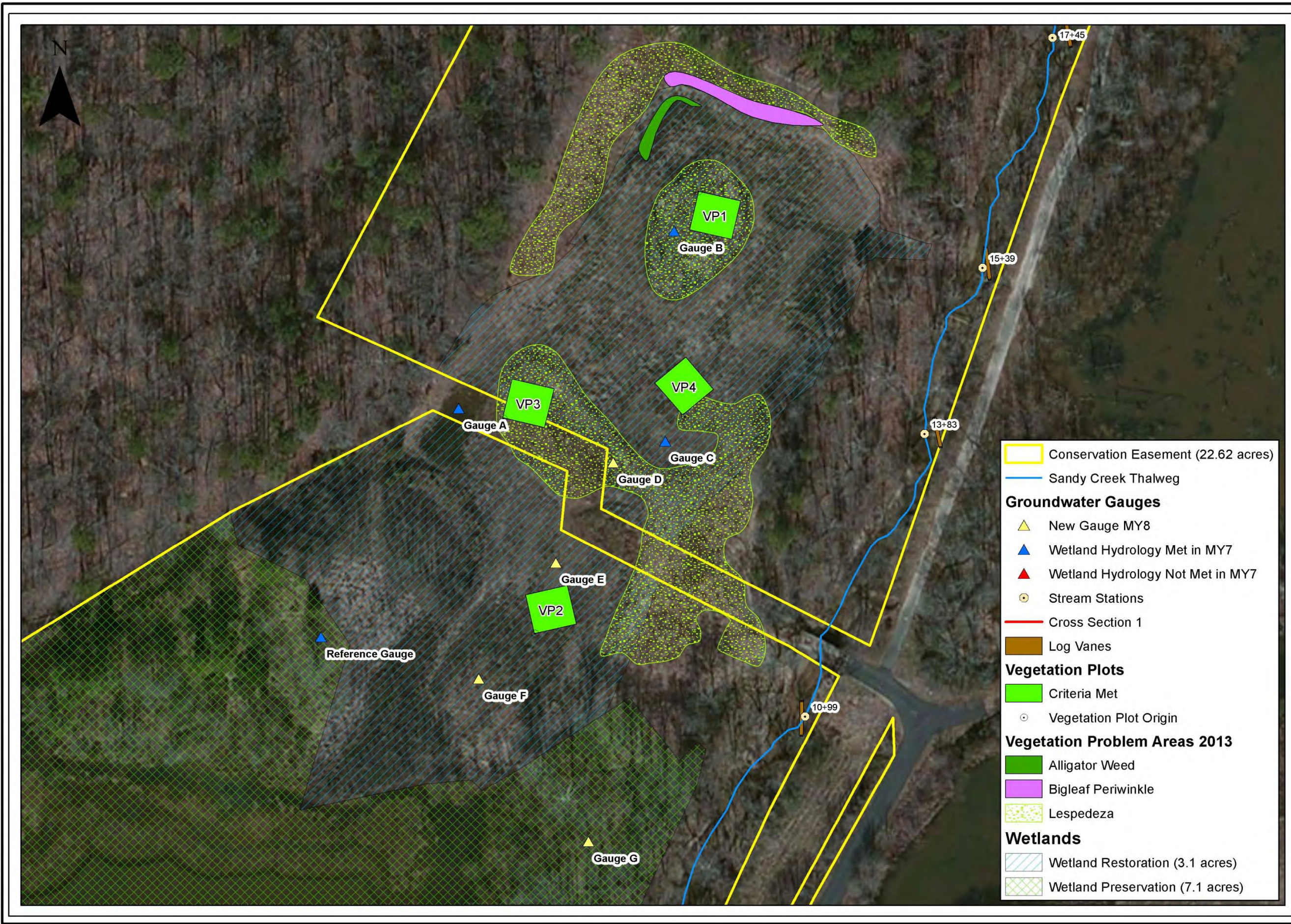
Date: November 2013

Scale: 0 50 100 200 Feet

Job No: 4134

Figure

2



**Conservation Easement (22.62 acres)**

**Sandy Creek Thalweg**

**Groundwater Gauges**

- New Gauge MY8
- Wetland Hydrology Met in MY7
- Wetland Hydrology Not Met in MY7
- Stream Stations

**Cross Section 1**

**Log Vanes**

**Vegetation Plots**

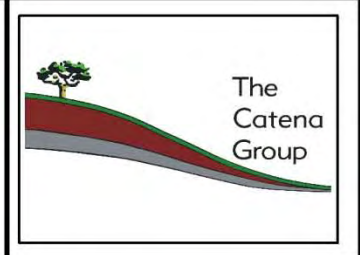
- Criteria Met
- Vegetation Plot Origin

**Vegetation Problem Areas 2013**

- Alligator Weed
- Bigleaf Periwinkle
- Lespedeza

**Wetlands**

- Wetland Restoration (3.1 acres)
- Wetland Preservation (7.1 acres)



Date:  
November 2013

Scale:  
0 30 60 Feet

Job No.  
4161

Title:  
**Sandy Creek  
Wetland  
Restoration  
and Stream  
Enhancement  
Site**  
**MY-08 CCPV**  
EEP Project No. 322  
2010 Aerial  
Orthophotography  
(NC OneMaps)  
Durham County,  
North Carolina

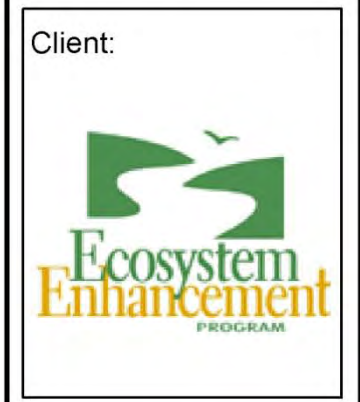


Figure  
**3**

**Table 5. Visual Stream Morphology Stability Assessment Table**

Not provided as project contains only stream enhancement via log vanes.

**Table 6. Vegetation Condition Assessment Table**

Table 6 Vegetation Condition Assessment  
Planted Acreage<sup>1</sup> 10.9

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.	0.1 acres	Pattern and Color	0	0.00	0.0%	
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Pattern and Color	0	0.00	0.0%	
				<b>Total</b>	0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	Pattern and Color	0	0.00	0.0%	
				<b>Cumulative Total</b>	0	0.00	0.0%

Easement Acreage<sup>2</sup> 14

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern <sup>4</sup>	Areas or points (if too small to render as polygons at map scale).	1000 SF	Pattern and Color	5	1.01	7.2%
5. Easement Encroachment Areas <sup>3</sup>	Areas or points (if too small to render as polygons at map scale).	none	Pattern and Color	0	0.10	0.0%

<sup>1</sup> = Enter the planted acreage within the easement. This number is calculated as the easement acreage minus any existing mature tree stands that were not subject to supplemental planting of the understory, the channel acreage, crossings or any other elements not directly planted as part of the project effort.

<sup>2</sup> = The acreage within the easement boundaries.

<sup>3</sup> = Encroachment may occur within or outside of planted areas and will therefore be calculated against the overall easement acreage. In the event a polygon is cataloged into items 1, 2 or 3 in the table and is the result of encroachment, the associated acreage should be tallied in the relevant item (i.e., item 1, 2 or 3) as well as a parallel tally in item 5.

<sup>4</sup> = Invasives may occur in or out of planted areas, but still within the easement and will therefore be calculated against the overall easement acreage. Invasives of concern/interest are listed below. The list of high concern species are those with the potential to directly outcompete native, young, woody stems in the short-term (e.g. monitoring period or shortly thereafter) or affect the community structure for existing, more established tree/shrub stands over timeframes that are slightly longer (e.g. 1-2 decades). The low/moderate concern group are those species that generally do not have this capacity over the timeframes discussed and therefore are not expected to be mapped with regularity, but can be mapped, if in the judgement of the observer their coverage, density or distribution is suppressing the viability, density, or growth of planted woody stems. Decisions as to whether remediation will be needed are based on the integration of risk factors by EEP such as species present, their coverage, distribution relative to native biomass, and the practicality of treatment. For example, even modest amounts of Kudzu or Japanese Knotweed early in the projects history will warrant control, but potentially large coverages of Microstegium in the herb layer will not likely trigger control because of the limited capacities to impact tree/shrub layers within the timeframes discussed and the potential impacts of treating extensive amounts of ground cover. Those species with the "watch list" designator in gray shade are of interest as well, but have yet to be observed across the state with any frequency. Those in *red italics* are of particular interest given their extreme risk/threat level for mapping as points where isolated specimens are found, particularly early in a projects monitoring history. However, areas of discreet, dense patches will of course be mapped as polygons. The symbology scheme below was one that was found to be helpful for symbolizing invasives polygons, particularly for situations where the condition for an area is somewhere between isolated specimens and dense, discreet patches. In any case, the point or polygon/area feature can be symbolized to describe things like high or low concern and species can be listed as a map inset, in legend items if the number of species are limited or in the narrative section of the executive summary.



## Sandy Creek Stream Enhancement Photo Stations



Photo Station 1: Log Vane #1 (Station 2+04)



Photo Station 4: Log Vane #4 (Station 8+88)



Photo Station 2: Log Vane #2 (Station 4+12)



Photo Station 5: Log Vane #5 (Station 10+99)

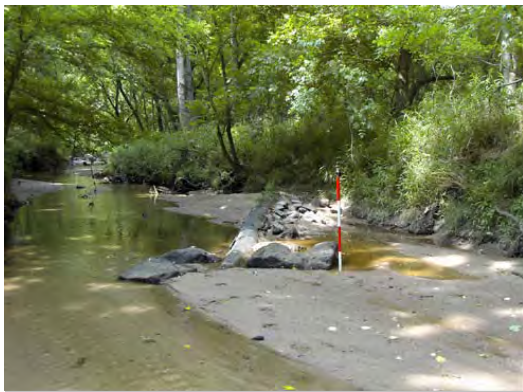


Photo Station 3: Log Vane #3 (Station 6+55)



Photo Station 6: Log Vane #6 (Station 13+83)



Photo Station 7: Log Vane #7 (Station 15+39)



Photo Station 10: Log Vane #10 (Station 20+91)



Photo Station 8: Log Vane #8 (Station 17+45)



Photo Station 11: Log Vane #11 (Station 22+66)

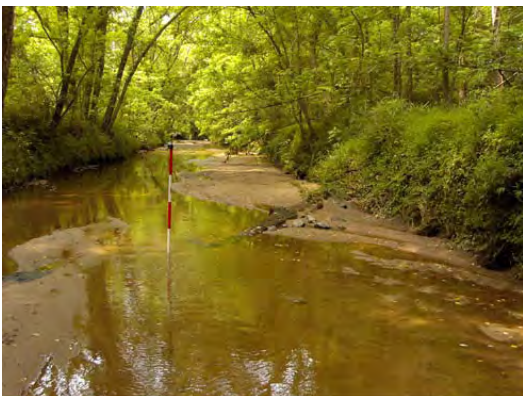


Photo Station 9: Log Vane #9 (Station 19+72)



Photo Station 12: Log Vane #12 (Station 24+20)



Photo Station 13: Log Vane #13 Station (26 + 12)

# Vegetation Plot Photos

**MY05 Aug 16, 2010**



Plot 1



Plot 2



Plot 3



Plot 4

**MY08 Aug 16, 2013**



Plot 1



Plot 2



Plot 3



Plot 4

Appendix C  
Vegetation Plot Data

**Table 7.** Vegetation Plot Success Summary Table

<b>Sandy Creek Stream Enhancement and Wetland Restoration Site / EEP Project No. 322</b>			
<b>Plot ID</b>	<b>Vegetation Survival Threshold Met? (260 total woody stems/acre)</b>	<b>Planted Stem Density stems/acre</b>	<b>Total Stem Density stems/acre</b>
P1	Yes	161	323
P2	Yes	323	809
P3	Yes	364	1092
P4	Yes	404	485

**Table 8. Vegetation Metadata Table**

<b>Report Prepared By</b>	The Catena Group
<b>Date Prepared</b>	10/31/2013 11:27
<b>database name</b>	
<b>database location</b>	TheCatenaGroup-2012-K-SandyCreek_MY7.mdb
<b>computer name</b>	P:\Jobs\2008\4130-34 (EEP Monitoring)\4134 (Sandy Crk)\2013_MY-08
<b>file size</b>	
<b>DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT-----</b>	
<b>Metadata</b>	
<b>Proj, planted</b>	Description of database file, the report worksheets, and a summary of project(s) and project data.
<b>Proj, total stems</b>	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
<b>Plots</b>	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.
<b>Vigor</b>	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
<b>Vigor by Spp</b>	Frequency distribution of vigor classes for stems for all plots.
<b>Damage</b>	Frequency distribution of vigor classes listed by species.
<b>Damage by Spp</b>	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
<b>Damage by Plot</b>	Damage values tallied by type for each species.
<b>Planted Stems by Plot and Spp</b>	Damage values tallied by type for each plot.
<b>ALL Stems by Plot and spp</b>	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
<b>PROJECT SUMMARY-----</b>	
<b>Project Code</b>	322
<b>project Name</b>	Sandy Creek
<b>Description</b>	Sandy Creek Wetland Restoration and Stream Enhancement Project MY-06 (2010) EEP project # 322; 1st CVS year for VP 1; VP 2,3,&4 reset in February 2010;
<b>River Basin</b>	Cape Fear
<b>length(ft)</b>	
<b>stream-to-edge width (ft)</b>	
<b>area (sq m)</b>	
<b>Required Plots (calculated)</b>	
<b>Sampled Plots</b>	4

**Table 9. CVS Stem Count Total and Planted by Plot and Species**

EEP Project Code 322. Project Name: Sandy Creek			Current Plot Data (MY8 2013)												Annual Means											
Scientific Name	Common Name	Species Type	E322-01-0001			E322-01-0002			E322-01-0003			E322-01-0004			MY8 (2013)			MY7 (2012)			MY6 (2011)			MY5 (2009)		
			Pno	LS	P-all	T	Pno	LS	P-all	T	Pno	LS	P-all	T	Pno	LS	P-all	T	Pno	LS	P-all	T	Pno	LS	P-all	T
Acer negundo	boxelder	Tree																								
Acer negundo var. negun	boxelder	Tree																								
Alnus serrulata	hazel alder	Shrub																								
Amorpha fruticosa	desert false indigo	Shrub																								
Baccharis halimifolia	eastern baccharis	Shrub																								
Betula nigra	river birch	Tree																								
Carpinus caroliniana	American hornbeam	Tree																								
Carpinus caroliniana var.	Coastal American Ho	Tree																								
Cephalanthus occidentali	common buttonbush	Shrub																								
Cornus amomum	silky dogwood	Shrub																								
Fraxinus pennsylvanica	green ash	Tree																								
Gleditsia triacanthos	honeylocust	Tree																								
Liriodendron tulipifera va	Tulip-tree, Yellow Pc	Tree																								
Nyssa sylvatica	blackgum	Tree																								
Pinus taeda	loblolly pine	Tree																								
Platanus occidentalis	American sycamore	Tree																								
Platanus occidentalis var.	Sycamore, Plane-tree	Tree																								
Quercus	oak	Tree																								
Quercus lyrata	overcup oak	Tree																								
Quercus michauxii	swamp chestnut oak	Tree																								
Quercus phellos	willow oak	Tree																								
Robinia pseudoacacia	black locust	Tree																								
Rosa palustris	swamp rose	Shrub																								
Salix nigra	black willow	Tree																								
Ulmus	elm	Tree																								
Ulmus rubra	slippery elm	Tree																								
<b>Stem count</b>			4	4	8	8	8	20	9	9	27	10	10	12	31	31	67	31	31	75	30	30	68	39	39	48
<b>size (ares)</b>			1			1			1			1			4			4			4			4		
<b>size (ACRES)</b>			0.02			0.02			0.02			0.02			0.10			0.10			0.10			0.10		
<b>Species count</b>			1	1	3	4	4	6	3	3	6	6	6	7	8	8	12	9	9	13	11	11	15	11	11	14
<b>Stems per ACRE</b>			161.9	161.9	323.7	323.7	323.7	809.4	364.2	364.2	1093	404.7	404.7	485.6	313.6	313.6	677.8	313.6	313.6	758.8	303.5	303.5	688	394.6	394.6	485.6

## **Appendix D**

### Stream Survey Data



### Cross Sectional Profiles with Annual Overlays

Project: Sandy Creek/Project No. 322		Summary (bankfull)															
Cross Section: Cross Section 1			MY0	MY1	MY3	MY5	MY7	MY8									
Feature: Riffle		A (BKF)	109.6	114.7	119.7	110.5	107.9	112.6									
Station: 18+25		W (BKF)	31.4	31.4	31.2	31.3	30.7	30.3									
Date: 6/5/12		Max d	4.1	4.6	5.3	4.2	4.2	4.4									
Crew: BW, RZ		Mean d	3.5	3.7	3.8	3.5	3.5	3.3									
		W/D	9.0	8.6	8.1	8.9	8.7	8.2									
MY00-2003			MY01-2005			MY03-2006			MY05-2010			MY07-2012			MY08-2013		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
1.00	264.33		1.00	264.50		1.00	264.55	LPIN	1.00	264.55	LEFT PIN	1.00	265.09	LPIN	1	265.02	LPIN
5.70	264.44		3.00	264.57		2.00	264.60		5.00	264.80		1.00	264.60		1	264.72	
8.00	264.20		5.00	264.66		4.00	264.69		8.00	264.55	TOBL	6.00	264.87		4.15	264.80	
9.50	263.64	TOBL Bankfull Left	7.00	264.60	TOBL	6.00	264.78		9.00	263.86	Bankfull Left	8.00	264.69	TOBL	5.65	264.83	
9.90	262.79		8.00	264.29		8.00	264.47	TOBL	10.00	262.72		9.00	263.83		8	264.72	TOBL
10.30	262.40		9.00	263.82	Bankfull Left	8.70	264.24		11.50	261.58		10.70	262.21		8.8	264.28	
11.20	261.72		10.00	262.78		9.50	263.84	Bankfull Left	12.60	260.06	TOE L	12.00	260.95		9.2	263.67	
12.00	261.12		11.00	261.96		10.00	263.11		17.60	259.84		12.50	260.05	TOE L	9.8	263.17	
12.20	260.07	Toe L	11.80	261.04		11.30	262.01		19.00	259.71		14.00	259.80		10.4	262.43	
13.00	259.97		12.00	259.54	Toe L	11.70	261.48		22.00	259.85		16.00	259.72		11.2	261.88	
14.00	259.99		15.00	259.49		12.40	260.37		23.00	259.75		19.00	259.86		11.8	260.90	
15.00	259.87		17.00	259.79		14.00	260.32		26.60	259.64	TW (WS = 259.91)	22.00	259.83		12.4	259.70	TOE L
16.00	259.83		21.00	259.82		18.00	260.49		31.00	259.93		28.00	259.43	TW	14.3	259.79	
17.00	259.86		25.00	259.88		19.50	260.11		35.00	260.02		29.00	259.61		16.3	259.48	
18.00	259.83		31.00	259.77		23.00	260.00		37.20	259.75	TOE R	32.00	259.68		19.4	259.45	
19.00	259.82		33.70	259.71		27.00	259.42		38.40	262.10		35.00	259.65		20.9	259.39	
22.00	259.60		35.00	259.51		32.00	258.52	TW	39.25	262.85	Bankfull right	37.80	259.55	TOE R	22	259.30	(WS= 259
23.00	259.72		35.70	259.37		36.00	258.66		40.40	263.97		38.50	262.13		24.5	259.27	
35.50	259.51	TW WS = elev 262.40	37.00	259.27	TW	38.20	258.76	Toe R	41.30	264.41	TOBR	39.50	263.38		26.7	259.51	
36.40	259.70		37.90	259.70	Toe R	39.00	262.32		44.00	264.52		41.00	264.47	TOBR	28.4	259.61	
37.40	259.81	Toe R	38.70	262.01		41.00	264.13	TOBR	48.00	264.16	RIGHT PIN	43.00	264.53		32	259.51	
38.40	260.96		39.60	263.09		43.00	264.47					45.00	264.44		33.9	259.38	
39.10	262.08		40.00	263.66		46.00	264.36					48.00	264.16		35.9	259.41	
39.70	262.64		41.00	264.11		48.00	264.19	RPIN				48.00	264.57	RPIN	37.7	259.46	TOE R
41.60	264.18	TOBR	42.00	264.35	TOBR										37.8	261.22	
43.00	264.30		45.00	264.35											38.6	262.79	
45.00	264.31		48.00	264.18											39	263.18	
48.00	264.13														40	264.00	
															41.4	264.46	TOBR
															43	264.44	
															45	264.35	
															46.5	264.20	
															48.00	264.08	
															48.00	264.50	RPIN



**Downstream facing view of Cross Section 1.**



**Longitudinal Profiles with Annual Overlays**

*Not provided as project contains only stream enhancement via log vanes.*

**Pebble Count Plots with Annual Overlays**

*Not provided as project contains only stream enhancement via log vanes.*

**Table 10a and b. Baseline – Stream Data Summary**

*Not provided as project contains only stream enhancement via log vanes.*

**Table 11a and b. Monitoring – Dimensional Morphology Summary**

*Not provided as project contains only stream enhancement via log vanes.*

**Appendix E**  
Hydrologic Data

**Table 12. Verification of Bankfull Events**

*Not provided as project contains only stream enhancement via log vanes.*

**Figure 4. Monthly Rainfall Data for Entire Year**

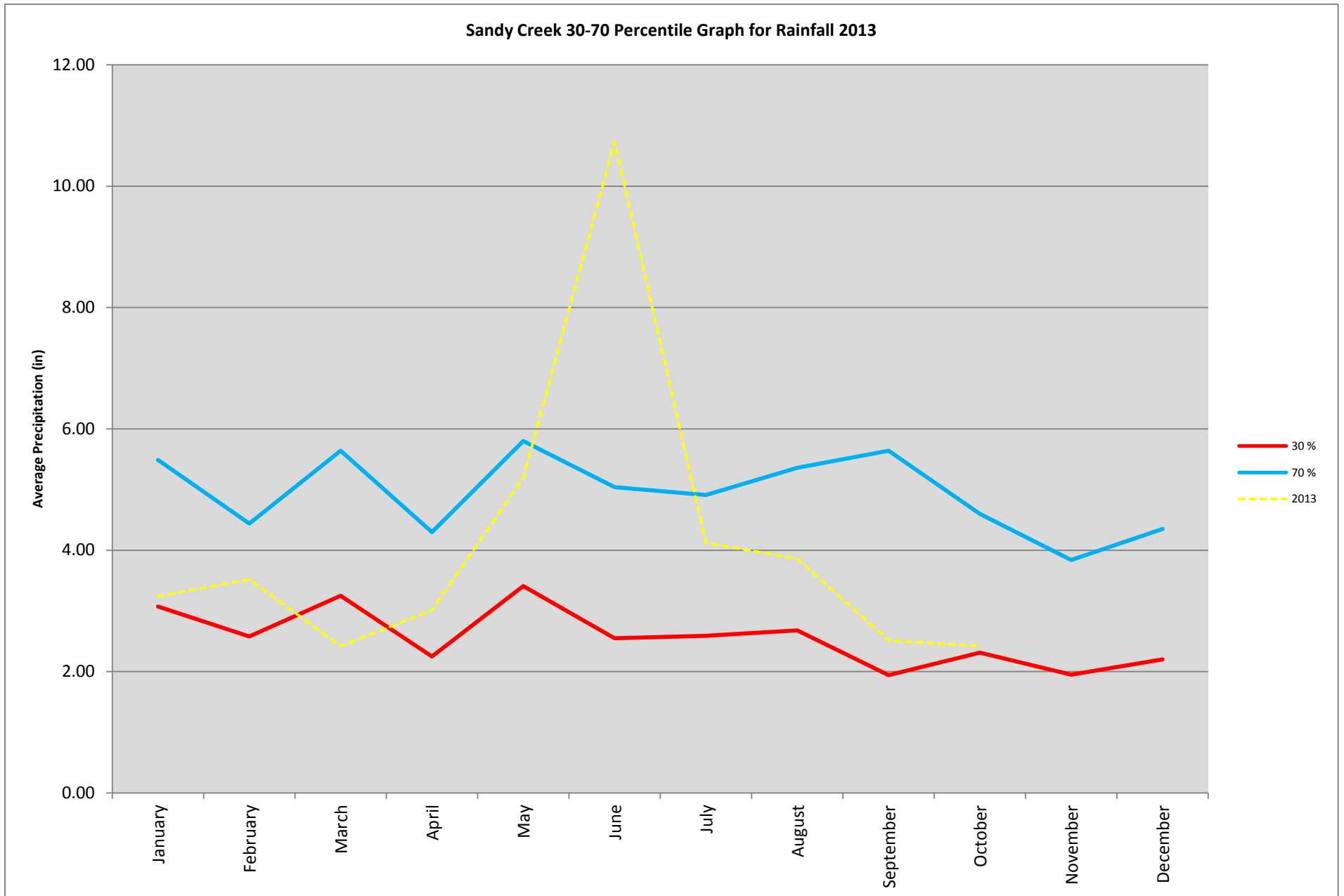
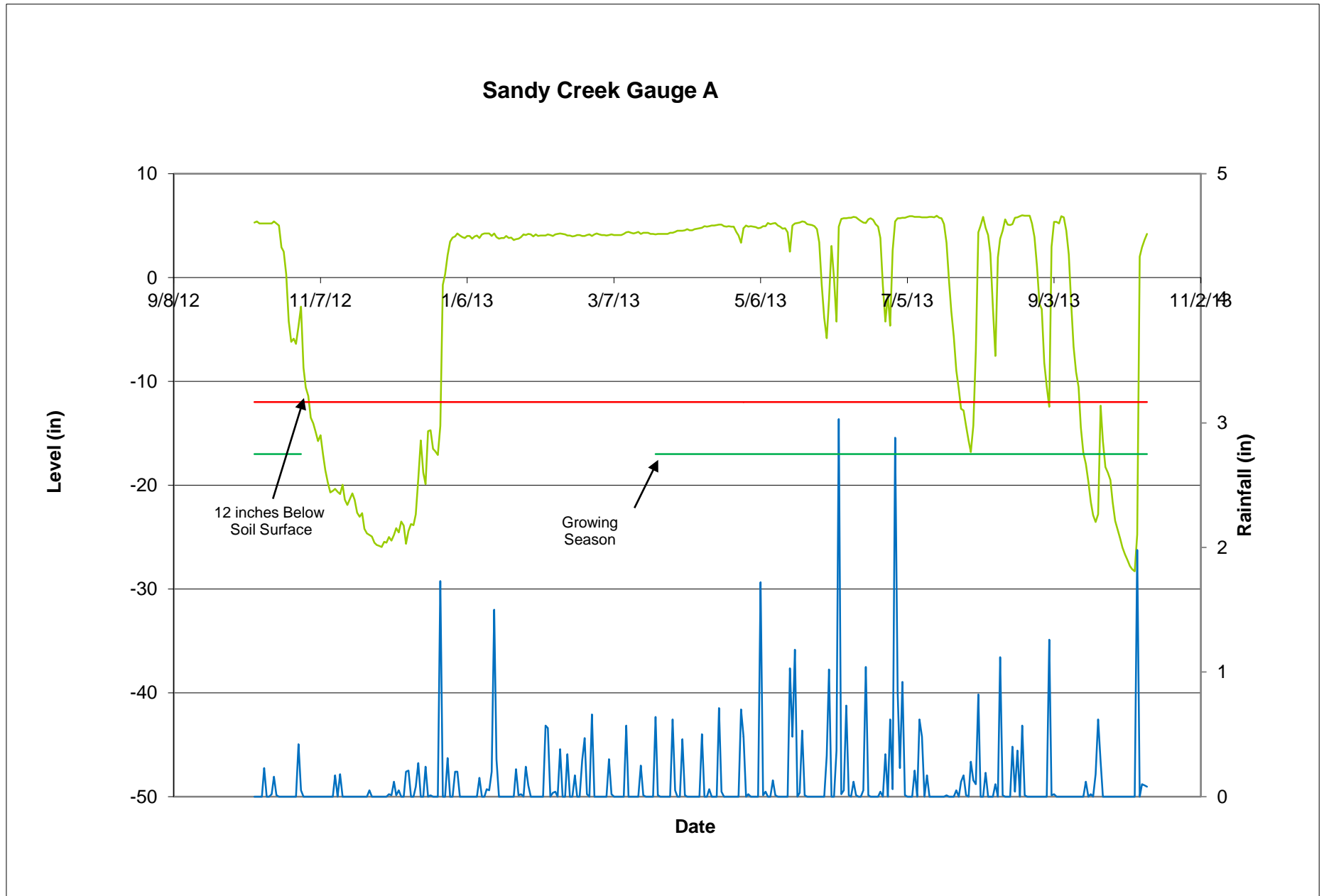
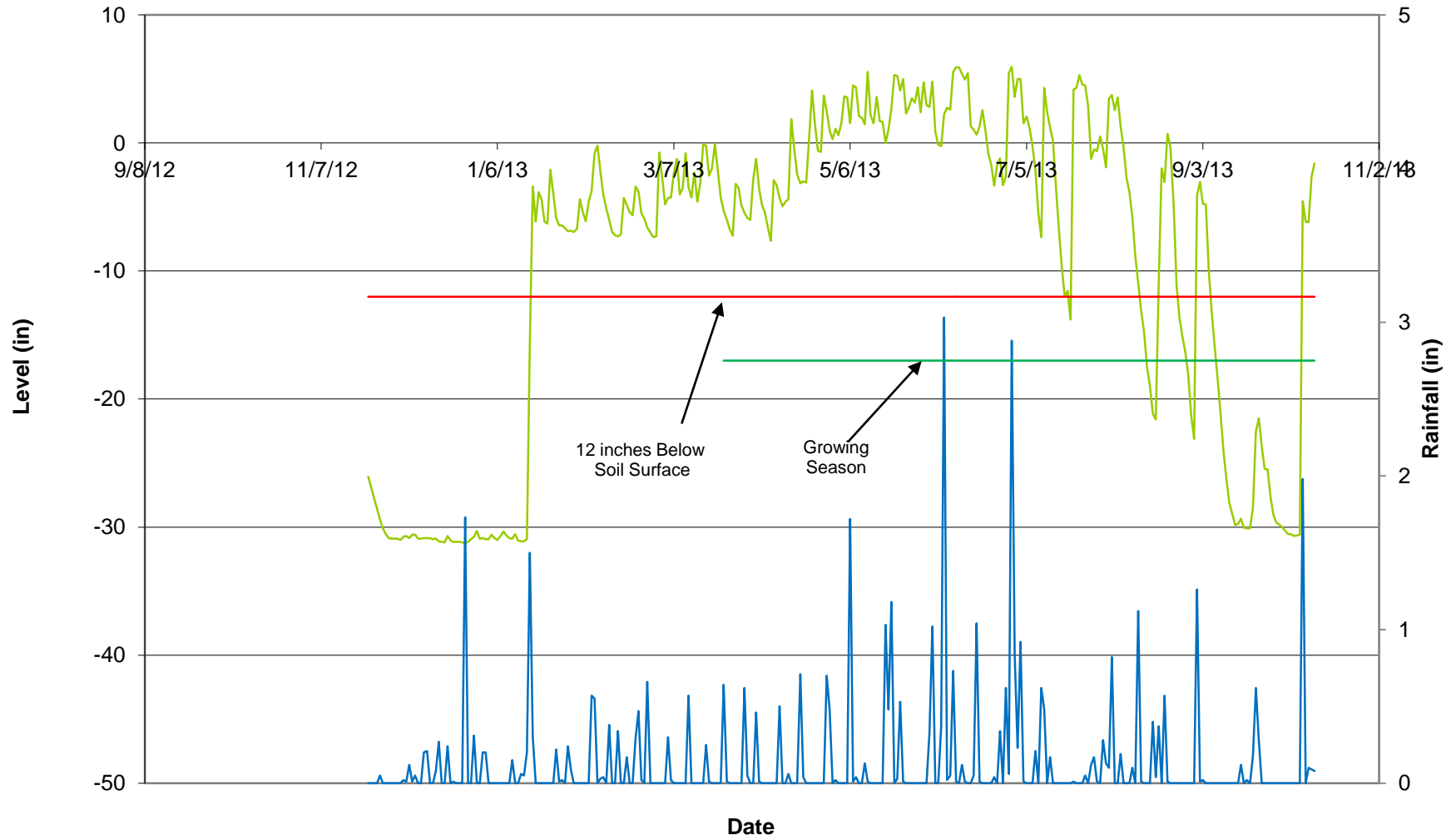


Figure 5. Precipitation and Water Level Plots

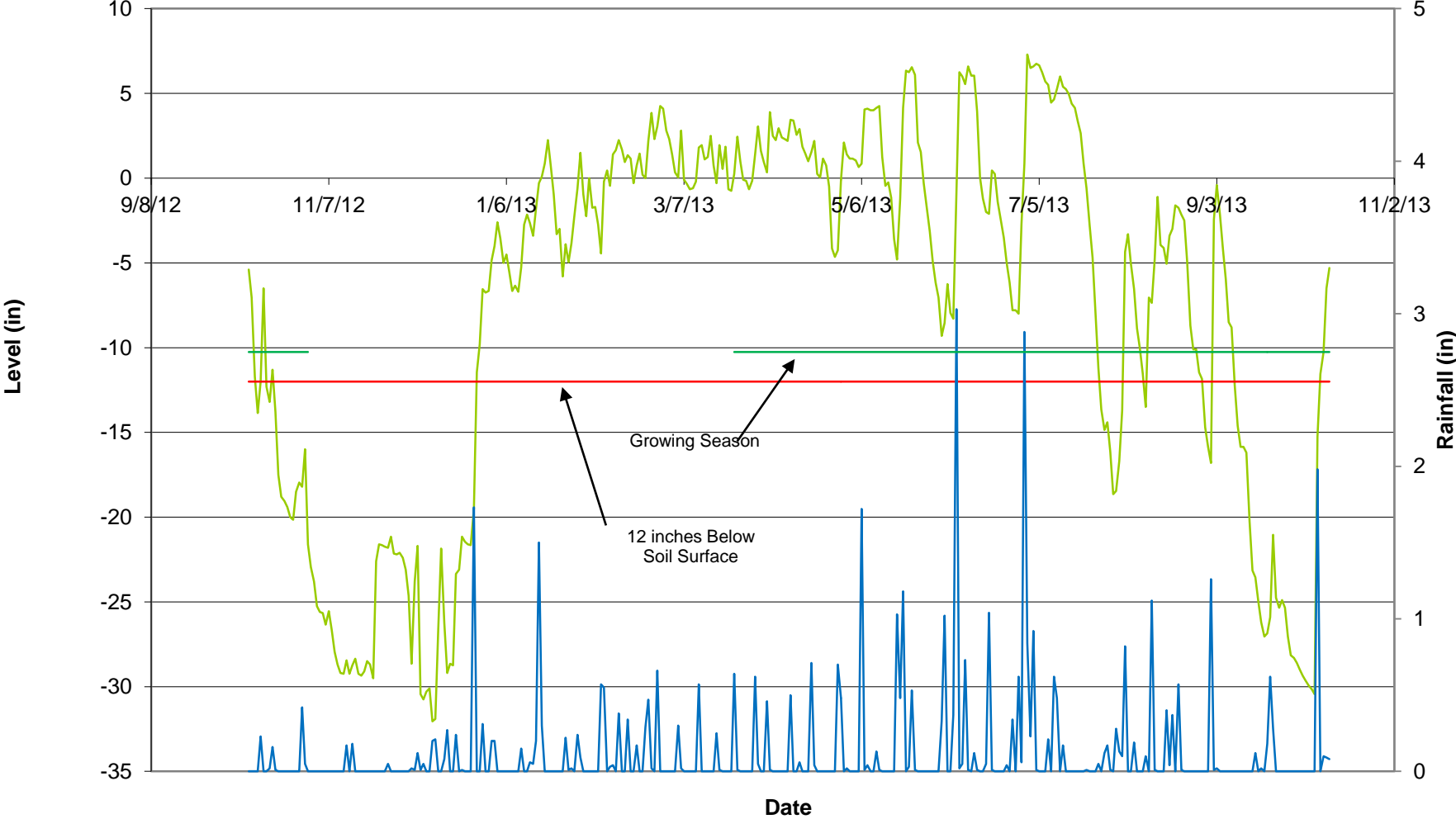




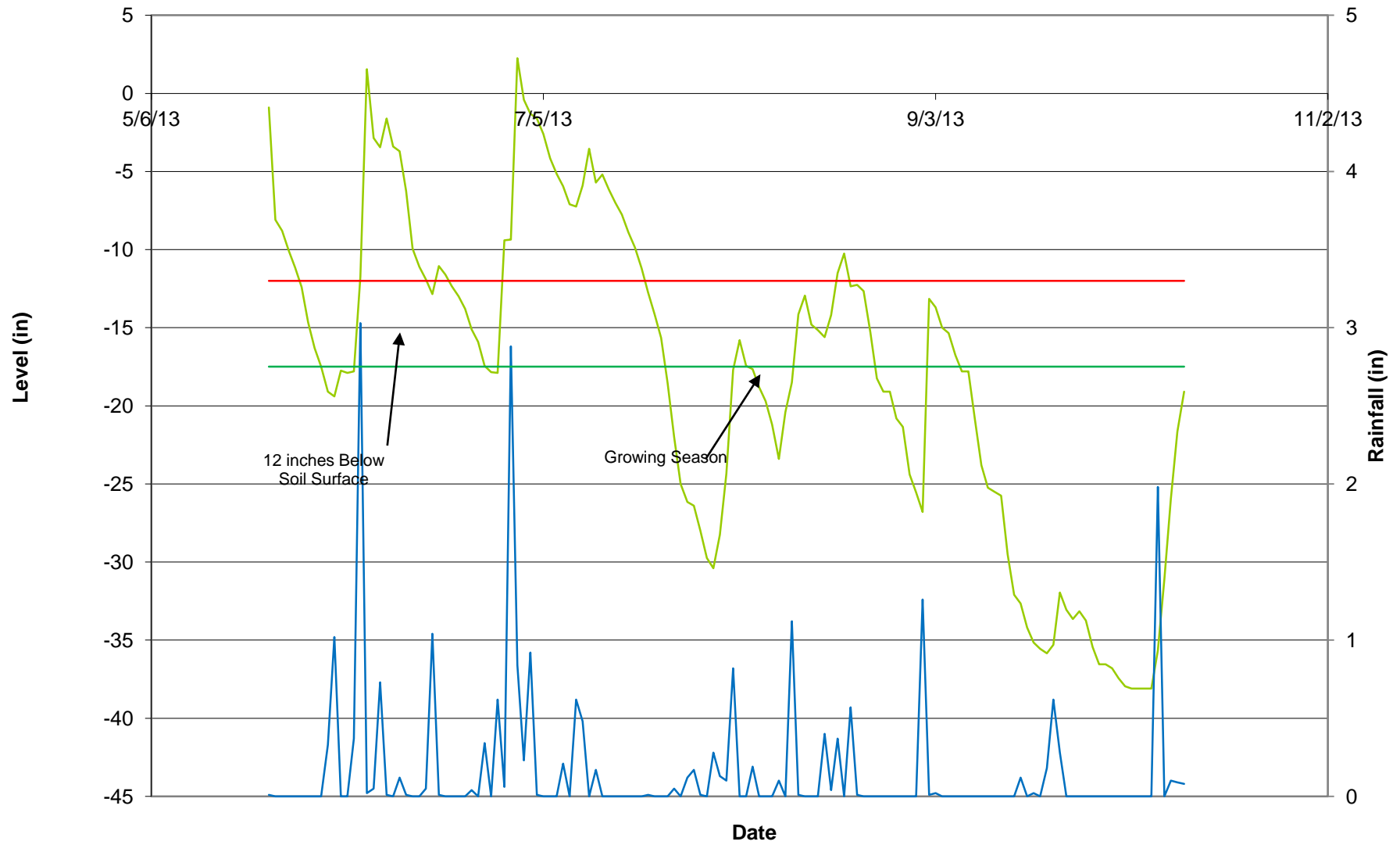
### Sandy Creek Gauge B



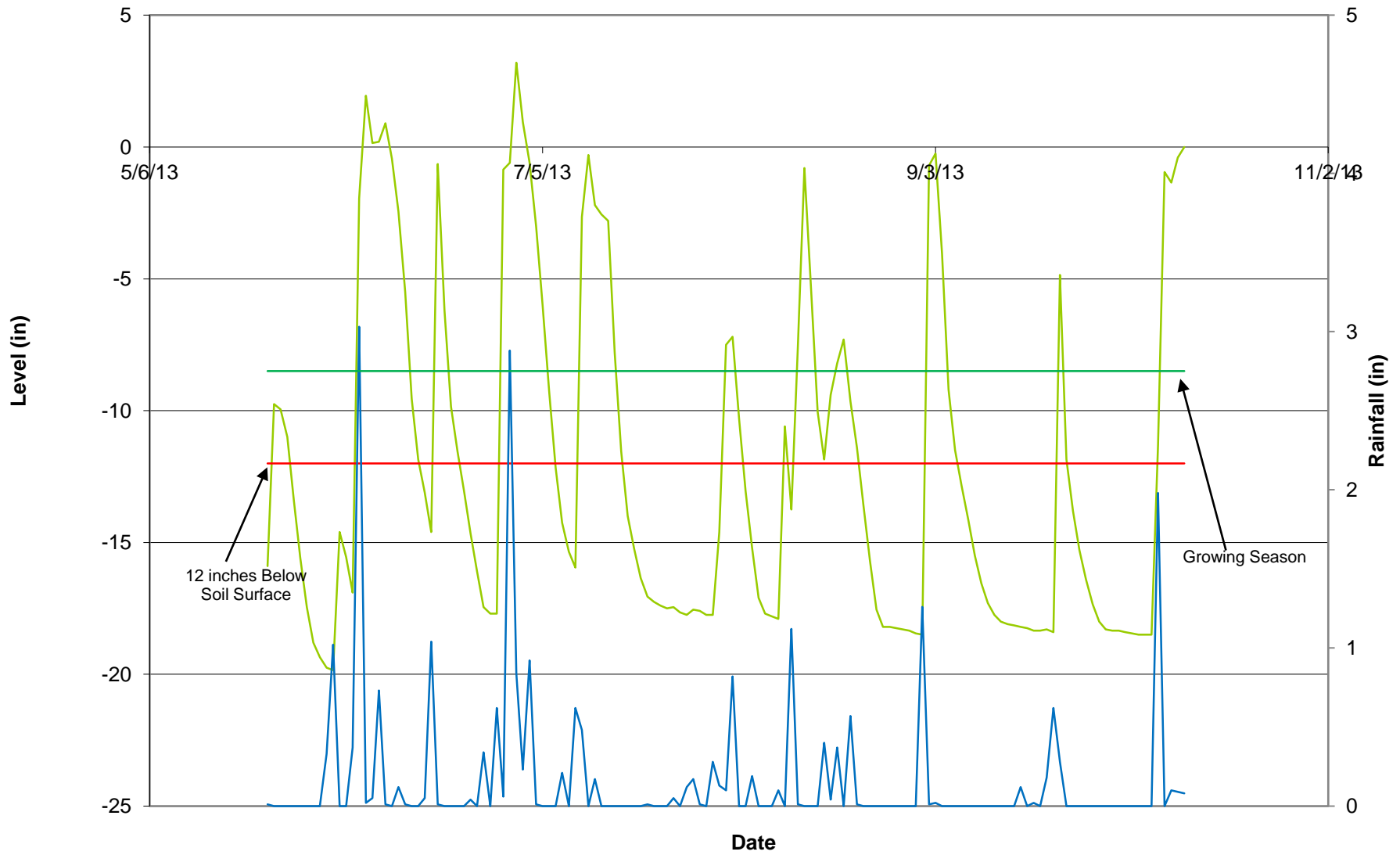
### Sandy Creek Gauge C



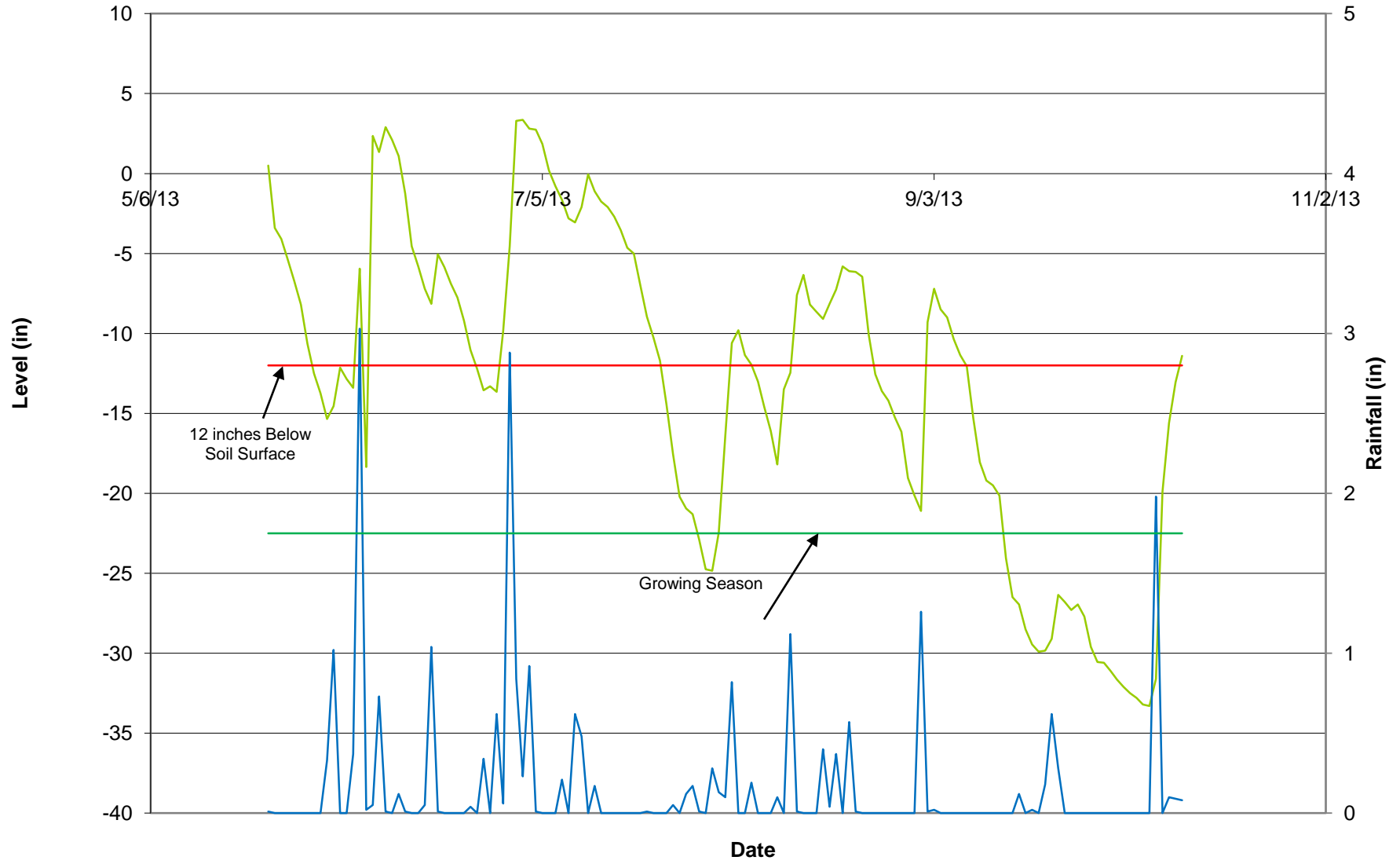
# Sandy Creek Gauge D



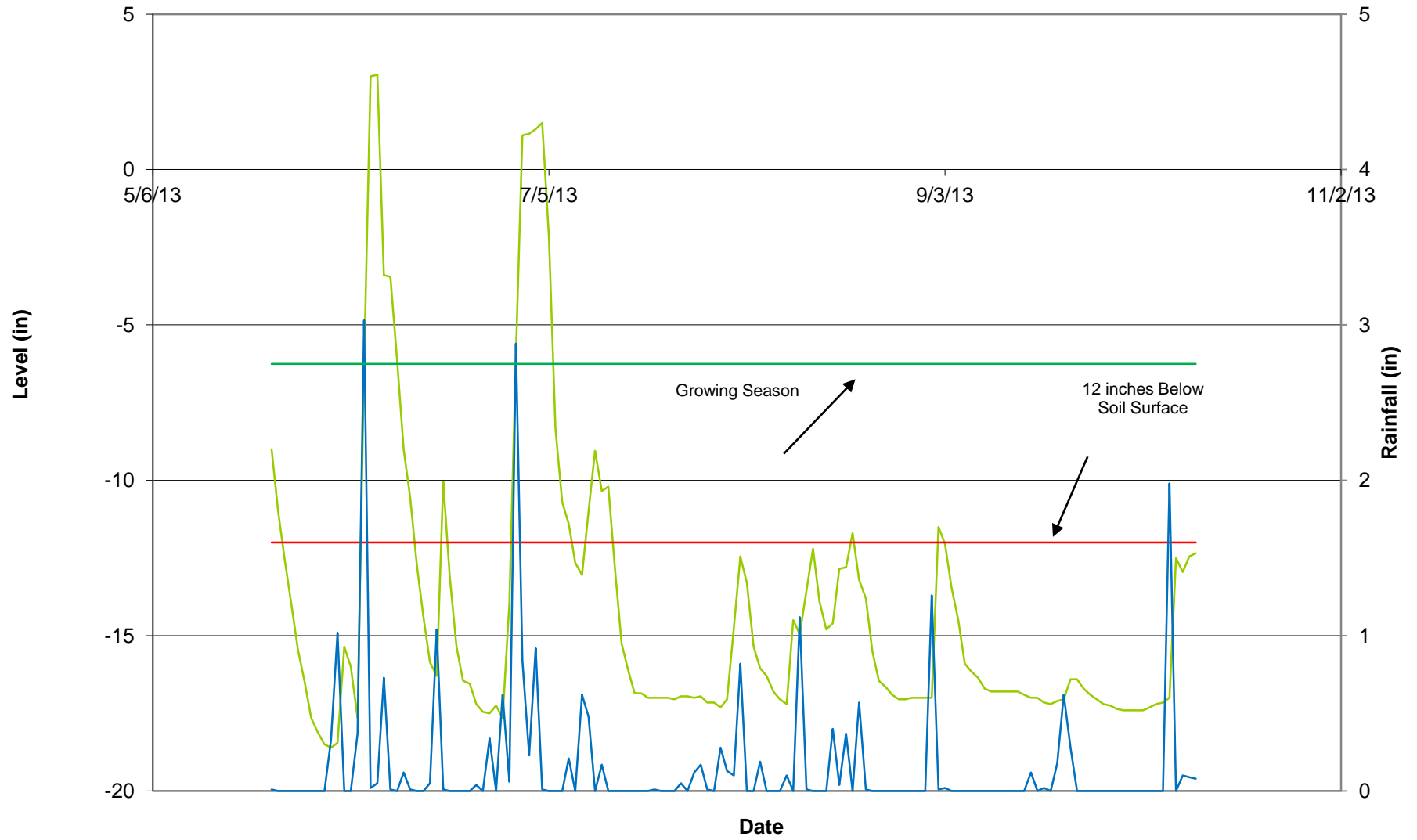
# Sandy Creek Gauge E



# Sandy Creek Gauge F



# Sandy Creek Gauge G



# Sandy Creek Wetland Reference Gauge 1

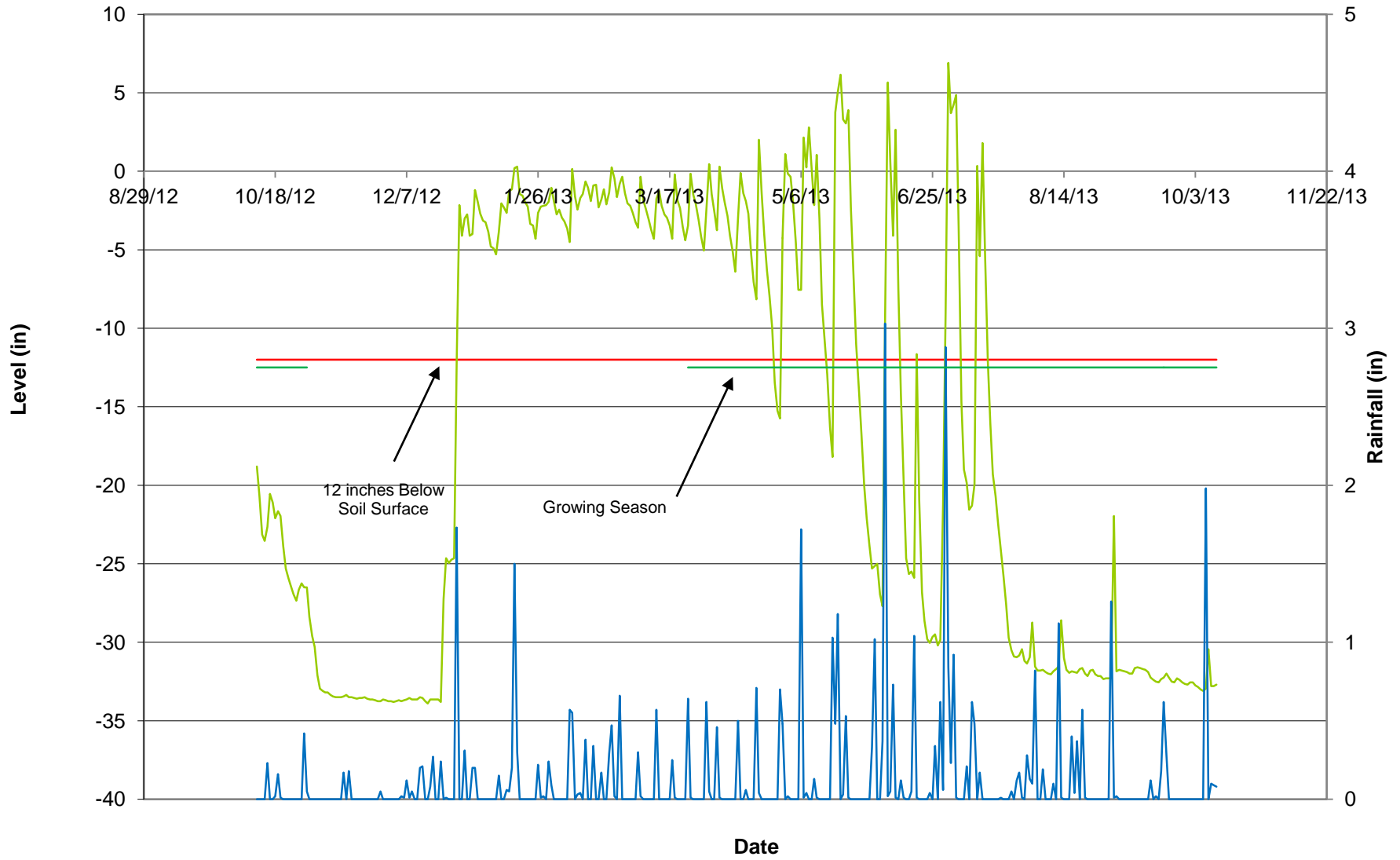


Table 13. Wetland Criteria Attainment 2010-2013

Gauge #	2010 (MY-05)			2011 (MY-06)			2012 (MY-07)			2013 (MY-08)		
	Max # Consecutive Days	% Growing Season	Success Criteria Attained	Max # Consecutive Days	% Growing Season	Success Criteria Attained	Max # Consecutive Days	% Growing Season	Success Criteria Attained	Max # Consecutive Days	% Growing Season	Success Criteria Attained
<b>A</b>	31 <sup>b</sup>	14%	Yes	62	28%	Yes	58 <sup>d</sup>	26%	Yes	125	56	Yes
<b>B</b>	21	9%	Yes	36	16%	Yes	33 <sup>e</sup>	15%	Yes	100	45	Yes
<b>C</b>	7 <sup>c</sup>	3%	No	38	17%	Yes	20	9%	No	124	56	Yes
<b>D</b>	~	~	~	~	~	~	~	~	~	22	10	No <sup>f</sup>
<b>E</b>	~	~	~	~	~	~	~	~	~	25	11	No <sup>f</sup>
<b>F</b>	~	~	~	~	~	~	~	~	~	10	5	No <sup>f</sup>
<b>G (Ref 2)</b>	~	~	~	~	~	~	~	~	~	25	9	No <sup>f</sup>
<b>Ref 1</b>	6 <sup>a</sup>	3%	No	29	13%	Yes	16	7%	No	34	15	Yes

a – Gauge installed 6/15/2010 – groundwater level monitored for 139 days of the growing season

b - Gauge installed 6/25/2010 – groundwater level monitored for 129 days of the growing season

c – Gauge installed 6/14/2010 – groundwater level monitored for 140 days of the growing season

d - Gauge malfunction – groundwater level monitored for 203 days of the growing season

e - Gauge malfunction – groundwater level monitored for 167 days of the growing season

f – Incomplete growing season; Gauges D, E, F, & G installed on May 23, 2013; Gauge G set in wetland reference

Growing Season: March 24 to November 1 (222 days)

(<http://www.wcc.nrcs.usda.gov/ftpref/support/climate/wetlands/nc/37063.txt>)