Suther (Dutch Buffalo Creek) Stream and Wetland Restoration Project

EEP Project No. 370
2010 Final Monitoring Report: Year 1 of 5

Construction Completed: November 2009
Submission Date: June 2011

Submitted to: NCDENR-EEP
1652 Mail Service Center
Raleigh, NC 27699

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SECTION 1
EXECUTIVE SUMMARY

SECTION 1
EXECUTIVE SUMMARY

Dutch Buffalo Creek is located in Cabarrus County, North Carolina, northeast of the City of Concord. The project is located in the Yadkin-Pee Dee River Basin, Hydrologic Unit Code 03040105, DWQ Subbasin 30712 with a watershed land use dominated by rural pasture land and forest. Dutch Buffalo Creek is a third-order stream with an approximate drainage area of 23 square miles at the farthest downstream point of the project. The unnamed tributary to Dutch Buffalo Creek is a first-order stream with an approximate drainage area of 0.3 square miles. Dutch Buffalo Creek drains into the Pee Dee River and is listed as WS-II class waters. Construction of the restoration project was completed in November 2009.

This report serves as year one of the five year monitoring plan for the Site.

1.1 Goals and Objectives

Historically, the Site had been disturbed through management for cattle grazing and rearing. Alterations to the Site included removal of riparian vegetation, dredging, ditching and conversion of wetlands, and straightening of drainage channels to Dutch Buffalo Creek and its tributary. The primary objective of the project was to stabilize and protect degraded or vulnerable streambanks along the unnamed tributary (UT) to Dutch Buffalo Creek. Specifically, the goals for the project include:

- Stabilize and protect degraded or vulnerable streambanks along a UT of Dutch Buffalo Creek.
- Enhance the upper project reach of Dutch Buffalo Creek by fencing out the livestock and vegetating streambanks where necessary.
- Restore a natural, stable dimension, pattern, and profile along one unnamed tributary using natural channel design techniques.
- Improve riffle and pool habitats supportive of macrobenthos and fish communities.
- Restore and/or enhance the natural hydrology, vegetation, and soil characteristics in adjacent wetlands.
- Provide alternate cattle watering sources and road access across Dutch Buffalo Creek to support exclusion of cattle from the channel.
- Improve the aesthetics of the stream.

To meet these goals, the following objectives have been established for the Dutch Buffalo Creek Stream and Wetland Restoration project:

- Enhancing approximately 3,004 linear feet (lf) in the main channel's upper reach.
- Preserving approximately 3,583 lf in the main channel's lower and upper reaches.

- Restoring 608 lf of an unnamed tributary into a C/E stream type.
- Preserving approximately 1.67 acres, enhancing approximately 4.26 acres, and restoring approximately 7.29 acres of riparian riverine[1] wetland area.
- Constructing access crossings across the main channel and the unnamed tributary of Dutch Buffalo Creek.
- Creating an alternative livestock watering source and install livestock exclusion fencing.

1.2 Vegetative Assessment

JJG conducted the 2010 (Year 1 of 5) vegetative assessment and vegetative plot analysis in October 2010. Vegetation assessments were conducted following the CVS-NCEEP Level 2 Protocol (Lee et al., 2008) to monitor and assess the planted woody vegetation in the wetland areas and along the UT stream reach. Seven vegetative plots were established in the design phase and situated randomly within the riparian buffer zone. The planted vegetative community goal for these plots is to establish a Piedmont floodplain forest. The following success criteria for vegetation were established for the Site:

- 320 stems per acre years 1 through 3
- 288 stems per acre year 4
- 260 stems per acre year 5

Vegetation problem areas are limited to the slower growth of planted woody vegetation within the riparian areas due to shading from adjacent mature trees and sporadic growth of Multiflora rose (*Rosa multifora*) throughout the main preservation channel and enhancement floodplain areas. Japanese stiltgrass (*Microstegium vimineum*) has also been observed along the UT and is dominating the herbaceous layer in limited areas along Dutch Buffalo Creek. Growth of this invasive specie; however, has not been observed to outcompete or stunt any planted or naturally recruited woody species within the vegetation plots. Typical on-site growth occurs as a uniform groundcover and is observed to dominate the herbaceous layer where limited woody canopy or native understory exists. Currently, the propagation and location of this species do not present any problem to the desired vegetation populations. Overall the streambanks are well vegetated. Herbaceous seeding along the restored streambanks and plugged wetland areas appears to provide adequate soil cover.

The 2010 vegetation monitoring results indicate that the Site has met the established vegetation success criteria. The Site's average stem density is approximately 729 planted stems per acre with a plot size of 0.0247 ac, which exceeds the Year 1 goal of 320 planted stems per acre. No vegetation plots resulted in a low survival rate having all

[1] The primary source hydrology appears to be groundwater, based on site observations. However, due to adjacency to Dutch Buffalo Creek and based on overbank flooding from Dutch Buffalo Creek at an apparent frequency of greater than once every 5 years, the wetlands appear to be riverine.

plots exceed the established criteria by 166 planted stems or more. Please refer to Appendix C, Tables 6 through 9 for detailed information regarding the 2010 vegetation current conditions and monitoring data results.

1.3 Stream Assessment

Visual assessments were conducted along the main channel of the Dutch Buffalo Creek enhancement reach (3,004 lf) and the restoration reach (608 lf) of the UT. Stream dimension, profile and substrate were also evaluated along the restored reach of the UT at four established cross-sections.

Main Channel

Overall, the enhancement and preservation areas within the main channel of Dutch Buffalo Creek are in generally favorable condition. Although the main channel is exhibiting bare and undercutting banks along much of the project length, reachwide disequilibria does not appear to be a concern at this time. Debris jams within the creek are common and will be monitored to ensure they do not become problematic. Vegetation growth in the channel is also present at several locations throughout the reach. The installed stream crossings appear to be in stable condition. Cattle exclusion fencing and devices appear to be intact and are keeping cattle out of the conservation areas.

Unnamed Tributary

A total of four cross-sections and 608 lf of longitudinal profile were monitored within the restored reach of the UT to Dutch Buffalo. Stream pattern, profile, and dimension are maintaining vertical and lateral stability and development within the channel is transitioning as anticipated. Limited problem areas associated with poor vegetative cover (3+62-3+88), aggradation and growth of in-stream vegetation (2+66-2+87), and structural complications (one affected sill and associated riffle structure, mid-reach) were noted; however, complications observed during this assessment are not effecting intended function and are anticipated to transition as monitoring progresses.

In-stream vegetation does not appear to have affected channel flow at this time and is associated with a minor, aggraded mid-channel bar. Aggraded sections of the restored reach (1+50-2+00 and 3+50-4+00) are likely a result of fine bed material accumulated since recent construction activities and are expected to flush from the system as the restored channel matures. These problem areas are not of immediate concern and will be monitored for an increase in negative trends during subsequent assessments. Overall, the streambanks are well vegetated and bed features are performing as intended with appropriate depths, lengths, and spacing. The log step-pools used to transition the restored reach to the main channel elevation are performing well and are in stable condition.

Average bankfull width (9.30 ft) of the surveyed cross-sections falls within the range of the as-built widths (8.34-11.01 ft), and the average surveyed mean bankfull depth of 0.93 ft is relatively consistent with the proposed depth of 0.985 ft. The surveyed bankfull widths and depths exhibit an average Width/Depth (W/D) ratio of 10.4 and a sinuosity of 1.64, which are consistent with as-built values. At the time of the survey a majority of the restored channel was dry; however, the defining characteristics of the stream display typical dimensions of an E-type channel and are expected to narrow and deepen.

Visual inspection of the channel indicated a stable profile characterized by well-defined riffle and pool features. Particle size distribution has developed toward a larger and more evenly distributed substrate population with limited areas exhibiting increased siltation and embedding. In stream structures are functioning appropriately and have maintained scour pools and zones of re-aeration, improving in-stream habitat.

As noted, a majority of the channel was dry at the time of the survey, which limited the collection of select data used for annual comparisons. Additionally, portions of the data collected for the longitudinal profile during the baseline survey effort were inadvertently omitted from the MY0 monitoring report. Information provided in this MY1 report includes the omitted longitudinal profile data. Please refer to Appendix D, Figure 4 for a comparison of the revised baseline longitudinal profile and the current monitoring year data.

1.4 Wetland Assessment

The following general observations were noted regarding the riparian and wetland areas and associated vegetation.

- Herbaceous seeding appears to provide adequate soil cover along the restored streambanks and plugged wetland areas.
- Multiflora rose is evident sporadically throughout the main channel preservation and enhancement floodplain, but does not appear to be a concern at this time.
- Visual assessment of planted woody vegetation suggests densities in riparian areas are adequate, but growth appears to be slower than expected due to shading from adjacent mature trees. Vegetation within Wetland Area C is being outcompeted by vigorous switch grass growth.
- Log sills installed to stabilize filled ditches and increase hydrology in wetland enhancement areas are performing as expected, although water is piping under one sill. The piping is not a concern at this time as the grade is being maintained and there is no erosion resulting.

Currently, there are ten (10) groundwater gauges located on the site. The monitoring gauges are programmed to download groundwater levels daily and were downloaded monthly from March to November in order to capture hydrological data during the 2010

growing season. The target wetland hydrological success criterion is saturation or inundation for at least 8 percent of the growing season in the lower landscape (floodplain) positions. To achieve the above hydrologic success criterion, groundwater levels must be within 12-inches of the ground surface for 18 consecutive days, which is 8 percent of the March 23 to November 7 (229 days) growing season.

Seven of the ten groundwater gauges achieved the established hydrology criterion of soil saturation during MY1. Two of the gauges (GW7 and GW8) were found to be malfunctioning and had only recorded data through April 14th; however, data recorded during this period had qualified as meeting the established saturation and period length criterion. Additionally, gauges GW7 and GW8 were observed to be located in areas with saturation or inundated conditions during each field visit indicating groundwater hydrology was appropriate. The two gauges (GW4 and GW5) that did not meet the hydrology criterion are likely within an area influenced by a declining groundwater table gradient as the groundwater is drawn down to the incised Dutch Buffalo Creek streambed elevation; therefore, reducing opportunity for saturation within the upper 12-inches of the soil surface. Please refer to Appendix B for wetland plot and groundwater gauge locations. A summary of the wetland groundwater gauge results can be found on Table 13.

1.5 Annual Monitoring Summary

In summary, the Site has met the vegetation, stream, and wetland mitigation goals for monitoring year 1. The 2010 vegetation plot monitoring results indicate that the planted and naturally recruited vegetation is established and estimated populations are exceeding expected success criteria. Enhancement areas within the main channel of Dutch Buffalo Creek are developing as anticipated and the pattern, profile, and dimension of the restored UT appears to be maintaining vertical and lateral stability with minimal bank erosion. No problem areas were observed within the wetland restoration zones for the Site. Appropriate hydrophytic vegetation and hydrology indicators were observed. Representative data and qualitative visual observations indicate the hydrology within the wetland restoration zones is appropriate for continued development and anticipated wetland function.

The background information provided in this report is referenced from the Baseline Monitoring Document and As-Built Baseline Report – Final (April 2011). Summary information/data related to the occurrence of items such as beaver or encroachment and statistics related to performance of various project and monitoring elements can be found in the tables and figures in the report appendices. Narrative background and supporting information formerly found in these reports can be found in the mitigation and restoration plan documents available on NCEEP's website. All raw data supporting the tables and figures in the appendices is available from NCEEP upon request.

SECTION 2
METHODOLOGY

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METHODOLOGY

Methods employed for the Site were a combination of those established by standard regulatory guidance and procedure documents as well as methods addressed in the Baseline Monitoring Document and As-Built Baseline Report (JJG 2011). Survey data collected was performed via total station to establish the current longitudinal profile and cross-section elevations. Data recorded during this monitoring event were georeferenced using historically established positions to evaluate annual progress. Longitudinal stationing for the stream profile, cross-sectional surveys, and additional geomorphic assessments were performed following guidelines outlined in the *Stream Channel Reference Sites: An Illustrated Guide to Field Techniques* (Harrelson et al., 1994) and in the *Stream Restoration a Natural Channel Design Handbook* (Doll et al, 2003). Substrate analysis and particle size distribution were established using a modified Wolman pebble count (Rosgen 1996) at each cross-section location.

Vegetation monitoring for Year 1 was performed based on the Carolina Vegetation Survey (CVS) Level 2 (Lee et al. 2006). Plot locations are consistent with previous years and plot sizes consist of four 5m x 20m and three 10m x 10m. The taxonomic standard for vegetation follows *Flora of the Carolinas, Virginia, Georgia, and surrounding areas* (Weakley, 2007). Precipitation data for the hydrographs was obtained from an off-site rain gauge located approximately 15 miles southwest of the site (EEP Site Project # 17). Historical rainfall data referenced for Figure 3 was obtained from NC Cronos Database Divisional Data for the Southern Piedmont of North Carolina (Data Period January 1980 through December 2010).

SECTION 3
REFERENCES

SECTION 3
REFERENCES

Doll, B.A., Grabow, G.L., Hall, K.A., Halley, J., Harman, W.A., Jennings, G.D., and Wise, D.E., 2003. Stream Restoration A Natural Channel Design Handbook.

Harrelson, Cheryl C; Rawlins, C.L.; Potyondy, John P. 1994. *Stream Channel Reference Sites: An Illustrated Guide to Field Technique.* Gen. Tech. Rep. RM-245. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 61 p.

Jordan, Jones, and Goulding. 2011. Baseline Monitoring Document and As-built Baseline Report – Final, Suther (Dutch Buffalo Creek), Stream and Wetland Restoration Project. Cabarrus County, North Carolina.

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

North Carolina Cronos Database Division Data for the Southern Piedmont of North Carolina. Concord Station ID 311975.
http://www.nc-climate.ncsu.edu/climate/climdiv.php

Weakley, A.S. 2008. *Flora of the Carolinas, Virginia, Georgia, Northern Florida, and Surrounding Areas* (Draft April 2008). University of North Carolina at Chapel Hill: Chapel Hill, NC.

SECTION 4
APPENDICES

Appendix A – Project Vicinity Map and Background Tables

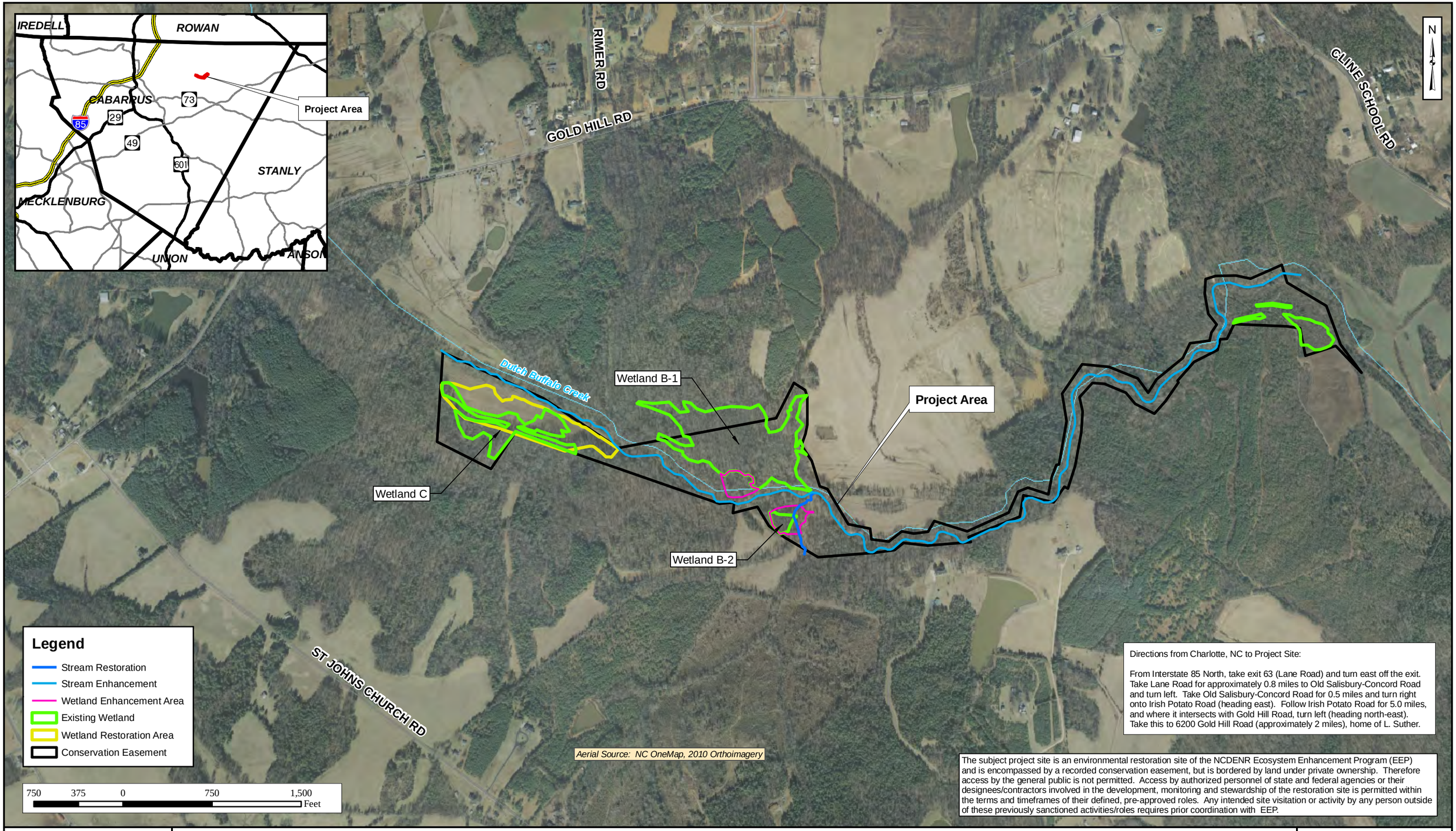
Appendix B – Visual Assessment Data

Appendix C – Vegetation Plot Data

Appendix D – Stream Survey Data

Appendix E – Hydrologic Data

APPENDIX A
PROJECT VICINITY MAP AND BACKGROUND TABLES



Directions from Charlotte, NC to Project Site:

From Interstate 85 North, take exit 63 (Lane Road) and turn east off the exit. Take Lane Road for approximately 0.8 miles to Old Salisbury-Concord Road and turn left. Take Old Salisbury-Concord Road for 0.5 miles and turn right onto Irish Potato Road (heading east). Follow Irish Potato Road for 5.0 miles, and where it intersects with Gold Hill Road, turn left (heading north-east). Take this to 6200 Gold Hill Road (approximately 2 miles), home of L. Suther.

The subject project site is an environmental restoration site of the NCDENR Ecosystem Enhancement Program (EEP) and is encompassed by a recorded conservation easement, but is bordered by land under private ownership. Therefore access by the general public is not permitted. Access by authorized personnel of state and federal agencies or their designees/contractors involved in the development, monitoring and stewardship of the restoration site is permitted within the terms and timeframes of their defined, pre-approved roles. Any intended site visitation or activity by any person outside of these previously sanctioned activities/roles requires prior coordination with EEP.

Figure 1. Vicinity Map
Dutch Buffalo Creek Stream and Wetland Restoration Project
Cabarrus County, NC
June 2011

Table 1. Project Components and Mitigation Credits
Dutch Buffalo Creek Stream and Wetland Restoration Project/EEP Project No. 370

Mitigation Credits

	Stream	Riparian Wetland	Non-riparian Wetland	Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	EII/P/R	P/E/R	**N/A**	**N/A**	**N/A**	**N/A**
Totals	3,004 lf/3,583 lf/608 lf	1.67 ac/4.26 ac/7.29 ac	**N/A**	**N/A**	**N/A**	**N/A**

Project Components

Project Component/Reach ID	Stationing (ft)	Existing Footage/ Acreage	Approach	Restoration or Restoration Equivalent	Restoration Footage or Acres	Mitigation Ratio
Dutch Buffalo Creek-Upper Reach	0+00 – 17+61	N/A	N/A	N/A	N/A	N/A
	17+61 - 53+72	3,004 lf	P4	Enhancement II	3,004 lf	2.5:1
Dutch Buffalo Creek-Lower Reach	53+72 – 100+50	4,678 ft	N/A	Preservation	3,583 ft	5:1
Unnamed Tributary	0+00 – 6+08	527 ft	P1, 2	Restoration	608 lf	1:1
Wetland Area B-2	NA	1.67 ac	N/A	Preservation	1.67 ac	5:1
Wetland Area B-1	NA	9.93 ac	N/A	Enhancement	2.47 ac	2:1
				Restoration	1.97 ac	1:1
Wetland Area C	NA	4.64 ac	N/A	Enhancement	1.79 ac	2:1
				Restoration	5.32 ac	1:1

Component Summations

Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-riparian Wetland (acres)	Buffer (square feet)	Upland (acres)
		Riverine	Non-Riverine			
Restoration (R)	608	7.29	N/A	N/A	N/A	N/A
Enhancement (E)		4.26	N/A	N/A	N/A	N/A
Enahncement I (E)	N/A					
Enhancement II (E)	3,004					
Creation (C)		N/A	N/A	N/A		
Preservation (P)	3,583	1.67	N/A	N/A		N/A
HQ Preservation (P)	N/A	N/A	N/A	N/A		N/A
Totals	**7,195**	**13.22**	**N/A**	**N/A**	**N/A**	**N/A**

BMP Elements

Element	Location	Purpose/Function	Notes
N/A	N/A	N/A	N/A

BMP Elements
BR = Bioretention Cell; SF = Sand Filter; SW = Stormwater Wetland; WDP = Wet Detention Pond; DDP - Dry Detention Pond; FS = Filter Strip; S = Grassed Swale; LS = Level Spreader; NI = Natural Infiltration Area; FB = Forested Buffer

Table 2. Project Activity and Reporting History Dutch Buffalo Creek Stream and Wetland Restoration Project EEP Project No. 370		
Activity or Report	**Data Collection Completed**	**Actual Completion or Delivery**
Restoration Plan	Jan-06	Sep-07
Final Design-90%	Nov-08	Nov-08
Construction	Nov-09	Dec-09
Temporary S&E mix applied to entire project area*	Nov-09	Nov-06
Permanent seed mix applied to reach	Nov-09	Nov-09
Bare root and livestake plantings for reach	Dec-09	Dec-09
Mitigation Plan/ As-Built (Year 0 Monitoring)	Dec-09	Jan-09
Year 1 Monitoring	2010	2010
Year 2 Monitoring	2011	2011
Year 3 Monitoring	2012	2012
Year 4 Monitoring	2013	2013
Year 5 Monitoring	2014	2014

*Seed and mulch is added as each section of construction is completed.

Table 3. Project Contact Table Dutch Buffalo Creek Stream and Wetland Restoration Project EEP Project No. 370	
Designer Matthew Clabaugh, PE	Jordan, Jones and Goulding, Inc. 309 E. Morehead Street, Suite 110 Charlotte, NC 28202 704-527-4106
Construction Will Pedersen	River Works, Inc. 8000 Regency Parkway, Suite 200 Cary, NC 27511 919-459-9001
Planting Contractor	River Works, Inc.
Seeding Contractor	River Works, Inc.
Monitoring Performers: **Baseline Year 0**	Jordan, Jones and Goulding, Inc. 309 E. Morehead Street, Suite 110 Charlotte, NC 28202
Stream Monitoring, POC	Alison Nichols, 704-247-9065
Vegetation Monitoring, POC	
Wetland Monitoring, POC	

Table 4. Project Baseline Information and Attributes			
Project Information			
Project Name	Dutch Buffalo Creek Stream and Wetland Restoration Project		
County	Cabarrus County, North Carolina		
Project Area (acres)	66		
Project Coordinates (latitude and longitude)	35° 27' 05" N, 80° 29' 32" W		
Project Watershed Summary Information			
Physiographic Province	Piedmont		
River Basin	Yadkin PeeDee		
USGS Hydrologic Unit 8-digit	3040105	USGS Hydrologic Unit 14-digit	03040105020060
DWQ Sub-basin	03-07-12		
Project Drainage Area (acres)	14,910		
Project Drainage Area Percentage of Impervious Area	3%		
CGIA Land Use Classification	Cultivated (3.00); Mixed Upland Hardwoods (10.00)		
Reach Summary Information			
Parameters	**Main Channel**	**UT**	
Length of Reach (linear feet)	10,050	608	
Valley Classification	VIII		
Drainage Area (sq.mi.)	21.3	0.31	
NCDWQ stream identification score	13-17-11-(4.5)		
NCDWQ Water Quality Classification	WS-II; HQW,CA		
Morphological Description (stream type)	Perennial	Intermittent	
Evolutionary trend	C→G→F→C	E→Gc→F→C→E	
Underlying mapped soils	Altavista, Cecil, Chewacala, Cullen, Enon, Pacolet, Mecklenburg		
Drainage class	U	U	
Soil Hydric status	Class B (Chewacla and Altavista)		
Slope	0.0011	0.0093	
FEMA Classification	100-year floodplain		
Native vegetation community	Piedmont/Mountain Bottomland Forest; Piedmont/Low Mountain Alluvial Forest		
Percent composition of exotic invasive vegetation	U	U	
Wetland Summary Information			
Parameters	**Main Channel**	**UT**	
Size of Wetland (acres)	11.55	1.67	
Wetland Type (non-riparian, riparian riverine or riparian non-riverine)	riparian riverine	riparian riverine	
Mapped Soil Series	Chewacla		
Drainage class	U	U	
Soil Hydric Status	B	B	
Source of Hydrology	streamflow, groundwater	streamflow, stormwater	
Hydrologic Impairment	U	U	
Native vegetation community	Piedmont/Mountain Bottomland Forest; Piedmont/Low Mountain Alluvial Forest; Piedmont/Low Mountain Bottomland Forest	Piedmont/Low Mountain Alluvial Forest	
Percent composition of exotic invasive vegetation	U	U	
Regulatory Considerations			
Regulation	**Applicable?**	**Resolved?**	**Supporting Documentation**
Waters of the United States - Section 404	Yes	Yes	Approved JD, NWP 27
Waters of the United States - Section 401	Yes	Yes	Approved 401 Certification
Endangered Species Act	No	N/A	N/A
Historic Preservation Act	No	N/A	N/A
Coastal Zone Management Act (CZMA)/Coastal Area Management Act (CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	No	N/A	N/A
Essential Fisheries Habitat	No	N/A	N/A

*Beaver activity was observed along the main channel of Dutch Buffalo Creek during the early stages of the design phase and has not impacted the UT. Beaver activity has not been observed in subsequent years.

"N/A": items do not apply / "-": items are unavailable / "U": items are unknown

APPENDIX B
VISUAL ASSESSMENT DATA

Table 5	**Visual Stream Morphology Stability Assessment Table**
Table 6	**Vegetation Condition Assessment Table**
Photos	**Stream Station Photos**
Photos	**Vegetation Plot Photos**

Appendix B. Visual Assessment Data
Table 5. Visual Stream Morphology Stability Assessment Table
Unnamed Tributary to Dutch Buffalo Creek (608 lf)
Dutch Buffalo Creek Stream and Wetland Restoration/EEP Project No. 370
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Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	**1. Vertical Stability (Riffle and Run units)**	Aggradation			1	11	98%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	7	7			100%			
	3. Meander Pool Condition	Depth Sufficient	7	8			88%			
		Length Appropriate	8	8			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	7	7			100%			
		Thalweg centering at downstream of meander bend (Glide)	7	7			100%			
2. Bank	**1. Scoured/Eroded**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			1	26	96%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	1	26	96%	0	0	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	7	8			88%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	8	8			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms	7	8			88%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	8	8			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow	8	8			100%			

Appendix B
Table 6: Vegetation Condition Assessment Table
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5

Planted Acreage **25.14**

Vegetation Category	Definitions	Mapping Threshold (acres)	Number of Polygons	Combined Acreage	% of Planted Acreage
Bare Areas	Very limited cover of both woody and herbaceous material.	0.1	0	0	0.00%
Low Stem Density Areas	Woody stem densities clearly below tart levels based on MY3 Low Stem Density MY3, 4, or 5 stem count criteria	0.1	0	0	0%
		Total	**0**	**0**	**0.00%**
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	0	0	0%
		Cumulative Total	**0**	**0**	**0.00%**

Easement Acreage **67.32**

Vegetation Category	Definitions	Mapping Threshold (SF)	Number of Polygons	Combined Acreage	% of Planted Acreage
Invasive Areas of Concern	Along banks and floodplain - BB various locations DBC main channel	1000	0	0	0%
Easement Encroachment Areas	Areas of points (if too small to render as polygons at map scale).	none	0	0	0%

LB - Left Bank Looking Downstream, RB - Right Bank Looking Downstream, BB - Both Banks

Photo Point 1-View Northwest
Tributary (1/2011)

Photo Point 1-View Southeast
Tributary (1/2011)

Photo Point 2-View Downstream
Tributary (1/2011)

Photo Point 2-View Upstream
Tributary (1/2011)

Prepared For:

Ecosystem Enhancement Program

Appendix B: Stream Station & Cross Section Photos
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5
Submittal Date: June 2011

Prepared by:

JJG

Photo Point 3
Tributary (1/2011)

Photo Point 4-View Downstream
Main Channel (1/2011)

Photo Point 4-View Upstream
Main Channel (1/2011)

Prepared For:	Appendix B: Stream Station & Cross Section Photos Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 370 Monitoring Year 1 of 5 Submittal Date: June 2011	Prepared by:

Photo Point 5-View Downstream
Main Channel (1/2011)

Photo Point 5-View Upstream
Main Channel (1/2011)

Photo Point 6-View Downstream
Main Channel (1/2011)

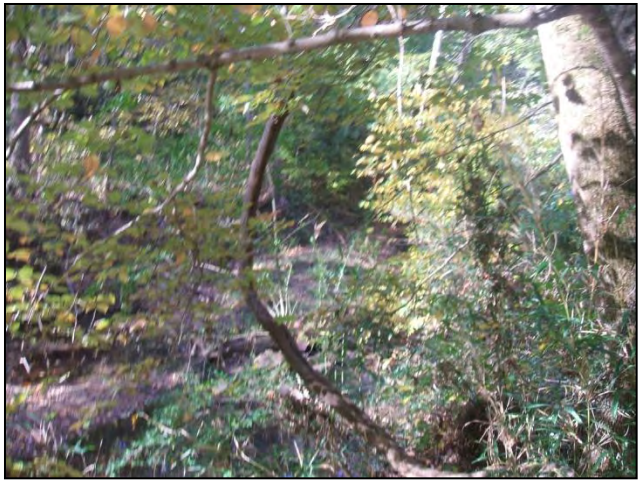

Photo Point 6-View Upstream
Main Channel (1/2011)

Prepared For:

Ecosystem Enhancement Program

Appendix B: Stream Station & Cross Section Photos
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 370
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JJG

Photo Point 7-View Downstream
Main Channel (1/2011)

Photo Point 7-View Upstream
Main Channel (1/2011)

Photo Point 8-View Downstream
Main Channel (1/2011)

Photo Point 8-View Upstream
Main Channel (1/2011)

Prepared For:

Ecosystem Enhancement Program

Appendix B: Stream Station & Cross Section Photos
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5
Submittal Date: June 2011

Prepared by:

JJG

Photo Point 9-View Downstream
Main Channel (1/2011)

Photo Point 9-View Upstream
Main Channel (1/2011)

Photo Point 10-View Downstream
Main Channel (1/2011)

Photo Point 10-View Upstream
Main Channel (1/2011)

Prepared For:

Ecosystem Enhancement Program

Appendix B: Stream Station & Cross Section Photos
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5
Submittal Date: June 2011

Prepared by:

JJG

Photo Point 11-View Downstream
Main Channel (1/2011)

Photo Point 11-View Upstream
Main Channel (1/2011)

Photo Point 12-View Downstream
Main Channel (1/2011)

Photo Point 12-View Upstream
Main Channel (1/2011)

Prepared For:

Ecosystem Enhancement Program

Appendix B: Stream Station & Cross Section Photos
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5
Submittal Date: June 2011

Prepared by:

JJG

Photo Point 13-View Downstream
Main Channel (1/2011)

Photo Point 13-View Upstream
Main Channel (1/2011)

Photo Point 14-View Downstream
Main Channel (1/2011)

Photo Point 14-View Upstream
Main Channel (1/2011)

Prepared For:

Ecosystem Enhancement Program

Appendix B: Stream Station & Cross Section Photos
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5
Submittal Date: June 2011

Prepared by:

JJG

Photo Point 15-View Downstream
Main Channel (1/2011)

Photo Point 15-View Upstream
Main Channel (1/2011)

Photo Point 17
Main Channel (1/2011)

Photo Point 18-View Downstream
Main Channel (1/2011)

Photo Point 18-View Upstream
Main Channel (1/2011)

Photo Point 19-View Downstream
Main Channel (1/2011)

Photo Point 19-View Upstream
Main Channel (1/2011)

Prepared For:

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Appendix B: Stream Station & Cross Section Photos
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5
Submittal Date: June 2011

Prepared by:

JJG

Photo Point 20-View Downstream
Main Channel (1/2011)

Photo Point 20-View Upstream
Main Channel (1/2011)

Photo Point 21-View Downstream
Main Channel (1/2011)

Photo Point 21-View Upstream
Main Channel (1/2011)

Prepared For:

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Appendix B: Stream Station & Cross Section Photos
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5
Submittal Date: June 2011

Prepared by:

JJG

Photo Point 22-View Downstream
Main Channel (1/2011)

Photo Point 22-View Upstream
Main Channel (1/2011)

Photo Point 23-Looking Northwest
Wetland Area (1/2011)

Photo Point 23-Looking Southwest
Wetland Area (1/2011)

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Appendix B: Stream Station & Cross Section Photos
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5
Submittal Date: June 2011

Prepared by:

JJG

Photo Point 24-View Downstream
Tributary (1/2011)

Photo Point 24-View Upstream
Tributary (1/2011)

Photo Point 25-View Downstream
Tributary (1/2011)

Photo Point 25-View Upstream
Tributary (1/2011)

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Appendix B: Stream Station & Cross Section Photos
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5
Submittal Date: June 2011

Prepared by:

JJG

Photo Point 26-View Downstream
Tributary (1/2011)

Photo Point 26-View Upstream
Tributary (1/2011)

Photo Point 27-View Downstream
Tributary (1/2011)

Photo Point 27-View Upstream
Tributary (1/2011)

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Appendix B: Stream Station & Cross Section Photos
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5
Submittal Date: June 2011

Prepared by:

JJG

Photo Point 28-View Downstream
Tributary (1/2011)

Photo Point 28-View Upstream
Tributary (1/2011)

Photo Point 29-View Downstream
Tributary (1/2011)

Photo Point 29-View Upstream
Tributary (1/2011)

Prepared For:

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Appendix B: Stream Station & Cross Section Photos
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5
Submittal Date: June 2011

Prepared by:

JJG

Photo Point 30-View Downstream
Tributary (1/2011)

Photo Point 30-View Upstream
Tributary (1/2011)

Photo Point 31-View Downstream
Tributary (1/2011)

Photo Point 31-View Upstream
Tributary (1/2011)

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Appendix B: Stream Station & Cross Section Photos
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5
Submittal Date: June 2011

Prepared by:

JJG

Cross Section 1 - View Downstream
(1/2011)

Cross Section 1 - View Upstream
(1/2011)

Cross Section 2 - View Downstream
(1/2011)

Cross Section 2 - View Upstream
(1/2011)

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Ecosystem Enhancement Program

Appendix B: Stream Station & Cross Section Photos
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5
Submittal Date: June 2011

Prepared by:

JJG

Cross Section 3 - View Downstream
(1/2011)

Cross Section 3 - View Upstream
(1/2011)

Cross Section 4 - View Downstream
(1/2011)

Cross Section 4 - View Upstream
(1/2011)

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Ecosystem Enhancement Program

Appendix B: Stream Station & Cross Section Photos
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5
Submittal Date: June 2011

Prepared by:

JJG

Vegetation Plot 1 (11/2010)

Vegetation Plot 2 (10/2010)

Vegetation Plot 3 (10/2010)

Prepared For:

Ecosystem Enhancement Program

Appendix B: Vegetation Monitoring Plot Photos
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5
Submittal Date: June 2011

Prepared by:

JJG

Vegetation Plot 5 (10/2010)

Vegetation Plot 6 (10/2010)

Vegetation Plot 7 (10/2010)

Prepared For:

Ecosystem Enhancement Program

Appendix B: Vegetation Monitoring Plot Photos
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5
Submittal Date: June 2011

Prepared by:

JJG

APPENDIX C
VEGETATION PLOT DATA

Appendix C
Table 7 Vegetation Plot Mitigation Success
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 172
Monitoring Year 1 of 5

Vegetation Plot ID	Vegetation Survival Threshold Met
Plot 1	Y
Plot 2	Y
Plot 3	Y
Plot 4	Y
Plot 5	Y
Plot 6	Y
Plot 7	Y

Appendix C
Table 8: CVS Vegetation Metadata Table
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 172
Monitoring Year 1 of 5

Report Prepared By	Jennifer Mathis
Date Prepared	5/17/2011 0:00
database name	DBC_2010.mdb
database location	J:\JJX31100\M5-Field Monitoring Data\MY-2010\Vegetation\DBC (Suther)
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Stem Count 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	6067501
project Name	Dutch Buffalo Creek
Description	Stream and Wetland Enhancement Cabarrus County, North Carolina
length(ft)	608
stream-to-edge width (ft)	33
area (sq m)	3727.64
Required Plots (calculated)	7
Sampled Plots	7

Appendix C
Table 9: CVS Stem Count Total and Planted by Plot and Species
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 172
Monitoring Year 1 of 5

			Current Data (MY1-11/2010)														Annual Means			
			Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6		Plot 7		Current Mean		MY0 - 4/2010	
Species	Common Name	Type	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T
Alnus serrulata	hazel alder	S	7	7	5	5	2	2			3	3			2	2	**4**	**4**	**4**	**4**
Asimina triloba	pawpaw	T			1	1		1	1	1	3	15			1	1	**2**	**4**	**2**	**2**
Betula nigra	river birch	T	1	1		1	3	3	6	8							**3**	**3**	**1**	**1**
Callicarpa americana	American beautyberry	S							1	1							**1**	**1**	**N/A**	**N/A**
Camellia	camellia	T							1								**1**	**N/A**	**N/A**	**N/A**
Carpinus caroliniana	American hornbeam	T	2	2											1	1	**2**	**2**	**1**	**1**
Celtis laevigata	sugarberry	T	1	1													**1**	**1**	**1**	**1**
Cornus amomum	silky dogwood	T	5	5	6	6											**6**	**6**	**6**	**6**
Fraxinus pennsylvanica	green ash	T					6	6	8	8	3	3	3	3			**5**	**5**	**4**	**4**
Lindera benzoin	northern spicebush	S	2	2	1	1	2	2					1	1			**2**	**2**	**2**	**2**
Liquidambar styraciflua	sweet gum	T						3		1							**N/A**	**2**	**N/A**	**N/A**
Liriodendron tulipifera	tuliptree	T			2	2					1	1			1	1	**1**	**1**	**2**	**2**
Nyssa sylvatica	blackgum	T			1	1	2	2	2	2			1	1			**2**	**2**	**1**	**1**
Platanus occidentalis	American sycamore	T				3		1		3			7	7			**7**	**4**	**7**	**7**
Quercus michauxii	swamp chestnut oak	T	1	1													**1**	**1**	**1**	**1**
Quercus phellos	willow oak	T													2	2	**2**	**2**	**2**	**2**
Ulmus americana	American elm	T	1	1	3	3	3	3			5	5	1	1	5	5	**3**	**3**	**3**	**3**
Unknown							1	1	3	3							**2**	**2**	**N/A**	**N/A**
Viburnum dentatum	southern arrowwood	S	1	1	5	5											**3**	**3**	**3**	**3**
Plot Area (acres)			**0.0247**																	
Species Count			**9**	**9**	**8**	**10**	**7**	**10**	**7**	**8**	**5**	**5**	**5**	**5**	**6**	**6**	**7**	**8**	**6**	**6**
Stem Count			**21**	**21**	**24**	**28**	**19**	**24**	**22**	**27**	**15**	**27**	**13**	**13**	**12**	**12**	**18**	**22**	**16**	**16**
Stems per Acre			**850**	**850**	**972**	**1134**	**769**	**972**	**891**	**1093**	**607**	**1093**	**526**	**526**	**486**	**486**	**729**	**879**	**677**	**677**

Type=**S**hrub or **T**ree
P = Planted
T = Total

APPENDIX D
STREAM SURVEY DATA

Figures 3a-3d	**Cross-sections with Annual Overlays**
Figure 4	**Longitudinal Profiles with Annual Overlays**
Figures 5a-5d	**Pebble Count Plots with Annual Overlays**
Tables 10a,b	**Baseline – Stream Data Summary Tables**
Table 11a	**Monitoring – Cross-Section Morphology Data Table**
Table 11b	**Monitoring – Stream Reach Morphology Data Table**

Appendix D. Stream Survey Data
Figure 3a: Cross-Section Plots and Raw Data Tables
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 370
Unnamed Tributary to Dutch Buffalo Creek
Monitoring Year 1 of 5

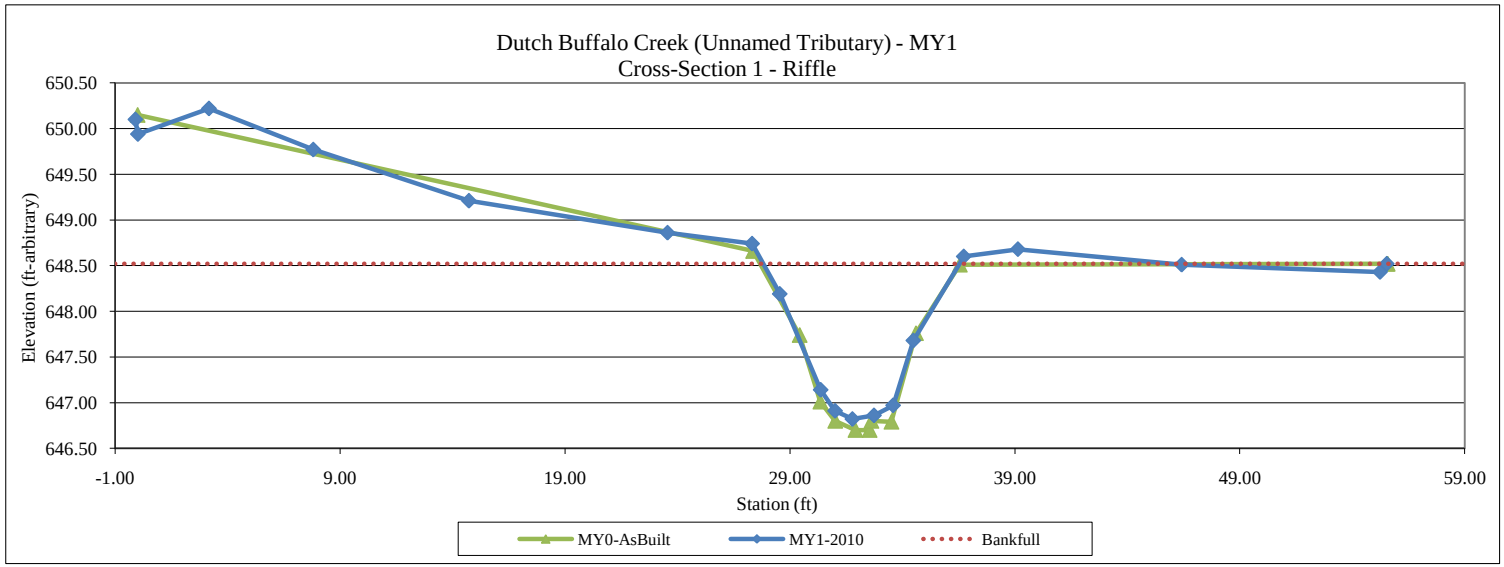
Project Name	**DBC (Suther)**
EEP Project Number	**370**
Cross-Section ID	**XS-1, Riffle, 2+98**
Survey Date	**11/2010**

SUMMARY DATA	
Bankfull Elevation (ft)	648.52
Bankfull Cross-Sectional Area (ft^2)	8.82
Bankfull Width (ft)	8.72
Flood Prone Area Elevation (ft)	650.22
Flood Prone Width (ft)	55.64
Bankfull Mean Depth (ft)	1.01
Bankfull Max Depth (ft)	1.70
W/D Ratio	8.63
Entrenchment Ratio	6.38
Bank Height Ratio	1.00

XS-1: View Upstream

XS-1: View Downstream

Station	Elevation	Notes
-0.1	650.1	xs1-lpt
0.01	649.94	xs1
3.17	650.22	xs1
7.81	649.77	xs1
14.73	649.21	xs1
23.56	648.86	xs1
27.32	648.74	xs1-lb
28.55	648.19	xs1
30.37	647.14	xs1
31.01	646.91	xs1
31.78	646.82	xs1
32.74	646.86	xs1
33.59	646.97	xs1
34.49	647.68	xs1
36.73	648.6	xs1-rb
39.14	648.68	xs1
46.42	648.51	xs1
55.24	648.43	xs1
55.54	648.52	xs1-rpt



Appendix D. Stream Survey Data
Figure 3b: Cross-Section Plots and Raw Data Tables
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 370
Unnamed Tributary to Dutch Buffalo Creek
Monitoring Year 1 of 5

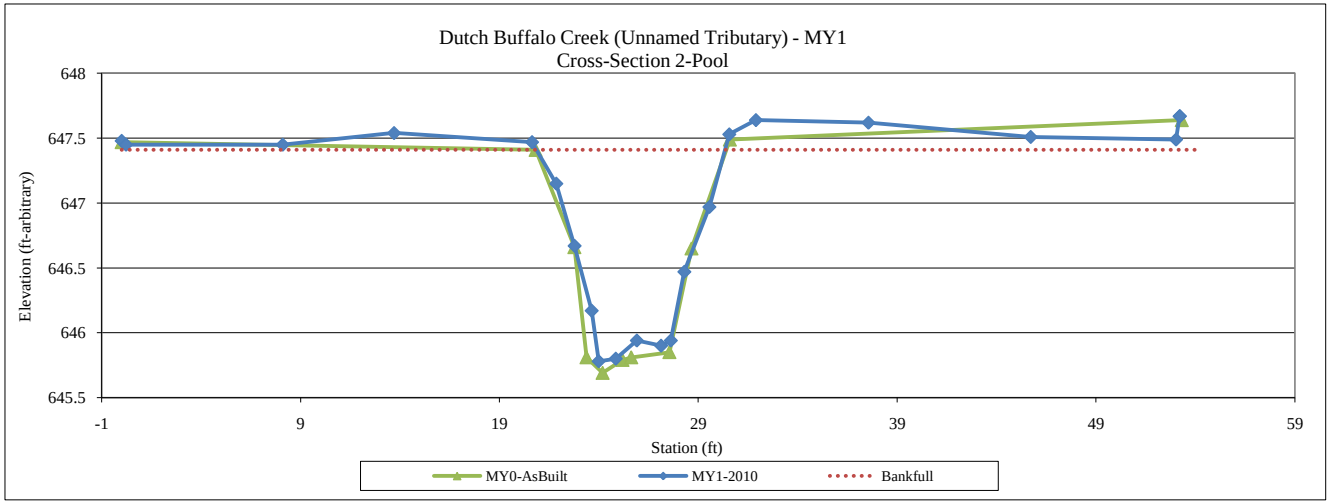
Project Name	**DBC (Suther)**
EEP Project Number	**370**
Cross-Section ID	**XS-2, Pool 2+98**
Survey Date	**11/2010**

SUMMARY DATA	
Bankfull Elevation (ft)	647.41
Bankfull Cross-Sectional Area (ft^2)	9.39
Bankfull Width (ft)	9.65
Flood Prone Area Elevation (ft)	649.04
Flood Prone Width (ft)	53.22
Bankfull Mean Depth (ft)	0.97
Bankfull Max Depth (ft)	1.63
W/D Ratio	9.95
Entrenchment Ratio	5.52
Bank Height Ratio	1.00

XS-2: View Upstream

XS-2: View Downstream

Station	Elevation	Notes
0	647.48	xs2
0.22	647.45	xs2-lpt
8.1	647.45	xs2
13.7	647.54	xs2
20.64	647.47	xs2-b
21.86	647.15	xs2
22.78	646.67	xs2
23.64	646.17	xs2
23.99	645.78	xs2
24.85	645.8	xs2
25.91	645.94	xs2
27.13	645.9	xs2
27.62	645.94	xs2
28.3	646.47	xs2
29.56	646.97	xs2
30.56	647.53	xs2-b
31.9	647.64	xs2
37.56	647.62	xs2
45.72	647.51	xs2
53.03	647.49	xs2
53.21	647.67	xs2-rpt
53.22	647.67	xs2-rpt



Appendix D. Stream Survey Data
Figure 3c: Cross-Section Plots and Raw Data Tables
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 370
Unnamed Tributary to Dutch Buffalo Creek
Monitoring Year 1 of 5

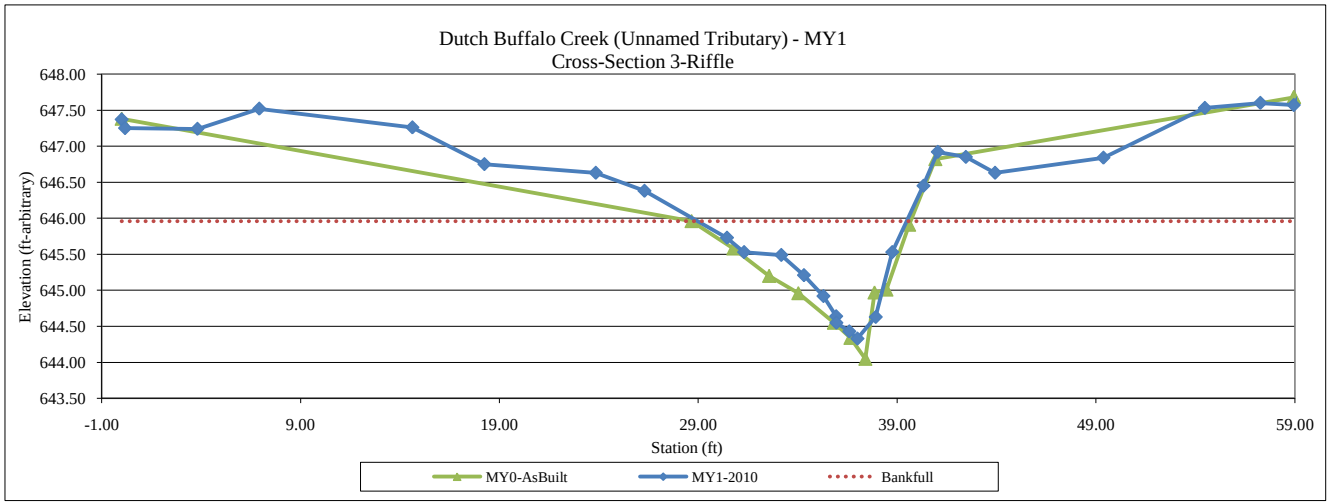
Project Name	**DBC (Suther)**
EEP Project Number	**370**
Cross-Section ID	**XS-3, Riffle 2+98**
Survey Date	**11/2010**

SUMMARY DATA	
Bankfull Elevation (ft)	645.96
Bankfull Cross-Sectional Area (ft^2)	7.49
Bankfull Width (ft)	10.51
Flood Prone Area Elevation (ft)	647.59
Flood Prone Width (ft)	58.02
Bankfull Mean Depth (ft)	0.71
Bankfull Max Depth (ft)	1.63
W/D Ratio	14.80
Entrenchment Ratio	5.52
Bank Height Ratio	1.00

XS-3: View Upstream

XS-3: View Downstream

Station	Elevation	Notes
0	647.37	xs3-lpt
0.17	647.25	xs3
3.81	647.24	xs3
6.92	647.52	xs3
14.62	647.26	xs3
18.24	646.75	xs3
23.84	646.63	xs3
26.29	646.38	xs3-lb
30.44	645.73	xs3
31.3	645.53	xs3
33.17	645.49	xs3
34.31	645.21	xs3
35.29	644.92	xs3
35.93	644.64	xs3-lew
35.94	644.55	xs3
36.59	644.43	xs3
37	644.33	xs3
37.92	644.63	xs3-rew
38.75	645.53	xs3
40.32	646.45	xs3
41.04	646.92	xs3
42.45	646.85	xs3
43.92	646.63	xs3
49.37	646.84	xs3
54.47	647.53	xs3
57.26	647.6	xs3
58.94	647.57	xs3
59.17	647.68	xs3-rpt



Appendix D. Stream Survey Data
Figure 3d: Cross-Section Plots and Raw Data Tables
Dutch Buffalo Creek (Suther) Stream and Wetland Restoration/EEP Project No. 370
Unnamed Tributary to Dutch Buffalo Creek
Monitoring Year 1 of 5

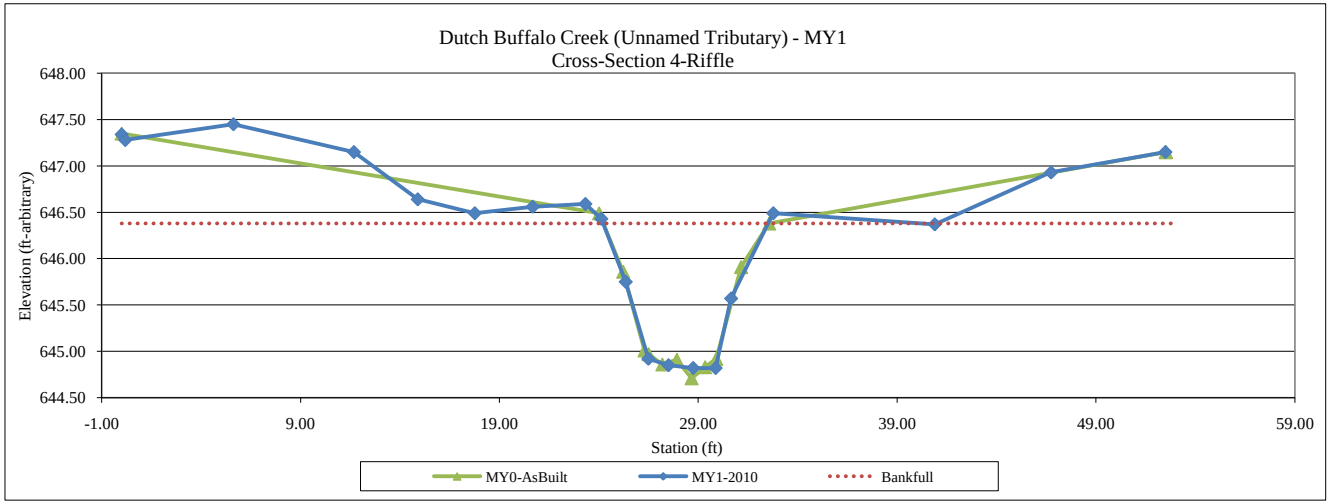
Project Name	**DBC (Suther)**
EEP Project Number	**370**
Cross-Section ID	**XS-4, Riffle 2+98**
Survey Date	**11/2010**

SUMMARY DATA	
Bankfull Elevation (ft)	646.38
Bankfull Cross-Sectional Area (ft^2)	8.42
Bankfull Width (ft)	8.31
Flood Prone Area Elevation (ft)	647.94
Flood Prone Width (ft)	52.49
Bankfull Mean Depth (ft)	1.01
Bankfull Max Depth (ft)	1.56
W/D Ratio	8.23
Entrenchment Ratio	6.32
Bank Height Ratio	1.00

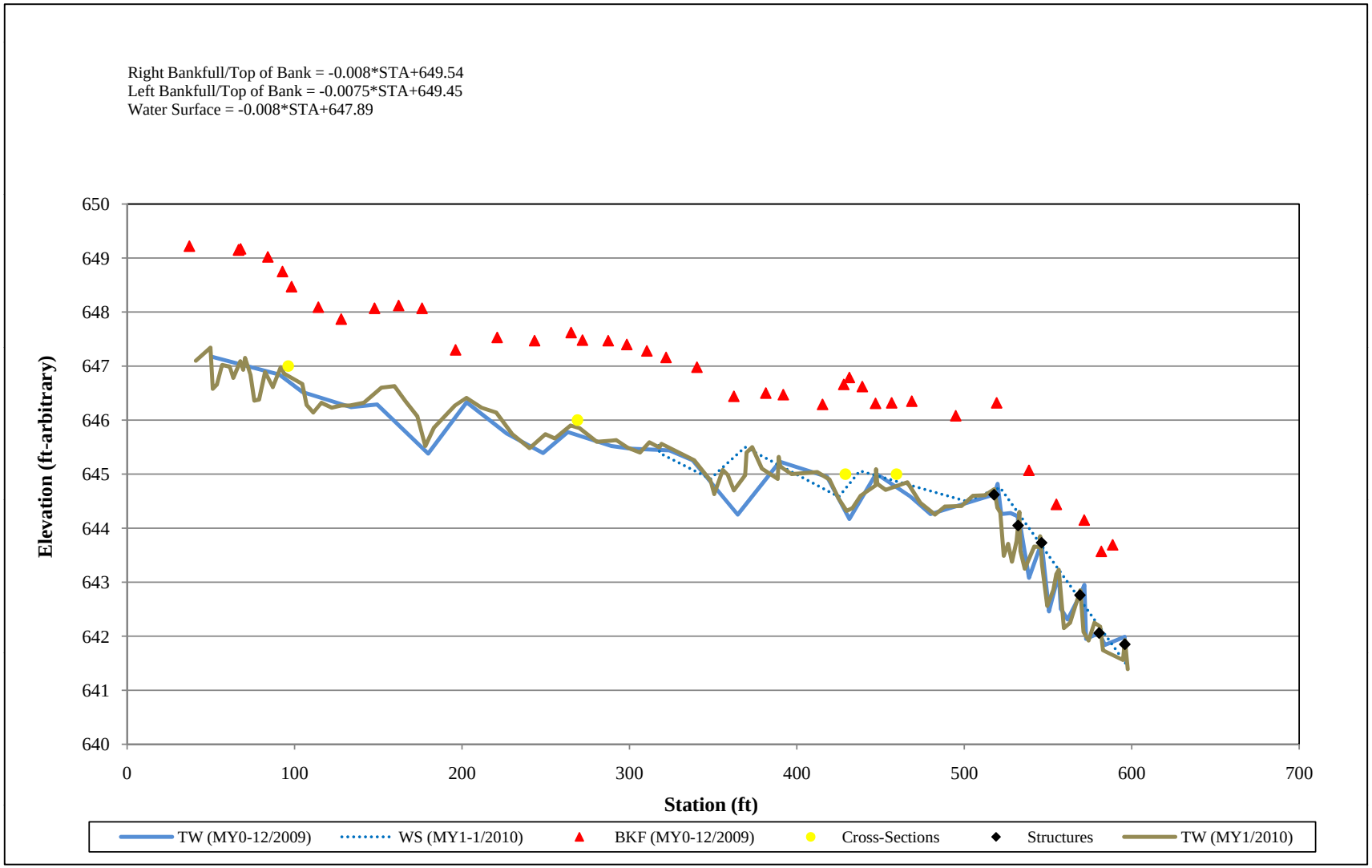
XS-4: View Upstream

XS-4: View Downstream

Station	Elevation	Notes
0.0	647.34	xs4-lpt
0.2	647.28	xs4
5.6	647.45	xs4
11.7	647.15	xs4
14.9	646.64	xs4
17.8	646.49	xs4
20.7	646.56	xs4
23.3	646.59	xs4-lb
24.1	646.43	xs4
25.4	645.75	xs4
26.5	644.92	xs4
27.5	644.85	xs4
28.7	644.82	xs4
29.9	644.82	xs4
30.7	645.57	xs4
32.8	646.49	xs4-lb
40.9	646.37	xs4
46.7	646.93	xs4
52.5	647.15	xs4-rpt



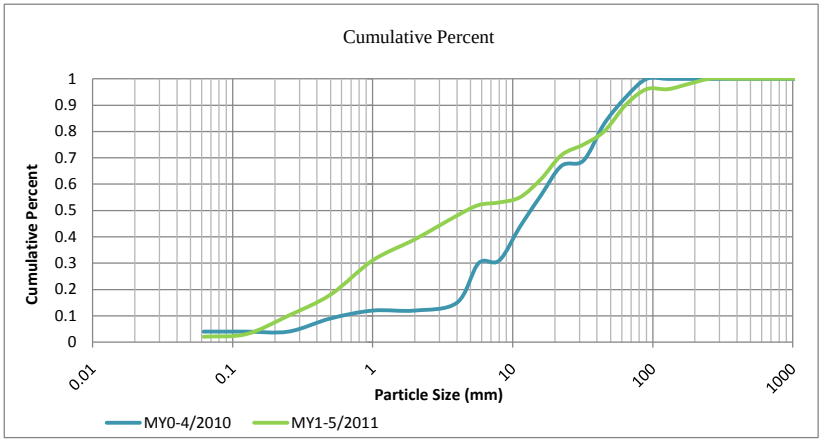
Appendix D
Figure 4. Longitudinal Profile with Annual Overlays
Dutch Buffalo Creek Stream and Wetland Restoration EEP Project No. 370
Monitoring Year 1 of 5

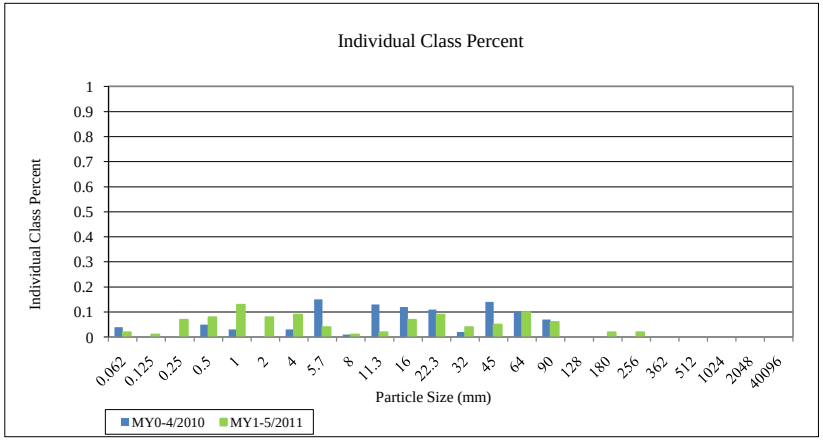


Appendix D. Stream Survey Data
Figure 5a: Pebble Count Plots with Annual Overlays
DBC (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5

Project Name: Dutch Buffalo Creek (Unnamed Tributary)					
Cross-Section: 1					
Feature: Riffle					
			MY1-5/2011		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	2	2%	2%
Sand	very fine sand	0.125	1	1%	3%
	fine sand	0.250	7	7%	10%
	medium sand	0.50	8	8%	18%
	coarse sand	1.00	13	13%	31%
	very coarse sand	2.0	8	8%	39%
Gravel	very fine gravel	4.0	9	9%	48%
	fine gravel	5.7	4	4%	52%
	fine gravel	8.0	1	1%	53%
	medium gravel	11.3	2	2%	55%
	medium gravel	16.0	7	7%	62%
	course gravel	22.3	9	9%	71%
	course gravel	32.0	4	4%	75%
	very coarse gravel	45	5	5%	80%
	very coarse gravel	64	10	10%	90%
Cobble	small cobble	90	6	6%	96%
	medium cobble	128	0	0%	96%
	large cobble	180	2	2%	98%
	very large cobble	256	2	2%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			100	100%	100%

Summary Data	
D50	4.85
D84	52.60
D95	85.67





Appendix D. Stream Survey Data

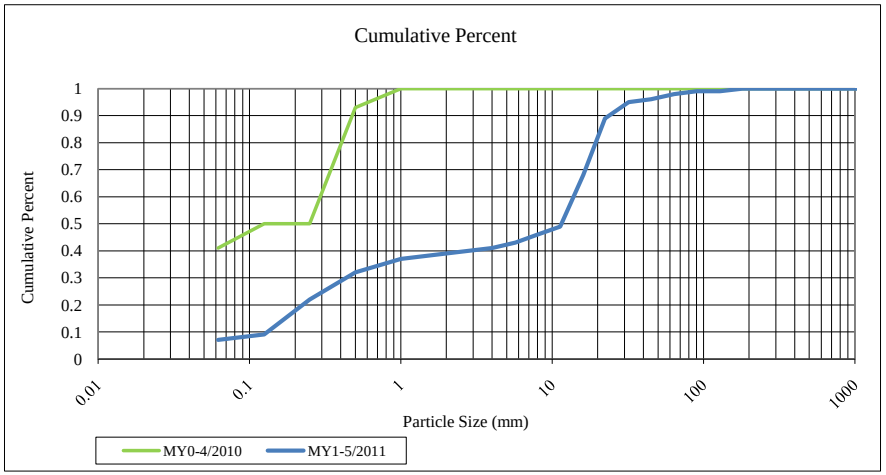
Figure 5b: Pebble Count Plots with Annual Overlays

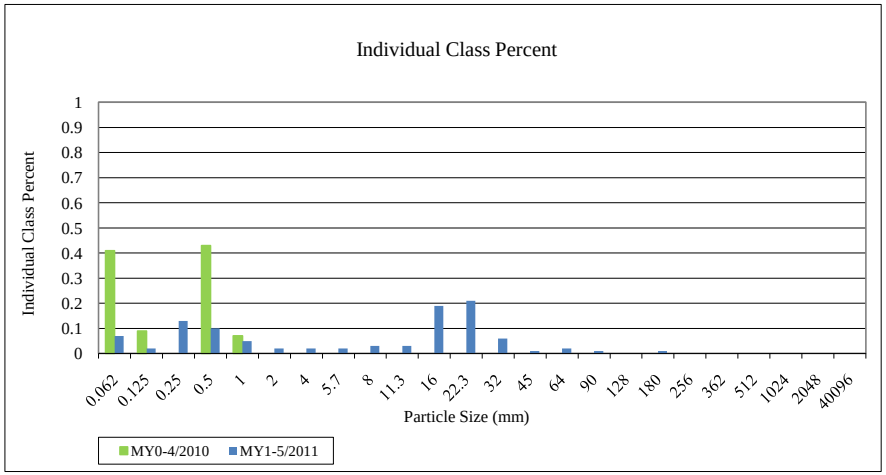
DBC (Suther) Stream and Wetland Restoration/EEP Project No. 370

Monitoring Year 1 of 5

Project Name: Dutch Buffalo Creek (Unnamed Tributary)					
Cross-Section: 2					
Feature: Pool					
			MY1-5/2011		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	7	7%	7%
Sand	very fine sand	0.125	2	2%	9%
	fine sand	0.250	13	13%	22%
	medium sand	0.50	10	10%	32%
	coarse sand	1.00	5	5%	37%
	very coarse sand	2.0	2	2%	39%
Gravel	very fine gravel	4.0	2	2%	41%
	fine gravel	5.7	2	2%	43%
	fine gravel	8.0	3	3%	46%
	medium gravel	11.3	3	3%	49%
	medium gravel	16.0	19	19%	68%
	course gravel	22.3	21	21%	89%
	course gravel	32.0	6	6%	95%
	very coarse gravel	45	1	1%	96%
	very coarse gravel	64	2	2%	98%
Cobble	small cobble	90	1	1%	99%
	medium cobble	128	0	0%	99%
	large cobble	180	1	1%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			100	100%	100%

Summary Data	
D50	11.55
D84	20.80
D95	32.00

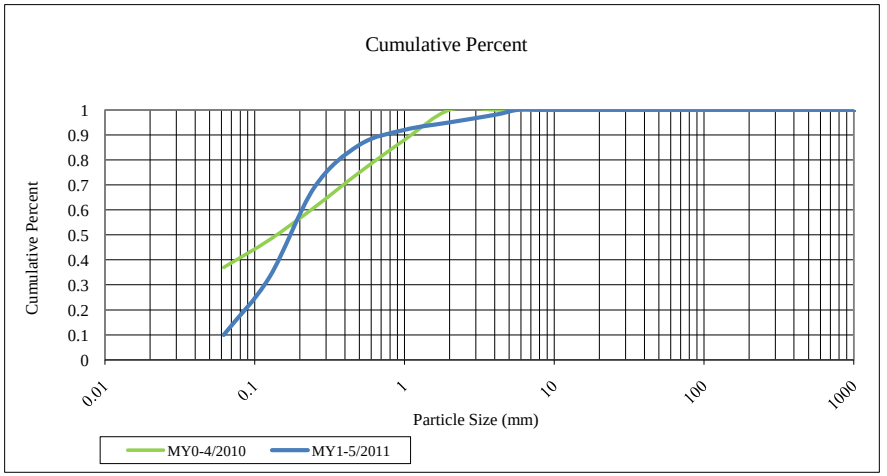


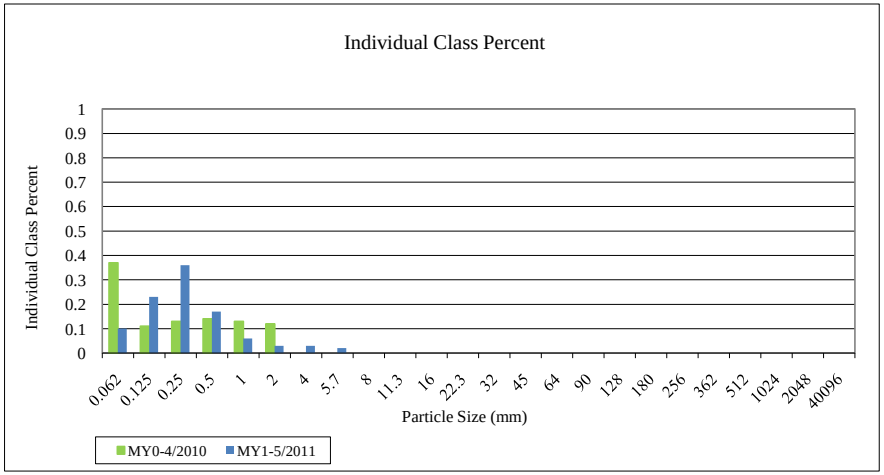


Appendix D. Stream Survey Data
Figure 5c: Pebble Count Plots with Annual Overlays
DBC (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5

Project Name: Dutch Buffalo Creek (Unnamed Tributary)					
Cross-Section: 3					
Feature: Pool					
			MY1-5/2011		
Description	**Material**	**Size (mm)**	**Total #**	**Item %**	**Cum %**
Silt/Clay	silt/clay	0.062	10	10%	10%
Sand	very fine sand	0.125	23	23%	33%
	fine sand	0.250	36	36%	69%
	medium sand	0.50	17	17%	86%
	coarse sand	1.00	6	6%	92%
	very coarse sand	2.0	3	3%	95%
Gravel	very fine gravel	4.0	3	3%	98%
	fine gravel	5.7	2	2%	100%
	fine gravel	8.0	0	0%	100%
	medium gravel	11.3	0	0%	100%
	medium gravel	16.0	0	0%	100%
	course gravel	22.3	0	0%	100%
	course gravel	32.0	0	0%	100%
	very coarse gravel	45	0	0%	100%
	very coarse gravel	64	0	0%	100%
Cobble	small cobble	90	0	0%	100%
	medium cobble	128	0	0%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			100	100%	100%

Summary Data	
D50	0.18
D84	0.47
D95	2.00

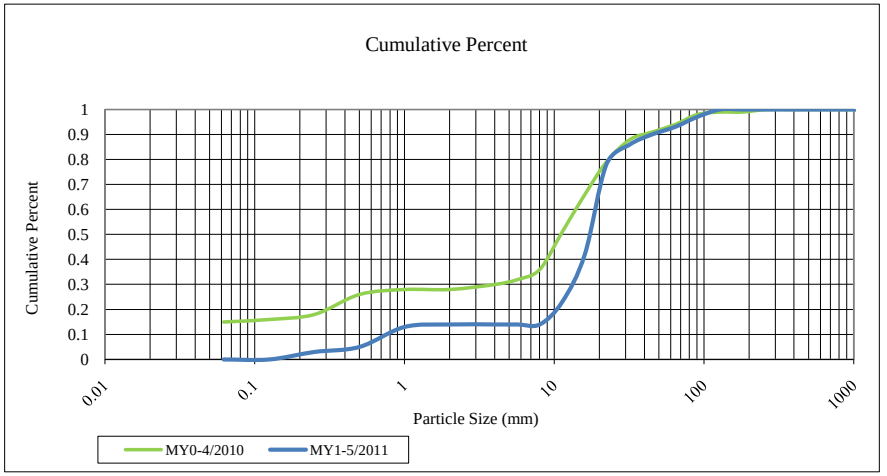




Appendix D. Stream Survey Data
Figure 5d: Pebble Count Plots with Annual Overlays
DBC (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5

Project Name: Dutch Buffalo Creek (Unnamed Tributary)					
Cross-Section: 4					
Feature: Riffle					
			MY1-5/2011		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	0	0%	0%
Sand	very fine sand	0.125	0	0%	0%
	fine sand	0.250	3	3%	3%
	medium sand	0.50	2	2%	5%
	coarse sand	1.00	8	8%	13%
	very coarse sand	2.0	1	1%	14%
Gravel	very fine gravel	4.0	0	0%	14%
	fine gravel	5.7	0	0%	14%
	fine gravel	8.0	0	0%	14%
	medium gravel	11.3	9	9%	23%
	medium gravel	16.0	19	19%	42%
	course gravel	22.3	36	36%	78%
	course gravel	32.0	8	8%	86%
	very coarse gravel	45	4	4%	90%
	very coarse gravel	64	3	3%	93%
Cobble	small cobble	90	4	4%	97%
	medium cobble	128	3	3%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			100	100%	100%

Summary Data	
D50	17.40
D84	29.58
D95	77.00



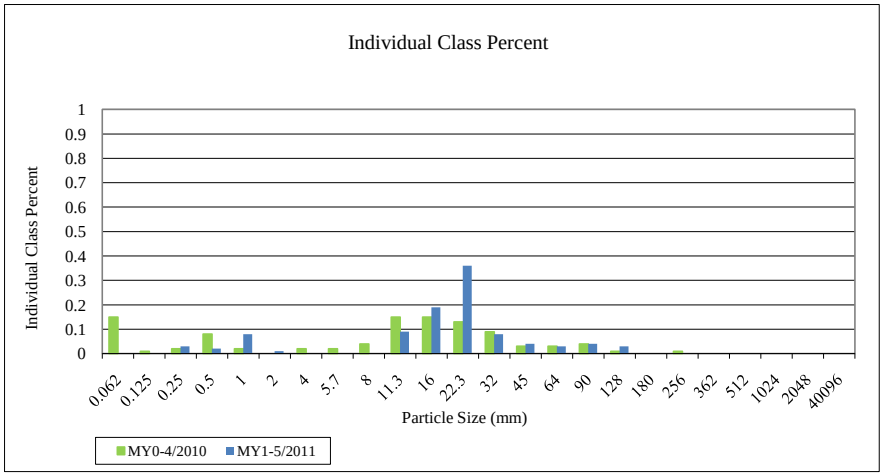


Table 10a. Baseline Stream Data Summary

Dutch Buffalo Creek Stream and Wetland Restoration/EEP Project Number 370

Unnammed Tributary to Dutch Buffalo (608 linear feet)

Parameter	Gauge	Regional Curve			Pre-Existing Condition						Reference Reach Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle	-	**LL**	**UL**	**Eq.**	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Med	Max	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)	-	6.83	7.55	7.19	-	8.68	-	-	-	10	-	8.3	-	-	-	-	-	9	-	8.34	8.60	8.60	8.85	-	-
Floodprone Width (ft)					-	9.8	-	-	-	10	-	130	-	-	-	-	-	150	-	52.52	54.05	54.05	55.57	-	-
Bankfull Mean Depth (ft)	-	0.98	1.08	1.03	-	1.17	-	-	-	10	-	1.3	-	-	-	-	-	1	-	1.00	1.02	1.02	1.04	-	-
Bankfull Max Depth (ft)	-				-	1.49	-	-	-	10	-	1.9	-	-	-	-	-	1.5	-	1.67	1.74	1.74	1.81	-	-
Bankfull Cross-Sectional Area (ft^2)	-	9.18	10.14	9.66	-	10.17	-	-	-	10	-	10.95	-	-	-	-	-	9	-	8.30	8.77	8.77	9.24	-	-
Width/Depth Ratio	-				-	7.42	-	-	-	10	-	6.4	-	-	-	-	-	9	-	8.34	8.43	8.43	8.51	-	-
Entrenchment Ratio	-				-	1.13	-	-	-	10	-	15.66	-	-	-	-	-	16.67	-	6.28	6.29	6.29	6.30	-	-
Bank Height Ratio	-				-	2.53	-	-	-	10	-	1.2	-	-	-	-	-	1	-	1	1	1	1	-	-
Pattern																									
Channel Beltwidth (ft)					2.5	-	-	19.4	-	46	33	51	-	69	-	2	33.3	57.15	81	33.3	57.15	57.15	81	-	-
Radius of Curvature (ft)					10.38	-	-	37.99	-	76	12	15.5	-	19	-	2	22.5	24.75	27	22.5	24.75	24.75	27	-	-
Rc:Bankfull width (ft/ft)					1.2	-	-	4.38	-	76		8.3	-		-	1	2.5	2.75	3	2.5	2.75	3		-	-
Meander Wavelength (ft)					43	-	-	109	-	50	60	64.5	-	69	-	2	57.6	91.80	126	57.6	91.8	91.8	126	-	-
Meander Width Ratio					0.29	-	-	2.24	-	46	4	6.15	-	8.3	-	2	3.7	6.35	9	3.7	6.35	6.35	9	-	-
Profile																									
Riffle Length (ft)					6.76	-	-	41.57	-	4	5.4	-	-	23	-	2	14.4	33.40	52.4	13.76	-	-	19.36	-	-
Riffle Slope (ft/ft)					0.0031	-	-	0.0386	-	4	0.016	-	-	0.024	-		0.014	0.02	0.024	0.00142	-	-	0.01113	-	-
Pool Length (ft)					5.89	-	-	37.56	-	7	7.8	-	-	35	-	2	54.12	64.72	75.32	10.32	-	-	31.4	-	-
Pool Max Depth (ft)						1.79	-	-	-	7		2.4	-	-	-	-	1	1.40	1.8	-	-	-	-	-	-
Pool Spacing (ft)					17.35	-	-	125.66	-	7	40.3	-	-	60	-	-	44.1	54.45	64.8	10.32	-	-	52.04	-	-
Transport Parameters																									
Reach Shear Stress (competency) lb/ft^2					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.95
Max part size (mm) mobilized at bankful					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stream Power (transport capacity) W/m^2					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Additional Reach Parameters																									
Rosgen Classification	-				G5c						E4						C/E4			E4					
Bankful Velocity (fps)	-	-	-	-	3.8						3.5						3.65			3.65					
Bankful Discharge (cfs)	-	-	-	-	39.04*						38						39.04*			39.04*					
Valley Length (ft)					-						-						-			0.0093					
Channel Thalweg Length (ft)					608						608						608			608					
Sinuosity (ft)					1.24						1.8						1.13			1.16					
Water Surface Slope (ft/ft)	-				0.008						0.005						0.006			0.008					
BF slope (ft/ft)	-				0.008						0.005						0.006			0.008					
Bankful Floodplain Area (acres)					0.14						1.81						2.09			0.75					
% of Reach with Eroding Banks					-						-						-			0					
Channel Stability or Habitat Metric					-						-						-			-					
Biological or Other					-						-						-			-					

*Calculated using Flowmaster

Table 10b. Baseline Stream Data Summary (Substrate, Bed, Bank and Hydrologic Containment Parameter Distributions)				
Dutch Buffalo Creek Stream and Wetland Restoration/EEP Project No. 370				
Unnammed Tributary to Dutch Buffalo (608 linear feet)				
Parameter	**Pre-Existing Condition**	**Reference Reach Data**	**Design**	**As-built/Baseline**
Ri%/Ru%/P%/G%/S%	-	-	-	-
SC% / Sa% / G% / C% / B% / Be%	-	-	-	24.5/35.75/36.75/3.25/0/0
d16 / d35 / d50 / d84 / d95 (mm)	0.12/0.83/2.36/11.03/22.6	-	-	1.45/5.85/8.29/25.06/47.52
Entrenchment Class<1.5/1.5-1.99/2.0-4.9/5.0-	100% <1.5 (1.13)	100% > 10 (15.66)	100% > 10 (16.67)	5.0 < 100% < 9.9 (5.35, 6.30)
Incision Class <1.2/1.2-1.49/1.5-1.99/>2.0	(2.53) 100% > 2.0	1.2=(1.2) 100% <1.49	(1.0) 100%< 1.2	(1.0) 100%< 1.2

Table 11a. Monitoring Data - Dimensional Morphology Summary
Dimensional Parameters - Cross Sections
Dutch Buffalo Creek Stream and Wetland Restoration/EEP Project No. 370
Unnammed Tributary to Dutch Buffalo (608 linear feet)

PARAMETER		Cross-Section 1 (Riffle)						Cross-Section 2 (Pool)					
DIMENSION	Baseline	MY1-2010	MY2-2011	MY3-2012	MY4-2013	MY5-2014	Baseline	MY1-2010	MY2-2011	MY3-2012	MY4-2013	MY5-2014
Bankfull Width (ft)	8.9	8.7					9.6	9.7				
Floodprone Width (ft)	55.6	55.6					53.3	53.2				
Bankfull Mean Depth	1.0	1.1					1.1	1.0				
Bankfull Max Depth (ft)	1.8	1.7					1.7	1.6				
Bankfull Cross-sectional Area (ft^2)	9.2	8.8					10.2	9.4				
Bankfull Width/Depth Ratio	8.5	8.6					9.1	10.0				
Bankfull Entrenchment Ratio	6.3	6.4					5.6	5.5				
Bankfull Bankheight Ratio	1.0	1.0					1.0	1.0				
Cross Sectional Area between end pins (ft^2)	75.0	69.6					12.0	9.8				
d50 (mm)	13.7	4.9					0.1	11.6				

PARAMETER		Cross-Section 3 (Pool)						Cross-Section 4 (Riffle)					
DIMENSION	Baseline	MY1-2010	MY2-2011	MY3-2012	MY4-2013	MY5-2014	Baseline	MY1-2010	MY2-2011	MY3-2012	MY4-2013	MY5-2014
Bankfull Width (ft)	11.0	10.5					8.3	8.3				
Floodprone Width (ft)	59.0	58.0					52.5	52.5				
Bankfull Mean Depth	0.8	0.7					1.0	1.0				
Bankfull Max Depth (ft)	1.9	1.6					1.7	1.6				
Bankfull Cross-sectional Area (ft^2)	9.3	7.5					8.3	8.4				
Bankfull Width/Depth Ratio	13.1	14.8					8.3	8.2				
Bankfull Entrenchment Ratio	5.4	5.5					6.3	6.3				
Bankfull Bankheight Ratio	1.0	1.0					1.0	1.0				
Cross Sectional Area between end pins (ft^2)	49.8	35.4					39.6	36.3				
d50 (mm)	0.1	0.2					11.1	17.5				

Table 11b. Monitoring Data - Stream Reach Data Summary
Dutch Buffalo Creek Stream and Wetland Restoration/EEP Project No. 370
Unnammed Tributary to Dutch Buffalo (608 linear feet)

Parameter	Baseline						MY 1 2010					
DIMENSION	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)	8.34	8.60	8.60	8.85	-	2	8.31	8.52	8.52	8.72	-	2
Floodprone Width (ft)	52.52	54.05	54.05	55.57	-	2	52.49	54.07	54.07	55.64	-	2
Bankfull Mean Depth (ft)	1.00	1.02	1.02	1.04	-	2	1.01	1.01	1.01	1.01	-	2
Bankfull Max Depth (ft)	1.67	1.74	1.74	1.81	-	2	1.56	1.63	1.63	1.70	-	2
Bankfull Cross Sectional Area (ft2)	8.30	8.77	8.77	9.24	-	2	8.42	8.62	8.62	8.82	-	2
Width/Depth Ratio	8.34	8.43	8.43	8.51	-	2	8.23	8.43	8.43	8.63	-	2
Entrenchment Ratio	6.28	6.29	6.29	6.30	-	2	6.32	6.35	6.35	6.38	-	2
Bank Height Ratio	1	1	1	1	-	2	1	1	1	1	-	2
Bankfull Velocity (fps)	4.70	4.45	4.45	4.23	-	2	4.64	4.53	4.53	4.43	-	2
PROFILE												
Riffle Length (ft)	13.76	21.29	21.29	28.82	-	2	16.07	22.09	22.09	28.11	-	3
Riffle Slope (ft/ft)	0.00142	0.01	0.01	0.01856	-	2	0.00916	0.01006	0.01006	0.01096	-	3
Pool Length (ft)	10.32	31.83	31.83	53.33	-	2	18.30	27.90	27.90	37.49	-	3
Pool Max depth	1.72	1.82	1.82	1.91	-	2	1.62	1.63	1.63	1.63	-	2
Pool Spacing (ft)	10.32	42.80	42.80	75.27	-	2	19.98	23.64	23.64	27.29	-	3
PATTERN												
Channel Beltwidth (ft)	33.30	57.15	57.15	81.00	-	2	33.30	57.15	57.15	81.00	-	2
Radius of Curvature (ft)	22.50	24.75	24.75	27.00	-	2	22.50	24.75	24.75	27.00	-	2
Meander Wavelength (ft)	57.60	91.80	91.80	126.00	-	2	57.60	91.80	91.80	126.00	-	2
Meander Width Ratio	3.70	6.35	6.35	9.00	-	2	3.70	6.35	6.35	9.00	-	2
ADDITIONAL REACH PARAMETERS												
Rosgen Classification	E4						E4					
Channel Thalweg length (ft)	608						608					
Sinuosity (ft)	1.16						1.16					
Water Surface Slope (Channel) (ft/ft)	0.008						N/A*					
BF slope (ft/ft)	0.008						0.008					
Ri%/Ru%/P%/G%/S%	-	-	-	-	-		29	1.20	38.10	-	0.2	
SC%/Sa%/G%/C%/B%/Be%												
d16 / d35 / d50 / d84 / d95												
% of reach with eroding banks	0						4					
Channel Stability or Habitat Metric	-						-					
Biological or Other	-						-					

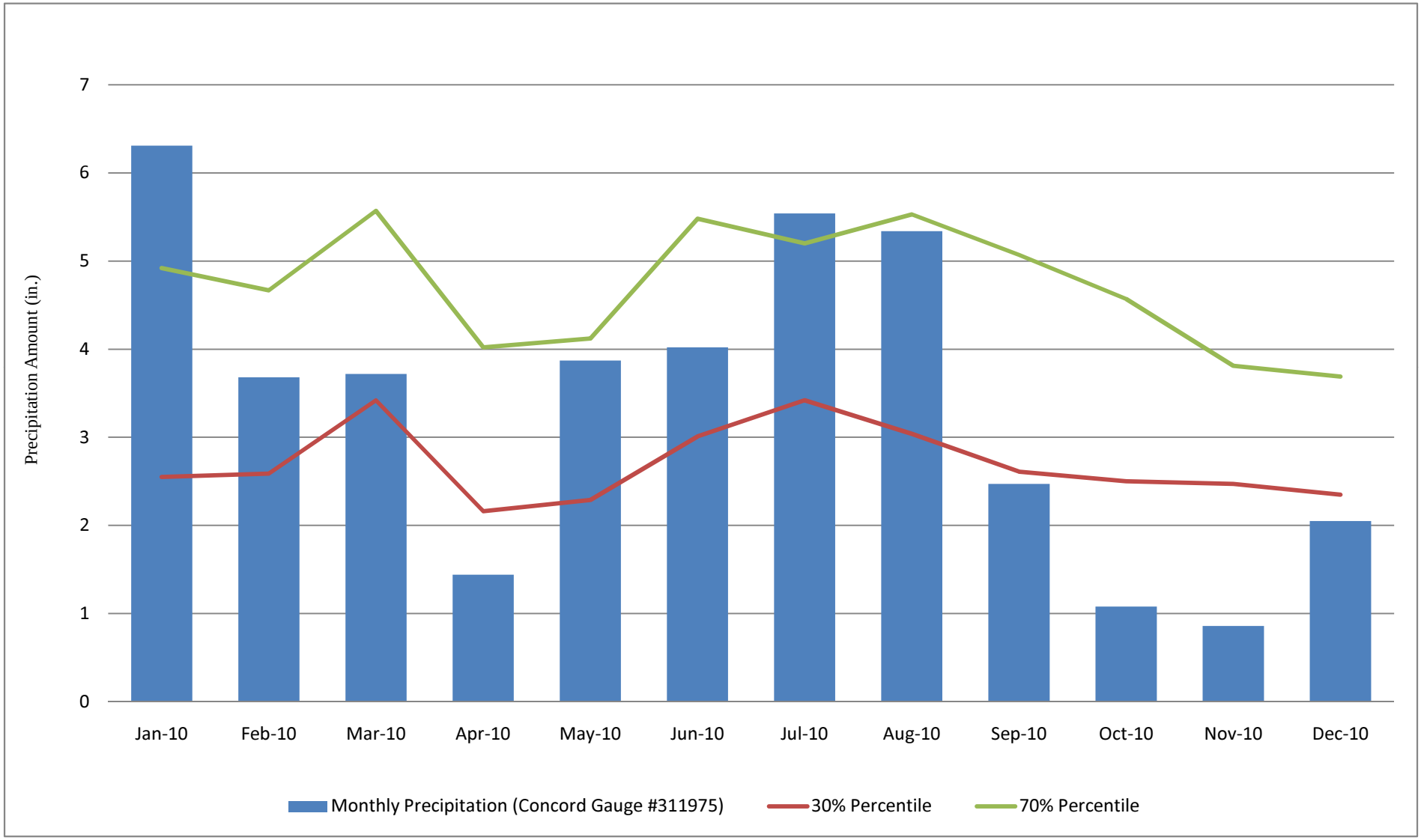
*Insufficient water in channel to estimate an approximate value

APPENDIX E
HYDROLOGIC DATA

Table 12. Verification of Bankfull Events
Dutch Buffalo Creek Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5

Date of Collection	Date of Occurrence	Method	Photo # (if available)
12/2009-4/2010	12/2009-4/2010	Visual	N/A
5/18//2011	4/2010-5/2011	Crest Gauge	N/A

Figure 6: Dutch Buffalo Creek 30-70 Percentile Graph for Rainfall in 2010, Concord NC
DBC (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5



*Historical rainfall data referenced from NC Cronos Database Divisional Data for the Southern Piedmont of North Carloina - Data Period January 1980 through December 2010

Data Period January 1980 through December 2010

Figure 7a: Precipitation and Water Level Plots for Gauges
DBC (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5

Growing Season: March 23-November 7

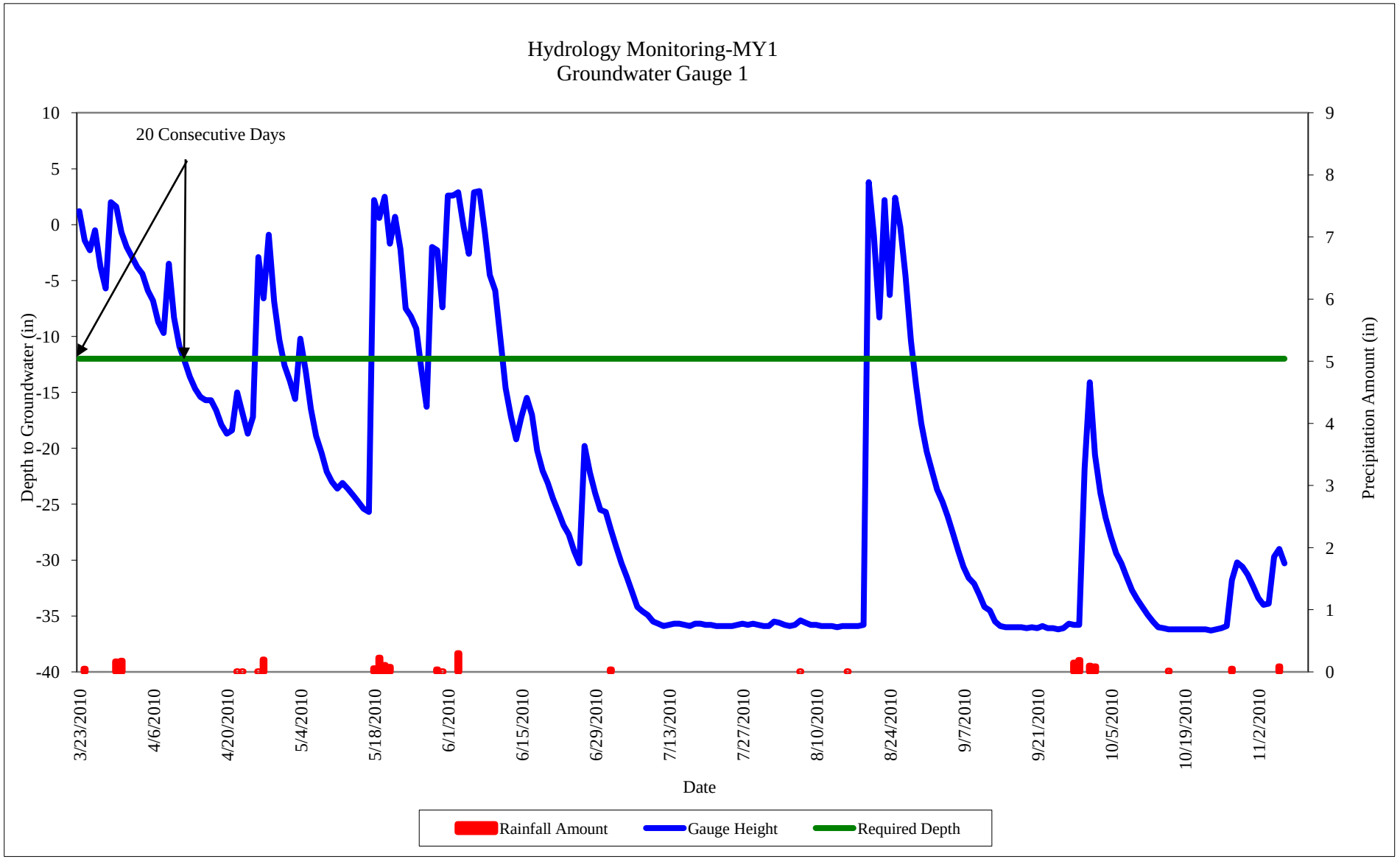


Figure 7b: Precipitation and Water Level Plots for Gauges
DBC (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5

Growing Season: March 23-November 7

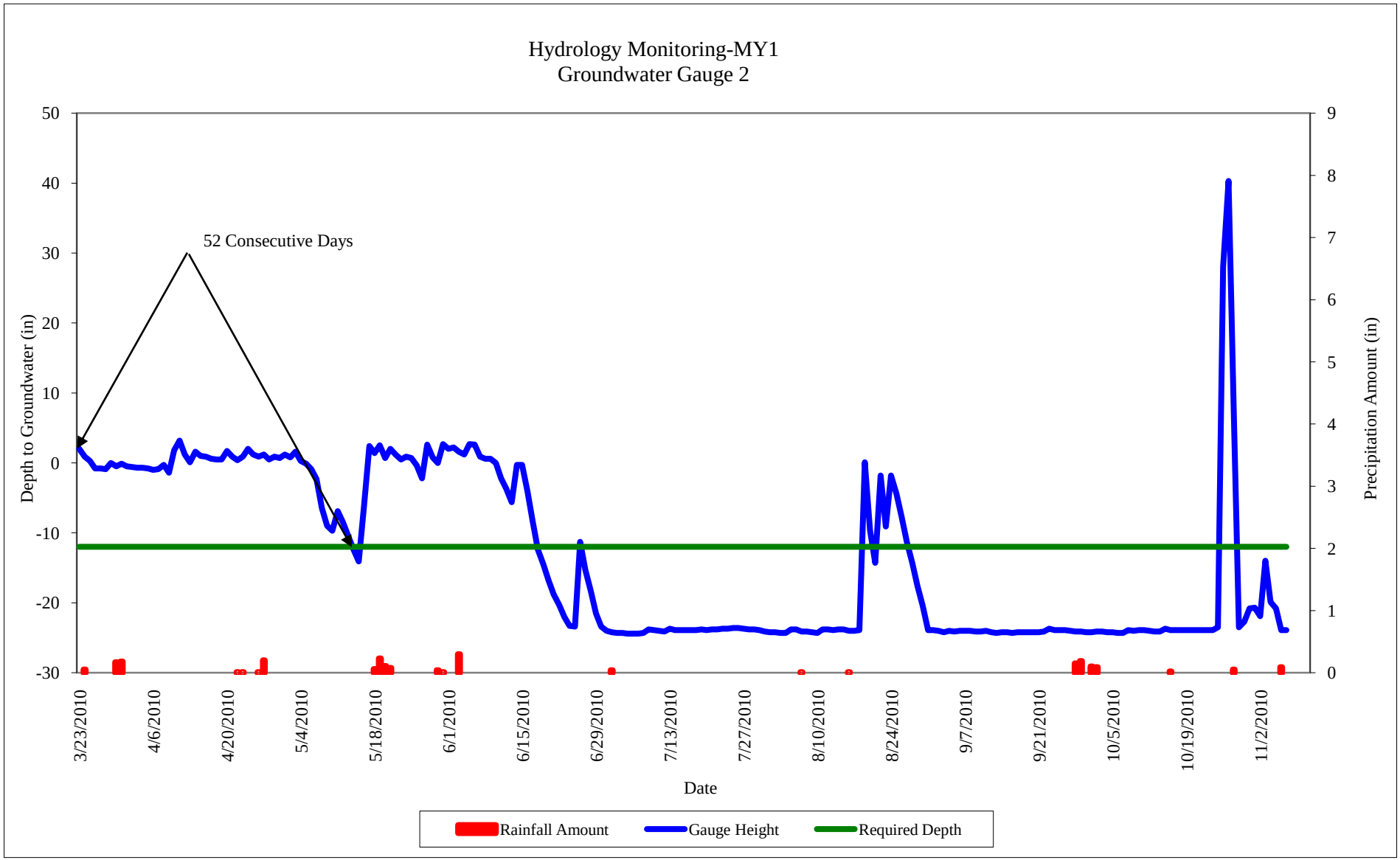


Figure 7c: Precipitation and Water Level Plots for Gauges
DBC (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5

Growing Season: March 23-November 7

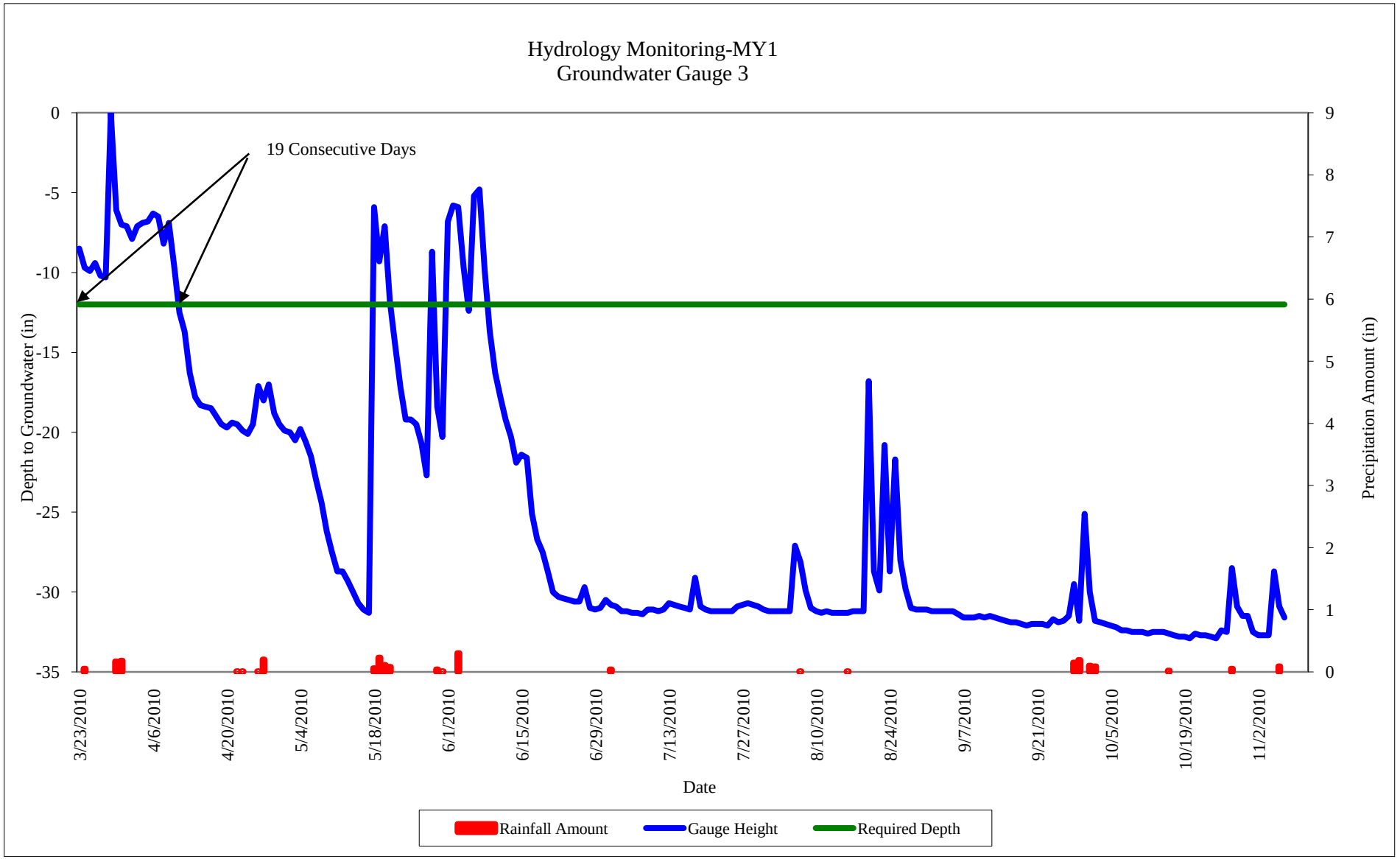


Figure 7d: Precipitation and Water Level Plots for Gauges
DBC (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5

Growing Season: March 23-November 7

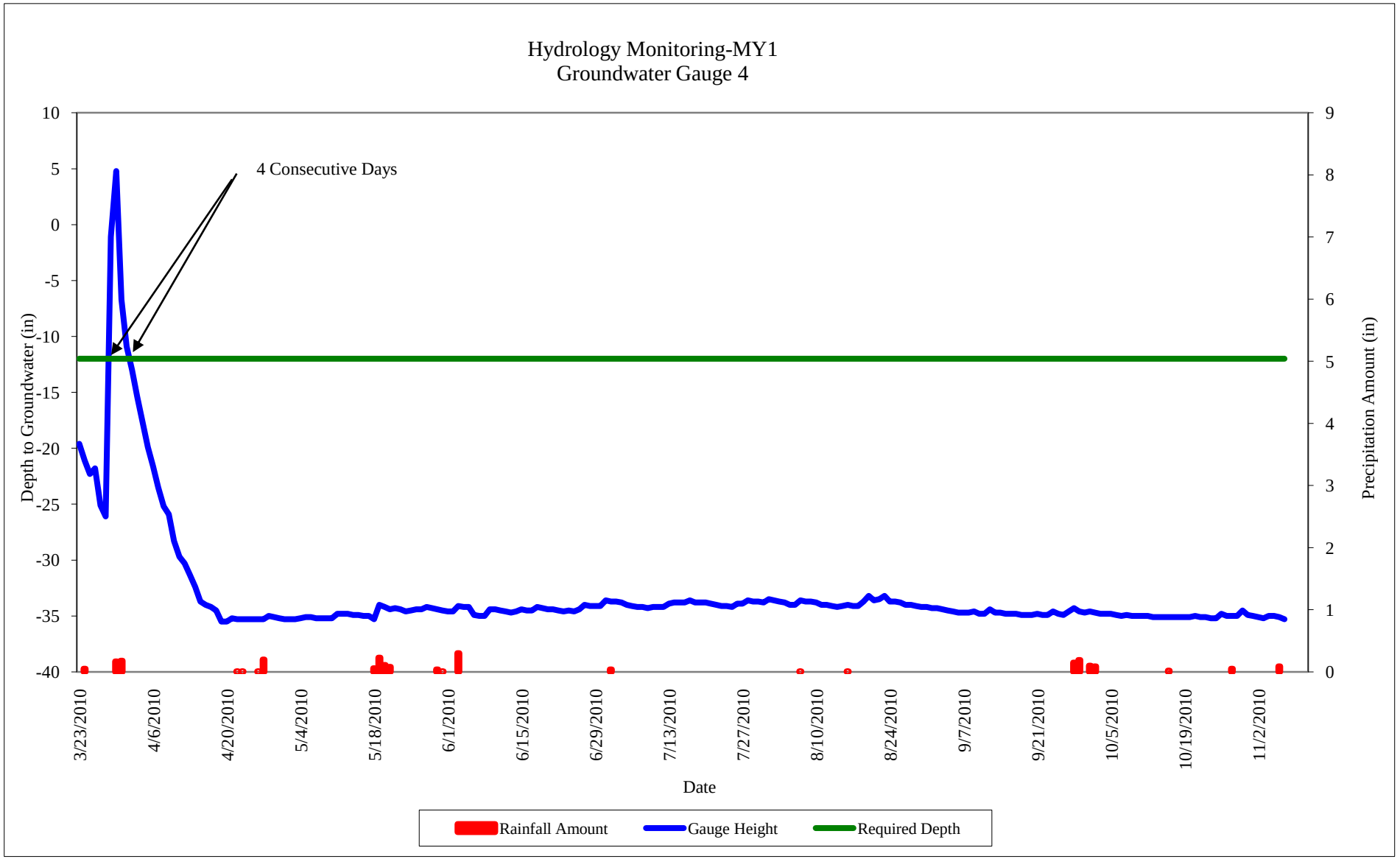


Figure 7e: Precipitation and Water Level Plots for Gauges
DBC (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5

Growing Season: March 23-November 7

(Groundwater gauge replaced April 2010 due to gauge malfunction prior to baseline monitoring.)

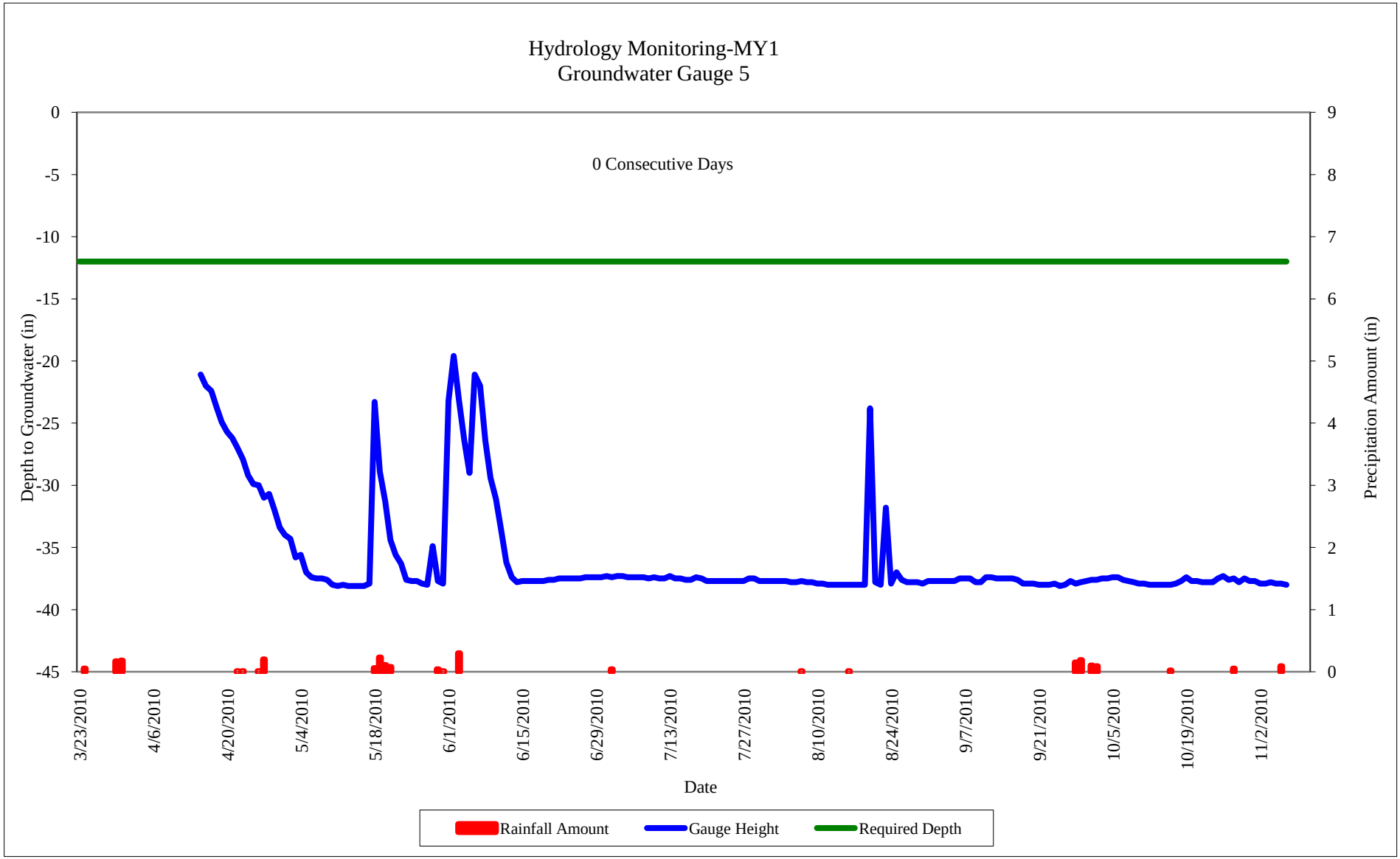


Figure 7f: Precipitation and Water Level Plots for Gauges
DBC (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5

Growing Season: March 23-November 7

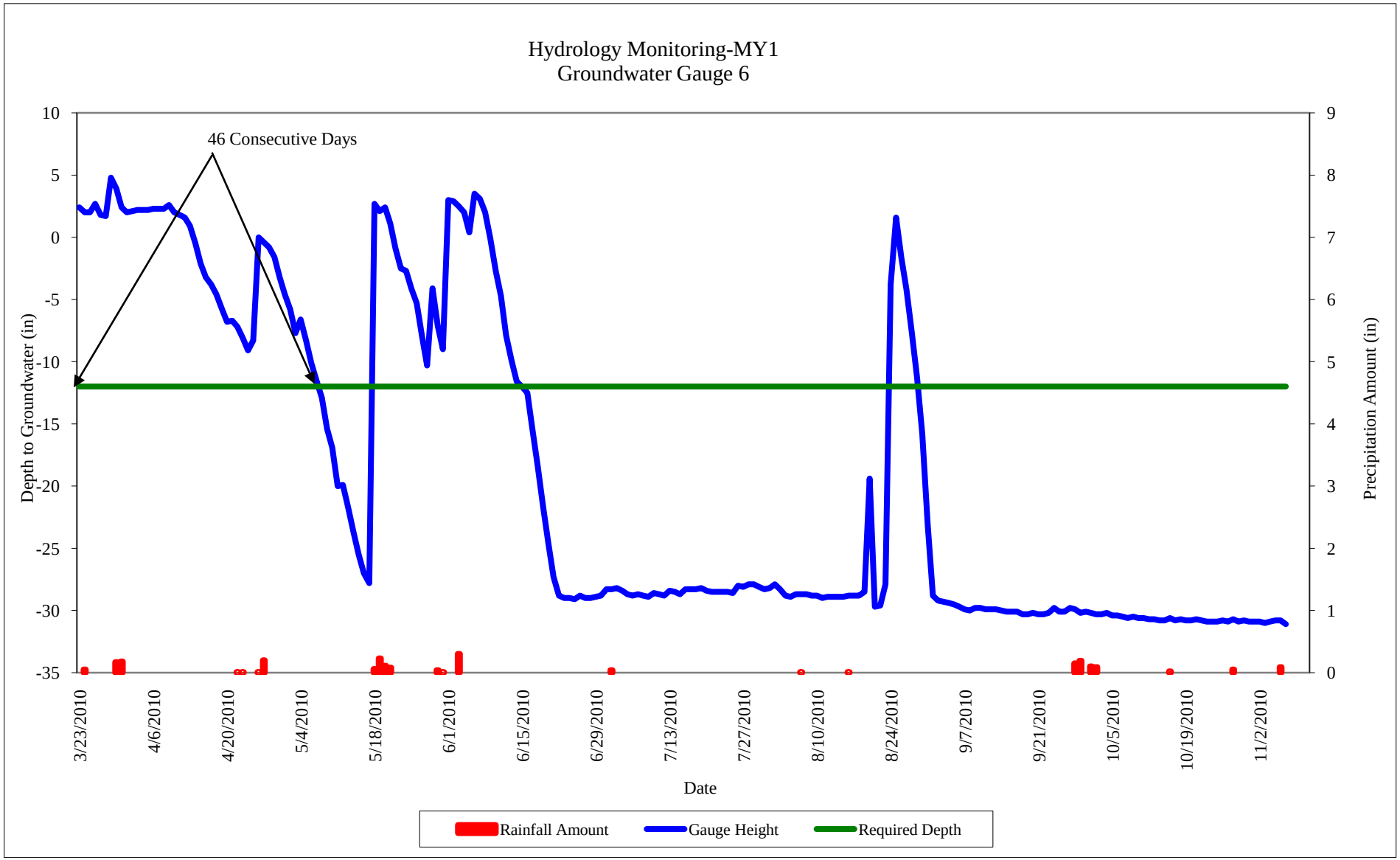


Figure 7g: Precipitation and Water Level Plots for Gauges
DBC (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5

Growing Season: March 23-November 7

(Gauge malfunctioned at the beginning of the growing season prior to starting the 2010 monitoring)

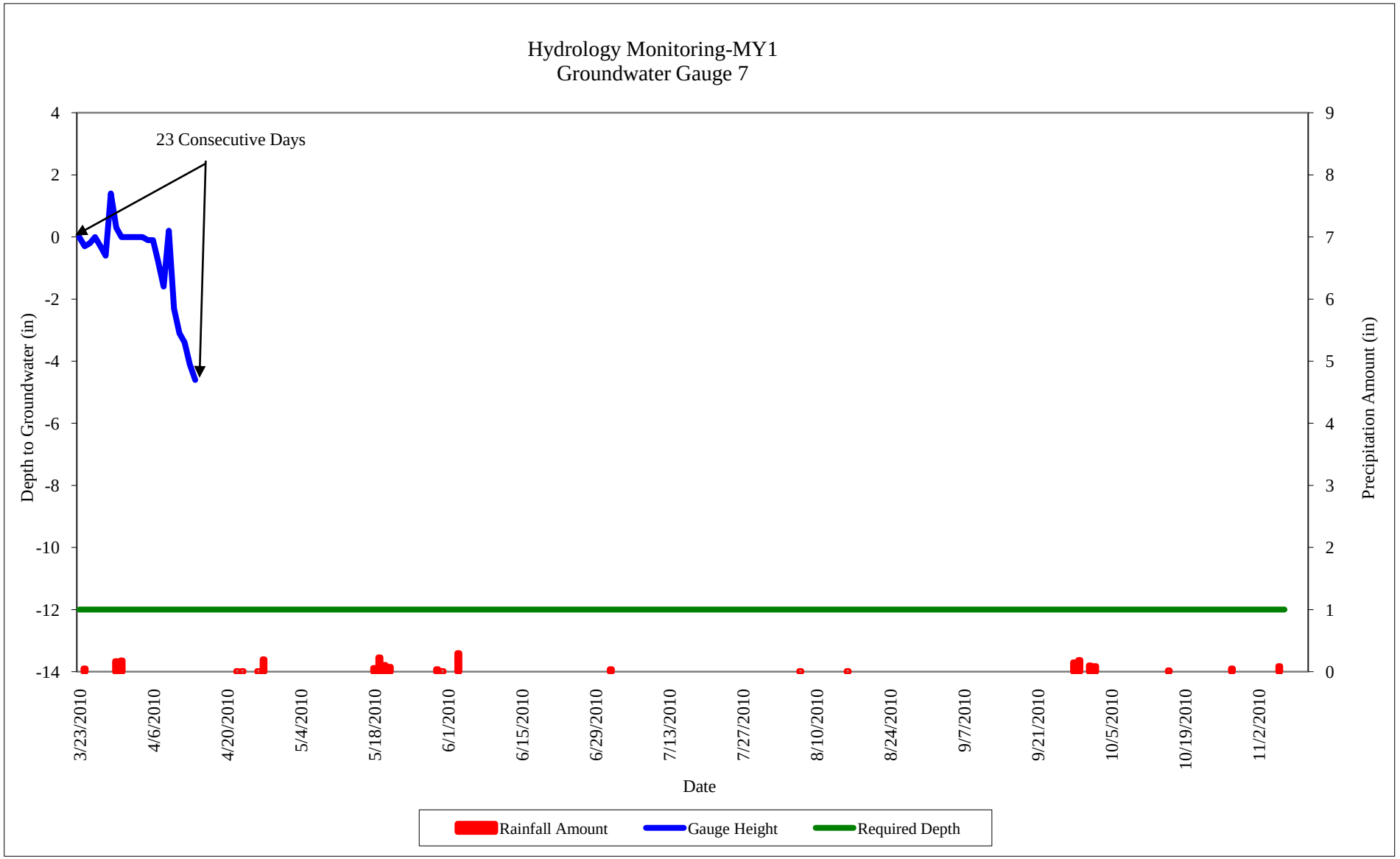


Figure 7h: Precipitation and Water Level Plots for Gauges
DBC (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5

Growing Season: March 23-November 7

(Gauge malfunctioned at the beginning of the growing season prior to starting the 2010 monitoring)

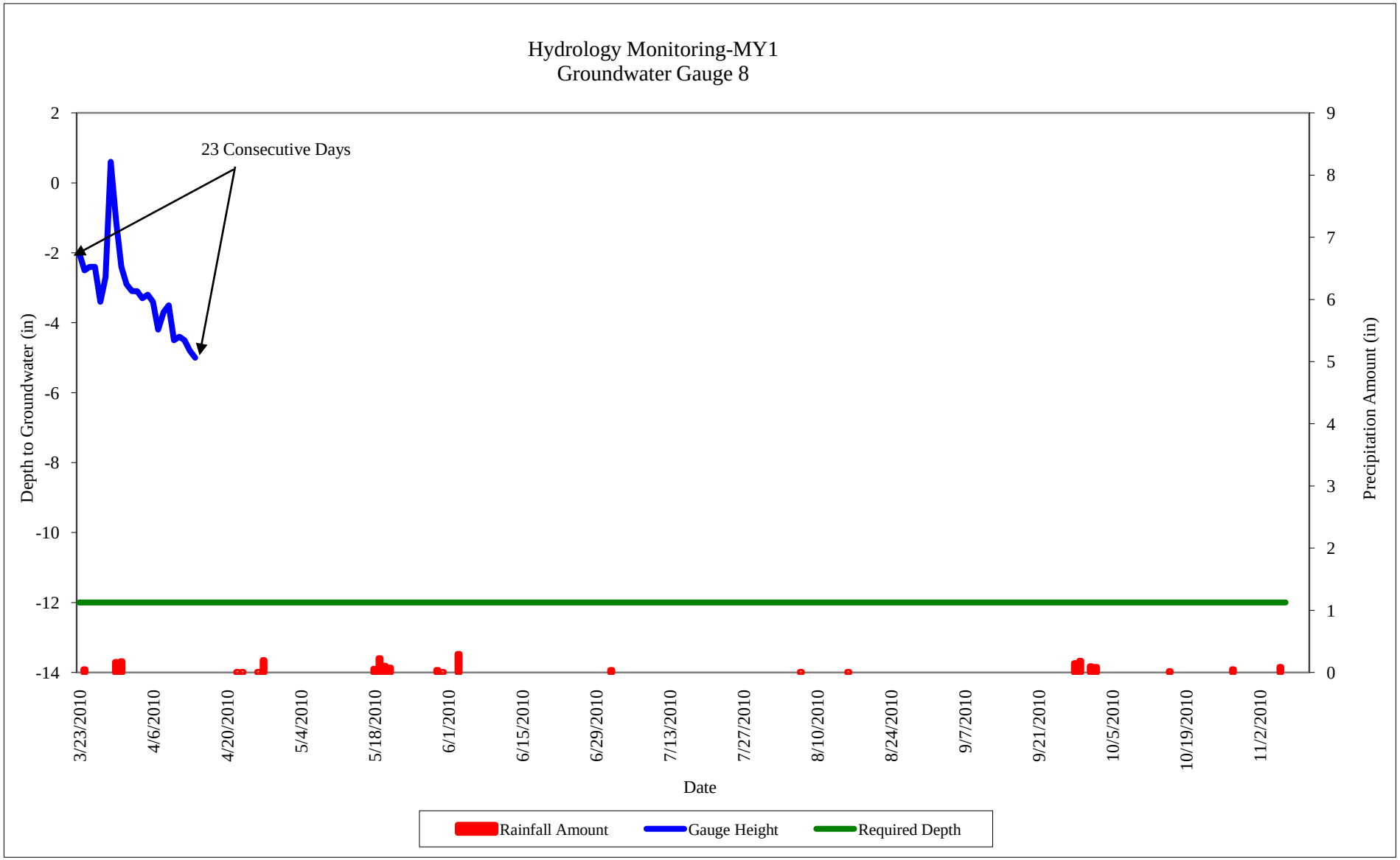


Figure 7i: Precipitation and Water Level Plots for Gauges
DBC (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5

Growing Season: March 23-November 7

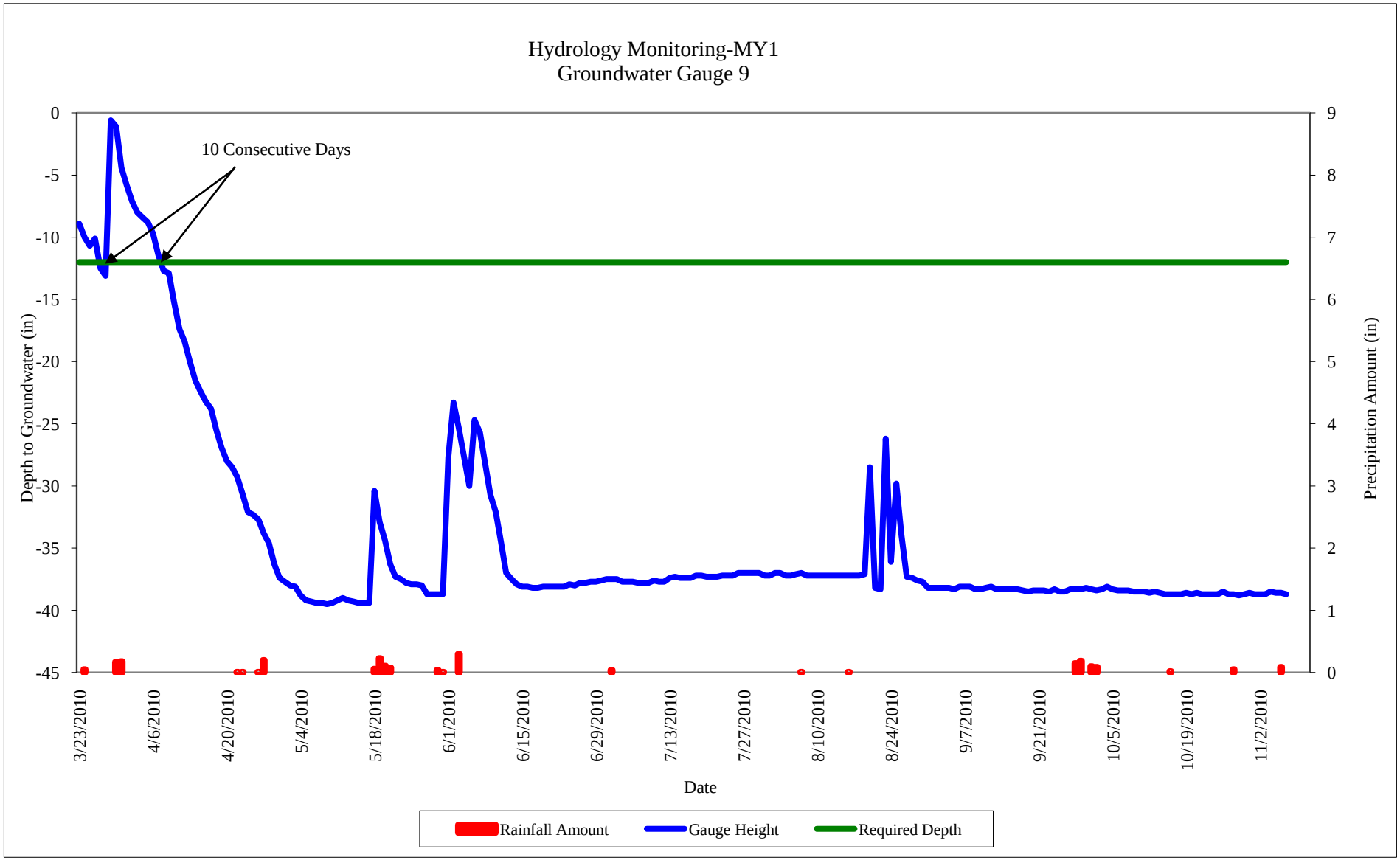


Figure 7j: Precipitation and Water Level Plots for Gauges
DBC (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5

Growing Season: March 23-November 7

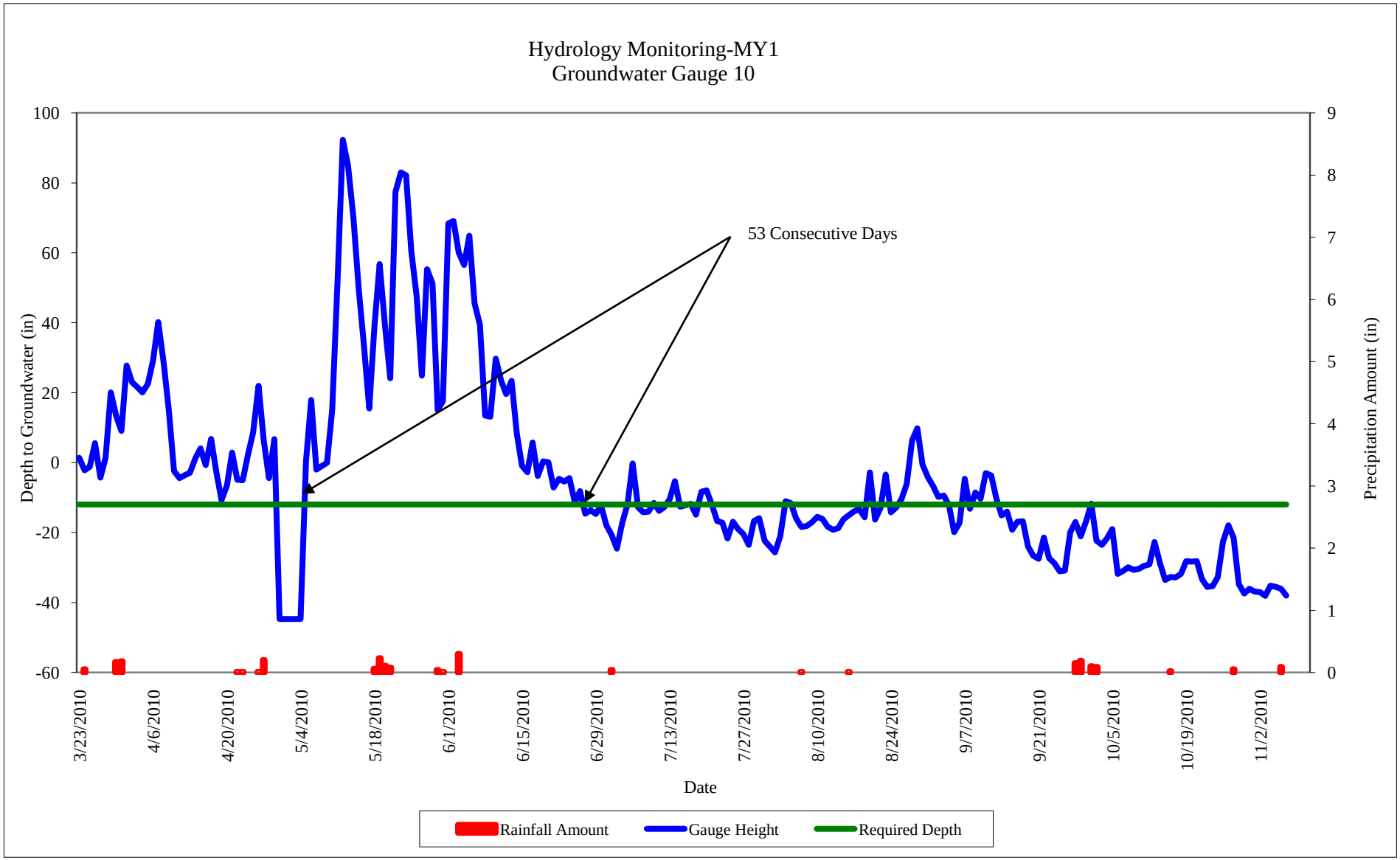


Table 13: Wetland Hydrology Criteria Attainment
DBC (Suther) Stream and Wetland Restoration/EEP Project No. 370
Monitoring Year 1 of 5

Summary of Groundwater Gauge Results for Years 1 through 5					
	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage %)				
Gauge	Year 1 (2010)	Year 2 (2011)	Year 3 (2012)	Year 4 (2013)	Year 5 (2014)
GW1	Yes/20 Days (9%)				
GW2	Yes/52 Days (23%)				
GW3	Yes/19 Days (8%)				
GW4	No/4 Days (2%)				
GW5	No/0 Days (0%)				
GW6	Yes/46 Days (20%)				
GW7	*N/A				
GW8	*N/A				
GW9	No/10 Days (4%)				
GW10	Yes/53 Days (23%)				

*N/A - Gauge malfunctioned 4/14/10 and was not replaced until 1/7/11. The 23 days collected from 3/23/10 to 4/14/10 met the required success criteria.