SUTHER STREAM & WETLAND RESTORATION SITE -- DMS #370
Cabarrus County NC -- PeeDee River HUC# 03040105-020060

MY-4 (2015) ANNUAL MONITORING REPORT (Draft)

North Carolina Department of Environmental Quality
Division of Mitigation Services (DENR-DMS) -- Contract # 5764

Data Collected: Sep-Oct 2015 **Final Report Submitted: Jan 2016**

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Appendix D. Stream Geomorphology Data

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1.0. Project Summary

1.1. Goals & Objectives

The Suther Stream and Wetland Restoration Project (Suther Site, DMS # 370) lies along Dutch Buffalo Creek and an unnamed tributary in northeastern Cabarrus County NC. The site lies within the Yadkin-Pee Dee watershed (HUC #03040105-020060). This project includes restoration of ditched and drained non-riverine wetlands, restoration of a channelized tributary, and enhancement and preservation along the main stem of Dutch Buffalo Creek. Project construction, planting, and the as-built survey were completed in late 2009, and annual monitoring was conducted in 2010 and 2011. During 2012-2013 DMS reevaluated the site with respect to project assets, necessary actions, and monitoring goals. Therefore, contracted site monitoring was temporarily suspended, and then resumed in 2014 by Robert J. Goldstein & Associates (MMI-RJGA) and will continue through 2016 (MY5) and project close-out in 2017. The 2014 through 2016 monitoring protocol includes additional stream and wetland gauges and main channel cross-sections as shown on the CCPV. Specific **goals** for the Suther Site project include:

- Stabilize and protect degraded stream banks along the main reach of Dutch Buffalo Creek.
- Restore a natural, stable dimension, pattern, and profile along the channelized tributary.
- Improve water quality and riffle and pool habitats to support benthos and fish communities.
- Restore or enhance natural hydrology, native vegetation, and soil functions in wetlands.
- Exclude livestock and establish cattle & farm vehicle crossings along Dutch Buffalo Creek.
- Decrease in-stream sediment and improve the aesthetics of the stream.

To meet these goals, the following **objectives** have been established for the Suther Site project:

- Enhance approximately 3,004 linear feet along the upper reach of Dutch Buffalo Creek by replanting the riparian areas with native trees and shrubs.
- Preserve 3,583 linear feet along the upper and lower reaches of Dutch Buffalo Creek.
- Restore a channelized tributary to re-create 608 linear feet of a Rosgen C/E stream type.
- Preserve approximately 1.67 acres, enhance approximately 4.26 acres, and restore approximately 7.29 acres of riparian non-riverine wetland area. (Note: acreages to be revised in 2016)
- Construct access crossings for cattle and farm vehicles across the main channel and tributary.
- Create an alternative livestock watering source and install livestock exclusion fencing.

1.2. Project Success Criteria

1.2.1. Stream Morphology and Stability Success

Stream morphology monitoring during the first two years (Jacobs, 2010 to 2011) was conducted along the restored tributary (608 lin. ft) and four cross-sections on this tributary. No morphologic survey was conducted on the main channel of Dutch Buffalo Creek during MY1 or MY2. In 2013 DMS staff installed eleven sets of bank erosion pins along the main channel upstream of the restored tributary (between stations 22+00 and 31+00). The revised monitoring scope for 2014 to 2016 includes the

restored UT longitudinal profile (608 lin. ft), two of the original four cross-sections on the UT, all remaining bank pins (some were lost between 2013 and 2014), and six new cross-sections along Dutch Buffalo Creek between stations 21+00 and 45+00. The bank pins and new cross-sections were added to assess the stability of the enhancement reach.

The annual profile and cross-section measurements along the restored tributary should indicate only minor changes from the 2010 as-built data. Any future changes that occur will be evaluated to determine whether they indicate unstable conditions or whether they are within the range of expected natural channel adjustment. Substrate particle samples should generally shift towards coarser materials (based on D50 and D84 sizes at riffle cross-sections).

1.2.2. Vegetation Success

Jacobs Engineering established and monitored seven CVS vegetation plots during 2010 and 2011. No vegetation data were collected during 2012 or 2013, and in April 2014 DMS staff determined that no CVS vegetation plot data collection would be necessary prior to replanting the areas exhibiting low planted stem survival. Consequently, no CVS plot data were collected during 2014 or 2015. DMS staff are reviewing the project and may replant selected problem areas during the winter of 2015-2016. MMI-RJGA will resume monitoring of existing and/or new CVS vegetation plots at the appropriate time and locations as directed by DMS.

To achieve vegetative success criteria the average number of planted stems per acre must exceed or meet 320 stems/acre after the third year of monitoring, 288 stems/acre after four years, and 260 stems/acre after the fifth year of project monitoring. High threat invasive species as defined in Version 1.3 of the EEP Monitoring Template should be limited in their spatial extent and density such that survival and diversity of native woody trees and shrubs is not compromised.

1.2.3. Hydrology Success

Stream and wetland hydrology attainment will be monitored in accordance with USACE standards. A continuous stage recorder (Onset Hobo pressure transducer) was installed on the DBC main stem on 10 April 2014, and was moved to the restored tributary on 07 Aug 2015 to better document flow height and duration on this tributary. At the end of the five year monitoring period, two or more bankfull events must occur in separate years within the restoration reach. For wetland restoration or enhancement areas, the target hydrologic success criterion is saturation or inundation within 12 inches of the ground surface for at least eight percent of the growing season in Cabarrus County, which is 18 consecutive days (March 23 to November 7 = 229 days x 8% = 18 days).

1.3. Project Setting & Pre-Restoration Conditions

The Suther Stream and Wetland Restoration Site is located in Cabarrus County, North Carolina, northeast of the City of Concord. The site is located within the Yadkin – Pee Dee River Watershed (USGS HUC 03040105, DWQ Sub-basin 30712). A Vicinity Map is included in Appendix A. The surrounding land use is primarily agricultural with cattle grazing, row crops, and rural residential development. Dutch Buffalo Creek (DBC) is a third order stream with an approximate drainage area of

23 square miles at the farthest downstream point of the project. The restored UT to Dutch Buffalo Creek (UT) is a first order stream with an approximate drainage area of 0.3 square miles.

Prior to restoration in 2009, much of the project site was managed for cattle grazing, including the dredging and straightening of one tributary along with 3 ditched areas. Riparian vegetation along the tributaries was removed as a result of channelization and livestock impacts. The riparian zones along the main channel of DBC include mature forest with a somewhat suppressed understory, and bank erosion impacts in some locations due to the long term livestock exposure and upstream changes in watershed land-use and hydrology. The DBC main stem is large (23 m^2 cross-sectional area) and the upper reach is enlarged in many areas, with steep banks and erosion on approximately 18% of the bank footage. The stream and buffer are now protected from livestock by a fenced conservation easement.

1.4. Project Components and Mitigation Assets

The Suther project consists of stream enhancement and preservation with approximately 600 feet of restoration on a channelized tributary. There are three areas of wetland at the top, middle, and bottom of the project that include restoration, enhancement and preservation. The specific mitigation components and their quantities are listed in Table 1 (Appendix A).

1.5. Project Design Approach

The project design was developed by Jacobs Engineering in 2007 (was Jordan Jones & Goulding prior to 2010), constructed and planted during Nov-Dec 2009 by River Works Inc., and monitored for two years (2010 and 2011) by Jacobs Engineering. During 2012 and 2013 no formal monitoring or reports were produced, but DMS staff conducted limited monitoring and instrument maintenance. Routine monitoring was resumed in 2014 by Mogensen Mitigation Inc / Robert J. Goldstein & Associates (MMI-RJGA) and will continue through 2016 (MY5) and project close-out in 2017.

The stream restoration effort consists of Enhancement Level II along the upper portion of the DBC main stem, and a combination of P1 and PII restoration applied along the UT to Dutch Buffalo Creek. Stream bed elevations and high banks on the main stem made any attempt at a P1 restoration impossible. The value of existing mature forest in stabilizing banks combined with the large size of the channel and changing nature of the watershed made it likely that there would be little functional benefit in exchange for a high level of construction impact and risk, thereby making any other traditional, sanctioned, creditable restoration approaches inadvisable. Therefore, the protection of the property and exclusion of cattle was determined to be the most feasible and advisable approach for the upper portion of the DBC main stem. The project also includes preservation, restoration and enhancement of wetlands, and re-establishment of native riparian vegetation.

The wetland restoration and enhancement areas and the areas of ditch filling on the DBC floodplain were planted with native species similar to those found in reference wetlands to achieve a Piedmont/Mountain Bottomland Forest community (Schafale and Weakley, 1990). Similarly, the restored tributary stream banks and adjacent riparian areas were stabilized and planted with suitable species to maintain a Piedmont/Low Mountain Alluvial Forest (Schafale and Weakley, 1990). With the

exception of the drainage ditches, minimal grading (fill or cut) occurred for the wetland restoration and enhancement areas. Top soil taken from cut areas along the stream was reserved for the top soil dressing utilized for ditch filling. The soil along the stream banks was naturally fertile due to its alluvial nature, so this top soil was well suited for planting. In addition, soil disking was conducted to ensure adequate drainage and beneficial microtopography for planting and drainage.

1.6. 2015 Current Conditions and Performance Summary

MMI-RJGA scientists collected monitoring data at the Suther Site during spring and fall of 2015 (MY-4). Based on the data and photographic documentation provided in the attached appendices, the project is generally maintaining the expected functions given the site characteristics and constraints, but has some minor concerns as described below.

1.6.1. Stream Assessment: Dutch Buffalo Creek

The condition of Dutch Buffalo Creek enhancement reach (main stem station 17+61 to 53+72) as observed in May, Aug, and Sep 2015 appears similar to its condition in 2014 and to the photos and description provided in the MY-2 (2011) monitoring report by Jordan Jones & Goulding (May 2012). Most of the stream bed is dominated by shifting sand and silt, with few areas of gravel or cobble. Limited areas with larger rocks (cobble to boulder) are mostly embedded with sand and silt. During the May visit DBC had moderate flow, but flow during the Aug and Sep site visits stream was unusually low. More than half the stream bed area appeared dry in between isolated pools of standing water, although there was likely hyporheic flow through the sandy bed. Some additional bank erosion, tree falls, and slumping were observed in areas with near-vertical banks, similar to the conditions reported in 2014 (Table 5a). A new beaver dam was built across DBC at station 17+50 just upstream of the enhancement reach, close to the beaver-cut trees reported in 2014, between the May and August visits. In Dec the dam was gone, apparently washed out by high flows.

Eight of the 11 bank-pin arrays on DBC (Table 7) exhibited some new erosion in May 2015, ranging from 0.1 to 0.7 feet of new pin exposure. The lower pin at A4 (station 26+30) was found for the first time since Mar 2013 and was exposed 0.9 ft; when this erosion occurred is unknown. No additional pin exposure was found during the Sep 2015 visit. The annualized average bank retreat rate for all bank erosion pins found is 0.24 ft/yr (based on 30 month period from Mar 2013 to Sep 2015).

The six cross-sections on DBC (Figure 3) show negligible change from 2014, except that the bed at cross-section #5 was a few inches higher, suggesting slight deposition. A new scour pool and minor bank erosion was observed in September at the confluence of Dutch Buffalo Cr and the restored tributary (DBC station 39+60), just below cross-section #6, apparently due to an unusual co-occurrence of high flow in the tributary and low flow in the main stem, as discussed below in section 1.6.2.

The Dutch Buffalo Creek preservation reach (main stem station 53+72 to 100+50) appears unchanged since 2014. Nearly all of this reach has well-forested stream banks. Bank undercutting is present along many segments, but tree root density is high, thus limiting slumping and erosion when occasional tree falls occur.

1.6.2. Stream Assessment: Restored Tributary of DBC

The 2015 visual condition assessment in the spring and fall of the tributary appears similar to the 2011 monitoring photos and 2014 reported condition. The stream pattern, profile, and dimension are maintaining vertical and lateral stability over most of the restored reach, and the cross-vanes and constructed riffles are performing as designed. Stream-bank vegetation density appears adequate in most areas, although growth of planted stems is slow as noted in 2011 and 2014. However, mature hardwood canopy surrounds the stream and planted riparian areas, providing an abundant seedling source. In-channel vegetation growth (grasses and herbs) is abundant, but is not significantly impeding flow or causing channel over-widening. Minor wash-out of fabric and was observed at some of the close-spaced step-pools along the lowermost 80 feet of this reach, and minor bank slumping was observed just below one of these step-pools. 99 percent of the bank length is stable (Table 5b).

Woody vegetation remains sparse along the lower 15 ft of tributary banks near the confluence with DBC, but channel grade and pattern of the tributary appear stable except at the mouth. In September 2015 the tributary confluence at Dutch Buffalo Creek exhibited bank erosion and bed scour (see problem area photos). Localized heavy rainfall on Aug 18-19 (nearly 4 inches collected in rain gauge at Mr. Suther's house) created high flow in the tributary (0.65 ft above bankfull recorded at Hobo gauge) while flow in DBC apparently remained low. We do not have flow or stage data for DBC during this time, but the stream bed was about 50% dry on both the Aug 6 and Sep 1 visits. High flow from the tributary into the main stem created a scour hole on the right side of Dutch Buffalo Cr just below the lowermost tributary step structure, causing stream banks at the confluence to erode, and pushing up a mound of sediment along the left side of Dutch Buffalo Cr.

1.6.3. Wetlands Assessment

The plugged ditch areas and grade-control steps installed in the ditches draining wetlands C, B1, and B2 appear to be stable and performing as designed, with minimal erosion. All three wetland areas showed extensive ponding and/or shallow saturation during the May 2015 field visit, but were conspicuously dry in Aug and Sep 2015.

Survival and growth of planted understory vegetation in the forested wetland areas of B1 and B2 remains low, as noted in 2011 and 2014, apparently due to shading from the forest canopy. Wetland C, formerly a pasture prior to restoration, now has adequate woody stem density (planted and volunteers combined) to meet the MY4 success criterion of 288 stems/ac. The 2.2 acre northwestern area mapped as "low woody density" in 2014 has been revised accordingly in the CCPV (Figure 2), although dense grasses, herbs, and blackberries remain dominant in this area. DMS has scheduled a supplemental planting of wetland C in early March 2016.

Evidence of feral hogs living in the former pasture area, in both the wetland and non-wetland portions, is similar to that reported in 2014 and Spring 2015. Hog rooting activity was also noted in one area along the banks of the restored tributary. Moderate grazing damage was also noted along the forested stream enhancement area along DBC downstream of the pasture, apparently from deer and/or feral hogs. Mr. Suther encourages hog hunting on the site, and reports 10-20 hogs per year are removed.

1.6.4. Vegetation and Easement Assessment

Planted and volunteer native trees are continuing to gradually reclaim the former pasture at the upper end of the project (south of DBC station 3+00 to 14+00), although grasses, herbs and blackberries still comprise the predominant cover in this area. The northwestern corner of this pasture (including part of Wetland C restoration area) was mapped in 2014 as a "low woody density" area needing supplemental planting, but in May 2015 it was apparent that native volunteer tree seedlings and saplings (ash, maple, sweetgum, elm, sycamore, and others) combined with surviving planted trees had reached sufficient density to meet the 288 stems per acre average density success criterion for MY-4. Large numbers of these tree seedlings are apparent in Apr-May, but are difficult to detect later when the grasses and herbs become tall and dense. Although woody densities are increasing, DMS will be adding additional stems to this area in March 2016.

The riparian restoration area along both sides of the restored tributary UT-1 are also still dominated by grasses and herbs, with planted and volunteer tree seedlings and saplings gradually becoming more prominent. The current density of planted and volunteer native trees in this area meets the 288 stems per acre average density success criterion for MY-4. Growth of the planted trees is slow, probably due to shading from the mature canopy which surrounds the channel and planted areas.

No quantitative data was collected at the CVS vegetation plots in 2014 or 2015, per instruction from the DMS project manager. Vegetation monitoring will resume after the scheduled supplemental planting.

The livestock exclusion fencing around the conservation areas appears to be effective in keeping cattle out of the stream beyond these crossings. The easement fence is broken along the south edge of the conservation area south of DBC station 15+00 due to a fallen tree (near photo-point 2), but no livestock are kept in the adjoining area, which is recently clearcut forest.

1.6.5. Hydrology Assessment

Groundwater depth data from the 17 wetland gauges installed in April 2014 are presented in Appendix E. Twelve gauges (#1, 2, 3, 4, 6, 7, 11, 14, 15, 16, 17 & 18) achieved the required hydrologic success criteria of 18 consecutive days (eight percent of the 229-day growing season), and four gauges (#8, 9, 12 & 13) failed to meet hydrologic success. However, gauge #12 came close, with a 12-day run and a 14-day run separated by 10 days. Gauge #5 malfunctioned during the critical period in March and April when hydrologic success may have occurred; this gage succeeded in 2014.

The rain gage functioned well from Nov 2014 until early Aug 2015, and data for that period are roughly similar to other nearby rain gages (USGS gauge at Rocky River WWTP and three CoCoRaHs gauges near Concord and Mt. Pleasant). Data after Aug 5 do not track those of nearby gauges, indicating a gauge malfunction. Data from the rain gauge at Rocky River WWTP are therefore used as a surrogate estimate of on-site precipitation for Aug to Dec 2015.

Bankfull flow events are assessed based on data from a pair of Hobo recording pressure transducers installed in April 2014 along Dutch Buffalo Creek 200 ft upstream from the restored tributary mouth. On 07 Aug 2015 the in-stream sensor was moved to the restored tributary at the request of the DMS

project manager. The upland (ambient pressure) sensor remains mounted on a ridge adjacent to DBC, with both sensors recording pressure at 30-min intervals. From Jan to July 2015, the in-stream sensor recorded two probable bankfull flow events in DBC on Mar 5 and Apr 20 (App. E, Table 10). From Aug to Dec 2015, the in-stream sensor recorded five apparent bankfull flow events in tributary UT-1 on Aug 19, Oct 3, Nov 2, Nov 10, and Nov 19. Matted vegetation and wrack lines were observed in multiple locations along the tributary floodplain during the May, Sep, and Dec site visits.

2.0. Monitoring Methods

Monitoring methodologies follow the CVS-EEP Level 2 Vegetation Monitoring Protocol for Recording Vegetation (Lee *et al.* 2008). Photos were taken with digital cameras and are available electronically. A Trimble Hand Held GPS unit was used to locate groundwater gauges, stream cross-sections, other monitoring features and problem areas.

An HP 48G+ calculator was used to download the Infinity rain gauge, an Aceeca Meazura PDA was used to download the RDS groundwater gauges, and an Onset Hobo Data Shuttle was used to download the Onset Hobo pressure transducers. CCPV graphics were prepared using ESRI ArcGIS.

2.1. Vegetation Methodologies

In the winter/spring of 2015, new 10 x 10 square meter veg. plots will be installed and monitored according to the CVS-EEP Level 2 Vegetation Monitoring Protocol Version 4.2 (Lee *et al.* 2008) starting in MY 4. All plot corners will be marked with 1" Aluminum pipe and flagged with bright red flagging tape. Data collected from each plot will be included in Appendix C. Monitoring plot locations will be shown on the maps in Appendix B.

2.2. Wetland Methodologies

All seventeen (17) RDS groundwater Monitoring Gauges were downloaded most recently in September, 2014, and have been downloaded quarterly throughout the growing season to ensure that the gauges are functioning properly. Data are provided in an Excel spreadsheet.

2.3. Stream Methodologies

The UT longitudinal profile was surveyed using a Trimble RDK survey-grade GPS unit, and cross-sections along the UT and DBC were surveyed with an automatic level and rod. The survey data locations were plotted using ARC GIS 10.0 and Excel. Cross-sectional data was based on a linear alignment between end points marked by metal pins. Measurements at each cross-section include points at point of origin, bankfull, top of bank, toe of slope and thalweg for each stream side supplemented with photo's. Long-pro measurements include thalweg, and water surface taken at the head of feature (i.e. riffle, run, pool glide) in addition to pool depths. In addition, visual and photographic assessment of in-stream structures was conducted to determine overall project success. Stream assessment data are included in Appendix D with cross-sections and monitored stream reaches indicated on maps in Appendix B. In addition, MMI used manual crest stage gauges to verify bankfull events.

3.0. References

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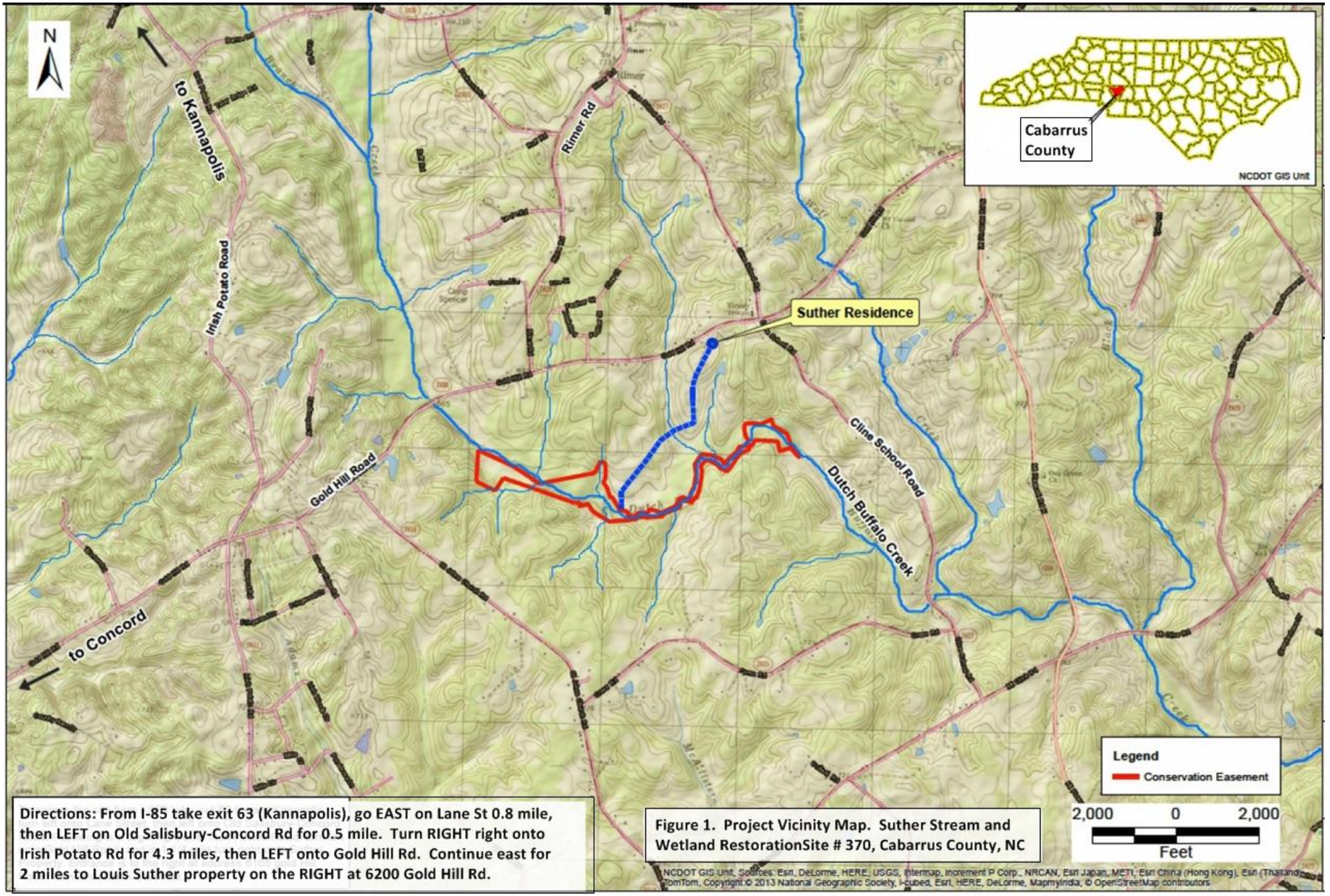


Figure 1. Project Vicinity Map. Suther Stream and Wetland RestorationSite # 370, Cabarrus County, NC

Appendix A. Project Background Tables

Table 1. Project Components and Mitigation Credits Suther Site # 370: Dutch Buffalo Cr Stream and Wetland Restoration, Cabarrus Co.						
Mitigation Credits						
	Stream (SMU)	**Riparian Wetland (WMU)**	**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	1,201.6/ 716.6/ 608	0.33/ 2.13/ 7.29	**N/A**	**N/A**	**N/A**	**N/A**
Project Components						
Project Component/Reach ID	**Stationing (ft)**	**Existing Footage or Acreage**	**Approach**	**Restoration or Equivalent**	**Restoration Footage or Acres**	**Mitigation Ratio and Credits**
Dutch Buffalo Cr Upper Reach	0+00 – 17+61	N/A	N/A	N/A	N/A	N/A
	17+61 - 53+72 *	3,611 lf	Enhance	RE	3,004 lf	2.5:1 = 1201.6
Dutch Buffalo Cr Lower Reach	53+72 – 100+50 *	4,678 lf	Preserve	RE	3,583 lf	5:1 = 716.6
UT to Dutch Buffalo Cr	0+00 – 6+08	527 lf	Restor P1, P2	R	608 lf	1:1 = 608.0
Wetland Area B-2	N/A	1.67 ac	Preserve	RE	1.67 ac	5:1 = 0.334
Wetland Area B-1	N/A	4.44 ac	Enhance	RE	2.47 ac	2:1 = 1.235
			Restore	R	1.97 ac	1:1 = 1.97
Wetland Area C	N/A	4.64 ac	Enhance	RE	1.79 ac	2:1 = 0.895
			Restore	R	5.32 ac	1:1 = 5.32
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	N/A	7.29	N/A	N/A	N/A
Enhancement (E)		N/A	4.26	N/A	N/A	N/A
Enhancement I (E)	N/A					
Enhancement II (E)	3,004					
Creation (C)		N/A	N/A	N/A		
Preservation (P)	3,583	N/A	1.67	N/A		N/A
HQ Preservation (P)	N/A	N/A	N/A	N/A		N/A
Totals	**7,195**	**N/A**	**13.22**	**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.
Mitigation Credits: SMU = Stream Mitigation Unit; WMU = Wetland Mitigation Unit.

* The existing footage is greater than the restoration footage, due to necessary reductions to the project assets. Crossings and minimum easement widths were evaluated, and previously listed assets were adjusted based on 4/11/2011 communication with PM Robin Hoffman. The stationing shown here is associated with the existing (pre-construction) stream footage.

Table 2. Project Activity and Reporting History Suther Site # 370: Dutch Buffalo Cr Stream and Wetland Restoration, Cabarrus Co.		
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 throughout	Nov-09	Nov-09
Permanent seed mix applied to UT reach	Nov-09	Nov-09
Bare root & livestake plantings UT	Dec-09	Dec-09
Mitigation Plan & As-Built MY-0 report	Dec-09	Jan-09
Year 1 Monitoring (2010)	Oct-10	Jun-11
Year 2 Monitoring (2011)	Aug-11	May-12
Year 3 Monitoring (2014)	Oct-14	Feb-15
Year 4 Monitoring (2015)	Sep-15	Nov-15
Year 5 Monitoring (2016)		

Table 3. Project Contacts Table Suther Site # 370: Dutch Buffalo Cr Stream and Wetland Restoration, Cabarrus Co.	
Designer Matthew Clabaugh, PE*	Jacobs Engineering Group (Jordan, Jones & Goulding) 6801 Governors Lake Parkway Norcross, GA 30071 770-455-8555
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 to Year 2**	Jacobs Engineering Group (Jordan, Jones & Goulding) 6801 Governors Lake Parkway Norcross, GA 30071
Stream Monitoring, POC	Alison Nichols, 704-247-9065
Vegetation Monitoring, POC	
Wetland Monitoring, POC	
Monitoring Performers: Year 3 to Closeout	Robert J Goldstein & Associates (RJGA) 1221 Corporation Parkway, Raleigh NC 27610 (Division of Mogensen Mitigation Inc.)
Stream Monitoring, POC	Gerald Pottern, 919-872-1174 gpottern@RJGAcarolina.com
Vegetation Monitoring, POC	
Wetland Monitoring, POC	

Table 4. Project Baseline Information and Attributes Suther Site # 370: Dutch Buffalo Cr Stream and Wetland Restoration, Cabarrus County				
Project Information				
Project Name		Suther Site, Dutch Buffalo Cr 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 8-digit Hydrologic Unit	3040105	USGS Hydrologic Unit 14-digit	03040105020060	
DWQ Sub-basin		03-07-12		
Project Drainage Area (sq mi)		21.3		
Project Drainage Area Percentage Impervious		3%		
CGIA Land Use Classification		Cultivated (3.00); Mixed Upland Hardwoods (10.00)		
Reach Summary Information				
Parameters		**Dutch Buffalo Creek**	**UT Dutch Buffalo Cr**	
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**		MWD, WD, SPD, WD, WD, WD, WD		
Soil Hydric status		Class B (Chewacla and Altavista)		
Slope		0.0011	0.0093	
FEMA Classification		100-year floodplain on Dutch Buffalo Cr		
Native vegetation community		Piedmont/Mountain Bottomland Forest; Piedmont/Low Mountain Alluvial Forest		
Percent composition of exotic invasive vegetation		10	80	
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 Loam		
Drainage class		SPD	SPD	
Soil Hydric Status		B	B	
Source of Hydrology		streamflow, groundwater	streamflow, stormwater	
Hydrologic Impairment		ditching	ditching	
Native vegetation community		Piedmont/Mountain Bottomland Forest & Piedmont/Low Mountain Alluvial Forest	Piedmont/Low Mountain Alluvial Forest	
Percent composition of exotic invasive plants		5	5	
Regulatory Considerations				
Regulation & Agency		**Applicable?**	**Resolved?**	**Documentation**
Waters of the US Section 404 (US-ACOE)		Yes	Yes	Approved JD, NWP 27
Waters of the US Section 401 (NC-DEQ)		Yes	Yes	Approved 401 Certificate
Endangered Species Act (US-FWS)		No	N/A	N/A
Historic Preservation Act (SHPO)		No	N/A	N/A
Coastal Area Management Act (CAMA)		No	N/A	N/A
FEMA Floodplain Compliance (FEMA)		No	N/A	N/A
Essential Fisheries Habitat (NMFS)		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. No beaver activity was observed during 2009-2012 post-construction monitoring.

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

SPD: Somewhat Poorly Drained; MWD: Moderately Well Drained; WD: Well Drained

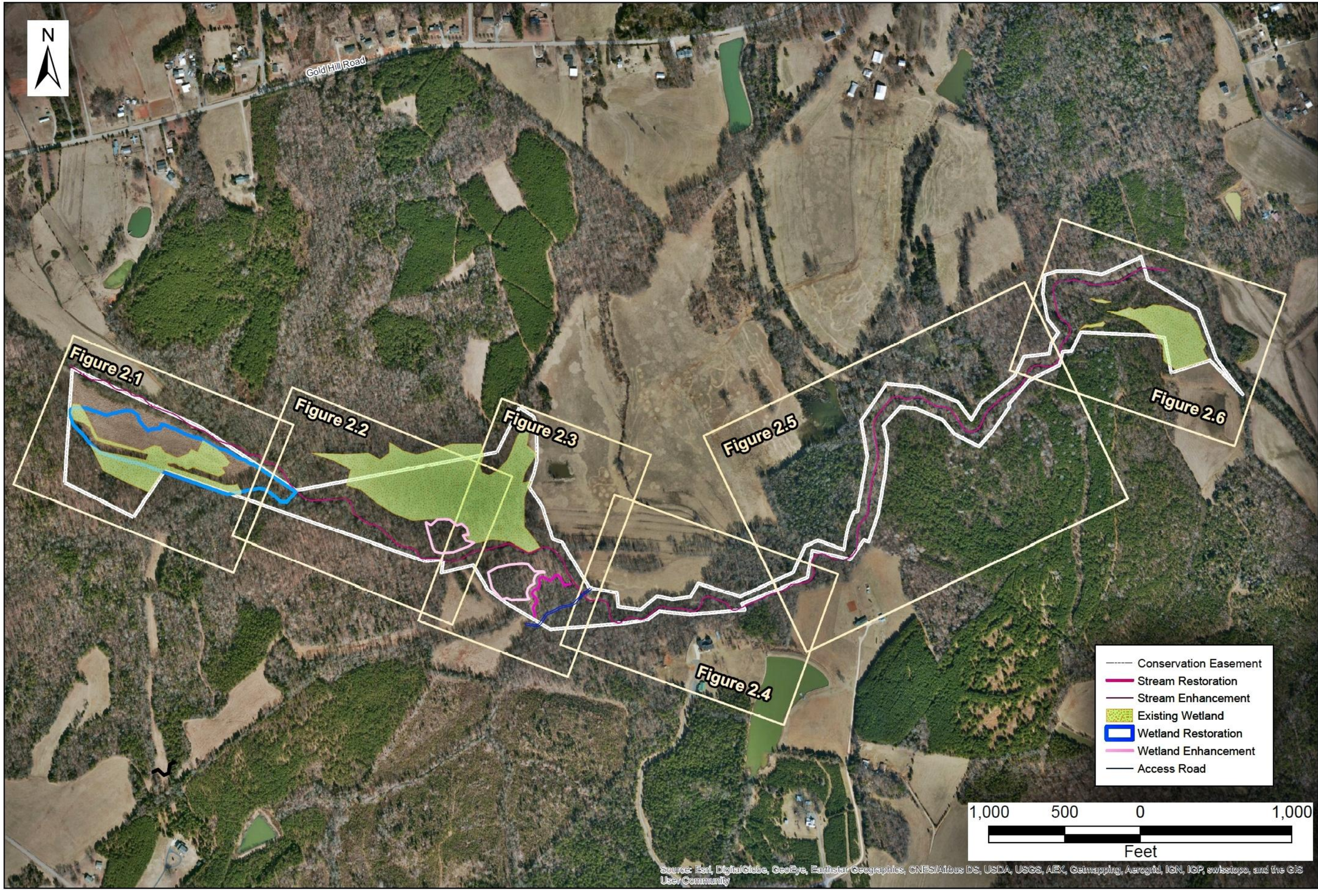
**Drainage classes correspond to the underlying mapped soils listed.

Appendix B. Visual Assessment Data

Figure 2.0-2.6. Current Conditions Plan View (CCPV)
Table 5. Visual Stream Stability Assessment
Table 6. Vegetation Condition Assessment

Stream Photo Points: Dutch Buffalo Cr & Restored Tributary
Problem Areas & Other Photos

e-Table: Stream & Vegetation Problem Areas



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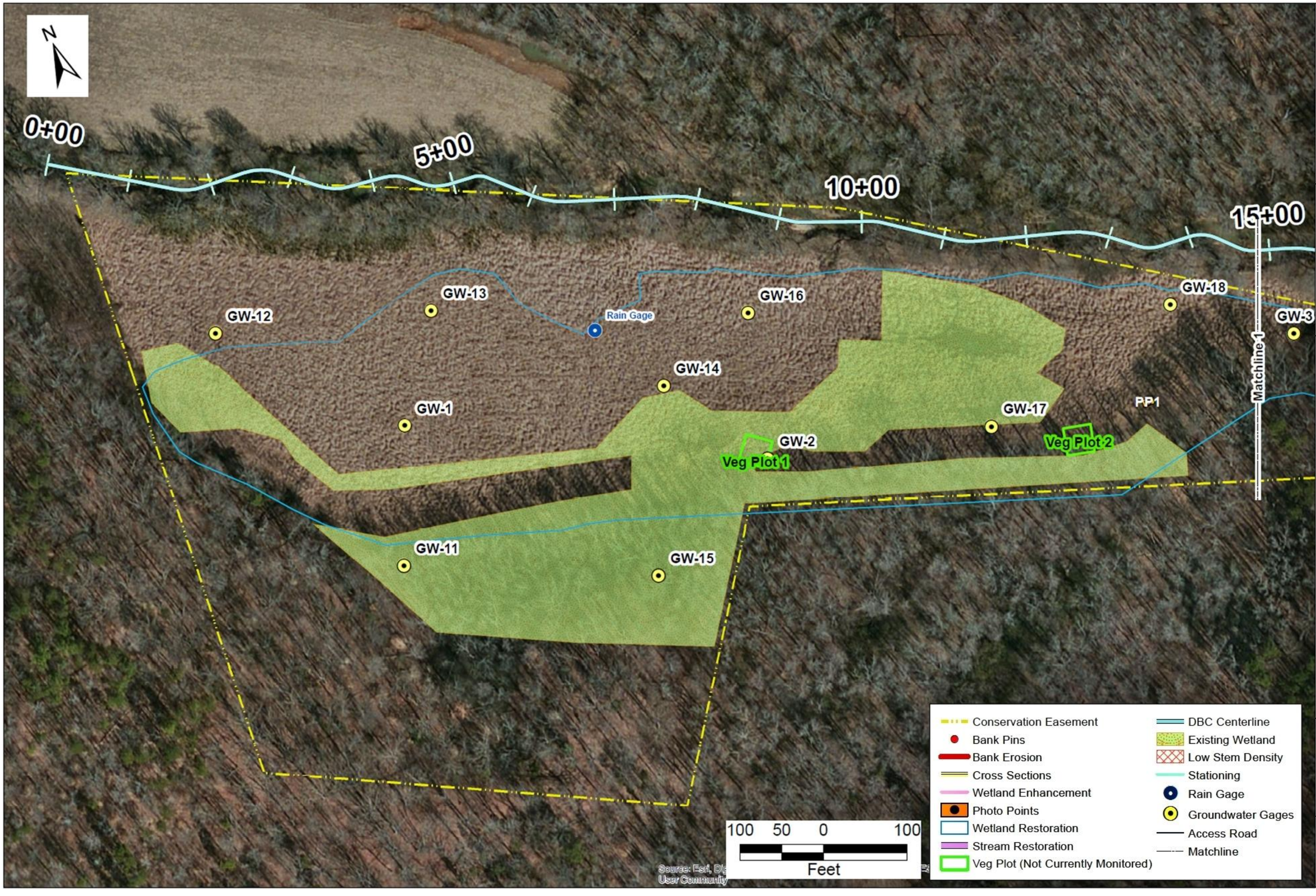
SUTHER SITE STREAM AND WETLAND RESTORATION
YADKIN-PEEDEE USGS-HUC# 03040105

CABARRUS COUNTY
NORTH CAROLINA

Environmental Quality

FIGURE 2.0
SEPT 2015
MY4 of 5



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NORTH CAROLINA

NC Environmental Quality

FIGURE 2.1
SEPT 2015
MY4 of 5

N

GW-4
GW-7
GW-5
Matchline 2
15+00
20+00
25+00
30+
PP6
DBC XS-2
Veg Plot 3
PP7
PP5
PP4
PP3
PP8
PP9
PP10
DBC XS-3
PP11
PP12
DBC XS-4
PP13
BP 1
BP 2
BP 3+4
BP 6+7
BP 8
BP 9
BP 10
BP 11
BP 12
GW-3
Matchline 1
ditch (plugged)
Dutch Buffalo Cr
Begin Stream Enhancement
Reach, Station 17+61

100 50 0 100
Feet

Source: Esri, Di
User Community

- Conservation Easement
- Bank Pins
- Bank Erosion
- Cross Sections
- Wetland Enhancement
- Photo Points
- Wetland Restoration
- Stream Restoration
- Veg Plot (Not Currently Monitored)
- DBC Centerline
- Existing Wetland
- Low Stem Density
- Stationing
- Rain Gage
- Groundwater Gages
- Access Road
- Matchline

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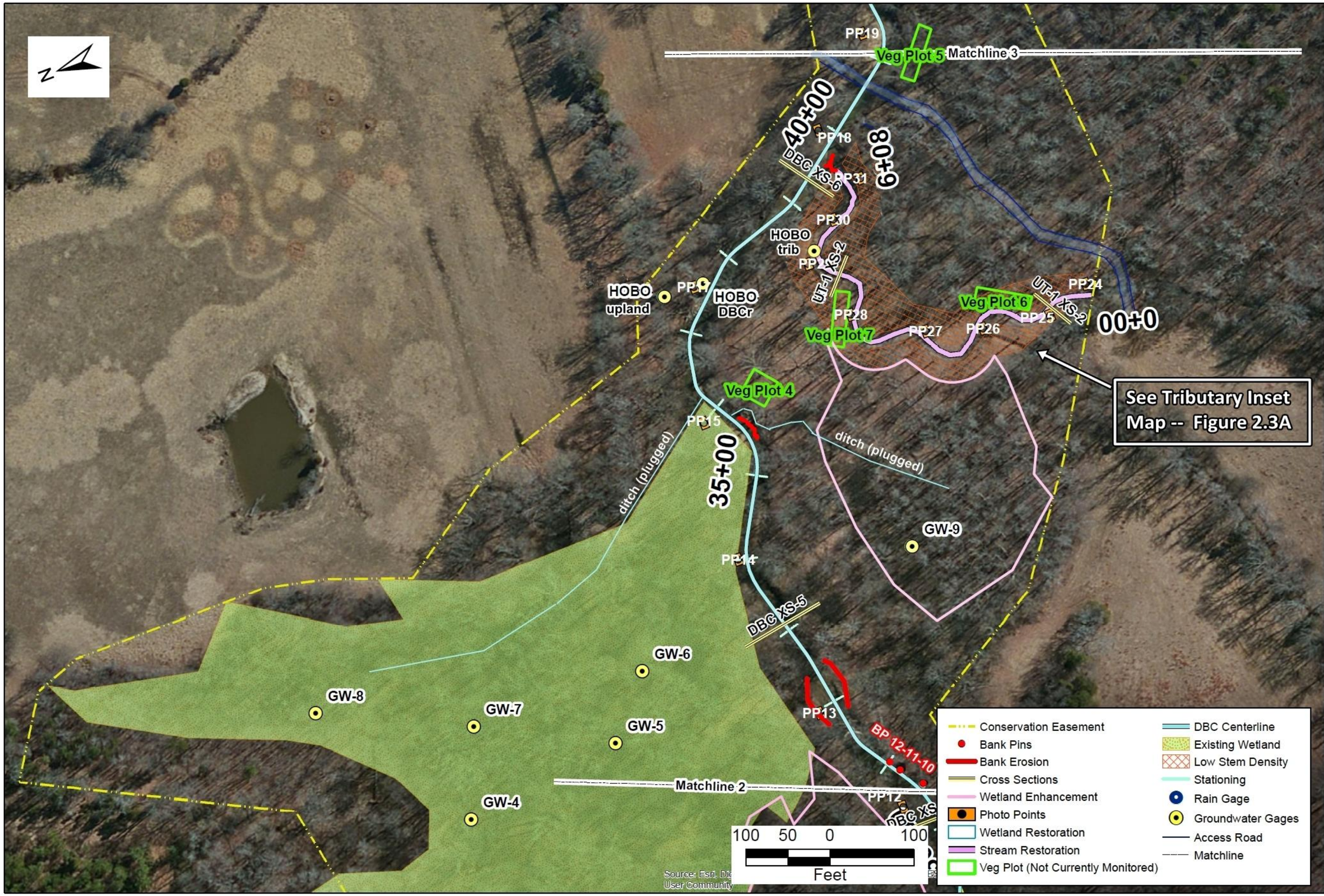
CABARRUS COUNTY
NORTH CAROLINA

Environmental Quality

FIGURE 2.2
SEPT 2015
MY 4 of 5



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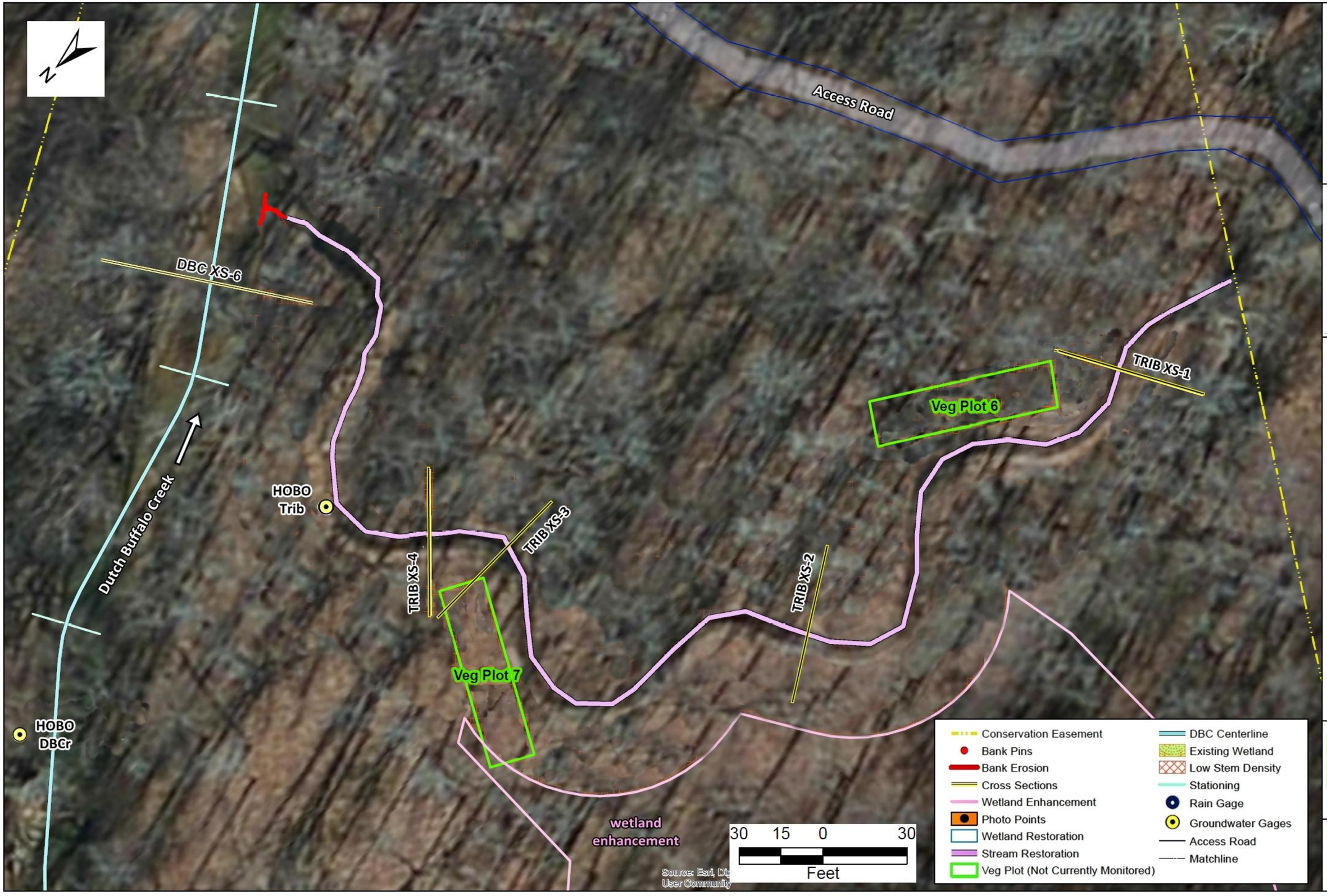
YADKIN-PEEDEE USGS-HUC # 03040105

CABARRUS COUNTY
NORTH CAROLINA

NC Environmental Quality

FIGURE 2.3
SEPT 2015
MY 4 of 5

x



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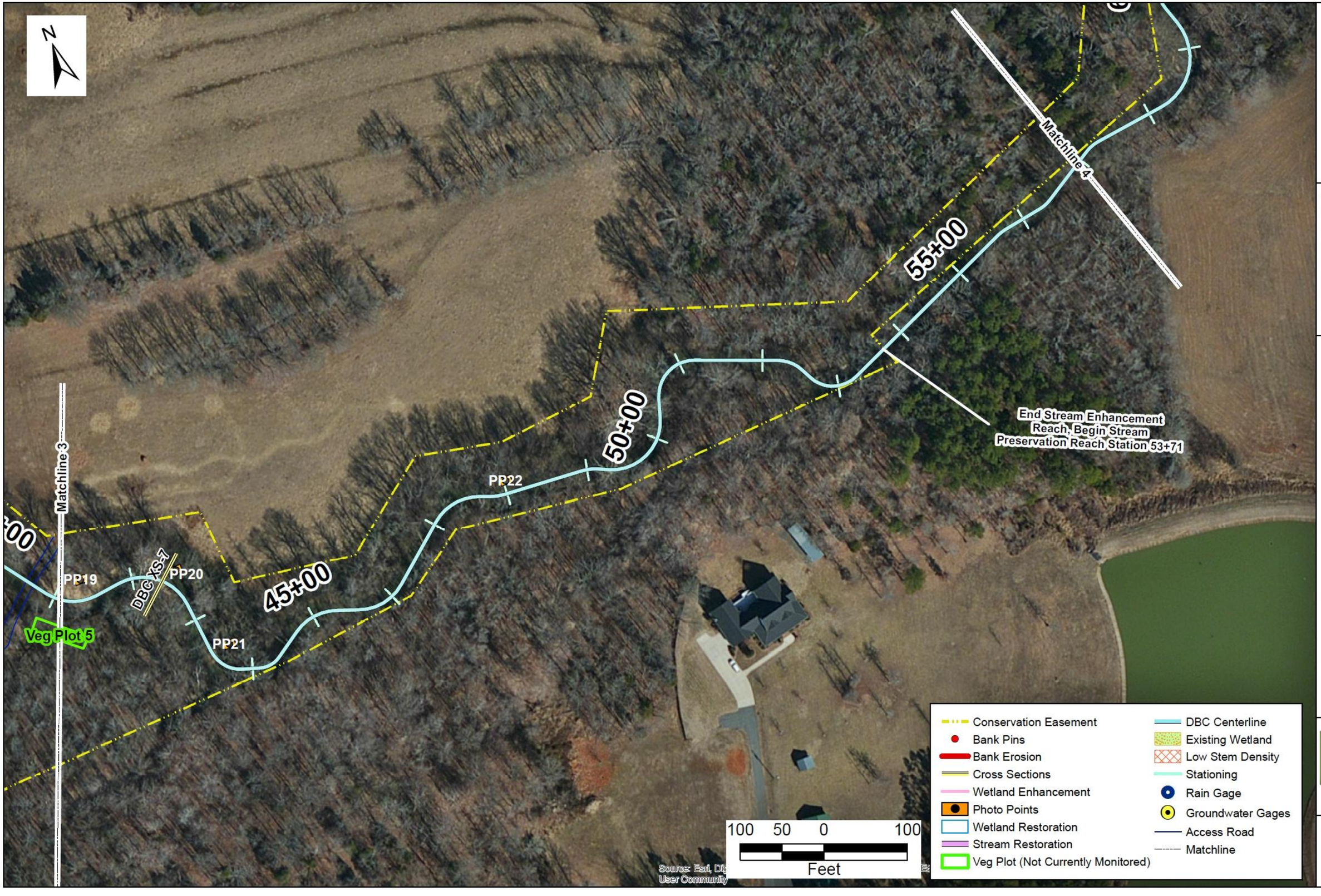
YADKIN-PEEDEE USGS-HUC # 03040105

CABARRUS COUNTY
NORTH CAROLINA

NC Environmental Quality

FIGURE 2.3A
SEPT 2015
MY 4 of 5



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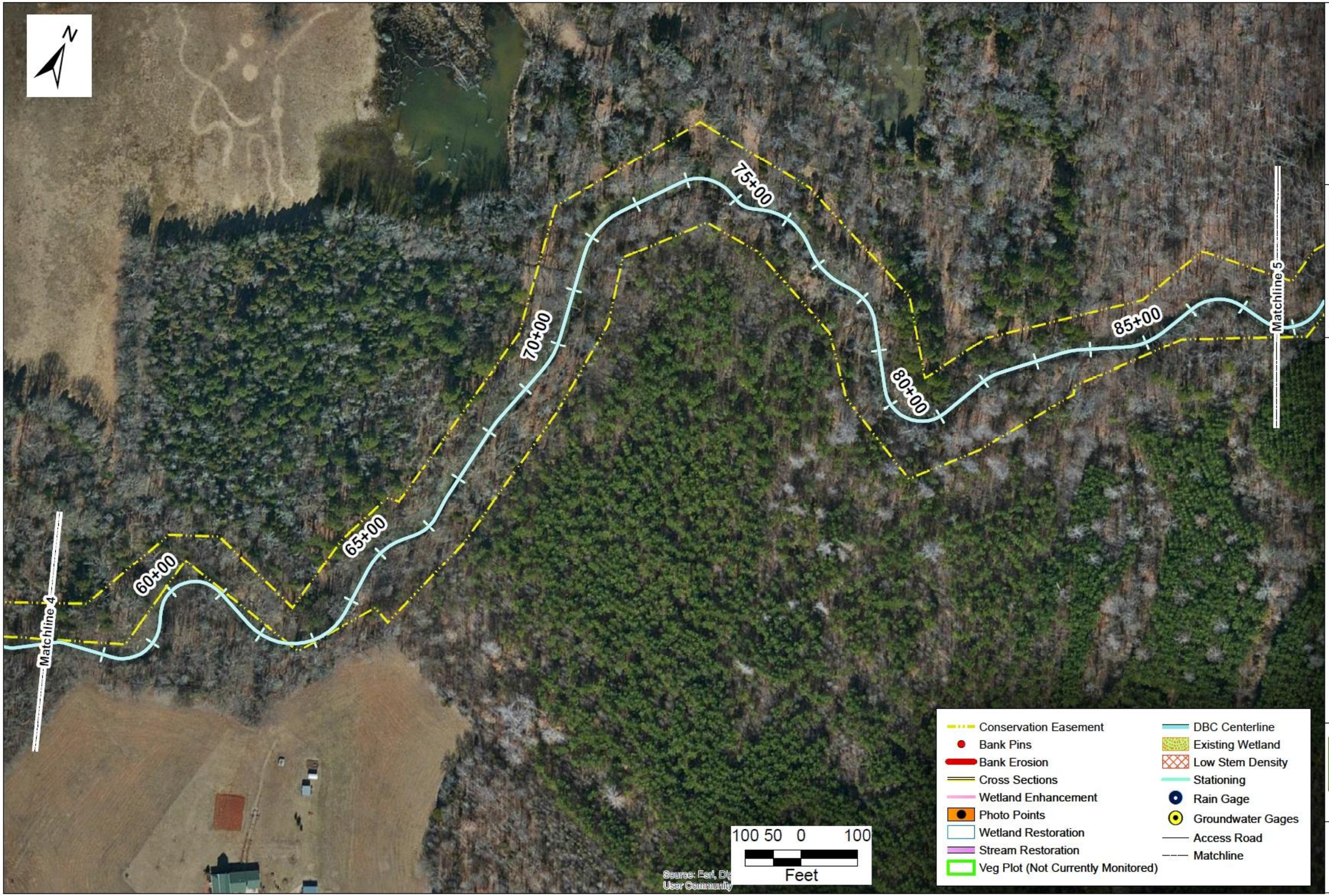
YADKIN-PEEDEE USGS-HUC # 03040105

CABARRUS COUNTY
NORTH CAROLINA

Environmental Quality

FIGURE 2.4
SEPT 2015
MY 4 of 5



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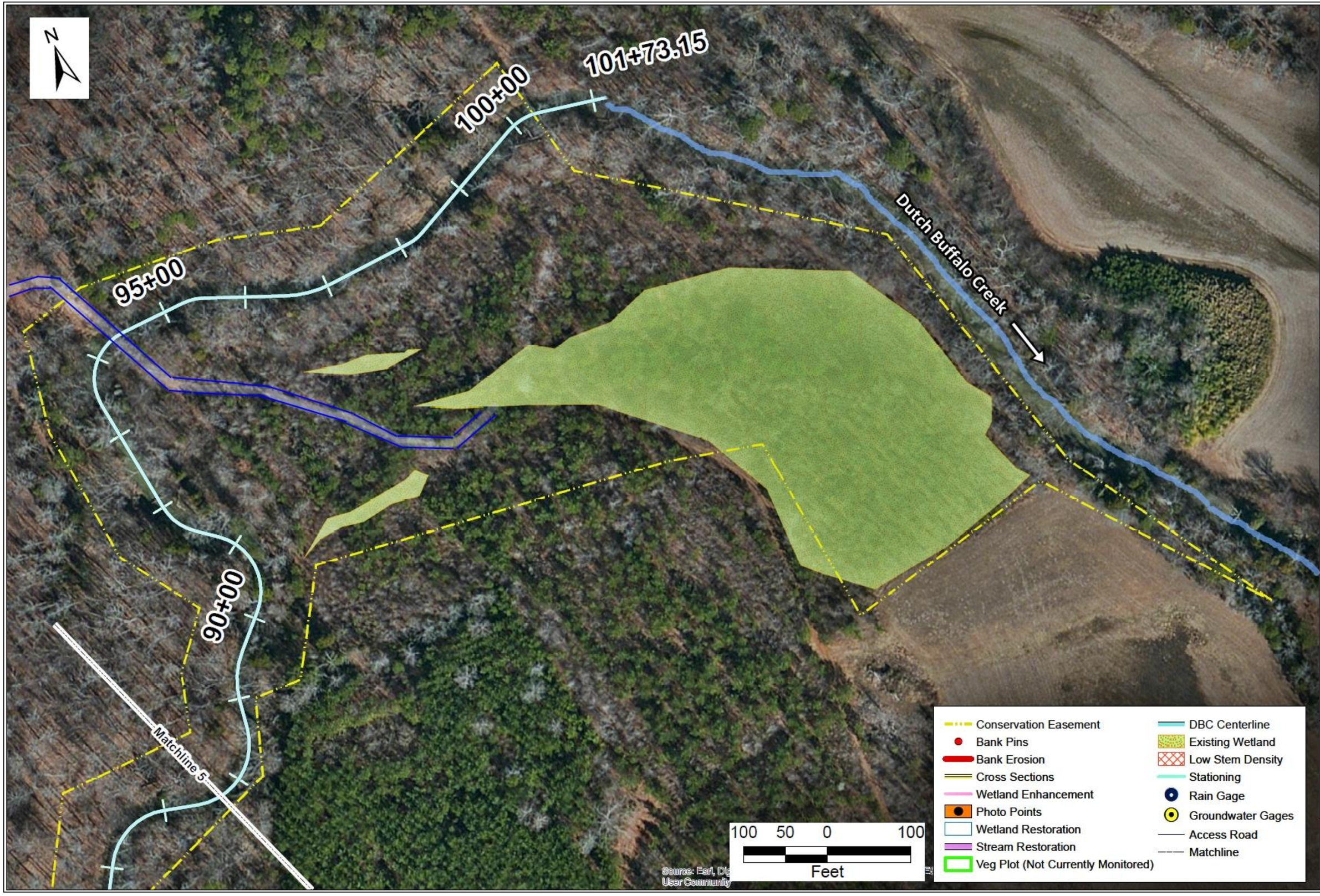
NORTH CAROLINA

Environmental Quality

FIGURE 2.5
SEPT 2015
MY 4 of 5



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CABARRUS COUNTY
NORTH CAROLINA

Environmental Quality

FIGURE 2.6
SEPT 2015
MY 4 of 5

Table 5a. Visual Stream Stability Assessment -- Main Stem Dutch Buffalo Creek Enhancement (3,611 lin.ft = 7,222 bank ft)
Suther Site (Dutch Buffalo Creek) Stream and Wetland Restoration: EEP Project # 370
Monitoring Year 4 of 5 (2015)

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			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	N/A*	N/A*			N/A*			
	3. Meander Pool Condition	Depth Sufficient	N/A*	N/A*			N/A*			
		Length Appropriate	N/A*	N/A*			N/A*			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	N/A*	N/A*			N/A*			
		Thalweg centering at downstream of meander bend (Glide)	N/A*	N/A*			N/A*			
2. Bank	**1. Scoured/Eroded**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			18	1303	82%	14	1031	96%
	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			3	160	98%	0	0	98%
	3. Mass Wasting	Bank slumping, calving, or collapse			2	110	98%	0	0	98%
				Totals	23	1573	78%	14	1031	92%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	N/A*	N/A*			N/A*			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	N/A*	N/A*			N/A*			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms	N/A*	N/A*			N/A*			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	N/A*	N/A*			N/A*			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow	N/A*	N/A*			N/A*			

The Dutch Buffalo Creek Enhancement II channel is incised and eroded. No channel restoration was performed on this reach.

*No engineered structures were installed within the Dutch Buffalo Creek Enhancement II segment.

Table 5b. Visual Stream Stability Assessment -- UT Dutch Buffalo Creek
Suther Site (Dutch Buffalo Creek) Stream and Wetland Restoration: Project # 370
Monitoring Year 4 of 5 (2015) Restored Tributary Length = 608 lin.ft = 1,216 bank feet

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			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	7	7			100%			
	3. Meander Pool Condition*	Depth Sufficient *	-	-			N/A			
		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	8	99%	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	8	99%	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	6	8			75%			
	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	-	-			N/A			

* Survey performed during dry conditions in channel. Parameter not assessed due to lack of water.
Piping: Two step-pools near the lower end of this reach have minor fabric washout and piping.

Table 6: Vegetation Condition Assessment Table
Suther Site (Dutch Buffalo Creek) Stream and Wetland Restoration: Project # 370
Monitoring Year 4 of 5 (2015)

Planted Acreage **25.14**

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

Easement Acreage **67.32**

Vegetation Problem Category	Definitions	Mapping Threshold (SF)	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
Invasive Areas of Concern ***	Areas of points (if too small to render as polygons at map scale).	1000	N/A	0	0	0%
Easement Encroachment Areas	Areas of points (if too small to render as polygons at map scale).	none	N/A	0	0	0%

Tabulated data are based on observations made between April and October 2015.
** Competition from tall grasses, herbs, and Rubus may be limiting planted tree survival and growth in Area C-1. Shading from adjacent forest plus competion from grasses and herbs may
*** Many forested areas on the site contain invasive groundover and shrub vegetation (*Microstegium, Lonicera, Ligustrum, Rosa*) but these are mostly beneath existing forest canopy and are not of concern.

Fall Assessment Photos - Sep 1-2, 2015 - Suther Stream Mitigation Site # 370

Photo Point 01, facing north west: 2010

Photo Point 01, facing west: 2015

Photo Point 02, Upstream: 2010

Photo Point 02, Upstream: 2015

Fall Assessment Photos - Sep 1-2, 2015 - Suther Stream Mitigation Site # 370

Photo Point 03, Upstream: 2010

Photo Point 03, Upstream: 2015

Photo Point 03 DBC, Upstream: 2010

Photo Point 03 DBC, Upstream: 2015

Fall Assessment Photos - Sep 1-2, 2015 - Suther Stream Mitigation Site # 370

Photo Point 04, Downstream: 2010

Photo Point 04, Downstream: 2015

Photo Point 05, Upstream: 2010

Photo Point 05, Upstream: 2015

Fall Assessment Photos - Sep 1-2, 2015 - Suther Stream Mitigation Site # 370

Photo Point 06, Upstream: 2010

Photo Point 06, Upstream: 2015

Photo Point 07, Downstream: 2010

Photo Point 07, Downstream: 2015

Fall Assessment Photos - Sep 1-2, 2015 - Suther Stream Mitigation Site # 370

Photo Point 08, Upstream: 2010

Photo Point 08, Upstream: 2015

Photo Point 09, Upstream: 2010

Photo Point 09, Upstream: 2015

Fall Assessment Photos - Sep 1-2, 2015 - Suther Stream Mitigation Site # 370

Photo Point 10, Downstream: 2010

Photo Point 010, Downstream: 2015

Photo Point 11, Upstream: 2010

Photo Point 11, Upstream: 2015

Fall Assessment Photos - Sep 1-2, 2015 - Suther Stream Mitigation Site # 370

Photo Point 12, Upstream: 2010

Photo Point 12, Usptream: 2015

Photo Point 13, Upstream: 2010

Photo Point 13, Upstream: 2015

Fall Assessment Photos - Sep 1-2, 2015 - Suther Stream Mitigation Site # 370

Photo Point 14, Downstream: 2010

Photo Point 14, Downstream: 2015

Photo Point 15, Upstream: 2010

Photo Point 15, Upstream: 2015

Fall Assessment Photos - Sep 1-2, 2015 - Suther Stream Mitigation Site # 370

Photo Point 17, Upstream: 2010

Photo Point 17, Upstream: 2015

Photo Point 18, Upstream: 2010

Photo Point 18, Upstream: 2015

Fall Assessment Photos - Sep 1-2, 2015 - Suther Stream Mitigation Site # 370

Photo Point 19, Downstream: 2010

Photo Point 19, Downstream: 2015

Photo Point 20, Downstream: 2010

Photo Point 20, Downstream: 2015

Fall Assessment Photos - Sep 1-2, 2015 - Suther Stream Mitigation Site # 370

Photo Point 21, Downstream: 2010

Photo Point 21, Downstream : 2015

Photo Point 22, Upstream: 2010

Photo Point 22, Upstream: 2015

Fall Assessment Photos - Sep 1-2, 2015 - Suther Stream Mitigation Site # 370

Photo Point 24, Upstream: 2010

Photo Point 24, Upstream: 2015

Photo Point 25, Upstream: 2010

Photo Point 25, Upstream: 2015

Fall Assessment Photos - Sep 1-2, 2015 - Suther Stream Mitigation Site # 370

Photo Point 26, Upstream: 2010

Photo Point 26, Upstream: 2015

Photo Point 27, Downstream: 2010

Photo Point 27, Downstream: 2015

Fall Assessment Photos - Sep 1-2, 2015 - Suther Stream Mitigation Site # 370

Photo Point 28, Upstream: 2010

Photo Point 28, Usptream: 2015

Photo Point 29, Upstream: 2010

Photo Point 29, Upstream (Hobo Gauge): 2015

Fall Assessment Photos - Sep 1-2, 2015 - Suther Stream Mitigation Site # 370

Photo Point 30, Upstream: 2010

Photo Point 30, Upstream: 2015

Photo Point 31, Upstream: 2010

Photo Point 31, Upstream: 2015

Problem Areas and Other Photos: Suther Site # 370, Cabarrus County -- Photos Sep 1-2, 2015 unless dated otherwise

Bank erosion at step-pool: Tributary station 5+30, Sep 2015

Hog-rooting along streambank: Tributary station 3+40, May 2015

DBC / Tributary confluence: pre-erosion, Aug 2014

DBC / Tributary confluence: erosion & bed scour, Sep 2015

Problem Areas and Other Photos: Suther Site # 370, Cabarrus County -- Photos Sep 1-2, 2015 unless dated otherwise

Bed scour in DBC at Trib confluence, face dnst, Sep 2015

Bed scour in DBC at Trib confluence, face upst, Sep 2015

Woody seedlings /scrub in field S of DBC sta 13+00, Sep 2015

Easement fence broken, SE of PhoPt-2, DBC sta 15+00, Sep 2015

Problem Areas and Other Photos: Suther Site # 370, Cabarrus County -- Photos Sep 1-2, 2015 unless dated otherwise

DBC RBK sta 16+80 erosion, face upst, Sep 2015

DBC RBK sta 17+40 erosion, face across channel, Sep 2015

DBC RBK sta 28+30 erosion pins 6-7, face upst, Sep 2015

DBC RBK sta 28+30 erosion pins 6-7, face dnst, Sep 2015

Problem Areas and Other Photos: Suther Site # 370, Cabarrus County -- Photos Sep 1-2, 2015 unless dated otherwise

DBC sta 32+50, construc crossing & mid-channel bar, Sep 2015

DBC sta 35+80, face upst, RBK erosion, Sep 2015

Hobo gauge at DBC sta 37+60, 4/2014 to 8/2015 (photo Sep 2014)

Hobo gauge moved to Trib sta 4+82 on 07 Aug 2015

Problem Areas and Other Photos: Suther Site # 370, Cabarrus County -- Photos Sep 1-2, 2015 unless dated otherwise

DBC station 94+00 facing upstream, Sep 2015

DBC station 94+00 facing dnst, crushed-rock crossing

DBC station 94+30 facing upst from rock crossing

DBC station 94+30 facing dnst from rock crossing

Appendix C: Vegetation Plot Data

No CVS vegetation plot data were collected during 2014 or 2015, as directed by the DMS Project Manager. DMS staff are reviewing the project to determine if supplementary planting will be necessary, and will reestablish an appropriate CVS monitoring regime.

Appendix D. Stream Survey Data

Figure 3.1-3.8. Stream Cross-Section Survey Plots
Figure 4. Stream Longitudinal Profile Survey Plot
Figure 5.1-5.4. Substrate Pebble Count Plots
Table 7. Bank Erosion Pin Exposure Data
Table 8.1-8.2. Baseline Stream Morphology Data Summary
Table 9.1. Stream Cross-Section Morphology Data Summary
Table 9.2. Stream Longitudinal Morphology Data Summary

e-Table: Raw Survey Data LongPro & Xsec Spreadsheet
e-Table: Raw Pebble Count Data Spreadsheet

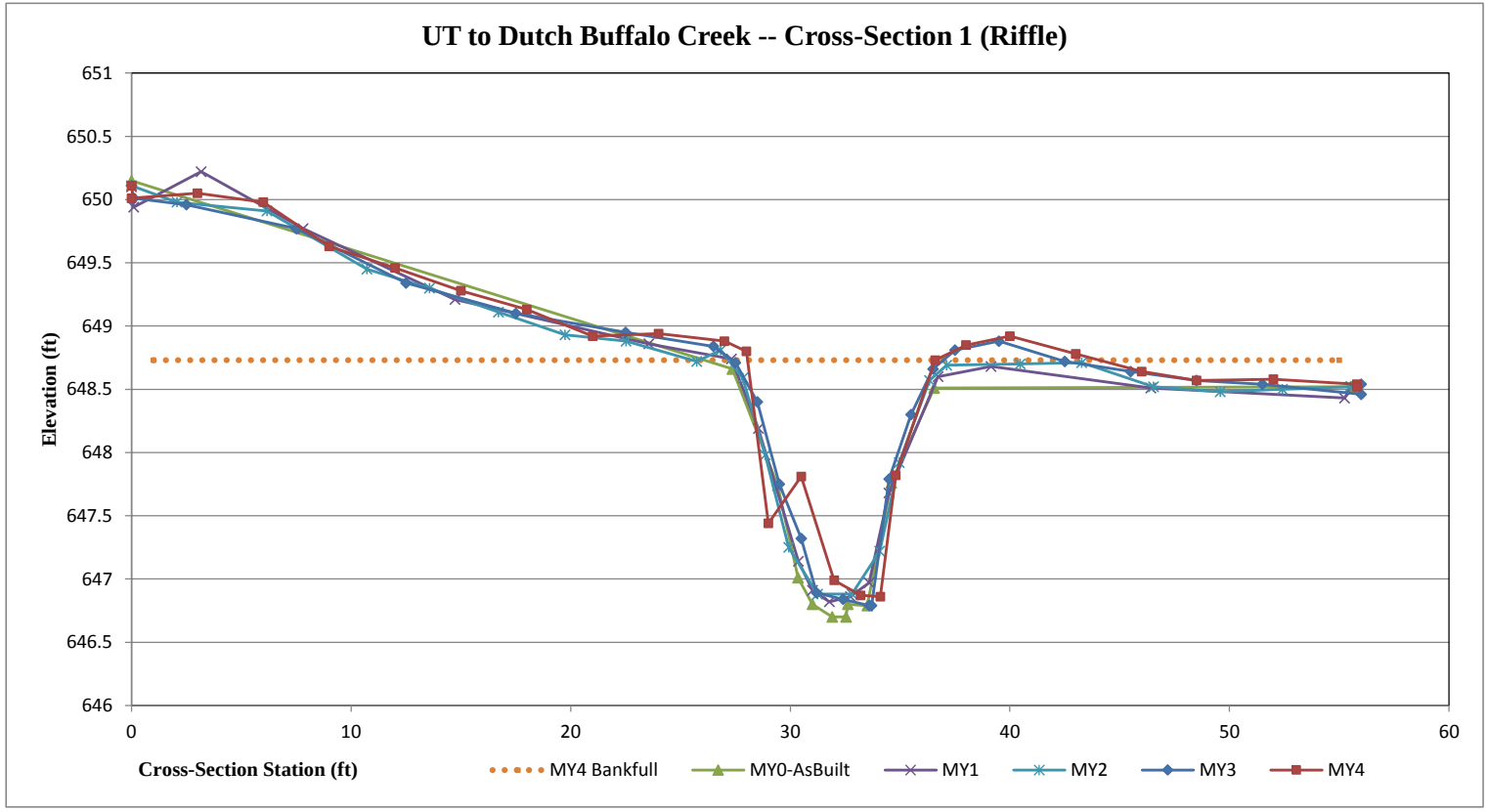
Appendix D. Stream Survey Data -- Suther Site Project #370
Figure 3.1. Stream Cross-Section Plots & Data -- Sep 2015 (MY4)
UT Dutch Buffalo Cr -- Trib X-Section 1

Project Name	**DBC (Suther)**
DMS Project Number	**370**
Cross-Section ID	**UT-1, XS-1, Riffle**
Survey Date	**9/2015**
SUMMARY DATA	
Bankfull Elevation (ft)	648.73
Bankfull Cross-Sectional Area (ft^2)	9.90
Bankfull Width (ft)	8.60
Flood Prone Area Elevation (ft)	650.59
Flood Prone Width (ft)	56.00
Bankfull Mean Depth (ft)	0.57
Bankfull Max Depth (ft)	1.86
W/D Ratio	15.09
Entrenchment Ratio	6.51
Bank Height Ratio	1.00

Trib XS-1: Upstream

Trib XS-1: Downstream

Station	Elevation	Notes
0.0	650.11	TLP
0.0	650.01	BLP
3.0	650.05	xs1
6.0	649.98	xs1
9.0	649.63	xs1
12.0	649.46	xs1
15.0	649.28	xs1
18.0	649.13	xs1
21.0	648.92	xs1
24.0	648.94	xs1
27.0	648.88	xs1
28.0	648.8	TLB
29.0	647.44	xs1
30.5	647.81	xs1
32.0	646.99	BLB
33.2	646.87	THW
34.1	646.86	BRB
34.8	647.82	xs1
36.6	648.73	TRB
38.0	648.85	xs1
40.0	648.92	xs1
43.0	648.78	xs1
46.0	648.64	xs1
48.5	648.57	xs1
52.0	648.58	xs1
55.8	648.54	TRP
55.8	648.52	BRP



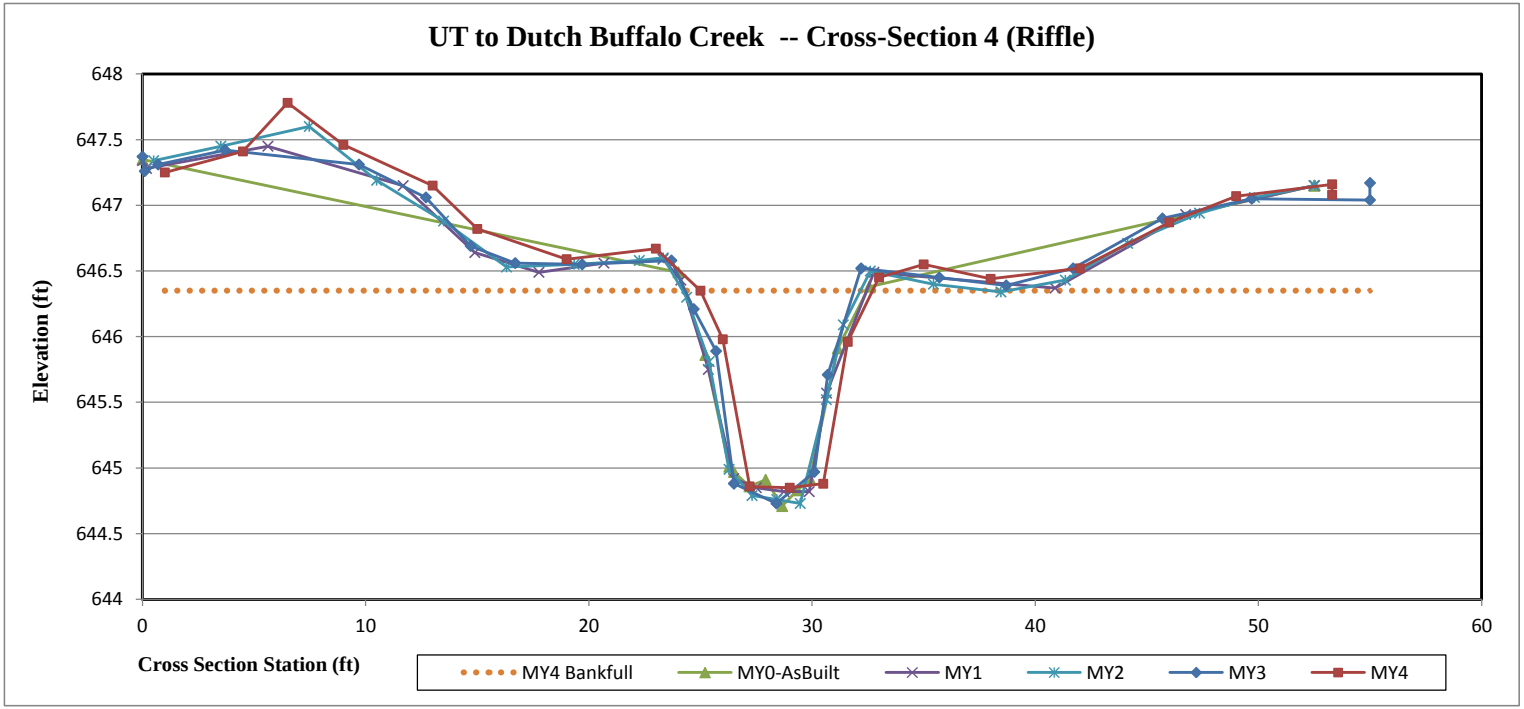
Appendix D. Stream Survey Data -- Suther Site Project #370
Figure 3.2. Stream Cross-Section Plots & Data -- Sep 2015 (MY4)
UT Dutch Buffalo Cr -- Trib X-Section 4

Project Name	**DBC (Suther)**
DMS Project Number	**370**
Cross-Section ID	**UT-1, XS-4, Riffle**
Survey Date	**9/2015**
SUMMARY DATA	
Bankfull Elevation (ft)	646.35
Bankfull Cross-Sectional Area (ft^2)	8.88
Bankfull Width (ft)	8.00
Flood Prone Area Elevation (ft)	647.85
Flood Prone Width (ft)	55.00
Bankfull Mean Depth (ft)	0.88
Bankfull Max Depth (ft)	1.50
W/D Ratio	9.09
Entrenchment Ratio	6.88
Bank Height Ratio	1.00

Trib XS-4: Upstream

Trib XS-4: Downstream

Station	Elevation	Notes
0	647.37	TLP
0	647.3	BLP
1.0	647.25	xs4
4.5	647.41	xs4
6.5	647.78	TR
9.0	647.46	xs4
13.0	647.15	xs4
15.0	646.82	xs4
19.0	646.59	xs4
23.0	646.67	xs4
25.0	646.35	TLB
26.0	645.98	xs4
27.2	644.86	BLB
29.0	644.85	THW
30.5	644.88	BRB
31.6	645.96	xs4
33.0	646.45	TRB
35.0	646.55	xs4
38.0	646.44	xs4
42.0	646.52	xs4
46.0	646.87	xs4
49.0	647.07	xs4
53.3	647.16	TRP
53.3	647.08	BRP



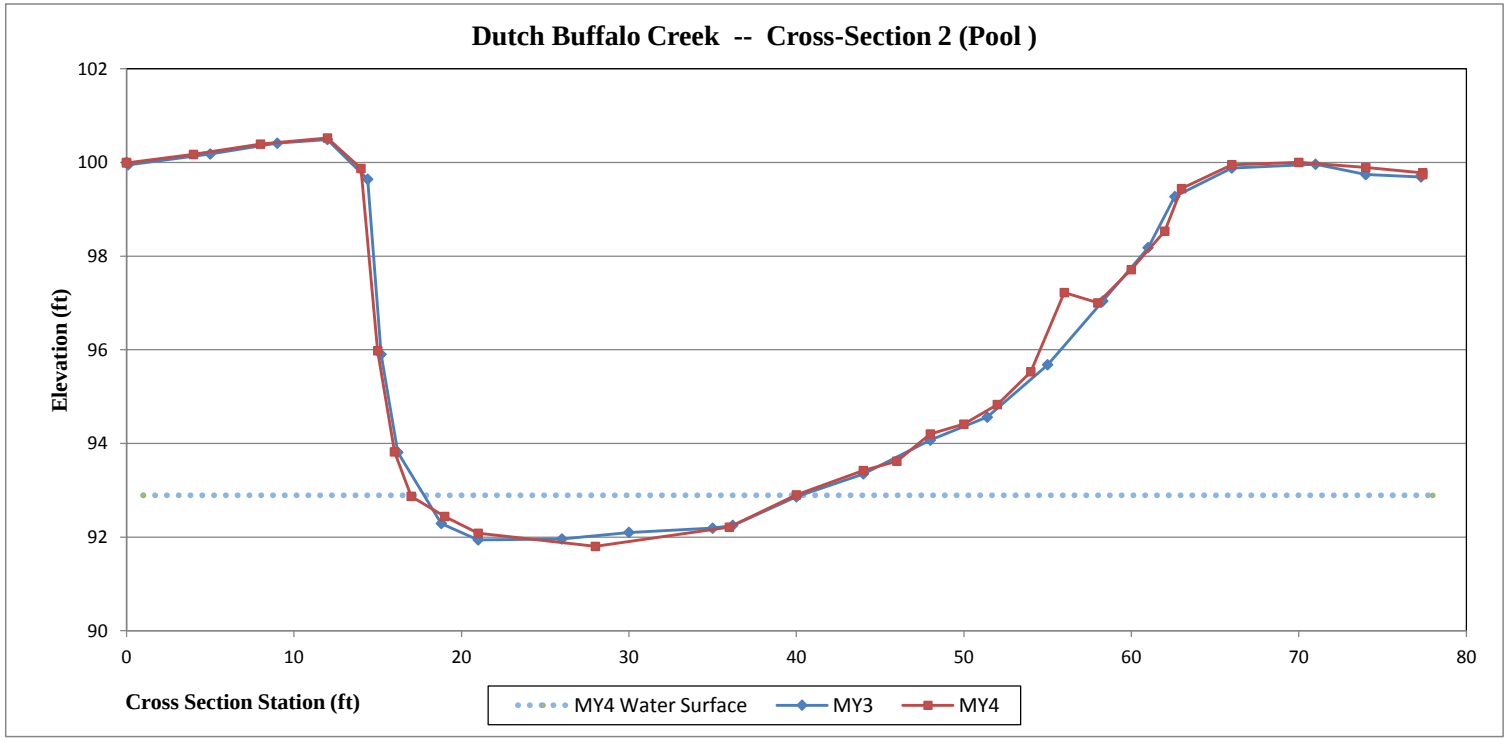
Appendix D. Stream Survey Data -- Suther Site Project #370
Figure 3.3. Stream Cross-Section Plots & Data -- Sep 2015 (MY4)
Dutch Buffalo Cr -- Main Stem X-Section 2

Project Name	DBC (Suther)	
DMS Project Number	370	
Cross-Section ID	DBCr, XS-2, Pool	
Survey Date	9/2015	
SUMMARY DATA		
Bankfull Elevation (ft)		99.87
Bankfull Cross-Sectional Area (ft^2)		274.10
Bankfull Width (ft)		49.00
Flood Prone Area Elevation (ft)		107.94
Flood Prone Width (ft)		77.00
Bankfull Mean Depth (ft)		5.61
Bankfull Max Depth (ft)		8.07
W/D Ratio		8.73
Entrenchment Ratio		1.57
Bank Height Ratio		1.00

XS-2: Upstream

XS-2: Downstream

Station	Elevation	Notes
0.0	100.00	TLP
0.0	99.99	BLP
4.0	100.17	xs2
8.0	100.39	xs2
12.0	100.52	xs2
14.0	99.87	TLB
15.0	95.98	xs2
16.0	93.82	xs2
17.0	92.87	xs2
19.0	92.44	BLB
21.0	92.08	LEW
28.0	91.80	PMD
36.0	92.21	REW
40.0	92.90	xs2
44.0	93.42	xs2
46.0	93.62	xs2
48.0	94.20	xs2
50.0	94.41	BRB
52.0	94.83	xs2
54.0	95.53	xs2
56.0	97.22	xs2
58.0	97.00	xs2
60.0	97.71	xs2
62.0	98.53	xs2
63.0	99.44	TRB
66.0	99.95	xs2
70.0	100.00	xs2
74.0	99.89	xs2
77.4	99.78	TRP
77.4	99.74	BRP



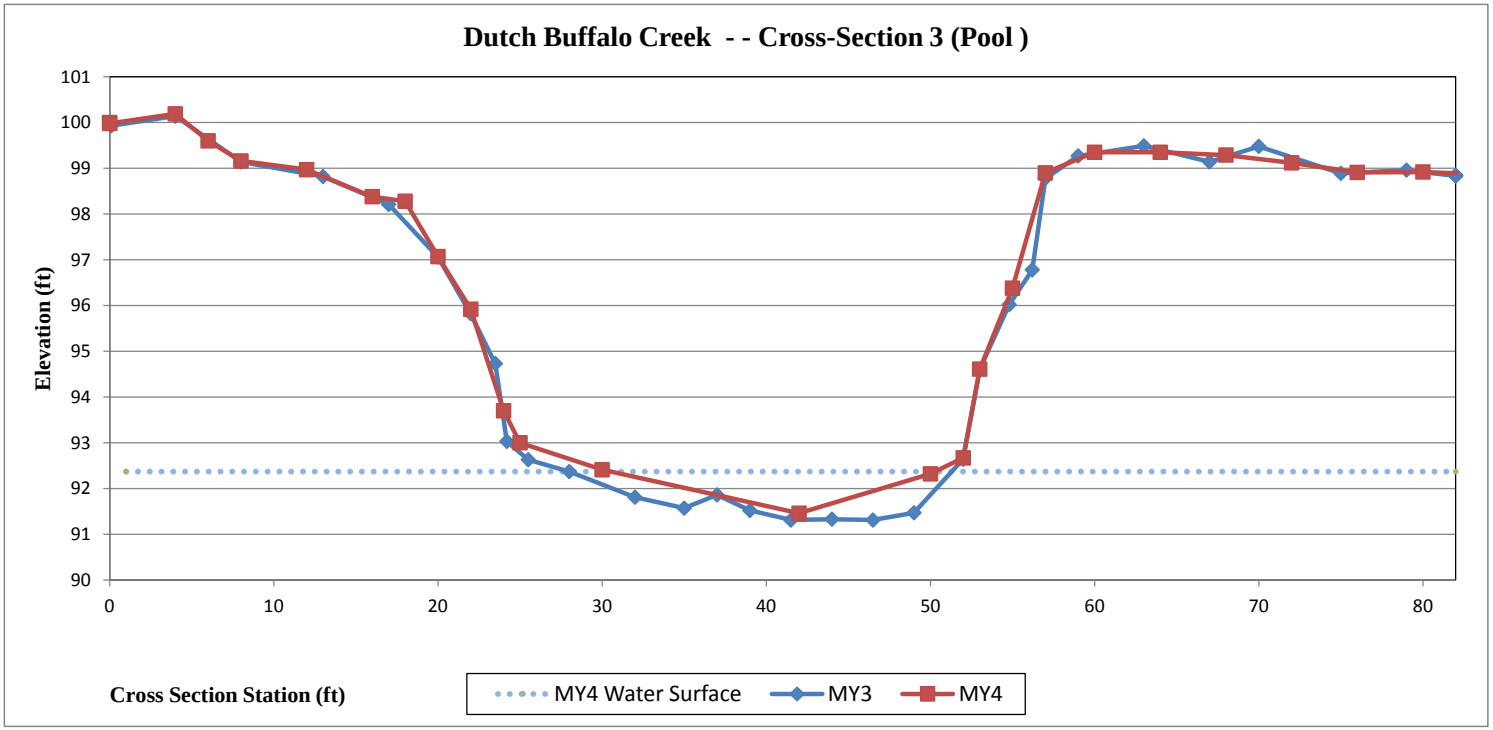
Appendix D. Stream Survey Data -- Suther Site Project #370
Figure 3.4. Stream Cross-Section Plots & Data -- Sep 2015 (MY4)
Dutch Buffalo Cr -- Main Stem X-Section 3

Project Name	**DBC (Suther)**
DMS Project Number	**370**
Cross-Section ID	**DBCr, XS-3, Pool**
Survey Date	**9/2015**
SUMMARY DATA	
Bankfull Elevation (ft)	99.28
Bankfull Cross-Sectional Area (ft^2)	241.20
Bankfull Width (ft)	39.00
Flood Prone Area Elevation (ft)	107.10
Flood Prone Width (ft)	82.00
Bankfull Mean Depth (ft)	3.65
Bankfull Max Depth (ft)	7.82
W/D Ratio	10.68
Entrenchment Ratio	2.10
Bank Height Ratio	0.99

XS-3: Upstream

XS-3: Downstream

Station	Elevation	Notes
0.0	100.00	TLP
0.0	99.98	BLP
4.0	100.19	xs3
6.0	99.60	xs3
8.0	99.16	xs3
12.0	98.97	xs3
16.0	98.38	xs3
18.0	98.28	TLB
20.0	97.07	xs3
22.0	95.92	xs3
24.0	93.70	xs3
25.0	93.00	BLB
30.0	92.41	LEW
42.0	91.46	PMD
50.0	92.32	REW
52.0	92.67	BRB
53.0	94.61	xs3
55.0	96.38	xs3
57.0	98.90	TRB
60.0	99.35	xs3
64.0	99.35	xs3
68.0	99.29	xs3
72.0	99.12	xs3
76.0	98.91	xs3
80.0	98.92	xs3
82.2	98.89	TRP
82.2	98.85	BRP



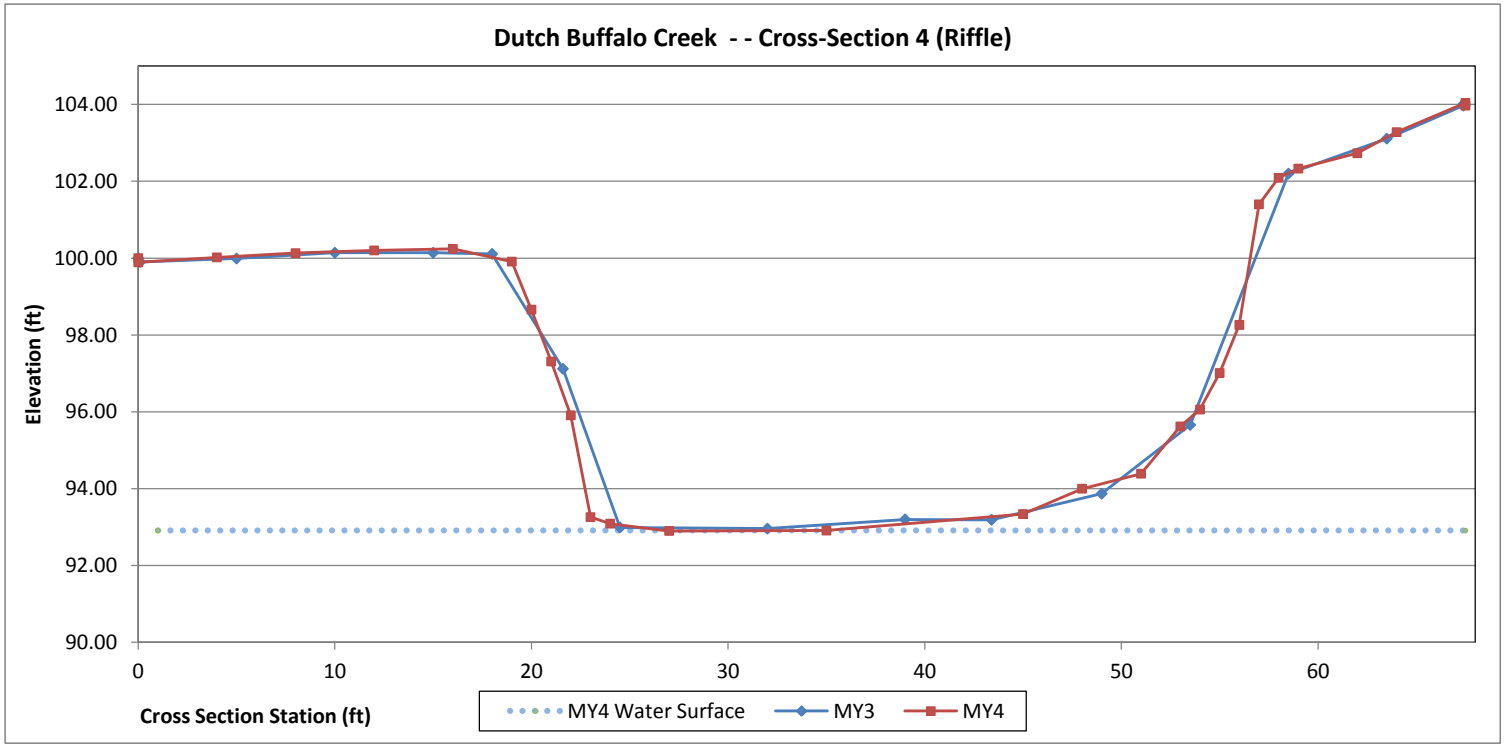
Appendix D. Stream Survey Data -- Suther Site Project #370
Figure 3.5. Stream Cross-Section Plots & Data -- Sep 2015 (MY4)
Dutch Buffalo Cr -- Main Stem X-Section 4

Project Name	DBC (Suther)	
DMS Project Number	370	
Cross-Section ID	DBCr, XS-4, Riffle	
Survey Date	9/2015	
SUMMARY DATA		
Bankfull Elevation (ft)		99.91
Bankfull Cross-Sectional Area (ft^2)		218.40
Bankfull Width (ft)		39.00
Flood Prone Area Elevation (ft)		106.92
Flood Prone Width (ft)		68.00
Bankfull Mean Depth (ft)		5.73
Bankfull Max Depth (ft)		7.01
W/D Ratio		6.81
Entrenchment Ratio		1.74
Bank Height Ratio		1.02

XS-4: Upstream

XS-4: Downstream

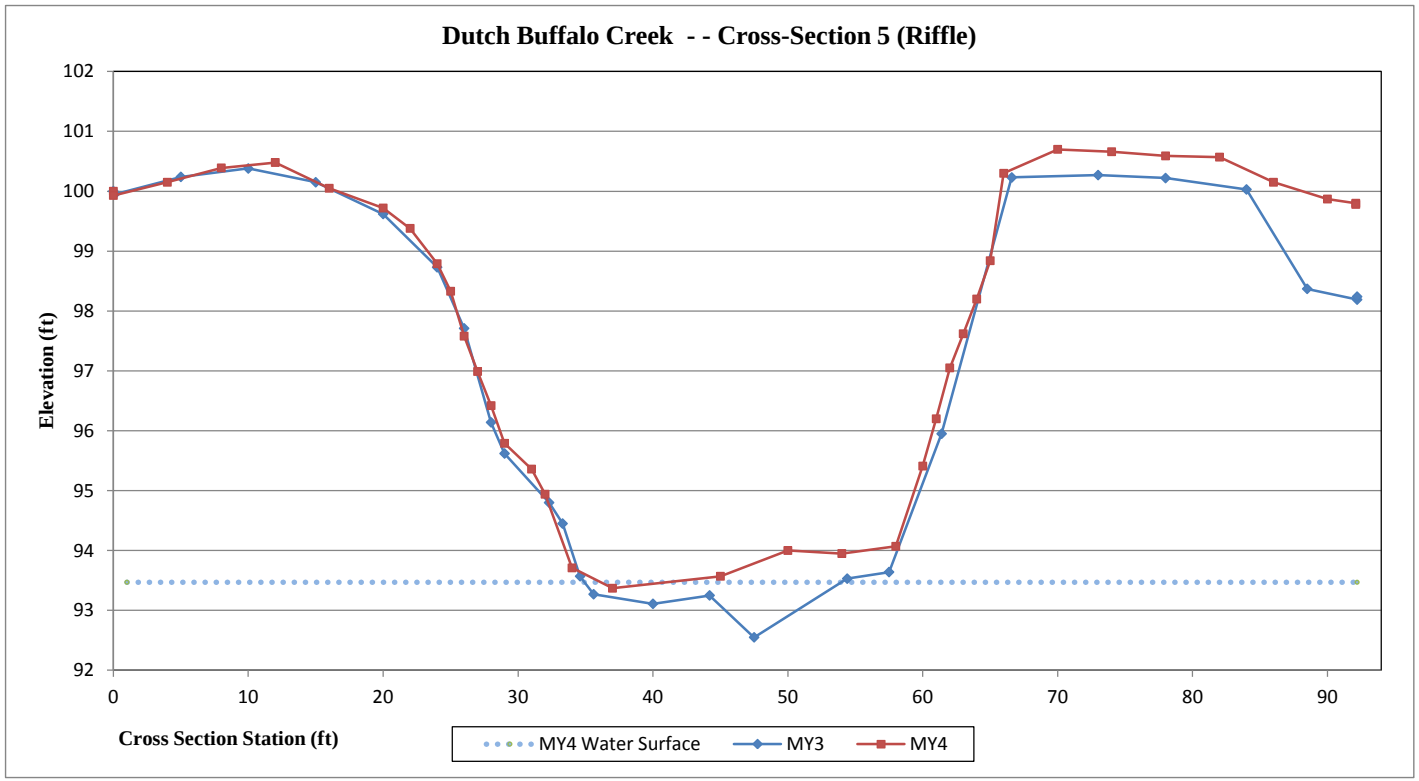
Station	Elevation	Notes
0.0	100.00	TLP
0.0	99.89	BLP
4.0	100.02	xs4
8.0	100.13	xs4
12.0	100.20	xs4
16.0	100.24	xs4
19.0	99.91	TLB
20.0	98.66	xs4
21.0	97.31	xs4
22.0	95.91	xs4
23.0	93.26	xs4
24.0	93.09	BLB
27.0	92.90	LEW
35.0	92.91	REW
45.0	93.34	xs4
48.0	94.00	xs4
51.0	94.39	BRB
53.0	95.62	xs4
54.0	96.06	xs4
55.0	97.01	xs4
56.0	98.26	xs4
57.0	101.40	xs4
58.0	102.09	TRB
59.0	102.33	xs4
62.0	102.73	xs4
64.0	103.28	xs4
67.5	104.04	TRP
67.5	103.97	BRP



Appendix D. Stream Survey Data -- Suther Site Project #370
Figure 3.6. Stream Cross-Section Plots & Data -- Sep 2015 (MY4)
Dutch Buffalo Cr -- Main Stem X-Section 5

Project Name	**DBC (Suther)**
DMS Project Number	**370**
Cross-Section ID	**DBCr, XS-5, Riffle**
Survey Date	**9/2015**
SUMMARY DATA	
Bankfull Elevation (ft)	98.79
Bankfull Cross-Sectional Area (ft^2)	235.90
Bankfull Width (ft)	42.00
Flood Prone Area Elevation (ft)	104.21
Flood Prone Width (ft)	92.00
Bankfull Mean Depth (ft)	3.56
Bankfull Max Depth (ft)	5.42
W/D Ratio	11.80
Entrenchment Ratio	2.19
Bank Height Ratio	1.02

Station	Elevation	Notes
0.0	100.00	TLP
0.0	99.93	BLP
4.0	100.15	xs5
8.0	100.39	xs5
12.0	100.48	xs5
16.0	100.05	xs5
20.0	99.72	xs5
22.0	99.38	xs5
24.0	98.79	TLB
25.0	98.33	xs5
26.0	97.58	xs5
27.0	96.99	xs5
28.0	96.42	xs5
29.0	95.79	LLB
31.0	95.36	xs5
32.0	94.94	xs5
34.0	93.71	BLB
37.0	93.37	LEW
45.0	93.57	REW
50.0	94.00	SB
54.0	93.95	xs5
58.0	94.07	BRB
60.0	95.41	xs5
61.0	96.20	xs5
62.0	97.05	xs5
63.0	97.62	xs5
64.0	98.20	xs5
65.0	98.84	xs5
66.0	100.30	TRB
70.0	100.70	xs5
74.0	100.66	xs5
78.0	100.59	xs5
82.0	100.57	xs5
86.0	100.15	xs5
90.0	99.87	xs5
92.1	99.80	TLP
92.1	99.78	BLP



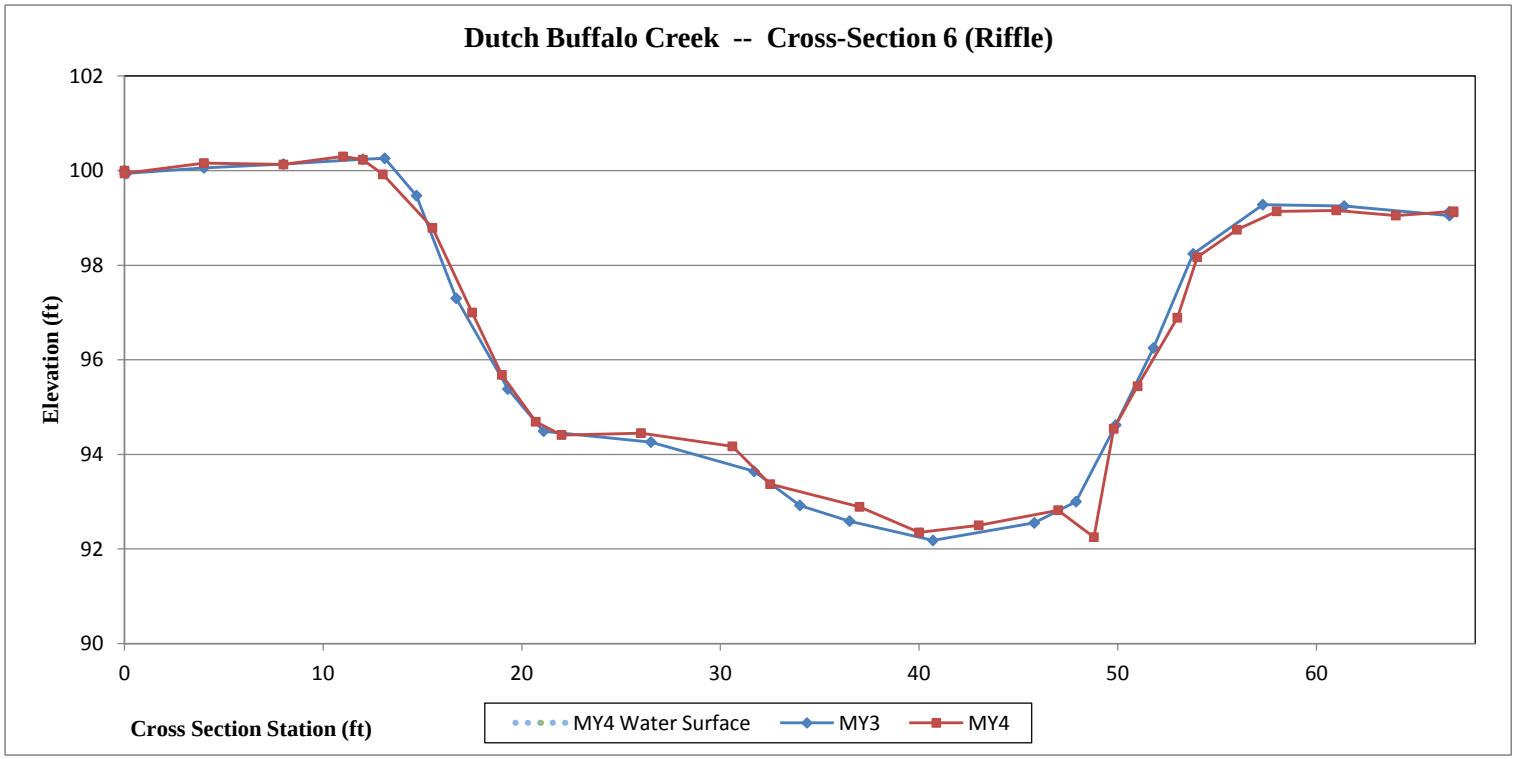
Appendix D. Stream Survey Data -- Suther Site Project #370
Figure 3.7. Stream Cross-Section Plots & Data -- Sep 2015 (MY4)
Dutch Buffalo Cr -- Main Stem X-Section 6

Project Name	**DBC (Suther)**
DMS Project Number	**370**
Cross-Section ID	**DBCr, XS-6, Riffle**
Survey Date	**9/2015**
SUMMARY DATA	
Bankfull Elevation (ft)	100.23
Bankfull Cross-Sectional Area (ft^2)	156.40
Bankfull Width (ft)	42.00
Flood Prone Area Elevation (ft)	108.11
Flood Prone Width (ft)	67.00
Bankfull Mean Depth (ft)	4.14
Bankfull Max Depth (ft)	7.88
W/D Ratio	10.14
Entrenchment Ratio	1.60
Bank Height Ratio	1.02

XS-6: Upstream

XS-6: Downstream

Station	Elevation	Notes
0.0	100.00	TLP
0.0	99.94	BLP
4.0	100.16	xs6
8.0	100.13	xs6
11.0	100.30	xs6
12.0	100.23	TLB
13.0	99.92	xs6
15.5	98.79	xs6
17.5	97.00	xs6
19.0	95.68	xs6
20.7	94.69	BLB
22.0	94.41	xs6
26.0	94.45	xs6
30.6	94.17	xs6
32.5	93.37	xs6
37.0	92.89	xs6
40.0	92.35	THW
43.0	92.50	xs6
47.0	92.82	BRB
48.8	92.25	xs6
49.8	94.54	xs6
51.0	95.44	xs6
53.0	96.89	xs6
54.0	98.17	TRB
56.0	98.75	xs6
58.0	99.14	xs6
61.0	99.16	xs6
64.0	99.05	xs6
66.9	99.14	TRP
66.9	99.12	BRP



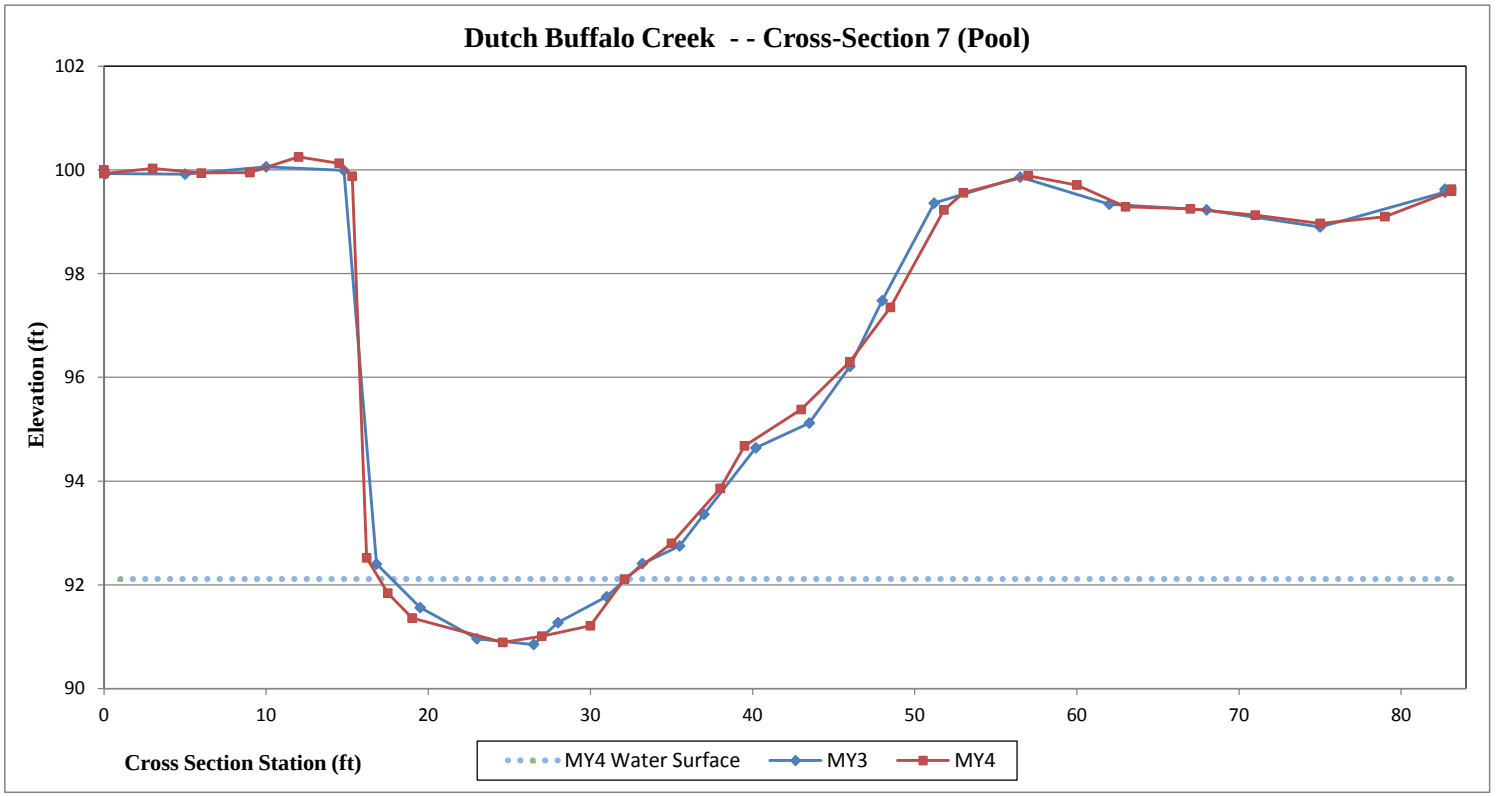
Appendix D. Stream Survey Data -- Suther Site Project #370
Figure 3.8. Stream Cross-Section Plots & Data -- Sep 2015 (MY4)
Dutch Buffalo Cr -- Main Stem X-Section 7

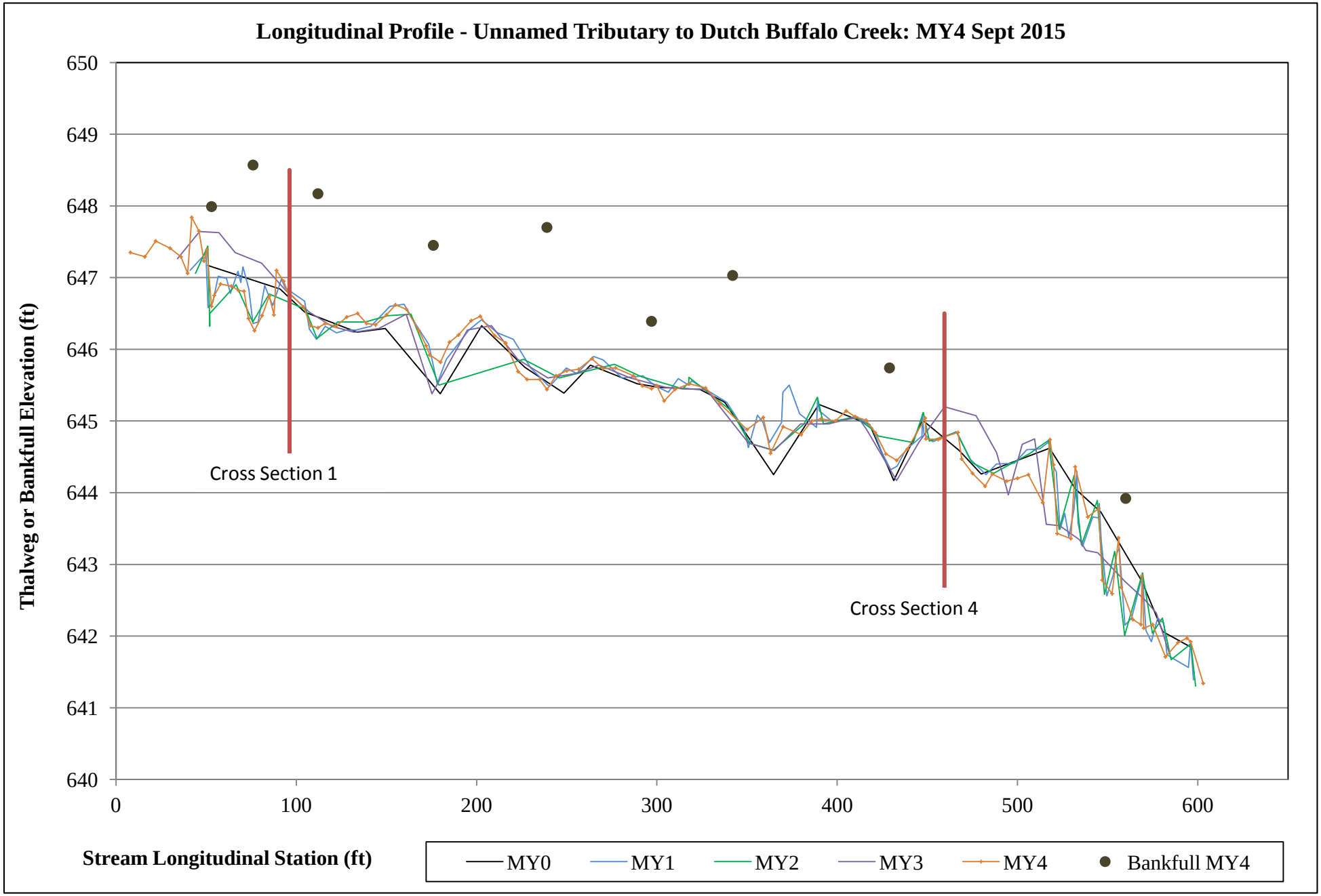
Project Name	**DBC (Suther)**
DMS Project Number	**370**
Cross-Section ID	**DBCr, XS-7, Pool**
Survey Date	**9/2015**
SUMMARY DATA	
Bankfull Elevation (ft)	99.88
Bankfull Cross-Sectional Area (ft^2)	248.00
Bankfull Width (ft)	36.50
Flood Prone Area Elevation (ft)	108.87
Flood Prone Width (ft)	83.00
Bankfull Mean Depth (ft)	3.67
Bankfull Max Depth (ft)	8.99
W/D Ratio	9.95
Entrenchment Ratio	2.27
Bank Height Ratio	1.01

XS-7: Upstream

XS-7: Downstream

Station	Elevation	Notes
0.0	100.00	TLP
0.0	99.93	BLP
3.0	100.03	xs7
6.0	99.94	xs7
9.0	99.95	xs7
12.0	100.25	xs7
14.5	100.13	xs7
15.3	99.88	TLB
16.2	92.52	xs7
17.5	91.84	xs7
19.0	91.36	xs7
24.6	90.89	THW
27.0	91.01	xs7
30.0	91.21	xs7
32.1	92.11	REW
35.0	92.80	BRB
38.0	93.86	xs7
39.5	94.68	xs7
43.0	95.38	xs7
46.0	96.30	xs7
48.5	97.35	xs7
51.8	99.23	TRB
53.0	99.56	xs7
57.0	99.89	xs7
60.0	99.71	xs7
63.0	99.29	xs7
67.0	99.25	xs7
71.0	99.13	xs7
75.0	98.97	xs7
79.0	99.10	xs7
83.1	99.59	BRP
83.1	99.63	TRP

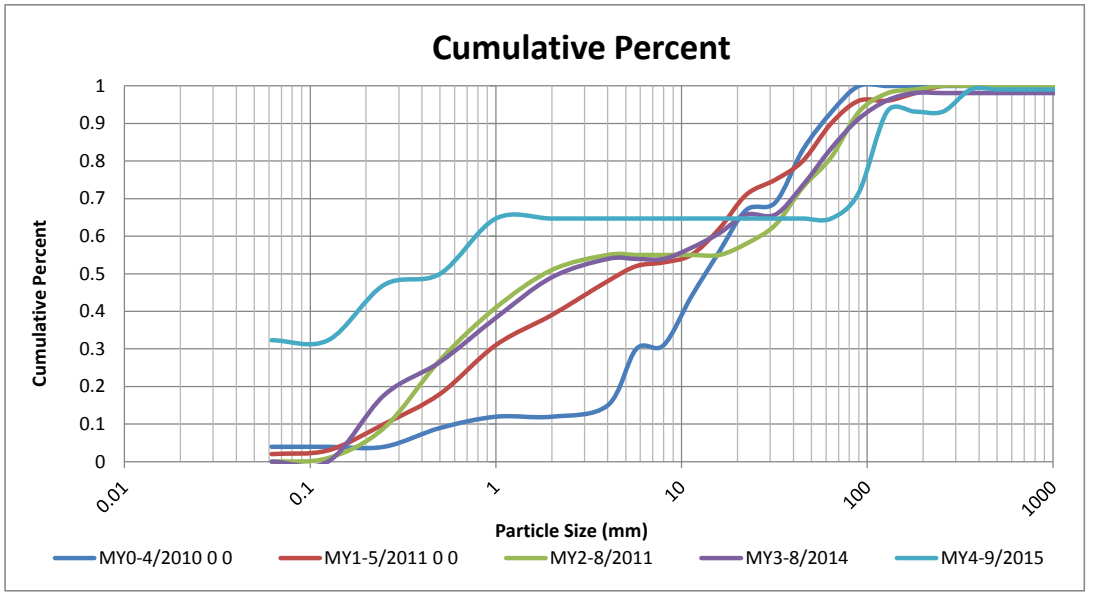


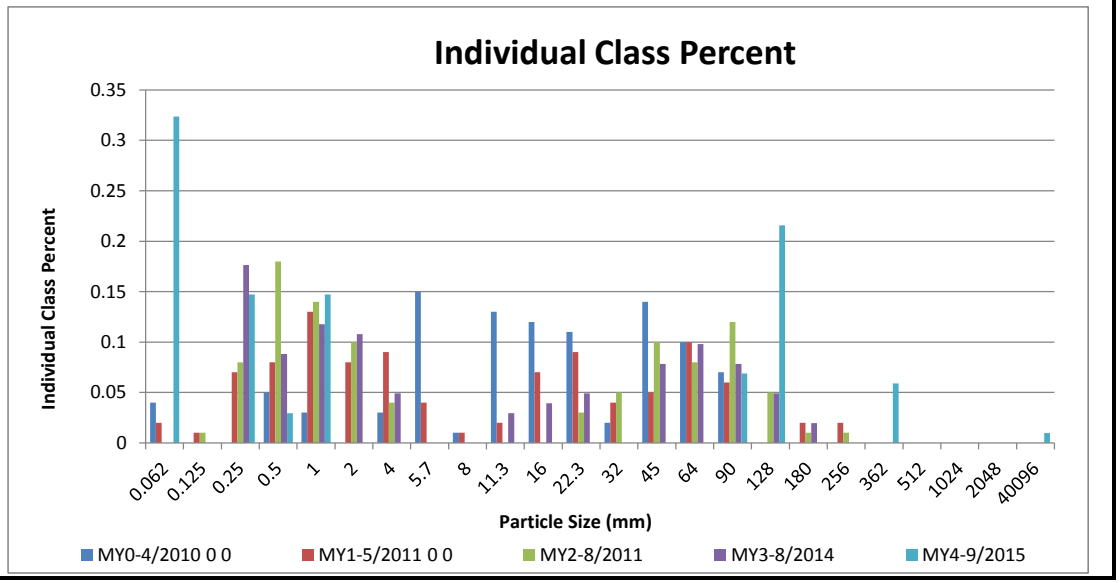

Longitudinal Profile - Unnamed Tributary to Dutch Buffalo Creek: MY4 Sept 2015
Thalweg or Bankfull Elevation (ft)
650
649
648
647
646
645
644
643
642
641
640
0
100
200
300
400
500
600
Cross Section 1
Cross Section 4
Stream Longitudinal Station (ft)
MY0
MY1
MY2
MY3
MY4
Bankfull MY4

Appendix D. Stream Survey Data -- Suther Site Project #370
Figure 5.1. Pebble Count Plots & Data -- Sep 2015 (MY4)
UT to Dutch Buffalo Creek -- Tributary Cross-Section 1

Project Name: Dutch Buffalo Creek (Unnamed Tributary)					
Cross-Section 1: RIFFLE					
			MY4-9/2015		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	33	32%	32%
Sand	very fine sand	0.125	0	0%	32%
	fine sand	0.250	15	15%	47%
	medium sand	0.500	3	3%	50%
	coarse sand	1.000	15	15%	65%
	very coarse sand	2.000	0	0%	65%
Gravel	very fine gravel	4.000	0	0%	65%
	fine gravel	5.700	0	0%	65%
	fine gravel	8.000	0	0%	65%
	medium gravel	11.300	0	0%	65%
	medium gravel	16.000	0	0%	65%
	course gravel	22.300	0	0%	65%
	course gravel	32.000	0	0%	65%
	very coarse gravel	45.000	0	0%	65%
	very coarse gravel	64.000	0	0%	65%
Cobble	small cobble	90.000	7	7%	72%
	medium cobble	128.000	22	22%	93%
	large cobble	180.000	0	0%	93%
	very large cobble	256.000	0	0%	93%
Boulder	small boulder	362.000	6	6%	99%
	small boulder	512.000	0	0%	99%
	medium boulder	1024.000	0	0%	99%
	large boulder	2048.000	0	0%	99%
Bedrock	bedrock	40096.000	1	1%	100%
TOTAL % of whole count			102	100%	100%

2015 Particle Size Summary (mm)	
D50	0.5
D84	112
D95	291

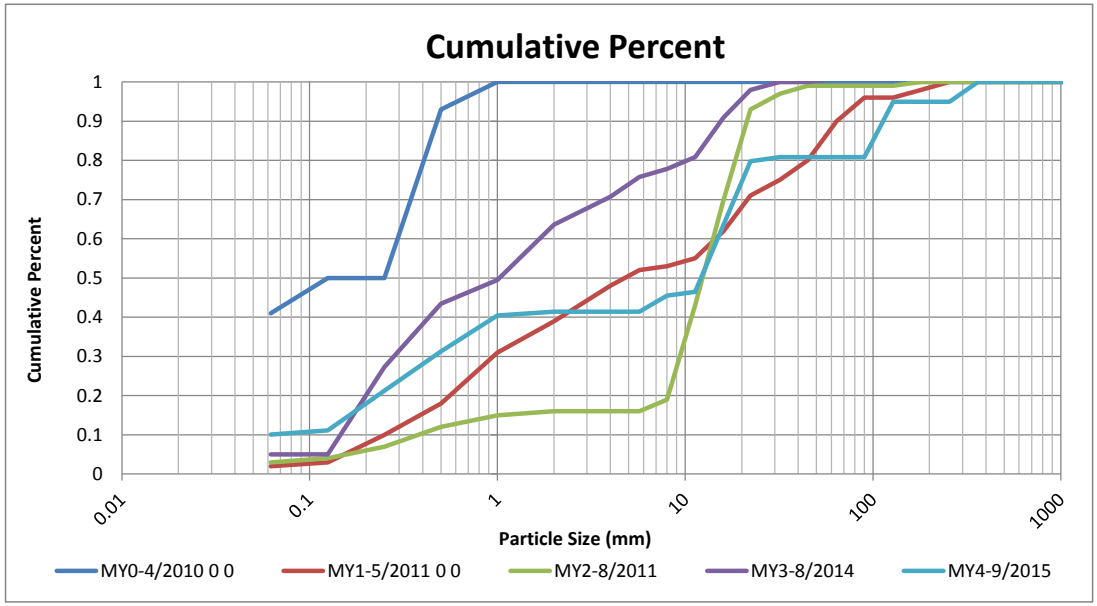


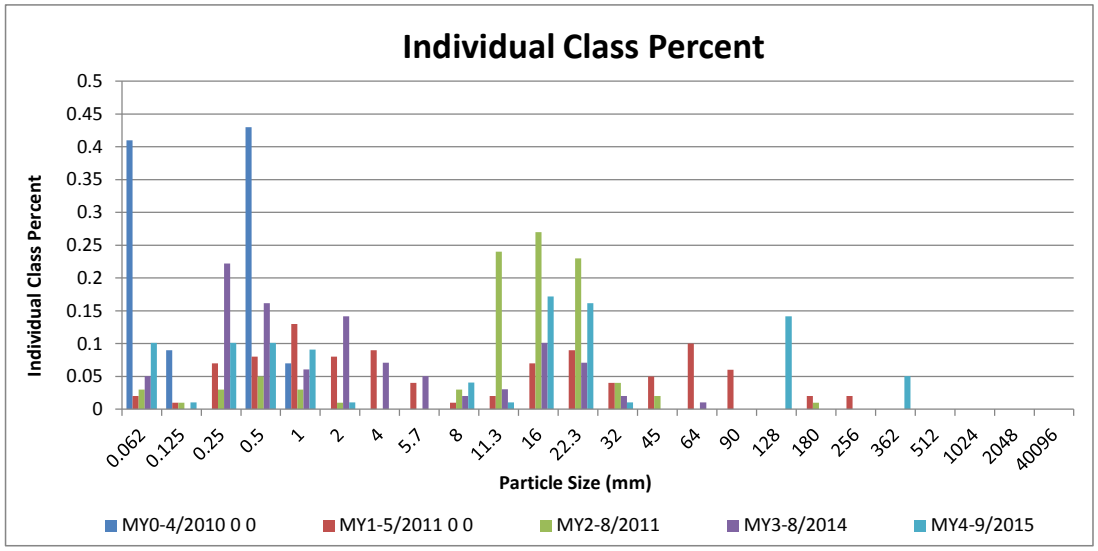


Appendix D. Stream Survey Data -- Suther Site Project #370
Figure 5.2. Pebble Count Plots & Data -- Sep 2015 (MY4)
UT to Dutch Buffalo Creek -- Tributary Cross-Section 2

Project Name: Dutch Buffalo Creek (Unnamed Tributary)					
Cross-Section 2: POOL					
			MY4-9/2015		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	10	10%	10%
Sand	very fine sand	0.125	1	1%	11%
	fine sand	0.250	10	10%	21%
	medium sand	0.50	10	10%	31%
	coarse sand	1.00	9	9%	40%
	very coarse sand	2.0	1	1%	41%
Gravel	very fine gravel	4.0	0	0%	41%
	fine gravel	5.7	0	0%	41%
	fine gravel	8.0	4	4%	45%
	medium gravel	11.3	1	1%	46%
	medium gravel	16.0	17	17%	64%
	coarse gravel	22.3	16	16%	80%
	coarse gravel	32.0	1	1%	81%
	very coarse gravel	45	0	0%	81%
	very coarse gravel	64	0	0%	81%
Cobble	small cobble	90	0	0%	81%
	medium cobble	128	14	14%	95%
	large cobble	180	0	0%	95%
	very large cobble	256	0	0%	95%
Boulder	small boulder	362	5	5%	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			99	100%	100%

2015 Particle Size Summary (mm)	
D50	12
D84	98
D95	128

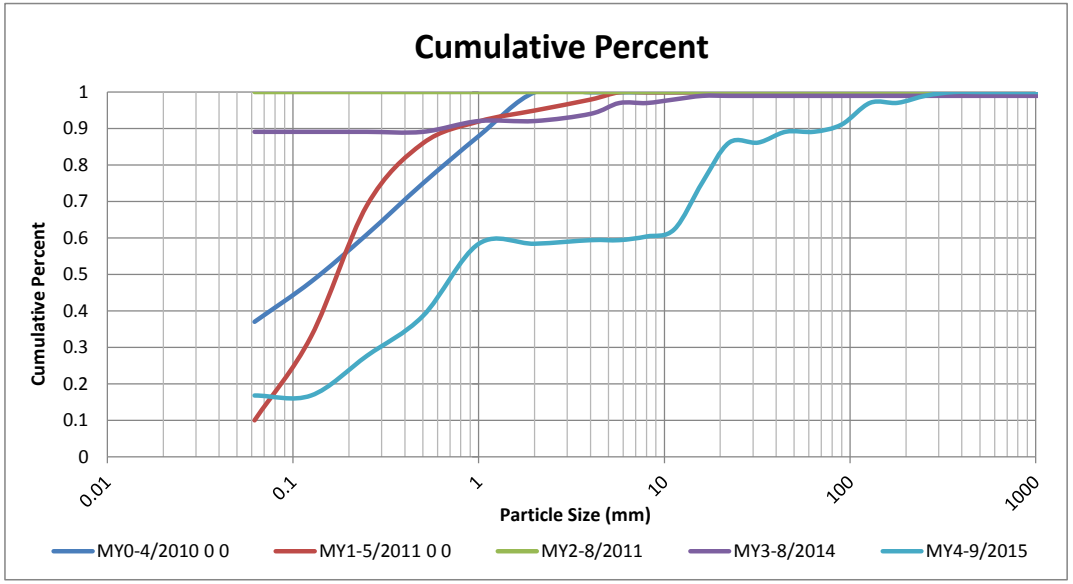


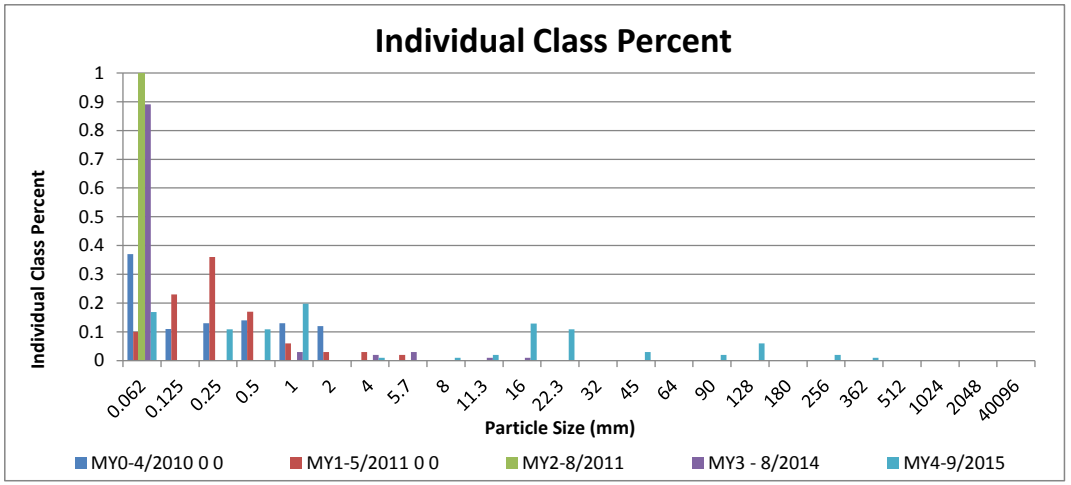


Appendix D. Stream Survey Data -- Suther Site Project #370
Figure 5.3. Pebble Count Plots & Data -- Sep 2015 (MY4)
UT to Dutch Buffalo Creek -- Tributary Cross-Section 3

Project Name: Dutch Buffalo Creek (Unnamed Tributary)					
Cross-Section 3: POOL					
			MY4-9/2015		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	17	17%	17%
Sand	very fine sand	0.125	0	0%	17%
	fine sand	0.250	11	11%	28%
	medium sand	0.50	11	11%	39%
	coarse sand	1.00	20	20%	58%
	very coarse sand	2.0	0	0%	58%
Gravel	very fine gravel	4.0	1	1%	59%
	fine gravel	5.7	0	0%	59%
	fine gravel	8.0	1	1%	60%
	medium gravel	11.3	2	2%	62%
	medium gravel	16.0	13	13%	75%
	coarse gravel	22.3	11	11%	86%
	coarse gravel	32.0	0	0%	86%
	very coarse gravel	45	3	3%	89%
	very coarse gravel	64	0	0%	89%
Cobble	small cobble	90	2	2%	91%
	medium cobble	128	6	6%	97%
	large cobble	180	0	0%	97%
	very large cobble	256	2	2%	99%
Boulder	small boulder	362	1	1%	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			101	100%	100%

2015 Particle Size Summary (mm)	
D50	0.8
D84	21
D95	115

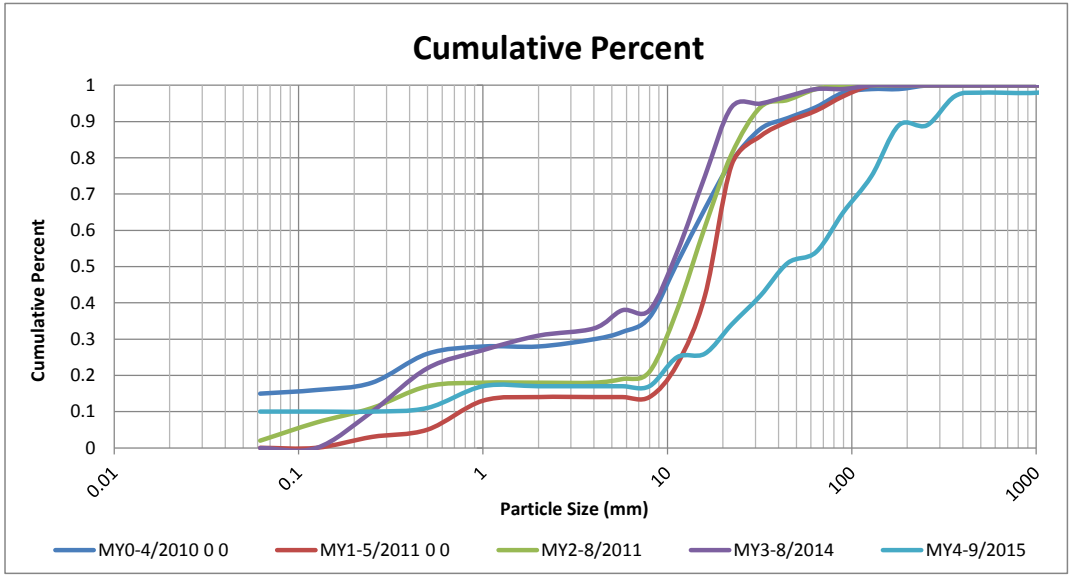




Appendix D. Stream Survey Data -- Suther Site Project #370
Figure 5.4. Pebble Count Plots & Data -- Sep 2015 (MY4)
UT to Dutch Buffalo Creek -- Tributary Cross-Section 4

Project Name: Dutch Buffalo Creek (Unnamed Tributary)					
Cross-Section 4: RIFFLE					
			MY4-9/2015		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	10	10%	10%
Sand	very fine sand	0.125	0	0%	10%
	fine sand	0.250	0	0%	10%
	medium sand	0.50	1	1%	11%
	coarse sand	1.00	6	6%	17%
	very coarse sand	2.0	0	0%	17%
Gravel	very fine gravel	4.0	0	0%	17%
	fine gravel	5.7	0	0%	17%
	fine gravel	8.0	0	0%	17%
	medium gravel	11.3	8	8%	25%
	medium gravel	16.0	1	1%	26%
	coarse gravel	22.3	8	8%	34%
	coarse gravel	32.0	8	8%	42%
	very coarse gravel	45	9	9%	51%
	very coarse gravel	64	3	3%	54%
Cobble	small cobble	90	11	11%	65%
	medium cobble	128	10	10%	75%
	large cobble	180	14	14%	89%
	very large cobble	256	0	0%	89%
Boulder	small boulder	362	8	8%	97%
	small boulder	512	1	1%	98%
	medium boulder	1024	0	0%	98%
	large boulder	2048	2	2%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			100	100%	100%

2015 Particle Size Summary (mm)	
D50	44
D84	169
D95	335



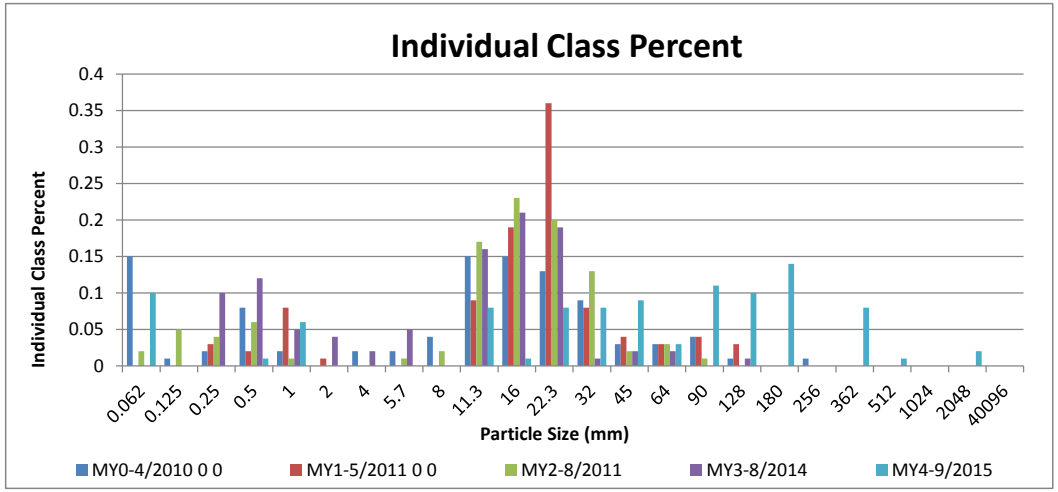


Table 7. Suther Site (Dutch Buffalo Cr) stream-bank erosion pins, length (feet) of exposed pins by date.

Pins	Sta+Bank	Height	13-Nov-13			10-Apr-14 (high flow)			22-Aug-14			4-May-15			2-Sep-15			i		Cumulativ Retreat	Annualiz Rate
			Exposed	New Ero	RemEx	Exposed	New Ero	RemEx	Exposed	New Ero	RemEx	Exposed	New Ero	RemEx	Exposed	New Ero	RemEx			(Feet)	(Feet/Yr)
A1	**22+70-R**	Upper, 4'	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.15	0.15	0.00	0.00	0.15	0.00	0.00			0.25	0.10
inst: 02-18-2013		Middle, 2'	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.15	0.00	0.20	0.20	0.00	0.20	0.00	0.00			0.35	0.14
		Lower, 0'	0.00	0.00	0.00	NF	NF	NF	0.90	0.90	0.00	0.10	0.10	0.00	0.10	0.00	0.00			1.00	0.40
																			A1 ave	**0.53**	**0.21**
A2	**23+00-R**	Upper, 4'	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.40	0.16
inst: 02-18-2013		Middle, 2'	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00
		Lower, 0'	0.00	0.00	0.00	NF	NF	NF	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.10	0.04
																			A2 ave	**0.17**	**0.07**
A3	**26+00-R**	Upper, 4'	0.00	0.00	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.70	0.70	0.20	0.20	0.00	0.20			1.20	0.48
inst: 03-19-2013		Middle, 2'	0.00	0.00	0.00	0.50	0.50	0.00	NF	NF	NF	NF	NF	NF	NF	NF	NF			0.50	0.20
		Lower, 0'	0.50	0.50	0.00	0.50	0.50	0.00	0.25	0.25	0.00	0.10	0.10	0.00	0.00	0.00	0.00			1.35	0.62
																			A3 ave	**1.02**	**0.43**
A4	**26+30-R**	Upper, 4'	0.00	0.00	0.00	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF			unk	unk
inst: 03-19-2013		Middle, 2'	0.33	0.33	0.33	NF	NF	NF	NF	NF	NF	**pin re-installed**		0.00	0.00	0.00	0.00			0.33	unk
		Lower, 0'	NF	NF	NF	NF	NF	NF	NF	NF	NF	0.90	0.90	0.00	0.00	0.00	0.00			0.90	0.36
																			A4 ave	**0.62**	**0.36**
A6	**27+90-R**	Upper, 4'	0.00	0.00	0.00	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.10	0.04
inst: 03-19-2013		Middle, 2'	0.00	0.00	0.00	0.20	0.20	0.00	0.10	0.10	0.00	0.20	0.20	0.20	0.20	0.00	0.20			0.50	0.20
		Lower **(a)**	0.30	0.00	0.30	0.30	0.00	0.30	0.30	0.00	0.30	NF	NF	NF	NF	NF	NF			0.00	0.00
																			A6 ave	**0.20**	**0.08**
A7	**28+20-R**	Upper, 4'	0.50	0.50	0.00	0.92	0.92	0.00	0.00	0.00	0.00	0.30	0.30	0.00	0.00	0.00	0.00			1.72	0.69
inst: 03-19-2013		Middle, 2'	0.50	0.50	0.00	0.98	0.98	0.00	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00			1.58	0.63
		Lower, 0'	0.50	0.50	0.00	1.30	1.30	0.00	0.20	0.20	0.00	NF	NF	NF	NF	NF	NF			2.00	0.80
																			A7 ave	**1.77**	**0.71**
A8	**28+50-L**	Upper, 5'	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10	0.00	NF	NF	NF	NF	NF	NF			0.10	0.04
inst: 02-18-2013		Middle, 3'	0.00	0.00	0.00	0.09	0.09	0.00	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.14	0.06
		Lower, 1'	0.00	0.00	0.00	0.30	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.30	0.12
																			A8 ave	**0.18**	**0.07**
A9	**28+80-L**	Upper, 5'	0.00	0.00	0.00	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.05	0.02
inst: 02-18-2013		Middle, 3'	0.00	0.00	0.00	0.18	0.18	0.00	0.00	0.00	0.00	0.20	0.20	0.00	0.00	0.00	0.00			0.38	0.15
		Lower, 1'	0.00	0.00	0.00	0.15	0.15	0.00	0.10	0.10	0.00	0.45	0.45	0.00	0.00	0.00	0.00			0.70	0.28
																			A9 ave	**0.38**	**0.15**
A10	**30+30-R**	Upper, 5'	0.00	0.00	0.00	0.10	0.10	0.00	0.00	0.00	0.00	0.10	0.10	0.10	0.10	0.00	0.10			0.20	0.08
inst: 03-19-2013		Middle, 3'	0.00	0.00	0.00	0.21	0.21	0.00	0.00	0.00	0.00	NF	NF	NF	NF	NF	NF			0.21	0.08
		(No Lower Pin Installed; Bedrock)																	**A10 ave**	**0.21**	**0.08**
A11	**30+60-R**	Upper, 4'	0.25	0.25	0.00	0.27	0.27	0.00	0.00	0.00	0.00	0.15	0.15	0.15	0.15	0.00	0.15			0.67	0.27
inst: 03-19-2013		Middle, 2'	0.10	0.10	0.00	0.25	0.25	0.00	0.00	0.00	0.00	0.20	0.20	0.20	0.20	0.00	0.20			0.55	0.22
		Lower, 0'	0.10	0.10	0.00	0.48	0.48	0.00	0.00	0.00	0.00	NF	NF	NF	NF	NF	NF			0.58	0.23
																			A11 ave	**0.60**	**0.24**
A12	**30+90-R**	Upper, 4'	0.83	0.83	0.00	0.37	0.37	0.00	0.00	0.00	0.00	0.20	0.20	0.20	0.20	0.00	0.20			1.40	0.56
inst: 03-19-2013		Middle, 2'	0.25	0.25	0.00	0.97	0.97	0.00	0.00	0.00	0.00	0.10	0.10	0.10	0.10	0.00	0.10			1.32	0.53
		Lower, 0'	0.00	0.00	0.00	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF			0.00	0.00
																			A12 ave	**0.91**	**0.36**
months / years from Mar 2013			8 months = 0.67 year			13 months = 1.08 year			17 months = 1.42 year			26 months = 2.17 yr			30 months = 2.50 yr			i			
																			Reach Av	**0.60**	**0.24**

NOTES

NF = Pin Not Found on monitoring date. **RemEx** = Remaining exposed pin (ft) after measuring and pounding in, if possible.

(a) A6 Lower Pin installed with 0.33 ft exposed due to bedrock. **(b)** A4 Pins lost or inaccessible due to tree fall/bank slump during winter 2013-14

Appendix D. Table 8.1. Baseline Stream Data Summary: Dimension, Pattern, Profile, and Transport Parameters

Suther Site (Dutch Buffalo Creek) Stream and Wetland Restoration Project # 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	-	2
Floodprone Width (ft)					-	9.8	-	-	-	10	-	130	-	-	-	-	-	150	-	52.52	54.05	54.05	55.57	-	2
Bankfull Mean Depth (ft)	-	0.98	1.08	1.03	-	1.17	-	-	-	10	-	1.3	-	-	-	-	-	1	-	1.00	1.02	1.02	1.04	-	2
Bankfull Max Depth (ft)	-				-	1.49	-	-	-	10	-	1.9	-	-	-	-	-	1.5	-	1.67	1.74	1.74	1.81	-	2
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	-	2
Width/Depth Ratio	-				-	7.42	-	-	-	10	-	6.4	-	-	-	-	-	9	-	8.34	8.43	8.43	8.51	-	2
Entrenchment Ratio	-				-	1.13	-	-	-	10	-	15.66	-	-	-	-	-	16.67	-	6.28	6.29	6.29	6.30	-	2
Bank Height Ratio	-				-	2.53	-	-	-	10	-	1.2	-	-	-	-	-	1.0	-	1.0	1.0	1.0	1.0	-	2
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)					0.003	-	-	0.0386	-	4	0.016	-	-	0.024	-		0.014	0.02	0.024	0.00142	-	-	0.0111	-	-
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					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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)					-						-						-			-					
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

Appendix D. Table 8.2. Baseline Stream Data Summary: Substrate, Bed, Bank and Hydrologic Containment Parameters				
Suther Site (Dutch Buffalo Creek) Stream and Wetland Restoration Project # 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 <1.5/1.5-1.99/2.0-4.9/5.0-9.9/>10	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 9.1. Cross Sectional Morphology Monitoring Data Summary												
Suther Site (Dutch Buffalo Creek) Stream and Wetland Restoration Project # 370												
Unnammed Tributary to Dutch Buffalo (608 linear feet)												
PARAMETER		Cross-Section 1 (Riffle)						Cross-Section 2 (Riffle)				
DIMENSION	Baseline	MY1-2010	MY2-2011	MY3-2014	MY4-2015	MY5-2016	Baseline	MY1-2010	MY2-2011	MY3-2014	MY4-2015	MY5-2016
Bankfull Width (ft)	8.9	8.7	8.3	9.0	8.6		9.6	9.7	9.4	NA	NA	
Floodprone Width (ft)	55.6	55.6	55.8	56.0	56.0		53.3	53.2	53.3	NA	NA	
Bankfull Mean Depth	1.0	1.1	1.1	1.1	0.6		1.1	1.0	1.0	NA	NA	
Bankfull Max Depth (ft)	1.8	1.7	1.6	1.9	1.9		1.7	1.6	1.6	NA	NA	
Bankfull Cross-sectional Area (ft^2)	9.2	8.8	8.8	9.8	9.9		10.2	9.4	9.4	NA	NA	
Bankfull Width/Depth Ratio	8.5	8.6	7.8	8.2	15.1		9.1	10.0	9.3	NA	NA	
Bankfull Entrenchment Ratio	6.3	6.4	6.7	6.2	6.5		5.6	5.5	5.7	NA	NA	
Bankfull Bankheight Ratio	1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0	NA	NA	
Cross Sectional Area between end pins (ft^2)	75.0	69.6	75.5	71.3	72.8		12.0	9.8	19.1	NA	NA	
d50 (mm)	13.7	4.9	1.9	2.0	0.5		0.1	11.6	12.5	NA	NA	
PARAMETER		Cross-Section 3 (Pool)						Cross-Section 4 (Riffle)				
DIMENSION	Baseline	MY1-2010	MY2-2011	MY3-2014	MY4-2015	MY5-2016	Baseline	MY1-2010	MY2-2011	MY3-2014	MY4-2015	MY5-2016
Bankfull Width (ft)	11.0	10.5	10.4	NA	NA		8.3	8.3	8.2	8.5	8.0	
Floodprone Width (ft)	59.0	58.0	55.3	NA	NA		52.5	52.5	55.1	55.00	55.0	
Bankfull Mean Depth	0.8	0.7	0.7	NA	NA		1.0	1.0	1.0	1.1	0.9	
Bankfull Max Depth (ft)	8.9	8.7	1.6	NA	NA		8.9	8.7	1.7	1.8	1.5	
Bankfull Cross-sectional Area (ft^2)	9.3	7.5	7.6	NA	NA		8.3	8.4	8.3	8.7	8.9	
Bankfull Width/Depth Ratio	13.1	14.8	14.3	NA	NA		8.3	8.2	8.1	7.7	9.1	
Bankfull Entrenchment Ratio	5.4	5.5	5.3	NA	NA		6.3	6.3	6.8	6.5	6.9	
Bankfull Bankheight Ratio	1.0	1.0	1.0	NA	NA		1.0	1.0	1.0	1.0	1.0	
Cross Sectional Area between end pins (ft^2)	49.8	35.4	53.4	NA	NA		39.6	36.3	41.3	39.7	38.2	
d50 (mm)	0.1	0.2	0.03	NA	NA		11.1	17.5	13.8	10.2	44.0	

Table 9.2.A. Stream Reach Morphology Monitoring Data Summary
Suther Site (Dutch Buffalo Creek) Stream and Wetland Restoration Project # 370
Unnammed Tributary to Dutch Buffalo Creek (608 linear feet)

Parameter	Baseline - 2009						MY 1 - 2010						MY 2 - 2011					
DIMENSION	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)	8.34	8.60	8.60	8.85	-	3	8.31	8.52	8.52	8.72	-	3	8.16	8.59	8.28	9.34	0.65	3
Floodprone Width (ft)	52.5	54.0	54.0	55.6	-	3	52.5	54.1	54.1	55.6	-	3	53.3	54.7	55.1	55.8	1.26	3
Bankfull Mean Depth (ft)	1.00	1.02	1.02	1.04	-	3	1.01	1.01	1.01	1.01	-	3	1.01	1.03	1.01	1.06	0.03	3
Bankfull Max Depth (ft)	1.67	1.74	1.74	1.81	-	3	1.56	1.63	1.63	1.70	-	3	1.62	1.64	1.64	1.65	0.02	3
BKF X-section Area (ft2)	8.30	8.77	8.77	9.24	-	3	8.42	8.62	8.62	8.82	-	3	8.27	8.82	8.77	9.42	0.58	3
Width /Depth Ratio	8.34	8.43	8.43	8.51	-	3	8.23	8.43	8.43	8.63	-	3	7.81	8.38	8.08	9.25	0.77	3
Entrenchment Ratio	6.28	6.29	6.29	6.30	-	3	6.32	6.35	6.35	6.38	-	3	5.71	6.40	6.74	6.75	0.60	3
Bank Height Ratio	1.00	1.00	1.00	1.00	-	3	1.00	1.00	1.00	1.00	-	3	1.00	1.00	1.00	1.00	0.00	3
Bankfull Velocity (fps)	4.70	4.45	4.45	4.23	-	3	4.64	4.53	4.53	4.43	-	3	4.14	4.44	4.45	4.72	0.29	3
PROFILE	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Riffle Length (ft)	13.76	21.29	21.29	28.82	-	2	16.07	22.09	22.09	28.11	-	3	9.01	16.90	17.46	22.53	5.05	6
Riffle Slope (ft/ft)	0.0014	0.0100	0.0100	0.0186	-	2	0.0092	0.0101	0.0101	0.0110	-	3	0.0093	0.0203	0.0158	0.0472	0.0140	6
Pool Length (ft)	10.32	31.83	31.83	53.33	-	2	18.30	27.90	27.90	37.49	-	3	15.77	38.02	40.93	61.57	15.69	8
Pool Max depth	1.72	1.82	1.82	1.91	-	2	1.62	1.63	1.63	1.63	-	2	1.95	2.29	2.17	2.80	0.30	9
Pool Spacing (ft)	10.32	42.80	42.80	75.27	-	2	19.98	23.64	23.64	27.29	-	3	25.45	54.46	58.32	77.41	18.41	8
PATTERN	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Channel Beltwidth (ft)	33.30	57.15	57.15	81.00	-	5	33.30	57.15	57.15	81.00	-	5	33.30	57.15	57.15	81.00	-	5
Radius of Curvature (ft)	22.50	24.75	24.75	27.00	-	9	22.50	24.75	24.75	27.00	-	9	22.50	24.75	24.75	27.00	-	9
Meander Wavelength (ft)	57.60	91.80	91.80	126.00	-	7	57.60	91.80	91.80	126.00	-	7	57.60	91.80	91.80	126.00	-	7
Meander Width Ratio	3.70	6.35	6.35	9.00	-	-	3.70	6.35	6.35	9.00	-	-	3.70	6.35	6.35	9.00	-	-
ADDITIONAL REACH PARAMETERS																		
Rosgen Classification	E4						E4						E4					
BF slope (ft/ft)	0						0.008						0.006					
Ri%/Ru%/P%/G%/S%	-	-	-	-	-		29.0	1.2	38.1	-	0.2		17.0	-	50.0	-	0.2	
SC%/Sa%/G%/C%/B%/Be%																		
d16 / d35 / d50 / d84 / d95																		
% reach w eroding banks	0						4						0					
Channel Stability or Habitat Metric	-						-						-					
Biological or Other	-						-						-					

> BKF velocity based on 39.04 cfs design flow

Table 9.2.B. Stream Reach Morphology Monitoring Data Summary
Suther Site (Dutch Buffalo Creek) Stream and Wetland Restoration Project # 370
Unnammed Tributary to Dutch Buffalo Creek (608 linear feet)

Parameter	Baseline - 2009						MY 3 - 2014						MY 4 - 2015					
DIMENSION	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)	8.34	8.60	8.60	8.85	-	3	8.50	8.75	8.75	9.00	0.35	2	8.00	8.30	8.30	8.60	0.65	2
Floodprone Width (ft)	52.5	54.0	54.0	55.6	-	3	55.00	55.50	55.50	56.00	0.71	2	55.0	55.5	55.5	56.0	0.95	2
Bankfull Mean Depth (ft)	1.00	1.02	1.02	1.04	-	3	1.10	1.10	1.10	1.10	0.00	2	0.57	0.73	0.73	0.88	0.03	2
Bankfull Max Depth (ft)	1.67	1.74	1.74	1.81	-	3	1.79	1.83	1.83	1.87	0.06	2	1.50	1.68	1.68	1.86	0.02	2
BKF X-section Area (ft2)	8.30	8.77	8.77	9.24	-	3	8.70	9.26	9.26	9.81	0.78	2	8.88	9.39	9.39	9.90	0.58	2
Width /Depth Ratio	8.34	8.43	8.43	8.51	-	3	7.73	7.95	7.95	8.18	0.32	2	9.09	12.09	12.09	15.09	0.77	2
Entrenchment Ratio	6.28	6.29	6.29	6.30	-	3	6.22	6.35	6.35	6.47	0.18	2	6.51	6.70	6.70	6.88	0.60	2
Bank Height Ratio	1.00	1.00	1.00	1.00	-	3	1.00	1.00	1.00	1.00	0.01	2	1.00	1.00	1.00	1.00	0.00	2
Bankfull Velocity (fps)	4.70	4.45	4.45	4.23	-	3	3.98	4.47	4.45	4.49	0.30	2	3.94	4.17	4.17	4.40	0.29	2
PROFILE	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Riffle Length (ft)	13.76	21.29	21.29	28.82	-	2	12.32	20.09	21.99	26.49	5.05	3	10.40	20.07	18.59	26.77	9.16	6
Riffle Slope (ft/ft)	0.0014	0.0100	0.0100	0.0186	-	2	0.0066	0.0135	0.0120	0.0256	0.014	3	0.0069	0.0187	0.0183	0.0297	0.012	6
Pool Length (ft)	10.32	31.83	31.83	53.33	-	2	14.80	32.58	33.55	59.50	15.69	4	14.80	36.08	37.64	57.36	13.62	8
Pool Max depth	1.72	1.82	1.82	1.91	-	2	1.63	1.93	1.89	2.21	0.40	4	1.45	1.71	1.65	2.23	0.36	8
Pool Spacing (ft)	10.32	42.80	42.80	75.27	-	2	18.58	43.20	41.58	59.99	18.41	4	10.70	34.45	38.95	58.20	17.23	8
PATTERN	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Channel Beltwidth (ft)	33.30	57.15	57.15	81.00	-	5	33.30	57.15	57.15	81.00	-	5	33.30	57.15	57.15	81.00	-	5
Radius of Curvature (ft)	22.50	24.75	24.75	27.00	-	9	22.50	24.75	24.75	27.00	-	9	22.50	24.75	24.75	27.00	-	9
Meander Wavelength (ft)	57.60	91.80	91.80	126.00	-	7	57.60	91.80	91.80	126.00	-	7	57.60	91.80	91.80	126.00	-	7
Meander Width Ratio	3.70	6.35	6.35	9.00	-	-	3.70	6.35	6.35	9.00	-	-	3.70	6.35	6.35	9.00	-	-
ADDITIONAL REACH PARAMETERS																		
Rosgen Classification	E4						E4						E4					
BF slope (ft/ft)	0						0.008						0.007					
Ri%/Ru%/P%/G%/S%	-	-	-	-	-		29.0	-	38.0	-	0.2		29.0	-	38.0	-	0.2	
SC%/Sa%/G%/C%/B%/Be%																		
d16 / d35 / d50 / d84 / d95																		
% reach w eroding banks	0						4						4					
Channel Stability or Habitat Metric	-						-						-					
Biological or Other	-						-						-					

Appendix E. Stream & Wetland Hydrology Data

Figure 6. Monthly Rainfall Data with Percentiles
Figure 7.1-7.16. Groundwater Gage Plots with Precipitation Data
Table 10. Verification of Bankfull Events
Table 11. Wetland Hydrology Criteria Attainment

e-Table: Rain Gage and Stream Gage Raw Data
e-Table: Groundwater Gage Raw Data

Figure 6. Monthly Rainfall Totals for 2015, with 30th and 70th Percentile Climate Normals, Concord, NC

Month & Year	Rain Gage @ Rocky R wwtp mon total inch	1980 - 2010 monthly climate normals	
		30th P*	70th P*
Jan-15	2.52	2.55	4.92
Feb-15	2.58	2.44	4.59
Mar-15	2.24	3.42	5.57
Apr-15	2.95	2.16	4.02
May-15	1.02	2.29	4.12
Jun-15	2.47	3.01	5.48
Jul-15	5.31	3.42	5.20
Aug-15	2.38	3.04	5.53
Sep-15	2.04	2.61	5.07
Oct-15	8.43	2.50	4.57
Nov-15	9.41	2.47	3.81
Dec-15		2.35	3.69

Monthly rainfall totals at Rocky River WWTP, USGS Gauge# 351943080323145 (9 miles SSW of Suther site)
Monthly Climate values are based on the 30 year period from 1981 to 2010 at Concord Airport, Cabarrus Co.

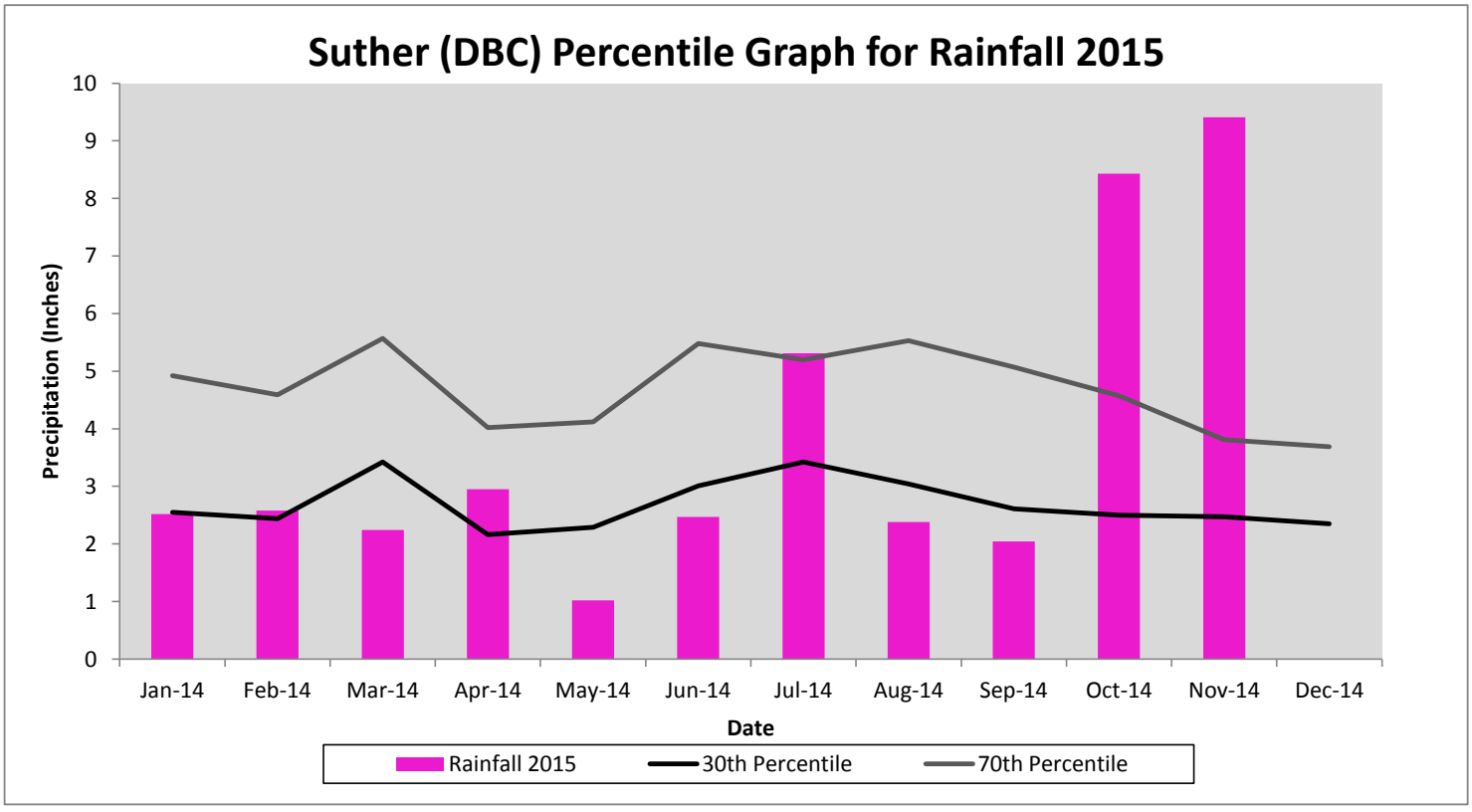
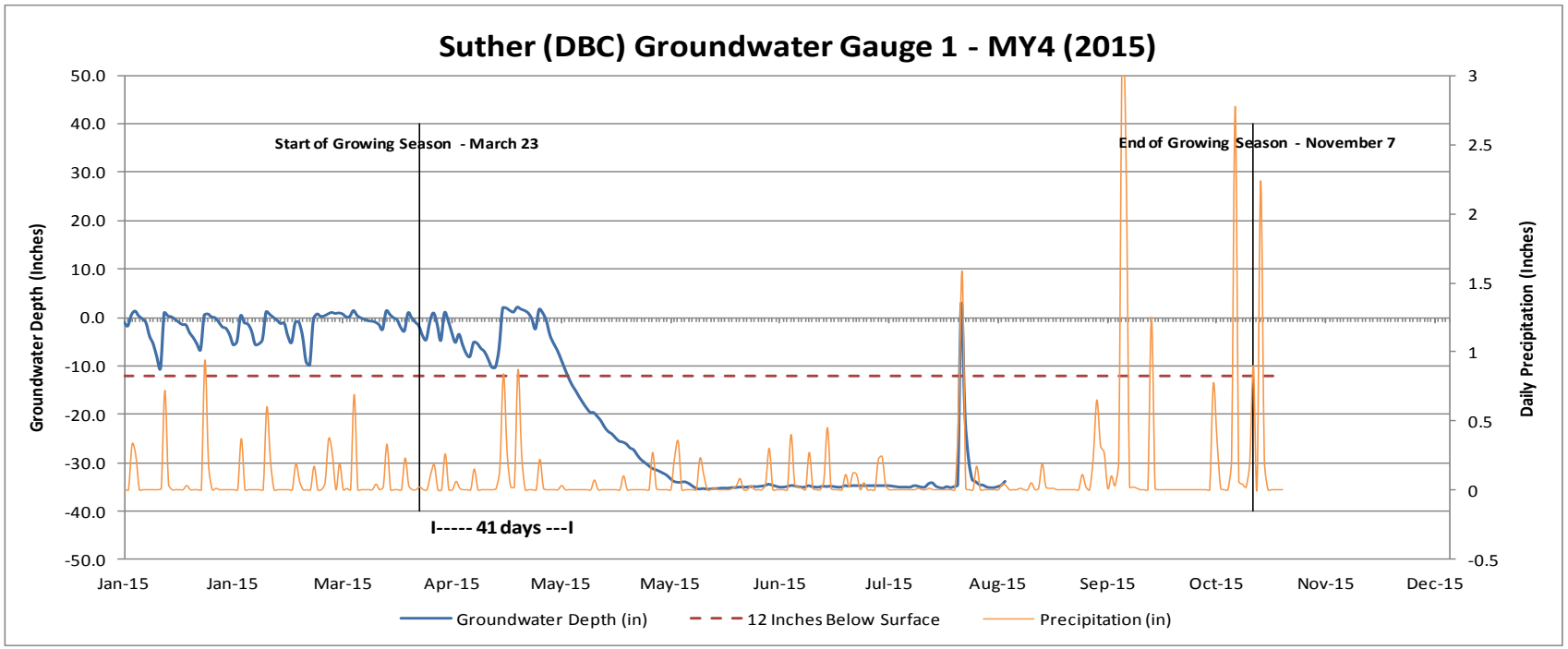


Figure 7.1. Groundwater Wells and Daily Precipitation Data, 2015 (MY4): Suther Site #370.



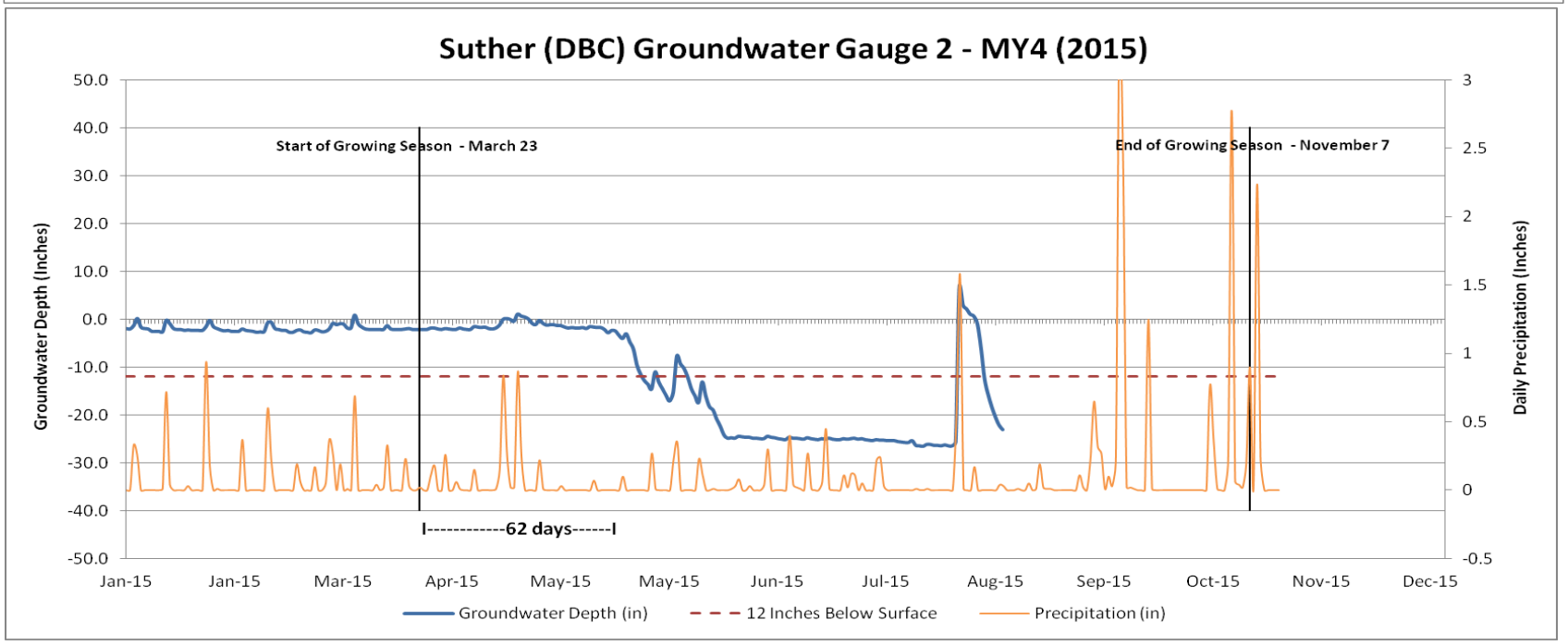
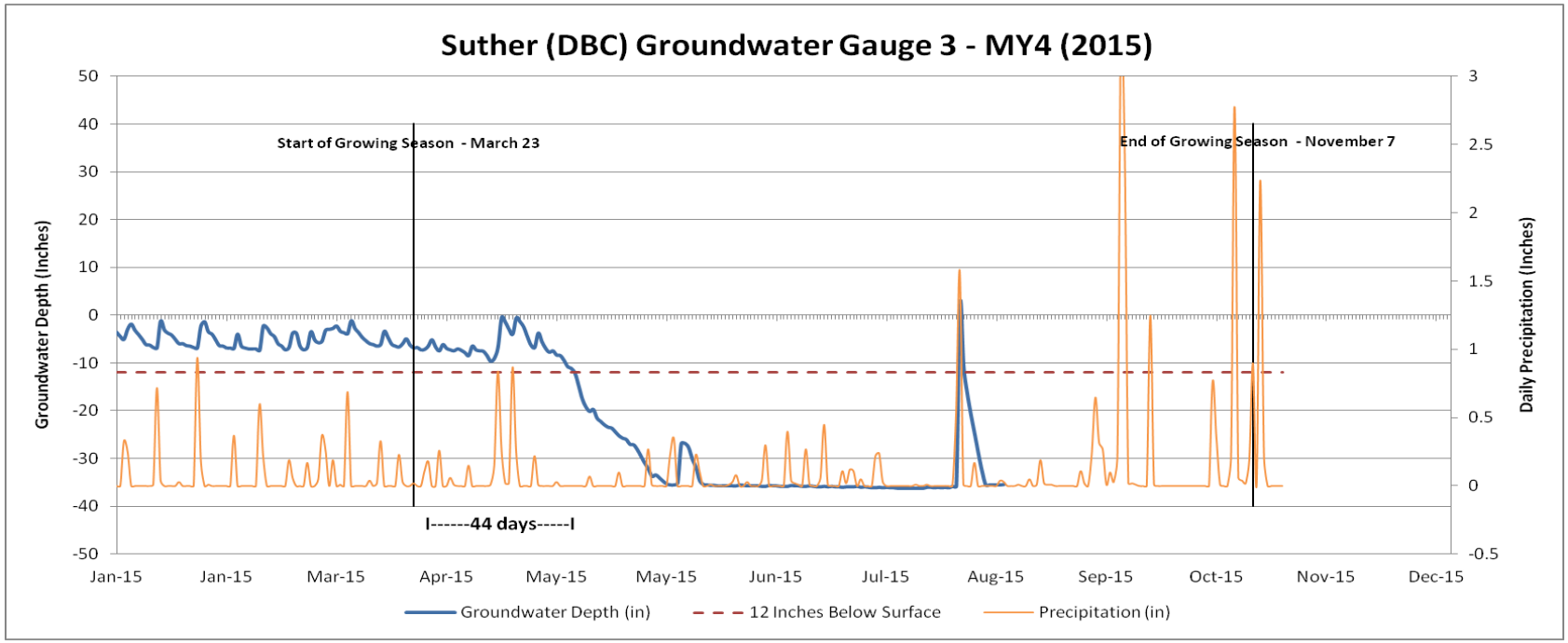


Figure 7.2. Groundwater Wells and Daily Precipitation Data, 2015 (MY4): Suther Site #370.



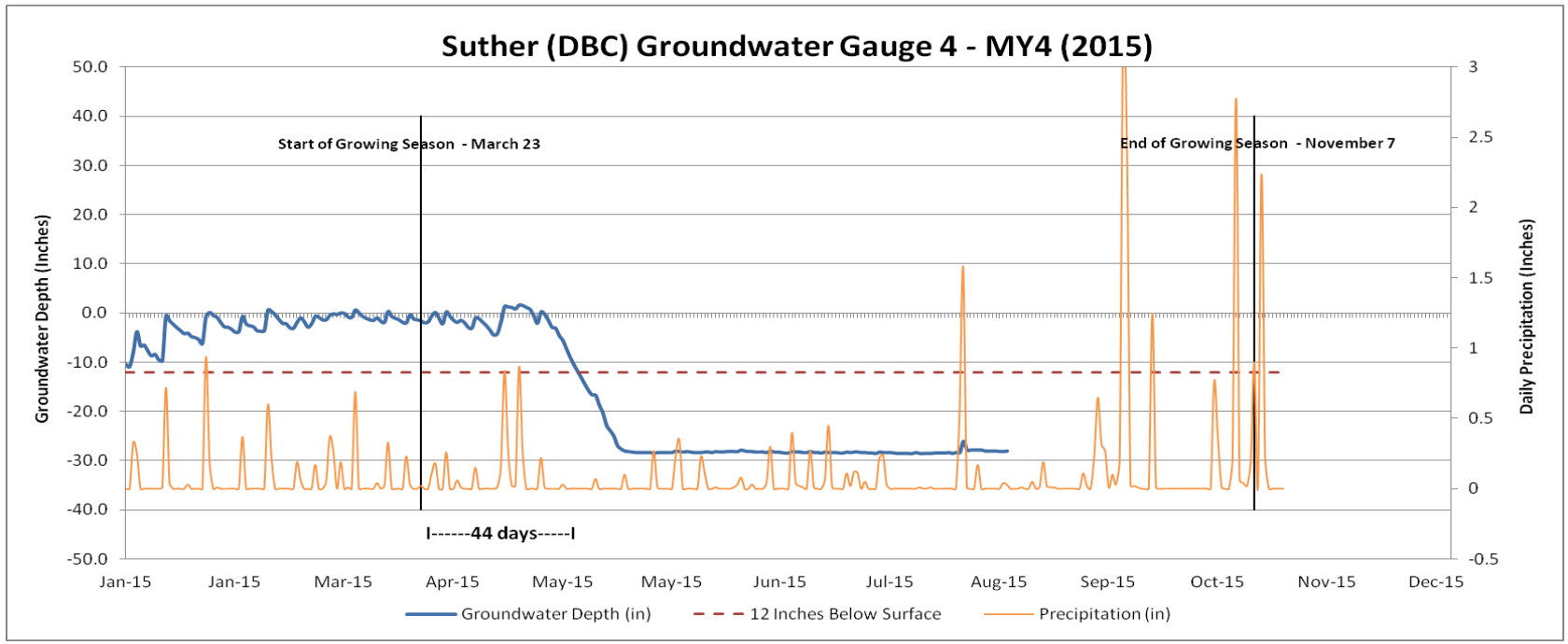
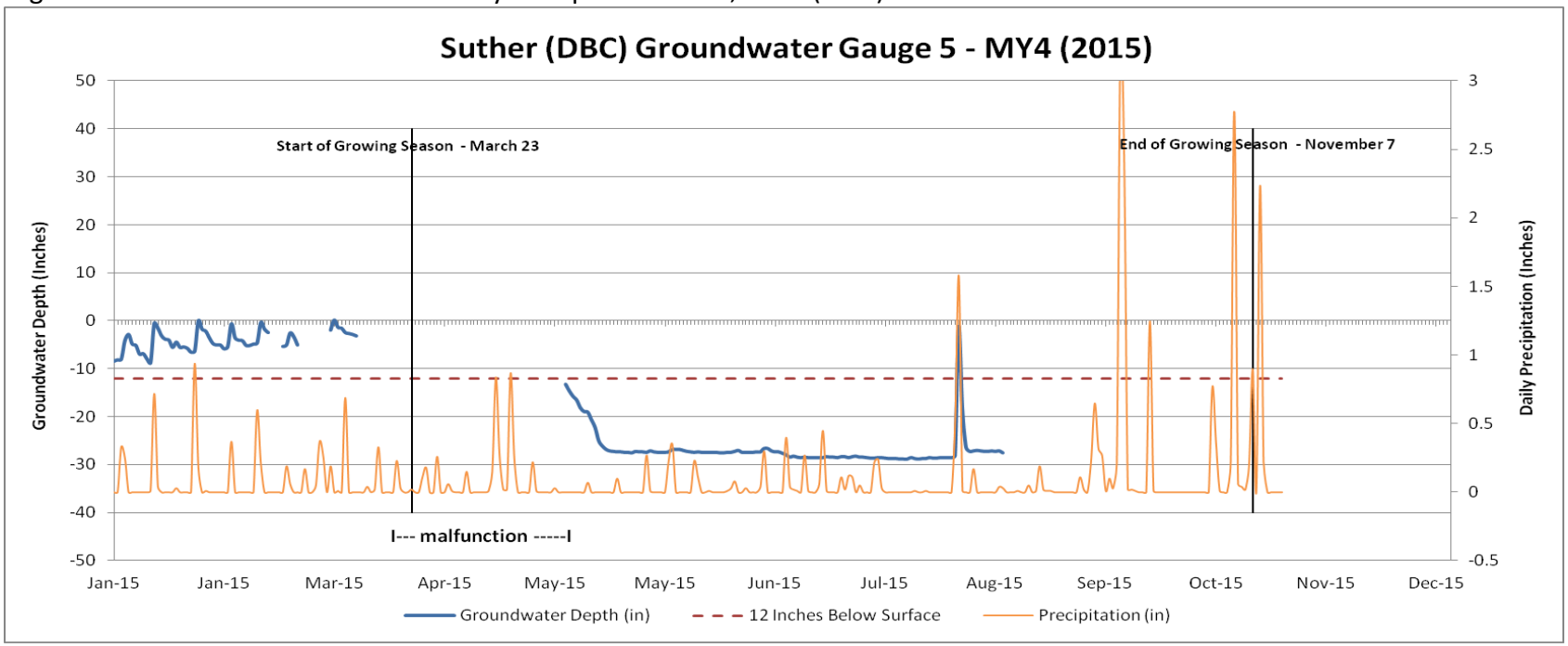


Figure 7.3. Groundwater Wells and Daily Precipitation Data, 2015 (MY4): Suther Site #370.



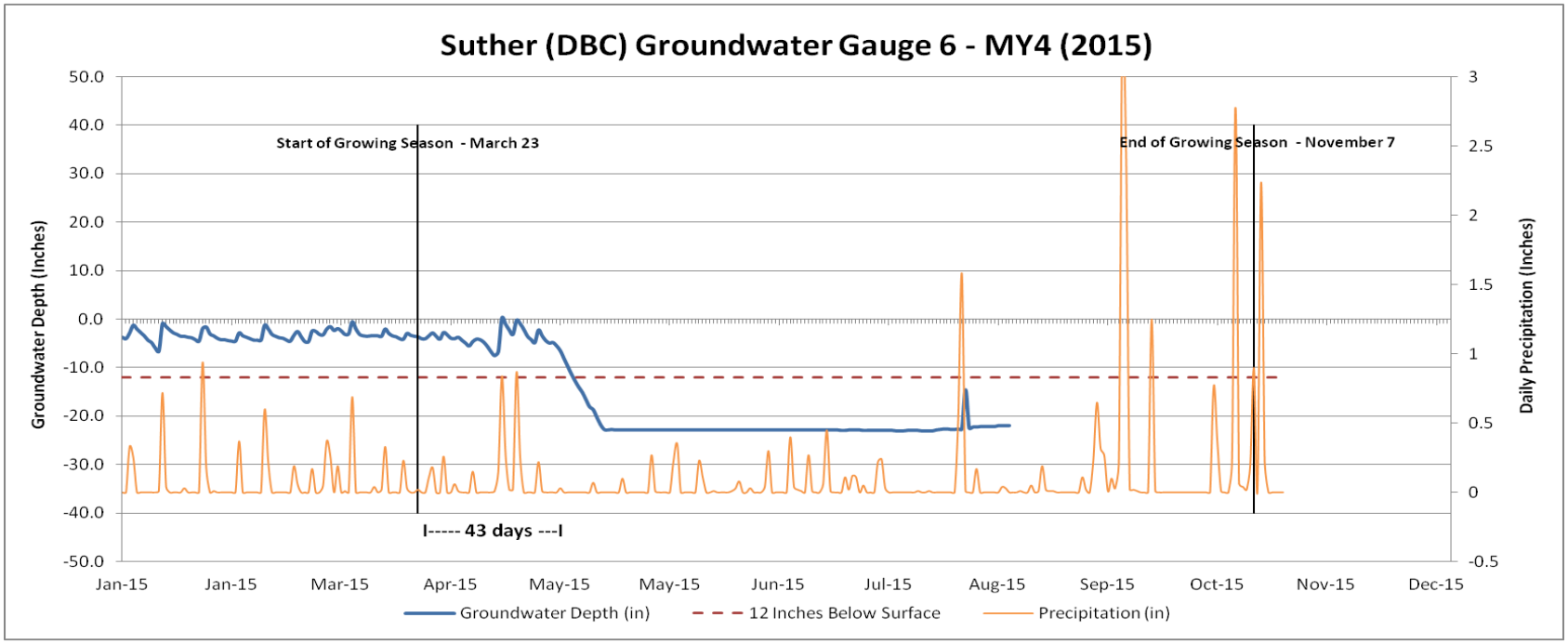
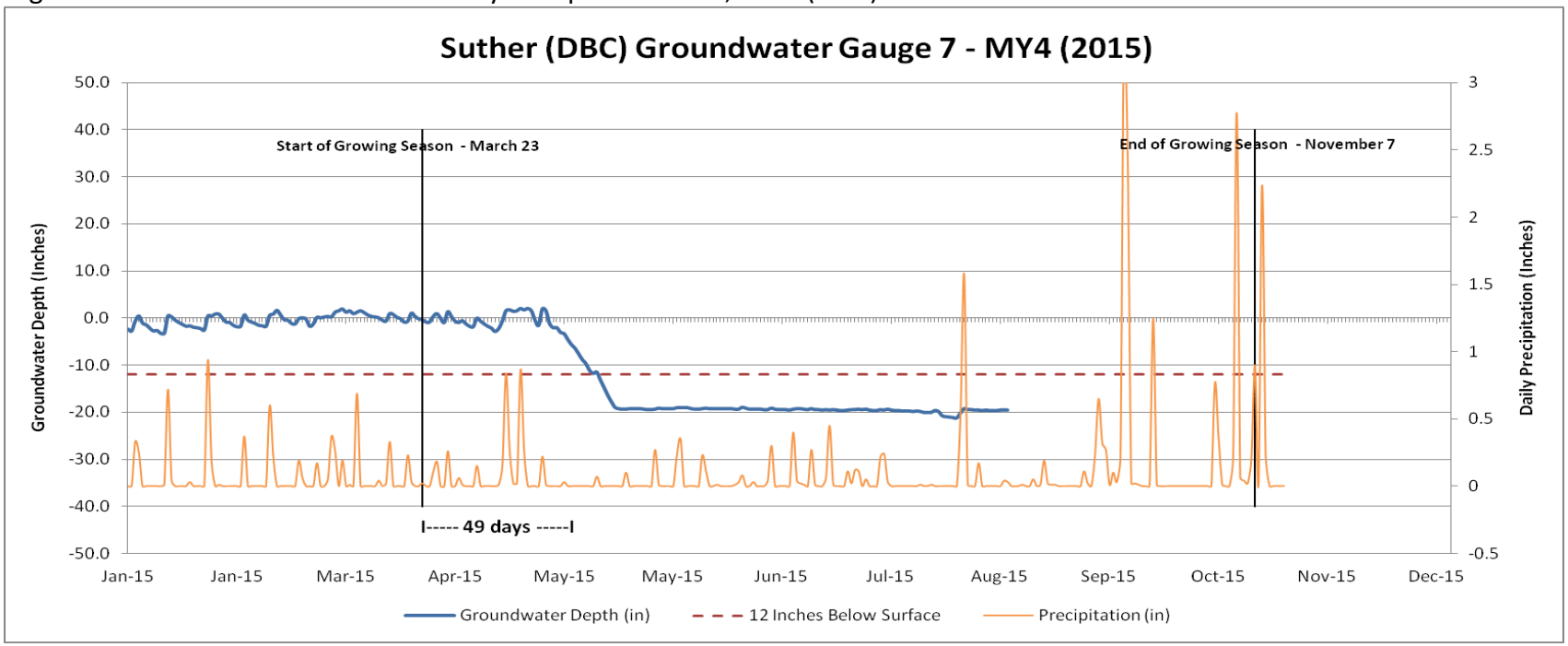


Figure 7.4. Groundwater Wells and Daily Precipitation Data, 2015 (MY4): Suther Site #370.



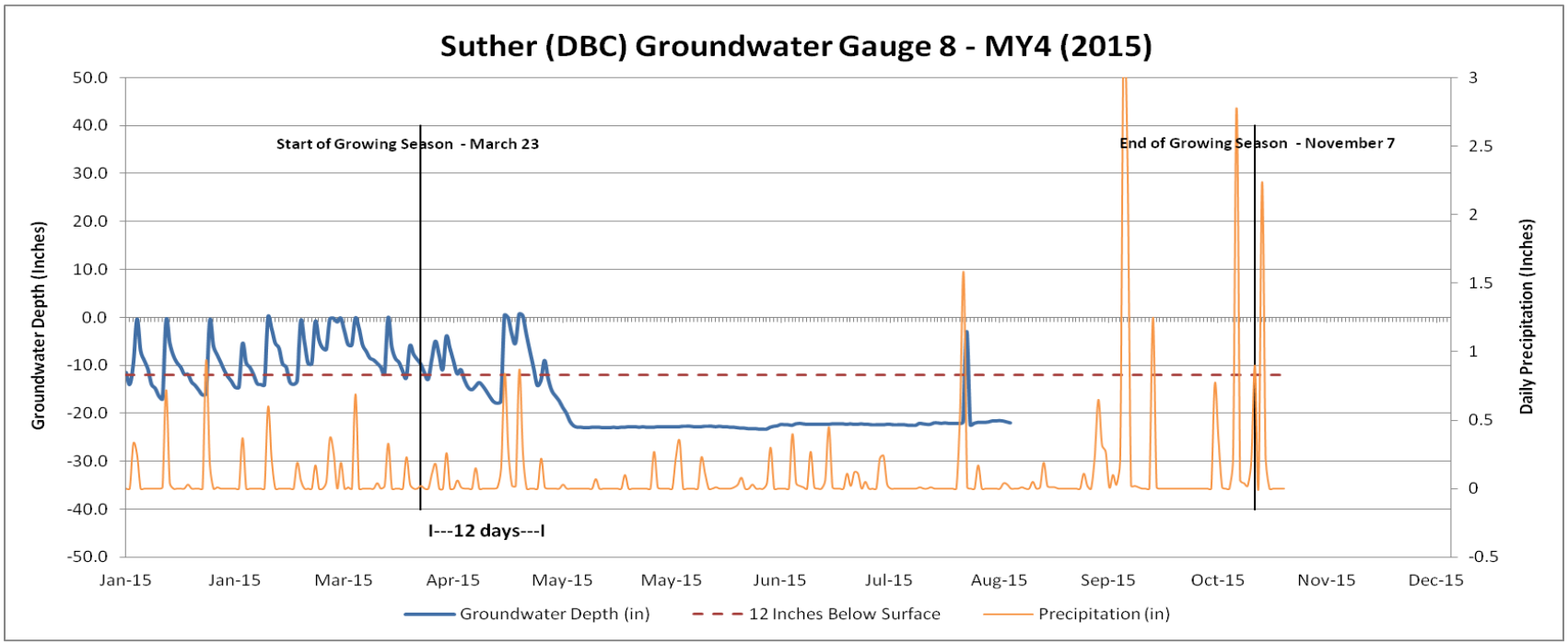
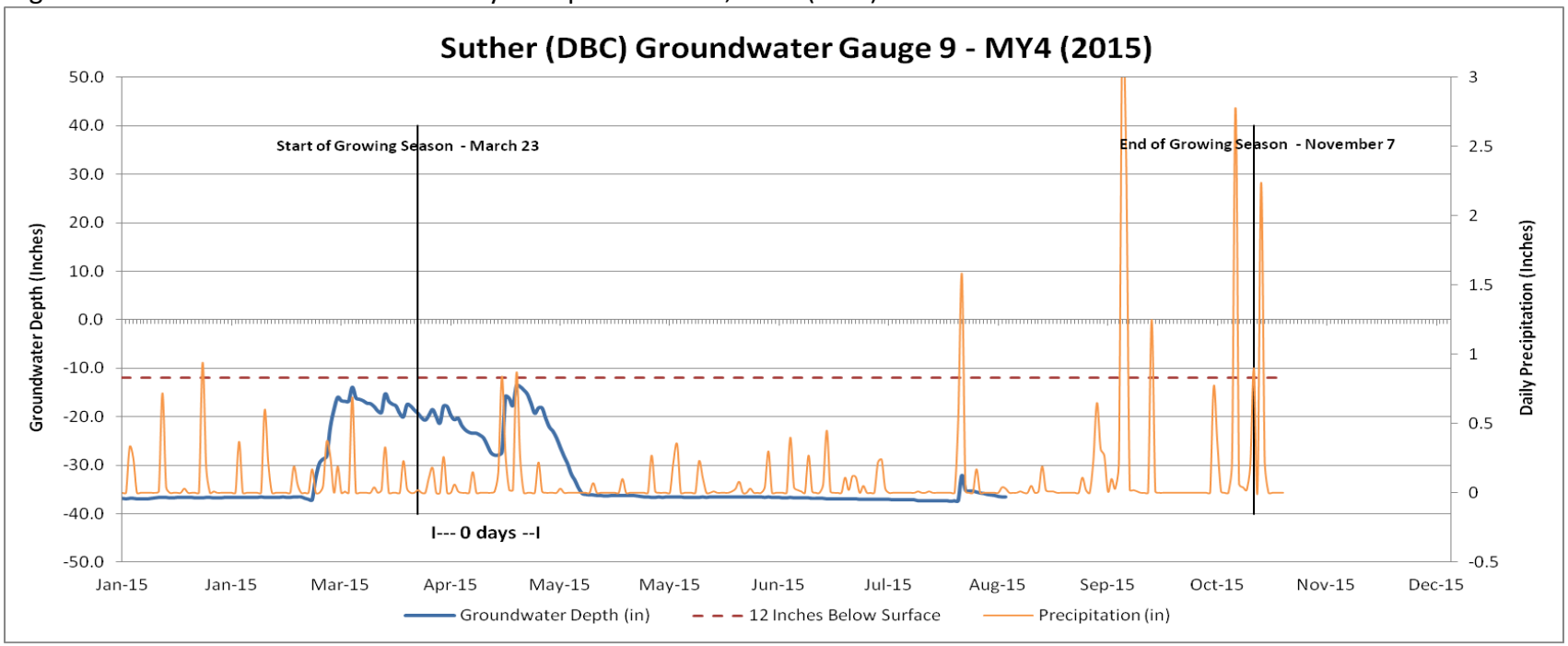


Figure 7.5. Groundwater Wells and Daily Precipitation Data, 2015 (MY4): Suther Site #370.



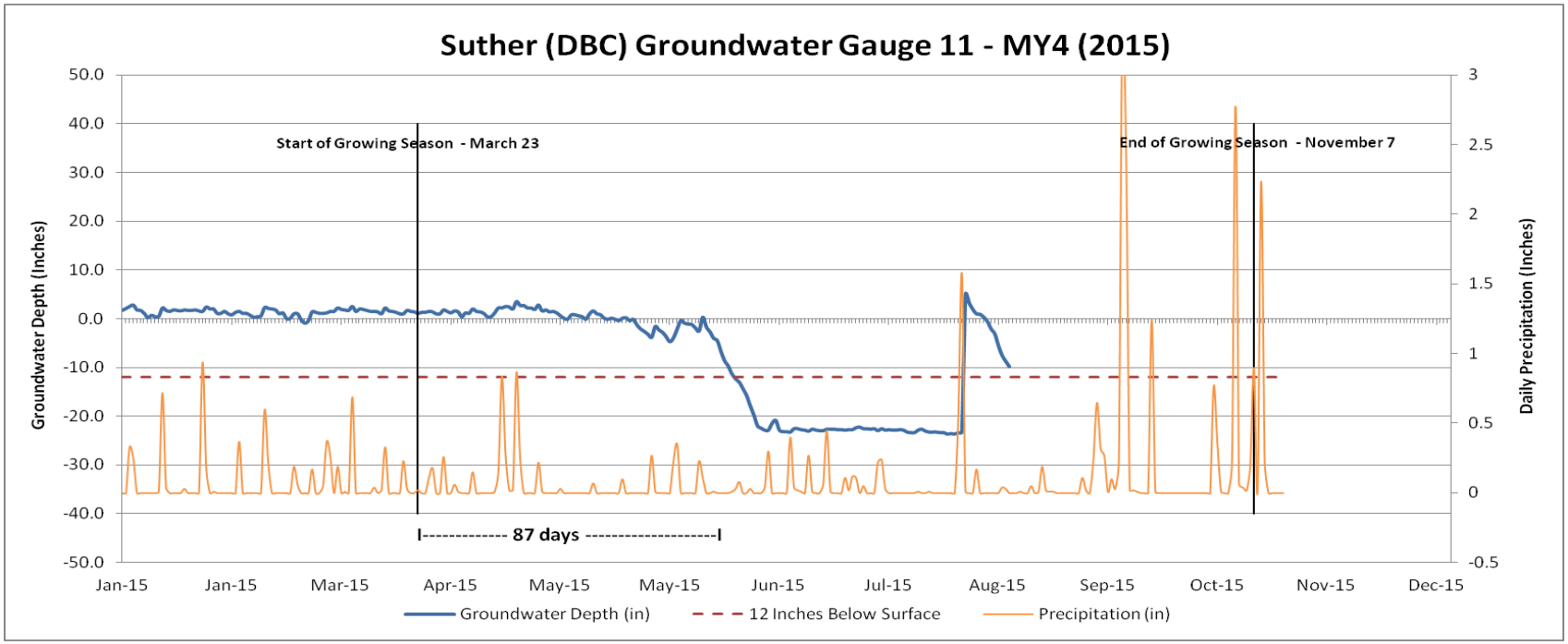
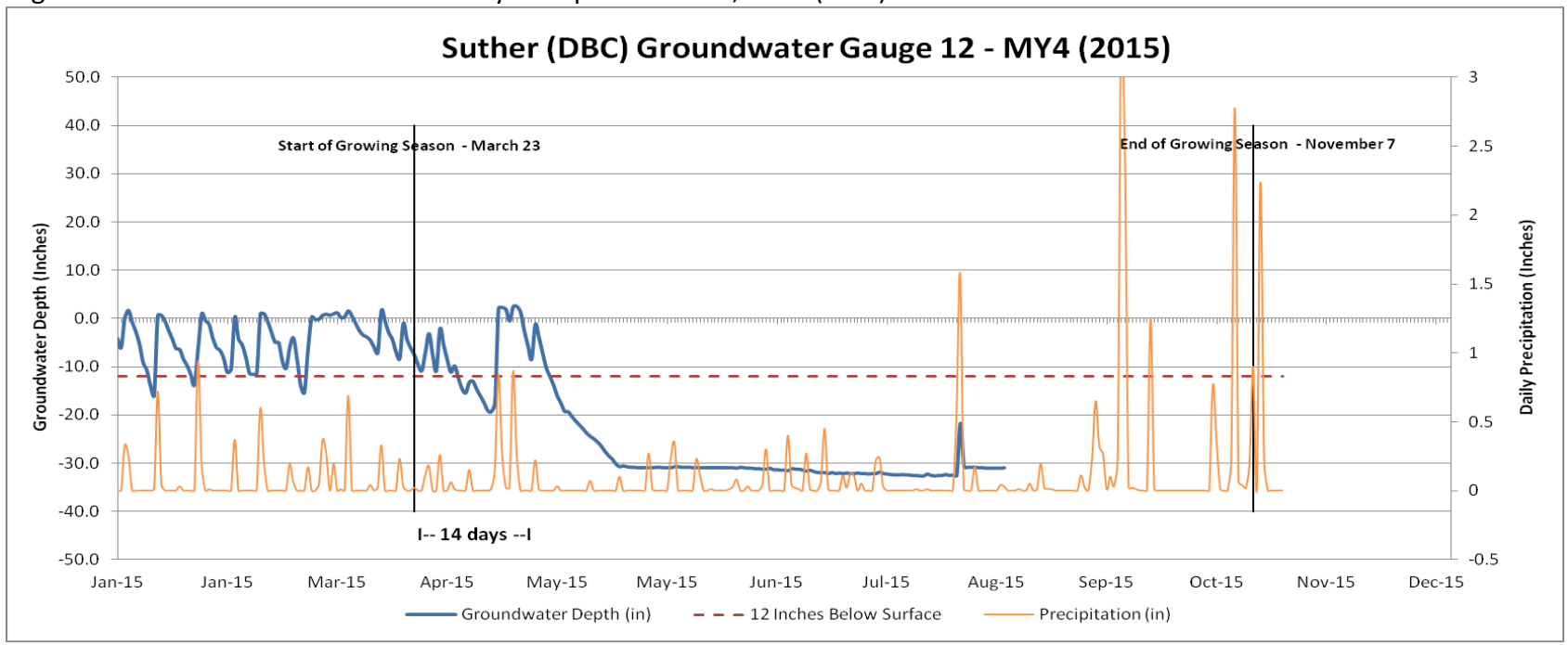


Figure 7.6. Groundwater Wells and Daily Precipitation Data, 2015 (MY4): Suther Site #370.



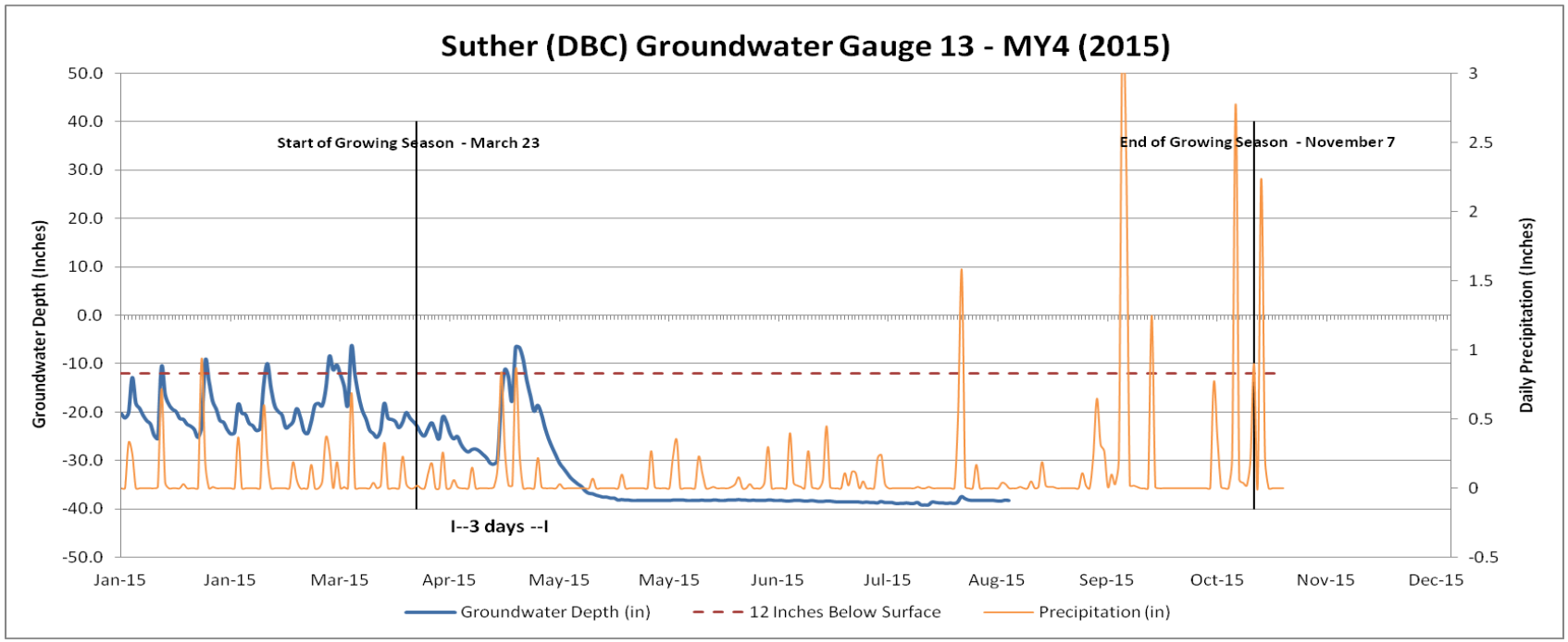
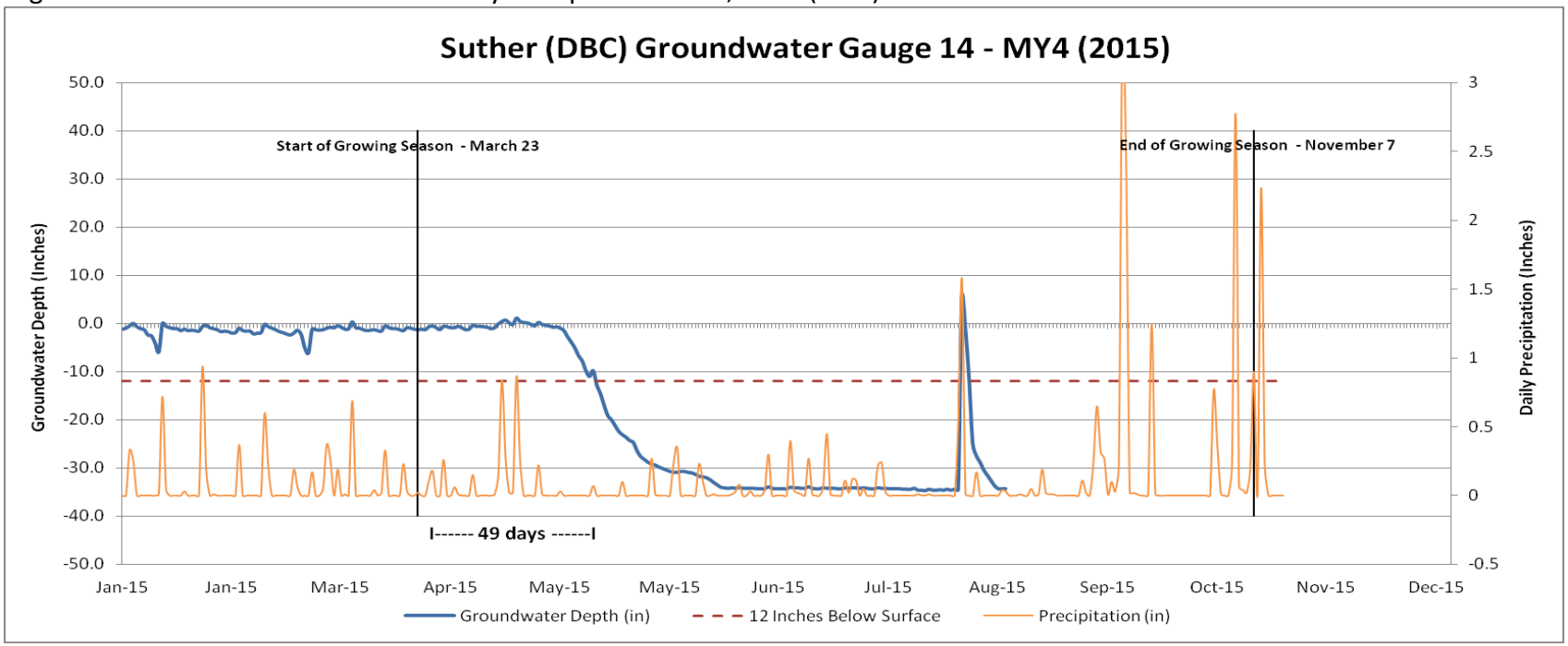


Figure 7.7. Groundwater Wells and Daily Precipitation Data, 2015 (MY4): Suther Site #370.



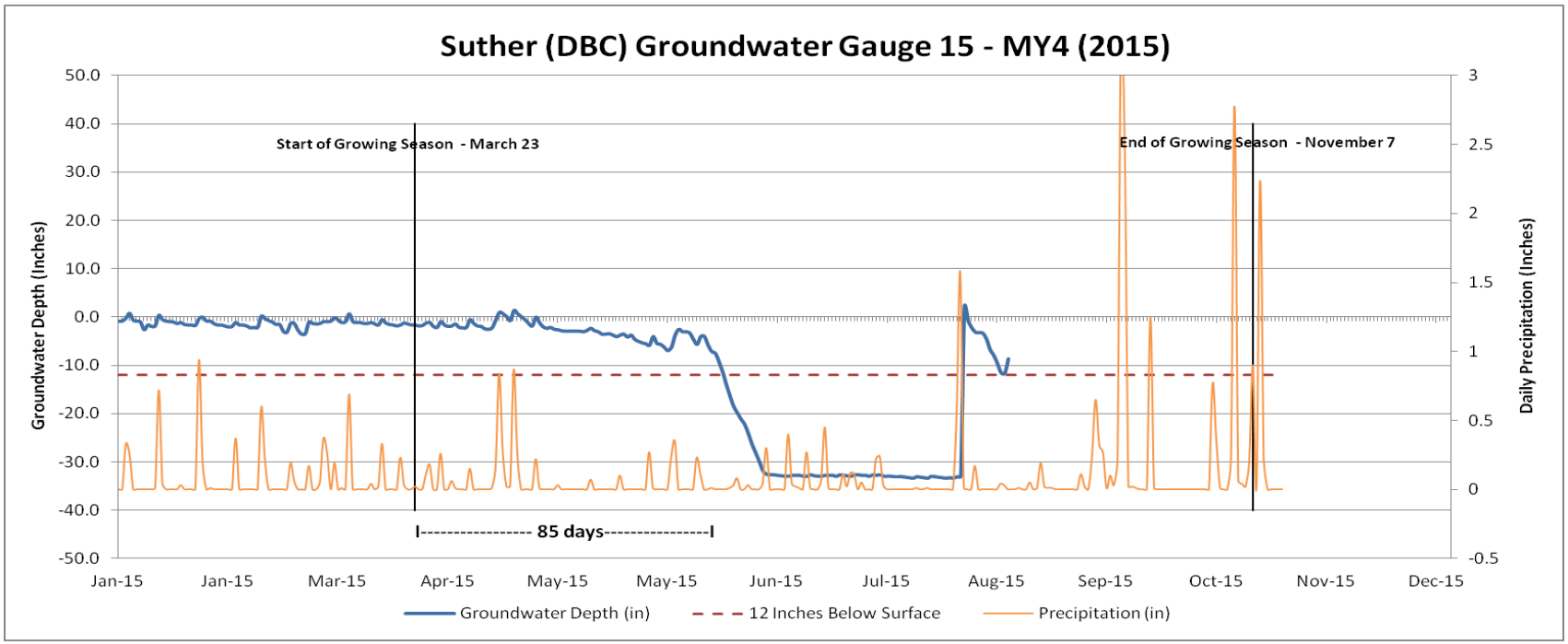
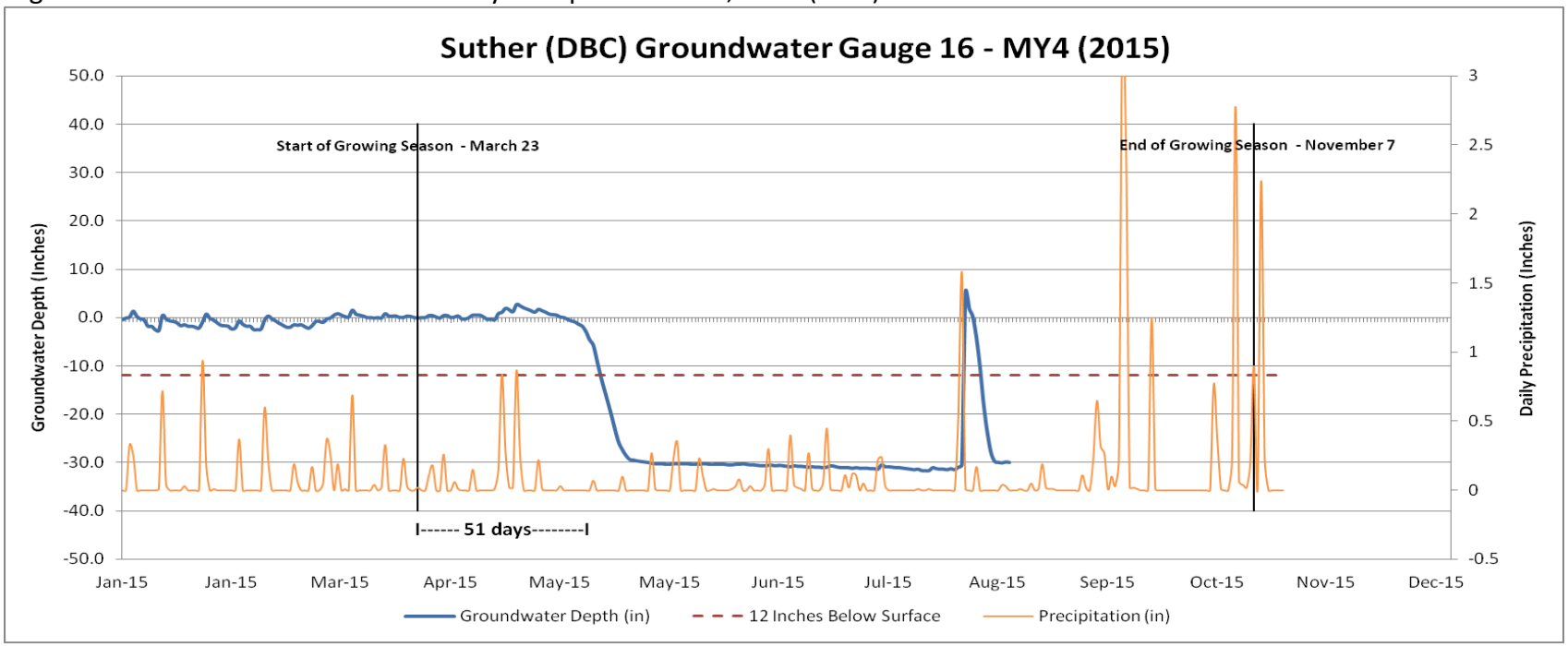


Figure 7.8. Groundwater Wells and Daily Precipitation Data, 2015 (MY4): Suther Site #370.



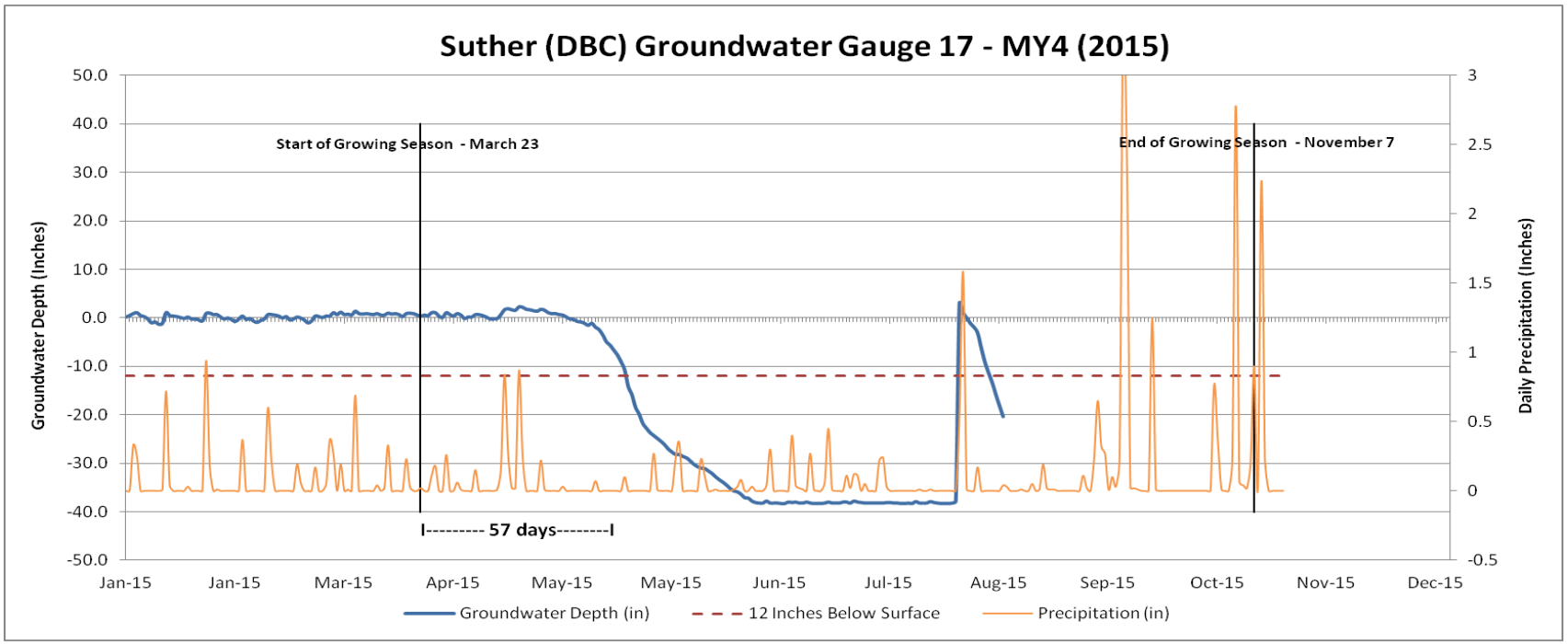
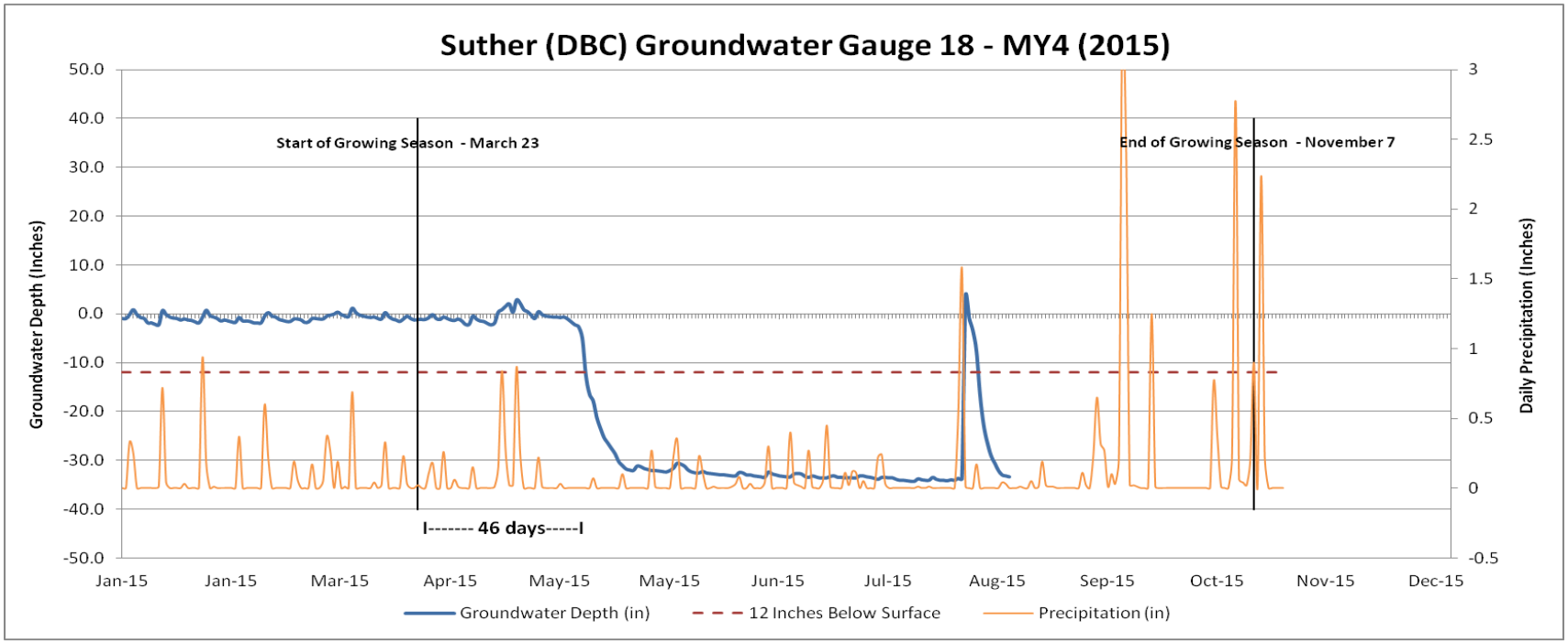


Figure 7.9. Groundwater Wells and Daily Precipitation Data, 2015 (MY4): Suther Site #370.



Appendix E - Hydrologic Data

Table 10. Indicators of Bankfull Flow Events

Data Collected	Event Date	Method	Trib Stage Feet above BKF Elev	DBCr Stage Feet above THW Elev
5/19/2011	Unknown	Crest Gauge	UNK	UNK
6/23/2011	Unknown	Crest Gauge	UNK	UNK
4/10/2014	4/7-8/2014	Matted vegetation	UNK	UNK
9/15/2014	4/15/2014	Hobo DBC = 4.9 ft	0.9	6.5
9/15/2014	4/19/2014	Hobo DBC = 5.7 ft	1.7	7.3
5/3/2015	3/5/2015	Hobo DBC = 4.8 ft	0.8	6.4
5/3/2015	4/20/2015	Hobo DBC = 5.5 ft	1.5	7.1
9/1/2015	8/19/2015	Hobo Trib = 2.2 ft	0.7	UNK
12/13/2015	10/3/2015	Hobo Trib = 3.8 ft	2.4	UNK
12/13/2015	11/2/2015	Hobo Trib = 3.4 ft	2.0	UNK
12/13/2015	11/10/2015	Hobo Trib = 4.1 ft	2.7	UNK
12/13/2015	11/19/2015	Hobo Trib = 3.0 ft	1.6	UNK

Hobo Gauge installed on DBC from 10 Apr 2014 to 07 Aug 2015. Major flow events with gauge height > 4.0 ft in DBC (approx 5.6 ft above THW) are reported in this Table, coinciding with bankfull flow events in the restored tributary. Dutch Buffalo Creek is severely incised and bankfull indicators are unclear, but BKF appears to be roughly 3 ft below top of bank.

Hobo Gauge installed on Restored Tributary from 07 Aug 2015 to present. Major flow events with gauge height > 1.4 ft in Trib (approx 2.1 ft above THW) are reported in this Table, coinciding with bankfull flow events. See Hobo gauge raw data (Excel spreadsheet in Support Files) for records of smaller flow events.

Gauge Sensor in DBCr = 1.6 ft above THW. Bank Ht = 7.9 ft above THW. THW elev = 640.4 ft
Gauge Sensor in Trib = 0.7 ft above THW. Bank Ht = 2.2 ft above THW. THW elev = 644.3 ft

Wrack deposits on floodplain near Tributary station 01+50, 02 Sep 2015

Appendix E - Hydrologic Data: Suther Site

Table 11. Wetland GW Gage Success Attainment, 2010-2016

Gage Site #	MY-01 (2010)			MY-02 (2011)			MY-xx (2012)			MY-xx (2013)			MY-03 (2014)			MY-04 (2015)			MY-05 (2016)		
	Days	% Gro	Crit	Days	% Gro	Crit	Days	% Gro	Crit	Days	% Gro	Crit	Days	% Gro	Crit	Days	% Gro	Crit	Days	% Gro	Crit
1	20	9	YES	63	28	YES	43	19	YES	66	29	YES	39	17	YES	41	18	YES			
2	52	23	YES	71	31	YES	44	19	YES	*MAL*	-	*Unk*	*MAL*	-	*Unk*	62	27	YES			
3	19	8	YES	12	5	NO	17	7	NO	26	11	YES	38	17	YES	44	19	YES			
4-O	4	2	NO	0	0	NO	3	1	NO	9	4	NO	--	--	--	--	--	--	--	--	--
4-N	--	--	--	--	--	--	--	--	--	--	--	--	28	12	YES	44	19	YES			
5-O	0	0	NO	3	1	NO	7	3	NO	15	7	NO	--	--	--	--	--	--	--	--	--
5-N	--	--	--	--	--	--	--	--	--	--	--	--	25	11	YES	*MAL*	-	*Unk*			
6	46	20	YES	64	28	YES	32	14	YES	56	24	YES	40	17	YES	43	19	YES			
7	--	--	--	41	18	YES	39	17	YES	57	25	YES	59	26	YES	49	21	YES			
8	--	--	--	18	8	YES	3	1	NO	*MAL*	-	*Unk*	24	10	YES	12	5	NO			
9	10	4	NO	3	1	NO	6	3	NO	13	6	NO	23	10	YES	6	3	NO			
10	20	9	YES	9	4	NO	9	4	NO	*MAL*	--	*Unk*	--	--	--	--	--	--	--	--	--
11													78	34	YES	87	38	YES			
12													11	5	NO	14	6	NO			
13													*MAL*	-	*Unk*	5	2	NO			
14													29	13	YES	49	21	YES			
15													71	31	YES	84	37	YES			
16													30	13	YES	51	22	YES			
17													46	20	YES	57	25	YES			
18													28	12	YES	46	20	YES			

Growing season = Mar 23 to Nov 7 = 229 days. Wetland Success Criterion = 8% of growing season = 18 consecutive days (Yes or No)
MAL = GW gage malfunction; data not usable. 2010 and 2011 data and success copied from Jacobs MY2 report (2012).

GW Well History: Nov 2009 original wells 1 thru 10 installed by JJG/Jacobs, maintained thru fall 2011.
No data downloaded during 2012 to 2013; some wells stopped recording during this period.
10 Apr 2014: MMI-RJGA replaced 9 old wells and installed 8 new well locations selected by EEP.

Gages 1,2,3,6,7,8,9 - Replaced in original locations with reconditioned RDS GW gages
Gage 4 – Replaced 450 ft NNE of original location with reconditioned RDS GW gage [O =old; N= new]
Gage 5 – Replaced 250 ft NNE of original location with reconditioned RDS GW gage [O =old; N= new]
Gage 10 – Removed permanently; not replaced.
Gages 11 to 18 – New well locations installed with reconditioned RDS GW gages