



YEAR 4 OF 5 MONITORING REPORT - FINAL

**Five-Mile Branch Stream and Wetland Restoration, Iredell County
NCDMS IMS ID# 92185**

DEQ Contract# 6036

**North Carolina Department of Environmental Quality,
Division of Mitigation Services Raleigh North Carolina**

April 25, 2017

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1. Project Summary

1.1 Goals and Objectives

The primary goals of this restoration project focus on the following:

- Increase bank stability, nutrient filtration and aquatic habitat
- Reduce soil disturbance and nutrient inputs to stream
- Improve soil physical and chemical properties in the near term
- Improve hydrologic connectivity with floodplain
- Attenuate site impacts of storm flows
- Restore ground water hydrology to pre-agricultural levels
- Restore wetland and riparian habitat

These goals were accomplished by:

- Establishing a minimum 50-foot buffer consisting of a mix of native species representative of piedmont/mountain bottomland hardwood forest. The planted species were selected by evaluation of adjacent reference sites and reviewing species listed in Classification of Natural Communities of North Carolina: Third Approximation (Schafale and Weakley 1990). A total of 1.9 acres of bottomland hardwood forest were preserved through land ownership or conservation easements. Land preservation reduced soil disturbance and nutrient input to the streams.
- Grading stream banks, installation of in-stream structures, and removal of an adjacent berm increased bank stability, improved in-stream habitat diversity and improved the hydrologic connectivity with the adjacent floodplain. Gently sloped, vegetated, stream banks in conjunction with in-stream structures increased bank stability. The in-stream structures all increased stream habitat diversity by establishing riffle-pool sequences and establishing stable woody debris. Removal of the berm reduced the water surface elevation required to reach the floodplain.
- Fill existing drainage ditches and excavating floodplain pools. Elimination of the drainage ditches and grading the floodplain restored groundwater hydrology to pre-agriculture conditions, in-turn restoring wetlands and riparian habitat.
- Ripping floodplain soil prior to planting to reduce ground compaction cause by past agricultural practice and allowing water infiltration.

1.2 Project History

The Five Mile Branch Mitigation site was selected for stream and wetland restoration originally by the North Carolina Department of Transportation (NCDOT) then transferred to the North Carolina Division of Mitigation Services (NCDMS). The purpose of this restoration project was to restore, enhance and preserve streams and wetlands within the site. Beaver and Fifth creeks are the primary stream within the site. There are five unnamed tributaries that were preserved. The site's original design was developed while the project was under NCDOT auspices and was a very sinuous, priority 2 stream restoration with a great deal of structure, which



presented concerns in terms of cost and stability (risk/cost-benefit). The proposed alignment also led to retrospective concerns of hydrologic trespass by NCDOT for the I-40 right of way. Collectively, this prompted an enhancement approach to the stream channel through stabilization, improvement of the profile, and the removal of berms to provide additional floodplain connection. (NCEEP 2013)

The Five Mile Branch Site (Site) is east of Statesville in Iredell County, southeast of Interstate 40 (I-40) and northwest of US Route 64 in the South Yadkin Watershed (03040102). The Site is in the Township of Cool Springs on the Statesville East, NC, 7.5-minute U.S. Geological Survey (USGS) topographic quadrangle (Figure 1). The Site comprises 12 adjacent parcels totaling approximately 229 acres (92.67 ha). It is bordered to the north by I-40 and to the south, east, and west by various forested, pasture, and residential properties. Swann Road (SR 2167), running north and south, bisects the site. Chimney Lane dead-ends on the site west of Swann Road.

The drainage area at the downstream end of the site (Reach 3) is 26.0 square miles. The drainage area for Beaver Creek (Reach 1) and Fifth Creek (Reach 2) at their confluence just west of Chimney Lane is 10.7 and 13.9 square miles respectively.

The restoration strategy implemented on Beaver and Fifth creeks consisted of Enhancement Level II. Both streams were stabilized in their current locations. Their north banks were re-graded to a flatter slope and boulder grade control structures were installed. No work was performed on the unnamed tributaries. They were preserved through conservation easements or property purchase. Wetland restoration was accomplished by filling in the drainage ditches, grading floodplain pools and replanting with native vegetation. Through these practices 11,676 linear feet of stream were enhanced, 1,537 feet of stream preserved, 27.7 acres of wetland restored and 1.9 acres of wetlands preserved. Due to the near systemic nature of the improvements to the channel cross section and the localized improvements to the profile/in-stream habitat, a credit ratio of 2:1 is being used.

Five vegetation monitoring plots are meeting the year four success criteria for planted stems. Twenty vegetation monitoring plots are meeting success criteria when including both planted and volunteer stems.

Project components were recalculated during Year 3. Inconsistencies between the as-built survey and existing site conditions were identified during monitoring site visits.

Wetland delineations were conducted in November and December 2016 using procedures outlined in January 1987 Technical Report Y-87-1, Corps of Engineers Wetlands Delineation Manual and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region (Version 2.0), April 2012. The wetland boundary was mapped using handheld GPS units and ARCMAP software. Wetland delineations identified a total of 29.6 acres of wetlands on the Site. Delineation have not been verified by the USACE. This is significantly less acreage than presented in the Baseline Monitoring Report. The reason for the reduction is due to an over estimation in the restored acreage and inaccuracies in the as-built topographic survey elevations. The proposed wetland line was estimated to be 1-2 feet higher than the ditch top of bank elevation. For the most part the proposed wetland line does follow as-built contour elevation. However, there are areas where the as-built contours are a foot or greater lower than the delineated wetlands. These low areas were not observed in the field. There are also topographic breaks observed on the site that are not reflected in the as-built topographical survey. The proposed wetland acreage was based on estimates that the wetlands would develop to a general topographic contour; however, it appears that the as-built topographic

contours may not be completely accurate, and there are likely site variabilities that are affecting wetland development.

1.3 Vegetation

Vegetation monitoring was conducted on September 23, and October 24-25, 2016. Five (Plots 1, 4, 6, 9, and 11) of the 23 vegetation plots are meeting the year four success criteria of 288 planted stems per acre. Including both planted and volunteer woody stems, 20 (Plots 2-12; 15-17; 19-23) of the 23 plots are far exceeding the year four success criteria.

Planted woody stem densities are low in Plots 2, 3, 5, 7, 8, 10, 12-16, and 18-23. River birch, silky dogwood (*Cornus amomum*), willow oak and cherrybark oak (*Quercus pagoda*) are the most successful and commonly occurring planted stems. Other planted species include possumhaw (*Ilex decidua*), black walnut (*Juglans nigra*), black gum (*Nyssa sylvatica*), sycamore and swamp chestnut oak (*Q. michauxii*). Natural stems observed in the floodplain of the conservation easement include red maple (*Acer rubrum*), ironwood (*Carpinus caroliniana*), tulip poplar (*Liriodendron tulipifera*), sycamore, sweetgum (*Liquidambar styraciflua*), silky dogwood, cottonwood (*Populus deltoides*), box elder (*Acer negundo*), green ash (*Fraxinus pennsylvanica*), river birch, and red elm (*Ulmus rubra*). Beyond the wetland boundaries in the conservation easement, natural stems such as black walnut (*Juglans nigra*), sweetgum, loblolly pine (*Pinus taeda*), American hazelnut (*Corylus americana*), and Eastern red cedar (*Juniperus virginiana*) were commonly observed.

Plot 13, 14, and 18 do not meet success criteria when combining both planted and volunteer woody stems due to frequent inundation. These plots are dominated by wetland herbaceous vegetation.

Plot 13 is situated on the edge of a non-tidal freshwater marsh and has only one surviving planted woody stem, a sycamore (*Platanus occidentalis*), and no natural woody stems. The plot and the immediate surroundings is dominated by herbaceous vegetation mostly consisting of sedges (*Carex* sp.), rushes (*Juncus* sp.), and bur-reed (*Sparganium americanum*).

Plot 14 is also situated in a frequently flooded area that is herb dominated with giant cutgrass (*Zizaniopsis miliacea*), sedges, and rushes. There are no surviving planted woody or volunteer stems in this plot.

Plot 18 has only two surviving planted trees, river birch (*Betula nigra*) and willow oak (*Q. phellos*), with no volunteer woody stems. This site is herb dominated with rushes, marshmallow (*Hibiscus moscheutos*), arrowleaf tearthumb (*Polygonum sagittatum*), and cattails (*Typha latifolia*).

Planted woody stem may not be detected during a particular monitoring year for various reasons, but could be detected the following monitoring period, resulting in a fluctuation in the total planted woody stems per acre. This undetectability is likely a result of a stem dying, being browsed by an herbivore (i.e. deer), or smothered by herbaceous vegetation. Some vegetation monitoring plot woody stem counts increased over the monitoring period based on the observations of planted woody stems in the plot that were likely overlooked during previous monitoring years due to reasons mentioned above. Vegetation plots 1, 6, 9, 11, 15, and 23 had an increase in their planted woody stems. Vegetation plot 1 increased due to being replanted after the adjacent landowner mowed the plot. This is the only area that has been replanted within the conservation easement. Plot 6 increased from 8 to 10 planted woody stems. During MY-03, a possumhaw was detected and an additional river birch was detected therefore increasing the stem count. Plot 9 increased from 10 to 12 planted woody stems, due to an additional river birch and ironwood was detected. Plot 11 increase from 7 to 8 planted



woody stems, due to one additional blackgum. Plot 15 increased from 2 to 3 planted woody stems, due to a buttonbush (*Cephalanthus occidentalis*) that was undetected in previous monitoring years. Plot 23 increased from 1 to 2 planted woody stems, due to a river birch that was undetected during the previous monitoring years.

Herbaceous vegetation diversity and density is high throughout the Site. The only area vegetation is absent is on some of the streambanks where erosion was observed. Mowing appears to have subsided and vegetation appears to be recovering within the vicinity of Plot 1. Due to landowner encroachment, Plot 1 was replanted in January 2016 with red maple (*Acer rubrum*), sycamore, redbud (*Cercis canadensis*) bare root seedlings. NCDMS has resolved the encroachment issue with the adjacent landowner and the area has also been further delineated with NCDMS signage to avoid future encroachment. On the east end of the Site, a 0.6 acre swath of vegetation was cleared and baited with corn for hunting. Refer to CCPV map.

Invasive vegetation is present throughout the site. Six invasive species were observed during the year four monitoring season; Chinese privet (*Ligustrum sinense*), Japanese honeysuckle (*Lonicera japonica*), Lespedeza (*Lespedeza cuneata*), multiflora rose (*Rosa multiflora*), Johnson grass (*Sorghum halapense*), and tree-of-heaven (*Ailanthus altissima*). NCDMS does not consider Lespedeza an invasive species of high concern. Johnson grass, Lespedeza and honeysuckle continue to persist throughout the site. Johnson grass and Lespedeza was observed within slightly dryer areas beyond the wetland boundaries and were most abundant north and adjacent of the main stem streams. Tree-of-heaven is very sparse throughout the floodplain; however, some dense patches were observed on the slopes near the NCDOT I-40 Right-of-Way (ROW) boundary. Some stems were observed in the understory within the undisturbed forested community on the south side of the main channel. Chinese privet was mainly observed in areas that were not disturbed during construction. Some privet stems were dead from herbicidal treatments.

The location of Johnson grass, Lespedeza, and honeysuckle are not shown on the CCPV. They occur throughout the planted areas of the Site. Depicting their locations would cover the majority of the site. The location of well-defined stands of Chinese privet and multiflora rose are depicted in the CCPV.

The project site is owned fee simple by NCDOT. People are illegally encroaching onto the site for hunting purposes. DMS has contacted the NCDOT, Iredell County Sheriff's office and the NCWRC in an effort to eliminate the encroachment. A hunting blind was observed near gauge 19 on 12/8/2016. There was an obvious foot trail leading from Swann Road to the blind. During the same visit, Sergeant Ron Robertson with the NC Wildlife Resource Commission Law Enforcement Division was on site. He was aware of the trespassing and additional illegal dumping on site. He had discussed the trespassing issue with NCDMS staff. The blind was still present on 12/15/2016. Evidence of a climbing tree stand was seen south of Beaver Creek near station 47+00 BVR on 12/15/2016.

1.4 Stream

There were no significant changes in the channel cross section dimensions. The bankfull width and cross sectional area decreased on riffle section 1 and pool cross section 3 causing a change in the W/D ratio, mean depth and entrenchment ratio. The decrease in bankfull width and area are a result of deposition on the upper stream bank and floodplain not channel instability. Pool cross section 9 increased in depth but the cross-sectional area remained consistent. Based on the cross-section surveys, all streams are meeting the established success criteria of maintaining a relatively consistent bankfull width, depth, cross-sectional area and bank height ratio.



During the Year 3 monitoring several discrepancies were notices between the as-built survey and the stream components presented in Table 1. The as-built survey incorporated only area where construction occurred. There are short sections of Beaver and Fifth Creeks where work did not occur and were therefore not included in the as-built survey. All preservation reaches were not included in the as-built survey either. The lengths of all stream reaches (restoration and preservation) were recalculated using a combination of the as-built survey data, GPS data and preconstruction topographic data. The revised lengths were calculated in ArcMap and used to complete Table 1. All feature locations on Beaver and Fifth creeks still use the as-built stationing.

Several bank stress areas were identified in the Year 4 monitoring; 350 feet (6% of the stream length) on Beaver Creek, 100 feet (6%) on Fifth Creek upstream Beaver Creek and 490 feet (9%) on Fifth Creek downstream of Beaver Creek, totaling approximately 950 feet (7.5%). Their locations are shown in the Current Condition Plan View. For the most part they are in the same areas as year previous years. Four areas are significant enough to consider repairs; 40 feet near 27+50 BVR, 60 foot near 29+00 BVR, 75 feet near 45+00 FTH and 60 feet near 59+00 FTH. These areas have increased in length and severity. A final determination will be made during the 2017 Initial Site Assessment and presented to NCDMS. Other areas of erosion and stress are shown on the CCPV and Appendix F.

Most the boulder structures are functioning as designed. However, several structures are compromised due to boulders moving, settling or dislodging. Structures of concern are identified below. None of the structures appeared to be on the verge of failure. Their performance will continue to be monitored. Photographs of the structures are included in Appendix F.

Beaver Creek

Cross vane 25+15 boulders in right arm settled. Directing main flow towards left arm. Portion of left arm has collapsed. Banks still appear stable.

Cross vane 32+25 Header boulder settled. Center of head is higher than sides. Banks are still stable.

Cross vane 37+10 Boulders in left arm dislodged. Some erosion around collapsed area.

Rock vane 65+50 Boulders in arm dislodged. Banks are still stable.

Fifth Creek Upstream Beaver

Cross vane 18+75 Boulders in left arm dislodged. Vegetated and stable around structure.

Fifth Creek Downstream Beaver

J-hook 46+10 Large gaps in boulders of left arm. Erosion around left arm.

Three bankfull events were recorded on Beaver Creek, one on Fifth Creek Upstream and one on Fifth Creek Downstream. Bankfull events occurred on February 3, May 3 and August 3, 2016. The cumulative total of documented bankfull events for the monitoring period is 11, exceeding the established success criteria of a minimum of two bankfull events within the five-year monitoring period.



Two beaver dams were present during the 2016 monitoring year. They were located at the Chimney Land bridge (56+80 BVR) and downstream of the Chimney Lane bridge (65+75 BVR). The dams were reported to the NCDMS project manager on 11/17/2016. The dams were removed by a NCDMS contractor and were not present on 12/15/2016.

1.5 Wetland

Wetland hydrology was monitored for the entire growing season (April 17 – October 17) in the Year 4 monitoring term. Two gauges (2 and 18) of the 30 on site gauges did not meet the established success criteria of saturation within 12 inches of the ground surface for 9 consecutive days of the growing season (5% of the 183-day growing season). Gauge 22 and 23 had ground water within 12 inches of the ground surface for 100% of the 2016 growing season and the previous three growing seasons. Gauges 6, 11 and 28 barely meet the established success criteria.

As with previous years, the functionality of the gauges was very unpredictable. Some gauges functioned during one download event, not the next and then functioned properly at the next event. Batteries were replaced and historical data was deleted from most gauges to help improve their functionality. Sometime this was successful. Gauges 7 and 17 malfunctioned during the 2016 monitoring year. These gauges were reprogrammed during the 4/12/2016 site visit. They were not functioning on subsequent visits and reprogrammed again. They will be replaced in the 2017 monitoring period.

During the 4/12/2016 site assessment, gauges 19 and 20 were missing. The screen was in place; only the gauge was missing. They were replaced and reprogrammed during the initial site assessment. With the gauge's proximity to the Swann Road access, it can be presumed that these gauges were taken by individuals illegally accessing the site.

In October 2016, the invasive vegetation management contractor's equipment damaged gauges 6 and 13. The gauges are not functioning and will be replaced during the 2017 Initial Site Assessment. Data was collected from the gauges for April 2016 – September 2016 and the gauges met the established success criteria.

1.6 Note

Summary information/data related to the occurrence of such things 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 Baseline Monitoring Report (formerly Mitigation Plan) and in the Mitigation Plan (formerly the Restoration Plan) documents available on NCDMS' website. All raw data supporting the tables and figures in the appendices are available from NCDMS upon request.



2 Methodology

2.1 Vegetation

Vegetation monitoring followed Carolina Vegetative Survey Level 2. Vegetation monitoring was conducted on September 23, October 24, and 25, 2016 and all planted and volunteer stems were tallied.

2.2 Stream Hydrology

Stream water depth was measured and recorded with HOBO[®] pressure sensor gauges manufactured by onset[®]. Three HOBO[®] devices were installed at the Five Mile Branch restoration site, one on Beaver Creek upstream of Chimney Lane, one on Fifth Creek upstream of the confluence with Beaver Creek and one on Fifth Creek downstream of Swann Road. The dataloggers were downloaded periodically during the monitoring period.

2.3 Cross Section Surveys

Cross sectional surveys were conducted by ARCADIS staff on May 14, 2015 using a Topcon total station. The survey data was imported and plotted using AutoCAD 2013 software.

2.4 Wetland Hydrology

Wetland hydrology was monitored using RDS Ecotone[®] WM Water Level Instruments (gauges). The gauges were programmed to take one reading daily at 8:00 AM EST. Gauges were downloaded using a Meazura[™] handheld device manufactured by ACEECA[™]. Data from the handheld device was then transferred to a Lenovo laptop computer and processed using Microsoft[®] Excel software.



3 **References**

Lee, Michael T., R. K. Peet, S. D. Roberts, and T. R. Wentworth. 2006. CVS-EEP Protocol for Recording Vegetation, Version 4.0 (<http://cvs.bio.unc.edu/methods.htm>).

North Carolina Division of Water Quality (NCDWQ). 2008. Yadkin Pee-Dee River Basinwide Water Quality Plan. Prepared by the North Carolina Division of Water Quality, Water Quality Section.

North Carolina Department of Environment and Natural Resources, Ecosystem Enhancement Program (NCDEQ) 2014. Annual Monitoring and Closeout Reporting Format, Data Requirements, and Content Guidance, February 2014.

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Schafale, M.P., and A. S. Weakley. 1990. Classification of the Natural Communities of North Carolina, A Third Approximation. North Carolina Natural Heritage Program, Division of Parks and Recreation, Department of Environment, Health and Natural Resources, Raleigh, NC.

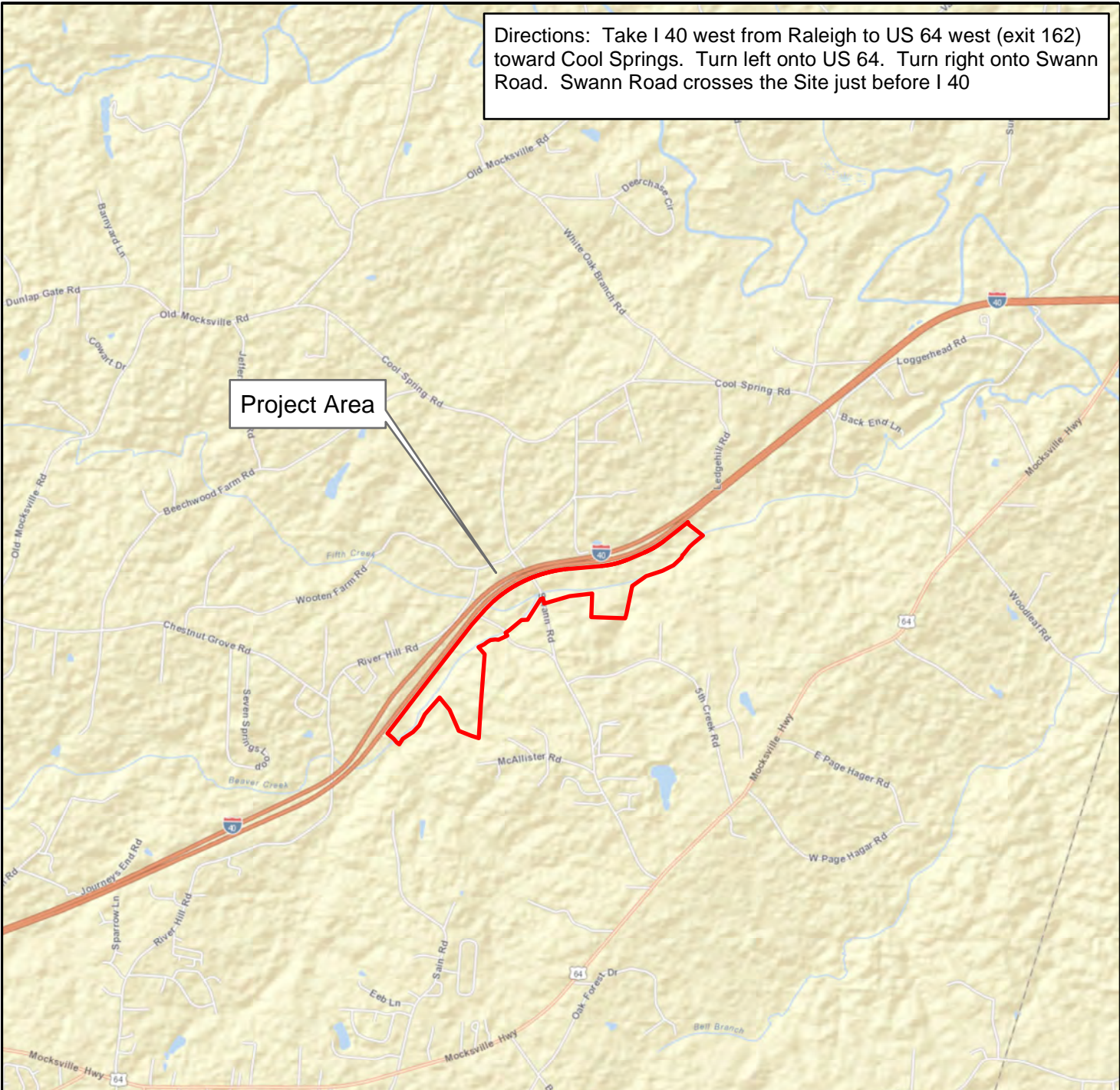
US Army Corps of Engineers (USACE) 2003. April 2003 Stream Mitigation Guidelines

United States Department of Agriculture, Natural Resources Conservation Service, 2011 Soil Survey of Iredell County, North Carolina. (Available online at http://soils.usda.gov/survey/printed_surveys/)


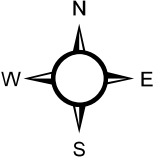



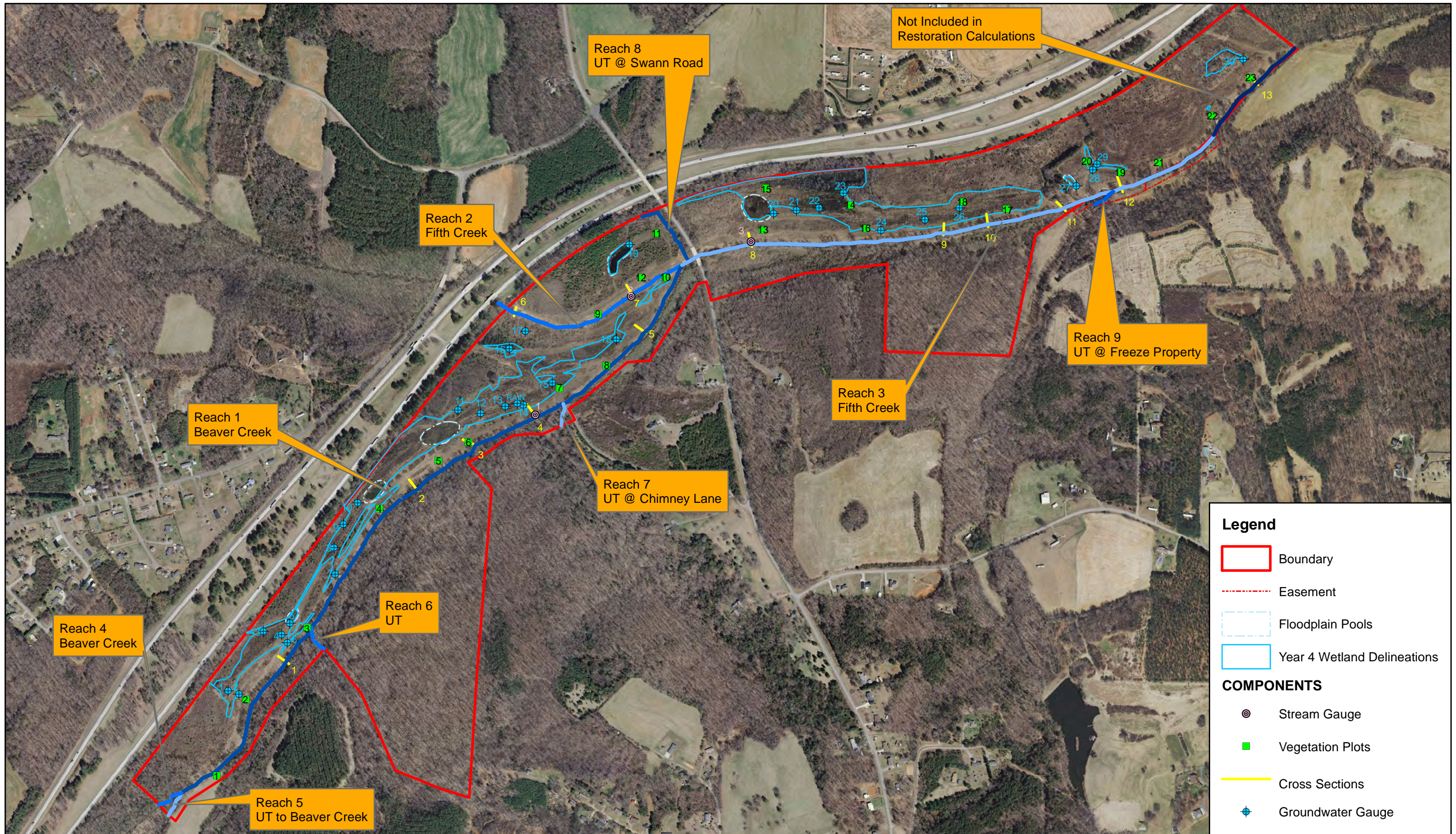
Appendix A

Directions: Take I 40 west from Raleigh to US 64 west (exit 162) toward Cool Springs. Turn left onto US 64. Turn right onto Swann Road. Swann Road crosses the Site just before I 40



The subject project site is an environmental restoration site of the NCDEQ Division of Mitigation Services (DMS) and is encompassed by a recorded conservation easement, but is bordered by land under private ownership. Accessing the site may require traversing areas near or along the easement boundary and 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, oversight and stewardship of the restoration site is permitted within the terms and time frames of their defined roles. Any intended site visitation or activities requires prior coordination with DMS.

<p>Prepared For</p> 	<p>0 0.5 1 2 Miles</p> <p>SCALE: 1:50,000</p> <p>Source: USGS Quadrangle Maps Statesville East and Cool Springs, NC</p>	
<p>Prepared By:</p> 	<p>VICINITY MAP</p> <p>Five Mile Branch Restoration Site Iredell County, North Carolina</p>	<p>Figure No.</p> <p>1</p>



Prepared For:



Prepared By:



PROJECT COMPONENTS
 FIVE MILE BRANCH RESTORATION SITE
 IREDELL COUNTY, NORTH CAROLINA

Aerial: 2014 NC OneMap Ortho Imagery

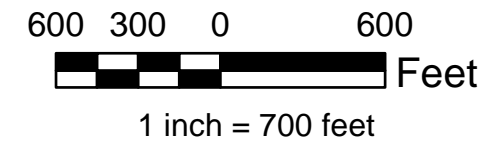


Figure No.

2

**Table 1. Project Components and Mitigation Credits
Five Mile Branch Stream Restoration, DMS IMS ID# 92185**

Mitigation Credits									
	Stream		Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	5,838.1	153.8	27.7	0.38	-	-	-	-	-
Project Components									
Project Component -or- Reach ID	Stationing/Location		Existing Footage/Acreage		Approach (PI, PII etc.)	Restoration - or- Restoration Equivalent	Restoration Footage or Acreage	Mitigation Ratio	
Reach 1 - Beaver Creek	10+87.03 PRBVR to Fifth Creek		5,794.1		E II	R	5,794.1	2:1**	
Reach 2 - Fifth Creek upstream of Beaver Creek	I-40 to Beaver Creek		1,586.4		E II	R	1,586.4	2:1**	
Reach 3 - Fifth Creek downstream of Beaver Creek	Beaver Creek to 78+60.00 PRFTH		5,215.2		E II	R	4,295.6*	2:1**	
Reach 4 - Beaver Creek (Upstream)	Property line to 10+87.03 PRBVR		205.8		Pres.	RE	205.8	10:1	
Reach 5 - UT to Beaver Creek (Upstream)	Property line to Beaver Creek		200.7		Pres.	RE	200.7	10:1	
Reach 6 - UT	Property line to Beaver Creek		203.1		Pres.	RE	203.1	10:1	
Reach 7 - UT at Chimney Lane	Property line to Beaver Creek		173.3		Pres.	RE	173.3	10:1	
Reach 8 - UT at Swann Road	Property line to Fifth Creek		576.0		Pres.	RE	576.0	10:1	
Reach 9 - UT at Freeze Property	Within the Conservation Easement		178.9		Pres.	RE	178.9	10:1	
Wetlands	Throughout the site		27.7		Rest.	R	27.7	1:1	
Wetlands	Throughout the site		1.9		Pres.	RE	1.9	5:1	
Component Summation									
Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-riparian Wetland (acres)	Buffer (square feet)	Upland (acres)			
		Riverine	Non-Riverine						
Restoration	N/A	27.7	N/A	N/A	N/A	N/A			
Enhancement		N/A	N/A	N/A	N/A	N/A			
Enhancement I	N/A								
Enhancement II	11,676.1								
Creation		N/A	N/A	N/A		N/A			
Preservation	1,537.8	1.9	N/A	N/A		N/A			
High Quality Preservation	N/A	N/A	N/A	N/A		N/A			

* Difference between existing and restoration footage is due to the absence of ownership of both side of the downstream most 919.6 linear feet of stream.

**Due to the near systemic nature of the improvement to the channel cross-section and the localized improvements to the profile/in-stream habitat, a credit ratio of 2.0:1.0 is being used.

**Table 2. Project Activity and Reporting History
Five Mile Branch Stream Restoration, DMS IMS ID# 92185**

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Restoration Plan	Dec-09	Dec-09
Final Design – Construction Plans	Nov-10	Nov-10
Construction	Apr-11	Apr-12
Mitigation Plan / As-built (Year 0 Monitoring – baseline)	Jun-12	Mar-13
Year 1 Monitoring	Dec-13	Dec-13
Year 2 Monitoring	Oct-14	Dec-14
Year 3 Monitoring	Nov-15	Dec-15
Year 4 Monitoring	Dec-16	Feb-17
Year 5 Monitoring	-	-

**Table 3. Project Contacts Table
Five Mile Branch Stream Restoration, DMS IMS ID# 92185**

Designer	ARCADIS G&M of NC, Inc. 801 Corporate Center Dr., Suite 300, Raleigh NC 27607
Primary project design POC	Brian Whitaker 813-353-5753
Construction Contractor	North State Environmental 2889 Lowery Street, Winston-Salem, NC 27101
Construction contractor POC	Michael Anderson 336-245-1253
Survey Contractor	North State Environmental 2889 Lowery Street, Winston-Salem, NC 27101
Survey contractor POC	David K. Alley, PLS 336-250-9225
Planting Contractor	Southern Garden, Inc. PO Box 808, Apex, NC 27502
Planting contractor POC	Todd Laasko 919-362-1050
Seeding Contractor	Canady's Landscape and Erosion Control 256 Fairview Acres Road, Lexington NC 27295
Contractor POC	336-236-1182
Seed Mix Sources	Green Resource, Colfax, NC 27235 336-855-6363
Nursery Stock Suppliers	Foggy Mountain Nursery 336-384-5323 Claridge Nursery 919-731-7988 Brook Run Plantation 434-292-1677
Monitoring Performers	Arcadis U.S., Inc. 801 Corporate Center Dr., Suite 300, Raleigh NC 27607
	Ecosystem Planning and Restoration LLC 559 Jones Franklin Road, Suite 150 Raleigh NC 27606
	Three Oaks Engineering 324 Blackwell St. #1200, Durham, NC 27701
Stream Monitoring POC	Brian Whitaker 813-353-5753
Vegetation Monitoring POC	Brian Whitaker 813-353-5753
Wetland Monitoring POC	Brian Whitaker 813-353-5753

Table 4. Attributes
Five Mile Branch Stream Restoration, DMS IMS ID# 92185

Project Information			
Project Name	Five Mile Branch Stream and Wetland Restoration		
County	Iredell		
Project Area (acres)	229		
Project Coordinates (latitude and longitude)	035° 50' 40.18" N	080° 46' 27.37" W	
Project Watershed Summary Information			
Physiographic Province	Piedmont		
River Basin	Yadkin-Pee Dee		
USGS Hydrologic Unit 8-digit		3040102	
DWQ Sub-basin	03-07-06		
Project Drainage Area (square miles)	26		
Project Drainage Area Percentage of Impervious Area	10-20		
CGIA Land Use Classification	Heavily developed, cultivated, herbaceous and shrubland, forest land, water bodies		
Reach Summary Information			
Parameters	Reach 1	Reach 2	Reach 3
Length of reach (linear feet)	5,794.1	1,586.4	5215.2*
Valley classification	VIII	VIII	VIII
Drainage area (square miles)	10.7	13.9	26.0
NCDWQ stream identification score	12-108-13-1	12-108-13	12-108-13
NCDWQ Water Quality Classification	Class C	Class C	Class C
Morphological Description (stream type)	E5	E5	E5
Evolutionary trend			
Underlying mapped soils	Codorus loam	Codorus loam	Codorus loam
Drainage class	somewhat poorly drained	somewhat poorly drained	somewhat poorly drained
Soil Hydric status	Yes	Yes	Yes
Slope	0-2%	0-2%	0-2%
FEMA classification	Zone AE	Zone AE	Zone AE

Native vegetation community	Bottomland hardwood	Bottomland hardwood	Bottomland hardwood
Percent composition of exotic invasive vegetation	<5	<5	<5
Wetland Summary Information			
Parameters	Wetland 1	Wetland 2	Wetland 3
Size of Wetland (acres)	29.6		
Wetland Type (non-riparian, riparian riverine or riparian non-riparian)	Riparian riverine		
Mapped Soil Series	Codorus loam		
Drainage class	somewhat poorly drained		
Soil Hydric Status	Yes		
Source of Hydrology	groundwater, precipitation and overbank flooding		
Hydrologic Impairment	Ditching		
Native vegetation community	Bottomland hardwood		
Percent composition of exotic invasive vegetation	<5		
Regulatory Considerations			
Regulation	Applicable?	Resolved?	Supporting Documentation
Waters of the United States — Section 404	Yes	Yes	Restoration Plan
Waters of the United States — Section 401	Yes	Yes	Restoration Plan
Endangered Species Act	Yes	Yes	Restoration Plan
Historic Preservation Act	Yes	Yes	Restoration Plan
Coastal Zone Management Act (CZMA)/ Coastal Area Management Act (CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	Yes	Yes	Restoration Plan
Essential Fisheries Habitat	No	N/A	N/A

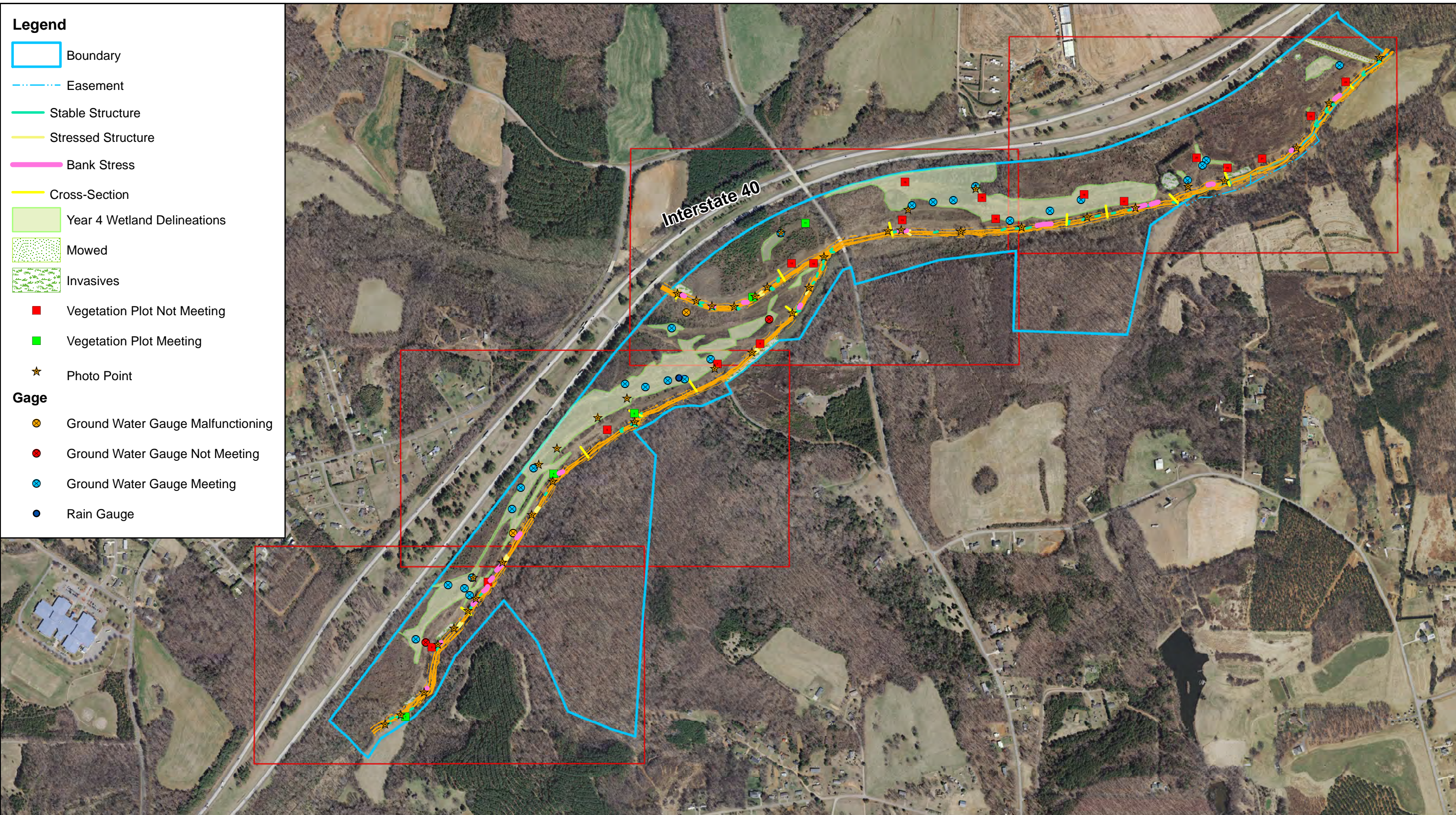
* included 919.6 linear feet of stream at downstream end without State ownership of both sides of stream.



Appendix B

Legend

- Boundary
- Easement
- Stable Structure
- Stressed Structure
- Bank Stress
- Cross-Section
- Year 4 Wetland Delineations
- Mowed
- Invasives
- Vegetation Plot Not Meeting
- Vegetation Plot Meeting
- ★ Photo Point
- Gage**
- ⊗ Ground Water Gauge Malfunctioning
- Ground Water Gauge Not Meeting
- ⊗ Ground Water Gauge Meeting
- Rain Gauge



Prepared For:



Prepared By:



**ECOSYSTEM
PLANNING &
RESTORATION**



CURRENT CONDITION PLAN VIEW
FIVE MILE BRANCH RESTORATION SITE
IREDELL COUNTY, NORTH CAROLINA

Aerial: 2014 NCDOT Aerial

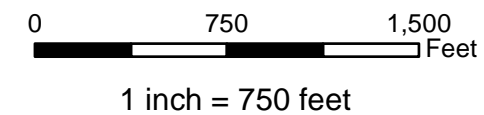
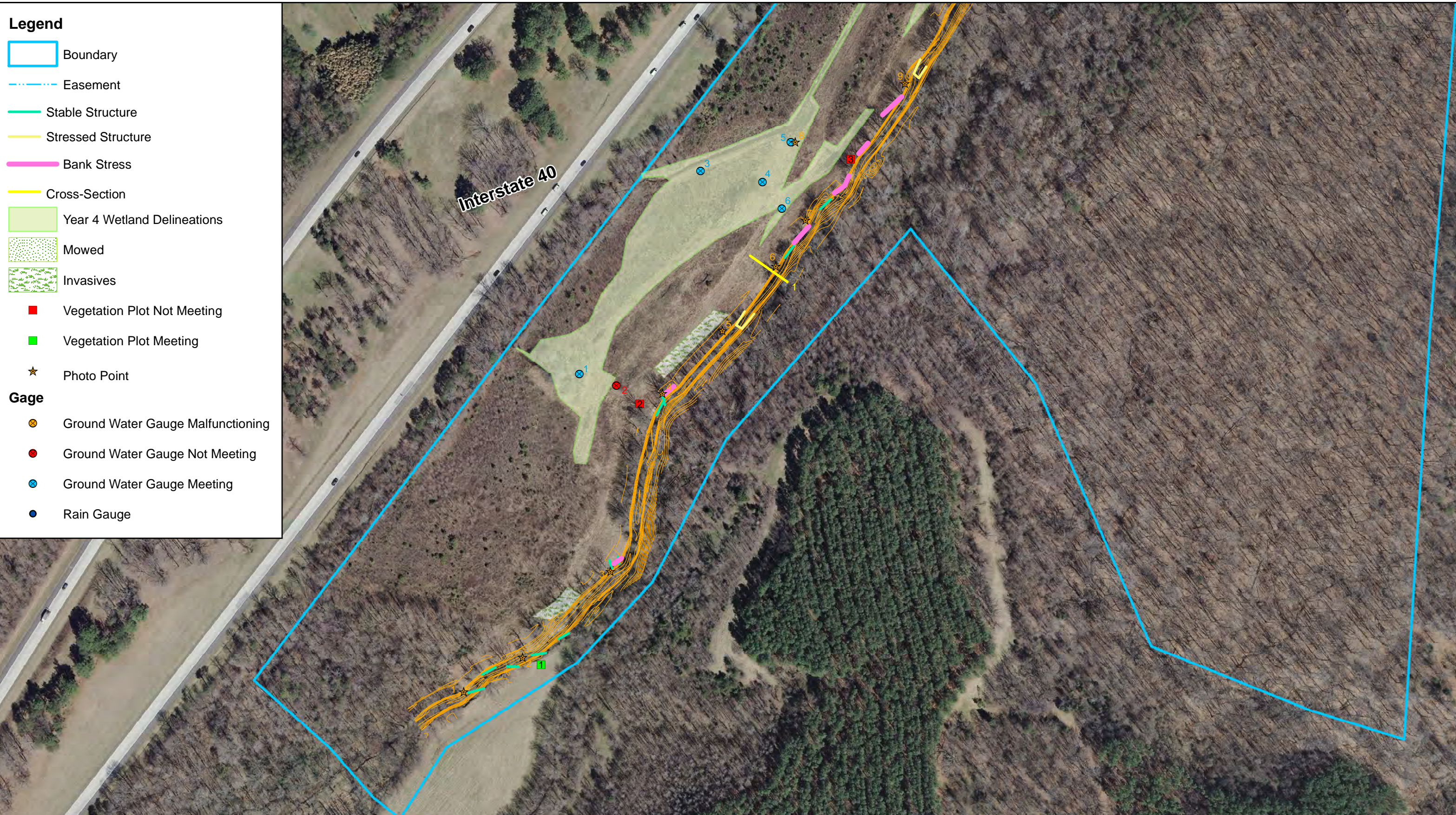


Figure No.

3



- Legend**
- Boundary
 - Easement
 - Stable Structure
 - Stressed Structure
 - Bank Stress
 - Cross-Section
 - Year 4 Wetland Delineations
 - Mowed
 - Invasives
 - Vegetation Plot Not Meeting
 - Vegetation Plot Meeting
 - ★ Photo Point
- Gage**
- ⊗ Ground Water Gauge Malfunctioning
 - Ground Water Gauge Not Meeting
 - ⊗ Ground Water Gauge Meeting
 - Rain Gauge

Interstate 40



Prepared By:
EPR
 ECOSYSTEM
 PLANNING &
 RESTORATION



CURRENT CONDITION PLAN VIEW
 FIVE MILE BRANCH RESTORATION SITE
 IREDELL COUNTY, NORTH CAROLINA

Aerial: 2014 NCDOT Aerial

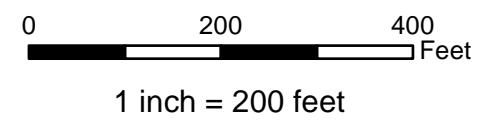


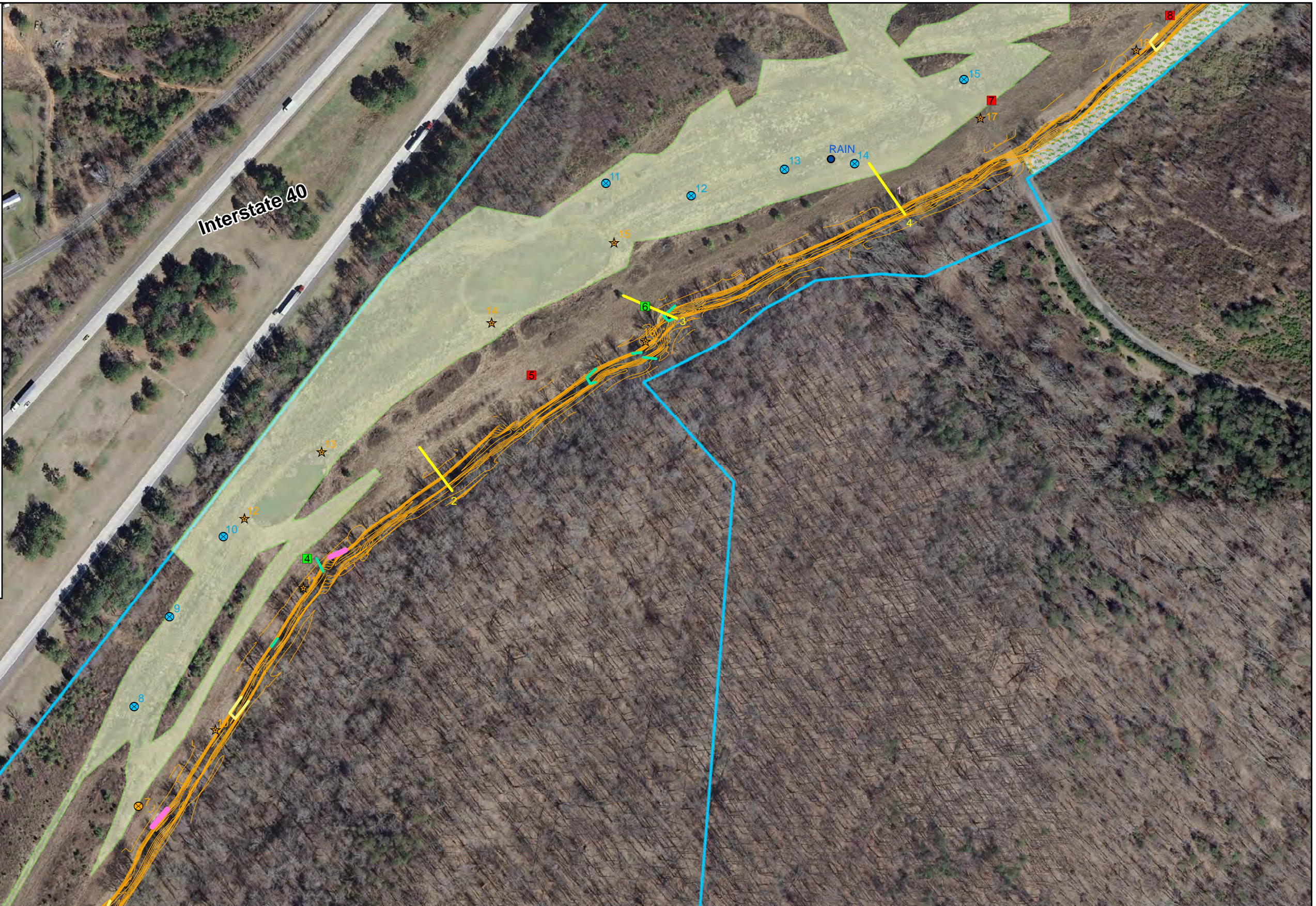
Figure No.
3A

Legend

- Boundary
- Easement
- Stable Structure
- Stressed Structure
- Bank Stress
- Cross-Section
- Year 4 Wetland Delineations
- Mowed
- Invasives
- Vegetation Plot Not Meeting
- Vegetation Plot Meeting
- ★ Photo Point

Gage

- ⊗ Ground Water Gauge Malfunctioning
- Ground Water Gauge Not Meeting
- ⊗ Ground Water Gauge Meeting
- Rain Gauge



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Prepared By:
 ECOSYSTEM
 PLANNING &
 RESTORATION



CURRENT CONDITION PLAN VIEW
 FIVE MILE BRANCH RESTORATION SITE
 IREDELL COUNTY, NORTH CAROLINA

Aerial: 2014 NCDOT Aerial

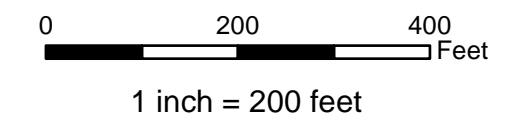


Figure No.
3B

Legend

- Boundary
- Easement
- Stable Structure
- Stressed Structure
- Bank Stress
- Cross-Section
- Year 4 Wetland Delineations
- Mowed
- Invasives
- Vegetation Plot Not Meeting
- Vegetation Plot Meeting
- ★ Photo Point
- Gage**
- ⊗ Ground Water Gauge Malfunctioning
- ⊗ Ground Water Gauge Not Meeting
- ⊗ Ground Water Gauge Meeting
- Rain Gauge



Prepared For:



Prepared By:



CURRENT CONDITION PLAN VIEW
 FIVE MILE BRANCH RESTORATION SITE
 IREDELL COUNTY, NORTH CAROLINA

Aerial: 2014 NCDOT Aerial

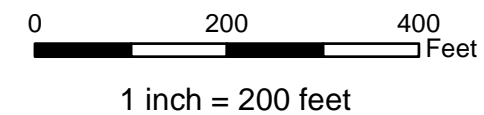


Figure No.

3C



Prepared For:



Prepared By:



ECOSYSTEM
PLANNING &
RESTORATION



CURRENT CONDITION PLAN VIEW
FIVE MILE BRANCH RESTORATION SITE
IREDELL COUNTY, NORTH CAROLINA

Aerial: 2014 NCDOT Aerial

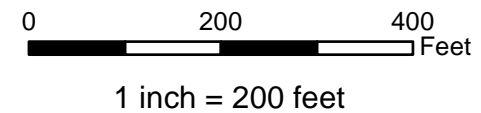


Figure No.

3D

Table 5a

Visual Stream Morphology Stability Assessment

Reach ID

Beaver Creek

Assessed Length

5794.1

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
1. Bed	1. Vertical Stability (Riffle and Run Units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not top include point bars)			0	0	100%
		2. Degradation - Evidence of downcutting			0	0	100%
	2. Riffle Condition*	1. Texture/Substrate - Riffle maintains coarser substrate	N/A	N/A			
		3. Meander Pool Condition**	1. Depth Sufficient (Max Pool Depth/Mean Bankfull Depth ≥ 1.5)	N/A			
		2. <u>Length</u> sufficient (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	N/A	N/A			
	4. Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	N/A	N/A			
2. Thalweg centering at downstream of meander (Glide)		N/A	N/A				
Totals							
2. Bank	1. Scoured/Eroding	Bank lacks vegetative cover due to active scour and erosion			6	220	96%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting is expected. Do <u>NOT</u> include undercuts that are stabilized by roots and are providing habitat.			0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			3	131	98%
Totals					9	351	98%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	19	24			80%
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	4	4			100%
3. Engineered Structures (cont'd.)	2a. Piping	Structures lacking any substantial flow underneath or around sills or arms.	20	20			100%
	3. Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. See exhibit describing bank influenced by vane arms.	17	20			85%
	4. Habitat	Pool forming structures maintaining Max Pool Depth/Mean Bankfull Depth ratio > 1.5. Rootwads/logs providing some cover at low flow.	8	8			100%

* Stream is a sand bed stream. No substrate sorting is occurring

** The stream is not a meandering stream. No meander pools exist.

Table 5b

Visual Stream Morphology Stability Assessment

Reach ID

Fifth Creek upstream of Beaver Creek

Assessed Length

1586.4

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
1. Bed	1. Vertical Stability (Riffle and Run Units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not top include point bars)			0	0	100%
		2. Degradation - Evidence of downcutting			0	0	100%
	2. Riffle Condition*	1. Texture/Substrate - Riffle maintains coarser substrate	N/A	N/A			
		3. Meander Pool Condition**	1. Depth Sufficient (Max Pool Depth/Mean Bankfull Depth ≥ 1.5)	N/A			
		2. <u>Length</u> sufficient (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	N/A	N/A			
	4. Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	N/A	N/A			
	2. Thalweg centering at downstream of meander (Glide)	N/A	N/A				
Totals					3	101	94%
2. Bank	1. Scoured/Eroding	Bank lacks vegetative cover due to active scour and erosion			1	38	98%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting is expected. Do <u>NOT</u> include undercuts that are stabilized by roots and are providing habitat.			0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			2	63	96%
Totals					3	101	94%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	5	6			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	2	2			
3. Engineered Structures (cont'd.)	2a. Piping	Structures lacking any substantial flow underneath or around sills or arms.	3	3			
	3. Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. See exhibit describing bank influenced by vane arms.	3	3			
	4. Habitat	Pool forming structures maintaining Max Pool Depth/Mean Bankfull Depth ratio > 1.5. Rootwads/logs providing some cover at low flow.	5	5			

* Stream is a sand bed stream. No substrate sorting is occurring

** The stream is not a meandering stream. No meander pools exist.

Table 5c

Visual Stream Morphology Stability Assessment

Reach ID

Fifth Creek downstream of Beaver Creek

Assessed Length

5,215.20

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
1. Bed	1. Vertical Stability (Riffle and Run Units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not top include point bars)			0	0	100%
		2. Degradation - Evidence of downcutting			0	0	100%
	2. Riffle Condition*	1. Texture/Substrate - Riffle maintains coarser substrate		N/A	N/A		N/A
		3. Meander Pool Condition**	1. Depth Sufficient (Max Pool Depth/Mean Bankfull Depth ≥ 1.5)	N/A	N/A		N/A
	2. <u>Length</u> sufficient (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)		N/A	N/A	N/A		
	4. Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)		N/A	N/A		N/A
2. Thalweg centering at downstream of meander (Glide)		N/A	N/A	N/A			
Totals					7		493
2. Bank	1. Scoured/Eroding	Bank lacks vegetative cover due to active scour and erosion			4	267	95%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting is expected. Do <u>NOT</u> include undercuts that are stabilized by roots and are providing habitat.			0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			3	226	96%
Totals					7	493	91%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	19	20		95%	
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	3	3		100%	
3. Engineered Structures (cont'd.)	2a. Piping	Structures lacking any substantial flow underneath or around sills or arms.	20	20		100%	
	3. Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. See exhibit describing bank influenced by vane arms.	16	20		80%	
	4. Habitat	Pool forming structures maintaining Max Pool Depth/Mean Bankfull Depth ratio > 1.5. Rootwads/logs providing some cover at low flow.	8	9		89%	

* Stream is a sand bed stream. No substrate sorting is occurring

** The stream is not a meandering stream. No meander pools exist.

Table 6

Vegetation Condition Assessment
Five Mile Branch Stream and Wetland Restoration

Planted Acreage 67.3

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very Limited cover of both woody and herbaceous material.	0.1 acres	None	0	0	0%
2. Low Stem Density Areas*	Woody stem densities clearly below target levels based on MY 4, or 5 stem count criteria.	0.1 acres	None	0	0.44	<1%
				Total	0.44	<1%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	None	0	0	0%
				Cumulative Total	0.44	<1%

Easement Acreage 229

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	1000SF	Grassland/ Green	9	1.6	2.4%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	None	Open Pasture/Green	1	0.6	<1%

* Acreage is combined acreage of 20 vegetation monitoring plots not meeting planted stem success criteria.



Appendix C



Vegetation Monitoring Plot #1 9/23/2016



Vegetation Monitoring Plot #5 10/24/2016



Vegetation Monitoring Plot #2 9/23/2016



Vegetation Monitoring Plot #6 10/24/2016



Vegetation Monitoring Plot #3 9/23/2016



Vegetation Monitoring Plot #7 10/24/2016



Vegetation Monitoring Plot #4 9/23/2016



Vegetation Monitoring Plot #8 10/24/2016



Vegetation Monitoring Plot #9 10/24/2016



Vegetation Monitoring Plot #13 10/24/2016



Vegetation Monitoring Plot #10 10/24/2016



Vegetation Monitoring Plot #14 10/25/2016



Vegetation Monitoring Plot #11 10/24/2016



Vegetation Monitoring Plot #15 10/24/2016



Vegetation Monitoring Plot #12 10/24/2016



Vegetation Monitoring Plot #16 10/24/2016



Vegetation Monitoring Plot #17 10/25/2016



Vegetation Monitoring Plot #21 10/25/2016



Vegetation Monitoring Plot #18 10/24/2016



Vegetation Monitoring Plot #22 10/25/2016



Vegetation Monitoring Plot #19 10/25/2016



Vegetation Monitoring Plot #23 10/25/2016



Vegetation Monitoring Plot #20 10/25/2016

Scientific Name	Common Name	Species Type	29185-01-0001			29185-01-0002			29185-01-0003			29185-01-0004			29185-01-0005			29185-01-0006			29185-01-0007			29185-01-0008			29185-01-0009			
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	
Acer negundo	boxelder	Tree						3			1			19			5						2			59			20	
Acer rubrum	red maple	Tree			2			2			2											1						1		
Ailanthus altissima	tree of heaven	Exotic																												
Alnus serrulata	hazel alder	Shrub																												
Asimina triloba	pawpaw	Tree																												
Baccharis halimifolia	eastern baccharis	Shrub																												
Betula nigra	river birch	Tree				1	1	1	3	3	3	1	1	3	1	1	1	2	2	2					2	2	2	4	4	4
Carpinus caroliniana	American hornbeam	Tree												2	2	2												1	1	2
Carya	hickory	Tree																												
Carya alba	mockernut hickory	Tree																												
Carya cordiformis	bitternut hickory	Tree																												
Celtis laevigata	sugarberry	Tree																												
Celtis occidentalis	common hackberry	Tree																												
Cephalanthus occidentalis	common buttonbush	Shrub																												
Cercis canadensis	eastern redbud	Tree	1	1	1																									
Cornus amomum	silky dogwood	Shrub										3	3	3				2	2	2									1	
Corylus americana	American hazelnut	Shrub																1	1	1			1							
Crataegus	hawthorn	Tree			1																									
Diospyros virginiana	common persimmon	Tree																												
Fraxinus americana	white ash	Tree																												
Fraxinus pennsylvanica	green ash	Tree									2					1						2					1	1	4	
Ilex decidua	possumhaw	shrub										1	1	1																
Juglans nigra	black walnut	Tree							1	1	1	1	1	1	1	1	1										1	1	1	
Juniperus virginiana	eastern redcedar	Tree																				2							2	
Ligustrum sinense	Chinese privet	Exotic																												
Liquidambar styraciflua	sweetgum	Tree			2			17			30			71			32			82			1			1			4	
Liriodendron tulipifera	tuliptree	Tree			1			3			1																			
Morus rubra	red mulberry	Tree																												
Nyssa sylvatica	blackgum	Tree										1	1	1				1	1	1	4	4	4							
Pinus taeda	loblolly pine	Tree																											1	
Pinus virginiana	Virginia pine	Tree																												
Platanus occidentalis	American sycamore	Tree	4	4	4	1	1	14			15			2					6			5	2	2	2				3	
Populus deltoides	eastern cottonwood	Tree									1																			
Quercus michauxii	swamp chestnut oak	Tree	5	5	5																3	3	3							
Quercus pagoda	cherrybark oak	Tree				2	2	2	3	3	3				2	2	2	4	4	4							5	5	5	
Quercus phellos	willow oak	Tree				1	1	1						1	1	1														
Rosa multiflora	multiflora rose	Exotic																												
Salix nigra	black willow	Tree																												
Sambucus canadensis	Common Elderberry	Shrub																												
Ulmus rubra	slippery elm	Tree												2																
Stem count			10	10	16	5	5	44	7	7	59	9	9	112	5	5	43	10	10	100	7	7	19	4	4	64	12	12	48	
size (ares)			1			1			1			1			1			1			1			1			1			
size (ACRES)			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			
Species count			3	3	7	4	4	9	3	3	10	6	6	11	4	4	7	5	5	8	2	2	8	2	2	4	5	5	12	
Stems per ACRE			404.7	404.7	647.5	202.3	202.3	1781	283.3	283.3	2388	364.2	364.2	4532	202.3	202.3	1740	404.7	404.7	4047	283.3	283.3	768.9	161.9	161.9	2590	485.6	485.6	1942	

Color for Density
Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%

Current Plot Data (MY4 2016)

Scientific Name	Common Name	Species Type	29185-01-0010			29185-01-0011			29185-01-0012			29185-01-0013			29185-01-0014			29185-01-0015			29185-01-0016			29185-01-0017			29185-01-0018			29185-01-0019		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer negundo	boxelder	Tree			111			12			57										2			1						10		
Acer rubrum	red maple	Tree						4											56											1		
Ailanthus altissima	tree of heaven	Exotic																														
Alnus serrulata	hazel alder	Shrub																														
Asimina triloba	pawpaw	Tree																														
Baccharis halimifolia	eastern baccharis	Shrub										1																				
Betula nigra	river birch	Tree	1	1	1					1	1	1						2	2	6				21	1	1	1	2	2	2		
Carpinus caroliniana	American hornbeam	Tree																														
Carya	hickory	Tree																												2		
Carya alba	mockernut hickory	Tree																						2								
Carya cordiformis	bitternut hickory	Tree																														
Celtis laevigata	sugarberry	Tree																														
Celtis occidentalis	common hackberry	Tree																														
Cephalanthus occidentalis	common buttonbush	Shrub															1	1	1													
Cercis canadensis	eastern redbud	Tree																														
Cornus amomum	silky dogwood	Shrub	1	1	3					1	1	1									1	1	1				2					
Corylus americana	American hazelnut	Shrub																														
Crataegus	hawthorn	Tree																														
Diospyros virginiana	common persimmon	Tree																						1						14		
Fraxinus americana	white ash	Tree																														
Fraxinus pennsylvanica	green ash	Tree					1	1	33	1	1	2						35	1	1	3											
Ilex decidua	possumhaw	shrub																														
Juglans nigra	black walnut	Tree	1	1	1																							1	1	1		
Juniperus virginiana	eastern redcedar	Tree										2																		1		
Ligustrum sinense	Chinese privet	Exotic																														
Liquidambar styraciflua	sweetgum	Tree							56			3						68			2									40		
Liriodendron tulipifera	tuliptree	Tree																														
Morus rubra	red mulberry	Tree																														
Nyssa sylvatica	blackgum	Tree					3	3	3																							
Pinus taeda	loblolly pine	Tree										1																				
Pinus virginiana	Virginia pine	Tree																														
Platanus occidentalis	American sycamore	Tree	1	1	1			14					1	1	1			6					29			2			3			
Populus deltoides	eastern cottonwood	Tree																														
Quercus michauxii	swamp chestnut oak	Tree	1	1	1																											
Quercus pagoda	cherrybark oak	Tree					1	1	1																							
Quercus phellos	willow oak	Tree	1	1	1		3	3	3											1	1	1		1	1	1	1	1	1	3		
Rosa multiflora	multiflora rose	Exotic																														
Salix nigra	black willow	Tree																														
Sambucus canadensis	Common Elderberry	Shrub																														
Ulmus rubra	slippery elm	Tree																						6				1	1	7		
Stem count			6	6	119	8	8	126	3	3	68	1	1	1	0	0	0	3	3	172	3	3	9	0	0	61	2	2	6	5	5	84
size (ares)			1			1			1			1			1			1			1			1			1			1		
size (ACRES)			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
Species count			6	6	7	4	4	8	3	3	8	1	1	1	0	0	0	2	2	6	3	3	5	0	0	7	2	2	4	4	4	11
Stems per ACRE			242.8	242.8	4816	323.7	323.7	5099	121.4	121.4	2752	40.47	40.47	40.47	0	0	0	121.4	121.4	6961	121.4	121.4	364.2	0	0	2469	80.94	80.94	242.8	202.3	202.3	3399

Color for Density
 Exceeds requirements by 10%
 Exceeds requirements, but by less than 10%
 Fails to meet requirements, by less than 10%
 Fails to meet requirements by more than 10%

Scientific Name	Common Name	Species Type	Annual Means																											
			29185-01-0020			29185-01-0021			29185-01-0022			29185-01-0023			MY4 (2016)			MY3 (2015)			MY2 (2014)			MY1 (2013)			MY0 (2012)			
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	
Acer negundo	boxelder	Tree			1			9			1			13			326			442.6			372			182			1	
Acer rubrum	red maple	Tree			1						4						74			12			24			22				
Ailanthus altissima	tree of heaven	Exotic																	1											
Alnus serrulata	hazel alder	Shrub																								2	2	2		
Asimina triloba	pawpaw	Tree																					1							
Baccharis halimifolia	eastern baccharis	Shrub															1			1										
Betula nigra	river birch	Tree	2	2	3				1	1	1	1	1	1	25	25	53	25	25	57	22	22	62	16	16	67	19	19	50	
Carpinus caroliniana	American hornbeam	Tree													3	3	4	2	2	2	2	2	2	4	2	2	2	4	4	4
Carya	hickory	Tree															2													
Carya alba	mockernut hickory	Tree															2			1			2							
Carya cordiformis	bitternut hickory	Tree																		1			1							
Celtis laevigata	sugarberry	Tree																					4	4	6	5	5	9		
Celtis occidentalis	common hackberry	Tree																		2										
Cephalanthus occidentalis	common buttonbush	Shrub	1	1	6										2	2	7	1	1	10	1	1	8			4				
Cercis canadensis	eastern redbud	Tree													1	1	1													
Cornus amomum	silky dogwood	Shrub					1	1	1			1			9	9	15	10	10	11	11	11	12	7	7	9	12	12	12	
Corylus americana	American hazelnut	Shrub													1	1	2	1	1	1	1	1	1							
Crataegus	hawthorn	Tree																		1										
Diospyros virginiana	common persimmon	Tree																		15			21			25		11		
Fraxinus americana	white ash	Tree																			1	1	1							
Fraxinus pennsylvanica	green ash	Tree			1										4	4	95	5	5	42	4	4	53	2	2	17	2	2	3	
Ilex decidua	possumhaw	shrub													1	1	1	1	1	1	5	5	5	12	12	12	14	14	14	
Juglans nigra	black walnut	Tree													6	6	6	7	7	8	6	6	13	3	3	7	15	15	15	
Juniperus virginiana	eastern redcedar	Tree																	15			2			1					
Ligustrum sinense	Chinese privet	Exotic																												
Liquidambar styraciflua	sweetgum	Tree			2			72			96						579			428			615			393				
Liriodendron tulipifera	tuliptree	Tree									1						6			3			2							
Morus rubra	red mulberry	Tree																					1	1	1	3	3	3		
Nyssa sylvatica	blackgum	Tree							1	1	1				10	10	10	9	9	9	6	6	6	2	2	2	2	2	2	
Pinus taeda	loblolly pine	Tree															2			1			1							
Pinus virginiana	Virginia pine	Tree																					1							
Platanus occidentalis	American sycamore	Tree			4		1	1	3					2	10	10	116	6	6	128	6	6	117	6	6	159	5	5	37	
Populus deltoides	eastern cottonwood	Tree															1			1			1							
Quercus michauxii	swamp chestnut oak	Tree													9	9	9	6	6	6	6	6	6	4	4	4	15	15	15	
Quercus pagoda	cherrybark oak	Tree								2	2	2			19	19	19	19	19	19	20	20	20	22	22	24	24	24	24	
Quercus phellos	willow oak	Tree			1		1	1	1				2	2	2	12	12	16	13	13	13	10	10	10	6	6	6	10	10	10
Rosa multiflora	multiflora rose	Exotic																		1										
Salix nigra	black willow	Tree																					1			1				
Sambucus canadensis	Common Elderberry	Shrub			4												4	1	1	10			4	3	3	28	5	5	5	
Ulmus rubra	slippery elm	Tree			1										1	1	16	1	1	8	1	1	10							
Stem count			3	3	24	3	3	86	4	4	119	3	3	18	113	113	1398	107	107	1244	102	102	1381	90	90	956	137	137	206	
size (ares)			1			1			1			1			23			23			23			23			23			
size (ACRES)			0.02			0.02			0.02			0.02			0.57			0.57			0.57			0.57			0.57			
Species count			2	2	10	3	3	5	3	3	9	2	2	4	15	15	28	15	15	30	15	15	30	14	14	19	15	15	16	
Stems per ACRE			121.4	121.4	971.2	121.4	121.4	3480	161.9	161.9	4816	121.4	121.4	728.4	198.8	198.8	2460	188.3	188.3	2188	179.5	179.5	2430	158.4	158.4	1682	241.1	241.1	362.5	

Color for Density
Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%



Appendix D

River Basin:	Catawba
Watershed:	Beaver Creek
XS ID:	X-1 BVR
Drainage Area (sq. mi.)	10.7
Date:	4/28/2016
Field Crew:	E. Toler, C. Campbell, R. Lepsic

Section 1 - Riffle

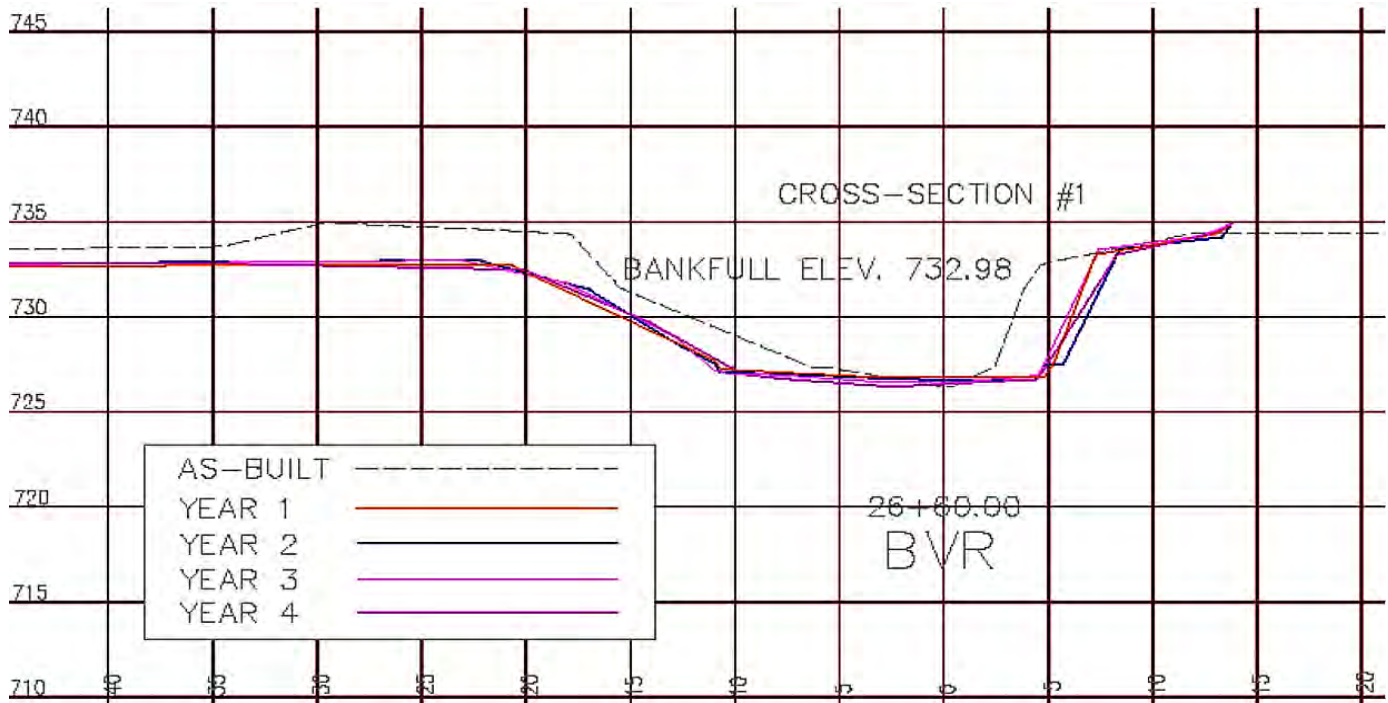


Northing	Easting	Elevation
764366.575	1472878.02	734.8
764369.841	1472874.75	733.655
764372.188	1472872.18	727.635
764372.43	1472872.47	727.086
764374.161	1472869.5	726.912
764376.234	1472866.75	726.698
764379.45	1472862.98	727.096
764380.834	1472861.28	727.371
764381.08	1472860.83	727.691
764383.141	1472857.41	730.122
764386.47	1472852.49	732.864
764395.776	1472838.5	733.244
764405.93	1472822.83	733.063
764414.39	1472809.56	732.645
764419.724	1472802.56	732.397

SUMMARY DATA	
Bankfull Elevation:	732.98
Bankfull Cross-Sectional Area:	119.5
Bankfull Width:	27.9
Floodprone Area Elevation:	739.18
Floodprone Width:	200+
Max Depth at Bankfull:	6.2
Mean Depth at Bankfull:	4.3
W/D Ratio:	6.5
Entrenchment Ratio:	7.2
Bank Height Ratio:	1.0

Stream Type: E5

The discrepancies between the as-built cross sections and the following year's cross sections are the result of the as-built cross sections being generated from the surface contours created from the as-built field survey, which was not surveyed by ARCADIS staff. The annual monitoring surveys of the channel were generated using field surveys and accurately represent actual field conditions.



River Basin:	Catawba
Watershed:	Beaver Creek
XS ID:	X-2 BVR
Drainage Area (sq. mi.)	10.7
Date:	4/28/2016
Field Crew:	E. Toler, C. Campbell, R. Lepsic

Section 2 - Riffle

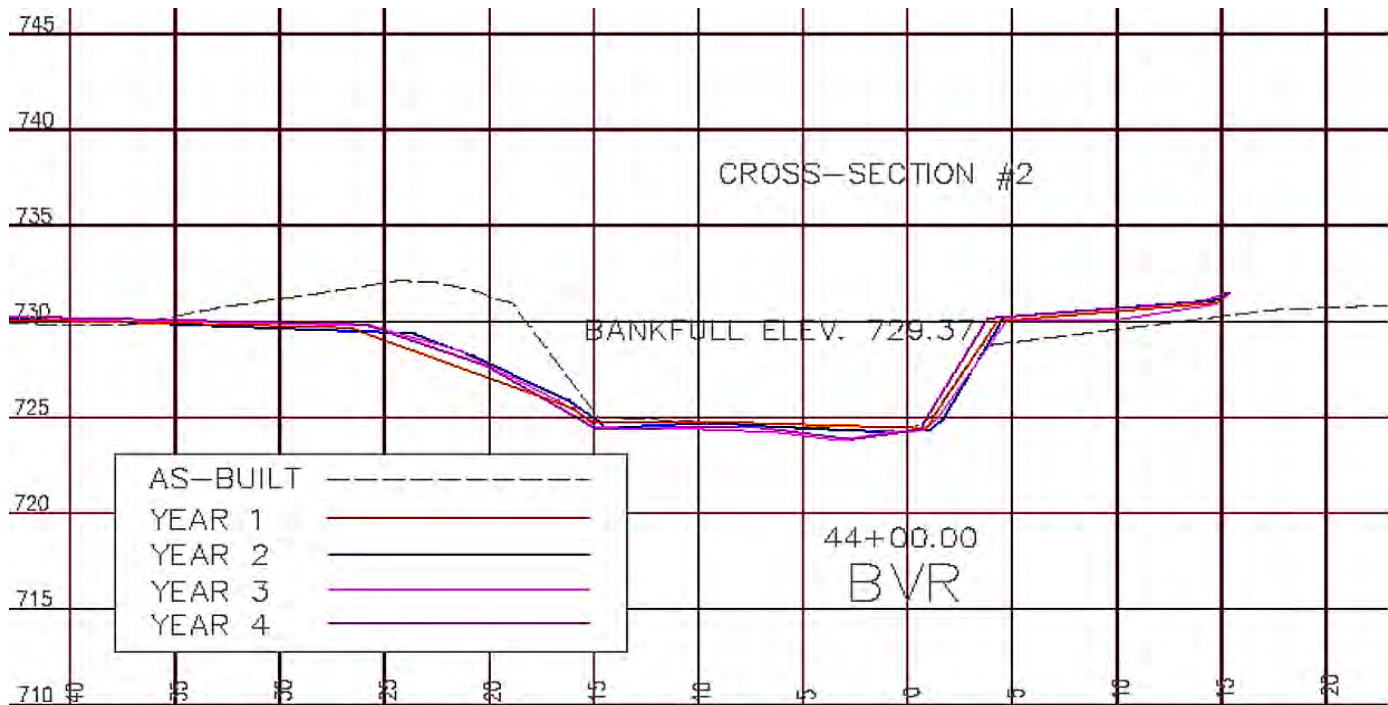


Northing	Easting	Elevation
765692.418	1473870.9	731.339
765700.264	1473864.37	730.481
765703.228	1473864.56	725.179
765703.36	1473864.43	724.702
765705.996	1473862.37	724.169
765709.343	1473858.92	724.838
765712.941	1473855.94	724.759
765715.113	1473854.33	724.693
765714.883	1473853.74	725.139
765718.646	1473851.1	728.009
765723.377	1473847.81	730.157
765736.804	1473837.7	730.563
765750.317	1473826.12	730.72
765762.37	1473815.84	730.427
765771.15	1473808.57	730.494

SUMMARY DATA	
Bankfull Elevation:	729.37
Bankfull Cross-Sectional Area:	119.9
Bankfull Width:	29.5
Floodprone Area Elevation:	735.37
Floodprone Width:	200+
Max Depth at Bankfull:	6.0
Mean Depth at Bankfull:	4.1
W/D Ratio:	7.2
Entrenchment Ratio:	6.8
Bank Height Ratio:	1.0

Stream Type: E5

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River Basin:	Catawba
Watershed:	Beaver Creek
XS ID:	X-3 BVR
Drainage Area (sq. mi.):	10.7
Date:	4/28/2016
Field Crew:	E. Toler, C. Campbell, R. Lepsic

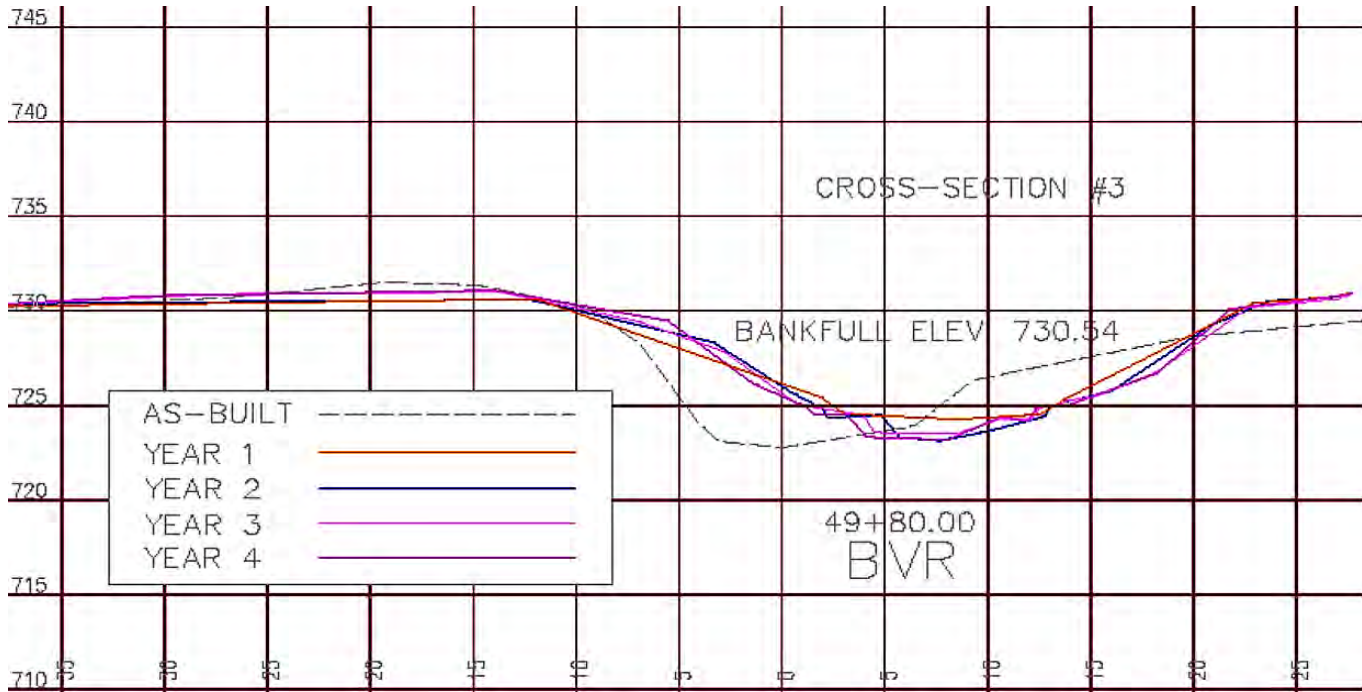
Section 3 - Pool



Northing	Easting	Elevation
766029.514	1474321.59	730.048
766031.922	1474317.2	729.402
766032.705	1474313.67	725.996
766033.968	1474309.38	724.264
766034.432	1474308.28	724.276
766034.446	1474308.16	724.204
766034.813	1474307.87	723.472
766035.504	1474306.8	723.701
766036.755	1474304.5	722.501
766038.864	1474301.25	722.64
766039.705	1474300.77	723.825
766040.769	1474299.6	723.858
766040.608	1474299.15	724.297
766042.195	1474297.27	725.441
766043.882	1474293.46	728.782
766047.711	1474285.89	730.378
766054.671	1474270.99	730.099
766062.264	1474254.1	728.982
766068.968	1474238.78	728.559
766074.251	1474226.6	728.443
766077.155	1474220.41	728.431

SUMMARY DATA	
Bankfull Elevation:	730.54
Bankfull Cross-Sectional Area:	124.0
Bankfull Width:	30.6
Floodprone Area Elevation:	737.44
Floodprone Width:	200+
Max Depth at Bankfull:	6.9
Mean Depth at Bankfull:	4.1
W/D Ratio:	7.5
Entrenchment Ratio:	6.5
Bank Height Ratio:	1.0

Stream Type: E5



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River Basin:	Catawba
Watershed:	Beaver Creek
XS ID:	X-4 BVR
Drainage Area (sq. mi.)	10.7
Date:	4/28/2016
Field Crew:	E. Toler, C. Campbell, R. Lepsic

Section 4 - Riffle

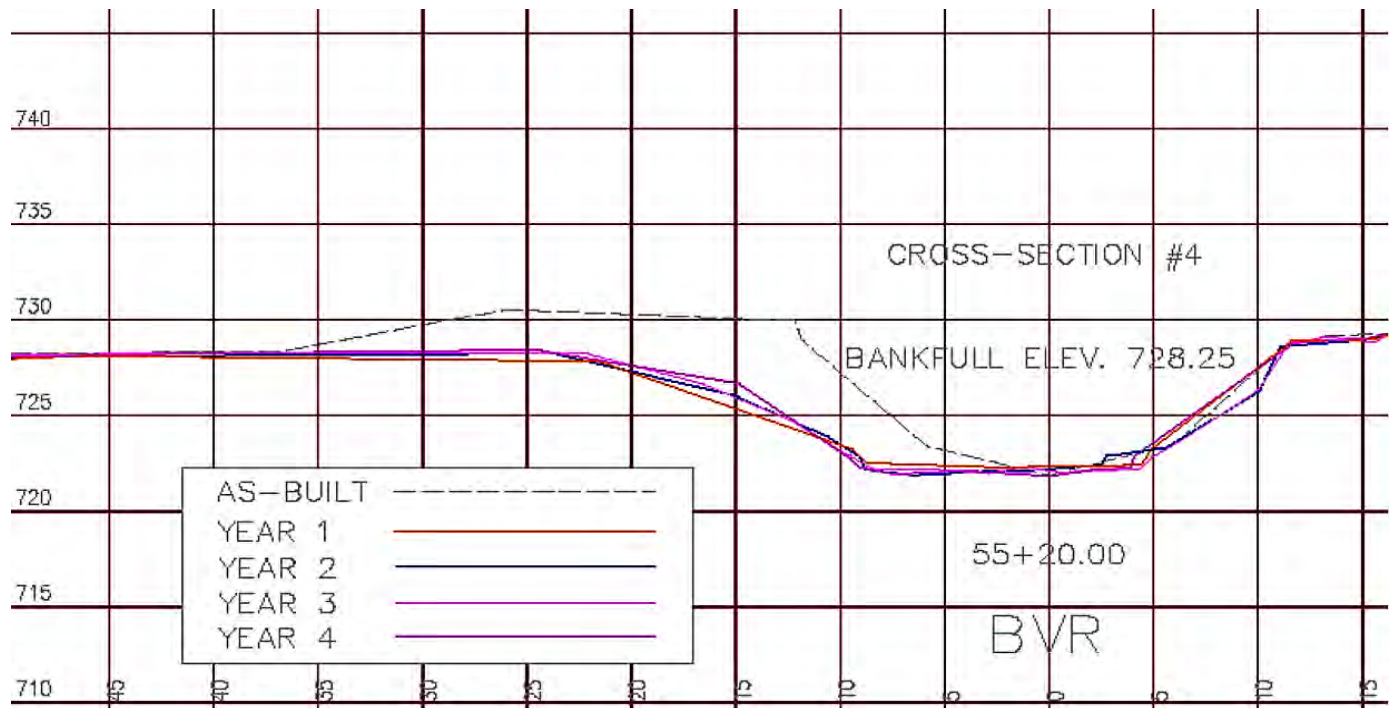


Northing	Easting	Elevation
766238.751	1474788.7	729.519
766241.893	1474787.02	729.262
766248.19	1474782.81	723.368
766248.056	1474782.73	722.736
766249.595	1474782.22	722.68
766251.555	1474781.21	722.328
766255.193	1474778.83	722.604
766257.647	1474776.95	722.41
766259.026	1474775.9	722.793
766259.504	1474775.83	723.293
766264.32	1474773.66	727.161
766272.26	1474768.06	728.911
766287.799	1474757.75	728.696
766302.567	1474747.02	728.284
766319.18	1474735.54	727.282
766335.246	1474722.75	727.341
766343.139	1474716.59	727.268

SUMMARY DATA	
Bankfull Elevation:	728.25
Bankfull Cross-Sectional Area:	134.4
Bankfull Width:	35.8
Floodprone Area Elevation:	734.85
Floodprone Width:	200+
Max Depth at Bankfull:	6.6
Mean Depth at Bankfull:	3.8
W/D Ratio:	9.4
Entrenchment Ratio:	5.6
Bank Height Ratio:	1.0

Stream Type: E5

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River Basin:	Catawba
Watershed:	Beaver Creek
XS ID:	X-5 BVR
Drainage Area (sq. mi.)	10.7
Date:	4/28/2016
Field Crew:	E. Toler, C. Campbell, R. Lepsic

Section 5 - Pool

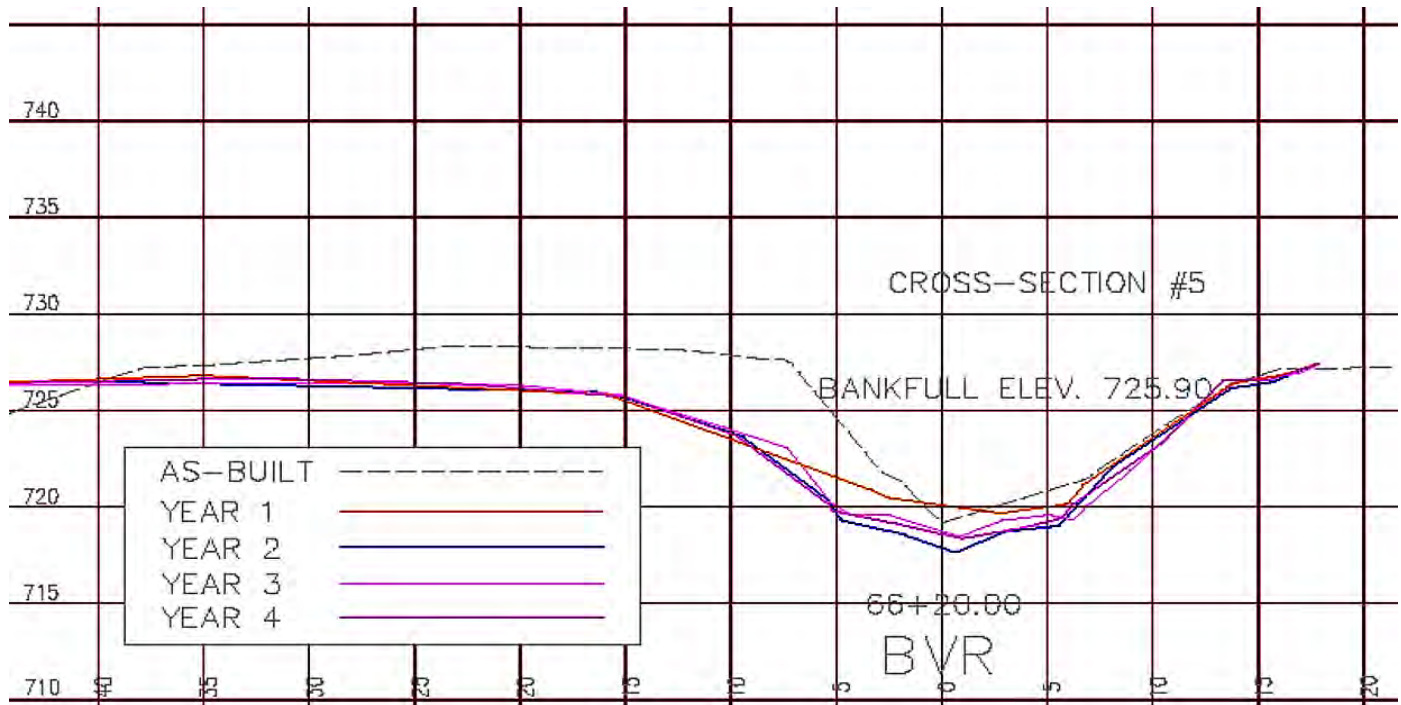


Northing	Easting	Elevation
766934.913	1475551.73	726.508
766928.764	1475568.1	726.811
766922.404	1475581.93	727.13
766918.524	1475591.14	726.808
766915.612	1475597.88	726.159
766913.696	1475602.8	724.189
766912.114	1475606.9	720.615
766912.223	1475607.08	720.243
766910.529	1475609.2	719.645
766908.853	1475612.16	718.827
766906.858	1475613.99	719.326
766905.681	1475615.58	719.868
766905.222	1475615.93	720.617
766902.424	1475619.13	723.813
766900.598	1475621.31	727.006
766900.207	1475623.53	727.06

SUMMARY DATA	
Bankfull Elevation:	725.9
Bankfull Cross-Sectional Area:	118.2
Bankfull Width:	27.6
Floodprone Area Elevation:	733.2
Floodprone Width:	200+
Max Depth at Bankfull:	7.3
Mean Depth at Bankfull:	4.3
W/D Ratio:	6.4
Entrenchment Ratio:	7.2
Bank Height Ratio:	1.0

Stream Type: E5

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River Basin:	Catawba
Watershed:	Beaver Creek
XS ID:	X-6 FTH
Drainage Area (sq. mi.)	13.9
Date:	4/28/2016
Field Crew:	E. Toler, C. Campbell, R. Lepsic

Section 6 - Pool

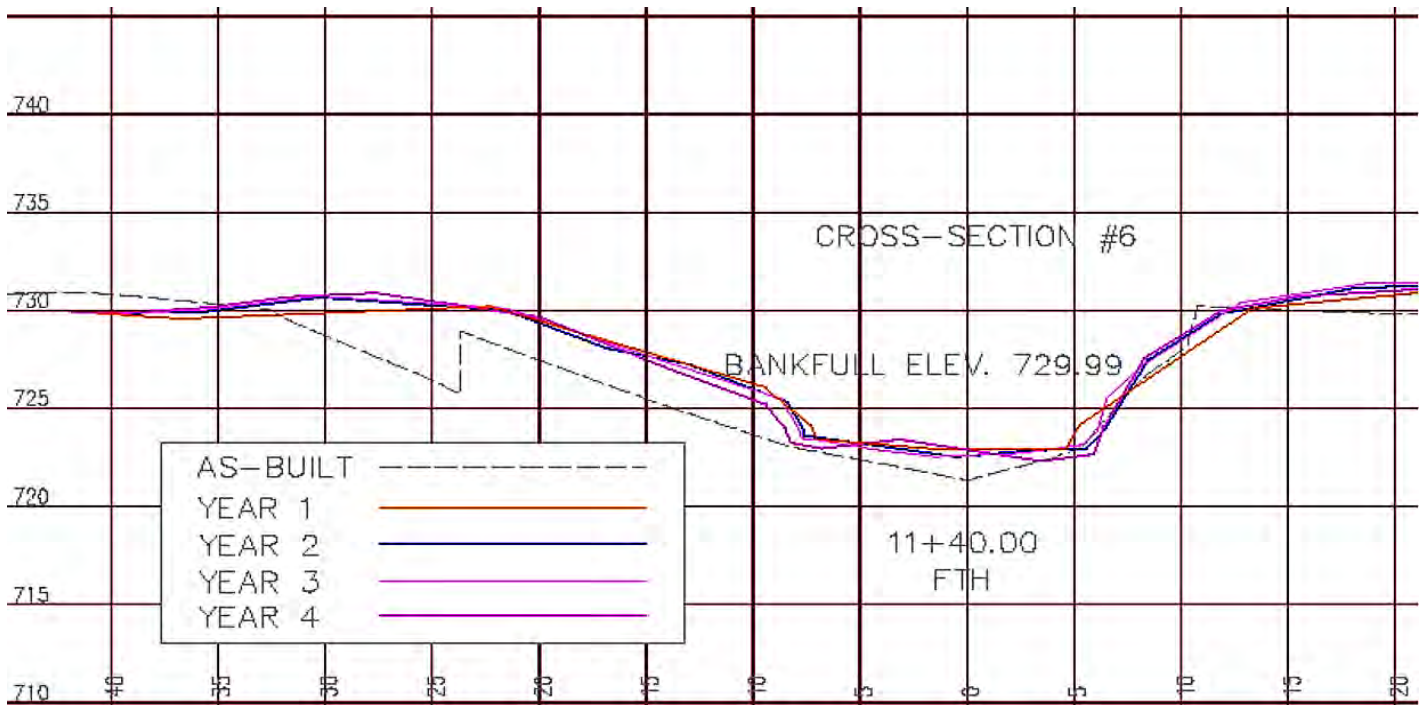


Northing	Easting	Elevation
767028.479	1474608.55	729.86
767038.853	1474611.26	729.161
767042.314	1474612.25	728.435
767045.762	1474613.14	726.028
767047.211	1474614.35	722.495
767047.614	1474614.6	721.126
767049.987	1474615.02	720.767
767053.586	1474615.22	721.358
767056.502	1474615.95	721.874
767060.003	1474617.12	721.41
767061.406	1474617.36	721.698
767061.503	1474617.09	722.487
767062.066	1474617.8	723.675
767066.743	1474619.05	725.631
767072.336	1474619.88	728.103
767079.964	1474621.21	729.331
767083.888	1474622.21	729.134
767087.509	1474622.92	728.594
767091.209	1474624.2	728.331

SUMMARY DATA	
Bankfull Elevation:	729.99
Bankfull Cross-Sectional Area:	149.6
Bankfull Width:	33.8
Floodprone Area Elevation:	737.69
Floodprone Width:	200+
Max Depth at Bankfull:	7.7
Mean Depth at Bankfull:	4.4
W/D Ratio:	7.7
Entrenchment Ratio:	5.9
Bank Height Ratio:	1.0

Stream Type: E5

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River Basin:	Catawba
Watershed:	Beaver Creek
XS ID:	X-7 FTH
Drainage Area (sq. mi.)	13.9
Date:	4/28/2016
Field Crew:	E. Toler, C. Campbell, R. Lepsic

Section 7 - Riffle

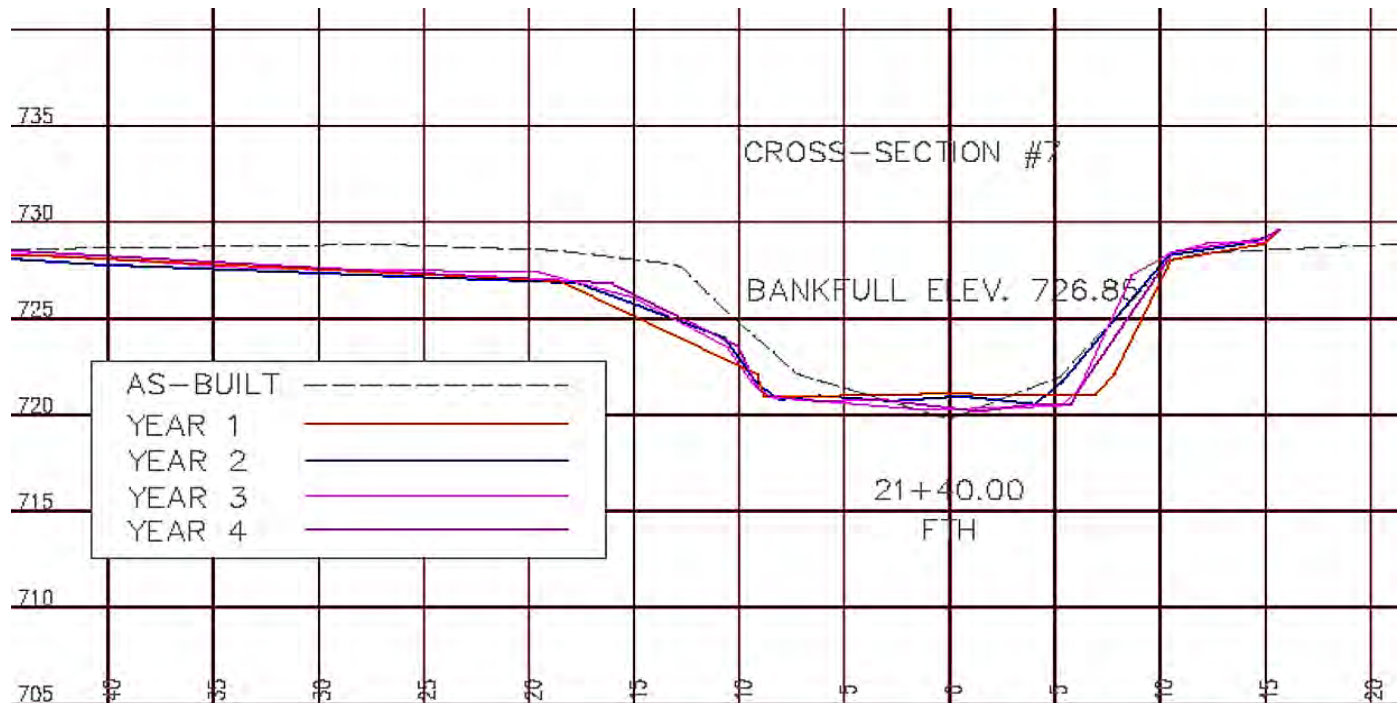


Northing	Easting	Elevation
767178.603	1475524.18	727.974
767182.182	1475522	727.319
767186.274	1475520.34	720.282
767186.72	1475520.21	719.353
767188.748	1475519.43	719.345
767190.222	1475517.79	719.036
767194.345	1475515.78	719.629
767196.731	1475514.05	719.563
767198.58	1475512.54	719.808
767199.049	1475512.17	720.304
767199.702	1475511.58	722.422
767204.762	1475508.26	725.696
767217.13	1475501.3	726.488
767230.191	1475493.85	727.424
767245.862	1475484.13	727.508
767256.12	1475477.76	727.07
767262.273	1475474.86	726.914

SUMMARY DATA	
Bankfull Elevation:	726.85
Bankfull Cross-Sectional Area:	118.7
Bankfull Width:	25.7
Floodprone Area Elevation:	733.55
Floodprone Width:	200+
Max Depth at Bankfull	6.7
Mean Depth at Bankfull	4.6
W/D Ratio	5.6
Entrenchment Ratio:	7.8
Bank Height Ratio:	1.0

Stream Type: E5

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River Basin:	Catawba
Watershed:	Beaver Creek
XS ID:	X-8 FTH
Drainage Area (sq. mi.)	26.0
Date:	4/28/2016
Field Crew:	E. Toler, C. Campbell, R. Lepsic

Section 8 - Riffle

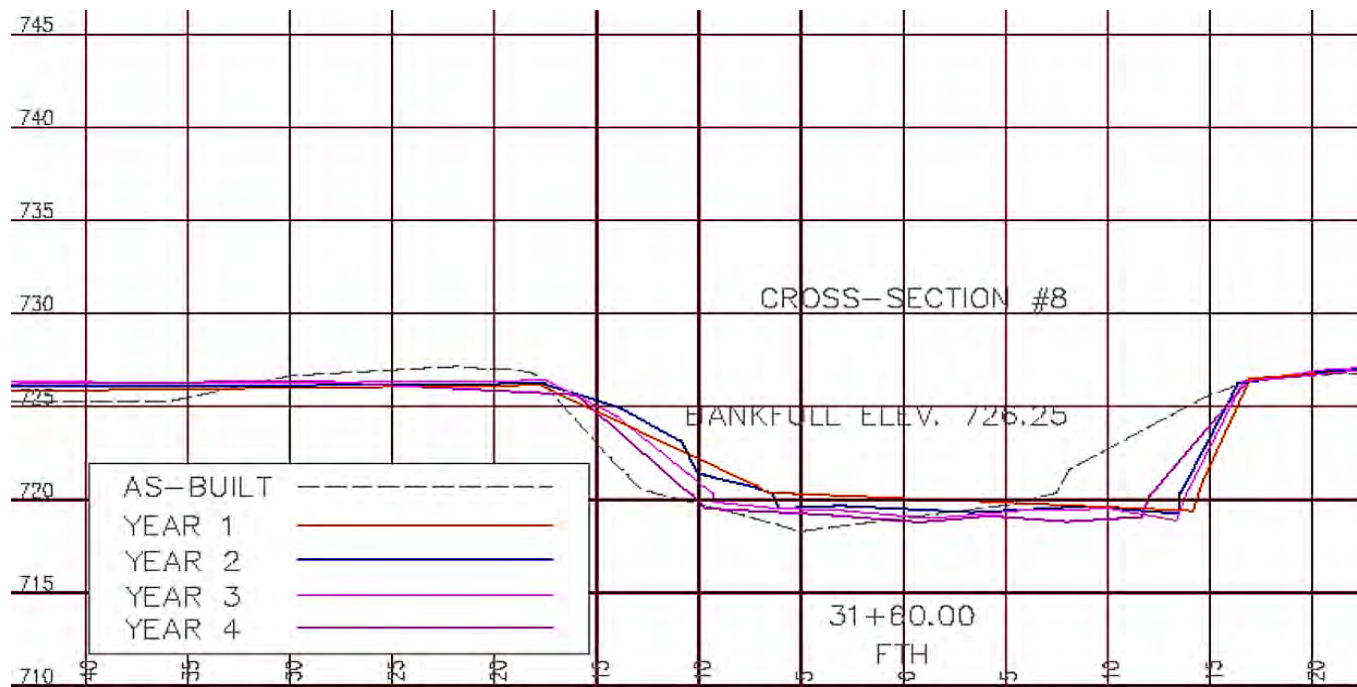


Northing	Easting	Elevation
767560.038	1476433.82	726.661
767566.988	1476431.99	725.598
767570.673	1476435.03	719.442
767571.016	1476435.2	718.307
767574.627	1476434.7	718.059
767578.103	1476433.35	718.352
767578.202	1476433.33	718.352
767581.307	1476432.01	718.02
767585.968	1476431.06	718.432
767591.408	1476429.46	718.765
767592.032	1476429.15	719.479
767597.315	1476427.21	724.867
767609.385	1476423.14	725.588
767622.938	1476419.4	725.466
767640.635	1476415.01	725.215
767656.255	1476409.73	724.734
767661.03	1476408.06	725.034

SUMMARY DATA	
Bankfull Elevation:	726.25
Bankfull Cross-Sectional Ar	172.4
Bankfull Width:	32.2
Floodprone Area Elevation:	733.05
Floodprone Width:	200+
Max Depth at Bankfull	6.8
Mean Depth at Bankfull	5.4
W/D Ratio	6.0
Entrenchment Ratio:	6.2
Bank Height Ratio:	1.0

Stream Type: E5

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River Basin:	Catawba
Watershed:	Beaver Creek
XS ID:	X-9 FTH
Drainage Area (sq. mi.)	26.0
Date:	4/28/2016
Field Crew:	E. Toler, C. Campbell, R. Lepsic

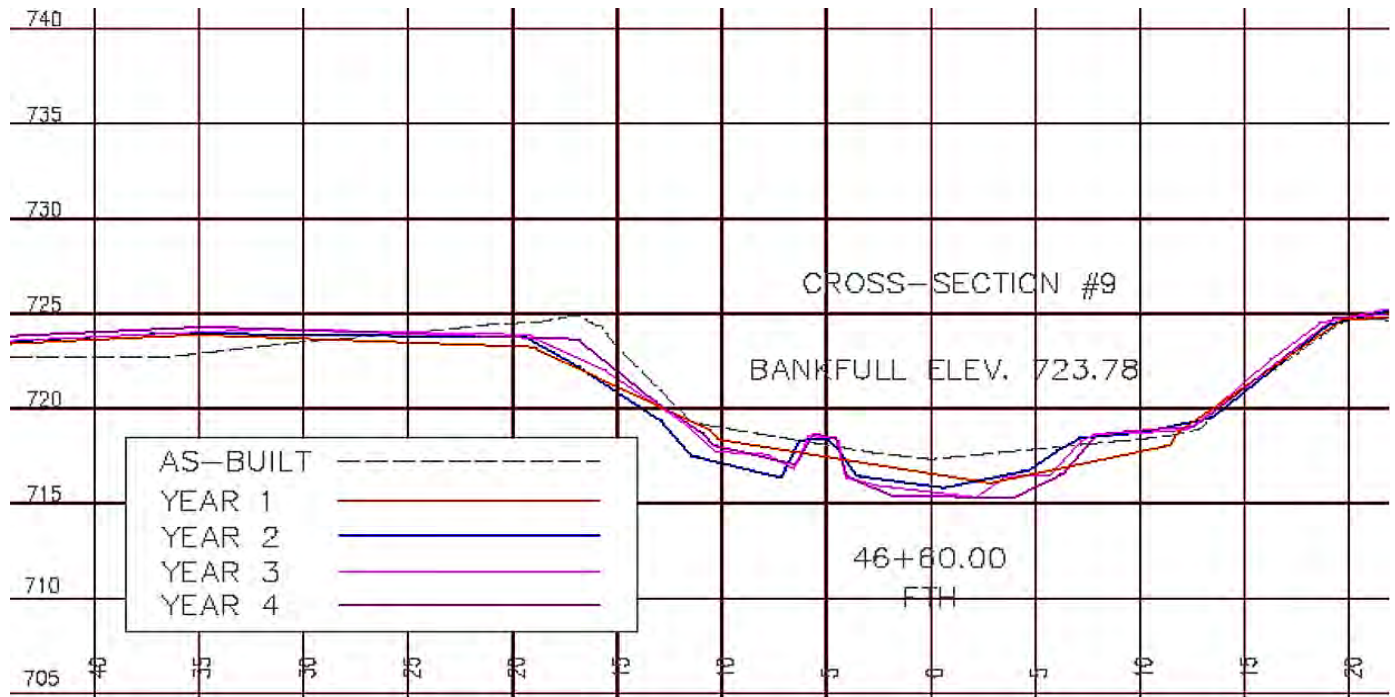
Section 9 - Pool



Northing	Easting	Elevation
767645.114	1477906.04	724.222
767650.244	1477905.86	723.805
767657.004	1477905.23	718.061
767658.5	1477905.44	717.976
767661.396	1477905.39	717.689
767661.605	1477905.32	717.636
767663.17	1477905.39	715.604
767665.577	1477905.13	714.33
767670.502	1477908.16	714.462
767672.563	1477907.57	715.506
767673.041	1477907.46	717.488
767674.03	1477907.08	717.71
767673.271	1477907.23	717.513
767674.875	1477907.27	716.109
767678.709	1477906.95	717.081
767679.21	1477907.2	717.747
767681.444	1477907.23	719.39
767685.198	1477907.24	722.694
767702.941	1477906.7	723.344
767719.91	1477906.15	722.447
767730.882	1477906.52	721.947
767734.826	1477906.73	721.957

SUMMARY DATA	
Bankfull Elevation:	723.78
Bankfull Cross-Sectional Area:	183.2
Bankfull Width:	34.9
Floodprone Area Elevation:	732.18
Floodprone Width:	200+
Max Depth at Bankfull:	8.4
Mean Depth at Bankfull:	5.2
W/D Ratio:	6.7
Entrenchment Ratio:	5.7
Bank Height Ratio:	1.0

Stream Type: E5



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River Basin:	Catawba
Watershed:	Beaver Creek
XS ID:	X-10 FTH
Drainage Area (sq. mi.)	26.0
Date:	4/28/2016
Field Crew:	E. Toler, C. Campbell, R. Lepsic

Section 10 - Riffle

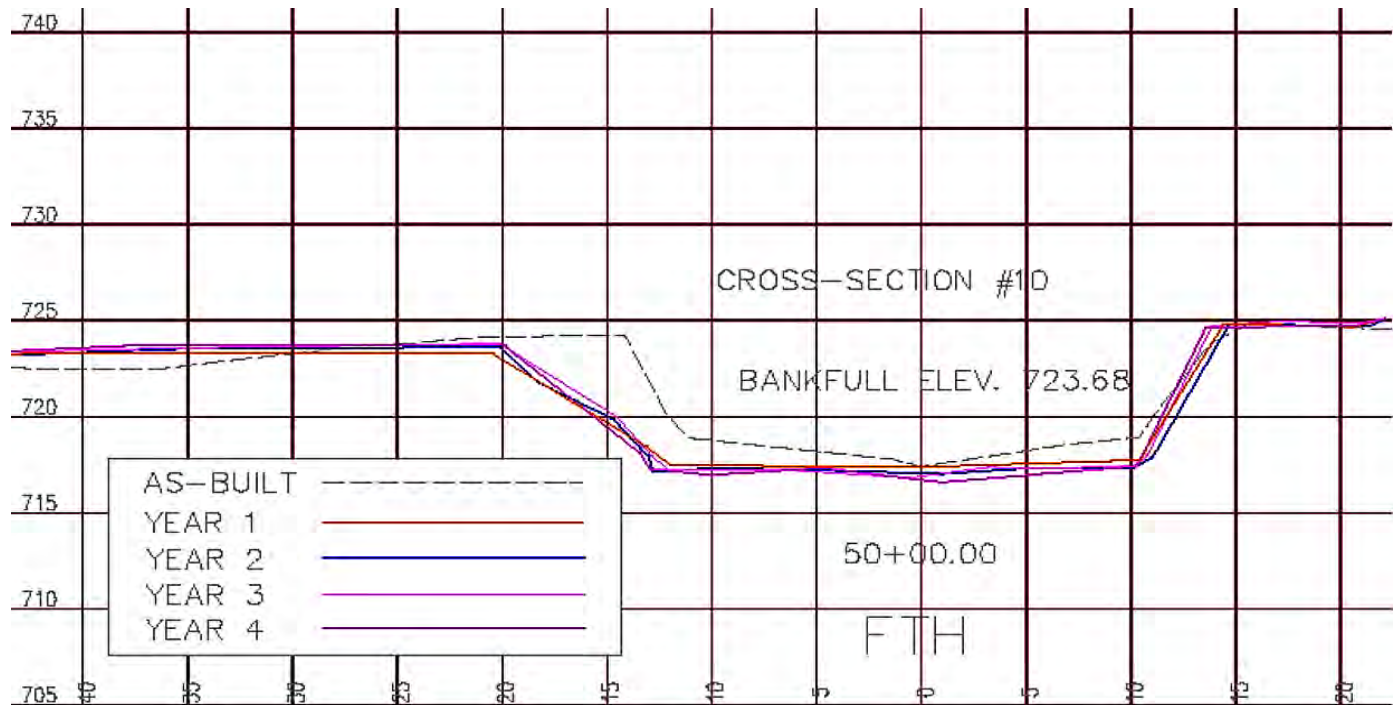


Northing	Easting	Elevation
767715.446	1478250.83	723.953
767722.149	1478248.85	723.902
767724.603	1478247.13	717.349
767724.974	1478247.03	716.661
767729.183	1478246.44	716.286
767734.053	1478245.54	715.834
767739.493	1478243.94	716.583
767744.705	1478242.61	716.218
767747.389	1478241.59	716.532
767747.615	1478242.01	717.363
767754.117	1478242.46	722.998
767771.823	1478238.8	722.924
767789.6	1478235.12	722.002
767804.043	1478232.49	721.58

SUMMARY DATA	
Bankfull Elevation:	723.68
Bankfull Cross-Sectional Area:	186
Bankfull Width:	33.1
Floodprone Area Elevation:	730.88
Floodprone Width:	200+
Max Depth at Bankfull:	7.2
Mean Depth at Bankfull:	5.6
W/D Ratio:	5.9
Entrenchment Ratio:	6.0
Bank Height Ratio:	1.0

Stream Type: E5

The discrepancies between the as-built cross sections and the following year's cross sections are the result of the as-built cross sections being generated from the surface contours created from the as-built field survey, which was not surveyed by ARCADIS staff. The annual monitoring surveys of the channel were generated using field surveys and accurately represent actual field conditions.



River Basin:	Catawba
Watershed:	Beaver Creek
XS ID:	X-11 FTH
Drainage Area (sq. mi.)	26.0
Date:	4/28/2016
Field Crew:	E. Toler, C. Campbell, R. Lepsic

Section 11 - Riffle

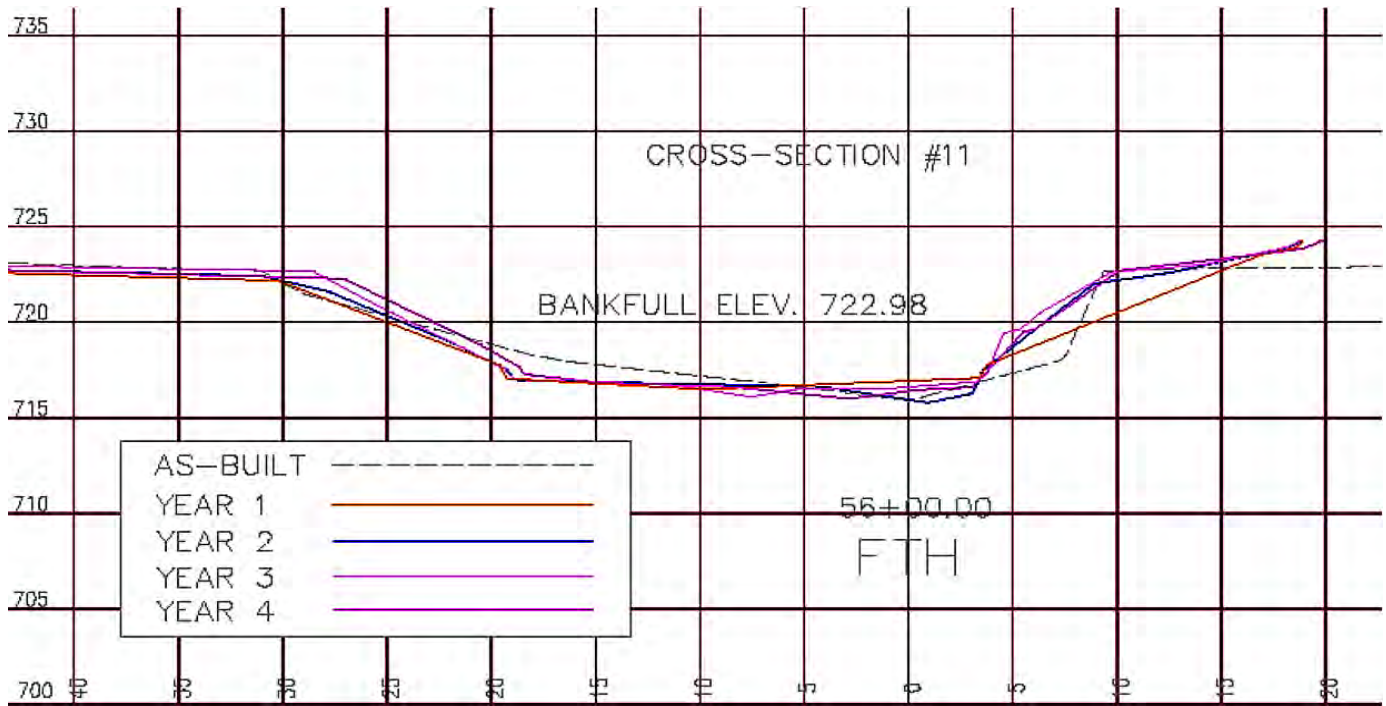


Northing	Easting	Elevation
767829.713	1478833.7	722.909
767833.356	1478830.47	722.252
767835.57	1478827.27	721.772
767838.056	1478824.03	718.692
767838.216	1478823.51	718.553
767839.063	1478822.36	716.857
767840.047	1478822.5	715.669
767842.224	1478821.19	715.54
767845.311	1478819.81	715.08
767850.073	1478816.77	715.704
767854.826	1478812.51	715.928
767857.555	1478810.42	716.333
767857.854	1478810.63	716.795
767859.095	1478809.21	717.947
767863.24	1478804.26	721.352
767876.765	1478792.98	721.831
767885.835	1478783.47	722.188
767894.11	1478775.92	722.101
767898.335	1478772.13	721.859

SUMMARY DATA	
Bankfull Elevation:	722.98
Bankfull Cross-Sectional Area:	158.7
Bankfull Width:	36.6
Floodprone Area Elevation:	729.28
Floodprone Width:	200+
Max Depth at Bankfull:	6.3
Mean Depth at Bankfull:	4.3
W/D Ratio:	8.5
Entrenchment Ratio:	5.5
Bank Height Ratio:	1.0

Stream Type: E5

The discrepancies between the as-built cross sections and the following year's cross sections are the result of the as-built cross sections being generated from the surface contours created from the as-built field survey, which was not surveyed by ARCADIS staff. The annual monitoring surveys of the channel were generated using field surveys and accurately represent actual field conditions.



River Basin:	Catawba
Watershed:	Beaver Creek
XS ID:	X-12 FTH
Drainage Area (sq. mi.)	26.0
Date:	4/28/2016
Field Crew:	E. Toler, C. Campbell, R. Lepsic

Section 12 - Pool

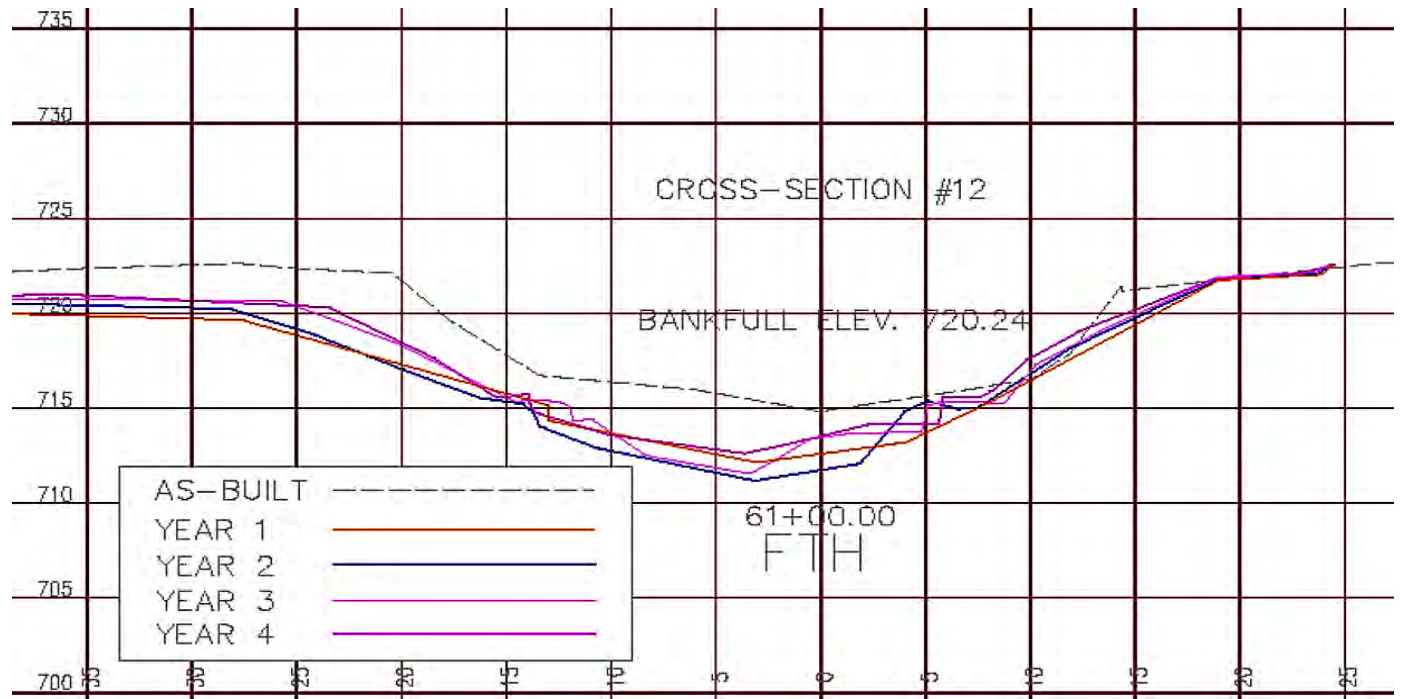


Northing	Easting	Elevation
767980.178	1479276.86	722.64
767984.356	1479276.41	722.338
767990.706	1479276.31	719.637
767993.183	1479275.47	718.08
767994.813	1479275.07	716.417
767995.421	1479275.07	716.085
767996.898	1479274.28	716.144
767997.093	1479274.41	714.702
768000.424	1479273.79	714.655
768003.267	1479272.69	713.82
768005.994	1479272.02	713.14
768012.436	1479270.98	714.125
768015.543	1479269.49	715.289
768015.536	1479269.19	715.784
768015.559	1479269.23	716.271
768016.981	1479268.94	716.066
768019.917	1479267.96	718.185
768024.554	1479266.14	720.836
768036.219	1479261.45	721.512
768051.587	1479254.96	721.126
768068.117	1479248.35	720.479
768084.67	1479240.2	720.446
768094.865	1479236.54	720.538

SUMMARY DATA	
Bankfull Elevation:	720.24
Bankfull Cross-Sectional Area:	181.2
Bankfull Width:	38.7
Floodprone Area Elevation:	727.94
Floodprone Width:	200+
Max Depth at Bankfull:	7.7
Mean Depth at Bankfull:	4.7
W/D Ratio:	8.2
Entrenchment Ratio:	5.2
Bank Height Ratio:	1.0

Stream Type: E5

The discrepancies between the as-built cross sections and the following year's cross sections are the result of the as-built cross sections being generated from the surface contours created from the as-built field survey, which was not surveyed by ARCADIS staff. The annual monitoring surveys of the channel were generated using field surveys and accurately represent actual field conditions.



River Basin:	Catawba
Watershed:	Beaver Creek
XS ID:	X-13 FTH
Drainage Area (sq. mi.)	26.0
Date:	4/28/2016
Field Crew:	E. Toler, C. Campbell, R. Lepsic

Section 13 - Pool



Northing	Easting	Elevation
768795.655	1480319.7	720.096
768798.317	1480316.95	719.655
768802.321	1480312.34	714.494
768802.41	1480311.51	713.678
768804.469	1480308.94	713.34
768806.681	1480306.56	712.711
768812.774	1480301.76	713.388
768817.28	1480296.72	713.564
768819.968	1480293.24	713.61
768820.163	1480292.96	714.468
768825.159	1480289.39	719.412
768833.917	1480280.27	719.869
768845.377	1480269.54	719.194
768856.125	1480257.05	717.9
768865.464	1480248.14	717.592

SUMMARY DATA	
Bankfull Elevation:	719.53
Bankfull Cross-Sectional Area:	191.1
Bankfull Width:	38.6
Floodprone Area Elevation:	726.23
Floodprone Width:	200+
Max Depth at Bankfull:	6.7
Mean Depth at Bankfull:	4.9
W/D Ratio:	7.9
Entrenchment Ratio:	5.2
Bank Height Ratio:	1.0

Stream Type: E5

The discrepancies between the as-built cross sections and the following year's cross sections are the result of the as-built cross sections being generated from the surface contours created from the as-built field survey, which was not surveyed by ARCADIS staff. The annual monitoring surveys of the channel were generated using field surveys and accurately represent actual field conditions.

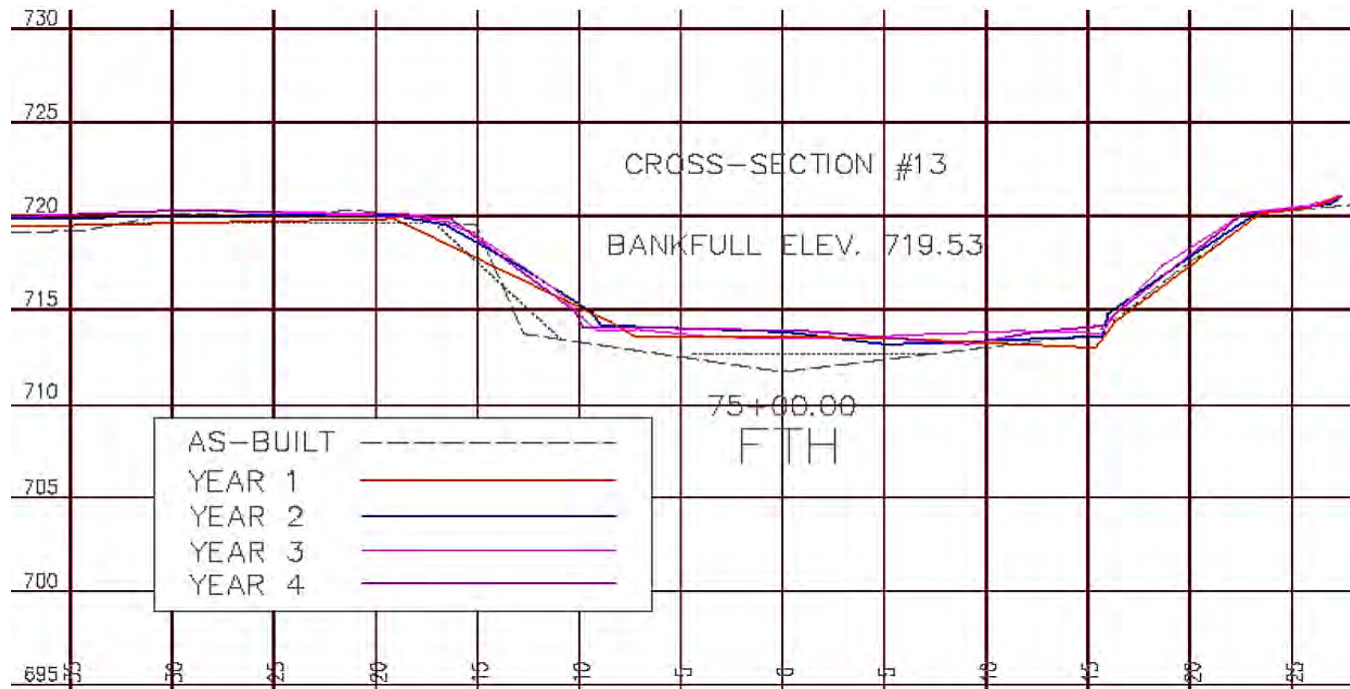


Exhibit Table 10a. Baseline Stream Data Summary
Five Mile Branch Stream Restoration, DMS IMS ID# 92185 Segment/Reach: Reach 1 Beaver Creek 5,794.1 feet

Parameter	Gauge ³	Regional Curve	Pre-Existing Condition							References Reach(es) Data ¹						Design			As-Built / Baseline ²					
			Equation	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Max	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle																								
Bankfull Width (ft)	51.0	41.9*	20.2	26.7	26.3	35.2	4.3	48	N/A	N/A	N/A	N/A	N/A	20.7	27.6	38.8	24.1	29.5	26.3	38.1	7.5	3		
Floodprone Width (ft)			100.0	180.0	-	250.0	-	-	N/A	N/A	N/A	N/A	N/A	100.0	180.0	250.0	-	>200	-	-	0.0	3		
Bankfull Mean Depth (ft)	2.7	2.2*	3.3	4.5	4.5	5.9	0.5	48	N/A	N/A	N/A	N/A	N/A	3.3	4.2	5.0	3.5	4.2	4.4	4.7	0.6	3		
Bankfull Max Depth (ft)	3.3		5.0	6.9	6.9	8.1	0.7	48	N/A	N/A	N/A	N/A	N/A	4.6	5.9	7.2	6.4	6.8	7.0	7.1	4.0	3		
Bankfull Cross Sectional Area (ft ²)	139.3	92.9**	79.7	119.4	116.9	176.0	22.9	48	N/A	N/A	N/A	N/A	N/A	75.0	115.5	163.2	105.4	121.1	124.5	133.4	14.3	3		
Width/Depth Ratio	18.8		4.4	6.0	5.9	9.1	1.2	48	N/A	N/A	N/A	N/A	N/A	5.1	6.6	9.5	5.5	7.3	5.6	10.9	3.1	3		
Entrenchment Ratio	1.4		4.6	8.2	-	10.9	-	-	N/A	N/A	N/A	N/A	N/A	3.6	6.4	9.0	5.2	7.0	7.6	8.3	1.6	3		
Bank Height Ratio	1.4		1.0	1.2	-	1.5	-	-	N/A	N/A	N/A	N/A	N/A	-	1.0	-	-	1.0	-	-	0.0	3		
d50 (mm)			-	0.2	-	-	-	-	N/A	N/A	N/A	N/A	N/A											
Profile																								
Riffle Length (ft)			-	-	-	-	-	-	N/A	N/A	N/A	N/A	N/A	-	-	-	-	-	-	-	-	-		
Riffle Slope (ft)			0.0	0.0020	0.0014	0.0094	0.003	26	N/A	N/A	N/A	N/A	N/A	0.0	0.0020	0.0094	-	-	-	-	-	-		
Pool Length (ft)			5.5	25.7	19.1	161.9	27.5	34	N/A	N/A	N/A	N/A	N/A	5.5	25.7	161.9	-	-	-	-	-	-		
Pool Max Depth (ft)			4.7	6.7	6.6	7.8	0.9	13	N/A	N/A	N/A	N/A	N/A	4.7	6.7	7.8	4.3	4.3	4.3	4.3	0	2		
Pool Spacing (ft)			20.6	176.7	19.1	748.9	27.5	34	N/A	N/A	N/A	N/A	N/A	20.6	176.7	748.9	-	-	-	-	-	-		
Pool Cross Sectional Area (ft ²)			80.9	100.6	-	119.8	-	-	N/A	N/A	N/A	N/A	N/A	80.9	100.6	119.8	74.4	40.4	40.4	52.1	16.5	2		
Pattern																								
Channel Beltwidth (ft)			47.0	235.0	-	443.0	-	-	N/A	N/A	N/A	N/A	N/A	47.0	235.0	443.0	47.0	235.0	-	443.0	-	-		
Radius of Curvature (ft)			60.0	3527.0	-	14000.0	-	-	N/A	N/A	N/A	N/A	N/A	60.0	3527.0	14000.0	60.0	3527.0	-	14000.0	-	-		
Rc: Bankfull Width (ft/ft)			2.7	161.8	-	642.2	-	-	N/A	N/A	N/A	N/A	N/A	2.2	127.8	507.2	2.2	127.8	-	507.2	-	-		
Meander Wavelength (ft)			575.0	1380.0	-	2132.0	-	-	N/A	N/A	N/A	N/A	N/A	575.0	1380.0	2132.0	575.0	1380.0	-	2132.0	-	-		
Meander Width Ratio			26.3	63.3	-	97.8	-	-	N/A	N/A	N/A	N/A	N/A	20.8	50.0	77.2	20.8	50.0	-	77.2	-	-		
Substrate, bed and transport parameters																								
Ri% / Ru% / P% / G% / S%																								
SC% / Sa% / G.% / C% / B% / Be%																								
d16 / d35 / d50 / d84 / d95 / di ^p / di ^{sp} (mm)						> 2.0 mm																		
Reach Shear Stress (competency) lb/ft ²						0.43									0.35					0.31				
Max part size (mm) mobilized at bankfull						33.0									24.0					22.7				
Stream power (transport capacity) W/m ²						1.58									1.3					1.29				
Additional Reach Parameters																								
Drainage Area (SM)						10.76																		
Impervious cover estimate (%)						10-20																		
Rosgen Classification		B				E5									E5					E5				
Bankfull Velocity (fps)		3.9	4.1***			3.8									3.7					3.6				
Bankfull Discharge (cfs)		539.9	379.2**			453.7																		
Valley length (ft)						-																		
Channel Thalweg length (ft)						-																		
Sinuosity (ft)						1.07									1.07					1.07				
Water Surface Slope (Channel) (ft/ft)		0.0032				0.0016									0.0016					0.0014				
BF slope (ft/ft)		-				-									-					-				
Bankfull Floodplain Area (acres)						-									-					-				
Additional Reach Parameters																								
Proportion over wide (%)						-																		
Entrenchment Class (ER Range)						-																		
Incision Class (BHR Range)						-																		
BEHI VL% / L% / M% / H% / VH% / E%						-																		
Channel Stability or Habitat Metric						-																		
Biological or Other						-																		

* NC Rural Mountain and Piedmont Regional Curve, Surry County NRCS, Draft 1/27/2010

** NC Rural Mountain and Piedmont Regional Curve, Surry County NRCS, Draft 3/16/2006

***Bankfull Discharge/Bankfull Cross Sectional Area

1 A singular reference stream was not used to design the Enhancement Level II project.

2 As built profile parameters not calculated for Enhancement Level II

Exhibit Table 10b. Baseline Stream Data Summary
Five Mile Branch Stream Restoration, DMS IMS ID# 92185 Segment/Reach: Reach 2 Fifth Creek upstream of Beaver Creek 1,586.4 feet

Parameter	Gauge ³	Regional Curve	Pre-Existing Condition							References Reach(es) Data ¹					Design			As-Built / Baseline ²					
			Equation	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Max	Min	Mean	Med	Max	SD
Dimension and Substrate - Riffle																							
Bankfull Width (ft)	51.0	46.0*	23.9	30.7	30.3	40.3	4.8	11	N/A	N/A	N/A	N/A	N/A	N/A	25.1	29.0	33.0	-	24.2	-	-	-	1
Floodprone Width (ft)			-	>200.0	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	-	>200.0	-	-	>200.0	-	-	-	1
Bankfull Mean Depth (ft)	2.7	2.3*	3.8	4.2	4.2	5.0	0.4	11	N/A	N/A	N/A	N/A	N/A	N/A	3.8	4.1	4.6	-	4.3	-	-	-	1
Bankfull Max Depth (ft)	3.3		6.7	7.8	7.9	9.1	0.6	11	N/A	N/A	N/A	N/A	N/A	N/A	6.4	7.4	8.3	-	7.7	-	-	-	1
Bankfull Cross Sectional Area (ft ²)	139.3	112.5**	94.0	130.1	128.2	176.4	4.8	11	N/A	N/A	N/A	N/A	N/A	N/A	104.5	119.7	144.7	-	104.2	-	-	-	1
Width/Depth Ratio	18.8		5.3	7.0	7.1	8.4	1.0	11	N/A	N/A	N/A	N/A	N/A	N/A	5.5	7.0	8.6	-	5.6	-	-	-	1
Entrenchment Ratio	1.4		-	6.5	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	-	6.5	-	-	8.3	-	-	-	1
Bank Height Ratio	1.4		1.1	1.1	-	1.2	-	-	N/A	N/A	N/A	N/A	N/A	N/A	1.0	1.0	1.0	-	1.0	-	-	-	1
d50 (mm)			-	0.2	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A									
Profile																							
Riffle Length (ft)			-	-	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	-	-	-	-	-	-	-	-	-
Riffle Slope (ft)			0.0009	0.0010	0.0010	0.0011	0.0001	2	N/A	N/A	N/A	N/A	N/A	N/A	0.0009	0.0010	0.0011	-	-	-	-	-	-
Pool Length (ft)			-	-	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	81.2	112.8	144.3	-	-	-	-	-	-
Pool Max Depth (ft)			-	-	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	7.5	7.8	8.0	-	7.2	-	-	-	1
Pool Spacing (ft)			-	-	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	272.0	297.0	322.0	-	-	-	-	-	-
Pool Cross Sectional Area (ft ²)			-	-	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	104.5	119.7	144.7	-	136.3	-	-	-	1
Pattern																							
Channel Beltwidth (ft)			48.0	639.0	-	1566.0	-	-	N/A	N/A	N/A	N/A	N/A	N/A	48.0	639.0	1566.0	48.0	639.0	-	1566.0	-	-
Radius of Curvature (ft)			1275.0	2693.0	-	3800.0	-	-	N/A	N/A	N/A	N/A	N/A	N/A	1275.0	2693.0	3800.0	1275.0	2693.0	-	3800.0	-	-
Rc: Bankfull Width (ft/ft)			49.6	104.8	-	147.8	-	-	N/A	N/A	N/A	N/A	N/A	N/A	49.6	104.8	147.8	49.6	104.8	-	147.8	-	-
Meander Wavelength (ft)			4464.0	4618.0	-	4771.0	-	-	N/A	N/A	N/A	N/A	N/A	N/A	4464.0	4618.0	4771.0	4464.0	4618.0	-	4771.0	-	-
Meander Width Ratio			173.7	179.7	-	185.6	-	-	N/A	N/A	N/A	N/A	N/A	N/A	173.7	179.7	185.6	173.7	179.7	-	185.6	-	-
Substrate, bed and transport parameters																							
Ri% / Ru% / P% / G% / S%																		-	-	-	-	-	-
SC% / Sa% / G.% / C% / B% / Be%																							
d16 / d35 / d50 / d84 / d95 / di ^p / di ^{sp} (mm)																							
Reach Shear Stress (competency) lb/ft ²																							
Max part size (mm) mobilized at bankfull																							
Stream power (transport capacity) W/m ²																							
Additional Reach Parameters																							
Drainage Area (SM)																							
Impervious cover estimate (%)																							
Rosgen Classification	B																						
Bankfull Velocity (fps)	3.9	4.1***																					
Bankfull Discharge (cfs)	539.9	466.8**																					
Valley length (ft)																							
Channel Thalweg length (ft)																							
Sinuosity (ft)																							
Water Surface Slope (Channel) (ft/ft)	0.0032																						
BF slope (ft/ft)	-																						
Bankfull Floodplain Area (acres)																							
Additional Reach Parameters																							
Proportion over wide (%)																							
Entrenchment Class (ER Range)																							
Incision Class (BHR Range)																							
BEHI VL% / L% / M% / H% / VH% / E%																							
Channel Stability or Habitat Metric																							
Biological or Other																							

* NC Rural Mountain and Piedmont Regional Curve, Surry County NRCS, Draft 1/27/2010

** NC Rural Mountain and Piedmont Regional Curve, Surry County NRCS, Draft 3/16/2006

***Bankfull Discharge/Bankfull Cross Sectional Area

1 A singular reference stream was not used to design the Enhancement Level II project.

2 As built profile parameters not calculated for Enhancement Level II

Exhibit Table 10c. Baseline Stream Data Summary
Five Mile Branch Stream Restoration, DMS IMS ID# 92185 Segment/Reach: Reach 3 Fifth Creek downstream of Beaver Creek 5,215.2 feet

Parameter	Gauge ³	Regional Curve	Pre-Existing Condition						References Reach(es) Data ¹						Design			As-Built / Baseline ²							
			Equation			Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Min	Mean	Med	Max	SD
Dimension and Substrate - Riffle																									
Bankfull Width (ft)	51	58*	27.9	35.6	34.7	44.1	3.9	27	N/A	N/A	N/A	N/A	N/A	N/A	26.3	33.4	40.8	28.4	34.1	32.2	41.7	6.9	3		
Floodprone Width (ft)			250	316.7	-	400.0	-	-	N/A	N/A	N/A	N/A	N/A	N/A	-	>200.0	-	-	>200.0	-	-	-	-	-	
Bankfull Mean Depth (ft)	2.7	2.8*	4.5	5.3	5.1	6.8	0.5	27	N/A	N/A	N/A	N/A	N/A	N/A	4.0	4.7	5.7	4.0	4.3	4.1	4.7	0.4	3		
Bankfull Max Depth (ft)	3.3		5.8	7.6	7.2	9.3	0.7	27	N/A	N/A	N/A	N/A	N/A	N/A	5.1	6.5	7.8	5.6	6.3	6.3	7.1	0.8	3		
Bankfull Cross Sectional Area (ft ²)	139.3	179.2**	192.6	202.5	175.5	222.2	22	27	N/A	N/A	N/A	N/A	N/A	N/A	120.3	157.8	202.7	115.3	143.5	150.2	165.2	25.6	3		
Width/Depth Ratio	18.8		4.7	6.6	6.8	8.2	1.0	25	N/A	N/A	N/A	N/A	N/A	N/A	5.2	7.1	8.8	6.9	8.1	6.9	10.4	2	3		
Entrenchment Ratio	1.4		7.1	8.6	-	10.8	-	-	N/A	N/A	N/A	N/A	N/A	N/A	-	>6.5	-	4.8	6.0	6.2	7.0	1.1	3		
Bank Height Ratio	1.4		1.3	1.5	-	1.7	-	-	N/A	N/A	N/A	N/A	N/A	N/A	-	1.0	-	1.0	1.0	1.0	1.0	0	3		
d50 (mm)			-	0.2	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A											
Profile																									
Riffle Length (ft)			-	-	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	-	-	-	-	-	-	-	-	-	-	-
Riffle Slope (ft)			0.0	0.0017	0.002	0.004	0	18	N/A	N/A	N/A	N/A	N/A	N/A	0.0022	0.0026	0.003	-	-	-	-	-	-	-	-
Pool Length (ft)			15.2	30	27.5	69.8	15	19	N/A	N/A	N/A	N/A	N/A	N/A	81.2	112.8	144.3	-	-	-	-	-	-	-	-
Pool Max Depth (ft)			8	9.4	9.5	11.4	1.1	15	N/A	N/A	N/A	N/A	N/A	N/A	7.5	7.8	8.0	6.1	6.4	6.2	7.0	0.5	3		
Pool Spacing (ft)			62.3	256.3	150.6	1206	298	18	N/A	N/A	N/A	N/A	N/A	N/A	272.0	297.0	322.0	-	-	-	-	-	-	-	-
Pool Cross Sectional Area (ft ²)			-	199.0	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	120.3	157.8	202.7	148.3	169.9	152.2	209.2	34.1	3		
Pattern																									
Channel Beltwidth (ft)			48	639	-	1556	-	-	N/A	N/A	N/A	N/A	N/A	N/A	48	639	1556	48	639	-	1556	-	-	-	-
Radius of Curvature (ft)			1275	2693	-	3800	-	-	N/A	N/A	N/A	N/A	N/A	N/A	1275	2693	3800	1275	2693	-	3800	-	-	-	-
Rc: Bankfull Width (ft/ft)			34.7	73.4	-	103.5	-	-	N/A	N/A	N/A	N/A	N/A	N/A	49.6	73.4	113.8	38.2	80.6	-	113.8	-	-	-	-
Meander Wavelength (ft)			4464	4618	-	4771	-	-	N/A	N/A	N/A	N/A	N/A	N/A	4464	4618	4771	4464	4618	-	4771	-	-	-	-
Meander Width Ratio			121.6	125.8	-	130	-	-	N/A	N/A	N/A	N/A	N/A	N/A	173.7	125.8	46.9	1.4	19.1	-	46.9	-	-	-	-
Substrate, bed and transport parameters																									
Ri% / Ru% / P% / G% / S%																									
SC% / Sa% / G.% / C% / B% / Be%																									
d16 / d35 / d50 / d84 / d95 / d ₁₀ ⁹⁵ (mm)																									
Reach Shear Stress (competency) lb/ft ²																									
Max part size (mm) mobilized at bankfull																									
Stream power (transport capacity) W/m ²																									
Additional Reach Parameters																									
Drainage Area (SM)																									
Impervious cover estimate (%)																									
Rosgen Classification	B																								
Bankfull Velocity (fps)	3.9	4.3***																							
Bankfull Discharge (cfs)	539.9	772.1**																							
Valley length (ft)																									
Channel Thalweg length (ft)																									
Sinuosity (ft)																									
Additional Reach Parameters																									
BF slope (ft/ft)	-																								
Bankfull Floodplain Area (acres)																									
Proportion over wide (%)																									
Entrenchment Class (ER Range)																									
Incision Class (BHR Range)																									
BEHI VL% / L% / M% / H% / VH% / E%																									
Channel Stability or Habitat Metric																									
Biological or Other																									

* NC Rural Mountain and Piedmont Regional Curve, Surry County NRCS, Draft 1/27/2010

** NC Rural Mountain and Piedmont Regional Curve, Surry County NRCS, Draft 3/16/2006

***Bankfull Discharge/Bankfull Cross Sectional Area

1 A singular reference stream was not used to design the Enhancement Level II project.

2 As built profile parameters not calculated for Enhancement Level II

Exhibit Table 11b. Morphology and Hydraulic Monitoring Summary (Dimensional Parameters -- Cross Section)
Five Mile Branch Stream Restoration, DMS IMS ID# 92185 Segment/Reach: Reach 2 Fifth Creek upstream of Beaver Creek 1,586.4

Dimension and substrate	Cross Section 6 (Pool)							Cross Section 7 (Riffle)							Cross Section # (##)							Cross Section # (##)							Cross Section # (##)						
	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation																																			
Bankfull Width (ft)	34.2	32.3	34.1	33.4	33.8			24.2	28.5	26.9	26.1	25.7																							
Floodprone Width (ft)	200.0	200.0	200.0	200.0	2.0			200.0	200.0	200.0	200.0	200.0																							
Bankfull Mean Depth (ft)	4.0	4.6	4.3	4.4	4.4			4.3	4.5	4.2	4.6	4.6																							
Bankfull Max Depth (ft)	7.2	7.2	7.5	7.4	7.7			7.7	6.0	6.1	6.6	6.7																							
Bankfull Cross Sectional Area (ft ²)	136.3	147.6	146.2	145.3	149.6			104.2	127.2	112.4	119.1	118.7																							
Bankfull Width/Depth Ratio	8.6	7.0	8.0	7.6	7.7			5.6	6.3	6.4	5.7	5.6																							
Bankfull Entrenchment Ratio	5.8	6.2	5.9	6.0	5.9			8.3	7.0	7.4	7.7	7.8																							
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0	1.0																							
Based on current/developing bankfull feature																																			
Bankfull Width (ft)																																			
Floodprone Width (ft)																																			
Bankfull Mean Depth (ft)																																			
Bankfull Max Depth (ft)																																			
Bankfull Cross Sectional Area (ft ²)																																			
Bankfull Width/Depth Ratio																																			
Bankfull Entrenchment Ratio																																			
Bankfull Bank Height Ratio																																			
Cross Sectional Area between end pins (ft ²)		203	197	142	204				247	232	229	227																							
d50 (mm)	0.2							0.2																											
	Cross Section # (##)							Cross Section # (##)							Cross Section # (##)							Cross Section # (##)							Cross Section # (##)						
Based on fixed baseline bankfull elevation	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)																																			
Floodprone Width (ft)																																			
Bankfull Mean Depth (ft)																																			
Bankfull Max Depth (ft)																																			
Bankfull Cross Sectional Area (ft ²)																																			
Bankfull Width/Depth Ratio																																			
Bankfull Entrenchment Ratio																																			
Bankfull Bank Height Ratio																																			
Based on current/developing bankfull feature																																			
Bankfull Width (ft)																																			
Floodprone Width (ft)																																			
Bankfull Mean Depth (ft)																																			
Bankfull Max Depth (ft)																																			
Bankfull Cross Sectional Area (ft ²)																																			
Bankfull Width/Depth Ratio																																			
Bankfull Entrenchment Ratio																																			
Bankfull Bank Height Ratio																																			
Cross Sectional Area between end pins (ft ²)																																			
d50 (mm)																																			

Exhibit Table 11c. Morphology and Hydraulic Monitoring Summary (Dimensional Parameters -- Cross Section)
Five Mile Branch Stream Restoration, DMS IMS ID# 92185 Segment/Reach: Reach 3 Fifth Creek downstream of Beaver Creek 5,215.2

Dimension and substrate	Cross Section 8 (Riffle)							Cross Section 9 (Pool)							Cross Section 10 (Riffle)							Cross Section 11 (Riffle)							Cross Section 12 (Pool)						
	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Based on fixed baseline bankfull elevation																																			
Bankfull Width (ft)	32.2	34.5	34.0	33.7	32.2			33.7	36.8	37.6	36.8	34.9			28.4	34.0	34.1	33.3	33.1			41.7	34.9	38.2	38.1	36.6			36.6	43.0	44.1	40.3	38.7		
Floodprone Width (ft)	200.0	200.0	200.0	200.0	200.0			200.0	200.0	200.0	200.0	200.0			200.0	200.0	200.0	200.0	200.0			200.0	200.0	200.0	200.0	200.0			200.0	200.0	200.0	200.0	200.0		
Bankfull Mean Depth (ft)	4.7	4.9	5.1	5.6	5.4			4.4	4.5	5.0	5.0	5.2			4.1	4.8	5.3	5.3	5.6			4.0	4.9	4.1	4.5	4.3			4.2	4.3	4.9	4.7	4.7		
Bankfull Max Depth (ft)	7.1	6.8	6.9	7.3	6.8			6.1	7.2	7.9	7.4	8.4			5.6	5.9	6.7	6.9	7.2			6.3	5.7	7.2	6.5	6.3			6.2	7.5	9.1	8.7	7.7		
Bankfull Cross Sectional Area (ft ²)	150.2	170.2	174.5	188.1	172.4			148.3	166.8	189.8	185.2	183.2			115.3	162.8	182.2	177.7	186.0			165.1	170.7	155.9	172.9	158.7			152.2	183.2	216.6	190.5	181.2		
Bankfull Width/Depth Ratio	6.9	7.0	6.6	6.1	6.0			7.7	8.2	7.4	7.4	6.7			6.9	7.1	6.4	6.3	5.9			10.4	7.1	9.4	8.5	8.5			8.8	10.0	9.0	8.6	8.2		
Bankfull Entrenchment Ratio	6.2	5.8	5.9	5.9	6.2			5.9	5.4	5.3	5.4	5.7			7.0	5.9	5.9	6.0	6.0			4.8	5.7	5.2	5.2	5.5			5.5	4.7	4.5	5.0	5.2		
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0	1.0		
Based on current/developing bankfull feature																																			
Bankfull Width (ft)																																			
Floodprone Width (ft)																																			
Bankfull Mean Depth (ft)																																			
Bankfull Max Depth (ft)																																			
Bankfull Cross Sectional Area (ft ²)																																			
Bankfull Width/Depth Ratio																																			
Bankfull Entrenchment Ratio																																			
Bankfull Bank Height Ratio																																			
Cross Sectional Area between end pins (ft ²)		284	271	279	287				248	246	236	237				229	228	215	222				285	268	252	254				376	322	293.0	271		
d50 (mm)	0.2							0.2							0.2							0.2							0.2						
	Cross Section 13 (Pool)							Cross Section # (##)							Cross Section # (##)							Cross Section # (##)							Cross Section # (##)						
Based on fixed baseline bankfull elevation	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	40.1	42.1	38.9	38.0	38.6																														
Floodprone Width (ft)	200.0	200.0	200.0	200.0	200.0																														
Bankfull Mean Depth (ft)	5.2	4.9	4.6	4.7	4.9																														
Bankfull Max Depth (ft)	7.0	6.7	6.4	6.0	6.7																														
Bankfull Cross Sectional Area (ft ²)	209.2	206.4	180.3	176.9	191.1																														
Bankfull Width/Depth Ratio	7.7	8.6	8.4	8.1	7.9																														
Bankfull Entrenchment Ratio	5.0	4.8	5.1	5.3	5.2																														
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.0	1.0																														
Based on current/developing bankfull feature																																			
Bankfull Width (ft)																																			
Floodprone Width (ft)																																			
Bankfull Mean Depth (ft)																																			
Bankfull Max Depth (ft)																																			
Bankfull Cross Sectional Area (ft ²)																																			
Bankfull Width/Depth Ratio																																			
Bankfull Entrenchment Ratio																																			
Bankfull Bank Height Ratio																																			
Cross Sectional Area between end pins (ft ²)		246	240	238	239																														
d50 (mm)	0.2																																		

Exhibit Table 12a. Monitoring Data - Stream Reach Data Summary
Five Mile Branch Stream Restoration, DMS IMS ID# 92185 Segment/Reach: Reach 1 Beaver Creek 5,794.1 feet

Parameter	Baseline						MY-1						MY-2						MY-3						MY-4						MY-5					
	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n
Dimension and Substrate - Riffle only																																				
Bankfull Width (ft)	24.1	29.5	26.3	38.1	7.5	3	27.9	30.1	30.7	31.8	2.0	3	27.7	30.9	30.5	34.6	3.6	3	28.6	30.7	30.3	33.3	2.4	3	27.9	31.1	29.5	35.8	4.2	3						
Floodprone Width (ft)	200	200	200	200	0.0	3	200	200.0	200	200	0.0	3	200	200	200	200	0.0	3	200	200	200	200	0.0	3	200	200	200	200	0	3						
Bankfull Mean Depth (ft)	3.5	4.2	4.4	4.7	0.6	3	3.7	3.9	3.7	4.4	0.4	3	3.8	4.0	3.9	4.4	0.3	3	3.8	4.1	4.1	4.3	0.3	3	3.8	4.1	4.1	4.3	0.3	3						
¹ Bankfull Max Depth (ft)	6.4	6.8	7.0	7.1	4.0	3	5.2	5.5	5.5	5.9	0.4	3	5.1	5.9	6.3	6.4	0.7	3	5.6	6.1	6.3	6.4	0.4	3	6	6.3	6.2	6.6	0.3	3						
Bankfull Cross Sectional Area (ft ²)	105.4	121.1	124.5	133.4	14.3	3	115	118.7	117.4	123.7	4.5	3	103.9	124.2	134	134.8	17.6	3	108.9	124.7	130.1	135.1	13.9	3	119.5	124.6	119.9	134.4	8.5	3						
Width/Depth Ratio	5.5	7.3	5.6	10.9	3.1	3	6.3	7.7	8.3	8.6	1.3	3	6.9	7.7	7.4	8.9	1.0	3	7.0	7.5	7.5	8.1	0.6	3	6.5	7.7	7.2	9.4	1.5	3						
Entrenchment Ratio	5.2	7.0	7.6	8.3	1.6	3	6.3	6.7	6.5	7.2	0.5	3	5.8	6.5	6.6	7.2	0.7	3	6.0	6.5	6.6	7.0	0.5	3	5.6	6.5	6.8	7.2	0.8	3						
¹ Bank Height Ratio	1	1	1	1	0	3	1	1	1	1	0	3	1	1	1	1	0	3	1	1	1	1	0	3	1	1	1	1	0	3						
Profile																																				
Riffle Length (ft)																																				
Riffle Slope (ft/ft)																																				
Pool Length (ft)																																				
Pool Max depth (ft)																																				
Pool Spacing (ft)																																				
Pattern																																				
Channel Beltwidth (ft)																																				
Radius of Curvature (ft)																																				
Rc:Bankfull width (ft/ft)																																				
Meander Wavelength (ft)																																				
Meander Width Ratio																																				
Additional Reach Parameters																																				
Rosgen Classification	E5						E5						E5						E5						E5											
Channel Thalweg length (ft)	2,794						2,794						2,794						2794.1						2794.1											
Sinuosity (ft)																																				
Water Surface Slope (Channel) (ft/ft)																																				
BF slope (ft/ft)																																				
³ Ri% / Ru% / P% / G% / S%																																				
³ SC% / Sa% / G% / C% / B% / Be%																																				
³ d16 / d35 / d50 / d84 / d95 /																																				
² % of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Shaded cells indicate that these will typically not be filled in.
 1 = The distributions for these parameters can include information from both the cross-section surveys and the longitudinal profile.
 2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
 3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
 4. = Of value/needed only if the n exceeds 3

Exhibit Table 12b. Monitoring Data - Stream Reach Data Summary
Five Mile Branch Stream Restoration, DMS IMS ID# 92185 Segment/Reach: Reach 2 Fifth Creek upstream of Beaver Creek 1,586.4 feet

Parameter	Baseline						MY-1						MY-2						MY-3						MY-4						MY-5					
	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n
Dimension and Substrate - Riffle only																																				
Bankfull Width (ft)	-	24.2	-	-	-	1	-	28.5	-	-	-	1	-	26.9	-	-	-	1	-	26.1	-	-	-	1	-	25.7	-	-	-	1						
Floodprone Width (ft)	-	>200.0	-	-	-	1	-	200	-	-	-	1	-	200	-	-	-	1	-	200	-	-	-	1	-	200	-	-	-	1						
Bankfull Mean Depth (ft)	-	4.3	-	-	-	1	-	4.5	-	-	-	1	-	4.2	-	-	-	1	-	4.6	-	-	-	1	-	4.6	-	-	-	1						
¹ Bankfull Max Depth (ft)	-	7.7	-	-	-	1	-	6.0	-	-	-	1	-	6.1	-	-	-	1	-	6.6	-	-	-	1	-	6.7	-	-	-	1						
Bankfull Cross Sectional Area (ft ²)	-	104.2	-	-	-	1	-	127.2	-	-	-	1	-	112.4	-	-	-	1	-	119.1	-	-	-	1	-	118.7	-	-	-	1						
Width/Depth Ratio	-	5.6	-	-	-	1	-	6.3	-	-	-	1	-	6.4	-	-	-	1	-	5.7	-	-	-	1	-	5.6	-	-	-	1						
Entrenchment Ratio	-	8.3	-	-	-	1	-	7.0	-	-	-	1	-	7.4	-	-	-	1	-	7.7	-	-	-	1	-	7.8	-	-	-	1						
¹ Bank Height Ratio	-	1	-	-	-	1	-	1	-	-	-	1	-	1	-	-	-	1	-	1	-	-	-	1	-	1	-	-	-	1						
Profile																																				
Riffle Length (ft)																																				
Riffle Slope (ft/ft)																																				
Pool Length (ft)																																				
Pool Max depth (ft)																																				
Pool Spacing (ft)																																				
Pattern																																				
Channel Beltwidth (ft)																																				
Radius of Curvature (ft)																																				
Rc:Bankfull width (ft/ft)																																				
Meander Wavelength (ft)																																				
Meander Width Ratio																																				
Additional Reach Parameters																																				
Rosgen Classification	E5						E5						E5						E5						E5											
Channel Thalweg length (ft)	1,586						1,586						1,586						1586.4						1586.4											
Sinuosity (ft)																																				
Water Surface Slope (Channel) (ft/ft)																																				
BF slope (ft/ft)																																				
³ Ri% / Ru% / P% / G% / S%																																				
³ SC% / Sa% / G% / C% / B% / Be%																																				
³ d16 / d35 / d50 / d84 / d95 /																																				
² % of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Shaded cells indicate that these will typically not be filled in.
 1 = The distributions for these parameters can include information from both the cross-section surveys and the longitudinal profile.
 2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
 3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
 4. = Of value/needed only if the n exceeds 3

Exhibit Table 12c. Monitoring Data - Stream Reach Data Summary
Five Mile Branch Stream Restoration, DMS IMS ID# 92185 Segment/Reach: Reach 3 Fifth Creek downstream of Beaver Creek 5,215.2 feet

Parameter	Baseline						MY-1						MY-2						MY-3						MY-4						MY-5					
	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n	Min	Mean	Med	Max	SD ⁴	n
Dimension and Substrate - Riffle only																																				
Bankfull Width (ft)	28.4	34.1	32.2	41.7	6.9	3	34	34.5	34.5	34.9	0.5	3	34	35.4	34.1	38.2	2.4	3	33.3	35.0	33.7	38.1	2.7	3	32.2	34.0	33.1	36.6	2.3	3						
Floodprone Width (ft)	200	200	200	200	0	3	200	200.0	200	200	0.0	3	200	200	200	200	0.0	3	200.0	200.0	200.0	200.0	0.0	3	200	200	200	200	0	3						
Bankfull Mean Depth (ft)	4	4.3	4.1	4.7	0.4	3	4.8	4.9	4.9	4.9	0.1	3	4.1	4.9	5.1	5.3	0.7	3	4.5	5.1	5.3	5.6	0.6	3	4.3	5.1	5.4	5.6	0.7	3						
¹ Bankfull Max Depth (ft)	5.6	6.3	6.3	7.1	0.8	3	5.7	6.1	5.9	6.8	0.6	3	6.6	6.9	6.9	7.2	0.3	3	6.5	6.9	6.9	7.3	0.4	3	6.3	6.8	6.8	7.2	0.5	3						
Bankfull Cross Sectional Area (ft ²)	115.3	143.5	150.2	165.2	25.6	3	162.8	167.9	170.2	170.7	4.4	3	155.9	170.9	174.5	182.2	13.5	3	172.9	179.6	177.7	188.1	7.8	3	158.7	172.4	172.4	186	13.7	3						
Width/Depth Ratio	6.9	8.1	6.9	10.4	2	3	7	7.1	7.1	7.1	0.1	3	6.4	7.5	6.6	9.4	1.7	3	6.1	7.0	6.3	8.5	1.3	3	5.9	6.8	6.0	8.5	1.5	3						
Entrenchment Ratio	4.8	6	6.2	7	1.1	3	5.7	5.8	5.8	5.9	0.1	3	5.2	5.7	5.9	5.9	0.4	3	5.2	5.7	5.9	6.0	0.4	3	5.5	5.9	6.0	6.2	0.4	3						
¹ Bank Height Ratio	1	1	1	1	0	3	1	1	1	1	0	3	1	1	1	1	0	3	1	1	1	1	0	3	1	1	1	1	0	3						
Profile																																				
Riffle Length (ft)																																				
Riffle Slope (ft/ft)																																				
Pool Length (ft)																																				
Pool Max depth (ft)																																				
Pool Spacing (ft)																																				
Pattern																																				
Channel Beltwidth (ft)																																				
Radius of Curvature (ft)																																				
Rc:Bankfull width (ft/ft)																																				
Meander Wavelength (ft)																																				
Meander Width Ratio																																				
Additional Reach Parameters																																				
Rosgen Classification	E5						E5						E5						E5						E5											
Channel Thalweg length (ft)	5,215						5,215						5,215						5215.2						5215.2											
Sinuosity (ft)																																				
Water Surface Slope (Channel) (ft/ft)																																				
BF slope (ft/ft)																																				
³ Ri% / Ru% / P% / G% / S%																																				
³ SC% / Sa% / G% / C% / B% / Be%																																				
³ d16 / d35 / d50 / d84 / d95 /																																				
² % of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Shaded cells indicate that these will typically not be filled in.
1 = The distributions for these parameters can include information from both the cross-section surveys and the longitudinal profile.
2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
4. = Of value/needed only if the n exceeds 3



Appendix E

Table 12. Verification of Bankfull Events
 Five Mile Branch Stream and Wetland Restoration
 NCDMS # 92185

Date of Data Collection	Date of Occurrence	Method	Greater than Q _{bkf} Stage	Notes
5/30/2012	Unknown	Debris on floodplain	Y	
10/8/2013	7/6/2013	On-site transducer/data logger	Y	
10/8/2013	7/27/2013	On-site transducer/data logger and silt inside rain gauge. 3.71 inches of rain.	Y	
12/5/2013	11/27/2013	On-site transducer/data logger	Y	
7/18/2014	1/11/2014	On site Transducer	Y	Beaver Creek, Fifth Creek Upstream and Fifth Creek Downstream
7/18/2014	3/7/2014	On site Transducer	Y	Beaver Creek
7/18/2014	4/7/2014	On site Transducer	Y	Beaver Creek
4/18/2015	3/15/2015	On site Transducer	Y	Beaver Creek and Fifth Creek Upstream
4/21/2016	2/3/2016	On site Transducer	Y	Beaver Creek
10/25/2016	5/3/2016	On site Transducer	Y	Beaver Creek, Fifth Creek Upstream and Fifth Creek Downstream
10/25/2016	8/3/2016	On site Transducer	Y	Beaver Creek

Five Mile Branch

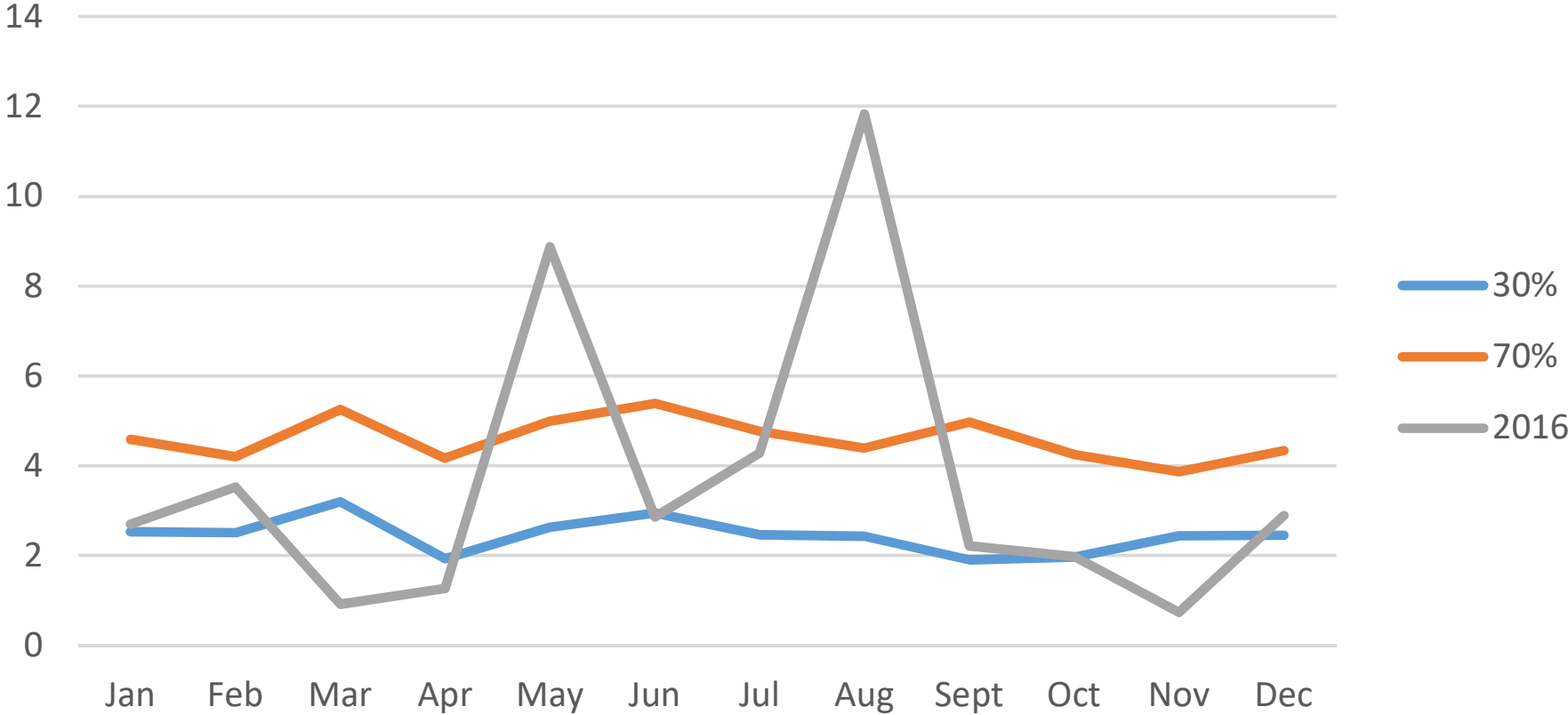


Table 13. Wetland Gauge Attainment Data
 Five Mile Branch Stream and Wetland Restoration
 NCDMS # 92185

Gauge	Max Consecutive Hydroperiod: Saturation within 12 Inches of Soil Surface (Percent of Growing Season) WETS Station: USGS 354822080521501 Growing Season: April 18 - Oct 17					Mean
	Year 1 (2013)	Year 2 (2014)	Year 3 (2015)	Year 4 (2016)	Year 5 (2017)	
1	68.3	36.1	32.8	31.1		42.1
2	23.0	3.8	5.5	4.9		9.3
3	23.0	13.1	13.7	21.3		17.8
4	54.1	13.1	13.7	20.7		25.4
5	48.6	8.7	9.3	82.5		37.3
6	16.9	7.7	8.2	7.7		10.1
7	16.4	3.0	6.0	M		8.5
8	100.0	42.1	32.8	31.1		51.5
9	22.4	33.9	20.7	30.6		26.9
10	100.0	33.3	19.1	30.6		45.8
11	16.4	11.5	8.2	6.0		10.5
12	42.6	20.8	12.6	26.2		25.6
13	44.3	19.7	12.6	18.6		23.8
14	37.2	10.9	10.4	14.8		18.3
15	23.0	0.0	11.5	17.5		13.0
16	23.5	0.0	12.6	19.1		13.8
17	2.2	0.0	1.6	M		1.3
18	9.8	8.2	6.0	4.9		7.2
19	34.4	0.0	11.4	15.3		15.3
20	20.8	14.2	11.4	18.6		16.3
21	100.0	42.1	36.6	81.4		65.0
22	100.0	100.0	100.0	100.0		100.0
23	100.0	100.0	100.0	100.0		100.0
24	16.9	13.7	13.7	30.0		18.6
25	53.6	27.9	14.7	29.0		31.3
26	54.6	20.8	13.7	27.9		29.3
27	16.4	0.0	8.7	15.8		10.2
28	7.7	8.2	6.0	5.5		6.9
29	67.2	34.4	19.1	30.6		37.8
30	20.2	10.9	9.3	15.8		14.1

Annual Precip

Total	39.0	33.5	45.4	44.1
WETS 30th Percentile	31.8	32.0	32.8	41.9
WETS 70th Percentile	40.4	40.2	41.1	49.4
Normal	Y	Y	H	Y

Table 14. Groundwater Gauge Downloading History
Five Mile Branch Stream and Wetland Restoration
NCDMS # 92185

Number	Initial Gauge Serial Number	Download Event Date											
		3/20/2013	4/3/2013	5/29/2013	6/4/2013	8/20/2013	12/5/2013	12/15/2013	7/18/2014	10/17/2014	4/17/2015*	8/28/2015	11/4/2015
1	13D4B648	ok	ok	Failed	No attempt.	ok	Replaced with EBD3010.	No attempt.	OK. Deleted old data.	ok	OK. Deleted old data.	No attempt due to weather.	ok
2	14E14322	Reprogrammed due to inconsistent logging interval.	Replaced with 12D4C9D8.	ok	No attempt.	ok	failed	No attempt.	OK. Deleted old data.	ok	OK. Deleted old data. Replaced battery.	No attempt due to weather.	OK. Missing 6/5 - 8/24 data.
3	1314FC9A	Failed	ok	ok	No attempt.	Failed	Replaced with 13152502.	No attempt.	OK. Deleted old data.	ok	OK. Deleted old data.	No attempt due to weather.	ok
4	13D49A3B	ok	ok	ok	No attempt.	ok	ok	No attempt.	OK. Replaced battery. Deleted old data.	ok	OK. Deleted old data.	No attempt due to weather.	ok
5	14E16DC9	ok	ok	ok	No attempt.	ok	ok	No attempt.	OK. Deleted old data.	ok	OK. Deleted old data. Replaced battery.	No attempt due to weather.	OK. Missing 6/5 - 6/12 data.
6	14E1A3C5	Reprogrammed due to not downloading.	ok	ok	No attempt.	Failed	ok	No attempt.	OK. Replaced battery. Deleted old data.	ok	OK. Deleted old data.	No attempt due to weather.	ok
7	13D4CA32	ok	ok	ok	No attempt.	ok	ok	No attempt.	Replaced with 1314FC9A	Partial data	OK. Deleted old data.	No attempt due to weather.	ok
8	13D49BC4	ok	ok	ok	No attempt.	ok	ok	No attempt.	OK. Deleted old data.	ok	OK. Deleted old data.	No attempt due to weather.	ok
9	136B6377	ok	ok	ok	No attempt.	Failed	Replaced with EBD20B9.	No attempt.	OK. Deleted old data.	ok	OK. Deleted old data.	No attempt due to weather.	ok
10	13D4B632	ok	ok	ok	No attempt.	ok	ok	No attempt.	OK. Deleted old data.	ok	OK. Deleted old data.	No attempt due to weather.	ok
11	14E178FC	ok	ok	ok	No attempt.	Failed	Replaced with EBD074F.	No attempt.	OK. Deleted old data.	ok	OK. Deleted old data. Replaced battery.	No attempt due to weather.	ok
12	14E13DAE	ok	ok	ok	No attempt.	ok	ok	No attempt.	OK. Deleted old data.	ok	OK. Deleted old data.	No attempt due to weather.	OK. Missing 6/5 - 6/11 data.
13	13D4A9D9	ok	ok	ok	No attempt.	ok	ok	No attempt.	OK. Reprogrammed. Deleted old data.	ok	OK. Deleted old data. Replaced battery.	ok	Wrong logging dates. Reprogrammed.
14	13D4C9C5	ok	ok	ok	No attempt.	Failed	ok	No attempt.	OK. Deleted old data.	ok	OK. Deleted old data. Replaced battery.	ok	ok
15	A28B85B	ok	ok	ok	No attempt.	No attempt due to malfunctioning handheld.	No attempt.	No attempt.	OK. Replaced battery. Deleted old data.	failed	OK. Deleted old data.	ok	ok
16	11312B9E	ok	Failed	ok	No attempt.	No attempt due to malfunctioning handheld.	No attempt. Submerged	No attempt.	Replaced with EBCFF2F	Partial data	OK. Deleted old data.	No attempt due to weather.	ok
17	14E16DE5	ok	ok	ok	No attempt.	No attempt due to malfunctioning handheld.	ok	No attempt.	OK. Replaced battery. Deleted old data.	Partial data	OK. Deleted old data. Replaced battery.	No attempt due to weather.	OK. No data after 6/27. Reprogrammed.
18	13153397	Failed	Replaced with 13D493A9.	No attempt due to accident.	No attempt. Could not locate.	No attempt due to malfunctioning handheld.	ok	No attempt.	OK. Deleted old data.	ok	OK. Deleted old data.	No attempt due to weather.	ok
19	14E15453	ok	ok	No attempt due to accident.	ok	No attempt due to malfunctioning handheld.	No attempt.	ok	Replaced with 13D4B648	Partial data	OK. Deleted old data.	ok	OK. Missing 10/29 - 11/7 data.
20	9DE6C32	ok	ok	No attempt due to accident.	ok	No attempt due to malfunctioning handheld.	No attempt.	ok	OK. Deleted old data.	ok	OK. Deleted old data.	ok	ok
21	9DE6D1F	ok	ok	No attempt due to accident.	ok	No attempt due to malfunctioning handheld.	No attempt.	ok	Failed	ok	OK. Deleted old data.	ok	ok
22	EBD1038	ok	ok	No attempt due to accident.	ok	No attempt due to malfunctioning handheld.	No attempt.	ok	OK. Deleted old data.	ok	OK. Deleted old data.	ok	ok
23	13D4B61D	ok	ok	No attempt due to accident.	ok	No attempt due to malfunctioning handheld.	No attempt.	ok	OK. Deleted old data.	ok	OK. Deleted old data.	ok	ok
24	A287DCE	ok	ok	No attempt due to accident.	ok	No attempt due to malfunctioning handheld.	No attempt.	ok	OK. Deleted old data.	ok	OK. Deleted old data.	ok	ok
25	13D4B624	ok	ok	No attempt due to accident.	ok	No attempt due to malfunctioning handheld.	No attempt.	ok	OK. Deleted old data.	ok	OK. Deleted old data.	ok	ok
26	EBDD6BE	ok	ok	No attempt due to accident.	ok	No attempt due to malfunctioning handheld.	No attempt.	ok	OK. Deleted old data.	ok	OK. Deleted old data.	ok	ok
27	14E13D38	Reprogrammed due to no data.	ok	No attempt due to accident.	Reprogrammed due to inconsistent logging interval.	No attempt due to malfunctioning handheld.	No attempt.	ok	Failed	Partial data	Replaced with 136B1CB7	ok	ok
28	14E1973F	ok	ok	No attempt due to accident.	ok	No attempt due to malfunctioning handheld.	No attempt.	ok	Failed	Partial data	OK. Deleted old data.	ok	ok
29	14E177C0	ok	ok	No attempt due to accident.	ok	No attempt due to malfunctioning handheld.	No attempt.	ok	OK. Deleted old data.	ok	OK. Deleted old data.	ok	ok
30	13D4CA00	ok	ok	No attempt due to accident.	No attempt.	No attempt due to malfunctioning handheld.	No attempt.	ok	OK. Deleted old data.	ok	OK. Deleted old data.	ok	ok
RAIN	13D4BAF9	ok	ok	ok full of ants	No attempt.	Failed. Silt in gauge from flooding.	Failed	Failed	No attempt. Wasp nest on gauge.	No attempt	No attempt	No attempt	No attempt

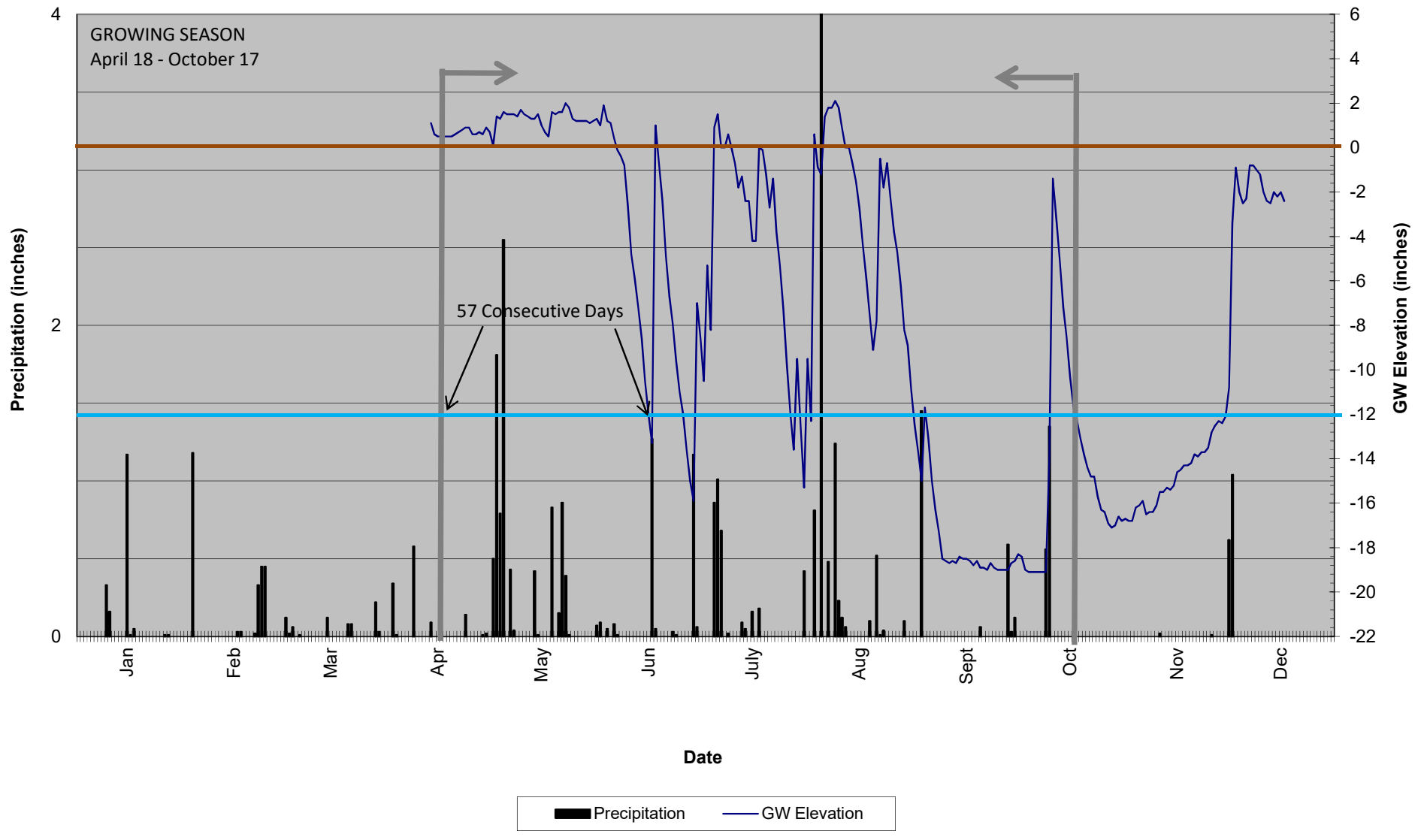
* Batteries replaced in several gauges.

Table 14. Groundwater
Five Mile Branch Stream
NCDMS # 92185

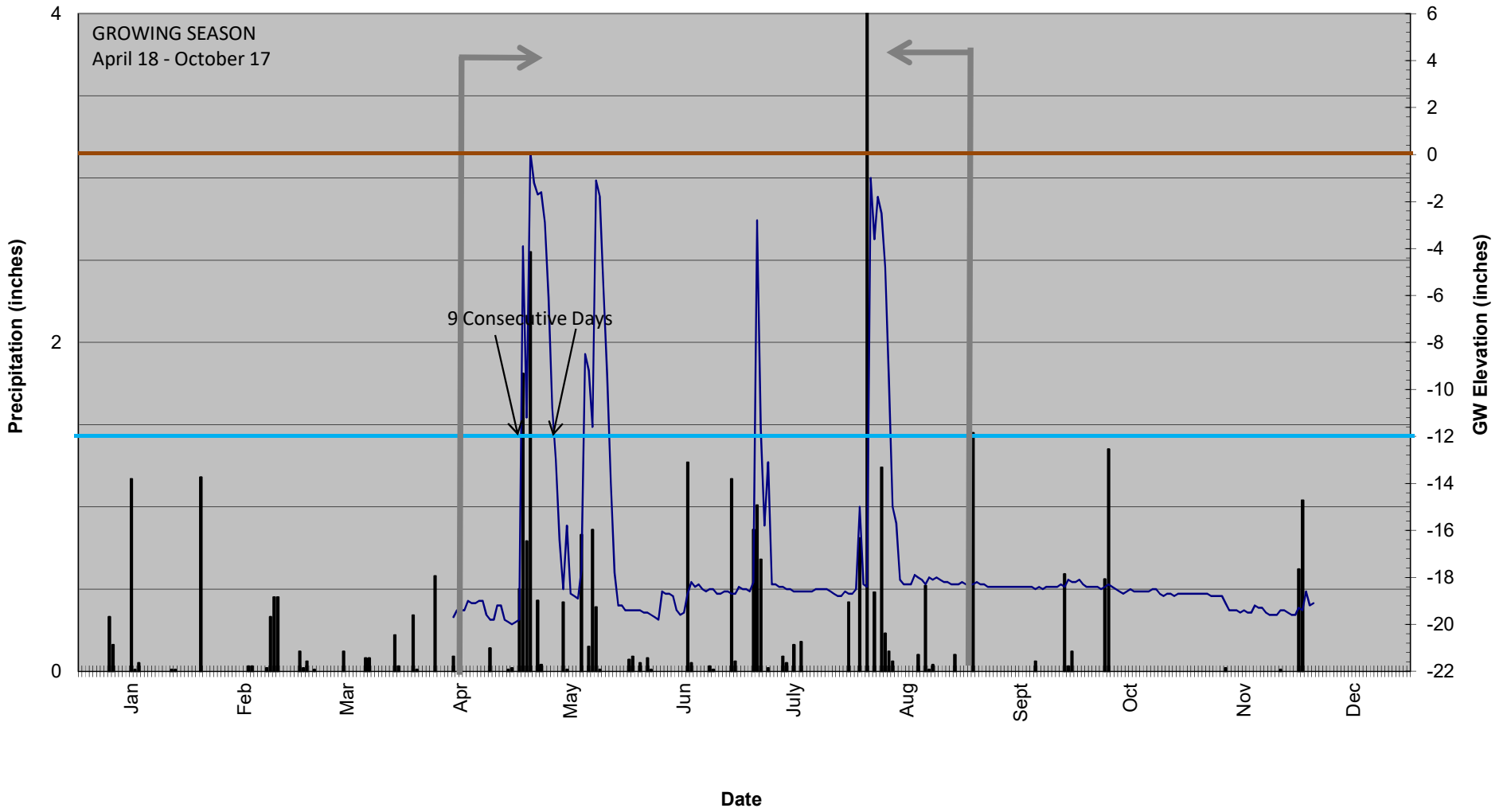
Number	Initial Gauge Serial Number	4/12/2016*	9/23/2016*	11/16/2016*	12/15/2016*
1	13D4B648	OK. Deleted old data.	ok	ok	ok
2	14E14322	OK. Deleted old data.	ok	ok	ok
3	1314FC9A	OK. Deleted old data.	ok	ok	ok
4	13D49A3B	OK. Deleted old data.	ok	ok	ok
5	14E16DC9	OK. Deleted old data.	OK. Missing 8/26 - 8/28 and 9/19 - 9/23 data.	ok	ok
6	14E1A3C5	OK. Deleted old data.	ok	Failed. Damaged	Failed
7	13D4CA32	OK. Deleted old data.	ok. Partial Data. Reprogrammed.	ok. Partial Data. Reprogrammed.	ok. Partial Data. Reprogrammed.
8	13D49BC4	OK. Deleted old data.	ok	ok	ok
9	136B6377	OK. Deleted old data.	ok	ok	ok
10	13D4B632	OK. Deleted old data.	ok	ok	ok
11	14E178FC	OK. Deleted old data.	ok	ok	ok
12	14E13DAE	OK. Deleted old data.	ok	ok	ok
13	13D4A9D9	OK. Deleted old data.	ok	Failed. Damaged	Failed
14	13D4C9C5	OK. Deleted old data.	ok	ok	ok
15	A28B85B	OK. Deleted old data.	ok	ok	ok
16	11312B9E	OK. Deleted old data.	ok	ok	ok
17	14E16DE5	ok. Partial Data. Reprogrammed.	ok. Partial Data. Reprogrammed.	ok. Partial Data. Reprogrammed.	ok. Partial Data. Reprogrammed.
18	13153397	OK. Deleted old data.	ok	ok	ok
19	14E15453	Missing. Replaced with EBDD9DE	ok	ok	ok
20	9DE6C32	Missing. Replaced with 136AC084	ok	ok	ok
21	9DE6D1F	OK. Deleted old data.	ok	OK. Missing 9/23 - 9/30 data.	OK. Missing 9/23 - 9/30 data.
22	EBD1038	ok	ok	ok	ok
23	13D4B61D	OK. Deleted old data.	ok	ok	ok
24	A287DCE	ok	ok	ok	ok
25	13D4B624	ok	ok	ok	ok
26	EBDD6BE	ok	ok	ok	ok
27	14E13D38	ok	ok	ok	ok
28	14E1973F	ok	ok	ok	ok
29	14E177C0	ok	ok	ok	ok
30	13D4CA00	ok	ok	ok	ok
RAIN	13D4BAF9	No attempt	No attempt	No attempt	No attempt

* Batteries replaced in several

Five Mile Branch Gauge #1 EBD3010

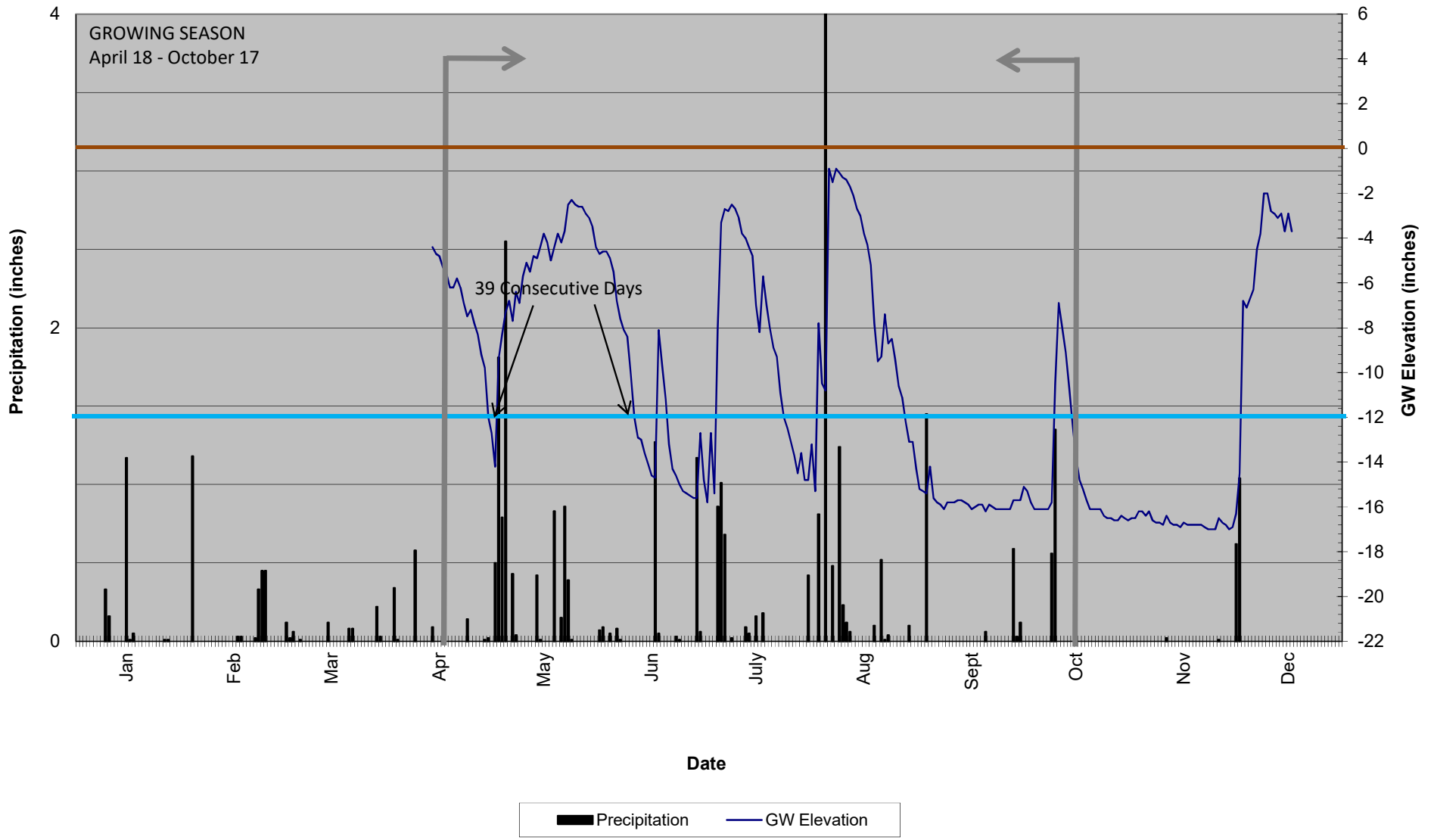


**Five Mile Branch
Gauge #2 13D4C9D8**

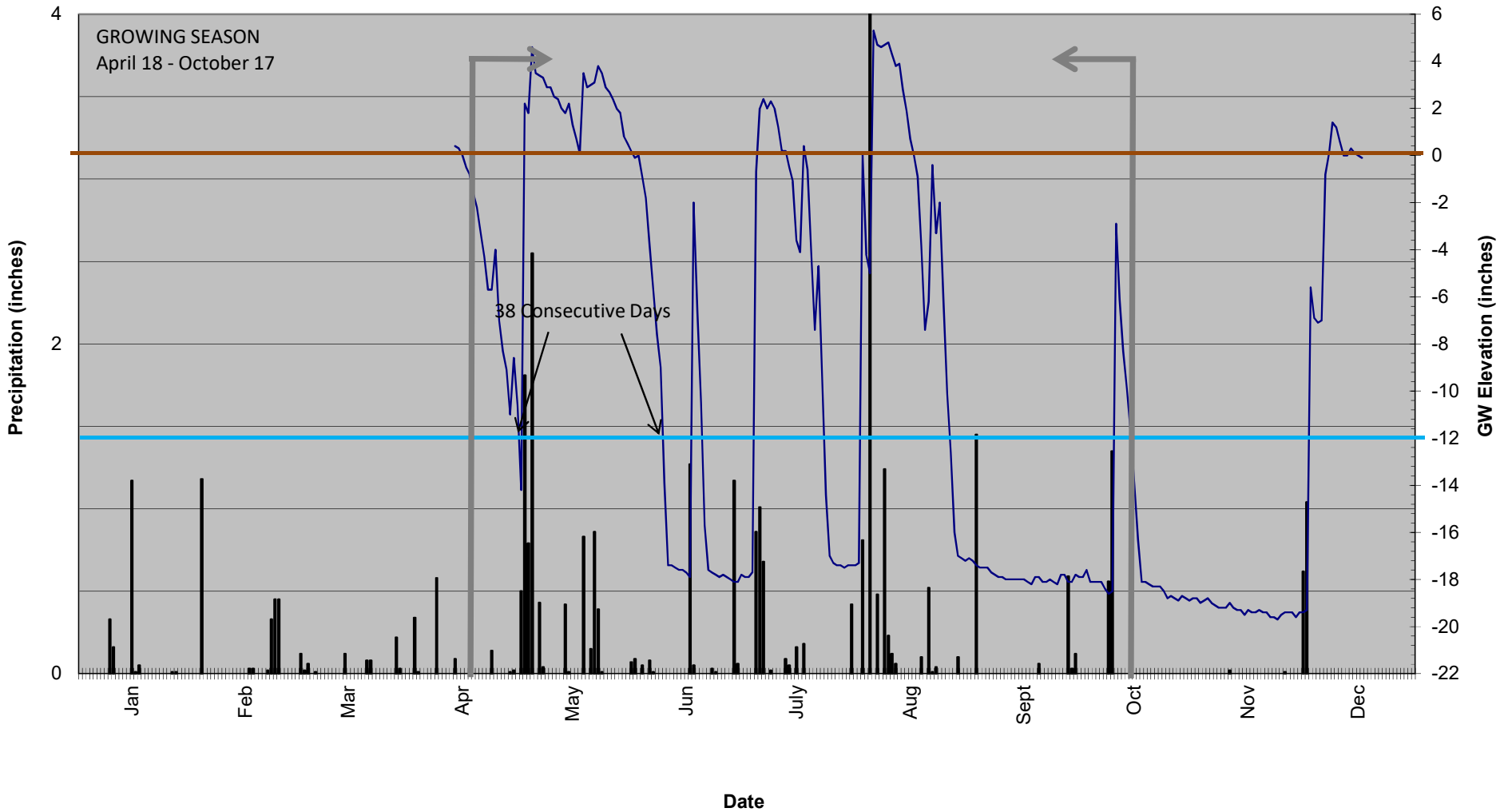


■ Precipitation — GW Elevation

Five Mile Branch Gauge #3 13152502

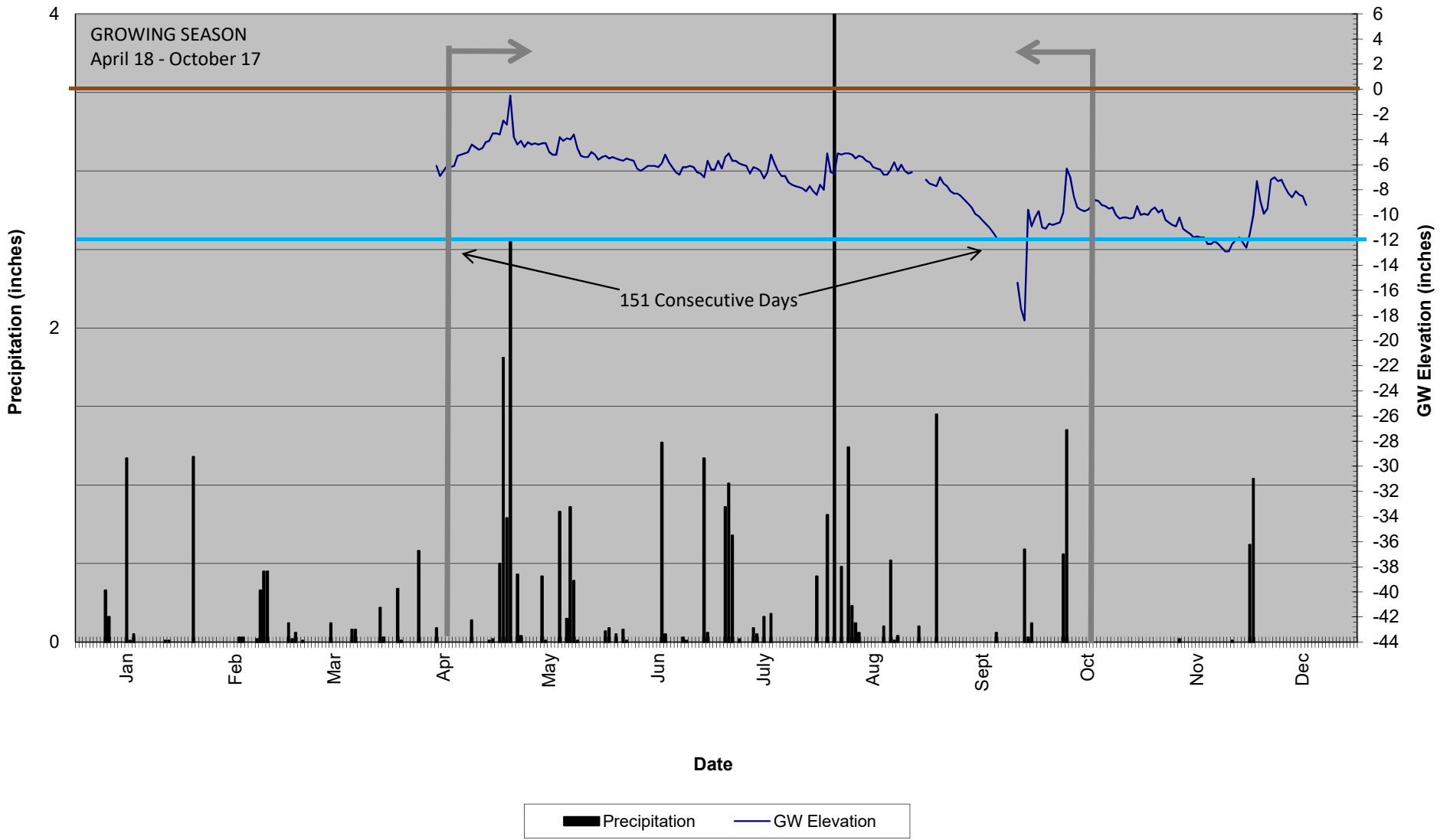


Five Mile Branch Gauge #4 13D49A3B

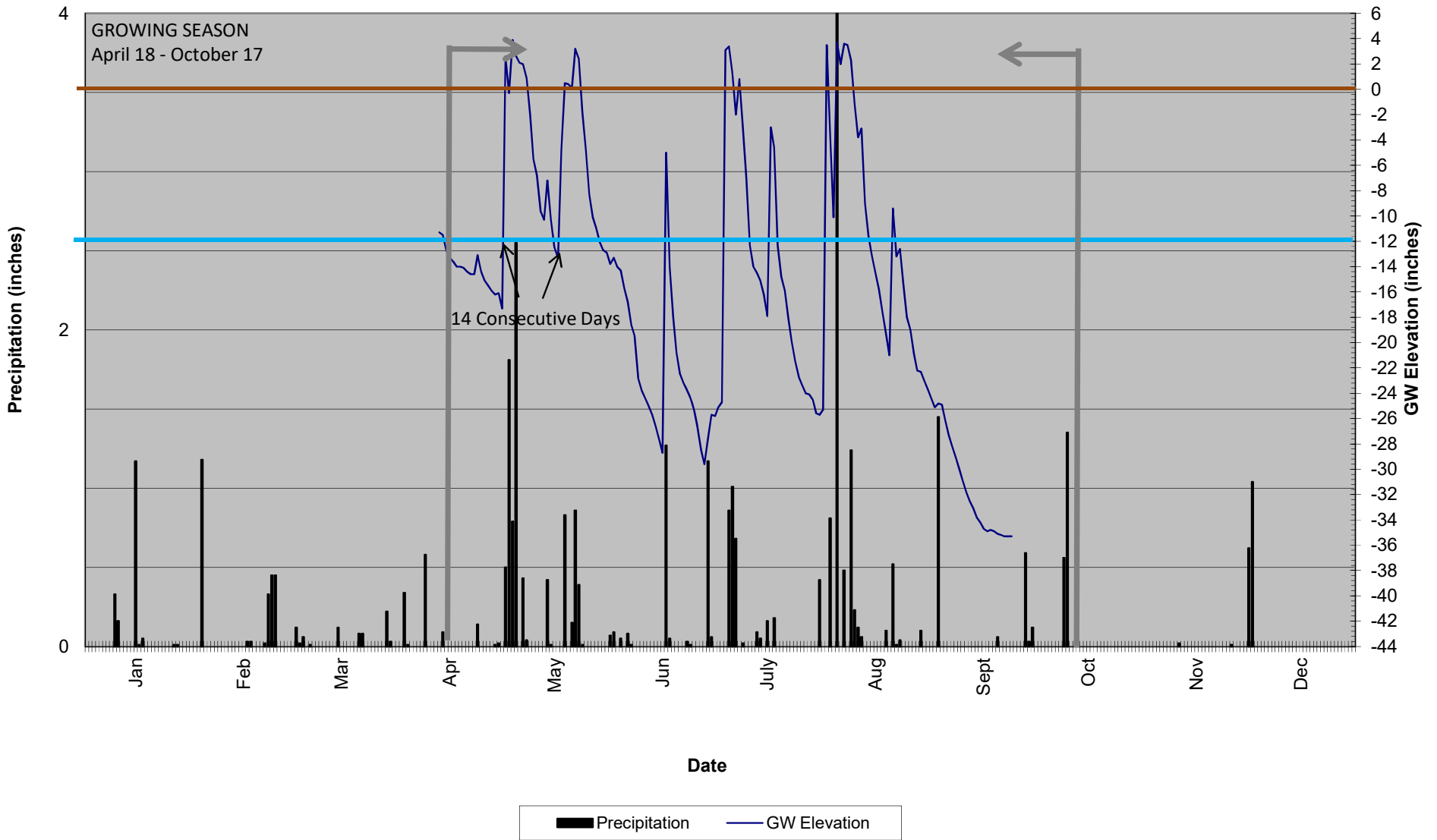


■ Precipitation — GW Elevation

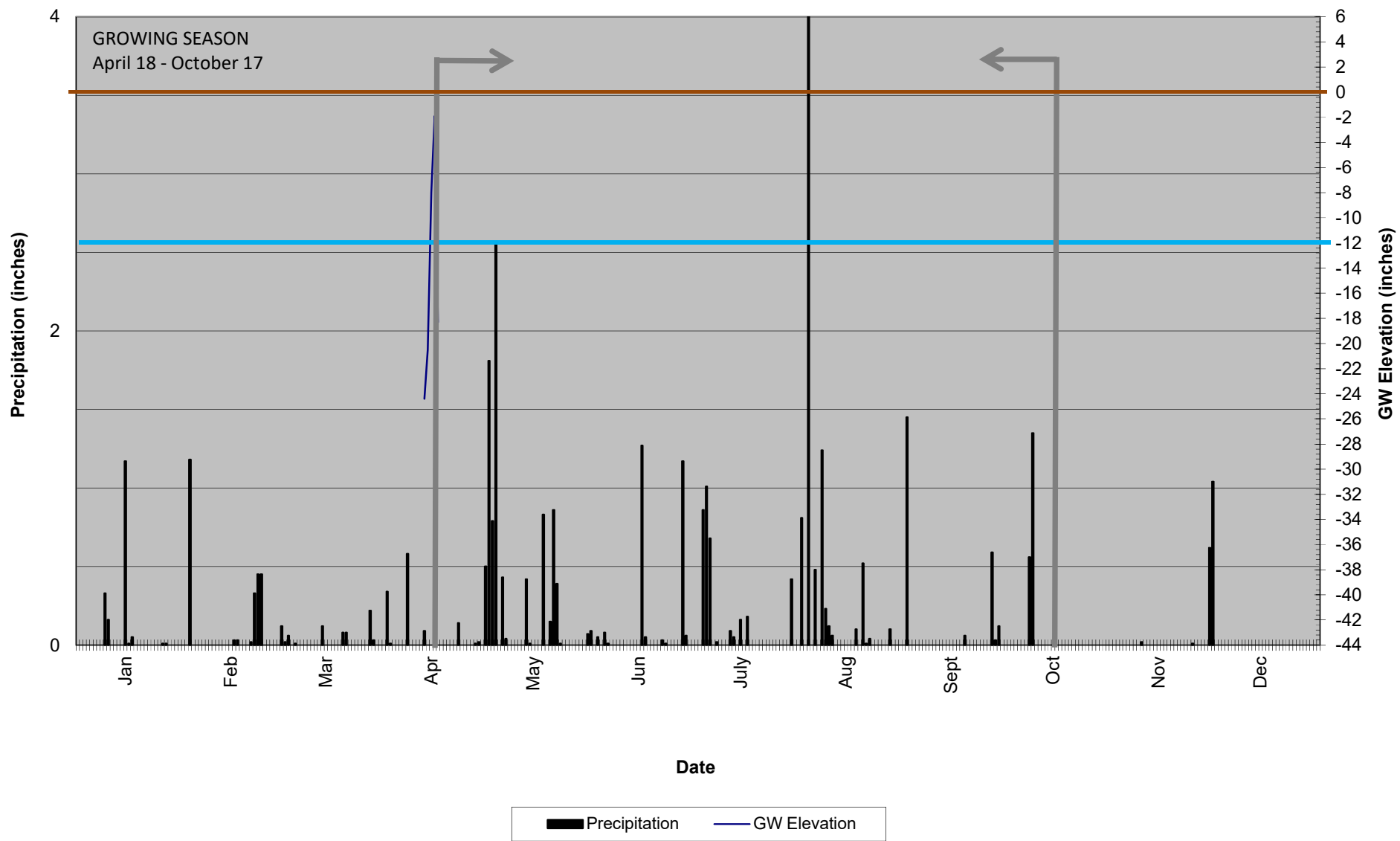
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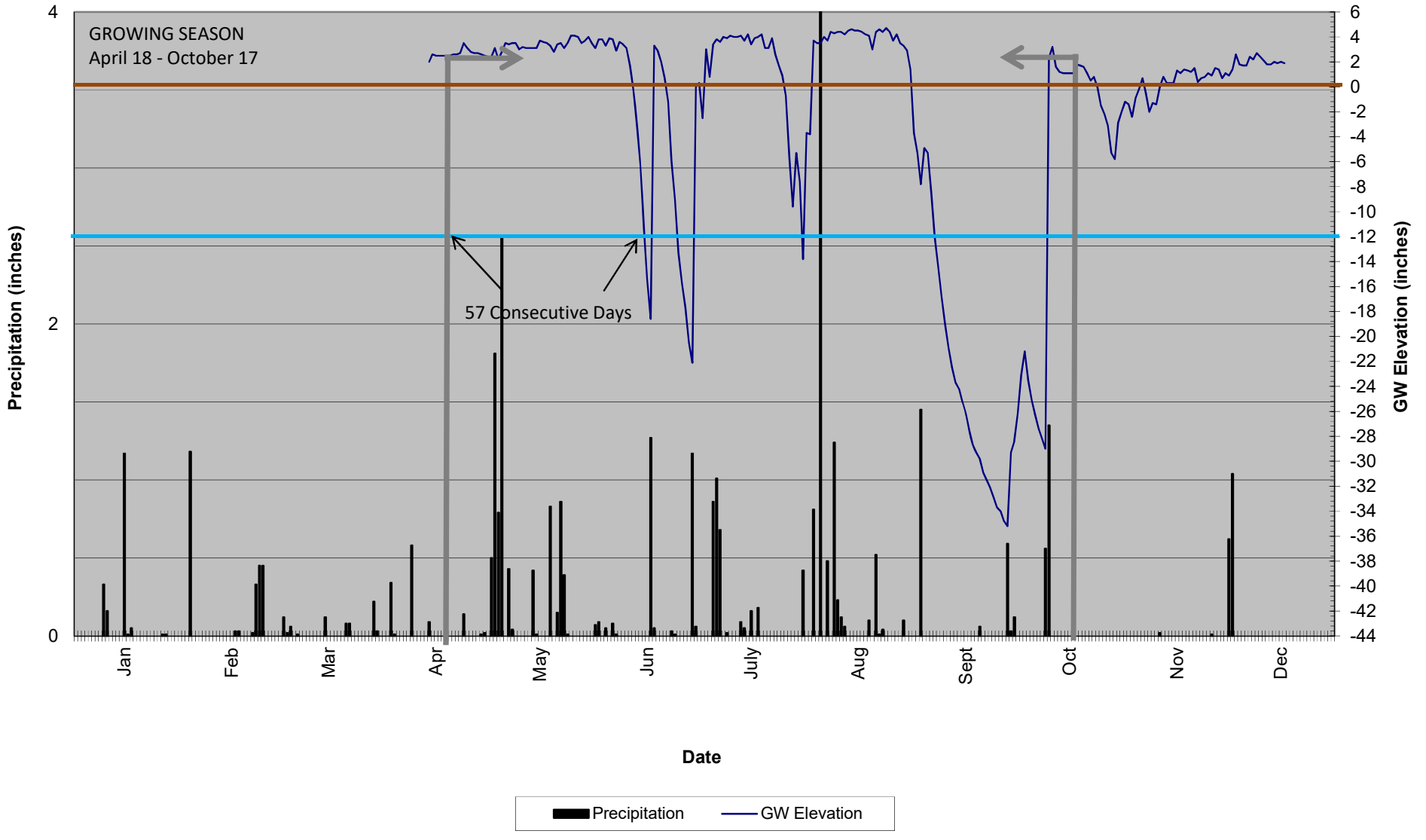
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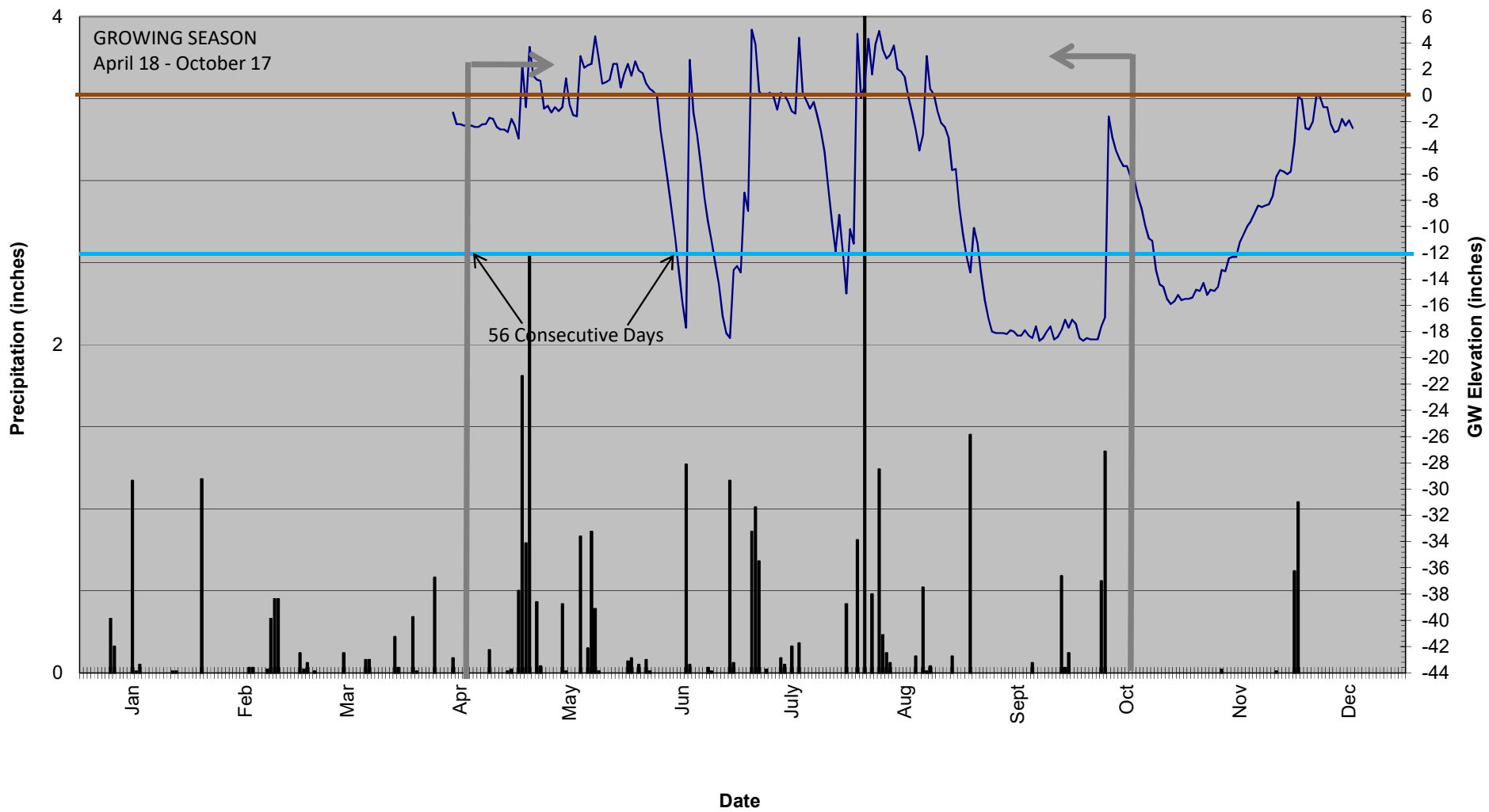
Five Mile Branch Gauge #7 1314FC9A



Five Mile Branch Gauge #8 13D49BC4

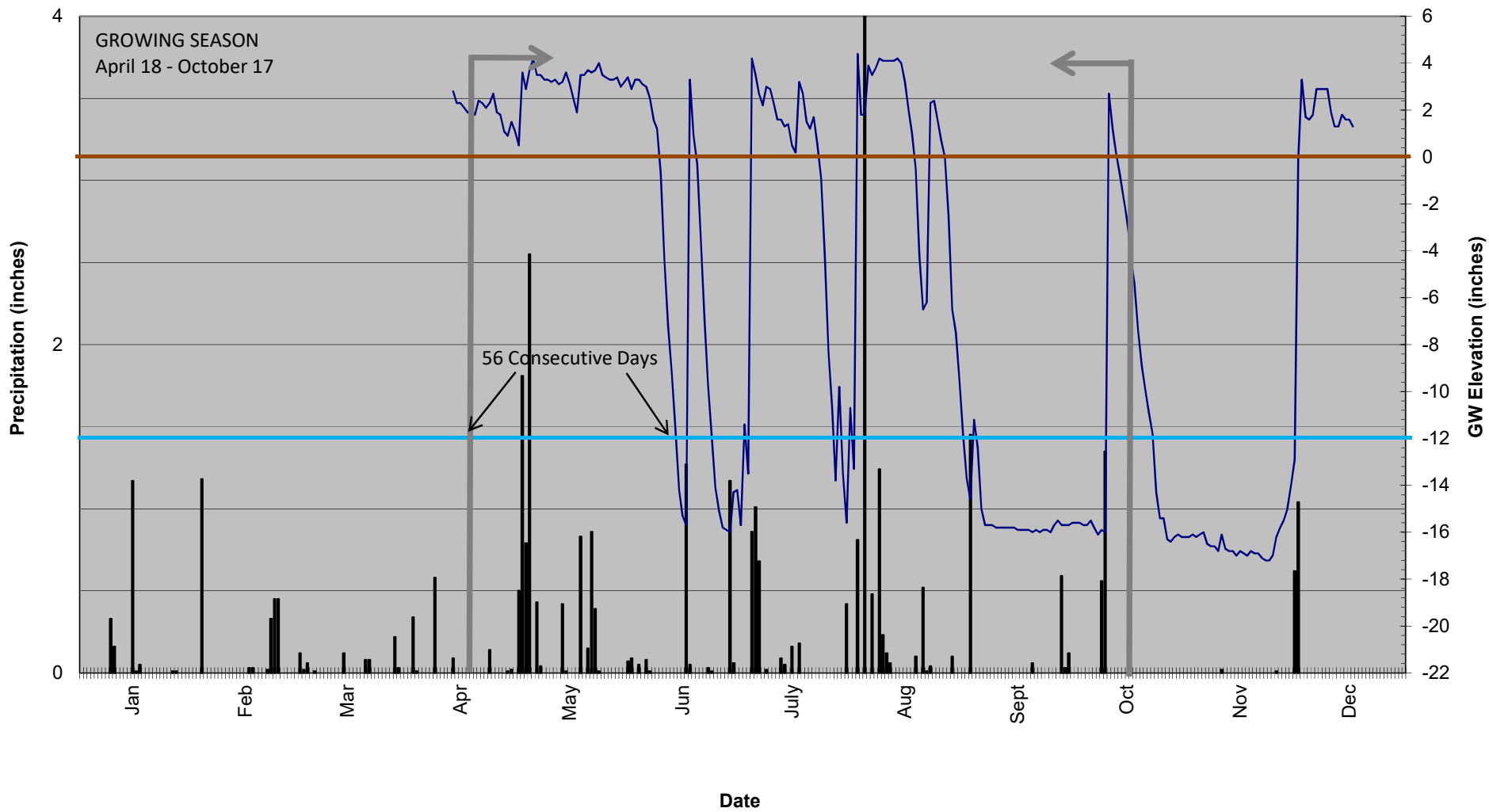


Five Mile Branch Gauge #9 EBD20B9



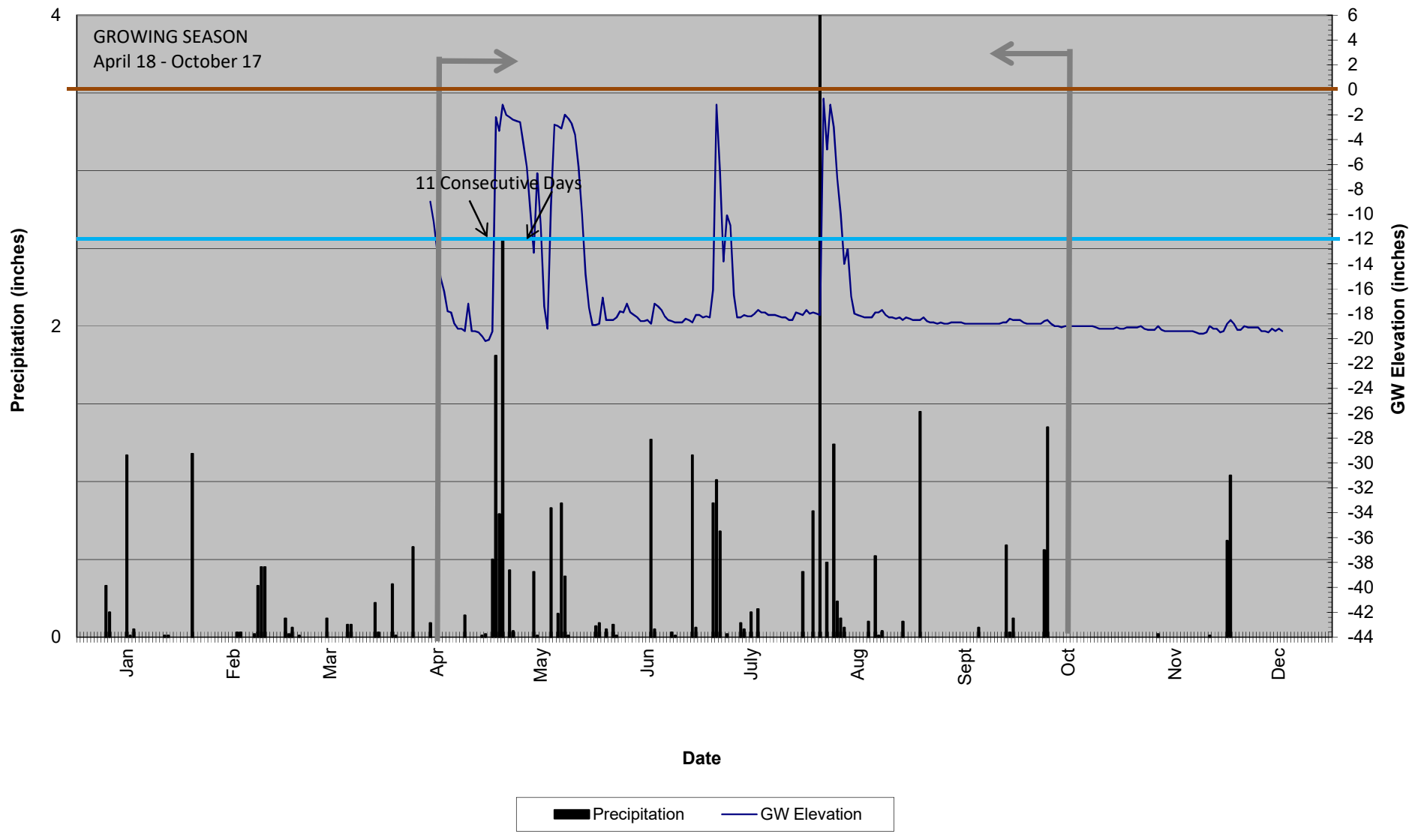
■ Precipitation — GW Elevation

Five Mile Branch Gauge #10 13D4B632

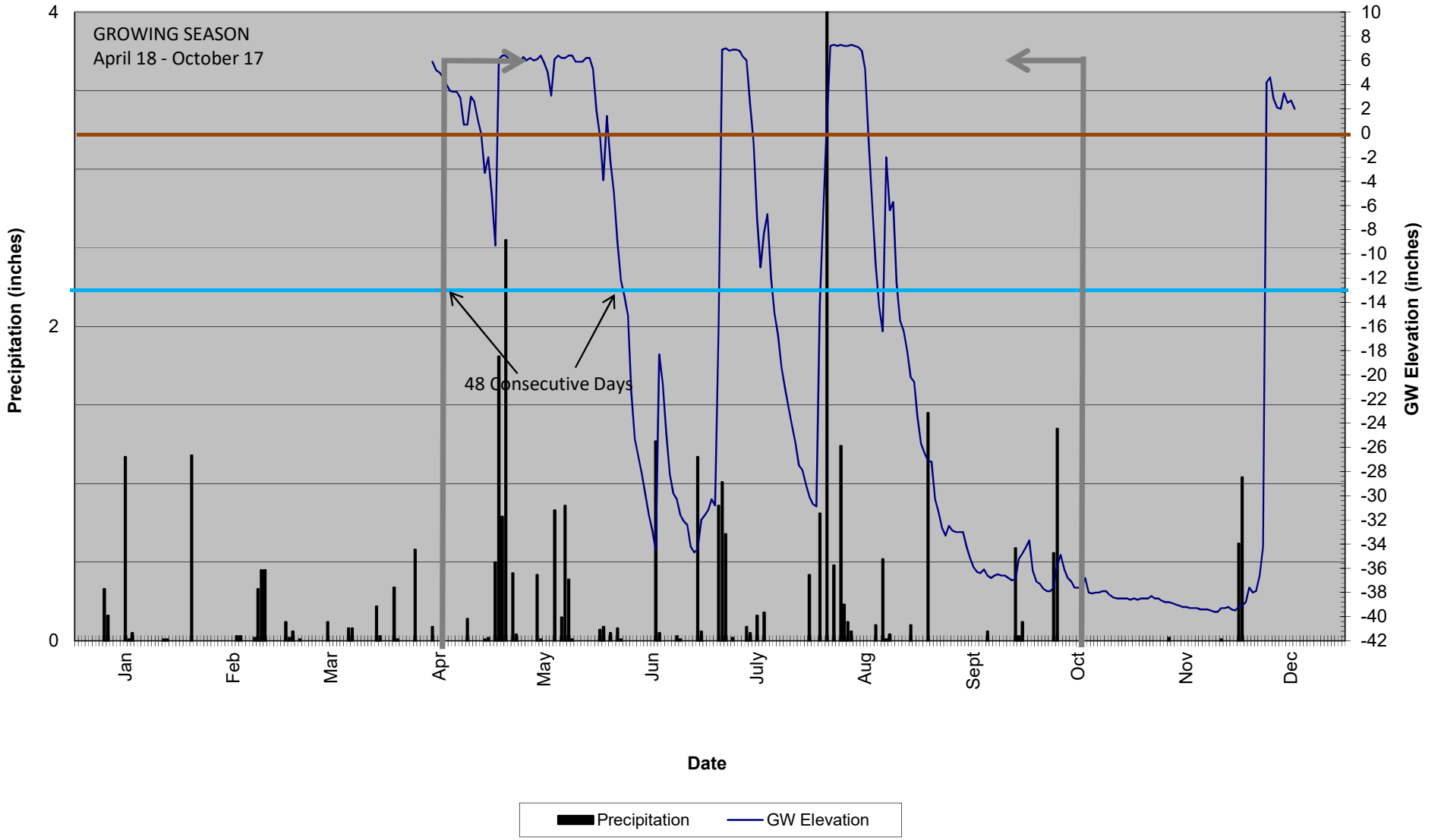


■ Precipitation — GW Elevation

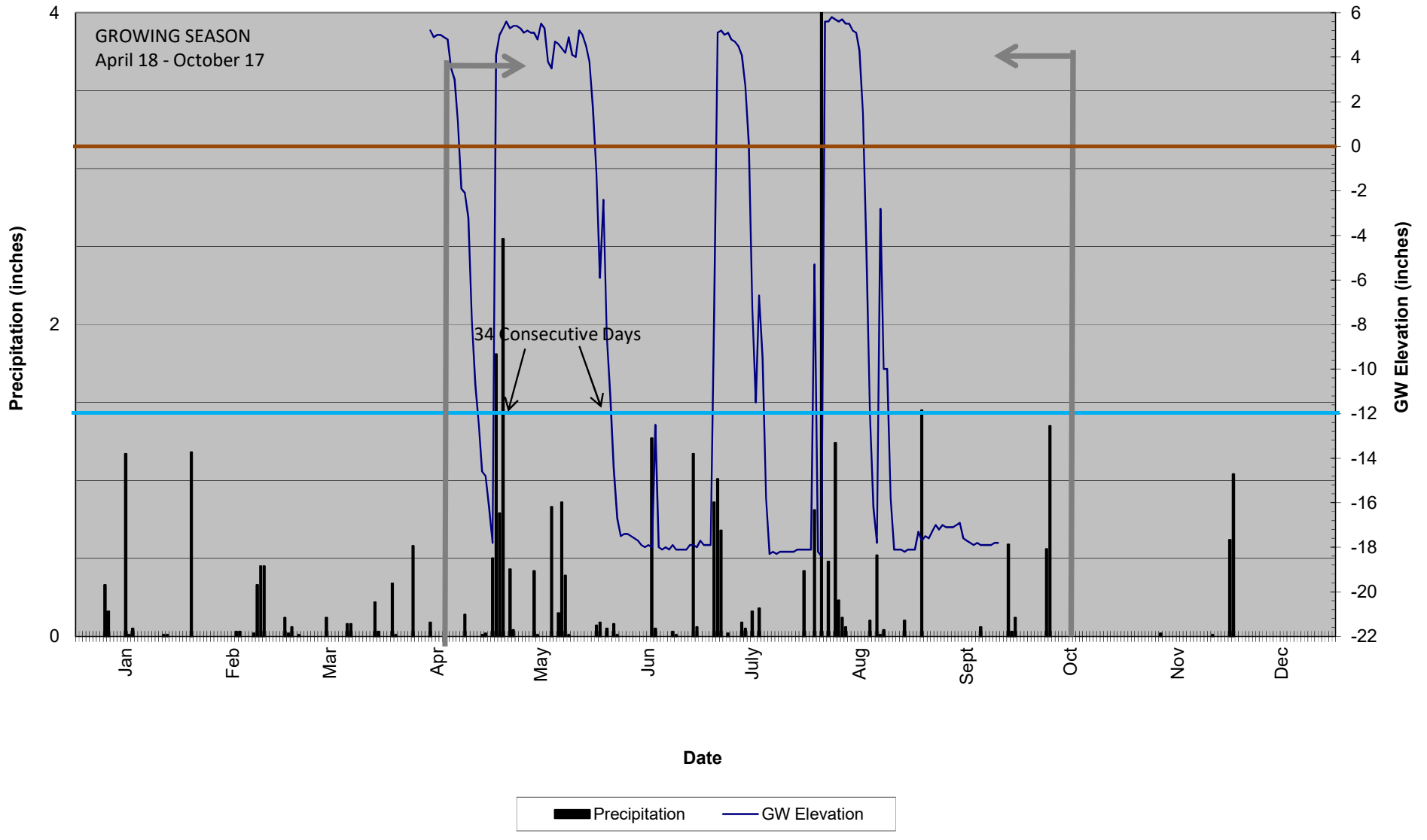
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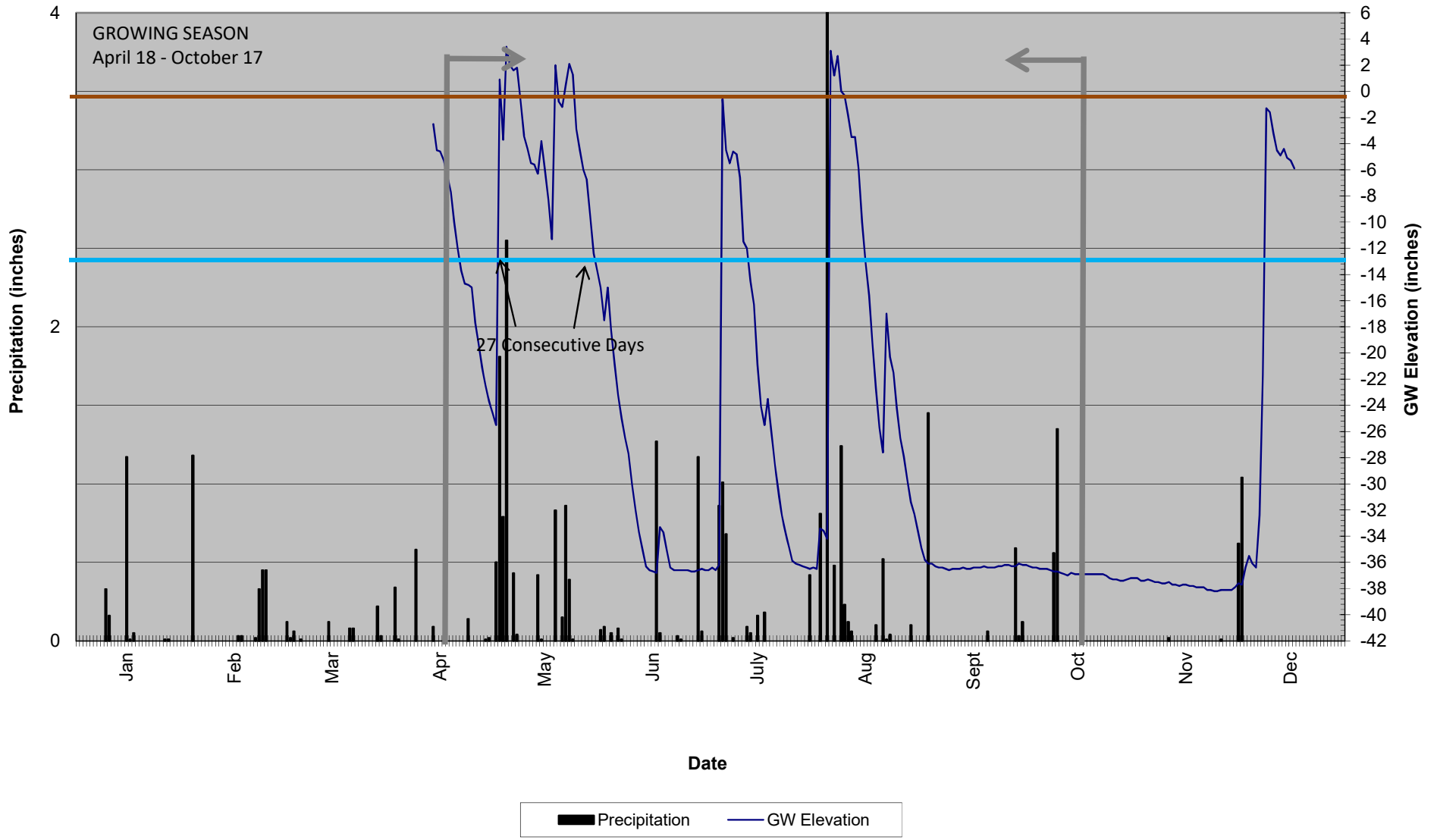
Five Mile Branch Gauge #12 14E13DAE



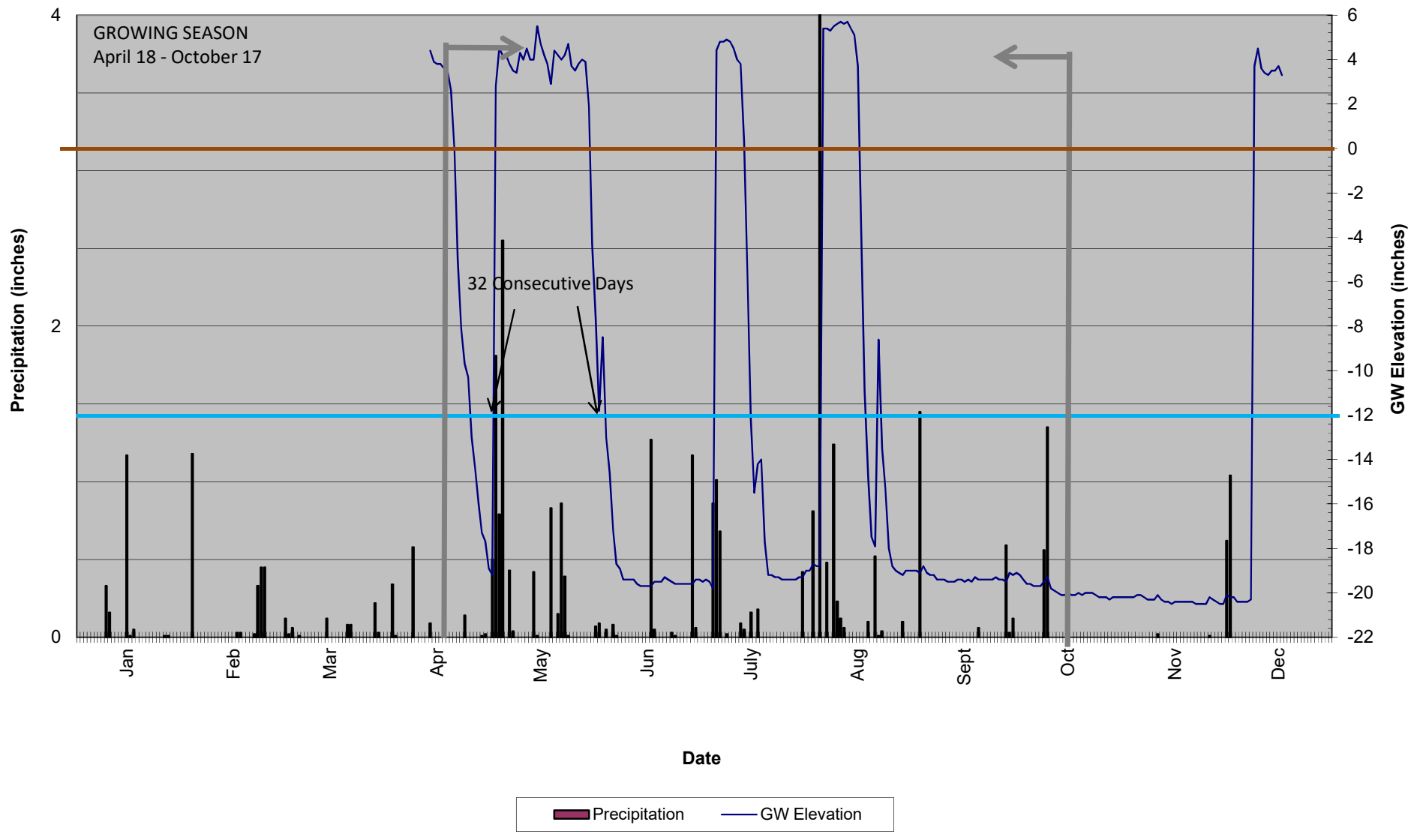
Five Mile Branch Gauge #13 13D4A9D9



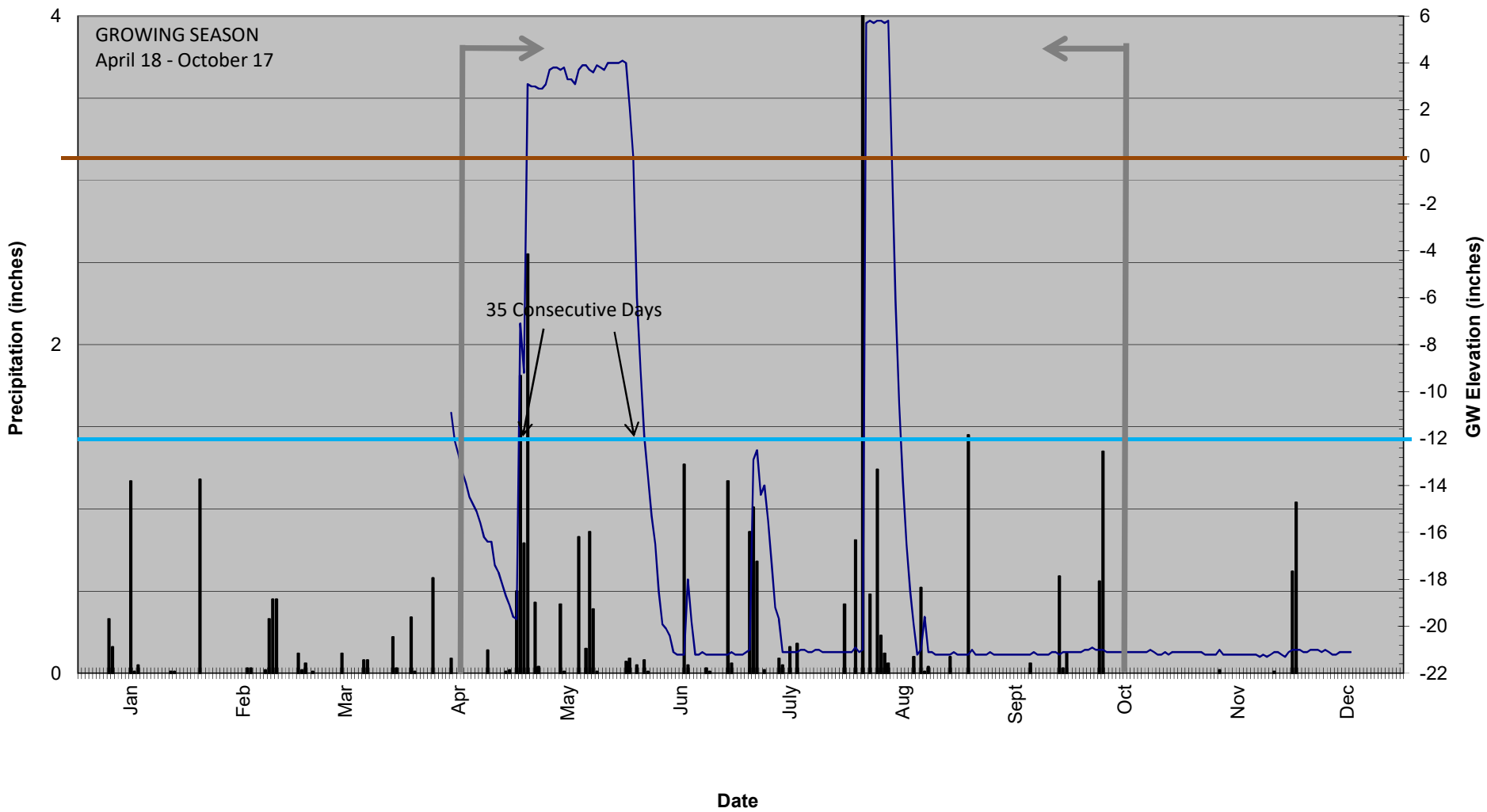
Five Mile Branch Gauge #14 13D4C9C5



Five Mile Branch Gauge #15 A28B85B

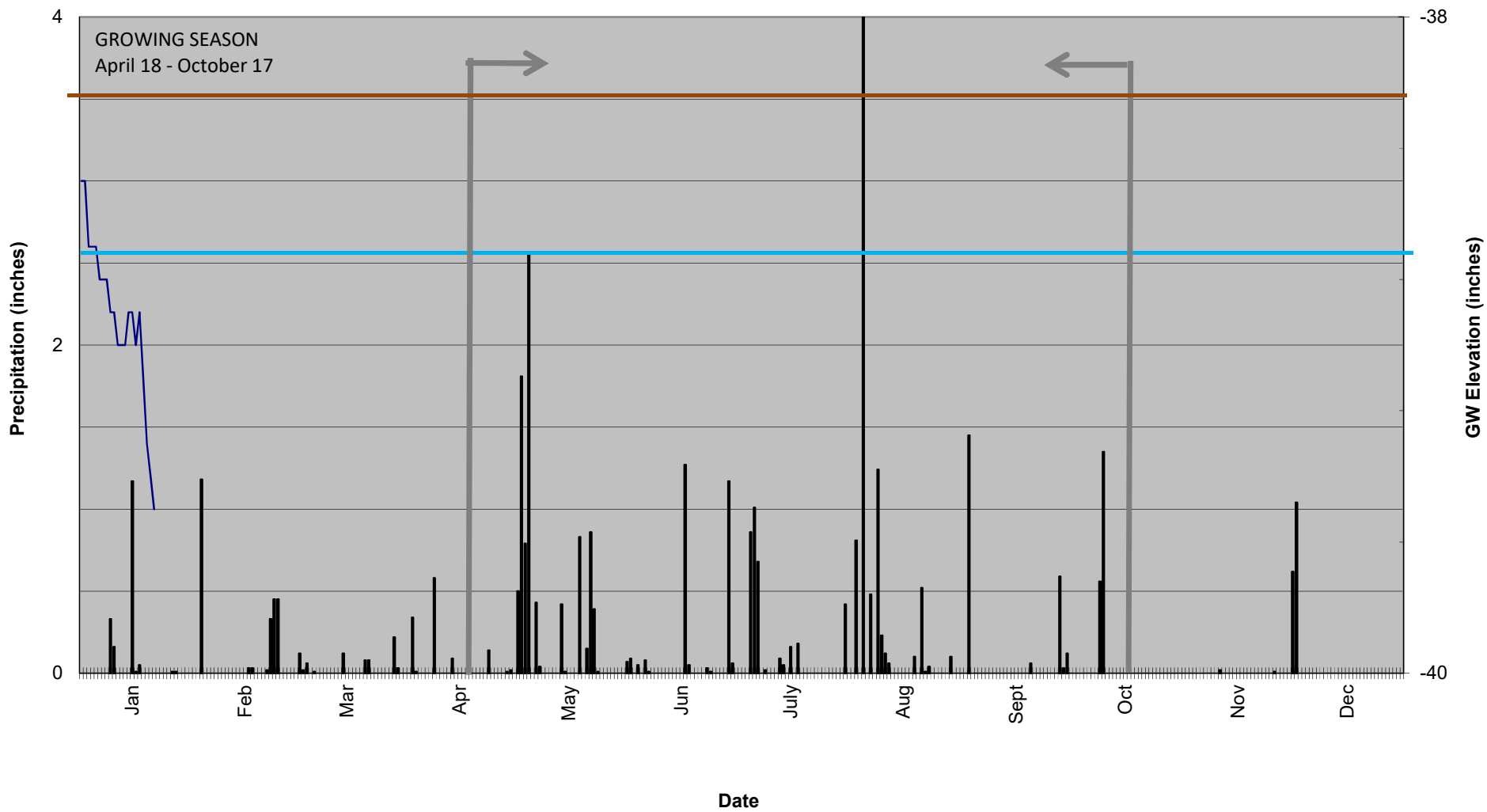


Five Mile Branch Gauge #16 EBCFF2F

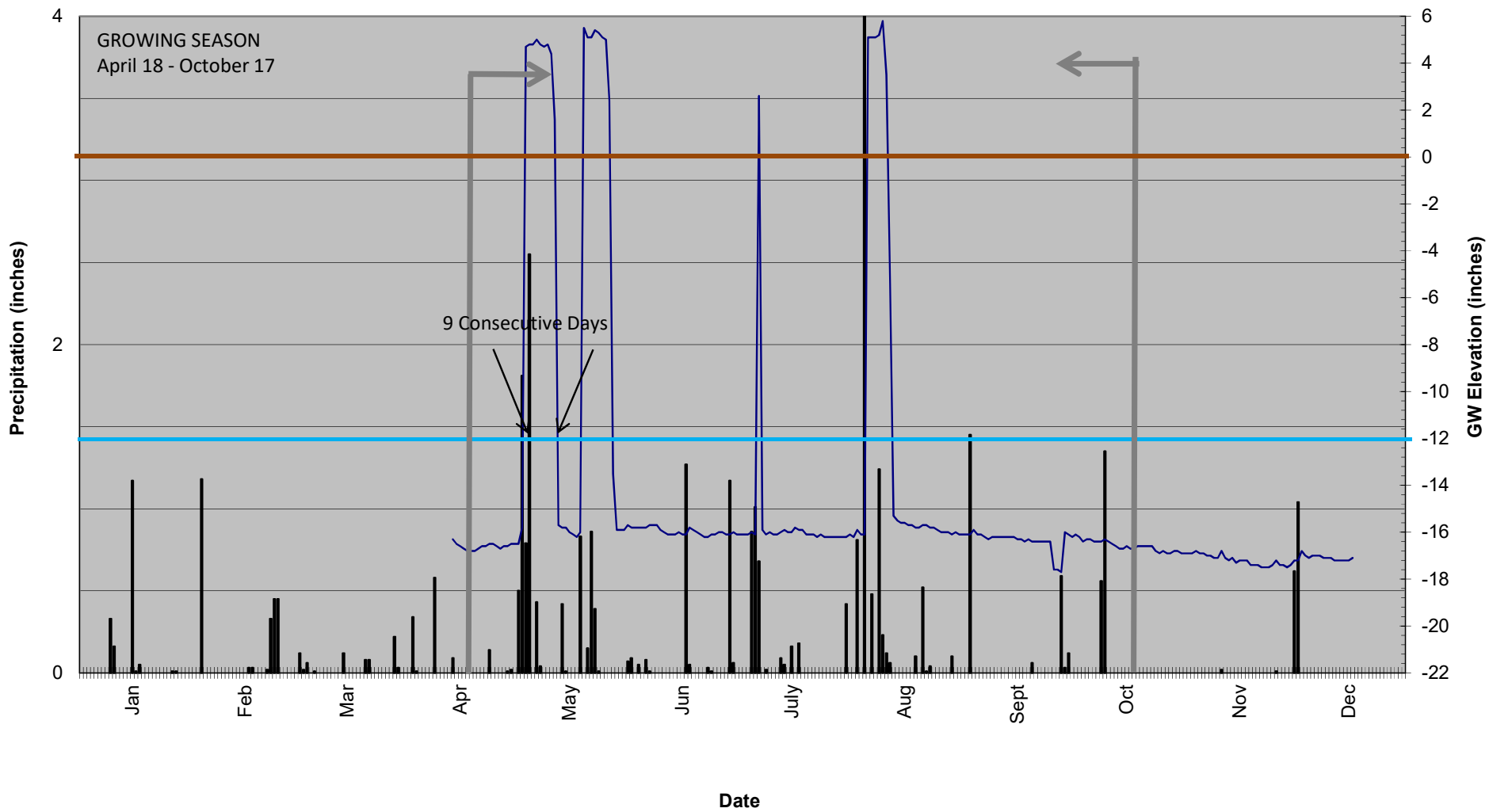


■ Precipitation — GW Elevation

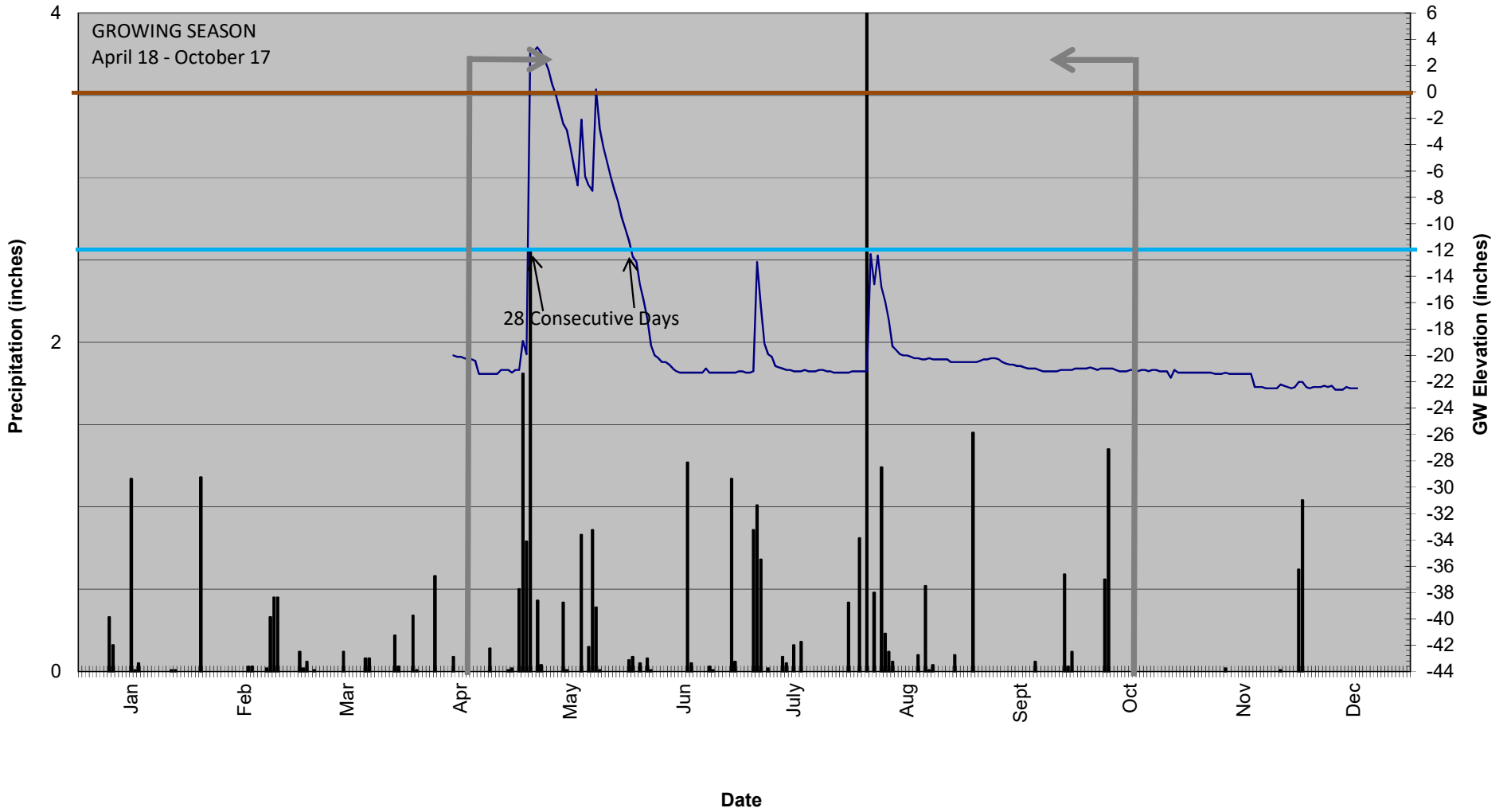
Five Mile Branch Gauge #17 14E16DE5



Five Mile Branch Gauge #18 13D493A9

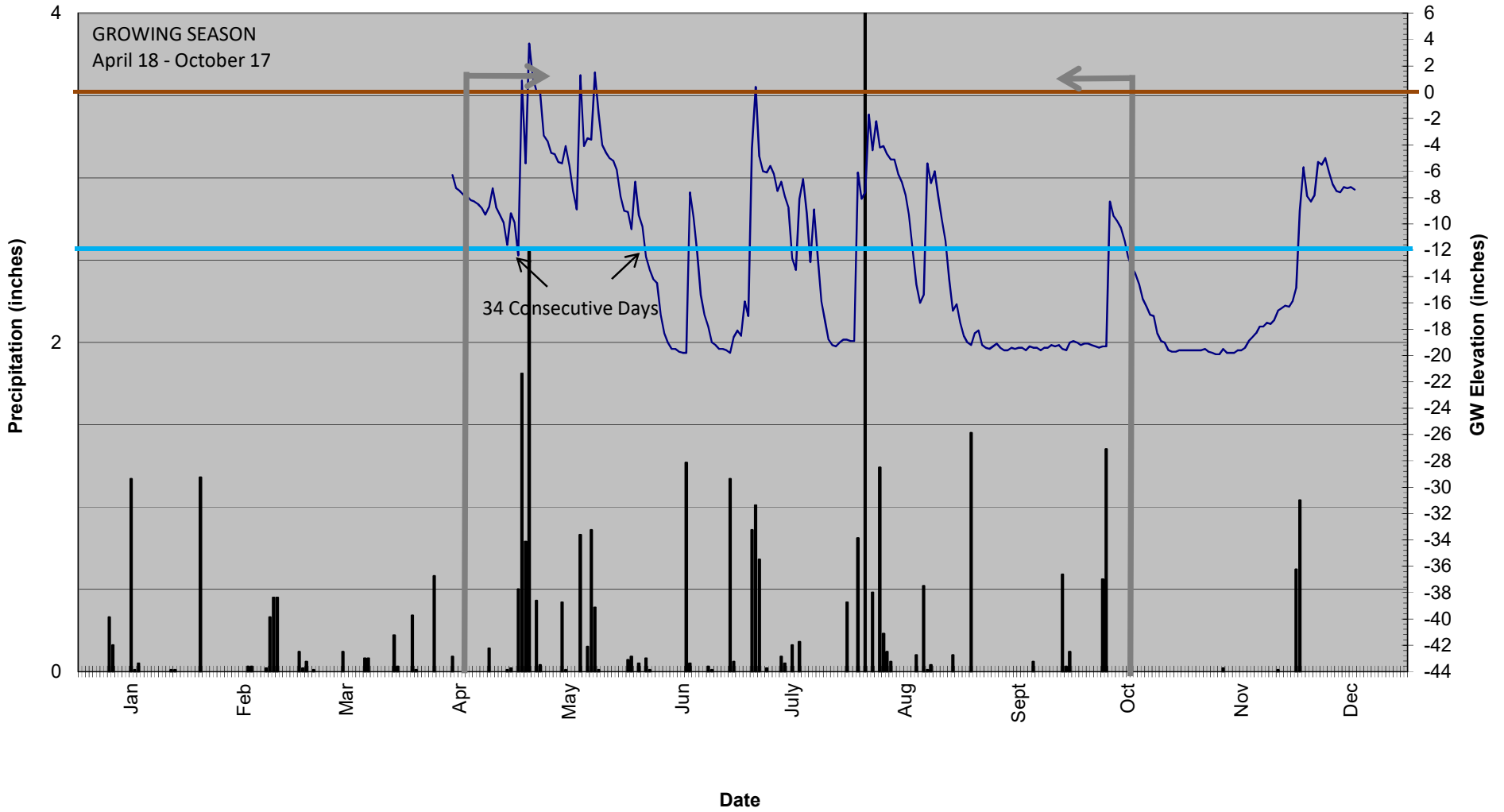


Five Mile Branch Gauge #19 EBDD9DE



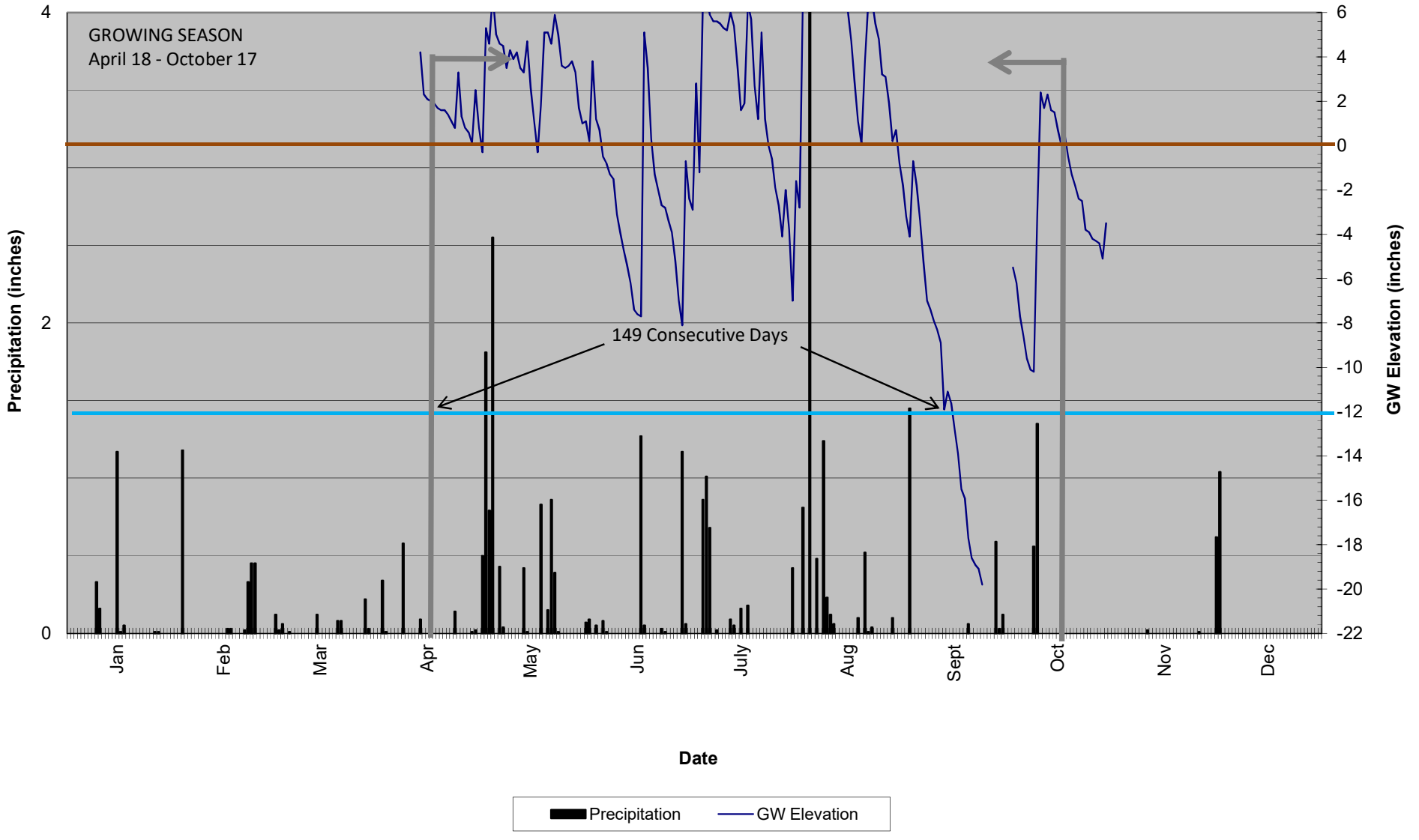
■ Precipitation — GW Elevation

Five Mile Branch Gauge #20 136AC084

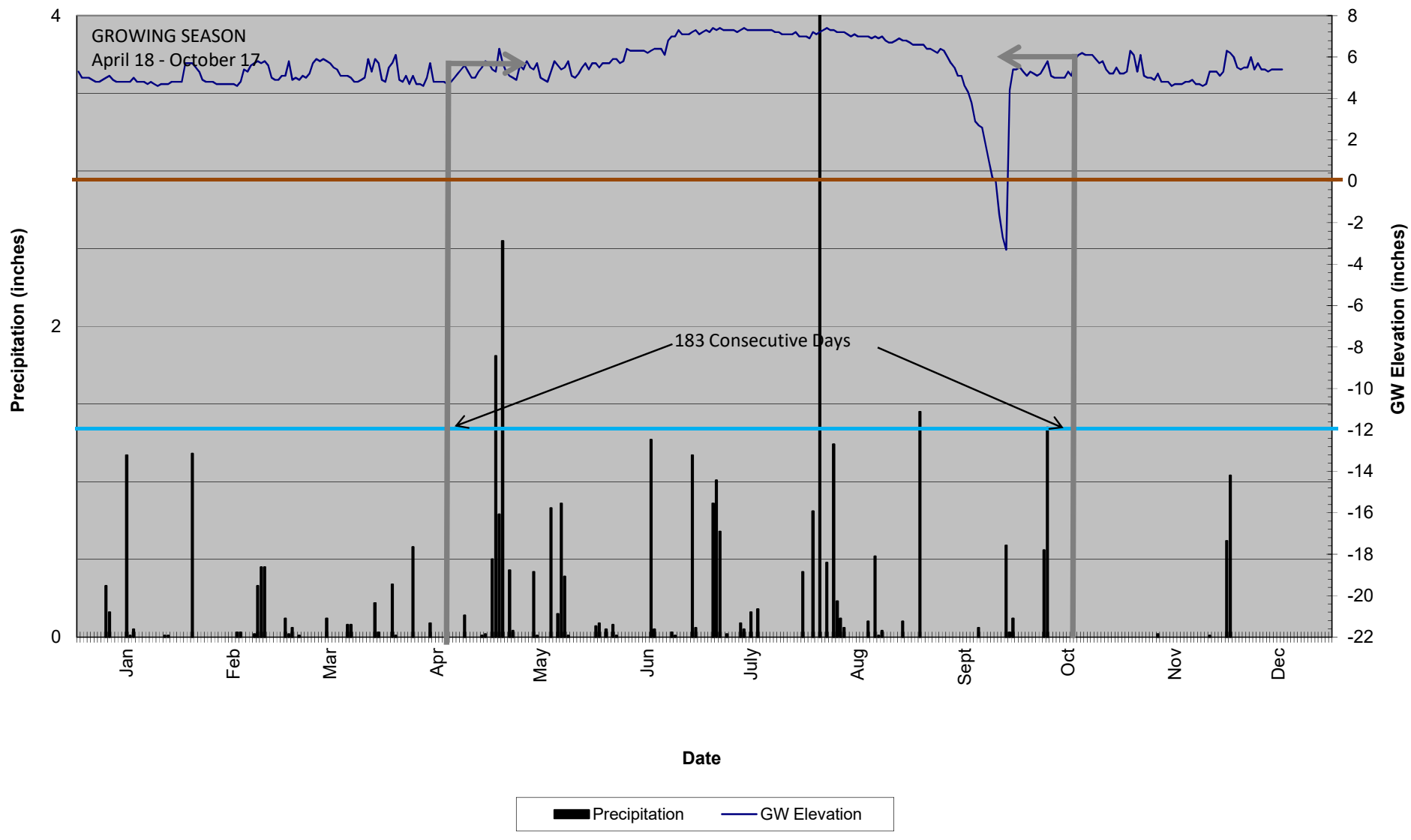


■ Precipitation — GW Elevation

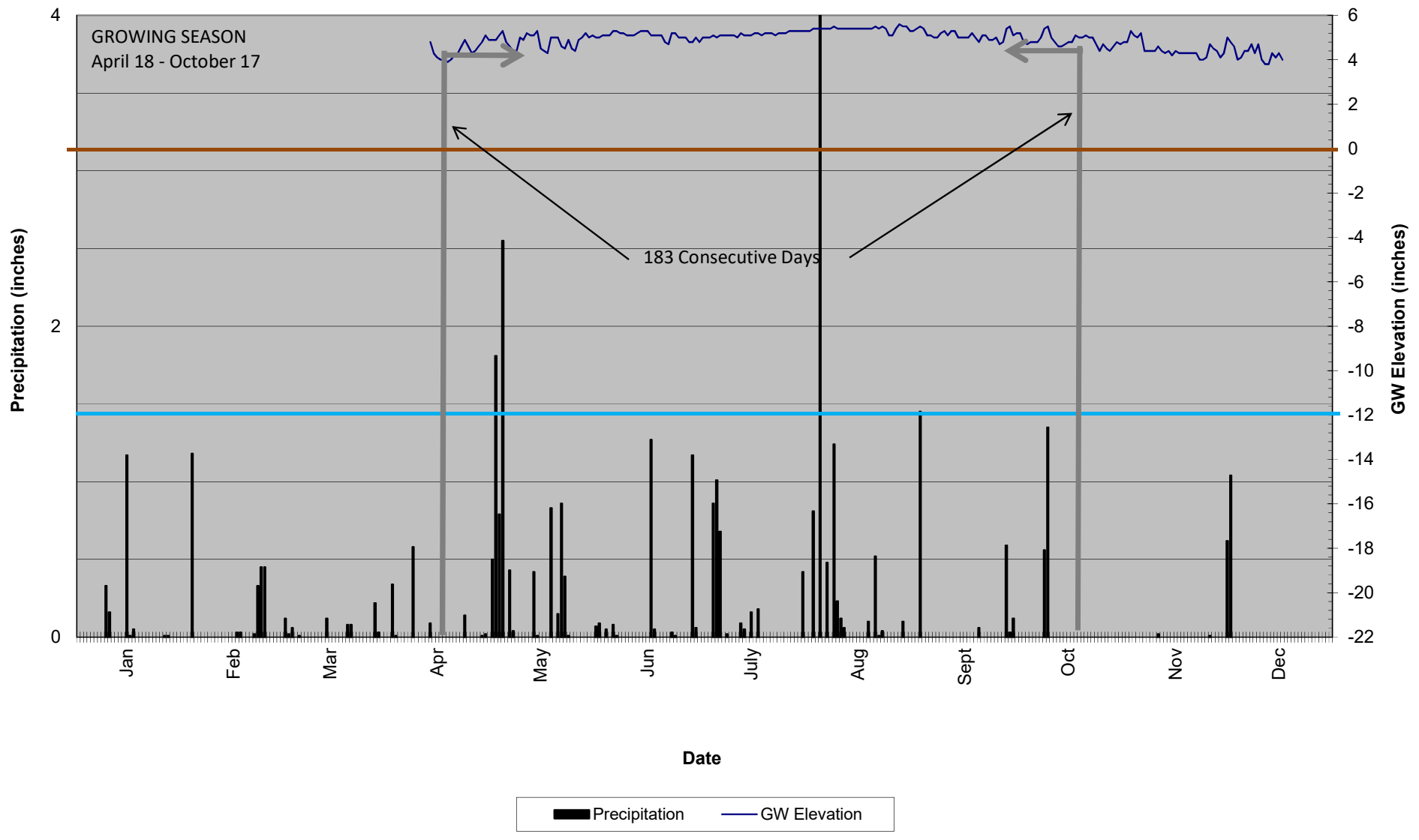
Five Mile Branch Gauge #21 9DE6D1F



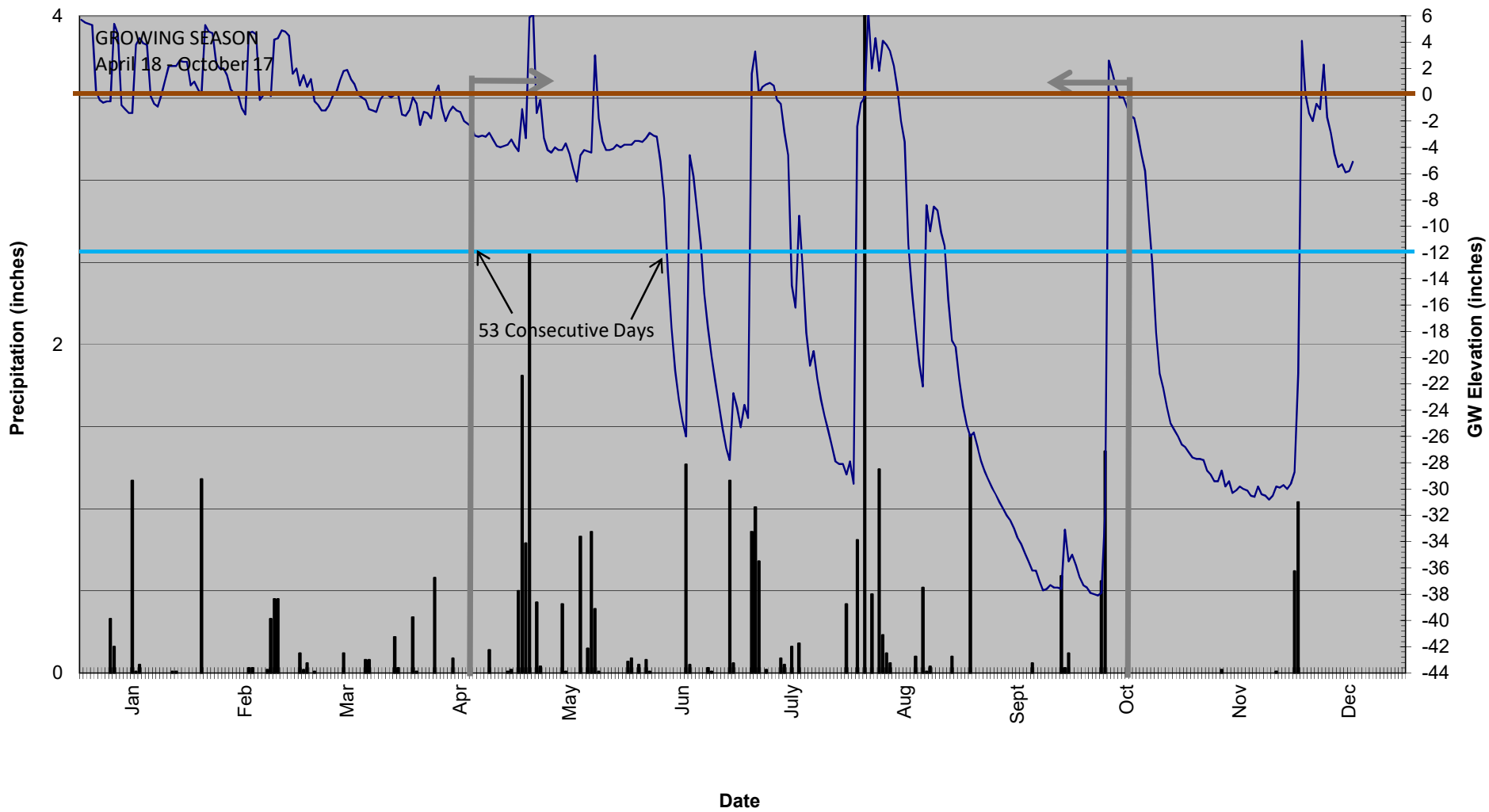
Five Mile Branch Gauge #22 EBD1038



Five Mile Branch Gauge #23 13D4B61D

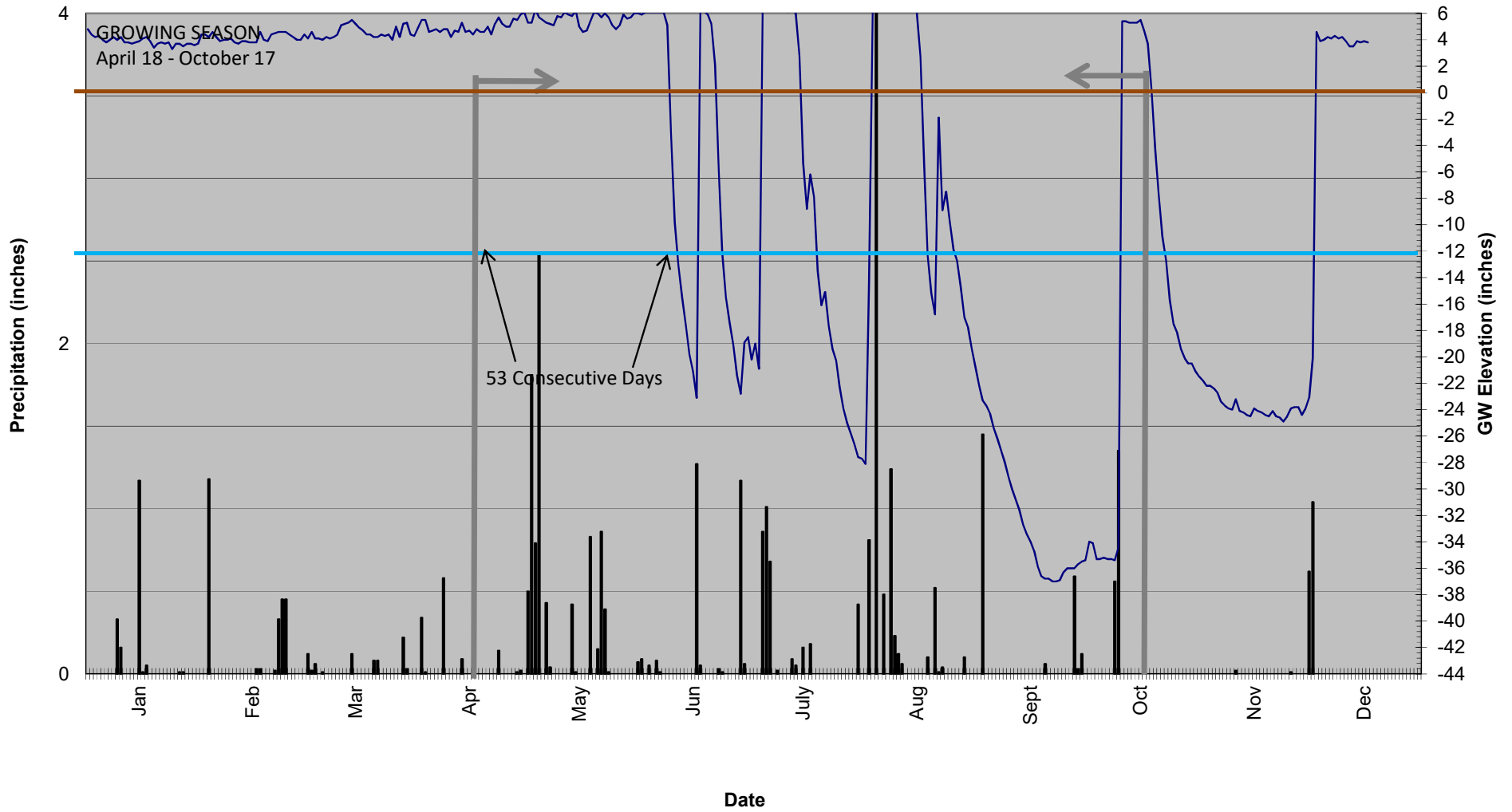


Five Mile Branch Gauge #24 A287DCE



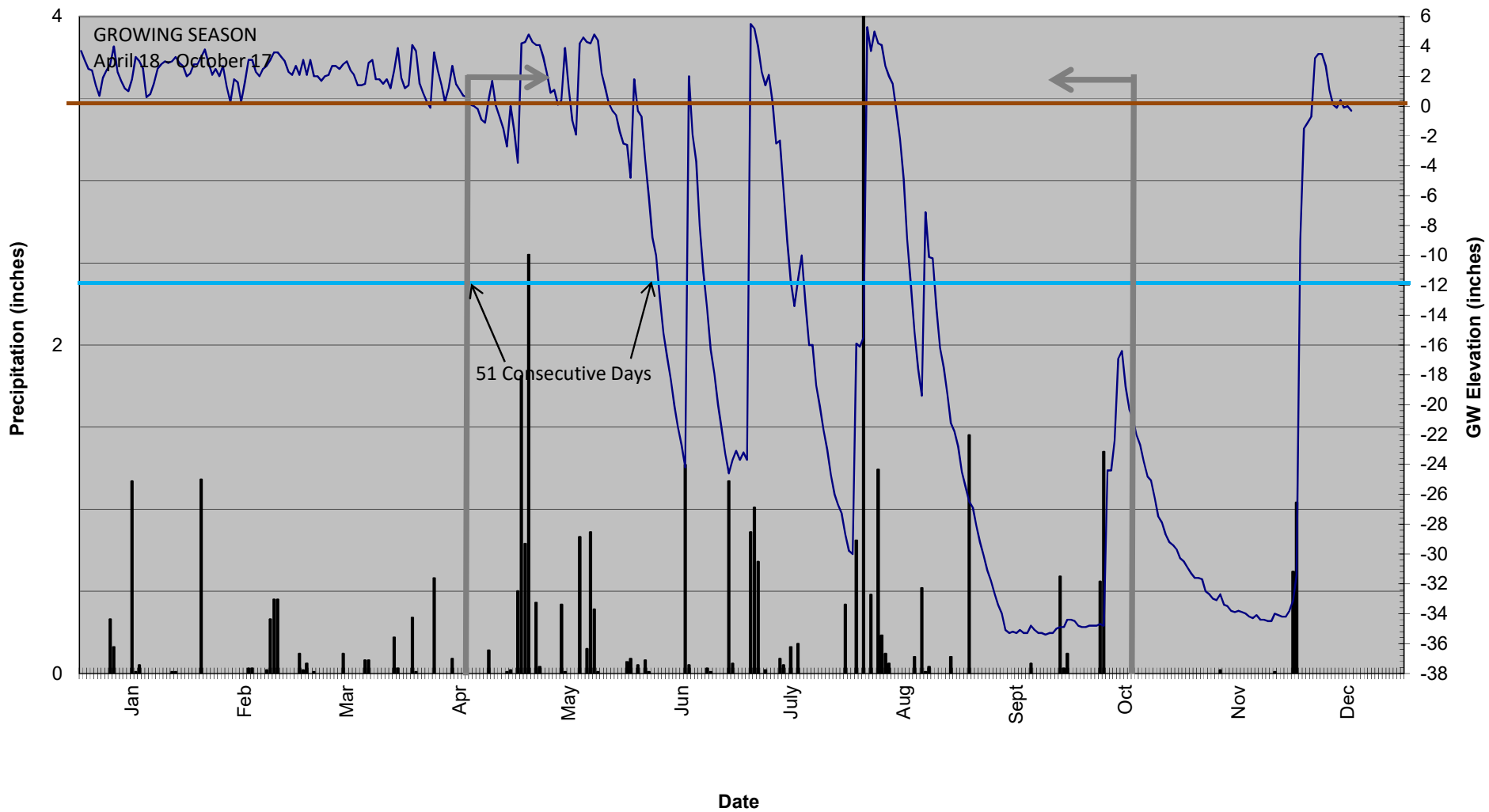
■ Precipitation — GW Elevation

Five Mile Branch Gauge #25 13D4B624



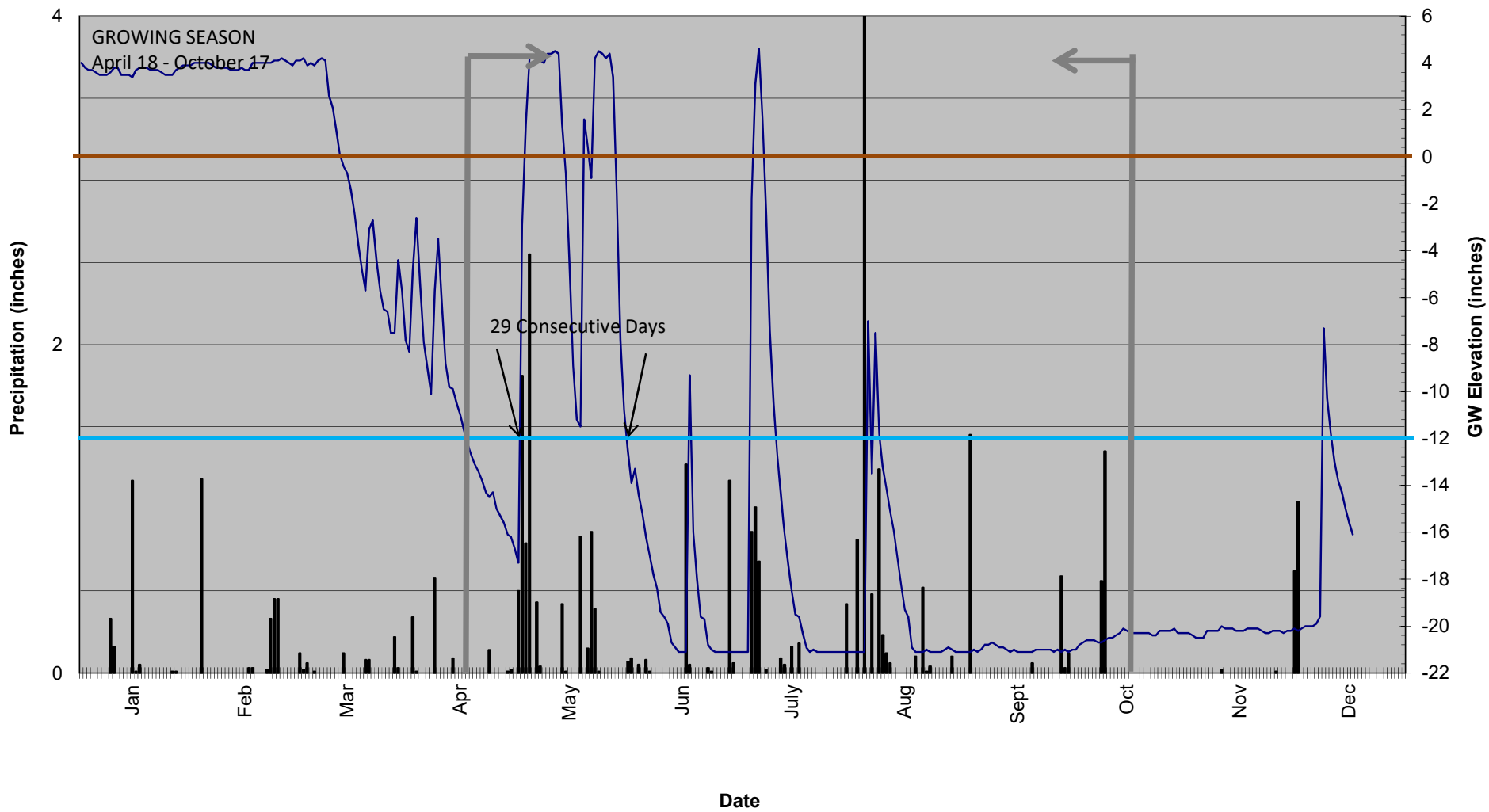
■ Precipitation — GW Elevation

Five Mile Branch Gauge #26 EBDD6BE



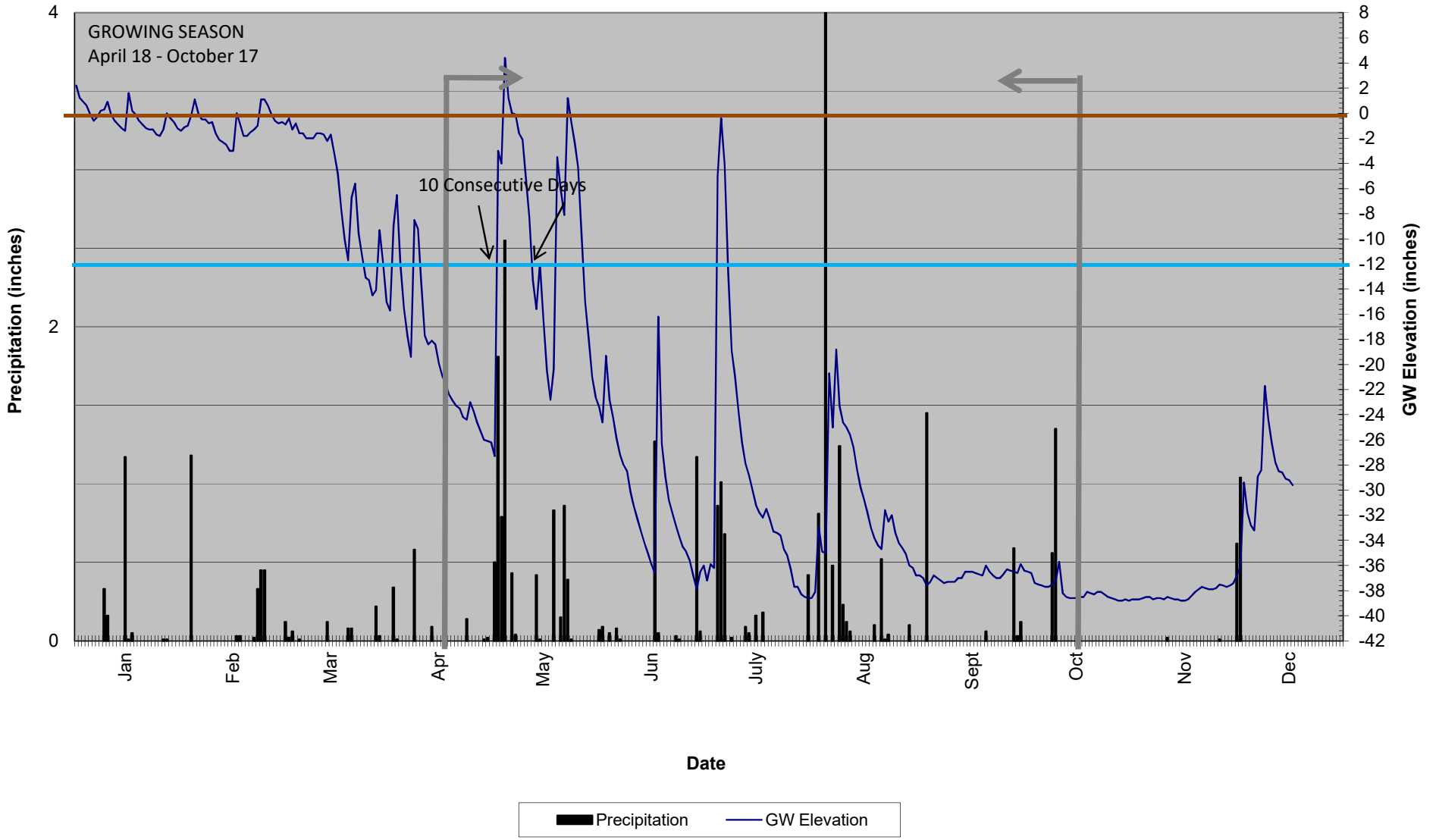
■ Precipitation — GW Elevation

Five Mile Branch Gauge #27 136B1CB7

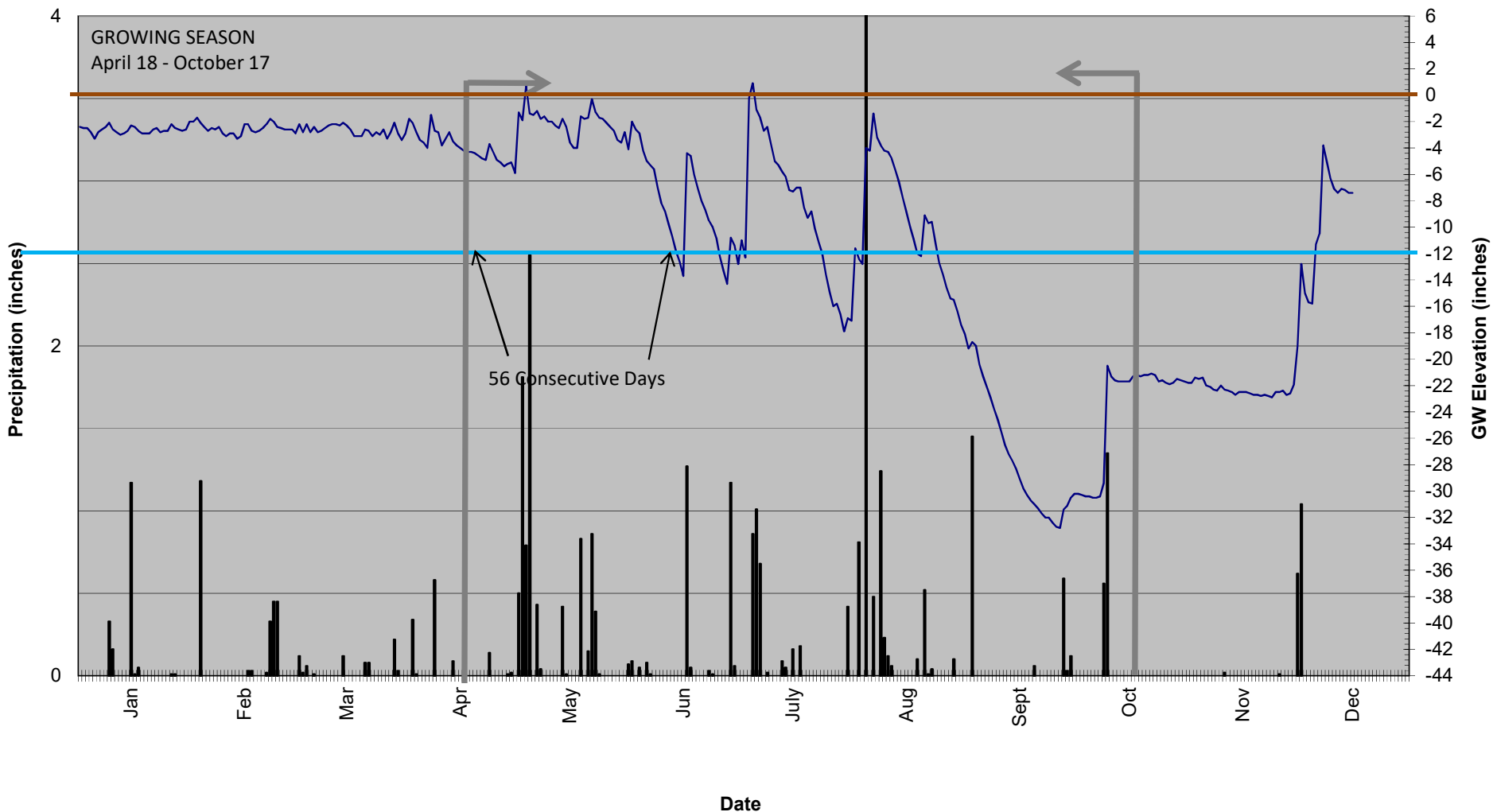


■ Precipitation — GW Elevation

Five Mile Branch Gauge #28 14E1973F

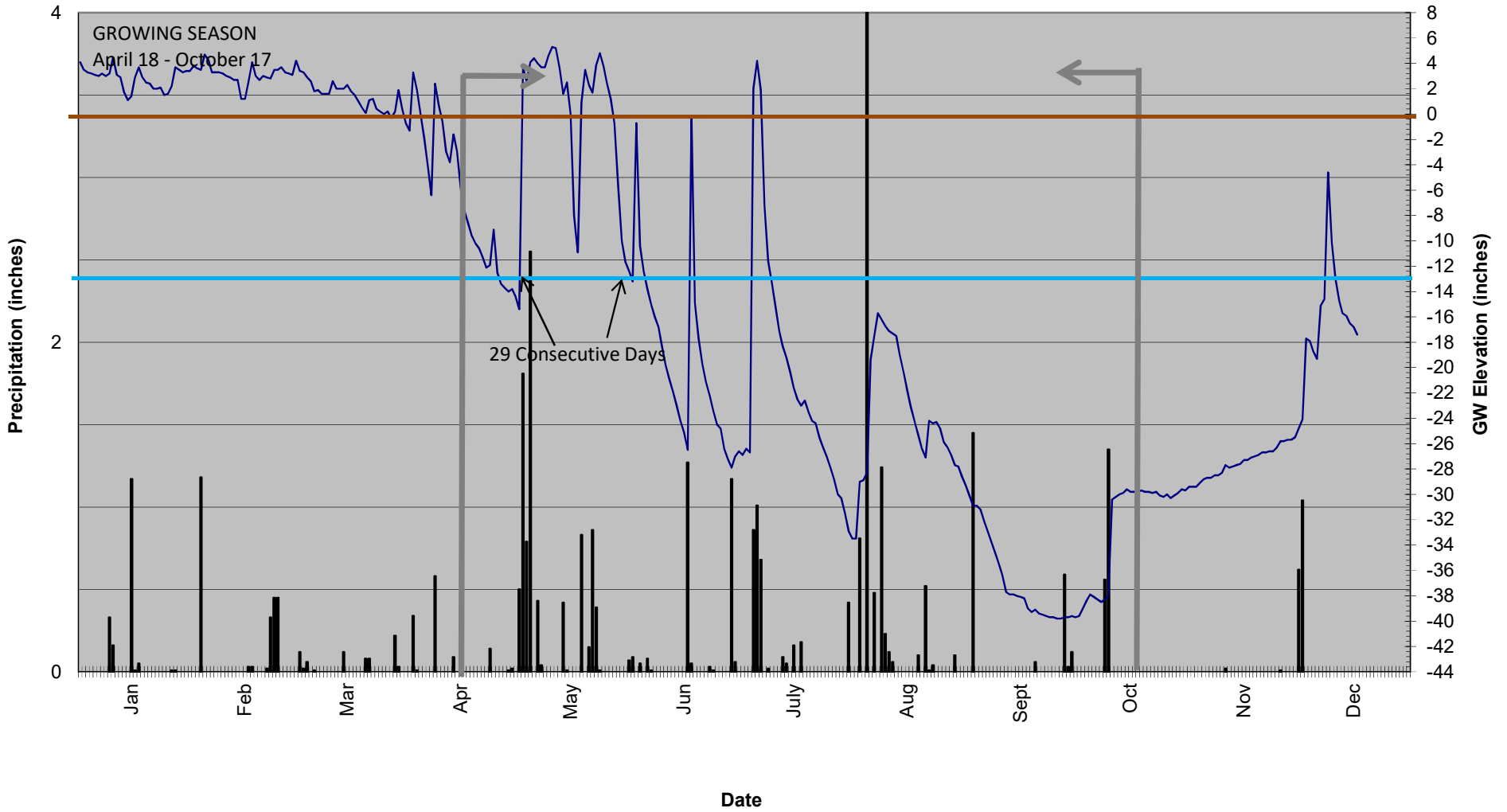


Five Mile Branch Gauge #29 14E177C0



■ Precipitation — GW Elevation

Five Mile Branch Gauge #30 13D4CA00



■ USGS Precipitation — GW Elevation



Appendix F

Beaver Creek



Photo Point 1. Boulder Vane 11/16/2016



Photo Point 3. Looking downstream 11/16/2016



Photo Point 1. Looking downstream 11/16/2016



Photo Point 4. Floodplain looking east 11/16/2016



Photo Point 2. Looking downstream 11/16/2016



Photo Point 4. Boulder Vane 11/16/2016

Beaver Creek



Photo Point 5. Cross Vane 11/16/2016



Photo Point 7. Floodplain looking east 11/16/2016



Photo Point 6. Boulder Vane 11/16/2016



Photo Point 7. Floodplain looking west 11/16/2016



Photo Point 7. Boulder Vane 11/16/2016



Photo Point 8. Floodplain pool looking east
11/16/2016

Beaver Creek



Photo Point 9. Cross Vane 11/16/2016



Photo Point 10. Floodplain looking west 11/16/2016

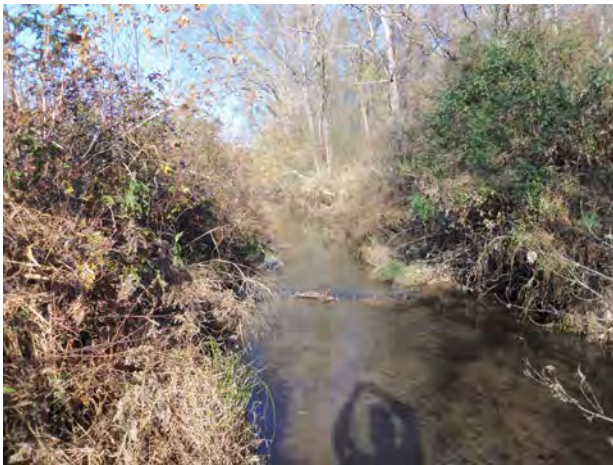


Photo Point 10. Cross Vane 11/16/2016



Photo Point 11. Looking downstream 11/16/2016



Photo Point 10. Floodplain looking east 11/16/2016



Photo Point 12. Floodplain looking west 11/16/2016

Beaver Creek



Photo Point 12. Floodplain pool looking east
11/16/2016



Photo Point 14. Floodplain pool looking east
11/16/2016



Photo Point 13. Floodplain pool looking west
11/16/2016



Photo Point 15. Floodplain pool looking west
11/16/2016



Photo Point 13. Floodplain looking east 11/16/2016



Photo Point 15. Floodplain looking east 11/16/2016

Beaver Creek



Photo Point 16. Looking downstream 11/16/2016



Photo Point 17. Floodplain looking north 11/16/2016



Photo Point 16. Looking upstream 11/16/2016



Photo Point 17. Floodplain looking east 11/16/2016



Photo Point 17. Floodplain looking west 11/16/2016



Photo Point 18. Cross Vane 11/16/2016

Beaver Creek



Photo Point 19. Boulder Vanes 11/16/2016



Photo Point 20. Looking downstream 11/16/2016



Photo Point 20. Looking upstream 11/16/2016

Fifth Creek Upstream of Beaver Creek



Photo Point 21. Rootwads 11/16/2016



Photo Point 23. Boulder Vane 11/16/2016



Photo Point 21. Looking downstream 11/16/2016



Photo Point 23. Looking downstream 11/16/2016



Photo Point 22. Cross Vane 11/16/2016



Photo Point 24. Rootwads 11/16/2016

Fifth Creek Upstream of Beaver Creek



Photo Point 24. Looking downstream 11/16/2016



Photo Point 26. Rootwads 11/16/2016



Photo Point 25. Cross Vane 11/16/2016



Photo Point 26. Looking downstream 11/16/2016



Photo Point 25. Cross Vane. Left arm scour. 11/16/2016



Photo Point 27. Floodplain pool looking west 11/16/2016

Fifth Creek Upstream of Beaver Creek



Photo Point 28. Floodplain looking west 11/16/2016

Fifth Creek Downstream of Beaver Creek



Photo Point 28. Confluence looking east 11/16/2016



Photo Point 30. Cross Vane 12/08/2016



Photo Point 29. Looking downstream 12/08/2016



Photo Point 31. Floodplain pool looking northwest 12/08/2016



Photo Point 29. Floodplain looking east 12/08/2016



Photo Point 31. Floodplain looking east 12/08/2016

Fifth Creek Downstream of Beaver Creek



Photo Point 32. Looking downstream 12/08/2016



Photo Point 34. Boulder Vane 12/08/2016



Photo Point 33. Floodplain looking west 12/08/2016



Photo Point 35. Boulder Vane 12/08/2016



Photo Point 34. Boulder Vane 12/08/2016



Photo Point 35. Boulder Vane 12/08/2016

Fifth Creek Downstream of Beaver Creek



Photo Point 36. Looking downstream 12/08/2016



Photo Point 37. Floodplain looking east 12/08/2016



Photo Point 36. Looking upstream 12/08/2016



Photo Point 38. Cross Vane 12/08/2016



Photo Point 37. Floodplain pool looking north 12/08/2016



Photo Point 38. Looking south 12/08/2016

Fifth Creek Downstream of Beaver Creek



Photo Point 39. Looking upstream 12/08/2016



Photo Point 40 Cross Vane 12/08/2016



Photo Point 39. Looking downstream 12/08/2016



Photo Point 40. Looking downstream 12/08/2016



Photo Point 39. Floodplain looking east 12/08/2016



Photo Point 41. Floodplain looking west 12/08/2016



Appendix G

Stream Problem Areas MY4 2016
Five Mile Branch 92185

Feature	Station	Suspected Cause	Photo #
Bank Erosion	19+00 BVR	Back eddy from structure	2499
Bank Erosion	23+00 BVR		2505
Bank Erosion	27+50 BVR	Back eddy from structure	2511
Bank Erosion	29+00 BVR		2512
Bank Erosion	30+25 BVR		N/A
Bank Erosion	31+25 BVR	Back eddy from structure	N/A
Bank Erosion	34+25 BVR		2514
Bank Erosion	41+00 BVR		2519
Bank Erosion	65+75 BVR	Back eddy from structure	N/A
Structure boulder settled/fell	25+25 BVR		2502
Structure boulder settled/fell	32+50 BVR		2513
Structure boulder settled/fell	37+25 BVR		N/A
Structure boulder settled/fell	60+75 BVR		2526
Structure boulder settled/fell	68+50 BVR		N/A
Bank Erosion	11+50 FTH		N/A
Bank Erosion	14+25 FTH		2536
Bank Erosion	17+25 FTH		2542
Structure boulder settled/fell	18+75 FTH		2545
Bank Erosion	32+00 FTH	Back eddy from structure	N/A
Bank Erosion	45+00 FTH		121
Bank Erosion	52+00 FTH	Back eddy from structure	110
Bank Erosion	54+00 FTH		107
Bank Erosion	59+00 FTH		106
Bank Erosion	67+00 FTH		99
Bank Erosion	73+25 FTH		94
Structure boulder settled/fell	32+50 FTH		84

Five Mile Branch Stream Problem Areas
NCDMS IMS# 92185
MY4 2016



Bank Erosion 19+00 BVR



Bank Erosion 29+00 BVR



Bank Erosion 23+00 BVR



Bank Erosion 34+25 BVR



Bank Erosion 27+50 BVR



Bank Erosion 41+00 BVR

Five Mile Branch Stream Problem Areas
NCDMS IMS# 92185
MY4 2016



Cross Vane 25+25 BVR



Bank Erosion 14+25 FTH



Cross Vane 32+50 BVR



Bank Erosion 17+25 FTH



Cross Vane 60+75 BVR



Bank Erosion 18+75 FTH

Five Mile Branch Stream Problem Areas
NCDMS IMS# 92185
MY4 2016



Bank Erosion 45+00 FTH



Bank Erosion 59+00 FTH



Bank Erosion 52+00 FTH



Bank Erosion 67+00 FTH



Bank Erosion 54+00 FTH



Bank Erosion 73+25 FTH

Five Mile Branch Stream Problem Areas
NCDMS IMS# 92185
MY4 2016



Cross Vane 32+50 FTH