# North Fork Mountain Creek Stream & Wetland Restoration

## Year 1 of 5 Final Monitoring Report

**Catawba County, North Carolina**
**NCEEP Project Number 94151**

**Prepared for:**
Environmental Banc and Exchange

909 Capability Drive, Suite 3100
Raleigh, NC 27606

**Prepared by:**
Equinox Environmental Consultation and Design, Inc.

37 Haywood Street, Suite 100
Asheville, NC 28801

**Submitted to**
NCDENR - Ecosystem Enhancement Program

1619 Mail Service Center
Raleigh, NC 27699

# TABLE OF CONTENTS

## LIST OF FIGURES



## LIST OF TABLES



## APPENDICES

# 1.0 SUMMARY

This annual monitoring report details the geomorphology, hydrology, and vegetation monitoring activities completed during the 2012 (Year 1 of 5) growing season on the North Fork Mountain Creek Stream & Wetland Mitigation Site. Construction of the site, including planting of trees and shrubs, was completed in May 2012.

This report presents the results of data collected from 26 cross sections, 2 crest gauges, 10 automated groundwater monitoring stations, 1 automated rain gauge, 14 vegetation monitoring plots, and 31 photographic reference locations; as specified in the approved Restoration Plan and Baseline Report (EBX 2009, 2012). Comparisons to reference data and the baseline report are included.

The stream design for the North Fork Mountain Creek Site involved restoration and enhancement associated with four stream reaches. Wetland components included riparian wetland restoration and creation. The Baseline survey documented the project generated 5,299 stream mitigation units and 2.81 riparian wetland mitigation units. An existing 0.97 acre wetland was preserved, but no wetland credits were allowed.

The Year 1 stream channel data indicates that the restored stream is generally stable and is providing the intended habitat and hydrologic functions. With the exception of some isolated areas of stream bed aggradation/degradation, the cross sections and visual assessments indicate little adjustment in stream dimension when compared to the as-built conditions. One bankfull event occurred at the project site during 2012.

Data from the groundwater gauges revealed the upper soil surfaces were saturated for more than eight percent of the growing season at six of the ten monitoring stations. This was in spite of the fact that the groundwater gauges were in place for only 171 of the 236 day growing season. Catawba County weather station data in conjunction with on-site rain gauges documented precipitation and was used to validate groundwater monitoring station data. On-site rainfall was below normal for the portion of the growing season monitored. Rainfall amounts were also highly variable; groundwater levels fluctuated in concert with the rainfall events.

Vegetation plot data for Year 1 indicates planted stem densities were between 607 and 1,295 stems per acre with an average of 902 planted stems per acre for the entire restoration site. Only 9% of planted stems were dead or missing. These data indicate that the planted stock were able to survive the highly variable rainfall and should be able to achieve the final success criterion of 210 planted stems per acre. Five commonly encountered woody volunteer species were document during the vegetation surveys. Herbaceous vegetation cover not only averaged 97% within the measured plots, but was well established throughout the project site. Herbicide treatment of exotic invasive plants scattered throughout the site contributed to the success of the herbaceous vegetation.

Summary information/data related to the occurrence 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. Additional background and supporting information

can be found in the Baseline Monitoring Report (EBX 2012) and in the Mitigation Plan (EBX 2011) documents.

# 2.0 INTRODUCTION

## 2.1 Project Description

The North Fork Mountain Creek Stream and Wetland Mitigation Site was identified and developed through the North Carolina Ecosystem Enhancement Program (NCEEP) full delivery process. The site is located approximately six miles south of Catawba, North Carolina in southeastern Catawba County (Figure 1). The project lies within the Piedmont physiographic region (NCGS 2004) and USGS (2002) Level III ecoregion. The North Fork Mountain Creek watershed is within Catawba River Basin 14-digit Hydrologic Unit Code 03050101150030 and the North Carolina Division of Water Quality (NCDWQ) sub-basin 03-08-32 (NCDWQ 2010).

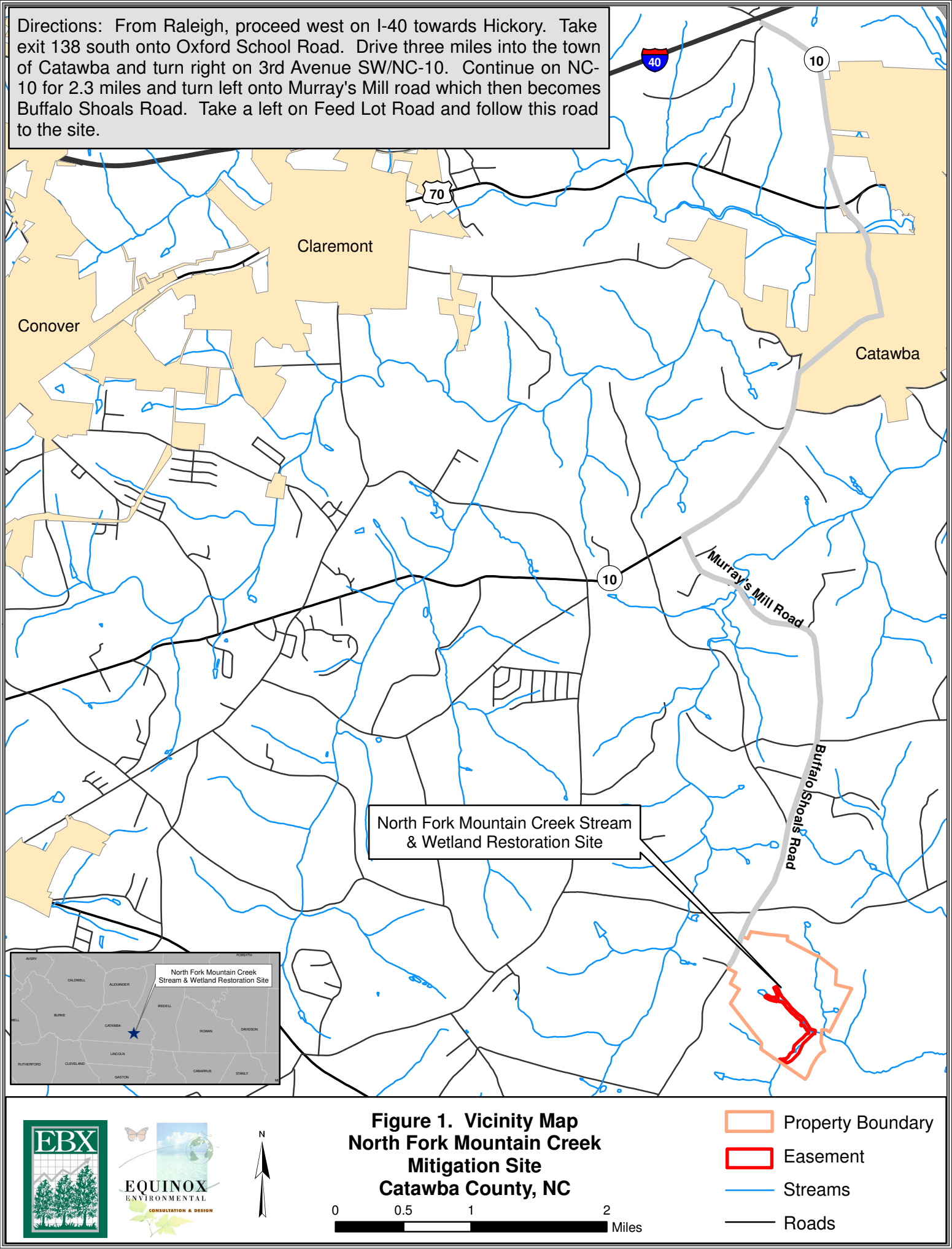
The project drains 960 acres of the North Fork Mountain Creek watershed that ranges in elevation from 875 to 1,065 feet above mean sea level (Figure 2). According to the Catawba County soil survey (NRCS 2010) the riparian corridor of the entire project is underlain by Chewacla loam (ChA) soils.

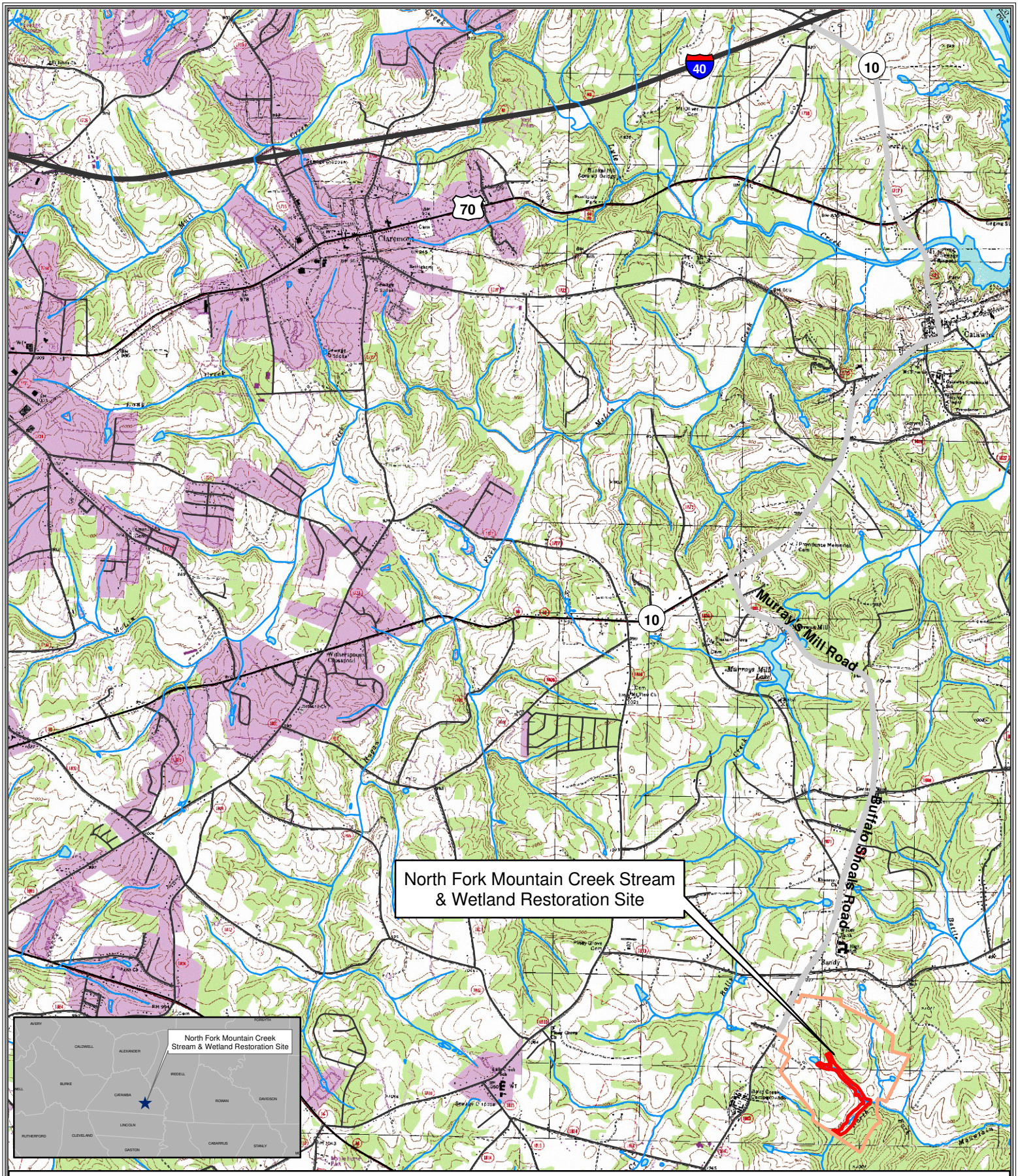
The mitigation site encompasses 17.2 acres containing 5,299 linear feet (lf) of stream channel and 4.44 acres of wetlands. The project consists of four reaches; reach 1 is on the mainstem of North Fork Mountain Creek, while reaches 2, 3, and 4 are on primary and secondary unnamed tributaries (UT1 and UT2) of North Fork Mountain Creek (Figure 3). Additional 0.97 acres of existing wetlands were preserved at the site; however, no mitigation credits were claimed for this wetland acreage per the RFP.

Channel restoration involving improved pattern, dimension, and longitudinal profile was completed on all four stream reaches. Priority I and II approaches were applied to the mainstem North Fork Mountain Creek (Rosgen 1996; NCSRI 2004), while only a Priority II approach was used on the tributary reaches. A total of 1.15 acres of wetlands were restored along reaches 1, 2, 3, and 4, while 3.27 acres of wetlands were created along reaches 2 and 4 (Figure 3).

Prior to restoration the stream channels and wetlands were highly disturbed due to the presence of livestock that had unfettered access to the riparian areas and stream channels. The riparian vegetation was decimated by overgrazing and trampling. The subsequently bare banks were then subject to severe erosion that was only exacerbated by hooves of the cattle.

The 2012 monitoring season represents Year 1 (MY1) of the required five-year monitoring period. Monitoring during 2012 included stream, wetland, and vegetation monitoring stations (Figure 3) as approved in the Baseline Monitoring Plan (EBX 2012).


Directions: From Raleigh, proceed west on I-40 towards Hickory. Take exit 138 south onto Oxford School Road. Drive three miles into the town of Catawba and turn right on 3rd Avenue SW/NC-10. Continue on NC-10 for 2.3 miles and turn left onto Murray's Mill road which then becomes Buffalo Shoals Road. Take a left on Feed Lot Road and follow this road to the site.
40
10
70
Claremont
Conover
Catawba
10
Murray's Mill Road
Buffalo Shoals Road
North Fork Mountain Creek Stream & Wetland Restoration Site
North Fork Mountain Creek Stream & Wetland Restoration Site
EBX
EQUINOX ENVIRONMENTAL CONSULTATION & DESIGN
N
Figure 1. Vicinity Map
North Fork Mountain Creek
Mitigation Site
Catawba County, NC
0
0.5
1
2
Miles
Property Boundary
Easement
Streams
Roads




EBX

EQUINOX ENVIRONMENTAL
CONSULTATION & DESIGN

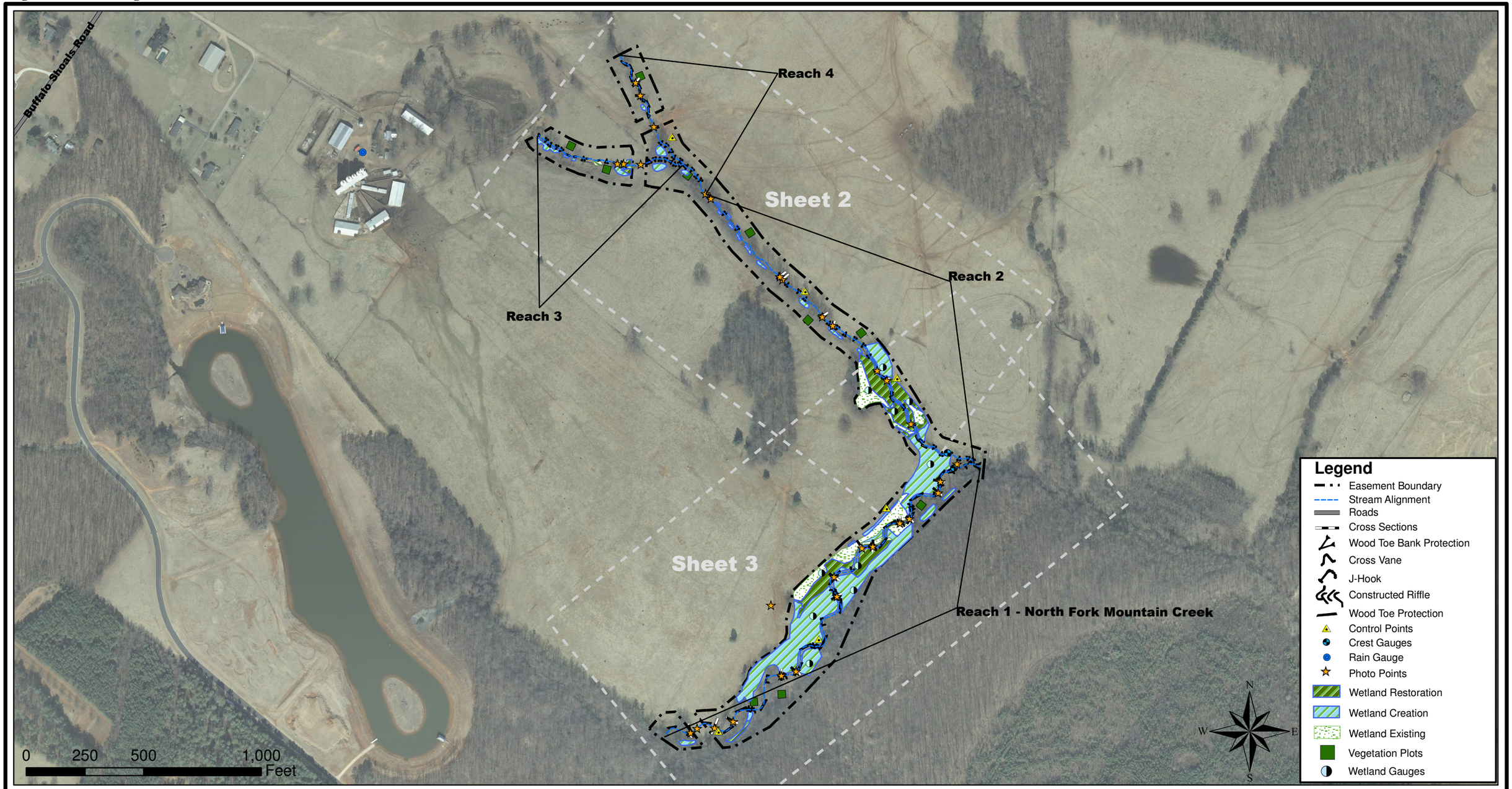
N

**Figure 2. USGS Map**
**North Fork Mountain Creek**
**Mitigation Site**
**Catawba County, NC**

0 0.5 1 2 Miles

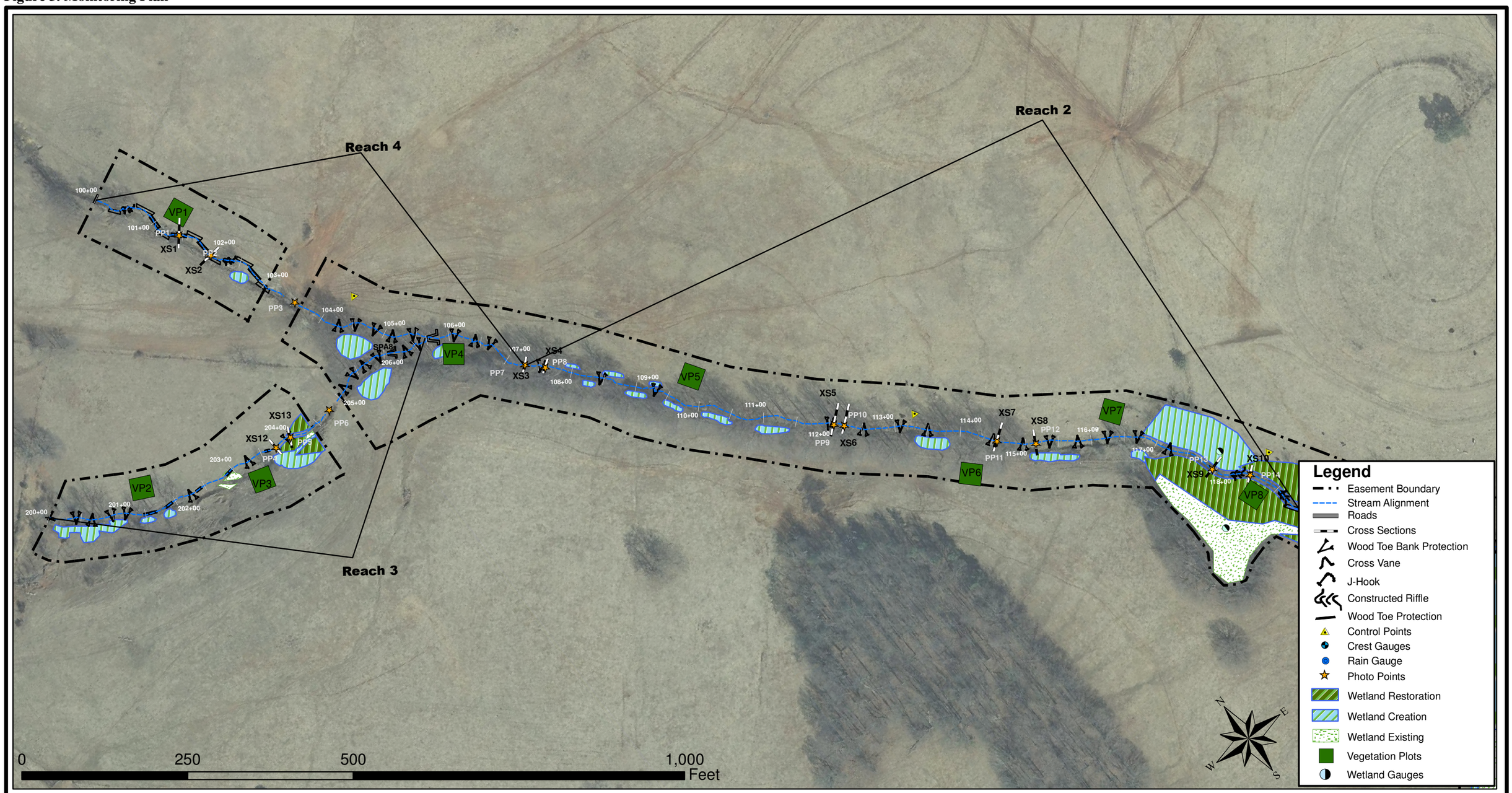
Property Boundary
Easement
Streams
Roads

**Figure 3. Monitoring Plan**




| Prepared for | **Project:** North Fork Mountain Creek Stream and Wetland Restoration Monitoring Plan<br>Catawba County, North Carolina | Notes: 1) 2010 Aerial Photo<br>2) Base Map Data Provided by Stantec. | Prepared by |
|---|---|---|---|
| EBX | Sheet 1 of 3 | | EQUINOX ENVIRONMENTAL CONSULTATION & DESIGN |
| | | Project Number | |
| | | NCEEP # 94151 | |

**Figure 3. Monitoring Plan**

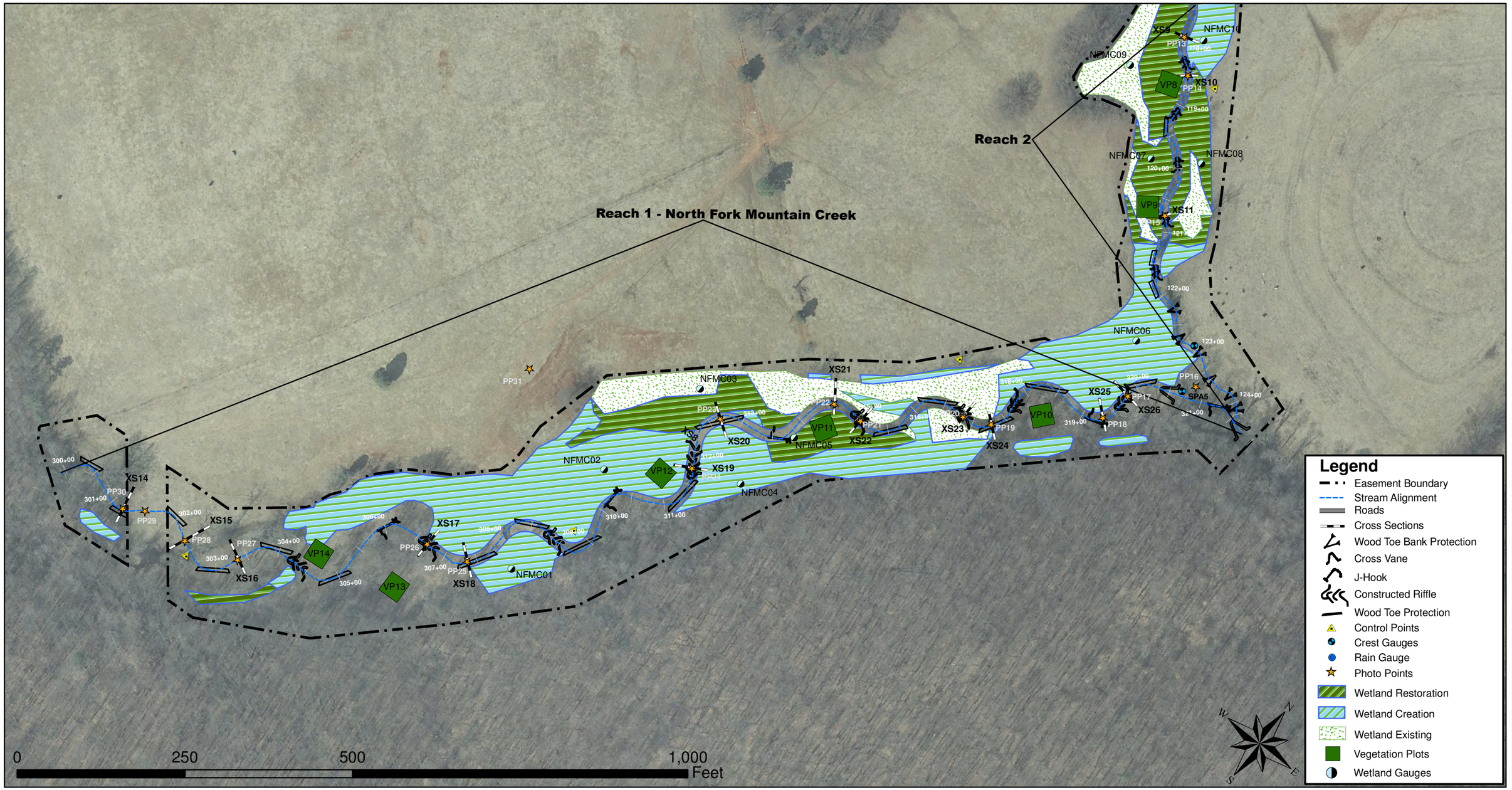



| | | |
|---|---|---|
| Prepared for | **Project:** North Fork Mountain Creek Stream and Wetland Restoration Monitoring Plan<br>Catawba County, North Carolina | Notes: 1) 2010 Aerial Photo<br>2) Base Map Data Provided by Stantec. |
| EBX | Sheet 2 of 3 | |
| | | Project Number |
| | | NCEEP # 94151 |

Prepared by

EQUINOX ENVIRONMENTAL CONSULTATION & DESIGN

**Figure 3. Monitoring Plan**




| Prepared for | | | Prepared by |
|---|---|---|---|
| EBX | **Project:** North Fork Mountain Creek Stream and Wetland Restoration Monitoring Plan<br>Catawba County, North Carolina | Notes: 1) 2010 Aerial Photo<br>2) Base Map Data Provided by Stantec. | EQUINOX ENVIRONMENTAL CONSULTATION & DESIGN |
| | Sheet 3 of 3 | | |
| | | Project Number | |
| | | NCEEP # 94151 | |

## 2.2 Project Purpose

The objective of the project was to provide 5,000 stream mitigation units (SMU's) and 3.4 riparian wetland mitigation units (WMU's) for the NCEEP full delivery process in the Catawba 03-08-32 sub-basin. In conjunction with providing mitigation credits; riparian habitat, aquatic habitat, and water quality improvements are an expected result of the ecological restoration and enhancement practices implemented on this site.

The North Fork Mountain Creek Baseline Report (EBX 2012) documented 5,299 linear feet of stream restoration (Table 1). Wetland mitigation components stated within the Baseline Report documented restoration of 1.17 acres of riparian wetlands and creation of an additional 3.27 riparian wetlands for a total of 2.81 WMUs (Table 1). An additional 0.97 acres of existing wetlands were preserved at the site, but for which no WMU credits were allowed per the RFP.

**Table 1. Project Mitigation Structure and Objectives**

| Reach Name | As-Built Length (feet) | Riparian Wetland (acres) | Non-Riparian Wetland (acres) | Total Wetland (acres) | Restoration Approach |
|---|---|---|---|---|---|
| NFMC-4 | 2,231 | | | | Restoration – P1/P2 |
| UT1-1 | 698 | | | | Restoration – P1 |
| UT1-2 | 1,756 | | | | Restoration – P1 |
| UT2-3 | 614 | | | | Restoration – P1 |
| W-R[1] | | 1.17 | | 4.44 | Restoration |
| W-C[1] | | 3.27[2] | | | Creation |
| W-P[1,3] | | 0.97[3] | | 0.97[3] | Preservation |
| Total Site | 5,299 | 4.44 | | 4.44 | |
| Total Mitigation Units | 5,299 | 2.81 | | | |

[1]W-R = wetlands restoration; W-C = wetlands creation; W-P = wetlands preservation.
[2]Wetland creation mitigation ratio was 2:1 as agreed upon with the USACE during the 401/404 permitting process (EBX 2012).
[3]Existing wetlands were preserved on the site, but no WMUs were credited to the project.

Annual monitoring of the site is required to demonstrate successful mitigation based on criteria established in the Restoration Plan (EBX 2011) and through a comparison to as-built and reference conditions (EBX 2012). The success criteria components adhere to guidance provided by the United States Army Corps of Engineers (USACE) – Wilmington District (USACE 2003; NCEEP 2011) and as prescribed by NCEEP in the restoration plan. Stream, hydrology, and vegetation monitoring are conducted annually for seven years or until success criteria have been met. This Annual Monitoring Report details the results of the monitoring efforts for MY1 at the North Fork Mountain Creek Stream and Wetland Mitigation Site. Findings of the MY1 monitoring efforts are described within the following sections and noted on the current condition plan view (CCPV) in Appendix A.

## 2.3 Project History and Schedule

Construction was completed in the spring of 2012 and the seven year monitoring is expected to be completed by the end of 2018 (Table 2). Service providers and primary contacts for the North Fork Mountain Creek project are listed in Table 3.

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

| Activity or Report | Data Collection Complete | Completion or Delivery |
|---|---|---|
| Restoration Plan | July 2011 | July 2011 |
| Final Design - Construction Plans | N/A | October 2011 |
| Construction | N/A | May 2012 |
| Temporary S&E mix applied to entire project | N/A | May 2012 |
| Permanent seed mix applied to Reach | N/A | May 2012 |
| Mitigation Plan / As-Built (Year 0 Monitoring - baseline) | June 2012 | August 2012 |
| Exotic Invasive Plant Control | June 2012 | June 2012 |
| Year 1 Monitoring – 2012 | December 2012 | January 2013 |
| Year 2 Monitoring – 2013 | | |
| Year 3 Monitoring – 2014 | | |
| Year 4 Monitoring – 2015 | | |
| Year 5 Monitoring – 2016 | | |

**Table 3. Project Contacts (NCEEP Project No. 94151)**

| Contact | Provider Information |
|---|---|
| **Designer**<br><br><br>Primary Project Design POC | Stantec Consulting, Inc.<br>801 Jones Franklin Rd. Suite 300<br>Raleigh, NC 27606<br>David Bidelspach (919) 218-0864 |
| **Construction Contractor**<br><br><br><br>Construction Contractor POC | North State Environmental, Inc.<br>2889 Lowery St.<br>Winston-Salem, NC 27101<br>Darrell Westmoreland (336) 725-2010<br>Nate Martin (336) 725-2010 |
| **Planting Contractor 1**<br><br><br>Planting Contractor 1 POC | New Forest Services<br>313 Condon Road<br>Manistee, MI 49660<br>Brian Jarvinen (231) 590-9198 |
| **Planting Contractor 2**<br>Planting Contractor 2 POC | Strader Farms, LLC<br>Kenneth Strader |
| Seed Mix Sources | Green Resource<br>5204 Highgreen Court<br>Colfax, NC 27235 |
| Nursery Stock Suppliers | ArborGen (Trees and Livestakes)<br>Blenheim, SC<br>Strader Farms (Livestakes) |
| **Baseline Monitoring Performers (Year 0)** | Stantec Consulting Services, Inc.<br>801 Jones Franklin Rd Suite 300<br>Raleigh, NC 27606 |
| Stream Monitoring POC | Tim Taylor (704) 329-0900 |
| Vegetation Monitoring POC | N/A |
| Wetland Monitoring POC | N/A |
| **Annual Monitoring Performers (Year 1-5)** | Equinox Environmental Consultation and Design, Inc.<br>37 Haywood St. Suite 100<br>Asheville, NC 28801 |
| Stream Monitoring POC | Kevin Mitchell (828) 253-6856 |
| Vegetation Monitoring POC | Kevin Mitchell (828) 253-6856 |
| Wetland Monitoring POC | Kevin Mitchell (828) 253-6856 |

# 3.0 STREAM MONITORING

The following success criteria descriptions are taken verbatim from the North Fork Mountain Creek Restoration Plan (EBX 2011).

## 3.1 Stream Success Criteria

Success criteria pertain to the stability of the restored channel's dimension, pattern, and sediment transport. The restored channel must demonstrate the general maintenance of a stable cross-section and have hydrologic access to the floodplain over the monitoring period. The restoration reach should mimic reference reach conditions and the channel will be considered stable if there are little or insignificant changes from the as-built dimensions. Some change in stream dimension is natural and expected.

### 3.1.1 Pattern Features and Cross-section Dimensions

Traditionally, the success of a stream's pattern and dimension is determined utilizing the dimensionless ratios of reference reaches. The range of values for the dimensionless ratios of the reference reaches are applied to the design reaches. In this case, design reaches are deemed successful if the variability of its pattern and dimension remain within the range of the dimensionless ratios taken from the reference reaches, plus or minus one-half the value of that range. For the North Fork Mountain Creek restoration project, dimensionless ratios of the design reaches vary slightly from the dimensionless ratios of the reference reaches. As a result, the restoration will be determined to be successful if the dimensionless ratios of the pattern and dimension of the restoration reaches remain within their 'as-built' range, plus or minus one-half the value of the range of the dimensionless ratios of the reference reaches. Pattern features (bedform distributions and riffle/pool lengths and slopes) should demonstrate little adjustment within the 5-year monitoring period. In terms of sediment transport, no significant trend in the aggradational or depositional potential of the restoration reaches should occur over the monitoring period. A minimum of two-bankfull events must be documented by crest gage [data] within the standard monitoring period.

## 3.2 Stream Morphology Monitoring Plan

The stability of the stream channel is being monitored for 5 years or until success criteria are met. The entire project is being monitored in depth for cross-sectional dimension and substrate composition as detailed below. These monitoring data are being collected in years 1, 2, 3, 4 and 5. The locations of the individual stream monitoring components described below are shown in Figure 3. The monitoring plan incorporates modified monitoring requirements as issued by NCEEP (2011) that were not specified in the original restoration plan (EBX 2011).

### 3.2.1 Visual Assessment

A visual assessment of stream stability is achieved by walking the all project reaches. Visual assessments are included to identify problem areas not encountered during cross-section measurement or visible in the graphical and tabular presentations of the monitoring data. Problem areas found during the visual assessments are documented by photos in Appendix D and their locations displayed on the CCPV (Appendix A).

### 3.2.2 Cross-Sections
A total of 26 cross-sections were installed as part of the baseline data collection effort; 14 in riffles and 12 in pools. Cross-sectional measurements are being collected in years 1, 2, 3, 4, and 5. Data collected and calculated for each cross-section will include, at a minimum, cross-sectional area, bankfull width, bankfull mean depth, bankfull max depth, flood-prone width, width-to-depth ratio, and entrenchment ratio. Stream type will be determined in riffle cross-sections only. Data is reported in graphical and tabular formats with each year's data overlain on the plots to allow changes in cross-sectional dimensions to be identified. Post-restoration, BEHI and near bank stress will not be monitored.

### 3.2.3 Longitudinal Profile
As per the recent guidance issued by NCEEP (2011), longitudinal profile data is collected only during the baseline survey unless monitoring demonstrates channel bank or bed instability, in which case the USACE may require additional channel profile data be collected from channel reaches of concern and to track changes in the channel stability. In lieu of the longitudinal profile data, extra cross-sections are being monitored. Should the USACE require longitudinal data be collected, they will be included in Appendix C of the monitoring reports and compared to baseline conditions.

### 3.2.4 Pattern
As per the recent guidance issued by NCEEP (2011), pattern data is collected only during the baseline survey unless monitoring demonstrates channel bank or bed instability, in which case the USACE may require additional channel profile data be collected from channel reaches of concern and to track changes in the channel stability. In lieu of the longitudinal profile data, extra cross-sections are being monitored. Should the USACE require longitudinal data be collected, they will be included in Appendix C of the monitoring reports and compared to baseline conditions.

### 3.2.5 Substrate
Pebble counts are being taken during monitoring years 1, 2, 3, 4, and 5 at each of the 14 riffle cross-sections (Figure 3) as well as one reach-wide count within each of the four delineated stream reaches (EBX 2012). Pebble counts are collected utilizing methods adapted from Harrelson et al. (1994). At each sample locations a minimum of 100 particles are selected at random and measured. Sampled materials are placed into size classes using the traditional Wentworth scale classes subdivided based on phi scale. These classes are grouped into broader sediment size categories (e.g. sand, gravel, or cobble) and are utilized to compare substrate changes from as-built conditions. Data is reported in graphical and tabular formats with each year's data overlain on the plots to allow trends in substrate composition to the identified. The D50, D84, and D95 particle sizes will be identified.

### 3.2.6 Photo Reference Stations
A total of 31 photo stations were established throughout the site to subjectively evaluate overall trends in project progression and general site conditions over the duration of the monitoring effort. For convenience, the photo stations were renumbered in a more logical sequence that differs from the baseline document (EBX 2012) and are labeled on the CCPV to correspond with the photos in Appendix D. Additionally, the entire site is visually assessed annually to document

stream (SPA) and wetland (WPA) problem areas. Once identified, problems areas will be monitored and conditions photo-documented in all subsequent monitoring years.

## 3.3 Stream Morphology Monitoring Results

The MY1 annual reference station photos were taken in November 2012 to document general conditions of the site. Stream cross-section and substrate data were collected in December 2012. Visual assessments and bankfull flow documentation were noted during each site visit.

### 3.2.1 Visual Assessment

Results from the MY1 visual monitoring effort indicated that all reaches generally remain in a stable condition and are functioning as designed. Several areas of minor riffle degradation and piping through structures were identified (Table 4 and Appendix D) as was one area of Japanese honeysuckle (*Lonicera japonica*) and one area of low stem densities. Prior to the MY1 visual assessment, other invasive exotic plants such as multiflora rose (*Rosa multiflora*), privet (*Ligustrum sp.*), and Johnson grass (*Sorghum halepense)* were found to be scattered throughout the easement area (Appendix A). Herbicides were applied to control these plants and to allow the new vegetation to become established. The herbicide treatments were effective in eliminating many of these plants. The treated areas will be closely observed for the remainder of the monitoring period.

**Table 4. Stream and Vegetation Problem Areas Requiring Observation**

| Problem Area and Type[1] | Feature | Reach | STA | Description | Recommendation |
|---|---|---|---|---|---|
| 1-S | Riffle | 1 | 305+50 | Degradation | Continue to monitor |
| 2-S | Riffle | 1 | 318+50 | Degradation | Continue to monitor |
| 3-S | Riffle | 1 | 320+50 | Degradation | Continue to monitor |
| 4-V | Bench | 2 | 118+00 | Low Stem Density | Replant |
| 5-V | Easement | 3 | 201+50 | Exotic Invasive | Treatment |
| 6-S | Riffle/Structure | 4 | 101+50 | Stressed Structure | Continue to monitor |
| 7-S | Structure | 4 | 102+30 | Stressed Structure | Continue to monitor |

[1]S = stream problem area; V = vegetation problem area

### 3.3.2 Cross-Sections

Cross-sectional data collected during MY1 have been compared with the baseline data set (Table 5; Appendices B and C). Except for cross-section 11, the MY1 channel cross-sectional data shows minimal changes since the baseline data were collected, indicating that the overall stream dimensions have remained stable. The stream bank at cross-section 11 appears to have migrated laterally about 2.5 feet when compared to the baseline data. Field observation determined this to be incorrect and was attributed to inconsistencies in surveying the correct pins between monitoring years. The misalignment of cross-sections 1 and 2 were due to the fact that the baseline survey pins could not be located and new pins were installed for the MY1 survey. Every effort was made to install the new pins as close as possible to the original cross-section location.

**Table 5. Summary of Mean Morphologic Monitoring Parameter Values**

| North Fork Mountain Creek – Reach 1 (n = 7) | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **As-Built[1]** | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** |
| Bankfull Cross-Section Area Abkf (sq ft) | 22.3 | 21.0 | | | | |
| Bankfull Width Wbkf (ft) | 18.6 | 18.8 | | | | |
| Bankfull Width/Depth Ratio | 15.7 | 17.0 | | | | |
| Bankfull Mean Depth Dbkf (ft) | 1.2 | 1.1 | | | | |
| Bankfull Max Depth Dmax (ft) | 2.1 | 2.2 | | | | |

[1]As-built data taken from Stantec (2012).

| Unnamed Tributary 1 – Reach 2 (n = 5) | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **As-Built[1]** | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** |
| Bankfull Cross-Section Area $A_{bkf}$ (sq ft) | 8.9 | 8.0 | | | | |
| Bankfull Width $W_{bkf}$ (ft) | 12.0 | 11.8 | | | | |
| Bankfull Width/Depth Ratio | 18.5 | 18.3 | | | | |
| Bankfull Mean Depth $D_{bkf}$ (ft) | 0.7 | 0.7 | | | | |
| Bankfull Max Depth $D_{max}$ (ft) | 1.4 | 1.4 | | | | |

[1]As-built data taken from Stantec (2012).

| Unnamed Tributary 1 – Reach 4 (n = 1) | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **As-Built[1]** | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** |
| Average Bankfull Cross-Section Area $A_{bkf}$ (sq ft) | 4.7 | 4.2 | | | | |
| Average Bankfull Width $W_{bkf}$ (ft) | 7.8 | 8.4 | | | | |
| Average Bankfull Width/Depth Ratio | 12.8 | 16.5 | | | | |
| Average Bankfull Mean Depth $D_{bkf}$ (ft) | 0.6 | 0.5 | | | | |
| Average Bankfull Max Depth $D_{max}$ (ft) | 0.9 | 0.8 | | | | |

[1]As-built data taken from Stantec (2012).

**Table 5 Continued. Summary of Mean Morphologic Monitoring Parameter Values**

| Unnamed Tributary 2 – Reach 3 (n = 1) | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **As-Built[1]** | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** |
| Bankfull Cross-Section Area $A_{bkf}$ (sq ft) | 4.2 | 3.8 | | | | |
| Bankfull Width $W_{bkf}$ (ft) | 7.2 | 8.3 | | | | |
| Bankfull Width/Depth Ratio | 12.5 | 17.9 | | | | |
| Bankfull Mean Depth $D_{bkf}$ (ft) | 0.6 | 0.5 | | | | |
| Bankfull Max Depth $D_{max}$ (ft) | 1.0 | 0.9 | | | | |

[1]As-built data taken from Stantec (2012).

### 3.3.3 Longitudinal Profile

Longitudinal profile data were not collected as part of the MY1 monitoring effort. It will be collected only if the USACE determines it is necessary to document channel instability. Baseline longitudinal profile attributes are documented in Appendix C.

### 3.3.4 Pattern

Pattern data were not collected as part of the MY1 monitoring effort. It will be collected only if the USACE determines it is necessary to document channel instability. Baseline pattern attributes are documented in Appendix C.

### 3.3.5 Substrate

Pebble count data collected during MY1 indicates that silt/clay dominate the substrate in Reach 4, whereas substrates in the other three reaches are fairly evenly distributed among size classes (Appendix B). The fine substrate in Reach 4 is most likely due to cattle access upstream of the project. Similar data were not taken during the baseline survey so no comparisons can be made as to changes in substrate composition.

### 3.3.6 Photo Reference Stations

The MY1 reference station photos are included in Appendix D. Other than the problem areas identified in the visual assessment, the site is performing well. Stream channels and banks are stable with no significant bank erosion or sloughing. Vegetation, both herbaceous and woody stems in the wetland and upland areas, appears to becoming well established throughout the site. With but one exception, exotic invasive plant infestations have not become established.

## 3.4 Stream Conclusions

The MY1 morphological monitoring and visual assessments indicate a stable system when compared to the as-built conditions (Tables 4 and 5; Appendices B and C). While the majority of pools and riffles were of appropriate depth, stream areas of concern identified during MY1 were primarily associated with isolated cases of riffle degradation. These areas, along with the two vegetation problem areas, will be monitored during subsequent years to document changes

in their function. If it is determined these areas become problematic to project success, repair recommendations will be proposed and appropriate action will be taken.

# 4.0 HYDROLOGY

## 4.1 Hydrologic Success Criteria

### 4.1.1 Streams

A minimum of two-bankfull events must be documented by the crest gages within the 5-year monitoring period. Qualifying events may not occur within the same monitoring year.

### 4.1.2 Wetlands

As per USACE guidelines, wetlands exhibiting water within 12 inches of the surface consecutively between 5% and 12.5% of the growing season in most years may be considered wetlands (USACE 1987, 1992). The growing season at the North Fork Mountain Creek site extends from March 21 to November 11, a total of 236 days (EBX 2012). Restored wetland hydrology is being compared to reference wetland hydrology both on-site and at the South Fork project (NCEEP Project No. 346, unpublished data). Based on data collected on-site, an 8% hydroperiod will be used as success criteria for this project.

## 4.2 Hydrology Monitoring Plan

### 4.2.1 Streams

Two crest gages were installed on the site post-construction (Figure 3); one is located on Reach 1 - North Fork Mountain Creek, while the other is positioned on the lower end of Reach 2 on UT1. The crest gauges are being monitored to verify the occurrence of bankfull events over the 5-year monitoring period. The crest gauges are checked during each site visit to document the highest flow between visits. Gauge height readings are recorded during each visit; digital images of floodplain debris lines and sediment deposition are being taken to document annual bankfull events.

### 4.2.2 Wetlands

Visual monitoring of all wetland creation and restoration areas are being conducted two times per year and a minimum of five months apart, in each of the required seven years of post-construction monitoring. Visual monitoring is conducted by walking through each wetland area to identify and document areas of low stem densities or poor plant vigor, invasive plant species, beaver activity, herbivory, easement encroachments, indicators of livestock access, or other issues of concern.

*Groundwater*-Groundwater levels within the wetland creation and restoration areas are being monitored using 10 automated groundwater gauges (Figure 3). The groundwater gauges are distributed across the project site and in association with both existing and created/restored wetland areas. The gauges were installed at a minimum depth of 48 inches below the ground surface. Groundwater levels will be monitored annually for all seven years unless the success criteria are not met at which time the USACE may require additional monitoring. At a minimum, the gauges will continuously record groundwater levels for the entire growing season, March 21 through November 11, as described in the Baseline Report (EBX 2012).

As stated in the Restoration Plan (EBX 2011), the hydrology success criteria for the North Fork Mountain Creek site is based on improvements to the frequency and duration of soil saturation of the restored wetlands. Wetland performance will be compared to both on-site and off-site (South Fork Project; NCEEP Project Number 346, unpublished data) reference gauge data. The groundwater hydrological characteristics of the existing reference wetlands serve as the target performance standard for the restored wetlands. The restored wetlands are in similar landscape positions and should have hydrological responses similar to the reference wetlands.

To determine the average daily groundwater level, the wetland gauges are set to take hourly readings, which are then averaged for each day. Suspected erroneous readings are checked to validate the readings. Where inconsistencies occur, the erroneous measures are excluded from the daily average calculations.

*Rainfall*-As part of the monitoring program automated rain gauges were installed on-site and at the South Fork project locations. They are located in open areas to prevent inaccurate readings due to overhead vegetation. The gauges automatically record rainfall with a tipping bucket calculated to record to 0.01 of an inch. Rain gauge data is downloaded bi-monthly and the units checked for malfunctions at the same time. Daily rainfall readings are summed to obtain monthly totals. Additional rainfall data for corresponding periods is downloaded from the NCCRONOS (2012) web site for the Hickory NC-CT-2 weather station. Long-term precipitation data for Catawba County was obtained from the NRCS National Water and Climate Center (NRCS 2002) web site.

*Data Interpretation*- The following hydroperiod statistics were calculated for each monitoring station:

1) Most consecutive days and percent of the growing season that the water table was within 12 inches of the soil surface;
2) Cumulative number of days and percent of growing season that the water table was within 12 inches of the soil surface; and
3) Number of times the water table rose to within 12 inches of the soil surface.

Individual groundwater and rain gauge data graphs were plotted and are presented in Appendix E. The graphs provide a visual representation of the relationship between rainfall events and groundwater level fluctuations among gauges. These comparisons are used to evaluate groundwater levels in relation to the hydrologic success criteria.

## 4.3 Results of Hydrology Monitoring

### 4.3.1 Streams

Since project completion in June 2012 one bankfull event has occurred at the project site. An initial bankfull event occurred in August 2012, which registered 0.58 feet above bankfull on UT1 - Reach 2 (Table 6). The crest gauge on North Fork Mountain Creek - Reach 1 was damaged from the event and, as a consequence, the water level above bankfull could not be determined; however, the event was photo-documented (Appendix D).

**Table 6. Crest Gauge Data**

| Month/Year Recorded | North Fork Mountain Creek Reach 1 (feet above bankfull) | UT1 Reach 2 (feet above bankfull) |
|---|---|---|
| August 2012 | --[1] | 0.58 |

[1]Crest Gauge was damaged from bankfull event; no reading was obtained; event was photo-documented (see Appendix D).

### 4.3.2 Wetland Hydrology

During Year 1, six of the ten groundwater gauges met the success criteria in spite of the fact that the wetland gauges were in place for only 180 of 236 days (76%) of the growing season. The portion of the entire growing season during which the maximum number of consecutive days groundwater levels were within 12 inches of the surface ranged from approximately 0.4 to 72.5 percent. In comparison, groundwater at the South Fork reference site met the criteria for at least 57.6 percent during the growing season (Table 7; Appendix E).

Cumulatively, eight of the gauges showed groundwater levels to be within 12 inches of the surface during the growing season, but none of them exceeded 72.5% of the period. Groundwater levels at the South Fork reference site appear to have been within 12 inches of the surface for 100% of the growing season if errant data are ignored.

Rainfall data indicate precipitation at the North Fork Mountain Creek was about 35% below normal for Catawba County (Table 8) over the period monitored in 2012. In comparison, precipitation was approximately 7% below normal at the Hickory NC-CT-2 station. Comparison to the South Fork data could not be made due to malfunction of the gauge for 25 days during the monitoring period. The highly variable rainfall events combined with the very low rainfall recorded in August could have been a causative factor in groundwater level fluctuations in the wetland areas of the North Fork Mountain Creek mitigation site (Figure 4).

**Table 7. Wetland Hydrologic Monitoring Results (Part 1 of 2)**

| 2012 Maximum Hydroperiod (Growing Season March 21 – November 11; 236 Days) | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gauge ID | Year 5 Consecutive | | Year 4 Consecutive | | Year 3 Consecutive | | Year 2 Consecutive | | Year 1[1] Consecutive | | Year 5 Cumulative | | Year 4 Cumulative | | Year 3 Cumulative | | Year 2 Cumulative | | Year 1[1] Cumulative | | Year 5 | Year 4 | Year 3 | Year 2 | Year 1 |
| | Days | Percent of Growing Season | Days | Percent of Growing Season | Days | Percent of Growing Season | Days | Percent of Growing Season | Days | Percent of Growing Season | Days | Percent of Growing Season | Days | Percent of Growing Season | Days | Percent of Growing Season | Days | Percent of Growing Season | Days | Percent of Growing Season | Occurrences | | | | |
| NFMC01 | | | | | | | | | 4 | 1.7 | | | | | | | | | 12 | 5.1 | | | | | 6 |
| NFMC02 | | | | | | | | | 86 | 36.4 | | | | | | | | | 142 | 60.2 | | | | | 6 |
| NFMC03 | | | | | | | | | 57 | 24.2 | | | | | | | | | 116 | 49.2 | | | | | 10 |
| NFMC04 | | | | | | | | | 5 | 2.1 | | | | | | | | | 15 | 6.4 | | | | | 9 |
| NFMC05 | | | | | | | | | 1 | 0.4 | | | | | | | | | 1 | 0.4 | | | | | 1 |
| NFMC06 | | | | | | | | | 87 | 36.9 | | | | | | | | | 137 | 58.1 | | | | | 7 |
| NFMC07 | | | | | | | | | 171 | 72.5 | | | | | | | | | 171 | 72.5 | | | | | 1 |
| NFMC08 | | | | | | | | | 57 | 24.2 | | | | | | | | | 122 | 51.7 | | | | | 10 |
| NFMC09 | | | | | | | | | 102 | 43.2 | | | | | | | | | 156 | 66.1 | | | | | 4 |
| NFMC10 | | | | | | | | | 12 | 5.1 | | | | | | | | | 40 | 16.9 | | | | | 11 |
| South Fork | | | | | | | | | 136[2] | 57.6[2] | | | | | | | | | 233[2] | 98.7[2] | | | | | 2[2] |

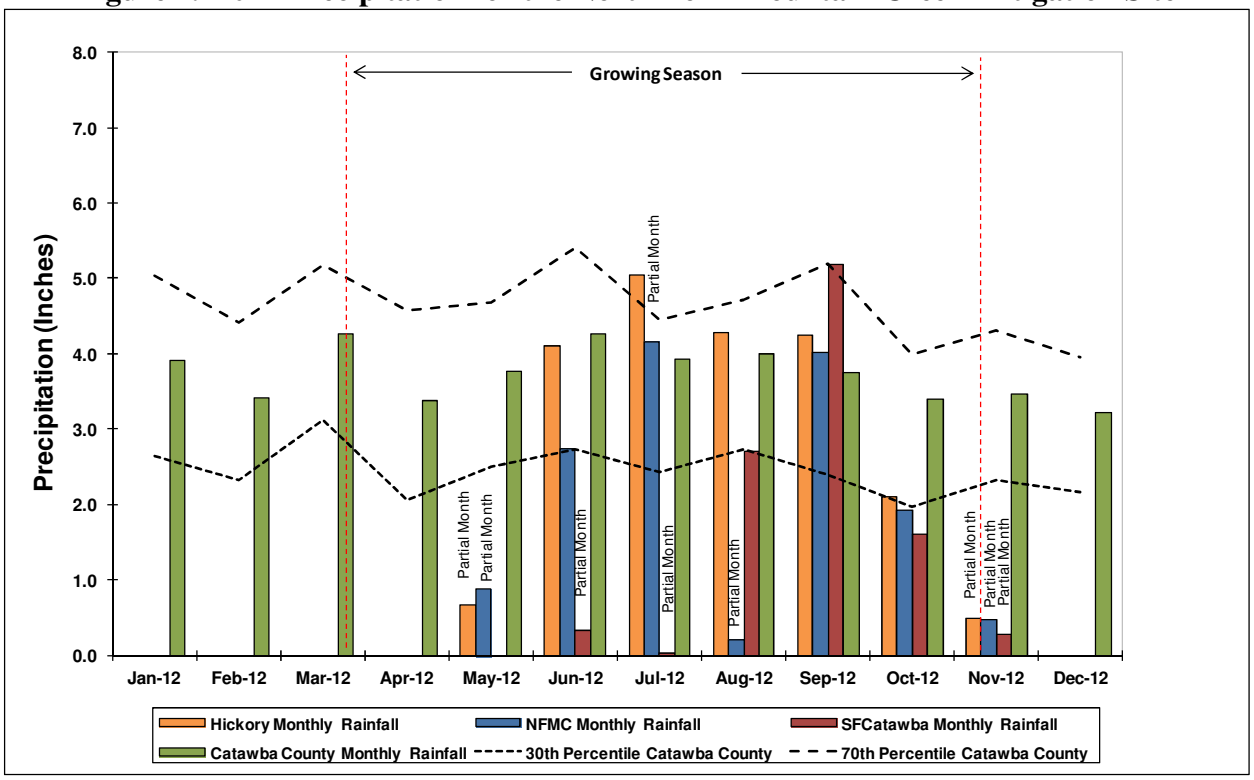
[1]Groundwater gauges not installed at North Fork Mountain Creek site until May 25, 2012, resulting in monitoring only 171 of the 266 days of the growing season.
[2]Data from three consecutive days were omitted from the analysis as they were considered erroneous, otherwise groundwater levels would have been within 12 inches of the surface for 100% (236 days) of the growing season.

**Table 8. Comparison of Normal Rainfall to 2012 Observed Rainfall**

| Month | Catawba County[1] | | | NCCRONOS Hickory NC-CT-2[1] Station Precipitation (inches) | NFMC Precipitation (inches) | South Fork Precipitation (inches) |
|---|---|---|---|---|---|---|
| | Average (inches) | Normal Limits (inches) | | | | |
| | | 30 Percent | 70 Percent | | | |
| January | 3.90 | 2.64 | 5.04 | -- | --[2] | --[2] |
| February | 3.42 | 2.33 | 4.41 | -- | --[2] | --[2] |
| March | 4.27 | 3.12 | 5.17 | -- | --[2] | --[2] |
| April | 3.37 | 2.06 | 4.57 | -- | --[2] | --[2] |
| May | 3.77 | 2.5 | 4.68 | 0.66 | 0.88[3] | --[2] |
| June | 4.27 | 2.73 | 5.41 | 4.11 | 2.73 | 0.33[3] |
| July | 3.92 | 2.43 | 4.45 | 5.05 | 4.16 | 0.02[3] |
| August | 4.00 | 2.73 | 4.71 | 4.28 | 0.20 | 2.70 |
| September | 3.75 | 2.39 | 5.20 | 4.24 | 4.01 | 5.18 |
| October | 3.40 | 1.96 | 3.98 | 2.10 | 1.92 | 1.60 |
| November | 3.47 | 2.33 | 4.30 | 0.49 | 0.47 | 0.27 |
| December | 3.21 | 2.17 | 3.96 | --[2] | --[2] | --[2] |
| Annual | 44.75 | | | --- | --- | --- |
| Period Total | 22.44 | --- | --- | 20.93 | 14.37 | 10.10[3] |

[1]Source NRCS (2002); NCCRONOS (2012); data retrieved for same days as NFMC and South Fork data.
[2]No data collected.
[3]NFMC rain gauge installed May 25 and retrieved November 20; South Fork rain gauge installed June 15 and retrieved November 20.; gauge malfunction for portion of the month; June = 6 days; July = 25 days.

**Figure 4. 2012 Precipitation for the North Fork Mountain Creek Mitigation Site**




## 4.4 Hydrology Conclusions

Given that one bankfull event was documented in 2012, it is highly likely that a second event will occur prior to the end of the monitoring period. This will satisfy the monitoring requirement that two bankfull events must occur in separate years. While some stream problem areas were noted, the stream channel is expected to stabilize and be able to withstand additional high flow events with little or no additional impact.

Groundwater levels at all gauge stations except numbers 07 and 09 appear to be closely related to rainfall events. Gauge 07 is located in a large wetland restoration area, whereas gauge 09 is located in an existing wetland area. The high variability in groundwater levels was likely caused by the highly variable rainfall pattern that occurred in 2012. Continued monitoring of the groundwater levels and rainfall will determine if wetland function is returning to the restored and created wetlands at the North Fork Mountain Creek Mitigation Site.

# 5.0 VEGETATION

## 5.1 Vegetation Success Criteria

The vegetative success of the Piedmont/Low Mountain Alluvial Forest and the Mesic Mixed Hardwood Forest will be evaluated based on the species density and percent survival. Vegetation monitoring will be considered successful if at least 210 woody stems/acre are surviving at the end of seven years. Seven year old desirable native volunteer species will be counted towards the 210 woody stems/acre threshold. Red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*) and pine (*Pinus* sp.) will be excluded from the desirable species list.

## 5.2 Vegetation Monitoring Plan

Fourteen 10 m X 10 m plots covering approximately 2.0% of the restoration areas were established within the project area (Figure 3). Five plots are located on North Fork Mountain Creek (Reach 1), seven are on UT1 (Reaches 2 and 4), and two are on UT2 (Reach 3). Vegetative sample plots are being quantitatively monitored during September of monitoring year 1 and June of years 2, 3, 4, and 5. Vegetation monitoring follows the CVS-EEP Level 2 Protocol for Recording Vegetation, version 4.2 (Lee et al. 2008) and includes analysis of species composition, density, and percent survival. The four corners of each plot were permanently located with rebar and photos of each plot taken from the origin are included in Appendix D. The vegetation monitoring plan included 23 tree and shrub species (Table 9)

Vegetative problem areas (VPAs) identified in the project are described and photo-documented. Once identified, these sites will be observed throughout the remainder of the monitoring period. Vegetative problems include areas that either lack vegetation or include populations of exotic vegetation. The root causes of these problems will be identified and remedial action recommendations included in monitoring reports.

**Table 9. Planted Tree Species**

| Common Name | Scientific Name | FAC Status |
|---|---|---|
| Willow Oak | *Quercus phellos* | FACW- |
| Water Oak | *Quercus nigra* | FAC |
| Swamp Chestnut Oak | *Quercus michauxii* | FACW- |
| White Oak | *Quercus alba* | FACU |
| Northern Red Oak | *Quercus rubra* | FACU |
| Laurel Oak | *Quercus laurifolia* | FACW |
| Shumard Oak | *Quercus shumardii* | FACW- |
| Overcup Oak | *Quercus lyrata* | OBL |
| Flowering Dogwood | *Cornus florida* | FACU |
| Silky Dogwood | *Cornus amomum* | FACW+ |
| River Birch | *Betula nigra* | FACW |
| Yellow Poplar | *Liriodendron tulipifera* | FAC |

**Table 9 Continued. Planted Tree Species**

| Common Name | *Scientific Name* | FAC Status |
|---|---|---|
| Tag Alder | *Alnus serrulata* | FACW+ |
| American Sycamore | *Platanus occidentalis* | FACW- |
| Green Ash | *Fraxinus pennsylvanica* | FACW |
| Buttonbush | *Cepalanthus occidentalis* | OBL |
| Ironwood | *Carpinus caroliniana* | FAC |
| Eastern Cottonwood | *Populus deltoids* | FAC+ |
| Black Walnut | *Juglans nigra* | FACU |
| Eastern Redbud | *Cercis canadensis* | FACU |
| Northern Spicebush | *Lindera benzoin* | FACW |
| Blackgum | *Nyssa sylvatica* | FAC |
| Bald Cypress | *Tastodium distichum* | OBL |

## 5.3 Results of Vegetation Monitoring

Results from the Year 1 vegetation monitoring documented 13 planted tree and shrub species within the monitoring plots (Table 10). Planted stem densities for the 10 plots ranged from 607 to 1,295 stems per acre (Table 11). Average planted stem density for the entire restoration site was found to be 902 stems per acre. Only 9% of planted stems were found to be dead or missing during MY1 monitoring. Planted stem mortality was highest at VP1, although the majority (85%) of planted stems observed in MY1 had good or excellent vigor scores.

A visual estimate of herbaceous vegetation cover within the monitoring plots is provided to assess the overall stability of the restoration site (Table 12). On average, herbaceous vegetation coverage is estimated to be 97% with individual plot values ranging from 80% to 100%.

Observations of herbaceous cover outside of the plots were noted during the visual assessment and are documented in Appendix A; representative photos are included in Appendix D. Herbaceous cover typically consists of dogfennel (*Eupatorium capillifolium*), goldenrod (*Solidago sp.*), horsenettle (*Solanum carolinensis*), soft rush (*Juncus effusus*), daisy fleabane (*Erigeron annuus*), and tickseed sunflower (*Bidens polylepis*). Overall, herbaceous cover has become well established and is expected to increase as a result of natural recruitment from adjacent wooded areas.

**Table 10. Results of 2012 Vegetation Monitoring by Plot**

| Species | North Fork Mountain Creek – Reach 1 | | | | | UT1 – Reach 2 | | | | | UT1 – Reach 4 | | UT2 Reach 3 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Plot ID | | | | | Plot ID | | | | | Plot ID | | Plot ID | |
| | VP10 | VP11 | VP12 | VP13 | VP14 | VP5 | VP6 | VP7 | VP8 | VP9 | VP1 | VP4 | VP2 | VP3 |
| *Alnus serrulata* | | | 1 | 2 | | | | | | | | | | |
| *Betula nigra* | 6 | | 7 | | 4 | | | | 4 | 3 | | | | |
| *Carpinus caroliniana* | 1 | 4 | 2 | | | | | | | | | | | |
| *Cephalanthus occidentalis* | | | 2 | 1 | 1 | | | | | | | | | |
| *Cornus amomum* | | | | | | | | | | | | | | 3 |
| *Fraxinus pennsylvanica* | 2 | 3 | 1 | 1 | 7 | | 1 | 4 | 2 | 4 | 2 | 9 | 4 | 1 |
| *Juglans nigra* | 2 | 1 | | 1 | 1 | | | | | 1 | | 1 | | 3 |
| *Liriodendron tulipifera* | 5 | 3 | | 4 | 2 | 9 | 6 | | | | 3 | 2 | 2 | 5 |
| *Platanus occidentalis* | 3 | 9 | 8 | 2 | 1 | 4 | 2 | 14 | 12 | 12 | 1 | 13 | 3 | 2 |
| *Quercus* | | | | | | | 1 | 1 | 1 | | | | | |
| *Quercus alba* | | | | | | | 3 | 1 | | | | | | 1 |
| *Quercus phellos* | 4 | 4 | 3 | 4 | | 4 | 4 | 8 | 5 | 6 | 1 | 6 | 6 | 7 |
| *Quercus rubra* | | | | 1 | | 8 | 2 | 2 | | | 8 | | 2 | |

**Table 11. Summary of Vegetation Monitoring Results**

| Reach ID | Plot ID | Stems Planted | 2012 Stems | Percent Survival | Stems per Acre | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Stems Planted 2012 | 2012 Year 1 | 2013 Year 2 | 2014 Year 3 | 2015 Year 4 | 2016 Year 5 |
| NFMC-1 | VP10 | 24 | 23 | 96 | 971 | 931 | | | | |
| | VP11 | 26 | 24 | 92 | 1,052 | 971 | | | | |
| | VP12 | 24 | 24 | 100 | 971 | 971 | | | | |
| | VP13 | 17 | 16 | 94 | 688 | 647 | | | | |
| | VP14 | 17 | 16 | 94 | 688 | 647 | | | | |
| UT1-2 | VP5 | 26 | 25 | 96 | 1,052 | 1,012 | | | | |
| | VP6 | 20 | 19 | 95 | 809 | 769 | | | | |
| | VP7 | 36 | 30 | 83 | 1,456 | 1,214 | | | | |
| | VP8 | 24 | 24 | 100 | 971 | 971 | | | | |
| | VP9 | 32 | 26 | 81 | 1,295 | 1,052 | | | | |
| UT1-4 | VP1 | 23 | 15 | 65 | 931 | 607 | | | | |
| | VP4 | 31 | 31 | 100 | 1,254 | 1,255 | | | | |
| UT2-3 | VP2 | 18 | 17 | 94 | 728 | 688 | | | | |
| | VP3 | 24 | 22 | 92 | 971 | 890 | | | | |
| | | | | Averages | 989 | 902 | | | | |

**Table 12. Estimated Herbaceous Total Percent Cover**

| Reach ID | Plot ID | Estimated Herbaceous Cover (%) |
|---|---|---|
| NFMC-1 | VP10 | 100 |
| | VP11 | 98 |
| | VP12 | 98 |
| | VP13 | 100 |
| | VP14 | 98 |
| UT1-2 | VP5 | 100 |
| | VP6 | 98 |
| | VP7 | 100 |
| | VP8 | 100 |
| | VP9 | 100 |
| UT1-4 | VP1 | 95 |
| | VP4 | 80 |
| UT2-3 | VP2 | 95 |
| | VP3 | 100 |

Five commonly encountered woody volunteer or natural species were documented during the MY1 vegetation monitoring surveys (Table 13). The limited numbers of plants observed is not unexpected since they have had less than one year to become established, the site is somewhat removed from mature seed sources, and the site was extensively disturbed during restoration activities. Natural recruitment is expected to increase over time as additional seeds are deposited in the project site.

**Table 13. Volunteer Tree Species Documented**

| Common Name | Scientific Name | FAC Status |
|---|---|---|
| Blackgum | *Nyssa sylvatica* | FAC |
| Yellow Poplar | *Liriodendron tulipifera* | FAC |
| Sumac | *Rhus spp.* | No Indicator |
| Sweetgum | *Liquidambar styraciflua* | FAC+ |
| Tag Alder | *Alnus serrulata* | FACW+ |
| Black Willow | *Salix nigra* | OBL |

## 5.4 Vegetation Conclusions

Overall, planted stems are surviving well at the North Fork Mountain Creek Stream and Wetland Restoration Site. Density of planted stems at all vegetation monitoring plots are well above the final success criterion of 210 woody stems/per acre that must be met at the end of seven years. Average stem density across the whole site for planted and volunteers combined is approximately 1,020 stems per acre.

Herbaceous vegetation is becoming well established and efforts to reduce competition from invasive exotic plant species appear to have been effective in allowing the native plants to thrive. Additional herbicide treatments will be considered should the invasive plants become a threat to project success.

# 6.0 CONCLUSIONS AND RECOMENDATIONS

Monitoring Year 1 data provides an initial look into how well the North Fork Mountain Creek Mitigation Site is performing. Evidence that the project site is meeting expectations is as follows:

- No major problems areas of structure integrity or channel stability were identified.
- Stream channels remained intact following a bankfull flow event
- Wetland function, while appearing to be good, was affected by the highly variable rainfall events occurring during the 2012 growing season.
- Planted vegetation is surviving well
- Only one minor invasive plant problem was identified; previous treatment of scattered invasive plants has effectively reduced their competition with native species
- Comparisons of baseline and MY1 data reveal no significant deviations from the as-built conditions

Overall the stream, hydrologic, and vegetative conditions at the North Fork Mountain Creek Mitigation Site appear to be performing as expected less than one year after construction. No changes in the monitoring plan are recommended at this time.

# 7.0 REFERENCES


EBX (Environmental Banc & Exchange). 2011. North Fork Mountain Creek Stream and Wetland Restoration, Restoration Plan, Catawba County, North Carolina. NCEEP Project No. 94151.

EBX (Environmental Banc & Exchange). 2012. North Fork Mountain Creek Stream and Wetland Restoration Final Baseline Monitoring Document and As-Built Baseline Report. Catawba County, North Carolina. NCEEP Project Number 94151. Prepared by Stantec Consulting Services, Inc. for EBX. Raleigh.

Harrelson, Cheryl, C. Rawlins and J. Potyondy. 1994. Stream Channel Reference Sites: An Illustrated Guide to Field Technique. Gen. Tech. Rep. RM-245. Rocky Mountain Forest and Range Experiment Station. USDA Forest Service. Fort Collins, Colorado.

Lee, M.T., Peet, R.K., Roberts, S.D. and T.R. Wentworth. 2008. CVS-EEP Protocol for Recording Vegetation. Version 4.2. http://cvs.bio.unc.edu/methods.htm; accessed November 2008

NCCRONOS (North Carolina Climate Retrieval and Observations Network of the Southeast Database). 2012. State Climate Office of North Carolina. Version 2.7.2. Hickory 2.4 Station ID No. NC-CT-2. http://www.nc-climate.ncsu.edu/cronos/; accessed November 2012.

NCDWQ (North Carolina Division of Water Quality). 2010. Catawba River Basinwide Water Quality Plan.

NCEEP (North Carolina Ecosystem Enhancement Program). 2011. Monitoring Requirements and Performance Standards for Stream and/or Wetland Mitigation. Dated November 7, 2011.

NCGS (North Carolina Geological Survey). 2004. Physiography of North Carolina. Map compiled by the Division of Land Resources. Raleigh.

NCSRI (North Carolina Stream Restoration Institute). 2004. Stream Restoration: A Natural Channel Design Handbook. North Carolina Stream Restoration Institute and North Carolina Sea Grant. Raleigh. http://www.bae.ncsu.edu/programs/extension/wqg/srp/guidebook.html; accessed November 2012

NRCS (Natural Resources Conservation Service). 2002. Climate Analysis for Wetlands by County. Catawba County Period of Record 1976-2000. http://www.wcc.nrcs.usda.gov/climate/wetlands.html; accessed November 2012.

NRCS (Natural Resources Conservation Service). 2010. Web Soil Survey for Catawba County. http://www.websoilsurvey.nrcs.usda.gov; Accessed November 2012.

Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, Colorado.

USACE (U.S. Army Corps of Engineers). 1987. Corps of Engineers Wetlands Delineation Manual. Tech report Y-87-1. AD/A176.

USACE (U.S. Army Corps of Engineers). 1992. Clarification and Interpretation of the 1987 Manual. Memo to USACE districts from Headquarters, US Army Corps of Engineers, Washington, DC, March 6, 1992; signed by MG Arthur E. Williams, Directorate of Civil Works.

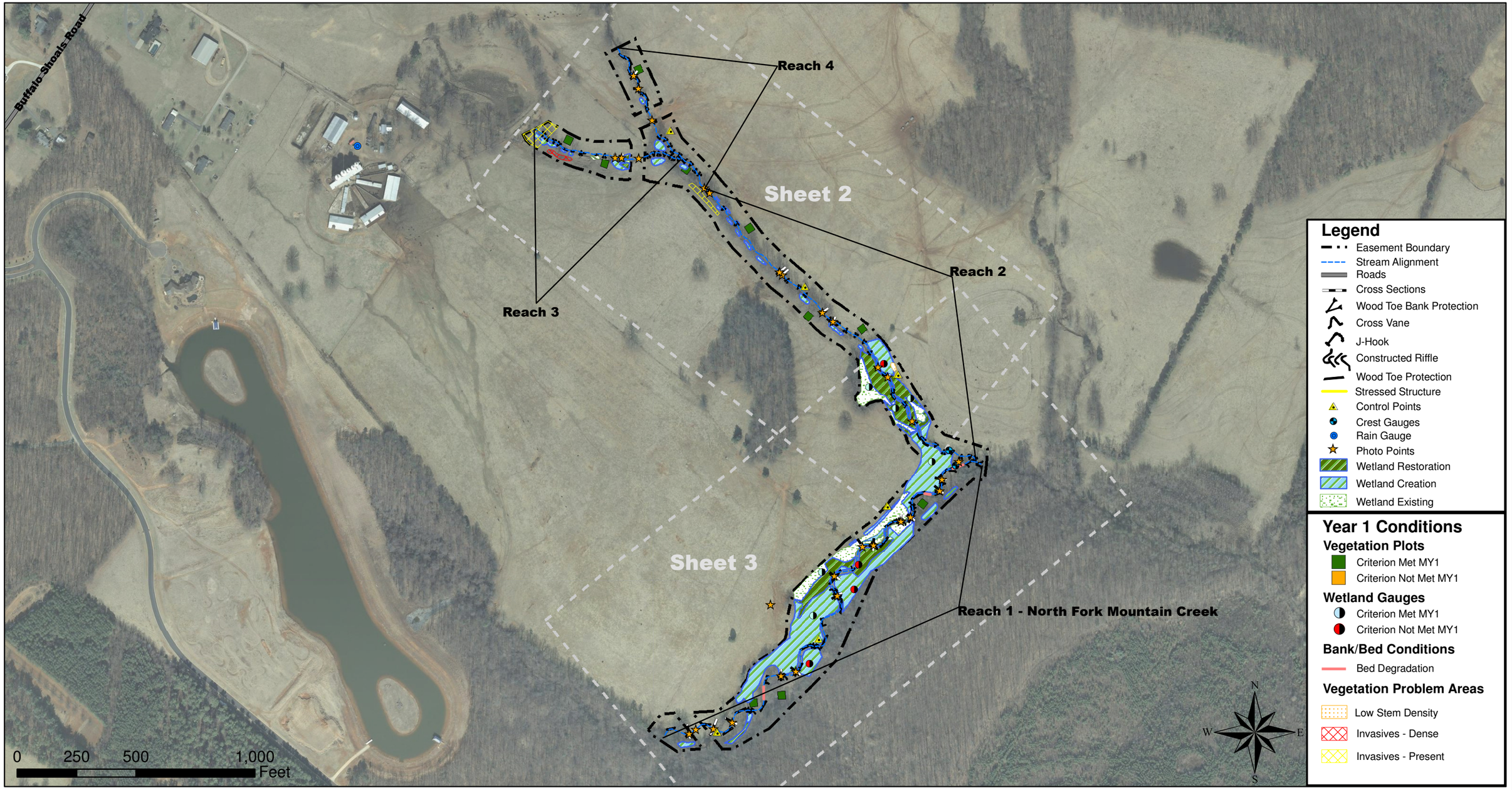
USACE (U.S. Army Corps of Engineers). 2003. Stream Mitigation Guidelines. U.S. Army Corps of Engineers – Wilmington District, U.S. Environmental Protection Agency, North Carolina Wildlife Resources Commission, and North Carolina Department of Environment and Natural Resources Division of Water Quality. Wilmington, North Carolina.

USGS (U.S. Geological Survey). 2002. Ecoregions of North Carolina and South Carolina. Color poster with map, descriptive text, summary tables, and photographs. Reston, Virginia.

# APPENDIX A

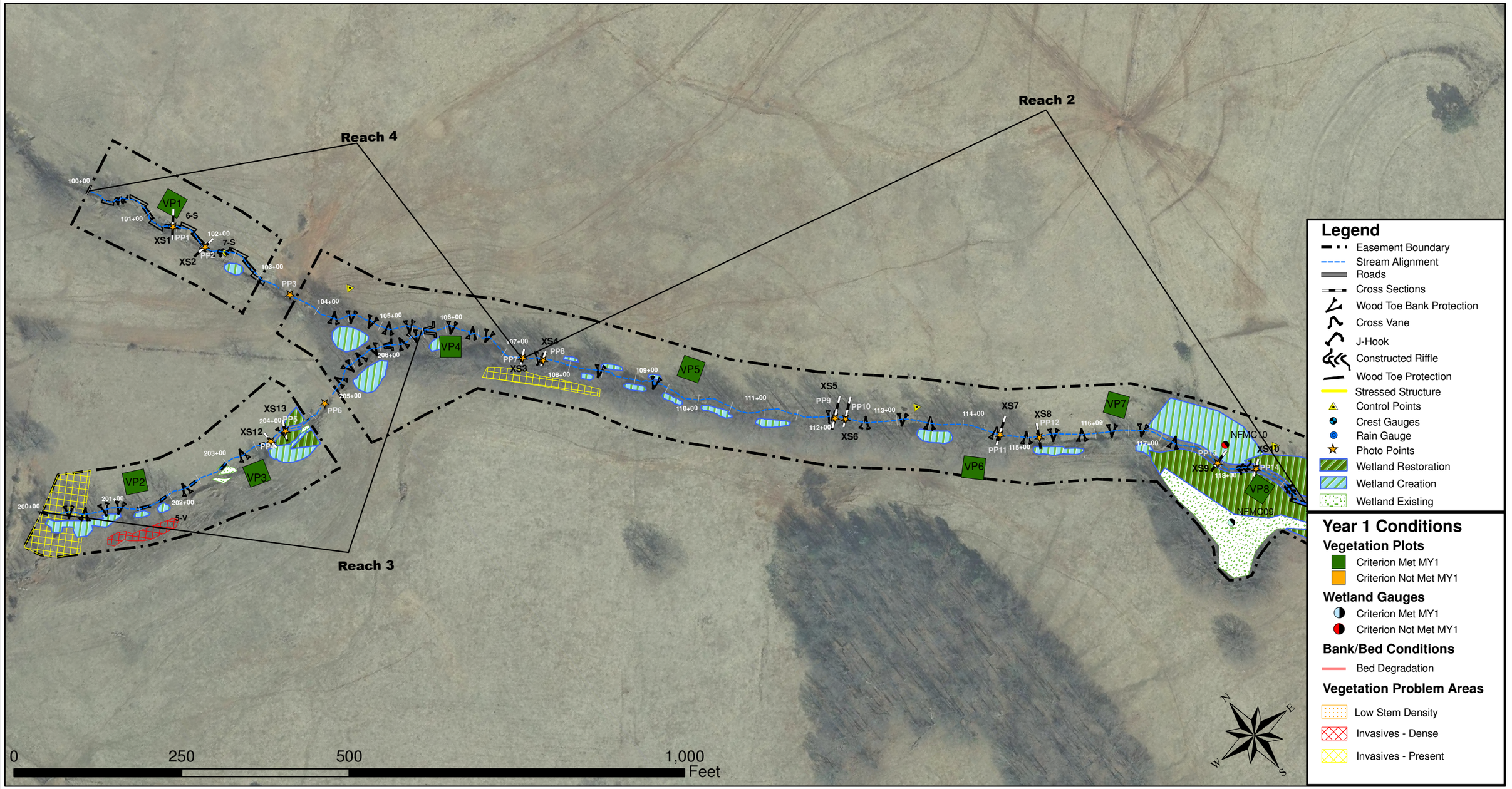
# Current Condition Plan View

**Figure 2. Integrated Current Condition Plan View Final**



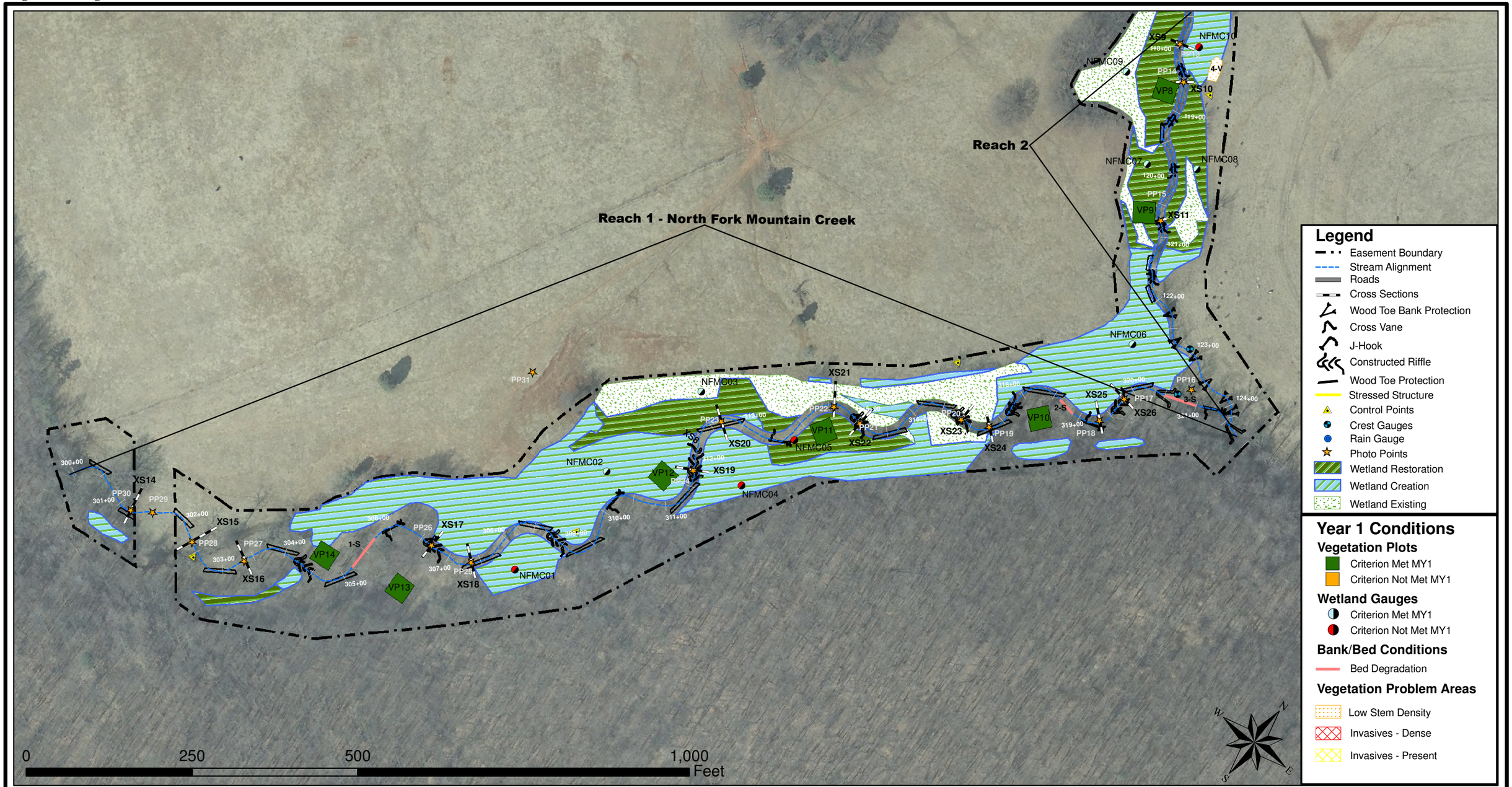

| Prepared for | **Project:** North Fork Mountain Creek Stream and Wetland Restoration<br>Year 1 Monitoring<br>Catawba County, North Carolina | Notes: 1) 2010 Aerial Photo<br>2) Base Map Data Provided by Stantec. | Prepared by |
|---|---|---|---|
| EBX | Sheet 1 of 3 | | EQUINOX ENVIRONMENTAL CONSULTATION & DESIGN |
| | Date | Project Number | |
| | December 2012 | NCEEP # 94151 | |

**Figure 2. Integrated Current Condition Plan View Final**




| | | | |
|---|---|---|---|
| Prepared for | **Project:** North Fork Mountain Creek Stream and Wetland Restoration<br>Year 1 Monitoring<br>Catawba County, North Carolina | Notes: 1) 2010 Aerial Photo<br>2) Base Map Data Provided by Stantec. | Prepared by |
| | Sheet 2 of 3 | | |
| | Date | Project Number | |
| | December 2012 | NCEEP # 94151 | |

**Figure 2. Integrated Current Condition Plan View Final**




| Prepared for | Project: North Fork Mountain Creek Stream and Wetland Restoration<br>Year 1 Monitoring<br>Catawba County, North Carolina | Notes: 1) 2010 Aerial Photo<br>2) Base Map Data Provided by Stantec. | Prepared by |
|---|---|---|---|
| EBX | Sheet 3 of 3 | | EQUINOX ENVIRONMENTAL CONSULTATION & DESIGN |
| | Date | Project Number | |
| | December 2012 | NCEEP # 94151 | |

# APPENDIX B

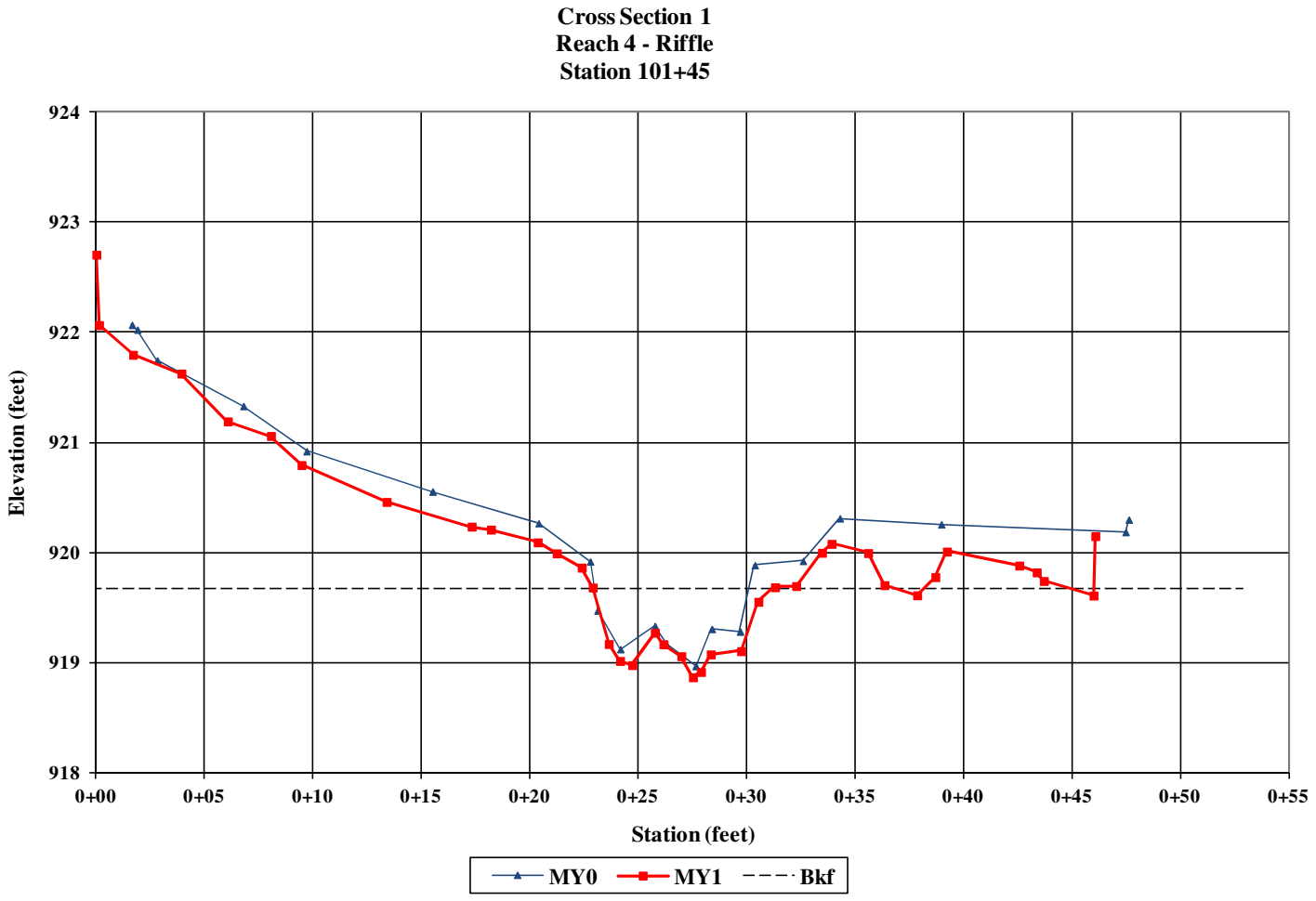
# 2012 Longitudinal Profile, Cross-Section, and Substrate Data

This page reserved for longitudinal profile figures should monitoring efforts demonstrate channel or bed instability and the USACE require such data be collected along reaches of concern and to track changes in channel stability.

## Cross Section 1 Reach 4 – Riffle


Downstream

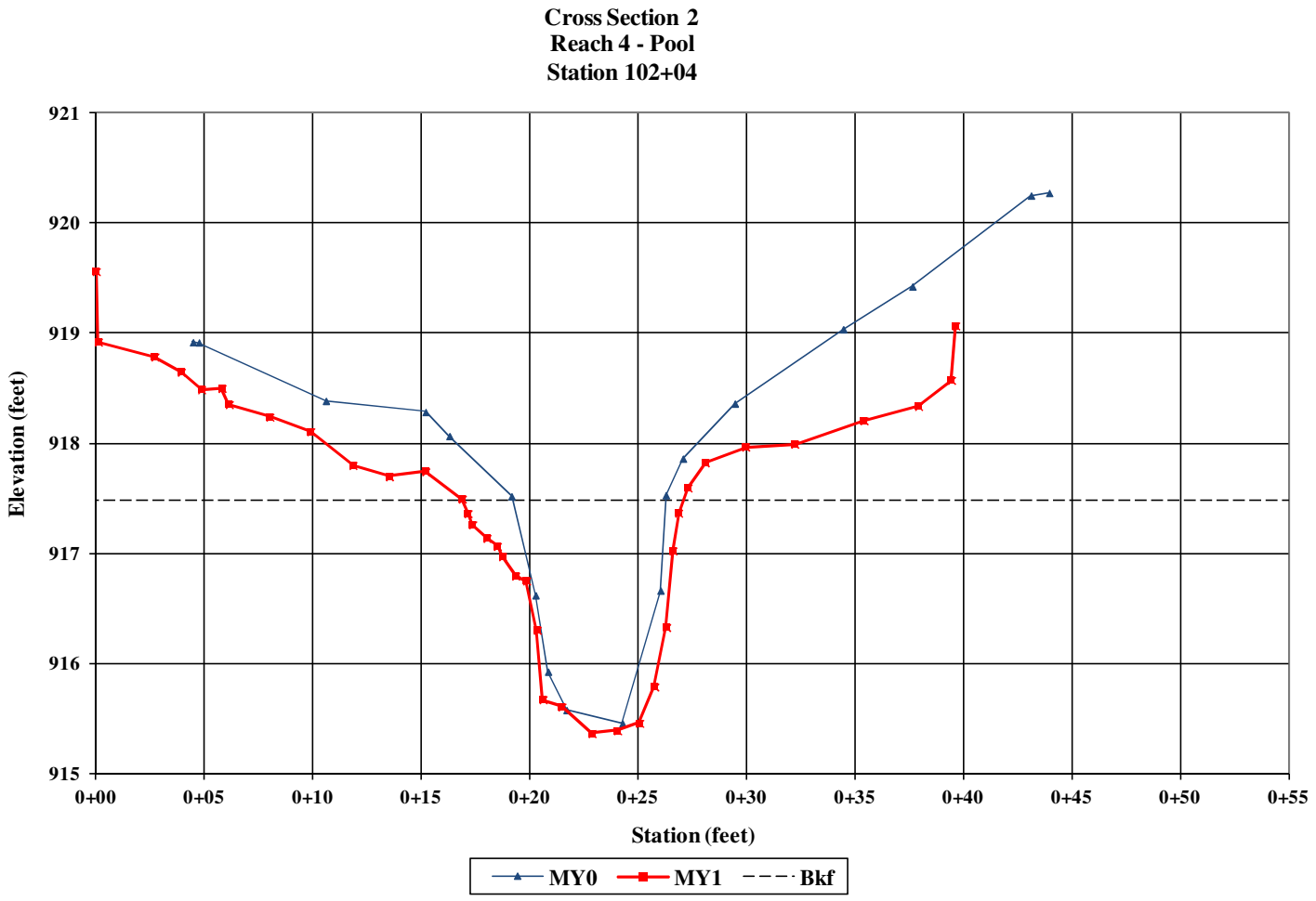

Upstream



## Cross Section 2 Reach 4 – Pool


Downstream

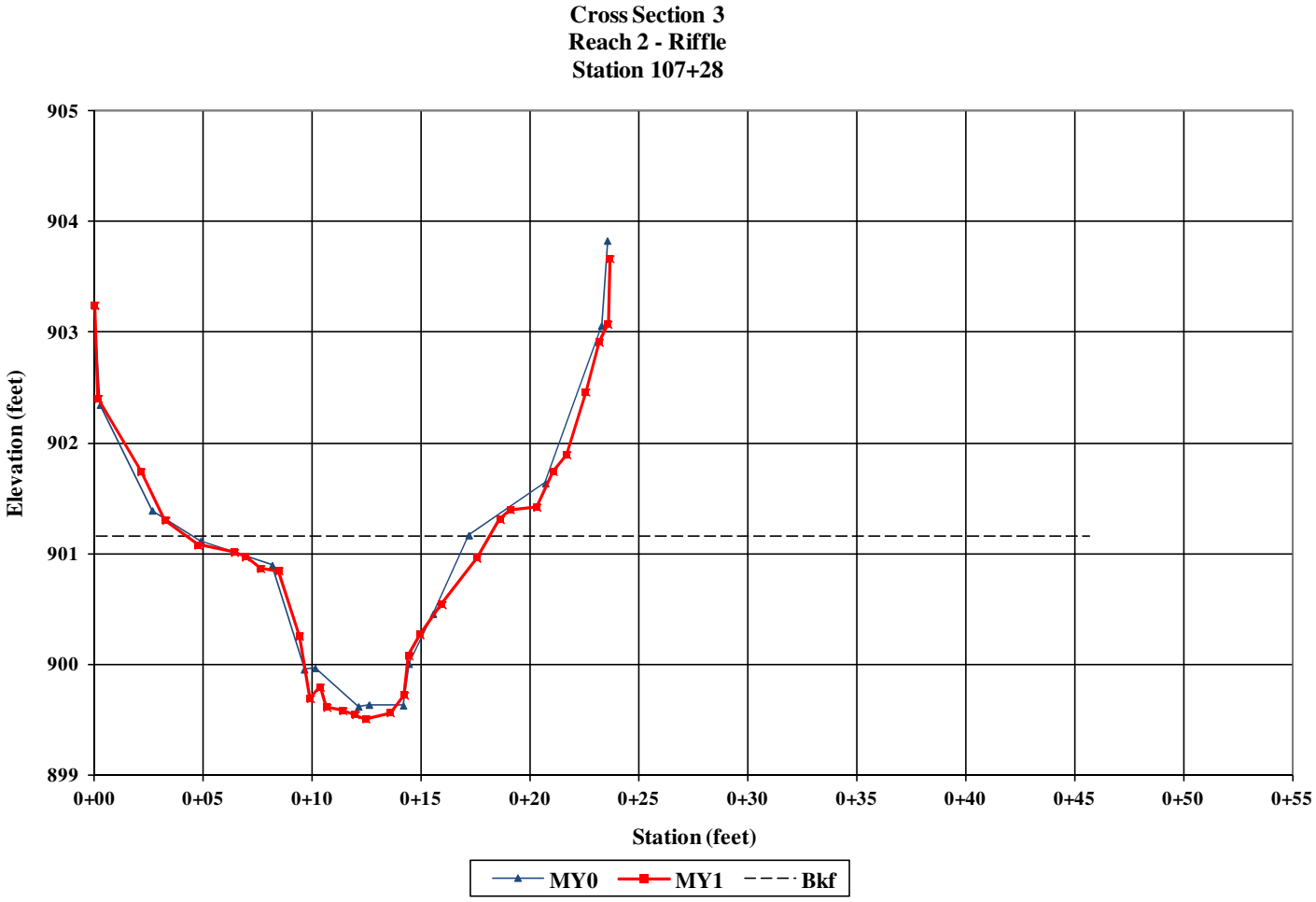

Upstream



## Cross Section 3 Reach 2 – Riffle


Downstream

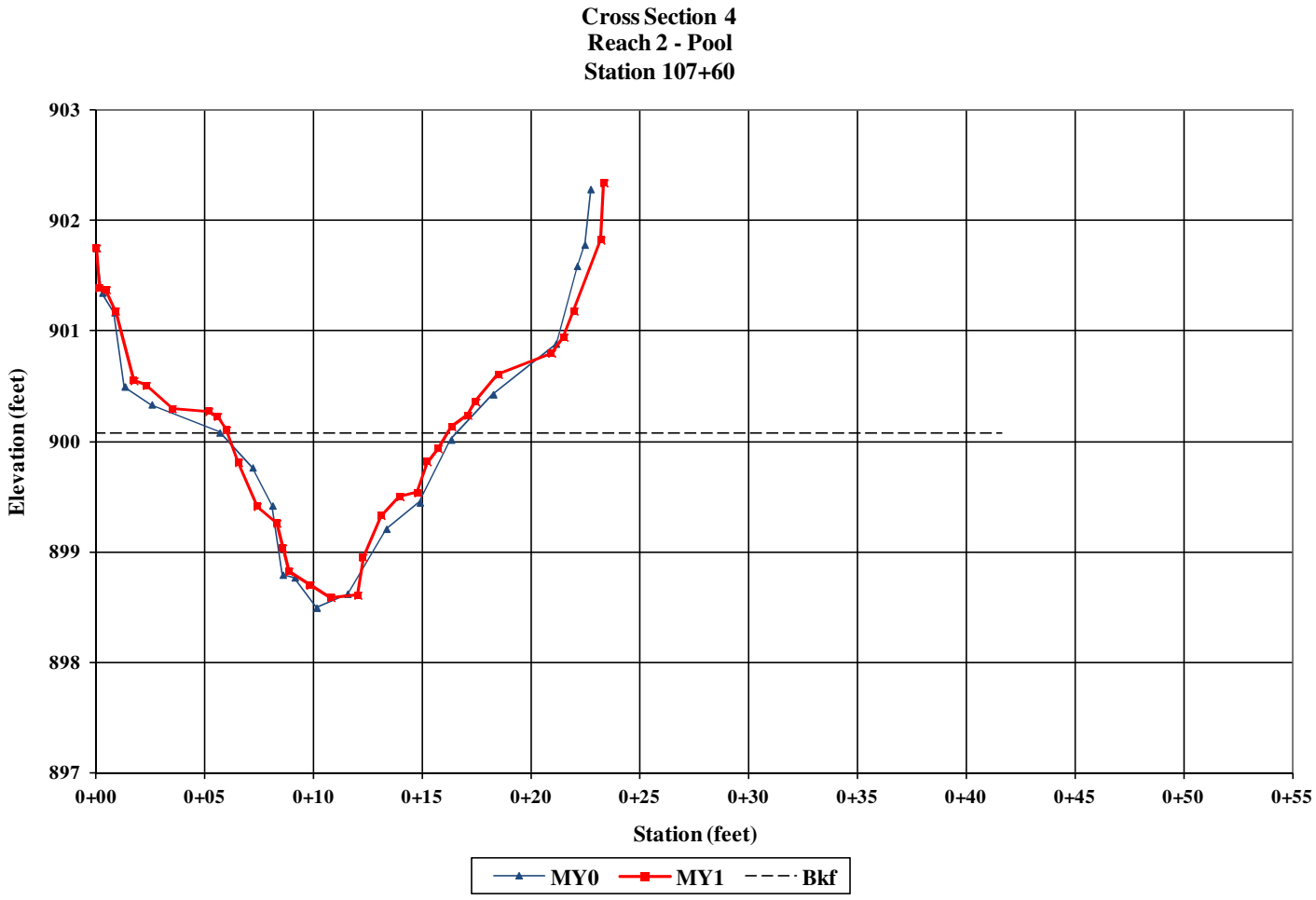

Upstream



## Cross Section 4 Reach 2 – Pool


Downstream

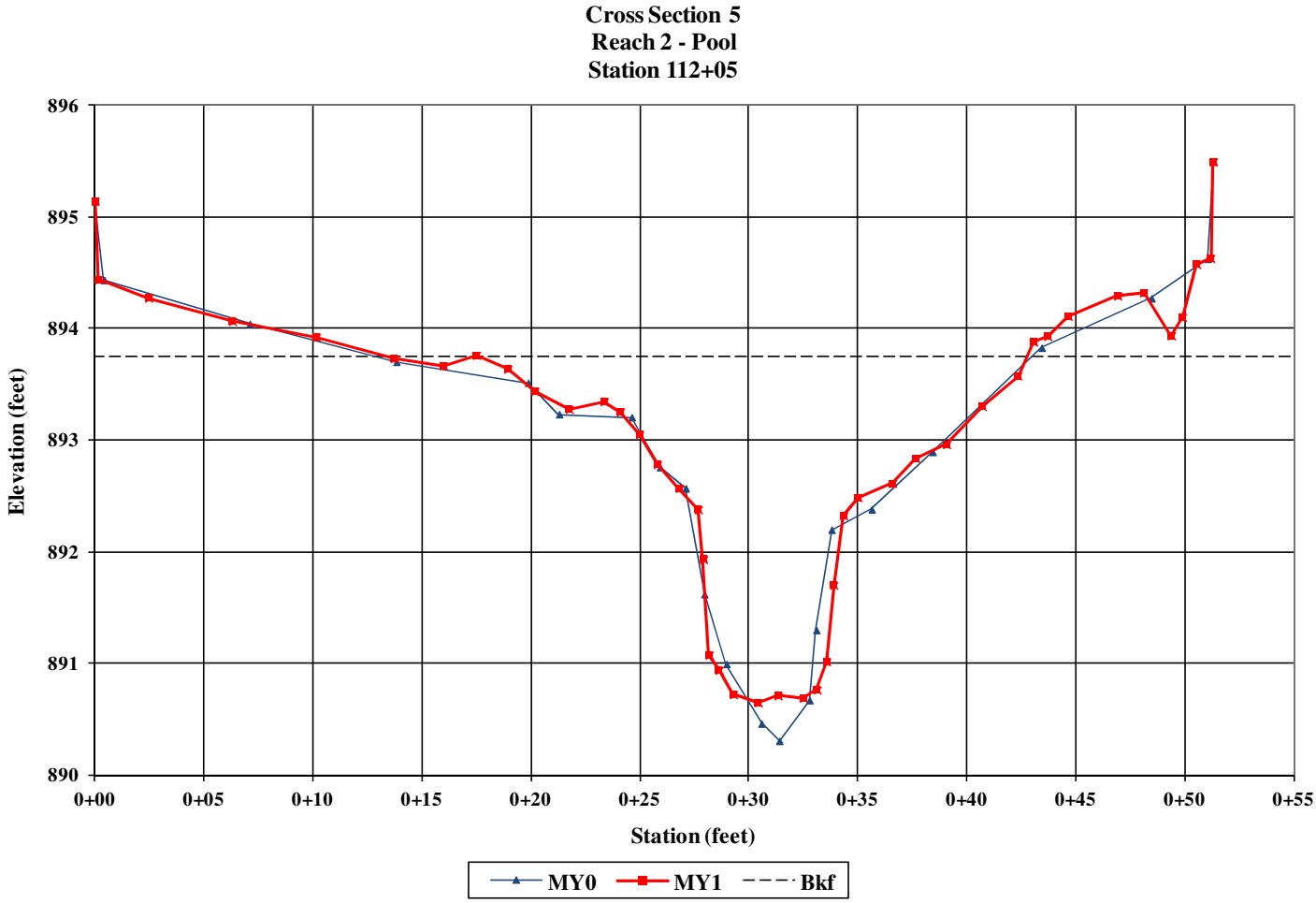

Upstream



## Cross Section 5 Reach 2 – Pool


Downstream

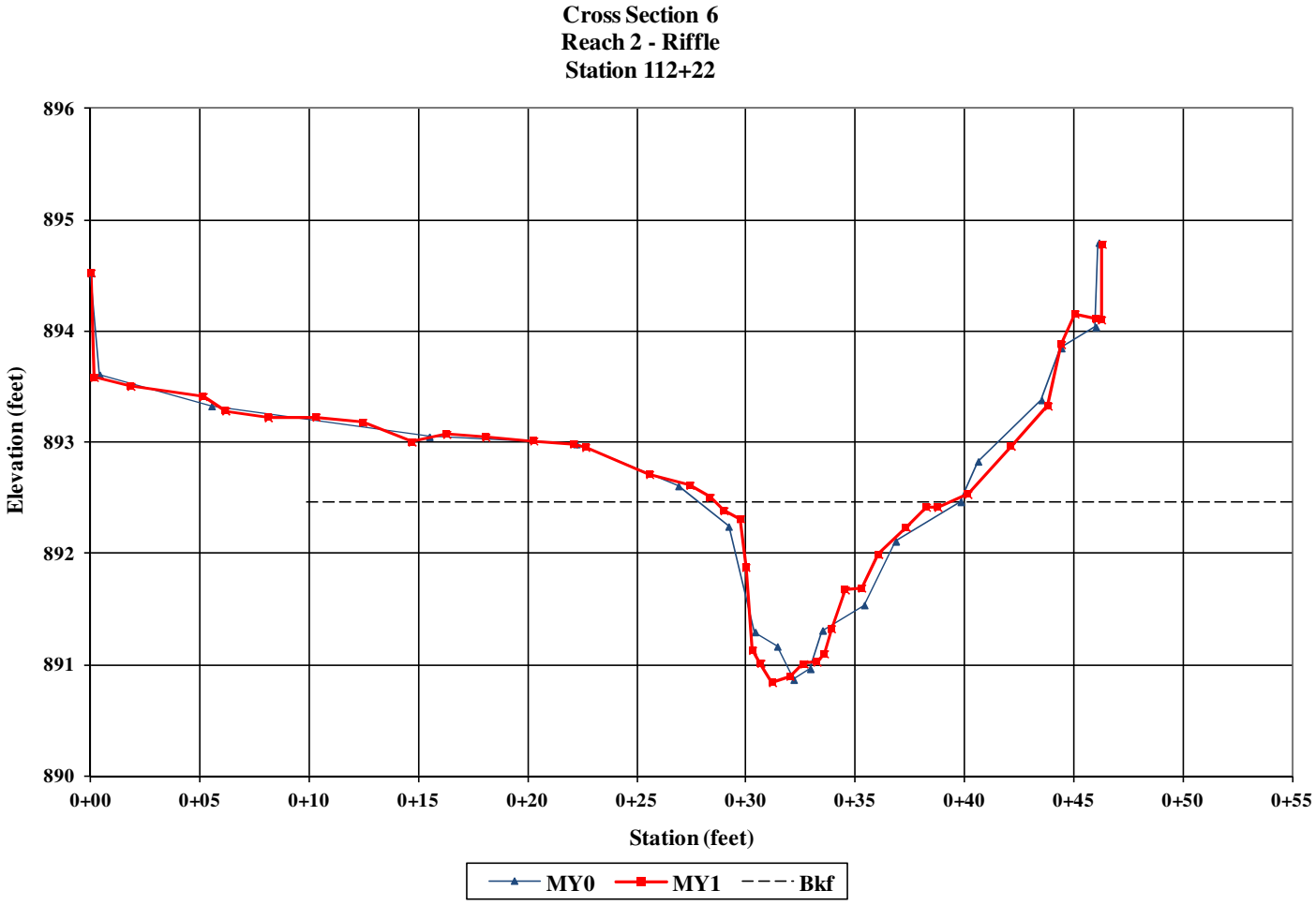

Upstream



## Cross Section 6 Reach 2 – Riffle


Downstream

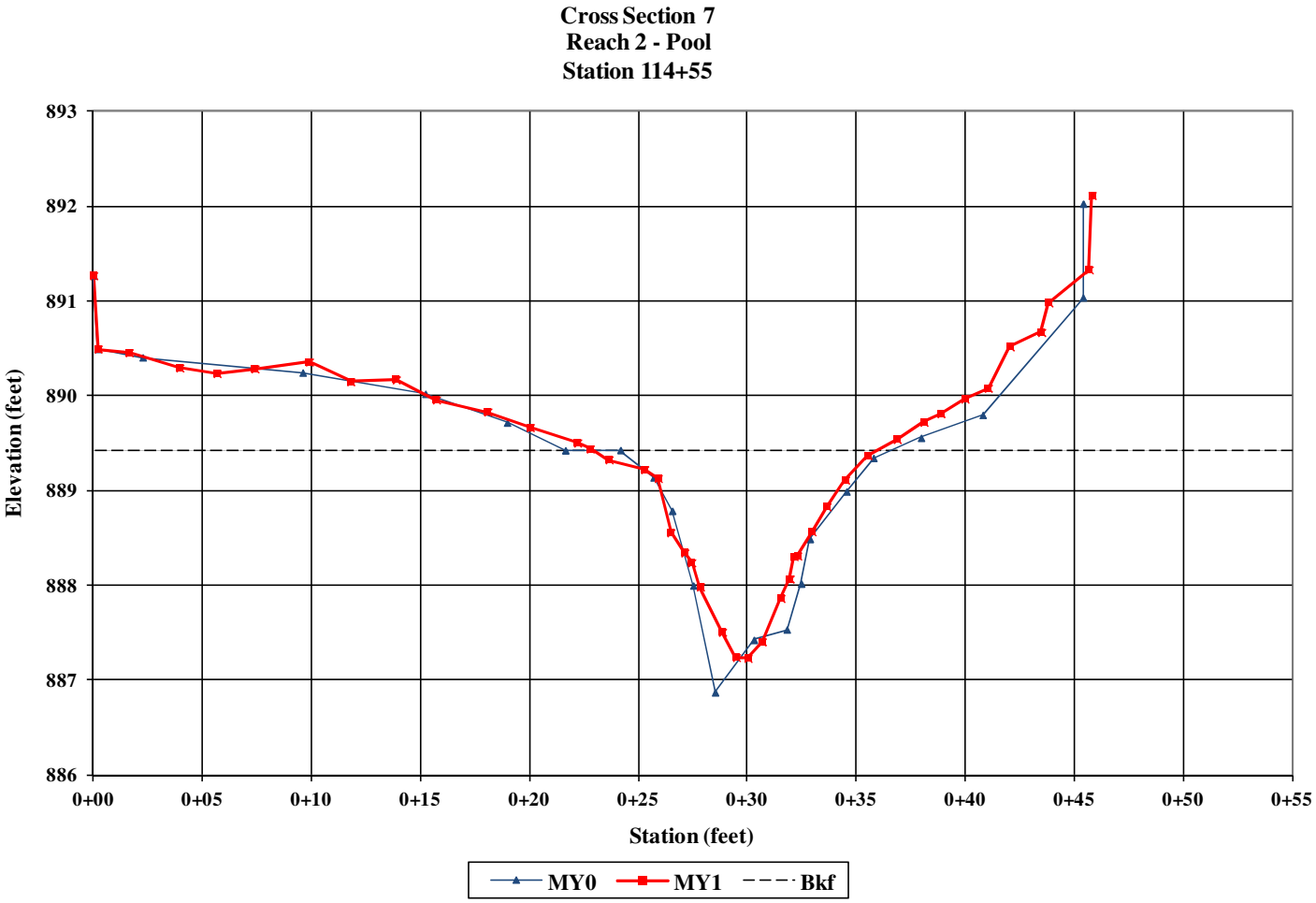

Upstream



## Cross Section 7 Reach 2 – Pool


Downstream

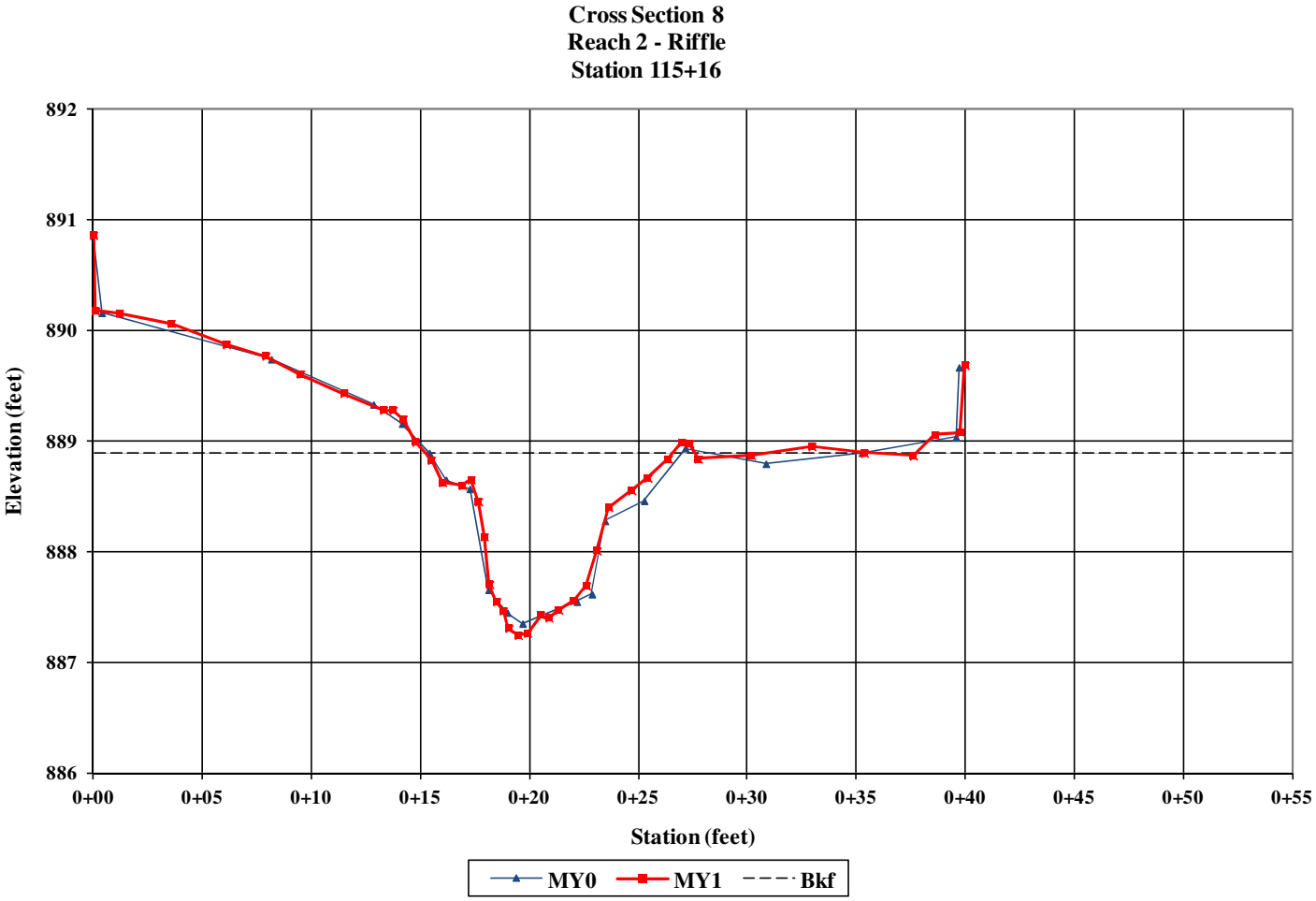

Upstream



## Cross Section 8 Reach 2 – Riffle


Downstream

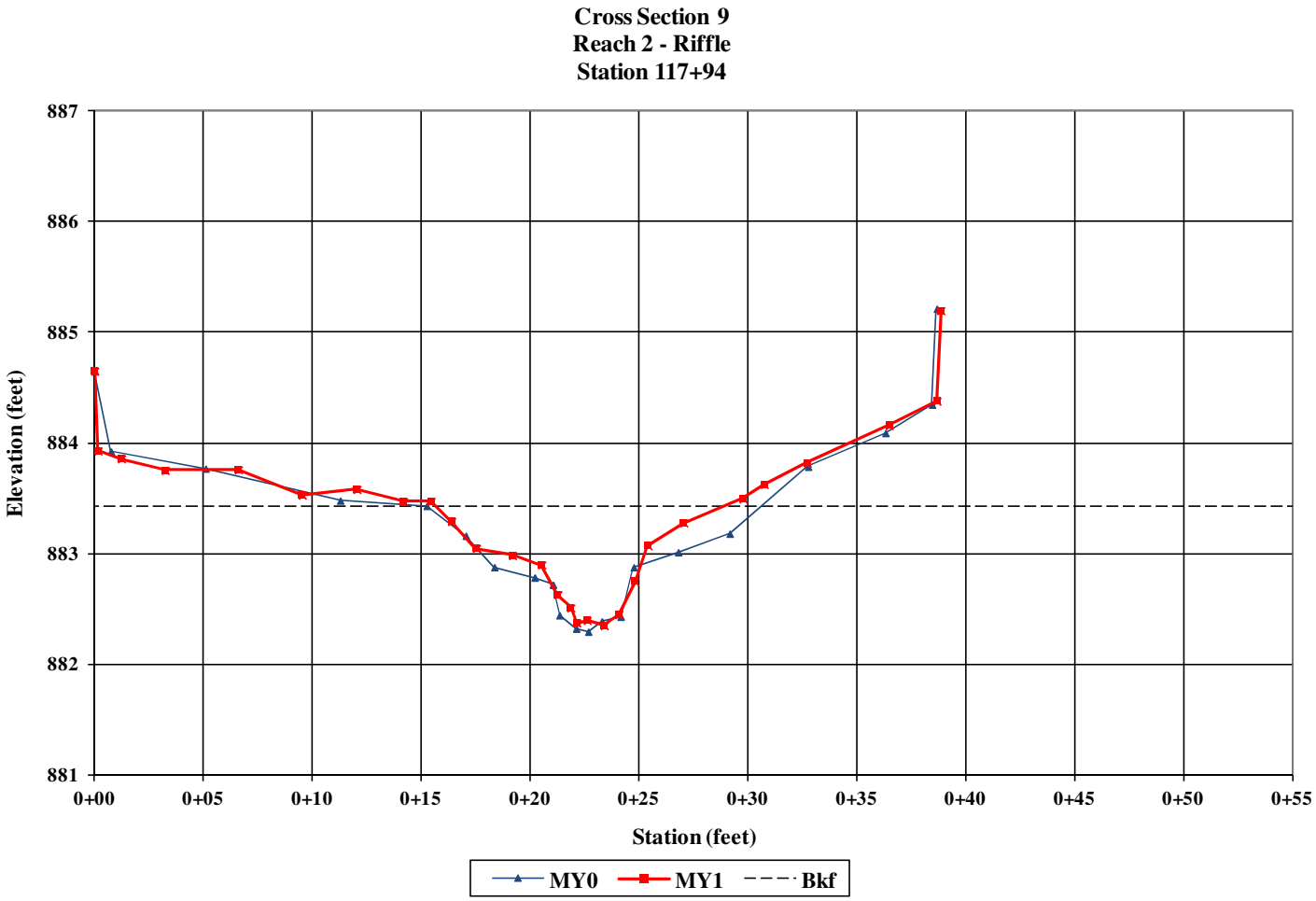

Upstream



## Cross Section 9 Reach 2 – Riffle


Downstream

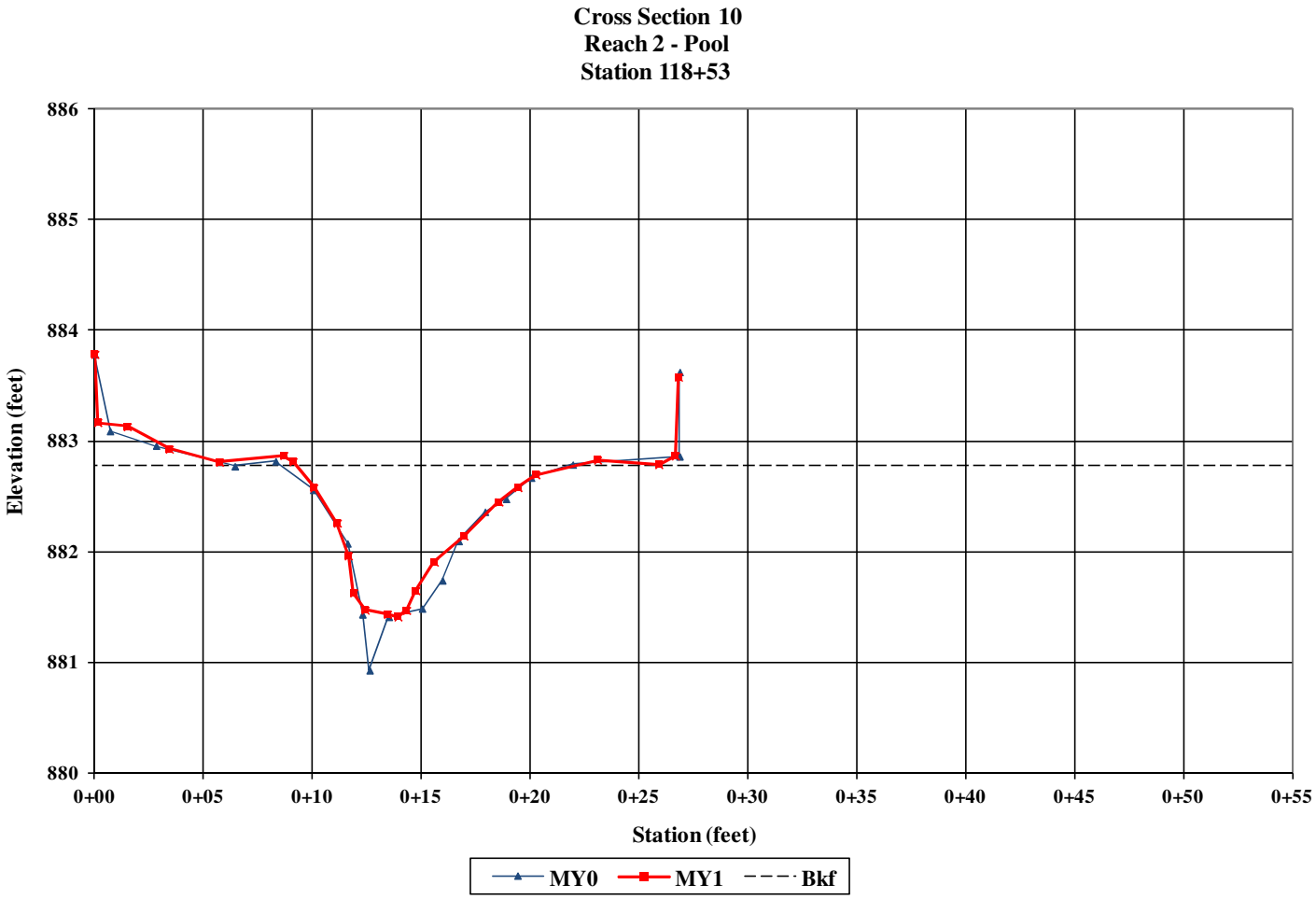

Upstream



## Cross Section 10 Reach 2 – Pool


Downstream

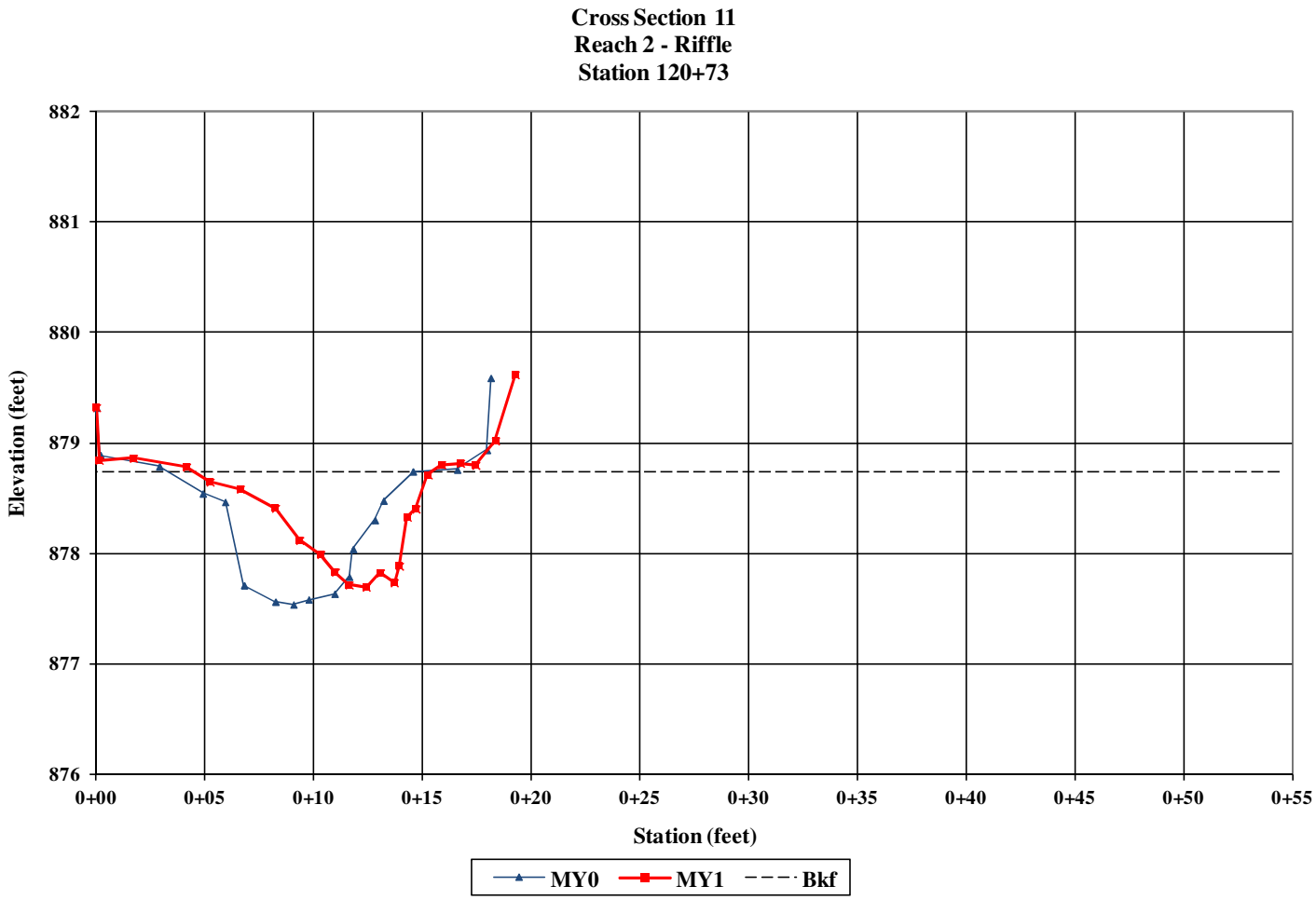

Upstream



## Cross Section 11 Reach 2 – Riffle


Downstream


Upstream

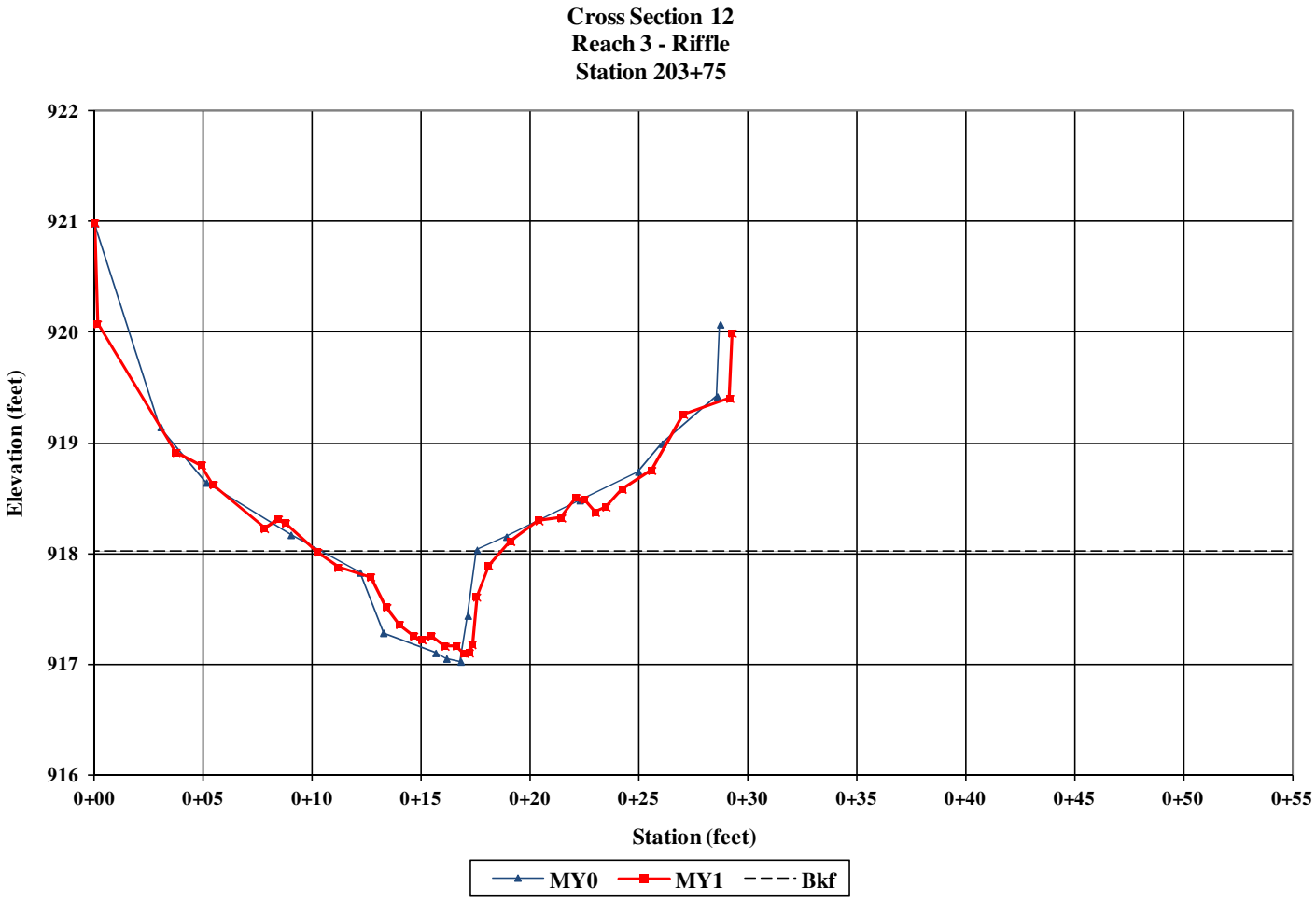



*The shift represented in the above figure is due to an inconsistency in surveying the correct pins between monitoring years.

## Cross Section 12 Reach 3 – Riffle


Downstream

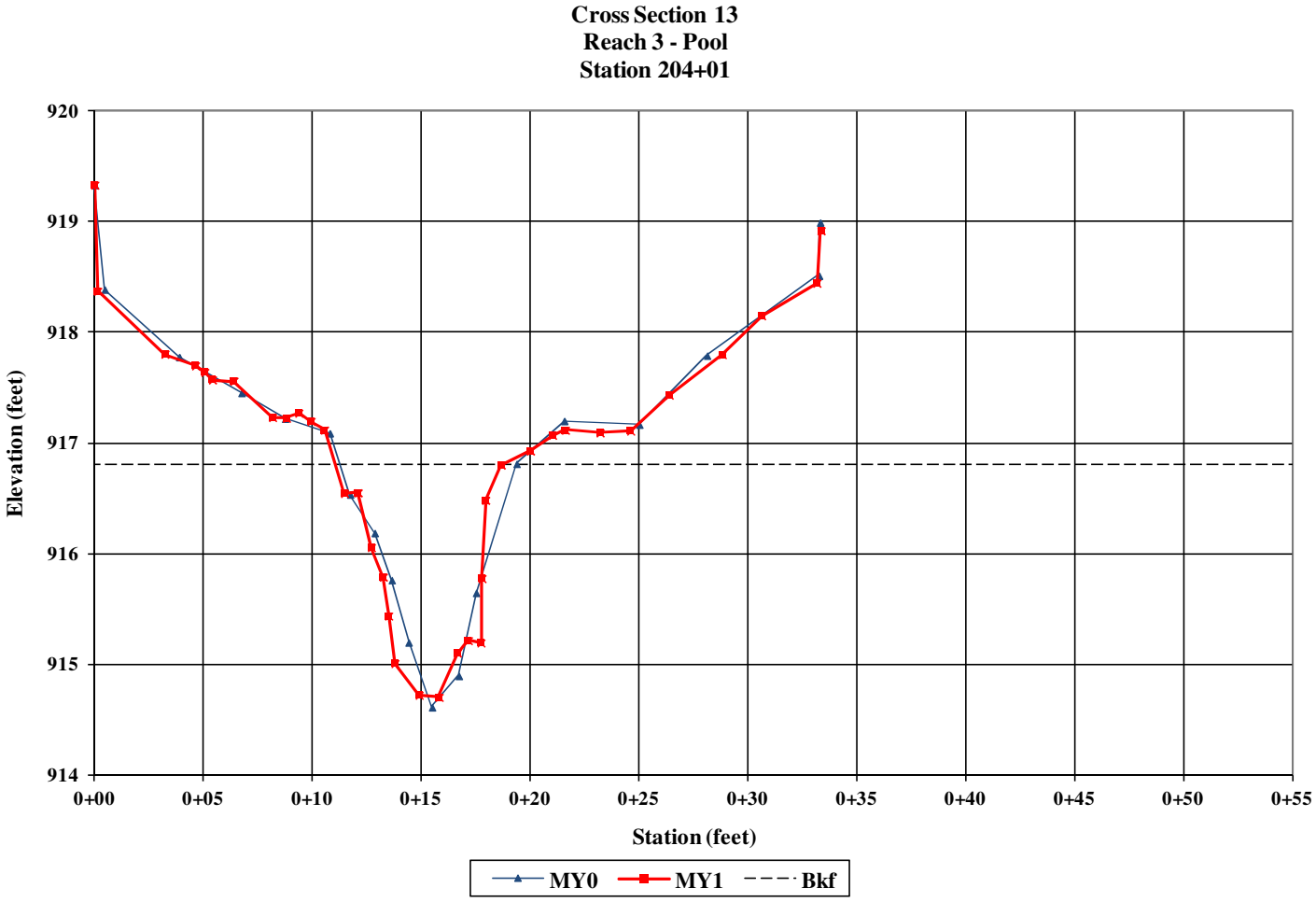

Upstream



## Cross Section 13 Reach 3 – Pool


Downstream

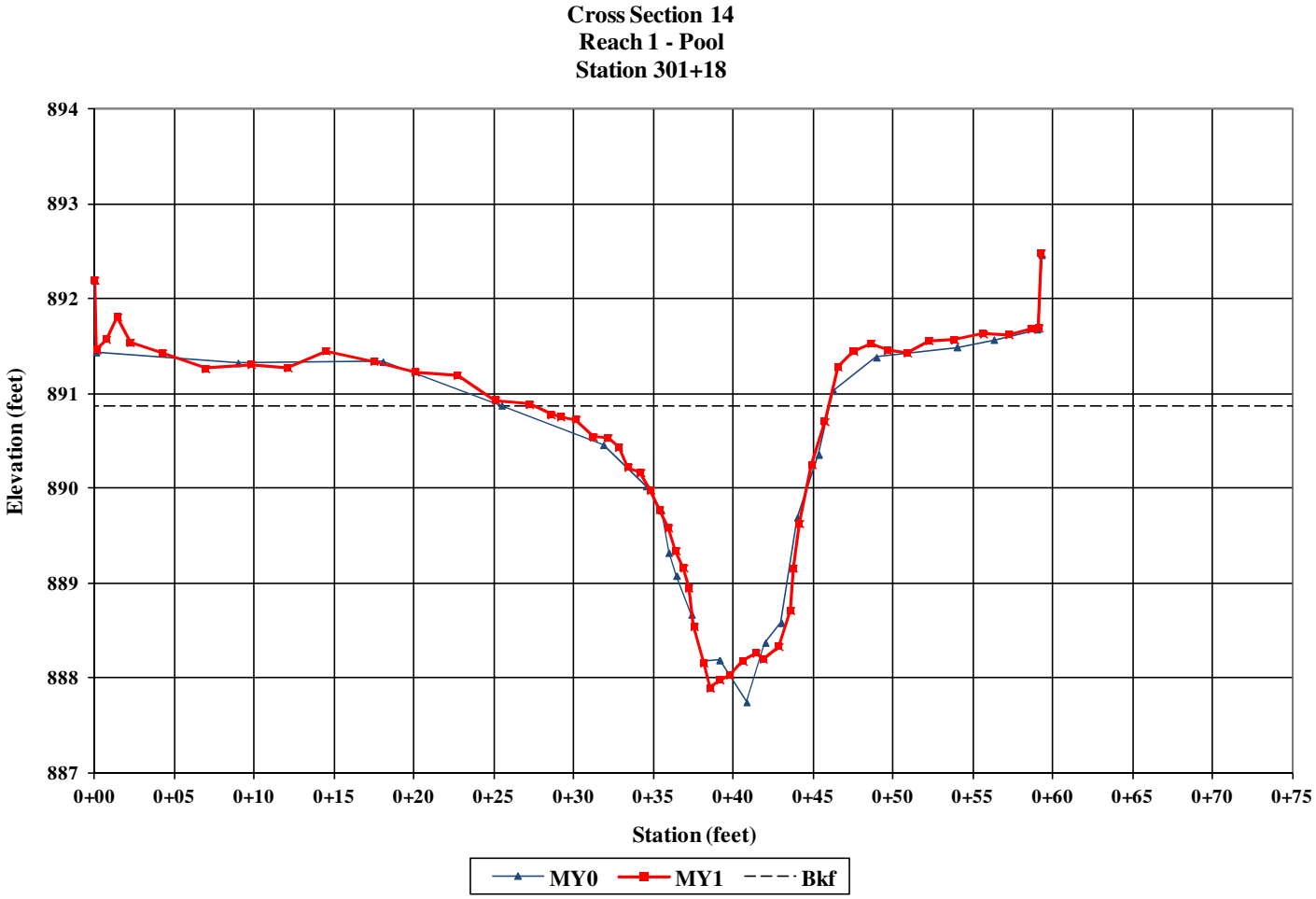

Upstream



## Cross Section 14 Reach 1 – Pool


Downstream

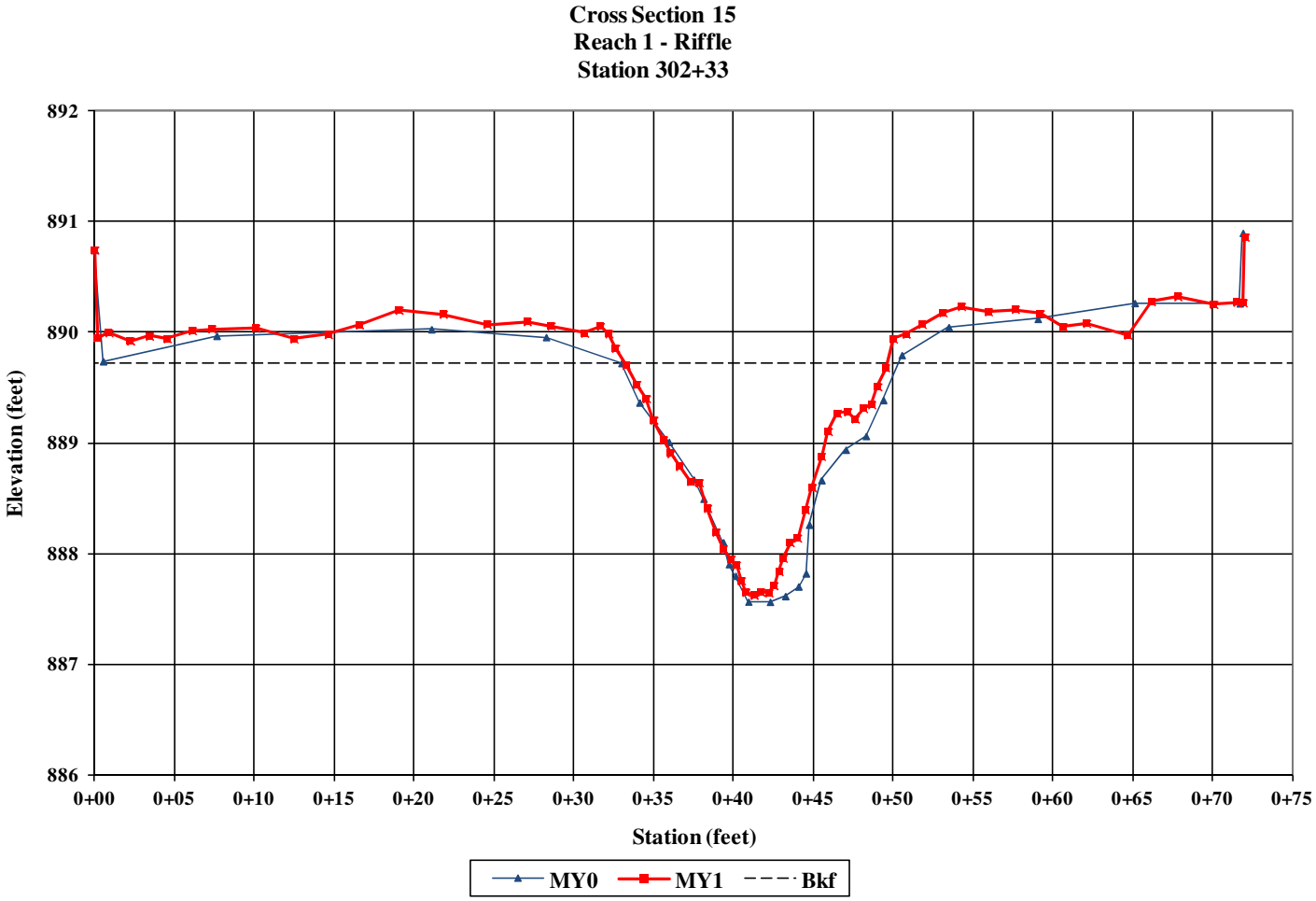

Upstream



## Cross Section 15 Reach 1 – Riffle


Downstream

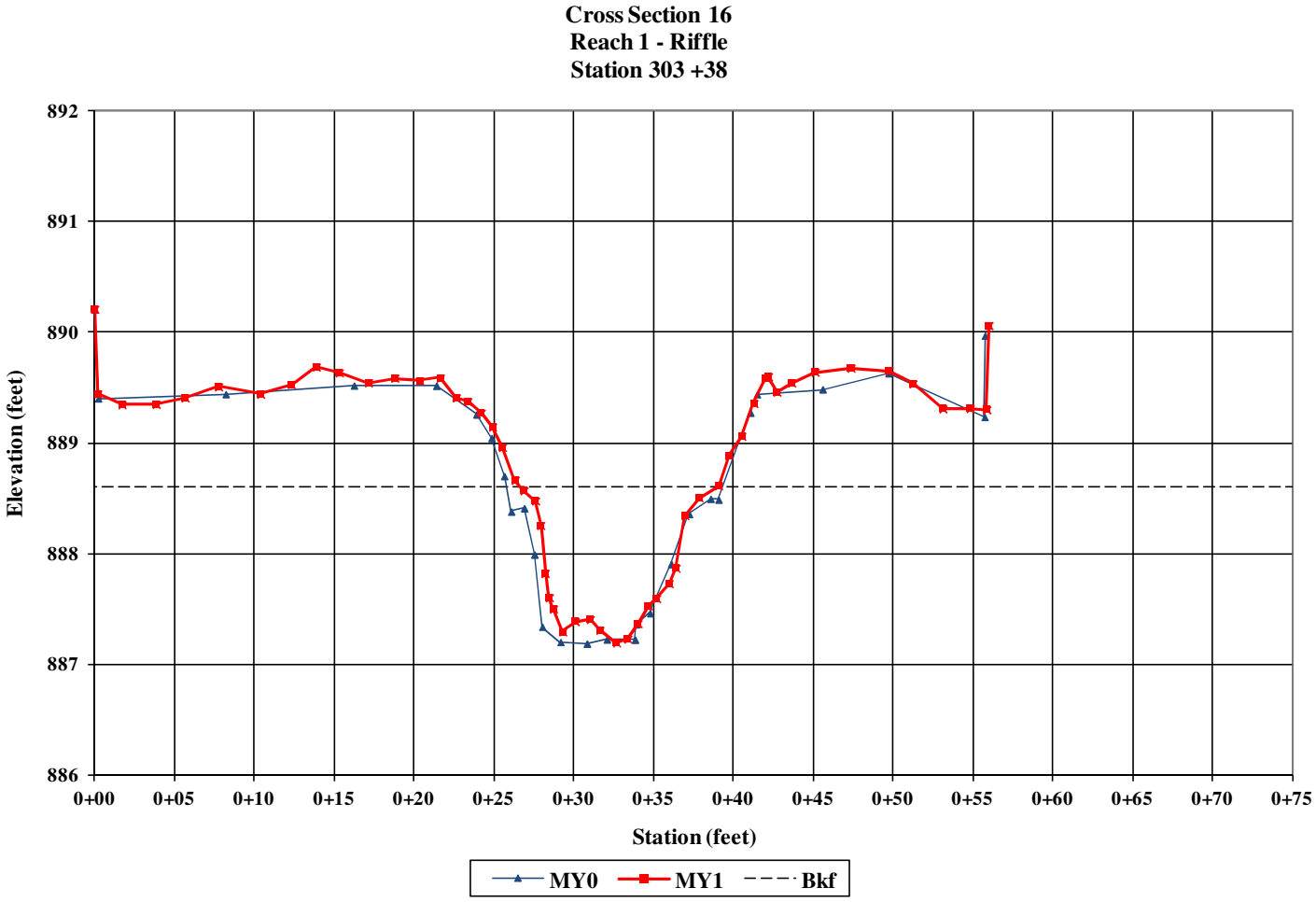

Upstream



## Cross Section 16 Reach 1 – Riffle


Downstream

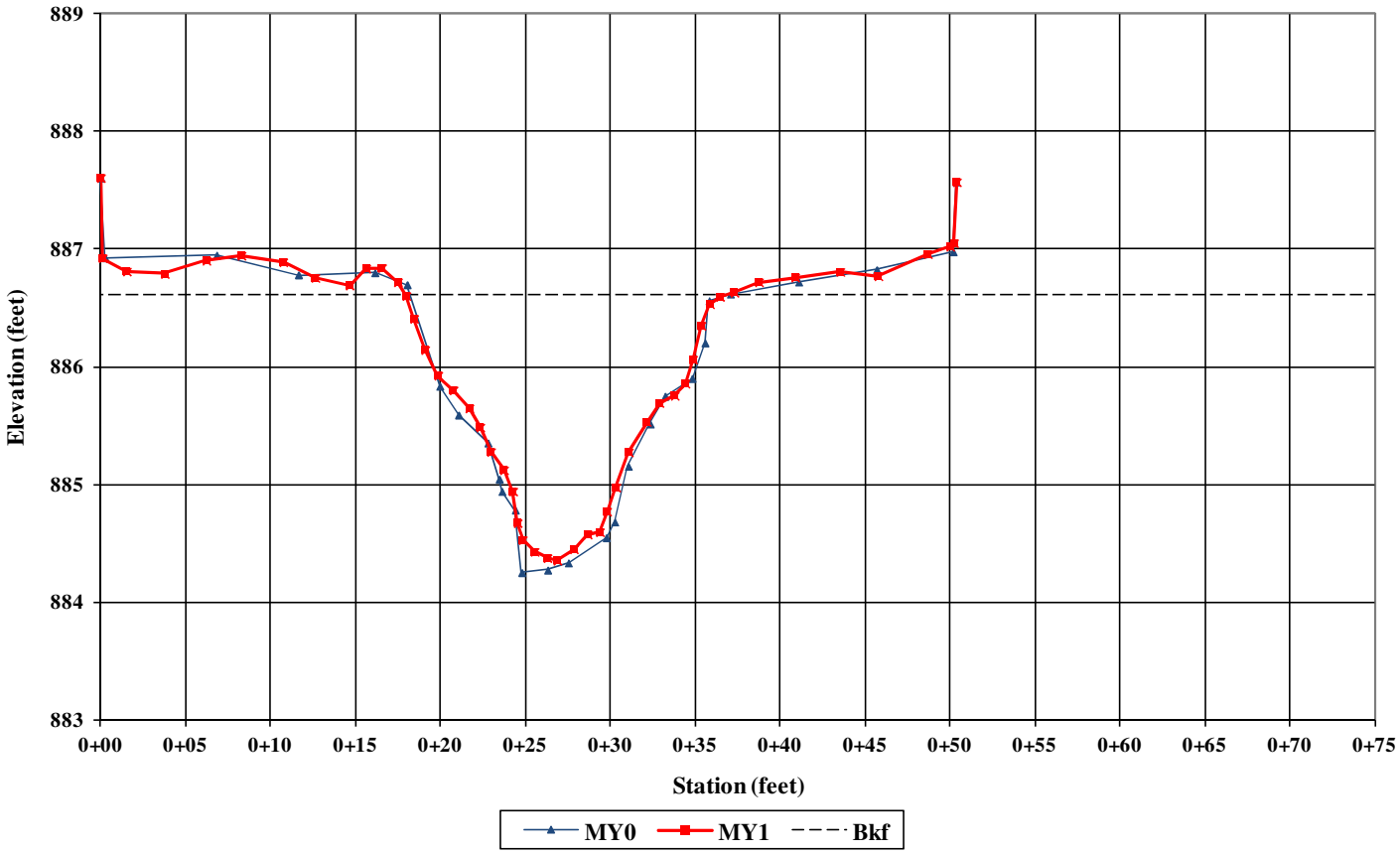

Upstream



## Cross Section 17 Reach 1 – Riffle

Downstream

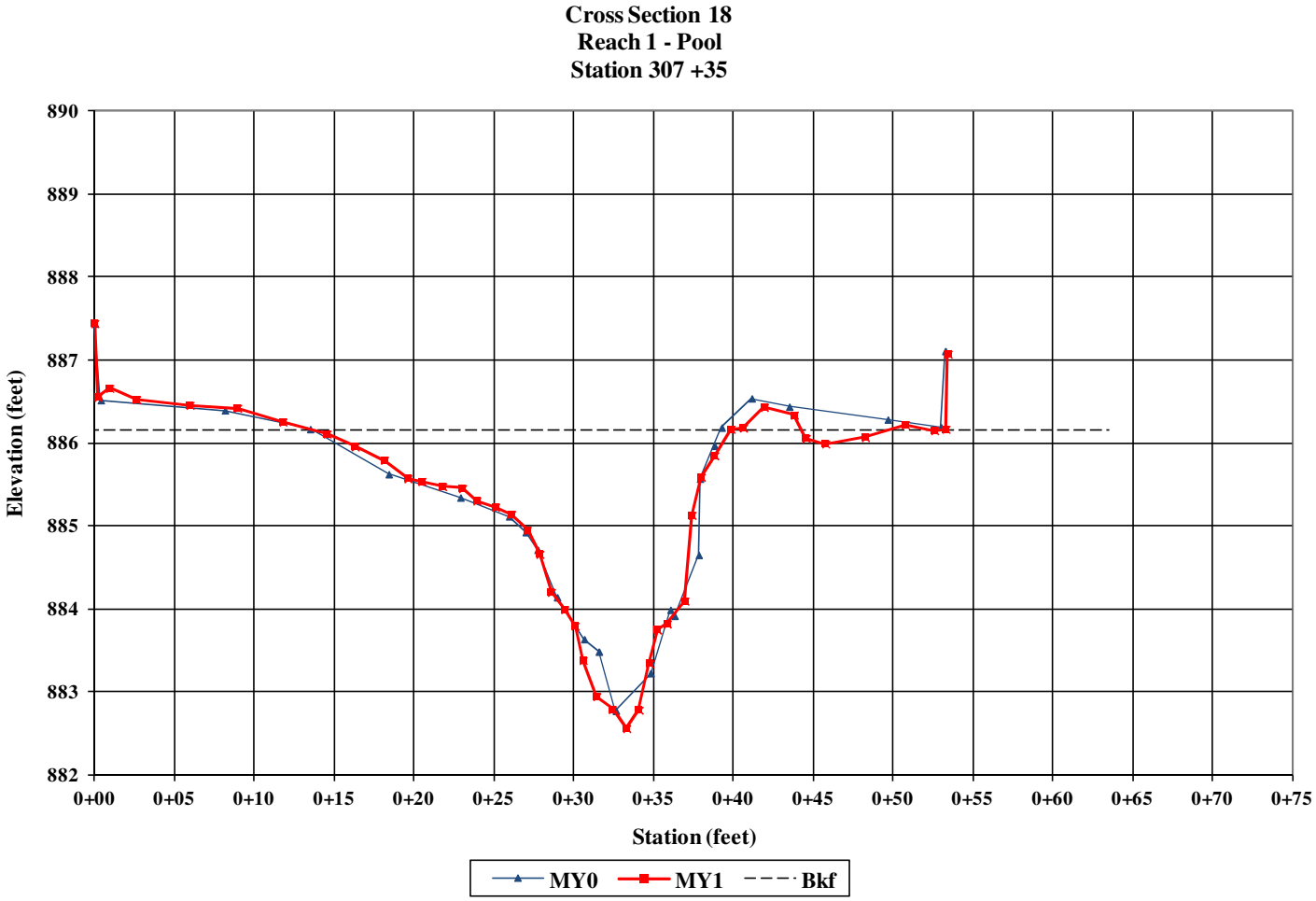
Upstream



## Cross Section 18 Reach 1 – Pool


Downstream

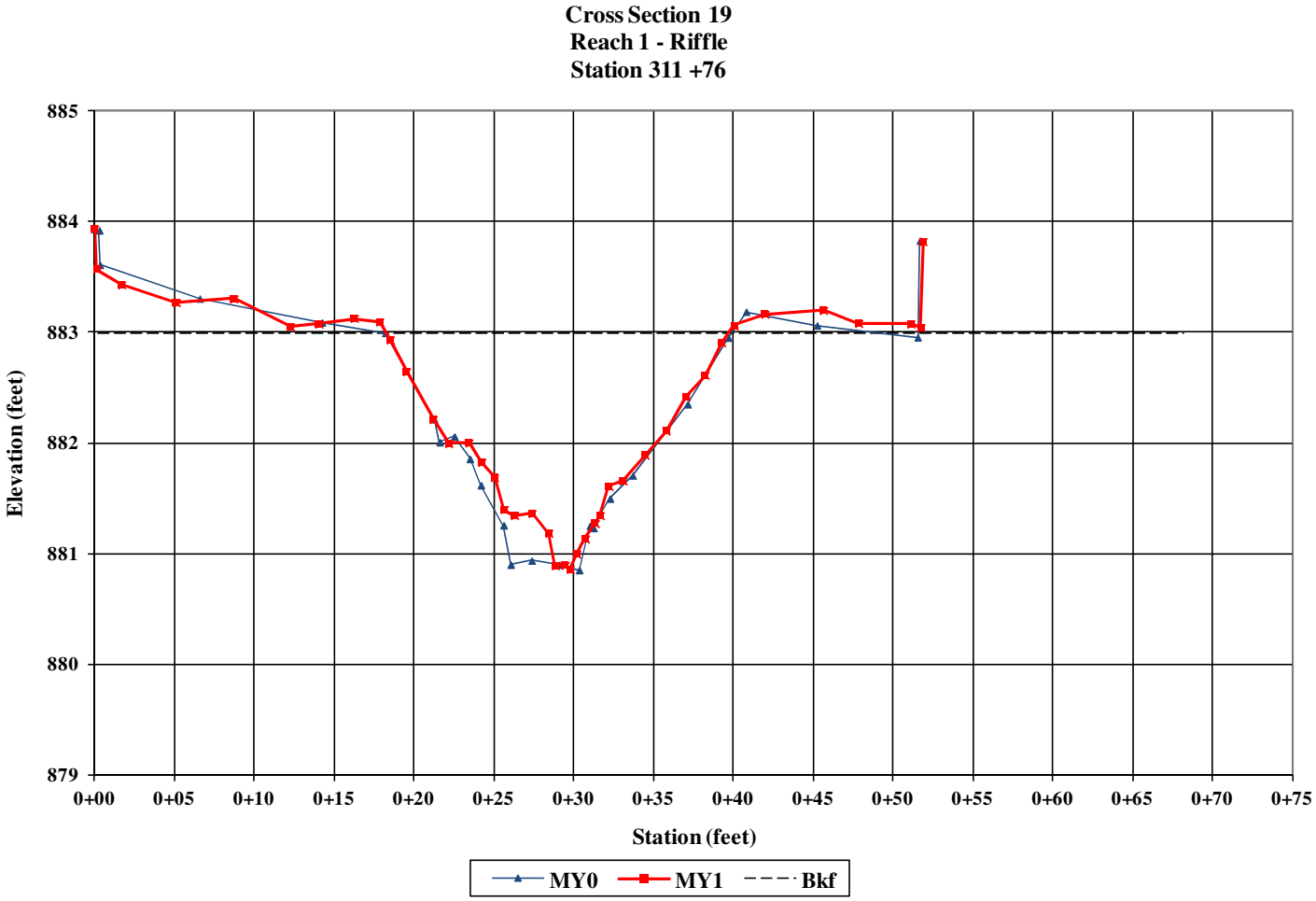

Upstream



## Cross Section 19 Reach 1 – Riffle


Downstream

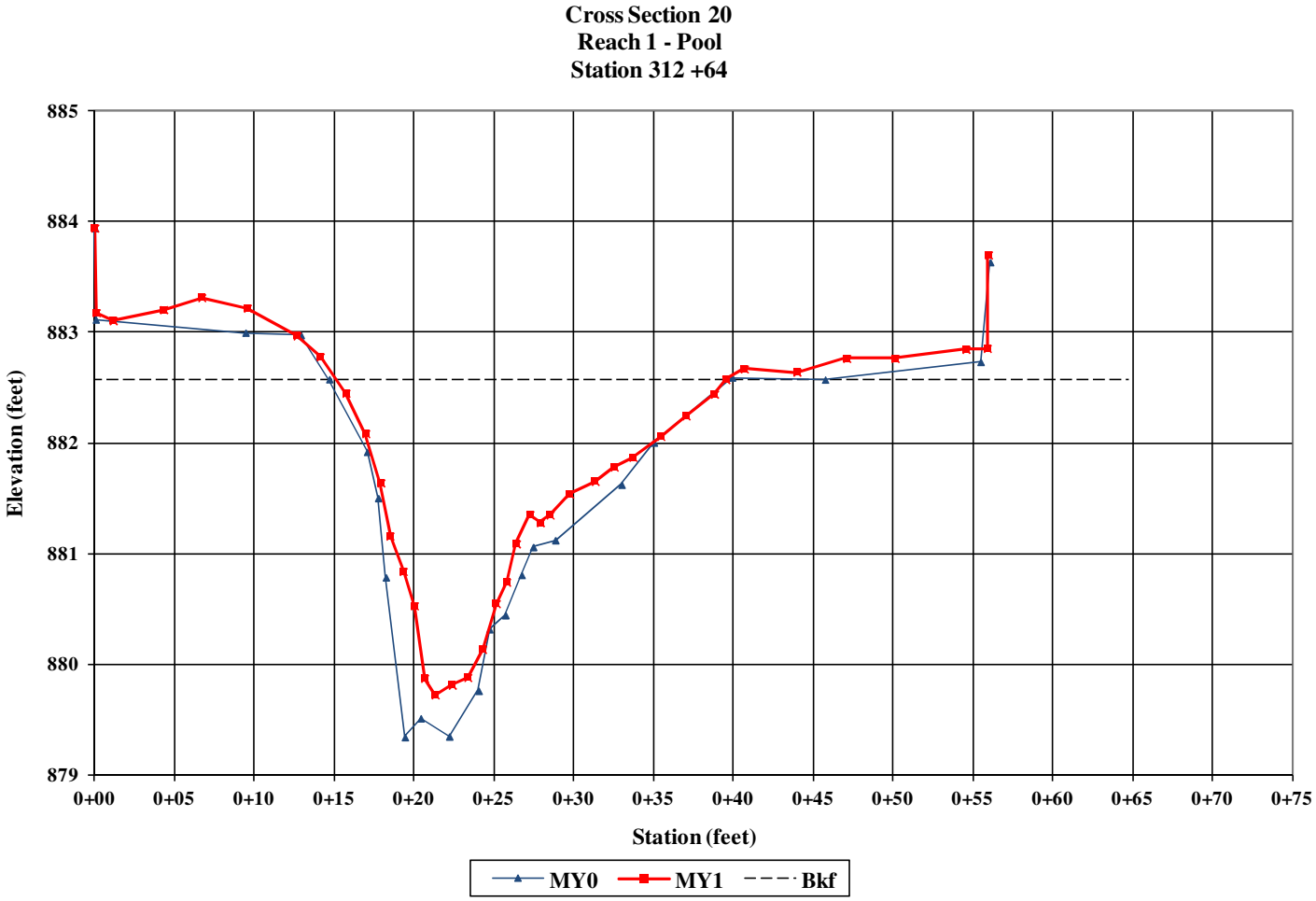

Upstream



## Cross Section 20 Reach 1 – Pool


Downstream

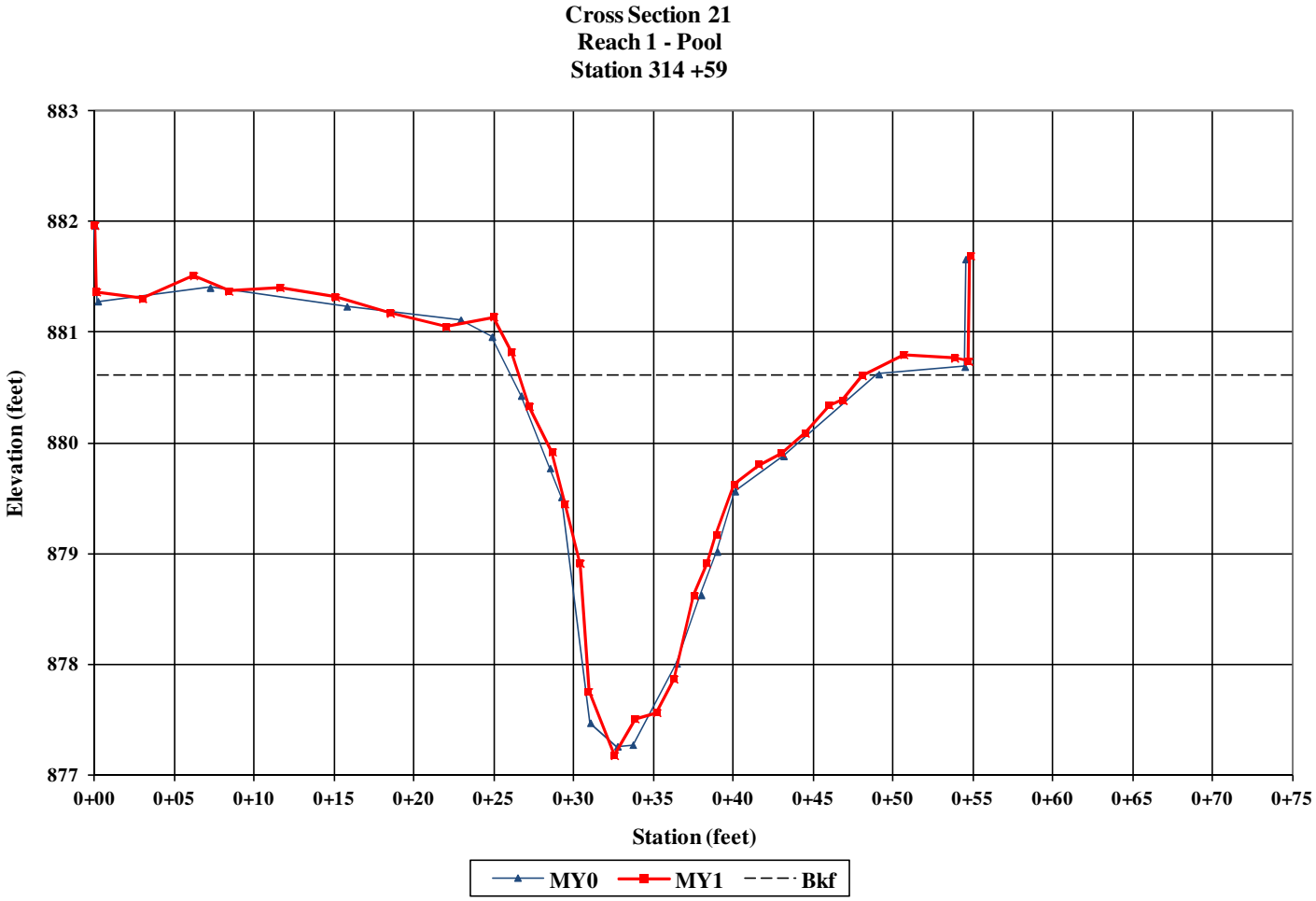

Upstream



## Cross Section 21 Reach 1 – Pool


Downstream

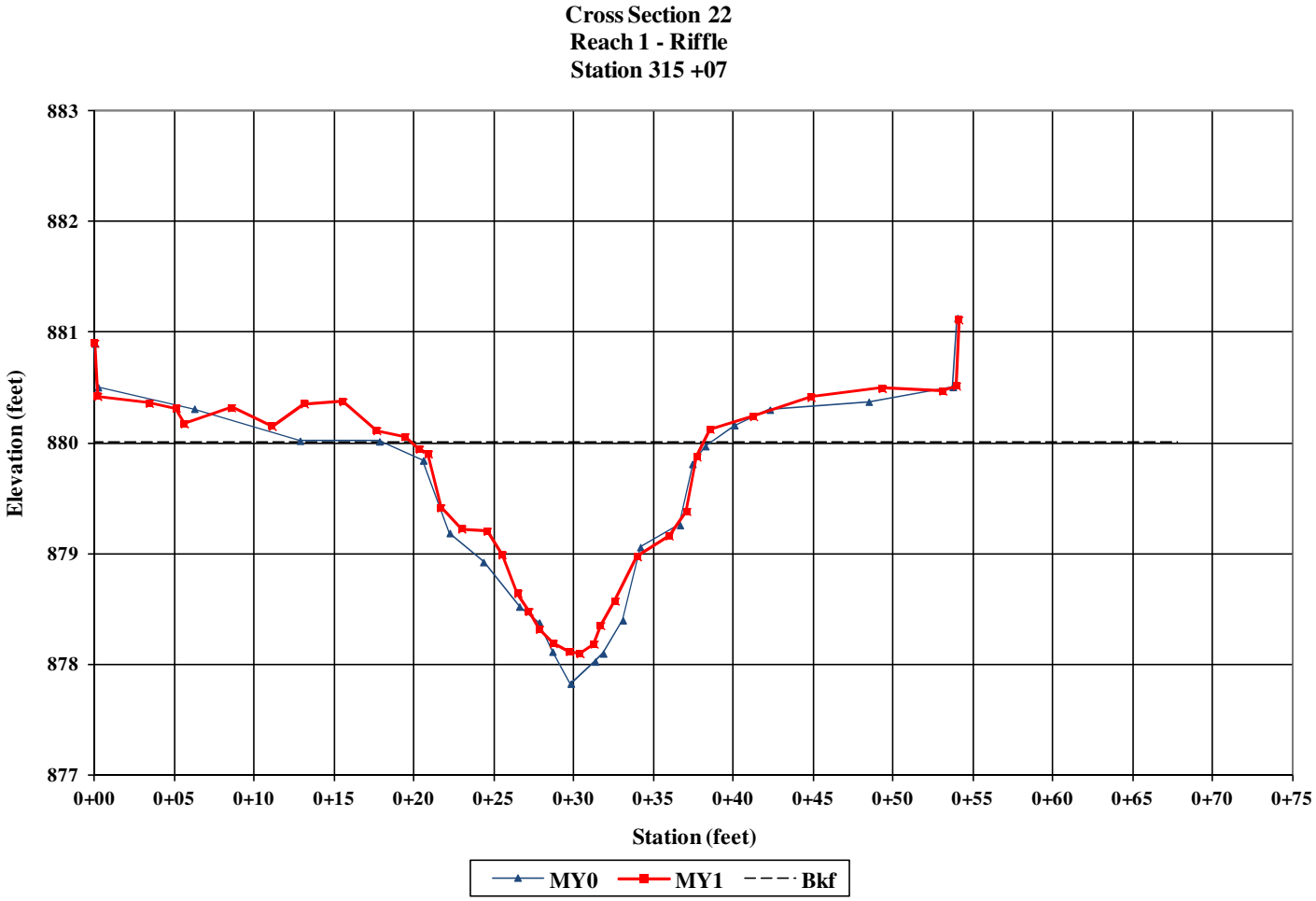

Upstream



## Cross Section 22 Reach 1 – Riffle


Downstream

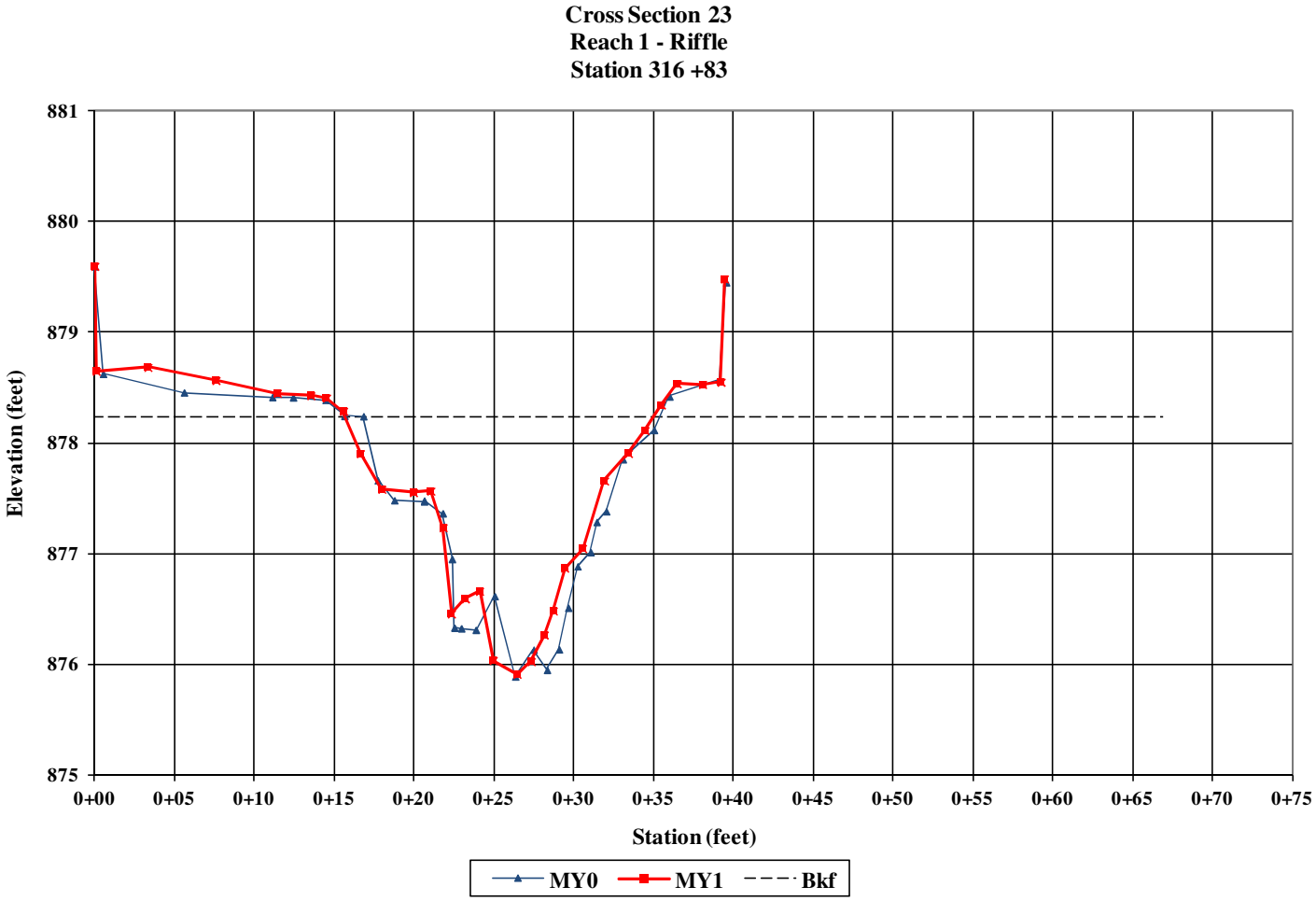

Upstream



## Cross Section 23 Reach 1 – Riffle


Downstream

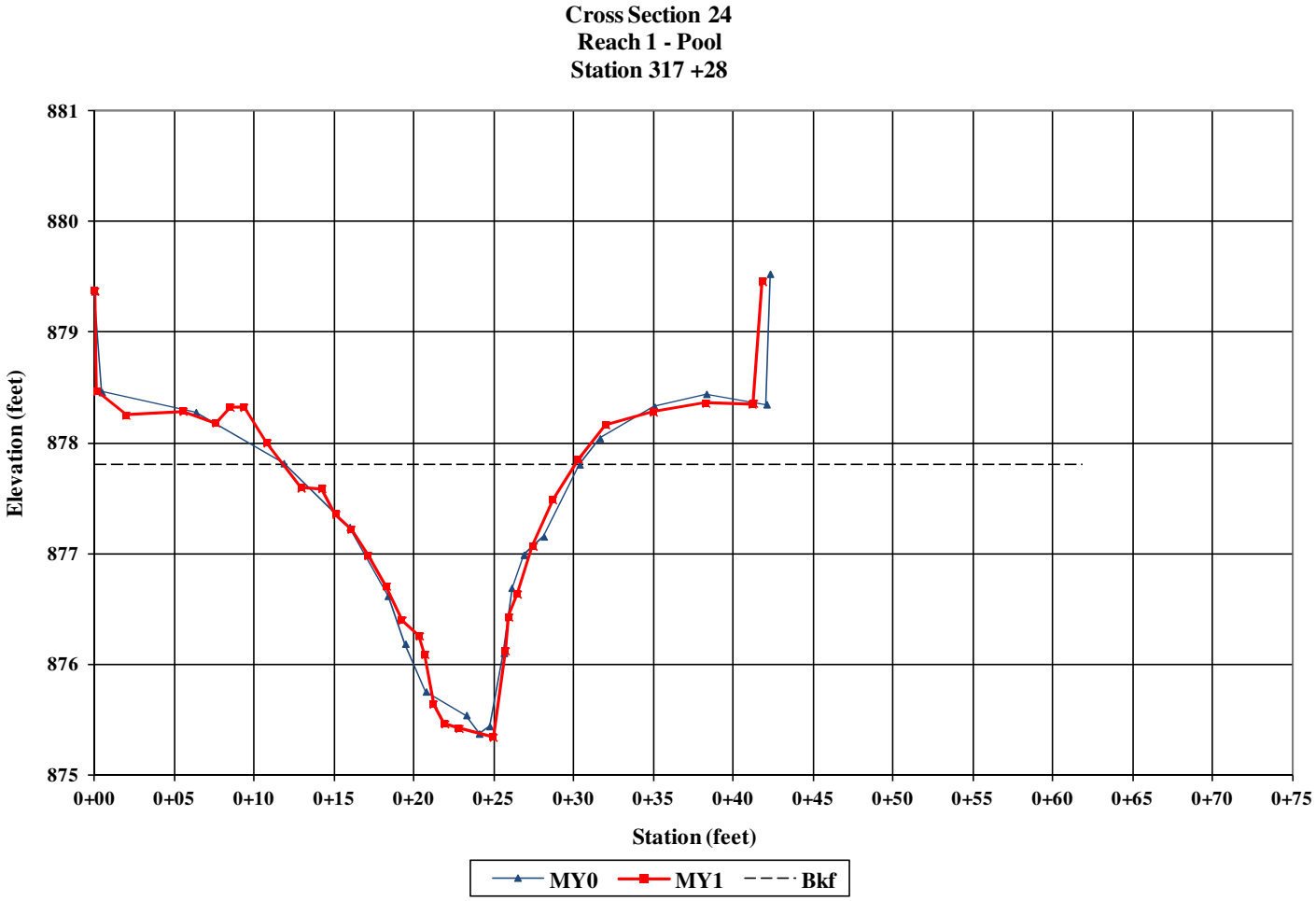

Upstream



## Cross Section 24 Reach 1 – Pool


Downstream

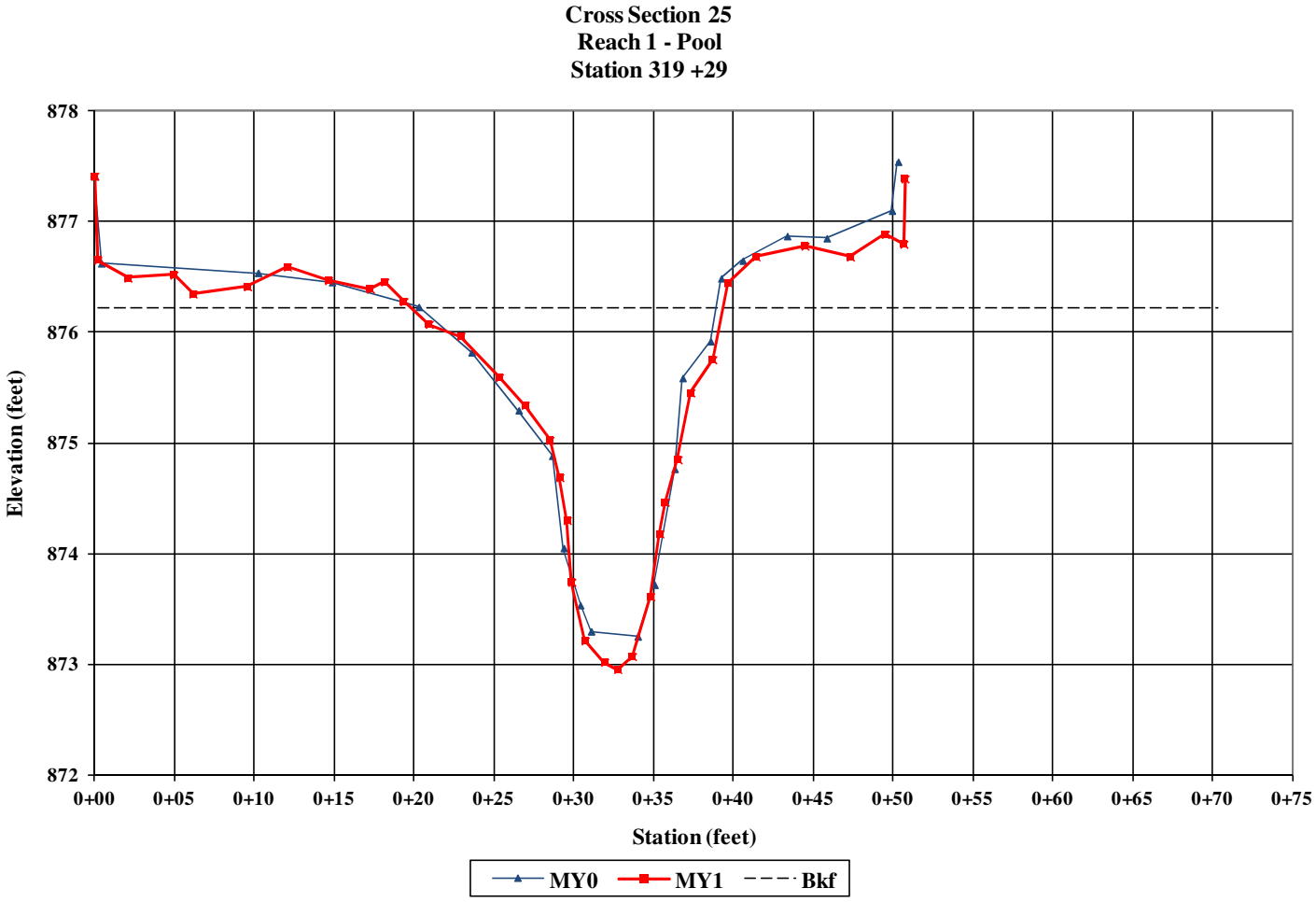

Upstream



## Cross Section 25 Reach 1 – Pool


Downstream

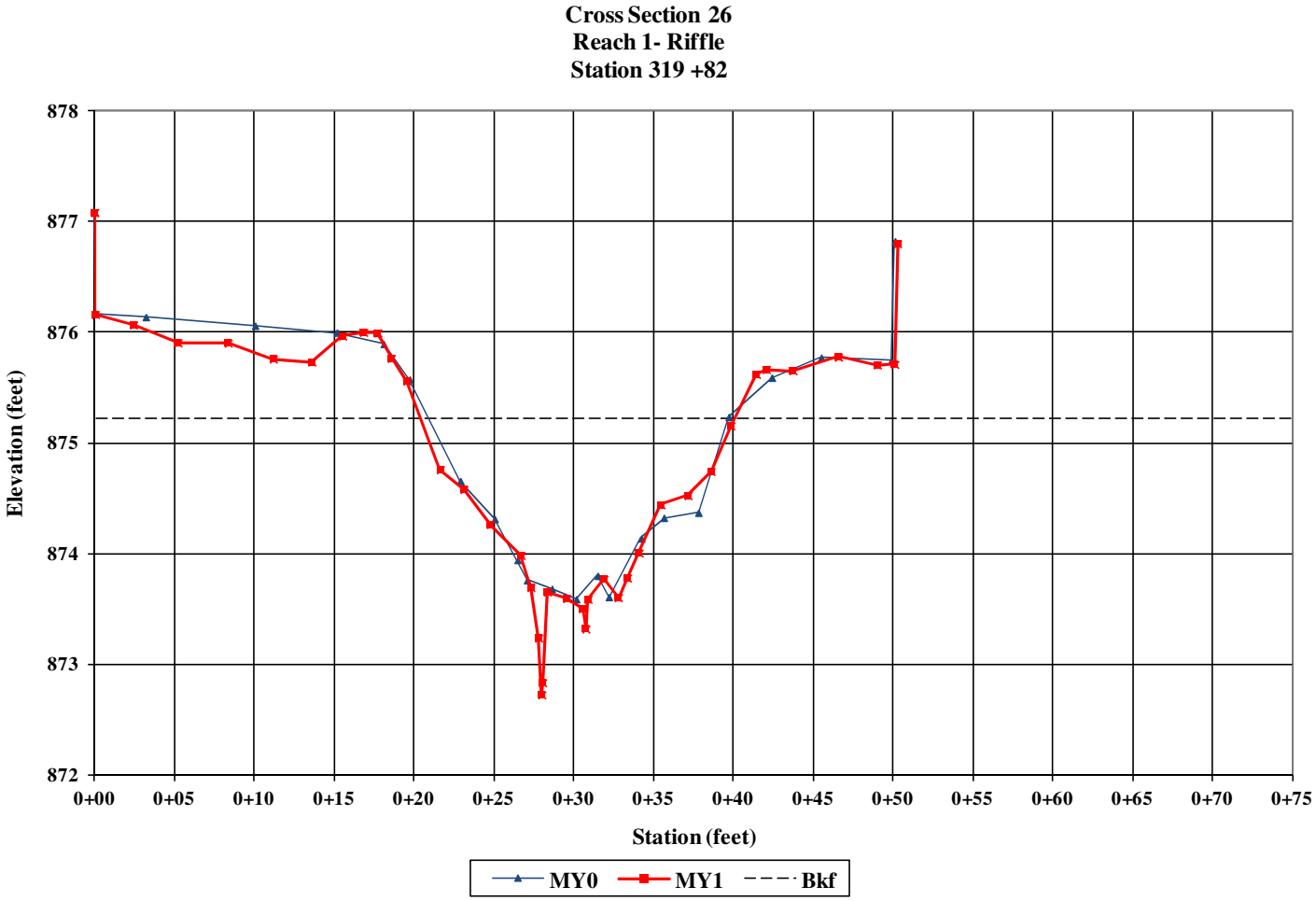

Upstream



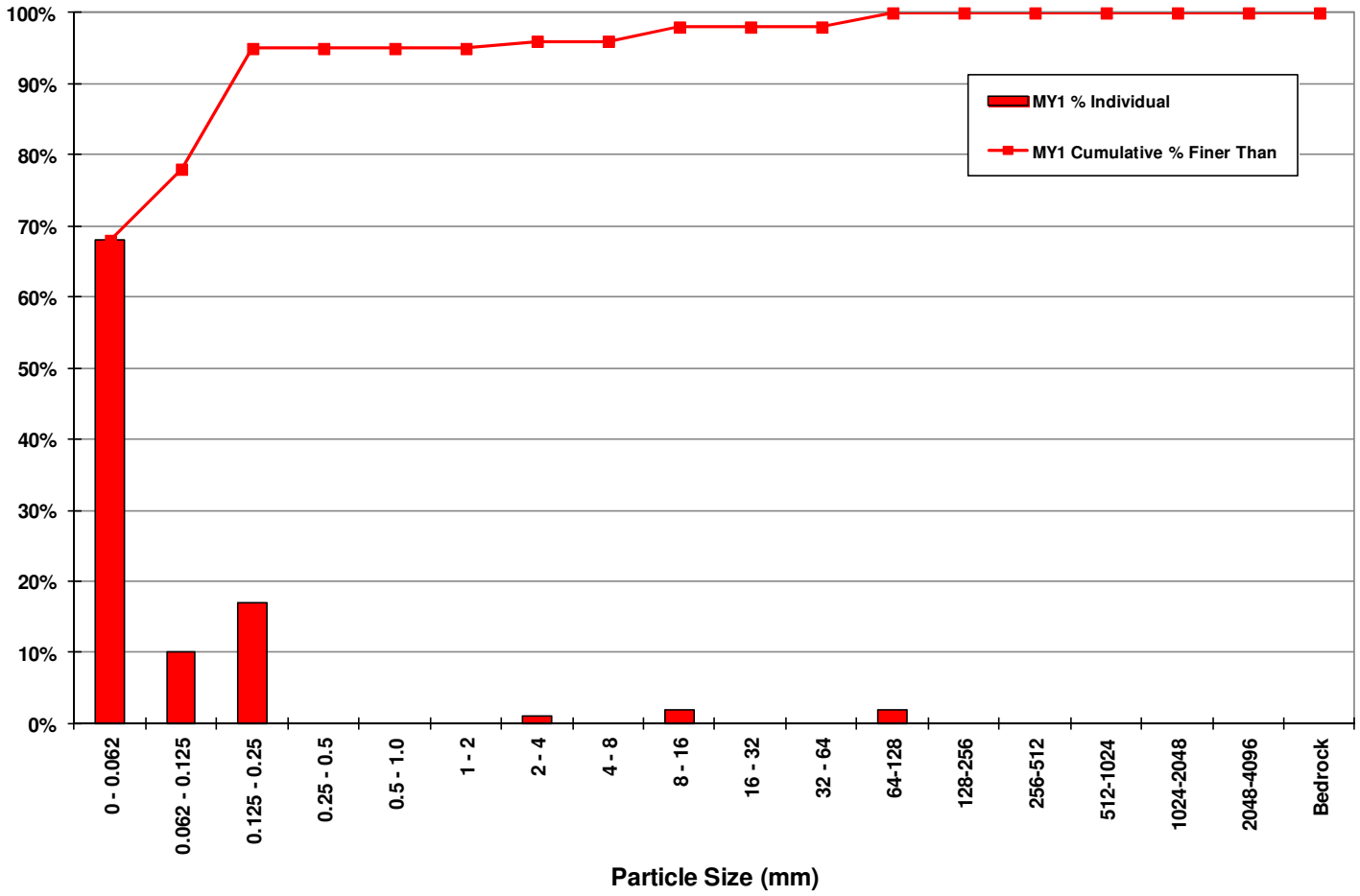
## Cross Section 26 Reach 1 – Riffle


Downstream


Upstream

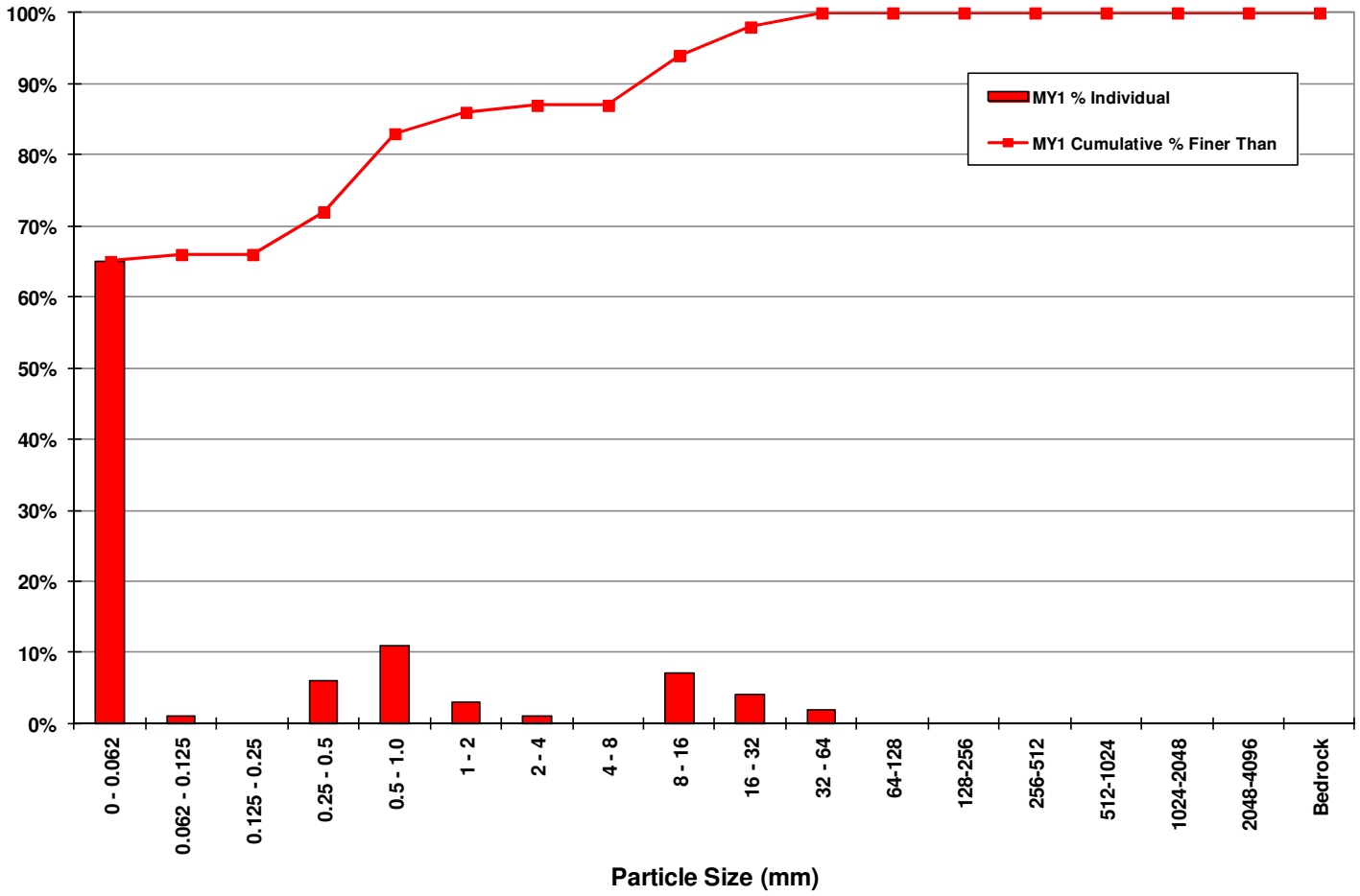


## Cross Section 1 Reach 4 – Riffle
## Pebble Count



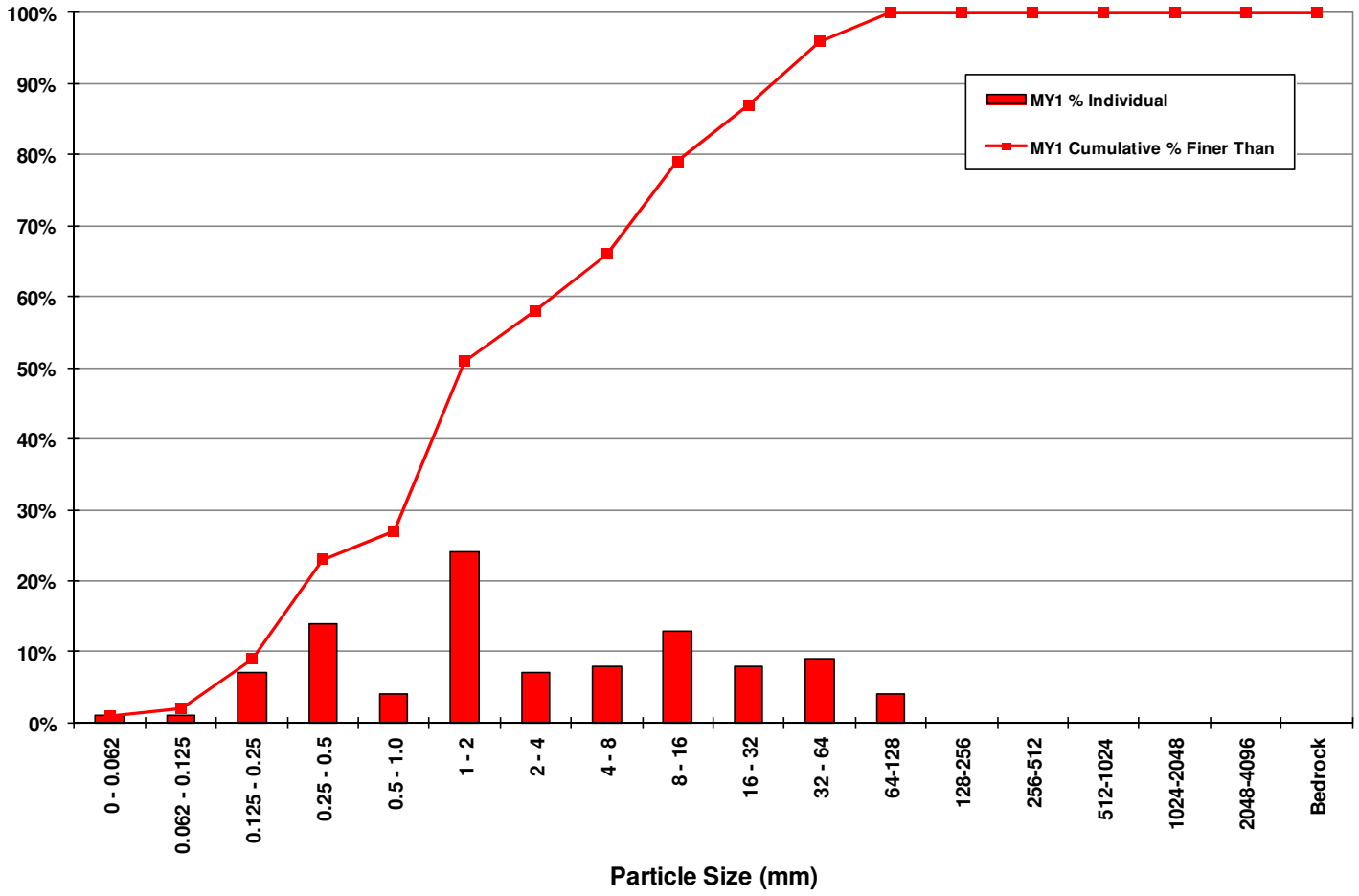

| Summary Data | |
|---|---|
| D50 | 0.062 mm |
| D84 | 0.16 mm |
| D95 | 0.5 mm |

## Cross Section 3 Reach 2 – Riffle
## Pebble Count



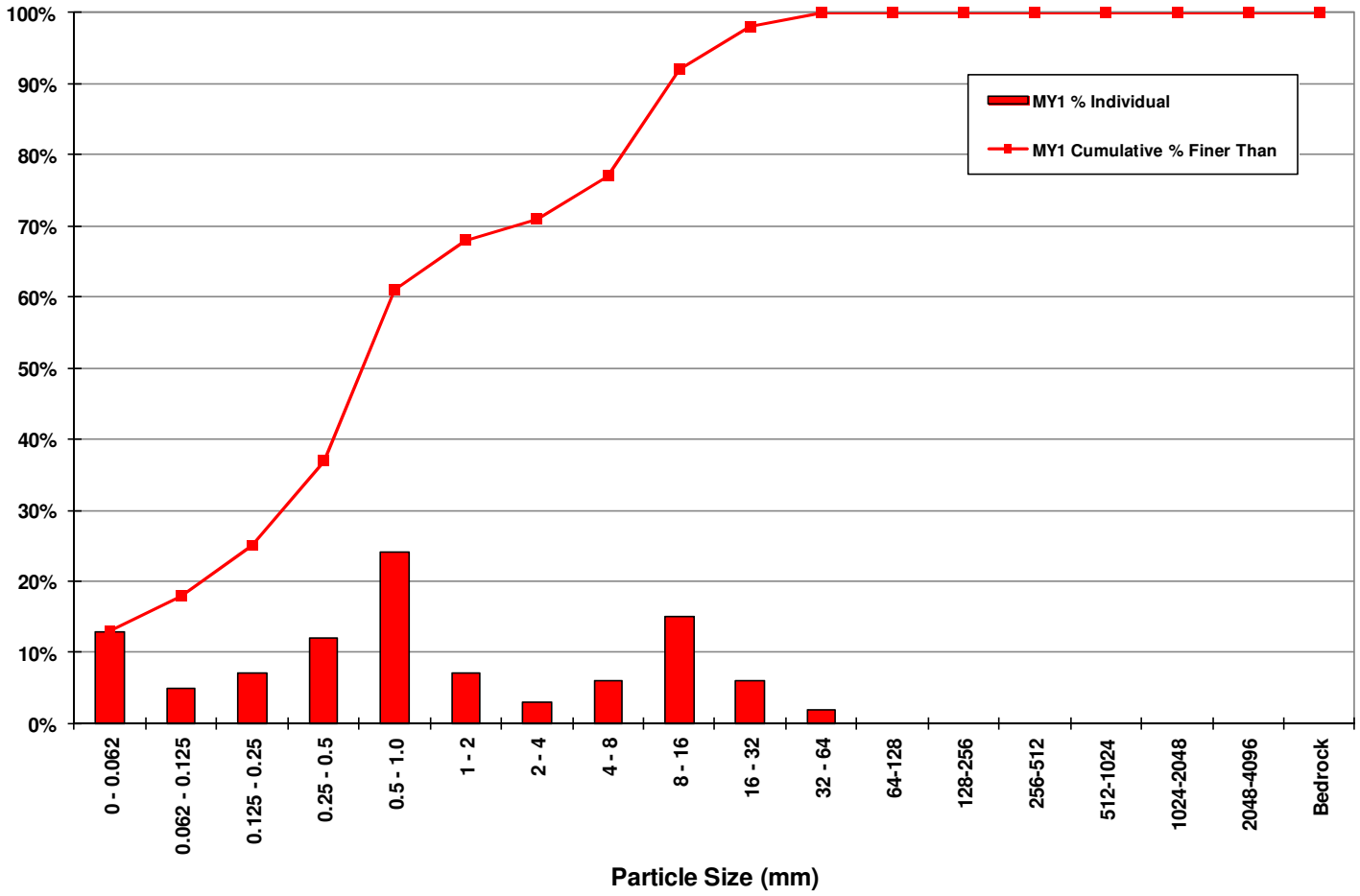

| Summary Data | |
|---|---|
| D50 | 0.062 mm |
| D84 | 1.3 mm |
| D95 | 18 mm |

## Cross Section 6 Reach 2 – Riffle
## Pebble Count



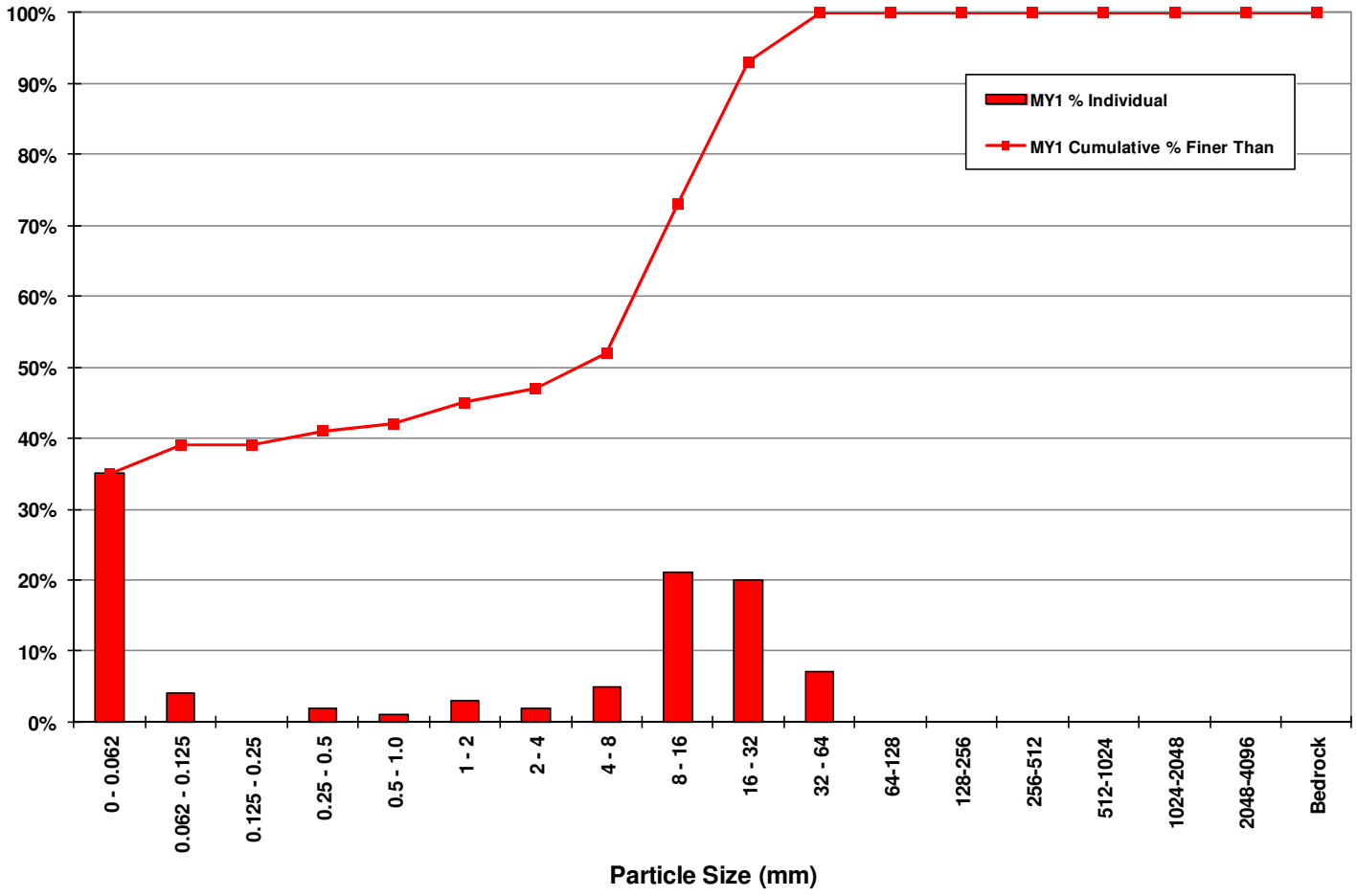

| Summary Data | |
|---|---|
| D50 | 1.9 mm |
| D84 | 24 mm |
| D95 | 43 mm |

## Cross Section 8 Reach 2 – Riffle
## Pebble Count



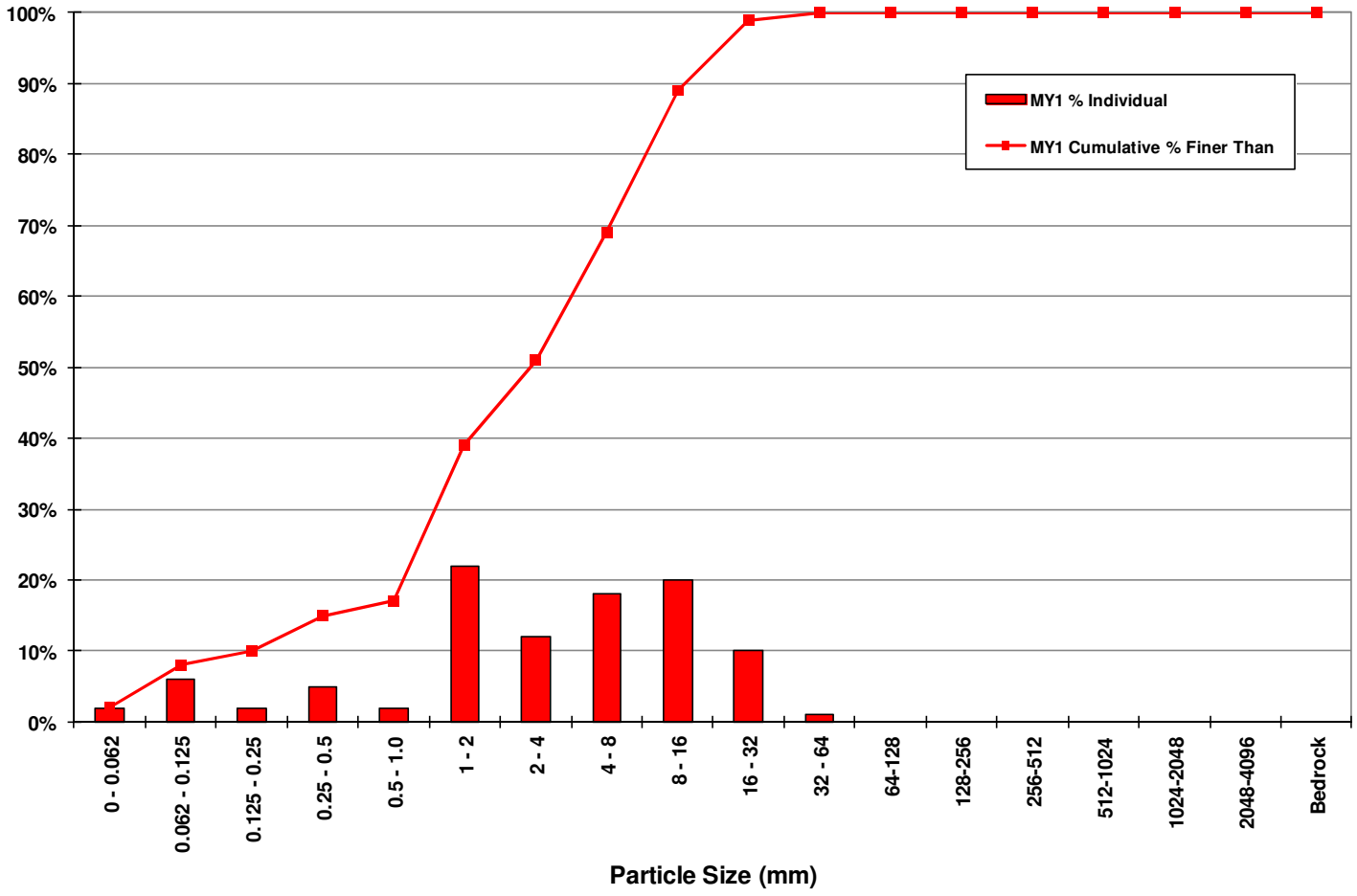

| Summary Data | |
|---|---|
| D50 | 0.73 mm |
| D84 | 11 mm |
| D95 | 20 mm |

## Cross Section 9 Reach 2 – Riffle
## Pebble Count



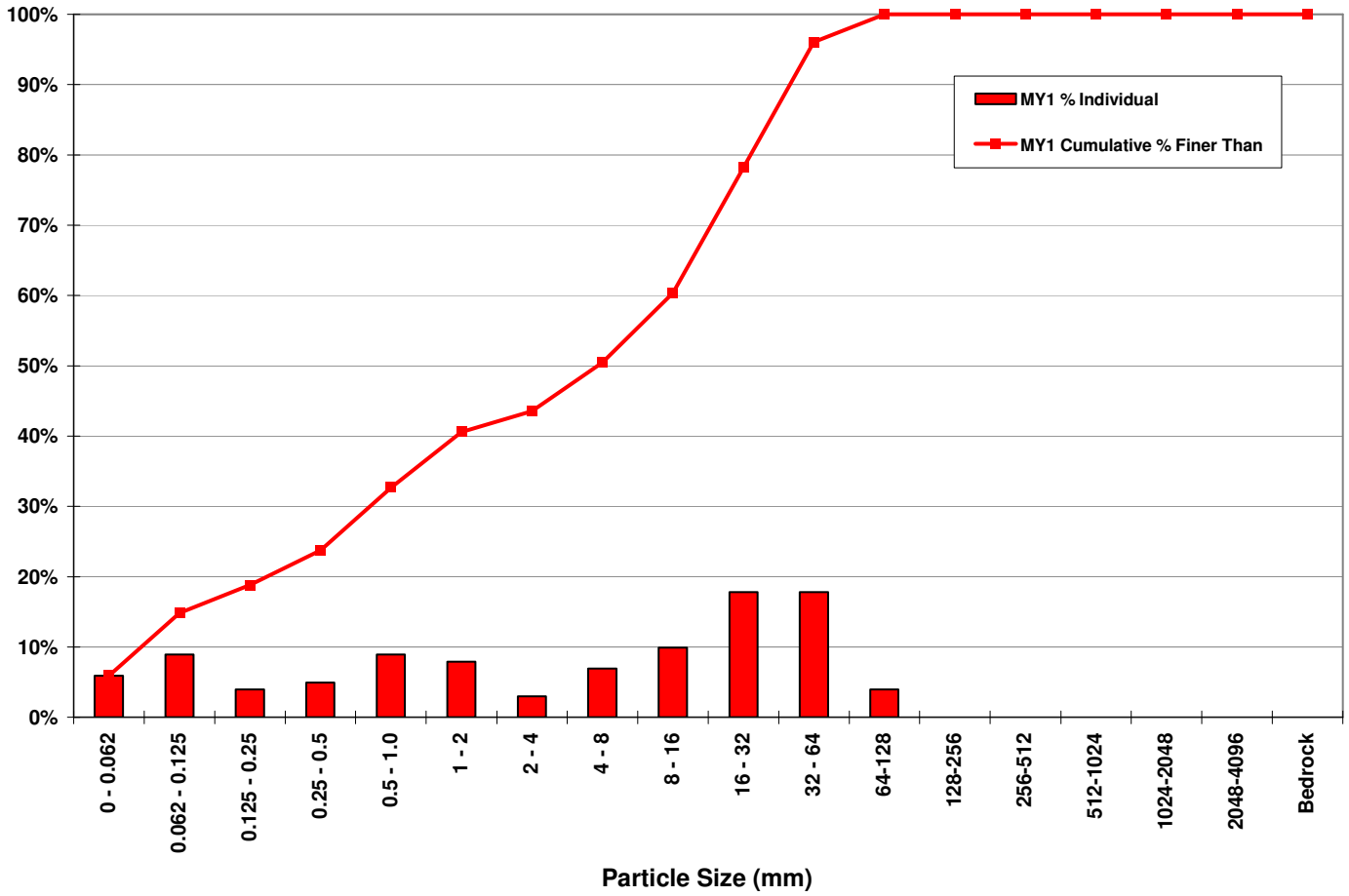

| Summary Data | |
|---|---|
| D50 | 6 mm |
| D84 | 24 mm |
| D95 | 38 mm |

## Cross Section 11 Reach 2 – Riffle
## Pebble Count



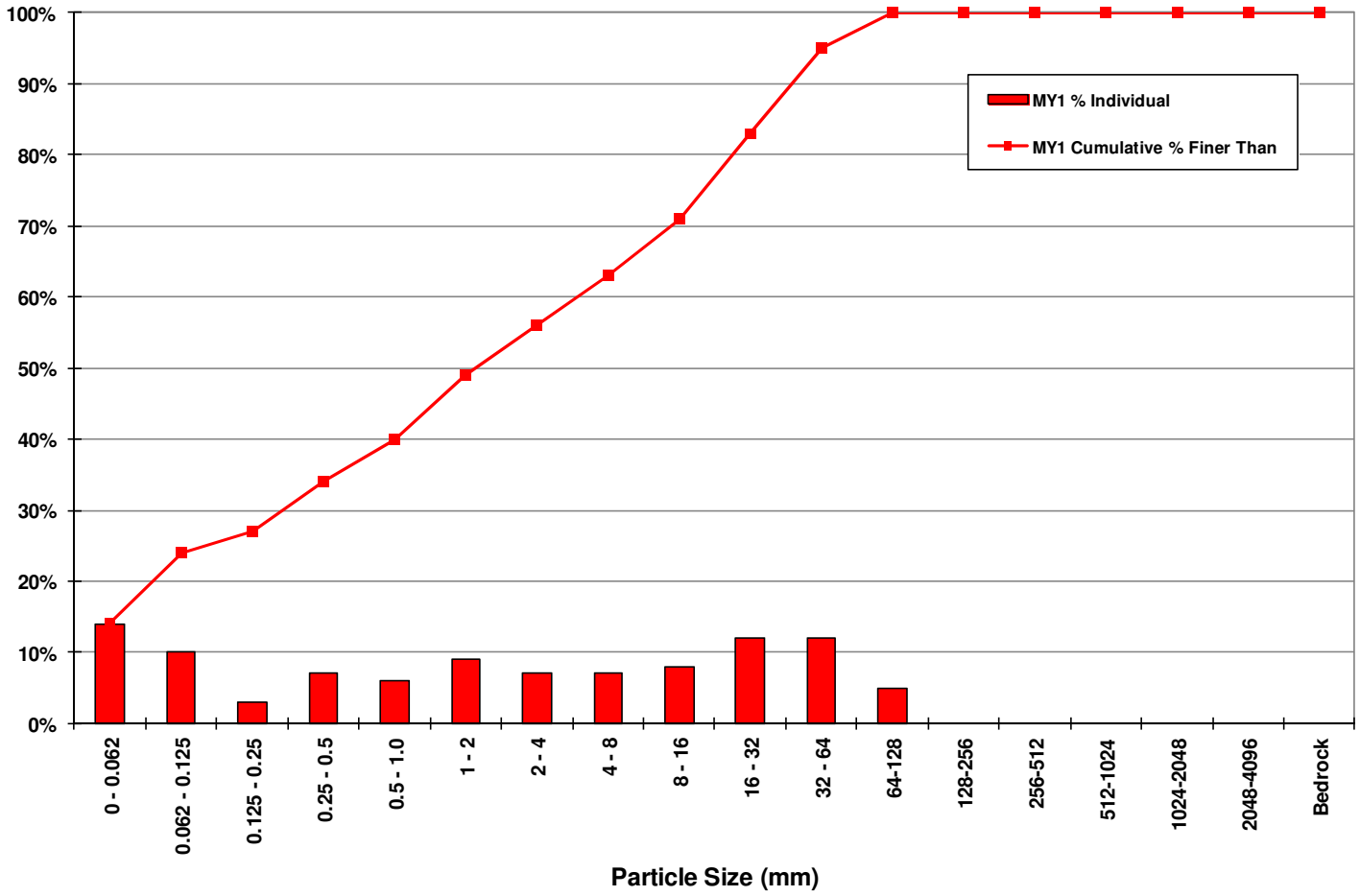

| Summary Data | |
|---|---|
| D50 | 3.8 mm |
| D84 | 13 mm |
| D95 | 24 mm |

## Cross Section 12 Reach 3 – Riffle
## Pebble Count



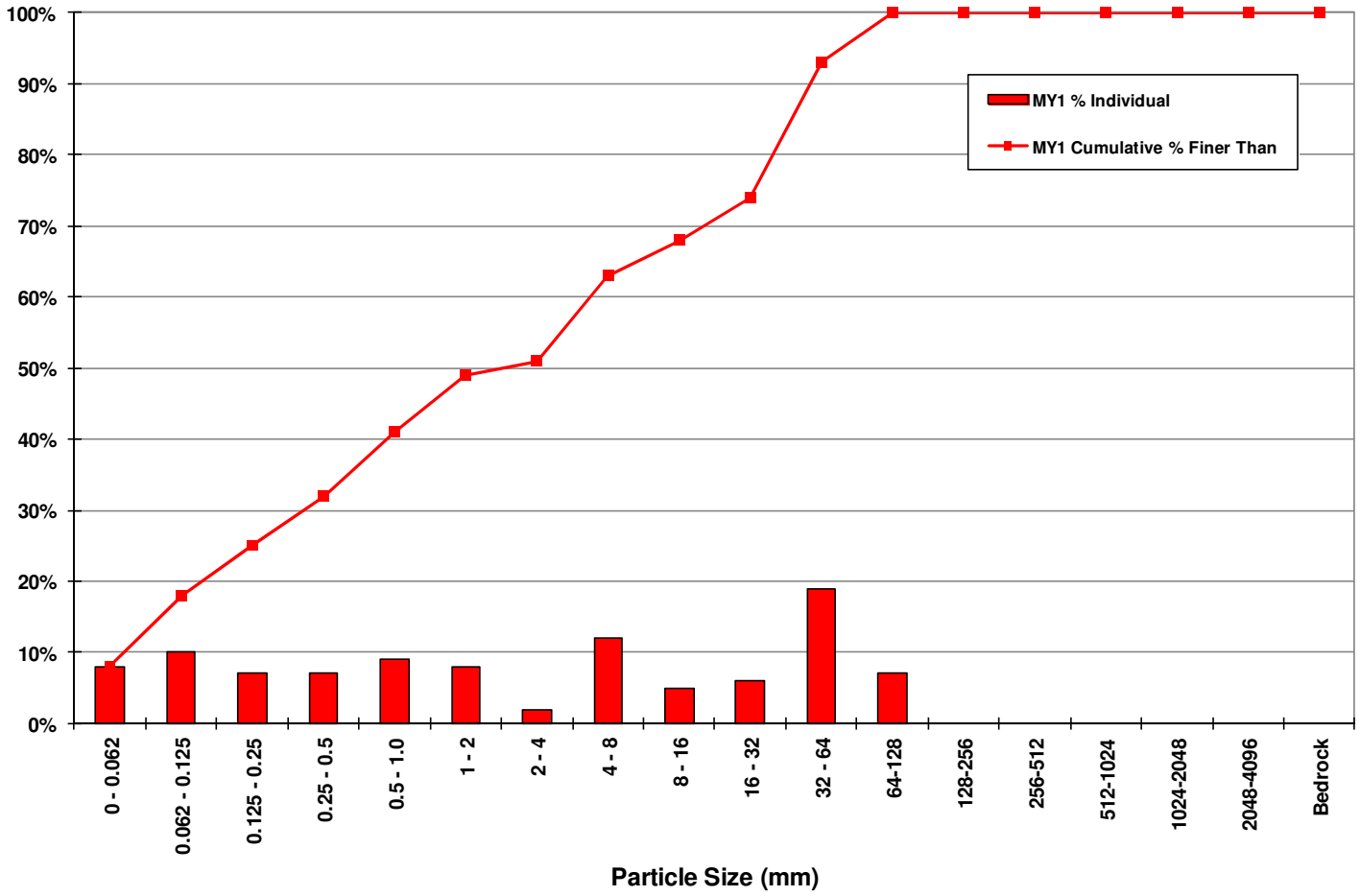

| Summary Data | |
|---|---|
| D50 | 7.6 mm |
| D84 | 37 mm |
| D95 | 58 mm |

## Cross Section 15 Reach 1 – Riffle
## Pebble Count



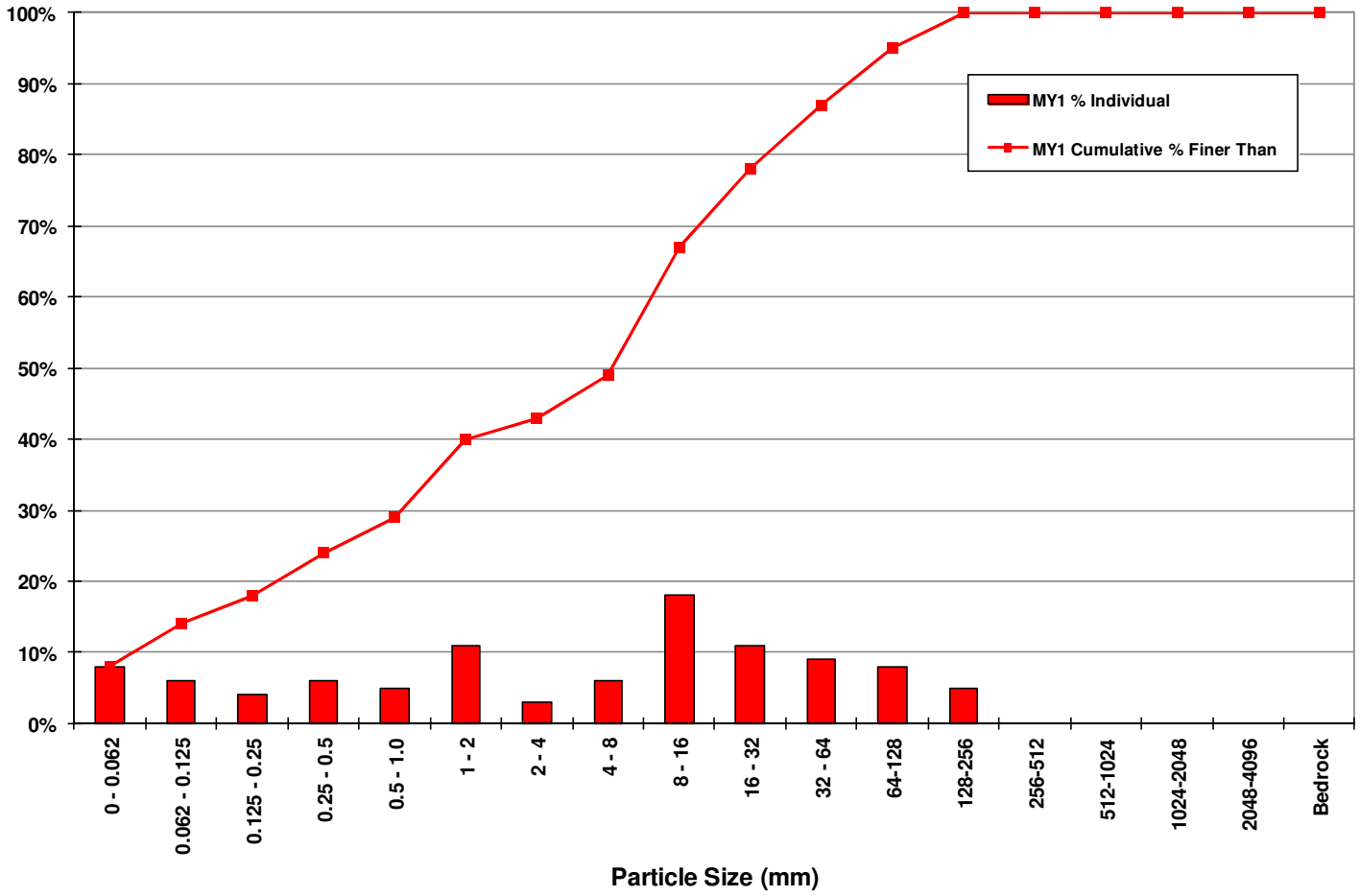

| Summary Data | |
|---|---|
| D50 | 2.2 mm |
| D84 | 34 mm |
| D95 | 64 mm |

## Cross Section 16 Reach 1 – Riffle
## Pebble Count



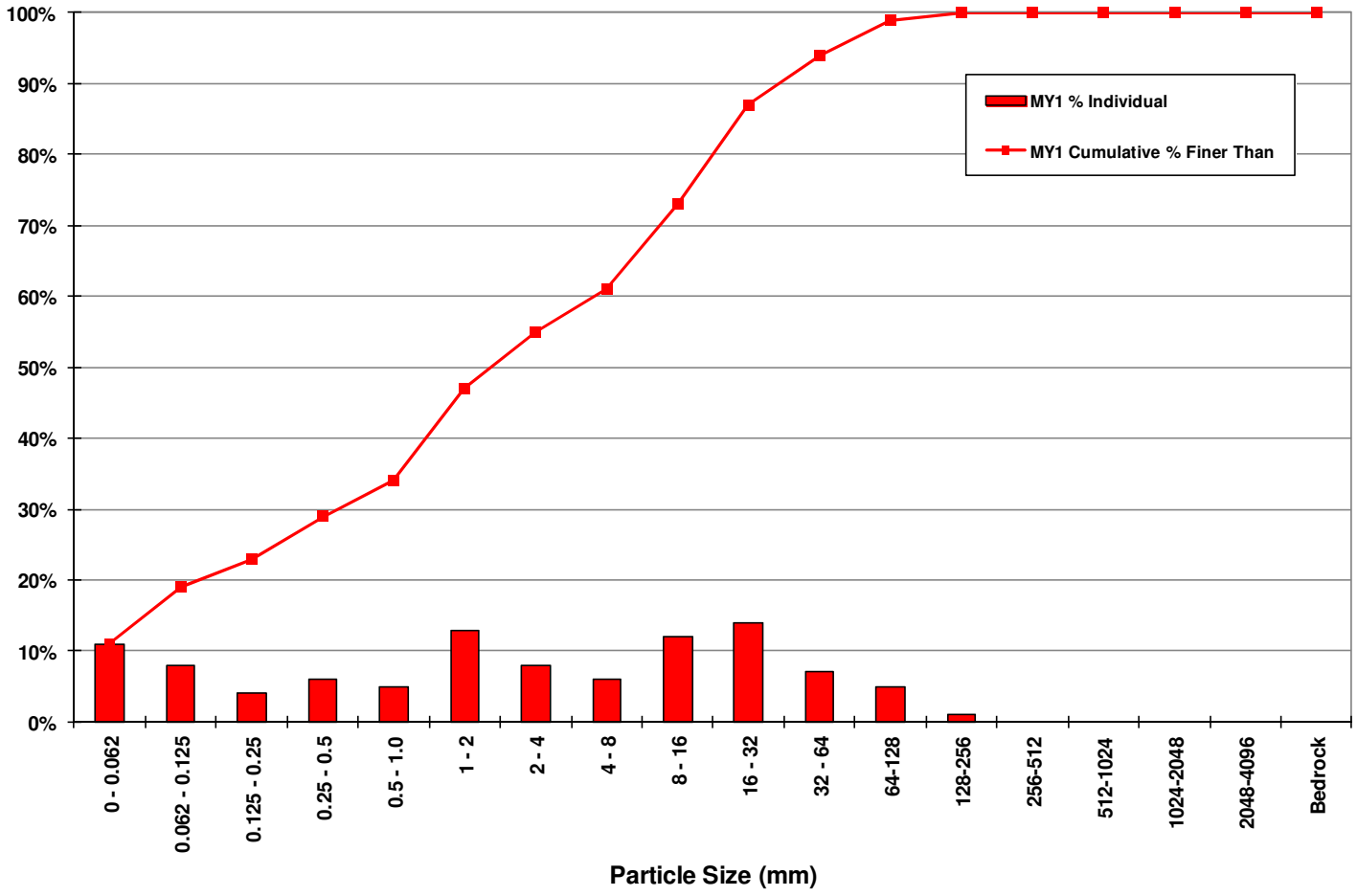

| Summary Data | |
|---|---|
| D50 | 2.8 mm |
| D84 | 48 mm |
| D95 | 76 mm |

## Cross Section 17 Reach 1 – Riffle
## Pebble Count



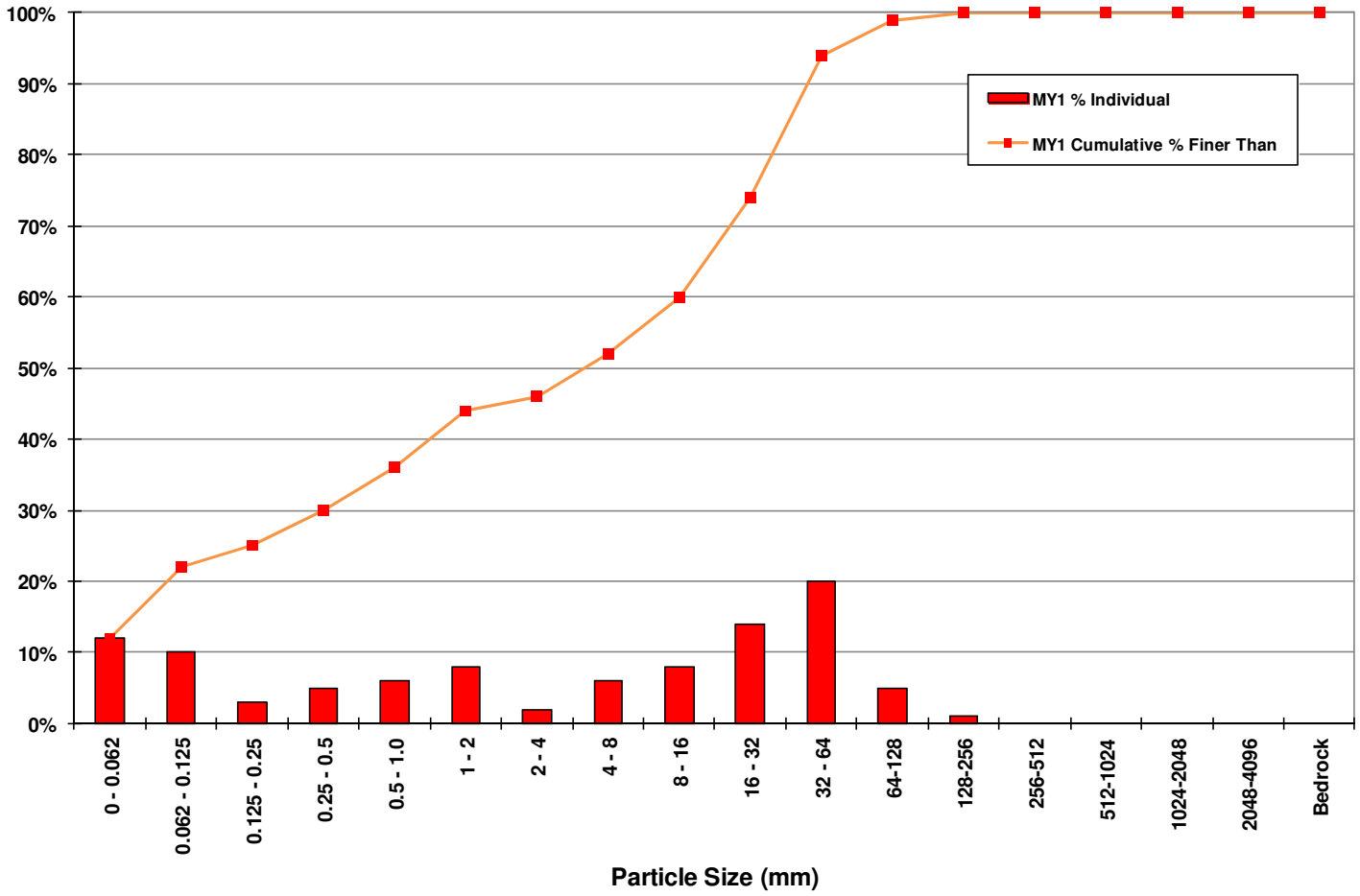

| Summary Data | |
|---|---|
| D50 | 8.4 mm |
| D84 | 49 mm |
| D95 | 130 mm |

## Cross Section 19 Reach 1 – Riffle
## Pebble Count



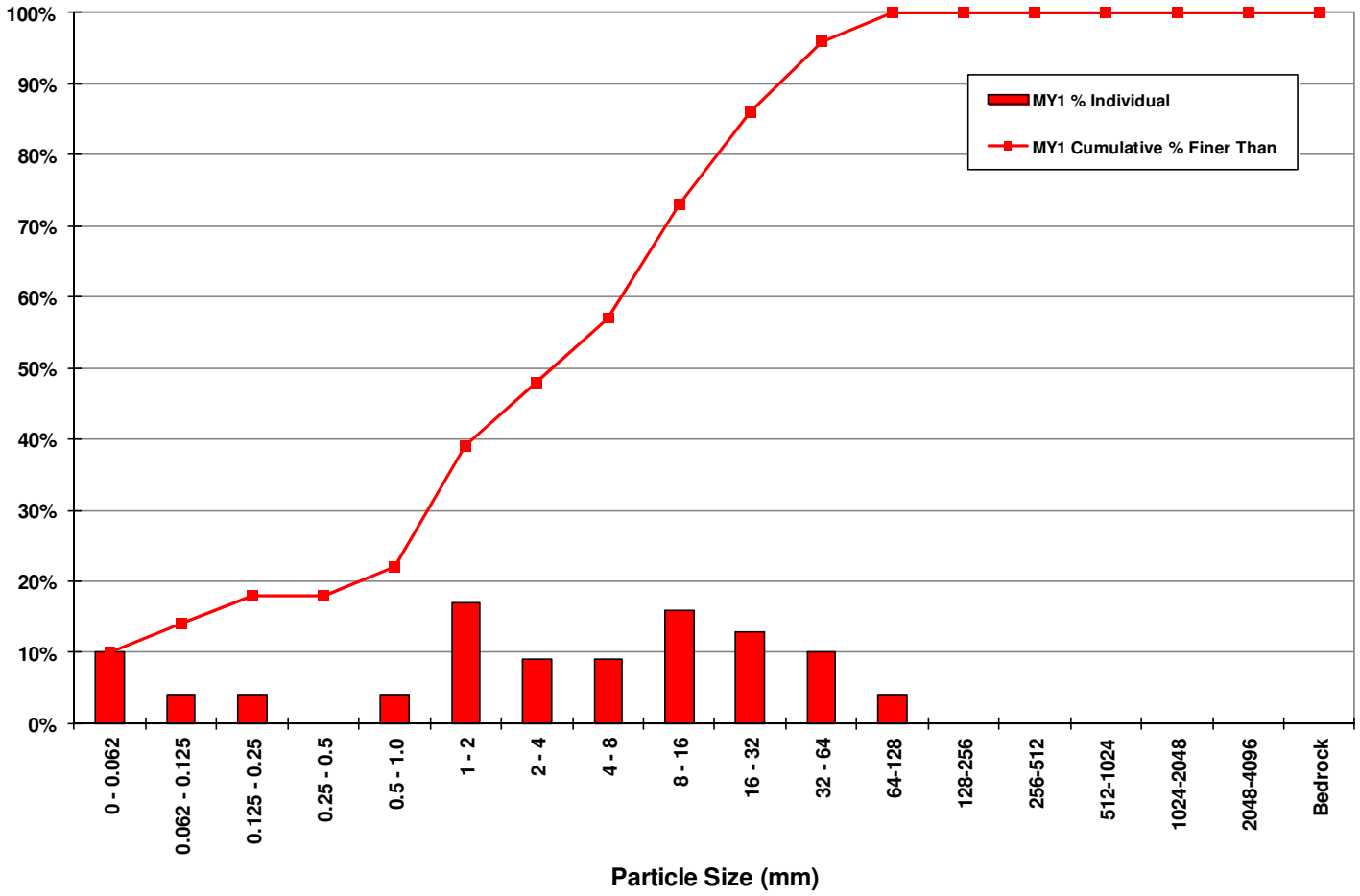

| Summary Data | |
|---|---|
| D50 | 2.6 mm |
| D84 | 28 mm |
| D95 | 70 mm |

## Cross Section 22 Reach 1 – Riffle
## Pebble Count



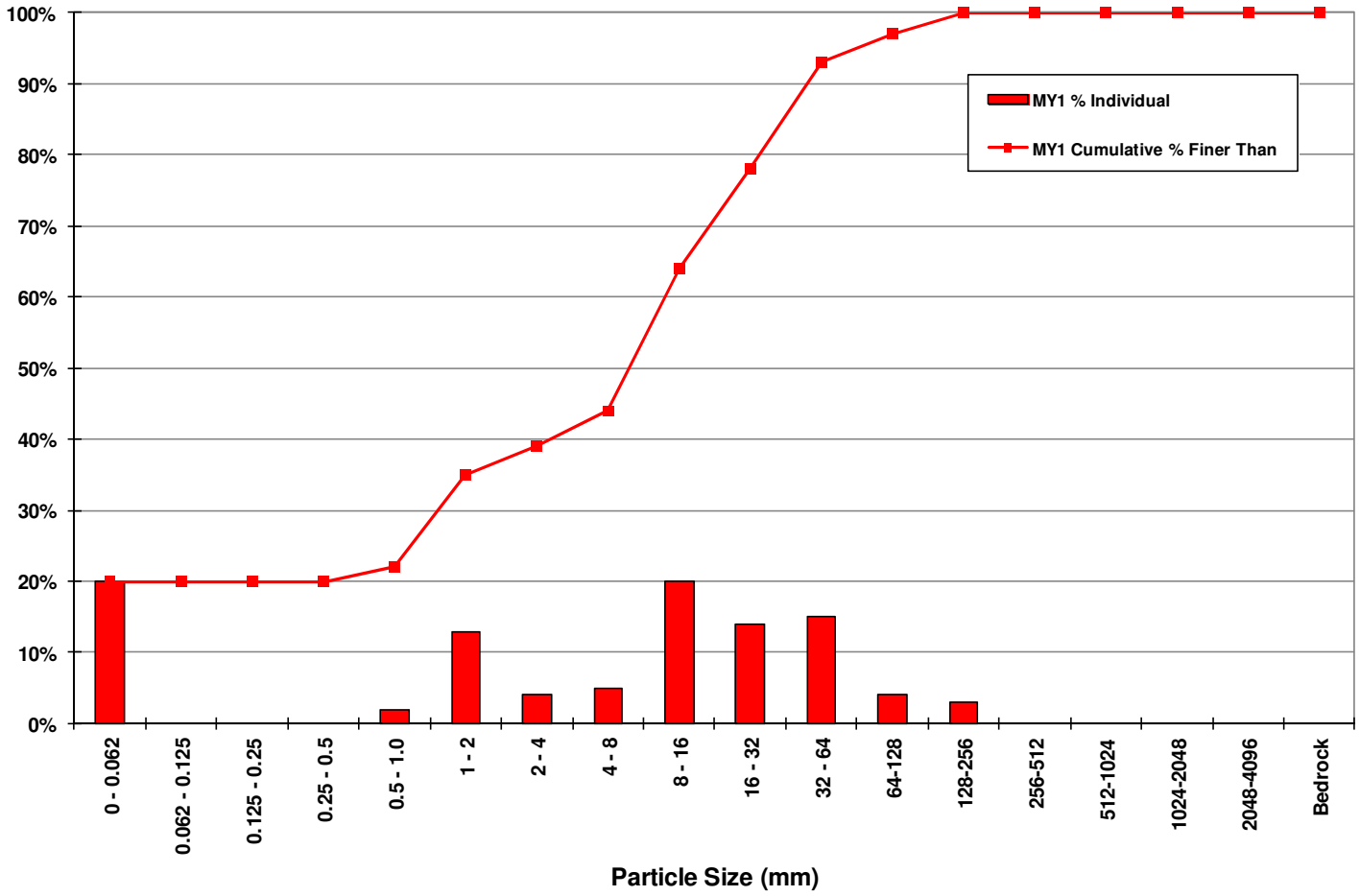

| Summary Data | |
|---|---|
| D50 | 6.6 mm |
| D84 | 43 mm |
| D95 | 70 mm |

## Cross Section 23 Reach 1 – Riffle
## Pebble Count



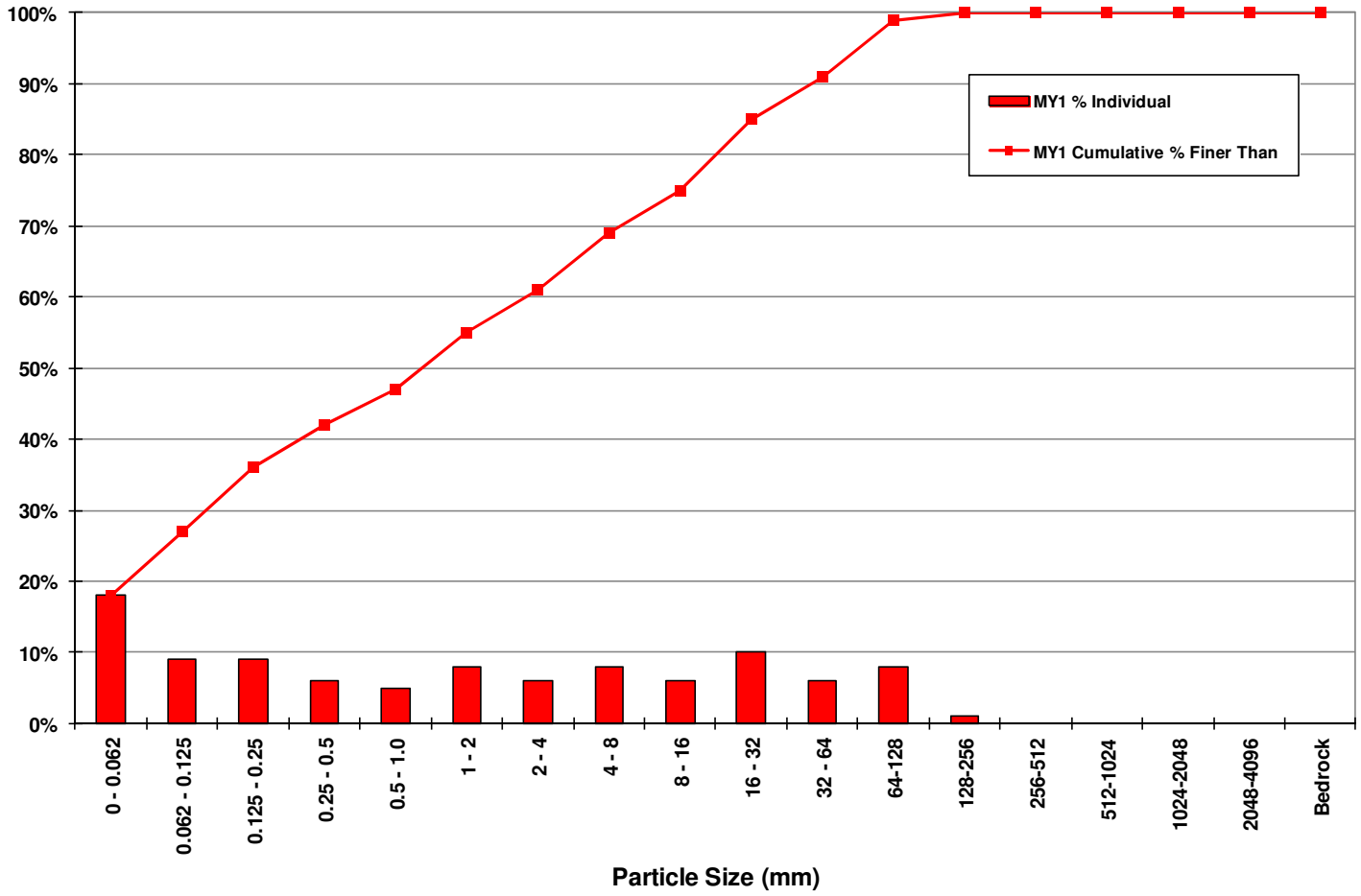

| Summary Data | |
|---|---|
| D50 | 4.6 mm |
| D84 | 28 mm |
| D95 | 60 mm |

## Cross Section 26 Reach 1 – Riffle
## Pebble Count



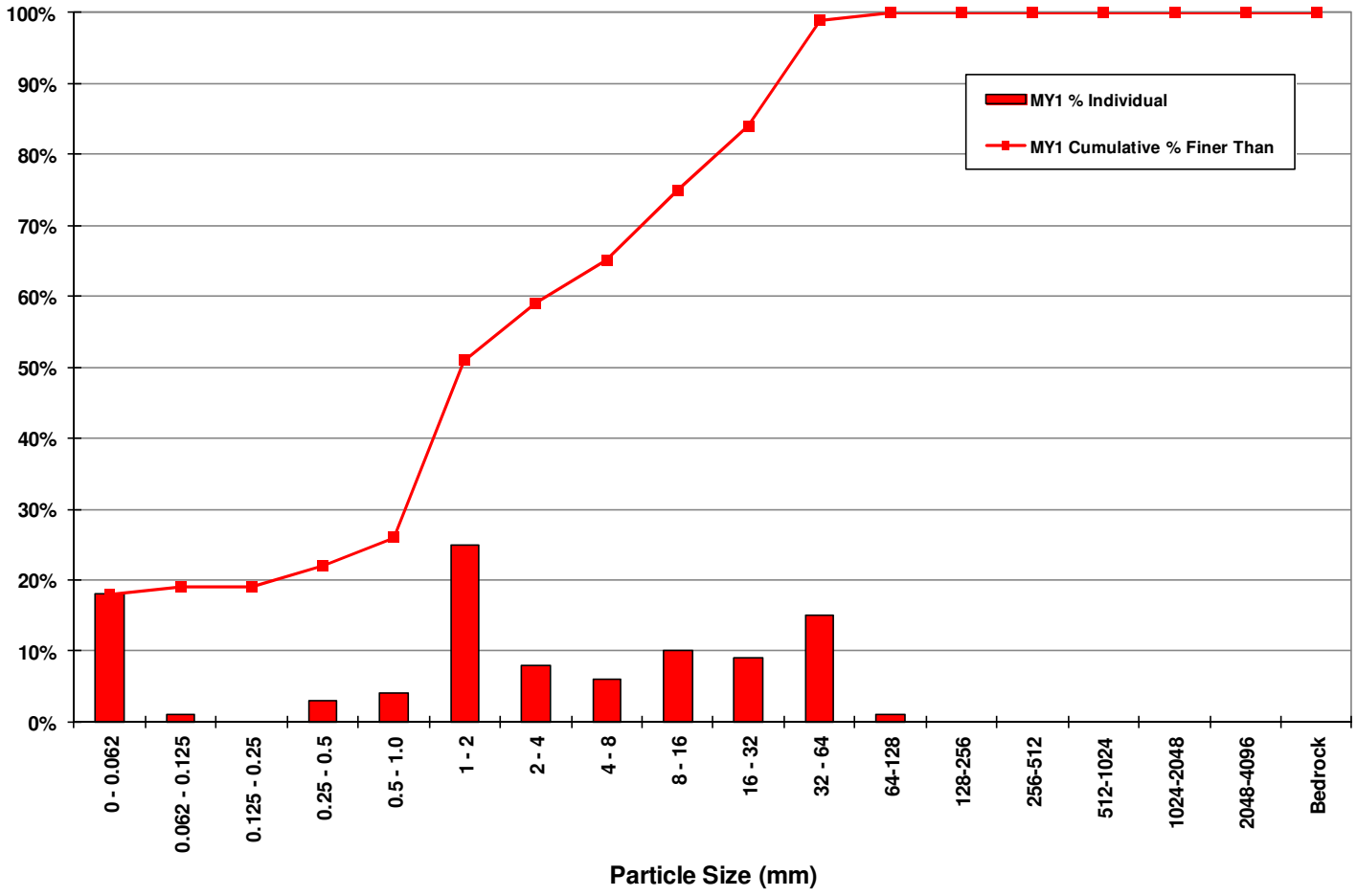

| Summary Data | |
|---|---|
| D50 | 9.9 mm |
| D84 | 43 mm |
| D95 | 100 mm |

## Reach 1 - Reachwide
## Pebble Count



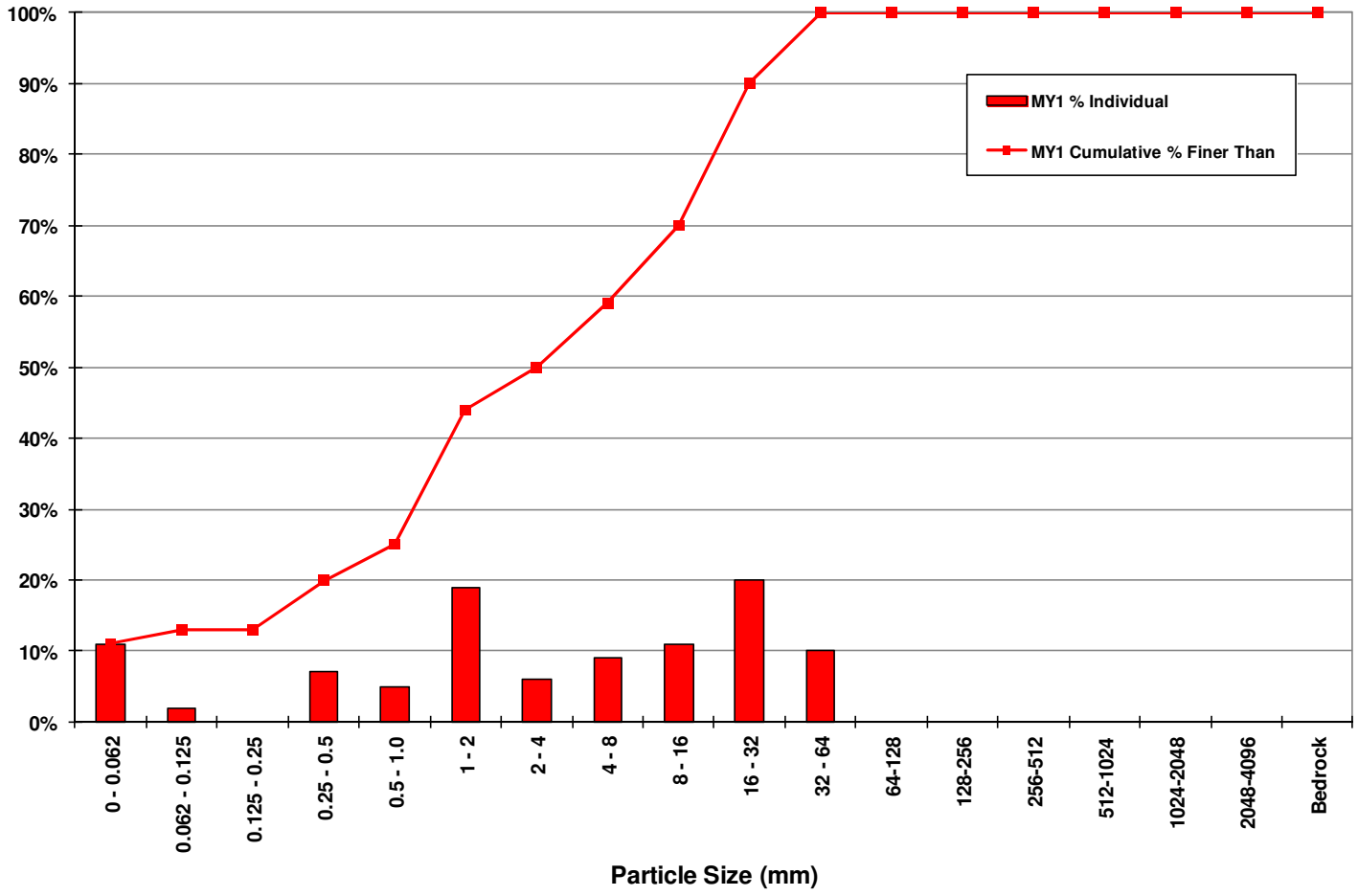

| Summary Data | |
|---|---|
| D50 | 1.3 mm |
| D84 | 30 mm |
| D95 | 97 mm |

**Reach 2 Reachwide**
**Pebble Count**



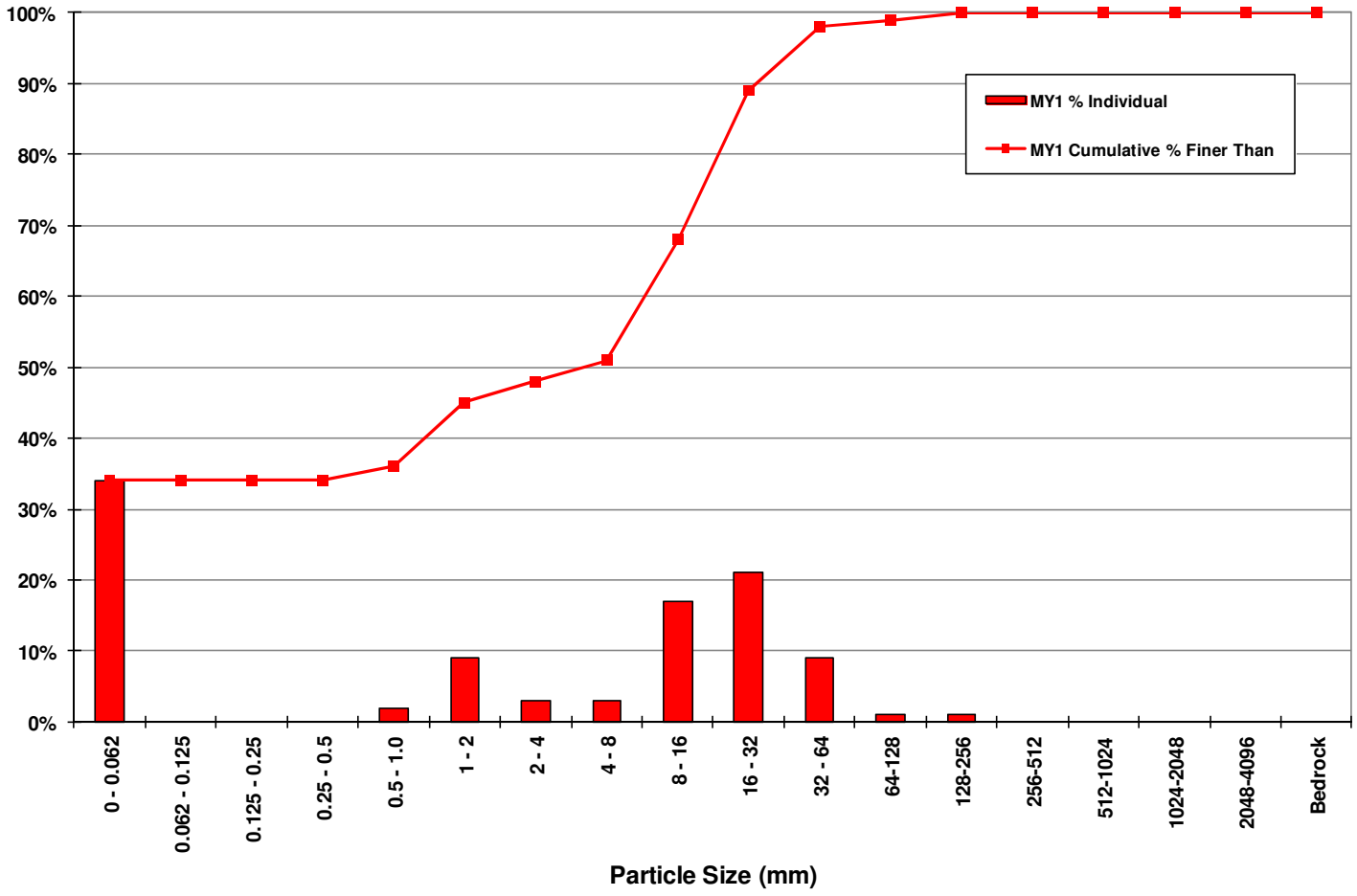

| Summary Data | |
|---|---|
| D50 | 1.9 mm |
| D84 | 32 mm |
| D95 | 52 mm |

## Reach 3 Reachwide
## Pebble Count




| Summary Data | |
|---|---|
| D50 | 4 mm |
| D84 | 25 mm |
| D95 | 43 mm |

## Reach 4 Reachwide
## Pebble Count




| Summary Data | |
|---|---|
| D50 | 5.2 mm |
| D84 | 23 mm |
| D95 | 43 mm |

# APPENDIX C

# 2012 Morphologic Monitoring Parameters

| Unnamed Tributary 1 – Reach 4 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Cross Section 1 @ STA 101+45 Riffle** | | | | | | **Cross Section 2 @ STA 102+04 Pool** | | | | | |
| Dimension | Base | MY1 | MY2 | MY3 | MY4 | MY5 | Base | MY1 | MY2 | MY3 | MY4 | MY5 |
| BF Width (ft) | 7.8 | 8.4 | | | | | 7.1 | 10.2 | | | | |
| Floodprone Width (ft) | 50.0 | >40.0 | | | | | 34.2 | >40.0 | | | | |
| BF Cross Sectional Area ($ft^2$) | 4.7 | 4.2 | | | | | 10.6 | 13.6 | | | | |
| BF Mean Depth (ft) | 0.6 | 0.5 | | | | | 1.5 | 1.3 | | | | |
| BF Max Depth (ft) | 0.9 | 0.8 | | | | | 2.1 | 2.1 | | | | |
| Width/Depth Ratio | 12.8 | 16.5 | | | | | 4.8 | 7.7 | | | | |
| Entrenchment Ratio | 6.4 | 5.0 | | | | | 4.8 | 2.4 | | | | |
| Wetted Perimeter (ft) | N/A[1] | 8.8 | | | | | N/A[1] | 11.9 | | | | |
| Hydraulic Radius (ft) | N/A[1] | 0.5 | | | | | N/A[1] | 1.1 | | | | |

[1]N/A = Not available in Baseline Report

| Unnamed Tributary 1 – Reach 2 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Cross Section 3 @ STA 107+28 Riffle** | | | | | | **Cross Section 4 @ STA 107+60 Pool** | | | | | |
| Dimension | Base | MY1 | MY2 | MY3 | MY4 | MY5 | Base | MY1 | MY2 | MY3 | MY4 | MY5 |
| BF Width (ft) | 12.8 | 14.4 | | | | | 10.9 | 9.3 | | | | |
| Floodprone Width (ft) | 22.5 | 23.1 | | | | | 22.2 | 20.6 | | | | |
| BF Cross Sectional Area ($ft^2$) | 10.1 | 11.5 | | | | | 9.2 | 8.0 | | | | |
| BF Mean Depth (ft) | 0.8 | 0.8 | | | | | 0.8 | 0.9 | | | | |
| BF Max Depth (ft) | 1.6 | 1.7 | | | | | 1.6 | 1.5 | | | | |
| Width/Depth Ratio | 16.2 | 18.0 | | | | | 13.0 | 10.9 | | | | |
| Entrenchment Ratio | 1.0 | 1.6 | | | | | 2.0 | 2.2 | | | | |
| Wetted Perimeter (ft) | N/A[1] | 15.2 | | | | | N/A[1] | 10.0 | | | | |
| Hydraulic Radius (ft) | N/A[1] | 0.8 | | | | | N/A[1] | 0.8 | | | | |

[1]N/A = Not available in Baseline Report

| Unnamed Tributary 1 – Reach 2 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Cross Section 5 @ STA 112+05 Pool** | | | | | | **Cross Section 6 @ STA 112+22 Riffle** | | | | | |
| Dimension | Base | MY1 | MY2 | MY3 | MY4 | MY5 | Base | MY1 | MY2 | MY3 | MY4 | MY5 |
| BF Width (ft) | 9.6 | 9.8 | | | | | 12.0 | 11.4 | | | | |
| Floodprone Width (ft) | 50.9 | 50.4 | | | | | 45.8 | 46.2 | | | | |
| BF Cross Sectional Area ($ft^2$) | 11.0 | 11.3 | | | | | 8.7 | 8.5 | | | | |
| BF Mean Depth (ft) | 1.2 | 1.2 | | | | | 0.7 | 0.7 | | | | |
| BF Max Depth (ft) | 2.3 | 2.0 | | | | | 1.6 | 1.7 | | | | |
| Width/Depth Ratio | 8.3 | 8.4 | | | | | 16.6 | 15.2 | | | | |
| Entrenchment Ratio | 5.3 | 5.2 | | | | | 3.8 | 4.1 | | | | |
| Wetted Perimeter (ft) | N/A[1] | 11.6 | | | | | N/A[1] | 12.5 | | | | |
| Hydraulic Radius (ft) | N/A[1] | 1.0 | | | | | N/A[1] | 0.7 | | | | |

[1]N/A = Not available in Baseline Report

| Unnamed Tributary 1 – Reach 2 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Cross Section 7 @ STA 114+55 Pool** | | | | | | **Cross Section 8 @ STA 115+16 Riffle** | | | | | |
| Dimension | Base | MY1 | MY2 | MY3 | MY4 | MY5 | Base | MY1 | MY2 | MY3 | MY4 | MY5 |
| BF Width (ft) | 15.0 | 12.7 | | | | | 11.9 | 11.4 | | | | |
| Floodprone Width (ft) | 45.4 | >40.0 | | | | | 50.0 | >40.0 | | | | |
| BF Cross Sectional Area ($ft^2$) | 13.7 | 11.8 | | | | | 10.2 | 9.1 | | | | |
| BF Mean Depth (ft) | 0.9 | 0.9 | | | | | 0.9 | 0.8 | | | | |
| BF Max Depth (ft) | 2.6 | 2.2 | | | | | 1.6 | 1.7 | | | | |
| Width/Depth Ratio | 16.5 | 13.6 | | | | | 13.9 | 14.3 | | | | |
| Entrenchment Ratio | 3.0 | 3.6 | | | | | 4.2 | 3.5 | | | | |
| Wetted Perimeter (ft) | N/A[1] | 13.7 | | | | | N/A[1] | 12.4 | | | | |
| Hydraulic Radius (ft) | N/A[1] | 0.9 | | | | | N/A[1] | 0.7 | | | | |

[1]N/A = Not available in Baseline Report

| Unnamed Tributary 1 – Reach 2 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Cross Section 9 @ STA 117+94 Riffle** | | | | | | **Cross Section 10 @ STA 118+53 Pool** | | | | | |
| Dimension | Base | MY1 | MY2 | MY3 | MY4 | MY5 | Base | MY1 | MY2 | MY3 | MY4 | MY5 |
| BF Width (ft) | 15.4 | 12.8 | | | | | 13.7 | 13.3 | | | | |
| Floodprone Width (ft) | 40.0 | 38.6 | | | | | 30.0 | >150.0 | | | | |
| BF Cross Sectional Area ($ft^2$) | 8.1 | 6.1 | | | | | 8.8 | 8.1 | | | | |
| BF Mean Depth (ft) | 0.5 | 0.5 | | | | | 0.6 | 0.6 | | | | |
| BF Max Depth (ft) | 1.1 | 1.1 | | | | | 1.9 | 1.4 | | | | |
| Width/Depth Ratio | 29.0 | 26.8 | | | | | 21.3 | 21.8 | | | | |
| Entrenchment Ratio | 2.6 | 3.0 | | | | | 2.2 | 11.3 | | | | |
| Wetted Perimeter (ft) | N/A[1] | 13.1 | | | | | N/A[1] | 13.8 | | | | |
| Hydraulic Radius (ft) | N/A[1] | 0.5 | | | | | N/A[1] | 0.6 | | | | |

[1]N/A = Not available in Baseline Report

| Unnamed Tributary 1 – Reach 2 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Cross Section 11 @ STA 120+73 Riffle** | | | | | | | | | | | |
| Dimension | Base | MY1 | MY2 | MY3 | MY4 | MY5 | Base | MY1 | MY2 | MY3 | MY4 | MY5 |
| BF Width (ft) | 11.3 | 9.0 | | | | | | | | | | |
| Floodprone Width (ft) | 30.0 | >150.0 | | | | | | | | | | |
| BF Cross Sectional Area ($ft^2$) | 7.4 | 4.7 | | | | | | | | | | |
| BF Mean Depth (ft) | 0.7 | 0.5 | | | | | | | | | | |
| BF Max Depth (ft) | 1.2 | 1.0 | | | | | | | | | | |
| Width/Depth Ratio | 17.1 | 17.0 | | | | | | | | | | |
| Entrenchment Ratio | 2.7 | 16.7 | | | | | | | | | | |
| Wetted Perimeter (ft) | N/A[1] | 9.4 | | | | | | | | | | |
| Hydraulic Radius (ft) | N/A[1] | 0.5 | | | | | | | | | | |

[1]N/A = Not available in Baseline Report

| Unnamed Tributary 2 – Reach 3 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Cross Section 12 @ STA 203+75 Riffle** | | | | | | **Cross Section 13 @ STA 204+01 Pool** | | | | | |
| Dimension | Base | MY1 | MY2 | MY3 | MY4 | MY5 | Base | MY1 | MY2 | MY3 | MY4 | MY5 |
| BF Width (ft) | 7.2 | 8.3 | | | | | 8.1 | 7.6 | | | | |
| Floodprone Width (ft) | 22.8 | 22.1 | | | | | 33.2 | 33.3 | | | | |
| BF Cross Sectional Area ($ft^2$) | 4.2 | 3.8 | | | | | 9.1 | 9.4 | | | | |
| BF Mean Depth (ft) | 0.6 | 0.5 | | | | | 1.1 | 1.2 | | | | |
| BF Max Depth (ft) | 1.0 | 0.9 | | | | | 2.2 | 2.1 | | | | |
| Width/Depth Ratio | 12.5 | 17.9 | | | | | 7.2 | 6.1 | | | | |
| Entrenchment Ratio | 3.2 | 2.7 | | | | | 4.1 | 4.4 | | | | |
| Wetted Perimeter (ft) | N/A[1] | 8.7 | | | | | N/A[1] | 9.6 | | | | |
| Hydraulic Radius (ft) | N/A[1] | 0.4 | | | | | N/A[1] | 1.0 | | | | |

[1]N/A = Not available in Baseline Report

| North Fork Mountain Creek – Reach 1 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Cross Section 14 @ STA 301+18 Pool** | | | | | | **Cross Section 15 @ STA 302+33 Riffle** | | | | | |
| Dimension | Base | MY1 | MY2 | MY3 | MY4 | MY5 | Base | MY1 | MY2 | MY3 | MY4 | MY5 |
| BF Width (ft) | 20.6 | 19.4 | | | | | 17.3 | 16.3 | | | | |
| Floodprone Width (ft) | 59.3 | >150.0 | | | | | 100.0 | >150.0 | | | | |
| BF Cross Sectional Area ($ft^2$) | 25.6 | 25.0 | | | | | 19.9 | 17.0 | | | | |
| BF Mean Depth (ft) | 1.2 | 1.3 | | | | | 1.2 | 1.0 | | | | |
| BF Max Depth (ft) | 3.1 | 3.0 | | | | | 2.2 | 2.1 | | | | |
| Width/Depth Ratio | 16.6 | 15.0 | | | | | 15.1 | 15.6 | | | | |
| Entrenchment Ratio | 2.9 | 7.7 | | | | | 5.8 | 9.2 | | | | |
| Wetted Perimeter (ft) | N/A[1] | 21.2 | | | | | N/A[1] | 17.0 | | | | |
| Hydraulic Radius (ft) | N/A[1] | 1.2 | | | | | N/A[1] | 1.1 | | | | |

[1]N/A = Not available in Baseline Report

| North Fork Mountain Creek – Reach 1 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Cross Section 16 @ STA 303+38 Riffle** | | | | | | **Cross Section 17 @ STA 306+69 Riffle** | | | | | |
| Dimension | Base | MY1 | MY2 | MY3 | MY4 | MY5 | Base | MY1 | MY2 | MY3 | MY4 | MY5 |
| BF Width (ft) | 19.3 | 18.6 | | | | | 17.5 | 18.6 | | | | |
| Floodprone Width (ft) | 55.7 | >150.0 | | | | | 50.3 | >150.0 | | | | |
| BF Cross Sectional Area ($ft^2$) | 25.4 | 22.4 | | | | | 23.9 | 23.0 | | | | |
| BF Mean Depth (ft) | 1.3 | 1.2 | | | | | 1.4 | 1.2 | | | | |
| BF Max Depth (ft) | 2.3 | 2.2 | | | | | 2.3 | 2.2 | | | | |
| Width/Depth Ratio | 14.8 | 15.4 | | | | | 12.7 | 15.0 | | | | |
| Entrenchment Ratio | 2.9 | 8.1 | | | | | 2.9 | 8.1 | | | | |
| Wetted Perimeter (ft) | N/A[1] | 19.6 | | | | | N/A[1] | 19.3 | | | | |
| Hydraulic Radius (ft) | N/A[1] | 1.1 | | | | | N/A[1] | 1.2 | | | | |

[1]N/A = Not available in Baseline Report

| North Fork Mountain Creek – Reach 1 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Cross Section 18 @ STA 307+35 Pool** | | | | | | **Cross Section 19 @ STA 311+76 Riffle** | | | | | |
| Dimension | Base | MY1 | MY2 | MY3 | MY4 | MY5 | Base | MY1 | MY2 | MY3 | MY4 | MY5 |
| BF Width (ft) | 25.8 | 27.8 | | | | | 21.7 | 21.5 | | | | |
| Floodprone Width (ft) | 53.3 | >150.0 | | | | | 100.0 | >150.0 | | | | |
| BF Cross Sectional Area ($ft^2$) | 35.1 | 36.0 | | | | | 25.8 | 23.9 | | | | |
| BF Mean Depth (ft) | 1.4 | 1.3 | | | | | 1.2 | 1.1 | | | | |
| BF Max Depth (ft) | 3.4 | 3.6 | | | | | 2.1 | 2.1 | | | | |
| Width/Depth Ratio | 19.0 | 21.5 | | | | | 18.2 | 19.4 | | | | |
| Entrenchment Ratio | 2.1 | 5.4 | | | | | 4.6 | 7.0 | | | | |
| Wetted Perimeter (ft) | N/A[1] | 29.8 | | | | | N/A[1] | 22.1 | | | | |
| Hydraulic Radius (ft) | N/A[1] | 1.2 | | | | | N/A[1] | 1.1 | | | | |

[1]N/A = Not available in Baseline Report

| North Fork Mountain Creek – Reach 1 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Cross Section 20 @ STA 312+64 Pool** | | | | | | **Cross Section 21 @ STA 314+59 Pool** | | | | | |
| Dimension | Base | MY1 | MY2 | MY3 | MY4 | MY5 | Base | MY1 | MY2 | MY3 | MY4 | MY5 |
| BF Width (ft) | 25.3 | 24.8 | | | | | 23.0 | 21.4 | | | | |
| Floodprone Width (ft) | 56.1 | >150.0 | | | | | 54.5 | >150.0 | | | | |
| BF Cross Sectional Area ($ft^2$) | 36.7 | 30.3 | | | | | 34.2 | 31.5 | | | | |
| BF Mean Depth (ft) | 1.5 | 1.2 | | | | | 1.5 | 1.5 | | | | |
| BF Max Depth (ft) | 3.3 | 2.9 | | | | | 3.4 | 3.4 | | | | |
| Width/Depth Ratio | 17.4 | 20.3 | | | | | 15.5 | 14.5 | | | | |
| Entrenchment Ratio | 2.2 | 6.0 | | | | | 2.4 | 7.0 | | | | |
| Wetted Perimeter (ft) | N/A[1] | 25.9 | | | | | N/A[1] | 23.2 | | | | |
| Hydraulic Radius (ft) | N/A[1] | 1.2 | | | | | N/A[1] | 1.4 | | | | |

[1]N/A = Not available in Baseline Report

| North Fork Mountain Creek – Reach 1 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Cross Section 22 @ STA 315+07 Riffle** | | | | | | **Cross Section 23 @ STA 316+83 Riffle** | | | | | |
| Dimension | Base | MY1 | MY2 | MY3 | MY4 | MY5 | Base | MY1 | MY2 | MY3 | MY4 | MY5 |
| BF Width (ft) | 20.7 | 18.2 | | | | | 18.6 | 19.0 | | | | |
| Floodprone Width (ft) | 54.0 | >150.0 | | | | | 39.5 | >150.0 | | | | |
| BF Cross Sectional Area ($ft^2$) | 22.0 | 19.6 | | | | | 22.7 | 21.0 | | | | |
| BF Mean Depth (ft) | 1.1 | 1.1 | | | | | 1.2 | 1.1 | | | | |
| BF Max Depth (ft) | 2.2 | 1.9 | | | | | 2.4 | 2.3 | | | | |
| Width/Depth Ratio | 19.6 | 17.0 | | | | | 15.2 | 17.3 | | | | |
| Entrenchment Ratio | 2.6 | 8.2 | | | | | 2.1 | 7.9 | | | | |
| Wetted Perimeter (ft) | N/A[1] | 18.9 | | | | | N/A[1] | 20.2 | | | | |
| Hydraulic Radius (ft) | N/A[1] | 1.0 | | | | | N/A[1] | 1.0 | | | | |

[1]N/A = Not available in Baseline Report

| North Fork Mountain Creek – Reach 1 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Cross Section 24 @ STA 317+28 Pool** | | | | | | **Cross Section 25 @ STA 319+29 Pool** | | | | | |
| Dimension | Base | MY1 | MY2 | MY3 | MY4 | MY5 | Base | MY1 | MY2 | MY3 | MY4 | MY5 |
| BF Width (ft) | 18.6 | 18.2 | | | | | 18.7 | 19.4 | | | | |
| Floodprone Width (ft) | 42.3 | >150.0 | | | | | 50.3 | >150.0 | | | | |
| BF Cross Sectional Area ($ft^2$) | 21.2 | 20.7 | | | | | 26.2 | 26.3 | | | | |
| BF Mean Depth (ft) | 1.1 | 1.1 | | | | | 1.4 | 1.4 | | | | |
| BF Max Depth (ft) | 2.5 | 2.5 | | | | | 3.0 | 3.2 | | | | |
| Width/Depth Ratio | 16.3 | 16.0 | | | | | 13.3 | 14.2 | | | | |
| Entrenchment Ratio | 2.3 | 8.2 | | | | | 2.7 | 7.7 | | | | |
| Wetted Perimeter (ft) | N/A[1] | 19.3 | | | | | N/A[1] | 21.1 | | | | |
| Hydraulic Radius (ft) | N/A[1] | 1.1 | | | | | N/A[1] | 1.2 | | | | |

[1]N/A = Not available in Baseline Report

| North Fork Mountain Creek – Reach 1 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Cross Section 26 @ STA 319+82 Riffle** | | | | | | | | | | | |
| Dimension | Base | MY1 | MY2 | MY3 | MY4 | MY5 | Base | MY1 | MY2 | MY3 | MY4 | MY5 |
| BF Width (ft) | 18.8 | 19.5 | | | | | | | | | | |
| Floodprone Width (ft) | 50.1 | >150.0 | | | | | | | | | | |
| BF Cross Sectional Area ($ft^2$) | 19.4 | 19.8 | | | | | | | | | | |
| BF Mean Depth (ft) | 1.0 | 1.0 | | | | | | | | | | |
| BF Max Depth (ft) | 1.6 | 2.5 | | | | | | | | | | |
| Width/Depth Ratio | 18.2 | 19.3 | | | | | | | | | | |
| Entrenchment Ratio | 2.7 | 7.7 | | | | | | | | | | |
| Wetted Perimeter (ft) | N/A[1] | 21.4 | | | | | | | | | | |
| Hydraulic Radius (ft) | N/A[1] | 0.9 | | | | | | | | | | |

[1]N/A = Not available in Baseline Report

Table provided as a place holder should longitudinal profile data be required by the USACE in a future monitoring year. Table has been populated with baseline data for reference.

| North Fork Mountain Creek – Reach 1 | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Baseline** | | | **MY1** | | | **MY2** | | | **MY3** | | | **MY4** | | | **MY5** | | |
| **Pattern** | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Channel Beltwidth (ft) | 46.13 | 93.89 | 67.24 | | | | | | | | | | | | | | | |
| Radius of Curvature (ft) | 28.20 | 54.20 | 37.60 | | | | | | | | | | | | | | | |
| Meander Wavelength (ft) | 121.67 | 331.59 | 209.50 | | | | | | | | | | | | | | | |
| Meander Width Ratio | 2.48 | 5.05 | 3.62 | | | | | | | | | | | | | | | |
| **Profile** | | | | | | | | | | | | | | | | | | |
| Riffle Length (ft) | 13.82 | 92.66 | 53.03 | | | | | | | | | | | | | | | |
| Riffle Slope (ft/ft) | 0.004 | 0.043 | 0.0178 | | | | | | | | | | | | | | | |
| Pool Length (ft) | 21.23 | 80.26 | 49.49 | | | | | | | | | | | | | | | |
| Pool Spacing (ft) | 62.18 | 147.20 | 98.91 | | | | | | | | | | | | | | | |
| **Additional Reach Parameters** | | | | | | | | | | | | | | | | | | |
| Valley Length (ft) | N/A[1] | | | | | | | | | | | | | | | | | |
| Channel Length (ft) | 2,135 | | | | | | | | | | | | | | | | | |
| Sinuosity | 1.25 | | | | | | | | | | | | | | | | | |
| Water Surface Slope (ft/ft) | N/A[1] | | | | | | | | | | | | | | | | | |
| BF Slope (ft/ft) | 0.0081 | | | | | | | | | | | | | | | | | |
| Rosgen Classification | C4 | | | | | | | | | | | | | | | | | |

[1]N/A = Not available in Baseline Report

| Unnamed Tributary 1 – Lower Reach – Reach 2 | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Baseline** | | | **MY1** | | | **MY2** | | | **MY3** | | | **MY4** | | | **MY5** | | |
| **Pattern** | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Channel Beltwidth (ft) | 14.27 | 32.41 | 20.57 | | | | | | | | | | | | | | | |
| Radius of Curvature (ft) | 14.18 | 66.62 | 22.61 | | | | | | | | | | | | | | | |
| Meander Wavelength (ft) | 76.24 | 107.14 | 92.01 | | | | | | | | | | | | | | | |
| Meander Width Ratio | | | | | | | | | | | | | | | | | | |
| **Profile** | | | | | | | | | | | | | | | | | | |
| Riffle Length (ft) | 7.49 | 34.11 | 18.09 | | | | | | | | | | | | | | | |
| Riffle Slope (ft/ft) | 0.012 | 0.675 | 0.033 | | | | | | | | | | | | | | | |
| Pool Length (ft) | 11.58 | 36.99 | 17.71 | | | | | | | | | | | | | | | |
| Pool Spacing (ft) | 24.37 | 60.68 | 41.80 | | | | | | | | | | | | | | | |
| **Additional Reach Parameters** | | | | | | | | | | | | | | | | | | |
| Valley Length (ft) | N/A[1] | | | | | | | | | | | | | | | | | |
| Channel Length (ft) | 1,700 | | | | | | | | | | | | | | | | | |
| Sinuosity | 1.03 | | | | | | | | | | | | | | | | | |
| Water Surface Slope (ft/ft) | N/A[1] | | | | | | | | | | | | | | | | | |
| BF Slope (ft/ft) | 0.0162 | | | | | | | | | | | | | | | | | |
| Rosgen Classification | C4 | | | | | | | | | | | | | | | | | |

[1]N/A = Not available in Baseline Report

| Unnamed Tributary 1 – Upper Reach – Reach 4 | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Baseline** | | | **MY1** | | | **MY2** | | | **MY3** | | | **MY4** | | | **MY5** | | |
| **Pattern** | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Channel Beltwidth (ft) | 11.09 | 28.74 | 22.28 | | | | | | | | | | | | | | | |
| Radius of Curvature (ft) | 18.69 | 56.01 | 26.29 | | | | | | | | | | | | | | | |
| Meander Wavelength (ft) | 56.93 | 95.78 | 64.68 | | | | | | | | | | | | | | | |
| Meander Width Ratio | 1.42 | 3.68 | 2.86 | | | | | | | | | | | | | | | |
| **Profile** | | | | | | | | | | | | | | | | | | |
| Riffle Length (ft) | 8.68 | 32.84 | 20.45 | | | | | | | | | | | | | | | |
| Riffle Slope (ft/ft) | 0.017 | 0.084 | 0.049 | | | | | | | | | | | | | | | |
| Pool Length (ft) | 5.59 | 34.45 | 21.66 | | | | | | | | | | | | | | | |
| Pool Spacing (ft) | 26.46 | 52.95 | 42.05 | | | | | | | | | | | | | | | |
| **Additional Reach Parameters** | | | | | | | | | | | | | | | | | | |
| Valley Length (ft) | N/A[1] | | | | | | | | | | | | | | | | | |
| Channel Length (ft) | 702 | | | | | | | | | | | | | | | | | |
| Sinuosity | 1.06 | | | | | | | | | | | | | | | | | |
| Water Surface Slope (ft/ft) | N/A[1] | | | | | | | | | | | | | | | | | |
| BF Slope (ft/ft) | 0.0342 | | | | | | | | | | | | | | | | | |
| Rosgen Classification | C4b | | | | | | | | | | | | | | | | | |

[1]N/A = Not available in Baseline Report

| Unnamed Tributary 2 – Reach 3 | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Baseline** | | | **MY1** | | | **MY2** | | | **MY3** | | | **MY4** | | | **MY5** | | |
| **Pattern** | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Channel Beltwidth (ft) | 7.66 | 18.12 | 12.81 | | | | | | | | | | | | | | | |
| Radius of Curvature (ft) | 17.03 | 50.06 | 26.34 | | | | | | | | | | | | | | | |
| Meander Wavelength (ft) | 20.09 | 97.59 | 59.35 | | | | | | | | | | | | | | | |
| Meander Width Ratio | 1.06 | 2.51 | 1.77 | | | | | | | | | | | | | | | |
| **Profile** | | | | | | | | | | | | | | | | | | |
| Riffle Length (ft) | 5.89 | 27.77 | 16.95 | | | | | | | | | | | | | | | |
| Riffle Slope (ft/ft) | 0.009 | 0.089 | 0.053 | | | | | | | | | | | | | | | |
| Pool Length (ft) | 7.48 | 26.49 | 10.59 | | | | | | | | | | | | | | | |
| Pool Spacing (ft) | 22.28 | 44.22 | 29.34 | | | | | | | | | | | | | | | |
| **Additional Reach Parameters** | | | | | | | | | | | | | | | | | | |
| Valley Length (ft) | N/A[1] | | | | | | | | | | | | | | | | | |
| Channel Length (ft) | 610 | | | | | | | | | | | | | | | | | |
| Sinuosity | 1.02 | | | | | | | | | | | | | | | | | |
| Water Surface Slope (ft/ft) | N/A[1] | | | | | | | | | | | | | | | | | |
| BF Slope (ft/ft) | 0.0412 | | | | | | | | | | | | | | | | | |
| Rosgen Classification | C4b | | | | | | | | | | | | | | | | | |

# APPENDIX D

# 2012 Site Photos

**Reach 4 Permanent Photo Points**


Reach 4 – Permanent Photo Point 1
Downstream
November 20, 2012


Reach 4 – Permanent Photo Point 2
Downstream
November 20, 2012

**Reach 4 Permanent Photo Points**


Reach 4 – Permanent Photo Point 3
Downstream
November 20, 2012


Reach 4 – Permanent Photo Point 3
Upstream
November 20, 2012

**Reach 3 Permanent Photo Points**


Reach 3 – Permanent Photo Point 4
Downstream
November 20, 2012


Reach 3 – Permanent Photo Point 5
Downstream
November 20, 2012

**Reach 3 Permanent Photo Points**


Reach 3 – Permanent Photo Point 6
Downstream
November 20, 2012


Reach 3 – Permanent Photo Point 6
Upstream
November 20, 2012

**Reach 2 Permanent Photo Points**


Reach 2 – Permanent Photo Point 7
Downstream
November 20, 2012


Reach 2 – Permanent Photo Point 8
Downstream
November 20, 2012

**Reach 2 Permanent Photo Points**


Reach 2 – Permanent Photo Point 9
Downstream
November 20, 2012


Reach 2 – Permanent Photo Point 10
Downstream
November 20, 2012

**Reach 2 Permanent Photo Points**


Reach 2 – Permanent Photo Point 11
Downstream
November 20, 2012


Reach 2 – Permanent Photo Point 12
Downstream
November 20, 2012

**Reach 2 Permanent Photo Points**


Reach 2 – Permanent Photo Point 13
Downstream
November 20, 2012


Reach 2 – Permanent Photo Point 14
Downstream
November 20, 2012

**Reach 2 Permanent Photo Points**


Reach 2 – Permanent Photo Point 15
Downstream
November 20, 2012


Reach 2 – Permanent Photo Point 16
North
November 20, 2012

**Reach 2 Permanent Photo Points**


Reach 2 – Permanent Photo Point 16
Northwest
November 20, 2012

**Reach 1 Permanent Photo Points**


Reach 1 – Permanent Photo Point 16
Southwest
November 20, 2012


Reach 1 – Permanent Photo Point 17
Downstream
November 20, 2012

**Reach 1 Permanent Photo Points**


Reach 1 – Permanent Photo Point 18
Downstream
November 20, 2012


Reach 1 – Permanent Photo Point 19
Downstream
November 20, 2012

**Reach 1 Permanent Photo Points**


Reach 1 – Permanent Photo Point 20
Downstream
November 20, 2012


Reach 1 – Permanent Photo Point 21
Downstream
November 20, 2012

**Reach 1 Permanent Photo Points**


Reach 1 – Permanent Photo Point 22
Downstream
November 20, 2012


Reach 1 – Permanent Photo Point 23
Downstream
November 20, 2012

**Reach 1 Permanent Photo Points**


Reach 1 – Permanent Photo Point 24
Downstream
November 20, 2012


Reach 1 – Permanent Photo Point 25
Downstream
November 20, 2012

**Reach 1 Permanent Photo Points**


Reach 1 – Permanent Photo Point 26
Downstream
November 20, 2012


Reach 1 – Permanent Photo Point 27
Downstream
November 20, 2012

**Reach 1 Permanent Photo Points**


Reach 1 – Permanent Photo Point 28
Downstream
November 20, 2012


Reach 1 – Permanent Photo Point 29
Downstream
November 20, 2012

**Reach 1 Permanent Photo Points**


Reach 1 – Permanent Photo Point 29
Upstream
November 20, 2012


Reach 1 – Permanent Photo Point 30
Downstream
November 20, 2012

**Reach 1 Permanent Photo Points**


Reach 1 – Permanent Photo Point 31
Northeast
November 20, 2012


Reach 1 – Permanent Photo Point 31
Southeast
November 20, 2012

**Reach 1 Permanent Photo Points**


Reach 1 – Permanent Photo Point 31
South
November 20, 2012

**Vegetation Plots**


Vegetation Plot 1

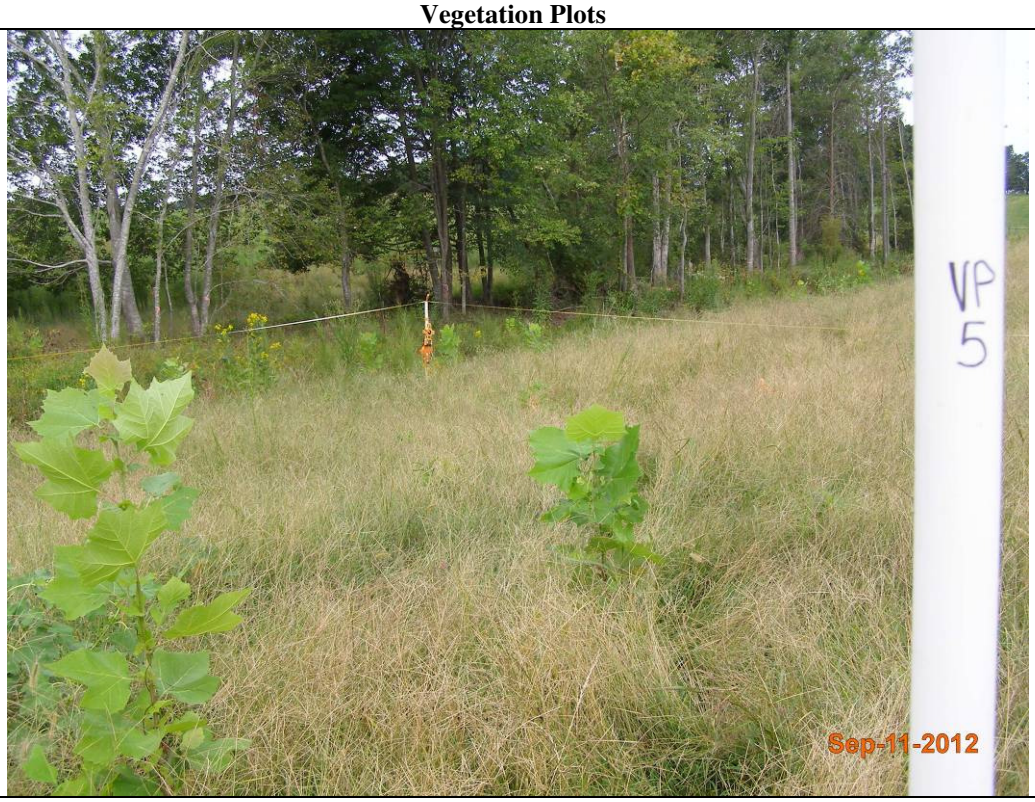

Vegetation Plot 2

**Vegetation Plots**


Vegetation Plot 3


Vegetation Plot 4

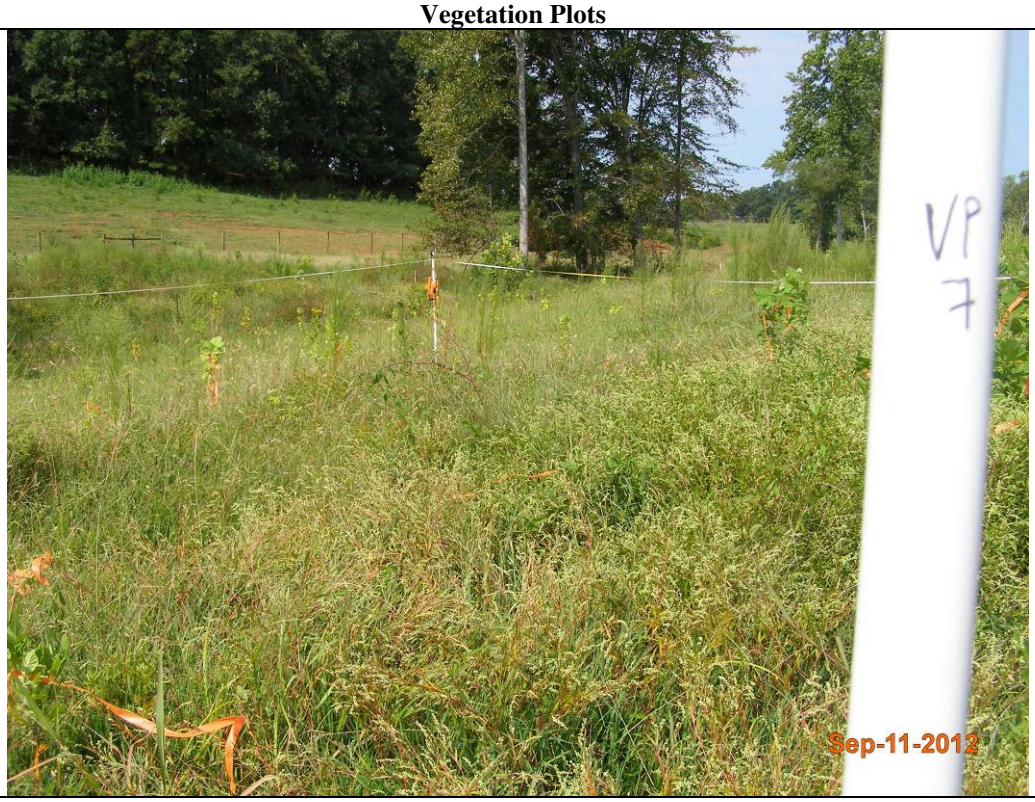
**Vegetation Plots**




Vegetation Plot 5


Vegetation Plot 6

**Vegetation Plots**




Vegetation Plot 7

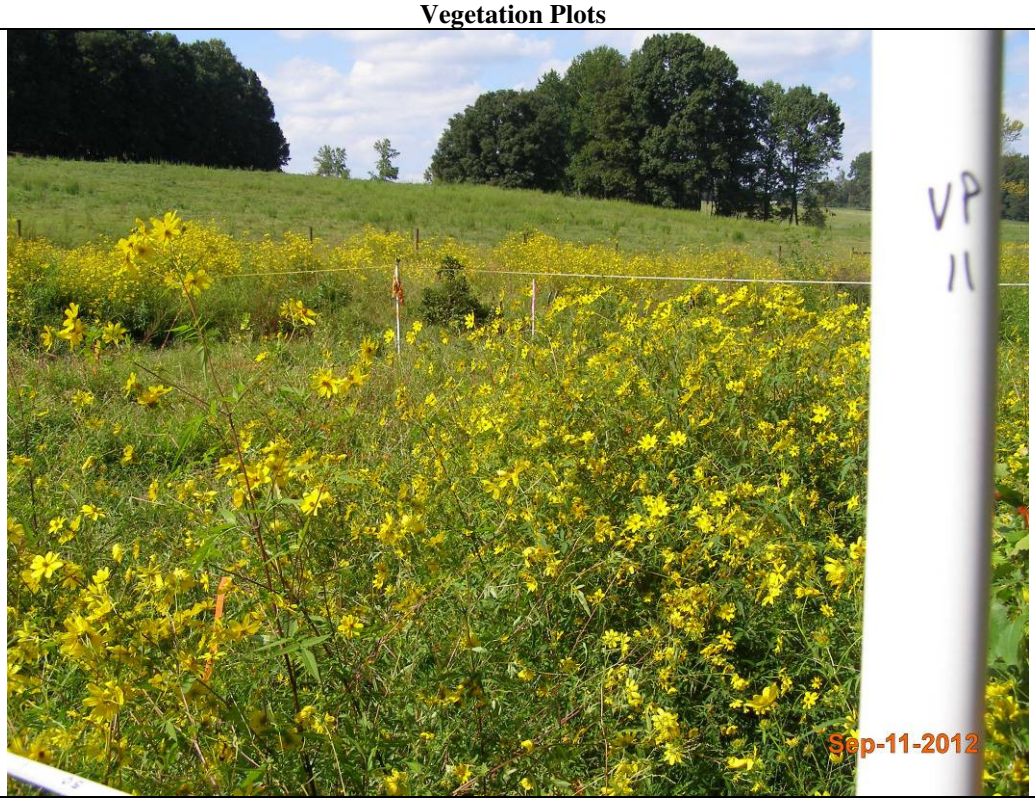

Vegetation Plot 8

**Vegetation Plots**


Vegetation Plot 9


Vegetation Plot 10

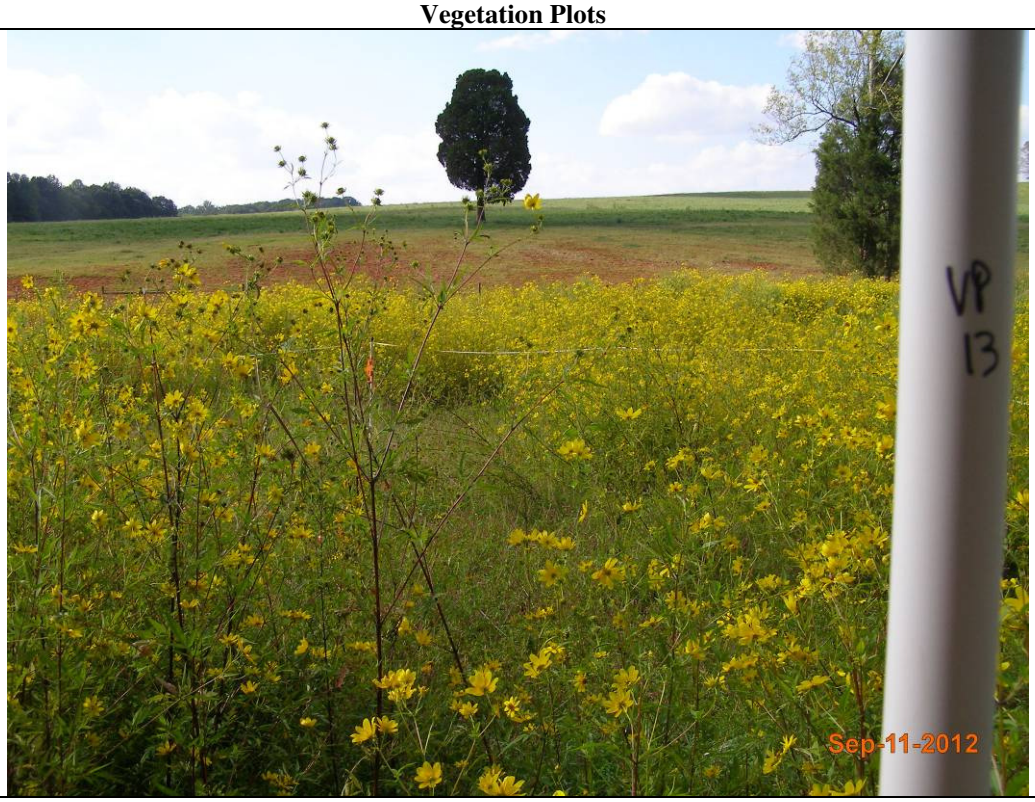
**Vegetation Plots**




Vegetation Plot 11


Vegetation Plot 12

**Vegetation Plots**




Vegetation Plot 13


Vegetation Plot 14

**Reach 1 Representative Photos of Stream and Vegetation Areas Requiring Observation**


1-S Reach 1 Sta. 305+50 – Riffle Degradation


2-S Reach 1 Sta. 318+50 – Riffle Degradation

**Reach 1 Representative Photos of Stream and Vegetation Areas Requiring Observation**


3-S Reach 1 Sta. 320+50 – Riffle Degradation

**Reach 2 Representative Photos of Stream and Vegetation Areas Requiring Observation**


4-V Reach 2 Sta. 118+00 – Low Stem Density

**Reach 3 Representative Photos of Stream and Vegetation Areas Requiring Observation**


5-V Reach 3 Sta. 201+50 – Isolated Area of Japanese honeysuckle *Lonicera japonica* to be treated


6-S Reach 4 Sta. 101+50 – Stressed Structure

**Reach 4 Representative Photos of Stream and Vegetation Areas Requiring Observation**


7-S Reach 4 Sta. 102+30 – Stressed Structure

**Reach 1 Representative Photos Documenting Bankfull Event**

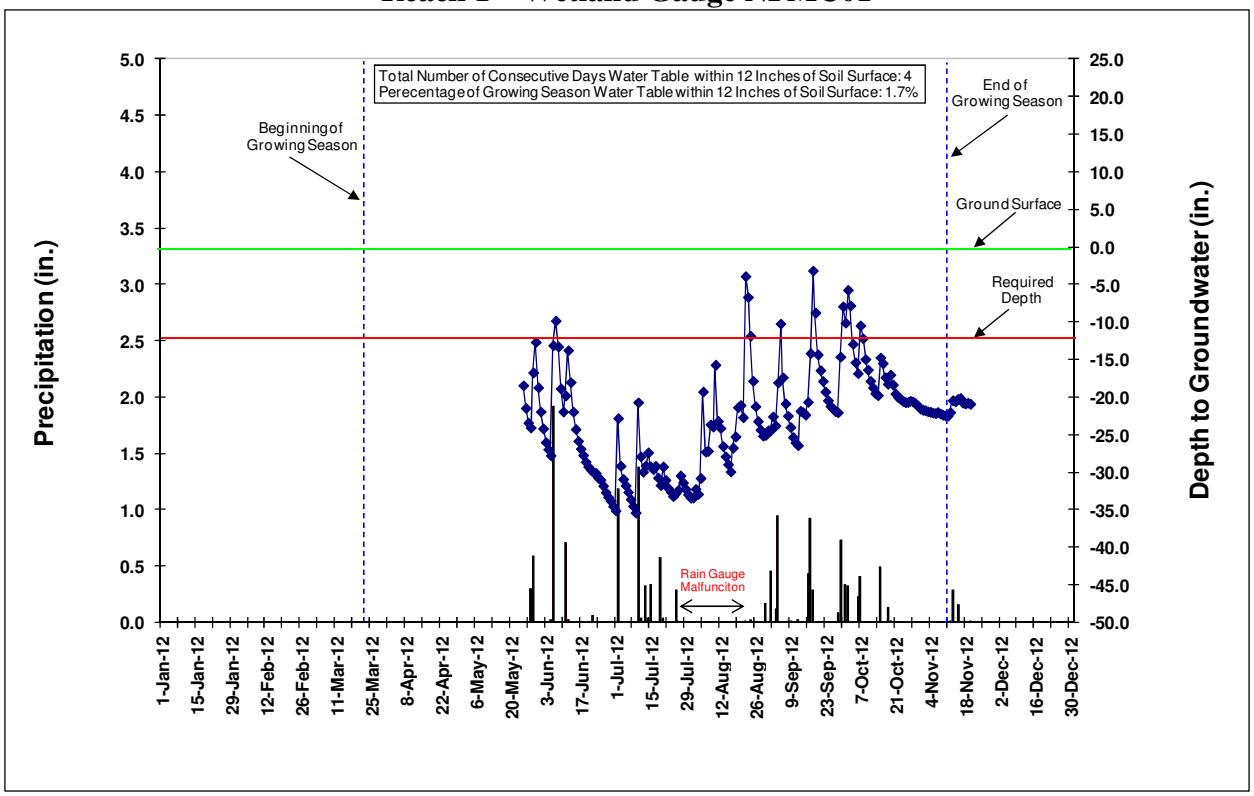

Reach 1 Sta. 307+00 – Wrack Lines


Reach 1 Sta. 305+00 – Wrack Lines

# APPENDIX E

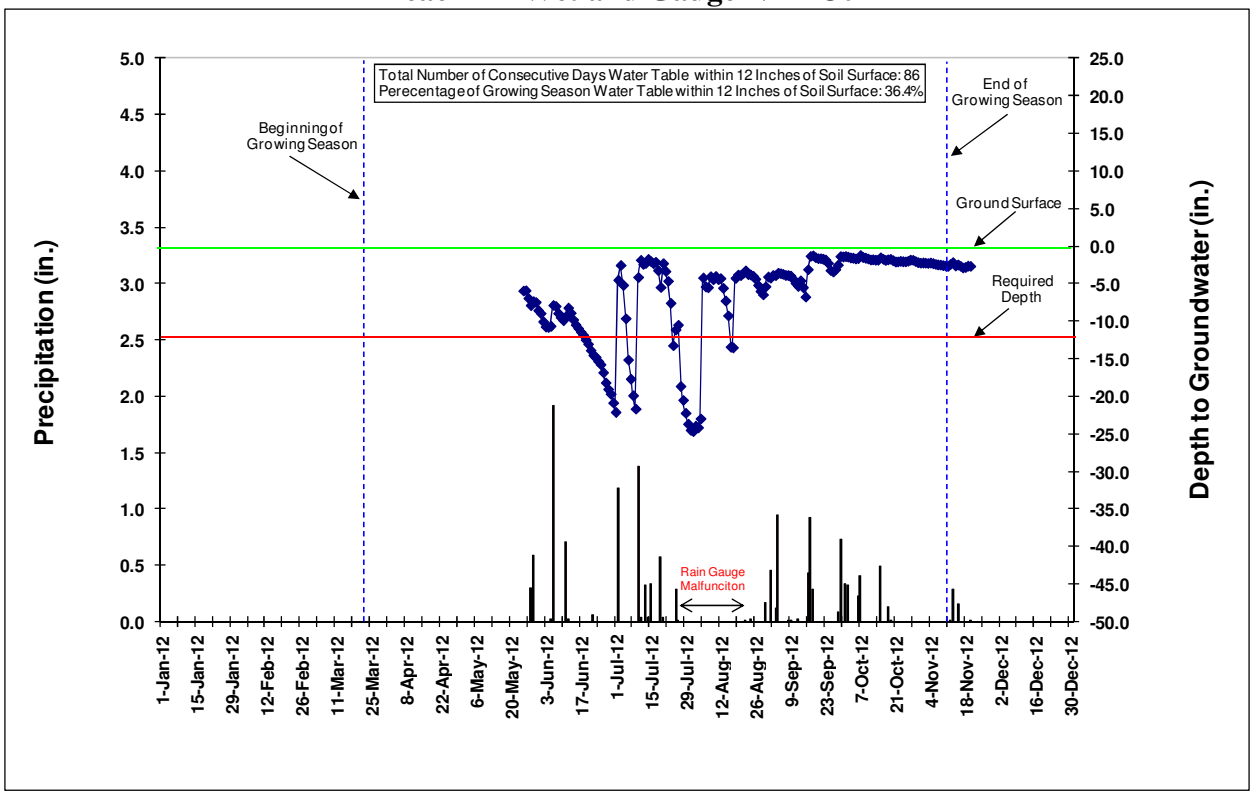
# 2012 Wetland Gauge Data

## Reach 1 – Wetland Gauge NFMC01



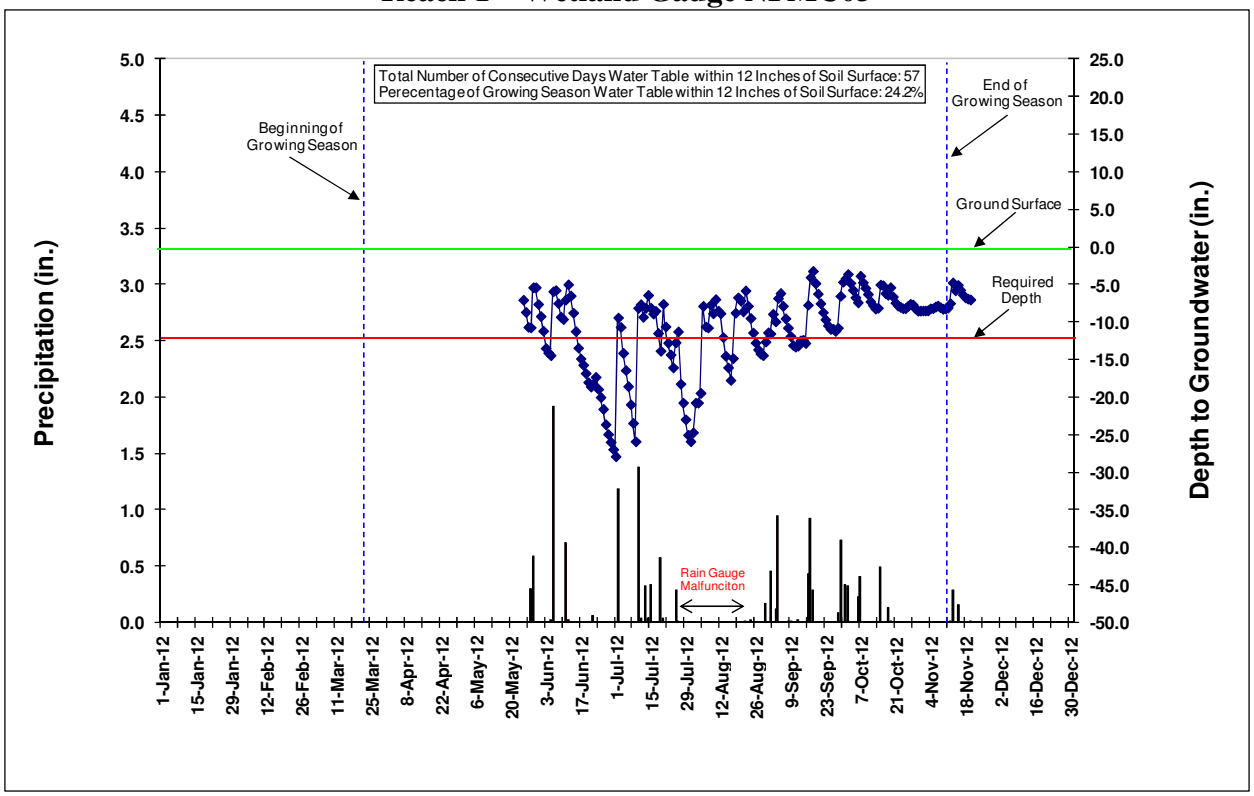

Number of days in growing season = 236
Total number of days groundwater was within 12 inches of the soil surface = 12

## Reach 1 – Wetland Gauge NFMC02



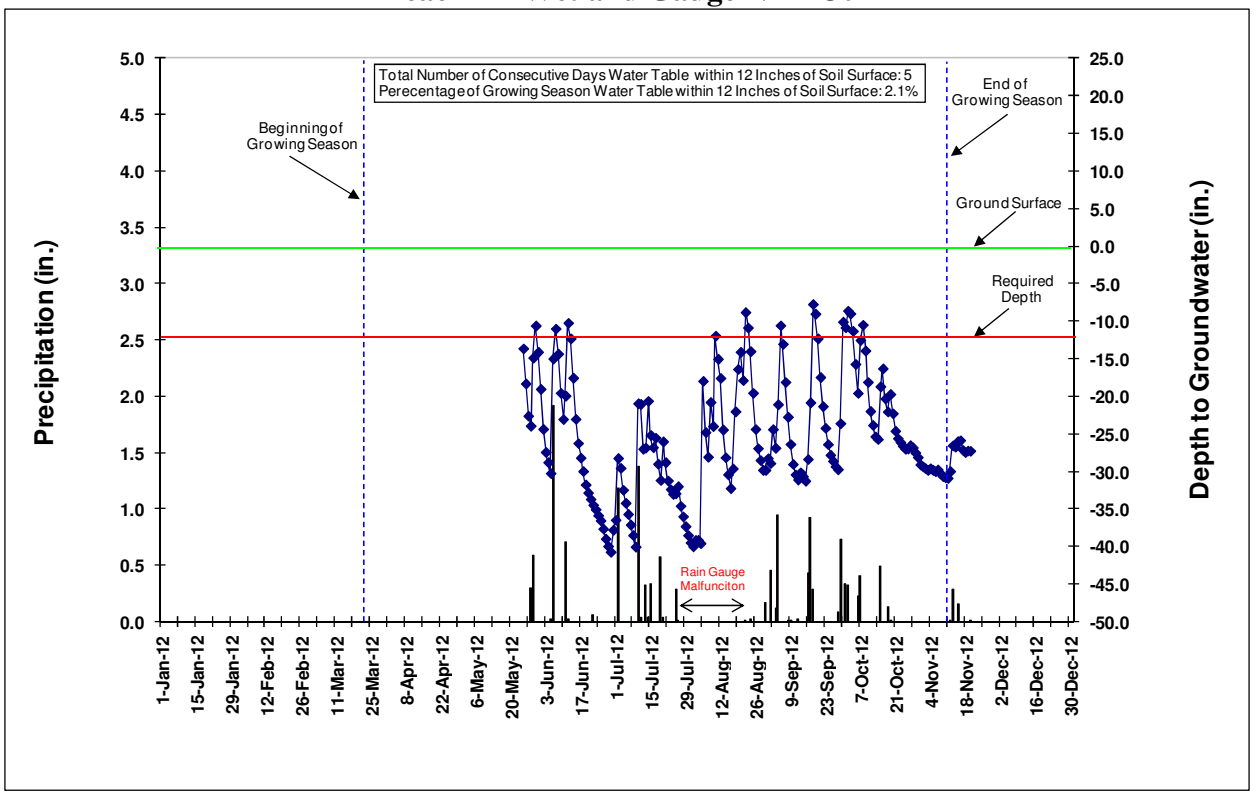

Number of days in growing season = 236
Total number of days groundwater was within 12 inches of the soil surface = 142

## Reach 1 – Wetland Gauge NFMC03



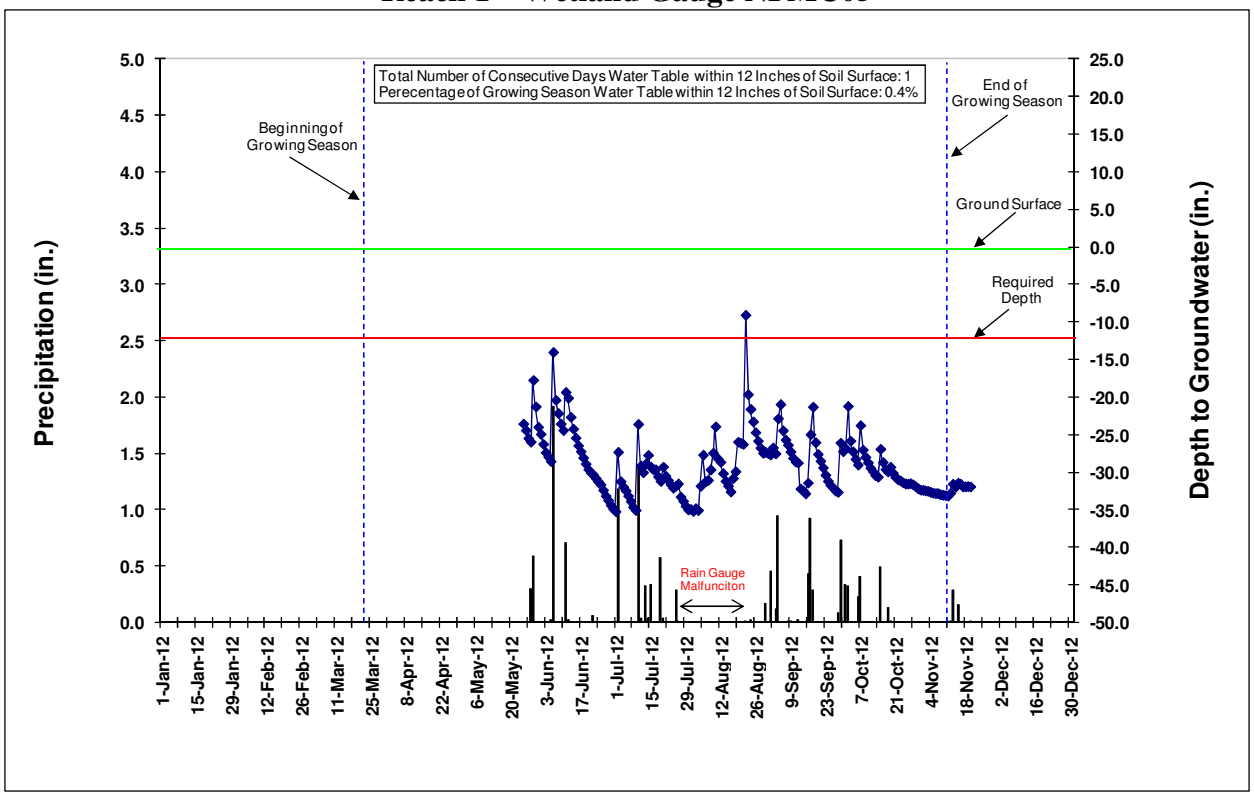

Number of days in growing season = 236
Total number of days groundwater was within 12 inches of the soil surface = 116

## Reach 1 – Wetland Gauge NFMC04



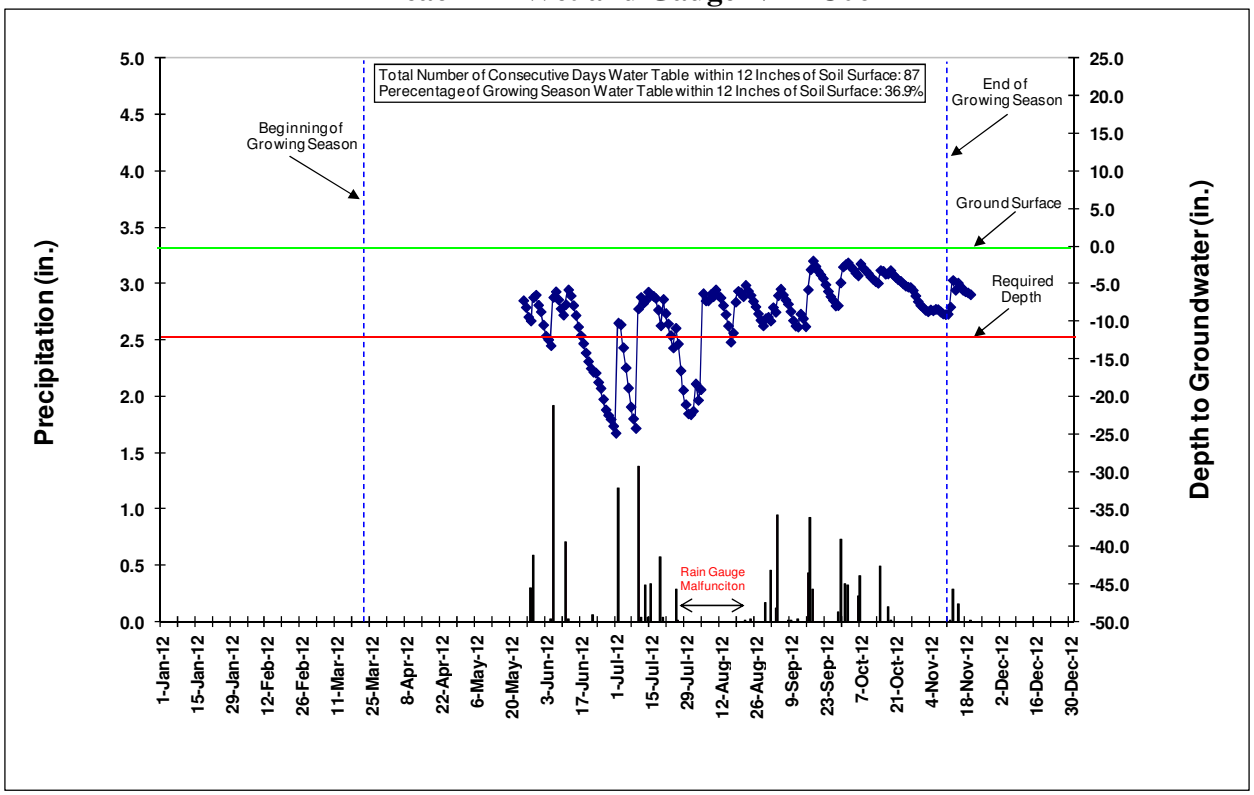

Number of days in growing season = 236
Total number of days groundwater was within 12 inches of the soil surface = 15

## Reach 1 – Wetland Gauge NFMC05



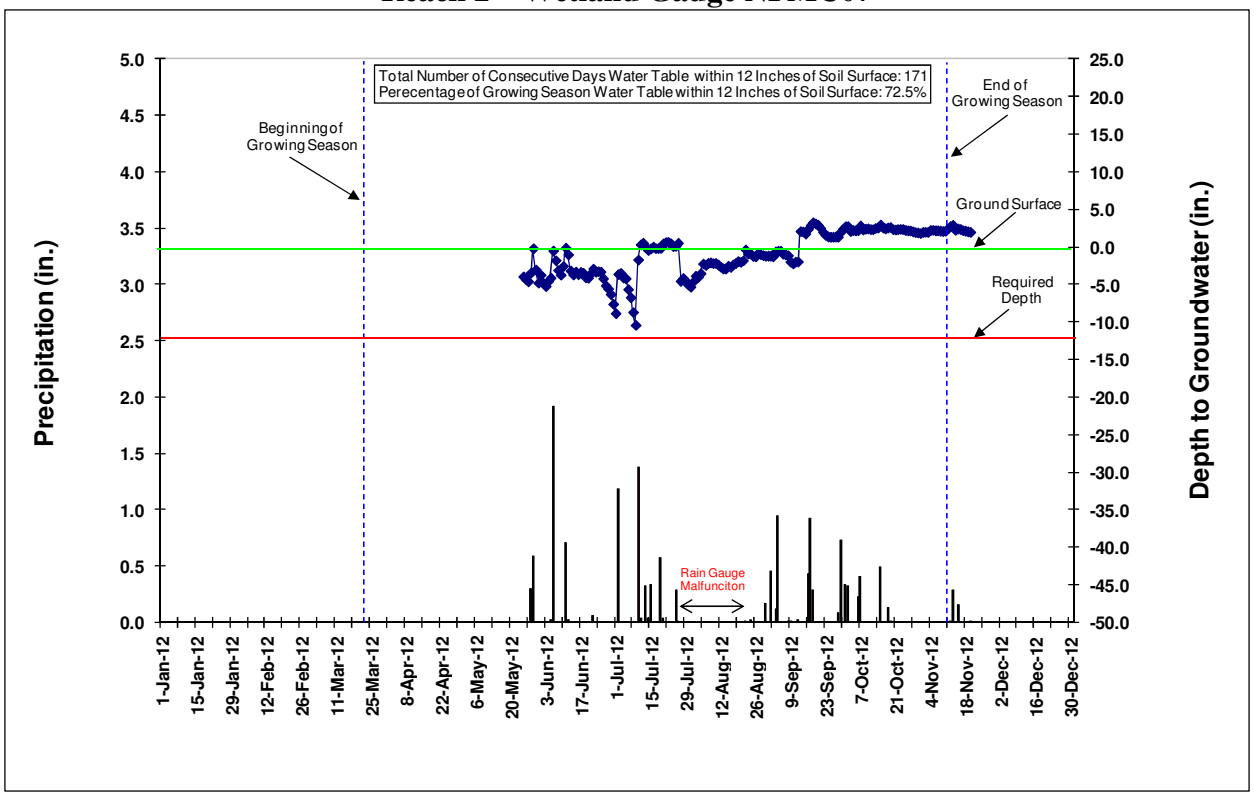

Number of days in growing season = 236
Total number of days groundwater was within 12 inches of the soil surface = 1

## Reach 1 – Wetland Gauge NFMC06



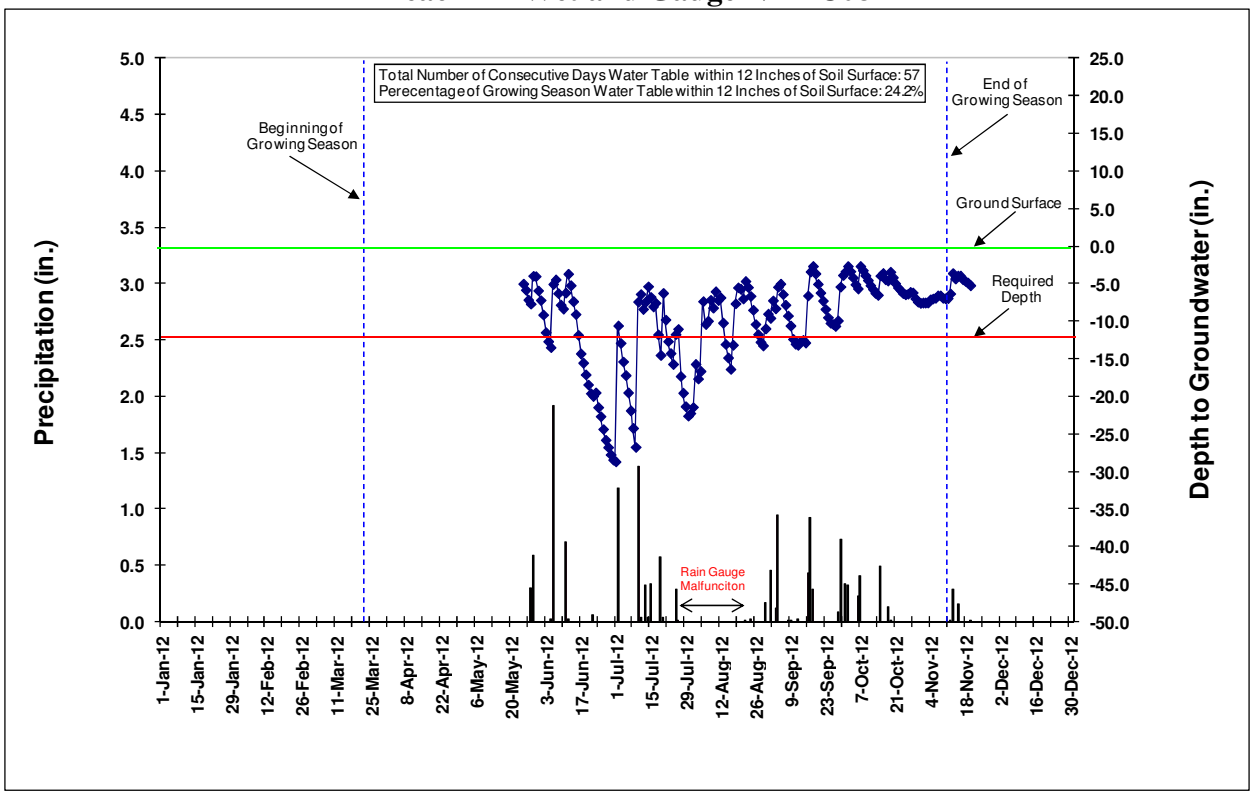

Number of days in growing season = 236
Total number of days groundwater was within 12 inches of the soil surface = 137

## Reach 2 – Wetland Gauge NFMC07



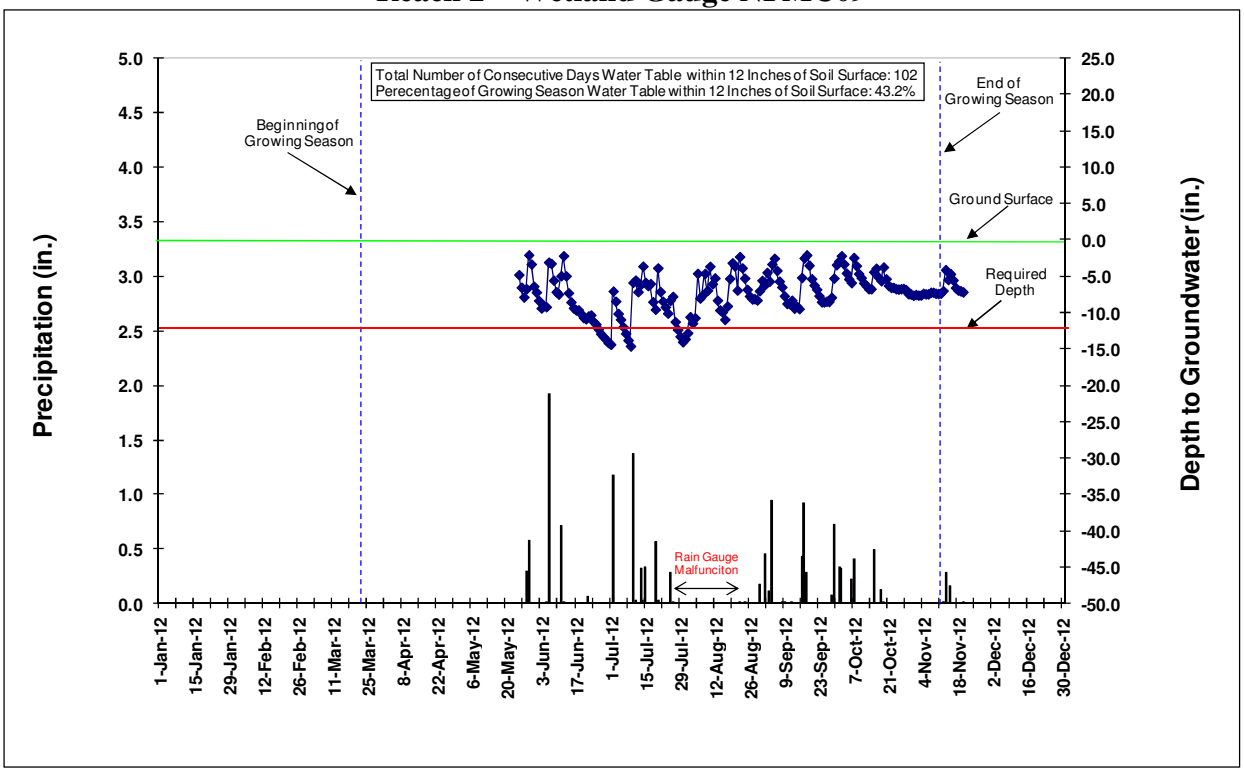

Number of days in growing season = 236
Total number of days groundwater was within 12 inches of the soil surface = 171

## Reach 2 – Wetland Gauge NFMC08



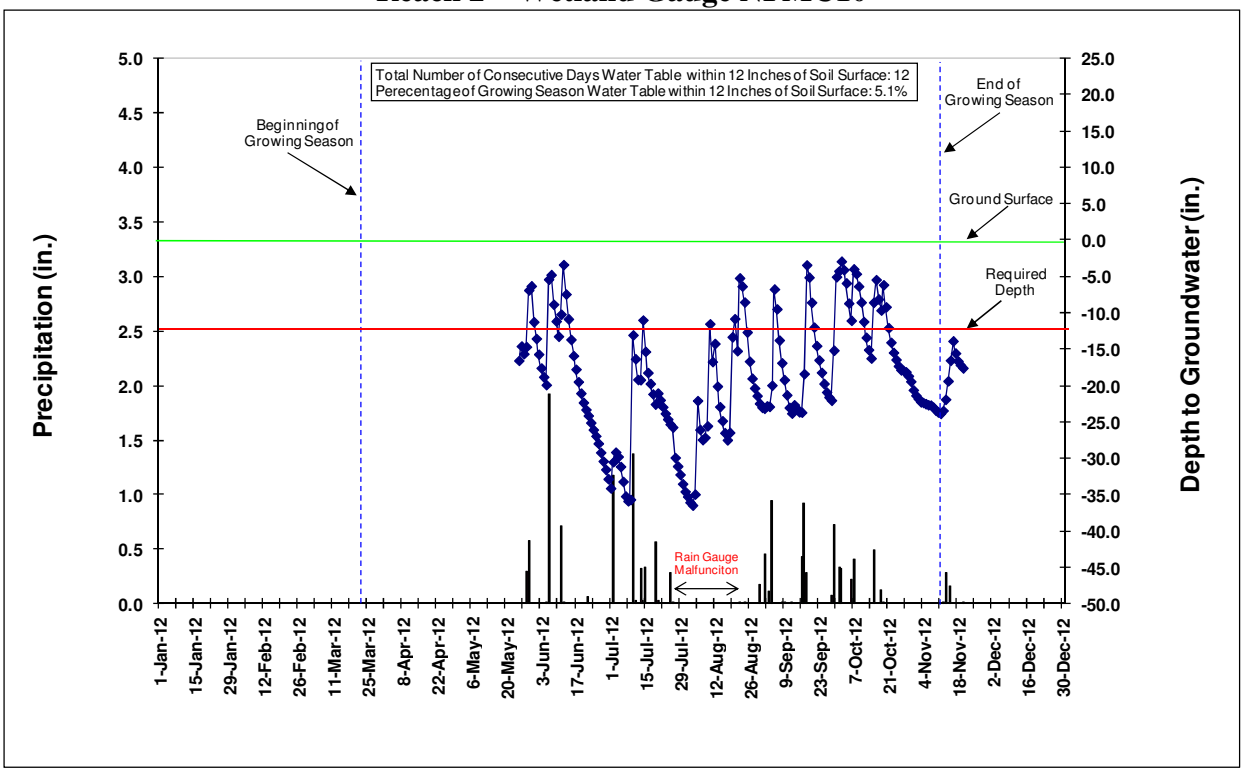

Number of days in growing season = 236
Total number of days groundwater was within 12 inches of the soil surface = 122

## Reach 2 – Wetland Gauge NFMC09



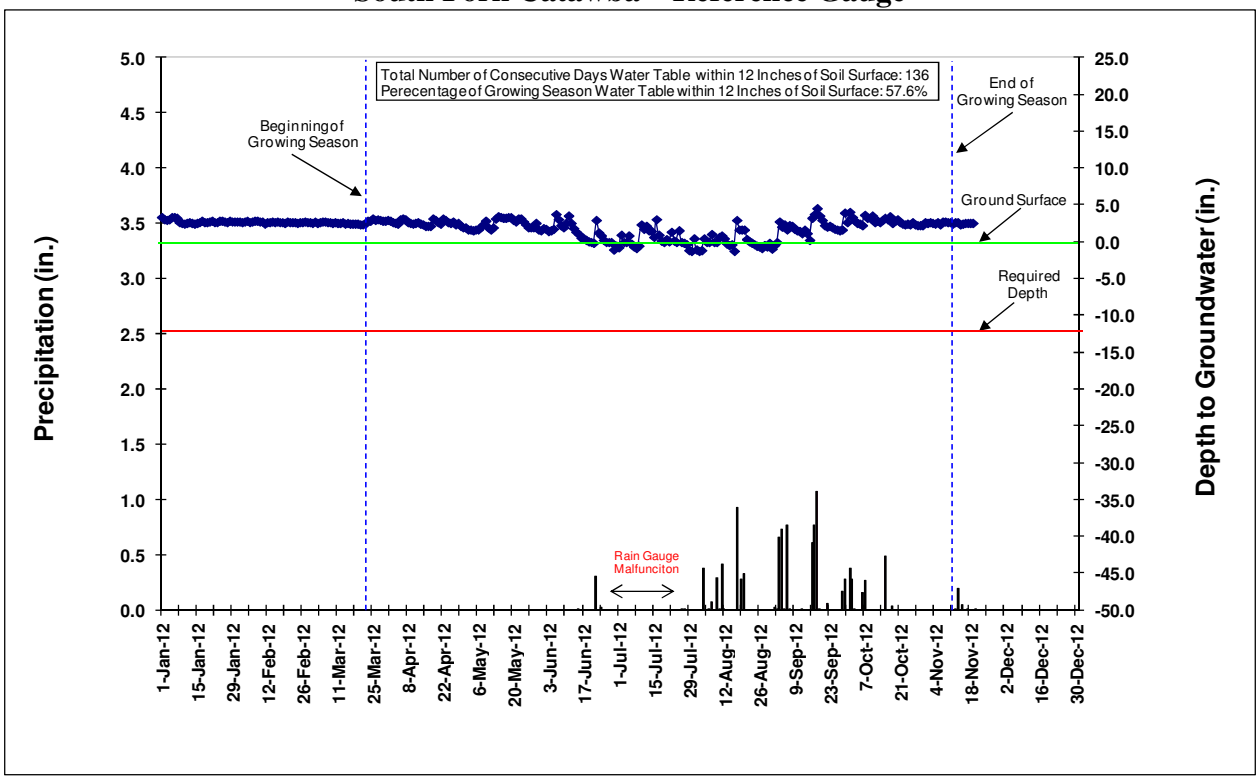

Number of days in growing season = 236
Total number of days groundwater was within 12 inches of the soil surface = 156

## Reach 2 – Wetland Gauge NFMC10




Number of days in growing season = 236
Total number of days groundwater was within 12 inches of the soil surface = 12

## South Fork Catawba – Reference Gauge




Number of days in growing season = 236
Total number of days groundwater was within 12 inches of the soil surface = 40