January 6, 2014

Mr. Guy Pearce
Full Delivery Supervisor
Ecosystem Enhancement Program
217 West Jones Street, Suite 3000A
Raleigh, North Carolina 27603

Subject: Year 5 Monitoring Report for Stream Mitigation of Thompsons Fork and UT; McDowell County, NC; SCO# D06030-A

Dear Guy,

On behalf of Wetlands Resource Center, EMH&T is pleased to submit the Year 5 Monitoring Report for Thompsons Fork and UT (SCO# D06030-A). This report contains data from the stream (geomorphic) and vegetation monitoring conducted in May and September 2013, respectively. Three hard copies and one electronic copy of the document are being provided in accordance with established submission guidelines.

We understand a final close-out meeting for this project will be conducted in Spring 2014. If there are any specific issues you wish for us to discuss prior to that meeting, please do not hesitate to contact either Cal Miller of Wetlands Resource Center at (614) 864-7511 or me at (614) 775-4205.

Sincerely,

Miles F. Hebert, PE, CFM
Director, Water Resources Engineering

Enclosures

Copies: Cal Miller, WRC

Year 5 Monitoring Report for Stream Restoration of Thompsons Fork and Unnamed Tributary

McDowell County, NC
SCO # D06030-A

Prepared for:
NCDENR – EEP
2728 Capital Blvd, Suite 1H 103
Raleigh NC 27604

Ecosystem Enhancement Program

Submitted: January 6, 2014

Prepared by:

Wetlands Resource Center
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EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers, Surveyors, Planners, Scientists

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I. EXECUTIVE SUMMARY

The Thompsons Fork stream restoration project is located near the City of Marion, in Nebo Township, McDowell County, North Carolina. Pre-restoration land use was primarily agricultural, resulting in impaired, channelized, eroding, incised and entrenched stream channels. The project reaches include the restoration of 2,727 linear feet of the Thompsons Fork main stem and 1,948 linear feet of an unnamed tributary (UT); also included is 390 linear feet of enhancement and 356 linear feet of preservation along the UT. Restoration of the project streams, completed during May 2008, provided the desired habitat and stability features required to improve and enhance the ecologic health of the streams for the long-term. The following report documents the Year 5 Annual Monitoring for this project.

Vegetative monitoring was completed in September 2013 following the Carolina Vegetation Survey methodology. Stem counts completed at eight vegetation plots show an average density of 780 stems/acre. This is a decrease over the Year 4 total of 982 stems/acre; however, it is an increase over the Year 2 total of 704 stems/acre for the site. Additionally, this density far exceeds the success criteria of 260 stems/acre after five years of monitoring. All individual plots had stem densities meeting the minimum requirement. Additionally, a large number of recruit stems were found in each plot. A vegetative problem area of low concern was noted in the project area along the riparian corridor of the UT. This problem area includes a dying back population of a rapidly spreading vine in the pea family; most likely hog peanut vine (*Amphicarpaea bracteata*). The problematic vine has been proactively managed by herbicide treatment since 2009. As of 2011, however, the vine had continued to spread and increase in density. An intensive herbicidal spraying effort was conducted in the fall of 2011, spring and summer of 2012, and spring of 2013 in order to knock down the spread. During the Year 5 vegetation monitoring event, the additional treatments were observed to be effective. The spread of the invasive vine has slowed and it's density has decreased significantly from Year 3 and 4.

Year 5 monitoring of the streams identified only minor problem areas along the project reaches, including some bank scour along the main stem of Thompsons Fork attributed to a beaver dam that has been removed and a small pocket of invasive species (multi-flora rose) along the unnamed tributary (UT). There is also some evidence of in-stream vegetation along the tributary channel, but it is not impacting stream channel stability. The visual stream stability assessments for Year 5 revealed that the majority of in-stream structures are functioning as designed and built on the main stem and unnamed tributary. Bed form features are evolving but are stable along the restored reaches, as compared to as-built conditions. Dimensional measurements of the monumented cross-sections remain stable when compared to the monitoring results from Years 1 thru 4.

The comparison of the Year 5 and Year 4 long-term stream monitoring profile and cross-section data shows stability with no significant change from as-built conditions. For Thompsons Fork main stem, constructed riffles and structures are stable, with the median particle distribution in the very coarse gravel range. Aggradation on the point bars and bankfull bench is evident in a few cross sections creating a smaller bankfull width and area. For the UT, the channel dimensions for each of the cross-sections seems to be consistent with prior years. As noted later in this report, previously observed aggradation within portions of the UT channel has been alleviated via stream maintenance activities. As a result, the reach-wide particle distribution (including pebble counts from both pool and riffle features) has improved within the past two years and has shifted from the medium sand category to the very coarse sand category. The riffle substrate has shifted from a gravel to cobble substrate. The channel is again classified as a C3b, as it was in the as-built.

Based on the crest gage network installed on the project reaches, one bankfull event was recorded along each reach during the Year 1, Year 2, and Year 5 monitoring periods. Due to cork being washed away within the two crest gages at the site, bankfull events were not captured in 2011 (Year 3). Again in 2012 (Year 4), bankfull events were not observed for either crest gage. This is presumably due in large part to the exceptionally dry summer months of 2012. This brings the total number of bankfull events for the main stem and UT to three, in three separate years.

The tables provided below summarize the geomorphological changes along the restoration reaches for each stream.

Thompsons Fork Main Stem

Parameter	Pre-Restoration	As-built	Year 1	Year 2	Year 3	Year 4	Year 5
Length (ft.)	**2,530**	**2,727**	**2,727**	**2,727**	**2,727**	**2,727**	**2,727**
Bankfull Width (ft.)	**20.9**	**37.7**	**36.3**	**34.1**	**31.9**	**29.8**	**28.7**
Bankfull Max Depth (ft.)	**5.1**	**2.5**	**2.4**	**2.6**	**2.6**	**2.5**	**2.3**
Width/Depth Ratio	**7.7**	**27.1**	**28.7**	**26.2**	**25.5**	**24.4**	**22.8**
Entrenchment Ratio	**1.5**	**3.0**	**3.0**	**3.0**	**3.5**	**3.7**	**3.4**
Bank Height Ratio	**2.4**	**1**	**1**	**1**	**1**	**1**	**1**
Sinuosity	**1.12**	**1.19**	**1.19**	**1.19**	**1.19**	**1.19**	**1.19**

Unnamed Tributary to Thompsons Fork (UT)

Parameter	Pre-Restoration	As-built	Year 1	Year 2	Year 3	Year 4	Year 5
Length (ft)	**1,598**	**1,948**	**1,948**	**1,948**	**1,948**	**1,948**	
Bankfull Width (ft.)	**13.1**	**14.0**	**15.4**	**11.6**	**14.7**	**15.8**	
Bankfull Max Depth (ft.)	**1.1**	**1.7**	**1.6**	**1.8**	**2.1**	**2.1**	
Width/Depth Ratio	**16**	**17.4**	**18.1**	**12.8**	**16.2**	**19.9**	
Entrenchment Ratio	**3.4**	**6**	**5.6**	**7.4**	**6.4**	**5.8**	
Bank Height Ratio	**1.6**	**1**	**1**	**1**	**1**	**1**	
Sinuosity	**1.09**	**1.36**	**1.36**	**1.36**	**1.36**	**1.36**	

II. PROJECT BACKGROUND

A. Location and Setting

The project is located near the intersection of Watson Road and South Creek Road on the north side of Interstate 40, approximately 7 miles east of the City of Marion, in Nebo Township, McDowell County, North Carolina as shown on **Figure 1**. The stream channels included in this project are the Thompsons Fork main stem and one unnamed tributary stream designated UT.

The directions to the project site are as follows:

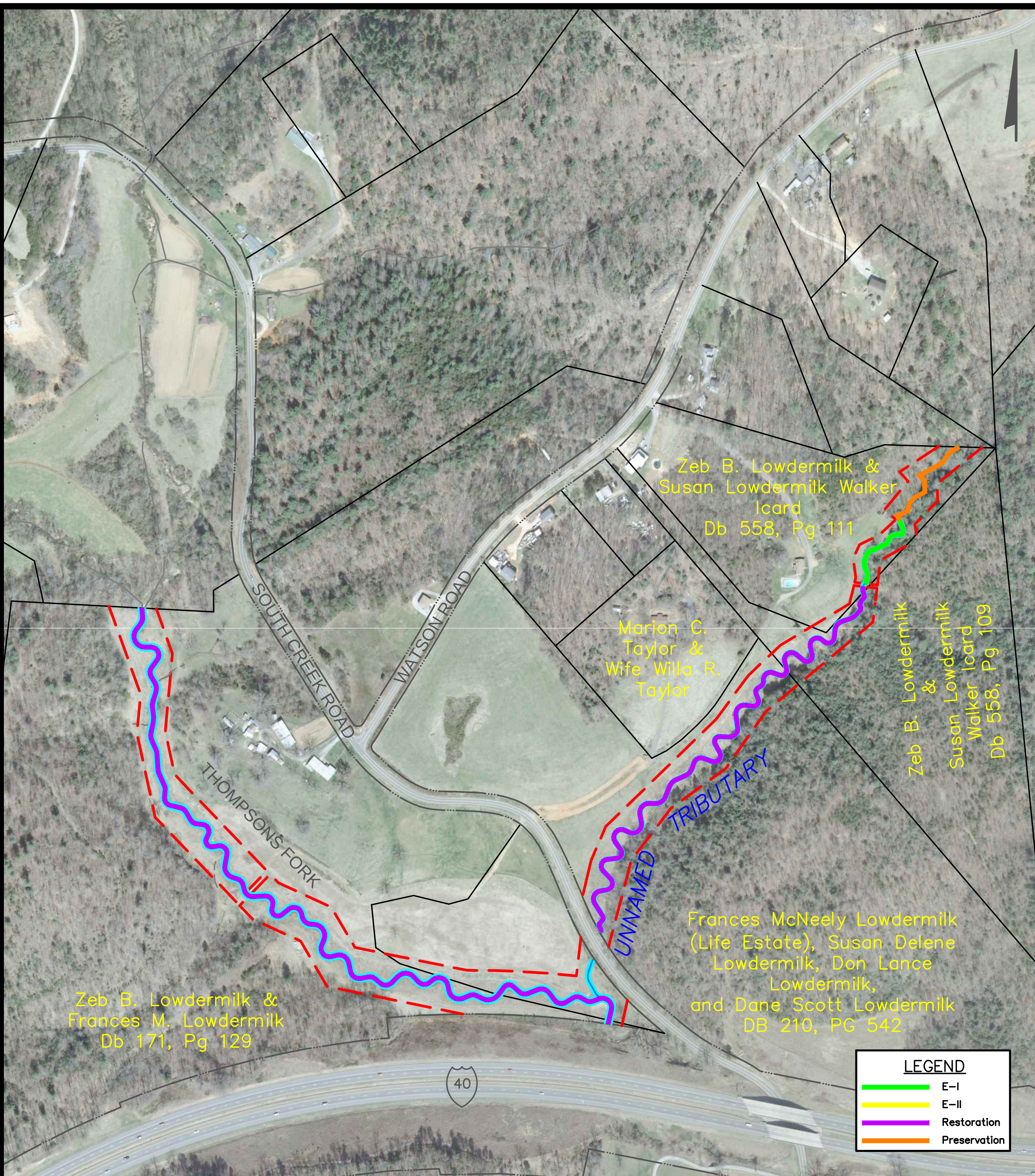
> Exit I-40 at Exit 94 and travel north on Dysartsville Road for 0.6 mile. Turn left and travel west onto US-70 for 3.2 miles, then turn left onto Watson Road. Travel 1.1 miles south on Watson Road to the intersection of South Creek Road. Zeb Lowdermilk's residence (1394 South Creek Road, Nebo, NC 28761) is located on the right (south) side of South Creek Road at the intersection of Watson Road. The project spans four tracts of land: (Tract 1) owned by Zeb B. Lowdermilk and wife Francis M. Lowdermilk (deceased); (Tract 2) owned by Francis McNeely Lowdermilk (Life Estate), Susan Delene Lowdermilk, Don Lance Lowdermilk, and Dane Scott Lowdermilk; and (Tracts 3 and 4) owned by Zeb B. Lowdermilk and daughter Susan Lowdermilk Walker Icard.

B. Project Structure, Mitigation Type, Approach and Objectives

Pre-restoration land use surrounding the project streams was predominantly agricultural, including pasture/hay land with wooded and cleared hillsides. Pre-restoration land use surrounding the Thompsons Fork restoration reach was active cattle pasture land. The pre-existing riparian corridor was absent to extremely narrow (5 to 10 feet wide) along the Thompsons Fork main stem, widening for only a short distance near the downstream limits of the main stem project reach. Streambanks were denuded and extremely unstable, with vertical to undercut banks up to 15 feet in height from the former farm stream crossing to the bottom of the main stem reach.

A hayland meadow was present along the UT right bank. Along the UT left bank the riparian corridor consists of mature hardwood forested hill slope. Along the 356 linear feet of UT preservation reach, beginning at the granite outcrop spring from which the perennial UT emerges, the stream exists in a mature mixed hardwood and evergreen forest with diversified herbaceous, shrub, mid-story and canopy species present. Typical species observed along the streams and adjacent forested areas include *Alnus rugosa* (tag alder), *Platanus occidentalis* (Eastern sycamore), *Abies* species (fir), *Pinus taeda* (loblolly pine), *Pinus elliottii* (slash pine), *Ostrya virginiana* (Eastern hophornbeam), *Diospyros virginiana* (persimmon), *Kalmia latifolia* (mountain laurel), *Cornus amomum* (silky dogwood), *Ilex opaca* (American holly), and the invasive species *Ligustrum sinense* (Chinese privet) and *Lonicera japonica* (Japanese honeysuckle).

Prior to restoration, a combination of historical and recent anthropogenic factors and practices impacted the channel along the impaired main stem reach, resulting in its unstable Rosgen G4 stream type. The deeply incised and entrenched condition of the channel prior to restoration was attributed to management of the riparian corridor for hay production, cattle intrusion resulting in



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MCDOWELL COUNTY, NORTH CAROLINA

THOMPSON FORK RESTORATION

FIGURE 1: SITE VICINITY MAP

N.C. ECOSYSTEM ENHANCEMENT PROGRAM

Date: December, 2013

Not To Scale

Ecosystem Enhancement PROGRAM

Stream bank hoof shear and vegetative denuding from grazing and browsing combined with the erosive nature of the discharge of "sediment hungry" water from the 30-inch reinforced concrete pipe outfall from Muddy Creek Flood Control Dam Number 8. Additionally, a shift in stream base level occurred during the construction of Interstate 40 (I-40), when the invert of the culvert carrying Thompsons Fork under I-40 was set 12 to 15 feet below the pre-disturbance invert of the streambed, triggering channel incision, head cutting, floodplain abandonment, and lowering of the water table. The Thompsons Fork main stem unstable bank height ratio, entrenchment ratio, channel slope (0.0039 ft/ft) greater than valley slope (0.0031 ft/ft) and poorly defined bedform features showed the instability of the deeply incised, unstable, degrading stream channel disconnected from its floodplain. Mid-channel, lateral, and transverse sand and gravel bars were present at locations throughout the main stem reach, demonstrating the stream lacked stable pattern, profile, dimension, capacity and competency to entrain the high sediment load. The locations of these depositional features in the near-bank region deflected flows from the center of the channel toward the incised vertical to undercut, steep, denuded streambanks, resulting in accelerated erosion rates. Utilizing the near-bank stress method algorithm, it was estimated 2,076 cubic yards per year (or 2,700 tons per year) of sediment was being eroded from the streambanks along the main stem.

The UT channel was a classic Rosgen Type I valley confined, A1-A2 stream type transitioning to a Type II colluvial valley, B3 stream type at the point where the stream emerges from its mixed deciduous hardwood and evergreen forested corridor into an open meadow at the top of the impaired reach. The forested reach segment has some bedrock control, in-stream boulders with negligible instream woody debris accumulation. The indigenous, well established, healthy riparian vegetative communities in the channel and in the overbank regions provide extremely stable channel conditions for the forested reach, and are preserved within the conservation easement recorded for the project. Agricultural land use adjacent to the stream corridor together with aggressive vegetative management resulted in steep to undercut streambanks, accelerated streambank erosion and channel incision along the Enhancement Level II and Priority Level I Restoration reaches. The unstable streambanks were contributing large volumes of suspended sediment and bedload material to the larger Thompsons Fork main stem. It was estimated 291 cubic yards per year (or 378 tons per year) of sediment was being eroded from streambanks along the UT under existing conditions.

The mitigation goals and objectives for the project streams are related to restoring stable physical and biological function of the project streams beyond pre-restoration (impaired) conditions. Pre-restoration conditions consisted of impaired, channelized, eroding, incised and entrenched stream channels. The specific mitigation goals for the project are listed below.

- Provide stable stream channels with features inherent of ecologically diverse environments, including appropriate stream-bed features, such as pools and riffles, and a riparian corridor with diverse and native vegetation. Utilize reference reach information as the foundation of the restoration design.
- Provide stream channels with the appropriate geometry and slope to convey bankfull flows while entraining bedload and suspended sediment readily available to the streams.
- Provide a connection between the bankfull channel and the flood prone area, and stable channel geometry and protective cover to prevent erosion.

- Provide a minimization of future land use impacts to the streams and a perpetual stream corridor protection via livestock exclusion fencing and restrictive conservation easement conveyances to the State of North Carolina.

Restoration of the streams has met the objective of the project along both the main stem of Thompsons Fork and the UT, providing the desired habitat and stability features required to improve and enhance the ecologic health of the streams for the long-term. Specifically, the completed restoration project has accomplished the items listed below.

Thompsons Fork Main stem:

- Reversed the effects of channelization through a combination of Priority I and Priority II restoration techniques. The restoration has changed the average width/depth ratio from 7.7 to 22.8 in Year 5.
- Restored a natural and stable sinuosity to the stream channel, increasing the sinuosity of the channel from 1.1 to 1.2, and providing a more stable relationship between the valley and bankfull slopes (the bankfull slope was higher than the valley slope in the pre-restoration condition and is now less than the valley slope with the completed restoration).
- Stabilized eroding streambanks by providing an appropriately sized channel with stable channel bank slopes with a combination of embedded stone, natural fabrics and hearty vegetation as protective cover. The average Bank Height Ratio has been changed from 2.36 to 1.0.
- Provided a re-connection between the restored stream channel and the adjacent flood prone area by both raising the stream bed and excavating the adjacent floodplain. The completed restoration changed the average entrenchment ratio from 1.53 to 3.4 in Year 5.
- Created in stream aquatic habitat features such as deep pools supported by riffles, including rock cross vanes with deep pools to transition the channel thalweg from the restored reach to the downstream existing channel.
- Re-vegetated the riparian corridor with indigenous trees and shrubs and preservation of existing riparian corridors where possible.

Unnamed Tributary (UT):

- Reversed the effects of channelization through a combination of Priority I and Priority II restoration techniques, as well as Enhancement Level I activities and Preservation of a short reach at the upstream end of the project. The average width/depth ratio of the restored stream channel is 17.9 in Year 5. In the restoration reach, stable pattern, profile and dimension were all restored to the stream channel. In the enhancement reach, a stable profile was provided and dimension of the stream channel was modified accordingly. The preservation reach is in a stable and heavily wooded corridor that is protected by the conservation easement for the project.
- Restored a natural and stable sinuosity to the stream channel, increasing the sinuosity of the channel from 1.1 to more than 1.3, and providing a more stable relationship between the valley and bankfull slopes (the bankfull and valley slopes were nearly identical in the pre-restoration condition and is substantially less than the valley slope with the completed restoration).

- Stabilized eroding streambanks by providing an appropriately sized channel with stable channel bank slopes. The average Bank Height Ratio has been changed from 1.63 to 1.0.
- Provided a re-connection between the restored stream channel and the adjacent flood prone area by both raising the stream bed and excavating the adjacent floodplain. The completed restoration changed the average entrenchment ratio from 3.4 to 6.1 in Year 5.
- Created instream aquatic habitat features such as pools supported a combination of riffles and step-log structures.
- Re-vegetated the riparian corridor with indigenous trees and shrubs and preservation of existing riparian corridors where possible.

Information on the project structure and objectives is included in Tables I and II.

Table I. Project Structure Table
Thompsons Fork Stream Restoration / EEP Project No. D06030-A

Project Segment/Reach ID	Linear Footage or Acreage
Thompsons Fork Main stem	2,727 ft
Unnamed Tributary (UT)	2,694 ft
TOTAL	**5,421 ft**

Table II. Project Mitigation Objectives Table
Thompsons Fork Stream Restoration / EEP Project No. D06030-A

Project Segment/ Reach ID	Mitigation Type	Linear Footage or Acreage	Mitigation Ratio	Mitigation Units	Comment
Thompsons Fork Main stem	Priority Level I Restoration	2,727 ft	1.0	2,727 ft	Restore dimension, pattern, and profile
UT	Preservation	356 ft	5.0	71 ft	Preserved within the conservation easement
UT	Enhancement Level I	390 ft	1.5	260 ft	Restore profile and dimension, step-pool bank stabilization
UT	Priority Level II Restoration	1,948 ft	1.0	1,948 ft	Restore dimension, pattern, and profile
TOTAL		**5,421 ft**		**5,006 ft**	

C. Project History and Background

Project activity and reporting history are provided in Table III. The project contact information is provided in Table IV. The project background history is provided in Table V.

Table III. Project Activity and Reporting History Thompsons Fork Stream Restoration / EEP Project No. D06030-A			
Activity or Report	**Scheduled Completion**	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration plan	Apr 2007	Aug 2006	Jun 2007
Final Design - 90%[1]	--	--	--
Construction	Jan 2008	N/A	May 2008
Temporary S&E applied to entire project area[2]	Jan 2008	N/A	May 2008
Permanent plantings	Mar 2008	N/A	Apr 2008
Mitigation plan/As-built	May 2008	Jun 2008	Oct 2008
Year 1 monitoring	2009	Sep 2009 (vegetation) Jul 2009 (geomorphology)	Dec 2009
Year 2 monitoring	2010	May 2010 (geomorphology) Sep 2010 (vegetation)	Dec 2010
Year 3 monitoring	2011	May 2011 (geomorphology) Sep 2011 (vegetation)	Dec 2011
Year 4 monitoring	2012	May 2012 (geomorphology) Sep 2012 (vegetation)	Dec 2012
Year 5 monitoring	2013	May 2013 (geomorphology) Sep 2013 (vegetation)	Dec 2013

[1]Full-delivery project; 90% submittal not provided.
[2]Erosion and sediment control applied incrementally throughout the course of the project.
N/A: Data collection is not an applicable task for these project activities.

Table IV. Project Contact Table Thompsons Fork Stream Restoration / EEP Project No. D06030-A	
Designer	Evans, Mechwart, Hambleton & Tilton, Inc. 5500 New Albany Road, Columbus, OH 43054
Construction Contractor	South Mountain Forestry 6624 Roper Hollow, Morganton, NC 28655
Monitoring Performers	Evans, Mechwart, Hambleton & Tilton, Inc. 5500 New Albany Road, Columbus, OH 43054
Stream Monitoring POC	Miles Hebert, EMH&T
Vegetation Monitoring POC	Melissa Queen-Darby, EMH&T

Table V. Project Background Table Thompsons Fork Stream Restoration / EEP Project No. D06030-A	
Project County	McDowell
Drainage Area	Main stem-7.57 sq mi UT-0.163 sq mi
Drainage Impervious Cover Estimate	2.36%
Stream Order	Main stem-3rd UT-1st
Physiographic Region	Blue Ridge Mountains/Southern Inner Piedmont
Ecoregion	Eastern Blue Ridge Foothills
Rosgen Classification of As-built	Main stem-C4 UT- C3b
Dominant Soil Types	Colvard loam, Evard-Cowee complex, Iotla sandy loam
Reference Site ID	Thompsons Fork Main stem, Brindle Creek
USGS HUC for Project and Reference	03050101
NCDWQ Sub-basin for Project and Reference	03050101040010
NCDWQ Classification for Project and Reference	C
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	No
Reason for 303d listing or stressor	N/A
% of project easement fenced	50%

D. Monitoring Plan View

The monitoring plan view is included as Figure 2.

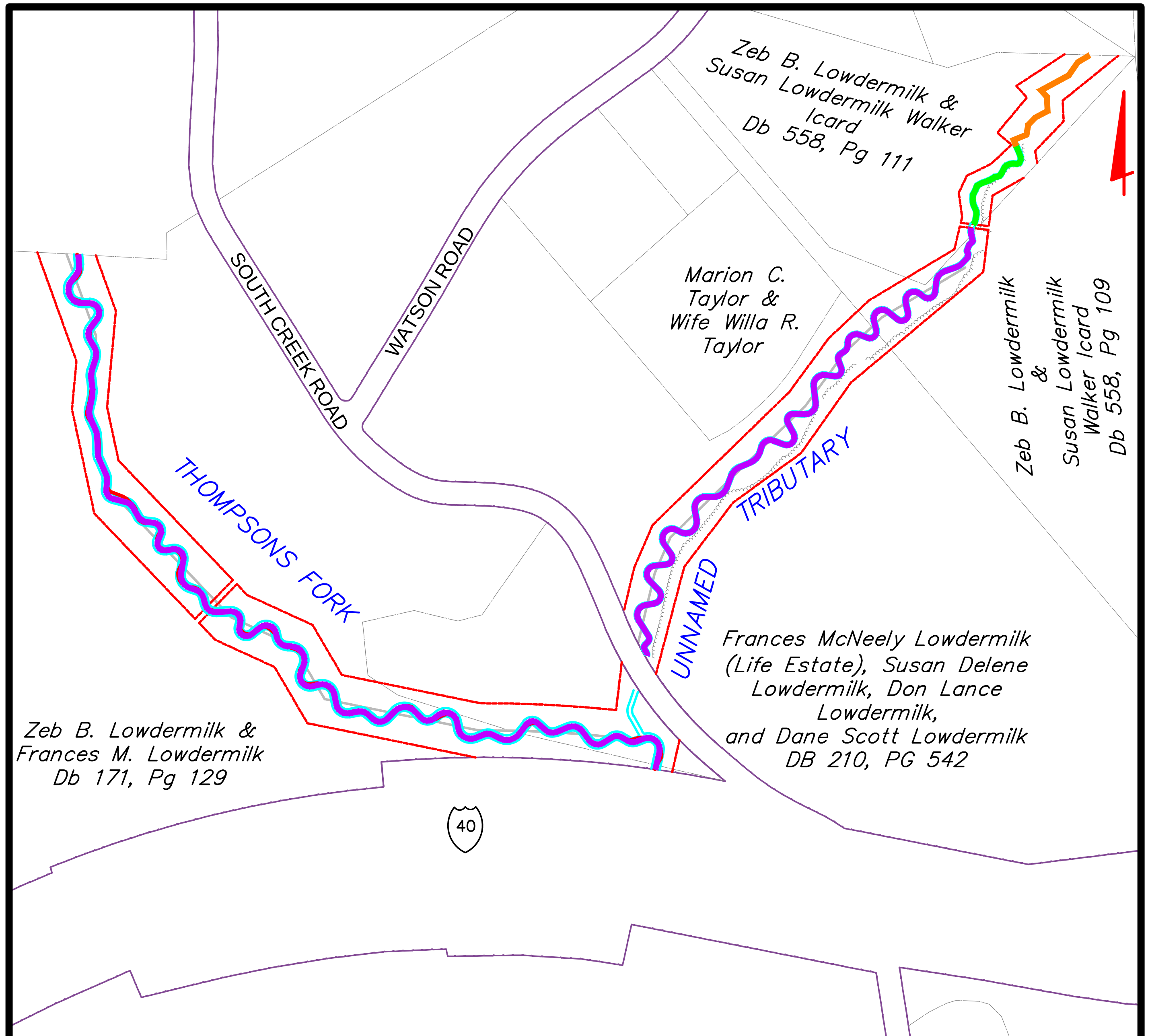
MCDOWELL COUNTY, NORTH CAROLINA

FIGURE 2 - MONITORING PLAN VIEW

FOR

THOMPSONS FORK AND UNNAMED TRIBUTARY

2013



LOCATION MAP
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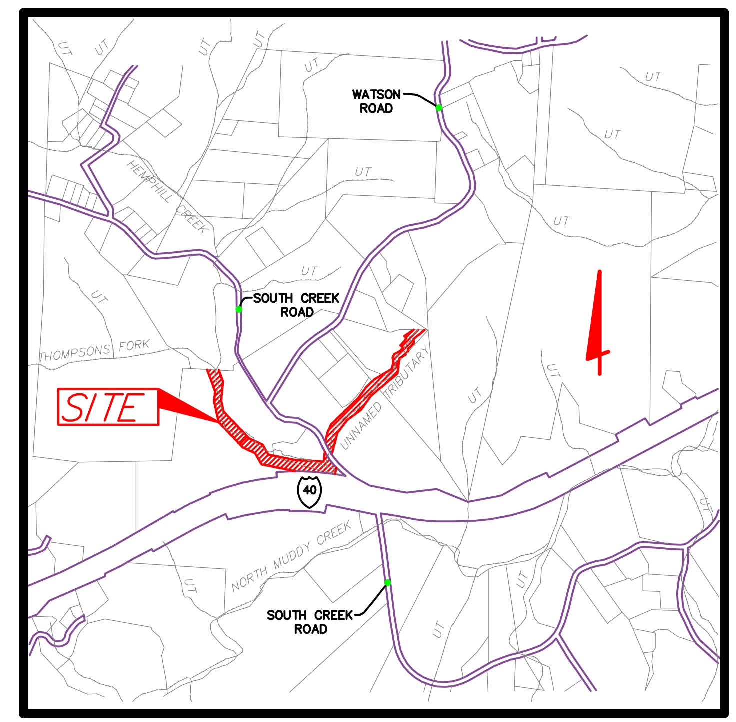
LEGEND

- E-I
- E-II
- Restoration
- Preservation



VICINITY MAP
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Sheet 1/8
Date December, 2013
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MCDOWELL COUNTY, NORTH CAROLINA
FIGURE 2 - MONITORING PLAN VIEW
FOR
THOMPSONS FORK
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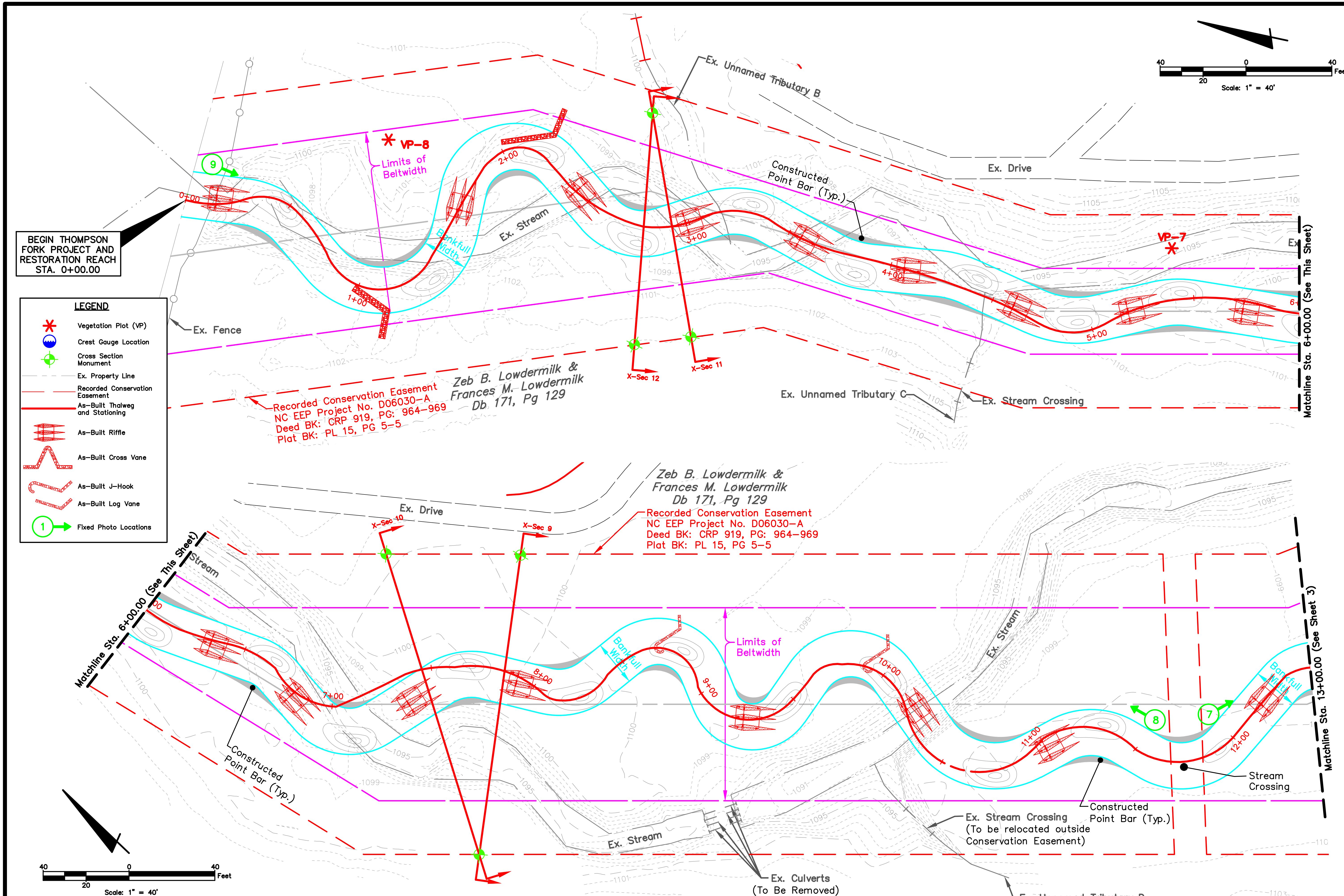

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MCDOWELL COUNTY, NORTH CAROLINA
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THOMPSONS FORK

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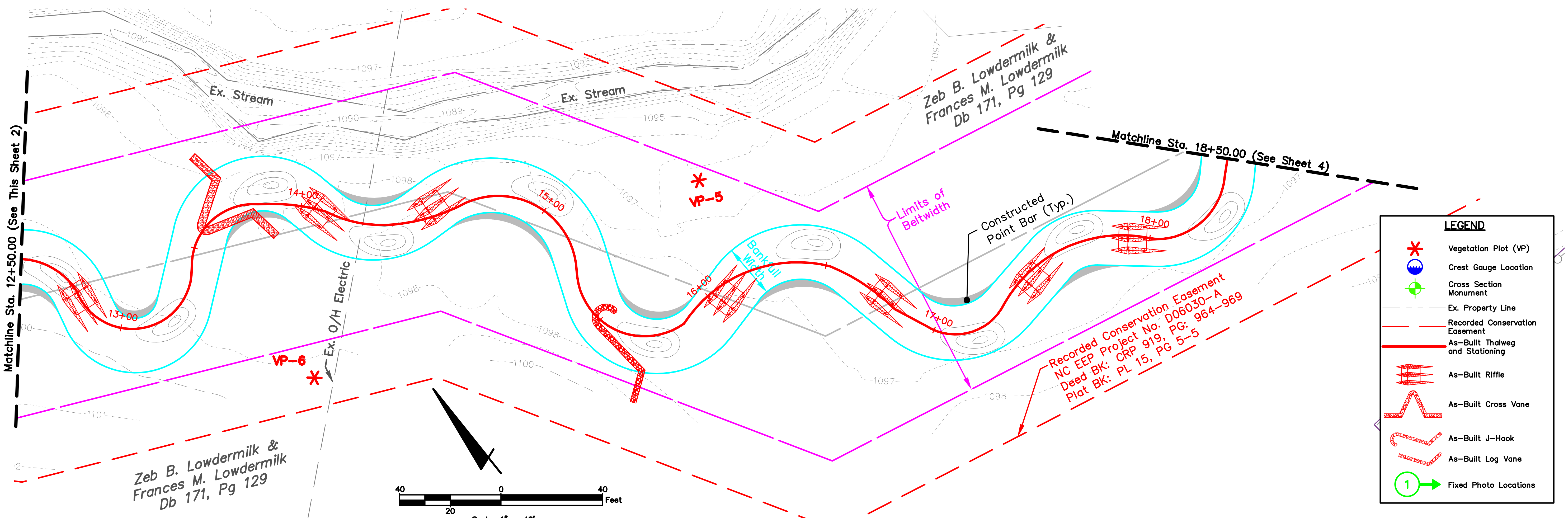

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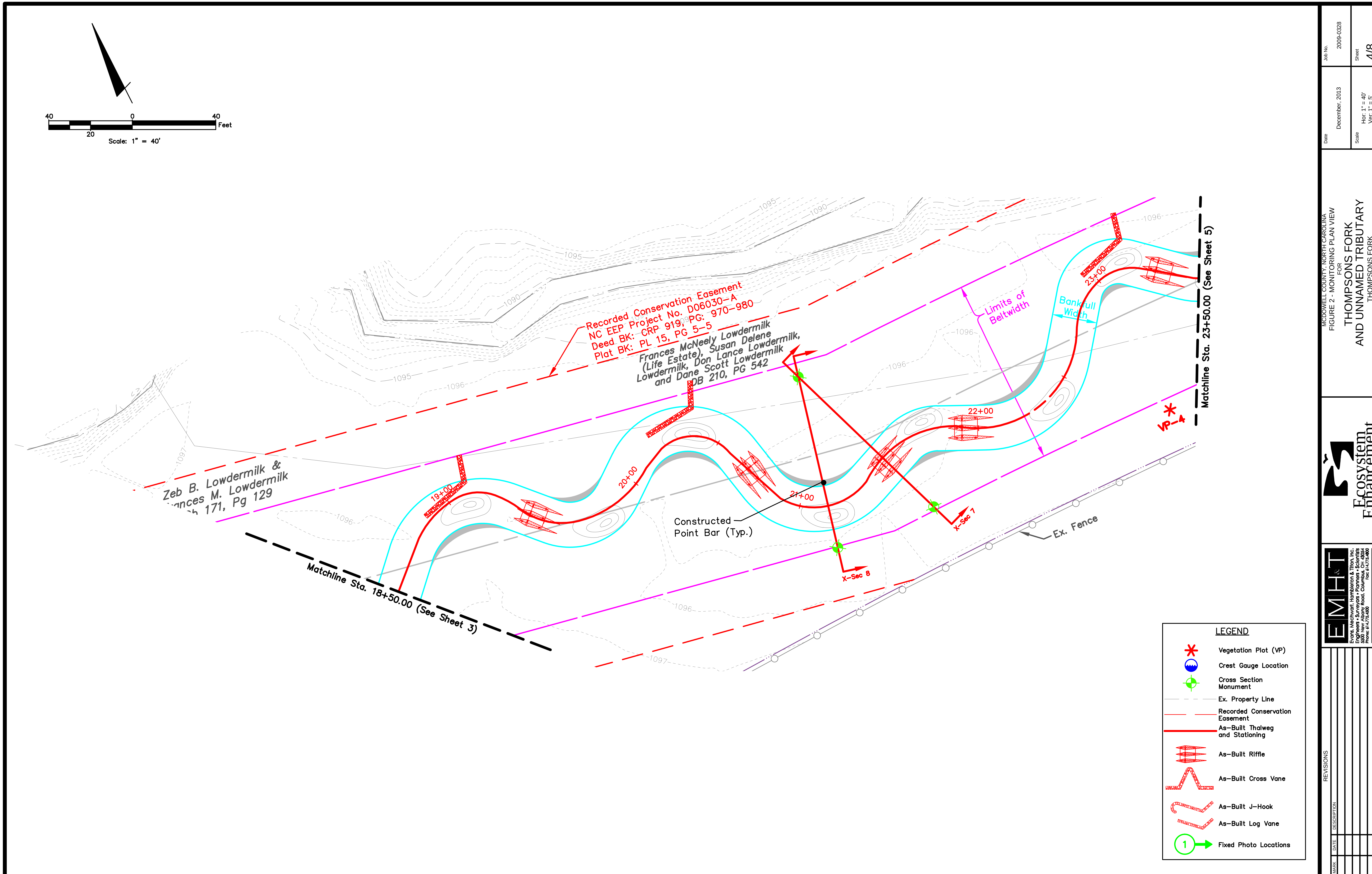

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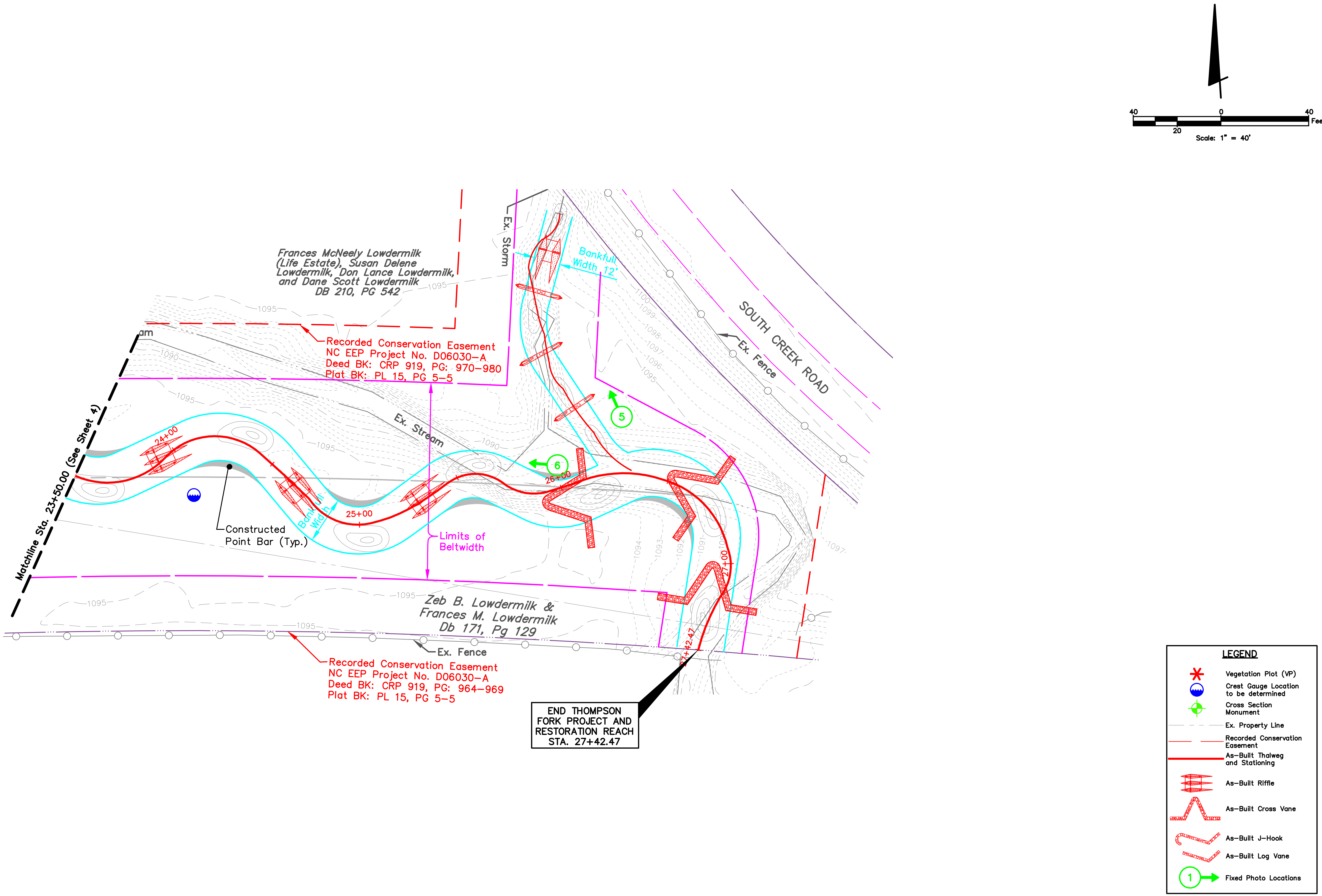

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THOMPSONS FORK

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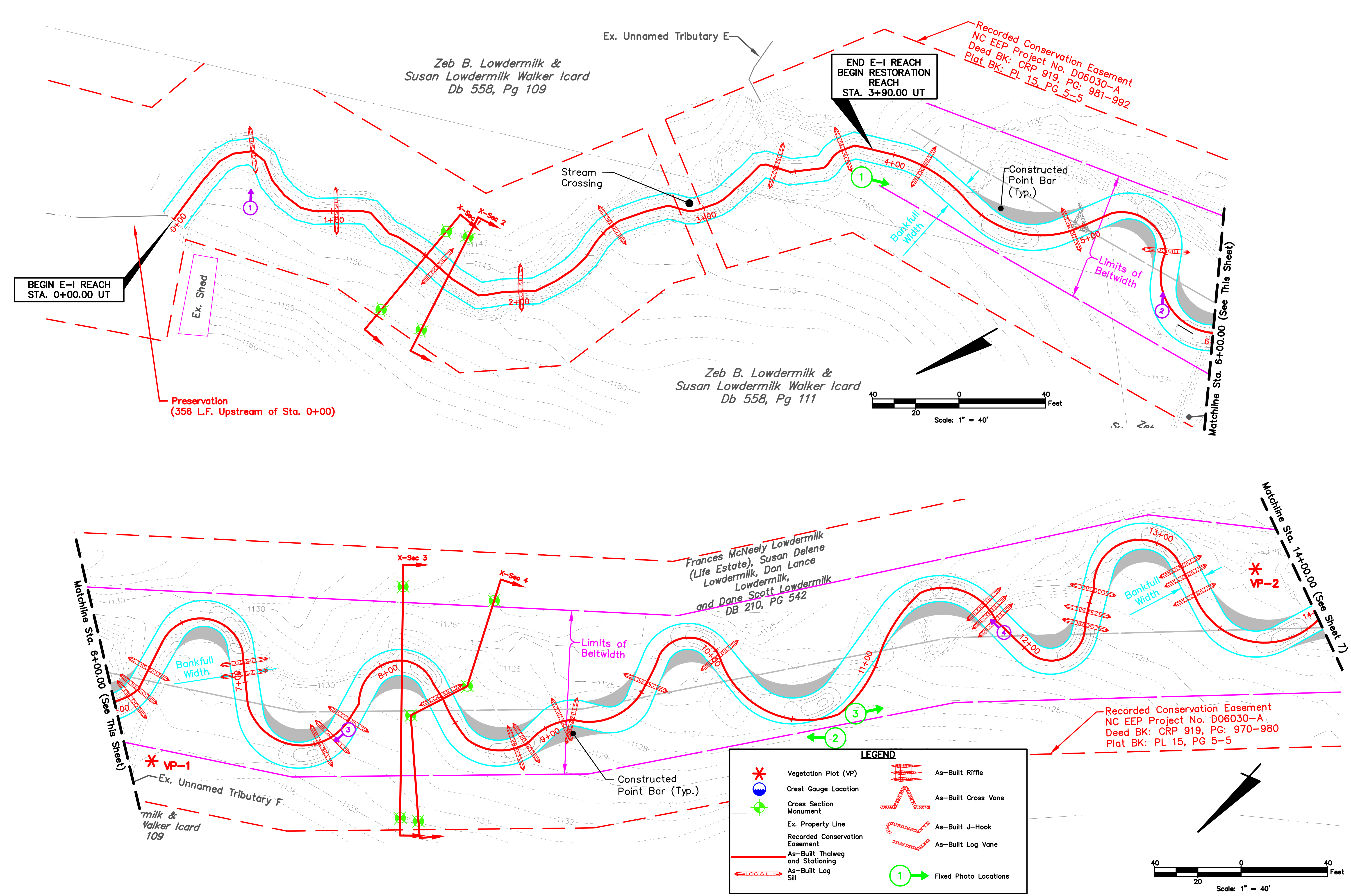

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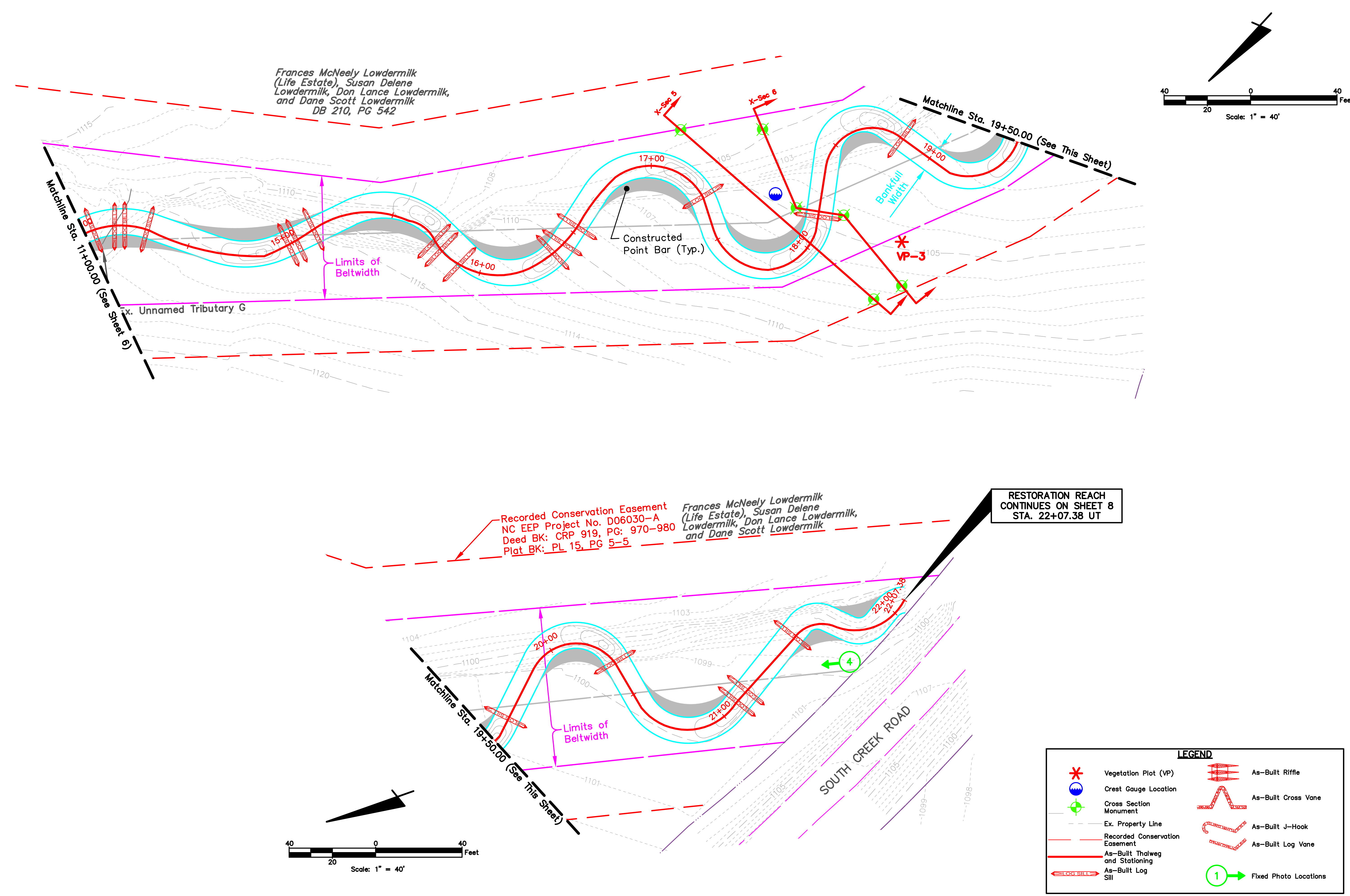

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MCDOWELL COUNTY, NORTH CAROLINA

FIGURE 2 - MONITORING PLAN VIEW FOR

THOMPSONS FORK AND UNNAMED TRIBUTARY

UNNAMED TRIBUTARY

Ecosystem Enhancement PROGRAM

EMH&T

Evans, Mechwart, Hambleton & Tilton, Inc. Engineers • Surveyors • Planners • Scientists

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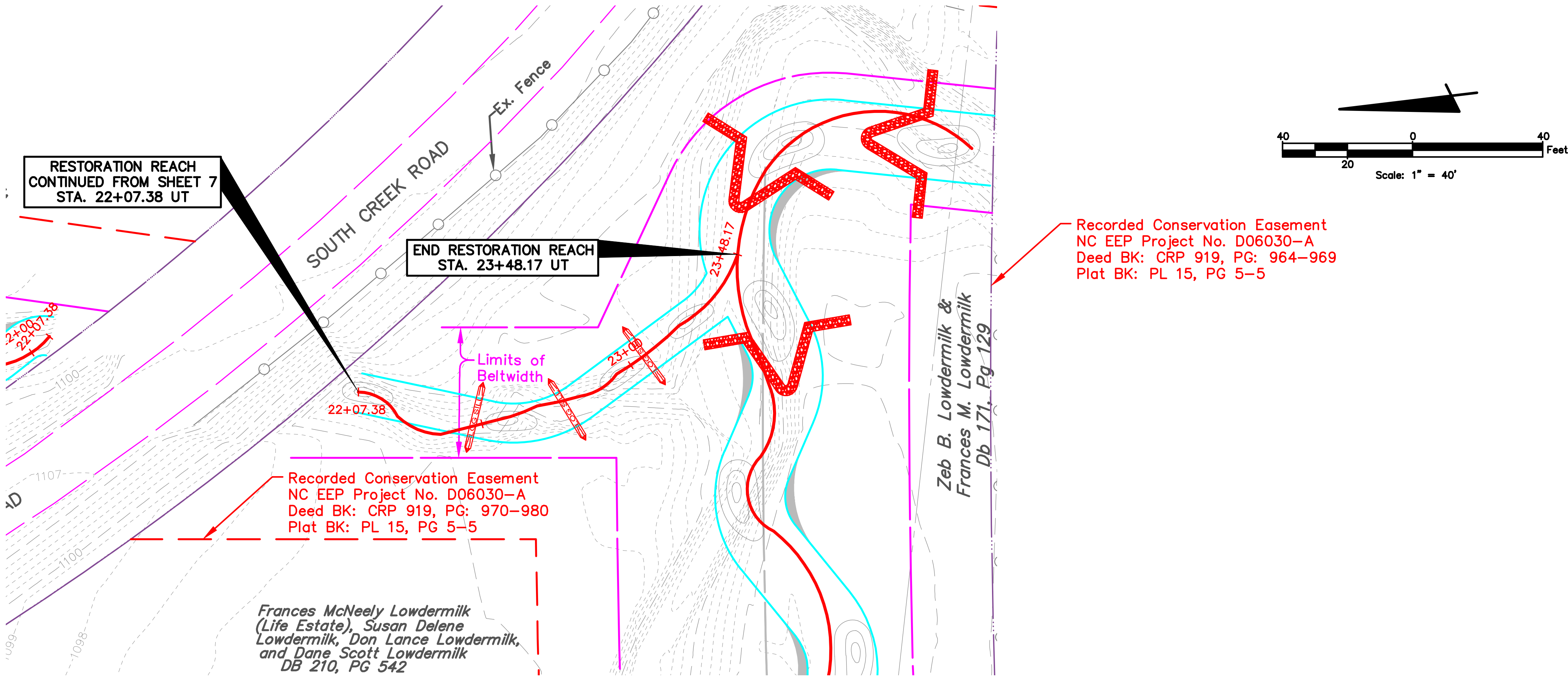

LEGEND

	Vegetation Plot (VP)		As–Built Riffle
	Crest Gauge Location		As–Built Cross Vane
	Cross Section Monument		As–Built J–Hook
	Ex. Property Line		As–Built Log Vane
	Recorded Conservation Easement	1	As–Built Photo Locations of Typical Structures
	As–Built Thalweg and Stationing	1	Fixed Photo Locations
LOG SILL	As–Built Log Sill		

Job No. 2009-0328

Sheet 8/8

Date December, 2013

Scale Hor: 1" = 40' Ver: 1" = 5'

MCDOWELL COUNTY, NORTH CAROLINA
FIGURE 2 - MONITORING PLAN VIEW
FOR
THOMPSONS FORK AND UNNAMED TRIBUTARY
UNNAMED TRIBUTARY

Ecosystem Enhancement PROGRAM

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III. PROJECT CONDITION AND MONITORING RESULTS

A. Vegetation Assessment

1. Soil Data

Soil information was obtained from the NRCS Soil Survey of McDowell County, North Carolina (USDA NRCS, September, 1995). The soils along the main stem of Thompsons Fork and its associated Unnamed Tributary include the Colvard Series consisting of loamy sediments ranging from 40 to 60 inches or more in thickness over deposits of sandy, loamy gravelly to cobbly sediments. Rock fragments range from 0 to 15 percent to a depth of 40 inches, and from 0 to 80 percent below 40 inches. Flakes of mica range from a few to common.

Data on the soils series found within and near the project site is summarized in Table VI.

Table VI. Preliminary Soil Data
Thompsons Fork Stream Restoration / EEP Project No. D06030-A

Series	Max. Depth (in.)	% Clay on Surface	K[1]	T[2]	% Organic Matter
Colvard loam (CoA)	60	8-18	0.15	4	1-2
Evard-Cowee complex (EwE)	30	7-25	0.28	2-5	1-5
Iotla sandy loam (IoA)	60	12-18	0.15	5	2-5

[1]Erosion Factor K indicates the susceptibility of a soil to sheet and rill erosion, ranging from 0.05 to 0.69.
[2]Erosion Factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity, measured in tons per acre per year.

2. Vegetative Problem Areas

Vegetative Problem Areas are defined as areas either lacking vegetation or containing populations of exotic vegetation. Each problem area identified during Year 5 of monitoring is summarized in Table VII. Since no vegetation problem areas of concern were noted during the Year 5 vegetation assessment, vegetation problem area photos are not included in Appendix A. In addition, the Vegetation Problem Area exhibit is also not included in Appendix A.

Table VII. Vegetative Problem Areas
Thompsons Fork Stream Restoration / EEP Project No. D06030-A

Feature/Issue	Station # / Range	Probable Cause	Photo #
NA	NA	NA	NA

In 2010, vegetation problem areas occurred on both the right and left banks of the unnamed tributary. In 2009, a species of pea vine had spread into the riparian corridor from the adjacent wooded hillside, with the most dense concentration located in the area of Vegetation Plot 2. The species is a member of the pea family, likely *Amphicarpaea bracteata* (hog peanut), which is native to North Carolina. In the Year 1 monitoring report it was noted that the vine was strangling the woody vegetation in and around monitoring plot 2, where approximately 80% of the planted woody stems were suffering from vine strangulation. Without control of the vine, tree mortality could be high in this area, jeopardizing the minimum stem count criteria. Because of this, the presence of the vine within the project corridor was considered a problem area of high priority and management with herbicide treatments were conducted in the fall of 2009. Follow-up treatments were applied the spring of 2010 and the spring and summer of 2011 in an effort to control the spread of this vine within the project corridor.

The herbicide treatments appeared to be working, as the vine slowed its spread and density in Year 4. Woody plantings installed in late 2009 were no longer being impacted by the fast growing pea vine. Although the vine cover had been much reduced, it remained a vegetation problem area of high concern in 2012. Another round of intensive herbicide spraying was conducted in the spring of 2013. The spread of hog peanut vine was closely monitored and documented during the fifth and final year of monitoring. In Year 5, the herbicide treatments were effective at reducing the spread and density of the vine. The majority of the vine had died back; therefore, it is now a vegetation problem area of low concern in 2013.

In Year 2, several areas along the unnamed tributary were noted to have low overall herbaceous cover along the riparian corridor on the right bank. These areas were said to be patchy in distribution and scattered throughout the corridor, with none of the areas showing banks that are completely bare. However, due to the threat of invasive species in the same areas along the tributary, particularly the pea vine mentioned above, the sparse vegetation was noted as an area of concern. The herbaceous cover has continued to increase in these areas, leaving fewer open patches that might provide an avenue for colonization and spread of invasive or problematic species. Areas observed to have low overall herbaceous cover in Year 2 had seen an increase in native cover over the past three years. Due to the reason listed above, areas with lower overall herbaceous cover were not included as vegetation problem areas in Years 4 and 5.

During 2013 vegetation monitoring, colonization by the problematic hog peanut vine was greatly reduced due to herbicide treatments. The vine has died back along the right and left banks of the UT. Therefore, these areas are now considered low concern and were not included as vegetation problem areas in Year 5. For the final year of vegetation monitoring, no significant vegetation problem areas were observed. *Rosa multiflora* (multiflora rose), which has the ability to grow aggressively, is located in one very small area along the UT. Due to the limited area of this invasive plant material and expected eradication, this was not noted as an additional problem area.

3. Vegetation Problem Area Plan View

Due to a lack of observed vegetation problem areas, no plan view map is provided in Appendix A.

4. Stem Counts

A summary of the stem count data for each species arranged by plot is shown in Table VIII. Table VIIIa provides the survival information for planted species, while Table VIIIb provides the total stem count for the plots, including all planted and recruit stems. This data was compiled from the information collected on each plot using the *CVS-EEP Protocol for Recording Vegetation, Version 4.0*. Additional data tables generated using the CVS-EEP format are included in Appendix A. All vegetation plots are labeled as VP on Figure 2.

Table VIIIa. Stem counts for each species arranged by plot - planted stems. Thompsons Fork Stream Restoration / EEP Project No. D06030-A															
	Plots								Year 0 Totals	Year 1 Totals	Year 2 Totals	Year 3 Totals	Year 4 Totals	Year 5 Totals	Survival %
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**							
Shrubs															
Alnus serrulata	3	3	3	3	8	7	6	5	42	42	39	42	42	38	90
Aronia arbutifolia				5	6	2	1	1	6	6	29	26	26	15	58
Cornus amomum									0	0	1	1	1	0	0
Ilex verticillata	2					2			2	2	2	2	2	4	200
Salix exigua					5	3			7	7	8	8	8	8	100
Sambucus canadensis	1		1	1	1	1	4		1	1	13	12	12	9	75
Trees															
Cercis canadensis				2					0	0	4	3	3	2	67
Diospyros virginiana									1	1	1	1	1	0	0
Fraxinus pennsylvanica	8	17	14	7	5	2	5		59	59	59	69	69	58	84
Platanus occidentalis				2		5	1	4	12	12	12	12	12	12	100
Quercus palustris	1	1	1		1	1		1	6	6	6	6	6	6	100
Salix nigra					1			1	3	3	4	3	12	2	17
Year 5 Totals	15	21	19	20	27	23	17	12	139	139	178	185	194	154	79
Live Stem Density	608	851	770	810	1094	932	689	486							
Average Live Stem Density	**780**														

Table VIIIb. Stem counts for each species arranged by plot - all stems. Thompsons Fork Stream Restoration / EEP Project No. D06030-A													
	Plots								Year 1 Totals	Year 2 Totals	Year 3 Totals	Year 4 Totals	Year 5 Totals
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**					
Shrubs													
Acer rubrum	1								0	0	3	3	1
Alnus serrulata	47	3	3	18	8	7	8	5	46	87	62	40	99
Aronia arbutifolia				5	8	7	1	1	6	29	27	24	22
Aronia melanocarpa									0	0	8	8	0
Cornus amomum						1			0	1	2	1	1
Ilex verticallata	2					2		1	2	2	3	2	5
Ligustrum sinense								3	0	0	0	0	3
Salix exigua					8	9			7	10	14	7	17
Salix lucida						2			0	0	0	0	2
Sambucus canadensis	2		1	2	6	3	8		11	20	17	12	22
Trees													
Ailanthus altissima		1							0	0	0	0	1
Betula nigra								30	0	0	0	0	30
Cercis canadensis				2					0	4	4	3	2
Fraxinus pennsylvanica	12	32	23	7	5	2	10		59	72	73	64	91
Juglans nigra									0	0	2	2	0
Liriodendron tulipifera								3	0	0	0	0	3
Pinus palustris				1					0	0	0	0	1
Platanus occidentalis				2		6	1	12	12	13	15	11	21
Prunus serotina	1								0	0	0	0	1
Quercus palustris	1	1	1		1	1		1	6	6	6	7	6
Quercus spp.						1			0	0	0	0	1
Rhus typhina							14	7	0	0	9	9	21
Robinia pseudoacacia									0	0	5	5	0
Salix nigra					1	2		4	3	6	6	3	7
Ulmus americana	1								0	0	0	0	1
Year 5 Totals	67	37	28	37	37	43	42	67	152	251	256	201	358
Live Stem Density	2714	1499	1134	1499	1499	1742	1701	2714					
Average Live Stem Density	**1812**												

The average stem density of planted species for the site exceeds the minimum criteria of 260 stems per acre after five years. Each individual plot also has a stem density above the minimum. In addition, a large number of recruit stems (358 total) were found in all plots in Year 5. The recruit stems increase the total stem density across the site by 132%.

5. Vegetation Plot Photos

Vegetation plot photos are provided in Appendix A.

B. Stream Assessment

1. Hydrologic Criteria

Two crest-stage stream gages were installed on the project reaches, each of which is located at the bankfull stage at a riffle cross-section, one along the main stem of Thompsons Fork and one along the UT. The locations of the crest-stage stream gages are shown on the monitoring plan view (Figure 2). In Year 3, bankfull events were not distinguishable because the cork in each crest gage had washed away. In Year 4, no bankfull events were recorded. This is presumably due to the exceptionally dry summer of 2012. Therefore, bankfull events were not recorded for 2011 & 2012, as documented in Table IX. Additional cork was added to each crest gage during the spring of 2012 and again in early 2013. Bankfull events have been recorded during Years 1, 2 and 5 for both crest gages. This brings the total number of documented bankfull events to three along each watercourse, in three separate monitoring years. The last recorded bankfull event is from Year 5 and is described below. Photographs of the crest gages are shown in Appendix B.

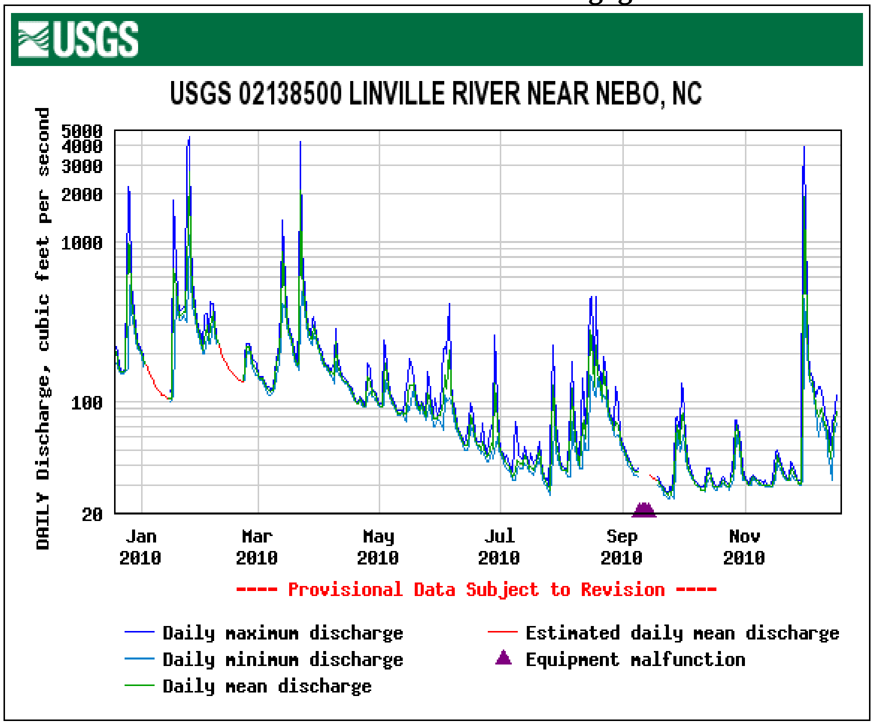
Table IX. Verification of Bankfull Events

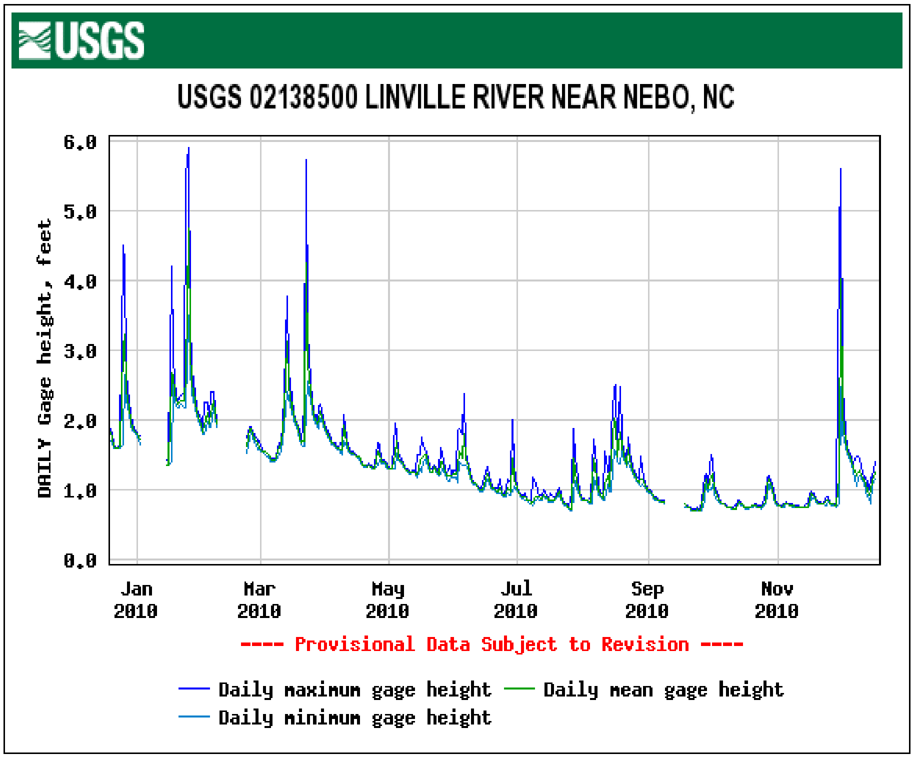
Date of Data Collection	Monitoring Year	Date of Occurrence	Method	Photo #
9/21/09	1	1/6/09-1/8/09*	Crest gage at XS-6 on UT	BF 1
9/21/09	1	1/6/09-1/8/09*	Crest gage at XS-7 on Main stem	BF 4
5/12/10	2	1/24/10-1/25/10 or 3/22/10*	Crest gage at XS-6 on the UT	BF 2
5/12/10	2	1/24/10-1/25/10 or 3/22/10*	Crest gage at XS-7 on Main stem	BF 5
5/18/11	3	NA (Bankfull event not recordable)	Crest gage at XS-6 on the UT and crest gage at XS-7 on Main stem	NA
5/30/12	4	NA (Bankfull event not recordable)	Crest gage at XS-6 on the UT and crest gage at XS-7 on Main stem	NA
5/13/13	5	5/6/13*	Crest gage at XS-6 on the UT	BF 3
3/11/13	5	1/30/13-1/31/13*	Crest gage at XS-7 on Main stem	BF 6

*Date is approximate; based on a review of recorded daily discharge and gage height data

The most likely date for the monitoring year 2 bankfull event was after the rain events that occurred on January 24 and January 25, 2010. These dates correspond to a high discharge events and gage heights, as recorded at USGS Gage 02138500 Linville River at Nebo, NC, which lies approximately 15 miles west of Morganton and 5 miles east of Marion, NC. Another large precipitation event occurred on March 22, 2010. The discharge and gage height recorded at the Nebo station are shown on the graphs below.

Year 2 bankfull event – recorded gage data



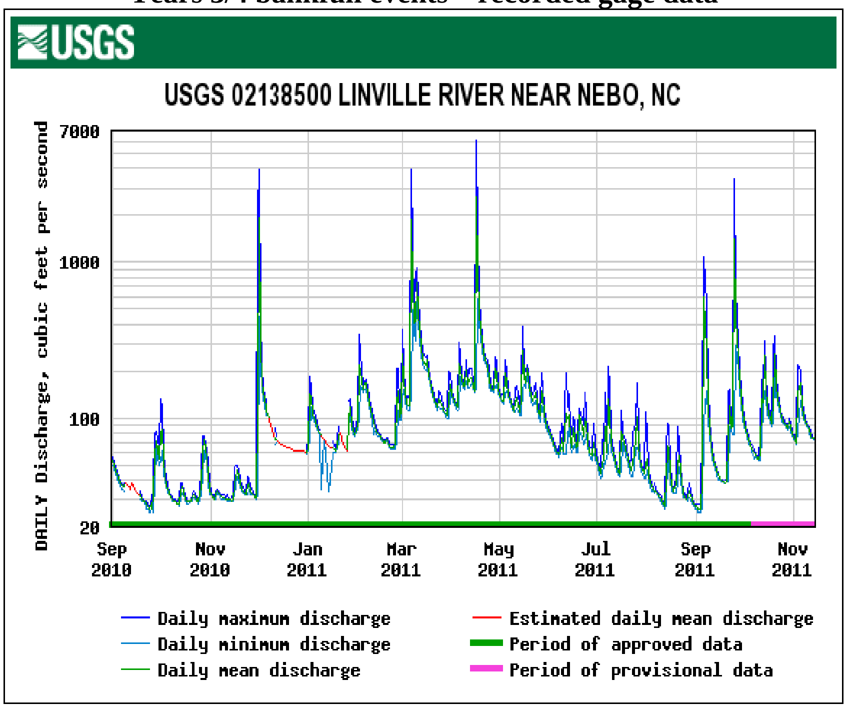


Even though crest gages for both reaches of the project were inconclusive in monitoring years 3 and 4, discharge and gage height statistics were gathered from the USGS Gage 02138500 along the Linville River at Nebo, NC (see figure below). The purpose of this was to estimate the timing of possible bankfull events. Gage statistics for these parameters were graphed from September 2011 through September 2012. The graphs for 2010-2011 (Year 3) data are located above the graphs for the 2011-2012 (Year 4) data.

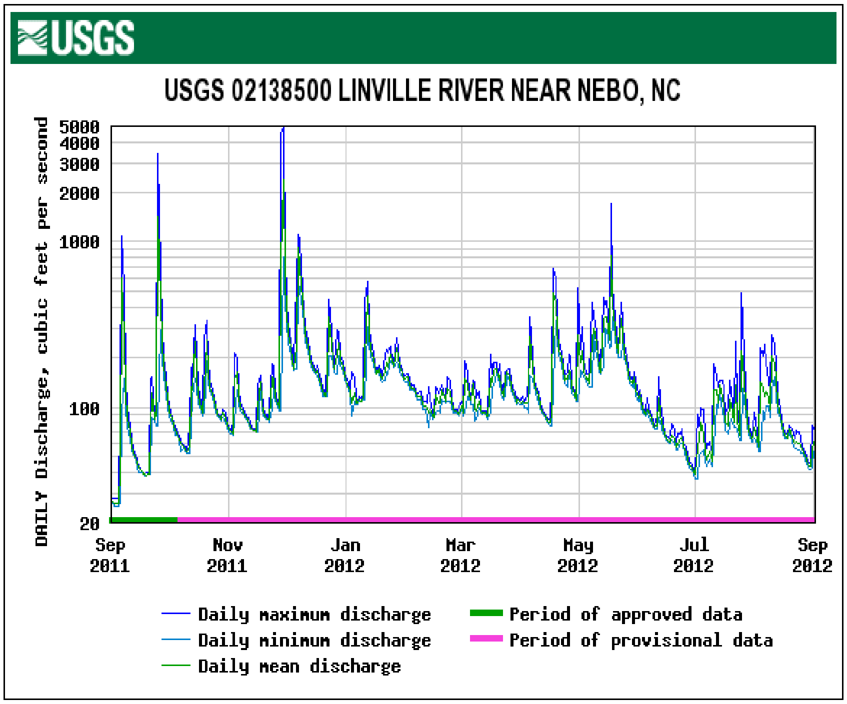
A good estimate for the timing of possible bankfull events can be made by looking at the dates throughout late 2011 to mid-2012 where daily mean and maximum discharge and gage height values reached very high levels. These dates correspond to 3 sets of days. September 29, 2011 saw a mean daily discharge rate and mean daily gage height of 1,410 ft^3/s and 3.35 feet, respectively. The maximum values for these parameters on that day were 3,440ft^3/s and 5.32 feet, respectively. The next set of days that could have produced a bankfull event was December 7 and 8, 2011. On these days, mean daily discharge and mean daily gage height reached 929 ft^3/s and 3.24 feet, and 700 ft^3/s and 2.89 feet, respectively. The maximum values for these parameters on these two days were 1,110 ft^3/s and 3.49 feet, and 1,020 ft^3/s and 3.38 feet, respectively.

The last day that could have produced a bankfull event was May 18, 2012. On this day, mean daily discharge and mean daily gage height reached 833 ft^3/s and 3.00 feet, respectively. The maximum values for these parameters on this day were 1,700 ft^3/s and 4.09 feet.

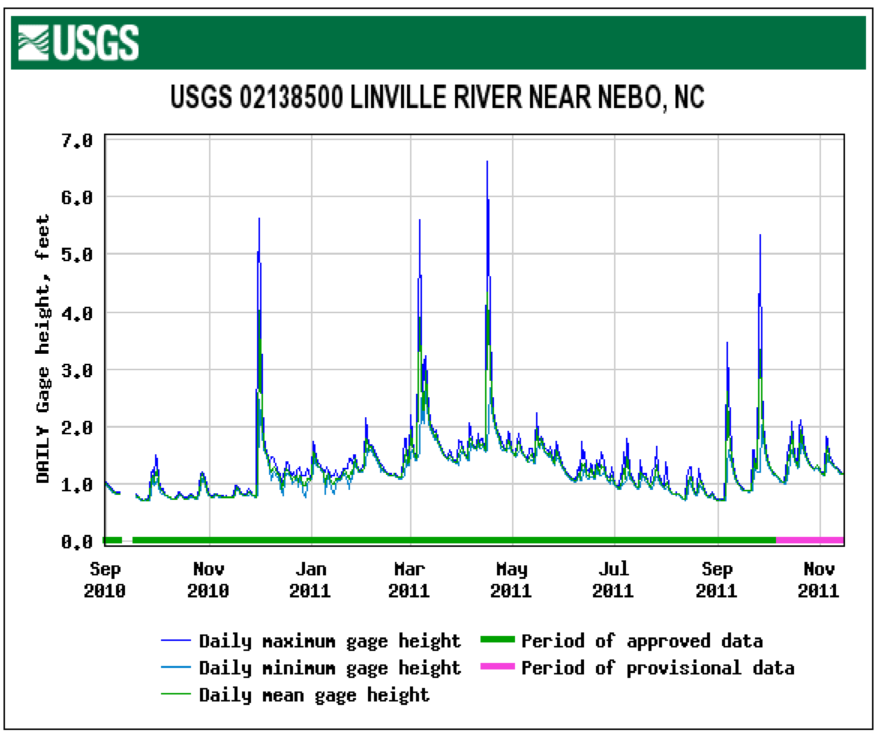
Years 3/4 bankfull events – recorded gage data



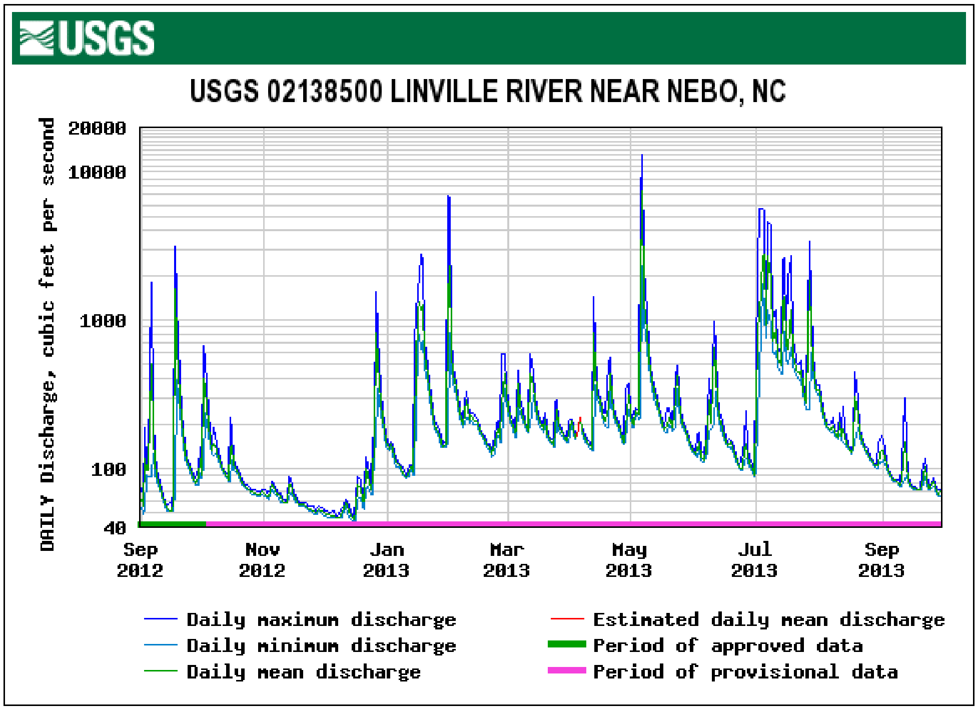
USGS Surface-Water Daily Data for North Carolina **(2010-2011 data)**
http://waterdata.usgs.gov/nc/nwis/dv?



USGS Surface-Water Daily Data for North Carolina **(2011-2012 data)**
http://waterdata.usgs.gov/nc/nwis/dv?



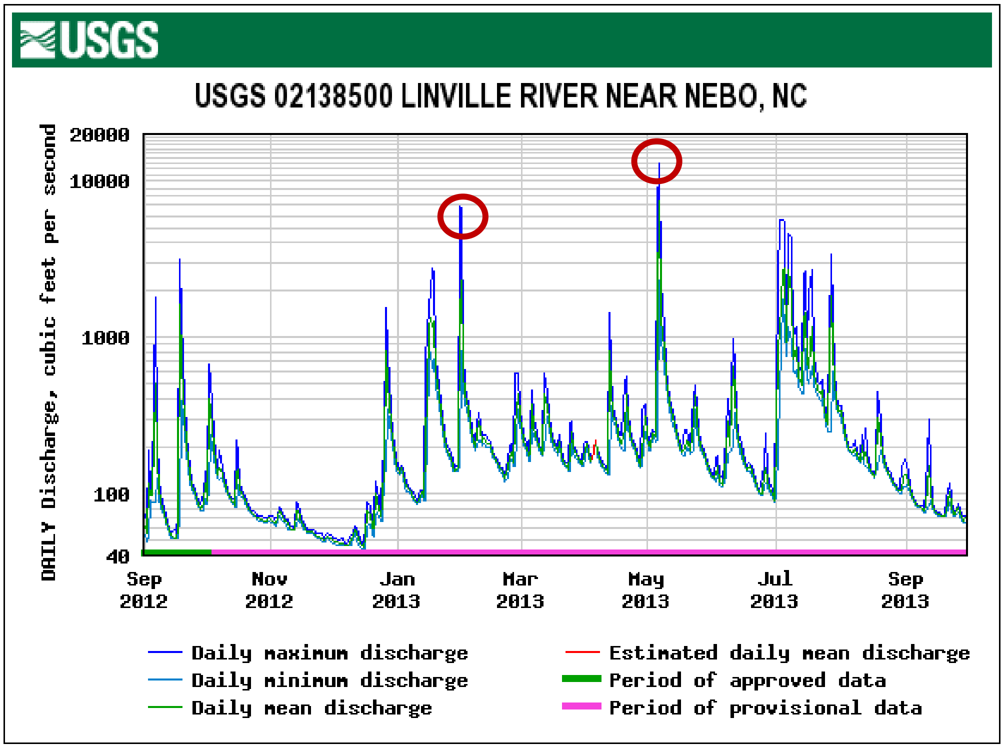
USGS Surface-Water Daily Data for North Carolina **(2010-2011data)**
http://waterdata.usgs.gov/nc/nwis/dv?

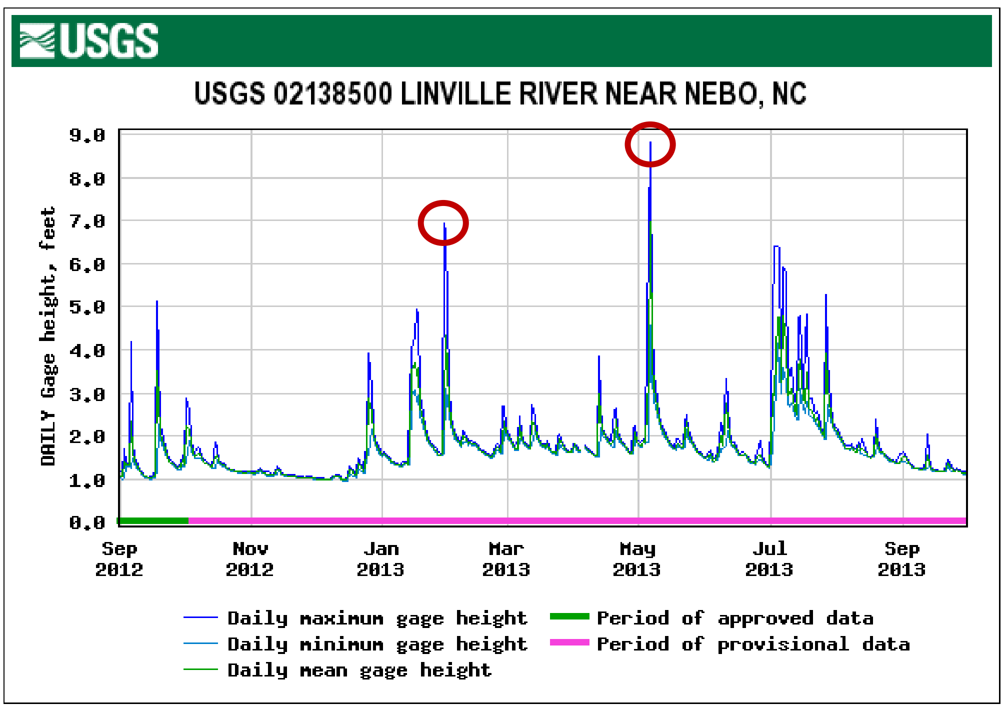


USGS Surface-Water Daily Data for North Carolina **(2011-2012 data)**
http://waterdata.usgs.gov/nc/nwis/dv?

In May 2013, the crest gage on the UT was examined and determined to have experienced a bankfull event at a height of 1-inch above the bottom of the crest gage. In March 2013, the crest gage on the main stem of Thompsons Fork documented a bankfull event, at a height of 6 1/2-inches above the bottom of the crest gage. The most likely date for the monitoring year 5 bankfull event along the main stem was in association with the rain event(s) that resulted in the peak stage and discharge on January 30 and 31, 2013, as recorded at USGS Gage 02138500 Linville River at Nebo, NC. The most likely date for the monitoring year 5 bankfull event along the UT was in association with the rain event(s) that resulted in the peak stage and discharge on May 6, 2013. The discharge and gage height recorded at the Nebo station for these two events are indicated on the graphs provided on the following page.

Years 5 bankfull events – recorded gage data





2. Stream Problem Areas

A summary of the areas of concern identified during the visual assessment of the stream for Year 5 is included in Table X. Stream problem area photos and a problem area map are included in Appendix B. In 2013, stream problem areas for Year 5 are located again at 3 different stations along the main stem of Thompsons Fork. All problem areas for 2013 are again scour and bank failure issues. The observed erosion and scour at stations 23+50 and 21+50 are the result of a beaver dam that was constructed in the spring of 2013, respectively. Even though the dam was again deconstructed within a few months of being built, significant scour and erosion resulted on both the right and left banks at these stations. It is likely that high flow events created excessive erosional flow around the sides and top of each dam.

In Year 5 bank erosion has also observed on the right bank of a meander bend at station 20+75 on the main stem. It appeared that the sloughing in this area was also caused by a high flow event. Pictures of the resultant erosion at these three stations are included in the stream problem area photos located within Appendix B. At this time, they are being called stream problem areas of low concern and are demarcated by yellow scour symbols on the Stream Problem Area Map in Appendix B. Plantings and bank stabilization occurred at all three stations in fall 2013. It is expected that the bank scour sloughing at these stations will be corrected once vegetation establishes on the newly exposed soil. During Year 5 monitoring, it was also observed that a small amount of wetland vegetation is infiltrating into the UT channel near station 8+00.

Table X. Stream Problem Areas
Thompsons Fork Stream Restoration / EEP Project No. D06030-A

Feature Issue	Station Numbers	Suspected Cause	Photo Number
Bank scour	23+50 , 21+50 and 20+75 on Main stem	Beaver dams caused scour and washout of both right and left bank at stations 23+50 and 21+50 and the right bank at station 20+75.	SPA 1, 2 & 3

Stream problem areas for Year 3 were located at 3 different stations along the main stem of Thompsons Fork. All problem areas for 2011 were scour and bank failure issues. The observed erosion and scour at stations 24+00 and 19+35 were the result of beaver dams that were constructed in the spring of 2011 and fall of 2010, respectively. Even though both dams were deconstructed within a few months of being built, significant scour and erosion resulted on both the right and left banks at these stations. The final area of bank erosion noted in Year 3 was observed on the right bank of a meander bend at station 8+25 on the main stem. At that time, it appeared that the sloughing in this area was caused by a high flow event. These areas were monitored closely in Year 4 in order to assess bank stability and the progression of vegetation reestablishment. Because significant vegetation establishment had occurred between the Year 3 and Year 4 monitoring events, these stream problem areas were removed from the Stream Problem Area Map in Appendix B.

In 2009 and 2010, it was observed that aggradation was occurring along the channel of the UT (mostly in the upstream half of the restoration reach). This aggradation lead to the colonization of wetland vegetation within the stream channel. It was decided there was a potential the vegetation would decrease channel flow capacity and reduce flow velocities during times of low flow. The reduced flow velocities could likely have lead to deposition of additional sediment and continued aggradation within the channel. In order to deter continued sedimentation within the channel and further colonization and growth of wetland plants that would affect channel morphology and performance, channel maintenance was suggested in Year 2. Wetlands Resource Center performed maintenance along the UT during the spring (late May) of 2011 in order to clear the channel of excessive sediment and wetland vegetation and restore the channel to a more functional channel morphology. This maintenance activity allowed the channel to sustain a sufficient flow velocity that prevented substantial deposition and aggradation.

As depicted in the map that accompanies this report (see Appendix C), remedial stream maintenance included proper installation of temporary aggregate check dams and a pump-around feature for each segment of tributary for which remedial work was completed. Temporary dams were situated at the upstream and downstream termini of each work reach. Stream maintenance was completed in 3 large "phases"; where a "phase" constituted 2 check dams and a pre-established length of approximately 135 linear feet of tributary channel. After each phase of stream maintenance was completed, the upstream check dam for that phase was removed and re-located to become the downstream check dam for the next phase. De-watering of the phases was not necessary as a pump-around system was re-established for each phase of stream work. This process effectively minimized erosion and sedimentation of the banks and stream channel. It also sped up the remedial maintenance work. All erosion and sediment control practices for the maintenance were consistent with the State's guidelines.

3. Stream Problem Areas Plan View

The location of each stream problem area is shown on the stream problem area plan view included in Appendix B. Each problem area is color coded with yellow for areas of low concern (areas to be watched) or red for high concern (areas where maintenance is warranted). For monitoring year 5, there are no locations where maintenance is recommended.

4. Stream Problem Area Photos

Stream problem area photos are included in Appendix B.

5. Fixed Station Photos

Photographs were taken at each established photograph station in September 2013. These photographs are provided in Appendix B.

6. Stability Assessment Table

The visual stream assessment was performed to determine the percentage of stream features that remain in a state of stability after the first year of monitoring. The visual assessment for each reach is summarized in Table XIa and Table XIb. This summary was compiled from the more comprehensive Table B1, included in Appendix B. Only those structures included in the as-built survey were assessed during monitoring and reported in the tables.

The visual stream stability assessment revealed that the majority of in-stream structures are functioning as designed and built on the Thompsons Fork main stem and UT in Year 5 (Tables XIa and XIb). This year, along the main stem, there were 2 categories of visual stability that included features which were in a state unlike that of the as-built. Three of the forty-two total pools of this reach were observed to be aggraded (6-12 inches of sediment accumulation within the past two years) when compared to Year 2 conditions. These pools are still functional, however.

Table XIa. Categorical Stream Feature Visual Stability Assessment
Thompsons Fork Stream Restoration / EEP Project No. D06030-A
Segment/Reach: Main stem

Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
A. Riffles	100%	100%	100%	100%	100%	100%
B. Pools	100%	100%	100%	98%	98%	98%
C. Thalweg	100%	100%	100%	100%	100%	100%
D. Meanders	100%	99%	100%	98%	100%	100%
E. Bed General	100%	99%	99%	99%	99%	99%
F. Vanes / J Hooks etc.	100%	100%	100%	100%	100%	100%
G. Wads and Boulders	N/A	N/A	N/A	N/A	N/A	N/A

Table XIb. Categorical Stream Feature Visual Stability Assessment
Thompsons Fork Stream Restoration / EEP Project No. D06030-A
Segment/Reach: UT

Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
A. Riffles[1]	100%	100%	100%	100%	100%	100%
B. Pools[2]	100%	96%	96%	98%	98%	98%
C. Thalweg	100%	100%	100%	100%	100%	100%
D. Meanders	100%	100%	100%	100%	100%	100%
E. Bed General	100%	100%	100%	100%	100%	100%
F. Vanes / J Hooks etc.[3]	N/A[4]	N/A	N/A	N/A	N/A	N/A
G. Wads and Boulders	N/A	N/A	N/A	N/A	N/A	N/A
H. Log Sills	100%	95%	92%	96%	99%	99%

[1]Riffles are assessed using the longitudinal profile. A riffle is determined to be stable based on a comparison of location and elevation with respect to the as-built profile.
[2]Pools are assessed using the longitudinal profile. A pool is determined to be stable based on a comparison of location and elevation with respect to the as-built profile and a consideration of appropriate depth.
[3]Physical structures such as vanes, J-hooks, and log sills are assessed using the as-built plan sheets to define the location of such features. A structure is considered stable if the feature remains functional in the same location as shown in the as-built plan.
[4]Those features not included in the stream restoration were labeled N/A. This includes structures such as rootwads and boulders.

The second area in which structures were not performing as intended is the “bed general” category of the visual stability assessment. It appears that narrow bars are forming along the stream banks at various places along the main stem. These bars are becoming vegetated with wetland species and are creating a noticeable change in the location and configuration of both the left and right bank for cross sections 7, 8 and 9 (see Cross Section Templates, Appendix B). The colonization of wetland plants is excellent for water quality, but these areas have been noted under the aggradation feature category. These areas of bar formation are not causing instability at this time. It is hypothesized that the stream is currently in a state of self-correction and is therefore shifting and readjusting its bank configuration in the downstream half in order to find the most natural flow path.

Aggradation (noted in Years 1 and 2) along the UT has been improved significantly due to stream maintenance in Year 3, which was previously discussed. Sedimentation that occurred in some of the pools located near grade-controlling log sills has been alleviated. All pools and associated log sills are still present and functional throughout the stream channel and their stability has increased since the conclusion of maintenance activities.

7. Quantitative Measures

Graphic interpretations of cross-sections, profiles and substrate particle distributions are presented in Appendix B. A summary of the baseline morphology for the site is included in Tables XII and XIII and is based on the more detailed monitoring data shown in the appendix. Table XIII contains a summary of the geomorphic analysis of all monitoring cross-sections, including pools and riffles. Table XII only includes a summary of riffle cross-sections, plus a summary of the geomorphic analysis of the stream profile, stream pattern, and various reach parameters and provides the determined Rosgen classification. These tables offer a year-to-year comparison of the observed and calculated geomorphic data to assess the stability of the restored stream channel. We have considered the data compiled into these tables to offer the summary conclusions presented below.

The stream pattern data provided for Years 1-5 is the same as the data provided from the As-Built survey, as pattern has not changed based on the Year 5 stream surveys and visual field assessment. Bedform features continue to evolve along the restored reaches as shown on the long-term longitudinal profiles. Overall, comparison of the long-term stream monitoring profile data shows stability with minor change for both reaches. Dimensional measurements of the monumented cross-sections from year 5 remain generally stable when compared to as-built and Year 1 thru 4 conditions.

On Thompsons Fork main stem, a number of cross sections demonstrate aggradation on the point bar and bankfull bench areas. This aggradation seems to be a natural evolution of the stream as the site becomes more densely vegetated; it does not appear to be causing any problems at this time. This change has created smaller bankfull dimensions for the Year 3 thru 5 cross sections compared to previous years; however these changes are fairly minor and fall within a level of tolerance related to the data collection and analysis process. Riffle lengths and slopes remain consistent with previous years while the pool length and spacing has fluctuated slightly.

For the unnamed tributary, riffle lengths and slopes are stable. The bankfull dimensions for the UT seem to have leveled off and have been relatively stable for the last 3 years, with any variations within a level of tolerance associated with the data collection and analysis process. None of these changes are significant and no signs of channel instability are evident in correlation to these changing values. Due to the Year 3 clean-out of sedimentation along the unnamed tributary, substrate of the constructed riffles has exhibited an improvement over Year 2 and 3 conditions with a significant increase in median particle size. Median particle size fell into the small cobble category in Year 4 and 5, as compared to a median particle distribution of medium gravel in 2011 and very fine sand in Year 2. This D_{50} categorization of small cobble is much more stable and healthy. This shift in particle size of riffle substrate illustrates the fact that the previous maintenance activities effectively removed much of the excessive silt and sand throughout the UT reach.

On the Thompsons Fork main stem, there was a slight shift in median particle distribution for the substrate in constructed riffles from course gravel in Years 1 thru 3 to very course gravel in Year 4; however, the particle distribution has returned to course gravel in Year 5. The pool substrate for the project reaches remain stable, with median particle sizes consisting of predominantly of very fine to fine sand particles, based on the Year 5 substrate analysis.

IV. METHODOLOGY

Vegetation monitoring was conducted in September 2013 for the final monitoring event using the *CVS-EEP Protocol for Recording Vegetation, Version 4.0* (Lee, M.T., Peet, RK., Roberts, S.R., Wentworth, T.R. 2006). Year 5, the final stream monitoring event was conducted in May 2013 to provide adequate time between the Years 4 and 5 monitoring surveys.

Table XII: Baseline Geomorphologic and Hydraulic Summary

Thompsons Fork & Unnamed Tributary Mitigation Plan / EEP Project No. D06030-A

Station/Reach: UT Priority Level I Restoration Reach - Station 4+00.00 to 16+37.32 (1,237.32 l.f.)

Parameter	Brindle Creek Reference Reach			Pre-Existing Condition			Design			As-Built XS-4 & XS-6			Year 1 XS-4 & XS-6			Year 2 XS-4 & XS-6			Year 3 XS-4 & XS-6			Year 4 XS-4 & XS-6			Year 5 XS-4 & XS-6		
Dimension	Min	Max	Mean	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Drainage Area (mi^2)			1.16			0.16			0.16			0.16			0.16			0.16			0.16			0.16			0.16
BF Width (ft)			24.02			13.10			12.00	13.94	14.08	14.01	14.03	16.67	15.35	10.94	12.21	11.58	14.51	14.85	14.68	15.42	16.12	15.77	14.98	15.06	15.02
Floodprone Width (ft)			232.00			44.80	45.00	85.00	71.50	78.48	88.08	83.28	74.03	97.32	85.68	76.72	94.68	85.70	91.06	95.33	93.20	90.62	93.09	91.86	94.10	95.82	94.96
BF Cross Sectional Area (ft^2)			30.77			10.70			11.50	11.17	11.37	11.27	11.15	14.89	13.02	9.50	11.52	10.51	12.43	14.35	13.39	11.61	13.76	12.69	11.78	13.38	12.58
BF Mean Depth (ft)			1.28			0.82			0.96	0.80	0.81	0.81	0.80	0.89	0.85	0.87	0.94	0.91	0.84	0.99	0.92	0.72	0.89	0.81	0.79	0.89	0.84
BF Max Depth (ft)			1.72			1.12			1.20	1.64	1.76	1.70	1.56	1.62	1.59	1.75	1.81	1.78	1.82	2.28	2.05	1.87	2.40	2.14	1.88	2.63	2.26
Width/Depth (ft)			18.77			15.98			12.50	17.38	17.42	17.40	17.54	18.73	18.14	12.57	12.99	12.78	14.66	17.68	16.17	17.33	22.39	19.86	16.92	18.96	17.94
Entrenchment Ratio			9.66			3.42	3.75	7.08	5.96	5.63	6.26	5.95	5.28	5.84	5.56	7.01	7.76	7.39	6.27	6.42	6.35	5.78	5.88	5.83	5.88	6.28	6.08
Bank Height Ratio			1.00			1.63			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Wetted Perimeter (ft)			26.58			14.74			13.92	14.41	14.56	14.49	14.39	17.02	15.71	11.59	12.84	12.22	15.55	16.35	15.95	16.94	17.03	16.99	16.25	16.89	16.57
Hydraulic Radius (ft)			1.16			0.73			0.83	0.77	0.78	0.78	0.78	0.87	0.83	0.82	0.90	0.86	0.76	0.92	0.84	0.68	0.81	0.75	0.73	0.79	0.76
BF Discharge (cfs)			98.2			54.9			54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9
BF Mean Velocity (ft/sec)			3.19			5.13			4.77	4.83	4.91	4.87	3.69	4.92	4.22	4.77	5.78	5.22	3.83	4.42	4.10	3.99	4.73	4.33	4.10	4.66	4.36
Pattern																											
*Channel Beltwidth (ft)	44.17	46.50	45.22				45.00	85.00	71.50	44.00	75.41	73.33	44.00	75.41	73.33	44.00	75.41	73.33	44.00	75.41	73.33	44.00	75.41	73.33	44.00	75.41	73.33
*Radius of Curvature (ft)	12.97	24.44	17.67				14.40	40.90	22.60	10.39	40.91	22.57	10.39	40.91	22.57	10.39	40.91	22.57	10.39	40.91	22.57	10.39	40.91	22.57	10.39	40.91	22.57
*Meander Wavelength (ft)	88.23	115.70	104.80				64.20	124.00	100.00	64.19	124.91	99.37	64.19	124.91	99.37	64.19	124.91	99.37	64.19	124.91	99.37	64.19	124.91	99.37	64.19	124.91	99.37
*Meander Width Ratio	1.84	1.94	1.88				3.75	7.08	5.96	3.14	5.38	5.23	3.14	4.78	4.52	3.60	6.89	6.34	2.96	5.20	5.00	2.73	4.89	4.65	2.92	5.03	4.88
Profile																											
Riffle Length (ft)	19.0	31.0	25.7				22.60	46.60	36.40	6.08	55.10	23.40	7.57	43.62	25.79	6.39	44.28	23.15	8.84	47.61	25.69	9.51	54.14	20.82	10.00	56.00	21.00
Riffle Slope (ft/ft)	0.0125	0.0362	0.0211				0.0603	0.1215	0.0578	0.0350	0.0940	0.0595	0.0400	0.0957	0.0633	0.0103	0.1198	0.0510	0.0153	0.0984	0.0539	0.0104	0.1090	0.0488	0.0103	0.1090	0.0490
Pool Length (ft)	11.0	31.6	17.4				18.40	43.00	27.60	8.19	48.20	24.71	6.28	52.80	21.02	4.99	52.71	20.89	5.60	73.61	25.77	9.33	65.70	34.65	9.20	67.00	35.00
Pool Spacing (ft)	67.6	77.5	71.4				63.40	112.00	78.40	20.94	159.00	65.21	14.18	99.67	59.44	13.50	93.87	45.43	21.83	100.20	55.70	15.83	104.68	59.67	16.00	105.00	60.00
Substrate																											
D50 (mm)			38.5			37.5			37.5	7.7	37.5	16.0	18.9	20.0	19.4	10.1	10.6	10.3	8.6	13.9	11.2	54.5	82.4	68.5	60.8	88.6	74.7
D84 (mm)			60.2			73.4			73.4	68.2	73.7	71.8	53.9	71.5	62.7	42.7	49.5	46.1	22.5	47.3	34.9	145.7	154.8	150.2	133.2	260.3	196.8
Additional Reach Parameters																											
Valley Length (ft)			294.00			1485			1437			1437			1437			1437			1437			1437			1437
Channel Length (ft)			353.00			1617			1966			1948			1948			1948			1948			1948			1948
Sinuosity			1.2			1.09			1.37			1.36			1.36			1.36			1.36			1.36			1.36
Valley Slope (ft/ft)			0.0106			0.0353			0.0353			0.0353			0.0350			0.0350			0.0350			0.0350			0.0350
Bankfull Slope (ft/ft)			0.0115			0.0324			0.0258			0.0243			0.0244			0.0258			0.0253			0.0259			0.0250
Rosgen Classification			C4			C3b			C3b			C3b			C4b			C4b			C4b			C3b			C3b
*Habitat Index																											
*Macrobenthos																											

Notes: * Inclusion will be project specific and determined primarily by As-built monitoring plan/success criteria

Blank fields = Historic project documentation necessary to provide these data were unavailable at the time of this report submission.

Where no min/max values provided, only one value was measured or computed and is presented as the median value.

Year 1, 2 and 3 Monitoring data were quantitatively and qualitatively evaluated using RiverMorph v 4.3.0.

XII: Baseline Geomorphologic and Hydraulic Summary

Thompsons Fork & Unnamed Tributary Mitigation Plan / EEP Project No. D06030-A

Station/Reach: Thompsons Fork Mainstem Priority I Restoration Reach - Station 0+00.00 to 18+06.42 (1,806.42 l.f.)

Parameter	Thompsons Fork Reference Reach			Pre-Existing Condition**			Design			As-Built Riffle XSs 7, 9, 10 & 11			Year 1 Riffle XSs 7, 9, 10 & 11			Year 2 Riffle XSs 7, 9, 10 & 11			Year 3 Riffle XSs 7, 9, 10 & 11			Year 4 Riffle XSs 7, 9, 10 & 11			Year 5 Riffle XSs 7, 9, 10 & 11		
Dimension	Min	Max	Mean	Min	Max	Mean	Min	Max	Med.	Min	Max	Med.	Min	Max	Med.	Min	Max	Med.	Min	Max	Med.	Min	Max	Med.	Min	Max	Med.
Drainage Area (mi^2)			5.57			7.57			7.57			7.57			7.57			7.57			7.57			7.57			7.57
BF Width (ft)			15.38			20.90			21.50	34.52	39.81	37.74	35.30	38.95	36.32	28.65	38.81	34.11	27.06	38.71	31.85	20.45	37.43	29.77	20.55	37.21	28.67
Floodprone Width (ft)			18.89			32.00	39.0	100.0	90.0	89.89	143.71	113.53	86.87	146.66	109.57	87.45	146.55	94.61	88.75	146.65	103.75	83.73	146.58	88.76	61.78	146.62	94.02
BF Cross Sectional Area (ft^2)			23.80			56.50			52.00	48.51	59.39	52.85	39.38	54.16	47.43	36.12	53.80	43.68	35.41	54.58	40.07	22.07	47.63	36.31	23.47	51.41	34.29
BF Mean Depth (ft)			1.55			2.70			2.40	1.30	1.60	1.40	1.09	1.39	1.32	1.14	1.42	1.33	1.16	1.41	1.33	1.08	1.28	1.22	1.14	1.38	1.20
BF Max Depth (ft)			2.09			5.05			3.00	2.16	2.88	2.52	2.14	2.59	2.38	2.29	2.62	2.56	2.48	2.90	2.61	2.19	2.65	2.50	2.14	3.09	2.27
Width/Depth (ft)			9.92			7.74			8.96	23.21	30.16	27.07	25.40	33.00	28.68	22.74	29.40	26.18	20.66	27.45	25.48	18.94	29.47	24.43	18.03	29.21	22.80
Entrenchment Ratio			1.23			1.53	1.81	4.65	4.19	2.30	4.16	3.00	2.31	4.15	3.00	2.31	4.23	3.01	2.32	4.50	3.53	2.38	4.57	3.65	2.51	4.82	3.38
Bank Height Ratio			1.18			2.36			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Wetted Perimeter (ft)			18.50			24.77			26.30	34.91	40.28	38.84	35.70	39.27	36.73	29.28	39.17	34.62	27.91	39.94	32.89	23.04	38.27	31.13	21.75	38.26	30.05
Hydraulic Radius (ft)			12.50			2.28			1.98	1.28	1.57	1.38	1.08	1.38	1.31	1.12	1.40	1.30	1.11	1.37	1.30	0.96	1.24	1.17	1.08	1.34	1.14
BF Discharge (cfs)			64.8			285.0			285.0	149.5	149.5	149.5	149.5	149.5	149.5	149.5	149.5	149.5	149.5	149.5	149.5	149.5	149.5	149.5	149.5	149.5	149.5
BF Mean Velocity (ft/sec)			2.72			5.04			4.77	2.52	3.08	2.83	2.76	3.80	3.15	2.78	4.14	3.42	2.74	4.22	3.73	3.14	6.77	4.12	2.91	6.37	4.36
Pattern																											
*Channel Beltwidth (ft)	16.30	56.00	36.40				39.00	100.00	90.00	40.00	90.00	90.00	40.00	90.00	90.00	40.00	90.00	90.00	40.00	90.00	90.00	40.00	90.00	90.00	40.00	90.00	90.00
*Radius of Curvature (ft)	9.70	48.90	25.40				18.70	48.90	28.30	18.70	48.90	27.70	18.70	48.90	27.70	18.70	48.90	27.70	18.70	48.90	27.70	18.70	48.90	27.70	18.70	48.90	27.70
*Meander Wavelength (ft)	49.50	119.40	104.30				89.20	119.90	110.40	84.17	119.85	110.35	84.17	119.85	110.35	84.17	119.85	110.35	84.17	119.85	110.35	84.17	119.85	110.35	84.17	119.85	110.35
*Meander Width Ratio	1.06	3.64	2.37				4.15	5.58	5.13	1.04	2.34	2.34	1.13	2.48	2.31	1.03	3.14	2.64	1.03	3.33	2.83	1.07	4.40	3.02	1.07	4.38	3.14
Profile																											
Riffle Length (ft)	15.0	21.6	18.3				14.3	39.4	21.8	8.6	30.6	17.2	7.2	19.6	14.7	5.8	28.1	13.3	8.8	22.8	16.9	4.8	28.8	12.8	5.0	29.0	13.0
Riffle Slope (ft/ft)	0.0099	0.0127	0.0113				0.0099	0.0127	0.0113	0.0051	0.0571	0.0166	0.00599	0.03391	0.01832	0.00107	0.04770	0.01060	0.00327	0.02481	0.01232	0.00219	0.03327	0.02044	0.00220	0.03330	0.02040
Pool Length (ft)	17.0	32.1	24.3				28.6	105.0	42.6	21.5	82.9	39.3	18.2	60.3	32.4	15.9	68.6	37.7	23.7	90.1	49.5	23.7	100.8	52.5	22.0	96.0	58.0
Pool Spacing (ft)	73.1	77.1	75.1				42.6	83.2	61.5	25.0	145.0	63.8	31.4	113.7	55.6	31.0	137.6	66.4	34.3	132.7	66.9	37.0	115.0	68.7	37.0	115.0	68.7
Substrate																											
D50 (mm)			29.4			13.7			13.7	5.7	10.6	9.1	23.8	32.7	29.1	28.3	67.6	33.8	19.3	65.9	32.3	37.4	79.2	63.3	17.1	42.8	30.1
D84 (mm)			50.1			26.2			26.2	35.9	66.3	43.4	60.8	87.1	73.9	77.5	130.5	104.7	53.4	140.5	58.9	117.4	233.2	173.5	111.8	548.8	144.1
Additional Reach Parameters																											
Valley Length (ft)			188.00			2261			2295			2295			2295			2295			2295			2295			2295
Channel Length (ft)			140.00			2530			2799			2742			2742			2742			2742			2742			2742
Sinuosity			1.34			1.12			1.22			1.19			1.19			1.19			1.19			1.19			1.19
Valley Slope (ft/ft)			0.0031			0.0044			0.0031			0.0036			0.0036			0.0036			0.0036			0.0036			0.0036
Bankfull Slope (ft/ft)			0.0024			0.0039			0.0024			0.0030			0.0030			0.0030			0.0030			0.0029			0.0250
Rosgen Classification			E4			G4			E4			C4			C4			C4			C4			C4			C4
*Habitat Index																											
*Macrobenthos																											

Notes: * Inclusion will be project specific and determined primarily by As-built monitoring plan success criteria

**Insufficient field indicators to estimate pattern and bedform features under impaired G4 channel conditions.

Blank fields = Historic project documentation necessary to provide these data were unavailable at the time of this report submission.

Where no min/max values are provided, only one value was measured or computed and is presented as the mean value.

Year 1, 2 and 3 Monitoring data were quantitatively and qualitatively evaluated using RiverMorph v 4.3.0.

Table XIII: Morphology and Hydraulic Monitoring Summary

Thompsons Fork & Unnamed Tributary Stream Restoration / EEP Project No. D06030-A

Reach: Mainstem

Parameter	Cross Section 7 (Riffle)						Cross Section 8 (Pool)						Cross Section 9 (Riffle)					
Dimension	**MY 0**	**MY 1**	**MY 2**	**MY 3**	**MY 4**	**MY 5**	**MY 0**	**MY 1**	**MY 2**	**MY 3**	**MY 4**	**MY 5**	**MY 0**	**MY 1**	**MY 2**	**MY 3**	**MY 4**	**MY 5**
BF Width (ft)	38.51	38.95	38.81	38.71	37.43	35.34	39.25	39.37	20.98	21.95	17.6	18.53	38.74	36.66	33.52	31.14	20.45	20.55
Floodprone Width (ft)	89.89	89.89	89.82	89.88	89.19	88.88	83.90	129.13	83.91	83.92	83.36	83.86	113.53	114.87	99.40	117.61	83.73	99.16
BF Cross Sectional Area (ft^2)	53.71	54.16	53.80	54.58	47.63	42.71	69.91	69.72	65.41	60.38	36.4	49.74	50.20	45.81	38.27	36.12	22.07	23.47
BF Mean Depth (ft)	1.39	1.39	1.39	1.41	1.27	1.21	1.78	1.77	3.12	2.75	2.07	2.68	1.30	1.25	1.14	1.16	1.08	1.14
BF Max Depth (ft)	2.16	2.14	2.29	2.48	2.37	2.14	3.60	4.84	5.60	5.14	4.03	5.21	2.49	2.34	2.58	2.9	2.19	2.39
Width/Depth Ratio	27.71	28.02	27.92	27.45	29.47	29.21	22.05	22.24	6.72	7.98	8.5	6.91	29.80	29.33	29.40	26.84	18.94	18.03
Entrenchment Ratio	2.33	2.31	2.31	2.32	2.38	2.51	2.14	3.28	4.00	3.82	4.74	4.52	2.93	3.13	2.97	3.78	4.09	4.82
Bank Height Ratio	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wetted Perimeter (ft)	38.84	39.27	39.17	39.94	38.27	36.98	40.02	41.03	24.10	24.46	22.21	21.78	39.10	37.00	34.06	32.6	23.04	21.75
Hydraulic Radius (ft)	1.38	1.38	1.37	1.37	1.24	1.16	1.75	1.70	2.71	2.47	1.64	2.28	1.28	1.24	1.12	1.11	0.96	1.08
Substrate																		
D50 (mm)	9.10	32.72	67.55	65.86	70.5	42.84	*	**	0.05	0.06	0.12	0.19	10.64	23.78	37.50	37.57	37.42	17.1
D84 (mm)	66.30	76.04	130.48	140.47	233.18	548.83	*	**	0.11	0.2	0.24	0.65	35.94	87.08	120.35	Bedrock	117.37	129.05

Parameter	Cross Section 10 (Riffle)						Cross Section 11 (Riffle)						Cross Section 12 (Pool)					
Dimension	**MY 0**	**MY 1**	**MY 2**	**MY 3**	**MY 4**	**MY 5**	**MY 0**	**MY 1**	**MY 2**	**MY 3**	**MY 4**	**MY 5**	**MY 0**	**MY 1**	**MY 2**	**MY 3**	**MY 4**	**MY 5**
BF Width (ft)	34.52	35.30	34.69	32.56	32.04	37.21	39.81	35.97	28.65	27.06	27.49	22	43.16	45.96	45.95	47.11	40.59	40.81
Floodprone Width (ft)	143.71	146.66	146.55	146.65	146.58	146.62	91.41	86.87	87.45	88.75	88.32	61.78	103.78	105.70	107.84	108.3	107.74	105.85
BF Cross Sectional Area (ft^2)	48.51	49.04	49.09	44.02	37.41	51.41	52.43	39.38	36.12	35.41	35.21	25.87	72.70	73.87	75.05	74.89	66.08	57.01
BF Mean Depth (ft)	1.41	1.39	1.42	1.35	1.17	1.38	1.32	1.09	1.26	1.31	1.28	1.18	1.68	1.61	1.63	1.59	1.63	1.4
BF Max Depth (ft)	2.52	2.59	2.62	2.7	2.65	3.09	2.88	2.42	2.54	2.52	2.63	2.15	3.69	3.80	3.89	4.15	3.89	3.76
Width/Depth Ratio	24.48	25.40	24.43	24.12	27.38	26.96	30.16	33.00	22.74	20.66	21.48	18.64	25.69	28.55	28.19	29.63	24.9	29.15
Entrenchment Ratio	4.16	4.15	4.23	4.5	4.57	3.94	2.30	2.41	3.05	3.28	3.21	2.81	2.40	2.30	2.35	2.3	2.65	2.59
Bank Height Ratio	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wetted Perimeter (ft)	34.91	35.70	35.18	33.18	33.39	38.26	40.28	36.46	29.28	27.91	28.87	23.12	43.94	46.84	47.73	49.12	42.33	43.55
Hydraulic Radius (ft)	1.39	1.37	1.40	1.33	1.12	1.34	1.30	1.08	1.23	1.27	1.22	1.12	1.65	1.58	1.57	1.52	1.56	1.31
Substrate																		
D50 (mm)	*	26.67	30.12	26.94	79.16	32.85	5.70	32.00	28.29	19.3	56.08	27.3	*	6.69	0.71	0.59	0.18	0.24
D84 (mm)	*	60.76	88.95	53.36	168.02	159.18	43.37	75.74	77.53	58.93	178.94	111.78	*	26.74	4.26	0.89	66.61	99.87

Table XIII: Morphology and Hydraulic Monitoring Summary

Thompsons Fork & Unnamed Tributary Stream Restoration/ EEP Project No. D06030-A

Reach: UT-1

Parameter	Cross Section 1 (Pool)						Cross Section 2 (Riffle)						Cross Section 3 (Pool)					
Dimension	**MY 0**	**MY 1**	**MY 2**	**MY 3**	**MY 4**	**MY 5**	**MY 0**	**MY 1**	**MY 2**	**MY 3**	**MY 4**	**MY 5**	**MY 0**	**MY 1**	**MY 2**	**MY 3**	**MY 4**	**MY 5**
BF Width (ft)	13.31	13.20	13.24	13.04	12.43	12.17	8.35	8.67	7.30	7.18	7.88	6.48	20.72	20.53	18.13	16.97	16.23	19.97
Floodprone Width (ft)	26.08	22.94	18.94	18.61	19.18	17.98	23.46	23.67	19.41	17.32	20.98	18.83	90.10	88.25	88.09	89.47	86.88	85.98
BF Cross Sectional Area (ft^2)	23.51	21.66	16.02	15.95	16.15	14.33	11.78	12.71	10.11	9.82	11.69	9.17	24.85	21.02	19.95	19.04	16.35	20.59
BF Mean Depth (ft)	1.77	1.64	1.21	1.22	1.3	1.18	1.41	1.47	1.39	1.37	1.48	1.41	1.20	1.02	1.10	1.12	1.01	1.03
BF Max Depth (ft)	2.78	2.41	1.80	1.72	1.74	1.48	2.40	2.43	2.15	2.09	2.27	2.09	2.29	2.09	2.10	2.1	2.05	1.99
Width/Depth Ratio	7.52	8.05	10.94	10.69	9.56	10.31	5.92	5.90	5.25	5.24	5.32	4.6	17.27	20.13	16.48	15.15	16.07	19.39
Entrenchment Ratio	1.96	1.74	1.43	1.43	1.54	1.36	2.81	2.73	2.66	2.41	2.66	2.9	4.35	4.30	4.86	5.27	5.35	4.3
Bank Height Ratio	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wetted Perimeter (ft)	14.76	14.51	13.94	13.85	13.48	13.07	9.93	10.33	8.92	9.36	9.91	8.49	21.25	21.02	18.66	18.15	16.92	20.46
Hydraulic Radius (ft)	1.59	1.49	1.15	1.15	1.2	1.1	1.19	1.23	1.13	1.05	1.18	1.08	1.17	1.00	1.07	1.05	0.97	1.01
Substrate																		
D50 (mm)	*	0.03	0.71	0.59	0.21	0.83	*	4.96	0.43	28.35	1.5	16	*	0.03	0.04	0.48	0.11	0.03
D84 (mm)	*	0.05	4.26	3.6	0.67	5.06	*	36.99	13.09	76.19	58.9	40.32	*	0.05	0.10	15.62	3.28	0.05

Parameter	Cross Section 4 (Riffle)						Cross Section 5 (Pool)						Cross Section 6 (Riffle)					
Dimension	**MY 0**	**MY 1**	**MY 2**	**MY 3**	**MY 4**	**MY 5**	**MY 0**	**MY 1**	**MY 2**	**MY 3**	**MY 4**	**MY 5**	**MY 0**	**MY 1**	**MY 2**	**MY 3**	**MY 4**	**MY 5**
BF Width (ft)	20.74	16.67	12.21	14.51	16.12	14.98	39.81	35.97	28.65	27.06	27.49	31.42	14.38	14.03	10.94	14.85	15.42	15.06
Floodprone Width (ft)	98.92	97.32	94.68	91.06	93.09	94.1	91.41	86.87	87.45	88.75	88.32	111.91	76.11	74.03	76.72	95.33	90.62	95.82
BF Cross Sectional Area (ft^2)	16.37	14.89	11.52	14.35	11.61	11.78	52.43	39.38	36.12	35.41	35.21	33.89	10.63	11.15	9.50	12.43	13.76	13.38
BF Mean Depth (ft)	0.79	0.89	0.94	0.99	0.72	0.79	1.32	1.09	1.26	1.31	1.28	1.08	0.74	0.80	0.87	0.84	0.89	0.89
BF Max Depth (ft)	1.61	1.62	1.75	1.82	1.87	1.88	2.88	2.42	2.54	2.52	2.63	2.72	1.55	1.56	1.81	2.28	2.4	2.63
Width/Depth Ratio	26.25	18.73	12.99	14.66	22.39	18.96	30.16	33.00	22.74	20.66	21.48	29.09	19.43	17.54	12.57	17.68	17.33	16.92
Entrenchment Ratio	4.77	5.84	7.76	6.27	5.78	6.28	2.30	2.41	3.05	3.28	3.21	3.56	5.29	5.28	7.01	6.42	5.88	5.88
Bank Height Ratio	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wetted Perimeter (ft)	21.07	17.02	12.84	15.55	17.03	16.25	40.28	36.46	29.28	27.91	28.87	33.87	14.73	14.39	11.59	16.35	16.94	16.89
Hydraulic Radius (ft)	0.78	0.87	0.90	0.92	0.68	0.73	1.30	1.08	1.23	1.27	1.22	1	0.72	0.78	0.82	0.76	0.81	0.79
Substrate																		
D50 (mm)	16.00	19.96	10.55	13.86	82.41	88.56	5.70	32.00	28.29	19.3	56.08	16	7.67	18.89	10.14	8.62	54.5	60.84
D84 (mm)	68.15	71.49	42.65	22.47	145.69	260.27	43.37	75.74	77.53	58.93	178.94	46.91	73.73	53.91	49.45	47.27	154.78	133.22

* Pebble counts were not collected for the As-Built (Year 0) stream substrate documentation

** Pebble counts were not collected for Year 1 stream substrate documentation

APPENDIX A

Vegetation Raw Data

1. Vegetation Monitoring Plot Photos
2. Vegetation Data Tables

Vegetation Plot 1
Monitoring Year 5
(EMH&T, 09/11/13)

Vegetation Plot 2
Monitoring Year 5
(EMH&T, 09/12/13)

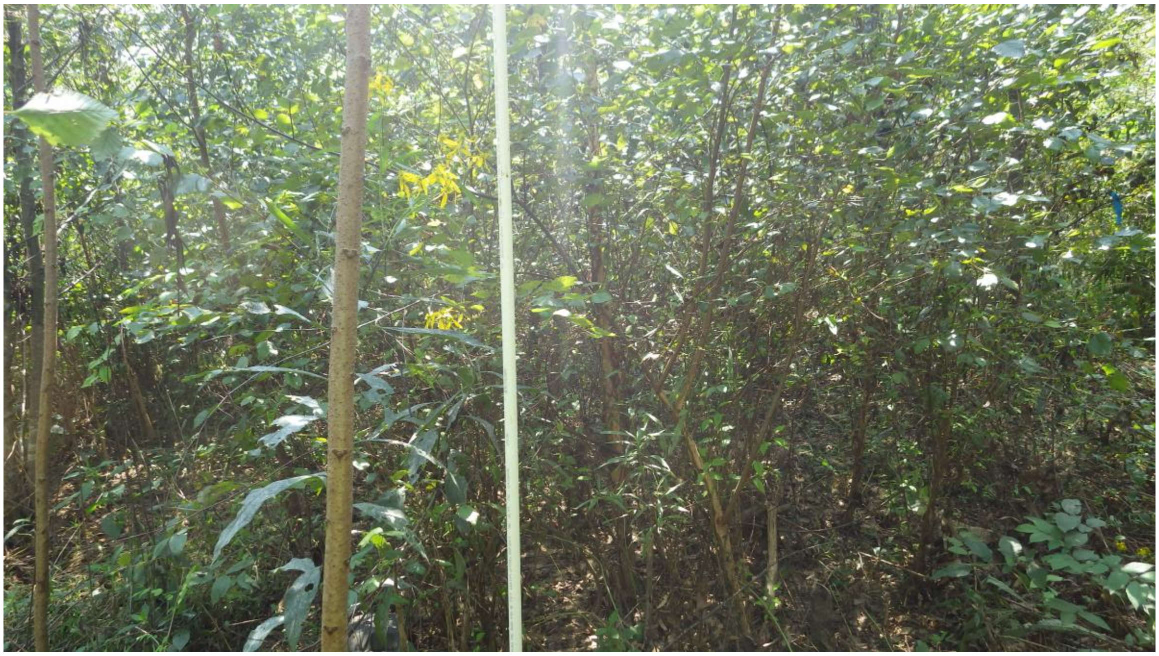
Vegetation Plot 3
Monitoring Year 5
(EMH&T, 09/11/13)

Vegetation Plot 4
Monitoring Year 5
(EMH&T, 09/25/13)

Vegetation Plot 5
Monitoring Year 5
(EMH&T, 09/10/13)

Vegetation Plot 6
Monitoring Year 5
(EMH&T, 09/11/13)

Vegetation Plot 7
Monitoring Year 5
(EMH&T, 09/11/13)



Vegetation Plot 8
Monitoring Year 5
(EMH&T, 09/11/13)

Table 1. Vegetation Metadata	
Report Prepared By	Marion Wells
Date Prepared	6/26/2013 11:16
database name	cvs-eep-entrytool-v2.2.6.mdb
database location	Q:\ENVIRONMENTAL\Monitoring\EEP Vegetation Database
computer name	2UA602108H
file size	53424128
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT------------	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY-------------------------------------	
Project Code	D06030A
project Name	Thompsons Fork
Description	Stream restoration of Thompsons Fork mainstem and tributary.
River Basin	
length(ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	8

Table 2. Vegetation Vigor by Species								
	Species	**4**	**3**	**2**	**1**	**0**	**Missing**	**Unknown**
	Alnus serrulata	9	15	14		1	1	
	Aronia arbutifolia	6	9				12	
	Cornus amomum						1	
	Fraxinus pennsylvanica	24	21	9	4	5	4	
	Ilex verticillata	1	2	1				
	Quercus palustris	1	4	1			1	
	Salix nigra	1	1				1	
	Sambucus canadensis	2	3	4		2		
	Cercis canadensis			2			1	
	Platanus occidentalis		6	6				
	Salix exigua	5	1	2			1	
TOT:	**11**	**49**	**62**	**39**	**4**	**8**	**22**	

Table 3. Vegetation Damage by Species

	Species	All Damage Categories	(no damage)	Beaver	Deer	Diseased	Flooding	Site Too Dry	Unknown	Vine Strangulation	(other damage)
	Alnus serrulata	40	25	8	1			1	2	3	
	Aronia arbutifolia	27	27								
	Cercis canadensis	3	1	1					1		
	Cornus amomum	1	1								
	Fraxinus pennsylvanica	67	46					7	1	11	2
	Ilex verticillata	4	3			1					
	Platanus occidentalis	12	10	1			1				
	Quercus palustris	7	6							1	
	Salix exigua	9	7		2						
	Salix nigra	3	3								
	Sambucus canadensis	11	8	1				1		1	
TOT:	**11**	**184**	**137**	**11**	**3**	**1**	**1**	**9**	**4**	**16**	**2**

Table 4: Vegetation Damage by Plot											
	plot	All Damage Categories	(no damage)	Beaver	Deer	Diseased	Flooding	Site Too Dry	Unknown	Vine Strangulation	(other damage)
	D06030A-01-0001-year:5	20	10			1		9			
	D06030A-01-0002-year:5	22	16							6	
	D06030A-01-0003-year:5	20	9							10	1
	D06030A-01-0004-year:5	34	26	6					2		
	D06030A-01-0005-year:5	32	27		3				1		1
	D06030A-01-0006-year:5	23	19	4							
	D06030A-01-0007-year:5	20	18	1					1		
	D06030A-01-0008-year:5	13	12				1				
TOT:	**8**	**184**	**137**	**11**	**3**	**1**	**1**	**9**	**4**	**16**	**2**

Table 5. Stem Count by Plot and Species - Planted Stems												
	Species	Total Planted Stems	# plots	avg# stems	plot D06030A-01-0001 (year 5)	plot D06030A-01-0002 (year 5)	plot D06030A-01-0003 (year 5)	plot D06030A-01-0004 (year 5)	plot D06030A-01-0005 (year 5)	plot D06030A-01-0006 (year 5)	plot D06030A-01-0007 (year 5)	plot D06030A-01-0008 (year 5)
	Alnus serrulata	38	8	4.75	3	3	3	3	8	7	6	5
	Aronia arbutifolia	15	5	3				5	6	2	1	1
	Cercis canadensis	2	1	2				2				
	Fraxinus pennsylvanica	58	7	8.29	8	17	14	7	5	2	5	
	Ilex verticillata	4	2	2	2					2		
	Platanus occidentalis	12	4	3				2		5	1	4
	Quercus palustris	6	6	1	1	1	1		1	1		1
	Salix exigua	8	2	4					5	3		
	Salix nigra	2	2	1					1			1
	Sambucus canadensis	9	6	1.5	1		1	1	1	1	4	
TOT:	**10**	**154**	**10**		**15**	**21**	**19**	**20**	**27**	**23**	**17**	**12**

Table 6. Stem Count by Plot and Species - All Stems												
	Species	Total Stems	# plots	avg# stems	D06030A-01-0001 (year 5)	D06030A-01-0002 (year 5)	D06030A-01-0003 (year 5)	D06030A-01-0004 (year 5)	D06030A-01-0005 (year 5)	D06030A-01-0006 (year 5)	D06030A-01-0007 (year 5)	D06030A-01-0008 (year 5)
	Ailanthus altissima	1	1	1		1						
	Alnus serrulata	99	8	12.38	47	3	3	18	8	7	8	5
	Aronia arbutifolia	22	5	4.4				5	8	7	1	1
	Cornus amomum	1	1	1						1		
	Fraxinus pennsylvanica	91	7	13	12	32	23	7	5	2	10	
	Ilex verticillata	5	3	1.67	2					2		1
	Ligustrum sinense	3	1	3								3
	Pinus palustris	1	1	1				1				
	Quercus palustris	6	6	1	1	1	1		1	1		1
	Rhus typhina	21	2	10.5							14	7
	Salix lucida	2	1	2						2		
	Salix nigra	7	3	2.33					1	2		4
	Sambucus canadensis	22	6	3.67	2		1	2	6	3	8	
	Betula nigra	30	1	30								30
	Cercis canadensis	2	1	2				2				
	Quercus spp.	1	1	1						1		
	Liriodendron tulipifera	3	1	3								3
	Platanus occidentalis	21	4	5.25				2		6	1	12
	Prunus serotina	1	1	1	1							
	Salix exigua	17	2	8.5					8	9		
	Acer rubrum	1	1	1	1							
	Ulmus americana	1	1	1	1							
TOT:	**23**	**358**	**23**		**67**	**37**	**28**	**37**	**37**	**43**	**42**	**67**

APPENDIX B

Geomorphologic Raw Data

1. Fixed Station Photos
2. Table B1. Qualitative Visual Stability Assessment
3. Cross Section Plots
4. Longitudinal Plots
5. Pebble Count Plots
6. Bankfull Event Photos
7. Stream Problem Areas Photos
8. Stream Problem Area Plan View

Fixed Station 1
Overview of valley along UT1 near the upstream terminus of the project, approximately Station 4+00, facing downstream.
(EMH&T, 9/11/13)

Fixed Station 2
Overview of valley along UT1 near the midpoint of the project, approximately Station 10+75, facing upstream.
(EMH&T, 9/11/13)

Fixed Station 3
Overview of valley along UT1 near the midpoint of the project, approximately Station 10+75, facing downstream.
(EMH&T, 9/11/13)

Fixed Station 4
Overview of valley along UT1 near the downstream terminus of the project, just north of South Creek Road, facing upstream.
(EMH&T, 9/11/13)

Fixed Station 5
Overview of valley along UT1 at the downstream terminus of the project, facing upstream.
(EMH&T, 9/25/13)

Fixed Station 6
Overview of valley along the mainstem near the downstream terminus of the project, facing upstream.
(EMH&T, 9/25/13)

Fixed Station 7
Overview of valley along the mainstem near the midpoint of the project, approximately Station 12+00, facing downstream.
(EMH&T, 9/11/13)

Fixed Station 8
Overview of valley along the mainstem near the midpoint of the project, approximately Station 11+50, facing upstream.
(EMH&T, 9/11/13)

Fixed Station 9
Overview of valley along the mainstem near the upstream terminus of the project, facing downstream.
(EMH&T, 9/11/13)

Table B1. Visual Morphological Stability Assessment
Thompsons Fork Stream Restoration / EEP Project No. D06030-A
Segment/Reach: Mainstem

Feature Category	Metric (per As-built and reference baselines	(# Stable) Number Performing as Intended	Total number per As-built	Total Number / feet in unstable state	% Perform in Stable Condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	42	42	0	100	
	2. Armor stable (e.g. no displacement)?	42	42	0	100	
	3. Facet grade appears stable?	42	42	0	100	
	4. Minimal evidence of embedding/fining?	42	42	0	100	
	5. Length appropriate?	42	42	0	100	**100%**
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	39	42	0	93	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?)	42	42	0	100	
	3. Length appropriate?	42	42	0	100	**98%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	42	42	0	100	
	2. Downstream of meander (glide/inflection) centering?	42	42	0	100	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	42	42	10	93	
	2. Of those eroding, # w/concomitant point bar formation?	42	42	0	100	
	3. Apparent Rc within spec?	42	42	0	100	
	4. Sufficient floodplain access and relief?	42	42	0	100	**100%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	N/A	N/A	3/25 feet	99	
	2. Channel bed degradation - areas of increasing downcutting or headcutting?	N/A	N/A	0/0 feet	100	**99%**
F. Vanes	1. Free of back or arm scour?	10	10	0	100	
	2. Height appropriate?	10	10	0	100	
	3. Angle and geometry appear appropriate?	10	10	0	100	
	4. Free of piping or other structural failures?	10	10	0	100	**100%**
G. Wads/ Boulders	1. Free of scour?	N/A	0	N/A	N/A	
	2. Footing stable?	N/A	0	N/A	N/A	**N/A**

Table B1. Visual Morphological Stability Assessment
Thompsons Fork Stream Restoration / EEP Project No. D06030-A
Segment/Reach: UT

Feature Category	Metric (per As-built and reference baselines	(# Stable) Number Performing as Intended	Total number per As-built	Total Number / feet in unstable state	% Perform in Stable Condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	35	35	0	100	
	2. Armor stable (e.g. no displacement)?	35	35	0	100	
	3. Facet grade appears stable?	35	35	0	100	
	4. Minimal evidence of embedding/fining?	35	35	0	100	
	5. Length appropriate?	35	35	0	100	**100%**
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	35	35	0	100	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?)	33	35	4	94	
	3. Length appropriate?	35	35	0	100	**98%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	38	38	0	100	
	2. Downstream of meander (glide/inflection) centering?	38	38	0	100	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	38	38	0	100	
	2. Of those eroding, # w/concomitant point bar formation?	38	38	0	100	
	3. Apparent Rc within spec?	38	38	0	100	
	4. Sufficient floodplain access and relief?	38	38	0	100	**100%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	N/A	N/A	0/0 feet	100	
	2. Channel bed degradation - areas of increasing downcutting or headcutting?	N/A	N/A	0/0 feet	100	**100%**
F. Vanes	1. Free of back or arm scour?	N/A	0	N/A	N/A	
	2. Height appropriate?	N/A	0	N/A	N/A	
	3. Angle and geometry appear appropriate?	N/A	0	N/A	N/A	
	4. Free of piping or other structural failures?	N/A	0	N/A	N/A	**N/A**
G. Wads/ Boulders	1. Free of scour?	N/A	0	N/A	N/A	
	2. Footing stable?	N/A	0	N/A	N/A	**N/A**
H. Log Sills	1. Maintaining grade control?	58	58	0	100	
	2. Minimal evidence of sedimentation in adjacent pool?	57	58	1	98	**99%**

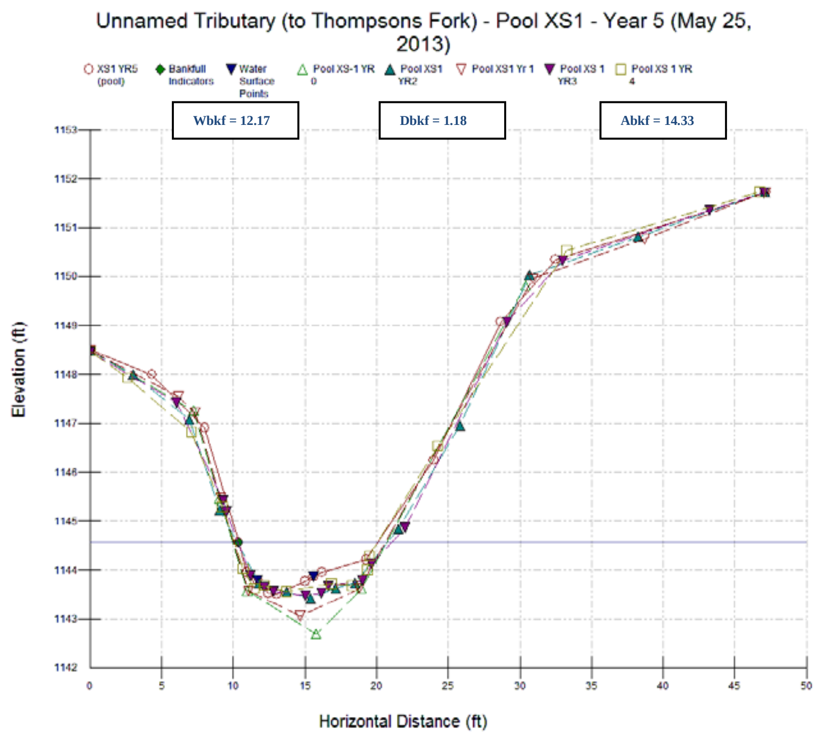
Summary Data
All dimensions in feet.

Bankfull Area	14.33 ft^2
Bankfull Width	12.17 ft
Mean Depth	1.18 ft
Maximum Depth	1.79 ft
Width/Depth Ratio	10.31
Entrenchment Ratio	1.48

PROJECT	Thompsons Fork	
	D06030-A	
	5-YEAR	
TASK	Cross-Section	
REACH	UT	
DATE	05/25/2013	
CROSS SECTION:	1	
FEATURE:	Pool	

Ecosystem Enhancement

Cross-section photo – looking downstream



EMH&T

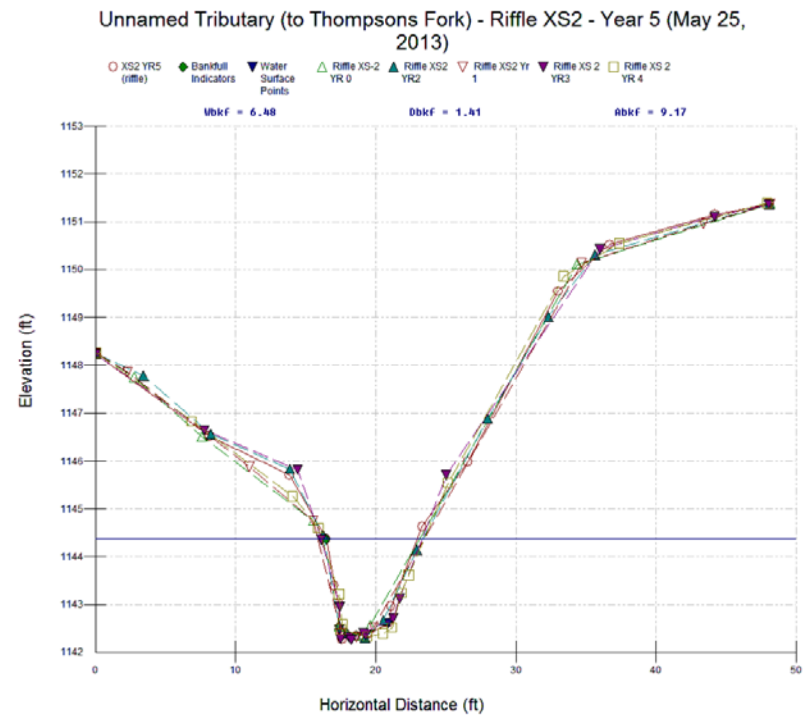
Summary Data
All dimensions in feet.

Bankfull Area	9.17 ft^2
Bankfull Width	6.48 ft
Mean Depth	1.41 ft
Maximum Depth	2.09 ft
Width/Depth Ratio	4.6
Entrenchment Ratio	2.9
Classification	E

PROJECT	Thompsons Fork
	D06030-A
	5-YEAR
TASK	Cross-Section
REACH	UT
DATE	05/25/2013
CROSS SECTION:	2
FEATURE:	Riffle

Ecosystem Enhancement

Cross-section photo – looking upstream



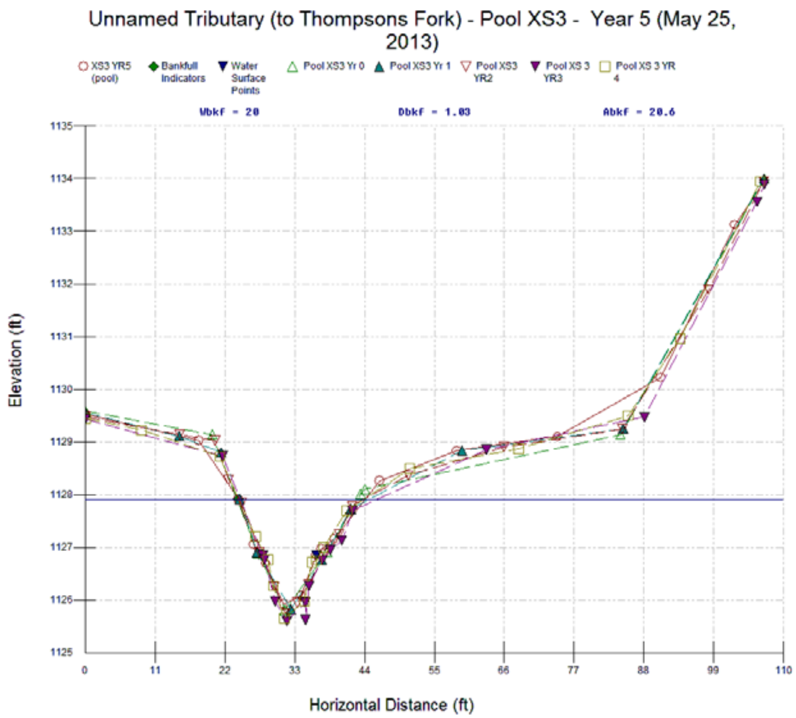
EMH&T

Summary Data
All dimensions in feet.

Bankfull Area	20.59 ft^2
Bankfull Width	19.97 ft
Mean Depth	1.03 ft
Maximum Depth	1.99 ft
Width/Depth Ratio	19.39
Entrenchment Ratio	4.3
Classification	C

PROJECT	Thompsons Fork
	D06030-A
	5-YEAR
TASK	Cross-Section
REACH	UT
DATE	05/25/2013
CROSS SECTION:	3
FEATURE:	Pool

Cross-section photo – looking across channel, from right bank to left bank



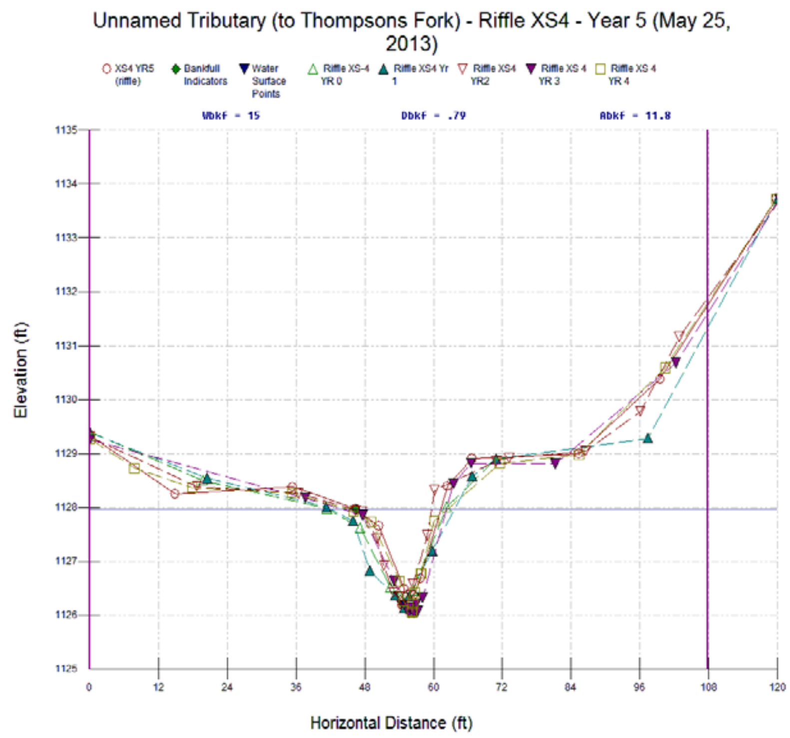
Summary Data
All dimensions in feet.

Bankfull Area	11.78 ft^2
Bankfull Width	14.98 ft
Mean Depth	0.79 ft
Maximum Depth	1.88 ft
Width/Depth Ratio	18.96
Entrenchment Ratio	6.28
Classification	C

		PROJECT	Thompsons Fork
			D06030-A
			5-YEAR
TASK	Cross-Section		
REACH	UT		
DATE	05/25/2013		
	CROSS SECTION:	4	
	FEATURE:	Riffle	

Ecosystem Enhancement

Cross-section photo – looking across stream, from right bank to left bank



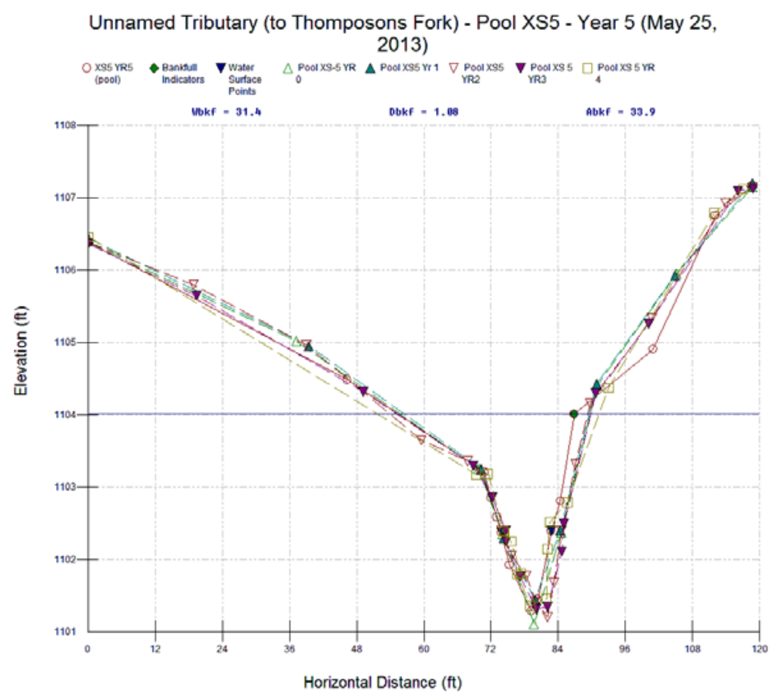
EMH&T

Summary Data
All dimensions in feet.

Bankfull Area	33.89 ft^2
Bankfull Width	31.42 ft
Mean Depth	1.08 ft
Maximum Depth	2.72 ft
Width/Depth Ratio	29.09
Entrenchment Ratio	3.56
Classification	C

PROJECT	Thompsons Fork
	D06030-A
	5-YEAR
TASK	Cross-Section
REACH	UT
DATE	05/25/2013
CROSS SECTION:	5
FEATURE:	Pool

Cross-section photo – looking across channel, from right bank to left bank



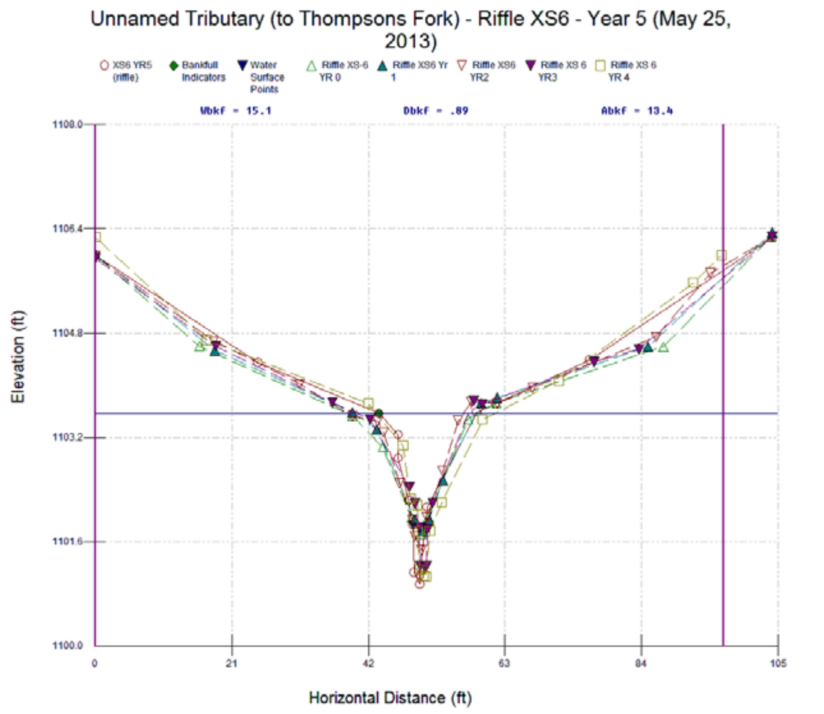
Summary Data
All dimensions in feet.

Bankfull Area	13.38 ft^2
Bankfull Width	15.06 ft
Mean Depth	0.89 ft
Maximum Depth	2.63 ft
Width/Depth Ratio	16.92
Entrenchment Ratio	6.36
Classification	C

		PROJECT	Thompsons Fork
			D06030-A
			5-YEAR
TASK	Cross-Section		
REACH	UT		
DATE	05/25/2013		
	CROSS SECTION:	6	
	FEATURE:	Riffle	

Ecosystem Enhancement

Cross-section photo – looking downstream



EMH&T

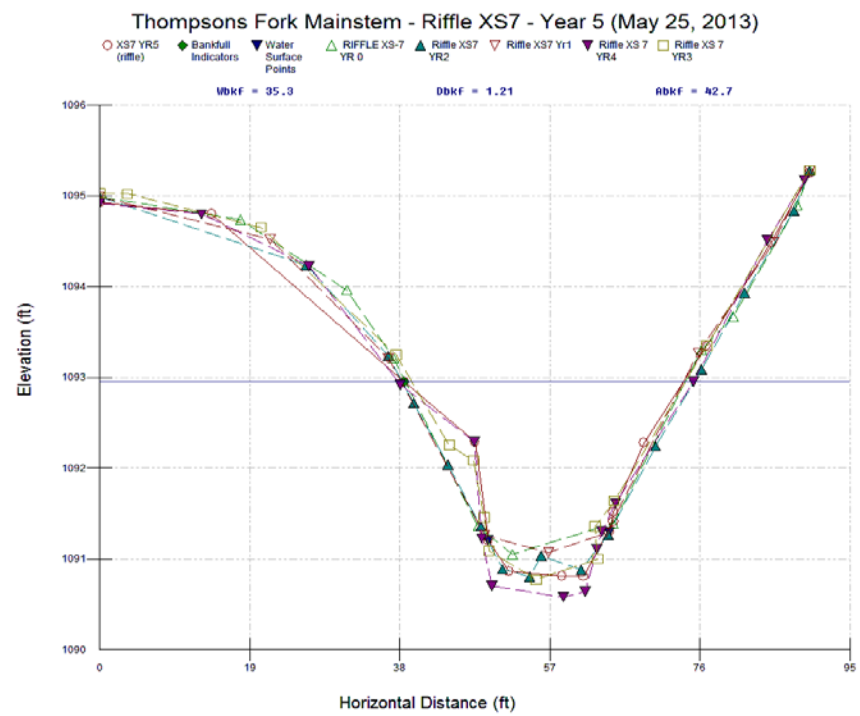
Summary Data
All dimensions in feet.

Bankfull Area	42.71 ft^2
Bankfull Width	35.34 ft
Mean Depth	1.21 ft
Maximum Depth	2.14 ft
Width/Depth Ratio	29.21
Entrenchment Ratio	2.51
Classification	C

PROJECT	Thompsons Fork D06030-A 5-YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	05/25/2013
CROSS SECTION:	7
FEATURE:	Riffle

Ecosystem Enhancement

Cross-section photo – looking from right bank to left bank



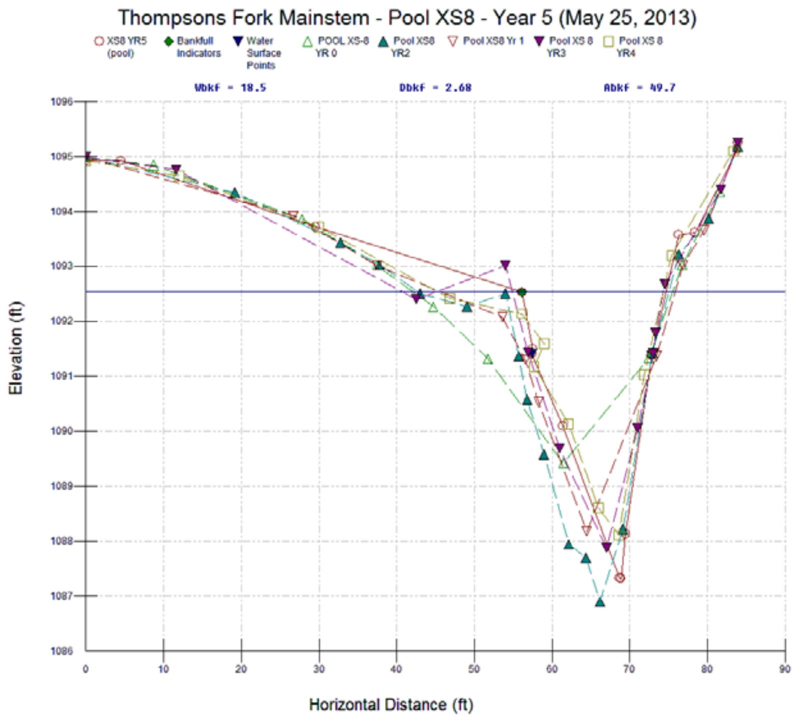
EMH&T

Summary Data
All dimensions in feet.

Bankfull Area	49.74 ft^2
Bankfull Width	18.53 ft
Mean Depth	2.68 ft
Maximum Depth	5.21 ft
Width/Depth Ratio	6.91
Entrenchment Ratio	4.52
Classification	E

PROJECT	Thompsons Fork
	D06030-A
	5-YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	05/25/2013
CROSS SECTION:	8
FEATURE:	Pool

Cross-section photo – looking across channel, from left bank to right bank

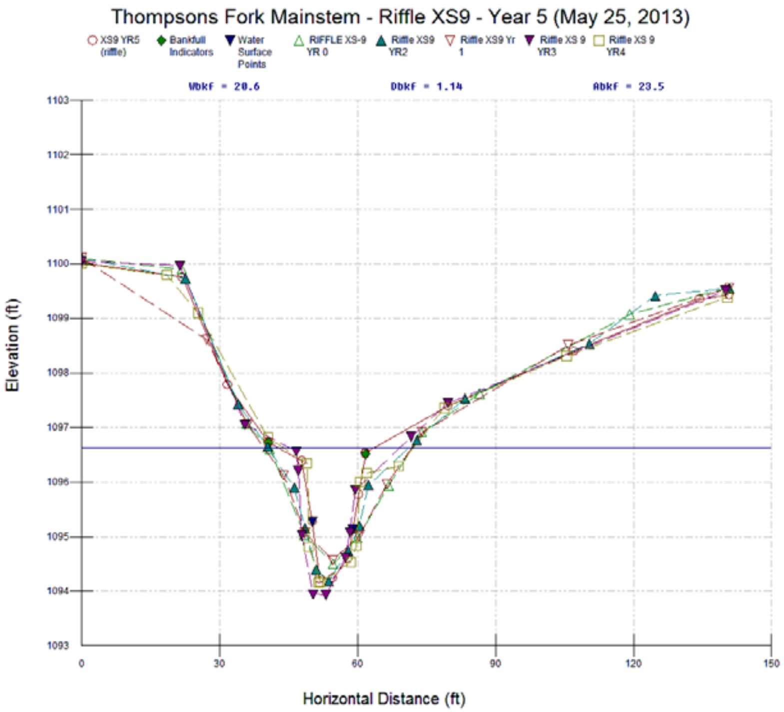


Summary Data
All dimensions in feet.

Bankfull Area	23.47ft^2
Bankfull Width	20.55 ft
Mean Depth	1.14 ft
Maximum Depth	2.39 ft
Width/Depth Ratio	18.03
Entrenchment Ratio	4.82
Classification	C

PROJECT	Thompsons Fork
	D06030-A
	5-YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	05/25/2013
CROSS SECTION:	9
FEATURE:	Riffle

Cross-section photo – looking across channel from left bank to right bank



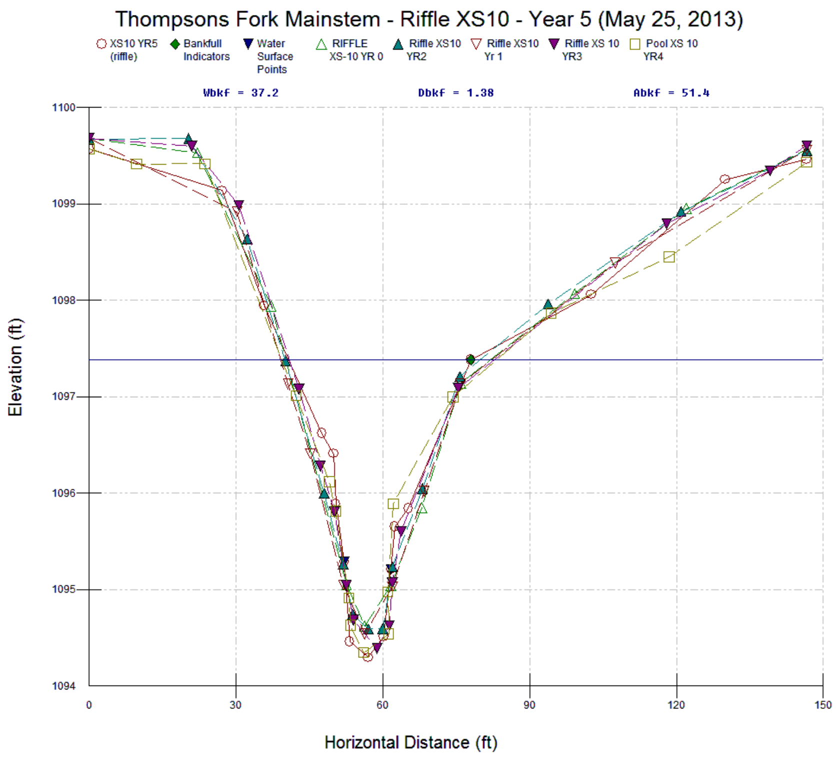
Summary Data
All dimensions in feet.

Bankfull Area	51.41 ft^2
Bankfull Width	37.21 ft
Mean Depth	1.38 ft
Maximum Depth	3.09 ft
Width/Depth Ratio	26.96
Entrenchment Ratio	3.94
Classification	C

PROJECT	Thompsons Fork
	D06030-A
	5-YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	05/25/2013
CROSS SECTION:	10
FEATURE:	Riffle

Ecosystem Enhancement

Cross-section photo – looking across channel from left bank to right bank



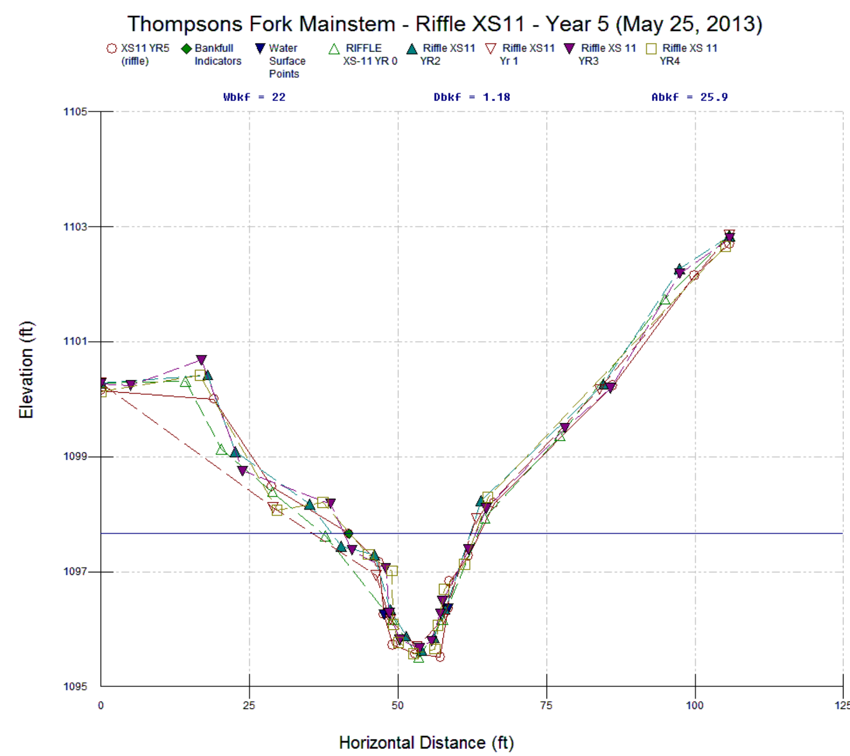
EMH&T

Summary Data
All dimensions in feet.

Bankfull Area	25.87 ft^2
Bankfull Width	22.0 ft
Mean Depth	1.18 ft
Maximum Depth	2.15 ft
Width/Depth Ratio	18.64
Entrenchment Ratio	2.81
Classification	C

PROJECT	Thompsons Fork
	D06030-A
	5-YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	05/25/2013
CROSS SECTION:	11
FEATURE:	Riffle

Cross-section photo – looking upstream

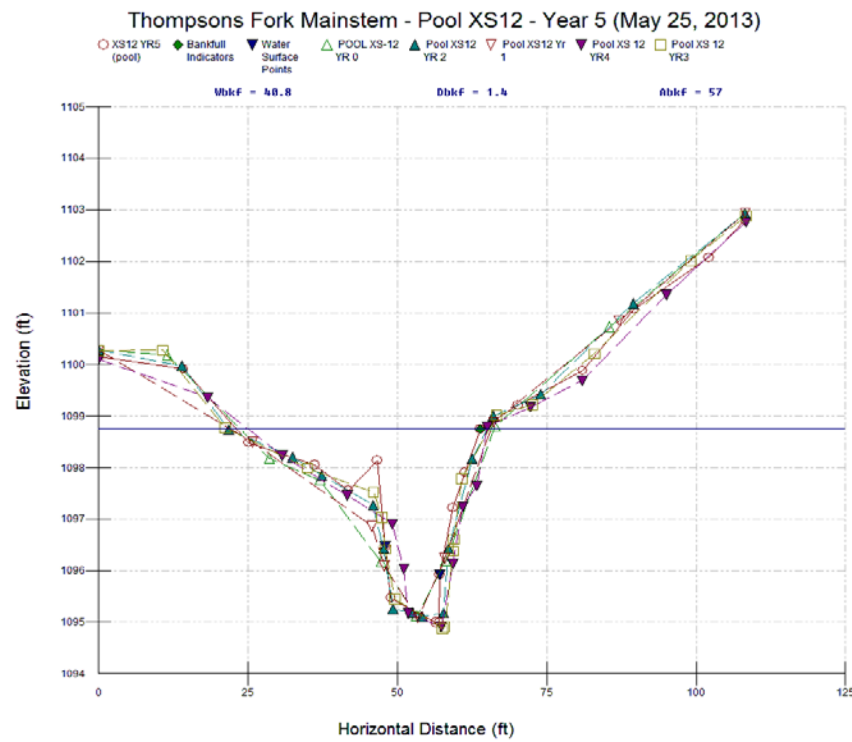


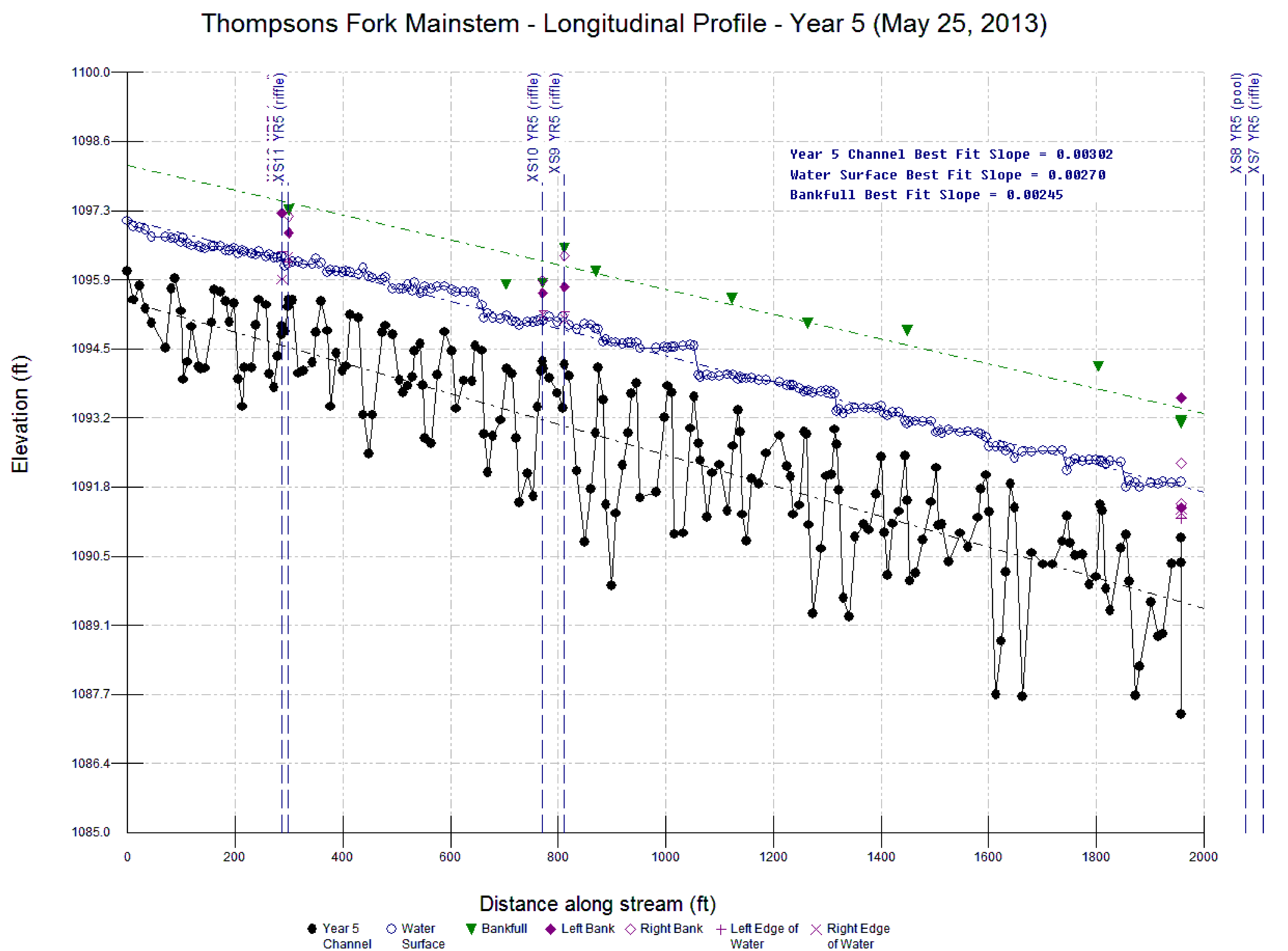
Summary Data
All dimensions in feet.

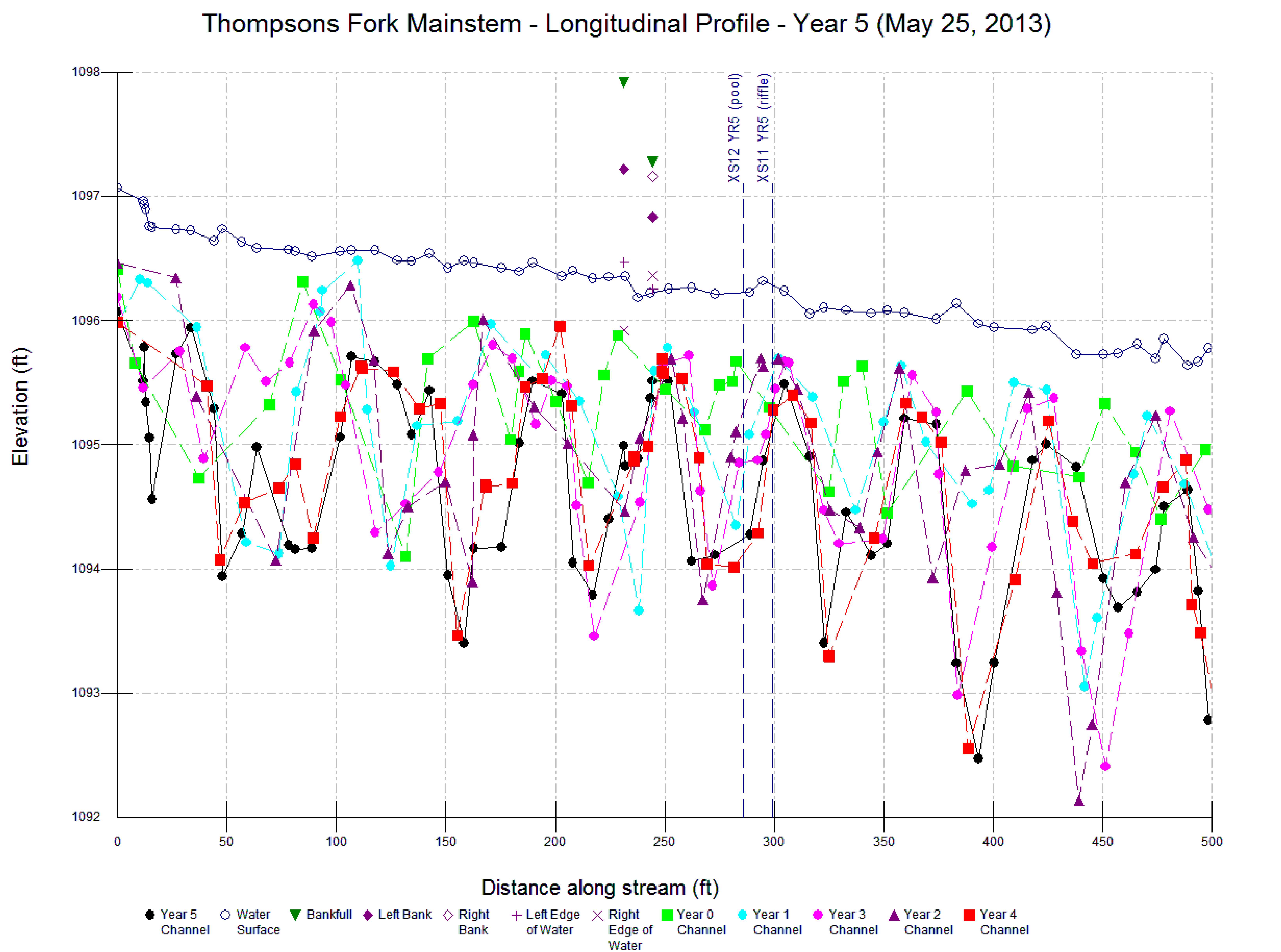
Bankfull Area	57.01 ft^2
Bankfull Width	40.81 ft
Mean Depth	1.4 ft
Maximum Depth	3.76 ft
Width/Depth Ratio	29.15
Entrenchment Ratio	2.59
Classification	C

PROJECT	Thompsons Fork
	D06030-A
	5-YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	05/25/2013
CROSS SECTION:	12
FEATURE:	Pool

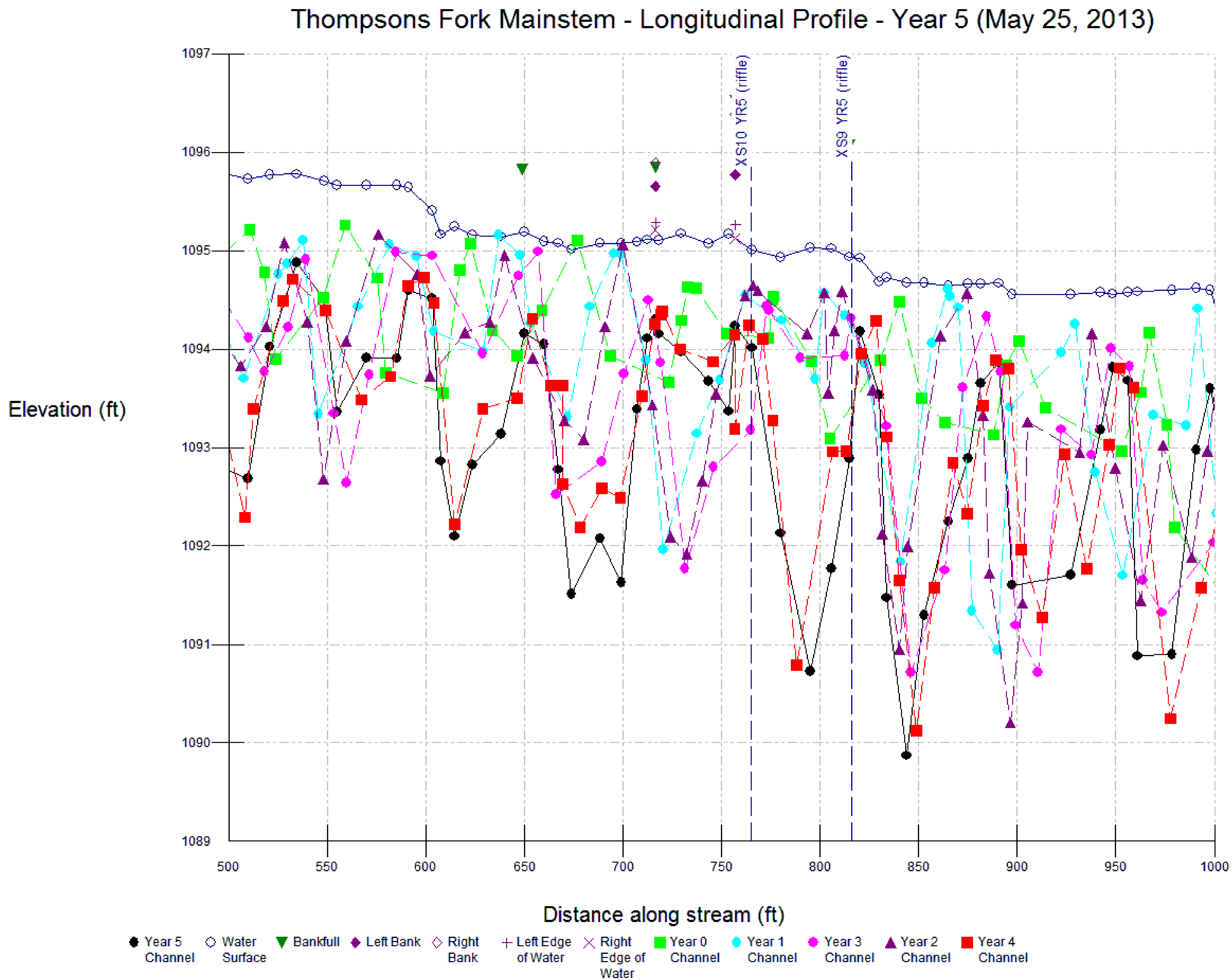
Cross-section photo – looking downstream



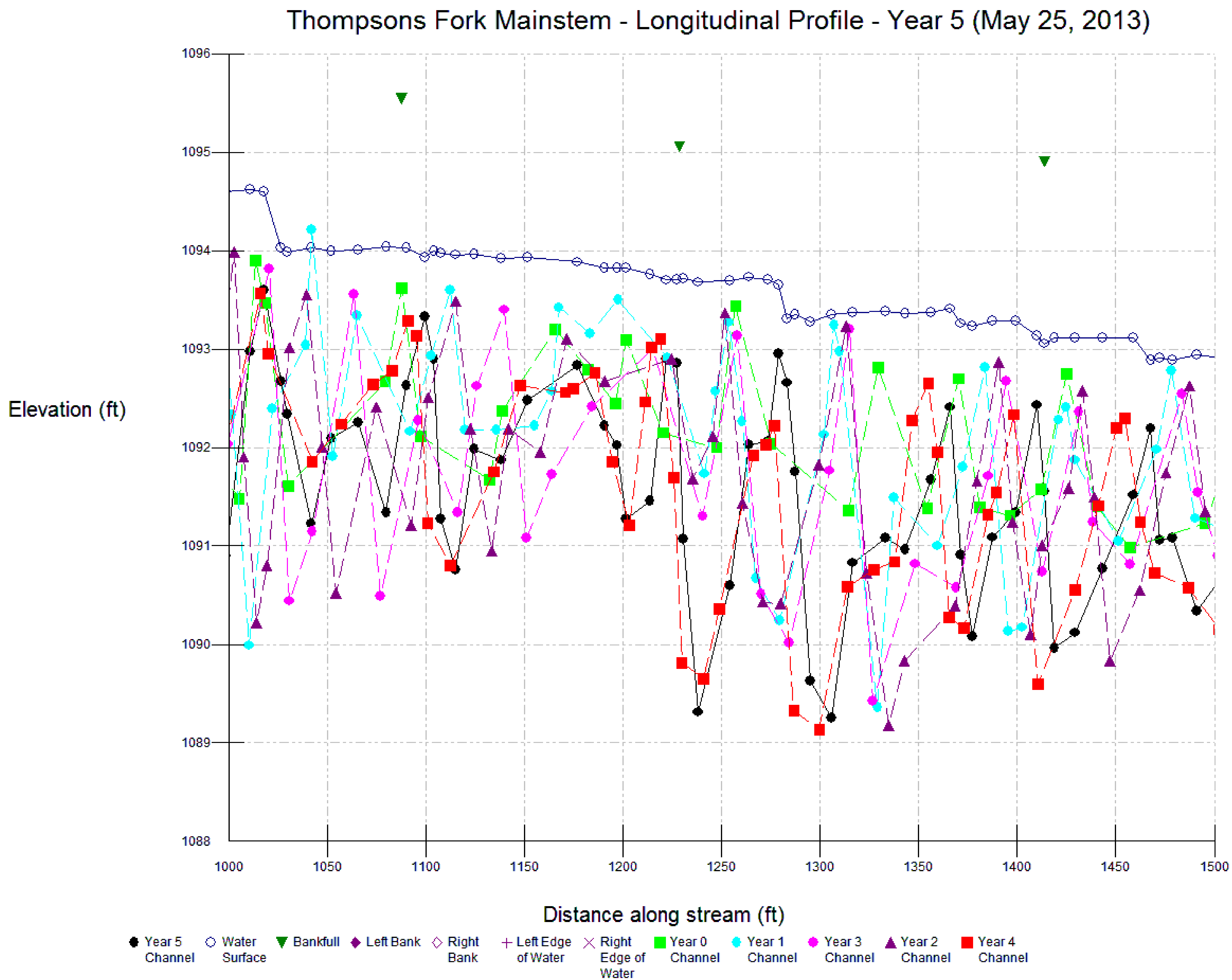

Thompsons Fork Mainstem - Longitudinal Profile - Year 5 (May 25, 2013)
Year 5 Channel Best Fit Slope = 0.00302
Water Surface Best Fit Slope = 0.00270
Bankfull Best Fit Slope = 0.00245
XS11 YR5 (riffle)
XS10 YR5 (riffle)
XS9 YR5 (riffle)
XS8 YR5 (pool)
XS7 YR5 (riffle)
Elevation (ft)
1100.0
1098.6
1097.3
1095.9
1094.5
1093.2
1091.8
1090.5
1089.1
1087.7
1086.4
1085.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Distance along stream (ft)
Year 5 Channel
Water Surface
Bankfull
Left Bank
Right Bank
Left Edge of Water
Right Edge of Water

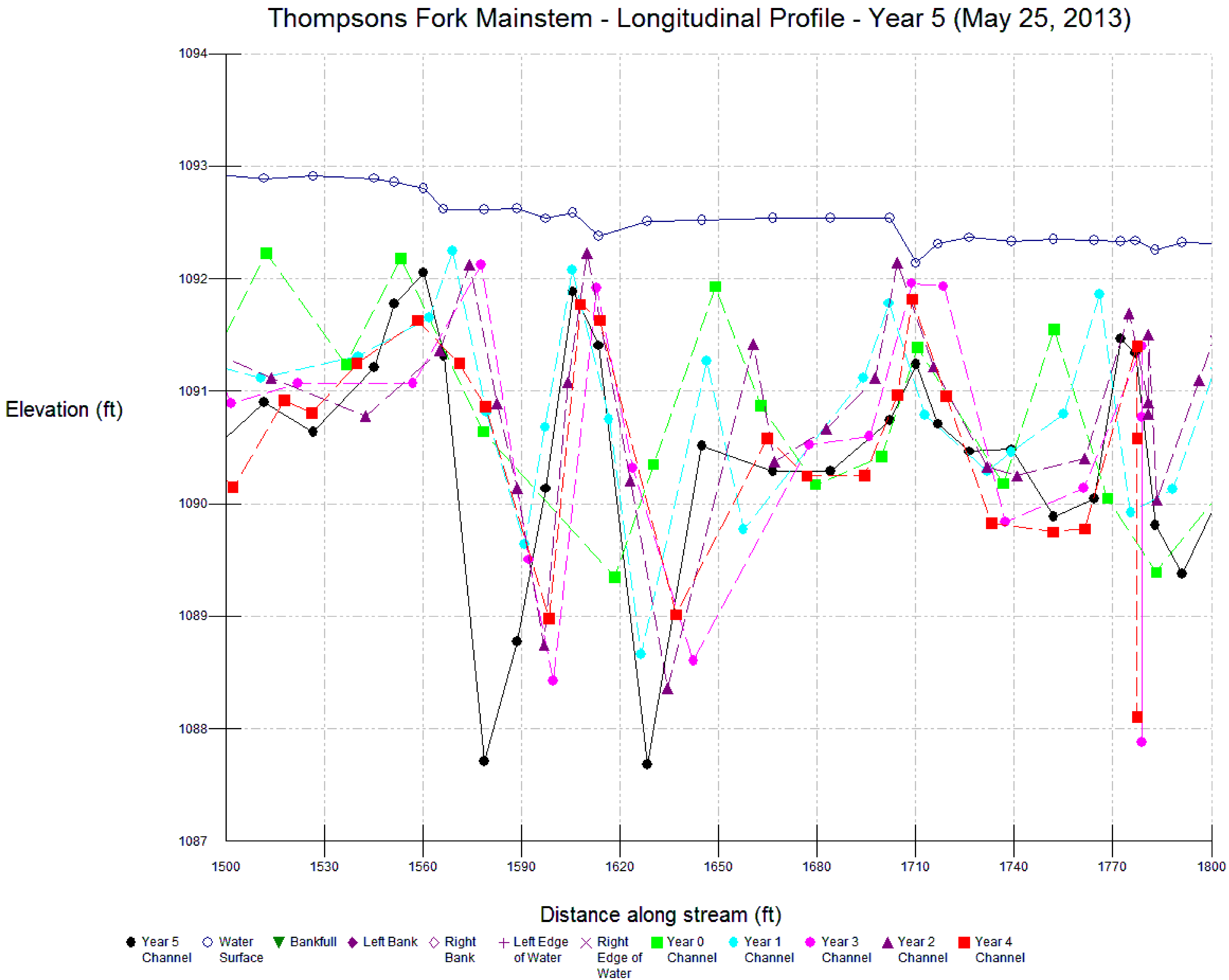


Thompsons Fork Mainstem - Longitudinal Profile - Year 5 (May 25, 2013)
Elevation (ft)
Distance along stream (ft)
1098
1097
1096
1095
1094
1093
1092
0
50
100
150
200
250
300
350
400
450
500
XS12 YR5 (pool)
XS11 YR5 (riffle)
Year 5 Channel
Water Surface
Bankfull
Left Bank
Right Bank
Left Edge of Water
Right Edge of Water
Year 0 Channel
Year 1 Channel
Year 3 Channel
Year 2 Channel
Year 4 Channel



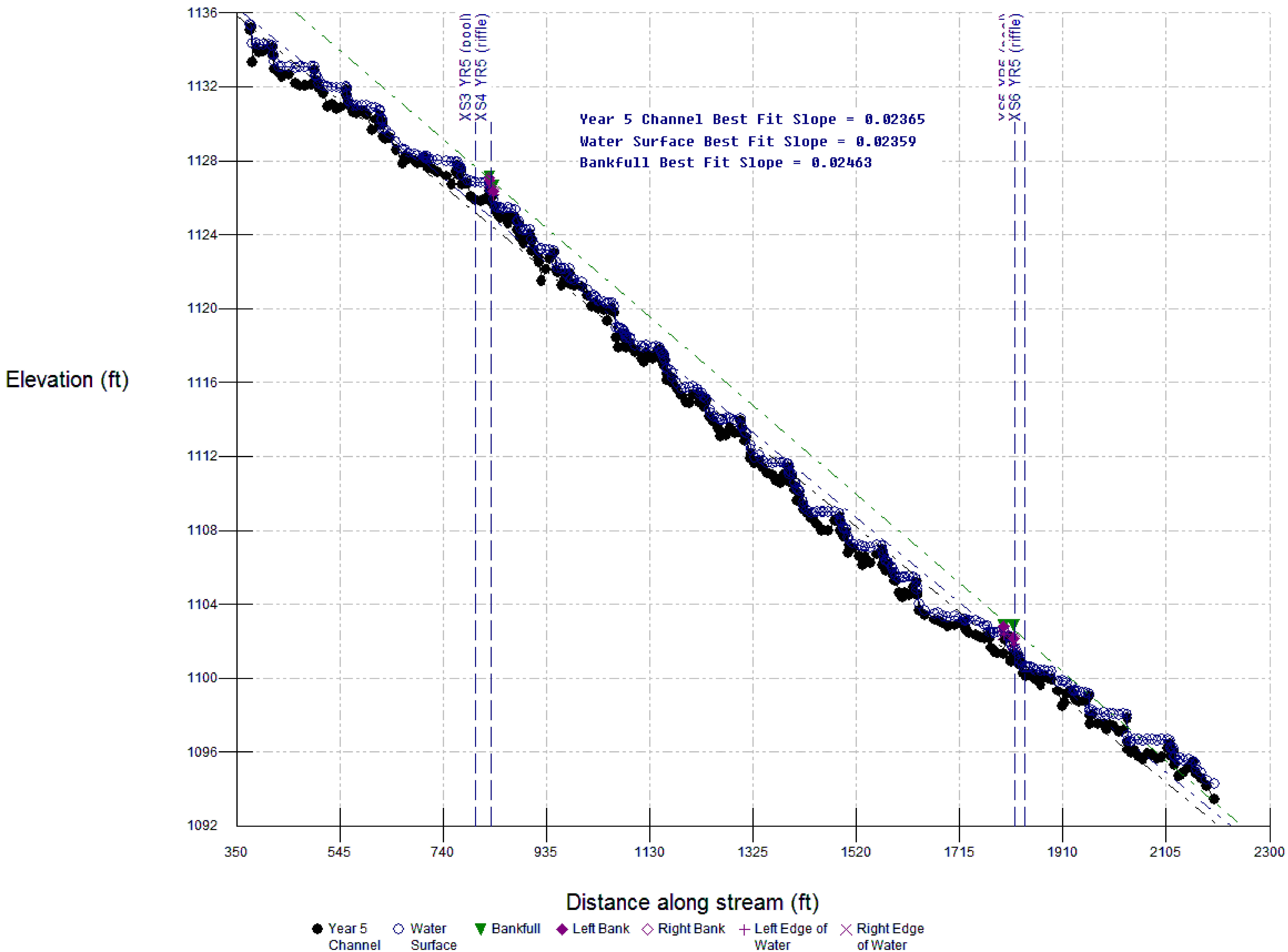
Thompsons Fork Mainstem - Longitudinal Profile - Year 5 (May 25, 2013)
Elevation (ft)
1097
1096
1095
1094
1093
1092
1091
1090
1089
XS10 YR5 (riffle)
XS9 YR5 (riffle)
500
550
600
650
700
750
800
850
900
950
1000
Distance along stream (ft)
Year 5 Channel
Water Surface
Bankfull
Left Bank
Right Bank
Left Edge of Water
Right Edge of Water
Year 0 Channel
Year 1 Channel
Year 3 Channel
Year 2 Channel
Year 4 Channel

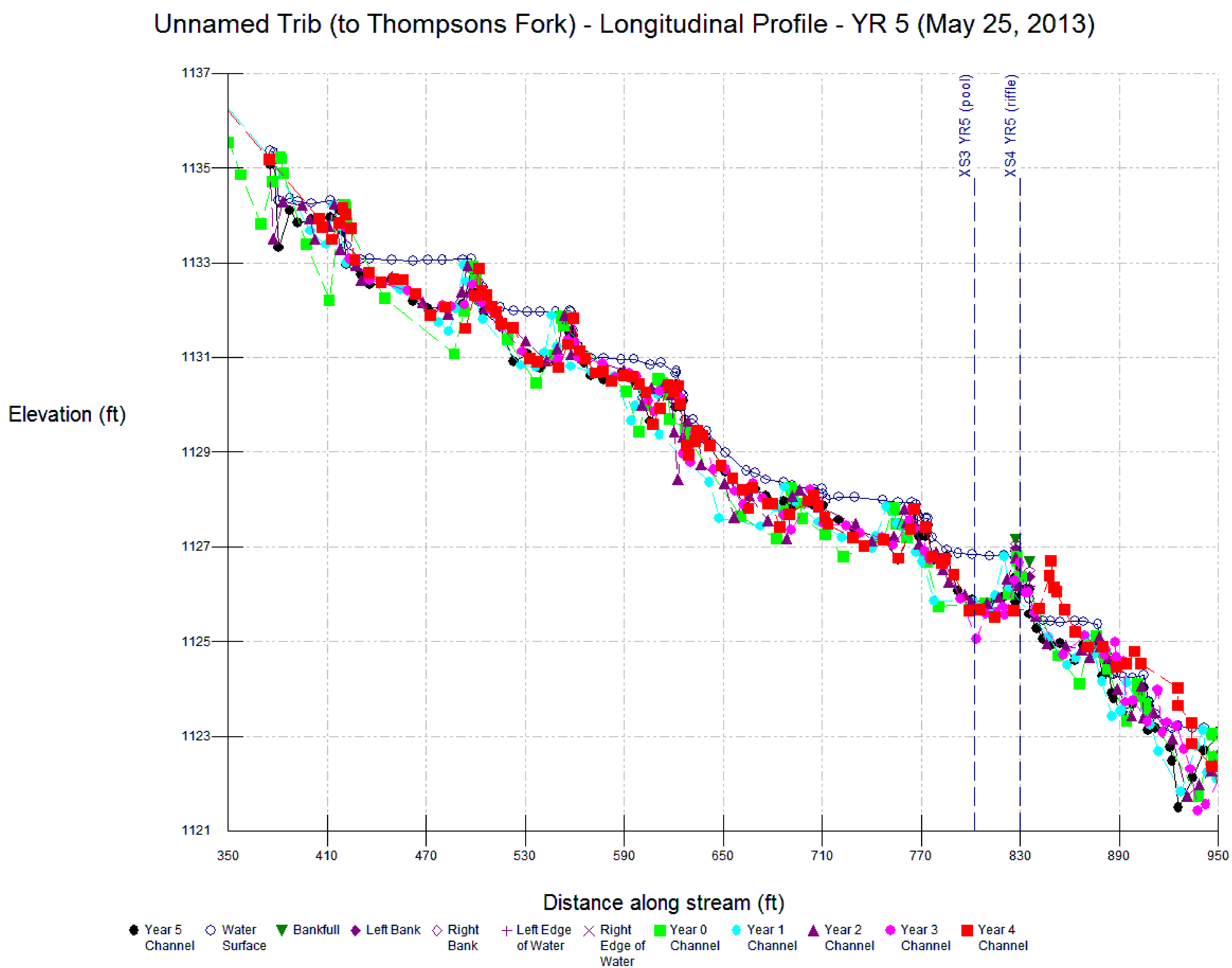

Thompsons Fork Mainstem - Longitudinal Profile - Year 5 (May 25, 2013)
Elevation (ft)
1096
1095
1094
1093
1092
1091
1090
1089
1088
1000
1050
1100
1150
1200
1250
1300
1350
1400
1450
1500
Distance along stream (ft)
Year 5 Channel
Water Surface
Bankfull
Left Bank
Right Bank
Left Edge of Water
Right Edge of Water
Year 0 Channel
Year 1 Channel
Year 3 Channel
Year 2 Channel
Year 4 Channel



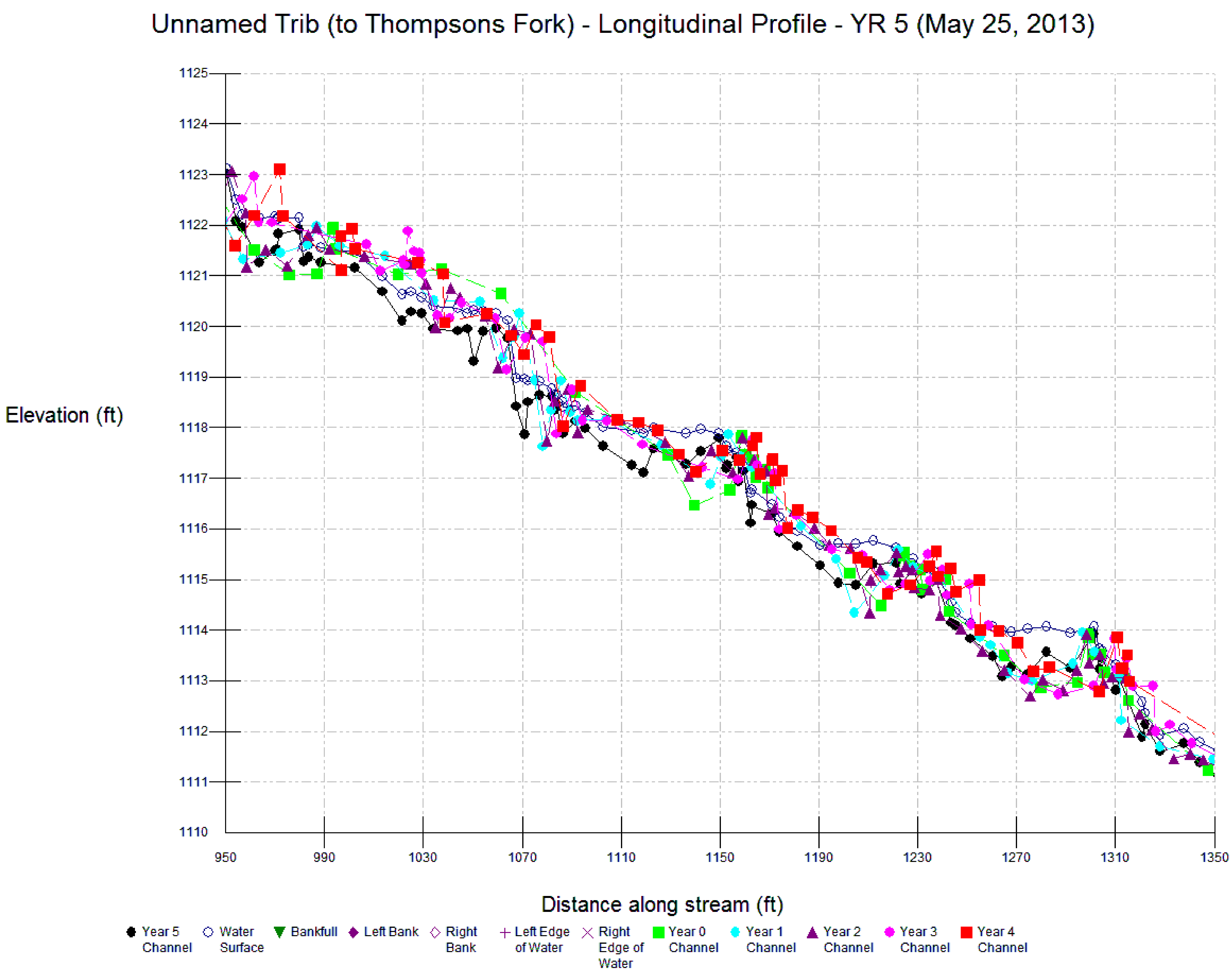
Thompsons Fork Mainstem - Longitudinal Profile - Year 5 (May 25, 2013)
Elevation (ft)
1094
1093
1092
1091
1090
1089
1088
1087
1500
1530
1560
1590
1620
1650
1680
1710
1740
1770
1800
Distance along stream (ft)
Year 5 Channel
Water Surface
Bankfull
Left Bank
Right Bank
Left Edge of Water
Right Edge of Water
Year 0 Channel
Year 1 Channel
Year 3 Channel
Year 2 Channel
Year 4 Channel

Unnamed Trib (to Thompsons Fork) - Longitudinal Profile - YR 5 (May 25, 2013)



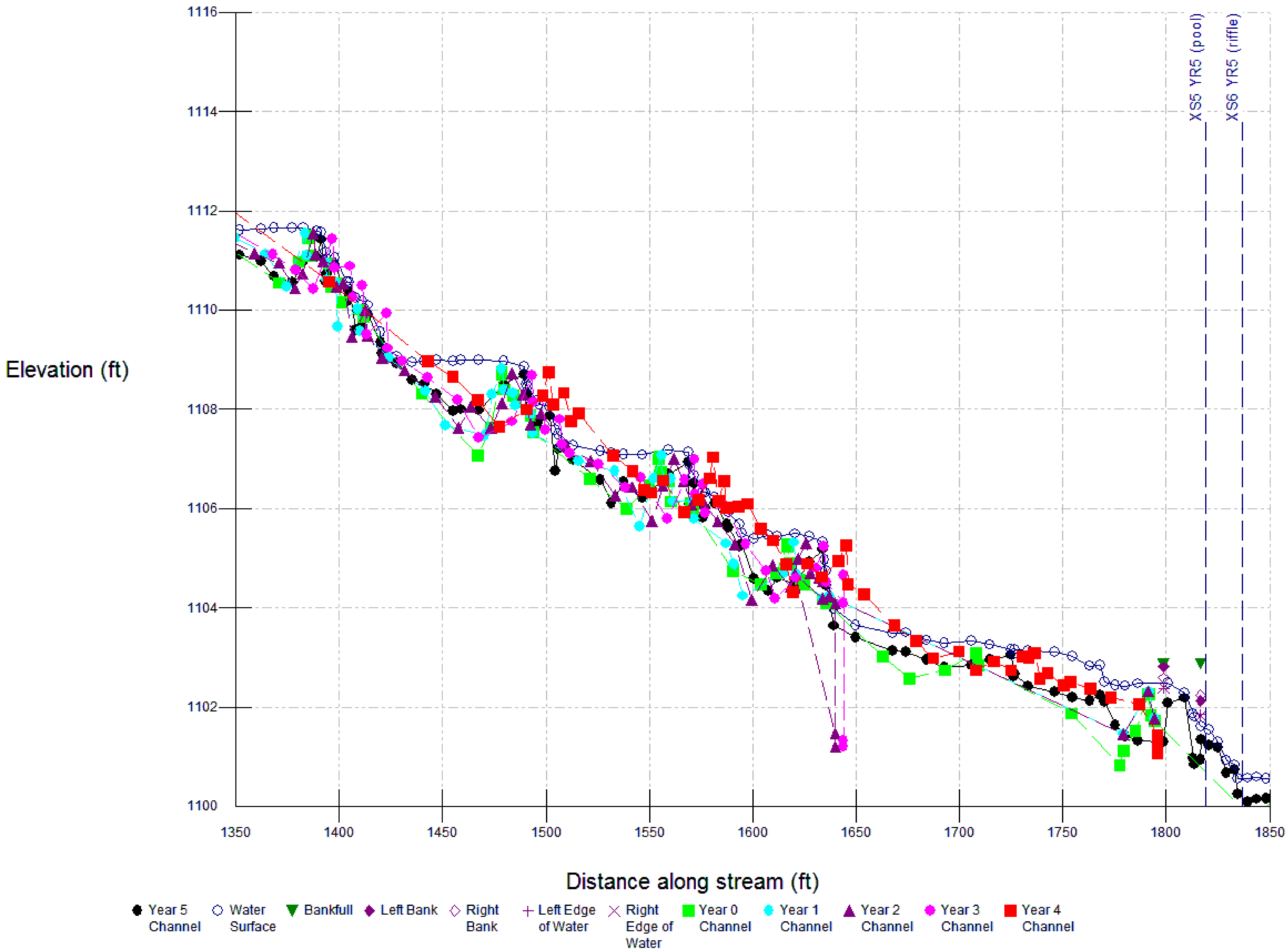


Unnamed Trib (to Thompsons Fork) - Longitudinal Profile - YR 5 (May 25, 2013)
Elevation (ft)
1137
1135
1133
1131
1129
1127
1125
1123
1121
350
410
470
530
590
650
710
770
830
890
950
Distance along stream (ft)
XS3 YR5 (pool)
XS4 YR5 (riffle)
Year 5 Channel
Water Surface
Bankfull
Left Bank
Right Bank
Left Edge of Water
Right Edge of Water
Year 0 Channel
Year 1 Channel
Year 2 Channel
Year 3 Channel
Year 4 Channel



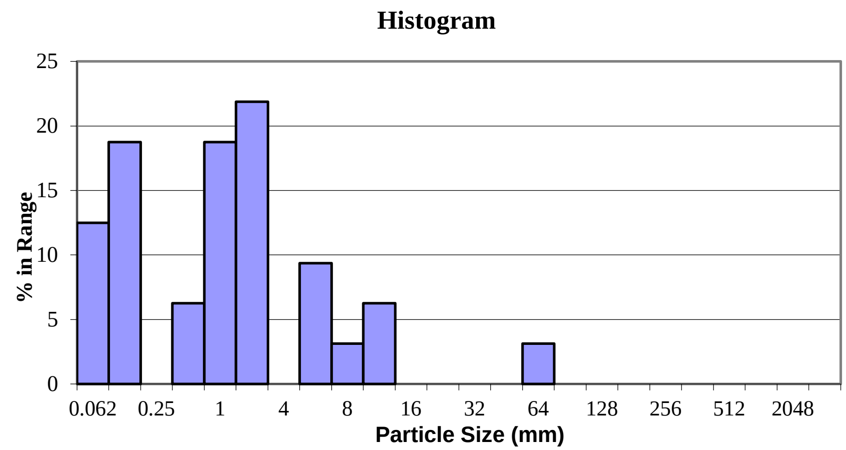
Unnamed Trib (to Thompsons Fork) - Longitudinal Profile - YR 5 (May 25, 2013)
Elevation (ft)
1125
1124
1123
1122
1121
1120
1119
1118
1117
1116
1115
1114
1113
1112
1111
1110
950
990
1030
1070
1110
1150
1190
1230
1270
1310
1350
Distance along stream (ft)
Year 5 Channel
Water Surface
Bankfull
Left Bank
Right Bank
Left Edge of Water
Right Edge of Water
Year 0 Channel
Year 1 Channel
Year 2 Channel
Year 3 Channel
Year 4 Channel

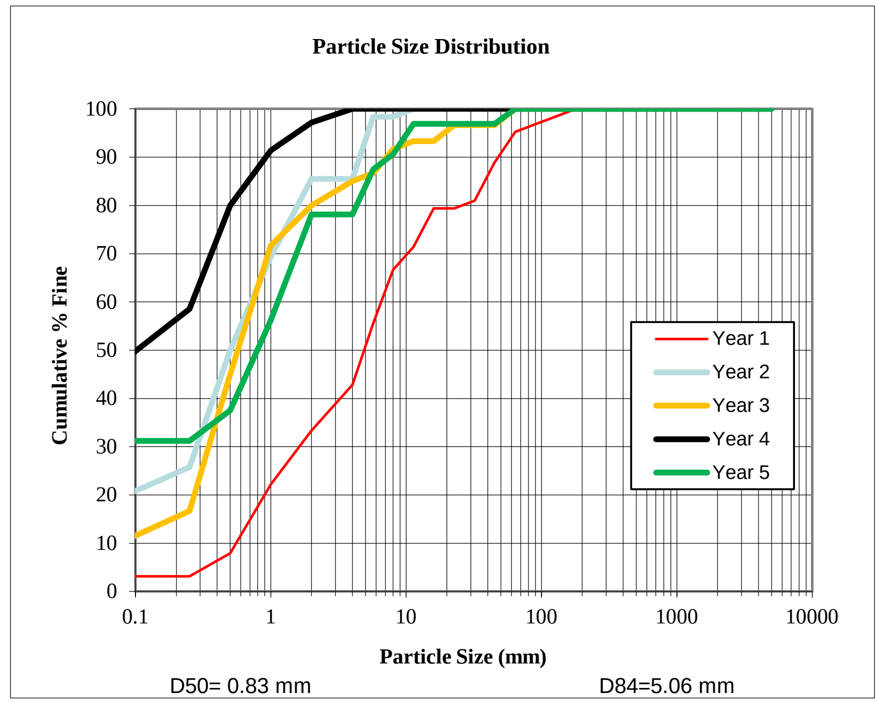
Unnamed Trib (to Thompsons Fork) - Longitudinal Profile - YR 5 (May 25, 2013)



Pebble Count - Pool (Year 5)				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	8	13	13
Very Fine Sand	0.062-0.125	12	19	31
Fine Sand	0.125-0.25	0	0	31
Medium Sand	0.25-0.5	4	6	38
Coarse Sand	0.5-1.0	12	19	56
Very Coarse Sand	1.0-2.0	14	22	78
Very Fine Gravel	2.0-4.0	0	0	78
Fine Gravel	4.0-5.7	6	9	88
Fine Gravel	5.7-8.0	2	3	91
Medium Gravel	8.0-11.3	4	6	97
Medium Gravel	11.3-16.0	0	0	97
Coarse Gravel	16.0-22.6	0	0	97
Coarse Gravel	22.6-32	0	0	97
Very Coarse Gravel	32-45	0	0	97
Very Coarse Gravel	45-64	2	3	100
Small Cobble	64-90	0	0	100
Small Cobble	90-128	0	0	100
Large Cobble	128-180	0	0	100
Large Cobble	180-256	0	0	100
Small Boulder	256-362	0	0	100
Small Boulder	362-512	0	0	100
Medium Boulder	512-1024	0	0	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		64	100	

Thompsons Fork Stream Restoration	EEP Project No. D06030-A		
Reach	UT	**X Sec**	1
Date	05/13/13	**Sta No.**	1+60

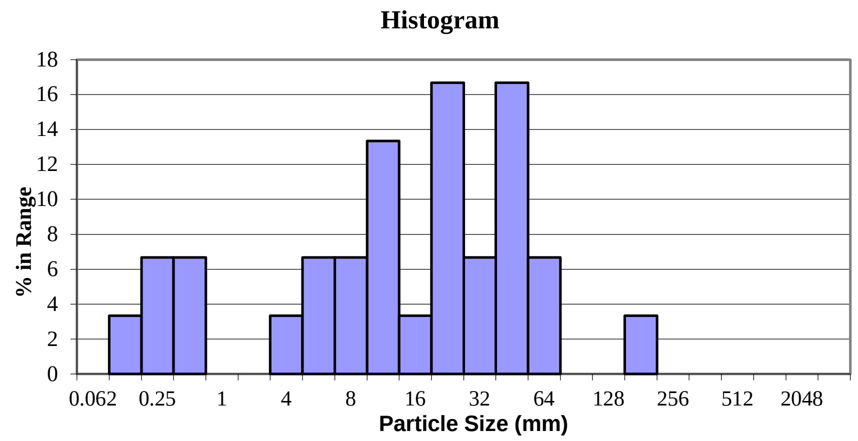


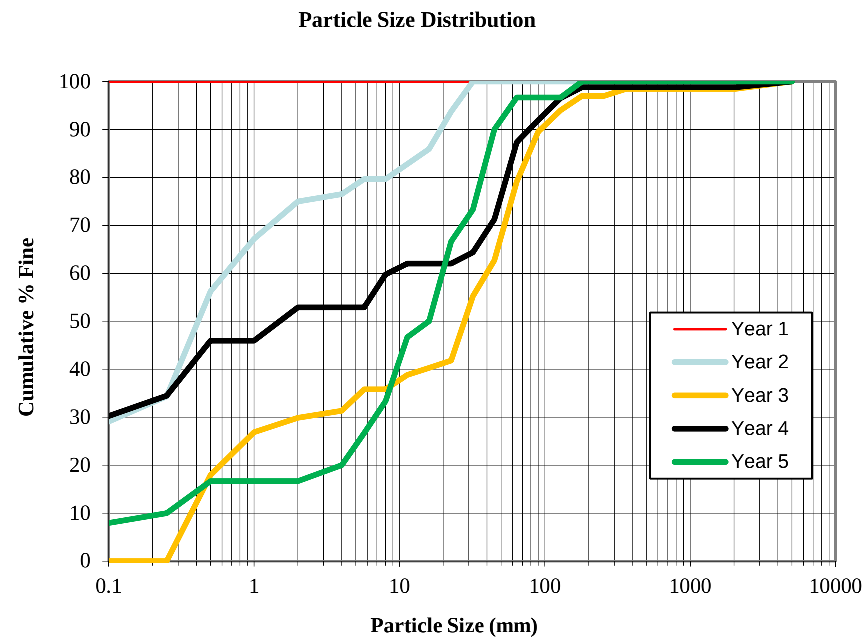


Pebble Count - Riffle (Year 5)

Material	Particle Size (mm)	Count	% in Range	% Cumulative
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	2	3	3
Fine Sand	0.125-0.25	4	7	10
Medium Sand	0.25-0.5	4	7	17
Coarse Sand	0.5-1.0	0	0	17
Very Coarse Sand	1.0-2.0	0	0	17
Very Fine Gravel	2.0-4.0	2	3	20
Fine Gravel	4.0-5.7	4	7	27
Fine Gravel	5.7-8.0	4	7	33
Medium Gravel	8.0-11.3	8	13	47
Medium Gravel	11.3-16.0	2	3	50
Coarse Gravel	16.0-22.6	10	17	67
Coarse Gravel	22.6-32	4	7	73
Very Coarse Gravel	32-45	10	17	90
Very Coarse Gravel	45-64	4	7	97
Small Cobble	64-90	0	0	97
Small Cobble	90-128	0	0	97
Large Cobble	128-180	2	3	100
Large Cobble	180-256	0	0	100
Small Boulder	256-362	0	0	100
Small Boulder	362-512	0	0	100
Medium Boulder	512-1024	0	0	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		60	100	

Thompsons Fork Stream Restoration	EEP Project No. D06030-A		
Reach	UT	**X Sec**	2
Date	05/13/13	**Sta No.**	1+74



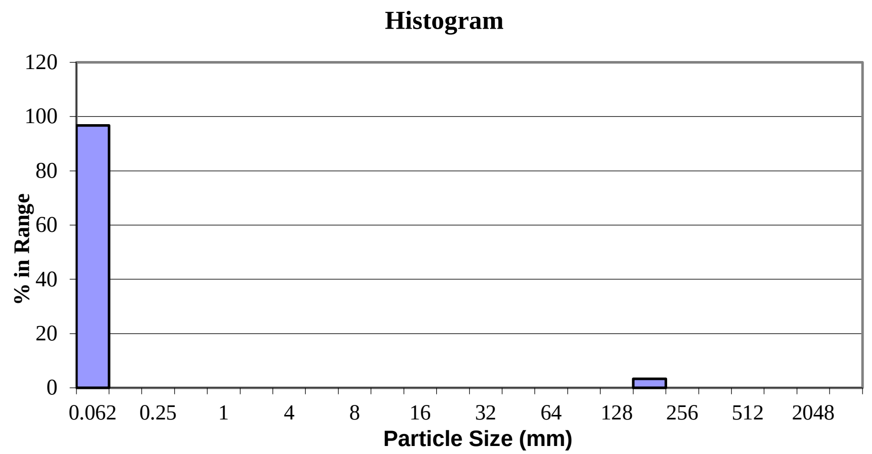


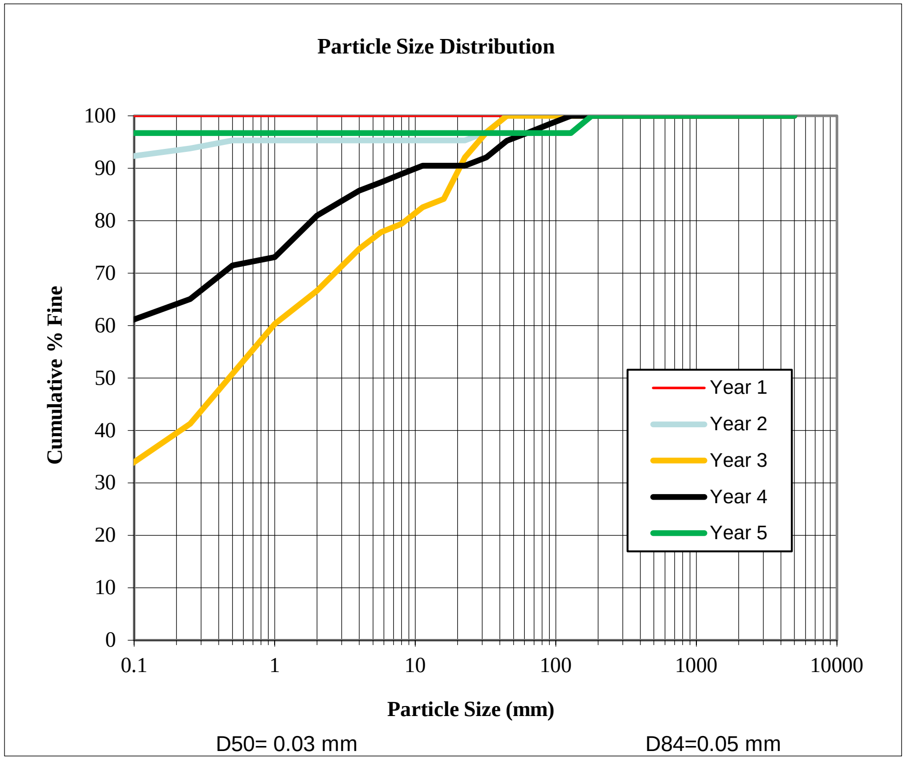
D50= 16.0 mm

D84=40.32 mm

Pebble Count - Pool (Year 5)				
Material	Particle Size (mm)	Count	% in Range	% Cumulative
Silt/Clay	<0.062	58	97	97
Very Fine Sand	0.062-0.125	0	0	97
Fine Sand	0.125-0.25	0	0	97
Medium Sand	0.25-0.5	0	0	97
Coarse Sand	0.5-1.0	0	0	97
Very Coarse Sand	1.0-2.0	0	0	97
Very Fine Gravel	2.0-4.0	0	0	97
Fine Gravel	4.0-5.7	0	0	97
Fine Gravel	5.7-8.0	0	0	97
Medium Gravel	8.0-11.3	0	0	97
Medium Gravel	11.3-16.0	0	0	97
Coarse Gravel	16.0-22.6	0	0	97
Coarse Gravel	22.6-32	0	0	97
Very Coarse Gravel	32-45	0	0	97
Very Coarse Gravel	45-64	0	0	97
Small Cobble	64-90	0	0	97
Small Cobble	90-128	0	0	97
Large Cobble	128-180	2	3	100
Large Cobble	180-256	0	0	100
Small Boulder	256-362	0	0	100
Small Boulder	362-512	0	0	100
Medium Boulder	512-1024	0	0	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		60	100	

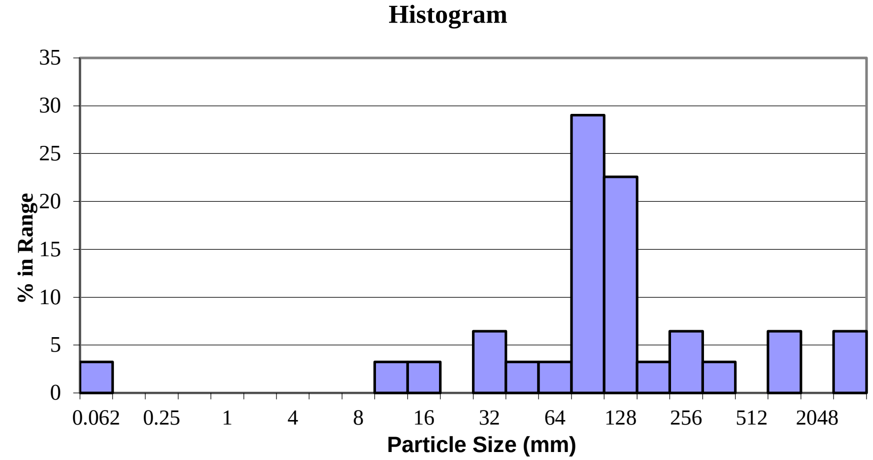
Thompsons Fork Stream Restoration EEP Project No. D06030-A			
Reach	UT	**X Sec**	3
Date	05/13/13	**Sta No.**	8+09

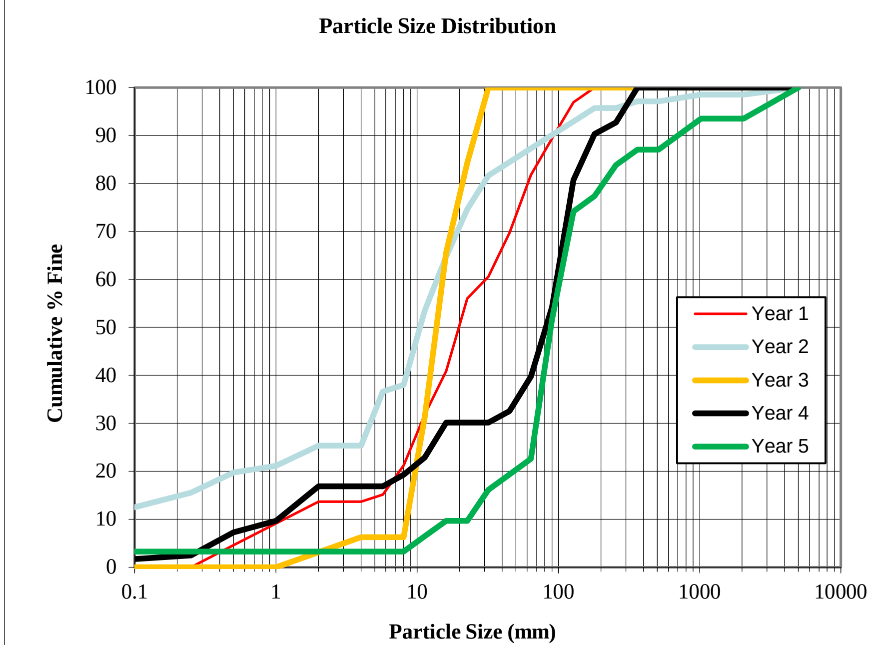




Pebble Count - Riffle (Year 5)				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	2	3	3
Very Fine Sand	0.062-0.125	0	0	3
Fine Sand	0.125-0.25	0	0	3
Medium Sand	0.25-0.5	0	0	3
Coarse Sand	0.5-1.0	0	0	3
Very Coarse Sand	1.0-2.0	0	0	3
Very Fine Gravel	2.0-4.0	0	0	3
Fine Gravel	4.0-5.7	0	0	3
Fine Gravel	5.7-8.0	0	0	3
Medium Gravel	8.0-11.3	2	3	6
Medium Gravel	11.3-16.0	2	3	10
Coarse Gravel	16.0-22.6	0	0	10
Coarse Gravel	22.6-32	4	6	16
Very Coarse Gravel	32-45	2	3	19
Very Coarse Gravel	45-64	2	3	23
Small Cobble	64-90	18	29	52
Small Cobble	90-128	14	23	74
Large Cobble	128-180	2	3	77
Large Cobble	180-256	4	6	84
Small Boulder	256-362	2	3	87
Small Boulder	362-512	0	0	87
Medium Boulder	512-1024	4	6	94
Large Boulder	1024-2048	0	0	94
Bedrock	<2048	4	6	100
Totals		62	100	

Thompsons Fork Stream Restoration EEP Project No. D06030-A			
Reach	UT	**X Sec**	4
Date	05/13/13	**Sta No.**	8+31





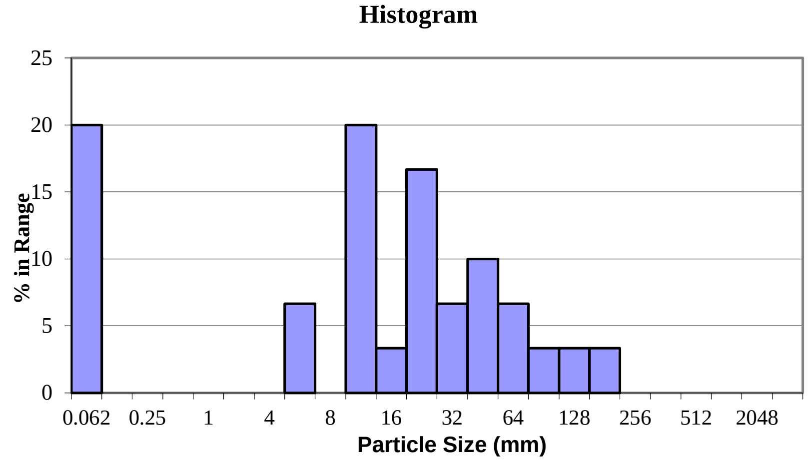
D50= 88.56 mm

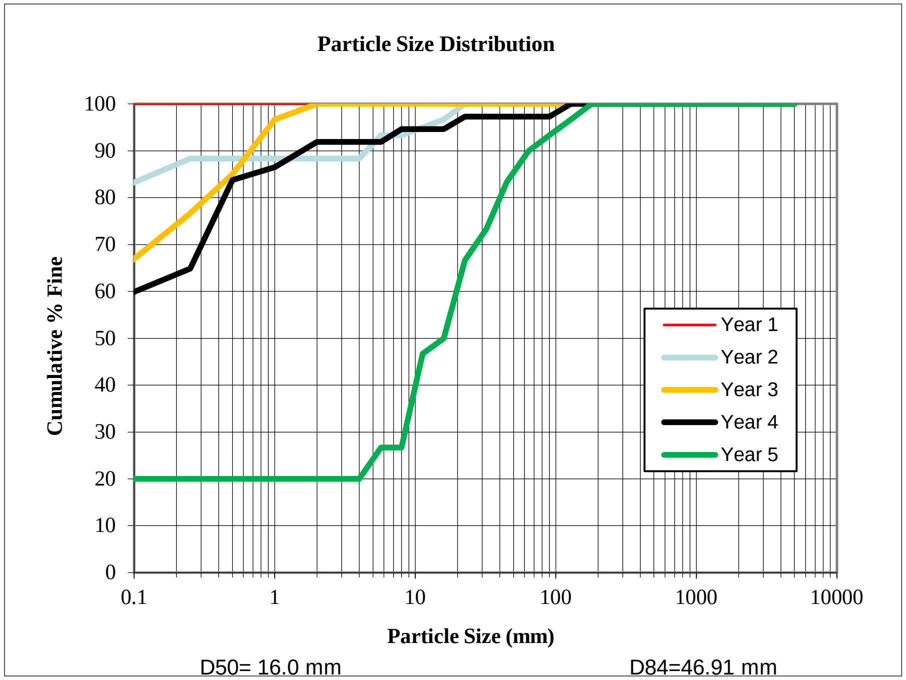
D84=260.27 mm

Pebble Count - Riffle (Year 5)

Material	Particle Size (mm)	Count	% in Range	% Cumulative
Silt/Clay	<0.062	12	20	20
Very Fine Sand	0.062-0.125	0	0	20
Fine Sand	0.125-0.25	0	0	20
Medium Sand	0.25-0.5	0	0	20
Coarse Sand	0.5-1.0	0	0	20
Very Coarse Sand	1.0-2.0	0	0	20
Very Fine Gravel	2.0-4.0	0	0	20
Fine Gravel	4.0-5.7	4	7	27
Fine Gravel	5.7-8.0	0	0	27
Medium Gravel	8.0-11.3	12	20	47
Medium Gravel	11.3-16.0	2	3	50
Coarse Gravel	16.0-22.6	10	17	67
Coarse Gravel	22.6-32	4	7	73
Very Coarse Gravel	32-45	6	10	83
Very Coarse Gravel	45-64	4	7	90
Small Cobble	64-90	2	3	93
Small Cobble	90-128	2	3	97
Large Cobble	128-180	2	3	100
Large Cobble	180-256	0	0	100
Small Boulder	256-362	0	0	100
Small Boulder	362-512	0	0	100
Medium Boulder	512-1024	0	0	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		60	100	

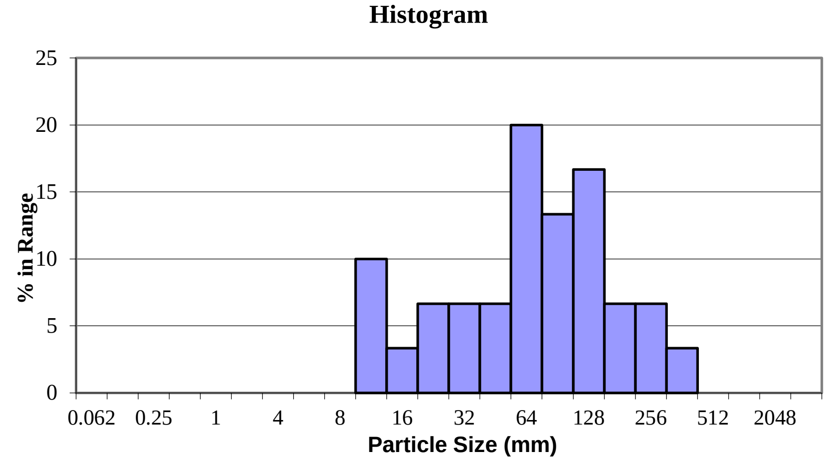
Thompsons Fork Stream Restoration	EEP Project No. D06030-A		
Reach	UT	**X Sec**	5
Date	05/13/13	**Sta No.**	17+79

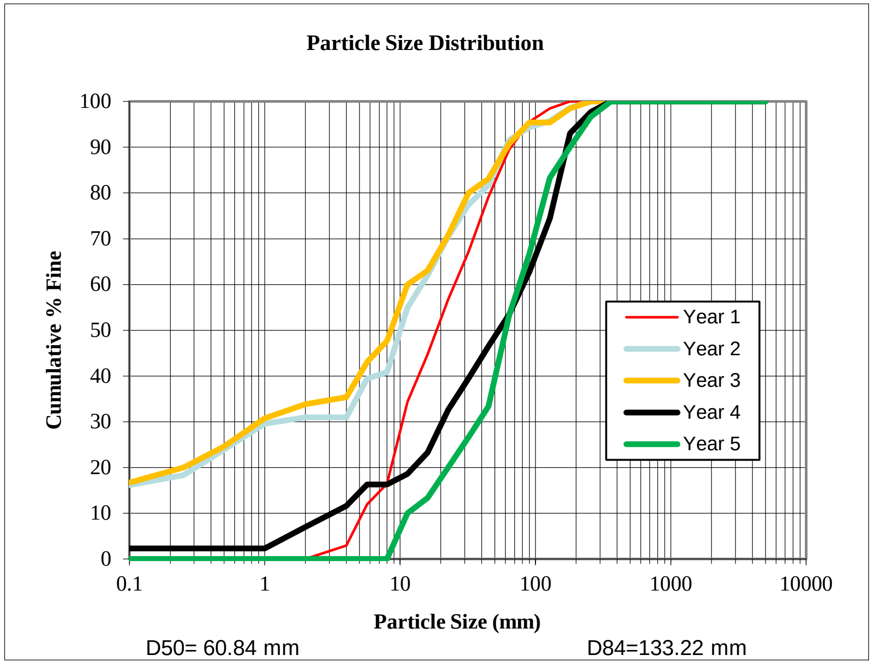




Pebble Count - Riffle (Year 5)				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	0	0	0
Medium Sand	0.25-0.5	0	0	0
Coarse Sand	0.5-1.0	0	0	0
Very Coarse Sand	1.0-2.0	0	0	0
Very Fine Gravel	2.0-4.0	0	0	0
Fine Gravel	4.0-5.7	0	0	0
Fine Gravel	5.7-8.0	0	0	0
Medium Gravel	8.0-11.3	6	10	10
Medium Gravel	11.3-16.0	2	3	13
Coarse Gravel	16.0-22.6	4	7	20
Coarse Gravel	22.6-32	4	7	27
Very Coarse Gravel	32-45	4	7	33
Very Coarse Gravel	45-64	12	20	53
Small Cobble	64-90	8	13	67
Small Cobble	90-128	10	17	83
Large Cobble	128-180	4	7	90
Large Cobble	180-256	4	7	97
Small Boulder	256-362	2	3	100
Small Boulder	362-512	0	0	100
Medium Boulder	512-1024	0	0	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		60	100	

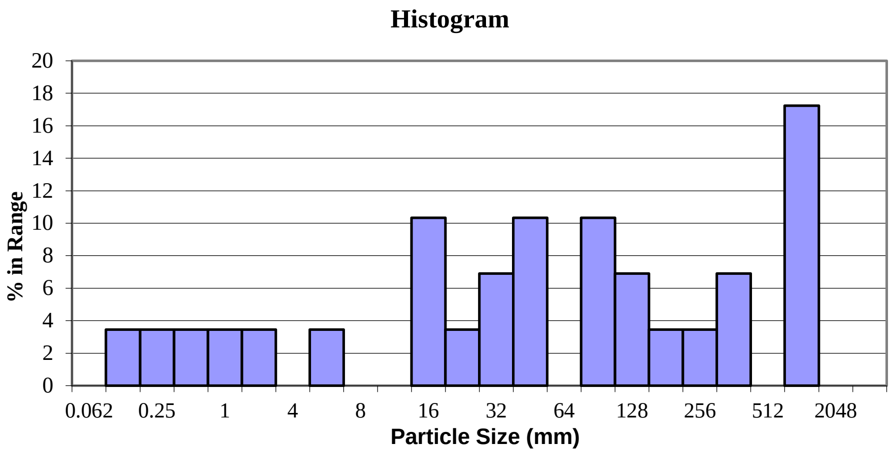
Thompsons Fork Stream Restoration	EEP Project No. D06030-A		
Reach	UT	**X Sec**	6
Date	05/13/13	**Sta No.**	17+94

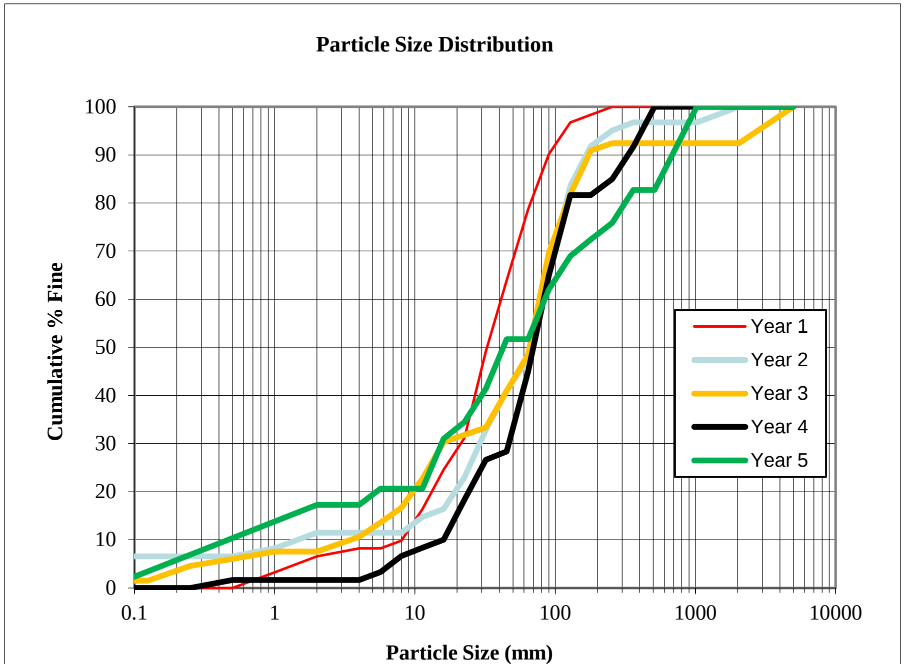




Pebble Count - Riffle (Year 5)				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	2	3	3
Fine Sand	0.125-0.25	2	3	7
Medium Sand	0.25-0.5	2	3	10
Coarse Sand	0.5-1.0	2	3	14
Very Coarse Sand	1.0-2.0	2	3	17
Very Fine Gravel	2.0-4.0	0	0	17
Fine Gravel	4.0-5.7	2	3	21
Fine Gravel	5.7-8.0	0	0	21
Medium Gravel	8.0-11.3	0	0	21
Medium Gravel	11.3-16.0	6	10	31
Coarse Gravel	16.0-22.6	2	3	34
Coarse Gravel	22.6-32	4	7	41
Very Coarse Gravel	32-45	6	10	52
Very Coarse Gravel	45-64	0	0	52
Small Cobble	64-90	6	10	62
Small Cobble	90-128	4	7	69
Large Cobble	128-180	2	3	72
Large Cobble	180-256	2	3	76
Small Boulder	256-362	4	7	83
Small Boulder	362-512	0	0	83
Medium Boulder	512-1024	10	17	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		58	100	

Thompsons Fork Stream Restoration		**EEP Project No. D06030-A**	
Reach	Main stem	**X Sec**	7
Date	05/13/13	**Sta No.**	21+11





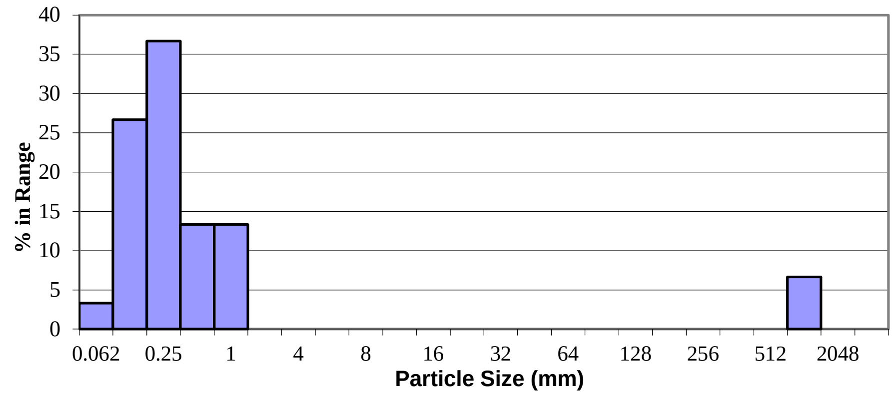
D50= 42.84 mm

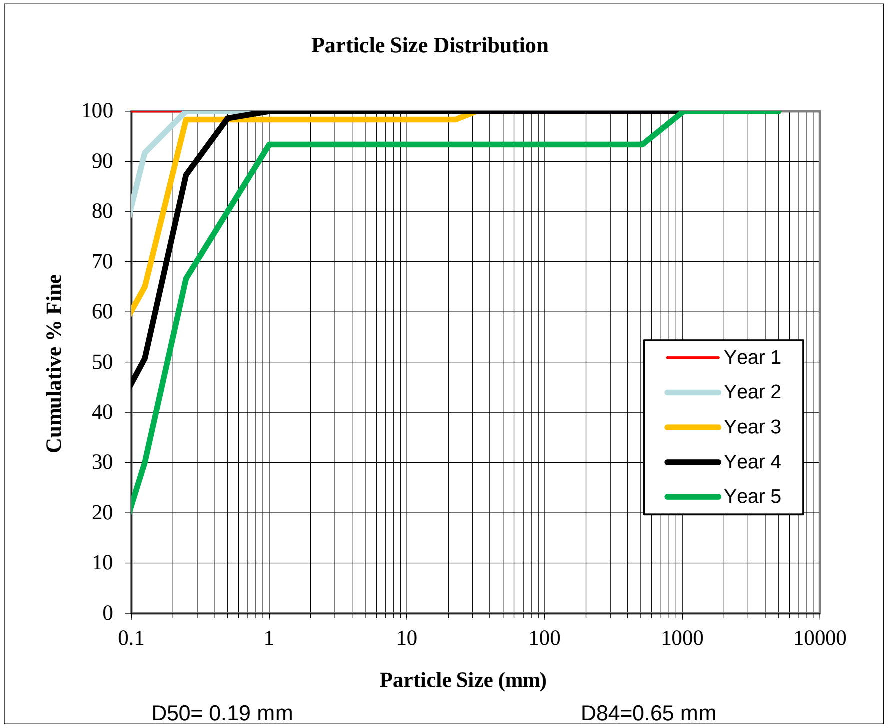
D84=548.83 mm

Pebble Count - Pool (Year 5)				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	2	3	3
Very Fine Sand	0.062-0.125	16	27	30
Fine Sand	0.125-0.25	22	37	67
Medium Sand	0.25-0.5	8	13	80
Coarse Sand	0.5-1.0	8	13	93
Very Coarse Sand	1.0-2.0	0	0	93
Very Fine Gravel	2.0-4.0	0	0	93
Fine Gravel	4.0-5.7	0	0	93
Fine Gravel	5.7-8.0	0	0	93
Medium Gravel	8.0-11.3	0	0	93
Medium Gravel	11.3-16.0	0	0	93
Coarse Gravel	16.0-22.6	0	0	93
Coarse Gravel	22.6-32	0	0	93
Very Coarse Gravel	32-45	0	0	93
Very Coarse Gravel	45-64	0	0	93
Small Cobble	64-90	0	0	93
Small Cobble	90-128	0	0	93
Large Cobble	128-180	0	0	93
Large Cobble	180-256	0	0	93
Small Boulder	256-362	0	0	93
Small Boulder	362-512	0	0	93
Medium Boulder	512-1024	4	7	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		60	100	

Thompsons Fork Stream Restoration EEP Project No. D06030-A			
Reach	Mainstem	**X Sec**	8
Date	05/13/13	**Sta No.**	20+77

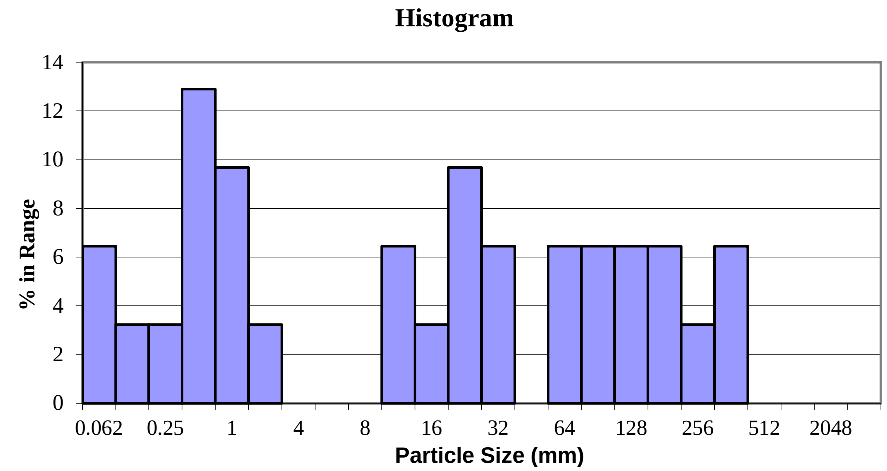
Histogram

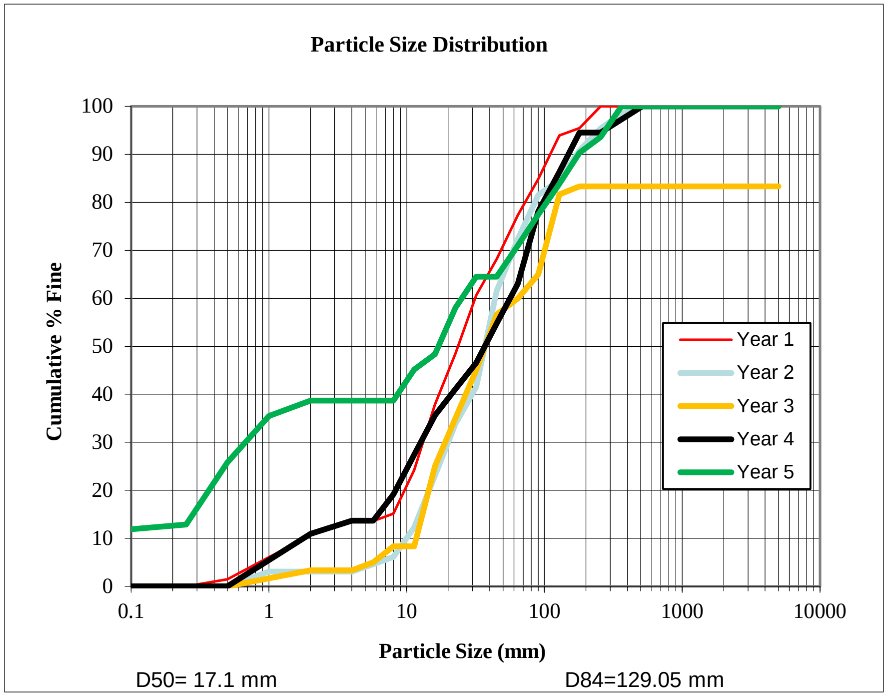




Pebble Count - Riffle (Year 5)				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	4	6	6
Very Fine Sand	0.062-0.125	2	3	10
Fine Sand	0.125-0.25	2	3	13
Medium Sand	0.25-0.5	8	13	26
Coarse Sand	0.5-1.0	6	10	35
Very Coarse Sand	1.0-2.0	2	3	39
Very Fine Gravel	2.0-4.0	0	0	39
Fine Gravel	4.0-5.7	0	0	39
Fine Gravel	5.7-8.0	0	0	39
Medium Gravel	8.0-11.3	4	6	45
Medium Gravel	11.3-16.0	2	3	48
Coarse Gravel	16.0-22.6	6	10	58
Coarse Gravel	22.6-32	4	6	65
Very Coarse Gravel	32-45	0	0	65
Very Coarse Gravel	45-64	4	6	71
Small Cobble	64-90	4	6	77
Small Cobble	90-128	4	6	84
Large Cobble	128-180	4	6	90
Large Cobble	180-256	2	3	94
Small Boulder	256-362	4	6	100
Small Boulder	362-512	0	0	100
Medium Boulder	512-1024	0	0	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		62	100	

Thompsons Fork Stream Restoration	EEP Project No. D06030-A		
Reach	Mainstem	**X Sec**	9
Date	05/13/13	**Sta No.**	7+76

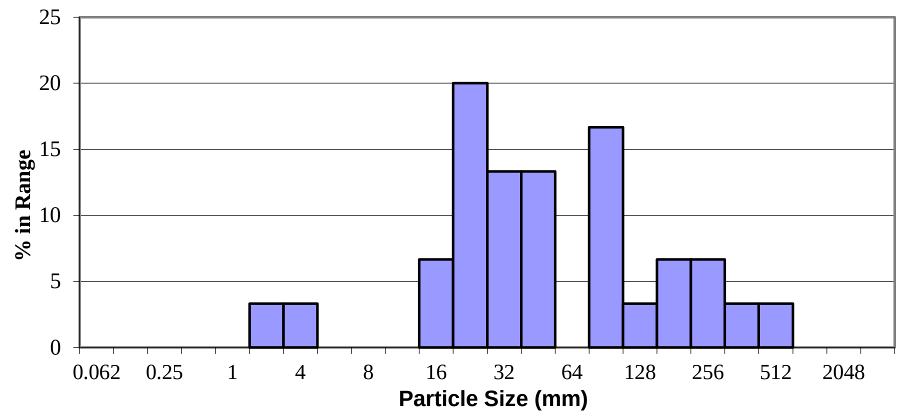


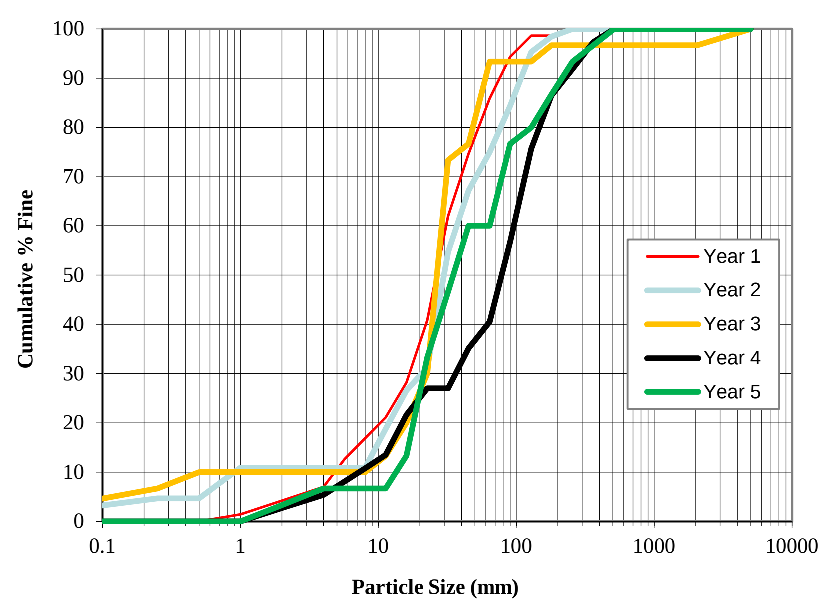


Pebble Count - Riffle (Year 5)				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	0	0	0
Medium Sand	0.25-0.5	0	0	0
Coarse Sand	0.5-1.0	0	0	0
Very Coarse Sand	1.0-2.0	2	3	3
Very Fine Gravel	2.0-4.0	2	3	7
Fine Gravel	4.0-5.7	0	0	7
Fine Gravel	5.7-8.0	0	0	7
Medium Gravel	8.0-11.3	0	0	7
Medium Gravel	11.3-16.0	4	7	13
Coarse Gravel	16.0-22.6	12	20	33
Coarse Gravel	22.6-32	8	13	47
Very Coarse Gravel	32-45	8	13	60
Very Coarse Gravel	45-64	0	0	60
Small Cobble	64-90	10	17	77
Small Cobble	90-128	2	3	80
Large Cobble	128-180	4	7	87
Large Cobble	180-256	4	7	93
Small Boulder	256-362	2	3	97
Small Boulder	362-512	2	3	100
Medium Boulder	512-1024	0	0	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		60	100	

Thompsons Fork Stream Restoration		**EEP Project No. D06030-A**	
Reach	Mainstem	**X Sec**	10
Date	05/13/13	**Sta No.**	7+37

Histogram





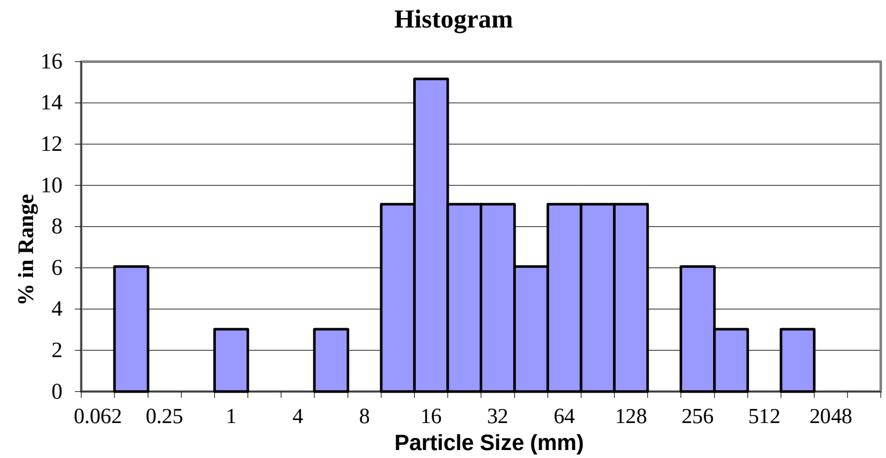
D50= 32.85 mm

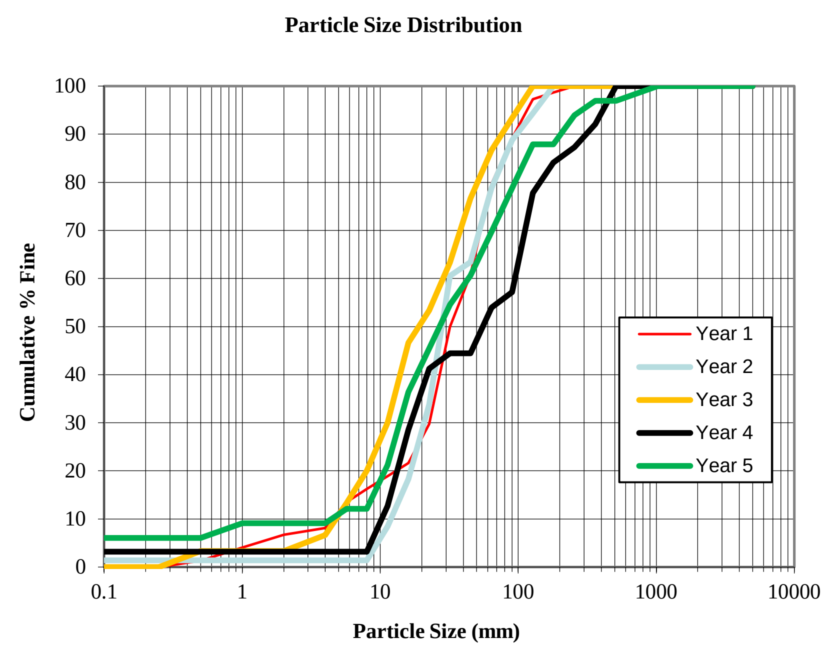
D84=159.18 mm

Thompsons Fork Stream Restoration	EEP Project No. D06030-A		
Reach	Mainstem	**X Sec**	11
Date	05/13/13	**Sta No.**	2+81

Pebble Count - Riffle (Year 5)

Material	Particle Size (mm)	Count	% in Range	% Cumulative
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	4	6	6
Fine Sand	0.125-0.25	0	0	6
Medium Sand	0.25-0.5	0	0	6
Coarse Sand	0.5-1.0	2	3	9
Very Coarse Sand	1.0-2.0	0	0	9
Very Fine Gravel	2.0-4.0	0	0	9
Fine Gravel	4.0-5.7	2	3	12
Fine Gravel	5.7-8.0	0	0	12
Medium Gravel	8.0-11.3	6	9	21
Medium Gravel	11.3-16.0	10	15	36
Coarse Gravel	16.0-22.6	6	9	45
Coarse Gravel	22.6-32	6	9	55
Very Coarse Gravel	32-45	4	6	61
Very Coarse Gravel	45-64	6	9	70
Small Cobble	64-90	6	9	79
Small Cobble	90-128	6	9	88
Large Cobble	128-180	0	0	88
Large Cobble	180-256	4	6	94
Small Boulder	256-362	2	3	97
Small Boulder	362-512	0	0	97
Medium Boulder	512-1024	2	3	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		66	100	

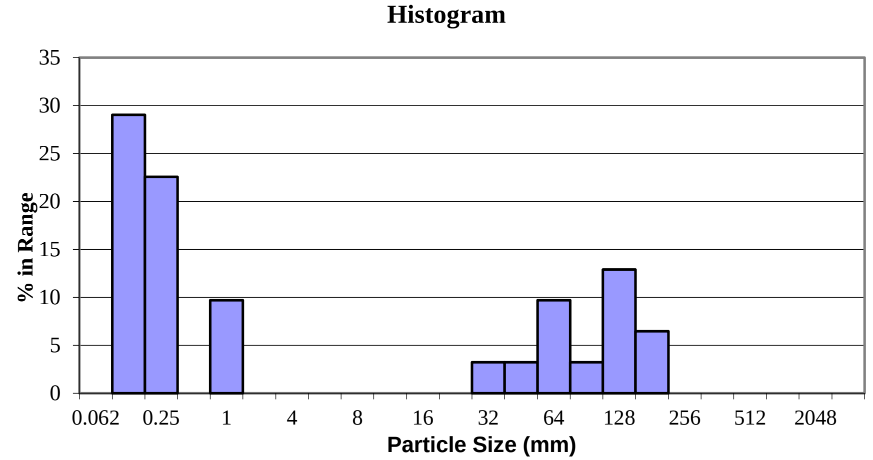


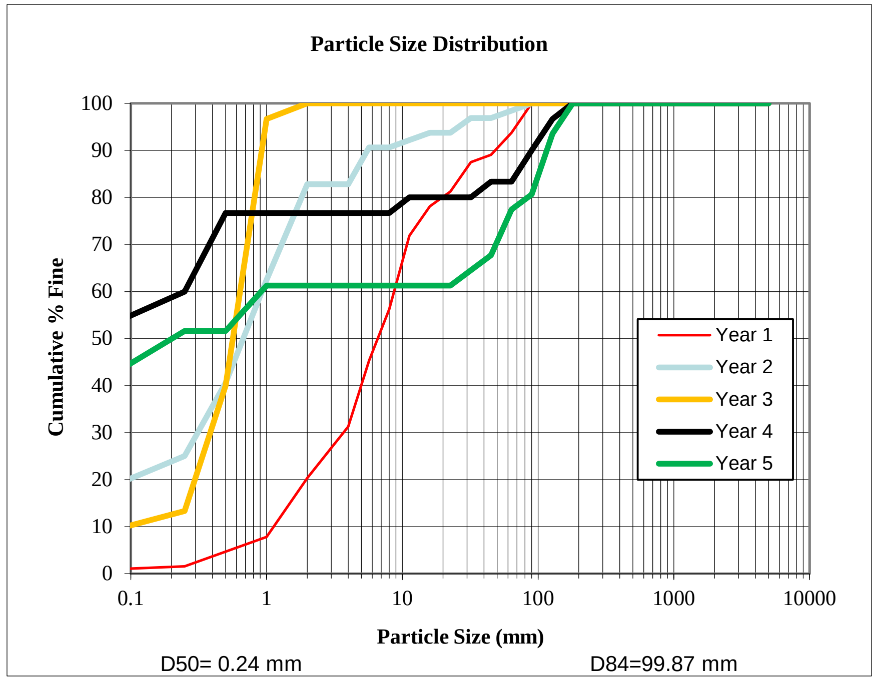


D50= 27.3 mm D84=111.78 mm

Pebble Count - Pool (Year 5)				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	18	29	29
Fine Sand	0.125-0.25	14	23	52
Medium Sand	0.25-0.5	0	0	52
Coarse Sand	0.5-1.0	6	10	61
Very Coarse Sand	1.0-2.0	0	0	61
Very Fine Gravel	2.0-4.0	0	0	61
Fine Gravel	4.0-5.7	0	0	61
Fine Gravel	5.7-8.0	0	0	61
Medium Gravel	8.0-11.3	0	0	61
Medium Gravel	11.3-16.0	0	0	61
Coarse Gravel	16.0-22.6	0	0	61
Coarse Gravel	22.6-32	2	3	65
Very Coarse Gravel	32-45	2	3	68
Very Coarse Gravel	45-64	6	10	77
Small Cobble	64-90	2	3	81
Small Cobble	90-128	8	13	94
Large Cobble	128-180	4	6	100
Large Cobble	180-256	0	0	100
Small Boulder	256-362	0	0	100
Small Boulder	362-512	0	0	100
Medium Boulder	512-1024	0	0	100
Large Boulder	1024-2048	0	0	100
Bedrock	<2048	0	0	100
Totals		62	100	

Thompsons Fork Stream Restoration		EEP Project No. D06030-A	
Reach	Mainstem	**X Sec**	12
Date	05/13/13	**Sta No.**	2+68





BF 1
Crest Gage at XS-6 on UT (Year 1).
(EMH&T, 9/21/09)

BF 2
Crest Gage at XS-6 on UT (Year 2).
(EMH&T, 5/12/10)

BF 3
Crest Gage at XS-6 on UT (Year 5).
(EMH&T, 5/13/13)

BF 4
Crest Gage at XS-7 on Mainstem (Year 1).
(EMH&T, 9/21/09)

BF 5
Crest Gage at XS-7 on Mainstem (Year 2).
(EMH&T, 5/12/10)

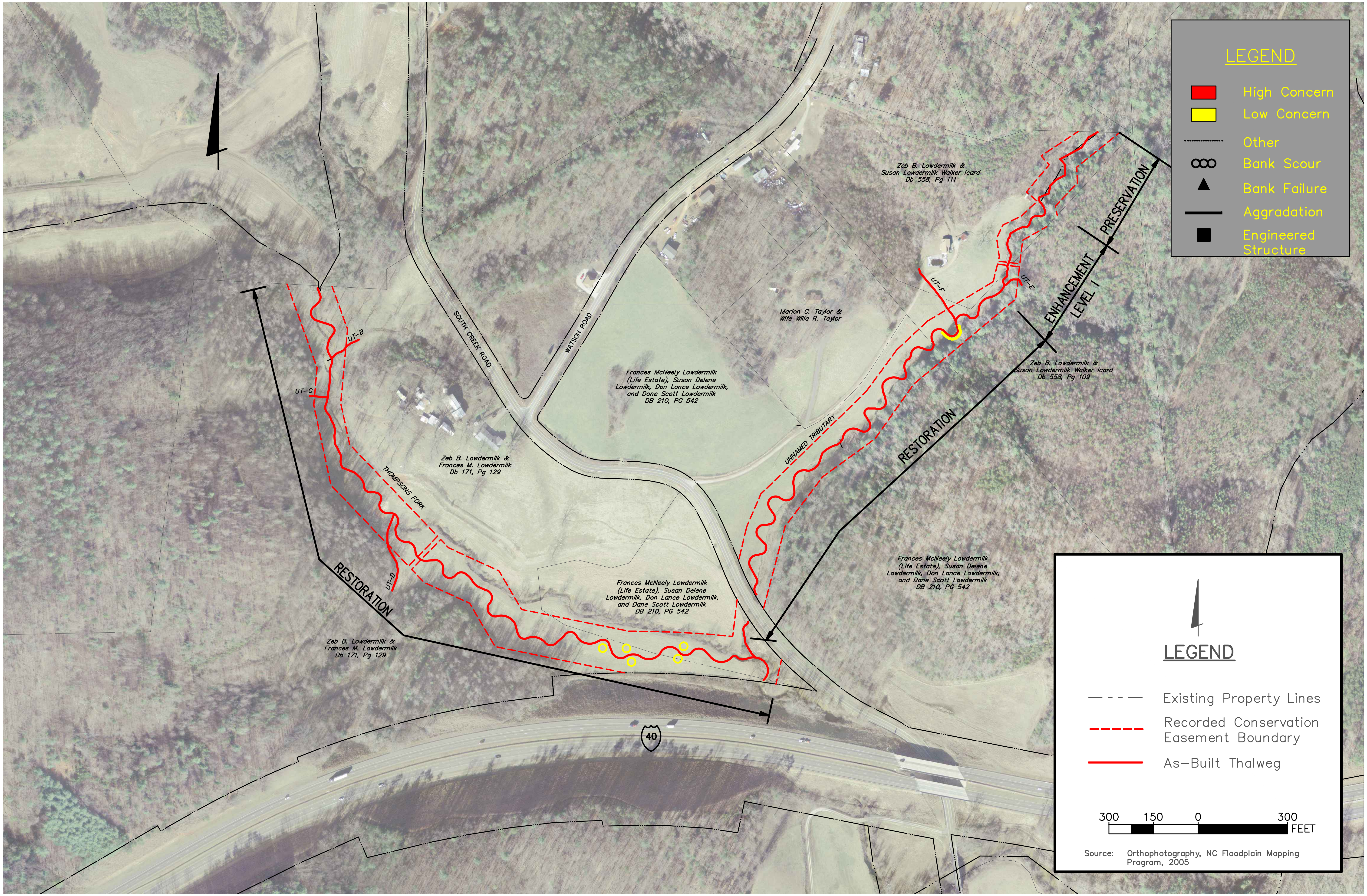
BF 6
Crest Gage at XS-7 on Mainstem (Year 5).
(EMH&T, 3/11/13)

SPA 1
Scour along left and right bank of Thompsons Fork Mainstem at station 23+50; caused by a beaver dam that was created and subsequently deconstructed in early spring, 2013.
(EMH&T, 5/13/13)

SPA 2
Scour along left and right bank of Thompsons Fork Mainstem at station 21+50; caused by a beaver dam that was created and subsequently deconstructed in early spring, 2013.
(EMH&T, 5/13/13)

SPA 3
Scour and sloughing along the right bank of Thompsons Fork Mainstem at station 20+75.
(EMH&T, 5/13/13)

SPA 4
Infiltrating wetland vegetation within UT at station 8+00.
(EMH&T, 5/13/13)



Job No. 2009-0328
Sheet 1/1
Date December, 2013
Scale 1" = 300'

MCDOWELL COUNTY, NORTH CAROLINA
THOMPSONS FORK
AND UNNAMED TRIBUTARY
APPENDIX B
STREAM PROBLEM AREA PLAN VIEW

EMH&T

APPENDIX C

UT-1 Maintenance

1. Maintenance Map for UT-1 (spring, 2011)

MCDOWELL COUNTY, NORTH CAROLINA
STREAM RESTORATION PLAN
FOR
THOMPSONS FORK
AND UNNAMED TRIBUTARY (UT)
REMEDIAL MAINTENANCE

EMH&T
Evans, Mechwart, Hambleton & Tilton, Inc.
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: 614.775.4500 Fax: 614.775.4800
M C M X X V I

Date:	April, 2011
Scale:	1" = 60'
Job No:	2009–0328
Sheet:	1 of 1