Year 3 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

Submitted: December, 2011

Prepared by:

Wetlands Resource Center
3970 Bowen Road
Canal Winchester, Ohio 43110
Project Manager: Cal Miller
P: (614) 864-7511
F: (614) 866-3691

And

EMH&T, Inc.
5500 New Albany Road
Columbus, Ohio 43054
Project Manager: Miles F. Hebert, PE
P: (614) 775-4205
F: (614) 775-4802
Main: (614) 775-4500

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

Table of Contents

List of Tables

List of Appendices

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 mainstem 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 3 Annual Monitoring for this project.

Vegetative monitoring was completed in September 2011 following the Carolina Vegetation Survey methodology. Stem counts completed at eight vegetation plots show an average density of 937 stems per acre for the site. This is a significant increase over the Year 2 total of 704. This density exceeds the success criteria of 320 stems/acre after three 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 high concern was noted in the project area along the riparian corridor of the UT. This problem area includes a growing 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 over the past two years. However, the vine continues to spread and increase in density. An intensive herbicidal spraying effort was conducted in the fall of 2011 to knock down the spread. Another spraying effort will be conducted in the spring of 2012.

Year 3 monitoring of the streams identified some minor problem areas along the project reaches. Narrow bars of wetland vegetation forming along the stream banks of the mainstem were noted under the aggradation feature category for future monitoring. In Year 2, aggradation was noted to be occurring in a few pools associated with log sills along the unnamed tributary to Thompsons Fork. The degree of aggradation on the tributary warranted maintenance at the time. Excessive sediment accumulation and resultant wetland vegetation was successfully removed in the spring of 2011 for the entire tributary reach.

The visual stream stability assessment for Year 3 revealed that the majority of in-stream structures are functioning as designed and built on the Thompsons Fork mainstem and unnamed tributary. Bedform features are evolving along the restored reaches compared to as-built conditions, as shown on the long-term longitudinal profiles. Dimensional measurements of the monumented cross-sections remain stable when compared to Year 1, Year 2, and as-built conditions. The comparison of the Year 3 and Year 2 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 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 have been alleviated via stream maintenance activities which occurred in late May, 2011. As a result, the reach-wide particle distribution (including pebble counts from both pool and riffle features) has improved within the past year and has shifted from the medium sand category to the very coarse sand category.

Although the channel is still classified as a C5b, as it was in Year 2, it is trending toward a more healthy and desirable C4b classification in which the dominant reach substrate is gravel.

Based on the crest gage network installed on the project reaches, one bankfull event was recorded along each reach during both the Year 1 and Year 2 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). This brings the total number of bankfull events for the mainstem and UT to two, in consecutive years.

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

Thompsons Fork Mainstem

Parameter	Pre-Restoration	As-built	Year 1	Year 2	Year 3
Length	**2,530 ft**	**2,727 ft**	**2,727 ft**	**2,727 ft**	**2,727 ft**
Bankfull Width	**20.9 ft**	**37.7 ft**	**36.3 ft**	**34.1 ft**	**31.9 ft**
Bankfull Max Depth	**5.1 ft**	**2.5 ft**	**2.4 ft**	**2.6 ft**	**2.6 ft**
Width/Depth Ratio	**7.7**	**27.1**	**28.7**	**26.2**	**25.5**
Entrenchment Ratio	**1.5**	**3**	**3**	**3.0**	**3.5**
Bank Height Ratio	**2.4**	**1**	**1**	**1**	**1**
Sinuosity	**1.12**	**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
Length	**1,598 ft**	**1,948 ft**	**1,948 ft**	**1,948 ft**	**1,948 ft**
Bankfull Width	**13.1 ft**	**14.0 ft**	**15.4 ft**	**11.6 ft**	**14.7 ft**
Bankfull Max Depth	**1.1 ft**	**1.7 ft**	**1.6 ft**	**1.8 ft**	**2.1 ft**
Width/Depth Ratio	**16**	**17.4**	**18.1**	**12.8**	**16.2**
Entrenchment Ratio	**3.4**	**6**	**5.6**	**7.4**	**6.4**
Bank Height Ratio	**1.6**	**1**	**1**	**1**	**1**
Sinuosity	**1.09**	**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 mainstem and one unnamed tributary stream designated UT.

The directions to the project site are as follows:

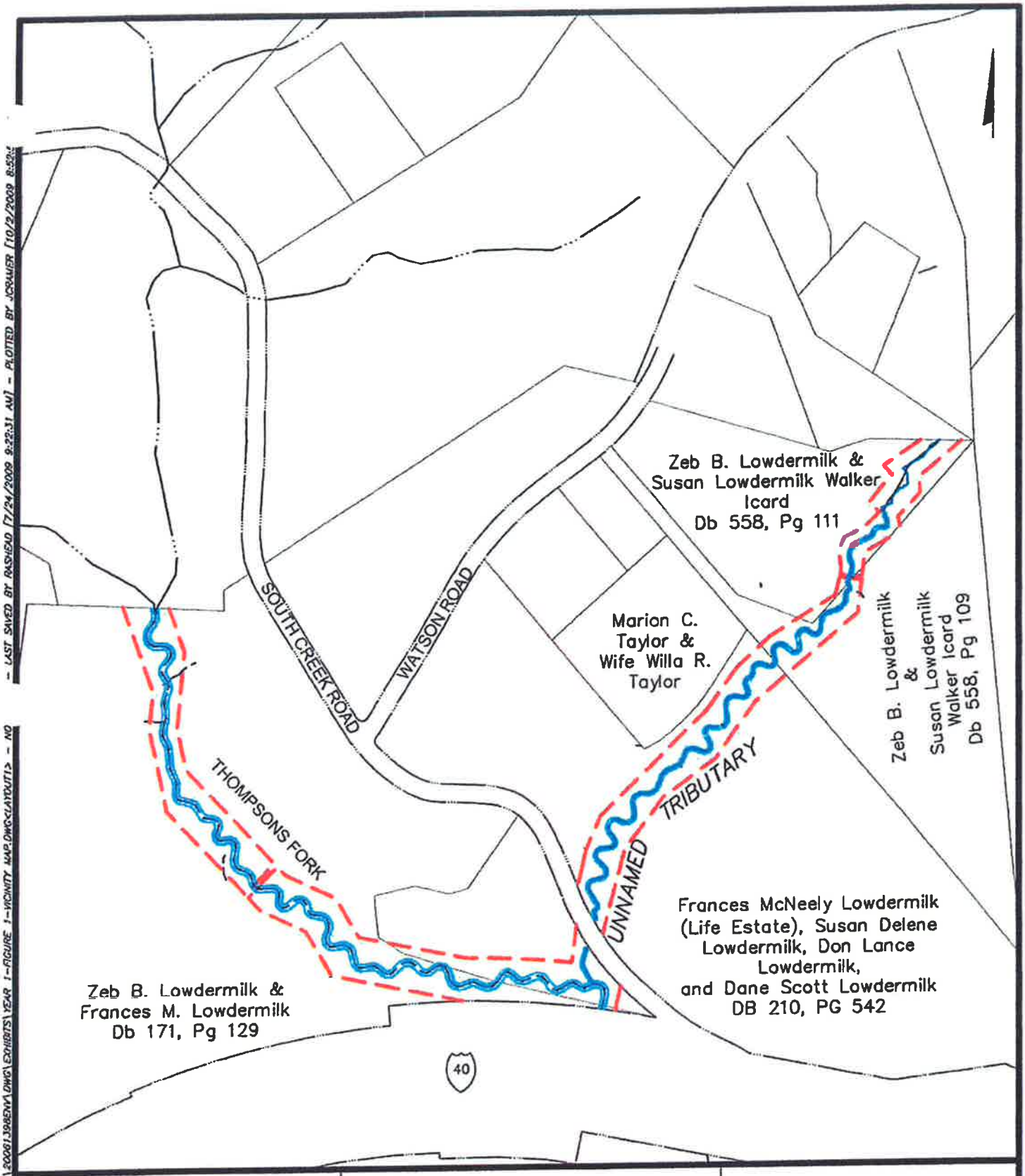
> Exit I-40 at Exit 94 and travel north on Dysartsville Road for 0.6 mile. Turn left and travel west onto US-70 for 3.2 miles, then turn left onto Watson Road. Travel 1.1 miles south on Watson Road to the intersection of South Creek Road. Zeb Lowdermilk's residence (1394 South Creek Road, Nebo, NC 28761) 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/hayland 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 mainstem, widening for only a short distance near the downstream limits of the mainstem 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 mainstem 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 mainstem 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



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

MCDOWELL COUNTY, NORTH CAROLINA
THOMPSON FORK RESTORATION
FIGURE 1: SITE VICINITY MAP
N.C. ECOSYSTEM ENHANCEMENT PROGRAM

Date: July, 2009
Not To Scale

Ecosystem Enhancement PROGRAM

streambank 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 mainstem 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 mainstem 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 mainstem.

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 mainstem. 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 floodprone 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 mainstem 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 Mainstem:

- 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 25 in Year 3.
- 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 floodprone area by both raising the stream bed and excavating the adjacent floodplain. The completed restoration changed the average entrenchment ratio from 1.53 to 3.5 in Year 3.
- Created instream 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 16.2 in Year 3. 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 floodprone area by both raising the stream bed and excavating the adjacent floodplain. The completed restoration changed the average entrenchment ratio from 3.4 to 6.4.
- 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 Mainstem	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 Mainstem	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		
Year 5 monitoring	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	Jud M. Hines, EMH&T
Vegetation Monitoring POC	Megan F. Wolf, EMH&T

Table V. Project Background Table Thompsons Fork Stream Restoration / EEP Project No. D06030-A	
Project County	McDowell
Drainage Area	Mainstem-7.57 sq mi UT-0.163 sq mi
Drainage Impervious Cover Estimate	2.36%
Stream Order	Mainstem-3rd UT-1st
Physiographic Region	Blue Ridge Mountains/Southern Inner Piedmont
Ecoregion	Eastern Blue Ridge Foothills
Rosgen Classification of As-built	Mainstem-C4 UT- C3b
Dominant Soil Types	Colvard loam, Evard-Cowee complex, Iotla sandy loam
Reference Site ID	Thompsons Fork Mainstem, 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.

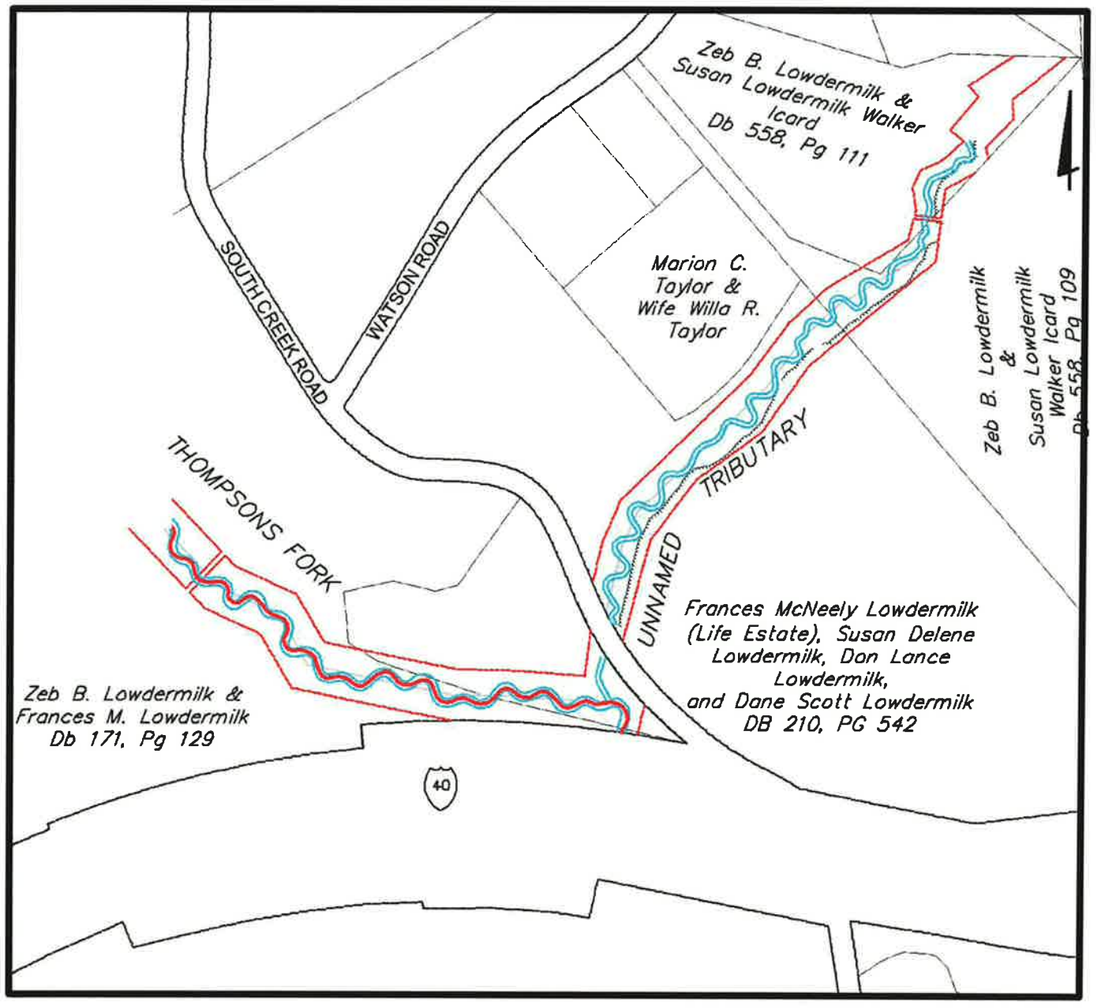
MCDOWELL COUNTY, NORTH CAROLINA

FIGURE 2 - MONITORING PLAN VIEW

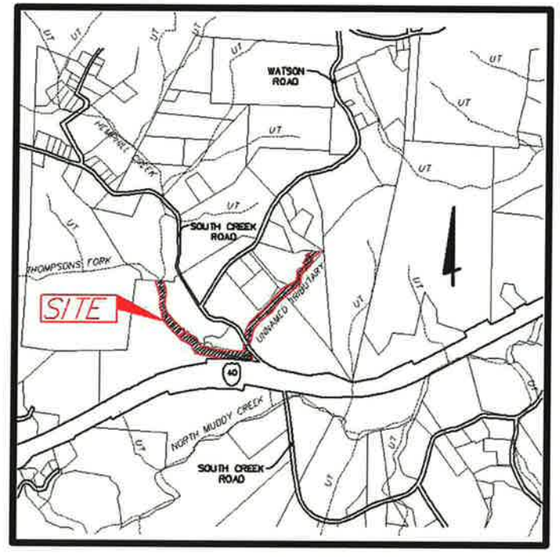
FOR

THOMPSONS FORK AND UNNAMED TRIBUTARY

2011



LOCATION MAP
Scale: 1"=400'



VICINITY MAP
Not To Scale

Job No. 2009-0028
Sheet 1/8
Date December, 2011
Scale Hor. 1" = 40'
Ver. 1" = 5'

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

Ecosystem Enhancement Program

EMH&T

REVISIONS

BEGIN AS-BUILT
STA. 0+00.00

LEGEND

- Vegetation Plot (VP)
- Crest Gauge Location
- Cross Section Monument
- Ex. Property Line
- Recorded Conservation Easement
- As-Built Thalweg and Stationing
- As-Built Riffle
- As-Built Cross Vane
- As-Built J-Hook
- As-Built Log Vane
- Fixed Photo Locations

VP-8
Limits of Beltwidth
Bankfull Width
Ex. Stream
Ex. Fence
Ex. Unnamed Tributary B
Constructed Point Bar (Typ.)
Ex. Drive
VP-7
Ex. Unnamed Tributary C
Ex. Stream Crossing
X-Sec 12
X-Sec 11
Recorded Conservation Easement
NC EEP Project No. D06030-A
Deed BK: CRP 919, PG: 964-969
Plat BK: PL 15, PG 5-5
Zeb B. Lowdermilk & Frances M. Lowdermilk — Db. 171, Pg 129
Matchline Sta. 6+00.00 (See This Sheet)

40 0 40 Feet
20
Scale: 1" = 40'

Zeb B. Lowdermilk &
Frances M. Lowdermilk
Db 171, Pg 129
Recorded Conservation Easement
NC EEP Project No. D06030-A
Deed BK: CRP 919, PG: 964-969
Plat BK: PL 15, PG 5-5

Ex. Drive
X-Sec 10
X-Sec 9
Matchline Sta. 6+00.00 (See Sheet AB-02)
Ex. Stream
Constructed Point Bar (Typ.)
Limits of Beltwidth
Bankfull Width
Ex. Stream
Ex. Culverts (To Be Removed)
Ex. Stream Crossing (To be relocated outside Conservation Easement)
Constructed Point Bar (Typ.)
Stream Crossing
Matchline Sta. 13+00.00 (See Sheet 3)

40 0 40 Feet
20
Scale: 1" = 40'

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

Job No. 2009-0328
Sheet 2/8
Date December, 2011
Scale Hor: 1" = 40'
Ver: 1" = 5'

Ecosystem Enhancement Program

EMH&T
Environmental • Hydrology • Transportation
Engineers • Surveyors • Planners • Scientists
5500 New Albany Road, Columbus, OH 43054
Phone: (614) 775-4500 www.emht.com

REVISIONS
MARK | DATE | DESCRIPTION

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

Date: December, 2011
Job No. 21909-0028
Scale: Hor. 1" = 40' Ver. 1" = 5'
Sheet 3/8

Ecosystem Enhancement Program

EMH&T
Engineers, Architects, Surveyors & Planners, Inc.
5500 New Albany Road, Columbus, Ohio 43054
Phone: 614.775.4500 Fax: 614.775.4800

REVISIONS
NO. | DATE | DESCRIPTION

40 0 40 Feet
20
Scale: 1" = 40'

Matchline Sta. 12+50.00 (See This Sheet)

Matchline Sta. 18+50.00 (See Sheet 4)

Ex. Stream

Ex. Stream

Zeb B. Lowdermilk & Frances M. Lowdermilk Db 171, Pg 129

Zeb B. Lowdermilk & Frances M. Lowdermilk Db 171, Pg 129

VP-5

VP-6

Ex. O/H Electric

Limits of Beltwidth

Bankfull Width

Constructed Point Bar (Typ.)

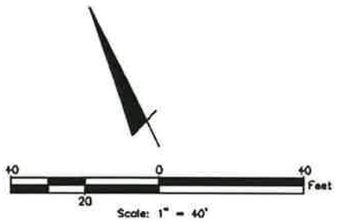
Recorded Conservation Easement
NC EEP Project No.: D080030-A
Deed BK.: CRP 919, PG: 964-969
Plat BK.: PL 15, PG 5-5

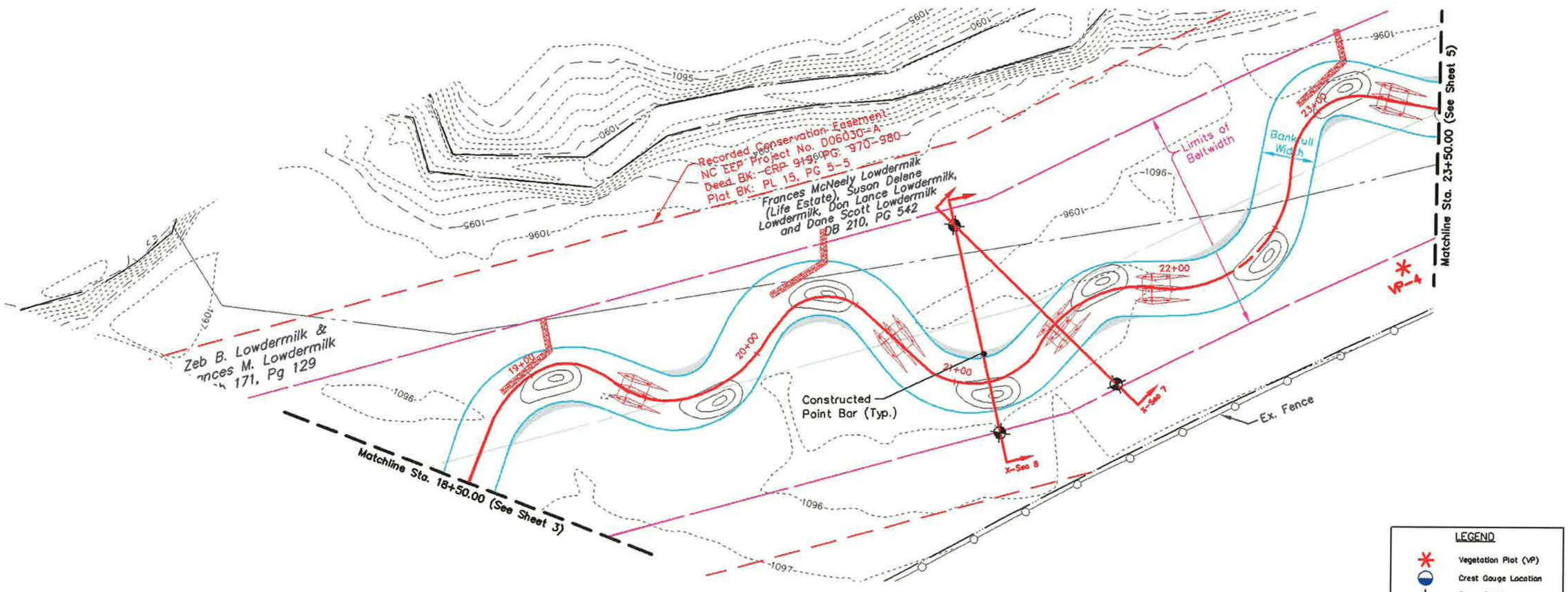
13+00 14+00 15+00 16+00 17+00 18+00

1090 1097 1095 1089 1098 1096 1100 1101

LEGEND
- Vegetation Plot (VP)
- Crest Gauge Location
- Cross Section Monument
- Ex. Property Line
- Recorded Conservation Easement
- As-Built Thalweg and Stationing
- As-Built Riffle
- As-Built Cross Vane
- As-Built J-Hook
- As-Built Log Vane
- Fixed Photo Locations

40 0 40 Feet
20
Scale: 1" = 40'





LEGEND

- Vegetation Plot (VP)
- Crest Gauge Location
- Cross Section Monument
- Ex. Property Line
- Recorded Conservation Easement
- As-Built Thalweg and Stationing
- As-Built Riffle
- As-Built Cross Vane
- As-Built J-Hook
- As-Built Log Vane
- Fixed Photo Locations

HOKE/HARNETT COUNTY, NORTH CAROLINA
FIGURE 2 - MONITORING PLAN VIEW
(MY1)

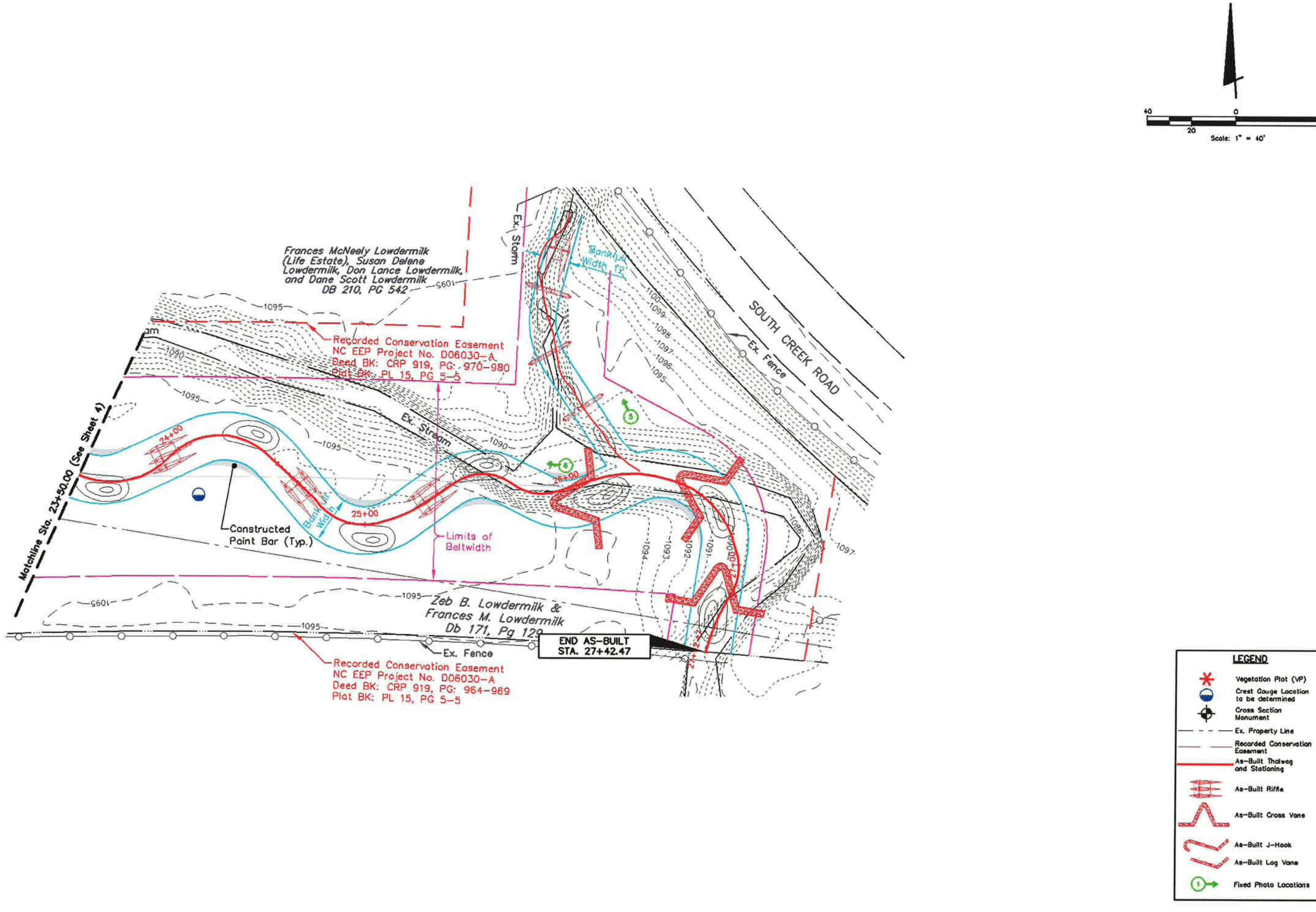
THOMPSONS FORK AND UNNAMED TRIBUTARY

THOMPSONS FORK

Date: December, 2011
Scale: Hor: 1" = 40' Ver: 1" = 5'
Job No.: 2008-0028
Sheet: 4/8

EMHT
Ecosystem Enhancement Program

REVISIONS



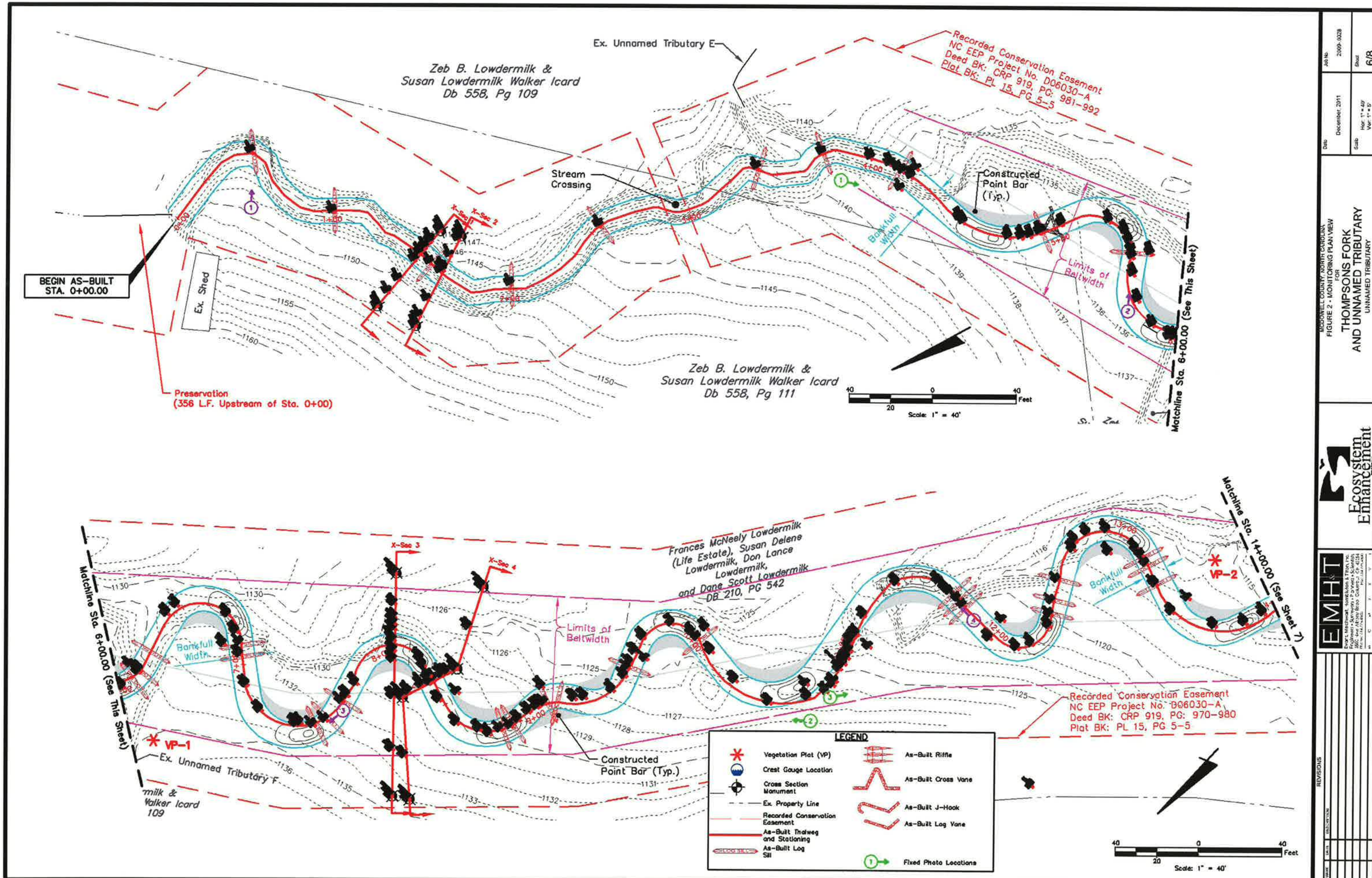
MCDOWELL COUNTY, NORTH CAROLINA
FIGURE 2 - MONITORING PLAN VIEW
FOR
THOMPSONS FORK
AND UNNAMED TRIBUTARY
THOMPSONS FORK

Ecosystem Enhancement PROGRAM

EMHT

Date: December, 2011
Scale: Hor: 1" = 40' Ver: 1" = 5'
Job No. 2009-0328
Sheet 5/8

REVISIONS


Ex. Unnamed Tributary E
Zeb B. Lowdermilk &
Susan Lowdermilk Walker Icard
Db 558, Pg 109
Recorded Conservation Easement
NC EEP Project No. D06030-A
Deed BK: CRP 919, PG: 981-992
Plat BK: PL 15, PG 5-5
Stream Crossing
Constructed Point Bar (Typ.)
Bankfull Width
Limits of Beltwidth
BEGIN AS-BUILT
STA. 0+00.00
Ex. Shed
X-Sec 1
X-Sec 2
Preservation
(356 L.F. Upstream of Sta. 0+00)
Zeb B. Lowdermilk &
Susan Lowdermilk Walker Icard
Db 558, Pg 111
Scale: 1" = 40'
Feet
Matchline Sta. 6+00.00 (See This Sheet)
Frances McNeely Lowdermilk
(Life Estate), Susan Delene
Lowdermilk, Don Lance
Lowdermilk,
and Dane Scott Lowdermilk
DB 210, PG 542
X-Sec 3
X-Sec 4
Limits of Beltwidth
Bankfull Width
Matchline Sta. 14+00.00 (See Sheet 7)
VP-1
VP-2
Ex. Unnamed Tributary F
Constructed Point Bar (Typ.)
Recorded Conservation Easement
NC EEP Project No. D06030-A
Deed BK: CRP 919, PG: 970-980
Plat BK: PL 15, PG 5-5
LEGEND
Vegetation Plot (VP)
Crest Gauge Location
Cross Section Monument
Ex. Property Line
Recorded Conservation Easement
As-Built Thalweg and Stationing
As-Built Log Sill
As-Built Riffle
As-Built Cross Vane
As-Built J-Hook
As-Built Log Vane
Fixed Photo Locations
Scale: 1" = 40'
MCDOWELL COUNTY, NORTH CAROLINA
FIGURE 2 - MONITORING PLAN VIEW
FOR
THOMPSONS FORK
AND UNNAMED TRIBUTARY
UNNAMED TRIBUTARY
Date December, 2011
Scale Hor: 1" = 40' Ver: 1" = 5'
Job No. 2009.0328
Sheet 6/8
Ecosystem Enhancement PROGRAM
EMHT
REVISIONS

\\CMHDATA01\Project01\20090328\20090328env\Dwg\Exhibits\Year 3-Figure 2 - Monitoring Plan View 06-08.dwg<Sheet 6> - No Xrefs - No Images - SavedBy: JCRAMER (6/14/2011 8:50:01 AM) - PlottedBy: JCRAMER (6/14/2011 8:50:22 AM)

Frances McNeely Lowdermilk (Life Estate), Susan Delene Lowdermilk, Don Lance Lowdermilk, and Dane Scott Lowdermilk
DB 210, PG 542

Matchline Sta. 11+00.00 (See Sheet 6)

Ex. Unnamed Tributary G

Limits of Beltwidth

Constructed Point Bar (Typ.)

X-Sec 8

X-Sec 8

Matchline Sta. 19+50.00 (See This Sheet)

Bankfull Width

VP-3

40 0 40 Feet
20
Scale: 1" = 40'

Recorded Conservation Easement
NC EEP Project No. D06030-A
Deed BK: CRP 919, PG: 970-980
Plat BK: PL 15, PG 5-5

Frances McNeely Lowdermilk (Life Estate), Susan Delene Lowdermilk, Lowdermilk, Don Lance Lowdermilk, and Dane Scott Lowdermilk

END AS-BUILT STREAM WORK STA. 20+07.38

Matchline Sta. 19+50.00 (See This Sheet)

Limits of Beltwidth

SOUTH CREEK ROAD

40 0 40 Feet
20
Scale: 1" = 40'

LEGEND

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

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

Date: December, 2011
Job No. 2009-0328
Sheet 7/8
Scale: Hor. 1" = 40'
Ver. 1" = 5'

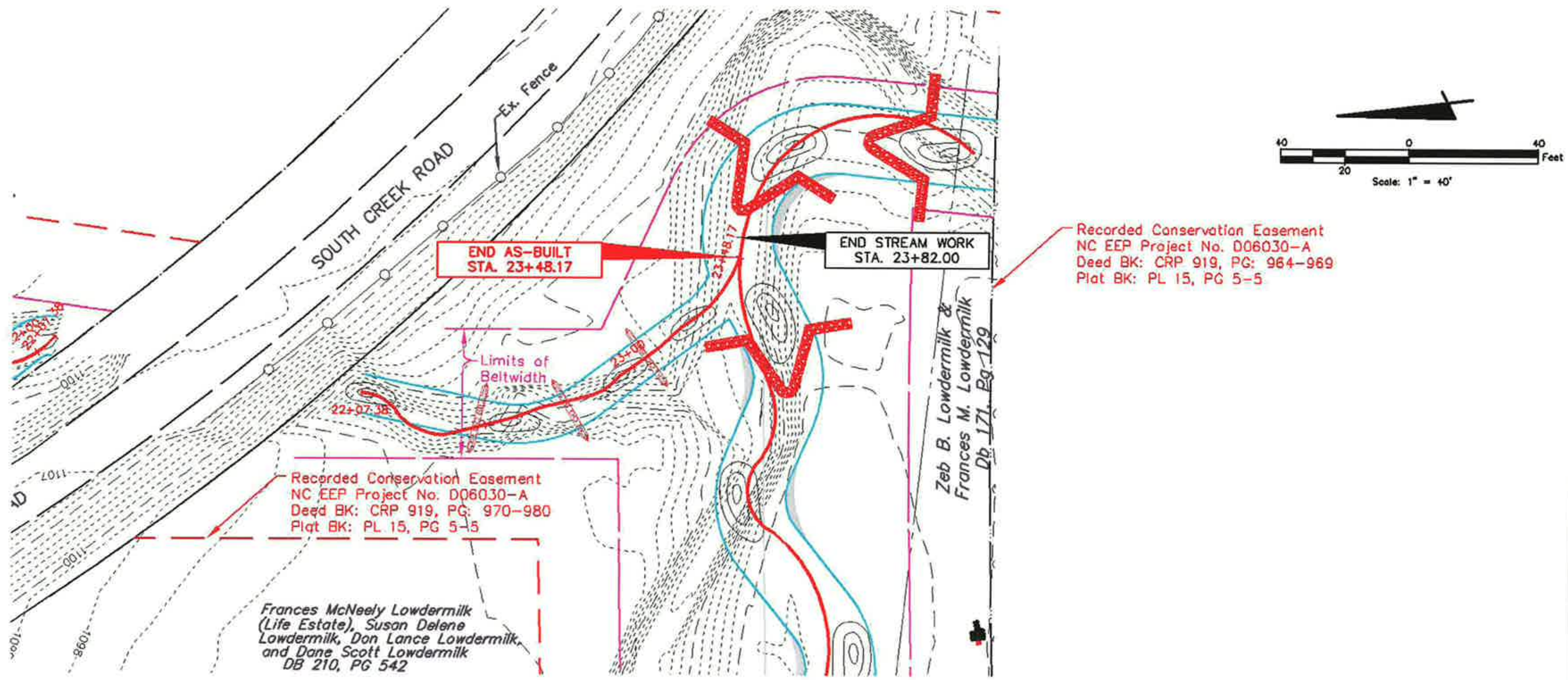
Ecosystem Enhancement Program

EMH&T
Environmental, Water Resources & Transportation Consultants
5500 New Albany Road, Columbus, Ohio 43054
Phone: (614) 775-4500 Fax: (614) 775-4800

REVISIONS

MARK	DATE	DESCRIPTION

\\CivilDATA01\Project01\20090328\20090328mw\Dwg\Exhibits\Year 3-Figure 2 - Monitoring Plan View 06-08.dwg<Sheet 7> - No Xrefs - No Images - Saved By: JCRAMER (6/14/2011 8:50:01 AM) - Plotted By: JCRAMER (6/14/2011 8:50:49 AM)



LEGEND

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

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

Date: December, 2011
Scale: Hor: 1" = 40' Ver: 1" = 5'
Job No. 2009-0328
Sheet 8/8

Ecosystem Enhancement PROGRAM

EMHT

REVISIONS

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 mainstem 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 each year of monitoring is summarized in Table VII. Photographs of the vegetative problem areas are shown in Appendix A.

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

Feature/Issue	Station # / Range	Probable Cause	Photo #
Invasive Population (likely: Hog Peanut vine - *Amphicarpaea bracteata*)	UT: See Vegetation Problem Area Plan View (Appendix A)	Native Vine: encroachment from adjacent woodland	VPA 1 & VPA 2

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 in an effort to control the spread of this vine within the project corridor.

Although treatments appear to be working to some degree, the vine has continued to spread during Year 3 and is affecting a larger area of the riparian corridor along the UT (see Vegetation Problem Area Plan View, Appendix A). Woody plantings installed in late 2009 are beginning to be impacted by the fast growing pea vine. The vine remains a vegetation problem area of high concern in 2011. Spraying will continue to be recommended in order to keep the vine under control within the project corridor. Intensive herbicidal spraying was conducted in the fall of 2011 in order to combat the spread of the vine. Another round of spraying is scheduled for the spring of 2012. The spread of hog peanut vine will be closely monitored and documented during all future years of monitoring.

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 increased in these areas, leaving fewer open patches that might provide an avenue for colonization and spread of invasive or problematic species.

During 2011 vegetation monitoring, colonization by the problematic hog peanut vine did appear to be happening to an alarming degree along the left bank of the UT. Since 2010 (Year 2), the vine has continued to spread and is now infiltrating the right bank of the tributary, along the majority of its length. The vine is not restricted to areas with low density herbaceous cover, however. Areas observed to have low overall herbaceous cover in Year 2 have seen an increase in native cover over the past year. Due to the reason listed above, areas with lower overall herbaceous cover were not included as vegetation problem areas in Year 3.

3. Vegetation Problem Area Plan View

The location of each vegetation problem area is shown on the vegetative problem area plan view included in Appendix A. 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).

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	Survival %
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**					
Shrubs													
Alnus serrulata	3	3	3	3	8	7	9	6	42	42	39	42	108
Aronia arbutifolia	2			13	7	2	1	1	6	6	29	26	90
Cornus amomum							1		0	0	1	1	100
Ilex verticillata						2			2	2	2	2	100
Salix exigua					5	3			7	7	8	8	100
Sambucus canadensis	1		1	3	1	1	5		1	1	13	12	92
Trees													
Cercis canadensis				3					0	0	4	3	75
Diospyros virginiana				1					1	1	1	1	100
Fraxinus pennsylvanica	12	19	15	10	5	2	6		59	59	59	69	117
Platanus occidentalis				2		5	1	4	12	12	12	12	100
Quercus palustris		1	1	1	1	1		1	6	6	6	6	100
Salix nigra					2			1	3	3	4	3	75
Year 3 Totals	18	23	20	36	29	23	23	13	139	139	178	185	104
Live Stem Density	729	932	810	1458	1175	932	932	527					
Average Live Stem Density	**937**												

Table VIIIb. Stem counts for each species arranged by plot - all stems. Thompsons Fork Stream Restoration / EEP Project No. D06030-A											
	Plots								Year 1	Year 2	Year 3
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Totals**	**Totals**	**Totals**
Shrubs											
Acer rubrum	3								0	0	3
Alnus serrulata	3	3	3	3	8	7	9	26	46	87	62
Aronia arbutifolia	2			13	8	2	1	1	6	29	27
Aronia melanocarpa				3		4	1		0	0	8
Cornus amomum						1	1		0	1	2
Ilex verticallata					1	2			2	2	3
Salix exigua					11	3			7	10	14
Sambucus canadensis	1		1	4	1	1	9		11	20	17
Trees											
Cercis canadensis				4						4	4
Fraxinus pennsylvanica	10	24	17	9	5	2	6		59	72	73
Juglans nigra			2						0	0	2
Platanus occidentalis				2		8	1	4	12	13	15
Quercus palustris		1	1	1	1	1		1	6	6	6
Rhus typhina					1		8		0	0	9
Robinia pseudoacacia					2	3			0	0	5
Salix nigra					3	2		1	3	6	6
Year 3 Totals	19	28	24	39	41	36	36	33	152	251	256
Live Stem Density	770	1134	972	1580	1661	1458	1458	1337			
Average Live Stem Density	**1296**										

The average stem density of planted species for the site exceeds the minimum criteria of 320 stems per acre after three years. Each individual plot also has a stem density above the minimum. In addition, a number of recruit stems have been found in all plots. The recruit stems increase the total stem density across the site by 38%.

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 unnamed tributary and one along the Thompsons Fork Mainstem. 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. Therefore, bankfull events were not recorded for 2011, as documented in Table IX. Thus far, bankfull events have been recorded during Years 1 and 2 for both crest gages. The last recorded bankfull event is from Year 2 and is described below.

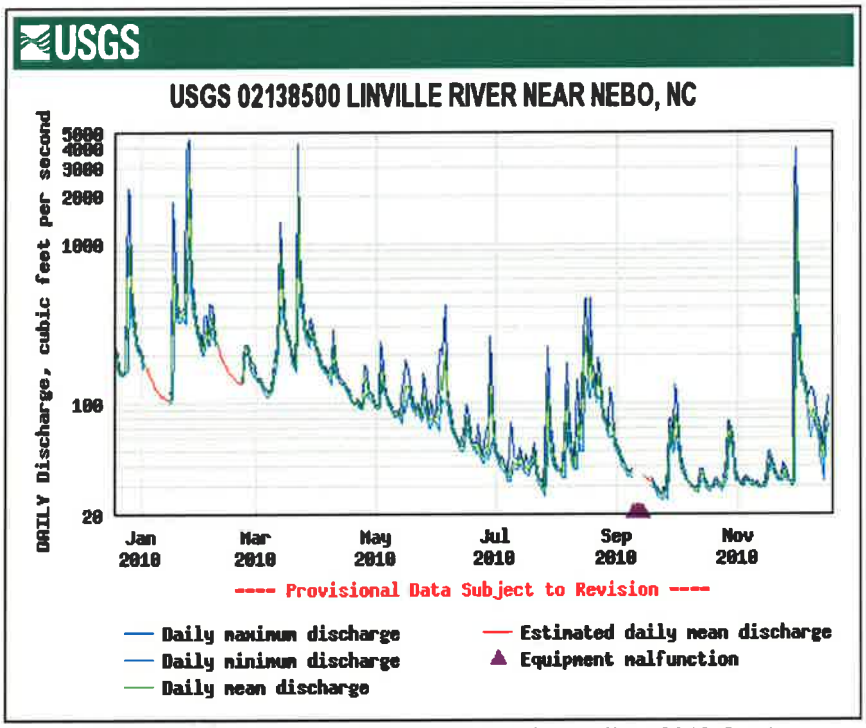
Table IX. Verification of Bankfull Events

Date of Data Collection	Date of Occurrence	Method	Photo #
5/12/10	1/24/10-1/25/10 or 3/22/10*	Crest gage at XS-6 on the UT	BF 1
5/12/10	1/24/10-1/25/10 or 3/22/10*	Crest gage at XS-7 on Mainstem	BF 2
5/18/11	NA (Bankfull event not recordable)	Crest gage at XS-6 on the UT and crest gage at XS-7 on Mainstem	NA

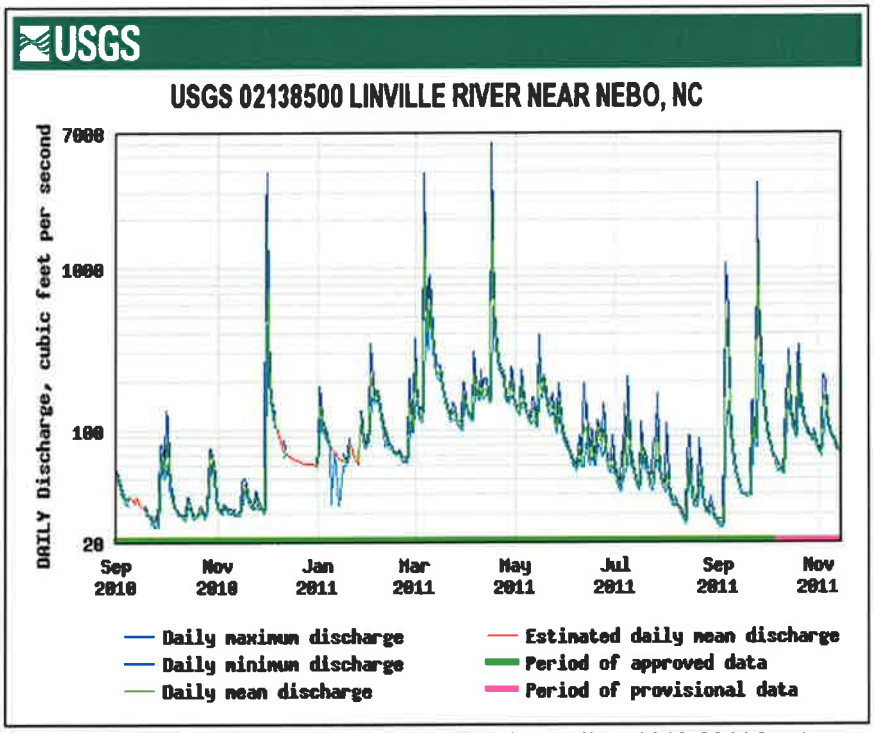
*Date is approximate; based on a review of recorded rainfall data

In May 2010, the crest gage on the unnamed tributary was examined and determined to have experienced a bankfull event at a height of 4-inches above the bottom of the crest gage. The crest gage on the mainstem of Thompsons Fork also documented a bankfull event, at a height of 1-inch above the bottom of the crest gage. These crest gages are set at or above the bankfull elevation of each stream channel. Photographs of the crest gages are shown in Appendix B.

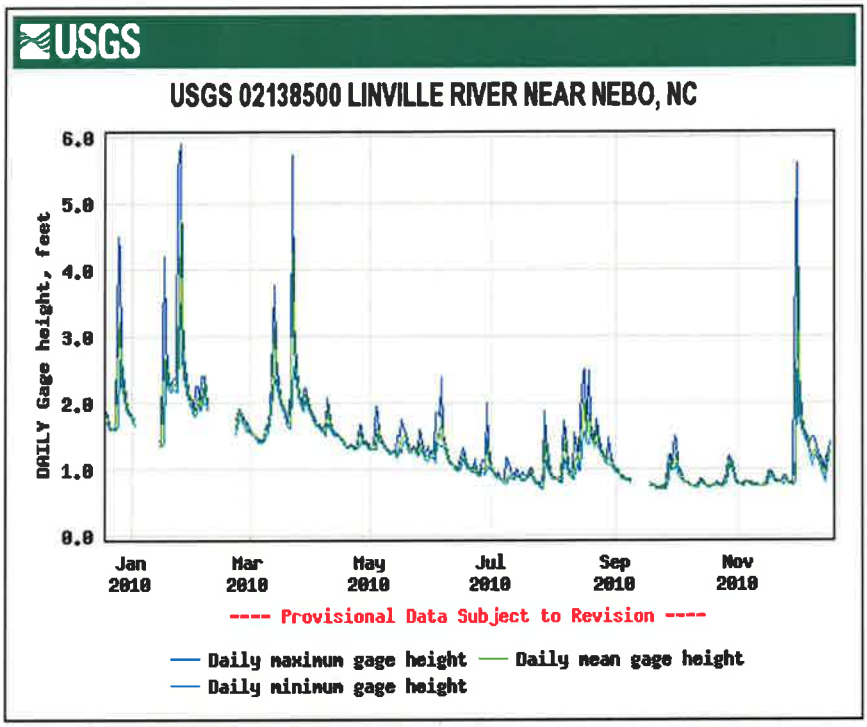
The most likely date for the bankfull event was after the rain events that occurred on January 24 and January 25, 2010. These dates correspond to a high discharge events and gage heights, as recorded at USGS Gage 02138500 Linville River at Nebo, NC, which lies approximately 15 miles west of Morganton 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 hydrographs below.



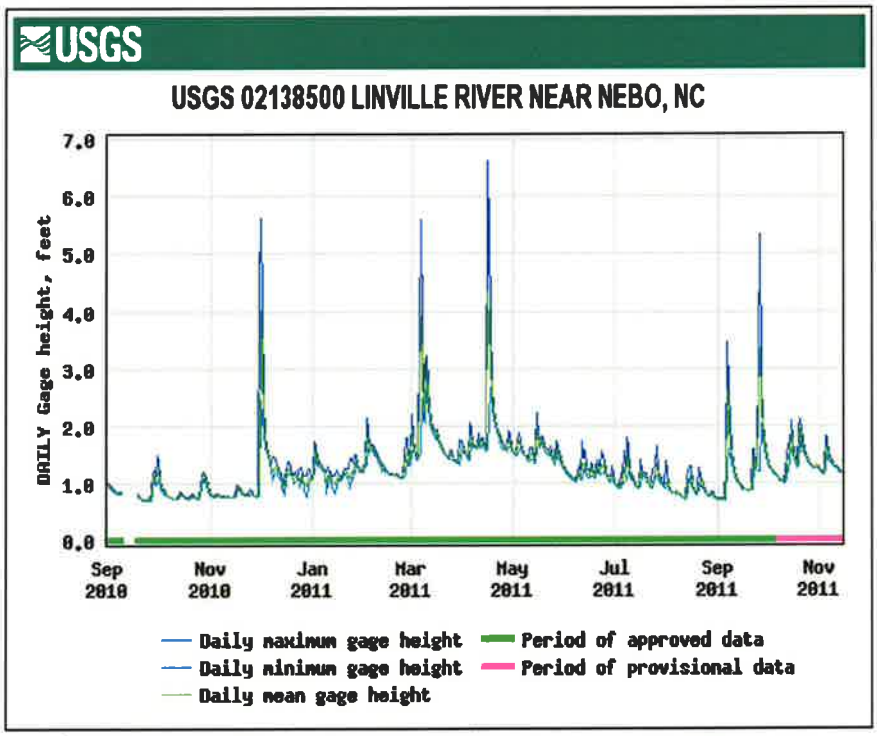
USGS Surface-Water Daily Data for North Carolina **(2010 data)**
http://waterdata.usgs.gov/nc/nwis/dv?



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 **(2010 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?

Even though crest gages for both reaches of the project were inconclusive in Year 3, discharge and gage height statistics were gathered from the USGS Gage 02138500 along the Linville River at Nebo, NC (see two figures above). The purpose of this was to estimate the timing of possible bankfull events. Gage statistics for these parameters were graphed from September 2010 through November 2011. The graphs for 2010-2011 (Year 3) data are located under the graphs for the 2010 (Year 2) data (see above).

A good estimate for the timing of possible bankfull events can be made by looking at the dates throughout late 2010 to mid-2011 where daily mean and maximum discharge and gage height values reached very high levels. These dates correspond to 3 sets of days. November 30, 2010 saw a mean daily discharge rate and mean daily gage height of 115 ft^3/s and 1.18 feet, respectively. The maximum values for these parameters on that day were 2,190 ft^3/s and 4.49 feet, respectively. The next day, on December 1, 2010, mean daily discharge and mean daily gage height were 1,920 ft^3/s and 4.01 feet, respectively. The maximum values for these parameters on that day were 3,970 ft^3/s and 5.61 feet, respectively.

The next set of days that could have produced a bankfull event were March 6 and 7, 2011. On these days, mean daily discharge and mean daily gage height reached 1,900 ft^3/s and 3.9 feet, and 729 ft^3/s and 2.91 feet, respectively. The maximum values for these parameters on these two days was 3,930 ft^3/s and 5.59 feet, and 1,260 ft^3/s and 3.66 feet, respectively. The final set of days that could have potentially raised water levels to bankfull stage were April 16 and 17, 2011. On these days, mean daily discharge and mean daily gage height reached 2,640 ft^3/s and 4.33 feet, and 864 ft^3/s and 3.12 feet, respectively. The maximum values for these parameters on these two days was 6,130 ft^3/s and 6.61 feet, and 1,510 ft^3/s and 3.92 feet, respectively. Crest gages will again be checked in the spring of 2012 in order to record bankfull events for Year 4.

2. Stream Problem Areas

A summary of the areas of concern identified during the visual assessment of the stream for Year 3 is included in Table X.

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

Feature Issue	Station Numbers	Suspected Cause	Photo Number
Bank scour	24+00 , 19+35 and 8+25 on Mainstem	A) Beaver dams caused scour and washout of both right and left bank at stations 24+00 and 19+35. B) Left bank scour most likely caused by a high flow event	SPA 1,2 & 3

Current stream problem areas for Year 3 are located at 3 different stations along the mainstem of Thompsons Fork (see Table X, above). No stream problem areas were noted for the UT. All problem areas for 2011 were scour and bank failure issues. The observed erosion and scour at stations 24+00 and 19+35 (see Stream Problem Area Map, Appendix B) 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. It is likely that high flow events created excessive erosional flow around the sides and top of each dam. Pictures of the resultant erosion at

these two stations are included in the stream problem area photos located within Appendix B. These areas will be monitored closely in Year 4 in order to assess bank stability and the progression of vegetation reestablishment. 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.

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 mainstem. It appears that the sloughing in this area was caused by a high flow event. It is expected that the bank sloughing at this station will be corrected once vegetation establishes on the newly exposed soil. This area will be closely monitored in 2012 in order to assess bank stability. At this time, station 8+25 is being considered a stream problem area of low concern and is demarcated by a yellow scour symbol on 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 has allowed the channel to sustain a sufficient flow velocity that will prevent 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 speed up the remedial maintenance work. All erosion and sediment control practices for the maintenance were consistent with the State's guidelines.

The past year's sedimentation caused the D_{50} of the tributary's reach-wide particle distribution to fall into the medium sand category. Because of this, the tributary shifted from a C4 channel classification to a C5 classification in Year 2. After the tributary maintenance in May 2011, pebble counts were conducted in September in order to assess the affect of channel clean-out on particle distributions. The reach particle composite for Year 3 is calculated to be 1.73 mm. The reach-wide composite places the stream into a low C5 category, bordering a C4 designation. This is a significant improvement from Year 2 and demonstrates the fact that this year's tributary

maintenance has removed much of the excessive fine sediment that had been accumulating during Years 1 &2. Appendix B contains before (2010) and after (2011) photographs for the UT which depict examples of the extent results of maintenance activities. Because of the success of channel maintenance on improving reach-wide particle distributions, aggradation has been removed from the stream problem area map for the UT (see Appendix B).

3. Stream Problem Areas Plan View

The locations of problem areas are 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 monitored) or red for high concern (areas where maintenance is warranted).

4. Stream Problem Areas Photos

Photographs of the stream problem areas are included in Appendix B.

5. Fixed Station Photos

Photographs were taken at each established photograph station on September 15, 2011. 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.

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

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

[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 visual stream stability assessment revealed that the majority of in-stream structures are functioning as designed and built on the Thompsons Fork mainstem and unnamed tributary in Year 3 (Tables XIa and XIb). This year, along the mainstem, there were 3 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 significantly aggraded (6-12 inches of sediment accumulation within the past year) when compared to Year 2 conditions. These pools are still functional, however. Three of the forty-two meander bends were observed to be in an unstable condition in Year 3, due to erosion. These areas were discussed previously in Section B2 of this report.

The final 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 mainstem. 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 for future monitoring. 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. The developing bars will be closely monitored in 2012 in order to determine any noticeable trends in stability.

Aggradation (noted in Years 1 and 2) along the UT has been improved significantly in Year 3 due to the stream maintenance, 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. Aggradational trends will be closely monitored for the UT in 2012.

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, 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 1-3 is the same as the data provided from the As-Built survey, as pattern has not changed based on the Year 2 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 3 remain generally stable when compared to as-built and Year 1 and 2 conditions.

On Thompson Fork mainstem, 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 cross sections compared to previous years. Riffle lengths and slopes remains consistent with previous years while the pool length and spacing has fluctuated slightly.

For the unnamed tributary, riffle lengths and slopes are stable. The median pool to pool spacing decreased in Year 2, but has returned to values closer to Year 1. The UT had slightly smaller bankfull dimension in Year 2 but most of those measurements have returned to values similar to the As-Built and Year 1. 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 exhibited an improvement over Year 2 conditions with a significant increase in median particle size. Median particle size fell into the medium gravel category in 2011, as compared to a median particle distribution of very fine sand in Year 2. This D_{50} categorization of

medium gravel is much more stable and healthy. This shift in particle size of riffle substrate illustrates the fact that Year 3's maintenance activities effectively removed much of the excessive silt and sand throughout the UT reach. Remedial maintenance has effectively promoted natural channel flushing and a more stable median particle distribution. Median particle size for riffles fell into the coarse gravel category in Year 1 and fine - very coarse gravel reported for the as-built condition.

On the Thompsons Fork mainstem, there was a slight shift in median particle distribution for the substrate in constructed riffles from coarse gravel (Year 2) to very course gravel in Year 3. In Year 1 the median particle distribution was in the very coarse gravel range. The as-built median particle distribution for the constructed riffles was in the fine to medium gravel range. The pool substrate for the project reaches remain stable, with median particle sizes consisting of mostly coarse sand particles, based on the Year 3 substrate analysis.

IV. METHODOLOGY

Vegetation monitoring was conducted in September 2011 using the *CVS-EEP Protocol for Recording Vegetation, Version 4.0* (Lee, M.T., Peet, RK., Roberts, S.R., Wentworth, T.R. 2006). Year 3 stream monitoring was conducted in May 2011 to provide adequate time between the Years 1 and 2 monitoring surveys. Subsequent stream monitoring will occur in the summer-fall of Years 4 and 5 to provide at least a full year between surveys. Vegetation monitoring will continue to be conducted in the fall of each subsequent year of monitoring, providing a full year between vegetative surveys.

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		
Dimension	Min	Max	Mean	Min	Max	Mean	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
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
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
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
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
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
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
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
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
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
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
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
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
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
*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
*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
*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
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
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
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
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
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
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
Additional Reach Parameters																					
Valley Length (ft)			188.00			2261			2295			2295			2295			2295			2295
Channel Length (ft)			140.00			2530			2799			2742			2742			2742			2742
Sinuosity			1.34			1.12			1.22			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
Bankfull Slope (ft/ft)			0.0024			0.0039			0.0024			0.0030			0.0030			0.0030			0.0030
Rosgen Classification			E4			G4			E4			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 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		
Dimension	Min	Max	Mean	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
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
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
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
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
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
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
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
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
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
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
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
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
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
*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
*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
*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
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
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
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
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
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
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
Additional Reach Parameters																					
Valley Length (ft)			294.00			1485			1437			1437			1437			1437			1437
Channel Length (ft)			353.00			1617			1966			1948			1948			1948			1948
Sinuosity			1.2			1.09			1.37			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
Bankfull Slope (ft/ft)			0.0115			0.0324			0.0258			0.0243			0.0244			0.0258			0.0253
Rosgen Classification			C4			C3b			C3b			C3b			C4b			C5b			C4b
*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.

Table XIII: Morphology and Hydraulic Monitoring Summary

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

Reach: Mainstem

Parameter	Cross Section (Riffle 7)				Cross Section (Pool 8)				Cross Section (Riffle 9)				Cross Section (Riffle 10)				Cross Section (Riffle 11)				Cross Section (Pool 12)			
Dimension	**MY 0**	**MY 1**	**MY 2**	**MY 3**	**MY 0**	**MY 1**	**MY 2**	**MY 3**	**MY 0**	**MY 1**	**MY 2**	**MY 3**	**MY 0**	**MY 1**	**MY 2**	**MY 3**	**MY 0**	**MY 1**	**MY 2**	**MY 3**	**MY 0**	**MY 1**	**MY 2**	**MY 3**
BF Width (ft)	38.51	38.95	38.81	38.71	39.25	39.37	20.98	21.95	38.74	36.66	33.52	31.14	34.52	35.30	34.69	32.56	39.81	35.97	28.65	27.06	43.16	45.96	45.95	47.11
Floodprone Width (ft)	89.89	89.89	89.82	89.88	83.90	129.13	83.91	83.92	113.53	114.87	99.40	117.61	143.71	146.66	146.55	146.65	91.41	86.87	87.45	88.75	103.78	105.70	107.84	108.3
BF Cross Sectional Area (ft^2)	53.71	54.16	53.80	54.58	69.91	69.72	65.41	60.38	50.20	45.81	38.27	36.12	48.51	49.04	49.09	44.02	52.43	39.38	36.12	35.41	72.70	73.87	75.05	74.89
BF Mean Depth (ft)	1.39	1.39	1.39	1.41	1.78	1.77	3.12	2.75	1.30	1.25	1.14	1.16	1.41	1.39	1.42	1.35	1.32	1.09	1.26	1.31	1.68	1.61	1.63	1.59
BF Max Depth (ft)	2.16	2.14	2.29	2.48	3.60	4.84	5.60	5.14	2.49	2.34	2.58	2.9	2.52	2.59	2.62	2.7	2.88	2.42	2.54	2.52	3.69	3.80	3.89	4.15
Width/Depth Ratio	27.71	28.02	27.92	27.45	22.05	22.24	6.72	7.98	29.80	29.33	29.40	26.84	24.48	25.40	24.43	24.12	30.16	33.00	22.74	20.66	25.69	28.55	28.19	29.63
Entrenchment Ratio	2.33	2.31	2.31	2.32	2.14	3.28	4.00	3.82	2.93	3.13	2.97	3.78	4.16	4.15	4.23	4.5	2.30	2.41	3.05	3.28	2.40	2.30	2.35	2.3
Bank Height Ratio	1	1	1	1	1	1	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	40.02	41.03	24.10	24.46	39.10	37.00	34.06	32.6	34.91	35.70	35.18	33.18	40.28	36.46	29.28	27.91	43.94	46.84	47.73	49.12
Hydraulic Radius (ft)	1.38	1.38	1.37	1.37	1.75	1.70	2.71	2.47	1.28	1.24	1.12	1.11	1.39	1.37	1.40	1.33	1.30	1.08	1.23	1.27	1.65	1.58	1.57	1.52
Substrate																								
D50 (mm)	9.10	32.72	67.55	65.86	*	**	0.05	0.06	10.64	23.78	37.50	37.57	*	26.67	30.12	26.94	5.70	32.00	28.29	19.3	*	6.69	0.71	0.59
D84 (mm)	66.30	76.04	130.48	140.47	*	**	0.11	0.2	35.94	87.08	120.35	Bedrock	*	60.76	88.95	53.36	43.37	75.74	77.53	58.93	*	26.74	4.26	0.89

Table XIII: Morphology and Hydraulic Monitoring Summary

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

Reach: UT-1

Parameter	Cross Section (Pool 1)				Cross Section (Riffle 2)				Cross Section (Pool 3)				Cross Section (Riffle 4)				Cross Section (Pool 5)				Cross Section (Riffle 6)			
Dimension	**MY 0**	**MY 1**	**MY 2**	**MY 3**	**MY 0**	**MY 1**	**MY 2**	**MY 3**	**MY 0**	**MY 1**	**MY 2**	**MY 3**	**MY 0**	**MY 1**	**MY 2**	**MY 3**	**MY 0**	**MY 1**	**MY 2**	**MY 3**	**MY 0**	**MY 1**	**MY 2**	**MY 3**
BF Width (ft)	13.31	13.20	13.24	13.04	8.35	8.67	7.30	7.18	20.72	20.53	18.13	16.97	20.74	16.67	12.21	14.51	17.47	16.88	18.49	18.75	14.38	14.03	10.94	14.85
Floodprone Width (ft)	26.08	22.94	18.94	18.61	23.46	23.67	19.41	17.32	90.10	88.25	88.09	89.47	98.92	97.32	94.68	91.06	72.80	59.96	73.19	72.91	76.11	74.03	76.72	95.33
BF Cross Sectional Area (ft^2)	23.51	21.66	16.02	15.95	11.78	12.71	10.11	9.82	24.85	21.02	19.95	19.04	16.37	14.89	11.52	14.35	19.00	16.74	19.66	19.41	10.63	11.15	9.50	12.43
BF Mean Depth (ft)	1.77	1.64	1.21	1.22	1.41	1.47	1.39	1.37	1.20	1.02	1.10	1.12	0.79	0.89	0.94	0.99	1.09	0.99	1.06	1.07	0.74	0.80	0.87	0.84
BF Max Depth (ft)	2.78	2.41	1.80	1.72	2.40	2.43	2.15	2.09	2.29	2.09	2.10	2.1	1.61	1.62	1.75	1.82	2.14	1.80	2.10	1.99	1.55	1.56	1.81	2.28
Width/Depth Ratio	7.52	8.05	10.94	10.69	5.92	5.90	5.25	5.24	17.27	20.13	16.48	15.15	26.25	18.73	12.99	14.66	16.03	17.05	17.44	17.52	19.43	17.54	12.57	17.68
Entrenchment Ratio	1.96	1.74	1.43	1.43	2.81	2.73	2.66	2.41	4.35	4.30	4.86	5.27	4.77	5.84	7.76	6.27	4.17	3.55	3.96	3.89	5.29	5.28	7.01	6.42
Bank Height Ratio	1	1	1	1	1	1	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	9.93	10.33	8.92	9.36	21.25	21.02	18.66	18.15	21.07	17.02	12.84	15.55	17.99	17.28	19.11	19.41	14.73	14.39	11.59	16.35
Hydraulic Radius (ft)	1.59	1.49	1.15	1.15	1.19	1.23	1.13	1.05	1.17	1.00	1.07	1.05	0.78	0.87	0.90	0.92	1.06	0.97	1.03	1.03	0.72	0.78	0.82	0.76
Substrate																								
D50 (mm)	*	0.03	0.71	0.59	*	4.96	0.43	28.35	*	0.03	0.04	0.48	16.00	19.96	10.55	13.86	*	0.03	0.05	0.14	7.67	18.89	10.14	8.62
D84 (mm)	*	0.05	4.26	3.6	*	36.99	13.09	76.19	*	0.05	0.10	15.62	68.15	71.49	42.65	22.47	*	0.05	0.22	0.47	73.73	53.91	49.45	47.27

APPENDIX A

Vegetation Raw Data

1. Vegetation Monitoring Plot Photos
2. Vegetation Data Tables
3. Vegetation Problem Area Photos
4. Vegetation Problem Area Plan View

Vegetation Plot 1
Monitoring Year 3
(EMH&T, 9/15/11)

Vegetation Plot 2
Monitoring Year 3
(EMH&T, 9/15/11)

Vegetation Plot 3
Monitoring Year 3
(EMH&T, 9/15/11)

Vegetation Plot 4
Monitoring Year 3
(EMH&T, 9/15/11)

Vegetation Plot 5
Monitoring Year 3
(EMH&T, 9/15/11)

Vegetation Plot 6
Monitoring Year 3
(EMH&T, 9/15/11)

Vegetation Plot 7
Monitoring Year 3
(EMH&T, 9/15/11)

Vegetation Plot 8
Monitoring Year 3
(EMH&T, 9/15/11)

Table 1. Vegetation Metadata	
Report Prepared By	Megan Wolf
Date Prepared	10/28/2011 14:44
database name	cvs-eep-entrytool-v2.2.6.mdb
database location	Q:\ENVIRONMENTAL\Monitoring\EEP Vegetation Database
computer name	HX1N941
file size	50302976
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	16	23	3				
	Aronia arbutifolia	7	15	4		1	3	
	Cornus amomum		1					
	Fraxinus pennsylvanica	46	11	10	2	1	1	
	Ilex verticillata	2						
	Quercus palustris	5		1				
	Salix nigra	3				1		
	Sambucus canadensis	3	5	2	2	1	1	
	Cercis canadensis		2	1			1	
	Platanus occidentalis	8	4					
	Salix exigua	3	5				1	
TOT:	**11**	**93**	**66**	**21**	**4**	**4**	**7**	

Table 3. Vegetation Damage by Species								
	Species	All Damage Categories	(no damage)	Insects	Site Too Dry	Unknown	Vine Strangulation	(other damage)
	Alnus serrulata	42	36	3	1			2
	Aronia arbutifolia	30	28	1				1
	Cercis canadensis	4	3			1		
	Cornus amomum	1	1					
	Fraxinus pennsylvanica	71	56	2	8		4	1
	Ilex verticillata	2	2					
	Platanus occidentalis	12	12					
	Quercus palustris	6	5			1		
	Salix exigua	9	9					
	Salix nigra	4	4					
	Sambucus canadensis	14	10		1	2		1
TOT:	**11**	**195**	**166**	**6**	**10**	**4**	**4**	**5**

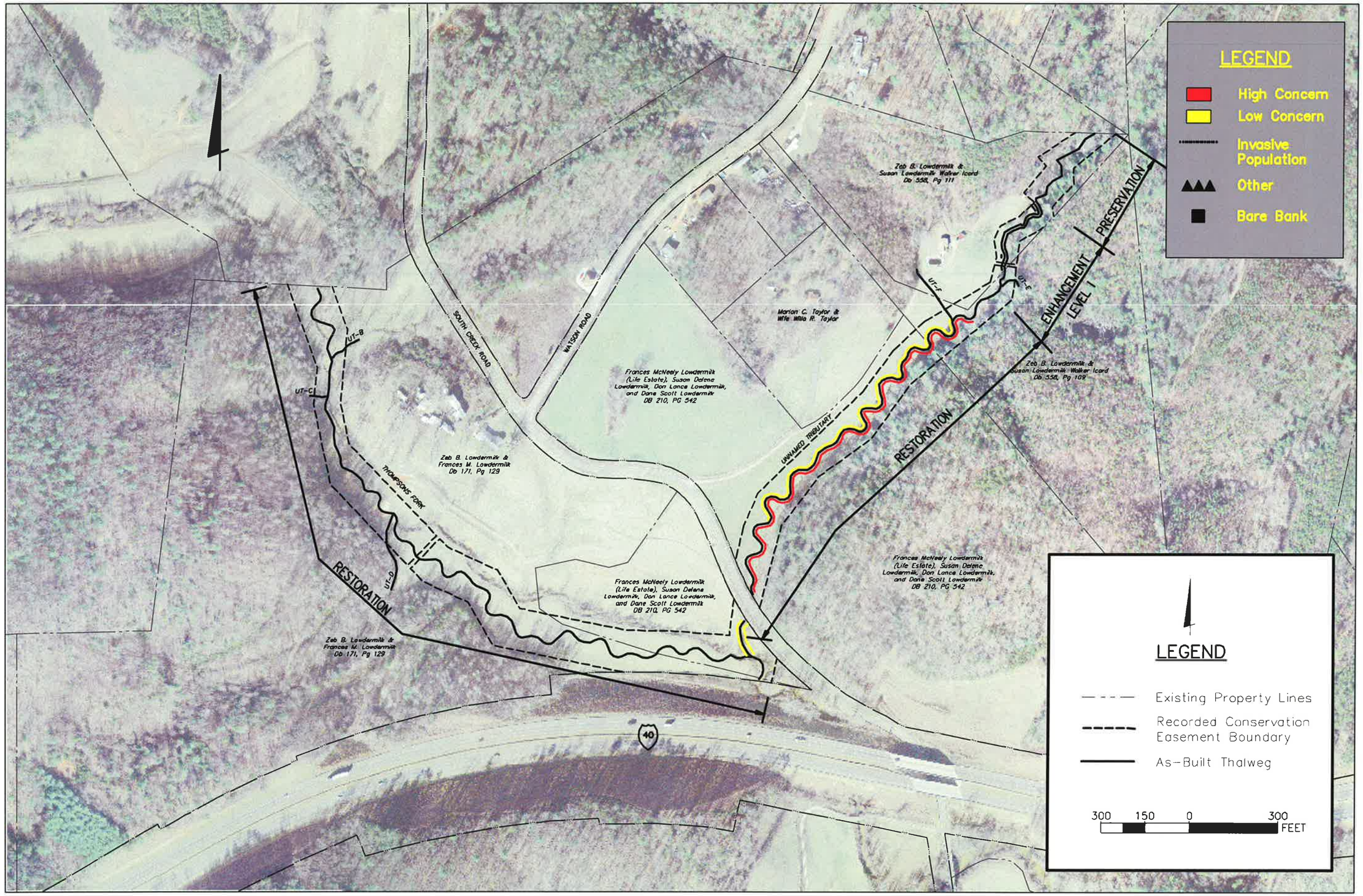
Table 4: Vegetation Damage by Plot								
	plot	All Damage Categorie	(no damage)	Insects	Site Too Dry	Unknown	Vine Strangulation	(other damage)
	D06030A-01-0001 (year 3)	19	11		8			
	D06030A-01-0002 (year 3)	25	20	1			4	
	D06030A-01-0003 (year 3)	20	20					
	D06030A-01-0004 (year 3)	36	33	2		1		
	D06030A-01-0005 (year 3)	33	30			1		2
	D06030A-01-0006 (year 3)	24	19	2	1			2
	D06030A-01-0007 (year 3)	24	20		1	2		1
	D06030A-01-0008 (year 3)	14	13	1				
TOT:	**8**	**195**	**166**	**6**	**10**	**4**	**4**	**5**

Table 5. Stem Count by Plot and Species - Planted Stems												
	Species	Total Planted Stems	# plots	avg# stems	plot D06030A-01-0001 (year 3)	plot D06030A-01-0002 (year 3)	plot D06030A-01-0003 (year 3)	plot D06030A-01-0004 (year 3)	plot D06030A-01-0005 (year 3)	plot D06030A-01-0006 (year 3)	plot D06030A-01-0007 (year 3)	plot D06030A-01-0008 (year 3)
	Alnus serrulata	42	8	5.25	3	3	3	3	8	7	9	6
	Aronia arbutifolia	26	6	4.33	2			13	7	2	1	1
	Cercis canadensis	3	1	3				3				
	Cornus amomum	1	1	1							1	
	Fraxinus pennsylvanica	69	7	9.86	12	19	15	10	5	2	6	
	Ilex verticillata	2	1	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	3	2	1.5					2			1
	Sambucus canadensis	12	6	2	1		1	3	1	1	5	
TOT:	**11**	**184**	**11**		**18**	**23**	**20**	**35**	**29**	**23**	**23**	**13**

Table 6. Stem Count by Plot and Species - All Stems												
	Species	Total Stems	# plots	avg# stems	plot D06030A-01-0001 (year 3)	plot D06030A-01-0002 (year 3)	plot D06030A-01-0003 (year 3)	plot D06030A-01-0004 (year 3)	plot D06030A-01-0005 (year 3)	plot D06030A-01-0006 (year 3)	plot D06030A-01-0007 (year 3)	plot D06030A-01-0008 (year 3)
	Alnus serrulata	62	8	7.75	3	3	3	3	8	7	9	26
	Aronia arbutifolia	27	6	4.5	2			13	8	2	1	1
	Aronia melanocarpa	8	3	2.67				3		4	1	
	Cornus amomum	2	2	1						1	1	
	Fraxinus pennsylvanica	88	7	12.57	12	36	17	10	5	2	6	
	Ilex verticillata	3	2	1.5					1	2		
	Juglans nigra	2	1	2			2					
	Quercus palustris	6	6	1		1	1	1	1	1		1
	Rhus typhina	9	2	4.5					1		8	
	Robinia pseudoacacia	5	2	2.5					2	3		
	Salix nigra	6	3	2					3	2		1
	Sambucus canadensis	17	6	2.83	1		1	4	1	1	9	
	Cornus sericea	2	1	2				2				
	Cercis canadensis	4	1	4				4				
	Platanus occidentalis	15	4	3.75				2		8	1	4
	Salix exigua	14	2	7					11	3		
	Acer rubrum	3	1	3	3							
TOT:	**17**	**273**	**17**		**21**	**40**	**24**	**42**	**41**	**36**	**36**	**33**

VPA 1
A view along the left bank of UT1 around station 10+00; the spread of hog peanut (*Amphicarpaea bracteata*) vine is apparent.
(EMH&T, 9/15/11)

VPA 2
A view along the left and right bank of UT1 around station 13+50; the spread of hog peanut vine is apparent. Picture was taken at station 12+30, facing downstream. Vegetation plot 2 can be seen in the background.
(EMH&T, 9/15/11)



MCDOWELL COUNTY, NORTH CAROLINA
THOMPSONS
AND UNNAMED
APPENDIX
VEGETATION PROBLEM

Job No.	Sheet
2009-0328	1/1
Date	Scale
December, 2011	1" = 300'

EMH&T
Environmental, Hydrologic & Transportation Engineers - Surveyors - Planners - Scientists
5500 New Albany Road Columbus, OH 43054
Phone: 614.775.4500 www.emht.com

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, 9/15/11)

Fixed Station 2
Overview of valley along UT1 near the midpoint of the project, approximately Station 10+75, facing upstream.
(EMH&T, 9/15/11)

Fixed Station 3
Overview of valley along UT1 near the midpoint of the project, approximately Station 10+75, facing downstream.
(EMH&T, 9/15/11)

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, 9/15/11)

Fixed Station 5
Overview of valley along UT1 at the downstream terminus of the project, facing upstream.
(EMH&T, 9/15/11)

Fixed Station 6
Overview of valley along the mainstem near the downstream terminus of the project, facing upstream.
(EMH&T, 9/15/11)

Fixed Station 7
Overview of valley along the mainstem near the midpoint of the project, approximately Station 12+00, facing downstream.
(EMH&T, 9/15/11)

Fixed Station 8
Overview of valley along the mainstem near the midpoint of the project, approximately Station 11+50, facing upstream.
(EMH&T, 9/15/11)

Fixed Station 9
Overview of valley along the mainstem near the upstream terminus of the project, facing downstream.
(EMH&T, 9/15/11)

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?	39	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	**98%**
E. Bed General	1. Geveral 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

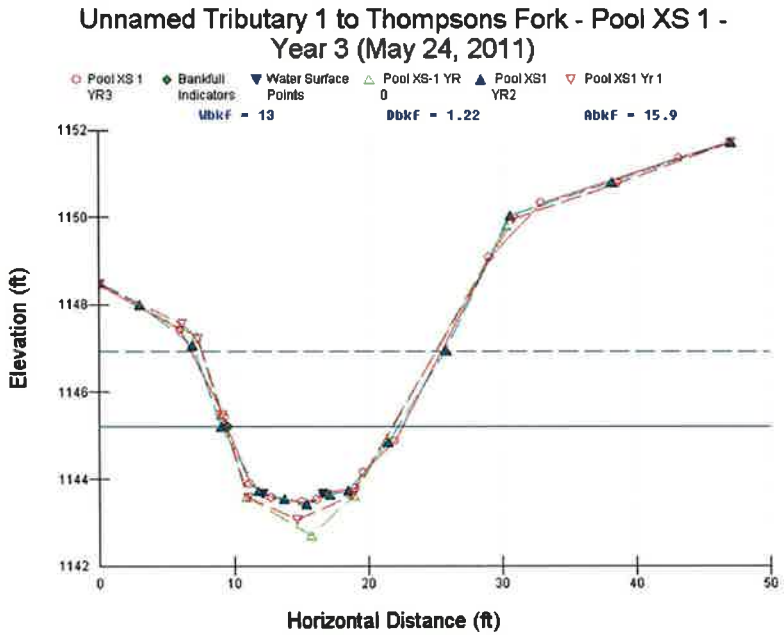
Feature Category	Metric (per As-built and reference baselines	(# Stable) Number Performing as Intended	Total number per As-built	Total Number / feet in unstable state	% Perform in Stable Condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	35	35	0	100	
	2. Armor stable (e.g. no displacement)?	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?	53	58	10	91	**96%**

Summary Data
All dimensions in feet.

Bankfull Area	15.95 ft^2
Bankfull Width	13.04 ft
Mean Depth	1.22 ft
Maximum Depth	1.72 ft
Width/Depth Ratio	10.69
Entrenchment Ratio	1.43

PROJECT	Thompsons Fork
	D06030-A
	3-YEAR
TASK	Cross-Section
REACH	UT
DATE	05/24/11
CROSS SECTION:	1
FEATURE:	Pool

Cross-section photo – looking downstream



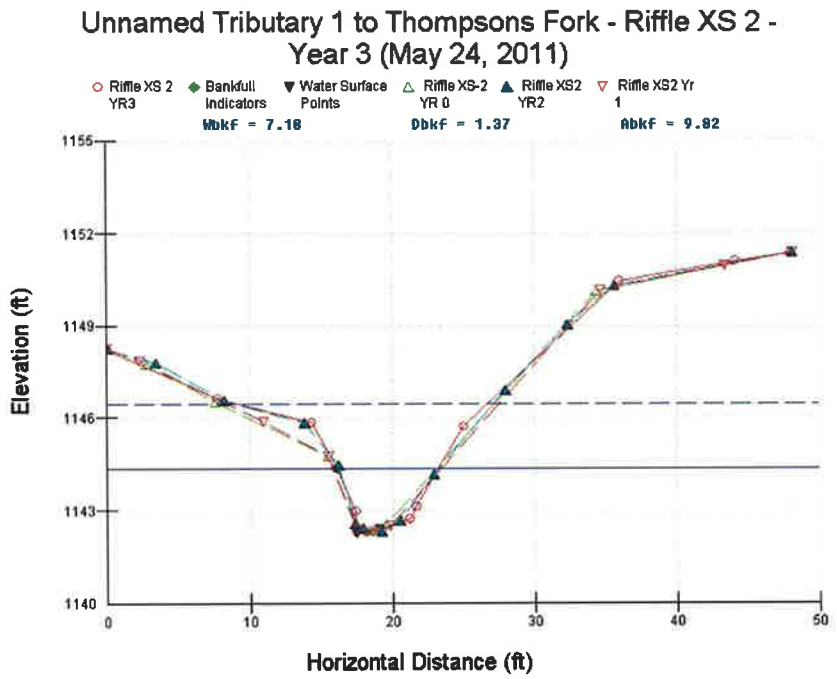
EMH&T

Summary Data
All dimensions in feet.

Bankfull Area	9.82 ft^2
Bankfull Width	7.18 ft
Mean Depth	1.37 ft
Maximum Depth	2.09 ft
Width/Depth Ratio	5.24
Entrenchment Ratio	2.41
Classification	E

PROJECT	Thompsons Fork
	D06030-A
	3-YEAR
TASK	Cross-Section
REACH	UT
DATE	5/24/11
CROSS SECTION:	2
FEATURE:	Riffle

Cross-section photo – looking upstream



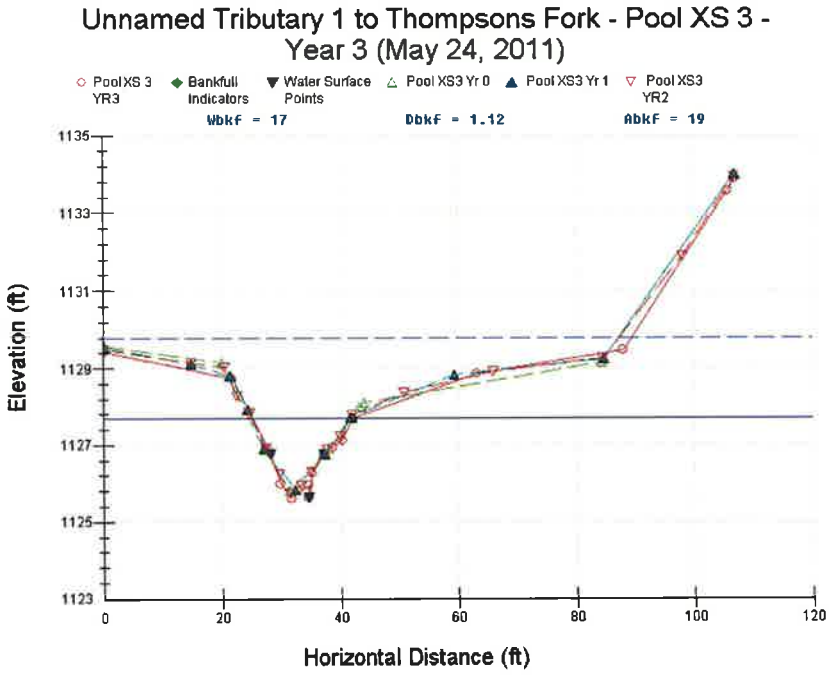
EMH&T

Summary Data
All dimensions in feet.

Bankfull Area	19.04 ft^2
Bankfull Width	16.97 ft
Mean Depth	1.12 ft
Maximum Depth	2.1 ft
Width/Depth Ratio	15.15
Entrenchment Ratio	5.27

PROJECT	Thompsons Fork
	D06030-A
	3-YEAR
TASK	Cross-Section
REACH	UT
DATE	5/24/11
CROSS SECTION:	3
FEATURE:	Pool

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

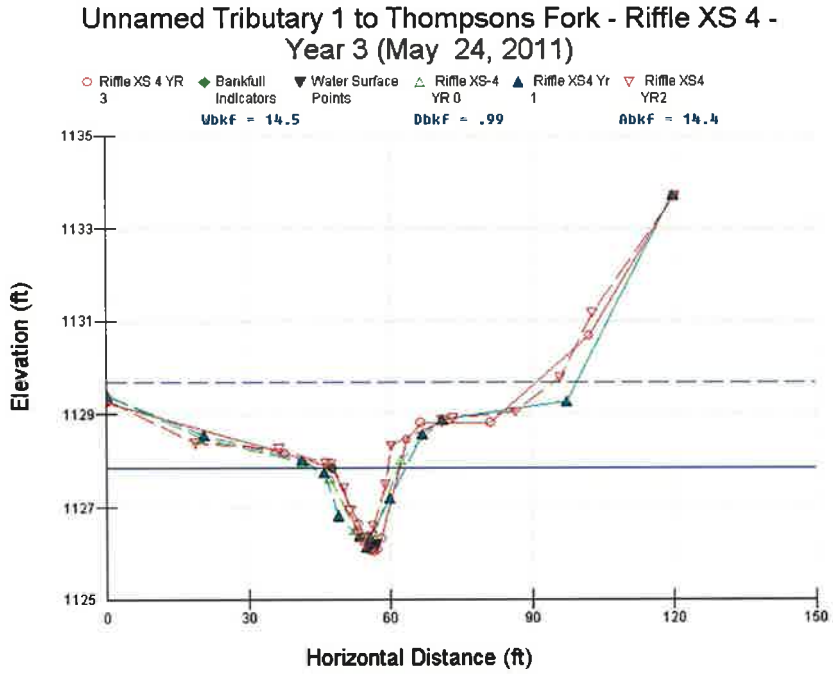


Summary Data
All dimensions in feet.

Bankfull Area	14.35 ft^2
Bankfull Width	14.51 ft
Mean Depth	0.99 ft
Maximum Depth	1.82 ft
Width/Depth Ratio	14.66
Entrenchment Ratio	6.27
Classification	C

PROJECT	Thompsons Fork
	D06030-A
	3-YEAR
TASK	Cross-Section
REACH	UT
DATE	5/24/11
CROSS SECTION:	4
FEATURE:	Riffle

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



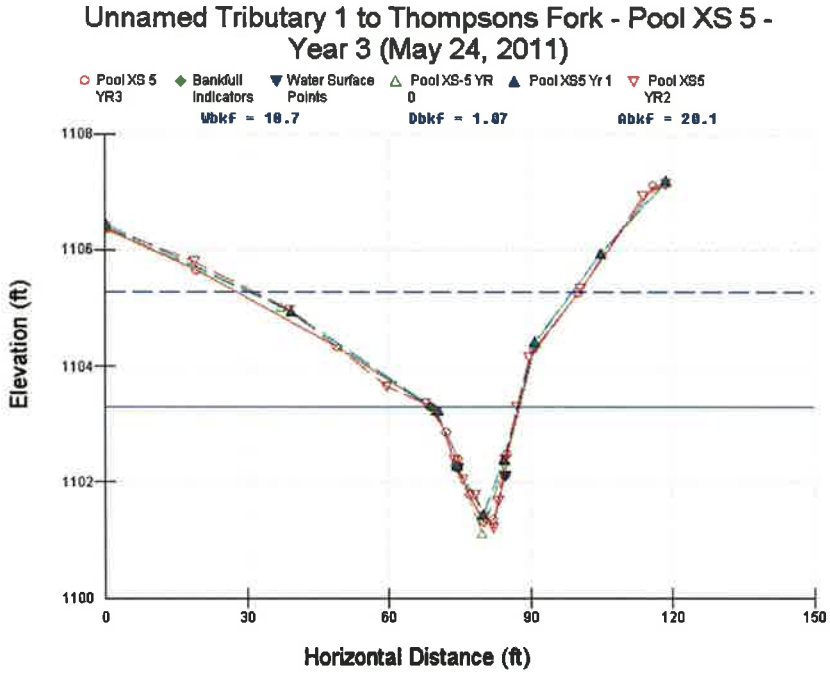
EMH&T

Summary Data
All dimensions in feet.

Bankfull Area	19.41 ft^2
Bankfull Width	18.75 ft
Mean Depth	1.07 ft
Maximum Depth	1.99 ft
Width/Depth Ratio	17.52
Entrenchment Ratio	3.89

PROJECT	Thompsons Fork
	D06030-A
	3-YEAR
TASK	Cross-Section
REACH	UT
DATE	5/24/11
CROSS SECTION:	5
FEATURE:	Pool

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

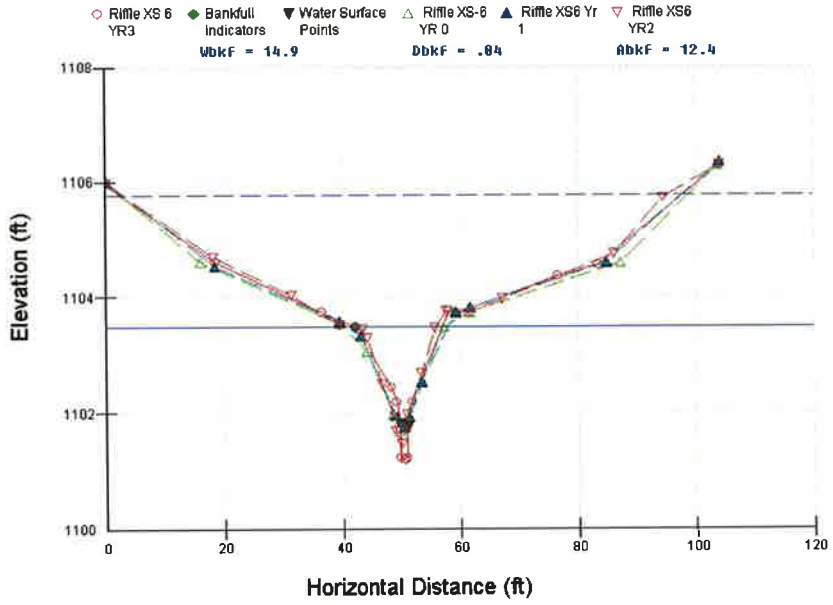


Summary Data
All dimensions in feet.

Bankfull Area	12.43 ft^2
Bankfull Width	14.85 ft
Mean Depth	0.84 ft
Maximum Depth	2.28 ft
Width/Depth Ratio	17.68
Entrenchment Ratio	6.42
Classification	C

PROJECT	Thompsons Fork
	D06030-A
	3-YEAR
TASK	Cross-Section
REACH	UT
DATE	5/24/11
CROSS SECTION:	6
FEATURE:	Riffle

Cross-section photo – looking downstream



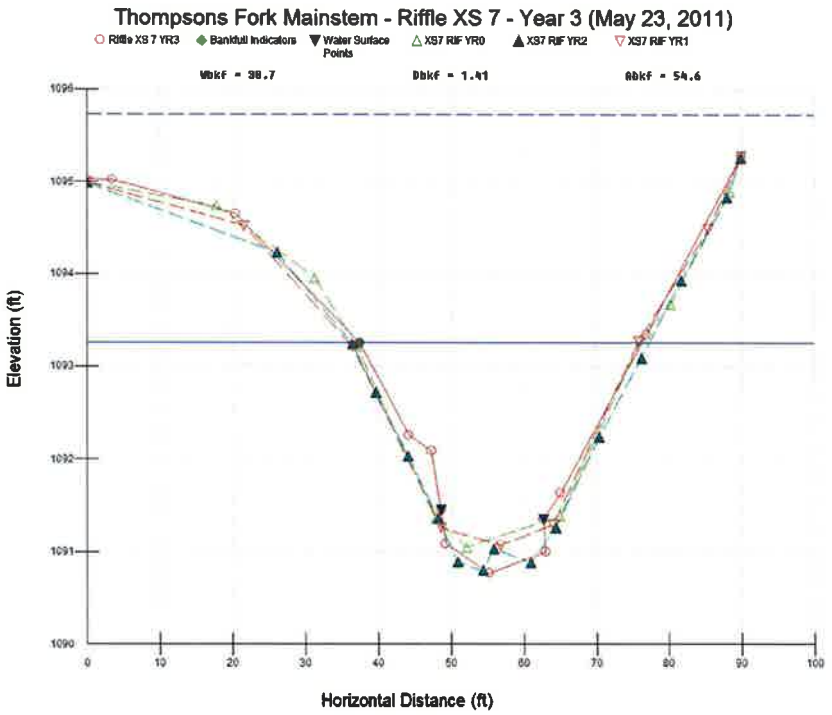
EMH&T

Summary Data
All dimensions in feet.

Bankfull Area	54.58 ft^2
Bankfull Width	38.71 ft
Mean Depth	1.41 ft
Maximum Depth	2.48 ft
Width/Depth Ratio	27.45
Entrenchment Ratio	2.32
Classification	C

PROJECT	Thompsons Fork
	D06030-A
	3-YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	5/24/11
CROSS SECTION:	7
FEATURE:	Riffle

Cross-section photo – looking from right to left bank

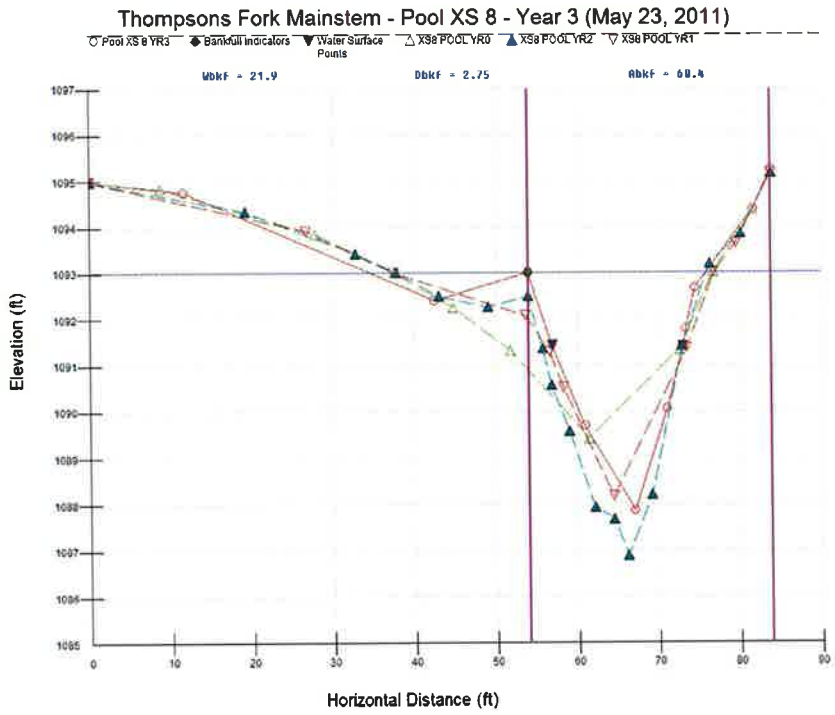


Summary Data
All dimensions in feet.

Bankfull Area	60.38 ft^2
Bankfull Width	21.95 ft
Mean Depth	2.75 ft
Maximum Depth	5.14 ft
Width/Depth Ratio	7.98
Entrenchment Ratio	3.82

PROJECT	Thompsons Fork
	D06030-A
	3-YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	5/24/11
CROSS SECTION:	8
FEATURE:	Pool

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

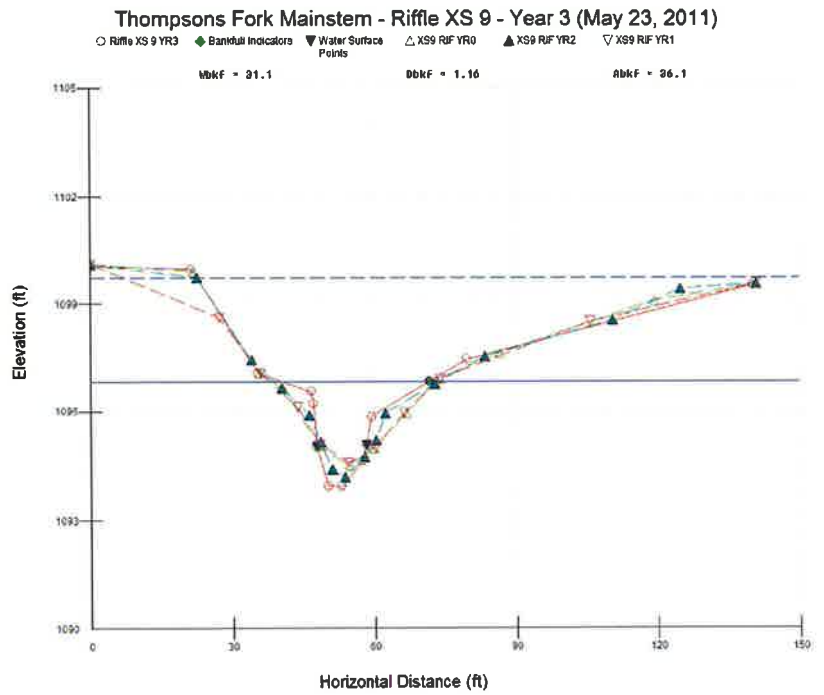


Summary Data
All dimensions in feet.

Bankfull Area	36.12 ft^2
Bankfull Width	31.14 ft
Mean Depth	1.16 ft
Maximum Depth	2.9 ft
Width/Depth Ratio	26.84
Entrenchment Ratio	3.78
Classification	C

PROJECT	Thompsons Fork
	D06030-A
	3-YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	5/24/11
CROSS SECTION:	9
FEATURE:	Riffle

Cross-section photo – looking upstream

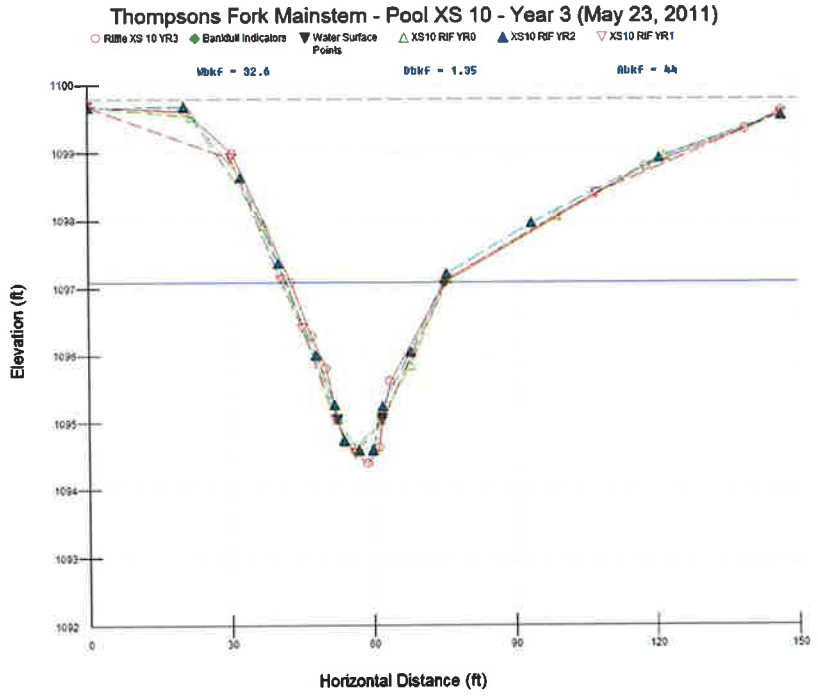


Summary Data
All dimensions in feet.

Bankfull Area	44.02 ft^2
Bankfull Width	32.56 ft
Mean Depth	1.35 ft
Maximum Depth	2.7 ft
Width/Depth Ratio	24.12
Entrenchment Ratio	4.5
Classification	C

PROJECT	Thompsons Fork D06030-A 3-YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	5/24/11
CROSS SECTION:	10
FEATURE:	Riffle

Cross-section photo – looking downstream



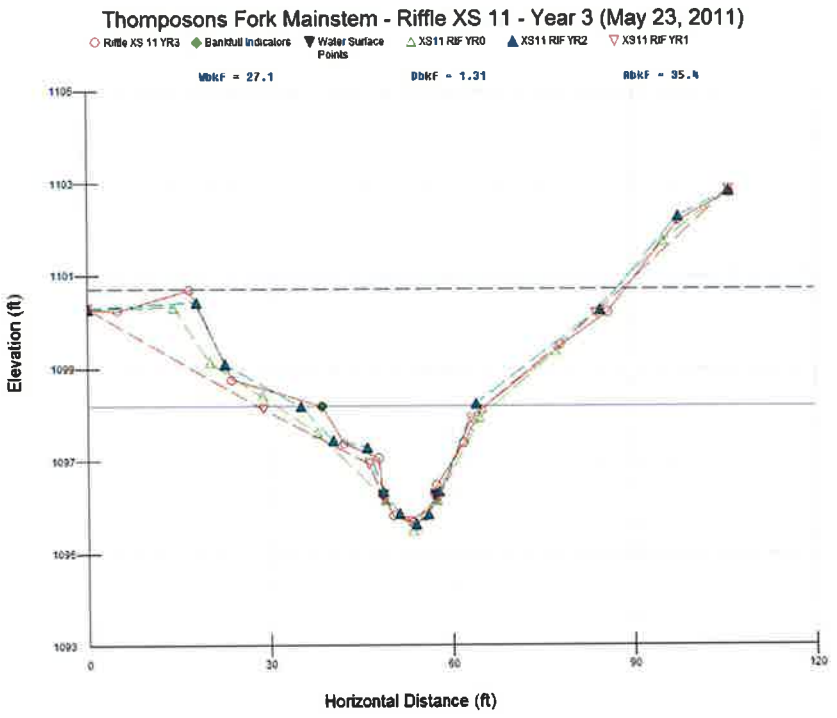
EMH&T

Summary Data
All dimensions in feet.

Bankfull Area	35.41 ft^2
Bankfull Width	27.06 ft
Mean Depth	1.31 ft
Maximum Depth	2.52 ft
Width/Depth Ratio	20.66
Entrenchment Ratio	3.28
Classification	C

PROJECT	Thompsons Fork
	D06030-A
	3YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	5/24/11
CROSS SECTION:	11
FEATURE:	Riffle

Cross-section photo – looking upstream



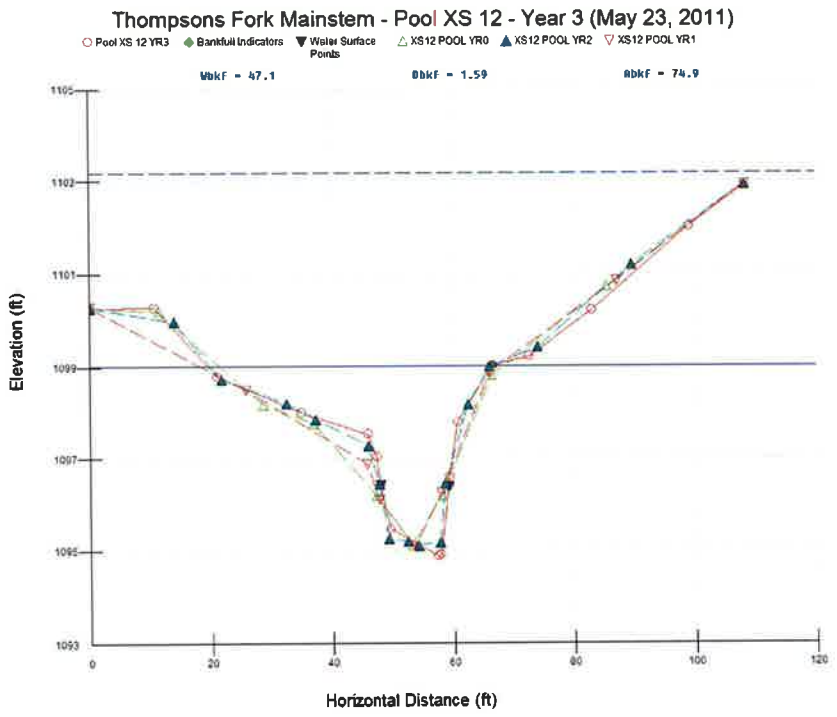
EMH&T

Summary Data
All dimensions in feet.

Bankfull Area	74.89 ft^2
Bankfull Width	47.11 ft
Mean Depth	1.59 ft
Maximum Depth	4.15 ft
Width/Depth Ratio	29.63
Entrenchment Ratio	2.3

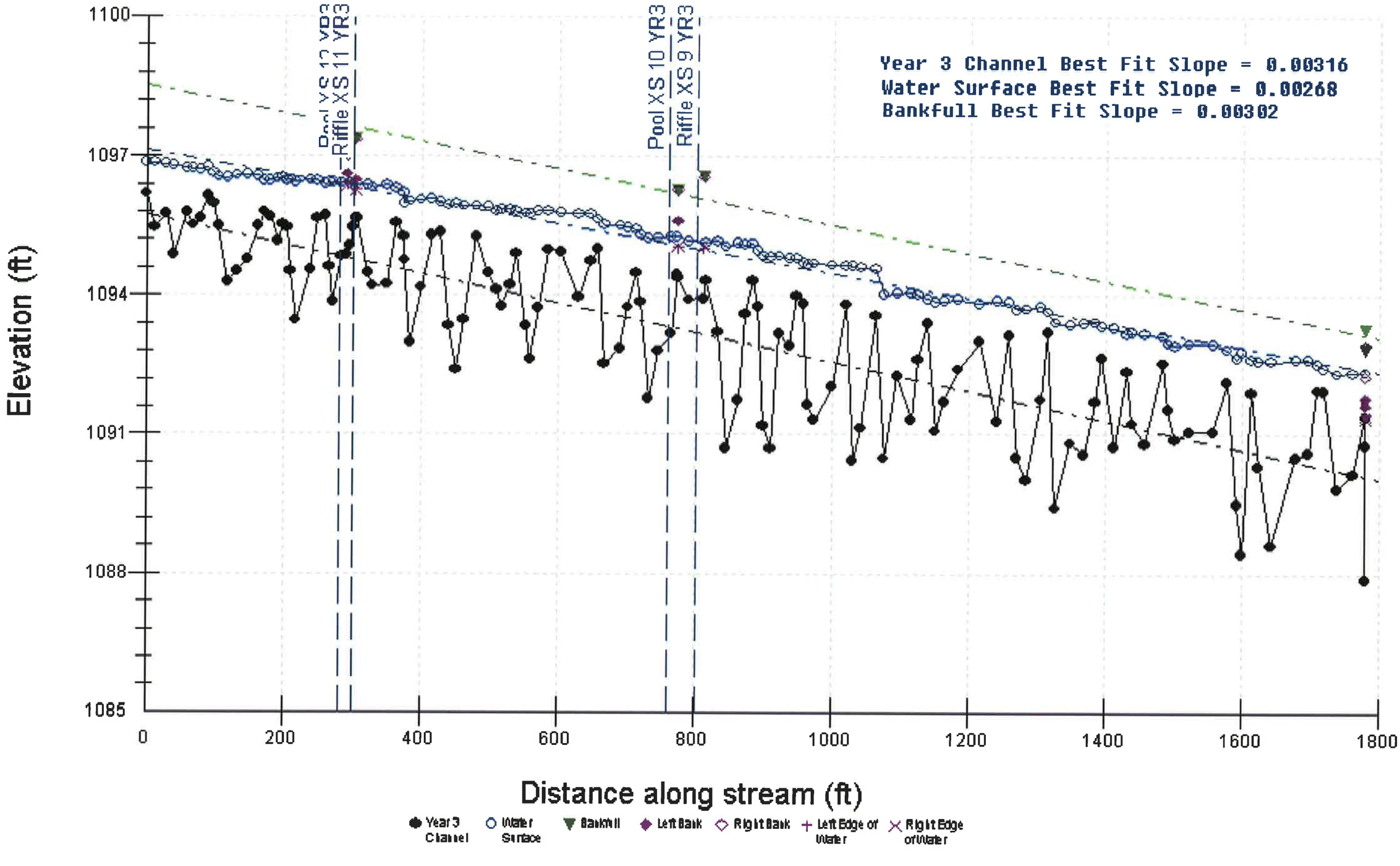
PROJECT	Thompsons Fork
	D06030-A
	3-YEAR
TASK	Cross-Section
REACH	Mainstem
DATE	5/24/11
CROSS SECTION:	12
FEATURE:	Pool

Cross-section photo – looking downstream

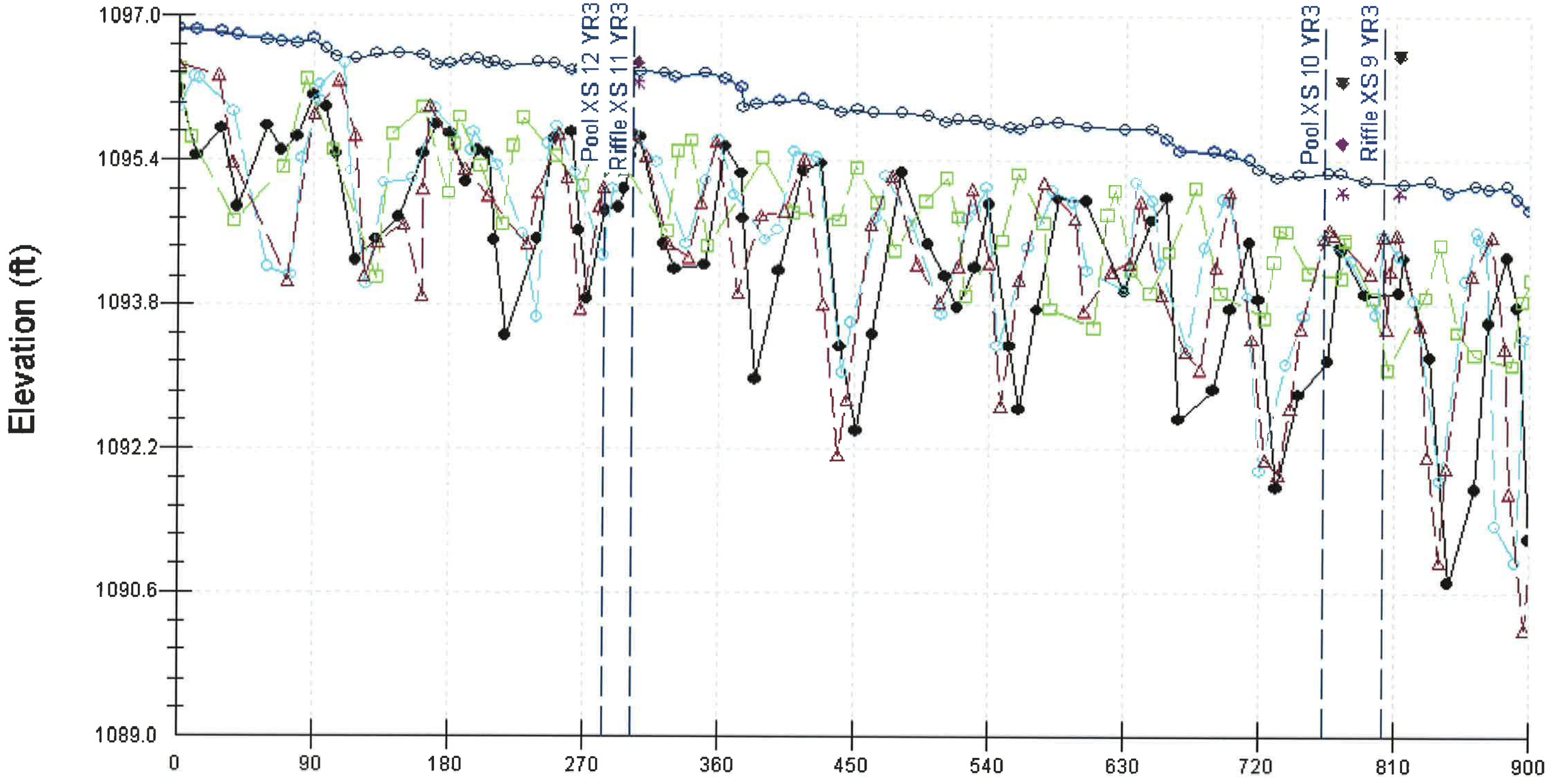


EMH&T

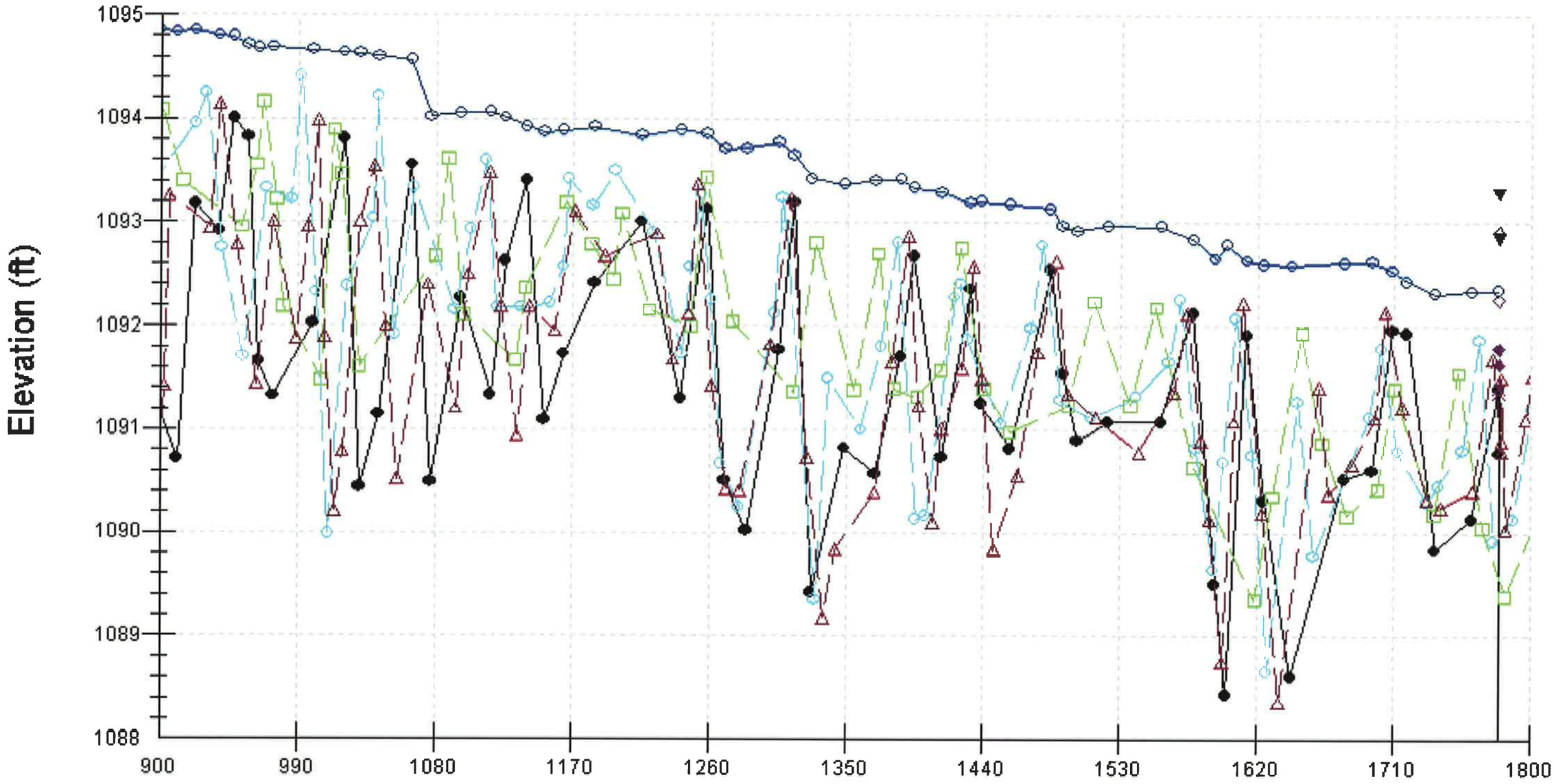
Thompsons Fork Mainstem - Longitudinal Profile - Year 3 (May 23, 2011)



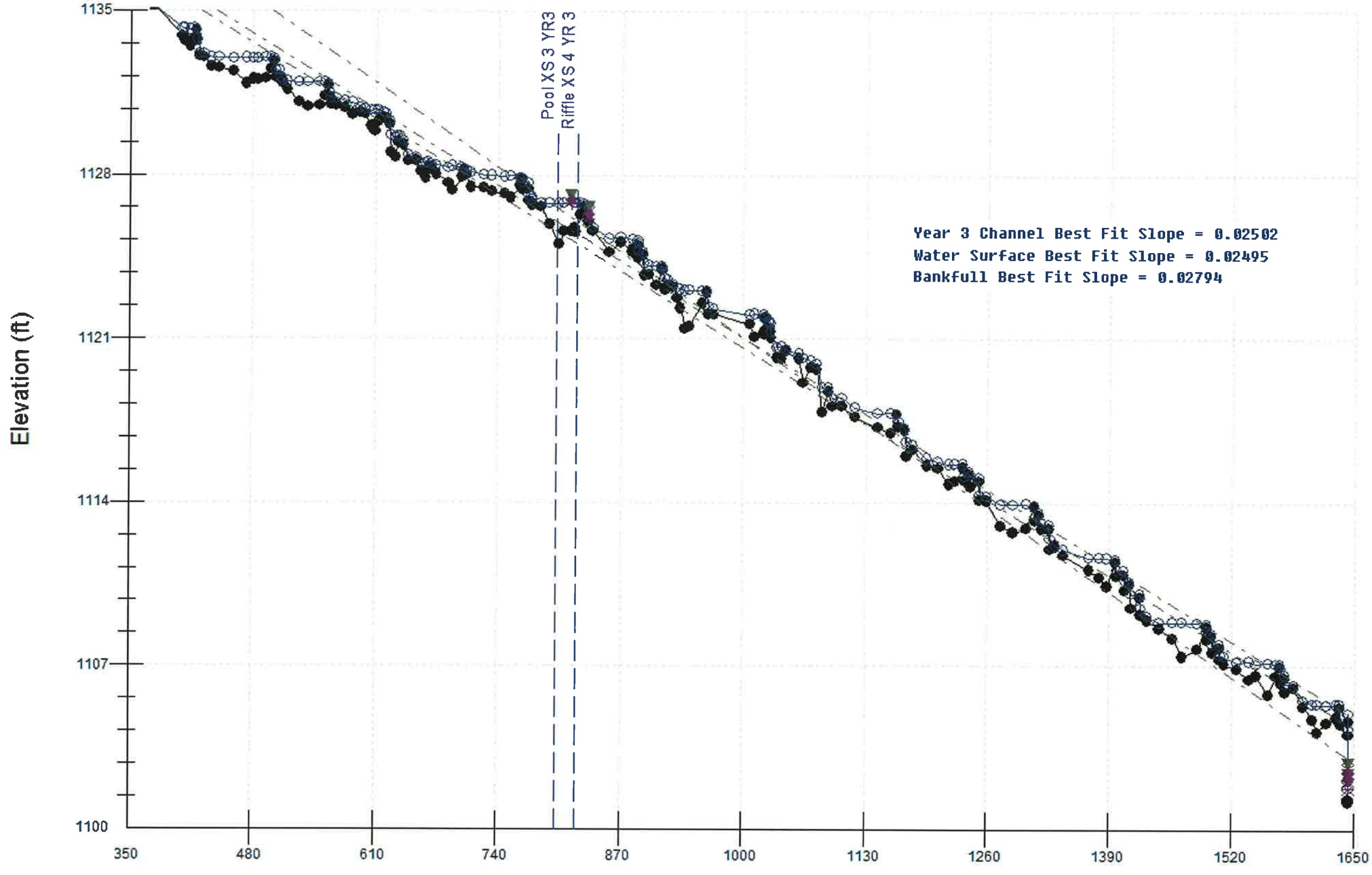
Thompsons Fork Mainstem - Longitudinal Profile - Year 3 (May 23, 2011)



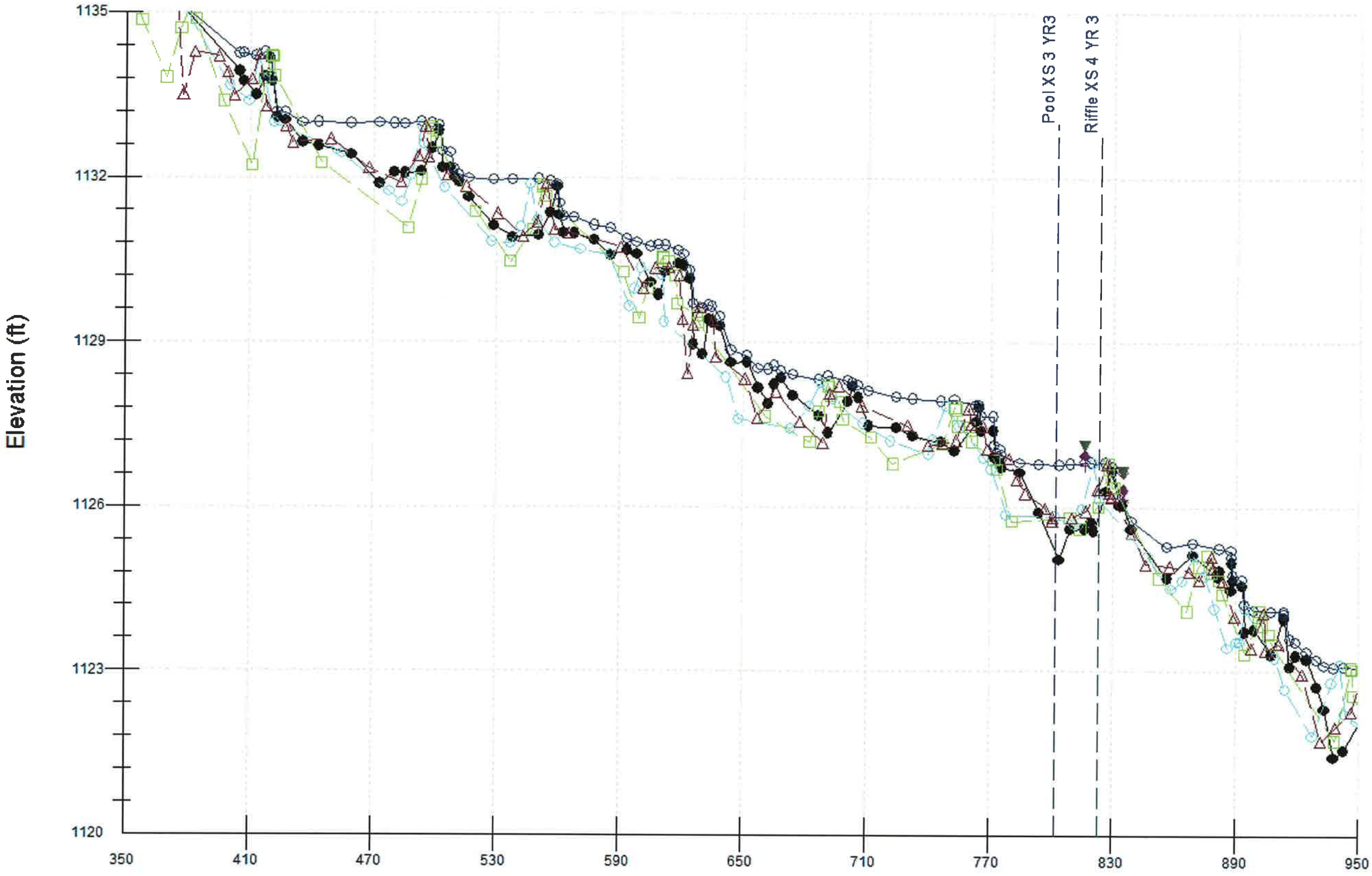
Thompsons Fork Mainstem - Longitudinal Profile - Year 3 (May 23, 2011)



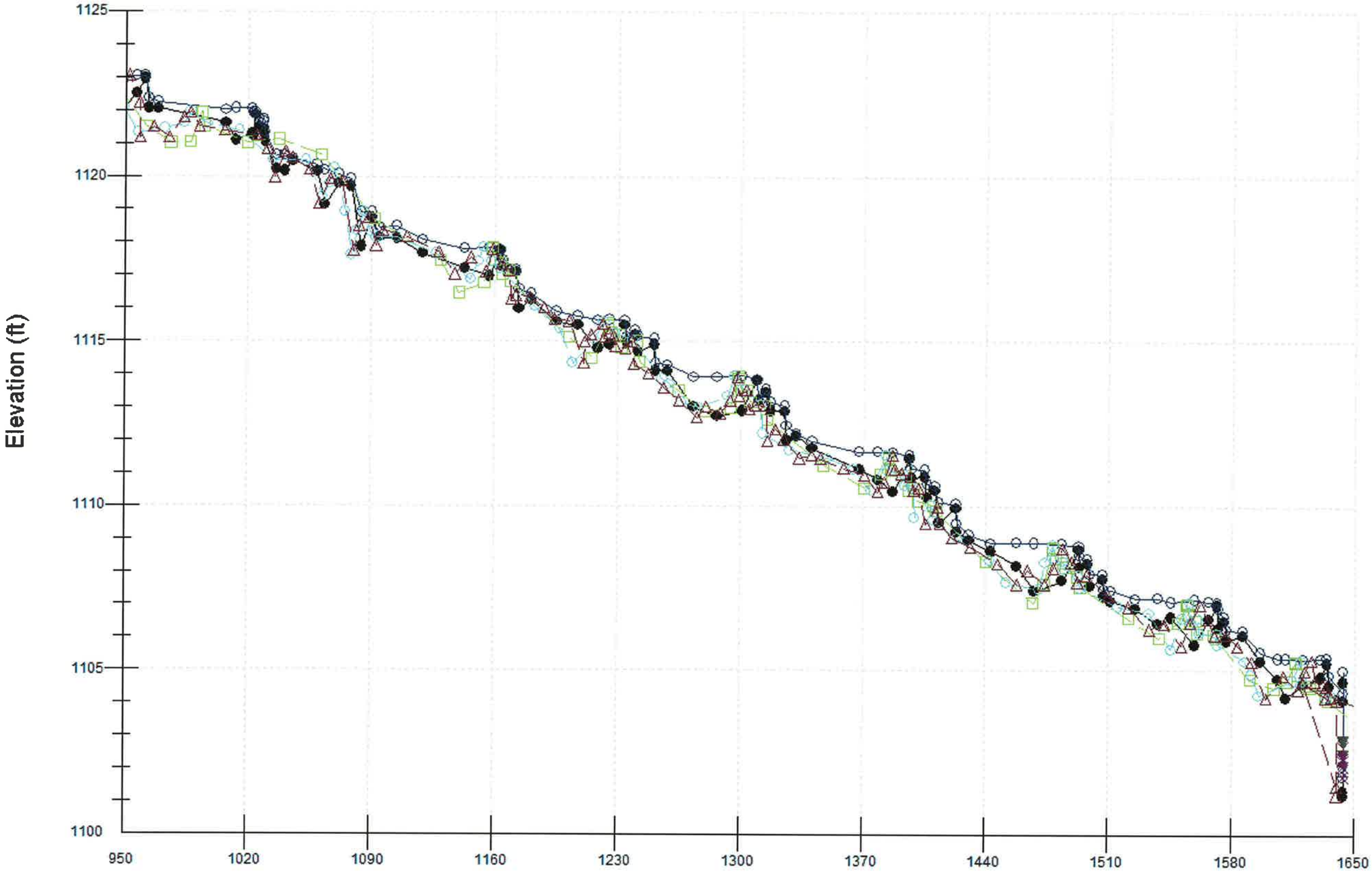
Unnamed Tributary (to Thompsons Fork) - Profile - Year 3 (May 23, 2011)



Unnamed Tributary (to Thompsons Fork) - Profile - Year 3 (May 23, 2011)

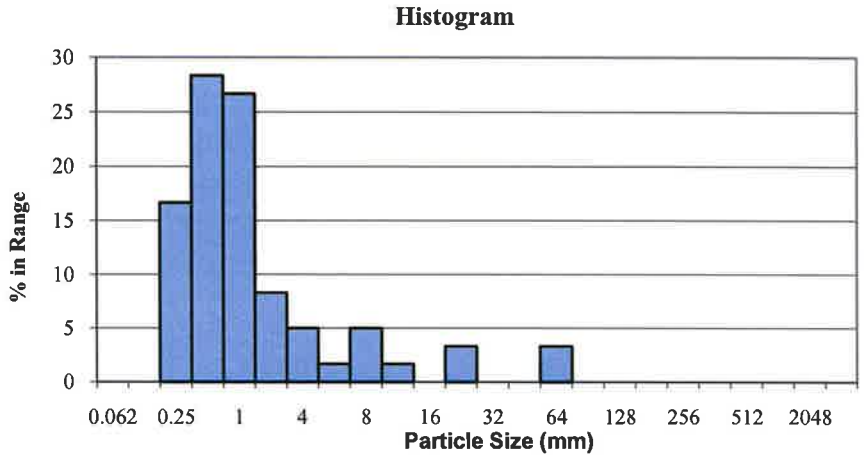


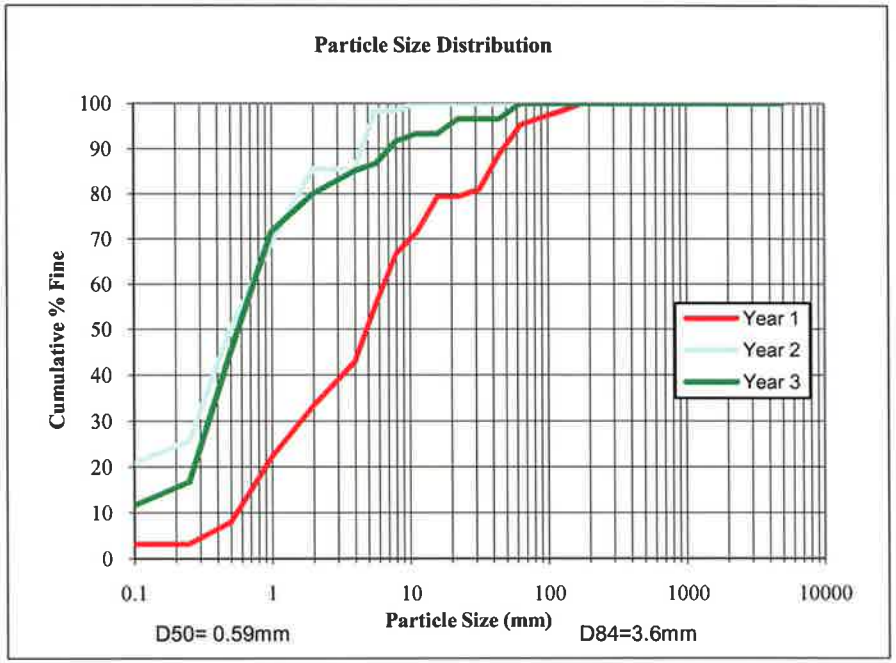
Unnamed Tributary (to Thompsons Fork) - Profile - Year 3 (May 23, 2011)



Pebble Count - Pool				
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	10	17	17
Medium Sand	0.25-0.5	17	28	45
Coarse Sand	0.5-1.0	16	27	72
Very Coarse Sand	1.0-2.0	5	8	80
Very Fine Gravel	2.0-4.0	3	5	85
Fine Gravel	4.0-5.7	1	2	87
Fine Gravel	5.7-8.0	3	5	92
Medium Gravel	8.0-11.3	1	2	93
Medium Gravel	11.3-16.0	0	0	93
Coarse Gravel	16.0-22.6	2	3	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		60	100	

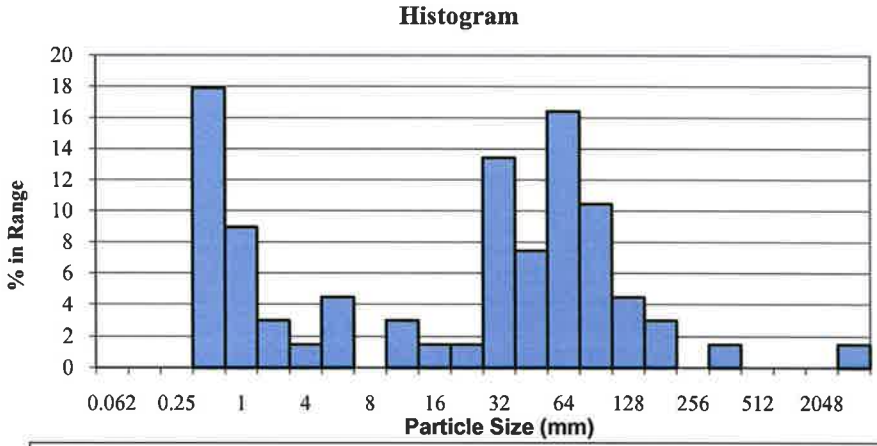
Thompsons Fork Stream Restoration EEP Project No. D06030-A			
Reach	UT	**X Sec**	1
Date	09/15/11	**Sta No.**	1+60

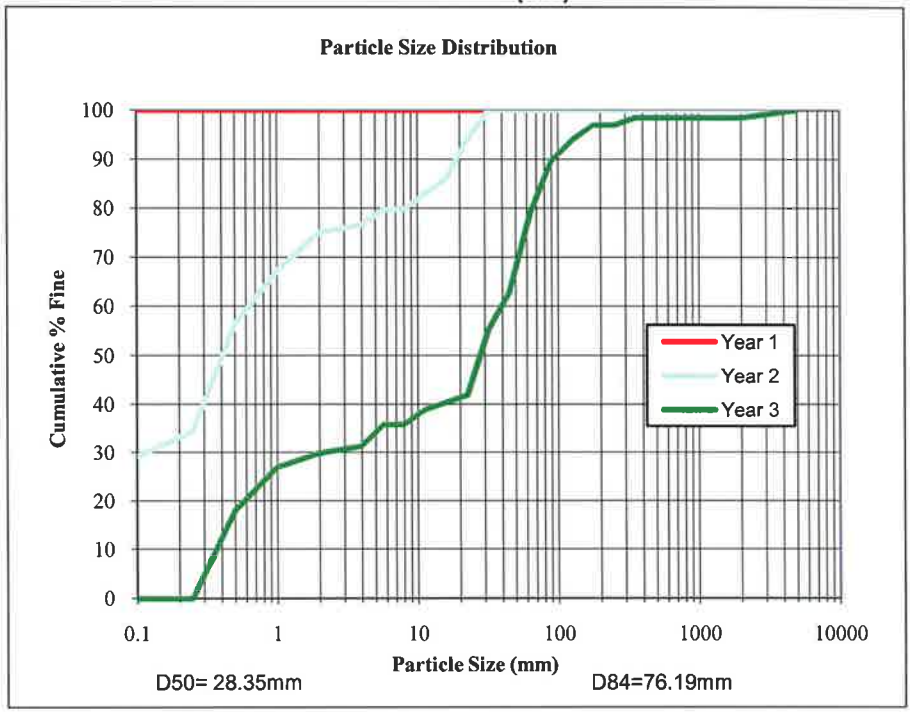




Pebble Count - Riffle				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	0	0	0
Medium Sand	0.25-0.5	12	18	18
Coarse Sand	0.5-1.0	6	9	27
Very Coarse Sand	1.0-2.0	2	3	30
Very Fine Gravel	2.0-4.0	1	1	31
Fine Gravel	4.0-5.7	3	4	36
Fine Gravel	5.7-8.0	0	0	36
Medium Gravel	8.0-11.3	2	3	39
Medium Gravel	11.3-16.0	1	1	40
Coarse Gravel	16.0-22.6	1	1	42
Coarse Gravel	22.6-32	9	13	55
Very Coarse Gravel	32-45	5	7	63
Very Coarse Gravel	45-64	11	16	79
Small Cobble	64-90	7	10	90
Small Cobble	90-128	3	4	94
Large Cobble	128-180	2	3	97
Large Cobble	180-256	0	0	97
Small Boulder	256-362	1	1	99
Small Boulder	362-512	0	0	99
Medium Boulder	512-1024	0	0	99
Large Boulder	1024-2048	0	0	99
Bedrock	<2048	1	1	100
Totals		67	100	

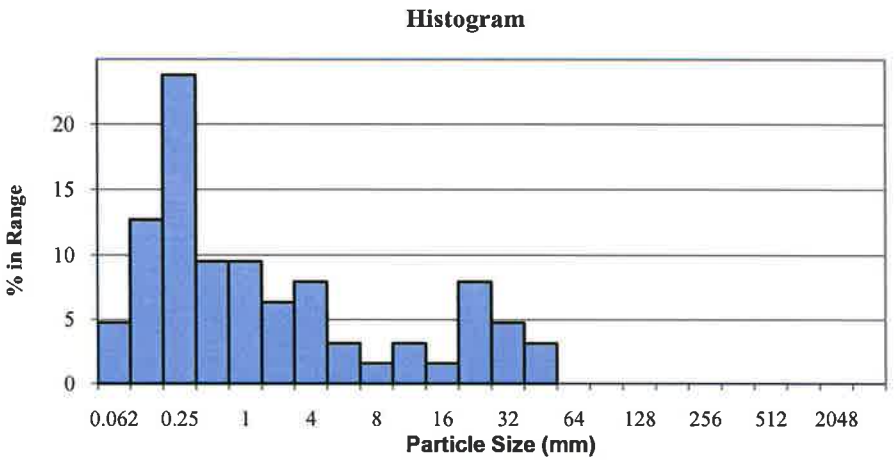
Thompsons Fork Stream Restoration EEP Project No. D06030-A			
Reach	UT	**X Sec**	2
Date	09/15/11	**Sta No.**	1+74

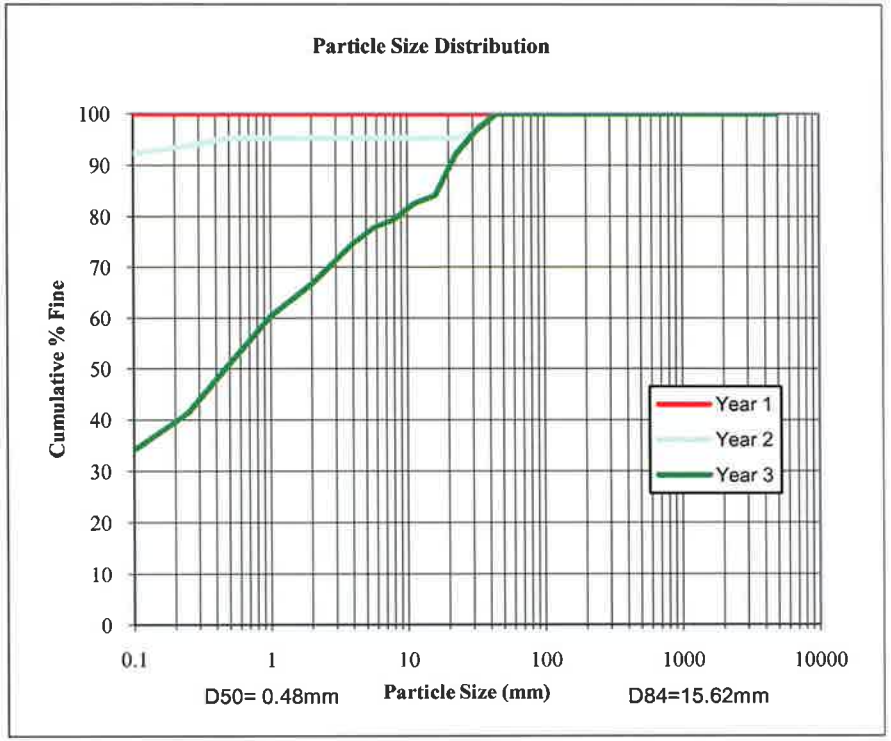




Pebble Count - Pool				
Material	Particle Size (mm)	Count	% in Range	% Cumulative
Silt/Clay	<0.062	3	5	5
Very Fine Sand	0.062-0.125	8	13	17
Fine Sand	0.125-0.25	15	24	41
Medium Sand	0.25-0.5	6	10	51
Coarse Sand	0.5-1.0	6	10	60
Very Coarse Sand	1.0-2.0	4	6	67
Very Fine Gravel	2.0-4.0	5	8	75
Fine Gravel	4.0-5.7	2	3	78
Fine Gravel	5.7-8.0	1	2	79
Medium Gravel	8.0-11.3	2	3	83
Medium Gravel	11.3-16.0	1	2	84
Coarse Gravel	16.0-22.6	5	8	92
Coarse Gravel	22.6-32	3	5	97
Very Coarse Gravel	32-45	2	3	100
Very Coarse Gravel	45-64	0	0	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		63	100	

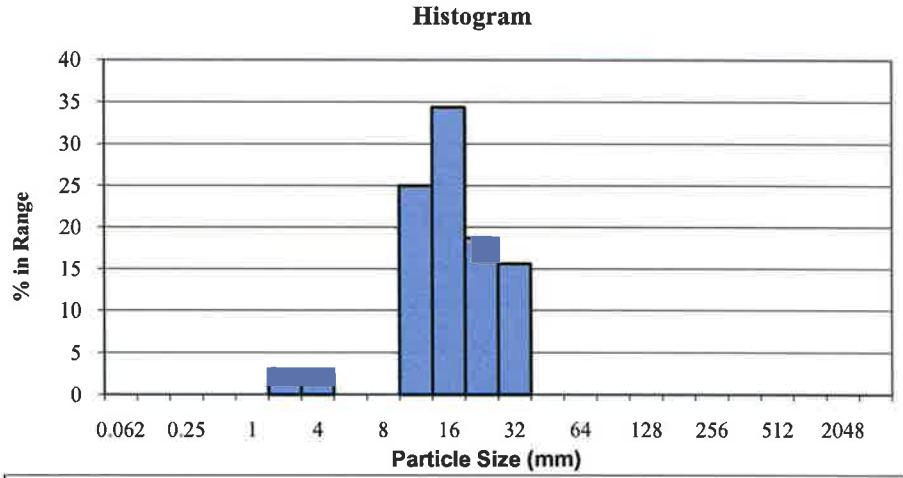
Thompsons Fork Stream Restoration EEP Project No. D06030-A			
Reach	UT	X Sec	3
Date	09/16/11	Sta No.	8+09

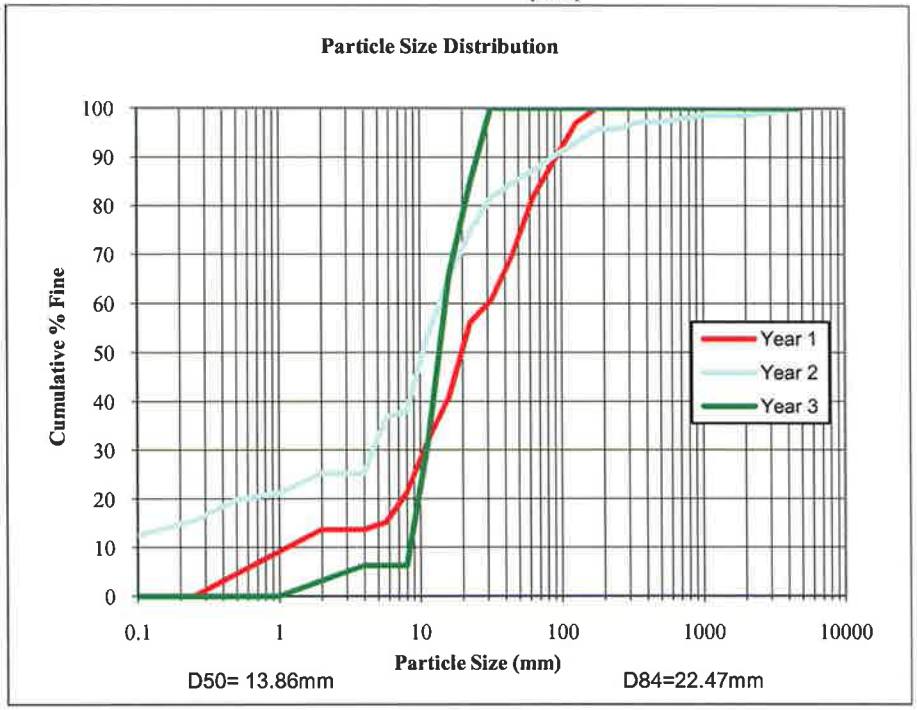




Pebble Count - Riffle				
Material	Particle Size (mm)	Count	% in Range	% Cumulative
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	0	0	0
Medium Sand	0.25-0.5	0	0	0
Coarse Sand	0.5-1.0	0	0	0
Very Coarse Sand	1.0-2.0	2	3	3
Very Fine Gravel	2.0-4.0	2	3	6
Fine Gravel	4.0-5.7	0	0	6
Fine Gravel	5.7-8.0	0	0	6
Medium Gravel	8.0-11.3	16	25	31
Medium Gravel	11.3-16.0	22	34	66
Coarse Gravel	16.0-22.6	12	19	84
Coarse Gravel	22.6-32	10	16	100
Very Coarse Gravel	32-45	0	0	100
Very Coarse Gravel	45-64	0	0	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	

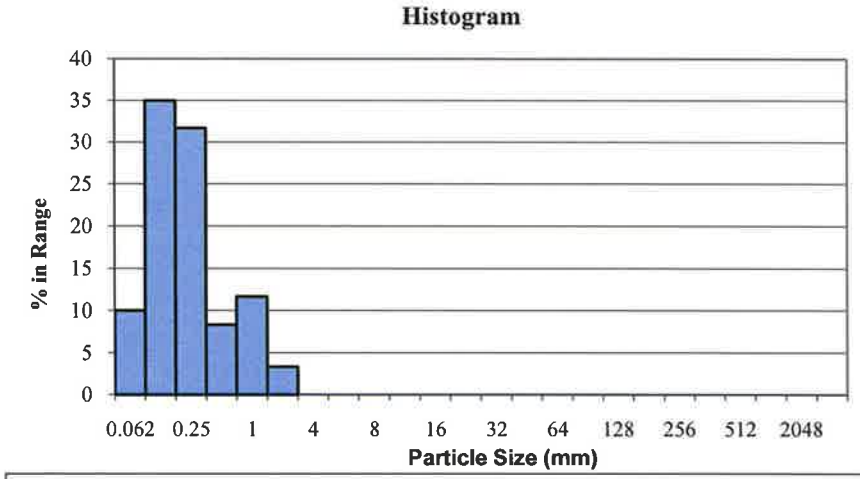
Thompsons Fork Stream Restoration EEP Project No. D06030-A			
Reach	UT	X Sec	4
Date	09/15/11	Sta No.	8+31

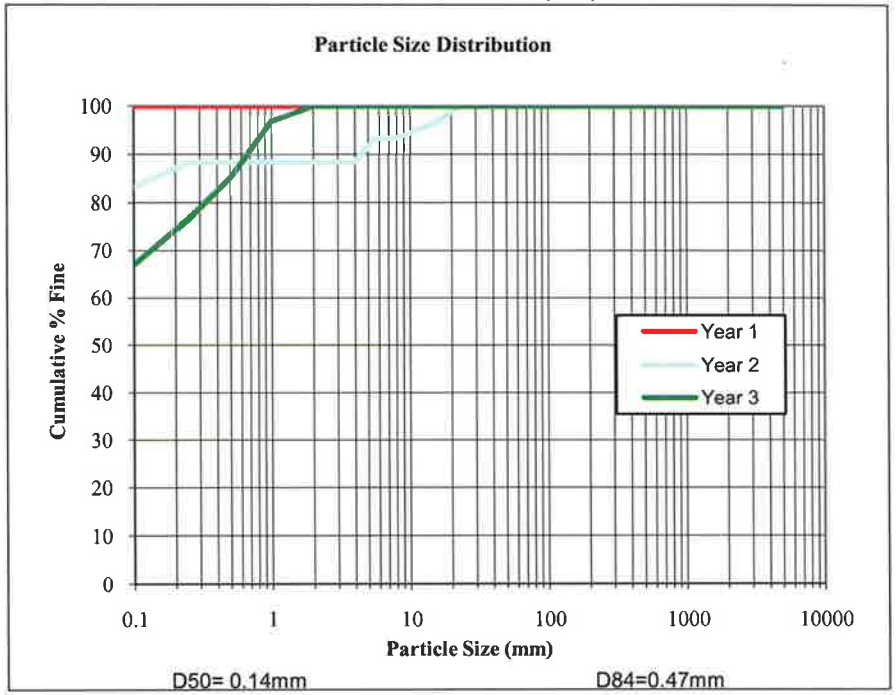




Pebble Count - Pool				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	6	10	10
Very Fine Sand	0.062-0.125	21	35	45
Fine Sand	0.125-0.25	19	32	77
Medium Sand	0.25-0.5	5	8	85
Coarse Sand	0.5-1.0	7	12	97
Very Coarse Sand	1.0-2.0	2	3	100
Very Fine Gravel	2.0-4.0	0	0	100
Fine Gravel	4.0-5.7	0	0	100
Fine Gravel	5.7-8.0	0	0	100
Medium Gravel	8.0-11.3	0	0	100
Medium Gravel	11.3-16.0	0	0	100
Coarse Gravel	16.0-22.6	0	0	100
Coarse Gravel	22.6-32	0	0	100
Very Coarse Gravel	32-45	0	0	100
Very Coarse Gravel	45-64	0	0	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		60	100	

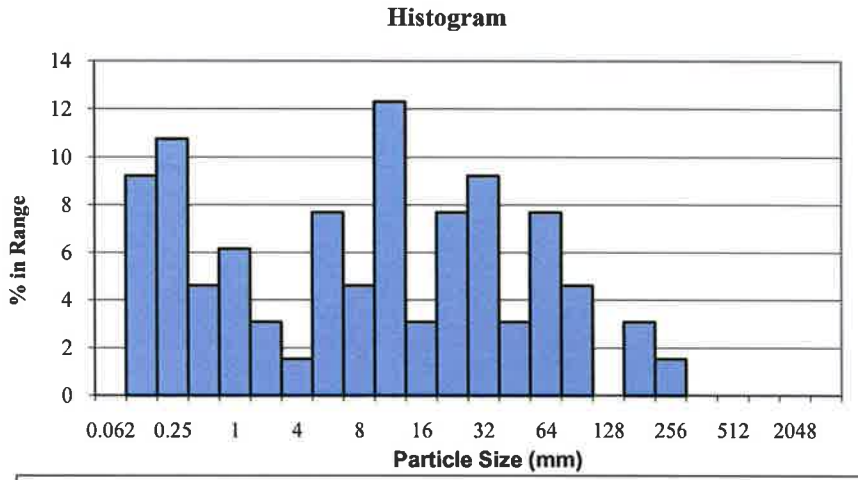
Thompsons Fork Stream Restoration EEP Project No. D06030-A			
Reach	UT	**X Sec**	5
Date	09/15/11	**Sta No.**	17+79

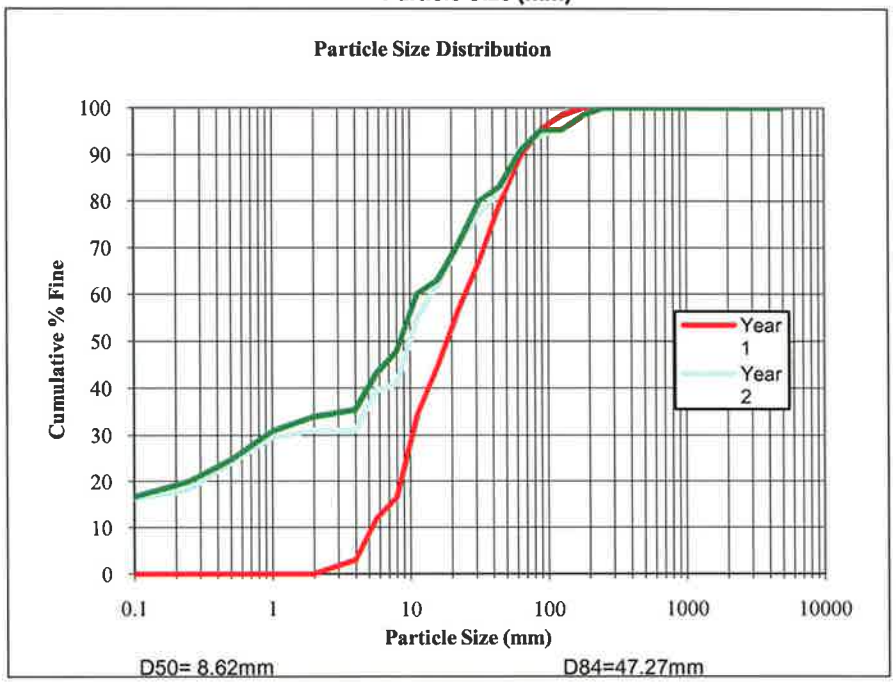




Pebble Count - Riffle				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	6	9	9
Fine Sand	0.125-0.25	7	11	20
Medium Sand	0.25-0.5	3	5	25
Coarse Sand	0.5-1.0	4	6	31
Very Coarse Sand	1.0-2.0	2	3	34
Very Fine Gravel	2.0-4.0	1	2	35
Fine Gravel	4.0-5.7	5	8	43
Fine Gravel	5.7-8.0	3	5	48
Medium Gravel	8.0-11.3	8	12	60
Medium Gravel	11.3-16.0	2	3	63
Coarse Gravel	16.0-22.6	5	8	71
Coarse Gravel	22.6-32	6	9	80
Very Coarse Gravel	32-45	2	3	83
Very Coarse Gravel	45-64	5	8	91
Small Cobble	64-90	3	5	95
Small Cobble	90-128	0	0	95
Large Cobble	128-180	2	3	98
Large Cobble	180-256	1	2	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		65	100	

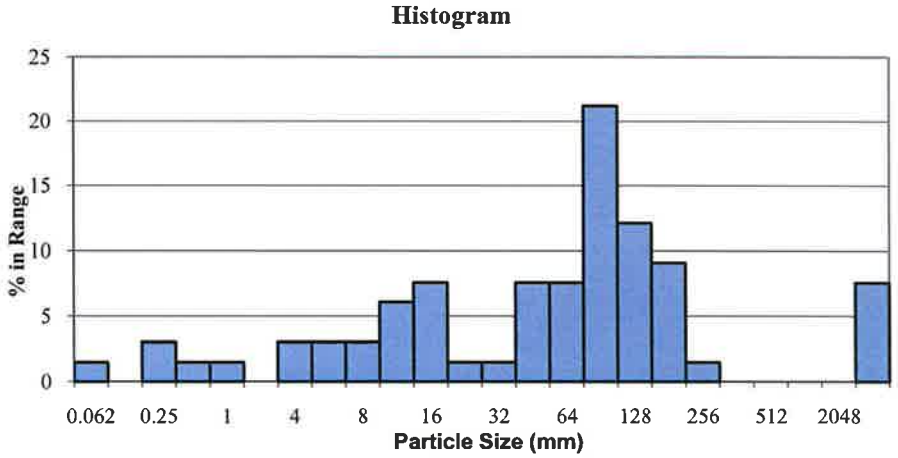
Thompsons Fork Stream Restoration EEP Project No. D06030-A			
Reach	UT	**X Sec**	6
Date	09/15/11	**Sta No.**	17+94

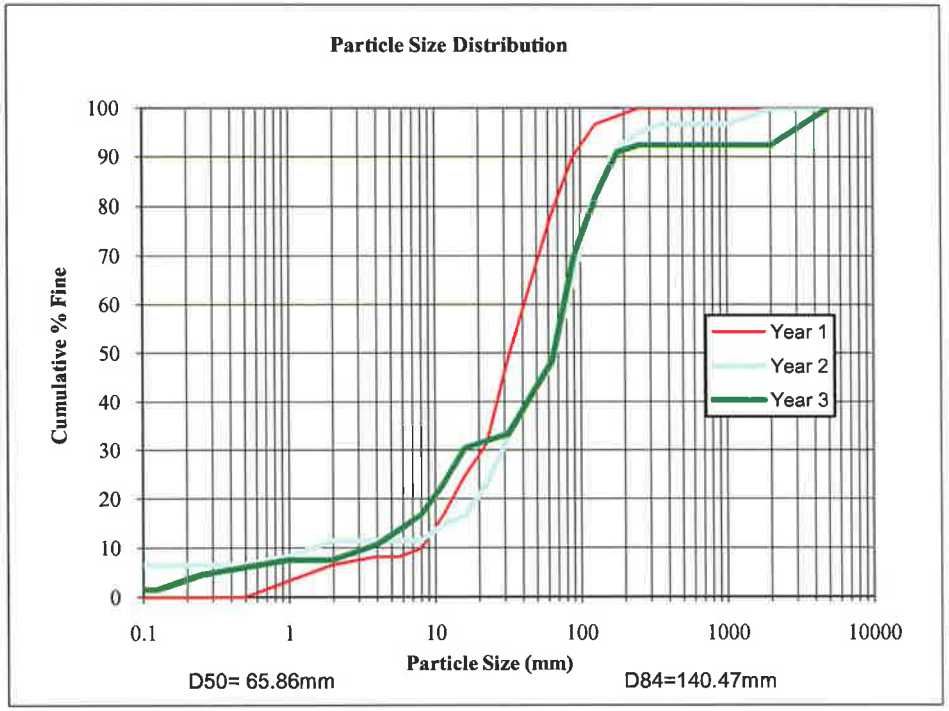




Pebble Count - Riffle				
Material	Particle Size (mm)	Count	% in Range	% Cumulative
Silt/Clay	<0.062	1	2	2
Very Fine Sand	0.062-0.125	0	0	2
Fine Sand	0.125-0.25	2	3	5
Medium Sand	0.25-0.5	1	2	6
Coarse Sand	0.5-1.0	1	2	8
Very Coarse Sand	1.0-2.0	0	0	8
Very Fine Gravel	2.0-4.0	2	3	11
Fine Gravel	4.0-5.7	2	3	14
Fine Gravel	5.7-8.0	2	3	17
Medium Gravel	8.0-11.3	4	6	23
Medium Gravel	11.3-16.0	5	8	30
Coarse Gravel	16.0-22.6	1	2	32
Coarse Gravel	22.6-32	1	2	33
Very Coarse Gravel	32-45	5	8	41
Very Coarse Gravel	45-64	5	8	48
Small Cobble	64-90	14	21	70
Small Cobble	90-128	8	12	82
Large Cobble	128-180	6	9	91
Large Cobble	180-256	1	2	92
Small Boulder	256-362	0	0	92
Small Boulder	362-512	0	0	92
Medium Boulder	512-1024	0	0	92
Large Boulder	1024-2048	0	0	92
Bedrock	<2048	5	8	100
Totals		66	100	

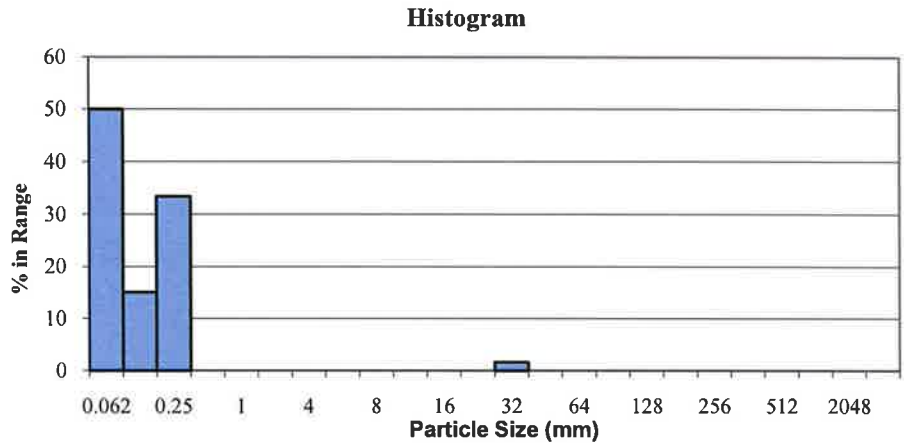
Thompsons Fork Stream Restoration EEP Project No. D06030-A			
Reach	Mainstem	X Sec	7
Date	05/18/11	Sta No.	21+11

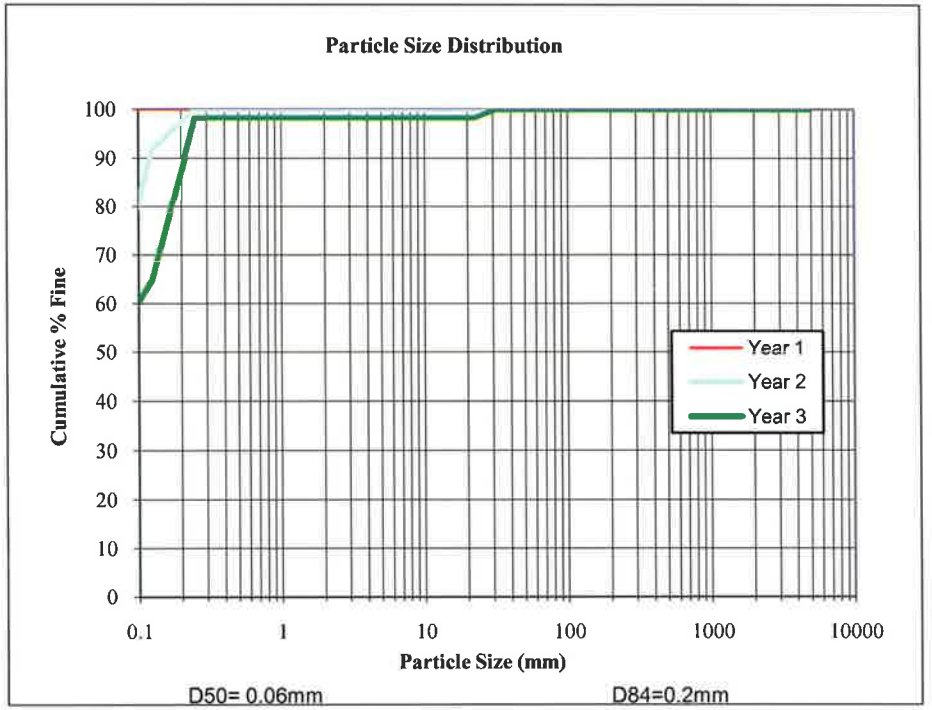




Pebble Count - Pool				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	30	50	50
Very Fine Sand	0.062-0.125	9	15	65
Fine Sand	0.125-0.25	20	33	98
Medium Sand	0.25-0.5	0	0	98
Coarse Sand	0.5-1.0	0	0	98
Very Coarse Sand	1.0-2.0	0	0	98
Very Fine Gravel	2.0-4.0	0	0	98
Fine Gravel	4.0-5.7	0	0	98
Fine Gravel	5.7-8.0	0	0	98
Medium Gravel	8.0-11.3	0	0	98
Medium Gravel	11.3-16.0	0	0	98
Coarse Gravel	16.0-22.6	0	0	98
Coarse Gravel	22.6-32	1	2	100
Very Coarse Gravel	32-45	0	0	100
Very Coarse Gravel	45-64	0	0	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		60	100	

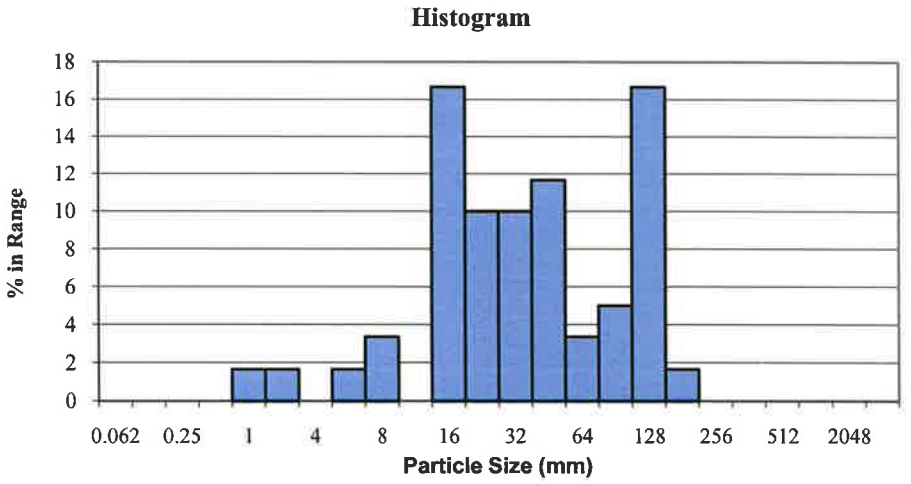
Thompsons Fork Stream Restoration EEP Project No. D06030-A			
Reach	Mainstem	**X Sec**	8
Date	05/18/11	**Sta No.**	20+77

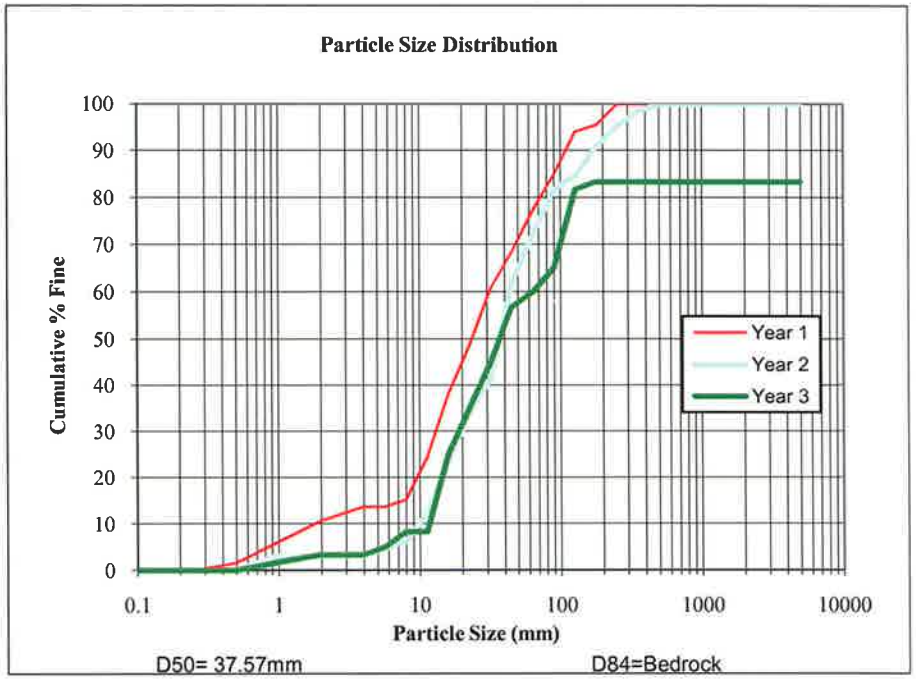




Pebble Count - Riffle				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	0	0	0
Medium Sand	0.25-0.5	0	0	0
Coarse Sand	0.5-1.0	1	2	2
Very Coarse Sand	1.0-2.0	1	2	3
Very Fine Gravel	2.0-4.0	0	0	3
Fine Gravel	4.0-5.7	1	2	5
Fine Gravel	5.7-8.0	2	3	8
Medium Gravel	8.0-11.3	0	0	8
Medium Gravel	11.3-16.0	10	17	25
Coarse Gravel	16.0-22.6	6	10	35
Coarse Gravel	22.6-32	6	10	45
Very Coarse Gravel	32-45	7	12	57
Very Coarse Gravel	45-64	2	3	60
Small Cobble	64-90	3	5	65
Small Cobble	90-128	10	17	82
Large Cobble	128-180	1	2	83
Large Cobble	180-256	0	0	83
Small Boulder	256-362	0	0	83
Small Boulder	362-512	0	0	83
Medium Boulder	512-1024	0	0	83
Large Boulder	1024-2048	0	0	83
Bedrock	<2048	10	0	83
Totals		60	83	

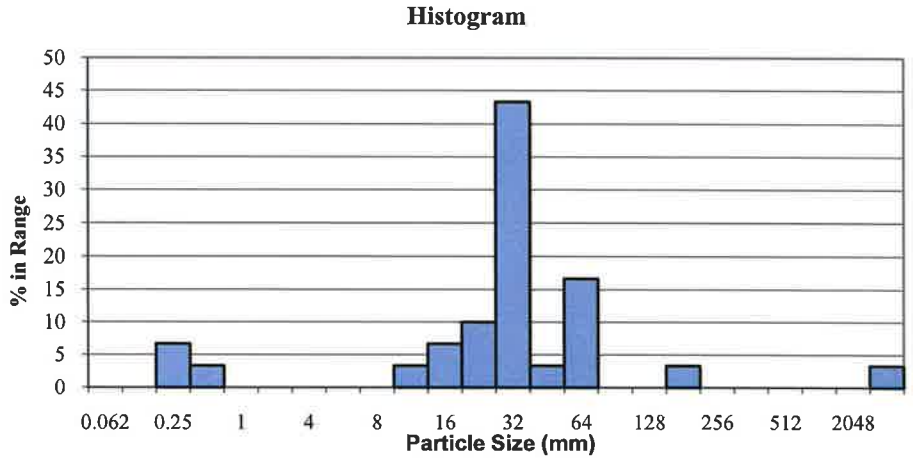
Thompsons Fork Stream Restoration EEP Project No. D06030-A			
Reach	Mainstem	**X Sec**	9
Date	05/18/11	**Sta No.**	7+76

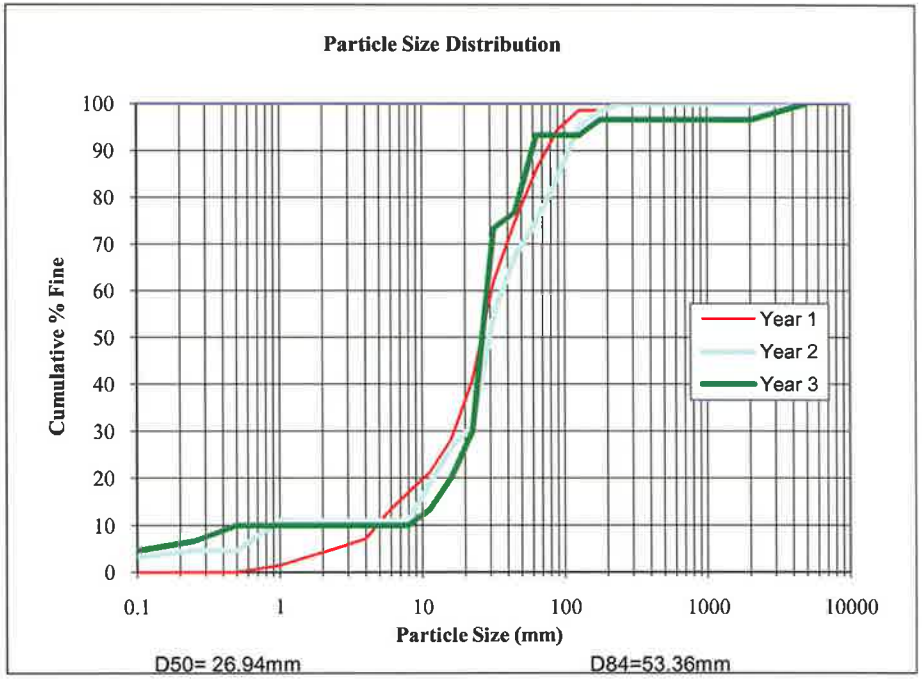




Pebble Count - Riffle				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	4	7	7
Medium Sand	0.25-0.5	2	3	10
Coarse Sand	0.5-1.0	0	0	10
Very Coarse Sand	1.0-2.0	0	0	10
Very Fine Gravel	2.0-4.0	0	0	10
Fine Gravel	4.0-5.7	0	0	10
Fine Gravel	5.7-8.0	0	0	10
Medium Gravel	8.0-11.3	2	3	13
Medium Gravel	11.3-16.0	4	7	20
Coarse Gravel	16.0-22.6	6	10	30
Coarse Gravel	22.6-32	26	43	73
Very Coarse Gravel	32-45	2	3	77
Very Coarse Gravel	45-64	10	17	93
Small Cobble	64-90	0	0	93
Small Cobble	90-128	0	0	93
Large Cobble	128-180	2	3	97
Large Cobble	180-256	0	0	97
Small Boulder	256-362	0	0	97
Small Boulder	362-512	0	0	97
Medium Boulder	512-1024	0	0	97
Large Boulder	1024-2048	0	0	97
Bedrock	<2048	2	3	100
Totals		60	100	

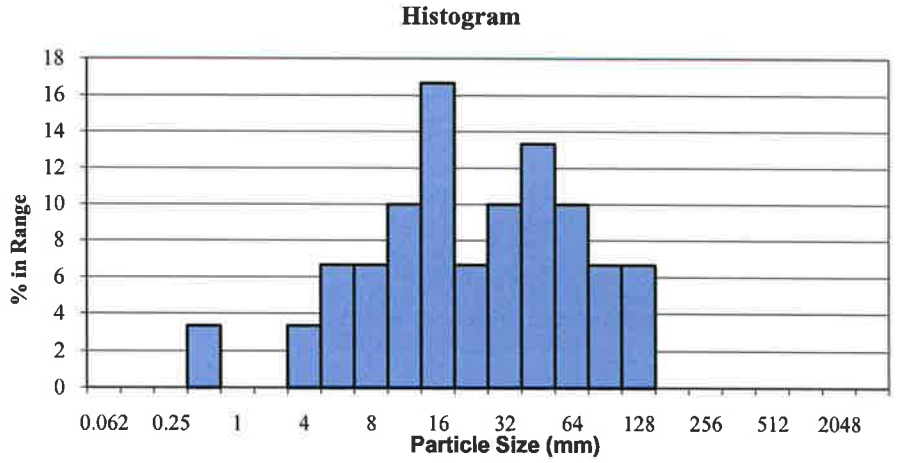
Thompsons Fork Stream Restoration EEP Project No. D06030-A			
Reach	Mainstem	**X Sec**	10
Date	05/18/11	**Sta No.**	7+37

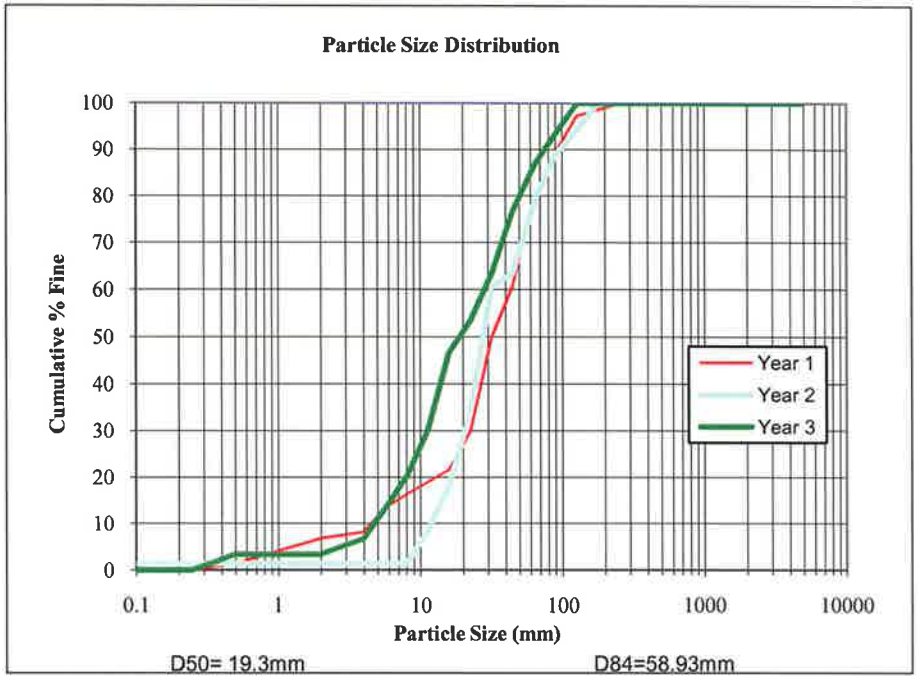




Pebble Count - Riffle				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	0	0	0
Medium Sand	0.25-0.5	2	3	3
Coarse Sand	0.5-1.0	0	0	3
Very Coarse Sand	1.0-2.0	0	0	3
Very Fine Gravel	2.0-4.0	2	3	7
Fine Gravel	4.0-5.7	4	7	13
Fine Gravel	5.7-8.0	4	7	20
Medium Gravel	8.0-11.3	6	10	30
Medium Gravel	11.3-16.0	10	17	47
Coarse Gravel	16.0-22.6	4	7	53
Coarse Gravel	22.6-32	6	10	63
Very Coarse Gravel	32-45	8	13	77
Very Coarse Gravel	45-64	6	10	87
Small Cobble	64-90	4	7	93
Small Cobble	90-128	4	7	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		60	100	

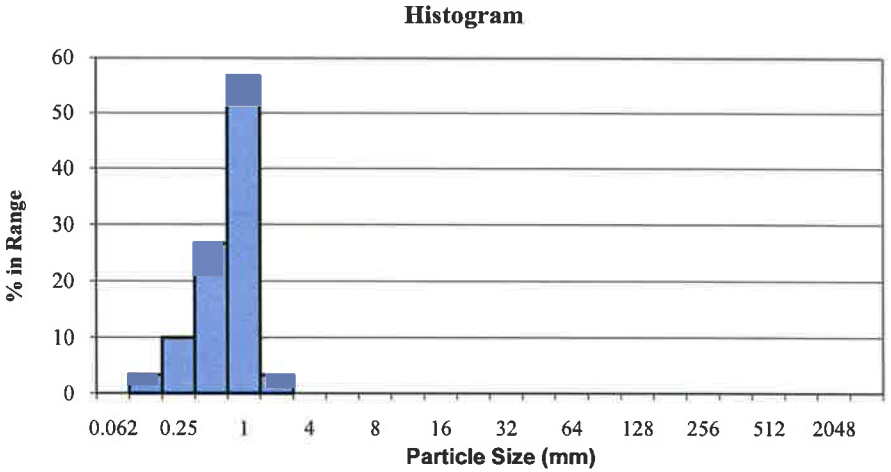
Thompsons Fork Stream Restoration EEP Project No. D06030-A			
Reach	Mainstem	**X Sec**	11
Date	05/18/11	**Sta No.**	2+81

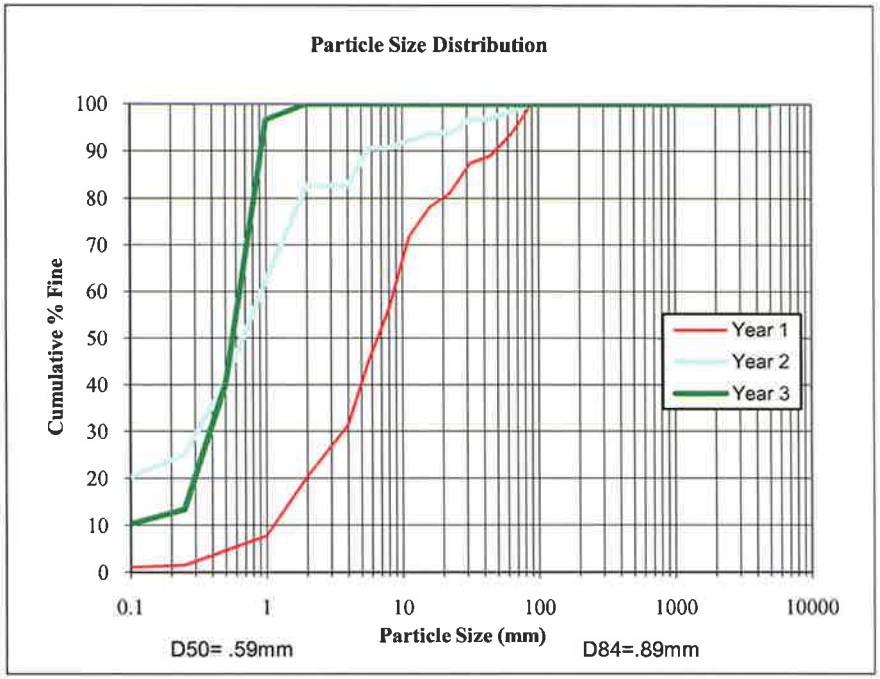




Pebble Count - Pool				
Material	**Particle Size (mm)**	**Count**	**% in Range**	**% Cumulative**
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	2	3	3
Fine Sand	0.125-0.25	6	10	13
Medium Sand	0.25-0.5	16	27	40
Coarse Sand	0.5-1.0	34	57	97
Very Coarse Sand	1.0-2.0	2	3	100
Very Fine Gravel	2.0-4.0	0	0	100
Fine Gravel	4.0-5.7	0	0	100
Fine Gravel	5.7-8.0	0	0	100
Medium Gravel	8.0-11.3	0	0	100
Medium Gravel	11.3-16.0	0	0	100
Coarse Gravel	16.0-22.6	0	0	100
Coarse Gravel	22.6-32	0	0	100
Very Coarse Gravel	32-45	0	0	100
Very Coarse Gravel	45-64	0	0	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		60	100	

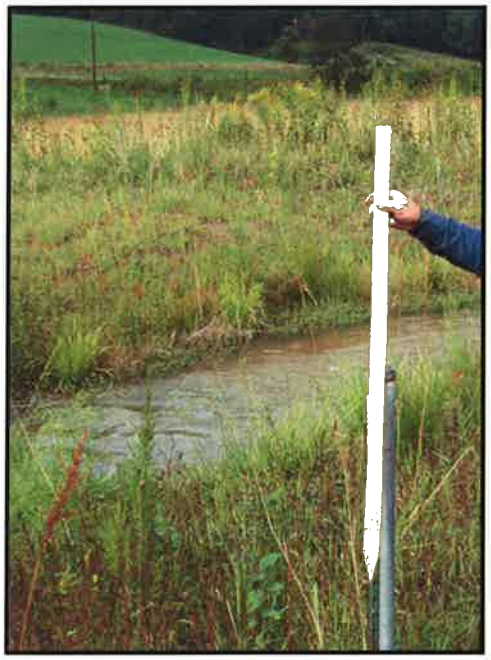
Thompsons Fork Stream Restoration EEP Project No. D06030-A			
Reach	Mainstem	**X Sec**	12
Date	05/18/11	**Sta No.**	2+68





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-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)

SPA 1
Scour along left and right bank of Thompsons Fork Mainstem at station 24+00; caused by a beaver dam that was created and subsequently deconstructed in spring, 2011.
(EMH&T, 9/15/11)

SPA 2
Scour along left and right bank of Thompsons Fork Mainstem at station 19+35; caused by a beaver dam that was created and subsequently deconstructed in late fall, 2010.
(EMH&T, 9/15/11)

SPA 3
Scour and sloughing along the right bank of Thompsons Fork Mainstem at station 8+25.
(EMH&T, 9/15/11)

SPA 4 *(resolved)*

An example of the aggradation which was noted throughout the length of UT-1 in 2010 (top photo). Stream maintenance was completed in the spring of 2011 which cleared the channel of accumulated sediment and the majority of infiltrating wetland vegetation (bottom photo).

Top Photo – (EMH&T, 9/18/10)

Bottom Photo - (EMH&T, 9/15/11)

SPA 5 ***(resolved)***

An example of the aggradation which was noted throughout the length of UT-1 in 2010 (top photo). Stream maintenance was completed in the spring of 2011 which cleared the channel of accumulated sediment and the majority of infiltrating wetland vegetation (bottom photo).

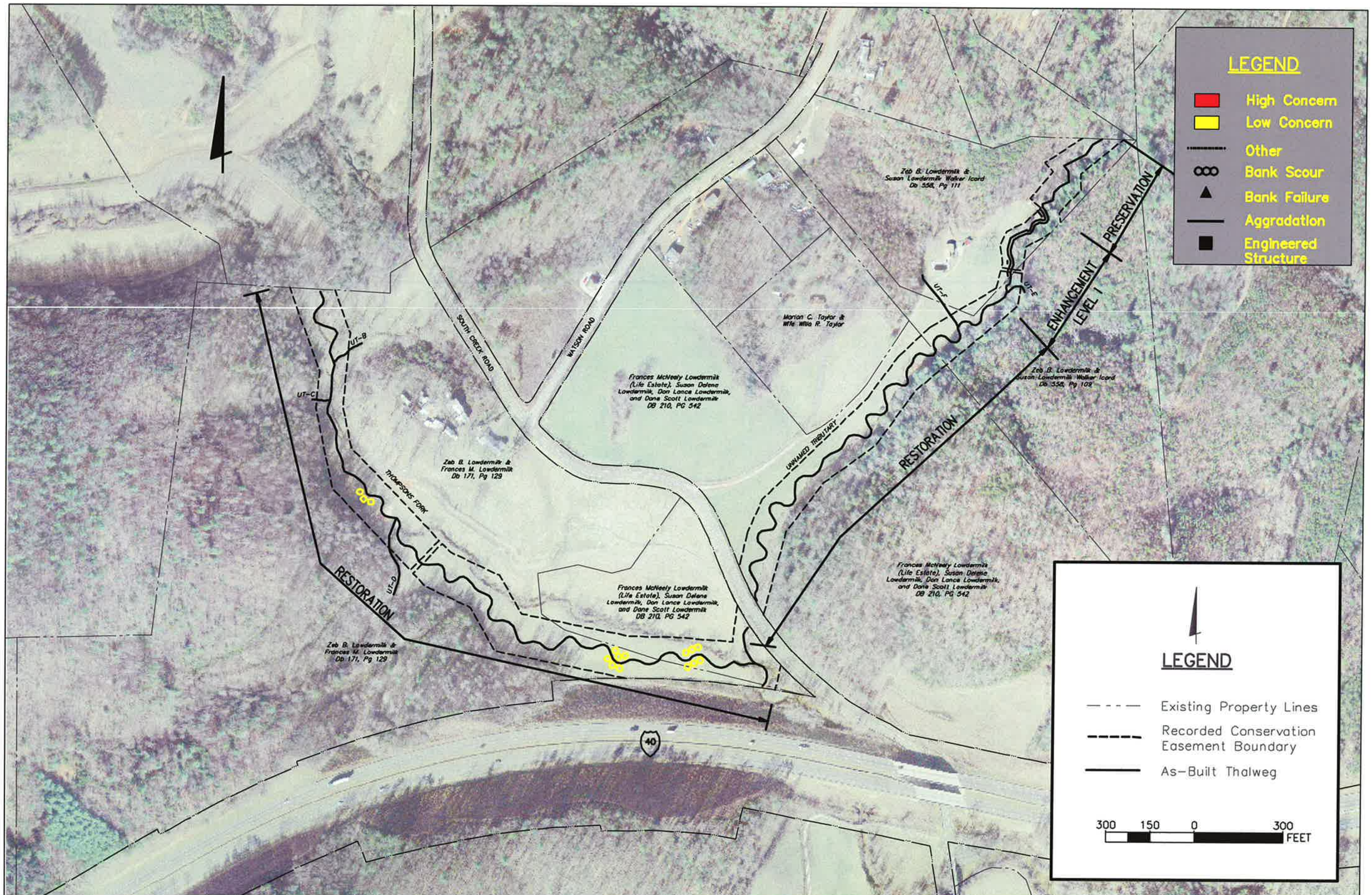
Top Photo – (EMH&T, 9/18/10)

Bottom Photo - (EMH&T, 9/15/11)

APPENDIX C

UT-1 Maintenance

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



MCDOWELL COUNTY, NORTH CAROLINA

THOMPSONS FORK AND UNNAMED TRIBUTARY

APPENDIX B

STREAM PROBLEM AREA PLAN VIEW

Job No. 2009-0328

Date December, 2011

Scale 1" = 300'

Sheet 1/1

EMH&T

Spoil Areas
Borrow Area
Temp. Plug
Temporary Plug
Temporary Rock Filter Outlet 3
Diversion Channel
Temporary Rock Filter Outlet 3
Temporary Plug
END STREAM WORK
Proposed Conservation Easement
Diversion Channel
Sediment Fence
Limits Of Disturbance
Ex. Unnamed Tributary G (Do Not Disturb Outside Conservation Easement)
Diversion Channel (Runoff Control)
PUMP
PUMP
UNNAMED TRIBUTARY
Temporary Plug
Temporary Plug
Temporary Rock Filter Outlet 2
Agg. Check Dam
Agg. Check Dam
PHASE 3
PHASE 2
Ex. Unnamed Tributary F (Do Not Disturb Outside Conservation Easement)
PUMP
PUMP
Temporary Plug
Temporary Plug
Temporary Rock Filter Outlet 1
Agg. Check Dam
Temporary Plug
Ex. Swale (Do Not Disturb Outside Conservation Easement)
PHASE 1
Ex. Unnamed Tributary E (Do Not Disturb Outside Conservation Easement)
Prop. Stream Crossing
Scale: 1" = 60'

2011 Key to Remedial Maintenance (UT)

- Stream Channel Maintenance Area
- Extent of 2011 Remedial Maintenance
- Pump-Around Water Flow (Phase 1)
- Pump
- Aggregate Check Dam
- Pump-Around Water Flow (Phase 2)
- Pump-Around Water Flow (Phase 3)

Extent of 2011 Remedial Maintenance

2006 STREAM RESTORATION LEGEND

- EX. TREE LINE
- EX. 1 FOOT CONTOURS
- EX. 5 FOOT CONTOURS
- EX. FENCE
- EX. PROPERTY LINE
- EX. RIGHT OF WAY
- EX. STREAM
- PROP. RIFFLE
- PROP. BANKFULL
- PROP. BELTWIDTH
- PROP. CONSERVATION EASEMENT
- SEDIMENT FENCE
- TEMPORARY DIVERSION CHANNEL
- TEMPORARY DIVERSION CHANNEL (RUNOFF CONTROL)
- EX. UTILITY POLE
- EX. TREE
- PROP. STREAM CROSSING
- TEMPORARY PLUG
- ROCK FILTER OUTLET

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

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

M C M X X V I