

# **Year 1 Monitoring Report for Stream Restoration of Davis Branch and Unnamed Tributary**

Union County, NC  
SCO # D06054-F



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**Submitted:** December 2009

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

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## I. EXECUTIVE SUMMARY

The Davis Branch stream restoration project is located near the town of Marshville, Union County, North Carolina. Prior to restoration, active use of the land for cattle grazing and hay resulted in impaired, channelized, eroding, incised and entrenched stream channels. The project reaches include the restoration of 1,799 linear feet of the Davis Branch mainstem, enhancement of 1,229 linear feet of the mainstem, preservation of 766 linear feet of the mainstem, restoration of 459 linear feet of an unnamed tributary (UT1) and enhancement of 396 linear feet of the same tributary. Restoration of the project streams, completed during April 2009, 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 1 Annual Monitoring for this project.

Vegetative monitoring was completed in September 15, 2009 following the Carolina Vegetation Survey methodology. Stem counts completed at ten (10) vegetation plots show an average density of 397 stems per acre for the site. This density meets the success criteria of 320 stems/acre after three years of monitoring. Two individual plots had stem densities below the minimum, and all plots showed woody stem mortality due to the dry summer and the rocky soil of the riparian corridor. To address the issue of low plant stem counts, specific areas will be targeted for supplemental planting within the riparian corridors, concentrated along UT1 and the portion of the Davis Branch downstream from the confluence with UT1. Supplemental planting will occur during spring 2010. The subsequent Year 2 (2010) monitoring report will contain specific documentation of this remedial planting effort. There were no additional vegetation problem areas documented on the project site.

Monitoring of the streams identified a few problem areas along the project reaches. The banks of a few of the outside meander bends are lacking vegetation to stabilize the slopes. These areas are considered low concern at this time, in order that they be watched to catch any erosion problems that may occur before vegetation becomes fully established along these slopes.

The visual stream stability assessment revealed that the majority of stream features are functioning as designed and built on the Davis Branch mainstem and unnamed tributary. Dimensional measurements of the monumented cross-sections remain stable when compared to as-built conditions. The comparison of the As-Built and Year 1 long-term stream monitoring profile data show stability with minimal change from as-built conditions. The substrate of the constructed riffles remains stable, with a median particle distributions ranging from very coarse gravel to small cobble. The pool substrate remains stable as well, with median particle sizes ranging from course sand to small cobble to slate bedrock based on Year 1 substrate analysis. Based on the crest gage network installed on the project reaches, one bankfull event was recorded since construction was completed.

The tables on the following page summarize the geomorphological changes along the restoration and enhancement level 1 reaches for each stream.

### Davis Branch Mainstem – Restoration Reach

Parameter	Pre-Restoration	As-built	Year 1
Length	1,562 ft	1,799 ft	1,799 ft
Bankfull Width	8.3 ft	11.3 ft	10.9 ft
Bankfull Max Depth	1.8 ft	1.3 ft	1.2 ft
Width/Depth Ratio	9.1	19.3	16.2
Entrenchment Ratio	12.8	8.5	8.9
Bank Height Ratio	1.4	1.0	1.0
Sinuosity	1.12	1.29	1.29

### Davis Branch Mainstem – Enhancement Reach

Parameter	Pre-Restoration	As-built	Year 1
Length	1,289 ft	1,289 ft	1,289 ft
Bankfull Width	8.8 ft	16.7 ft	17.5 ft
Bankfull Max Depth	2.0 ft	1.3 ft	1.3 ft
Width/Depth Ratio	6.9	27.0	24.8
Entrenchment Ratio	7.2	3.7	3.5
Bank Height Ratio	1.7	1.0	1.0
Sinuosity	1.06	1.06	1.06

### Unnamed Tributary 1 – Restoration Reach

Parameter	Pre-Restoration	As-built	Year 1
Length	334 ft	459 ft	459 ft
Bankfull Width	7.8 ft	12.4 ft	11.7 ft
Bankfull Max Depth	0.9 ft	1.0 ft	0.9 ft
Width/Depth Ratio	14.4	29.1	31.6
Entrenchment Ratio	3.6	4.4	4.0
Bank Height Ratio	2.8	1.0	1.0
Sinuosity	1.09	1.34	1.34

## **II. PROJECT BACKGROUND**

### **A. Location and Setting**

The project is located southeast of Olive Branch Road and west of Marshville-Olive Branch Road, 7.8 miles north-northeast of the town of Marshville, Union County, North Carolina. The site location and vicinity map is presented on **Figure 1**. The project is located on properties owned by Edward Bruce Staton and wife Deborah H. Staton, and Keith Bunyan Griffin and wife Phyllis Griffin. The project includes restoration activities along Davis Branch mainstem and one unnamed tributary stream, designated as UT1 throughout this document.

The directions to the project site are as follows:

From U.S. Route 74 in Marshville, North Carolina, turn onto North Elm Street (SR 205) and travel 5.3 miles to Olive Branch Road (SR 1006). Turn right onto Olive Branch Road and travel 3.9 miles to 9406 Olive Branch Road (Edward and Deborah Staton Residence). Turn right onto the Staton's driveway, the dedicated egress/ingress access to the recorded EEP Conservation Easement Areas on the Davis Branch and Unnamed Tributary, Stream Restoration Project.

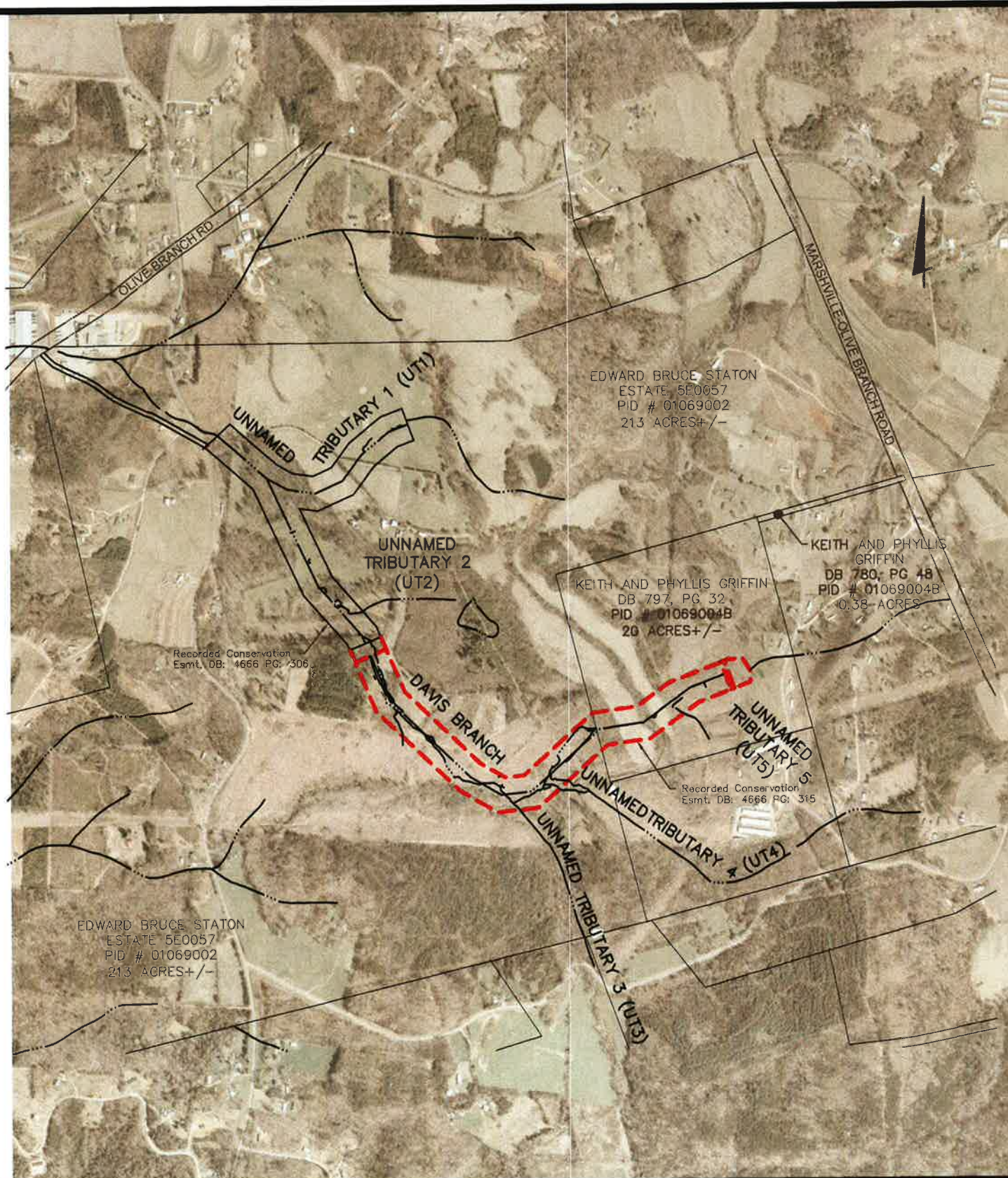
### **B. Project Structure, Mitigation Type, Approach and Objectives**

Pre-restoration land use surrounding the project streams involved cattle pasture and hay land. Cattle had direct access to the project stream reaches for drinking water, and in areas where established riparian canopy exist, cattle frequently accessed the project corridors for shade. In doing so, the cattle had denuded and destabilized streambanks due to grazing, browsing and associated hoof shear. The unstable streambanks and denuded riparian corridors were contributing large quantities of nutrient laden sediment to the project stream reaches. Eroded sediment from the unstable streambanks was transported downstream and off site into the larger Davis Branch, Gourdvine Creek and Richardson Creek watersheds.

Runoff from agricultural land use together with cattle intrusion along the project corridors provided direct nutrient pathways into the project stream reaches. Pre-restoration, the upper reach of UT1 had sparse riparian vegetation along its stream corridor. The lower third of UT1 and the upper Davis Branch mainstem reaches had established hardwood forested riparian corridors. However, cattle intrusion had denuded herbaceous groundcover, and adversely impaired shrub, mid-story and canopy vegetation.

Prior to restoration, a number of anthropogenic factors impacted the stream channel and riparian corridor along the impaired upper mainstem restoration reach, resulting in an unstable, moderately incised and braided condition. In its pre-existing impaired state, upper Davis Branch was transitioning from E4/1 channel dimensions to a multiple thread Rosgen D4/1 stream type, albeit under incised conditions along the reach. Deep channel incision was attributed to uncontrolled cattle intrusion (herbaceous groundcover grazing, shrub vegetation browsing and hoof shear) resulting in a denuded riparian landscape and destabilized, eroding streambanks. Multiple thread channels, created by breaches that rerouted the channel around woody debris jams (avulsions) were present at locations throughout the reach. In addition to cattle intrusion, channelization and an average channel slope of 1.58 percent increased critical shear stresses acting on the streambed and banks during

\\CAMHDA7401\PROJECT01\20061397\20061397ENV\DWG\EXHIBITS\YEAR 1-FIGURE 1-VICINITY MAP.DWG\CLAYOUTH\ - NO XREFS - LAST SAVED BY RASHEAD [7/22/2009 8:16:40 AM] - PLOTTED BY RASHEAD [7/24/2009 10:23:53 AM]



**EMH&T**

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BURKE COUNTY, NORTH CAROLINA  
DAVIS BRANCH RESTORATION  
FIGURE 1: SITE VICINITY MAP  
N.C. ECOSYSTEM ENHANCEMENT PROGRAM

Date: December, 2009 Not To Scale





bankfull flows. Bank height ratios (BHR) calculated at impaired conditions cross-sections ranged from 1.38 to 1.41 (moderately incised).

A number of anthropogenic factors also impacted the stream channel and riparian corridor along the impaired lower mainstem Enhancement Level I (EI) reach, resulting in its pre-restoration channelized, deeply incised, eroding impaired condition. Bank height ratios calculated at impaired conditions cross-sections ranged from 1.58 to 1.86 (deeply incised). Deep channel incision resulted from steep channel gradient (2.16 percent), linear channel alignment (channel sinuosity = 1.06), mean bankfull flow velocities approaching 5.5 ft/sec, high shear velocity ( $u^* = 0.93$  ft/sec), and extremely high nearbank critical shear stress ( $\tau_c = 1.48$  lbs/ft<sup>2</sup>). In addition to unstable channel hydraulics and morphology, uncontrolled cattle intrusion exacerbated streambank and streambed erosion. The cumulative effect of these factors resulted in nearly 5 feet high, vertical eroding streambanks on the lower Davis Branch, EI mainstem reach.

A number of anthropogenic factors impacted the stream channel and riparian corridor along the impaired UT1 reach, resulting in a channelized, entrenched and deeply incised condition. In its pre-existing impaired state, UT1 maintained E4/1b channel morphology, albeit under incised conditions. Bank height ratios calculated at impaired riffles were 2.47, 3.67 and 2.32, respectively, with a mean BHR of 2.82. The extreme degree of channel incision leading to entrenchment was attributed to steep profile gradient (2.3 percent), linear channel alignment (sinuosity = 1.09) high bankfull mean velocity (6.58 ft/sec), high shear velocity ( $u^* = 0.68$  ft/sec), high nearbank critical shear stress ( $\tau_c = 0.85$  lbs/ft<sup>2</sup>) and uncontrolled cattle intrusion. The cumulative effects of these impacts resulted in nearly 4 feet high, vertical, eroding streambanks on the impaired UT1 reach.

As discussed in the Restoration Plan for Davis Branch and UT1, the mitigation goals and objectives for the project involved restoring stable physical and biological function of the project streams beyond pre-restoration (impaired) conditions. Impaired conditions consisted of channelized, eroding, incised and entrenched stream channels. Nutrient and sediment loading from agricultural land use and runoff, together with vegetative denuding and destabilized streambanks associated with hoof shear resulting from uncontrolled cattle access and was evident. The specific mitigation goals and objectives proposed and achieved for the project are listed below.

- Stable stream channels with features inherent of ecologically diverse environments, with appropriate streambed features including appropriately spaced pool and riffle sequences, and riparian corridors planted with a diversity of indigenous vegetation.
- Reference reach boundary conditions were superimposed on the impaired project reaches in the restoration design and construction of improvements.
- Constructed stream channels with the appropriate geometry and gradient to convey bankfull flows while entraining suspended sediment (wash load) and bedload materials readily available to the streams.
- Restored connection between the bankfull channels and their floodplains, by constructing stable stream channels, protected by vegetation and jute coir fabric to prevent erosion.
- Minimized future land use impacts to project stream reaches by conveying perpetual, restrictive conservation easements to the State of North Carolina, including stream corridor protection via livestock exclusion fencing at the surveyed and recorded conservation easement boundaries, with gates at the edge of the riparian corridor on river right and left at reserved conservation easement crossings adjacent to active hay and pasture land.

The restoration of Davis Branch mainstem and UT1 met project goals and objectives set forth in the restoration plan, by providing desired habitat and stability features required to enhance and provide long-term ecologic health for the project reaches. More specifically, the completed restoration project accomplished the enhancements listed below.

**Davis Branch Mainstem:**

- Reversed the effects of channelization using a Priority Level I/Level II (PI/II) and Enhancement Level I (EI) restoration approaches; restoration increased the average width/depth ratio from 9.13 to 16.22 on the PI/II reach and from 6.91 to 24.84 on the EI reach after one year of monitoring.
- Restored natural pattern to the PI/PII reach channel alignment, increasing sinuosity from 1.12 to 1.29 on the PI/II reach, while maintaining a stable relationship between the valley slope and bankfull slope (the bankfull slope was steeper than the valley slope prior to restoration and is now less than the valley slope post-restoration). Stable pattern, profile and dimension were restored based on extrapolation from reference reach boundary conditions. On the mainstem EI reach, profile and dimension were restored based upon reference reach boundary conditions. Pattern (sinuosity = 1.06) was not modified).
- Stabilized eroding streambanks by constructing appropriately sized channels with stable streambank slopes built using a combination of embedded stone, grade control structures, topsoil, herbaceous seeding, mulch, natural fabrics and hearty vegetation including live branch (3-foot spacings), bareroot (4-foot spacings) and 1-gallon tree (100-foot spacings) plantings.
- The average Bank Height Ratio was decreased from 1.41 to 1.00 on the PI/II reach and 1.86 to 1.00 on the EI reach, respectively (i.e., deeply incised to stable).
- Restored connection between the bankfull channel and the adjacent floodprone area by raising the bankfull channel to the elevation of the adjacent floodplain. The restored mainstem PI/II and EI reach entrenchment ratios range from 3.43 to 13.07 after one year of monitoring.
- Created instream aquatic habitat features, including appropriately spaced pool and riffle sequences, and a stable transition of the mainstem reach EI thalweg to the invert of the existing channel at the bottom of the mainstem project reach.
- Revegetated the riparian corridor with indigenous canopy, mid-story, shrub and herbaceous ground cover species, and preserved existing forested riparian corridors where present.
- Protected the riparian corridors by placing livestock exclusion fencing at the edge of the perpetual, recorded conservation easement boundary.

**Davis Branch UT1:**

- Reversed the effects of channelization through a combination of Enhancement Level II (EII) and Priority Level I (PI) restoration techniques. The average width/depth ratio of the restored UT1 project reach is 31.58 after one year of monitoring. Stable dimension and profile grade control was restored on the EII reach (profile station 0+00 to 3+96). Stable pattern, profile and dimension were restored on the PI reach (profile station 3+96 to 8+54) based on extrapolation from reference reach to restored reach boundary conditions.
- Restored stable channel pattern on the PI reach, increasing sinuosity from 1.09 to 1.34.

- Stabilized eroding streambanks by providing appropriately sized channels with stable streambank slopes. The average Bank Height Ratio has been reduced from 2.82 to 1.00 (deeply incised to stable).
- Improved the connection between the restored stream channel and the adjacent floodprone area by raising the bankfull channel to the elevation of the adjacent floodplain. The completed restoration increased the average entrenchment ratio from 3.63 to 4.00 after one year of monitoring.
- Created stable channel dimensions, substrate and grade control structures (rock sills) on the EII reach; Created stable pattern, profile and dimension, including appropriately spaced riffle, run, pool and glide sequences, together with a stable transition of the UT1 PI reach thalweg at its confluence with the Davis Branch Mainstem.
- Revegetated the riparian corridor with indigenous canopy, mid-story, shrub and herbaceous ground cover, preserving existing forested riparian corridors where present.
- Protected the riparian corridor by placing livestock exclusion fencing at the edge of the perpetual, recorded conservation easement boundary.

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

<b>Project Segment/Reach ID</b>	<b>Linear Footage or Acreage</b>
Davis Branch Mainstem	3,794 ft
UT1	855 ft
<b>TOTAL</b>	<b>4,649 ft</b>

<b>Project Segment/ Reach ID</b>	<b>Mitigation Type</b>	<b>Linear Footage or Acreage</b>	<b>Mitigation Ratio</b>	<b>Mitigation Units</b>	<b>Comment</b>
Davis Branch Mainstem	Preservation	766 ft	5	153 SMU's	Preserved within the conservation easement
Davis Branch Mainstem	Priority Level I/II Restoration	1,799 ft	1	1,799 SMU's	Restore dimension, pattern, and profile
Davis Branch Mainstem	Enhancement Level I	1,229 ft	1.5	819 SMU's	Restore dimension and profile
UT1	Enhancement Level II	396 ft	2.5	158 SMU's	Restore dimension and profile grade control
UT1	Priority Level I Restoration	459 ft	1	459 SMU's	Restore dimension, pattern, and profile
<b>TOTAL</b>		<b>4,649 ft</b>		<b>3,388 SMU's</b>	

### 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.

<b>Table III. Project Activity and Reporting History Davis Branch Stream Restoration / EEP Project No. D06054-F</b>			
<b>Activity or Report</b>	<b>Scheduled Completion</b>	<b>Data Collection Complete</b>	<b>Actual Completion or Delivery</b>
Restoration plan	Apr 2007	Jul 2007	Jun 2008
Final Design - 90% <sup>1</sup>	--	--	--
Construction	Dec 2008	N/A	Apr 2009
Temporary S&E applied to entire project area <sup>2</sup>	Dec 2008	N/A	Apr 2009
Permanent plantings	Mar 2009	N/A	Apr 2009
Mitigation plan/As-built	July 2009	May 2009	June 2009
Year 1 monitoring	2009	Sep 2009 (Vegetation) Nov 2009 (Geomorphology)	Dec 2009
Year 2 monitoring	2010		
Year 3 monitoring	2011		
Year 4 monitoring	2012		
Year 5 monitoring	2013		

<sup>1</sup>Full-delivery project; 90% submittal not provided.

<sup>2</sup>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.

<b>Table IV. Project Contact Table Davis Branch Stream Restoration / EEP Project No. D06054-F</b>	
<b>Designer</b>	Evans, Mechwart, Hambleton & Tilton, Inc. 5500 New Albany Road, Columbus, OH 43054
<b>Construction Contractor</b>	South Mountain Forestry 6624 Roper Hollow, Morganton, NC 28655
<b>Monitoring Performers</b>	Evans, Mechwart, Hambleton & Tilton, Inc. 5500 New Albany Road, Columbus, OH 43054
<b>Stream Monitoring POC</b>	Warren E. Knotts, PG, EMH&T
<b>Vegetation Monitoring POC</b>	Holly M. Blunck, EMH&T

<b>Table V. Project Background Table</b>	
<b>Davis Branch Stream Restoration / EEP Project No. D06054-F</b>	
Project County	Union
Drainage Area	Mainstem-214.5 acres
	UT1-46.1 acres
Drainage Impervious Cover Estimate	0.52%
Stream Order	Mainstem - 1st, 2nd UT1 - 1st
Physiographic Region	Piedmont
Ecoregion	Carolina Slate Belt
Rosgen Classification of As-built	Mainstem restoration reach - C4/1
	Mainstem E1 reach – C4/1b
	UT1 restoration reach - C4/1
Dominant Soil Types	Badin channery silt loam, Cid channery silt loam , Goldston-Badin complex
Reference Site ID	Davis Branch
USGS HUC for Project and Reference	03040105
NCDWQ Sub-basin for Project and Reference	3040105070080
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?	Yes
Reason for 303d listing or stressor	Sediment
% of project easement fenced	100%

\*The classification for Davis Branch was not listed within the NC DWQ Schedule of Classifications. Gourdvine Creek, the receiving water for Davis Branch, has been assigned as a Class C water.

#### **D. Monitoring Plan View**

The monitoring plan view is included as Figure 2.



KEITH AND PHYLLIS GRIFFIN  
DB 797, PG 32  
PID # 01069004B  
20 ACRES+/-

Recorded Conservation Easement  
DB. 4666 PG. 315-324  
PB. K, PG. 173  
Union Co. Registry

EDWARD BRUCE STATON  
ESTATE 5E0057  
PID # 01069002  
213 ACRES+/-

KEITH AND PHYLLIS GRIFFIN  
DB 797, PG 32  
PID # 01069004B  
20 ACRES+/-

Recorded Conservation Easement  
DB. 4666 PG. 315-324  
PB. K, PG. 173  
Union Co. Registry

As-Built Fence

As-Built Gate

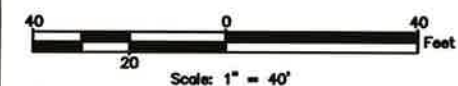
As-Built Low Water Crossing

As-Built Gate

As-Built Fence

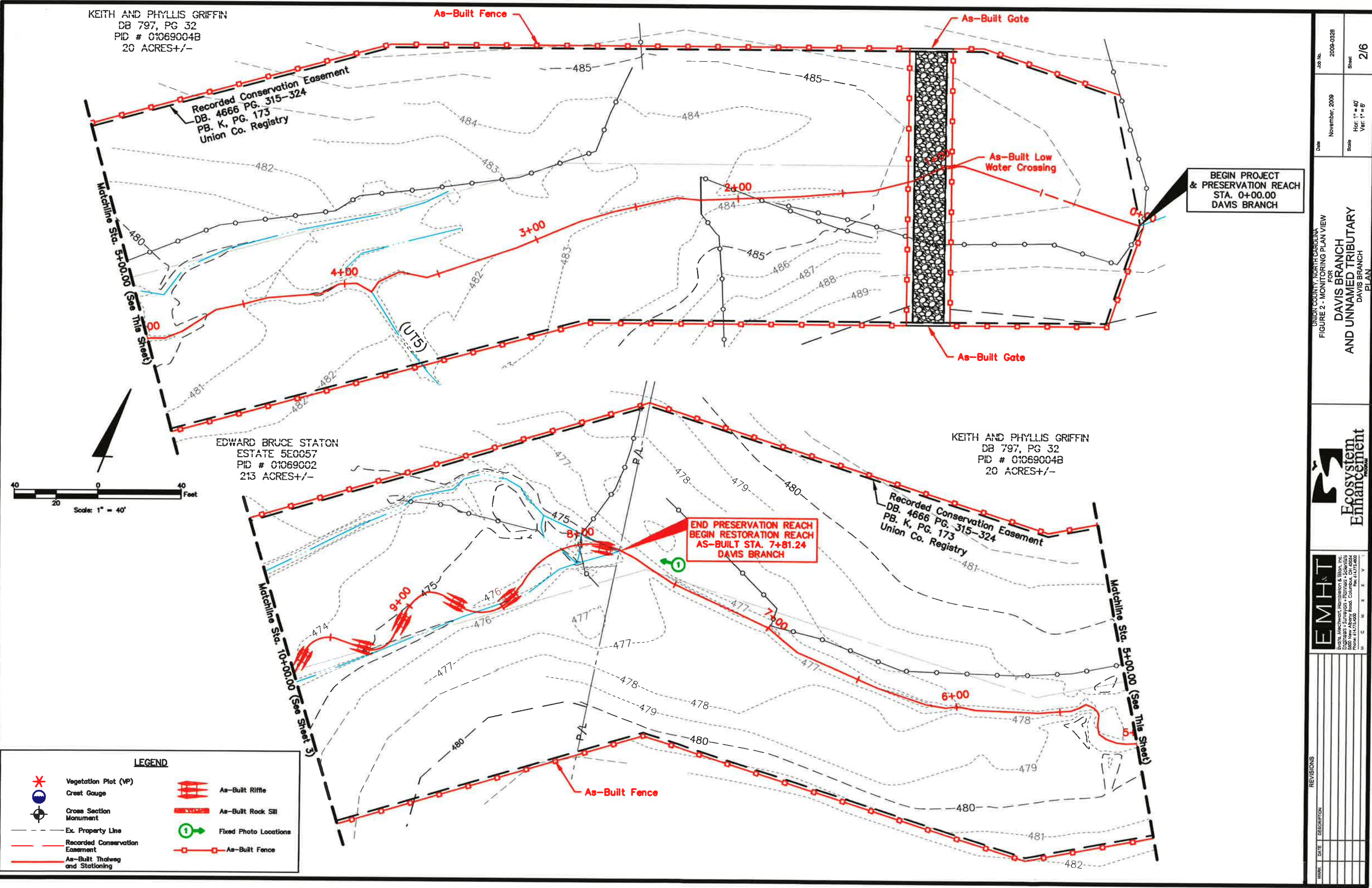
BEGIN PROJECT & PRESERVATION REACH  
STA. 0+00.00  
DAVIS BRANCH

END PRESERVATION REACH  
BEGIN RESTORATION REACH  
AS-BUILT STA. 7+81.24  
DAVIS BRANCH



**LEGEND**

- Vegetation Plot (VP)
- Crest Gauge
- Cross Section Monument
- Ex. Property Line
- Recorded Conservation Easement
- As-Built Thruway and Stationing
- As-Built Riffle
- As-Built Rock Sill
- Fixed Photo Locations
- As-Built Fence



Job No. 2008-0028  
Date November, 2009  
Sheet 2/6  
Scale Hor: 1" = 40'  
Ver: 1" = 8'

UNION COUNTY, NORTH CAROLINA  
FIGURE 2 - MONITORING PLAN VIEW  
FOR  
DAVIS BRANCH  
AND UNNAMED TRIBUTARY  
DAVIS BRANCH  
PLAN



**EMHT**  
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1000 S. Salisbury Road, Salisbury, NC 28146  
Phone: 817.734.4200 Fax: 817.734.4600

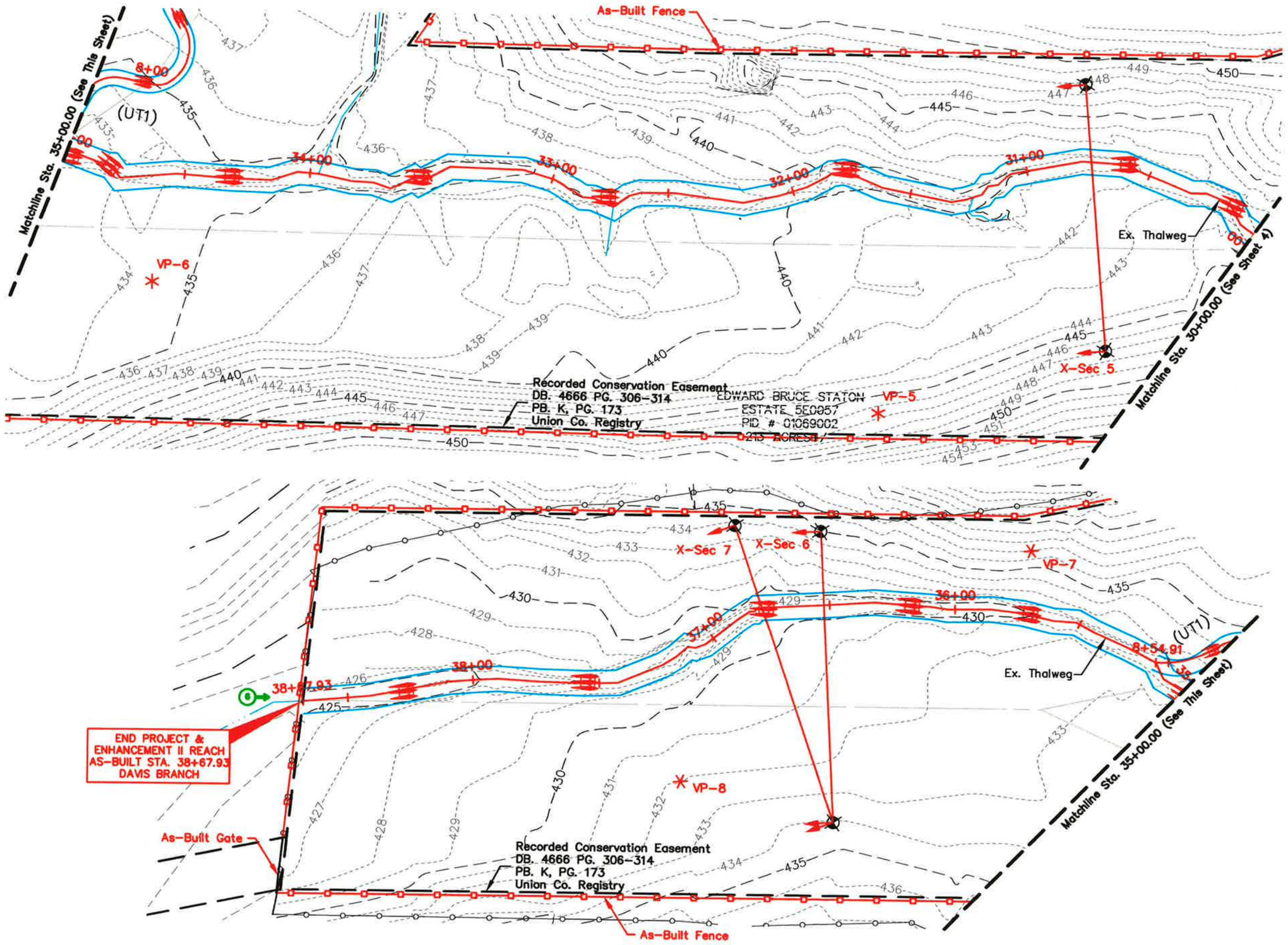
MARK	DATE	DESCRIPTION





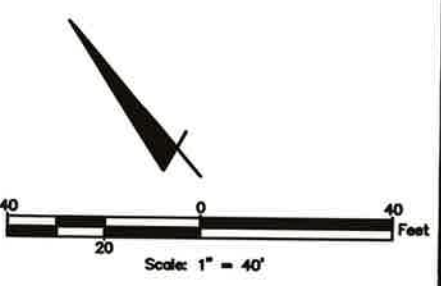
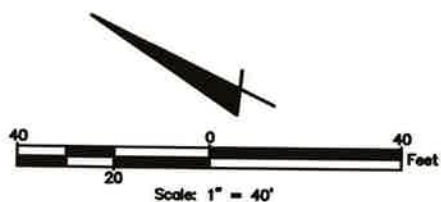


EDWARD BRUCE STATION  
 ESTATE 5E0057  
 PID # 01069002  
 213 ACRES +/-



**LEGEND**

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



**END PROJECT & ENHANCEMENT II REACH AS-BUILT STA. 38+67.93 DAVIS BRANCH**

UNION COUNTY, OHIO PROJECT LOCATION  
 FIGURE 2 - MONITORING PLAN VIEW  
 FOR  
**DAVIS BRANCH  
 AND UNNAMED TRIBUTARY**  
 DAVIS BRANCH  
 PLAN



**EMHT**  
 Earth Management & Technology, Inc.  
 Engineers • Surveyors • Planners • OH 43054  
 5000 New Albany Road, Columbus, OH 43224  
 Phone: 614.777.4800 Fax: 614.777.4800

REVISIONS

NO.	DATE	DESCRIPTION

Job No. 2009-0328  
 Date November, 2009  
 Scale Hor: 1" = 40'  
 Ver: 1" = 8'

Sheet 5/6

I:\Projects\2009\2009-0328\2009-0328.dwg - LAST SAVED BY JCHAMBER [11/10/2009 11:28:48 AM] - PLOTTED BY JCHAMBER [11/10/2009 11:28:50 AM] - MONITORING PLAN VIEW - SHEET 5/6 - 1 XREF: 6147774800.DWG

EDWARD BRUCE STATION  
ESTATE 5E0057  
PID # 01069002  
213 ACRES+/-

As-Built Fence

Recorded Conservation Easement  
DB: 4666 PG. 306-314  
PB: K, PG. 173  
Union Co. Registry

BEGIN PROJECT & ENHANCEMENT II REACH STA. 0+00.00 UNNAMED TRIBUTARY 1

END ENHANCEMENT II REACH BEGIN RESTORATION REACH AS-BUILT STA. 3+95.76 UNNAMED TRIBUTARY 1

Matchline Sta. 5+00.00 (See This Sheet)

**LEGEND**

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

Job No. 2009-0326  
Date November, 2009  
Scale Hor: 1" = 40'  
Ver: 1" = 8'

UNION COUNTY, NORTH CAROLINA  
FIGURE 2 - MONITORING PLAN VIEW FOR  
DAVIS BRANCH  
AND UNNAMED TRIBUTARY  
UNNAMED TRIBUTARY  
PLAN



**EMHT**  
Evans, Machwirth, Hamilton & Tilton, Inc.  
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1000 S. Salisbury Road, Suite 100  
Renoir, NC 27135  
Phone: 814.777.6200  
Fax: 814.777.6200

NO.	DATE	DESCRIPTION

EDWARD BRUCE STATION  
ESTATE 5E0057  
PID # 01069002  
213 ACRES+/-

As-Built Fence

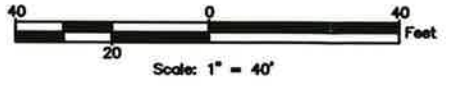
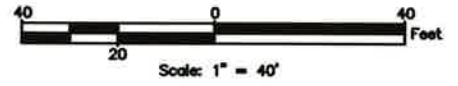
Matchline Sta. 5+00.00  
(See Sheet AB-10)

END PROJECT & RESTORATION REACH AS-BUILT STA. 8+54.91 UNNAMED TRIBUTARY 1

DAVIS BRANCH

Recorded Conservation Easement  
DB: 4666 PG. 306-314  
PB: K, PG. 173  
Union Co. Registry

As-Built Fence



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### III. PROJECT CONDITION AND MONITORING RESULTS

#### A. Vegetation Assessment

##### 1. Soil Data

Soil information was obtained from the NRCS Soil Survey of Union County, North Carolina (USDA NRCS, January, 1996). The predominant soil type mapped on the Davis Branch mainstem is the Cid channery silt loam, 1 to 5 percent slopes. This map unit consists mainly of moderately deep, moderately well drained and somewhat poorly drained, nearly level and gently sloping Cid and similar soils on flats, on ridges in the uplands, in depressions and in headwater drainageways. Typically, the surface layer is light brownish gray channery silt loam 4 inches thick, while the subsurface layer is a pale yellow channery silt loam 5 inches thick. The subsoil is 18 inches thick. Weathered, fractured slate bedrock is encountered at a depth of about 27 inches. Hard, fractured slate bedrock is encountered at a depth of about 32 inches. The depth to hard bedrock ranges from 20 to 40 inches.

Included with the Cid soils on site are areas of Badin channery silt loam (BaB), 2 to 8 percent slopes, mapped on river left along the mainstem Priority Level I/II restoration reach and along the mainstem preservation reach. The Badin map unit consists mainly of moderately deep, well drained undulating soils on convex upland ridges that are highly dissected by intermittent drainageways. Typically, the surface layer is brown Channery silt loam 7 inches thick. The subsoil is 21 inches thick. Weathered, fractured slate bedrock is encountered at a depth of about 28 inches. Hard, fractured slate bedrock is at a depth of about 41 inches. An area of Badin Channery silty clay loam, 2 to 8 percent, eroded (BdC2) is present along the lower Enhancement Level 1 mainstem reach on Davis Branch. The soil taxonomy is essentially identical to the BaB map unit.

Goldston-Badin complex soils (map symbols - GsB and GsC), 2 to 8 and 8 to 15 percent slopes, respectively, are the mapped units on UT-1. GsB soils are mapped along the upper third of the project reach. GsC soils are mapped to the confluence of UT-1 with Davis Branch mainstem. The GsB mapped soil unit consists mainly of shallow and moderately deep, well drained to excessively drained, undulating Goldston and Badin soils on ridges in upland areas, as opposed to the GsC (2 to 8 percent slopes) soils mapped on side slopes. The topography is highly dissected by intermittent drainageways. The GsB unit is about 45 percent Goldston soil and about 40 percent Badin soil, while the GsC unit is about 55 percent Goldston soil and about 30 percent Badin soil.

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

<b>Table VI. Preliminary Soil Data Davis Branch Stream Restoration / EEP Project No. D06054-F</b>					
<b>Series</b>	<b>Max. Depth (in.)</b>	<b>% Clay on Surface</b>	<b>K<sup>1</sup></b>	<b>T<sup>2</sup></b>	<b>% Organic Matter</b>
Badin channery silt loam, 2 to 8 percent slopes (BaB)	41	12-27	0.24	2	0.5-2
Badin channery silty clay loam, 8 to 15 percent slopes, eroded (BdC2)	41	27-40	0.24	2	0.5-2
Cid channery silt loam, 1 to 5 percent slopes (CmB)	32	12-27	0.32	2	0.5-2
Goldston-Badin complex, 2 to 8 percent slopes (GsB)	27	5-15	0.05	1	0.5-2
Goldston-Badin complex, 8 to 15 percent slopes (GsC)	27	5-15	0.05	1	0.5-2

<sup>1</sup>Erosion Factor K indicates the susceptibility of a soil to sheet and rill erosion, ranging from 0.05 to 0.69.

<sup>2</sup>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. There were no problem areas identified along the Davis Branch Mainstem and UT1 in Monitoring Year 1 to report in Table VII. There were several areas along the streams where the herbaceous vegetation was sparse underneath the canopy of the large trees preserved during stream restoration. Photographs exhibiting this condition are shown in Appendix A. It is likely that the herbaceous vegetation was patchy in the riparian woodlands prior to construction for stream restoration, and the condition as it exists in Year 1 is an artifact of the previously sparse vegetative community; therefore, this was not considered a problem area. In addition, there are two specific vegetation plot locations where the density of planted woody stems is not high enough to meet the required stem counts. Densities of planted woody species are discussed in the Stem Counts section of this report.

## 3. Vegetation Problem Area Plan View

The location of each vegetation problem area found in future monitoring years will be shown on a vegetative problem area plan view.

## 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. Davis Branch Stream Restoration / EEP Project No. D06054-F													
Species	Plots										Year 0 Totals	Year 1 Totals	Survival %
	1	2	3	4	5	6	7	8	9	10			
<b>Shrubs</b>													
<i>Alnus serrulata</i>	3		1	1						1	6	6	100
<i>Aronia arbutifolia</i>	4										4	4	100
<i>Cephalanthus occidentalis</i>		5	2	6						1	14	14	100
<i>Cornus amomum</i>						1	1			3	5	5	100
<b>Trees</b>													
<i>Fraxinus pennsylvanica</i>	2	1	5		1	3					12	12	100
<i>Liriodendron tulipifera</i>										3	3	3	100
<i>Nyssa sylvatica</i>					2						2	2	100
<i>Platanus occidentalis</i>	2		1	1	6	9		2			21	21	100
<i>Quercus bicolor</i>	3	4		1	6	2		5		1	18	18	100
<i>Quercus palustris</i>					1	1		1			3	3	100
<i>Ulmus rubra</i>				1		2	2			1	6	6	100
Year 1 Totals	14	10	9	10	16	18	3	8	0	10	94	94	100
Live Stem Density	567	405	365	405	648	729	122	324	0	405			
Average Live Stem Density	397												

<b>Table VIIIb. Stem counts for each species arranged by plot - all stems. Davis Branch Stream Restoration / EEP Project No. D06054-F</b>										
<b>Species</b>	<b>Plots</b>									
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
<b>Shrubs</b>										
<i>Alnus serrulata</i>	3		1	1						1
<i>Aronia arbutifolia</i>	4									
<i>Cephalanthus occidentalis</i>		5	2	6						1
<i>Cornus amomum</i>						1	1			3
<b>Trees</b>										
<i>Diospyros virginiana</i>	12			1						
<i>Fraxinus pennsylvanica</i>	2	1	5		1	3				
<i>Nyssa sylvatica</i>					2					
<i>Quercus bicolor</i>	3	4		1	6	2		5		1
<i>Quercus palustris</i>					1	1		1		
<i>Ulmus rubra</i>				1		2	2		1	1
<i>Liriodendron tulipifera</i>										3
<i>Platanus occidentalis</i>	2		1	1	6	9		2		
<b>Year 1 Totals</b>	<b>26</b>	<b>10</b>	<b>9</b>	<b>11</b>	<b>16</b>	<b>18</b>	<b>3</b>	<b>8</b>	<b>1</b>	<b>10</b>
<b>Live Stem Density</b>	<b>1053</b>	<b>405</b>	<b>365</b>	<b>446</b>	<b>648</b>	<b>729</b>	<b>122</b>	<b>324</b>	<b>41</b>	<b>405</b>
<b>Average Live Stem Density</b>	<b>454</b>									

The average stem density of planted species for the site exceeds the minimum criteria of 320 stems per acre after three years. Two individual plots have stem densities below the minimum. All of the plots showed woody stem mortality due to the dry summer and the rocky soil of the riparian corridor. Tree mortality is the likely cause for the deficiency of woody stems in the remaining plot. A substantial number of recruit stems have been found across the site, increasing the total stem density by approximately 14%. However, the number of recruit stems for the individual plots was not large enough to bring all plots into compliance with the three year minimum criteria.

To address the issue of low plant stem counts, specific areas will be targeted for supplemental planting within the Davis Branch and Unnamed Tributary riparian corridors, which will include the deficient sample plots and surrounding areas within the buffer. The majority of these plantings will therefore be concentrated along UT1 and the portion of the Davis Branch EI mainstem reach downstream from the confluence with UT1. All deficient portions of the riparian corridors will be supplemented with additional native tree and shrub plantings. These supplemental plantings will follow the specifications in the project Restoration Plan and Mitigation Plan documents. Consideration will be given to using larger woody stock, such as three-gallon potted material (versus bare root specimens) in performing the remedial plantings. These larger saplings should have a more developed root system and thus be better able to compete with the existing vegetation. Supplemental planting will occur during spring 2010. The subsequent Year 2 (2010) monitoring report will contain specific documentation of this remedial planting effort including the specific locations of planting, and the quantity and species of tree and shrub material installed.

## 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, one each on the Davis Branch Mainstem and UT1. The locations of the crest-stage stream gages are shown on the monitoring plan view (Figure 2). One bankfull event was documented during the first year of monitoring as presented in Table IX.

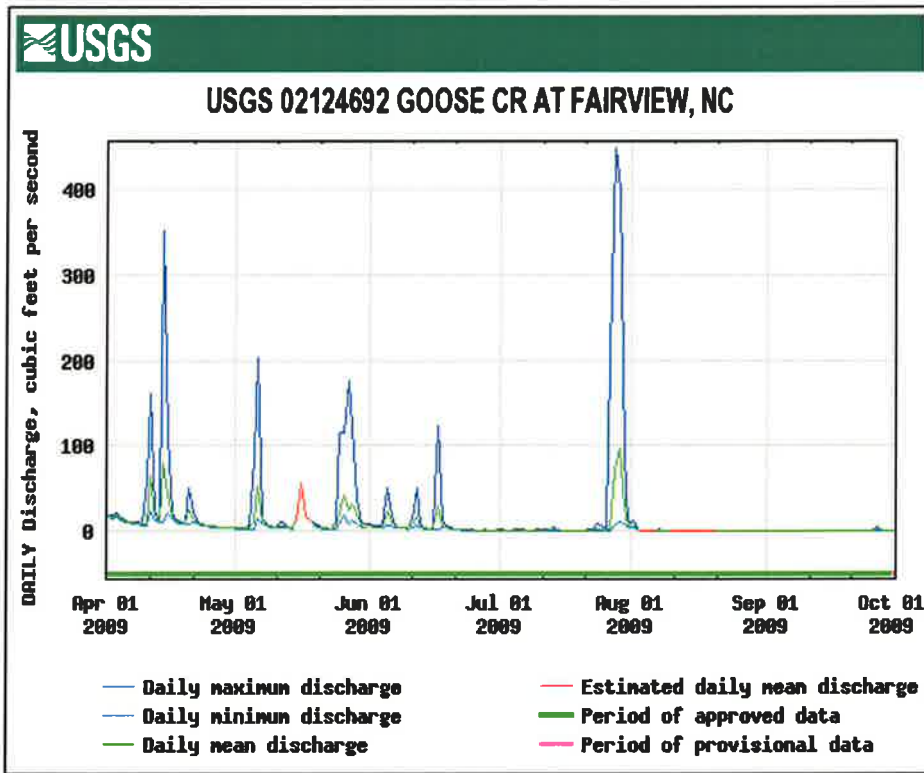
<b>Date of Data Collection</b>	<b>Date of Occurrence</b>	<b>Method</b>	<b>Photo #</b>
9/20/2009	7/28/2009*	Mainstem & UT1 Crest Gage Data	BF1, BF2

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

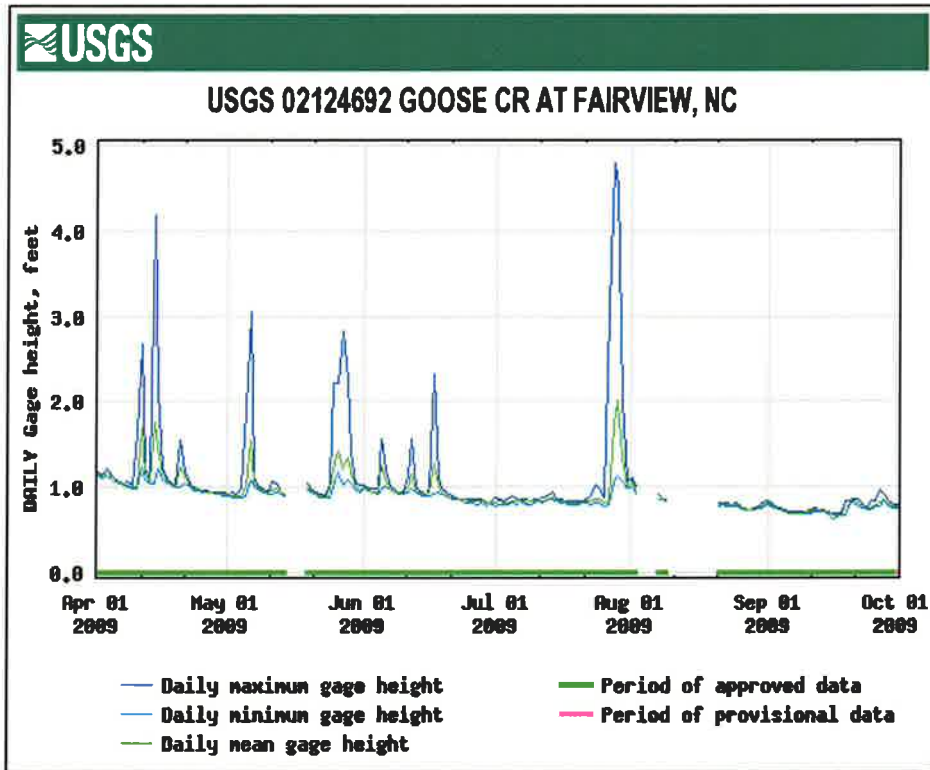
On September 20, 2009, the crest gage on UT1 registered a bankfull event at a level of 5.0 inches above the bottom of the crest gage. The crest gage on the Davis Branch mainstem reach also documented the bankfull event, with a height of 3.5 inches above the bottom of the crest gage. These crest gages 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 event that occurred on July 28, 2009. On this date, rainfall as recorded in Monroe, NC totaled 1.2 inches. As this was the largest precipitation event of significance since the crest gages were installed in April 2009, this is likely the bankfull event recorded by both crest gages. This corresponds to a high discharge event on July 28, as recorded at USGS Gage 02124692 Goose Creek at Fairview, NC, which lies approximately 15 miles west of the project site. The discharge and gage height recorded at the Fairview station are shown on the hydrographs below.





USGS Surface-Water Daily Data for North Carolina  
<http://waterdata.usgs.gov/nc/nwis/dv?>



USGS Surface-Water Daily Data for North Carolina  
<http://waterdata.usgs.gov/nc/nwis/dv?>

## 2. Stream Problem Areas

A summary of the areas of concern identified during the visual assessment of the stream for Year 1 is included in Table X.

<b>Table X. Stream Problem Areas Davis Branch Stream Restoration / EEP Project No. D06054-F</b>			
<b>Feature Issue</b>	<b>Station Numbers</b>	<b>Suspected Cause</b>	<b>Photo Number</b>
Other	18+75 Mainstem	Large tree fall; hole from root mass next to stream channel has been repaired	SPA 1
	14+00 Mainstem	Bare banks - concern for future stability if vegetation does not develop	SPA 2, 3
	25+60 Mainstem	Bare banks - concern for future stability if vegetation does not develop	
	29+90 Mainstem	Bare banks - concern for future stability if vegetation does not develop	
	7+25 UT1 PI/II	Bare banks - concern for future stability if vegetation does not develop	
	5+50 UT1 PI/II	Bare banks - concern for future stability if vegetation does not develop	

One area of concern is located along the restored portion of the Davis Branch mainstem where a large tree had fallen in the riparian corridor. While the bulk of the tree fell away from the stream channel, a large hole was formed where the root mass previously existed near the edge of the stream. No erosion was witnessed here in Year 1, and the area has subsequently been repaired. This location is noted as a problem area of low concern that will be watched over time to monitor the develop of bank scour that may occur near the former hole.

The other type of problem area is isolated to a few outside meander bends along the project streams. The banks of the outside bends have little established vegetation to stabilize the slopes. These areas are considered low concern at this time, as the bends are not actively eroding beyond the minor sloughing of loose soil. No remedial maintenance is scheduled at this time. These areas are noted in order that they be watched to catch any erosion problems that may occur before vegetation becomes fully established along these slopes. Actively monitoring these areas will allow developing problems to be caught early and managed without the need for mechanical intervention. If erosion problems arise, the outside meander bends could be stabilized using vegetative methods such as seeding and live stakes, or with a natural fiber (coconut) geotextile.

## 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 19, 2009. 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 through Table XIc. 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.

<b>Table XIa. Categorical Stream Feature Visual Stability Assessment Davis Branch &amp; UT1 Stream Restoration / EEP Project No. D06054-F Segment/Reach: Mainstem Restoration Reach</b>						
<b>Feature</b>	<b>Initial</b>	<b>MY-01</b>	<b>MY-02</b>	<b>MY-03</b>	<b>MY-04</b>	<b>MY-05</b>
<b>A. Riffles<sup>1</sup></b>	100%	99%				
<b>B. Pools<sup>2</sup></b>	100%	99%				
<b>C. Thalweg</b>	100%	100%				
<b>D. Meanders</b>	100%	99%				
<b>E. Bed General</b>	100%	100%				
<b>F. Vanes / J Hooks etc.<sup>3</sup></b>	N/A	N/A				
<b>G. Wads and Boulders<sup>3</sup></b>	N/A	N/A				

<b>Table XIb. Categorical Stream Feature Visual Stability Assessment Davis Branch &amp; UT1 Stream Restoration / EEP Project No. D06054-F Segment/Reach: Mainstem EI Reach</b>						
<b>Feature</b>	<b>Initial</b>	<b>MY-01</b>	<b>MY-02</b>	<b>MY-03</b>	<b>MY-04</b>	<b>MY-05</b>
<b>A. Riffles<sup>1</sup></b>	100%	100%				
<b>B. Pools<sup>2</sup></b>	100%	100%				
<b>C. Thalweg</b>	100%	100%				
<b>D. Meanders</b>	100%	96%				
<b>E. Bed General</b>	100%	100%				
<b>F. Vanes / J Hooks etc.<sup>3</sup></b>	N/A	N/A				
<b>G. Wads and Boulders<sup>3</sup></b>	N/A	N/A				

**Table XIc. Categorical Stream Feature Visual Stability Assessment  
Davis Branch & UT1 Stream Restoration / EEP Project No. D06054-F  
Segment/Reach: Unnamed Tributary 1**

<b>Feature</b>	<b>Initial</b>	<b>MY-01</b>	<b>MY-02</b>	<b>MY-03</b>	<b>MY-04</b>	<b>MY-05</b>
<b>A. Riffles<sup>1</sup></b>	100%	97%				
<b>B. Pools<sup>2</sup></b>	100%	98%				
<b>C. Thalweg</b>	100%	100%				
<b>D. Meanders</b>	100%	96%				
<b>E. Bed General</b>	100%	100%				
<b>F. Vanes / J Hooks etc.<sup>3</sup></b>	N/A	N/A				
<b>G. Wads and Boulders<sup>3</sup></b>	N/A	N/A				

<sup>1</sup>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.

<sup>2</sup>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.

<sup>3</sup>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 in-stream structures are functioning as designed and built on the Davis Branch mainstem and UT1. Rock-toe channel protection, constructed riffles and pools are functioning as designed and built. There are a few meanders along the project reaches that have minor erosion along the outer bends. In addition, there are a few meanders with bare banks, that, although not currently eroding, are in danger of doing so due to the lack of vegetation that would provide stabilization. In addition to the meander category, there were a few pools and riffles that did not match the as-built condition as presented in the graphs of the longitudinal profile. It is assumed that the rock substrate is shifting over time, evolving into that which better matches a stable channel morphology. The pool and riffle features are all still present and functional.

### 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 Table XII for comparison with the monitoring data shown in the tables in the appendix.

The stream pattern data provided for Year 1 is the same as the data provided from the As-Built survey, as pattern has not changed based on the Year 1 stream surveys and visual field assessment.

Bedform features continue to evolve along the restored reaches as shown on the long-term longitudinal profiles. Dimensional measurements of the monumented cross-sections remain stable when compared to as-built conditions. Riffle lengths, slopes and pool to pool spacings are representative of reference conditions. A few parameter measurements have changed when comparing the Year 1 and As-built profile data. The longitudinal profile survey in Year 1 detected microfeatures that were not identified during the as-built survey. Pool and riffle features are developing in the restored and enhanced reaches as the stream distributes its bedload and redistributes the constructed substrate during high flow events. The comparison of the As-Built and

Year 1 long-term stream monitoring profile graphs show stability with minimal change from as-built conditions, with the exception of the aforementioned microfeatures.

The constructed riffles remain stable, with a median particle distributions ranging from very coarse gravel to small cobble. The pool substrate remains stable as well, with median particle sizes ranging from course sand to small cobble to slate bedrock based on Year 1 substrate analysis. A shift in particle distribution along the enhancement reach of Davis Branch resulted in a classification change from C3/1 (according to the as-built) to C4/1 (according to the Year 1 data). The as-built data was collected immediately after construction, at which time the riffle substrate was composed almost entirely of the large material placed into the channel during construction. The Year 1 data was collected after enough time had passed to allow smaller particles to settle naturally into the channel and flow events had occurred to sort the developing substrate. The substrate is therefore stable; remedial maintenance work is not warranted at this time.

#### **IV. METHODOLOGY**

Year 1 vegetation monitoring was conducted in September 2009 using the *CVS-EEP Protocol for Recording Vegetation, Version 4.0* (Lee, M.T., Peet, R.K., Roberts, S.R., Wentworth, T.R. 2006). Year 1 stream monitoring was conducted in November 2009 to provide adequate time between the as-built survey (completed in May 2009) and the Year 1 monitoring survey. Stream monitoring for Year 2 will occur in the summer of 2010, providing a full year between the Year 1 and Year 2 surveys. Subsequent stream monitoring will occur in the summer of Years 3 through 5 to provide 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.

**Table 12a: Baseline Geomorphologic and Hydraulic Summary**  
**Davis Branch and Unnamed Tributary Restoration / EEP Project No. D06054-F**  
**Station/Reach: Davis Branch Priority Level I/II Restoration Reach Station 7+81 to 25+80 (1,799 linear feet)**

Parameter	Regional Curve Data			Davis Branch Reference Reach			Pre-Existing Condition			Design			As-Built (Riffle XS-1 & XS-3)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Median	Min	Max	Median
<b>Dimension</b>															
Drainage Area (mi <sup>2</sup> )			0.5712			0.5712			0.1823			0.1823			0.1823
Bankfull Discharge (cfs)			80.0			77.6			24.8			24.8			24.8
BF Width (ft)			11.77			12.91			8.31			9.00	9.17	13.38	11.28
Floodprone Width (ft)						50.00	52.12	165.18	106.28	63.19	238.17	117.44	63.06	112.74	87.90
BF Cross Sectional Area (ft <sup>2</sup> )			15.85			15.65			7.56			7.92	3.99	9.98	6.99
BF Mean Depth (ft)			1.35			1.21			0.91			0.88	0.44	0.75	0.60
BF Max Depth (ft)						1.61			1.81			1.20	0.87	1.62	1.25
Width/Depth Ratio			8.72			10.67			9.13			10.23	17.84	20.84	19.34
Entrenchment Ratio						3.87	6.27	19.88	12.79	7.02	26.46	13.05	4.71	12.30	8.51
Bank Height Ratio						1.00	1.38	1.41	1.40			1.00	1.00	1.00	1.00
Wetted Perimeter (ft)			14.47			13.72			9.84			9.57	9.33	13.80	11.57
Hydraulic Radius (ft)			1.10			1.14			0.77			0.83	0.43	0.72	0.58
<b>Pattern</b>															
Channel Beltwidth (ft)				27.80	53.00	38.00	Incised Linear Braided Channel					50.00			50.00
Radius of Curvature (ft)				16.40	45.30	29.40	Incised Linear Braided Channel			10.65	35.00	19.70	10.65	35.00	19.70
Meander Wavelength (ft)				80.10	116.50	99.20	Incised Linear Braided Channel			49.94	101.80	77.76	49.94	101.80	77.76
Meander Width Ratio				2.15	4.11	2.94	Incised Linear Braided Channel					5.56			4.43
<b>Profile</b>															
Riffle Length (ft)				12.0	18.5	15.0	25.0	31.0	27.0	7.7	45.2	21.3	7.1	34.5	12.6
Riffle Slope (ft/ft)				0.02830	0.07990	0.05200	0.02080	0.06290	0.04499	0.02270	0.07620	0.03990	0.02806	0.07468	0.04822
Pool Length (ft)				12.0	29.1	21.2	19.5	29.8	22.9	17.1	36.8	23.9	11.5	42.6	24.5
Pool Spacing (ft)				33.4	43.7	38.6	35.3	43.7	40.0	24.9	78.1	48.5	16.8	79.8	40.3
<b>Substrate</b>															
D50 (mm)						69.2			17.7			17.7	33.3	36.3	34.8
D84 (mm)						140.1			28.9			28.9	52.8	61.5	57.2
<b>Additional Reach Parameters</b>															
Valley Length (ft)						974			1,397			1,397			1,397
Channel Length (ft)						1129			1,562			1,802			1,799
Sinuosity						1.2			1.12			1.29			1.29
Water Surface Slope (ft/ft)						0.03110			0.01579			0.01320	0.00828	0.01917	0.01304
Valley Slope (ft/ft)						0.03256			0.01760			0.01703	0.01066	0.02469	0.01679
Rosgen Classification			E			E3/1b*			E4/1→DA4/1			E4/1			C4/1

Notes: \*E channel morphology, large cobble substrate with bedrock control, bankfull slope greater than 0.02 ft/ft.

**Table 12b: Baseline Geomorphologic and Hydraulic Summary**  
**Davis Branch and Unnamed Tributary Restoration / EEP Project No. D06054-F**  
**Station/Reach: Davis Branch Enhancement Level I Reach Station 25+83 to 38+72 (1,289 linear feet)**

Parameter	Regional Curve Data			Davis Branch Reference Reach			Pre-Existing Condition			Design			As-Built (Riffle XS-5 & XS-7)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Median	Min	Max	Median
<b>Dimension</b>															
Drainage Area (mi <sup>2</sup> )			0.5712			0.5712			0.3352			0.3352			0.3352
Bankfull Discharge (cfs)			80.0			77.6			45.5			45.5			45.5
BF Width (ft)			11.77			12.91			8.78			10.00	15.97	17.38	16.68
Floodprone Width (ft)						50.00	21.57	97.94	62.74	70.58	144.67	104.34	59.88	63.70	61.79
BF Cross Sectional Area (ft <sup>2</sup> )			15.85			15.65			11.18			11.52	10.30	10.38	10.34
BF Mean Depth (ft)			1.35			1.21			1.27			1.15	0.59	0.65	0.62
BF Max Depth (ft)						1.61			2.04			1.60	1.22	1.31	1.27
Width/Depth Ratio			8.72			10.67			6.91			8.70	24.57	29.46	27.02
Entrenchment Ratio						3.87	2.46	11.15	7.15	7.06	14.47	10.43	3.67	3.75	3.71
Bank Height Ratio						1.00	1.58	1.86	1.72			1.00	1.00	1.00	1.00
Wetted Perimeter (ft)			14.47			13.72			10.21			10.85	16.19	17.57	16.88
Hydraulic Radius (ft)			1.10			1.14			1.10			1.06	0.59	0.64	0.62
<b>Pattern</b>															
Channel Beltwidth (ft)				27.80	53.00	38.00	Incised Linear Channel			Linear Channel			Restored Linear Channel		
Radius of Curvature (ft)				16.40	45.30	29.40	Incised Linear Channel			Linear Channel			Restored Linear Channel		
Meander Wavelength (ft)				80.10	116.50	99.20	Incised Linear Channel			Linear Channel			Restored Linear Channel		
Meander Width Ratio				2.15	4.11	2.94	Incised Linear Channel			Linear Channel			Restored Linear Channel		
<b>Profile</b>															
Riffle Length (ft)				12.0	18.5	15.0	57.9	85.3	67.1	24.0	57.0	45.0	18.7	109.9	62.3
Riffle Slope (ft/ft)				0.0283	0.0799	0.0520	0.0264	0.0518	0.0393	0.0098	0.0549	0.0504	0.0316	0.1217	0.0591
Pool Length (ft)				12.0	29.1	21.2	29.5	48.8	39.2	6.0	40.0	22.5	9.5	50.1	29.5
Pool Spacing (ft)				33.4	43.7	38.6	92.2	103.0	97.6	40.0	88.0	68.5	28.3	109.1	63.4
<b>Substrate</b>															
D50 (mm)						69.2			154.0			154.0	63.1	97.1	80.1
D84 (mm)						140.1			207.4			207.4	179.3	216.5	197.9
<b>Additional Reach Parameters</b>															
Valley Length (ft)						974			1213			1213			1213
Channel Length (ft)						1129			1289			1289			1289
Sinuosity						1.2			1.06			1.06			1.06
Water Surface Slope (ft/ft)						0.03110			0.02160			0.02160			0.02122
Valley Slope (ft/ft)						0.03256			0.02290			0.02290			0.02290
Rosgen Classification			E			E3/1b*			E3/1b			E3/1b			C3/1b

Notes: \*E channel morphology, large cobble substrate with bedrock control, bankfull slope greater than 0.02 ft/ft.

**Table 12c: Baseline Geomorphologic and Hydraulic Summary**  
**Davis Branch and Unnamed Tributary Restoration / EEP Project No. D06054-F**  
**Station/Reach: Davis Branch UT1 Restoration Reach Station 3+96 to 8+54 (459 linear feet)**

Parameter	Regional Curve Data			Davis Branch Reference Reach			Pre-Existing Condition			Design			As-Built (Riffle XS-8 & XS-9)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Median	Min	Max	Median
<b>Dimension**</b>															
Drainage Area (mi <sup>2</sup> )			0.5712			0.5712			0.0721			0.0721			0.0721
Bankfull Discharge (cfs)			80.0			77.6			9.8			9.8			9.8
BF Width (ft)			11.77			12.91	6.85	8.39	7.82			6.20	12.18	12.58	12.38
Floodprone Width (ft)						50.00	7.17	78.27	28.42	32.37	105.76	47.40	50.49	57.74	54.12
BF Cross Sectional Area (ft <sup>2</sup> )			15.85			15.65	4.27	4.31	4.30			4.45	5.14	5.45	5.30
BF Mean Depth (ft)			1.35			1.21	0.51	0.63	0.55			0.72	0.42	0.43	0.43
BF Max Depth (ft)						1.61	0.77	0.92	0.88			1.00	0.95	1.02	0.99
Width/Depth Ratio			8.72			10.67	10.87	16.45	14.37			8.61	29.00	29.26	29.13
Entrenchment Ratio						3.87	0.92	10.01	3.63	5.22	17.06	7.65	4.01	4.74	4.38
Bank Height Ratio						1.00	2.32	3.67	2.82			1.00	1.00	1.00	1.00
Wetted Perimeter (ft)			14.47			13.72	7.28	8.74	8.15			6.73	12.38	12.74	12.56
Hydraulic Radius (ft)			1.10			1.14	0.49	0.59	0.53			0.66	0.42	0.43	0.43
<b>Pattern</b>															
Channel Beltwidth (ft)				27.80	53.00	38.00	Incised Linear Channel					50.00	50.00	50.00	50.00
Radius of Curvature (ft)				16.40	45.30	29.40	Incised Linear Channel			11.10	18.00	12.60	11.10	18.00	12.60
Meander Wavelength (ft)				80.10	116.50	99.20	Incised Linear Channel			50.53	58.82	52.60	50.53	58.82	52.60
Meander Width Ratio				2.15	4.11	2.94	Incised Linear Channel					8.06	3.97	4.11	4.04
<b>Profile</b>															
Riffle Length (ft)				12.0	18.5	15.0	1.1	305.7	30.6	9.0	23.0	17.1	8.7	45.0	17.0
Riffle Slope (ft/ft)				0.0283	0.0799	0.0520	0.0372	0.1001	0.0586	0.0278	0.0486	0.0314	0.0372	0.0682	0.0496
Pool Length (ft)				12.0	29.1	21.2	7.2	31.9	19.2	12.8	22.8	18.7	11.9	28.4	17.2
Pool Spacing (ft)				33.4	43.7	38.6	15.6	324.8	76.9	24.6	41.5	34.7	12.8	50.3	28.7
<b>Substrate</b>															
D50 (mm)						69.2			11.4			11.4	28.8	38.5	34.8
D84 (mm)						140.1			15.4			15.4	62.0	91.0	57.2
<b>Additional Reach Parameters</b>															
Valley Length (ft)						974			670			343			343
Channel Length (ft)						1129			730			450			459
Sinuosity						1.2			1.09			1.31			1.34
Water Surface Slope (ft/ft)						0.03110			0.02300			0.02010			0.02021
Valley Slope (ft/ft)						0.03256			0.02506			0.02637			0.02704
Rosgen Classification			E			E3/1b*		E4/1b→C4/1b				E4/1b			C4/1b

Notes: \*E channel morphology, large cobble substrate with bedrock control, bankfull slope greater than 0.02 ft/ft.



## **APPENDIX A**

### **Vegetation Raw Data**

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



#### **VPA 1**

**Example of the patchy herbaceous vegetation growing along the stream corridor of UT1. The herbaceous vegetation is sparse anywhere the existing large trees were preserved, and is likely a natural condition for the woodland areas.**

(EMH&T, Inc. 9/19/09)



**Vegetation Plot 1**  
**Monitoring Year 1**  
(EMH&T, Inc. 9/19/09)



**Vegetation Plot 2**  
**Monitoring Year 1**  
(EMH&T, Inc. 9/19/09)



**Vegetation Plot 3**  
**Monitoring Year 1**  
(EMH&T, Inc. 9/19/09)



**Vegetation Plot 4**  
**Monitoring Year 1**  
(EMH&T, Inc. 9/19/09)



**Vegetation Plot 5**  
**Monitoring Year 1**  
(EMH&T, Inc. 9/19/09)



**Vegetation Plot 6**  
**Monitoring Year 1**  
(EMH&T, Inc. 9/19/09)



**Vegetation Plot 7**  
**Monitoring Year 1**  
(EMH&T, Inc. 9/19/09)



**Vegetation Plot 8**  
**No photo for Monitoring Year 1; Photo above shows the as-built condition**  
(EMH&T, Inc. 4/8/09)



**Vegetation Plot 9**  
**Monitoring Year 1**  
(EMH&T, Inc. 9/19/09)



**Vegetation Plot 10**  
**Monitoring Year 1**  
(EMH&T, Inc. 9/19/09)

**Table 1. Vegetation Metadata**

<b>Report Prepared By</b>	Holly Blunck
<b>Date Prepared</b>	9/23/2009 9:53
<b>database name</b>	cvs-eep-entrytool-v2.2.6.mdb
<b>database location</b>	Q:\ENVIRONMENTAL\Monitoring\EEP Vegetation Database
<b>computer name</b>	26WYM41
<b>file size</b>	61800448
<b>DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT-----</b>	
<b>Metadata</b>	Description of database file, the report worksheets, and a summary of project(s) and project data.
<b>Proj, planted</b>	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
<b>Proj, total stems</b>	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.
<b>Plots</b>	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
<b>Vigor</b>	Frequency distribution of vigor classes for stems for all plots.
<b>Vigor by Spp</b>	Frequency distribution of vigor classes listed by species.
<b>Damage</b>	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
<b>Damage by Spp</b>	Damage values tallied by type for each species.
<b>Damage by Plot</b>	Damage values tallied by type for each plot.
<b>ALL Stems by Plot and spp</b>	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.
<b>PROJECT SUMMARY-----</b>	
<b>Project Code</b>	D06054F
<b>Project Name</b>	Davis Branch
<b>Description</b>	Stream restoration of Davis Branch mainstem and unnamed tributary.
<b>River Basin</b>	
<b>length(ft)</b>	
<b>stream-to-edge width (ft)</b>	
<b>area (sq m)</b>	
<b>Required Plots (calculated)</b>	
<b>Sampled Plots</b>	10



**Table 2. Vegetation Vigor by Species**

	<b>Species</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>Missing</b>	<b>Unknown</b>
	Alnus serrulata		5	1				
	Aronia arbutifolia			2	2			
	Cephalanthus occidentalis	2	10	1	1			
	Cornus amomum		1	3	1			
	Fraxinus pennsylvanica	1	3	6	2			
	Nyssa sylvatica			1	1			
	Quercus bicolor	1	5	10	6			
	Quercus palustris		2	1				
	Ulmus rubra		2	3	1			
	Liriodendron tulipifera			3				
	Platanus occidentalis	3	10	4	4			
	Unknown					40		
<b>TOT:</b>	<b>12</b>	<b>7</b>	<b>38</b>	<b>35</b>	<b>18</b>	<b>40</b>		

**Table 3. Vegetation Damage by Species**

	Species	All Damage Categories	(no damage)	Site Too Dry
	<i>Alnus serrulata</i>	6	2	4
	<i>Aronia arbutifolia</i>	4	1	3
	<i>Cephalanthus occidentalis</i>	14	12	2
	<i>Cornus amomum</i>	5	1	4
	<i>Fraxinus pennsylvanica</i>	12	10	2
	<i>Liriodendron tulipifera</i>	3	3	
	<i>Nyssa sylvatica</i>	2	1	1
	<i>Platanus occidentalis</i>	21	13	8
	<i>Quercus bicolor</i>	22	10	12
	<i>Quercus palustris</i>	3	3	
	<i>Ulmus rubra</i>	6	5	1
	Unknown			40
<b>TOT:</b>	<b>12</b>	<b>138</b>	<b>61</b>	<b>77</b>

**Table 4. Vegetation Damage by Plot**

	plot	All Damage Categories	(no damage)	Site Too Dry
	D06054F-01-0001-year:1	14	10	6
	D06054F-01-0002-year:1	10	7	7
	D06054F-01-0003-year:1	9	6	7
	D06054F-01-0004-year:1	10	7	9
	D06054F-01-0005-year:1	16	6	13
	D06054F-01-0006-year:1	18	10	9
	D06054F-01-0007-year:1	3	2	8
	D06054F-01-0008-year:1	8	7	5
	D06054F-01-0009-year:1			5
	D06054F-01-0010-year:1	10	6	8
<b>TOT:</b>	<b>10</b>	<b>138</b>	<b>61</b>	<b>77</b>

**Table 5. Stem Count by Plot and Species - Planted Stems**

Species	Total Planted Stems	# plots	avg# stems	plot D06054F-01-0001-year:1	plot D06054F-01-0002-year:1	plot D06054F-01-0003-year:1	plot D06054F-01-0004-year:1	plot D06054F-01-0005-year:1	plot D06054F-01-0006-year:1	plot D06054F-01-0007-year:1	plot D06054F-01-0008-year:1	plot D06054F-01-0009-year:1	plot D06054F-01-0010-year:1
Alnus serrulata	6	4	1.5	3		1	1						1
Aronia arbutifolia	4	1	4	4									
Cephalanthus occidentalis	14	4	3.5		5	2	6						1
Cornus amomum	5	3	1.67						1	1			3
Fraxinus pennsylvanica	12	5	2.4	2	1	5		1	3				
Liriodendron tulipifera	3	1	3										3
Nyssa sylvatica	2	1	2					2					
Platanus occidentalis	21	6	3.5	2		1	1	6	9		2		
Quercus bicolor	18	7	2.57	3	4		1	6	2		5		1
Quercus palustris	3	3	1					1	1		1		
Ulmus rubra	6	4	1.5				1		2	2			1
<b>TOT: 11</b>	<b>94</b>	<b>11</b>		<b>14</b>	<b>10</b>	<b>9</b>	<b>10</b>	<b>16</b>	<b>18</b>	<b>3</b>	<b>8</b>	<b>0</b>	<b>10</b>

**Table 6. Stem Count by Plot and Species - All Stems**

Species	Total Stems	# plots	avg# stems	D06054F-01-0001-year:1	D06054F-01-0002-year:1	D06054F-01-0003-year:1	D06054F-01-0004-year:1	D06054F-01-0005-year:1	D06054F-01-0006-year:1	D06054F-01-0007-year:1	D06054F-01-0008-year:1	D06054F-01-0009-year:1	D06054F-01-0010-year:1
<i>Alnus serrulata</i>	6	4	1.5	3		1	1						1
<i>Aronia arbutifolia</i>	4	1	4	4									
<i>Cephalanthus occidentalis</i>	14	4	3.5		5	2	6						1
<i>Cornus amomum</i>	5	3	1.67						1	1			3
<i>Diospyros virginiana</i>	13	2	6.5	12			1						
<i>Fraxinus pennsylvanica</i>	12	5	2.4	2	1	5		1	3				
<i>Nyssa sylvatica</i>	2	1	2					2					
<i>Quercus bicolor</i>	18	7	2.57	3	4		1	6	2		5		1
<i>Quercus palustris</i>	3	3	1					1	1		1		
<i>Ulmus rubra</i>	7	5	1.4				1		2	2		1	1
<i>Liriodendron tulipifera</i>	3	1	3										3
<i>Platanus occidentalis</i>	21	6	3.5	2		1	1	6	9		2		
<b>TOT: 12</b>	<b>108</b>	<b>12</b>		<b>26</b>	<b>10</b>	<b>9</b>	<b>11</b>	<b>16</b>	<b>18</b>	<b>3</b>	<b>8</b>	<b>1</b>	<b>10</b>

## **APPENDIX B**

### **Geomorphologic Raw Data**

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





**SPA 1**  
**Large tree fall on Davis Branch near station 18+75.**  
(EMH&T, Inc. 9/19/09)



**SPA 2**  
**Bare banks along an outer meander bend on UT1 near station 5+50. Concern for stability if vegetation does not develop.**  
(EMH&T, Inc. 9/19/09)





**SPA 3**

**Bare banks along an outer meander bend on Davis Branch near station 29+90. Concern for stability if vegetation does not develop.**

(EMH&T, Inc. 9/19/09)



**Fixed Station 1**  
**Overview of Davis Branch, looking downstream at Station 7+80.**  
(EMH&T, Inc. 9/19/09)



**Fixed Station 2**  
**Overview of Davis Branch, looking downstream near Station 14+75.**  
(EMH&T, Inc. 9/19/09)



**Fixed Station 3**  
**Overview of Davis Branch, looking downstream near Station 15+50.**  
(EMH&T, Inc. 9/19/09)



**Fixed Station 4**  
**Overview of Davis Branch, looking upstream near Station 25+75.**  
(EMH&T, Inc. 9/19/09)



**Fixed Station 5**  
**Overview of Davis Branch, looking upstream near Station 27+25.**  
(EMH&T, Inc. 9/19/09)



**Fixed Station 6**  
**Overview of Davis Branch, looking upstream near Station 38+75.**  
(EMH&T, Inc. 9/19/09)



**Fixed Station 7**  
**Overview of UT1, looking upstream near Station 6+50.**  
(EMH&T, Inc. 9/19/09)



**Fixed Station 8**  
**Overview of UT1, looking downstream near Station 4+50.**  
(EMH&T, Inc. 9/19/09)

**Table B1. Visual Morphological Stability Assessment**  
**Davis Branch Stream Restoration / EEP Project No. D06054-F**  
**Segment/Reach: Mainstem restoration**

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?	41	41	0	100	
	2. Armor stable (e.g. no displacement)?	38	41	3	93	
	3. Facet grade appears stable?	41	41	0	100	
	4. Minimal evidence of embedding/fining?	41	41	0	100	
	5. Length appropriate?	41	41	0	100	99%
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	40	40	0	100	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?)	39	40	1	98	
	3. Length appropriate?	40	40	0	100	99%
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	36	36	0	100	
	2. Downstream of meander (glide/inflection) centering?	36	36	0	100	100%
D. Meanders	1. Outer bend in state of limited/controlled erosion?	35	36	1	97	
	2. Of those eroding, # w/concomitant point bar formation?	36	36	0	100	
	3. Apparent Rc within spec?	36	36	0	100	
	4. Sufficient floodplain access and relief?	36	36	0	100	99%
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

**Table B1. Visual Morphological Stability Assessment**  
**Davis Branch Stream Restoration / EEP Project No. D06054-F**  
**Segment/Reach: Mainstem enhancement**

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?	18	18	0	100	
	2. Armor stable (e.g. no displacement)?	17	18	1	94	
	3. Facet grade appears stable?	18	18	0	100	
	4. Minimal evidence of embedding/fining?	18	18	0	100	
	5. Length appropriate?	18	18	0	100	<b>100%</b>
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	19	19	0	100	
	2. Sufficiently deep (Max Pool D:Mean Bkt>1.6?)	18	19	1	95	
	3. Length appropriate?	19	19	0	100	<b>100%</b>
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	18	18	0	100	
	2. Downstream of meander (glide/inflection) centering?	18	18	0	100	<b>100%</b>
D. Meanders	1. Outer bend in state of limited/controlled erosion?	17	18	1	94	
	2. Of those eroding, # w/concomitant point bar formation?	18	18	0	100	
	3. Apparent Rc within spec?	18	18	0	100	
	4. Sufficient floodplain access and relief?	16	18	2	89	<b>96%</b>
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	<b>100%</b>
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	<b>N/A</b>
G. Wads/ Boulders	1. Free of scour?	N/A	0	N/A	N/A	
	2. Footing stable?	N/A	0	N/A	N/A	<b>N/A</b>

**Table B1. Visual Morphological Stability Assessment**  
**Davis Branch Stream Restoration / EEP Project No. D06054-F**  
**Segment/Reach: UT1 restoration**

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?	14	14	0	100	
	2. Armor stable (e.g. no displacement)?	12	14	2	86	
	3. Facet grade appears stable?	14	14	0	100	
	4. Minimal evidence of embedding/fining?	14	14	0	100	
	5. Length appropriate?	14	14	0	100	<b>97%</b>
B. Pools	1. Present? (e.g. not subject to severe aggrad. or migrat.?)	14	14	0	100	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?)	13	14	1	93	
	3. Length appropriate?	14	14	0	100	<b>98%</b>
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	12	12	0	100	
	2. Downstream of meander (glide/inflection) centering?	12	12	0	100	<b>100%</b>
D. Meanders	1. Outer bend in state of limited/controlled erosion?	12	12	0	100	
	2. Of those eroding, # w/concomitant point bar formation?	12	12	0	100	
	3. Apparent Rc within spec?	12	12	0	100	
	4. Sufficient floodplain access and relief?	10	12	2	83	<b>96%</b>
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	<b>100%</b>
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	<b>N/A</b>
G. Wads/ Boulders	1. Free of scour?	N/A	0	N/A	N/A	<b>N/A</b>
	2. Footing stable?	N/A	0	N/A	N/A	<b>N/A</b>



**Summary Data**

All dimensions in feet.

Bankfull Area	4.22 ft <sup>2</sup>
Bankfull Width	8.76 ft
Mean Depth	0.48 ft
Maximum Depth	0.87 ft
Width/Depth Ratio	18.25
Entrenchment Ratio	13.07
Classification	C

**PROJECT**

Davis Branch  
D06054-F  
1-YEAR

**TASK**

Cross-Section

**REACH**

Davis Branch

**DATE**

11/5/09



**CROSS SECTION:**

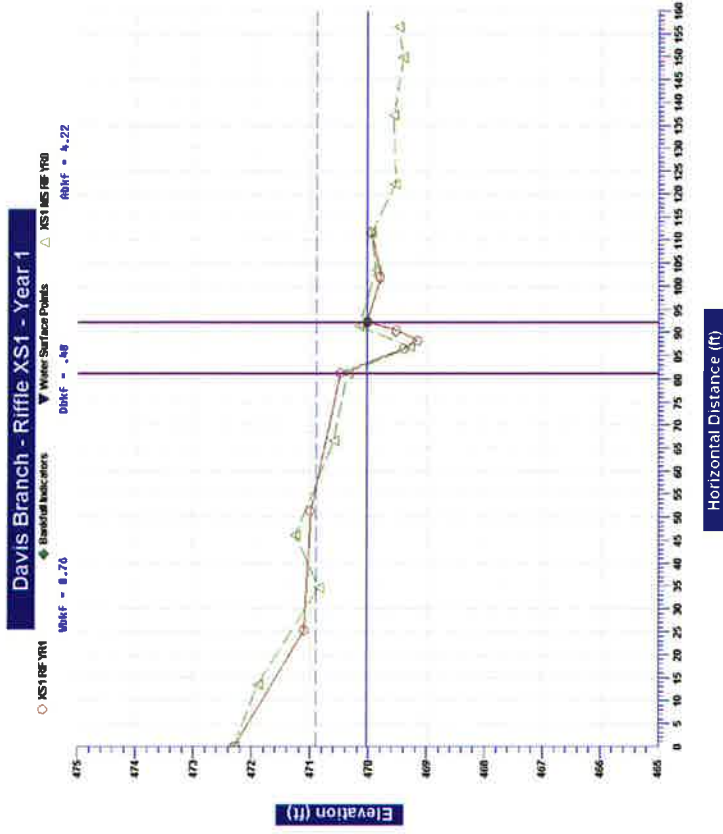
1

**FEATURE:**

Riffle



Cross-section photo – looking downstream



**Summary Data**

All dimensions in feet.

Bankfull Area 11.49 ft<sup>2</sup>  
 Bankfull Width 11.09 ft  
 Mean Depth 1.04 ft  
 Maximum Depth 2.0 ft  
 Width/Depth Ratio 10.66  
 Entrenchment Ratio 13.53

**PROJECT** Davis Branch  
 D06054-F  
 1-YEAR

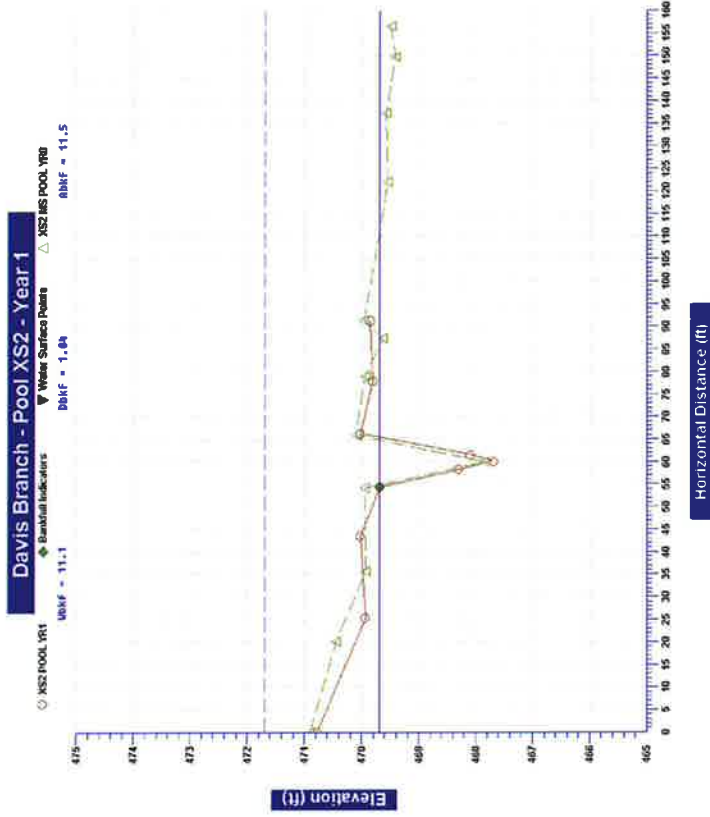
**TASK** Cross-Section  
**REACH** Davis Branch  
**DATE** 11/5/09



**CROSS SECTION:** 2  
**FEATURE:** Pool



Cross-section photo – looking downstream



**Summary Data**

All dimensions in feet.

Bankfull Area 12.01 ft<sup>2</sup>  
 Bankfull Width 13.05 ft  
 Mean Depth 0.92 ft  
 Maximum Depth 1.57 ft  
 Width/Depth Ratio 14.18  
 Entrenchment Ratio 4.62  
 Classification C

**PROJECT** Davis Branch  
 D06054-F  
 1-YEAR

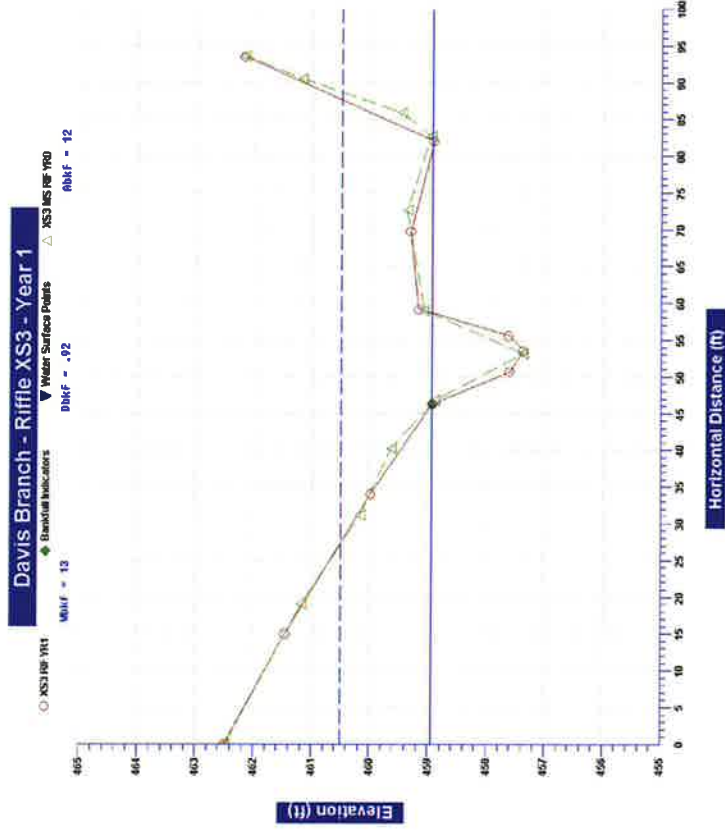
**TASK** Cross-Section  
**REACH** Davis Branch  
**DATE** 11/5/09



**CROSS SECTION:** 3  
**FEATURE:** Riffle



Cross-section photo – looking upstream



**Summary Data**

All dimensions in feet.

Bankfull Area 20.97 ft<sup>2</sup>  
 Bankfull Width 21.92 ft  
 Mean Depth 0.96 ft  
 Maximum Depth 2.32 ft  
 Width/Depth Ratio 22.83  
 Entrenchment Ratio 3.26

**PROJECT** Davis Branch  
 D06054-F  
 1-YEAR

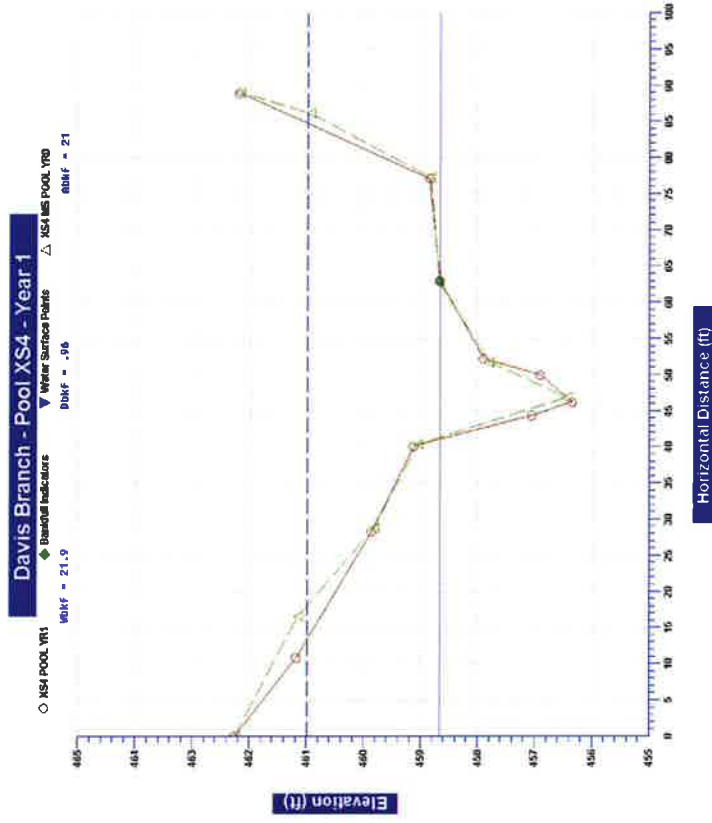
**TASK** Cross-Section  
**REACH** Davis Branch  
**DATE** 11/5/09



**CROSS SECTION:** 4  
**FEATURE:** Pool



Cross-section photo – looking downstream



**Summary Data**

All dimensions in feet.

Bankfull Area 11.35 ft<sup>2</sup>  
 Bankfull Width 18.43 ft  
 Mean Depth 0.62 ft  
 Maximum Depth 1.25 ft  
 Width/Depth Ratio 29.73  
 Entrenchment Ratio 3.43  
 Classification C

**PROJECT** Davis Branch  
 D06054-F  
 1-YEAR

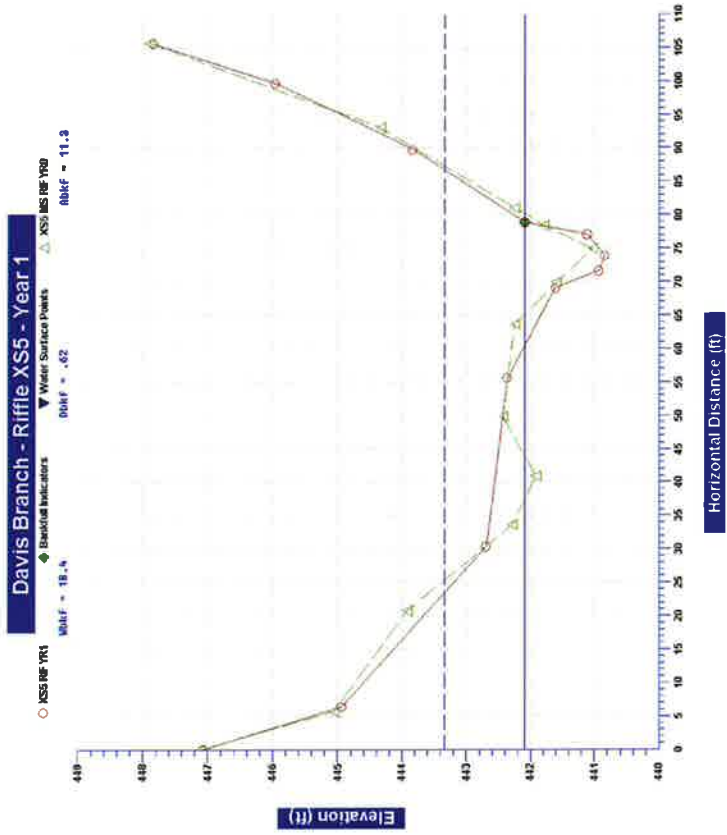
**TASK** Cross-Section  
**REACH** Davis Branch  
**DATE** 11/5/09



**CROSS SECTION:** 5  
**FEATURE:** Riffle



Cross-section photo – looking downstream



**Summary Data**

All dimensions in feet.

Bankfull Area 18.35 ft<sup>2</sup>  
 Bankfull Width 12.61 ft  
 Mean Depth 1.46 ft  
 Maximum Depth 2.33 ft  
 Width/Depth Ratio 8.64  
 Entrenchment Ratio 6.33

**PROJECT** Davis Branch  
 D06054-F  
 1-YEAR

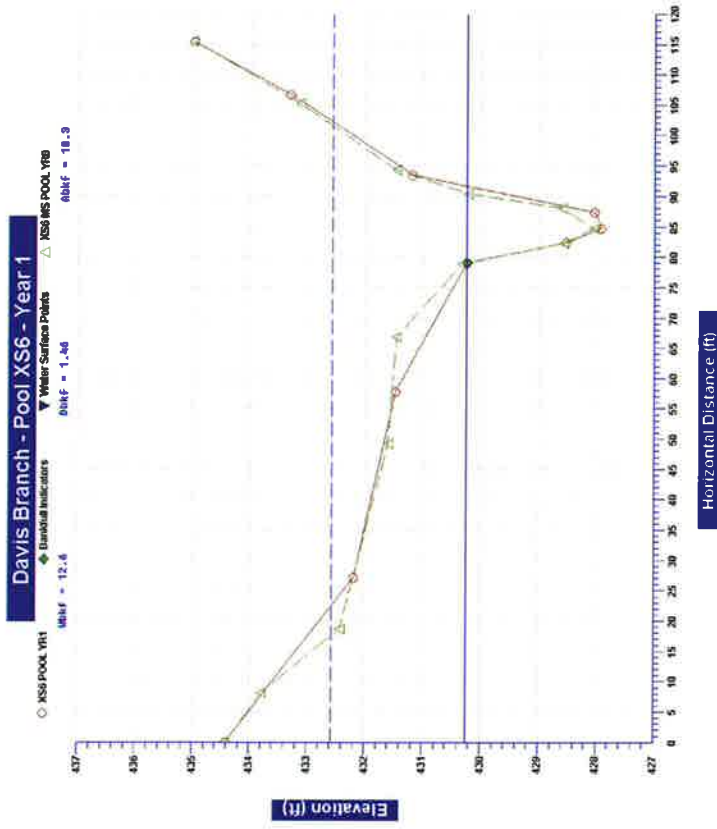
**TASK** Cross-Section  
**REACH** Davis Branch  
**DATE** 11/5/09



**CROSS SECTION:** 6  
**FEATURE:** Pool



Cross-section photo – looking upstream



**Summary Data**

All dimensions in feet.

Bankfull Area 13.76 ft<sup>2</sup>  
 Bankfull Width 16.56 ft  
 Mean Depth 0.83 ft  
 Maximum Depth 1.33 ft  
 Width/Depth Ratio 19.95  
 Entrenchment Ratio 3.61  
 Classification C

**PROJECT**

Davis Branch  
 D06054-F  
 1-YEAR

**TASK**

**REACH**

**DATE**

Cross-Section

Davis Branch

11/5/09

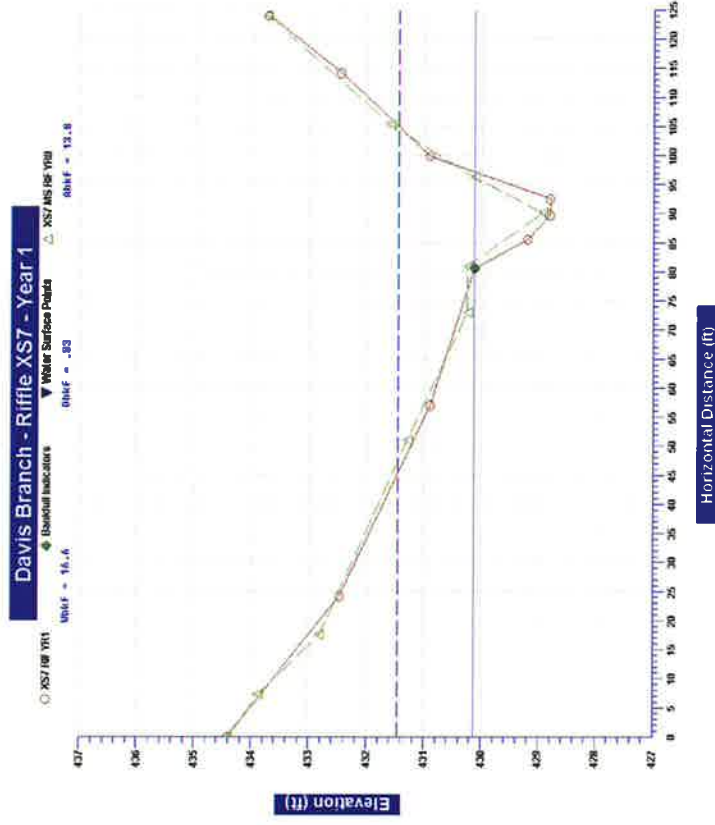


**CROSS SECTION:** 7

**FEATURE:** Riffle



Cross-section photo – looking upstream



### Summary Data

All dimensions in feet.

Bankfull Area 3.69 ft<sup>2</sup>  
Bankfull Width 11.57 ft  
Mean Depth 0.32 ft  
Maximum Depth 0.7 ft  
Width/Depth Ratio 36.16  
Entrenchment Ratio 3.22  
Classification C

**PROJECT** Davis Branch  
D06054-F  
1-YEAR

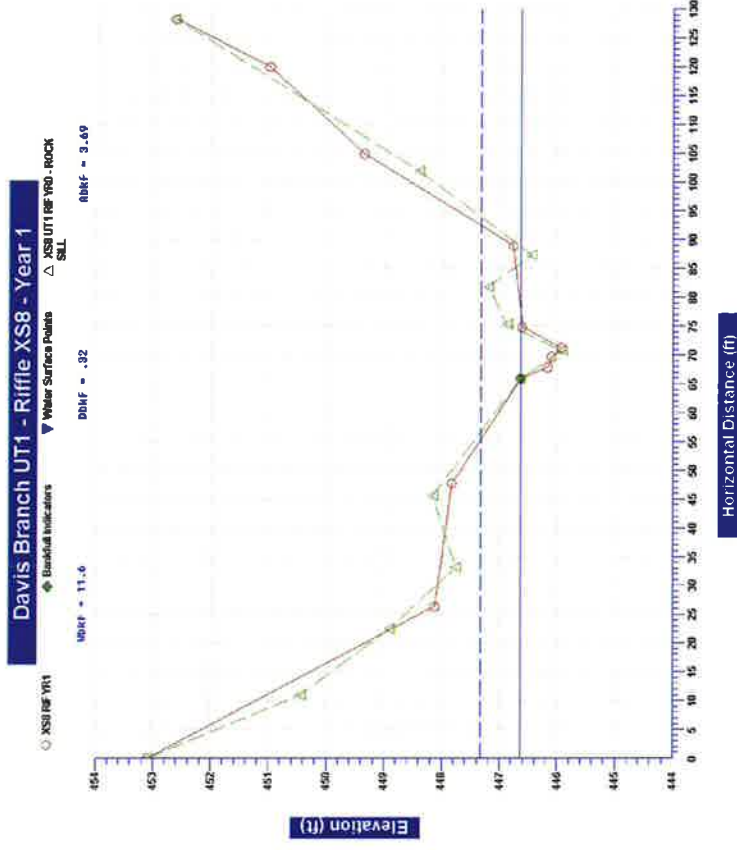
**TASK** Cross-Section  
**REACH** Unnamed Trib. 1  
**DATE** 11/5/09



**CROSS SECTION:** 8  
**FEATURE:** Riffle



Cross-section photo - looking upstream





### Summary Data

All dimensions in feet.

Bankfull Area 5.18 ft<sup>2</sup>  
Bankfull Width 11.88 ft  
Mean Depth 0.44 ft  
Maximum Depth 0.99 ft  
Width/Depth Ratio 27.0  
Entrenchment Ratio 4.78  
Classification C

**PROJECT** Davis Branch  
D06054-F  
1-YEAR

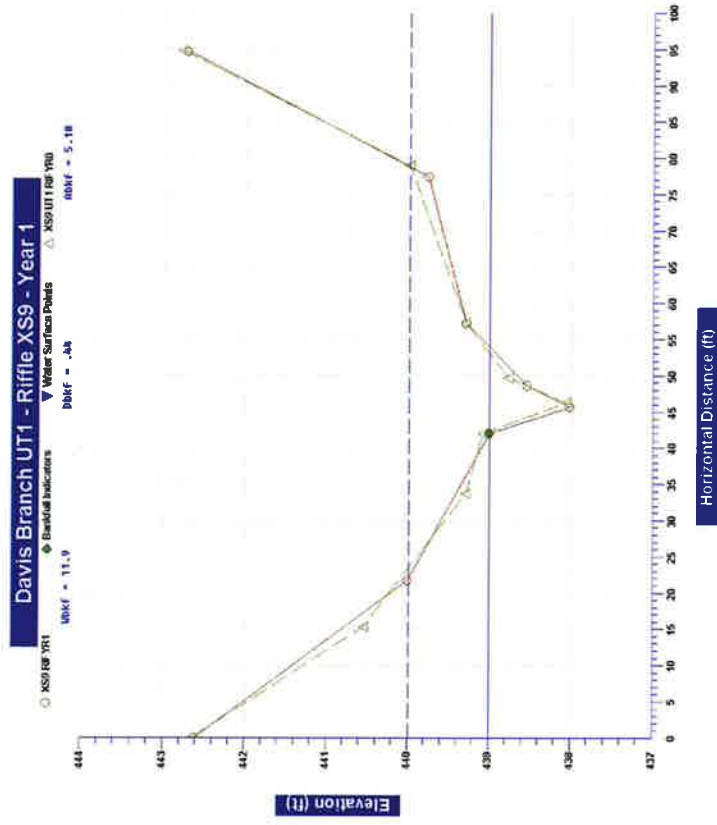
**TASK** Cross-Section  
**REACH** Unnamed Trib. 1  
**DATE** 11/5/09



**CROSS SECTION:** 9  
**FEATURE:** Riffle

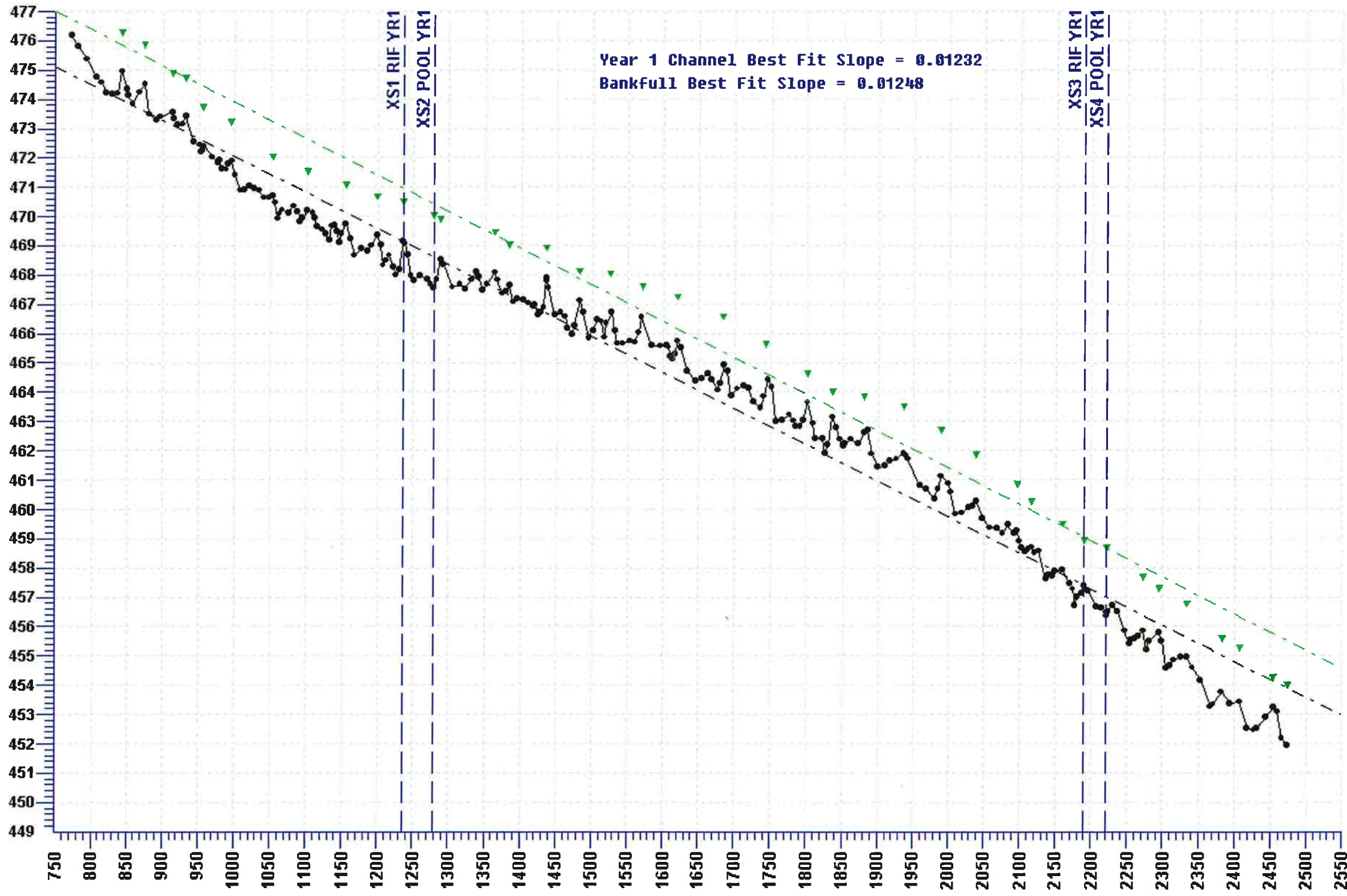


Cross-section photo – looking upstream



# Davis Branch Priority Level 1 & Priority Level 2 Profile - Year 1 - 9 Sep 2009

Elevation (ft)

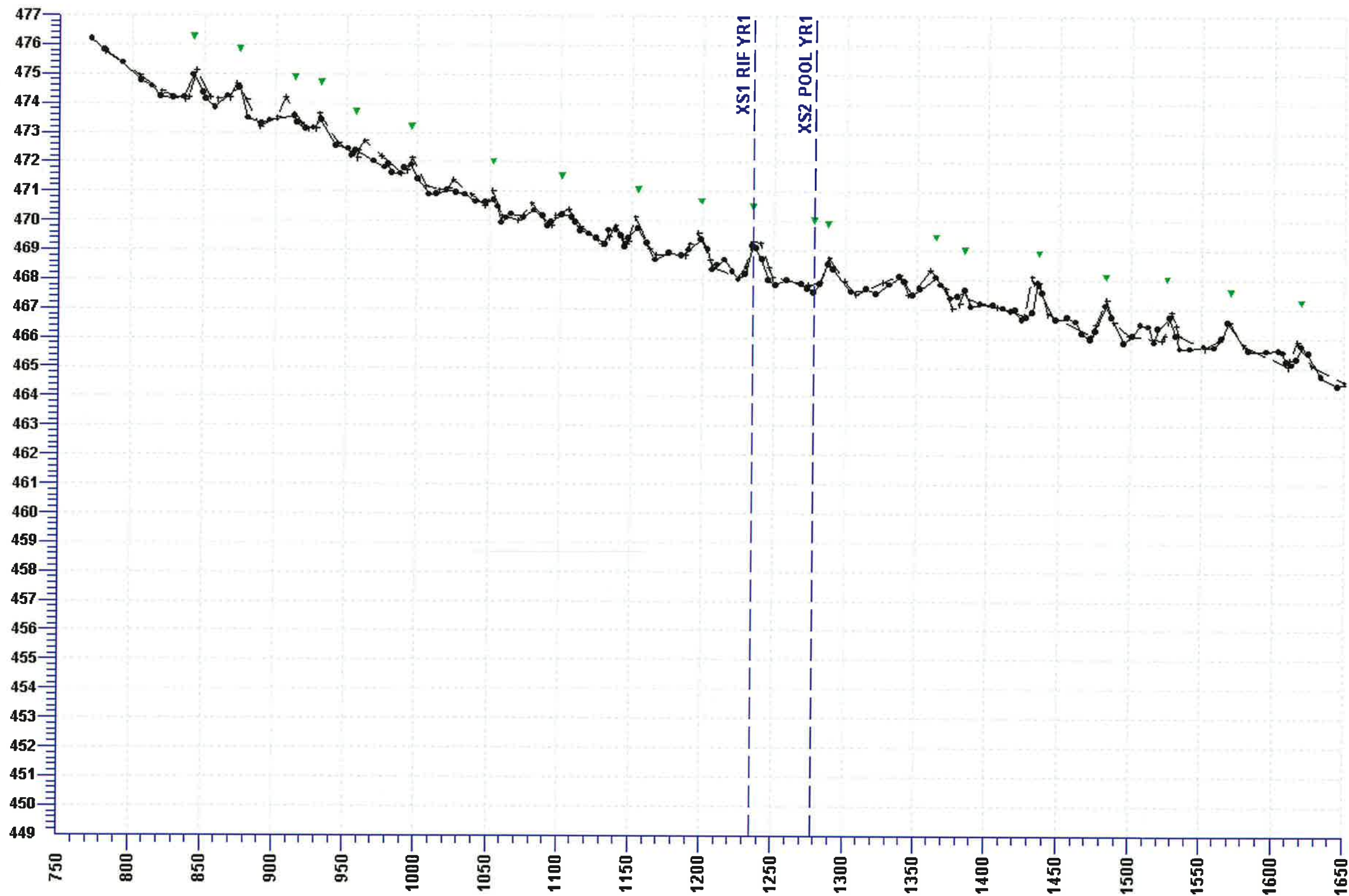


Distance along stream (ft)

- Year 1 Channel
- Water Surface
- ▼ Bankfull
- ◆ Left Bank
- ◇ Right Bank
- + Left Edge of Water
- × Right Edge of Water

# Davis Branch Priority Level 1 & Priority Level 2 Profile - Year 1 - 9 Sep 2009

Elevation (ft)

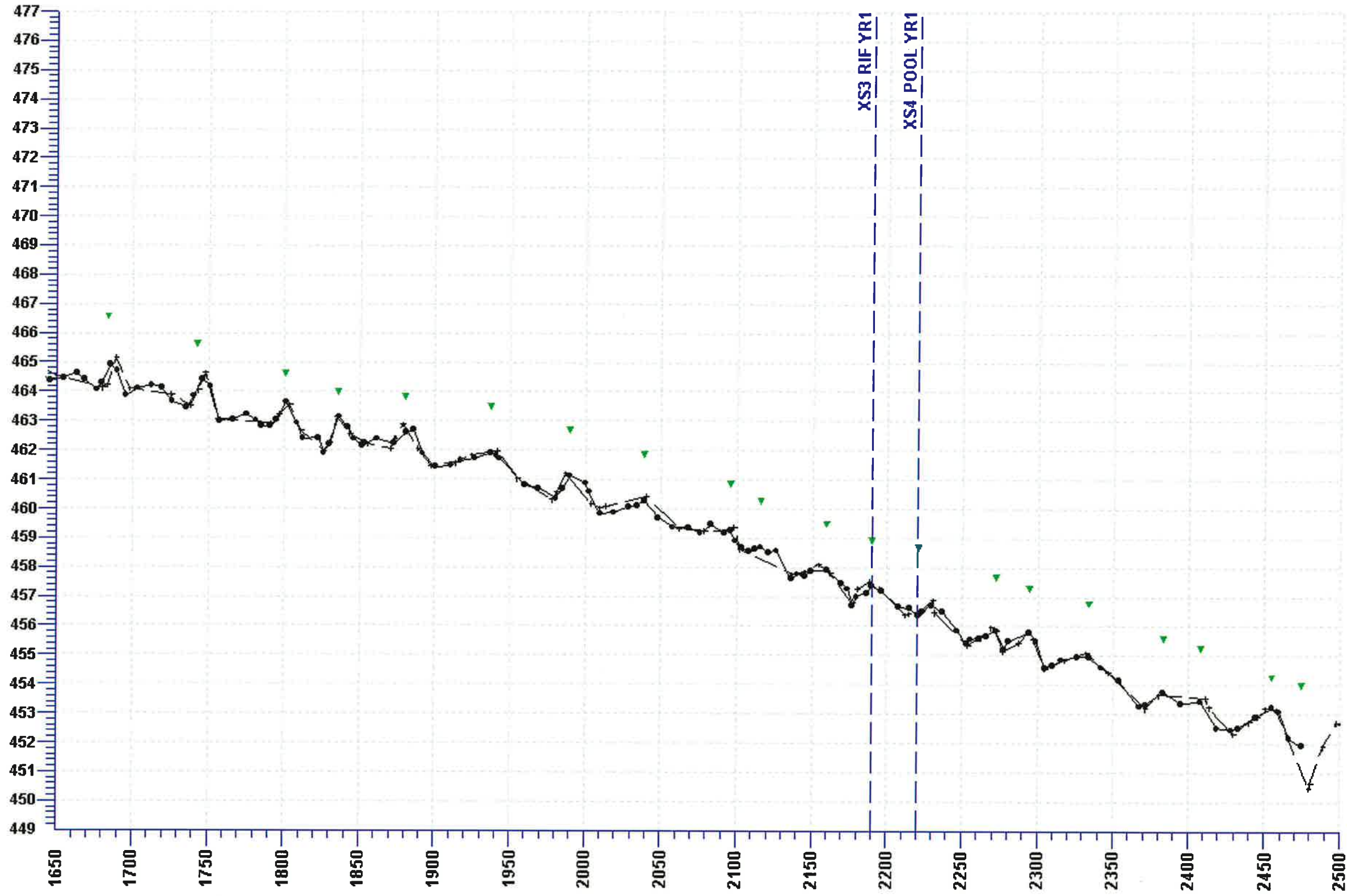


Distance along stream (ft)

- Year 1 Channel
- Water Surface
- ▼ Bankfull
- ◆ Left Bank
- ◆ Right Bank
- + Left Edge of Water
- × Right Edge of Water
- Year 0 Channel

# Davis Branch Priority Level 1 & Priority Level 2 Profile - Year 1 - 9 Sep 2009

Elevation (ft)

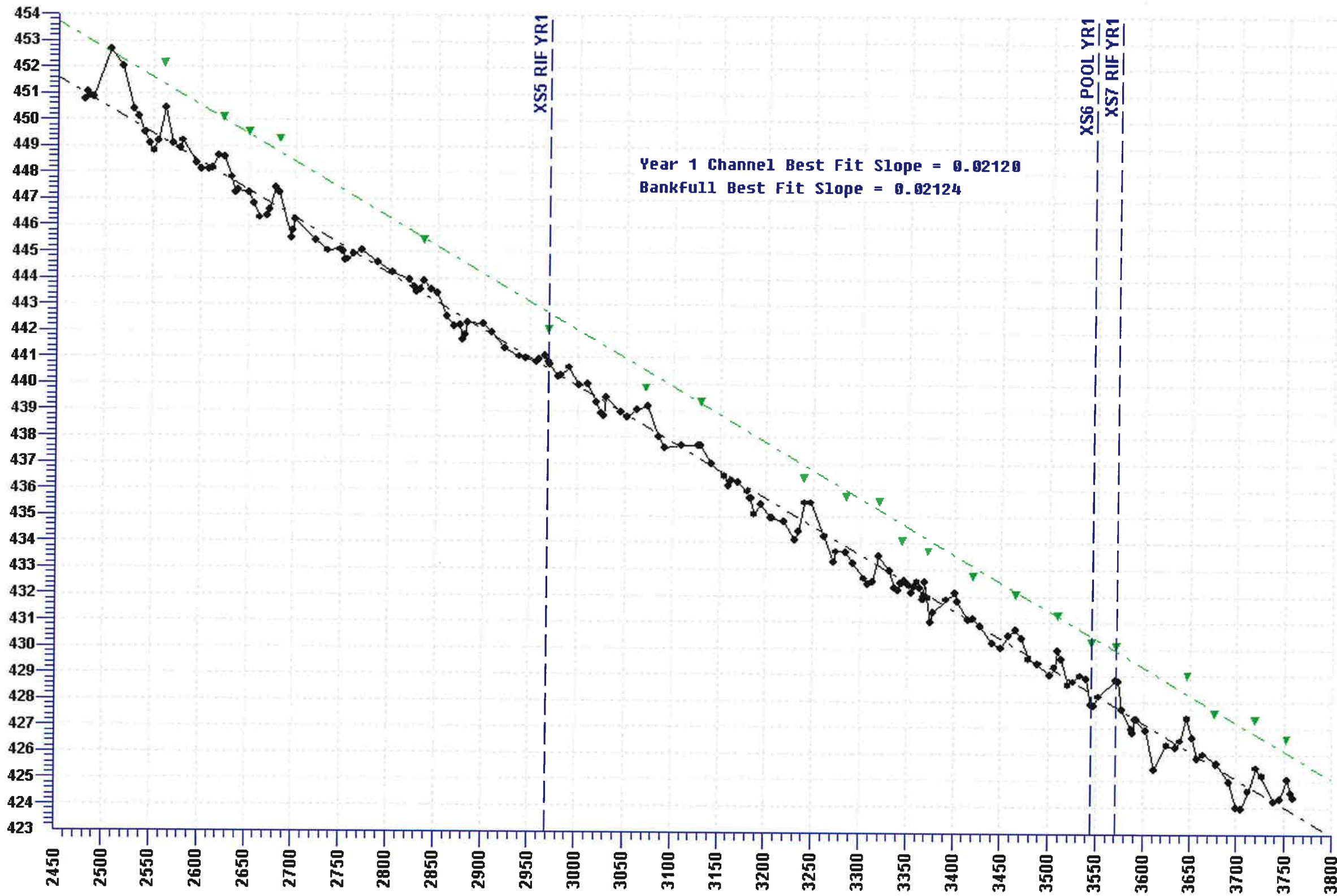


Distance along stream (ft)

- Year 1 Channel
- Water Surface
- ▼ Bankfull
- ◆ Left Bank
- ◇ Right Bank
- + Left Edge of Water
- × Right Edge of Water
- ◁ Year 0 Channel

# Davis Branch Mainstem - Enhancement Level 1 Profile - Year 1 - 9 Sep 2009

Elevation (ft)

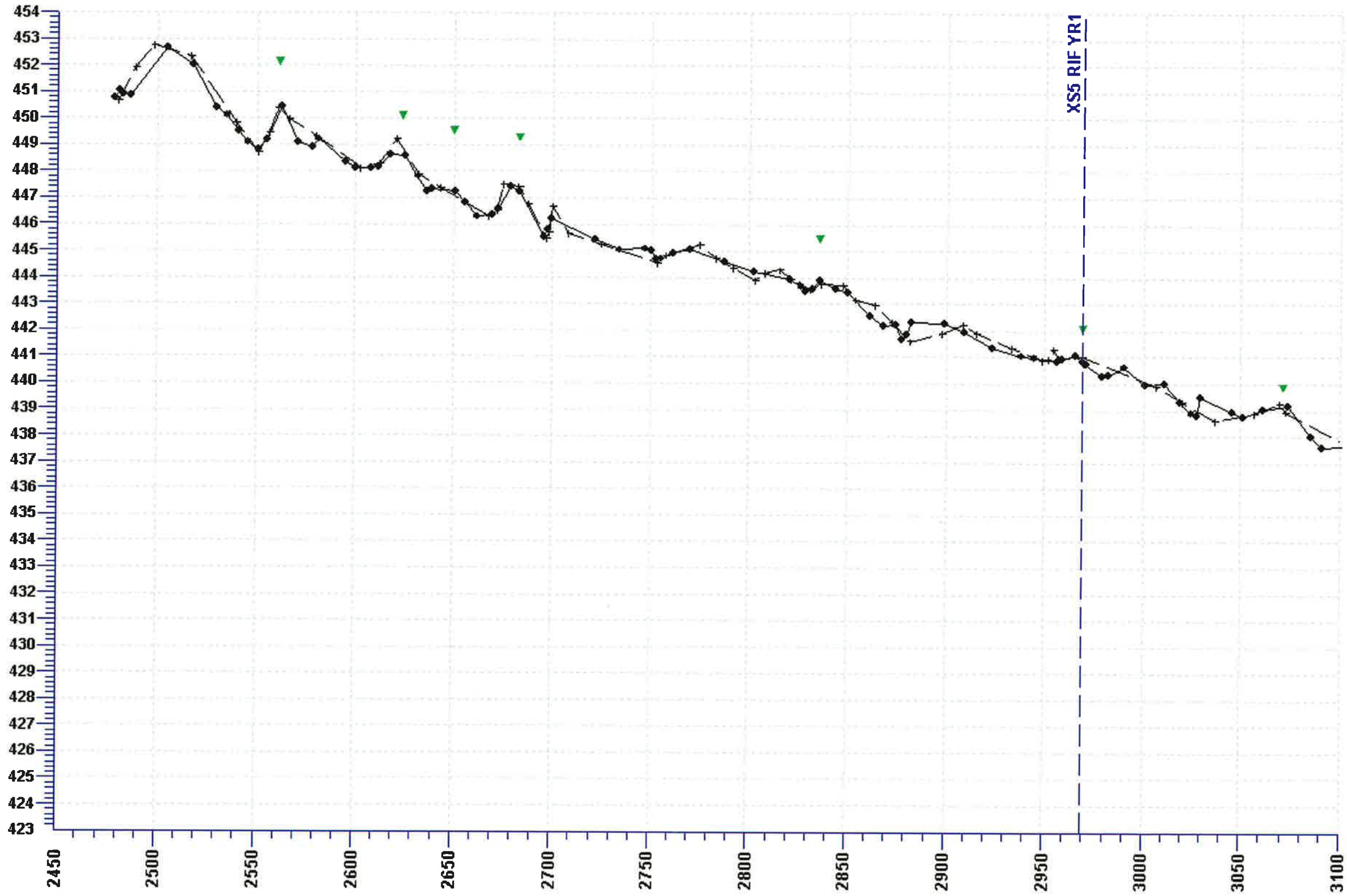


Distance along stream (ft)

- Year 1 Channel
- ◊ Water Surface
- ▼ Bankfull
- ◆ Left Bank
- ◇ Right Bank
- + Left Edge of Water
- × Right Edge of Water

# Davis Branch Mainstem - Enhancement Level 1 Profile - Year 1 - 9 Sep 2009

Elevation (ft)

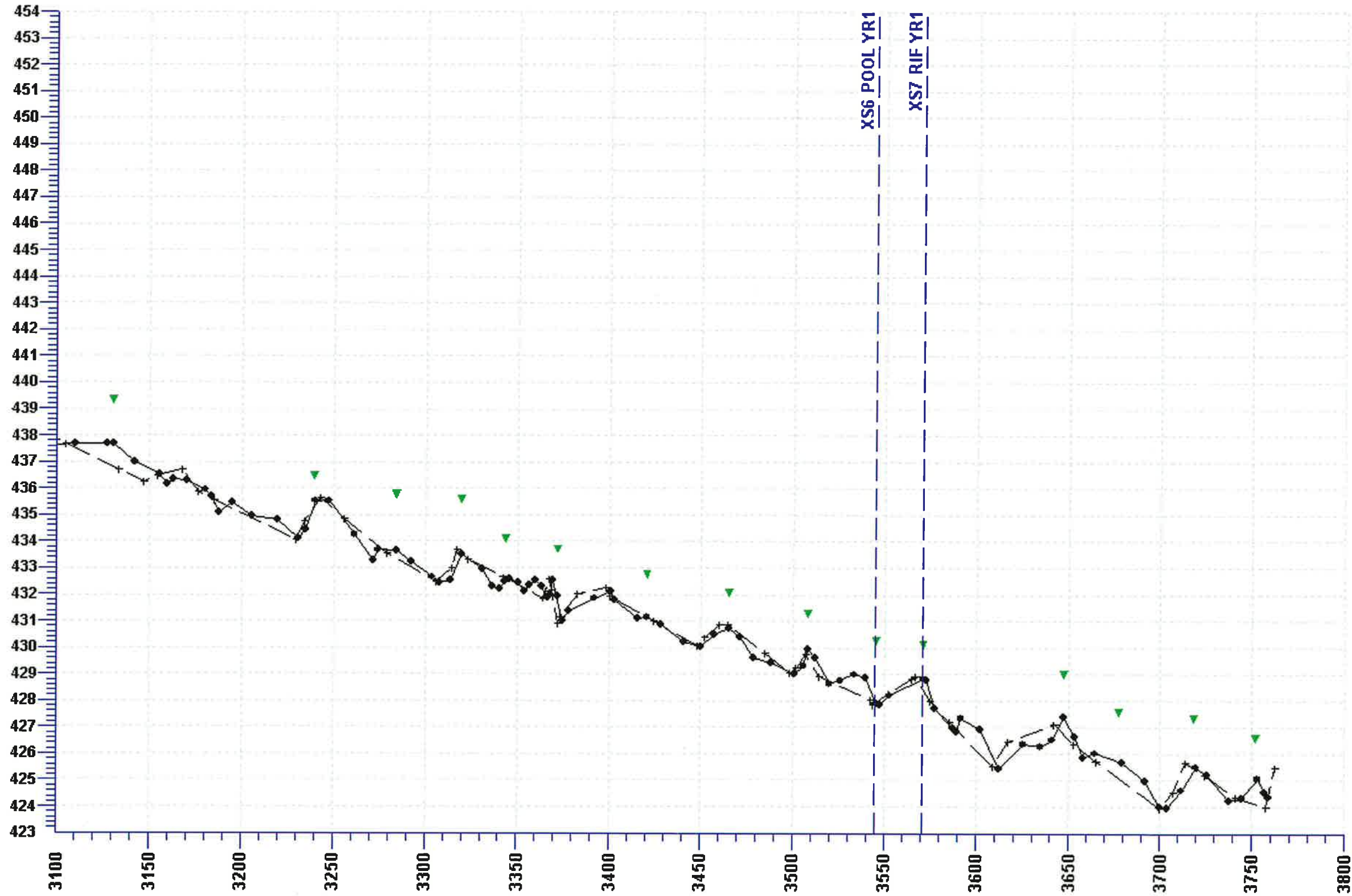


Distance along stream (ft)

- Year 1 Channel
- ◊ Water Surface
- ▼ Bankfull
- ◆ Left Bank
- ◇ Right Bank
- + Left Edge of Water
- × Right Edge of Water
- + Year 0 Channel

# Davis Branch Mainstem - Enhancement Level 1 Profile - Year 1 - 9 Sep 2009

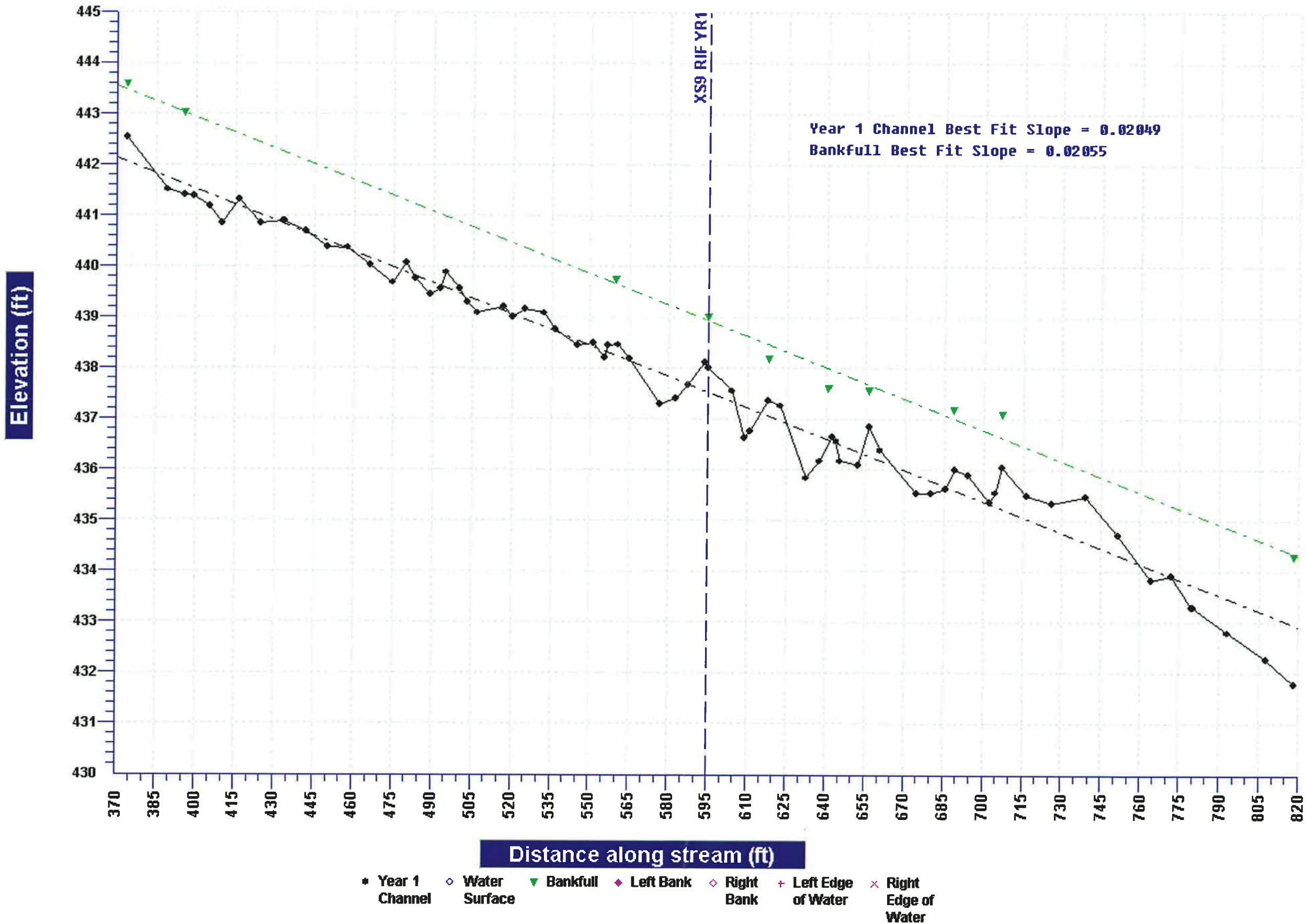
Elevation (ft)



Distance along stream (ft)

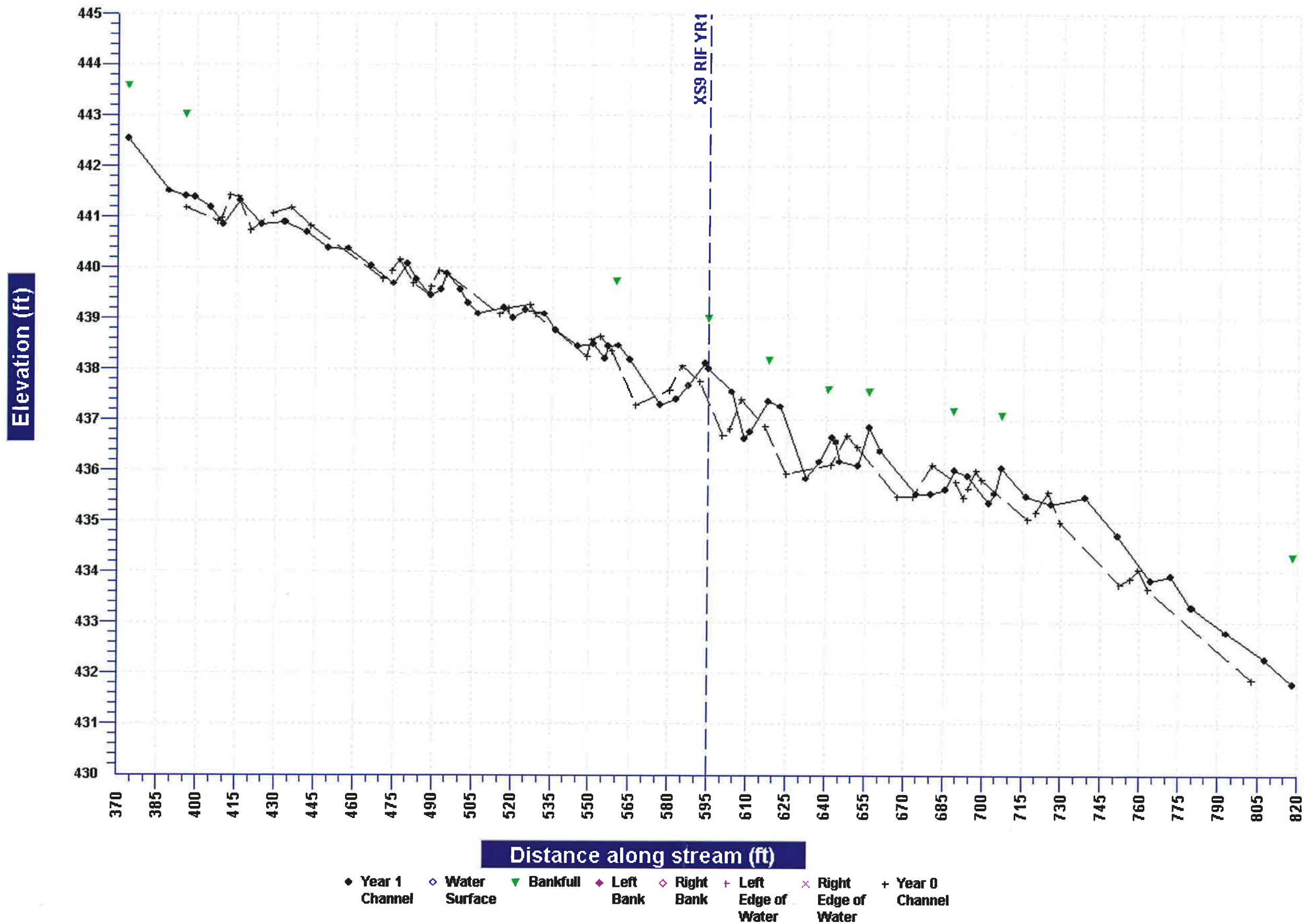
- ◆ Year 1 Channel
- ◇ Water Surface
- ▼ Bankfull
- ◆ Left Bank
- ◇ Right Bank
- + Left Edge of Water
- × Right Edge of Water
- + Year 0 Channel

# UT1 Priority Level 1 / Level 2 Profile - Year 1 - 9 Sep 2009





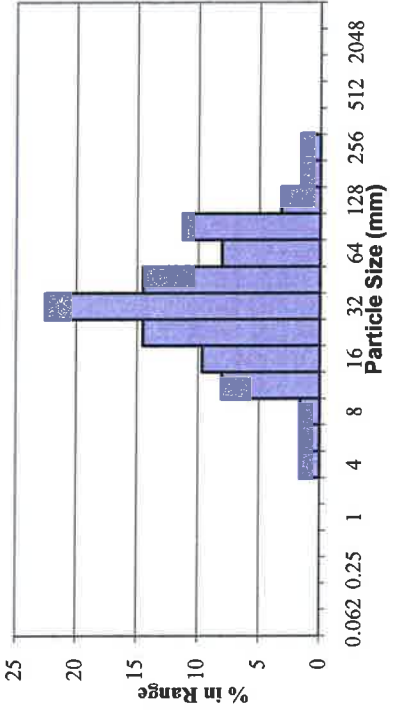
# UT1 Priority Level 1 / Level 2 Profile - Year 1 - 9 Sep 2009



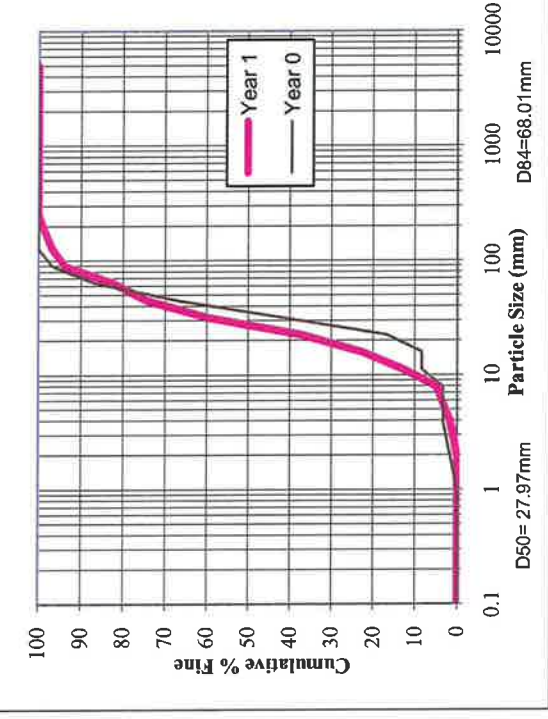
Pebble Count - Riffle				
Material	Particle Size (mm)	Count	% in Range	% Cumulative
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	0	0	0
Medium Sand	0.25-0.5	0	0	0
Coarse Sand	0.5-1.0	0	0	0
Very Coarse Sand	1.0-2.0	0	0	0
Very Fine Gravel	2.0-4.0	1	2	2
Fine Gravel	4.0-5.7	1	2	3
Fine Gravel	5.7-8.0	1	2	5
Medium Gravel	8.0-11.3	5	8	13
Medium Gravel	11.3-16.0	6	10	23
Coarse Gravel	16.0-22.6	9	15	37
Coarse Gravel	22.6-32	14	23	60
Very Coarse Gravel	32-45	9	15	74
Very Coarse Gravel	45-64	5	8	82
Small Cobble	64-90	7	11	94
Small Cobble	90-128	2	3	97
Large Cobble	128-180	1	2	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		62	100	

Davis Branch Restoration EEP Project No. D06054-F			
Reach	Mainstem	X Sec	I
Date	11/5/2009	Sta No.	12+31.44

Histogram

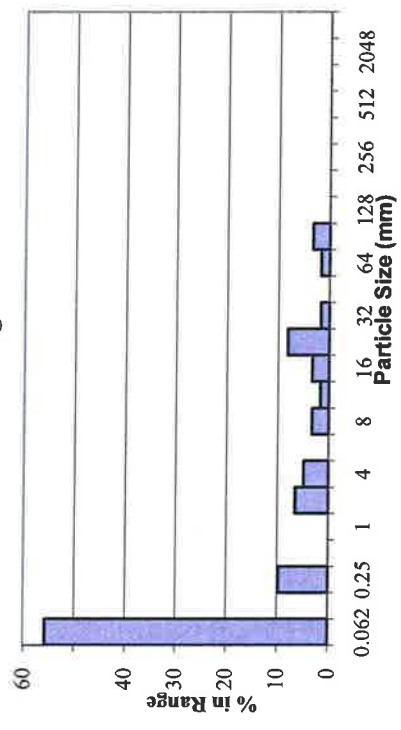


Particle Size Distribution

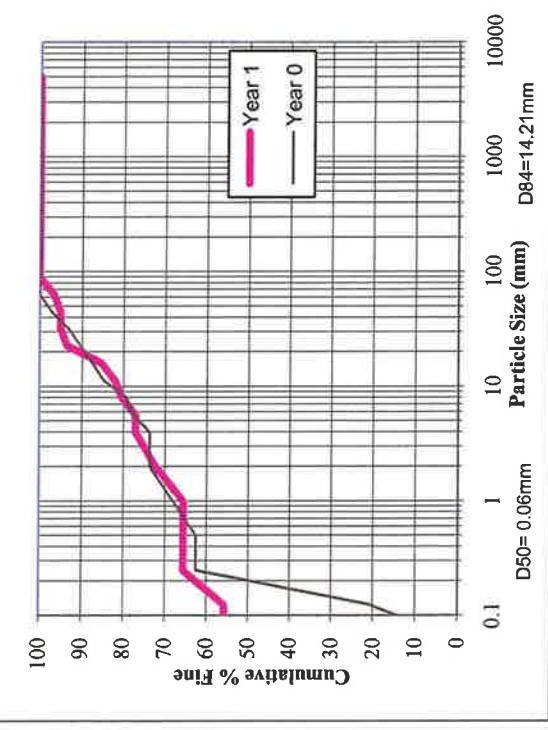


Davis Branch Restoration EEP Project No. D06054-F			
Reach	Mainstem	X Sec	2
Date	11/5/2009	Sta No.	12+66.55

Histogram



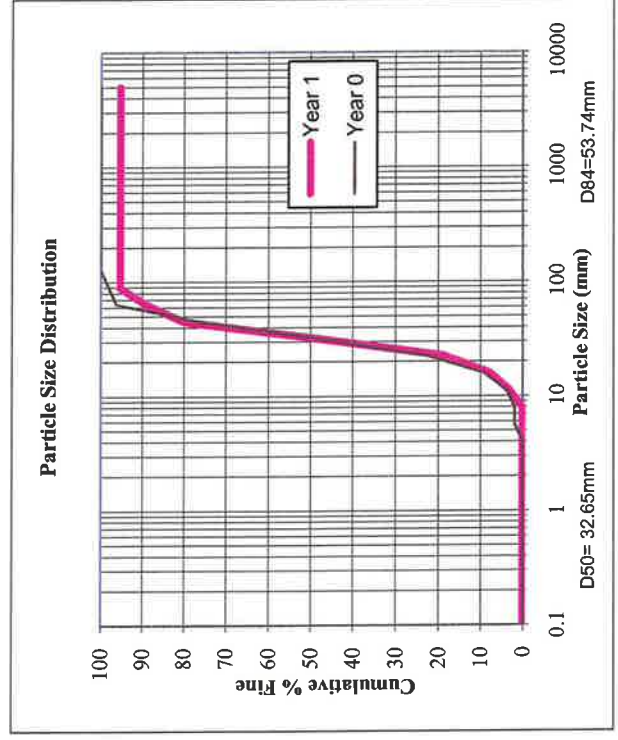
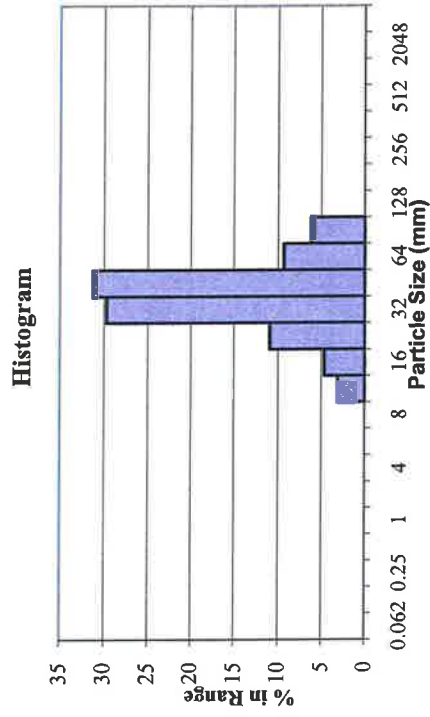
Particle Size Distribution



Pebble Count - Pool					
Material	Particle Size (mm)	Count	% in Range	% Cumulative	
Silt/Clay	<0.062	34	56	56	
Very Fine Sand	0.062-0.125	0	0	56	
Fine Sand	0.125-0.25	6	10	66	
Medium Sand	0.25-0.5	0	0	66	
Coarse Sand	0.5-1.0	0	0	66	
Very Coarse Sand	1.0-2.0	4	7	72	
Very Fine Gravel	2.0-4.0	3	5	77	
Fine Gravel	4.0-5.7	0	0	77	
Fine Gravel	5.7-8.0	2	3	80	
Medium Gravel	8.0-11.3	1	2	82	
Medium Gravel	11.3-16.0	2	3	85	
Coarse Gravel	16.0-22.6	5	8	93	
Coarse Gravel	22.6-32	1	2	95	
Very Coarse Gravel	32-45	0	0	95	
Very Coarse Gravel	45-64	1	2	97	
Small Cobble	64-90	2	3	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		61	100		

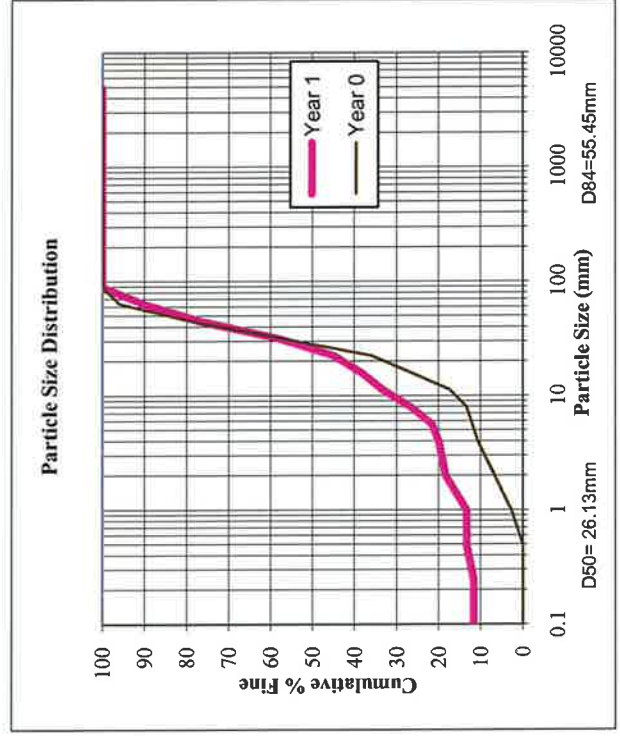
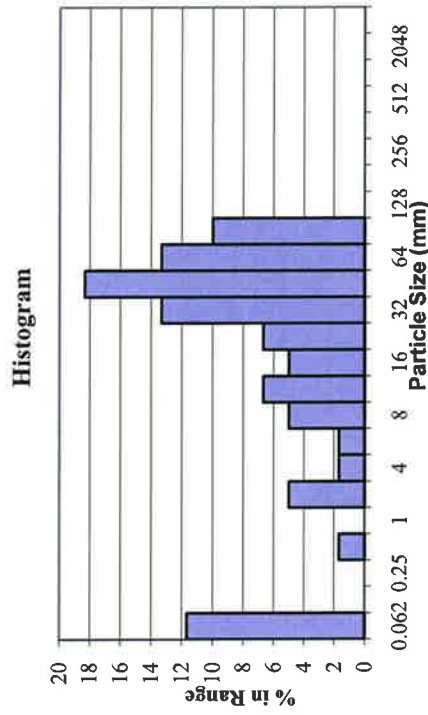
Pebble Count - Riffle				
Material	Particle Size (mm)	Count	% in Range	% Cumulative
Silt/Clay	<0.062	0	0	0
Very Fine Sand	0.062-0.125	0	0	0
Fine Sand	0.125-0.25	0	0	0
Medium Sand	0.25-0.5	0	0	0
Coarse Sand	0.5-1.0	0	0	0
Very Coarse Sand	1.0-2.0	0	0	0
Very Fine Gravel	2.0-4.0	0	0	0
Fine Gravel	4.0-5.7	0	0	0
Fine Gravel	5.7-8.0	0	0	0
Medium Gravel	8.0-11.3	2	3	3
Medium Gravel	11.3-16.0	3	5	8
Coarse Gravel	16.0-22.6	7	11	19
Coarse Gravel	22.6-32	19	30	48
Very Coarse Gravel	32-45	20	31	80
Very Coarse Gravel	45-64	6	9	89
Small Cobble	64-90	4	6	95
Small Cobble	90-128	0	0	95
Large Cobble	128-180	0	0	95
Large Cobble	180-256	0	0	95
Small Boulder	256-362	0	0	95
Small Boulder	362-512	0	0	95
Medium Boulder	512-1024	0	0	95
Large Boulder	1024-2048	0	0	95
Bedrock	<2048	3	0	95.3125
Totals		64	95.3125	95.3125

Davis Branch Restoration EEP Project No. D06054-F			
Reach	Mainstem	X Sec	3
Date	11/5/2009	Sta No.	21+61.52



Pebble Count - Pool				
Material	Particle Size (mm)	Count	% in Range	% Cumulative
Silt/Clay	<0.062	7	12	12
Very Fine Sand	0.062-0.125	0	0	12
Fine Sand	0.125-0.25	0	0	12
Medium Sand	0.25-0.5	1	2	13
Coarse Sand	0.5-1.0	0	0	13
Very Coarse Sand	1.0-2.0	3	5	18
Very Fine Gravel	2.0-4.0	1	2	20
Fine Gravel	4.0-5.7	1	2	22
Fine Gravel	5.7-8.0	3	5	27
Medium Gravel	8.0-11.3	4	7	33
Medium Gravel	11.3-16.0	3	5	38
Coarse Gravel	16.0-22.6	4	7	45
Coarse Gravel	22.6-32	8	13	58
Very Coarse Gravel	32-45	11	18	77
Very Coarse Gravel	45-64	8	13	90
Small Cobble	64-90	6	10	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	

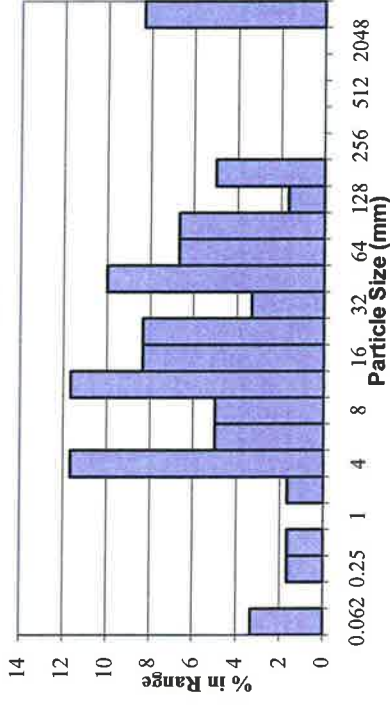
Davis Branch Restoration EEP Project No. D06054-F			
Reach	Mainstem	X Sec	4
Date	11/5/2009	Sta No.	21+85.85



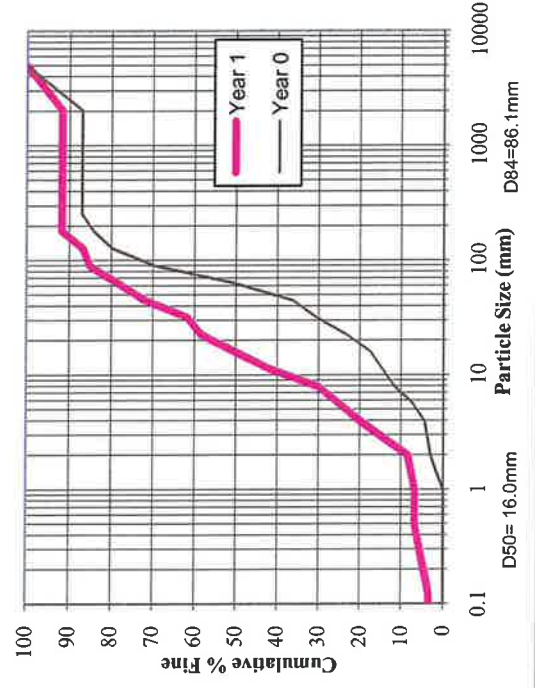
Davis Branch Restoration EEP Project No. D06054-F			
Reach	Mainstem	X Sec	5
Date	11/5/2009	Sta No.	29+36.09

Pebble Count - Pool				
Material	Particle Size (mm)	Count	% in Range	% Cumulative
Silt/Clay	<0.062	2	3	3
Very Fine Sand	0.062-0.125	0	0	3
Fine Sand	0.125-0.25	1	2	5
Medium Sand	0.25-0.5	1	2	7
Coarse Sand	0.5-1.0	0	0	7
Very Coarse Sand	1.0-2.0	1	2	8
Very Fine Gravel	2.0-4.0	7	12	20
Fine Gravel	4.0-5.7	3	5	25
Fine Gravel	5.7-8.0	3	5	30
Medium Gravel	8.0-11.3	7	12	42
Medium Gravel	11.3-16.0	5	8	50
Coarse Gravel	16.0-22.6	5	8	58
Coarse Gravel	22.6-32	2	3	62
Very Coarse Gravel	32-45	6	10	72
Very Coarse Gravel	45-64	4	7	78
Small Cobble	64-90	4	7	85
Small Cobble	90-128	1	2	87
Large Cobble	128-180	3	5	92
Large Cobble	180-256	0	0	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		60	100	100

Histogram

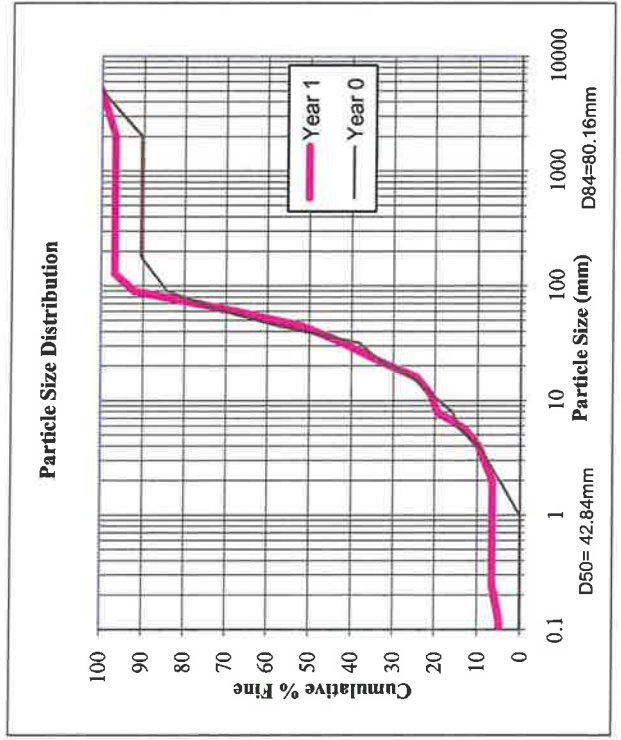
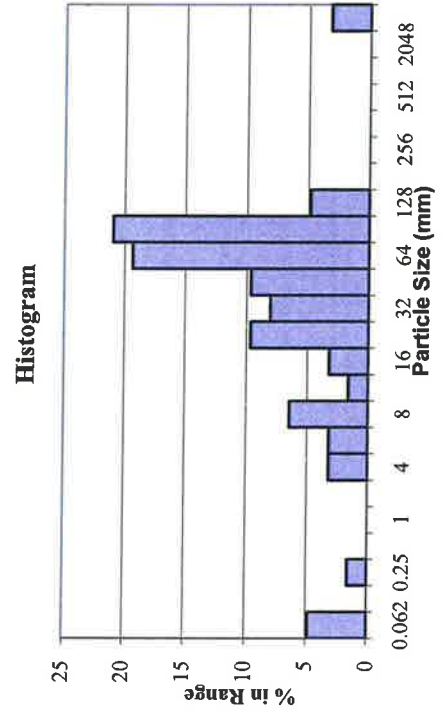


Particle Size Distribution



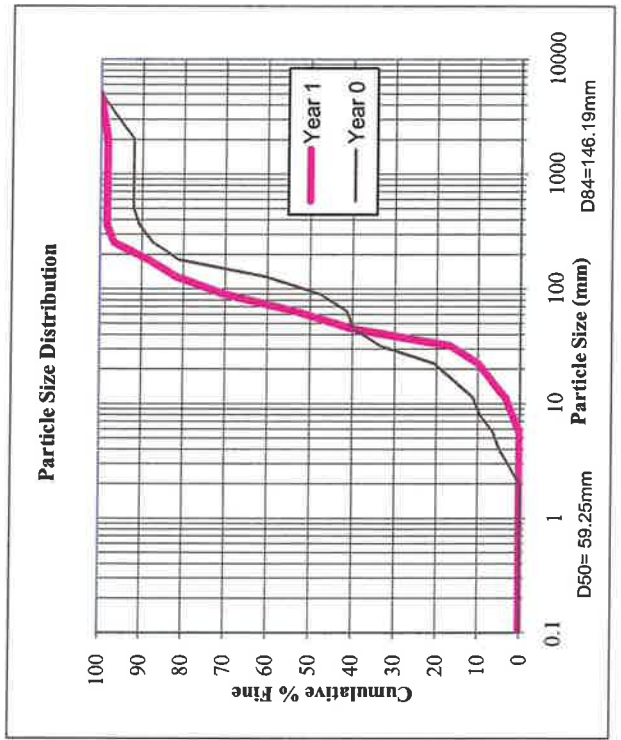
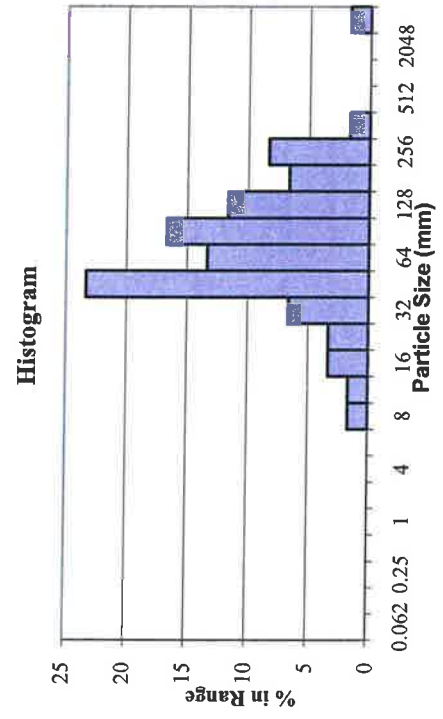
Pebble Count - Riffle				
Material	Particle Size (mm)	Count	% in Range	% Cumulative
Silt/Clay	<0.062	3	5	5
Very Fine Sand	0.062-0.125	0	0	5
Fine Sand	0.125-0.25	1	2	6
Medium Sand	0.25-0.5	0	0	6
Coarse Sand	0.5-1.0	0	0	6
Very Coarse Sand	1.0-2.0	0	0	6
Very Fine Gravel	2.0-4.0	2	3	10
Fine Gravel	4.0-5.7	2	3	13
Fine Gravel	5.7-8.0	4	6	19
Medium Gravel	8.0-11.3	1	2	21
Medium Gravel	11.3-16.0	2	3	24
Coarse Gravel	16.0-22.6	6	10	34
Coarse Gravel	22.6-32	5	8	42
Very Coarse Gravel	32-45	6	10	52
Very Coarse Gravel	45-64	12	19	71
Small Cobble	64-90	13	21	92
Small Cobble	90-128	3	5	97
Large Cobble	128-180	0	0	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		62	100	

Davis Branch Restoration EEP Project No. D06054-F			
Reach	Mainstem	X Sec	
Date	11/5/2009	Sta No.	35+09.15



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	0	0	0
Medium Sand	0.25-0.5	0	0	0
Coarse Sand	0.5-1.0	0	0	0
Very Coarse Sand	1.0-2.0	0	0	0
Very Fine Gravel	2.0-4.0	0	0	0
Fine Gravel	4.0-5.7	0	0	0
Fine Gravel	5.7-8.0	1	2	2
Medium Gravel	8.0-11.3	1	2	3
Medium Gravel	11.3-16.0	2	3	7
Coarse Gravel	16.0-22.6	2	3	10
Coarse Gravel	22.6-32	4	7	17
Very Coarse Gravel	32-45	14	23	40
Very Coarse Gravel	45-64	8	13	53
Small Cobble	64-90	10	17	70
Small Cobble	90-128	7	12	82
Large Cobble	128-180	4	7	88
Large Cobble	180-256	5	8	97
Small Boulder	256-362	1	2	98
Small Boulder	362-512	0	0	98
Medium Boulder	512-1024	0	0	98
Large Boulder	1024-2048	0	0	98
Bedrock	<2048	1	2	100
Totals		60	100	

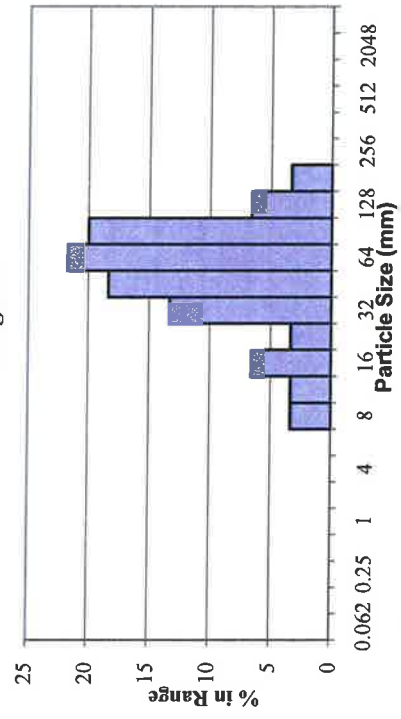
Davis Branch Restoration EEP Project No. D06054-F			
Reach	Mainstem	X Sec	7
Date	11/5/2009	Sta No.	35+33.67





<b>Davis Branch Restoration EEP Project No. D06054-F</b>			
<b>Reach</b>	UT1	<b>X Sec</b>	8
<b>Date</b>	11/5/2009	<b>Sta No.</b>	2+00.10

**Histogram**







**BF 1**  
**Crest Gage on the mainstem of Davis Branch.**  
(EMH&T, Inc. 9/20/09)



**BF 2**  
**Crest Gage 4 on UT1 of Davis Branch.**  
(EMH&T, Inc. 9/20/09)