

# Year 1 Monitoring Report

## Trout Cove Stream Restoration



**January 2007**  
**EEP Project No. 388**

Prepared for



NCEEP, 1652 Mail Service Center, Raleigh, NC 27699-1652

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## **I. Executive Summary / Project Abstract**

This report summarizes the monitoring efforts for Year 1 (2006) of the Trout Cove Stream Restoration in Clay County, NC.

Monitoring of the vegetated buffer was performed during the growing season of 2006, by Soil & Environmental Consultants, PA. Stem counts were performed within the established vegetation monitoring plots, resulting in a live stem density of approximately 632 stems per acre.

The physical stream channel was surveyed, and a visual stability assessment was performed for the Trout Cove Branch Stream Restoration project. While there are several problem areas along the restored channel, the overall channel is deemed stable and successful. In 2007, Year 2 Monitoring will commence.

## II. Project Background

The background information for this report is referenced from previous monitoring reports submitted to the North Carolina Ecosystem Enhancement Program (NCEEP) by the Biological and Agricultural Engineering Department at North Carolina State University.

### A. Location and Setting

The Trout Cove Stream Restoration Project is an approximately 6.32 acre project in southwestern Clay County, NC. The site is located south of US 64 and east of old US 64 approximately 2 miles north of the Georgia state line. The site is located along Trout Cove Road just north of the community of Ogden, NC. This area is shown in detail in the attached vicinity map (Figure 1).

### B. Structure and Objectives

The restoration site consists of approximately 1,876 linear feet of stream restoration and approximately 6.32 acres of riparian buffer restoration. Explicit project objectives and restoration quantities were not included in the materials provided. Restoration units are estimates based on site data collected. The structure and objectives are detailed in Tables I and II.

| <b>Table I: Project Structure Table<br/>Trout Cove Stream Restoration Site (EEP Project # 388)</b> |                               |
|--|-------------------------------|
| <b>Segment/Reach ID</b>  | <b>Linear Feet or Acreage</b> |
| Reach 1  | 1,876 linear feet             |
| Buffer Restoration   | 6.32 ac                       |

| <b>Table II: Project Objectives Table<br/>Trout Cove Stream Restoration Site (EEP Project # 388)</b> |                   |                               |                |
|--|-------------------|-------------------------------|----------------|
| <b>Segment/Reach ID</b>  | <b>Objectives</b> | <b>Linear Feet or Acreage</b> | <b>Comment</b> |
| Reach 1  | Restoration       | 1,876 linear feet             |                |
| Buffer   | Restoration       | 6.32 Acres                    |                |

### C. Project History and Background

We have assumed that 2006 serves as Monitoring Year 1 of 5. Additional details, to include the project designer, original design parameters, and the history of the project, have not been provided. Details regarding the timeline of the project are included as Table III.



| <b>Table III: Project Activity and Reporting History<br/>Trout Cove Stream Restoration Site (EEP Project #388)</b> |  |                               |
|--|--|-------------------------------|
| <b>Activity or Report</b>  | <b>Calendar Year of<br/>Completion or<br/>Planned<br/>Completion</b> | <b>Actual Completion Date</b> |
| Restoration Plan   | Unknown  | Unknown                       |
| Site Planted   | Unknown  | Unknown                       |
| Initial-Year 1 monitoring  | 2006   | Dec-06                        |
| Year 1 Vegetation Monitoring   | 2006   | Aug-06                        |
| Year 2 Monitoring  | 2007   |                               |
| Year 3 Monitoring  | 2008   |                               |
| Year 4 Monitoring  | 2009   |                               |
| Year 5 Monitoring  | 2010   |                               |

Based on data provided by NCEEP, it is unknown at this time who designed and constructed the Trout Cove project. Monitoring activities for Year 1 were performed by S&EC. Additional information regarding contractors is shown in Table IV.

| <b>Table IV: Project Contact Table<br/>Trout Cove Stream Restoration Site (EEP Project #388)</b> |   |
|--|---|
| <b>Designer</b>  | Unknown   |
| <b>Monitoring Performers</b>   | Soil & Environmental Consultants, PA<br>11010 Raven Ridge Road<br>Raleigh, NC 26714 |
| Stream Monitoring POC  | Jessica Regan, S&EC   |
| Vegetation Monitoring POC  |   |
| Wetland Monitoring POC   |   |

The project is located within Clay County, which is located within the Blue Ridge Belt of the Mountains of North Carolina. The site is located within a rural area. Additional information regarding the stream is included as Table V.

| <b>Table V: Project Background Table<br/>Trout Cove Stream Restoration Site (EEP Project #388)</b> |               |
|--|---------------|
| Project County   | Clay          |
| Drainage Area  | 0.453 sq. mi. |
| Drainage impervious cover estimate (%)   | 5%            |
| Stream Order   | 2nd           |
| Physiographic Region   | Mountain      |
| Ecoregion  | Blue Ridge    |
| Rosgen Classification of As-Built  | *             |
| Dominant Soil Types  | RhA LoC, FrA  |
| USGS HUC for Project and Reference   | 06020002      |
| NCDWQ Sub-basin for Project and Reference  | 04-05-01      |
| NCDWQ classification for Project and Reference   | WS-IV         |
| Any portion of any project segment 303d listed?  | No            |
| Any portion of any project segment upstream of a 303d listed segment?                              | No            |
| Reasons for 303d listing or stressor   | No            |
| % of project easement fenced   | 100%          |

\*Unknown – As-built data not provided

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

Original site survey data has been obtained by S&EC which includes the location of a series of monitoring devices that were previously established onsite. The survey shows five (5) cross-sections installed on site. During our initial site visit on January 12, 2006, all cross-sections were located. Cross-sections are marked with red flagging on wood stakes next to a section of rebar on either side of the stream (pins were not located on both sides of the stream for all cross-sections). Cross-section endpoints were marked by S&EC using a GPS.

Using provided survey data from 2005, we were able to located five (5) previously established vegetation monitoring plots. A single corner of each of these plots was marked with iron pipe with a plastic yellow cap but four permanent corners had not been set. During our August 21, 2006 site visit S&EC established permanent corners with 1.5" PVC. The permanent corners were picked up with the survey data collected in November 2006.

Each cross-section and vegetation monitoring plot is also a designated photo point that will be photographed annually.

The locations of all monitoring devices are shown on Sheets 1 through 3 (Monitoring Plan View).

### III. Project Condition and Monitoring Results

#### A. Vegetation Assessment

The Trout Cove stream restoration site vegetation is dense and healthy throughout the site with a variety of herbaceous and woody species. The site contains a lush herbaceous layer particularly in the wetland areas and pond edges. Herbaceous species observed included large amounts of goldenrod (*Solidago* sp.) as well as boneset (*Eupatorium perfoliatum*), soft rush (*Juncus effusus*), sedges (*Carex* sp.), ironweed (*Vernonia noveboracensis*), great blue lobelia (*Lobelia siphilitica*), cutgrass (*Leersia oryzoides*) and jewelweed (*Impatiens capensis*).

Larger trees (5-20' tall) were also observed throughout the buffer mostly consisting of black willow (*Salix nigra*), river birch (*Betula nigra*) and sycamore (*Platanus occidentalis*). Saplings and smaller individuals of oak, pine, maple, tulip poplar and sweetgum were observed. Shrubs observed in the buffer included pepperbush (*Clethra acuminata*), silky dogwood (*Cornus amomum*), tag alder (*Alnus serrulata*), buttonbush (*Cephalanthus occidentalis*) and possumhaw (*Viburnum nudum*).

The buffer area also contains a large amount of blackberry (*Rubus* sp.) which is extremely dense in some areas. The stream bank vegetation was extremely dense and primarily made up of tag alder (*Alnus serrulata*) and silky dogwood (*Cornus amomum*).

Exotic, invasive plant species do not appear to be a problem on the Trout Cove restoration site. Japanese honeysuckle (*Lonicera japonica*) was observed but it was not dense or widespread.

Five (5) vegetation monitoring plots were established onsite as previously described. Three (3) plots are standard 10m x 10m plots and two (2) are non-standard 5m x 20m plots. The plots established this year by S&EC were based on iron pins set in previous monitoring years however only a single corner was located for each plot and plots were set from that point. The iron pin found was used as the downstream corner closest to the stream as most were close to the stream bank. This corner was also used as the photo point for the plot.

The success criteria for the site require a minimum of 320 live stems per acre for the first three (3) years of monitoring. At the end of Year 4, a density of 290 stems per acre is required. At the end of the 5-year monitoring period, a live stem density of 260 stems per acre must be achieved.

## 1. Soil Data

| Table VI: Preliminary Soil Data<br>Trout Cove Stream Restoration Site (EEP Project # 388) |                 |                   |      |   |      |
|---|-----------------|-------------------|------|---|------|
| Series  | Max Depth (in.) | % Clay on Surface | K    | T | OM % |
| Reddies Loam, 0-3% slopes (RhA)   | 80              | 5-18              | 0.20 | 4 | 3-8  |
| Lonon Loam, 8-15% slopes (LoC)  | 80              | 7-20              | 0.24 | 5 | 0-2  |
| French fine sandy loam, 0-3% slopes (FrA)   | 45              | 5-20              | 0.24 | 4 | 0-4  |

## 2. Problem Areas Plan View (vegetation)

Vegetation problem areas were not observed during visual inspection of the restoration site.

## 3. Stem Counts

On August 21, 2006, S&EC conducted vegetation counts within each plot. The results of this survey are shown below in Table VIII.

The following tree and shrub species were observed within the vegetation monitoring plots in previous monitoring years according to stem count data obtained by S&EC: *Acer Rubrum* (Red Maple), *Alnus serrulata* (Tag Alder), *Betula nigra* (River Birch), *Cephalanthus occidentalis* (Buttonbush), *Cornus amomum* (Silky Dogwood), *Liquidambar styraciflua* (Sweetgum), *Platanus occidentalis* (Sycamore), *Salix nigra* (Black Willow) and *Viburnum nudum* (Possumhaw).

| Table VIII: Stem Counts for Each Species Arranged by Plot<br>Trout Cove Stream Restoration Site (EEP Project # 388) |       |   |   |   |    |               |
|---|-------|---|---|---|----|---------------|
| Species   | Plots |   |   |   |    | Year 1 Totals |
|   | 1     | 2 | 3 | 4 | 5  |               |
| <i>Acer rubrum</i><br>(Red Maple)   |       | 1 |   | 1 | 1  | 3             |
| <i>Alnus serrulata*</i><br>(Tag Alder)  | 5     | 4 | 3 | 8 | 13 | 33            |
| <i>Betula nigra</i><br>(River Birch)  |       |   |   |   | 1  | 1             |
| <i>Cephalanthus occidentalis</i><br>(Buttonbush)  |       |   |   |   | 2  | 2             |

|  |          |           |          |           |           |            |
|--|----------|-----------|----------|-----------|-----------|------------|
| <i>Cornus amomum</i> *<br>(Silky Dogwood)    | 1        | 6         | 1        | 10        | 10        | 28         |
| <i>Liquidambar styraciflua</i><br>(Sweetgum) |          |           |          |           |           | 0          |
| <i>Platanus occidentalis</i><br>(Sycamore)   |          | 1         |          |           |           | 1          |
| <i>Salix nigra</i> *<br>(Black Willow)       |          | 6         |          | 3         | 1         | 10         |
| <i>Viburnum nudum</i><br>(Possumhaw)         |          |           |          |           |           | 0          |
| <b>Year 1 Totals</b>                         | <b>6</b> | <b>18</b> | <b>4</b> | <b>22</b> | <b>28</b> | <b>78</b>  |
| Previous Plot Totals                         | 5        | 4         | 5        | 22        | 14        | 50         |
| Live Stem Density                            | 243      | 728       | 162      | 891       | 1134      |            |
| <b>Average Live Stem Density</b>             |          |           |          |           |           | <b>632</b> |

\* Numerous volunteers observed – not included in the stem counts shown

The average number of stems per sample plot is 16 stems. The 2006 vegetation monitoring of the site revealed an average tree density of 632 stems per acre.

As shown in Table VIII, several plots have shown a stem density of less than 320 stems per acre. However, while not quantified in the above table, each plot has shown a large number of volunteers in addition to the original planted stems including additional species such as red oak and pepperbush. If these new plants are taken into consideration, stem densities would be much higher than 320 stems per acre.

#### 4. Vegetation Plot Photos

Photos taken during the August 21, 2006 Vegetation Sampling event are included as Appendix A.

### B. Stream Assessment

#### 1. Problem Areas Plan View (Stream)

An assessment of channel stability was performed on November 15 and 16, 2006, by S&EC. Areas of concern that were observed and documented included localized bank scour, and stressed or failing structures. These problem areas are shown on Sheets 4 and 5 (Problem Area Plan View) and described in Table IX.

## 2. Problem Areas Table Summary

| <b>Table IX: Stream Problem Areas<br/>Trout Cove Stream Restoration Site (EEP Project # 388)</b> |                    |                            |                     |
|--|--------------------|----------------------------|---------------------|
| <b>Feature Issues</b>  | <b>Number</b>      | <b>Suspected Cause</b>     | <b>Photo number</b> |
| Structure<br>(Rock Shift)  | 1 (0+25 – 0+38)    | Erosion/Undercutting       | 1-3                 |
|  | 2 (1+40 – 1+55)    | Erosion/Undercutting       |                     |
|  | 3 (2+87 – 3+00)    | Erosion/Undercutting       |                     |
|  | 4 (4+60 – 4+70)    | Erosion/Undercutting       |                     |
|  | 5 (40+45 – 40+55)  | Erosion/Undercutting       |                     |
|  | 6 (40+80 – 40+90)  | Erosion/Undercutting       |                     |
|  | 7 (40+92 – 41+05)  | Erosion/Undercutting       |                     |
|  | 8 (41+15 – 41+25)  | Erosion/Undercutting       |                     |
| Structure<br>(Rock Piping)   | 1 (0+25 – 0+38)    | Erosion                    | 4                   |
| Bank Scour   | 1 (2+50 – 2+60)    | Erosion/Undercutting Banks | 5-6                 |
|  | 2 (4+10 – 4+18)    | Erosion/Undercutting Banks |                     |
|  | 3 (6+20 – 6+27)    | Erosion/Undercutting Banks |                     |
|  | 4 (8+52 – 8+59)    | Erosion/Undercutting Banks |                     |
|  | 5 (33+15 – 33+23)  | Erosion/Undercutting Banks |                     |
|  | 6 (33+70 – 33+77)  | Erosion/Undercutting Banks |                     |
|  | 7 (34+81 – 35+01)  | Erosion/Undercutting Banks |                     |
|  | 8 (35+20 – 35+52)  | Erosion/Undercutting Banks |                     |
|  | 9 (37+43 – 37+51)  | Erosion/Undercutting Banks |                     |
|  | 10 (38+49 – 38+56) | Erosion/Undercutting Banks |                     |
|  | 11 (39+49 – 39+55) | Erosion/Undercutting Banks |                     |

### 3. Numbered Issues Photo Section

Representative photos of each category of stream problem area were taken and are shown in Appendix B.

### 4. Fixed Photo Station Photos

Photos from established photo stations (at each cross-section) were collected during the stream survey (November 2006). These photos are included in Appendix B. No photos from previous monitoring activities or as-builts were provided for comparison.

## 5. Stability assessment

A visual qualitative assessment was performed to inspect channel facets, meanders, bed, banks, and installed structures. This visual assessment was confirmed and enhanced with a quantitative assessment of the physical stream survey. The goal of this assessment is to provide a percentage of the features listed in Table X that are in a state of stability. Table X was compiled from the data in Table B1 in Appendix B of this report.

| <b>Table X: Categorical Stream Feature Visual Stability Assessment<br/>Trout Cove Stream Restoration Site (EEP # 388)</b> |                      |  |  |  |
|---|----------------------|--|--|--|
| <b>Feature</b>  | <b>MY-1<br/>2006</b> |  |  |  |
| A. Riffles  | 100%                 |  |  |  |
| B. Pools  | 100%                 |  |  |  |
| C. Thalweg  | 100%                 |  |  |  |
| D. Meanders   | 100%                 |  |  |  |
| E. Bed General  | 95%                  |  |  |  |
| F. Channel General  | N/A                  |  |  |  |
| G. Banks  | 85%                  |  |  |  |
| H. Vanes/ J Hooks, etc.   | 85%                  |  |  |  |
| I. Wads and Boulders  | N/A                  |  |  |  |

## 6. Quantitative Morphology

The following tables (Table XI and Table XII) summarize the quantitative data collected from the cross-sectional and longitudinal stream survey. This data was analyzed and summarized, and then compared with baseline data types available for this project. The Quantitative Morphology Tables illustrate the degree of departure, if any, of the current channel from the baseline data.

2005 stream survey data received from NCEEP, was provided by NCSU. Both reaches of the 2005 data were surveyed based on two different setups using assumed coordinates, both vertically and horizontally. S&EC had to adjust elevations to compare the cross-sections, and cannot confirm whether these were taken at the same exact stream location since they cannot be positively tied in to the plan view.

S&EC also had to use assumed northings, eastings, and elevations since control points have still not been provided by the surveyor of the conservation easement. The entire 2006 survey was surveyed using one assumed benchmark and all of the 2006 data can be adjusted to match State Plane and Mean Sea Level once this control data is received. S&EC plans to continue to request this data, and hopes to receive it prior to the 2007 survey.

Because of the uncertainty in the available data, at this time S&EC cannot comment on differences in cross-section, but can only provide the observation that the cross-sections appeared stable, and not as though they had experienced recent volatility.

Based on a review of available site data and observations made during 2006 site visits, no crest gauge has been installed on the site. A review of available on-line USGS gauge sites was performed to determine if a suitable surrogate gauge was present in the area. No nearby gauge was identified. The closest USGS gauge to the site was on Brasstown Creek (near Brasstown, NC, Gauge Identification Number 03548330) which is approximately 3.3 miles from the project site. Based on this large distance, significant disparity in watershed sizes, and topographic variation, it is unlikely that a conclusive determination regarding the number of bankfull events experienced on the restoration site could be made.

Based on observed site conditions, to include wrack lines, staining of vegetation, displaced/flattened vegetation, and observable sediment deposition, it is apparent that multiple overbank events have occurred.



**Table XI. Baseline Morphology and Hydraulic Summary  
TROUT COVE STREAM RESTORATION SITE (EEP Project #388)**

| Parameter                                  | Pre-Existing Condition |     |      | Project Reference Stream |     |      | Design |     |      | As-built |     |      |
|--|------------------------|-----|------|--------------------------|-----|------|--------|-----|------|----------|-----|------|
|  | Min                    | Max | Avg. | Min                      | Max | Avg. | Min    | Max | Avg. | Min      | Max | Avg. |
| <b>Dimension</b>                           |                        |     |      |                          |     |      |        |     |      |          |     |      |
| BF Width (ft)                              | *                      | *   | *    | *                        | *   | *    | *      | *   | *    | *        | *   | *    |
| Floodprone Width (ft)                      | *                      | *   | *    | *                        | *   | *    | *      | *   | *    | *        | *   | *    |
| BF Cross Sectional Area (ft <sup>2</sup> ) | *                      | *   | *    | *                        | *   | *    | *      | *   | *    | *        | *   | *    |
| BF Mean Depth (ft)                         | *                      | *   | *    | *                        | *   | *    | *      | *   | *    | *        | *   | *    |
| BF Max Depth (ft)                          | *                      | *   | *    | *                        | *   | *    | *      | *   | *    | *        | *   | *    |
| Width/Depth Ratio                          | *                      | *   | *    | *                        | *   | *    | *      | *   | *    | *        | *   | *    |
| Entrenchment Ratio                         | *                      | *   | *    | *                        | *   | *    | *      | *   | *    | *        | *   | *    |
| Bank Height Ratio                          | *                      | *   | *    | *                        | *   | *    | *      | *   | *    | *        | *   | *    |
| Wetted Perimeter (ft)                      | *                      | *   | *    | *                        | *   | *    | *      | *   | *    | *        | *   | *    |
| Hydraulic radius (ft)                      | *                      | *   | *    | *                        | *   | *    | *      | *   | *    | *        | *   | *    |
| <b>Pattern</b>                             |                        |     |      |                          |     |      |        |     |      |          |     |      |
| Channel Beltwidth (ft)                     | *                      | *   | *    | *                        | *   | *    | *      | *   | *    | *        | *   | *    |
| Radius of Curvature (ft)                   | *                      | *   | *    | *                        | *   | *    | *      | *   | *    | *        | *   | *    |
| Meander Wavelength (ft)                    | *                      | *   | *    | *                        | *   | *    | *      | *   | *    | *        | *   | *    |
| Meander Width ratio                        | *                      | *   | *    | *                        | *   | *    | *      | *   | *    | *        | *   | *    |
| <b>Profile</b>                             |                        |     |      |                          |     |      |        |     |      |          |     |      |
| Riffle length (ft)                         | *                      | *   | *    | *                        | *   | *    | *      | *   | *    | *        | *   | *    |
| Riffle slope (ft/ft)                       | *                      | *   | *    | *                        | *   | *    | *      | *   | *    | *        | *   | *    |
| Pool length (ft)                           | *                      | *   | *    | *                        | *   | *    | *      | *   | *    | *        | *   | *    |
| Pool spacing (ft)                          | *                      | *   | *    | *                        | *   | *    | *      | *   | *    | *        | *   | *    |
| <b>Substrate</b>                           |                        |     |      |                          |     |      |        |     |      |          |     |      |
| d50 (mm)                                   | *                      | *   | *    | *                        | *   | *    | *      | *   | *    | *        | *   | *    |
| d84 (mm)                                   | *                      | *   | *    | *                        | *   | *    | *      | *   | *    | *        | *   | *    |
| <b>Additional Reach Parameters</b>         |                        |     |      |                          |     |      |        |     |      |          |     |      |
| Valley Length (ft)                         |                        | *   |      |                          | *   |      |        | *   |      |          | *   |      |
| Channel Length (ft)                        |                        | *   |      |                          | *   |      |        | *   |      |          | *   |      |
| Sinuosity                                  |                        | *   |      |                          | *   |      |        | *   |      |          | *   |      |
| Water Surface Slope (ft/ft)                |                        | *   |      |                          | *   |      |        | *   |      |          | *   |      |
| BF slope (ft/ft)                           |                        | *   |      |                          | *   |      |        | *   |      |          | *   |      |
| Rosgen Classification                      |                        | *   |      |                          | *   |      |        | *   |      |          | *   |      |
| *Habitat Index                             |                        | *   |      |                          | *   |      |        | *   |      |          | *   |      |
| *Macrobenthos                              |                        | *   |      |                          | *   |      |        | *   |      |          | *   |      |

\* Items denoted with an asterisk have not been provided due to: lack of data provided for previous monitoring years, incorrect data provided for previous monitoring years, or these are items outside the scope of this year's monitoring effort.

**Exhibit Table XII. Morphology and Hydraulic Monitoring Summary  
TROUT COVE STREAM RESTORATION SITE (EEP Project #388)**

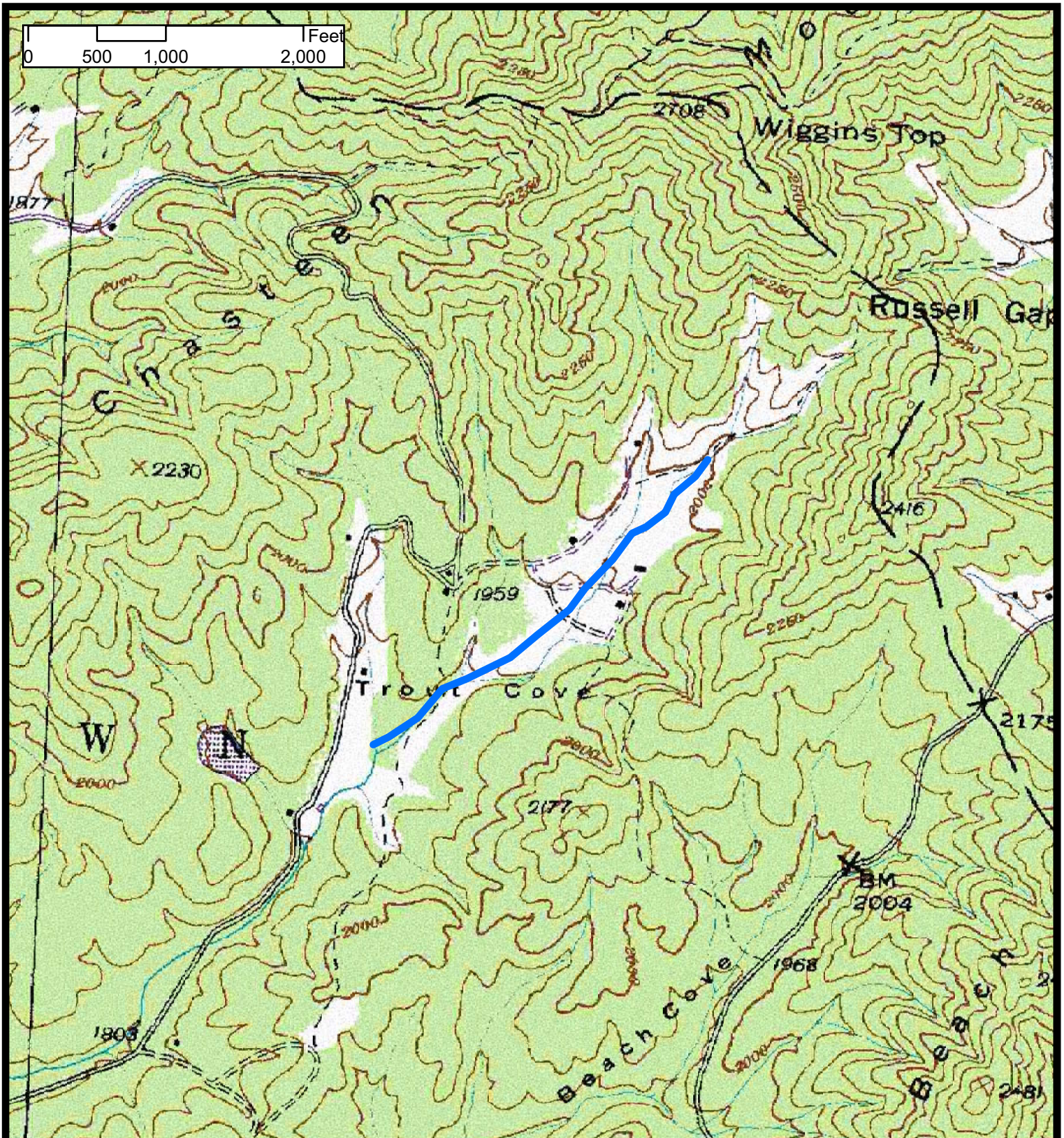
| Parameter                                  | LOWER REACH  |       |      |                |       |      | UPPER REACH  |       |      |                |       |      |              |       |      |
|--|--------------|-------|------|----------------|-------|------|--------------|-------|------|----------------|-------|------|--------------|-------|------|
|  | XS1 - POOL 1 |       |      | XS2 - RIFFLE 2 |       |      | XS3 - POOL 2 |       |      | XS4 - RIFFLE 2 |       |      | XS5 - POOL 3 |       |      |
|  | AS BUILT     | MY1   | MY2  | AS BUILT       | MY1   | MY2  | AS BUILT     | MY1   | MY2  | AS BUILT       | MY1   | MY2  | AS BUILT     | MY1   | MY2  |
|  | 2005         | 2006  | 2007 | 2005           | 2006  | 2007 | 2005         | 2006  | 2007 | 2005           | 2006  | 2007 | 2005         | 2006  | 2007 |
| BF Width (ft)                              | *            | 15.69 |      | *              |       |      | *            | 18.63 |      | *              | 22.33 |      | *            | 12.47 |      |
| Floodprone Width (ft)                      | *            | 54.22 |      | *              | 9.6   |      | *            | 50    |      | *              | 50    |      | *            | 50    |      |
| BF Cross Sectional Area (ft <sup>2</sup> ) | *            | 11.21 |      | *              | 10.02 |      | *            | 10.1  |      | *              | 10.3  |      | *            | 10.07 |      |
| BF Mean Depth (ft)                         | *            | 0.71  |      | *              | 1.04  |      | *            | 0.54  |      | *              | 0.46  |      | *            | 0.81  |      |
| BF Max Depth (ft)                          | *            | 2.35  |      | *              | 2.3   |      | *            | 1.48  |      | *              | 1.22  |      | *            | 1.81  |      |
| Width/Depth Ratio                          | *            | 22.1  |      | *              | 9.23  |      | *            | 34.5  |      | *              | 48.54 |      | *            | 15.4  |      |
| Entrenchment Ratio                         | *            | 3.46  |      | *              | 5.21  |      | *            | 2.68  |      | *              | 2.24  |      | *            | 4.01  |      |
| Bank Height Ratio                          | *            | 1.04  |      | *              | 1.20  |      | *            | 1.54  |      | *              | 1.06  |      | *            | 1.49  |      |
| Wetted Perimeter (ft)                      | *            | 16.93 |      | *              | 10.88 |      | *            | 19.35 |      | *              | 22.73 |      | *            | 13.57 |      |
| Hydraulic radius (ft)                      | *            | 0.66  |      | *              | 0.92  |      | *            | 0.52  |      | *              | 0.45  |      | *            | 0.74  |      |
| <b>Substrate</b>                           |              |       |      |                |       |      |              |       |      |                |       |      |              |       |      |
| d50 (mm)                                   | *            | *     |      | *              | *     |      | *            | *     |      | *              | *     |      | *            | *     |      |
| d84 (mm)                                   | *            | *     |      | *              | *     |      | *            | *     |      | *              | *     |      | *            | *     |      |

| Parameter                          | As-built (2005) |     |     | MY-1 (2006) |         |         | MY-2 (2007) |     |     |
|------------------------------------|-----------------|-----|-----|-------------|---------|---------|-------------|-----|-----|
|                                    | Min             | Max | Med | Min         | Max     | Med     | Min         | Max | Med |
| <b>Pattern</b>                     |                 |     |     |             |         |         |             |     |     |
| Channel Beltwidth (ft)             | *               | *   | *   | 24.28       | 84.5    | 45.88   |             |     |     |
| Radius of Curvature (ft)           | *               | *   | *   | 19.03       | 38.59   | 28.26   |             |     |     |
| Meander Wavelength (ft)            | *               | *   | *   | 87.75       | 135.06  | 103.88  |             |     |     |
| Meander Width ratio                | *               | *   | *   | 3.92969     | 6.04837 | 4.65204 |             |     |     |
| <b>Profile</b>                     |                 |     |     |             |         |         |             |     |     |
| Riffle length (ft)                 | *               | *   | *   | *           | *       | *       |             |     |     |
| Riffle slope (ft/ft)               | *               | *   | *   | 0.08714     | 0.07284 | 0.04092 |             |     |     |
| Pool length (ft)                   | *               | *   | *   | 4.34        | 30.09   | 14.39   |             |     |     |
| Pool spacing (ft)                  | *               | *   | *   | 11.29       | 105.54  | 52.21   |             |     |     |
| <b>Additional Reach Parameters</b> |                 |     |     |             |         |         |             |     |     |
| Valley Length (ft)                 | *               |     |     |             | 1746    |         |             |     |     |
| Channel Length (ft)                | *               |     |     |             | 1876    |         |             |     |     |
| Sinuosity                          | *               |     |     |             | 1.07    |         |             |     |     |
| Water Surface Slope (ft/ft)        | *               |     |     |             | 0.04092 |         |             |     |     |
| BF slope (ft/ft)                   | *               |     |     |             | 0.04092 |         |             |     |     |
| Rosgen Classification              | *               |     |     |             | C4b     |         |             |     |     |
| Habitat Index*                     | *               |     |     |             | *       |         |             |     |     |
| Macrobenthos*                      | *               |     |     |             | *       |         |             |     |     |

#### **IV. Methodology Section**

No unavoidable deviations from initially prescribed methodologies were implemented as a part of monitoring Year 1 (2006) activities.





Project Number:  
10079.D1

Project Manager:  
JER

Scale:  
1" = 1000'

Date:  
JANUARY 2007

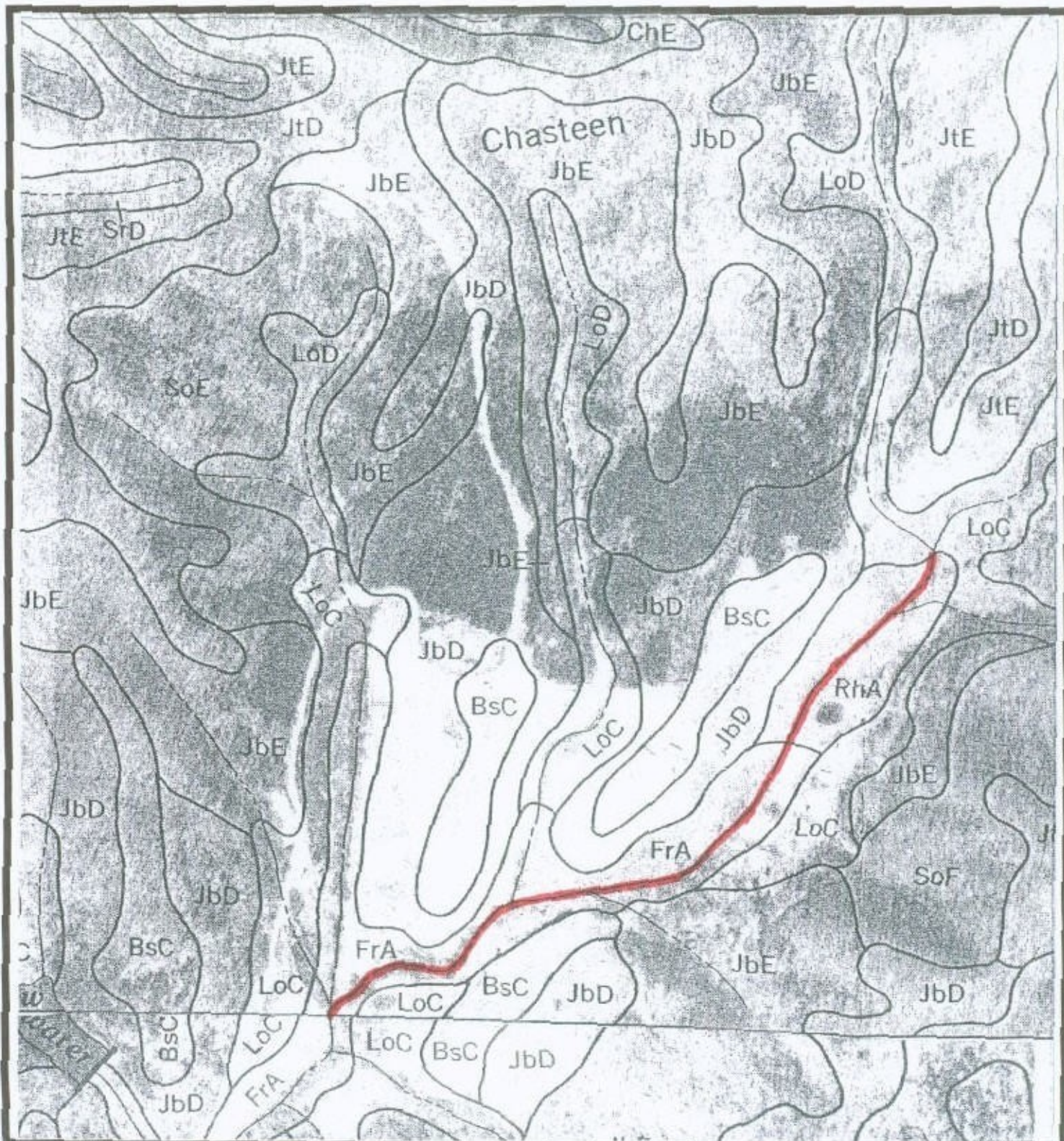
Map Title:  
Figure 1 - USGS Map  
Trout Cove  
Stream Restoration  
Clay County, NC

Source:  
Peachtree Quadrangle

**S&EC**

Soil & Environmental Consultants, PA  
11010 Raven Ridge Rd. • Raleigh, NC 27614  
(919) 846-5900 • (919) 846-9467  
Web Page: [www.SandEC.com](http://www.SandEC.com)





|                                    |   |  |
|------------------------------------|---|--|
| Project Number:<br><b>10079.D1</b> | Map Title:<br><b>Figure 2 - Soil Map</b>            |  <b>Soil &amp; Environmental Consultants, PA</b><br>11010 Raven Ridge Rd. • Raleigh, NC 27614<br>(919) 846-5800 • (919) 846-9467<br>Web Page: www.SandEC.com |
| Project Manager:<br><b>JER</b>     | Trout Cove<br>Stream Restoration<br>Clay County, NC |  |
| Scale:<br><b>1" = 250'</b>         | Source:<br>Soil Survey of Clay County, NC           |  |
| Date:<br><b>JANUARY 2007</b>       |   |  |






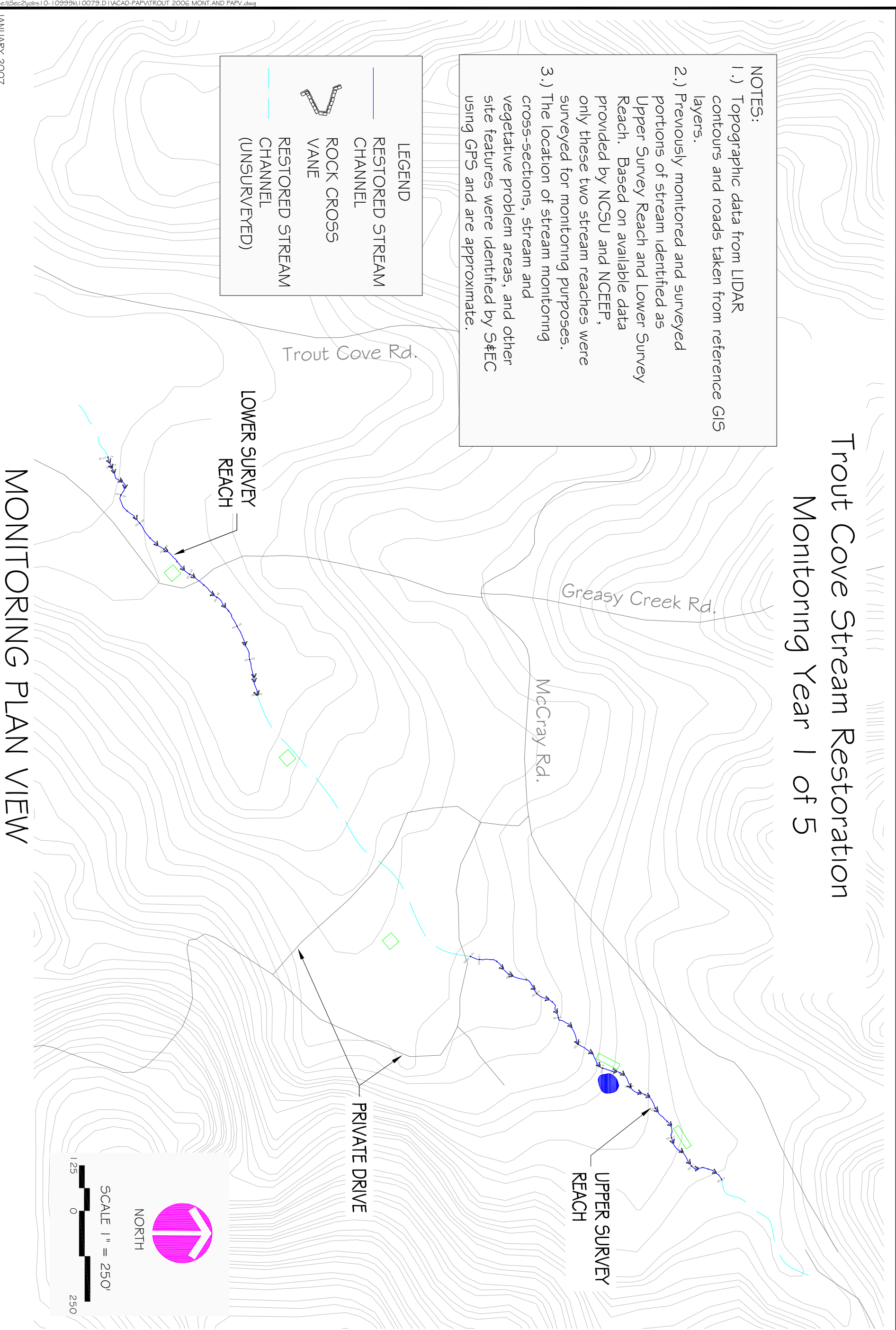
# Trout Cove Stream Restoration Monitoring Year 1 of 5

**NOTES:**

- 1.) Topographic data from LIDAR contours and roads taken from reference GIS layers.
- 2.) Previously monitored and surveyed portions of stream identified as Upper Survey Reach and Lower Survey Reach. Based on available data provided by NCSU and NCEEP, only these two stream reaches were surveyed for monitoring purposes.
- 3.) The location of stream monitoring cross-sections, stream and vegetative problem areas, and other site features were identified by S&EC using GPS and are approximate.

**LEGEND**

-  RESTORED STREAM CHANNEL
-  ROCK CROSS VANE
-  RESTORED STREAM CHANNEL (UNSURVEYED)

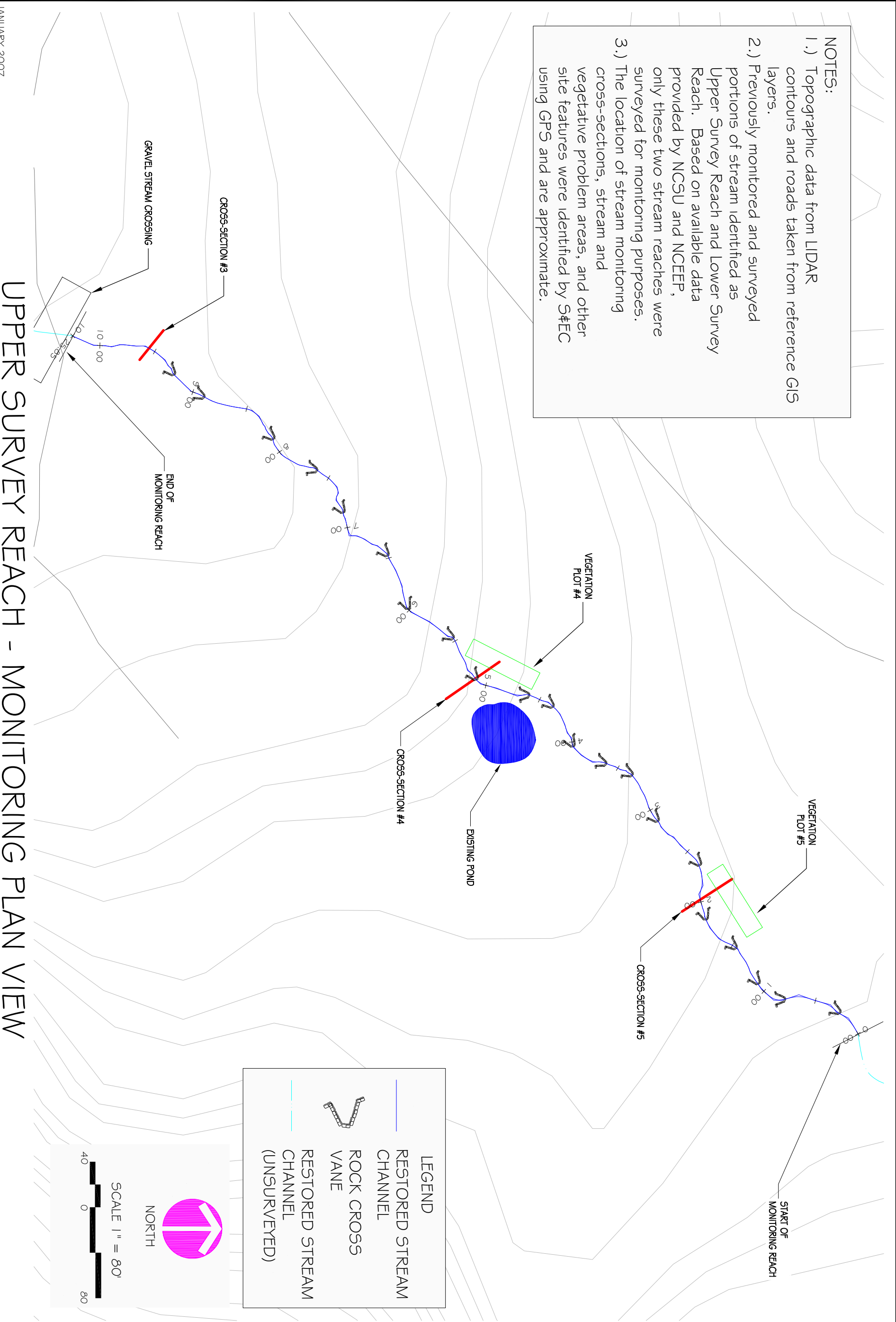


MONITORING PLAN VIEW

JANUARY 2007

**NOTES:**

- 1.) Topographic data from LIDAR contours and roads taken from reference GIS layers.
- 2.) Previously monitored and surveyed portions of stream identified as Upper Survey Reach and Lower Survey Reach. Based on available data provided by NCSU and NCEEP, only these two stream reaches were surveyed for monitoring purposes.
- 3.) The location of stream monitoring cross-sections, stream and vegetative problem areas, and other site features were identified by S&EC using GPS and are approximate.



UPPER SURVEY REACH - MONITORING PLAN VIEW

**LEGEND**

- RESTORED STREAM CHANNEL
- - - RESTORED STREAM CHANNEL (UNSURVEYED)
- ROCK CROSS VANE

NORTH

SCALE 1" = 80'



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 11010 Raven Ridge Road · Raleigh, North Carolina 27614 · Phone: (919) 846-5900 · Fax: (919) 846-9467  
[www.SandEC.com](http://www.SandEC.com)

|  |               |                               |
|--|---------------|-------------------------------|
| Project: TROUT COVE STREAM RESTORATION               |               | Project No.: 10079.D1         |
| Location: CLAY CO., NC                               | Client: NCEEP | Proj. Mgr.: JER<br>Drawn: JER |
| Sheet Title: MONITORING PLAN VIEW UPPER SURVEY REACH |               | Scale: 1" = 80'               |
|  |               | Sheet No.: 2 OF 5             |

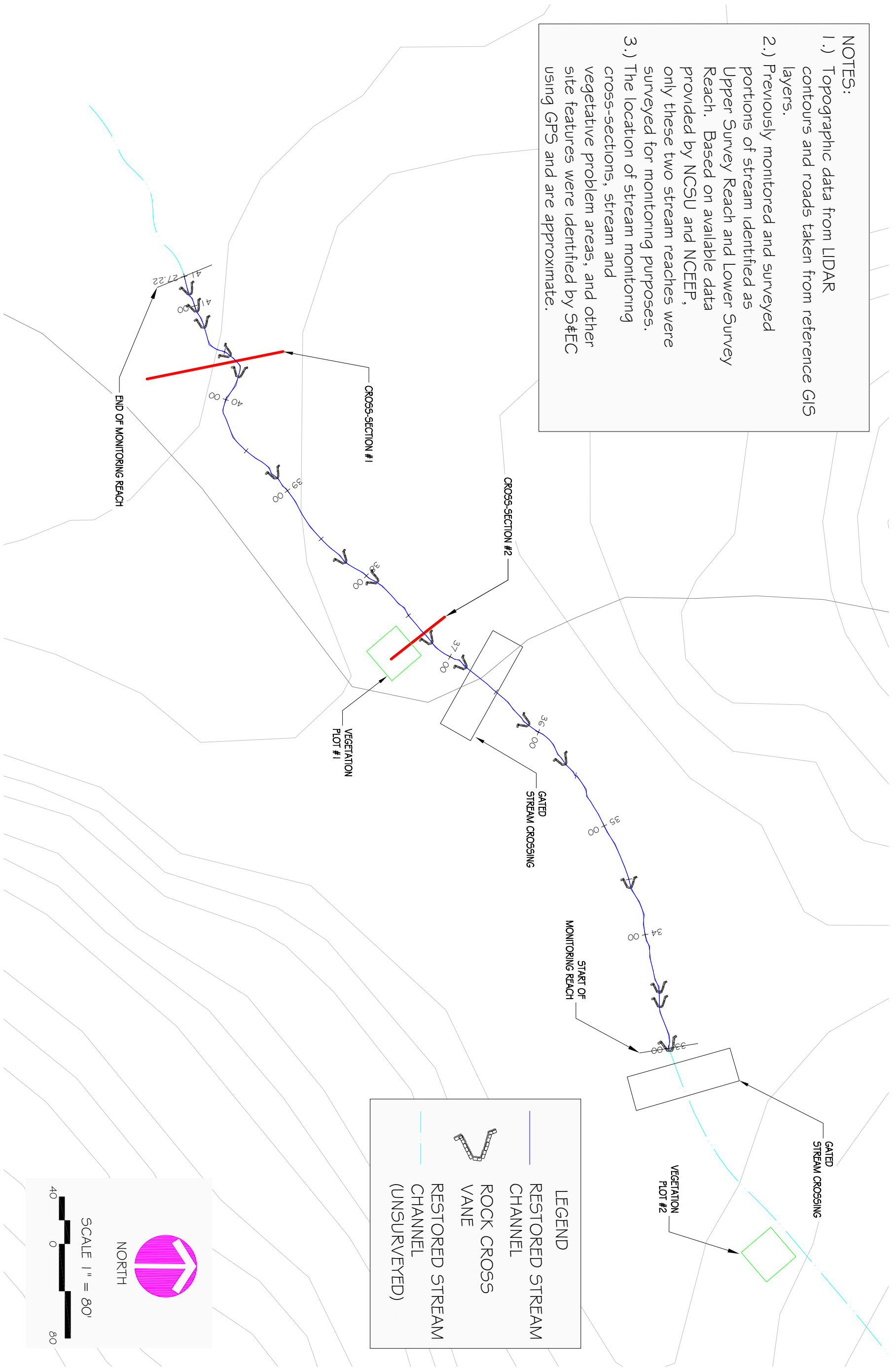
JANUARY 2007

JANUARY 2007

**NOTES:**

- 1.) Topographic data from LIDAR contours and roads taken from reference GIS layers.
- 2.) Previously monitored and surveyed portions of stream identified as Upper Survey Reach and Lower Survey Reach. Based on available data provided by NCSU and NCEEP, only these two stream reaches were surveyed for monitoring purposes.
- 3.) The location of stream monitoring cross-sections, stream and vegetative problem areas, and other site features were identified by S&EC using GPS and are approximate.

LOWER SURVEY REACH - MONITORING PLAN VIEW



**LEGEND**

- RESTORED STREAM CHANNEL
- ROCK CROSS VANE
- RESTORED STREAM CHANNEL (UNSURVEYED)

**SCALE 1" = 80'**

NORTH

**S&EC**

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www.SandEC.com

|  |               |                               |
|--|---------------|-------------------------------|
| Project: TROUT COVE STREAM RESTORATION               |               | Project No.: 10079.D1         |
| Location: CLAY CO., NC                               | Client: NCEEP | Proj. Mgr.: JER<br>Drawn: JER |
| Sheet Title: MONITORING PLAN VIEW LOWER SURVEY REACH |               | Scale: 1" = 80'               |
|  |               | Sheet No.: 3 OF 5             |







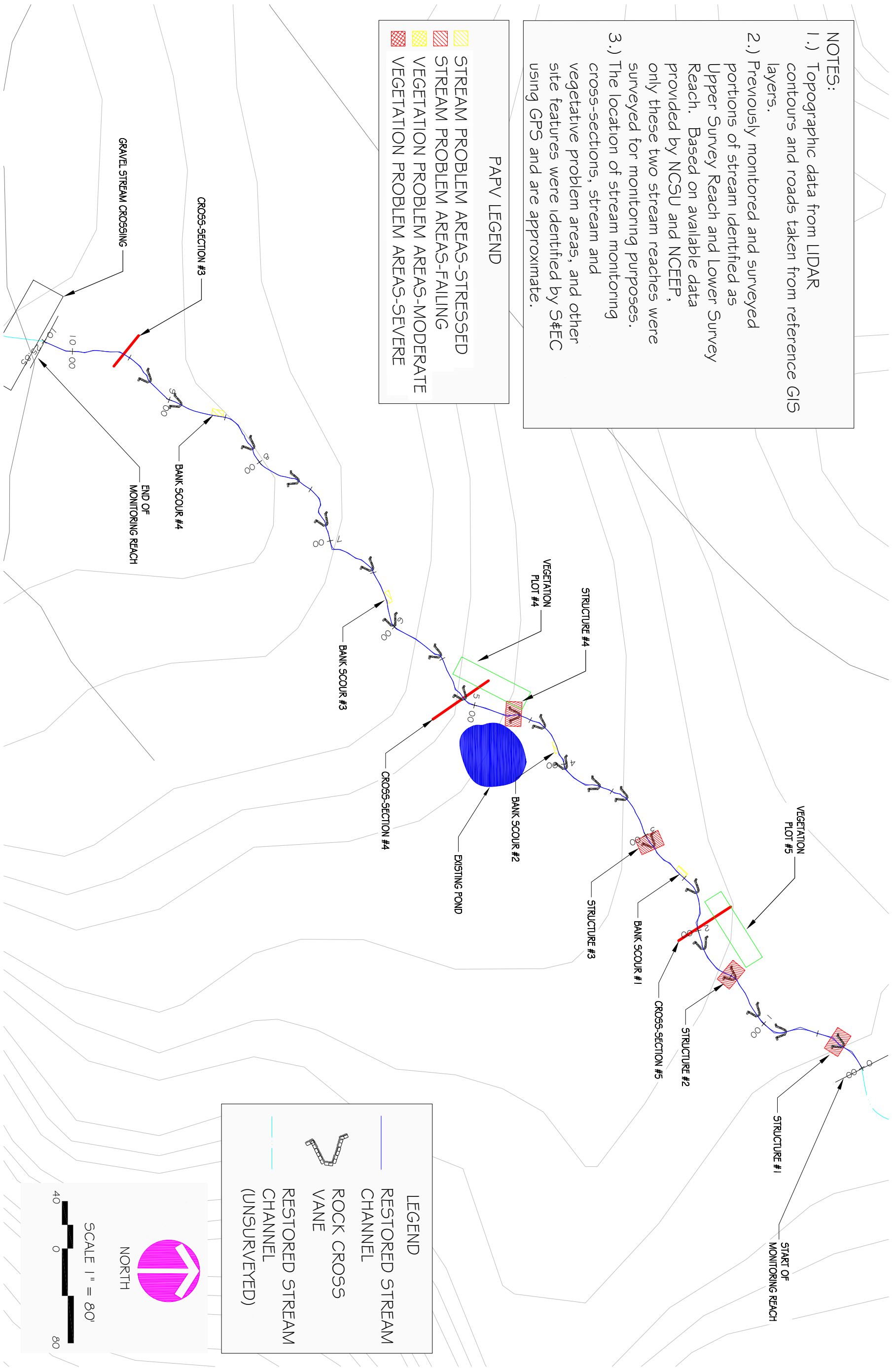
JANUARY 2007

**NOTES:**




- 1.) Topographic data from LIDAR contours and roads taken from reference GIS layers.
- 2.) Previously monitored and surveyed portions of stream identified as Upper Survey Reach and Lower Survey Reach. Based on available data provided by NCSU and NCEEP, only these two stream reaches were surveyed for monitoring purposes.
- 3.) The location of stream monitoring cross-sections, stream and vegetative problem areas, and other site features were identified by S&EC using GPS and are approximate.

**PAPV LEGEND**

-  STREAM PROBLEM AREAS-STRESSED
-  STREAM PROBLEM AREAS-FALLING
-  VEGETATION PROBLEM AREAS-MODERATE
-  VEGETATION PROBLEM AREAS-SEVERE





**LEGEND**

-  RESTORED STREAM CHANNEL
-  ROCK CROSS VANE
-  RESTORED STREAM CHANNEL (UNSURVEYED)

**SCALE 1" = 80'**

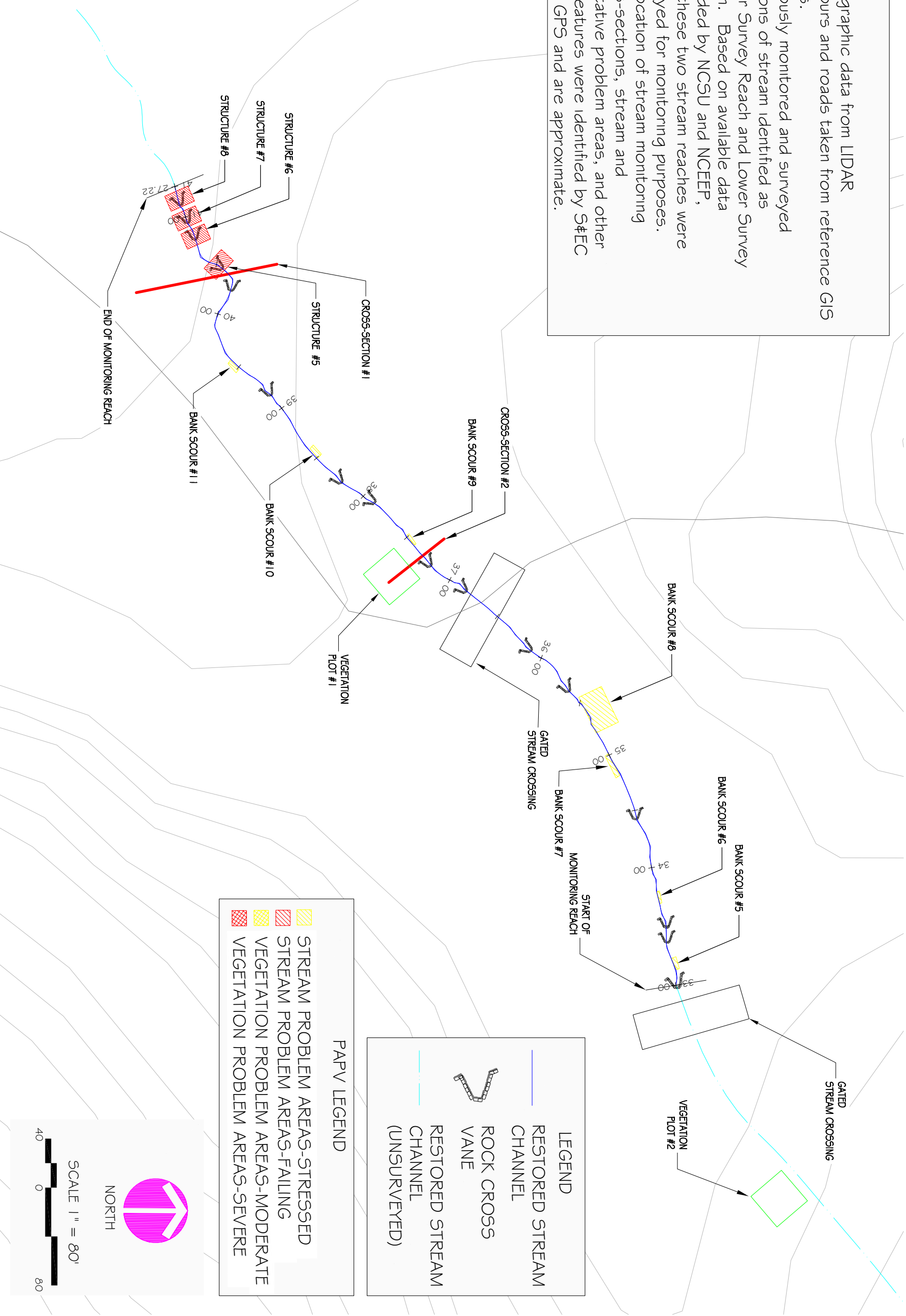
**NORTH**

**UPPER SURVEY REACH - PROBLEM AREA PLAN VIEW**

**NOTES:**

- 1.) Topographic data from LIDAR contours and roads taken from reference GIS layers.
- 2.) Previously monitored and surveyed portions of stream identified as Upper Survey Reach and Lower Survey Reach. Based on available data provided by NCSU and NCEEP, only these two stream reaches were surveyed for monitoring purposes.
- 3.) The location of stream monitoring cross-sections, stream and vegetative problem areas, and other site features were identified by S&EC using GPS and are approximate.



**PAPV LEGEND**

- STREAM PROBLEM AREAS-STRESSED
- STREAM PROBLEM AREAS-FAILING
- VEGETATION PROBLEM AREAS-MODERATE
- VEGETATION PROBLEM AREAS-SEVERE

**LEGEND**

- RESTORED STREAM CHANNEL
- ROCK CROSS
- RESTORED STREAM CHANNEL (UNSURVEYED)

**SCALE 1" = 80'**

NORTH

**LOWER SURVEY REACH - PROBLEM AREA PLAN VIEW**

## **APPENDIX A**

APPENDIX A –  
Vegetation Data Survey Tables

| Trout Cove Stream Restoration Vegetation Monitoring (EEP Project# 388) |        |     |     |     |      |               |
|--|--------|-----|-----|-----|------|---------------|
| Live Stem Counts per Plot arranged by Species                          |        |     |     |     |      |               |
| Species  | Plot # |     |     |     |      | Year 1 Totals |
|  | 1      | 2   | 3   | 4   | 5    |               |
| <i>Cephalanthus occidentalis</i><br>Buttonbush                         |        |     |     |     | 2    | 2             |
| <i>Cornus amomum</i> *<br>Silky Dogwood                                | 1      | 6   | 1   | 10  | 10   | 28            |
| <i>Salix nigra</i><br>Black Willow                                     |        | 6   |     | 3   | 1    | 10            |
| <i>Viburnum nudum</i><br>Possum Haw                                    |        |     |     |     |      | 0             |
| <i>Alnus serrulata</i> *<br>Tag Alder                                  | 5      | 4   | 3   | 8   | 13   | 33            |
| <i>Acer rubrum</i><br>Red Maple  |        | 1   |     | 1   | 1    | 3             |
| <i>Betula nigra</i><br>River Birch                                     |        |     |     |     | 1    | 1             |
| <i>Clethra alnifolia</i><br>Pepperbush                                 | 1      |     |     | 1   | 1    | 3             |
| <i>Platanus occidentalis</i><br>Sycamore                               |        | 1   |     |     |      | 1             |
| <i>Liriodendron tulipifera</i><br>Tulip polar                          |        |     |     | 1   | 2    | 3             |
| <i>Rosa palustris</i><br>Swamp Rose                                    |        | 1   |     |     |      | 1             |
| <i>Rhus copallinum</i> *<br>Smooth Sumac                               |        | 2   |     |     |      | 2             |
| <b>Year (2006) Plot Totals</b>   | 7      | 21  | 4   | 24  | 31   | 87            |
| <b>Previous Plot Totals</b>  | 5      | 4   | 5   | 22  | 14   |               |
| <b>Plot Live Stem Density</b>  | 283    | 850 | 162 | 971 | 1254 |               |
| <b>Overall Site Stem Density</b>                                       |        |     |     |     |      | <b>704</b>    |

APPENDIX A –  
Vegetation Monitoring Plot Photos





Vegetation Monitoring Plot #1 – Year 1 (2006)



Vegetation Monitoring Plot #2 – Year 1 (2006)





Vegetation Monitoring Plot #3 – Year 1 (2006)



Vegetation Monitoring Plot #4 – Year 1 (2006)





Vegetation Monitoring Plot #5– Year 1 (2006)

## **APPENDIX B**

APPENDIX B –  
Stream Problem Areas



Figure 1— Typical Rock Shift



Figure 2—Typical Rock Shift





Figure 3— Typical Rock Shift



Figure 4—Typical Rock Piping



Figure 5—Typical Bank Scour

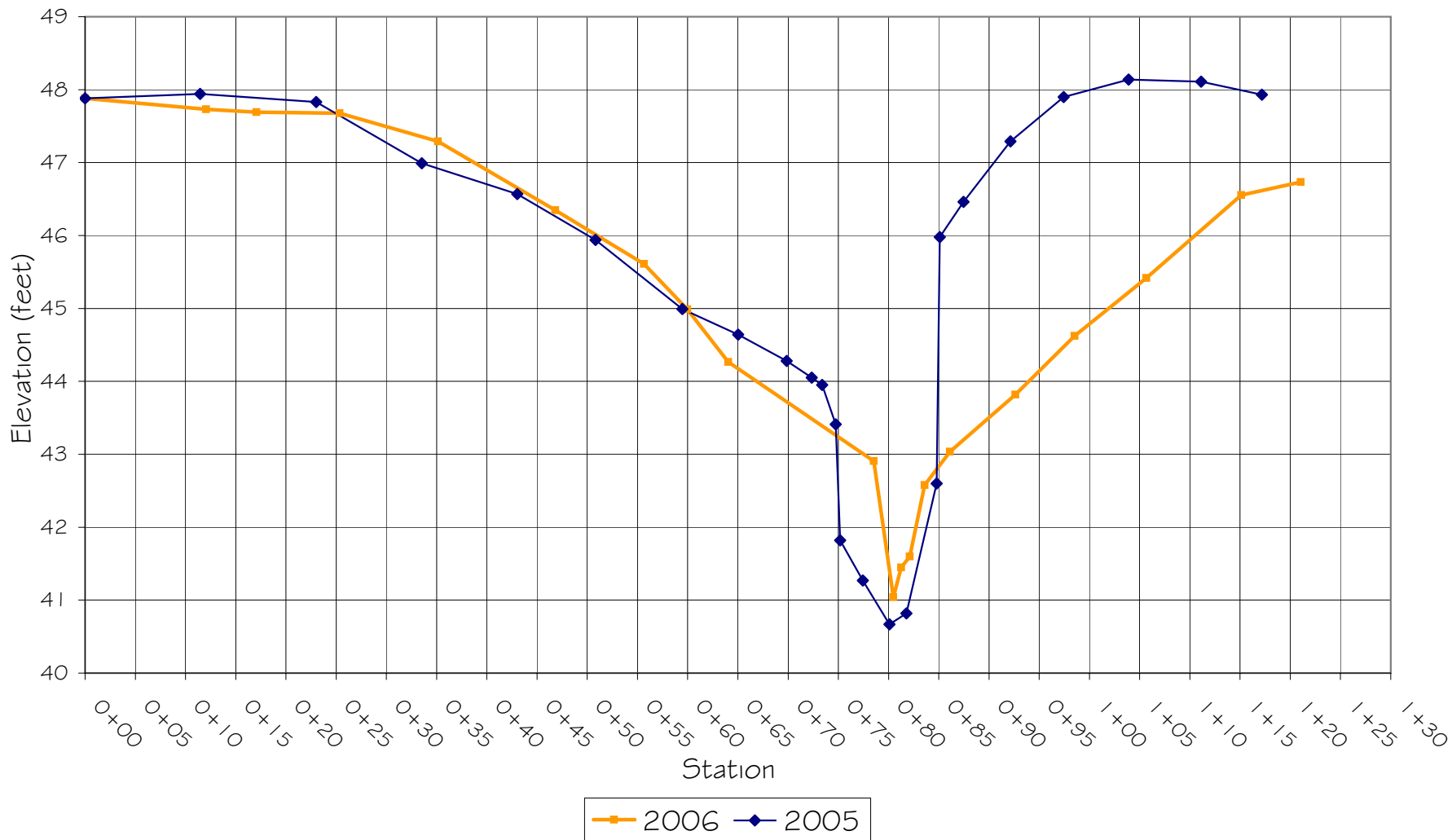


Figure 6—Typical Bank Scour

APPENDIX B –

Cross-section Data

Trout Cove Stream Restoration  
Cross-Section #1 - Pool





RI VERMORPH CROSS SECTION SUMMARY

-----  
 River Name: TROUT COVE  
 Reach Name: 2006  
 Cross Section Name: XS1  
 Survey Date: 11/29/06  
 -----

Cross Section Data Entry

BM Elevation: 0 ft  
 Backsight Rod Reading: 0 ft

| TAPE   | FS | ELEV    | NOTE |
|--------|----|---------|------|
| 0      | 0  | 47.88   |      |
| 12.04  | 0  | 47.7317 |      |
| 17.05  | 0  | 47.6929 |      |
| 25.34  | 0  | 47.6769 |      |
| 35.14  | 0  | 47.2895 |      |
| 46.81  | 0  | 46.3478 |      |
| 55.66  | 0  | 45.6117 |      |
| 59.97  | 0  | 44.987  |      |
| 64.04  | 0  | 44.2655 |      |
| 78.52  | 0  | 42.907  |      |
| 80.49  | 0  | 41.0411 |      |
| 81.25  | 0  | 41.4493 |      |
| 82.13  | 0  | 41.5969 |      |
| 83.6   | 0  | 42.577  |      |
| 86.11  | 0  | 43.0361 |      |
| 92.63  | 0  | 43.8174 |      |
| 98.52  | 0  | 44.6248 |      |
| 105.68 | 0  | 45.4172 |      |
| 115.12 | 0  | 46.5555 |      |
| 121.05 | 0  | 46.7324 |      |

-----  
 Cross Sectional Geometry  
 -----

|                           | Channel | Left  | Right |
|---------------------------|---------|-------|-------|
| Floodprone Elevation (ft) | 45.74   | 45.74 | 45.74 |
| Bankfull Elevation (ft)   | 43.39   | 43.39 | 43.39 |
| Floodprone Width (ft)     | 54.22   | ----- | ----- |
| Bankfull Width (ft)       | 15.69   | 6.64  | 9.05  |
| Entrenchment Ratio        | 3.46    | ----- | ----- |
| Mean Depth (ft)           | 0.71    | 0.45  | 0.91  |
| Maximum Depth (ft)        | 2.35    | 1.89  | 2.35  |
| Width/Depth Ratio         | 22.1    | 14.76 | 9.95  |
| Bankfull Area (sq ft)     | 11.21   | 3.01  | 8.19  |
| Wetted Perimeter (ft)     | 16.93   | 9.12  | 11.6  |
| Hydraulic Radius (ft)     | 0.66    | 0.33  | 0.71  |
| Begin BKF Station         | 73.37   | 73.37 | 80.01 |
| End BKF Station           | 89.06   | 80.01 | 89.06 |

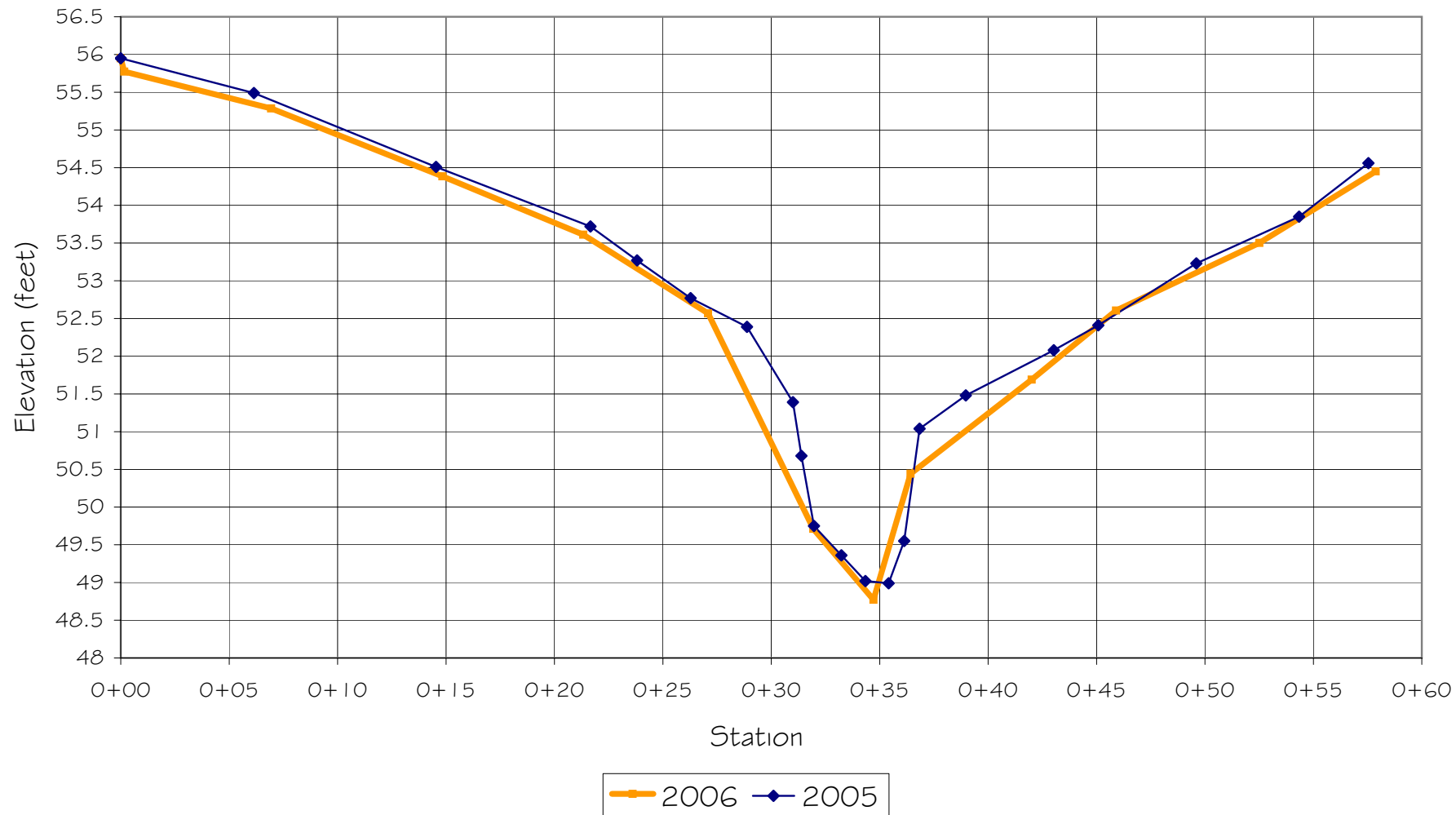
-----  
 Entrainment Calculations  
 -----

Entrainment Formula: Rosgen Modified Shields Curve

| Slope | Channel | Left Side | Right Side |
|-------|---------|-----------|------------|
|       | 0       | 0         | 0          |

Shear Stress (lb/sq ft)  
Movable Particle (mm)

Trout Cove Stream Restoration  
Cross-Section #2- Riffle



RI VERMORPH CROSS SECTION SUMMARY

-----  
 River Name: TROUT COVE  
 Reach Name: 2006  
 Cross Section Name: XS2  
 Survey Date: 11/29/06  
 -----

Cross Section Data Entry

BM Elevation: 0 ft  
 Backsight Rod Reading: 0 ft

| TAPE  | FS | ELEV    | NOTE |
|-------|----|---------|------|
| 0     | 0  | 55.95   |      |
| 0.16  | 0  | 55.7725 |      |
| 6.94  | 0  | 55.2855 |      |
| 14.83 | 0  | 54.3854 |      |
| 21.33 | 0  | 53.612  |      |
| 27.09 | 0  | 52.5681 |      |
| 31.94 | 0  | 49.711  |      |
| 34.72 | 0  | 48.7713 |      |
| 36.42 | 0  | 50.442  |      |
| 42.01 | 0  | 51.6899 |      |
| 45.9  | 0  | 52.6053 |      |
| 52.51 | 0  | 53.5023 |      |
| 57.87 | 0  | 54.4515 |      |

-----  
 Cross Sectional Geometry

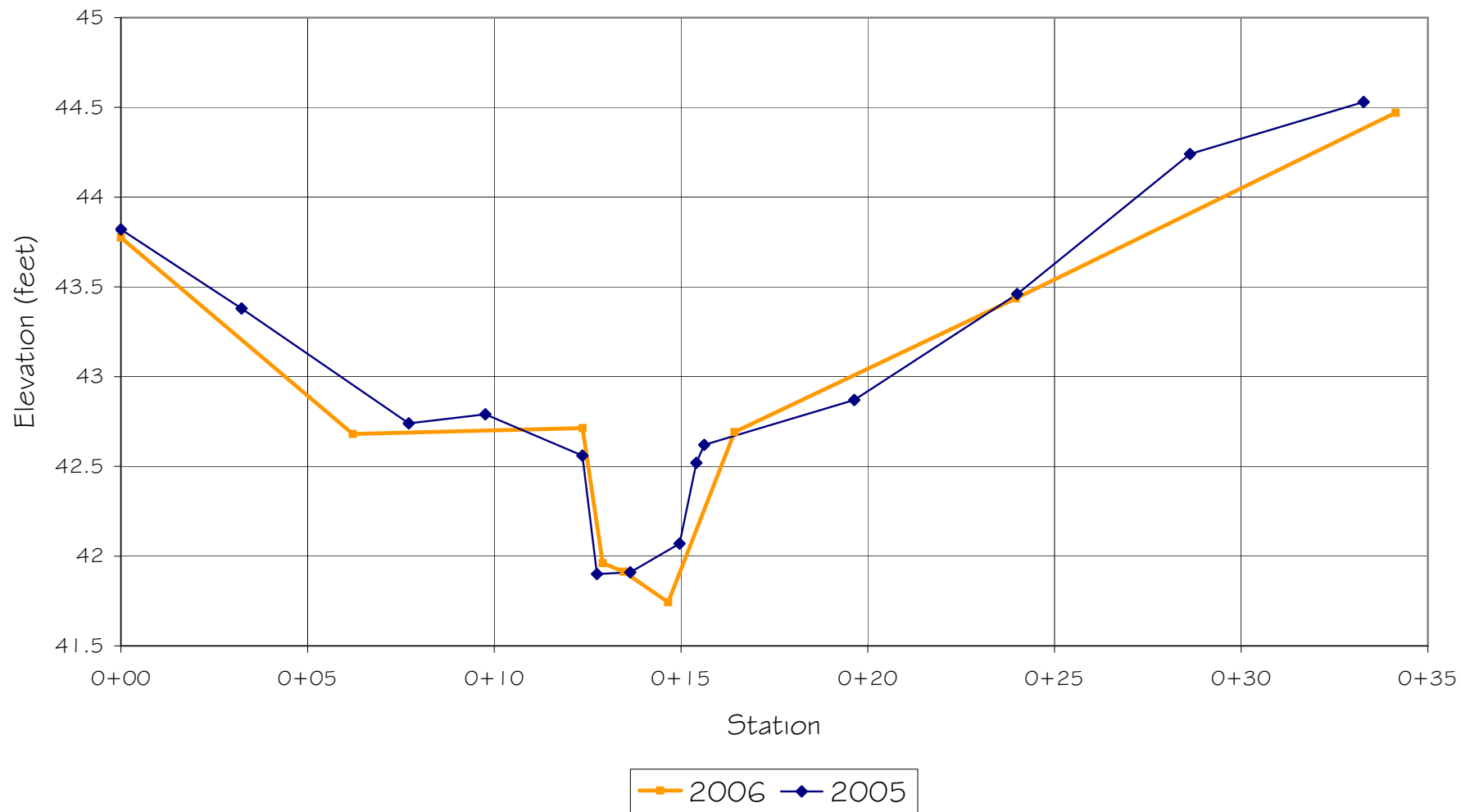
|                           | Channel | Left  | Right |
|---------------------------|---------|-------|-------|
| Floodprone Elevation (ft) | 53.37   | 53.37 | 53.37 |
| Bankfull Elevation (ft)   | 51.07   | 51.07 | 51.07 |
| Floodprone Width (ft)     | 50      | ----- | ----- |
| Bankfull Width (ft)       | 9.6     | 6.82  | 2.78  |
| Entrenchment Ratio        | 5.21    | ----- | ----- |
| Mean Depth (ft)           | 1.04    | 1.34  | 0.31  |
| Maximum Depth (ft)        | 2.3     | 2.3   | 0.62  |
| Width/Depth Ratio         | 9.23    | 5.09  | 8.97  |
| Bankfull Area (sq ft)     | 10.02   | 9.16  | 0.86  |
| Wetted Perimeter (ft)     | 10.88   | 8.65  | 3.47  |
| Hydraulic Radius (ft)     | 0.92    | 1.06  | 0.25  |
| Begin BKF Station         | 29.63   | 29.63 | 36.45 |
| End BKF Station           | 39.23   | 36.45 | 39.23 |

-----  
 Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

|                         | Channel | Left Side | Right Side |
|-------------------------|---------|-----------|------------|
| Slope                   | 0       | 0         | 0          |
| Shear Stress (lb/sq ft) |         |           |            |
| Movable Particle (mm)   |         |           |            |

Trout Cove Stream Restoration  
Cross-Section #3 - Pool



RI VERMORPH CROSS SECTION SUMMARY

River Name: TROUT COVE  
 Reach Name: 2006  
 Cross Section Name: XS3  
 Survey Date: 11/29/06

Cross Section Data Entry

BM Elevation: 0 ft  
 Backsight Rod Reading: 0 ft

| TAPE  | FS | ELEV    | NOTE |
|-------|----|---------|------|
| 0     | 0  | 43.7751 |      |
| 6.21  | 0  | 42.6805 |      |
| 12.36 | 0  | 42.7136 |      |
| 12.9  | 0  | 41.9609 |      |
| 13.46 | 0  | 41.9136 |      |
| 14.66 | 0  | 41.743  |      |
| 16.43 | 0  | 42.6912 |      |
| 23.97 | 0  | 43.4361 |      |
| 34.14 | 0  | 44.4706 |      |

Cross Sectional Geometry

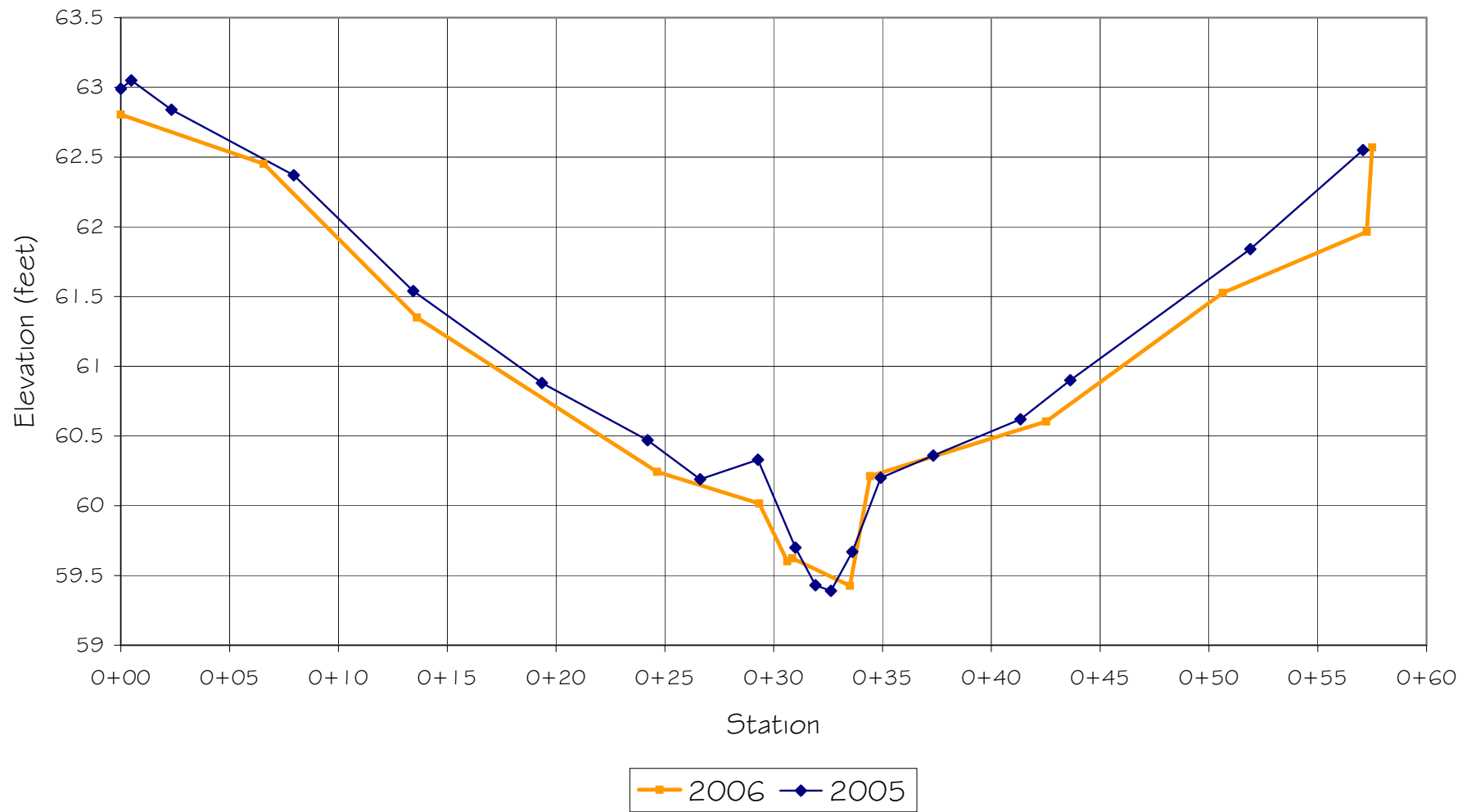
|                           | Channel | Left  | Right |
|---------------------------|---------|-------|-------|
| Floodprone Elevation (ft) | 44.7    | 44.7  | 44.7  |
| Bankfull Elevation (ft)   | 43.22   | 43.22 | 43.22 |
| Floodprone Width (ft)     | 50      | ----- | ----- |
| Bankfull Width (ft)       | 18.63   | 10.45 | 8.18  |
| Entrenchment Ratio        | 2.68    | ----- | ----- |
| Mean Depth (ft)           | 0.54    | 0.52  | 0.57  |
| Maximum Depth (ft)        | 1.48    | 1.33  | 1.48  |
| Width/Depth Ratio         | 34.5    | 20.1  | 14.35 |
| Bankfull Area (sq ft)     | 10.1    | 5.42  | 4.68  |
| Wetted Perimeter (ft)     | 19.35   | 12.21 | 9.78  |
| Hydraulic Radius (ft)     | 0.52    | 0.44  | 0.48  |
| Begin BKF Station         | 3.15    | 3.15  | 13.6  |
| End BKF Station           | 21.78   | 13.6  | 21.78 |

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

|                         | Channel | Left Side | Right Side |
|-------------------------|---------|-----------|------------|
| Slope                   | 0       | 0         | 0          |
| Shear Stress (lb/sq ft) |         |           |            |
| Movable Particle (mm)   |         |           |            |

Trout Cove Stream Restoration  
Cross-Section #4 - Riffle



RI VERMORPH CROSS SECTION SUMMARY

-----  
 River Name: TROUT COVE  
 Reach Name: 2006  
 Cross Section Name: XS4  
 Survey Date: 11/29/06  
 -----

Cross Section Data Entry

BM Elevation: 0 ft  
 Backsight Rod Reading: 0 ft

| TAPE  | FS | ELEV    | NOTE |
|-------|----|---------|------|
| 0     | 0  | 62.8047 |      |
| 6.57  | 0  | 62.4519 |      |
| 13.61 | 0  | 61.3497 |      |
| 24.64 | 0  | 60.2432 |      |
| 29.34 | 0  | 60.0162 |      |
| 30.63 | 0  | 59.602  |      |
| 30.85 | 0  | 59.6238 |      |
| 33.5  | 0  | 59.4266 |      |
| 34.43 | 0  | 60.2124 |      |
| 42.52 | 0  | 60.6047 |      |
| 50.64 | 0  | 61.5262 |      |
| 57.25 | 0  | 61.9644 |      |
| 57.5  | 0  | 62.5692 |      |

-----  
 Cross Sectional Geometry

|                           | Channel | Left  | Right |
|---------------------------|---------|-------|-------|
| Floodprone Elevation (ft) | 61.87   | 61.87 | 61.87 |
| Bankfull Elevation (ft)   | 60.65   | 60.65 | 60.65 |
| Floodprone Width (ft)     | 50      | ----- | ----- |
| Bankfull Width (ft)       | 22.33   | 10.9  | 11.44 |
| Entrenchment Ratio        | 2.24    | ----- | ----- |
| Mean Depth (ft)           | 0.46    | 0.48  | 0.44  |
| Maximum Depth (ft)        | 1.22    | 1.07  | 1.22  |
| Width/Depth Ratio         | 48.54   | 22.71 | 26    |
| Bankfull Area (sq ft)     | 10.3    | 5.24  | 5.05  |
| Wetted Perimeter (ft)     | 22.73   | 12.06 | 12.82 |
| Hydraulic Radius (ft)     | 0.45    | 0.43  | 0.39  |
| Begin BKF Station         | 20.58   | 20.58 | 31.48 |
| End BKF Station           | 42.92   | 31.48 | 42.92 |

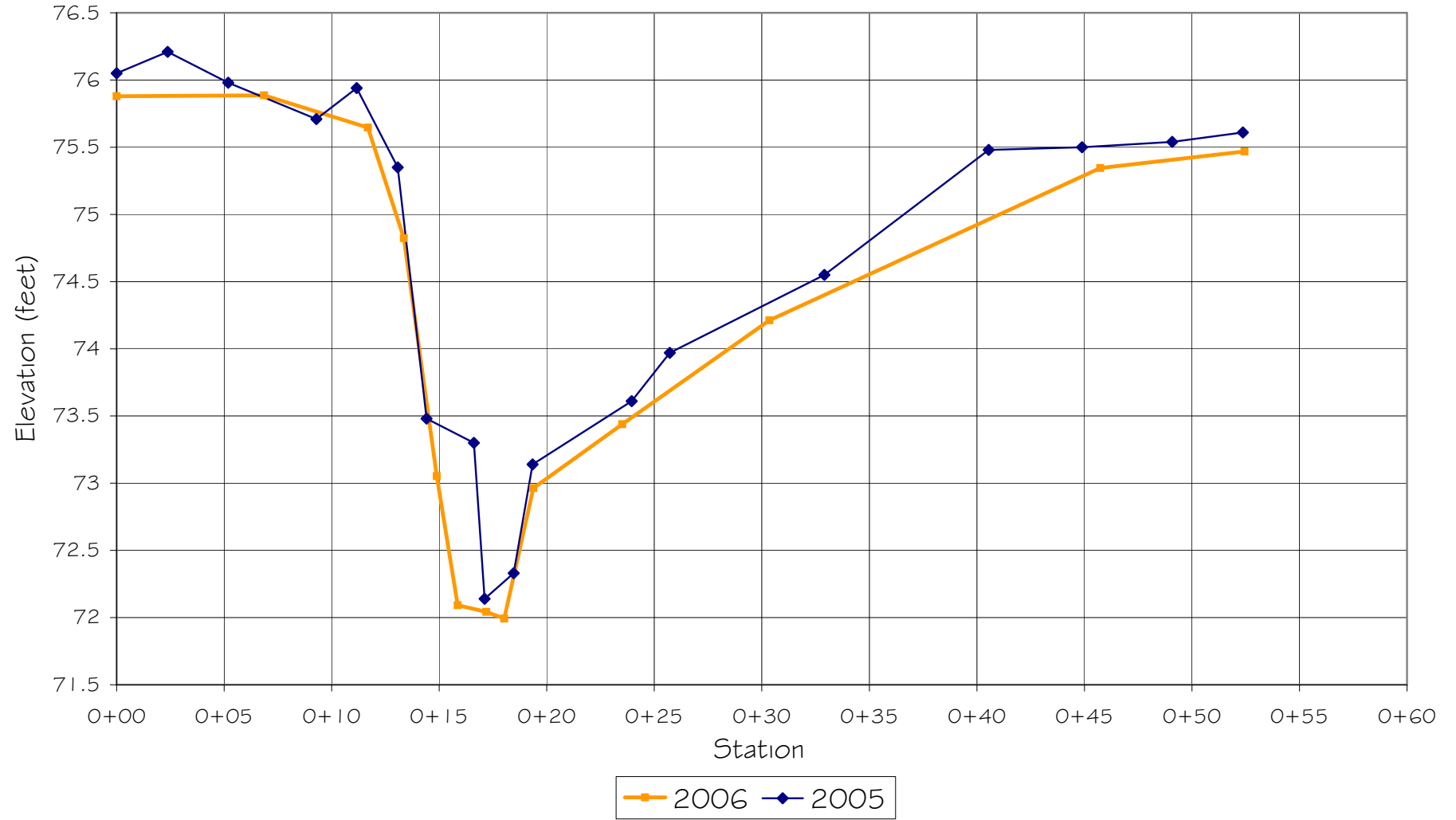
-----  
 Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

|                         | Channel | Left Side | Right Side |
|-------------------------|---------|-----------|------------|
| Slope                   | 0       | 0         | 0          |
| Shear Stress (lb/sq ft) |         |           |            |
| Movable Particle (mm)   |         |           |            |



Trout Cove Stream Restoration  
Cross-Section #5 - Pool



RI VERMORPH CROSS SECTION SUMMARY

-----  
 River Name: TROUT COVE  
 Reach Name: 2006  
 Cross Section Name: XS5  
 Survey Date: 11/29/06  
 -----

Cross Section Data Entry

BM Elevation: 0 ft  
 Backsight Rod Reading: 0 ft

| TAPE  | FS | ELEV    | NOTE |
|-------|----|---------|------|
| 0     | 0  | 75.8791 |      |
| 6.85  | 0  | 75.8863 |      |
| 11.68 | 0  | 75.6457 |      |
| 13.36 | 0  | 74.8229 |      |
| 14.88 | 0  | 73.0523 |      |
| 15.86 | 0  | 72.0925 |      |
| 17.19 | 0  | 72.0427 |      |
| 18.02 | 0  | 71.9923 |      |
| 19.37 | 0  | 72.9631 |      |
| 23.51 | 0  | 73.4386 |      |
| 30.35 | 0  | 74.2122 |      |
| 45.73 | 0  | 75.3451 |      |
| 52.45 | 0  | 75.4688 |      |

-----  
 Cross Sectional Geometry

|                           | Channel | Left  | Right |
|---------------------------|---------|-------|-------|
| Floodprone Elevation (ft) | 75.61   | 75.61 | ----- |
| Bankfull Elevation (ft)   | 73.8    | 73.8  | ----- |
| Floodprone Width (ft)     | 50      | ----- | ----- |
| Bankfull Width (ft)       | 12.47   | 12.84 | ----- |
| Entrenchment Ratio        | 4.01    | ----- | ----- |
| Mean Depth (ft)           | 0.81    | 0.81  | ----- |
| Maximum Depth (ft)        | 1.81    | 1.81  | ----- |
| Width/Depth Ratio         | 15.4    | 15.85 | ----- |
| Bankfull Area (sq ft)     | 10.07   | 10.07 | ----- |
| Wetted Perimeter (ft)     | 13.57   | 13.57 | ----- |
| Hydraulic Radius (ft)     | 0.74    | 0.74  | ----- |
| Begin BKF Station         | 14.24   | 14.24 | ----- |
| End BKF Station           | 26.71   | 26.71 | ----- |

-----  
 Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

|                         | Channel | Left Side | Right Side |
|-------------------------|---------|-----------|------------|
| Slope                   | 0       | 0         | 0          |
| Shear Stress (lb/sq ft) |         |           |            |
| Movable Particle (mm)   |         |           |            |



Cross-section #1



Cross-section #2





Cross-section #3



Cross-section #4

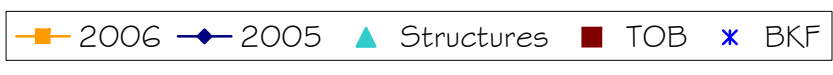
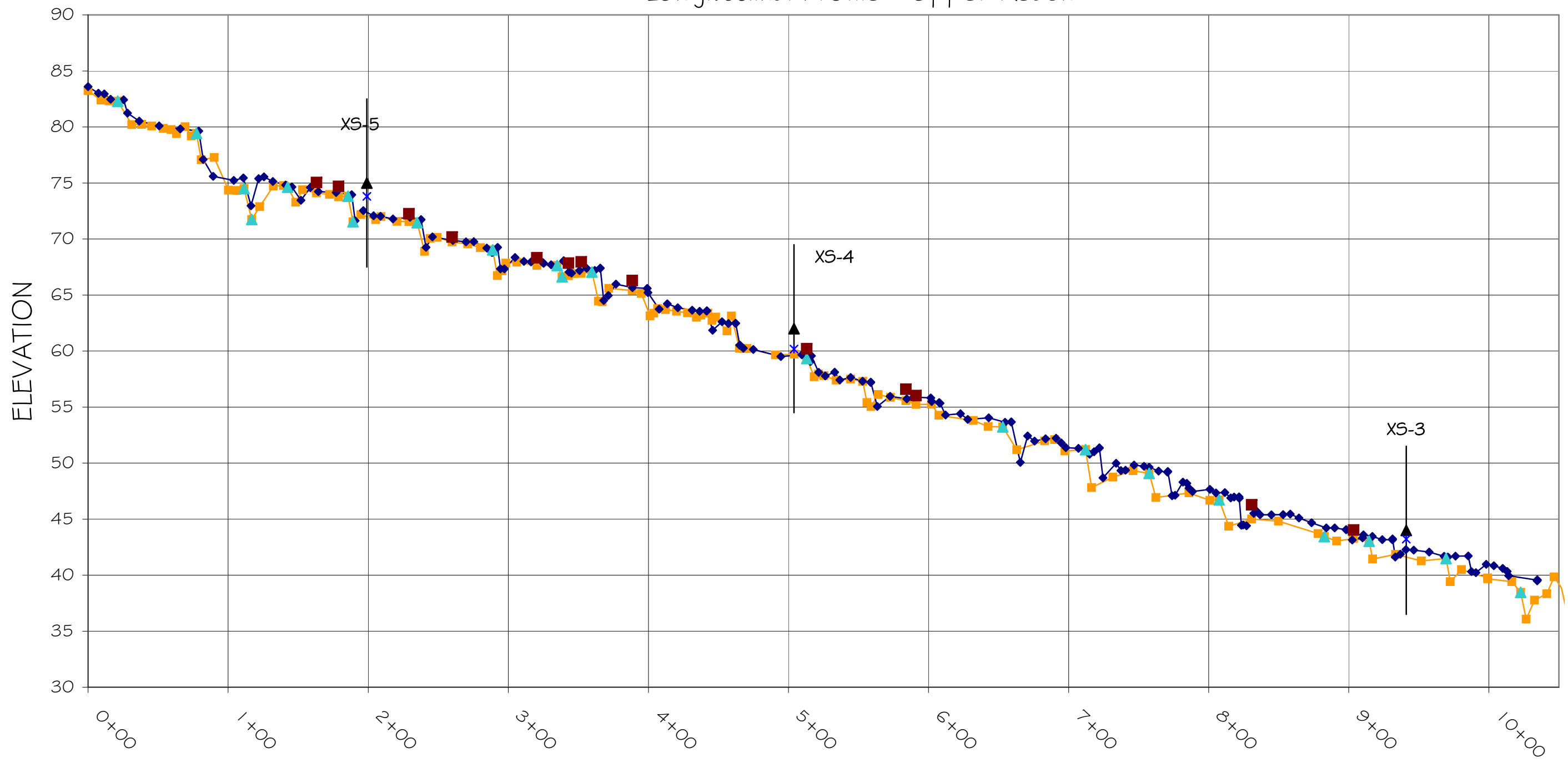


Cross-section #5



APPENDIX B –  
Longitudinal Profile Data

# Trout Cove Stream Restoration Longitudinal Profile - Upper Reach



RI VERMORPH PROFI LE SUMMARY

-----  
 Ri ver Name: TROUT COVE  
 Reach Name: 2006  
 Profi le Name: UPPER  
 Survey Date: 11/29/06  
 -----

Survey Data

| DIST | CH      | WS | BKF  | P1 | P2 | P3 | P4 |
|------|---------|----|------|----|----|----|----|
| 0    | 83.2308 |    |      |    |    |    |    |
| 9    | 82.3961 |    |      |    |    |    |    |
| 15   | 82.3147 |    |      |    |    |    |    |
| 21   | 82.3036 |    |      |    |    |    |    |
| 31   | 80.2051 |    |      |    |    |    |    |
| 38   | 80.2217 |    |      |    |    |    |    |
| 45   | 80.0812 |    |      |    |    |    |    |
| 54   | 79.8747 |    |      |    |    |    |    |
| 59   | 79.7654 |    |      |    |    |    |    |
| 63   | 79.4021 |    |      |    |    |    |    |
| 69   | 80.0096 |    |      |    |    |    |    |
| 74   | 79.1897 |    |      |    |    |    |    |
| 77   | 79.4243 |    |      |    |    |    |    |
| 81   | 77.0617 |    |      |    |    |    |    |
| 90   | 77.2688 |    |      |    |    |    |    |
| 100  | 74.3613 |    |      |    |    |    |    |
| 106  | 74.3309 |    |      |    |    |    |    |
| 111  | 74.5007 |    |      |    |    |    |    |
| 117  | 71.741  |    |      |    |    |    |    |
| 123  | 72.8779 |    |      |    |    |    |    |
| 132  | 74.7301 |    |      |    |    |    |    |
| 140  | 74.776  |    |      |    |    |    |    |
| 142  | 74.6216 |    |      |    |    |    |    |
| 148  | 73.2847 |    |      |    |    |    |    |
| 153  | 74.3863 |    |      |    |    |    |    |
| 163  | 74.1009 |    |      |    |    |    |    |
| 172  | 73.9848 |    |      |    |    |    |    |
| 179  | 73.7568 |    |      |    |    |    |    |
| 186  | 73.8143 |    |      |    |    |    |    |
| 189  | 71.5314 |    |      |    |    |    |    |
| 195  | 72.1689 |    | 73.8 |    |    |    |    |
| 205  | 71.7344 |    |      |    |    |    |    |
| 209  | 72.0043 |    |      |    |    |    |    |
| 221  | 71.5756 |    |      |    |    |    |    |
| 229  | 71.5461 |    |      |    |    |    |    |
| 235  | 71.4559 |    |      |    |    |    |    |
| 240  | 68.8965 |    |      |    |    |    |    |
| 244  | 70.0398 |    |      |    |    |    |    |
| 249  | 70.1479 |    |      |    |    |    |    |
| 260  | 69.7293 |    |      |    |    |    |    |
| 271  | 69.5493 |    |      |    |    |    |    |
| 280  | 69.2288 |    |      |    |    |    |    |
| 289  | 69.0303 |    |      |    |    |    |    |
| 292  | 66.7355 |    |      |    |    |    |    |
| 296  | 67.1481 |    |      |    |    |    |    |
| 298  | 67.8499 |    |      |    |    |    |    |
| 306  | 67.9166 |    |      |    |    |    |    |
| 320  | 67.642  |    |      |    |    |    |    |
| 335  | 67.6342 |    |      |    |    |    |    |
| 338  | 66.6293 |    |      |    |    |    |    |

343 66. 7171  
347 66. 9055  
352 66. 9306  
360 67. 0448  
364 64. 4568  
367 64. 3909  
372 65. 5929  
389 65. 399  
395 65. 1385  
401 63. 1367  
404 63. 3722  
407 63. 789  
412 63. 6871  
420 61. 5429  
428 61. 4098  
434 61. 0073  
437 61. 3272  
442 59. 2429  
446 59. 1175  
448 59. 4003  
456 58. 166  
459 59. 4856  
465 56. 5999  
468 56. 5781  
470 56. 5894  
491 56. 0207  
504 56. 0918  
513 55. 7054  
518 54. 0698  
521 54. 3155  
525 54. 1616  
534 53. 7756  
544 53. 8605  
553 53. 6583  
556 51. 7807  
559 51. 4132  
564 52. 4915  
573 52. 2295  
584 51. 9322  
591 55. 2303  
602 55. 2449  
607 54. 2567  
632 53. 7977  
643 53. 2648  
653 53. 2288  
663 51. 1812  
683 51. 9782  
690 52. 0867  
697 51. 074  
712 51. 1976  
716 47. 8178  
732 48. 7482  
746 49. 3138  
758 49. 0875  
762 46. 9315  
786 47. 3315  
801 46. 6687  
808 46. 7145  
814 44. 356  
831 45. 0023  
850 44. 8204  
878 43. 7081  
883 43. 4378  
891 43. 0502  
904 43. 2661  
914 43. 0248

60. 65

|      |         |       |
|------|---------|-------|
| 917  | 41.4392 |       |
| 933  | 41.8535 |       |
| 941  |         | 43.22 |
| 952  | 41.2739 |       |
| 969  | 41.492  |       |
| 972  | 39.4215 |       |
| 980  | 40.4985 |       |
| 999  | 39.7453 |       |
| 999  | 39.6639 |       |
| 1016 | 39.4182 |       |
| 1023 | 38.467  |       |
| 1027 | 36.0752 |       |
| 1033 | 37.7686 |       |
| 1041 | 38.3378 |       |
| 1047 | 39.8341 |       |
| 1052 | 38.8683 |       |
| 1059 | 34.8303 |       |
| 1065 | 36.5309 |       |
| 1084 | 36.0769 |       |
| 1106 | 35.2883 |       |
| 1120 | 35.5562 |       |
| 1130 | 33.7426 |       |
| 1140 | 34.8869 |       |

Cross Section / Bank Profile Locations

| Name | Type        | Profile Station |
|------|-------------|-----------------|
| XS1  | Pool XS     | 4042            |
| XS2  | Ri ffl e XS | 3779            |
| XS3  | Ri ffl e XS | 941             |
| XS4  | Ri ffl e XS | 504             |
| XS5  | Ri ffl e XS | 199             |

Measurements from Graph

Bankfull Slope: 0.04099

| Variable      | Min     | Avg     | Max     |
|---------------|---------|---------|---------|
| S ri ffl e    | 0.02714 | 0.04092 | 0.07284 |
| S pool        | 0.00000 | 0.00745 | 0.03661 |
| S run         | 0.00000 | 0.01129 | 0.04992 |
| S glide       | 0.01144 | 0.05741 | 0.18303 |
| P - P         | 11.29   | 52.21   | 105.54  |
| P length      | 4.34    | 14.39   | 30.09   |
| Dmax ri ffl e | 0.72    | 1.38    | 2.54    |
| Dmax pool     | 1.83    | 4.07    | 6.12    |
| Dmax run      | 1.35    | 2.25    | 4.13    |
| Dmax glide    | 1.75    | 2.82    | 4.37    |
| Low Bank Ht   | 0       | 0       | 0       |

Length and depth measurements in feet, slopes in ft/ft.

RI VERMORPH PROFILE SUMMARY

Notes

-----  
 River Name: TROUT COVE  
 Reach Name: 2006  
 Profile Name: UPPER  
 Survey Date: 11/29/06

DIST Note

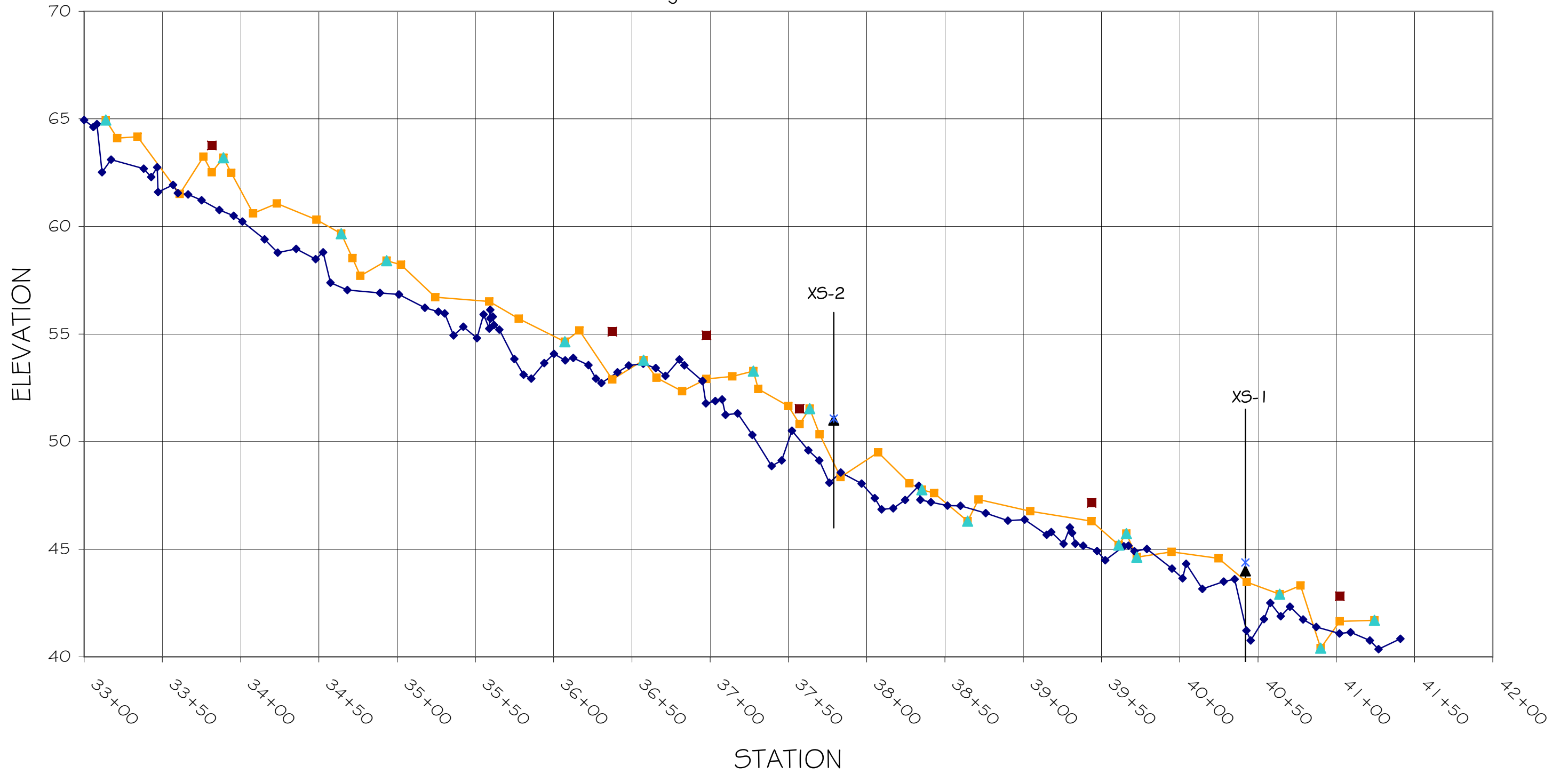


0 beg tw  
9 tw  
15 tw  
21 tw @ str  
31 tw  
38 tw  
45 tw  
54 tw  
59 tw  
63 tw  
69 tb  
74 tw  
77 tw @ str  
81 tw  
90 tw  
100 tw  
106 tw  
111 tw @ str  
117 tw @ btmstr  
123 tw  
132 tw  
140 tw  
142 tw @ str  
148 tw  
153 tw  
163 tw  
172 tw  
179 tw  
186 tw @ str  
189 tw @ btmstr  
195 tw  
205 tw  
209 tw  
221 tw  
229 tw  
235 tw @ str  
240 tw  
244 tw  
249 tw  
260 tw  
271 tw  
280 tw  
289 tw @ str  
292 tw  
296 tw  
298 tw  
306 tw  
320 tw  
335 tw @ str  
338 tw @ str  
343 tw  
347 tw  
352 tw  
360 tw @ str  
364 tw  
367 tw  
372 tw  
389 tw  
395 tw  
401 tw  
404 tw  
407 tw  
412 tw  
420 tw  
428 tw

434 tw  
437 tw  
442 tw  
446 tw  
448 tw  
456 tw  
459 tw  
465 tw  
468 tw  
470 tw  
491 tw @ confl uence  
504 tw  
513 tw @ str  
518 tw  
521 tw  
525 tw  
534 tw  
544 tw  
553 tw  
556 tw  
559 tw  
564 tw  
573 tw  
584 tw  
591 tw  
602 tw  
607 tw  
632 tw  
643 tw  
653 tw @ str  
663 tw  
683 tw  
690 tw @ i sl and  
697 tw  
712 tw @ str  
716 tw  
732 tw  
746 tw  
758 tw @ str  
762 tw  
786 tw  
801 tw  
808 tw @ str  
814 tw  
831 tw  
850 tw  
878 tw  
883 tw @ str  
891 tw  
904 tw  
914 tw @ str  
917 tw  
933 tw  
952 tw  
969 tw @ str  
972 tw  
980 tw  
999 tw @ cul vert  
999 tw @ cul vert  
1016 cul vert  
1023 tw @ str  
1027 tw  
1033 tw  
1041 tw  
1047 tw  
1052 tw @ str

|      |          |
|------|----------|
| 1059 | tw       |
| 1065 | tw       |
| 1084 | tw       |
| 1106 | tw       |
| 1120 | tw       |
| 1130 | tw       |
| 1140 | tw @ str |

# Trout Cove Stream Restoration Longitudinal Profile - Lower Reach



—■— 2006 —◆— 2005 ▲ Structures ■ TOB \* BKF

RI VERMORPH PROFI LE SUMMARY

-----  
 Ri ver Name: TROUT COVE  
 Reach Name: 2006  
 Profi le Name: LOWER  
 Survey Date: 11/29/06  
 -----

Survey Data

| DIST | CH      | WS | BKF   | P1 | P2 | P3 | P4 |
|------|---------|----|-------|----|----|----|----|
| 3314 | 64.95   |    |       |    |    |    |    |
| 3321 | 64.1057 |    |       |    |    |    |    |
| 3334 | 64.1704 |    |       |    |    |    |    |
| 3350 | 67.6423 |    |       |    |    |    |    |
| 3356 | 61.5109 |    |       |    |    |    |    |
| 3362 | 63.2419 |    |       |    |    |    |    |
| 3377 | 62.5196 |    |       |    |    |    |    |
| 3383 | 63.1908 |    |       |    |    |    |    |
| 3390 | 62.4913 |    |       |    |    |    |    |
| 3395 | 60.6087 |    |       |    |    |    |    |
| 3409 | 61.0704 |    |       |    |    |    |    |
| 3424 | 60.317  |    |       |    |    |    |    |
| 3450 | 59.6669 |    |       |    |    |    |    |
| 3466 | 58.5307 |    |       |    |    |    |    |
| 3473 | 57.7058 |    |       |    |    |    |    |
| 3478 | 58.4126 |    |       |    |    |    |    |
| 3495 | 58.224  |    |       |    |    |    |    |
| 3504 | 56.7101 |    |       |    |    |    |    |
| 3526 | 56.5156 |    |       |    |    |    |    |
| 3560 | 55.7128 |    |       |    |    |    |    |
| 3579 | 54.6427 |    |       |    |    |    |    |
| 3608 | 55.1668 |    |       |    |    |    |    |
| 3618 | 52.89   |    |       |    |    |    |    |
| 3639 | 53.7863 |    |       |    |    |    |    |
| 3659 | 52.9713 |    |       |    |    |    |    |
| 3667 | 52.3464 |    |       |    |    |    |    |
| 3683 | 52.9157 |    |       |    |    |    |    |
| 3699 | 53.0303 |    |       |    |    |    |    |
| 3715 | 53.2801 |    |       |    |    |    |    |
| 3729 | 52.4478 |    |       |    |    |    |    |
| 3732 | 51.6543 |    |       |    |    |    |    |
| 3751 | 50.822  |    |       |    |    |    |    |
| 3765 | 50.3465 |    |       |    |    |    |    |
| 3771 | 48.3529 |    |       |    |    |    |    |
| 3785 | 49.5011 |    | 51.07 |    |    |    |    |
| 3809 | 48.0634 |    |       |    |    |    |    |
| 3829 | 47.7642 |    |       |    |    |    |    |
| 3837 | 47.6087 |    |       |    |    |    |    |
| 3844 | 46.3065 |    |       |    |    |    |    |
| 3866 | 47.3164 |    |       |    |    |    |    |
| 3873 | 46.7682 |    |       |    |    |    |    |
| 3906 | 46.3028 |    |       |    |    |    |    |
| 3945 | 45.1933 |    |       |    |    |    |    |
| 3962 | 45.7285 |    |       |    |    |    |    |
| 3967 | 44.6309 |    |       |    |    |    |    |
| 3974 | 44.8748 |    |       |    |    |    |    |
| 3996 | 44.5786 |    |       |    |    |    |    |
| 4026 | 43.4747 |    |       |    |    |    |    |
| 4044 | 42.9148 |    | 43.45 |    |    |    |    |
| 4065 | 43.3142 |    |       |    |    |    |    |



4078 40.4039  
 4091 41.6527  
 4104 41.7001  
 4126 41.1776

Cross Section / Bank Profile Locations

| Name | Type      | Profile Station |
|------|-----------|-----------------|
| XS1  | Pool XS   | 4042            |
| XS2  | Riffle XS | 3779            |
| XS3  | Pool XS   | 941             |
| XS4  | Riffle XS | 504             |
| XS5  | Pool XS   | 199             |

Measurements from Graph

Bankfull Slope: 0.0271

| Variable    | Min     | Avg     | Max     |
|-------------|---------|---------|---------|
| S riffle    | 0.02081 | 0.02551 | 0.03019 |
| S pool      | 0.00449 | 0.00662 | 0.00838 |
| S run       | 0.0027  | 0.00679 | 0.01712 |
| S glide     | 0.00583 | 0.00945 | 0.013   |
| P - P       | 41.04   | 72.56   | 108.31  |
| P length    | 12.78   | 24.05   | 41.71   |
| Dmax riffle | 0.44    | 0.56    | 0.87    |
| Dmax pool   | 1.48    | 2.16    | 3.68    |
| Dmax run    | 0.58    | 0.91    | 1.74    |
| Dmax glide  | 0.63    | 1.04    | 1.33    |
| Low Bank Ht | 0       | 0       | 0       |

Length and depth measurements in feet, slopes in ft/ft.

RI VERMORPH PROFILE SUMMARY

Notes

River Name: TROUT COVE  
 Reach Name: 2006  
 Profile Name: LOWER  
 Survey Date: 11/29/06

| DIST | Note         |
|------|--------------|
| 3314 | tw @ str     |
| 3321 | tw           |
| 3334 | tw @ fence   |
| 3350 | tw str fence |
| 3356 | tw           |
| 3362 | tw           |
| 3377 | tw           |
| 3383 | tb           |
| 3390 | tw @ str     |
| 3395 | tw           |
| 3409 | tw           |
| 3424 | tw           |
| 3450 | tw           |
| 3466 | tw @ str     |
| 3473 | tw           |
| 3478 | tw           |
| 3495 | tw @ str     |
| 3504 | tw           |

|      |            |
|------|------------|
| 3526 | tw         |
| 3560 | tw         |
| 3579 | tw/rw      |
| 3608 | tw @ str   |
| 3618 | tw         |
| 3639 | tw         |
| 3659 | tw @ str   |
| 3667 | tw         |
| 3683 | tw         |
| 3699 | tw         |
| 3715 | tw @ fence |
| 3729 | tw @ str   |
| 3732 | tw @ fence |
| 3751 | tw         |
| 3765 | tw @ str   |
| 3771 | tw         |
| 3785 | tw         |
| 3809 | tw         |
| 3829 | tw         |
| 3837 | tw @ str   |
| 3844 | tw         |
| 3866 | tw @ str   |
| 3873 | tw         |
| 3906 | tw         |
| 3945 | tw         |
| 3962 | tw @ str   |
| 3967 | tw @ str   |
| 3974 | tw @ str   |
| 3996 | tw         |
| 4026 | tw         |
| 4044 | tw/rw      |
| 4065 | tw @ str   |
| 4078 | tw/rw      |
| 4091 | tw @ str   |
| 4104 | tw         |
| 4126 | tw @ str   |

Table B1. Qualitative Visual Stability Assessment

Date: November, 2006

Project # 10079.D1

| 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 | % perfor. in stable condition | Feature Perform. Mean or Total |
|-------------------------|--|--|---------------------------|---------------------------------------|-------------------------------|--------------------------------|
| A. Riffles              | 1. Present?  | 64                                       | 64                        | NA                                    | 100%                          |                                |
|                         | 2. Armor stable (e.g. no displacement)?  | 64                                       | 64                        | NA                                    | 100%                          |                                |
|                         | 3. Facet grade appears stable?   | 64                                       | 64                        | NA                                    | 100%                          |                                |
|                         | 4. Stable interval grade?  | 64                                       | 64                        | NA                                    | 100%                          |                                |
|                         | 5. Feature spacing appropriate?  | 41                                       | 64                        | NA                                    | 64%                           |                                |
|                         | 6. Minimal evidence of embedding/fining?   | 64                                       | 64                        | NA                                    | 100%                          |                                |
|                         | 7. Depth appears appropriate for current discharge?  | 64                                       | 64                        | NA                                    | N/A                           |                                |
|                         | 8. Length appropriate?   | 41                                       | 64                        | NA                                    | N/A                           | <b>94%</b>                     |
| B. Pools                | 1. Present? (e.g. not subject to severe aggradation?)  | 59                                       | 59                        | NA                                    | 100%                          |                                |
|                         | 2. Sufficiently deep (Max Pool D:Mean Bkf>1.6)   | 59                                       | 59                        | NA                                    | 100%                          |                                |
|                         | 3. Thalweg located outer bend?   | 59                                       | 59                        | NA                                    | 100%                          |                                |
|                         | 4. Spacing appropriate?  | 59                                       | 59                        | NA                                    | N/A                           |                                |
|                         | 5. Non-aggrading (not filling)?  | 59                                       | 59                        | NA                                    | 100%                          |                                |
|                         | 6. Length appropriate?   | 59                                       | 59                        | NA                                    | N/A                           | <b>100%</b>                    |
| C. Thalweg              | 1. Upstream of meander bend (run/inflection) centering?  | 59                                       | 59                        | NA                                    | 100%                          |                                |
|                         | 2. Downstream of meander (glide/inflection) centering?   | 59                                       | 59                        | NA                                    | 100%                          | <b>100%</b>                    |
| D. Meanders             | 1. Outer bend in state of limited/controlled erosion?  | 59                                       | 59                        | NA                                    | 100%                          |                                |
|                         | 2. Of those eroding, # w/ concomitant point bar formation?   | 0  | 59                        | NA                                    | 0%                            |                                |
|                         | 3. Apparent Rc within spec?  | N/A                                      | N/A                       | NA                                    | N/A                           |                                |
|                         | 4. Sufficient floodplain access and relief?  | 59                                       | 59                        | NA                                    | 100%                          | <b>100%</b>                    |
| E. Bed General          | 1. General channel bed aggradation areas (bar formation)   | NA                                       | NA                        | 0                                     | 100%                          |                                |
|                         | 2. Channel bed degradation - areas of increasing down cutting or head cutting?                     | NA                                       | NA                        |                                       | 100%                          | <b>100%</b>                    |
| F. Channel Capac./Dimen | 1. Channel width: depth appears out of design/type spec?   | NA                                       | NA                        | N/A                                   | N/A                           | <b>N/A</b>                     |
| G. Banks                | 1. Apparent scour points from channel processes  | NA                                       | NA                        | 0                                     | 100%                          |                                |
|                         | 2. Apparent cut points from overland flow  | NA                                       | NA                        | 0                                     | 100%                          |                                |
|                         | 3. Apparent cut or scour from flood water re-entry to channel (e.g. inadequate floodplain access?) | NA                                       | NA                        | 0                                     | 100%                          |                                |
|                         | 4. Tension cracks  | NA                                       | NA                        | 0                                     | 100%                          |                                |
|                         | 5. Bank gradient in excess of 40%?   | NA                                       | NA                        | 130                                   | 99%                           |                                |
|                         | 6. Collapse/slumping   | NA                                       | NA                        | 0                                     | 100%                          |                                |
|                         | 7. Ratio of bank height: bankfull height elevated  | NA                                       | NA                        | N/A                                   | 100%                          | <b>100%</b>                    |
| H. Vanes                | 1. Free of back or arm scour?  | 53                                       | 56                        | NA                                    | 95%                           |                                |
|                         | 2. Height appropriate?   | 53                                       | 56                        | NA                                    | 95%                           |                                |
|                         | 3. Angle and geometry appear appropriate?  | 53                                       | 56                        | NA                                    | 95%                           |                                |
|                         | 4. Free of piping or other structural failures?  | 55                                       | 56                        | NA                                    | 98%                           | <b>96%</b>                     |
| I. Wads/Boulders        | 1. Free of scour?  | N/A                                      | N/A                       | N/A                                   | N/A                           | <b>N/A</b>                     |
|                         | 2. Footing stable?   | N/A                                      | N/A                       | N/A                                   | N/A                           | <b>N/A</b>                     |

Notes: