TICK CREEK STREAM RESTORATION – NCEEP Project #379

Third Annual Monitoring Report – FINAL

January 2009

Submitted to:

North Carolina Department of
Environment and Natural Resources
Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, NC 27699-1652

TICK CREEK STREAM RESTORATION – Project # 379
2008 MONITORING REPORT

CONDUCTED FOR THE NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

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I. Executive Summary/Project Abstract

The Tick Creek stream restoration and preservation project is located southeast of Siler City, in Chatham County, North Carolina, southeast of the intersection of Rives Chapel Church Road and Jim Moody Road. The project design, completed by the North Carolina Department of Transportation (NCDOT) in 2002, includes preservation of a 114 foot wide buffer along 3,733 feet of Tick creek (immediately downstream of the Rives Chapel Church Road bridge), and restoration of 2,597 feet of an unnamed tributary to Tick Creek (UT). The entire project occupies 29 contiguous acres in USGS HUC 03030003070023 (NCDWQ Cape Fear River Subbasin 03-06-12). Construction was completed on the Tick Creek site on 1 September 2005 and bare rootstock planting was completed during the week of 6 February 2006. Per the September 2002 Mitigation Plan, the site is to be monitored for three years. Upon successful completion of three years of monitoring, the site will be ready of review by the resource agencies (NCDOT 2002).

RJG&A has monitored the site since 2006. In both 2006 and 2007 the project met its geomorphologic and vegetation goals. Per our contract with NCEEP, 2008 is the last year that the project will be monitored and no geomorphic quantitative data were collected.

Average planted woody stem density (excluding live stakes) was 587 live stem per acre and has exceeded the vegetation success criteria by 83 percent. Dog fennel (*Eupatorium capillofolium*) and Chinese lespedeza (*Lespedeza cuneata*) continue to thrive in portions of Reach 2. Exotic invasives (*Eleaganus umbellate, Albizia julibrissin, Ligustrum sinense* and *L. japonicum*) are present throughout the restoration.

II. Project Background

2.1. Project Objectives

According to the 2002 Mitigation Plan written by NCDOT, the Tick Creek Stream Restoration Project was designed to achieve the following eight goals and objectives:

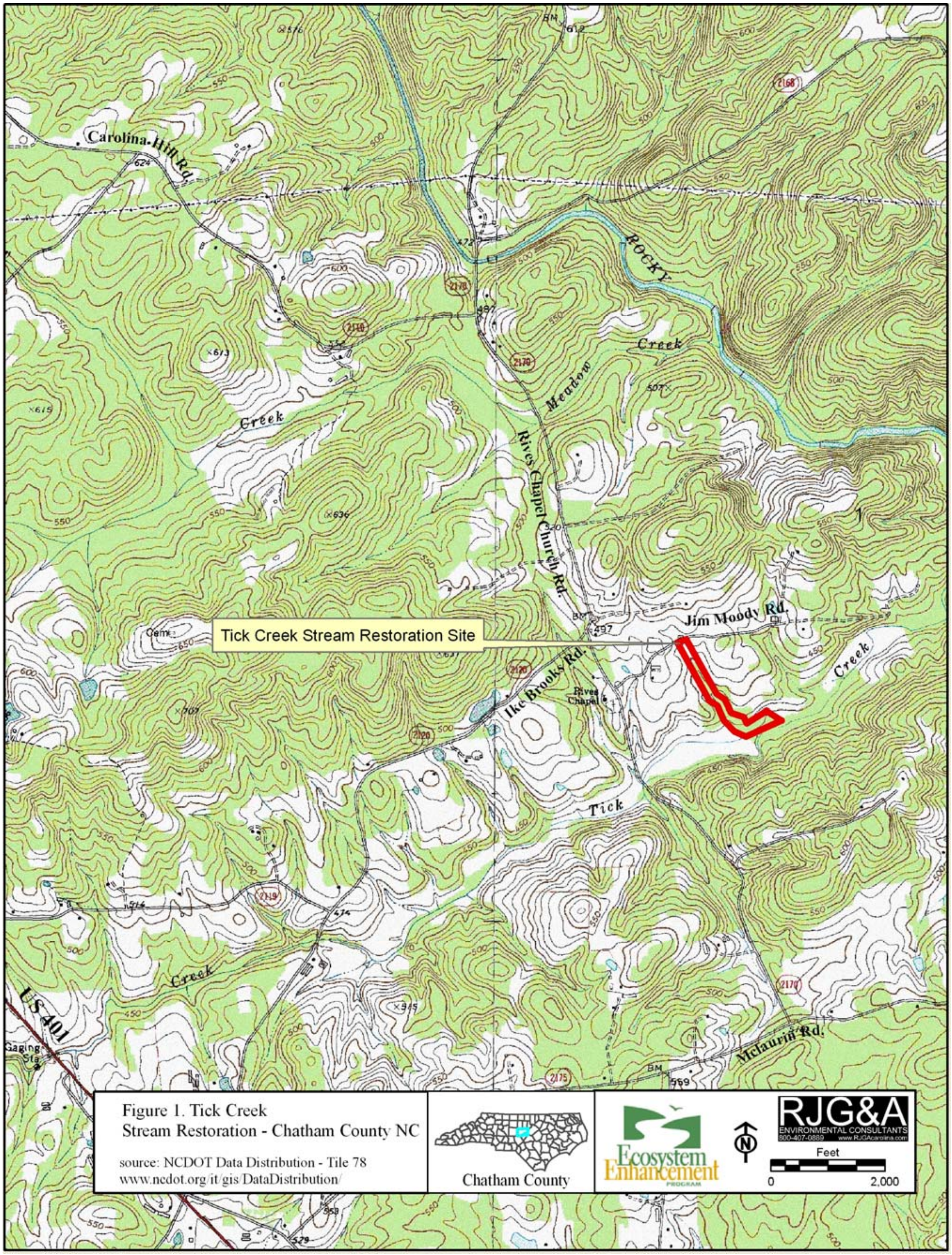
1. Preserve 3,733 linear feet of Tick Creek (as measured along the thalweg);
2. Restore 2,946 linear feet (349 feet longer than the existing reach of an unnamed tributary);
3. Provide a minimum of a 200-foot buffer along the Tick Creek reach being preserved for the protection of freshwater mussels found along the 3,733 linear foot reach;
4. Provide a stable stream channel for the Unnamed Tributary that neither aggrades nor degrades while maintaining its dimension, pattern, and profile with the capacity to transport its watershed's water and sediment load;
5. Improve water quality and reduce erosion by stabilizing the stream banks for both streams by improving riparian vegetation;
6. Reconnect the Unnamed Tributary to its floodplain;
7. Improve aquatic habitat of the tributary with the use of natural material stabilization structures such as root wads, rock vanes, woody debris, and a riparian buffer;
8. Provide aesthetic value, wildlife habitat, and bank stability through the creation or enhancement of a riparian zone (NCDOT 2002).

2.2. Project Structure, Mitigation Type, and Approach

The Tick Creek Stream Restoration Project involved the preservation of 3,733 linear feet of Tick Creek and a Priority I restoration of 2,946 linear feet of an unnamed tributary that flows into Tick Creek. The project involved bedform transformations, channel dimension adjustments, pattern alterations, structure installation (root wads, rock vanes, and woody debris), and riparian buffer restoration (woody vegetation planting and stock exclusion).

2.3. Location and Setting

To get to the Tick Creek restoration site from U.S. 64, turn south on Rives Chapel Church Road (~0.9 mile east of Siler City), travel 4.4 miles, turn left (east) onto Jim Moody Road. The upstream boundary of the unnamed tributary restoration site is 0.3 miles east of the intersection, on the right (south) side of the road. The project's western easement boundary (preservation) begins on the downstream side of the Rives Chapel Church Road Bridge over Tick Creek (south of the Jim Moody Rd. intersection) (Figure 1).


Tick Creek Stream Restoration Site
Carolina Hill Rd.
Rives Chapel Church Rd.
Jim Moody Rd.
Ike Brooks Rd.
Mclaurin Rd.
Meadow
Creek
ROCKY
Tick
Creek
US 401
Figure 1. Tick Creek
Stream Restoration - Chatham County NC
source: NCDOT Data Distribution - Tile 78
www.ncdot.org/it/gis/DataDistribution/
Chatham County
Ecosystem Enhancement
RJG&A
ENVIRONMENTAL CONSULTANTS
Feet
0
2,000

The 2002 Tick Creek Restoration Plan describes the site's pre-restoration land use as cattle pasture that involved agricultural clearing, stream ditching and straightening, and unrestricted cattle access to the stream. This land use caused bank instability, which increased sediment load. This caused the direct loss of aquatic habitat and caused the impairment and degradation of aquatic resources along the restoration project's entire reach (from the Jim Moody Road culvert, to the confluence with Tick Creek).

2.4. History and Background

The project design was completed by the North Carolina Department of Transportation (NCDOT) in 2002, and includes preservation of a 114 foot wide buffer along 3,733 feet of Tick Creek and restoration of 2,597 feet of an unnamed tributary to Tick Creek (UT). Construction was completed on the Tick Creek site on 1 September 2005 and bare rootstock planting was completed during the week of 6 February 2006.

Exhibit Table I. Mitigation Structure and Objectives (from NCDOT Tick Creek Restoration Plan) Tick Creek Stream Restoration – EEP Project #379

Reach ID	Existing Feet/Acres	Type	Approach	Footage or Acreage	Stationing	Comment
Tick Creek	3,733	P		3,733		Protection of high quality aquatic habitat (rare mussels)
Reach 1	2,597	R	P1	300	00-300	Shallow pools, small meanders, and steep riffles
Reach 2		R	P1	1,500	300-1800	Realigned, widened floodplain
Reach 3		R	P1	980	1800-2780	Realigned, reconnected to floodplain

Exhibit Table II. Activity and Reporting History Tick Creek Stream Restoration - EEP Project #379		
Activity or Report	**Data Collection**	**Completion**
Restoration Plan	February – May 2002	September 2002
Construction	NA	September 2005
Temporary S&E mix applied	NA	NA
Permanent seed mix applied	NA	NA
Bare Root Planting	NA	February 2006
Mitigation Plan	NA	NA
As-built	March 2006	
Year 1 Monitoring		November 2006
Vegetation	September 2006	
Geomorphologic	October 2006	
Year 2 Monitoring		October 2007
Qualitative Evaluation	April and October 2007	
Vegetation	July 2007	
Geomorphologic	July 2007	
Year 3 Monitoring		November 2008
Qualitative Evaluation	May and November 2008	
Vegetation	July 2008	
Geomorphologic	N/A	

Exhibit Table III. Project Contacts - Tick Creek Stream Restoration – EEP Project #379 – Chatham County, NC	
Design:	Earth Tech 701 Corporation Center Drive, Suite 475 Raleigh, NC 27607 Mr. Ron Johnson (919) 854-6210 North Carolina Department of Transportation Natural Environment Unit Natural Environment Engineering Group 1598 Mail Service Center, Raleigh, NC 27699-1598 Mr. Jamie Lancaster, Supervisor (919) 715-1441
Construction Contractor:	Not Provided
Planting Contractor:	Not Provided
Seeding Contractor:	Not Provided
Seed Mix Sources:	Not Provided
Nursery Stock Suppliers:	Not Provided
Monitoring Performers (2006-2008):	Monitoring Performers: RJG&A 1221 Corporation Parkway, Suite 100 Raleigh, NC 27616 Mr. Sean Doig (919) 872-1174

Exhibit Table IV. Project Background - Tick Creek Stream Restoration - EEP Project #379	
County	Chatham
Drainage Area	96 acres (0.15 square miles)
Drainage Impervious Cover Estimate (%)	<5%
Stream Order	First Order
Physiographic Region	Piedmont
Ecoregion	Carolina Slate Belt
Rosgen Classification of As-built	
Reach 1	B6
Reach 2	C5b
Reach 3	E6
Dominant Soil Types	
Reach 1	Georgeville silt loam
Reach 2	Georgeville silt loam
Reach 3	Nanford Badin complex (upper ~500 feet), Riverview (lower ~400 feet, to confluence with Tick Creek)

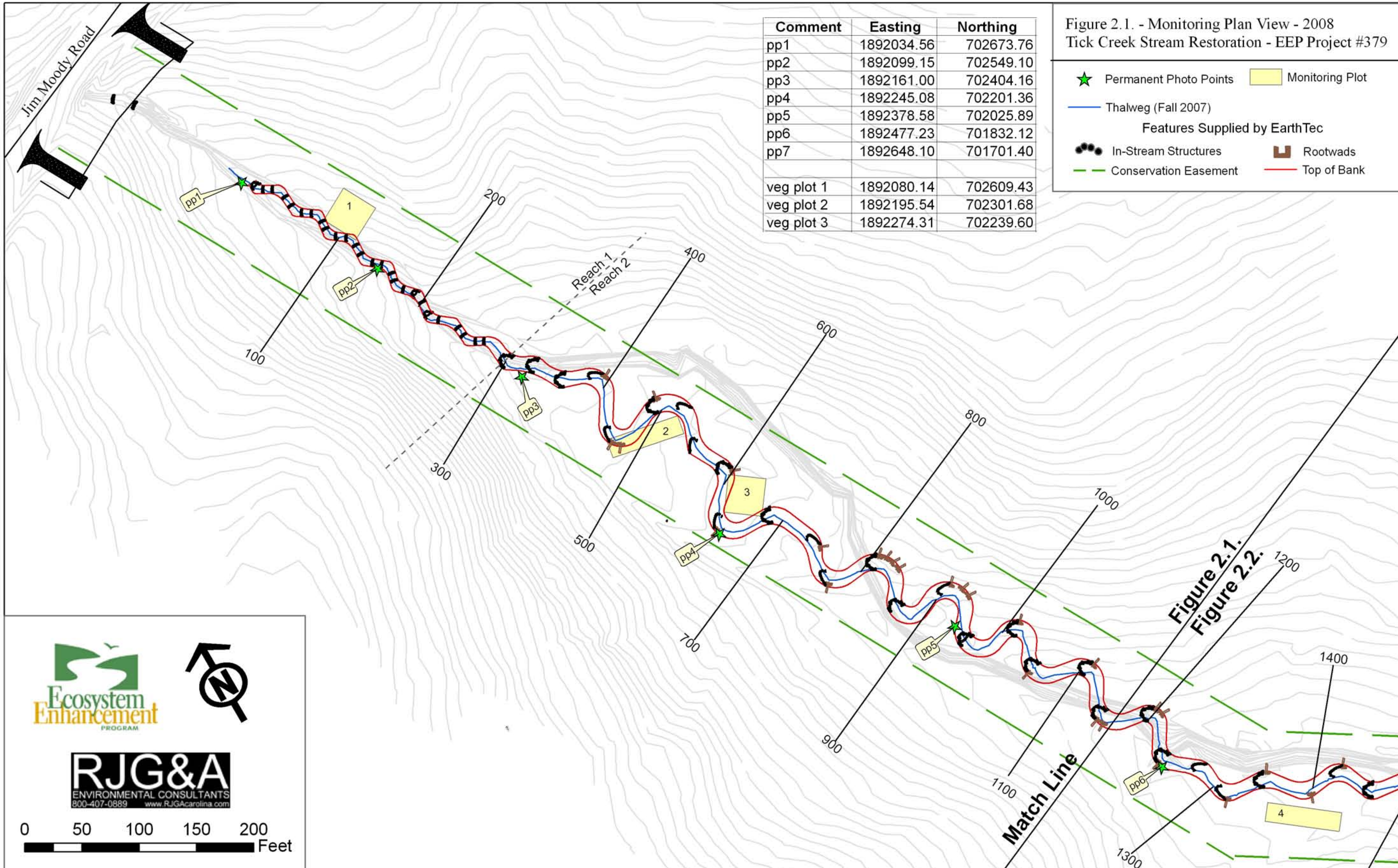
Exhibit Table IV. Project Background - Tick Creek Stream Restoration - EEP Project #379	
Reference Site ID	Spencer Creek (located in Uwharrie National Forest in the Yadkin-Pee Dee River Basin)
USGS HUC for Project and Reference	03030003070023, 03040103050090
NCDWQ Sub-basin for Project and Reference	03-06-12, 03-07-09
NCDWQ Classification for Project and Reference	C
Any portion of the project segment 303d listed?	No
Any portion of the project segment upstream of a 303d listed segment?	No – not in NCDWQ 30-06-12
Reasons for 303d Listing or Stressor	NA
% of Project Easement Fenced	0%

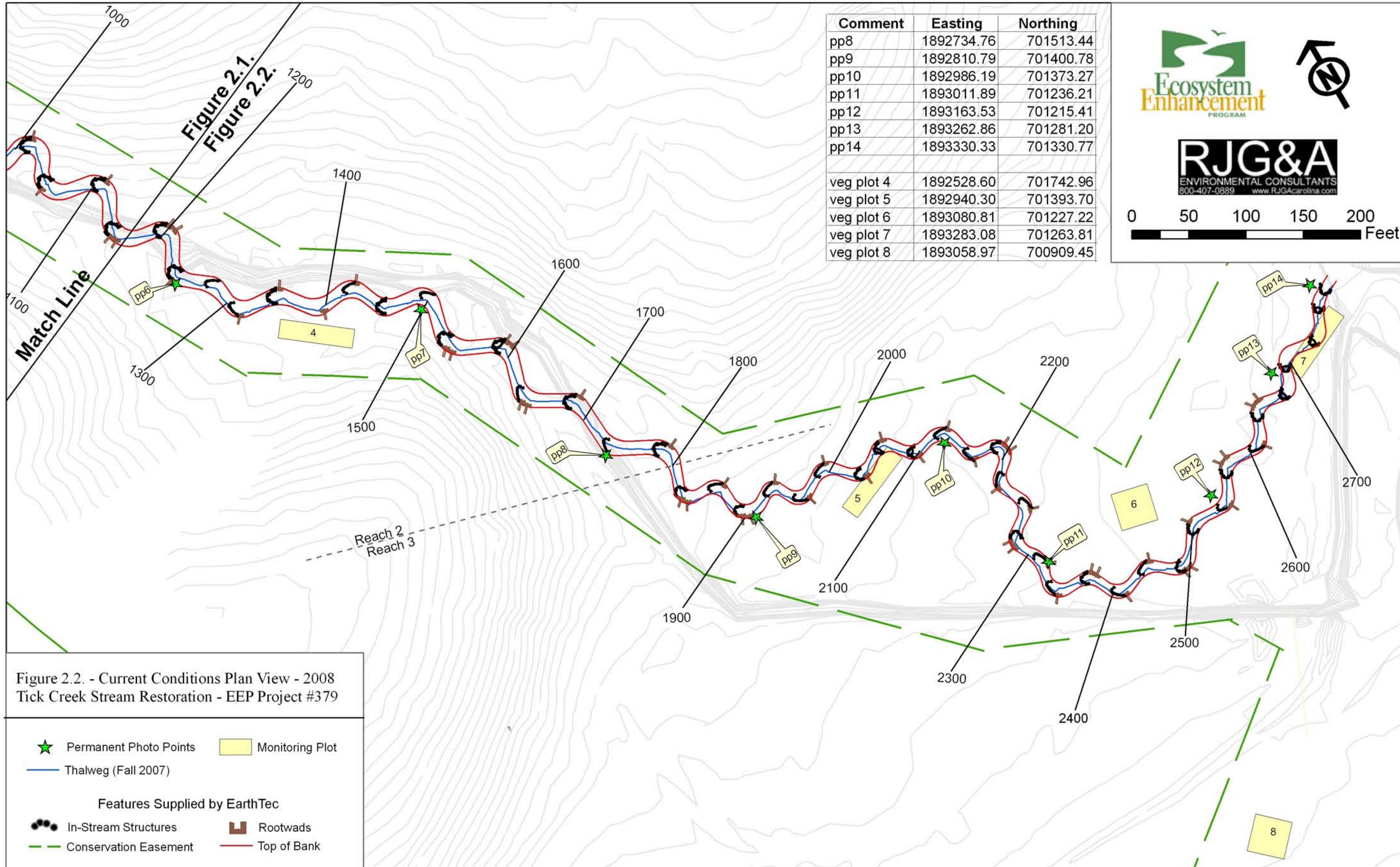
2.5. Monitoring Plan View

See Figure 2 for Monitoring Plan View.

Figure 2.1. - Monitoring Plan View - 2008
Tick Creek Stream Restoration - EEP Project #379

Comment	Easting	Northing
pp1	1892034.56	702673.76
pp2	1892099.15	702549.10
pp3	1892161.00	702404.16
pp4	1892245.08	702201.36
pp5	1892378.58	702025.89
pp6	1892477.23	701832.12
pp7	1892648.10	701701.40
veg plot 1	1892080.14	702609.43
veg plot 2	1892195.54	702301.68
veg plot 3	1892274.31	702239.60





Comment	Easting	Northing
pp8	1892734.76	701513.44
pp9	1892810.79	701400.78
pp10	1892986.19	701373.27
pp11	1893011.89	701236.21
pp12	1893163.53	701215.41
pp13	1893262.86	701281.20
pp14	1893330.33	701330.77
veg plot 4	1892528.60	701742.96
veg plot 5	1892940.30	701393.70
veg plot 6	1893080.81	701227.22
veg plot 7	1893283.08	701263.81
veg plot 8	1893058.97	700909.45

Figure 2.2. - Current Conditions Plan View - 2008
Tick Creek Stream Restoration - EEP Project #379

Permanent Photo Points
Monitoring Plot
Thalweg (Fall 2007)

Features Supplied by EarthTec
In-Stream Structures
Rootwads
Conservation Easement
Top of Bank

III. Project Conditions and Monitoring Results

The first qualitative project evaluation in monitoring year 3 was conducted on 15 May 2008. Third annual quantitative vegetation data were collected during July 2008. The site was again qualitatively assessed on 11 November 2008.

Flowing water was observed in the channel in 2008 during the May and November site visits. No water was observed during the July site visit. Several geomorphologic problem areas were observed during the May and November evaluations.

3.1. Vegetation Assessment

In 2008, the average density for all reaches was 587 live stems per acre, exceeding the required stem density (320 live stems per acre) by 83 percent. Twelve woody stem species were originally planted at Tick Creek. *Quercus alba*, *Platanus occidentalis*, *Fraxinus pennsylvanica*, and *Salix nigra* had the highest stem density (Appendix A: Table 5). A total of 37 stems recorded in 2007 were missing or dead in 2008, resulting in a mortality rate of 23 percent (Appendix A: Table 2). Summary vegetation monitoring data and plot photos for Monitoring Year 2 can be found in Appendix A.

3.1.1. Vegetation Problem Areas

Vegetation problem areas at the Tick Creek restoration site include sparse planting, invasive herbaceous cover, and relatively low planting success (Figures B.1.1. and B.1.2.). Reach 1 woody stem planting density was an issue in the areas furthest from the stream banks (Appendix A3-VP1). Natural succession of perennials, primarily blackberry (*Rubus argutus*) has begun throughout Reach 1. This type of early sucessional herbaceous density is common in recently disturbed areas and can be beneficial to the planted stems by prolonging soil moisture in upland areas and reducing early evapotranspiration.

In Reach 2, dog fennel (*Eupatorium capillofolium*), and Chinese lespedeza's (*Lespedeza cuneata*) continue to be a problem (Appendix A.3.-VP2). The planted woody stem success under these invasive herbaceous stands is relatively high, so, continued observation, without remedial action, is appropriate.

Reach 3 continues to have relatively minimal invasive species problems. *Rubus argutus* has become more widespread around monitoring plot 8. Plot 6 continues to suffer from a lower success rate than the remaining plots in the restoration (Appendix A.3.-VP3). As noted in previous years, suspected cause is substrate compaction. The Restoration Design Plan View map indicates that a relatively large *staging area* was located here during construction. Because of the adequate live planted stem density in plot 6, no remedial action is recommended at this time.

3.1.2. Current Conditions Plan View

See Figures B.1.1 and B.1.2. in Appendix B for the Current Conditions Plan View.

3.2. Stream Assessment

3.2.1. Procedural Items

3.2.1.1. Morphometric Criteria

RJG&A staff qualitatively evaluated the condition and success of the Tick Creek Stream Restoration project during May, July, and November 2008. Overall, the site appears to be maintaining its as-built dimension, pattern, and profile. Based on guidance from EEP, RJG&A did not collect any geomorphologic data. Photographs were taken at 14 permanent photo locations (established by NCDOT during February 2006) during the May survey.

3.1.1.2. Hydrologic Criteria

No crest gauges are installed on the Tick Creek site and on-site quantitative hydrologic evaluation is therefore not possible. As reported in the spring 2008 Initial Assessment, on-site qualitative evidence of at least one bankfull event (rack and drift lines and downed vegetation/stems above the bankfull elevation) was observed on 15 May 2008 at several cross vanes and on the inside of meanders. The previous site visit/observation was October 2007.

The USGS stream gauge on Tick Creek near Mount Vernon Springs (USGS 02101800) is located approximately three miles upstream from the restoration's confluence with Tick Creek. It has a drainage of 15.5 square miles. Bankfull discharge at this gage is 655.2 cubic feet per second (cfs) (Harmen 1999). Data from this gage from September 2005, when construction was completed, to December 2008 appears in Figure 3 (USGS 2009) and demonstrates that bankfull events likely occurred in November and December of 2006, April and May of 2007, and March and September 2008. The graph also highlights the drought that affected the area for much of 2007 into the first few months of 2008. Heavy precipitation on 4 March and 6-7 September confirms the likelihood of bankfull events at the restoration site (NC CRONOS 2009).

Figure 3. USGS Stream gauge data for Tick Creek upstream of US 421 - Tick Creek Stream Restoration - EEP Project #379

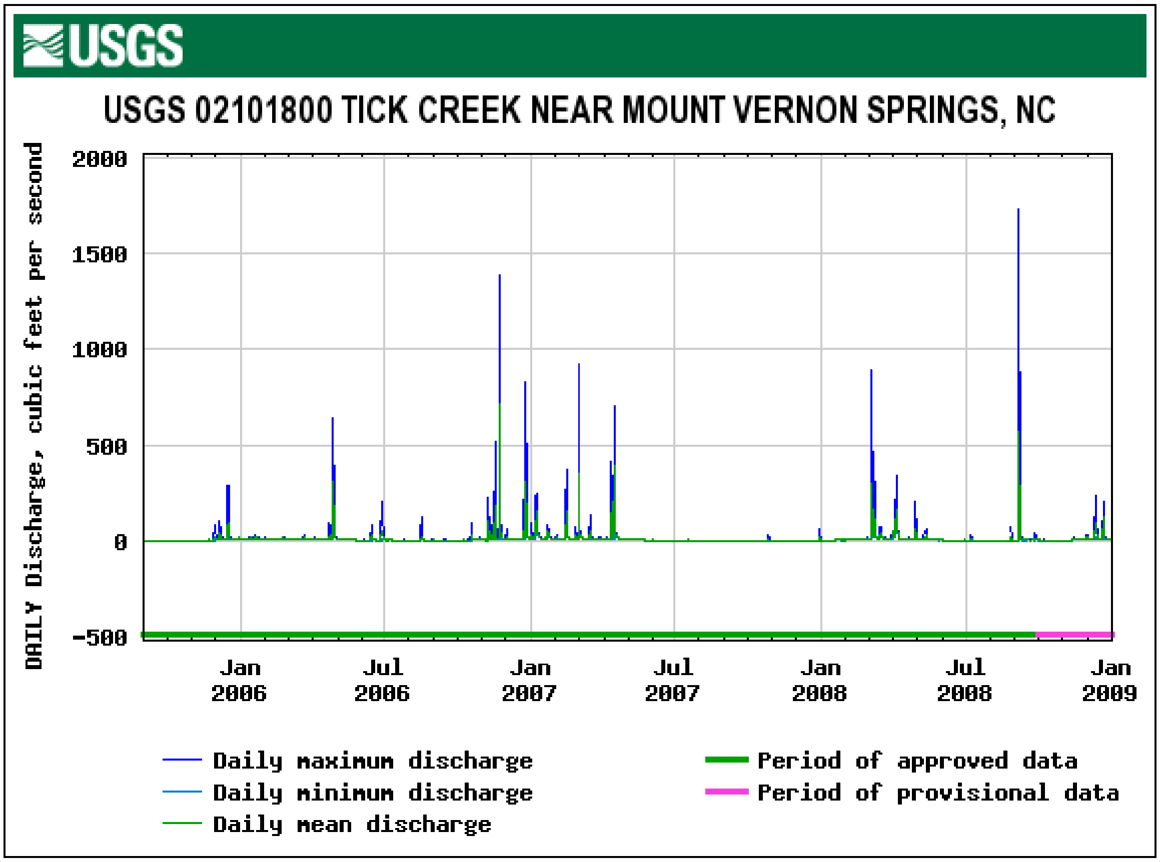


Exhibit Table V. Verification of Bankfull Events – Tick Creek Stream Restoration - EEP Project #379			
Date of Data Collection	**Date of Occurrence (mm/dd/yy)**	**Method**	**CFS**
NA	11/26/06	Proximal USGS gauge resource	1,390
NA	12/25/06	Proximal USGS gauge resource	832
NA	4/15/07	Proximal USGS gauge resource	670
NA	4/16/07	Proximal USGS gauge resource	704
NA	5/2/07	Proximal USGS gauge resource	919
NA	3/4/08	Proximal USGS gauge resource	880
15 May 2008	4 March 2008	Wrack and drift lines	NA
NA	9/7/08	Proximal USGS gauge resource	1700

3.2.2. Stream Problem Areas

Headcuts and piping around some of the cross vanes in Reaches 2 and 3 continue to be a problem. The headcuts and piping at stations 2050 and 2568 continue to be the most severe and should be monitored. Additionally, low flow during the 2007 drought allowed fescue and other herbaceous cover to grow in the stream channel (Appendix B.3). This has negatively affected the bank stability and pattern of the channel and in several places the thalweg is unidentifiable. It is assumed, however, that if normal rainfall patterns return and stream distcharge increases that herbaceous cover will die back and the creek will re-establish a sediment discharge regime.

3.2.3. Fixed Photo Station Photos

Appendix B4 contains the 16 photo station photos.

3.2.4. Stability Assessment

Exhibit Table VII. Categorical Stream Feature Visual Stability Assessment Tick Creek Stream Restoration - EEP Project #379				
Reach 1(300 feet)				
Feature	Initial*	MY-01	MY-02	MY-03
A. Riffles	100%	100%	100%	100%
B. Pools	100%	100%	100%	100%
C. Thalweg	100%	100%	100%	100%
D. Meanders	100%	100%	100%	100%
E. Bed General	100%	100%	100%	100%
F. Bank	100%	100%	100%	100%
G. Vanes/J Hooks, etc.	100%	100%	100%	100%
H. Wads and Boulders	NA	NA	NA	NA
Reach 2 (1,500 feet)				
A. Riffles	100%	100%	100%	92%
B. Pools	100%	100%	100%	90%
C. Thalweg	100%	100%	82%	91%
D. Meanders	100%	100%	100%	100%
E. Bed General	100%	100%	100%	99%
F. Bank	100%	100%	100%	100%
F. Vanes/J Hooks, etc.	100%	93%	95%	100%
G. Wads and Boulders	100%	100%	99%	97%

*These percentages are assumed. Neither the As-built Monitoring Report nor the First Year Monitoring Report contained any visual stability assessment data.

Exhibit Table VII. Categorical Stream Feature Visual Stability Assessment Tick Creek Stream Restoration - EEP Project #379				
Reach 3 (980 feet)				
A. Riffles	100%	100%	100%	96%
B. Pools	100%	99%	100%	94%
C. Thalweg	100%	100%	100%	100%
D. Meanders	100%	100%	100%	100%
E. Bed General	100%	100%	100%	97%
F. Bank	100%	100%	100%	97%
G. Vanes/J Hooks, etc.	100%	92%	92%	85%
H. Wads and Boulders	100%	100%	100%	96%

IV. Methodology

Monitoring methodologies follow the current EEP-provided templates and guidelines (Lee *et al* 2006). Photographs were taken digitally. A Trimble Geo XT handheld mapping-grade unit was used to collect problem area locations.

4.1. Stream Methodology

Following guidance from NCEEP, RJG&A did not collect any geomorphologic data in 2008. Qualitative assessments of the stream restoration were done during May, July, and November using the criteria specified in the Mitigation Plan, the First Annual Monitoring Report, and standard regulatory guidance and procedures documents.

4.2. Vegetation Methodology

Eight representative vegetation survey plots were selected and installed in reaches 1, 2, and 3 during September 2006, pursuant to the EEP/CVS vegetation monitoring protocol (Lee *et al* 2006). All plots measure 100 square meters and are either 10 meters by 10 meters, or five meters by 20 meters. Pursuant to the guidelines, the four corners of each plot (0,0; 0,10; 10,0; and 10,10) were marked with 18 inch long one half inch diameter galvanized steel conduit.

Level 1 (planted woody stems) and Level 2 (volunteer woody stems) data collection was performed in all plots, pursuant to the most recent CVS/EEP protocol (Lee *et al* 2006). Within each plot, each planted woody stem location (x and y) was recorded, and height and live stem diameter were recorded for each stem location. All planted stems were identified with pink flagging. Vegetation was identified using Weakley (Weakley 2007). Photos were taken of each vegetation plot from the 0,0 corner.

Tables 1 through 5 in Appendix A contain the data from the vegetation monitoring. Monitoring plot photos can also be found in Appendix A.

References

Harrelson, Cheryl, C. L. Rawlins, and John Potpondy. (1994). *Stream Channel Reference Sites: An Illustrated Guide to Field Technique.* USDA, Forest Service. General Technical Report RM-245.

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Weakley, Alan (2007). *Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas*. Retrieved March 27, 2007 from: http://www.herbarium.unc.edu/flora.htm.

Appendix A Vegetation Data

A1. Vegetation Data Tables

- Table 1. Vegetation Metadata
- Table 2. Vegetation Vigor by Species
- Table 3. Damage by Species
- Table 4. Damage by Plot
- Table 5. Stem Count by Plot and Species
- Table 6. Vegetation Problem Areas

A2. Vegetation Problem Area Photos

A3. Vegetation Monitoring Plot Photos

Appendix A.1.
Table 1. Vegetation Metadata

Report Prepared By	Sean Doig
Date Prepared	10/21/2008 10:43
database name	379TickCreek-2008Resampling-EntryTool-v2.2.5.mdb
database location	C:\Documents and Settings\Owner\Desktop\CVS EEP
computer name	GATELAP
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT------------	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY	
Project Code	379
project Name	Tick Creek
Description	Stream Restoration
River Basin	Cape Fear
length(ft)	2,946
stream-to-edge width (ft)	50
area (sq m)	27,369
Required Plots (calculated)	8
Sampled Plots	8

Appendix A.1.

Table 2. Vegetation Vigor by Species

	Species	**4**	**3**	**2**	**1**	**0**	**Missing**	**Unknown**
	Betula nigra	8				2		
	Cornus amomum	2						
	Fraxinus pennsylvanica	12	7	5		2	2	
	Quercus alba	8	9	4		2	6	
	Quercus falcata	1						
	Quercus nigra	3					1	
	Quercus phellos	2						
	Salix nigra	19	6	1		7	2	
	Quercus rubra	7	2	1				
	Liriodendron tulipifera	9	2	1		10	1	
	Platanus occidentalis	33	1				2	
TOT:	**11**	**104**	**27**	**12**		**23**	**14**	

Appendix A.1.
Table 3. Vegetation Damage by Species

	Species	All Damage Categories	(no damage)	Beaver	Diseased	Insects	Vine Strangulation
	Betula nigra	10	10				
	Cornus amomum	2	2				
	Fraxinus pennsylvanica	28	23		2	1	2
	Liriodendron tulipifera	23	23				
	Platanus occidentalis	36	21	14		1	
	Quercus alba	30	30				
	Quercus falcata	1	1				
	Quercus nigra	4	4				
	Quercus phellos	2	2				
	Quercus rubra	10	10				
	Salix nigra	37	37				
TOT:	**11**	**183**	**163**	**14**	**2**	**2**	**2**

Appendix A.1.
Table 4. Damage by Plot

	plot	All Damage Categories	(no damage)	Beaver	Diseased	Insects	Vine Strangulation
	379-wjs-0003-year:2	21	20			1	
	379-wjs-0004-year:2	12	12				
	379-wjs-0005-year:2	31	30			1	
	379-wjs-0006-year:2	18	18				
	379-wjs-0007-year:2	42	28	14			
	379-wjs-0008-year:2	23	22		1		
	379-wjs-tck1-year:2	17	17				
	379-wjs-tckwjs2-year:2	19	16		1		2
TOT:	**8**	**183**	**163**	**14**	**2**	**2**	**2**

Appendix A.1.
Table 5. Stem Count by Plot and Species

	Species	Total Planted Stems	# plots	avg# stems	plot 379-wjs-0003-year:2	plot 379-wjs-0004-year:2	plot 379-wjs-0005-year:2	plot 379-wjs-0006-year:2	plot 379-wjs-0007-year:2	plot 379-wjs-0008-year:2	plot 379-wjs-tck1-year:2	plot 379-wjs-tckwjs2-year:2
	Betula nigra	8	1	8							8	
	Cornus amomum	2	1	2							2	
	Fraxinus pennsylvanica	24	3	8	13					4		7
	Liriodendron tulipifera	12	3	4			2	5		5		
	Platanus occidentalis	34	3	11.33		10	10		14			
	Quercus alba	21	2	10.5				10	11			
	Quercus falcata	1	1	1								1
	Quercus nigra	3	2	1.5		1						2
	Quercus phellos	2	1	2								2
	Quercus rubra	10	1	10						10		
	Salix nigra	26	6	4.33	5	1	11		3		4	2
TOT:	**11**	**143**	**11**		**18**	**12**	**23**	**15**	**28**	**19**	**14**	**14**

Appendix A.1.

Table 6. Vegetation Problem Areas – Tick Creek Stream Restoration EEP Project #379			
Feature/Issue	**Station/Range**	**Probable Cause**	**Photo #**
No/Limited planting	30 - 290	Planting oversight	VP1
Dense herbaceous invasives	550 - 1530	Abundant groundwater	VP2
Lower planted woody stem success (relative to Reaches 1 and 2)	2340 - 2575	Soil compaction during construction	VP3

A.2. Representative Vegetation Problem Photos - Year 3 - 2008 - Tick Creek Stream Restoration (EEP Project #379)

VP1 - Limited/No planting (11/11/2008)

VP2 - Dense herbaceous cover (11/11/2008)

VP3 - Lower planted woody stem success (11/11/2008)

Appendix A3. Vegetation Monitoring Plot Photographs - 2007 & 2008 - Tick Creek Stream Restoration

Plot 1 (August 13, 2007)

Plot 1 (July 23, 2008)

Plot 2 (August 13, 2007)

Plot 2 (July 23, 2008)

Appendix A3. Vegetation Monitoring Plot Photographs - 2007 & 2008 - Tick Creek Stream Restoration

Plot 3 (August 13, 2007)

Plot 3 (July 23, 2008)

Plot 4 (August 13, 2007)

Plot 4 (July 23, 2008)

Appendix A3. Vegetation Monitoring Plot Photographs - 2007 & 2008 - Tick Creek Stream Restoration

Plot 5 (August 13, 2007)

Plot 5 (July 23, 2008)

Plot 6 (August 13, 2007)

Plot 6 (July 23, 2008)

Appendix A3. Vegetation Monitoring Plot Photographs - 2007 & 2008 - Tick Creek Stream Restoration

Plot 7 (August 13, 2007)

Plot 7 (July 23, 2008)

Plot 8 (August 13, 2007)

Plot 8 (July 23, 2008)

Appendix B Geomorphologic Raw Data

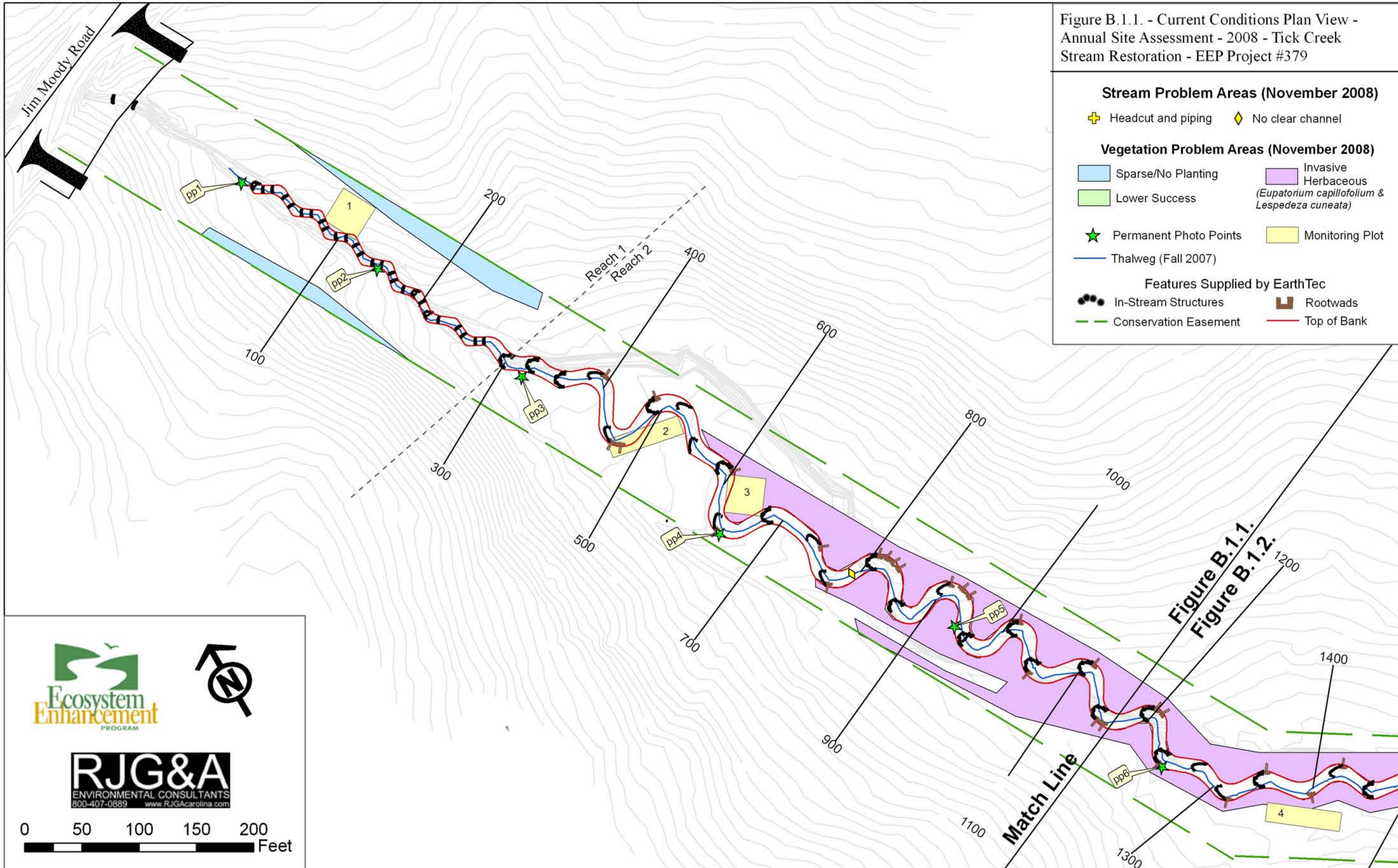
Figure B.1.1. - Current Conditions Plan View - Annual Site Assessment - 2008 - Tick Creek Stream Restoration - EEP Project #379
Stream Problem Areas (November 2008)
Headcut and piping
No clear channel
Vegetation Problem Areas (November 2008)
Sparse/No Planting
Lower Success
Invasive Herbaceous
(Eupatorium capillofolium & Lespedeza cuneata)
Permanent Photo Points
Monitoring Plot
Thalweg (Fall 2007)
Features Supplied by EarthTec
In-Stream Structures
Rootwads
Conservation Easement
Top of Bank
Jim Moody Road
Reach 1
Reach 2
Match Line
Figure B.1.1.
Figure B.1.2.
pp1
pp2
pp3
pp4
pp5
pp6
1
2
3
4
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
Ecosystem Enhancement Program
RJG&A
ENVIRONMENTAL CONSULTANTS
800-407-0889 www.RJGAcarolina.com
N
0
50
100
150
200
Feet

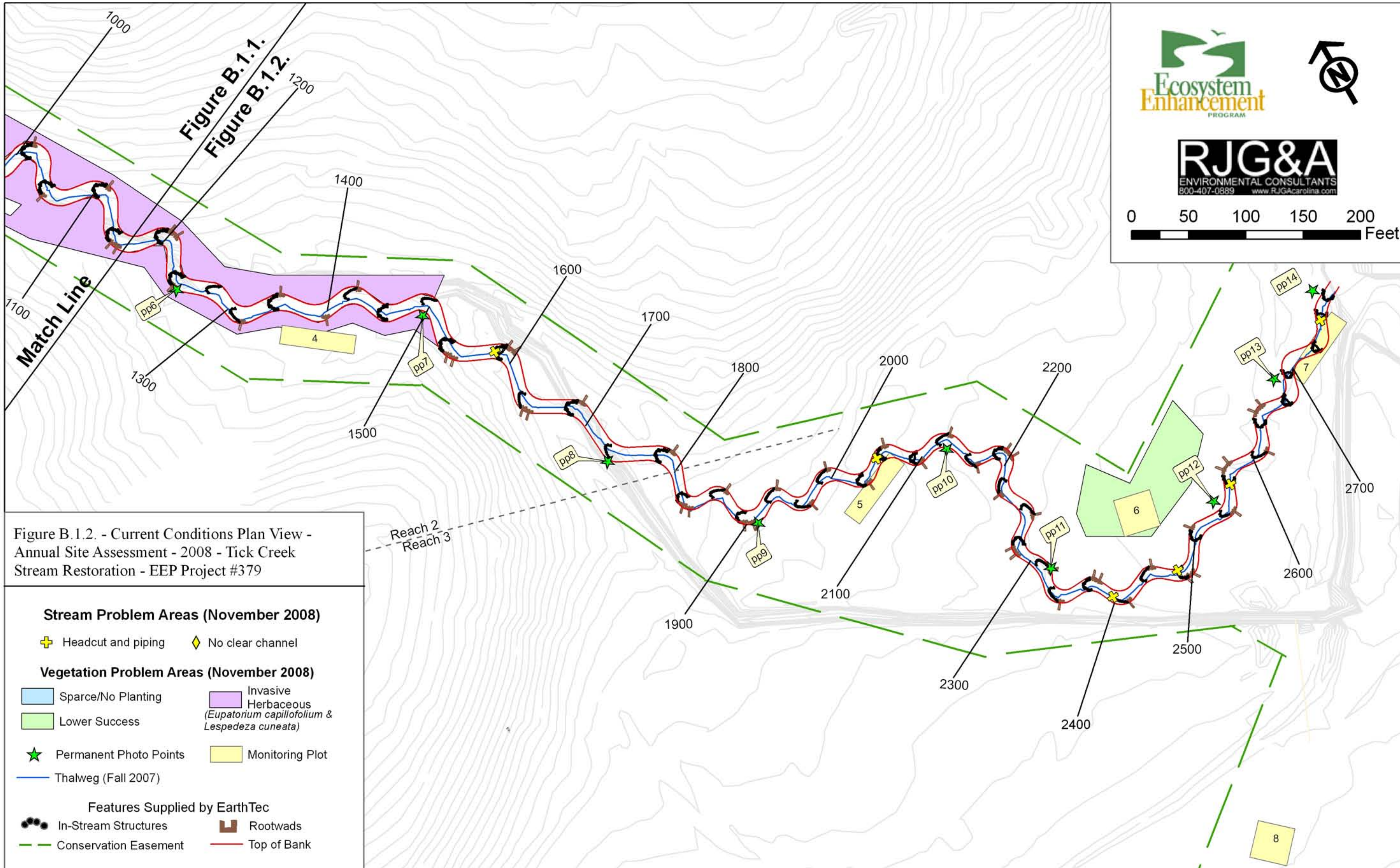

Figure B.1.2. - Current Conditions Plan View - Annual Site Assessment - 2008 - Tick Creek Stream Restoration - EEP Project #379

Appendix B.2. Stream Problem Areas Table - Year 3 - 2008 - Tick Creek Stream Restoration (EEP Project #379)

Feature/Issue	Station	Suspected Cause	Photo #
Reach 2			
No clear channel	790	Low flows have allowed vegetation to establish itself in the channel	SP1
Backcut and piping	1580	Low flows, poor sediment transport, lack of coarse backfill	SP2 & SP3
Reach 3			
Backcut and piping	2051	Low flows, poor sediment transport, lack of coarse backfill	SP2 & SP3
Backcut and piping	2398	Low flows, poor sediment transport, lack of coarse backfill	SP2 & SP3
Backcut and piping	2465	Low flows, poor sediment transport, lack of coarse backfill	SP2 & SP3
Backcut and piping	2568	Low flows, poor sediment transport, lack of coarse backfill	SP2 & SP3
Backcut and piping	2748	Low flows, poor sediment transport, lack of coarse backfill	SP2 & SP3

B.3. Representative Stream Problem Photos - Year 3 - 2008 - Tick Creek Stream Restoration (EEP Project #379)

SP1 - Lack of defined channel (11/11/2008)

SP2 - Backcut and piping (11/11/2008)

SP3 - Backcut and piping (11/11/2008)

Appendix B.4. Permanent Photopoint Photographs - 2007 & 2008 - Tick Creek - EEP Project #379

PP#1 Looking Upstream (08/23/07)

PP#1 Looking Upstream (05/15/08)

PP#2 Looking Upstream (08/17/07)

PP#2 Looking Upstream (05/15/07)

Appendix B.4. Permanent Photopoint Photographs - 2007 & 2008 - Tick Creek - EEP Project #379

PP#3 Looking Upstream (08/17/07)

PP#3 Looking Upstream (05/15/08)

PP#4 Looking Downstream (08/17/07)

PP#4 Looking Downstream (05/15/08)

Appendix B.4. Permanent Photopoint Photographs - 2007 & 2008 - Tick Creek - EEP Project #379

PP#5 Looking Downstream (08/17/07)

PP#5 Looking Downstream (05/15/08)

PP#6 Looking Downstream (08/17/07)

PP#6 Looking Downstream (05/15/08)

Appendix B.4. Permanent Photopoint Photographs - 2007 & 2008 - Tick Creek - EEP Project #379

PP#7 Looking Downstream (08/17/07)

PP#7 Looking Downstream (05/15/08)

PP#8 Looking Downstream (08/17/07)

PP#8 Looking Downstream (05/15/08)

Appendix B.4. Permanent Photopoint Photographs - 2007 & 2008 - Tick Creek - EEP Project #379

PP#9 Looking Downstream (08/17/07)

PP#9 Looking Downstream (05/15/08)

PP#10 Looking Downstream (08/20/07)

PP#10 Looking Downstream (05/15/08)

Appendix B.4. Permanent Photopoint Photographs - 2007 & 2008 - Tick Creek - EEP Project #379

PP#11 Looking Downstream (08/20/07)

PP#11 Looking Downstream (05/15/08)

PP#12 Looking Downstream (08/20/07)

PP#12 Looking Downstream (05/15/08)

Appendix B.4. Permanent Photopoint Photographs - 2007 & 2008 - Tick Creek - EEP Project #379

PP#13 Looking Downstream (08/20/07)

PP#13 Looking Downstream (05/15/08)

PP#14 Looking Downstream (08/20/07)

PP#14 Looking Downstream (05/15/08)

Appendix B.5. Visual Morphology Stability Assessment - Tick Creek Stream Restoration Project - Project #379

Reach 1 (300 feet)

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	Percent Performing in Stable Condition	**Feature Performing Mean (%)**
A. Riffles	1. Present	12	12	NA	100	
	2. Armor stable	12	12	NA	100	
	3. Facet grade appears stable	12	12	NA	100	
	4. Minimal evidence of embedding/fining	12	12	NA	100	
	5. Length appropriate	12	12	NA	100	**100**
B. Pools	1. Present	13	13	NA	100	
	2. Sufficiently deep	13	13	NA	100	
	3. Length appropriate	13	13	NA	100	**100**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering	12	12	NA	100	
	2. Downstream of meander (glide/inflection) centering	12	12	NA	100	**100**
D. Meanders	1. Outer bend in state of limited/controlled erosion	12	12	NA	100	
	2. Of those eroding, # w/concomitant point bar formation	0	0	NA	100	
	3. Apparent Rc within spec	12	12	NA	100	
	4. Sufficient floodplain access and relief	12	12	NA	100	**100**
E. Bed (General)	1. General channel bed aggradation areas (bar formation)	NA	NA	0/0	100	
	2. Channel bed degradation – areas of increasing downcutting or head cutting	NA	NA	0/0	100	**100**
F. Bank	1. Actively eroding, wasting, or slumping bank	NA	NA	0/0	100	**100**
G. Vanes	1. Free of back or arm scour	27	27	NA	100	
	2. Height appropriate	27	27	NA	100	
	3. Angle and geometry appear appropriate	27	27	NA	100	
	4. Free of piping or other structural failures	27	27	NA	100	**100**
H. Wads/ Boulders	1. Free of scour	NA	NA	NA	NA	
	2. Footing stable	NA	NA	NA	NA	**NA**

Appendix B.5. Visual Morphology Stability Assessment - Tick Creek Stream Restoration Project - Project #379

Reach 2 (1500 feet)

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	Percent Performing in Stable Condition	**Feature Performing Mean (%)**
A. Riffles	1. Present	36	39	NA	92	
	2. Armor stable	35	39	NA	90	
	3. Facet grade appears stable	37	39	NA	95	
	4. Minimal evidence of embedding/fining	36	39	NA	92	
	5. Length appropriate	35	39	NA	90	**92**
B. Pools	1. Present	41	44	NA	93	
	2. Sufficiently deep	30	44	NA	68	
	3. Length appropriate	38	44	NA	86	**83**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering	30	32	NA	94	
	2. Downstream of meander (glide/inflection) centering	28	32	NA	88	**91**
D. Meanders	1. Outer bend in state of limited/controlled erosion	32	32	NA	100	
	2. Of those eroding, # w/concomitant point bar formation	0	0	NA	100	
	3. Apparent Rc within spec	32	32	NA	100	
	4. Sufficient floodplain access and relief	32	32	NA	100	**100**
E. Bed (General)	1. General channel bed aggradation areas (bar formation)	NA	NA	0/0	100	
	2. Channel bed degradation – areas of increasing downcutting or head cutting	NA	NA	4/27	98	**99**
F. Bank	1. Actively eroding, wasting, or slumping bank	NA	NA	0/0	100	**100**
G. Vanes	1. Free of back or arm scour	27	27	NA	100	
	2. Height appropriate	27	27	NA	100	
	3. Angle and geometry appear appropriate	27	27	NA	100	
	4. Free of piping or other structural failures	27	27	NA	100	**100**
H. Wads/ Boulders	1. Free of scour	32	34	NA	94	
	2. Footing stable	34	34	NA	100	**NA**

Appendix B.5. Visual Morphology Stability Assessment - Tick Creek Stream Restoration Project - Project #379

Reach 3 (980 feet)

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	Percent Performing in Stable Condition	**Feature Performing Mean (%)**
A. Riffles	1. Present	31	31	NA	100	
	2. Armor stable	31	31	NA	100	
	3. Facet grade appears stable	27	31	NA	87	
	4. Minimal evidence of embedding/fining	31	31	NA	100	
	5. Length appropriate	29	31	NA	94	**96**
B. Pools	1. Present	32	32	NA	100	
	2. Sufficiently deep	28	32	NA	88	
	3. Length appropriate	30	32	NA	94	**94**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering	30	30	NA	100	
	2. Downstream of meander (glide/inflection) centering	30	30	NA	100	**100**
D. Meanders	1. Outer bend in state of limited/controlled erosion	30	30	NA	100	
	2. Of those eroding, # w/concomitant point bar formation	0	30	NA	100	
	3. Apparent Rc within spec	30	30	NA	100	
	4. Sufficient floodplain access and relief	30	30	NA	100	**100**
E. Bed (General)	1. General channel bed aggradation areas (bar formation)	NA	NA	1/5	97	
	2. Channel bed degradation – areas of increasing downcutting or head cutting	NA	NA	2/15	97	**97**
F. Bank	1. Actively eroding, wasting, or slumping bank	NA	NA	2/10	97	**97**
G. Vanes	1. Free of back or arm scour	29	31	NA	94	
	2. Height appropriate	25	31	NA	81	
	3. Angle and geometry appear appropriate	25	31	NA	81	
	4. Free of piping or other structural failures	27	31	NA	87	**85**
H. Wads/ Boulders	1. Free of scour	32	34	NA	94	
	2. Footing stable	33	34	NA	97	**96**