

**UNNAMED TRIBUTARY TO BEAR SWAMP CREEK
STREAM RESTORATION SITE
2005 Annual Monitoring Report (Year 3)**

**Franklin County
EEP Project No. 27
Design Firm: Arcadis G&M of North Carolina, Inc.**



February, 2006

**Prepared for: NCDENR/ ECOSYSTEM ENHANCEMENT PROGRAM
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1.0 EXECUTIVE SUMMARY

The Unnamed Tributary to Bear Swamp Creek Stream Mitigation Site (hereafter referred to as the “Site”) was constructed for the North Carolina Ecosystem Enhancement Program (EEP) to provide compensatory stream mitigation in the Tar/Pamlico River Basin. This stream restoration project is located on an unnamed tributary to Bear Swamp Creek at the Murphy Hay Farm just north of the Town of Louisburg. This project involves the permanent exclusion of cattle from the stream, stabilization of eroding stream banks, installation of cross-vane structures for habitat, and the planting of a forested riparian buffer.

The following report summarizes the monitoring activities that have occurred in the past year (the third year of project monitoring) at the Site. Site construction began and was completed in July 2002. As-built surveys for the Site were performed in August 2002. First year monitoring was conducted in September 2003, and second year monitoring was performed in 2004. The Site must demonstrate vegetative criteria success and a stable restored stream channel for a minimum of five years or until the Site is deemed successful. The following paragraphs summarize the results of the current year monitoring.

Vegetation Monitoring

Vegetation success criteria for the forested riparian restoration areas is based on a minimum survival of 320 stems per acre of planted species at the end of Year 5. Volunteer woody vegetation will also be included in the survivability calculations. Based on the third year surveys, the average count of the surviving planted species is 620 stems per acre. If volunteer species are included, the total number of stems increases to 8,120 stems per acre.

The Site is meeting the established success criteria for vegetation based on the survival of the planted species. When volunteer species are included in the calculation, the densities are very high. This is typical of the early forest successional development process when open fields and pastures go fallow. Early successional species in abundance on the site include loblolly pine (*Pinus taeda*), red maple (*Acer rubrum*), and sweet gum (*Liquidambar styraciflua*). The heavy loblolly pine colonization, in particular, is becoming a nuisance as they compete with the more desirable species for light and nutrients. Measures may need to be undertaken in the near future to cull their numbers.

Stream Enhancement Monitoring

Success criteria for the restored stream reach has been established to confirm no significant changes have occurred to the dimension, pattern, profile, and bed material over the 5-year monitoring period. Location surveys of the constructed features were conducted to verify the performance of the stream. A total station survey was used to describe the stream longitudinal profile and five permanent stream cross-section (3 riffles and 2 pools). A modified Wolman pebble count and assessment of the constructed features was also undertaken.

Overall, the stream channel bed form is stable. Water surface and bed slopes have changed little from the as-built conditions. However, many of the grade control structures (rock vanes) in the stream have failed which has led to low to moderate bed degradation immediately behind these structures. Of the twenty-four rock vanes that were installed, ten are not performing their intended function. Six vanes have water piping through or behind the structure. The remaining four have filled-in with sediment and have become obsolete.

Based on the cross-sections and visual observations, the channel dimensions have not changed significantly. However, observed features and surveyed cross-section indicate that the channel has narrowed slightly and is developing a bankfull bench at many locations. The stream was designed as a B5c (step-pool) stream (Rosgen 1996), which provides a sand bed channel with moderate entrenchment and a moderate width-depth ratio. The current classification measurements are split, with the current channel exhibiting the moderate entrenchment characteristic of a B-channel, yet exhibiting a very low width-depth ratio of an E-channel. During the current survey, bankfull indicators were also found at a significantly lower elevation than those described by the designer. Caution is advised in interpreting and comparing past years data. This years morphological data is based on the newly identified bankfull elevation. Pebble counts show no significant change to the channel substrate.

2.0 PROJECT BACKGROUND

2.1 LOCATION AND SETTING

The Site is located north of Louisburg in Franklin County, NC, immediately south of Dyking Road (SR 1235) at the Murphy Hay Farm (Figure 1, Appendix A). From Raleigh follow Highway 401 north to Louisburg. Approximately one mile past the the Highway 561 split in Louisburg take a left onto Dyking Road. The Murphy Hay Farm will be approximately one mile on your left. The entrance to the stream restoration area is accessed by several gates through the electric fence. The stream restoration reach begins approximately 460 feet upstream of the road crossing and ends approximately 775 feet downstream.

2.2 RESTORATION STRUCTURE AND OBJECTIVES

Approximately 1,400 linear feet of an Unnamed Tributary to Bear Swamp Creek were identified on the 32-acre Murphy Hay Farm. The stream had severely degraded and eroded significantly due to past vegetation removal and the unrestricted access of cattle. The torrential rain events associated with Hurricanes Fran and Floyd provided the final impetus for restoration work. The stream originates at a pond approximately 500 feet east of Dyking Road and 1,000 feet east of the project. Land use in the watershed consists of agriculture, pature, forest, and single-family residential.

The design of the new stream included both Priority II and III stream restoration. The degraded F5 and G5c stream types were restored to a B5c (Rosgen 1996). Approxiamtely 664 linear feet of new channel was constructed; and 771 linear feet of stream was stabilized in-place. Approximalely 800 tons of rock were used to construct 24 rock vanes throughout the reach (Figure 2, Appendix A). The vanes were designed to improve hyraulic flow and reduce shear stress. The vanes also provided bed stabilization and improved stream habitat by creating pools. The steep, eroded banks were graded back and expanded to increase the entrenchment ratio. Root wads were also installed to provide bank protecting and additional habitat diversity. Approximately 2.4 acres of riparian vegetation was also established along the restored channel in Zone 1 (inner 30 feet) of the Tar/Pamlico Riparian Buffer. This riparian buffer zone has been fenced to exclude cattle. Site construction began and was completed in July 2002. Project monitoring began the next year in September 2003.

The objective of this project is to restore habitat and water quality to the restored reach and the Tar-Pamlico River Basin as a whole. By stablizing the streambed and banks, the restoration will improve water quality by reducing the amount of sediment contributed to the watershed. Exclusion of cattle and establishment of a permanent riparian buffer should further help reduce sediment and nutrient input. The newly established riparian buffer will provide shade, thereby reducing water temperatures, and increase habitat and food for wildlife.

Project Segment or Reach ID	Restoration Type	Approach	Linear Footage or Acreage	Stationing	Comments
Reach 1	R	P2/P3	780 linear feet*	Exact locations unknown	--
	S	SSS	680 linear feet*	Exact locations unknown	--
Riparian Vegetation Re-establishment	R	--	2.4 acres	N/A	--

*Linear footage values provided in the project's Mitigation Plan—reaches are not distinguished on figures or in text narrative

R = Restoration

P1 = Priority I

EI = Enhancement I

P2 = Priority II

EII = Enhancement II

P3 = Priority III

S = Stabilization

SSS = Stream Bank Stabilization

2.3 PROJECT HISTORY AND BACKGROUND

Activity Report	Scheduled Completion	Data Collection Complete	Actual Completion or Delivery
Restoration Plan	NA*	NA*	NA*
Final Design (90%)	NA*	NA*	NA*
Construction	NA*	NA*	July 2002
Temporary S&E mix applied to entire project area	NA*	NA*	NA*
Permanent seed mix applied to reach/segments	NA*	NA*	NA*
Bare Root Seedling Installation	NA*	NA*	NA*
Mitigation Plan	NA*	NA*	April 2003
Minor repairs made filling small washed out areas			May 2003
Final Report	NA*	NA	July 2003
Year 1 Vegetation Monitoring	NA*	Fall 2003	Jan 2004
Year 1 Stream Monitoring	NA*	Sept 2003	
Year 2 Vegetation Monitoring	NA*	NA*	NA*
Year 2 Stream Monitoring	NA*	NA*	
Year 3 Vegetation Monitoring	Dec 2005	Oct 2005	Dec 2005
Year 3 Stream Monitoring	Dec 2005	Nov 2005	

Bolded Items represent those events or deliverables that are variable. Non-bolded items represent events that are standard over the course of a typical project.

*NA – Historical project documents necessary to provide this data were unavailable at the time of this report submission.

Table 3. Project Contacts UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27	
Designer Arcadis G&M of North Carolina, Inc. (ARCADIS)	Mr. Robert Lepsic 801 Corporate Center Drive, Suite 300 Raleigh, NC 27607 (919) 854-1282
Construction Contractor SEI Environmental, Inc.	130 Penmarc Drive, Suite 108 Raleigh, NC 27603-2434
Planting Contractor North State Environmental, Inc.	2889 Lowery Street Winston Salem, NC 27101 (336) 725-2010
Seeding Contactor NA*	NA*
Seed Mix Sources	NA*
Nursery Stock Suppliers	NA*
Monitoring Performers	EcoScience Corporation 1101 Haynes Street, Suite 101 Raleigh, NC 27604 (919) 828-3433
Stream Monitoring POC	Jens Geratz
Vegetation Monitoring POC	Elizabeth Scherrer

*NA – Historical project documents necessary to provide this data were unavailable at the time of this report submission.

Table 4. Project Background UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27	
Project County	Franklin
Drainage Area	0.26 square miles
Impervious cover estimate (%)	<1 percent
Stream Order	1st order
Physiographic Region	Piedmont
Ecoregion (Griffith and Omernik)	Northern Outer Piedmont
Rosgen Classification of As-built	B5c
Cowardin Classification	Stream (R3UB2)
Dominant soil types	Wake-Saw-Wedowee Complex (WaB)
	Wedowee (WeB, WeC)
	Wake-Wateree-Wedowee Complex (WbD)
Reference Site ID	000543201A
USGS HUC for Project and Reference	03020101040010
NCDWQ Sub-basin for Project and Reference	03-03-01
NCDWQ classification for Project and Reference	NA*
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	N/A
Percent of project easement fenced	30-foot buffer fenced around entire reach

*NA – Historical project documents necessary to provide this data were unavailable at the time of this report submission.

3.0 PROJECT MONITORING AND RESULTS

3.1 VEGETATION ASSESSMENT

3.1.1 Soil Data

Series	Max Depth (in.)	% Clay on Surface	K	T	OM %
Wake-Saw-Wedowee Complex (WaB)	32	3-20	0.15-0.28	1-4	0.5-3
Wedowee (WeB, WeC)	32	5-20	0.24-0.28	4	0.5-3
Wake-Wateree-Wedowee Complex (WbD)	54	2-20	0.15-0.28	1-4	0.5-3

3.1.2 Vegetation Problem Areas

Feature / Issue	Station # / Range	Probable Cause	Photo #
Invasive Populations	Throughout, but especially at Vegetation Plot 1	<i>Pinus taeda</i> : seeding from adjacent stands	1 and 2
	Near Vegetation Plots 1 and 4	<i>Acer rubrum</i> : outside seed source	--
	Mainly at upstream end of site	<i>Lonicera japonica</i> : outside seed source	--
Bare Ground	0+50 to 1+00 and 1+50 to 2+00	Steep dry cut slope	3

A vegetation problem area plan view and photos are provided in Appendix B.

3.1.3 Stem Counts

The existing five 20-foot by 45-foot plots were located and the corners marked with steel fence posts painted orange. Stem counts were conducted for all woody species, including volunteer species. An inventory of planted species is given in Table 7. A tally of volunteer woody species is listed in Table 7a.

Species	Plots					Year 1 Totals*	Year 2 Totals	Survival %
	1	2	3	4	5			
Shrubs								
<i>Alnus serrulata</i>						0	0	--
<i>Cornus amomum</i>	3	6		3		13	12	92
<i>Ilex verticillata</i>						0	0	--
<i>Salix nigra</i>	4	21		3		19	29	153
<i>Sambucus canadensis</i>						0	0	--
Trees								
<i>Betula nigra</i>	4	1		1		0	6	--

Species	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Year 1 Totals	Year 2 Totals
<i>Carpinus caroliniana</i>						1	0
<i>Fraxinus pennsylvanica</i>		6	1		1	8	100
<i>Juglans nigra</i>	1	2				3	100
<i>Morus rubra</i>						1	0
<i>Ostrya virginiana</i>						5	0
<i>Quercus michauxii</i>	1			2	2	3	167
<i>Quercus pagoda</i>						1	0

* Initial Totals for planted species within vegetation plots are not available.

Species	Plots					Year 1 Totals	Year 2 Totals
	1	2	3	4	5		
<i>Acer negundo</i>	2	1				0	3
<i>Acer rubrum</i>	43			27	3	51	73
<i>Baccharis halimifolia</i>		2				0	2
<i>Celtis laevigata</i>			2			0	2
<i>Diospyros virginiana</i>			1			0	1
<i>Liquidambar styraciflua</i>	13				13	20	26
<i>Liriodendron tulipifera</i>	2			1		7	2
<i>Pinus taeda</i>	200	161	36	72	78	250	547
<i>Platanus occidentalis</i>					1	0	1
<i>Prunus serotina</i>		2		1	2	0	5
<i>Rhus copallina</i>						1	0
<i>Rhus glabra</i>	43					2	43
<i>Ulmus alata</i>	37		1	2	1	0	41
<i>Viburnum nudum</i>			3			0	3

An inventory of herbaceous species on the site was also taken. Dominant herbaceous species over the Site as a whole are listed below:

<i>Aster dumosus</i> (frost aster)	<i>Phytolacca americana</i> (pokeweed)
<i>Bidens frondosa</i> (beggar ticks)	<i>Polygonum</i> sp. (smartweed)
<i>Duchesnea indica</i> (Indian strawberry)	<i>Rumex crispus</i> (curly dock)
<i>Eupatorium capillifolium</i> (dog fennel)	<i>Solanum carolinianum</i> (horse nettle)
<i>Eupatorium fistulosum</i> (Joe Pye weed)	<i>Solidago</i> sp. (goldenrod)
<i>Helianthus angustifolius</i> (swamp sunflower)	<i>Toxicodendron radicans</i> (poison ivy)
<i>Lonicera japonica</i> (Japanese honeysuckle)	<i>Vernonia</i> sp. (ironweed)

3.2 STREAM ASSESSMENT

3.1.1 Bank Stability Assessment

Time Point	Segment/ Reach	Linear Footage	Extreme		Very High		High		Moderate		Low		Very Low		Sediment Export Tons/year
			ft	%	ft	%	ft	%	ft	%	ft	%	Ft	%	
3 rd year monitoring	Reach 1 Above Road	460	--	--	--	--	--	--	100	22	--	--	360	78	1.3
3 rd year monitoring	Reach 2 Below Road	975	--	--	--	--	--	--	--	--	50	5	925	95	0.4
3 rd year monitoring	Project Total	1435	--	--	--	--	--	--	100	7	50	3	1225	90	6.0

3.1.2 Stream Problem Areas

Feature Issue	Station Numbers	Suspected Cause	Photo Number
Vane 2, filled in		low slope, excess sediment	1
Vane 3, structure failure		Piping, inadequate use of filter fabric, steep vane arms	2
Vane 6, structure failure		Piping, inadequate use of filter fabric, steep vane arms	3
Vane 8, structure failure		Piping, inadequate use of filter fabric, steep vane arms	4
Vane 10, structure failure		Piping, inadequate use of filter fabric, steep vane arms	5
Vane 11, structure failure		Piping, inadequate use of filter fabric, steep vane arms	6
Vane 14, filled in		low slope, excess sediment	7
Vane 17, filled in		low slope, excess sediment	8
Vane 19, structure failure		Piping, inadequate use of filter fabric, steep vane arms	9
Vane 24, filled in		low slope, excess sediment	Not available
Incoming 4-inch pipe		No energy dissipater	10
Slight Bank Erosion		Floodplain restriction	11

A stream problem area plan view and photos of problem areas are provided in Appendix C

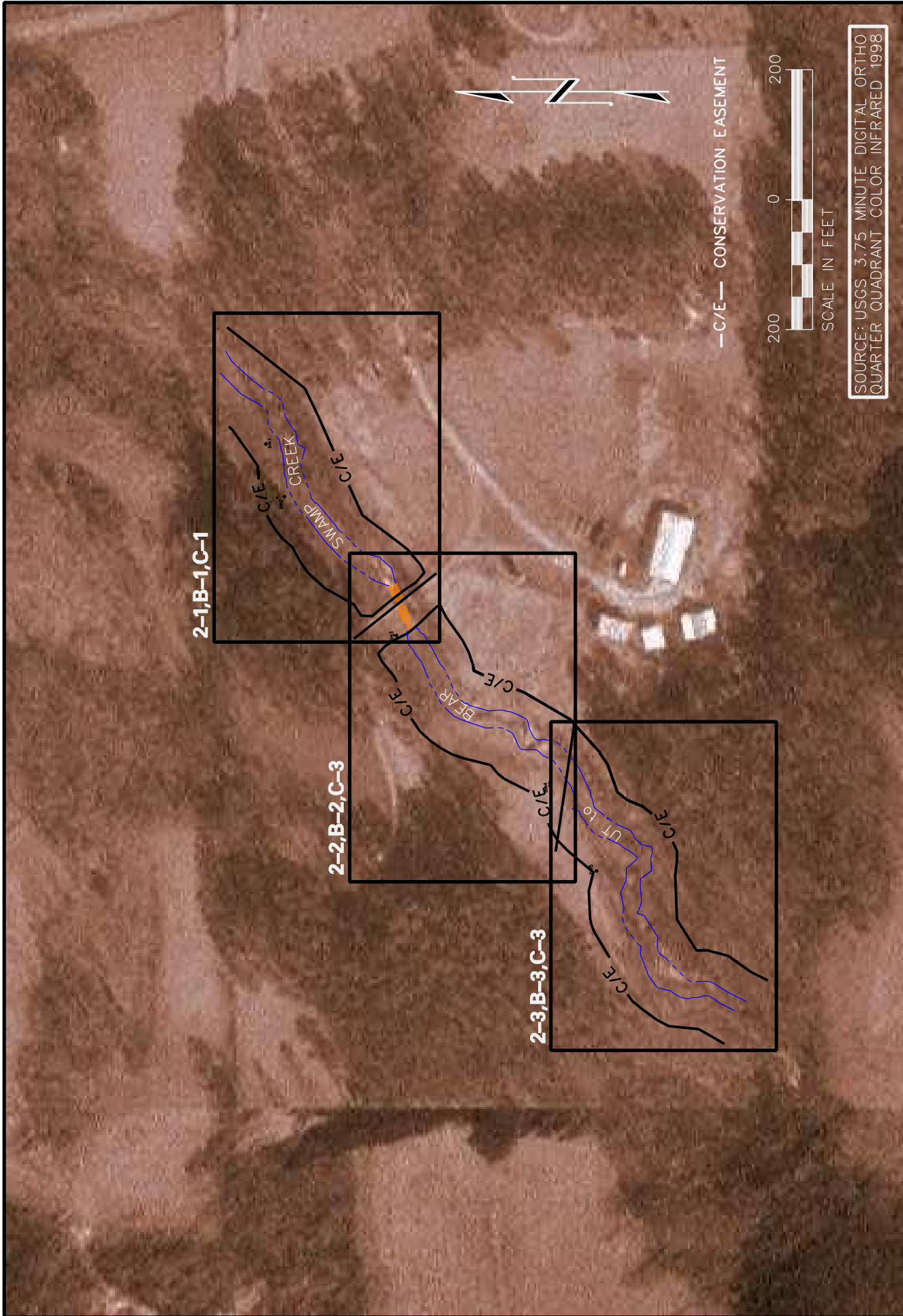
**Table 10. Categorical Stream Feature Visual Stability Assessment
 UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27
 Segment/Reach: 1,439 feet**

Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
A. Riffles	100%	NA*	NA*	80%		
B. Pools	100%	NA*	NA*	91%		
C. Thalweg	100%	NA*	NA*	88%		
D. Meanders	100%	NA*	NA*	77%		
E. Bed General	100%	NA*	NA*	95%		
F. Rock Vanes	100%	NA*	NA*	82%		
G. Root Wads	100%	NA*	NA*	86%		

*NA – Historical project documents necessary to provide this data were unavailable at the time of this report submission.

APPENDIX A

FIGURES



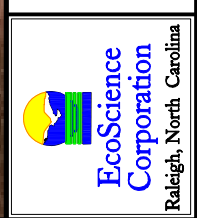
SOURCE: USGS 3,75 MINUTE DIGITAL ORTHO QUARTER QUADRANT COLOR INFRARED 1998

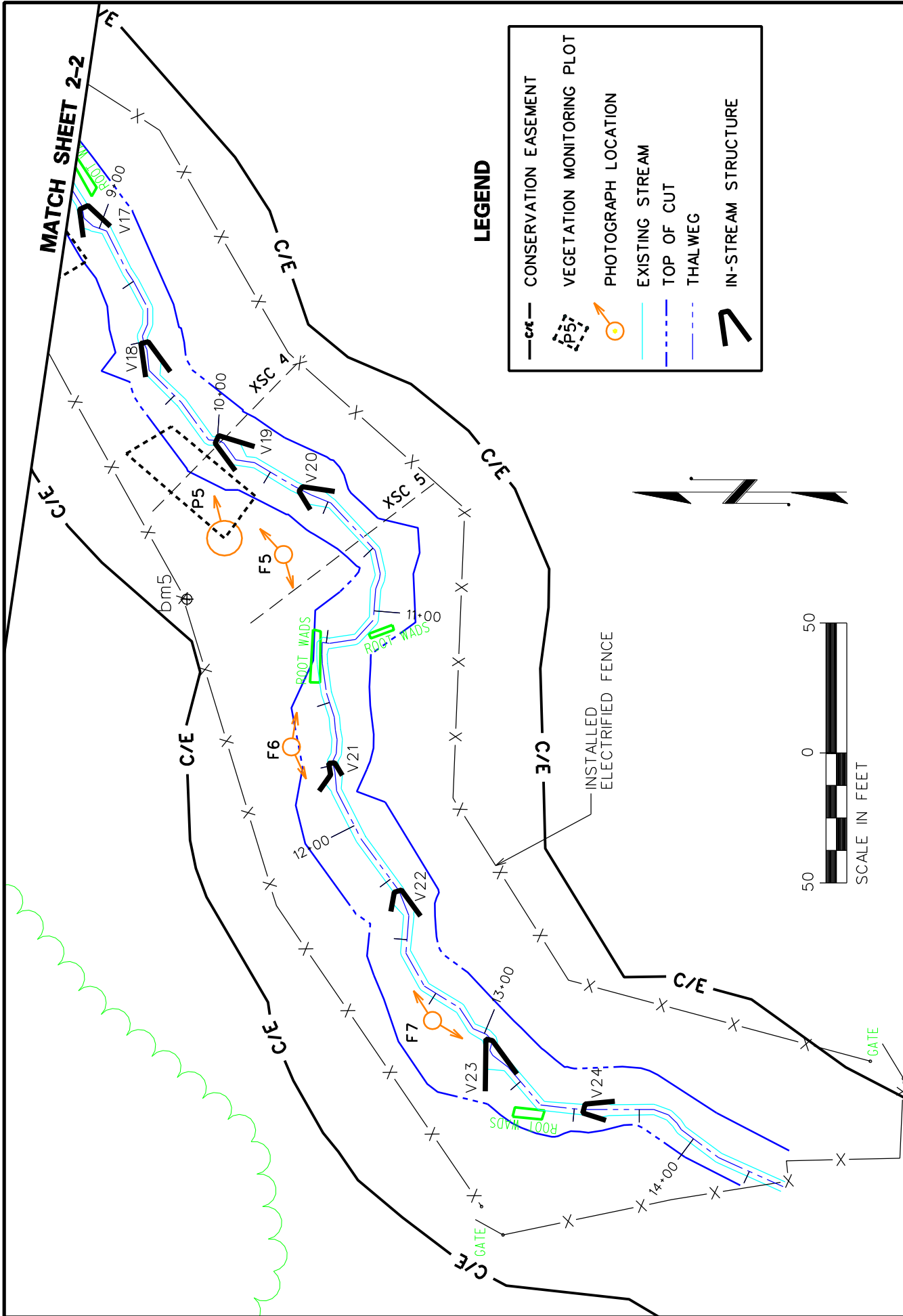
FIGURE
2

Dwn By:	JDG	Date:	DEC 2005
Ckd By:	JWG	Scale:	1" = 200'
ESC Project No.:		05-243.04	

MONITORING PLAN VIEW/SHEET INDEX
Unnamed Tributary to Bear Swamp Creek Stream Restoration Site

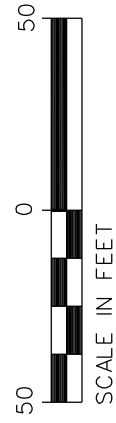
EEP Project No. 27
 FRANKLIN COUNTY, NORTH CAROLINA





LEGEND

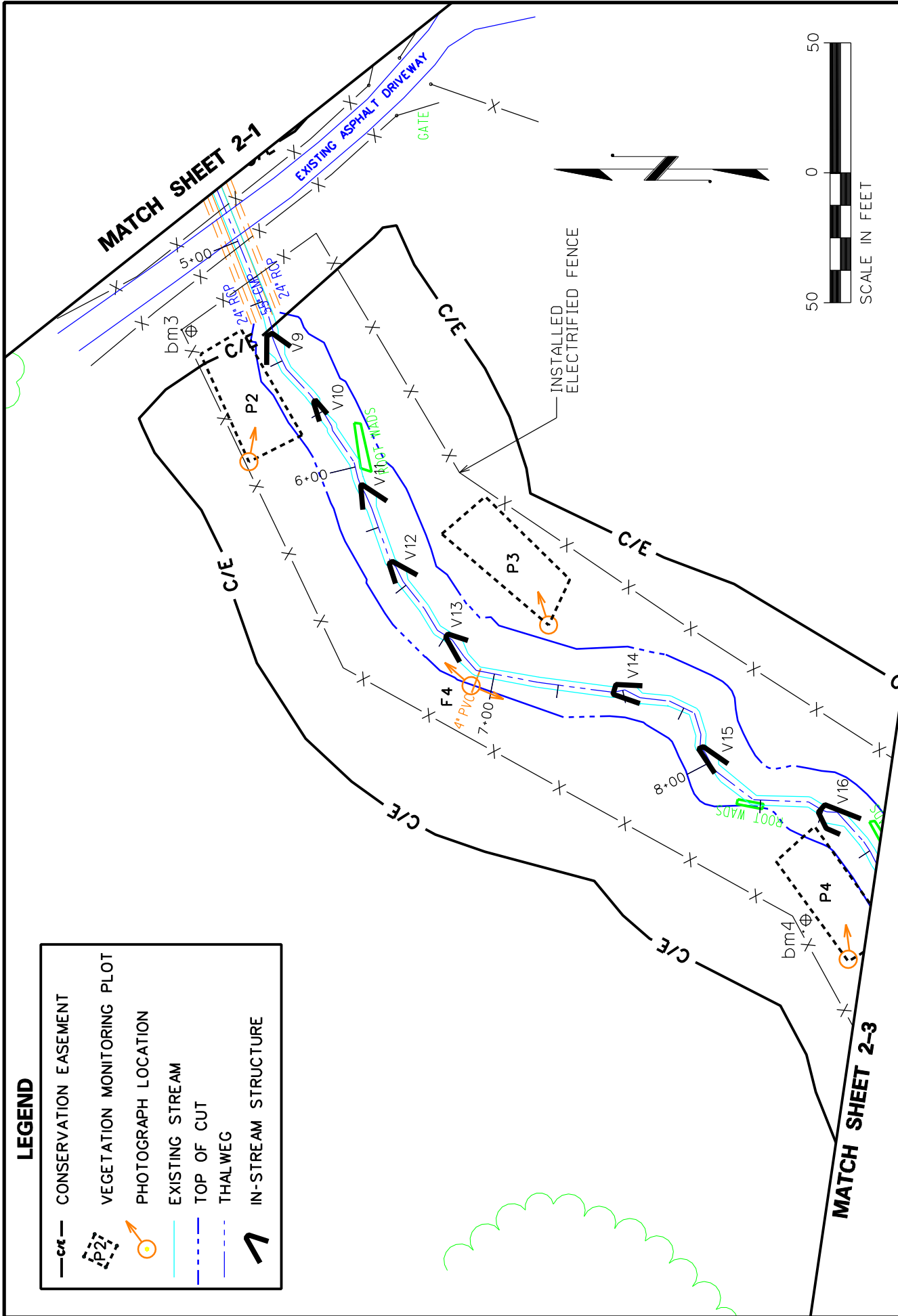
- CONSERVATION EASEMENT
- VEGETATION MONITORING PLOT
- PHOTOGRAPH LOCATION
- EXISTING STREAM
- TOP OF CUT
- THALWEG
- IN-STREAM STRUCTURE



 EcoScience Corporation Raleigh, North Carolina	Client:  Ecosystem Enhancement Program		Project: Monitoring Plan View Unnamed Tributary to Bear Swamp Creek Stream Restoration Site	
	Drawn By: JDG	Date: DEC 2005	FIGURE 2-3	
	Checked By: JWG	Scale: 1" = 50'	ESC Project No.: 05-243.04	

LEGEND

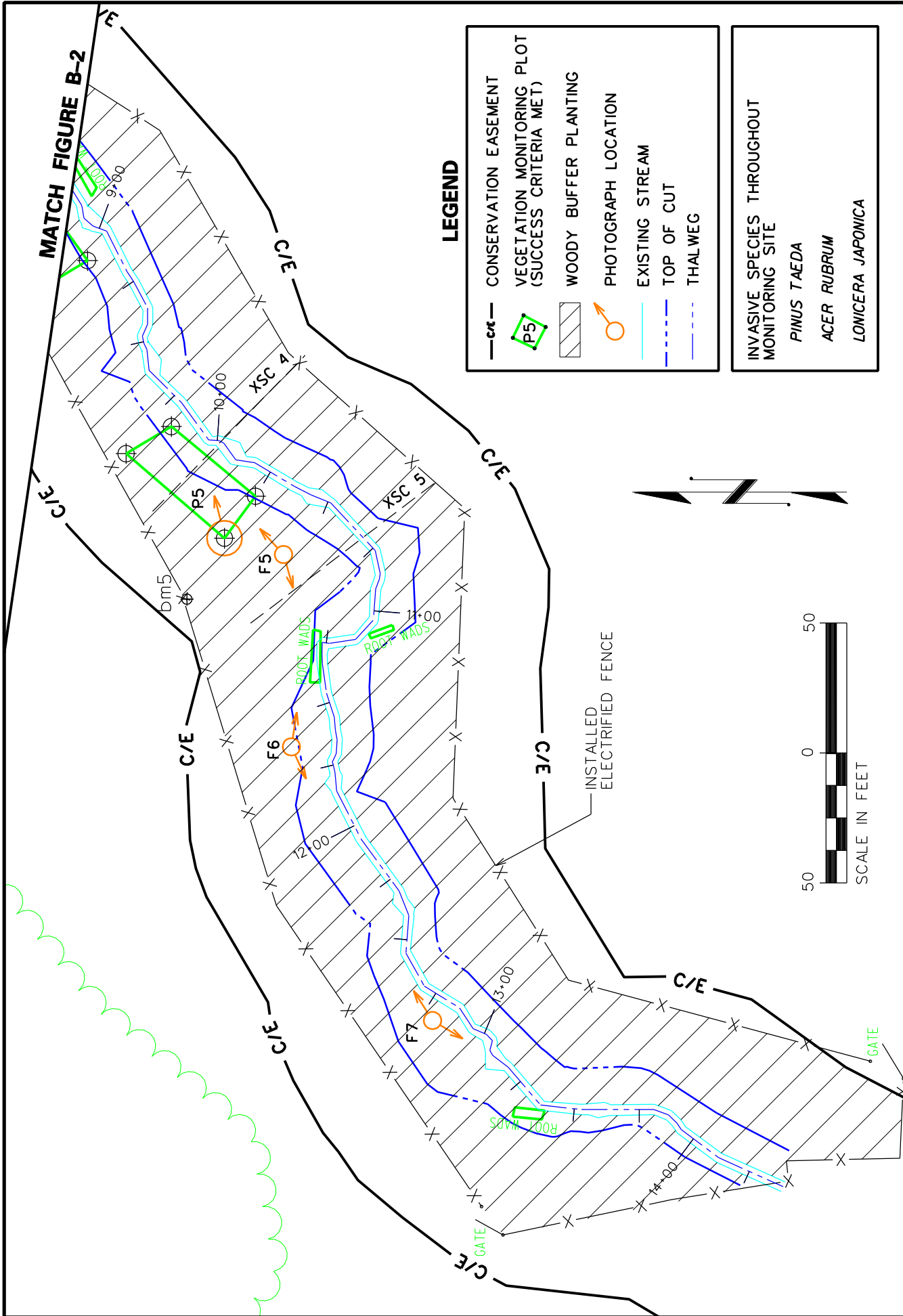
	CONSERVATION EASEMENT
	VEGETATION MONITORING PLOT
	PHOTOGRAPH LOCATION
	EXISTING STREAM
	TOP OF CUT
	THALWEG
	IN-STREAM STRUCTURE





 EcoScience Corporation Raleigh, North Carolina	 Ecosystem Enhancement PROGRAM	Project: Monitoring Plan View Unnamed Tributary to Bear Swamp Creek Stream Restoration Site		Figure: 2-2
		Client: EEP Project No. 27 FRANKLIN COUNTY, NORTH CAROLINA	Date: DEC 2005 Scale: 1" = 50'	Drawn By: JDG Checked By: JWG ESC Project No.: 05-243.04

APPENDIX B

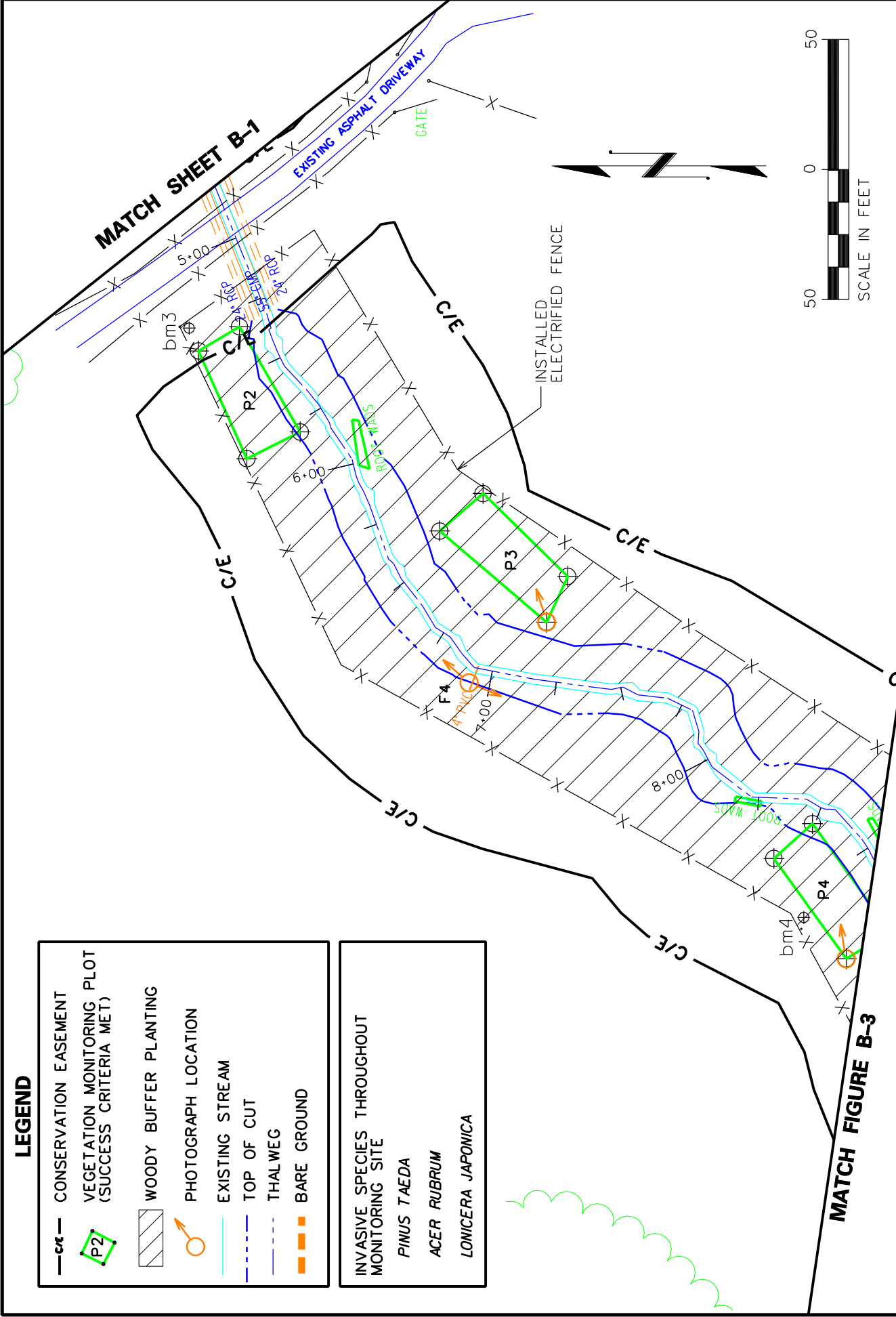
VEGETATION DATA



 <p>EcoScience Corporation Raleigh, North Carolina</p>	 <p>Ecosystem Enhancement PROGRAM</p>	VEGETATION PROBLEM AREAS Unnamed Tributary to Bear Swamp Creek Stream Restoration Site		Date: DEC 2005 Dwn By: JDG Ckd By: JWG ESC Project No.: 05-243.04	FIGURE <h1>B-3</h1>
		EEP Project No. 27 FRANKLIN COUNTY, NORTH CAROLINA		Scale: 1" = 50' Date: DEC 2005	

LEGEND

	CONSERVATION EASEMENT
	VEGETATION MONITORING PLOT (SUCCESS CRITERIA MET)
	WOODY BUFFER PLANTING
	PHOTOGRAPH LOCATION
	EXISTING STREAM
	TOP OF CUT
	THALWEG
	BARE GROUND
INVASIVE SPECIES THROUGHOUT MONITORING SITE	
	<i>PINUS TAEDA</i>
	<i>ACER RUBRUM</i>
	<i>LONICERA JAPONICA</i>



<p>EcoScience Corporation Raleigh, North Carolina</p>	<p>Ecosystem Enhancement PROGRAM</p>	<p>VEGETATION PROBLEM AREAS</p> <p>Unnamed Tributary to Bear Swamp Creek Stream Restoration Site</p>		<p>FIGURE</p> <p>B-2</p>
		<p>Client:</p>	<p>Project:</p>	<p>Date: DEC 2005</p> <p>Scale: 1" = 50'</p>
<p>EEP Project No. 27</p> <p>FRANKLIN COUNTY, NORTH CAROLINA</p>		<p>Drawn By: JDG</p> <p>Checked By: JWG</p>	<p>Date: DEC 2005</p> <p>Scale: 1" = 50'</p>	

APPENDIX C

STREAM GEOMORPHOLOGY DATA