UNNAMED TRIBUTARY TO BEAR SWAMP CREEK
STREAM RESTORATION SITE

2006 Annual Monitoring Report (Year 4)

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

January, 2007

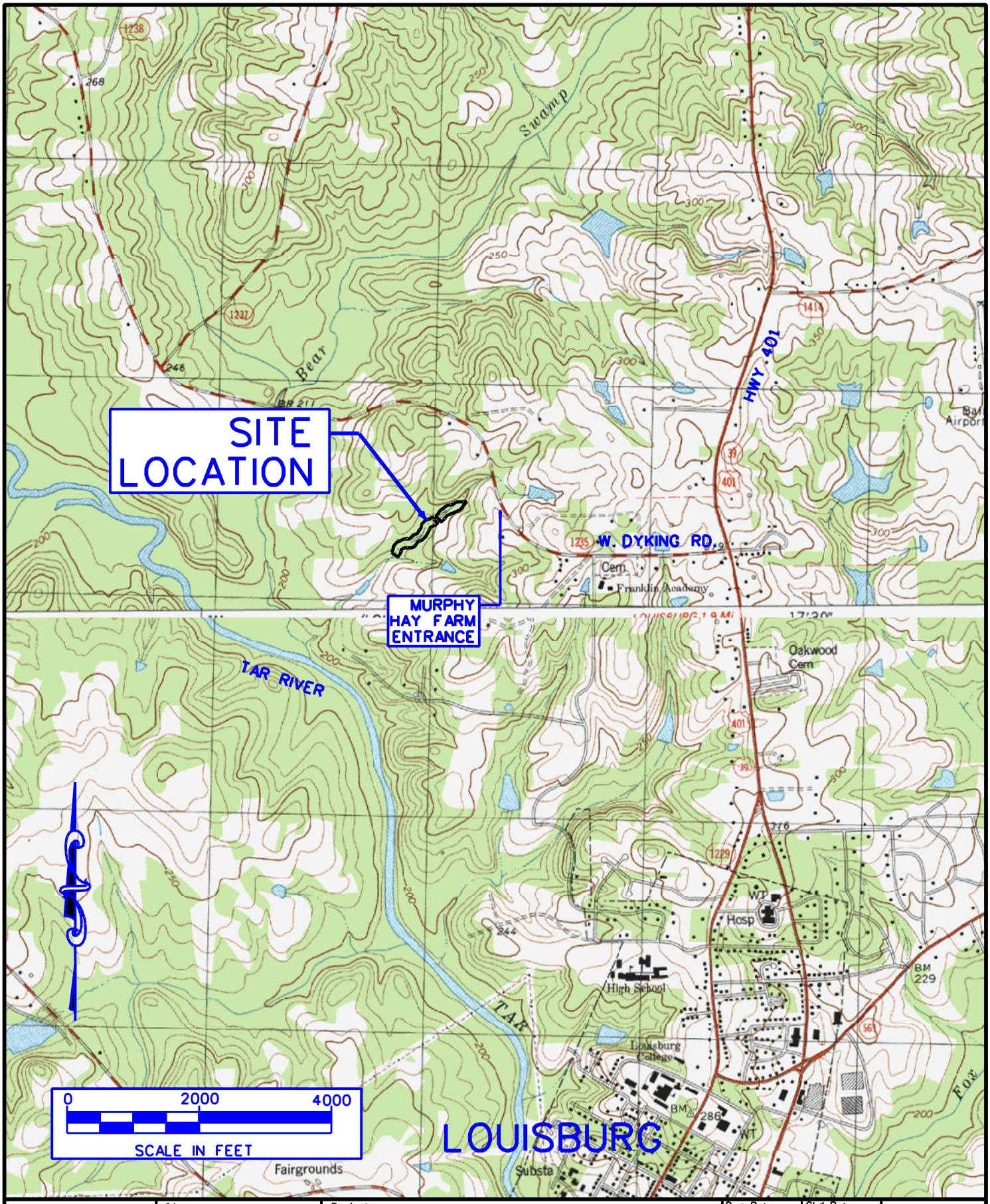
Prepared for: **NCDENR/ ECOSYSTEM ENHANCEMENT PROGRAM**
1619 Mail Service Center
Raleigh, NC 27699-1619

Prepared by: **ECOSCIENCE CORPORATION**
1101 Haynes Street, Suite 101
Raleigh, NC 27604

Ecosystem Enhancement PROGRAM

APPENDIX A

FIGURES



EcoScience Corporation
Raleigh, North Carolina

Client: Ecosystem Enhancement Program

Project:

Unnamed Tributary to Bear Swamp Creek Stream Restoration Site

EEP Project No. 27

FRANKLIN COUNTY, NORTH CAROLINA

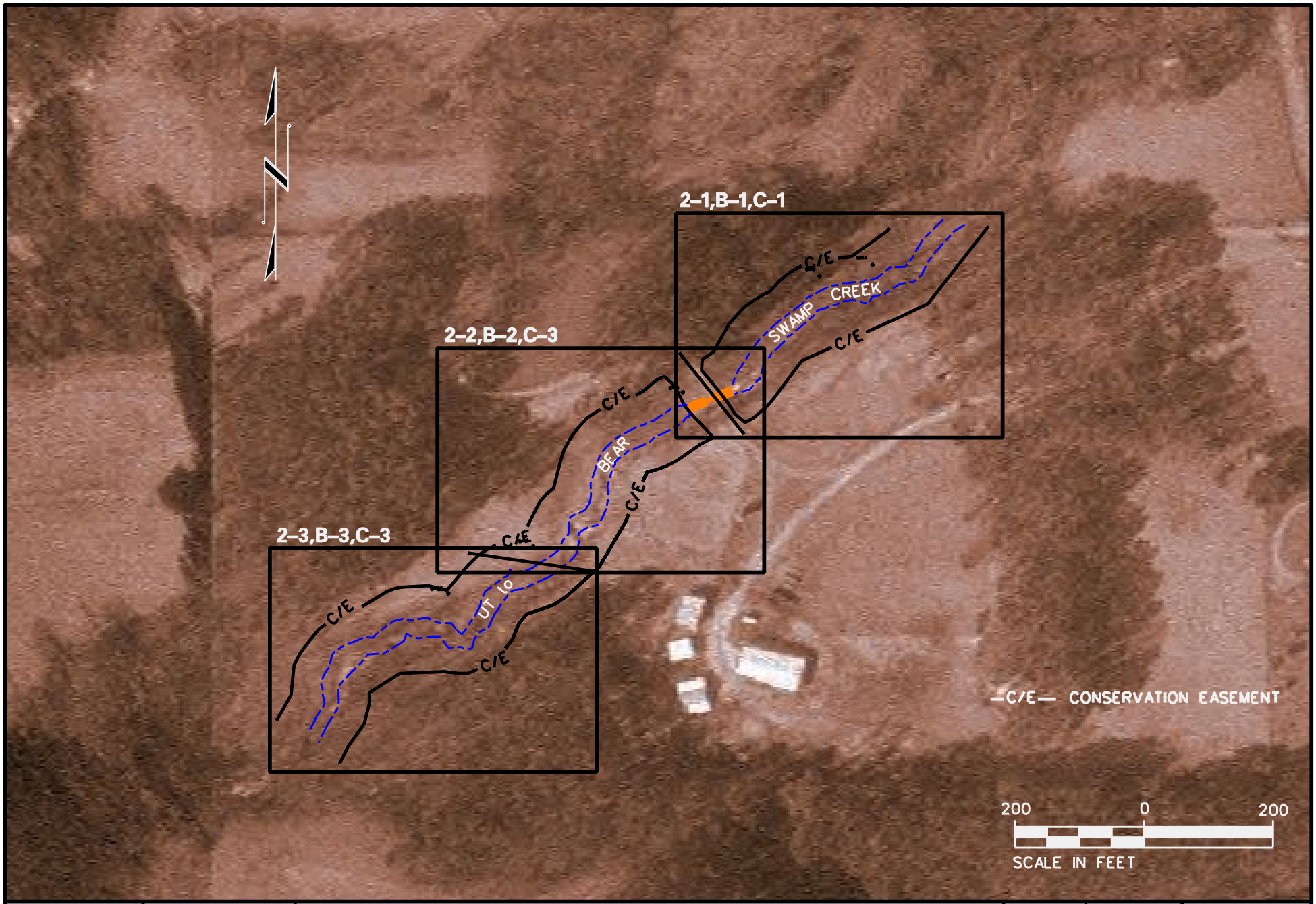
Dwn By:	Ckd By:
GWN	JWG

Date: DEC 2006

Scale: 1"=2000'

ESC Project No.: 06-282.04

FIGURE 1



EcoScience Corporation
Raleigh, North Carolina

Client: Ecosystem Enhancement Program

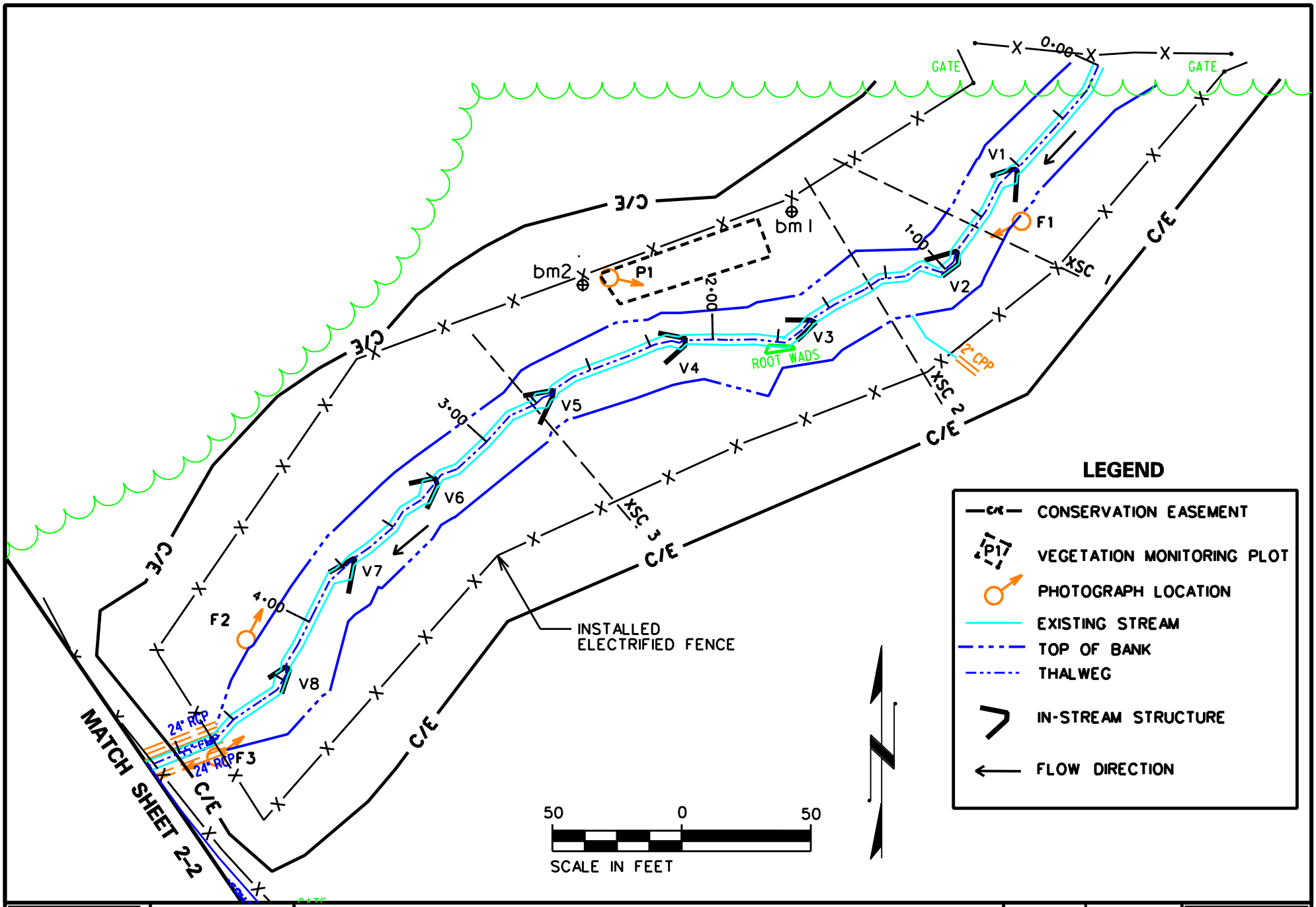
Project:

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

FRANKLIN COUNTY, NORTH CAROLINA

Dwn By: GWN	Date: DEC 2006
Ckd By: JWG	Scale: 1" = 200'
ESC Project No.: 06-282.03	

FIGURE
2



EcoScience Corporation
Raleigh, North Carolina

Client: Ecosystem Enhancement Program

Project:

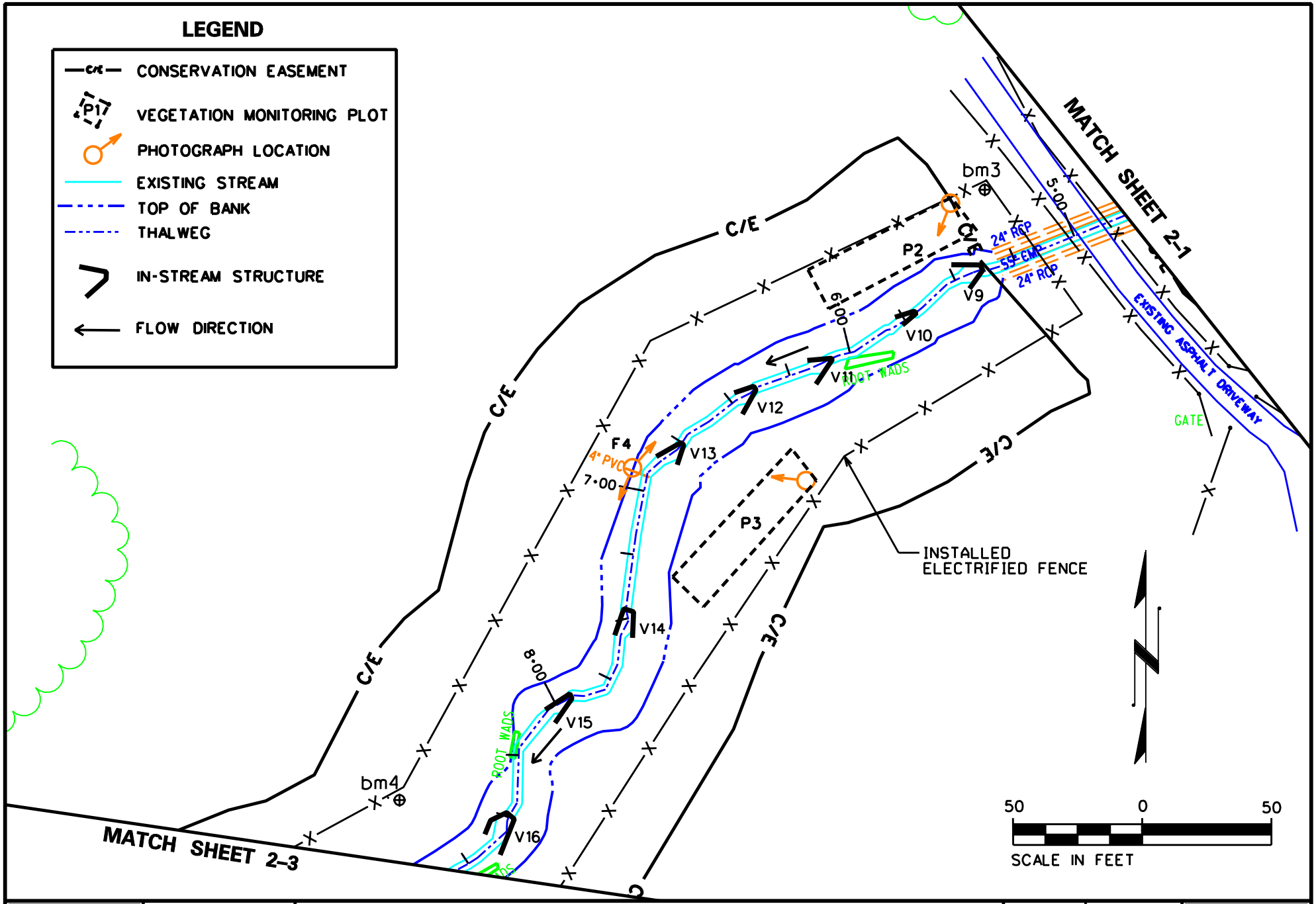
MONITORING PLAN VIEW
Unnamed Tributary to Bear Swamp Creek Stream Restoration Site

EEP Project No. 27

FRANKLIN COUNTY, NORTH CAROLINA

Dwn By: GWN	Date: JAN 2007
Ckd By: JWG	Scale: 1" = 50'
ESC Project No.: 06-282.04	

FIGURE 2-1



EcoScience Corporation
Raleigh, North Carolina

Client: Ecosystem Enhancement Program

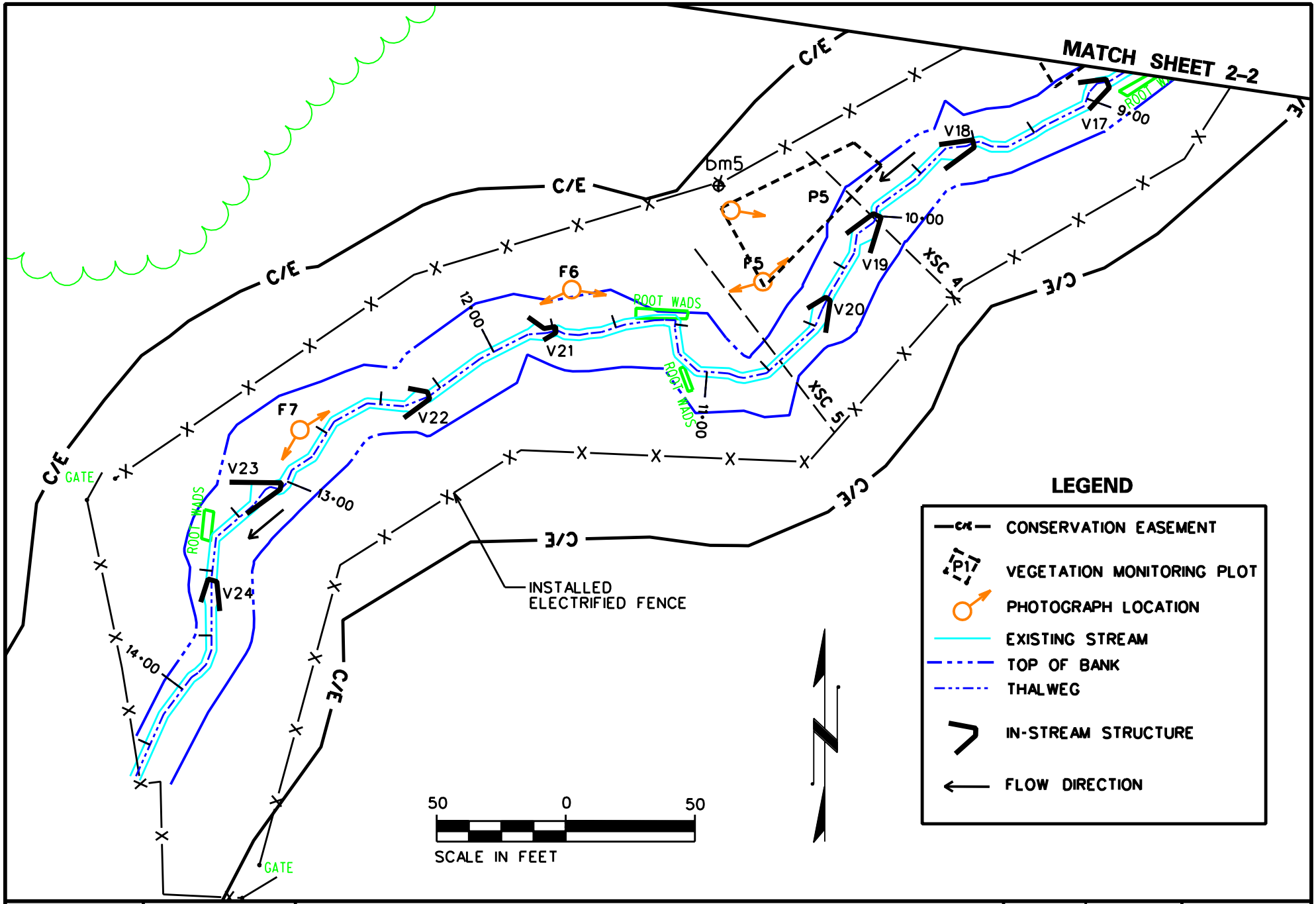
Project:

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

EEP Project No. 27
FRANKLIN COUNTY, NORTH CAROLINA

Dwn By:	Date:
GWN	JAN 2007
Ckd By:	Scale:
JWG	1" = 50'
ESC Project No.:	
06-282.04	

FIGURE
2-2



EcoScience Corporation
Raleigh, North Carolina

Client: Ecosystem Enhancement Program

Project:

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

EEP Project No. 27
FRANKLIN COUNTY, NORTH CAROLINA

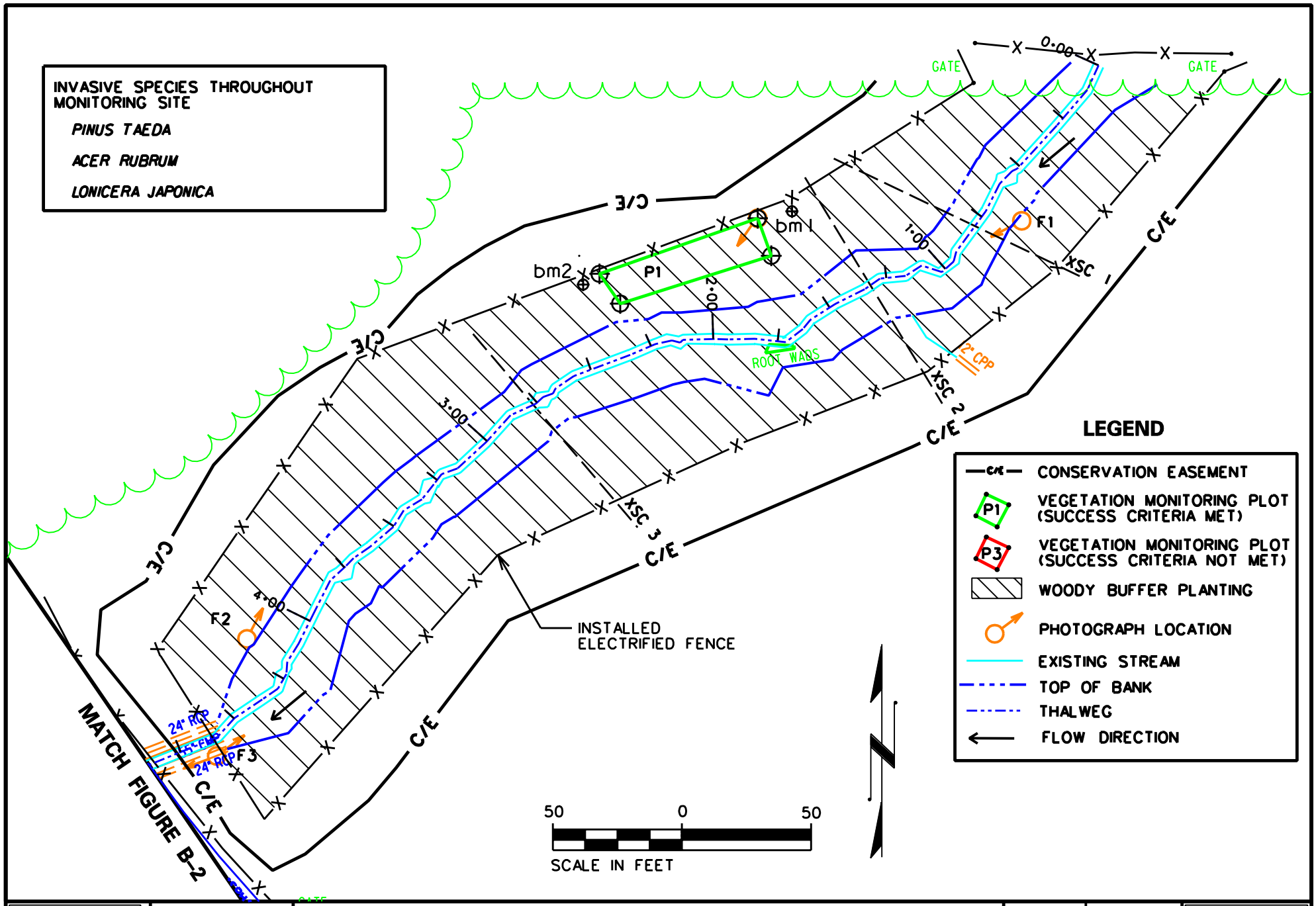
Dwn By:	Date:
GWN	JAN 2007
Ckd By:	Scale:
JWG	1" = 50'
ESC Project No.:	
06-282.04	

FIGURE
2-3

Appendix B
(Click here)

APPENDIX B

VEGETATION DATA



EcoScience Corporation
Raleigh, North Carolina

Client: Ecosystem Enhancement Program

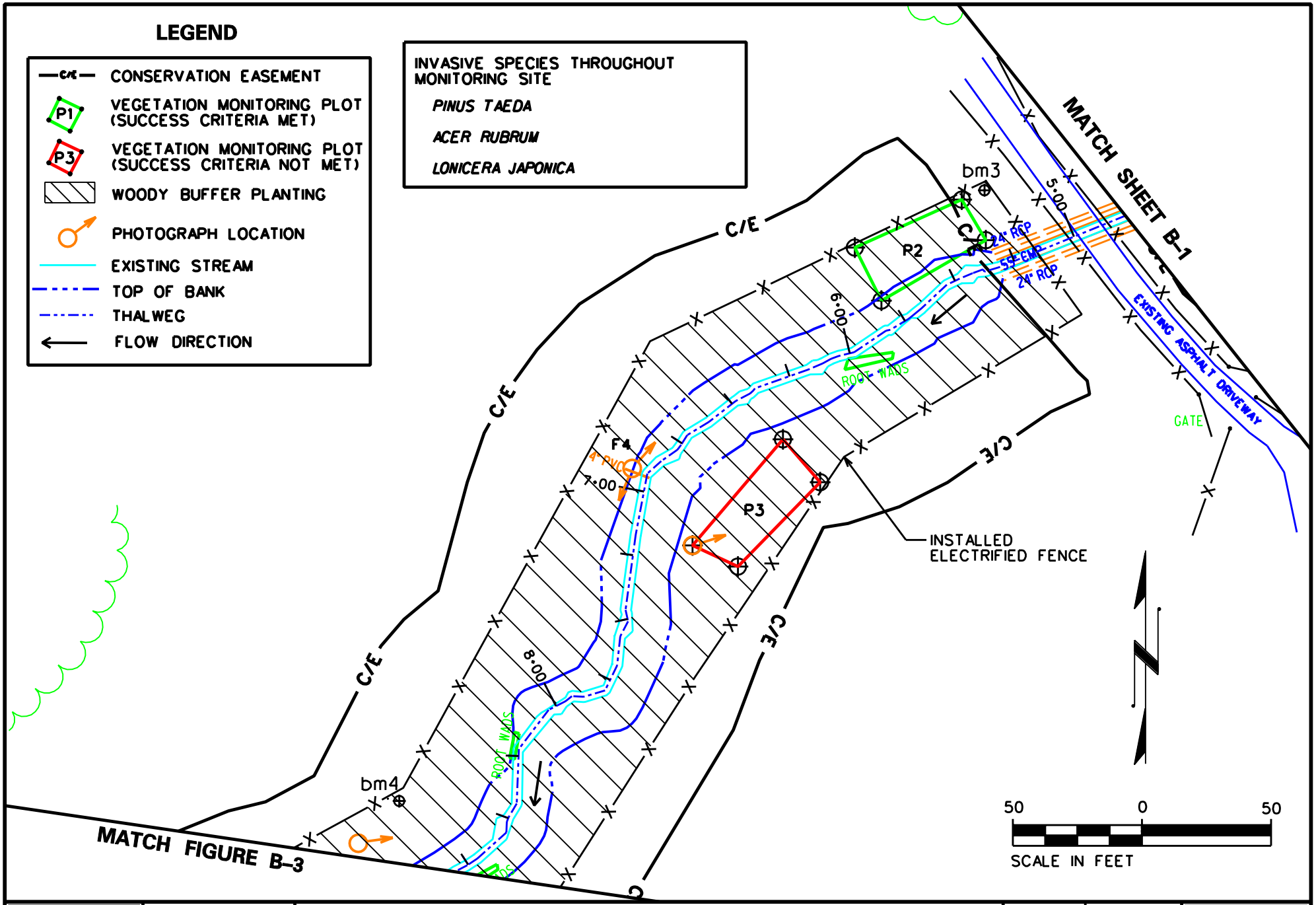
Project:

VEGETATION PROBLEM AREAS
Unnamed Tributary to Bear Swamp Creek Stream Restoration Site

EEP Project No. 27
FRANKLIN COUNTY, NORTH CAROLINA

Dwn By:	Date:
GWN	JAN 2007
Ckd By:	Scale:
JWG	1" = 50'
ESC Project No.:	
06-282.04	

FIGURE
B–1



EcoScience Corporation
Raleigh, North Carolina

Client: Ecosystem Enhancement Program

Project:

VEGETATION PROBLEM AREAS

Unnamed Tributary to Bear Swamp Creek Stream Restoration Site

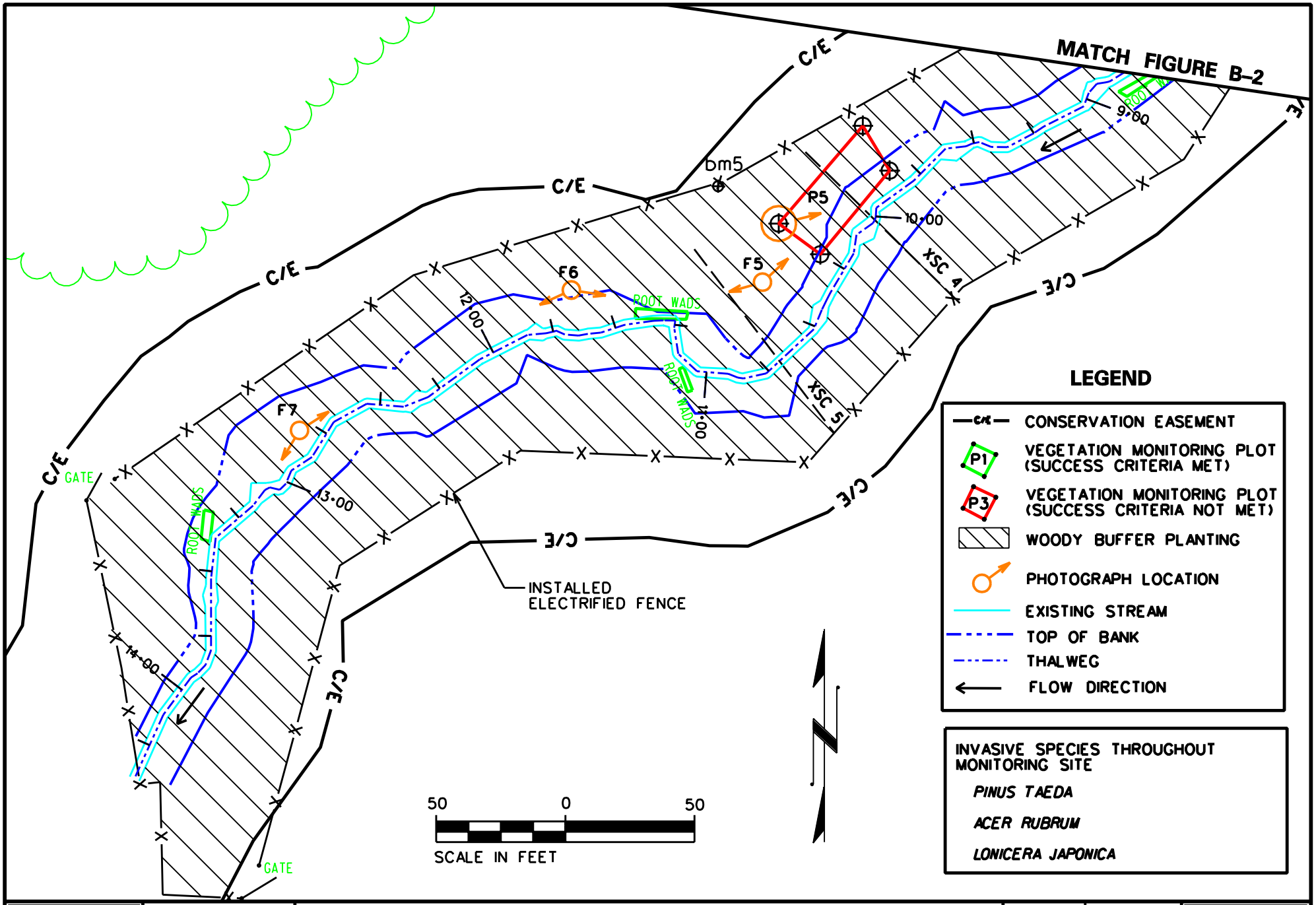
EEP Project No. 27

FRANKLIN COUNTY, NORTH CAROLINA

Dwn By:	Date:
GWN	JAN 2007
Ckd By:	Scale:
JWG	1" = 50'

ESC Project No.: 06-282.04

FIGURE **B–2**



EcoScience Corporation
Raleigh, North Carolina

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VEGETATION PROBLEM AREAS

Unnamed Tributary to Bear Swamp Creek Stream Restoration Site

EEP Project No. 27

FRANKLIN COUNTY, NORTH CAROLINA

Dwn By:	Date:
GWN	JAN 2007
Ckd By:	Scale:
JWG	1" = 50'

ESC Project No.: 06-282.04

FIGURE

B-3

UT to Bear Swamp Creek Stream Restoration Site
Representative Vegetation Problem Area

Photo 1. Heavy loblolly pine colonization near Station 1+00.

Photo 2. Heavy loblolly pine colonization near Station 1+50.

Unnamed Tributary to Bear Swamp Creek Restoration Site
Year-3 Monitoring
Data Collected 8/30/06
5m x 20m plots

Stem Counts for Each Species Arranged by Plot								
Species	**Plots**				**Year 2 Totals***	**Year 3 Totals**	**Year 4 Totals**	**Survival %**
	1	2	3	5				
Shrubs								
Alnus serrulata					0	0	0	--
Cornus amomum	1				13	12	7	8
Ilex verticillata					0	0	0	--
Salix nigra	5	1		1	19	29	23	37
Sambucus canadensis					0	0	0	--
Trees								
Betula nigra	13				0	6	16	--
Carpinus caroliniana					1	0	0	0
Fraxinus pennsylvanica		6		1	8	8	5	88
Juglans nigra		2			3	3	4	66
Morus rubra					1	0	0	0
Ostrya virginiana			2		5	0	5	40
Quercus michauxii	2			1	3	5	3	100
Quercus pagoda	1			1	1	0	1	200
Total	22	9	2	4				
Density	890	364	81	162				
Average Density	374							

Unnamed Tributary to Bear Swamp Creek Restoration Site
Year-3 Monitoring
Data Collected 8/30/06
5m x 20m plots

Stem Counts for Volunteer Species Arranged by Plot							
Species	**Plots**				**Year 2 Totals**	**Year 3 Totals**	**Year 4 Totals**
	1	2	3	5			
Acer negundo	1	2			0	3	3
Acer rubrum	19			4	51	73	23
Baccharis halimifolia		8			0	2	8
Celtis laevigata					0	2	0
Diospyros virginiana			1		0	1	1
Juniperus virginiana				1	0	0	1
Liquidambar styraciflua	11			28	20	26	39
Liriodendron tulipifera	3				7	2	3
Pinus taeda	525	87	42		250	547	654
Platanus occidentalis					0	1	0
Prunus serotina				12	0	5	12
Rhus copallina					1	0	0
Rhus glabra					2	43	0
Ulmus alata	10			1	0	41	11
Viburnum nudum	1				0	3	1
Ligustrum sinense		1			0	0	1
Total	570	98	43	46			
Density	23067	3966	1740	1862			
Average Density	7659						

Combined Stem Counts for Planted and Volunteer Species Arranged by Plot				
	Plot 1	**Plot 2**	**Plot 3**	**Plot 5**
Totals	592	107	45	50
Density	23957	4330	1821	2023
Average Density	8033			

Vegetation Plot 1 – UT to Bear Swamp Creek Restoration Site (Year 4)

Photo was taken July 27, 2006 from the northeast corner looking southwest.

Vegetation Plot 2 – UT to Bear Swamp Creek Restoration Site (Year 4)

Photo was taken July 27, 2006 from the northwest corner looking southeast.

Vegetation Plot 3 – UT to Bear Swamp Creek Restoration Site (Year 4)

Photo was taken July 27, 2006 from the southwest corner looking northe

Vegetation Plot 4 – UT to Bear Swamp Creek Restoration Site (Year 4)

Photo was taken July 27, 2006 from the southwest corner looking northeast.

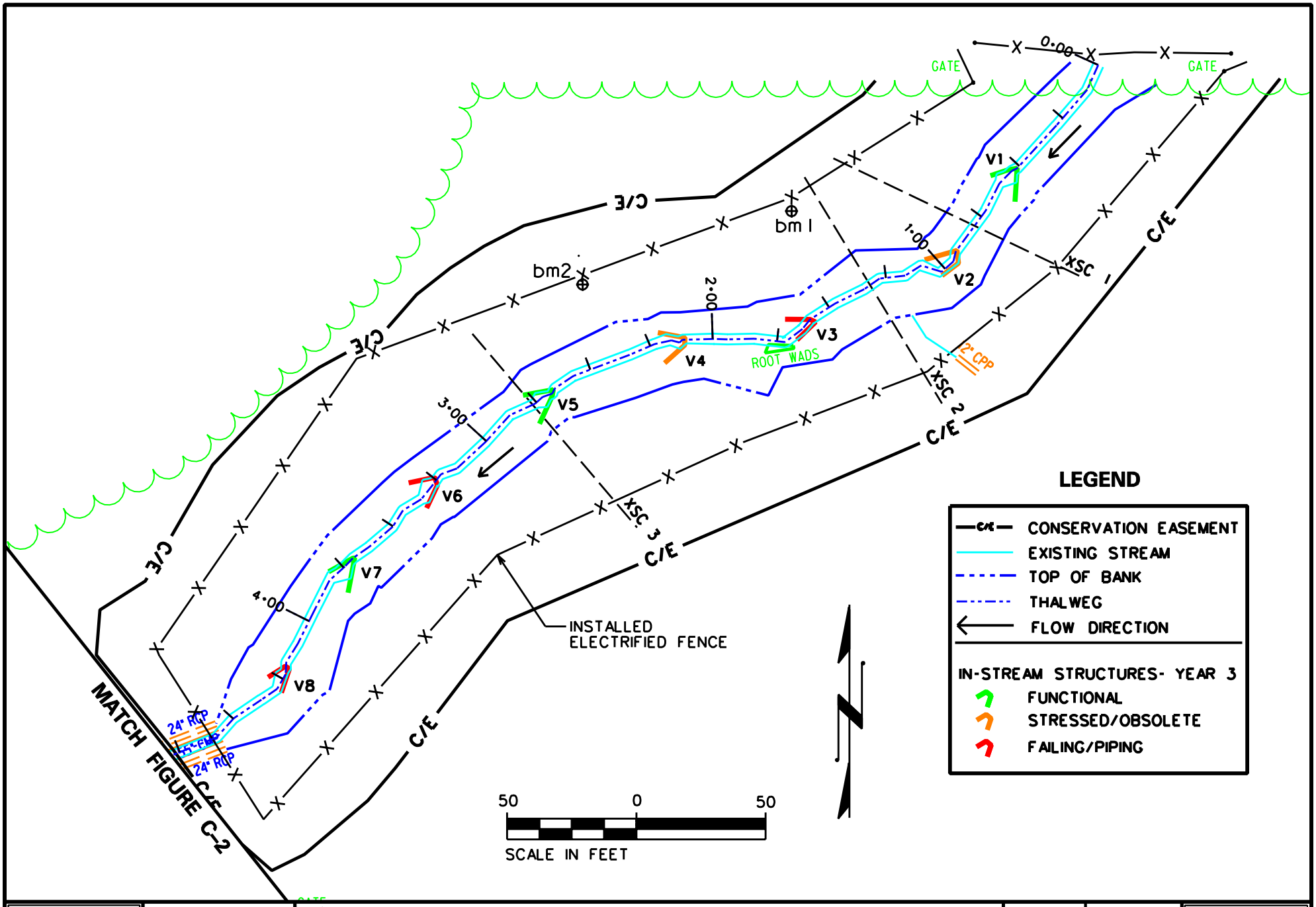
Vegetation Plot 5 – UT to Bear Swamp Creek Restoration Site (Year 4)

Photo was taken July 27, 2006 from the northwest corner looking southeast.

Appendix C
(Click here)

APPENDIX C

STREAM GEOMORPHOLOGY DATA



EcoScience Corporation
Raleigh, North Carolina

Client: Ecosystem Enhancement Program

Project:

STREAM PROBLEM AREAS

Unnamed Tributary to Bear Swamp Creek Stream Restoration Site

EEP Project No. 27

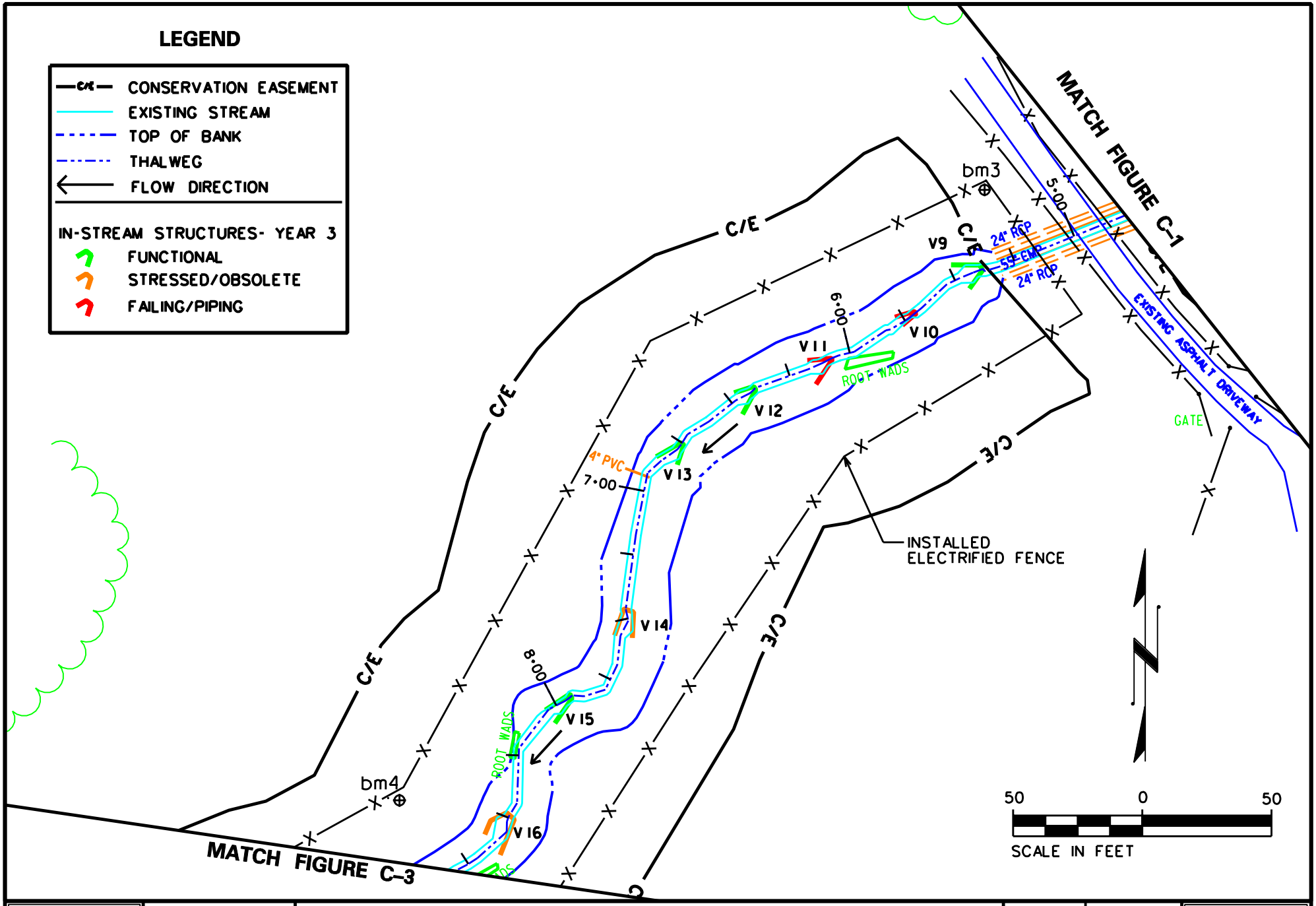
FRANKLIN COUNTY, NORTH CAROLINA

Dwn By:	Date:
GWN	JAN 2007
Ckd By:	Scale:
JWG	1" = 50'

ESC Project No.: 06-282.04

FIGURE

C-1



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Raleigh, North Carolina

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STREAM PROBLEM AREAS
Unnamed Tributary to Bear Swamp Creek Stream Restoration Site

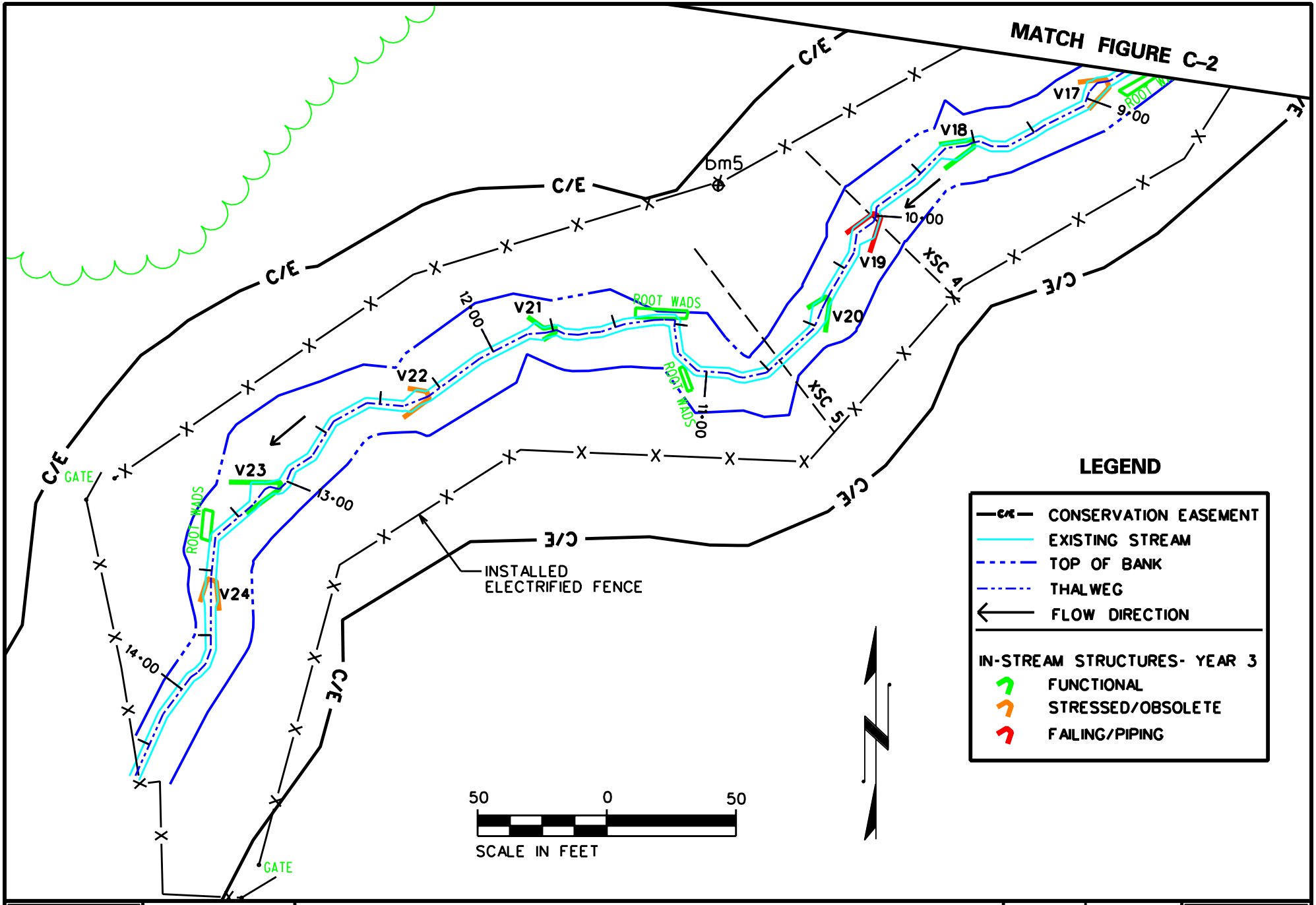
EEP Project No. 27

FRANKLIN COUNTY, NORTH CAROLINA

Dwn By:	Date:
GWN	JAN 2007
Ckd By:	Scale:
JWG	1" = 50'
ESC Project No.:	
06-282.04	

FIGURE

C-2



EcoScience Corporation
Raleigh, North Carolina

Client: Ecosystem Enhancement Program

Project:

STREAM PROBLEM AREAS

Unnamed Tributary to Bear Swamp Creek Stream Restoration Site

EEP Project No. 27

FRANKLIN COUNTY, NORTH CAROLINA

Dwn By:	Date:
GWN	JAN 2007
Ckd By:	Scale:
JWG	1"= 50'
ESC Project No.:	
06-282.04	

FIGURE

C-3

UT to Bear Swamp Creek Stream Restoration Site (Year 4)
Stream Problem Areas

Photo 1. Rock Vane 2 has filled in with sediment but stream remains stable.

Photo 2. Piping of flow behind Rock Vane 3.

UT to Bear Swamp Creek Stream Restoration Site (Year 4)
Stream Problem Areas

Photo 3. Rock Vane 4 has accrued sediment but stream remains stable.

Photo 4. Piping of flow behind Rock Vane 6.

UT to Bear Swamp Creek Stream Restoration Site (Year 4)
Stream Problem Areas

Photo 5. Piping of flow behind Rock Vane 8.

Photo 6. Piping of flow behind Rock Vane 10.

UT to Bear Swamp Creek Stream Restoration Site (Year 4)
Stream Problem Areas

Photo 7. Piping of flow behind Rock Vane 11.

Photo 8. Rock Vane 14 has filled in with sediment but stream remains stable.

UT to Bear Swamp Creek Stream Restoration Site (Year 4)
Stream Problem Areas

Photo 9. Rock Vane 16 has accrued sediment but stream remains stable.

Photo 10. Rock Vane 17 has filled in with sediment but stream remains stable.

UT to Bear Swamp Creek Stream Restoration Site (Year 4)
Stream Problem Areas

Photo 11. Piping of flow behind Rock Vane 19.

Photo 12. Rock Vane 22 has accrued sediment but stream remains stable.

UT to Bear Swamp Creek Stream Restoration Site (Year 4)
Stream Problem Areas

Photo 13. Rock Vane 24 has filled accrued sediment but stream remains stable.

UT to Bear Swamp Creek Stream Restoration Site (Year 4)
Photo Stations

Photo Station 1 – UT to Bear Swamp Creek

Photo was taken October 12, 2006 looking downstream

Photo Station 2 – UT to Bear Swamp Creek

Photo was taken October 12, 2006 looking upstream.

UT to Bear Swamp Creek Stream Restoration Site (Year 4)
Photo Stations

Photo Station 3 – UT to Bear Swamp Creek

Photo was taken October 12, 2006 looking upstream.

Photo was taken October 12, 2006 looking downstream.

UT to Bear Swamp Creek Stream Restoration Site (Year 4)
Photo Stations

Photo Station 4 – UT to Bear Swamp Creek

Photo was taken October 12, 2006 looking upstream.

Photo was taken October 12, 2006 looking downstream.

UT to Bear Swamp Creek Stream Restoration Site (Year 4)
Photo Stations

Photo Station 5 – UT to Bear Swamp Creek

Photo was taken October 12, 2006 looking upstream.

Photo was taken October 12, 2006 looking downstream.

UT to Bear Swamp Creek Stream Restoration Site (Year 4)
Photo Stations

Photo Station 6 – UT to Bear Swamp Creek

Photo was taken October 12, 2006 looking upstream.

Photo was taken October 12, 2006 looking downstream.

UT to Bear Swamp Creek Stream Restoration Site (Year 4)
Photo Stations

Photo Station 7 – UT to Bear Swamp Creek

Photo was taken October 12, 2006 looking upstream.

Photo was taken October 12, 2006 looking downstream.

Table B1. Visual Morphological Stability Assessment UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27 1,439 linear feet						
Feature Category	Metric (per As-built and reference baselines)	(# Stable) Number Performing as Intended	Total number per As-built[1]	Total Number / feet in unstable state	% Perform in Stable Condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	23	25	N/A	92	
	2. Armor stable (e.g. no displacement)?	23	25	N/A	92	
	3. Facet grade appears stable?	23	25	N/A	92	
	4. Minimal evidence of embedding/fining?	23	25	N/A	92	
	5. Length appropriate?	23	25	N/A	92	**92%**
B. Pools	1. Present? (e.g not subject to severe aggrad. or migrat.?)	22	24	N/A	92	
	2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?)	22	24	N/A	92	
	3. Length appropriate?	22	24	N/A	92	**92%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	7	7	N/A	100	
	2. Downstream of meander (glide/inflection) centering?	6	8	N/A	75	**88%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	12	14	N/A	86	
	2. Of those eroding, # w/concomitant point bar formation?	1	2	N/A	50	
	3. Apparent Rc within spec?	14	14	N/A	100	
	4. Sufficient floodplain access and relief?	10	14	N/A	71	**77%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	N/A	N/A	3/75	96	
	2. Channel bed degradation – areas of increasing down-cutting or head cutting?	N/A	N/A	2/150	93	**95%**
F. Vanes	1. Free of back or arm scour?	16	24	N/A	67	
	2. Height appropriate?	20	24	N/A	83	
	3. Angle and geometry appear appropriate?	22	24	N/A	92	
	4. Free of piping or other structural failures?	10	24	N/A	42	**71%**
G. Wads/ Boulders	1. Free of scour?	7	8	N/A	88	
	2. Footing stable?	7	8	N/A	88	**88%**

1. Based on Rosgen type B stream with every structure having an associated riffle and pool.

Survey Data

Cross-Section 1: Riffle

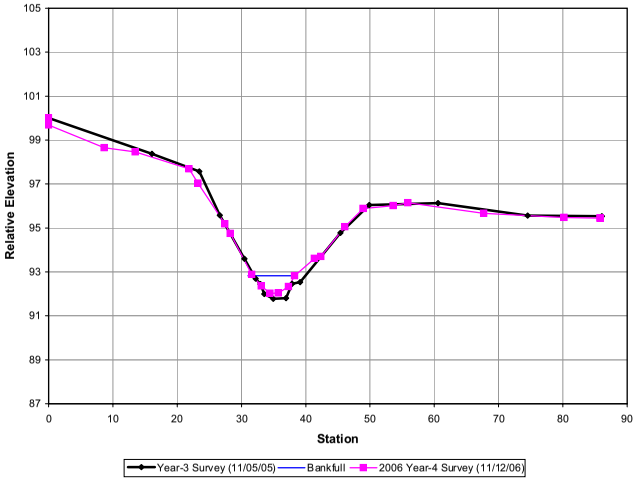
Station		Elevation	Feature
0.00		100.00	LPIN
0.00		99.69	
8.66		98.65	
13.50		98.46	
21.84		97.69	
23.22		97.04	
27.42		95.19	
28.29		94.75	
31.60		92.89	
33.11		92.36	LEOW
34.46		92.02	
35.75		92.04	
37.35		92.32	REOW
38.26		92.82	BKF
41.36		93.61	
42.37		93.70	
46.11		95.06	
48.93		95.88	
53.62		96.01	
55.92		96.14	
67.72		95.67	
80.21		95.48	
85.83		95.44	
85.83		95.44	RPIN

Summary Data

Bankful Cross Sectional Area	3.4 sq. ft.
Bankfull Width	6.5 ft.
Bankfull Mean Depth	0.5 ft.
Bankful Max Depth	0.8 ft.
Width/Depth Ratio	12.2
Entrenchment Ratio	1.7
Classification	E5/Bc5

Cross-Section

Cross-Section Plot - Looking Downstream



Cross-Section Photos

Cross-Section 1, looking downstream

Cross-Section 1, looking upstream

Title Cross-Section 1

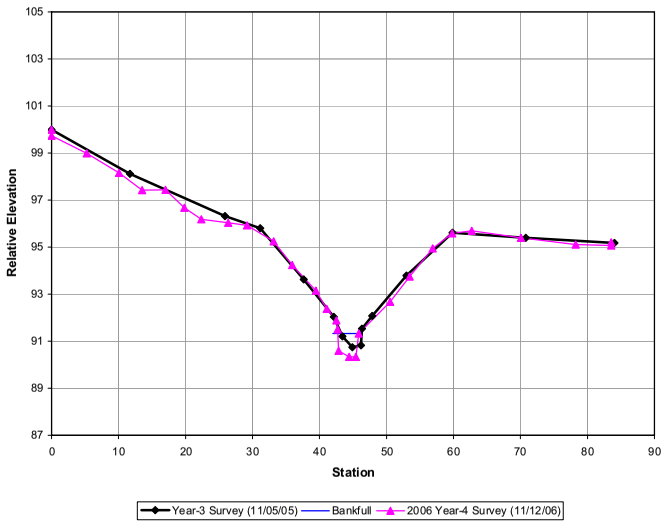
Project	**UT to Bear Swamp Creek Stream Restoration Site, Franklin County**	**EEP Project #**	27
		Figure	Cross-Section Appendix C
Survey Date	**Survey Weather**	**Field Team**	**Location**
11/12/06	Sunny	Michael Gloden, Jim Cooper	Station 0+76

Survey Data			
Cross-Section 2: Riffle			
Station		**Elevation**	**Feature**
0		100	LPIN
0		99.73	
5.27		98.99	
10.07		98.15	
13.51		97.42	
17.03		97.43	
19.82		96.67	
22.34		96.19	
26.35		96.03	
29.21		95.92	
33.14		95.25	
35.94		94.24	
39.44		93.15	
41.07		92.37	
42.52		91.88	
42.71		91.51	
42.84		90.59	
44.45		90.33	
45.42		90.33	
45.85		91.32	BKF
50.54		92.67	
53.47		93.75	
56.9		94.94	
59.81		95.59	
62.7		95.69	
70.09		95.39	
78.26		95.11	
83.57		95.07	
83.57		95.2	RPIN

Summary Data	
Bankful Cross Sectional Area	2.6 sq. ft.
Bankfull Width	3.1 ft.
Bankfull Mean Depth	0.8 ft.
Bankful Max Depth	0.9 ft.
Width/Depth Ratio	3.7
Entrenchment Ratio	1.8
Classification	E5/Bc5

Cross-Section

Cross-Section Plot - Looking Downstream



Cross-Section Photos

Cross-Section 2, looking downstream

Cross-Section 2, looking upstream

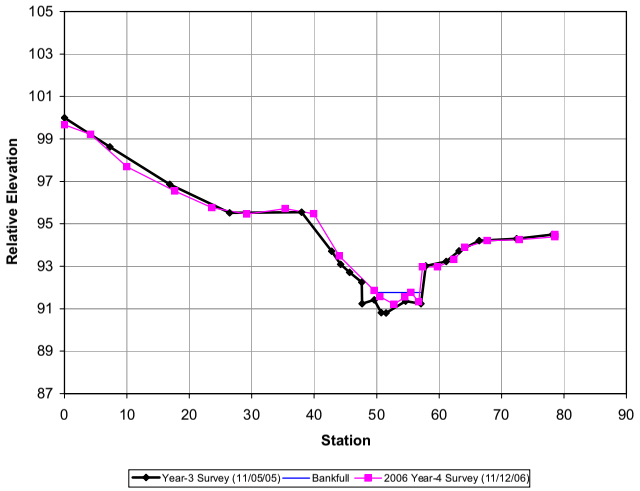
Title	**Cross-Section 2**		
Project	**UT to Bear Swamp Creek Stream Restoration Site, Franklin County**	**EEP Project #**	27
		Figure	Cross-Section Appendix C
Survey Date	**Survey Weather**	**Field Team**	**Location**
11/12/06	Sunny	Michael Gloden, Jim Cooper	Station 1+30

Survey Data			
Cross-Section 3: Pool			
Station		Elevation	Feature
0.00		99.66	LPIN
4.21		99.21	
9.99		97.69	
17.66		96.55	
23.62		95.76	
29.21		95.46	
35.38		95.71	
39.93		95.47	
44.01		93.48	
49.59		91.86	
50.55		91.57	
52.81		91.20	
54.56		91.55	
55.50		91.76	BKF
56.72		91.33	
57.36		92.97	
59.76		92.97	
62.37		93.32	
64.10		93.89	
67.71		94.21	
72.84		94.24	
78.59		94.38	
78.59		94.49	RPIN

Summary Data	
Bankful Cross Sectional Area	2.0 sq. ft.
Bankfull Width	6.9 ft.
Bankfull Mean Depth	0.3 ft.
Bankful Max Depth	0.6 ft.
Width/Depth Ratio	24.5
Entrenchment Ratio	1.9
Classification	E5/Bc5

Cross-Section

Cross-Section Plot - Looking Downstream



Cross Section Photos

Cross-Section 3, looking downstream

Cross-Section 3, looking upstream

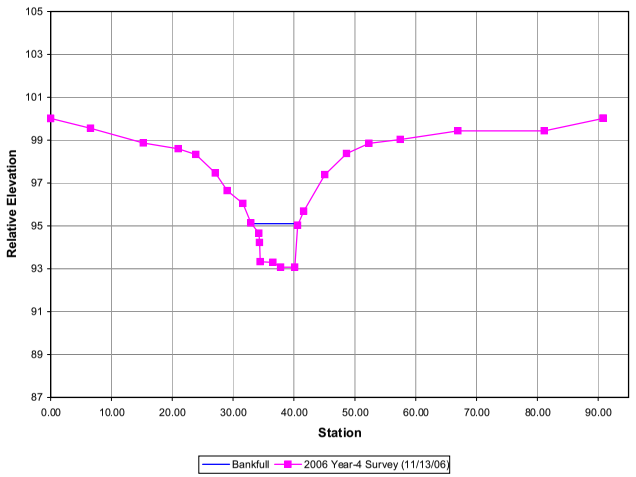
Title	Cross-Section 3				
Project	UT to Bear Swamp Creek Stream Restoration Site, Franklin County			EEP Project #	27
				Figure	Cross-Section Appendix C
Survey Date	Survey Weather	Field Team	Location		
11/12/06	Sunny	Michael Gloden, Jim Cooper	Station 2+78		

Survey Data			
Cross-Section 4: Pool			
Station		Elevation	Feature
0.00		100.00	LPIN
0.00		100.01	
6.55		99.56	
15.24		98.86	
20.96		98.60	
23.86		98.33	
27.08		97.46	
29.06		96.65	
31.63		96.04	
32.93		95.13	
34.22		94.65	
34.34		94.22	
34.43		93.32	
36.54		93.30	
37.84		93.08	
40.16		93.08	
40.61		95.02	
41.63		95.69	
45.10		97.39	
48.64		98.37	
52.32		98.84	
57.50		99.04	
66.98		99.43	
81.18		99.44	
90.83		100.01	
90.83		100.01	RPIN

Summary Data	
Bankful Cross Sectional Area	11.9 sq. ft.
Bankfull Width	7.7 ft.
Bankfull Mean Depth	1.5 ft.
Bankful Max Depth	2.1 ft.
Width/Depth Ratio	5
Entrenchment Ratio	2.3
Classification	E5/Bc5

Cross-Section

Cross-Section Plot - Looking Downstream



Original cross-section pins were not recovered in Year 4. Only current year data is plotted in the above graph.

Cross-Section Photos

Cross-Section 4, looking downstream

Cross-Section 4, looking upstream

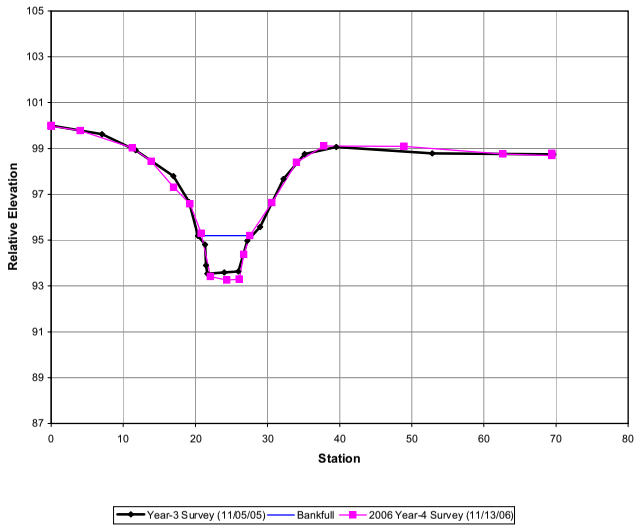
Title	Cross-Section 4			
Project	UT to Bear Swamp Creek Stream Restoration Site, Franklin County		EEP Project #	27
			Figure	Cross-Section Appendix C
Survey Date	Survey Weather	Field Team	Location	
11/13/06	Sunny	Michael Gloden, Jim Cooper	Station 10+03	

Survey Data			
Cross-Section 5: Riffle			
Station		**Elevation**	**Feature**
0.00		100.00	LPIN
0.00		99.97	
4.06		99.77	
11.27		99.02	
13.87		98.44	
17.00		97.30	
19.25		96.59	
20.79		95.29	
22.10		93.41	
24.34		93.26	
26.07		93.30	
26.70		94.37	
27.56		95.20	BKF
30.60		96.63	
34.05		98.39	
37.80		99.11	
48.96		99.09	
62.64		98.75	
69.46		98.69	
69.46		98.78	RPIN

Summary Data	
Bankful Cross Sectional Area	9.8 sq. ft.
Bankfull Width	6.7 ft.
Bankfull Mean Depth	1.5 ft.
Bankful Max Depth	1.9 ft.
Width/Depth Ratio	4.6
Entrenchment Ratio	2.0
Classification	E5/Bc5

Cross-Section

Cross Section Plot - Looking Downstream



Cross-Section Photos

Cross-Section 5, looking downstream

Cross-Section 5, looking upstream

Title Cross-Section 5

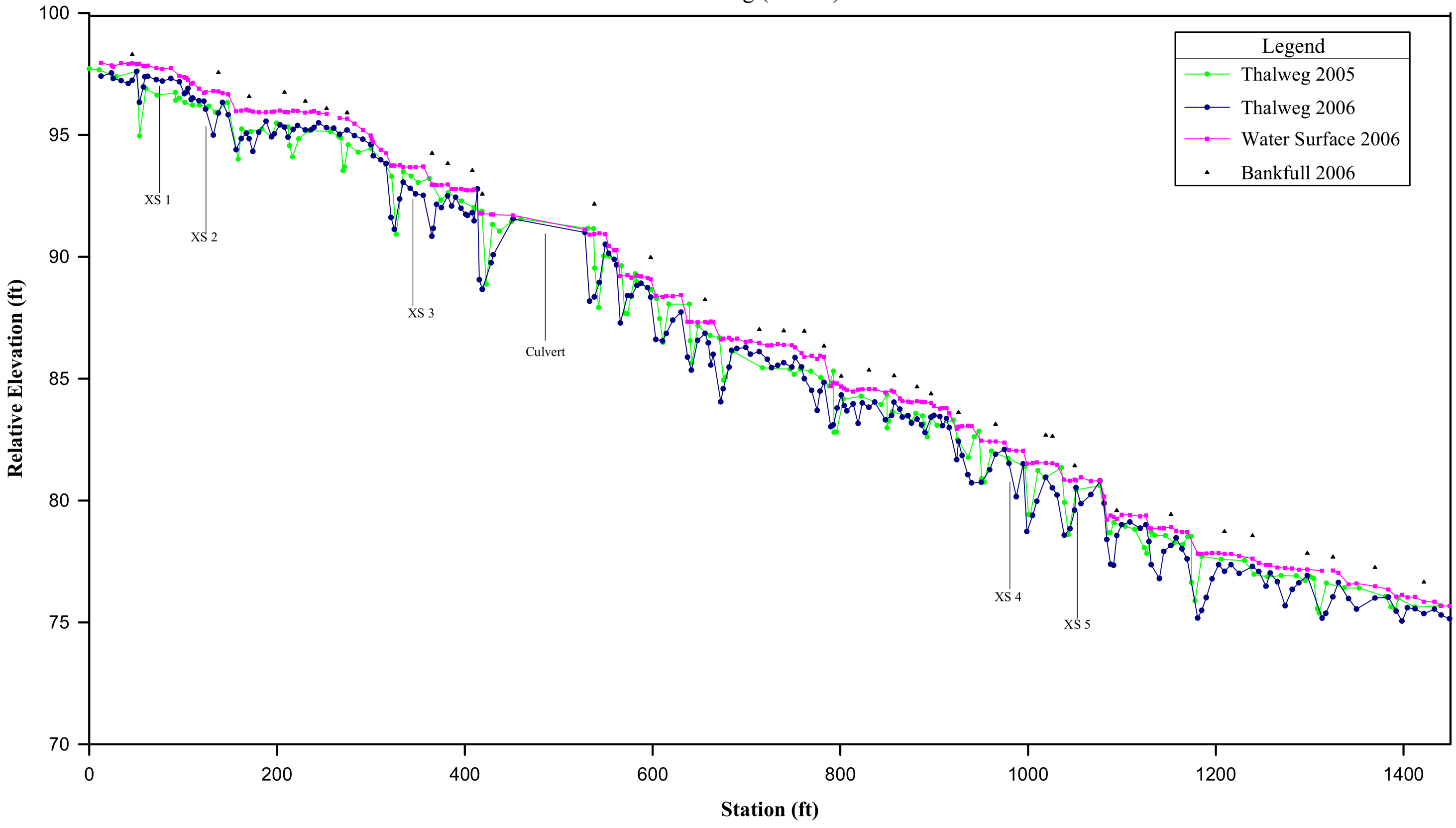
Project	UT to Bear Swamp Creek Stream Restoration Site, Franklin County	**EEP Project #**	27
		Figure	Cross-Section Appendix C

Survey Date	**Survey Weather**	**Field Team**	**Location**
11/13/06	Sunny	Michael Gloden, Jim Cooper	Station 10+68

UT to Bear Swamp Creek

Longitudinal Profile

2006 Monitoring (Year 4)



UT to Bear Swamp Creek
Longitudinal Profile Data
November 2006

Station	TW Elevation	WS Elevation	BKF Elevation	Station	TW Elevation	WS Elevation	BKF Elevation
0.00	99.30	99.62		217.21	95.23	96.00	
12.53	97.41	97.96		221.89	95.39	95.98	
23.68	97.54	97.85		230.11	95.21	95.92	96.39
25.50	97.32	97.81		236.20	95.21	95.95	
33.95	97.23	97.95		239.41	95.30	95.98	
41.59	97.11	97.91		244.28	95.50	95.90	
45.77	97.24	97.94	98.30	252.73	95.30	95.87	96.08
50.31	97.60	97.91		260.47	95.28		
53.42	96.34	97.93		266.69	95.02	95.70	
57.71	96.97	97.83		274.57	95.20	95.67	95.91
59.24	97.38	97.82		282.59	94.97	95.47	
62.25	97.41	97.85		291.43	94.82	95.20	
71.52	97.27	97.75		299.76	94.61	94.97	
77.81	97.21	97.71		300.76	94.62	94.85	
86.86	97.31	97.74		302.45	94.14	94.72	
96.07	97.18	97.43		310.46	93.98	94.40	
101.20	96.69	97.37		316.21	93.83	94.25	
103.40	96.75	97.33		321.46	91.61	93.75	
105.24	96.91	97.26		324.95	91.13	93.75	
108.60	96.45	97.09		330.65	92.37	93.76	
110.24	96.51	97.14		334.37	93.06	93.68	
116.90	96.40	96.90		341.85	92.81	93.69	
122.26	96.39	96.72		347.55	92.58	93.68	
123.91	96.06	96.76		355.86	92.52	93.71	
132.14	94.99	96.80		365.01	90.85	92.97	94.25
137.53	95.90	96.79	97.56	366.55	91.17	92.97	
141.99	96.33	96.72		369.93	92.16	92.94	
147.95	95.83	96.67		375.09	92.02	92.94	
156.40	94.40	95.98		381.82	92.50	92.97	93.83
161.90	94.85	96.00		385.96	92.08	92.78	
167.31	95.07	96.04		390.21	92.44	92.78	
170.40	94.85	96.00	96.57	396.03	91.99	92.79	
174.19	94.33	95.96		400.98	91.74	92.74	
180.54	95.11	95.94		403.01	91.70	92.73	
188.40	95.56	95.94		407.91	91.81	92.73	93.54
194.22	94.92	95.95		409.91	91.48	92.77	
197.09	95.04	95.96		413.46	92.78		
203.07	95.41	96.00		415.47	89.06	91.79	
207.89	95.32	95.95	96.75	418.66	88.67	91.78	92.58
211.73	94.91	95.94		428.04	89.76	91.74	

UT to Bear Swamp Creek
Longitudinal Profile Data
November 2006

Station	TW Elevation	WS Elevation	BKF Elevation	Station	TW Elevation	WS Elevation	BKF Elevation
430.33	90.08	91.74		739.84	85.66	86.39	86.96
451.44	91.56	91.70		748.48	85.47	86.37	
527.82	90.50	91.12		751.78	85.87	86.29	
532.82	88.18	90.91		758.71	85.48	86.05	
537.90	88.36	90.94	92.17	761.66	85.00	85.90	86.95
543.30	88.95	90.97		769.51	84.52	85.94	
549.63	90.51	90.93		775.48	83.69	85.81	
553.34	90.14	90.45		778.51	84.48	85.95	
559.25	89.89	90.28		782.69	84.84	85.90	86.34
561.55	89.67	90.28		789.86	83.03	84.69	
565.68	87.29	89.21		792.68	83.10	84.83	
573.26	88.41	89.25		796.75	83.79	84.80	
577.44	88.40	89.15		801.08	84.33	84.68	85.10
583.38	88.82	89.23		804.29	83.89	84.59	
587.73	88.91	89.20		806.98	83.68	84.54	
594.68	88.74	89.14		813.76	83.96	84.47	
598.00	88.35	89.08	89.97	819.05	83.17	84.55	
603.47	86.61	88.41		823.52	84.00	84.56	
610.59	86.55	88.36		830.54	83.83	84.57	85.36
614.75	86.85	88.39		836.69	84.04	84.56	
621.57	87.40	88.39		848.08	83.31	84.43	
630.25	87.73	88.44		854.62	83.49	84.51	
637.32	85.88	87.34		857.30	84.03	84.46	85.12
641.33	85.35	87.34		863.54	83.75	84.19	
648.01	86.57	87.32		866.17	83.42	84.09	
655.91	86.86	87.33	88.24	872.29	83.48	84.06	
659.45	86.47	87.30		875.95	83.17	84.03	
662.09	85.56	87.35		881.82	83.34	84.07	84.66
664.71	86.00	87.32		886.59	83.10	84.05	
672.69	84.04	86.61		890.30	82.79	84.05	
675.36	84.58	86.65		896.69	83.42	84.00	84.38
681.62	85.47	86.69		899.81	83.49	83.88	
684.22	86.16	86.61		906.05	83.44	83.77	
689.94	86.24	86.65		908.90	83.07	83.79	
699.44	86.28	86.51		913.22	83.36	83.79	
704.29	86.01	86.54		916.14	82.99	83.58	
713.73	86.11	86.46	87.02	924.07	81.67	82.94	
722.34	85.80	86.37		925.92	82.42	83.04	83.62
726.85	85.45	86.38		929.86	81.84	83.05	
733.39	85.55	86.42		935.92	81.06	83.07	

UT to Bear Swamp Creek
Longitudinal Profile Data
November 2006

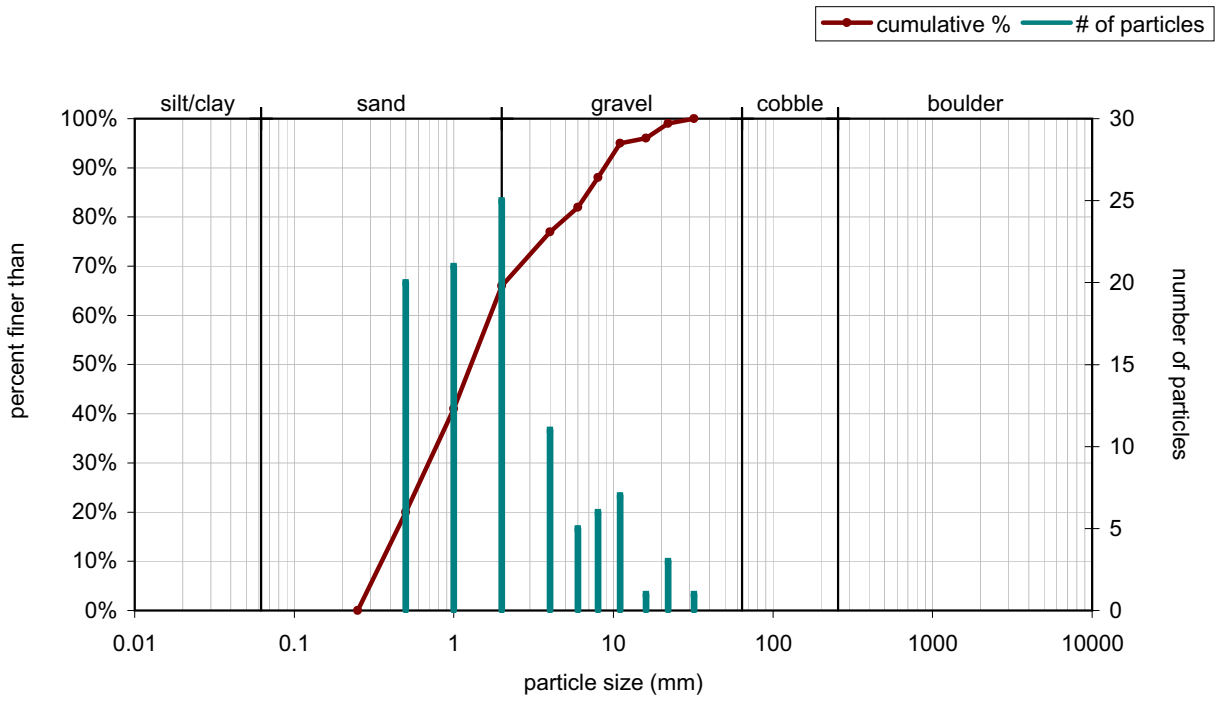
Station	TW Elevation	WS Elevation	BKF Elevation
939.84	80.72	83.05	
950.18	80.75	82.46	
959.16	81.26	82.42	
965.52	81.90	82.43	83.13
974.87	82.09	82.38	
979.70	81.52	82.07	
987.49	80.15	82.04	
994.84	81.50	82.04	
998.77	78.73	81.51	
1004.86	79.39	81.54	
1009.33	79.97	81.57	
1018.85	80.95	81.54	82.69
1025.94	80.52	81.53	82.64
1030.97	80.23	81.46	
1038.55	78.57	80.86	
1044.65	78.84	80.81	
1049.65	79.60	80.85	81.43
1051.11	80.53	80.83	
1056.43	79.87	80.96	
1067.01	80.25	80.79	
1076.64	80.81	80.83	
1081.06	79.88	80.17	
1083.89	78.40	79.21	
1087.98	77.39	79.39	
1091.12	77.34	79.32	
1094.55	78.56	79.24	79.59
1099.76	79.00	79.42	
1108.54	79.12	79.41	
1119.49	78.86	79.35	
1125.69	79.00	79.39	
1128.89	78.31	78.86	
1131.22	77.37	78.86	
1139.93	76.80	78.86	
1144.54	77.91	78.86	
1152.19	78.16	78.92	79.43
1157.83	78.46	78.77	
1164.05	78.02	78.72	
1169.47	77.60	78.72	
1180.65	75.18	77.82	
1184.97	75.49	77.81	
1189.89	76.02	77.83	
1196.07	76.78	77.85	
1202.96	77.37	77.84	
1209.32	77.09	77.81	78.73
1216.21	77.37	77.81	
1224.87	77.01	77.72	
1238.98	77.30	77.62	78.56
1245.83	77.08	77.44	
1253.46	76.49	77.36	
1257.97	77.02	77.36	
1265.56	76.66	77.26	
1273.92	75.68	77.23	
1281.33	76.35	77.21	
1288.46	76.62	77.16	
1297.49	76.92	77.18	77.84
1313.27	75.17	77.12	
1317.23	75.37		
1324.76	76.05	77.13	77.68
1330.55	76.63	77.04	
1341.46	75.97	76.56	
1349.91	75.55	76.60	
1369.66	76.00	76.48	77.25
1383.80	76.04	76.35	
1392.24	75.46	76.06	
1398.33	75.05	76.13	
1404.09	75.60	76.03	
1412.32	75.56	76.04	
1421.69	75.36	75.85	76.66
1432.99	75.54	75.85	
1440.06	75.30	75.68	
1449.05	75.15	75.67	

Bed Surface

Material	Size Range (mm		Count
silt/clay	0	- 0.062	
very fine sand	0.062	- 0.125	
fine sand	0.125	- 0.25	
medium sand	0.25	- 0.5	**20**
coarse sand	0.5	- 1	**21**
very coarse sand	1	- 2	**25**
very fine gravel	2	- 4	**11**
fine gravel	4	- 6	**5**
fine gravel	6	- 8	**6**
medium gravel	8	- 11	**7**
medium gravel	11	- 16	**1**
coarse gravel	16	- 22	**3**
coarse gravel	22	- 32	**1**
very coarse gravel	32	- 45	
very coarse gravel	45	- 64	
small cobble	64	- 90	
medium cobble	90	- 128	
large cobble	128	- 180	
very large cobble	180	- 256	
small boulder	256	- 362	
small boulder	362	- 512	
medium boulder	512	- 1024	
large boulder	1024	- 2048	
very large boulder	2048	- 4096	
total particle count:			100
bedrock ----------			
clay hardpan ----------			
detritus/wood ----------			
artificial ----------			
total count:			100

Note: Reach-wide classification count

Bed Surface Pebble Count, ---



Size (mm)	
D16	0.44
D35	0.82
D50	1.3
D65	1.9
D84	6.6
D95	11

Size Distribution	
mean	1.7
dispersion	4.0
skewness	0.11

Type	
silt/clay	0%
sand	66%
gravel	34%
cobble	0%
boulder	0%

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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 fourth 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 monitoring for Year 4 was performed based on the Carolina Vegetation Survey (CVS) Levels 1 and 2. Plot locations are consistent with previous years but plot size changed to 5m x 20m. Based on recommendations by EEP, Plot 4 was not surveyed in the current monitoring Year 4.

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 fourth year surveys, the average count of the surviving planted species is 374 stems per acre. If volunteer species are included, the total number of stems increases to 8033 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 is a continuing nuisance as pines 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 that 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-sections (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. 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, thirteen are not performing their intended function. Six vanes have water piping through or behind the structure. The remaining eight have filled-in with sediment and have become obsolete.

Based on the cross-sections and visual observations, the channel dimensions have not changed significantly. 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 continue to be found at a significantly lower elevation than those described by the designer. Pebble counts show no significant change to the channel substrate.

2.0 PROJECT BACKGROUND

2.1 LOCATION AND SETTING

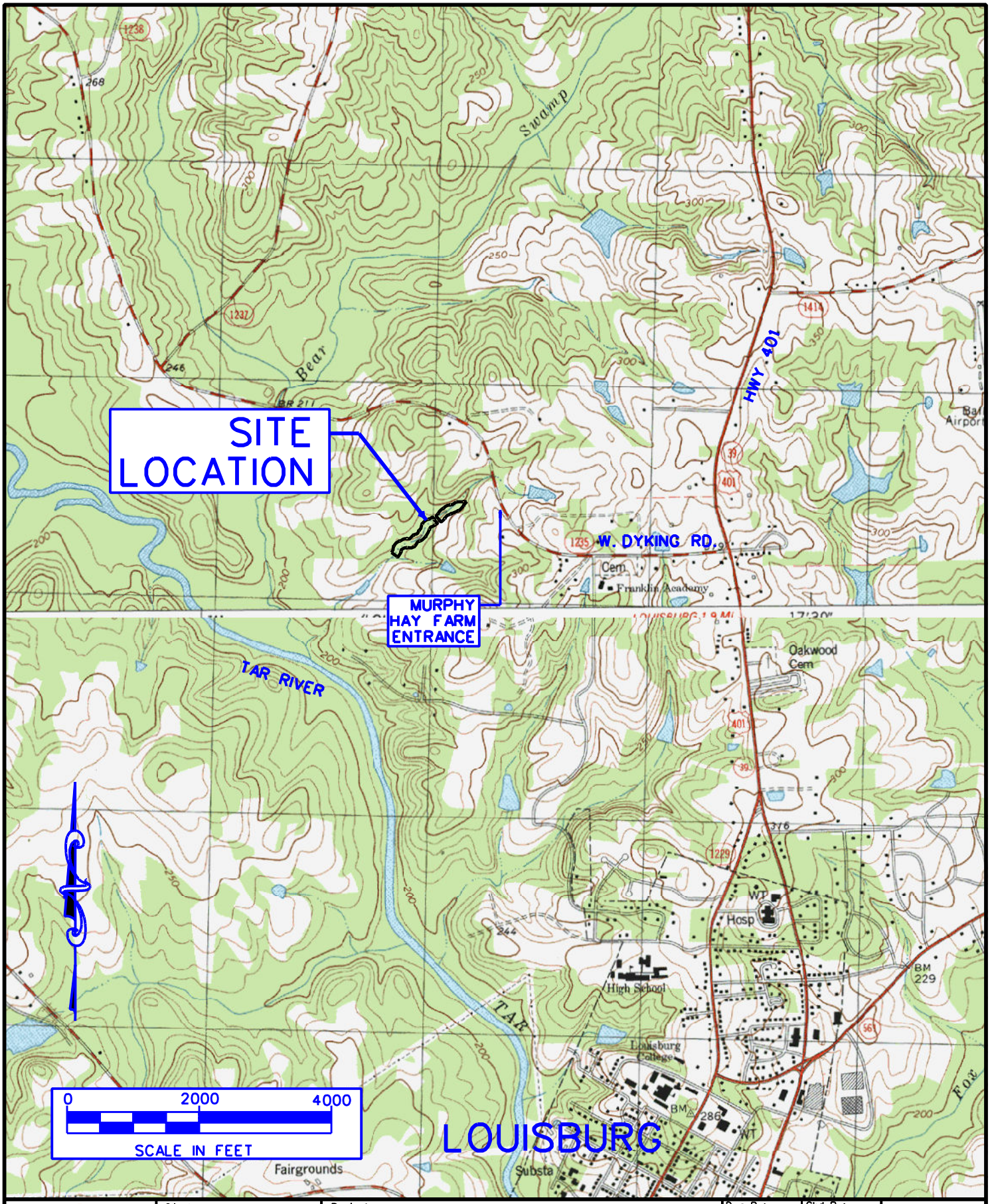
The Site is located north of Louisburg in Franklin County, NC, immediately south of Dyking Road (SR 1235) at the Murphy Hay Farm (Figure 1). From Raleigh follow Highway 401 north to Louisburg. Approximately one mile past the Highway 561 split in Louisburg take a left onto Dyking Road. The Murphy Hay 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 1400 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 1000 feet east of the project. Land use in the watershed consists of agriculture, pasture, 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). Approximately 664 linear feet of new channel was constructed; and 771 linear feet of stream was stabilized in-place. Approximately 800 tons of rock was used to construct 24 rock vanes throughout the reach (Figure 2, Appendix A). The vanes were designed to improve hydraulic 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 stabilizing 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.



EcoScience Corporation
Raleigh, North Carolina

Client: Ecosystem Enhancement Program

Project:

Unnamed Tributary to Bear Swamp Creek Stream Restoration Site

EEP Project No. 27

FRANKLIN COUNTY, NORTH CAROLINA

Dwn By:	Ckd By:
GWN	JWG

Date: DEC 2006

Scale: 1"=2000'

ESC Project No.: 06-282.04

FIGURE 1

Exhibit Table I. Project Mitigation Structure and Objectives UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27					
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 P2 = Priority II S = Stabilization

SSS = Stream Bank Stabilization P3 = Priority III

2.3 PROJECT HISTORY AND BACKGROUND

Exhibit Table II. Project Activity and Reporting History UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27			
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	Dec 2005
Year 4 Vegetation Monitoring	Dec 2006	Nov 2006	Dec 2006
Year 4 Stream Monitoring	Dec 2006	Nov 2006	Dec 2006

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.

Exhibit Table III. 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.

Exhibit Table IV. 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	WS-IV, NSW
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

Exhibit Table V. Preliminary Soil Data UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27					
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

Exhibit Table VI. Vegetative Problem Areas UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27			
Feature / Issue	**Station # / Range**	**Probable Cause**	**Photo #**
Invasive Populations	Throughout, but especially at Vegetation Plot 1	*Pinus taeda*: seeding from adjacent stands	1 and 2

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

3.1.3 Stem Counts

Vegetation monitoring for Year 4 was performed based on the Carolina Vegetation Survey (CVS) Levels 1 and 2. Plot locations are consistent with previous years but plot size changed to 5m x 20m. Based on recommendations by EEP, Plot 4 was not surveyed in the current monitoring Year 4. Stem counts were conducted for all woody species, including volunteer species. An inventory of planted species is given in Table VIIa. A tally of volunteer woody species is listed in Table VIIb.

Exhibit Table VIIa: Stem Counts for Each Species Arranged by Plot UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27								
Species	**Plots**				Year 2 Totals*	Year 3 Totals	Year 4 Totals	Survival %
	1	2	3	5				
Shrubs								
Alnus serrulata					0	0	0	--
Cornus amomum	1				13	12	7	8
Ilex verticillata					0	0	0	--
Salix nigra	5	1		1	19	29	23	37
Sambucus canadensis					0	0	0	--
Trees								
Betula nigra	13				0	6	16	--
Carpinus caroliniana					1	0	0	0
Fraxinus pennsylvanica		6		1	8	8	5	88
Juglans nigra		2			3	3	4	66
Morus rubra					1	0	0	0
Ostrya virginiana			2		5	0	5	40
Quercus michauxii	2			1	3	5	3	100
Quercus pagoda	1			1	1	0	1	200

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

A total of 37 stems of planted species were counted in the four plots. Stem density per acre for Plots 1, 2, 3, and 5 are 890, 364, 81, and 162 stems per acre. The average density for planted species in all plots is 374 stems per acre.

Cornus amomum and *Sambucus canadensis* have survived and grown on moister and more exposed sites on the stream banks, but have largely been out-competed in the more upland sites where the vegetation plots are located. Survival of *Alnus serrulata*, *Ilex verticillata*, *Carpinus caroliniana*, *Morus rubra*, and *Quercus pagoda* appears to have been very poor. The apparent cause of mortality for these species is competition from fast-growing woody species, principally *Pinus taeda*, and from large herbs such as *Sorghum halapense*, *Solidago* sp., and *Eupatorium capillifolium*.

Exhibit Table VIIb. Stem Counts for Volunteer Species Arranged by Plot UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27							
Species	**Plots**				Year 2 Totals	Year 3 Totals	Year 4 Totals
	1	2	3	5			
Acer negundo	1	2			0	3	3
Acer rubrum	19			4	51	73	23
Baccharis halimifolia		8			0	2	8
Celtis laevigata					0	2	0
Diospyros virginiana			1		0	1	1
Juniperus virginiana				1	0	0	1
Liquidambar styraciflua	11			28	20	26	39
Liriodendron tulipifera	3				7	2	3
Pinus taeda	525	87	42		250	547	654
Platanus occidentalis					0	1	0
Prunus serotina				12	0	5	12
Rhus copallina					1	0	0
Rhus glabra					2	43	0
Ulmus alata	10			1	0	41	11
Viburnum nudum	1				0	3	1
Ligustrum sinense		1			0	0	1

A total of 757 stems of volunteer species were counted in the four plots. Density per acre for Plots 1 through 5 is 23067, 3966, 1740, and 1862, with an average of 7659 volunteer woody stems per acre.

Density for Plots 1 through 5, including planted and volunteer species, is 23957, 4330, 1821, and 2023, with an average of 8033 stems per acre.

The Year 3 data from last year indicated invasive populations of *Acer rubrum*. This problem seems to have abated somewhat through competition with *Pinus taeda* and fast-growing, large herbs. Increased rainfall during the 2006 growing season appears to have favored the growth of dense herbaceous vegetation, shading out and suppressing the growth of *Acer rubrum* during the spring and early summer. *Cornus amomum* is a planted species that also appears to be suppressed by vegetative competition.

Aggressive recruitment of *Pinus taeda* continues at the site, especially at the northeastern end (Appendix B). A mixed pine-hardwood woodlot near this area provides a nearby source of pine propagules. The northeastern end of the Site, near Plot 1, also features abundant *Rhus* shrubs, principally *Rhus glabra*. While these are abundant, they do not generate the dense shade found under pine saplings. The unbranched stems and weak vegetative growth result in an open understory where grasses and herbs flourish. It was noted that the *Rhus* thickets were used by deer as a bedding area.

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

Aster dumosus (frost aster)
Bidens frondosa (beggar ticks)
Duchesnea indica (Indian strawberry)
Echinacea purpurea (purple coneflower)
Elymus hystrix (bottlebrush grass)
Eupatorium capillifolium (dog fennel)
Eupatorium fistulosum (Joe Pye weed)
Helianthus angustifolius (swamp sunflower)
Lonicera japonica (Japanese honeysuckle)
Phytolacca americana (pokeweed)
Polygonum sp. (smartweed)
Rumex crispus (curly dock)
Solanum carolinianum (horse nettle)
Solidago sp. (goldenrod)
Sorghum halapense (Johnson grass)
Toxicodendron radicans (poison ivy)
Vernonia sp. (ironweed)

3.2 STREAM ASSESSMENT

3.2.1 Bankfull Events

Exhibit Table VIII. Verification of Bankfull Events
UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27

Date of Data Collection	Date of Occurrence	Method	Photo Number
06/19/2006	06/15/2006	Crest Gauge (Water level was 10 inches above bankfull)	NA

3.2.2 Bank Stability Assessment

A detailed BEHI and NBS assessment are required in years 3, 5, and post construction. This report represents the fourth year of monitoring, therefore no bank stability assessment was conducted.

3.2.3 Stream Problem Areas

Exhibit Table X. Stream Problem Areas
UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27

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 4, filled in		low slope, excess sediment	3
Vane 6, structure failure		Piping, inadequate use of filter fabric, steep vane arms	4
Vane 8, structure failure		Piping, inadequate use of filter fabric, steep vane arms	5
Vane 10, structure failure		Piping, inadequate use of filter fabric, steep vane arms	6
Vane 11, structure failure		Piping, inadequate use of filter fabric, steep vane arms	7
Vane 14, filled in		low slope, excess sediment	8
Vane 16, filled in		low slope, excess sediment	9
Vane 17, filled in		low slope, excess sediment	10
Vane 19, structure failure		Piping, inadequate use of filter fabric, steep vane arms	11
Vane 22, filled in		low slope, excess sediment	12
Vane 24, filled in		low slope, excess sediment	13

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

Exhibit Table XI. 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%	92%	
B. Pools	100%	NA*	NA*	91%	92%	
C. Thalweg	100%	NA*	NA*	88%	88%	
D. Meanders	100%	NA*	NA*	77%	77%	
E. Bed General	100%	NA*	NA*	95%	95%	
F. Rock Vanes	100%	NA*	NA*	82%	71%	
G. Root Wads	100%	NA*	NA*	86%	88%	

Exhibit Table XII. Baseline Morphology and Hydraulic Summary
UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27
1,439 linear feet

Parameter	USGS Gage Data			Regional Curve Interval			Pre-Existing Condition			Project Reference Stream			Design			As-built		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
BF Width (ft)	NA*	NA*	NA*	N/A	N/A	6.7	NA*	NA*	NA*	11.0	11.8	11.4	10.0	10.0	10.0	8.1	10.7	9.6
Floodprone Width (ft)	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	25.5	80.0	40.6	14.0	22.0	18.0	11.4	19.0	13.5
BF Cross Sectional Area (ft^2)	NA*	NA*	NA*	N/A	N/A	8.5	NA*	NA*	NA*	10.3	14.0	12.1	8.6	8.6	8.6	8.1	10.7	9.3
BF Mean Depth (ft)	NA*	NA*	NA*	N/A	N/A	1.0	NA*	NA*	NA*	0.9	1.2	1.1	0.8	0.8	0.8	0.9	1.0	1.0
BF Max Depth (ft)	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	1.9	2.4	2.1	1.4	1.8	1.6	1.5	1.7	1.6
Width/Depth Ratio	NA*	NA*	NA*	N/A	N/A	6.7	NA*	NA*	NA*	11.0	11.8	10.7	12	12	12	8.2	11.4	10.0
Entrenchment Ratio	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	2.2	2.4	2.3	1.4	2.2	1.8	1.7	1.8	1.8
Wetted Perimeter(ft)	**NA***	NA*	NA*	N/A	N/A	8.7	NA*	NA*	NA*	13.2	14.0	13.6	11.6	11.6	11.6	10.1	12.7	11.6
Hydraulic radius (ft)	NA*	NA*	NA*	N/A	N/A	1.0	NA*	NA*	NA*	0.8	1.0	0.9	0.7	0.7	0.7	0.8	0.8	0.8
Pattern																		
Channel Beltwidth (ft)	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	6.0	8.0	7.0	20.0	80.0	37.0	5.5	82.5	31.3
Radius of Curvature (ft)	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	63.0	390.0	240.0	55.0	342.0	199.0	11.0	221.0	77.8
Meander Wavelength (ft)	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	21.0	88.0	46.0	18.0	77.0	40.0	42.4	236.9	121.3
Meander Width ratio	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	0.5	0.7	0.6	2.0	8.0	3.7	0.6	8.6	3.3
Profile																		
Riffle length (ft)	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*
Riffle slope (ft/ft)	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	0.001	0.14	0.04	0.0015	0.132	0.067	0.0026	0.0238	0.0108
Pool length (ft)	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	7.0	13.0	9.3	6.0	11.0	8.0	3.9	30.6	11.1
Pool spacing (ft)	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	22.0	69.0	42.0	19.0	61.0	37.0	31.7	115.5	53.5
Substrate																		
d50 (mm)	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	3	3	3	0.2	0.2	0.2	0.4	0.4	0.4
d84 (mm)	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	49.7	49.7	49.7	2.9	2.9	2.9	16	16	16
Additional Reach Parameters																		
Valley Length (ft)	NA*			N/A			NA*			NA*			1,300			1,300		
Channel Length (ft)	NA*			N/A			NA*			NA*			1,435			1,435		
Sinuosity	NA*			N/A			NA*			1.1			1.1			1.1		
Water Surface Slope (ft/ft)	NA*			N/A			NA*			0.016			0.0157			0.0154		
BF slope (ft/ft)	NA*			N/A			NA*			0.016			0.0157			0.0154		
Rosgen Classification	NA*			N/A			NA*			B5c			B5c			B5c		
**Habitat Index	NA*			N/A			NA*			NA*			NA*			NA*		

Exhibit Table XIII. Morphology and Hydraulic Monitoring Summary
UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27

Parameter	Cross-Section 1 Riffle						Cross-Section 2 Riffle						Cross-Section 3 Pool						Cross-Section 4 Pool					
Dimension	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
BF Width (ft)	NA*	NA*	5.0	6.5			NA*	NA*	3.4	3.1			NA*	NA*	5.0	6.9			NA*	NA*	4.1	7.7		
Floodprone Width (ft)	NA*	NA*	9.5	11.1			NA*	NA*	7.3	5.6			NA*	NA*	9.8	13.1			NA*	NA*	32.4	17.7		
BF Cross Sectional Area (ft^2)	NA*	NA*	2.6	3.4			NA*	NA*	1.9	2.6			NA*	NA*	1.9	2.0			NA*	NA*	9.3	11.9		
BF Mean Depth (ft)	NA*	NA*	0.5	0.5			NA*	NA*	0.6	0.8			NA*	NA*	0.4	0.3			NA*	NA*	2.2	1.5		
BF Max Depth (ft)	NA*	NA*	0.7	0.8			NA*	NA*	0.8	0.9			NA*	NA*	0.6	0.6			NA*	NA*	3.2	2.1		
Width/Depth Ratio	NA*	NA*	9.6	12.2			NA*	NA*	6.1	3.7			NA*	NA*	13.3	24.5			NA*	NA*	1.9	5.0		
Entrenchment Ratio	NA*	NA*	1.9	1.7			NA*	NA*	2.1	1.8			NA*	NA*	2.0	1.9			NA*	NA*	7.8	2.3		
Wetted Perimeter(ft)	NA*	NA*	6.0	6.0			NA*	NA*	4.6	4.4			NA*	NA*	5.8	5.8			NA*	NA*	12.9	12.9		
Hydraulic radius (ft)	NA*	NA*	0.8	0.6			NA*	NA*	0.4	0.6			NA*	NA*	0.3	0.3			NA*	NA*	0.7	0.9		
Substrate																								
d50 (mm)	0.4	NA*	0.33	1.8			NA*	NA*	0.73	1.4			1.9	NA*	0.65	1.0			6.9	NA*	0.87	0.43		
d84 (mm)	3.0	NA*	0.65	3.9			NA*	NA*	4.5	5.2			2937	NA*	1.5	5.4			3129	NA*	1.6	0.97		

Parameter	MY-01 (2003)			MY-02 (2004)			MY-03 (2005)			MY-04 (2006)			MY-05 (2007)			MY+ (2008)		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	13.3	62.7	33.2	NA*	NA*	NA*	13.3	62.7	33.2	13.3	62.7	33.2						
Radius of Curvature (ft)	40.0	500.0	158.5	NA*	NA*	NA*	40.0	500.0	158.5	40.0	500.0	158.5						
Meander Wavelength (ft)	19.2	112.4	57.0	NA*	NA*	NA*	19.2	112.4	57.0	19.2	112.4	57.0						
Meander Width ratio	1.3	6.3	3.4	NA*	NA*	NA*	2.8	23.9	12.1	2.8	23.9	12.1						
Profile																		
Riffle length (ft)	NA*	NA*	NA*	NA*	NA*	NA*	3.8	62.7	28.0	3.8	62.7	28.0						
Riffle slope (ft/ft)	0.0024	0.0487	0.0197	NA*	NA*	NA*	0.001	0.061	0.014	0.001	0.061	0.014						
Pool length (ft)	3.7	23.9	12.6	NA*	NA*	NA*	1.8	22.7	5.2	1.8	22.7	5.2						
Pool spacing (ft)	17.7	69.3	41.6	NA*	NA*	NA*	14.0	183.0	64.6	14.0	183.0	64.6						
Additional Reach Parameters																		
Valley Length (ft)	1,300			NA*			1,300			1,300								
Channel Length (ft)	1,435			NA*			1,439			1,439								
Sinuosity	1.1			NA*			1.1			1.1								
Water Surface Slope (ft/ft)	0.0161			NA*			0.0153			0.015								
BF slope (ft/ft)	0.0161			NA*			0.0165			0.016								
Rosgen Classification	B5c			NA*			E5/Bc5			E5/Bc5								
Habitat Index*	NA*			NA*			N/A			N/A								
Macrobenthos*	NA*			NA*			N/A			N/A								

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

Exhibit Table XIII. cont. Morphology and Hydraulic Monitoring Summary
UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27
1,439 linear feet

Parameter	Cross Section 5 Riffle																							
Dimension	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
BF Width (ft)	NA*	NA*	5.7	6.7																				
Floodprone Width (ft)	NA*	NA*	10.1	13.4																				
BF Cross Sectional Area (ft^2)	NA*	NA*	6.1	9.8																				
BF Mean Depth (ft)	NA*	NA*	1.1	1.5																				
BF Max Depth (ft)	NA*	NA*	1.3	1.9																				
Width/Depth Ratio	NA*	NA*	5.3	4.6																				
Entrenchment Ratio	NA*	NA*	1.8	2.0																				
Wetted Perimeter(ft)	NA*	NA*	7.9	7.9																				
Hydraulic radius (ft)	NA*	NA*	0.8	1.2																				
Substrate																								
d50 (mm)	0.4	NA*	1.5	4.0																				
d84 (mm)	3.0	NA*	14.0	9.7																				

Appendix A
(Click here)