FINAL MITIGATION PLAN
and AS-BUILT BASELINE REPORT
UT to CANE CREEK RESTORATION SITE
ALAMANCE COUNTY, NORTH CAROLINA
(EEP Project No. 395)

Submitted to:
North Carolina Department of Environment and Natural Resources
Ecosystem Enhancement Program
Raleigh, North Carolina

November 2009

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Ecosystem Enhancement PROGRAM

November 2009

EXECUTIVE SUMMARY

The North Carolina Ecosystem Enhancement Program (NCEEP) has completed restoration of streams and wetlands at the UT to Cane Creek Restoration Site (hereafter referred to as the "Site") to assist in fulfilling stream and wetland mitigation goals in the area. The Site is located in southwest Alamance County approximately 5 miles east of Liberty, North Carolina in United States Geological Survey Hydrologic Unit 03030002050050 (North Carolina Division of Water Quality Subbasin 03-06-04) of the Cape Fear River Basin. This Hydrologic Unit has been identified as a Targeted Local Watershed in NCEEP's *Cape Fear River Basin Restoration Priorities 2009*.

Prior to construction, the Site was characterized by pasture land utilized for livestock grazing. Land use practices including the maintenance and removal of riparian vegetation and hoof shear from livestock had resulted in degraded water quality, unstable channel characteristics (stream entrenchment, erosion, and bank collapse), and reduced storage capacity and floodwater attenuation. In addition, hydric soils were disturbed due to regular plowing and vegetation maintenance and hoof shear from livestock.

The goals and objectives of this project focus on improving local water quality, enhancing flood attenuation, and restoring aquatic and riparian habitat. These goals were accomplished by the following.

1. Reestablished stream stability and the capacity to transport watershed flows and sediment load by restoring stable channel morphology supported by natural instream habitat and grade/bank stabilization structures.
2. Reduced nonpoint source sedimentation and nutrient inputs into the Site by eliminating the acceleration of bank erosion as a result of land use activities, excluding livestock, and reestablishing a native riparian buffer greater than 50 feet in width.
3. Enhanced the capacity of the Site to mitigate flood flows by reconnecting the stream to the historic floodplain.

This project was constructed between March 17, 2008 and March 15, 2009. Final grading, stream structure installation, and site stabilization was completed by March 4, 2009, and planting of trees and shrubs was completed between March 11-15, 2009. As constructed, Site activities restored historic stream and wetland functions, which existed onsite prior to impacts from unrestricted livestock access, riparian and bank vegetation removal, and nutrient loading from surrounding pasture land. Stream construction of meandering, E-type stream channels resulted in 6783 linear feet of stream restoration. The removal of invasive species and subsequent planting with native riparian vegetation resulted in 1.3 acres of riparian riverine wetland enhancement and 2.0 acres of riparian riverine wetland preservation. Site activitites provided 6783 Stream Mitigation Units and 1.1 riparian riverine Wetland Mitigation Units. The Site will be protected by a 50.75 acre permanent conservation easement held by the State of North Carolina. Baseline measurements/evaluations indicate that Site streams, wetlands, and vegetation compare favorably to plans as set forth in the detailed restoration plan and construction plans.

The UT to Cane Creek Restoration Site monitoring plan will entail analysis of the stream channel and riparian vegetation. Monitoring of restoration efforts will be performed for a minimum of 5 years or until success criteria are fulfilled.

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APPENDICES

1.0 INTRODUCTION

1.1 Location and Setting

The North Carolina Ecosystem Enhancement Program (NCEEP) has completed restoration of streams and wetlands at the UT to Cane Creek Restoration Site (hereafter referred to as the "Site") to assist in fulfilling stream and wetland mitigation goals in the area. The Site is located in southwest Alamance County approximately 5 miles east of Liberty, North Carolina in United States Geological Survey (USGS) Hydrologic Unit 03030002050050 (North Carolina Division of Water Quality Subbasin 03-06-04) of the Cape Fear River Basin (Figure 1, Appendix A). This Hydrologic Unit has been identified as a Targeted Local Watershed in NCEEP's *Cape Fear River Basin Restoration Priorities 2009*.

Directions to the Site:

- From Raleigh, take US-64 West to exit 381 for NC-87 towards Spring Lake and Fayetteville
- Turn right on NC-87/Graham Road
- Take a slight left onto Silk Hope Gum Springs Road/Silk Hope Road
- Turn right on Snow Camp Road
- Turn left on Old Dam Road
- The Site is located at the stream crossing between Wild Rose Road and Cocoa Road
- Latitude, Longitude of Site: 35.8644°N, 79.4800°W (NAD83/WGS84)

1.2 Project Goals and Objectives

The goals and objectives of this project focus on improving local water quality, enhancing flood attenuation, and restoring aquatic and riparian habitat. These goals were accomplished by the following.

1. Reestablished stream stability and the capacity to transport watershed flows and sediment load by restoring stable channel morphology supported by natural instream habitat and grade/bank stabilization structures.
2. Reduced nonpoint source sedimentation and nutrient inputs into the Site by eliminating the acceleration of bank erosion as a result of land use activities, excluding livestock, and reestablishing a native riparian buffer greater than 50 feet in width.
3. Enhanced the capacity of the Site to mitigate flood flows by reconnecting the stream to the historic floodplain.

1.3 Project Structure, Restoration Type, and Approach

Prior to construction, the Site was characterized by pasture land utilized for livestock grazing. Land use practices including the maintenance and removal of riparian vegetation and hoof shear from livestock had resulted in degraded water quality, unstable channel characteristics (stream entrenchment, erosion, and bank collapse), and reduced storage capacity and floodwater attenuation. In addition, hydric soils were disturbed due to regular plowing and vegetation maintenance and hoof shear from livestock.

As constructed, Site activities restored historic stream and wetland functions, which existed onsite prior to impacts from unrestricted livestock access, riparian and bank vegetation removal, and nutrient loading from surrounding pasture land. Stream construction of meandering, E-type stream channels resulted in 6783 linear feet of stream restoration. The removal of invasive species and subsequent planting with native riparian vegetation resulted in 1.3 acres of riparian riverine wetland enhancement and 2.0 acres of riparian riverine wetland preservation (Table 1, Appendix A). Planting occurred within 41 acres of the conservation easement, including constructed streambanks, floodplain, wetland enhancement areas, and uplands. The target natural community within uplands of the Site is Mixed-Mesic Hardwood Forest and within the remainder of the Site is Piedmont/Mountain Bottomland Forest (Schafale and Weakley 1990). Table 7

(Appendix C) outlines woody and herbaceous species planted within the Site. Completed project activities, reporting history, completion dates, project contacts, and background information are summarized in Tables 2-4 (Appendix A).

2.0 MONITORING PLAN

The UT to Cane Creek Restoration Site monitoring plan will entail analysis of the stream channel and riparian vegetation. Monitoring of restoration efforts will be performed for a minimum of 5 years or until success criteria are fulfilled. Locations of stream cross-sections and vegetation monitoring plots are depicted on Figure 2 (Appendix A).

2.1 Stream

After completion of Site construction, five reaches approximately 600 linear feet in length were monitored for geometric activity along the restored channel. In addition, 12 stream cross-sections were established and permanently monumented throughout the Site.

Annual fall monitoring will include development of channel cross-sections on riffles and pools, pebble counts, and a water surface profile of the channel. The data will be presented in graphic and tabular format. Data to be presented will include 1) cross-sectional area, 2) bankfull width, 3) average depth, 4) maximum depth, 5) width-to-depth ratio, 6) water surface slope, and 7) stream substrate composition.

Baseline/as-built measurements, performed in September 2009, emulated the proposed channel morphology. Baseline data are included in Tables 5A-5D in Appendix B.

2.2 Vegetation

Following Site planting, 15 (10-meter by 10-meter) vegetation monitoring plots were established within the Site. During the first year, vegetation will receive a cursory, visual evaluation on a periodic basis to ascertain the degree of overtopping of planted elements by nuisance species. Subsequently, quantitative sampling of vegetation will be performed each year using the *CVS-EEP Protocol for Recording Vegetation Level 1-2 Plot Sampling Only* (Version 4.0) (Lee et al. 2006) in September of the first monitoring year and between June 1 and September 30 for each subsequent year until the vegetation success criteria are achieved. A photographic record of plant growth will be included in each annual monitoring report. Attributes of the vegetation plots are included in Table 6 in Appendix C.

3.0 SUCCESS CRITERIA

3.1 Stream Success Criteria

Success criteria for stream restoration will include 1) successful classification of the reach as a functioning stream system (Rosgen 1996) and 2) channel variables indicative of a stable stream system. Annual monitoring will continue until success criteria are met and no less than two bankfull events have occurred, otherwise monitoring will continue until the second bankfull event has occurred.

Visual assessment of in-stream structures will be conducted to determine if failure has occurred. Failure of a structure may be indicated by collapse of the structure, undermining of the structure, abandonment of the channel around the structure, and/or stream flow beneath the structure.

3.2 Vegetation Success Criteria

Success criteria have been established to verify that the vegetation component supports community elements necessary for forest development. Success criteria are dependent upon the density and growth of

characteristic forest species. An average density of 320 stems per acre must be surviving at the end of the third monitoring year. Subsequently, 290 stems per acre must be surviving at the end of year 4 and 260 stems per acre at the end of year 5.

If vegetation success criteria are not achieved, based on average density calculations from combined plots over the entire restoration area, supplemental planting may be performed with tree species approved by regulatory agencies. Supplemental planting will be performed as needed until achievement of vegetation success criteria.

4.0 MAINTENANCE AND CONTINGENCY

In the event that success criteria are not fulfilled, a mechanism for contingency will be implemented.

Stream

In the event that stream success criteria are not fulfilled, a mechanism for contingency will be implemented. Stream contingency may include, but may not be limited to 1) structure installation; 2) repair of dimension, pattern, and/or profile variables; and 3) bank stabilization. The method of contingency is expected to be dependent upon stream variables that are not in compliance with success criteria. Primary concerns, which may jeopardize stream success include 1) headcut migration through the Site, and/or 2) bank erosion.

Headcut Migration Through the Site

In the event that a headcut occurs within the Site (identified visually or through onsite measurements [i.e. bank-height ratios exceeding 1.4]), provisions for impeding headcut migration and repairing damage caused by the headcut will be implemented. Headcut migration may be impeded through the installation of in-stream grade control structures (rip-rap sill and/or log cross-vane weir) and/or restoring stream geometry variables until channel stability is achieved. Channel repairs to stream geometry may include channel backfill with coarse material and stabilizing the material with erosion control matting, vegetative transplants, and/or willow stakes.

Bank Erosion

In the event that severe bank erosion occurs at the Site resulting in elevated width-to-depth ratios, contingency measures to reduce bank erosion and width-to-depth ratio will be implemented. Bank erosion contingency measures may include the installation of cross-vane weirs and/or other bank stabilization measures. If the resultant bank erosion induces shoot cutoffs or channel abandonment, a channel may be excavated which will reduce shear stress to stable values.

Vegetation

If vegetation success criteria are not achieved based on average density calculations from combined plots over the entire restoration area, supplemental planting may be performed with tree species approved by regulatory agencies. Supplemental planting will be performed as needed until achievement of vegetation success criteria.

5.0 REFERENCES

Lee, M.T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2006. CVS-EEP Protocol for Recording Vegetation. Version 4.0. North Carolina Department of Environment and Natural Resources, Ecosystem Enhancement Program. Raleigh, North Carolina.

North Carolina Ecosystem Enhancement Program. 2009. Cape Fear River Basin Restoration Priorities 2009 (online). Available: http://www.nceep.net/services/lwps/cape_fear/RBRP%20Cape%20Fear%202008.pdf [November 20, 2009].

Rosgen D. 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, Colorado.

Schafale, M.P. and A.S. Weakley. 1990. Classification of the Natural Communities of North Carolina: Third Approximation. North Carolina Natural Heritage Program, Division of Parks and Recreation, North Carolina Department of Environment, Health, and Natural Resources. Raleigh, North Carolina.

United States Army Corps of Engineers, United States Environmental Protection Agency, North Carolina Wildlife Resources Commission, North Carolina Division of Water Quality (USACE et al.). 2003. Stream Mitigation Guidelines.

Appendix A.
General Tables and Figures

Table 1. Site Restoration Structures and Objectives

Restoration Segment/ Reach ID*	Station Range	Mitigation Type	Priority Approach	Linear Footage/ Acreage	Comment
Reach A	10+00-28+10.76	Restoration	Priority 1	1738.76**	Restoration of dimension and profile through a combination of new location and in place restoration.
Reach B	28+10.76-49+29.45	Restoration	Priority 1	2118.69	
Reach C	49+29.45-61+24.03	Restoration	Priority 2	1194.58	
Reach D	100+00-113.57.31	Restoration	Priority 1	1357.31	
Reach E	200+00-203+73.25	Restoration	Priority 1	373.25	
Wetlands	--	Enhancement	--	1.3	Invasive species removal and planting with native forest vegetation.
Wetlands	--	Preservation	--	2.0	Invasive species removal.

Component Summation			
Restoration Level	**Stream (linear footage)**	**Riverine Riparian Wetland (acreage)**	**Planted Riparian Buffer (acreage)**
Restoration	6782.59	--	--
Enhancement	--	1.3	--
Preservation		2.0	--
Totals	**6782.59 linear feet**	**3.3 acres**	**41 acres**
Mitigation Units	**6783 SMUs**	**1.1 WMUs**	**--**

* Locations of each reach are depicted on the As-built Drawings in Appendix A

** Constructed linear footage excludes the 72-foot corrugated metal pipe at Old Dam Road; therefore, the linear footage is shorter than stationing depicts.

Table 2. Project Activity and Reporting History

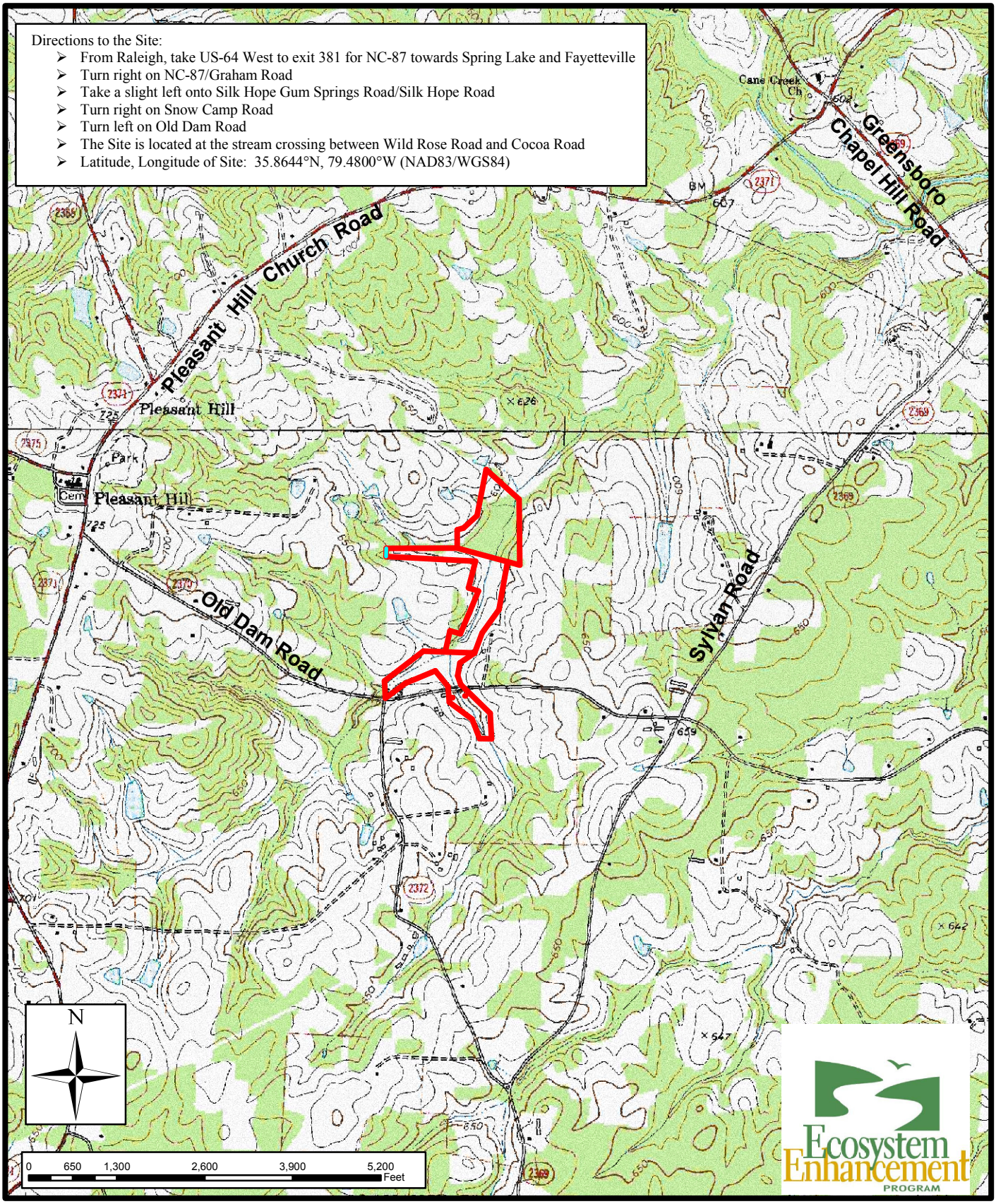
Activity or Report	Data Collection Complete	Completion or Delivery
Restoration Plan	--	February 2006
Construction Completion	--	March 2009
Site Planting	--	March 2009
As-built Drawings	July-October 2008	July 2009
Mitigation Plan	--	October 2009

Table 3. Project Contacts Table

Designer	URS Corporation 1600 Perimeter Park Drive, Suite 400 Morrisville, North Carolina 27560 Kathleen McKeithan (919) 461-1597
Construction Contractor	River Works, Inc. 8000 Regency Parkway, Suite 200 Cary, North Carolina 27511 Will Pederson (919) 459-9001
Conservation Easement Contractor	Landmark Surveying, Inc. 109 E. Harden Street Graham, North Carolina 27253 (336) 229-6275
As-built Surveying Contractor	Level Cross Surveying, PLLC 668 Marsh County Lane Randleman, North Carolina 23717 Sherri Willard (336) 495-1713

Table 4. Project Attribute Table

Project County	Alamance County, North Carolina				
Physiographic Region	Piedmont				
Ecoregion	Carolina Slate Belt				
Project River Basin	Cape Fear				
USGS 14-digit HUC	03030002050050				
NCDWQ Subbasin	03-06-04				
Within EEP Watershed Plan Extent?	Yes-Targeted Local Watershed				
WRC Class	Warm				
% of project easement fenced	100 %				
Beaver activity observed during design phase	No				
Restoration Component Attribute Table					
	Reach A	**Reach B**	**Reach C**	**Reach D**	**Reach E**
Drainage area (acres)	390	1333	1640	892	282
Stream order	first	third	third	third	second
Restored length (linear feet)	1738.76	2118.69	1194.58	1357.31	373.25
Perennial or Intermittent	perennial	perennial	perennial	perennial	perennial
NCDWQ Index Number	16-28	16-28	16-28	16-28	16-28
NCDWQ Classification	C, NSW	C, NSW	C, NSW	C, NSW	C, NSW
303d list?	No	No	No	No	No
Upstream of a 303d listed segment?	No	No	No	No	No
Total acreage of easement	50.75	50.75	50.75	50.75	50.75
Total planted acreage of easement	41	41	41	41	41
Rosgen classification of preexisting	Degraded E4	Degraded E4	Degraded E4	Degraded E4	Degraded E4
Rosgen classification of asbuilt	E4	E4	E4	E4	E4
Valley type	VIII	VIII	VIII	VIII	VIII
Valley slope	0.0083	0.0041	0.0045	0.0046	0.0156
Cowardin classification	R3UB1	R3UB1	R3UB1	R3UB1	R3UB1
Trout waters designation?	No	No	No	No	No
Species of concern, T&E, etc?	No	No	No	No	No
Dominant Soil Series and Characteristics	Tirzah silt loam, Georgeville silt loam, Starr loam, Colfax silt loam, Herndon silt loam, and mixed alluvial land				
Watershed Land Use (%)					
Managed Herbaceous Coverage	49.8				
Mixed Upland Hardwoods	31.4				
Cultivated	9.9				
Southern Yellow Pine	4.6				
Deciduous Shrubland	2.0				
Mixed Hardwoods/Conifers	0.9				
Unmanaged Herbaceous Upland	0.6				
Evergreen Shrubland	0.4				
Water Bodies	0.4				
Impervious Surfaces	<0.1				



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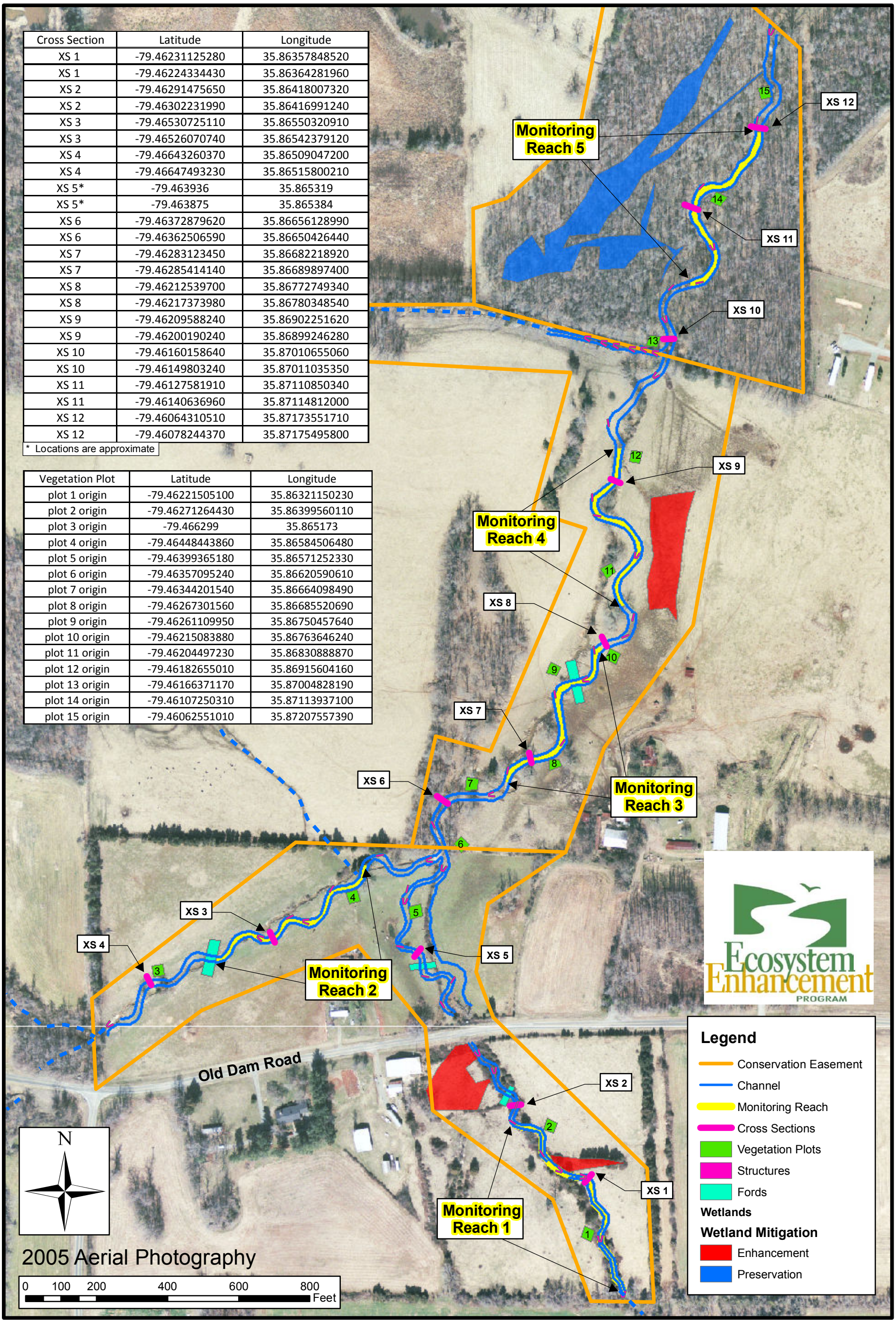
SITE LOCATION
UT to CANE CREEK RESTORATION SITE
EEP Project # 395
Alamance County, North Carolina

Dwn. By: WGL	FIGURE
Date: Nov 2009	1
Project: 08-001	

Cross Section	Latitude	Longitude
XS 1	-79.46231125280	35.86357848520
XS 1	-79.46224334430	35.86364281960
XS 2	-79.46291475650	35.86418007320
XS 2	-79.46302231990	35.86416991240
XS 3	-79.46530725110	35.86550320910
XS 3	-79.46526070740	35.86542379120
XS 4	-79.46643260370	35.86509047200
XS 4	-79.46647493230	35.86515800210
XS 5*	-79.463936	35.865319
XS 5*	-79.463875	35.865384
XS 6	-79.46372879620	35.86656128990
XS 6	-79.46362506590	35.86650426440
XS 7	-79.46283123450	35.86682218920
XS 7	-79.46285414140	35.86689897400
XS 8	-79.46212539700	35.86772749340
XS 8	-79.46217373980	35.86780348540
XS 9	-79.46209588240	35.86902251620
XS 9	-79.46200190240	35.86899246280
XS 10	-79.46160158640	35.87010655060
XS 10	-79.46149803240	35.87011035350
XS 11	-79.46127581910	35.87110850340
XS 11	-79.46140636960	35.87114812000
XS 12	-79.46064310510	35.87173551710
XS 12	-79.46078244370	35.87175495800

* Locations are approximate

Vegetation Plot	Latitude	Longitude
plot 1 origin	-79.46221505100	35.86321150230
plot 2 origin	-79.46271264430	35.86399560110
plot 3 origin	-79.466299	35.865173
plot 4 origin	-79.46448443860	35.86584506480
plot 5 origin	-79.46399365180	35.86571252330
plot 6 origin	-79.46357095240	35.86620590610
plot 7 origin	-79.46344201540	35.86664098490
plot 8 origin	-79.46267301560	35.86685520690
plot 9 origin	-79.46261109950	35.86750457640
plot 10 origin	-79.46215083880	35.86763646240
plot 11 origin	-79.46204497230	35.86830888870
plot 12 origin	-79.46182655010	35.86915604160
plot 13 origin	-79.46166371170	35.87004828190
plot 14 origin	-79.46107250310	35.87113937100
plot 15 origin	-79.46062551010	35.87207557390



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MONITORING PLANVIEW
UT to CANE CREEK RESTORATION SITE
EEP Project # 395
Alamance County, North Carolina

Dwn. By: WGL	FIGURE
Date: Nov 2009	2
Project: 08-001	

Appendix B.
Baseline Morphological Tables

Tables 5A-5D. Baseline Morphology and Hydraulic Summary

Table 5A. Baseline Morphology and Hydraulic Summary
Reach 1
UT to Cane Creek - EEP Project Number 395

Parameter	USGS Gage Data			Pre-Existing Condition Reach 1			Project Reference Stream #1			Project Reference Stream #2			Design Reach 1			As-built Reach 1		
Dimension	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
BF Width (ft)	USGS gage data is unavailable for this project					11.6			11.2			11			10			12.4
Floodprone Width (ft)						65			100			105			65			150
BF Cross Sectional Area (ft2)						14.3			10.1			16.2			11			9
BF Mean Depth (ft)						1.2			0.9			1.5			1.1			0.7
BF Max Depth (ft)						1.6			1.7			2			1.5			1.6
Width/Depth Ratio						9.4			12.4			7.5			9.1			17.1
Entrenchment Ratio						5.6			8.9			9.5			6.5			12.1
Bank Height Ratio						1.2			1.0			1.4			1.0			1.0
Wetted Perimeter(ft)						===			===			===			===			13.1
Hydraulic radius (ft)						===			===			===			===			0.7
Pattern																		
Channel Beltwidth (ft)				20	50		15	50		50	77		35	70		24	64	46
Radius of Curvature (ft)				40	385		9	26		11	27		23	42		16	68	29
Meander Wavelength (ft)				80	460		29	57		29	96		40	140		74	198	121
Meander Width ratio				1.7	4.3		1.3	4.5		4.5	7.0		3.5	7.0		6.0	16.0	9.8
Profile																		
Riffle length (ft)				===	===	===	===	===	===	===	===	===	===	===	===	5	66	17
Riffle slope (ft/ft)						0.0080			0.0073			0.0112			0.0065	0.0014	0.0212	0.0066
Pool length (ft)				===	===	===	===	===	===	===	===	===	===	===	===	12	33	20
Pool spacing (ft)				100	240		15	87		2	95		13	66		39	113	70
Substrate																		
d50 (mm)						===			===			===			===			20.9
d84 (mm)						===			===			===			===			63
Additional Reach Parameters																		
Valley Length (ft)				1375			===			===			1379			1379		
Channel Length (ft)				1430			===			===			1737			1811		
Sinuosity				1.04			1.24			1.62			1.26			1.31		
Water Surface Slope (ft/ft)				0.0080			0.0046			0.0008			0.0043			0.0066		
BF slope (ft/ft)				===			===			===			===			===		
Rosgen Classification				Degraded E4			E4			E4			E4			C4		

Table 5B. Baseline Morphology and Hydraulic Summary
Reach 2
UT to Cane Creek - EEP Project Number 395

Parameter	USGS Gage Data			Pre-Existing Condition Reach 2			Project Reference Stream #1			Project Reference Stream #2			Design Reach 2			As-built Reach 2		
Dimension	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
BF Width (ft)	USGS gage data is unavailable for this project					13.8			11.2			11			14			8.6
Floodprone Width (ft)						150			100			105			100			150
BF Cross Sectional Area (ft2)						27.4			10.1			16.2			24			6.1
BF Mean Depth (ft)						2.0			0.9			1.5			1.7			0.7
BF Max Depth (ft)						2.9			1.7			2			2.1			1.2
Width/Depth Ratio						7.0			12.4			7.5			8.2			12.1
Entrenchment Ratio						10.9			8.9			9.5			7.1			17.4
Bank Height Ratio						1.1			1.0			1.4			1.0			1.0
Wetted Perimeter(ft)						===			===			===			===			9.3
Hydraulic radius (ft)						===			===			===			===			0.6
Pattern																		
Channel Beltwidth (ft)				20	40		15	50		50	77		49	98		33	61	44
Radius of Curvature (ft)				22	70		9	26		11	27		32	58		19	45	36
Meander Wavelength (ft)				80	540		29	57		29	96		56	140		122	159	144
Meander Width ratio				1.4	2.9		1.3	4.5		4.5	7.0		3.5	7.0		14.0	19.0	17.0
Profile																		
Riffle length (ft)				===	===	===	===	===	===	===	===	===	===	===	===	6	54	13
Riffle slope (ft/ft)						0.0044			0.0073			0.0112			0.0055	***	***	***
Pool length (ft)				===	===	===	===	===	===	===	===	===	===	===	===	15	84	22
Pool spacing (ft)				31	295		15	87		2	95		19	93		64	109	82
Substrate																		
d50 (mm)						===			===			===			===			0.4
d84 (mm)						===			===			===			===			11
Additional Reach Parameters																		
Valley Length (ft)				1986			===			===			1049			1121		
Channel Length (ft)				2065			===			===			1322			1357		
Sinuosity				1.04			1.24			1.62			1.26			1.21		
Water Surface Slope (ft/ft)				0.0044			0.0046			0.0008			0.0037			***		
BF slope (ft/ft)				===			===			===			===			===		
Rosgen Classification				Degraded E4			E4			E4			E4			E/C5		

*** No water in channel during as-built measurments

Table 5D. Baseline Morphology and Hydraulic Summary
Reach 5
UT to Cane Creek - EEP Project Number 395

Parameter	USGS Gage Data			Pre-Existing Condition Reach 5			Project Reference Stream #1			Project Reference Stream #2			Design Reach 5			As-built Reach 5		
Dimension	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
BF Width (ft)	USGS gage data is unavailable for this project					20.3			11.2			11			18	14.5	20.6	15.9
Floodprone Width (ft)						300			100			105			300	150.0	150.0	150.0
BF Cross Sectional Area (ft2)						42.9			10.1			16.2			38	22.9	25.7	24.5
BF Mean Depth (ft)						2.1			0.9			1.5			2.1	1.2	1.6	1.6
BF Max Depth (ft)						2.9			1.7			2			2.7	2.0	2.6	2.4
Width/Depth Ratio						9.6			12.4			7.5			8.5	9.2	17.3	9.8
Entrenchment Ratio						14.8			8.9			9.5			16.7	7.3	10.3	9.4
Bank Height Ratio						1.6			1.0			1.4			1.0	1.0	1.0	1.0
Wetted Perimeter(ft)						===			===			===			===	15.3	21.1	17.1
Hydraulic radius (ft)						===			===			===			===	1.2	1.5	1.5
Pattern																		
Channel Beltwidth (ft)				23	91		15	50		50	77		63	126		34	104	82
Radius of Curvature (ft)				19	34		9	26		11	27		41	75		33	90	54
Meander Wavelength (ft)				99	150		29	57		29	96		72	180		124	303	156
Meander Width ratio				1.1	4.5		1.3	4.5		4.5	7.0		3.5	7.0		7.8	19.1	9.8
Profile																		
Riffle length (ft)				===	===	===	===	===	===	===	===	===	===	===	===	12	78	33
Riffle slope (ft/ft)						0.0029			0.0073			0.0112			0.0063	0.0000	0.0238	0.0036
Pool length (ft)				===	===	===	===	===	===	===	===	===	===	===	===	15	54	28
Pool spacing (ft)				74	220		15	87		2	95		24	119		58	201	83
Substrate																		
d50 (mm)						===			===			===			===			16
d84 (mm)						===			===			===			===			32
Additional Reach Parameters																		
Valley Length (ft)				1112			===			===			1077			962		
Channel Length (ft)				1435			===			===			1174			1194		
Sinuosity				1.29			1.24			1.62			1.09			1.24		
Water Surface Slope (ft/ft)				0.0035			0.0046			0.0008			0.0041			0.0023		
BF slope (ft/ft)				===			===			===			===			===		
Rosgen Classification				Degraded E4			E4			E4			E4			E/C4		

Table 5C. Baseline Morphology and Hydraulic Summary
Reach 3 and 4
UT to Cane Creek - EEP Project Number 395

Parameter	USGS Gage Data			Pre-Existing Condition Reach 3 and 4			Project Reference Stream #1			Project Reference Stream #2			Design Reach 3 and 4			As-built Reach 3 and 4		
Dimension	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
BF Width (ft)	USGS gage data is unavailable for this project					16			11.2			11			16	15.2	18.3	17.8
Floodprone Width (ft)						300			100			105			200	150.0	150.0	150.0
BF Cross Sectional Area (ft2)						34.2			10.1			16.2			32	22.2	26.3	24.4
BF Mean Depth (ft)						2.1			0.9			1.5			2.0	1.2	1.7	1.3
BF Max Depth (ft)						3.3			1.7			2			2.4	2.0	2.5	2.3
Width/Depth Ratio						7.5			12.4			7.5			8.0	8.8	14.3	13.7
Entrenchment Ratio						18.8			8.9			9.5			12.5	8.2	9.9	8.4
Bank Height Ratio						1.3			1.0			1.4			1.0	1.0	1.0	1.0
Wetted Perimeter(ft)						===			===			===			===	16.6	19.3	18.6
Hydraulic radius (ft)						===			===			===			===	1.2	1.6	1.3
Pattern																		
Channel Beltwidth (ft)				18	148		15	50		50	77		56	112		15	100	63
Radius of Curvature (ft)				23	32		9	26		11	27		37	66		23	72	45
Meander Wavelength (ft)				120	340		29	57		29	96		64	160		105	274	182
Meander Width ratio				1.1	9.2		1.3	4.5		4.5	7.0		3.5	7.0		5.9	15.4	10.2
Profile																		
Riffle length (ft)				===	===	===	===	===	===	===	===	===	===	===	===	5	136	33
Riffle slope (ft/ft)						0.0070			0.0073			0.0112			0.0049	0.0000	0.0108	0.0033
Pool length (ft)				===	===	===	===	===	===	===	===	===	===	===	===	10	54	31
Pool spacing (ft)				29	395		15	87		2	95		21	106		58	180	113
Substrate																		
d50 (mm)						===			===			===			===			0.6
d84 (mm)						===			===			===			===			16
Additional Reach Parameters																		
Valley Length (ft)				1541			===			===			1562			1669		
Channel Length (ft)				2065			===			===			1984			2119		
Sinuosity				1.34			1.24			1.62			1.27			1.27		
Water Surface Slope (ft/ft)				0.0031			0.0046			0.0008			0.0032			0.0031		
BF slope (ft/ft)				===			===			===			===			===		
Rosgen Classification				Degraded E4			E4			E4			E4			E/C5		

Appendix C.
Vegetation Data

Table 6. Vegetation Plot Attribute Table
Table 7. Planted Woody and Herbaceous Species

Table 6. Vegetation Plot Attributes Data

Plot ID	Community Type	Planting Zone ID	Reach ID	Associated Gauge	Method	CVS Level
1	Piedmont/Mountain Bottomland Forest	streamside/floodplain	Reach A-Monitoring Profile 1	Not applicable, there are no gauges at the Site	Vegetation plots will be monitored using the *CVS-EEP Protocol for Recording Vegetation Level 1-2 Plot Sampling Only* (Version 4.0) (Lee et al. 2006).	
2		streamside/floodplain	Reach A-Monitoring Profile 1			
3		streamside/floodplain	Reach D-Monitoring Profile 2			
4		streamside/floodplain	Reach D-Monitoring Profile 2			
5		floodplain	Reach A			
6		floodplain	Reach B-Monitoring Profile 3			
7		streamside/floodplain	Reach B-Monitoring Profile 3			
8		streamside/floodplain	Reach B-Monitoring Profile 3			
9		floodplain	Reach B-Monitoring Profile 4			
10		streamside/floodplain	Reach B-Monitoring Profile 4			
11		streamside/floodplain	Reach B-Monitoring Profile 4			
12		streamside/floodplain	Reach C-Monitoring Profile 5			
13		streamside/floodplain	Reach C-Monitoring Profile 5			
14		streamside/floodplain	Reach C-Monitoring Profile 5			
15		streamside/floodplain	Reach C-Monitoring Profile 5			

Table 7. Planted Woody and Herbaceous Vegetation

Planting Zone	Common Name	Scientific Name	Form	Number of Stems
Streamside	Black willow	*Salix nigra*	Live Stake	1800
	Elderberry	*Sambucus Canadensis*		2700
	Silky dogwood	*Cornus amomum*		2700
	Silky willow	*Salix sericea*		1800
Wetland Enhancement	Silky dogwood	*Cornus amomum*	Live Stakes	100
	Tag alder	*Alnus serrulata*	Containerized	100
	Buttonbush	*Cephalanthus occidentalis*	Bare Root	113
	Elderberry	*Sambucus Canadensis*	Bare Root	100
	Silky willow	*Salix sericea*	Live Stakes	75
	Swamp rose	*Rosa palustris*	Containerized	32
Floodplain	Black gum	*Nyssa sylvatica*	Bare Root	300
	Sugarberry	*Celtis laevigata*	Bare Root	400
	Willow oak	*Quercus phellos*	Bare Root	1300
	Green ash	*Fraxinus pennsylvanica*	Bare Root	1400
	River birch	*Betula nigra*	Bare Root	500
	Silky dogwood	*Cornus amomum*	Live Stakes	175
	Tag alder	*Alnus serrulata*	Containerized	40
	Ironwood	*Carpinus caroliniana*	Bare Root	1000
	Sycamore	*Platanus occidentalis*	Bare Root	600
	Buttonbush	*Cephalanthus occidentalis*	Bare Root	437
	Hazelnut	*Corylus americana*	Containerized	500
	Black walnut	*Juglans nigra*	Bare Root	1300
	Cherrybark oak	*Quercus pagoda*	Bare Root	300
	Swamp chestnut oak	*Quercus michauxii*	Bare Root	400
	Flowering dogwood	*Cornus florida*	Bare Root	80
	Red chokeberry	*Aronia arbutifolia*	Containerized	165
	Tulip poplar	*Liriodendron tulipifera*	Bare Root	1000
	Serviceberry	*Amelanchier arbutifolia*	Containerized	200
	Sweetbay magnolia	*Magnolia virginiana*	Bare Root	100
	Ninebark	*Physocarpus* sp.	Live Stakes	100
	Spicebush	*Lindera benzoin*	Containerized	106
	Blueberry	*Vaccinium* sp.	Containerized	15
	Coralberry	*Symphoricarpos orbiculatus*	Containerized	200
Upland Slope	Persimmon	*Diospyros virginiana*	Bare Root	600
	Southern red oak	*Quercus falcate*	Bare Root	500
	Black oak	*Quercus velutina*	Containerized	1300
	Flowering dogwood	*Cornus florida*	Bare Root	70
	Eastern red cedar	*Juniperus virginiana*	Bare Root	400
	Hackberry	*Celtis occidentalis*	Bare Root	1000
				Percent of Composition
Herbaceous Seed Mixture within Streamside and Floodplain Planting Zones	Swamp sunflower	*Helianthus angustifolius*	Permanent Seeding at a rate of 15 lbs/acre	8
	Ironweed	*Veronica noveboracensis*		5
	Swamp milkweed	*Asclepias incarnate*		2
	Joe-pye-weed	*Eupatorium fistulosus*		2
	Tearthumb	*Polygonum sagittatum*		5
	Bushy beard grass	*Andropogon glomeratus*		8
	Deertongue	*Panicum clandestinum*		12
	Switchgrass	*Panicum virgatum*		7
	Soft rush	*Juncus effusus*		7
	Showy tickseed sunflower	*Bidens aristosa*		12
	Swamp rose	*Rosa palustris*		5
	Fox sedge	*Carex vulpinoidea*		12
	Leafy bullrush	*Scirpus polyphyllus*		5
	Sneezeweed	*Helenium autumnale*		5
	Virginia wild rye	*Elymus virginicus*		5

Appendix D.
As-built Construction Drawings

Sheets AB0-AB5. As-built Drawings
Sheets 1-11. As-built Survey

AS-BUILT DRAWINGS FOR

UNNAMED TRIBUTARY TO CANE CREEK STREAM RESTORATION PROJECT

STREAM DATA

EXISTING LENGTH (FT)	6330 LF
PROPOSED LENGTH (FT)	6440 LF
RESTORED LENGTH (FT)	6857 LF
PROPOSED STREAM CLASSIFICATION	E4

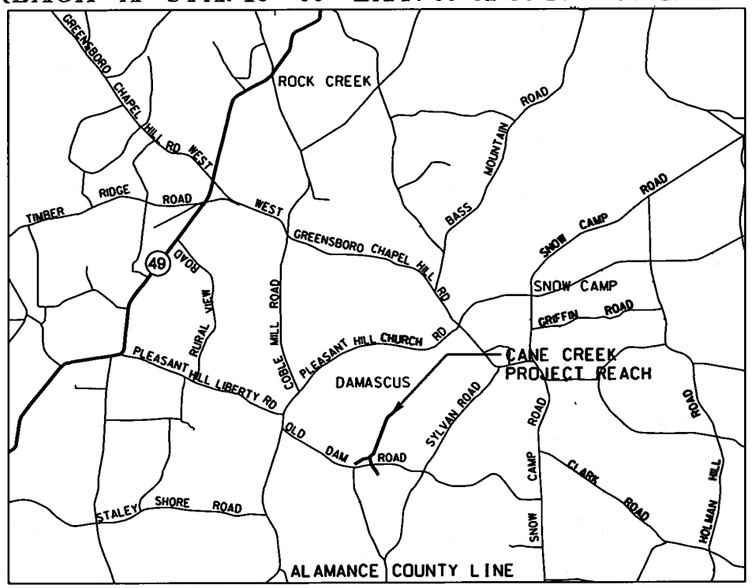
DISTURBED AREA - 41 ACRES

SHEET NO.	DESCRIPTION
AB0	TITLE SHEET
AB1 - AB5	PLAN SHEETS

50 25 0 50 100
PLANS

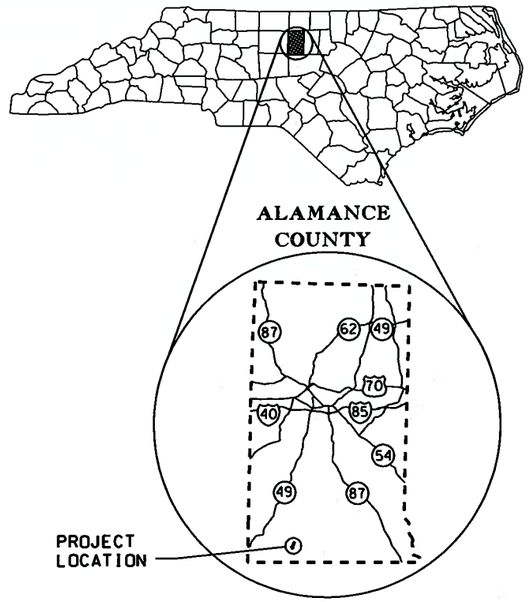
Ecosystem Enhancement PROGRAM

ALAMANCE COUNTY, NORTH CAROLINA
REACH A STA. 10+00 LAT. 35° 51' 36"N 79° 27' 38"W



LOCATION MAP

STATE OF NORTH CAROLINA



SITE DATA

ECOSYSTEM ENHANCEMENT PROGRAM
1652 MAIL SERVICE CENTER
RALEIGH, NC 27699-1652
CONTACT: PERRY SUGG PHONE: 919-715-1359

URS CORPORATION - NORTH CAROLINA
1600 PERIMETER PARK DRIVE
SUITE 400
MORRISVILLE, NC 27560
CONTACT: KATHLEEN MCKEITHAN PHONE: 919-461-1597

EXISTING SURVEY PREPARED BY:

KCI TECHNOLOGIES
4601 SIX FORKS ROAD, RALEIGH, NC 27609
CONTACT: JAMES M. GELLENTHIN (L-3860) PHONE: 919-783-9214
SEALED L-3860

CONSERVATION EASEMENT PREPARED BY:

LANDMARK SURVEYING, INC.
PHONE: 336-229-6275

AS-BUILT SURVEY PREPARED BY

LEVEL CROSS SURVEYING, PLLC
668 MARSH COUNTY LANE
RANDLEMAN, NC 23717
CONTACT: SHERI WILLARD, PLS PHONE: 336-495-1713
SEALED L-3385 7-22-09

URS
1600 Perimeter Park Drive, Suite 400
Morrisville, North Carolina 27560
Phone (919)461-1100 Fax (919)461-1415
NC Lic.# C-2243

RECORD DRAWING

REVISIONS

NO.	DATE

Prepared by
URS
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Phone (919)461-1100 Fax (919)461-1415
NC Lic.# C-2243

PROJECT: UT TO CANE CREEK (PICKARD SITE) STREAM RESTORATION PROJECT ALAMANCE COUNTY

TITLE: AS-BUILT PLAN SHEETS TITLE SHEET

CLIENT: ECOSYSTEM ENHANCEMENT PROGRAM

SEAL: NORTH CAROLINA PROFESSIONAL SEAL 28432 ENGINEER KEVIN M. MCKEITHAN 10-15-09

DATE: OCT 2009
TECHNICIAN: EHJ
CHECKED BY: KMM
URS PROJECT NO. 31823659
PROJ. NO. SCO FILE #020594101
SHEET NO. AB0

EXISTING TOPOGRAPHY (KCI TECHNOLOGIES, JAMES M. GELLENTHIN L-3860)

DESIGN (URS CORPORATION, KATHLEEM M. MCKEITHAN NC-28432)

AS-BUILT SURVEY (LEVEL CROSS SURVEYING, SHERI WILLARD L-3385)

CONSERVATION EASEMENT (LANDMARK SURVEYING, INC., DOUGLAS R. YARBROUGH L-3395)

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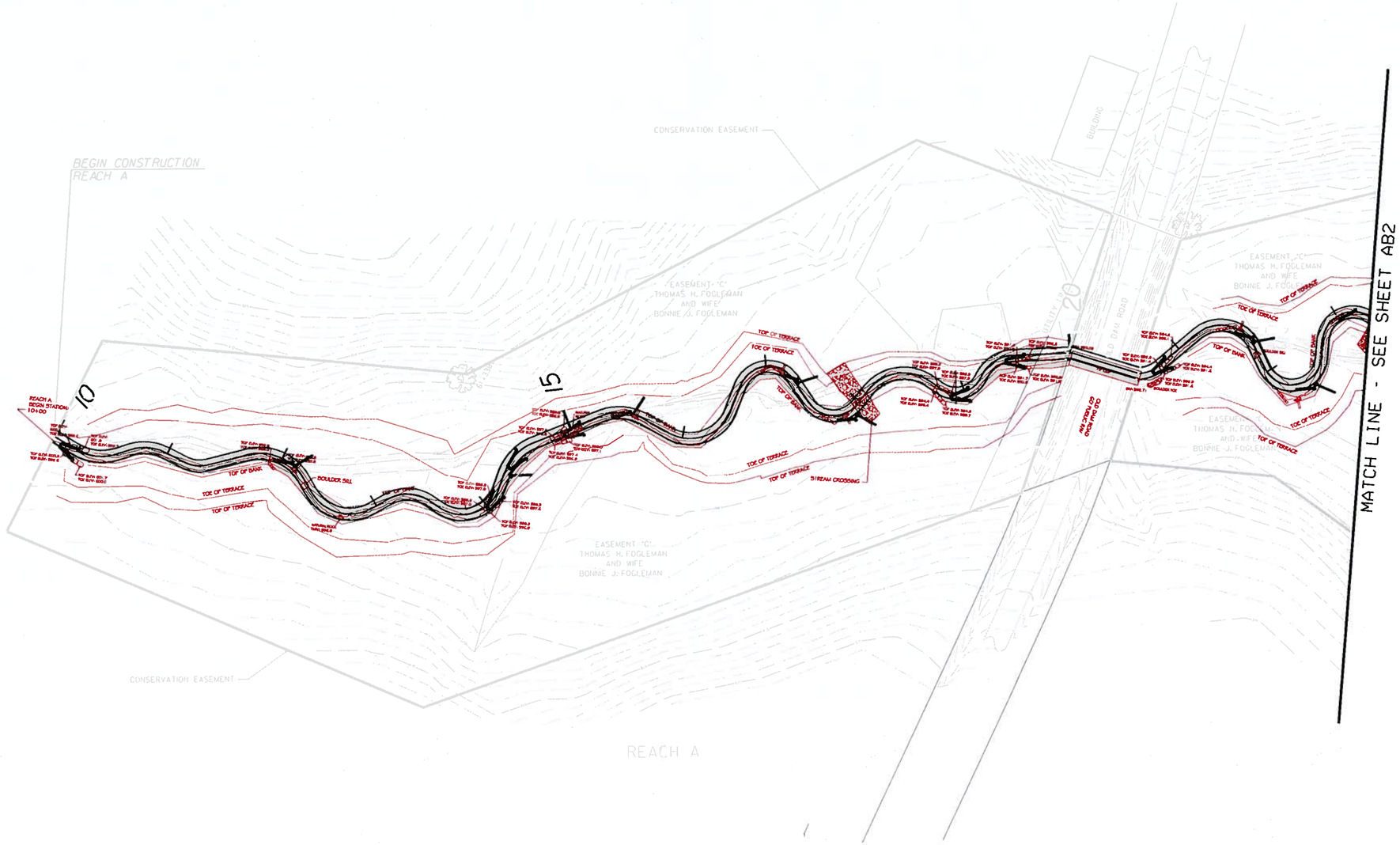

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PROJECT: UT TO CANE CREEK (PICKARD SITE) STREAM RESTORATION PROJECT ALAMANCE COUNTY

TITLE: AS-BUILT PLAN SHEETS

CLIENT: ECOSYSTEM ENHANCEMENT PROGRAM

Ecosystem Enhancement

SEAL

DATE: OCT 2009

TECHNICIAN: EHJ

CHECKED BY: KM

URS PROJECT NO.
31823659

PROJ. NO.
SCO FILE #020594101

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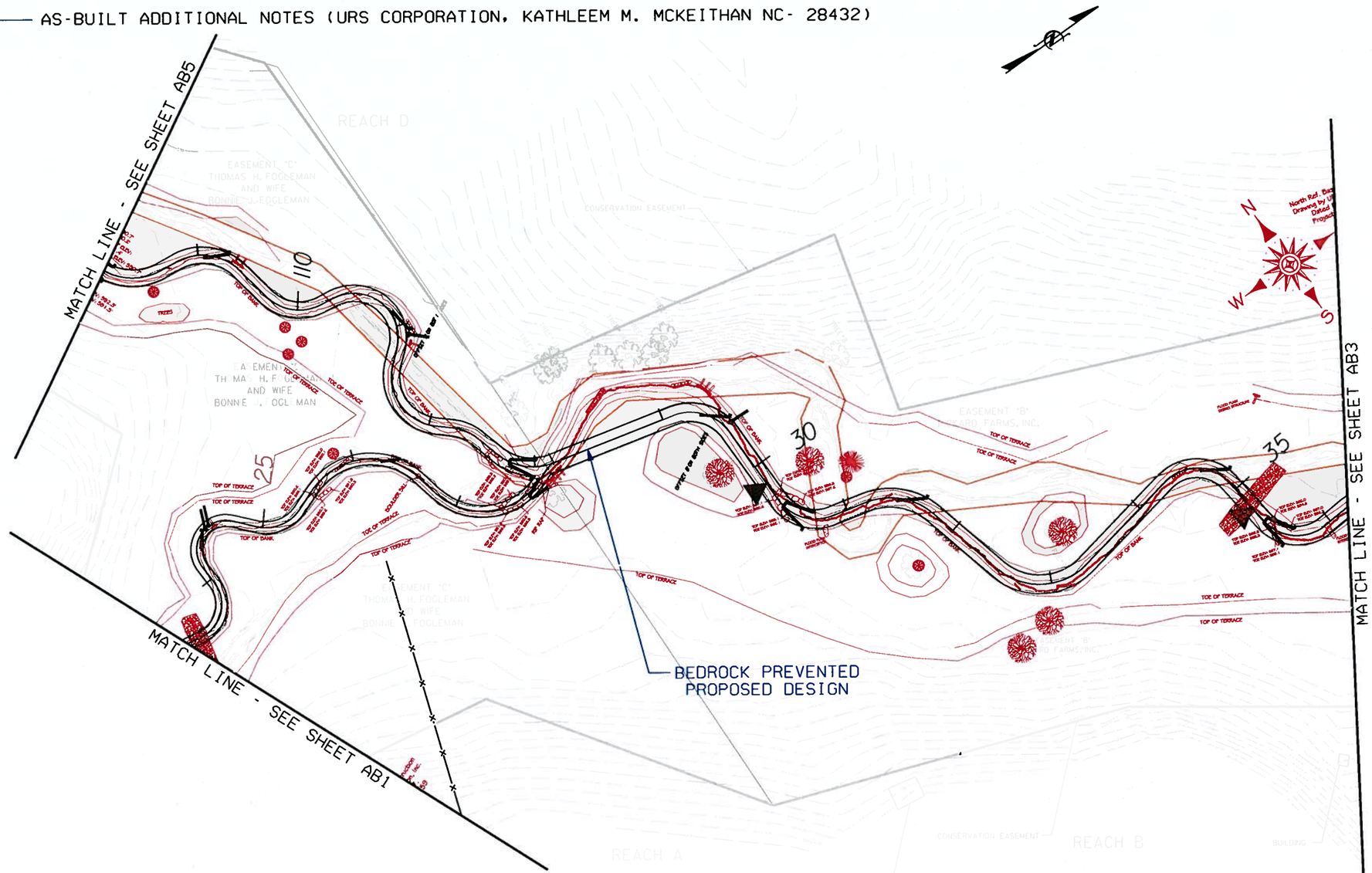

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CLIENT: ECOSYSTEM ENHANCEMENT PROGRAM

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PROJ. NO. SCO FILE #02059401

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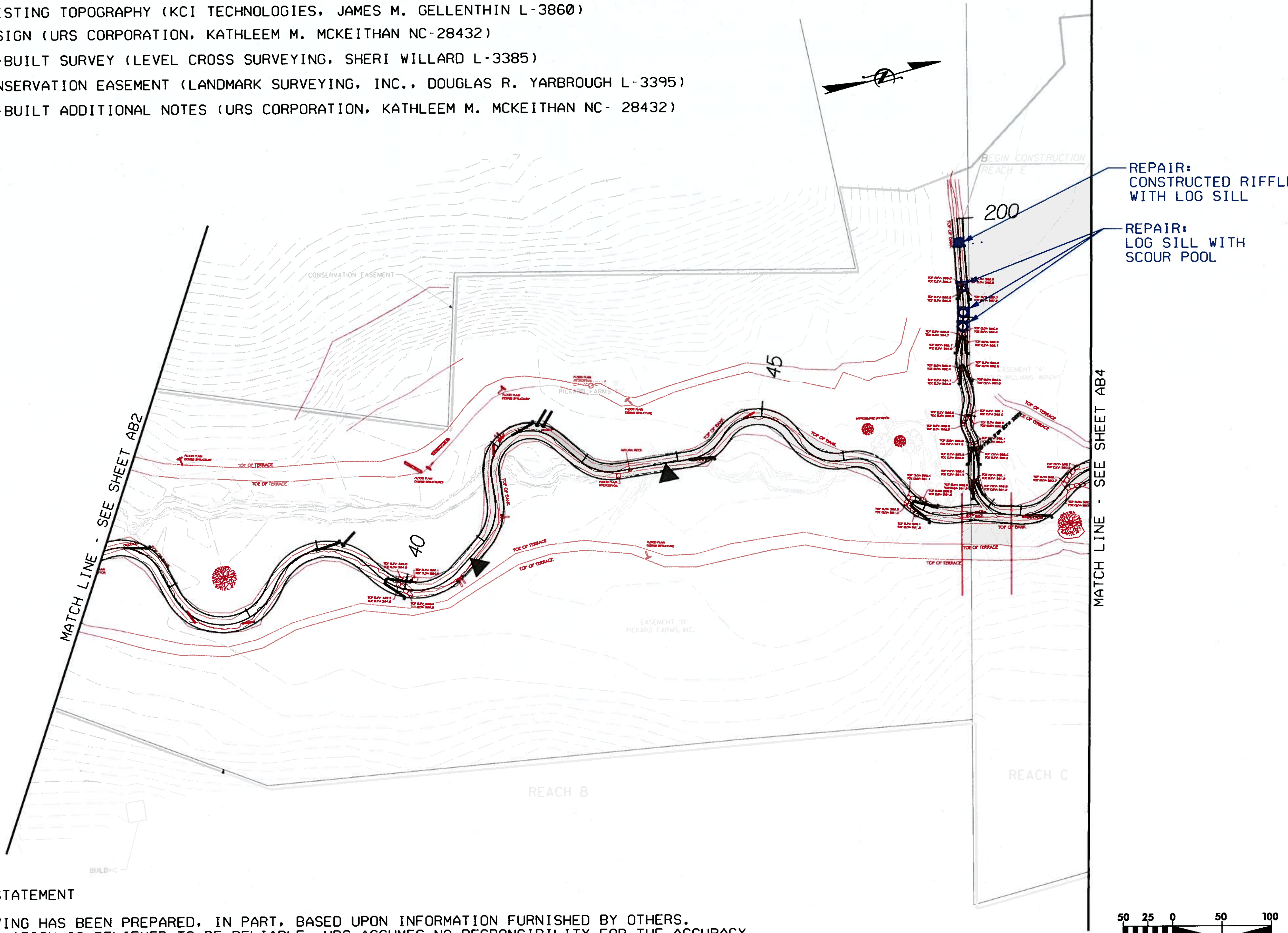

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PROJ. NO. SCO FILE #020594101
SHEET NO. AB3

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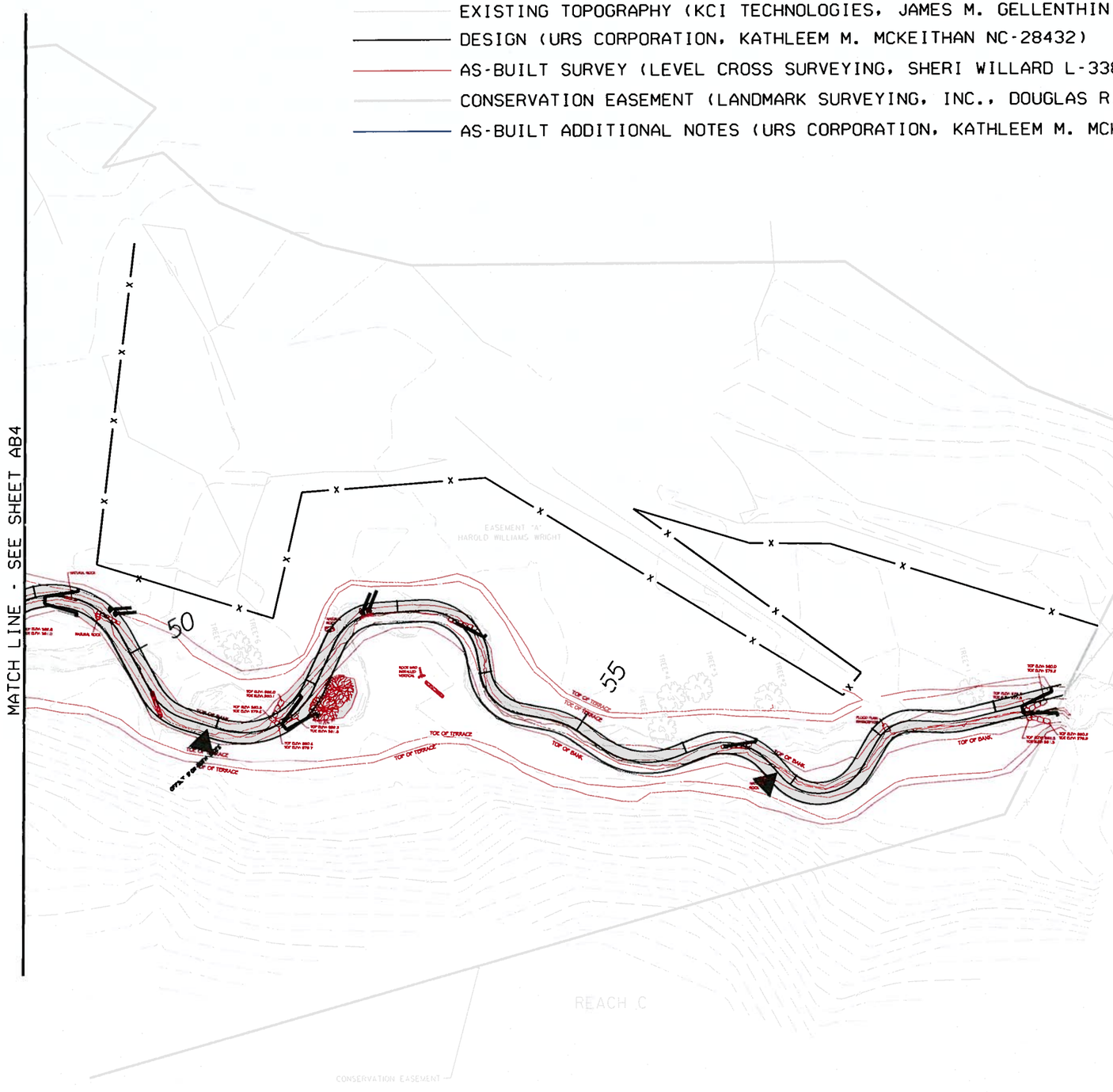

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TITLE: AS-BUILT PLAN SHEETS

CLIENT: ECOSYSTEM ENHANCEMENT PROGRAM

Ecosystem Enhancement Program

SEAL

DATE: OCT 2009

TECHNICIAN: EHJ

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URS PROJECT NO. 31823659

PROJ. NO. SCO FILE #02059401

SHEET NO. AB4

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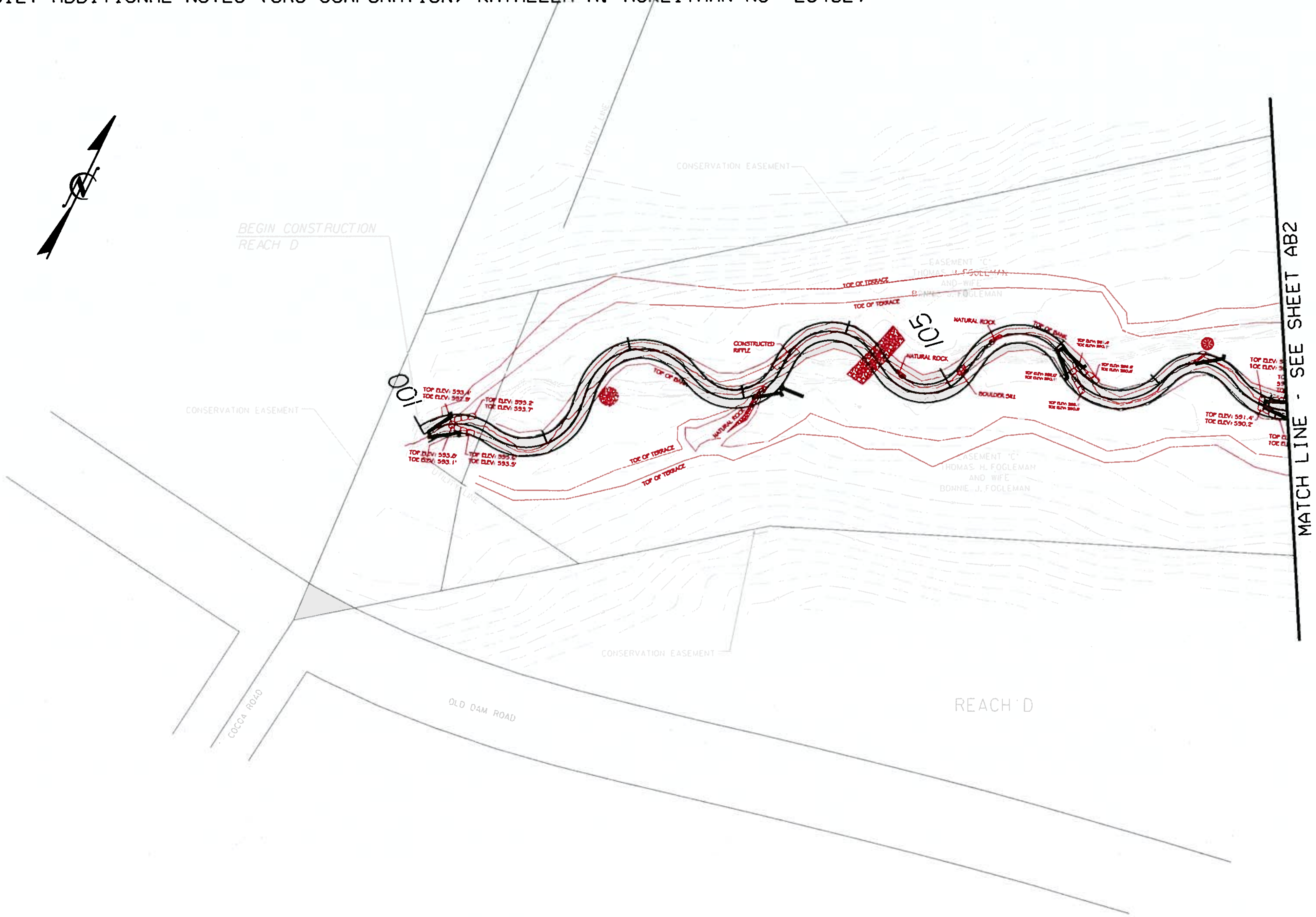
CONSERVATION EASEMENT (LANDMARK SURVEYING, INC., DOUGLAS R. YARBROUGH L-3395)
AS-BUILT ADDITIONAL NOTES (URS CORPORATION, KATHLEEM M. MCKEITHAN NC- 28432)



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TITLE: AS-BUILT PLAN SHEETS

CLIENT: ECOSYSTEM ENHANCEMENT PROGRAM

SEAL

DATE: OCT 2009

TECHNICIAN: EHJ

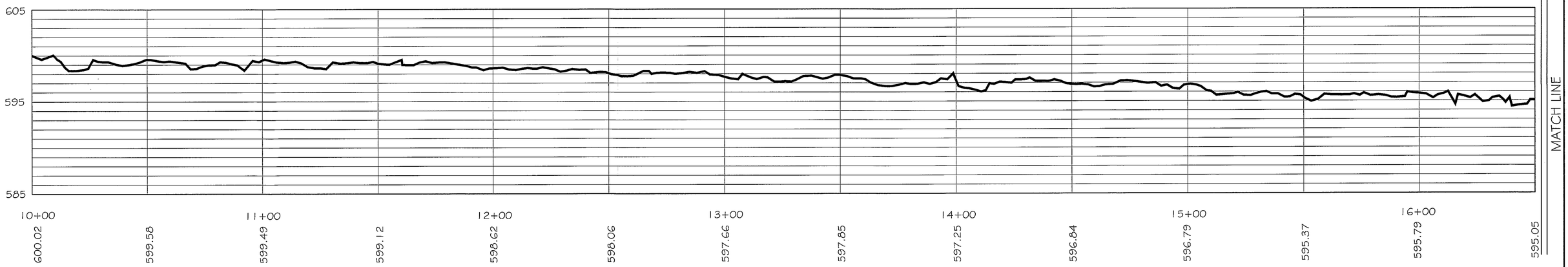
CHECKED BY: KM

URS PROJECT NO. 31823659

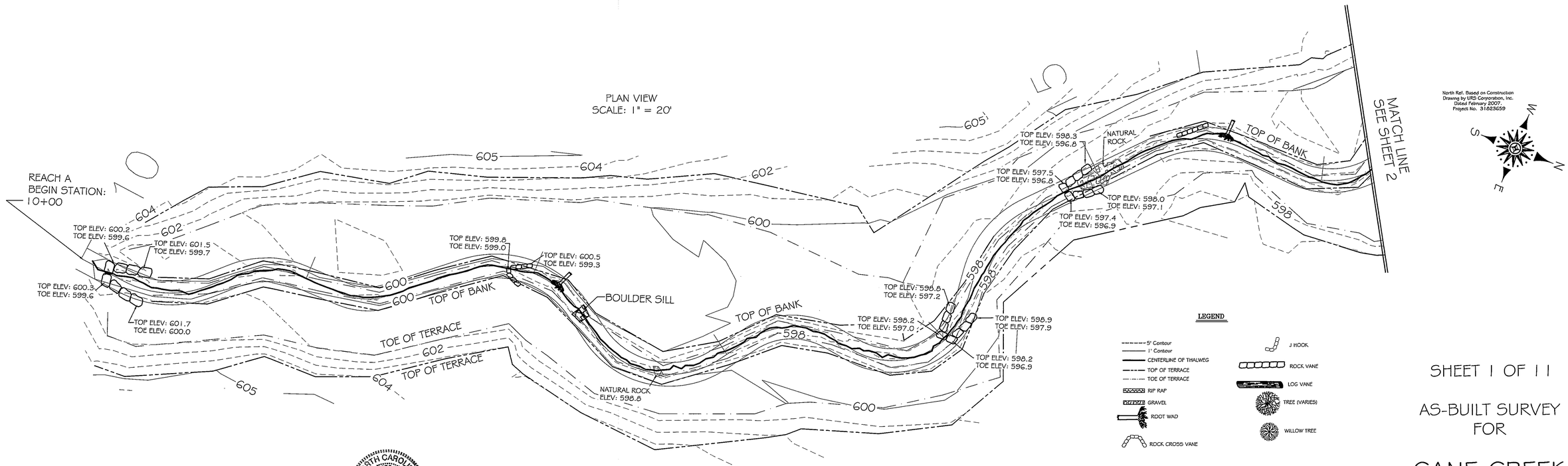
PROJ. NO. SCO FILE #020594101

SHEET NO. AB5

PROFILE
VERTICAL SCALE: 1" = 5'
HORIZONTAL SCALE: 1" = 20'



PLAN VIEW
SCALE: 1" = 20'



North Ref. Based on Construction Drawing by URS Corporation, Inc. Dated February 2007, Project No. 31623659

LEGEND

- 5' Contour
- 1' Contour
- CENTERLINE OF THALWEG
- TOP OF TERRACE
- TOE OF TERRACE
- RIP RAP
- GRAVEL
- ROOT WAD
- ROCK CROSS VANE
- J HOOK
- ROCK VANE
- LOG VANE
- TREE (VARIES)
- WILLOW TREE

LEVEL CROSS SURVEYING, PLLC
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Randleman, N.C. 27317
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Fax (336) 495-1745

NORTH CAROLINA PROFESSIONAL SEAL L-3385 LAND SURVEYOR SHERIE M. WILLIARD

7-22-09

Sherie M Williard

Note:
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SURVEY DATES:
JULY - OCTOBER 2008

PROJECT NO. 13080017CC

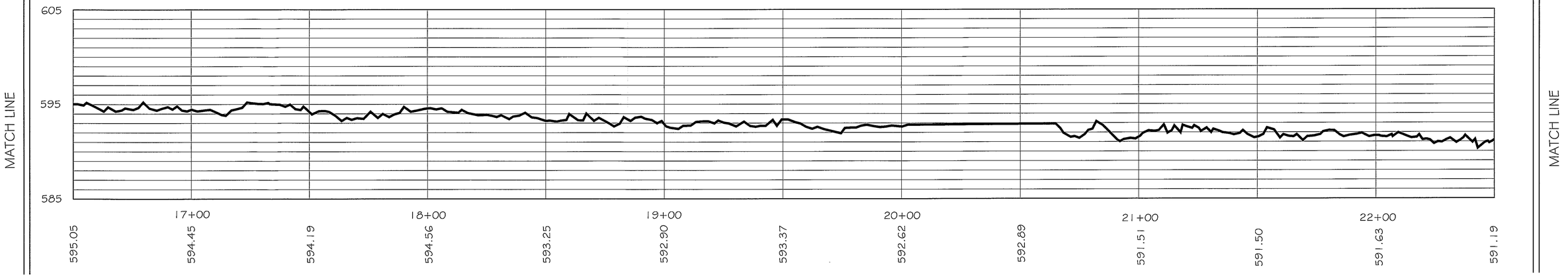
SHEET 1 OF 11

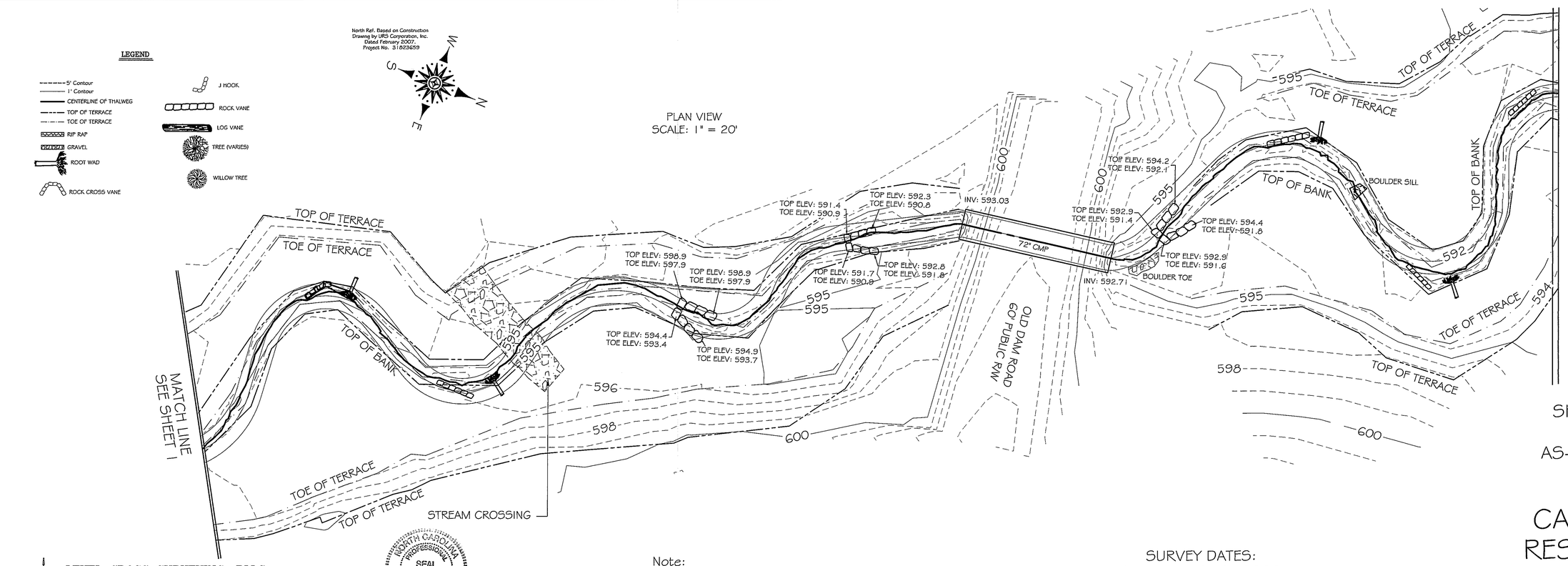
AS-BUILT SURVEY
FOR

CANE CREEK RESTORATION

REACH A
ALAMANCE COUNTY
NORTH CAROLINA

PROFILE
VERTICAL SCALE: 1" = 5'
HORIZONTAL SCALE: 1" = 20'





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NORTH CAROLINA PROFESSIONAL SEAL L-3386 LAND SURVEYOR STEVEN M. WILLARD

7-22-09

Steven M. Willard

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SURVEY DATES:
JULY - OCTOBER 2008

PROJECT NO. 13080017CC

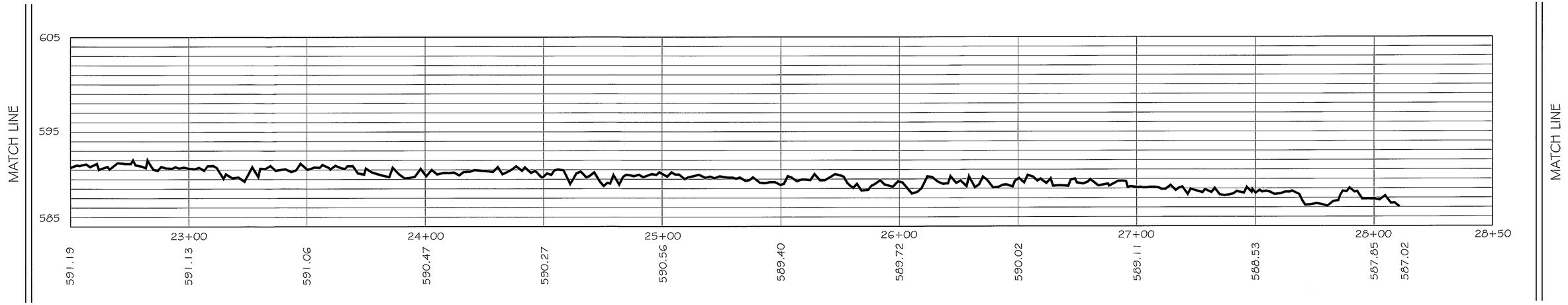
SHEET 2 OF 11

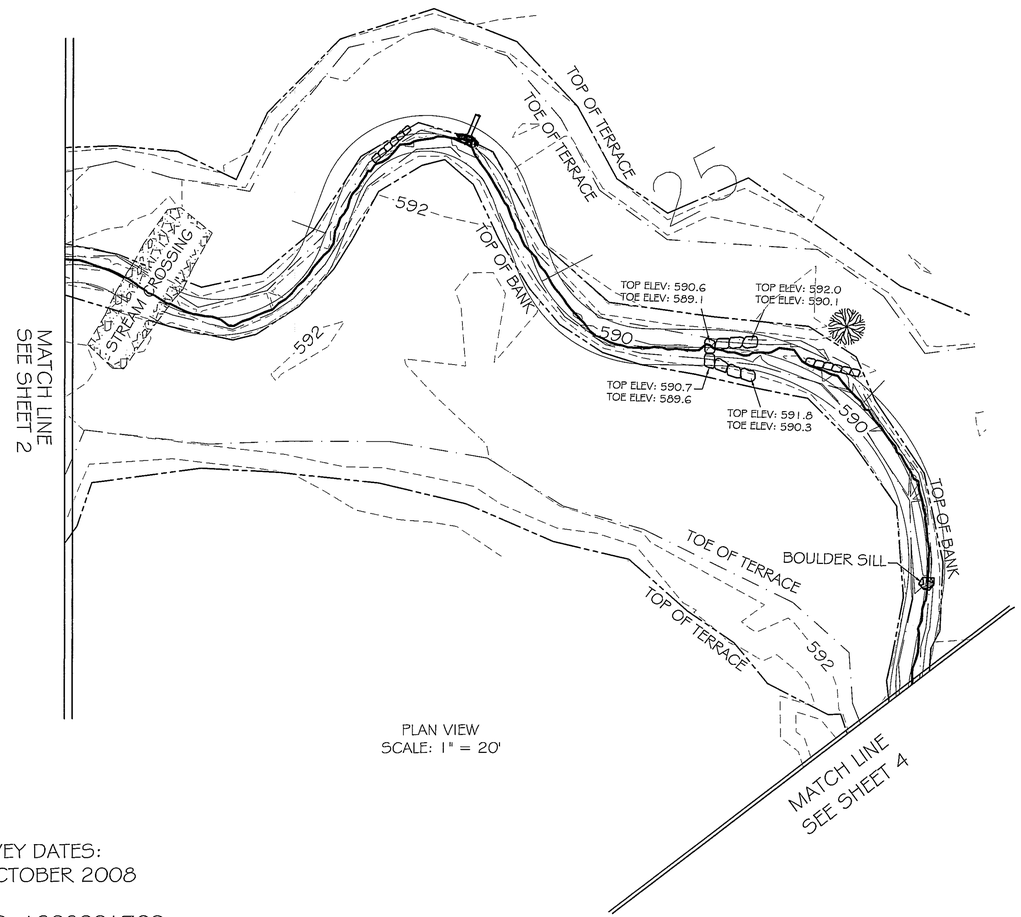
AS-BUILT SURVEY
FOR

CANE CREEK RESTORATION

REACH A
ALAMANCE COUNTY
NORTH CAROLINA

PROFILE
VERTICAL SCALE: 1" = 5'
HORIZONTAL SCALE: 1" = 20'





PLAN VIEW
SCALE: 1" = 20'

LEGEND

- 5' Contour
- 1' Contour
- CENTERLINE OF THALWEG
- TOP OF TERRACE
- TOE OF TERRACE
- RIP RAP
- GRAVEL
- ROOT WAD
- ROCK CROSS VANE
- J HOOK
- ROCK VANE
- LOG VANE
- TREE (VARIES)
- WILLOW TREE

Note:
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North Ref. Based on Construction Drawing by URS Corporation, Inc. Dated February 2007. Project No. 31823659

NORTH CAROLINA PROFESSIONAL SEAL L-3385 LAND SURVEYOR STEVIE M. WILLIARD

7-22-09

LEVEL CROSS SURVEYING, PLLC
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Randleman, N.C. 27317
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SURVEY DATES:
JULY - OCTOBER 2008

PROJECT NO. 13080017CC

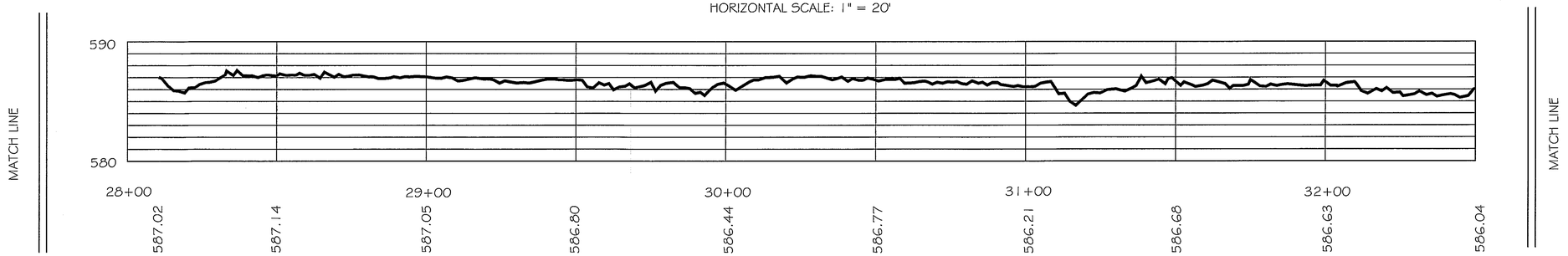
SHEET 3 OF 11

AS-BUILT SURVEY
FOR

CANE CREEK RESTORATION

REACH A
ALAMANCE COUNTY
NORTH CAROLINA

PROFILE
VERTICAL SCALE: 1" = 5'
HORIZONTAL SCALE: 1" = 20'



PLAN VIEW
SCALE: 1" = 20'

North Ref. Based on Construction Drawing by URS Corporation, Inc. Dated February 2007. Project No. 31823659

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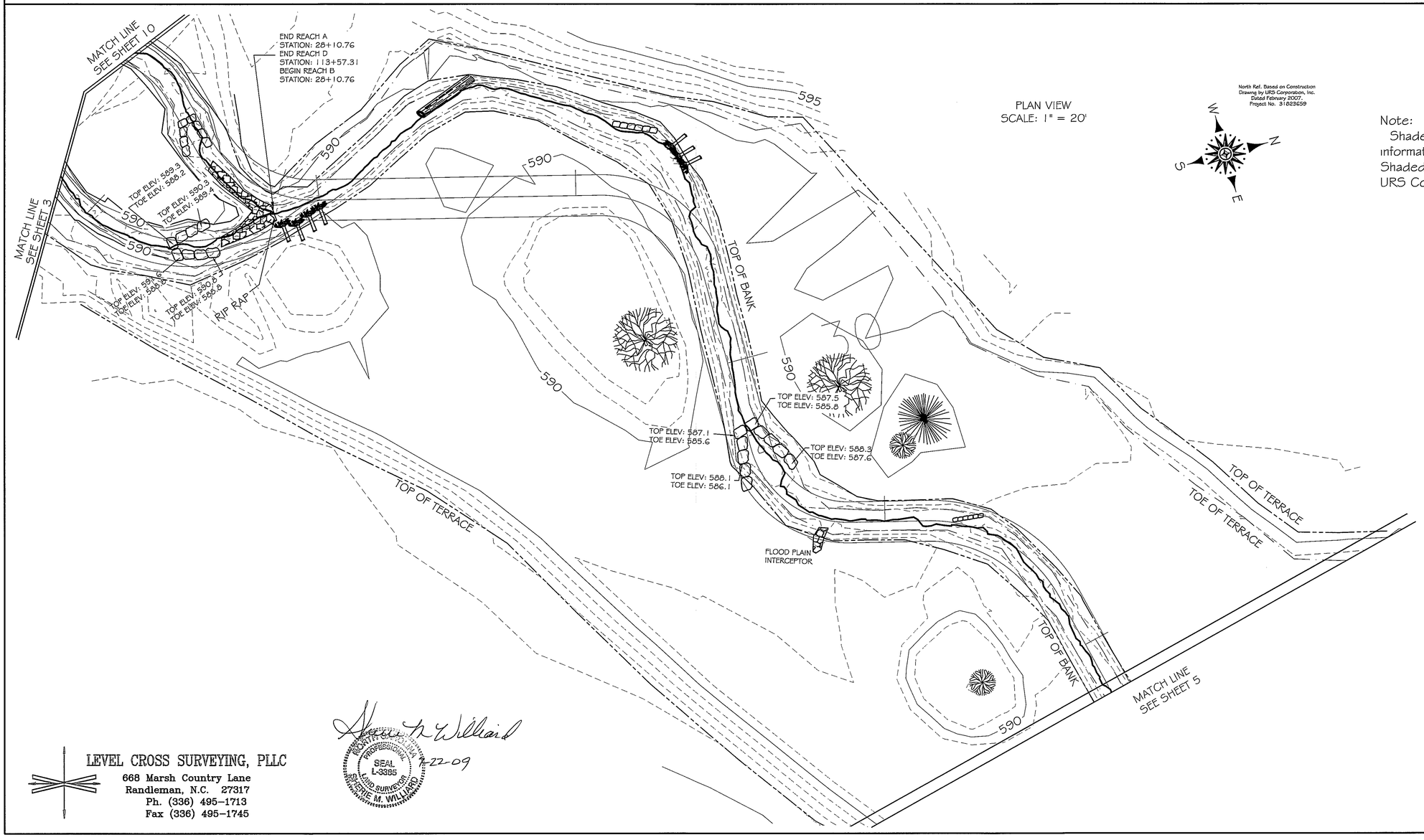

LEGEND

- 5' Contour
- 1' Contour
- CENTERLINE OF THALWEG
- TOP OF TERRACE
- TOE OF TERRACE
- RIP RAP
- GRAVEL
- ROOT WAD
- ROCK CROSS VANE
- J HOOK
- ROCK VANE
- LOG VANE
- TREE (VARIES)
- WILLOW TREE

SHEET 4 OF 11

AS-BUILT SURVEY
FOR

CANE CREEK RESTORATION
REACH B

ALAMANCE COUNTY
NORTH CAROLINA

SURVEY DATES:
JULY - OCTOBER 2008

PROJECT NO. 13080017CC

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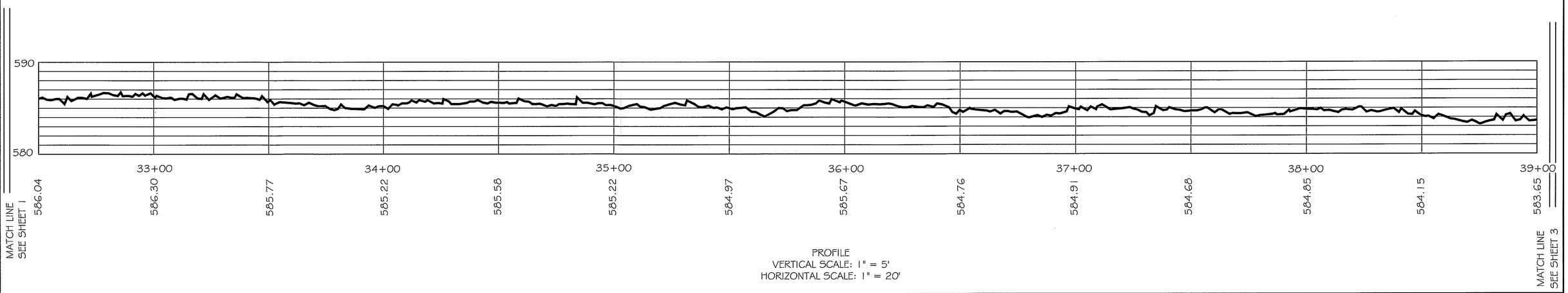
Fax (336) 495-1745

NORTH CAROLINA PROFESSIONAL SEAL L-3385 LAND SURVEYOR SHERRIE M. WILLIARD

Sherrie M. Williard 7-22-09



PROFILE
VERTICAL SCALE: 1" = 5'
HORIZONTAL SCALE: 1" = 20'

North Rel. Based on Construction Drawing by URS Corporation, Inc. Dated February 2007, Project No. 31623659

MATCH LINE SEE SHEET 4

MATCH LINE SEE SHEET 6

FLOOD PLAIN DEBRIS STRUCTURE

FLOOD PLAIN DEBRIS STRUCTURE

TOP OF TERRACE

TOE OF TERRACE

TOP OF BANK

TOP OF BANK

TOE OF TERRACE

TOP OF TERRACE

STREAM CROSSING

TOP ELEV: 586.0
TOE ELEV: 584.8

TOP ELEV: 586.2
TOE ELEV: 585.3

TOP ELEV: 587.0
TOE ELEV: 586.3

TOP ELEV: 587.1
TOE ELEV: 585.1

FLOOD PLAIN INTERCEPTOR

590 595 592 586 588 585 594

PLAN VIEW
SCALE: 1" = 20'

SHEET 5 OF 11

AS-BUILT SURVEY
FOR

CANE CREEK RESTORATION

REACH B
ALAMANCE COUNTY
NORTH CAROLINA

SURVEY DATES:
JULY - OCTOBER 2008

PROJECT NO. 13080017CC

LEGEND

- 5' Contour
- 1' Contour
- CENTERLINE OF THALWEG
- TOP OF TERRACE
- TOE OF TERRACE
- RIP RAP
- GRAVEL
- ROOT WAD
- ROCK CROSS VANE
- J HOOK
- ROCK VANE
- LOG VANE
- TREE (VARIES)
- WILLOW TREE

Note:
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NORTH CAROLINA PROFESSIONAL SEAL L-3385 LAND SURVEYOR SHERRIE M. WILLIARD

1-22-09

Sherrie M. Williard

LEVEL CROSS SURVEYING, PLLC
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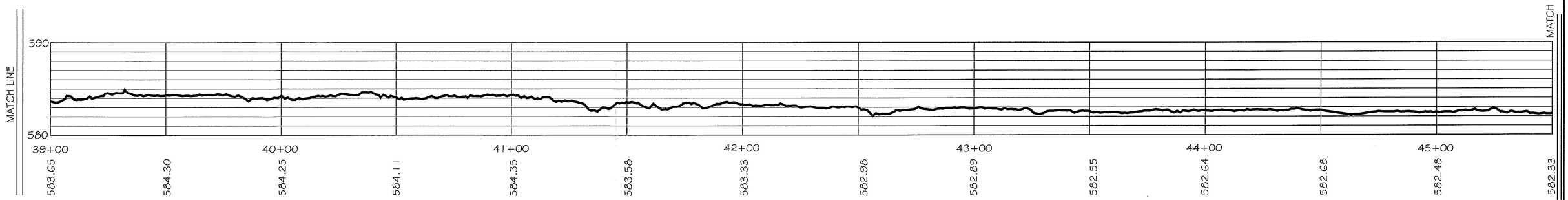

PROFILE
VERTICAL SCALE: 1" = 5'
HORIZONTAL SCALE: 1" = 20'

Note:
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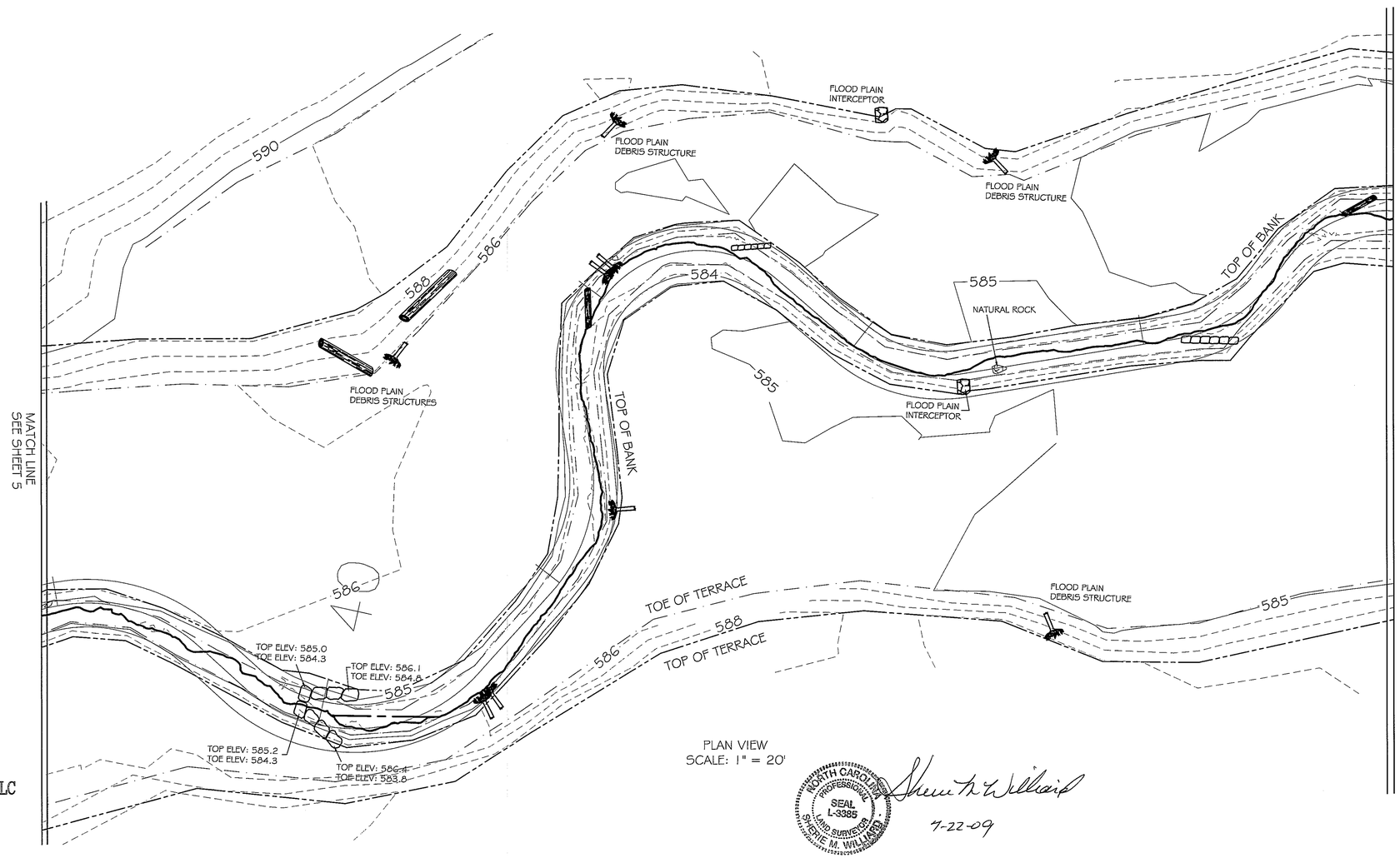

PLAN VIEW
SCALE: 1" = 20'

LEGEND

- 5' Contour
- 1' Contour
- CENTERLINE OF THALWEG
- TOP OF TERRACE
- TOE OF TERRACE
- RIP RAP
- GRAVEL
- ROOT WAD
- ROCK CROSS VANE
- J HOOK
- ROCK VANE
- LOG VANE
- TREE (VARIES)
- WILLOW TREE

North Ref. Based on Construction Drawing by URS Corporation, Inc. Dated February 2007. Project No. 31823659

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NORTH CAROLINA PROFESSIONAL SEAL L-3385 LAND SURVEYOR SHERIE M. WILLIARD

7-22-09

SHEET 6 OF 11

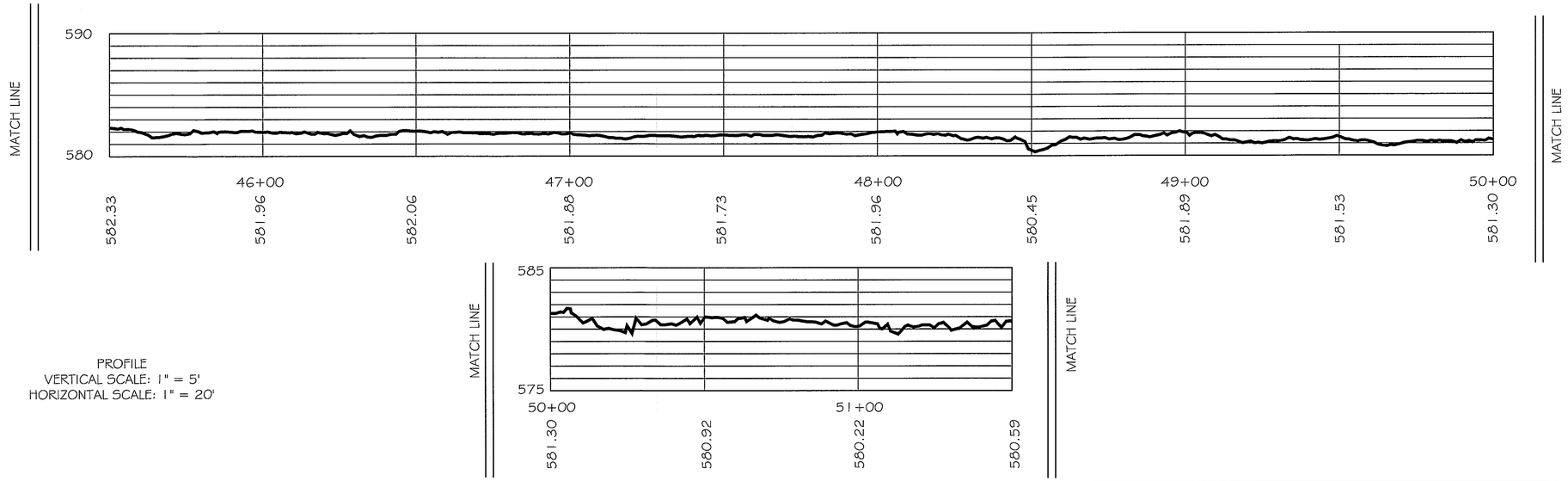
AS-BUILT SURVEY FOR

CANE CREEK RESTORATION

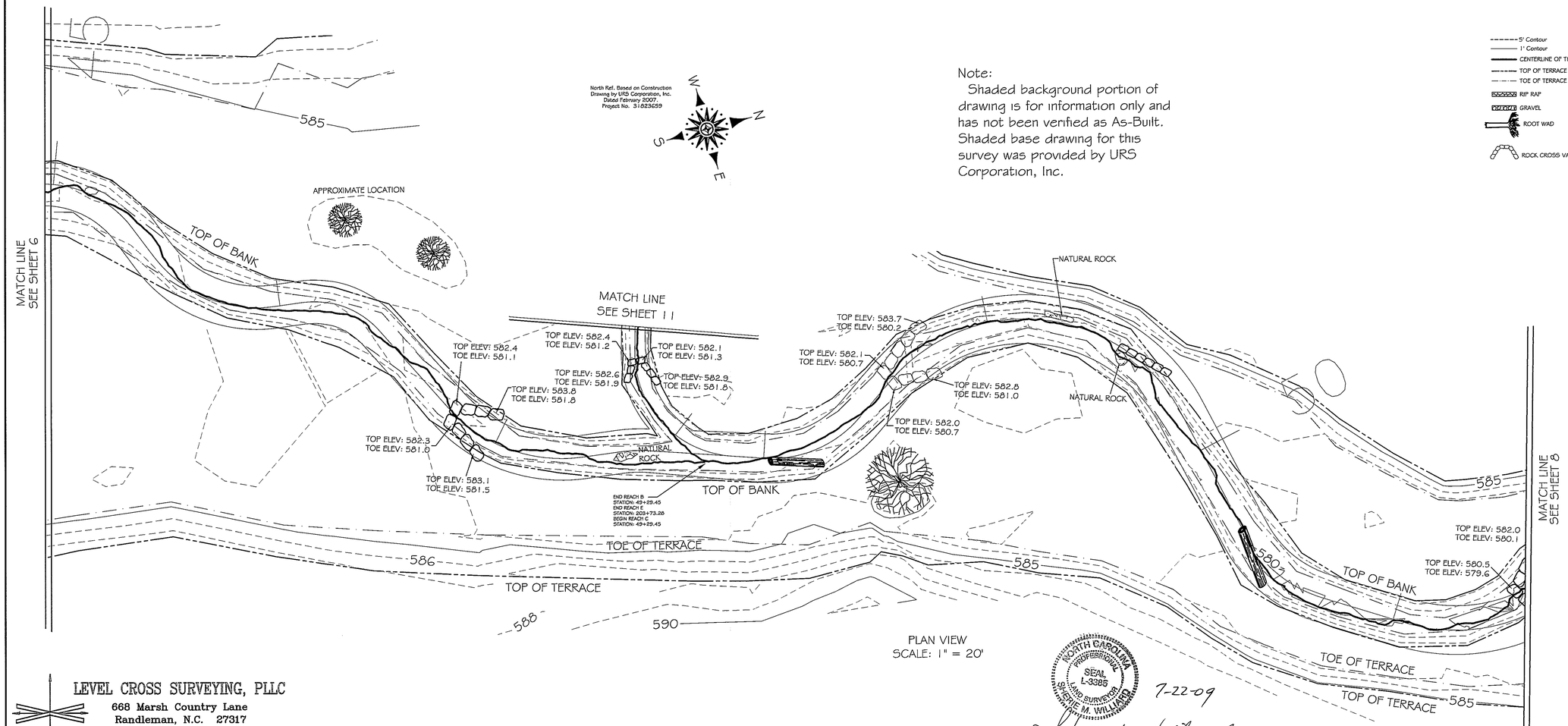
REACH B
ALAMANCE COUNTY
NORTH CAROLINA

SURVEY DATES:
JULY - OCTOBER 2008

PROJECT NO. 13080017CC



PROFILE
VERTICAL SCALE: 1" = 5'
HORIZONTAL SCALE: 1" = 20'



PLAN VIEW
SCALE: 1" = 20'

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LEGEND

- 5' Contour
- 1' Contour
- CENTERLINE OF THALWEG
- TOP OF TERRACE
- TOE OF TERRACE
- RIP RAP
- GRAVEL
- ROOT WAD
- ROCK CROSS VANE
- J HOOK
- ROCK VANE
- LOG VANE
- TREE (VARIES)
- WILLOW TREE

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NORTH CAROLINA PROFESSIONAL SEAL L-3385 LAND SURVEYOR SHERRIE M. WILLIARD

7-22-09

Sherrie M Williard

SHEET 7 OF 11

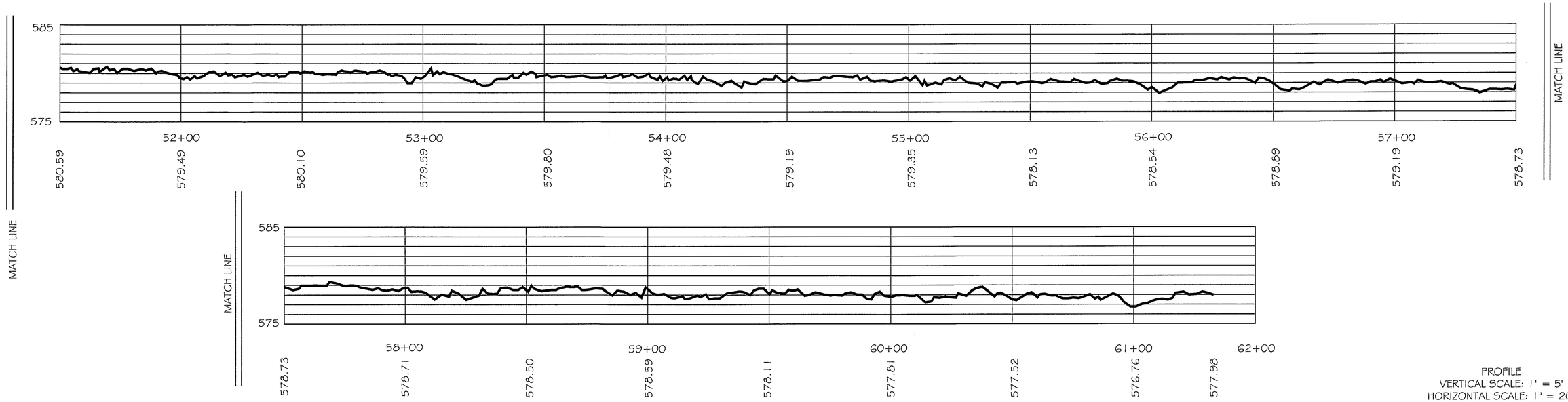
AS-BUILT SURVEY
FOR

CANE CREEK RESTORATION

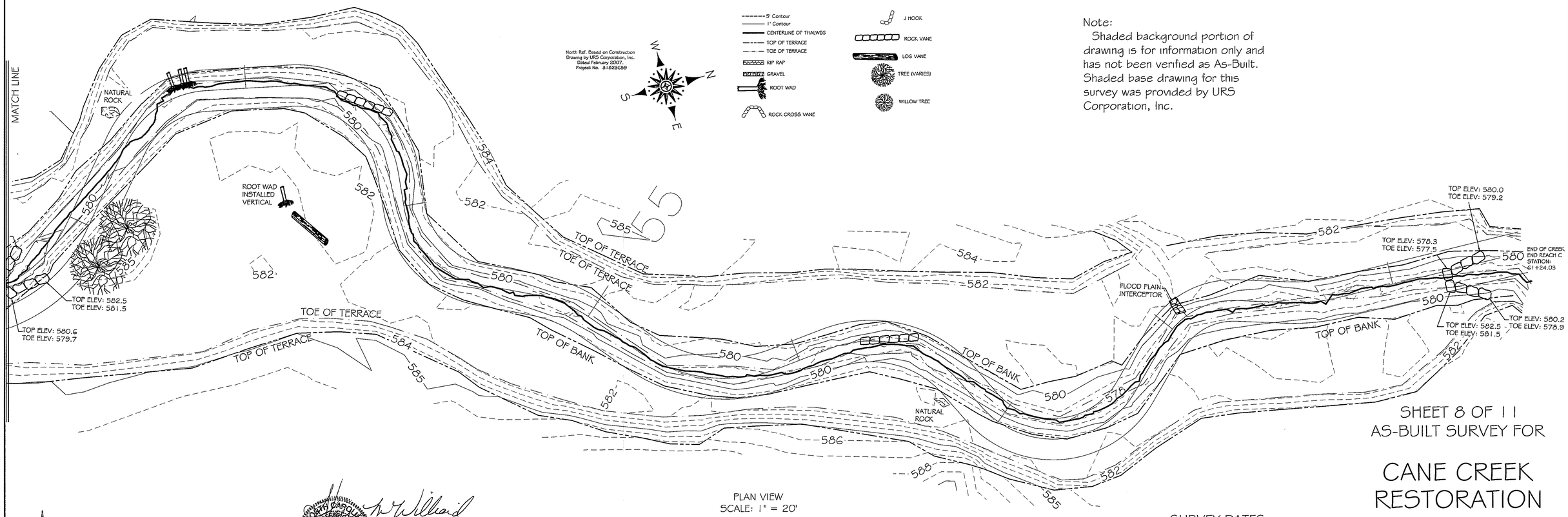
REACH B & C
ALAMANCE COUNTY
NORTH CAROLINA

SURVEY DATES:
JULY - OCTOBER 2008

PROJECT NO. 13080017CC



PROFILE
VERTICAL SCALE: 1" = 5'
HORIZONTAL SCALE: 1" = 20'



PLAN VIEW
SCALE: 1" = 20'

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NORTH CAROLINA PROFESSIONAL SEAL L-3385 LAND SURVEYOR SHERIE M. WILLIARD

1-22-09

SURVEY DATES:
JULY - OCTOBER 2008

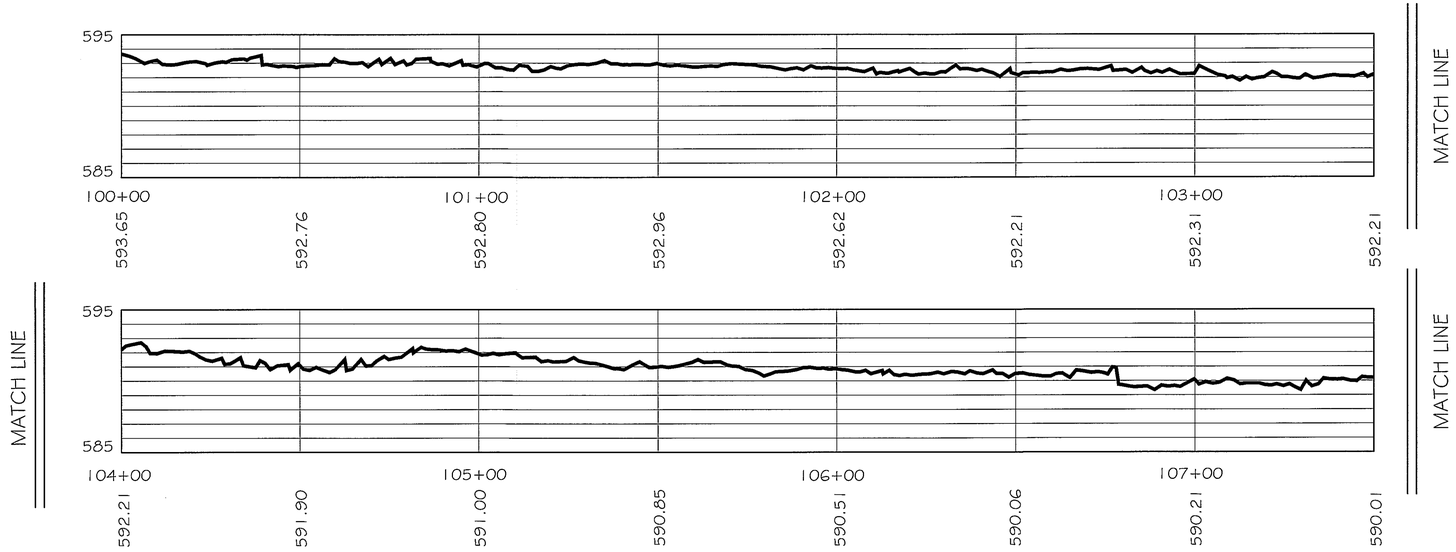
PROJECT NO. 13080017CC

SHEET 8 OF 11
AS-BUILT SURVEY FOR

CANE CREEK RESTORATION

REACH C
ALAMANCE COUNTY
NORTH CAROLINA

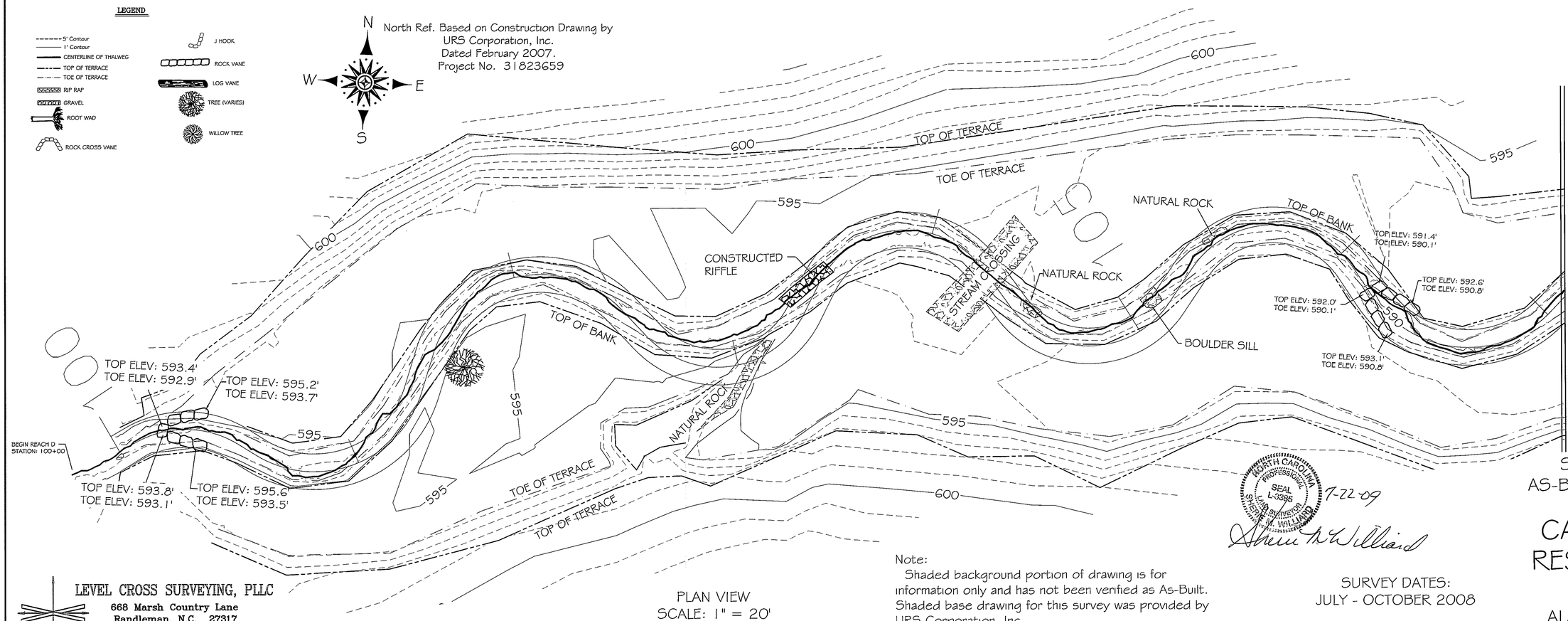
PROFILE
VERTICAL SCALE: 1" = 5'
HORIZONTAL SCALE: 1" = 20'



LEGEND

- 5' Contour
- 1' Contour
- CENTERLINE OF THALWEG
- TOP OF TERRACE
- TOE OF TERRACE
- RIP RAP
- GRAVEL
- ROOT WAD
- ROCK CROSS VANE
- J HOOK
- ROCK VANE
- LOG VANE
- TREE (VARIES)
- WILLOW TREE

North Ref. Based on Construction Drawing by
URS Corporation, Inc.
Dated February 2007.
Project No. 31823659



PLAN VIEW
SCALE: 1" = 20'

NORTH CAROLINA PROFESSIONAL SEAL L-3386 SURVEYOR ADRIAN M. WILLIARD

7-22-09

Adrian M. Williard

Note:
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SURVEY DATES:
JULY - OCTOBER 2008

PROJECT NO. 13080017CC

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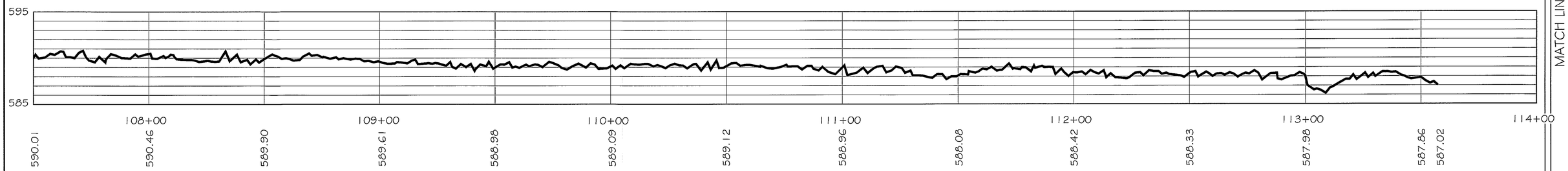
SHEET 9 OF 11
AS-BUILT SURVEY FOR

CANE CREEK RESTORATION

REACH D
ALAMANCE COUNTY
NORTH CAROLINA

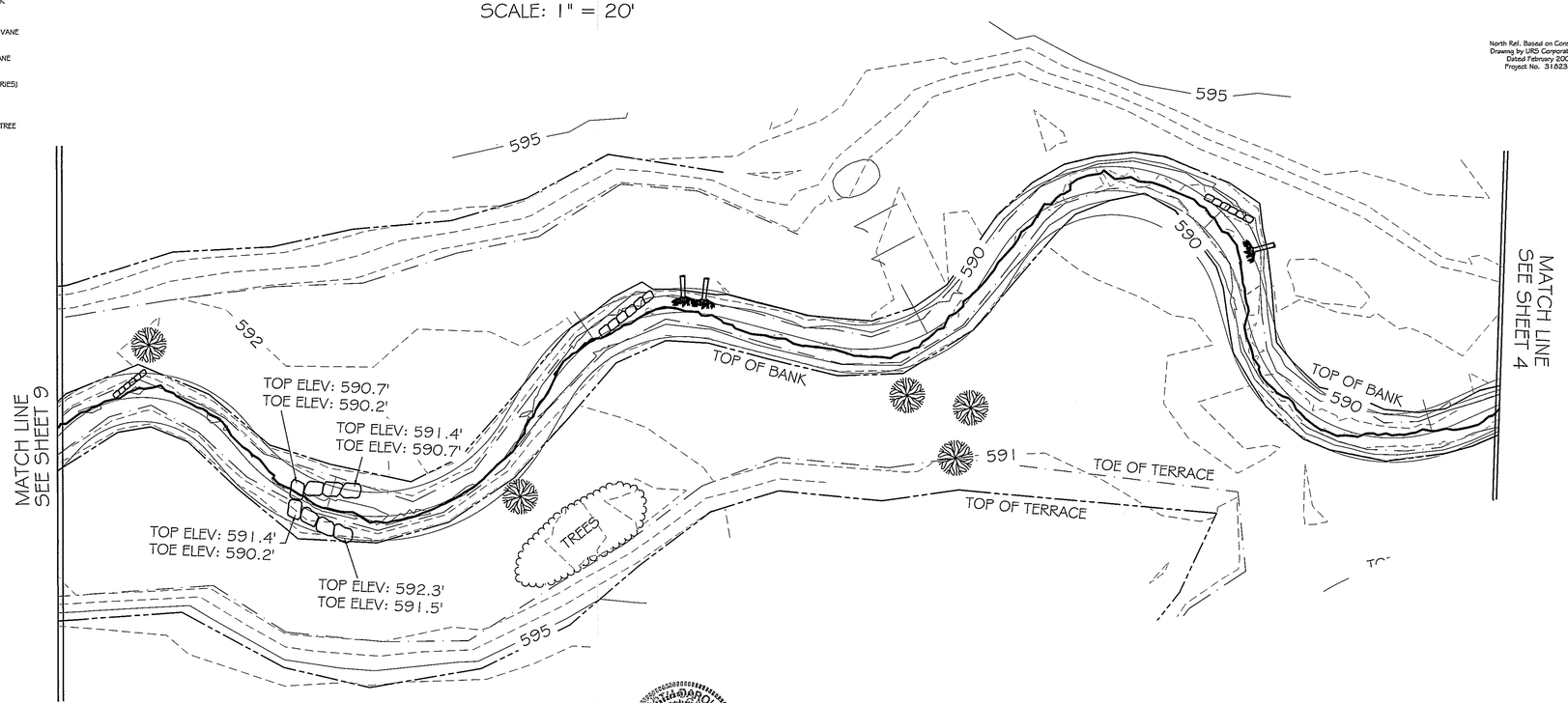
PROFILE
VERTICAL SCALE: 1" = 5'
HORIZONTAL SCALE: 1" = 20'



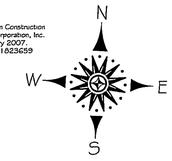
LEGEND

- 5' Contour
- 1' Contour
- CENTERLINE OF THALWEG
- TOP OF TERRACE
- TOE OF TERRACE
- RIP RAP
- GRAVEL
- ROOT WAD
- ROCK CROSS VANE
- J HOOK
- ROCK VANE
- LOG VANE
- TREE (VARIES)
- WILLOW TREE

PLAN VIEW
SCALE: 1" = 20'



North Ref. Based on Construction Drawing by URS Corporation, Inc. Dated February 2007, Project No. 31623659



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NORTH CAROLINA
PROFESSIONAL
SEAL
L-3965
LAND SURVEYOR
SHERIE M. WILLIARD

7-22-09

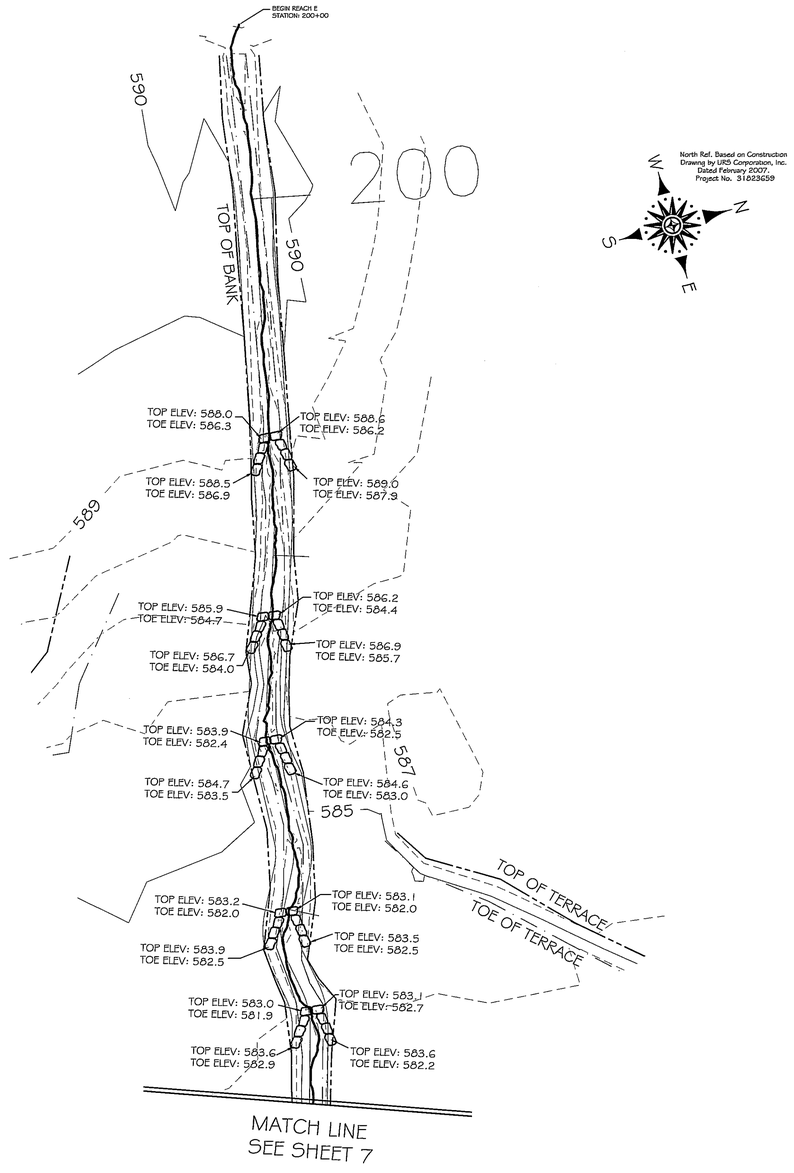
SURVEY DATES:
JULY - OCTOBER 2008

PROJECT NO. 13080017CC

SHEET 10 OF 11
AS-BUILT SURVEY
FOR

CANE CREEK RESTORATION

REACH D
ALAMANCE COUNTY
NORTH CAROLINA



PLAN VIEW
SCALE: 1" = 20'

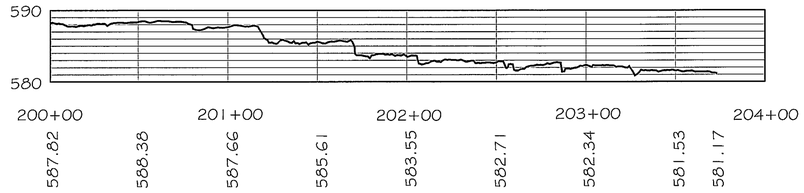
North Ref. Based on Construction Drawing by URS Corporation, Inc. Dated February 2007. Project No. 31623659

NORTH CAROLINA PROFESSIONAL SEAL L-3385 LAND SURVEYOR SHERRIE M. WILLIARD

7-22-09

LEVEL CROSS SURVEYING, PLLC
668 Marsh Country Lane
Randleman, N.C. 27317
Ph. (336) 495-1713
Fax (336) 495-1745

PROFILE
VERTICLE SCALE: 1" = 5'
HORIZONTAL SCALE: 1" = 40'



Note:
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LEGEND

- 5' Contour
- 1' Contour
- CENTERLINE OF THALWEG
- TOP OF TERRACE
- TOE OF TERRACE
- RIP RAP
- GRAVEL
- ROOT WAD
- ROCK CROSS VANE
- J HOOK
- ROCK VANE
- LOG VANE
- TREE (VARIES)
- WILLOW TREE

SHEET 11 OF 11

AS-BUILT SURVEY
FOR

CANE CREEK RESTORATION

ALAMANCE COUNTY
NORTH CAROLINA

SURVEY DATES:
JULY - OCTOBER 2008

PROJECT NO. 13080017CC