UT to Barnes Creek Restoration Project
Mitigation Report
Montgomery County, North Carolina

Prepared for:

Ecosystem Enhancement PROGRAM

Design Report Prepared by Buck Engineering, A Unit of Michael Baker

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EXECUTIVE SUMMARY

The UT to Barnes Creek site was restored through a contract with the NC Ecosystem Enhancement Program. The goals and objectives of this project were as follows:

- Restore 4,063 LF of channel dimension, pattern and profile;
- Enhance 3.12 acres of existing wetland by planting vegetation in previously grazed wetland areas;
- Restore wetland hydrology to 1.38 acres of wetland by raising the water table, restoring over bank flooding, and increasing surface storage;
- Create 0.39 acres of wetland as ephemeral pools in the existing stream bed after construction of the proposed meandering channel;
- Improve floodplain functionality by matching floodplain elevation with bankfull stage;
- Establish native stream bank and floodplain vegetation in the buffer;
- Improve the water quality in the Barnes Creek watershed by fencing cattle out of the stream and reducing bank erosion;
- Improve in-stream and riparian habitat by creating deeper pools, areas of re-aeration, planting a riparian buffer, and reducing bank erosion.

This report is being submitted to document completion of the project and to present base-line as-built data for the 5-year monitoring period.

Table 1 **Background Information**	
Project	UT to Barnes Creek Restoration Project
Designer	Buck Engineering 1447 South Tryon Street, Suite 200, Charlotte, NC 28203 (704) 334-4454
Contractor	North State Environmental, INC.
Project County	Montgomery County
Directions to Project Site	From Charlotte, take NC-24/26 east through Albemarle, NC, and continue just over the Pee Dee River and turn left on River Road. Take River Road to SR-109 in Uwharrie, NC. Turn left on 109 and then right on Ophir Road. Take Ophir Road to Flint Hill Road. Take a right onto Flint Hill Road. Continue on Flint Hill to the intersection with Love Joy Road. The intersection occurs at the upstream end of the project site.
Drainage Area	Hurley and Harris Reaches (UT Mainstem) = 1280 acres (2.0 square miles) Harris Tributary = 115 acres (0.18 square miles)
USGS Hydro Unit	03040103050080
NCDWQ Subbasin	03-07-09
Project Length	3,916 linear feet (As-built), 4,063 linear feet (Design)
Restoration Approach	Restore channel dimension, pattern and profile to two separate stream reaches.
	Restore or enhance wetland functions to approximately 4.89 acres of wetlands, 4.95 acres (As-built) of wetlands restored or enhanced
Date of Completion	June 1, 2006
Monitoring	A site visit will be conducted monthly during the growing season. An annual report will be submitted for the 5 year duration

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1.0 INTRODUCTION

The UT to Barnes Creek Restoration Project is located north of Troy in Montgomery County, North Carolina, (Figure 1.1). The site has a history of pasture and general agricultural usage. The unnamed tributary (UT) and a tributary described as the Harris Tributary had been channelized and riparian vegetation was cleared during agricultural practices. Cattle were allowed to graze on the banks and access the channels. Stream and riparian functions on the site are severely impacted as a result of agricultural conversion.

The project design involved the restoration of 4.89 acres of floodplain wetlands and 4,063 linear feet (LF) of stream along UT to Barnes Creek and Harris Tributary. When constructed, the project restored channel dimension, pattern and profile to 3,916 LF of stream channel and 4.95 acres of floodplain wetlands. The watershed boundaries for the UT and the Harris tributary are delineated in Figure 1.2.

1.1 Project Goals

The specific goals for the UT to Barnes Creek Restoration Project were as follows:

- Restore 4,063 LF of channel dimension, pattern and profile;
- Enhance 3.12 acres of existing wetland by planting vegetation in previously grazed wetland areas;
- Restore wetland hydrology to 1.38 acres of wetland by raising the water table, restoring over bank flooding, and increasing surface storage;
- Create 0.39 acres of wetland as ephemeral pools in the existing stream bed after construction of the proposed meandering channel;
- Improve floodplain functionality by matching floodplain elevation with bankfull stage;
- Establish native stream bank and floodplain vegetation in the buffer;
- Improve the water quality in the Barnes Creek watershed by fencing cattle out of the stream and reducing bank erosion.
- Improve in-stream and riparian habitat by creating deeper pools, areas of re-aeration, planting a riparian buffer, and reducing bank erosion.

1.2 Project Location

The UT to Barnes Creek Restoration Project is located north of Troy in Montgomery County, North Carolina. Directions to the site are included in the Executive Summary.

Site Location Map – Figure 1.1

2.0 SUMMARY

2.1 Project Description and Watershed

For analysis and design purposes, the on-site streams were divided into three reaches: two reaches along the main stem of UT to Barnes Creek (Hurley and Harris Reaches) and a small tributary referred to as the Harris tributary. The UT begins off site and enters the site from the south via two 72" RCP culverts under Flint Hill Road. The stream flows across the site from south to north through a conservation easement on the Hurley property and then through a conservation easement on the Harris property. The Harris tributary enters on the northeast site of the site and flows to the northwest and ends at its confluence with the UT. The UT then exits the site to the northwest via a 72" CMP culvert under Love Joy Road. After exiting the project site, the UT flows approximately 8,500 linear feet to its confluence with Barnes Creek.

Wetland functions on the site were degraded as a result of agricultural conversion. The stream had been straightened and had incised slightly which dropped the water table within the wetlands. The wetlands were also drained by small ditches in order to promote agricultural production in areas that would normally have been determined unsuitable.

2.2 Methodologies

Construction activities, in accordance with the approved restoration plan for the site, began on December 24, 2005. Construction stakeout was preceded by the establishment of access sites and stockpile areas. Materials were stockpiled as needed for the initial stages of construction and the perimeter fence was constructed to prevent cattle access to the site.

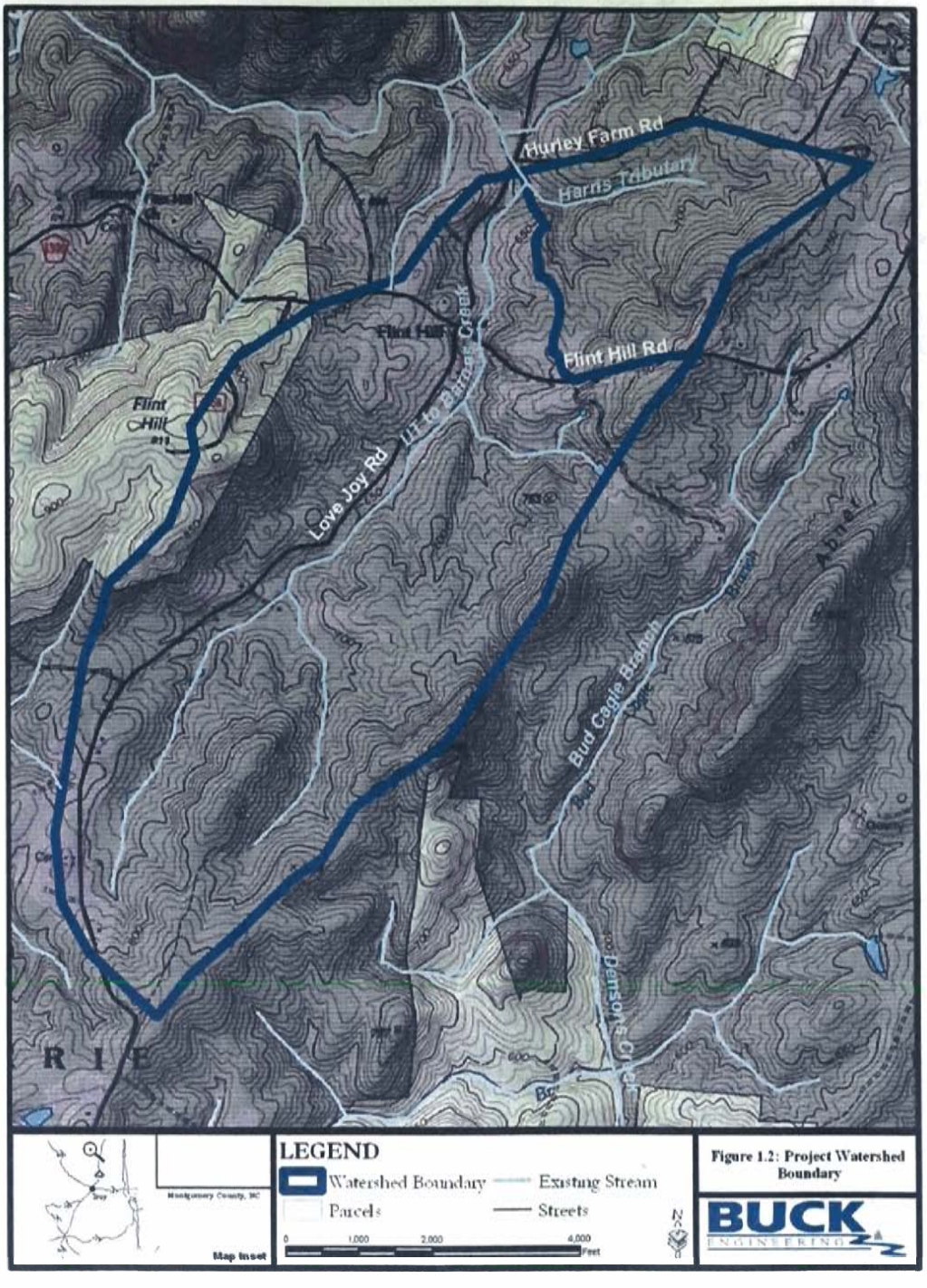
Construction began upstream with off line channel excavation and migrated downstream. Pump around operations were utilized for construction of on line sections and when tying constructed stream sections together. In-stream structures were constructed along with channel excavation. The next step involved grading the floodplain areas to achieve design elevations and filling the existing channel; ephemeral pools were constructed along with floodplain grading.

Wetland areas were constructed by grading the existing floodplain to design elevations. Existing drainage ditches were backfilled and drainage was diverted to wetland areas.

No major delays were experienced and construction proceeded with few changes to the proposed restoration plan. During construction the site experienced both wet and dry conditions, neither causing any major delays. Two major field changes were made based on professional judgment; the proposed stream alignment was adjusted between proposed stations 10+00 and 11+50 and 39+50 to 41+50. The alignment was adjusted between 10+00 and 11+50 due to the actual field location and angle of the culvert passing under Flint Hill Road; the proposed stream alignment would not function correctly with actual field conditions. The stream was straightened to convey flows from the culvert into the pool near 12+00; two additional riffles, a cross vane and a rock vane were added to dissipate energy. The other realignment occurred between stations 39+50 and 41+50; the radius of curvature of the stream was increased due to several bedrock outcroppings, preventing excavation of the stream to design elevations. A brush mattress was substituted for root wads at this location. Minor modifications made during construction included:

- not constructing the access road or installing the culvert stream crossing at proposed station 20+70,
- mixing class 1 riprap with riffle substrate and using less #57 stone during riffle construction,
- adding a step structure at as-built station 34+10 to prevent scour behind the top of bank,
- adding an additional ephemeral pool near as-built station 17+25,

Watershed Boundary – Figure 1.2



- removing two ephemeral pools from the plans at proposed conditions 10+50 and 31+00, and
- constructing a small channel to drain a culvert passing under Flint Hill Road.

These changes are documented in the attached as-built drawings.

Table 2 summarizes the as-built reach lengths and restoration approaches.

Early observations indicate that the vegetation treatments were effective at quickly establishing herbaceous ground cover. Temporary seeding applied to the stream banks beneath the erosion control matting sprouted within two weeks of application and has provided ground coverage.

The design for the restored streams involved the construction of new meandering channels across the agricultural field. The stream types for the designed streams were Rosgen "C" channels with dimensions modeled after a stable reference reach. Wetland restoration on the site involved raising the local water table and restoring a natural flooding regime. The streams through the site were restored to a stable dimension, pattern, and profile, such that riverine wetland functions were restored to the adjacent hydric soil areas. Drainage ditches within the restoration areas were filled to decrease surface and subsurface drainage and raise the local water table.

The design allows stream flows larger than bankfull flows to access the floodplain, which dissipates flow energies and reduces stress on stream banks. In-stream structures were used to control streambed grade, reduce stresses on stream banks, and promote bed form sequences and habitat diversity. The in-stream structures consisted of root-wads, log vanes, a cross vane, a rock vane, rock weirs and log weirs, which promote a diversity of habitat features in the restored channel. Where grade control was a consideration, constructed riffles or rock weirs were installed to provide long-term stability. Stream banks were stabilized using a combination of erosion control matting, bare-root planting, brush mattresses, and transplants. Native riparian vegetation was planted across the site and the entire restoration site is protected through a permanent conservation easement.

Table 2
Summary of As-Built Lengths and Restoration Approaches

Reach Name	Design Conditions	As-Built Conditions	Restoration Approach
Mainstem Hurley Reach	2,475 LF	2,400 LF	Priority 1 Restoration
Mainstem Harris Reach	965 LF	905 LF	Priority 1/2 Restoration
Harris Tributary	623 LF	611 LF	Priority 2 Restoration
Total Length	**4,063 LF**	**3,916 LF**	
Wetland Enhancement	3.12 acres	3.12 acres	Planting
Wetland Restoration	1.38 acres	1.38 acres	Grading and Planting
Wetland Creation	0.39 acres	0.45 acres	Grading and Planting
Total Acreage	**4.89 ac**	**4.95 ac**	---------

2.3 Plan View

See Attached Plan Set S1-S6

2.4 Points of Contact

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Construction Firm:

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336.725.2010
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3.0 SUCCESS CRITERIA

The five-year monitoring plan for the UT to Barnes site includes criteria to evaluate the success of the vegetation, wetland, and stream components of the project. The specific locations of vegetation plots, gauges, permanent cross sections, crest gauges, and the rainfall gauge are shown on the as-built drawing sheets. Photo points are located at each of the grade control structures along the restored stream channel.

3.1 Vegetation

Bare-root trees were planted within all areas of the conservation easement. A minimum 50-foot buffer was planted along the restored stream reaches. In general, bare-root vegetation was planted at a target density of 680 stems per acre, in an 8 foot by 8 foot grid pattern. Planting of bare-root trees was completed in March 2006. Species planted are summarized in Table 3.

Table 3
Percentages of Vegetation Species Planted

Scientific Name	Common Name	Percent Planted by Species	Total Number of Stems
Riparian Woody Vegetation			
Quercus michauxii	Swamp chestnut oak	1.3%	90
Quercus nigra	Water oak	16.4%	1,167
Acer negundo	Box elder	4.9%	350
Betula nigra	River birch	14.8%	1,050
Platanus occidentalis	Sycamore	14.8%	1,050
Alnus serrulata	Tag Alder	11.6%	822
Carpinus caroliniana	Ironwood	11.6%	822
Cornus amomum	Silky dogwood	7.4%	530
Scientific Name	Common Name	Percent Planted by Species	Total Number of Stems
Lindera benzoin	Spicebush	7.4%	530
Viburnum dentatum	Arrowwood	9.9%	704
	Total	100.0%	7,115
Hillside Woody Vegetation			
Carya cordiformis	Bitternut hickory	1.2%	35
Quercus falcata	Southern red oak	17.1%	510
Acer rubrum	Red maple	8.5%	252
Liquidambar styraciflua	Sweetgum	8.5%	252
Quercus alba	White oak	16.0%	475
Carpinus caroliniana	Ironwood	8.4%	250
Corylus americana	Hazelnut	8.4%	250
Diospyros virginiana	Persimmon	7.6%	227
Symphoricarpos orbiculatus	Coralberry	7.6%	227
Calycanthus floridus	Sweetshrub	8.4%	250
Viburnum dentatum	Arrowwood	8.4%	250
	Total	100.0%	2,978
Native Herbaceous Species for Restored Stream Banks and Riverine Wetland Areas			
Ludwigia alternifolia	Bushy seedbox	25.0 %	500
Schizachyrium scoparium	Little bluestem	25.0 %	500

Scientific Name	Common Name	Percent Planted by Species	Total Number of Stems
Scirpus cyperinus	Wool grass	25.0 %	500
Uniola latifolia	River oats	25.0 %	500
	Total	100.0%	2,000
Native Grass Species for Stream Banks and Buffers			
Trifolium repens	White clover	5.0 %	n/a
Carex crinata	Fringed sedge	15.0 %	n/a
Juncus effusus	Soft rush	30.0 %	n/a
Elymus virginica	Virginia wild rye	20.0 %	n/a
Panicum virgatum	Switchgrass	30.0 %	n/a
	Total	100.0%	n/a
Woody Vegetation for Live Stakes			
Salix nigra	Black willow	2.9%	450
Cornus amomum	Silky dogwood	32.4%	5,100
Sambueus canadensis	Elderberry	32.4%	5,100
Salix sericea	Silky willow	32.4%	5,100
		100.0%	15,750

The restoration plan for the UT to Barnes Site specifies that the number of quadrats required will be based on EEP monitoring guidance documents available at the time of the July 8, 2004 Restoration Plan submittal, with a minimum of three quadrats. The size of individual quadrats is 100 square meters for woody tree species and 1 square meter for herbaceous vegetation. A total of four vegetation plots, each 10 by 10 meters in size, were established across the restored site, to sample each 1,000 LF segment of the riparian buffer as prescribed by EEP guidance. The initial planted density within each of the vegetation monitoring plots is given in Table 4. The average density of planted bare root stems, based on the data from the four monitoring plots, is 800 stems/acre. The locations of the vegetation plots are shown on the as-built plan sheets.

Table 4
Initial Density of Planted Trees for the Four Vegetation Sampling Plots

Sampling Plot No.	Counted Stems per Plot	Stems per Acre (extrapolated)
BC1	20	800
BC2	24	960
BC3	18	720
BC4	18	720

No results are available at the submittal of this report. As-built data will be compared with first year monitoring data in the Year 1 monitoring report, scheduled for submittal to EEP during November 2006.

3.2 Morphology

For monitoring stream success criteria, 8 permanent cross sections, one rain gauge, and three crest gauges were installed. The permanent cross sections will be used to monitor channel dimension and bank erosion over time. The rain gauge and crest gauges will be used to document the occurrence of bankfull events. In addition, a longitudinal survey was completed for the restored stream channels to provide a base-line for evaluating changes in bed conditions over time. The longitudinal profiles included the elevations of all grade control structures. The permanent cross sections and longitudinal data are provided in Appendix 2. The location of the permanent cross sections, rain gauge, and the stream gauges are shown on the as-built plan sheets in Appendix 3.

No results are available at the submittal of this report. As-built data will be compared with first year monitoring data in the Year 1 monitoring report, scheduled for submittal to EEP during November 2006.

3.3 Hydrology

The restoration plan for the UT to Barnes site specified that 8 monitoring gauges (4 automated and 4 manual) would be established across the restored site. Gauges were installed during late March to document water table hydrology in all required monitoring locations. The locations of monitoring gauges are shown on the as-built plan sheets. In order to determine if the rainfall is normal for the given year, rainfall amounts will be recorded using a rain gauge and data obtained from the Jackson Springs, Albemarle, Mt. Gilead, and Asheboro automated weather stations (COOP: 314464, COOP: 310090, COOP: 315898, COOP: 310286).

3.4 Photo Reference Sites

Photo reference sites were established and marked with wooden stakes at each permanent cross section during the as-built survey. Photos were taken with a digital camera and labeled.

Photographs will be used to qualitatively evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation, and effectiveness of in-stream structures and erosion control measures. Longitudinal photos should indicate the absence of developing bars within the channel or an excessive increase in channel depth. Lateral photos should indicate stable banks over time. A series of photos over time should indicate successional maturation of riparian vegetation. Vegetative succession should include initial herbaceous growth, followed by increasing densities of woody vegetation, and then ultimately a mature overstory with herbaceous understory.

3.5 Areas of Concern

No areas of concern have been identified during the first months following completion of the project.

4.0 MONITORING SCHEDULE AND METHODS

Monitoring will be conducted annually for five years. Buck Engineering conducted the as-built survey in April 2006 and will conduct the first-year survey in Novembers 2006. Additional yearly surveys (to be completed by others) will be completed in November of each year ending in 2011 to complete the 5 year monitoring effort.

5.0 MITIGIATION

The NC EEP will complete the mitigation credit proposal. Buck Engineering has provided EEP with a plan view, showing reaches and sub-reaches.

6.0 MAINTENANCE AND CONTINGENCY PLANS

Maintenance requirements vary from site to site and are generally driven by the following conditions:

- Projects without established woody floodplain vegetation are more susceptible to erosion from floods than those with a mature hardwood forest.
- Projects with sandy non-cohesive soils are more prone to short-term bank erosion than cohesive soils or soils with high gravel and cobble content.
- Alluvial valley channels with wide floodplains are less vulnerable than confined channels.
- Wet weather during construction can make accurate channel and floodplain excavations difficult.
- Extreme and/or frequent flooding can cause floodplain and channel erosion.
- Extreme hot, cold, wet, or dry weather during and after construction can limit vegetation growth, particularly temporary and permanent seed.
- The presence and aggressiveness of invasive species can affect the extent to which a native buffer can be established.

No maintenance issues are apparent at this time.

APPENDIX A
SELECTED PROJECT PHOTOGRAPHS

Stock Piling Material for Construction

Root Wad Installation during Construction

Station 14+00 Riffle Construction

Coir Matting Installation

Station 12+50 Riffle construction

Constructed Riffle during Construction

Cross Vane

Cross Vane

Station 17+40 Pool Construction

Station 18+00 Riffle

Ephemeral Pool

Brush Mattress at Plunge Pool

Station 25+80 Pool with Root Wads

Construction of Riffle Station 26+25

Log Vane Station 27+00

Privet Clearing

Pool Construction

Harri : Tributary Station 10+35

Site Picture Looking Downstream

Step Pool Station 34+00

	
As-Built Typical Pool	As-Built Typical Constructed Riffle

APPENDIX B

AS-BUILT CROSS SECTIONS AND

LONGITUDINAL PROFILES

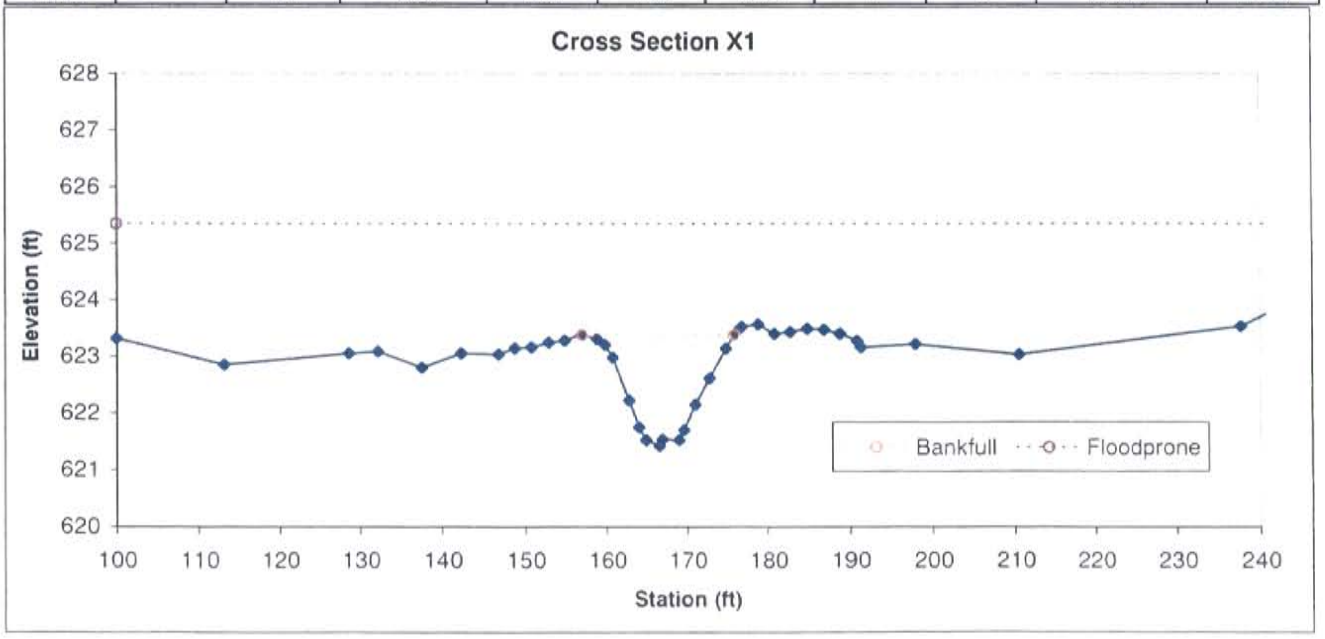
Permanent Cross Section X1

(As-Built Data - collected Mar. 2006)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle		19	18.84	1.01	1.96	18.69	1	8	623.39	623.4



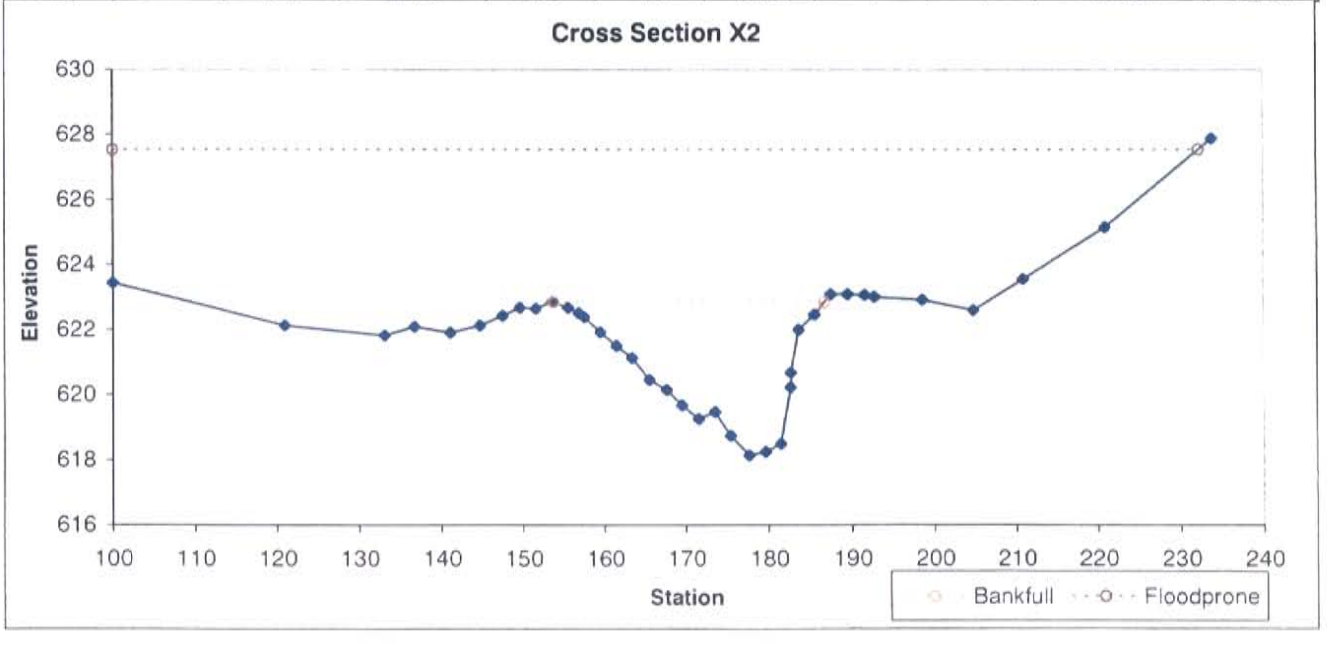
Permanent Cross Section X2

(As-Built Data - collected Mar. 2005)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		77.3	32.88	2.35	4.7	13.99	1	4	622.85	622.87



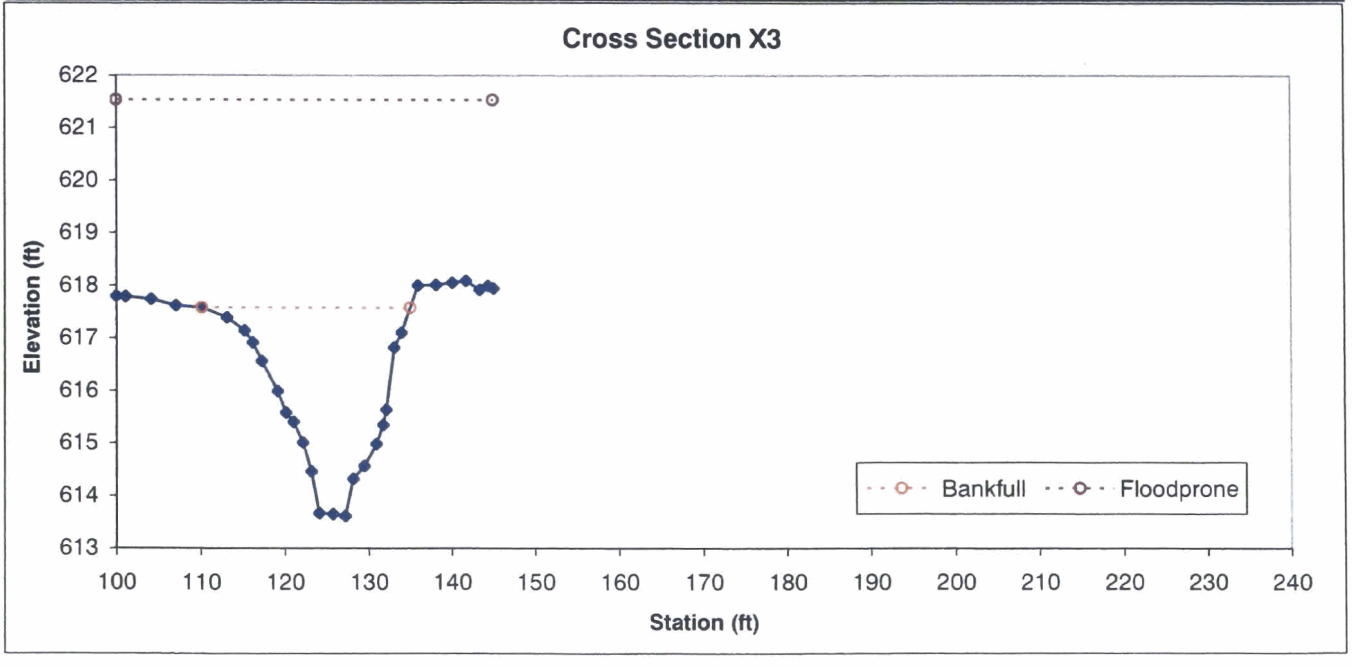
Permanent Cross Section X3

(As-Built Data - collected Mar. 2006)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		46.1	24.93	1.85	3.96	13.49	1	1.8	617.58	617.58



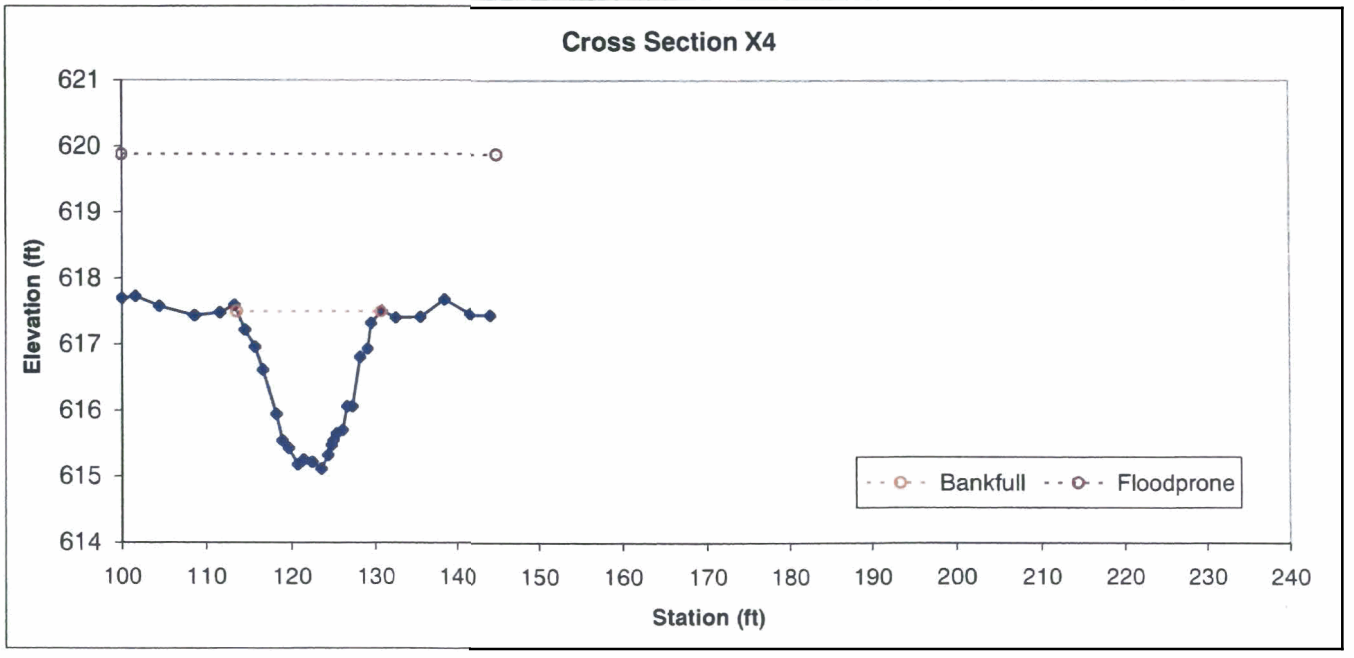
Permanent Cross Section X4

(As-Built Data - collected Mar. 2006)

Looking at the Left Bank

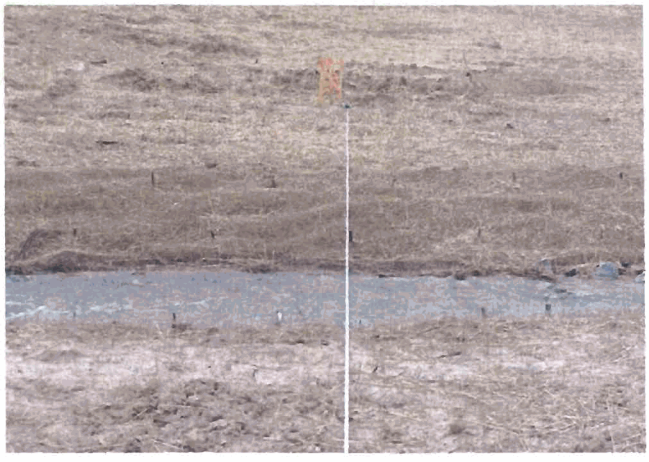
Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle		23.5	17.17	1.37	2.38	12.53	1	2.6	617.5	617.51



Permanent Cross Section X5

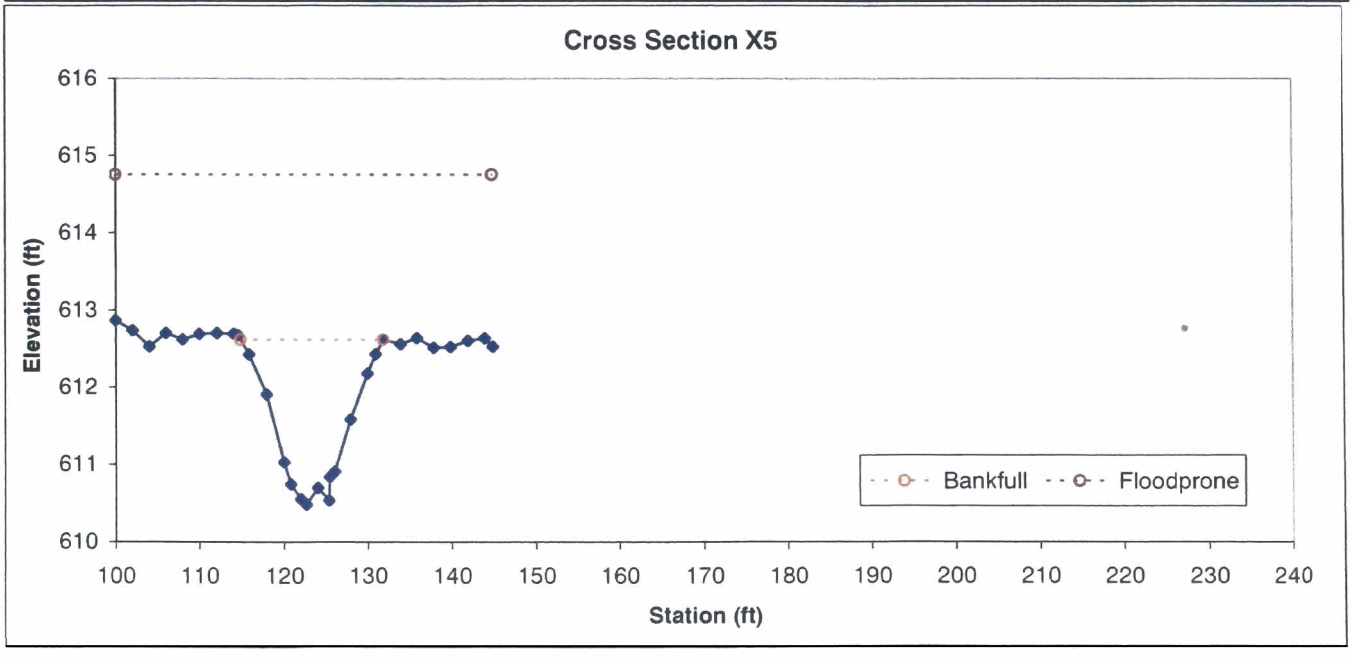
(As-Built Data - collected Mar. 2006)



Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle		19.7	17.04	1.16	2.14	14.75	1	2.6	612.62	612.62



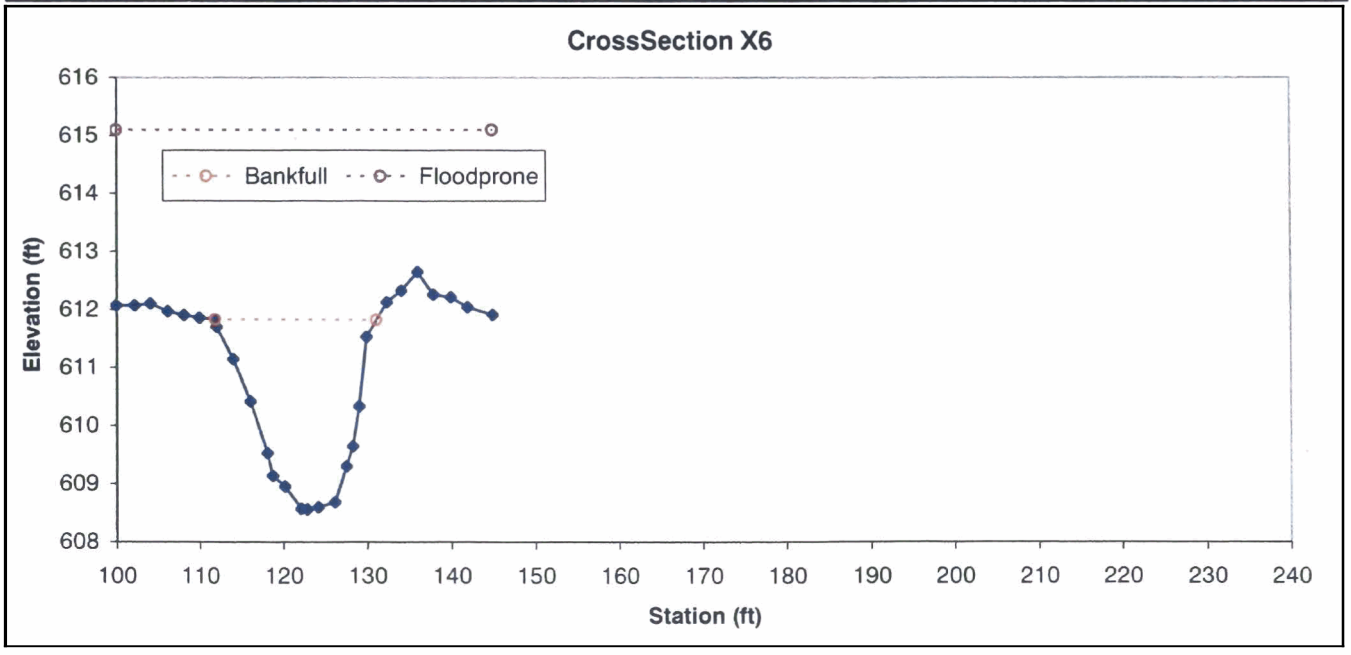
Permanent Cross Section X6

(As-Built Data - collected Mar. 2006)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		39.4	19.3	2.04	3.27	9.47	1	2.3	611.83	611.84



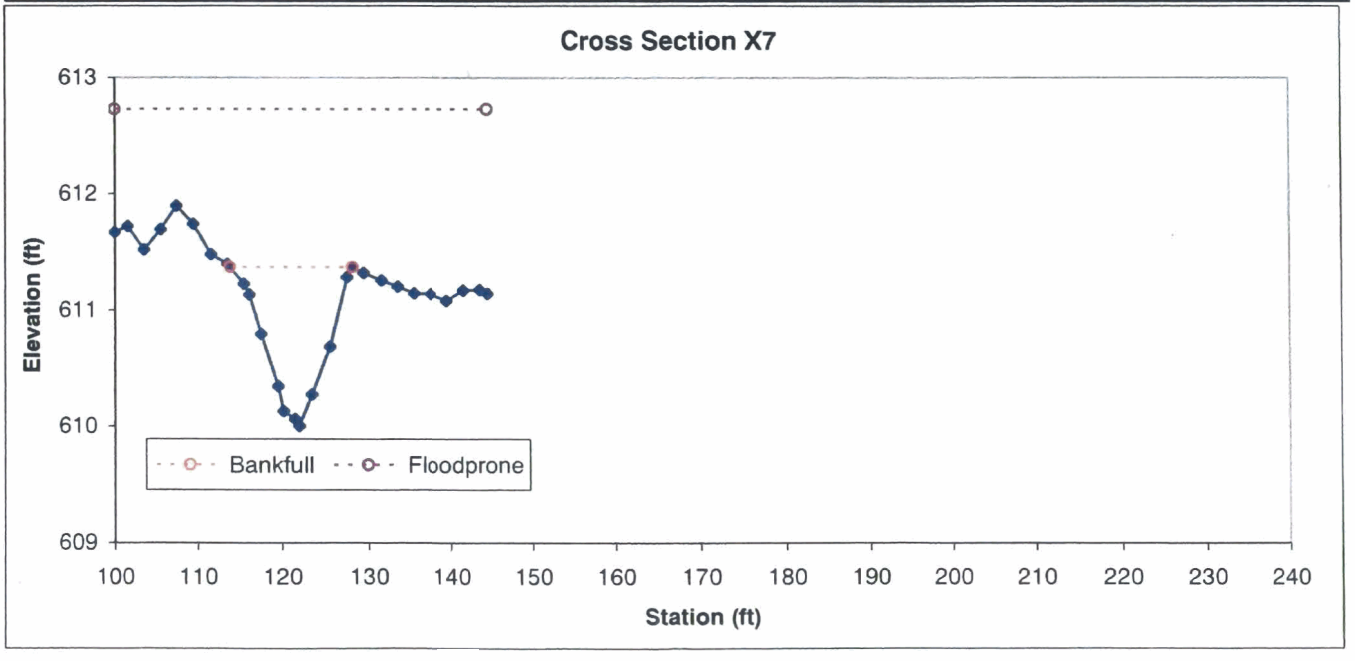
Permanent Cross Section X7

(As-Built Data - collected Mar. 2006)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle		9.9	14.35	0.69	1.36	20.72	1	3.1	611.37	611.37



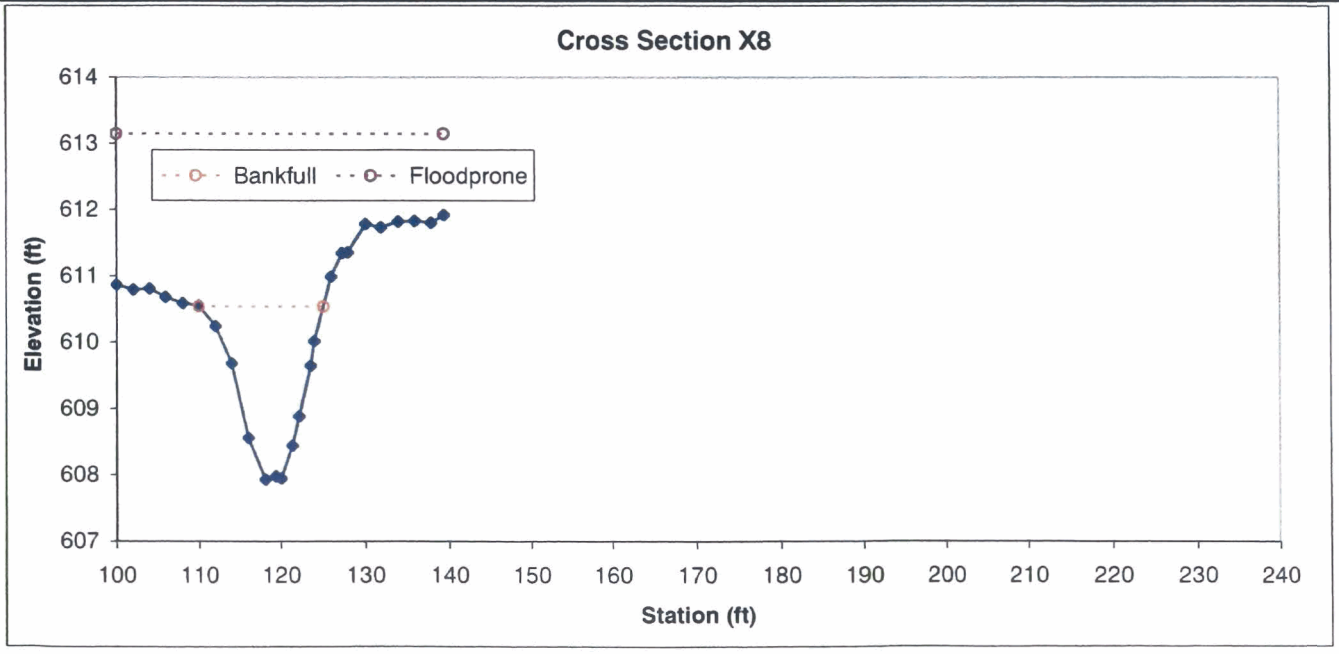
Permanent Cross Section X8

(As-Built Data - collected Mar. 2006)

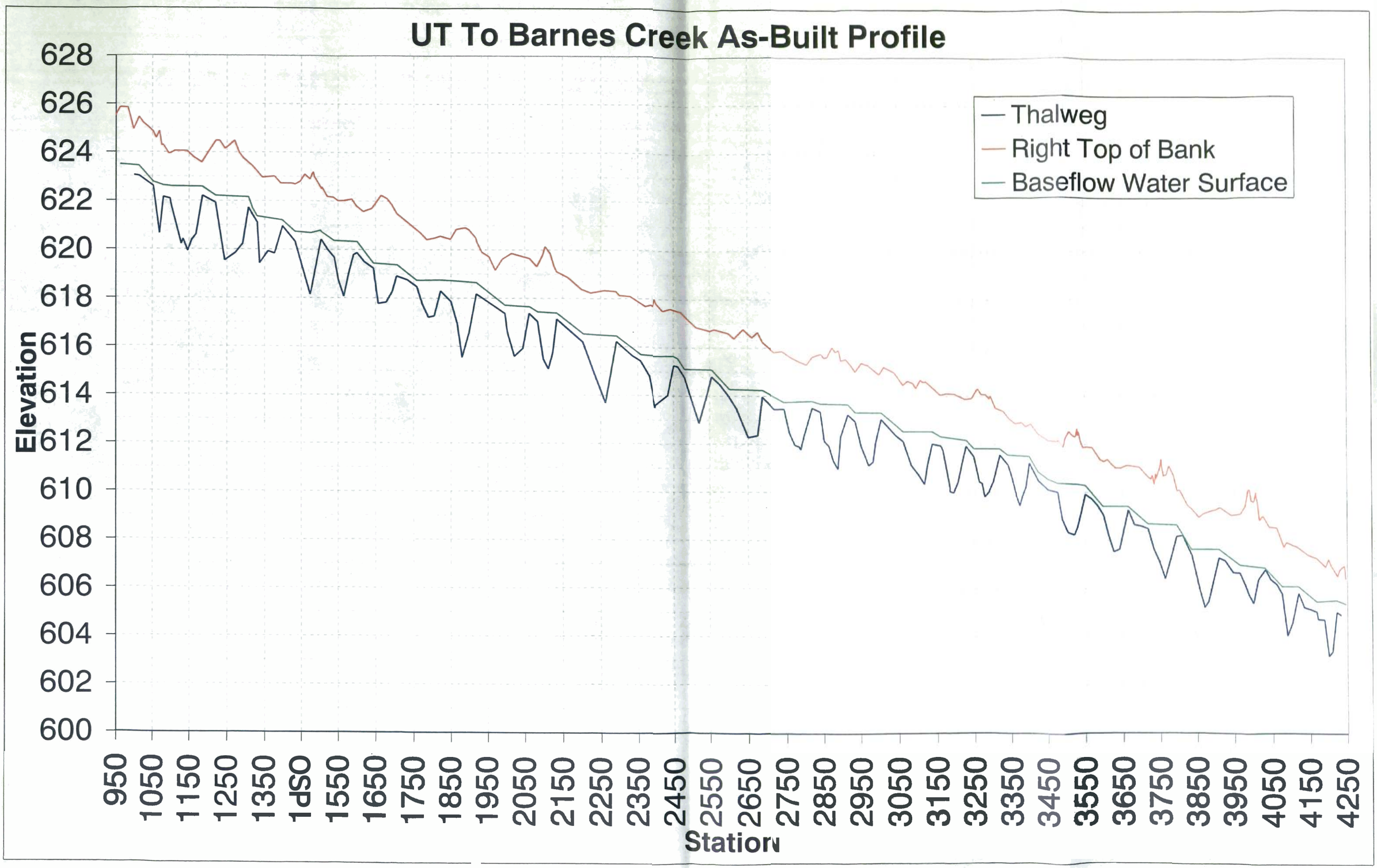
Looking at the Left Bank

Looking at the Right Bank

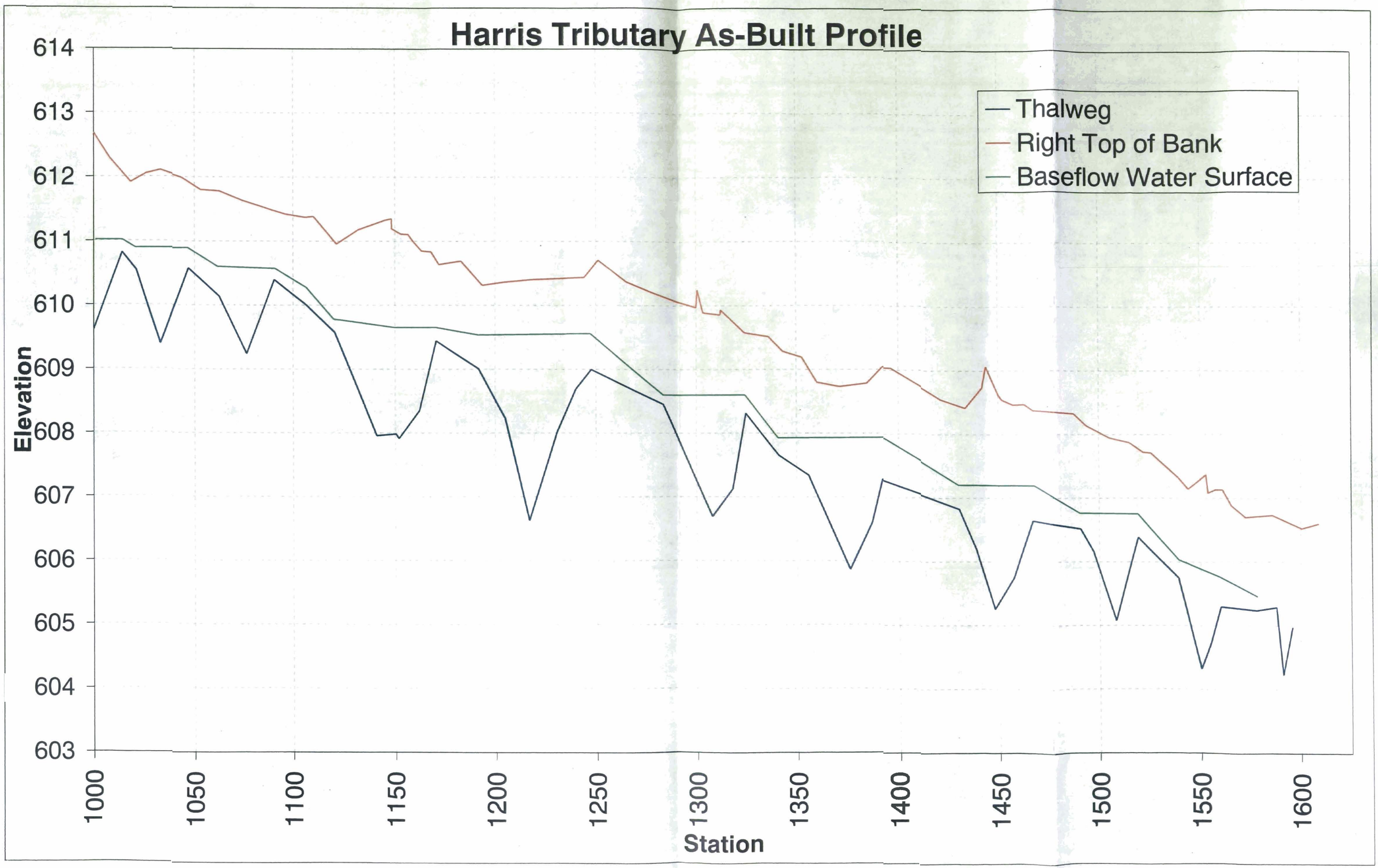
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		21.1	15.05	1.4	2.61	10.74	1	2.6	610.54	610.55



UT To Barnes Creek As-Built Profile



Harris Tributary As-Built Profile



APPENDIX C

AS-BUILT PLAN SHEETS

PROJECT REFERENCE NO.	SHEET NO.
172	T1

PROJECT ENGINEER
ASE

APPROVED BY
SDW

DATE
01/08/2007

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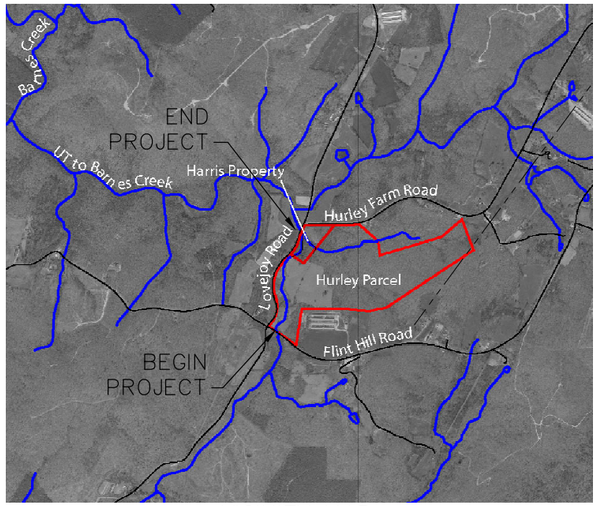
AS-BUILT PLANS

UT TO BARNES CREEK RESTORATION PROJECT

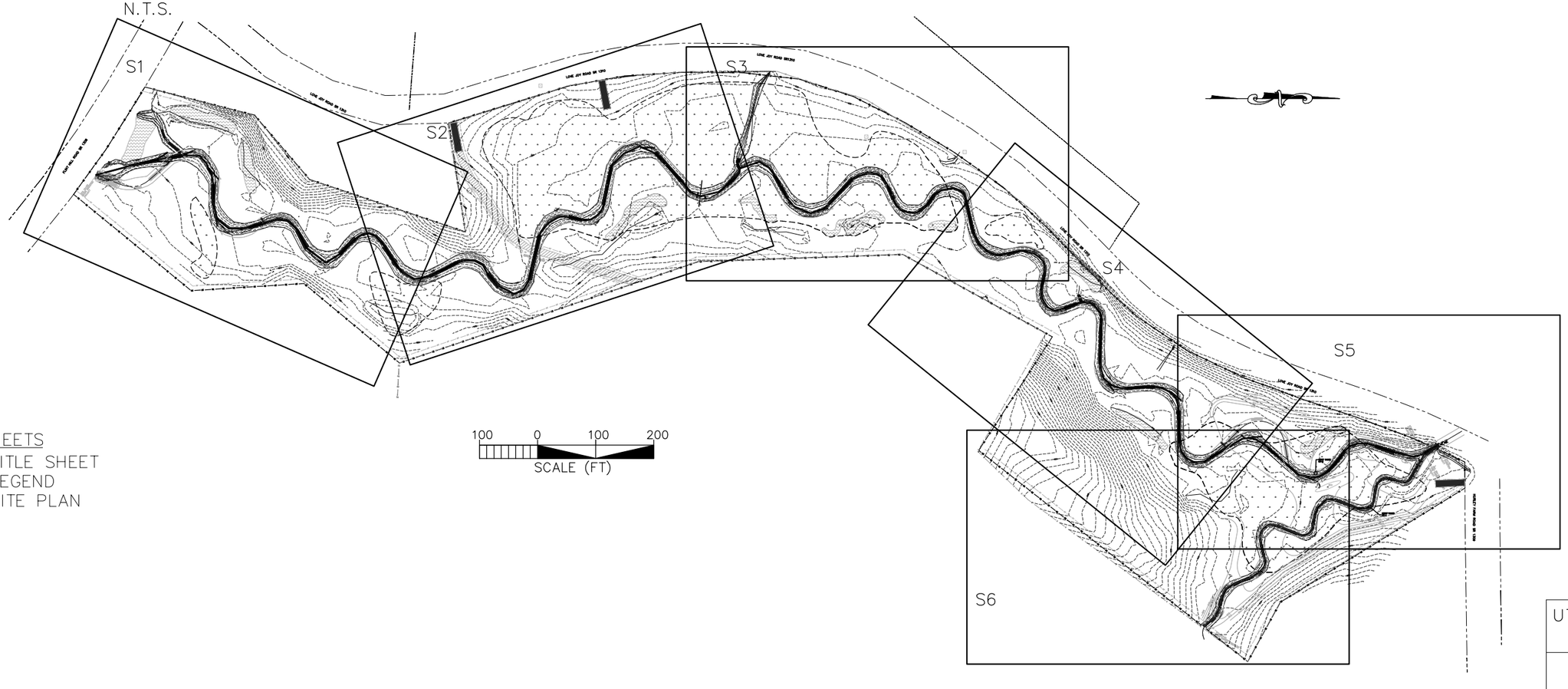
MONTGOMERY COUNTY, NORTH CAROLINA

PREPARED FOR:

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
ECOSYSTEM ENHANCEMENT PROGRAM



VICINITY MAP
N.T.S.



100 0 100 200
SCALE (FT)

INDEX OF SHEETS

UT TO BARNES CREEK RESTORATION

TITLE SHEET
AS-BUILT PLANS

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PROJECT REFERENCE NO.	SHEET NO.
172	T2

NORTH CAROLINA PROFESSIONAL SEAL 029340 ENGINEER AARON S. EARLEY

PROJECT ENGINEER
ASE

APPROVED BY
SDW

DATE
01/08/2007

BUCK ENGINEERING
1447 S. Tryon Street, Suite 200
Charlotte, North Carolina 28203
Phone: 704-334-4454
Fax: 704-334-4492

17+00 AS-BUILT STREAM ALIGNMENT

10+00 DESIGN ALIGNMENT

AS-BUILT TOP OF BANK

CE CE CE CONSERVATION EASEMENT

NCDOT RIGHT OF WAY

PROPERTY LIMITS

625 AS-BUILT MAJOR CONTOURS

AS-BUILT MINOR CONTOURS

CONSTRUCTED RIFFLE

ROCK VANE

ROCK CROSS VANE

ROOT WAD

LOG VANE

LOG WEIR

COVER LOG

BOULDER

BRUSH MATTRESS

EPHEMERAL POOL

WETLAND AREA

CHANNEL PLUG

PRE-PROJECT CHANNEL LOCATION

GROUNDWATER MONITORING GAUGE

SURVEY CONTROL POINT (BCP-XXX)

PHOTO POINT

STEP POOL

UT TO BARNES CREEK RESTORATION

LEGEND
AS-BUILT PLANS

PROJECT REFERENCE NO.	SHEET NO.
172	S1

NORTH CAROLINA PROFESSIONAL SEAL 029340 ENGINEER AARON S. CARLEY

PROJECT ENGINEER
ASE

APPROVED BY
SDW

DATE
01/08/2007

BUCK ENGINEERING
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CHANNEL WAS INSTALLED TO ACCOMMODATE OUTFALL PIPE UNCOVERED DURING CONSTRUCTION.

BEGIN PROJECT
STA 10+00

FLINT HILL ROAD SR 1306

STA 10+00
BEGIN MAINSTEM PROJECT

EXISTING TWO 72" RCP CULVERTS
INV 627.0

PROPOSED PLUNGE POOL 3
D5

MAINTAIN FLOW IN EXISTING CHANNEL UNTIL PROPOSED CHANNEL IS CONSTRUCTED AND STABILIZED AND CONNECTED TO EXISTING CHANNEL AT A DOWNSTREAM LOCATION.

STAGING AREA 1

STOCKPILE AREA

EPHEMERAL POOL-1

EPHEMERAL POOL-2

EPHEMERAL POOL-3

TEMPORARY STREAM CROSSING #1

EXISTING STREAM CHANNEL TO BE BACKFILLED AFTER NEW CHANNEL CONSTRUCTED (TYP)

VEGETATION PLOT-4

MONITORING GAUGE MW-4

PHOTO POINT M-58
PHOTO POINT M-59
PHOTO POINT M-57
PHOTO POINT M-56
PHOTO POINT M-55
PHOTO POINT M-54
PHOTO POINT M-53
PHOTO POINT M-52
PHOTO POINT M-51
PHOTO POINT M-50
PHOTO POINT M-49

X1 CROSS SECTION
X2 CROSS SECTION

BCP-1
REBAR AND CAP
N 630447.80
E 1728313.97
ELEV. 639.03

M AND C 181
BRASS DISK
N 630033.92
E 1728360.15
ELEV. 637.63

BCP-8229
BRASS DISK
N 630236.40
E 1728525.85
ELEV. 630.24

BCP-8236
BRASS DISK
N 630430.44
E 1728513.52
ELEV. 628.68

MATCHLINE S2 STA 17+00

CHANNEL ALIGNMENT FROM DESIGN STATION 10+00 TO 11+50 WAS REVISED DURING CONSTRUCTION TO MORE CLOSELY MATCH SKEW ANGLE OF THE TWO 72" RCP CULVERTS.

20 0 20 40
SCALE (FT)

UT TO BARNES CREEK RESTORATION

SITE PLAN AS-BUILT PLANS

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PROJECT REFERENCE NO.	SHEET NO.
172	S2

NORTH CAROLINA PROFESSIONAL SEAL 029340 ENGINEER AARON S. CARLEY

PROJECT ENGINEER
ASE

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LOVE JOY ROAD SR 1310

CONTRUCTION ENTRANCE 1

CONSTRUCTION ENTRANCE 2

BM
NORTHING 630837.68
EASTING 1728173.31
ELEV. 625.14

MATCH LINE S1 STA 17+00

MATCH LINE S3 STA 24+50

DEMOLISH WOODEN STRUCTURE (APPROXIMATE LOCATION)

PROTECT 36" TREE DURING GRADING DO NOT DISTURB (APPROXIMATE LOCATION)

N/F
PHILLIP R. HURLEY and wife
BRENDA C. HURLEY
DB 416, PG. 275
PC D, SLIDE 51-A
PIN#7633-01-8313

PROPOSED GRAVEL ACCESS ROAD LOCATION TO BE COORDINATED WITH PROPERTY OWNER

PROTECT EXISTING MONITORING WELL TO REMAIN

MONITORING GAUGE MW-2

RAIN GAUGE

GRAVEL ACCESS ROAD AND CULVERT WERE NOT INSTALLED DUE TO AGREEMENT WITH LAND OWNER

RIPRAP APRON
44 TONS CLASS I RIPRAP
WITH FILTER FABRIC
20' X 15' X 2' MIN.

PHOTO POINT M-49

PHOTO POINT M-39

PHOTO POINT M-38

PHOTO POINT M-37

PHOTO POINT M-42

PHOTO POINT M-46

PHOTO POINT M-40

PHOTO POINT M-41

PHOTO POINT M-48

PHOTO POINT M-45

PHOTO POINT M-47

PHOTO POINT M-43

PHOTO POINT M-44

PHOTO POINT M-36

PHOTO POINT M-35

AUTOMATIC GAUGE AW-4

MONITORING GAUGE MW-3

CONSTRUCT 5' WIDE BY 1' TALL BERM AT OUTSIDE POOL SECTION TO PROTECT BANK FROM HILL SLOPE RUNOFF

PROPOSED 28LF OF 6'-1" X 4'-8" CMP ARCH CULVERT WITH ENDWALL
INV IN 616.80
INV OUT 616.50

TEMPORARY STREAM CROSSING #3

VEGETATION PLOT-3

EPHEMERAL POOL-4

EPHEMERAL POOL-5

EXISTING STREAM CHANNEL TO BE BACKFILLED AFTER NEW CHANNEL IS STABILIZED (TYP)

BCP-633
REBAR AND CAP
N 631058.60
E 1728464.87
ELEV. 619.89

STAGING AREA 2

STAGING

DITCH 1

DITCH 2

STEP POOL

INSTALL CHECK DAMS IMMEDIATELY PRIOR TO CONSTRUCTING DITCH
INTALL TEMPORARY LINING IN DITCH IMMEDIATELY AFTER DITCH IS GRADED

X4 CROSS SECTION

SCALE (FT)
20 0 20 40

UT TO BARNES CREEK RESTORATION

SITE PLAN AS-BUILT PLANS

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PROJECT REFERENCE NO.	SHEET NO.
172	S3

NORTH CAROLINA PROFESSIONAL SEAL 029340 ENGINEER AARON S. CARLEY

PROJECT ENGINEER
ASE

APPROVED BY
SDW

DATE
01/08/2007

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Fax: 704-334-4492

MATCH LINE S2 STA 24+50

MATCH LINE S4 STA 32+25

LOVE JOY ROAD SR1310

EXISTING 18" RCP
INV 618.35

RIPRAP APRON 2 TONS
CLASS A RIPRAP
WITH FILTER FABRIC
6'X4.5'X1' MIN.
(7/D3)

GRADE BANKS TO 2:1;
SEED AND MAT AS
DIRECTED BY ENGINEER.

AUTOMATIC GAUGE
AW-4

PROTECT EXISTING
MONITORING WELL TO REMAIN
DO NOT DISTURB (TYP)

MW

TIE-IN TO
EXISTING TEMPORARY
WET/DEEP POOLS

PHOTO POINT
M-34

MONITORING
GAUGE
MW-1

PHOTO POINT
M-33

PHOTO POINT
M-35

PHOTO POINT
M-32

PHOTO POINT
M-31

PHOTO POINT
M-29

PHOTO POINT
M-28

PHOTO POINT
M-30

PHOTO POINT
M-27

AUTOMATIC WELL
AW-3

PHOTO POINT
M-25

PHOTO POINT
M-24

PHOTO POINT
M-26

PHOTO POINT
M-23

PHOTO POINT
M-22

PHOTO POINT
M-21

PHOTO POINT
M-20

X4 CROSS SECTION

X8 CROSS SECTION

TEMPORARY STREAM
CROSSING #5

TEMPORARY STREAM
CROSSING #4

TEMPORARY STREAM
CROSSING #6

STOCKPILE
AREA

STAGING
AREA 2

EXISTING STREAM CHANNEL
TO BE BACKFILLED AFTER NEW
CHANNEL IS STABILIZED (TYP)

EPHEMERAL POOL-6

EPHEMERAL POOL-7

N/F
MILDRED HURLEY YONGUE and husband,
DOUGLAS Y. YONGUE
DB 416, PG. 284
PC D, SLIDE 51-B
PIN#7623-70-8893

BM
NORTHING 631398.53
EASTING 1728260.93

BM
NORTHING 631567.76
EASTING 1728287.37
ELEV. 619.20

BMP-1245
14" REBAR AND CAP
N: 631660.02
E: 1728406.18
ELEV. 611.65

N/F
PHILLIP R. HURLEY and wife,
BRENDA C. HURLEY
DB 416, PG. 275
PC D, SLIDE 51-A
PIN#7633-01-8313

20 0 20 40
SCALE (FT)

UT TO BARNES CREEK
RESTORATION

SITE PLAN
AS-BUILT PLANS

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PROJECT REFERENCE NO.	SHEET NO.
172	S4

NORTH CAROLINA PROFESSIONAL SEAL 029340 ENGINEER AARON S. CARLEY

PROJECT ENGINEER
ASE

APPROVED BY
SDW

DATE
01/08/2007

BUCK ENGINEERING
1447 S. Tryon Street, Suite 200
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Fax: 704-334-4492

N/F
MILDRED HURLEY YONGUE and husband,
DOUGLAS Y. YONGUE
DB 416, PG. 284
PC D, SLIDE 51-B
PIN#7623-70-8893

N/F
FRANK M. HARRIS and wife,
DEBORAH K. HARRIS
DB 186, PG. 883
DB 184, PG. 443
PIN#7623-82-3014

N/F
PHILLIP R. HURLEY and wife,
BRENDA C. HURLEY
DB 416, PG. 275
PC D, SLIDE 51-A
PIN#7633-01-8313

LOVE JOY ROAD SR 1310

BCP-1245
REBAR AND CAP
N 631660.02
E 1728406.16
ELEV. 614.65

BCP-2357
REBAR AND CAP
N 631907.46
E 1728658.06
ELEV. 612.34

MATCH LINE S3 STA 33+25

MATCH LINE S5 STA 38+00

PHOTO POINT M-24
PHOTO POINT M-23
PHOTO POINT M-22
PHOTO POINT M-21
PHOTO POINT M-20
PHOTO POINT M-19
PHOTO POINT M-18
PHOTO POINT M-17
PHOTO POINT M-16
PHOTO POINT M-15
PHOTO POINT E-3
PHOTO POINT M-14
PHOTO POINT M-13
PHOTO POINT M-12
PHOTO POINT M-11
PHOTO POINT M-10
PHOTO POINT M-9
PHOTO POINT E-2
PHOTO POINT M-8
PHOTO POINT E-1
PHOTO POINT M-7
PHOTO POINT M-6

AUTOMATIC GAUGE AW-2

EPHEMERAL POOL-8
EPHEMERAL POOL-9
EPHEMERAL POOL-10

VEGETATION PLOT-2

X5 CROSS SECTION
X6 CROSS SECTION

TEMPORARY STREAM CROSSING #6
TEMPORARY STREAM CROSSING #7
TEMPORARY STREAM CROSSING #8

IMPOUNDMENT EXCAVATION

EXISTING STREAM CHANNEL TO BE BACKFILLED AFTER NEW CHANNEL IS OPEN (TYP)

PROTECT EXISTING UTILITY POLE AND GUY WIRES TO REMAIN

STAGING AREA 3

STOCKPILE AREA

31+00
32+00
33+00
34+00
35+00
36+00
37+00
38+00
39+00
40+00

20 0 20 40
SCALE (FT)

UT TO BARNES CREEK RESTORATION

SITE PLAN AS-BUILT PLANS

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PROJECT REFERENCE NO.	SHEET NO.
172	S5

NORTH CAROLINA PROFESSIONAL SEAL 029340 ENGINEER AARON S. CARLEY

PROJECT ENGINEER
ASE

APPROVED BY
SDW

DATE
01/08/2007

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CHANNEL ALIGNMENT FROM DESIGN STATION 39+75 TO 41+60 WAS REVISED DURING CONSTRUCTION DUE TO BEDROCK.

N/F
FRANK M. HARRIS and wife,
DEBORAH K. HARRIS
DB 186, PG. 883
DB 184, PG. 443
PIN#7623-82-3014

LOVE JOY ROAD SR 1310

PROTECT EXISTING PHONE PED AND GUY WIRES TO REMAIN

MATCH LINE S3 STA 38+00

MATCH LINE S6 STA 83+50

HURLEY FARM ROAD SR 1309

STAGING AREA 3

STAGING AREA 4

CONSTRUCTION ENTRANCE 3

LIMIT OF PRIVET EXCAVATION

TEMPORARY STREAM CROSSING #9

TEMPORARY STREAM CROSSING #10

EXISTING STREAM CHANNEL TO BE BACKFILLED AFTER NEW CHANNEL IS STABILIZED (TYP.)

NOTE:
PROTECT EXISTING MONITORING WELLS BETWEEN EXISTING TRIBUTARY AND PROPOSED CHANNEL AS DIRECTED BY ENGINEER

PROTECT EXISTING MONITORING WELL TO REMAIN

TRANSPLANT AND STOCKPILE VEGETATION AS DIRECTED BY ENGINEER

VEGETATION PLOT-1

AUTOMATIC GAUGE AW-1

AUTOMATIC GAUGE AW-2

CREST GAUGE CG-1

CREST GAUGE CG-2

PHOTO POINT M-1
PHOTO POINT M-2
PHOTO POINT M-3
PHOTO POINT M-4
PHOTO POINT M-5
PHOTO POINT M-6
PHOTO POINT M-7
PHOTO POINT M-8
PHOTO POINT M-9
PHOTO POINT M-10
PHOTO POINT E-1
PHOTO POINT T-1
PHOTO POINT T-2
PHOTO POINT T-3
PHOTO POINT T-4
PHOTO POINT T-5
PHOTO POINT T-6
PHOTO POINT T-7
PHOTO POINT T-8

END PROJECT STA 43+05

CONFLUENCE OF HARRIS TRIBUTARY STA 42+78

END HARRIS TRIBUTARY STA 16+11

EXISTING 72" CMP CULVERT INV 604.26

EXISTING 72" CMP CULVERT INV 604.49

ROCK CHECK DAMS

SCALE (FT)
20 0 20 40

UT TO BARNES CREEK RESTORATION

SITE PLAN
AS-BUILT PLANS

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PROJECT REFERENCE NO.	SHEET NO.
172	S6

NORTH CAROLINA PROFESSIONAL SEAL 029340 ENGINEER AARON S. CARLEY

PROJECT ENGINEER
ASE

APPROVED BY
SDW

DATE
01/08/2007

BUCK ENGINEERING
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Charlotte, North Carolina 28203
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Fax: 704-334-4492

EPHEMERAL POOL-9
EPHEMERAL POOL-10
VEGETATION PLOT-2
VEGETATION PLOT-1
AUTOMATIC GAUGE AW-1
PHOTO POINT E-1
PHOTO POINT E-2
PHOTO POINT M-8
PHOTO POINT M-9
PHOTO POINT M-4
PHOTO POINT M-5
PHOTO POINT T-5
PHOTO POINT T-6
PHOTO POINT T-7
PHOTO POINT T-8
PHOTO POINT T-9
PHOTO POINT T-10
PHOTO POINT T-11
STATION 39+70 BEGIN FLOODPLAIN GRADING
EXISTING STREAM CHANNEL TO BE BACKFILLED AFTER NEW CHANNEL IS STABILIZED (TYP.)
NOTE: PROTECT EXISTING MONITORING WELLS BETWEEN EXISTING TRIBUTARY AND PROPERTY LINE AS DIRECTED BY ENGINEER
PROTECT EXISTING MONITORING WELL TO REMAIN
MATCH LINE - S5 STA 13+25
X8 CROSS SECTION
X7 CROSS SECTION
BCP-1657
REBAR AND CAP
N 632072.39
E 1729074.96
ELEV. 616.18
BEGIN HARRIS TRIBUTARY PROJECT STA 10+00
STA 80+21 BEGIN HARRIS TRIBUTARY
N/F
PHILLIP R. HURLEY and wife,
BRENDA C. HURLEY
DB 416, PG. 275
PC D, SLIDE 51-A
PIN#7633-01-8313

SCALE (FT): 20 0 20 40

UT TO BARNES CREEK RESTORATION

SITE PLAN
AS-BUILT PLANS

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