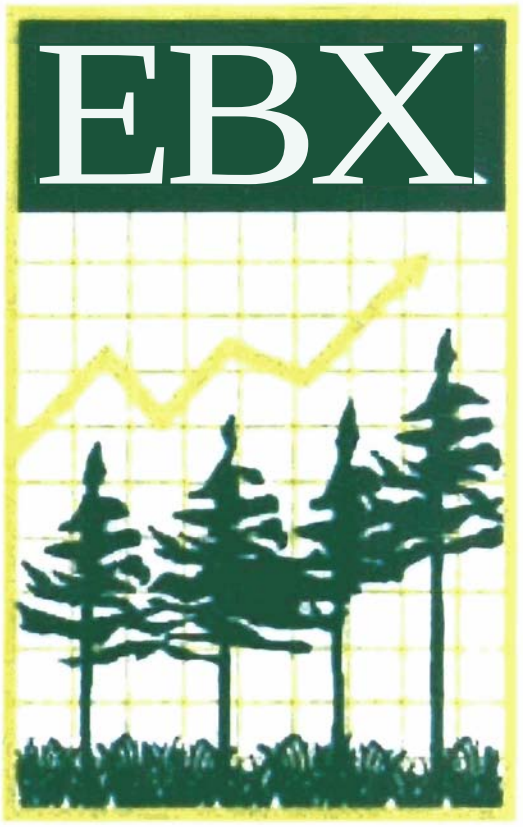
Neu-Con Umbrella Wetland and Stream Mitigation Bank

# Westbrook Lowgrounds Wetland and Stream Mitigation Site
# As-Built Report




Environmental Banc & Exchange, LLC

"We Invest in the Environment"

## EXECUTIVE SUMMARY

This report is submitted to document completion of construction on the Westbrook Lowgrounds wetland and stream mitigation site, and to provide a description of the completed construction activities. This report will also serve as a baseline for future monitoring reports to be submitted pursuant to the requirements set forth in the Neu-Con Mitigation Banking Instrument (MBI).

The approved site specific Mitigation Plan for the Westbrook Lowgrounds site specifies the restoration of a Coastal Plain small stream swamp and associated wet flats, as described by Schafale and Weakley (1990). Restoration involved the filling of drainage ditches and topographic manipulation to raise the local water table and restore site hydrology. Surface water flow was routed from an existing deep drainage ditch to a new meandering channel constructed across the abandoned floodplain. The abandoned ditch was then filled. Several natural grade control structures were used to control streambed grade, reduce stresses on streambanks, and promote bedform sequences and thus habitat diversity. The design allows for flows larger than the bankfull flow to spread onto the floodplain, dissipating flow energies and reducing the stress on streambanks. Streambanks were stabilized using a combination of erosion matting, live staking, and transplants. An existing bridge crossing was removed. Bare root stems of eleven tree species appropriate for small stream swamp and wet flats ecosystems were planted at a density between 550 and 660 stems per acre with and average density of 590 stems per acre, based on information collected from sampling plots.

All grading activities and restoration practices were completed in January 2003. Planting of bare root trees was completed in February 2003. Installation of post-restoration monitoring wells on the site was completed in March 2003. A total of 66.2 acres of wetland and 5,414 feet of stream channel were restored. Initial site observations and well data indicate that the site is performing well as a stream and wetland system.

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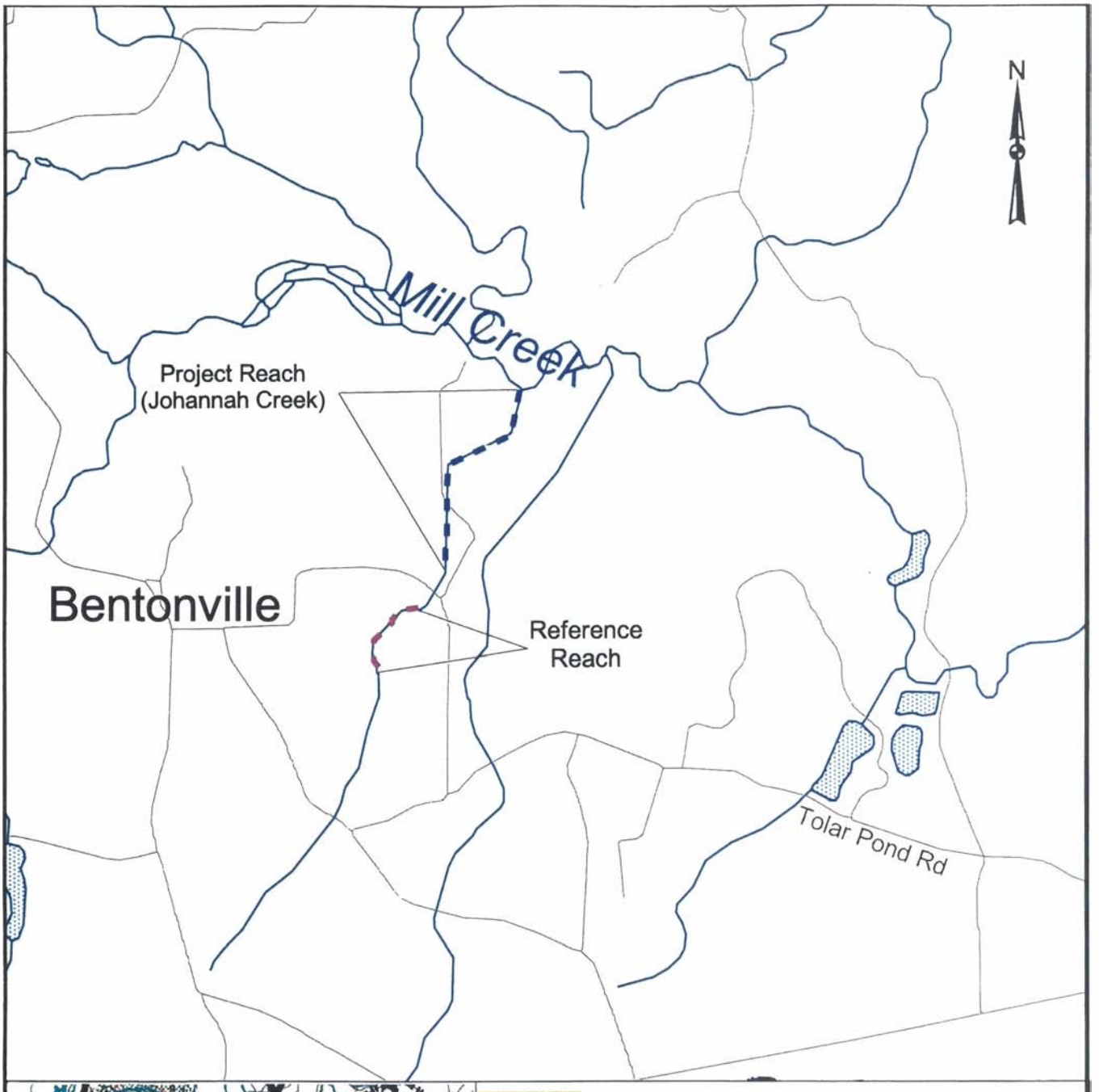
## INTRODUCTION

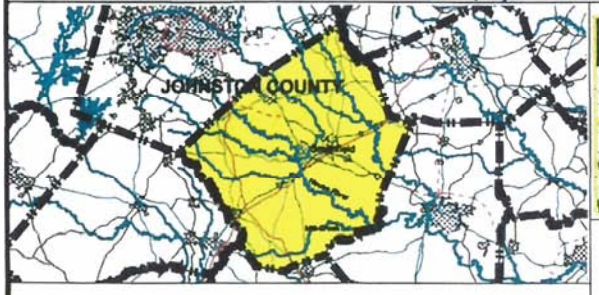
The Westbrook Lowlands wetland and stream mitigation site is located in Johnston County, approximately one mile east of the town of Bentonville, North Carolina (Figure 1). The site has a past history of agricultural use, consisting primarily of row crop agriculture. Approximately 1,600 feet of ditches existed on the site prior to restoration and were used to promote drainage when the land was under agricultural production. The mitigation site is part of a larger 135 acre tract owned by Environmental Banc and Exchange, LLC.

The design for the Westbrook Lowlands property involved the restoration of a Coastal Plain small stream swamp and associated wet flats as described by Schafale and Weakley (1990). The coastal plain small stream swamp communities exist as the floodplains of small blackwater streams in which separate fluvial features and associated vegetation are too small or poorly developed to distinguish.

**Table 1. Project History**

| | |
|---|---|
| June 2001 | Monitoring Wells Installed |
| Fall 2002 | Approved Mitigation Plan |
| November 2002 | Construction Began |
| January 2003 | Construction Completed |
| February 2003 | Planting Completed |
| March 2003 | Post-Construction Monitoring Wells Installed |
| November 2003 (scheduled) | 1st Monitoring Report |




EBX

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**10055 Red Run Boulevard, Suite 130**
**Owings Mills, MD 21117**

Figure 1.
Location of Westbrook Lowgrounds
Wetland and Stream Mitigation Site

2000 0 2000 4000 Feet

## AS-BUILT REPORT

### Construction

Construction activities, in accordance with the approved Mitigation Plan for the site, commenced in November 2002 and began with construction of access sites and stockpile areas. Materials were stockpiled as needed for the initial stages of construction. A single, temporary culverted ditch crossing (culvert size of 42 inches in diameter) was constructed along the main stem of Johannah Creek at an approximate existing channel station of 17+00. This crossing was installed to allow equipment to cross the existing channel during construction activities. Ditches were left open during these initial stages of construction to allow for drainage and to keep the site accessible.

The next step was the grading of the floodplain areas to reach design grades across the site. Grading activities were not allowed within 10 feet of the active stream channel to prevent deposition of sediment into the channel. The material excavated was stockpiled in specified areas, and was used to construct the access roads as shown on the plans. In any areas where the excavation depth was greater than one foot, topsoil was stockpiled and placed back over the excavated area to a depth of four to six inches to achieve design grades and to create a soil base for vegetation. When necessary, silt fencing was installed between stockpiles and the active channel to prevent erosion of sediment into the channel.

Once the design floodplain grades were achieved, the new stream channel was excavated in a downstream to upstream progression. In areas where water was diverted from the old channel to the new channel, a 10 foot wide "plug" of undisturbed soil was left in place until water was ready to be turned into the new channel. The downstream ends of the new channel sections were left open to allow for drainage during rain events. Temporary sediment traps were installed on the downstream end of all new sections of channel to trap any sediment that was transported down the channel during rainfall events.

Upon completion of new channel segments, in-stream structures, matting, and transplants were installed, and the channel was prepared to accept water from the old channel. Once fully prepared, temporary sediment traps at the downstream ends of the channels were removed, and water was turned into the newly constructed channel. Abandoned channel sections were immediately filled and graded. Disking of the site in the areas adjacent to each completed channel segment was completed after water had been turned into the channel segment and all construction activities on that section of channel were completed. Upon completion of earthmoving activities in an area, temporary seeding, permanent seeding, and mulch were applied according to the plans and specifications.

### Vegetation

Earthmoving activities were completed in January 2003. Live staking of the streambank areas and the spreading of the permanent seed mixture was completed on the same date. Planting of bare root trees was completed in February 2003. Species planted and

quantities are provided in Table 2 below. Based on information collected from sampling plots (data provided in Monitoring section), the average density of planted stems across the site was approximately 590 stems per acre.

The approved Mitigation Plan for the Westbrook Lowgrounds site called for the planting of seven (7) bare-root tree species. Due to limited quantities and availability of species at the time of planting, four (4) additional species were added to the species identified in the Mitigation Plan and were planted to reach the targeted planting density. These additional species were selected based on those presented by Shafale and Weakley (1990) as existing in similar types of wetland systems. The only species identified in the Mitigation Plan that was not planted on the site was overcup oak (*Quercus lyrata*), since no suppliers of this species could be identified. In its place, three additional oak species were planted; cherrybark oak (*Quercus pagoda*), shumard oak (*Quercus shumardii*), and swamp white oak (*Quercus bicolor*).

**Table 2. Tree species planted over the Westbrook Lowlands restoration site.**

| Species Planted |
|---|
| Cherrybark Oak (*Quercus pagoda*) |
| Shumard Oak (*Quercus shumardii*) |
| Swamp White Oak (*Quercus bicolor*) |
| Coastal Willow Oak (*Quercus phellos*) |
| Swamp Chestnut Oak (*Quercus michauxii*) |
| Laurel Oak (*Quercus laurifolia*) |
| Blackgum (*Nyssa sylvatica*) |
| Bald Cypress (*Taxodium distichum*) |
| Swamp Tupelo (*Nyssa biflora*) |
| Sugarberry (*Leltis laevigata*) |
| Water Oak (*Quercus nigra*) |

**General Observations**

Construction of the site proceeded with very few problems or changes to the proposed plans. The alignment of the channel at the outlet end of the project was reconfigured during construction so that two large existing oak trees could be saved and the new channel could be better aligned to tie back into the existing channel at Mill Creek. This was the only significant design change made during construction. Several rainfall events occurred during construction. However, the rainfall amounts and intensities were not

large enough to cause problems with construction or significant erosion. The final as-built stream length for the project, as indicated on Sheet 1, is 5,414 feet.

Construction of the stream channel proceeded as planned throughout the project. The rock-cross vane structures at the downstream end of the project were constructed first and proved to be the most time consuming structures constructed during the project. However, the structures proved to be absolutely essential in stabilizing the streambed and allowing for a steeper gradient at the downstream end to connect the channel back to the elevation of Mill Creek. During a large flow event approximately one month after construction, water flowed around cross-vane #3 and caused a gully to form behind the left arm of the structure where overbank flows re-entered the channel. The structure has shifted slightly but is still holding the bed of the stream as designed. Repair of the structure is scheduled for mid-April 2003 and will involve the re-alignment of boulder rocks, filling a low area in the floodplain so that future out-of-bank flows will flow back into the channel at a more stable location, and more transplants and matting along the streambank downstream of the structure.

The use of on-site logs, root-wads, and transplants during construction to stabilize the stream channel worked well. Use of on-site materials allowed for the collection of only the materials that were needed and avoided delays that occur when waiting for materials to be delivered. Early observations since construction was completed indicate that the transplanted vegetation is working very well at stabilizing the outside of meander bends and other sensitive areas. The transplants, mostly native cane with some small trees, are easily installed and provide immediate bank stabilization and habitat values. It is anticipated that the cane will spread over the coming years, providing further stabilization benefits.

Based on early observations, the hydrology of the site has been altered to a much wetter regime than present prior to construction. Ponding on the site in isolated pockets has been observed for extended periods after rainfall events. At least one overbank flooding event has also occurred since construction was completed. The wetland pockets restored on the northern end of the tract also appear to be performing well.

Early observations also indicate that the vegetation treatments were effective at establishing ground cover quickly. Temporary seeding (rye grain) applied to streambanks beneath the erosion matting came up within two weeks of application and has provided good ground coverage. Live stakes and planted bare-root trees are also beginning to bud as the growing season begins.

The Mitigation Plan predicted that approximately 65 acres of restoration were available on the site. This number was based on evaluation of soils and topographic information. Upon the completion of the project, the restored areas were surveyed for recordation of the conservation easement which will protect the site in perpetuity. The final surveyed plat for the conservation easement indicates a total of 66.2 acres of wetland were restored to the Westbrook Lowgrounds site (see Sheets 2 through 8). An additional 70 acres of

wetland preservation was recorded on the site and protected within the permanent conservation easement placed on the site.

## MONITORING

The five-year monitoring plan for the Westbrook Lowlands restoration site includes criteria to evaluate the success of both the wetland and the stream components of the project. The specific locations of vegetation plots, monitoring wells, photo points, permanent cross-sections, and rainfall and crest gauges are shown on the as-built drawings in Sheets 2 through 8.

Consistent with the Westbrook Lowlands site-specific Mitigation Plan, thirteen vegetation plots, 0.1 acre in size, three automated monitoring wells (Wells #A1, #A2, and #A3), and two manual monitoring wells (Wells #M1 and #M2) were established in areas that would represent a range of hydrologic conditions and community types across the restoration site. The initial planted density within each of the thirteen vegetation monitoring plots is given in Table 3. The locations of the vegetation plots and the monitoring wells are shown on the as-built plan sheets.

**Table 3. Initial Planted Density of Trees for the Thirteen Vegetation Sampling Plots.**

| Sampling Plot No. | Counted Stems per Plot | Stems per Acre (extrapolated) |
|---|---|---|
| 1 | 57 | 570 |
| 2 | 59 | 590 |
| 3 | 63 | 630 |
| 4 | 65 | 650 |
| 5 | 66 | 660 |
| 6 | 55 | 550 |
| 7 | 61 | 610 |
| 8 | 57 | 570 |
| 9 | 56 | 560 |
| 10 | 55 | 550 |
| 11 | 56 | 560 |
| 12 | 61 | 610 |
| 13 | 56 | 560 |

For monitoring stream success criteria, eleven permanent cross-sections and a crest gauge were installed. The permanent cross-sections will be used to monitor channel dimension and bank erosion over time. The crest gauge will be used to document bankfull events. In addition, a complete longitudinal survey was completed for the restored stream channel after construction to provide a base-line for evaluating changes in bed conditions over time. The longitudinal profile included the elevations of all grade control structures. Permanent cross-sections were also surveyed after construction to provide base-line data

for monitoring. The longitudinal and permanent cross-section data are provided in Appendix 2. The locations of the permanent cross-sections and the crest gage are shown on the as-built plan sheets.

Monitoring success criteria applied to the Westbrook Lowlands site are provided in the site specific Mitigation Plan. Monitoring data will be provided in the monitoring report for Year 1.

## REFERENCE

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, NCDEHNR, Raleigh, North Carolina.

PROJECT: 043 WESTBROOK LOWGROUNDS

# STREAM AND WETLAND RESTORATION PROJECT
# ENVIRONMENTAL BANC AND EXCHANGE, LLC
# WESTBROOK LOWGROUNDS SITE

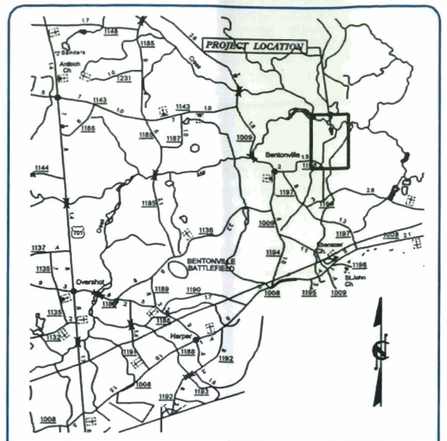
## JOHNSTON COUNTY

***LOCATION: WESTBROOK LOWGROUNDS ROAD (SR 1198) NEAR BENTONVILLE, NC***

***TYPE OF WORK: AS-BUILT DRAWING FOR WETLAND AND STREAM MITIGATION***

| STATE | BUCK PROJECT REFERENCE NO. | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|
| N.C. | 043 | 1 | 8 |

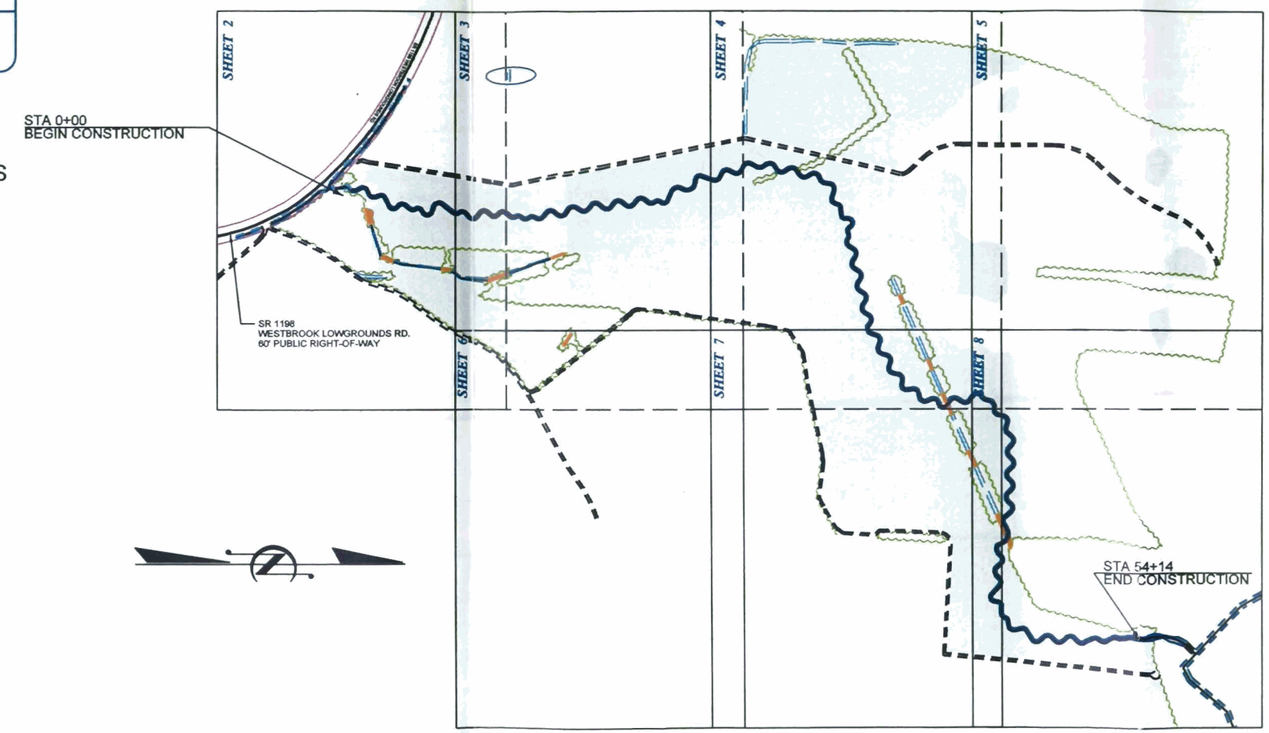
| NO. | DATE | CHECKED BY | APPROVED BY |
|---|---|---|---|
| 1 | 28 JAN 2005 | KEVIN TWEEDY | KEVIN TWEEDY |




VICINITY MAP

INDEX OF SHEETS:






***GRAPHIC SCALES***

50 25 0 50 100
PLANS

***PROJECT SUMMARY***

RESTORED STREAM LENGTH = 5414 FEET
RESTORED WETLAND ACREAGE = 66.2 ACRES

***PREPARED FOR THE OFFFICE OF:***
***ENVIRONMENTAL BANC AND EXCHANGE, LLC***

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8000 REGENCY PARKWAY SUITE 200A
CARY, NORTH CAROLINA 27511

***EBX CONTACT:***
GEORGE KELLY
*PROJECT MANAGER*

***PREPARED IN THE OFFICE OF:***

BUCK ENGINEERING

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Phone: 919-463-5488
Fax: 919-463-5490

APRIL 11, 2003
*DATE PREPARED:*

KEVIN L. TWEEDY, PE
*PROJECT ENGINEER*

***PROJECT ENGINEER***

NORTH CAROLINA PROFESSIONAL SEAL 027337 ENGINEER KEVIN L. TWEEDY

*SIGNATURE:* P.E.

MATCHLINE SHEET 3

SR 1198 WESTBROOK LOWGROUNDS RD.

ROAD DITCH

CULVERT #4 18" RCP
PERMANENT SITE ACCESS
LENGTH = 40 FT

X-SECTION 2
STA 2+07

X-SECTION 1
STA 1+59

VEGETATION PLOT #7

DITCH PLUG

DITCH PLUG

DIVERSION DITCH TO ROUTE ROAD RUNOFF INTO WETLAND SITE

DITCH PLUG

STATION 0+00
BEGIN CONSTRUCTION
N=4746.7993
E=5392.6200

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| 043 | 2 |

EBX WESTBROOK LOWGROUNDS

PLAN VIEW OF
EXISTING ASBUILT CONDITIONS

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 027337 ENGINEER KEVIN L. TWEEDY

SIGNATURE

5-8-03
DATE

BUCK
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Fax: 919-463-5490

LEGEND

- ACCESS ROAD
- OLD STREAM TOP OF BANK
- TREELINE
- RIGHT-OF-WAY
- RECONSTRUCTED CHANNEL
- CENTERLINE OF ROADWAY/STREAM
- CONTOUR LINE
- PROPERTY LINE
- CONSERVATION EASEMENT
- TRANSPLANTS
- LOG VANE (LOCATED IN BENDS)
- LOG WEIR (LOCATED IN STRAIGHT REACHES)
- ROOT WAD
- PROPOSED RESTORED WETLAND
- XSEC PIN
- (W) WELL
- (R) RAIN GAUGE
- (C) CREST GAUGE
- (P) PHOTO POINT

50 25 0 50 100
SCALE (FT)

MATCHLINE SHEET 4

MATCHLINE SHEET 6

MATCHLINE SHEET 2

X-SECTION 4
STA 15+22

X-SECTION 3
STA 14+78

VEGETATION PLOT #9

ACCESS ROAD

VEGETATION PLOT #8

DITCH PLUG

AUTOMATED WELL #1
AND PHOTO POINT

VEGETATION PLOT #1

ACCESS ROAD

DITCH PLUG

EXISTING POND

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| 043 | 3 |

EBX WESTBROOK LOWGROUNDS

PLAN VIEW OF
EXISTING ASBUILT CONDITIONS

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 027337 ENGINEER KEVIN L. TWEEDY

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LEGEND

- ACCESS ROAD
- OLD STREAM TOP OF BANK
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- XSEC PIN
- (W) WELL
- (R) RAIN GAUGE
- (C) CREST GAUGE
- (P) PHOTO POINT

N

50 25 0 50 100
SCALE (FT)

MATCHLINE SHEET 5

MATCHLINE SHEET 7

MATCHLINE SHEET 3

ACCESS ROAD

CHANNEL BLOCK

MANUAL WELL #1
AND PHOTO POINT

AUTOMATED WELL #2
AND PHOTO POINT

ACCESS ROAD

ACCESS ROAD

VEGETATION PLOT #5

VEGETATION PLOT #3

VEGETATION PLOT #2

VEGETATION PLOT #10

X-SECTION 5
STA 28+15

X-SECTION 8
STA 28+44

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| 043 | 4 |

EBX WESTBROOK LOWGROUNDS

PLAN VIEW OF
EXISTING ASBUILT CONDITIONS

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 027337 ENGINEER KEVIN L. TWEEDY

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LEGEND

- ACCESS ROAD
- OLD STREAM TOP OF BANK
- TREELINE
- RIGHT-OF-WAY
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- XSEC PIN
- (W) WELL
- (R) RAIN GAUGE
- (C) CREST GAUGE
- (P) PHOTO POINT

SCALE (FT)
50 25 0 50 100

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| 043 | 5 |

EBX WESTBROOK LOWGROUNDS

PLAN VIEW OF
EXISTING ASBUILT CONDITIONS

PROJECT ENGINEER

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5-8-03
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Phone: 919-463-5488
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ACCESS ROAD CONTINUES TO MILL CREEK

ACCESS ROAD

ACCESS ROAD

MANUAL WELL #2 AND PHOTO POINT

VEGETATION PLOT #4

MATCHLINE SHEET 8

MATCHLINE SHEET 4

LEGEND

- ACCESS ROAD
- OLD STREAM TOP OF BANK
- TREELINE
- RIGHT-OF-WAY
- RECONSTRUCTED CHANNEL
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- CONTOUR LINE
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- ROOT WAD
- PROPOSED RESTORED WETLAND
- XSEC PIN
- W WELL
- R RAIN GAUGE
- C CREST GAUGE
- P PHOTO POINT

50 25 0 50 100
SCALE (FT)

MATCHLINE SHEET 7

MATCHLINE SHEET 3

EARTHEN BERM CONSTRUCTED ACROSS ABANDONED ROAD

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| 043 | 6 |

EBX WESTBROOK LOWGROUNDS

PLAN VIEW OF EXISTING ASBUILT CONDITIONS

PROJECT ENGINEER

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5-8-03
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LEGEND

- ACCESS ROAD
- OLD STREAM TOP OF BANK
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- W WELL
- R RAIN GAUGE
- C CREST GAUGE
- P PHOTO POINT

N

50 25 0 50 100
SCALE (FT)

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| 043 | 7 |

EBX WESTBROOK LOWGROUNDS

PLAN VIEW OF
EXISTING ASBUILT CONDITIONS

PROJECT ENGINEER

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MATCHLINE SHEET 8

MATCHLINE SHEET 4

MATCHLINE SHEET 6

CHANNEL BLOCK

CHANNEL BLOCK

VEGETATION PLOT #12

AUTOMATED WELL #3 AND PHOTO POINT

ACCESS ROAD

VEGETATION PLOT #11

ACCESS ROAD

LEGEND

- ACCESS ROAD
- OLD STREAM TOP OF BANK
- TREELINE
- RIGHT-OF-WAY
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- PROPOSED RESTORED WETLAND
- XSEC PIN
- W WELL
- R RAIN GAUGE
- C CREST GAUGE
- P PHOTO POINT

50 25 0 50 100
SCALE (FT)

INSET "A"

MILL CREEK
(APPROX. LOCATION)

MATCHLINE SHEET 5

MATCHLINE SHEET 7

SEE INSET "A"

STATION 54+14
END CONSTRUCTION
N=7744.4772
E=7046.1261

X-SECTION 11
STA 53+08

VEGETATION
PLOT #6

VEGETATION
PLOT #12

VEGETATION
PLOT #13

CHANNEL BLOCK

CHANNEL BLOCK

X-SECTION 8
STA 37+31

X-SECTION 7
STA 37+11

X-SECTION 10
STA 45+22

X-SECTION 9
STA 44+94

ACCESS ROAD

## LEGEND

- ACCESS ROAD
- OLD STREAM TOP OF BANK
- TREELINE
- RIGHT-OF-WAY
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- XSEC PIN
- (W) WELL
- (R) RAIN GAUGE
- (C) CREST GAUGE
- (P) PHOTO POINT

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| 043 | 8 |

EBX WESTBROOK LOWGROUNDS

PLAN VIEW OF
EXISTING ASBUILT CONDITIONS

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 027337 ENGINEER KEVIN L. TWEEDY

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5-8-03
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50 25 0 50 100
SCALE (FT)

# APPENDIX A. - PHOTOGRAPHS OF THE PROJECT SITE

## CONSTRUCTION PHOTOGRAPHS

Photo C1. Minor grading of the site was performed to remove field crowns and provide fill material for ditches on the site (Nov. 22,2002).

Photo C2. A section of channel excavated and ready for the installation of structures, transplants, and matting. The orange stakes mark the design top of banks (Dec. 2,2002).

Photo C3. Installation of rootwads on the outside of a meander bend. The rootwads provide stability and habitat features (Dec. 2, 2002).

Photo C4. Native cane transplants ready to be installed along the new streambanks (Dec. 2, 2002).

Photo C5. Construction of one of the cross-vane structures installed at the outlet end of the project. Cross-vanes control the bed elevation of the new stream and protect the stream from downcutting (Dec. 4, 2002).

Photo C6. Installation of coir fiber matting along completed sections of new streambank (Dec.16, 2002).

Photo C7. Water begins to flow in the first new segment of restored stream channel. The trackhoe in the background has just installed a plug in the old channel, diverting the water into the new channel (Dec. 16, 2002).

Photo C8. The last segment of new channel is completed at the upstream end of the project and ready to receive water (Jan. 16, 2003).

**Photo C9. Live stakes being installed on the newly constructed streambanks (Jan. 28,2003).**

**Photo C10. Bare-root trees being planted on the restored wetland areas of the site (Feb. 28,2003).**

## COMPLETED PROJECT PHOTOGRAPHS

Photo P1. The downstream end of the project where the new channel connects with the existing channel and Mill Creek. Two cross-vane structures are visible in this picture (Jan. 28,2003).

Photo P2. A restored sectionof channel near station 46+00 looking upstream (Jan. 28,2003).

Photo P3. Completed stream channel near station 41+00 looking downstream. Existing trees along the old stream channel were left standing to the extent possible to allow for shading, habitat, and seed source (Jan. 28,2003).

Photo P4. A completed log weir structure. The log weir is used to set the grade of the streambed upstream of the structure and keep the channel from downcutting. Log weirs also provide habitat features (Feb. 28,2003).

Photo P5. A completed segment of stream channel near station 6+00 looking downstream (March 11,2003).

Photo P6. Stream channel at approximate station 17+00 looking downstream after bankfull event the night before (March 21,2003).

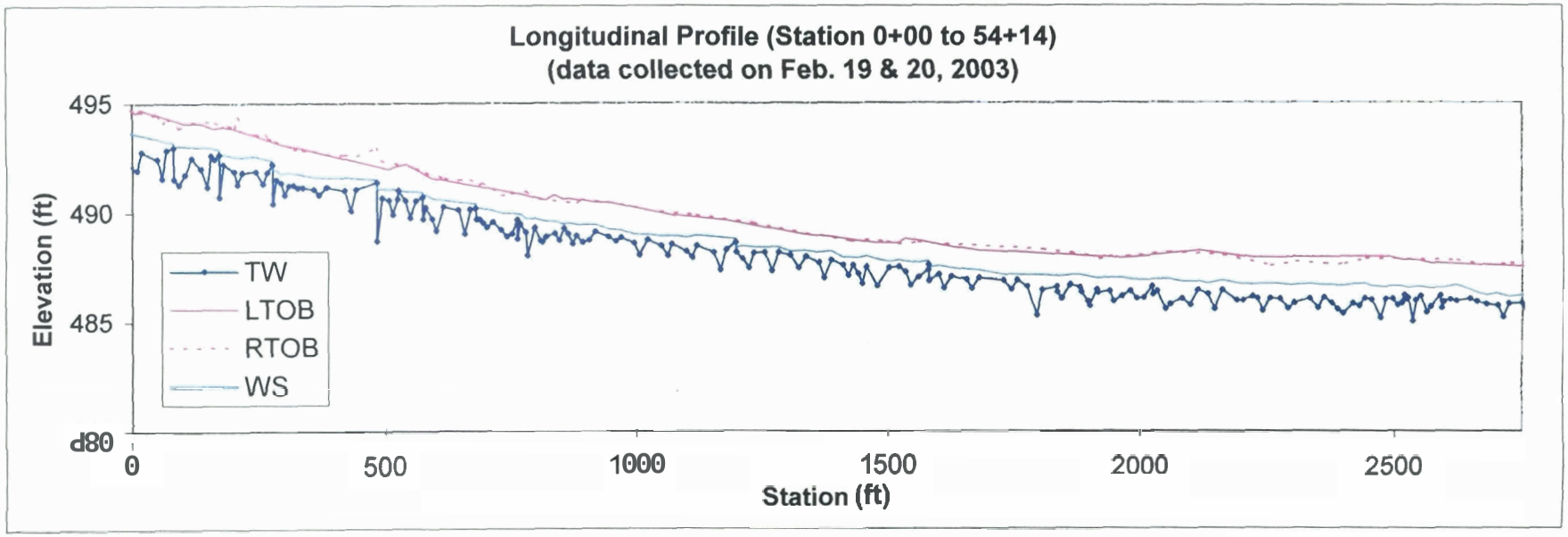
Photo P7. Stream channel at approximate station 46+00 looking downstream after bankfull event the night before (March 21,2003).

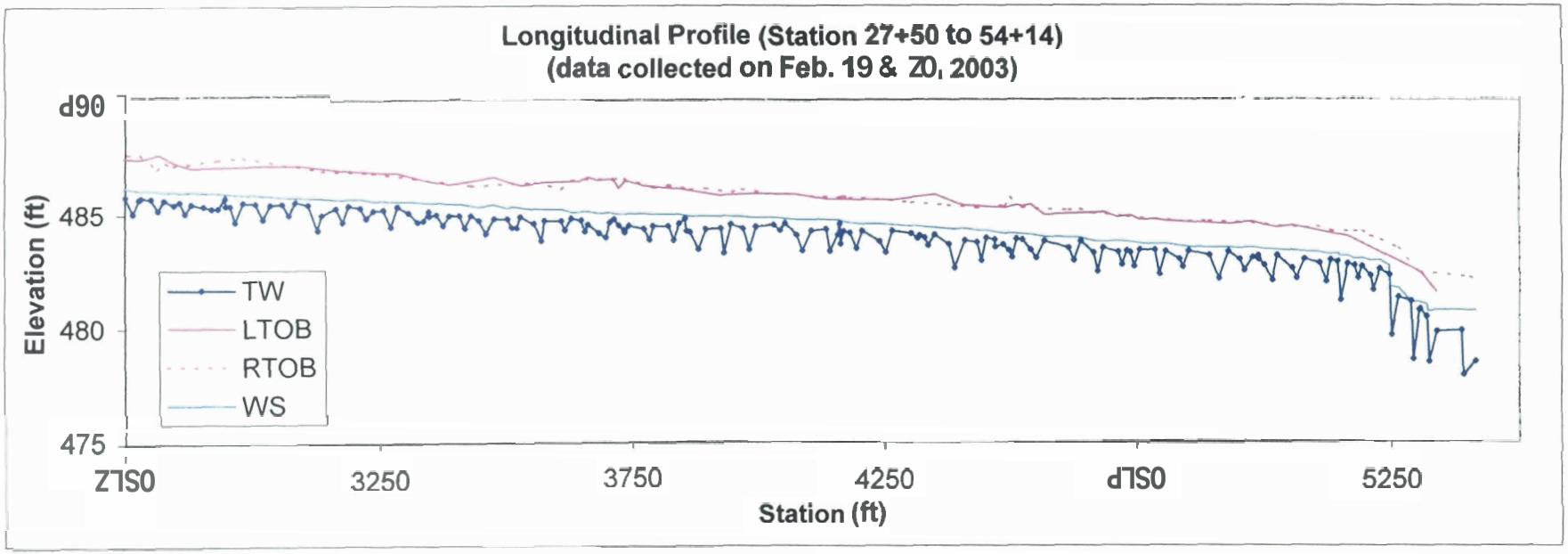
Photo P8. Stream channel at approximate station 14+00 looking upstream after bankfull event the night before. Note the development of the point bar depositional feature on the inside of the meander bend (March 21, 2003).

Photo ??. A meander bend of the restored channel after a bankfull event the night before. The outside of the meander bend shows no erosion due to the transplants that were placed there. The log vane structure is keeping the strongest velocities and energy near the center of the channel and away from the banks. Note the debris on the live stake in the foreground, indicating stream stage, and the deposition of sediment on the point bar (March 21,2003).

Photo P10. Surface ponding across the site after a bankfull event the night before (March 21,2003).

# APPENDIX B. – AS-BUILT LONGITUDINAL PROFILE AND PERMANENT CROSS SECTION DATA


Longitudinal Profile (Station 0+00 to 54+14)
(data collected on Feb. 19 & 20, 2003)
Elevation (ft)
495
490
485
480
0
500
1000
1500
2000
2500
Station (ft)
TW
LTOB
RTOB
WS


Longitudinal Profile (Station 27+50 to 54+14)
(data collected on Feb. 19 & 20, 2003)
Elevation (ft)
490
485
480
475
3250
3750
4250
5250
Station (ft)
TW
LTOB
RTOB
WS

**Location and elevation information for grade control structures (log weirs and rock cross vanes) on the restored Westbrook Lowgrounds site.**

| Survey Point Number | Northing (ft) | Easting (ft) | Elevation (ft)* | Note | Longitudinal Station (ft) |
|---|---|---|---|---|---|
| 32 | 4810.54 | 5405.48 | 493.00 | LOG-WEIR 1 | 80.70 |
| 90 | 4877.64 | 5436.84 | 492.67 | LOG-WEIR 2 | 171.33 |
| 152 | 4954.46 | 5458.55 | 492.23 | LOG-WEIR 3 | 276.34 |
| 188 | 5107.85 | 5464.92 | 491.39 | LOG-WEIR 4 | 482.52 |
| 209 | 5181.29 | 5486.89 | 490.70 | LOG-WEIR 5 | 572.93 |
| 230 | 5263.43 | 5477.77 | 490.20 | LOG-WEIR 6 | 678.70 |
| 250 | 5331.45 | 5479.36 | 489.67 | LOG-WEIR 7 | 760.73 |
| 324 | 5686.10 | 5451.17 | 488.63 | LOG-WEIR 8 | 1195.95 |
| 418 | 5985.45 | 5383.94 | 487.34 | LOG-WEIR 9 | 1578.92 |
| 1112 | 6331.60 | 5306.11 | 486.59 | LOG-WEIR 10 | 2023.36 |
| 1110 | 6602.10 | 5547.75 | 486.19 | LOG-WEIR 11 | 2519.88 |
| 1108 | 6619.50 | 5605.56 | 486.16 | LOG-WEIR 12 | 2590.46 |
| 1106 | 6682.60 | 5886.38 | 485.75 | LOG-WEIR 13 | 2946.09 |
| 1104 | 6868.32 | 6150.66 | 485.14 | LOG-WEIR 14 | 3347.25 |
| 867 | 7205.60 | 6299.28 | 484.78 | LOG-WEIR 15 | 3855.68 |
| 911 | 7198.12 | 6545.71 | 484.55 | LOG-WEIR 16 | 4162.49 |
| 954 | 7165.39 | 6786.91 | 483.85 | LOG-WEIR 17 | 4468.98 |
| 1026 | 7369.29 | 7060.26 | 483.13 | LOG-WEIR 18 | 4989.41 |
| | | | | | |
| 1052 | 7492.83 | 7066.09 | 482.88 | Cross Vane 1 | 5145.01 |
| 1074 | 7582.43 | 7057.22 | 482.27 | Cross Vane 2 | 5245.97 |
| 1082 | 7622.82 | 7053.37 | 481.14 | Cross Vane 3 | 5288.09 |
| 1088 | 7651.99 | 7048.23 | 480.46 | Cross Vane 4 | 5319.00 |
| 1095 | 7718.92 | 7054.52 | 479.86 | Cross Vane 5 | 5386.80 |

* Elevations are relative to an onsite benchmark of 500 ft.

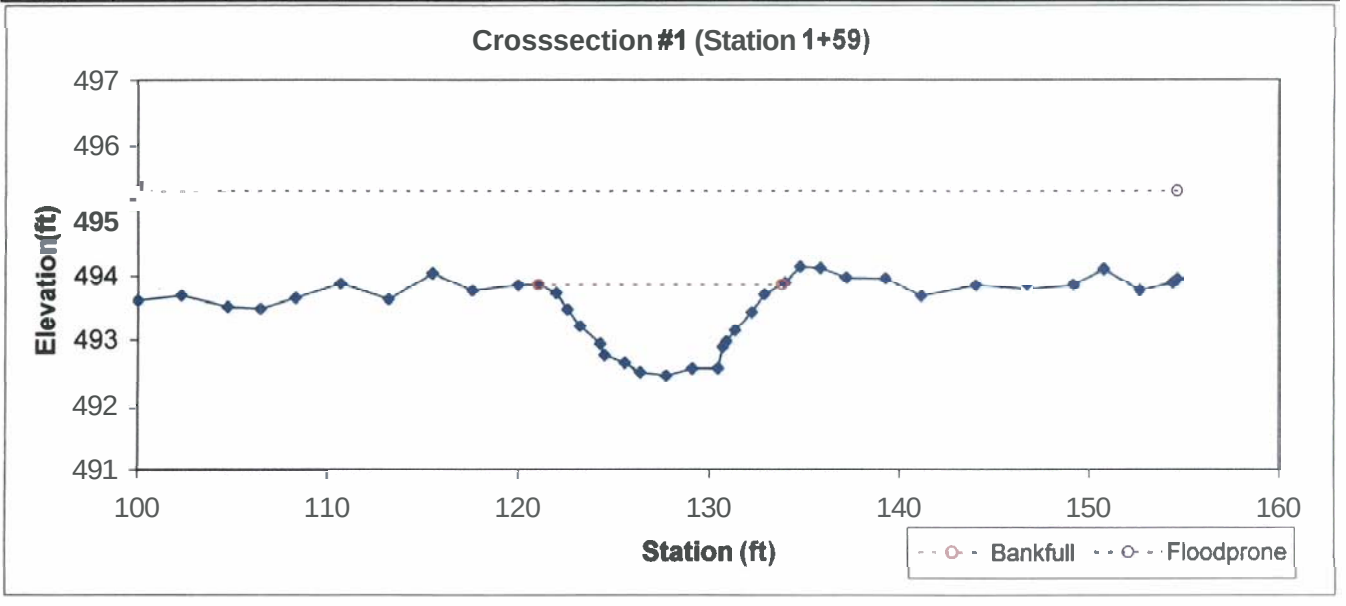
## Permanent Cross-section #1 (Station 1+59)

(Year 1 Data - collected Feb. 20,2003)

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 | C5 | 11 | 12.76 | 0.87 | 1.42 | 14.74 | 1 | 4.3 | 493.87 | 493.87 |



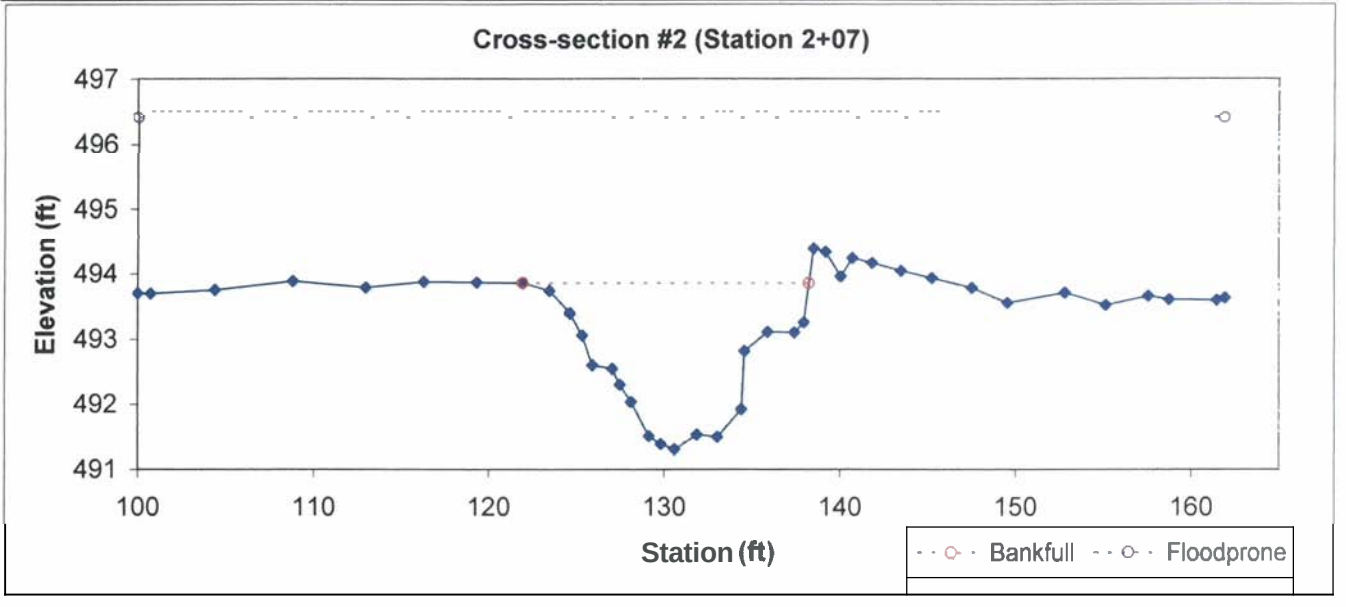
## Permanent Cross-section #2 (Station 2+07)

(Year 1 Data - **collected Feb. 20, 2003)**

**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 | ---- | 22.2 | 16.3 | 1.36 | 2.55 | 11.98 | 1 | 3.8 | 493.86 | 493.86 |



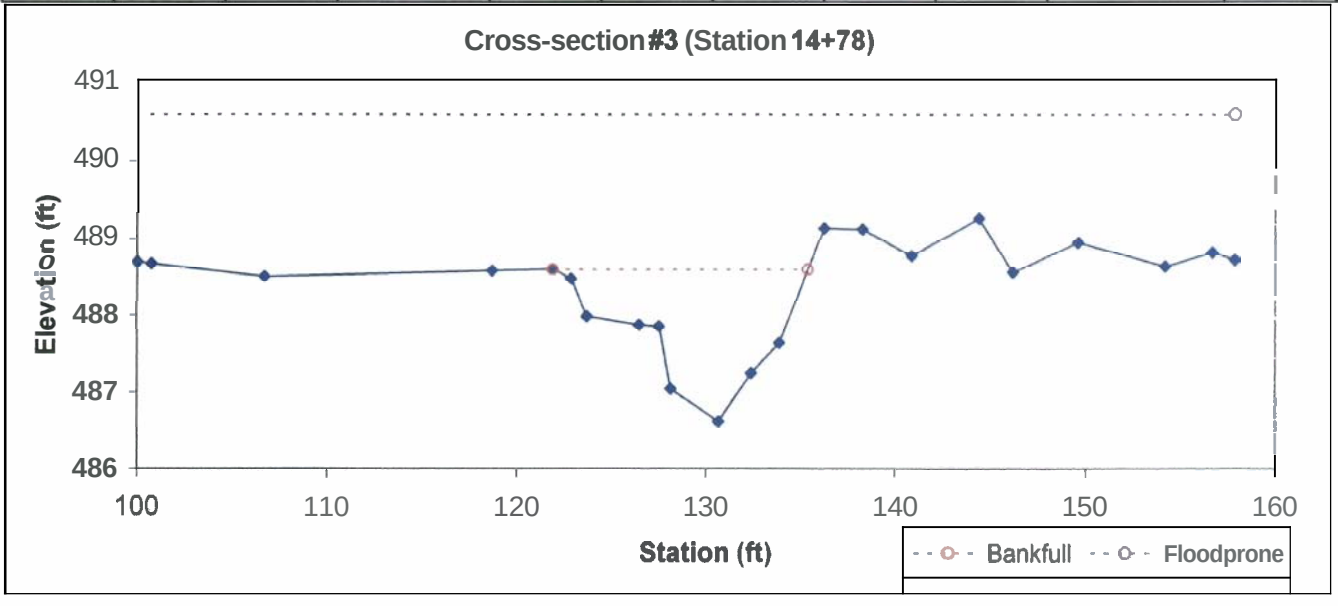
## Permanent Cross-section #3 (Station 14+78)

(Year 1 Data -collected Feb. 20, 2003)

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 | ---- | 13.4 | 13.48 | 0.99 | 1.97 | 13.58 | 1 | 4.3 | 488.58 | 488.58 |



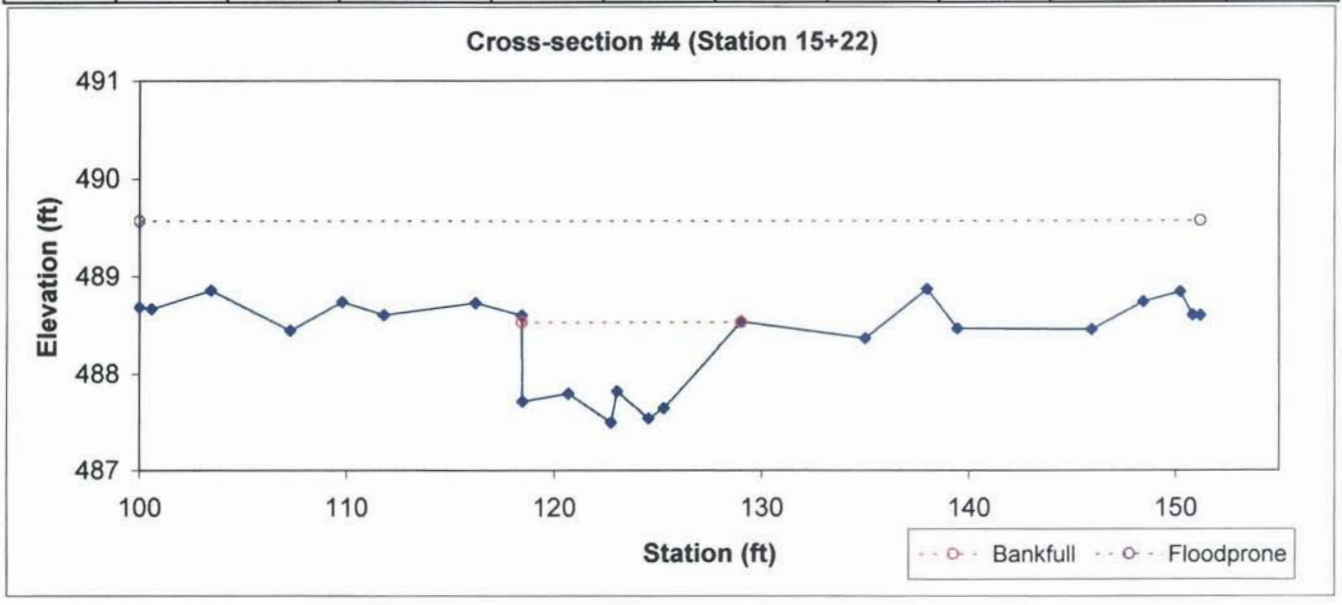
## Permanent Cross-section #4 (Station 15+22)

(Year 1 Data - collected Feb. 20, 2003)

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 | C5 | 7.4 | 10.56 | 0.7 | 1.04 | 15 | 1 | 4.9 | 488.53 | 488.53 |



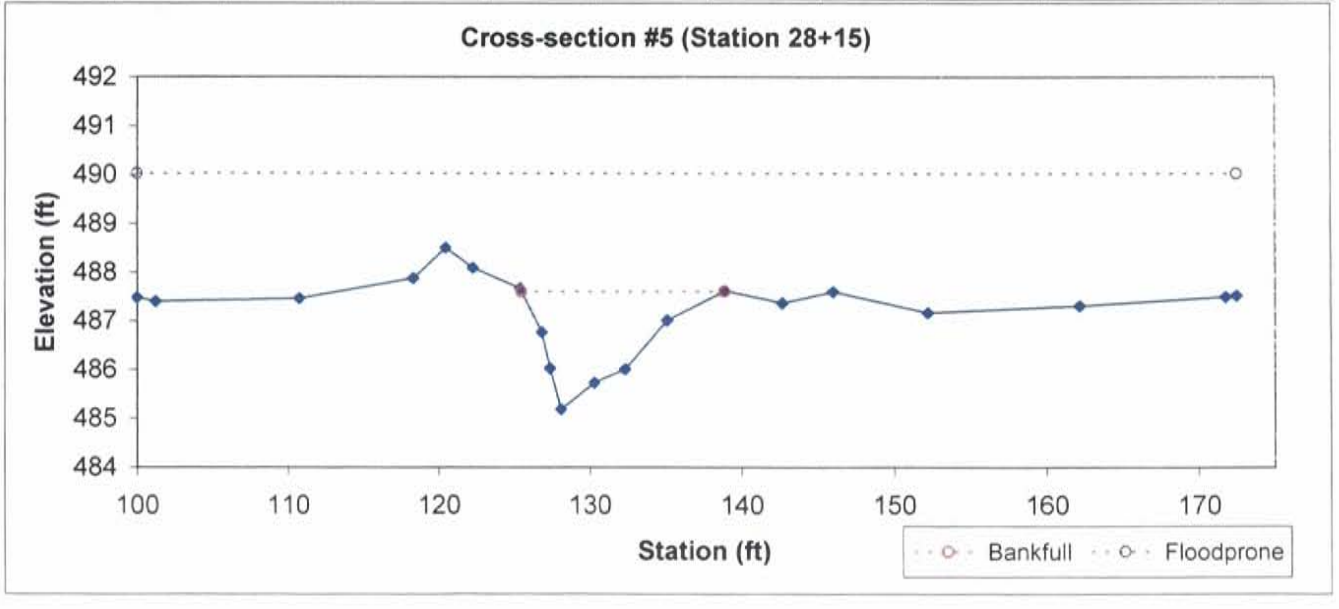
## Permanent Cross-section #5 (Station 28+15)

(Year 1 Data - collected Feb. 20, 2003)

**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 | ---- | 15 | 13.37 | 1.13 | 2.42 | 11.88 | 1 | 5.4 | 487.61 | 487.61 |



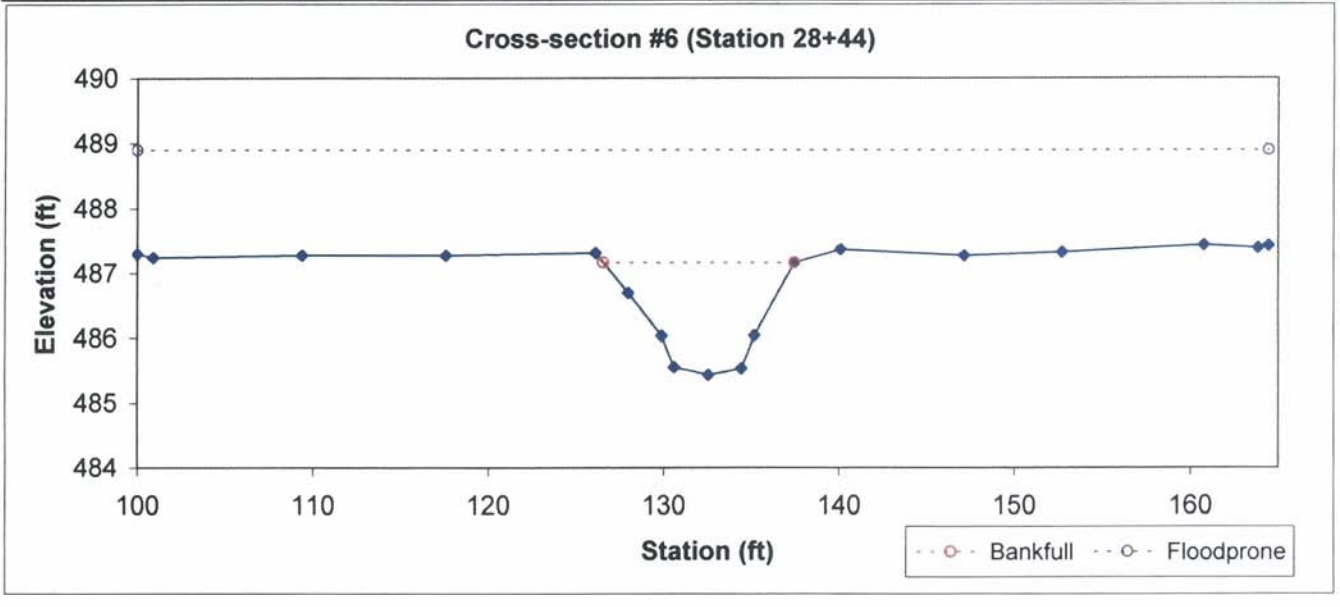
## Permanent Cross-section #6 (Station 28+44)

(Year 1 Data - collected Feb. 20, 2003)

Looking at the Left Bank

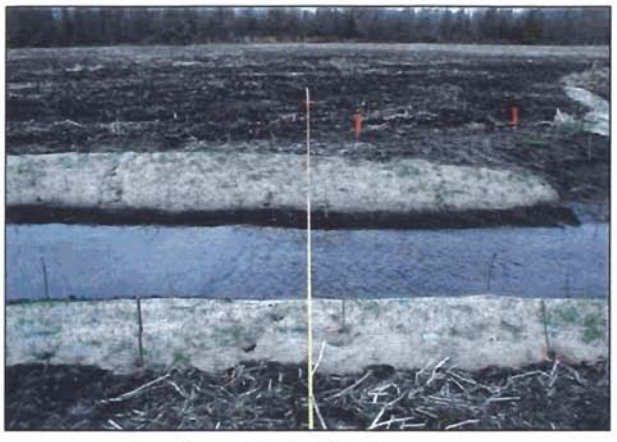
Looking at the Right Bank

| Feature | Stream Type | BKF Area | BKF Width | BKF Depth | Max BKF Depth | W/D | BH Ratio | ER | BKF Elev | TOB Elev |
|---|---|---|---|---|---|---|---|---|---|---|
| Riffle | E5 | 11.6 | 10.91 | 1.06 | 1.73 | 10.27 | 1 | 5.9 | 487.17 | 487.17 |



## Permanent Cross-section #7 (Station 37+11)

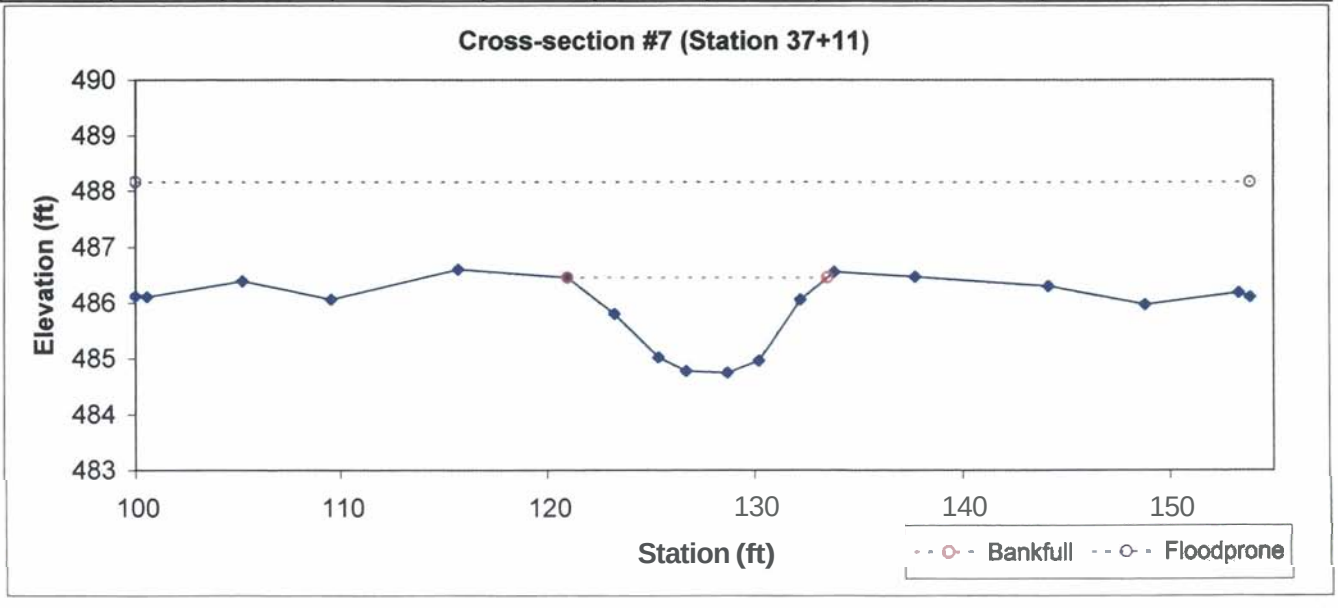
(Year 1 Data - collected Feb. 20,2003)



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 | C5 | 13 | 12.53 | 1.04 | 1.72 | 12.05 | 1 | 4.3 | 486.46 | 486.46 |



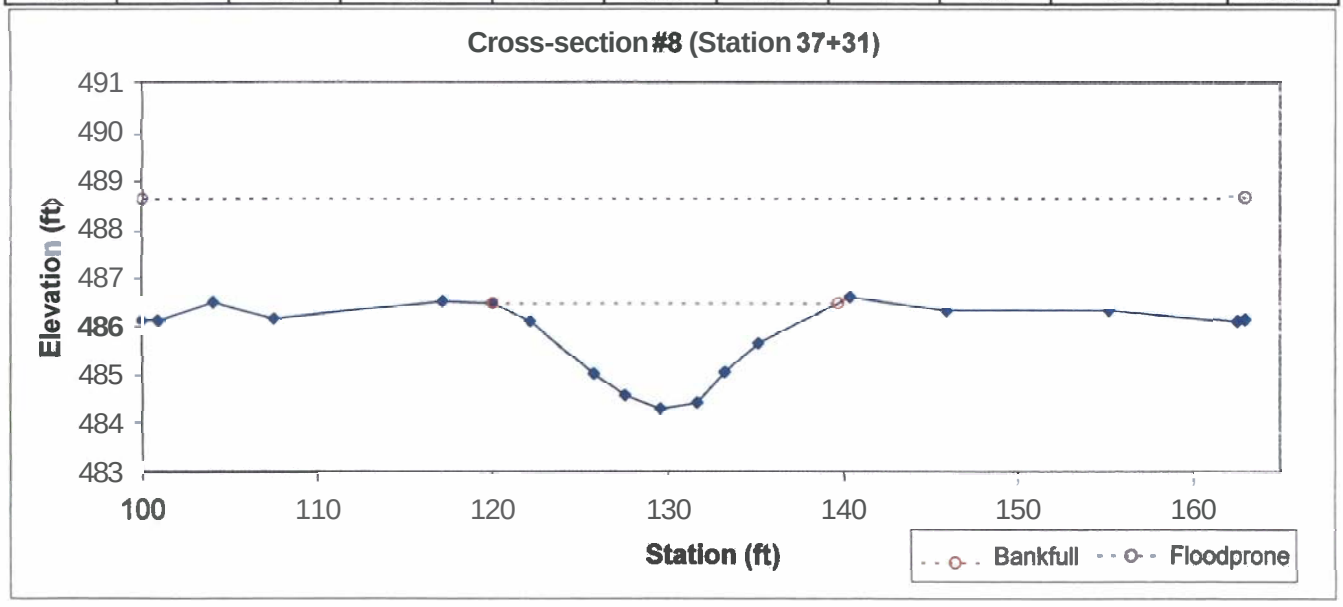
## Permanent Cross-section #8 (Station 37+31)

(Year 1 Data - collected Feb. 20.2003)

Looking at the Left Bank

Looking at the Right Bank

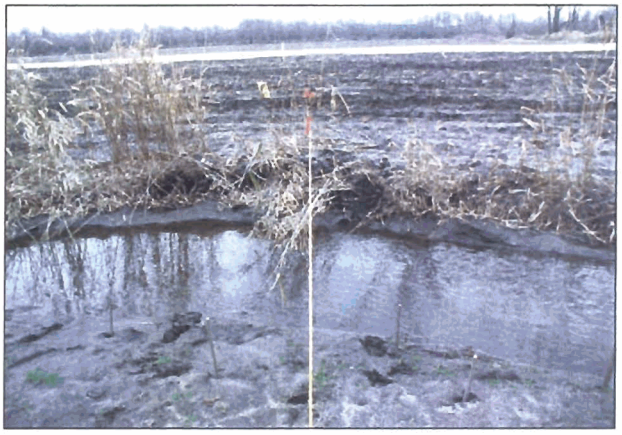
| Feature | Stream Type | BKF Area | BKF Width | BKF Depth | Max BKF Depth | W/D | BH Ratio | ER | BKF Elev | TOB Elev |
|---|---|---|---|---|---|---|---|---|---|---|
| Pool | ---- | 21.8 | 19.62 | 1.11 | 2.16 | 17.68 | 1 | 3.2 | 486.46 | 486.46 |



## Permanent Cross-section #9 (Station 44+94)

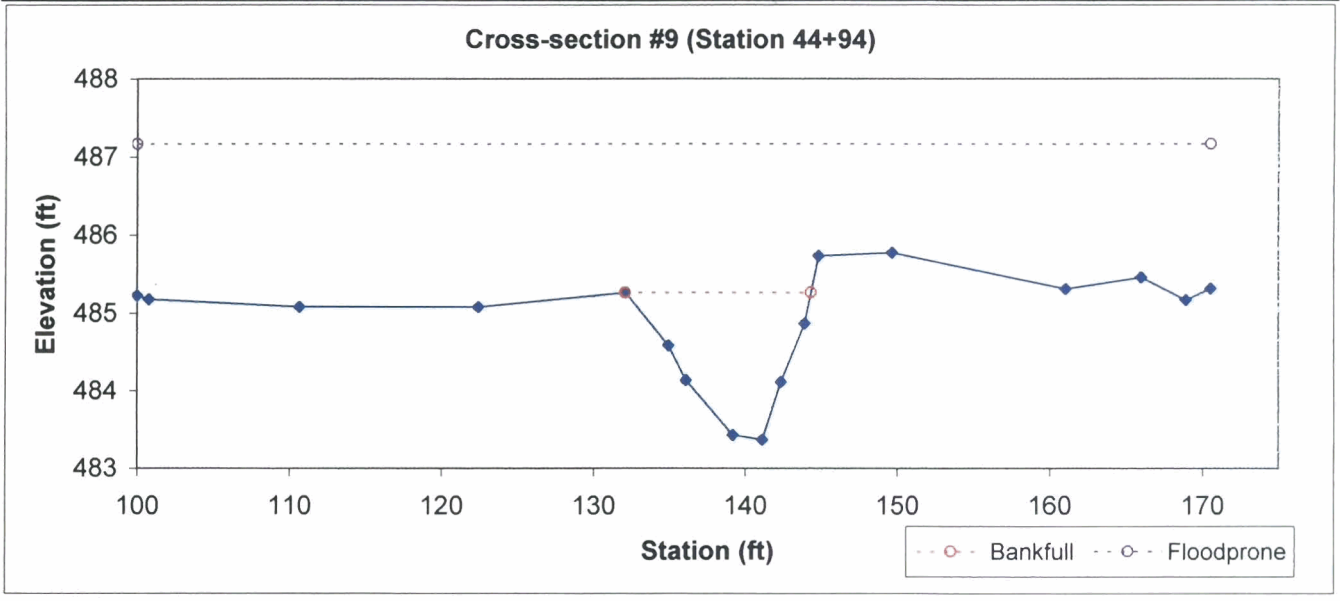
(Year 1 Data - collected Feb. 20, 2003)

**Looking at the Left Bank**



**Looking at the Right Bank**

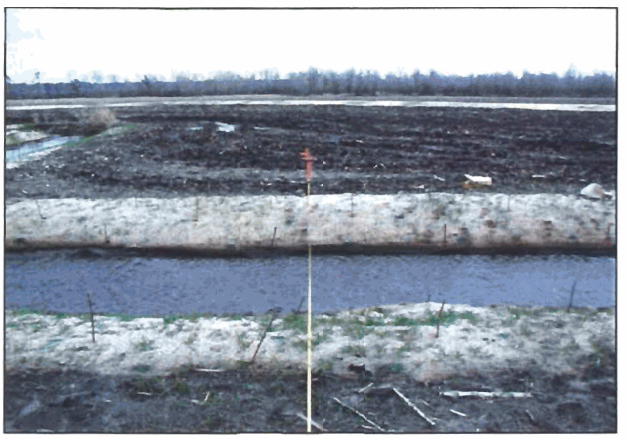
| Feature | Stream Type | BKF Area | BKF Width | BKF Depth | Max BKF Depth | W/D | BH Ratio | ER | BKF Elev | TOB Elev |
|---|---|---|---|---|---|---|---|---|---|---|
| Pool | ---- | 13.4 | 12.23 | 1.09 | 1.9 | 11.19 | 1 | 5.8 | 485.27 | 485.27 |



## Permanent Cross-section #10 (Station 45+22)

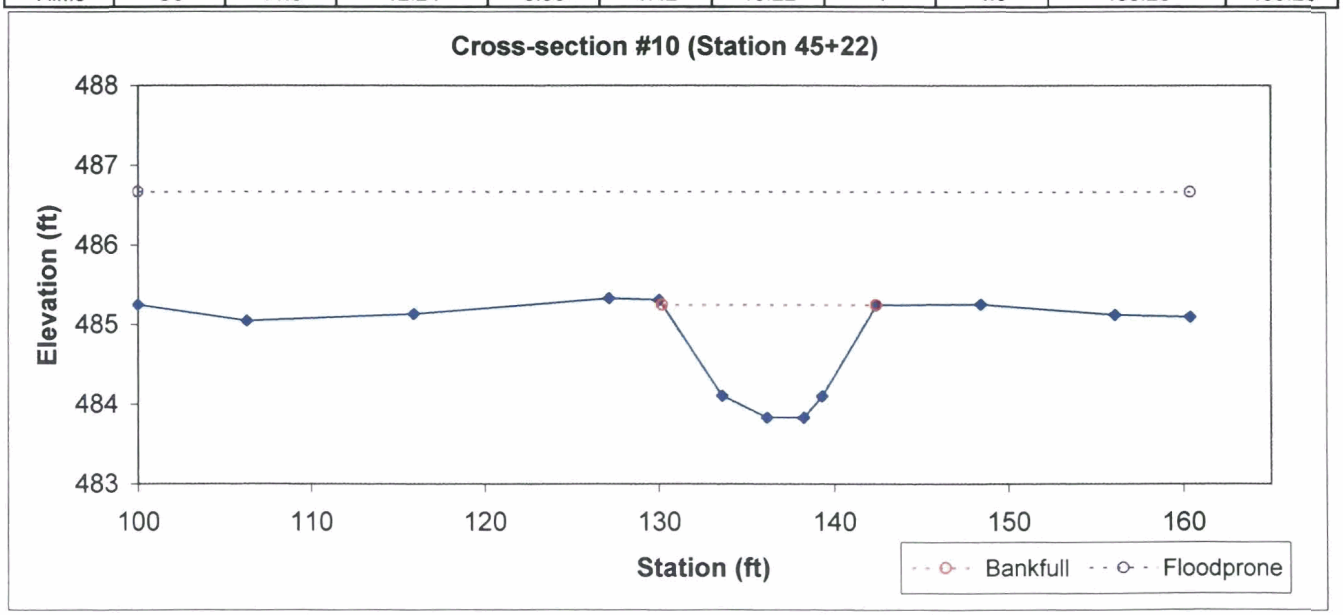
(Year 1 Data - collected Feb. 20, 2003)

Looking at the Left Bank



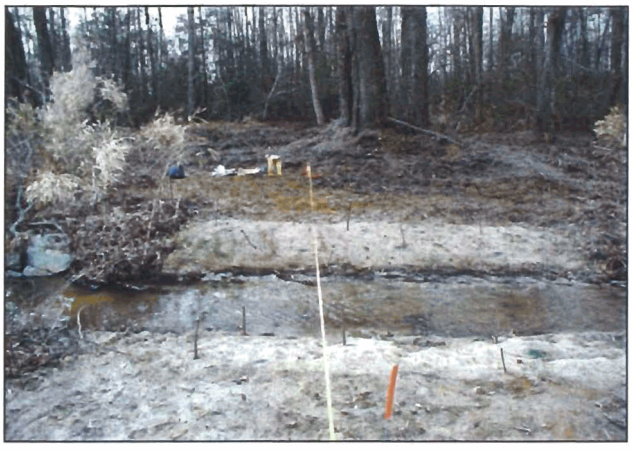
Looking at the Right Bank

| Feature | Stream Type | BKF Area | BKF Width | BKF Depth | Max BKF Depth | W/D | BH Ratio | ER | BKF Elev | TOB Elev |
|---|---|---|---|---|---|---|---|---|---|---|
| Riffle | C5 | 11.3 | 12.24 | 0.93 | 1.42 | 13.22 | 1 | 4.9 | 485.25 | 485.25 |

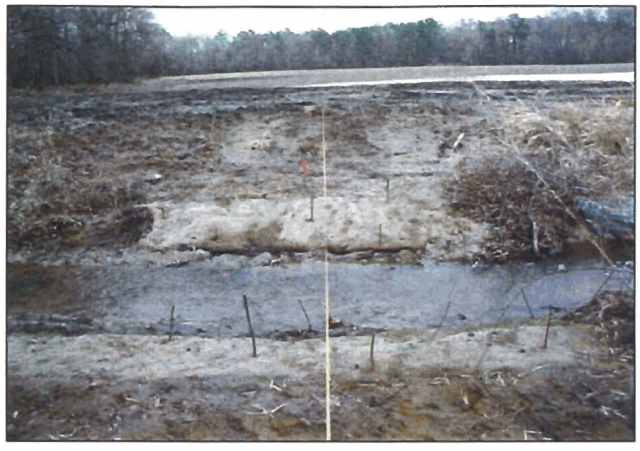


## Permanent Cross-section #11 (Station 53+08)

(Year 1 Data - collected Feb. 20, 2003)



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 | C5 | 13.4 | 13.38 | 1 | 1.61 | 13.35 | 1 | 3.1 | 482.4 | 482.4 |