South Fork Mitigation Project
Catawba County, North Carolina

Year 5 Monitoring Report

FINAL

Prepared for
Environmental Banc and Exchange, LLC
909 Capability Drive, Suite 3100
Raleigh, NC 27606

Prepared by
WK Dickson and Co., Inc.
3101 John Humphries Wynd
Raleigh, NC 27612
(919) 782-0495

and

Ecosystem & Land Trust Monitoring
PO Box 1492
3674 Pine Swamp Road
Sparta, NC 28675

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APPENDICES

1.0 SUMMARY

In May 2005, all construction and vegetation planting was completed at the South Fork Mitigation Site to re-establish natural channel dimension, pattern, and/or profile on nine unnamed tributaries to the South Fork Catawba River. **Appendix A** contains the As-Built Survey. Monitoring of this restoration project is to take place during the five growing seasons subsequent to construction completion. This annual report summarizes the vegetative and stream monitoring activities performed on the South Fork Mitigation Site during 2009, the fifth (and final) year after construction completion.

This Annual Report presents stream flow data from two crest gauges, stream geometry data from 25 cross sections, and 4,600 linear feet of profile survey. In addition, photographs are presented that document the conditions of the restored and enhanced stream reaches. Additional collected data includes on-site rain gauge readings and observations of potential problems with stream stability. This information is used to determine the overall condition of the reconstructed stream during 2009 monitoring.

Stream monitoring data in Years 1 through 5 documented multiple bankfull events and little change in channel dimension and profile. Minor adjustments in channel dimension have occurred at several cross section locations, mostly due to slight aggradation in pools as a result of vegetation in the channel. Most in-stream structures continue to function as designed. Several structures on the downstream end of Reach M2 were repaired in 2008. The South Fork Mitigation Site has met the stream success criteria specified in the Restoration Plan.

This Annual Report documents vegetation survival based on seven 1/10th acre vegetation monitoring plots, as specified in the Restoration Plan. Vegetation monitoring documented a range of vegetation density between 470 and 650 trees per acre. The site has met the final vegetation success criteria of 260 stems per acre surviving at the end of the fifth growing season.

2.0 INTRODUCTION

2.1 PROJECT DESCRIPTION

The South Fork Mitigation Site is located in Catawba County, North Carolina approximately five miles southwest of Newton (**Figure 1** & **Figure 2**). The site has a history of pasture and general agricultural usage. The streams on the project were channelized and riparian vegetation was cleared in most locations. Cattle were allowed to graze on the banks and access the channels causing significant erosion of the banks. Stream and riparian functions on the site were severely impacted as a result of agricultural conversion.

The project restored or enhanced 14,294 linear feet of channelized stream on several unnamed tributaries to the South Fork of the Catawba River. The project restored 9,590 linear feet of channel dimension, pattern, and profile and enhanced 4,704 linear feet of channel dimension and/or profile. **Table 1** shows the as-built lengths and restoration type per reach. The contracted mitigation amount was 11,260 stream mitigation units and the as-built quantity was 11,811 stream mitigation units. Monitoring in 2009 represents the fifth year of monitoring for this site.

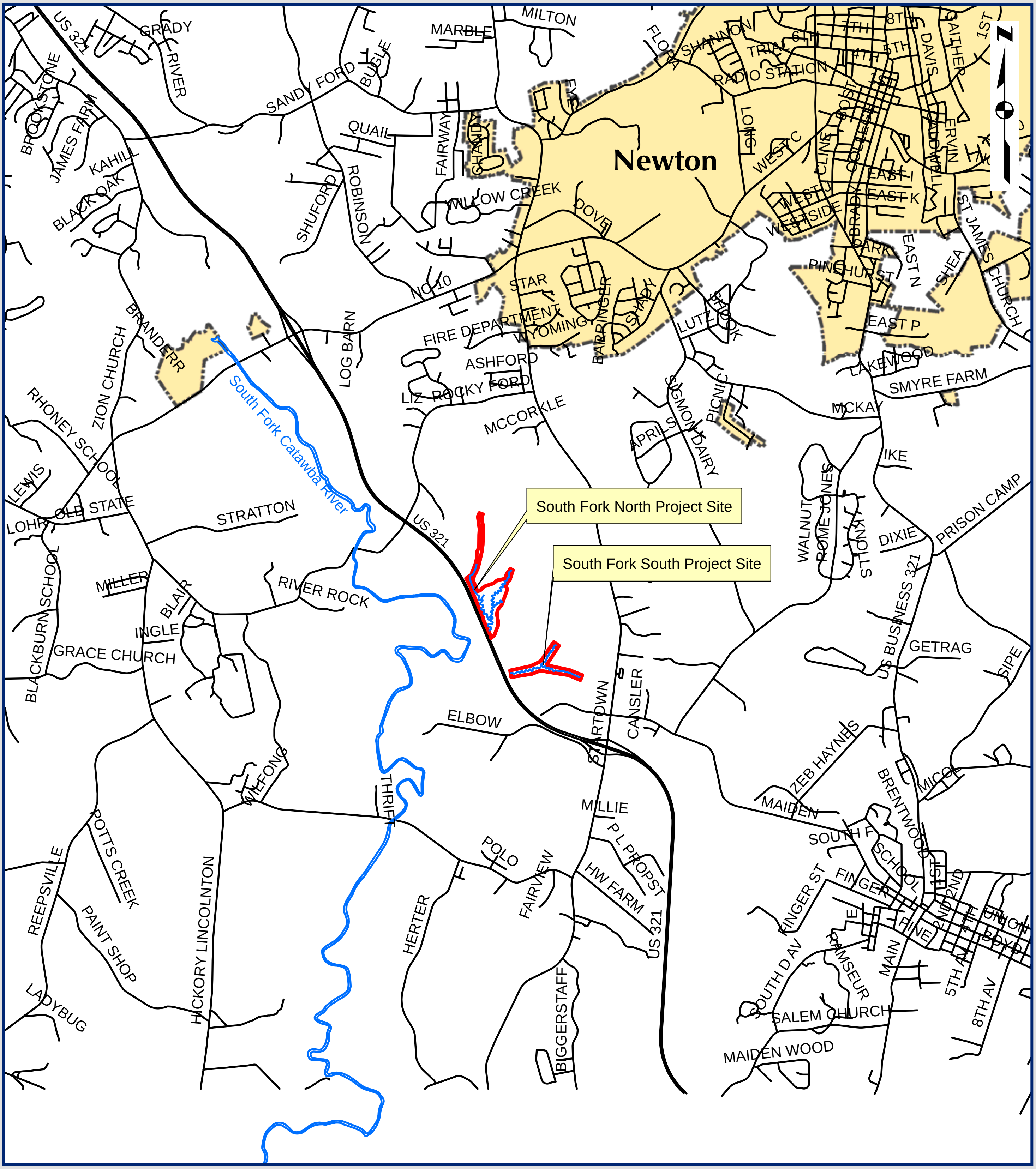
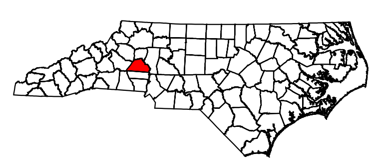


Figure 1.
South Fork Stream Mitigation Site
Project Location Map
Catawba County, NC



1 inch equals 1 miles

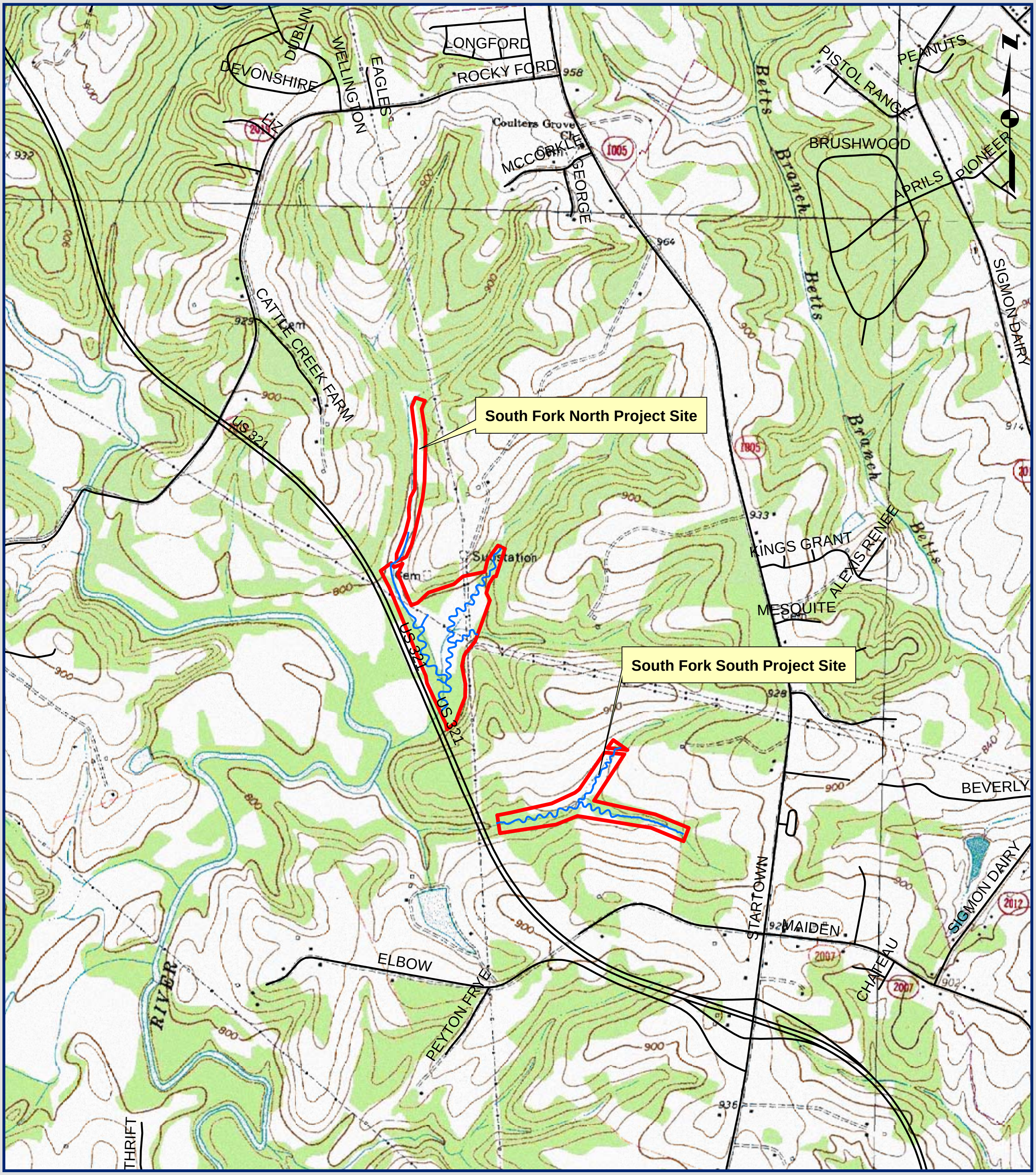


Figure 2.
South Fork Stream Mitigation Site
USGS Topographic Map
Catawba County, NC

1 inch equals 2,000 feet

2.2 PROJECT PURPOSE

Monitoring of the South Fork Site is required to demonstrate successful mitigation based on the criteria described in the South Fork Restoration Plan. Both stream and vegetation monitoring are conducted throughout the growing season. Success criteria must be met for five years. This Annual Report details the results of the stream monitoring for 2009 (Year 5) at the South Fork Stream Mitigation Site. **Figure 3** presents a plan view of the South Fork site.

Table 1. Project Mitigation Structure and Objectives

Reach Name	As-Built Length (ft)	Restoration Approach
UT1a	3,431	Enhancement Level II
UT1b	1,681	Restoration
UT2a	2,159	Restoration
UT2a	271	Enhancement Level I
UT2b	816	Restoration
UT3	526	Restoration
M1	726	Restoration
UT4	1,226	Restoration
UT5	896	Restoration
UT5	1,002	Enhancement Level I
M2	1,560	Restoration
Total	**14,294 (11,811 SMU)**	

2.3 PROJECT HISTORY & SCHEDULE

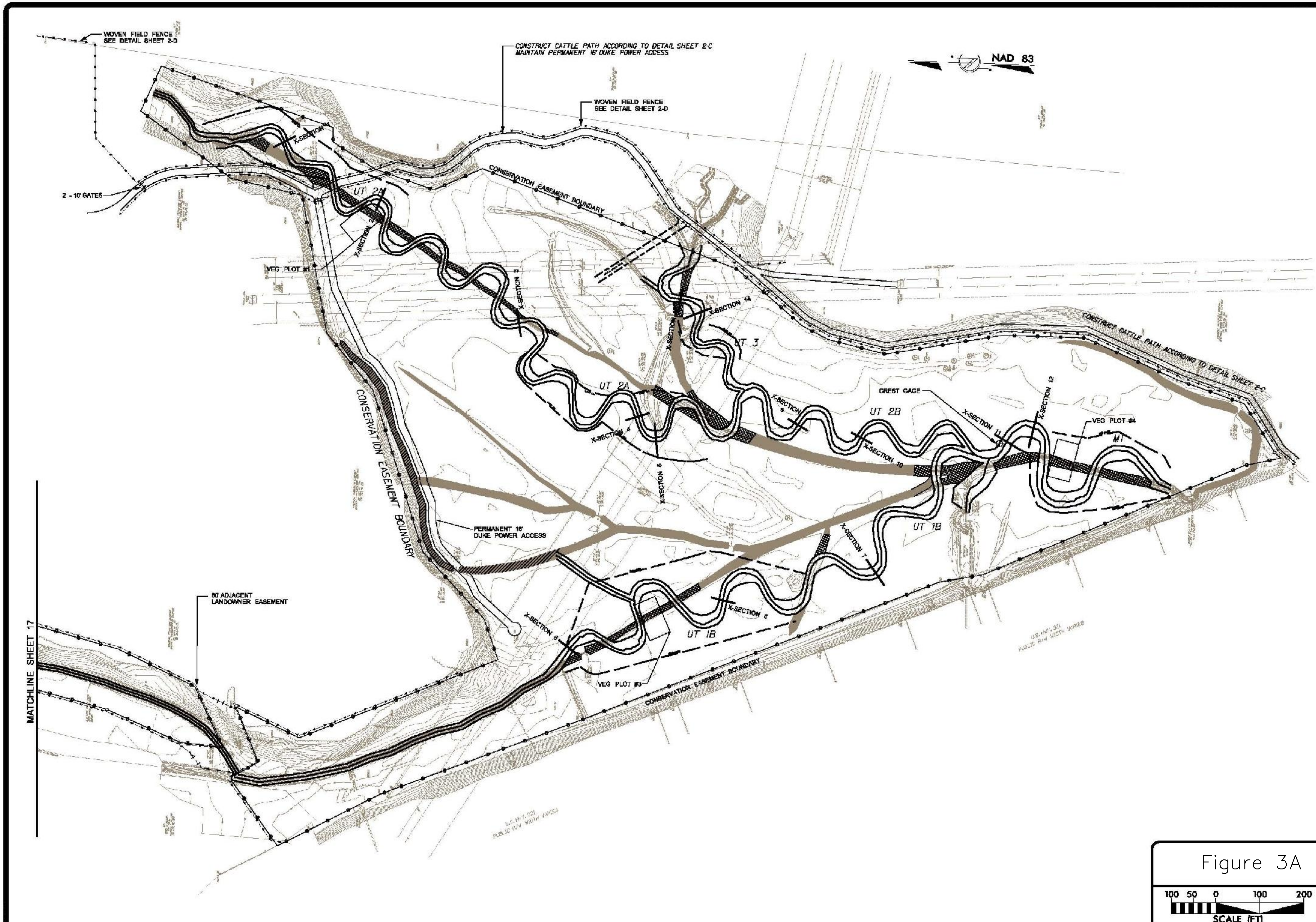
This project was identified by EBX in the spring of 2004. The following tables outline project history and milestones (**Table 2**) and contacts (**Table 3**).

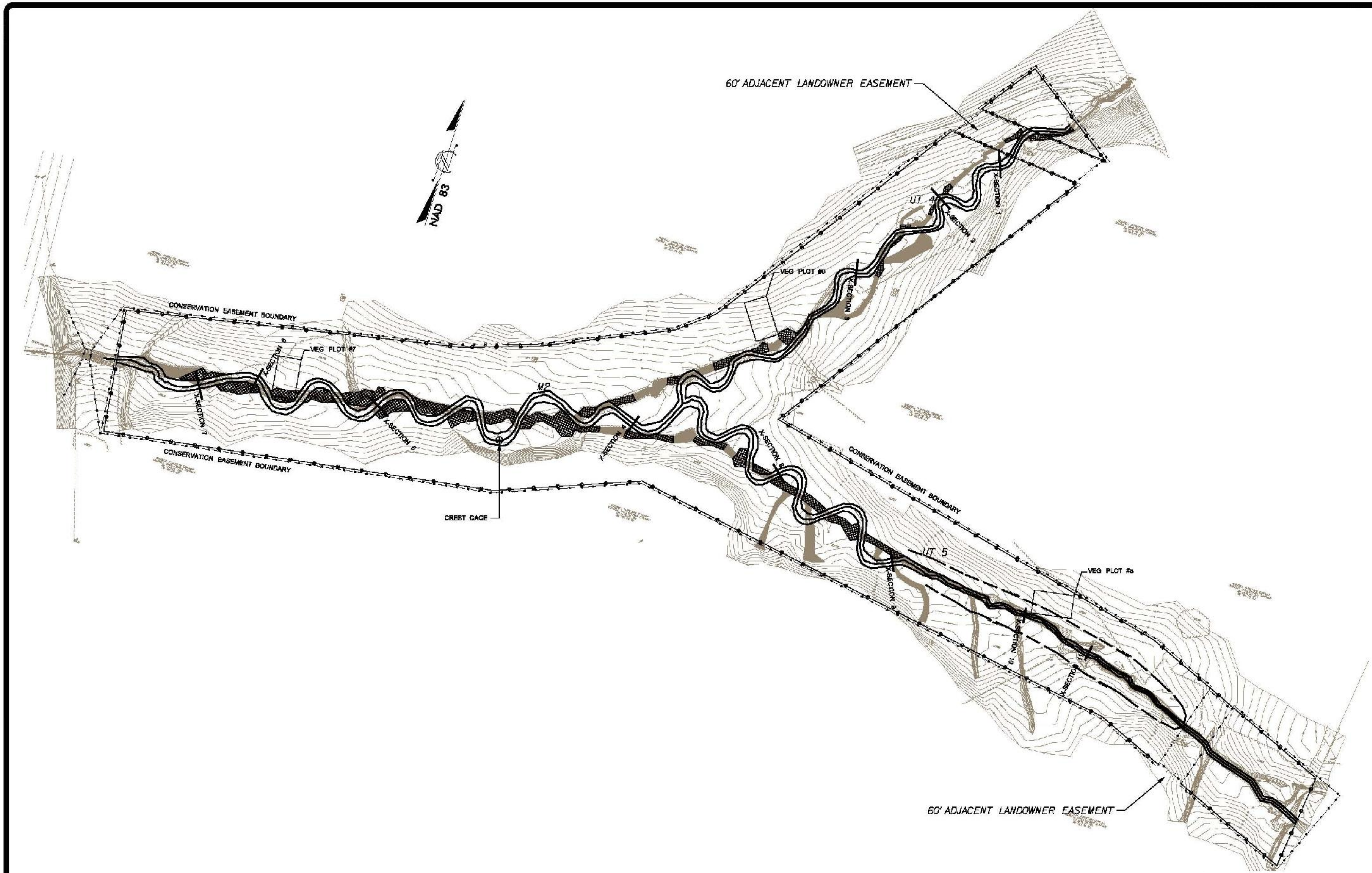
Table 2. Project Activity and Reporting History

Month	Activity
January 2005	Construction Began
May 2005	Construction Completed
April 2005	Planting Completed
June 2005	Post Construction Monitoring Gauges Installed
July 2005	As-Built Report Submitted
November 2005	1st Annual Monitoring Report
November 2006	2nd Annual Monitoring Report
November 2007	3rd Annual Monitoring Report
November 2008	4th Annual Monitoring Report
November 2009	5th Annual Monitoring Report

Table 3. Project Contacts

Contact	Firm Information
Project Manager Norton Webster	EBX-Neuse 1, LLC (919) 608-9688
Designer Kevin Tweedy, PE	Buck Engineering PC (919) 463-5488
Monitoring Contractor Daniel Ingram	WK Dickson and Co., Inc (919) 782-0495


WOVEN FIELD FENCE SEE DETAIL SHEET 2-D
CONSTRUCT CATTLE PATH ACCORDING TO DETAIL SHEET 2-C MAINTAIN PERMANENT 16' DUKE POWER ACCESS
NAD 83
WOVEN FIELD FENCE SEE DETAIL SHEET 2-D
2 - 10' GATES
CONSERVATION EASEMENT BOUNDARY
UT 2B
VEG PLOT #1
X-SECTION 14
UT 3
CONSTRUCT CATTLE PATH ACCORDING TO DETAIL SHEET 2-C
CREST GAGE
UT 2A
UT 2B
X-SECTION 12
VEG PLOT #4
X-SECTION 11
X-SECTION 10
X-SECTION 4
X-SECTION 8
CONSERVATION EASEMENT BOUNDARY
PERMANENT 16' DUKE POWER ACCESS
UT 1B
X-SECTION 7
60' ADJACENT LANDOWNER EASEMENT
X-SECTION 6
UT 1B
X-SECTION 9
VEG PLOT #3
CONSERVATION EASEMENT BOUNDARY
MATCHLINE SHEET 17
100 50 0 100 200
SCALE (FT)
Figure 3A



60' ADJACENT LANDOWNER EASEMENT
NAD 83
CONSERVATION EASEMENT BOUNDARY
VEG PLOT #7
VEG PLOT #6
VEG PLOT #5
UT 4
UT 5
MP
CREST GAGE
X-SECTION 1
X-SECTION 2
X-SECTION 3
X-SECTION 4
X-SECTION 5
X-SECTION 6
X-SECTION 7
X-SECTION 8
X-SECTION 9
X-SECTION 10
X-SECTION 11
60' ADJACENT LANDOWNER EASEMENT
100 50 0 100 200
SCALE (FT)

Figure 3B

3.0 VEGETATION MONITORING

3.1 VEGETATION SUCCESS CRITERIA

The interim measure of vegetative success for the South Fork Catawba Mitigation Plan is the survival of at least 320 three years-old planted trees per acre at the end of Year 3 of the monitoring period. The final vegetative success criteria is the survival of 260 five year-old planted trees per acre at the end of year five of the monitoring period. Up to 20 percent of the site species composition may be comprised of invaders. Remedial action may be required should these (i.e. loblolly pine (*Pinus taeda*), red maple (*Acer rubrum*), sweet gum (*Liquidambar styraciflua*), etc.) present a problem and exceed 20 percent composition.

3.2 DESCRIPTION OF SPECIES AND VEGETATION MONITORING

The vegetation monitoring protocol was designed to determine planted tree density and vegetation trends across the restoration area. Seven plots were established on the South Fork Catawba Mitigation Site to monitor approximately 2 percent of the site. The vegetation monitoring plots are 1/10th of an acre (50 feet x 87 feet dimensionally). The plots are randomly located and randomly oriented within the restoration area.

Plot construction includes metal fence posts at each of the four corners to clearly and permanently establish the area to be sampled. Ropes are hung connecting all four corners to help in determining if trees close to the plot boundary are inside or outside of the plot. Trees right on and just outside of the boundaries that appear to have greater than 50 percent of their canopy inside the plot are included in the stem counts. A piece of white PVC pipe ten feet tall is placed over the metal post on one corner to facilitate visual location of each plot throughout the five-year monitoring period. All of the planted stems inside the plot are flagged with orange flagging. A 3 foot-tall piece of half inch PVC is placed in the ground beside each stem to mark them as the planted stems (vs. colonizers) and to help in locating them in the future. Each stem is then tagged with a permanent numbered aluminum tag. The following tree species were planted in the Restoration Area:

Table 4. Planted Tree Species

ID	Scientific Name	Common Name	FAC Status
1	*Platanus occidentalis*	Sycamore	FACW-
2	*Betula nigra*	River Birch	FACW
3	*Tilia heterophylla*	White Basswood	N/I
4	*Diospyrus virginiana*	Persimmon	FAC
5	*Asimina triloba*	Pawpaw	FAC
6	*Hamamelis virginiana*	Witch-hazel	FACU
7	*Cephalanthus occiden.*	Buttonbush	OBL
8	*Alnus serrulata*	Tag Alder	FACW+
9	*Lindera benzoin*	Spicebush	FACW
10	*Viburnum dentatum*	Southern Arrow-wood	FAC
11	*Fraxinus pennsylvan.*	Green Ash	FACW
12	*Quercus phellos*	Willow Oak	FACW-
13	*Sambucus Canadensis*	Elderberry	FACW-

3.3 RESULTS OF VEGETATION MONITORING

Table 5 presents stem counts for each monitoring plot. Each planted tree species is identified across the top row, and each plot is identified down the left column. The numbers on the top row correlate to the ID column of **Table 4**.

Table 5. 2009 Vegetation Monitoring Plot Species Composition

Plot	1	2	3	4	5	6	7	8	9	10	11	12	13	Total	Trees per Acre
SFC1	8	0	0	12	12	0	0	3	0	0	4	26	0	65	650
SFC2	4	16	0	10	0	0	0	0	0	0	12	13	0	55	550
SFC3	31	1	0	10	8	0	0	0	0	0	0	7	0	57	570
SFC4	24	1	0	25	2	0	0	2	0	0	0	0	0	54	540
SFC5	23	0	0	13	1	0	0	0	0	0	10	0	0	47	470
SFC6	2	14	0	5	1	1	0	10	0	0	11	1	4	49	490
SFC7	8	3	0	17	1	0	0	2	0	0	17	2	0	50	500

Average Trees per Acre: 538
Range of Trees per Acre: 470-650

Volunteer species are also monitored throughout the five year monitoring period. **Table 6** identifies the most commonly found woody volunteer species.

Table 6. Volunteer Tree Species

ID	Scientific Name	Common Name	FAC Status
A	*Liquidambar styraciflua*	Sweetgum	FAC+
B	*Acer rubrum*	Red Maple	FAC
C	*Juniperus virginiana*	Eastern Red Cedar	FACU-
D	*Populus deltoides*	Eastern Cottonwood	FAC+
E	*Platanus occidentalis*	Sycamore	FACW-
F	*Diospyrus virginiana*	Persimmon	FAC

Volunteer woody species were observed in most of the vegetation plots, but were too small to record. Sweetgum (*Liquidambar styraciflua*) is the most common volunteer, though red maple (*Acer rubrum*), eastern red cedar (*Juniperus virginiana*), sycamore (*Platanus occidentalis*), persimmon (*Diospyros virginiana*) and eastern cottonwood (*Populus deltoides*) were also observed.

3.4 GENERAL VEGETATION OBSERVATIONS

After construction of the mitigation site, a permanent ground cover seed mixture of switch grass (*Panicum virgatum*), big bluestem (*Andropogon gerardii*), ironweed (*Vernonia noveboracensis*), joe pye weed (*Eupatorium fistulosum*), and deertongue (*Panicum clandestinum*) was broadcast on the site. These species are dominant on the site, though they pose no threat to the survival or health of the planted vegetation. Hydrophytic herbaceous vegetation is also occurring on site. Rush (*Juncus effusus*), bulrush (*Scirpus sp.*), knotweed (*Polygonum persicaria*), jewelweed (*Impatiens capensis*) and sedge (*Carex sp.*) were frequently observed across the site, particularly in areas of inundation. Arrow-head (*Sagitarria spp.*), another wetland species, is found in wetter areas of the site.

There are zones of weedy species occurring on the site, though none seem to be posing any problems for the planted vegetation. The majority of the weedy species are annuals. Commonly seen weedy vegetation includes hay, dallisgrass (*Paspalum dilatatum*), dogfennel (*Eupatorium capillifolium*) and buttercup (*Ranunculus sp.*).

3.5 VEGETATION CONCLUSIONS

This site was planted in bottomland hardwood forest species in March 2005. There were seven $1/10^{th}$ acre vegetation monitoring plots established throughout the planting areas. The 2009 vegetation monitoring revealed an average tree density of 538 stems per acre. The site met the final success criteria of 260 trees per acre at the end of year five.

4.0 STREAM MONITORING

3.1 STREAM SUCCESS CRITERIA

As stated in the approved Restoration Plan, the stream restoration success criteria for the site includes the following:

- *Bankfull Events:* Two bankfull flow events must be documented within the five-year monitoring period.
- *Cross sections*: There should be little change in as-built cross sections. Cross sections shall be classified using the Rosgen stream classification method and all monitored cross sections should fall within the quantitative parameters defined for “E” or “C” type channels. Cross-section data will be collected annually.
- *Longitudinal Profile*: The longitudinal profiles should show that the bedform features are remaining stable, i.e. they are not aggrading or degrading. Bedforms observed should be consistent with those observed in “E” or “C” type channels. Profile data will be collected in monitoring Years 1, 3, and 5.
- *Photo Reference Stations:* Photographs will be used to subjectively evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation and effectiveness of erosion control measures. Photos will be taken annually at permanent cross-sections and grade control structures.
- *Benthic Macroinvertebrate Sampling*: Benthic macroinvertebrates will be sampled annually in monitoring years 1, 2, and 3. Benthic macroinvertebrates will be identified and a tolerance value will be calculated. All benthic monitoring has been reported in previous monitoring reports. No benthic monitoring was conducted in 2009.

3.2 STREAM MONITORING PLAN

Along UT1B, UT2A, UT2B, UT3, UT4, UT5, M1 and M2 a natural channel design approach was applied to develop stable hydraulic geometry parameters. Construction began in January 2005 and was completed in May 2005. The rebuilding of the channel established stable cross-sectional geometry, increased plan form sinuosity, and restored riffle-pool sequences and other streambed diversity to improve benthic habitat. Approximately 9,590 linear feet of stream restoration has been constructed.

3.2.1 Cross Sections

According to the as-built document written in July 2005, twenty-five cross sections are to be monitored along the restored tributaries UT1B, UT2A, UT2B, UT3, UT4, UT5, M1 and M2. The cross sections were established during monitoring set-up in evenly distributed pairs of one riffle and one pool cross section per 1,000 linear feet of restored stream. Each cross section was marked on both banks with permanent pins to establish the exact transect used. Permanent cross-section pins were surveyed and located relative to a common benchmark to facilitate easy comparison of year-to-year data. The annual cross-section surveys include points measured at all breaks in slope, including floodplain, top of bank, bankfull, inner berm, edge of water, and thalweg. In addition, any fluvial features present will be documented. Permanent cross sections for 2009 (Year 5) were surveyed in July 2008 and are shown in **Figure 4**.

3.2.2 Longitudinal Profile

Longitudinal profiles will be surveyed annually during the five-year monitoring period. The profile will be conducted for a length of restored channel at least 3,000 feet in length. Features measured will include thalweg, inverts of stream structures, water surface, bankfull, and top of low bank. Approximately 4,600 linear feet of longitudinal profile was surveyed for Year 5 in July 2009.

3.2.3 Hydrology

Two crest gauges were installed on the site to document bankfull events. The gauges record the highest out-of-bank flow events that occurred and are checked monthly through the year. The gauges are located on reaches M1 and M2 (See Figures 3A and 3B). The gauge on reach M1 is located near stream station 61+25 (cross section 11). The gauge on reach M2 is located near stream station 28+50 (between cross section 4 and cross section 5).

3.2.4 Benthic Macroinvertebrates

Benthic macroinvertebrate sampling data will be collected from two locations within the project limits. Pre-restoration data were collected on November 1, 2004, prior to initiation of stream restoration. Post-restoration sampling began in November 2005 and annually thereafter for a total of three years. All benthic monitoring has been reported in previous monitoring reports. No benthic monitoring was conducted in 2009.

3.3 STREAM MORPHOLOGY MONITORING RESULTS

In-stream structures installed within the channel included constructed riffles, cross vanes, log vanes, log weirs, root wads, and step-pool structures. Visual observations of structures throughout the past growing season indicated that nearly all structures are functioning as designed. Detailed plan view drawings of the stream reaches are provided in **Figure 4**.

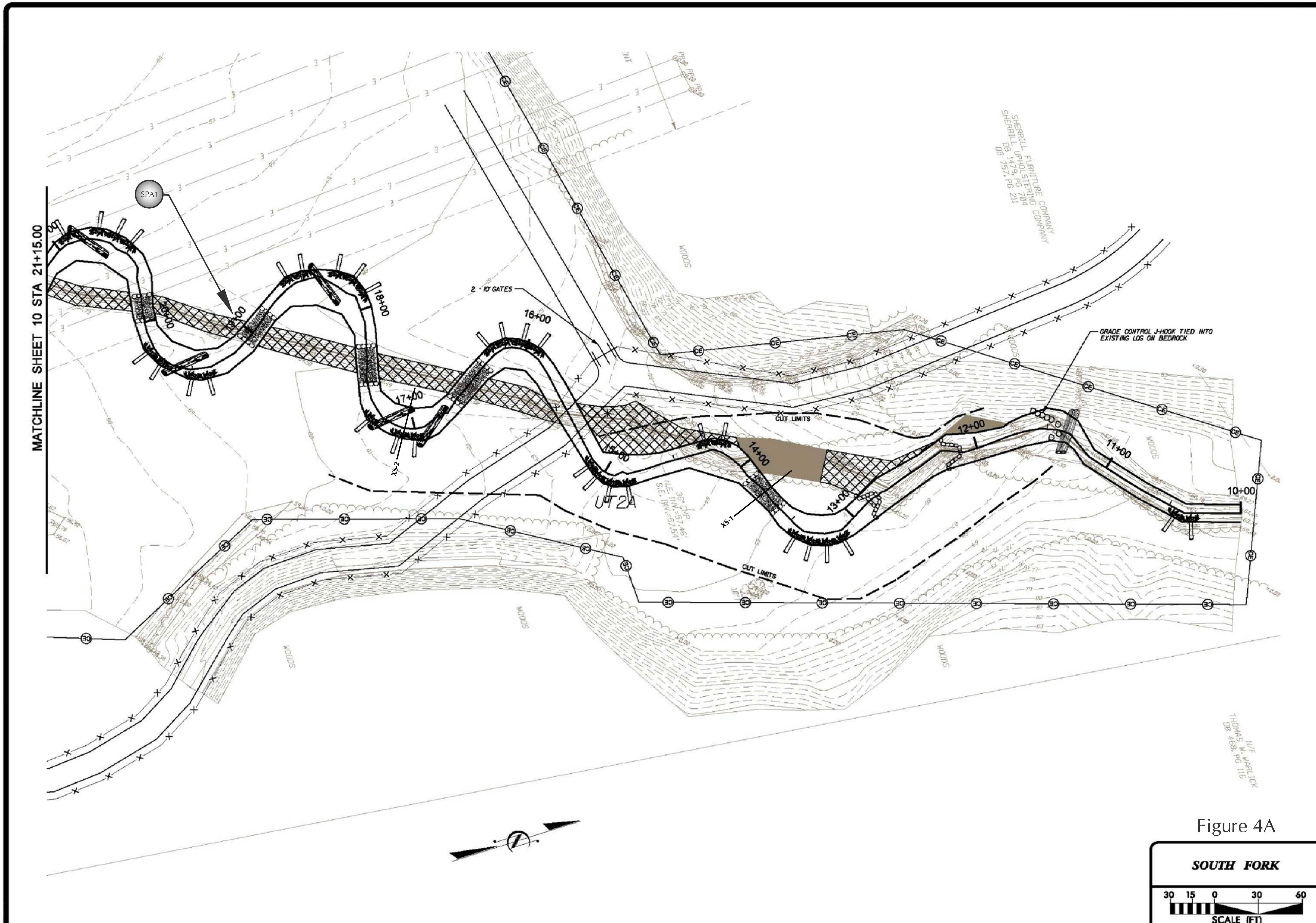

MATCHLINE SHEET 10 STA 21+15.00
SPA1
18+00
17+00
16+00
15+00
14+00
13+00
12+00
11+00
10+00
2 - 10' GATES
GRADE CONTROL J-HOOK TIED INTO EXISTING LOG ON BEDROCK
CUT LIMITS
CUT LIMITS
UT2A
XS-1
XS-2
WOODS
SHERRILL FURNITURE COMPANY
SHERRILL UPHOLSTERING COMPANY
N/F THOMAS W. WARLICK
SOUTH FORK
SCALE (FT)

Figure 4A

MATCHLINE SHEET 9 STA 37+15.00
MATCHLINE SHEET 11 STA 21+15.00
UT2A
UT2B
UT3
CUT LIMITS
FILL LIMITS
TOE LOG
DITCH TIED INTO REALIGNED CHANNEL
DUKE POWER ACCESS
36 INCH CMP
48 INCH CMP
60 INCH CMP
2 - 10' GATES
SPA2
XS-3
XS-4
XS-5
XS-9
XS-14
SOUTH FORK
SCALE (FT)

Figure 4B

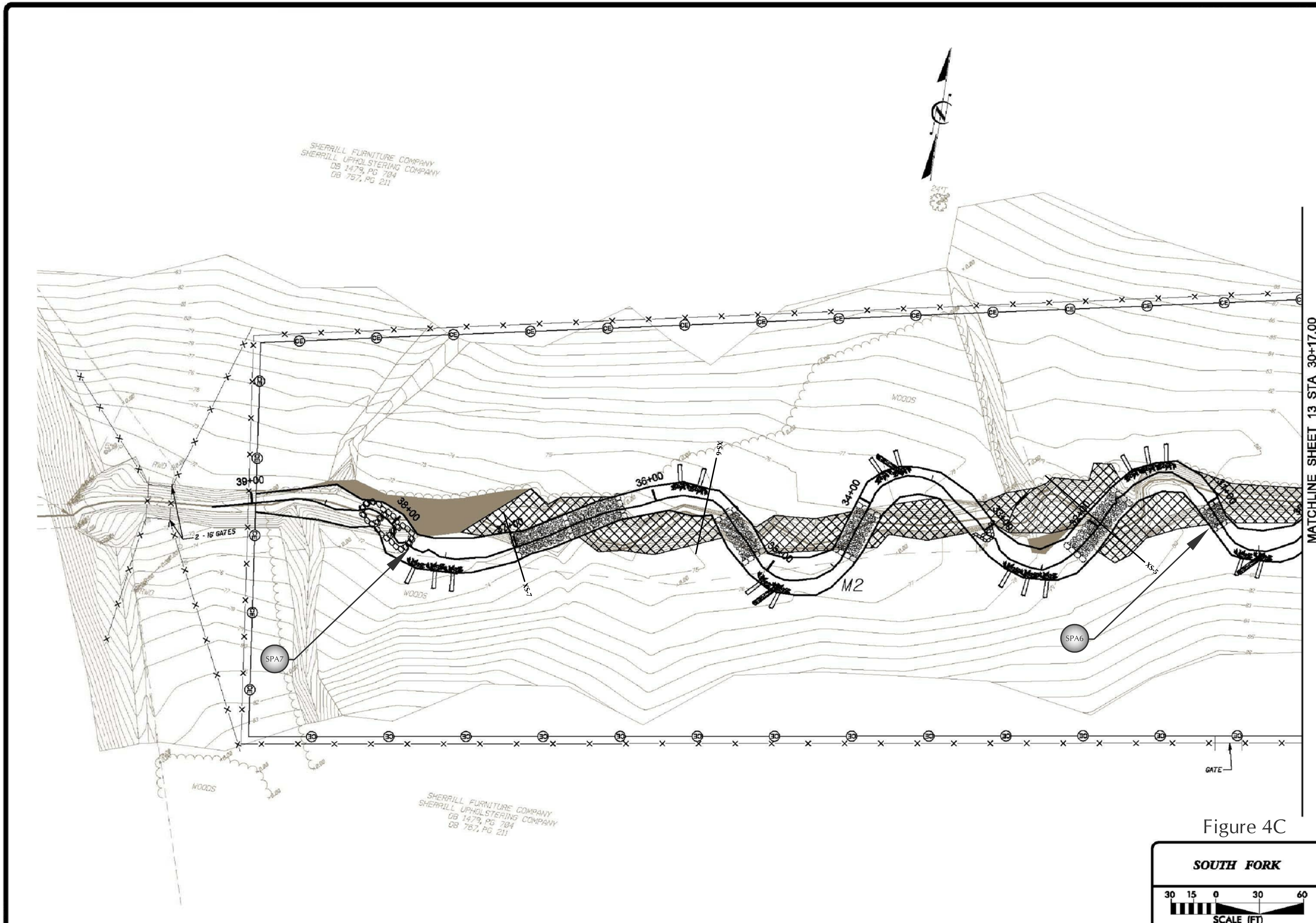
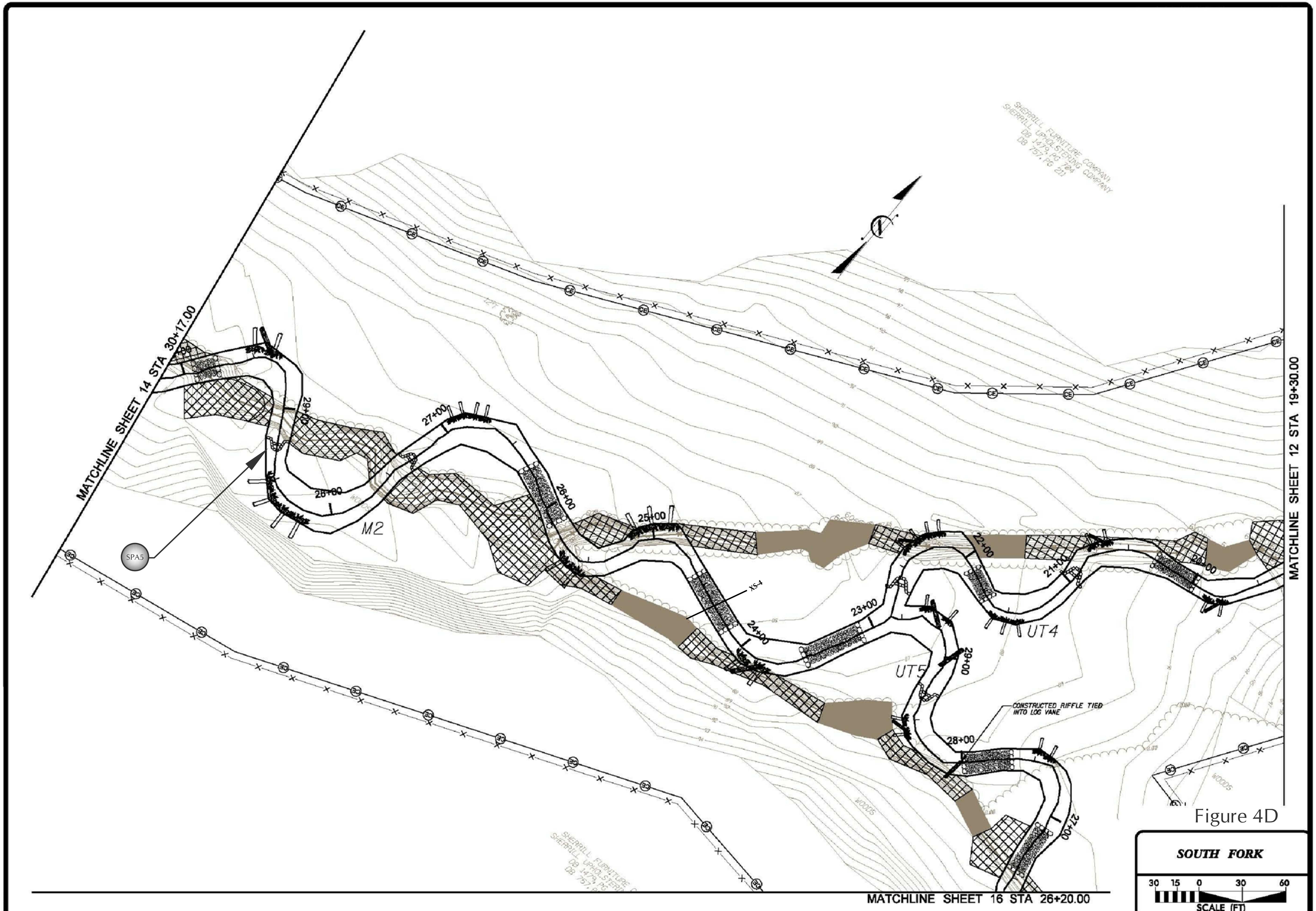


Figure 4C

SOUTH FORK

SCALE (FT)


MATCHLINE SHEET 14 STA 30+17.00
MATCHLINE SHEET 12 STA 19+30.00
MATCHLINE SHEET 16 STA 26+20.00
SHERRILL FURNITURE COMPANY
SHERRILL UPHOLSTERING COMPANY
DB 1479, PG 704
DB 757, PG 221
SPA5
M2
UT4
UT5
XS-4
CONSTRUCTED RIFFLE TIED INTO LOG VANE
29+00
28+00
27+00
26+00
25+00
24+00
23+00
22+00
21+00
20+00
WOODS
SOUTH FORK
30 15 0 30 60
SCALE (FT)
Figure 4D

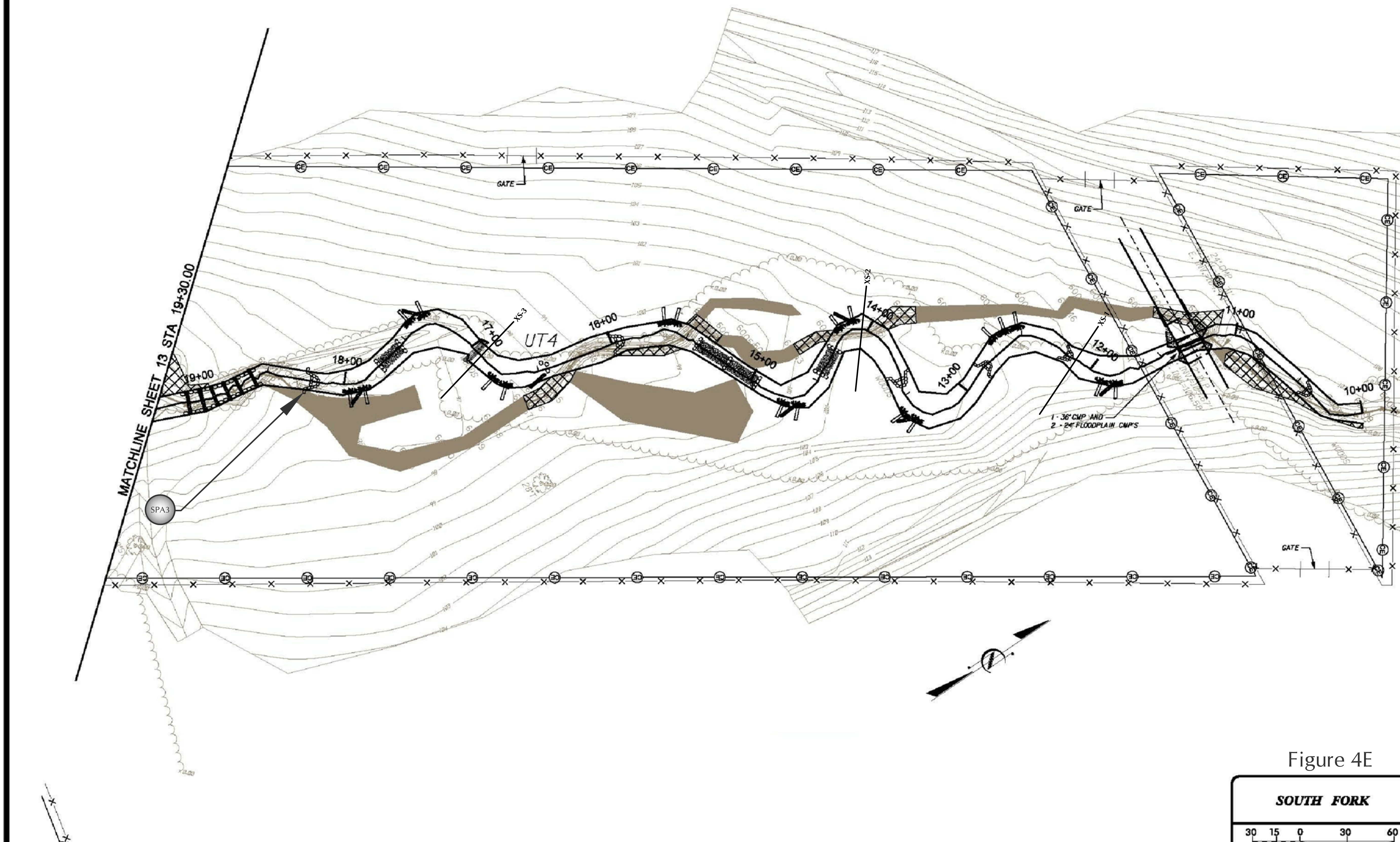


Figure 4E

SOUTH FORK

30 15 0 30 60
SCALE (FT)

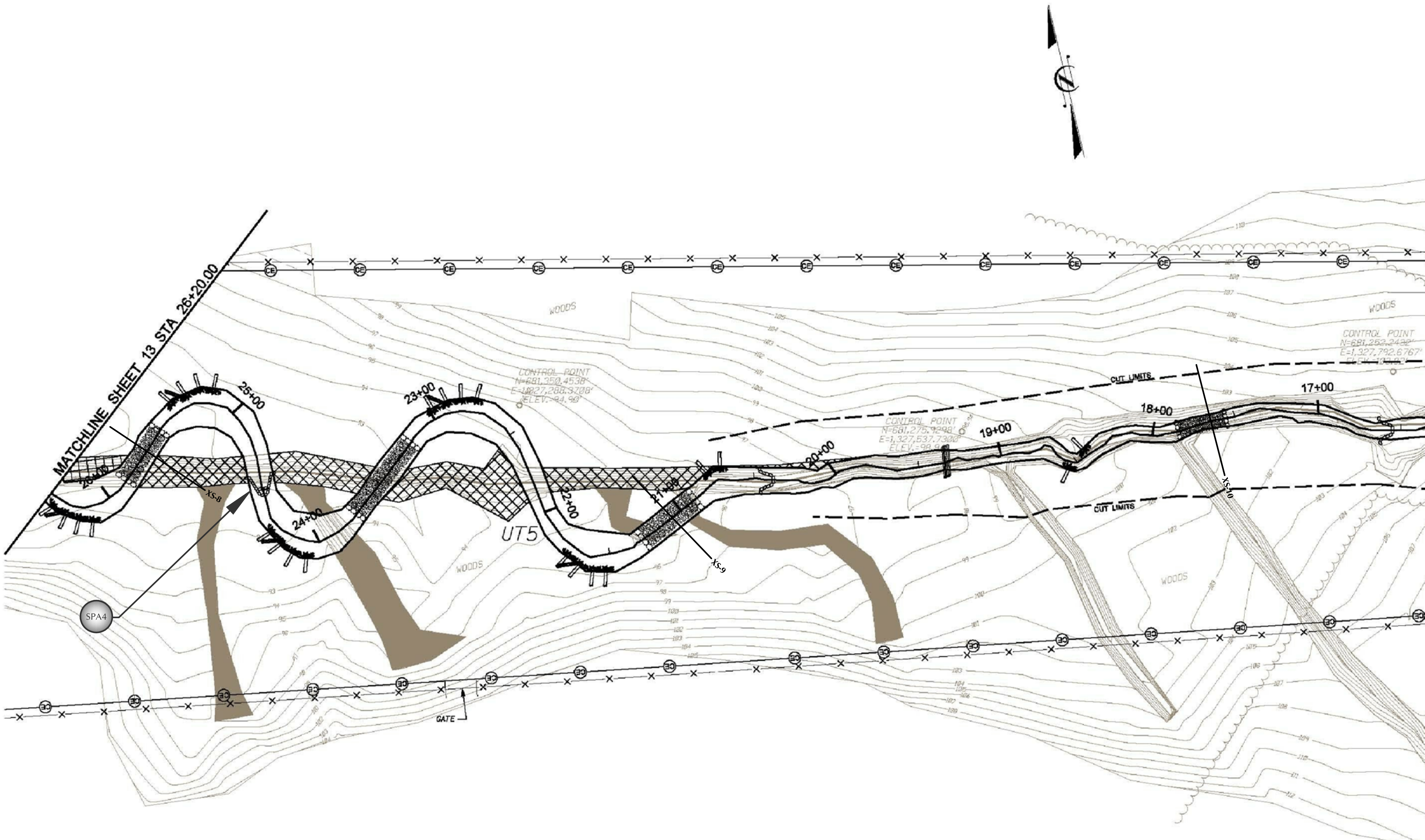
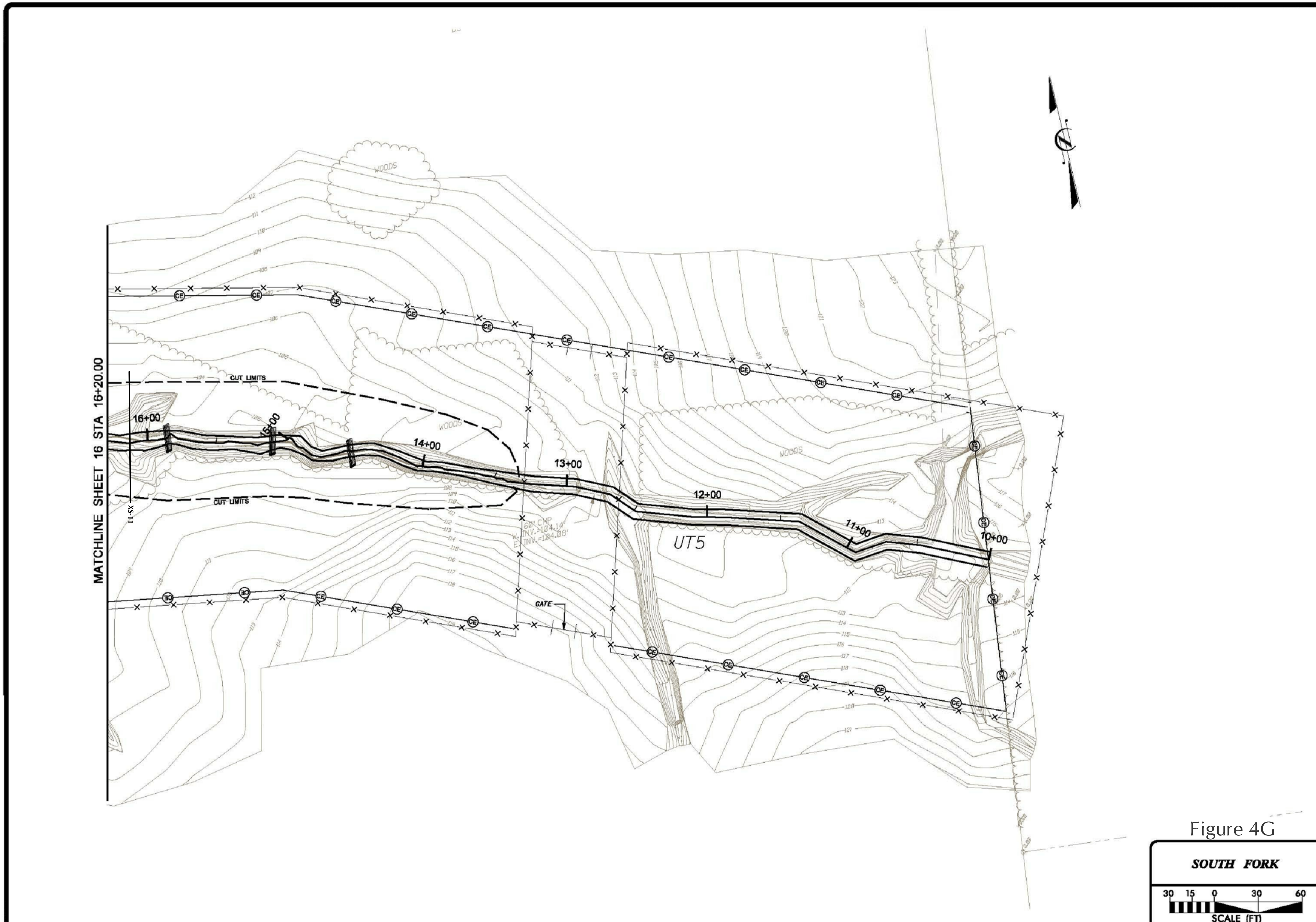


Figure 4F

SOUTH FORK

30 15 0 30 60
SCALE (FT)



MATCHLINE SHEET 16 STA 16+20.00
CUT LIMITS
CUT LIMITS
16+00
15+00
14+00
13+00
12+00
11+00
10+00
UT5
WOODS
WOODS
WOODS
GATE
SOUTH FORK
30 15 0 30 60
SCALE (FT)

Figure 4G

3.3.1 Cross Sections

Permanent cross sections were initially surveyed during the monitoring set-up and then annually in the late growing season. Year 5 cross sections were surveyed in July 2009. The as-built data have been compared with the Year 1, 2, 3, 4, and 5 data in **Appendix B**. The Year 5 channel cross sections showed that overall stream dimension remained stable during the fourth growing season. Some localized areas of bed scour and/or aggradation were noted; however, these adjustments are common and indicate a movement toward greater stability. There is very little difference between the baseline cross sections, and Year 1, 2, 3, 4, and 5 cross sections. Changes in cross section measurements such as Bankfull Area and width/Depth ratio are primarily due to minor deviations in the assumed bankfull elevation. Reach UT2A in the vicinity of XS1 experienced sediment deposition in the channel and floodplain between monitoring events. The channel remained dimensionally stable and herbaceous vegetation is stabilizing the floodplain sediment.

3.3.2 Longitudinal Profile

The longitudinal profile was surveyed for Year 5 in July 2009 at six representative reaches. Profile lengths were as follows: 1,000 feet in Reach UT2A, 1,825 combined feet of Reaches UT1B and M1, 660 feet of Reach UT5, 525 feet of Reach UT4, and 600 feet of Reach M2 for a total of 4,610 linear feet. These profiles were compared to as-built profiles conducted in October 2005 and previous monitoring year profiles. Based on these comparisons, there has been little adjustment to the stream profile or dimension since construction. Minor aggradation has occurred in the pools as the channel has adjusted to an equilibrium condition. The riffles have remained stable. Profiles surveys can be viewed in **Appendix B**.

5.3.3 Hydrology

The crest gauges were read and reset on monthly sites visits from March through November 2009. A bankfull event occurred during April on both crest gauges. Over the five year monitoring period multiple bankfull events have been recorded at each crest gauge. The crest gauge data is included in **Table 7**.

Table 7. Crest Gauge Data

Month	Year 1		Year 2		Year 3		Year 4		Year 5	
	Reach UT2B	Reach M2	Reach UT2B	Reach M2	Reach UT2B	Reach M2	Reach UT2B	Reach M2	Reach UT2B	Reach M2
January	---	---	---	---	---	---	---	---	---	---
February	---	---	---	---	3.8	0.00	---	---	---	---
March	---	---	1.25	1.50	3.5	0.00	0.00	0.00	0.00	0.00
April	---	---	0.00	0.00	0.00	0.00	0.00	0.00	0.20	1.40
May	---	---	0.10	0.15	0.00	0.00	0.20	0.00	0.00	0.00
June	---	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
July	---	---	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00
August	---	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
September	---	---	0.47	0.00	0.00	0.00	0.15	1.25	0.00	0.00
October	>4.00	0.30	0.00	0.00	0.00	0.00	0.00	3.80	---	---
November	---	---	---	---	---	---	---	---	---	---
December	---	---	---	---	---	---	---	---	---	---

Documented bankfull events and observed stream flows were compared with monthly rainfall totals to assess stream response to precipitation events. Monthly precipitation data were collected from the Conover Oxford Shoals weather station in Conover, NC. An on-site rain gauge was also monitored throughout 2009. The precipitation data are summarized in **Table 8**.

Table 8. Summary Precipitation Data

Month	Average	Normal Limits		Conover Precipitation	On-Site Precipitation
		30 Percent	70 Percent		
January	3.90	2.64	5.04	3.62	---
February	3.42	2.33	4.41	1.93	---
March	4.27	3.12	5.17	5.16	1.90
April	3.37	2.06	4.57	2.89	5.90
May	3.77	2.50	4.68	5.18	5.34
June	4.27	2.73	5.41	6.07	4.84
July	3.92	2.43	4.45	1.82	3.09
August	4.00	2.73	4.71	5.42	1.85
September	3.75	2.39	5.20	1.98	3.38
October	3.40	1.96	3.98	---	---
November	3.47	2.33	4.30	---	---
December	3.21	2.17	3.96	---	---
Total	**44.76**	**40.76**	**47.22**		

3.5 STREAM CONCLUSIONS

Very few problems with stream stability were observed during the 2009 monitoring field visits. Based on cross-sectional survey, longitudinal profile survey, and streamwalk observations, it was concluded that the site has achieved the stream success criteria specified in the Restoration Plan. Throughout the project localized areas of siltation are present. There was also minor bank erosion on some outside meander bends. The step-pool system at the downstream end of Reach M2 was repaired in early 2008 and is now stable and functional. A prior problem has been cattle entering the easement area. The landowner has been notified and the fences have been repaired. **Table 11** presents potential areas of instability with station and description of each area. No repairs or remedial actions are necessary or recommended. Photos of these areas are included in **Appendix C**.

Table 11. Stream Areas Requiring Observation

SPA No.	Reach	Station	Feature	Condition
1	UT1A	10+00 – 35+00	Easement Area	Cattle in easement have degraded stream banks at several channel access points; the banks are stabilizing and no repairs are recommended
2	UT2A	19+00	Constructed Riffle	Header rock is perched; bed is stable; no repair necessary
3	UT2A	21+50	Constructed Riffle	Minor piping around header rock; no repair necessary
4	UT4	18+60	Step Pools	Piping beneath lower header rocks; upper step pools stable; no repair necessary
5	UT5	24+50	Rock Cross Vane	Piping below header rock; bed is stable; no repair necessary
6	M2	28+70	Rock Cross Vane	Header rock perched; bed is stable; no repair necessary
7	M2	30+90	Constructed Riffle	Minor piping beneath header rock; bed is stable; no repair necessary
8	M2	38+10	Step Pools	Lower header rocks are perched; minor erosion on banks; overall system is stable and re-vegetating; no repairs recommended

4.0 CONCLUSIONS AND RECOMMENDATIONS

- Vegetation monitoring documented the average planted stems per acre on site is 538. Invasive and volunteer species do not pose significant risks to vegetation success. The site has met the final vegetation success criteria of 260 stems per acre surviving at the end of the fifth growing season.

- Data collected during monitoring Year 5 and observations of conditions at the site indicate that the stream restoration project is successful and has achieved the stream success criteria as specified in the Restoration Plan. The stream morphology is stable. Repairs to structures specified in prior South Fork Adaptive Management Reports successfully corrected problem areas and no additional repairs are necessary. Several in-stream structures have minor piping, but are stable and do not affect the overall system integrity. Some slight siltation in pools is occurring, resulting in vegetation growth in the channel. Several aquatic organisms and fish were observed along the reaches. Habitat has been improved significantly throughout the project site.

- 2009 is Year 5 of the monitoring period. No further monitoring of the South Fork Mitigation Site is required.

APPENDIX A

As-Built Survey

STATE	PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	0169R	1	24

NO.	DATE	CHECKED BY	APPROVED BY
1	07/11/06	JOHN HUTTON	KEVIN TWEEDY

SOUTH FORK

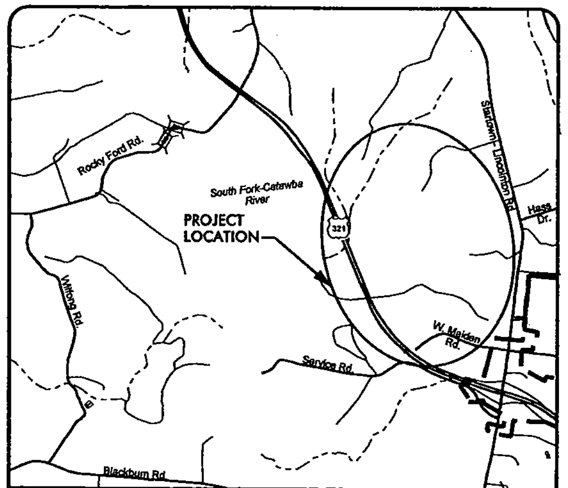
PROJECT: 169

STREAM RESTORATION PROJECT
ENVIRONMENTAL BANC AND EXCHANGE, LLC

CATAWBA COUNTY

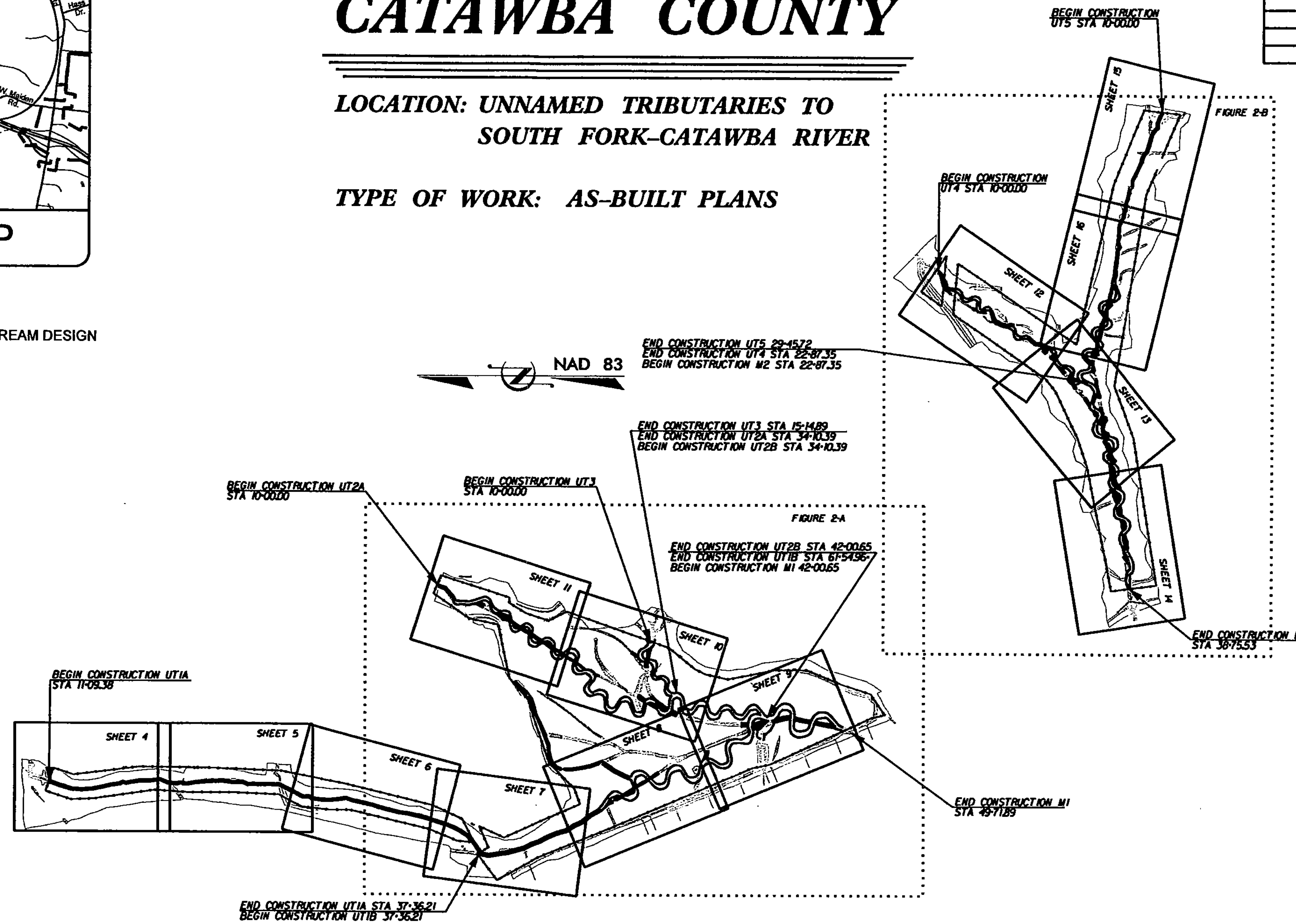
LOCATION: UNNAMED TRIBUTARIES TO SOUTH FORK-CATAWBA RIVER

TYPE OF WORK: AS-BUILT PLANS



VICINITY MAP

INDEX OF SHEETS



NOTE:
SEE APPENDIX FOR SHEETS 4-16

GRAPHIC SCALES

50 25 0 50 100
PLANS

50 25 0 50 100
PROFILE (HORIZONTAL)

0
PROFILE (VERTICAL)

PROJECT SUMMARY

Project Feature	Existing Condition	As-Built Condition
UT1	4,642LF	5,112LF
UT2	2,109LF	3,246LF
UT3	417LF	526LF
M1	547LF	726LF
UT4	1,154LF	1,226LF
UT5	1,795LF	1,898LF
M2	1,254LF	1,560LF
Total	**11,918LF**	**14,294LF**

NOTE: LANDOWNER EASEMENTS SUBTRACTED FROM DESIGN STREAM LENGTHS

PREPARED FOR THE OFFICE OF:
ENVIRONMENTAL BANC AND EXCHANGE, LLC

EBX

10055 RED RUN BOULEVARD, SUITE 130
OWING MILLS, MD 21117

220 CHATHAM BUSINESS DRIVE
PITTSBORO, NORTH CAROLINA 27312

EBX CONTACT:
TARA DISY ALLDEN
PROJECT MANAGER

PREPARED IN THE OFFICE OF:

BUCK ENGINEERING
8000 Regency Parkway, Suite 200
Cary, North Carolina 27511
Phone: 919-463-5488
Fax: 919-463-5490

November 2004
LETTING DATE:

KEVIN L. TWEEDY, PE
PROJECT ENGINEER

JOHN HUTTON
PROJECT MANAGER

PROJECT ENGINEER

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027337
JULY 21, 2005

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2/26/03

PROJECT REFERENCE NO.	SHEET NO.
169	18

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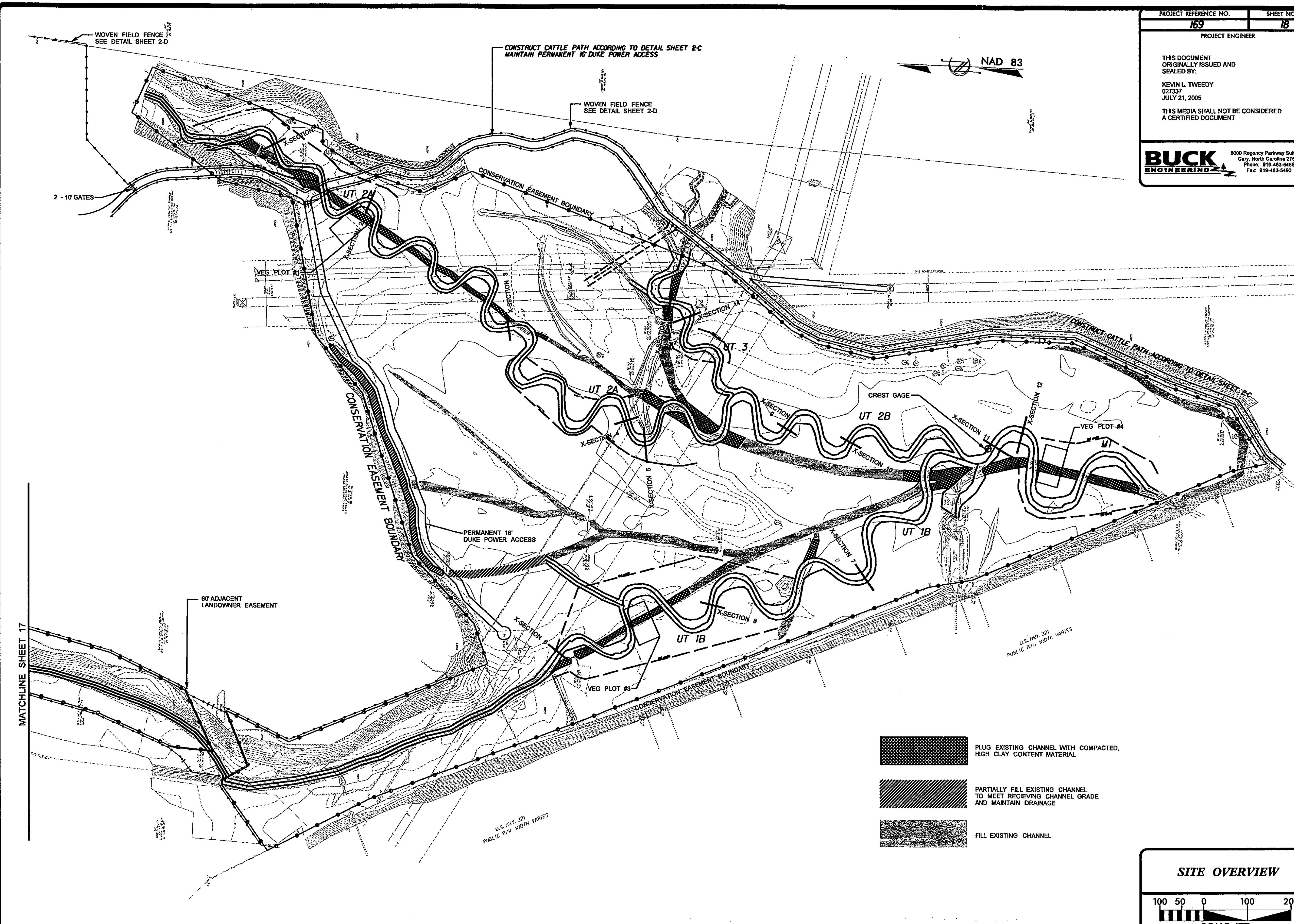

PLUG EXISTING CHANNEL WITH COMPACTED, HIGH CLAY CONTENT MATERIAL

PARTIALLY FILL EXISTING CHANNEL TO MEET RECIEVING CHANNEL GRADE AND MAINTAIN DRAINAGE

FILL EXISTING CHANNEL

SITE OVERVIEW

100 50 0 100 200

SCALE (FT)

11/10/2005
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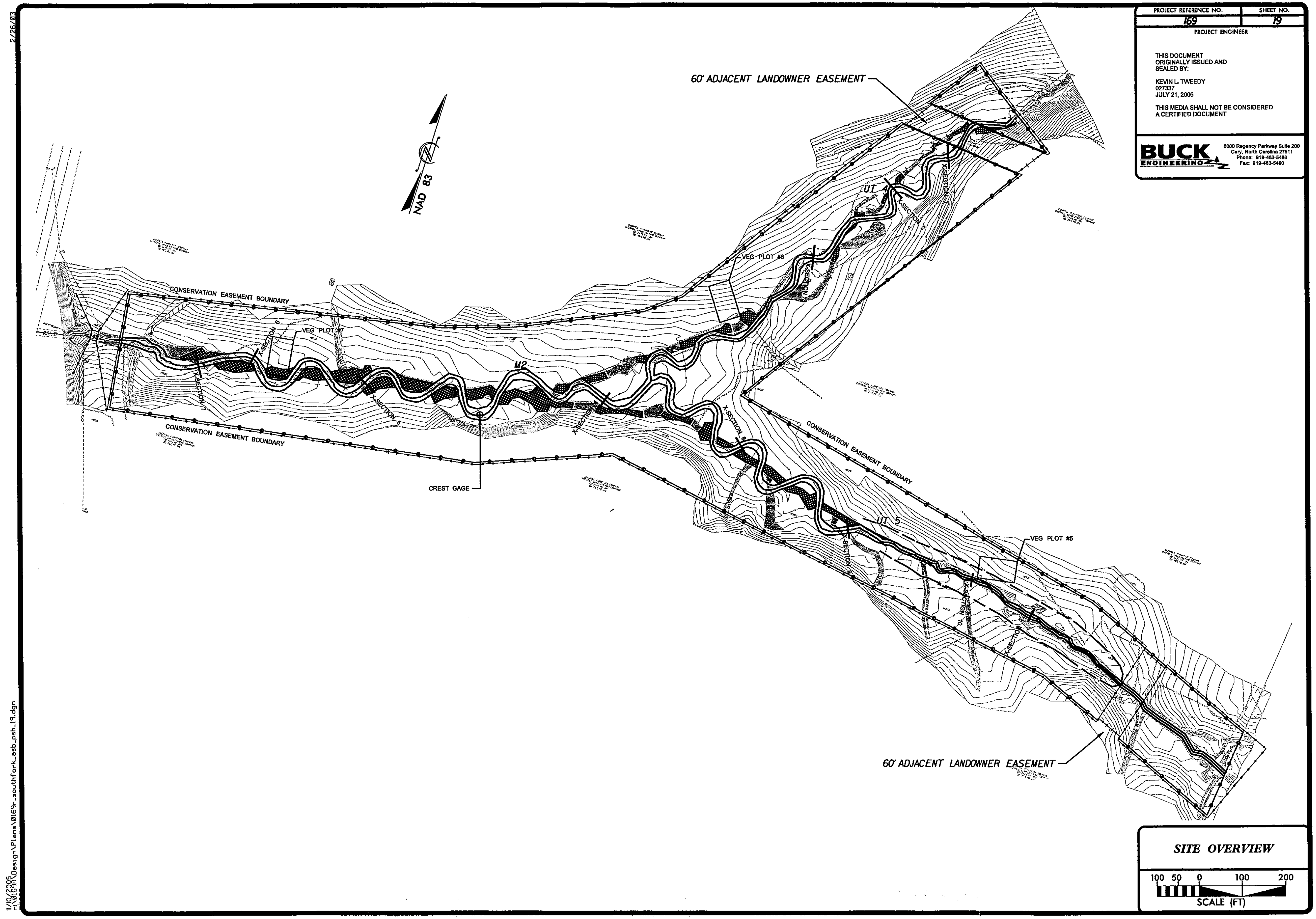

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SHEET NO. 19
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NAD 83
60' ADJACENT LANDOWNER EASEMENT
CONSERVATION EASEMENT BOUNDARY
VEG PLOT #7
VEG PLOT #6
VEG PLOT #5
X-SECTION 7
X-SECTION 6
X-SECTION 5
X-SECTION 8
X-SECTION 9
X-SECTION 10
X-SECTION 3
X-SECTION 2
X-SECTION 1
M2
UT 4
UT 5
CREST GAGE
SITE OVERVIEW
100 50 0 100 200
SCALE (FT)
2/26/03
11/10/2005
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PROJECT REFERENCE NO.	SHEET NO.
0169	4

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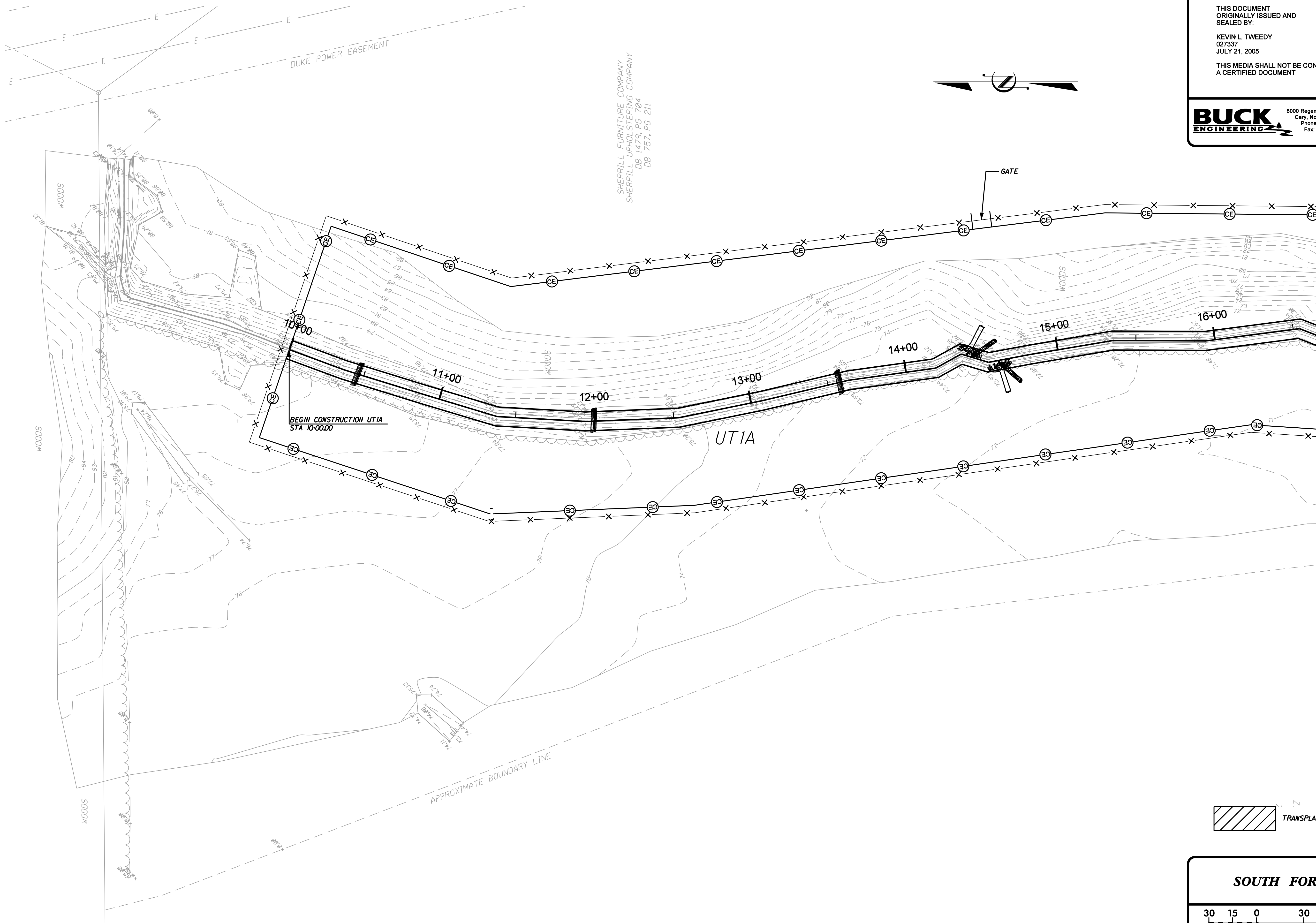

SOUTH FORK

SCALE (FT) 30 15 0 30 60

2/26/03
10/18/2005
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PROJECT REFERENCE NO.	SHEET NO.
0169	5

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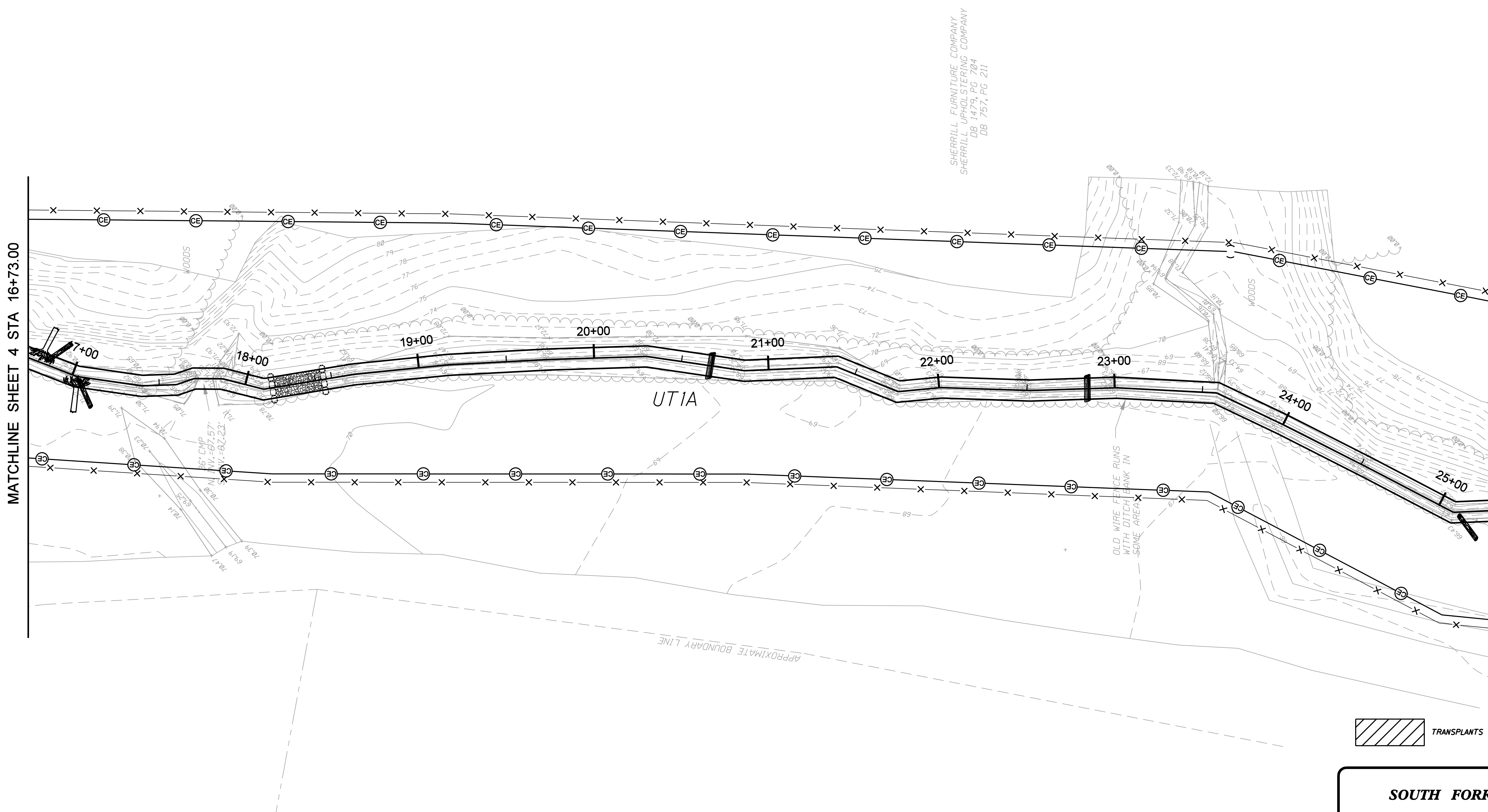

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SCALE (FT)

2/26/03
10/18/2005
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PROJECT REFERENCE NO.	SHEET NO.
0169	6

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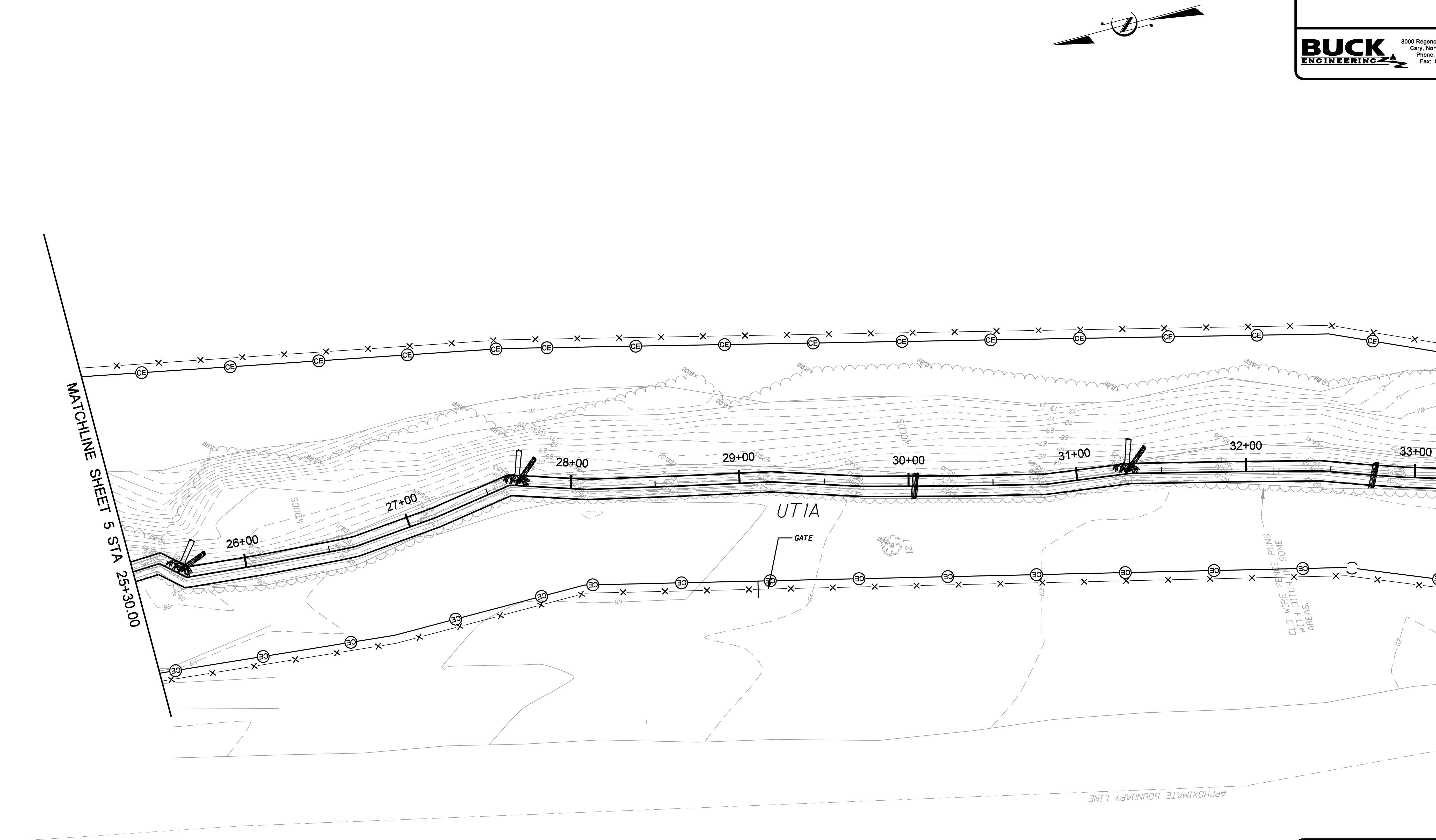

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2/26/03

10/18/2005
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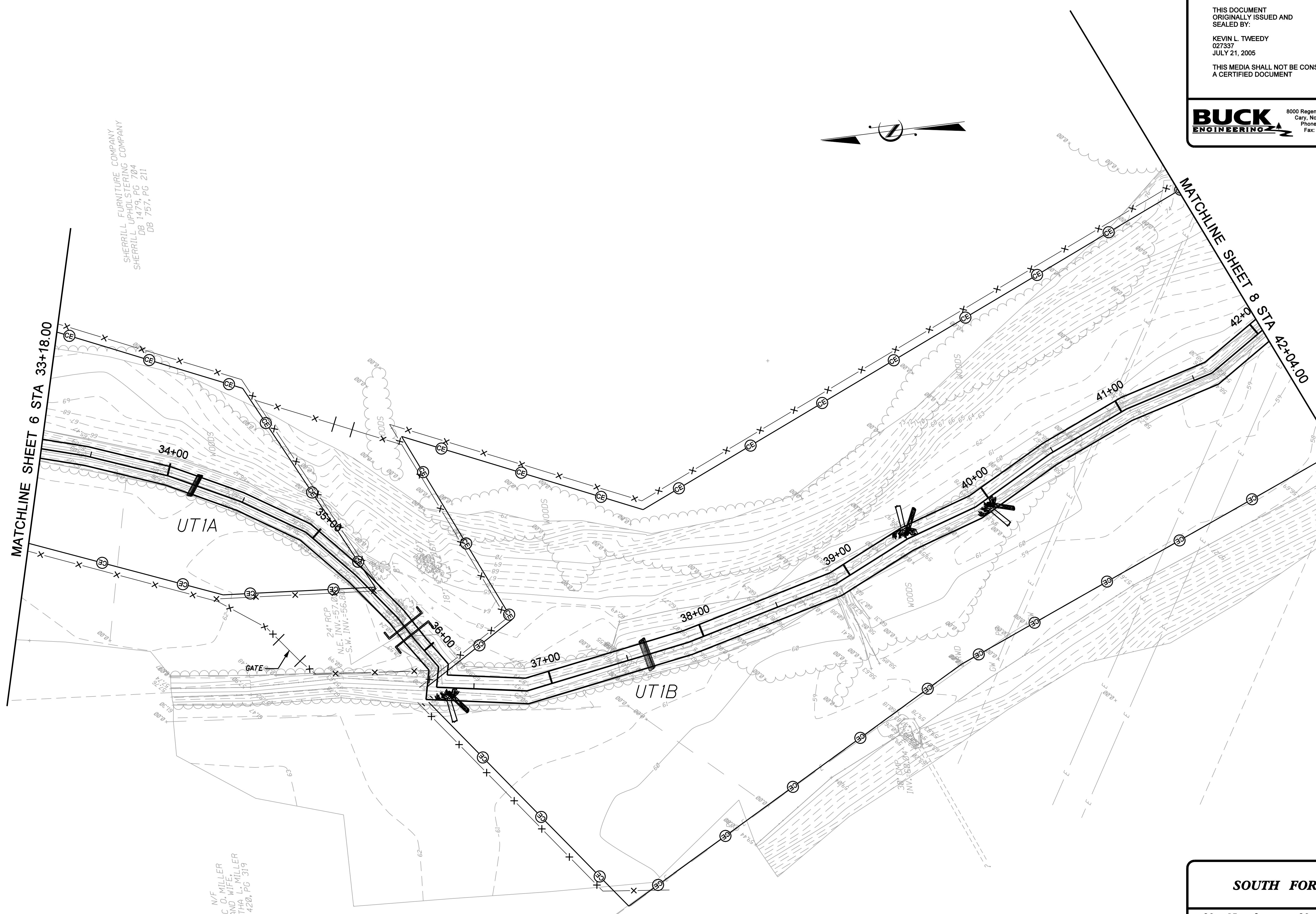

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0169	7

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SOUTH FORK

30 15 0 30 60
SCALE (FT)

2/26/03

10/18/2005
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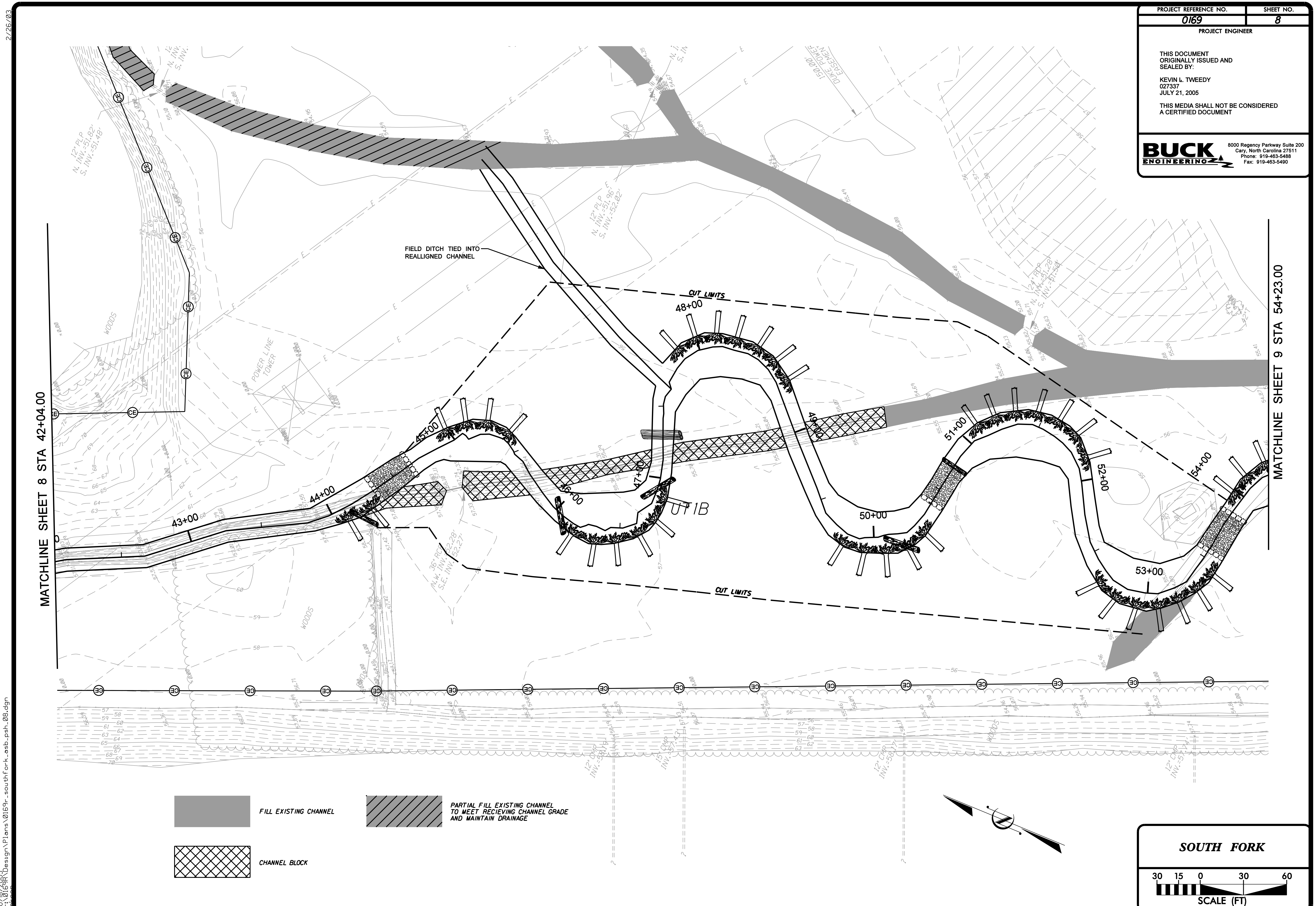
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SHEET NO.
8
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Fax: 919-463-5490
FIELD DITCH TIED INTO REALLIGNED CHANNEL
CUT LIMITS
CUT LIMITS
MATCHLINE SHEET 8 STA 42+04.00
MATCHLINE SHEET 9 STA 54+23.00
43+00
44+00
45+00
46+00
47+00
48+00
49+00
50+00
51+00
52+00
53+00
54+00
UT1B
POWER LINE TOWER
WOODS
FILL EXISTING CHANNEL
PARTIAL FILL EXISTING CHANNEL TO MEET RECIEVING CHANNEL GRADE AND MAINTAIN DRAINAGE
CHANNEL BLOCK
SOUTH FORK
30 15 0 30 60
SCALE (FT)
2/26/03
10/18/2005
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PROJECT REFERENCE NO.	SHEET NO.
0169	9

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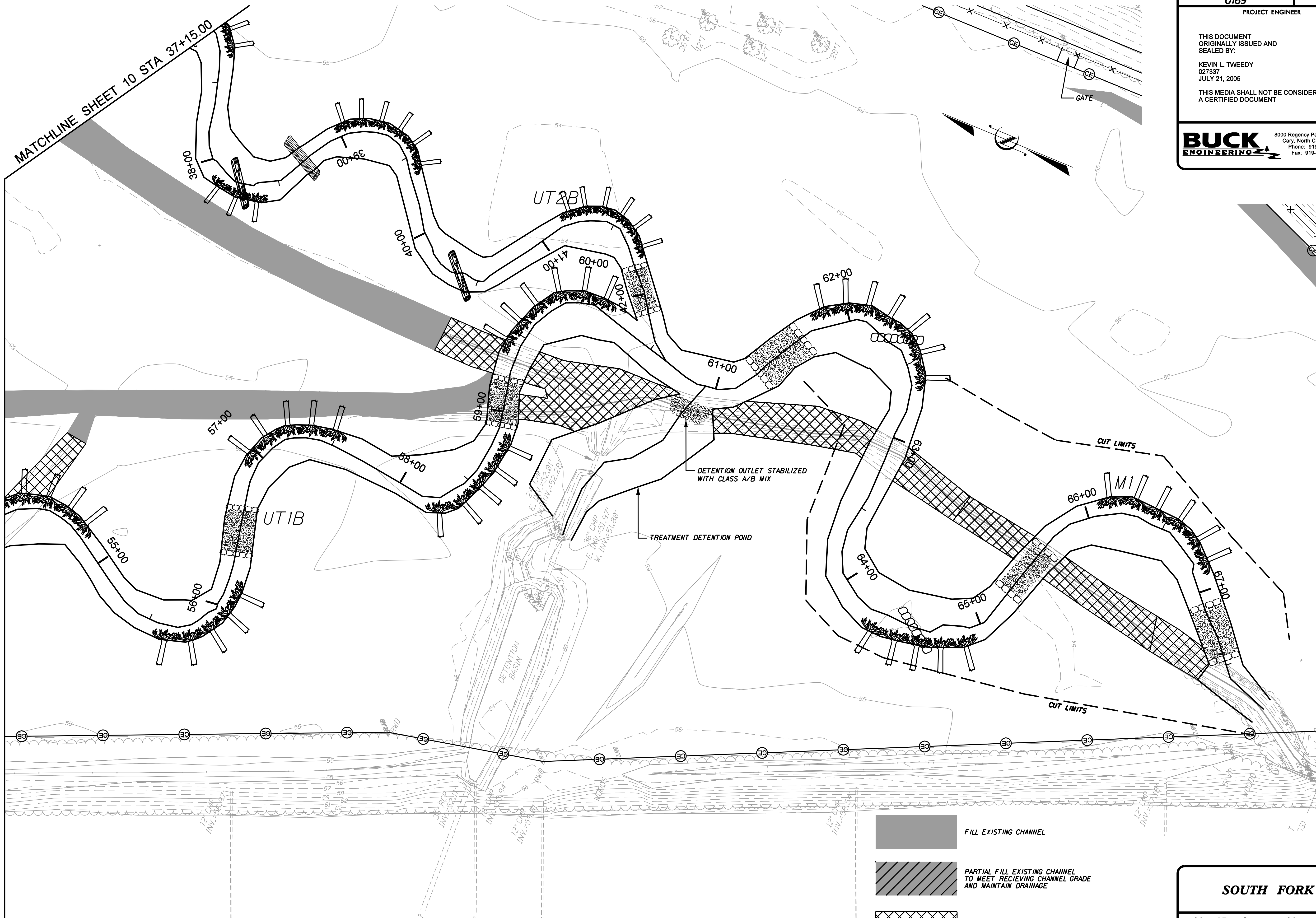

FILL EXISTING CHANNEL

PARTIAL FILL EXISTING CHANNEL TO MEET RECIEVING CHANNEL GRADE AND MAINTAIN DRAINAGE

CHANNEL BLOCK

SOUTH FORK

30 15 0 30 60
SCALE (FT)

2/26/03

10/18/2005
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PROJECT REFERENCE NO.	SHEET NO.
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SOUTH FORK

30 15 0 30 60
SCALE (FT)

PROJECT REFERENCE NO.	SHEET NO.
169	11

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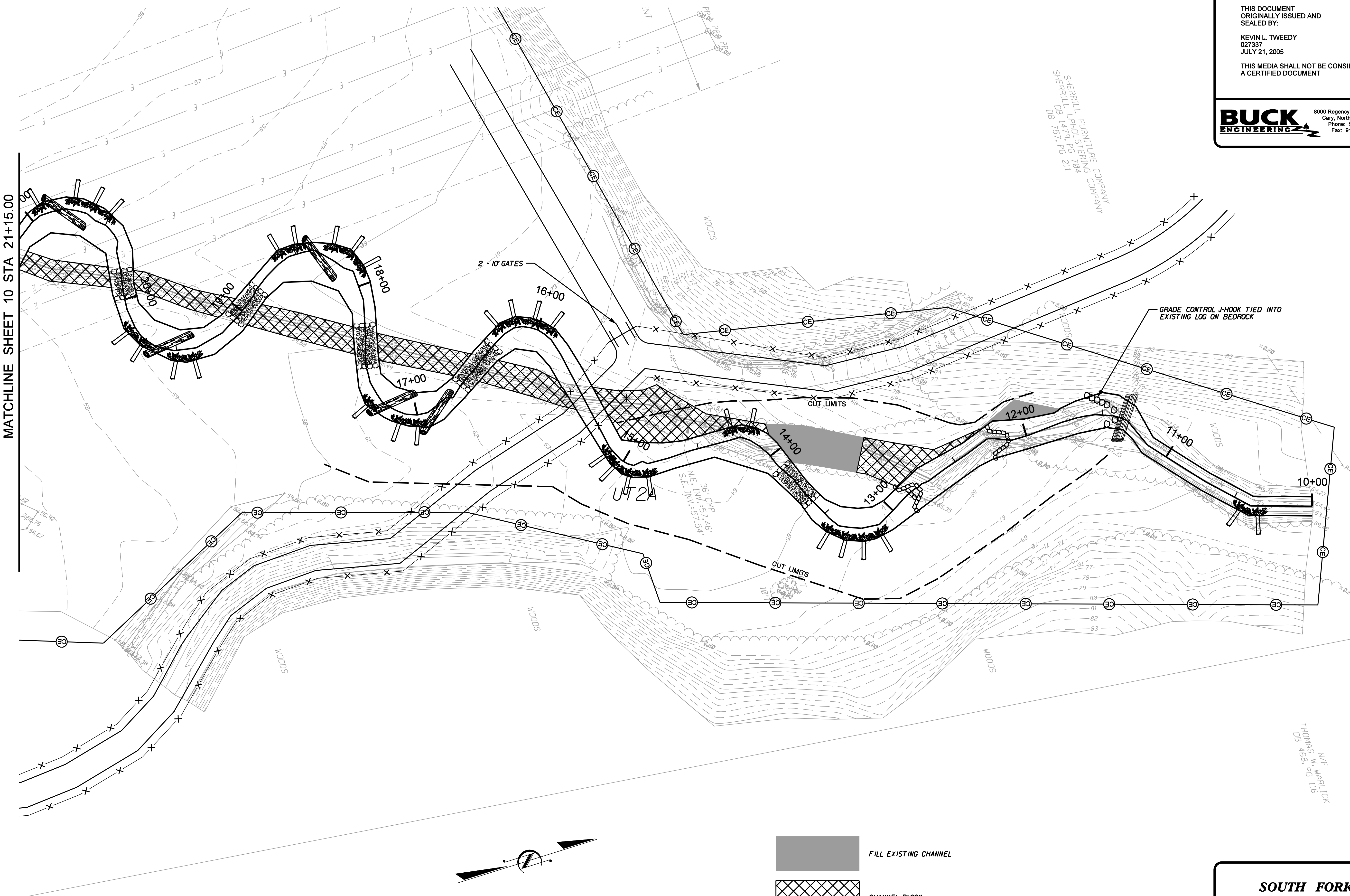

SOUTH FORK

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SCALE (FT)

2/26/03
10/18/2005
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169	12

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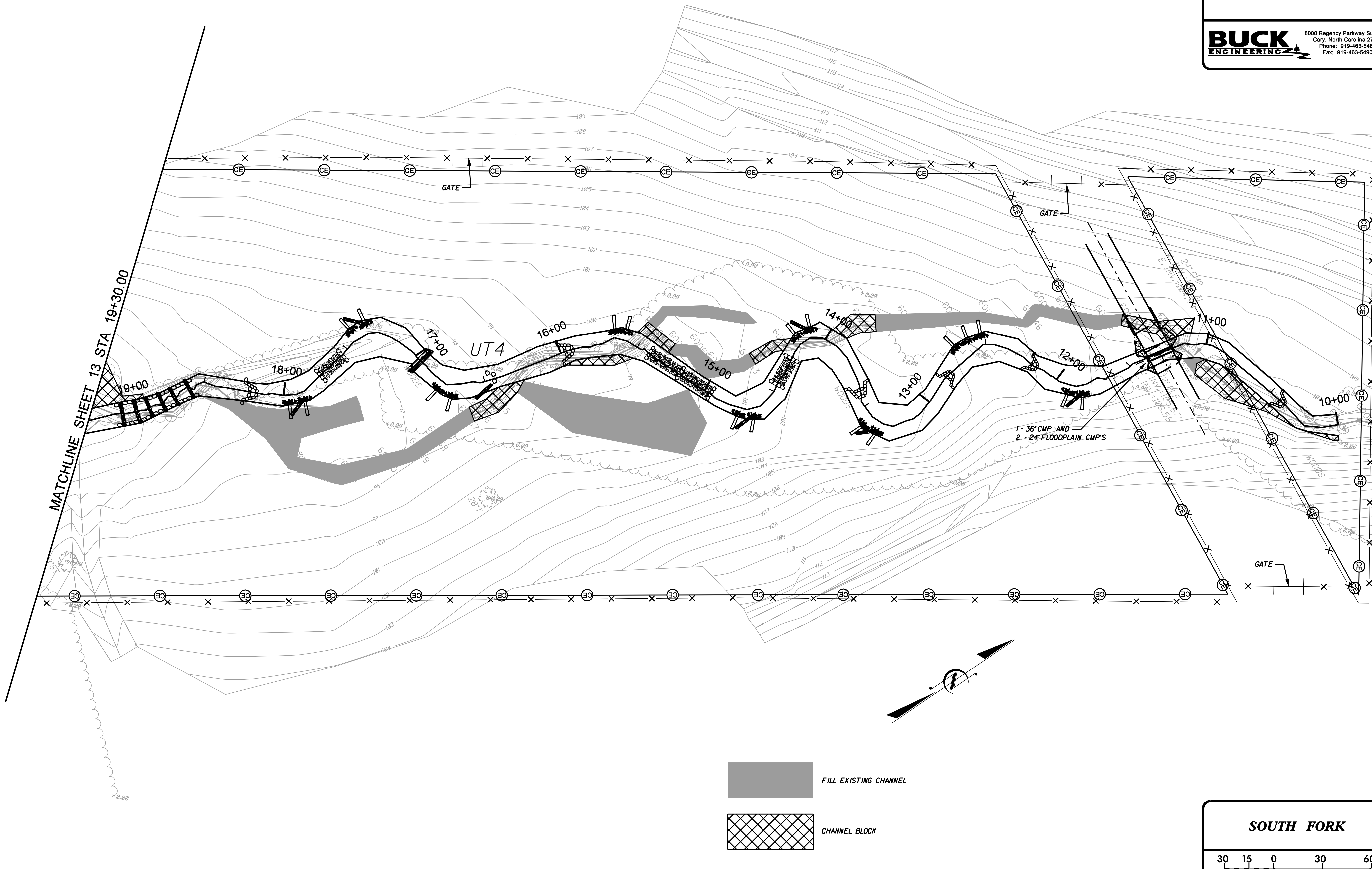
2/26/03



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SCALE (FT)

10/18/2005
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PROJECT REFERENCE NO.	SHEET NO.
169	13

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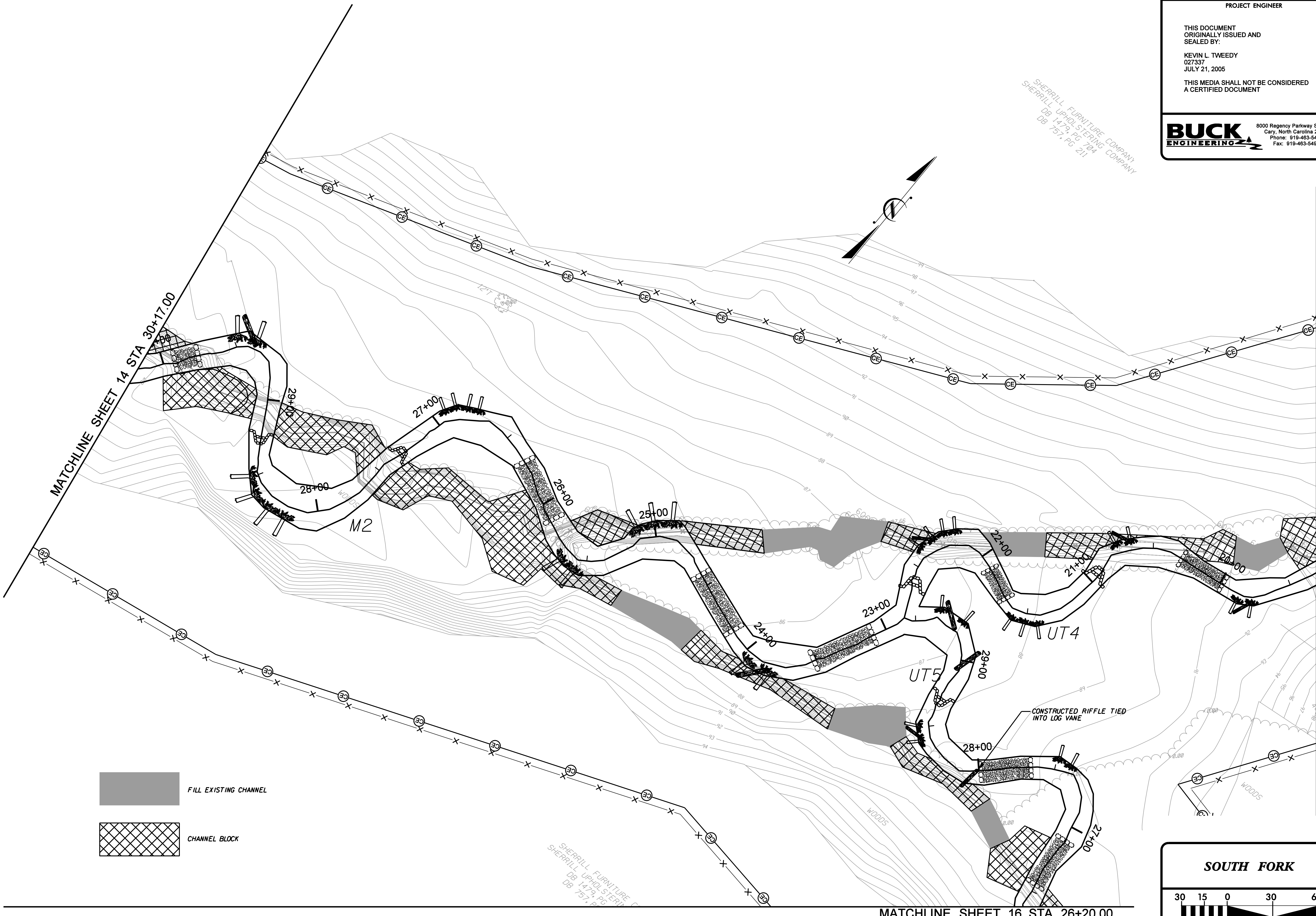

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SCALE (FT)

2/26/03

10/18/2005
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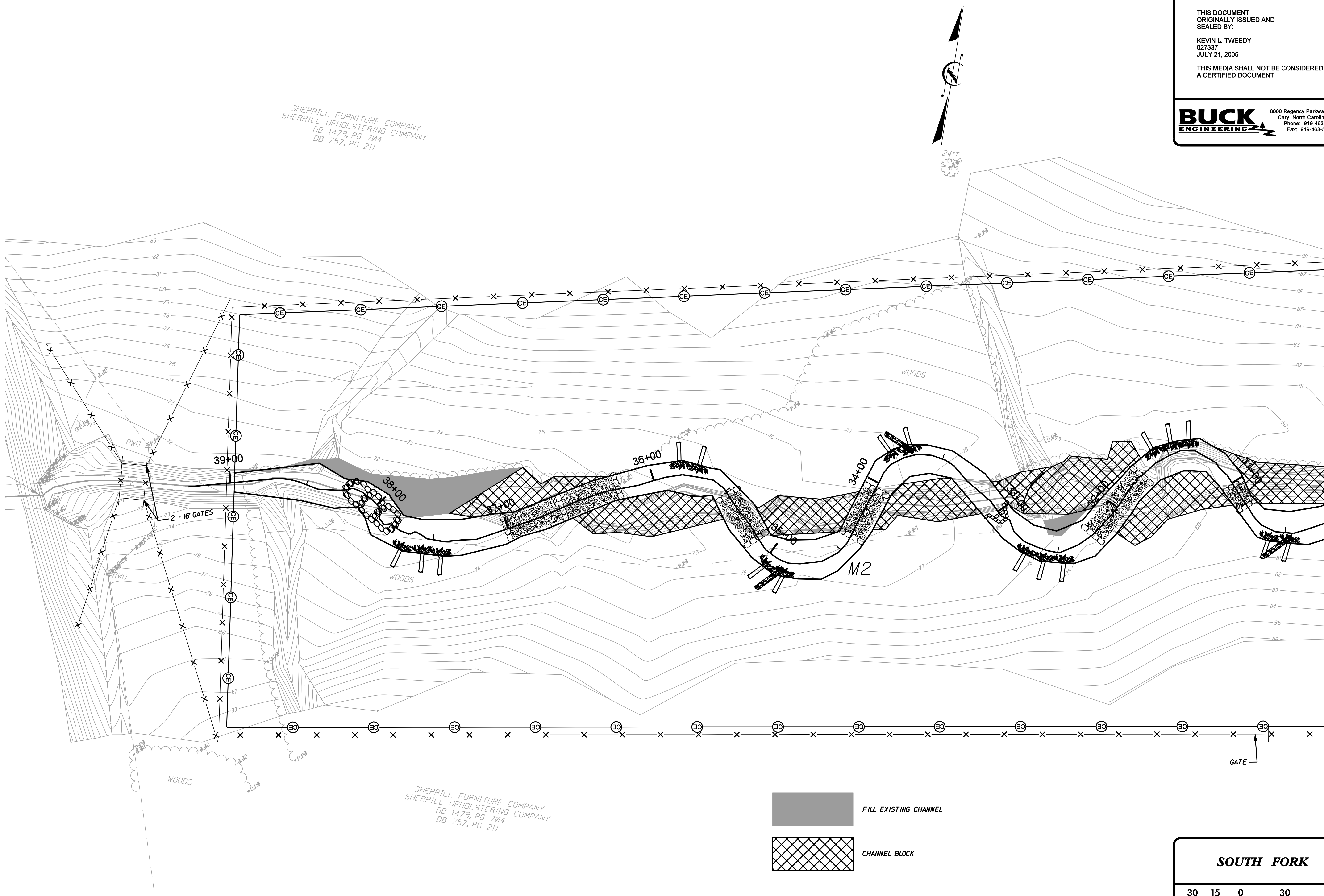

SOUTH FORK

30 15 0 30 60
SCALE (FT)

2/26/03

10/18/2005
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PROJECT REFERENCE NO.	SHEET NO.
169	15

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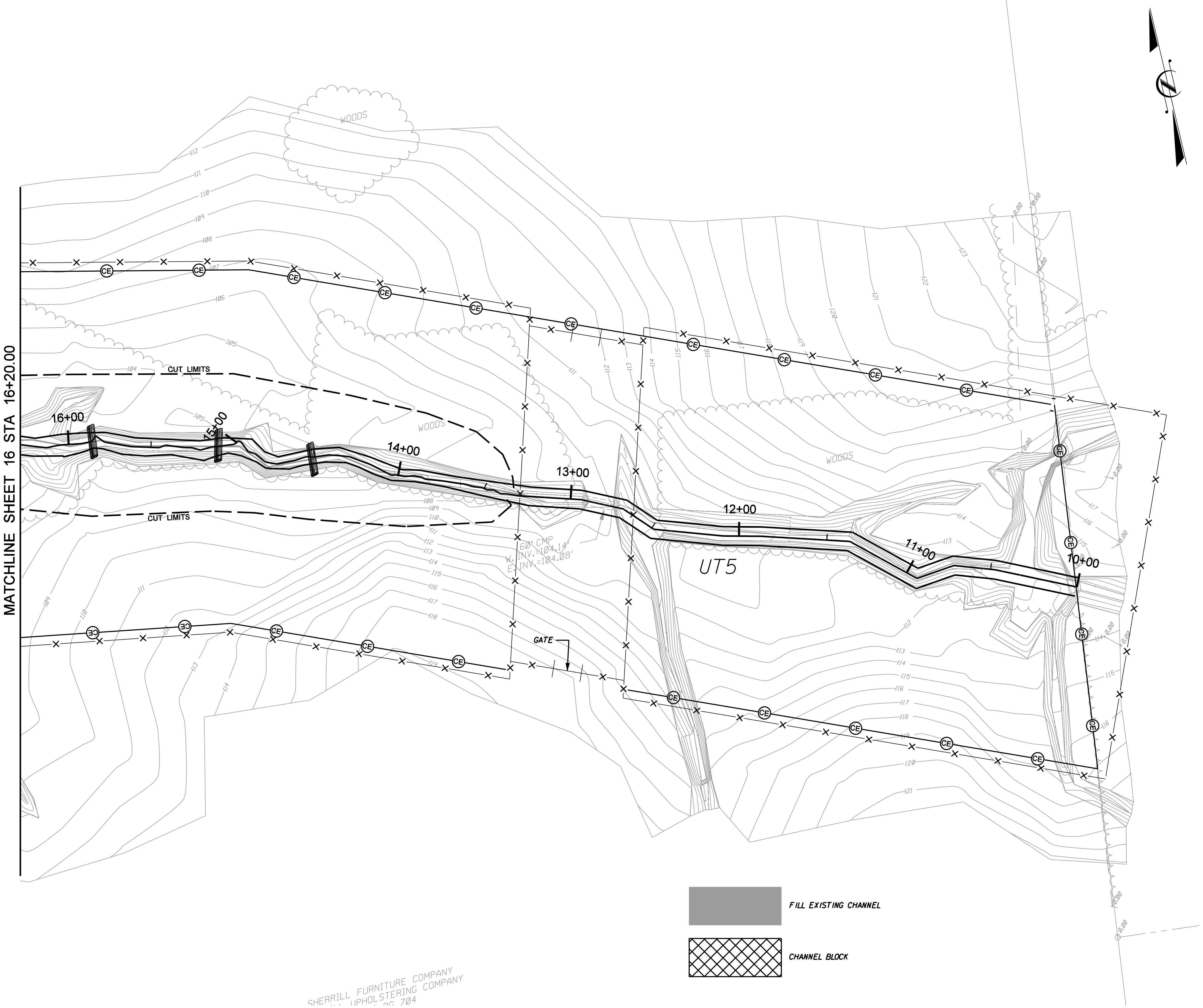

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SCALE (FT)

2/26/03
10/18/2005
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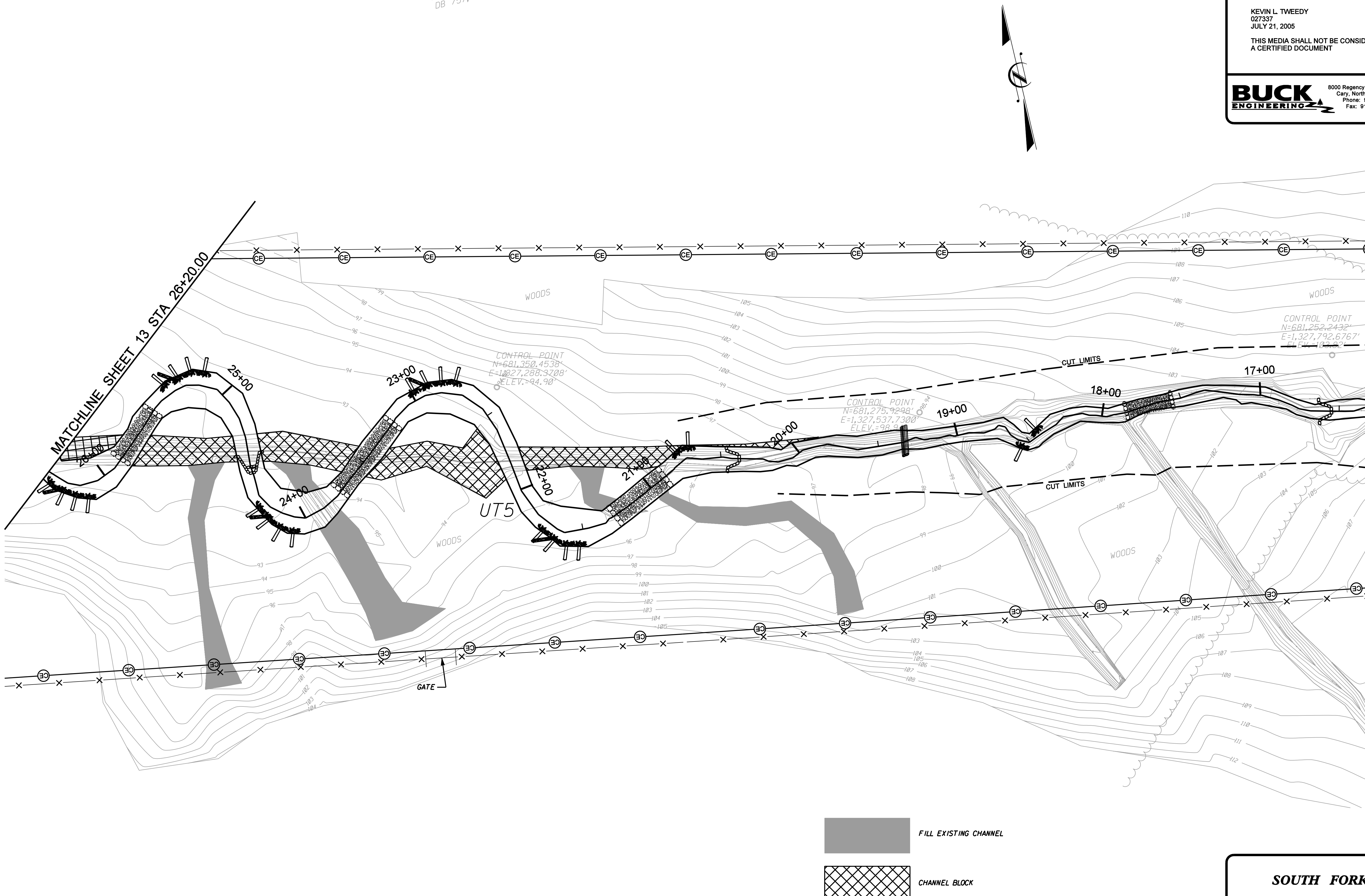

SOUTH FORK

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SCALE (FT)

2/26/03

10/18/2005
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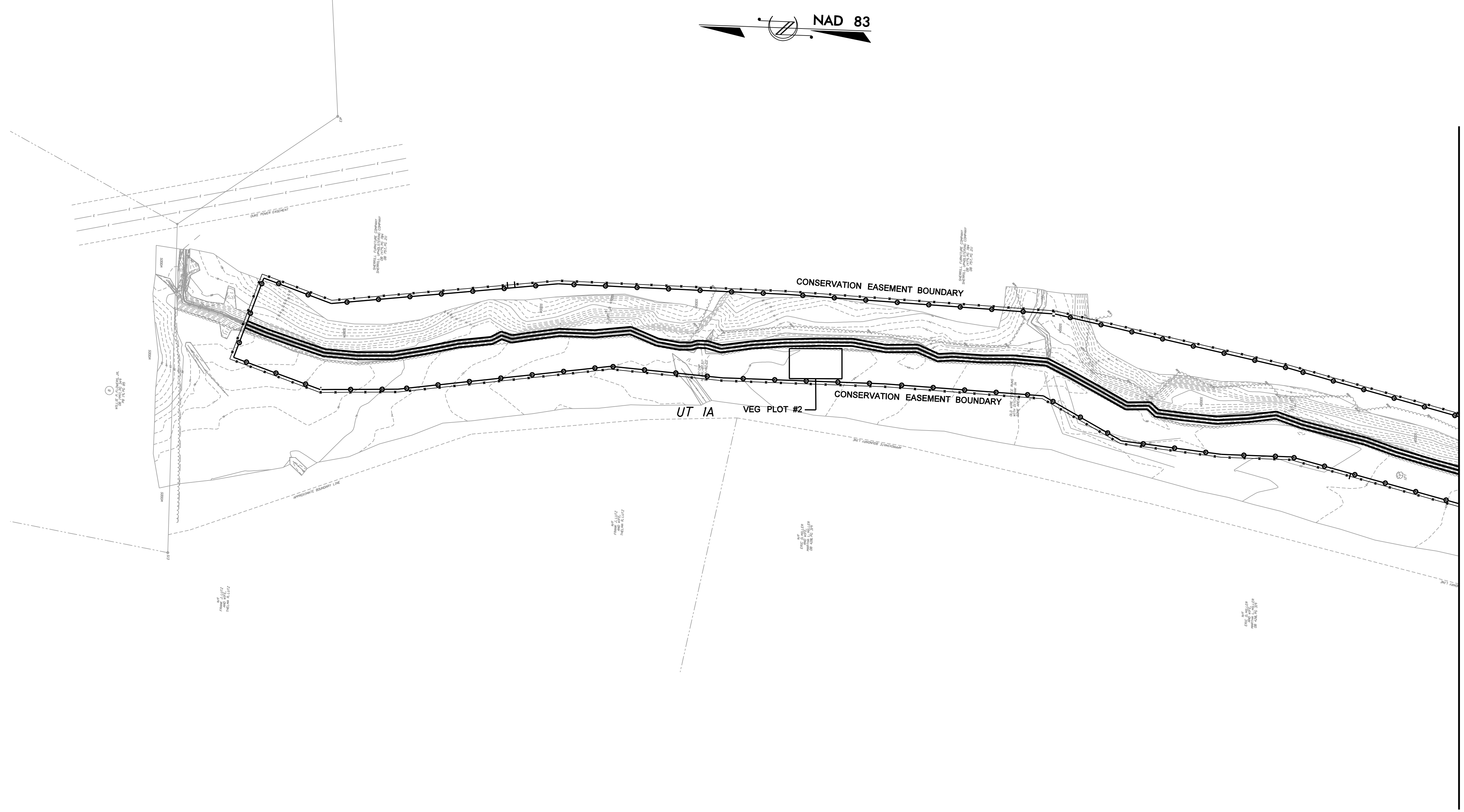

SITE OVERVIEW

100 50 0 100 200
SCALE (FT)

2/26/03

10/18/2005
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PROJECT REFERENCE NO.	SHEET NO.
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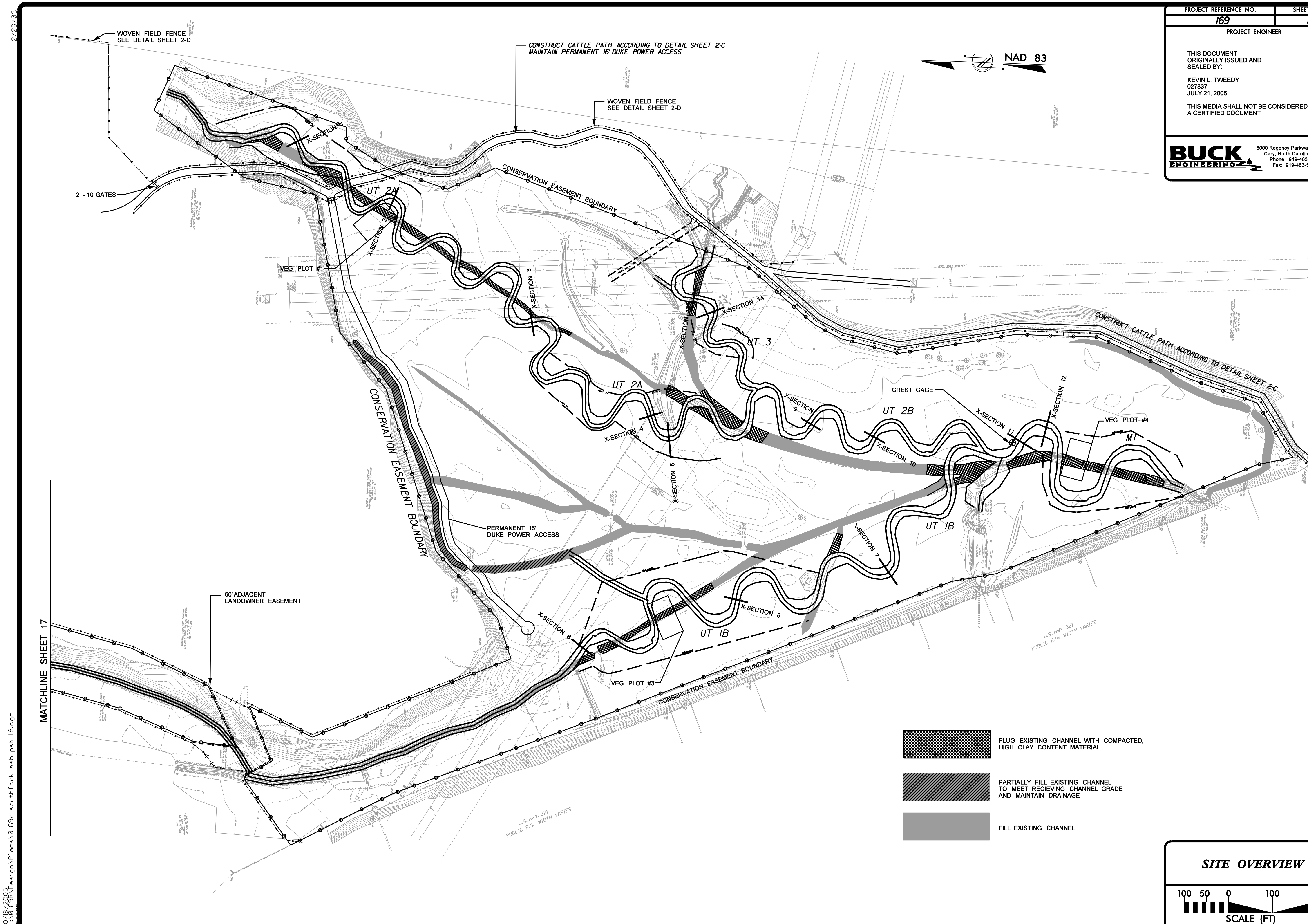


PLUG EXISTING CHANNEL WITH COMPACTED, HIGH CLAY CONTENT MATERIAL

PARTIALLY FILL EXISTING CHANNEL TO MEET RECIEVING CHANNEL GRADE AND MAINTAIN DRAINAGE

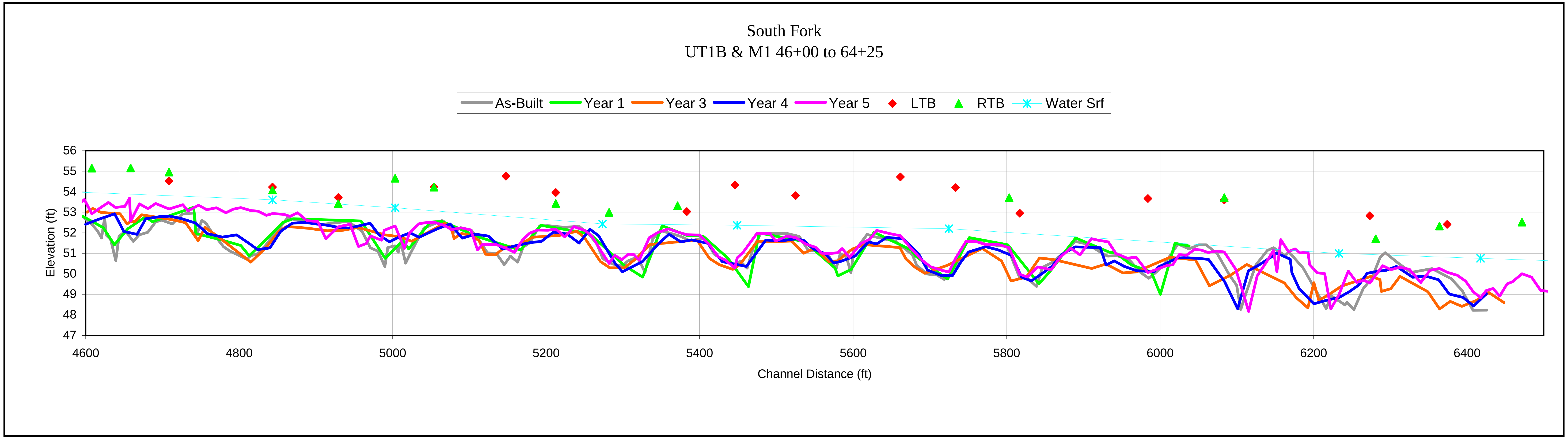
FILL EXISTING CHANNEL

SITE OVERVIEW

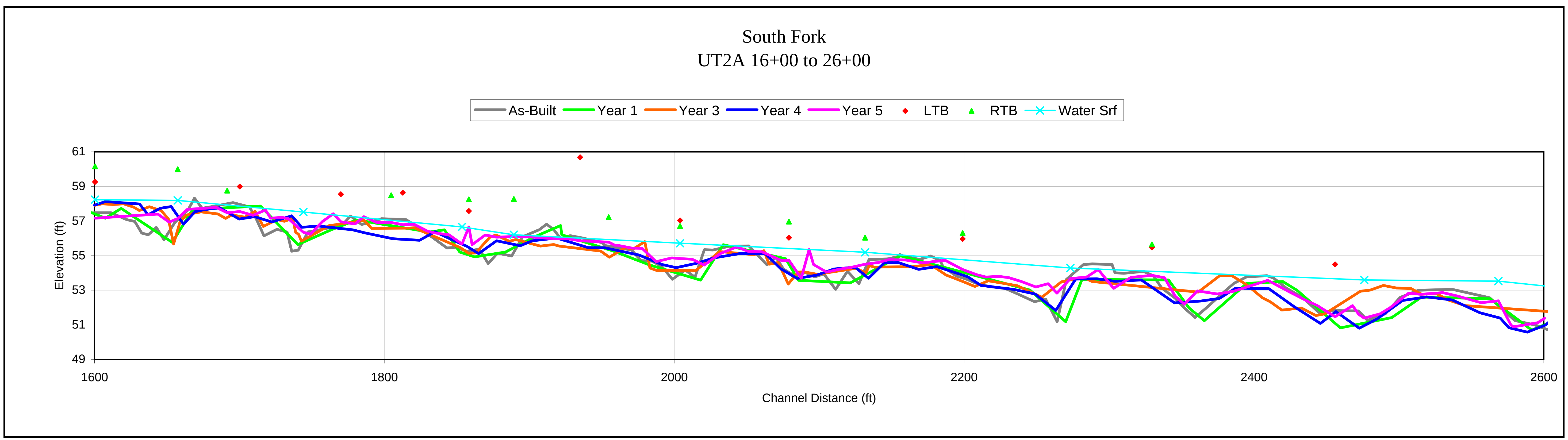
100 50 0 100 200
SCALE (FT)

APPENDIX B

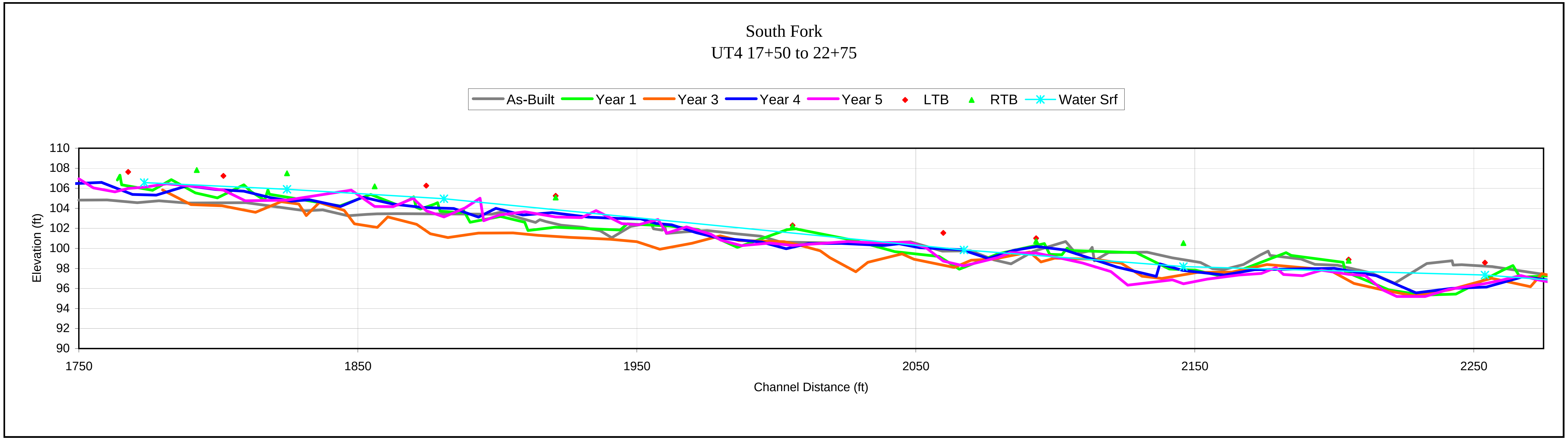
2009 Cross Section Data and Profile Data

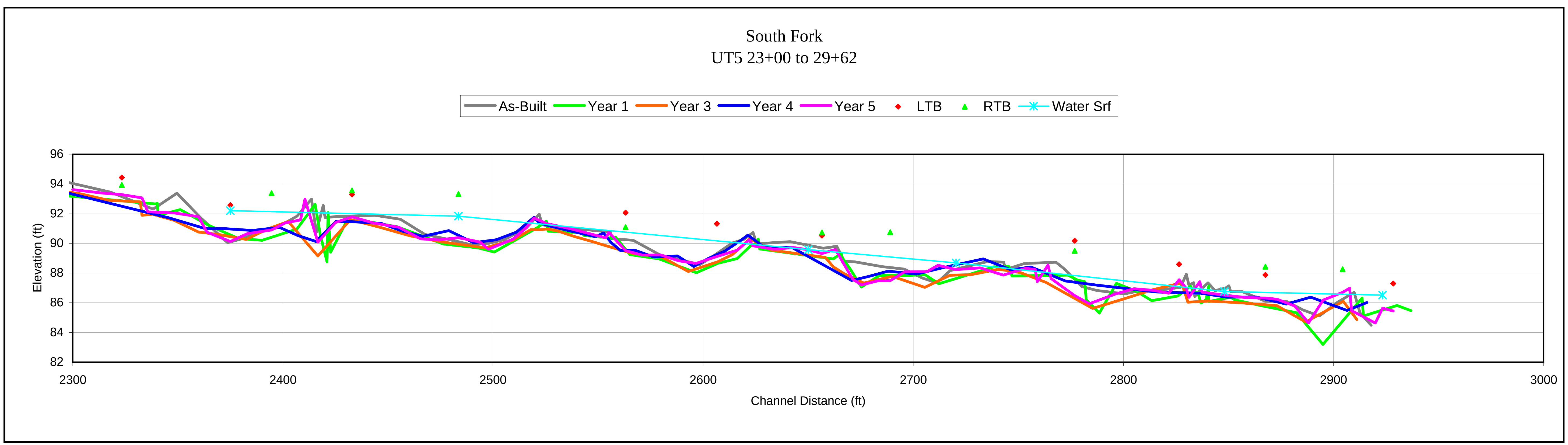


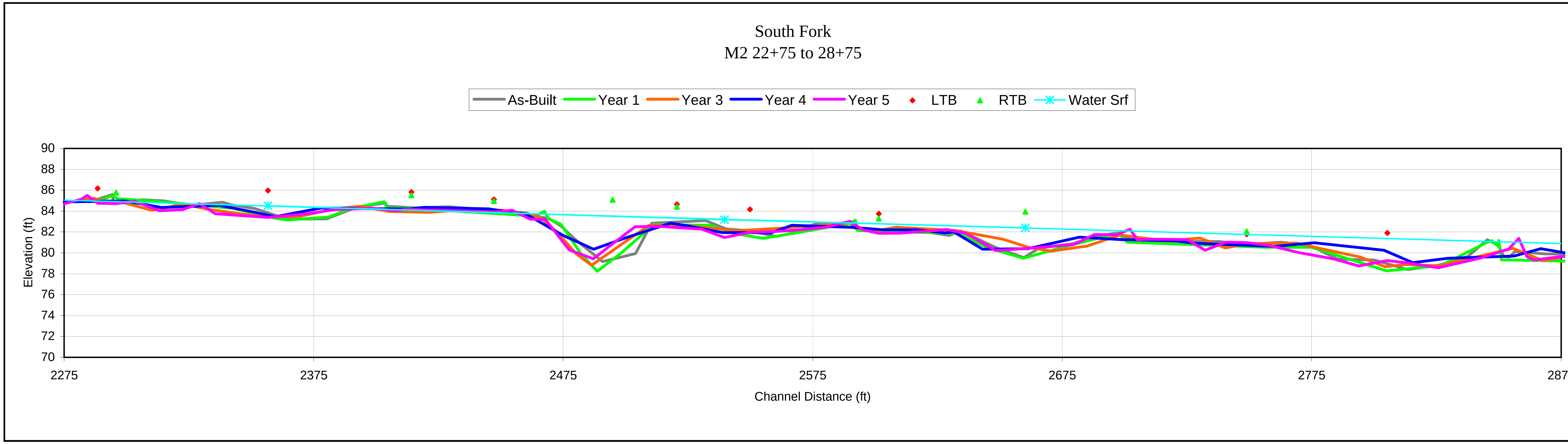
South Fork
UT1B & M1 46+00 to 64+25
As-Built
Year 1
Year 3
Year 4
Year 5
LTB
RTB
Water Srf
Elevation (ft)
56
55
54
53
52
51
50
49
48
47
4600
4800
5000
5200
5400
5600
5800
6000
6200
6400
Channel Distance (ft)



South Fork
UT2A 16+00 to 26+00
As-Built
Year 1
Year 3
Year 4
Year 5
LTB
RTB
Water Srf
Elevation (ft)
61
59
57
55
53
51
49
1600
1800
2000
2200
2400
2600
Channel Distance (ft)


South Fork
UT4 17+50 to 22+75
As-Built
Year 1
Year 3
Year 4
Year 5
LTB
RTB
Water Srf
Elevation (ft)
Channel Distance (ft)
110
108
106
104
102
100
98
96
94
92
90
1750
1850
1950
2050
2150
2250

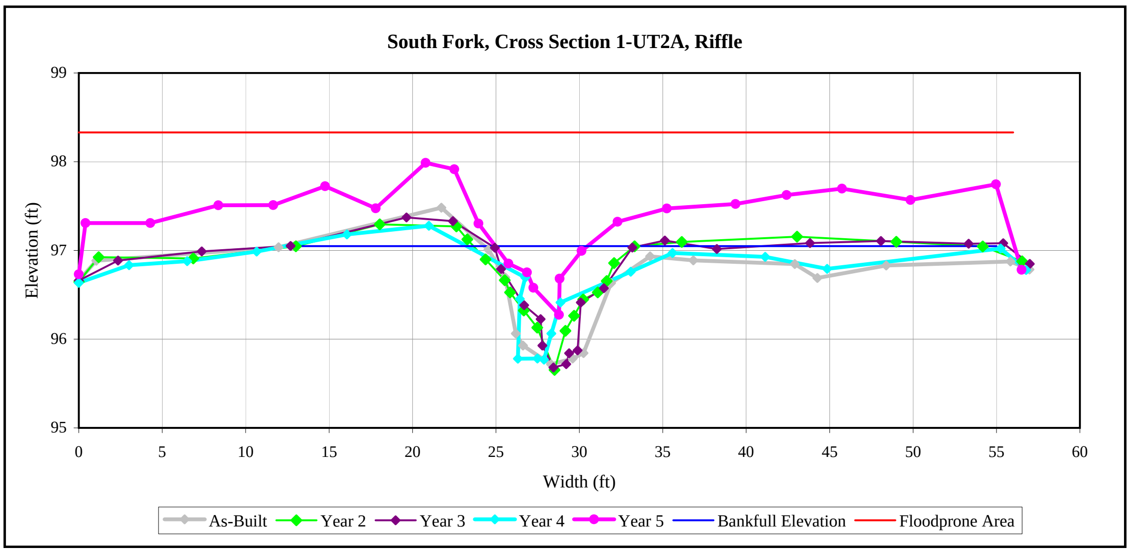

South Fork
UT5 23+00 to 29+62
As-Built
Year 1
Year 3
Year 4
Year 5
LTB
RTB
Water Srf
Elevation (ft)
Channel Distance (ft)
96
94
92
90
88
86
84
82
2300
2400
2500
2600
2700
2800
2900
3000



South Fork
M2 22+75 to 28+75
As-Built
Year 1
Year 3
Year 4
Year 5
LTB
RTB
Water Srf
Elevation (ft)
90
88
86
84
82
80
78
76
74
72
70
2275
2375
2475
2575
2675
2775
2875
Channel Distance (ft)

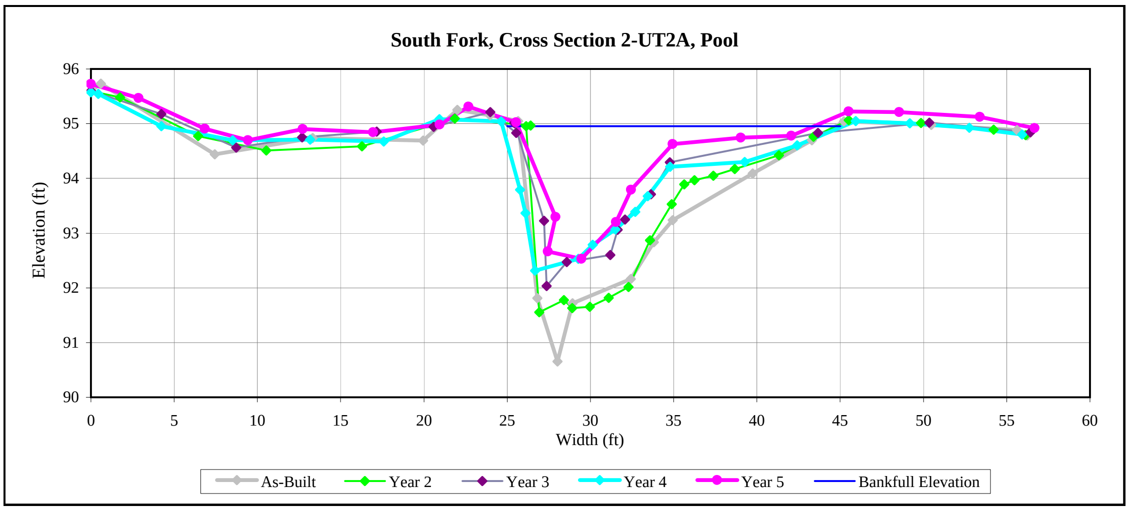
Looking at the left bank.

Looking at the right bank.



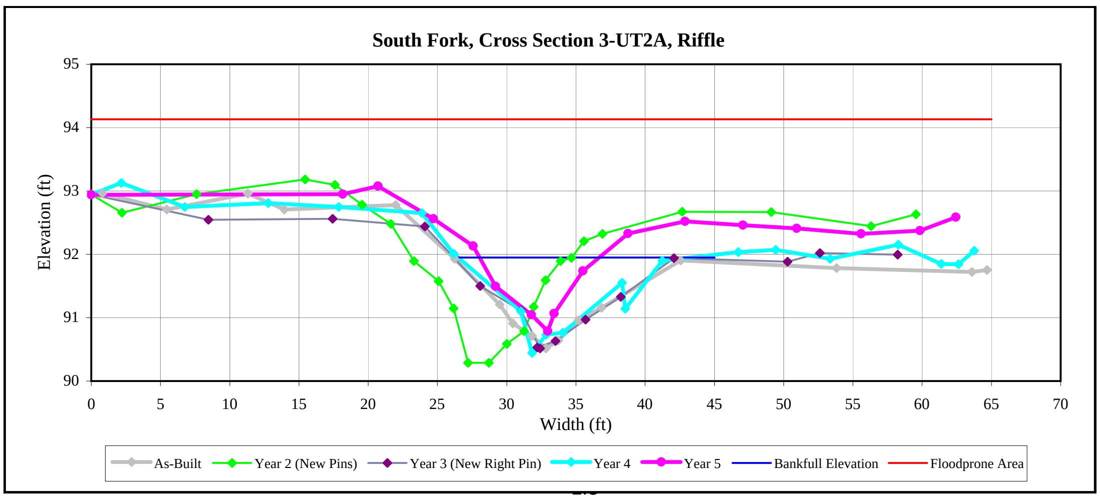
Looking at left bank.

Looking at right bank.



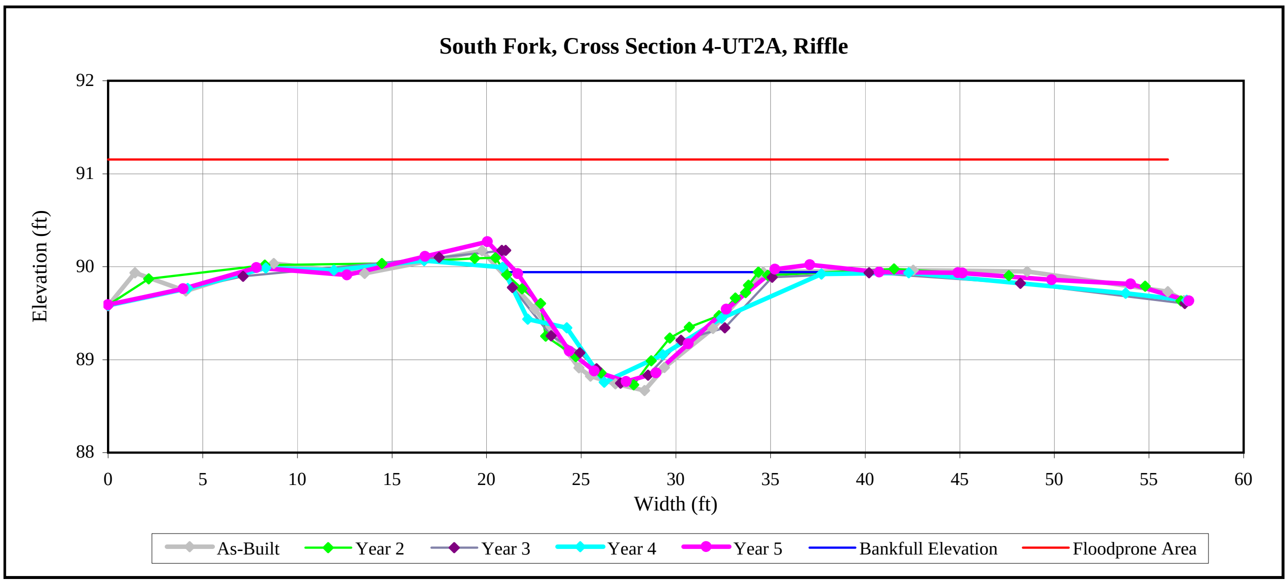
Looking at the left bank.

Looking at the right bank.



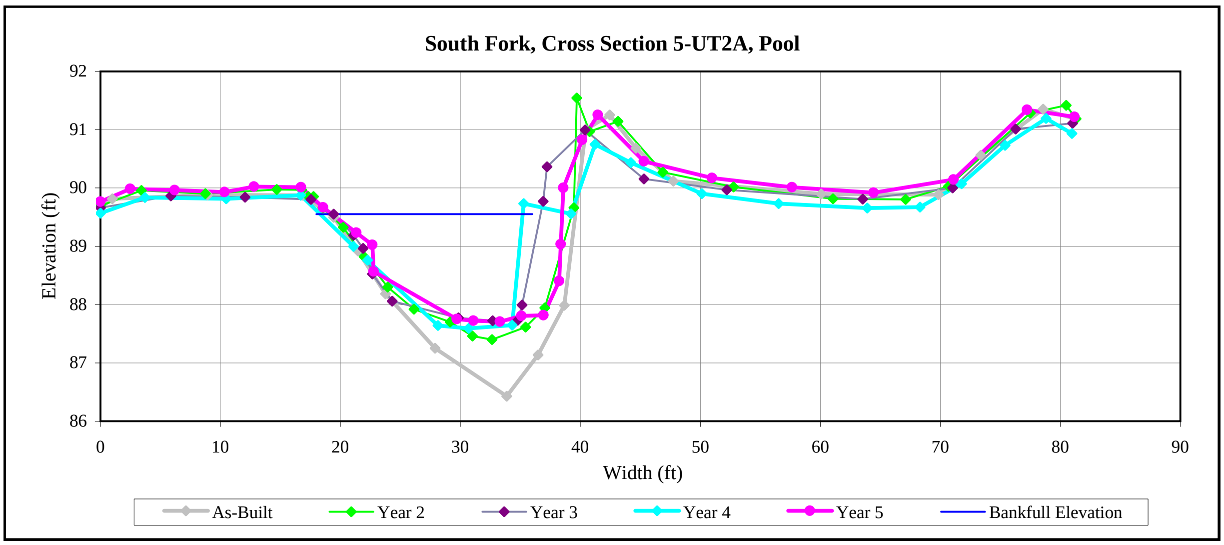
Looking at the left bank.

Looking at the right bank.



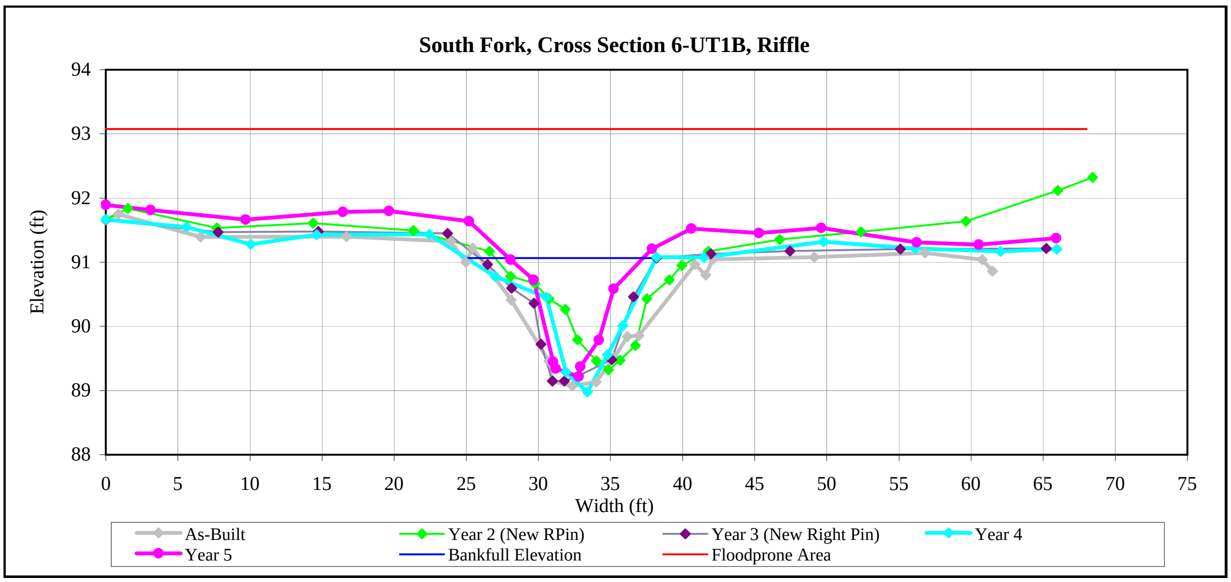
Looking at the left bank.

Looking at the right bank.



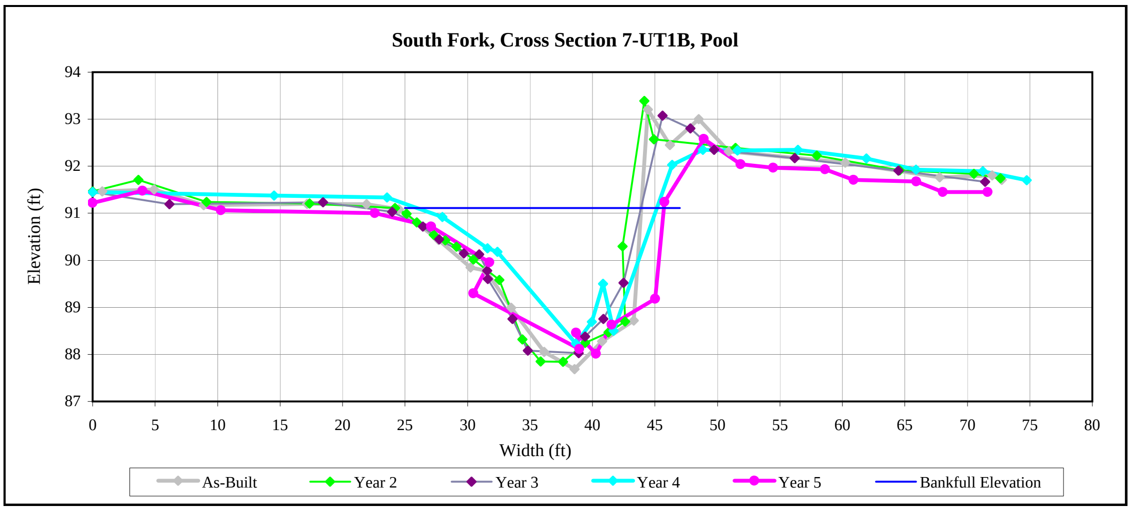
Looking at the left bank.

Looking at the right bank.



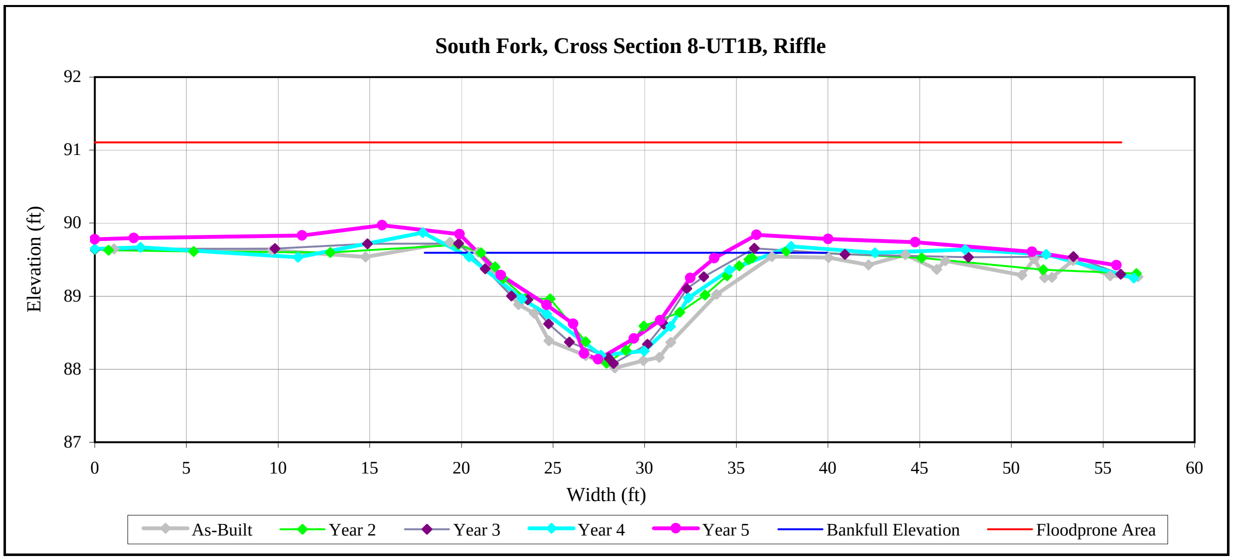
Looking at the left bank.

Looking at the right bank.



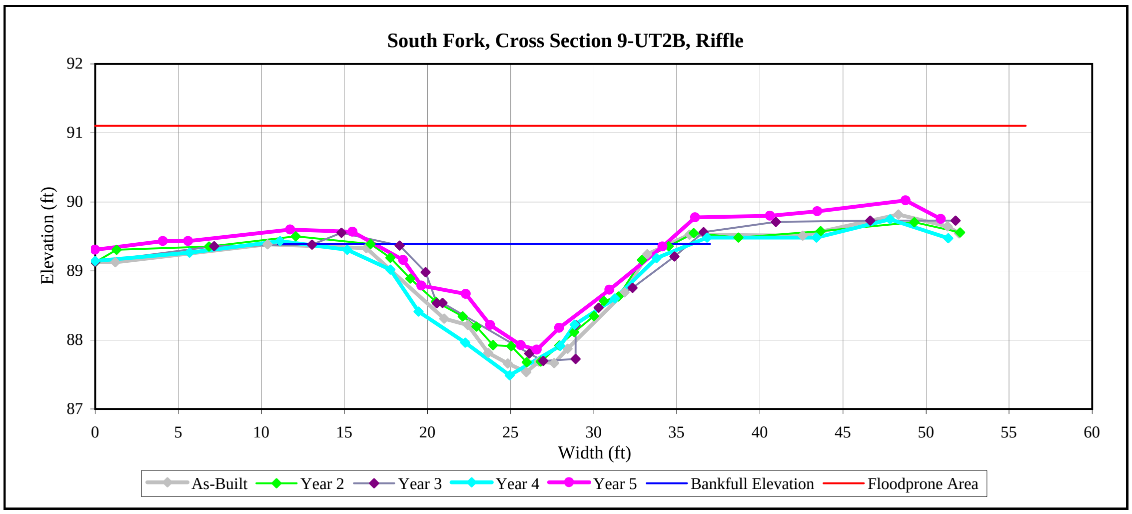
Looking at the left bank.

Looking at the right bank.



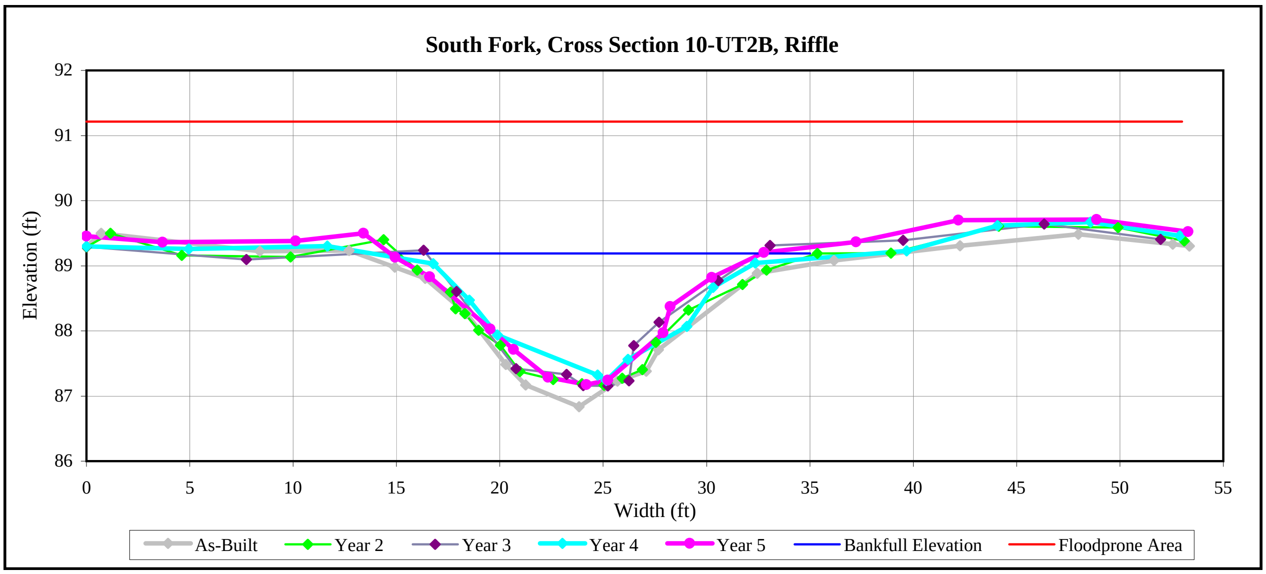

Looking at left bank.


Looking at right bank.



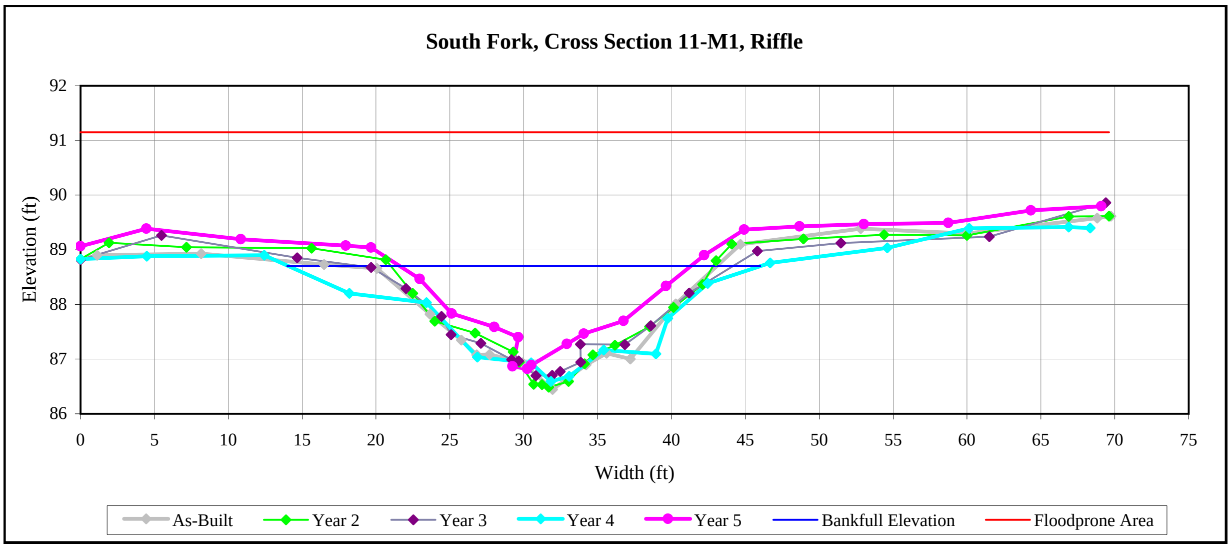
Looking at the left bank.

Looking at the right bank.



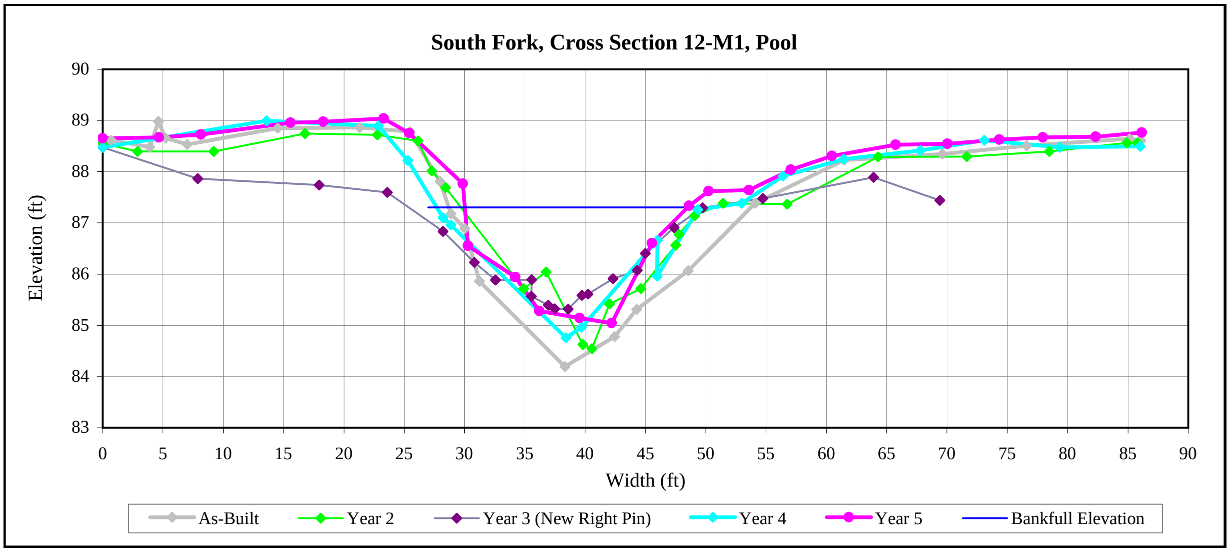
Looking at the left bank.

Looking at the right bank.



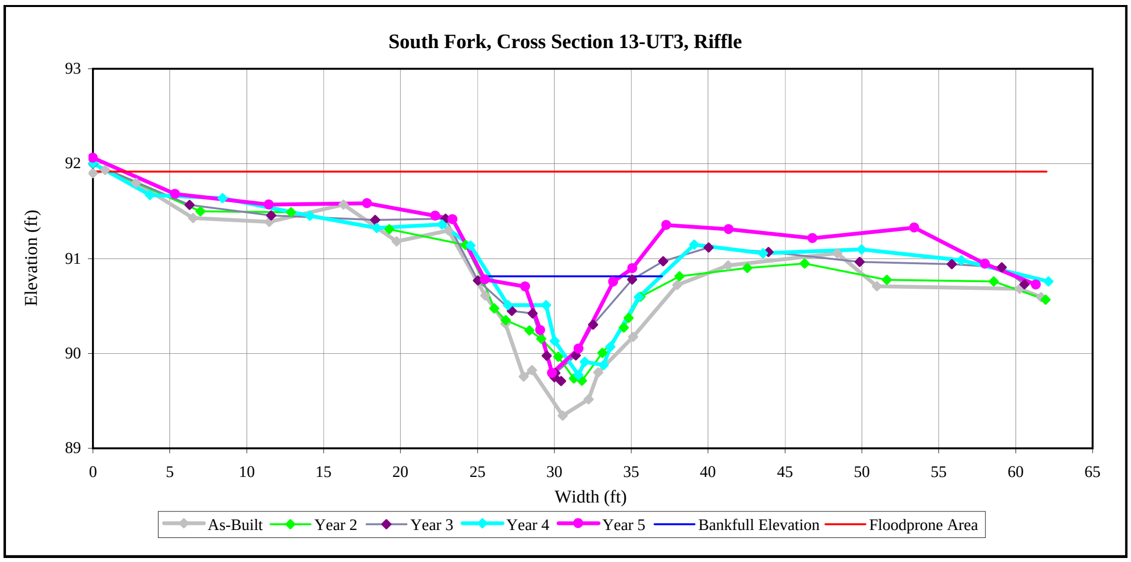
Looking at the left bank.

Looking at the right bank.



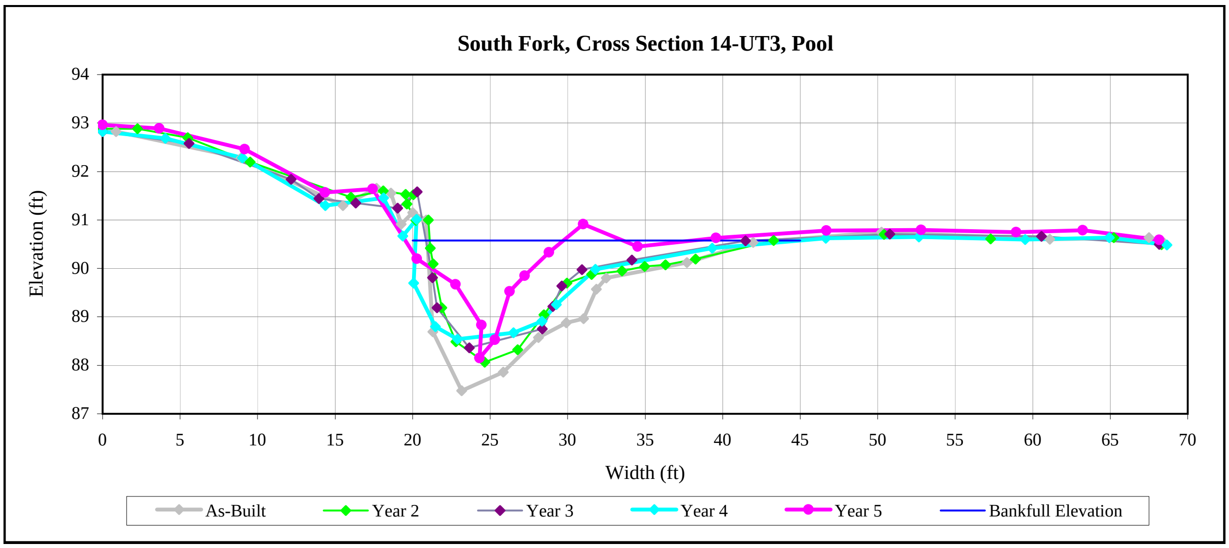
Looking at the left bank.

Looking at the right bank.



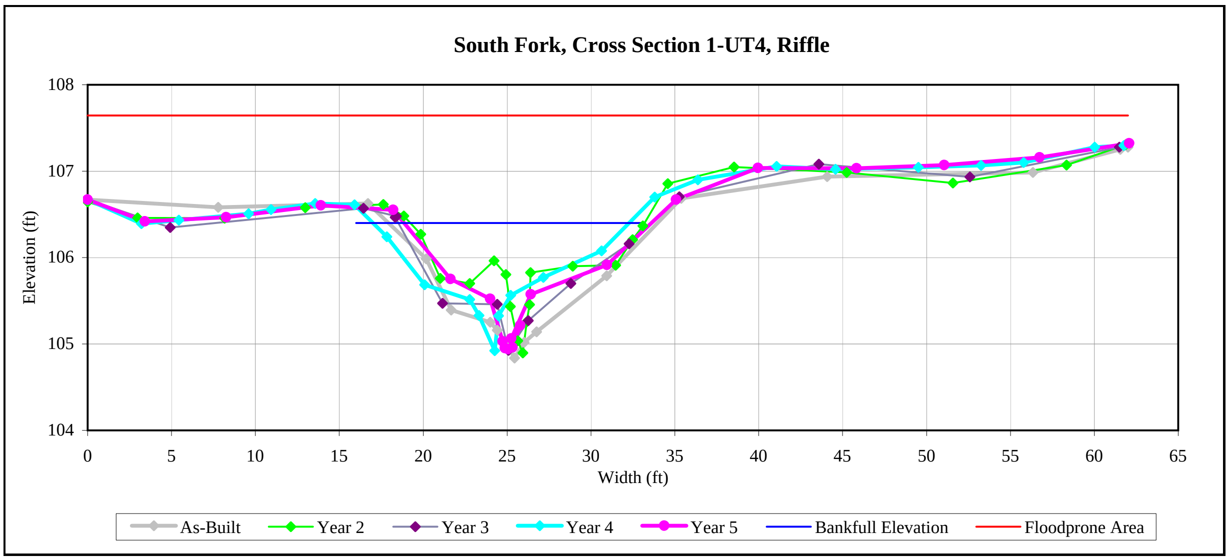
Looking at the left bank.

Looking at the right bank.



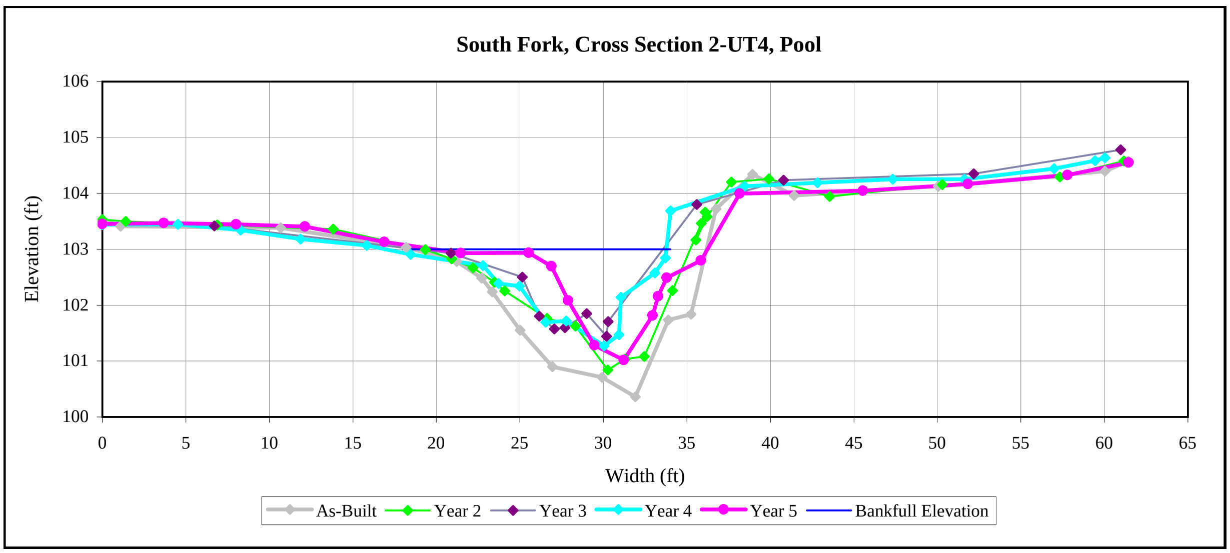
Looking at the left bank.

Looking at the right bank.



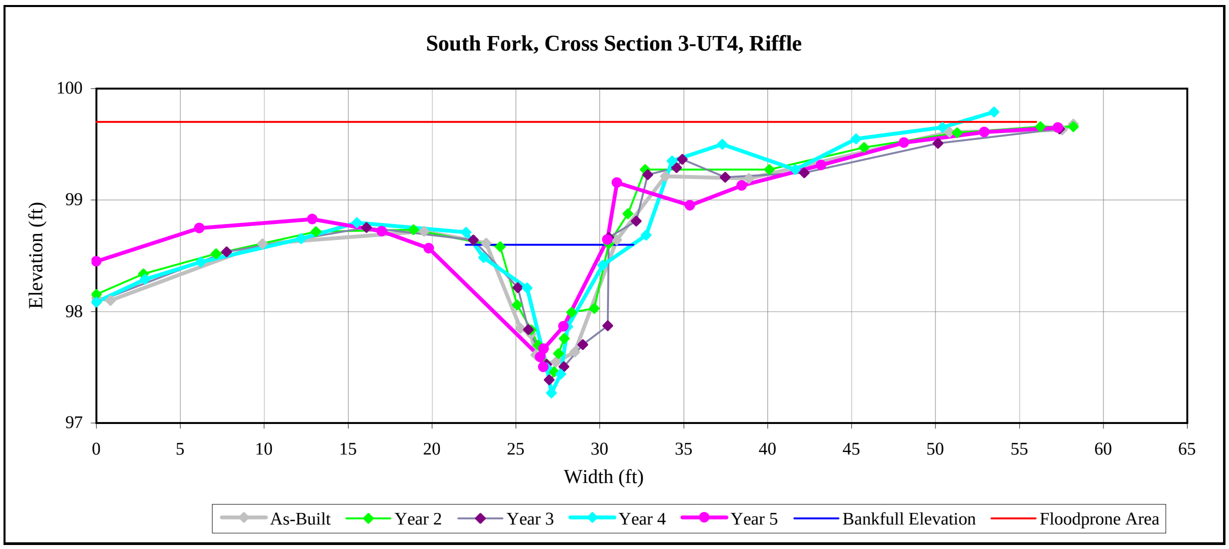
Looking at the left bank.

Looking at the right bank.



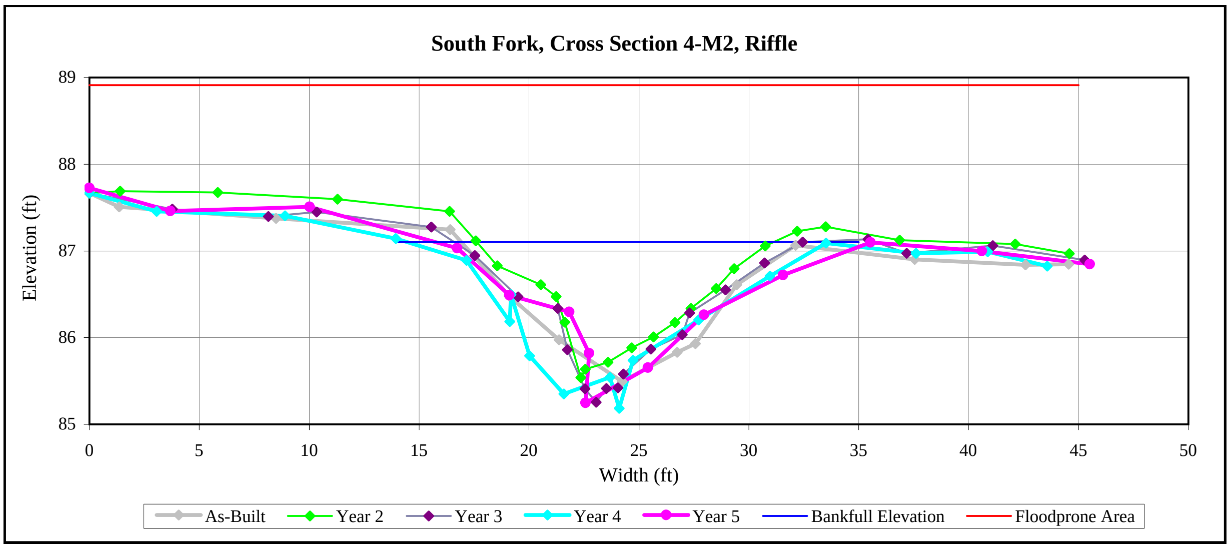
Looking at the left bank.

Looking at the right bank.



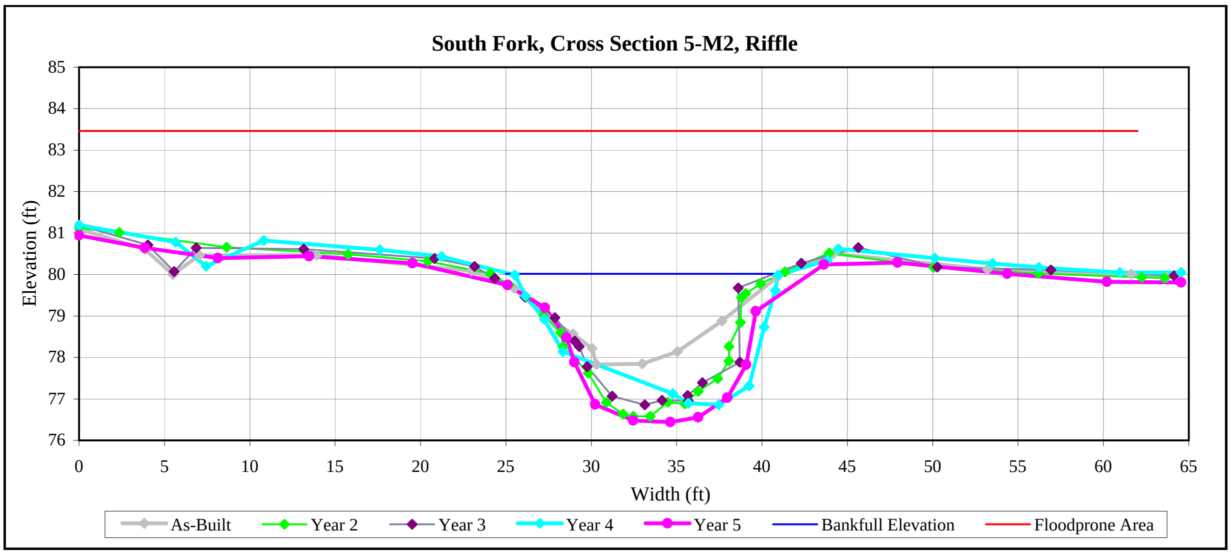
Looking at the left bank.

Looking at the right bank.



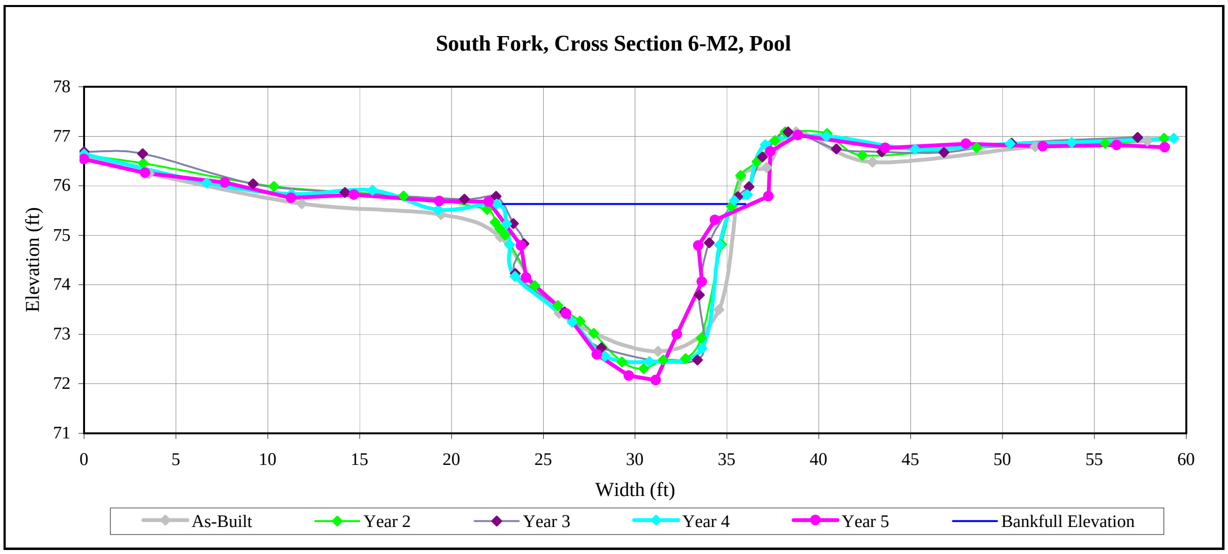
Looking at the left bank.

Looking at the right bank.



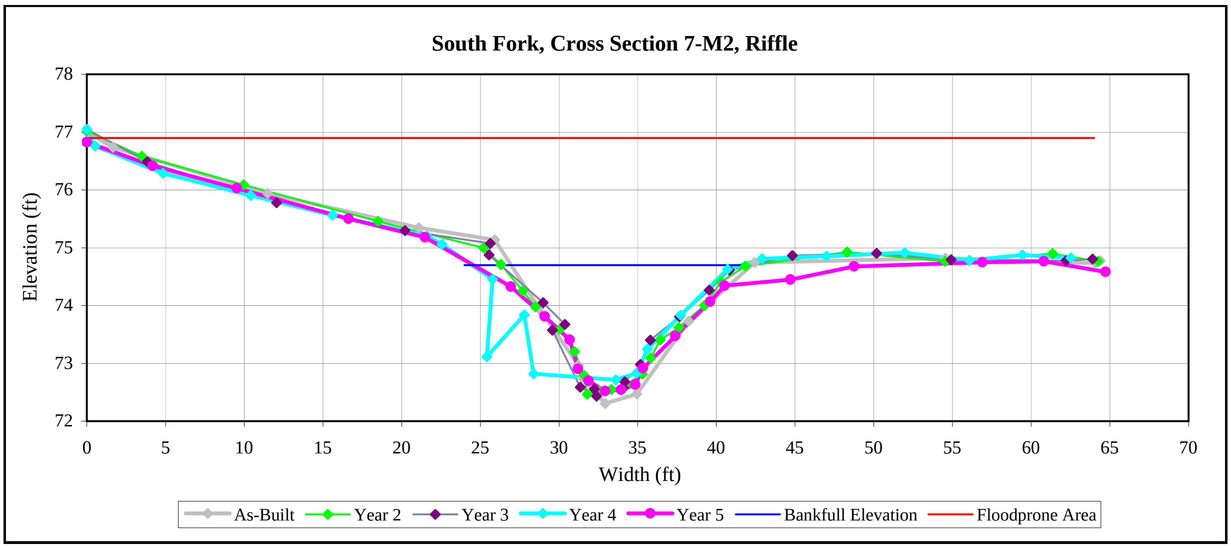
Looking at the left bank.

Looking at the right bank.



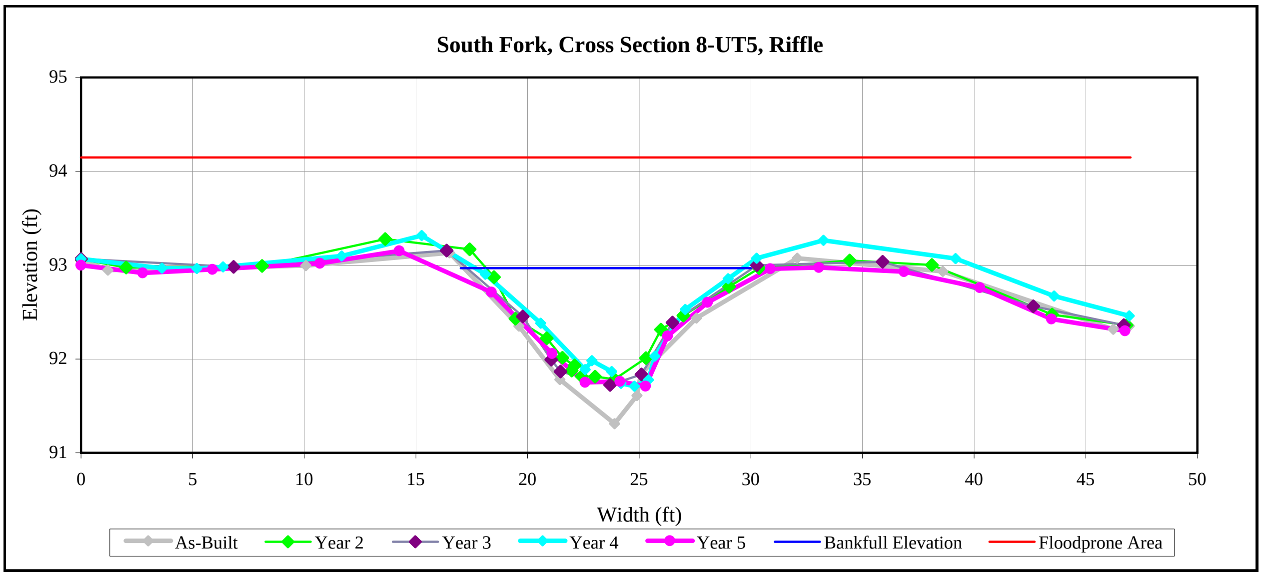
Looking at the left bank.

Looking at the right bank.



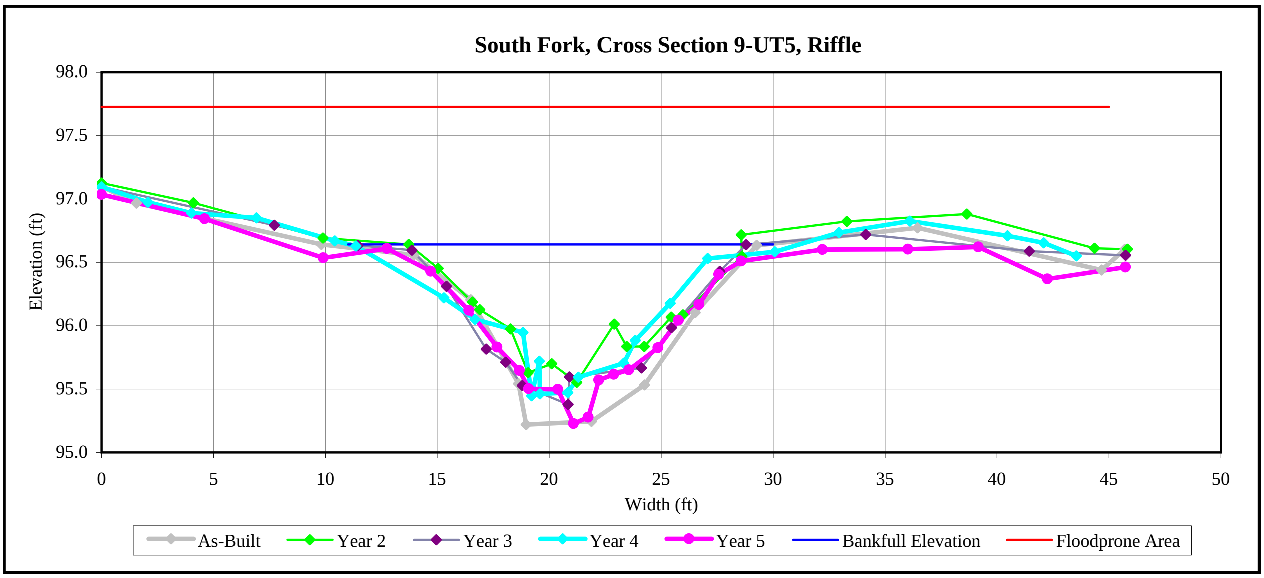
Looking at the left bank.

Looking at the right bank.



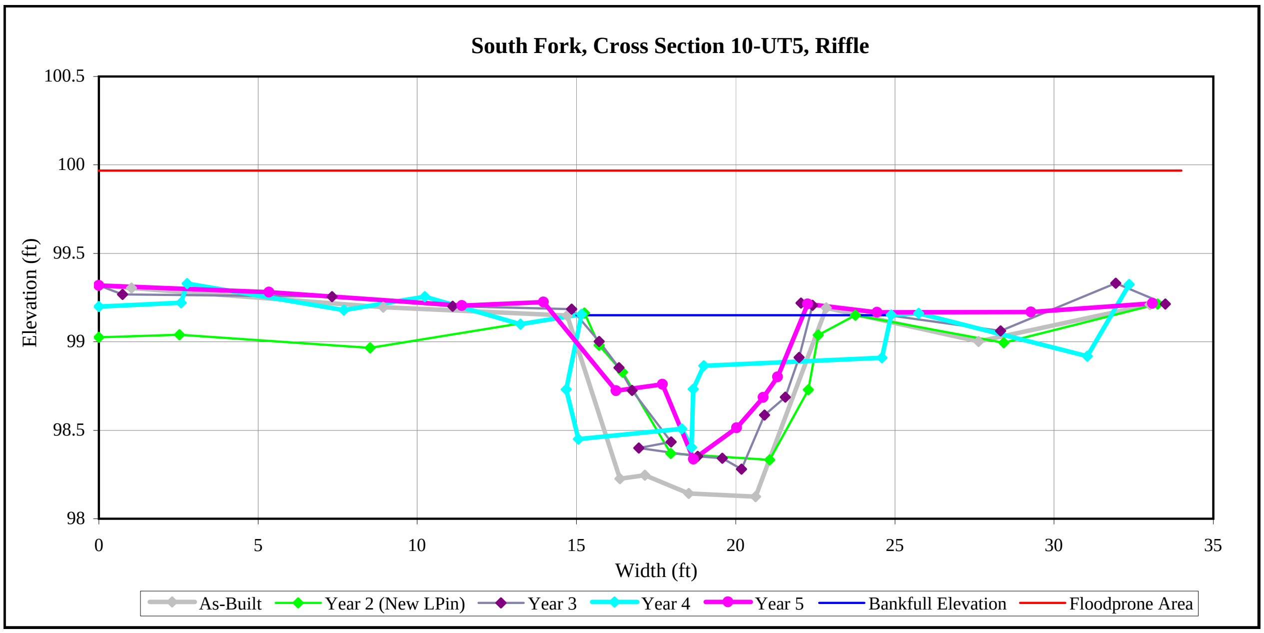
Looking at the left bank.

Looking at the right bank.



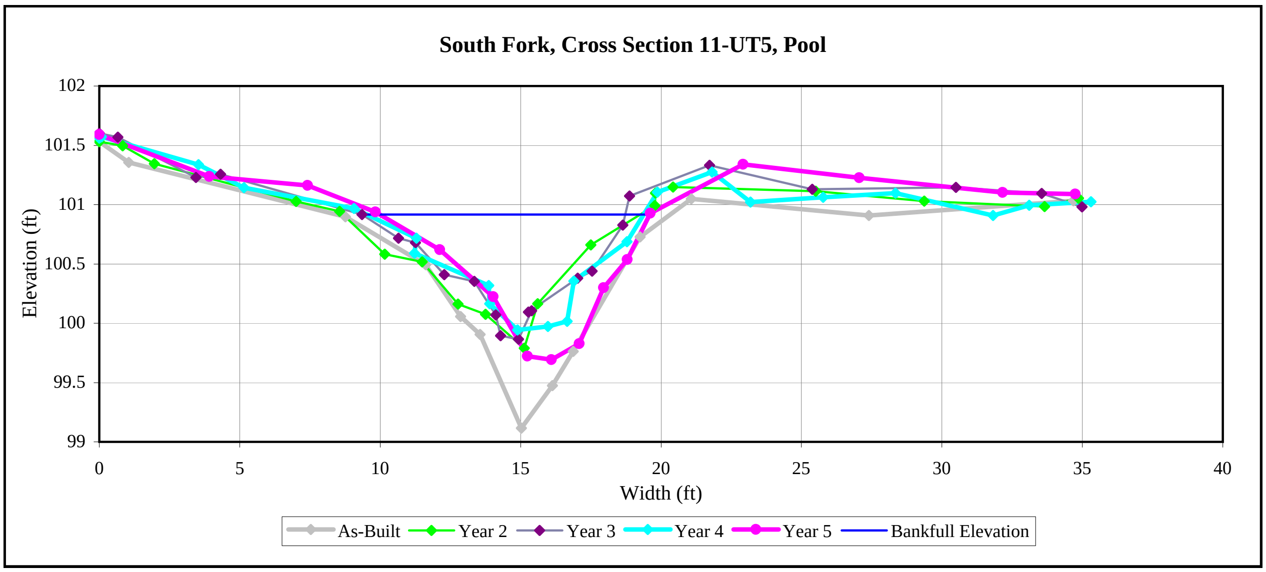
Looking at the left bank.

Looking at the right bank.




Looking at the left bank.


Looking at the right bank.



Cross Section	Parameter	As-Built	Year 1	Year 2	Year 3	Year 4	Year 5
XS1-UT2A-RIFFLE	Bankfull Area	6.5	5.3	5.45	5.5	4.8	5.1
	Bankfull Width	9.45	7.53	9.65	7.9	11.6	11.6
	Bankfull Depth	0.69	0.71	0.56	0.7	0.4	0.4
	Max. Bankfull Depth	1.22	1.26	1.4	1.4	1.2	1.2
	Width/Depth Ratio	13.78	10.61	17.08	11.2	28	26.2
	Bank Height Ratio	1	1	1	1.0	1	1
	Entrenchment Ratio	6	7.6	6.2	7.2	---	---
XS2-UT2A-POOL	Bankfull Area	35.8	29.7	30.46	16.5	25.3	20.2
	Bankfull Width	19.57	19	18.6	9.2	21.3	21.9
	Bankfull Depth	1.83	1.56	1.63	1.8	1.2	0.9
	Max. Bankfull Depth	4.38	3.51	3.4	2.9	2.7	2.7
	Width/Depth Ratio	10.68	12.17	11.36	5.1	18	23.7
	Bank Height Ratio	0.9	1	1	0.8	1	1
	Entrenchment Ratio	2.9	3	---	6.1	---	---
XS3-UT2A-RIFFLE	Bankfull Area	11.1	10.3	12.94	11.0	9.6	11.6
	Bankfull Width	16.22	16.51	12.16	15.9	14.5	17.6
	Bankfull Depth	0.68	0.62	0.98	0.7	0.7	0.7
	Max. Bankfull Depth	1.39	1.35	1.92	1.4	1.5	1.7
	Width/Depth Ratio	23.72	26.52	13.37	22.9	21.7	26.7
	Bank Height Ratio	1	1	1	1.0	1	1
	Entrenchment Ratio	4	3.9	4.6	3.8	---	---
XS4-UT2A-RIFFLE	Bankfull Area	10.2	8.7	8.9	10.0	9.6	10.2
	Bankfull Width	13.83	14.06	13.88	13.9	16.7	15.8
	Bankfull Depth	0.74	0.62	0.64	0.7	0.6	0.6
	Max. Bankfull Depth	1.27	1.13	1.21	1.2	1.2	1.3
	Width/Depth Ratio	18.75	22.71	21.63	19.5	29	24.5
	Bank Height Ratio	1	1	1	1.0	1	1
	Entrenchment Ratio	4.1	4	4.3	4.3	---	---
XS5-UT2A-POOL	Bankfull Area	37.9	35	31.08	23.2	29	35.0
	Bankfull Width	20.1	20.63	20.95	17.2	22.5	21.6
	Bankfull Depth	1.88	1.7	1.48	1.3	1.3	1.6
	Max. Bankfull Depth	3.07	2.6	2.26	1.8	2.3	2.3
	Width/Depth Ratio	10.67	12.15	14.12	12.8	17.5	13.3
	Bank Height Ratio	1.1	1.1	1.1	1.1	1	1
	Entrenchment Ratio	4	3.9	---	4.6	---	---
XS6-UT1B-RIFFLE	Bankfull Area	16.9	10.2	12.92	12.6	11.7	13.7
	Bankfull Width	16.07	13.95	16.45	11.7	16.3	14.8
	Bankfull Depth	1.05	0.73	0.79	1.1	0.7	0.9
	Max. Bankfull Depth	1.97	1.41	1.88	1.9	2.1	2.3
	Width/Depth Ratio	15.3	19.04	20.94	10.3	22.7	16.1
	Bank Height Ratio	1	1	1	1.0	1	1
	Entrenchment Ratio	3.8	4.4	3.6	5.6	---	---
XS7-UT1B-POOL	Bankfull Area	37	41	34.17	34.0	30	36.1
	Bankfull Width	19.35	22.08	18.66	19.9	17.5	22.9
	Bankfull Depth	1.91	1.86	1.83	1.7	1.7	1.6
	Max. Bankfull Depth	3.4	3.57	3.27	3.1	3.1	3.0
	Width/Depth Ratio	10.11	11.87	10.19	11.7	10.2	14.6
	Bank Height Ratio	1.1	1	1	1.0	1	1
	Entrenchment Ratio	3.8	3.3	---	3.5	---	---
XS8-UT1B-RIFFLE	Bankfull Area	14	13.9	11.25	11.9	13.8	13.5
	Bankfull Width	15.83	16.16	16.31	15.2	18.6	16.2
	Bankfull Depth	0.89	0.86	0.69	0.8	0.7	0.8
	Max. Bankfull Depth	1.53	1.54	1.51	1.5	1.5	1.7
	Width/Depth Ratio	17.84	18.78	23.65	19.3	25.2	19.4
	Bank Height Ratio	1	1	1	1.0	1	1
	Entrenchment Ratio	3.6	3.5	3.7	4.0	---	---
XS9-UT2B-RIFFLE	Bankfull Area	17.5	17.3	16.47	16.3	13	17.5
	Bankfull Width	17.72	19.31	17.95	17.4	15.3	23.5
	Bankfull Depth	0.99	0.89	0.92	0.9	0.9	0.7
	Max. Bankfull Depth	1.8	1.78	1.71	1.7	1.5	1.7
	Width/Depth Ratio	17.89	21.59	19.56	18.7	18	31.7
	Bank Height Ratio	1	1	1	1.0	1	1
	Entrenchment Ratio	2.9	2.7	2.8	3.0	---	---
XS10-UT2B-RIFFLE	Bankfull Area	17	20.9	21.68	18.7	15.7	19.0
	Bankfull Width	15.74	21.67	20.25	16.1	15.7	17.8
	Bankfull Depth	1.08	0.96	1.07	1.2	1	1.1
	Max. Bankfull Depth	1.97	1.91	2.02	2.0	1.8	2.0
	Width/Depth Ratio	14.61	22.51	18.91	13.8	15.8	16.7
	Bank Height Ratio	1	1	1	1.0	1	1
	Entrenchment Ratio	3.4	2.5	2.5	3.3	---	---

Cross Section	Parameter	As-Built	Year 1	Year 2	Year 3	Year 4	Year 5
XS11-M1-RIFFLE	Bankfull Area	28.1	25.4	29.52	26.3	15.5	25.6
	Bankfull Width	22.83	23.98	22.42	24.4	17.7	22.5
	Bankfull Depth	1.23	1.06	1.32	1.1	0.9	1.1
	Max. Bankfull Depth	2.21	2.04	2.33	2.0	1.4	2.2
	Width/Depth Ratio	18.54	22.69	17.02	22.6	20.2	19.7
	Bank Height Ratio	1	1.1	1	1.1	1	1
	Entrenchment Ratio	3.1	2.9	3.1	2.9	---	---
XS12-M1-POOL	Bankfull Area	70.8	66.2	58.15	26.3	28	59.3
	Bankfull Width	34.76	36.94	37.53	24.4	21.6	39.2
	Bankfull Depth	2.04	1.79	1.55	1.1	1.3	1.5
	Max. Bankfull Depth	4.04	4.18	3.75	2.0	2.5	3.5
	Width/Depth Ratio	17.07	20.63	24.22	22.6	16.6	25.9
	Bank Height Ratio	1	1	1	1.0	1	1
	Entrenchment Ratio	2.5	2.3	---	2.9	---	---
XS13-UT3-RIFFLE	Bankfull Area	9.2	7.9	6.99	4.8	9.8	9.8
	Bankfull Width	12.85	12.18	12.92	10.0	14.6	13.7
	Bankfull Depth	0.72	0.65	0.54	0.5	0.7	0.7
	Max. Bankfull Depth	1.38	1.18	1.1	1.1	1.4	1.6
	Width/Depth Ratio	17.9	18.76	23.87	21.1	21.8	19.2
	Bank Height Ratio	1	1	1	1.0	1	1
	Entrenchment Ratio	4.8	4.9	4.6	6.0	---	---
XS14-UT3-POOL	Bankfull Area	28.4	28.9	22.4	19.6	23.1	12.9
	Bankfull Width	21.01	22.97	22.17	20.6	26.3	12.1
	Bankfull Depth	1.35	1.26	1.01	0.9	0.9	1.1
	Max. Bankfull Depth	3.07	2.81	2.51	2.2	2.1	2.8
	Width/Depth Ratio	15.53	18.29	21.94	21.7	30	11.4
	Bank Height Ratio	1	1	1	1.0	1	1
	Entrenchment Ratio	3.3	3	---	3.4	---	---
XS1-UT4-RIFFLE	Bankfull Area	35.8	29.7	30.46	16.5	7.7	12.5
	Bankfull Width	19.57	19	18.6	9.2	9.3	20.7
	Bankfull Depth	1.83	1.56	1.63	1.8	0.8	0.6
	Max. Bankfull Depth	4.38	3.51	3.4	2.9	1.7	1.7
	Width/Depth Ratio	10.68	12.17	11.36	5.1	11.2	34.3
	Bank Height Ratio	0.9	1	1	0.8	1	1
	Entrenchment Ratio	2.9	3	---	6.1	---	---
XS2-UT4-POOL	Bankfull Area	16.3	13.4	16.47	9.6	12.8	19.1
	Bankfull Width	13.04	13.49	15.84	12.7	20.3	24.8
	Bankfull Depth	1.25	0.99	1.04	0.8	0.6	0.8
	Max. Bankfull Depth	2.12	1.85	2.15	1.5	2.2	2.4
	Width/Depth Ratio	10.45	13.59	15.23	16.8	32.2	32.3
	Bank Height Ratio	1.3	1.5	1.2	1.0	1	1
	Entrenchment Ratio	4.7	4.3	---	4.7	---	---
XS3-UT4-RIFFLE	Bankfull Area	5.1	6.7	4	5.7	3.9	8.7
	Bankfull Width	7.71	12.07	6.43	8.1	11.9	17.6
	Bankfull Depth	0.67	0.56	0.62	0.7	0.3	0.5
	Max. Bankfull Depth	1.07	1.24	1.12	1.3	1.5	1.3
	Width/Depth Ratio	11.57	21.66	10.37	11.4	36.2	35.7
	Bank Height Ratio	1.1	1	1	1.0	1	1
	Entrenchment Ratio	7.6	4.8	9.3	7.4	---	---
XS4-M2-RIFFLE	Bankfull Area	12.9	13.9	11.54	12.4	16.8	13.9
	Bankfull Width	15.07	16.74	15.01	15.8	18.4	18.8
	Bankfull Depth	0.85	0.83	0.77	0.8	0.9	0.7
	Max. Bankfull Depth	1.57	1.66	1.69	1.8	1.8	1.9
	Width/Depth Ratio	17.65	20.22	19.53	20.2	20.1	25.4
	Bank Height Ratio	1	1.1	1	0.6	1	1
	Entrenchment Ratio	3	2.7	3	2.9	---	---
XS5-M2-RIFFLE	Bankfull Area	16.3	31.6	32.48	30.3	33.4	44.7
	Bankfull Width	14.59	17.76	17.05	16.8	15.4	24.1
	Bankfull Depth	1.12	1.78	1.91	1.8	2.2	1.9
	Max. Bankfull Depth	1.84	3.38	3.44	3.2	3.1	3.8
	Width/Depth Ratio	13.07	9.97	8.95	9.4	7.1	13.0
	Bank Height Ratio	1.2	1.2	1	0.9	1	1
	Entrenchment Ratio	4.4	3.6	3.5	3.9	---	---
XS6-M2-POOL	Bankfull Area	26	27.5	27.82	29.2	29.8	27.8
	Bankfull Width	15.99	14.5	13.24	13.2	12.9	14.5
	Bankfull Depth	1.63	1.89	2.1	2.2	2.3	1.9
	Max. Bankfull Depth	2.76	2.98	3.21	3.3	3.2	3.6
	Width/Depth Ratio	9.83	7.66	6.3	5.9	5.6	7.5
	Bank Height Ratio	1	1	1	1.0	1	1
	Entrenchment Ratio	3.7	4.1	---	4.6	---	---

Cross Section	Parameter	As-Built	Year 1	Year 2	Year 3	Year 4	Year 5
XS7-M2-RIFFLE	Bankfull Area	19.9	20	17.39	15.3	23.2	17.9
	Bankfull Width	15.56	18.72	15.44	14.2	19.4	19.6
	Bankfull Depth	1.28	1.07	1.13	1.1	1.2	0.9
	Max. Bankfull Depth	2.44	2.36	2.22	2.2	2.1	2.1
	Width/Depth Ratio	12.15	17.49	13.71	13.1	16.2	21.4
	Bank Height Ratio	1	1	1	1.0	1	1
	Entrenchment Ratio	4.1	3.1	3.9	4.4	---	---
XS8-UT5-RIFFLE	Bankfull Area	12.3	10.1	7.9	8.9	11.7	9.1
	Bankfull Width	15.34	14.08	12.22	13.1	17.5	14.8
	Bankfull Depth	0.8	0.72	0.65	0.7	0.7	0.6
	Max. Bankfull Depth	1.76	1.45	1.19	1.3	1.6	1.3
	Width/Depth Ratio	19.21	19.56	18.9	19.4	26.2	24.1
	Bank Height Ratio	1	1	1	1.0	1	1
	Entrenchment Ratio	3.1	2.6	4.1	3.8	---	---
XS9-UT5-RIFFLE	Bankfull Area	11.1	12.4	8.85	10.7	4.6	10.6
	Bankfull Width	14.91	16.99	14.86	14.9	9	19.3
	Bankfull Depth	0.75	0.73	0.6	0.7	0.5	0.5
	Max. Bankfull Depth	1.34	1.28	1.09	1.3	1.1	1.4
	Width/Depth Ratio	19.94	23.27	24.95	20.8	17.5	35.2
	Bank Height Ratio	1	1	1	1.0	1	1
	Entrenchment Ratio	3.1	2.4	3.4	3.1	---	---
XS10-UT5-RIFFLE	Bankfull Area	6	4.9	4.44	4.2	4.2	3.8
	Bankfull Width	8.04	7.83	8.47	7.5	9.7	8.2
	Bankfull Depth	0.75	0.62	0.52	0.6	0.4	0.5
	Max. Bankfull Depth	1.02	0.98	0.82	0.9	0.7	0.9
	Width/Depth Ratio	10.76	12.6	16.17	13.7	22.7	17.6
	Bank Height Ratio	1	1	1.1	1.0	1	1
	Entrenchment Ratio	4.1	4.2	3.5	4.5	---	---
XS11-UT5-POOL	Bankfull Area	8.4	9	5.52	4.7	3.2	9.9
	Bankfull Width	11.47	16.42	10.88	9.4	7.6	17.8
	Bankfull Depth	0.73	0.55	0.51	0.5	0.4	0.6
	Max. Bankfull Depth	1.78	1.25	1.15	1.1	0.8	1.5
	Width/Depth Ratio	15.66	29.85	21.43	18.7	18.1	32.1
	Bank Height Ratio	1	1	1	1	1	1
	Entrenchment Ratio	3	2.1	---	3.7	---	---

APPENDIX C

2009 Site Photos


UT1A STA 10+00–35+00 Typical minor bank erosion from cattle access


UT2A STA 21+50 minor piping around header rock on left bank of constructed riffle

UT4 STA 18+60 Piping beneath lower header rocks of step pool system


UT5 STA 24+50 Piping below header rock of rock cross vane


M2 STA 28+70 Perched header on rock cross vane


M2 STA 30+90 Minor piping beneath constructed riffle header rock


M2 STA 38+10 Lower header rocks perched in step pool system


Typical stable culvert outlet


Typical narrow riffle with closed canopy


Typical densely vegetated banks


Typical stable and functional rock cross vane, well vegetated

Typical stable and naturalized root wad

Vegetation Plot 1

Vegetation Plot 2

Vegetation Plot 3

Vegetation Plot 4

Vegetation Plot 5

Vegetation Plot 6

Vegetation Plot 7