South Fork Mitigation Project
Catawba County, North Carolina

Year 3 Monitoring Report

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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 2007, the third year after construction completion.

This Annual Report presents stream flow data from two crest gauges and stream geometry data from twenty-three cross sections. In addition, photographs are presented that document the conditions of the restored and enhanced stream reaches. The photos are taken at established reference points along each stream reach (at each cross-section and at all in-stream structures). Additional collected data includes benthic macroinvertebrate survey, on-site rain gauge readings, and observations of potential problems with stream stability. This information is used to determine the overall behavior of the reconstructed stream during the period of monitoring.

Stream monitoring data in Years 1 through 3 documented that subsequent to construction completion, multiple bankfull events have occurred each year and little change has occurred in channel dimension and profile. Minor adjustments in channel dimension have occurred at a few cross section locations, mainly due to backwater conditions caused by overgrowth of channel vegetation in two reaches and beaver activity in Reach M1. Most in-stream structures continue to function as designed. As a result, the South Fork Mitigation Site is on track to meet the stream success criteria specified in the Restoration Plan for the site.

This Annual Report documents vegetation survivability based on seven vegetation monitoring plots, as specified in the approved Restoration Plan for this site. The vegetation monitoring documented range of survivability between 460 and 620 stems per acre, and therefore the site has met the interim vegetation success criteria of 320 stems per acre surviving at the end of this third growing season specified in the Restoration Plan for the site.

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 recent 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 involved the restoration and enhancement of 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 2007 monitoring season represents the third year of monitoring for this site.

2.2 PURPOSE

Monitoring of the South Fork Site is required to demonstrate successful mitigation based on the criteria described in the South Fork Mitigation Plan. Both stream and vegetation monitoring are conducted throughout the growing season. Success criteria must be met for five consecutive years. This Annual Report details the results of the stream monitoring for 2007 at the South Fork Stream Mitigation Site.

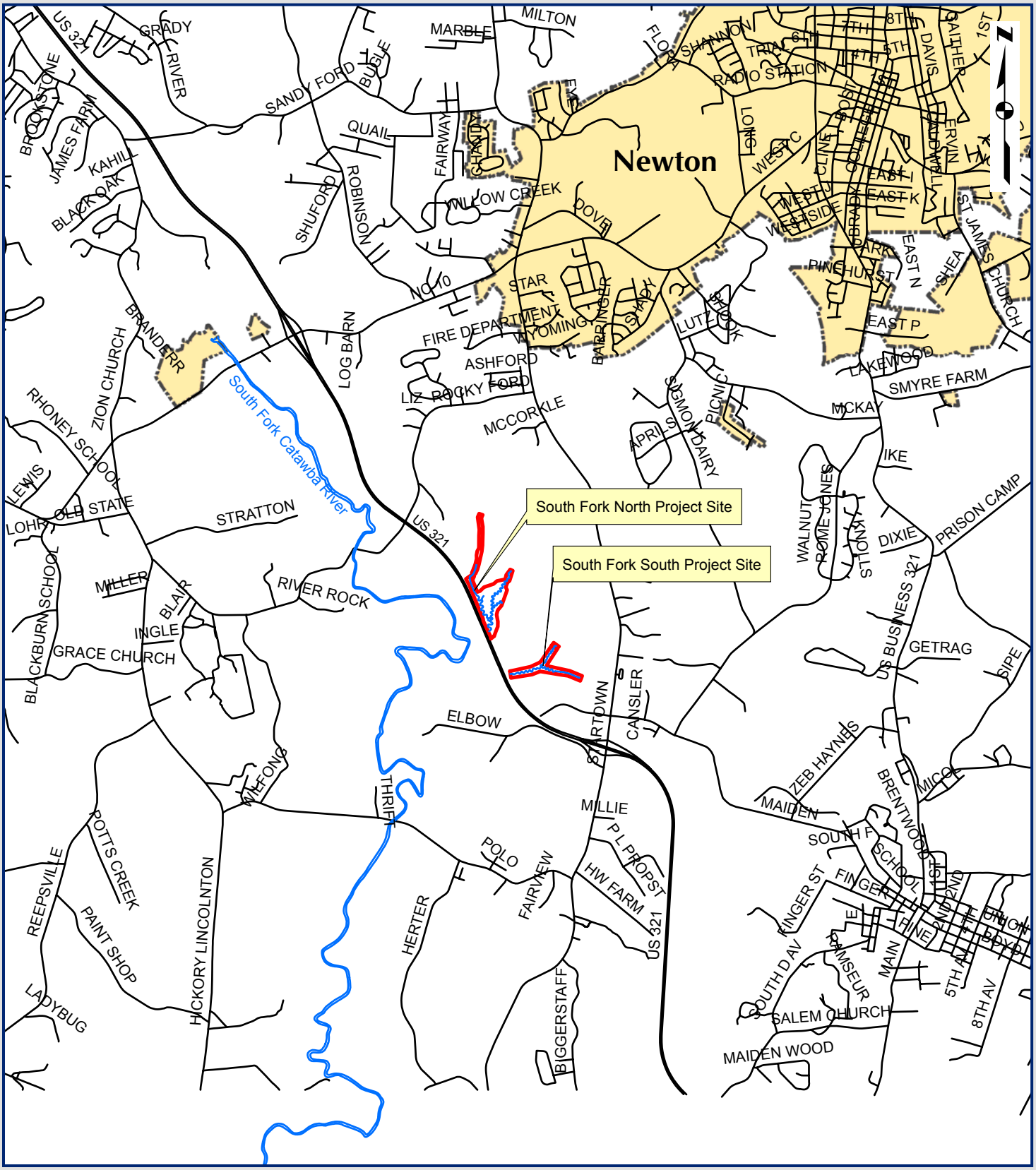
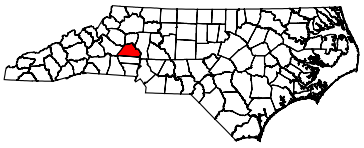


Figure 1.
South Fork Stream Mitigation Site
Project Location Map
Catawba County, NC

1 inch equals 1 miles



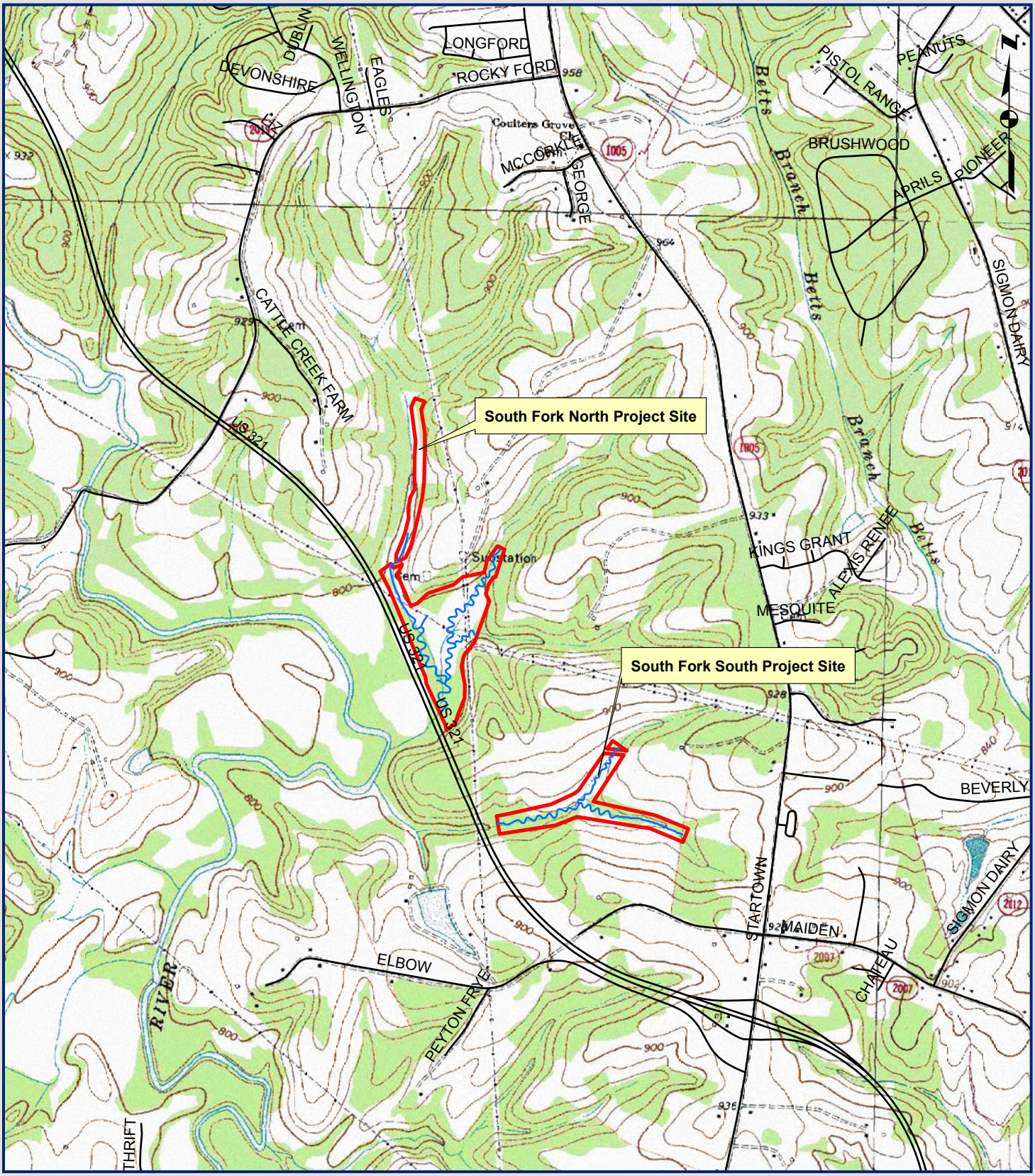


Figure 2.
South Fork Stream Mitigation Site
USGS Topographic Map
Catawba County, NC

1 inch equals 2,000 feet

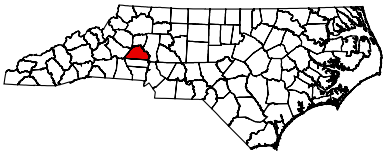


Table 1. Project Mitigation Structure and Objectives

Reach Name	As-Built Length (ft)	Restoration Approach
UT1	1,681	Restoration
UT1	3,431	Enhancement Level II
UT2	2,975	Restoration
UT2	271	Enhancement Level I
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**	

2.3 PROJECT HISTORY AND SCHEDULE

This project was identified by EBX in the spring of 2004. The following three tables outline project history and milestones (**Table 2**), contacts (**Table 3**), and background information (**Table 4**).

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 (Scheduled)
November 2009	5th Annual Monitoring Report (Scheduled)

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

Table 4. Project Background Table

Project County	**Catawba County**
Drainage Area	South Fork North-1,173 ac.
	South Fork South-297 ac.
Drainage Impervious Cover Estimate	<10%
Stream Order	South Fork North-Second
	South Fork South-Second
Physiographic Region	Piedmont
Rosgen Classification of As-Built	C4/E4
Dominant Soil Types	Cecil, Chewacla, Congaree, Hiwassee
Reference Site ID	NA
USGS HUC for Project and Reference	03050102
Any portion of project 303(d) listed?	No
Percent of project easement fenced	100%

2.4 MONITORING PLAN VIEW

Plan view drawings of the project site are provided in **Figures 3A** and **3B**. The drawings include the appropriate information pertaining to monitoring of the project. These drawings show the locations of the cross-section surveys, crest gauges, and vegetation plots.

3.0 VEGETATION

3.1 VEGETATION SUCCESS CRITERIA

The interim measure of vegetative success for the South Fork Catawba Mitigation Plan will be the survival of at least 320 3 year-old planted trees per acre at the end of Year 3 of the monitoring period. The final vegetative success criteria will be the survival of 260 5 year-old planted trees per acre at the end of year five of the monitoring period. Up to 20% 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% composition.

3.2 DESCRIPTION OF SPECIES AND VEGETATION MONITORING

The following monitoring protocol was designed to predict vegetative survivability. Seven plots were established on the South Fork Catawba Mitigation Site to monitor approximately 2% of the site. The vegetation monitoring plots were designed to be 1/10th of an acre in size, or 50 feet x 87 feet dimensionally. The plots were randomly located and randomly oriented within the wetland restoration area.

Plot construction involved using metal fence posts at each of the four corners to clearly and permanently establish the area that was to be sampled. Ropes were hung connecting all four corners to help in determining if trees close to the plot boundary were inside or outside of the plot. Trees right on and just outside of the boundary that appear to have greater than 50 percent of their canopy inside the plot were included in the stem counts. A piece of white PVC pipe ten feet tall was 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 were flagged with orange flagging. A 3 foot-tall piece of half inch PVC was placed in the ground beside each stem to mark them as the planted stems (vs. any colonizers) and to help in locating them in the future. Each stem was then tagged with a permanent numbered aluminum tag.

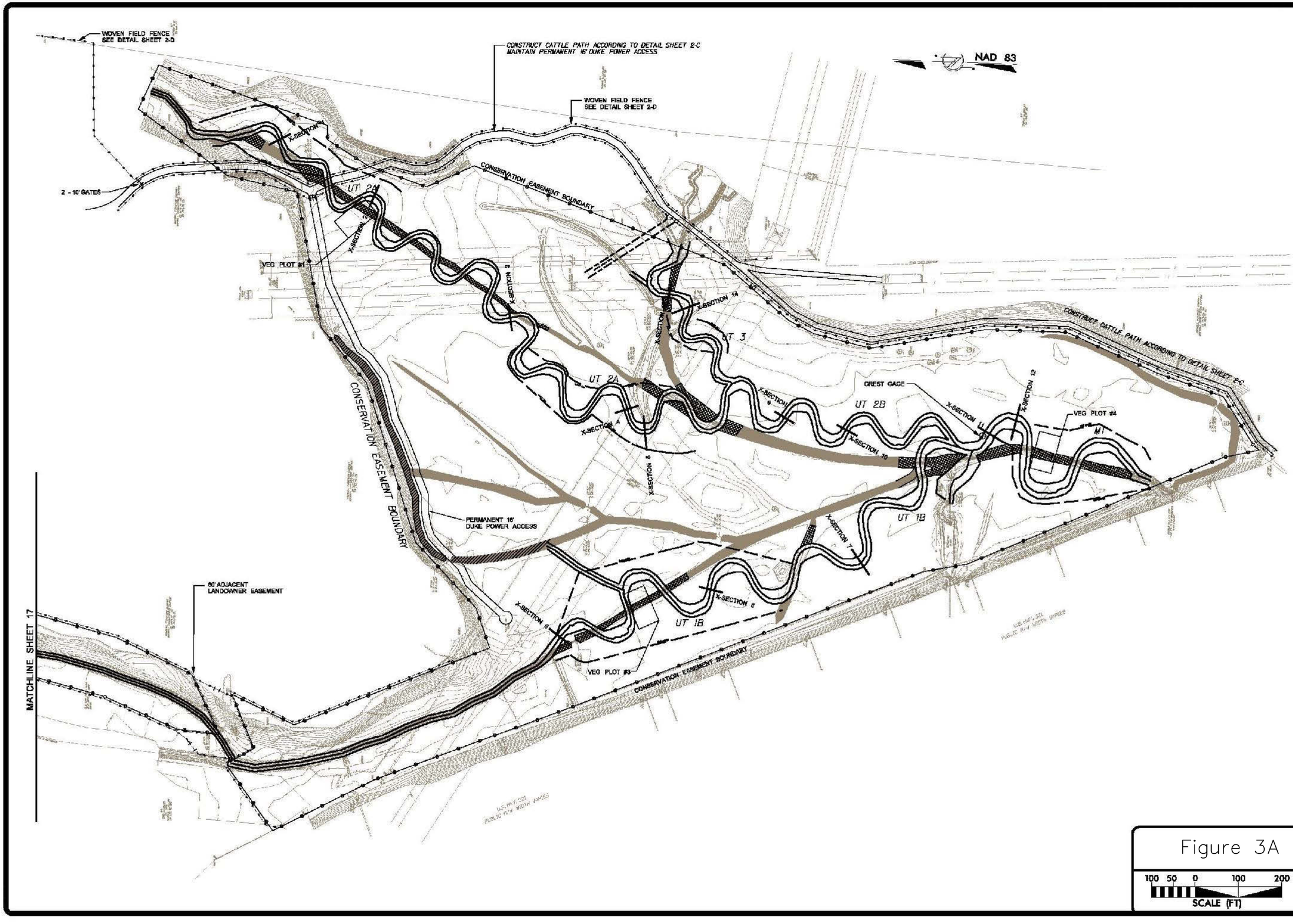

WOVEN FIELD FENCE SEE DETAIL SHEET 2-D
CONSTRUCT CATTLE PATH ACCORDING TO DETAIL SHEET 2-C MAINTAIN PERMANENT 15' DUKE POWER ACCESS
NAD 83
WOVEN FIELD FENCE SEE DETAIL SHEET 2-D
2 - 10' GATES
CONSERVATION EASEMENT BOUNDARY
UT 2A
X-SECTION 1
X-SECTION 2
VEG PLOT #1
X-SECTION 3
X-SECTION 14
UT 3
CONSTRUCT CATTLE PATH ACCORDING TO DETAIL SHEET 2-C
UT 2A
X-SECTION 4
X-SECTION 5
X-SECTION 6
CREST GAGE
UT 2B
X-SECTION 11
X-SECTION 12
VEG PLOT #4
M1
X-SECTION 10
CONSERVATION EASEMENT BOUNDARY
PERMANENT 15' DUKE POWER ACCESS
UT 1B
X-SECTION 7
80' ADJACENT LANDOWNER EASEMENT
X-SECTION 9
X-SECTION 8
UT 1B
VEG PLOT #3
CONSERVATION EASEMENT BOUNDARY
MATCHLINE SHEET 17
100 50 0 100 200
SCALE (FT)

Figure 3A

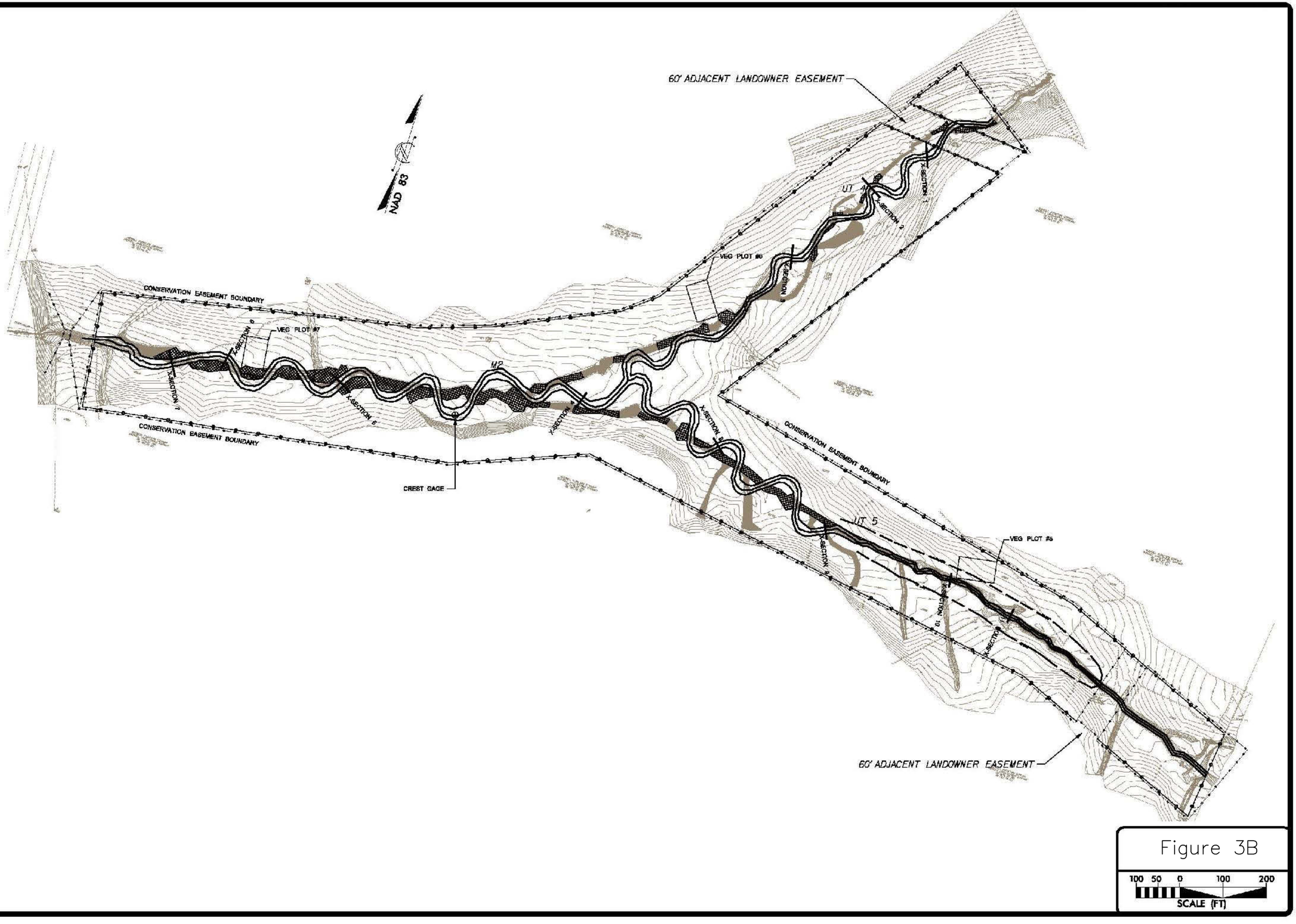


Figure 3B

100 50 0 100 200
SCALE (FT)

The following tree species were planted in the Wetland Restoration Area:

Table 5. 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 6 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 5**. Trees are flagged in the field on a quarterly basis before the flags degrade. Flags are utilized, because they will not interfere with the growth of the tree. Volunteers are also flagged during this process.

Table 6. 2006 Vegetation Monitoring Plot Species Composition

Plot	1	2	3	4	5	6	7	8	9	10	11	12	13	Total	Stem/ acre
SFC1	9	0	0	19	0	0	0	4	0	0	4	26	0	62	620
SFC2	4	17	0	9	0	0	0	0	0	0	12	12	0	55	550
SFC3	24	0	0	25	0	0	0	0	0	0	0	7	0	56	560
SFC4	23	1	0	14	0	0	0	10	0	0	0	0	0	48	480
SFC5	24	0	0	15	0	0	0	1	0	0	11	0	0	51	510
SFC6	2	14	0	5	1	1	0	10	0	0	9	2	2	46	460
SFC7	10	5	0	16	2	0	0	2	0	0	18	2	0	55	550

Average Stems/Acre: 533
Range of Stems/Acre: 460 to 620

Volunteer species will also be monitored throughout the five year monitoring period. **Table 7** identifies the most commonly found woody volunteer species.

Table 7. 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 deltoids*	Eastern Cotton-wood	FAC+
E	*Platanus occidentalis*	Sycamore	FACW-
F	*Diospyrus virginiana*	Persimmon	FAC

Volunteer woody species were observed in most of the vegetation plots, but were deemed too small to include in the vegetation counts. If these trees persist into the next growing season and exceed 12 inches tall, they will be flagged and added to the overall stems per acre assessment of the site. Sweetgum is the most common volunteer, though red maple, eastern red cedar, and eastern cottonwood 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 or naturally occurring hydrophytic vegetation. Herbaceous vegetation is also occurring on site. Rush (*Juncus effusus*), bulrush (*Scirpus* sp.), knotweed (*Polygonum persicaria*), and sedge (*Carex* sp.), all hydrophytic herbaceous plants, are frequently observed across the site, particularly in areas of inundation. Arrow-head (*Sagitarria* sp.), another wetland species, is found in some of the 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 woody or herbaceous vegetation. The majority of the weedy species are annuals and seem to pose very little threat to survivability onsite. Commonly seen weedy vegetation includes hay, dallisgrass (*Paspalum dilatatum*), and buttercup (*Ranunculus* sp.). Any threatening weedy vegetation found in the future will be documented and discussed.

3.5 VEGETATION CONCLUSIONS

This site was planted in bottomland hardwood forest species in March 2005. There were seven 1/10th acre vegetation monitoring plots established throughout the planting areas. The 2007 vegetation monitoring documented an average tree density of 533 stems per acre. The site meets the minimum interim success criteria of 320 trees per acre by the end of Year 3 and is on track to meet the final success criteria of 260 trees per acre by the end of Year 5 as specified in the Restoration Plan for this site.

4.0 STREAM MONITORING

4.1 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.

4.2 STREAM MORPHOLOGY 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.

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 2007 (Year 3) were surveyed in August 2007.

Longitudinal Profile: Longitudinal profiles will be surveyed in years one, three, and five of 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. The longitudinal profile was surveyed for Year 3 in August 2007.

Bankfull Events: 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).

Benthic Macroinvertebrates: Sampling data will be collected from a reference reach upstream of the project reach and 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. Year 3 data will appear in this report. Sampling will be conducted each year between September and November to be consistent with pre-restoration samples. Sample collection will follow protocols described in the standard operating procedures of the Biological Assessment Unit of the NCDWQ. The Qual-4 collection method will be used for the collection of macroinvertebrate samples. The metrics to be calculated will include total and ephemeroptera, plecoptera, and trichoptera (EPT) taxa richness, EPT abundance, and biotic index values.

4.3 STREAM MORPHOLOGY MONITORING RESULTS-YEAR 3

Cross Sections

The cross sections were surveyed during the monitoring set-up, Year 1 in October 2005, Year 2, September 2006 and Year 3 September 2007. The baseline data have been compared with the Year 1, 2 and 3 data in Appendix B. The Year 3 channel cross sections showed that overall stream dimension remained stable during the third 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, Year 1 cross sections, Year 2 cross sections, and Year 3 cross sections.

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. The step pool structure in Reach M2 is beginning to show signs of wear. Erosion was evident behind boulders at the step pool and there is a head cut occurring just upstream of the step pool. A plan view drawing of the stream areas is provided in **Figure 4A-4F** for each reach and **Table 8** below outlines areas requiring further observation with station and description of each issue.

Table 8. Stream Areas Requiring Observation

ID	Station	Feature	Problem
SPA1	UT2A 10+50	Left Bank	Erosion
SPA2	UT2A 15+50	Channel	Aggradation and veg in channel
SPA3	UT2A 25+50	Channel	Stagnant flow from channel veg
SPA4	UT2A 27+50	Channel	Aggradation
SPA5	UT2A 33+00	Log Vanes	Buried by sediment
SPA6	UT1B 50+00	Log Vane	Submerged and buried by sediment
SPA7	UT1B 53+50	Constructed riffle	Vegetation growing in the channel
SPA8	UT1B 60+00	Root wad	Minor erosion
SPA9	UTM1 67+50	Constructed riffle	Buried in sediment
SPA10	UT3 throughout	Channel	Vegetation in the channel
SPA11	South	Easement	Cows in easement
SPA12	M2 31+00	Log Weir and constructed riffle	Water backing up over riffle
SPA13	M2 37+25	Channel	Head cut
SPA14	M2 37+50	Channel	Incision downstream of head cut
SPA15	M2 38+00	Step pool	Erosion behind boulder

Longitudinal Profile

A longitudinal profile was surveyed at six representative reaches during August 2007. 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. Based on comparisons, there has been very little adjustment to the stream profile or dimension since construction. As-built and 2007 profiles can be viewed in Appendix B.

Hydrology

During each visit to the site, the crest gauges were read and reset. This was done in February-September 2007. At least two out-of-bank or bankfull events occurred during this time on Reach M1 in South Fork North. No bankfull events were observed at the crest gauge on Reach M2 in South Fork South. Crest gauge data is included in **Table 9**. Rainfall totals were compared to document bankfull events and observed stream flow to

MATCHLINE SHEET 10 STA 21+15.00

E - W GATES

18+00

17+00

16+00

15+00

14+00

13+00

12+00

11+00

10+00

GRADE CONTROL U-NOOK TIED INTO EXISTING LOG ON BEDROCK

GOI LIMITS

UT2

XS-1

SPA2

SPA1

OUT LIMITS

Figure 4A

SOUTH FORK

30 15 0 30 60

SCALE (FT)

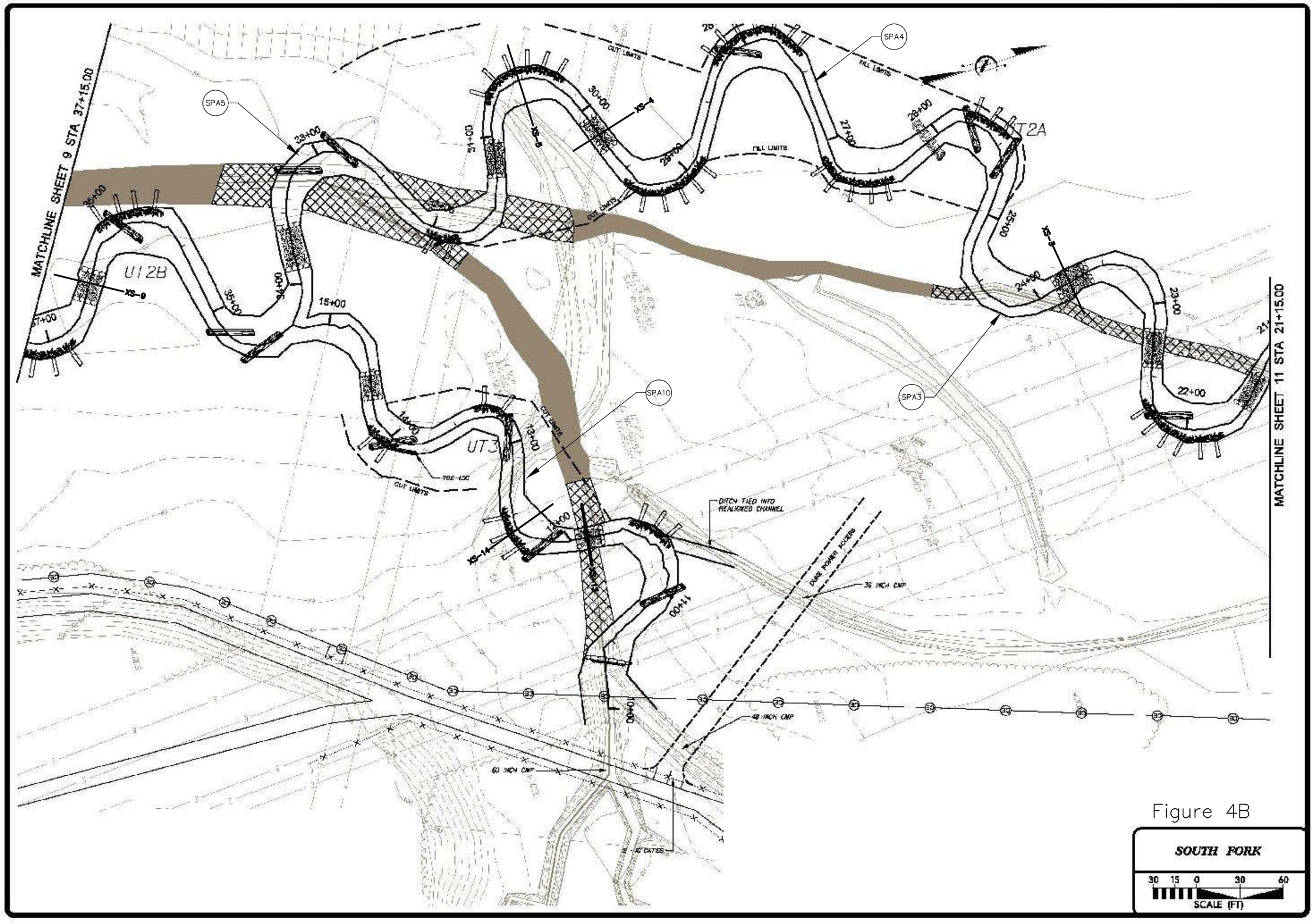


Figure 4B

SOUTH FORK

30 15 0 30 60

SCALE (FT)

MATCHLINE SHEET 10 STA 37+15.00

MATCHLINE SHEET 8 STA 54+23.00

38+00

39+00

XS-10

40+00

UT2B

SPA8

41+00

60+00

42+00

62+00

XS-11

XS-12

61+00

59+00

57+00

58+00

DETENTION OUTLET STABILIZED WITH CLASS A/B MIX

TREATMENT DETENTION POND

UT1B

55+00

56+00

XS-7

63+00

CUT LIMITS

M1

66+00

64+00

65+00

67+00

SPA9

CUT LIMITS

Figure 4C

SOUTH FORK

30 15 0 30 60

SCALE (FT)

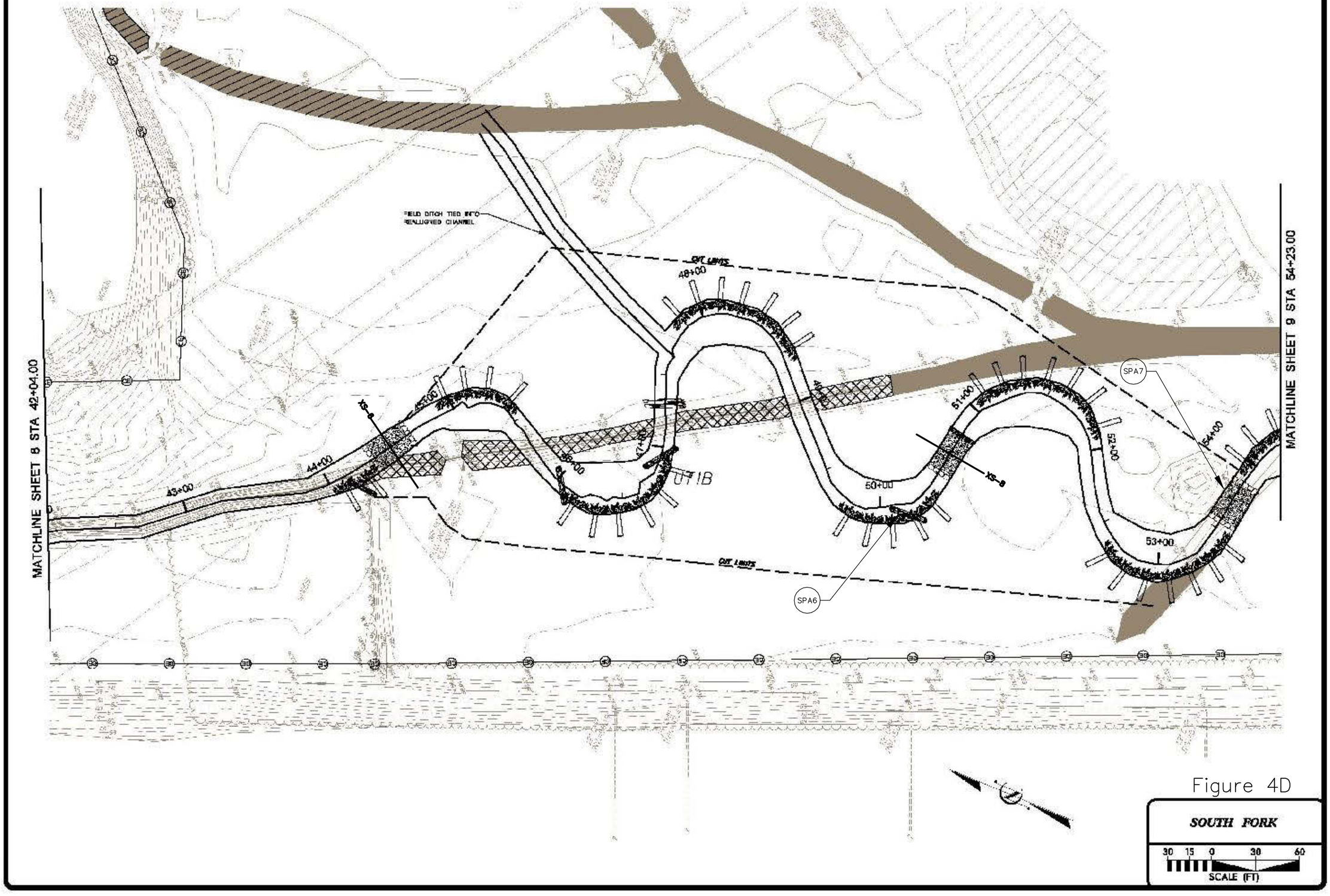

MATCHLINE SHEET 8 STA 42+04.00
FIELD DITCH TIED INTO
REALIGNED CHANNEL
CUT LIMITS
48+00
XS-8
42+00
43+00
44+00
45+00
46+00
47+00
UT1B
50+00
51+00
52+00
53+00
54+00
SPA7
SPA6
CUT LIMITS
MATCHLINE SHEET 9 STA 54+23.00
SOUTH FORK
30 15 0 30 60
SCALE (FT)

Figure 4D

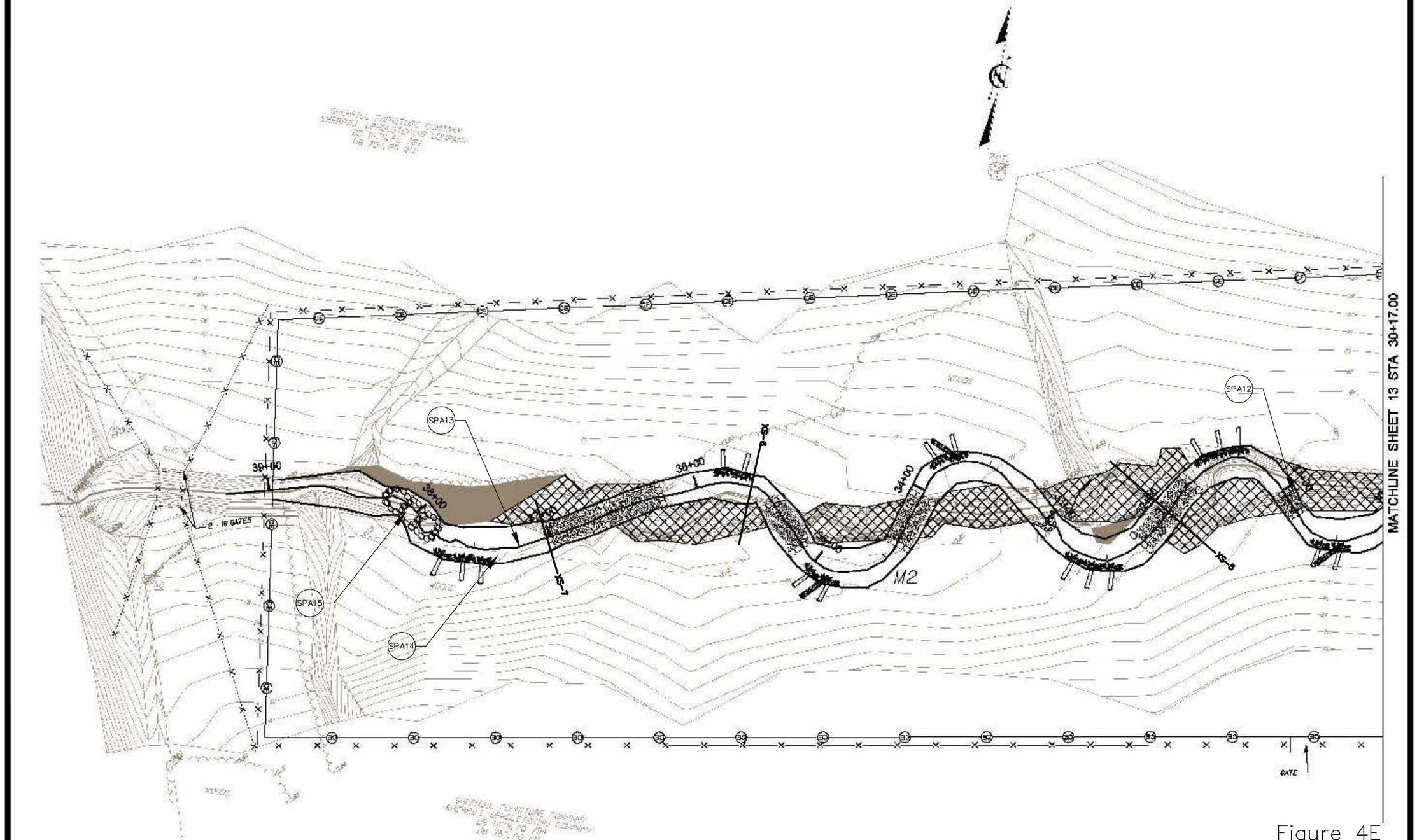


Figure 4E

SOUTH FORK

30 15 0 30 60

SCALE (FT)

MATCHLINE SHEET 14 STA 30+17.00

MATCHLINE SHEET 12 STA 19+30.00

MATCHLINE SHEET 16 STA 26+20.00

M2

UT4

UT5

15-4

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

Figure 4F

SOUTH FORK

30 15 0 30 60

SCALE (FT)

assess stream response to precipitation events. Weather data were collected from a weather station in Conover Oxford Shoals gauge. An on-site rain gauge was also monitored throughout 2007. The on-site data is generally higher than the readings taken in Conover. The data are summarized in **Table 10**. Data collected from the on-site gauge in February is a composite sample for December 2006 through February 2007. During a stream walk conducted March 27, 2007, beaver dams were observed in Reach M1 and these structures were causing water to back up significantly over the banks. No beaver dams were observed during the stream walk conducted in August 2007. South Fork experienced extreme drought in 2007 consistent with trends in western North Carolina. Drought is likely the reason there were no bankfull events at the south crest gauge. Water was observed in all restored reaches throughout 2007 despite the extremely dry conditions.

Table 9. Crest Gauge Data

Date of Data Collection	North Crest Gauge	South Crest Gauge
January	NA	NA
February	3.8	0
March	3.5	0
April	0	0
May	0	0
June	0	0
July	0	0
August	0	0
September	0	0
October	0	0
November	0	0

Table 10. Summary Precipitation Data

Month	Average	Normal Limits		Conover Precipitation	On-Site Precipitation	Accumulated Rainfall Deficit
		30 Percent	70 Percent			
January	3.9	2.64	5.04	0.45	NA	-3.45
February	3.42	2.33	4.41	1.93	10.02	-4.94
March	4.27	3.12	5.17	3.49	Broken	-5.72
April	3.37	2.06	4.57	2.06	2.24	-7.03
May	3.77	2.5	4.68	0.29	0.24	-10.51
June	4.27	2.73	5.41	1.46	3.24	-13.32
July	3.92	2.43	4.45	1.15	1.97	-16.09
August	4	2.73	4.71	0.31	0.17	-19.78
September	3.75	2.39	5.2	3.44	0.00	-20.09
October	3.7	1.88	4.9	0.00	0.00	-23.49
November	3.67	2.61	4.47	0.00	0.84	-26.96
December	3.32	2.13	4.26	---	---	---
Total	45.36	29.55	57.27	14.58	18.72	---

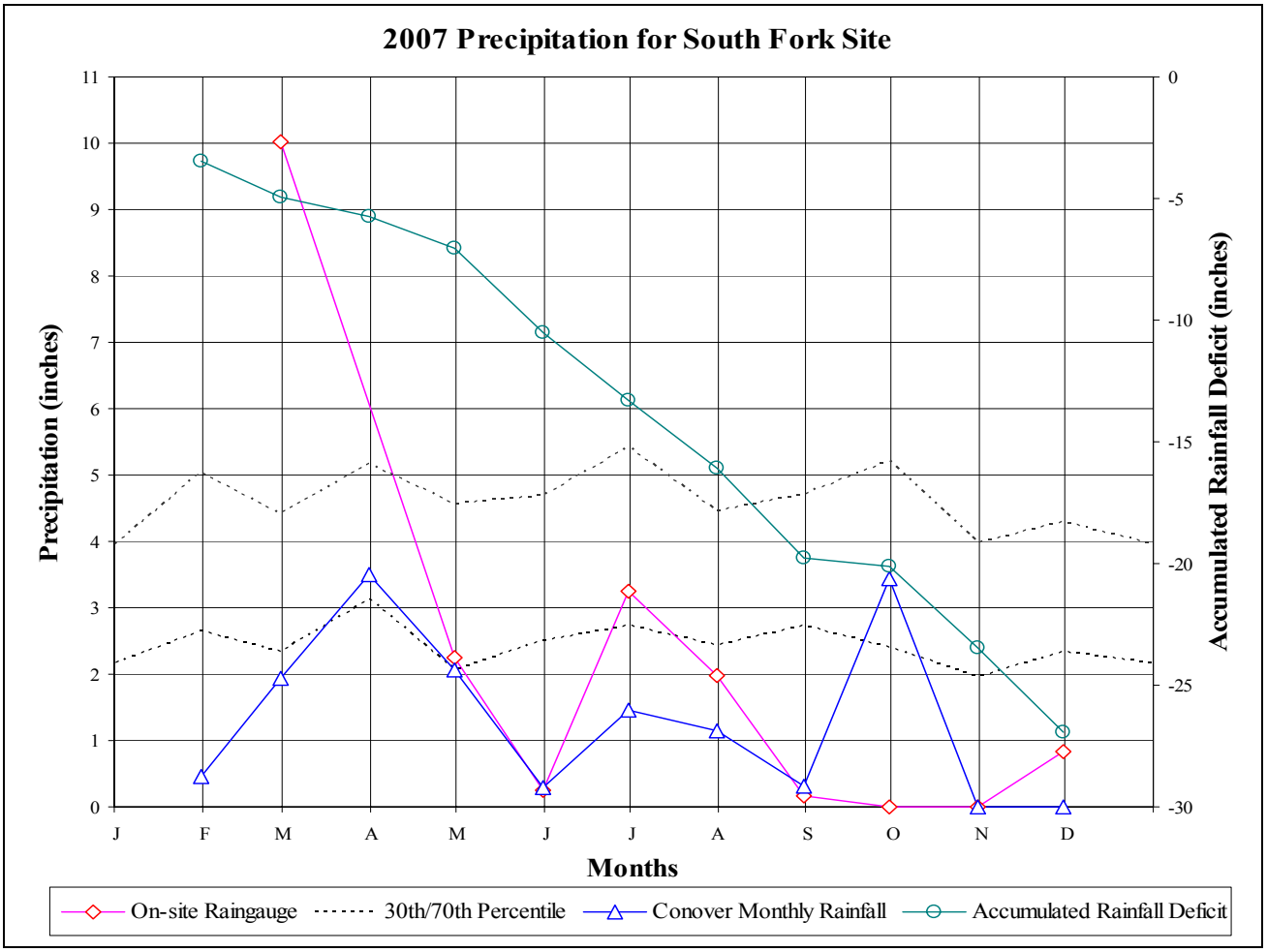


Figure 5 Precipitation Data-Year 3

4.4 DROUGHT CONDITIONS

The entire state of North Carolina experienced increasingly severe drought conditions throughout 2007, with some areas experiencing the lowest average stream flows on record. The first signs of drought began in February in the western part of the state. By early spring, abnormally dry conditions had spread across the state, and the western edge of the state began to see "moderate" drought conditions. From late spring through the summer, conditions steadily worsened. By August, 98 percent of North Carolina's land area was designated as being in either "severe", "extreme", or "exceptional" drought. Additionally, lowest-ever average stream flows were recorded at 13 monitoring stations in August, including 9 in central North Carolina, two in the mountains, and two on the coastal plain. Nearly the entire state was categorized as experiencing "extreme" drought in September, with the southwest portion of the state categorized as experiencing "exceptional" drought. **Figure 6** depicts the increasing severity of the drought throughout the year.

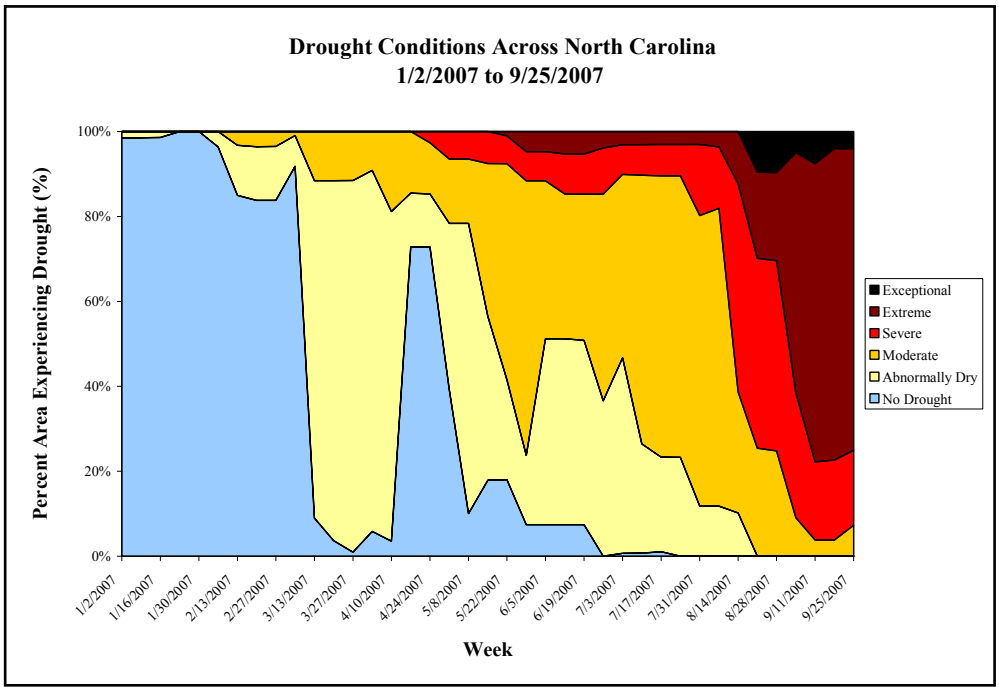


Figure 6 Drought Conditions Across North Carolina

The South Fork restoration site experienced drought conditions consistent with state-wide trends. The Conover monitoring station, near the South Fork site, received below-normal precipitation from January through October, except for the months of March and September, in which precipitation levels fell within the normal range (**Figure 5** and **Table 10**). The lowest precipitation levels, ranging from 3.40 to 3.69 inches below normal, occurred in January (0.45 inches), May (0.29 inches), August (0.17 inches), and October (0.00 inches). The accumulated rainfall deficit—the difference between the long-term average and the observed monthly precipitation levels, aggregated monthly—began at -3.45 inches in January and increased steadily throughout the year to -26.96 inches by November. Normal precipitation levels in September were insufficient to reverse the increasing rainfall deficit. Persistent and worsening drought conditions severely impacted stream flows at the South Fork site.

4.5 BENTHIC MACROINVERTEBRATE MONITORING

Composite Benthic macroinvertebrate samples were taken at the northern and southern South Fork sites in October 2007. The North Carolina Division of Water Quality (NCDWQ) Qual-4 collection method was utilized. In addition to benthic sampling, NCDWQ habitat assessment forms were completed at each monitoring site. Benthos samples were preserved in alcohol and later identified to the lowest possible taxonomic level by an aquatic ecologist. Tables 11 and 12 list the taxa encountered, relative abundance, and tolerance values. The NCDWQ Standard Operating Procedures for Benthic Macroinvertebrates (2006) assigns tolerance values for common macroinvertebrates in North Carolina. Tolerance values range from 0 to 10 with low scores indicating species that are intolerant to pollution, excess sediment, or other disturbances. Overall, taxa collected at both sites were moderately to very tolerant species.

The northern reach (M1) received a habitat score of 65 out of 100 possible points. A total of 57 EPT species were collected represented by 5 taxa (Table 11). Taxa collected are moderately to very tolerant (Table 11).

Table 11. Benthic Macroinvertebrates Northern Reach M1 October 2007.

Order	Family	Genus Species	Tolerance Value	No.
Ephemeroptera	Caenidae	*Caenis spp*	7.4	11
Ephemeroptera	Heptageniidae	*Stenacron interpunctatum*	6.9	11
Ephemeroptera	Heptageniidae	*Stenonema modestum*	5.5	2
Trichoptera	Hydropsychidae	*Hydropsyche betteni*	7.8	27*
Trichoptera	Hydropsychidae	*Cheumatopsyche spp*	6.2	6
Odonata	Coanagrionidae	*Argia spp*	8.2	3
Odonata	Coanagrionidae	*Enalagma spp*	8.9	4
Odonata	Caliopterigidae	*Caliopteryx spp*	7.8	3
Coleoptera	Dytiscidae	*Agabus spp*	8.9	6
Coleoptera	Dytiscidae	*Hydroporus spp*	8.6	1
Gastrapoda	Physidae	*Physella spp*	8.8	1
Veneroida	Corbiculidae	*Corbicula spp*	NA	2
Amphipoda	Gammaridae	*Gammarus spp*	9.1	*
Isopoda	Asellidae	*Caecidotea sp*	9.1	1
			Total Number of Organisms	78
			Total Number of Taxa	14
			Total Number of EPT	57

* Abundant

The southern reach (M2) received a habitat score of 70 out of 100 possible points. A total of nine EPT taxa were collected represented by 2 species (Table 12). The majority of taxa collected are dragonfly and damselfly nymphs characteristic of slower moving depositional habitats. Taxa collected are moderately to very tolerant species.

Table 12. Benthic Macroinvertebrates Southern Reach M2 October 2007

Order	Family	Genus Species	Tolerance Value	No.
Ephemeroptera	Heptageniidae	*Stenonema modestum*	5.5	5
Trichoptera	Hydropsychidae	*Cheumatopsyche spp*	6.2	4
Odonata	Caliopterigidae	*Caliopteryx spp*	7.8	10
Odonata	Coanagrionidae	*Argia spp*	8.2	3
Odonata	Coanagrionidae	*Enalagma spp*	8.9	1
Odonata	Aeshinidae	*Boyeria vinosa*	5.9	1
Diptera	Simulidae	*Prosimulium spp*	4.0	7
Diptera	Chironomidae	*Conchapelopia group*	8.4	1
			Total Number of Organisms	32
			Total Number of Taxa	8
			Total Number of EPT	9

4.5 STREAM CONCLUSIONS

Very few problems with stream morphology were observed during the monitoring field visit. Based on cross-sectional and longitudinal profile data, and on field visit observations, it was concluded that the site continues to be on track to achieve stream success criteria specified in the Restoration Plan for the site. Throughout the project, some siltation is occurring and vegetation is beginning to grow in the channel. There was some slight

erosion around some of the root wads and in-stream structures. One concern is the step-pool feature in Reach M2. Significant erosion is occurring behind boulders placed in the step pool, and just upstream of the step pool a head cut is working its way upstream. Cows were observed in the easement in South Fork South. Repairs have been made to gates in order to prevent cows from entering the easement. Photos of problem areas and other structures taken during August 2007 are included in Appendix C.

5.0 OVERALL CONCLUSIONS AND RECOMMENDATIONS

- Data collected during monitoring Year 3 and observations of conditions at the site indicate that the stream restoration project continues to be successful and is on track to achieve the stream success criteria as specified in the Restoration Plan for the site. The stream morphology is generally stable. Several in-stream structures have some scour, but appear to be functioning correctly. Very little fluvial erosion was observed overall, though there are areas of concern that will continue to be observed. Some siltation is occurring resulting in vegetation growth in the channel. One step-pool structure at the downstream end of M2 needs to be repaired and a head cut upstream of this structure should be monitored closely over the next year. (STA 38+15 to 39+80). Several organisms and fish were observed along the reaches. Habitat has been improved significantly throughout the project site.

- Vegetation monitoring efforts have demonstrated the average number of stems per acre on site to be 533, which is a survival rate of greater than 76 percent based on the initial planting count of 679 stems per acre. With an average of 533 stems per acre, the site has achieved the interim vegetative success criteria of greater than 320 stems per acre at the end of Year 3 and is on track to achieve the final success criteria of 260 stems per acre at the end of Year 5 as specified in the Restoration Plan for the site.

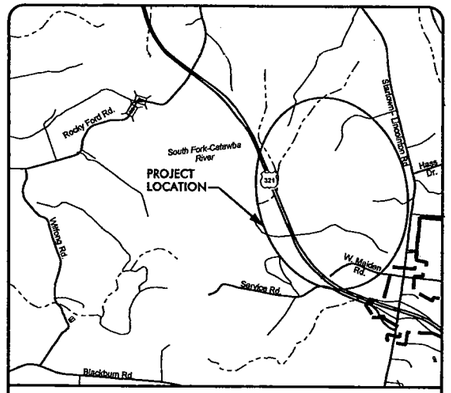
- Monitoring of vegetation and stream stability will continue through the 2009 growing season.

APPENDIX A

As-Built Survey

SOUTH FORK

PROJECT: 169



VICINITY MAP

INDEX OF SHEETS

STREAM RESTORATION PROJECT
ENVIRONMENTAL BANC AND EXCHANGE, LLC

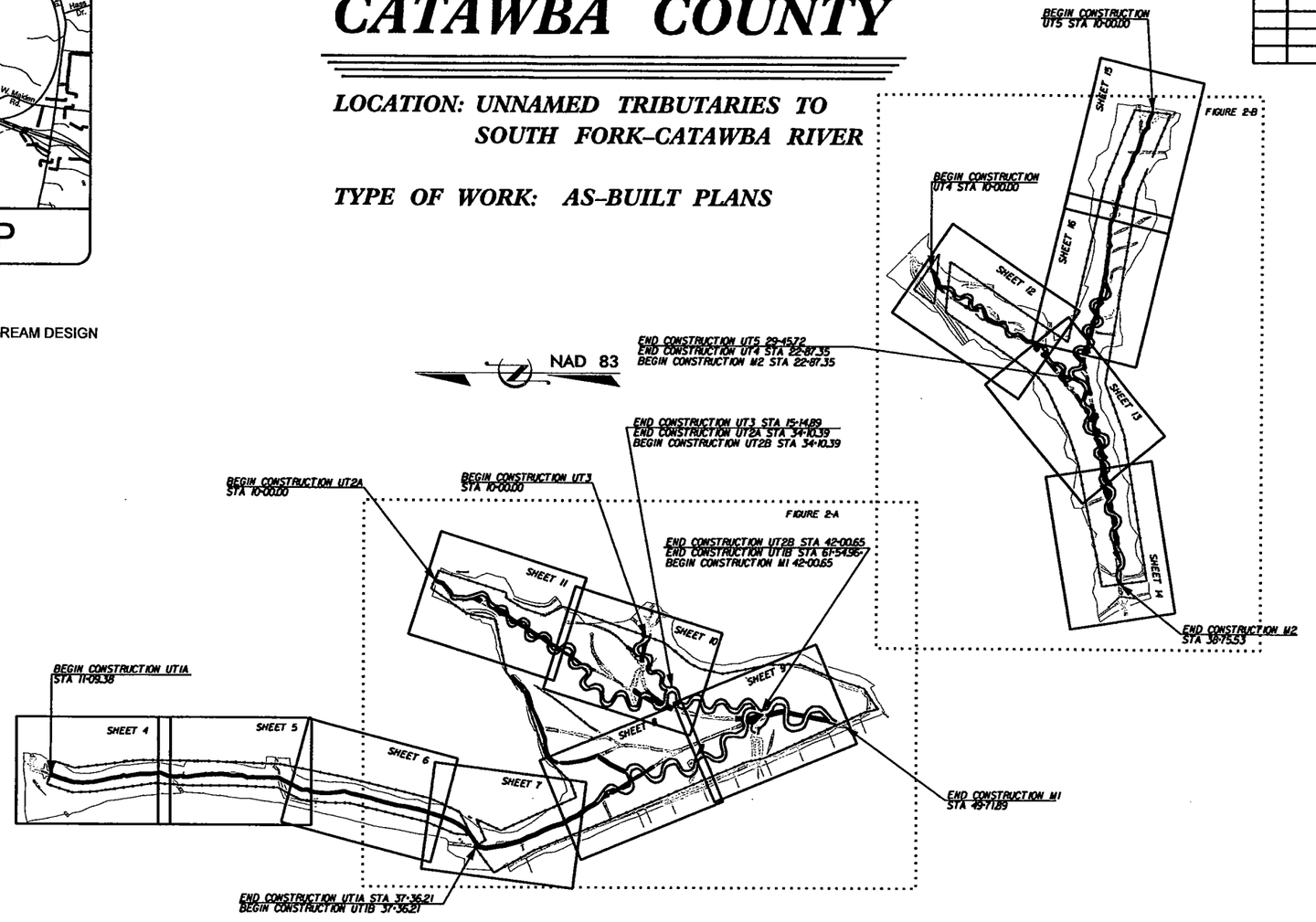
CATAWBA COUNTY

LOCATION: UNNAMED TRIBUTARIES TO SOUTH FORK-CATAWBA RIVER

TYPE OF WORK: AS-BUILT PLANS

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



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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SIGNATURE: *P.E.*

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NAD 83

WOVEN FIELD FENCE SEE DETAIL SHEET 2-D

CONSTRUCT CATTLE PATH ACCORDING TO DETAIL SHEET 2-C MAINTAIN PERMANENT 16' DUKE POWER ACCESS

WOVEN FIELD FENCE SEE DETAIL SHEET 2-D

2 - 10' GATES

CONSERVATION EASEMENT BOUNDARY

UT 2N

X-SECTION 1

X-SECTION 2

VEG PLOT #1

X-SECTION 3

X-SECTION 14

UT 3

X-SECTION 13

CONSTRUCT CATTLE PATH ACCORDING TO DETAIL SHEET 2-C

UT 2A

X-SECTION 4

X-SECTION 5

X-SECTION 9

CREST GAGE

UT 2B

X-SECTION 11

X-SECTION 12

VEG PLOT #4

M1

X-SECTION 10

CONSERVATION EASEMENT BOUNDARY

PERMANENT 16' DUKE POWER ACCESS

UT IB

X-SECTION 7

60' ADJACENT LANDOWNER EASEMENT

X-SECTION 6

X-SECTION 8

UT IB

VEG PLOT #3

U.S. HWY. 321 PUBLIC R/W WIDTH VARIES

CONSERVATION EASEMENT BOUNDARY

U.S. HWY. 321 PUBLIC R/W WIDTH VARIES

MATCHLINE SHEET 17

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

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SCALE (FT)

11/10/2005
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PROJECT REFERENCE NO.	SHEET NO.
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Fax: 919-463-5490

60' ADJACENT LANDOWNER EASEMENT

NAD 83

CONSERVATION EASEMENT BOUNDARY

X-SECTION 6

VEG PLOT #7

X-SECTION 7

X-SECTION 5

M2

CREST GAGE

X-SECTION 4

X-SECTION 8

CONSERVATION EASEMENT BOUNDARY

UT 4

X-SECTION 1

VEG PLOT #6

X-SECTION 2

UT 5

X-SECTION 3

VEG PLOT #5

OL KOLB CREEK

X-SECTION 10

60' ADJACENT LANDOWNER EASEMENT

SITE OVERVIEW

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11/10/2005
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DUKE POWER EASEMENT

SHERRILL FURNITURE COMPANY
SHERRILL UPHOLSTERING COMPANY
DB 1479, PG 704
DB 757, PG 211

GATE

WOODS

10+00

11+00

12+00

13+00

14+00

15+00

16+00

BEGIN CONSTRUCTION UTIA
STA 10+00.00

UTIA

APPROXIMATE BOUNDARY LINE

MATCHLINE SHEET 5 STA 16+73.05

TRANSPLANTS

SOUTH FORK

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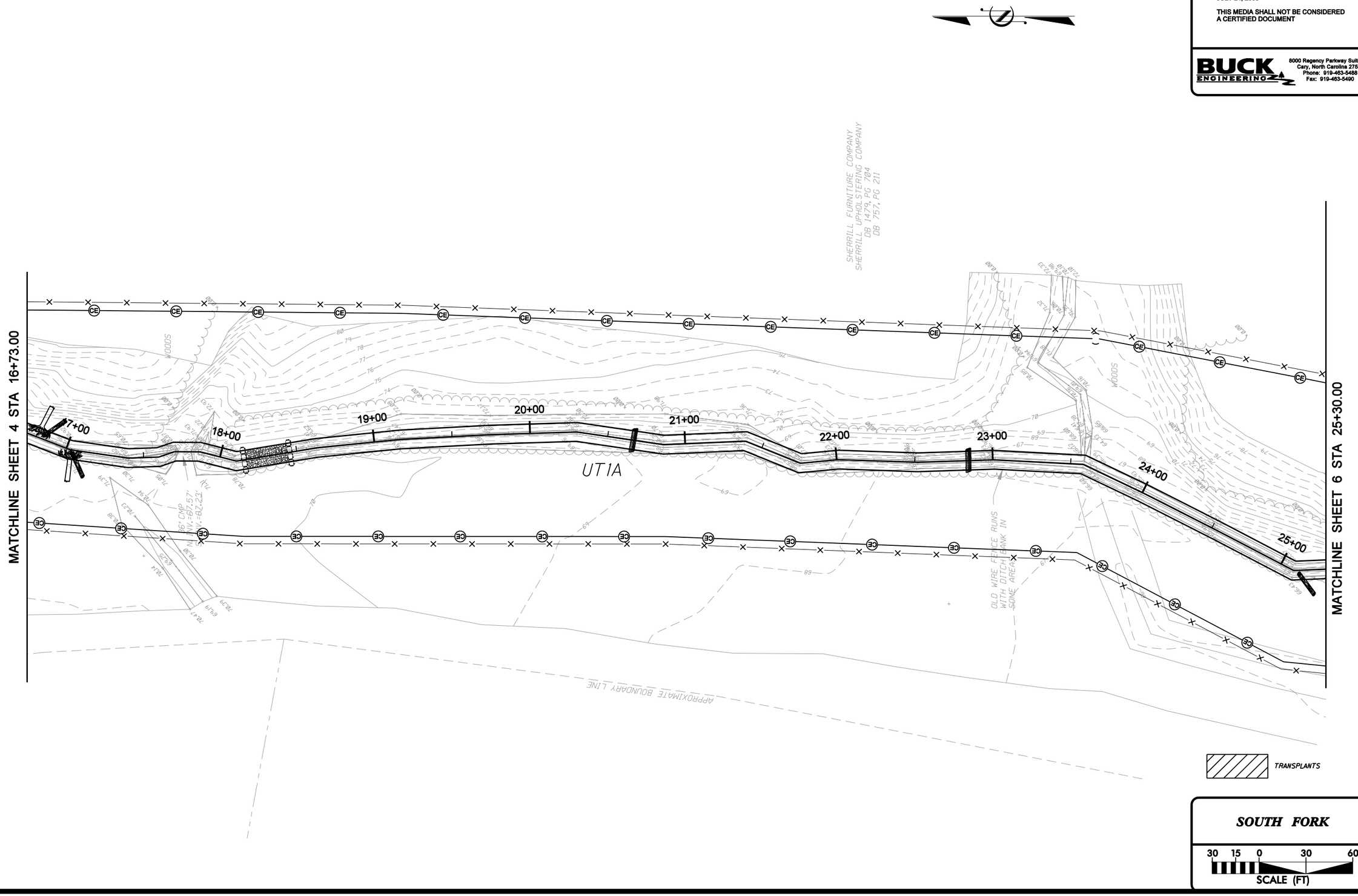

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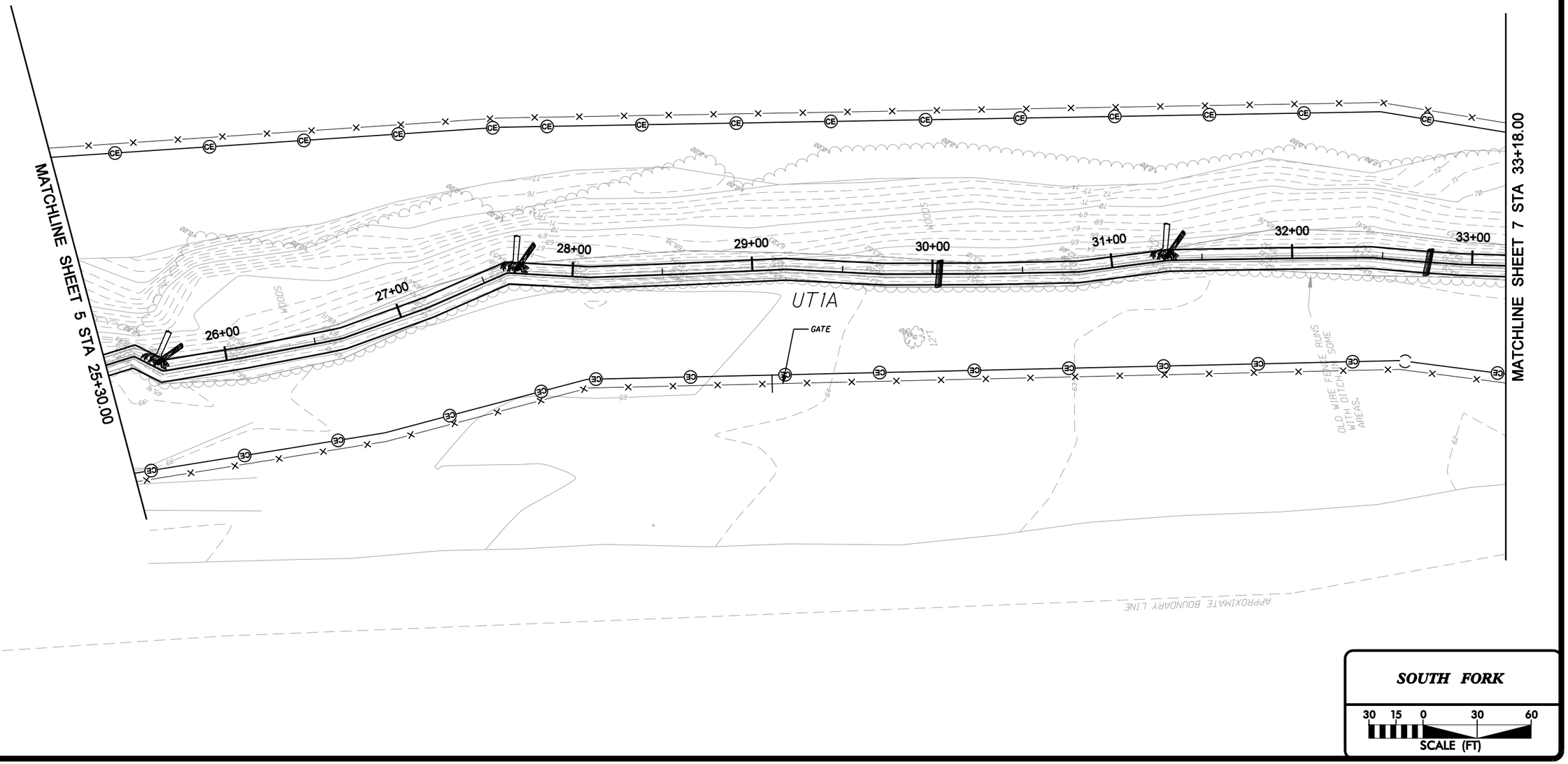

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Phone: 919-463-5488
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MATCHLINE SHEET 6 STA 33+18.00

MATCHLINE SHEET 8 STA 42+04.00

SHERRILL FURNITURE COMPANY
SHERRILL UPHOLSTERING COMPANY
DB 1479, PG 704
DB 757, PG 211

34+00
35+00
36+00
37+00
38+00
39+00
40+00
41+00
42+0

UT1A
UT1B

24" RCP
N.E. INV.=57.0
S.W. INV.=56.8

GATE

N/F
IC. O. MILLER
AND WIFE,
THA L. MILLER
420, PG 319

WOODS

SOUTH FORK

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SCALE (FT)

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MATCHLINE SHEET 8 STA 42+04.00

MATCHLINE SHEET 9 STA 54+23.00

FIELD DITCH TIED INTO REALLIGNED CHANNEL

CUT LIMITS

UT 1B

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12" PLP N. INV.=51.96' S. INV.=52.02'

36" RCP N.W. INV.=52.28' S.E. INV.=52.27'

12" CMP INV.=58.19

15" CMP INV.=57.41

12" CMP INV.=58.17

12" CMP INV.=57.74

WOODS

POWER LINE TOWER

150.00' DUKE POWER EASEMENT

42+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

FILL EXISTING CHANNEL

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

CHANNEL BLOCK

SOUTH FORK

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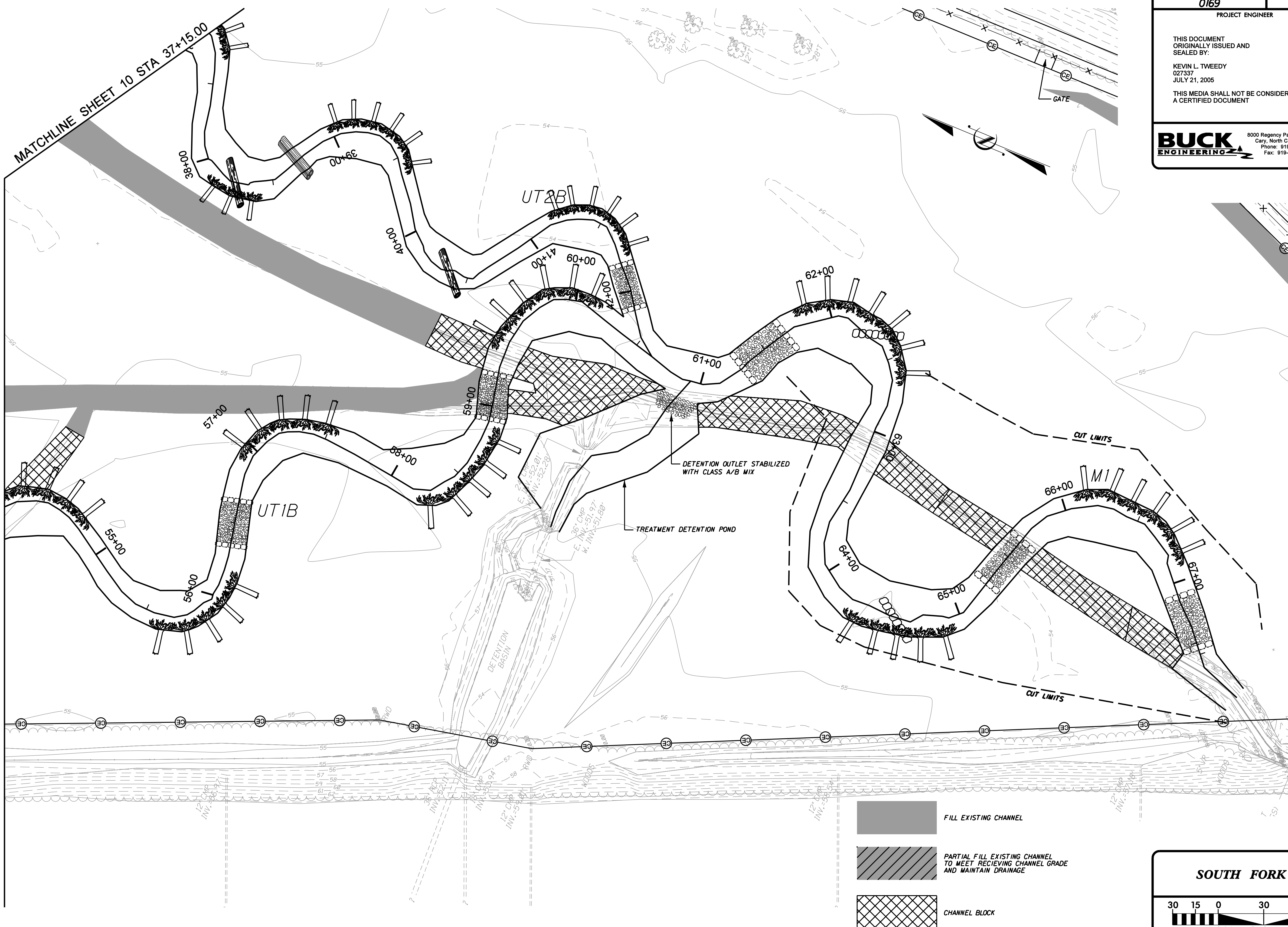

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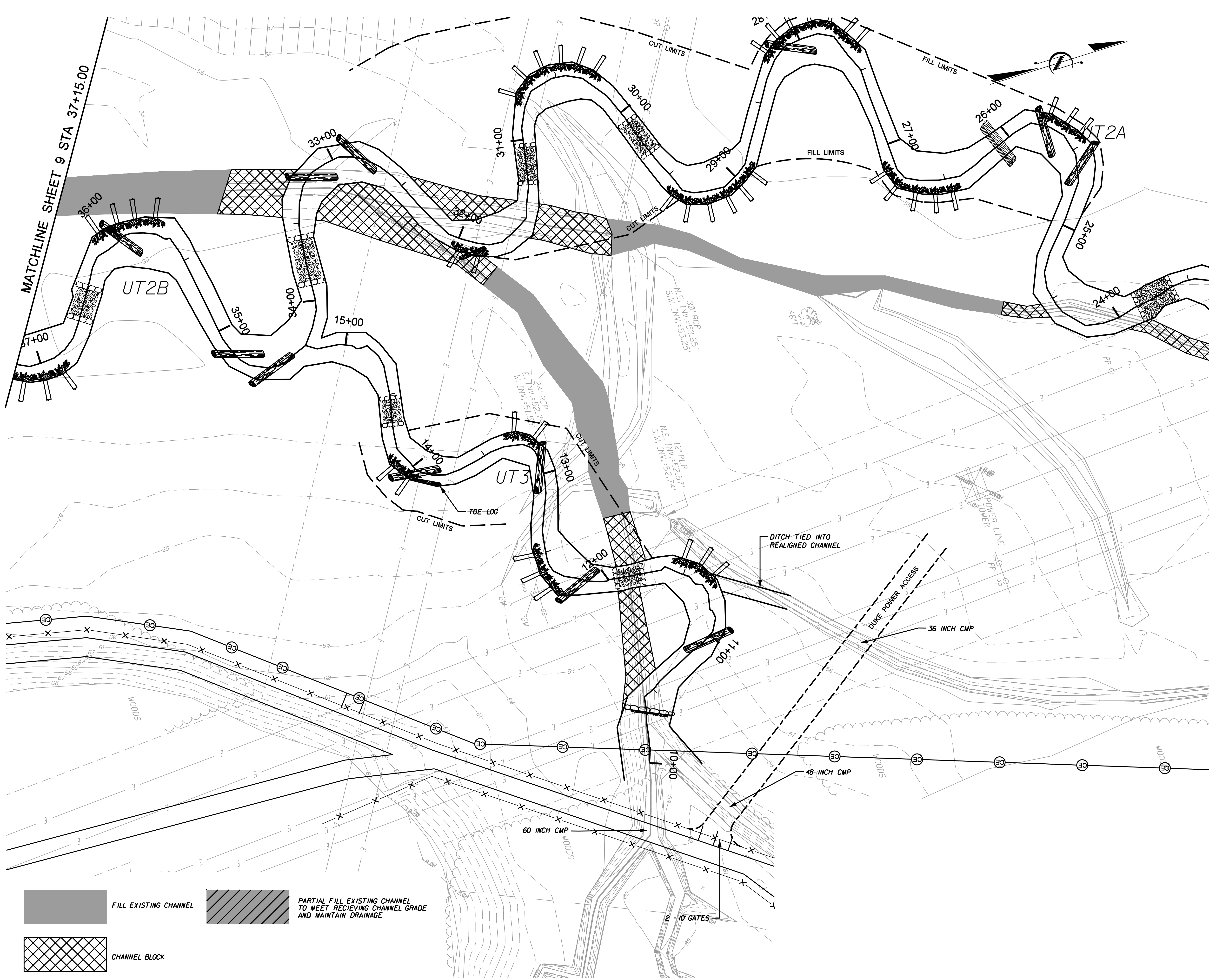

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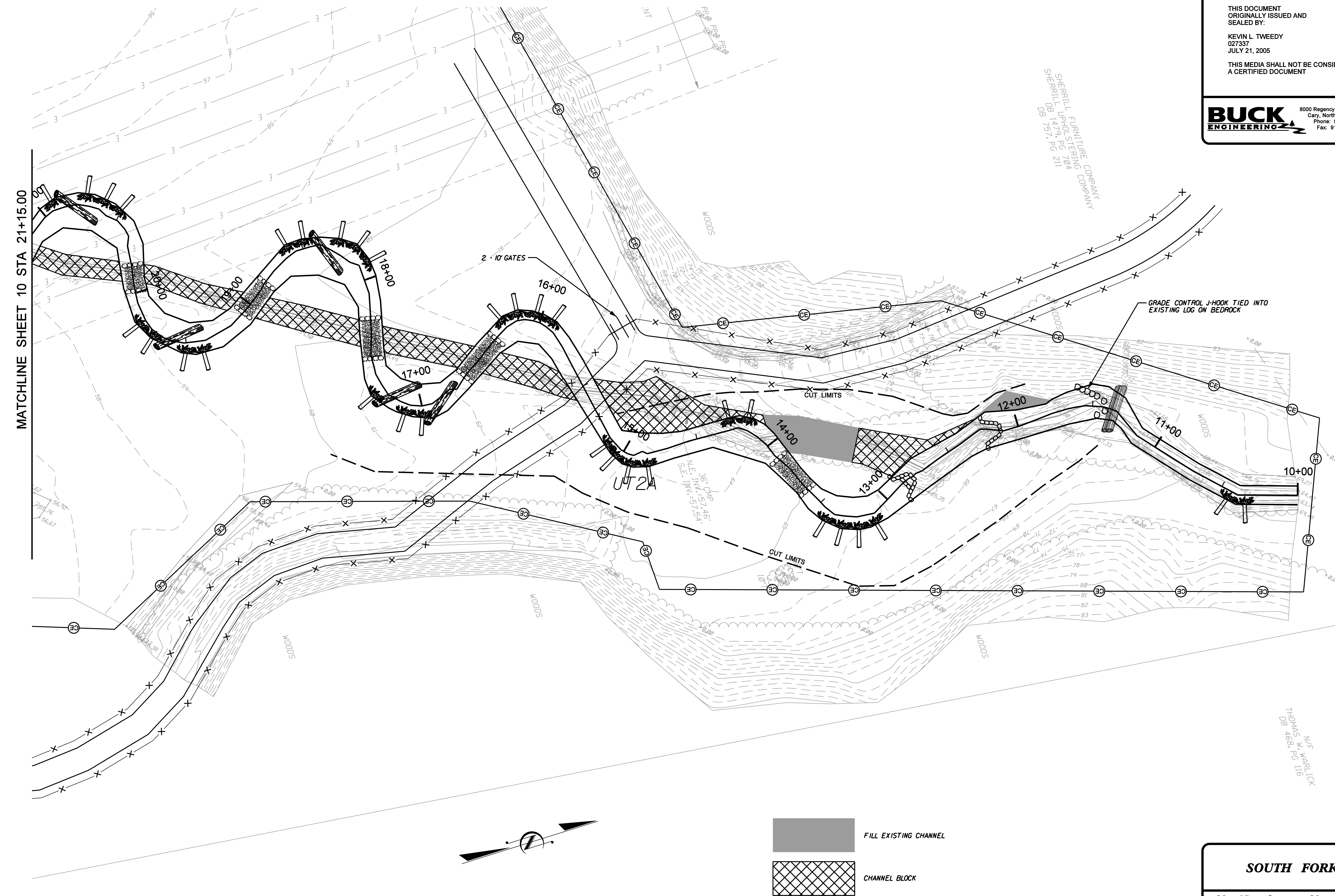
SOUTH FORK

SCALE (FT) 30 15 0 30 60

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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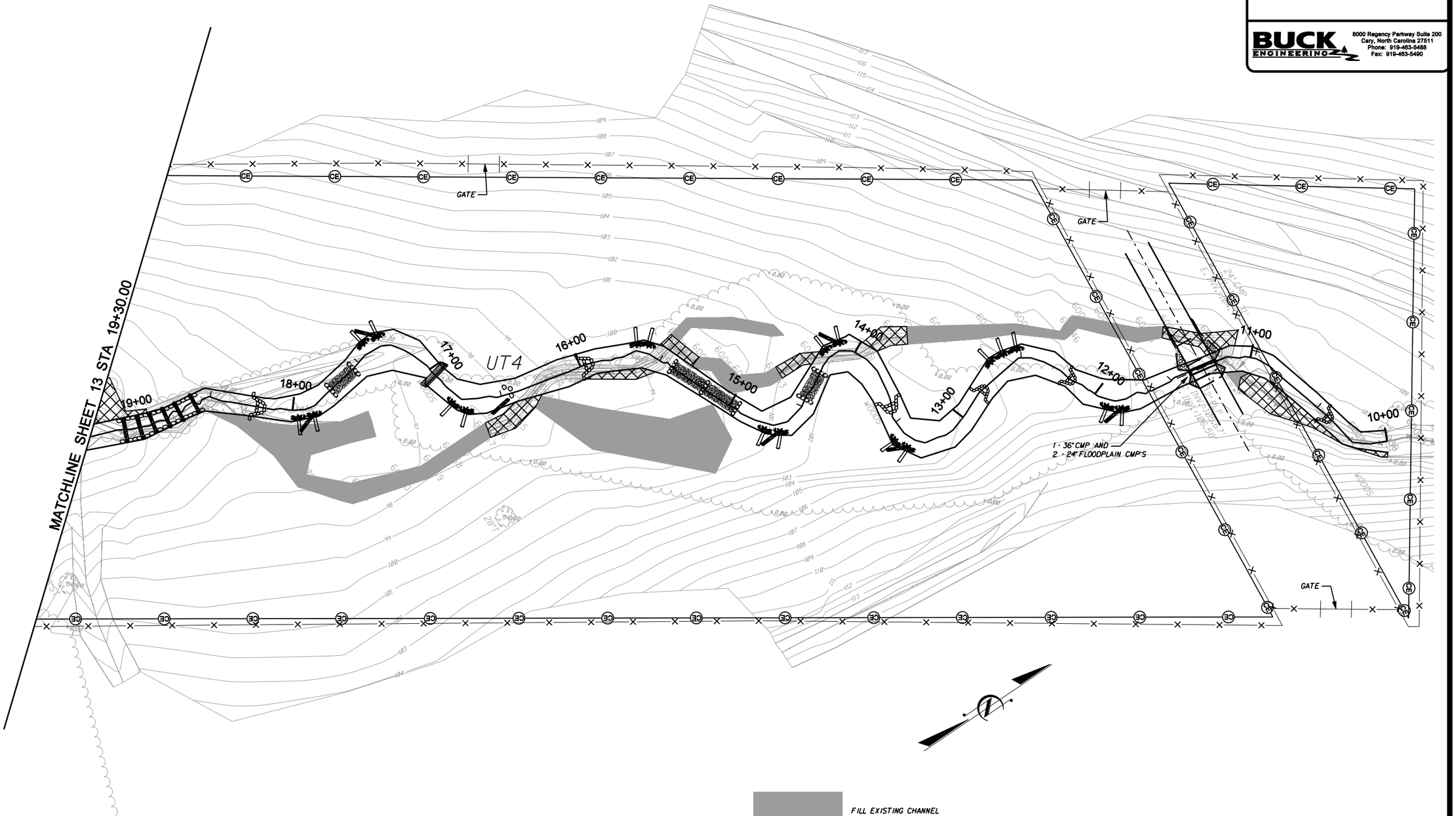

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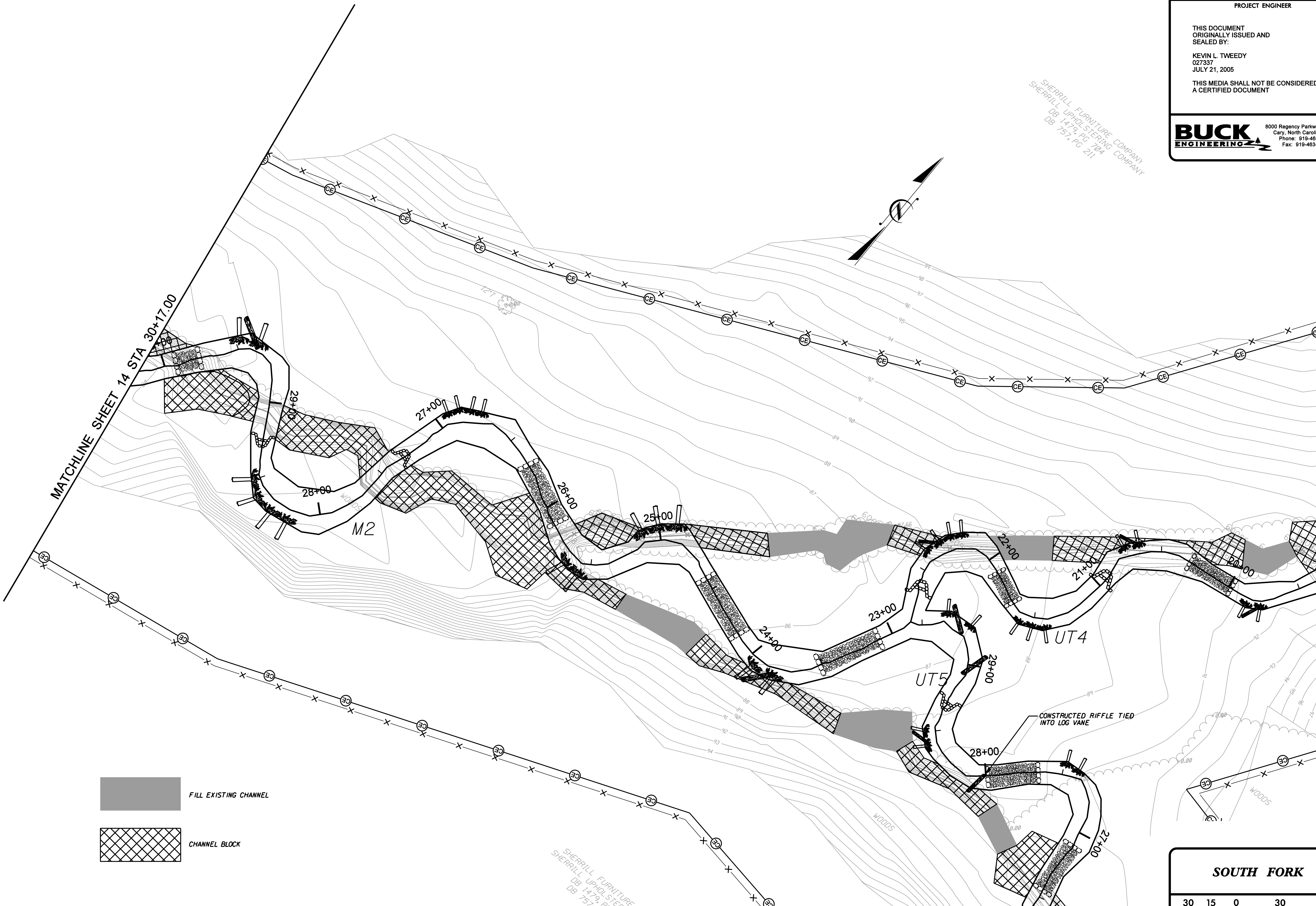

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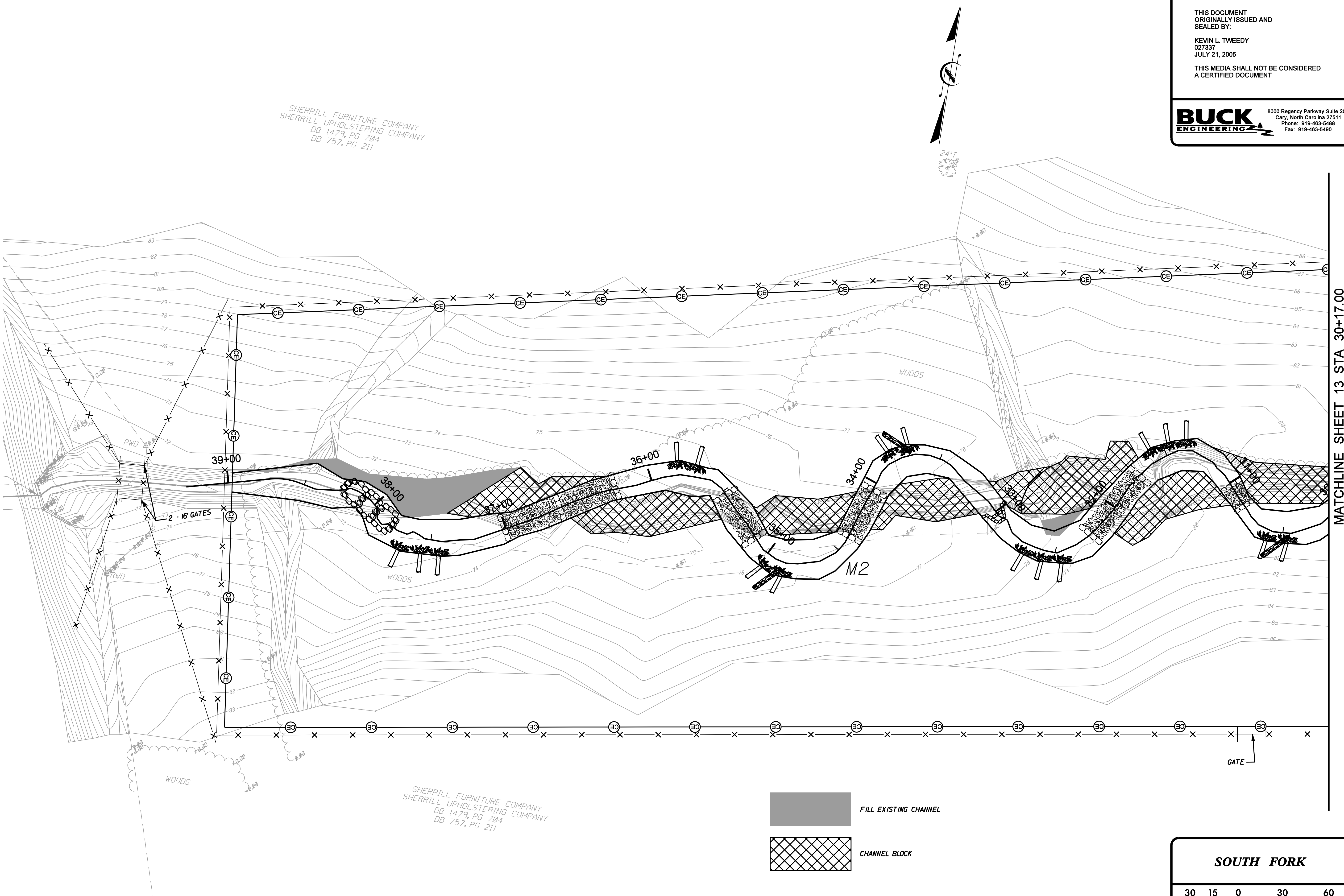

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KEVIN L. TWEEDY
027337
JULY 21, 2005

THIS MEDIA SHALL NOT BE CONSIDERED
A CERTIFIED DOCUMENT

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

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

WOODS

WOODS

WOODS

60" CMP
W. INV.=104.14'
E. INV.=104.08'

UT5

GATE

TROY P. CANSLER, JR.
DB 1914, PG 148

SHERRILL FURNITURE COMPANY
UPHOLSTERING COMPANY
PG. 704

FILL EXISTING CHANNEL

CHANNEL BLOCK

SOUTH FORK

30 15 0 30 60
SCALE (FT)

10/18/2005
c:\projects\design\Plans\0169r_southfork_esb_psh_15.dgn

2/26/03

PROJECT REFERENCE NO.	SHEET NO.
169	16

PROJECT ENGINEER

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Fax: 919-463-5490

MATCHLINE SHEET 13 STA 26+20.00

MATCHLINE SHEET 15 STA 16+20.00

CONTROL POINT
N=681,350.4538'
E=1,327,288.3708'
ELEV.=94.90'

CONTROL POINT
N=681,252.2432'
E=1,327,792.6767'
ELEV.=103.62'

CONTROL POINT
N=681,275.9298'
E=1,327,537.7300'
ELEV.=98.9[illegible]

CUT LIMITS

CUT LIMITS

GATE

UT5

WOODS

25+00 24+00 23+00 22+00 21+00 20+00 19+00 18+00 17+00

FILL EXISTING CHANNEL

CHANNEL BLOCK

SOUTH FORK

30 15 0 30 60
SCALE (FT)

10/18/2005
I:\projects\Design\Plans\0169-_southfork_asb_psh_16.dgn

PROJECT REFERENCE NO.	SHEET NO.
169	17

PROJECT ENGINEER

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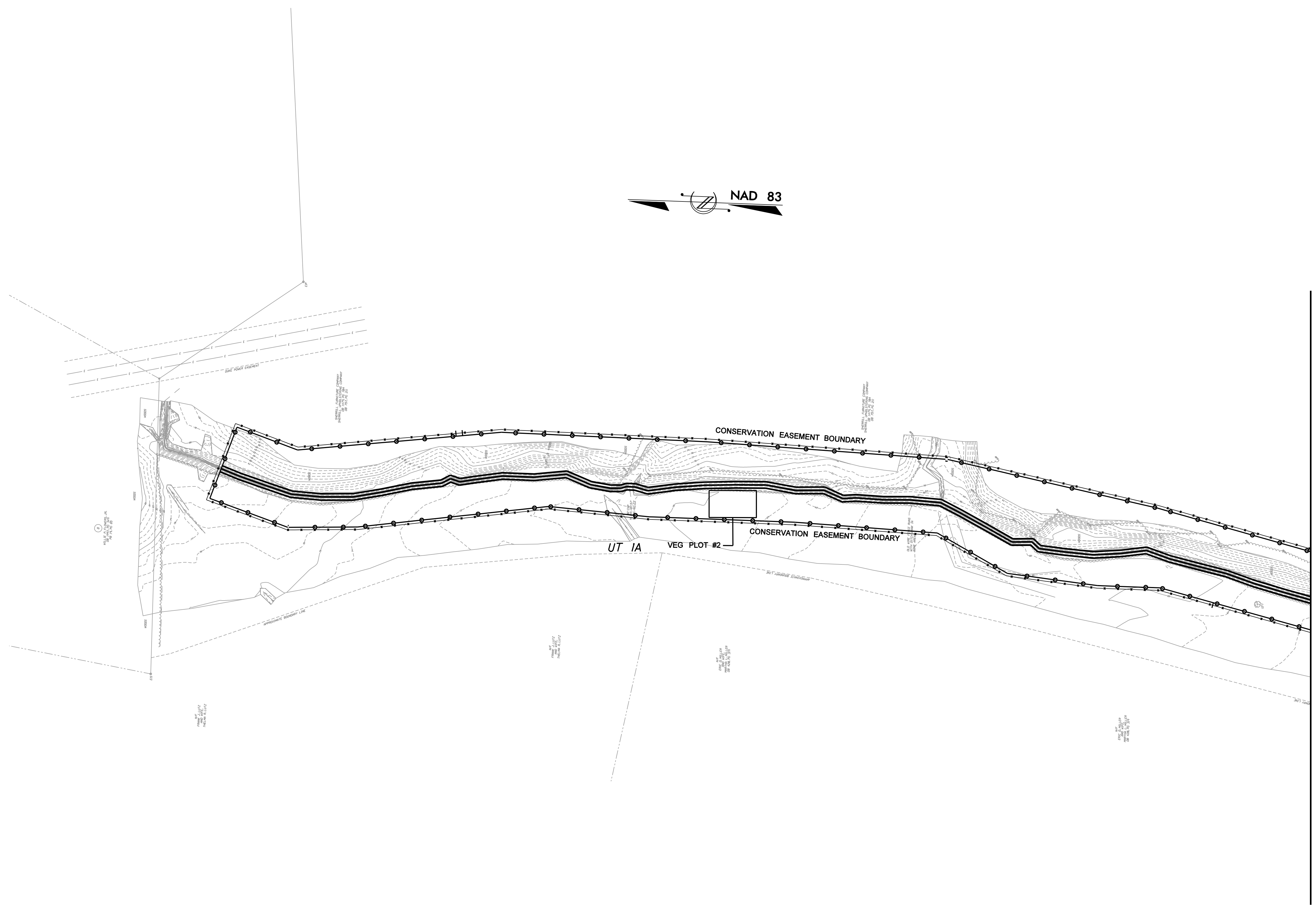

SITE OVERVIEW

100 50 0 100 200
SCALE (FT)

2/26/03

10/18/2005
r:\0169R\Design\Plans\0169r_southfork_asb_psh_17.dgn

PROJECT REFERENCE NO.	SHEET NO.
169	18

PROJECT ENGINEER

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Cary, North Carolina 27511
Phone: 919-463-5488
Fax: 919-463-5490

NAD 83

WOVEN FIELD FENCE
SEE DETAIL SHEET 2-D

CONSTRUCT CATTLE PATH ACCORDING TO DETAIL SHEET 2-C
MAINTAIN PERMANENT 16' DUKE POWER ACCESS

WOVEN FIELD FENCE
SEE DETAIL SHEET 2-D

2 - 10' GATES

X-SECTION 1

UT 2A

X-SECTION 2

CONSERVATION EASEMENT BOUNDARY

VEG PLOT #1

X-SECTION 3

X-SECTION 14

UT 3

CONSTRUCT CATTLE PATH ACCORDING TO DETAIL SHEET 2-C

UT 2A

X-SECTION 4

X-SECTION 9

CREST GAGE

UT 2B

X-SECTION 11

X-SECTION 12

VEG PLOT #4

X-SECTION 10

X-SECTION 5

CONSERVATION EASEMENT BOUNDARY

PERMANENT 16'
DUKE POWER ACCESS

UT IB

X-SECTION 7

60' ADJACENT
LANDOWNER EASEMENT

X-SECTION 6

X-SECTION 8

UT IB

VEG PLOT #3

CONSERVATION EASEMENT BOUNDARY

U.S. HWY. 321
PUBLIC R/W WIDTH VARIES

U.S. HWY. 321
PUBLIC R/W WIDTH VARIES

MATCHLINE SHEET 17

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)

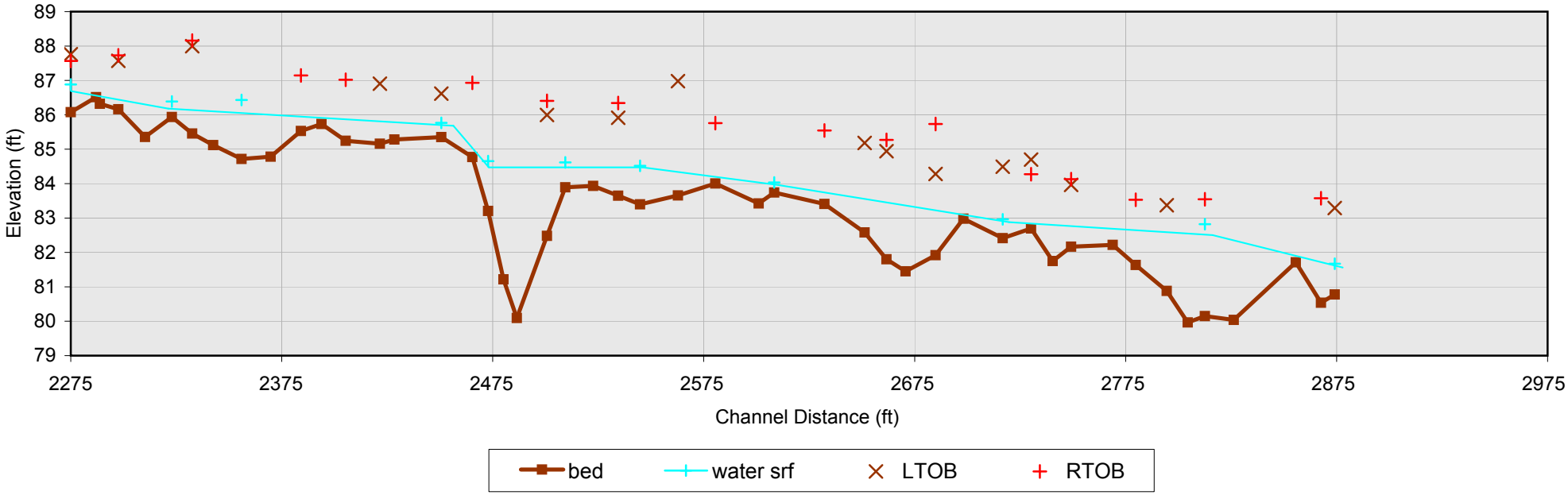
2/26/03

10/18/2005
I:\169PR\Design\Plans\0169r_southfork_asb_psh_18.dgn

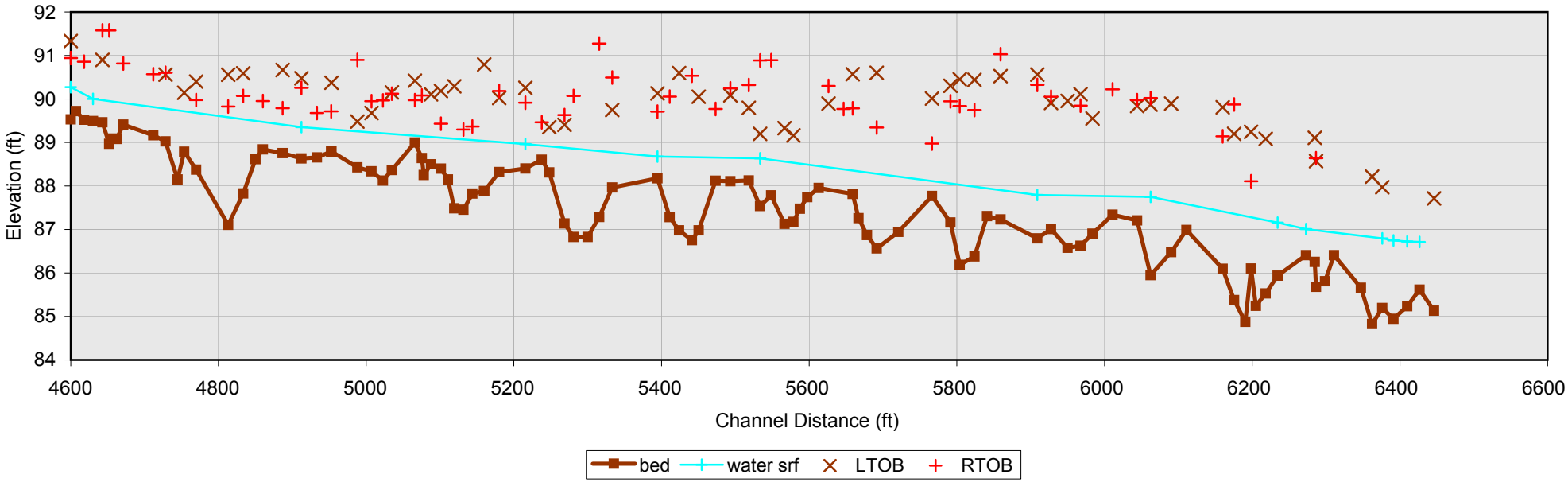
APPENDIX B

Profile and Cross Section Data

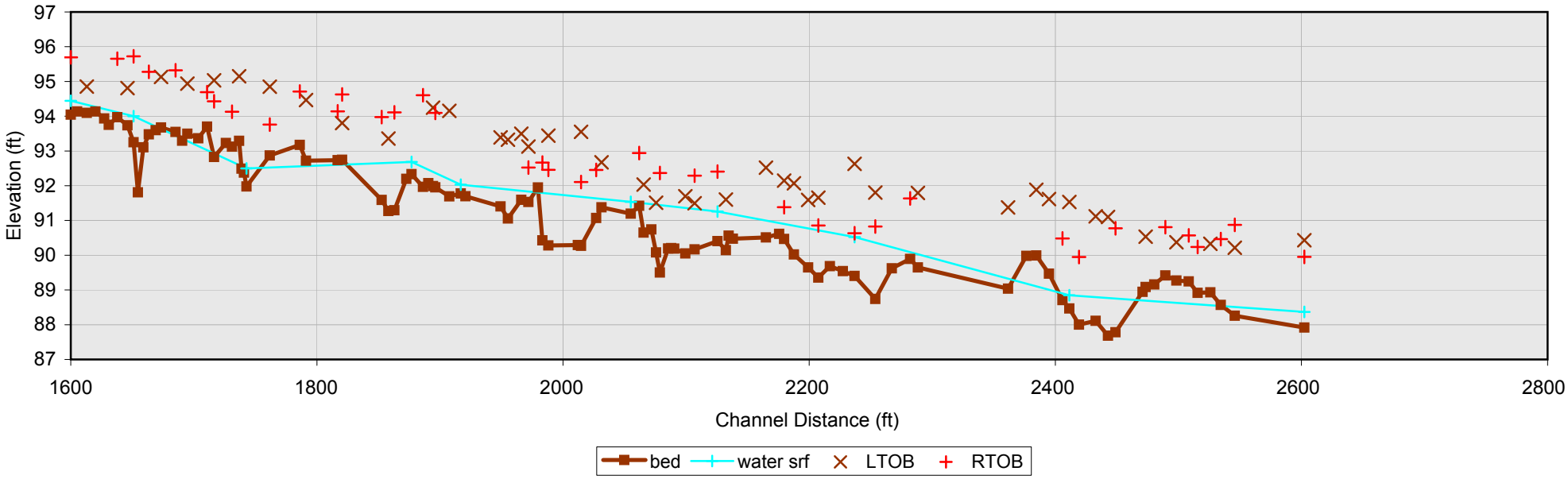
Year 3 2007
South Fork Profile Reach M2
STA 22+75 to STA 28+75



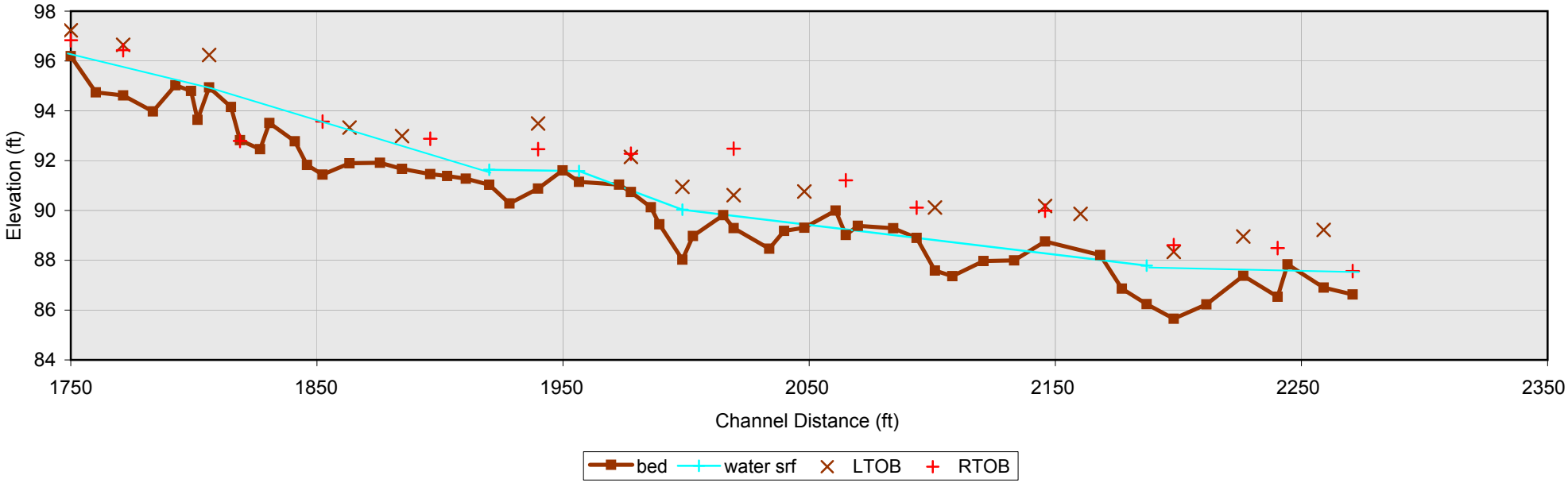
Year 3 2007
South Fork Profile UT1B & M1
STA 46+00 to STA 64+00



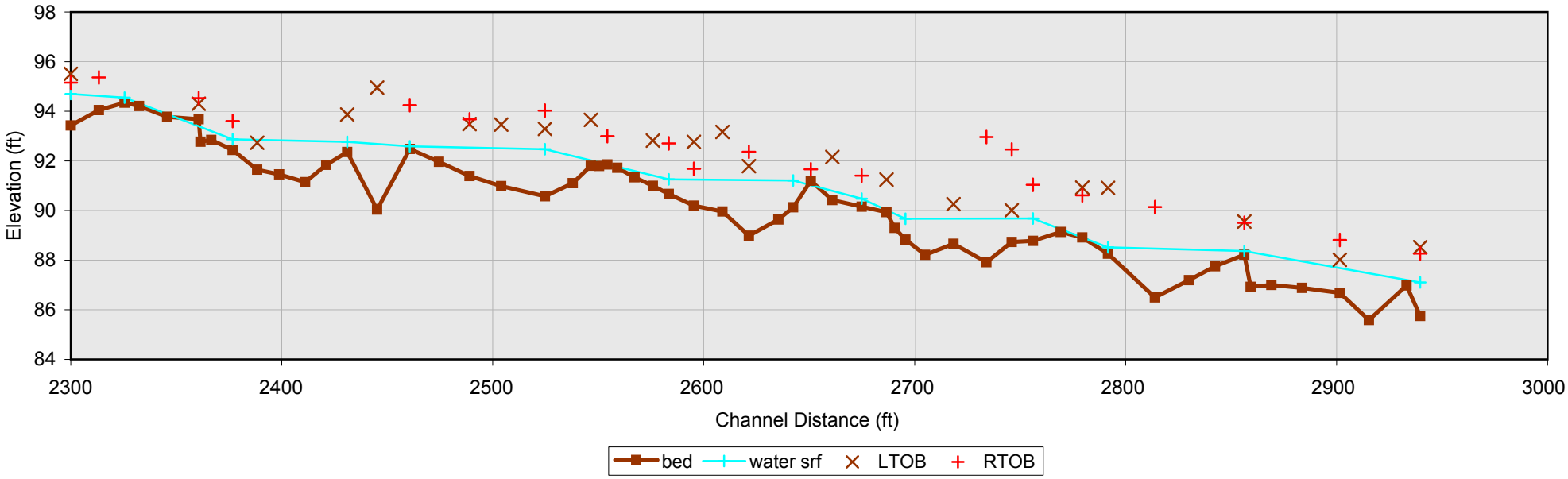
Year 3 2007
South Fork Profile Reach UT2A
STA 16+00 to STA 26+00

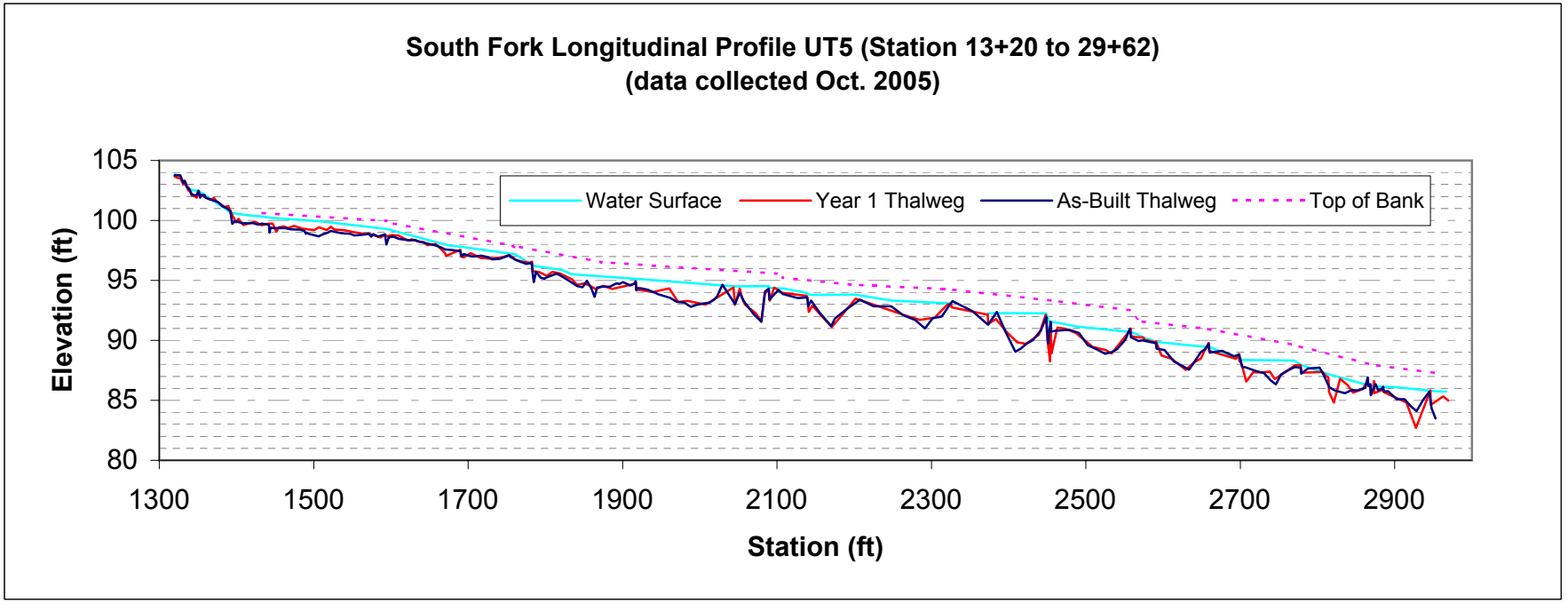


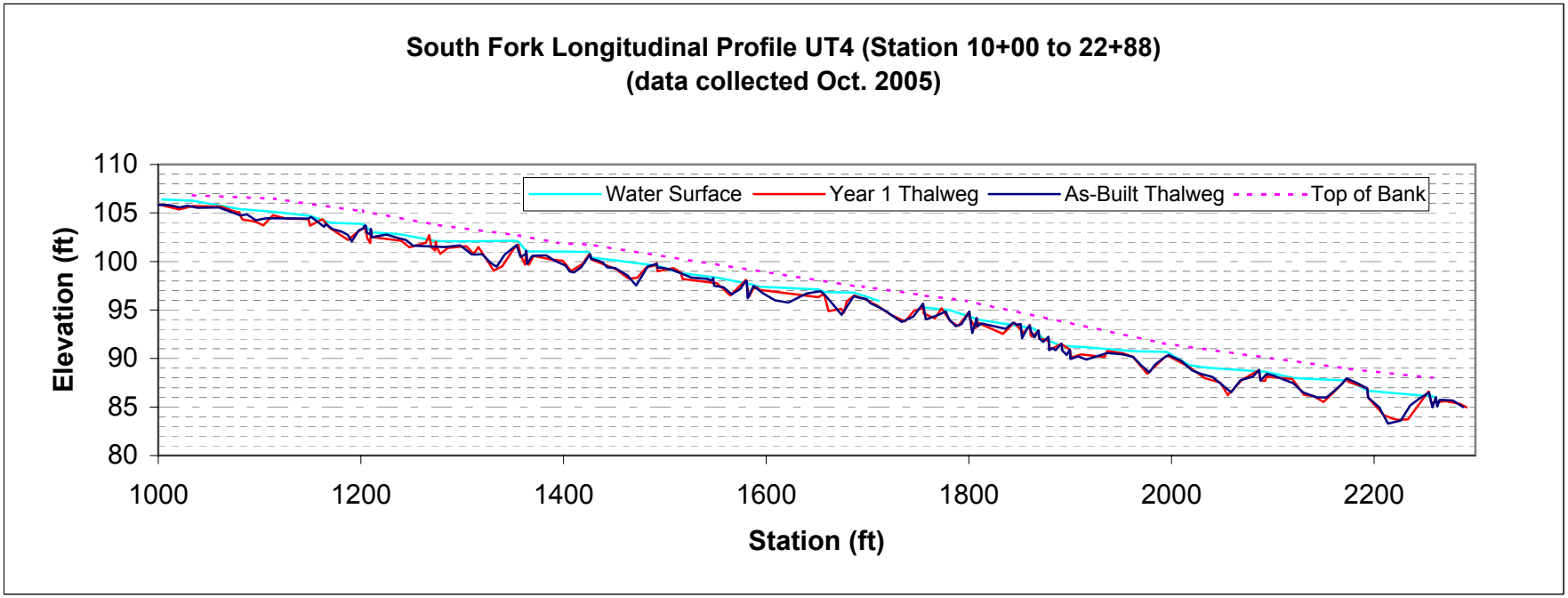
Year 3 2007
South Fork Profile Reach UT4
STA 17+50 to STA 22+75

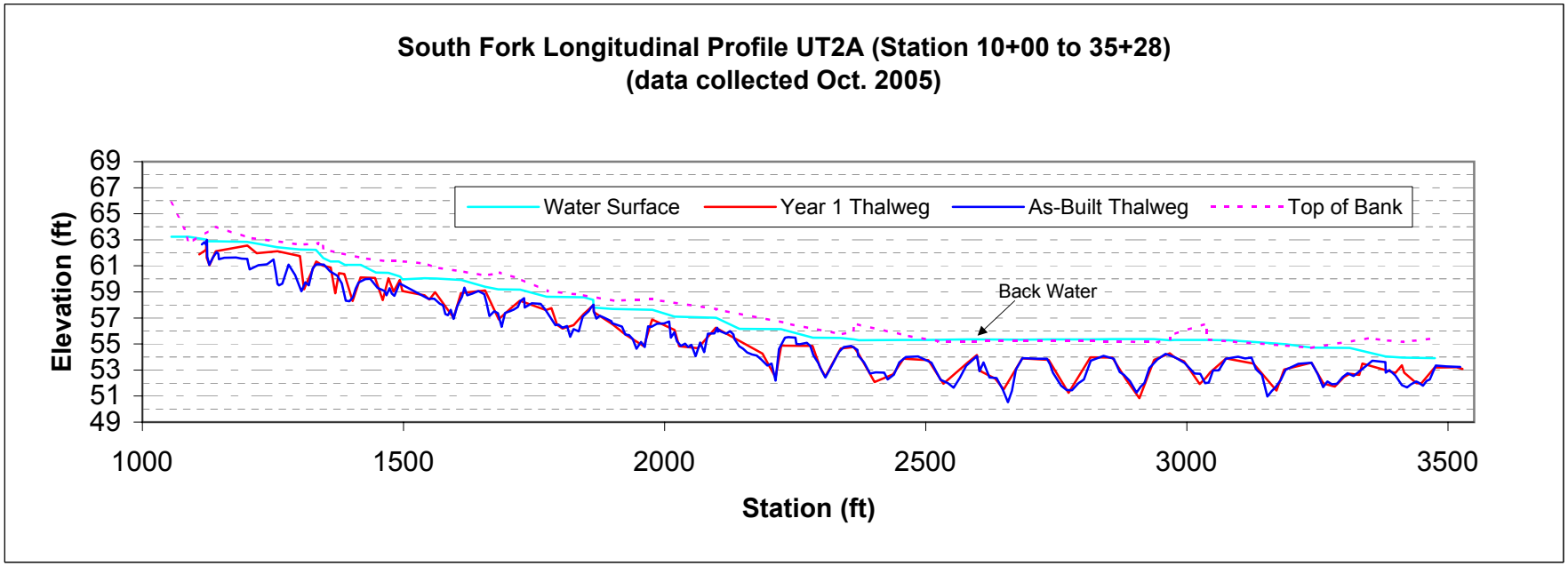


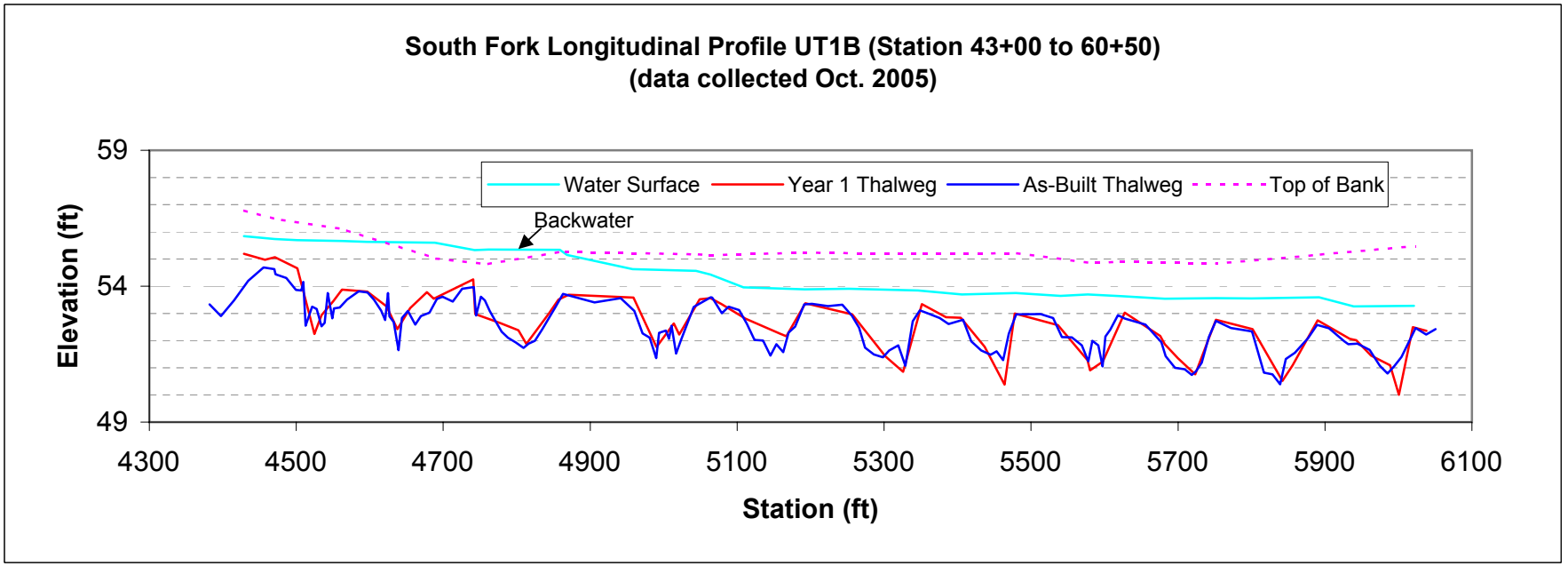
Year 3 2007
South Fork Profile Reach UT5
STA 23+00 to STA 29+62

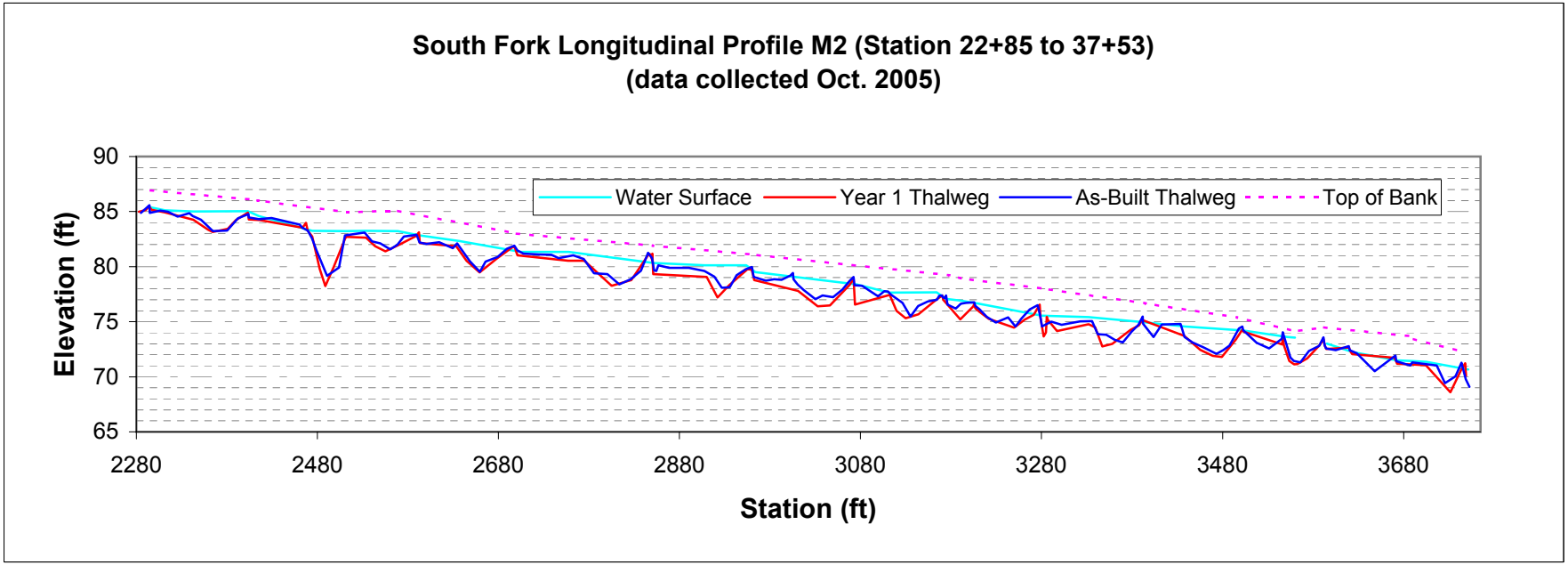


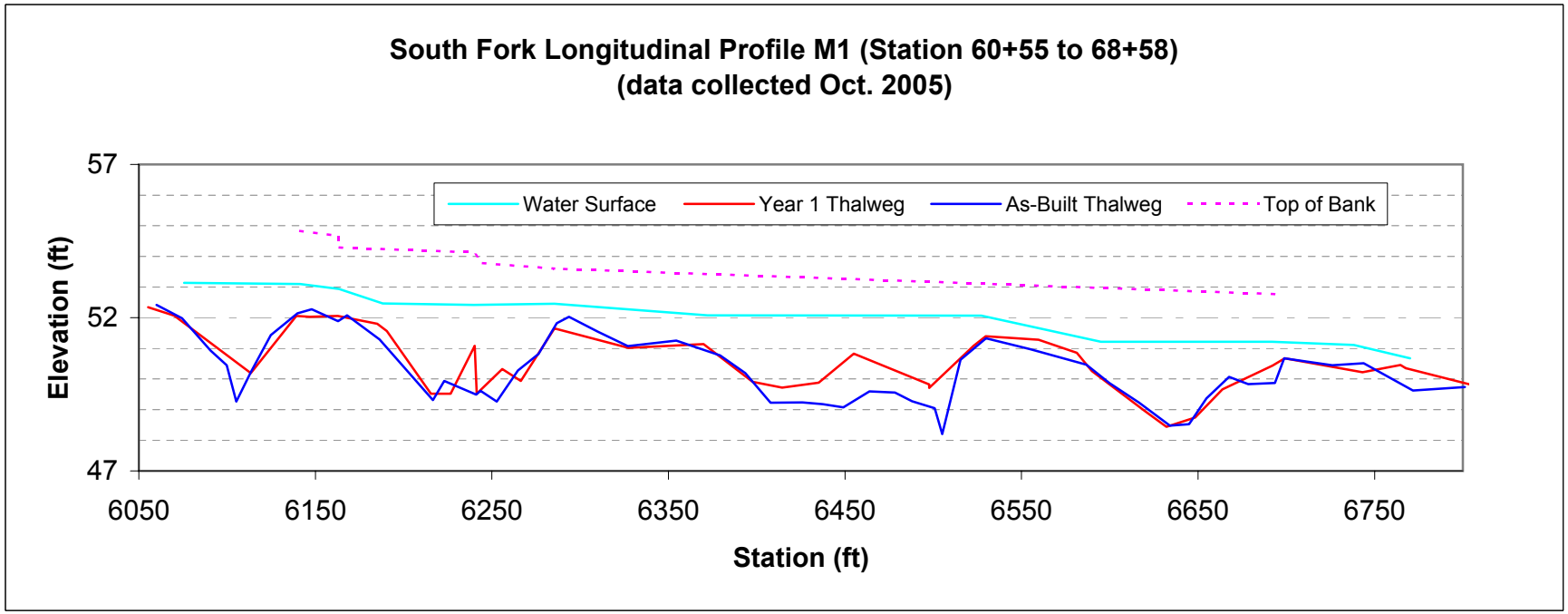

South Fork Longitudinal Profile UT5 (Station 13+20 to 29+62)
(data collected Oct. 2005)
Water Surface
Year 1 Thalweg
As-Built Thalweg
Top of Bank
Elevation (ft)
105
100
95
90
85
80
1300
1500
1700
1900
2100
2300
2500
2700
2900
Station (ft)


South Fork Longitudinal Profile UT4 (Station 10+00 to 22+88)
(data collected Oct. 2005)
Water Surface
Year 1 Thalweg
As-Built Thalweg
Top of Bank
Elevation (ft)
110
105
100
95
90
85
80
1000
1200
1400
1600
1800
2000
2200
Station (ft)


South Fork Longitudinal Profile UT2A (Station 10+00 to 35+28)
(data collected Oct. 2005)
Water Surface
Year 1 Thalweg
As-Built Thalweg
Top of Bank
Back Water
Elevation (ft)
69
67
65
63
61
59
57
55
53
51
49
1000
1500
2000
2500
3000
3500
Station (ft)

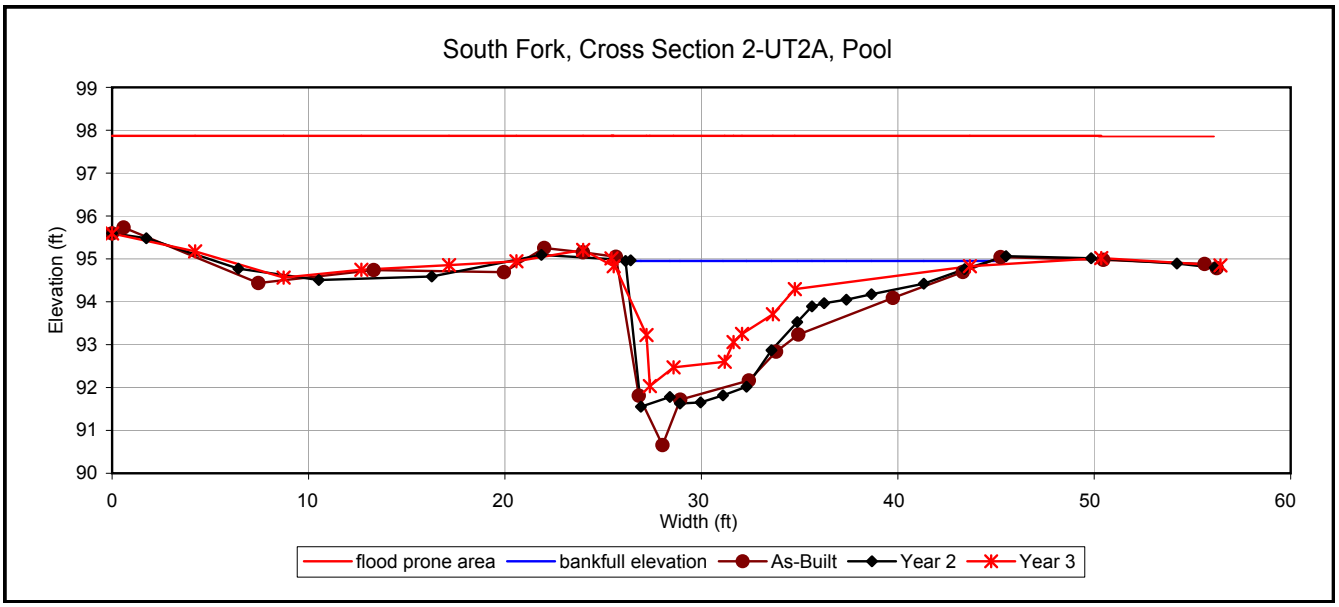

South Fork Longitudinal Profile UT1B (Station 43+00 to 60+50)
(data collected Oct. 2005)
Water Surface
Year 1 Thalweg
As-Built Thalweg
Top of Bank
Backwater
Elevation (ft)
59
54
49
4300
4500
4700
4900
5100
5300
5500
5700
5900
6100
Station (ft)


South Fork Longitudinal Profile M2 (Station 22+85 to 37+53)
(data collected Oct. 2005)
Water Surface
Year 1 Thalweg
As-Built Thalweg
Top of Bank
Elevation (ft)
90
85
80
75
70
65
2280
2480
2680
2880
3080
3280
3480
3680
Station (ft)


South Fork Longitudinal Profile M1 (Station 60+55 to 68+58)
(data collected Oct. 2005)
Water Surface
Year 1 Thalweg
As-Built Thalweg
Top of Bank
Elevation (ft)
57
52
47
6050
6150
6250
6350
6450
6550
6650
6750
Station (ft)

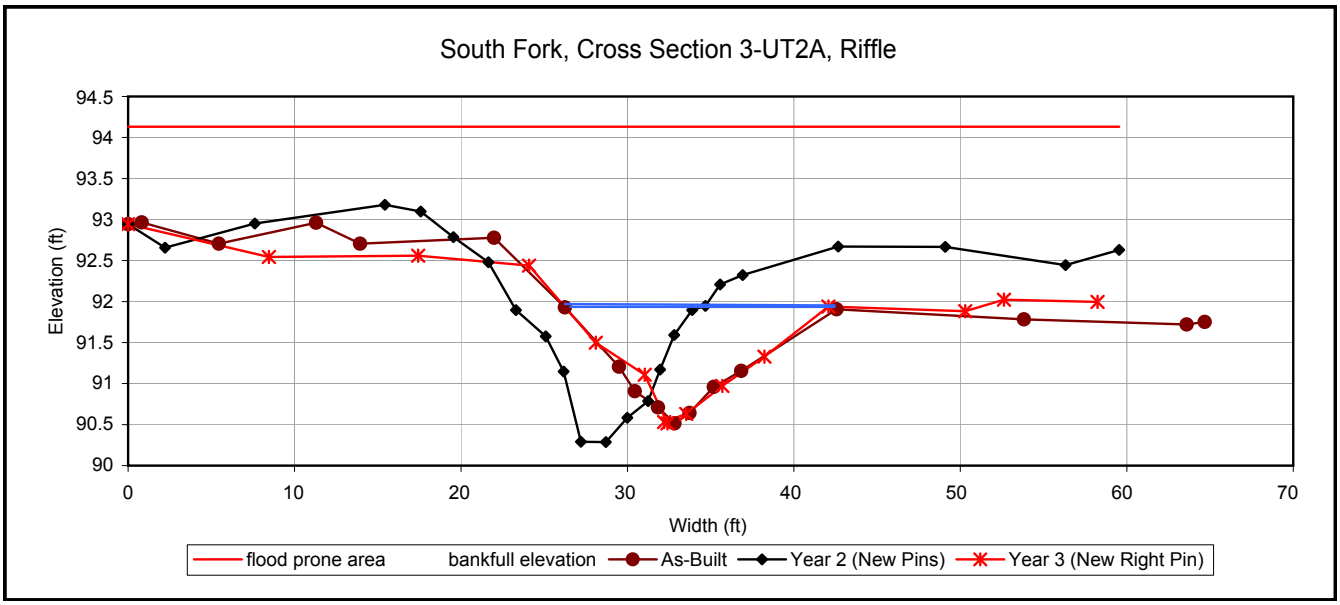
Looking at left bank.

Looking at right bank.



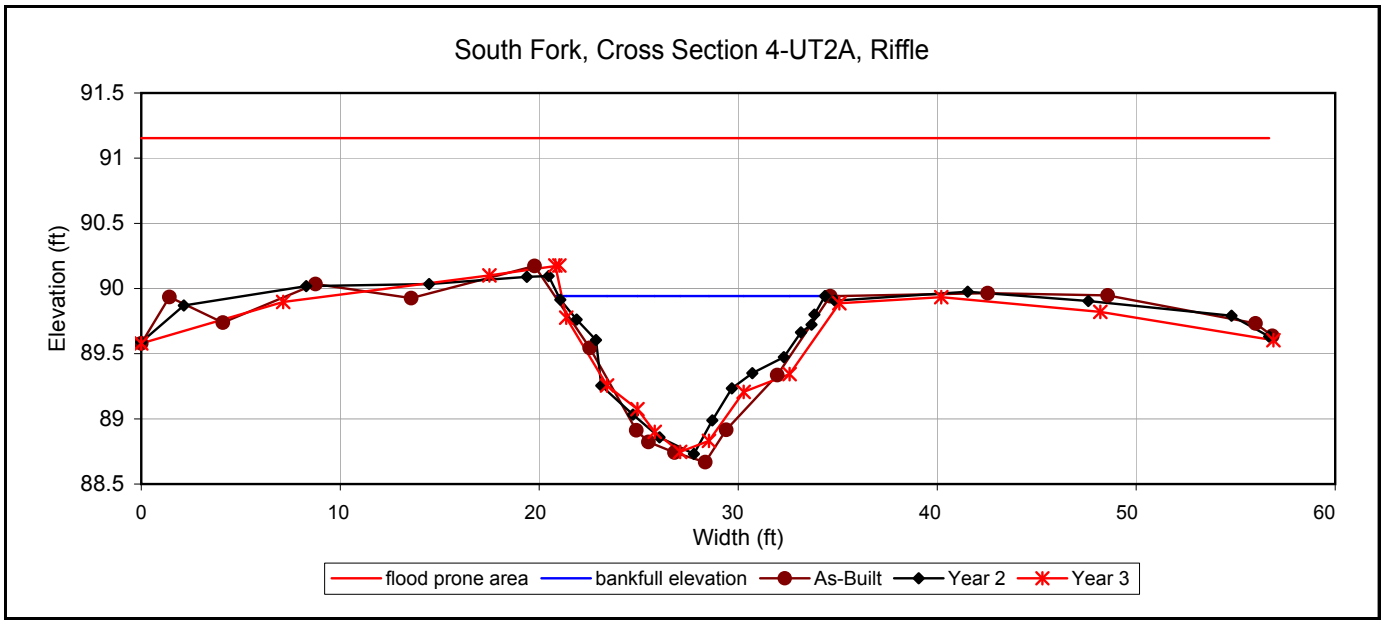
Looking at the left bank.

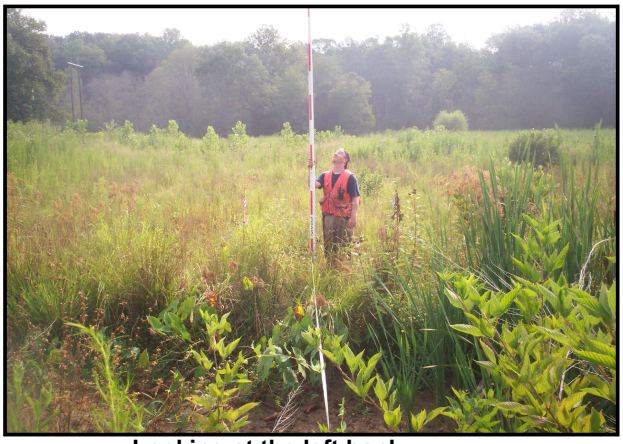
Looking at the right bank.



Looking at the left bank.

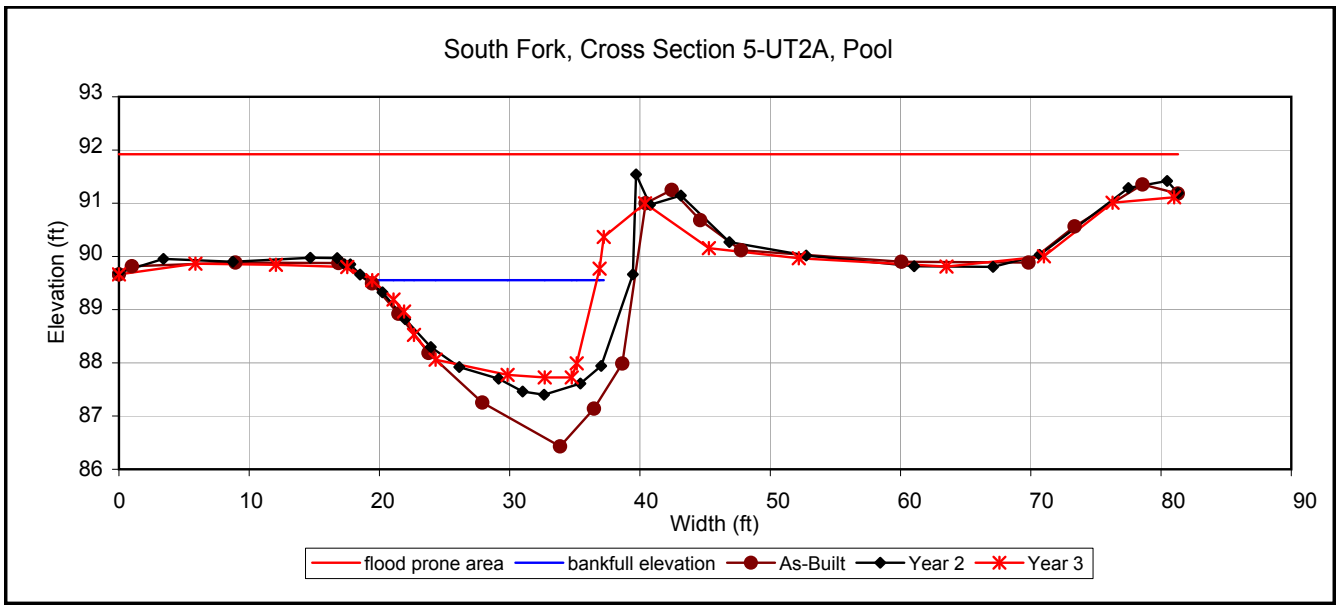
Looking at the right bank.

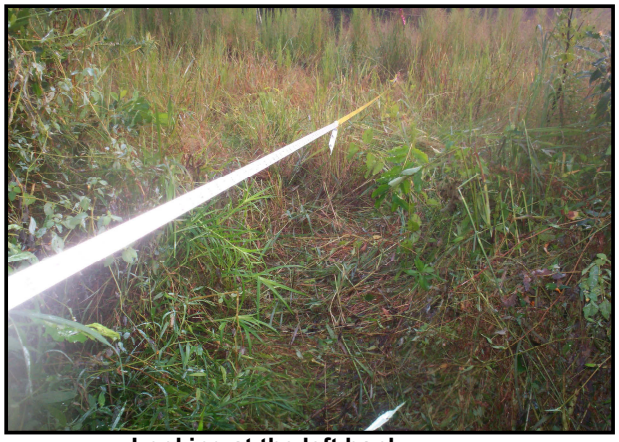




Looking at the left bank.

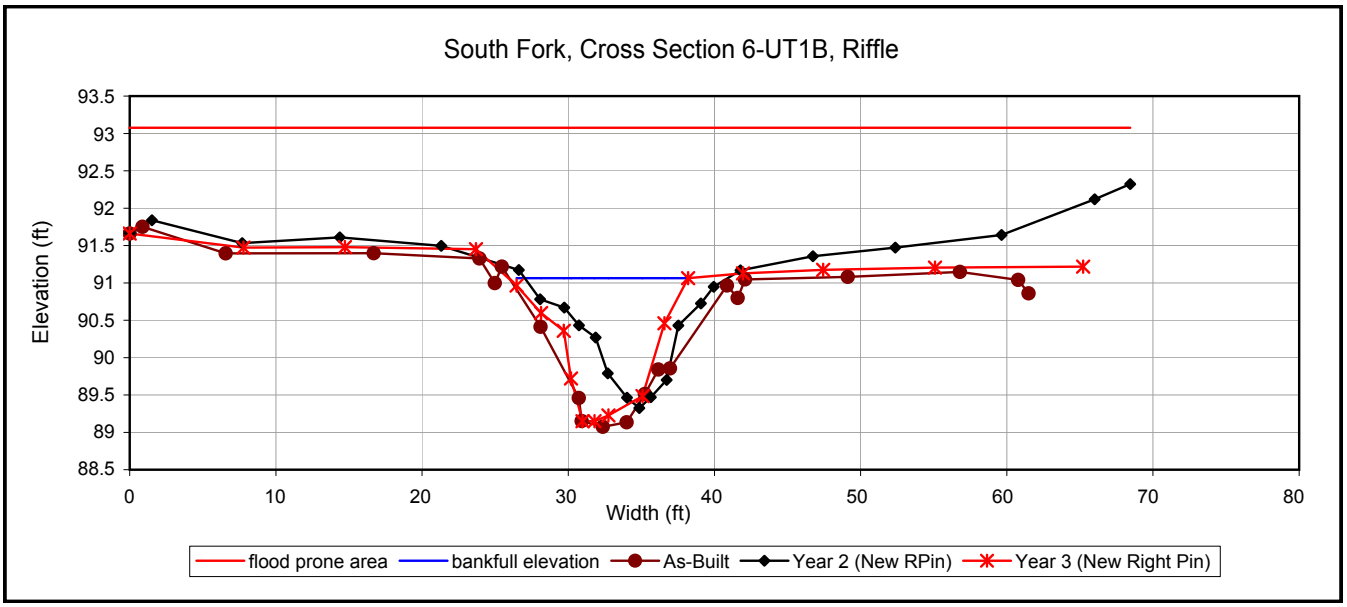
Looking at the right bank.

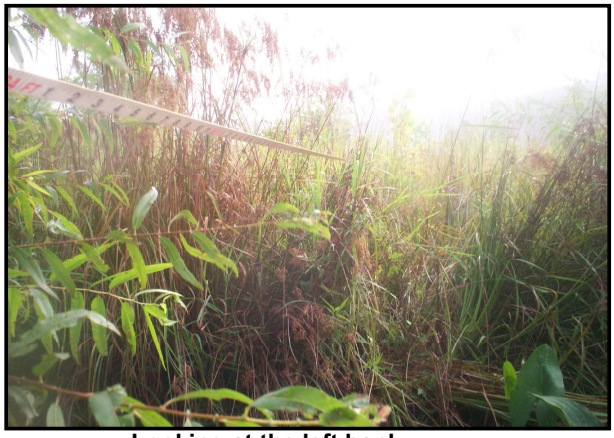




Looking at the left bank.

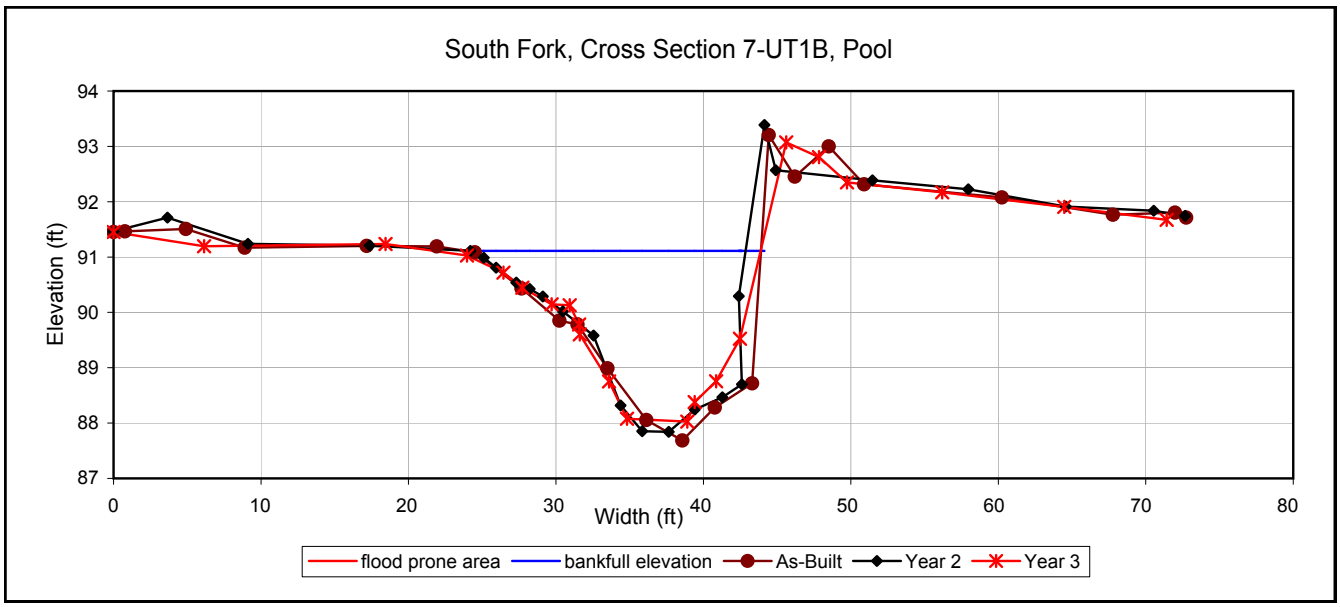
Looking at the right bank.

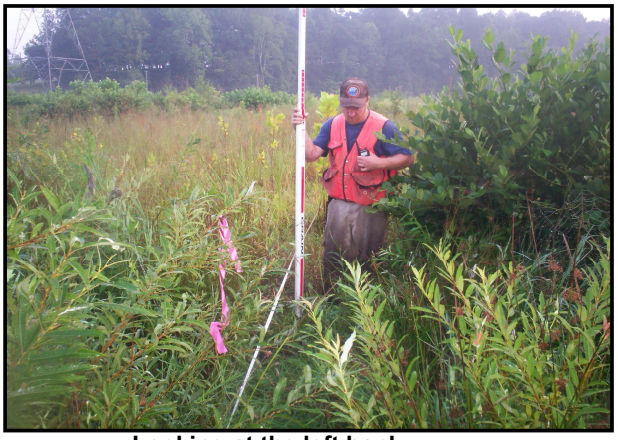




Looking at the left bank.

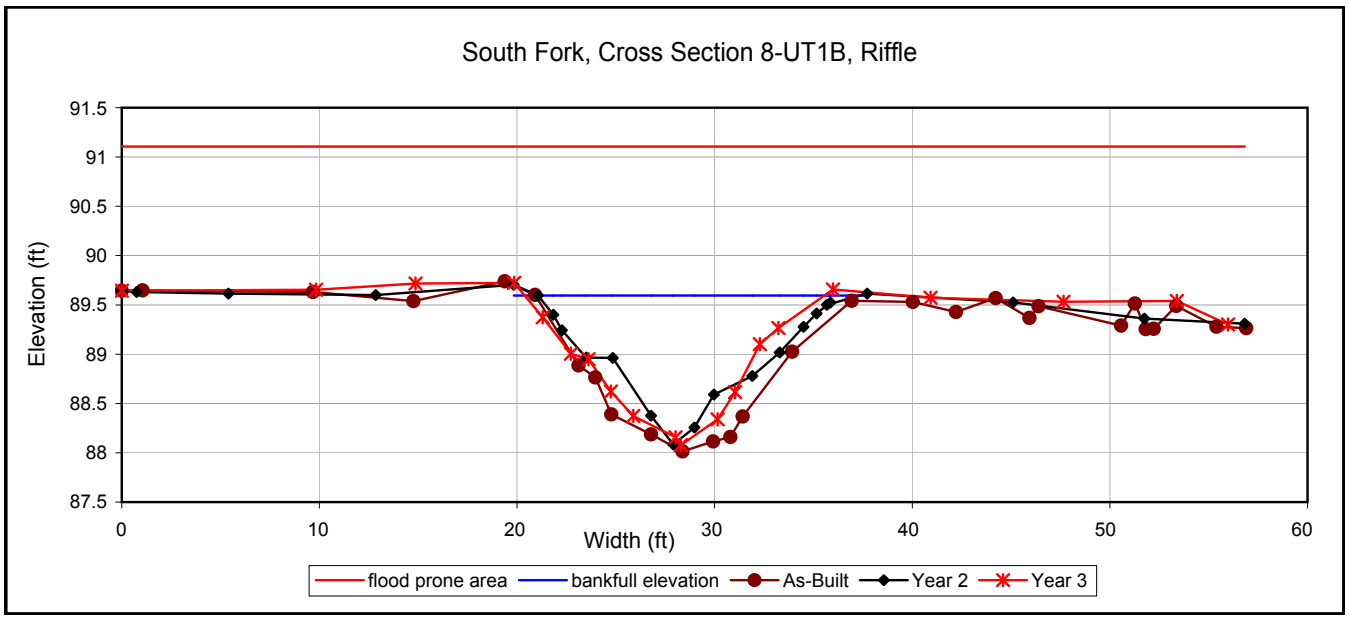
Looking at the right bank.





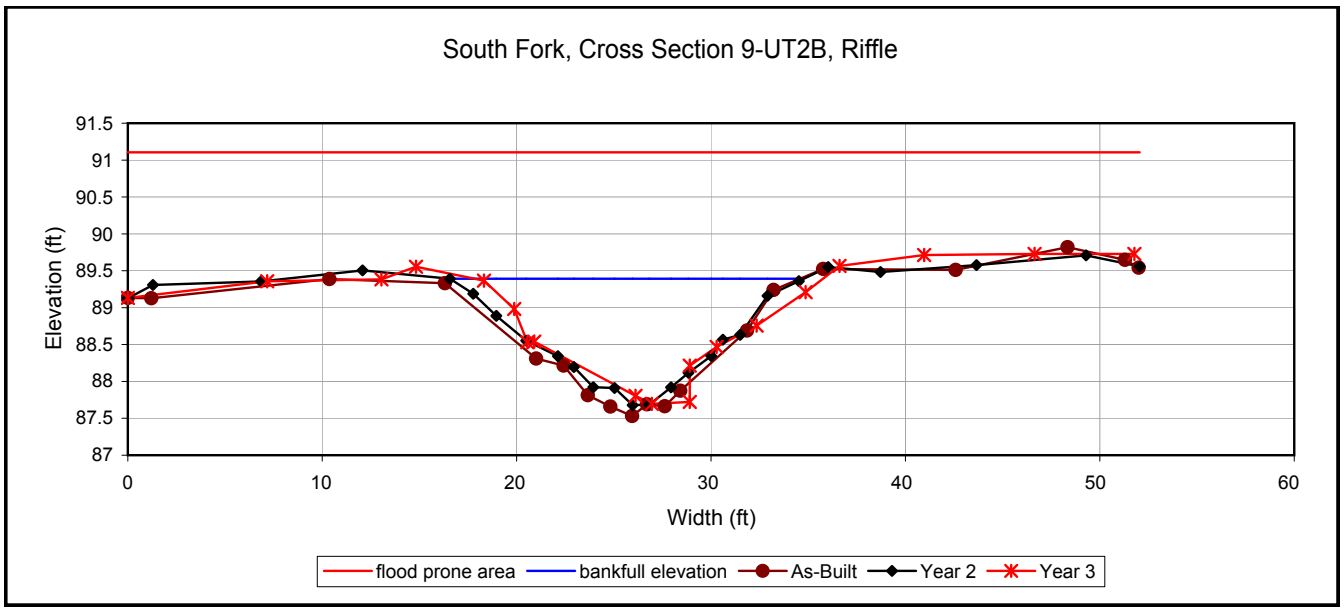
Looking at the left bank.

Looking at the right bank.



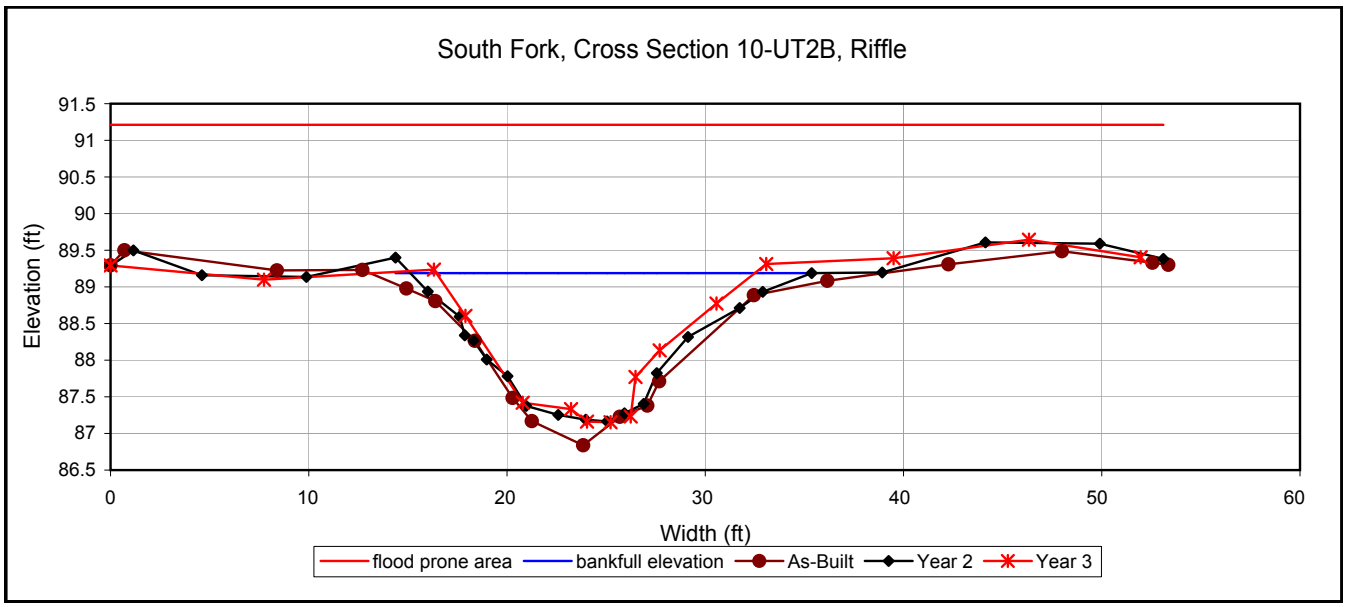
Looking at left bank.

Looking at right bank.



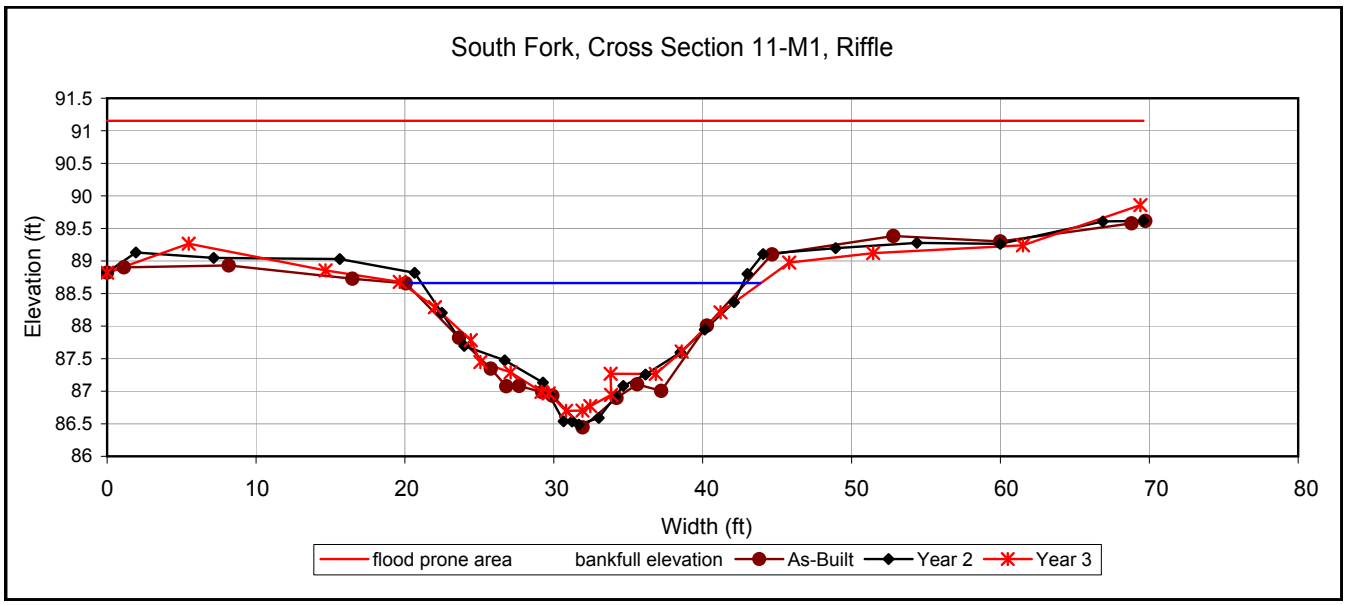
Looking at the left bank.

Looking at the right bank.

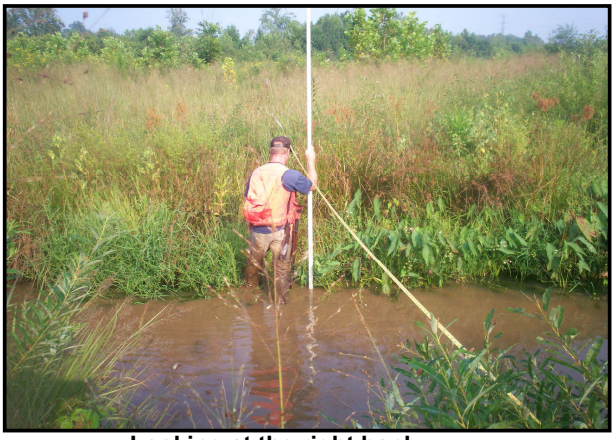


Looking at the left bank.

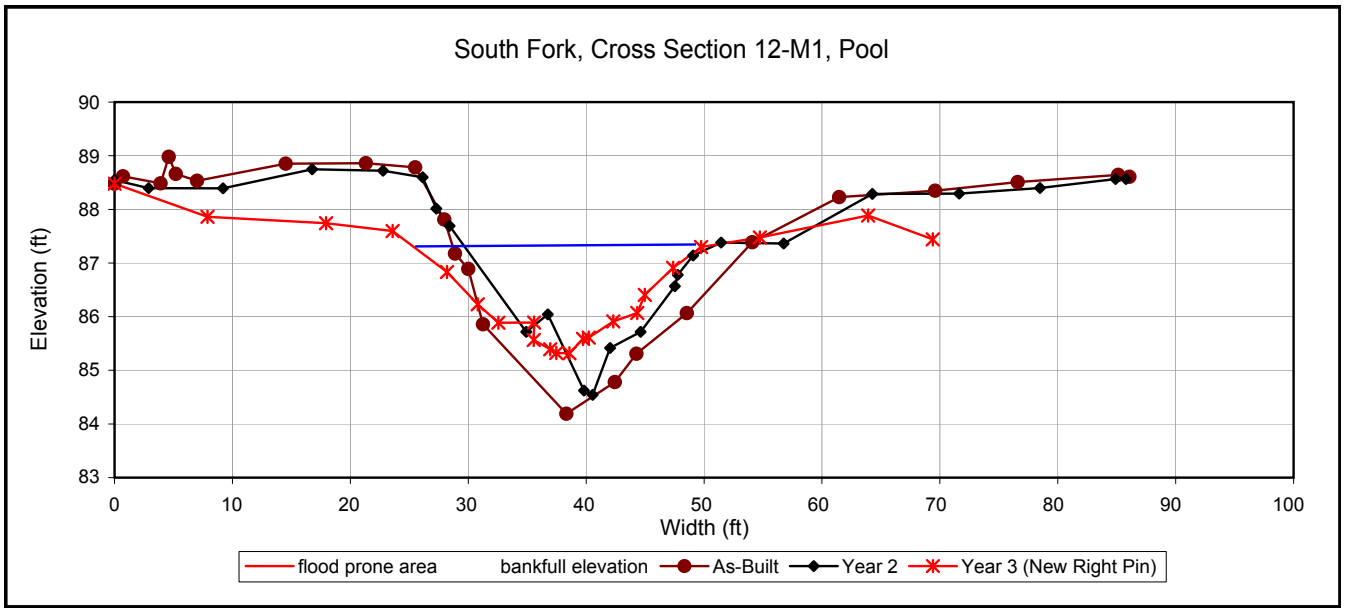
Looking at the right bank.



Looking at the left bank.

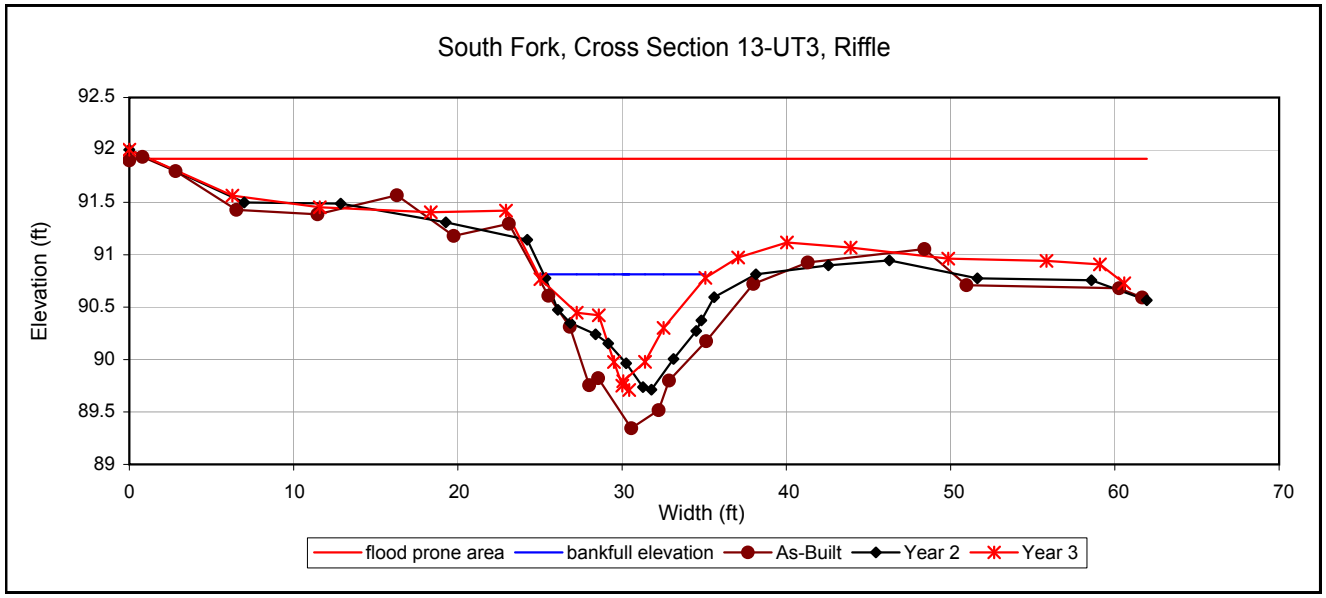


Looking at the right bank.



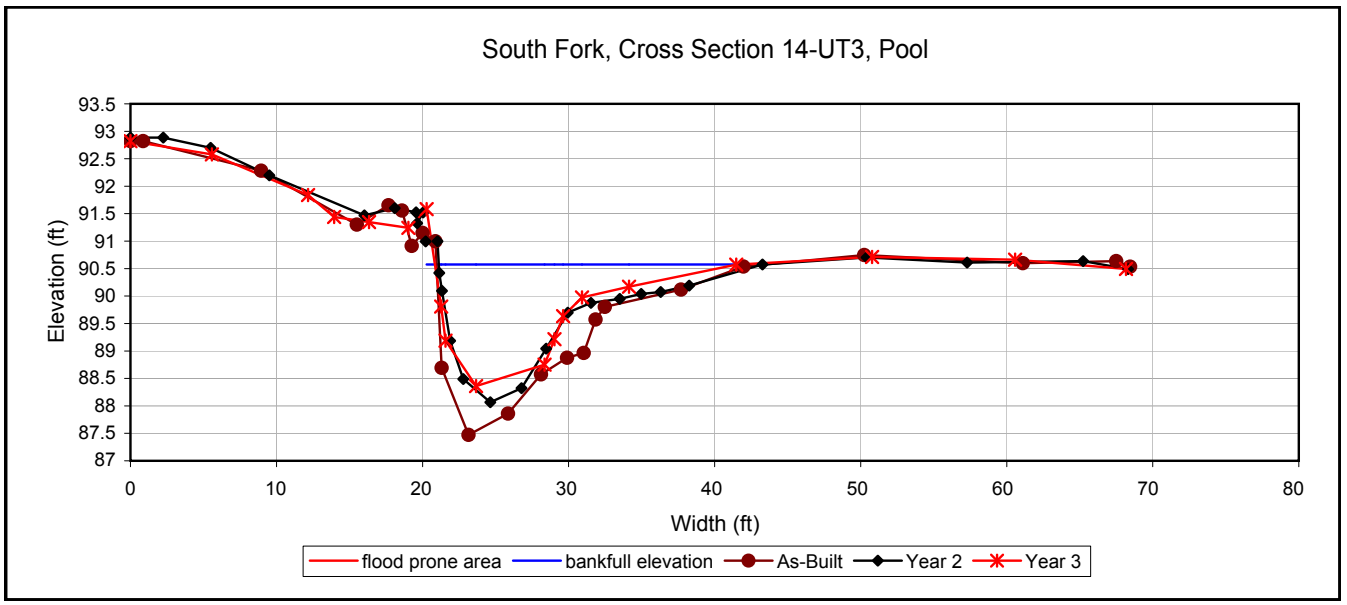
Looking at the left bank.

Looking at the right bank.



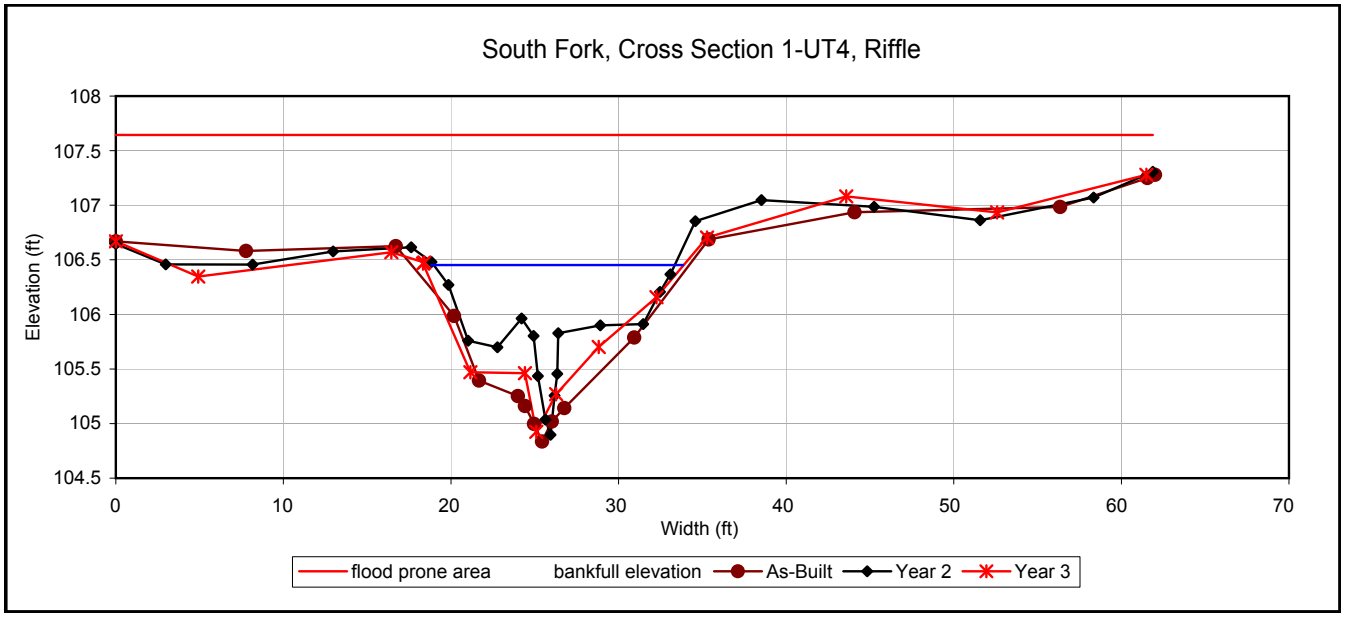
Looking at the left bank.

Looking at the right bank.



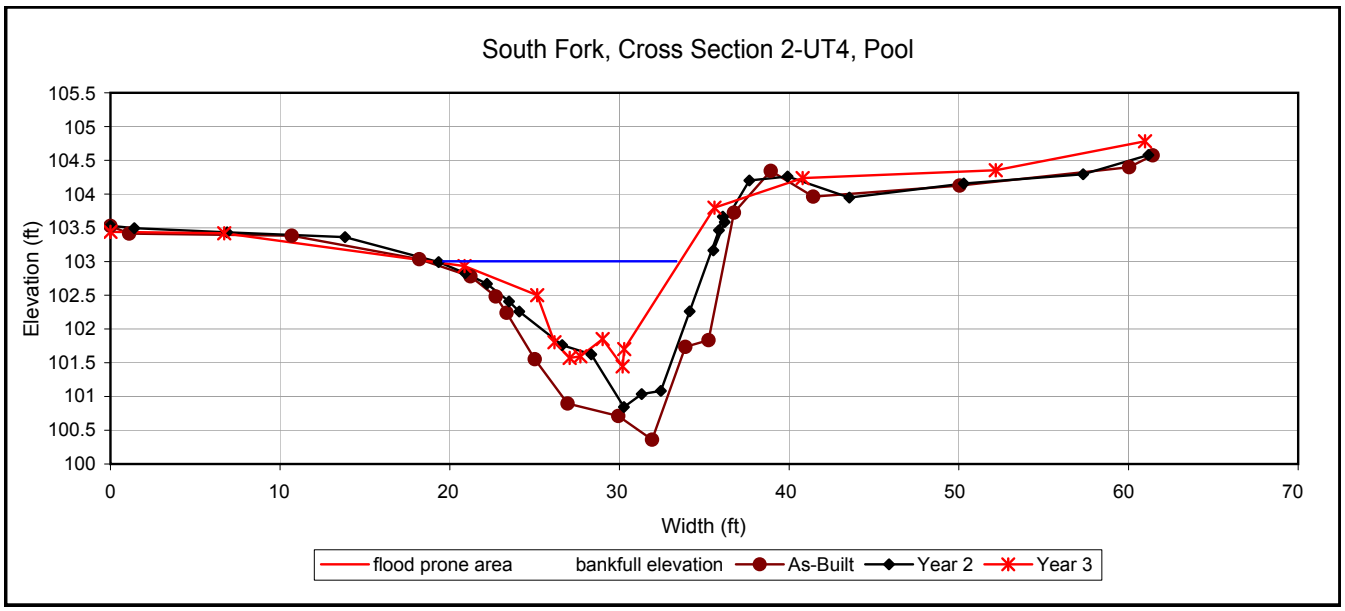
Looking at the left bank.

Looking at the right bank.



Looking at the left bank.

Looking at the right bank.



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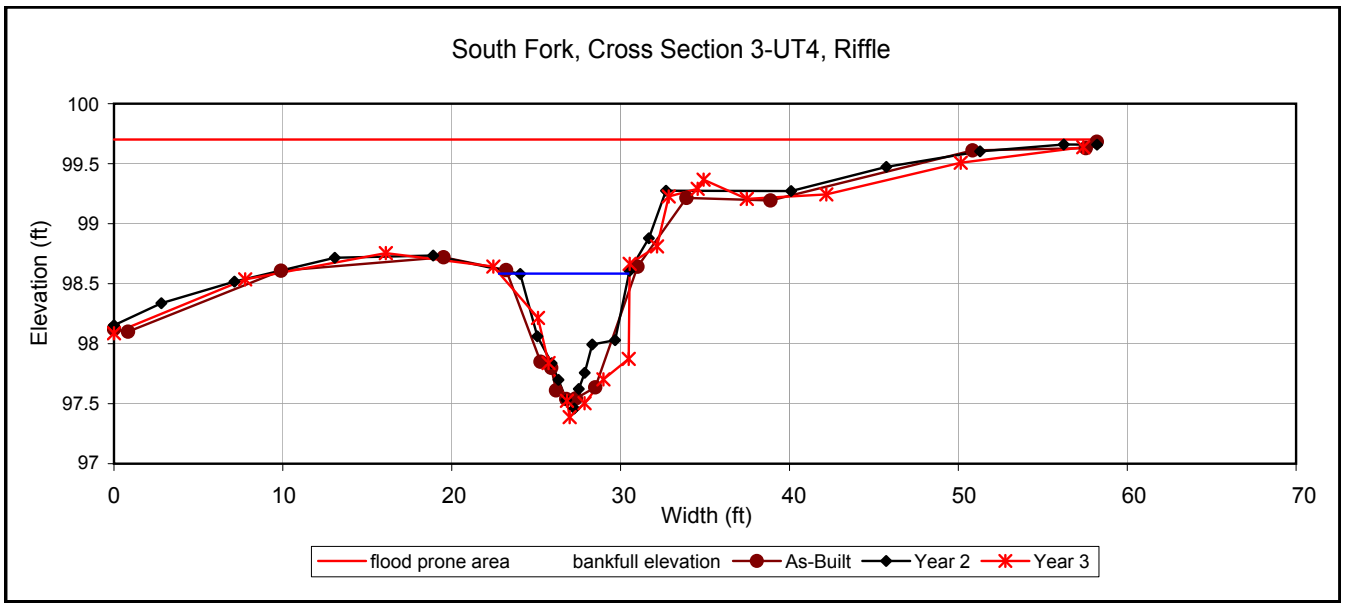
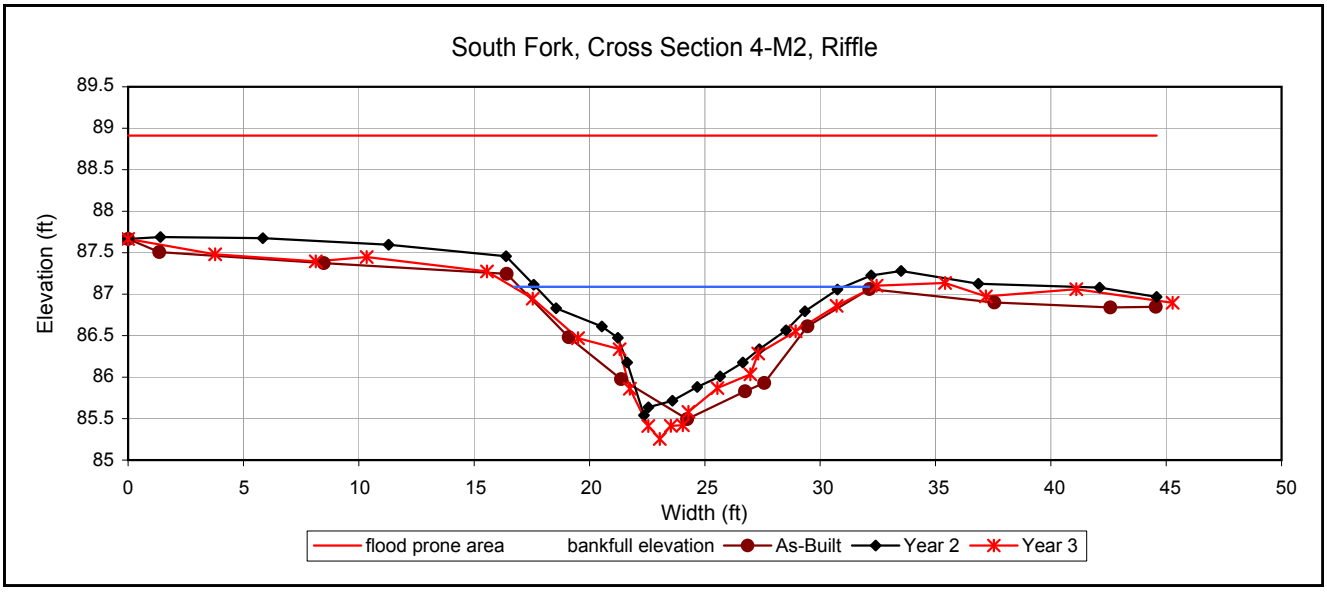


Looking at the left bank.

Looking at the right bank.



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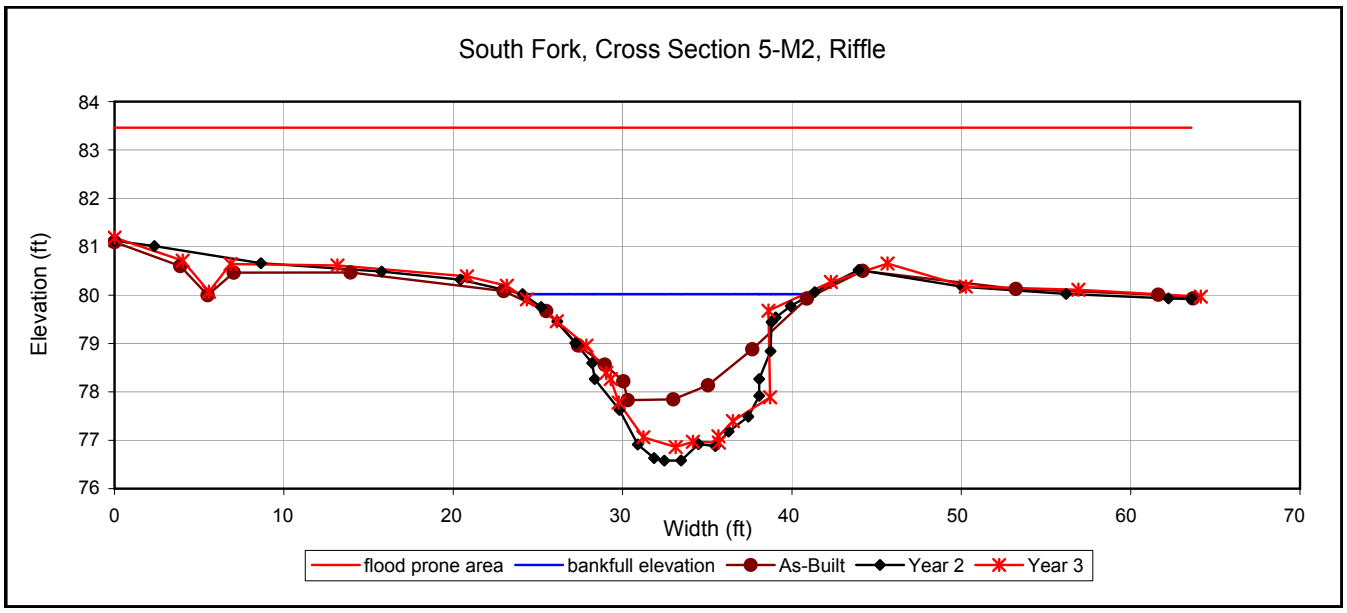
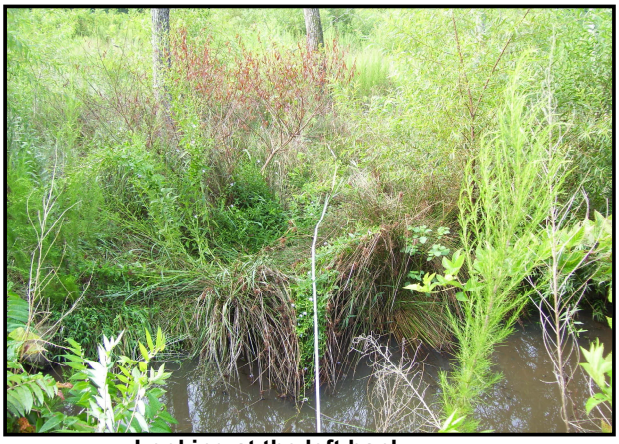
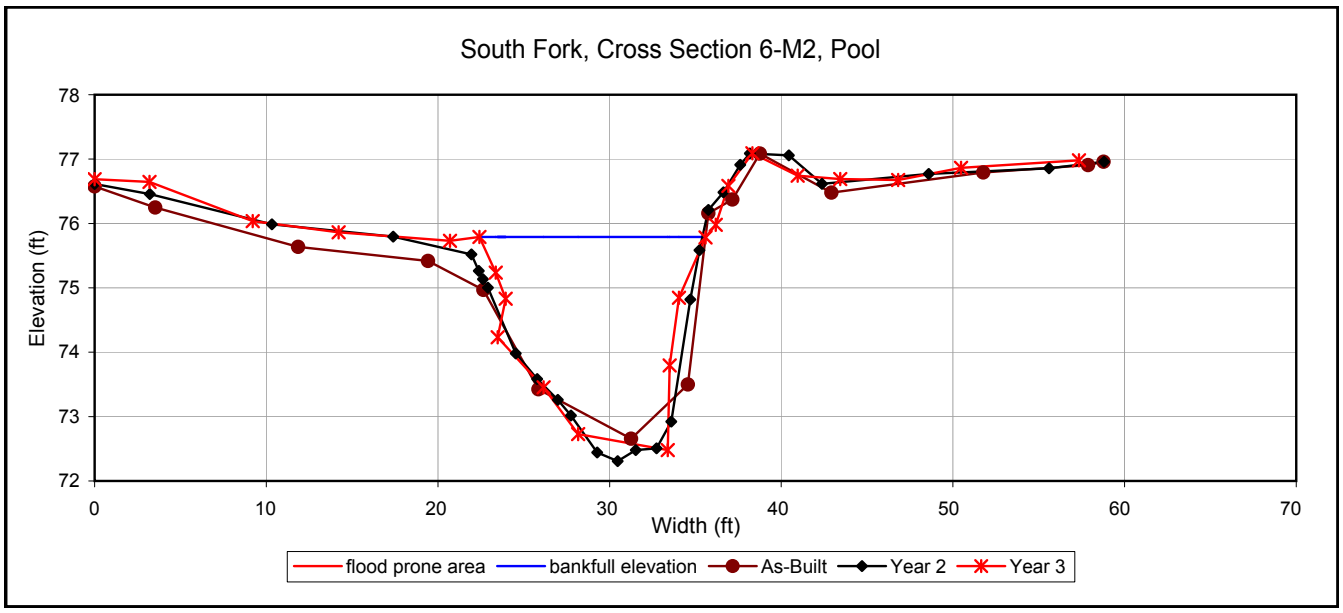
Looking at the right bank.

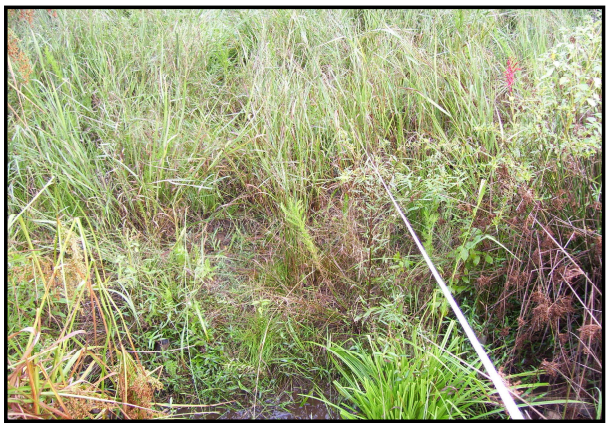




Looking at the left bank.

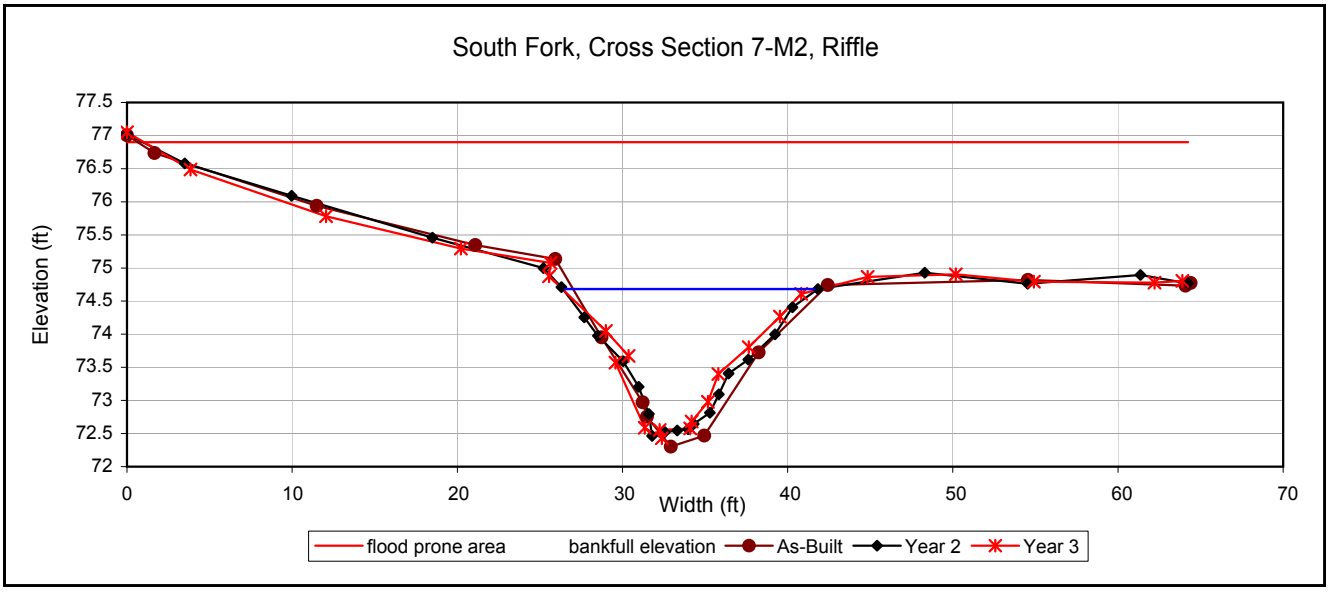
Looking at the right bank.





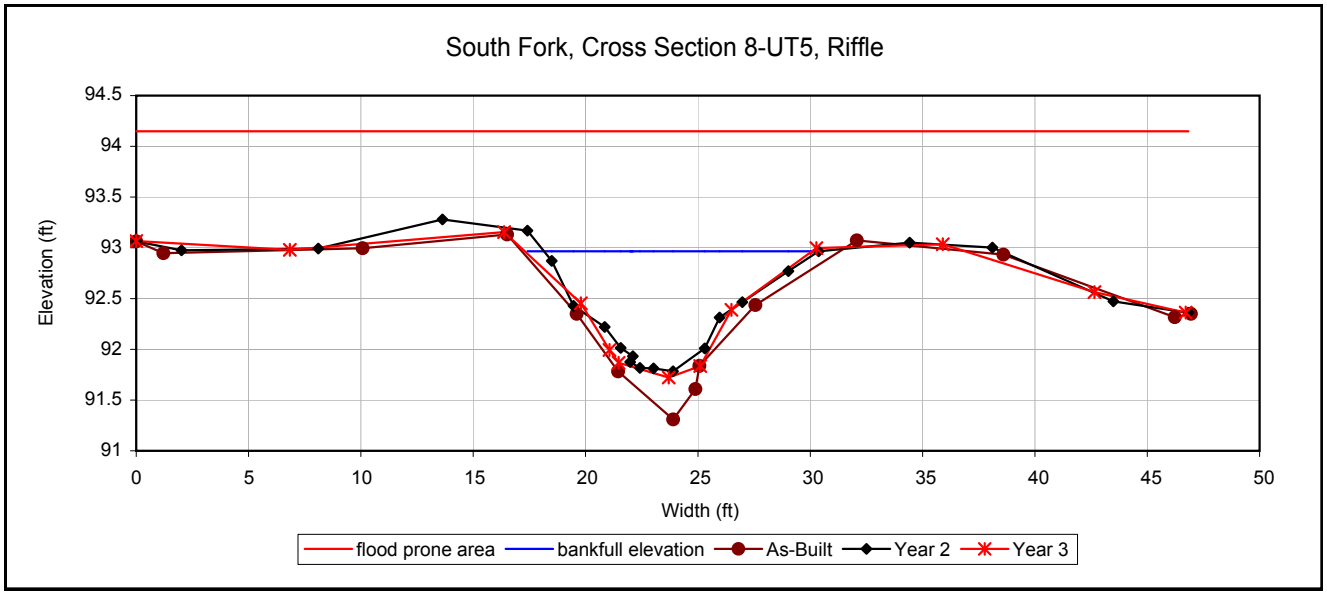
Looking at the left bank.

Looking at the right bank.



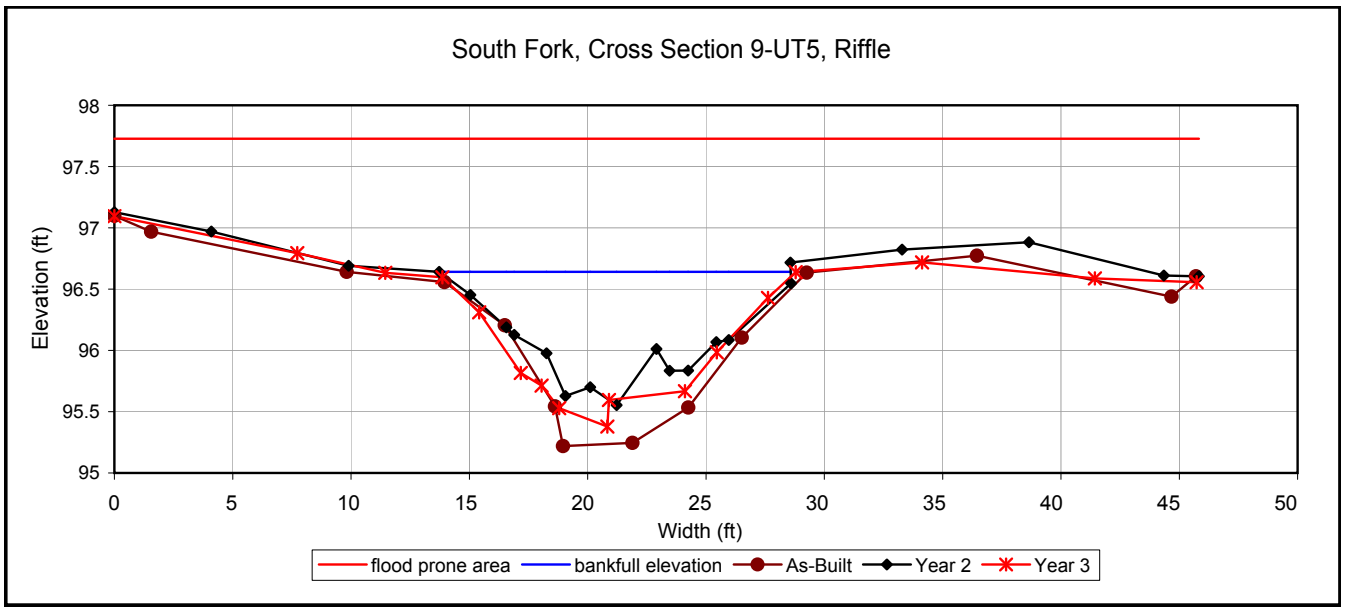
Looking at the left bank.

Looking at the right bank.



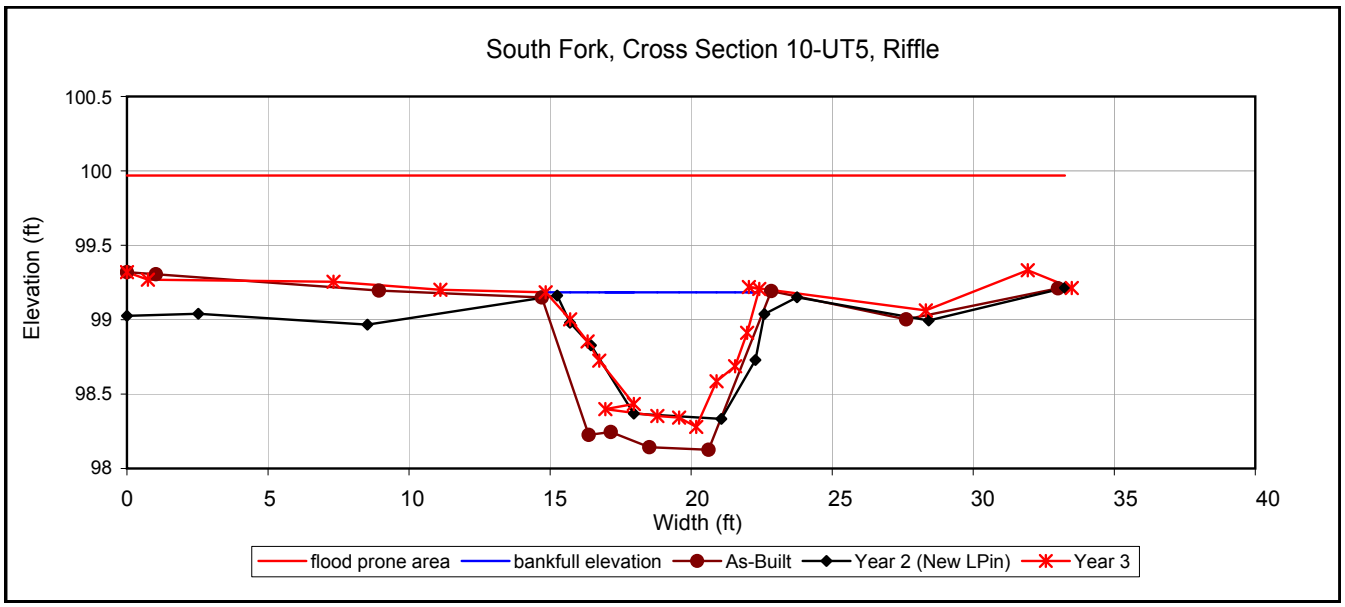
Looking at the left bank.

Looking at the right bank.



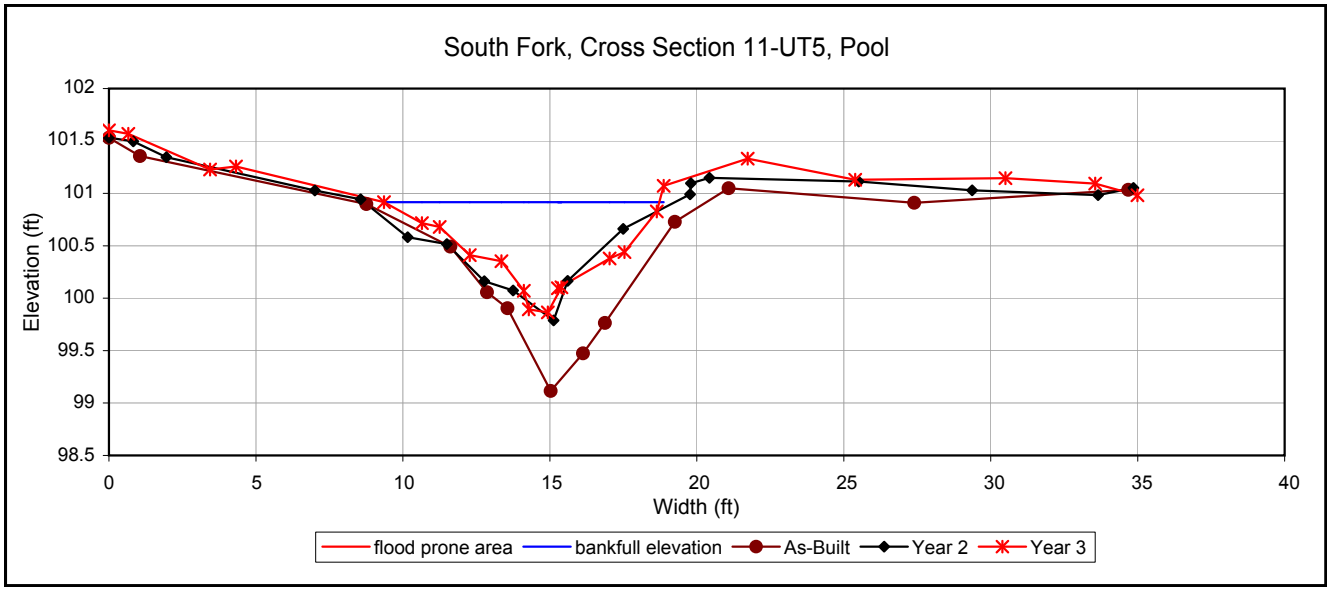
Looking at the left bank.

Looking at the right bank.



Looking at the left bank.

Looking at the right bank.



Wet floodplain on RB

APPENDIX C

2007 Site Photos

South Fork – Stream Problem Area Photographs

SPA 1. Erosion along left bank in UT-2A North at STA 10+50

SPA 2. Aggradation mid-channel below culvert and vegetation growing in the channel in UT 2A North at STA 15+50 and throughout upstream section of UT 2A

SPA 3. Stagnant flow in UT2A North at STA 25+50 resulting from excess vegetation downstream of the photo.

SPA 4. Sediment aggradation in UT2A North at STA 27+50.

SPA 5. Log vanes buried by sediment in UT2A North at STA 33+00.

SPA 6. Vegetation filling channel in UT3 North at station 12+00 and throughout UT3.

SPA 7. Buried log vane in UT1A North at STA 50+00.

SPA 8. Vegetation growing in the channel channel at constructed riffle in UT1A North at STA 53+25.

SPA 9. Minor erosion at root wad in UT1A North at STA 60+00.

SPA 10. Upstream portion of constructed riffle buried in UT1A North at STA 67+50.

Upstream of culvert at cattle crossing in UT5 South.

Downstream of culvert at cattle crossing in UT5 South.

SPA 11. Cows in Easement in UT5 South.

SPA 12. Water backing up below Log weir and over constructed riffle in M2 South at STA 31+00.

SPA 13. Head cut in M2 South at STA 37+25.

SPA 14. Bank incision downstream of head cut in M2 South at STA 37+50.

SPA 15. Erosion behind boulder at step pool in M2 South at STA 38+00

Vegetation Plot Photos

Vegetation Plot 1

Vegetation Plot2

Vegetation Plot 3

Vegetation Plot 4

Vegetation Plot 5

Vegetation Plot 6

Vegetation Plot 7