South Fork Mitigation Project
Catawba County, North Carolina

Year 4 Monitoring Report

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

December 2008

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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 2008, the fourth 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 benthic macroinvertebrate survey, 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 2008 monitoring.

Stream monitoring data in Years 1 through 4 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 as specified in the South Fork Adaptive Management Report. The South Fork Mitigation Site is on track to meet 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 is on track to achieve 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. 2008 monitoring represents the fourth year of monitoring for this site.

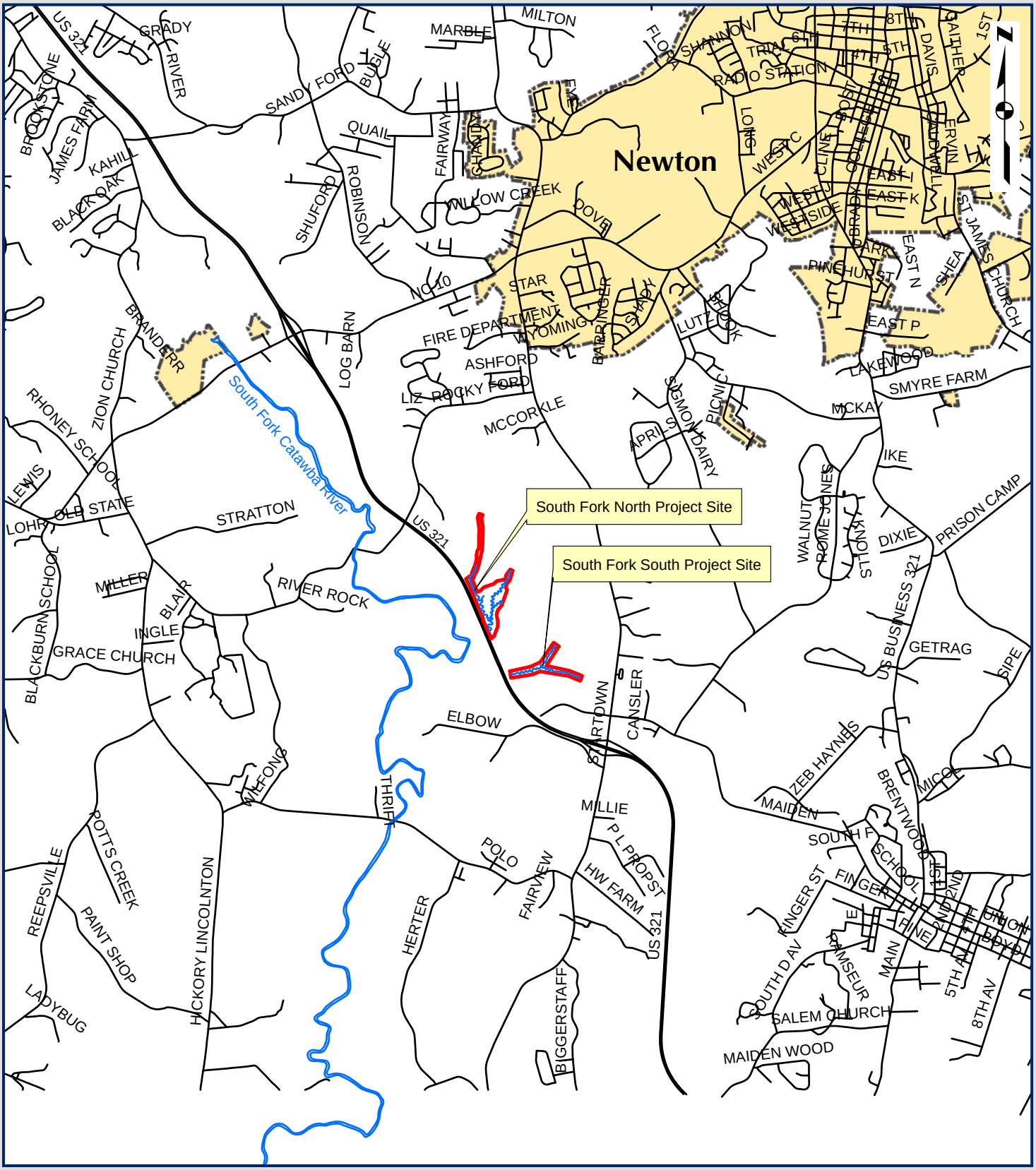
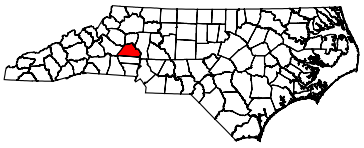
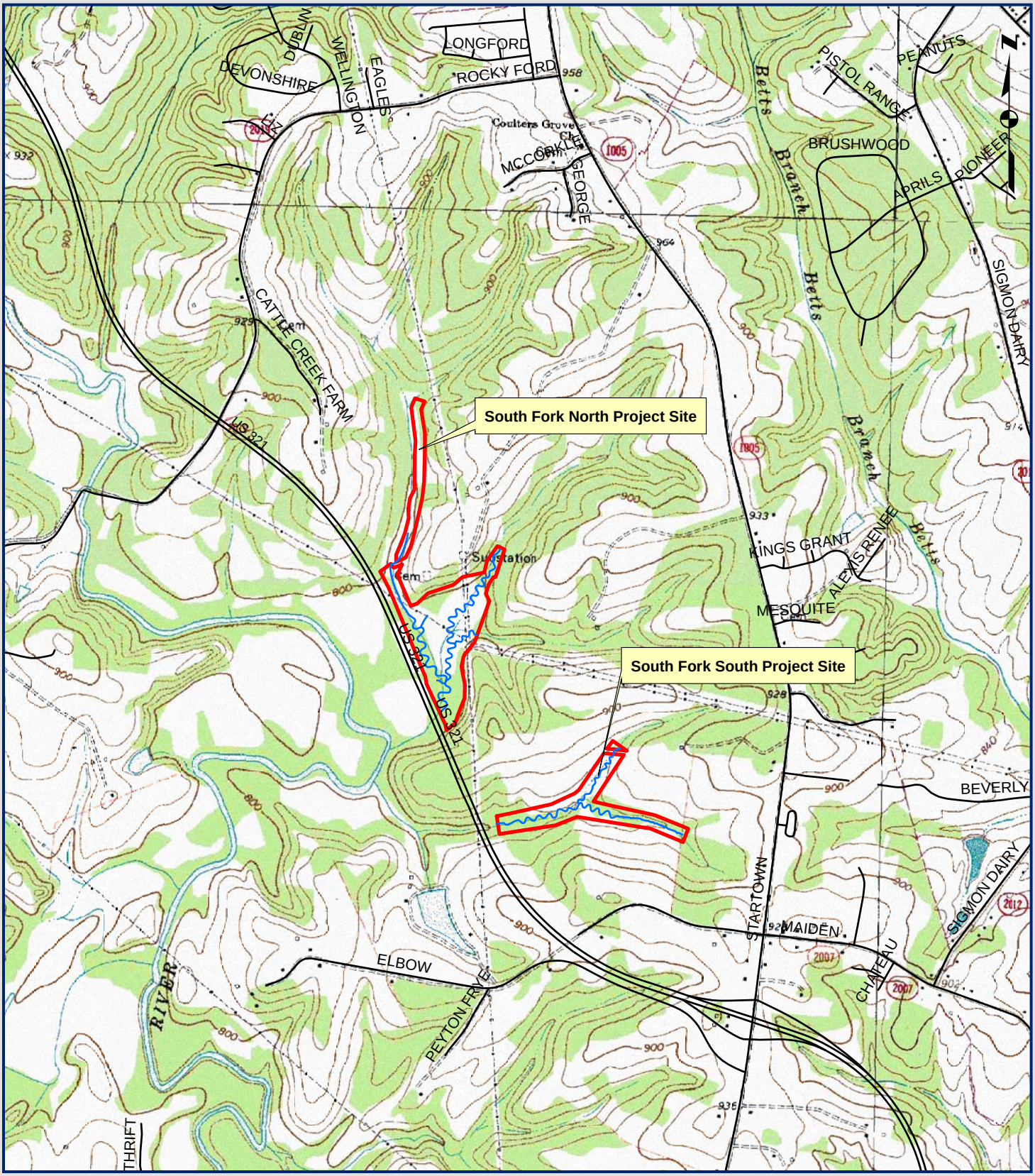


Figure 1.
South Fork Stream Mitigation Site
Project Location Map
Catawba County, NC

1 inch equals 1 miles

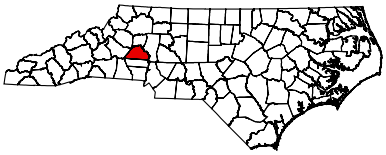




EBX

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 2008 (Year 4) 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
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 & 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 (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

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 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

CREST GAGE

UT 2B

X-SECTION 11

X-SECTION 12

VEG PLOT #4

X-SECTION 10

CONSERVATION EASEMENT BOUNDARY

PERMANENT 16' 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

Figure 3A

100 50 0 100 200

SCALE (FT)

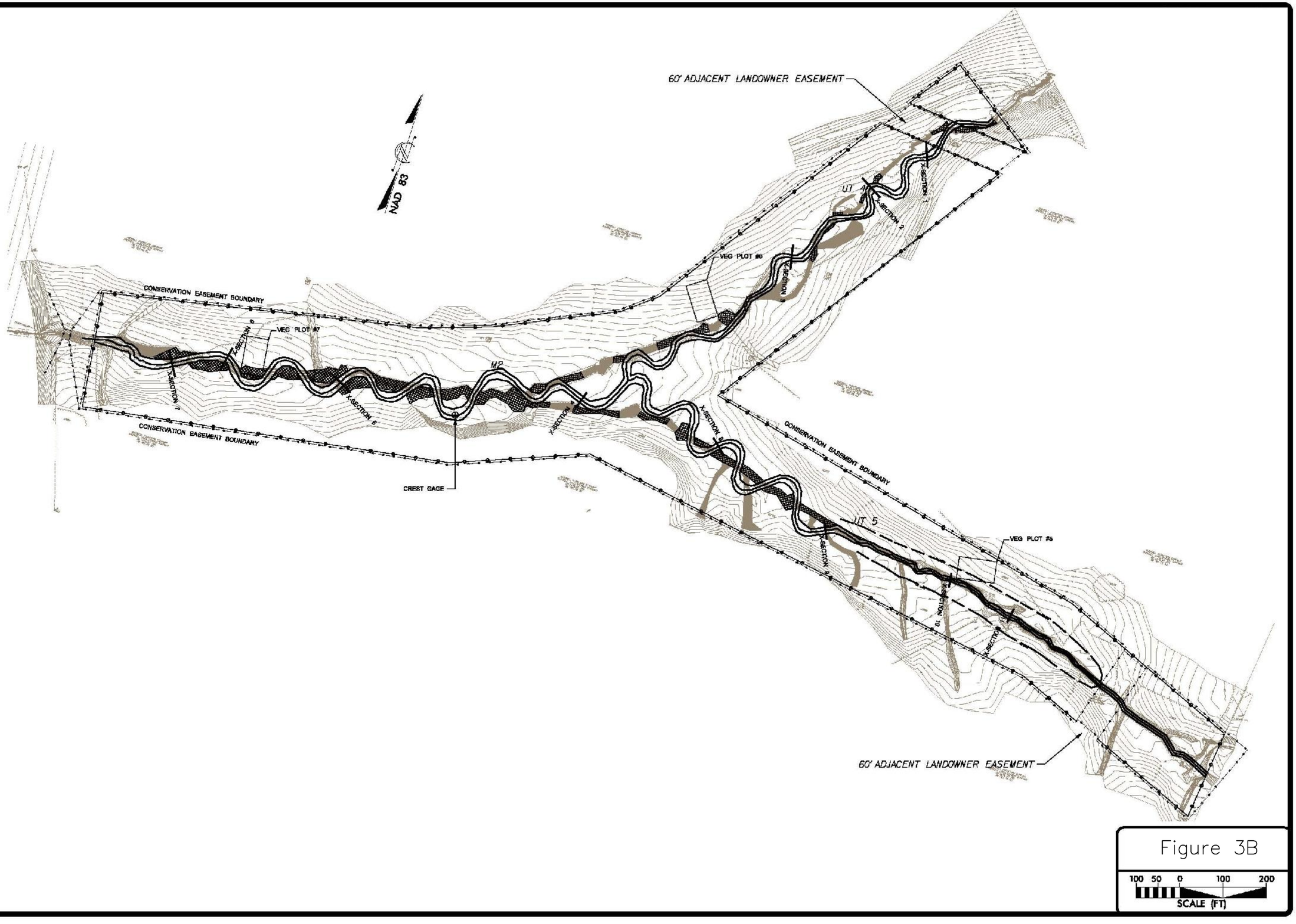

60' ADJACENT LANDOWNER EASEMENT
NAD 83
CONSERVATION EASEMENT BOUNDARY
VEG PLOT #7
X-SECTION 6
X-SECTION 7
X-SECTION 5
M2
X-SECTION 4
CREST GAGE
UT 4
X-SECTION 3
X-SECTION 2
VEG PLOT #6
X-SECTION 1
X-SECTION 8
CONSERVATION EASEMENT BOUNDARY
UT 5
VEG PLOT #5
X-SECTION 10
X-SECTION 9
60' ADJACENT LANDOWNER 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 3 year-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 5 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 boundary 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 Wetland 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. 2008 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	18	2	0	51	510

Average Trees per Acre: 540
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. If these trees persist into 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 (*Liquidambar styraciflua*) is the most common volunteer 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. Volunteer hydrophytic herbaceous vegetation is also occurring on site. Rush (*Juncus effusus*), bulrush (*Scirpus sp.*), knotweed (*Polygonum persicaria*), jewelweed (*Impatiens capensis*) and sedge (*Carex sp.*), all

hydrophytic herbaceous plants, are frequently observed across the site particularly in areas of inundation. Arrow-head (*Sagitarria spp.*), another wetland species, is found in some of the wetter areas of the site.

There are zones of less desirable weedy species occurring on the site, though none seem to be posing any problems for the woody or herbaceous hydrophytic vegetation. The majority of the weedy species are annuals and pose little threat to planted tree survival. Commonly seen weedy vegetation includes hay, dallisgrass (*Paspalum dilatatum*), dogfennel (*Eupatorium* capillifolium) 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 $1/10^{th}$ acre vegetation monitoring plots established throughout the planting areas. The 2008 vegetation monitoring revealed an average tree density of 540 stems per acre. The site met the minimum interim success interim criteria of 320 trees per acre by the end of year three and is on track to achieve 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.

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 2008 (Year 4) 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 4 in July 2008.

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. 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.

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

2 - 10' GATES

GRADE CONTROL J-HOOK TIED INTO EXISTING LOG OR BEDROCK

CUT LIMITS

CUT LIMITS

UT 2A

XS2

XS1

18+00

17+00

16+00

14+00

13+00

12+00

11+00

10+00

Figure 4A

SOUTH FORK

30 15 0 30 60

SCALE (FT)

MATCHLINE SHEET 9 STA 37+15.00

MATCHLINE SHEET 11 STA 21+15.00

UT2A

UT2B

UT3

XS5

XS4

XS9

XS14

XS3

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

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

XS10

40+00

UTIB

41+00

60+00

61+00

62+00

XS11

XS12

59+00

57+00

58+00

UTIB

55+00

56+00

XS7

DETENTION OUTLET STABILIZED WITH CLASS A/B MIX

TREATMENT DETENTION POND

GATE

CUT LIMITS

M1

66+00

64+00

65+00

67+00

CUT LIMITS

Figure 4C

SOUTH FORK

30 15 0 30 60

SCALE (FT)

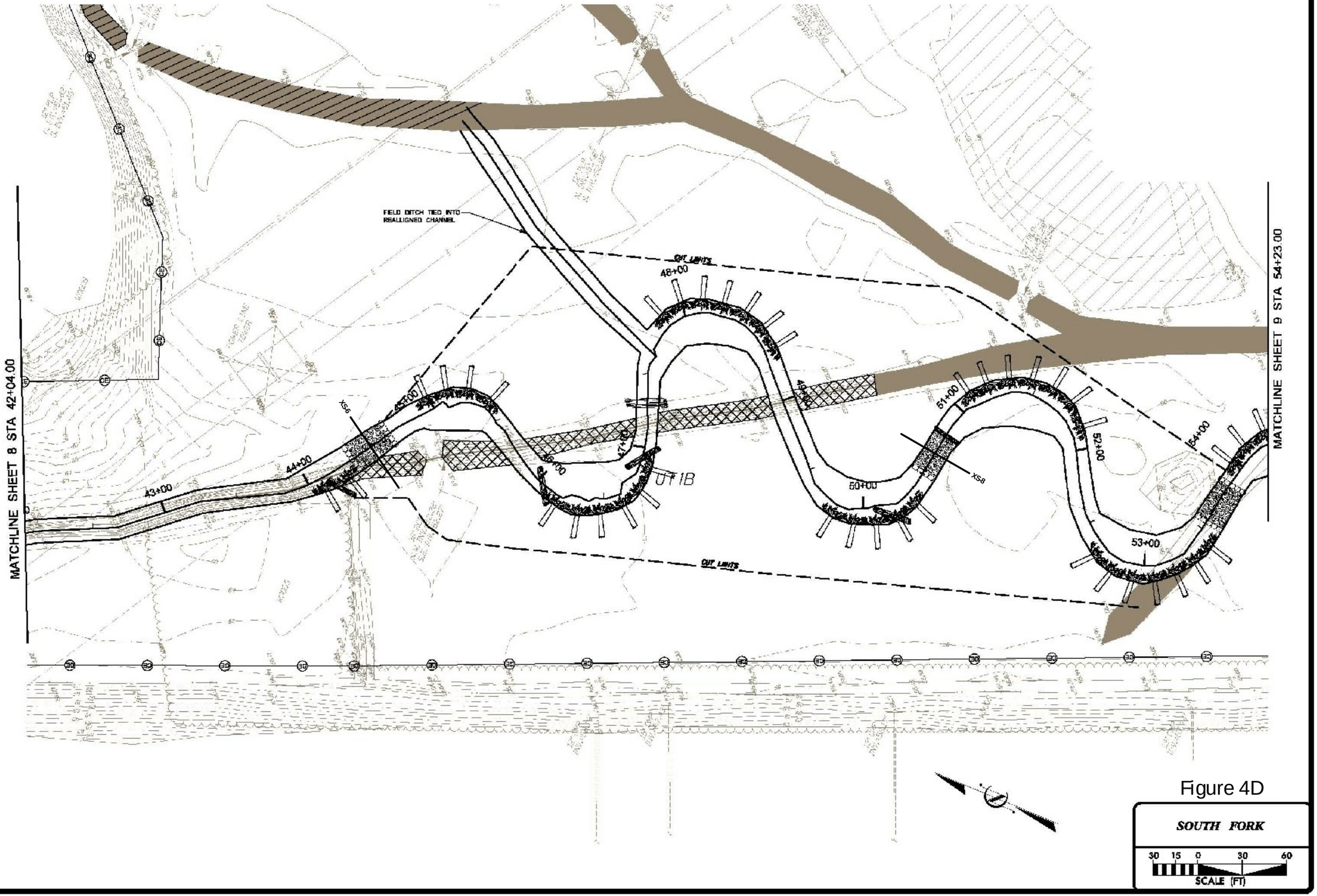


Figure 4D

SOUTH FORK

30 15 0 30 60

SCALE (FT)

SHERRILL FURNITURE COMPANY
SHERRILL UPHOLSTERING COMPANY
DB 1479, PG 784
DB 751, PG 211

N

39+00
38+00
37+00
36+00
35+00
34+00
XS-6
XS-7
XS-5
M2
2 - 15' GATES
GATE

MATCHLINE SHEET 13 STA 30+17.00

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

XS4

CONSTRUCTED RIFFLE TIED INTO LOG VANE

19+00

20+00

21+00

22+00

23+00

24+00

25+00

26+00

27+00

28+00

Figure 4F

SOUTH FORK

30 15 0 30 60

SCALE (FT)

3.3.1 Cross Sections

Permanent cross sections for 2008 (Year 4) were surveyed in July 2008. The cross sections were surveyed during the monitoring set-up and annually in the late growing season. Year 4 cross sections were surveyed in July 2008. The baseline data have been compared with the Year 1, 2, 3, and 4 data in **Appendix B**. The Year 4 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 Years 1, 2, 3, and 4 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.

3.3.2 Longitudinal Profile

The longitudinal profile was surveyed for Year 4 in July 2008. A longitudinal profile was surveyed at six representative reaches during July 2008. 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. Minor aggradation has occurred in the pools as the channel has adjusted to an equilibrium condition. The riffles have remained stable. As-built and 2008 profiles 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 2008. Data collected from the gauge in March is a composite sample for December 2007 through March 2008. Three bankfull events occurred during the March to November time period on Reach UT2B in South Fork North. Three bankfull events were observed at the crest gauge on Reach M2 in South Fork South. The crest gauge data is included in **Table 8**.

Documented bankfull events and observed stream flows were compared with monthly rainfall totals to assess stream response to precipitation events. Daily precipitation data were collected from the Conover Oxford Shoals weather station in Conover, NC. An on-site rain gauge was also monitored throughout 2008. The precipitation data are summarized in **Table 9**.

Table 8. Crest Gauge Data

Month Recorded	UT2B Crest Gauge	M2 Crest Gauge
January	---	---
February	---	---
March	---	---
April	---	---
May	0.20	---
June	---	---
July	0.05	---
August	---	---
September	0.15	1.25
October	---	3.80
November	---	---
December	---	---

Table 9. Summary Precipitation Data

Month	Average	Normal Limits		Conover Precipitation	On-Site Precipitation
		30 Percent	70 Percent		
January	3.90	2.64	5.04	0.98	---
February	3.42	2.33	4.41	2.79	---
March	4.27	3.12	5.17	1.68	---
April	3.37	2.06	4.57	4.31	3.25
May	3.77	2.50	4.68	1.95	4.16
June	4.27	2.73	5.41	2.64	---
July	3.92	2.43	4.45	4.28	7.54
August	4.00	2.73	4.71	12.7	3.88
September	3.75	2.39	5.20	3.31	8.95
October	3.70	1.88	4.90	1.32	---
November	3.67	2.61	4.47	0.76	1.75
December	3.32	2.13	4.26	---	---

3.4 BENTHIC MACROINVERTEBRATE SURVEY RESULTS

Composite Benthic macroinvertebrate samples were taken at the northern and southern South Fork sites in October 2008. 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. **Table 10** and **Table 11** 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 75 out of 100 possible points. Eight EPT species were collected and 25 total taxa were collected. Taxa collected were moderately tolerant.

Table 10. Reach M1 Macroinvertebrate Data

Order	Species	Tolerance Value	No.
Ephemeroptera	*Mccaffertium modestum*	5.5	23
Ephemeroptera	*Stenacron interpunctatum*	6.9	45
Ephemeroptera	*Baetis intercalaris*	7.0	9
Ephemeroptera	*Baetis flavistriga*	7.0	3
Ephemeroptera	*Paraleptophlebia sp*	0.9	2
Ephemeroptera	*Caenis sp*	7.4	2
Trichoptera	*Cheumatopsyche sp*	6.2	12
Trichopetera	*Hydropsyche betteni*	7.8	17
Coleoptera	*Helichus sp*	4.6	1
Odonata	*Argia sp*	8.2	1
Odonata	*Calopteryx sp*	7.8	10
Odonata	*Libellula sp*	9.6	1
Odonata	*Gomphus spp*	5.8	1
Hemiptera	*Corixidae*	9.0	1
Diptera	*Simulium sp*	6.0	4
Diptera	*Simulium venustrum gr*	7.1	5
Diptera	*Ablabesmyia mallochi*	7.2	1
Diptera	*Chironomus sp*	9.6	1
Diptera	*Cryptotendipes sp*	6.2	2
Diptera	*Rheotanytarsus sp*	5.9	1
Diptera	*Tanytarsus sp*	6.8	1
Diptera	*Rheocricotopus robacki*	7.3	1
Oligochaeta	*Stylaria lacustris*	9.4	1
Crustacea	*Caecidotea sp*	9.1	1
Crustacea	*Hyallela azteca*	7.8	13
Mollusca	*Corbicula fluminea*	6.1	1
		Total Number of Organisms	160
		Total Number of Taxa	25
		Total Number of EPT	8
		NC Biotic Index	6.8

The southern reach (M2) received a habitat score of 66 out of 100 possible points. Four EPT taxa were collected and 10 total taxa were collected. Taxa collected were moderately to very tolerant species.

Table 11. Reach M2 Macroinvertebrate Data

Order	Species	Tolerance Value	No.
Ephemeroptera	*Mccaffertium modestum*	5.5	11
Ephemeroptera	*Stenacron interpunctatum*	6.9	1
Trichoptera	*Cheumatopsyche sp*	6.2	5
Trichopetera	*Hydropsyche betteni*	7.8	26
Odonata	*Argia sp*	8.2	2
Odonata	*Calopteryx sp*	7.8	1
Diptera	*Simulium venustrum gr*	7.1	12
Diptera	*Tipula spp*	7.3	4
Diptera	*Rheocricotopus robacki*	7.3	2
Crustacea	*Caecidotea sp*	9.1	1
		Total Number of Organisms	65
		Total Number of Taxa	10
		Total Number of EPT	4
		NC Biotic Index	7.1

3.5 STREAM CONCLUSIONS

Very few problems with stream stability were observed during the 2008 monitoring field visits. Based on cross-sectional survey, longitudinal profile survey, and streamwalk observations, it was concluded that the site continues to be on track to achieve stream success criteria specified in the Restoration Plan. Throughout the project localized areas of siltation are present and vegetation is beginning to grow in the channel. There was some slight erosion around some of the root wads and in-stream structures. The step-pool at the downstream end of Reach M2 was repaired in 2008 and is stable and functioning as designed. A persistent problem has been cattle in the easement. Recent landowner coordination and fence repairs appear to have corrected this problem. **Table 12** outlines areas requiring further observation with station and description of each area. Photos of potential areas of instability are included in **Appendix C**.

Table 12. Stream Areas Requiring Observation

Station	Feature	Problem
UT1A 13+00	Channel	Small debris jam, no repair necessary
UT1A 14+80	Right bank	Minor slump, no repair necessary
UT1A 19+00	Right bank	Minor erosion, no repair necessary
UT1A 33+00	Channel/Right bank	Debris jam and right bank erosion, possible repair to prevent further erosion
UT1B 37+60	Right bank	End cut at grade control structure, no head cut is forming, no repair necessary
UT1B 58+40	Root wad	Structure is unstable, bank vegetation is dense, no repair necessary
UT1B 60+00	Root wad	Structure is unstable, bank vegetation is dense, no repair necessary
UT2A 17+60	Left bank	Minor erosion, no repair necessary
UT2A 18+90	Grade control structure	Header rock is perched, bed is stable, no repair necessary
M2 38+20	Right bank	Minor erosion at recent structure repair, no repair necessary

4.0 CONCLUSIONS AND RECOMMENDATIONS

- Vegetation monitoring documented the average planted stems per acre on site is 540. Invasive and volunteer species do not pose significant risks to vegetation success. The site is on track to achieve the final vegetation success criteria of 260 stems per acre surviving at the end of the fifth growing season.

- Data collected during monitoring Year 4 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. The stream morphology is stable. Repairs to structures specified in the South Fork Adaptive Management Report successfully corrected the only major problem areas. Several in-stream structures have some scour, but are functioning correctly. Very little fluvial erosion was observed overall, though there are areas of concern that will continue to be observed. 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.

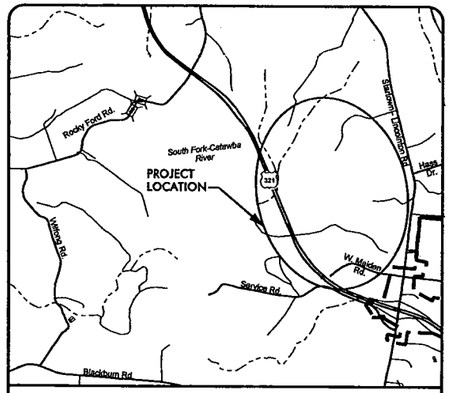
- Monitoring of vegetation and stream stability will continue through the 2009 growing season.

APPENDIX A

As-Built Survey

SOUTH FORK

PROJECT: 169



VICINITY MAP

INDEX OF SHEETS

1 ..... TITLE SHEET
4 TO 16 ..... PLAN VIEW OF AS-BUILT STREAM DESIGN
FIG. 2A - 2-B .. SITE OVERVIEW

STREAM RESTORATION PROJECT
ENVIRONMENTAL BANC AND EXCHANGE, LLC

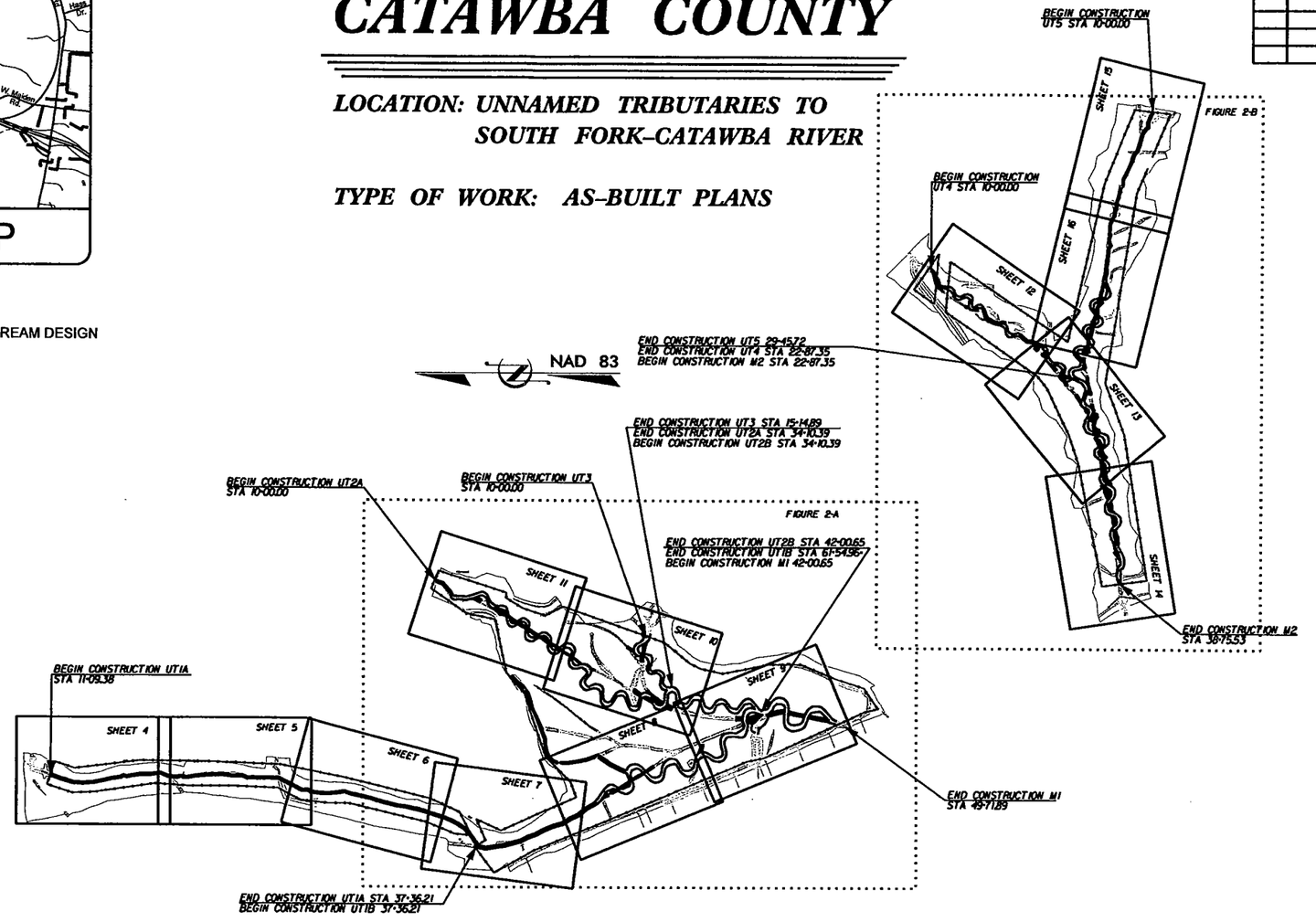
CATAWBA COUNTY

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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KEVIN L TWEEDY
027337
JULY 21, 2005

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SIGNATURE: *P.E.*

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PROJECT REFERENCE NO.	SHEET NO.
169	18

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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

100 50 0 100 200
SCALE (FT)

11/10/2005
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PROJECT REFERENCE NO.	SHEET NO.
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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

100 50 0 100 200
SCALE (FT)

2/26/03

11/10/2005
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2/26/03

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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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SCALE (FT)

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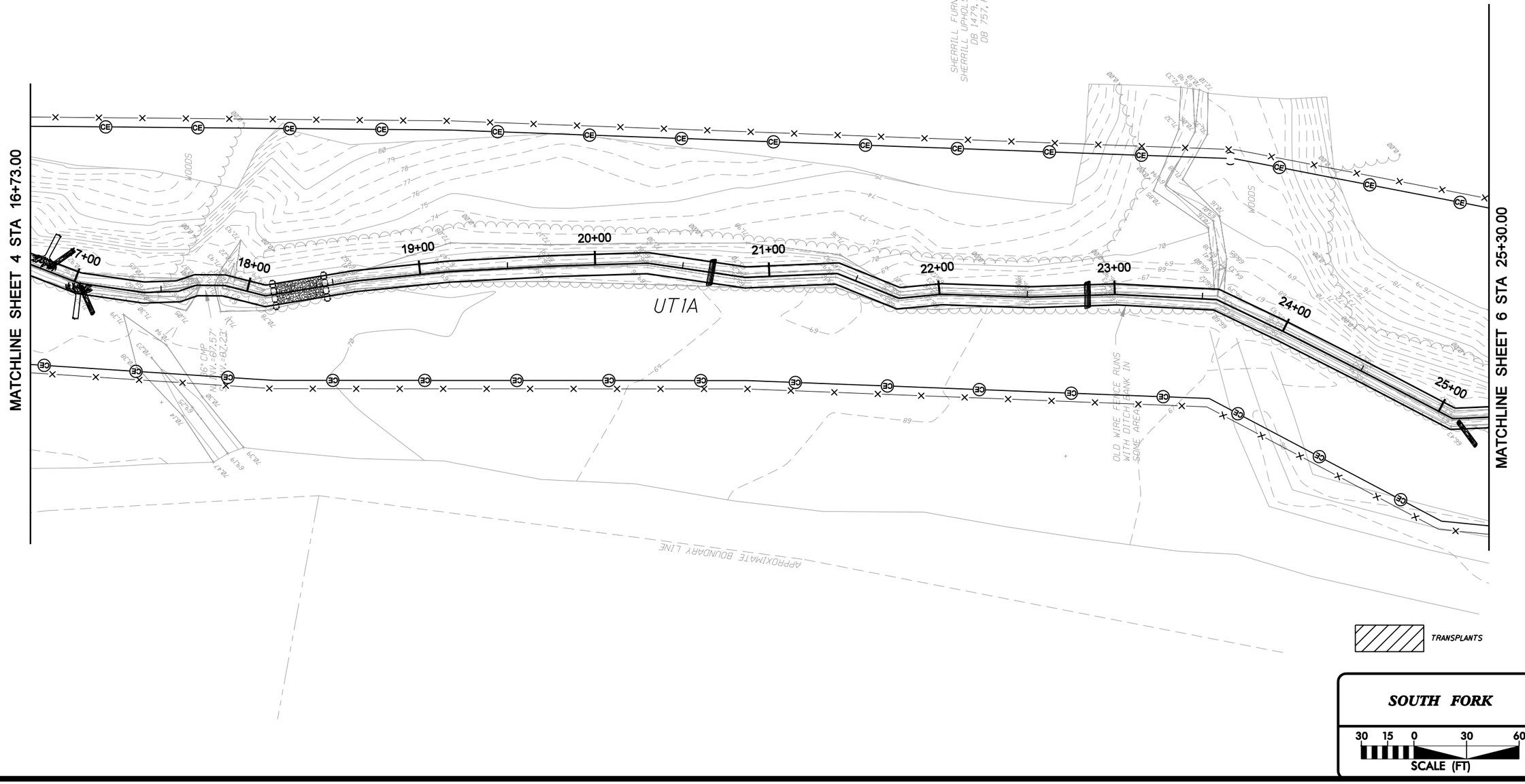

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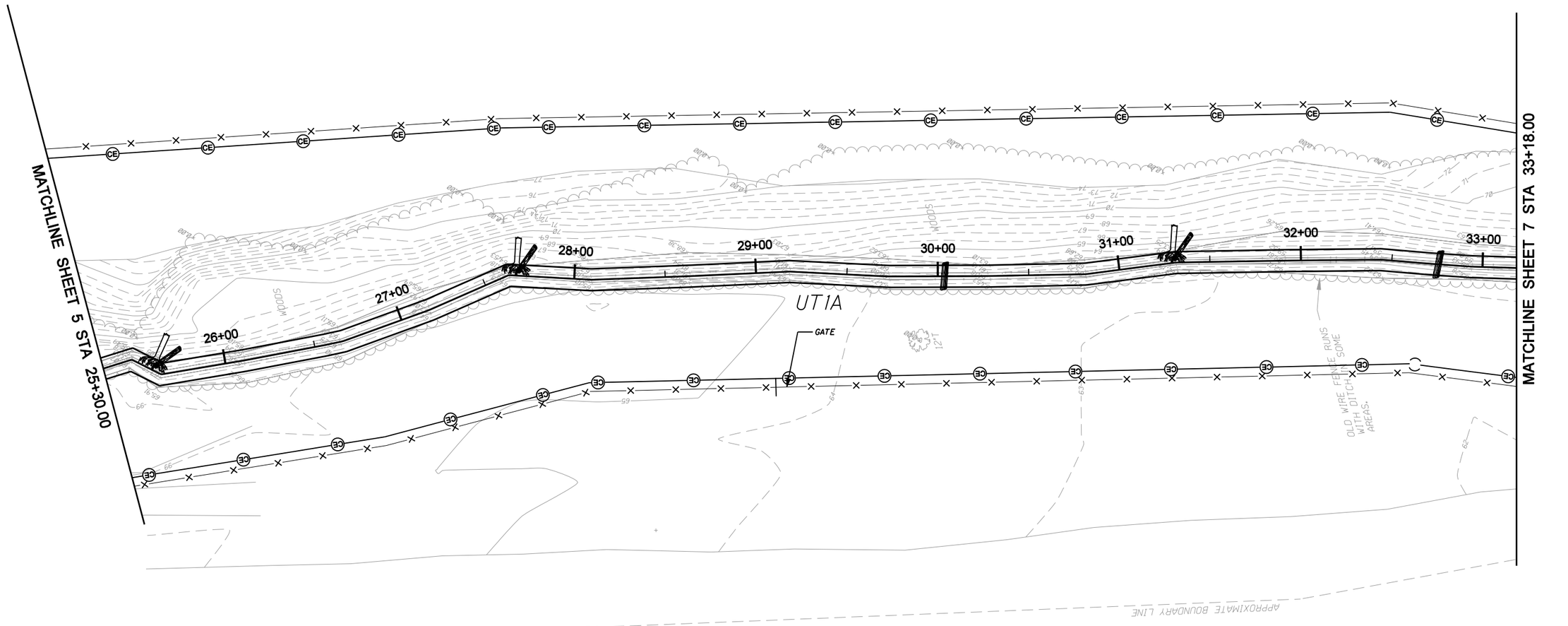

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MATCHLINE SHEET 6 STA 33+18.00

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+00

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

30 15 0 30 60
SCALE (FT)

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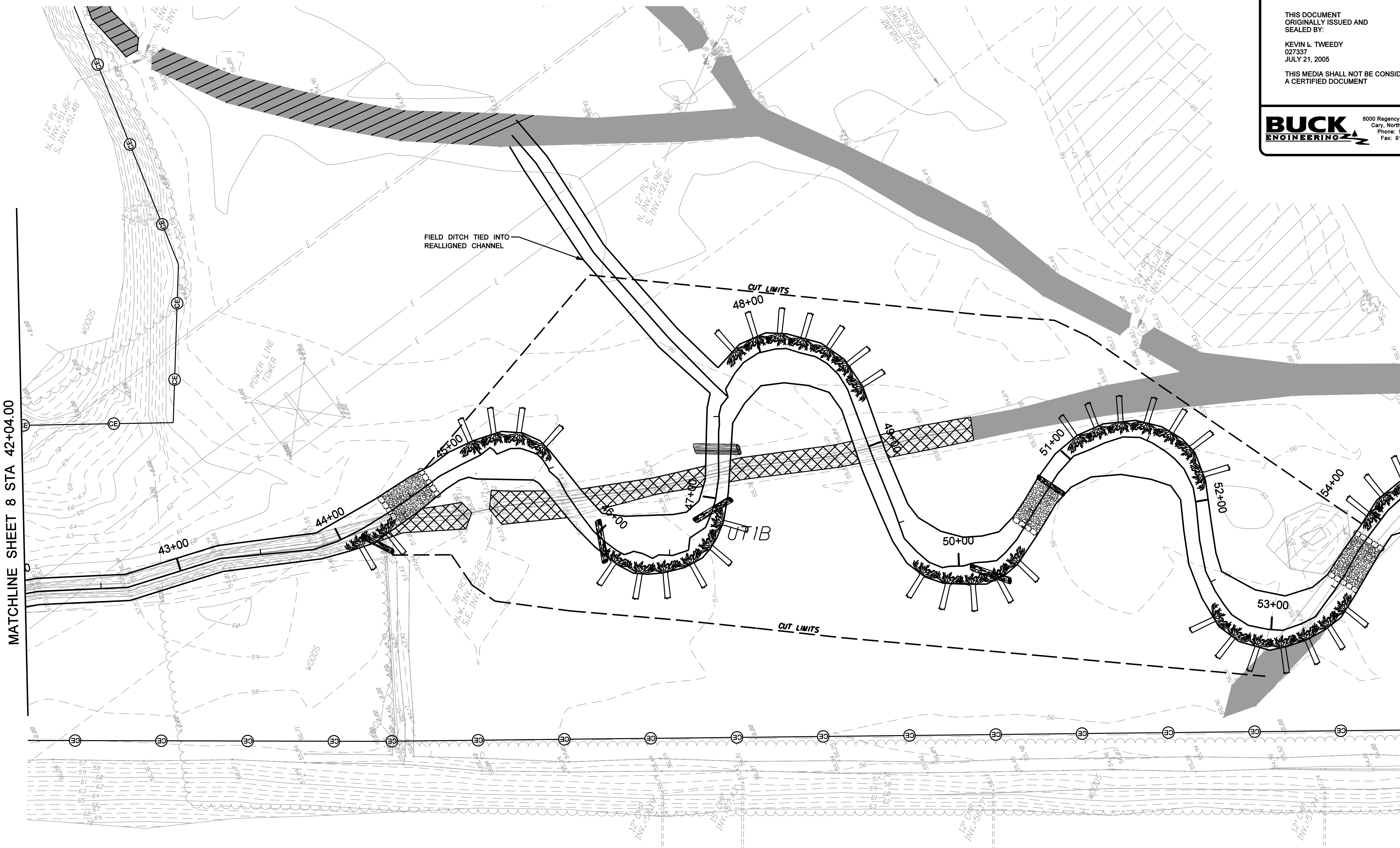

FILL EXISTING CHANNEL

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

CHANNEL BLOCK

SOUTH FORK

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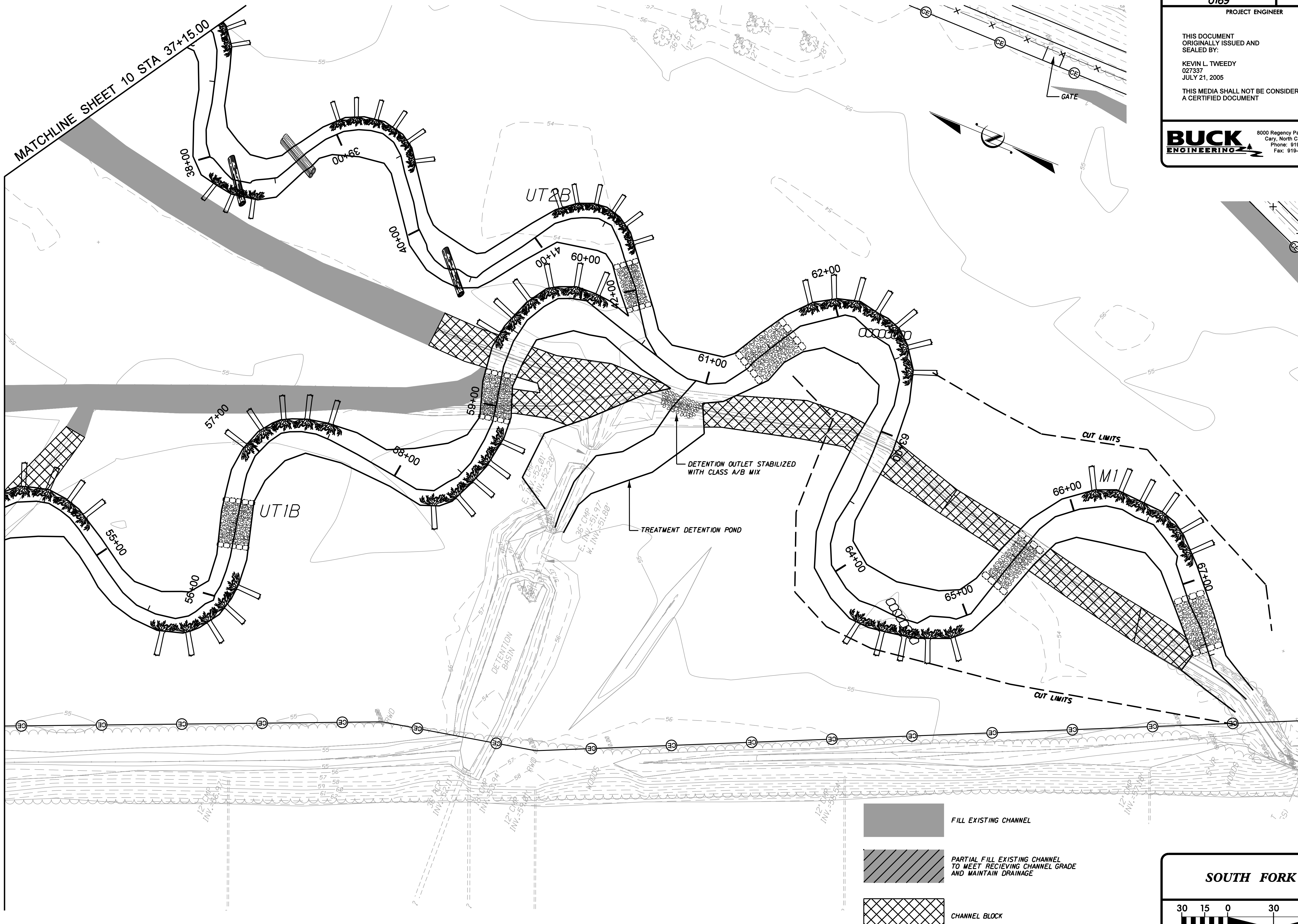

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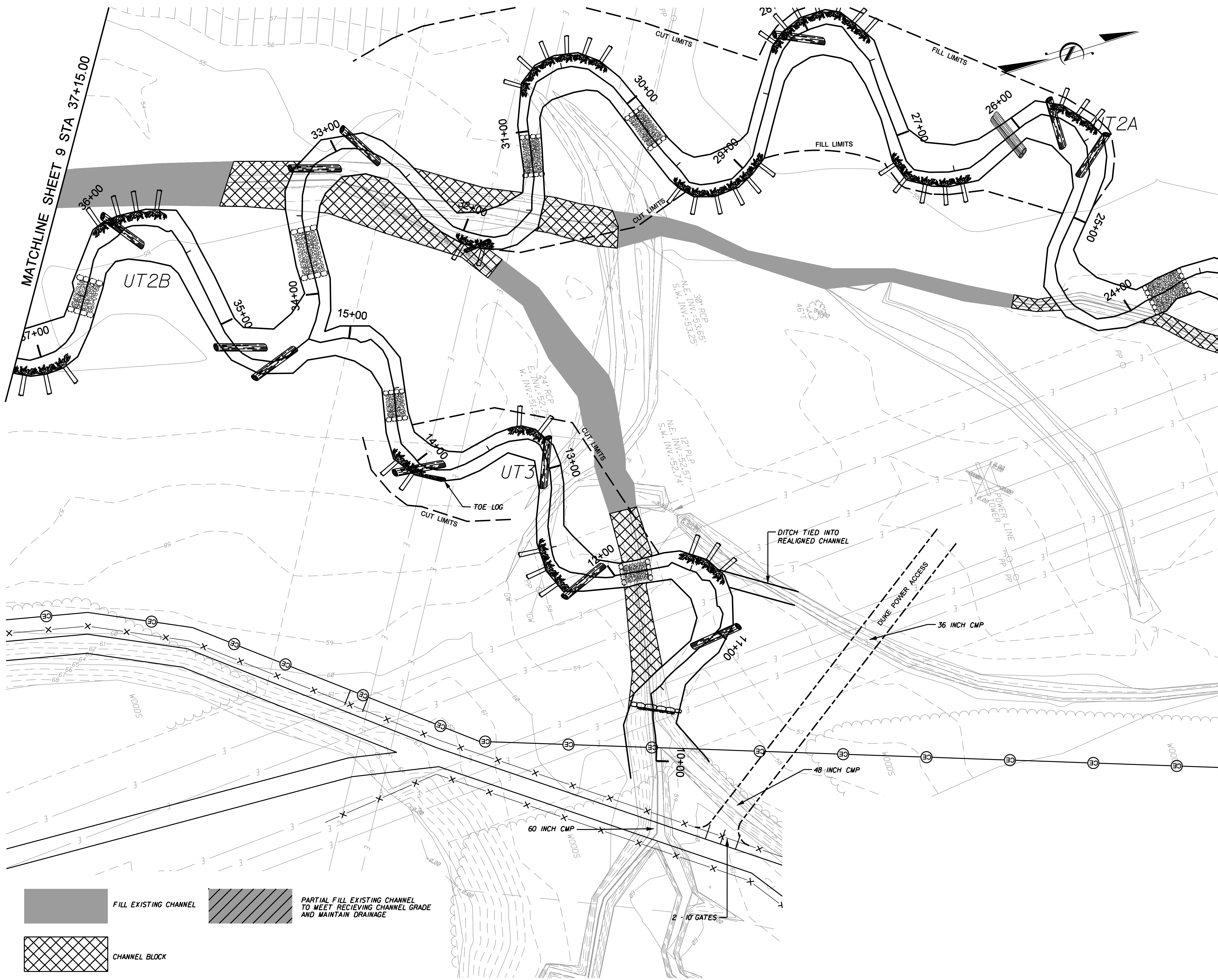

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SCALE (FT)

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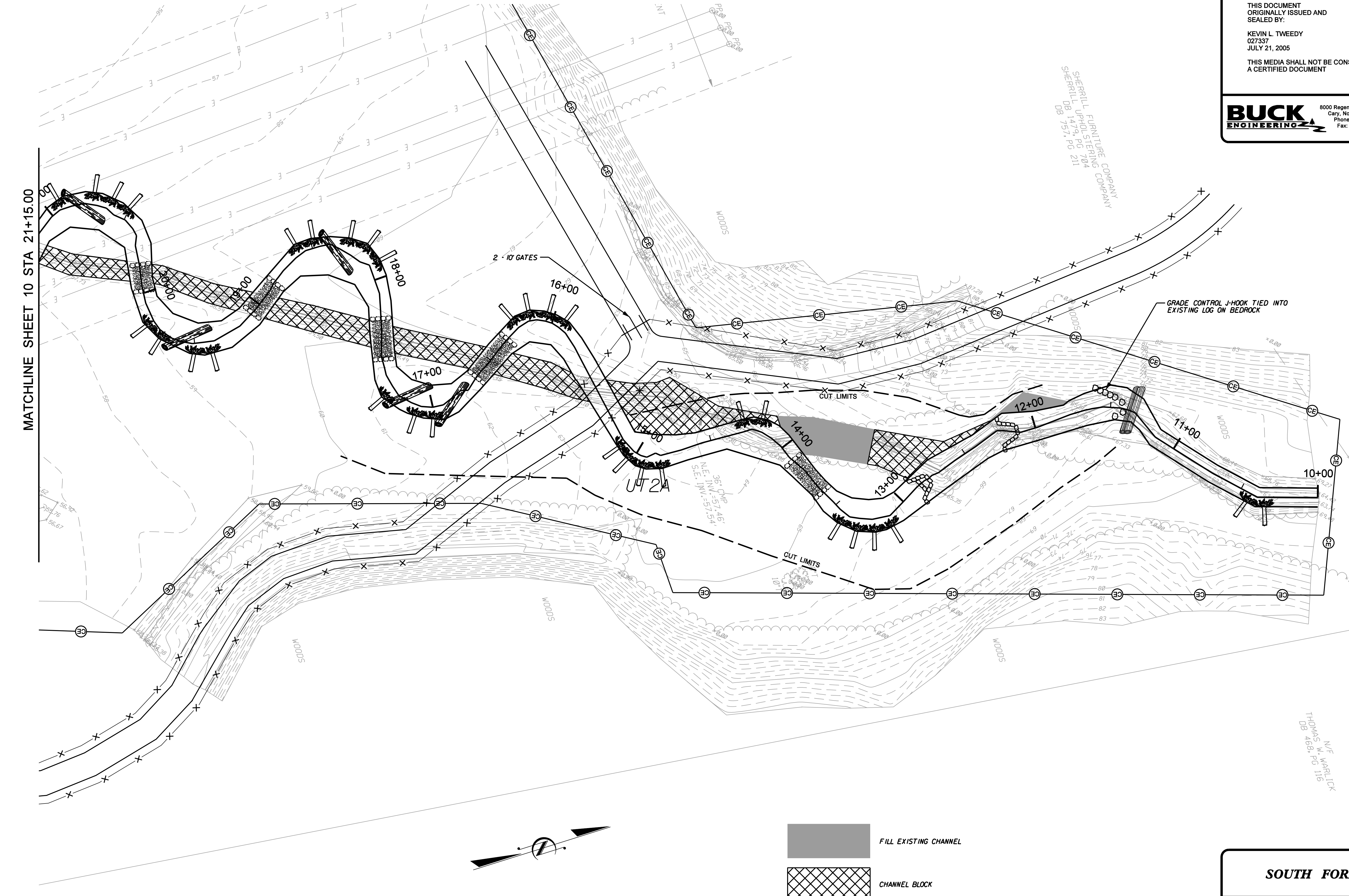

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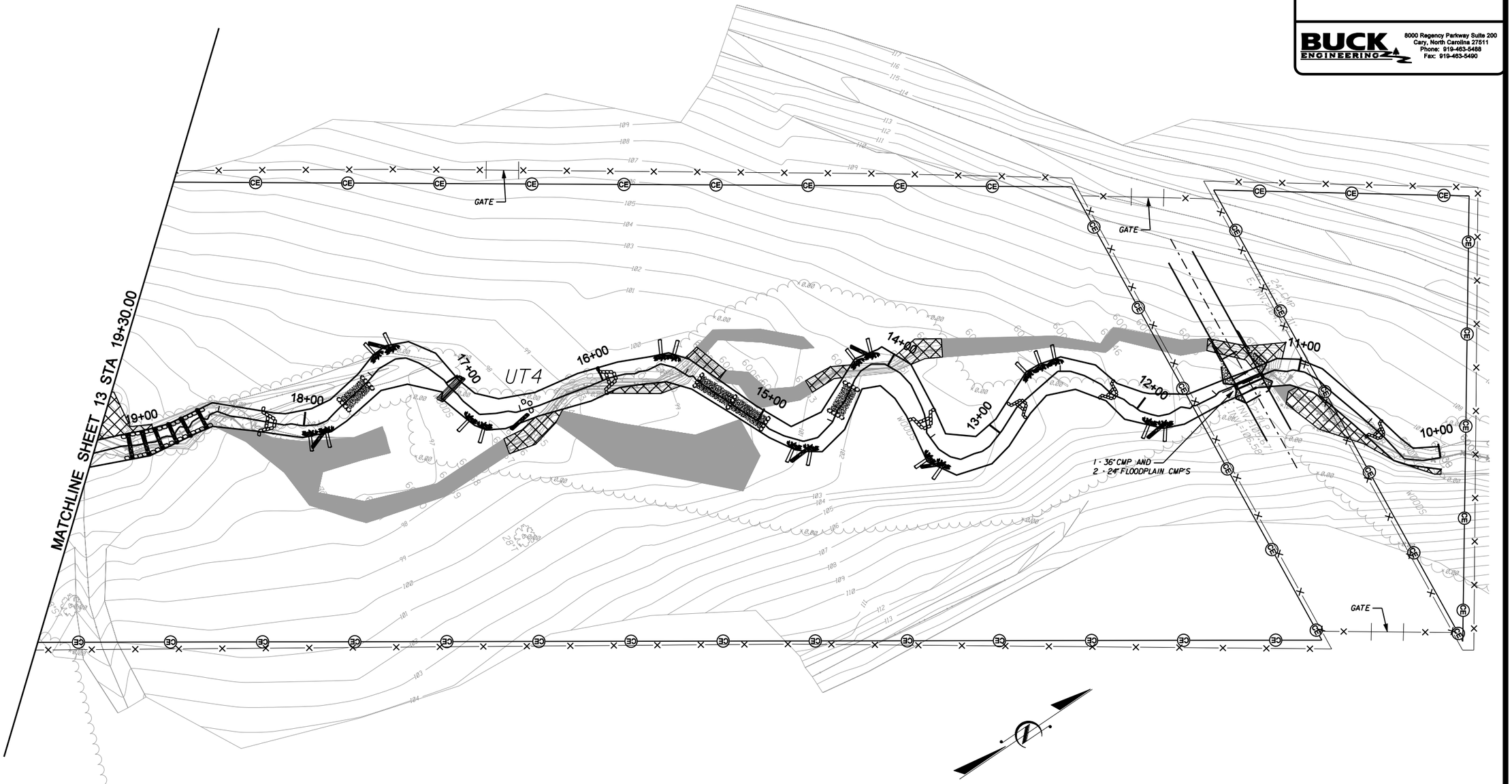

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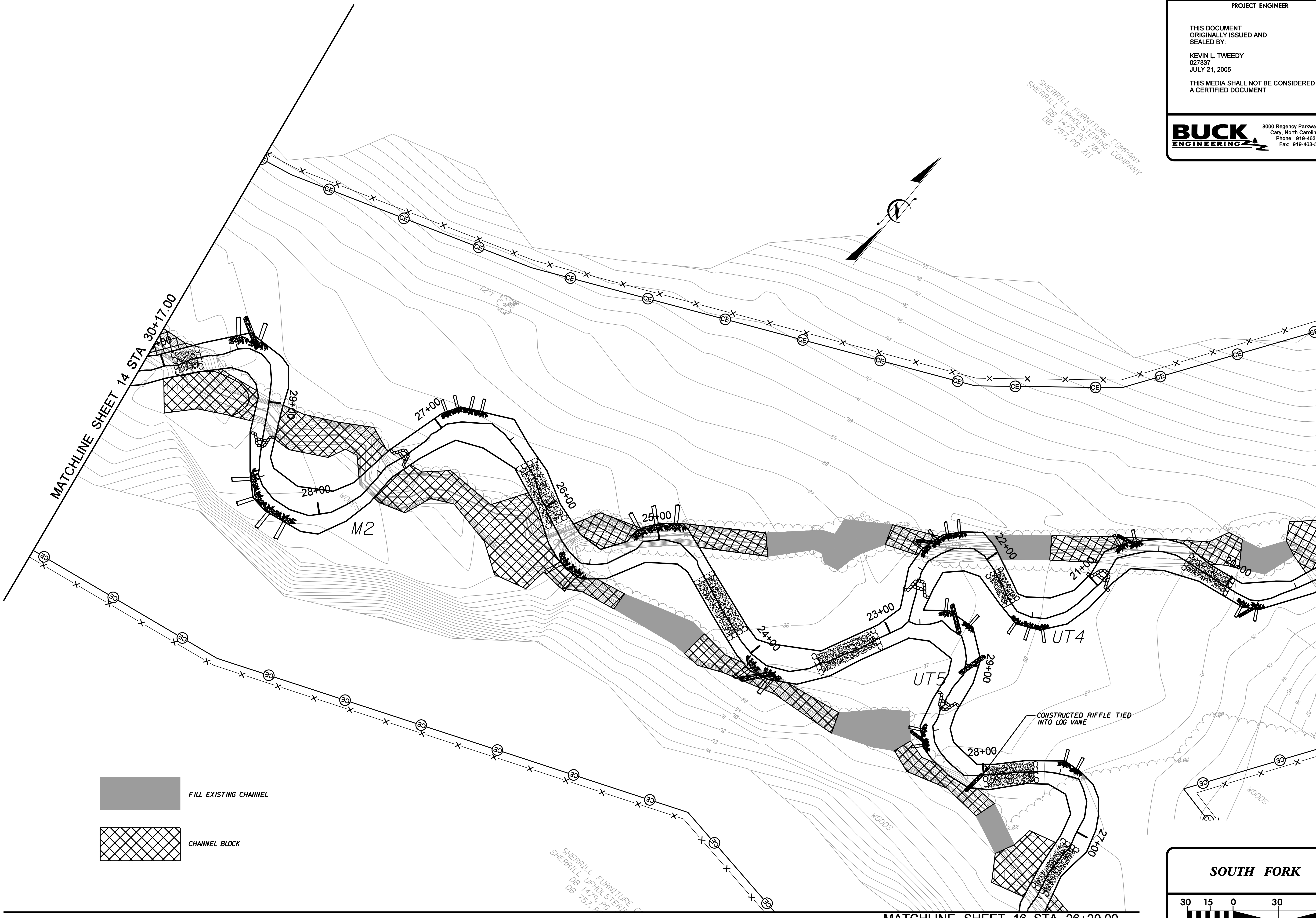

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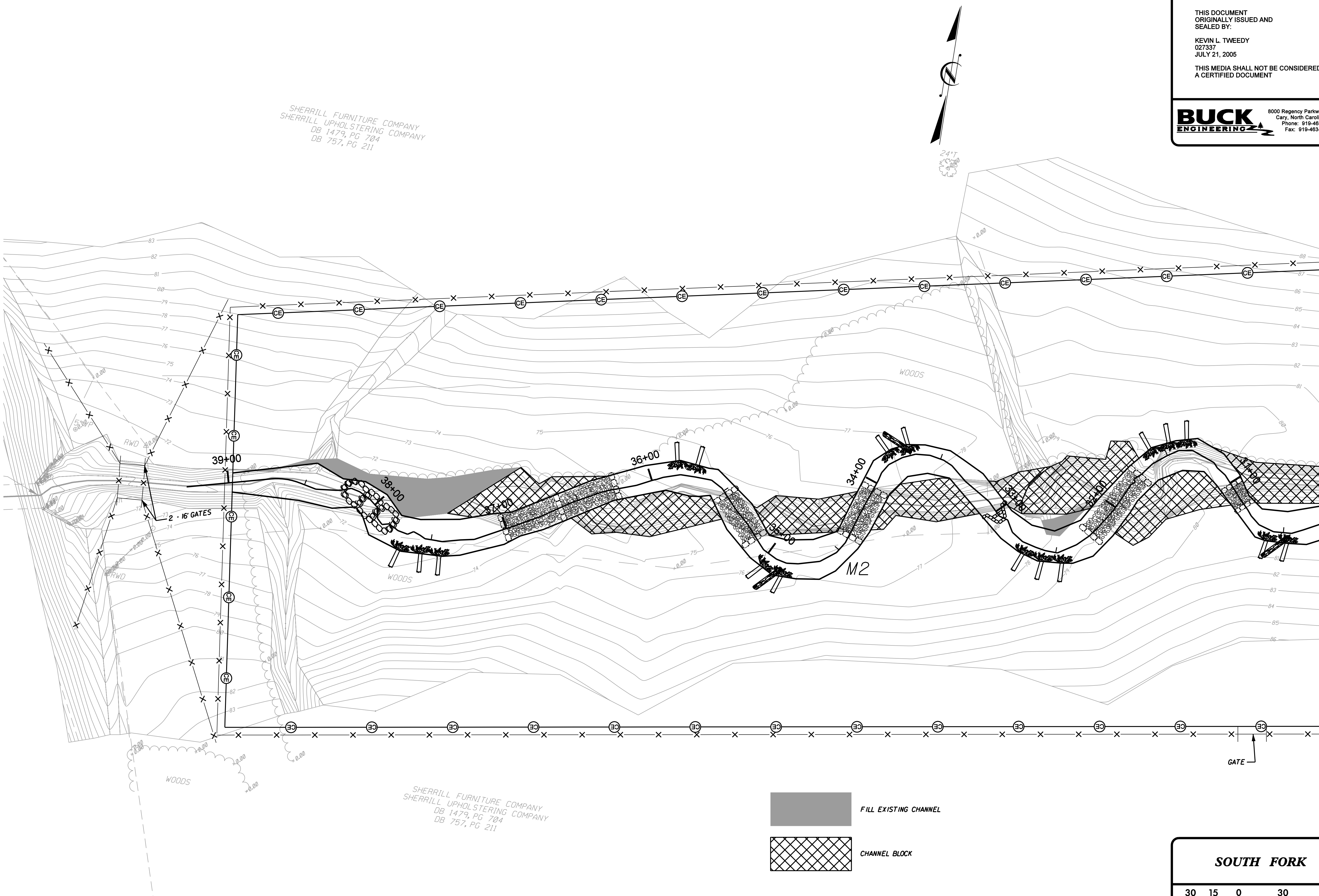

SOUTH FORK

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SCALE (FT)

2/26/03

10/18/2005
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169	15

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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
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PROJECT REFERENCE NO.	SHEET NO.
169	16

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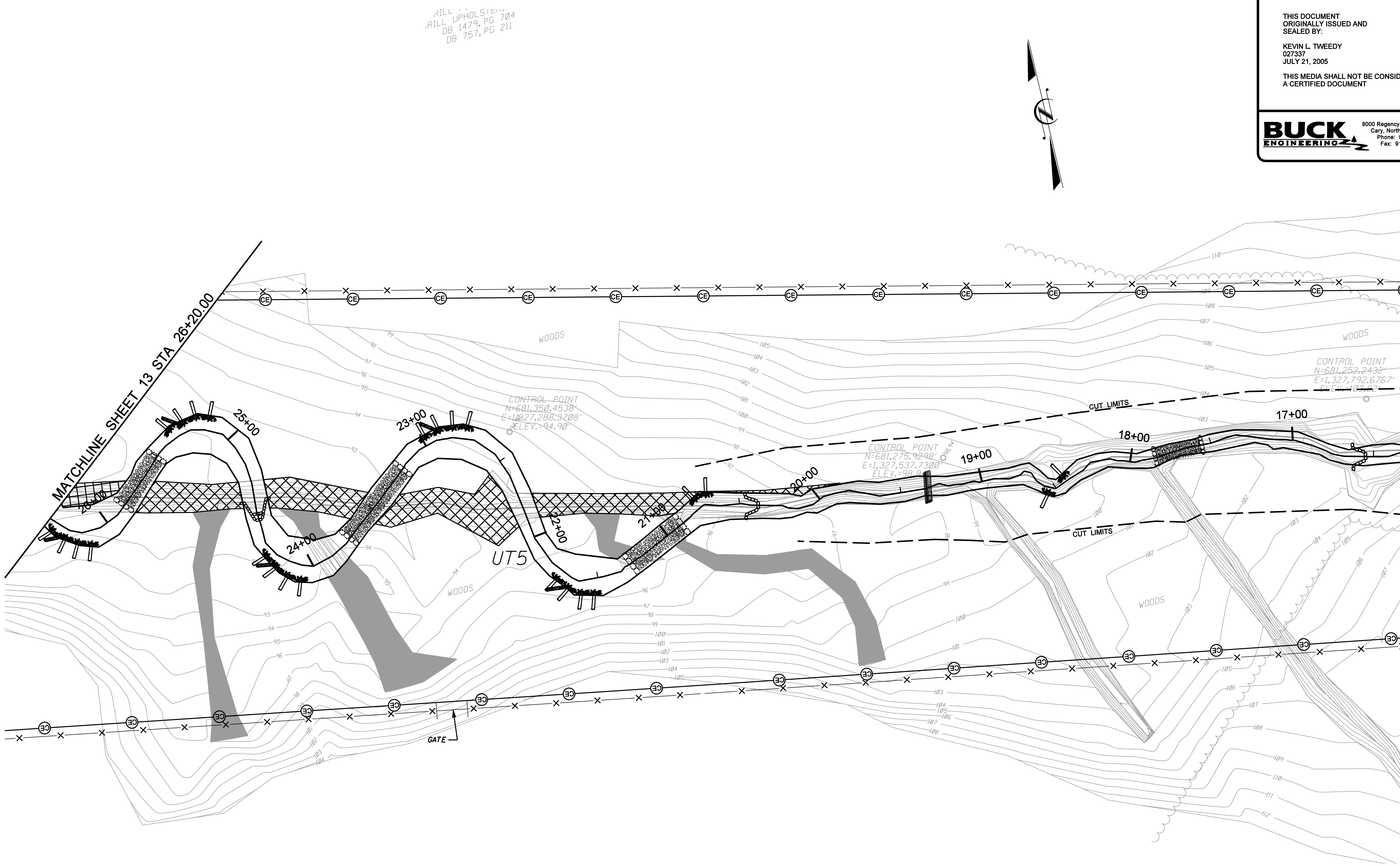
Fax: 919-463-5490



FILL EXISTING CHANNEL

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.
169	17

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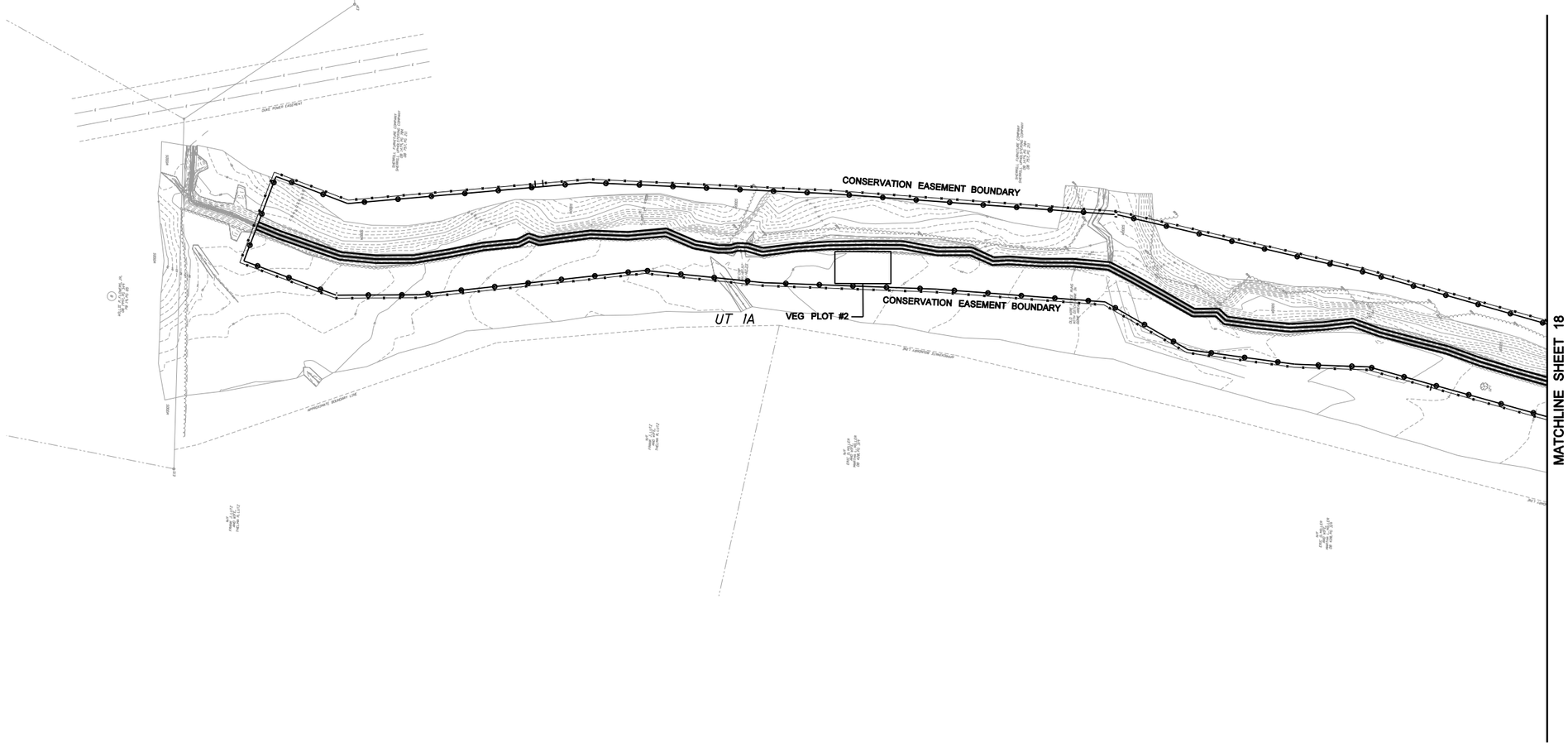
NAD 83



SITE OVERVIEW

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SCALE (FT)

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2/26/03

PROJECT REFERENCE NO.	SHEET NO.
169	18

PROJECT ENGINEER

THIS DOCUMENT
ORIGINALLY ISSUED AND
SEALED BY:

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

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

CONSERVATION EASEMENT BOUNDARY

UT 2A

X-SECTION 2

VEG PLOT #1

X-SECTION 3

X-SECTION 14

X-SECTION 13

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)

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

APPENDIX B

2008 Cross Section Data and Profile Data

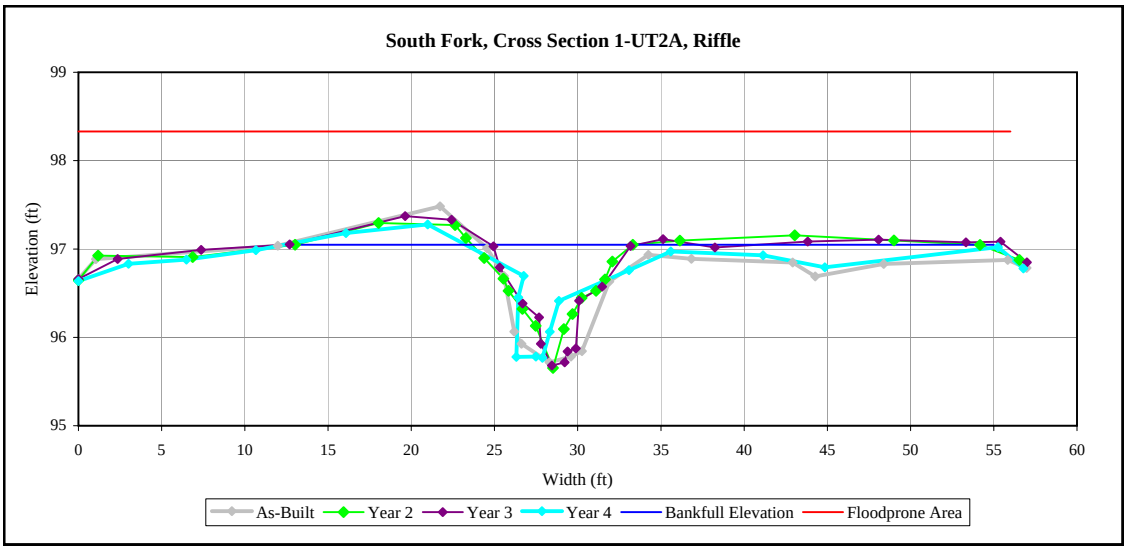
Cross Section	Parameter	As-Built	Year 1	Year 2	Year 3	Year 4
XS1-UT2A-RIFFLE	Bankfull Area	6.5	5.3	5.45	5.5	4.8
	Bankfull Width	9.45	7.53	9.65	7.9	11.6
	Bankfull Depth	0.69	0.71	0.56	0.7	0.4
	Max. Bankfull Depth	1.22	1.26	1.4	1.4	1.2
	Width/Depth Ratio	13.78	10.61	17.08	11.2	28
	Bank Height Ratio	1	1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

Cross Section	Parameter	As-Built	Year 1	Year 2	Year 3	Year 4
XS11-M1-RIFFLE	Bankfull Area	28.1	25.4	29.52	26.3	15.5
	Bankfull Width	22.83	23.98	22.42	24.4	17.7
	Bankfull Depth	1.23	1.06	1.32	1.1	0.9
	Max. Bankfull Depth	2.21	2.04	2.33	2.0	1.4
	Width/Depth Ratio	18.54	22.69	17.02	22.6	20.2
	Bank Height Ratio	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
	Bankfull Width	34.76	36.94	37.53	24.4	21.6
	Bankfull Depth	2.04	1.79	1.55	1.1	1.3
	Max. Bankfull Depth	4.04	4.18	3.75	2.0	2.5
	Width/Depth Ratio	17.07	20.63	24.22	22.6	16.6
	Bank Height Ratio	1	1	1	1.0	1
	Entrenchment Ratio	2.5	2.3	---	2.9	---
XS13-UT3-RIFFLE	Bankfull Area	9.2	7.9	6.99	4.8	9.8
	Bankfull Width	12.85	12.18	12.92	10.0	14.6
	Bankfull Depth	0.72	0.65	0.54	0.5	0.7
	Max. Bankfull Depth	1.38	1.18	1.1	1.1	1.4
	Width/Depth Ratio	17.9	18.76	23.87	21.1	21.8
	Bank Height Ratio	1	1	1	1.0	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
	Bankfull Width	21.01	22.97	22.17	20.6	26.3
	Bankfull Depth	1.35	1.26	1.01	0.9	0.9
	Max. Bankfull Depth	3.07	2.81	2.51	2.2	2.1
	Width/Depth Ratio	15.53	18.29	21.94	21.7	30
	Bank Height Ratio	1	1	1	1.0	1
	Entrenchment Ratio	3.3	3	---	3.4	---
XS1-UT4-RIFFLE	Bankfull Area	35.8	29.7	30.46	16.54292	7.7
	Bankfull Width	19.57	19	18.6	9.203541	9.3
	Bankfull Depth	1.83	1.56	1.63	1.797452	0.8
	Max. Bankfull Depth	4.38	3.51	3.4	2.9179	1.7
	Width/Depth Ratio	10.68	12.17	11.36	5.120327	11.2
	Bank Height Ratio	0.9	1	1	0.772782	1
	Entrenchment Ratio	2.9	3	---	6.128076	---
XS2-UT4-POOL	Bankfull Area	16.3	13.4	16.47	9.6	12.8
	Bankfull Width	13.04	13.49	15.84	12.7	20.3
	Bankfull Depth	1.25	0.99	1.04	0.8	0.6
	Max. Bankfull Depth	2.12	1.85	2.15	1.5	2.2
	Width/Depth Ratio	10.45	13.59	15.23	16.8	32.2
	Bank Height Ratio	1.3	1.5	1.2	1.0	1
	Entrenchment Ratio	4.7	4.3	---	4.7	---
XS3-UT4-RIFFLE	Bankfull Area	5.1	6.7	4	5.7	3.9
	Bankfull Width	7.71	12.07	6.43	8.1	11.9
	Bankfull Depth	0.67	0.56	0.62	0.7	0.3
	Max. Bankfull Depth	1.07	1.24	1.12	1.3	1.5
	Width/Depth Ratio	11.57	21.66	10.37	11.4	36.2
	Bank Height Ratio	1.1	1	1	1.0	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
	Bankfull Width	15.07	16.74	15.01	15.8	18.4
	Bankfull Depth	0.85	0.83	0.77	0.8	0.9
	Max. Bankfull Depth	1.57	1.66	1.69	1.8	1.8
	Width/Depth Ratio	17.65	20.22	19.53	20.2	20.1
	Bank Height Ratio	1	1.1	1	0.6	1
	Entrenchment Ratio	3	2.7	3	2.9	---
XS5-M2-RIFFLE	Bankfull Area	16.3	31.6	32.48	30.3	33.4
	Bankfull Width	14.59	17.76	17.05	16.8	15.4
	Bankfull Depth	1.12	1.78	1.91	1.8	2.2
	Max. Bankfull Depth	1.84	3.38	3.44	3.2	3.1
	Width/Depth Ratio	13.07	9.97	8.95	9.4	7.1
	Bank Height Ratio	1.2	1.2	1	0.9	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
	Bankfull Width	15.99	14.5	13.24	13.2	12.9
	Bankfull Depth	1.63	1.89	2.1	2.2	2.3
	Max. Bankfull Depth	2.76	2.98	3.21	3.3	3.2
	Width/Depth Ratio	9.83	7.66	6.3	5.9	5.6
	Bank Height Ratio	1	1	1	1.0	1
	Entrenchment Ratio	3.7	4.1	---	4.6	---

Cross Section	Parameter	As-Built	Year 1	Year 2	Year 3	Year 4
XS7-M2-RIFFLE	Bankfull Area	19.9	20	17.39	15.3	23.2
	Bankfull Width	15.56	18.72	15.44	14.2	19.4
	Bankfull Depth	1.28	1.07	1.13	1.1	1.2
	Max. Bankfull Depth	2.44	2.36	2.22	2.2	2.1
	Width/Depth Ratio	12.15	17.49	13.71	13.1	16.2
	Bank Height Ratio	1	1	1	1.0	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
	Bankfull Width	15.34	14.08	12.22	13.1	17.5
	Bankfull Depth	0.8	0.72	0.65	0.7	0.7
	Max. Bankfull Depth	1.76	1.45	1.19	1.3	1.6
	Width/Depth Ratio	19.21	19.56	18.9	19.4	26.2
	Bank Height Ratio	1	1	1	1.0	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
	Bankfull Width	14.91	16.99	14.86	14.9	9
	Bankfull Depth	0.75	0.73	0.6	0.7	0.5
	Max. Bankfull Depth	1.34	1.28	1.09	1.3	1.1
	Width/Depth Ratio	19.94	23.27	24.95	20.8	17.5
	Bank Height Ratio	1	1	1	1.0	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
	Bankfull Width	8.04	7.83	8.47	7.5	9.7
	Bankfull Depth	0.75	0.62	0.52	0.6	0.4
	Max. Bankfull Depth	1.02	0.98	0.82	0.9	0.7
	Width/Depth Ratio	10.76	12.6	16.17	13.7	22.7
	Bank Height Ratio	1	1	1.1	1.0	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
	Bankfull Width	11.47	16.42	10.88	9.4	7.6
	Bankfull Depth	0.73	0.55	0.51	0.5	0.4
	Max. Bankfull Depth	1.78	1.25	1.15	1.1	0.8
	Width/Depth Ratio	15.66	29.85	21.43	18.7	18.1
	Bank Height Ratio	1	1	1	1	1
	Entrenchment Ratio	3	2.1	---	3.7	---

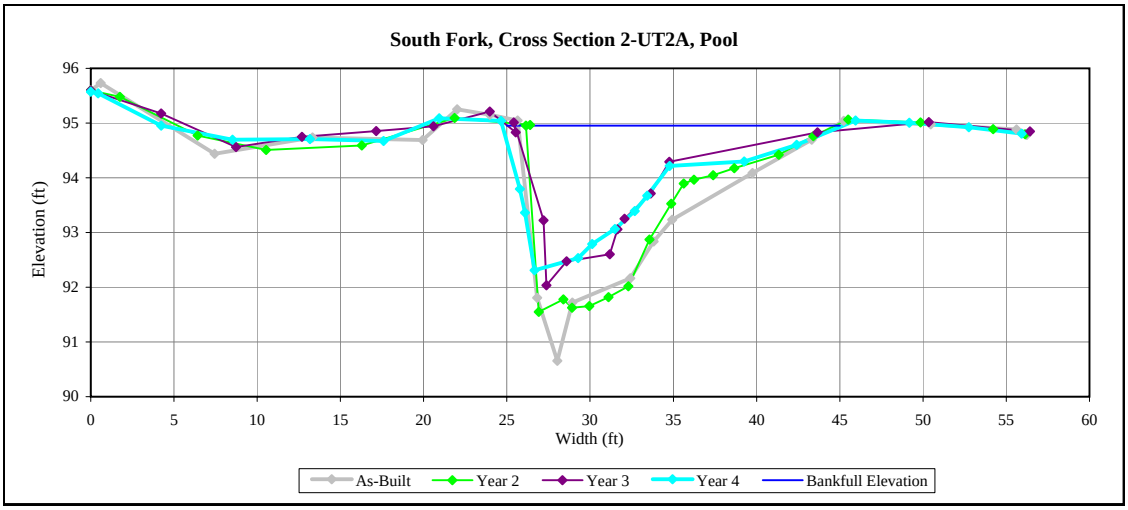
Looking at the left bank.

Looking at the right bank.



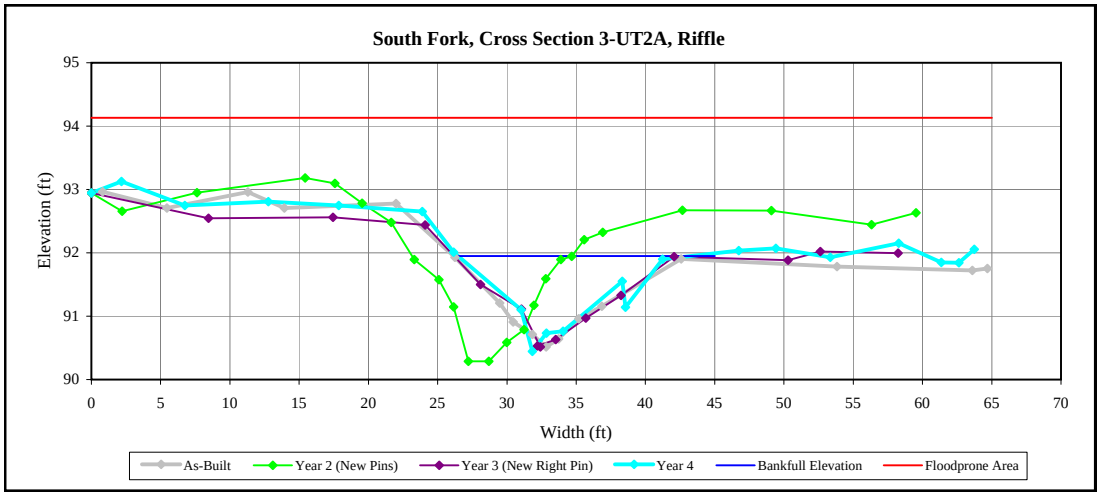
Looking at left bank.

Looking at right bank.



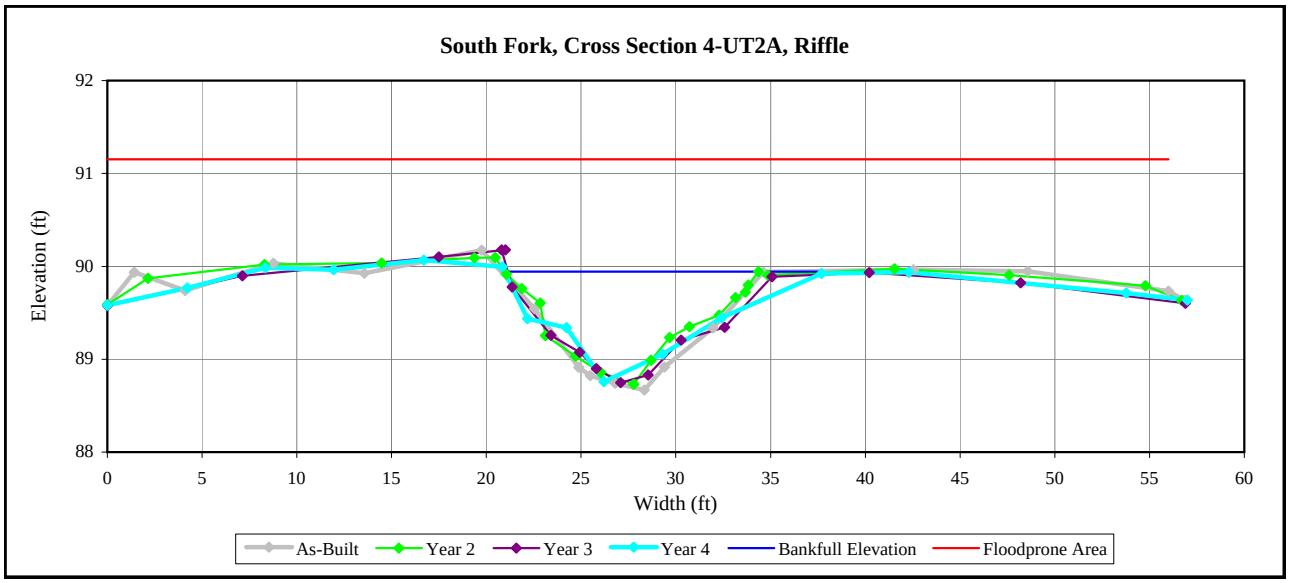
Looking at the left bank.

Looking at the right bank.



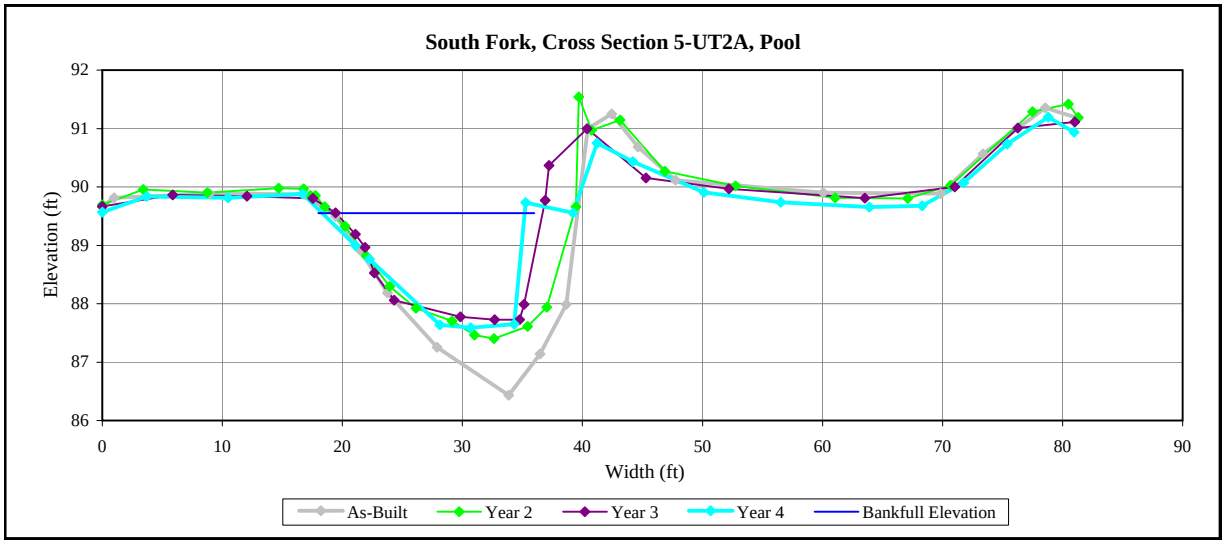
Looking at the left bank.

Looking at the right bank.



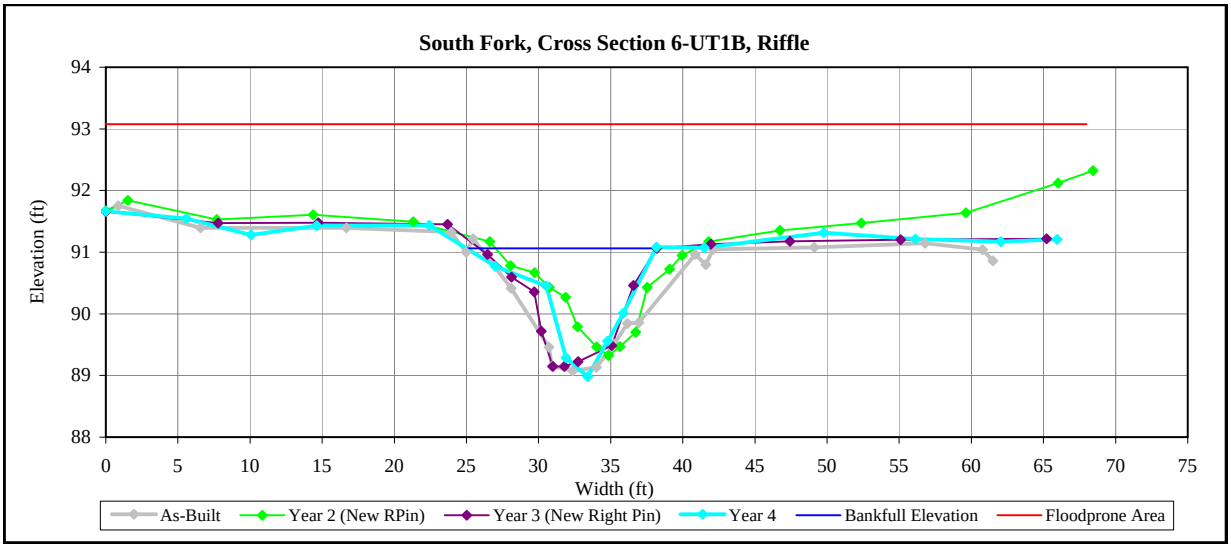
Looking at the left bank.

Looking at the right bank.



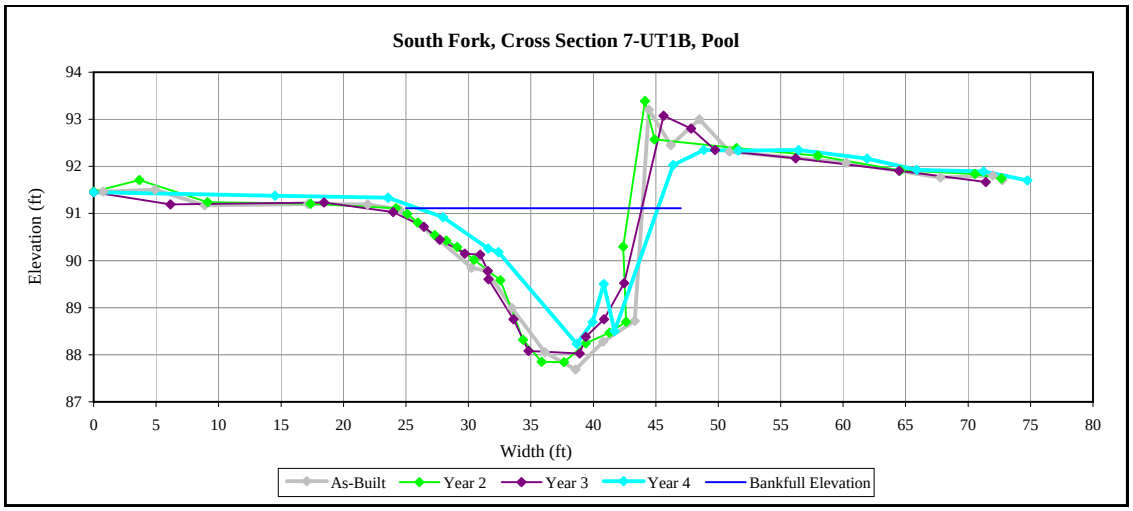
Looking at the left bank.

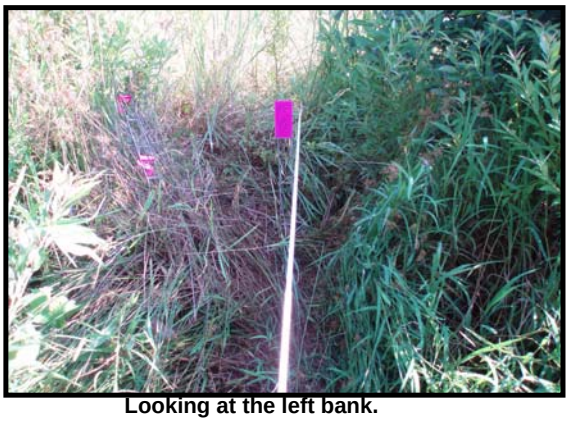
Looking at the right bank.



Looking at the left bank.

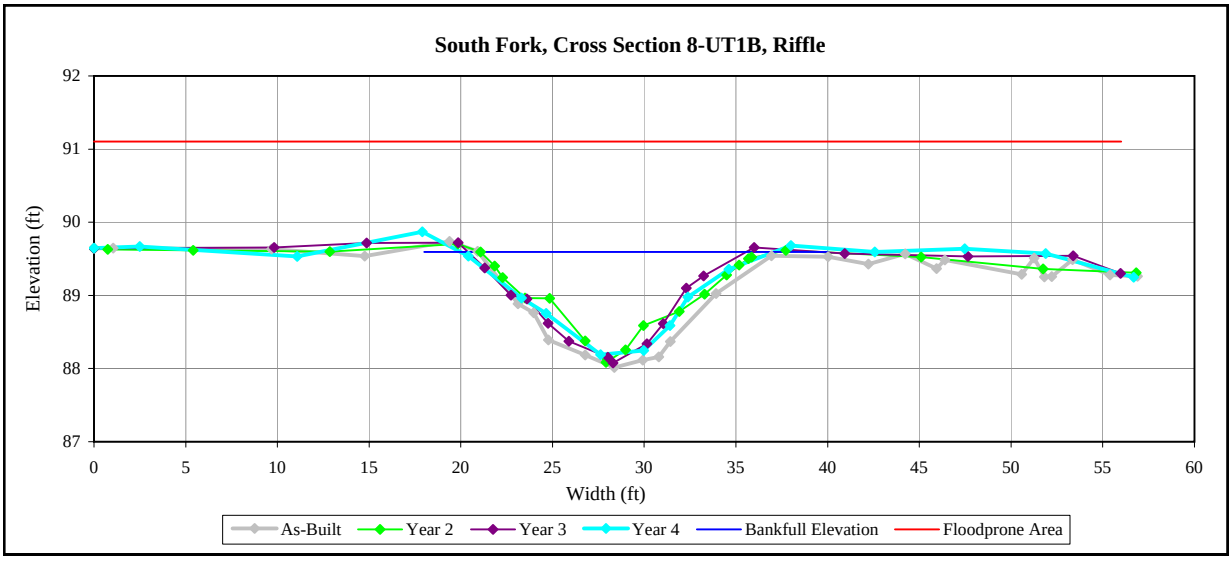
Looking at the right bank.





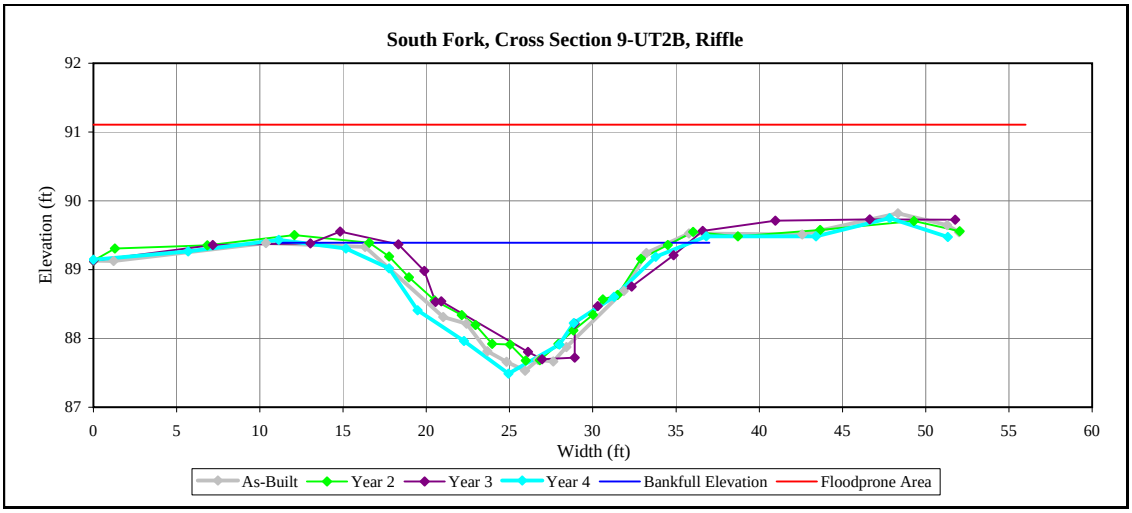
Looking at the left bank.

Looking at the right bank.



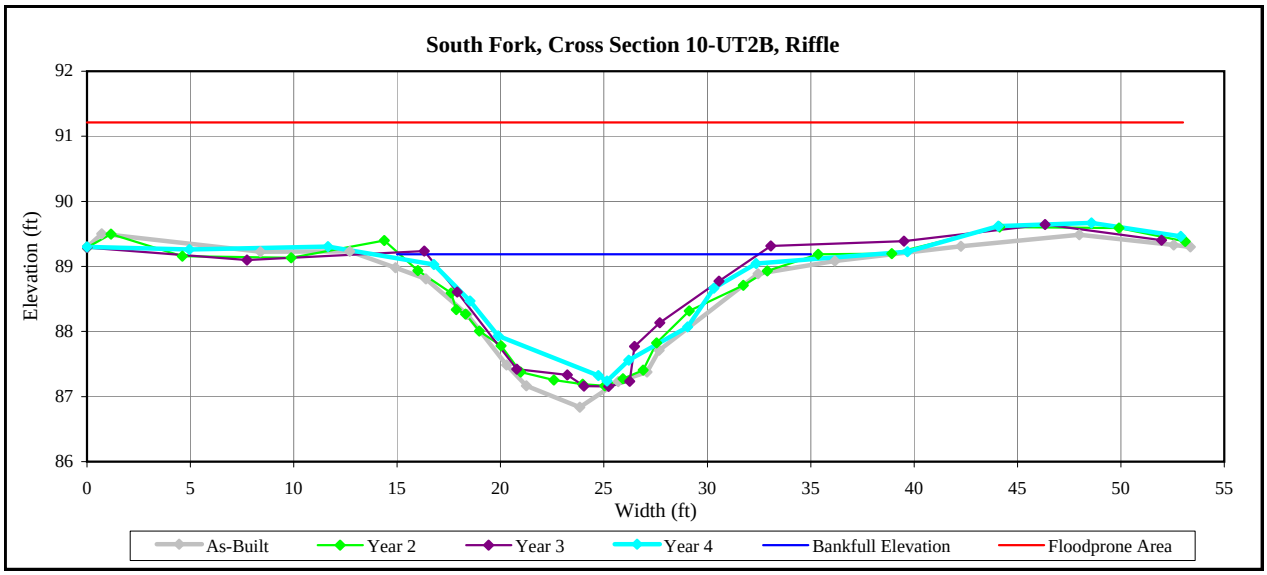
Looking at left bank.

Looking at right bank.



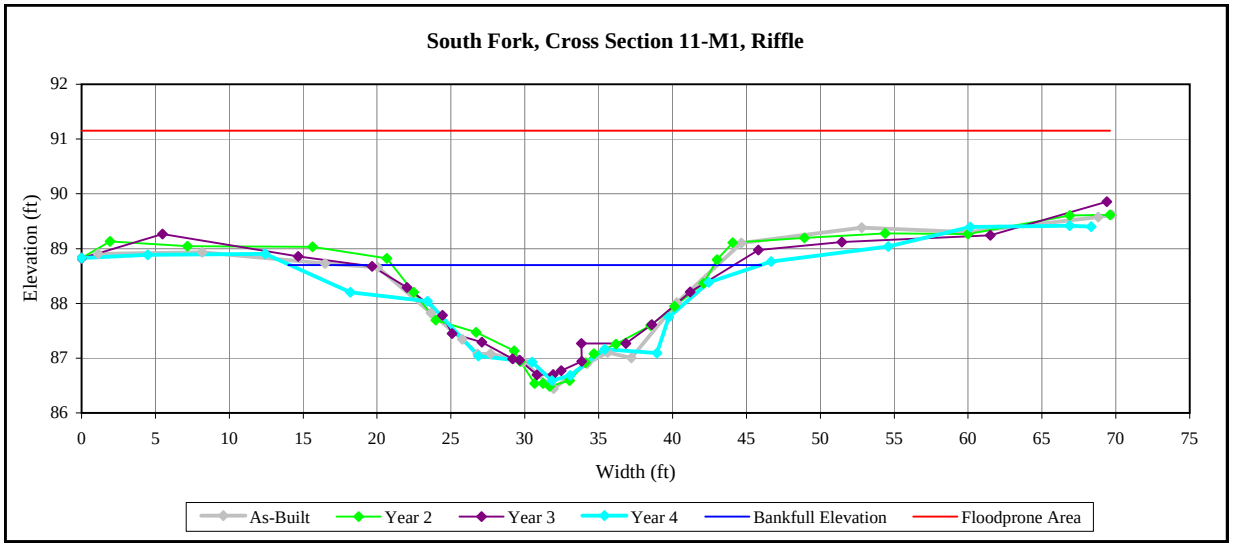
Looking at the left bank.

Looking at the right bank.



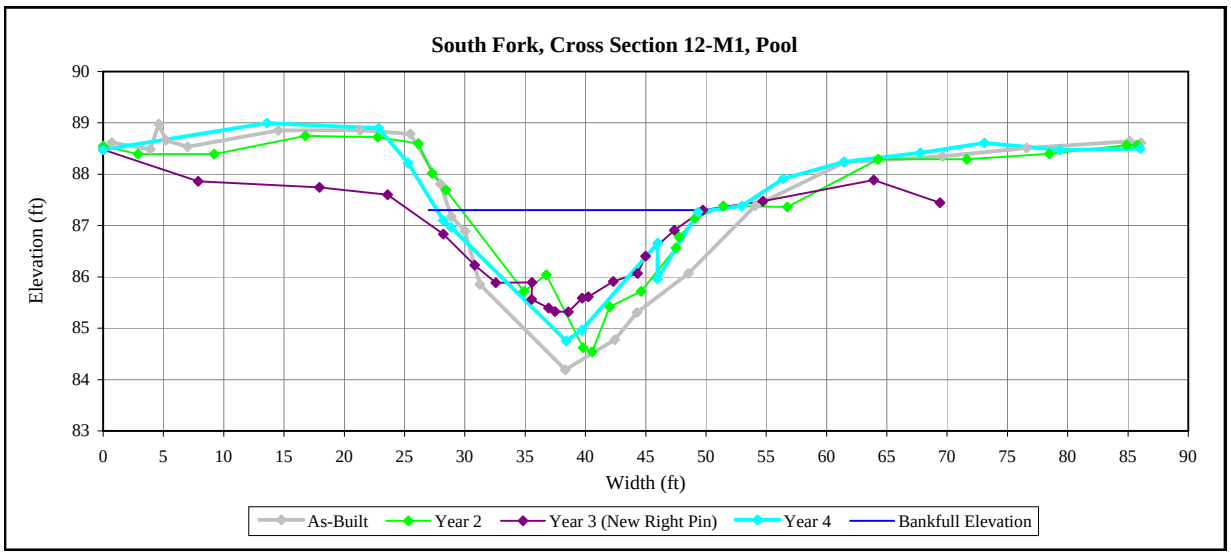
Looking at the left bank.

Looking at the right bank.



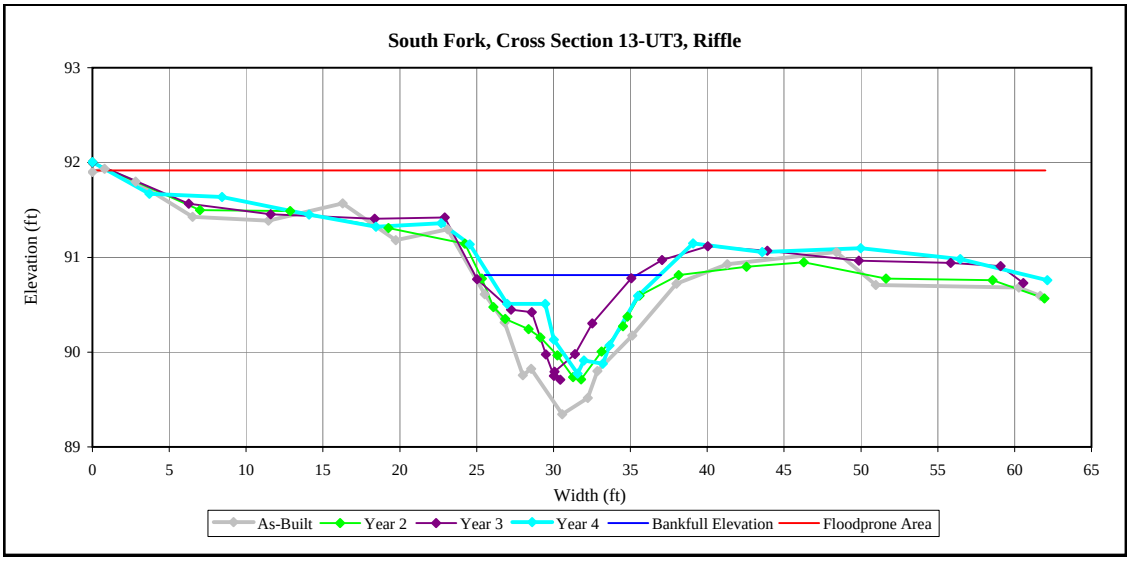
Looking at the left bank.

Looking at the right bank.



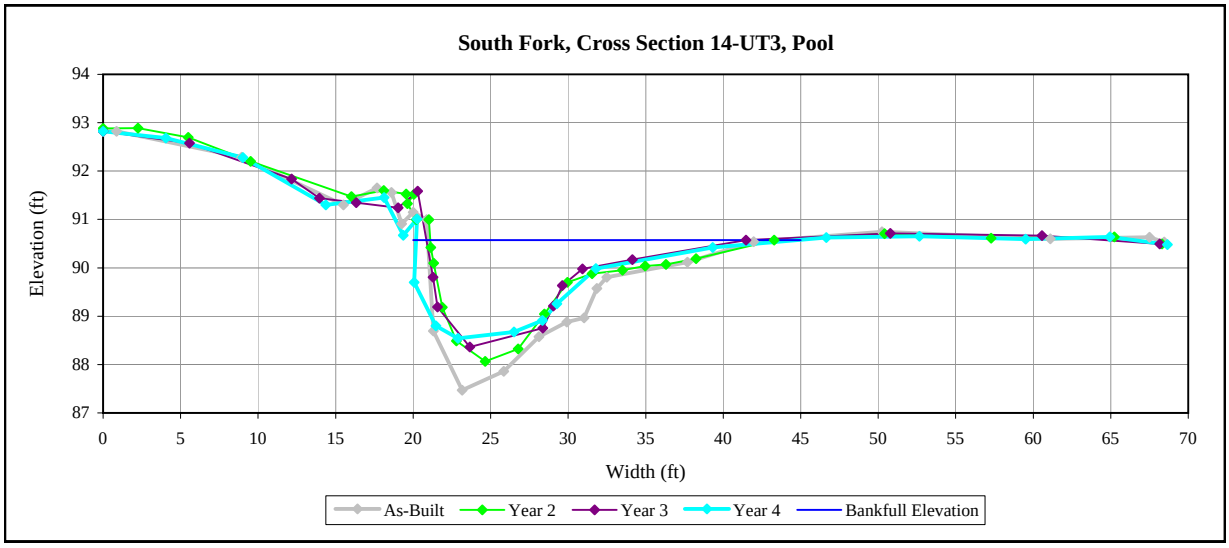
Looking at the left bank.

Looking at the right bank.



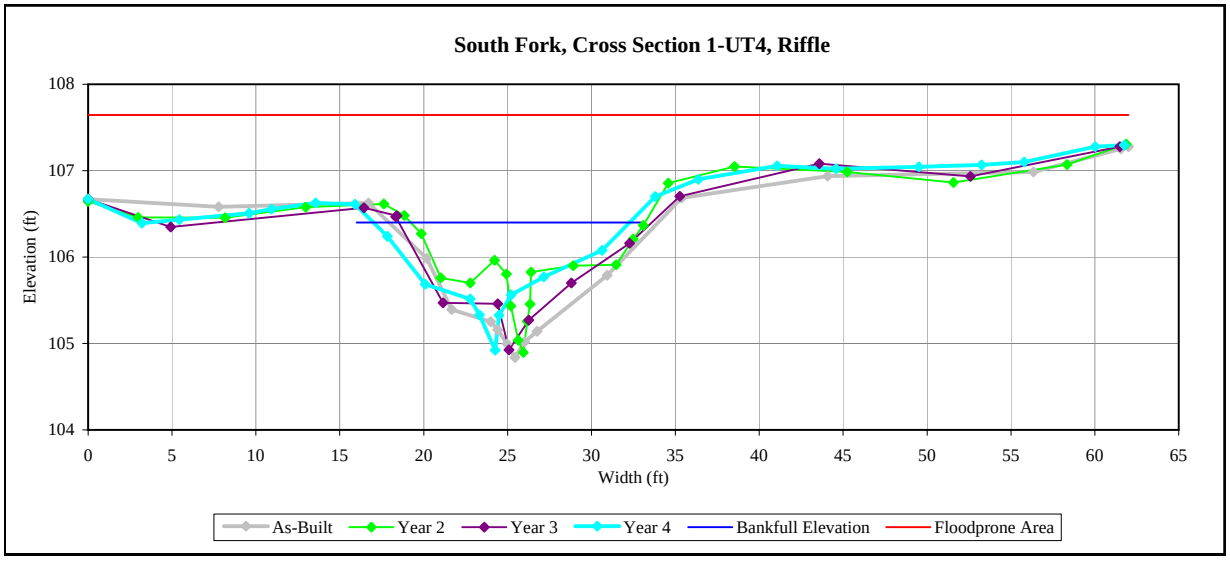
Looking at the left bank.

Looking at the right bank.



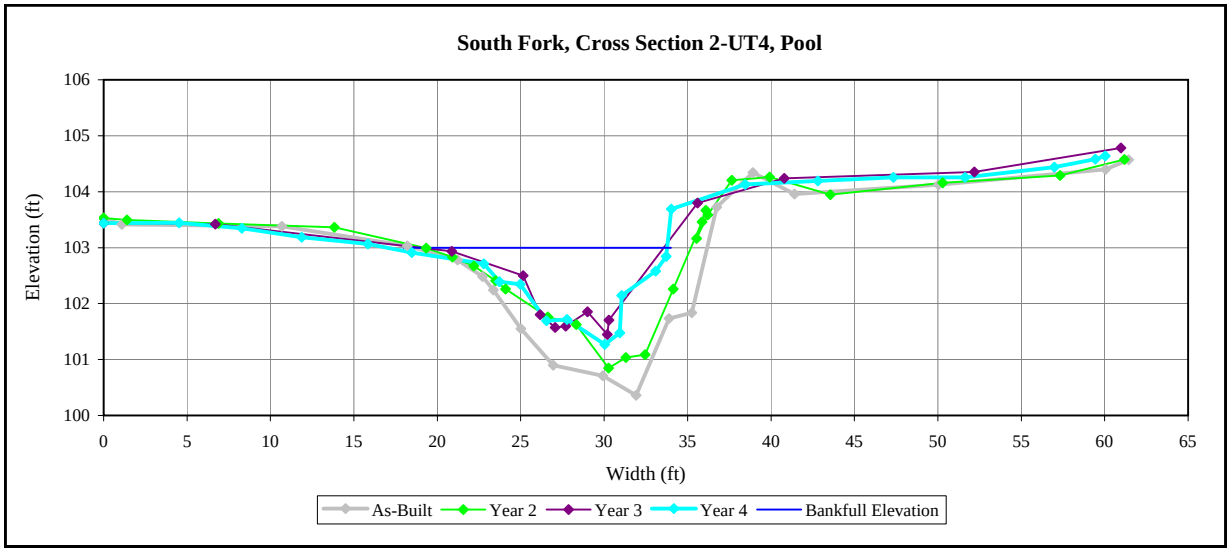
Looking at the left bank.

Looking at the right bank.



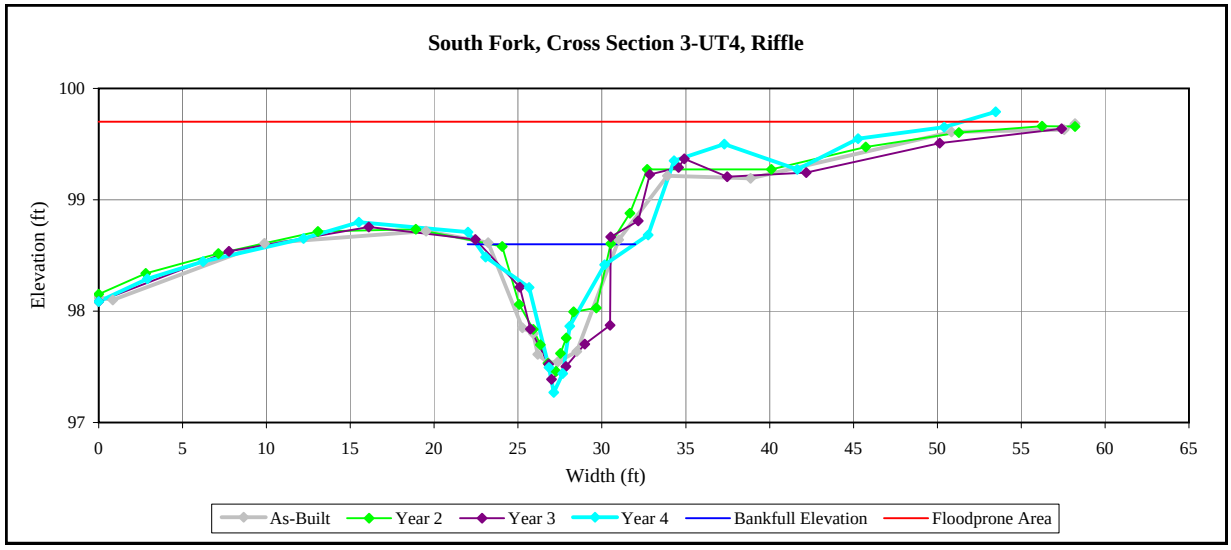
Looking at the left bank.

Looking at the right bank.



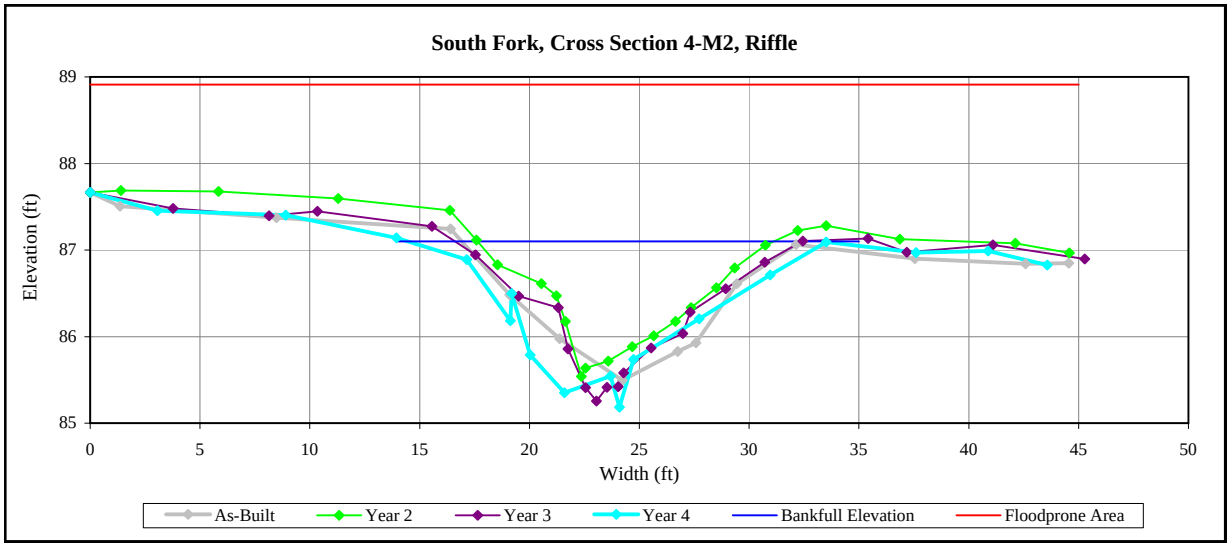
Looking at the left bank.

Looking at the right bank.



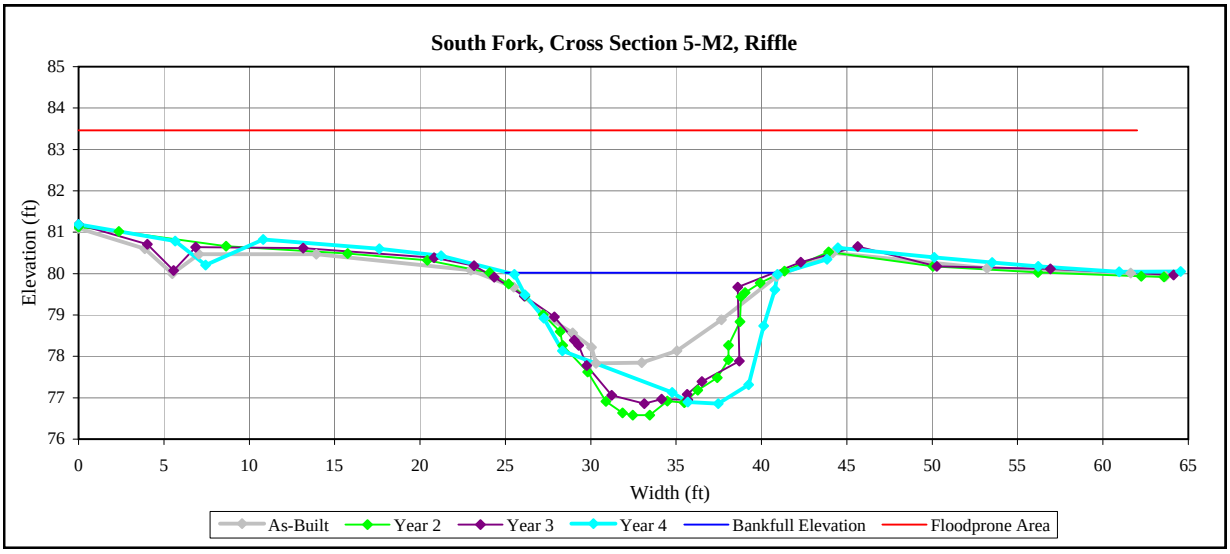
Looking at the left bank.

Looking at the right bank.



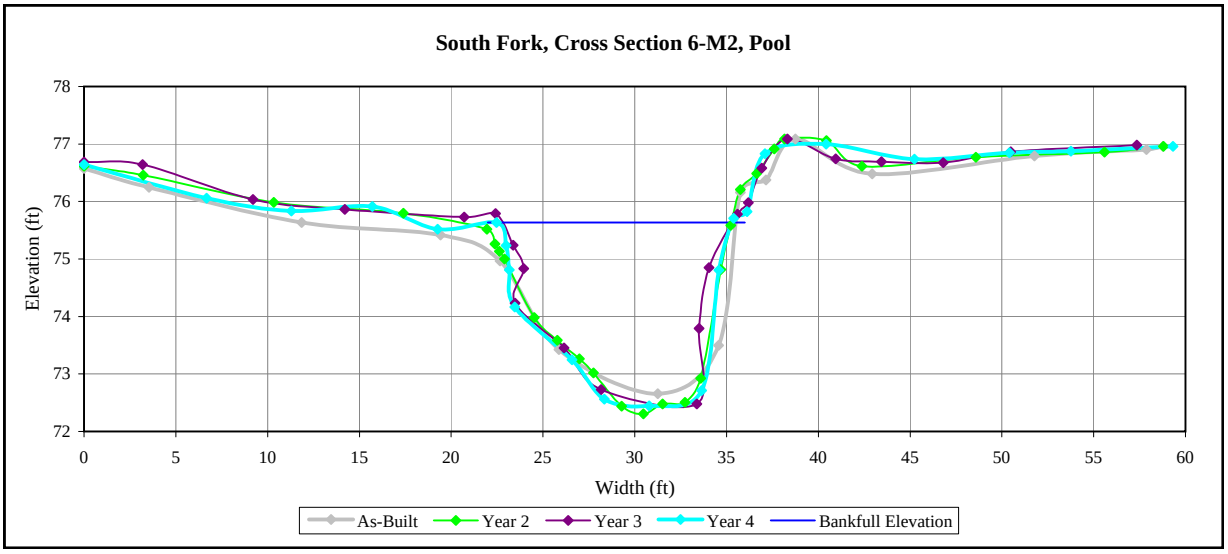
Looking at the left bank.

Looking at the right bank.



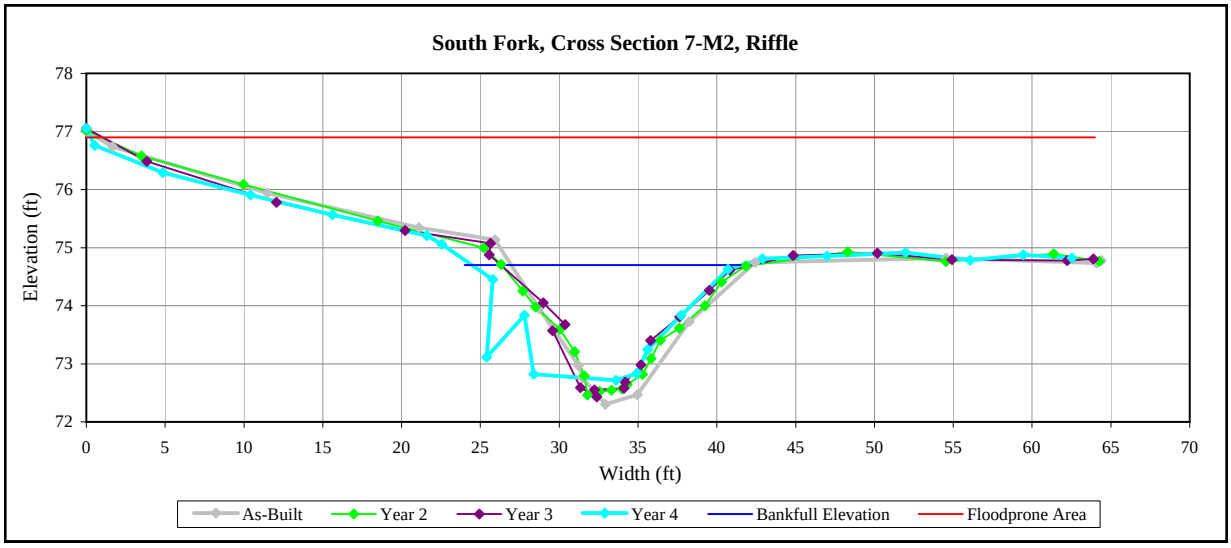
Looking at the left bank.

Looking at the right bank.



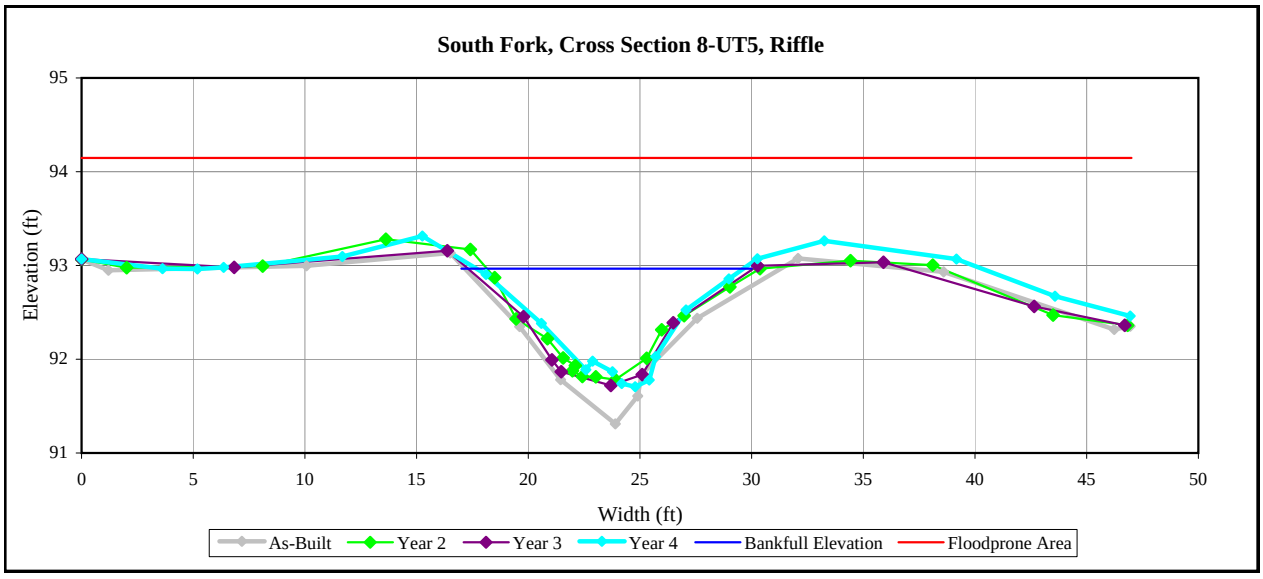
Looking at the left bank.

Looking at the right bank.



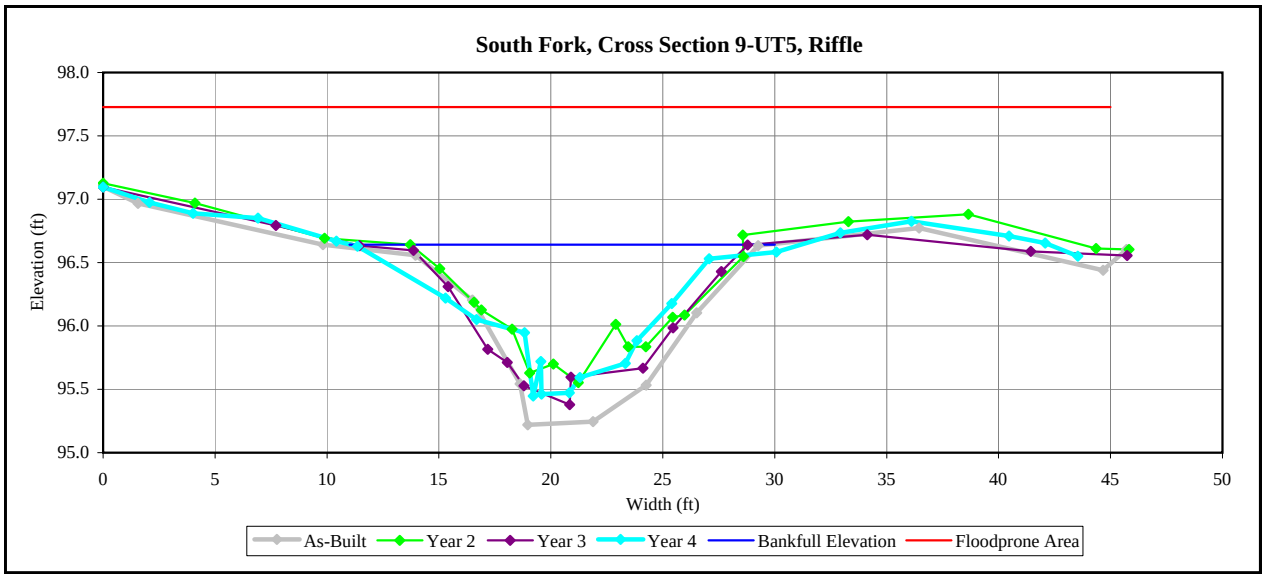
Looking at the left bank.

Looking at the right bank.



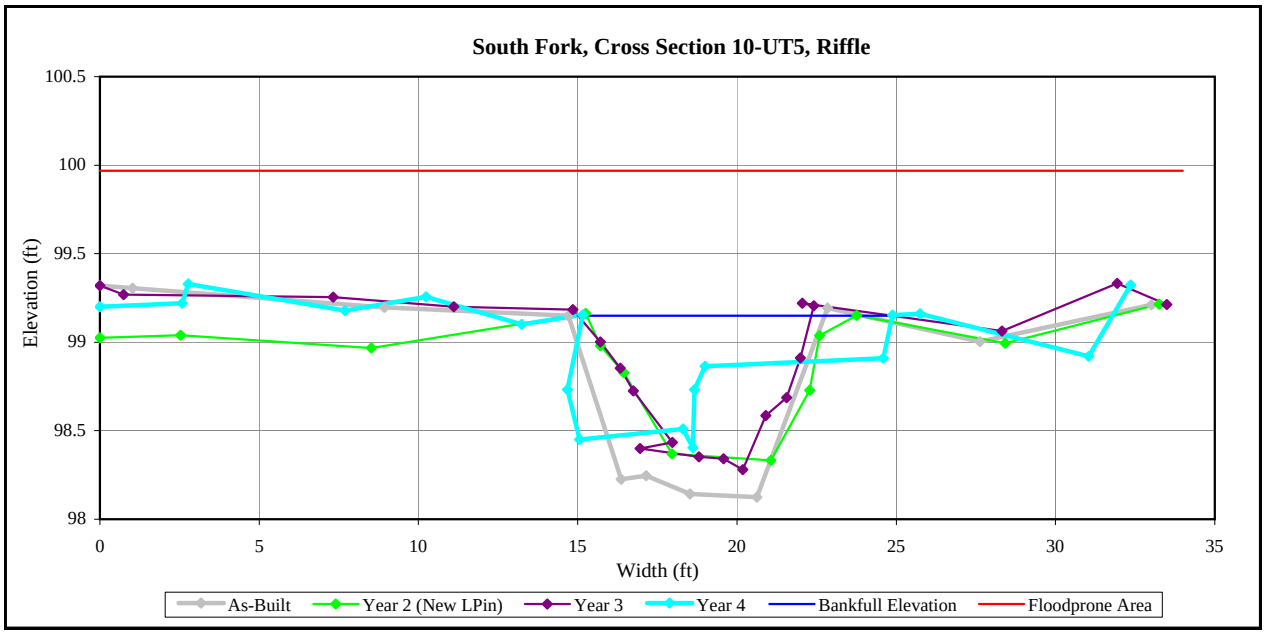
Looking at the left bank.

Looking at the right bank.



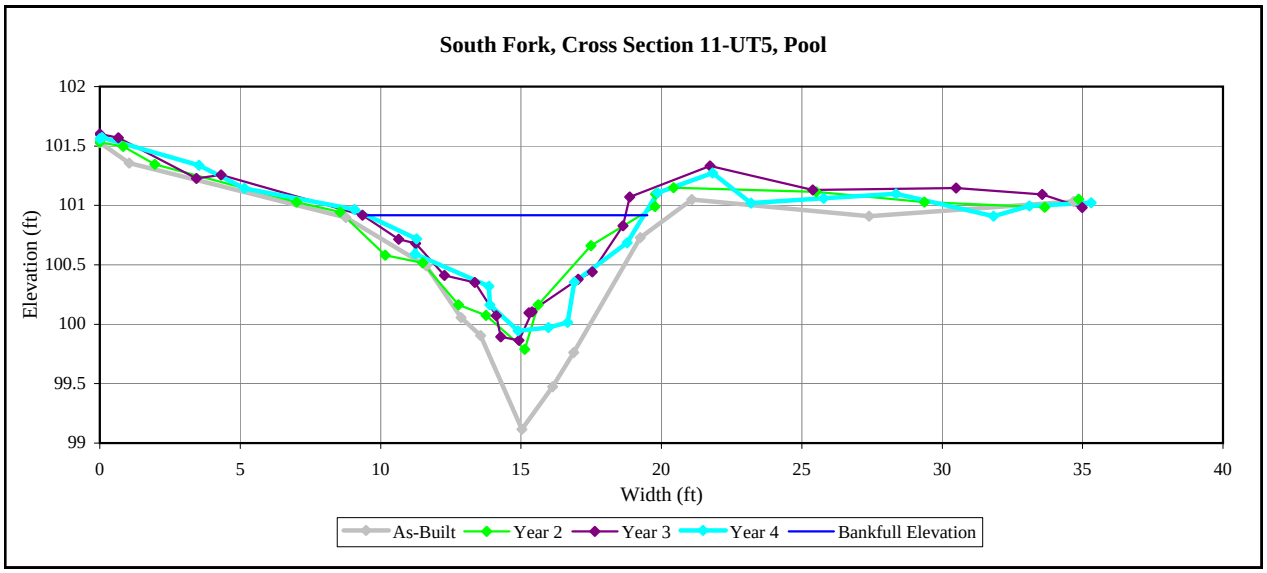
Looking at the left bank.

Looking at the right bank.

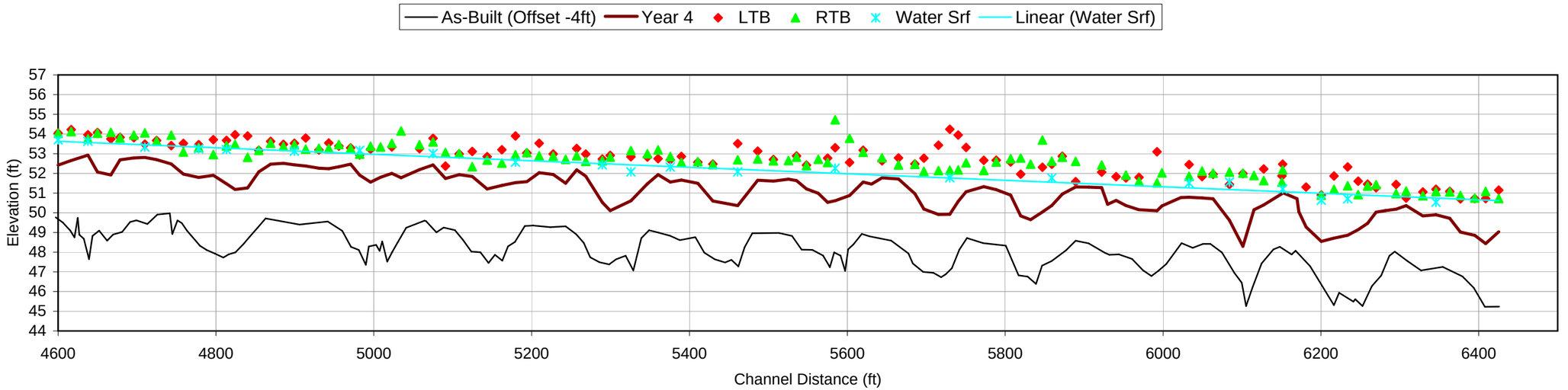


Looking at the left bank.

Looking at the right bank.

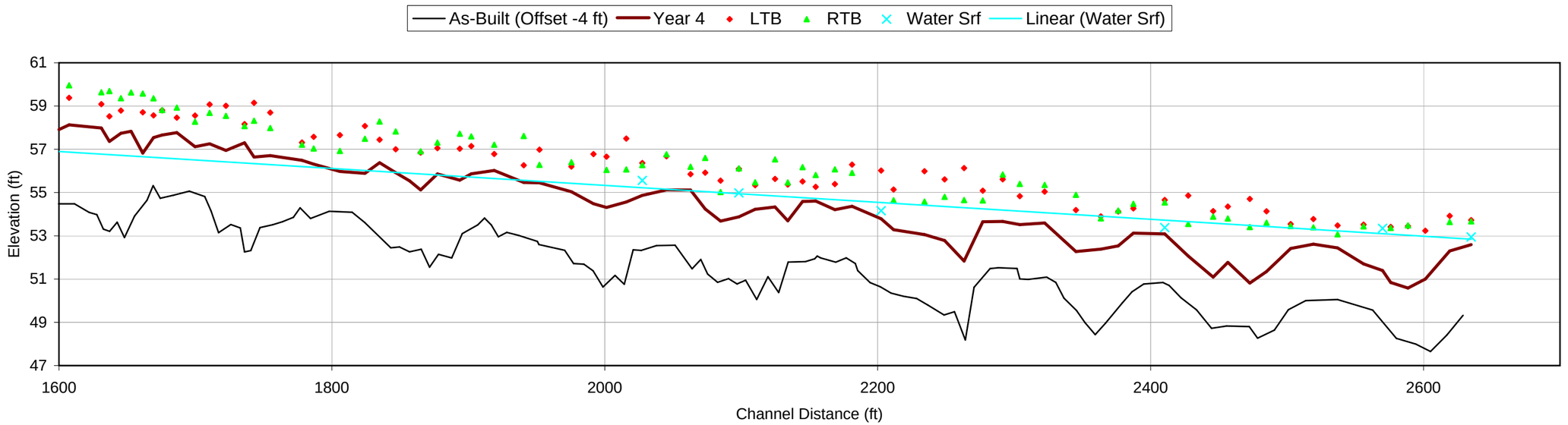


South Fork
UT1B & M1 46+00 to 64+25

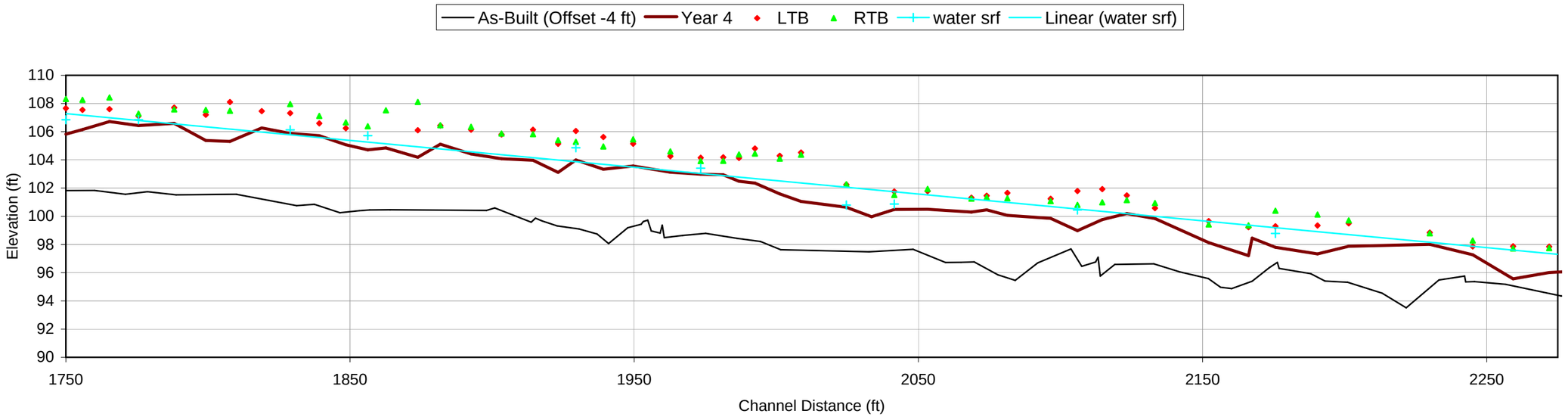


Channel Distance (ft)

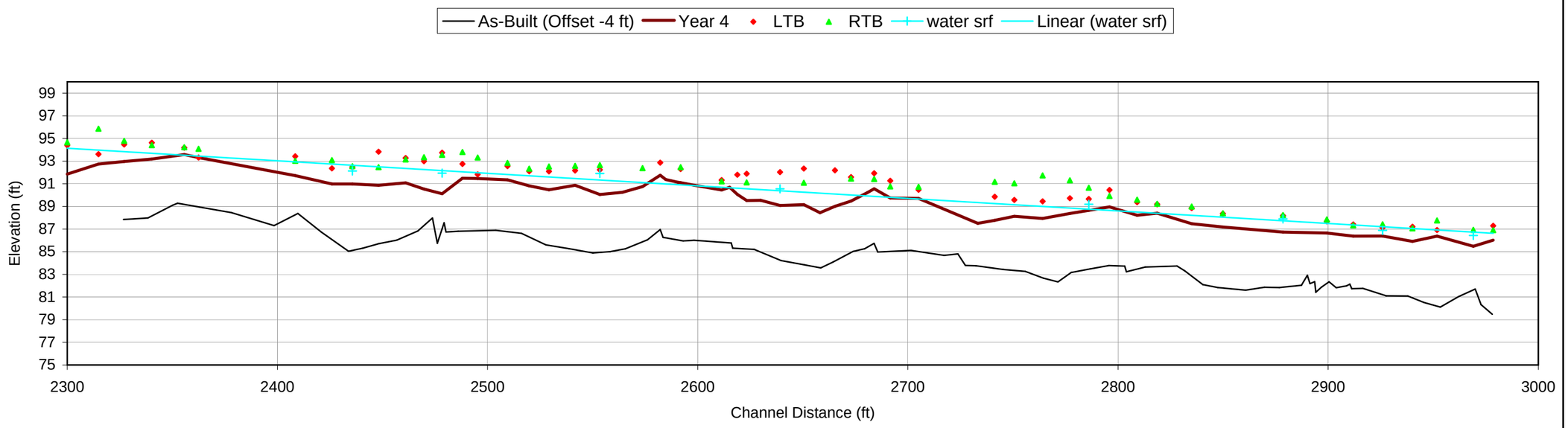
South Fork
UT2A 16+00 to 26+00



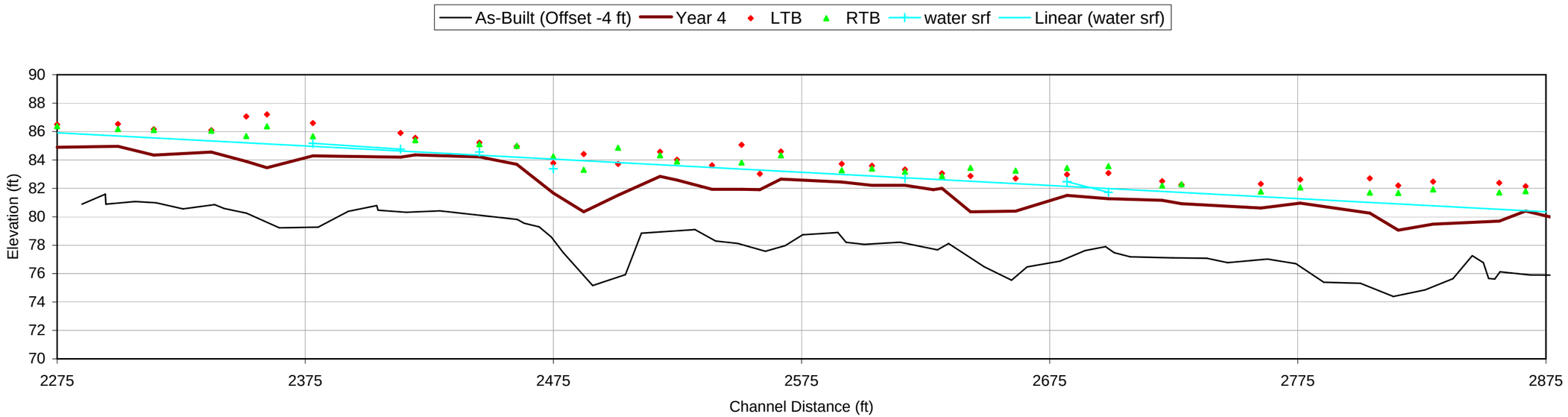
South Fork
UT4 17+50 to 22+75



South Fork
UT5 23+00 to 29+62



South Fork
M2 22+75 to 28+75



APPENDIX C

2008 Site Photos

Stream Photos

UT1A station 10+00. Wrack in fence.

UT1A station 13+00. Small debris jam.

UT1A station 14+80. Slump on right bank.

UT1A station 19+00. Typical bank erosion.

UT1A station 33+00. Debris jam and right bank erosion.

UT1B station 37+60. End cut on right bank at grade control structure.

UT1B station 58+40. Unstable root wad.

UT1B station 60+00. Unstable root wad.

UT2A station 17+60. Left bank erosion.

UT2A station 18+90. Rock cross vane header perched.

UT2A station 21+60. Constructed riffle header perched.

M2 station 38+20. Erosion/settling on right bank.

Vegetation Photos

Vegetation Plot 1.

Vegetation Plot 2.

Vegetation Plot 3.

Vegetation Plot 4.

Vegetation Plot 5.

Vegetation Plot 6.

Vegetation Plot 7.