

CONOCONNARA STREAM AND WETLAND
MITIGATION PROJECT
HALIFAX COUNTY, NORTH CAROLINA

AS-BUILT REPORT



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CONOCONNARA STREAM AND WETLAND MITIGATION PROJECT AS-BUILT REPORT

PROJECT DESCRIPTION

The Conoconnara Stream and Wetland Mitigation Project is in Halifax County, North Carolina. Stream mitigation was provided through restoration on Looking Glass Run. Non-riverine wetland mitigation was provided through preservation, enhancement, and restoration. The site was identified and developed by EBX to support the NC EEP full delivery mitigation process. The objective of this project is to provide 5,000 stream mitigation units (SMU) and 87 wetland mitigation units (WMU) to the EEP through the full delivery process in the Roanoke River 03010107 hydrologic unit.

This documents the stream and wetland mitigation activities at the Conoconnara site. The report includes plan views, elevations, cross sections, and photographs of completed mitigation activities. The report also includes a list of the species planted and the associated densities and the five-year monitoring protocol.

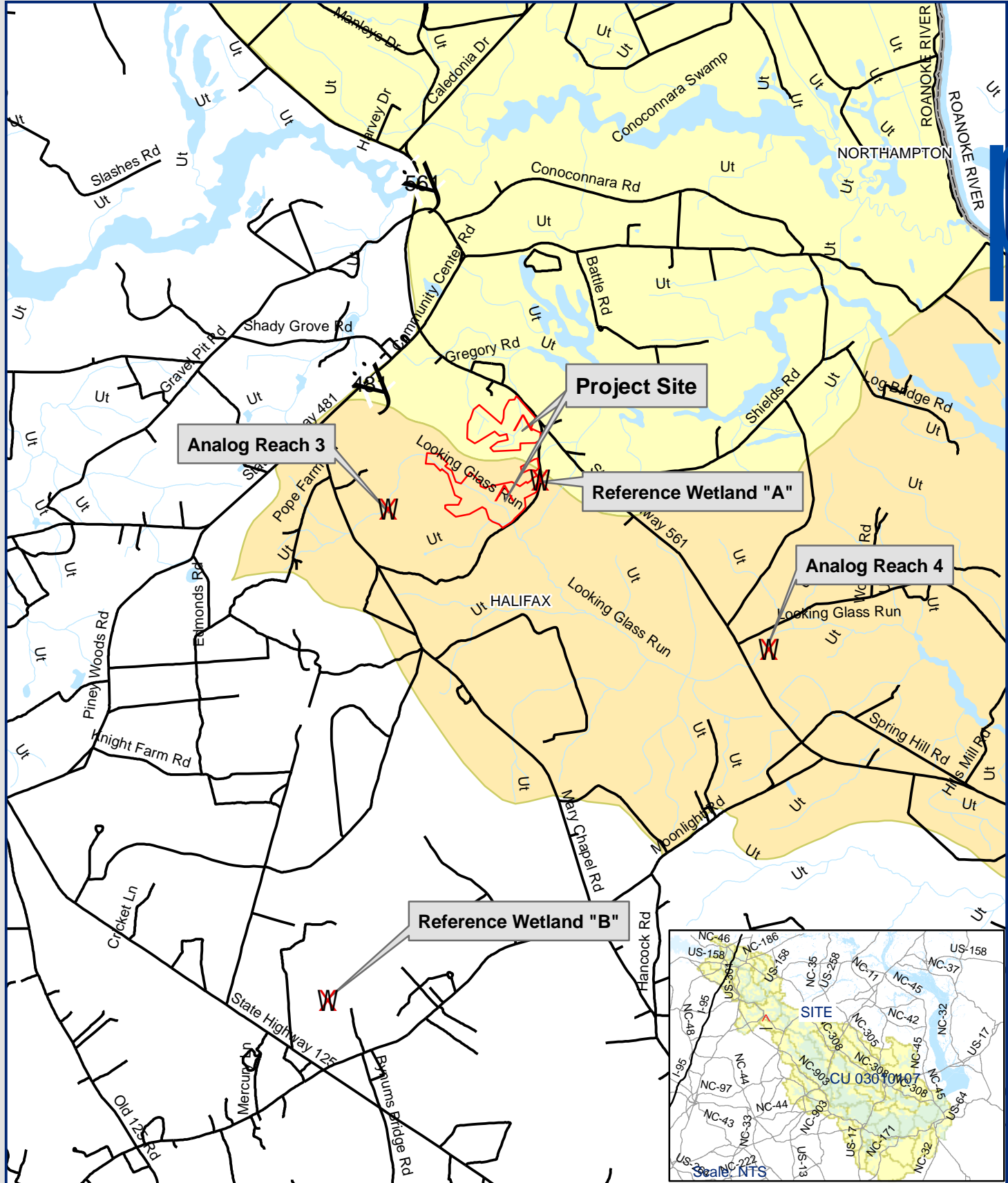
PROJECT SITE

The Conoconnara site is located just outside of Tillery, approximately seventeen miles southeast of Roanoke Rapids (Figure 1). The property is 567 acres located immediately south of NC 561 and is accessed via a farm road 1.1 miles east of Tillery.

Looking Glass Run has a drainage area of 562 acres (0.88 mi²) at the downstream end of the restoration project. The wetland mitigation is divided between four distinct sites. These include restoration areas in prior-converted cropland, one enhancement area in the Looking Glass Run headwaters, and one preservation area adjacent to the stream restoration corridor. The 63.64 acre wetland restoration area has a drainage area of 130 acres (0.20 mi²). The 5.36 acre wetland restoration area has a drainage area of 13.73 acres (0.02 mi²). The dominant historic land use was agricultural production of cotton and soybeans, pine plantation, and woodland. Local drainage patterns had been altered in the past to drain wetlands and promote agricultural production. The USGS Scotland Neck, NC topographic quadrangle (Figure 2) shows that drainage from the site flows in two directions. The northern portion of the site flows primarily to Conoconnara Swamp, while the southern portion of the site drains to Looking Glass Run. There were numerous agricultural ditches and swales on the project property that were used to promote drainage. The ditches and swales were constructed to route water off the site, draining areas that were once wetland. On-site topography, soils, and existing wetland areas demonstrate that the site historically supported both riverine and non-riverine wetland areas. The restoration and preservation areas are protected by a conservation easement.

MITIGATION SUMMARY

The objective of this project is to produce a minimum of 5,000 stream mitigation units (SMU), 87 non-riverine wetland mitigation units (WMU), and maximize the improvement of riparian and aquatic habitats and water quality through ecological restoration and preservation practices. The as-built survey documented 5,050 linear feet of stream restoration. The wetland and stream restoration project will provide multiple ecological and water quality benefits within the Roanoke River Basin. Benefits include nutrient removal, sediment reduction, water storage, improved groundwater recharge, enhanced in-stream habitat, and enhanced and restored wetland habitat.



Analog Reach 3

Project Site

Reference Wetland "A"

Analog Reach 4

Reference Wetland "B"

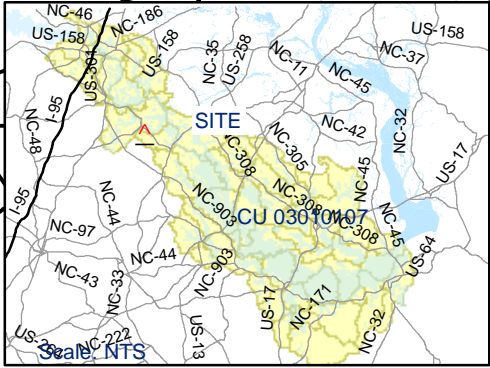
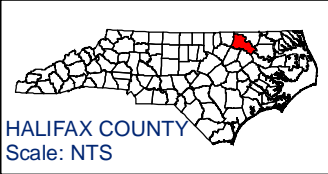


Figure 1.
Site Location Map
Conoconarra

SOURCES: NCDOT, NRCS, USGS
0 0.25 0.5 1 1.5 2 Miles

LEGEND

- Road
- Existing Waterbody
- HUC 03010107090020
- HUC 03010107090030



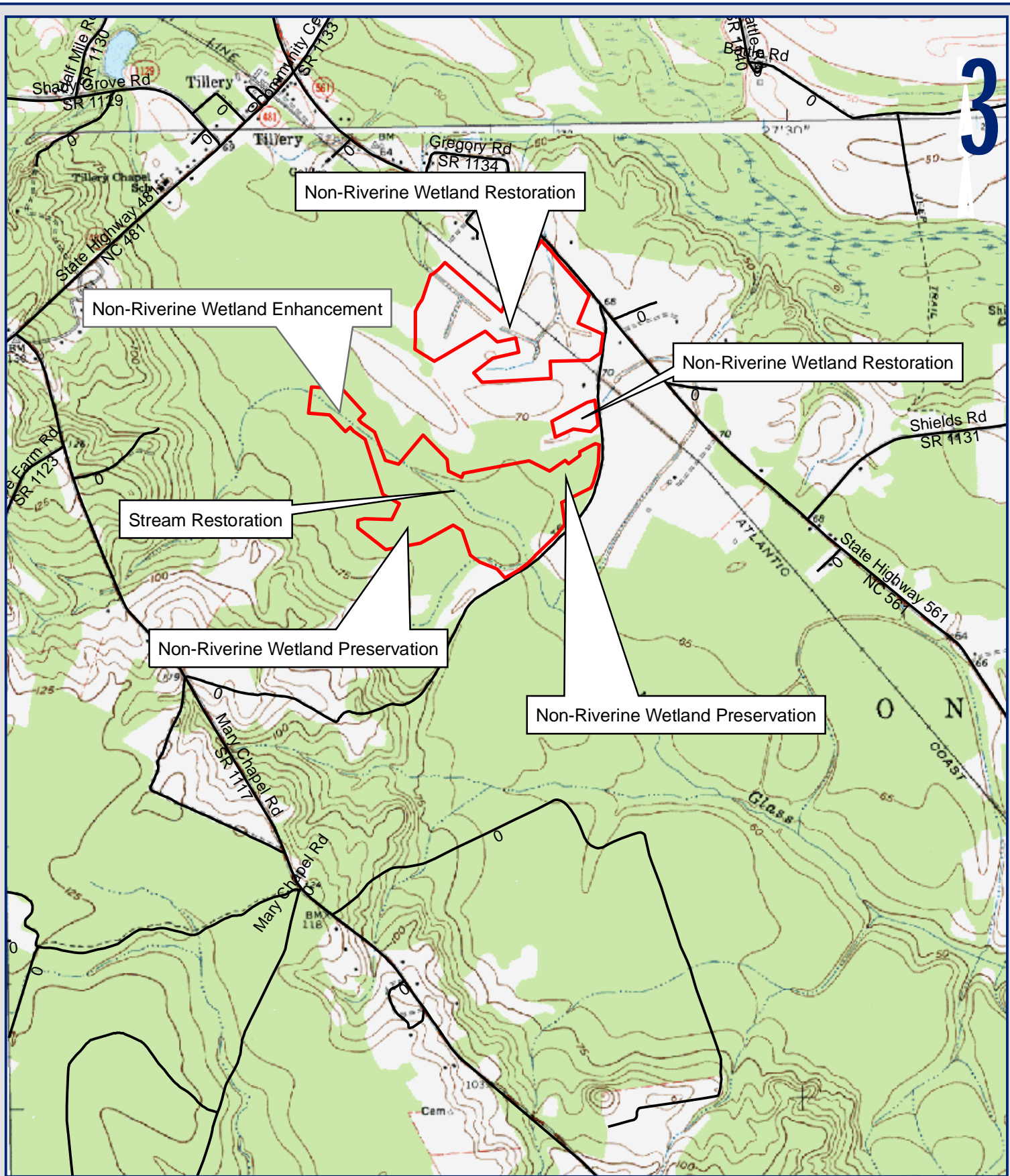


Figure 2.
 USGS Quad Map
 Conoconnara, Halifax County, NC
 0 500 1,000 2,000 3,000 4,000
 Feet

LEGEND
 — Conservation Easement
 — Road
 — Stream
 SOURCES: USGS, Scotland Neck, NC, Quadrangle, 1962
 Dawson Crossroads, NC, Quadrangle, 1960

Table 1. Conoconnara Mitigation Summary			
MITIGATION PRACTICE	SIZE	RATIO	MITIGATION UNITS
Wetland			
Non-riverine wetland preservation	71 ac	1:5	14
Non-riverine wetland enhancement	8 ac	1:2	4
Non-riverine wetland restoration	69 ac	1:1	69
Total:			87 WMU's
Stream			
Stream Restoration (Looking Glass Run)	5,050 lf	1:1	5,050
Total:			5,050 SMU's

WETLAND CONSTRUCTION

Wetland construction began September 25, 2006 and was completed January 24, 2007.

The primary wetland restoration activity was construction of ditch plugs throughout the prior-converted areas. A typical ditch plug is 15 feet wide and extends above the top of the ditch bank approximately 6 inches. Plugs were constructed of compacted fill (clay or sandy clay). At the point of departure from the conservation easement, a ditch plug with a Pyramat geotextile-lined spillway was constructed to protect against erosion during high-flow events.

An abandoned railroad bed that bisected the main restoration site was removed and the adjacent ditches filled to create a seamless transition between the northern and southern portions of the wetland restoration site. Also, the overhead power line adjacent to the railroad bed was rerouted to the north of the conservation easement (along NC 561) to allow a full conversion to wet hardwood forest. All farm paths within the easement were removed and planted.

As part of the restoration effort 54 shallow depressions were excavated on the upper elevations of the restoration area (outside of the immediate vicinity of the ditches). These depressions are typically 80 feet long, 40 feet wide, 0.8 feet deep, and are roughly elliptically shaped. These depressions replicate those found in the reference wetlands and were constructed with slight irregularities for a diversity of habitat. During construction of the depressions the surface soil horizon (upper eight inches) was removed and stockpiled, then replaced following excavation of the subsoil. In addition several raptor poles were installed to provide opportunities for raptor perching and predation on rodents.

Locations of pertinent wetland restoration structures and elevations are given in the As-Built drawings in Appendix C.

Prior to construction the wetland enhancement area was a disturbed scrub-shrub community dominated by invasive early successional facultative species. Enhancement activities included clearing the standing vegetation at ground level. Stumps were left in place to provide soil stabilization and organic matter. The wetland enhancement will improve wildlife habitat by providing mast producing species and enhance water quality functions. Invasive species will be monitored and subsequent invasive species control will be undertaken as needed.

WETLAND PLANTING

All wetland vegetation was planted at the site during the March 18-26, 2007 time period. A combination of container grown and bare root native tree and shrub species were planted to establish a forested non-riverine wetland. The plants were selected to establish vertical habitat structure and a diverse mix of species upon maturation. The planted area consists of two zones.

Zone 1 is a wetter zone where inundated and saturated conditions will be typical. Zone 2 is a zone where saturation will be common but drier periods will also likely occur. The initial stocking density of plantings across the wetland sites was approximately 544 stems per acre (8 ft. X 10 ft. spacing). A list of all species planted and their percent composition is included in Table 2. All disturbed areas were seeded with an appropriate seasonal temporary seed mix to provide erosion control.

Table 2. Baseline wetland planted trees and shrubs.

COMMON NAME	SCIENTIFIC NAME	ZONE	TOTAL PLANTED	TREES/ACRE	PERCENT COMPOSITION
Pawpaw	<i>Asimina triloba</i>	2	1,900	44	8
River birch	<i>Betula nigra</i>	2	2,004	49	9
Musclewood	<i>Carpinus caroliniana</i>	1	3,000	49	9
Green ash	<i>Fraxinus pennsylvanica</i>	1	4,200	71	13
		2	1,980	49	9
Yellow poplar	<i>Liriodendron tulipifera</i>	2	3,850	92	17
Water tupelo	<i>Nyssa aquatica</i>	1	4,175	71	13
Swamp blackgum	<i>Nyssa biflora</i>	1	4,240	71	13
Blackgum	<i>Nyssa sylvatica</i>	2	2,100	49	9
Sycamore	<i>Platanus occidentalis</i>	1	4,200	71	13
Laurel oak	<i>Quercus laurifolia</i>	1	800	11	2
Swamp chestnut oak	<i>Quercus michauxii</i>	1	2,000	33	6
		2	800	22	4
Water oak	<i>Quercus nigra</i>	1	3,920	65	12
		2	1,440	33	6
Cherrybark oak	<i>Quercus pagodafolia</i>	2	2,800	65	12
Willow oak	<i>Quercus phellos</i>	1	2,040	33	6
		2	2,140	49	9
Bald cypress	<i>Taxodium distichum</i>	1	4,220	71	13
American elm	<i>Ulmus americana</i>	2	3,650	87	16
Total:			55,459		

STREAM CONSTRUCTION

Stream construction began September 25, 2006 and was completed January 24, 2007. The channel construction established stable cross-sectional geometry, restored planform sinuosity, and increased in-stream pools and other streambed diversity to improve benthic habitat. The total restored length is 5,050 linear feet.

To begin construction, a survey crew staked out the new channel alignment. Two construction access routes were designated to access the work area from established farm roads. A pump-around system was used so that the new channels were constructed in the dry. Material for root wads, log veins, and log toes was obtained on site and stockpiled. An excavator with a hydraulic thumb was used to construct the new channel and install the structures. Channel construction and structure installation were completed sequentially in sections. The existing stream was typically filled with material excavated from the new channel and floodplain areas. Native material revetments were installed as needed to reduce bank stress, provide grade control, and increase habitat diversity.

Analog natural channel design techniques were used to develop the restoration design. Two analog channel types were used in the design, a single-thread channel near the design reach and

a multiple-thread reach downstream of the project site on Looking Glass Run. The multi-thread channel is similar to those observed throughout the bottomlands of the North Carolina Coastal Plain.

RIPARIAN PLANTING

All riparian vegetation was planted at the site in March 18-26, 2007 after stream construction was complete. Container grown trees and bare root native tree and shrub species were planted to establish forested riparian buffers of approximately fifty feet on both sides of the restored stream and other disturbed areas. The plants were selected to establish vertical habitat structure and a diverse mix of species. The planted area consists of two zones. Zone 3 is located along Reach 1 and Reach 2 and is subject to periodic flooding and also dry conditions. Zone 4 is located along Reach 3 and is more prone to prolonged flooding and saturation. Both zones are within riverine wetlands. The initial stocking of riparian plantings across the site was approximately 544 stems per acre. A list of all species planted and their percent composition is included in Table 3. In addition to the riparian plantings, 2,893 black willow (*Salix nigra*) live stakes were installed on the outside of stream meander bends along the entire restoration length. Sod mats of existing riparian vegetation were placed on the stream banks where available (primarily Reach 1 and Reach 3).

Table 3. Baseline riparian planted trees and shrubs.					
COMMON NAME	SCIENTIFIC NAME	ZONE	TOTAL PLANTED	TREES/ACRE	PERCENT COMPOSITION
River birch	<i>Betula nigra</i>	3	950	49	9
		4	600	98	18
Carolina Ash	<i>Fraxinus caroliniana</i>	3	1,750	87	16
		4	650	103	19
Green Ash	<i>Fraxinus pennsylvanica</i>	3	1,975	98	18
Water Tupelo	<i>Nyssa aquatica</i>	4	679	109	20
Swamp blackgum	<i>Nyssa biflora</i>	3	510	27	5
		4	150	22	4
Sycamore	<i>Platanus occidentalis</i>	3	1,500	76	14
Laurel oak	<i>Quercus laurifolia</i>	4	300	49	9
Overcup Oak	<i>Quercus lyrata</i>	3	1,050	54	10
		4	550	87	16
Water oak	<i>Quercus nigra</i>	3	1,184	60	11
		4	156	27	5
Willow oak	<i>Quercus phellos</i>	3	1,520	76	14
Bald Cypress	<i>Taxodium distichum</i>	3	555	27	5
		4	325	54	10
		Total:	14,404		

COMMENTS AND OBSERVATIONS

Construction progressed steadily throughout the fall and winter and was completed on time. The vast majority of the project was built according to the design plans. Minor alterations to horizontal structure placement did occur and were approved by EBX and its engineer WK Dickson and company. In the wetland restoration area two ditch plugs were added to provide additional hydrologic storage.

The final design plans described 5,073 linear feet of stream restoration. The as-built survey documented construction of 5,050 linear feet of restored stream. Comparison of final design

plans with the as-built survey shows several locations where the constructed channel deviates slightly from the design. The deviations are very slight and impossible to identify on the ground.

The early construction period was marked by several large rain events and persistent rain throughout October and November. No channel stability problems were observed as a result of these rain events. Reach 3 was frequently inundated and water had to be pumped out of the Reach 3 area to allow for construction.

MONITORING SET-UP

The five-year monitoring plan for the Conoconnara Stream and Wetland Mitigation Project includes monitoring criteria for wetland hydrology, wetland vegetation, stream channel stability, stream hydrology, riparian vegetation, and rainfall. Shortly after completion of construction and planting, an as-built survey was conducted. Following completion of the as-built survey, the monitoring program set-up was completed. This task included installation of 15 groundwater gauges (three in a reference wetland), establishment of 10 semi-permanent stream cross sections, installation of two crest gages and establishment of 24 vegetation monitoring plots. Specific locations of vegetation plots, permanent cross sections, and crest gages are shown on the as-built drawings (Appendix C). Photos were taken to document as-built appearance of the cross sections and vegetation plots throughout the project (Appendix A and Appendix B).

WETLAND HYDROLOGY

Successful establishment of wetland hydrology will be demonstrated by a wetland hydroperiod in excess of seven percent of one growing season at each groundwater gauge location. Twelve groundwater gauges have been installed across the restoration areas to provide representative hydrologic data across the site. The gauge data will be compared to contemporaneous reference wetland well data in growing seasons with less than normal rainfall. Three reference gauges are located in the on-site wetland preservation area.

In periods of abnormally low rainfall, if a restoration gauge hydroperiod exceeds the reference gauge hydroperiod and both exceed five percent of the growing season, then the wetland area represented by that gauge will be deemed successful.

If a gauge location fails to meet these success criteria in the five year monitoring period then monitoring may be extended, remedial actions may be undertaken, or groundwater modeling may be used to demonstrate the limits of wetland hydrology restoration.

WETLAND VEGETATION

Eighteen semi-permanent vegetation sampling plots were established within the wetland restoration area and one plot was established within the wetland enhancement area to monitor the success of planted vegetation. The wetland vegetation plots are 0.10 acres in size. The vegetation plots are distributed across the site but the precise location and orientation of the plots was random (see locations on as-built drawings in Appendix C). The plots cover approximately 2 percent of the restored site. Each planted woody stem is located with a three-foot high section of white PVC pipe and identified with a permanent number. Total planted trees are summarized in Table 4.

PLOT	TREES OBSERVED	STOCKING LEVEL (PER ACRE)
1	58	580
2	54	540
3	45	450
4	55	550
5	55	550
6	54	540
7	61	610
8	56	560
9	79	790
10	65	650
11	60	600
12	59	590
13	54	540
14	55	550
15	54	540
16	56	560
17	53	530
18	62	620
19	65	650
	Average	579

Planted woody species will be monitored twice per year each year for the first three years and annually in monitoring years four and five. Herbaceous plant cover will be assessed annually using the notched-boot method and qualitative observations.

Successful establishment of wetland vegetation will be the survival of 260 planted trees per acre following five years of monitoring, with 320 planted trees per acre as an interim measure of success.

STREAM STABILITY

CROSS SECTIONS

The mitigation plan for the Conoconnara project requires 10 cross sections to be monitored on the restored channel. The cross sections were established during monitoring set-up in evenly distributed pairs of one shallow and one pool per 1,000 linear feet of restored stream. Locations of cross sections are specified on as-built drawings in Appendix C. The cross sections were surveyed during the as-built survey. The cross section surveys and photos are shown in Appendix B. Each cross section will be photographed and surveyed annually including measurements of floodplain, top of bank, bankfull, edges of water, and thalweg. In addition, any fluvial features present will be documented.

LONGITUDINAL PROFILE

Longitudinal profiles will be surveyed in years one, three, and five of the monitoring period. The length of the measured profile will be at least 3,000 linear feet. Features measured will include

thalweg, inverts of in-stream structures, water surface, bankfull and top of low bank. The longitudinal profiles presented in Appendix C were derived from the as-built survey data. Looking Glass Run is a sand bed channel and is expected to have a dynamic bed and profile.

HYDROLOGY

Two crest gauges were installed at the site: one near the upstream end of Reach 2 (STA 11+95) and one near the downstream end of Reach 3 (STA 48+46). Crest gauges will be checked monthly to document high flows. During the gauge inspections any high water marks will or debris lines observed will be documented and photographed.

RIPARIAN VEGETATION

Five semi-permanent vegetation sampling plots were established along stream restoration riparian buffer to monitor the success of planted vegetation. These include two 0.10 acre plots and four 0.05 acre plots. The vegetation plots were distributed across the site but the precise location and orientation of the plots was random (see locations on as-built drawings in Appendix C). The plots cover approximately 2 percent of the site. Each planted woody stem is located with a three-foot section of white PVC pipe and identified with a number. Total planted trees are summarized in Table 5.

PLOT	TREES OBSERVED	STOCKING LEVEL (PER ACRE)
20 (0.05 ac)	23	460
21 (0.05 ac)	41	820
22 (0.05 ac)	50	1,000
23 (0.05 ac)	48	960
24 (0.10 ac)	61	610
	Average	770

Planted woody species will be monitored twice per year each year for the first three years and annually in monitoring years four and five. Herbaceous plant cover will be assessed annually using the notched-boot method and qualitative observations.

Successful establishment of wetland vegetation will be the survival of 260 planted trees per acre following five years of monitoring, with 320 planted trees per acre as an interim measure of success.

Appendix A

As-Built Vegetation Plot Photos



Conoconnara Wetland Restoration Veg Plot 1



Conoconnara Wetland Restoration Veg Plot 2



Conoconnara Wetland Restoration Veg Plot 3



Conoconnara Wetland Restoration Veg Plot 4



Conoconnara Wetland Restoration Veg Plot 5



Conoconnara Wetland Restoration Veg Plot 6



Conoconnara Wetland Restoration Veg Plot 7



Conoconnara Wetland Restoration Veg Plot 8



Conoconnara Wetland Restoration Veg Plot 9



Conoconnara Wetland Restoration Veg Plot 10



Conoconnara Wetland Restoration Veg Plot 11



Conoconnara Wetland Restoration Veg Plot 12



Conoconnara Wetland Restoration Veg Plot 13



Conoconnara Wetland Restoration Veg Plot 14



Conoconnara Wetland Restoration Veg Plot 15



Conoconnara Wetland Restoration Veg Plot 16



Conoconnara Wetland Restoration Veg Plot 17



Conoconnara Wetland Restoration Veg Plot 18



Conoconnara Wetland Enhancement Veg Plot 19



Conoconnara Riparian Buffer Veg Plot 20



Conoconnara Riparian Buffer Veg Plot 21



Conoconnara Riparian Buffer Veg Plot 22



Conoconnara Riparian Buffer Veg Plot 23



Conoconnara Riparian Buffer Veg Plot 24



Conoconnara Stream Restoration STA 3+84 Upstream



Conoconnara Stream Restoration STA 3+84 Downstream



Conoconnara Stream Restoration STA 12+45 Upstream



Conoconnara Stream Restoration STA 12+45 Downstream



Conoconnara Stream Restoration STA 25+53 Upstream



Conoconnara Stream Restoration STA 25+53 Downstream



Conoconnara Stream Restoration STA 34+19 Upstream



Conoconnara Stream Restoration STA 34+19 Downstream



Conoconnara Stream Restoration STA 44+63 Upstream



Conoconnara Stream Restoration STA 44+63 Downstream

Appendix B

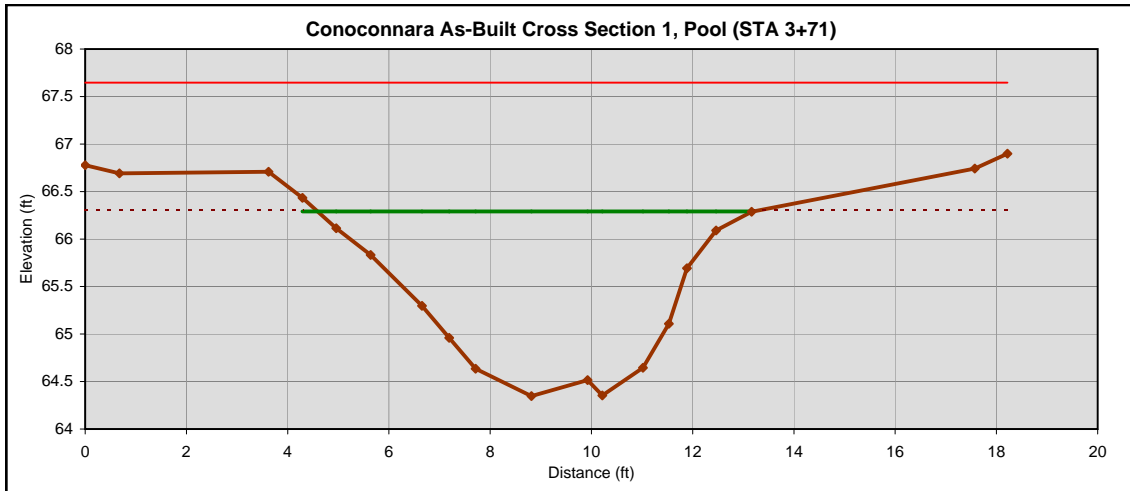
As-Built Cross Sections



Left bank



Right bank



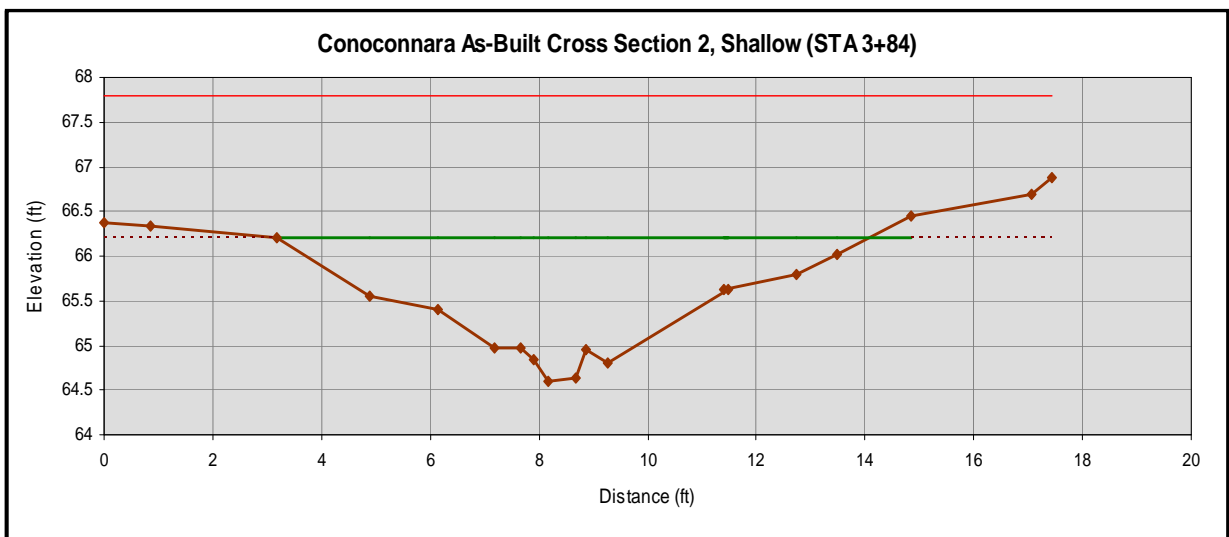
Bankfull Dimensions	
9.8	x-section area (ft.sq.)
8.6	width (ft)
1.1	mean depth (ft)
1.9	max depth (ft)
9.8	wetted perimeter (ft)
1.0	hyd radi (ft)
7.5	width-depth ratio



Left bank



Right bank



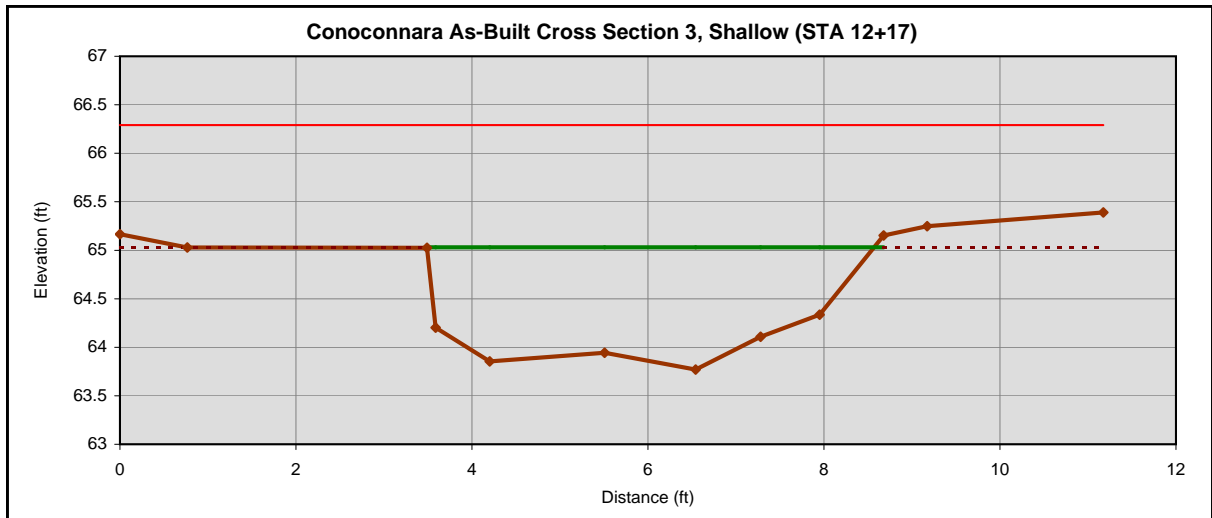
Bankfull Dimensions	
8.5	x-section area (ft.sq.)
10.9	width (ft)
0.8	mean depth (ft)
1.6	max depth (ft)
11.8	wetted parimeter (ft)
0.7	hyd radi (ft)
13.9	width-depth ratio



Left bank



Right bank



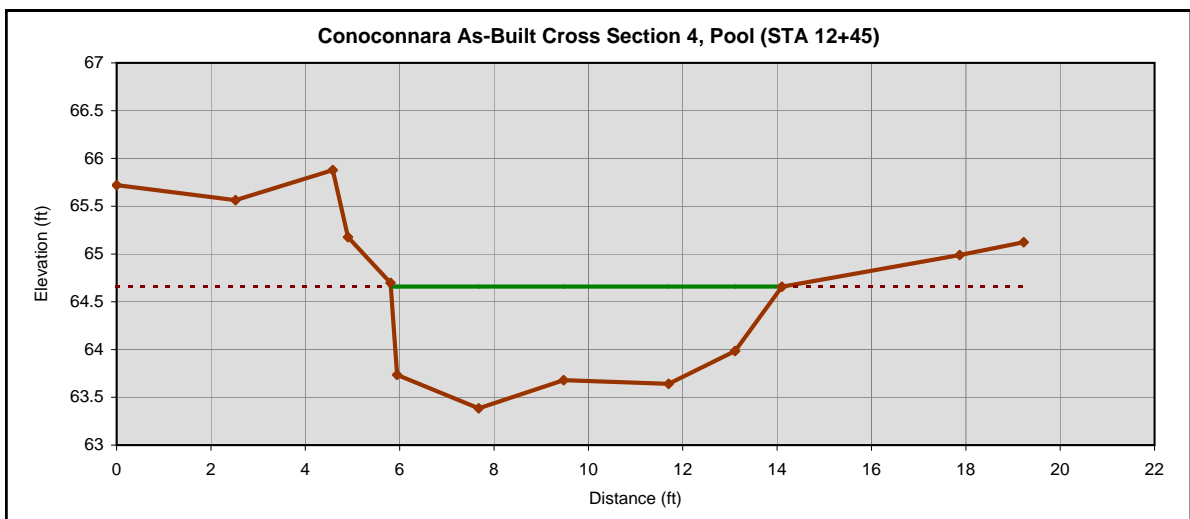
Bankfull Dimensions	
4.91	x-section area (ft.sq.)
5.08	width (ft)
0.97	mean depth (ft)
1.26	max depth (ft)
6.34	wetted parimeter (ft)
0.77	hyd radi (ft)
5.26	width-depth ratio



Left bank



Right bank



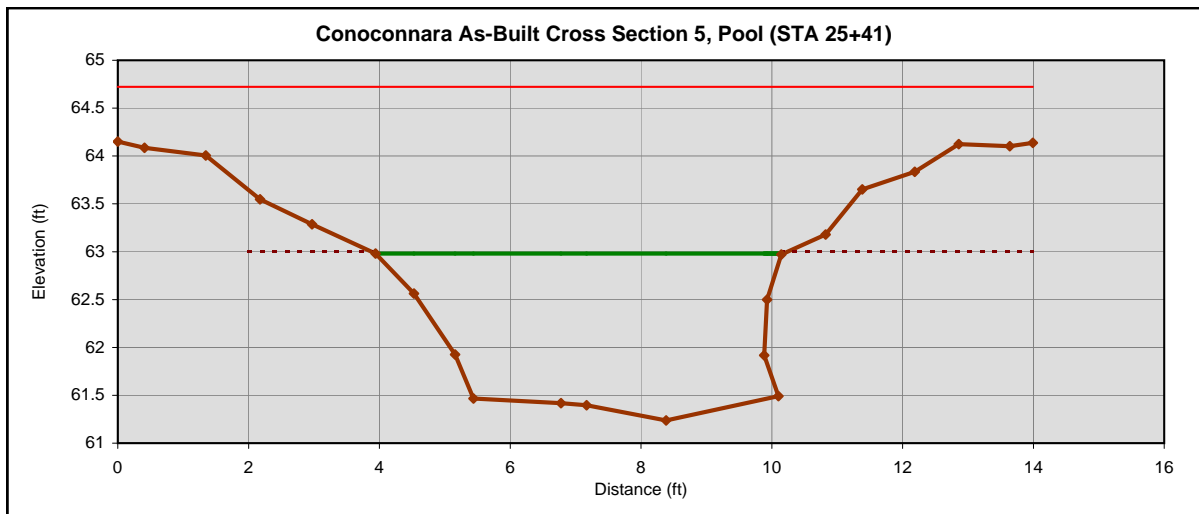
Bankfull Dimensions	
7.7	x-section area (ft.sq.)
8.3	width (ft)
0.9	mean depth (ft)
1.3	max depth (ft)
9.4	wetted parimeter (ft)
0.8	hyd radi (ft)
8.9	width-depth ratio



Left bank



Right bank



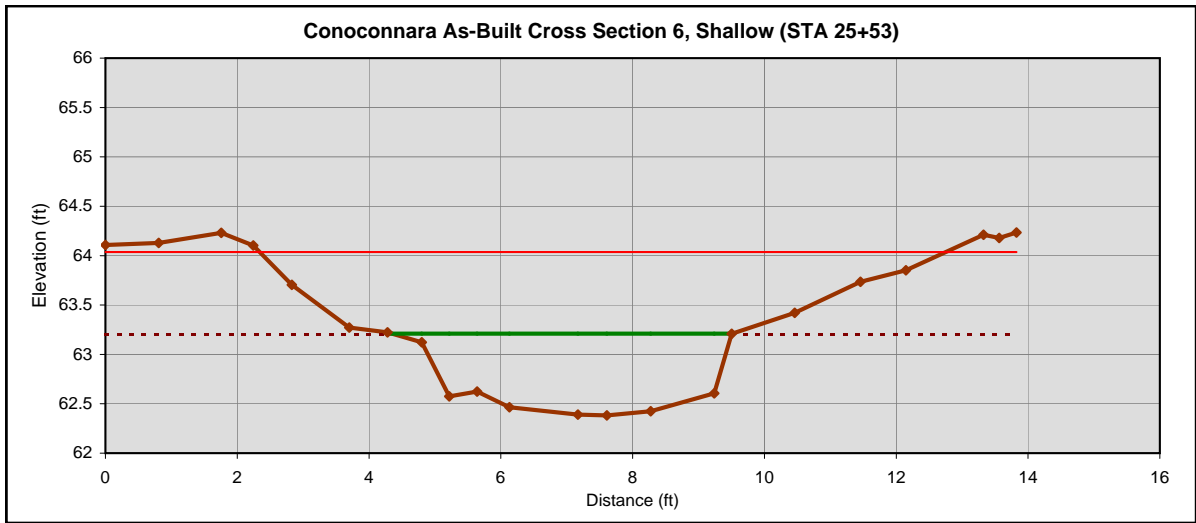
Bankfull Dimensions	
8.23	x-section area (ft.sq.)
6.20	width (ft)
1.33	mean depth (ft)
1.74	max depth (ft)
8.43	wetted parimeter (ft)
0.98	hyd radi (ft)
4.68	width-depth ratio



Left bank



Right bank



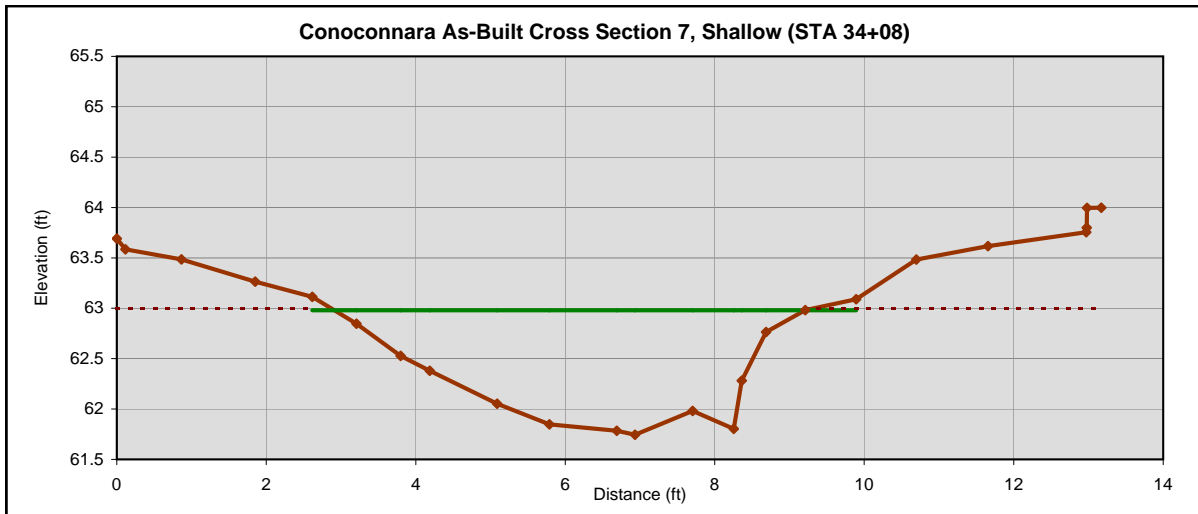
Bankfull Dimensions	
3.22	x-section area (ft.sq.)
5.16	width (ft)
0.62	mean depth (ft)
0.83	max depth (ft)
5.88	wetted parimeter (ft)
0.55	hyd radi (ft)
8.27	width-depth ratio



Left bank



Right bank



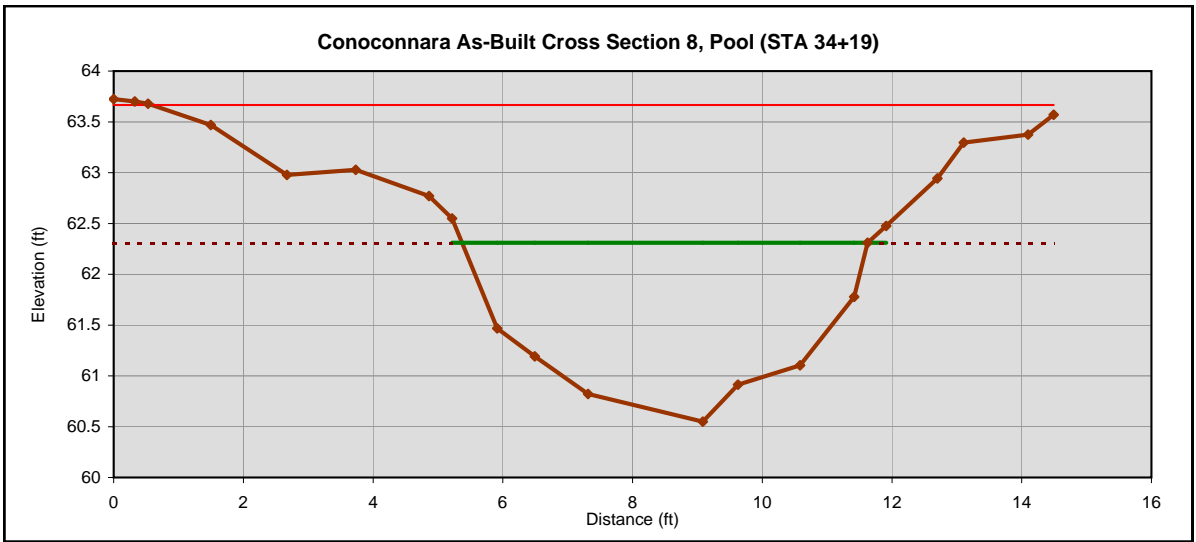
Bankfull Dimensions	
4.92	x-section area (ft.sq.)
6.30	width (ft)
0.78	mean depth (ft)
1.24	max depth (ft)
7.27	wetted parimeter (ft)
0.68	hyd radi (ft)
8.07	width-depth ratio



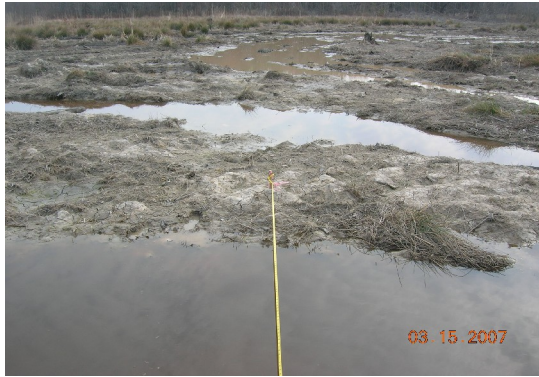
Left bank



Right bank



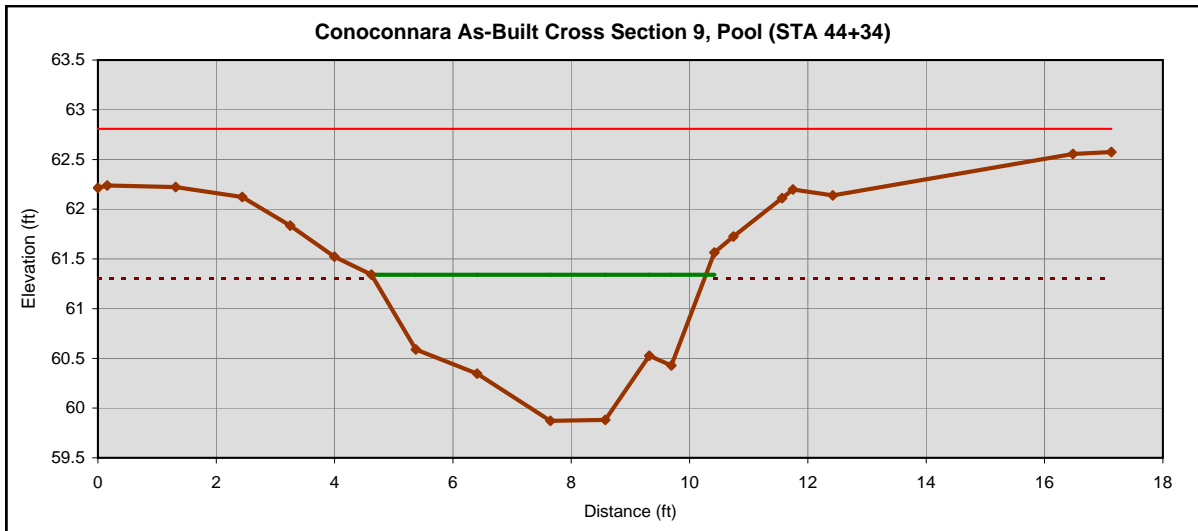
Bankfull Dimensions	
7.62	x-section area (ft.sq.)
6.25	width (ft)
1.22	mean depth (ft)
1.76	max depth (ft)
7.61	wetted parimeter (ft)
1.00	hyd radi (ft)
5.13	width-depth ratio



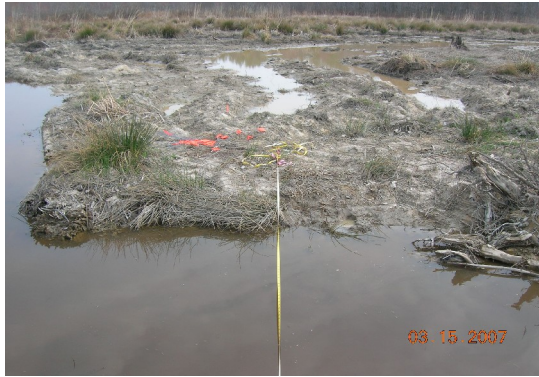
Left bank



Right bank



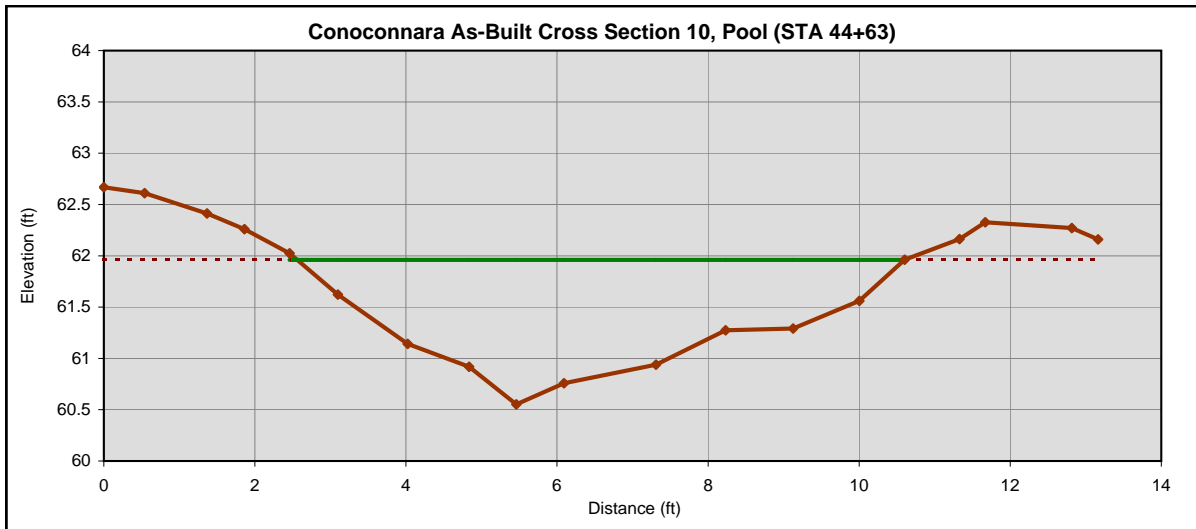
Bankfull Dimensions	
5.50	x-section area (ft.sq.)
5.65	width (ft)
0.97	mean depth (ft)
1.47	max depth (ft)
6.83	wetted parimeter (ft)
0.81	hyd radi (ft)
5.81	width-depth ratio



Left bank



Right bank



Bankfull Dimensions	
6.30	x-section area (ft.sq.)
8.04	width (ft)
0.78	mean depth (ft)
1.41	max depth (ft)
8.65	wetted parimeter (ft)
0.73	hyd radi (ft)
10.25	width-depth ratio

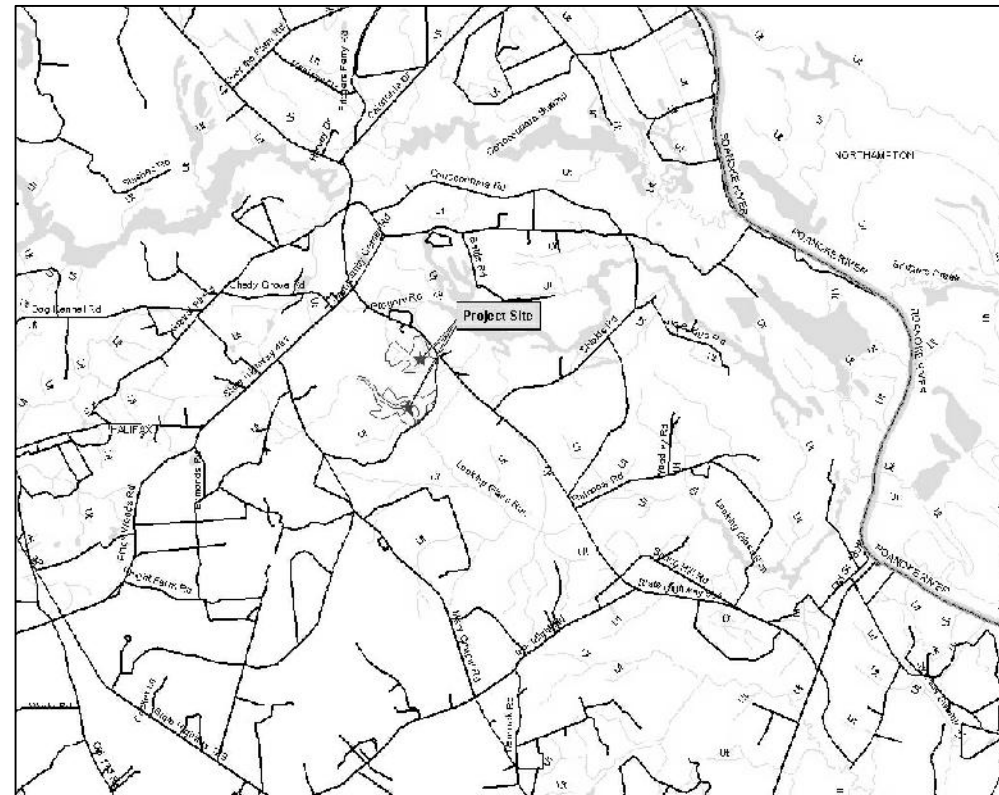
Appendix C

As-Built Plans

CONOCONNARA MITIGATION PROJECT

AS-BUILT PLANS

APRIL 2007



VICINITY MAP
NTS

ENVIRONMENTAL BANC & EXCHANGE, LLC

**MANAGERS, BANKERS AND TRADERS OF
ENVIRONMENTAL RIGHTS**

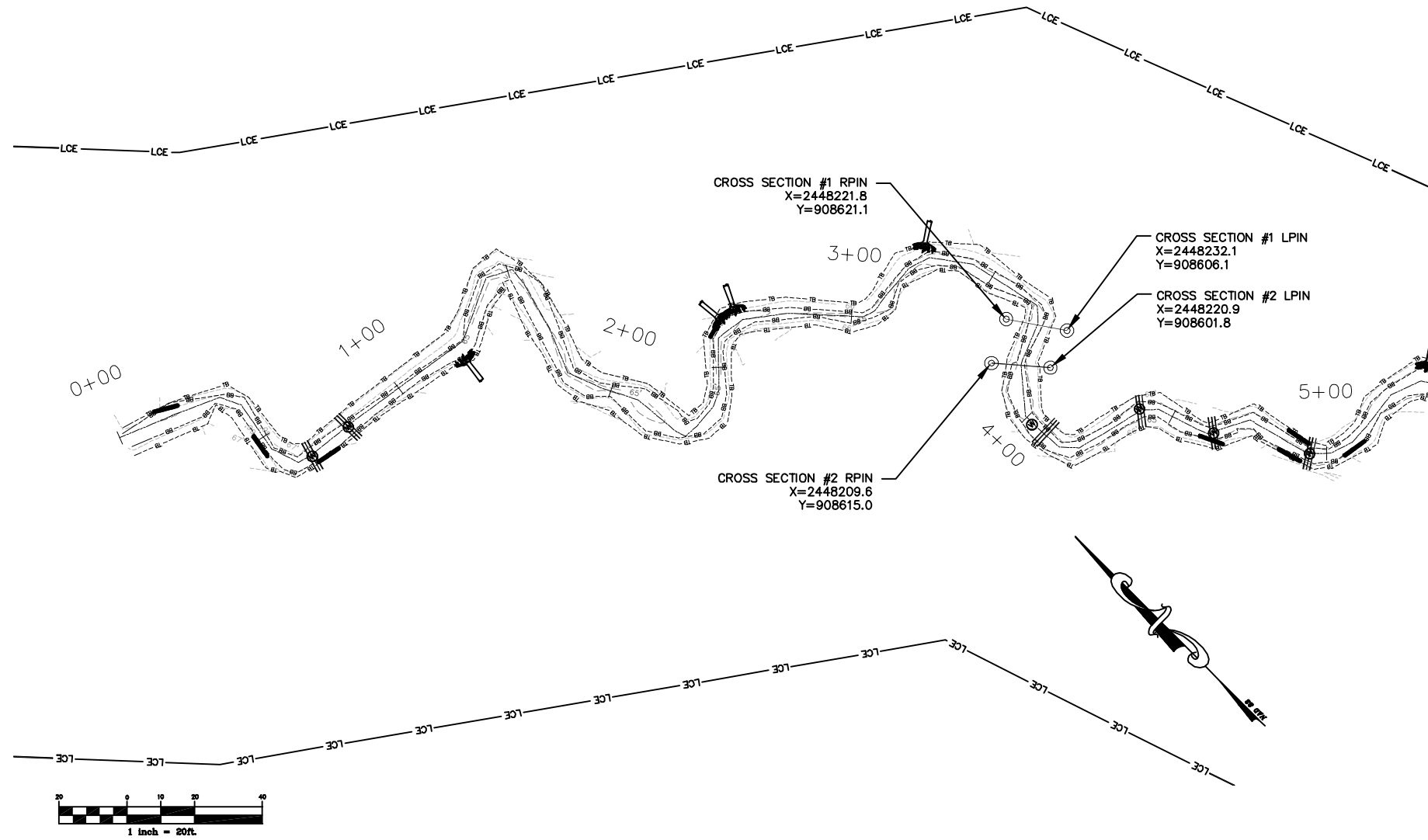
**2530 MERIDIAN PARKWAY SUITE 200
DURHAM, NC 27713
919-545-2929**



3101 JOHN HUMPHRIES WYND
RALEIGH, NC 27612
(919) 782-0495



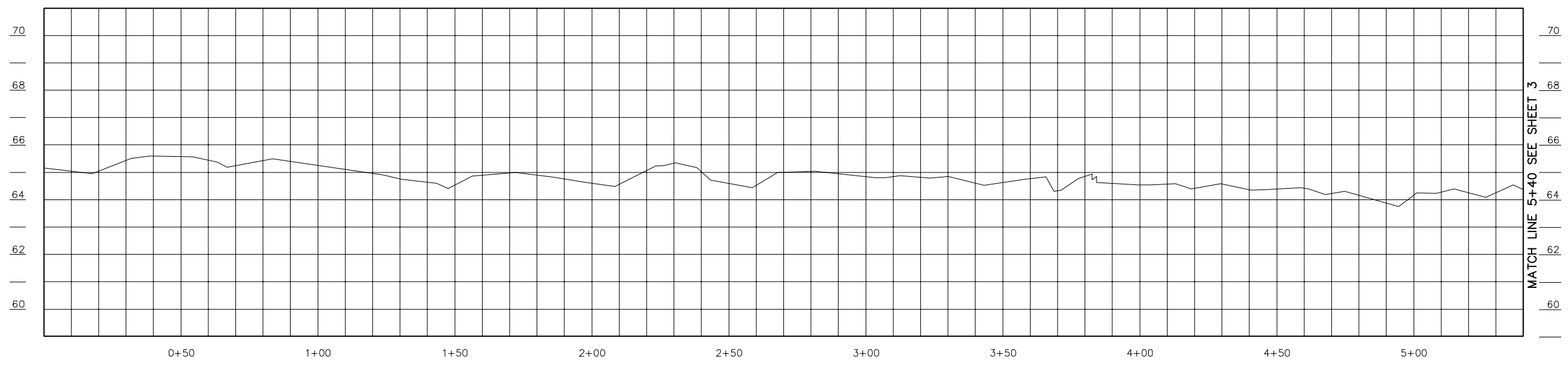
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MATCH LINE 5+40 SEE SHEET 3

LEGEND

BOTTOM OF BANK	-----
TOP OF BANK	-----
CONTOURS	-----
CENTER OF CHANNEL	-----
LIMITS OF CONSERVATION EASEMENT	-----
LOG RAMP	■
SMALL WOODY DEBRIS	⊙
CROSS SECTION	⊙
LOG GRADE CONTROL	
LOG TOE PROTECTION	▬
FORD CROSSING	▬
ROOT WAD	■



Horizontal Scale: 1 inch = 20ft.
Vertical Scale: 1 inch = 2ft.

NOTE:
Profile Alignment is Thalweg of As-Built Channel

MATCH LINE 5+40 SEE SHEET 3

I:\Projects\EBX\6002000RA\CADD\Swamp Restoration\Conoconnara Swamp Restoration\dwg\As-Built

REV. NO.	DESCRIPTION	DATE

PROJECT MANAGER DPI	DRAWING SCALE 1" = 20'
DRAWN BY TMS	PROJECT DATE 06/20/06
APPROVED BY MSE	PROJECT NUMBER 6002000RA
FILE NAME as-built.dwg	PLOT DATE 11/07/06

WK DICKSON
community infrastructure consultants

3101 JOHN HUMPHRIES WYND
RALEIGH, NC 27612
(919) 782-0495

Office Locations:
North Carolina
South Carolina
Georgia
Florida

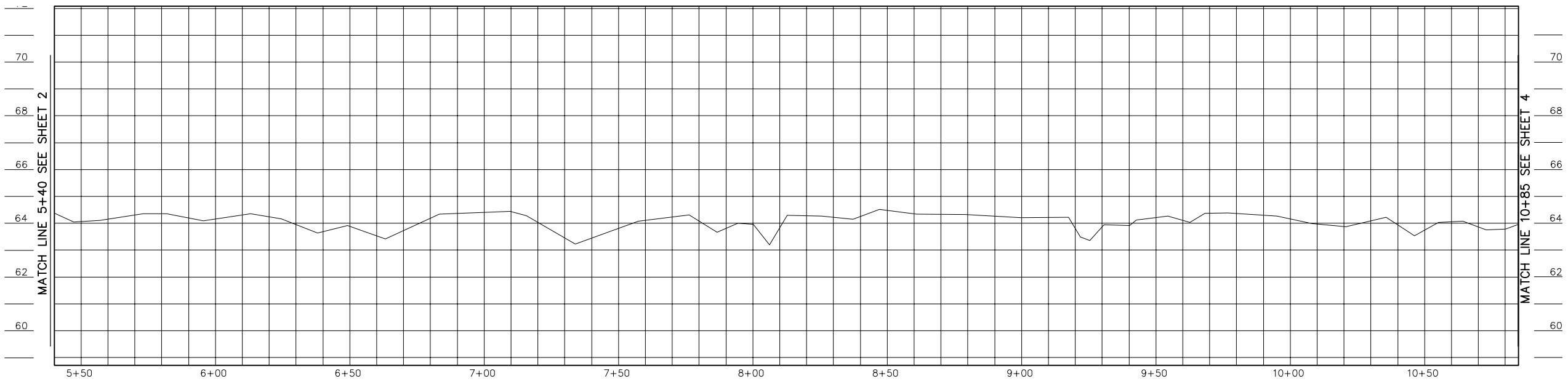
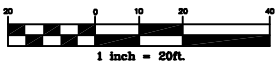
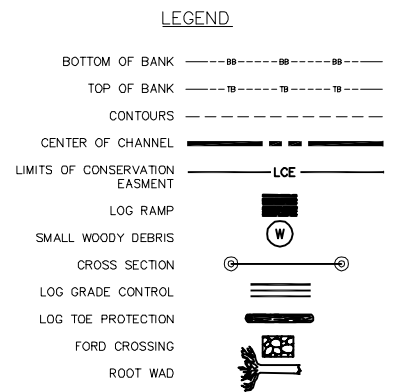
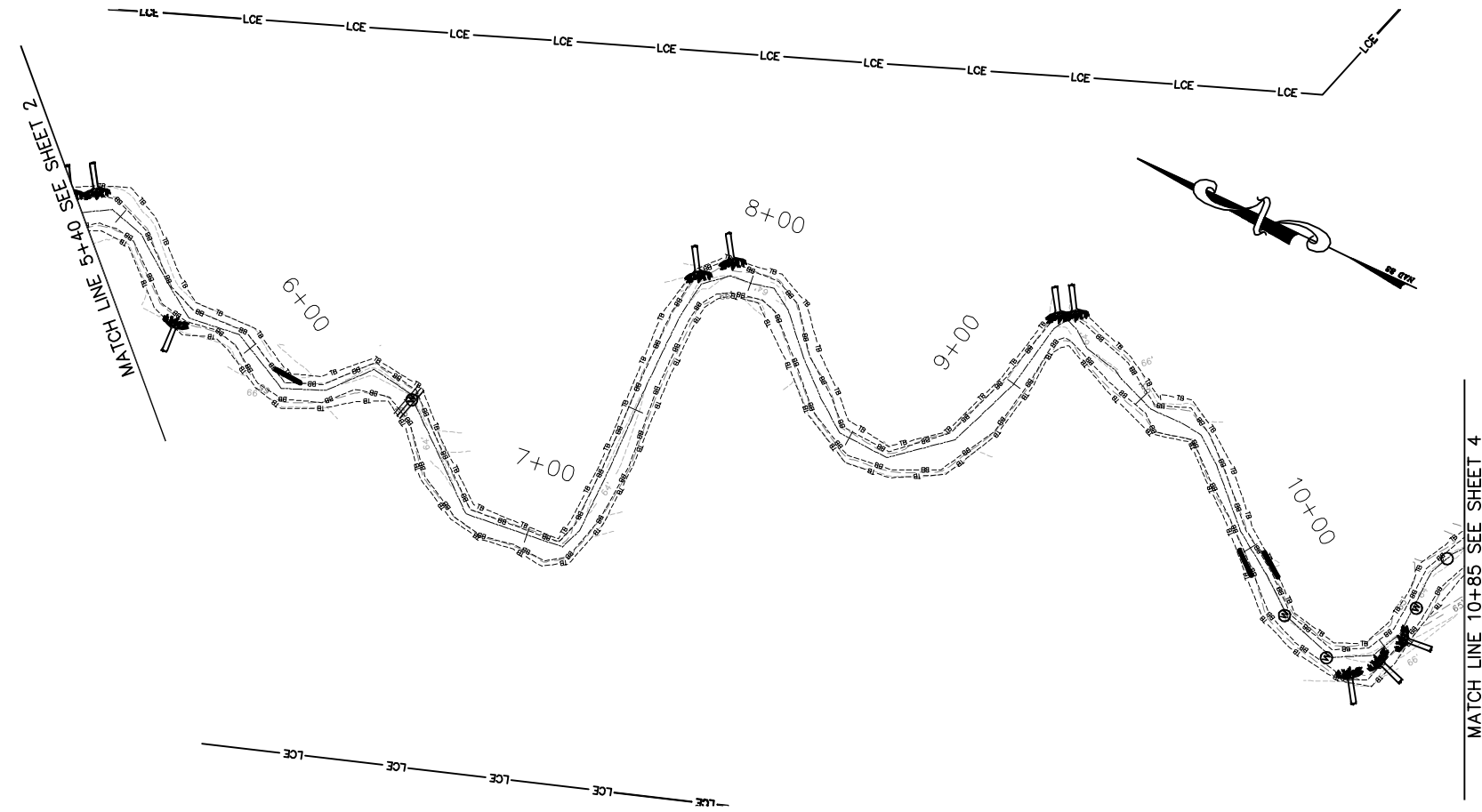
RELEASED FOR	DATE
APPROVALS	
BIDDING	
CONSTRUCTION	
RECORD DWG.	



ENVIRONMENTAL BANK & EXCHANGE, LLC
CONOCONNARA RESTORATION
HALIFAX COUNTY, NORTH CAROLINA

CONOCONNARA AS-BUILT PLANS
STA. 0+00 TO STA. 5+40

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Horizontal Scale: 1 inch = 20ft.
Vertical Scale: 1 inch = 2ft.
NOTE: Profile Alignment is Thalweg of As-Built Channel

REV. NO.	DESCRIPTION	DATE

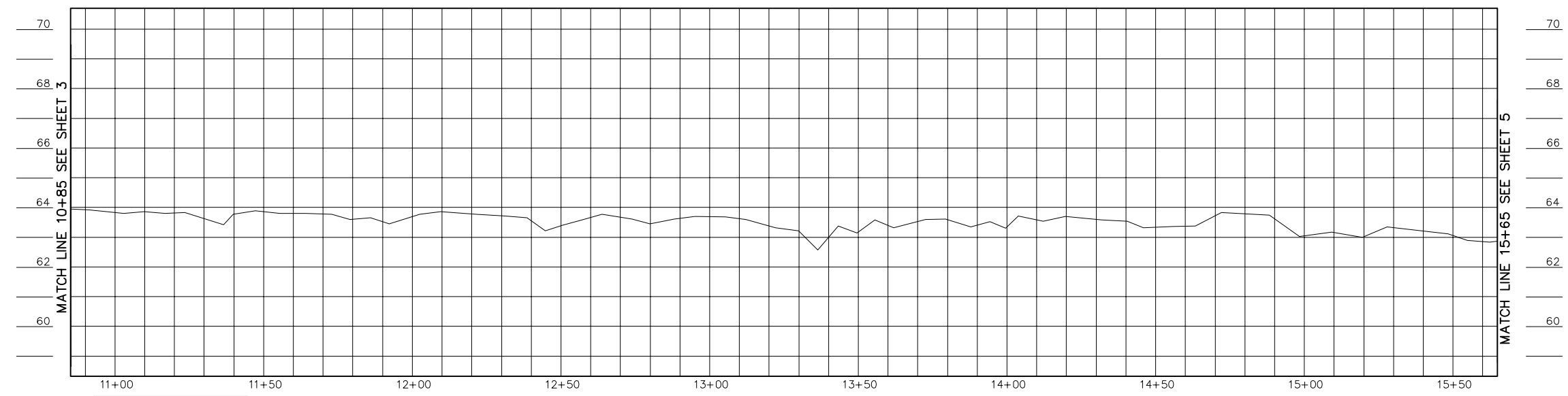
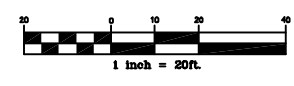
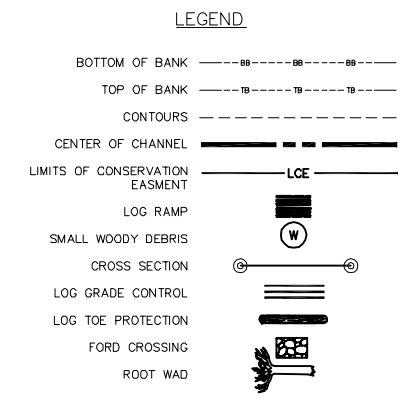
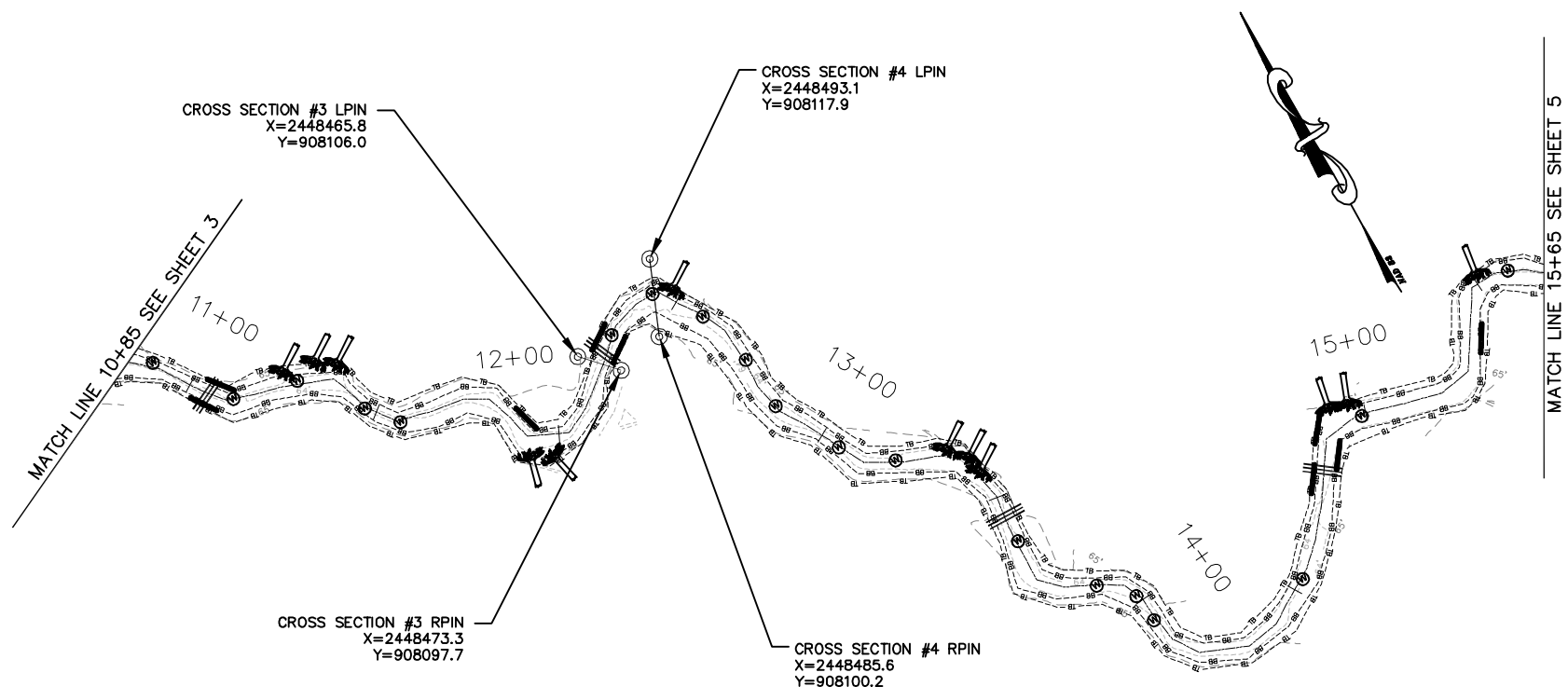
PROJECT MANAGER DPI	DRAWING SCALE 1" = 20'	3101 JOHN HUMPHRIES WYND RALEIGH, NC 27612 (919) 782-0495	RELEASED FOR APPROVALS	DATE
DRAWN BY TMS	PROJECT DATE 06/20/06	Office Locations: North Carolina South Carolina Georgia Florida	BIDDING	
APPROVED BY MSE	PROJECT NUMBER 600200ORA		CONSTRUCTION	
FILE NAME as-built.dwg	PLOT DATE 11/07/08	community infrastructure consultants	RECORD DWG.	



ENVIRONMENTAL BANK & EXCHANGE, LLC
CONOCONNARA RESTORATION
HALIFAX COUNTY, NORTH CAROLINA

CONOCONNARA AS-BUILT PLANS
STA. 5+40 TO STA. 10+85

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NOTE:
 Profile Alignment is Thalweg of As-Built Channel

Horizontal Scale: 1 inch = 20ft.
 Vertical Scale: 1 inch = 2ft.

I:\Projects\EBX\602000RA\CADD\Swamp Restoration\Conoconnara_Swamp_Restoration\dwg\As-Built

REV. NO.	DESCRIPTION	DATE

PROJECT MANAGER
 DPI
 DRAWN BY
 TRS
 APPROVED BY
 MSE
 FILE NAME
 as-built.dwg



3101 JOHN HUMPHRIES WYND
 RALEIGH, NC 27612
 (919) 782-0495

Office Locations:
 North Carolina
 South Carolina
 Georgia
 Florida

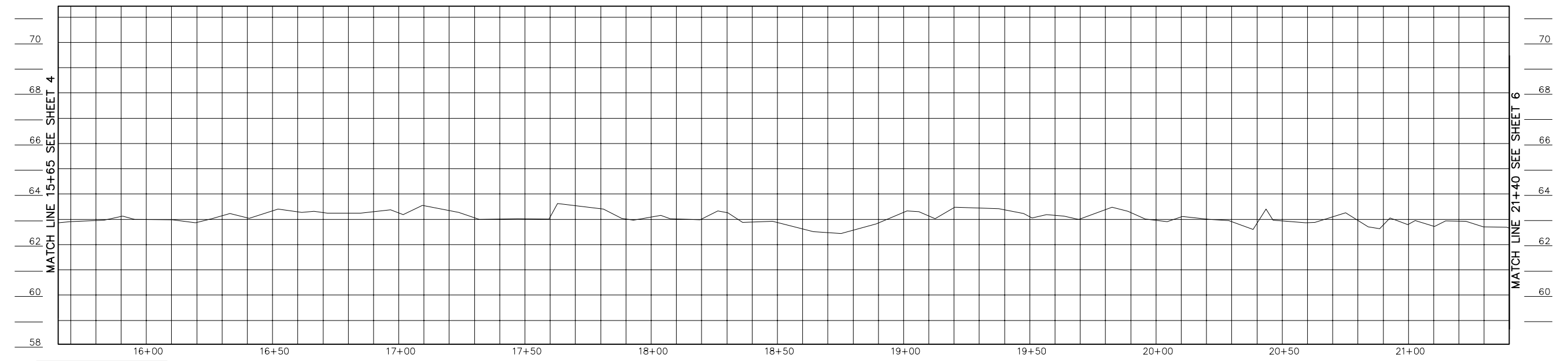
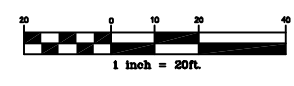
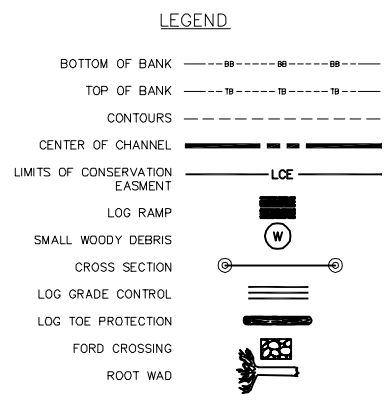
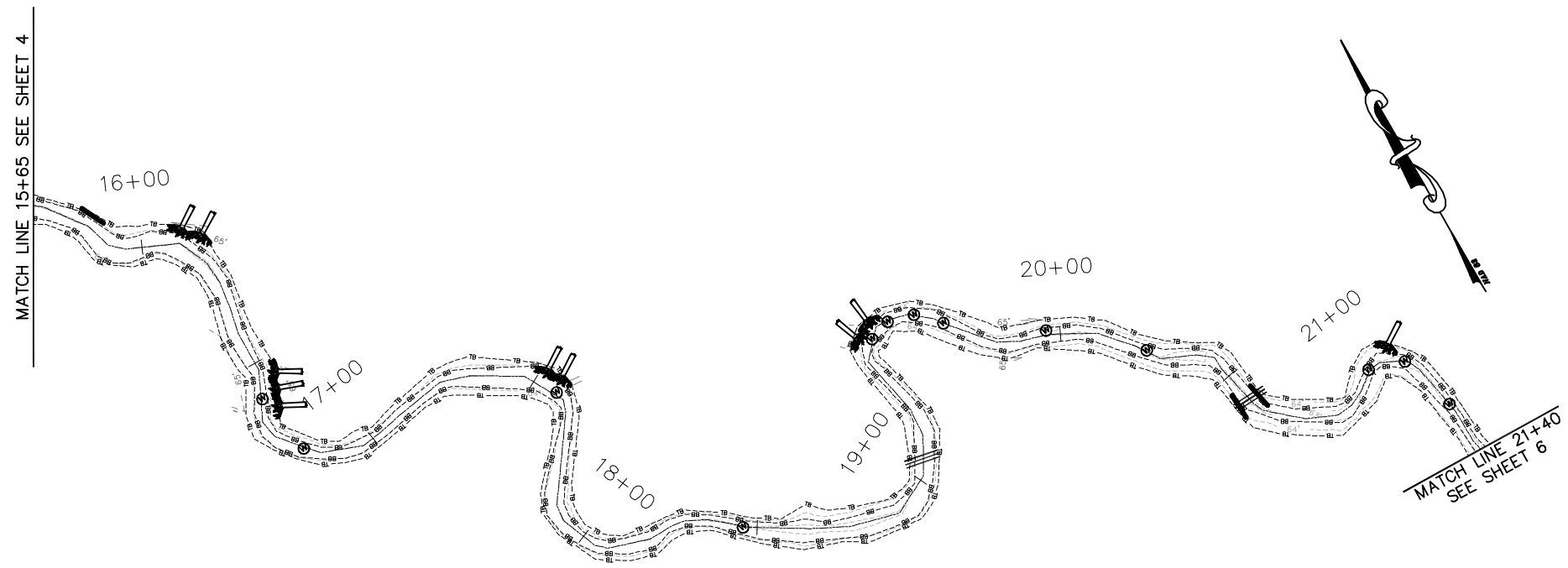
RELEASED FOR
 APPROVALS
 BIDDING
 CONSTRUCTION
 RECORD DWG.



ENVIRONMENTAL BANK & EXCHANGE, LLC
 CONOCONNARA RESTORATION
 HALIFAX COUNTY, NORTH CAROLINA

CONOCONNARA AS-BUILT PLANS
 STA. 10+85 TO STA. 15+65

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NOTE:
 Horizontal Scale: 1 inch = 20ft.
 Vertical Scale: 1 inch = 2ft.
 Profile Alignment is Thalweg
 of As-Built Channel

REV. NO.	DESCRIPTION	DATE

PROJECT MANAGER DPI	DRAWING SCALE 1" = 20'	3101 JOHN HUMPHRIES WYND RALEIGH, NC 27612 (919) 782-0495	RELEASED FOR APPROVALS	DATE
DRAWN BY TRS	PROJECT DATE 06/2006	Office Locations: North Carolina South Carolina Georgia Florida	BIDDING	
APPROVED BY MSE	PROJECT NUMBER 600200ORA		CONSTRUCTION	
FILE NAME as-built.dwg	PLOT DATE 11/07/08	community infrastructure consultants	RECORD DWG.	

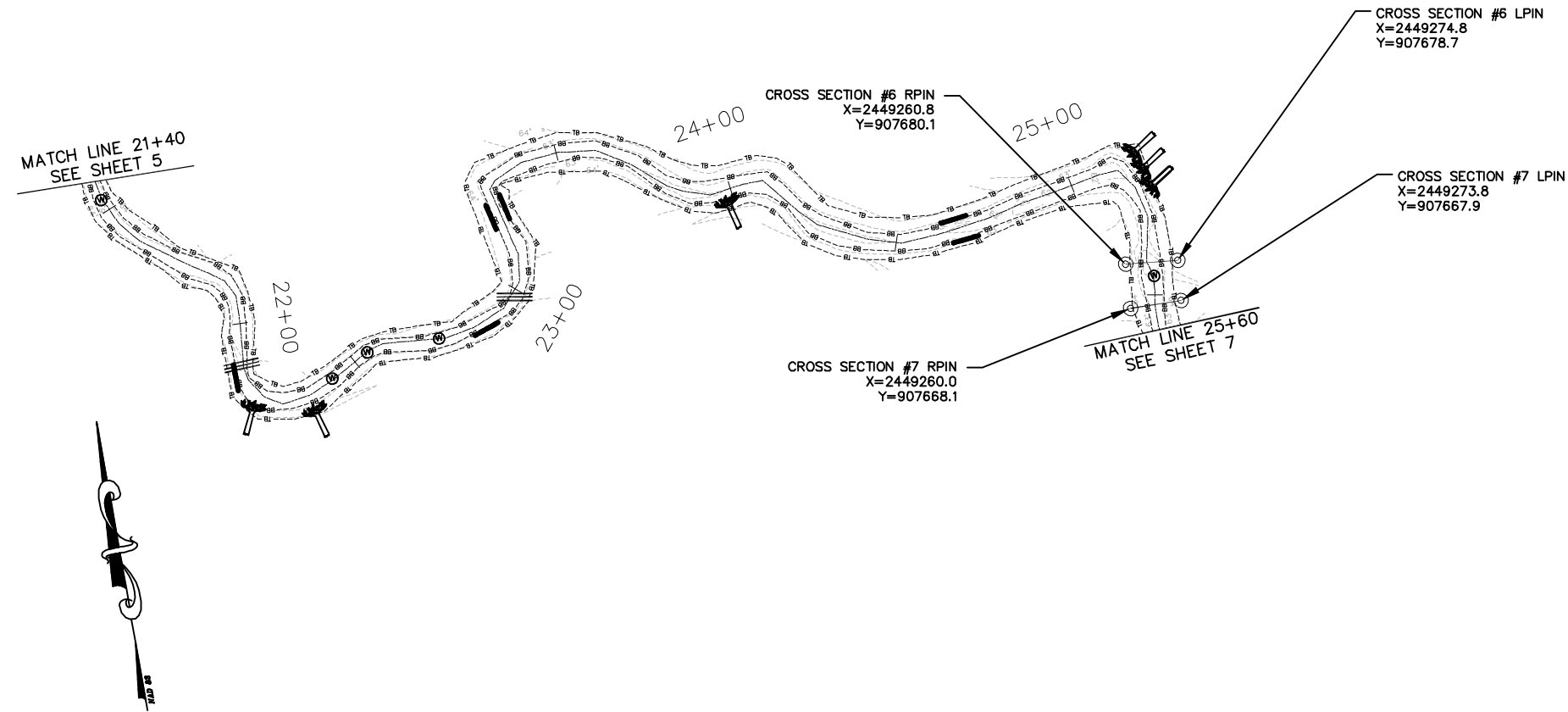


ENVIRONMENTAL BANK & EXCHANGE, LLC
 CONOCONNARA RESTORATION
 HALIFAX COUNTY, NORTH CAROLINA

CONOCONNARA AS-BUILT PLANS
 STA. 15+65 TO STA. 21+40

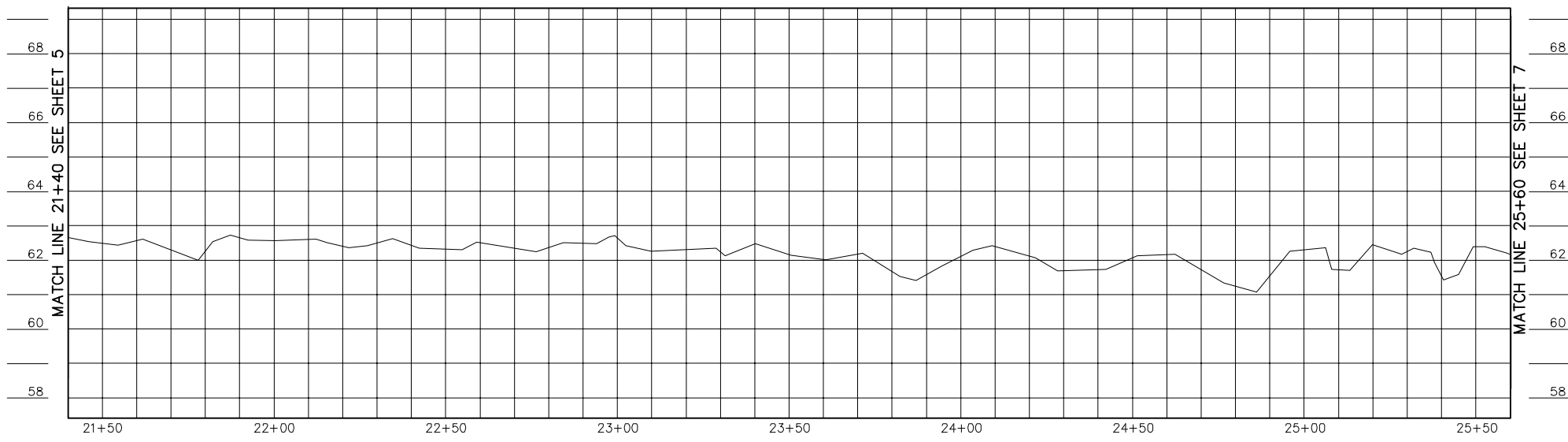
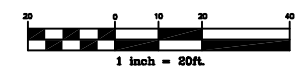
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LEGEND

BOTTOM OF BANK	-----
TOP OF BANK	-----
CONTOURS	-----
CENTER OF CHANNEL	-----
LIMITS OF CONSERVATION EASEMENT	-----
LOG RAMP	
SMALL WOODY DEBRIS	
CROSS SECTION	
LOG GRADE CONTROL	
LOG TOE PROTECTION	
FORD CROSSING	
ROOT WAD	



Horizontal Scale: 1 inch = 20ft.
 Vertical Scale: 1 inch = 2ft.

NOTE:
 Profile Alignment is Thalweg
 of As-Built Channel

REV. NO.	DESCRIPTION	DATE

PROJECT MANAGER DPI DRAWN BY TRS APPROVED BY MSE FILE NAME as-built.dwg	DRAWING SCALE 1" = 20' PROJECT DATE 06/2006 PROJECT NUMBER 600200RA PLOT DATE 11/07/08	 community infrastructure consultants 3101 JOHN HUMPHRIES WYND RALEIGH, NC 27612 (919) 782-0495 Office Locations: North Carolina South Carolina Georgia Florida	RELEASED FOR APPROVALS BIDDING CONSTRUCTION RECORD DWG.	DATE _____ _____ _____ _____
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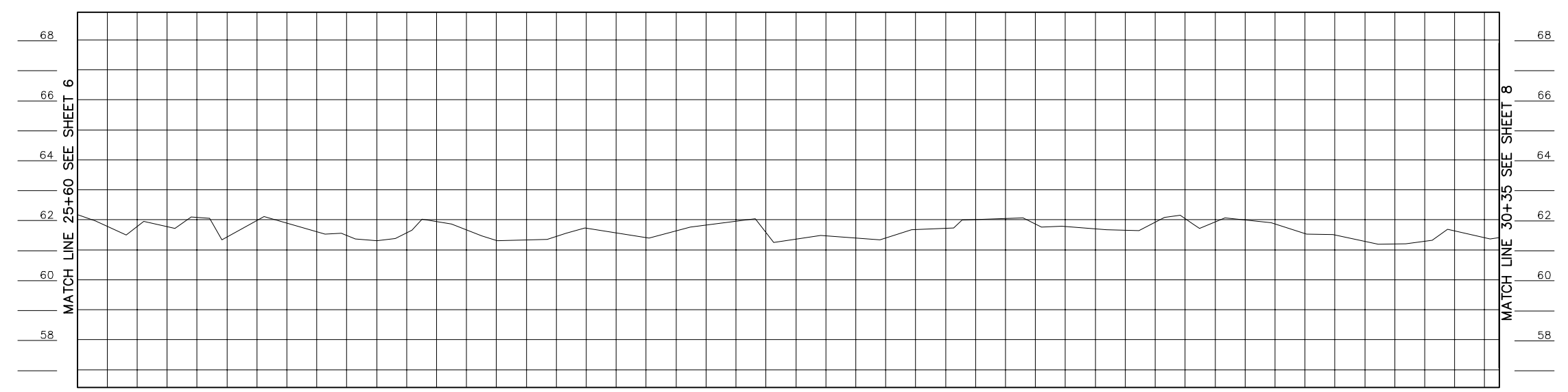
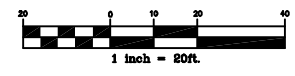
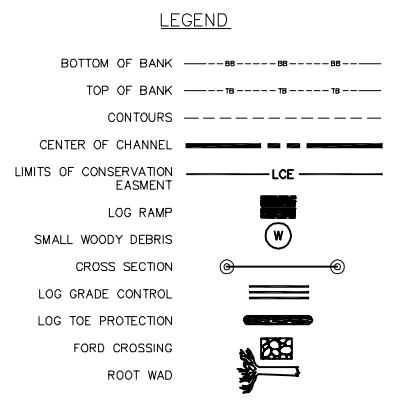
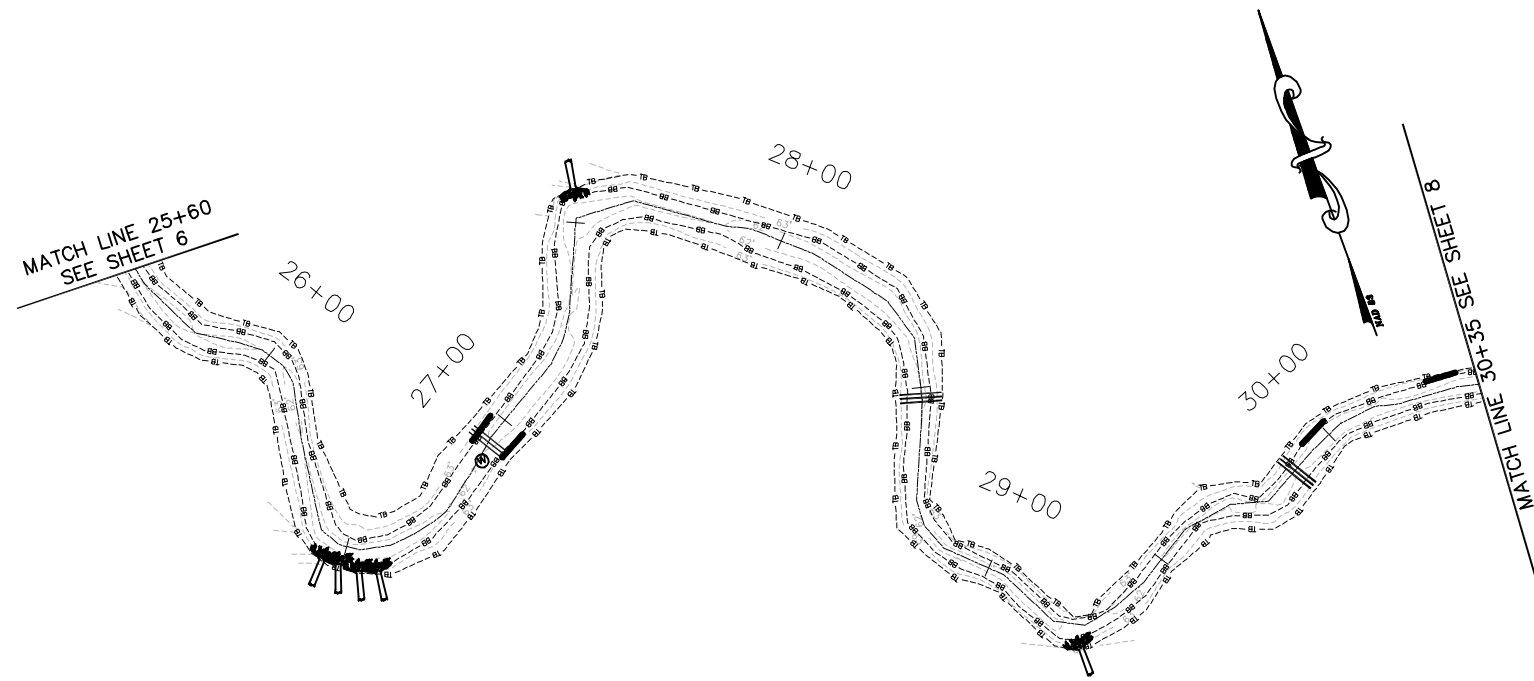


ENVIRONMENTAL BANK & EXCHANGE, LLC
 CONOCONNARA RESTORATION
 HALIFAX COUNTY, NORTH CAROLINA

CONOCONNARA AS-BUILT PLANS
 STA. 21+40 TO STA. 25+60

I:\Projects\EBX\600200RA\CADD\Swamp Restoration\Conoconnara Swamp Restoration.dwg\As-Built

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Horizontal Scale: 1 inch = 20ft.
Vertical Scale: 1 inch = 2ft.

NOTE:
Profile Alignment is Thalweg
of As-Built Channel

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REV. NO.	DESCRIPTION	DATE

PROJECT MANAGER DPI	DRAWING SCALE 1" = 20'
DRAWN BY TMS	PROJECT DATE 06/20/06
APPROVED BY MSE	PROJECT NUMBER 600200RA
FILE NAME as-built.dwg	PLOT DATE 11/07/06

WK DICKSON
community infrastructure consultants

3101 JOHN HUMPHRIES WYND
RALEIGH, NC 27612
(919) 782-0495

Office Locations:
North Carolina
South Carolina
Georgia
Florida

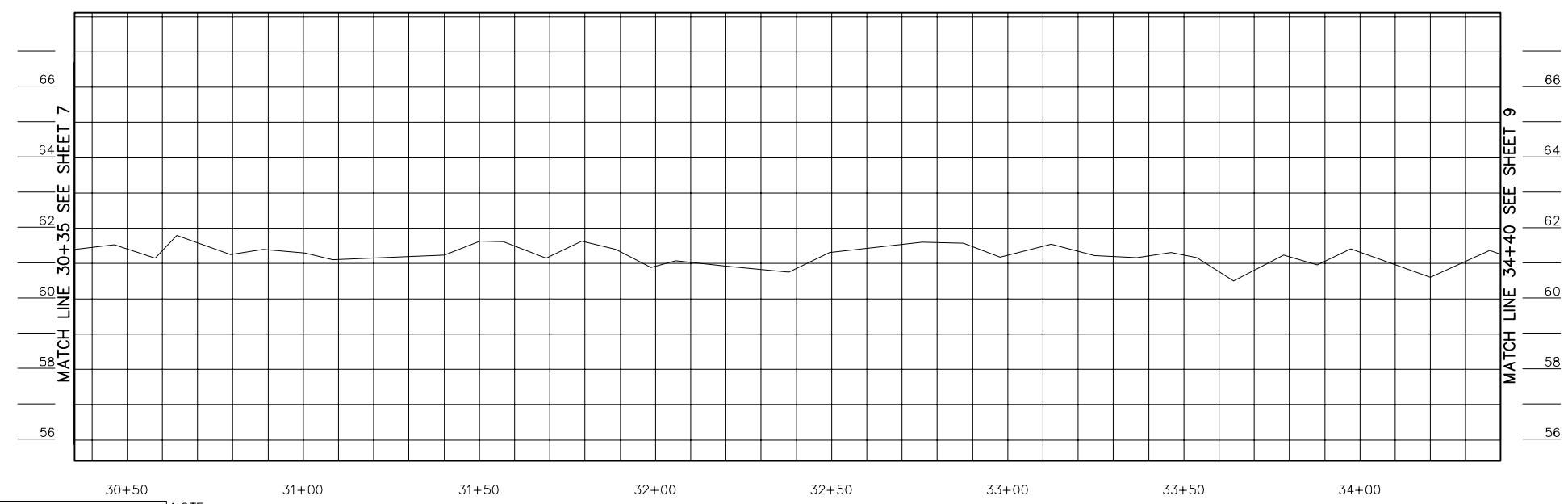
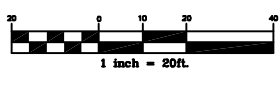
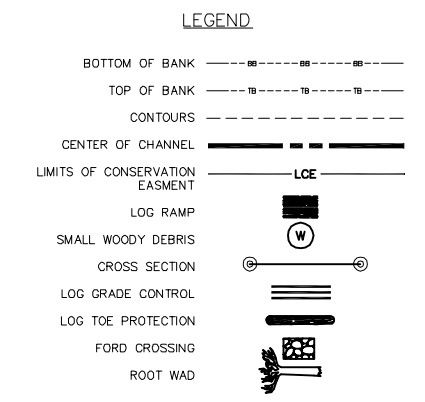
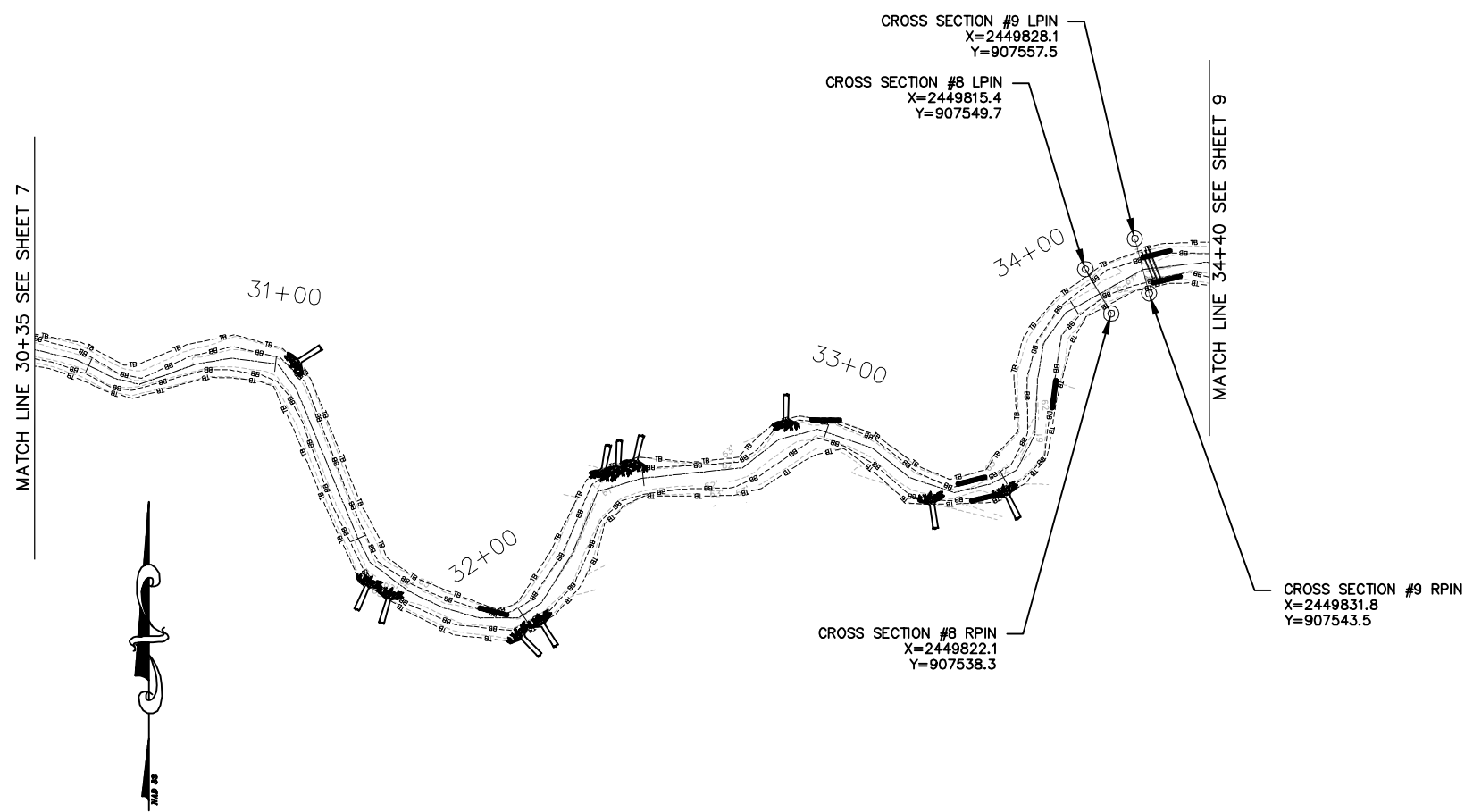
RELEASED FOR	DATE
APPROVALS	
BIDDING	
CONSTRUCTION	
RECORD DWG.	



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CONOCONNARA RESTORATION
HALIFAX COUNTY, NORTH CAROLINA

CONOCONNARA AS-BUILT PLANS
STA. 25+60 TO STA. 30+35

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NOTE:
Horizontal Scale: 1 inch = 20ft.
Vertical Scale: 1 inch = 2ft.
Profile Alignment is Thalweg
of As-Built Channel

REV. NO.	DESCRIPTION	DATE

PROJECT MANAGER DPI	DRAWING SCALE 1" = 20'	3101 JOHN HUMPHRIES WYND RALEIGH, NC 27612 (919) 782-0495	RELEASED FOR APPROVALS	DATE
DRAWN BY TMS	PROJECT DATE 06/2006	Office Locations: North Carolina South Carolina Georgia Florida	BIDDING	
APPROVED BY MSE	PROJECT NUMBER 6002000RA		CONSTRUCTION	
FILE NAME as-built.dwg	PLOT DATE 11/07/08	community infrastructure consultants	RECORD DWG.	

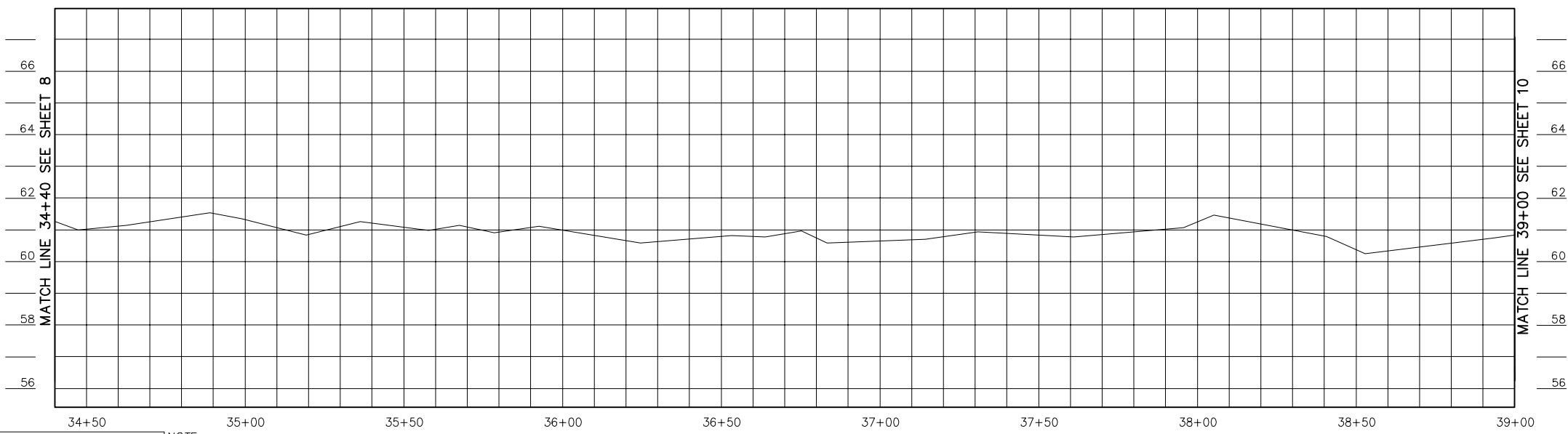
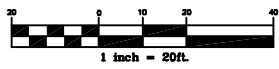
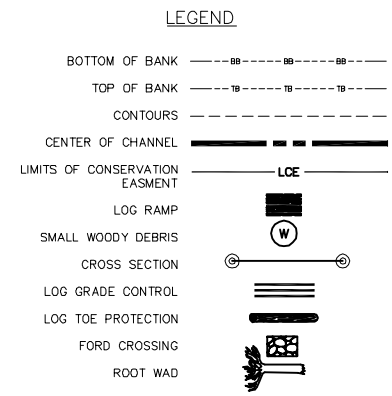
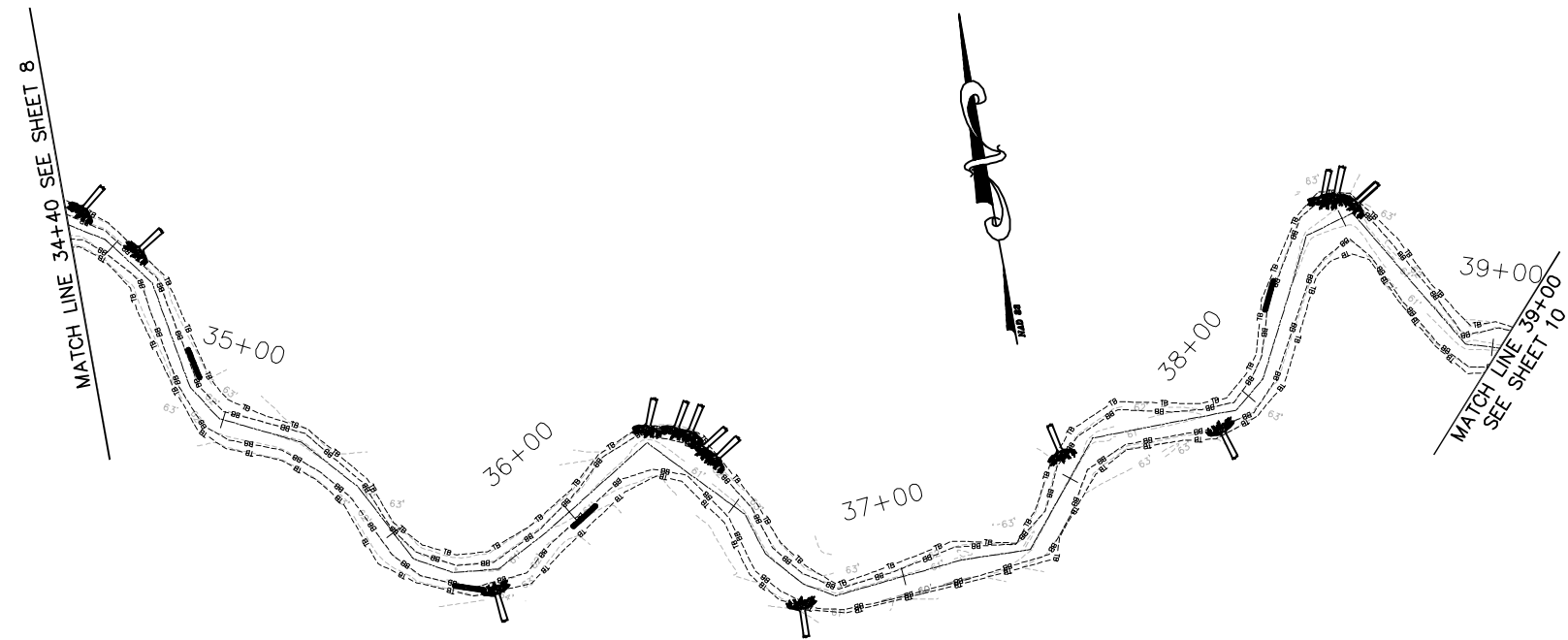


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CONOCONNARA RESTORATION
HALIFAX COUNTY, NORTH CAROLINA

CONOCONNARA AS-BUILT PLANS
STA. 30+35 TO STA. 34+40

I:\Projects\EBX\6002000RA\CADD\Swamp_Restoration\Conoconnara_Swamp_Restoration\dwg\As-Built

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Vertical Scale: 1 inch = 2ft.

NOTE:
Profile Alignment is Thalweg
of As-Built Channel

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REV. NO.	DESCRIPTION	DATE

PROJECT MANAGER	DRIVING SCALE
DPI	1" = 20'
DRAWN BY	PROJECT DATE
TJS	06/2006
APPROVED BY	PROJECT NUMBER
MSE	600200RA
FILE NAME	PLOT DATE
as-built.dwg	11/07/08

3101 JOHN HUMPHRIES WYND
RALEIGH, NC 27612
(919) 782-0495

Office Locations:
North Carolina
South Carolina
Georgia
Florida

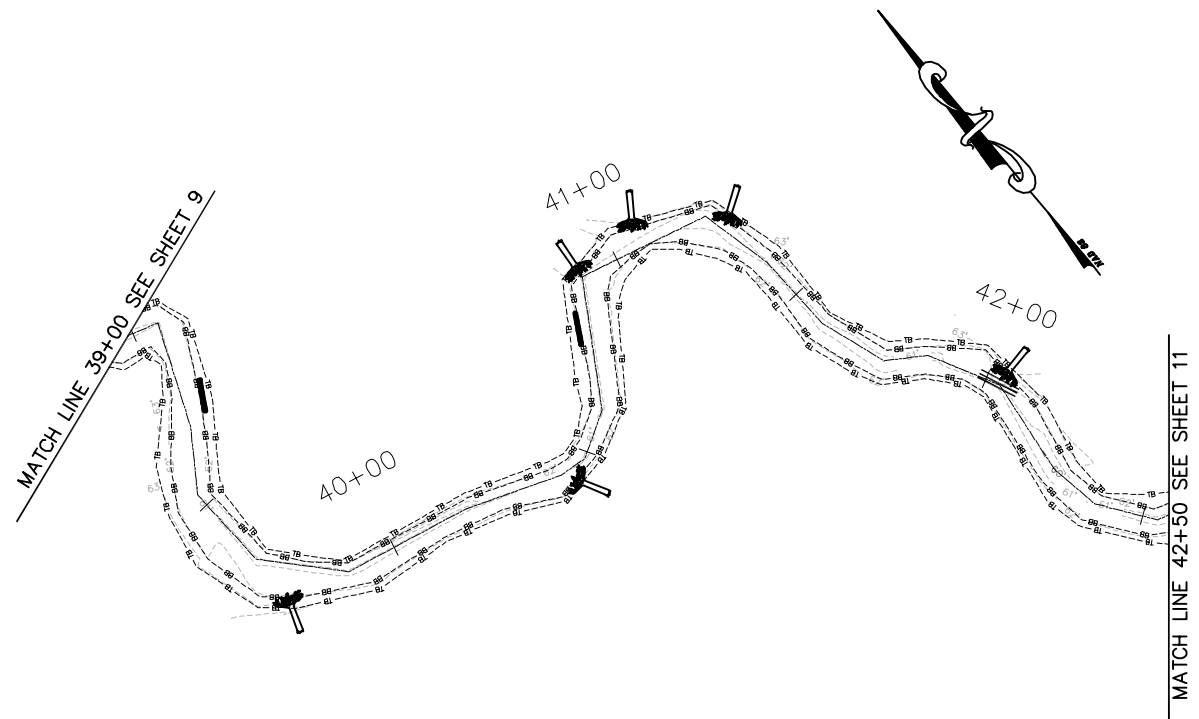
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APPROVALS	
BIDDING	
CONSTRUCTION	
RECORD DWG.	



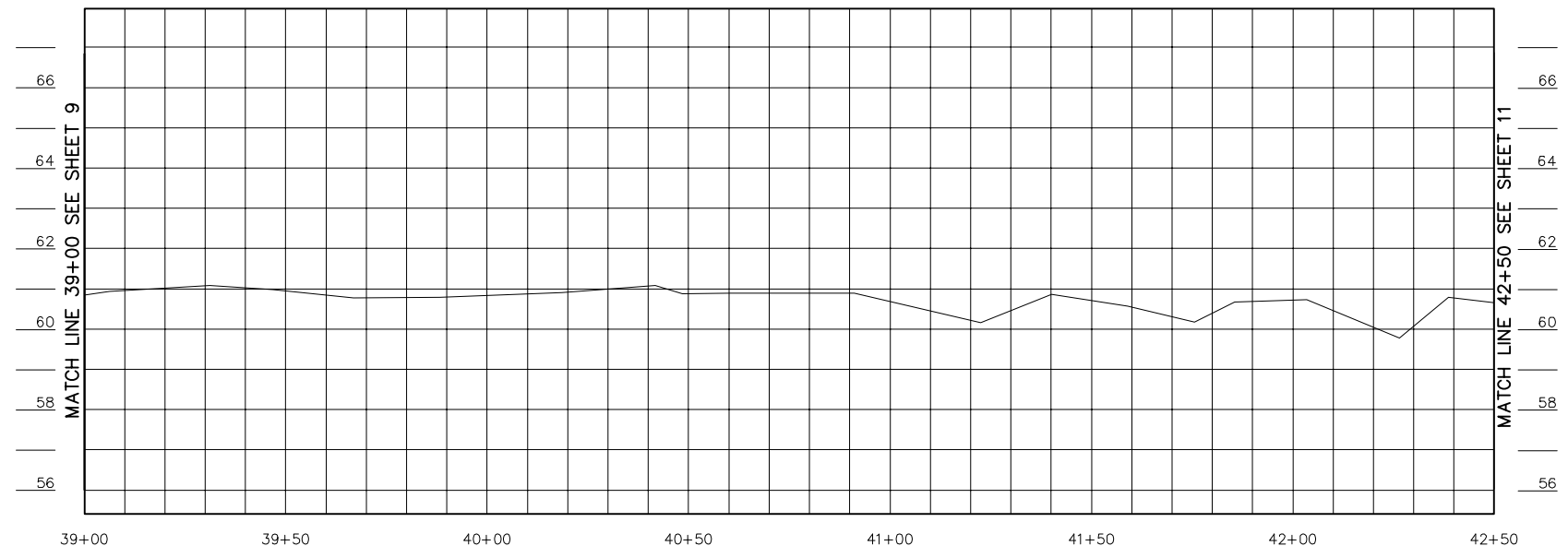
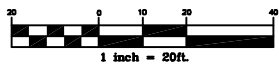
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HALIFAX COUNTY, NORTH CAROLINA

CONOCONNARA AS-BUILT PLANS
STA. 34+40 TO STA. 39+00

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- LEGEND**
- BOTTOM OF BANK ---●●●●●●---
 - TOP OF BANK ---▬▬▬▬---
 - CONTOURS - - - - -
 - CENTER OF CHANNEL ————
 - LIMITS OF CONSERVATION EASEMENT ———— LCE ————
 - LOG RAMP [Symbol]
 - SMALL WOODY DEBRIS (W) [Symbol]
 - CROSS SECTION [Symbol]
 - LOG GRADE CONTROL [Symbol]
 - LOG TOE PROTECTION [Symbol]
 - FORD CROSSING [Symbol]
 - ROOT WAD [Symbol]



Horizontal Scale: 1 inch = 20ft.
Vertical Scale: 1 inch = 2ft.

NOTE:
Profile Alignment is Thalweg
of As-Built Channel

REV. NO.	DESCRIPTION	DATE

PROJECT MANAGER DPI	DRAWING SCALE 1" = 20'
DRAWN BY TMS	PROJECT DATE 06/2006
APPROVED BY MSE	PROJECT NUMBER 600200ORA
FILE NAME as-built.dwg	PLOT DATE 11/07/08

3101 JOHN HUMPHRIES WYND
RALEIGH, NC 27612
(919) 782-0495

Office Locations:
North Carolina
South Carolina
Georgia
Florida

RELEASED FOR	DATE
APPROVALS	
BIDDING	
CONSTRUCTION	
RECORD DWG.	

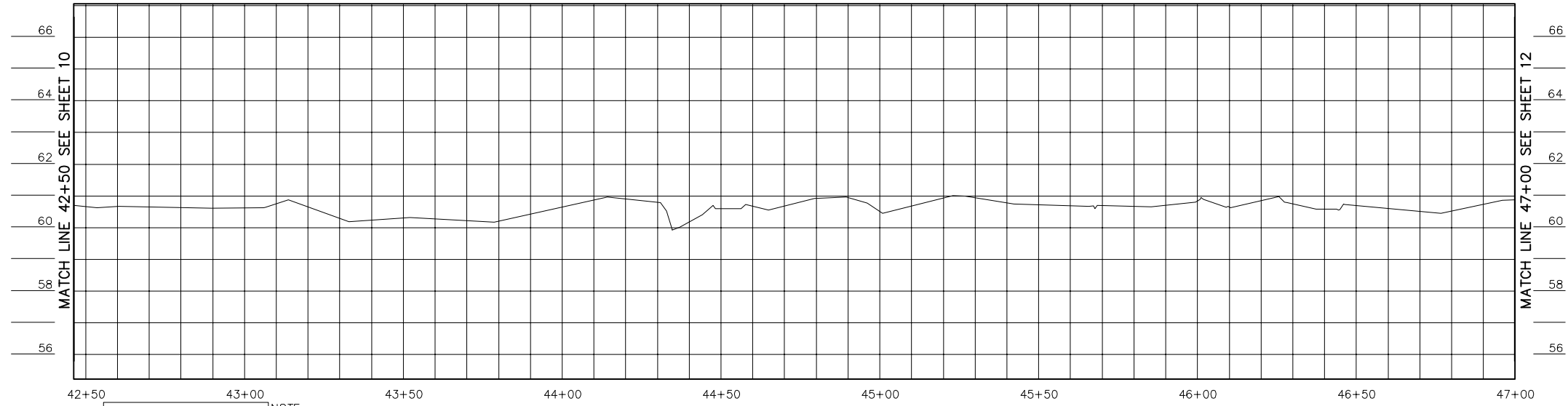
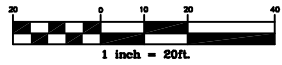
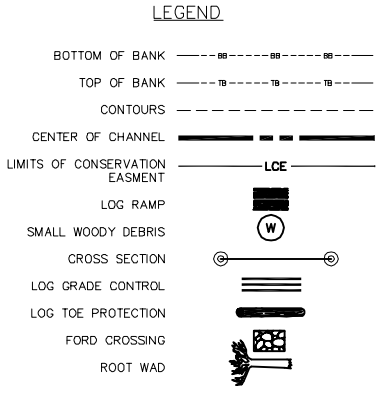
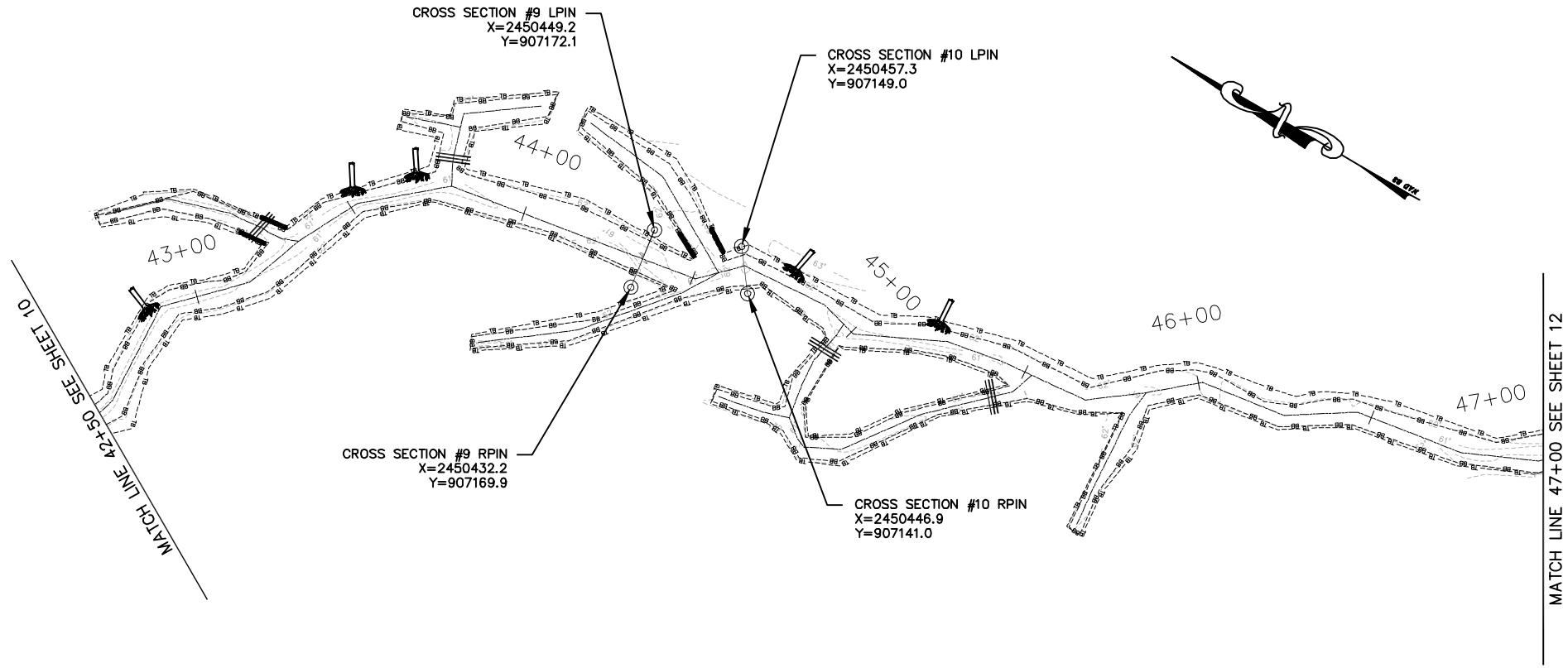


ENVIRONMENTAL BANK & EXCHANGE, LLC
CONOCONNARA RESTORATION
HALIFAX COUNTY, NORTH CAROLINA

CONOCONNARA AS-BUILT PLANS
STA. 39+00 TO STA. 42+50

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Horizontal Scale: 1 inch = 20ft.
Vertical Scale: 1 inch = 2ft.

NOTE:
Profile Alignment is Thalweg
of As-Built Channel

REV. NO.	DESCRIPTION	DATE

PROJECT MANAGER DPI	DRAWING SCALE 1" = 20'
DRAWN BY TMS	PROJECT DATE 06/20/06
APPROVED BY MSE	PROJECT NUMBER 6002000RA
FILE NAME as-built.dwg	PLOT DATE 11/07/08

WK DICKSON
community infrastructure consultants

3101 JOHN HUMPHRIES WYND
RALEIGH, NC 27612
(919) 782-0495

Office Locations:
North Carolina
South Carolina
Georgia
Florida

RELEASED FOR	DATE
APPROVALS	
BIDDING	
CONSTRUCTION	
RECORD DWG.	

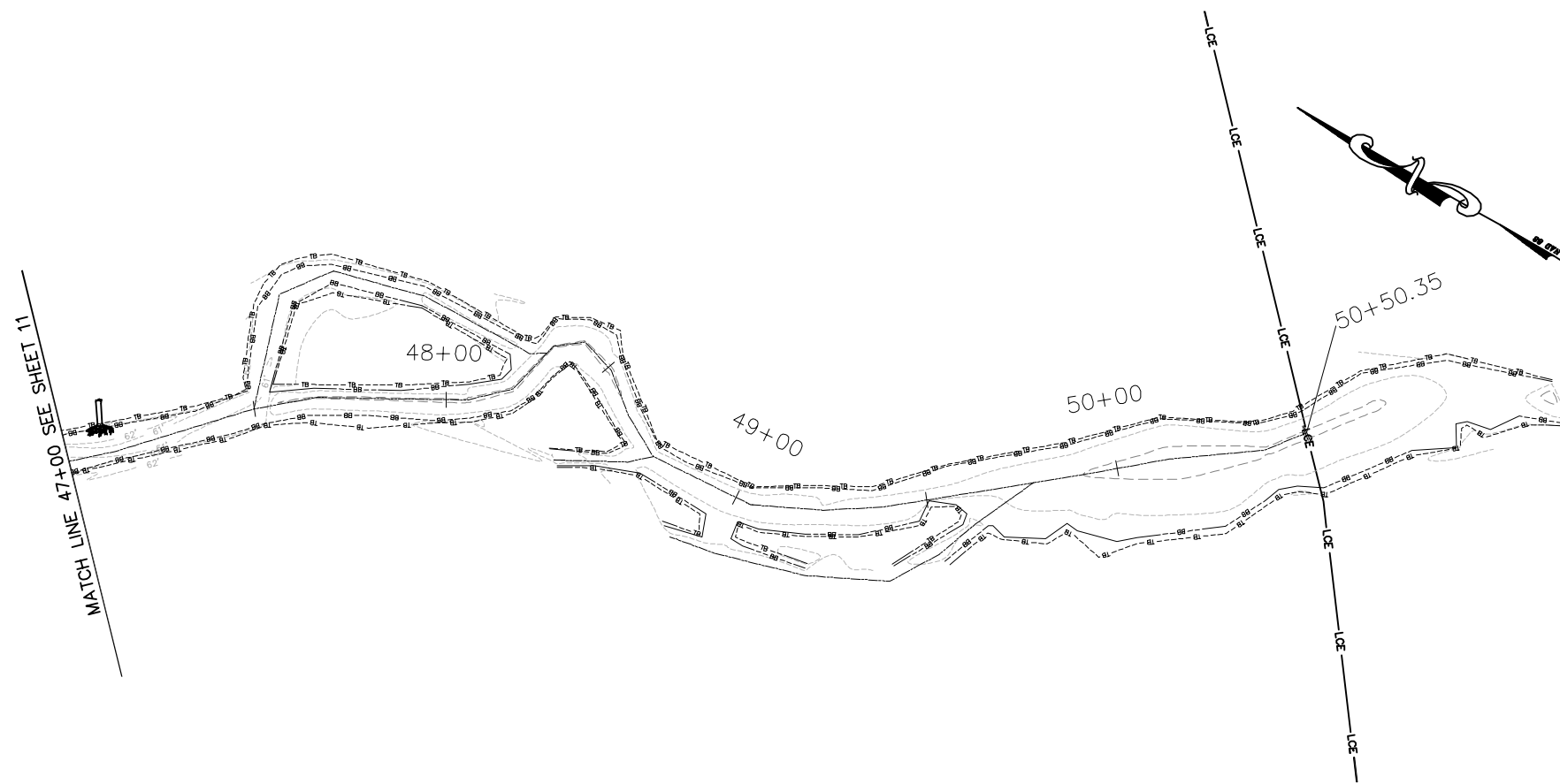
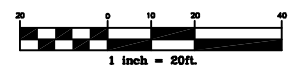


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CONOCONNARA RESTORATION
HALIFAX COUNTY, NORTH CAROLINA

CONOCONNARA AS-BUILT PLANS
STA. 42+50 TO STA. 47+00

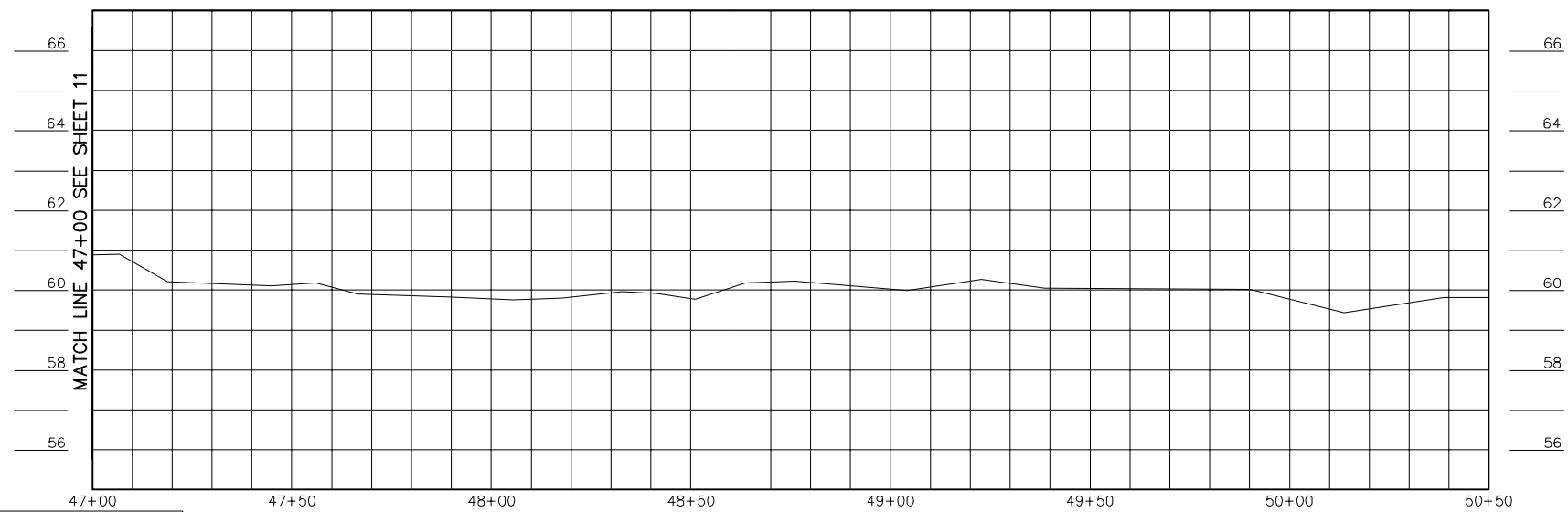
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LEGEND

BOTTOM OF BANK	---□---□---
TOP OF BANK	-□-□-□-□-
CONTOURS	- - - - -
CENTER OF CHANNEL	—————
LIMITS OF CONSERVATION EASEMENT	— LCE —
LOG RAMP	■
SMALL WOODY DEBRIS	⊙ W
CROSS SECTION	⊙ — ⊙
LOG GRADE CONTROL	▬▬▬▬
LOG TOE PROTECTION	▬▬▬▬
FORD CROSSING	⊕
ROOT WAD	⊕



Horizontal Scale: 1 inch = 20ft.
Vertical Scale: 1 inch = 2ft.

NOTE:
Profile Alignment is Thalweg
of As-Built Channel

REV. NO.	DESCRIPTION	DATE

PROJECT MANAGER	DPI
DRAWN BY	TRS
APPROVED BY	MSE
FILE NAME	as-built.dwg
DRAWING SCALE	1" = 20'
PROJECT DATE	06/20/06
PROJECT NUMBER	600200RA
PLOT DATE	11/07/08

WK DICKSON
community infrastructure consultants

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ENVIRONMENTAL BANK & EXCHANGE, LLC
CONOCONNARA RESTORATION
HALIFAX COUNTY, NORTH CAROLINA

CONOCONNARA AS-BUILT PLANS
STA. 47+00 TO STA. 50+50.35

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PLANTING PLAN

Zone 1 (saturated/undated)		Quantity
Willow oak (<i>Quercus phellos</i>)	2040	2040
Water oak (<i>Quercus nigra</i>)	3920	3920
Sycamore (<i>Platanus occidentalis</i>)	4200	4200
Green Ash (<i>Fraxinus pennsylvanica</i>)	4200	4200
Laurel oak (<i>Quercus laurifolia</i>)	800	800
Swamp blackgum (<i>Nyssa biflora</i>)	4240	4240
Musclewood (<i>Carpinus caroliniana</i>)	3000	3000
Water tupelo (<i>Nyssa aquatica</i>)	4175	4175
Bald cypress (<i>Taxodium distichum</i>)	4220	4220
Swamp chestnut oak (<i>Quercus phellos</i>)	2000	2000

Zone 2 (saturated)		Quantity
Yellow poplar (<i>Liriodendron tulipifera</i>)	3850	3850
American elm (<i>Ulmus americana</i>)	3650	3650
Cherrybark oak (<i>Quercus pagodaefolia</i>)	2800	2800
Pawpaw (<i>Asimina triloba</i>)	1900	1900
Blackgum (<i>Nyssa sylvatica</i>)	2100	2100
Willow oak (<i>Quercus phellos</i>)	2140	2140
Water oak (<i>Quercus nigra</i>)	1440	1440
River Birch (<i>Betula nigra</i>)	2004	2004
Green Ash (<i>Fraxinus pennsylvanica</i>)	1980	1980
Swamp chestnut oak (<i>Quercus phellos</i>)	800	800

UPSTREAM SINGLE THREAD CHANNEL

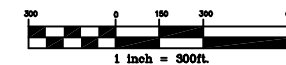
DOWNSTREAM MULTIPLE THREAD CHANNEL

PLANTING PLAN

ZONE 3 (Upstream Single-Thread Channel)		Quantity
Green Ash (<i>Fraxinus pennsylvanica</i>)	1975	1975
Sycamore (<i>Platanus occidentalis</i>)	1500	1500
Swamp blackgum (<i>Nyssa biflora</i>)	510	510
Bald cypress (<i>Taxodium distichum</i>)	555	555
Water oak (<i>Quercus nigra</i>)	1184	1184
Willow oak (<i>Quercus phellos</i>)	1520	1520
Overcup Oak (<i>Quercus lyrata</i>)	1050	1050
River Birch (<i>Betula nigra</i>)	950	950
Carolina Ash (<i>Fraxinus caroliniana</i>)	1750	1750

ZONE 4 (Downstream Multiple Thread Channel)

	Quantity
Bald cypress (<i>Taxodium distichum</i>)	325
Water tupelo (<i>Nyssa aquatica</i>)	679
Overcup oak (<i>Quercus lyrata</i>)	550
River Birch (<i>Betula nigra</i>)	600
Water oak (<i>Quercus nigra</i>)	156
Laurel oak (<i>Quercus laurifolia</i>)	300
Swamp blackgum (<i>Nyssa biflora</i>)	150
Carolina Ash (<i>Fraxinus caroliniana</i>)	650



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REV. NO.	DESCRIPTION	DATE

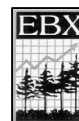
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DRAWN BY TRS	PROJECT DATE 06/2006
APPROVED BY ME	PROJECT NUMBER 600200RA
FILE NAME wetland.dwg	PLOT DATE 11/07/2008



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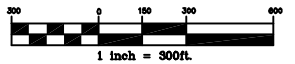
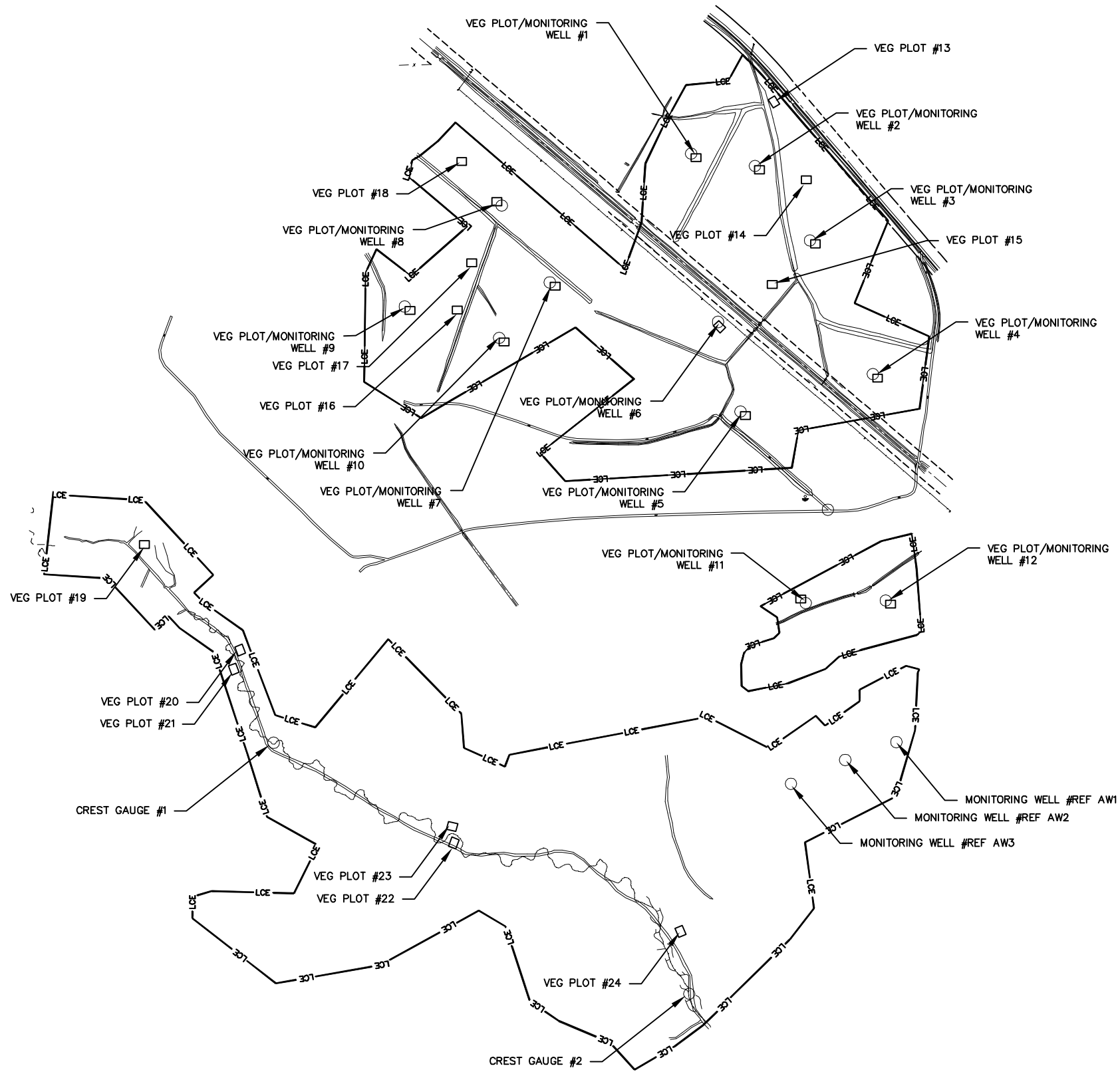
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AS-BUILT
PLANTING PLAN

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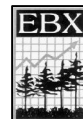
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APPROVED BY ME	PROJECT NUMBER 6002006RA
FILE NAME welland.dwg	PLOT DATE 11/07/2008



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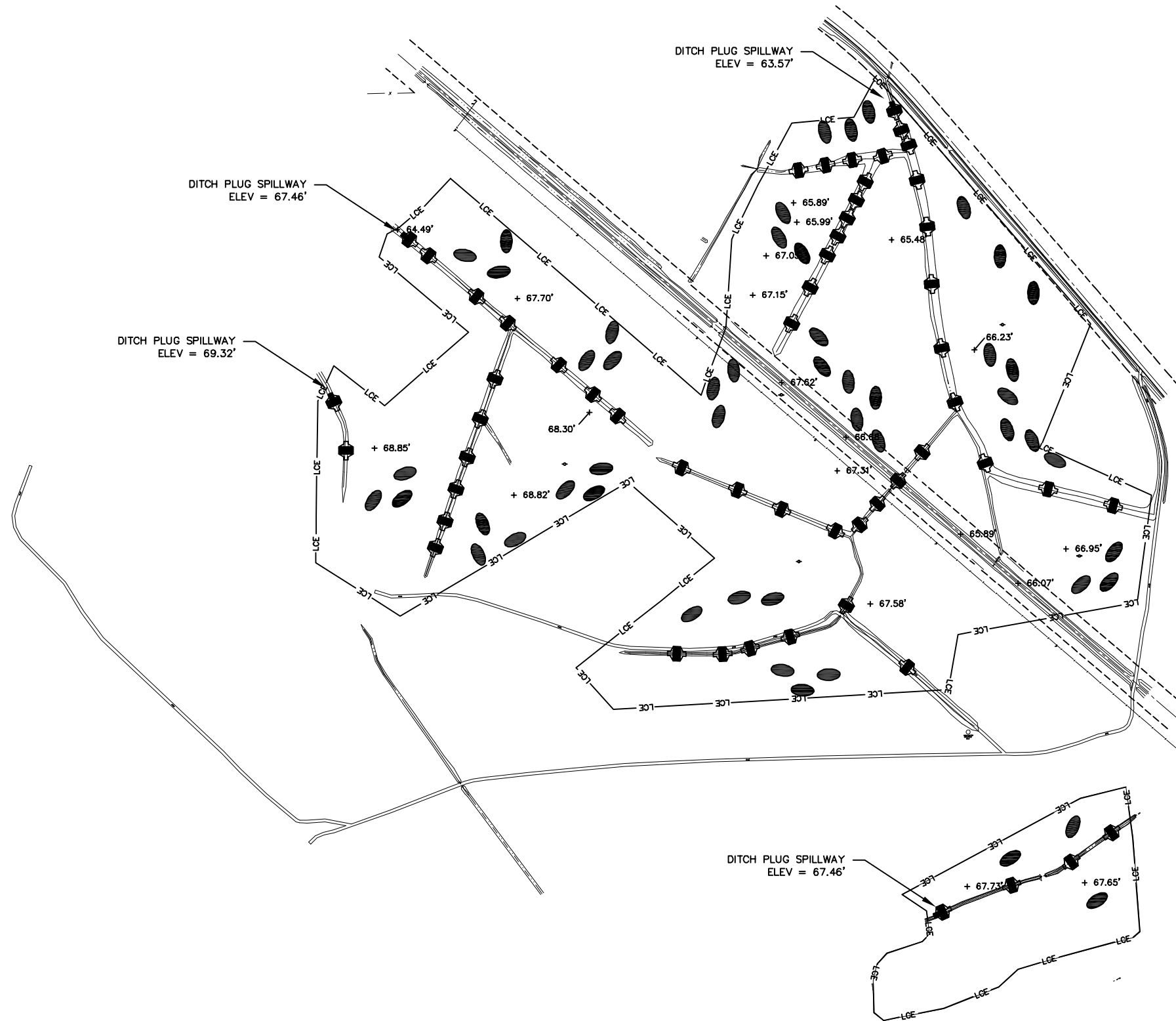
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
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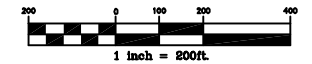
WELL/VEG PLOT LOCATIONS

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LEGEND

- CHANNEL PLUG 
- CHANNEL PLUG WITH SPILLWAY 
- WETLAND DEPRESSION 
- LIMITS OF CONSERVATION EASEMENT 
- PROPOSED SPOT ELEVATION **+ 66.50'**
- RAPTOR POLE 



REV. NO.	DESCRIPTION	DATE

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