FLOOGIE STREAM AND WETLAND MITIGATION PROJECT BERTIE COUNTY, NORTH CAROLINA

DENR-EEP CONTRACT NO. D06011

MITIGATION PLAN

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September 2008

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FLOOGIE STREAM AND WETLAND MITIGATION PLAN

PROJECT DESCRIPTION

The Floogie Stream and Wetland Mitigation Project is in Bertie County, North Carolina. The project is located in the Lower Roanoke River Basin 03010107 hydrologic unit. Stream mitigation was provided through restoration on Flat Swamp Creek, headwater stream restoration, and riverine wetland mitigation was provided through restoration. The site was identified and developed by EBX to support the NC EEP full delivery mitigation process. The objectives of the Project are:

- provide 10,929 stream mitigation units (SMU); and,
- provide 25 riverine wetland mitigation units (WMU).

This Mitigation Plan (Plan) documents the stream and wetland mitigation activities at the Floogie site. The Plan includes narrative project description, plan views, elevations, cross sections, and photographs of completed mitigation activities. The Plan also includes a list of the species planted and their associated densities, and the five-year monitoring protocol.

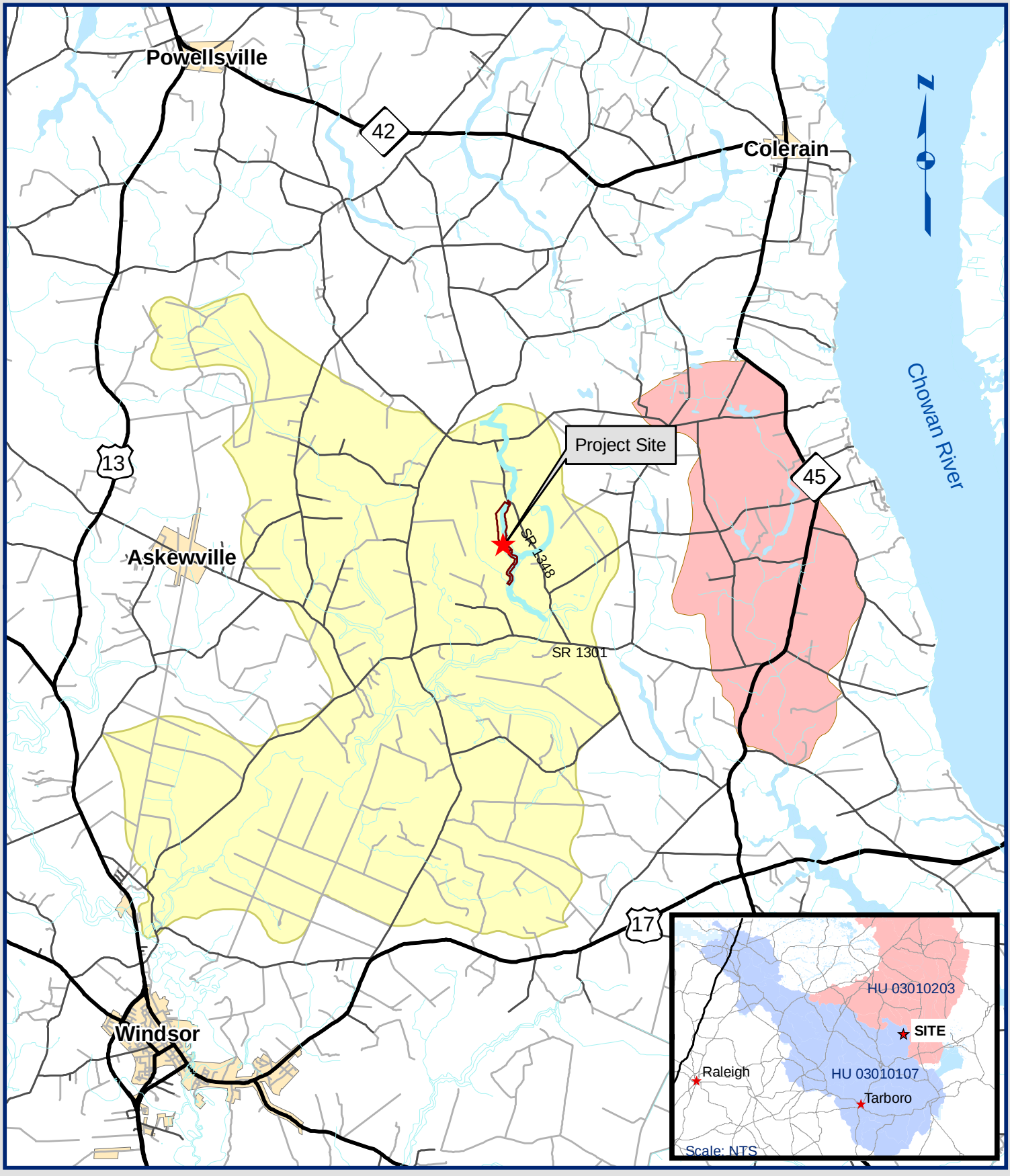
The restoration project will provide multiple ecological and water quality benefits within the Roanoke River Basin. Anticipated benefits include:

- nutrient removal;
- sediment reduction;
- water storage;
- improved groundwater recharge;
- improved in-stream and riparian habitat; and,
- restored wetland habitat.

PROJECT SITE

The Floogie site is located 9 miles northeast of Windsor (Figure 1). The property is 104 acres located immediately southwest of SR 1348 (Browns School Road) and is accessed via a farm road that runs adjacent to the channel (Flat Swamp Creek).

Flat Swamp Creek has a drainage area of 1,168 acres (1.83 mi^2) at the upstream end of the restoration project and 2,150 acres (3.36 mi^2) at the downstream end (Figure 2). The wetland restoration area has a drainage area of 1,456 acres (2.28 mi^2). The floodplain is mapped as Wehadkee loam, and the adjacent side slope drainages are mapped as Rains sandy loam. Wehadkee is an alluvial soil indicative of floodplains and valley features. Rains soils are nearly level and can occupy shallow depressions. As detailed in the Floogie Restoration Plan, soil borings confirmed hydric soils on the floodplain and adjacent side slope drainageways. The dominant historic land use was agricultural production of crops including cotton, soybeans, corn, and timber, although some areas were woodlands. Natural drainage patterns throughout the watershed had been historically altered to drain wetlands and promote agricultural production. Numerous agricultural ditches had been constructed on the project site, and streams had been channelized to route water off the site, draining areas that were once wetland. Decades of agricultural production and human manipulation altered the landforms and disturbed many of the indicators of headwater valleys adjacent to Flat Swamp Creek. Prior to restoration activities, the two headwater stream systems were conveyed down the valley and across the floodplain in agricultural drainage ditches. As detailed in the Floogie Restoration Plan, soil borings confirmed hydric soils on the floodplain and adjacent side slope drainageways. Both USGS topographic mapping and LiDAR imagery (Figure 3) clearly indicate valley features extending from the Flat Swamp Creek floodplain into the adjacent side slopes. At the conservation easement boundary



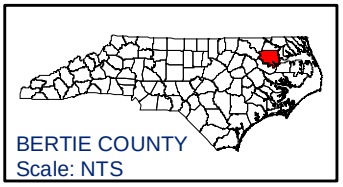
EBX

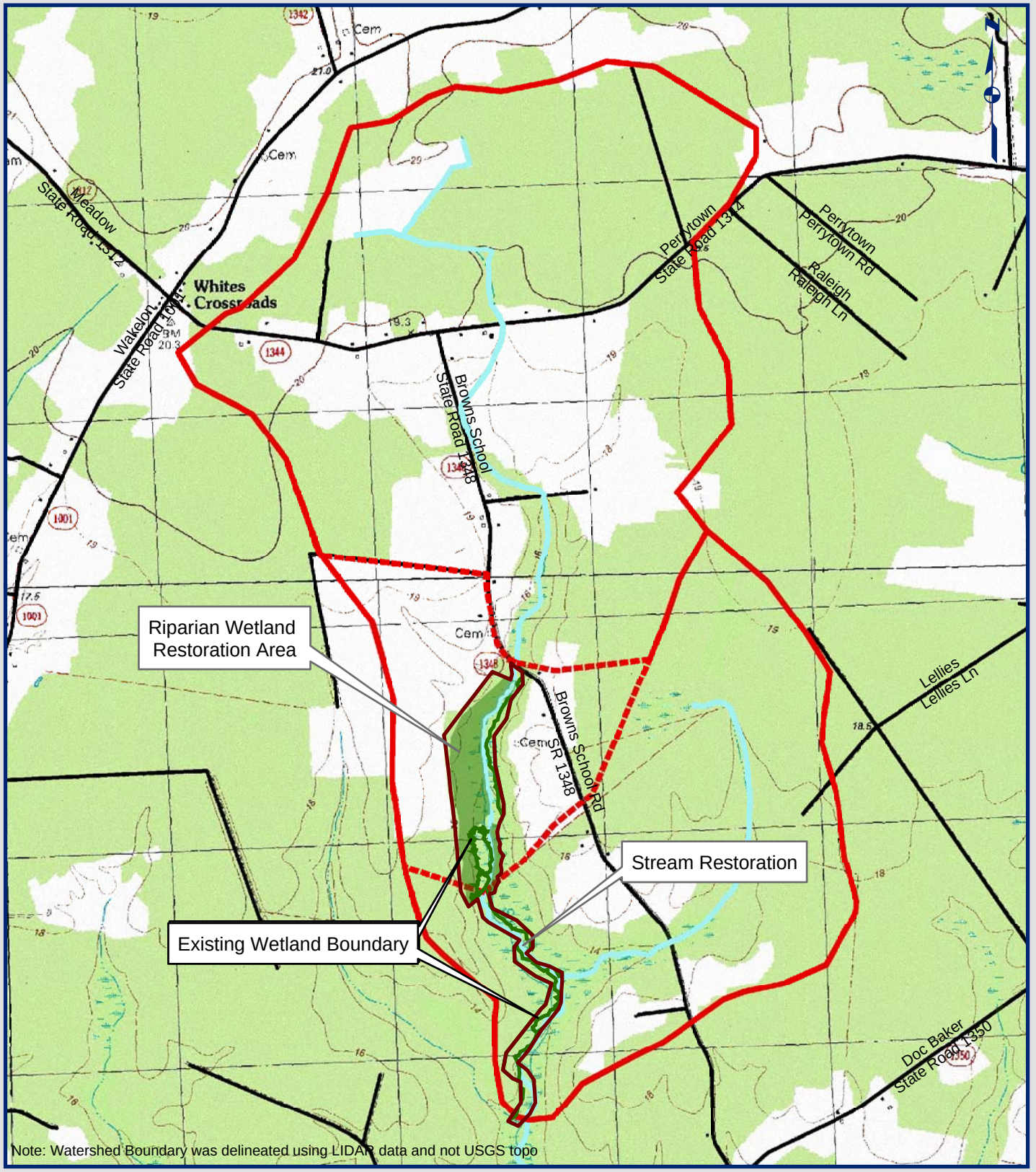
Figure 1.
Project Vicinity Map
Floogie Site

0 0.5 1 2 3 4 Miles

LEGEND

- NCDOT Roads
- Existing Waterbody
- HUC 03010107160050
- HUC 03010203090030





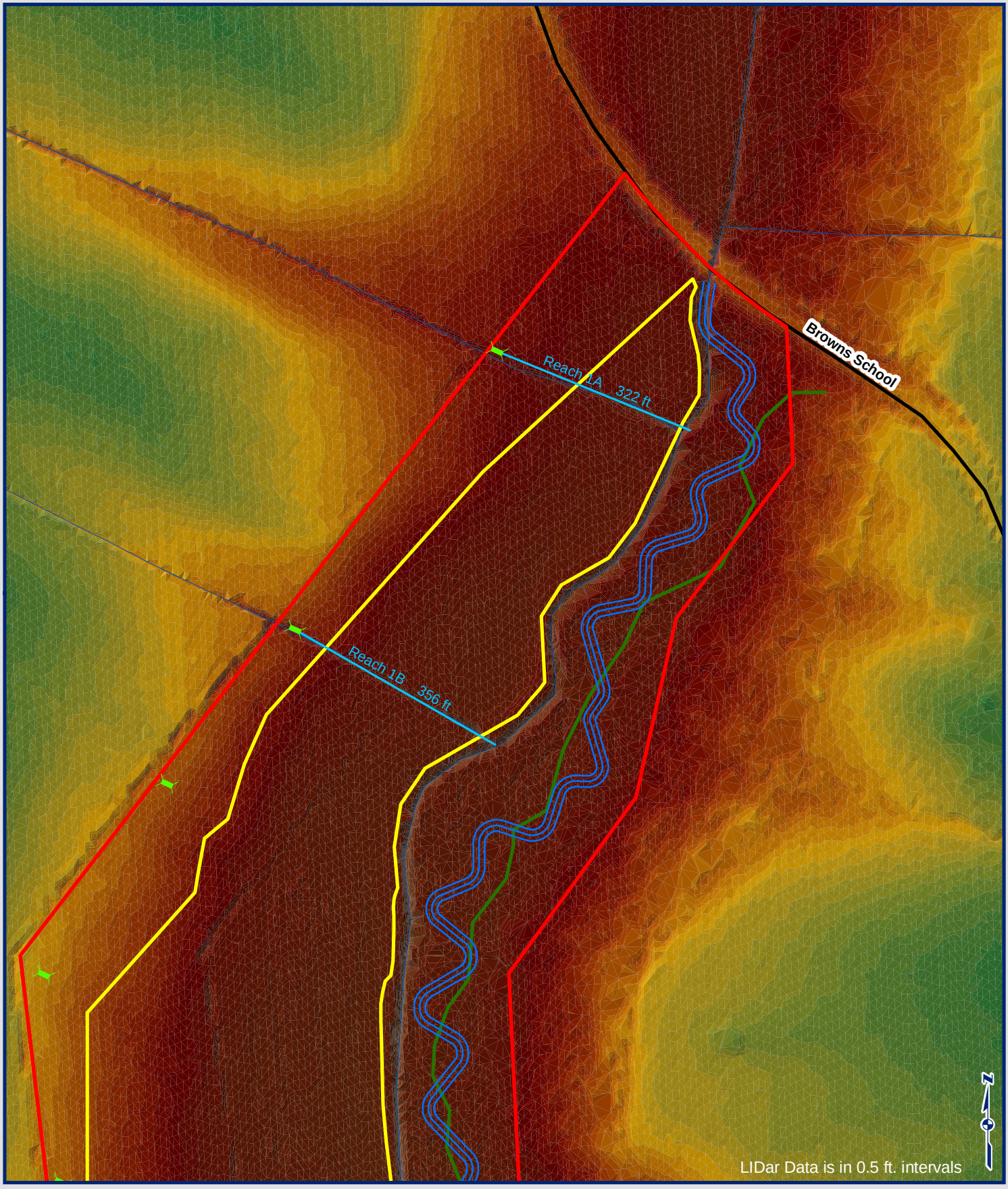
EBX

Figure 2.
USGS Quadrangle Map
Floogie Site

0 1,000 2,000 4,000 Feet

LEGEND

- NCDOT Roads
- Stream
- Project Area
- Potential Riverine Wetland Restoration
- Watershed Boundary



EBX

0 100 200 400 Feet

1 inch equals 200 feet

Figure 3
LIDAR Image
Floogie Site

LEGEND

- NCDOT Roads
- Restored Stream
- Head-Water Stream Restoration
- Culvert Outlets
- Existing Wetland Boundaries
- Restored Wetland Boundaries
- Easement Boundary

(upstream limit) the Reach 1A valley is approximately 250 feet wide. At the conservation easement boundary (upstream limit) the Reach 1B valley is approximately 100 feet wide. DWQ Stream Identification Forms (v3.1) were completed for the pre-construction conditions based on records of initial condition investigations, photographs, and personal knowledge of the site (Appendix D). Reach 1A scored 22.5 points. Reach 1B scored 20.0 points. The restoration areas are protected by a conservation easement.

MITIGATION SUMMARY

The objective of this project is to produce a minimum of 11,149 stream mitigation units (SMU), 25 riverine wetland mitigation units (WMU), and maximize the improvement of riparian and aquatic habitats and water quality through ecological restoration practices. The as-built survey documented 10,471 linear feet of stream restoration (Table 1). An additional 678 SMU were produced from two headwater stream restorations pursuant to the "Information Regarding Stream Restoration on the Outer Coastal Plain of North Carolina" (USACE 2005). Overbank stream flows will provide a portion of the hydrology for the wetlands. 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, improved in-stream and riparian habitat, and restored wetland habitat.

Table 1. Floogie Mitigation Summary

MITIGATION PRACTICE	SIZE	RATIO	MITIGATION UNITS
Wetland			
Riverine wetland restoration	25.19 ac	1:1	25.19
		Total:	25.19 WMU's
Stream			
Stream Restoration (Flat Swamp Creek)	10,471 lf	1:1	10,471
Headwater Stream Restoration Reach 1A	322 lf	1:1	322
Headwater Stream Restoration Reach 1B	356 lf	1:1	356
		Total:	11,149 SMU's

WETLAND CONSTRUCTION

Wetland construction began in October 2007 and was completed in February 2008.

Wetland restoration activities included plugging existing ditches, opening ditches outside the restoration area to promote infiltration, restoring microtopography, planting wetland species, and relocating an existing farm road outside of the easement. This roadbed interrupted surface flow to and from the channel. Grading included microtopograhy on the floodplain to create hydrologic retention, and encourage species diversification. Combined with the stream restoration, these actions will result in a sufficiently high water table and flood frequency to support hydrophytic vegetation and wetland hydrology, resulting in restored riverine wetlands.

The primary restoration activities included constructing a stream channel that floods the adjacent wetlands more frequently, and construction of ditch plugs and backfilling ditches throughout the prior converted farmland area and clearcut/pine plantation area. A typical ditch plug was 15 feet wide and extended above the ditch bank elevation approximately six inches. Plugs were constructed of compacted fill (clay or sandy clay) in 12 inch lifts with the upper 18 inches minimally compacted to facilitate plant growth. Plugs were spaced such that successive plugs are no more than 12 inches in elevation below the adjacent plug. Where plugs may impact adjacent ditches (outside of the proposed conservation easement) the top of plug elevation was equal to the existing ditch invert outside of the easement to prevent hydrologic trespass. Several ditches extend in a north-south direction outside of the proposed restoration area adjacent to existing

agricultural land. A series of eight culverts were installed below the relocated farm path to convey flow from these ditches into the restoration area. Outlets were constructed at these culverts to allow diffuse surface flow into the restoration area. The farm road adjacent to the existing stream was relocated outside of the proposed easement.

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

WETLAND PLANTING

All wetland vegetation was planted at the site during the March 10-16, 2008 time period. The planted area consists of two zones. Zone 1 is a wetter zone where inundated and saturated conditions will be typical. In Zone 2, saturation will be common, but drier periods will also likely occur. Plant materials used were bare-root seedlings and live stakes. Species selection was based on reference wetland vegetation and literature, and will produce a diverse habitat that includes mast producing species and fast-growing early successional species. The initial stocking density of plantings across the wetland sites was approximately 691 stems per acre (9 ft. X 7 ft. spacing). A list of all species planted and their percent composition is included in Table 2. All disturbed areas were seeded with appropriate seasonal temporary and permanent seed mixes to provide erosion control.

Table 2. Baseline wetland and riparian planted trees

Common Name	Scientific Name	Total Planted	Trees/Acre	Percent Composition
River birch	*Betula nigra*	2,000	31	4
Green Ash	*Fraxinus pennsylvanica*	7,100	110	16
Tulip poplar	*Liriodendron tulipifera*	2,000	31	4
Water Tupelo	*Nyssa aquatica*	5,100	79	11
Swamp blackgum	*Nyssa biflora*	6,800	105	15
Laurel oak	*Quercus laurifolia*	900	14	2
Overcup Oak	*Quercus lyrata*	4,800	74	11
Swamp Chestnut Oak	*Quercus michauxii*	2,000	31	4
Willow oak	*Quercus phellos*	7,100	110	16
Bald Cypress	*Taxodium distichum*	6,900	107	15
	Total:	44,700		

STREAM CONSTRUCTION

Stream construction began in October 2007 and was completed in February 2008. 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 10,471 linear feet. An additional 678 linear feet of headwater stream restoration was achieved on Reach 1A and 1B. Reach 1A and Reach 1B headwater streams are located in the wetland restoration area adjacent to the restored Flat Swamp Creek.

To begin construction, a survey crew staked out the new channel alignment. A construction access route was designated to access the work area from the established farm path. The channel was constructed in sections from downstream to upstream such that the existing channel remained open and no pump-around was required. 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. Following construction of the new channel,

the existing stream was 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.

Natural channel design techniques have been used to develop the restoration designs described in this document. The reference reach design method was determined to be appropriate for this project because the watershed is rural, the causes of disturbance are known and have been abated, and there are no infrastructure constraints. The original design parameters were developed from reference stream data and applied to the subject stream. The parameters were then analyzed and adjusted through an iterative process as necessary using analytical tools and numerical simulations of fluvial processes. The designs presented in this report provide for the restoration of natural Coastal Plain sand-bed channel features and stream bed diversity to improve benthic habitat. The proposed design will allow flows that exceed the design bankfull stage to spread out over the floodplain and provide a portion of the hydrology for the restored riverine wetland.

Construction techniques pertaining to headwater stream restoration Reaches 1A and 1B included back-filling and plugging existing ditches, restoring microtopography, planting wetland species, and relocating an existing farm road outside of the easement. A typical ditch plug was 15 feet wide and extended approximately six inches above the ditch bank elevation. Plugs were constructed of compacted fill (clay or sandy clay) in 12 inch lifts with the upper 18 inches minimally compacted to facilitate plant growth. Plugs were spaced such that successive plugs are no more than 12 inches in elevation below the adjacent upslope plug. Specific to the headwater streams, culverts were placed beneath the new access road to convey surface flow into the wetland through the headwater valleys. The culverts were placed such that the agricultural ditches upgradient of the restoration area will remain open. Grading included microtopograhy on the floodplain to create hydrologic retention and to encourage species diversity. Locations of pertinent restoration features are given in the As-Built drawings Sheet 18A (attached).

RIPARIAN PLANTING

All riparian vegetation was planted at the site March 18-26, 2007 after stream construction was complete. Bare root native tree species were planted to establish forested riparian buffers of approximately fifty feet on both sides of the restored stream and other disturbed areas. The initial stocking of riparian plantings across the site was approximately 691 stems per acre. A list of all species planted and their percent composition is included in Table 2. In addition to the riparian plantings, 4,300 black willow (*Salix nigra*) and 4,700 silky dogwood (*Cornus amomum*) live stakes were installed on the outside of stream meander bends and downstream of grade control structures along the entire restoration length. Sod mats of existing riparian vegetation were placed on the stream banks where available. The headwater stream valleys were contained in Zone 1, a wetter zone where inundated and saturated conditions will be typical. Typical species included river birch, green ash, water tupelo, Overcup oak, and bald cypress. Plant materials used were bare-root seedlings and live stakes. Species selection was based on reference wetland vegetation and literature, and will produce a diverse habitat that includes mast producing species and fast-growing early successional species. The initial stocking density of plantings across the wetland sites was approximately 691 stems per acre (9 ft. X 7 ft. spacing). All disturbed areas were seeded with appropriate permanent and seasonal temporary seed mixes to provide erosion control.

COMMENTS AND OBSERVATIONS

Construction progressed steadily throughout the fall and winter and was completed on time. The majority of the project was built according to the design plans. Minor alterations to horizontal

structure placement and channel alignment did occur and were approved by EBX and its engineer WK Dickson. Specifically the following changes were made:

- Five proposed log ramps from STA 72+50 to STA 75+50 were replaced with four rock weirs due to stability concerns in the sandy bank and bed material;
- Several minor changes to the channel alignment were made from STA 58+00 to STA 72+00 to protect existing mature bottomland hardwood trees;
- The proposed relocated farm path outside of the wetland restoration area was moved to the east side of the field ditch, and eight culverts were installed beneath the farm path to convey runoff into the wetland restoration area;
- A small drainage swale was constructed along the northern edge of the wetland restoration area to facilitate drainage off of existing agricultural fields and into the wetland restoration area and restored channel;
- Five log grade control structures were removed from Reach 4 due to inconsistencies with the surveyed thalweg and field conditions (STA 80+67, 82+73, 83+54, 86+02, and 92+97); as proposed, the structures would have been located at a lower elevation than downstream grade control structures and therefore offer no stability function;
- Breaks were constructed in the farm path adjacent to Reach 4 (STA 77+00 to STA 102+00) approximately 50 feet wide and spaced every 200 feet to facilitate overbank flooding and reconnection with the floodplain.

WK Dickson performed weekly or bi-weekly construction observation from October 29, 2007 through planting on March 12, 2008. All construction observations were recorded in a notebook with standard forms and plan sheets. The notebook is on file at WK Dickson. WK Dickson observed installation of several of each structure type, and assisted the contractor on proper installation early in the construction process. All structure locations were verified both horizontally and vertically weekly to ensure proper placement. WK Dickson also performed spot checks of bed elevation, channel dimension, and sinuosity. The contractor performed superbly and only a few minor problems required repair.

All construction was performed in the dry, and all disturbed areas were immediately stabilized with temporary seed and mulch following construction. Proper erosion control was maintained throughout construction and no large sediment discharges were observed. The early construction period was marked by consistent dry weather and proceeded rapidly. From December through February rainfall was consistent and included several large storms. The restored channel was connected in late January and immediately had two out of bank flood events. Only minor damage was observed and was easily repaired. A walkthrough of the near-complete site was conducted with WK Dickson, EBX, and the contractor on February 11 to develop a final punch list of items to complete. The contractor completed the punch list and construction was documented as complete on February 26, 2008. Planting was documented as complete on March 19, 2008. Following construction, a small area of bank erosion was observed at STA 34+00 where consistent flow from the old backfilled channel enters the restored channel. This area will be observed to make sure that stream stability or wetland hydrology is not compromised.

The final design plans described 10,294 linear feet of stream restoration. The as-built survey documented construction of 10,471 linear feet of restored stream and 678 linear feet of headwater stream restoration. 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 imperceptible on the ground. The proposed 25.19 acres of wetland restoration will be documented through groundwater monitoring and observations of site

conditions. Following completion of restoration activities, several months of normal rainfall occurred, and significant surface flow was observed from the adjacent agricultural ditches onto the restored wetland area. This surface flow was observed for several days or weeks following rainfall events. In addition to sheet flow across the wetland area, small braided channels or rills were observed forming near the culvert outlets into the restoration area. These small braided channels concentrated flow as the channel approached the restored Flat Swamp Creek, and minor head-cutting was observed. Based on observed channel formation and the consistency and longevity of surface flow following rain events, it appears that Reach 1A and 1B are headwater streams. DWQ Stream Identification Forms (v3.1) were completed for the post-construction conditions (Appendix D). Reach 1A scored 23.25 points. Reach 1B scored 23.25 points. All groundwater monitoring locations had wetland hydrology and consistent saturation and seepage was observed across the wetland restoration area.

MONITORING SET-UP

The five-year monitoring plan for the Floogie 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 nine groundwater gauges (three in a reference wetland), two crest gauges, a rain gauge, 20 permanent stream cross sections, and 18 vegetation monitoring plots. Specific locations of vegetation plots, permanent cross sections, and gauges are shown on the as-built drawings (Appendix E). Photos were taken to document the as-built condition of the vegetation plots, Reach 1A and 1B, and cross sections throughout the project (Appendix A, Appendix B, and Appendix C).

WETLAND HYDROLOGY

Successful establishment of wetland hydrology will be demonstrated by a wetland hydroperiod in excess of 7.0 percent of the growing season. Six 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.

WETLAND VEGETATION

Five vegetation sampling plots were established within the wetland restoration 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 planted wetland restoration area. Each planted woody stem is identified with a permanent number on an aluminum tag attached to the tree. Total planted trees are summarized in Table 3.

Table 3. Wetland planted trees per plot and corresponding stocking levels

Plot	Trees Observed	Stocking Level (per acre)
1	61	610
2	60	600
3	70	700
4	69	690
5	65	650
	Average:	650

Planted woody species will be monitored twice per year for the first three years, and annually in monitoring years four and five. Herbaceous plant cover will be assessed annually using qualitative observations of species percent cover.

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 at the end of the third year of monitoring as an interim measure of success.

STREAM STABILITY

CROSS SECTIONS

The mitigation plan for the Floogie project requires 20 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. Flat Swamp Creek is a sand bed channel and is expected to have a dynamic bed and profile.

LONGITUDINAL PROFILE

Longitudinal profiles will be surveyed in years one, two, three, four, and five of the monitoring period. The length of the measured profile will be at least 3,142 linear feet (30% of the restored length). 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.

HYDROLOGY

Two crest gauges were installed at the site: one at station 38+25 and one at station 88+25 (Appendix C). Crest gauges will be checked monthly to document high flows. During the gauge inspections any high water marks or debris lines observed will be documented and photographed.

HEADWATER STREAMS

The headwater stream restoration will be monitored using visual observations of surface flow, photographs of dye marking, and movement of deposited sand. Monthly site visits will be conducted during the growing season. At each site visit, a visual observation of each restored headwater stream will be made to document the presence of surface water. When surface water is present, a water soluble dye will be released in the water at a reference location, and time-sequenced photographs will be taken to document water movement. In addition to the visual observations, a small amount of white sand will be left at a reference location in each headwater stream. This sand will be observed monthly to determine if, and how much, the deposit has moved down the valley. Both photographs and qualitative observations will document this sand movement. Records of stream flow will be correlated with on-site rainfall data to document intermittent or seasonal flow. Success criteria will be met if the headwater streams exhibit intermittent or seasonal flow. Monitoring results will be presented in the annual monitoring report.

RIPARIAN VEGETATION

Thirteen semi-permanent vegetation sampling plots were established along the stream restoration riparian buffer to monitor the success of planted vegetation. The 0.05 acre 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 planted riparian area. Each planted woody stem is identified with a number on an aluminum tag attached to the tree. Total planted trees are summarized in Table 4.

Table 4. Riparian planted trees per plot and corresponding stocking levels

Plot	Trees Observed	Stocking Level (per acre)
6	40	800
7	37	740
8	49	980
9	45	900
10	50	1000
11	47	940
12	45	900
13	40	800
14	51	1020
15	48	960
16	49	980
17	30	600
18	28	560
	Average:	860

Planted woody species will be monitored twice per year for the first three years, and annually in monitoring years four and five. Herbaceous plant cover will be assessed annually using qualitative observations of species percent cover.

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 at the end of the third year of monitoring as an interim measure of success.

BENTHIC MACROINVERTEBRATES

Benthic macroinvertebrates will be monitored on the Floogie site. Pre-construction monitoring was performed prior to disturbance to the existing channel in January 2008. Following restoration, Year 1 monitoring will be conducted in January 2009. Additional monitoring will be conducted in January of 2011 (Year 3) and 2013 (Year 5).

Sampling will take place at two sites along the restoration reach and one site upstream of the project area on Flat Swamp Creek. Restoration Site 1 will be near the downstream end of Reach 4 (between STA 101+00 and 102+00). Restoration Site 2 will be near the downstream end of Reach 2 (between STA 36+00 and 37+00). In addition to the restoration sites, one sample will be taken upstream of the project area on Flat Swamp Creek. The Qual 4 sampling method outlined in *Standard Operating Procedures for Benthic Macroinvertebrates* (NCDWQ 2006) will be utilized at all sampling locations.

A North Carolina Division of Water Quality stream habitat evaluation form will be completed at each sample reach during each sampling event. This form requires that 100 meters of stream be evaluated. At each sampling site, habitat will be evaluated approximately 50 meters upstream and 50 meters downstream of where macroinvertebrates are collected.

All macroinvertebrates collected will be identified to the lowest taxonomic level by a laboratory certified to do macroinvertebrate identifications through the DWQ Lab Certification program administered by the Environmental Services Section. Findings and conclusions will be reported in the subsequent annual monitoring report. Year 5 benthic macroinvertebrate data will be provided as a supplement following the Year 5 report submittal.

Appendix A

As-Built Vegetation Plot Photos

Floogie Wetland Restoration Veg Plot 1

Floogie Wetland Restoration Veg Plot 2

Floogie Wetland Restoration Veg Plot 3

Floogie Wetland Restoration Veg Plot 4

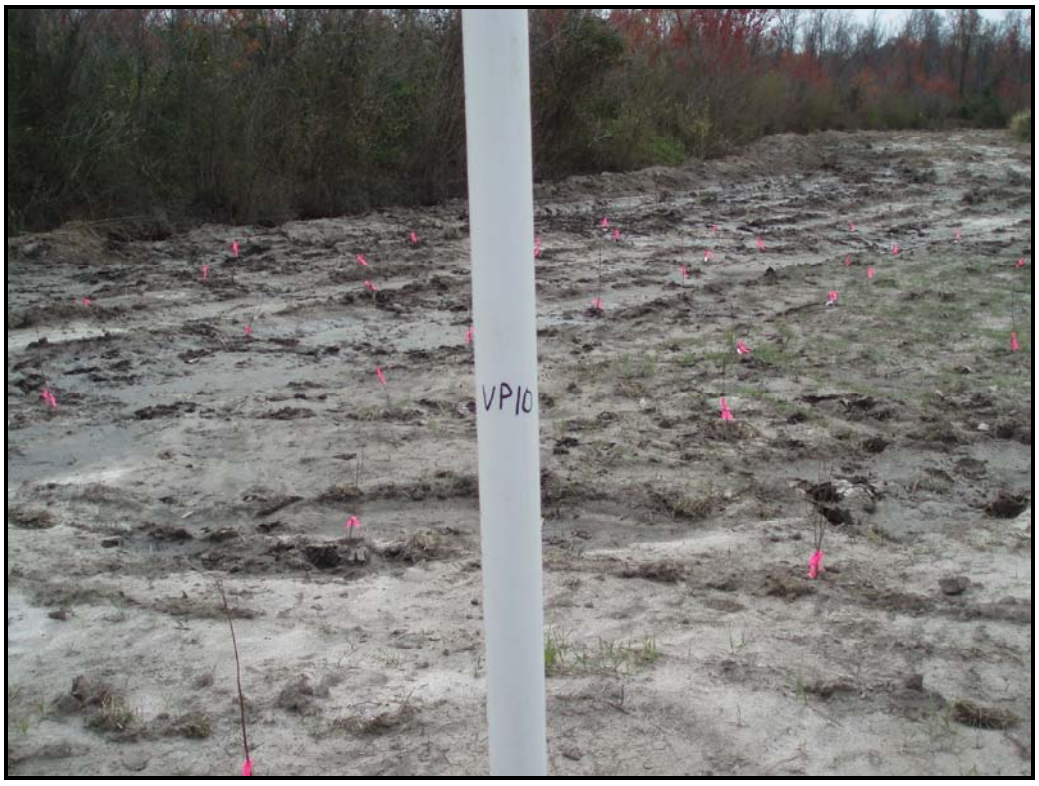
Floogie Wetland Restoration Veg Plot 5

Floogie Stream Restoration Veg Plot 6

Floogie Stream Restoration Veg Plot 7

Floogie Stream Restoration Veg Plot 8

Floogie Stream Restoration Veg Plot 9



Floogie Stream Restoration Veg Plot 10

Floogie Stream Restoration Veg Plot 11

Floogie Stream Restoration Veg Plot 12

Floogie Stream Restoration Veg Plot 13

Floogie Stream Restoration Veg Plot 14

Floogie Stream Restoration Veg Plot 15

Floogie Stream Restoration Veg Plot 16

Floogie Stream Restoration Veg Plot 17

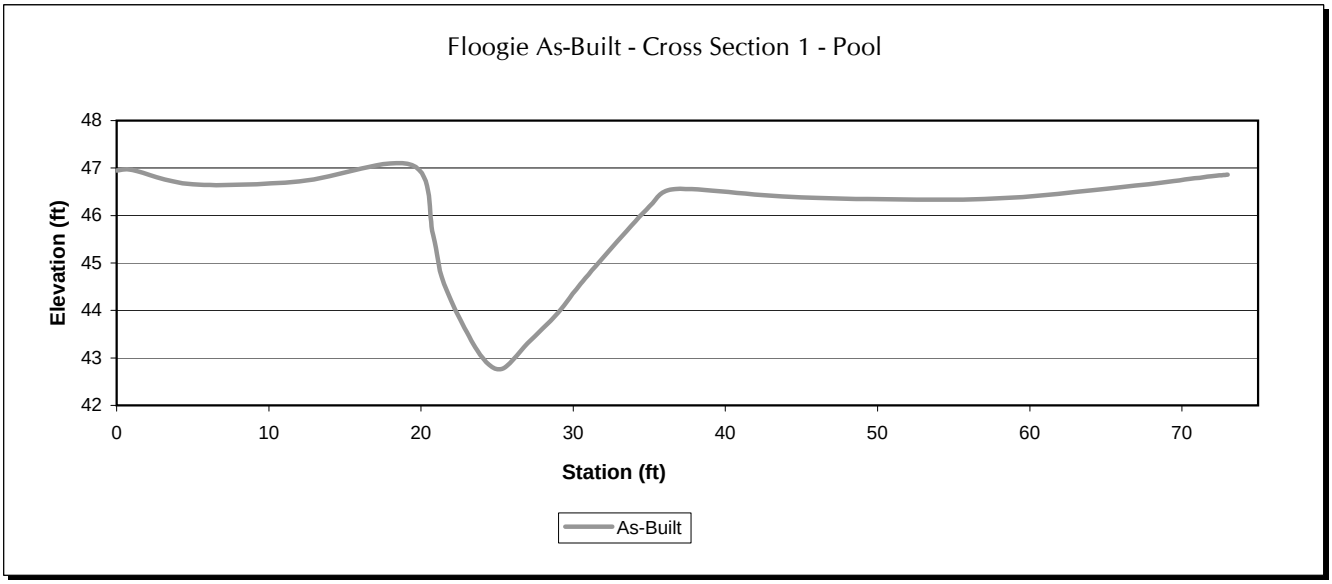
Floogie Stream Restoration Veg Plot 18

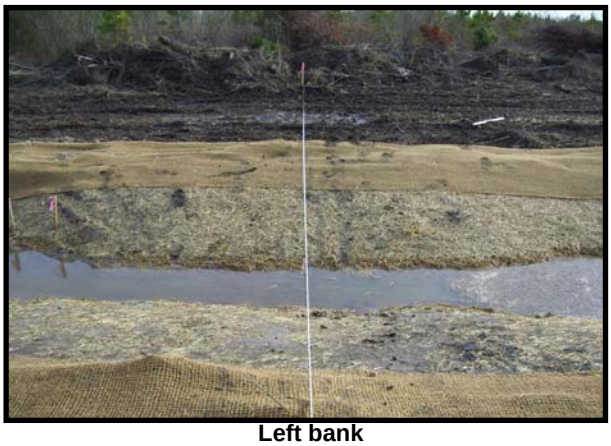
Appendix B

As-Built Cross Sections

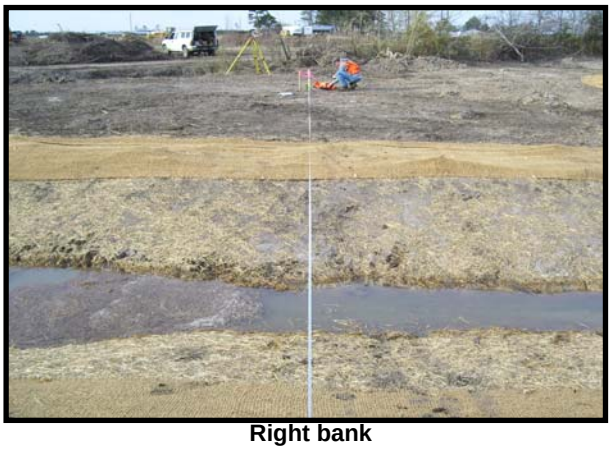
Left bank

Right bank

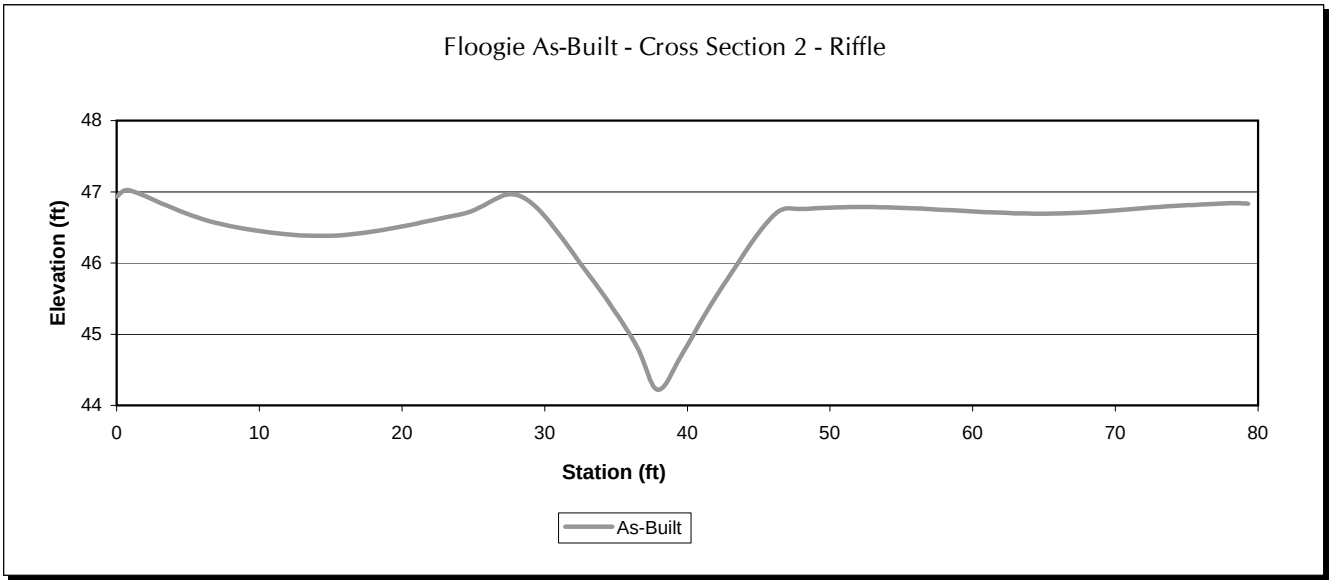




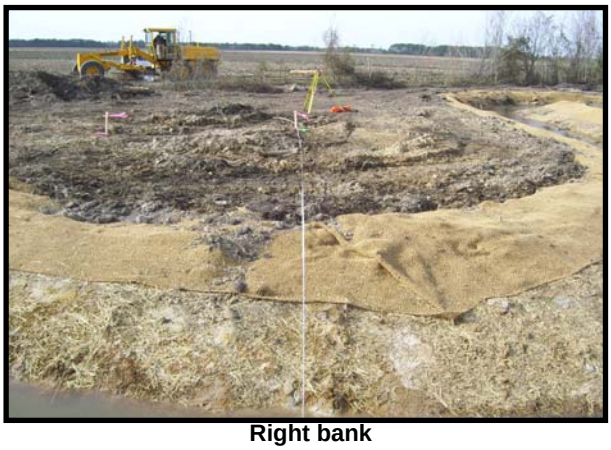
Left bank



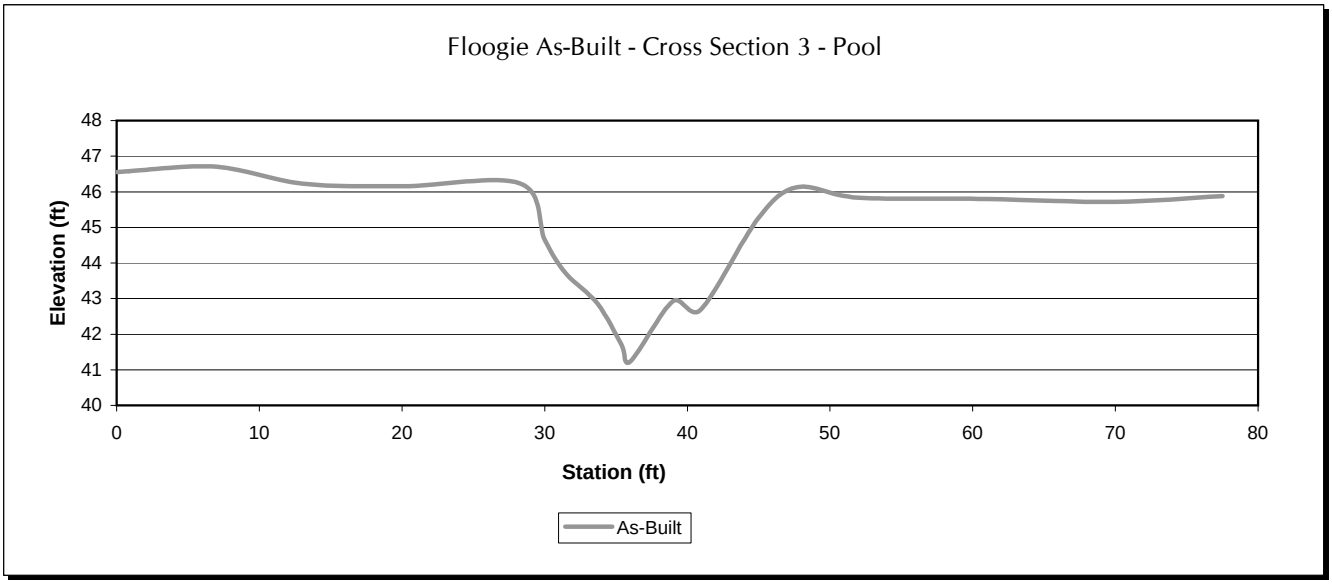
Right bank



Left bank

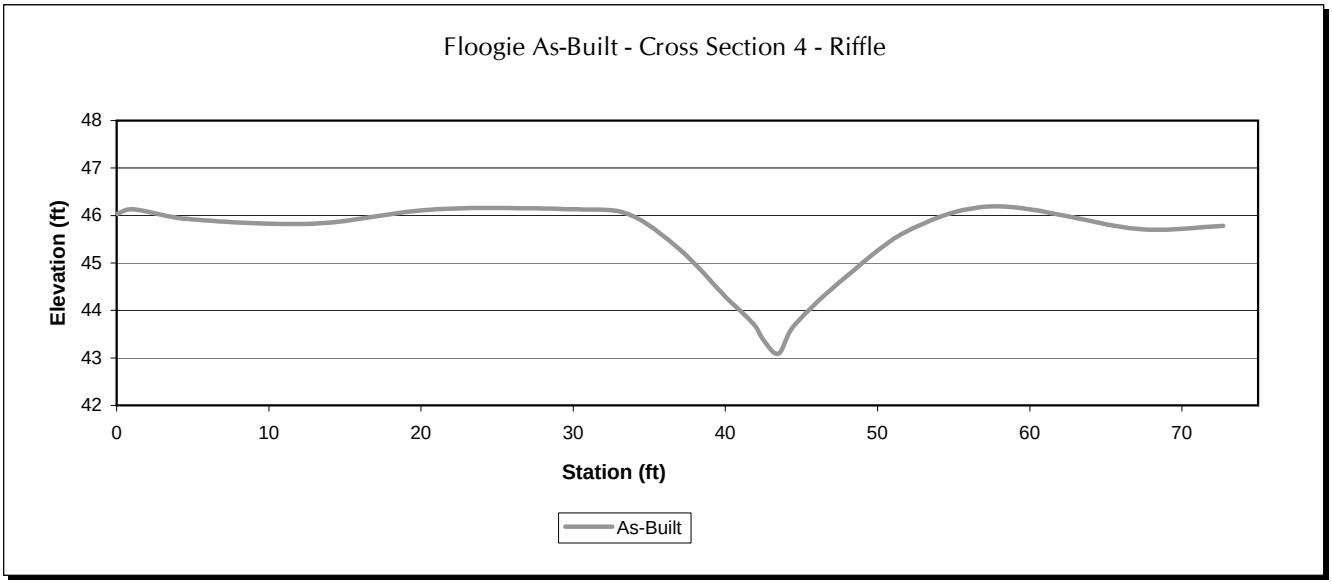


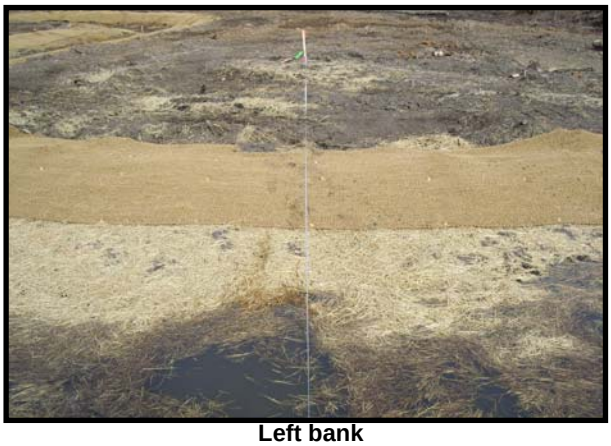
Right bank



Left bank

Right bank





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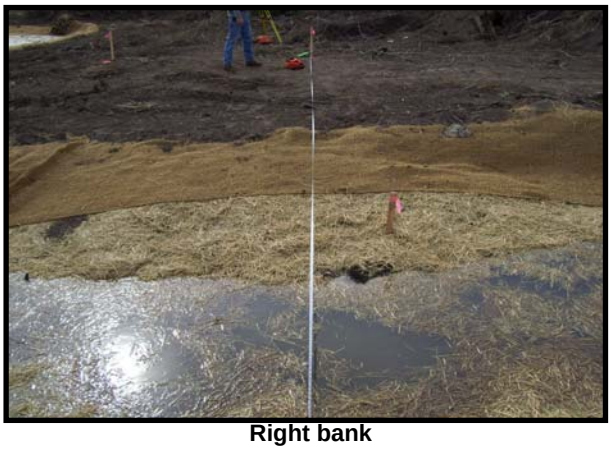

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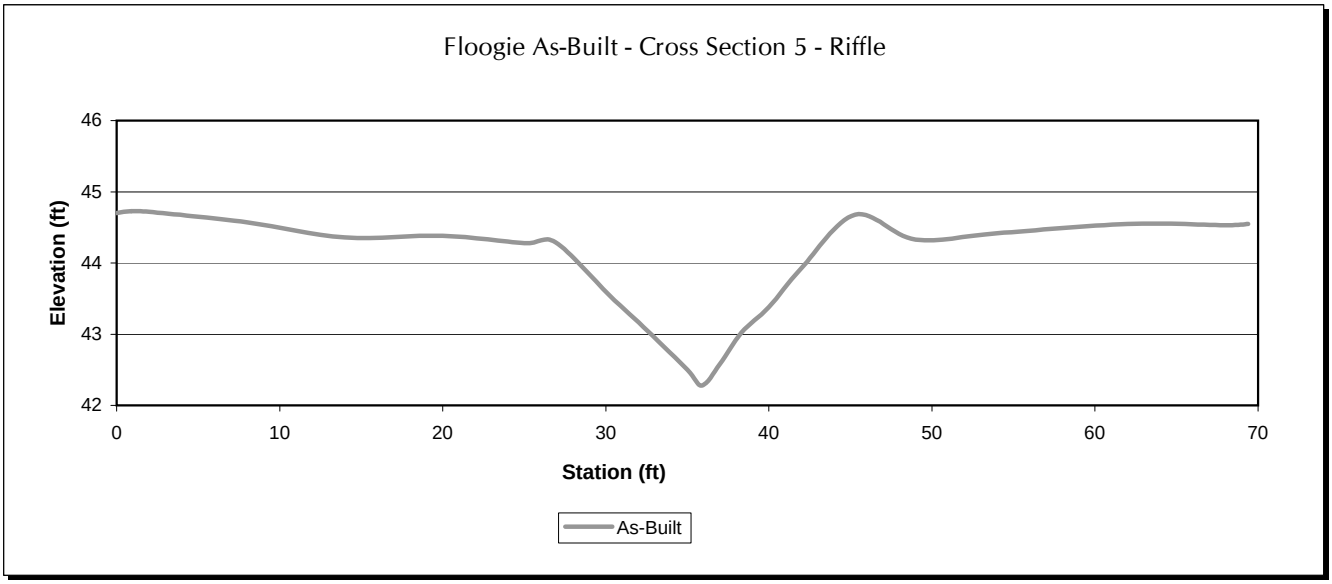
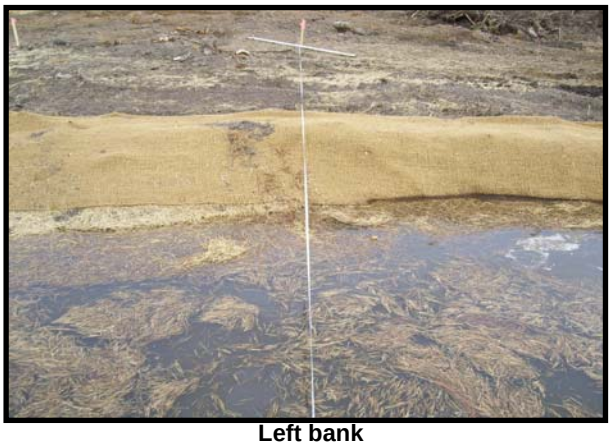
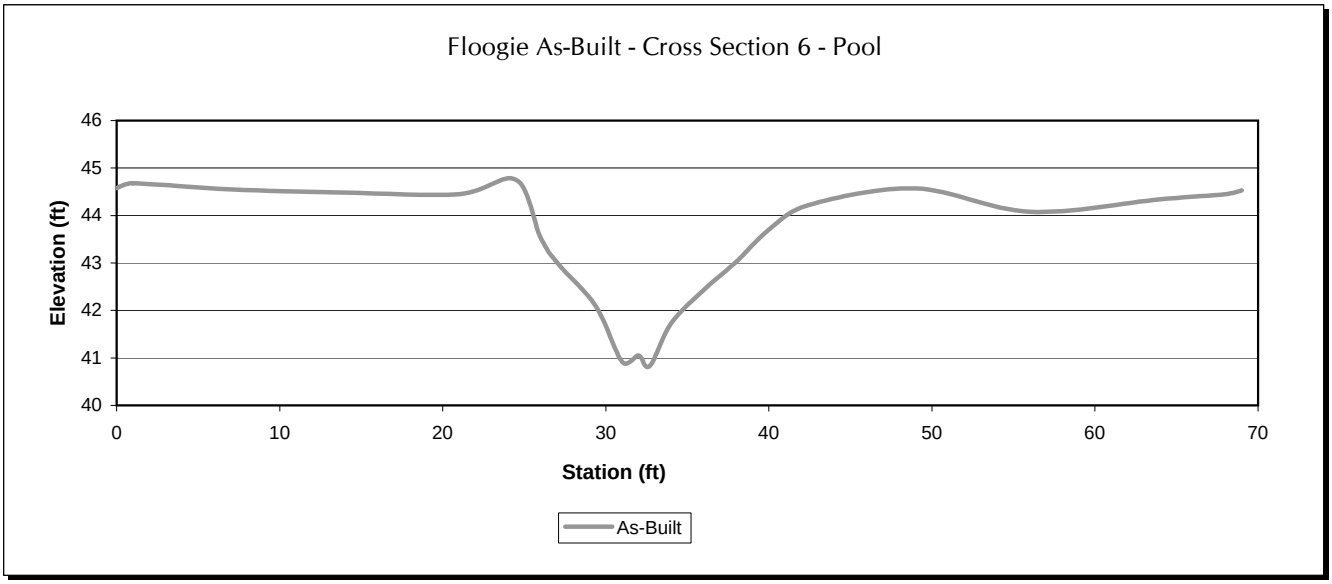
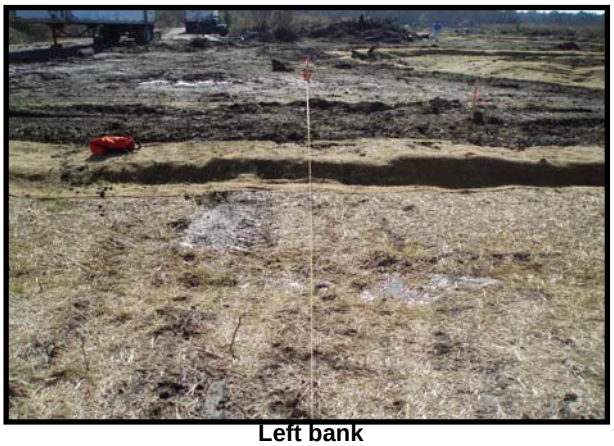




Left bank

Right bank





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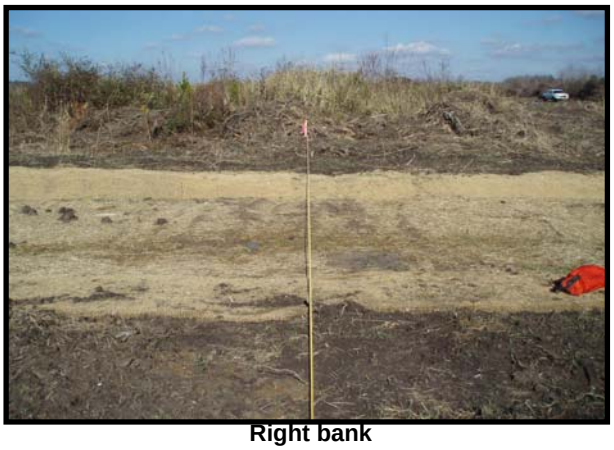

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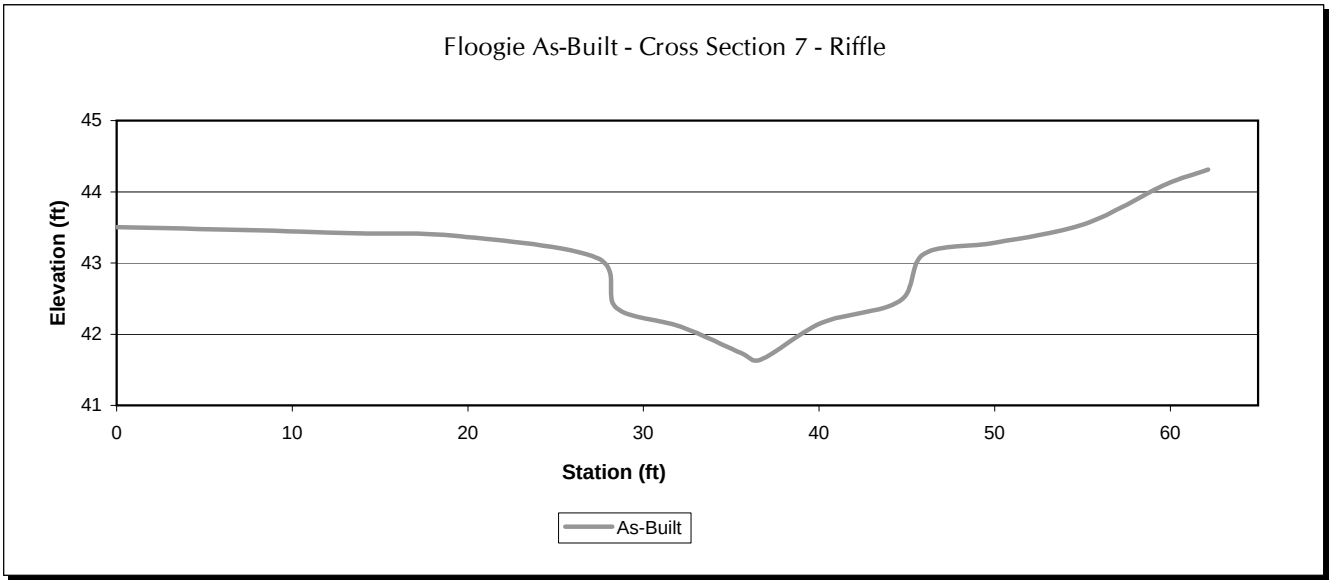

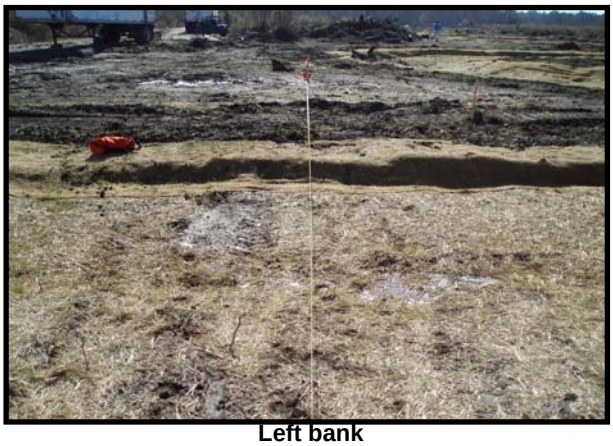

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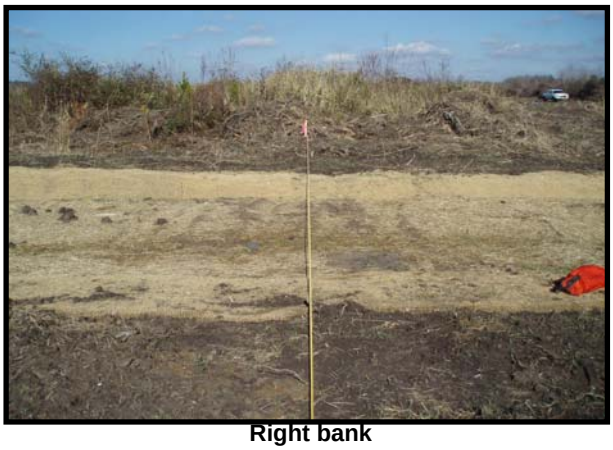

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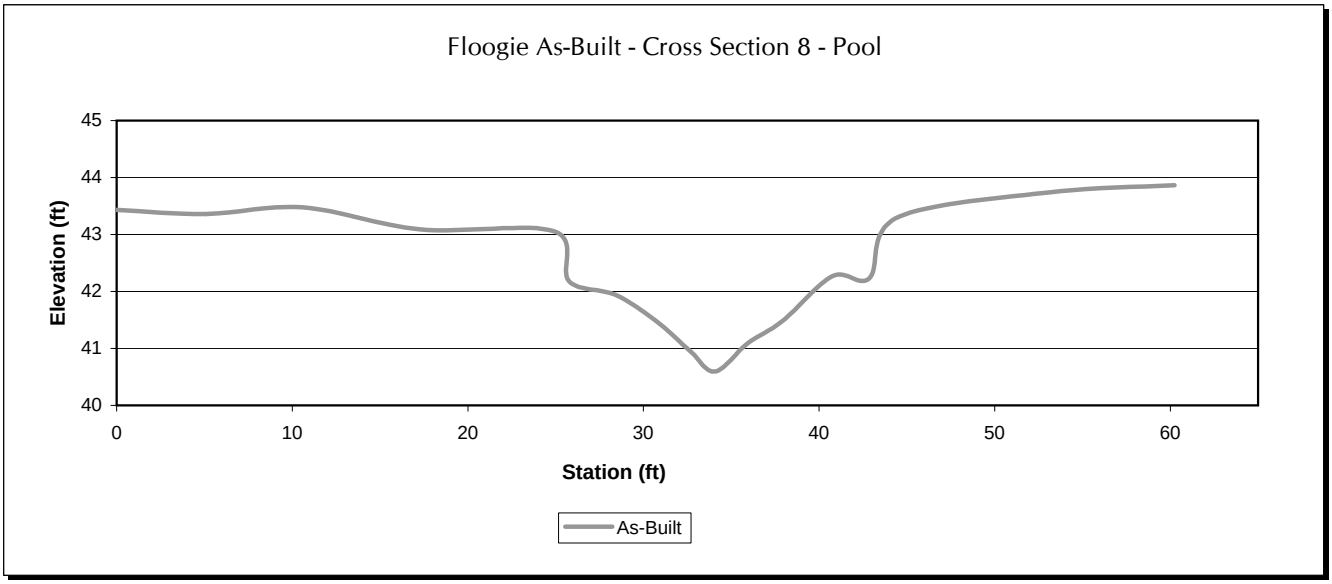

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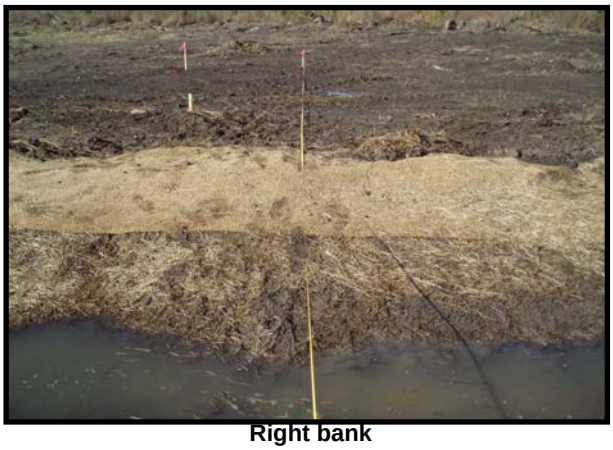

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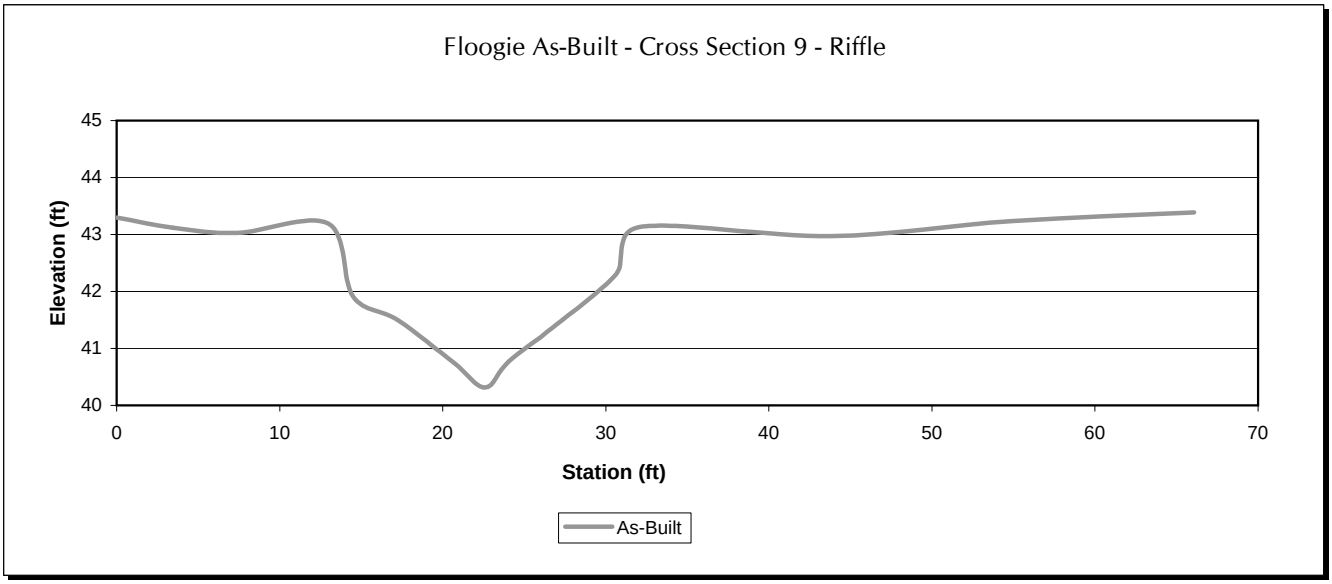
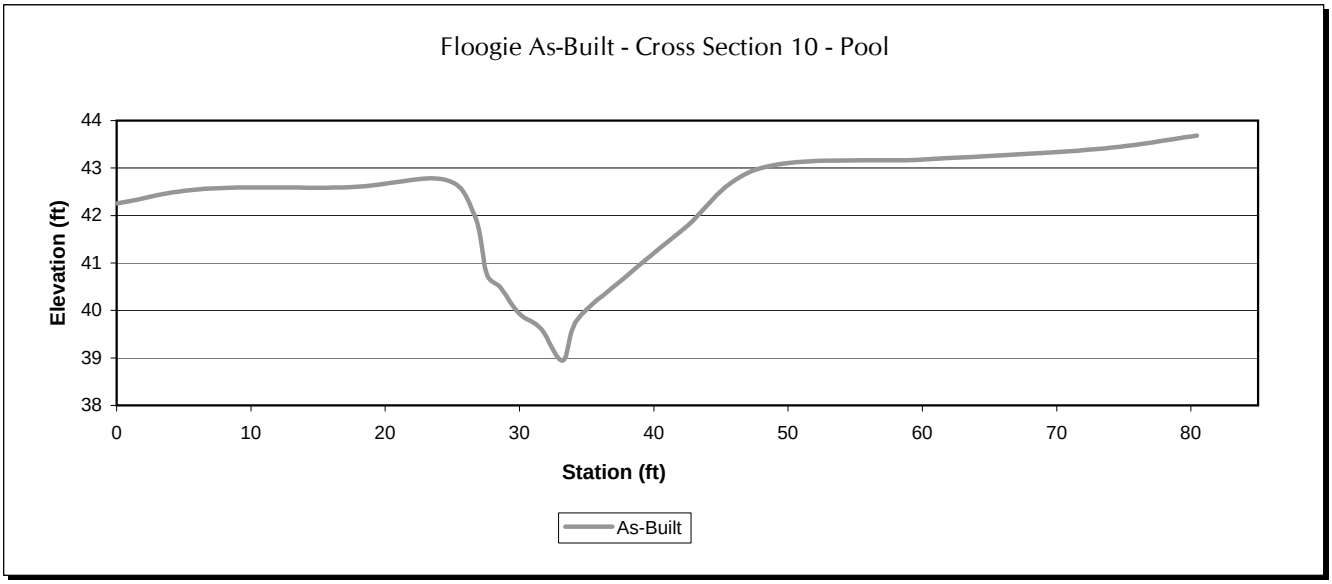
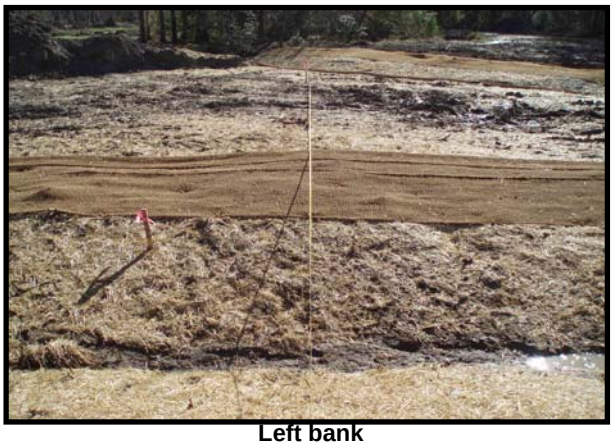


Left bank

Right bank





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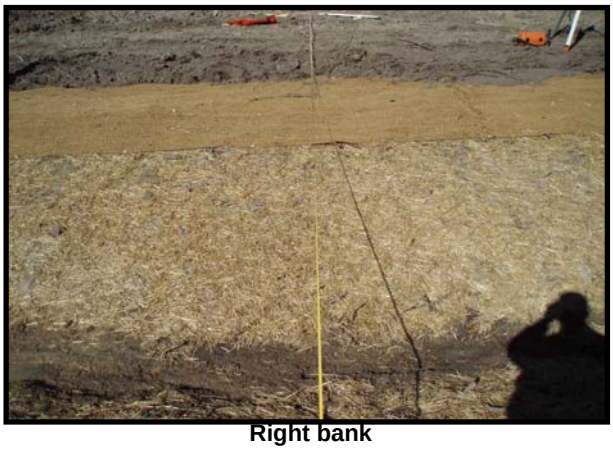

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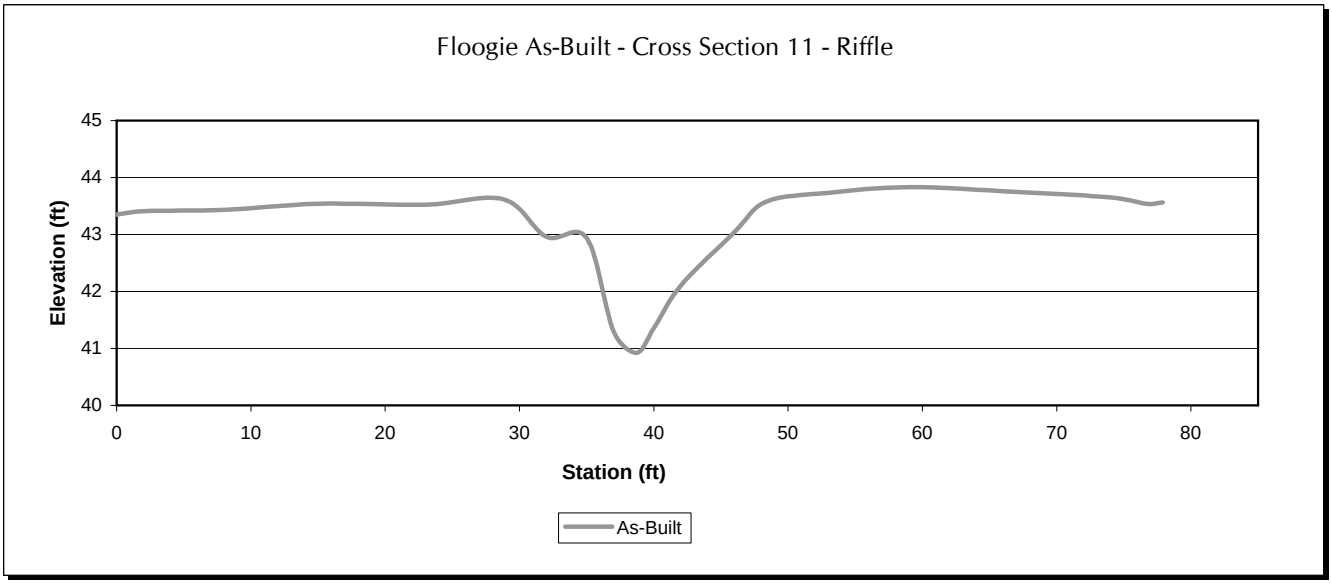
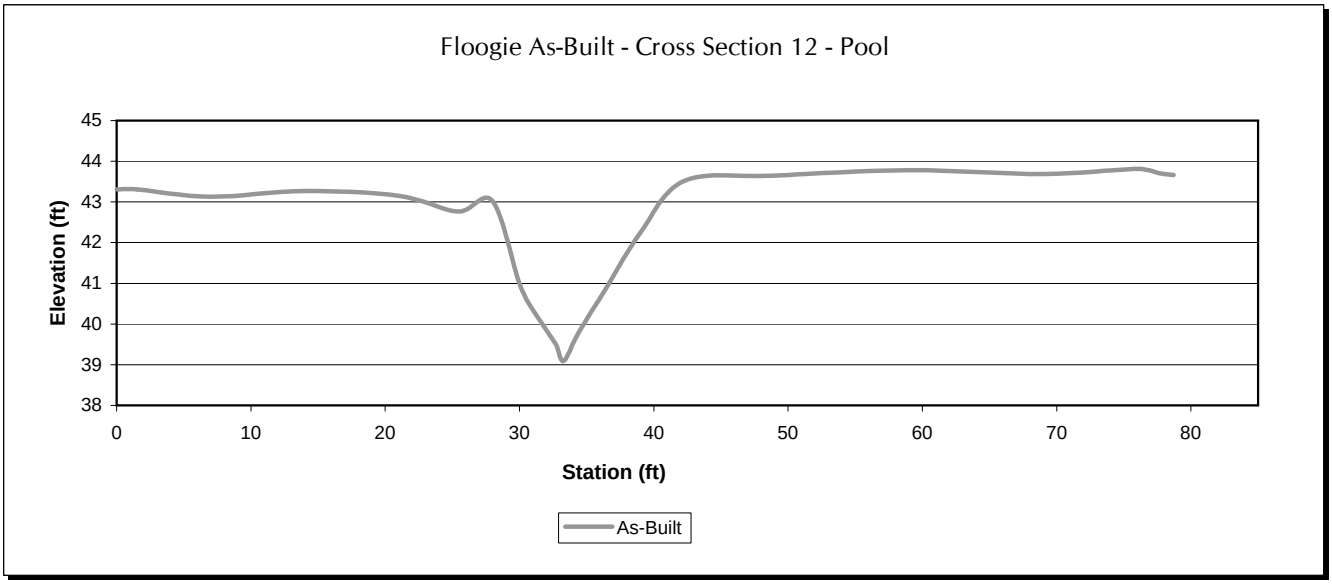


Left bank

Right bank



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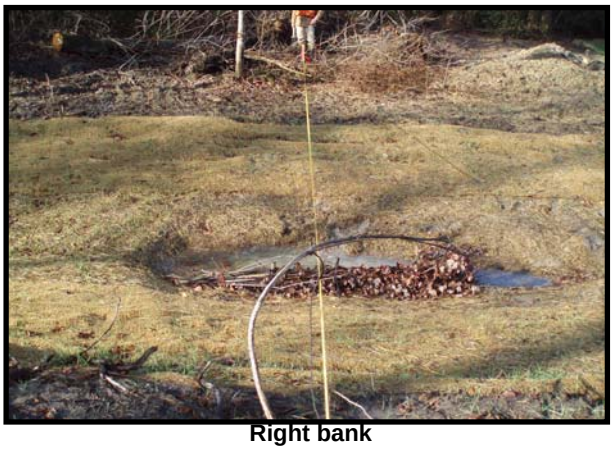

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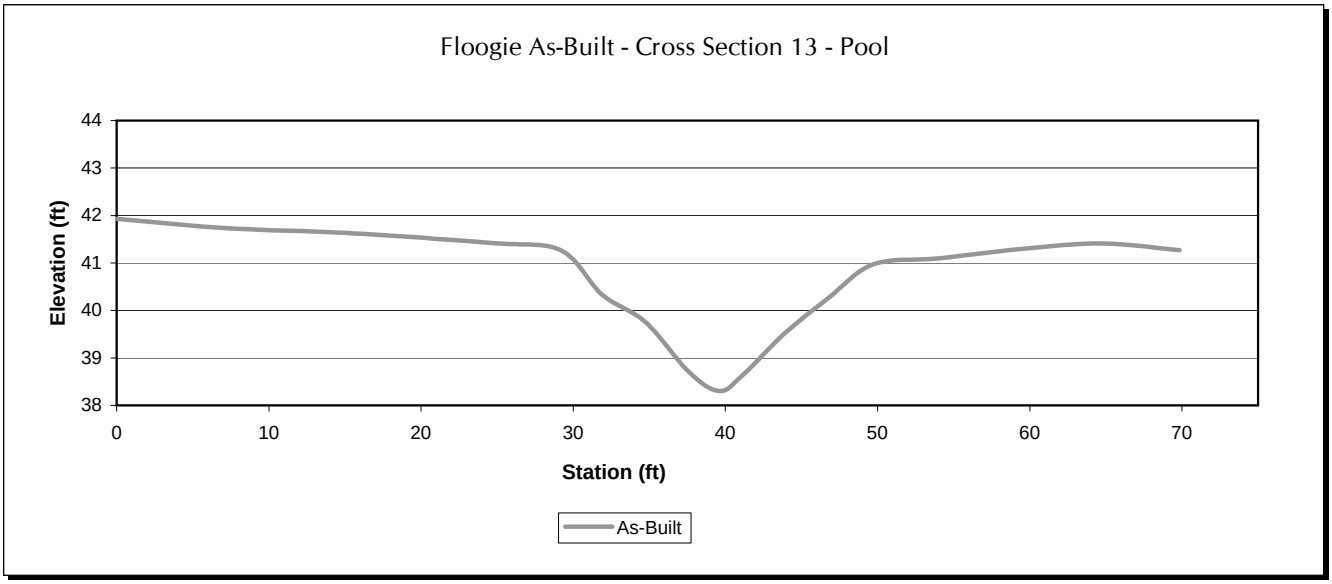

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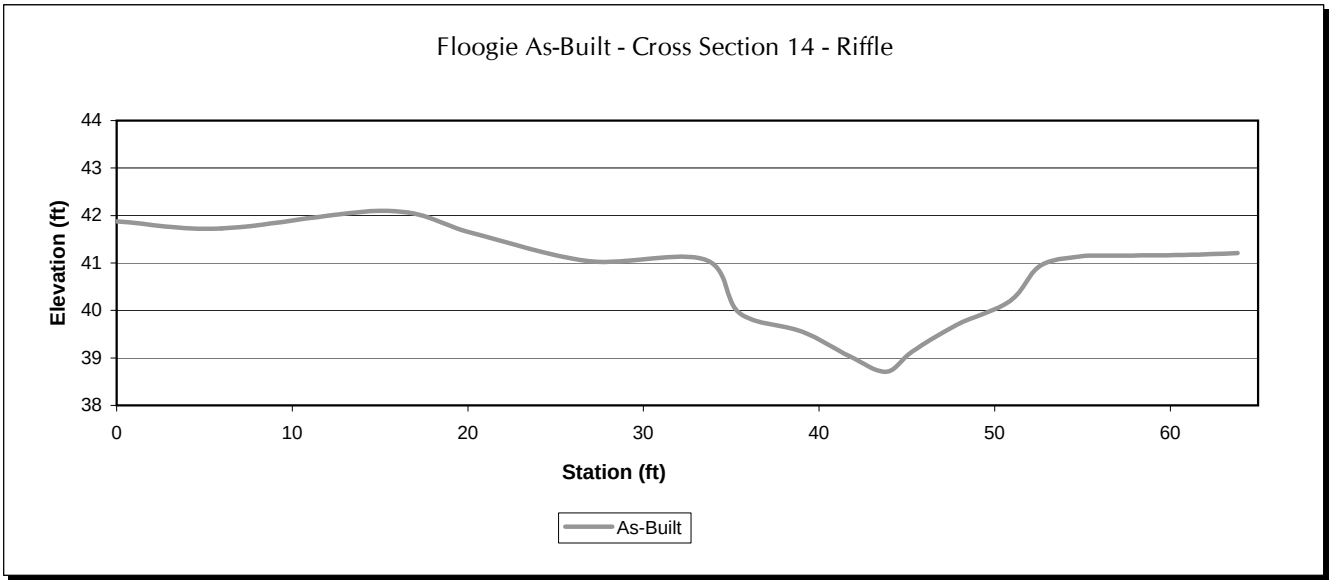

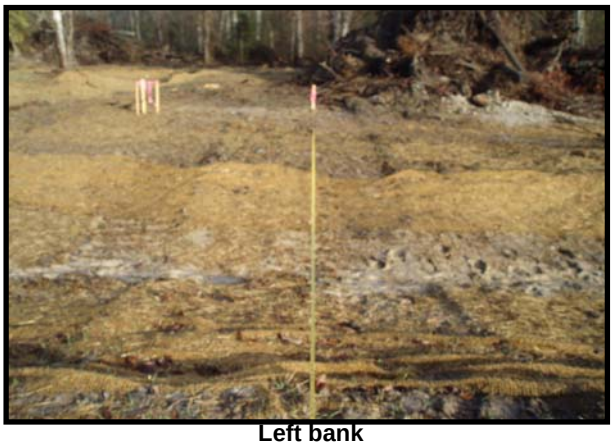

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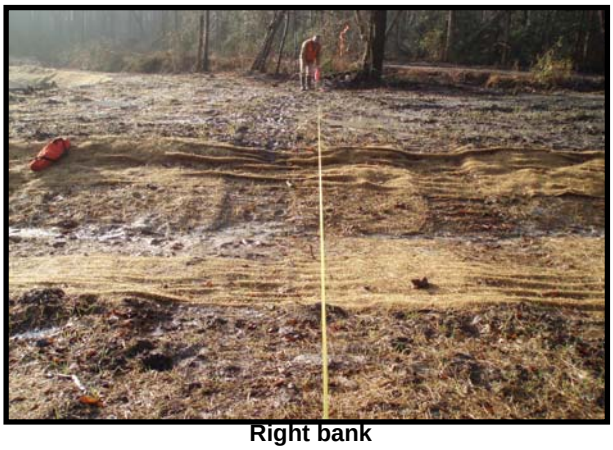

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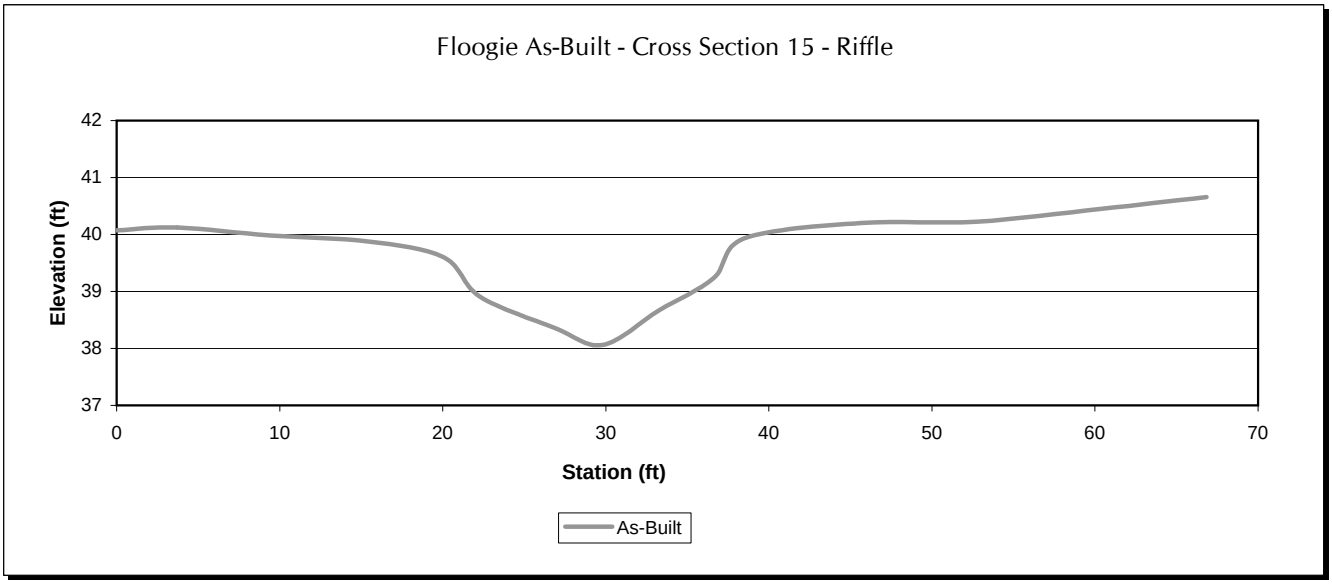
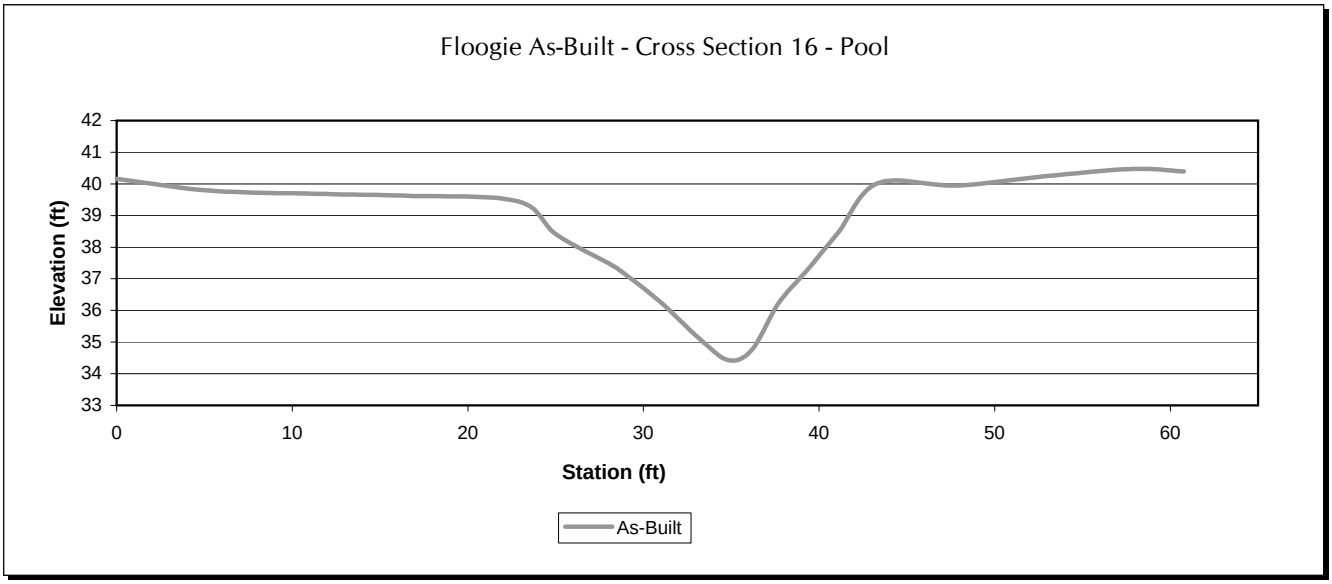


Left bank

Right bank



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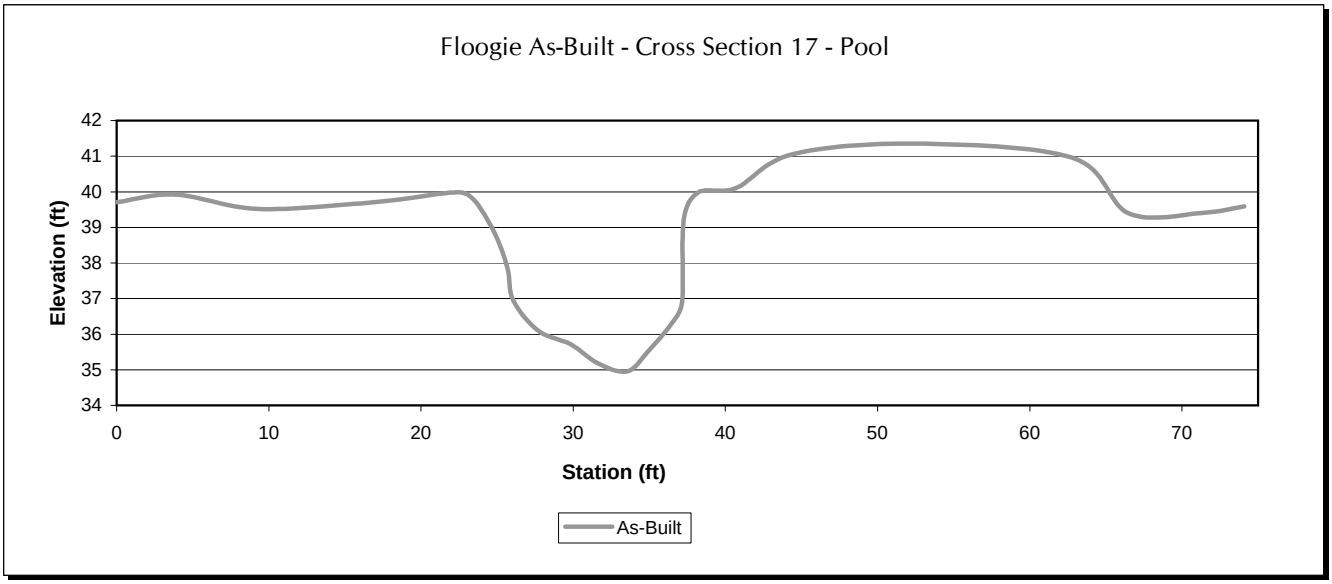

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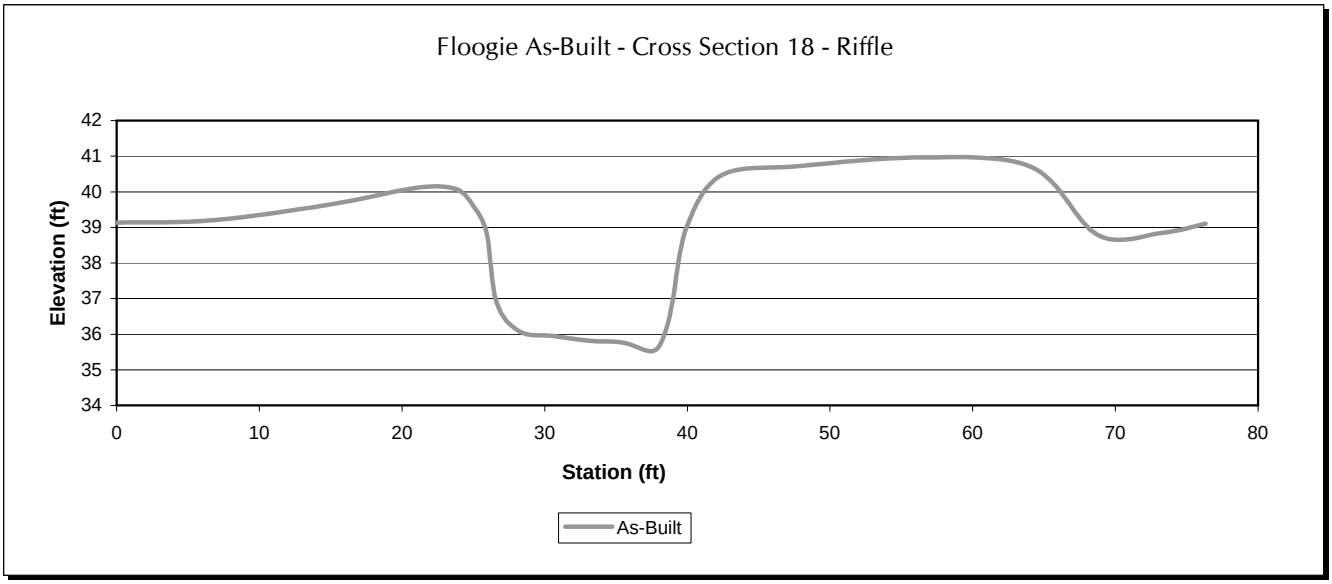

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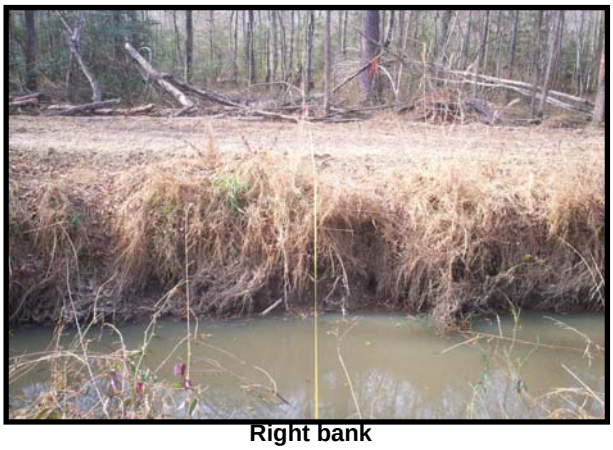

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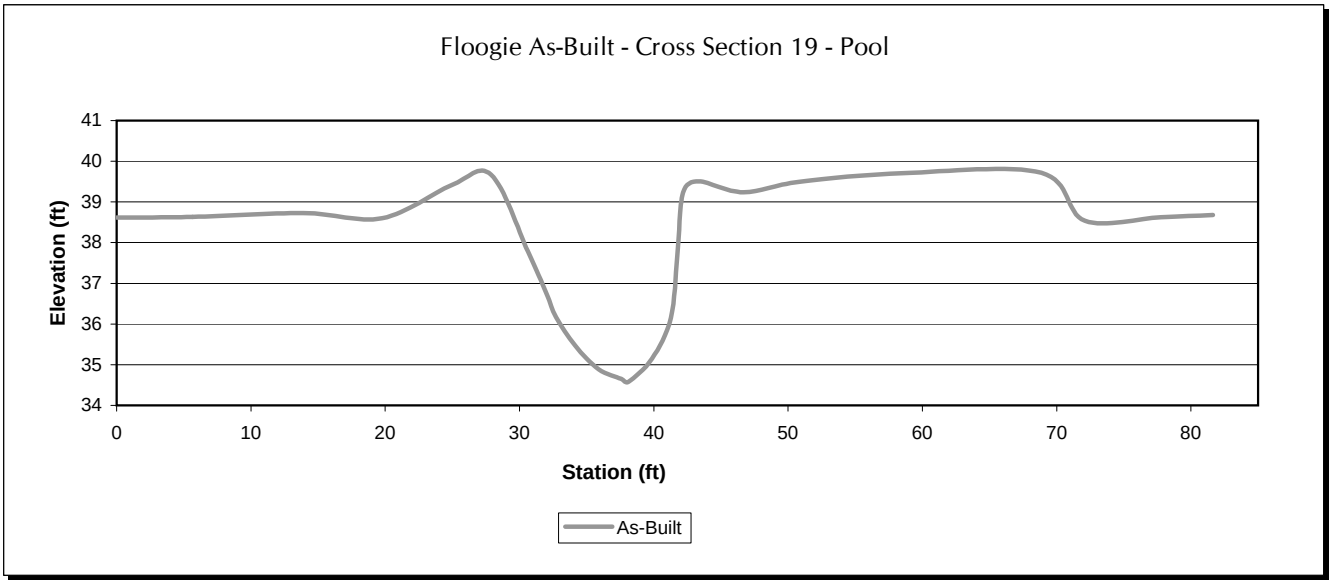

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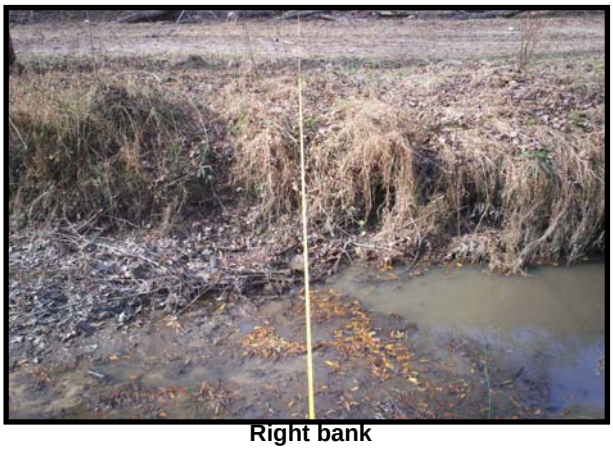

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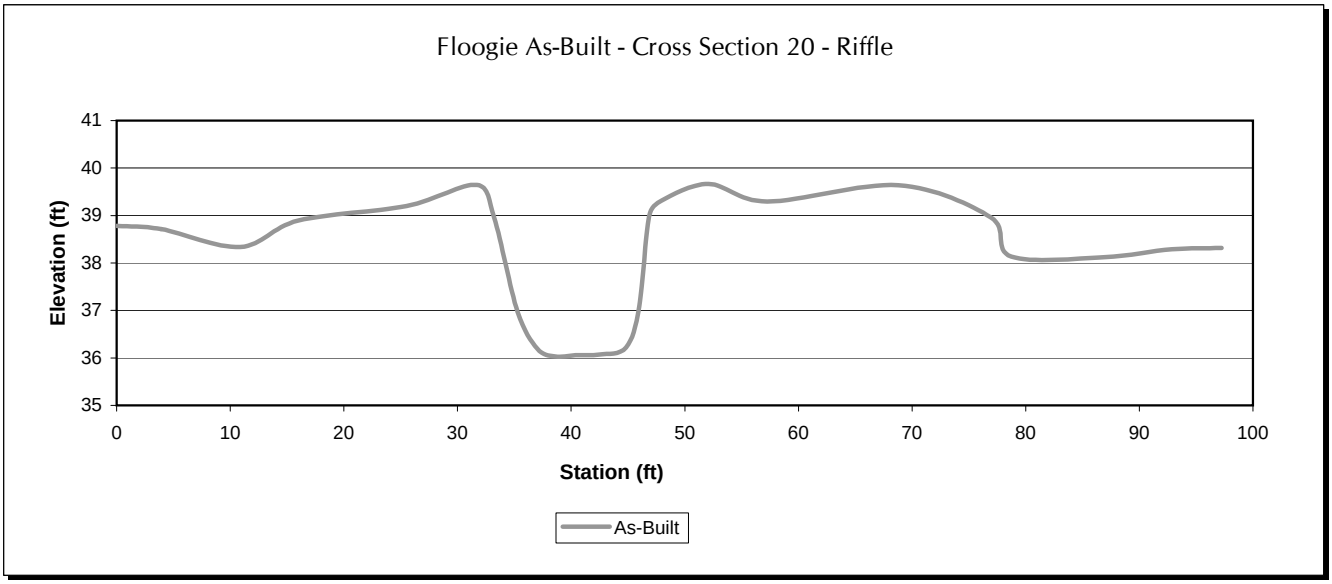


Appendix C

Photos of Headwater Stream Restoration Reaches 1A and 1B

Restored headwater stream 1A.

Surface flow in restored headwater stream.

Appendix D

DWQ Stream Forms

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 5/7/08	**Project:** Floogie		**Latitude:**
Evaluator: DPI	**Site:** Reach 1A - Pre-restoration		**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 22.5	**County:** Bertie		**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 8.0)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	(0)	1	2	3
3. In-channel structure: riffle-pool sequence	(0)	1	2	3
4. Soil texture or stream substrate sorting	0	(1)	2	3
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	0	(1)	2	3
7. Braided channel	(0)	1	2	3
8. Recent alluvial deposits	(0)	1	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	(0)	1	2	3
11. Grade controls	(0)	0.5	1	1.5
12. Natural valley or drainageway	0	0.5	(1)	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	(No = 0)		Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 8.5)				
14. Groundwater flow/discharge	0	1	(2)	3
15. Water in channel and > 48 hrs since rain, **or** Water in channel -- dry or growing season	0	1	(2)	3
16. Leaflitter	1.5	(1)	0.5	0
17. Sediment on plants or debris	0	0.5	(1)	1.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	(1)	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = (1.5)	

C. Biology (Subtotal = 6.0)				
20[b]. Fibrous roots in channel	3	2	(1)	0
21[b]. Rooted plants in channel	3	2	(1)	0
22. Crayfish	0	(0.5)	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	0	(0.5)	1	1.5
26. Macrobenthos (note diversity and abundance)	(0)	0.5	1	1.5
27. Filamentous algae; periphyton	0	(1)	2	3
28. Iron oxidizing bacteria/fungus.	0	(0.5)	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = (1.5) SAV = 2.0; Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

This form was completed based on collected data, upstream observations, photos, and GIS data to represent pre-restoration conditions.

Channel is an excavated natural drainageway

Sketch:

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 5/7/08	**Project:** Floogie		**Latitude:**
Evaluator: DPI	**Site:** Reach 1B - pre-restoration		**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 20.0	**County:** Bertie		**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 8.0)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	(0)	1	2	3
3. In-channel structure: riffle-pool sequence	(0)	1	2	3
4. Soil texture or stream substrate sorting	0	(1)	2	3
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	0	(1)	2	3
7. Braided channel	(0)	1	2	3
8. Recent alluvial deposits	(0)	1	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	(0)	1	2	3
11. Grade controls	(0)	0.5	1	1.5
12. Natural valley or drainageway	0	0.5	(1)	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	(No = 0)		Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 6.0)				
14. Groundwater flow/discharge	0	(1)	2	3
15. Water in channel and > 48 hrs since rain, **or** Water in channel -- dry or growing season	0	(1)	2	3
16. Leaflitter	1.5	(1)	0.5	0
17. Sediment on plants or debris	0	0.5	(1)	1.5
18. Organic debris lines or piles (Wrack lines)	0	(0.5)	1	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = 1.5	

C. Biology (Subtotal = 6.0)				
20[b]. Fibrous roots in channel	3	2	(1)	0
21[b]. Rooted plants in channel	3	2	(1)	0
22. Crayfish	0	(0.5)	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	0	(0.5)	1	1.5
26. Macrobenthos (note diversity and abundance)	0	0.5	1	1.5
27. Filamentous algae; periphyton	0	(1)	2	3
28. Iron oxidizing bacteria/fungus.	0	(0.5)	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; (OBL = 1.5) SAV = 2.0; Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

This form was completed based on collected data, upstream observations, photos, and GIS data to represent pre-restoration conditions

channel is an excavated natural drainage way

Sketch:

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 5/7/08	**Project:** Floogie	**Latitude:**
Evaluator: DPE	**Site:** Reach 1A - post-restoration	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 23	**County:** Bertie	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 11)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	(0)	1	2	3
2. Sinuosity	0	(1)	2	3
3. In-channel structure: riffle-pool sequence	0	(1)	2	3
4. Soil texture or stream substrate sorting	0	(1)	2	3
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	(0)	1	2	3
7. Braided channel	0	1	(2)	3
8. Recent alluvial deposits	0	(1)	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	0	1	(2)	3
11. Grade controls	(0)	0.5	1	1.5
12. Natural valley or drainageway	0	0.5	(1)	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	(No = 0)		Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 7.5)				
14. Groundwater flow/discharge	0	1	(2)	3
15. Water in channel and > 48 hrs since rain, **or** Water in channel -- dry or growing season	0	1	(2)	3
16. Leaflitter	1.5	(1)	0.5	0
17. Sediment on plants or debris	0	(0.5)	1	1.5
18. Organic debris lines or piles (Wrack lines)	0	(0.5)	1	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = (1.5)	

C. Biology (Subtotal = 4.5)				
20[b]. Fibrous roots in channel	3	2	(1)	0
21[b]. Rooted plants in channel	3	2	(1)	0
22. Crayfish	0	(0.5)	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	0	(0.5)	1	1.5
26. Macrobenthos (note diversity and abundance)	(0)	0.5	1	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; (OBL = 1.5) SAV = 2.0; Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Reach 1A was evaluated approximately 3 months following valley restoration

Sketch:

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 5/7/10	**Project:** Floogie	**Latitude:**
Evaluator: DPI	**Site:** Reach 1B - post-restoration	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 21.5	**County:** Bertie	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 11)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	(0)	1	2	3
2. Sinuosity	0	(1)	2	3
3. In-channel structure: riffle-pool sequence	0	(1)	2	3
4. Soil texture or stream substrate sorting	0	(1)	2	3
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	(0)	1	2	3
7. Braided channel	0	1	(2)	3
8. Recent alluvial deposits	0	(1)	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	0	1	(2)	3
11. Grade controls	(0)	0.5	1	1.5
12. Natural valley or drainageway	0	0.5	(1)	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	(No = 0)		Yes = 3	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 6)				
14. Groundwater flow/discharge	0	1	(2)	3
15. Water in channel and > 48 hrs since rain, **or** Water in channel – dry or growing season	0	1	(2)	3
16. Leaflitter	1.5	1	(0.5)	0
17. Sediment on plants or debris	(0)	0.5	1	1.5
18. Organic debris lines or piles (Wrack lines)	(0)	0.5	1	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = (1.5)	

C. Biology (Subtotal = 4.5)				
20[b]. Fibrous roots in channel	3	2	(1)	0
21[b]. Rooted plants in channel	3	2	(1)	0
22. Crayfish	0	(0.5)	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	0	(0.5)	1	1.5
26. Macrobenthos (note diversity and abundance)	(0)	0.5	1	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = (1.5) SAV = 2.0; Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

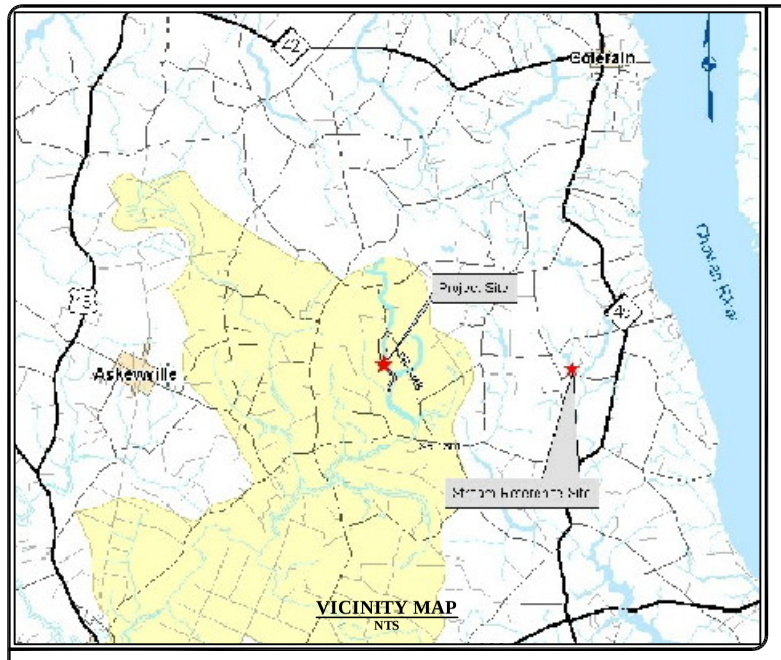
Notes: (use back side of this form for additional notes.)

Reach 1B was evaluated ~3 months following headwater valley restoration.

Sketch:

Appendix E

As-Built Plans

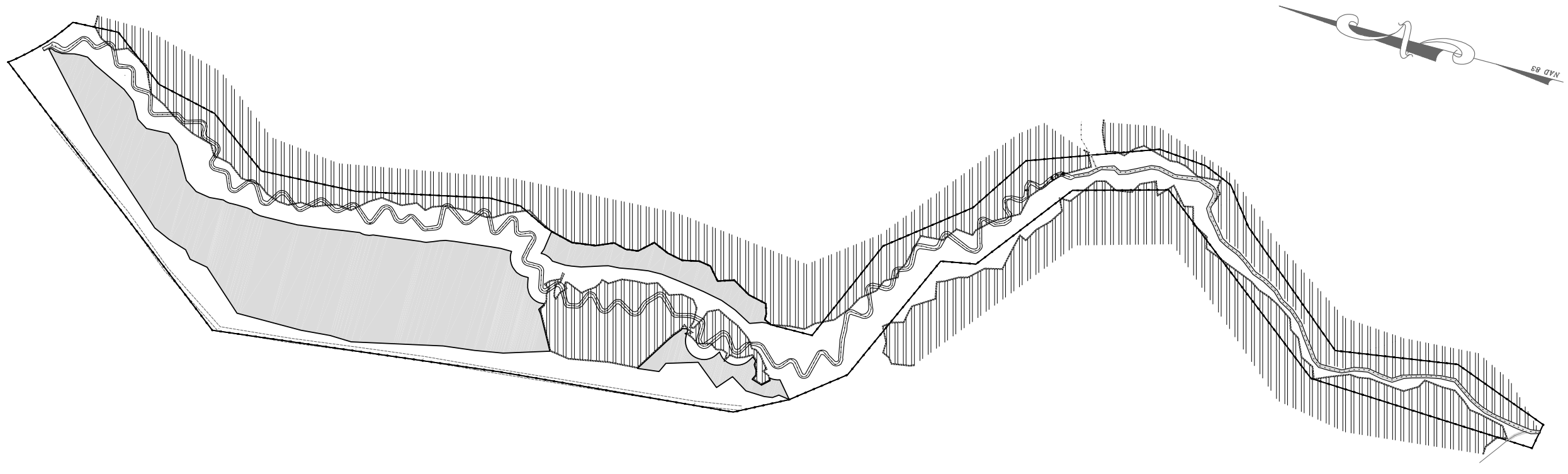


FLOOGIE MITIGATION PROJECT
AS-BUILT PLAN SET

APRIL 2008

LOCATION: BERTIE COUNTY, NORTH CAROLINA

SHEET INDEX



250 0 125 250 500
1 inch = 250ft.

REV. NO.	DESCRIPTION	DATE
	REVISIONS	

PROJECT MANAGER	DRAWING SCALE
DPI	1" = 250'
DRAWN BY	PROJECT DATE
JLL	08/2007
APPROVED BY	PROJECT NUMBER
DPI	5043100RA
FILE NAME	PLOT DATE
design.dwg	03/28/08

WK DICKSON
community infrastructure consultants

3101 JOHN HUMPHRIES WYND
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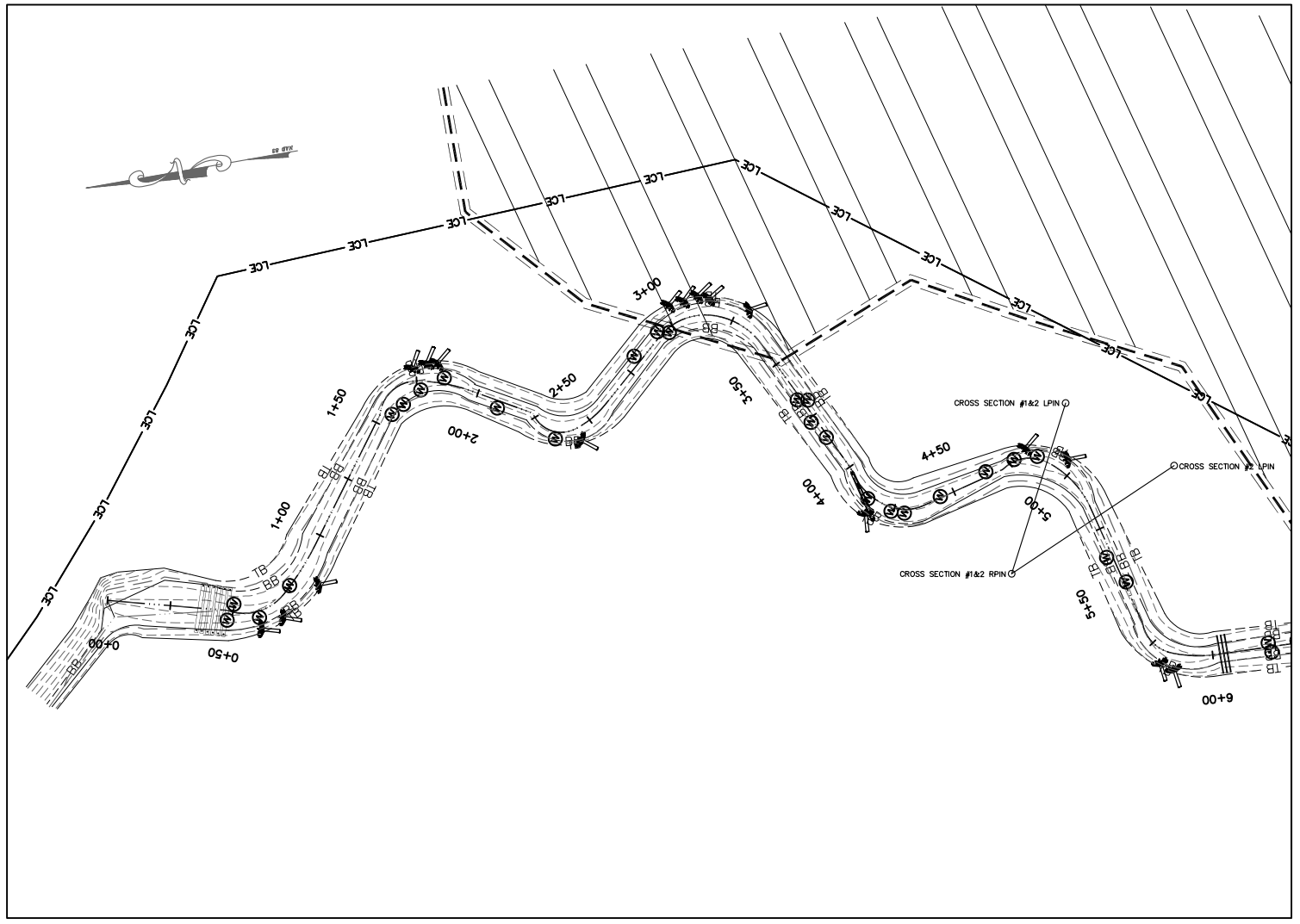
Office Locations:
North Carolina Georgia
South Carolina

RELEASED FOR	DATE
APPROVALS	10/9/06
BIDDING	
CONSTRUCTION	
RECORD DWG.	

ENVIRONMENTAL BANC & EXCHANGE, LLC
FLOOGIE MITIGATION PROJECT
BERTIE COUNTY, NORTH CAROLINA

FLOOGIE AS-BUILT PLANS
COVER & INDEX SHEET

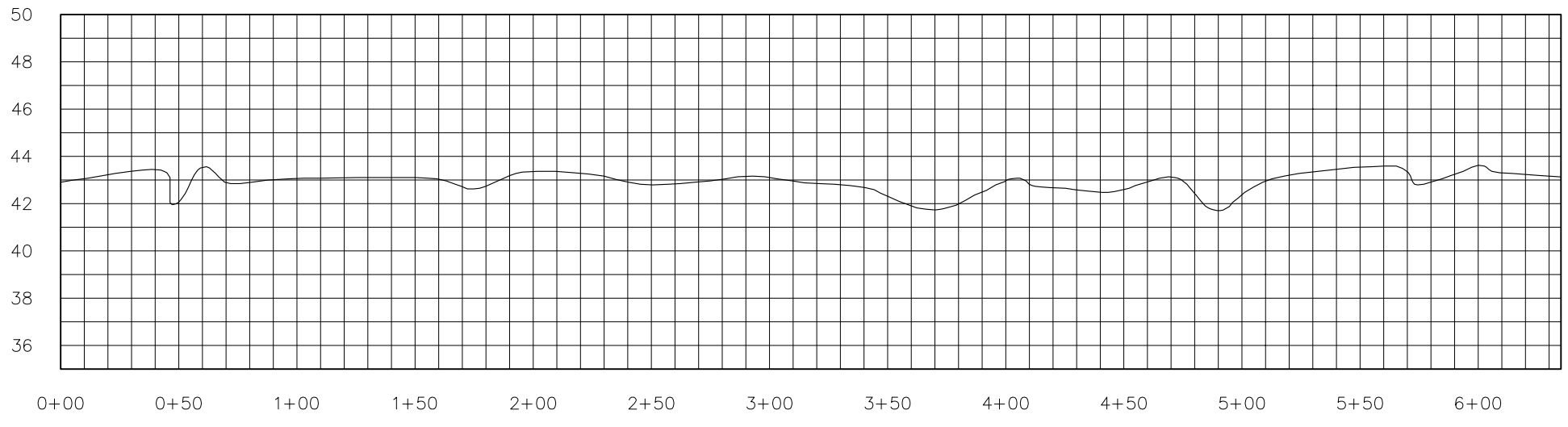


LEGEND

- EXISTING CONTOURS
- CENTERLINE OF EXISTING DITCH
- BOTTOM OF BANK (BB)
- TOP OF BANK (TB)
- LIMITS OF CONSERVATION EASMENT (LCE)
- LOG RAMP
- LOG GRADE CONTROL
- LOG TOE PROTECTION
- LOG VANE
- FORD CROSSING
- ROOT WAD
- CHANNEL PLUG
- WETLAND CHANNEL PLUG
- EXISTING WETLANDS
- BEDDED LOG STRUCTURE
- SMALL WOODY DEBRIS (W)

150 0 75 150 300

1 inch = 150ft.



Horizontal Scale: 1 inch = 30ft.
Vertical Scale: 1 inch = 3ft.

REV. NO.	DESCRIPTION	DATE
	REVISIONS	

PROJECT MANAGER: DPI	DRAWING SCALE: 1" = 30'
DRAWN BY: TRS	PROJECT DATE: 08/2007
APPROVED BY: DPI	PROJECT NUMBER: 5043100RA
FILE NAME: design.dwg	PLOT DATE: 03/28/08

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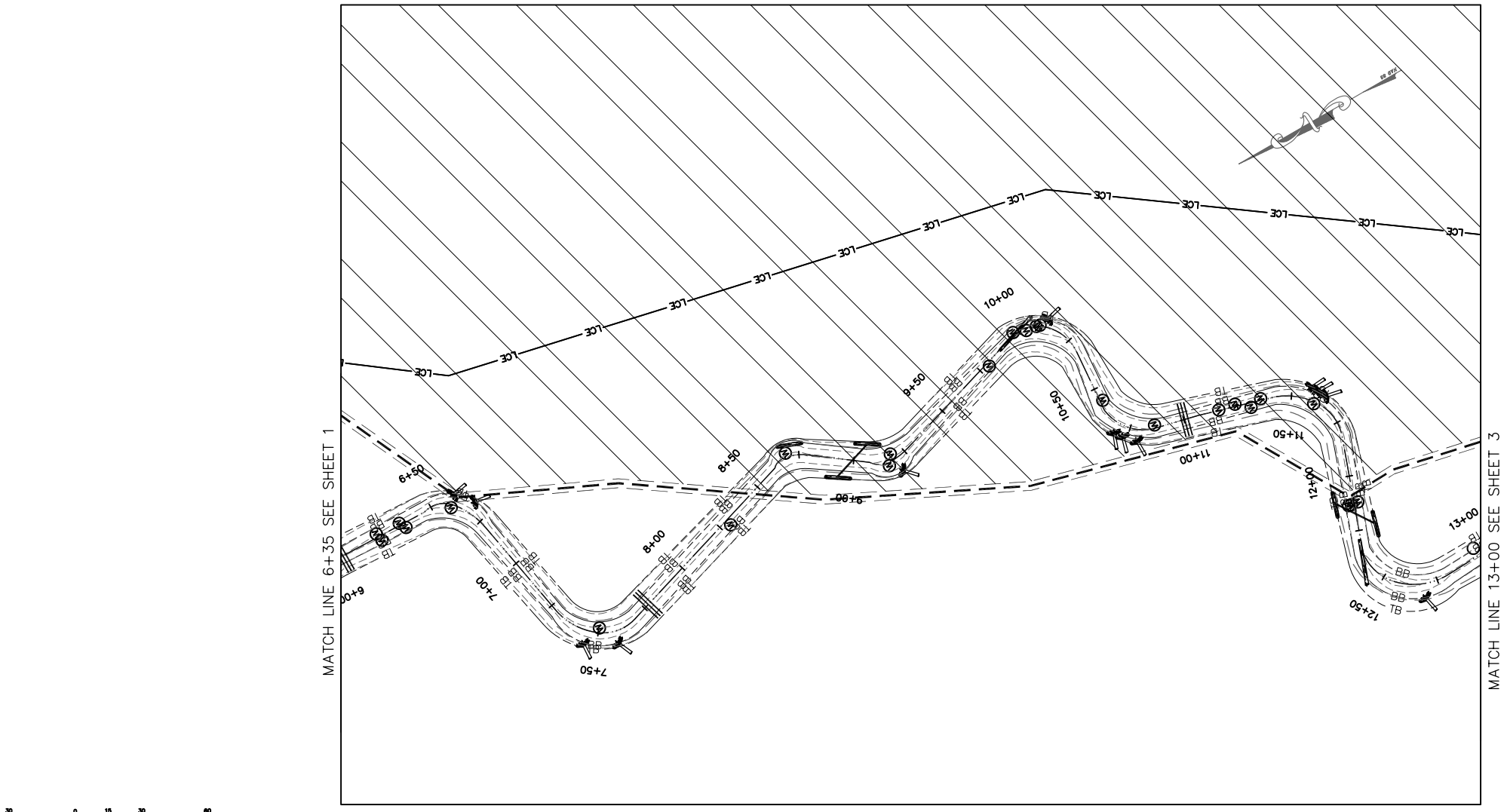
Office Locations:
North Carolina
South Carolina
Georgia

RELEASED FOR	DATE
APPROVALS	
BIDDING	
CONSTRUCTION	
RECORD DWG.	

ENVIRONMENTAL BANC & EXCHANGE, LLC
FLOOGIE MITIGATION PROJECT
BERTIE COUNTY, NORTH CAROLINA

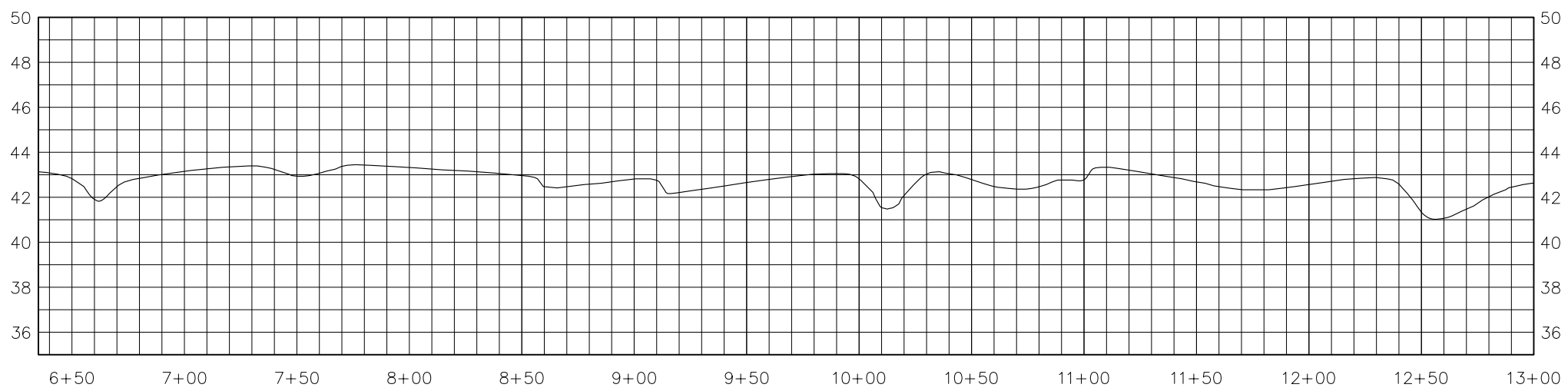
FLOOGIE AS-BUILT PLANS
STA. 0+00 TO STA. 6+35

2 / 20



LEGEND

- EXISTING CONTOURS
- CENTERLINE OF EXISTING DITCH
- BOTTOM OF BANK (BB)
- TOP OF BANK (TB)
- LIMITS OF CONSERVATION EASMENT (LCE)
- LOG RAMP
- LOG GRADE CONTROL
- LOG TOE PROTECTION
- LOG VANE
- FORD CROSSING
- ROOT WAD
- CHANNEL PLUG
- WETLAND CHANNEL PLUG
- EXISTING WETLANDS
- BEDDED LOG STRUCTURE
- SMALL WOODY DEBRIS (W)



Horizontal Scale: 1 inch = 30ft.
Vertical Scale: 1 inch = 3ft.

REV. NO.	DESCRIPTION	DATE
	REVISIONS	

PROJECT MANAGER: DPI	DRAWING SCALE: 1" = 30'
DRAWN BY: JLL	PROJECT DATE: 08/2007
APPROVED BY: DPI	PROJECT NUMBER: 5043100RA
FILE NAME: design.dwg	PLOT DATE: 03/28/08

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Office Locations:
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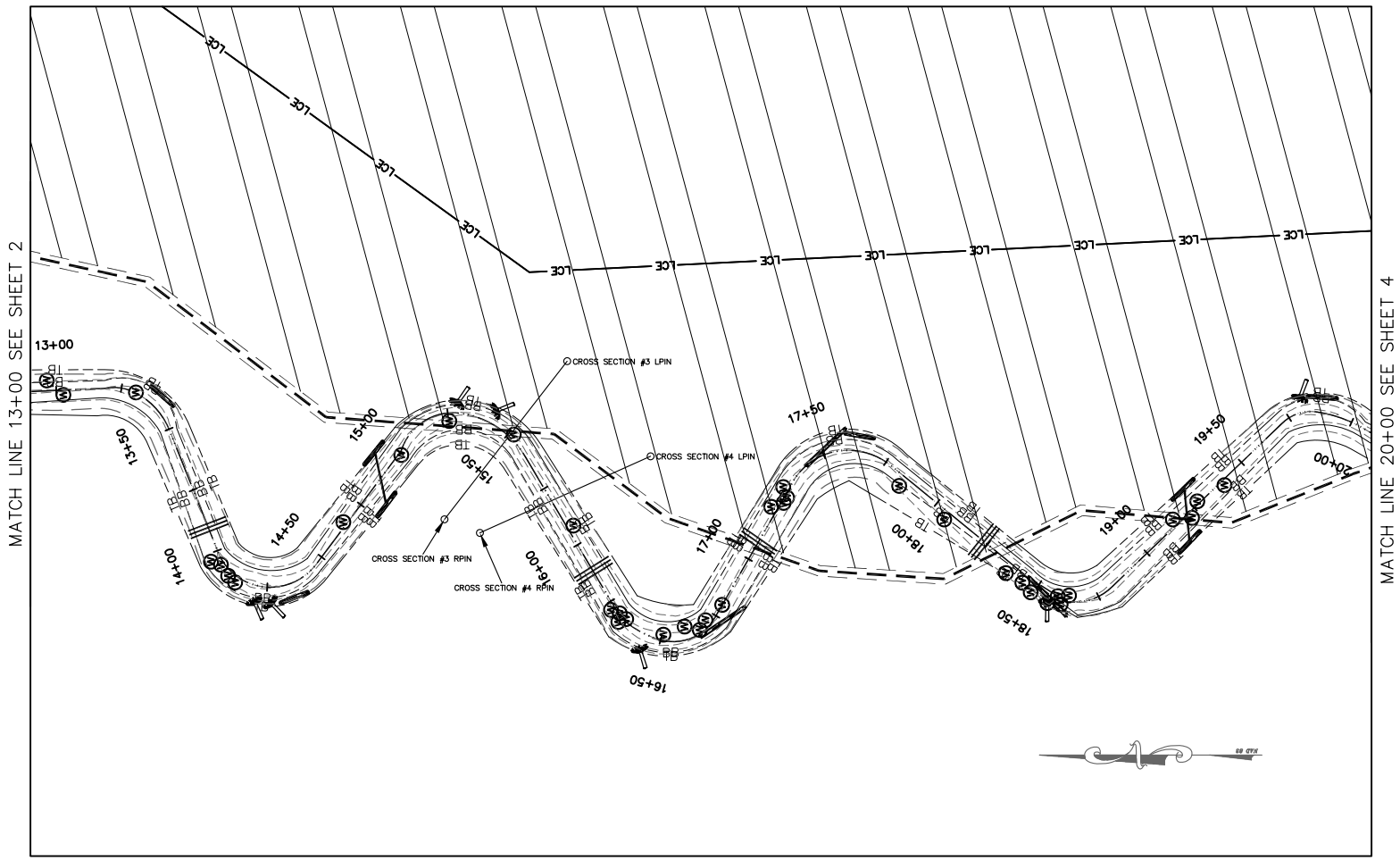
South Carolina

RELEASED FOR	DATE
APPROVALS	
BIDDING	
CONSTRUCTION	
RECORD DWG.	

ENVIRONMENTAL BANC & EXCHANGE, LLC
FLOOGIE MITIGATION PROJECT
BERTIE COUNTY, NORTH CAROLINA

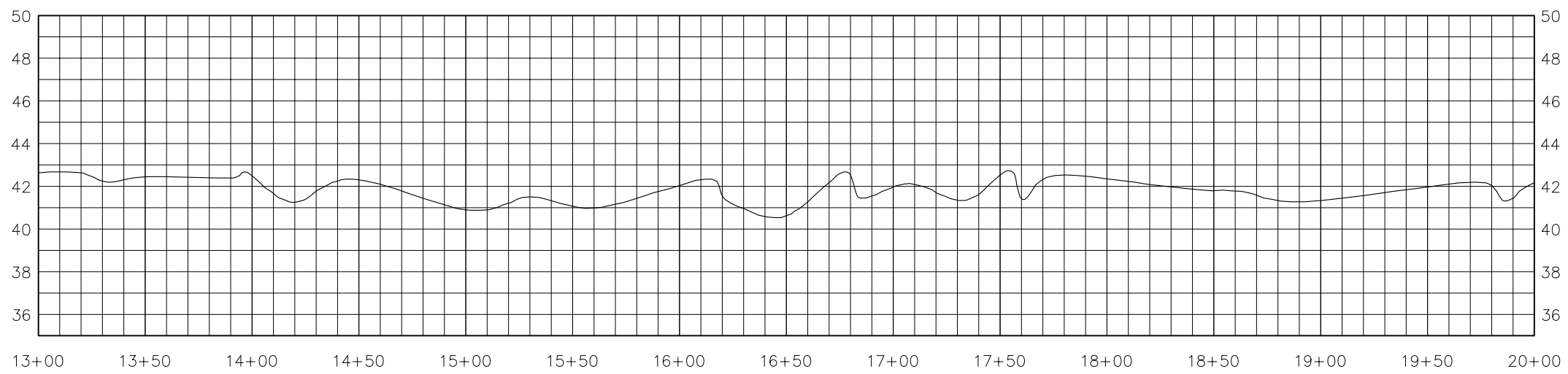
FLOOGIE AS-BUILT PLANS
STA. 6+35 TO STA. 13+00



LEGEND

- EXISTING CONTOURS
- CENTERLINE OF EXISTING DITCH
- BOTTOM OF BANK (BB)
- TOP OF BANK (TB)
- LIMITS OF CONSERVATION EASMENT (LCE)
- LOG RAMP
- LOG GRADE CONTROL
- LOG TOE PROTECTION
- LOG VANE
- FORD CROSSING
- ROOT WAD
- CHANNEL PLUG
- WETLAND CHANNEL PLUG
- EXISTING WETLANDS
- BEDDED LOG STRUCTURE
- SMALL WOODY DEBRIS (W)

30 0 15 30 60
1 inch = 30ft.



Horizontal Scale: 1 inch = 30ft.
Vertical Scale: 1 inch = 3ft.

REV. NO.	DESCRIPTION	DATE
	REVISIONS	

PROJECT MANAGER: DPI	DRAWING SCALE: 1" = 30'
DRAWN BY: JLL	PROJECT DATE: 08/2007
APPROVED BY: DPI	PROJECT NUMBER: 504310REA
FILE NAME: design.dwg	PLOT DATE: 03/28/08

WK DICKSON
community infrastructure consultants

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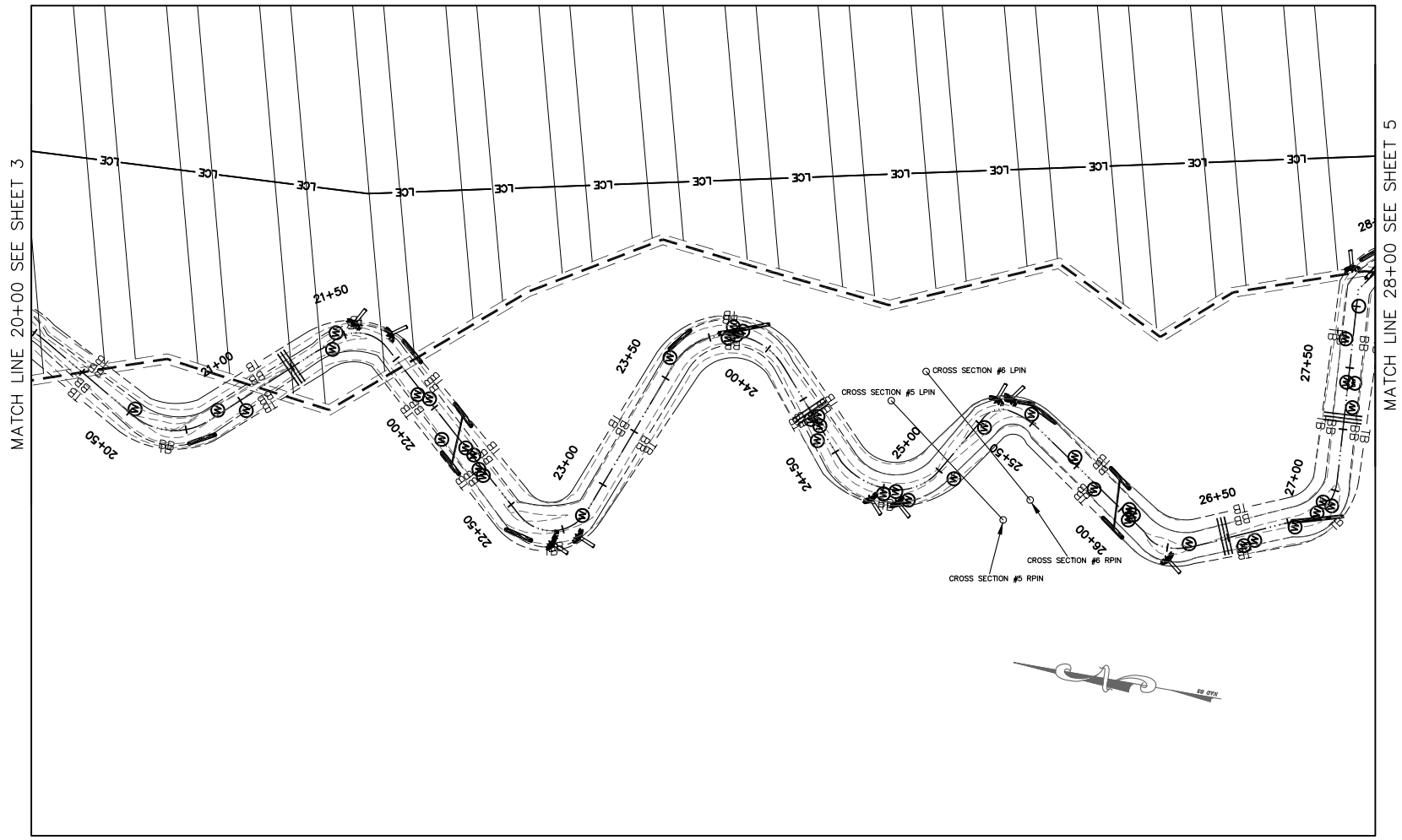
RALEIGH, NC 27607
(919) 782-0495

Office Locations:
North Carolina
South Carolina
Georgia

RELEASED FOR	DATE
APPROVALS	
BIDDING	
CONSTRUCTION	
RECORD DWG.	

ENVIRONMENTAL BANC & EXCHANGE, LLC
FLOOGIE MITIGATION PROJECT
BERTIE COUNTY, NORTH CAROLINA

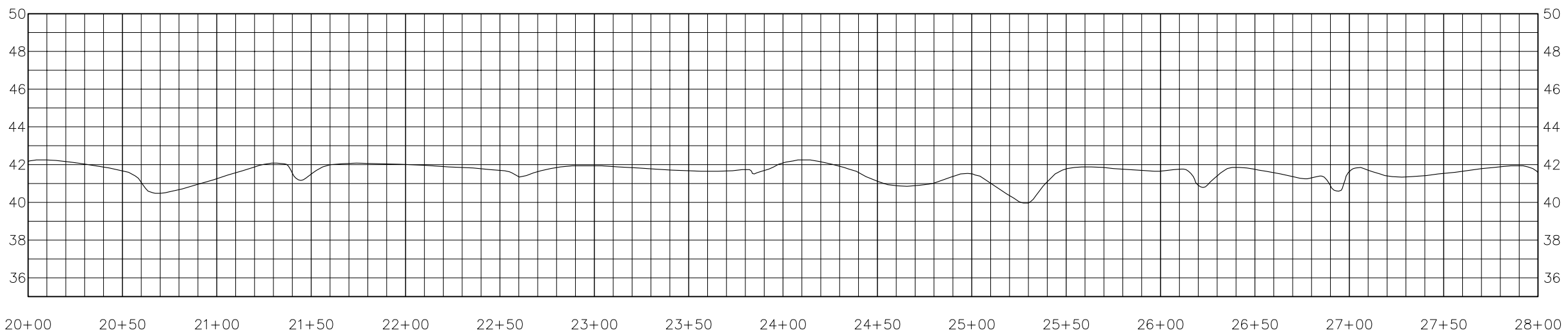
FLOOGIE AS-BUILT PLANS
STA. 13+00 TO STA. 20+00



LEGEND

- EXISTING CONTOURS
- CENTERLINE OF EXISTING DITCH
- BOTTOM OF BANK — BB
- TOP OF BANK — TB
- LIMITS OF CONSERVATION EASMENT — LCE
- LOG RAMP
- LOG GRADE CONTROL
- LOG TOE PROTECTION
- LOG VANE
- FORD CROSSING
- ROOT WAD
- CHANNEL PLUG
- WETLAND CHANNEL PLUG
- EXISTING WETLANDS
- BEDDED LOG STRUCTURE
- SMALL WOODY DEBRIS — (W)

30 0 15 30 60
1 inch = 30ft.



Horizontal Scale: 1 inch = 30ft.
Vertical Scale: 1 inch = 3ft.

REV. NO.	DESCRIPTION	DATE
	REVISIONS	

PROJECT MANAGER	DPI
DRAWN BY	JLL
APPROVED BY	DPI
FILE NAME	design.dwg
DRAWING SCALE	1" = 30'
PROJECT DATE	08/2007
PROJECT NUMBER	5043100RA
PLOT DATE	03/28/08

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RELEASED FOR	DATE
APPROVALS	
BIDDING	
CONSTRUCTION	
RECORD DWG.	

ENVIRONMENTAL BANC & EXCHANGE, LLC
FLOOGIE MITIGATION PROJECT
BERTIE COUNTY, NORTH CAROLINA

FLOOGIE AS-BUILT PLANS
STA. 20+00 TO STA. 28+00

ENVIRONMENTAL BANC & EXCHANGE, LLC
FLOODGIE MITIGATION PROJECT
BERTIE COUNTY, NORTH CAROLINA

REVISIONS		
REV. NO.	DESCRIPTION	DATE

PROJECT MANAGER: DPI
DRAWN BY: JLL
APPROVED BY: DPI
FILE NAME: design.dwg
DRAWING SCALE: 1" = 30'
PROJECT NUMBER: 504.5100BA
PROJECT DATE: 08/2007
PLOT DATE: 03/28/08

WK DICKSON
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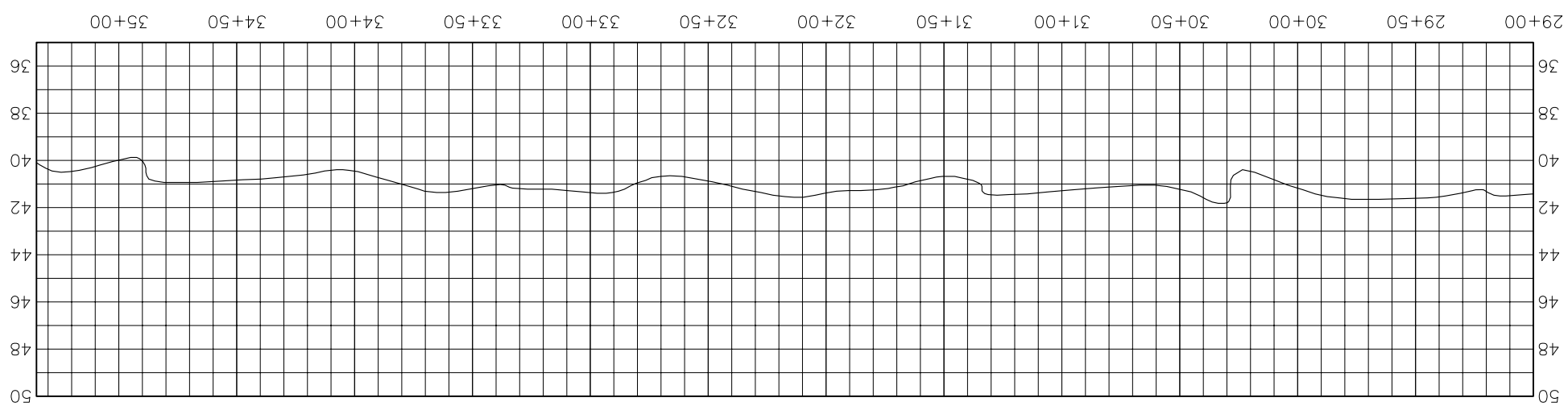
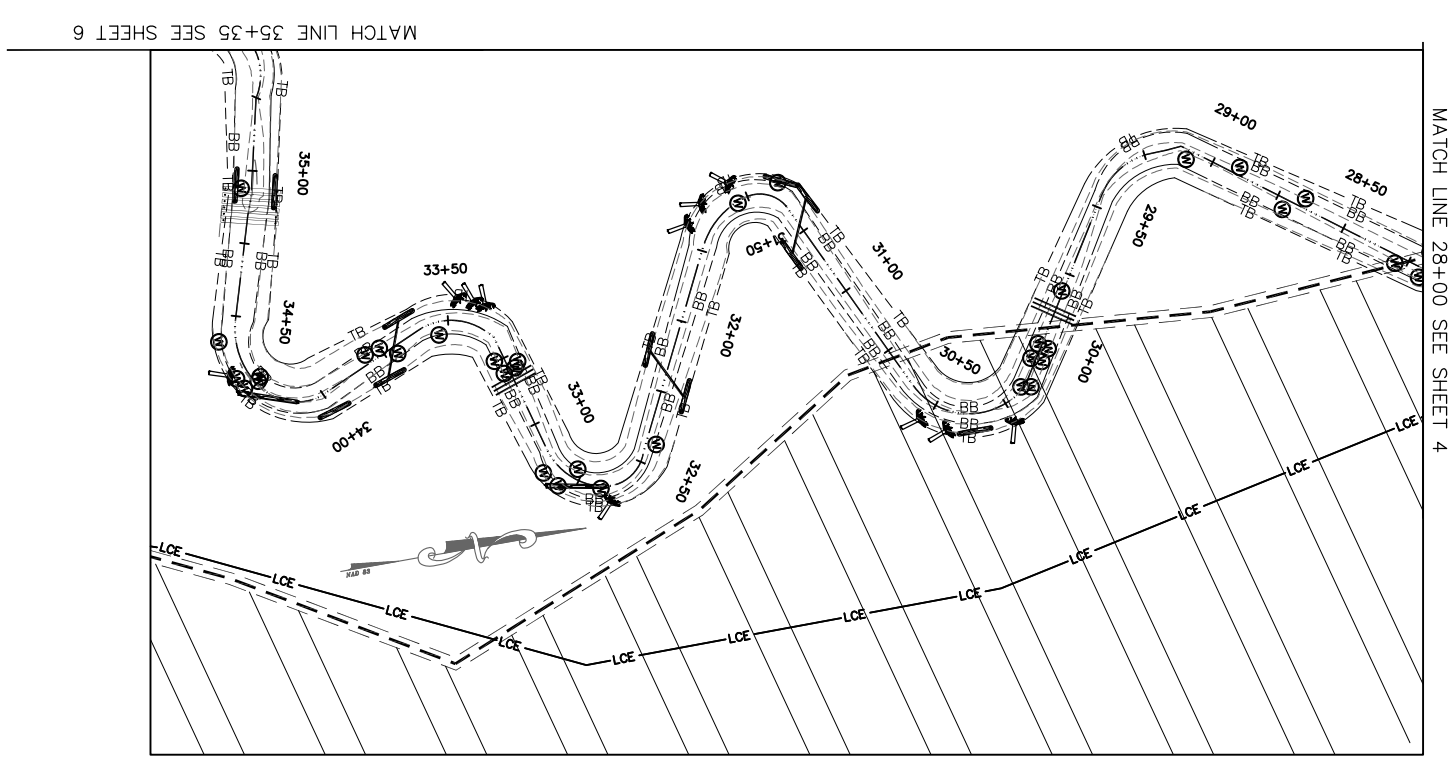
(919) 782-0495
Office Locations: Georgia, North Carolina, South Carolina

RELEASED FOR	DATE
APPROVALS	
BIDDING	
CONSTRUCTION	
RECORD DWG.	

Horizontal Scale: 1 inch = 30ft.
Vertical Scale: 1 inch = 3ft.

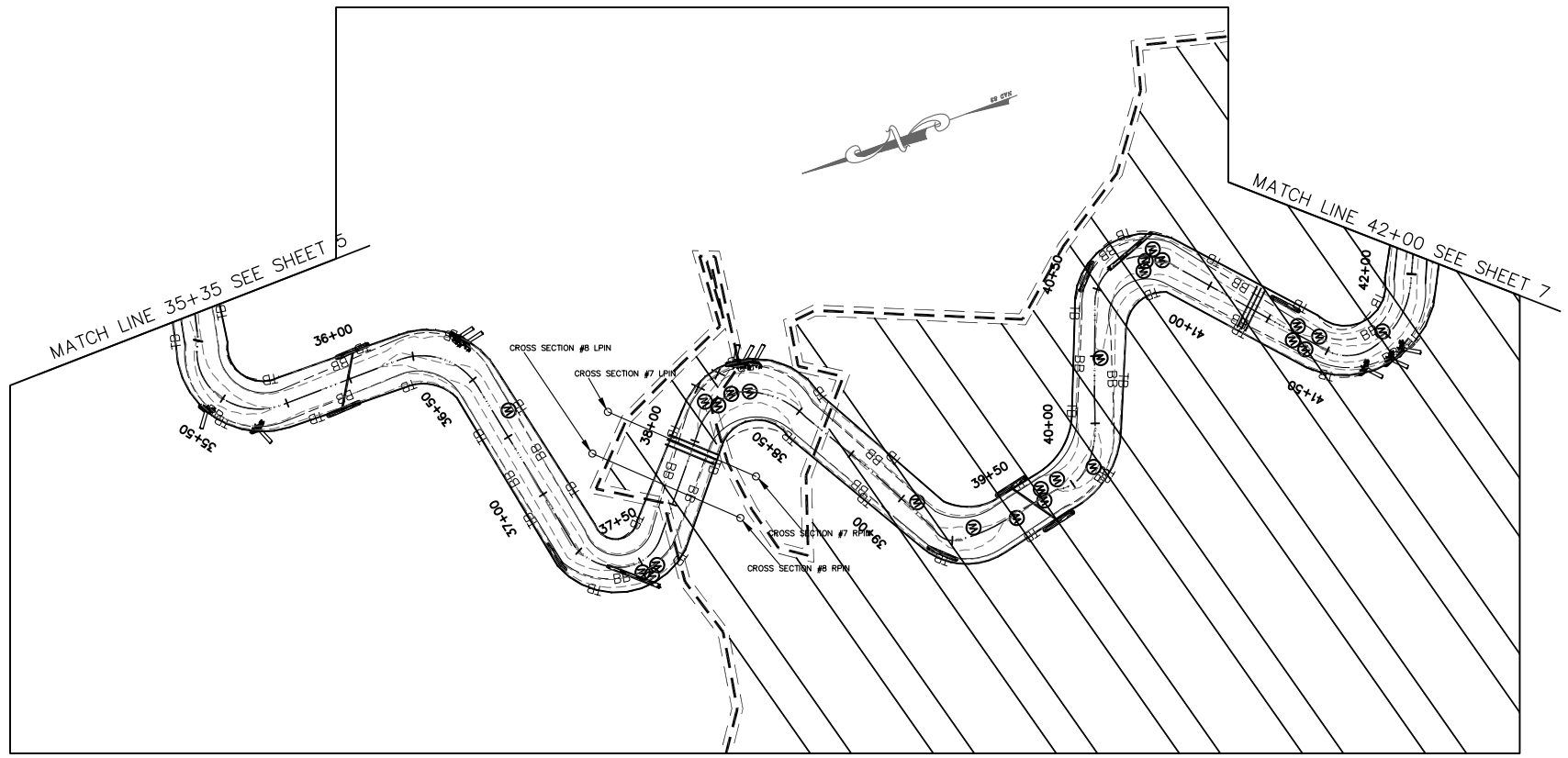


1 inch = 30ft.



LEGEND

- EXISTING CONTOURS
- CENTERLINE OF EXISTING DITCH
- BOTTOM OF BANK (BB)
- TOP OF BANK (TB)
- LIMITS OF CONSERVATION EASEMENT (LCE)
- LOG RAMP
- LOG GRADE CONTROL
- LOG TOE PROTECTION
- LOG VANE
- FORD CROSSING
- ROOT WAD
- CHANNEL PLUG
- WETLAND CHANNEL PLUG
- EXISTING WETLANDS
- EMBEDDED LOG STRUCTURE
- SMALL WOODY DEBRIS



LEGEND

- EXISTING CONTOURS
- CENTERLINE OF EXISTING DITCH
- BOTTOM OF BANK (BB)
- TOP OF BANK (TB)
- LIMITS OF CONSERVATION EASMENT (LCE)
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- LOG TOE PROTECTION
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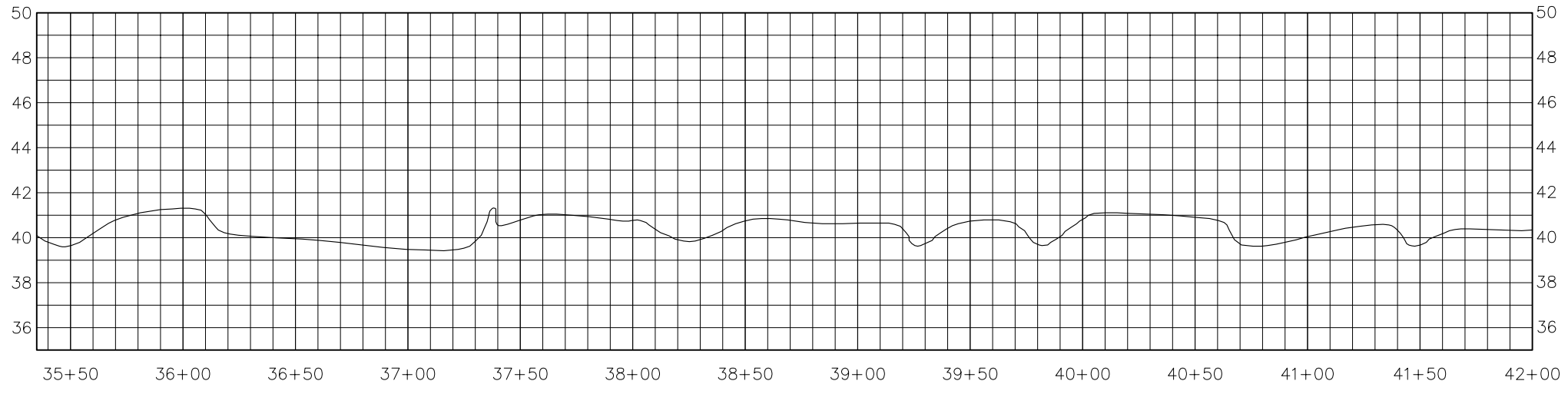
- FORD CROSSING
- ROOT WAD
- CHANNEL PLUG
- WETLAND CHANNEL PLUG
- EXISTING WETLANDS
- BEDDED LOG STRUCTURE
- SMALL WOODY DEBRIS (W)

30 0 15 30 60
1 inch = 30ft.



Horizontal Scale: 1 inch = 30ft.
Vertical Scale: 1 inch = 3ft.

REV. NO.	DESCRIPTION	DATE
	REVISIONS	

PROJECT MANAGER	DPI
DRAWN BY	JLL
APPROVED BY	DPI
FILE NAME	design.dwg
DRAWING SCALE	1" = 30'
PROJECT DATE	08/2007
PROJECT NUMBER	5043100RA
PLOT DATE	03/28/08

WK DICKSON
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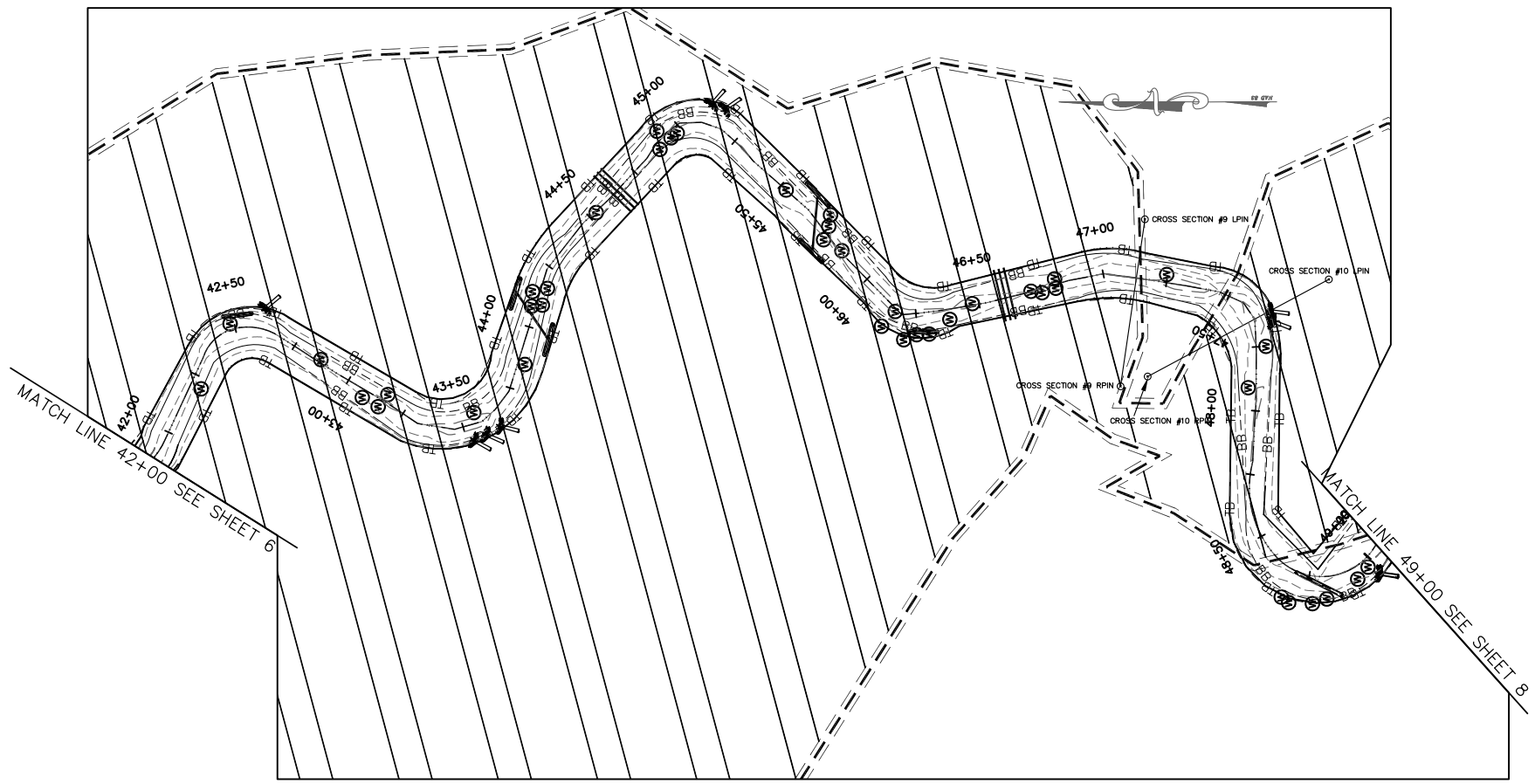
Office Locations:
North Carolina Georgia
South Carolina

RELEASED FOR	DATE
APPROVALS	
BIDDING	
CONSTRUCTION	
RECORD DWG.	

ENVIRONMENTAL BANC & EXCHANGE, LLC
FLOOGIE MITIGATION PROJECT
BERTIE COUNTY, NORTH CAROLINA

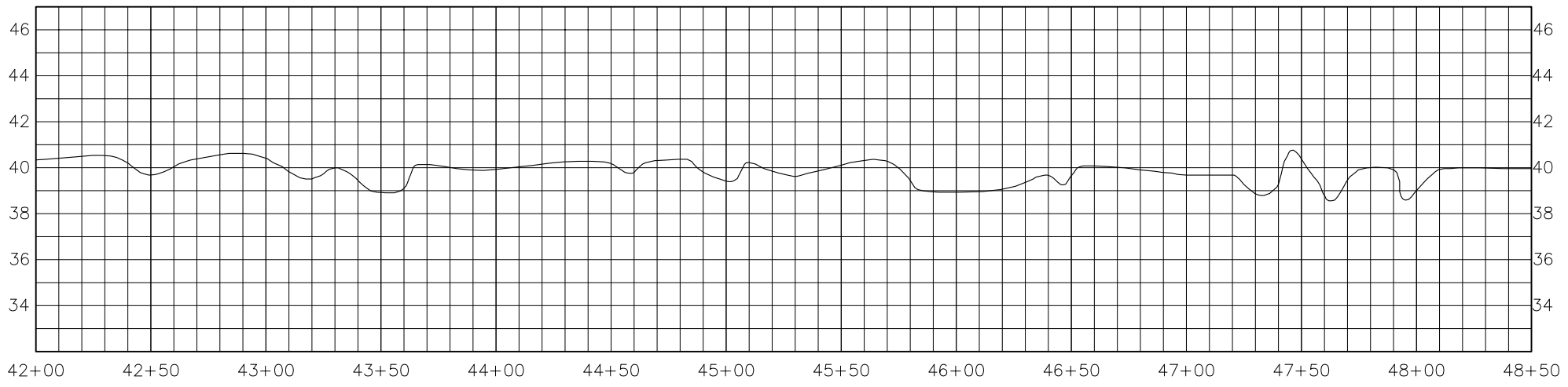
FLOOGIE AS-BUILT PLANS
STA. 35+35 TO STA. 42+00



LEGEND

- EXISTING CONTOURS
- CENTERLINE OF EXISTING DITCH
- BOTTOM OF BANK (BB)
- TOP OF BANK (TB)
- LIMITS OF CONSERVATION EASMENT (LCE)
- LOG RAMP
- LOG GRADE CONTROL
- LOG TOE PROTECTION
- LOG VANE
- FORD CROSSING
- ROOT WAD
- CHANNEL PLUG
- WETLAND CHANNEL PLUG
- EXISTING WETLANDS
- BEDDED LOG STRUCTURE
- SMALL WOODY DEBRIS (W)

30 0 15 60
1 inch = 30ft.



Horizontal Scale: 1 inch = 30ft.
Vertical Scale: 1 inch = 3ft.

REV. NO.	DESCRIPTION	DATE
	REVISIONS	

PROJECT MANAGER: DPI	DRAWING SCALE: 1" = 30'
DRAWN BY: JLL	PROJECT DATE: 08/2007
APPROVED BY: DPI	PROJECT NUMBER: 5043100RA
FILE NAME: design.dwg	PLOT DATE: 03/28/08

WK DICKSON
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Office Locations:
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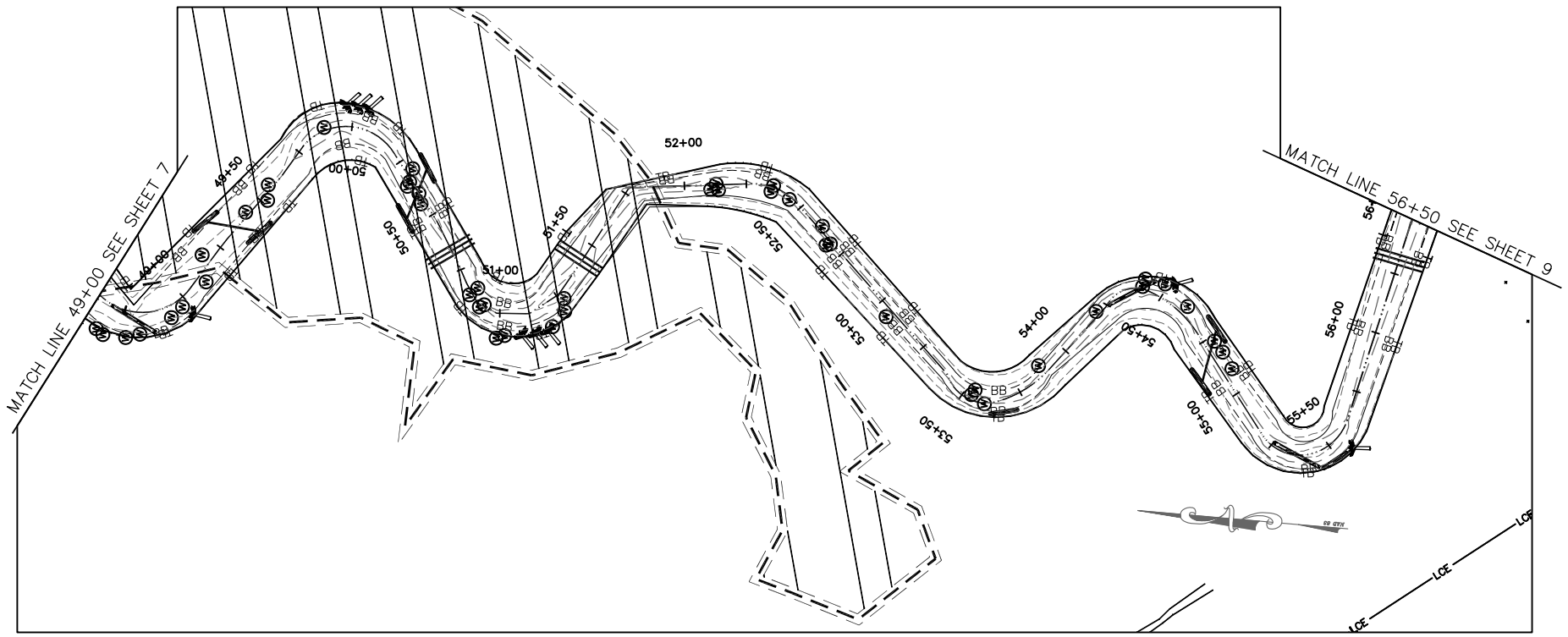
South Carolina

RELEASED FOR	DATE
APPROVALS	
BIDDING	
CONSTRUCTION	
RECORD DWG.	

ENVIRONMENTAL BANC & EXCHANGE, LLC
FLOOGIE MITIGATION PROJECT
BERTIE COUNTY, NORTH CAROLINA

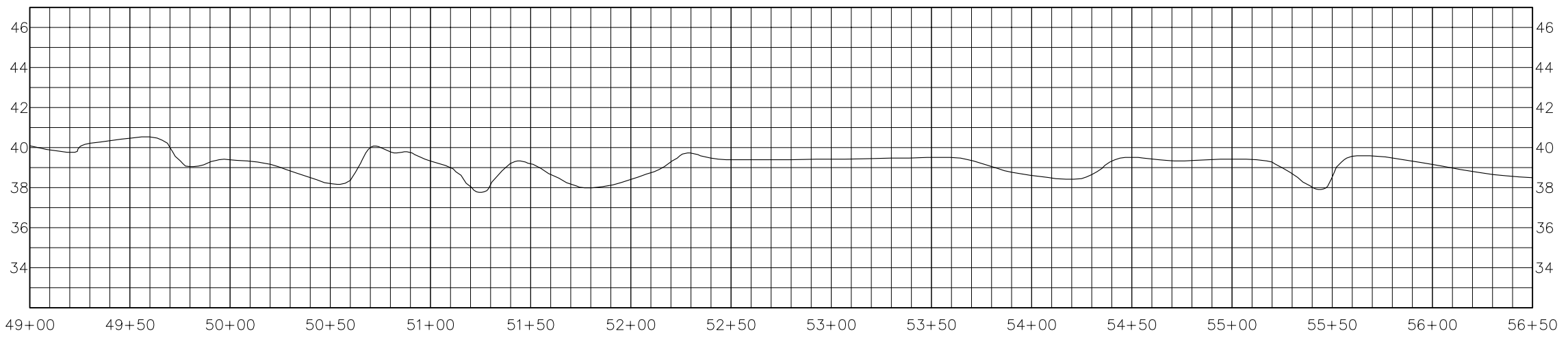
FLOOGIE AS-BUILT PLANS
STA. 42+00 TO STA. 49+00



LEGEND

- EXISTING CONTOURS
- CENTERLINE OF EXISTING DITCH
- BOTTOM OF BANK (BB)
- TOP OF BANK (TB)
- LIMITS OF CONSERVATION EASMENT (LCE)
- LOG RAMP
- LOG GRADE CONTROL
- LOG TOE PROTECTION
- LOG VANE
- FORD CROSSING
- ROOT WAD
- CHANNEL PLUG
- WETLAND CHANNEL PLUG
- EXISTING WETLANDS
- BEDDED LOG STRUCTURE
- SMALL WOODY DEBRIS (W)

30 0 15 30 60
1 inch = 30ft.



Horizontal Scale: 1 inch = 30ft.
Vertical Scale: 1 inch = 3ft.

REV. NO.	DESCRIPTION	DATE
	REVISIONS	

PROJECT MANAGER: DPI	DRAWING SCALE: 1" = 30'
DRAWN BY: JLL	PROJECT DATE: 08/2007
APPROVED BY: DPI	PROJECT NUMBER: 5043100RA
FILE NAME: design.dwg	PLOT DATE: 03/28/08

WK DICKSON
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(919) 782-0495
Office Locations:
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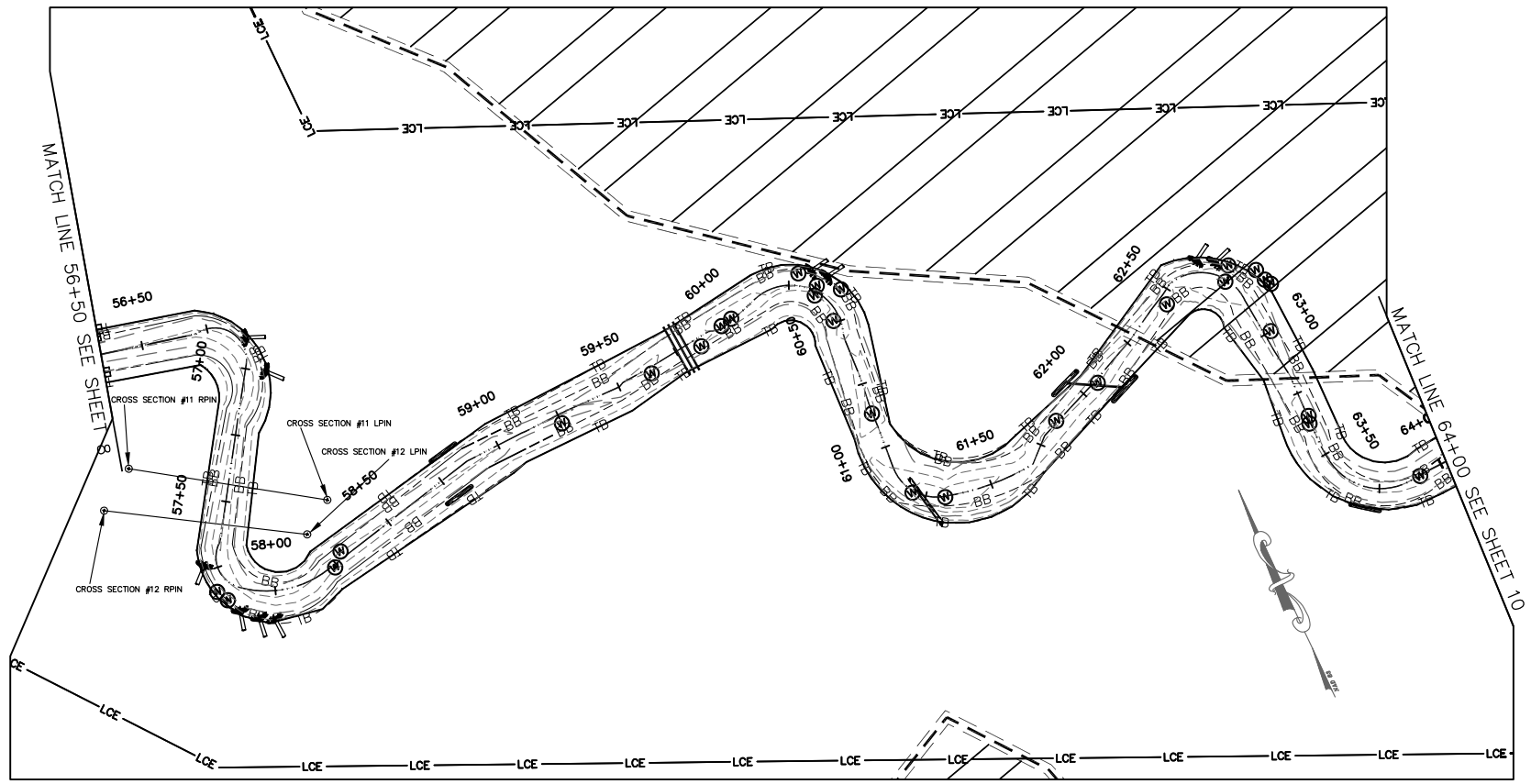
South Carolina

RELEASED FOR	DATE
APPROVALS	
BIDDING	
CONSTRUCTION	
RECORD DWG.	

ENVIRONMENTAL BANC & EXCHANGE, LLC
FLOOGIE MITIGATION PROJECT
BERTIE COUNTY, NORTH CAROLINA

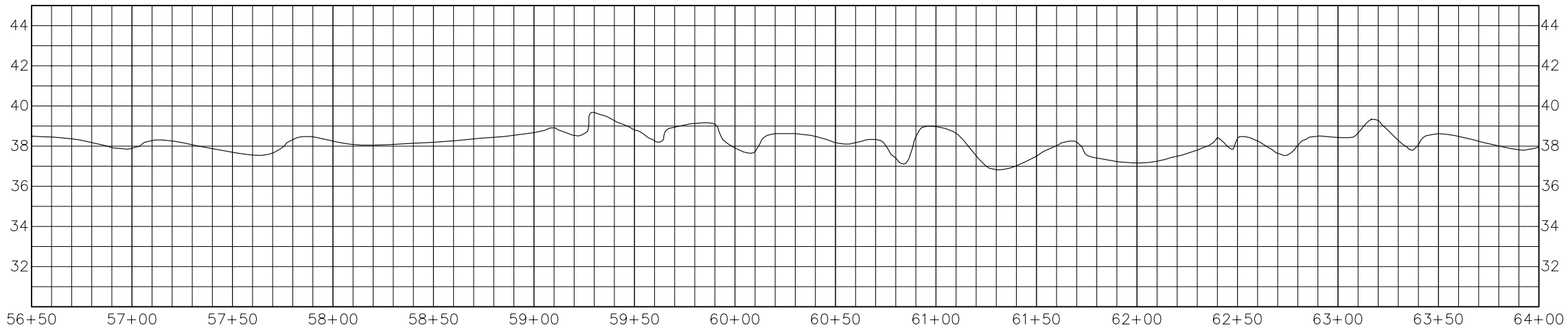
FLOOGIE AS-BUILT PLANS
STA. 49+00 TO STA. 56+50



LEGEND

- EXISTING CONTOURS
- CENTERLINE OF EXISTING DITCH
- BOTTOM OF BANK (BB)
- TOP OF BANK (TB)
- LIMITS OF CONSERVATION EASMENT (LCE)
- LOG RAMP
- LOG GRADE CONTROL
- LOG TOE PROTECTION
- LOG VANE
- FORD CROSSING
- ROOT WAD
- CHANNEL PLUG
- WETLAND CHANNEL PLUG
- EXISTING WETLANDS
- BEDDED LOG STRUCTURE
- SMALL WOODY DEBRIS (W)

30 0 15 30 60
1 inch = 30ft.



Horizontal Scale: 1 inch = 30ft.
Vertical Scale: 1 inch = 3ft.

REV. NO.	DESCRIPTION	DATE
	REVISIONS	

PROJECT MANAGER	DPI
DRAWN BY	JLL
APPROVED BY	DPI
FILE NAME	design.dwg
DRAWING SCALE	1" = 30'
PROJECT DATE	08/2007
PROJECT NUMBER	5043100RA
PLOT DATE	03/28/08

WK DICKSON
community infrastructure consultants

720 CORPORATE CENTER DRIVE
RALEIGH, NC 27607
(919) 782-0495

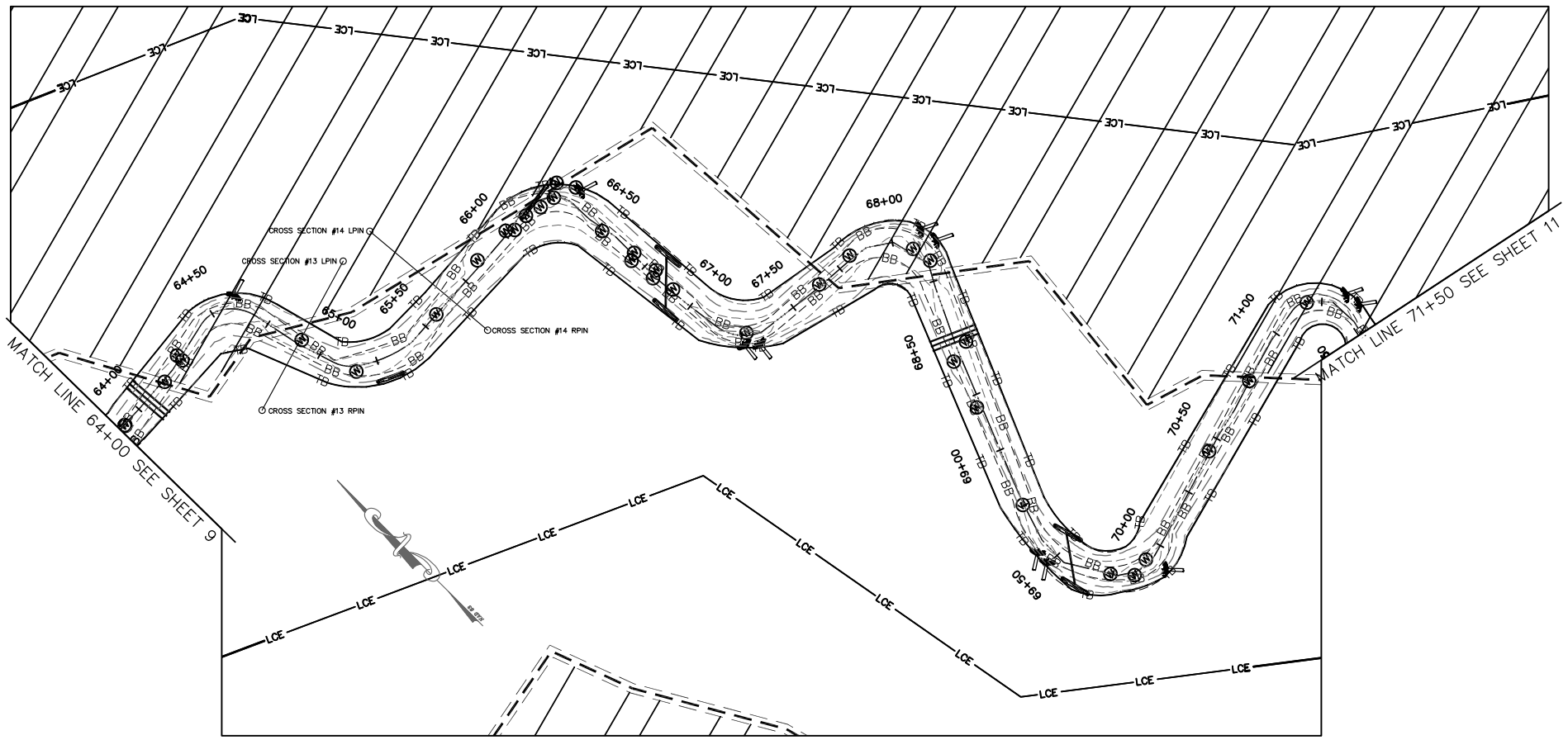
Office Locations:
North Carolina
South Carolina
Georgia

RELEASED FOR	DATE
APPROVALS	
BIDDING	
CONSTRUCTION	
RECORD DWG.	

ENVIRONMENTAL BANC & EXCHANGE, LLC
FLOOGIE MITIGATION PROJECT
BERTIE COUNTY, NORTH CAROLINA

FLOOGIE AS-BUILT PLANS
STA. 56+50 TO STA. 64+00

10
20

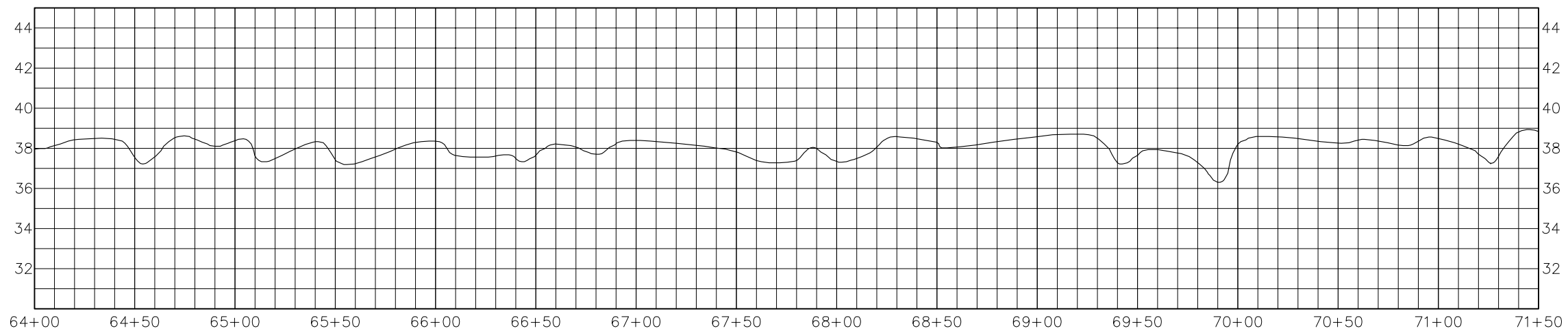


LEGEND

- EXISTING CONTOURS
- CENTERLINE OF EXISTING DITCH
- BOTTOM OF BANK (BB)
- TOP OF BANK (TB)
- LIMITS OF CONSERVATION EASMENT (LCE)
- LOG RAMP
- LOG GRADE CONTROL
- LOG TOE PROTECTION
- LOG VANE
- FORD CROSSING
- ROOT WAD
- CHANNEL PLUG
- WETLAND CHANNEL PLUG
- EXISTING WETLANDS
- BEDDED LOG STRUCTURE
- SMALL WOODY DEBRIS (W)

30 0 15 30 60

1 inch = 30ft.



Horizontal Scale: 1 inch = 30ft.
Vertical Scale: 1 inch = 3ft.

REV. NO.	DESCRIPTION	DATE
	REVISIONS	

PROJECT MANAGER: DPI	DRAWING SCALE: 1" = 30'
DRAWN BY: JLL	PROJECT DATE: 08/2007
APPROVED BY: DPI	PROJECT NUMBER: 5043100RA
FILE NAME: design.dwg	PLOT DATE: 03/28/08

WK DICKSON
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720 CORPORATE CENTER DRIVE
RALEIGH, NC 27607
(919) 782-0495
Office Locations:
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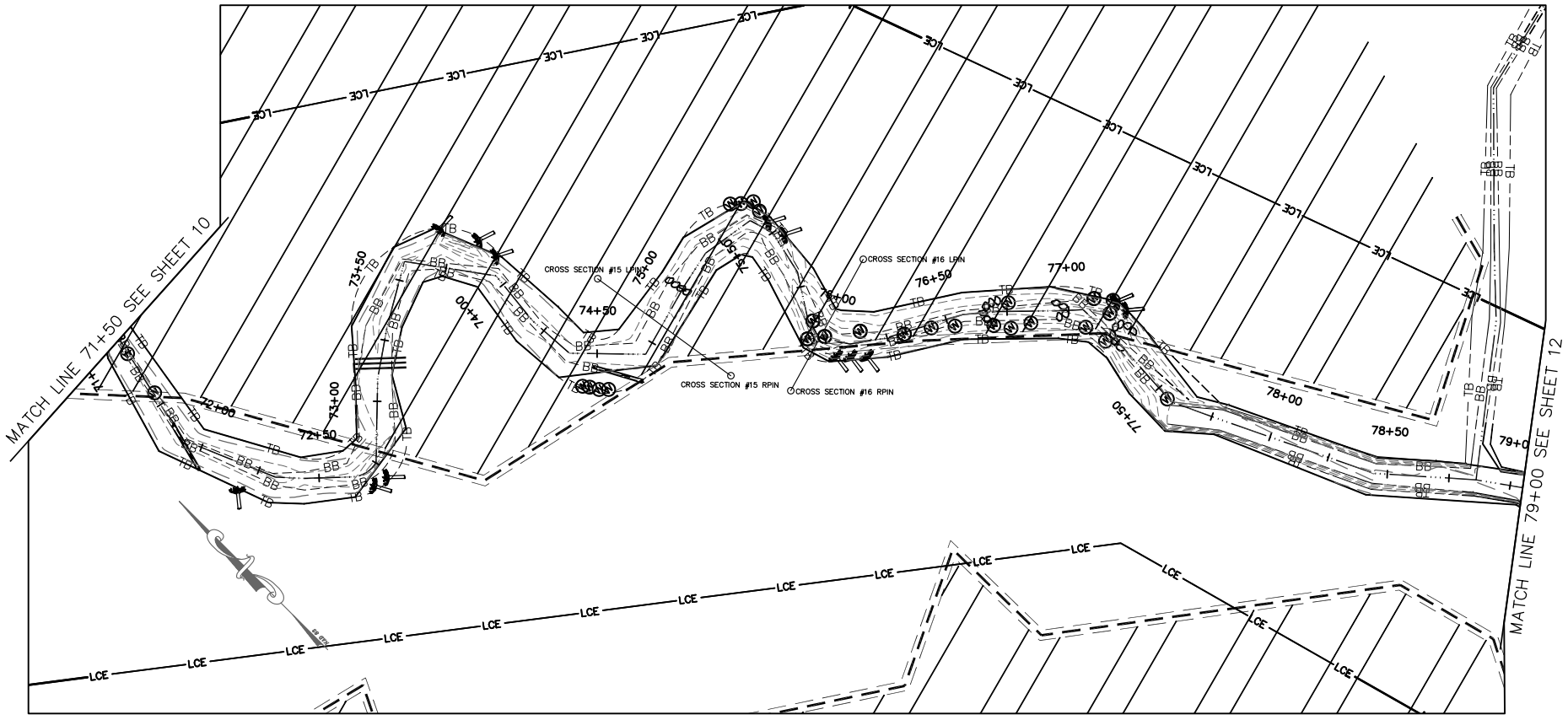
South Carolina

RELEASED FOR	DATE
APPROVALS	
BIDDING	
CONSTRUCTION	
RECORD DWG.	

ENVIRONMENTAL BANC & EXCHANGE, LLC
FLOOGIE MITIGATION PROJECT
BERTIE COUNTY, NORTH CAROLINA

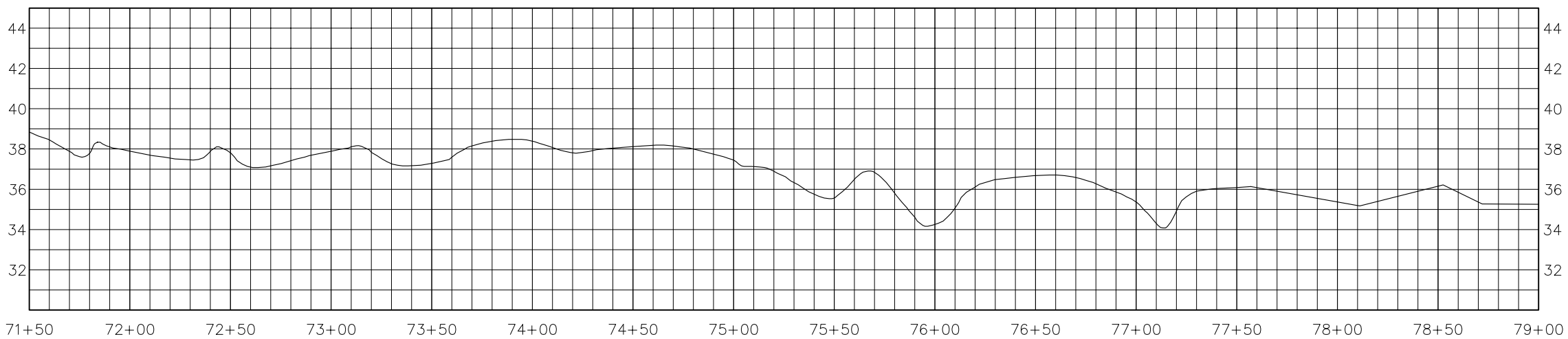
FLOOGIE AS-BUILT PLANS
STA. 64+00 TO STA. 71+50



LEGEND

- EXISTING CONTOURS
- CENTERLINE OF EXISTING DITCH
- BOTTOM OF BANK (BB)
- TOP OF BANK (TB)
- LIMITS OF CONSERVATION EASMENT (LCE)
- LOG RAMP
- LOG GRADE CONTROL
- LOG TOE PROTECTION
- LOG VANE
- FORD CROSSING
- ROOT WAD
- CHANNEL PLUG
- WETLAND CHANNEL PLUG
- EXISTING WETLANDS
- BEDDED LOG STRUCTURE
- SMALL WOODY DEBRIS (W)

30 0 15 30 60
1 inch = 30ft.



Horizontal Scale: 1 inch = 30ft.
Vertical Scale: 1 inch = 3ft.

REV. NO.	DESCRIPTION	DATE
	REVISIONS	

PROJECT MANAGER	DPI
DRAWN BY	JLL
APPROVED BY	DPI
FILE NAME	design.dwg
DRAWING SCALE	1" = 30'
PROJECT DATE	08/2007
PROJECT NUMBER	5043100RA
PLOT DATE	03/28/08

WK DICKSON
community infrastructure consultants

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(919) 782-0495

Office Locations:
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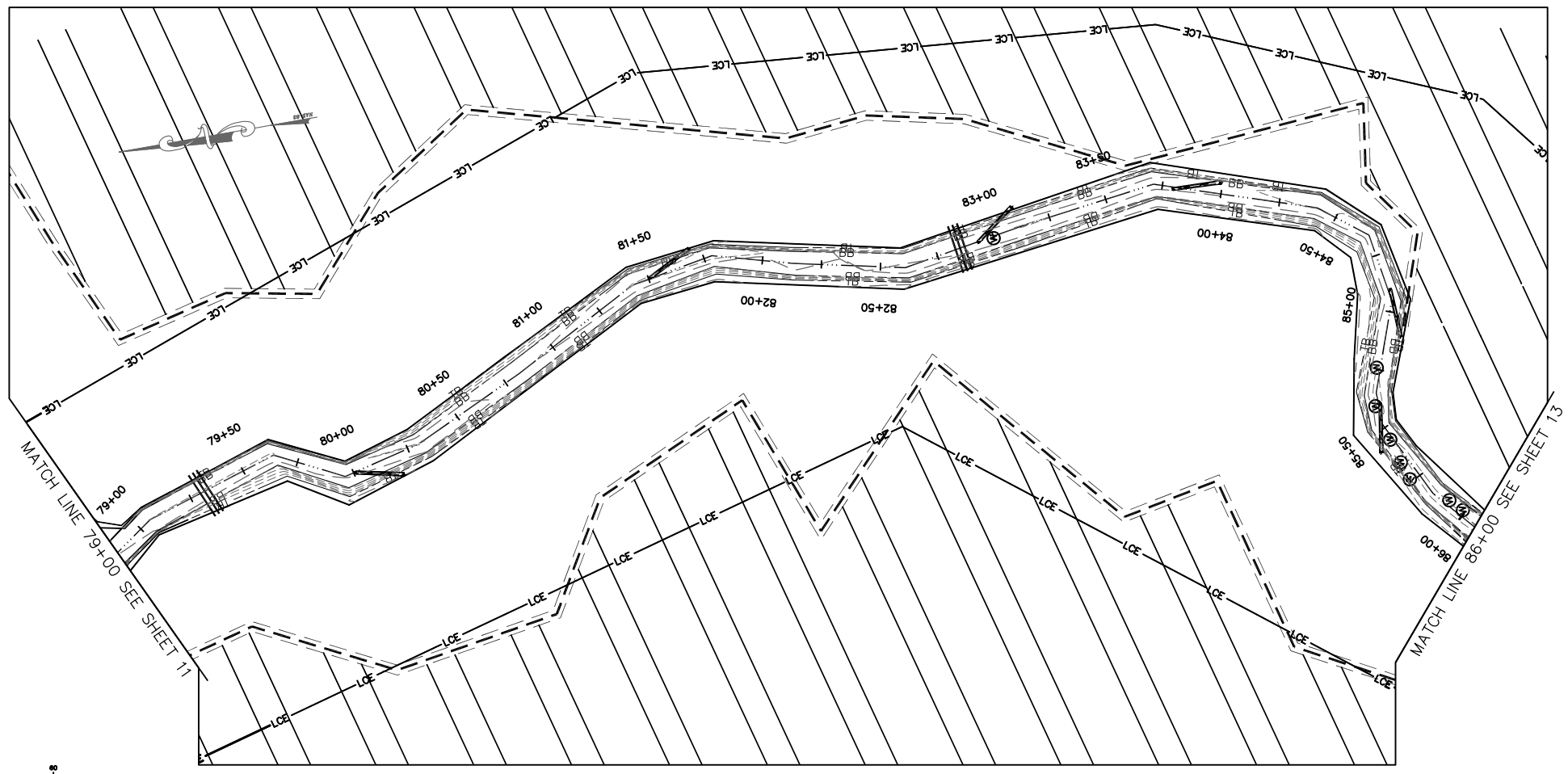
BIDDING	
CONSTRUCTION	
RECORD DWG.	

ENVIRONMENTAL BANC & EXCHANGE, LLC
FLOOGIE MITIGATION PROJECT
BERTIE COUNTY, NORTH CAROLINA

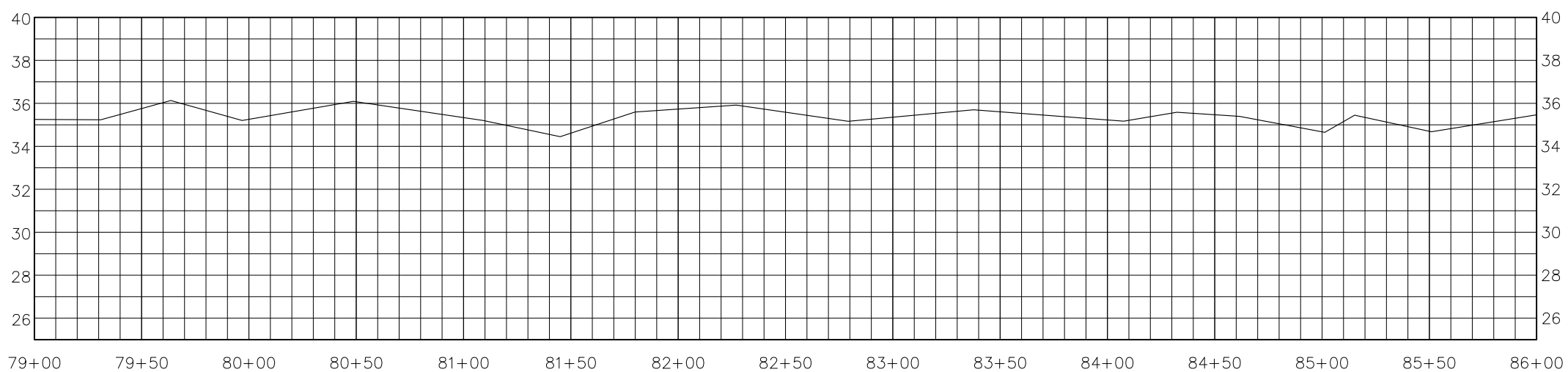
FLOOGIE AS-BUILT PLANS
STA. 71+50 TO STA. 79+00

12/20



LEGEND

- EXISTING CONTOURS
- CENTERLINE OF EXISTING DITCH
- BOTTOM OF BANK (BB)
- TOP OF BANK (TB)
- LIMITS OF CONSERVATION EASMENT (LCE)
- LOG RAMP
- LOG GRADE CONTROL
- LOG TOE PROTECTION
- LOG VANE
- FORD CROSSING
- ROOT WAD
- CHANNEL PLUG
- WETLAND CHANNEL PLUG
- EXISTING WETLANDS
- BEDDED LOG STRUCTURE
- SMALL WOODY DEBRIS (W)



Horizontal Scale: 1 inch = 30ft.
Vertical Scale: 1 inch = 3ft.

REV. NO.	DESCRIPTION	DATE
	REVISIONS	

PROJECT MANAGER	DPI
DRAWN BY	JLL
APPROVED BY	DPI
FILE NAME	design.dwg
DRAWING SCALE	1" = 30'
PROJECT DATE	08/2007
PROJECT NUMBER	5043100RA
PLOT DATE	03/28/08

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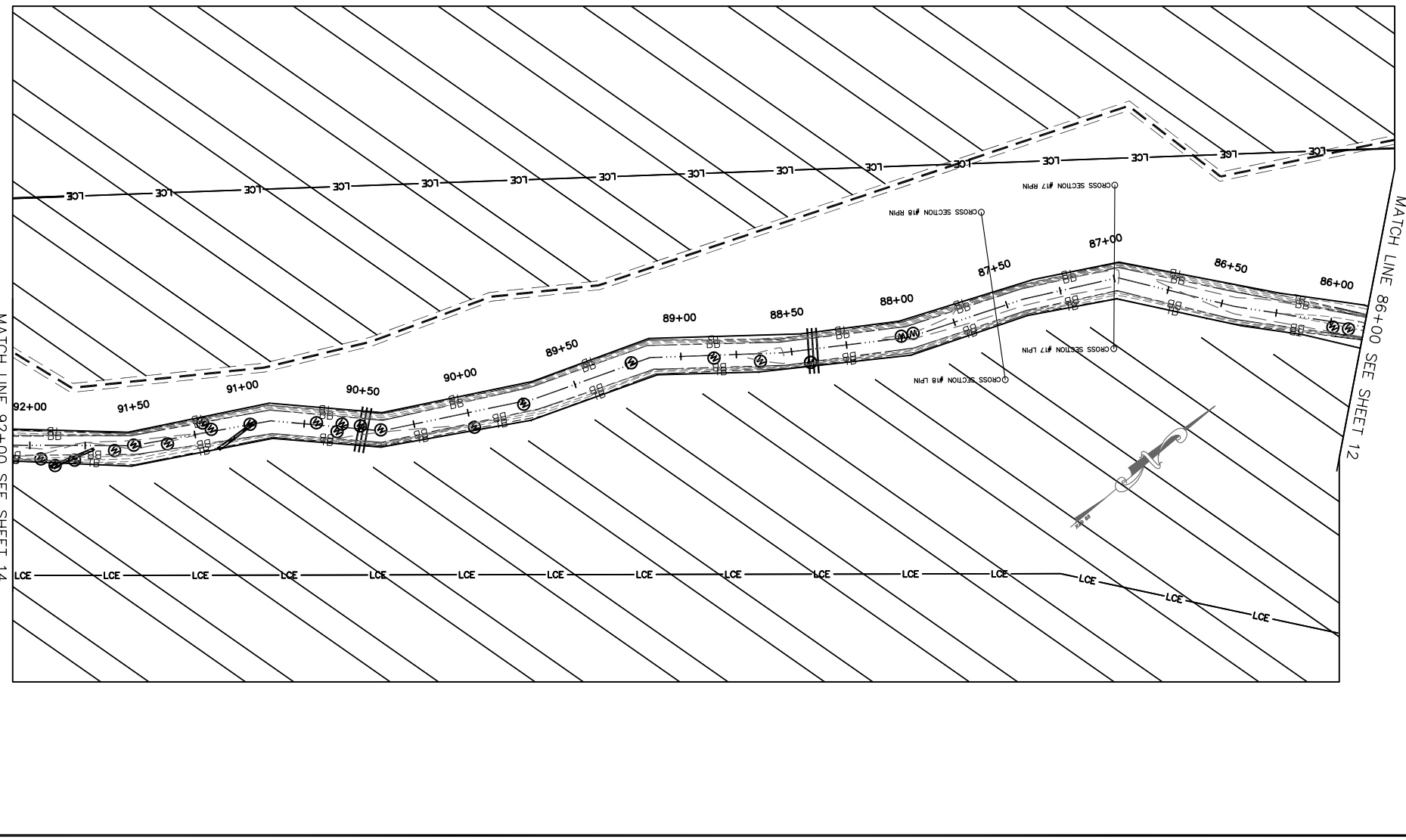
ENVIRONMENTAL BANC & EXCHANGE, LLC
FLOOGIE MITIGATION PROJECT
BERTIE COUNTY, NORTH CAROLINA

FLOOGIE AS-BUILT PLANS
STA. 79+00 TO STA. 86+00

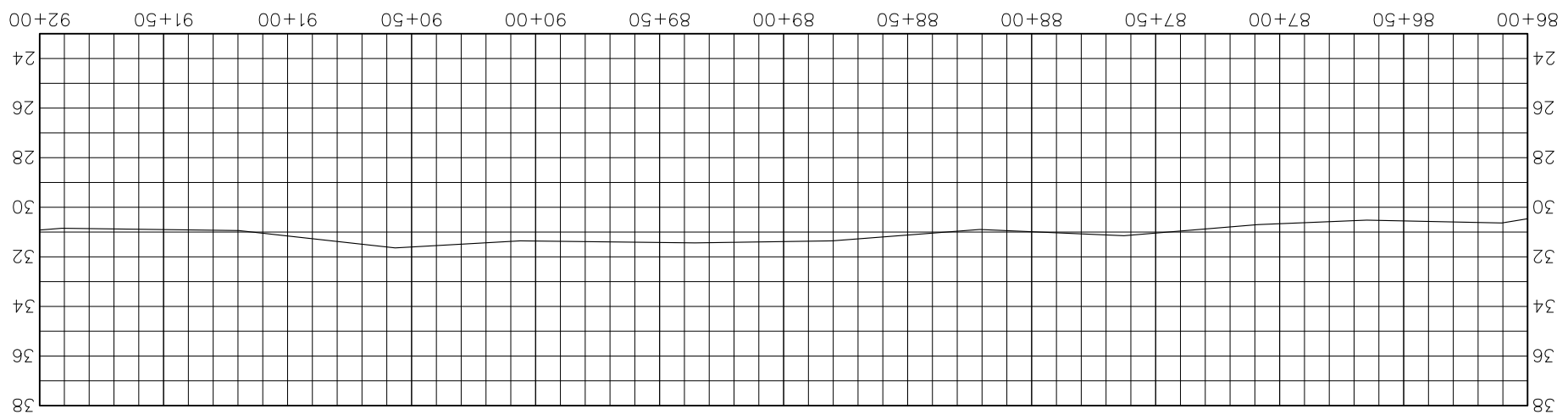


1 inch = 30ft.

LEGEND

- EXISTING CONTOURS
- CENTERLINE OF EXISTING DITCH
- BOTTOM OF BANK (BB)
- TOP OF BANK (TB)
- LIMITS OF CONSERVATION EASEMENT (LCE)
- LOG RAMP
- LOG GRADE CONTROL
- LOG TOE PROTECTION
- LOG VANE
- FORD CROSSING
- ROOT WAD
- CHANNEL PLUG
- WETLAND CHANNEL PLUG
- EXISTING WETLANDS
- BEDDED LOG STRUCTURE
- SMALL WOODY DEBRIS

Horizontal Scale: 1 inch = 30ft.
Vertical Scale: 1 inch = 3ft.



REVISIONS		
REV. NO.	DESCRIPTION	DATE

PROJECT MANAGER	DRAWING SCALE
DPI	1" = 30'
APPROVED BY	PROJECT NUMBER
JLL	08/2007
FILE NAME	PROJECT DATE
DPI	50413008A
design.dwg	03/28/08

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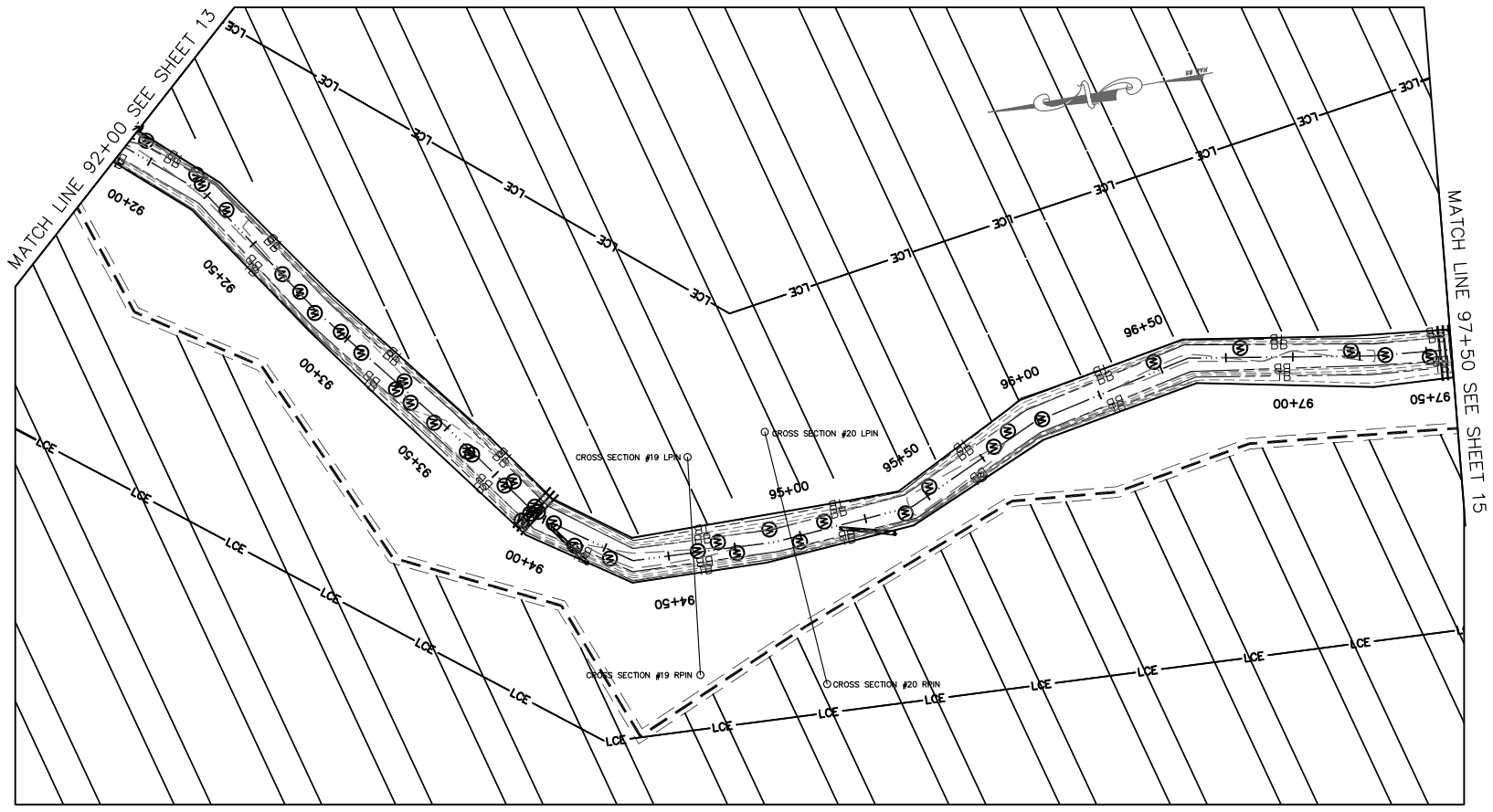
ENVIRONMENTAL BANC & EXCHANGE, LLC
FLOOGIE MITIGATION PROJECT
BERTIE COUNTY, NORTH CAROLINA

FLOOGIE AS-BUILT PLANS
STA. 86+00 TO STA. 92+00

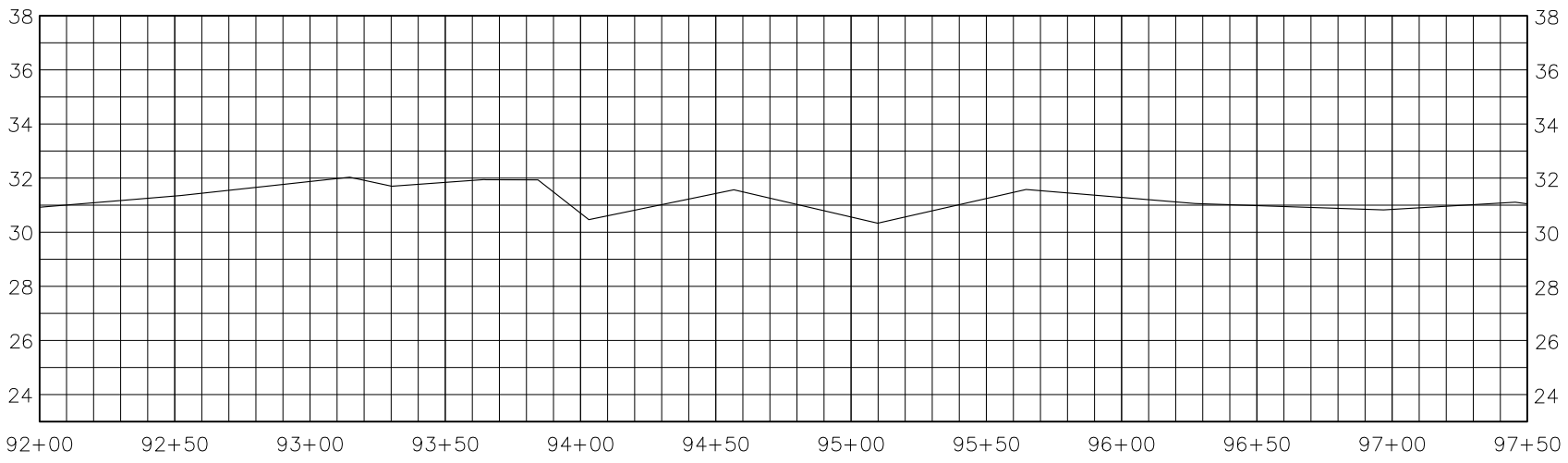
14 / 20



LEGEND

- EXISTING CONTOURS
- CENTERLINE OF EXISTING DITCH
- BOTTOM OF BANK (BB)
- TOP OF BANK (TB)
- LIMITS OF CONSERVATION EASMENT (LCE)
- LOG RAMP
- LOG GRADE CONTROL
- LOG TOE PROTECTION
- LOG VANE
- FORD CROSSING
- ROOT WAD
- CHANNEL PLUG
- WETLAND CHANNEL PLUG
- EXISTING WETLANDS
- BEDDED LOG STRUCTURE
- SMALL WOODY DEBRIS (W)

30 0 15 30 60
1 inch = 30ft.



Horizontal Scale: 1 inch = 30ft.
Vertical Scale: 1 inch = 3ft.

REV. NO.	DESCRIPTION	DATE
	REVISIONS	

PROJECT MANAGER	DPI
DRAWN BY	JLL
APPROVED BY	DPI
FILE NAME	design.dwg
DRAWING SCALE	1" = 30'
PROJECT DATE	08/2007
PROJECT NUMBER	5043100RA
PLOT DATE	03/28/08

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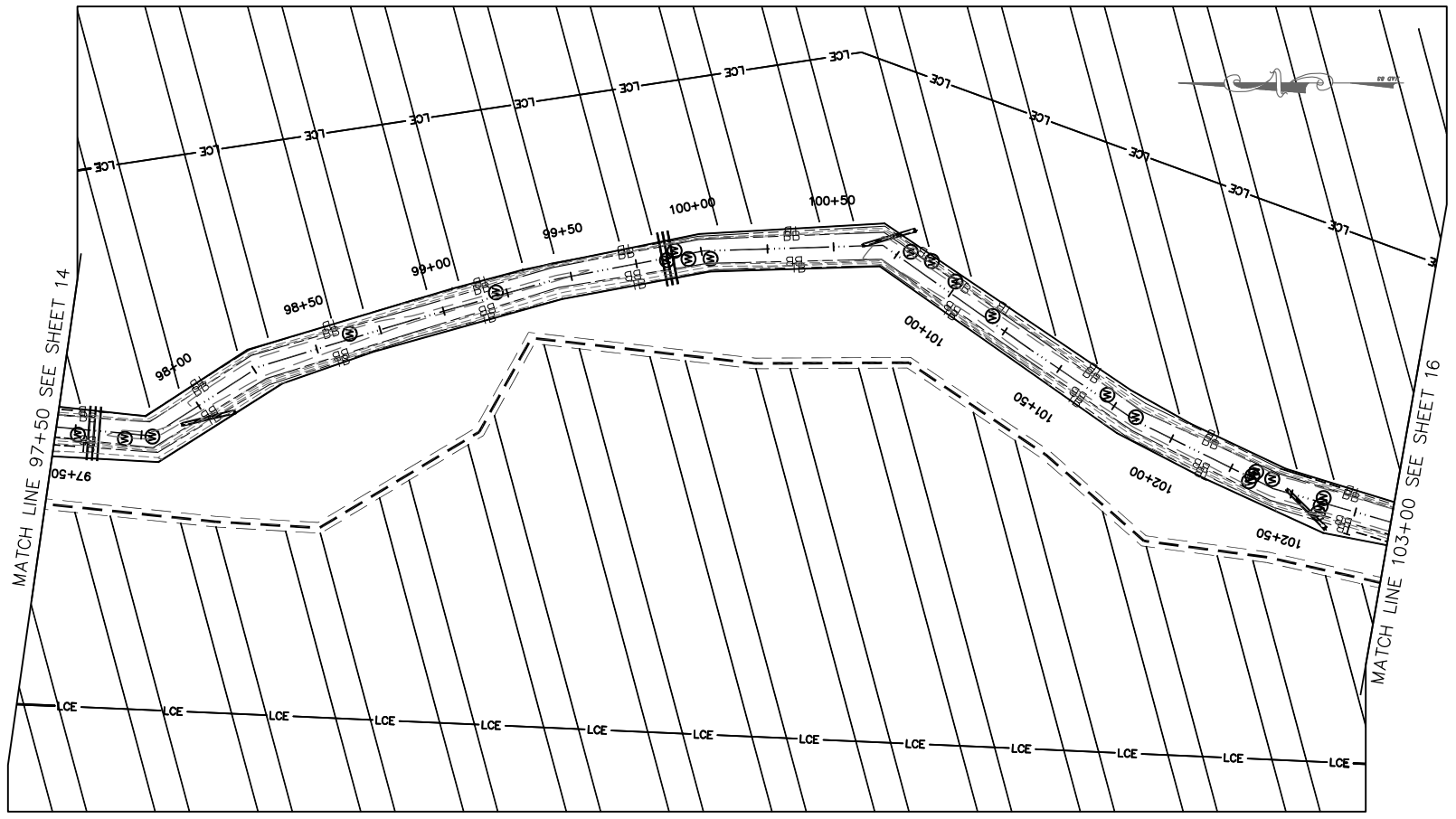
FLOOGIE MITIGATION PROJECT
BERTIE COUNTY, NORTH CAROLINA

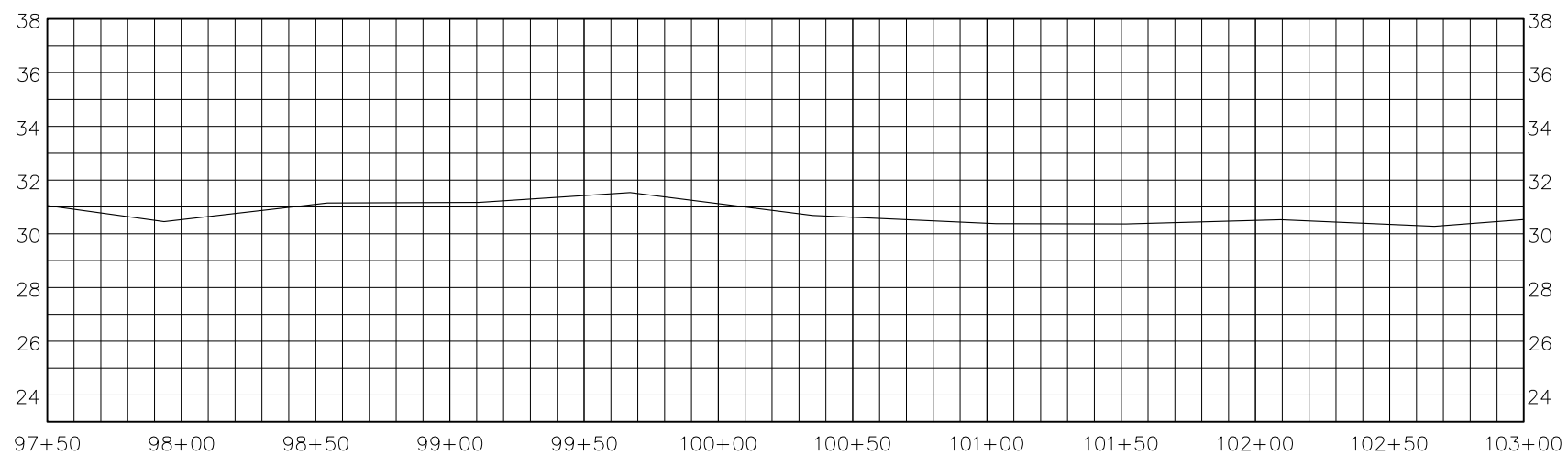
FLOOGIE AS-BUILT PLANS
STA. 92+00 TO STA. 97+50



LEGEND

- EXISTING CONTOURS
- CENTERLINE OF EXISTING DITCH
- BOTTOM OF BANK (BB)
- TOP OF BANK (TB)
- LIMITS OF CONSERVATION EASMENT (LCE)
- LOG RAMP
- LOG GRADE CONTROL
- LOG TOE PROTECTION
- LOG VANE
- FORD CROSSING
- ROOT WAD
- CHANNEL PLUG
- WETLAND CHANNEL PLUG
- EXISTING WETLANDS
- BEDDED LOG STRUCTURE
- SMALL WOODY DEBRIS (W)

30 0 15 30 60
1 inch = 30ft.



Horizontal Scale: 1 inch = 30ft.
Vertical Scale: 1 inch = 3ft.

REV. NO.	DESCRIPTION	DATE
	REVISIONS	

PROJECT MANAGER	DPI
DRAWN BY	JLL
APPROVED BY	DPI
FILE NAME	design.dwg
DRAWING SCALE	1" = 30'
PROJECT DATE	08/2007
PROJECT NUMBER	5043100RA
PLOT DATE	03/28/08

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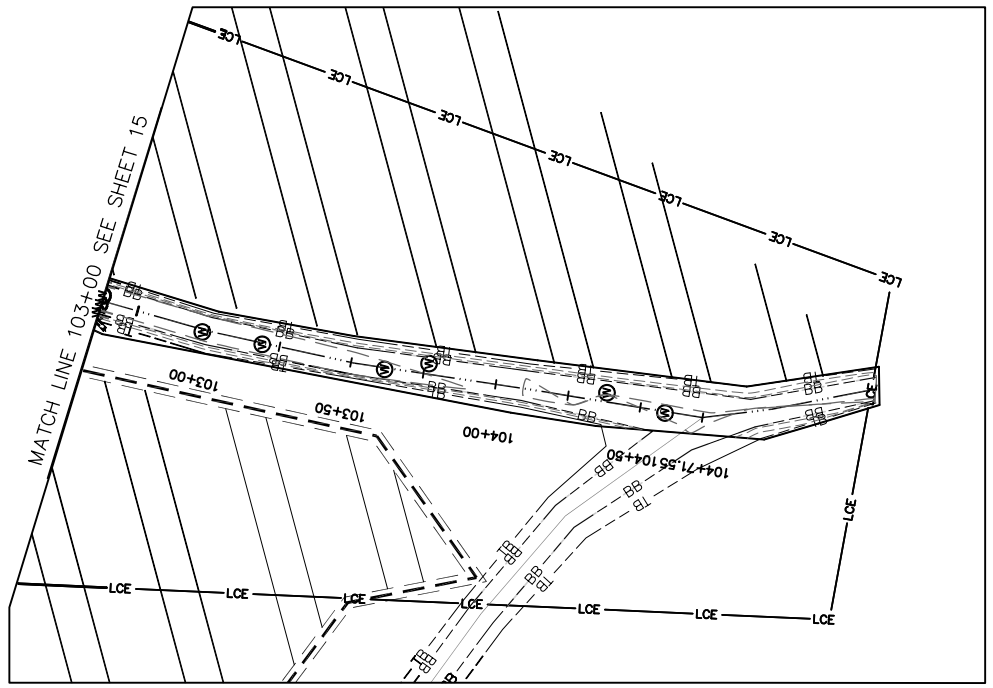
ENVIRONMENTAL BANC & EXCHANGE, LLC
FLOOGIE MITIGATION PROJECT
BERTIE COUNTY, NORTH CAROLINA

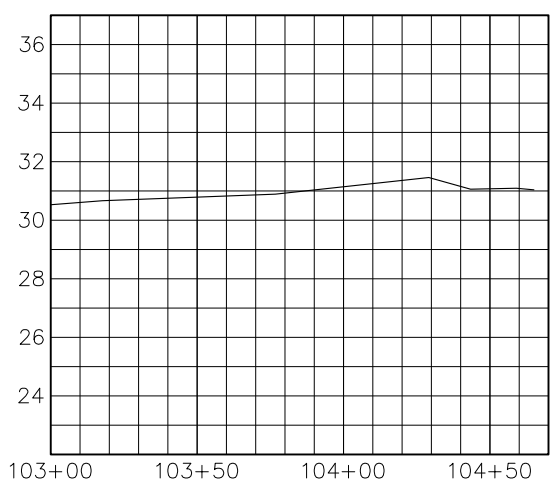
FLOOGIE AS-BUILT PLANS
STA. 97+50 TO STA. 103+00



LEGEND

- EXISTING CONTOURS
- CENTERLINE OF EXISTING DITCH
- BOTTOM OF BANK (BB)
- TOP OF BANK (TB)
- LIMITS OF CONSERVATION EASMENT (LCE)
- LOG RAMP
- LOG GRADE CONTROL
- LOG TOE PROTECTION
- LOG VANE
- FORD CROSSING
- ROOT WAD
- CHANNEL PLUG
- WETLAND CHANNEL PLUG
- EXISTING WETLANDS
- BEDDED LOG STRUCTURE
- SMALL WOODY DEBRIS (W)

30 0 15 30 60
1 inch = 30ft.



Horizontal Scale: 1 inch = 30ft.
Vertical Scale: 1 inch = 3ft.

REV. NO.	DESCRIPTION	DATE
	REVISIONS	

PROJECT MANAGER	DPI
DRAWN BY	JLL
APPROVED BY	DPI
FILE NAME	design.dwg
DRAWING SCALE	1" = 30'
PROJECT DATE	08/2007
PROJECT NUMBER	5043100RA
PLOT DATE	03/28/08

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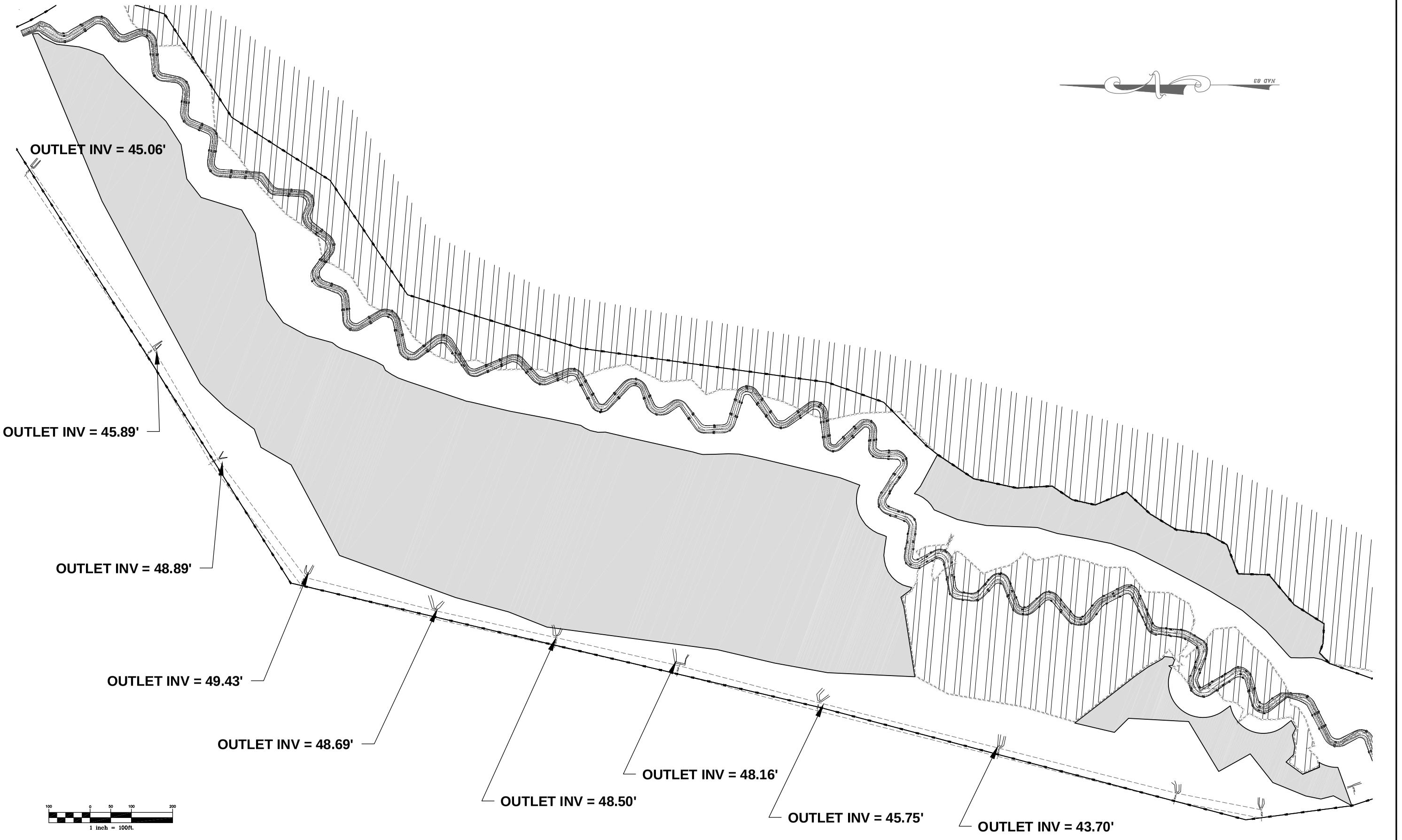
ENVIRONMENTAL BANC & EXCHANGE, LLC
FLOOGIE MITIGATION PROJECT
BERTIE COUNTY, NORTH CAROLINA

FLOOGIE AS-BUILT PLANS
STA. 103+00 TO STA. 104+71.55



REV. NO.	DESCRIPTION	DATE
	REVISIONS	

PROJECT MANAGER	DPI
DRAWN BY	JLL
APPROVED BY	DPI
FILE NAME	design.dwg
DRAWING SCALE	1" = 100'
PROJECT DATE	08/2007
PROJECT NUMBER	504310ORA
PLOT DATE	03/28/08

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ENVIRONMENTAL BANC & EXCHANGE, LLC
FLOOGIE MITIGATION PROJECT
BERTIE COUNTY, NORTH CAROLINA

FLOOGIE AS-BUILT PLANS

WETLAND CONDITIONS

LEGEND

- EXISTING CONTOURS
- CENTERLINE OF HEADWATER STREAMS
- RESTORED BOTTOM OF BANK (BB)
- RESTORED TOP OF BANK (TB)
- LIMITS OF CONSERVATION EASEMENT (LCE)
- WETLAND RESTORATION AREA

NAD 83

REACH 1B - 356 LF

REACH 1A - 322 LF

50 0 25 50 100

1 inch = 50ft.

REV. NO.	DESCRIPTION	DATE
	REVISIONS	

PROJECT MANAGER: DPI	DRAWING SCALE: 1" = 100'
DRAWN BY: TRS	PROJECT DATE: 08/2007
APPROVED BY: DPI	PROJECT NUMBER: 5043100RA
FILE NAME: design.dwg	PLOT DATE: 06/09/08

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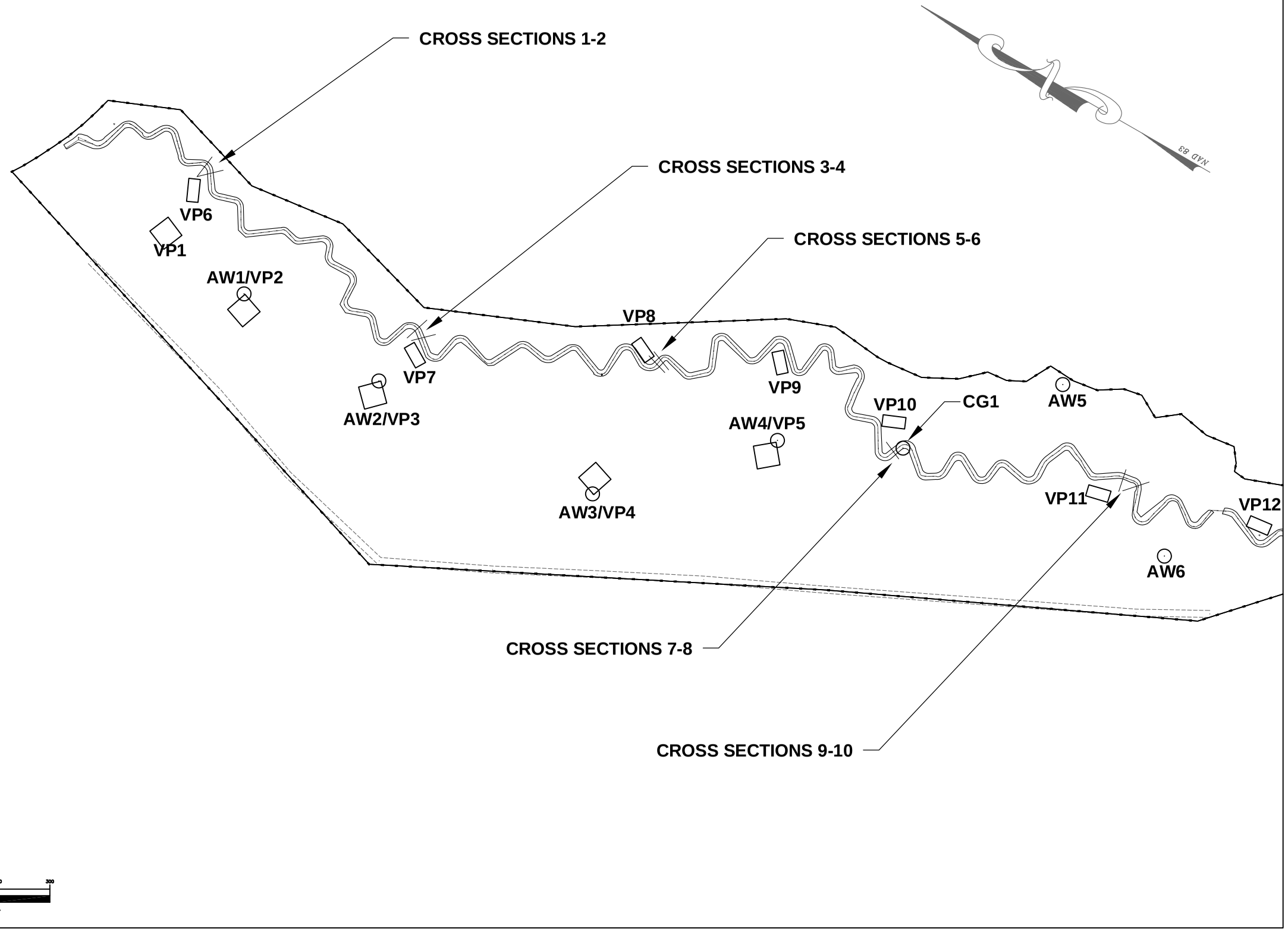
BIDDING	
CONSTRUCTION	
RECORD DWG.	

ENVIRONMENTAL BANC & EXCHANGE, LLC
FLOOGIE MITIGATION PROJECT
BERTIE COUNTY, NORTH CAROLINA

FLOOGIE AS-BUILT PLANS

HEADWATER RESTORATION



REV. NO.	DESCRIPTION	DATE
	REVISIONS	

PROJECT MANAGER: DPI	DRAWING SCALE: 1" = 150'
DRAWN BY: JLL	PROJECT DATE: 08/2007
APPROVED BY: DPI	PROJECT NUMBER: 5043100RA
FILE NAME: design.dwg	PLOT DATE: 03/28/08

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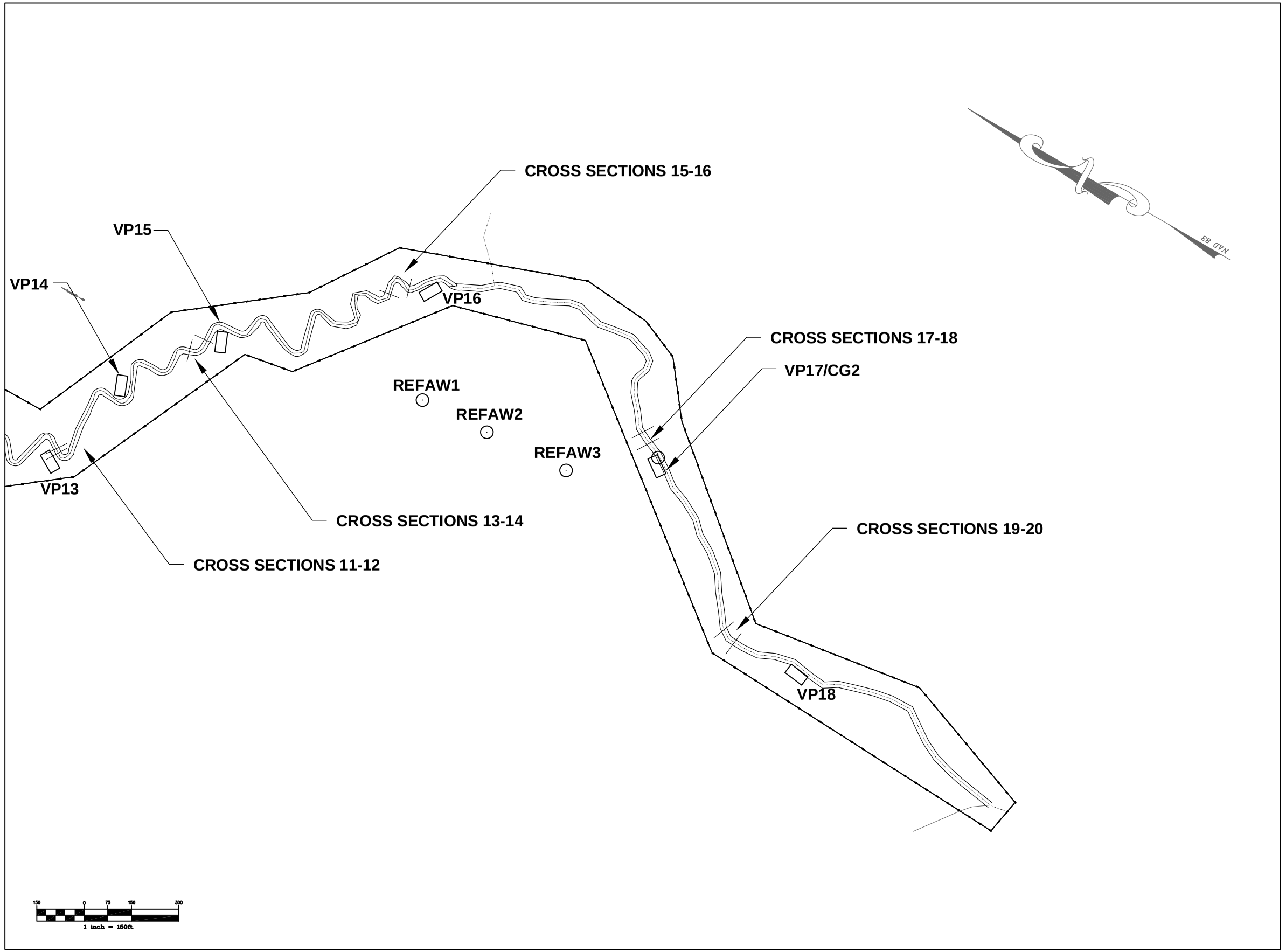
RECORD DWG.	

ENVIRONMENTAL BANC & EXCHANGE, LLC
FLOOGIE MITIGATION PROJECT
BERTIE COUNTY, NORTH CAROLINA

FLOOGIE AS-BUILT PLANS
MONITORING OVERVIEW



REV. NO.	DESCRIPTION	DATE
	REVISIONS	

PROJECT MANAGER	DPI
DRAWN BY	JLL
APPROVED BY	DPI
FILE NAME	design.dwg
DRAWING SCALE	1" = 150'
PROJECT DATE	08/2007
PROJECT NUMBER	504.3100RA
PLOT DATE	03/28/08

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ENVIRONMENTAL BANC & EXCHANGE, LLC
FLOOGIE MITIGATION PROJECT
BERTIE COUNTY, NORTH CAROLINA

FLOOGIE AS-BUILT PLANS
MONITORING OVERVIEW