

**AS-BUILT REPORT
BUSHY BRANCH AT KENTWOOD PARK
RALEIGH, NORTH CAROLINA**

Prepared for:

**North Carolina Ecosystem Enhancement Program
Raleigh, North Carolina**



Prepared by:



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February 2005

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**AS-BUILT REPORT
BUSHY BRANCH STREAM RESTORATION PROJECT
KENTWOOD PARK, RALEIGH NORTH CAROLINA**

1.0 INTRODUCTION

The North Carolina Ecosystem Enhancement Program (EEP), formerly the Wetlands Restoration Program, identified stream reaches for potential restoration within Kentwood Park, Raleigh, NC in 1999. Subsequently, the EEP obtained a 2.9-acre conservation easement within Kentwood Park which includes an approximately 1000-foot reach of Bushy Branch and an approximately 350-foot reach of an unnamed tributary (UT) to Bushy Branch. The reach of Bushy Branch generally extends along a north-south axis (flowing to the south) with the northern terminus located just downstream of Kaplan Drive (Figure 1). These two reaches and adjacent areas within the conservation easement comprise the Bushy Branch Stream Restoration Site, hereafter referred to as the "Site."

The goals of this stream restoration project were to stabilize the stream and enhance the riparian corridor in order to improve water quality and aquatic habitat. To this end, an effort was made to restore the natural flow pattern of the stream and stabilize the steep and eroding channel banks. Stream stabilization efforts were implemented through the following activities: 1) installation of in-stream structures to define additional bed features (i.e. riffles and pools) 2) relocation of a section of stream to new location in order to restore stream pattern, 3) grade severely eroding banks and excavate new bankfull benches, 4) installation of root wads to promote bank stability, and 5) the revegetation of the adjacent banks to promote the establishment of native plant communities.

2.0 SUMMARY

Stream restoration plans were prepared by Arcadis G&M of North Carolina, Inc. (Arcadis 2002), and stream construction occurred in 2002. Poor planting success and safety concerns expressed by the City of Raleigh prompted EPP to put together contingency plans for the site. In the winter of 2004 EcoScience Corporation (ESC) prepared a stream maintenance and planting plan which outlined plant community revegetation efforts and in-stream structure modifications to the UT (ESC 2004). The planting plan and structure modifications were completed in the autumn of 2004. ESC has prepared the current report to establish the characteristics of the Site at present, which are to be used as a baseline for future monitoring efforts at the Site.

2.1 DATA COLLECTION

Data collected to quantify as-built conditions included in-field stream geometry and vegetation surveys. A Topcon GTS-226 Total Station (total station) was used to develop the stream profile and to locate permanent cross-section benchmarks, vegetation plot corners, and physical features throughout the Site. Cross-section geometry was measured using a Topcon RL-60B rotating laser (rotating laser). The Wolman Pebble Count technique (1954) was used to characterize stream bed composition for both Bushy Branch and UT to Bushy Branch.

Permanent vegetation monitoring plots were installed and surveyed following EEP vegetation monitoring protocol (Draft: Vegetation Monitoring Requirements, September 21, 2004).

2.1.1 Survey Data

Stream survey data was collected according to constructs outlined in Rosgen (1996) and the State of North Carolina Interagency Stream Mitigation Guidelines (USACE et al. 2003). Graphic as-built stream data is provided in Appendix A (Figures 1-4).

Total Station Survey

The stream reaches within the conservation easement boundary were surveyed with a total station to locate the top and toe of stream banks, as well as the bankfull bench, where present. Stream profile, in-stream structures and root wads, storm drainage outlet pipes, cross-section monuments, and corners of vegetation monitoring plots were also located. Sewer and storm drainage covers were used to tie the located features to the existing plans. Elevations were established by differential level readings using the left bank monument for cross-section 2 as an arbitrary benchmark (EL = 100). All of these features are shown in Figure 1.

Cross-vane and j-hook structures were identified by at least three points to locate each structure in the stream (Figure 1). The stream profile and stationing of the channel was established using the total station. The stream profile including the proposed and as-built channel elevations (Figures 2 and 3). The profile also depicts the location of all constructed in-stream structures and the locations of permanent cross sections.

Rotating Laser Survey

Monumented cross-sections were placed perpendicular to the channel at representative stream feature locations. The monumented benchmarks were established using concrete and a carriage bolt. The stream channel cross sections were surveyed by ESC personnel using a rotating laser to measure the elevations. The station for each elevation point was located by stretching a tape from one monument to the other and observing the position of the survey rod along the extended tape. The elevations at each cross-section point were established by differential level readings using the elevations of the cross-section monuments.

There are four cross sections, representing a riffle and pool for each stream segment (Figure 1). Graphical cross-sections are depicted in Figure 4. Additional detailed tabular and graphical cross-section information using the "Mecklenburg" Excel spreadsheet is provided in Appendix B. These cross sections are located at the following locations along the stream profile, and are described in detail below.

Cross Section No.	Profile Station
1	UT 0+98
2	UT 2+27
3	4+99
4	7+38

Cross Section 1 is located in a pool just upstream of the vegetation monitoring plot on the UT. In this section of stream, the channel was modified with additional cross vane and rock sill structures as shown on the as-built plan. These structures were designed to create bed form features for habitat, as well as to stabilize the channel bed. The banks were stabilized with vegetation.

Cross Section 2 is located in a riffle on the UT nearly halfway between the two walking bridges. In this portion of the UT, the benches adjacent to the channel are more defined though the overall width of the channel remains consistent. Work in this area includes the addition of cross vane structures for bed stability and grading of the banks to form a floodplain bench. Vegetation was planted throughout the floodplain in order to stabilize the banks.

Cross Section 3 is located in a riffle on Bushy Branch. In this section, a bench was created in order to allow the stream to overbank in higher flows. Structures were installed to create bed form features for habitat and to stabilize the channel bed.

Cross Section 4 is located in a pool within the newly located channel near the bottom of the Site. This area was selected as a representative pool cross section for the restored reach of Bushy Branch. No bankfull bench was created in this area, and the formation of a sediment bar is evident on the inside of the meander bend. In this area structures were placed to create bed form features for habitat and to stabilize the channel bed.

Pebble Count

Wolman pebble counts were taken from the channel beds of Bushy Branch and the UT. These data are included in Appendix B. Counts were taken in four pools and four riffles for each reach. The substrate of both reaches consists of mostly gravel and sand particles with some cobble and exposed bedrock.

Photo Reference Points

Photo reference points have been established throughout the Site. Site locations are shown in Figure 1 and are described below.

- Photo Location #1: Taken at the top of the box culvert at Kaplan Drive looking downstream on Bushy Branch.
- Photo Location #2: J-hook structure just upstream of the UT confluence, on the east bank. Photos were taken looking upstream and downstream at this location.
- Photo Location #3: Standing on upstream pedestrian bridge on UT. Upstream picture shows vegetation plot and cross-section 1. Downstream picture shows several structures and cross-section 2.
- Photo Location #4: Just downstream of first J-hook structure below the confluence on west bank. Photos were taken looking upstream and downstream.
- Photo Location #5: Standing on the left pin of cross-section 4 on Bushy Branch. Photos taken looking upstream and downstream.
- Photo Location #6: Standing on the west bank at most downstream boulder vane. Downstream photo shows last cross vane as it ties into the existing stream. Upstream photo shows several structures looking toward cross-section 4.

2.1.2 Vegetation Plots and Vegetation Survey

The remedial planting of the Site took place in the fall of 2004. A list of species and planting locations are provided in Appendix C. Vegetation plots were established at three locations throughout the Site (Figure 1) by setting metal (18 inch long, ¾ inch) conduit to permanently mark corners of the plots. The plot dimensions measure approximately 10 meter X 10 meter (100 square meters). Vegetation surveys were completed on November 22, 2004 by ECS personnel and were evaluated by species occurrence and cover within specified strata. The first year vegetation data are included in Appendix C

Vegetation Plot Locations:

- Vegetation Plot #1: Just upstream of cross-section 1 on the UT, extending across the stream to encompass both stream banks.
- Vegetation Plot #2: Upstream of cross-section 3 on the east bank of Bushy Branch. This plot extends from the bankfull bench up the bank and into the existing hardwood vegetation.
- Vegetation Plot #3: Between cross-sections 3 and 4 on the west bank of Bushy Branch.

2.2 Consultant, Contractor & Project Manager

The following design firms and contractors supplied services for the stream restoration on the Site.

Design Firm: *Arcadis G&M of North Carolina, Inc.*

Contact: Mr. William Scott Hunt, III (Design Engineer)
2301 Rexwoods Drive
Suite 102
Raleigh, North Carolina 27607
Phone: (919) 782-5511
Fax: (919) 782-5905

Design Firm: *EcoScience Corporation (2004 vegetation plan)*

Contact: Mr. Jens Geratz
1101 Haynes Street
Suite 101
Raleigh, North Carolina 27604
Phone: (919) 828-3433
Fax: (919) 828-3518

Contractor: *Shamrock Environmental Group (Prime)*

Contact: Mr. Bill Wright
6106 Corporate Park Drive
Brown Summit, North Carolina 27214
Phone: (336) 375-1989
Fax: (336) 375-1801

Contractor: *Seal Brothers (Supplemental Vegetation & Structure Repair)*

Contact: Mr. Brian Seal
P.O. Box 86
Dobson, NC 27017
Phone: (336) 710-3560

EEP Project Manager:

North Carolina Ecosystem Enhancement Program
Contact: Mr. Steve Roberts
2728 Capitol Blvd.
Raleigh, North Carolina 27604
Phone: (919) 715-1985
Fax: (919) 715-7578, or 715-2001

3.0 MONITORING PLAN

Monitoring protocol and success criteria have been modified from the Stream Maintenance, Planting Plan, and Monitoring Plan (ESC 2004) to reflect the most recent guidelines from EEP. (Content, Format and Data Requirements for EEP Monitoring Reports, Version 2/21/05; Draft: Vegetation Monitoring Requirements, September 21, 2004). Monitoring of the Site will be performed over a 5 year period (e.g. five growing seasons from 2005-2010), including a minimum of two bankfull events recorded at the Site, or thereafter until success criteria are fulfilled. Monitoring reports will be submitted at the end of each monitoring year. Monitoring is proposed for stream and buffer restoration areas. Two distinct tasks, stream monitoring and vegetation monitoring, are covered under the monitoring plan. These tasks, as well as success criteria and contingency plans, are outlined below.

3.1 Stream Monitoring

As part of the monitoring report, the entire stream reach of both Brushy Branch and the unnamed tributary will be surveyed to calculate geometric stream parameters, including dimension, pattern and profile. The as-built document establishes the existing channel plan view, permanent channel cross-sections on riffles and pools, provides substrate analysis, and the channel profile. Profile measurements will include bed facets, water surface, and bankfull elevations. Two pools and two riffle cross-section locations have been identified within the monitoring reach. The proposed permanent cross-section locations are depicted on Figure 1. Subsequent monitoring will revisit cross-section locations; include a resurvey of the profile; and a substrate analysis. Data will be presented in graphic and tabular format. Data to be presented will be based on bankfull measurements and include 1) cross-sectional area, 2) width, 3) average depth, 4) maximum depth, 5) width/depth ratio, 6) water surface slope, and 7) stream substrate composition. The stream will subsequently be classified according to stream geometry and substrate (Rosgen 1996). Stream monitoring shall also include photo documentation of changes observed within the channel, including bank erosion, aggradation, degradation, structure failure, and presences of instream bars.

3.2 Stream Success Criteria

Success criteria for stream restoration will include 1) successful classification of the reach as a functioning stream system (Rosgen 1996) and 2) channel attributes indicative of a stable stream system. Channel configuration will be evaluated every year to monitor for changes in channel geometry, profile, or substrate. These data will be utilized to determine the success in restoring stream channel stability. Summary performance tables for stream criteria and figures depicting plan view, cross-sections, and profile will be generated and included in the monitoring document. Problem stream locations will be photographed, assessed, described, and shown on a plan view exhibit as necessary.

The channel configuration will be compared to the as-built plans and previous geometry data to track changes in channel geometry, profile, or substrate. These data will be utilized to assist in determining the success of restoring stream channel stability. Specifically, there shall be no significant or detrimental change in channel geometry from the as-built channel. Therefore, pool and riffle depths and width should remain consistent with the constructed geometry; the profile should continue to show the development of bed features, and no channel aggradation or degradation should be within the limits natural stream sediment patterns. The field indicator of bankfull will be described in each monitoring year and indicated on representative channel cross-sections.

Channel stability will be assessed based on dimension, pattern, and profile variables. Bank erosion and headcut migration through the Site, as well as in-stream structure integrity will be assessed visually (photo record) and through cross-section and profile data.

3.3 Stream Contingency

In the event that stream success criteria are not fulfilled, a mechanism for contingency will be implemented. Stream contingency may include, but is not be limited to 1) structure repair and/or installation; 2) repair of dimension, pattern, and/or profile variables; and 3) bank stabilization and excavation. The method of contingency is expected to be dependent upon stream variables not in compliance with success criteria. Primary concerns that may jeopardize stream success include in-stream structure failure and bank erosion.

In-stream Structure Failure – In the event that failure of a structure occurs, provisions for repairing, replacing, or removing the damaged structure may be implemented. Structures which have failed may be left as is, if the structure is deemed to have no undesirable consequence to the stream channel.

Bank Erosion – In the event that severe bank erosion occurs, contingency measures to reduce these variables may take place in the form of suitable bank stabilization measures, repair or modification to in-stream structures, the excavation of a bankfull bench, or the increase in width of the bankfull bench.

3.4 Vegetation Monitoring

Monitoring procedures for vegetation are designed in accordance with vegetation monitoring protocol described in the “Draft: Vegetation Monitoring Requirements, September 21, 2004”. Vegetation will receive a cursory, visual evaluation to ascertain problem areas and the degree of overtopping of planted elements by nuisance species. One representative digital photo of each sample plot must be taken on the day vegetation sampling is completed. The photos shall be in color of adequate quality and presented in the appendixes of the monitoring report.

Quantitative sampling of vegetation will be performed between September 1 and October 30 in each monitoring years or until the vegetation success criterion is achieved. Within each 100 square meter plot, all species will be identified and recorded on a standard Vegetation Data Form. Cover estimates and strata presence determination will be collected for all species. In addition, stem counts for surviving planted and transplanted vegetation will be recorded. Summary performance tables for vegetation criteria will be generated and included in the monitoring document. Problem vegetation locations will be photographed, assessed, described, and shown on a plan view exhibit as necessary.

3.5 Vegetative Success Criteria

Success criteria have been established to verify that the vegetation component supports community elements necessary for natural community forest development. Success criteria are dependent upon the density and growth of "Character Tree/Shrub Species," which include planted species and those species listed for the particular forest type by Schafale and Weakley (1990). Criteria for success will vary for each vegetation community type.

The vegetation development should be observed to show progressive growth over the five-year monitoring period. Vegetation success will be determined by the survival of Character Tree Species. An average density of 320 stems per acre of Character Tree Species must be surviving in the first year of monitoring. Subsequently, 290 character tree stems per acre must

be surviving in year 3, and 260 character tree stems per acre in year 5. A minimum of five Character Tree Species should be present in the sample.

3.6 Vegetation Contingency

If vegetation success criteria are not achieved based on average density calculations from combined sample plot data, supplemental planting will be performed with tree species approved by regulatory agencies. Supplemental planting will be performed as needed until achievement of vegetation success criteria. No direct quantitative sampling requirements are proposed for herb assemblages as part of the vegetation success criteria. Development of floodplain forests over several decades shall dictate the success in migration and establishment of desired understory and groundcover populations. Visual estimates of the percent cover of herbaceous species and photographic evidence will be reported for information purposes only.

3.7 Special Considerations

The Site shall be periodically monitored for structures that significantly impede surface flow of the newly constructed stream channel (e.g. beaver dams or fallen snags). Snags and other woody debris that pose such obstruction shall be removed by hand or "cabled out" of the riparian area with minimum impacts to soil and vegetation. There shall be no excessive clearing or pruning of vegetation within the Site boundary, except where vegetation may obstruct the adjacent frisbee golf course or create a safety hazard. Any vegetation that is removed for temporary access or crossing shall be re-established. Corrective action shall be applied to any monitored activity that causes channelized flow within the riparian area.

4.0 REFERENCES

Arcadis G&M of North Carolina, Inc. 2002. Design Plans for Bushy Branch at Kentwood Park. Raleigh, North Carolina.

EcoScience Corporation. 2004. Kentwood Park Stream Restoration Site: Stream Maintenance, Planting Plan, and Monitoring Plan. Raleigh, North Carolina.

Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, Colorado.

Schafale, M.P. and A.S. Weakley. 1990. Classification of the Natural Communities of North Carolina: Third Approximation. North Carolina Natural Heritage Program, Division of Parks and Recreation, N.C. Department of Environment, Health, and Natural Resources. Raleigh, North Carolina.

Wolman, M.G., 1954. A method of sampling coarse river-bed material: Transactions, American Geophysical Union, v. 35, n. 6, p. 951-956.

Appendix A: Figures

PROJECT: BUSHY BRANCH AT KENTWOOD PARK AS-BUILT PLAN

BUSHY BRANCH AT KENTWOOD PARK AS-BUILT PLAN

WAKE COUNTY, NORTH CAROLINA



SITE

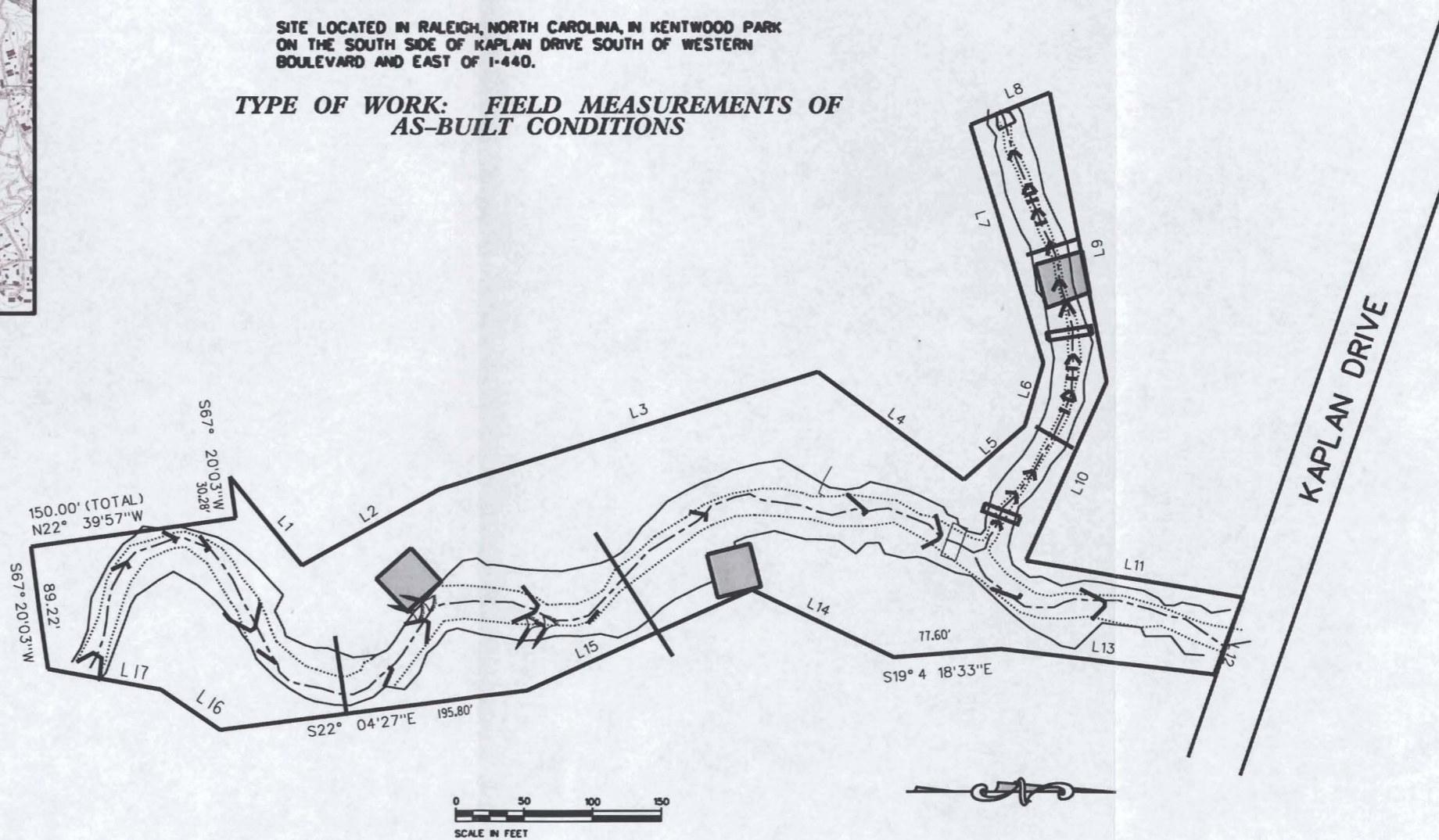
LOCATION MAP
NOT TO SCALE

LOCATION:

SITE LOCATED IN RALEIGH, NORTH CAROLINA, IN KENTWOOD PARK ON THE SOUTH SIDE OF KAPLAN DRIVE SOUTH OF WESTERN BOULEVARD AND EAST OF I-440.

TYPE OF WORK: FIELD MEASUREMENTS OF AS-BUILT CONDITIONS

LINE TABLE		
LINE	BEARING	DISTANCE
L1	N35° 53'25"E	82.77'
L2	N43° 38'42"W	113.95'
L3	N31° 52'19"W	288.15'
L4	N21° 40'20"E	131.69'
L5	N56° 11'21"W	58.82'
L6	N88° 15'35"W	47.66'
L7	S58° 13'41"W	180.43'
L8	N36° 54'33"W	61.94'
L9	N64° 05'52"E	213.65'
L10	S80° 25'13"E	142.06'
L11	N05° 12'48"W	160.50'
L12	S84° 17'27"E	59.53'
L13	S07° 56'27"E	154.80'
L14	S10° 19'24"W	116.28'
L15	S38° 50'19"E	178.35'
L16	S18° 52'31"W	52.91'
L17	S04° 28'47"E	83.38'



0 50 100 150
SCALE IN FEET

Prepared In the office of:



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Ph: 919 828-3433 Fax: 919 828-3518

ENGINEER: DAVID G. MODLIN

PROJECT MANAGER: JENS GERATZ

PROJECT NUMBER: 04-178

SEAL:



David G. Modlin
3/8/2005

Prepared for:

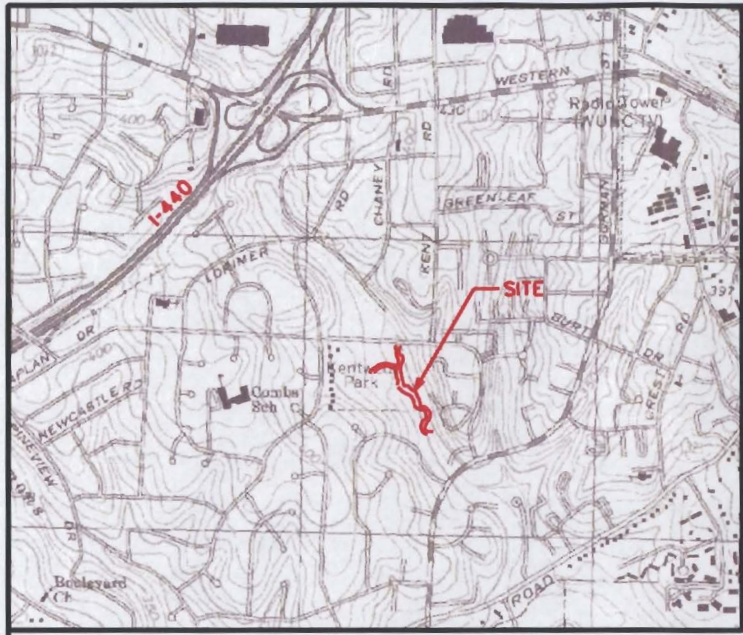
**NC DENR ECOSYSTEM
ENHANCEMENT PROGRAM**
Raleigh, North Carolina

No.	Revisions	Date

Des. By:	Rev. By:	Chk. By:
N/A	JDG	DGM

Date: **JAN 2005**
ESC Project No: **04-178**

SHEET

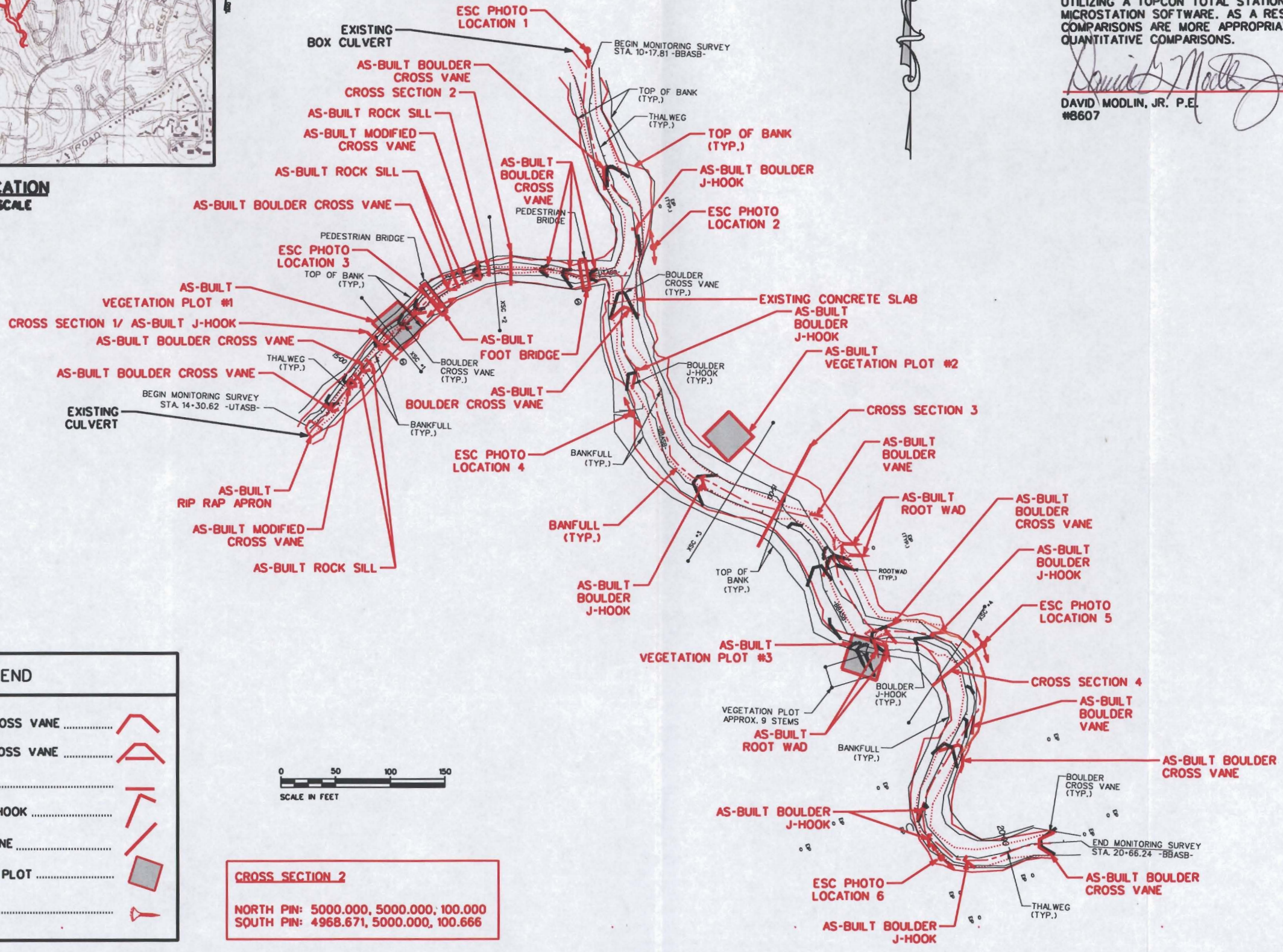


SITE LOCATION
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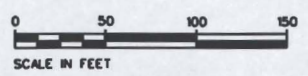
NOTE:

PLANS ENTITLED, "BUSHY BRANCH AT KENTWOOD PARK", DATED 05/03/02 (BLACK LINES,) WERE PREPARED BY ARCADIS G&M OF NORTH CAROLINA AND FURNISHED THROUGH ECOSYSTEM ENHANCEMENT PROGRAM TO ECOSCIENCE CORPORATION AS A .PDF FILE. AS-BUILT CONDITIONS (RED LINES) DETERMINED BY ECOSCIENCE CORPORATION WERE DEVELOPED FROM ACTUAL FIELD MEASUREMENTS UTILIZING A TOPCON TOTAL STATION AND MICROSTATION SOFTWARE. AS A RESULT, SUBJECTIVE COMPARISONS ARE MORE APPROPRIATE THAN DIRECT QUANTITATIVE COMPARISONS.

David G. Modlin, Jr.
DAVID MODLIN, JR. P.E.
#8607

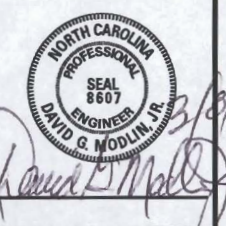


LEGEND	
AS-BUILT BOULDER CROSS VANE	
AS-BUILT MODIFIED CROSS VANE	
AS-BUILT ROCK SILL	
AS-BUILT BOULDER J-HOOK	
AS-BUILT BOULDER VANE	
AS-BUILT VEGETATION PLOT	
AS-BUILT ROT WAD	



CROSS SECTION 2
NORTH PIN: 5000.000, 5000.000, 100.000
SOUTH PIN: 4968.671, 5000.000, 100.666

REVISIONS



Client: **BUSHY BRANCH AT KENTWOOD PARK STREAM RESTORATION AS-BUILT**

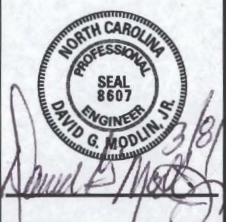
Project: **WAKE COUNTY, NORTH CAROLINA**

Title: **AS-BUILT PLAN VIEW**

Dwn By: JGD	Date: JAN 2005
Ckd By: JCD	Scale: AS SHOWN
ESC Project No.: 04-178	

FIGURE
1

REVISIONS



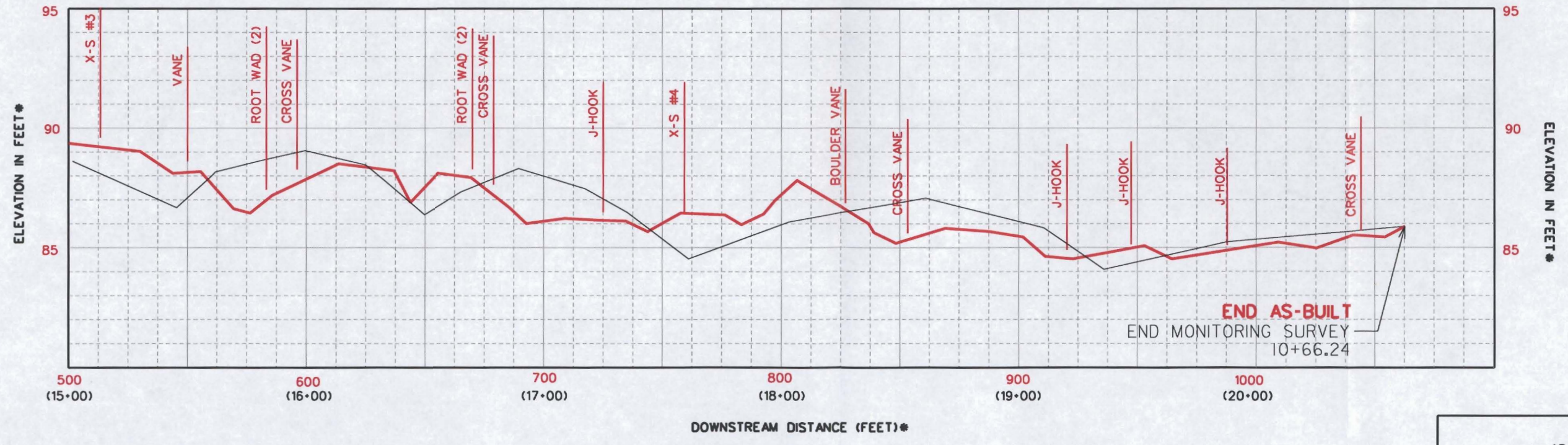
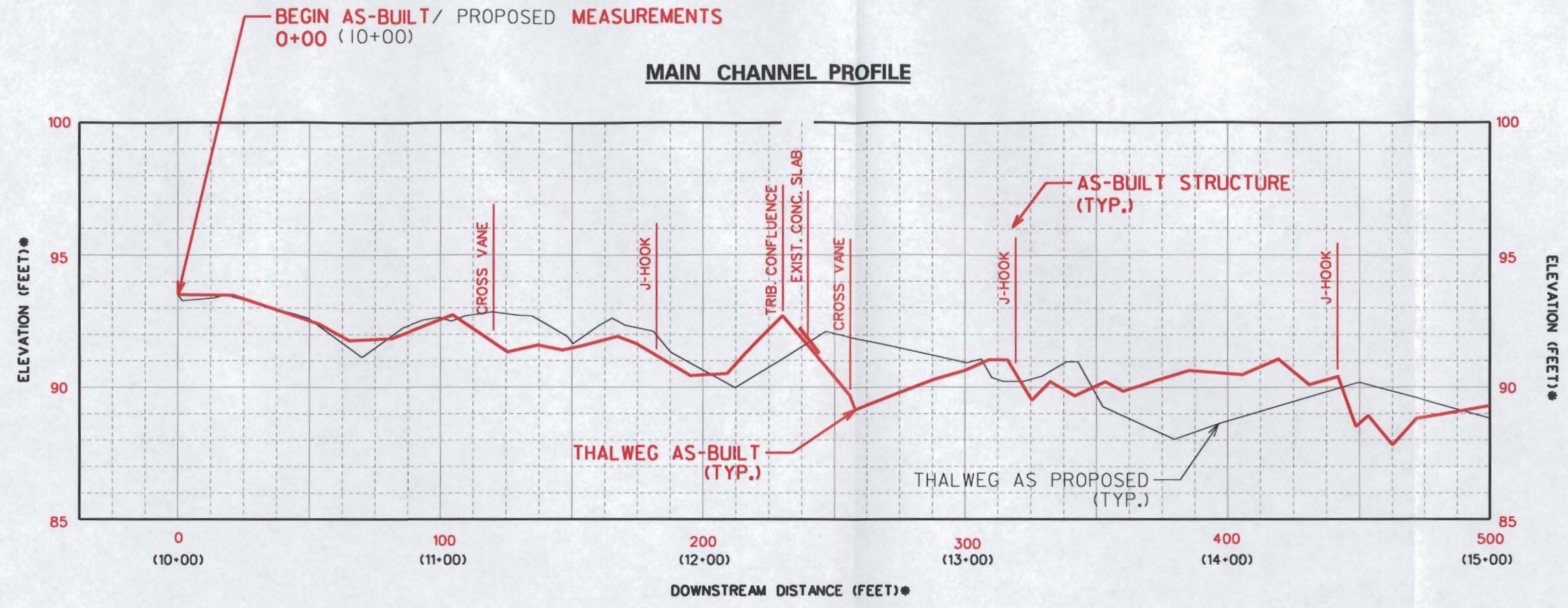
Client: **BUSHY BRANCH AT KENTWOOD PARK STREAM RESTORATION AS-BUILT**

Project: **WAKE COUNTY, NORTH CAROLINA**



Title: **AS-BUILT PROFILE BUSHY BRANCH**

Drawn By: JDC	Date: JAN 2005
Okd By: JCD	Scale: AS SHOWN
ESC Project No.: 04-178	

FIGURE
2



*NOTE:
AS-BUILT PROFILE BASED ON CURRENT THALWEG LOCATION WHICH HAS MIGRATED IN SOME PLACES, DUE TO NATURAL STREAM PROCESSES, SINCE CONSTRUCTION IN 2002.

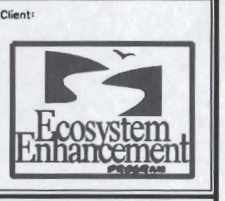
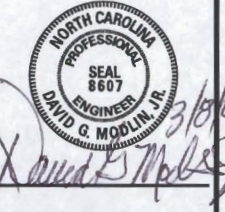
	AS-BUILT CHANNEL ELEVATION
	PROPOSED CHANNEL ELEVATION



EcoScience Corporation

Raleigh, North Carolina

REVISIONS



Client:

Project:

BUSHY BRANCH AT KENTWOOD PARK STREAM RESTORATION AS-BUILT

WAKE COUNTY, NORTH CAROLINA

Title:

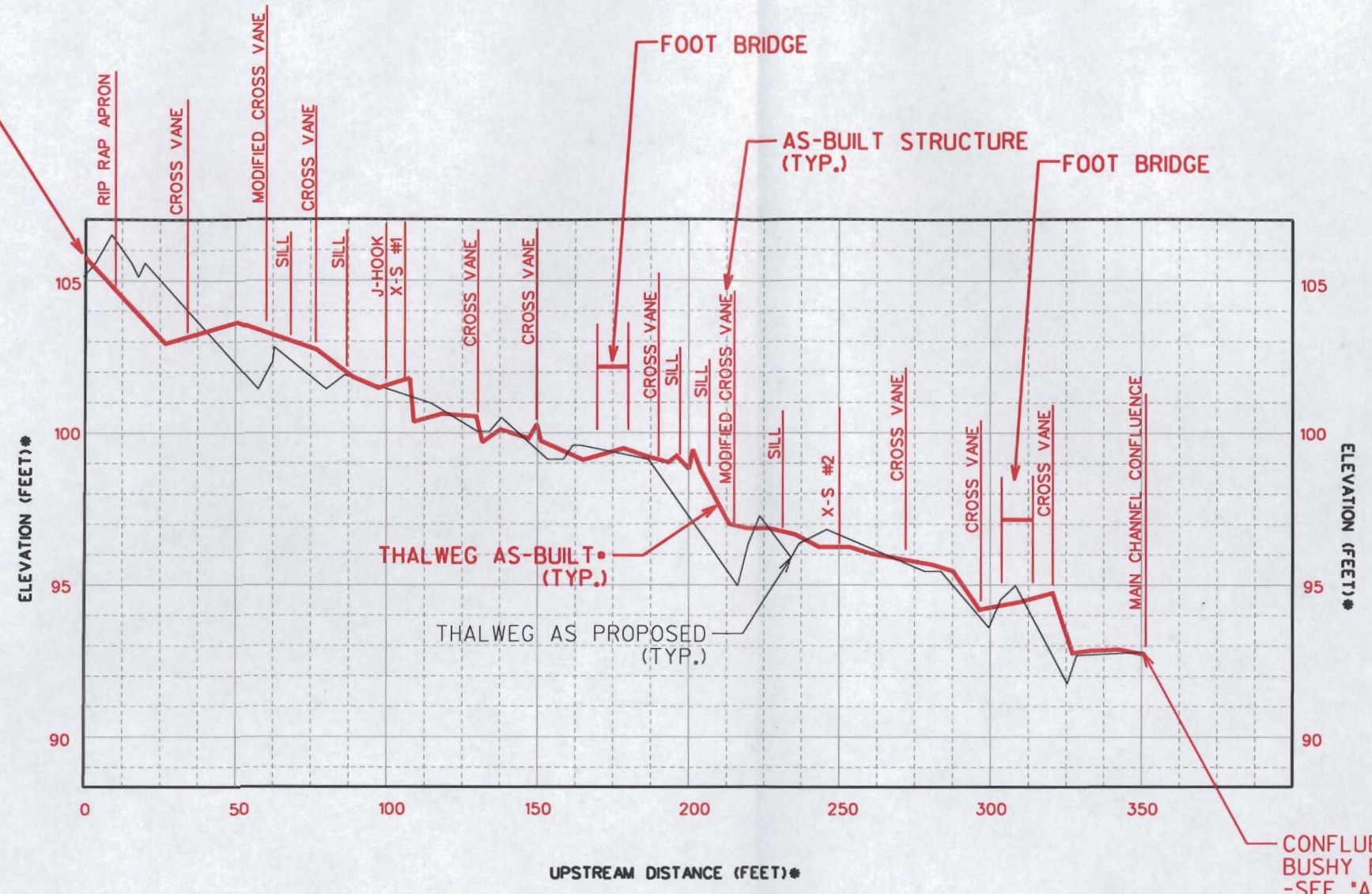
AS-BUILT PROFILE UT TO BUSHY BRANCH

Dwn By:	Date:
JDG	JAN 2005
Chd By:	Scale:
JCD	AS SHOWN
ESC Project No.:	
04-178	

FIGURE

3

BEGIN AS-BUILT MEASUREMENTS 0+00



CONFLUENCE WITH BUSHY BRANCH -SEE "AS-BUILT PROFILE BUSHY BRANCH," FIGURE 2

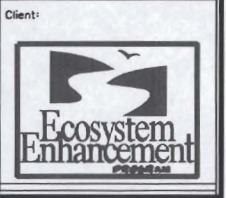
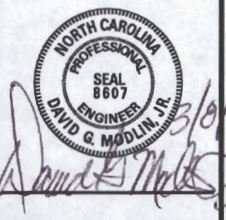
TRIBUTARY PROFILE

***NOTE:**

AS-BUILT PROFILE BASED ON CURRENT THALWEG LOCATION WHICH HAS MIGRATED IN SOME PLACES, DUE TO NATURAL STREAM PROCESSES, SINCE CONSTRUCTION IN 2002.

	AS-BUILT CHANNEL ELEVATION
	PROPOSED CHANNEL ELEVATION

REVISIONS



Project:

BUSHY BRANCH AT KENTWOOD PARK STREAM RESTORATION AS-BUILT

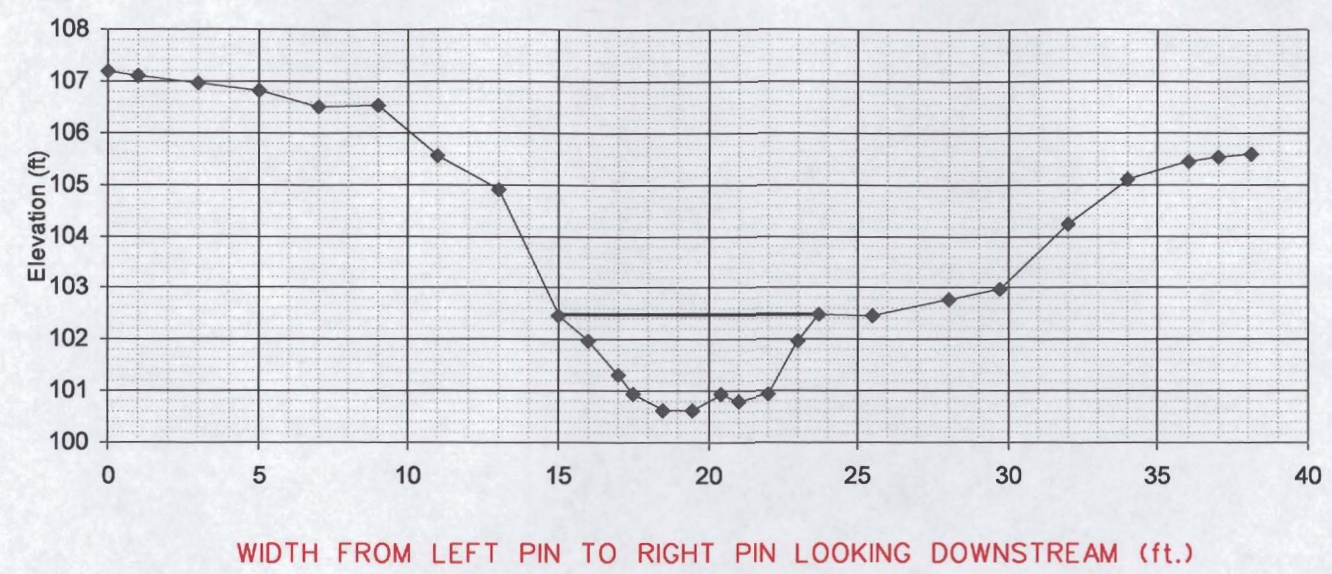
WAKE COUNTY, NORTH CAROLINA

Title:

AS-BUILT PROFILE BUSHY BRANCH

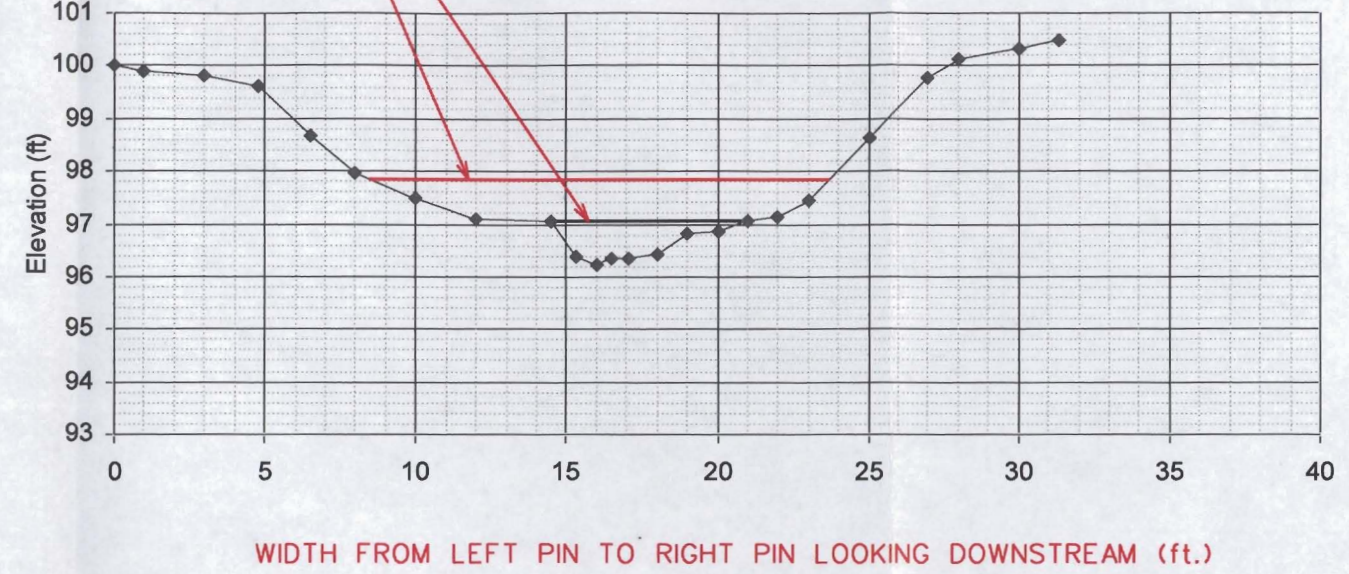
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JDG	JAN 2005
Checked By:	Scale:
JCD	AS SHOWN
ESC Project No.:	
04-178	

CROSS SECTION 1
UT to Bushy Branch
POOL

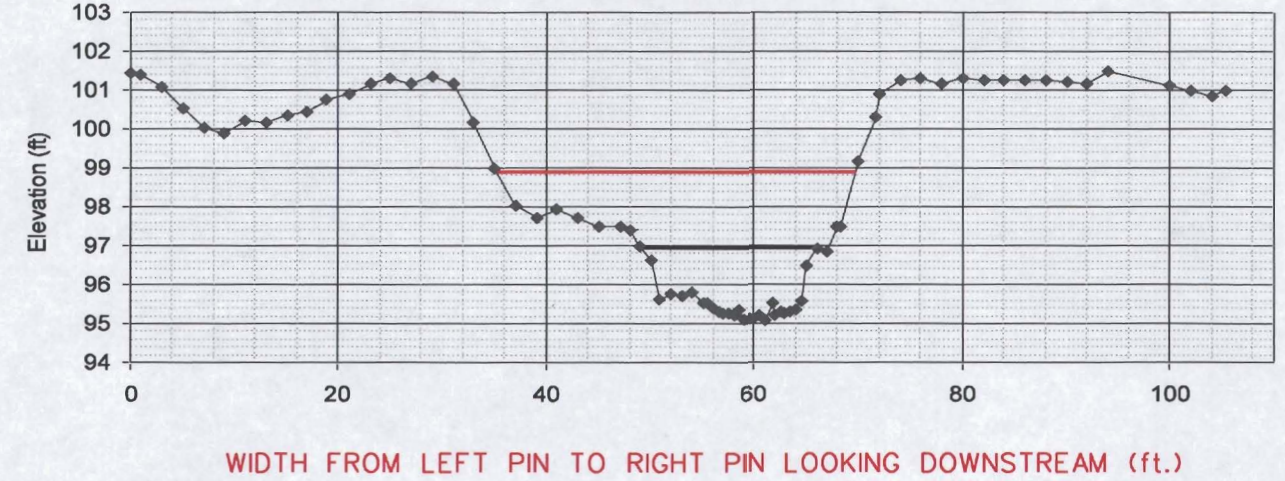


CROSS SECTION 2
UT to Bushy Branch
RIFFLE

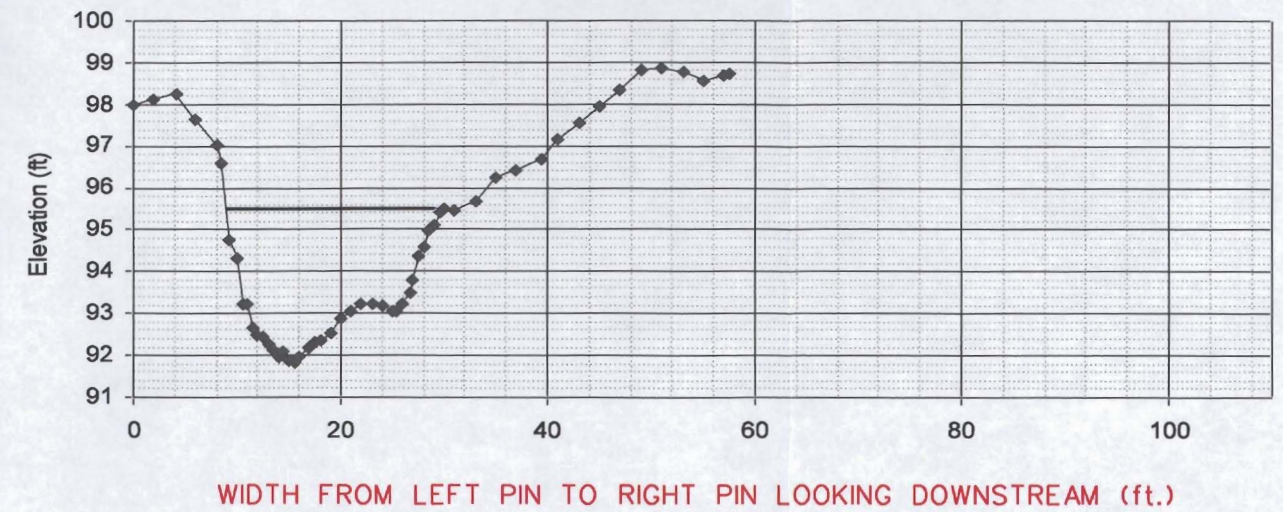
BANKFULL (BLACK, TYP.)
FLOOD-PRONE AREA (RED, TYP.)



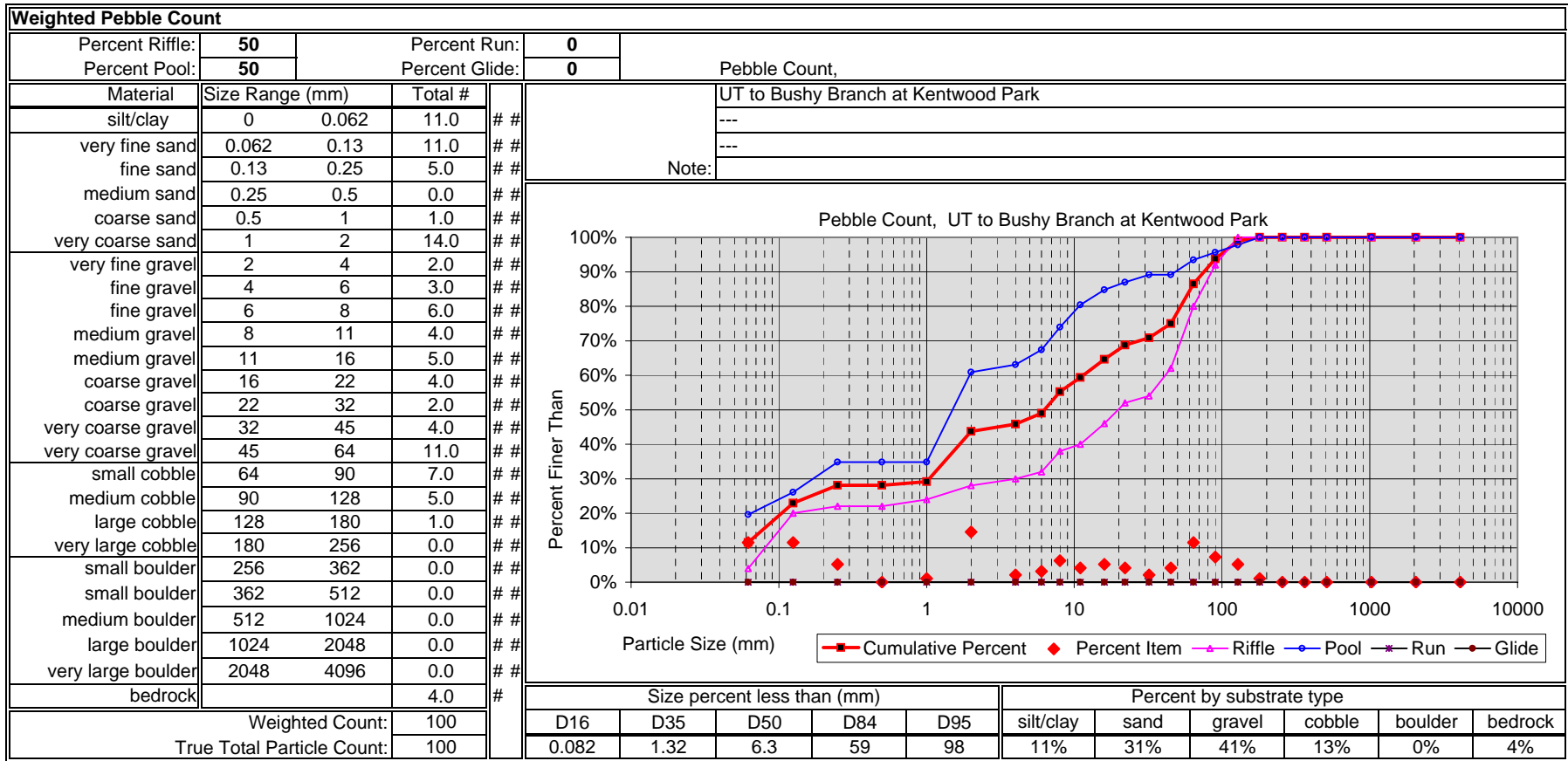
CROSS SECTION 3
Bushy Branch
RIFFLE



CROSS SECTION 4
Bushy Branch
POOL

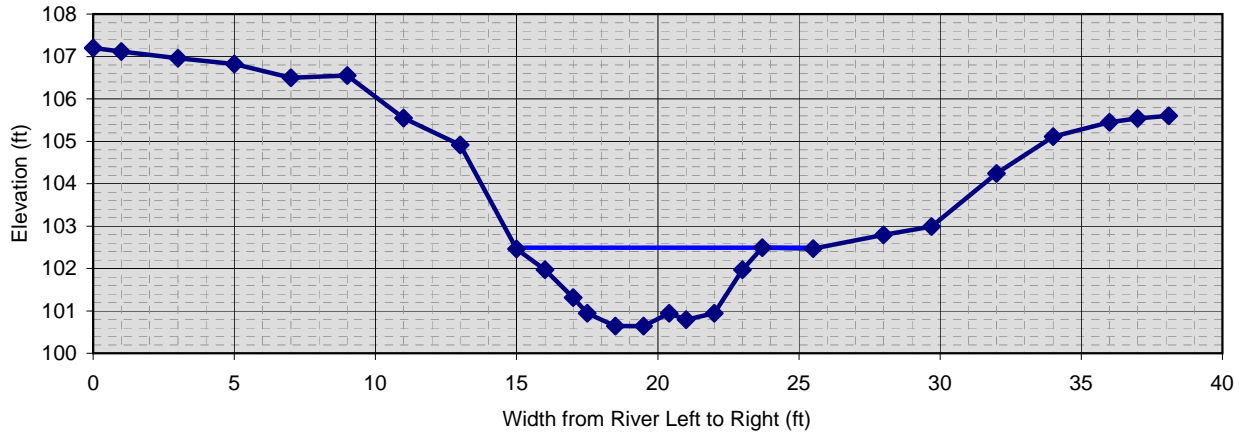


Appendix B: Stream Data



Cross Section

1 Pool UT to Bushy Branch at Kentwood Park



section: 1

Pool
UT to Bushy Branch at Kentwood Park

description: Assumed Lpin elevation = 100.00

height of instrument (ft): 113.13

notes	omit pt.	distance (ft)	FS (ft)	elevation
Lpin	<input checked="" type="checkbox"/>	0	5.93	107.2
	<input checked="" type="checkbox"/>	1	6.01	107.12
	<input checked="" type="checkbox"/>	3	6.17	106.96
	<input checked="" type="checkbox"/>	5	6.31	106.82
	<input checked="" type="checkbox"/>	7	6.63	106.5
mulchpile	<input checked="" type="checkbox"/>	9	6.58	106.55
mulchpile	<input checked="" type="checkbox"/>	11	7.58	105.55
	<input checked="" type="checkbox"/>	13	8.22	104.91
	<input type="checkbox"/>	15	10.67	102.46
	<input type="checkbox"/>	16	11.16	101.97
Bnkfull?	<input type="checkbox"/>	17	11.82	101.31
	<input type="checkbox"/>	17.5	12.19	100.94
	<input type="checkbox"/>	18.5	12.49	100.64
Thalweg	<input type="checkbox"/>	19.5	12.49	100.64
Rock	<input type="checkbox"/>	20.4	12.19	100.94
	<input type="checkbox"/>	21	12.34	100.79
	<input type="checkbox"/>	22	12.19	100.94
	<input type="checkbox"/>	23	11.16	101.97
Top XVane	<input type="checkbox"/>	23.7	10.64	102.49
	<input type="checkbox"/>	25.5	10.66	102.47
	<input checked="" type="checkbox"/>	28	10.34	102.79
	<input checked="" type="checkbox"/>	29.7	10.14	102.99
	<input checked="" type="checkbox"/>	32	8.89	104.24
	<input checked="" type="checkbox"/>	34	8.02	105.11
	<input checked="" type="checkbox"/>	36	7.68	105.45
	<input checked="" type="checkbox"/>	37	7.59	105.54
Rpin	<input checked="" type="checkbox"/>	38.1	7.53	105.6
	<input type="checkbox"/>			

FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
10.64				
102.49	---			

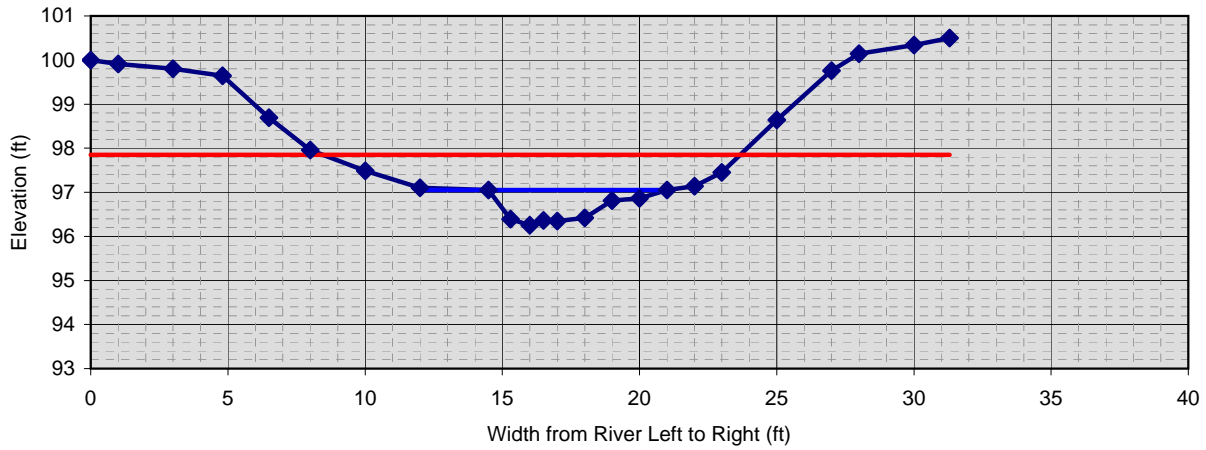
dimensions			
10.7	x-section area	1.0	d mean
10.5	width	11.7	wet P
1.8	d max	0.9	hyd radi
0.0	bank ht	10.3	w/d ratio
0.0	W flood prone area	0.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
59	measured D84 (mm)		
5.2	relative roughness	6.9	fric. factor
0.000	Manning's n from channel material		

Cross Section

2 Riffle UT to Bushy Branch at Kentwood Park



section: 2

Riffle
UT to Bushy Branch at Kentwood Park

description: Assumed Lpin elevation = 100.00

height of instrument (ft): 105.94

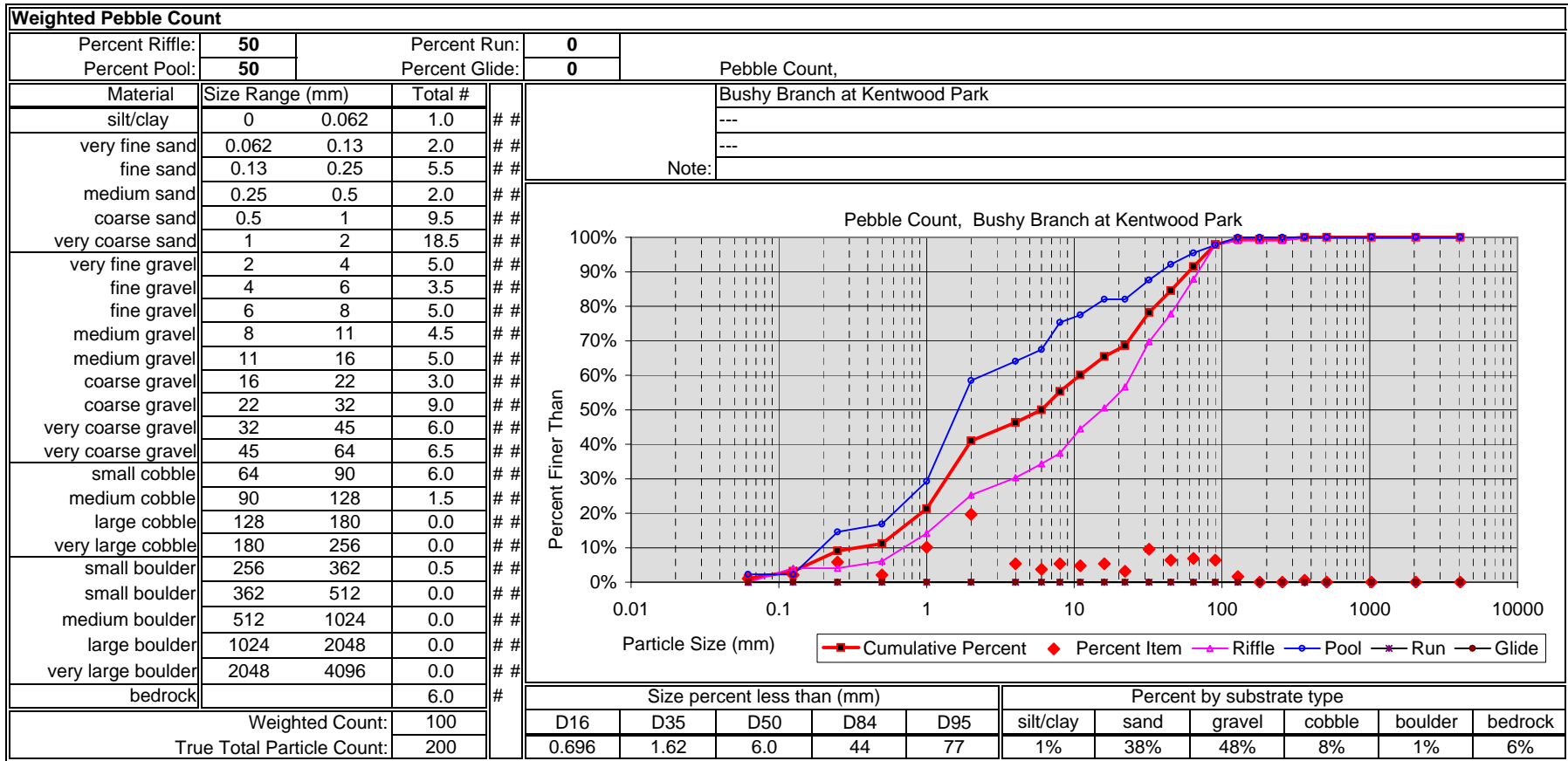
notes	omit pt.	distance (ft)	FS (ft)	elevation
Lpin	<input checked="" type="checkbox"/>	0	5.94	100
	<input checked="" type="checkbox"/>	1	6.03	99.91
	<input checked="" type="checkbox"/>	3	6.14	99.8
TOB	<input checked="" type="checkbox"/>	4.8	6.3	99.64
	<input checked="" type="checkbox"/>	6.5	7.25	98.69
	<input checked="" type="checkbox"/>	8	7.98	97.96
	<input checked="" type="checkbox"/>	10	8.45	97.49
	<input type="checkbox"/>	12	8.84	97.1
	<input type="checkbox"/>	14.5	8.89	97.05
WaterEdge	<input type="checkbox"/>	15.3	9.55	96.39
	<input type="checkbox"/>	16	9.69	96.25
	<input type="checkbox"/>	16.5	9.58	96.36
	<input type="checkbox"/>	17	9.59	96.35
	<input type="checkbox"/>	18	9.52	96.42
	<input type="checkbox"/>	19	9.13	96.81
	<input type="checkbox"/>	20	9.08	96.86
	<input type="checkbox"/>	21	8.89	97.05
	<input checked="" type="checkbox"/>	22	8.8	97.14
	<input checked="" type="checkbox"/>	23	8.49	97.45
	<input checked="" type="checkbox"/>	25	7.3	98.64
	<input checked="" type="checkbox"/>	27	6.18	99.76
	<input checked="" type="checkbox"/>	28	5.8	100.14
	<input checked="" type="checkbox"/>	30	5.6	100.34
Rpin	<input checked="" type="checkbox"/>	31.3	5.44	100.5
	<input type="checkbox"/>			

FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
8.89	6.3			
97.05	99.64			

dimensions			
2.9	x-section area	0.4	d mean
6.5	width	6.9	wet P
0.8	d max	0.4	hyd radi
3.4	bank ht	14.5	w/d ratio
0.0	W flood prone area	0.0	ent ratio

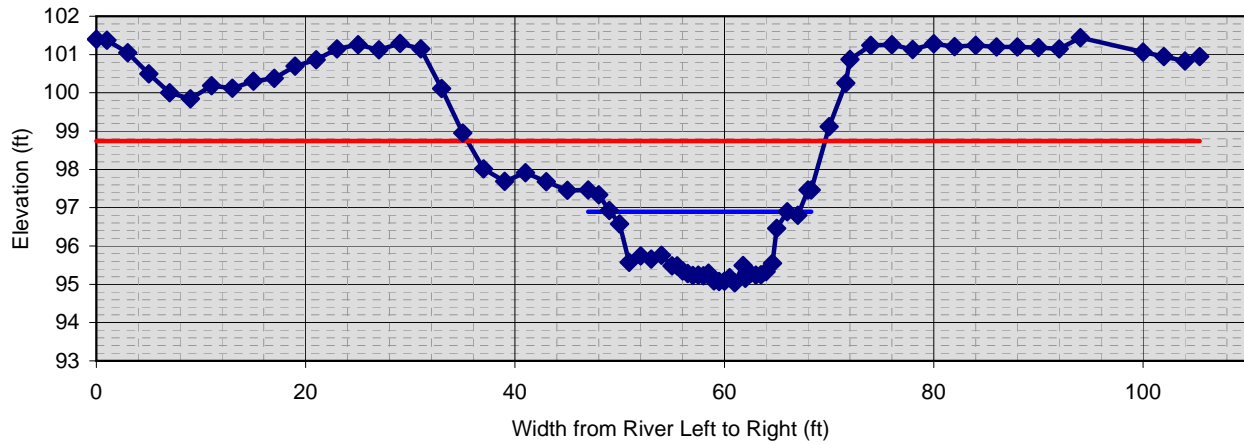
hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
59	measured D84 (mm)		
2.3	relative roughness	4.9	fric. factor
0.000	Manning's n from channel material		



Cross Section

3 Riffle Bushy Branch at Kentwood Park



section: 3

Riffle
Bushy Branch at Kentwood Park

description:

height of instrument (ft): 107.07

notes	omit pt.	distance (ft)	FS (ft)	elevation
Lpin	<input checked="" type="checkbox"/>	0	5.67	101.4
	<input checked="" type="checkbox"/>	1	5.7	101.37
	<input checked="" type="checkbox"/>	3	6.02	101.05
	<input checked="" type="checkbox"/>	5	6.57	100.5
	<input checked="" type="checkbox"/>	7	7.07	100
	<input checked="" type="checkbox"/>	9	7.23	99.84
	<input checked="" type="checkbox"/>	11	6.88	100.19
	<input checked="" type="checkbox"/>	13	6.95	100.12
	<input checked="" type="checkbox"/>	15	6.77	100.3
	<input checked="" type="checkbox"/>	17	6.69	100.38
	<input checked="" type="checkbox"/>	19	6.37	100.7
	<input checked="" type="checkbox"/>	21	6.21	100.86
	<input checked="" type="checkbox"/>	23	5.92	101.15
	<input checked="" type="checkbox"/>	25	5.81	101.26
	<input checked="" type="checkbox"/>	27	5.95	101.12
	<input checked="" type="checkbox"/>	29	5.78	101.29
	<input checked="" type="checkbox"/>	31	5.92	101.15
	<input checked="" type="checkbox"/>	33	6.96	100.11
	<input checked="" type="checkbox"/>	35	8.12	98.95
	<input checked="" type="checkbox"/>	37	9.06	98.01
	<input checked="" type="checkbox"/>	39	9.38	97.69
	<input checked="" type="checkbox"/>	41	9.16	97.91
	<input checked="" type="checkbox"/>	43	9.39	97.68
	<input checked="" type="checkbox"/>	45	9.62	97.45
	<input type="checkbox"/>	47	9.61	97.46
TOB	<input type="checkbox"/>	48	9.73	97.34

FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
10.18	9.73	43.0		
96.89	97.34			

dimensions			
22.2	x-section area	1.2	d mean
18.0	width	19.8	wet P
1.8	d max	1.1	hyd radi
2.3	bank ht	14.6	w/d ratio
43.0	W flood prone area	2.4	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

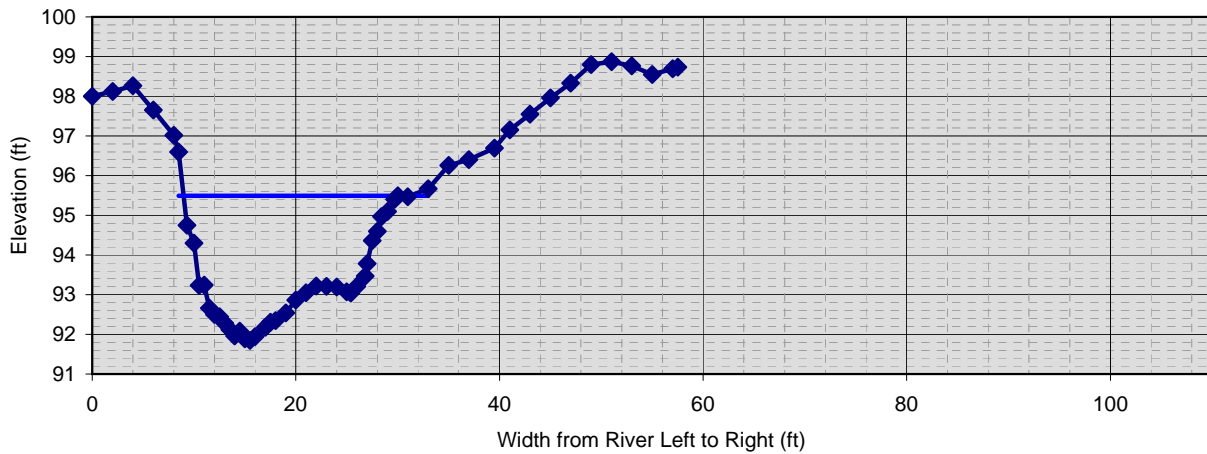
check from channel material			
44	measured D84 (mm)		
8.6	relative roughness	8.2	fric. factor
0.000	Manning's n from channel material		



	<input type="checkbox"/>	49	10.14	96.93
	<input type="checkbox"/>	50	10.49	96.58
	<input type="checkbox"/>	50.9	11.5	95.57
	<input type="checkbox"/>	52	11.33	95.74
	<input type="checkbox"/>	53	11.41	95.66
	<input type="checkbox"/>	54	11.31	95.76
	<input type="checkbox"/>	55	11.59	95.48
	<input type="checkbox"/>	55.5	11.59	95.48
	<input type="checkbox"/>	56	11.72	95.35
	<input type="checkbox"/>	56.5	11.79	95.28
	<input type="checkbox"/>	57	11.84	95.23
	<input type="checkbox"/>	57.5	11.83	95.24
	<input type="checkbox"/>	58	11.85	95.22
	<input type="checkbox"/>	58.5	11.78	95.29
	<input type="checkbox"/>	59	11.98	95.09
	<input type="checkbox"/>	59.5	12	95.07
	<input type="checkbox"/>	60	11.99	95.08
	<input type="checkbox"/>	60.5	11.9	95.17
	<input type="checkbox"/>	61	12.03	95.04
	<input type="checkbox"/>	61.8	11.58	95.49
	<input type="checkbox"/>	62	11.91	95.16
	<input type="checkbox"/>	62.5	11.79	95.28
	<input type="checkbox"/>	63	11.83	95.24
	<input type="checkbox"/>	63.5	11.82	95.25
	<input type="checkbox"/>	64	11.74	95.33
	<input type="checkbox"/>	64.6	11.52	95.55
	<input type="checkbox"/>	65	10.61	96.46
	<input type="checkbox"/>	66	10.18	96.89
	<input type="checkbox"/>	67	10.27	96.8
Rock	<input type="checkbox"/>	68	9.61	97.46
	<input type="checkbox"/>	68.3	9.61	97.46
	<input checked="" type="checkbox"/>	70	7.95	99.12
	<input checked="" type="checkbox"/>	71.6	6.82	100.25
	<input checked="" type="checkbox"/>	72	6.2	100.87
	<input checked="" type="checkbox"/>	74	5.83	101.24
	<input checked="" type="checkbox"/>	76	5.81	101.26
	<input checked="" type="checkbox"/>	78	5.94	101.13
	<input checked="" type="checkbox"/>	80	5.79	101.28
	<input checked="" type="checkbox"/>	82	5.86	101.21
	<input checked="" type="checkbox"/>	84	5.83	101.24
	<input checked="" type="checkbox"/>	86	5.87	101.2
	<input checked="" type="checkbox"/>	88	5.87	101.2
	<input checked="" type="checkbox"/>	90	5.89	101.18
	<input checked="" type="checkbox"/>	92	5.92	101.15
	<input checked="" type="checkbox"/>	94	5.63	101.44
	<input checked="" type="checkbox"/>	100	6.01	101.06
	<input checked="" type="checkbox"/>	102	6.12	100.95
	<input checked="" type="checkbox"/>	104	6.24	100.83
Rpin	<input checked="" type="checkbox"/>	105.4	6.12	100.95
	<input type="checkbox"/>			

Cross Section

4 Pool Bushy Branch at Kentwood Park



section: 4

Pool
Bushy Branch at Kentwood Park

description:

height of instrument (ft): 103.90

notes	omit pt.	distance (ft)	FS (ft)	elevation
Lpin	<input checked="" type="checkbox"/>	0	5.9	98
	<input checked="" type="checkbox"/>	2	5.78	98.12
	<input checked="" type="checkbox"/>	4	5.63	98.27
	<input checked="" type="checkbox"/>	6	6.25	97.65
	<input checked="" type="checkbox"/>	8	6.88	97.02
	<input type="checkbox"/>	8.5	7.3	96.6
	<input type="checkbox"/>	9.3	9.15	94.75
	<input type="checkbox"/>	10	9.6	94.3
	<input type="checkbox"/>	10.5	10.67	93.23
	<input type="checkbox"/>	11	10.66	93.24
	<input type="checkbox"/>	11.5	11.24	92.66
	<input type="checkbox"/>	12	11.4	92.5
	<input type="checkbox"/>	12.5	11.46	92.44
	<input type="checkbox"/>	13	11.62	92.28
	<input type="checkbox"/>	13.5	11.78	92.12
	<input type="checkbox"/>	14	11.94	91.96
	<input type="checkbox"/>	14.5	11.82	92.08
	<input type="checkbox"/>	15	12.01	91.89
	<input type="checkbox"/>	15.5	12.05	91.85
	<input type="checkbox"/>	16	11.96	91.94
	<input type="checkbox"/>	17	11.72	92.18
	<input type="checkbox"/>	17.5	11.59	92.31
	<input type="checkbox"/>	18	11.55	92.35
	<input type="checkbox"/>	19	11.36	92.54
	<input type="checkbox"/>	20	11.04	92.86
	<input type="checkbox"/>	21	10.85	93.05
	<input type="checkbox"/>	22	10.68	93.22

FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
8.41				
95.49	---			

dimensions			
49.8	x-section area	2.2	d mean
22.2	width	24.9	wet P
3.6	d max	2.0	hyd radi
0.0	bank ht	9.9	w/d ratio
0.0	W flood prone area	0.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
44	measured D84 (mm)		
15.6	relative roughness	9.6	fric. factor
0.000	Manning's n from channel material		

	<input type="checkbox"/>	23	10.69	93.21
	<input type="checkbox"/>	24	10.71	93.19
	<input type="checkbox"/>	25	10.83	93.07
	<input type="checkbox"/>	25.4	10.86	93.04
	<input type="checkbox"/>	26	10.69	93.21
	<input type="checkbox"/>	26.8	10.43	93.47
	<input type="checkbox"/>	27	10.12	93.78
	<input type="checkbox"/>	27.5	9.54	94.36
	<input type="checkbox"/>	28	9.3	94.6
	<input type="checkbox"/>	28.4	8.93	94.97
	<input type="checkbox"/>	29	8.8	95.1
	<input type="checkbox"/>	29.7	8.5	95.4
	<input type="checkbox"/>	30	8.41	95.49
	<input type="checkbox"/>	31	8.43	95.47
	<input type="checkbox"/>	33	8.23	95.67
	<input checked="" type="checkbox"/>	35	7.64	96.26
	<input checked="" type="checkbox"/>	37	7.5	96.4
	<input checked="" type="checkbox"/>	39.5	7.21	96.69
	<input checked="" type="checkbox"/>	41	6.75	97.15
	<input checked="" type="checkbox"/>	43	6.35	97.55
	<input checked="" type="checkbox"/>	45	5.94	97.96
	<input checked="" type="checkbox"/>	47	5.57	98.33
	<input checked="" type="checkbox"/>	49	5.1	98.8
	<input checked="" type="checkbox"/>	51	5.03	98.87
	<input checked="" type="checkbox"/>	53	5.13	98.77
	<input checked="" type="checkbox"/>	55	5.35	98.55
	<input checked="" type="checkbox"/>	57	5.21	98.69
Rpin	<input checked="" type="checkbox"/>	57.5	5.17	98.73
	<input type="checkbox"/>			



Appendix C: Vegetation Planting Information

Final Species Planted at Kentwood Park in Fall of 2004

<u>Scientific Name</u>	<u>Common Name</u>	<u>No. and Size of Material</u>
<i>Quercus alba</i>	White Oak	45 (2"C)
<i>Nyssa sylvatica</i>	Black Gum	10 (2"C), 150 (1G)
<i>Cornus florida</i>	Flowering Dogwood	45 (2"C)
<i>Quercus falcata</i>	Spanish Oak	30 (2"C)
<i>Liriodendron tulipifera</i>	Yellow Poplar	50 (3G), 100 (1G)
<i>Carya cordiformis</i>	Bitternut Hickory	20 (3G)
<i>Quercus michauxi</i>	Swamp Chestnut Oak	60 (3G)
<i>Ulmus americana</i>	American Elm	60 (3G)
<i>Fraxinus pennsylvanica</i>	Green Ash	50 (3G), 300 BR
<i>Oxydendron arboreum</i>	Sourwood	150 (1G)
<i>Ilex verticillata</i>	Common Winterberry	100 (1G)
<i>Hamamelis virginiana</i>	Witch Hazel	50 (1G)
<i>Euonymus americana</i>	American Strawberry Bush	200 (1G)
<i>Arundinaria gigantea</i>	Giant Cane	1250 BR
<i>Salix nigra</i>	Black Willow	1000 LS
<i>Viburnum nudum</i>	Southern Wild Raisin	300 BR
<i>Platanus occidentalis</i>	Sycamore	400 BR
<i>Carpinus caroliniana</i>	Ironwood	400 BR
<i>Alnus serrulata</i>	Tag Alder	500 BR
<i>Cornus amomum</i>	Silky Dogwood	750 BR
<i>Acer negundo</i>	Box Elder	200 BR
<i>Betula nigra</i>	River Birch	400 BR
<i>Lindera benzoin</i>	Spice Bush	400 BR
<i>Sambucus canadensis</i>	Canada Elder	200 BR

BR = Bare Root

LS = Live Stakes

1G = one gallon

C = Caliper

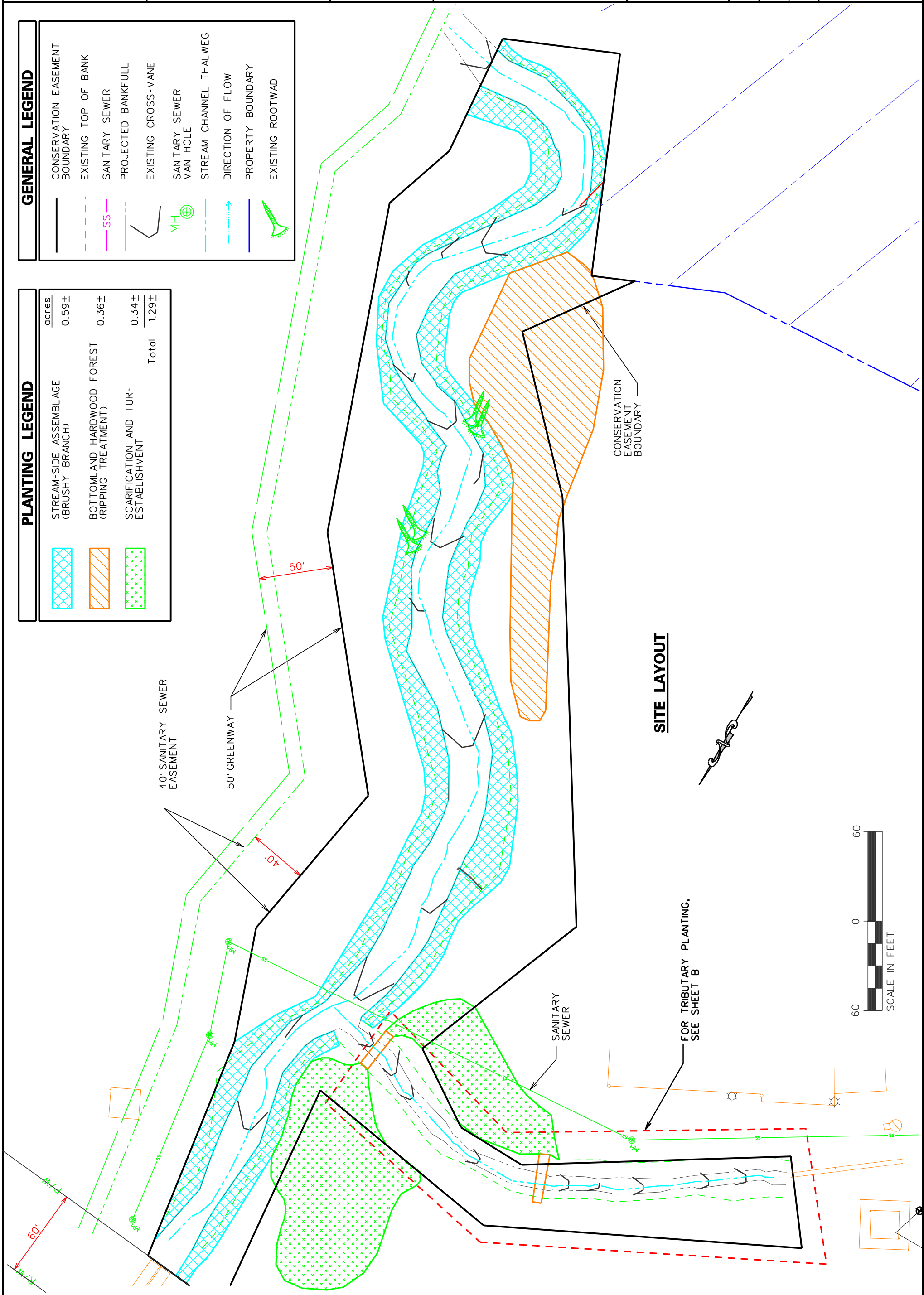
GENERAL LEGEND

—	CONSERVATION EASEMENT BOUNDARY
- - -	EXISTING TOP OF BANK
SS	SANITARY SEWER
- · - · -	PROJECTED BANKFULL
- - -	EXISTING CROSS-VANE
MH ⊕	SANITARY SEWER MAN HOLE
—	STREAM CHANNEL THALWEG
—>—	DIRECTION OF FLOW
—	PROPERTY BOUNDARY
	EXISTING ROOTWAD

PLANTING LEGEND

	acres
	0.59±
	0.36±
	0.34±
Total	1.29±

- STREAM-SIDE ASSEMBLAGE (BRUSHY BRANCH)
- BOTTOMLAND HARDWOOD FOREST (RIPPING TREATMENT)
- SCARIFICATION AND TURF ESTABLISHMENT



SITE LAYOUT

REVISIONS	

Client: **NC DENR**
ECOSYSTEM ENHANCEMENT PROGRAM

Project: **KENTWOOD PARK PLANTING AND MAINTENANCE PLAN**
WAKE COUNTY, NORTH CAROLINA

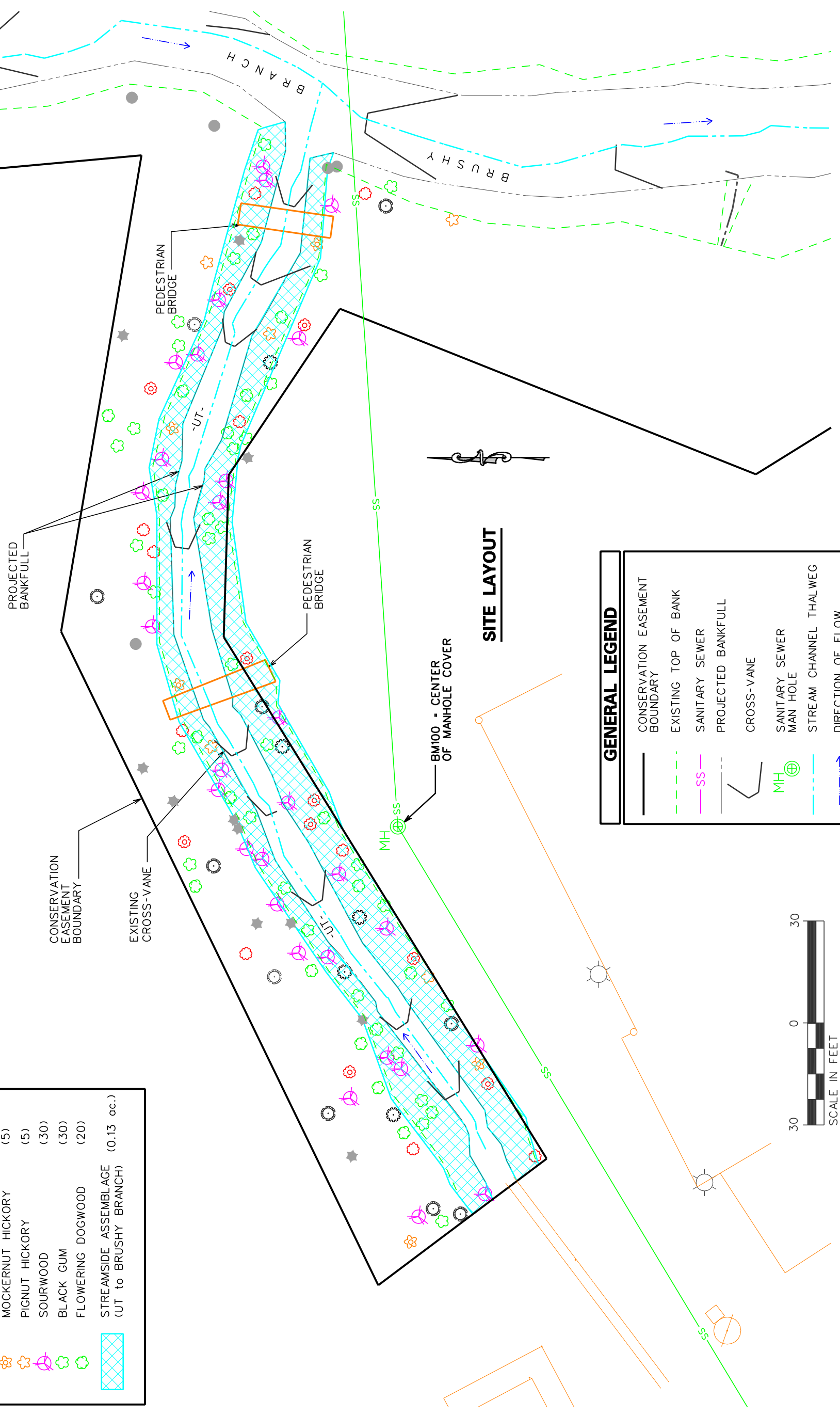
Title: **PLANTING PLAN**
UT TO BRUSHY BRANCH

Dwn By: MAF Date: FEB 2004
Ckd By: JG Scale: 1" = 30'

ESC Project No.: 04-178

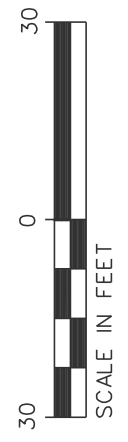
FIGURE **6**

PLANTING LEGEND	
SYMBOL	QUANTITY
★	EXISTING PINE
●	EXISTING HARDWOOD
○	WHITE OAK (10)
⊙	SOUTHERN RED OAK (10)
⊗	SCARLET OAK (10)
⊘	BLACK OAK (5)
⊙	MOCKERNUT HICKORY (5)
⊗	PIGNOT HICKORY (5)
⊘	SOURWOOD (30)
⊙	BLACK GUM (30)
⊗	FLOWERING DOGWOOD (20)
⊘	STREAMSIDE ASSEMBLAGE (UT to BRUSHY BRANCH) (0.13 ac.)



SITE LAYOUT

GENERAL LEGEND	
—	CONSERVATION EASEMENT BOUNDARY
- - -	EXISTING TOP OF BANK
SS	SANITARY SEWER
—	PROJECTED BANKFULL
—	CROSS-VANE
MH ⊕	SANITARY SEWER MAN HOLE
—	STREAM CHANNEL THALWEG
→	DIRECTION OF FLOW



Hypericum sp.	2	1																	
Duchesnea indica	2	1		1	1														
Lycopus virginicus	1	1																	
Geranium carolinianum	1	1																	
Rubus sp.	1	1					1	1											
Antennaria sp.	2	1					1	1											
Sida rhombifolia	2	1																	
Taraxacum officinale	2	1																	
Quercus phellos	2	1					4	5	4										
Cornus amomum				4	1	32	1	1	2										
Platanus occidentalis				1	1	8													
Alnus serrulata				3	2	13	1	1	1										
Liriodendron tulipifera				1	1		3	2	6										
Acer rubrum				3	5		1	1											
Quercus alba				4	5		2	2	2										
Arundinaria gigantea				6	2														
Quercus nigra				5	30														
Smilax rotundifolia				3	5														
Xanthorhiza simplicissima				5	1														
Prunus serotina				1	1														
Albizia julibrissin				3	5														
Microstegium vimineum				7	1														
Impatiens capensis				2	2														
Solidago sp.				1	1														
Coreopsis sp.				1	1														
Lespedeza cuneata				1	1		1	1											
Itea virginica				2	1														
Rumex sp.				1	1														
Vicia sp.				1	1														
Acer negundo							3	2	4										
Ulmus americana							2	1	2										
Helianthus angustifolia							2	1											

Cover Values: Trace = 1, 0.01-1% = 2, 1-2% = 3, 2-5% = 4, 5-10% = 5, 10-25% = 6, 25-50% = 7, 50-75% = 8, 75-95% = 9, 95-100% = 10

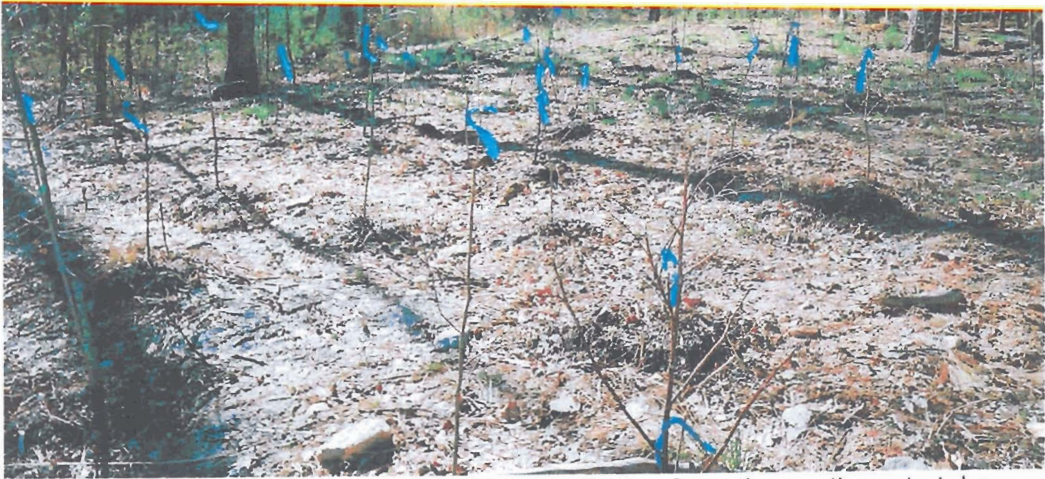
Strata Values: 1m agl, 2m agl, 5m agl, 10m agl, 20m agl, 30m agl



Vegetation Monitoring Plot 1 looking south from the north stake



Vegetation Monitoring Plot 2 looking south from the north stake



Vegetation Monitoring Plot 3 looking southeast from the northwest stake

Appendix D: Photographs

Photograph Locations and Descriptions



Photo Location 1: Standing on Kaplan Road Looking downstream.



Photo Location 2: at J-hook upstream of confluence, looking upstream toward culvert.



Photo Location 3: Standing on pedestrian bridge over UT looking upstream



Photo Location 3: Standing on pedestrian bridge over UT looking downstream.



Photo Location 4: Looking downstream toward Vegetation Plot 2 and Cross Section 3



Photo Location 4: Looking upstream toward a J-hook, a cross vane, and the confluence.



Photo Location 5: At cross section 4 looking upstream toward cross vane and root wads.



Photo Location 5: At cross section 4 looking downstream toward vane and cross vane.



Photo Location 6: West bank at most downstream vane looking toward final cross vane.



Photo Location 6: At most downstream vane looking upstream toward cross vane and cross-section 4.



Vegetation Monitoring Plot 1 looking south from the north stake



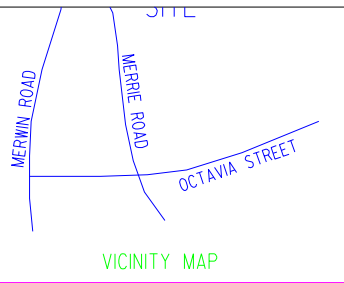
Vegetation Monitoring Plot 2 looking south from the north stake



Vegetation Monitoring Plot 3 looking southeast from the northwest stake

Appendix E:
Easement Exhibit for
Kentwood Park Property

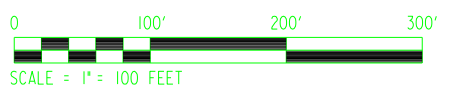
L7	S58° ³⁴ / ₄	13'41"W	180.43'
L8	N36° ³⁴ / ₄	54'33"W	61.94'
L9	N64° ³⁴ / ₄	05'52"E	213.65'
L10	S80° ³⁴ / ₄	25'13"E	142.06'
L11	N05° ³⁴ / ₄	12'48"W	160.50'
L12	S84° ³⁴ / ₄	17'27"E	59.53'
L13	S07° ³⁴ / ₄	56'27"E	154.80'
L14	S10° ³⁴ / ₄	19'24"W	116.28'
L15	S38° ³⁴ / ₄	50'19"E	178.35'
L16	S18° ³⁴ / ₄	52'31"W	52.91'
L17	S04° ³⁴ / ₄	28'47"E	83.38'



EASEMENT EXHIBIT FOR
KENTWOOD PARK PROPERTY

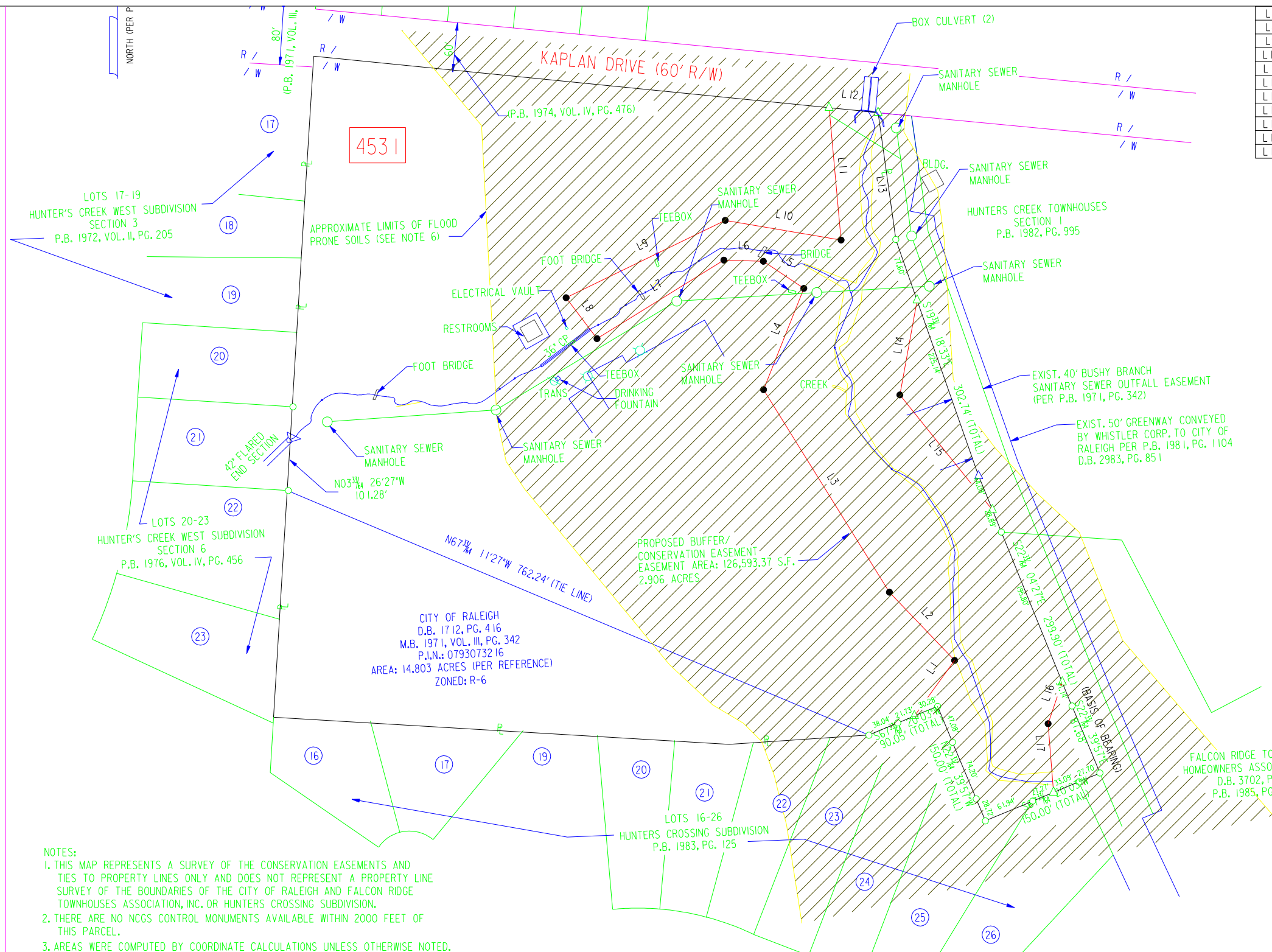
BUFFER/CONSERVATION EASEMENT

RALEIGH TOWNSHIP
WAKE COUNTY NORTH CAROLINA
DATE: MAY 30, 2002 SCALE: 1" = 100'
REFERENCE: DEED BOOK 1712, PAGE 416



LEGEND

- LINE SURVEYED
- - - LINE NOT SURVEYED
- IRON PIN FOUND
- △ NO POINT SET
- LIGHT POLE
- ⊗ UTILITY POLE
- SS SANITARY SEWER LINE
- IRON PIN SET
- 1234 ADDRESS



- NOTES:
1. THIS MAP REPRESENTS A SURVEY OF THE CONSERVATION EASEMENTS AND TIES TO PROPERTY LINES ONLY AND DOES NOT REPRESENT A PROPERTY LINE SURVEY OF THE BOUNDARIES OF THE CITY OF RALEIGH AND FALCON RIDGE TOWNHOUSES ASSOCIATION, INC. OR HUNTERS CROSSING SUBDIVISION.
 2. THERE ARE NO NCGS CONTROL MONUMENTS AVAILABLE WITHIN 2000 FEET OF THIS PARCEL.
 3. AREAS WERE COMPUTED BY COORDINATE CALCULATIONS UNLESS OTHERWISE NOTED.
 4. ALL DISTANCES SHOWN HEREON ARE HORIZONTAL GROUND DISTANCES.
 5. THE SUBJECT PARCEL IS DETERMINED TO BE OUTSIDE THE 100-YEAR FLOOD PLAIN AND IS ZONED "X" ACCORDING TO THE FEMA FLOOD INSURANCE RATE MAP 37183C0526E, DATED MARCH 3, 1992.
 6. APPROXIMATE LIMITS OF FLOOD PRONE SOILS WAS TAKEN FROM THE MULTIACCESS PARCEL SYSTEM (IMAPS) OF THE CITY OF RALEIGH ON MAY 23, 2002.

THIS IS TO CERTIFY THAT THIS MAP IS A SURVEY OF ANOTHER CATEGORY, SUCH AS THE RE-COMBINATION OF EXISTING PARCELS, A COURT-ORDERED SURVEY OR OTHER EXCEPTION TO THE DEFINITION OF A SUBDIVISION.

THIS DOCUMENT ORIGINALLY ISSUED AND SEALED BY WATTS B. FEARRINGTON, JR. NC LICENSE NO. L-3468 ON 30 MAY 2002. THIS DOCUMENT SHALL NOT BE CONSIDERED A CERTIFIED DOCUMENT.

STATE OF NORTH CAROLINA, WAKE COUNTY

I, WATTS B. FEARRINGTON, JR., CERTIFY THAT THIS MAP WAS DRAWN UNDER MY SUPERVISION FROM AN ACTUAL SURVEY MADE UNDER MY SUPERVISION, THAT THE RATIO OF PRECISION AS CALCULATED BY LATITUDES AND DEPARTURES IS 1 : 10,000+ ; THAT THE BOUNDARIES NOT SURVEYED ARE SHOWN AS BROKEN LINES; THAT THIS PLAT WAS PREPARED IN ACCORDANCE WITH G.S. 47-30 AS AMENDED. WITNESS MY HAND AND SEAL THIS DAY OF _____, 2002.

PROFESSIONAL LAND SURVEYOR NC L-3468

CITY OF RALEIGH
FILE NUMBER
BS-105-02

NO.	DATE	REVISION DESCRIPTION	BY
PROJECT MANAGER		DEPARTMENT MANAGER	
W FEARRINGTON		A HALL	
PARTY CHIEF		CHECKED	
G CILLEY		W FEARRINGTON	
DRAWN		DATE	
R KOONCE		MAY 14, 2002	
PROJECT NUMBER		DRAWING NUMBER	
NC402007.000 1		SRV 1	