BROWN BRANCH STREAM RESTORATION

POST-CONSTRUCTION MITIGATION PLAN

Prepared For:

Wetlands Restoration Program
Division of Water Quality
320 W. Jones St.
Raleigh, NC 27603

Prepared by:

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March 2003

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FIGURES

APPENDICES

1.0 INTRODUCTION

The Brown Branch stream restoration is located 3 miles northwest of Lenoir, North Carolina in the rural Mountain physiographic province. The study reach begins at the confluence of two 1st-order tributaries and follows the 2nd-order channel downstream through an alluvial valley (Figure 1). The study reach ends approximately 1 mile downstream at the confluence of Brown Branch with Mulberry Creek. Mulberry Creek then flows southwest to the Johns River, which continues south to the Catawba River.

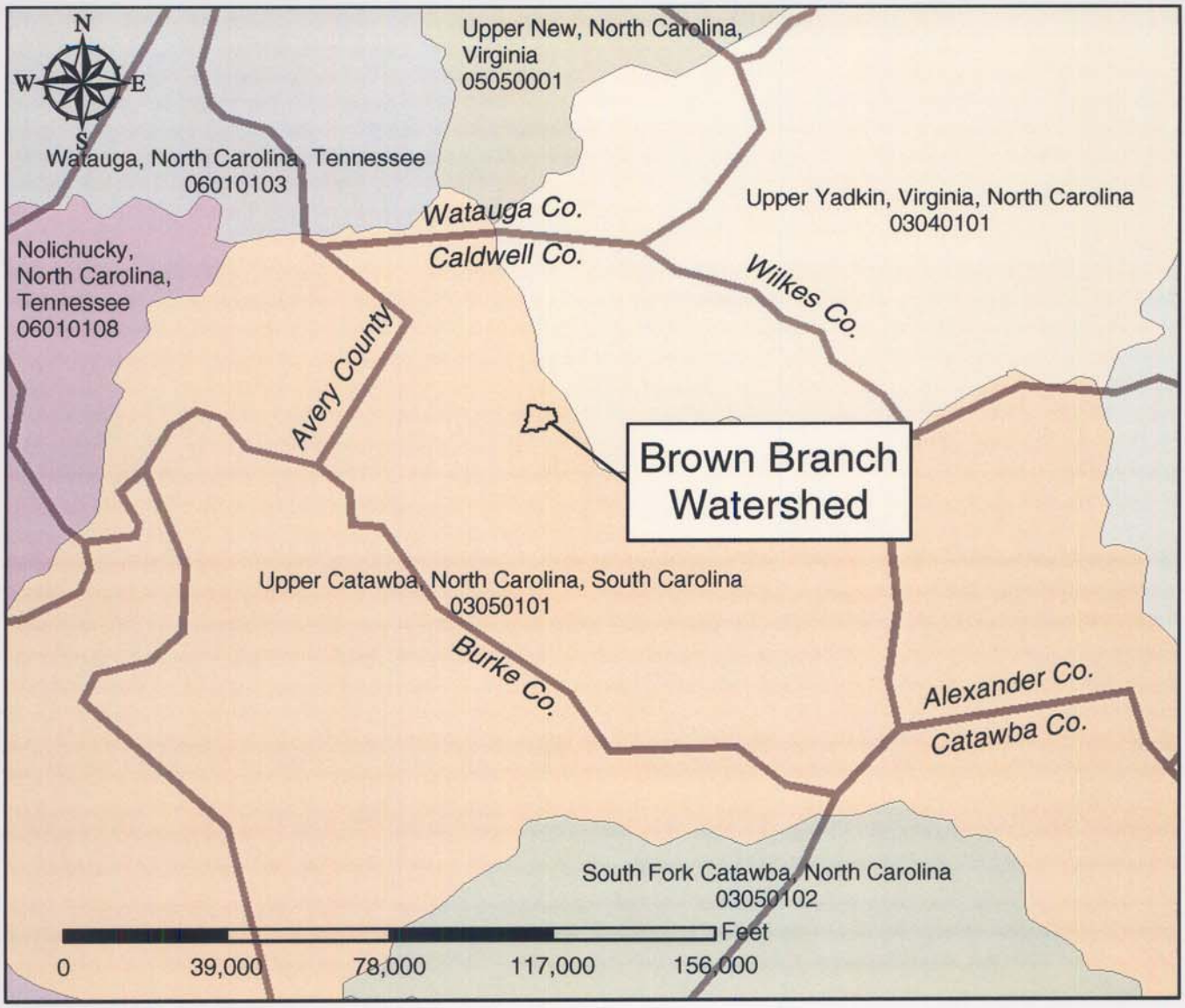
The overarching goal of the project is to establish a stable planform, cross-sectional, and profile pattern to Brown Branch, with the premise that geomorphic and habitat function will follow appropriate channel form. Specific objectives include the following:

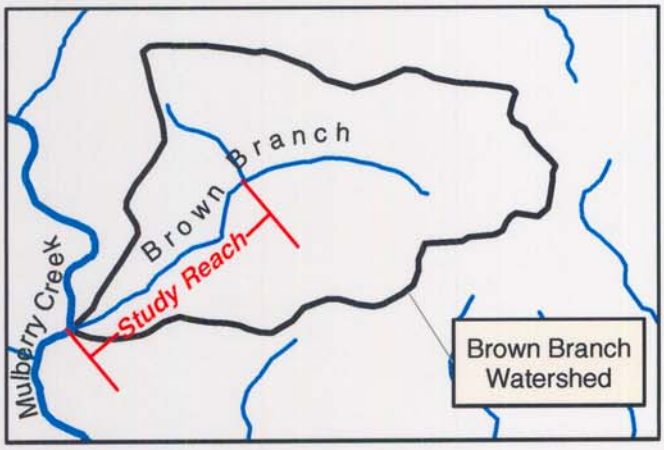
1. **Reduce bank erosion.** The natural channel design is intended to create a dynamically stable stream geomorphology such that the extent and severity of bank erosion will decrease and keep pace with sediment transport processes.

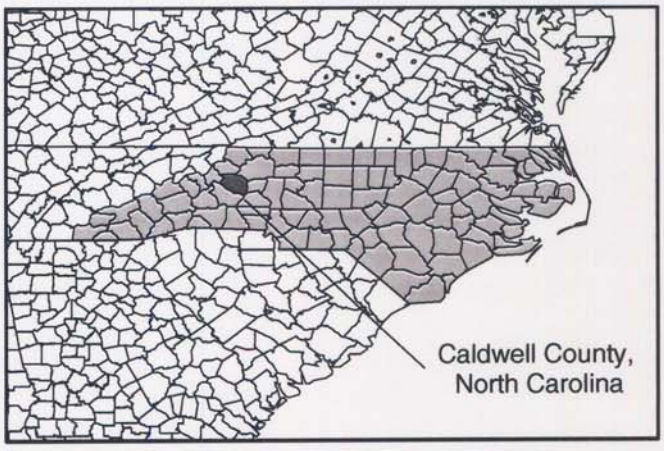
2. **Improve water quality.** By reducing bank erosion, total suspended sediment will decrease and water quality will be improved. Increased connectivity between the channel and floodplain will allow greater deposition of suspended sediments on the floodplain.

3. **Enhance in-stream habitat**. The reconfiguration of the channel will enhance sediment transport processes in pools to promote deeper scour and greater hydraulic variability. Elements such as large woody debris and overhanging vegetation also will improve pool formation and provide shade and refuge to aquatic species.

4. **Improve functional and aesthetic value of the riparian corridor.** Where the riparian buffer was sparse to absent throughout the study area, riparian buffer enhancement or establishment has been undertaken based on native plant communities endemic of the region. In depressions of abandoned existing channel and those created by regrading, the restoration also includes areas with plant community adapted to vernal pool wetlands.







N.C. Wetlands Restoration Program
NCDENR DWQ

Brown Branch Stream Restoration, Caldwell County, North Carolina
Biohabitats Project No. 01015.01

Figure 1
Location of Brown Branch Stream Restoration

February 2003

Biohabitats

2.0 SUMMARY

The physical monitoring described in this Mitigation Plan is intended to provide a framework for documenting channel and riparian conditions in the 5 years following project construction. This information is needed to diagnose unforeseen problems resulting from the design and construction of the project and/or changes in the stream environment.

This Mitigation Plan presents an overview of the stream restoration site, the methodologies utilized in developed baseline (post-construction) conditions, and recently recorded baseline monitoring data. Success criteria are established for use in evaluating monitoring data collected over the next 5 years. In the event that problems are identified during monitoring, a contingency plan is outlined to suggest immediate remedial actions.

2.1 Description

In September 2003 a stream restoration design and construction project using natural stream channel geometry design parameters was completed on Brown Branch, a tributary to Mulberry Creek in Caldwell County, North Carolina near Lenoir. The project was undertaken by the Wetlands Restoration Program (WRP) of the North Carolina Department of Environment and Natural Resources. Biohabitats has established the monitoring stations and protocol, and collected baseline monitoring data.

The project limits begin at Brown Branch's confluence with Mulberry Creek and extends approximately 5,200 feet upstream through the narrow valley. The Brown Branch watershed lies in the Upper Catawba, United States Geological Survey (USGS) Cataloging Unit 3050101 in the middle of Caldwell County. Figure 1 shows the project location, as well as its location within the hydrologic catalog unit.

The stream restoration was motivated by an unstable channel configuration that was causing poor water quality, a featureless bed, a lack of riparian cover, and poor habitat (particularly for trout use). The stream restoration design entailed reconfiguration of the cross-sectional geometry, planform pattern, and channel profile and reforestation of the alluvial valley to improve physical conditions at the site.

2.2 Field Methods

The following section describes the methods applied to establish monitoring stations and collect monitoring data. Parameters to be measured during each monitoring period include longitudinal profile, channel cross sections, pebble counts, photographs, and vegetative plots. Locations of all monitoring stations are depicted in the planform maps in Appendix A.

2.2.1 Longitudinal Profile and Cross Sections

Surveying of the longitudinal profile and selected cross sections was conducted with a standard survey level, survey rod and measuring tapes. Several convenient semi-permanent monuments persisted following construction. The associated benchmark elevations were made available to Biohabitats by the Contractor's surveyor, WK Dickson, and these elevation were used to tie the longitudinal profile into real vertical space during survey data reduction. There is one permanent benchmark at the project site, also established by WK Dickson. The benchmark consists of a large "X" chiseled into the concrete pad of an outdoor pavilion at the upstream end of the project site (see Sheet 4 of Appendix A). Future surveying for this monitoring plan can tie into this benchmark.

One continuous profile was surveyed through the project reach along the thalweg to establish baseline streambed elevations. Features such at riffles and pools were noted in the survey. The elevation of flow deflection and grade control structures such as log vanes and rock cross vanes were also surveyed. The baseline longitudinal profile is shown in Appendix B. Stationing of features shown in the baseline profile (Appendix B) differs slightly from stationing shown in the as-built (Appendix A) due to minor differences in the field interpretation of thalweg.

To construct the baseline profile survey shown in Appendix B, measuring tapes were stretched end-to-end along the thalweg to record cumulative distance downstream. Because the thalweg will adjust slightly in planform from year to year, it should be expected that the total reach length will be somewhat different for each monitoring year. As a result, a point at a given distance on a profile graph may not represent the same location within Brown Branch. (The magnitude of the offset can, however, be evaluated by comparing the x-axis "distance" of a stationary in-stream structure (e.g., a cross vane) between years.)

Monumented cross sections were also installed at six (6) locations along the restored channel. Beginning at the upstream end of Brown Branch, the cross sections alternate between riffle and pool channel units, for a total of three (3) riffle and three (3) pool cross sections. The baseline cross sections are intended to document a range of adjustments in cross sectional geometry with downstream distance. Cross-sectional features measured during the surveying efforts included monumented cross-sectional endpoints (capped rebar), topographic breaks in slope, bankfull indicators, edge of water at time of survey, and channel features that may influence the direction and/or speed of flow in the channel. The locations of monumented cross sections are shown by purple line segments in Appendix A. Results from the baseline cross-sectional measurements are shown in Appendix C.

2.2.2 Pebble Counts

To evaluate textural properties of the bed following completion of construction, pebble counts were conducted at three locations using standard Wolman pebble count methodology (Wolman, 1954). The 100 particles selected for sampling were chosen from pool and riffle units in proportion to the percentage area that the channel units represented through the sample area (e.g., for a reach with 40% riffle and 60% pool, 40 particles were selected from the riffle and 60 particles were selected from the pool). Baseline results from the pebble counts are shown in Appendix D. Pebble counts taken in the future at these same locations will be compared with the baseline data in this report to establish changes in particle size and persistence of riffle armoring.

2.2.3 Photographs

To document the overall channel stability and development of the riparian zone with time, twenty-two (22) permanent photo stations were established along the length of the project reach. A color photograph was taken at each photo station to document baseline conditions. Each photo station location is marked in the field by a partially embedded 4-foot long rebar with a yellow cap. The locations of photo stations are depicted by numbered red dots in Appendix A. Photographs from each station are included in this report in the beginning of Appendix E.

A photograph was also taken at each series of bed and bank structures to document post-construction conditions. These photographs were not monumented, but taken from the clearest vantage at that time. The vantages of these structures photographs may change with time if

conditions (e.g. vegetation growth, bank erosion) warrant it. Baseline photographs of bed and bank structures are also included with Appendix E.

2.2.4 Vegetation Plots

Seven (7) sample vegetation plots were established in the field. The locations of vegetation sampling were selected using predetermined sample plot locations to straddle the range of planting zones. The locations of vegetation plots are shown on Sheets 5 through 8 of Appendix A. At each monitoring location, a center point and four (4) additional points were identified around which to configure the sampling. The center points of the sample plots are marked in the field by partially embedded 4-foot long rebar with yellow caps, and will be reoccupied annually.

The four sample points around the center point were located due North, South, East and West of the center point, each approximately 37 feet from the center point. The 37-foot radial distance equates to approximately 1/10 of an acre. At each of the five points, a 6-foot diameter circle was established to estimate percent understory cover, canopy closure, and herbaceous cover. All trees and shrubs within the 37-foot radius were identified and tallied and the overall condition of the tree or shrub was assessed to identify mortality, herbivory, disease, and/or infestation. A sampling data worksheet was used to compile the data gathered at each of the 7 sample plots. Baseline monitoring results for each plot are shown in Appendix F, along with a summary of cumulative tree density at the end of the appendix. Tree density currently exceeds the State requirement of 320 stems per acre.

2.3 Plan View of Project

As previously mentioned, Appendix A includes scaled 11" by 17" planform maps adapted from the as-built drawings to reflect monitoring locations. The plots show the as-built topography superimposed on the design plans for reference. The maps show the location of all in-stream structures, photo station locations, vegetation planting zones, vegetation sample plots, the easement boundary, location of the permanent benchmark. Final planting schedules are shown in Appendix G.

Many changes where made during construction in the field with the agreement of the Designer and the Contractor based on the unexpected presence of bedrock, low availability of logs at the

downstream end of the project, and professional judgment of what would improve the installation. These changes are noted as callouts on the plan sheets to add clarity, especially where bank and in-stream structures changed from the original design.

2.4 Contact Information

The table below summarizes contact information for the design firm, construction firm, and the Wetlands Restoration Program.

Table 2.1 Contact Information for Brown Branch Stream Restoration

Design Firm	Construction Firm	WRP
Address: Biohabitats, Inc. 15 West Aylesbury Road Timonium, MD 21093	**Address:** Shamrock Environmental Corporation, Inc. P.O. Box 14987 Greensboro, NC 27415	**Address:** Wetlands Restoration Program 320 W. Jones St. Raleigh, NC 27603
Phone: (410) 337-3659	**Phone:** (336) 375-1989	**Phone:** (919) 733-5316
Primary Contact: Ellen McClure	**Primary Contact:** Bill Wright	**Project Manager:** Jeff Jurek

3.0 SUCCESS CRITERIA

Determining whether changes in stream conditions constitute problems can be difficult. Streams, by their nature, are dynamic systems which gradually adjust their cross section, profile, and planform with changing environmental conditions. Because rivers are dynamic systems which are subject to catastrophic events, evaluation of changes in the newly constructed channel must be taken in the context of the entire river system. Therefore, each annual monitoring plan will synthesize all monitoring results to evaluate if a local change does in fact pose a problem to the larger stream restoration project.

To evaluate the physical success of the constructed stream restoration, monitoring results will be reviewed annually from Year 1 through Year 5. Results from that monitoring will be evaluated in terms of the success criteria outlined below. If results show that significant problems have developed between monitoring rounds, a suite of contingencies will be undertaken, as outlined in Section 6.0.

3.1 Channel Dimension

Channel aggradation (bar formation) and/or degradation (bed and bank scour) all occur naturally as part of fluvial processes and one should not be overly concerned when they occur, especially in areas where they are expected. Unexpected occurrence of channel bars and/or bed scour of the new channel may form after a storm event, but these changes are typically transient and may be reversed by the next storm. These features will be noted during all scheduled monitoring to ascertain if they are temporary, static, or growing. Monumented cross sections will provide the best means for evaluating channel dimension during the monitoring period. Table 3.1 summarizes success criteria for the cross-sectional monitoring data to help determine if observed changes shall be considered as in the realm of acceptable channel dynamics versus contrary to the intent and integrity of the project.

In meander cross sections, some erosion of the outer bank and along the pool bottom will not constitute a problem. To indicate success, pools should persist in meander bends, riffles should persist in straight sections, and cross-sectional areas should show no radical change in width/depth ratio. Along the pool, however, if erosion is very rapid (e.g., ½ ft/yr) and continues

for five years, some contingency measure should be undertaken. Also if the progression of bed or bank scour threatens the overall stability of the bank, its structures or in-stream structures, again, the problems will need to be addressed. Similarly, if a bar is aggrading (growing) it could expand to the point where flows are directed into one or both banks causing erosion and possible bank failure. In this case the bar needs to be removed before bank failure occurs and the cause of the bar formation should be determined.

Bar formation is often caused by debris jams or grade control structures. Large woody debris is generally beneficial to natural streams, where it creates important habitat niches and affects sediment dynamics. However, in a newly constructed channel without the stabilizing role of bank vegetation, large woody debris can deflect flow and cause local scour beyond the intended range of stream dynamics. Therefore, large accumulations of woody material during the first five years after construction could be problematic. Such debris jams will be removed along with the bar material, and grade control structures will be modified to stop the accumulation of sediments.

In riffle cross sections, some aggradation and/or degradation is expected as the thalweg shifts slightly across the bankfull channel and as frequent flood events slightly reshape the banks. However, if bar development is so pronounced that the thalweg is split and flow is directed towards a vulnerable bank, some contingency measure may be undertaken.

Table 3.1 Summary of Success Criteria for Channel Dimension

Associated Monitoring Tasks	Success Criteria
Permanent Cross Sections	▪ Pools are maintained in meanders; riffles persist in straight cross sections. ▪ Measured bankfull dimensions are similar (+/-25%) to that of design and/or within range of ratios for reference reaches ▪ No rapid, chronic bank erosion (> ½ ft/yr) and/or imminent threat to bank stability ▪ No significant mid-channel bar development in riffles; thalweg does not bifurcate ▪ No significant chronic sedimentation in pools

3.2 Channel Planform Pattern

The overall channel pattern and therefore sinuosity should remain the same during the monitoring period. Significant planform problems that would warrant contingencies include a meander cutoff, extensive erosion in the vicinity of bank and bed protection structures, and debris jams obstructing or redirecting flow. Table 3.2 outlines these success criteria. Both the longitudinal profile and photographs will provide a means for assessment of channel planform pattern.

Table 3.2 Summary of Success Criteria for Channel Planform Pattern

Associated Monitoring Tasks	Success Criteria
Longitudinal Profile (to obtain thalweg length)	▪ Measured sinuosity is same as as-built design (+/- 0.1 ft/ft), based on measured thalweg length and same valley length
Photographs	▪ No channel avulsions ▪ No significant changes in radius of curvature ▪ Valley and stream type persist

3.3 Longitudinal Profile

Monitoring of the longitudinal profile will indicate success if the general pool/riffle sequence persists through the monitoring period—that is, pools remain in the same location in meander bends, and riffles remain in straight sections of the channel between individual pools. The most serious problem that could occur would be the development of a headcut that progresses past a grade control device. If this is observed, contingency measures should be undertaken immediately (see Section 6.0).

Table 3.3 Summary of Success Criteria for Longitudinal Profile

Associated Monitoring Tasks	Success Criteria
Longitudinal Profile	▪ Pool-riffle sequences persist in sequence with planform pattern (i.e. pools in meander bends; riffles in straight sections) ▪ No development of headcuts ▪ Riffles slopes do not exceed reference reach and/or design values ▪ Measured thalweg length undergoes little change (+/- <200ft)

Particularly in the first few years of monitoring, we anticipate that the extent of individual riffles will change slightly. For example, the downstream end of a riffle may extend somewhat

towards a pool, but will not fill or eliminate the pool feature. Conversely, if scour during high flows mobilizes sediment through a pool, the pool may extend longitudinally or deepen slightly. Table 3.3 summarizes success criteria for evaluation of Brown Branch's longitudinal profile.

3.4 Channel Bed Materials

We expect that pebble counts will indicate some fluctuations in the grain size distribution of bed materials, and possibly some minor net coarsening as finer materials are flushed from the bed with time. As shown in Table 3.4, success criteria include pools remaining distinctly finer than riffles, and no major shift in the median classification of the grain size distribution (e.g., a gravel riffle becomes sand-dominated). A major deviation in particles size may indicate an adjacent or upstream erosion problem, and should be evaluated for its root cause.

Table 3.4 Summary of Success Criteria for Channel Bed Materials

Associated Monitoring Tasks	Success Criteria
Pebble Counts	▪ D_{50} and D_{84} measurements remain gravel-sized (as based on percent pools and riffles) ▪ Some coarsening of riffles and/or fining of pools may occur

3.5 Photographs

Repeat photography should show no major changes in channel pattern and no progressive bank erosion. In addition, photographs should indicate the net survival and gradual growth of vegetation in the planting zones through the project (Table 3.5). Non-monumented photographs of bank and bed structures should show no serious threat to their stability during monitoring.

Table 3.5 Summary of Success Criteria for Photo Points

Associated Monitoring Tasks		Success Criteria
Photographs	Permanent Photo Stations	▪ No rapid, chronic bank erosion ▪ No major change in planform pattern ▪ Vegetation growth evident
	Non-monumented Photographs	▪ No threat to structural stability of structures

3.6 Vegetation Survival

North Carolina State guidelines require the survival of at least 320 tree stems/acre. Success will be determined by survival of tree species within the sample plots. At least six different planted tree species should be present at the entire site. If the vegetative success criteria are not met, the cause of failure will be determined and appropriate corrective action will be taken.

Table 3.6 Summary of Success Criteria for Vegetation Survival

Associated Monitoring Tasks	Success Criteria
Vegetation Plots	▪ Survival is at least 320 stems/acre for trees after 5 years ▪ At least 6 planted species are represented in surviving species
Photographs	▪ Vegetation growth evident throughout planted zones ▪ Vegetation forms contiguous riparian zone

4.0 MONITORING

Monitoring of the Brown Branch Stream Restoration project will occur for a 5-year period from September 2003 through September 2007, as shown in the table below.

Table 4.1 Proposed Monitoring Schedule

Monitoring Parameter	Post-Construction Documentation	Annual Monitoring*				
		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
		Sept 2003	Sept 2004	Sept 2005	Sept 2006	Sept 2007
Cross Sections	■	X	X	X	X	X
Longitudinal Profile	■	X	X	X	X	X
Permanent Photo Stations	■	X	X	X	X	X
Photos of Structures	■	X	X	X	X	X
Vegetation	■	X	X	X	X	X

* Most construction was completed in September 2002 (minor punch list items were completed in January 2003). Installation of vegetation was completed in February 2003. Annual monitoring should be conducted during September, when vegetation can be evaluated sufficiently prior to the dormancy.
■ = Baseline data collected
X = Measurement proposed

The Year 1 monitoring will be conducted by Biohabitats, Inc. At present, the WRP has not delegated data collection and report preparation for monitoring in Years 2 through 5. This will be determined at a later date.

5.0 MITIGATION

5.1 Stream Restoration

The majority of the constructed channel qualifies as "Restoration," under the following definition following the April 2001 (Version 3.0) "Internal Technical Guide for Stream Work in North Carolina" by NCDENR:

> *"Stream restoration is defined as the process of converting an unstable, altered or degraded stream corridor, including adjacent riparian zone and flood-prone areas to its natural or referenced, stable conditions considering recent and future watershed conditions. This process also includes restoring the geomorphic dimension, pattern, and profile as well as the biological and chemical integrity, including transport of water and sediment produced by the stream's watershed in order to achieve dynamic equilibrium."*

The total length of constructed stream that qualifies for restoration is 5,107 feet and is shown (in green lettering above the stream course) on Sheets 1 through 4 of Appendix A. The channel design through these areas was based on reference reach data (dimension, pattern, and profile) from similar, stable streams in the same geographic province of North Carolina. The design also accounted for watershed hydrology, stream hydraulics, and associated sediment transport processes.

5.2 Stream Enhancement

Two small areas upstream of the restored channel qualify as "Stream Enhancement" under the Internal Technical Guide's definition:

> *"Stream enhancement is the process of implementing certain stream rehabilitation practices in order to improve water quality and/or ecological function. These practices are typically conducted on a stream bank or in the flood prone area. For example, an enhancement procedure may be fencing out a stream from cattle and re-establishing vegetation in order to provide stream bank stability. However, these types of practices should only be attempted on a stream reach that is not experiencing severe aggradation or erosion. Enhancement activities may also include the placement of instream habitat structures. However, care must be taken to ensure that the placement of the instream structures will not affect the overall dimension, pattern, or profile of a stable stream."*

These areas are shown on Sheet 4 of Appendix A, and span a total length of 120 feet. Enhancement activities here included regrading the oversteepened stream banks along the

otherwise stable stream, planting a native riparian buffer, and installing rock toe protection for additional stability and habitat.

6.0 MAINTENANCE AND CONTINGENCY

Table 6.1 summarizes contingency plans for common problems that may be identified during monitoring.

Table 6.1 Stream Restoration Contingency Plan

Parameter	Concern	Contingency Plan	Timeframe*
Cross Section	Severe bank erosion threatening stability of bank and/or bed/bank structure(s)	▪ Pump baseflow around work area ▪ Place large rock(s) (min. 30" dia.) at base of scour ▪ Fill scour area with clean fill ▪ Place topsoil in eroded area and compact. Seed with permanent seed mixture and stabilize with biodegradable matting ▪ Plant with Sandbar willow (*Salix exigua, interior*) or Silky willow (*Salix sericea*) and Silky dogwood (*Cornus amomum*) (1' - 2' cont.) on outer edge of eroded area.	Monthly
Planform	Serious bank erosion in vicinity of bank/bed structure(s)	▪ Place top soil in eroded area and compact. Seed with permanent seed mixture and stabilize with biodegradable matting ▪ Plant with Sandbar willow (*Salix exigua, interior*) or Silky willow (*Salix sericea*) and Silky dogwood (*Cornus amomum*) (1' - 2' cont.) on outer edge of eroded area	Monthly
	Debris jam or beaver dam obstructing/ redirecting flow	▪ Remove any obstruction that forms within the first five years	Monthly
Profile	Headcut progresses past grade control device	▪ Pump baseflow around work area ▪ Stabilize head cut with placed large rock (min. 30" dia.) structure, such as a cross vane or step, as appropriate	Immediate
	Severe scour at downstream end of bed structure	▪ Divert flow away from work area or pump around ▪ Place large rock (min. 30" dia.) in scour hole without excavating ▪ Push rock down if necessary to make flush with channel	Monthly
Vegetation	Section of planted vegetation not growing or stem survival <320 tree stems/acre	▪ Determine reason for failure. ▪ If failure was due to insufficient light, and shade tolerant species were used, remove the dead plant material and plant containerized stock of shade tolerant shrubs such as silky dogwood (*Cornus amomum*), arrowwood (*Viburnum dentatum*), and blackhaw (*Viburnum prunifolium*). ▪ If failure was due to use of dead plant material, improper installation, disease, or drought, remove the dead plant material and replace with live plant material during the proper season.	Seasonally

*Timeframe is as follows: Immediate (1-7 days), Monthly (within 1 month), Seasonal (within 6 months).

7.0 REFERENCES

Internal Technical Guide for Stream Work in North Carolina, The Division of Land Resources (DLR) and The Division of Water Quality (DWQ), NCDENR, Version 3.0, April 2001.

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

Appendix A
PLANFORM MAPS

SCALE IN FEET
1"=85'
20 10 0 10 20 40 60

MULBERRY TOWNSHIP – CALDWELL COUNTY
NORTH CAROLINA

DESIGN LEGEND

- ROOTWAD
- LOG VANE
- CROSS VANE
- ROOTWAD / LOG J VANE
- ROCK J VANE
- DESIGN CONTOUR
- DESIGN THALWEG

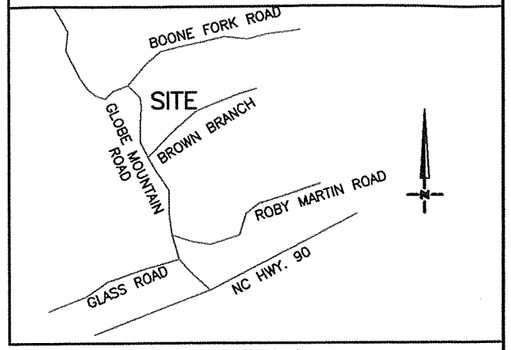
AS-BUILT LEGEND

- IRON MARKER FOUND
- IRON MARKER SET
- STONE FOUND
- PK NAIL FOUND
- POINT
- PK NAIL SET
- CONCRETE NAIL SET
- MAG NAIL SET
- CONC. MONUMENT FOUND
- CONC. MONUMENT SET
- ROOTWAD
- ROCK OR STONE
- LOGS WITH LENGTH AS SHOWN
- AS-BUILT CONTOUR
- EASEMENT
- EXISTING THALWEG
- AS-BUILT THALWEG
- FIELD ADJUSTMENT, CHANGE FROM PROPOSED DESIGN BASED ON DESIGNER'S DISCRETION AND SITE CONSTRAINTS

MONITORING LEGEND

- 14 PHOTO STATION
- CROSS SECTION
- PEBBLE COUNT LOCATION

LOCATION MAP

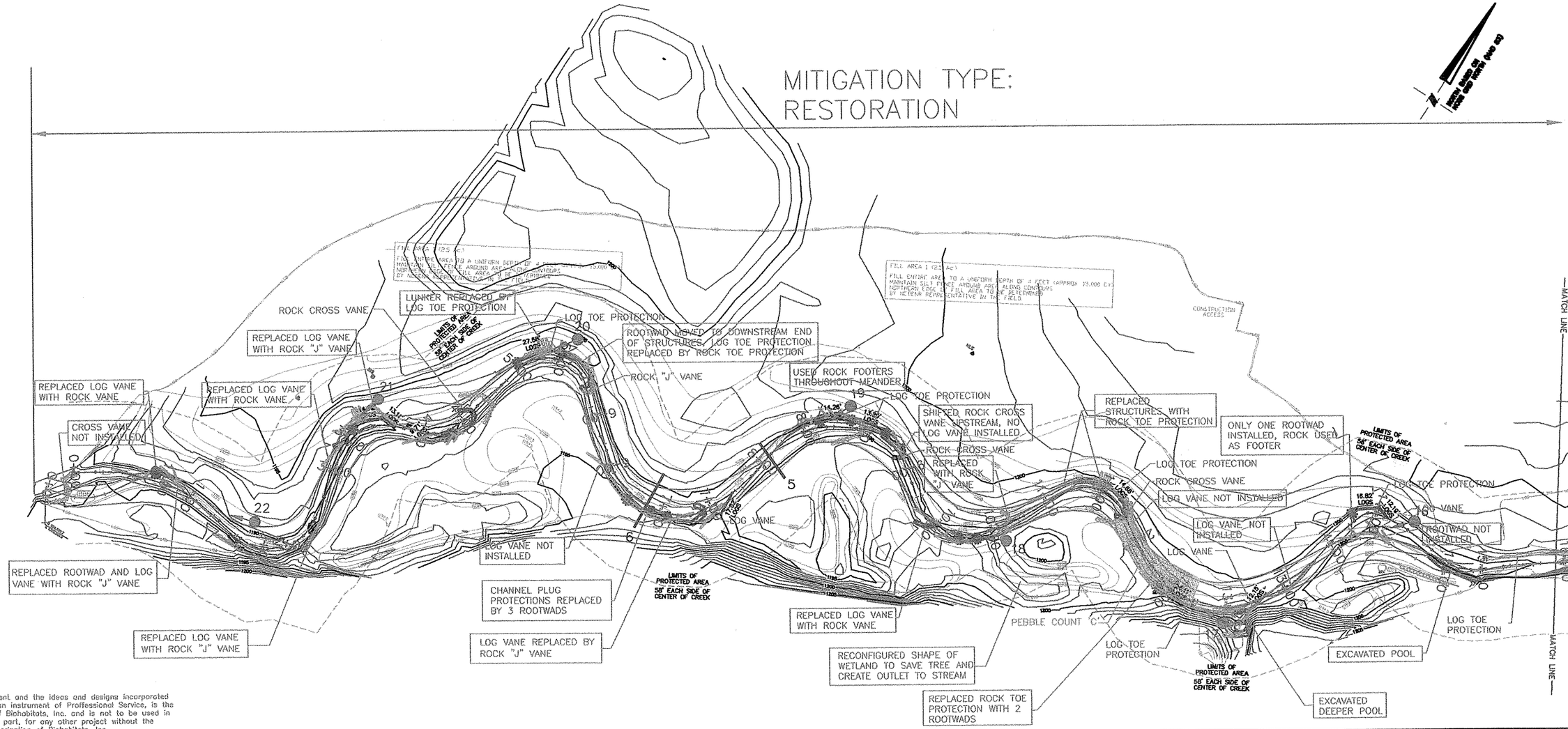


NOT TO SCALE

NOTES

1. AS-BUILT SURVEY PERFORMED BY WK DICKSON, OCTOBER 2002.

MITIGATION TYPE:
RESTORATION



NO.	BY	REVISION DESCRIPTION

DATE: 2/19/03
DESIGNED: EMM
DRAWN: JR
CHECKED: JKB
APPROVED:
Biohabitats Project No. 01015.01

Biohabitats

BROWN BRANCH STREAM RESTORATION

MULBERRY TOWNSHIP CALDWELL COUNTY NORTH CAROLINA

PLAN VIEW OF MONITORING PLAN:

CROSS SECTIONS, PHOTO STATIONS, PEBBLE COUNTS, AND MITIGATION TYPES

SCALE: 1"=85'
CONTRACT NO.
SHEET 1 OF 8

DESIGN LEGEND

SCALE IN FEET

30 10 0 10 20 40 60

MULBERRY TOWNSHIP – CALDWELL COUNTY
NORTH CAROLINA

- ROOTWAD
- LOG VANE
- CROSS VANE
- ROOTWAD / LOG J VANE
- ROCK J VANE
- DESIGN CONTOUR
- DESIGN THALWEG

AS-BUILT LEGEND

- IRON MARKER FOUND
- IRON MARKER SET
- STONE FOUND
- PK NAIL FOUND
- POINT
- PK NAIL SET
- CONCRETE NAIL SET
- MAG NAIL SET
- CONC. MONUMENT FOUND
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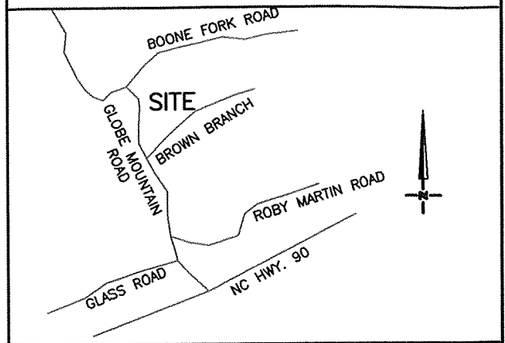

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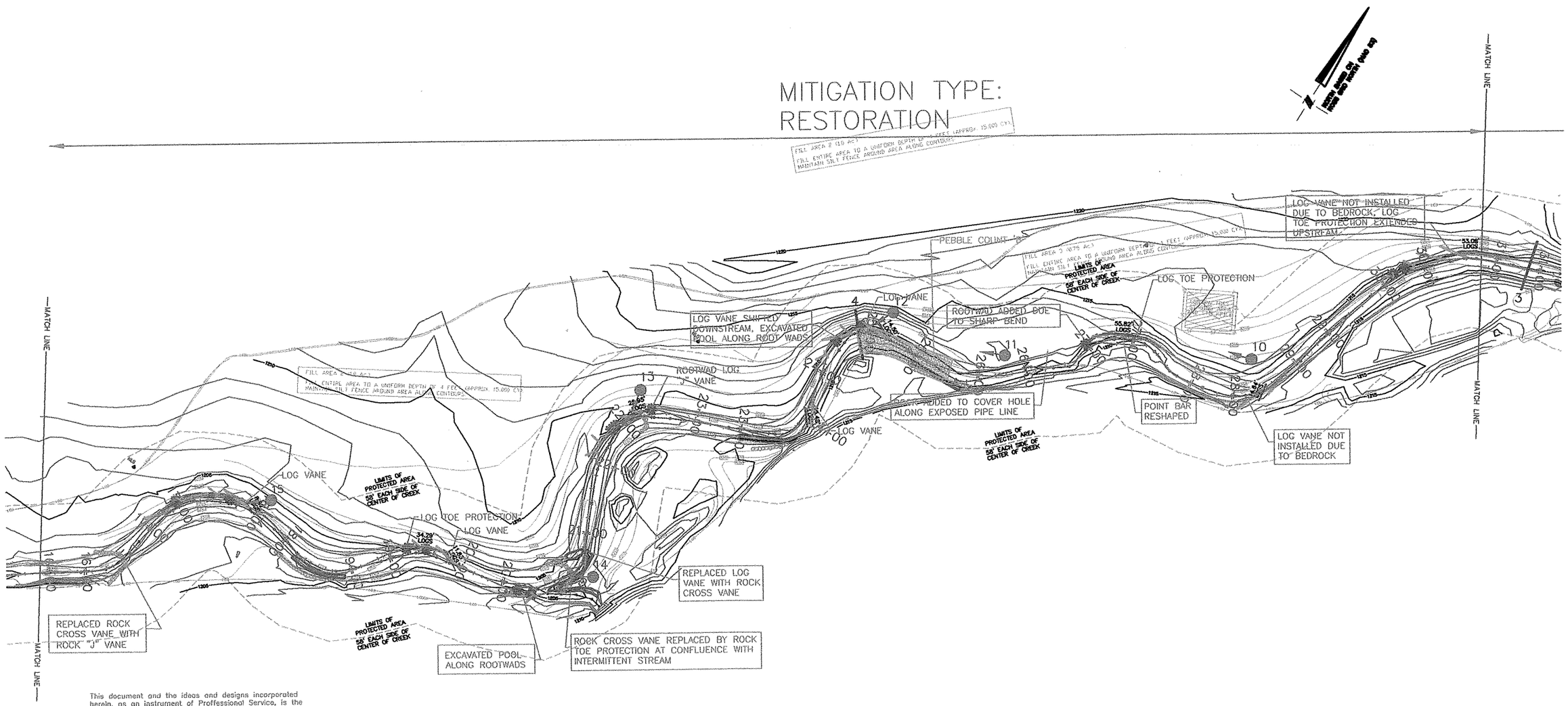
NOTES

1. AS-BUILT SURVEY PERFORMED BY WK DICKSON, OCTOBER 2002.

MITIGATION TYPE: RESTORATION



NO.	BY	DESCRIPTION

DATE: 2/19/03
DESIGNED: EMM
DRAWN: JR
CHECKED: JKB
APPROVED:
Biohabitats Project No. 01015.01

Biohabitats
Environmental

BROWN BRANCH STREAM RESTORATION

MULBERRY TOWNSHIP CALDWELL COUNTY NORTH CAROLINA

PLAN VIEW OF MONITORING PLAN:
CROSS SECTIONS, PHOTO STATIONS, PEBBLE COUNTS, AND MITIGATION TYPES

SCALE: 1"=85'
CONTRACT NO.
SHEET 2 OF 8

DESIGN LEGEND

SCALE IN FEET
20 10 0 10 20 40 60
MULBERRY TOWNSHIP – CALDWELL COUNTY
NORTH CAROLINA

- ROOTWAD
- LOG VANE
- CROSS VANE
- ROOTWAD / LOG J VANE
- ROCK J VANE
- DESIGN CONTOUR
- DESIGN THALWEG

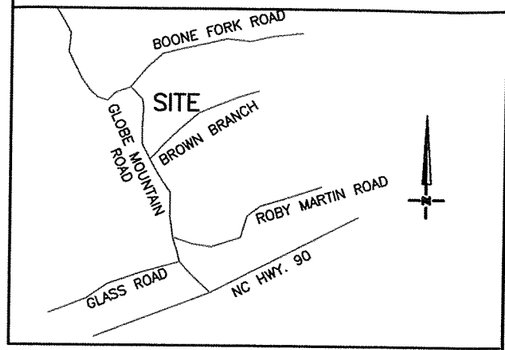
AS-BUILT LEGEND

- IRON MARKER FOUND
- IRON MARKER SET
- STONE FOUND
- PK NAIL FOUND
- POINT
- PK NAIL SET
- CONCRETE NAIL SET
- MAG NAIL SET
- CONC. MONUMENT FOUND
- CONC. MONUMENT SET
- ROOTWAD
- ROCK OR STONE
- LOGS WITH LENGTH AS SHOWN
- AS-BUILT CONTOUR
- EASEMENT
- EXISTING THALWEG
- AS-BUILT THALWEG
- FIELD ADJUSTMENT, CHANGE FROM PROPOSED DESIGN BASED ON DESIGNER'S DISCRETION AND SITE CONSTRAINTS

MONITORING LEGEND

- 14 PHOTO STATION
- CROSS SECTION
- PEBBLE COUNT LOCATION

LOCATION MAP

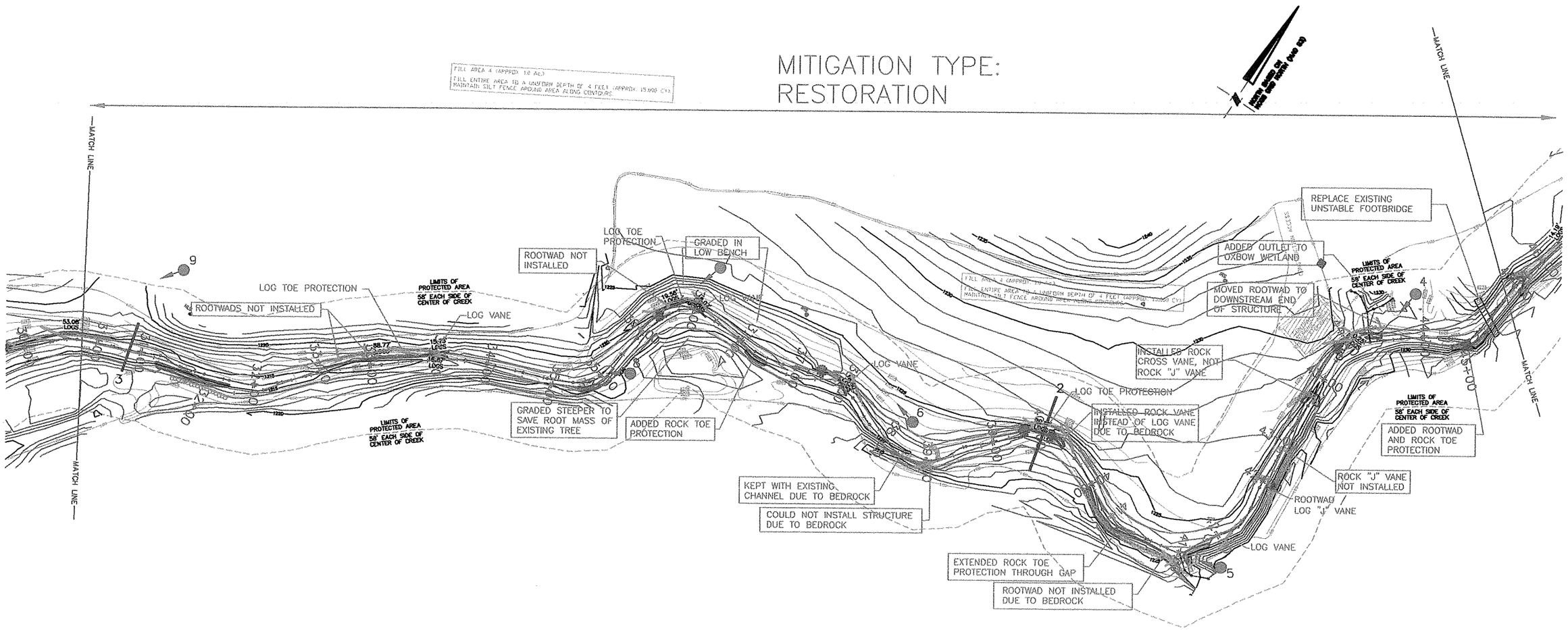


NOT TO SCALE

NOTES

1. AS-BUILT SURVEY PERFORMED BY WK DICKSON, OCTOBER 2002.

MITIGATION TYPE: RESTORATION



REVISION			
DATE	BY	DESCRIPTION	
			DATE: 2/19/03
			DESIGNED: EMM
			DRAWN: JR
			CHECKED: JKB
			APPROVED:
			Biohabitats Project No. 01015.01

Biohabitats

BROWN BRANCH STREAM RESTORATION

MULBERRY TOWNSHIP CALDWELL COUNTY NORTH CAROLINA

PLAN VIEW OF MONITORING PLAN:
CROSS SECTIONS, PHOTO STATIONS, PEBBLE COUNTS, AND MITIGATION TYPES

SCALE: 1"=85'
CONTRACT NO.
SHEET 3 OF 8

DESIGN LEGEND

SCALE IN FEET

20 10 0 10 20 40 60

MULBERRY TOWNSHIP – CALDWELL COUNTY
NORTH CAROLINA

- ROOTWAD
- LOG VANE
- CROSS VANE
- ROOTWAD / LOG J VANE
- ROCK J VANE
- DESIGN CONTOUR
- DESIGN THALWEG

AS-BUILT LEGEND

- IRON MARKER FOUND
- IRON MARKER SET
- STONE FOUND
- PK NAIL FOUND
- POINT
- PK NAIL SET
- CONCRETE NAIL SET
- MAG NAIL SET
- CONC. MONUMENT FOUND
- CONC. MONUMENT SET
- ROOTWAD
- ROCK OR STONE
- LOGS WITH LENGTH AS SHOWN
- AS-BUILT CONTOUR
- EASEMENT
- EXISTING THALWEG
- AS-BUILT THALWEG
- FIELD ADJUSTMENT, CHANGE FROM PROPOSED DESIGN BASED ON DESIGNER'S DISCRETION AND SITE CONSTRAINTS

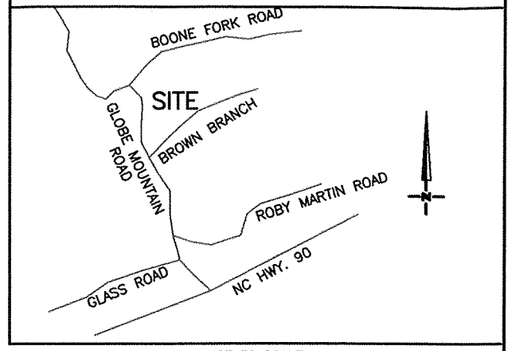
MONITORING LEGEND

- 14 PHOTO STATION
- CROSS SECTION
- PEBBLE COUNT LOCATION

NOTES

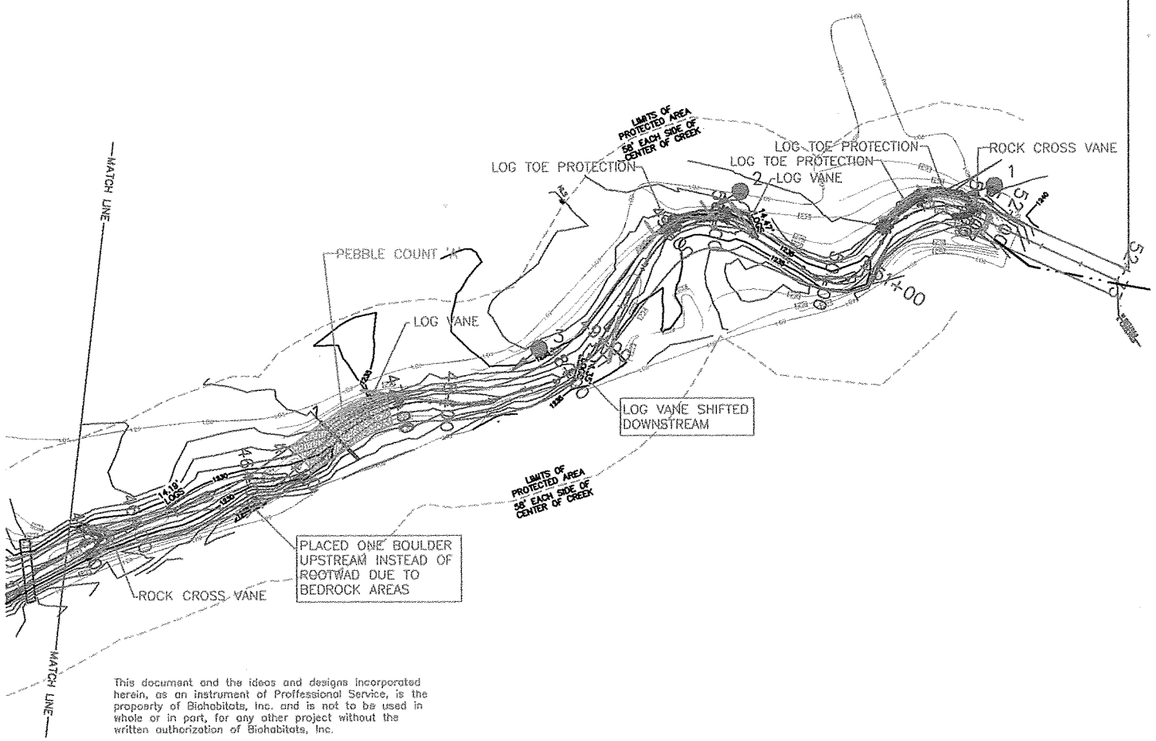
1. AS-BUILT SURVEY PERFORMED BY WK DICKSON, OCTOBER 2002.

LOCATION MAP

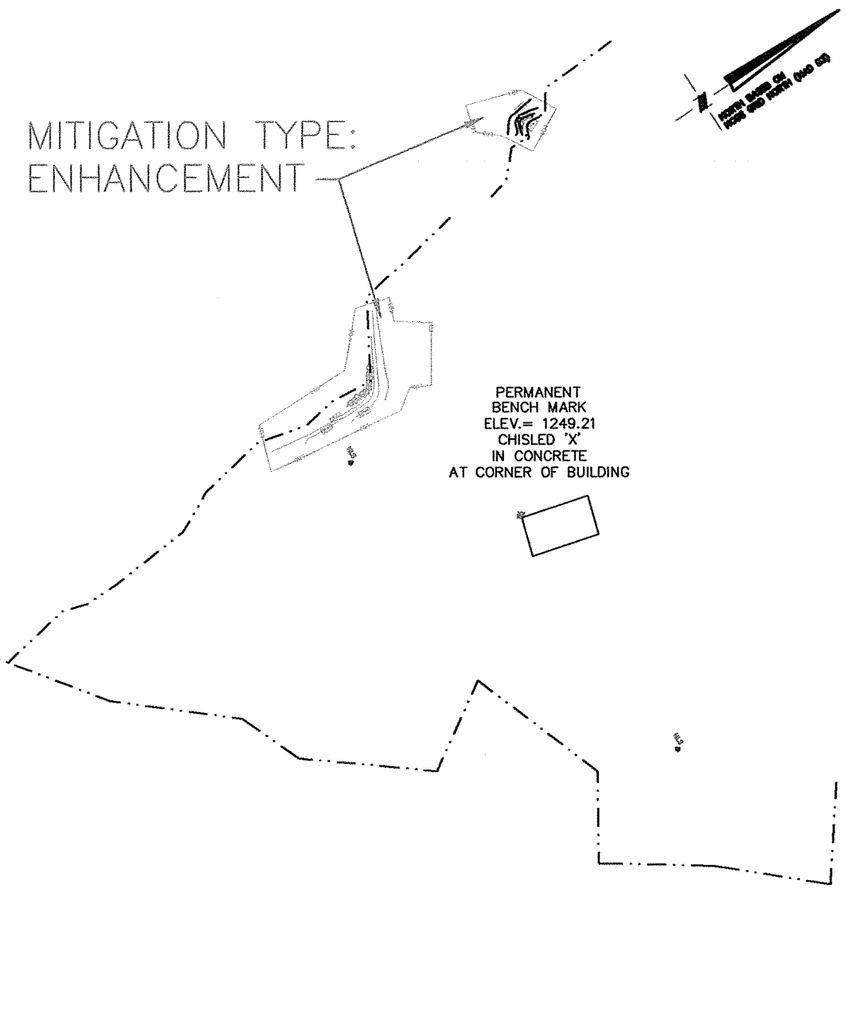


NOT TO SCALE

MITIGATION TYPE: RESTORATION



MITIGATION TYPE: ENHANCEMENT



DATE	BY	REVISION DESCRIPTION

DATE 2/19/03
DESIGNED EMM
DRAWN JR
CHECKED JKB
APPROVED
Biohabitats Project No. 01015.01

Biohabitats

BROWN BRANCH STREAM RESTORATION

MULBERRY TOWNSHIP CALDWELL COUNTY NORTH CAROLINA

PLAN VIEW OF MONITORING PLAN:

CROSS SECTIONS, PHOTO STATIONS, PEBBLE COUNTS, AND MITIGATION TYPES

SCALE: 1"=85'
CONTRACT NO.
SHEET 4 OF 8

SCALE IN FEET
1"=85'

20 10 0 10 20 40 60

MULBERRY TOWNSHIP – CALDWELL COUNTY
NORTH CAROLINA

DESIGN LEGEND

- PLANTING ZONE 1– RIPARIAN WOODLANDS– MESIC
- PLANTING ZONE 2– RIPARIAN WOODLANDS– LOWER FLOODPLAIN
- PLANTING ZONE 3– LOWER FLOODPLAIN– MEANDER BUFFER
- PLANTING ZONE 4– SCRUB SHRUB WETLAND
- PLANTING ZONE 5– VERNAL POOL– EMERGENT
- PLANTING ZONE 8– NATIVE GRASSLAND
- DOWNED LOG
- BRUSH PILE
- STANDING SNAG
- DESIGN THALWEG

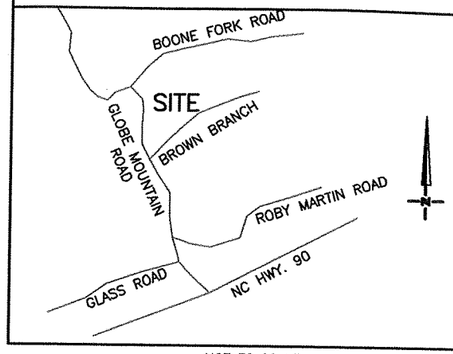
AS-BUILT LEGEND

- AS-BUILT THALWEG
- RELOCATED FLOODPLAIN STRUCTURES
- FIELD ADJUSTMENT
- DOWNED LOG
- BRUSH PILE
- STANDING SNAG

MONITORING LEGEND

- VEGETATION PLOT

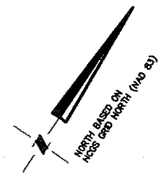
LOCATION MAP

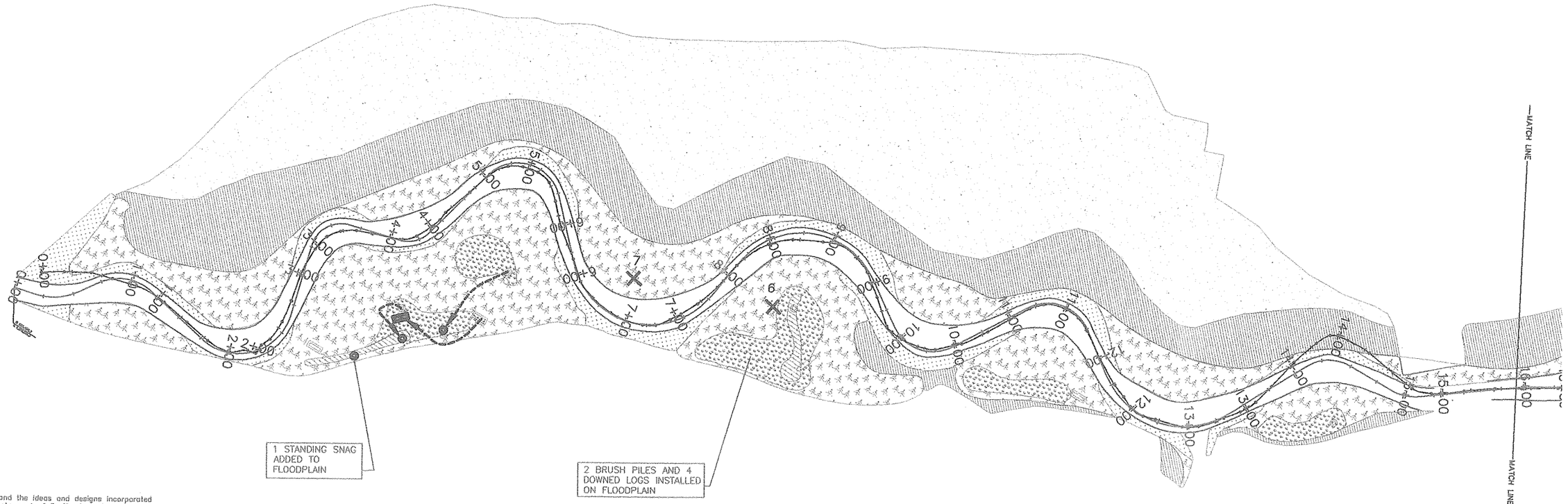


NOT TO SCALE

NOTES

1. AS-BUILT SURVEY PERFORMED BY WK DICKSON, OCTOBER 2002.





DATE	BY	DESCRIPTION

Date: 2/19/03
Designed: EMM
Drawn: JR
Checked: JKB
Approved:
Biohabitats Project No. 01015.01

Biohabitats

BROWN BRANCH STREAM RESTORATION

MULBERRY TOWNSHIP CALDWELL COUNTY NORTH CAROLINA

PLAN VIEW OF MONITORING PLAN:

PLANTING ZONES, FLOODPLAIN STRUCTURES, AND VEGETATION PLOTS

SCALE: 1"=85'
CONTRACT NO.
SHEET 5 OF 8

DESIGN LEGEND

- PLANTING ZONE 1– RIPARIAN WOODLANDS– MESIC
- PLANTING ZONE 2– RIPARIAN WOODLANDS– LOWER FLOODPLAIN
- PLANTING ZONE 3– LOWER FLOODPLAIN– MEANDER BUFFER
- PLANTING ZONE 4– SCRUB SHRUB WETLAND
- PLANTING ZONE 5– VERNAL POOL– EMERGENT
- PLANTING ZONE 8– NATIVE GRASSLAND
- DOWNED LOG
- BRUSH PILE
- STANDING SNAG
- DESIGN THALWEG

AS–BUILT LEGEND

- AS–BUILT THALWEG
- RELOCATED FLOODPLAIN STRUCTURES
- FIELD ADJUSTMENT
- DOWNED LOG
- BRUSH PILE
- STANDING SNAG

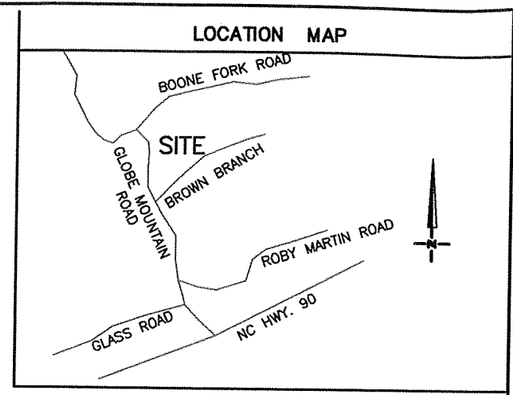
MONITORING LEGEND

- VEGETATION PLOT

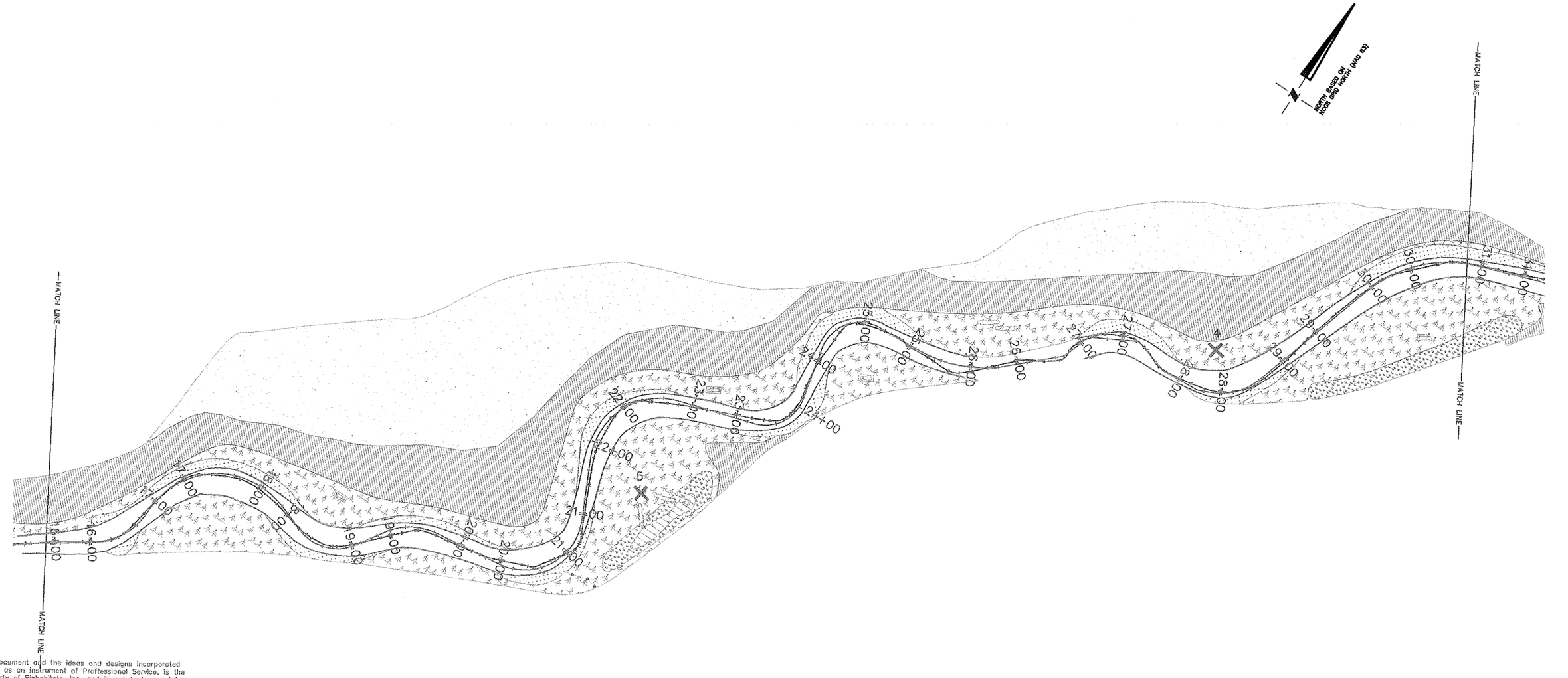
NOTES

1. AS–BUILT SURVEY PERFORMED BY WK DICKSON, OCTOBER 2002.

LOCATION MAP



NOT TO SCALE



DATE	BY	DESCRIPTION

DATE 2/19/03
DESIGNED EMM
DRAWN JR
CHECKED JKB
APPROVED
Biohabitats Project No. 01015.01

Biohabitats

BROWN BRANCH
STREAM RESTORATION

MULBERRY TOWNSHIP CALDWELL COUNTY NORTH CAROLINA

PLAN VIEW OF MONITORING PLAN:
PLANTING ZONES, FLOODPLAIN STRUCTURES, AND VEGETATION PLOTS

SCALE: 1"=85'
CONTRACT NO.
SHEET 6 OF 8

DESIGN LEGEND

- PLANTING ZONE 1– RIPARIAN WOODLANDS– MESIC
- PLANTING ZONE 2– RIPARIAN WOODLANDS– LOWER FLOODPLAIN
- PLANTING ZONE 3– LOWER FLOODPLAIN– MEANDER BUFFER
- PLANTING ZONE 4– SCRUB SHRUB WETLAND
- PLANTING ZONE 5– VERNAL POOL– EMERGENT
- PLANTING ZONE 8– NATIVE GRASSLAND
- DOWNED LOG
- BRUSH PILE
- STANDING SNAG
- DESIGN THALWEG

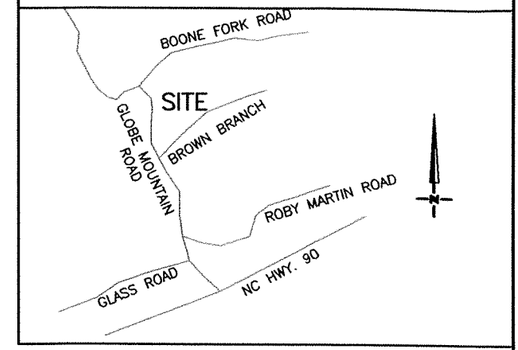
AS-BUILT LEGEND

- AS-BUILT THALWEG
- RELOCATED FLOODPLAIN STRUCTURES
- FIELD ADJUSTMENT
- DOWNED LOG
- BRUSH PILE
- STANDING SNAG

MONITORING LEGEND

- VEGETATION PLOT

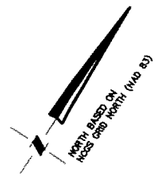
LOCATION MAP

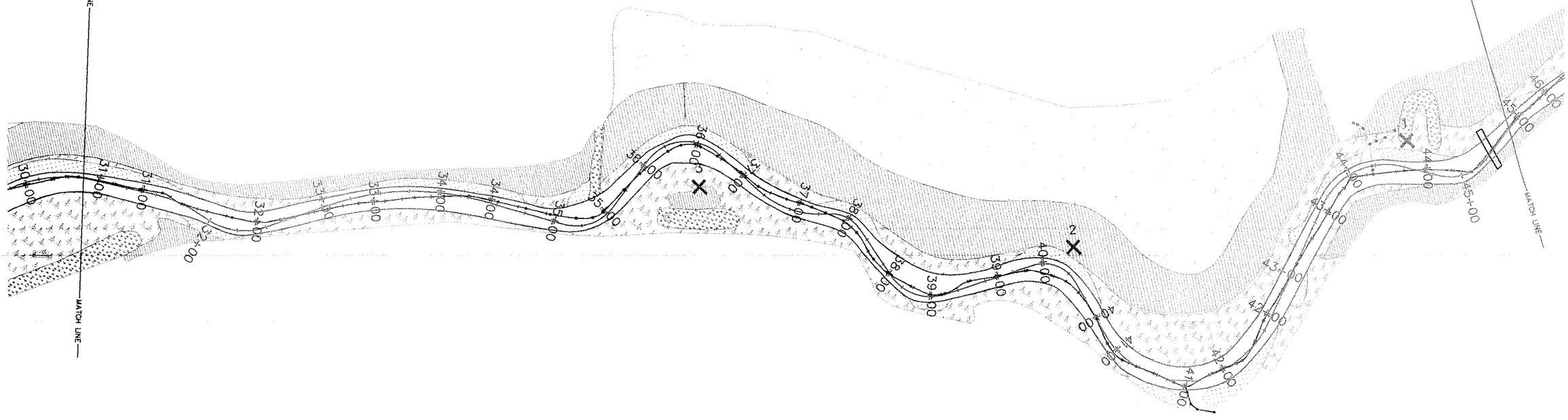


NOT TO SCALE

NOTES

1. AS-BUILT SURVEY PERFORMED BY WK DICKSON, OCTOBER 2002.





DATE	2/19/03	BROWN BRANCH STREAM RESTORATION	PLAN VIEW OF MONITORING PLAN: PLANTING ZONES, FLOODPLAIN STRUCTURES, AND VEGETATION PLOTS
DRAWN	EMM	MULBERRY TOWNSHIP CALDWELL COUNTY NORTH CAROLINA	SCALE: 1"=85'
CHECKED	JR		CONTRACT NO.
APPROVED	JKB		SHEET 7 OF 8
Biohabitats Project No.	01015.01		

Biohabitats

DESIGN LEGEND

- PLANTING ZONE 1– RIPARIAN WOODLANDS– MESIC
- PLANTING ZONE 2– RIPARIAN WOODLANDS– LOWER FLOODPLAIN
- PLANTING ZONE 3– LOWER FLOODPLAIN– MEANDER BUFFER
- PLANTING ZONE 4– SCRUB SHRUB WETLAND
- PLANTING ZONE 5– VERNAL POOL– EMERGENT
- PLANTING ZONE 6– NATIVE GRASSLAND
- DOWNED LOG
- BRUSH PILE
- STANDING SNAG
- DESIGN THALWEG

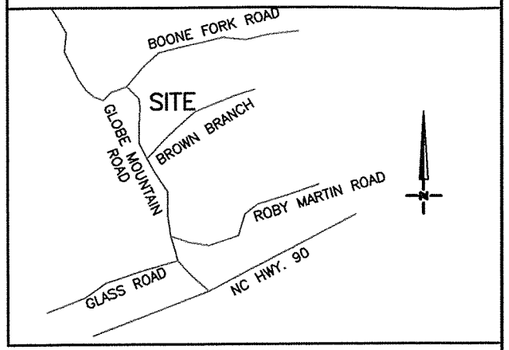
AS-BUILT LEGEND

- AS-BUILT THALWEG
- RELOCATED FLOODPLAIN STRUCTURES
- FIELD ADJUSTMENT
- DOWNED LOG
- BRUSH PILE
- STANDING SNAG

MONITORING LEGEND

- VEGETATION PLOT

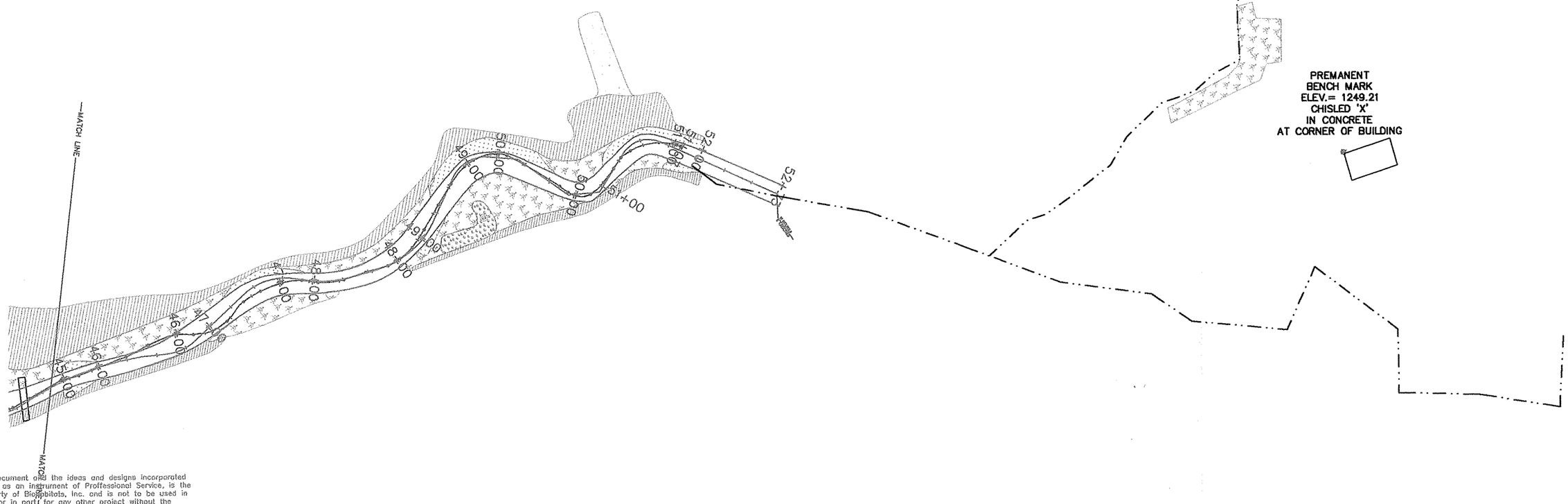
LOCATION MAP



NOT TO SCALE

NOTES

1. AS-BUILT SURVEY PERFORMED BY WK DICKSON, OCTOBER 2002.



DATE	BY	COMMENT

DATE: 2/19/03
DESIGNED: EMM
DRAWN: JR
CHECKED: JKB
APPROVED:
Biohabitats Project No. 01015.01

Biohabitats

BROWN BRANCH STREAM RESTORATION

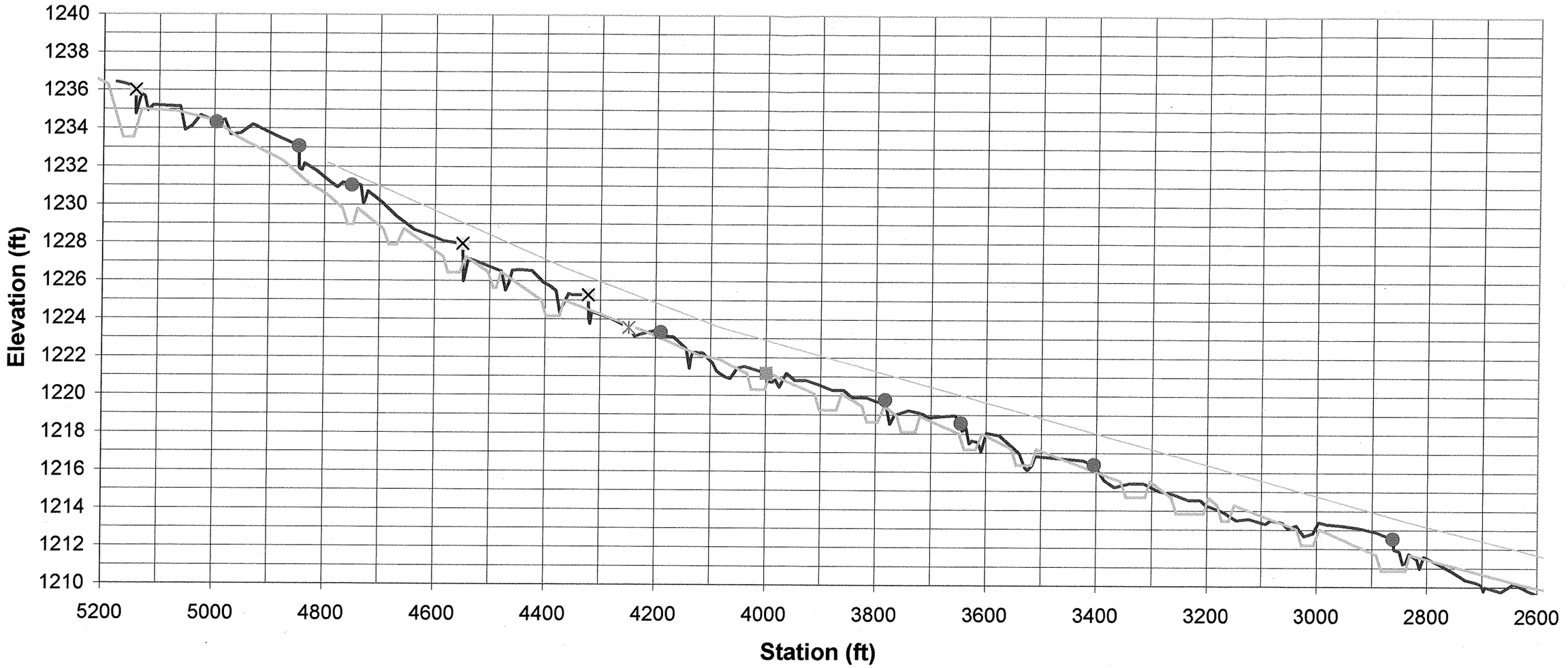
MULBERRY TOWNSHIP CALDWELL COUNTY NORTH CAROLINA

PLAN VIEW OF MONITORING PLAN:

PLANTING ZONES, FLOODPLAIN STRUCTURES, AND VEGETATION PLOTS

SCALE: 1"=85'
CONTRACT NO.
SHEET 8 OF 8

Appendix B
LONGITUDINAL PROFILE



LEGEND

- As-Built Thalweg Profile
- Design Thalweg Profile
- Design Bankfull Slope
- Log Vane
- Cross Vane
- Rock Vane
- Rock J Vane
- Rootwad/Log J Vane

NOTES:

1) Stationing of features shown above differs slightly from stationing shown in the as-built drawings (Appendix A) due to minor differences in the field interpretation of thalweg.

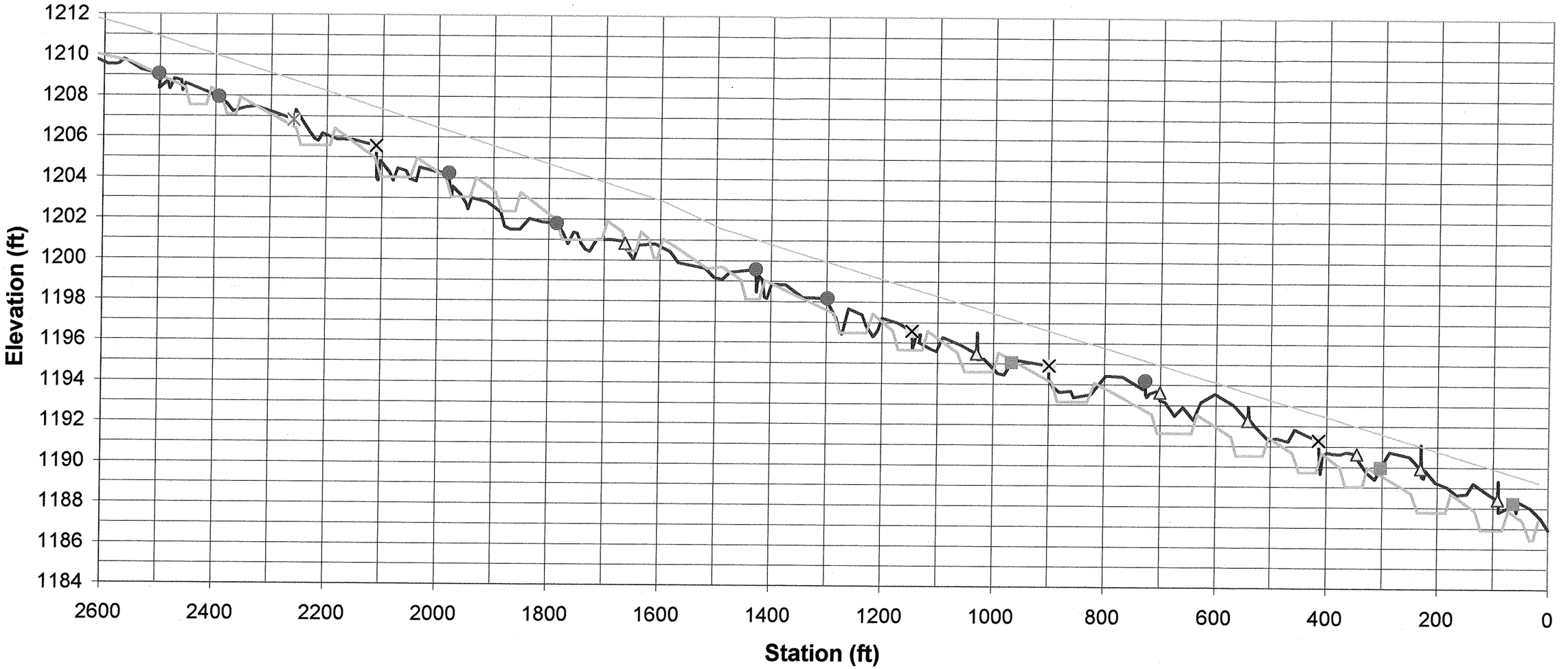
2) Due to minor differences in the cumulative length of the thalweg in the design versus as-built drawings, an individual feature (e.g., top of riffle) may not plot at the same Station in the two profiles (design and as-built) shown above.

Longitudinal Profile
Upstream Portion of Brown Branch

Baseline Monitoring Conditions

Survey Date: January 15, 2003

Biohabitats
Incorporated



LEGEND

- As-Built Thalweg Profile
- Design Thalweg Profile
- Design Bankfull Slope
- Log Vane
- Cross Vane
- Rock Vane
- Rock J Vane
- Rootwad/Log J Vane

NOTES:

1) Stationing of features shown above differs slightly from stationing shown in the as-built drawings (Appendix A) due to minor differences in the field interpretation of thalweg.

2) Due to minor differences in the cumulative length of the thalweg in the design versus as-built drawings, an individual feature (e.g., top of riffle) may not plot at the same Station in the two profiles (design and as-built) shown above.

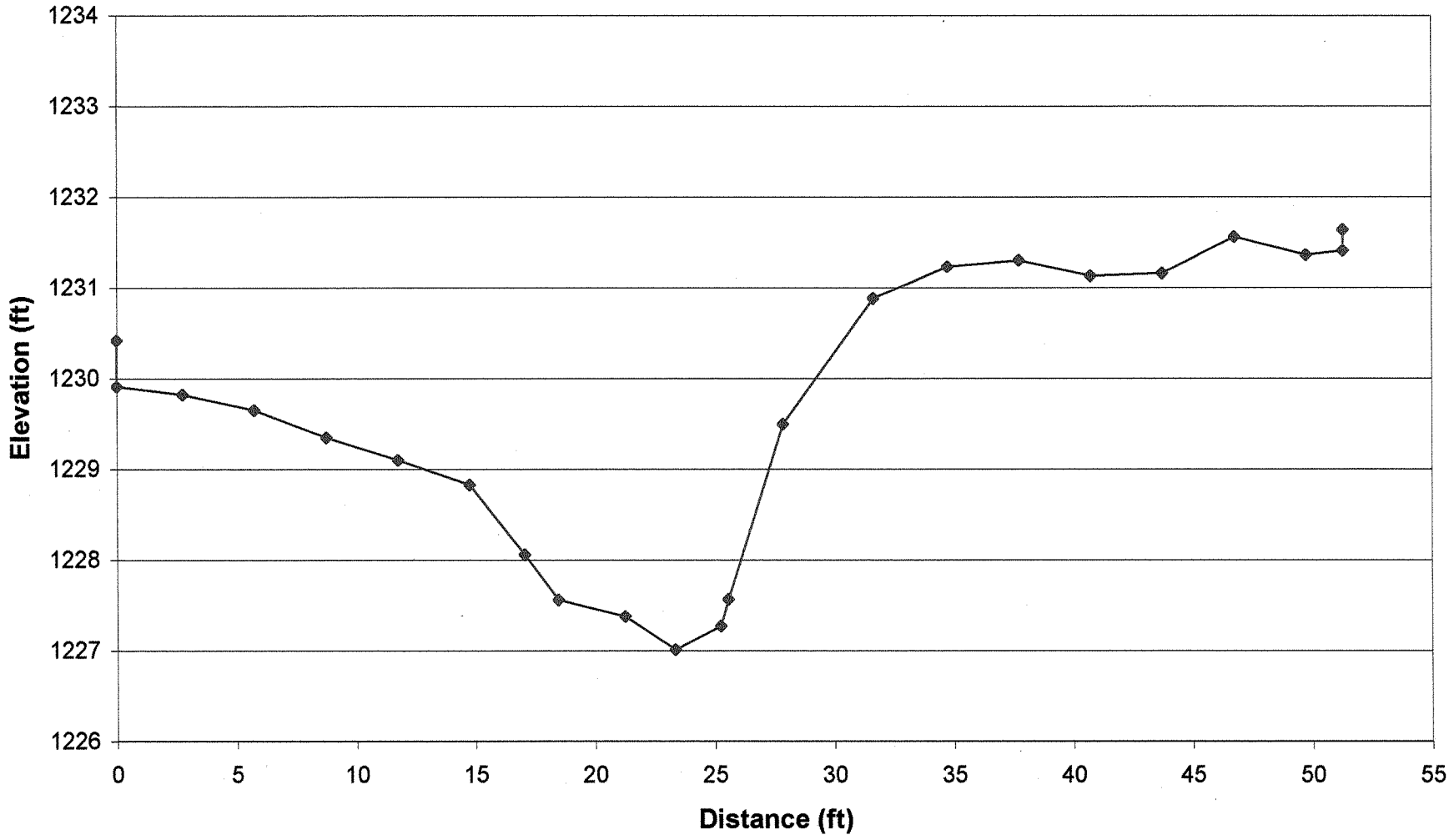
3) Vertical segments shown above Rock "J" Vanes indicate elevation of the top of the middle rock.

Longitudinal Profile
Downstream Portion of Brown Branch

Baseline Monitoring Conditions
Survey Date: January 15, 2003

Biohabitats
Incorporated

Appendix C
CROSS SECTIONS



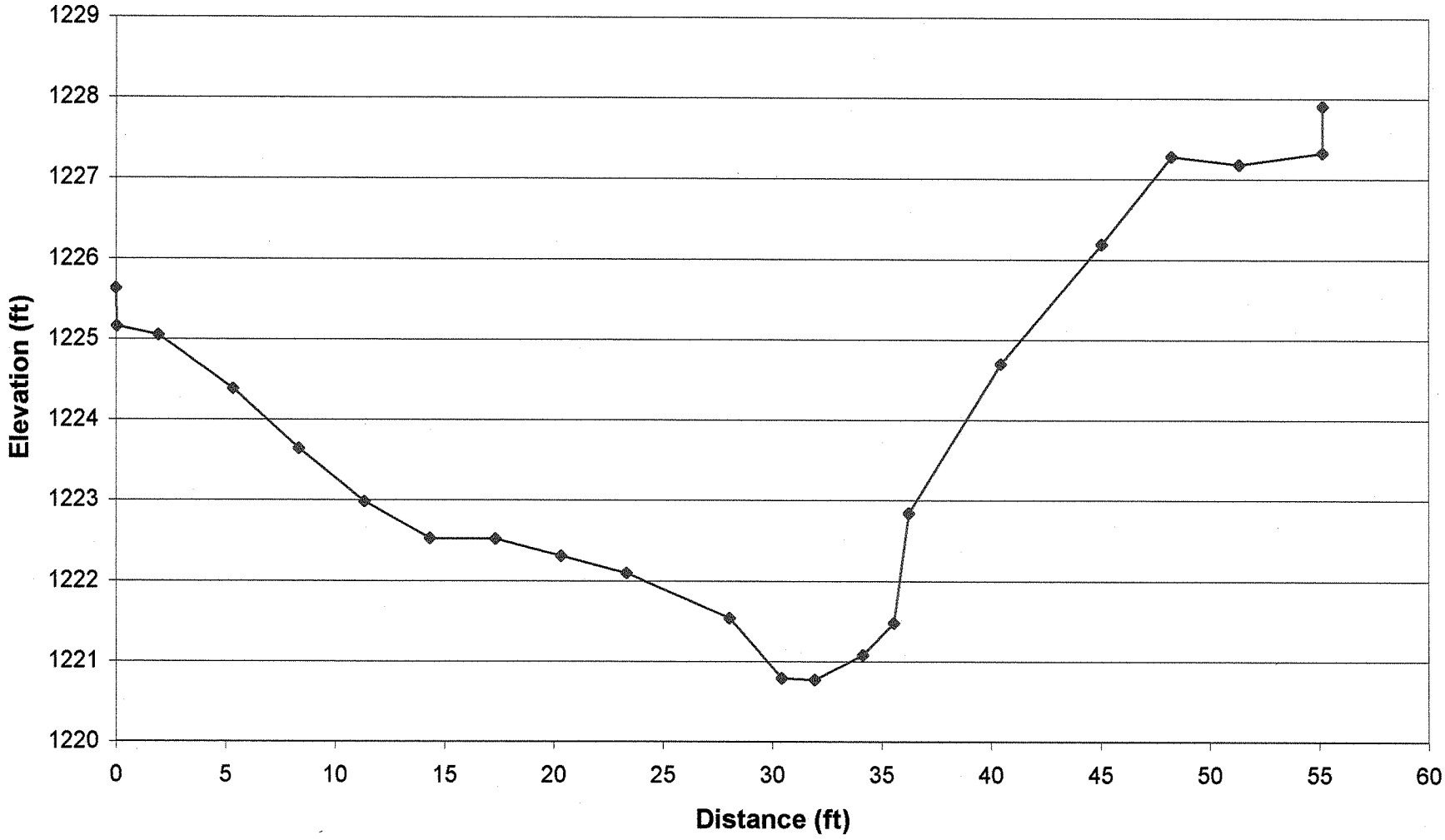
LEGEND

Baseline Survey

NOTES:

1) All data points represent ground, except for vertical endpoints which indicate the top of rebar protruding from ground at monumented stations.
2) The perspective shown is looking downstream.

Cross Section #1, Riffle
As-Built Thalweg STA 46+50
Baseline Monitoring Conditions
Survey Date: January 15, 2003



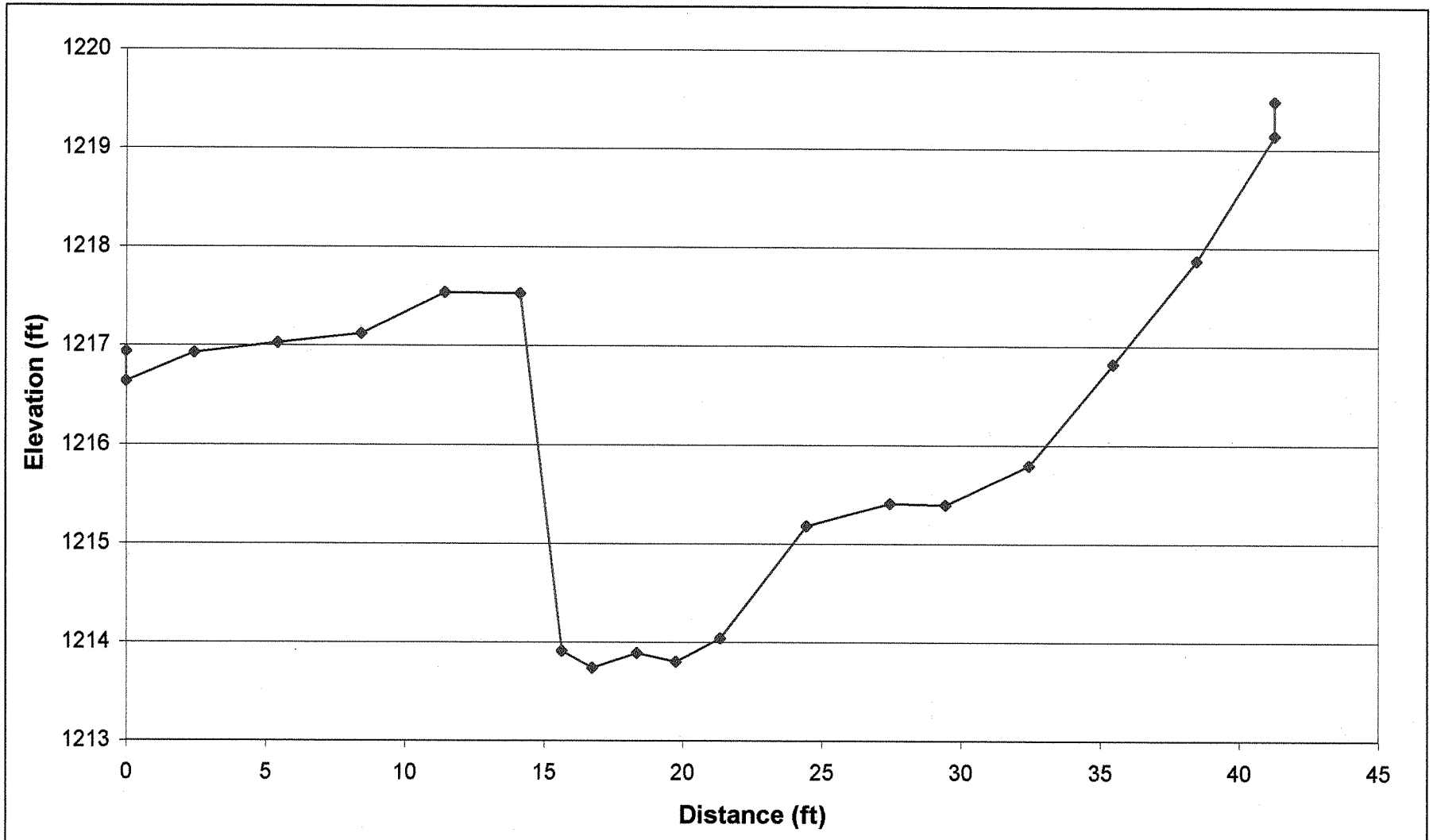
LEGEND

Baseline Survey

NOTES:

1) All data points represent ground, except for vertical endpoints which indicate the top of rebar protruding from ground at monumented stations.
2) The perspective shown is looking downstream.

Cross Section #2, Meander
As-Built Thalweg STA 39+40
Baseline Monitoring Conditions
Survey Date: January 15, 2003



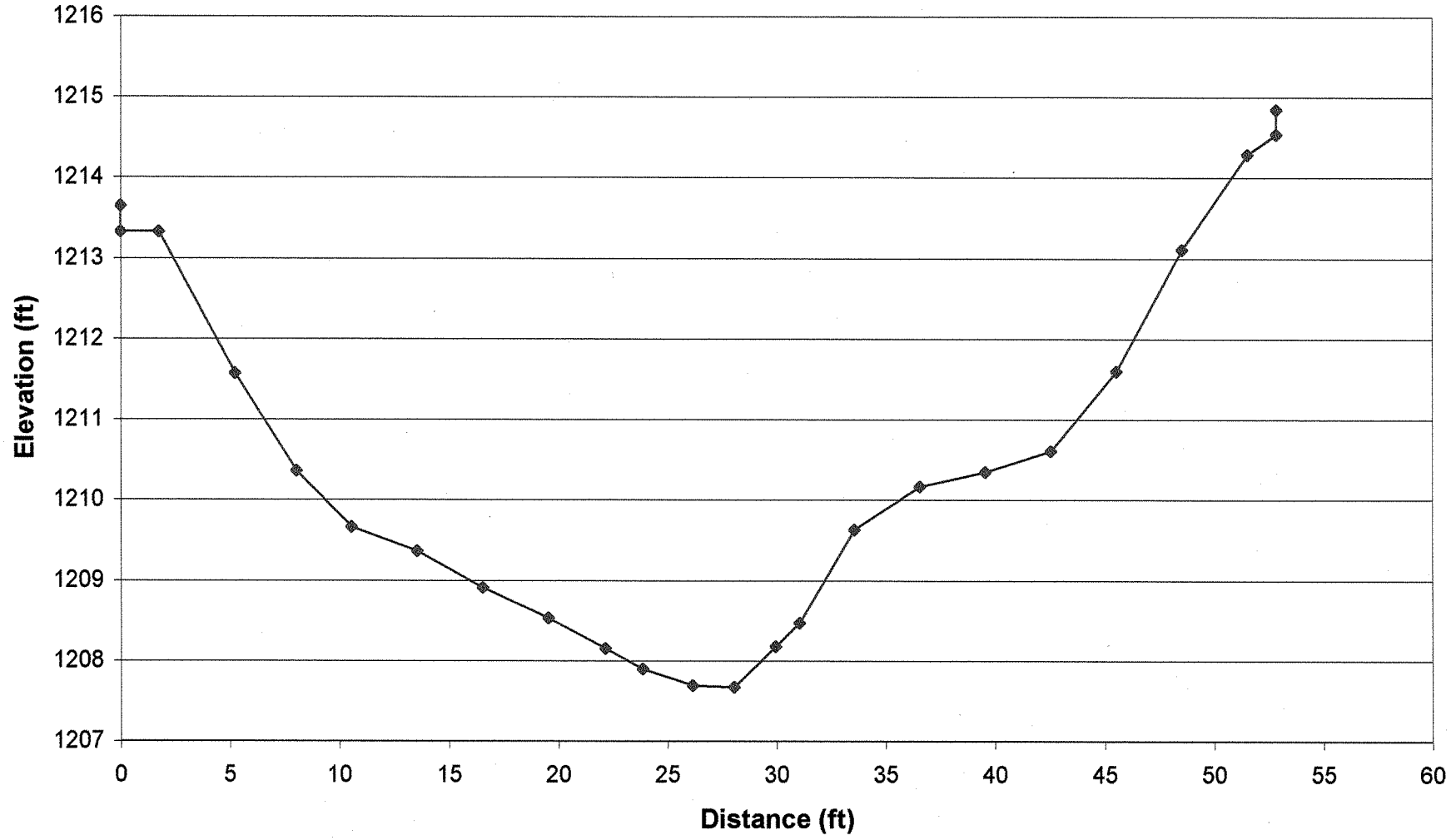
LEGEND

Baseline Survey

NOTES:

1) All data points represent ground, except for vertical endpoints which indicate the top of rebar protruding from ground at monumented stations.
2) The perspective shown is looking downstream.

Cross Section #3, Riffle
As-Built Thalweg STA 30+85
Baseline Monitoring Conditions
Survey Date: January 15, 2003



LEGEND

Baseline Survey

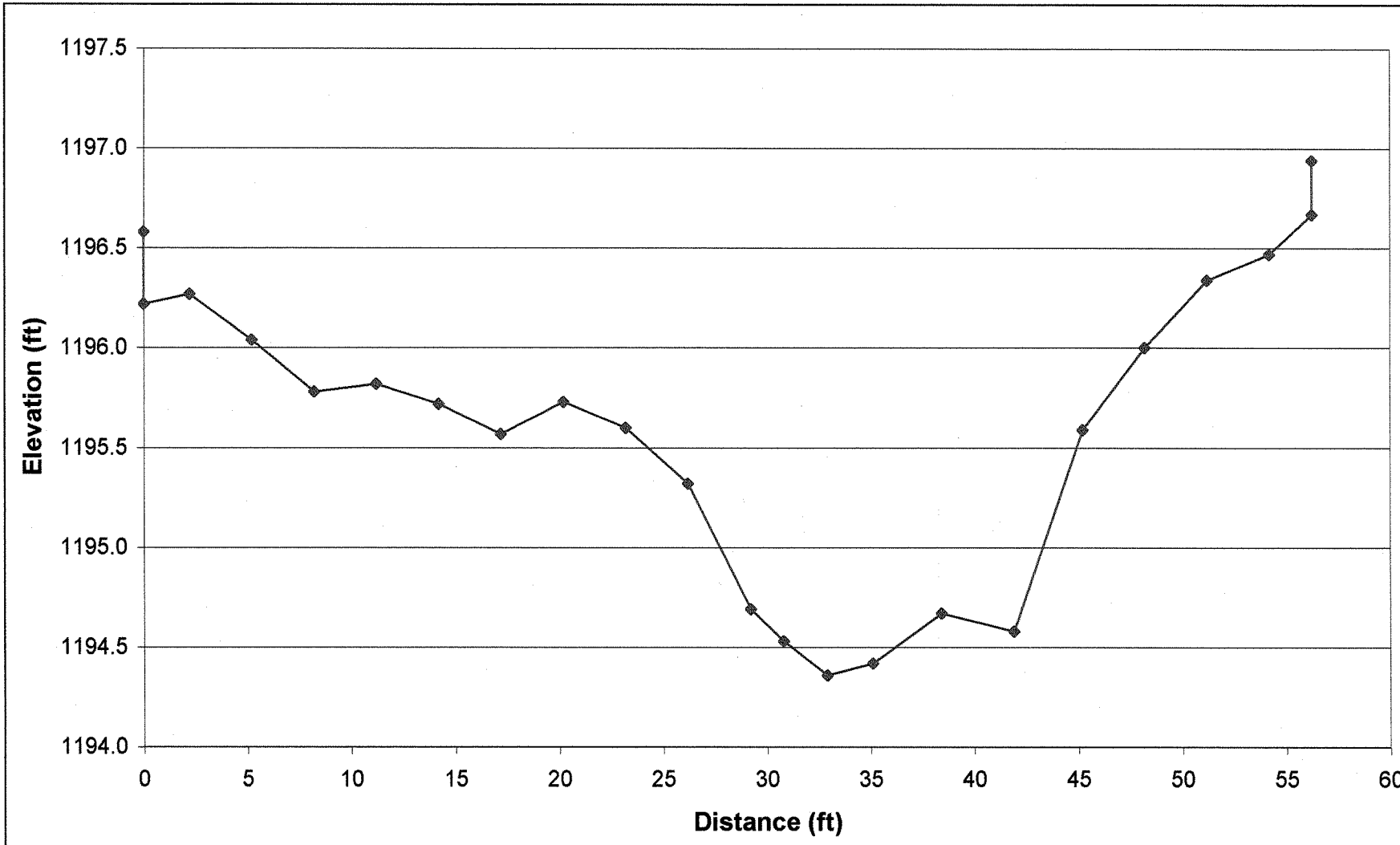
NOTES:

1) All data points represent ground, except for vertical endpoints which indicate the top of rebar protruding from ground at monumented stations.
2) The perspective shown is looking downstream.

Cross Section #4, Meander As-Built Thalweg STA 24+40

Baseline Monitoring Conditions

Survey Date: January 15, 2003



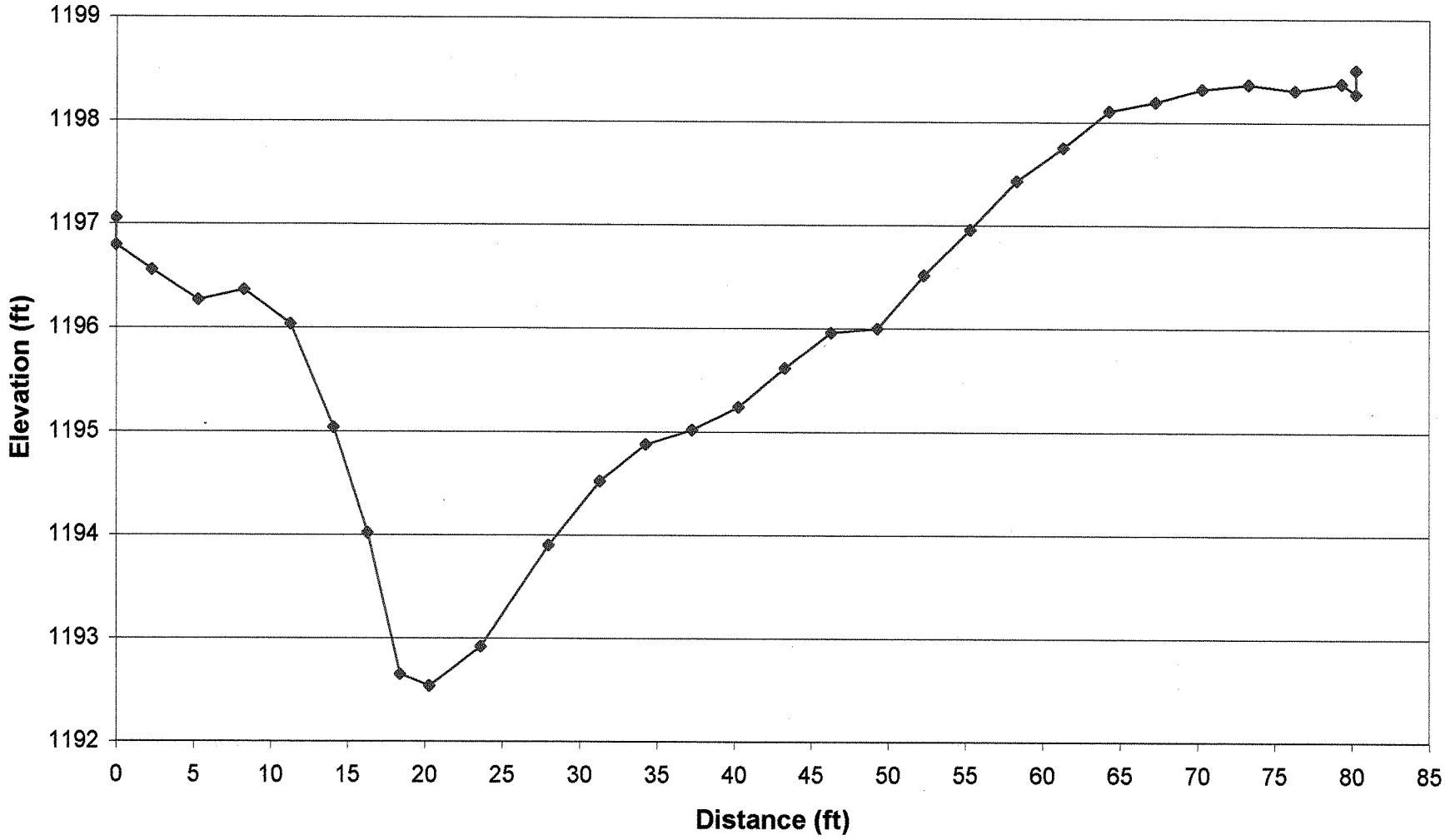
LEGEND

Baseline Survey

NOTES:

1) All data points represent ground, except for vertical endpoints which indicate the top of rebar protruding from ground at monumented stations.
2) The perspective shown is looking downstream.

Cross Section #5, Riffle
As-Built Thalweg STA 7+55
Baseline Monitoring Conditions
Survey Date: January 15, 2003



LEGEND

Baseline Survey

NOTES:

1) All data points represent ground, except for vertical endpoints which indicate the top of rebar protruding from ground at monumented stations.
2) The perspective shown is looking downstream.

Cross Section #6, Meander
As-Built Thalweg STA 6+45
Baseline Monitoring Conditions
Survey Date: January 15, 2003

Appendix D
PEBBLE COUNTS

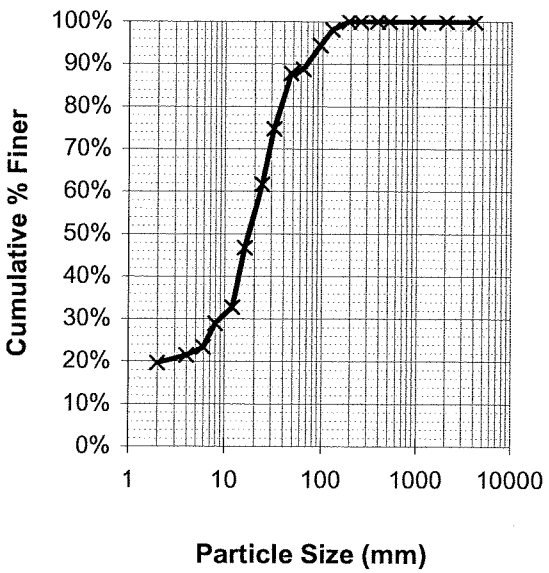
BASELINE CONDITIONS, PEBBLE COUNT A

Site Name:	Brown Branch	Biohabitats, Inc.
Project No:	01015.01	Pebble Count Data Sheet
Date:	1/17/2003	As-Built STA 46+30-46+90, Pool 20%, Riffle 80%

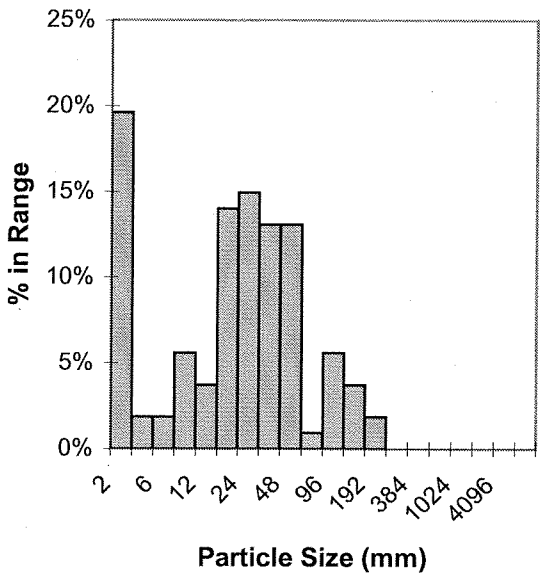
	Particle Size [mm]	Total #	% in Range	% Cumulative
Sand and Silt	< 2	21	20%	20%
Gravels	2 - 4	2	2%	21%
	4 - 6	2	2%	23%
	6 - 8	6	6%	29%
	8 - 12	4	4%	33%
	12 - 16	15	14%	47%
	16 - 24	16	15%	62%
	24 - 32	14	13%	75%
	32 - 48	14	13%	88%
	48 - 64	1	1%	89%
Cobbles	64 - 96	6	6%	94%
	96 - 128	4	4%	98%
	128 - 192	2	2%	100%
	192 - 256	0	0%	100%
Boulders	256 - 384	0	0%	100%
	384 - 512	0	0%	100%
	512 - 1024	0	0%	100%
	1024 - 2048	0	0%	100%
	2048 - 4096	0	0%	100%
Bedrock		0	0%	100%
	TOTALS:	107	100%	

D_{50} = 17.8 mm, D_{75} = 32.3 mm, D_{84} = 43.3 mm, D_{90} = 70.9 mm

Particle Size Distribution



Histogram



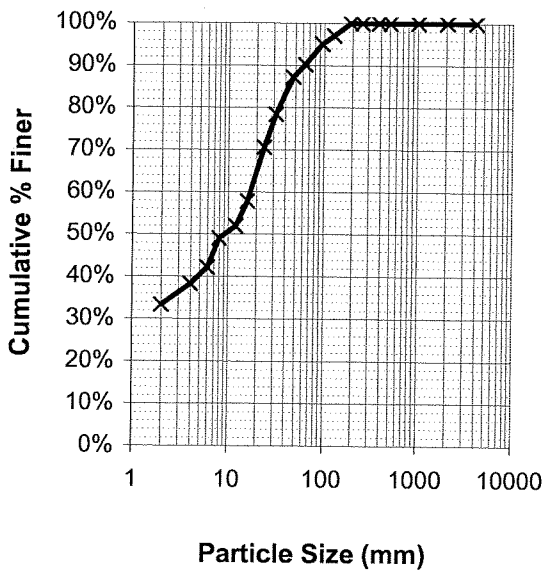
BASELINE CONDITIONS, PEBBLE COUNT B

Site Name:	Brown Branch	Biohabitats, Inc.
Project No:	01015.01	Pebble Count Data Sheet
Date:	1/16/2003	As-built STA 24+45-25+30, Pool 40%, Riffle 60%

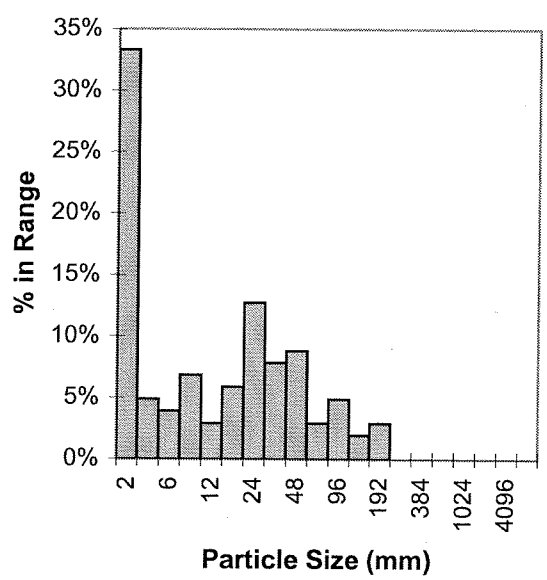
	Particle Size [mm]	Total #	% in Range	% Cumulative
Sand and Silt	< 2	34	33%	33%
Gravels	2 - 4	5	5%	38%
	4 - 6	4	4%	42%
	6 - 8	7	7%	49%
	8 - 12	3	3%	52%
	12 - 16	6	6%	58%
	16 - 24	13	13%	71%
	24 - 32	8	8%	78%
	32 - 48	9	9%	87%
	48 - 64	3	3%	90%
Cobbles	64 - 96	5	5%	95%
	96 - 128	2	2%	97%
	128 - 192	3	3%	100%
	192 - 256	0	0%	100%
Boulders	256 - 384	0	0%	100%
	384 - 512	0	0%	100%
	512 - 1024	0	0%	100%
	1024 - 2048	0	0%	100%
	2048 - 4096	0	0%	100%
Bedrock		0	0%	100%
	TOTALS:	102	100%	

D_{50} = 9.3 mm, D_{75} = 28.5 mm, D_{84} = 42.1 mm, D_{90} = 62.9 mm

Particle Size Distribution



Histogram



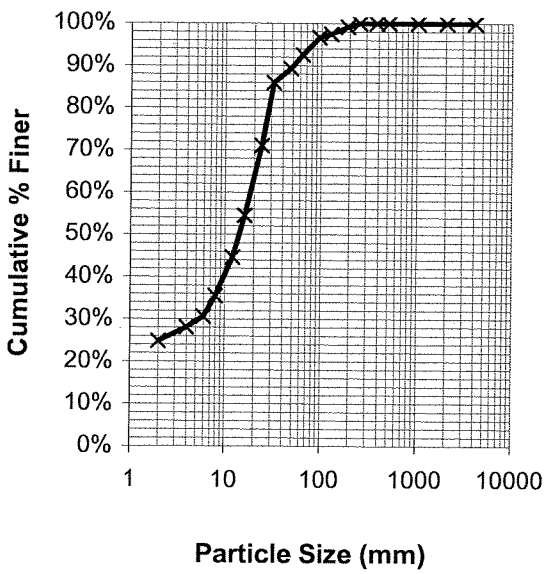
BASELINE CONDITIONS, PEBBLE COUNT C

Site Name:	Brown Branch	Biohabitats, Inc.
Project No:	01015.01	Pebble Count Data Sheet
Date:	1/16/2003	As-built STA 11+30-12+20, Pool 40%, Riffle 60%

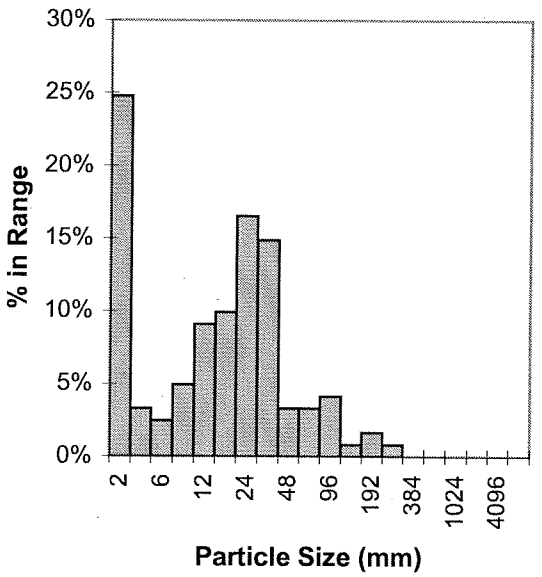
	Particle Size [mm]	Total #	% in Range	% Cumulative
Sand and Silt	< 2	30	25%	25%
Gravels	2 - 4	4	3%	28%
	4 - 6	3	2%	31%
	6 - 8	6	5%	36%
	8 - 12	11	9%	45%
	12 - 16	12	10%	55%
	16 - 24	20	17%	71%
	24 - 32	18	15%	86%
	32 - 48	4	3%	89%
	48 - 64	4	3%	93%
Cobbles	64 - 96	5	4%	97%
	96 - 128	1	1%	98%
	128 - 192	2	2%	99%
	192 - 256	1	1%	100%
Boulders	256 - 384	0	0%	100%
	384 - 512	0	0%	100%
	512 - 1024	0	0%	100%
	1024 - 2048	0	0%	100%
	2048 - 4096	0	0%	100%
Bedrock		0	0%	100%
	TOTALS:	121	100%	

D_{50} = 14.2 mm, D_{75} = 26.1 mm, D_{84} = 31.0 mm, D_{90} = 51.6 mm

Particle Size Distribution



Histogram



Appendix E
PHOTOGRAPHS

Photographs from Monumented Photo Stations #1 through #22
Brown Branch Stream Restoration
Post-Construction Photographs taken January 2003

Photo Station #1. Looking downstream from as-built Station ~51+00.

Photo Station #2. Looking downstream from as-built Station ~49+30.

Photo Station #3. Looking downstream from as-built Station ~47+90.

Photo Station #4. Looking downstream from as-built Station ~44+00. Oxbow wetland in foreground.

Photo Station #5. Looking downstream from as-built Station ~41+25.

Photo Station #6. Looking downstream from as-built Station ~38+00.

Photo Station #7. Looking downstream from as-built Station ~36+10.

Photo Station #8. Looking downstream from as-built Station ~35+15.

Photo Station #9. Looking downstream from as-built Station ~31+10 near gravel roadway.

Photo Station #10. Looking downstream from as-built Station ~28+25.

Photo Station #11. Looking downstream from as-built Station ~25+85.

Photo Station #12. Looking downstream from as-built Station ~24+50.

Photographs from Monumented Photo Stations #1 through #22
Brown Branch Stream Restoration
Post-Construction Photographs taken January 2003

Photo Station #13. Looking downstream from as-built Station ~22+20.

Photo Station #14. Looking downstream from as-built Station ~20+70. Small tributary confluence to left.

Photo Station #15. Looking downstream from as-built Station ~17+75.

Photo Station #16. Looking downstream from as-built Station ~14+25.

Photo Station #17. Looking downstream from as-built Station ~12+50. Tributary confluence to left.

Photo Station #18. Looking downstream from as-built Station ~10+05.

Photo Station #19. Looking downstream from as-built Station ~8+30.

Photo Station #20. Looking downstream from as-built Station ~5+05.

Photo Station #21. Looking downstream from as-built Station ~3+25.

Photo Station #22. Looking downstream from as-built Station 1+60.

Photographs from Non-Monumented Locations
Brown Branch Stream Restoration
Post-Construction Photographs taken January 2003

Photograph NM-1. Looking upstream at cross vane from as-built Station ~51+00.

Photograph NM-2. Looking downstream at rootwads and log toe protection from as-built Station ~51+00.

Photograph NM-3. Looking downstream at rootwads and log toe protection from as-built Station ~49+25.

Photograph NM-4. Looking upstream at buried log vane from as-built Station ~49+25.

Photograph NM-5. Looking upstream at log vane from as-built Station ~48+25.

Photograph NM-6. Looking downstream at log vane from as-built Station ~47+25.

Photographs from Non-Monumented Locations
Brown Branch Stream Restoration
Post-Construction Photographs taken January 2003

Photograph NM-7. Looking upstream at cross vane from as-built Station ~44+80.

Photograph NM-8. Looking downstream at rootwad and rock toe protection from pedestrian bridge at as-built Station ~44+60.

Photograph NM-9. Looking downstream at rootwads and rock toe protection from as-built Station ~43+80.

Photograph NM-10. View of oxbow wetland from as-built Station ~43+40.

Photograph NM-11. Looking down outlet channel draining oxbow wetland into mainstem channel, at as-built Station ~43+40.

Photograph NM-12. Looking upstream at cross vane from as-built Station ~42+50.

Photographs from Non-Monumented Locations
Brown Branch Stream Restoration
Post-Construction Photographs taken January 2003

Photograph NM-13. Looking downstream at rootwad/log "J" vane from as-built Station ~42+25.

Photograph NM-14. Looking downstream at log vane at as-built Station ~41+50.

Photograph NM-15. Looking up tributary at confluence with Brown Branch, as-built Station ~41+00.

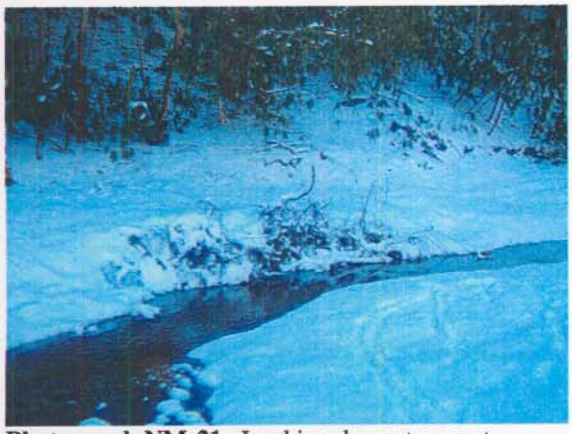
Photograph NM-16. Looking downstream at rock toe protection along opposite bank, view from as-built Station ~41+00.

Photograph NM-17. Looking downstream at rock vane, rootwads, and log toe protection from as-built Station ~39+75.

Photograph NM-18. Looking downstream at log vane and rootwads from as-built Station 37+75.

Photograph NM-19. Looking upstream at log vane from as-built Station ~37+50.

Photograph NM-20. Looking downstream at log vane, rootwad, and log toe protection from as-built Station ~36+25.



Photograph NM-21. Looking downstream at rootwads from as-built Station ~35+00.

Photograph NM-22. Looking downstream at log vane and log toe protection from as-built Station ~34+00.

Photograph NM-23. Looking upstream at log toe protection from as-built Station ~32+50.

Photograph NM-24. Looking downstream at rock toe protection from as-built Station ~32+00.

Photograph NM-25. Looking downstream at log toe protection from as-built Station ~31+00.

Photograph NM-26. Looking downstream at log toe protection from as-built Station ~30+85.

Photograph NM-27. Looking downstream at rootwad and log toe protection from as-built Station ~ 30+50.

Photograph NM-28. Looking upstream at log vane from as-built Station ~28+10.

Photograph NM-29. Looking downstream at log toe protection and rootwad from as-built Station ~27+25.

Photograph NM-30. Looking upstream at log vane and rock toe protection from as-built Station ~24+60.

Photograph NM-31. Looking downstream at log vane and rootwads from as-built Station 24+60.

Photograph NM-32. Looking downstream at log vane from as-built Station ~23+30.

Photograph NM-33. Looking upstream at rock toe protection from as-built Station ~23+00.

Photograph NM-34. Looking downstream at rootwad and rootwad/log "J" vane from as-built Station ~22+50.

Photograph NM-35. Looking upstream at cross vane from as-built Station ~20+50.

Photograph NM-36. Looking upstream at rootwads and rock toe protection from as-built Station ~20+00.

Photograph NM-37. Looking downstream at log toe protection and log vane from Station ~19+70.

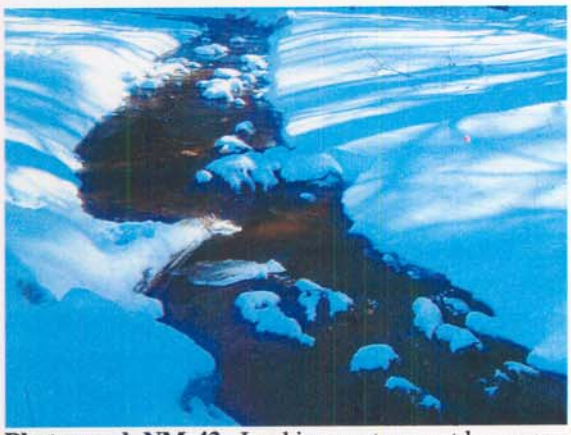
Photograph NM-38. Looking downstream at rock toe protection from as-built Station ~19+00.

Photograph NM-39. Looking downstream at log vane and rootwad from as-built Station ~17+75.

Photograph NM-40. Looking upstream at rock "J" vane from as-built Station ~16+00.

Photograph NM-41. Looking upstream at rock toe protection from as-built Station ~14+50.

Photograph NM-42. Looking downstream at log vane from as-built Station ~14+25.



Photograph NM-43. Looking upstream at log vane from as-built Station ~14+00.

Photograph NM-44. Looking upstream at log vane from as-built Station ~12+75.

Photograph NM-45. Looking upstream into tributary that joins Brown Branch at as-built Station ~12+50.

Photograph NM-46. Looking downstream at rootwads from as-built Station ~12+25.

Photograph NM-47. Looking downstream at rock cross vane from as-built Station ~11+30.

Photograph NM-48. Looking downstream at rock "J" vane from as-built Station ~10+25.

Photograph NM-49. Looking downstream at rootwads and rock vane from as-built Station ~10+00.

Photograph NM-50. Looking downstream at rock vane and rootwads from as-built Station ~9+50.

Photograph NM-51. Looking downstream at cross vane and rootwads from as-built Station ~9+00.

Photograph NM-52. Looking upstream at rock vane and rootwads from as-built Station ~8+75.

Photograph NM-53. Looking north across wetland near as-built Station ~8+00.

Photograph NM-54. Looking west across wetland near as-built Station ~8+00.

Photographs from Non-Monumented Locations
Brown Branch Stream Restoration
Post-Construction Photographs taken January 2003

Photograph NM-55. Looking downstream at rootwads from as-built Station ~8+50.

Photograph NM-56. Looking downstream along riffle from as-built Station ~8+00.

Photograph NM-57. Looking upstream at log vane from as-built Station ~7+00.

Photograph NM-58. Looking downstream at rock "J" vane from as-built Station ~6+80.

Photograph NM-59. Looking upstream at rock "J" vane from as-built Station ~6+80.

Photograph NM-60. Looking upstream at rock "J" vane and wetland from as-built Station ~ 6+50.

Photograph NM-61. Looking downstream at rootwads and rock toe protection from as-built Station ~6+50.

Photograph NM-62. Looking downstream at rock "J" vane, rock toe protection, and rootwad from as-built Station ~5+50.

Photograph NM-63. Looking upstream at rock "J" vane from as-built Station ~5+25.

Photograph NM-64. Looking downstream at log toe protection and rootwad from as-built Station ~5+25.

Photograph NM-65. Looking upstream at log toe protection, rootwad, and rock vane from as-built Station ~4+50.

Photograph NM-66. Looking upstream at cross vane from as-built Station ~4+00.

Photograph NM-67. Looking downstream at rootwad from as-built Station ~4+00.

Photograph NM-68. Looking upstream at rock "J" vane from as-built Station ~3+25.

Photograph NM-69. Looking downstream at rock "J"vane from as-built Station ~3+25.

Photograph NM-70. Looking upstream from as-built Station ~2+75.

Photograph NM-71. Looking downstream at rock vane from as-built Station ~2+75.

Photograph NM-72. Looking upstream at rock "J" vane from as-built Station ~2+00.

Photograph NM-73. Looking downstream at rock "J" vane and rootwad from as-built Station ~1+00.

Photograph NM-74. Looking upstream at rock "J" vane from as-built Station ~0+85.

Photograph NM-75. Looking upstream at rock vane and rootwad from as-built Station ~0+65.

Appendix F
VEGETATION PLOTS

Project: Brown Branch Stream Restoration
Monitoring Year: Post-Planting, Year 0
Sampling Date: 4 Feb 2003
Vegetation Plot: #1
Plot Size: 1/10 acre

BASELINE CONDITIONS, VEGETATION PLOT #1

Tree Species		Planting Plan Strata (or Volunteer)	# of Trees															TOTAL
			Saplings	2-5.9" dbh			6-11.9" dbh			12-19.9" dbh			20-29.9" dbh			>30" dbh			
Scientific Name	Common Name	Crown Position*	N/A	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	
Acer rubrum	Red maple	Tree	1																1
Amelanchier arborea	Downy serviceberry	Midstory Tree																	0
Betula lenta	Sweet birch	Midstory Tree																	0
Betula nigra	River birch	Midstory Tree	5																5
Carpinus caroliniana	Ironwood	Midstory Tree	2			4			2										8
Carya sp.	Hickory	Volunteer	4								1								5
Chionanthus virginicus	Fringetree	Midstory Tree																	0
Cornus florida	Flowering dogwood	Midstory Tree																	0
Fraxinus americana	White ash	Tree	1																1
Fraxinus pennsylvanica	Green ash	Tree	4																4
Liriodendron tulipifera	Tulip poplar	Tree	1																1
Nyssa sylvatica	Black gum	Tree	3																3
Platanus occidentalis	American sycamore	Tree						2											2
Prunus serotina	Black cherry	Tree	7																7
Quercus falcata	Southern red oak	Tree	3																3
Quercus pagoda	Cherrybark oak	Tree	5																5
TOTAL			36	4			4			1			0			0			45

*(N/A= Not applicable, D= Dominant, CoD= Co-Dominant, O= Other)

NET TREE DENSITY= 450 trees/acre

NOTES:
1) This sample plot includes some portions of Planting Zones 4 (scrub shrub wetland), 5 (vernal pool), and 6 (native grassland), which do not include planted trees. Therefore, tree densities may be slightly lower in this plot than in the overall project area.
2) A small number of plants were installed after this sampling occurred, so actual densities may be slightly higher than shown.
3) Where sufficient visual clues were not available to differentiate species, trees were identified to the Genus level.

Project: Brown Branch Stream Restoration
Monitoring Year: Post-Planting, Year 0
Sampling Date: 4 Feb 2003
Vegetation Plot: #2
Plot Size: 1/10 acre

BASELINE CONDITIONS, VEGETATION PLOT #2

Tree Species		Planting Plan Strata (or Volunteer)	# of Trees																TOTAL
			Saplings	2-5.9" dbh			6-11.9" dbh			12-19.9" dbh			20-29.9" dbh			>30" dbh			
Scientific Name	Common Name	Crown Position*	N/A	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	
Acer rubrum	Red maple	Tree	4																4
Amelanchier arborea	Downy serviceberry	Midstory Tree																	0
Betula lenta	Sweet birch	Midstory Tree	8																8
Betula nigra	River birch	Midstory Tree																	0
Carpinus caroliniana	Ironwood	Midstory Tree	7																7
Carya sp.	Hickory	Volunteer																	0
Chionanthus virginicus	Fringetree	Midstory Tree																	0
Cornus florida	Flowering dogwood	Midstory Tree	13																13
Fraxinus americana	White ash	Tree	10																10
Fraxinus pennsylvanica	Green ash	Tree																	0
Liriodendron tulipifera	Tulip poplar	Tree	5																5
Nyssa sylvatica	Black gum	Tree																	0
Platanus occidentalis	American sycamore	Tree																	0
Prunus serotina	Black cherry	Tree																	0
Quercus falcata	Southern red oak	Tree	7																7
Quercus pagoda	Cherrybark oak	Tree																	0
TOTAL			54	0			0			0			0			0			54

*(N/A= Not applicable, D= Dominant, CoD= Co-Dominant, O= Other)

NET TREE DENSITY= 540 trees/acre

NOTES: 1) A small number of plants were installed after this sampling, so actual densities may be slightly higher than shown.
2) Where sufficient visual clues were not available to differentiate species, trees were identified to the Genus level.

Project: Brown Branch Stream Restoration
Monitoring Year: Post-Planting, Year 0
Sampling Date: 4 Feb 2003
Vegetation Plot: #3
Plot Size: 1/10 acre

BASELINE CONDITIONS, VEGETATION PLOT #3

Tree Species		Planting Plan Strata (or Volunteer)	# of Trees															TOTAL
			Saplings	2-5.9" dbh			6-11.9" dbh			12-19.9" dbh			20-29.9" dbh			>30" dbh			
Scientific Name	Common Name	Crown Position*	N/A	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	
Acer rubrum	Red maple	Tree	7			1													8
Amelanchier arborea	Downy serviceberry	Midstory Tree																	0
Betula lenta	Sweet birch	Midstory Tree	7					1			1								9
Betula nigra	River birch	Midstory Tree	6								1								7
Carpinus caroliniana	Ironwood	Midstory Tree																	0
Carya sp.	Hickory	Volunteer									2								2
Chionanthus virginicus	Fringetree	Midstory Tree																	0
Cornus florida	Flowering dogwood	Midstory Tree	4																4
Fraxinus americana	White ash	Tree	2																2
Fraxinus pennsylvanica	Green ash	Tree																	0
Liriodendron tulipifera	Tulip poplar	Tree																	0
Nyssa sylvatica	Black gum	Tree																	0
Platanus occidentalis	American sycamore	Tree																	0
Prunus serotina	Black cherry	Tree																	0
Quercus falcata	Southern red oak	Tree	13																13
Quercus pagoda	Cherrybark oak	Tree																	0
Tsuga canadensis	Eastern hemlock	Volunteer	14			4					1								19
TOTAL			53	1			1			4			0			0			59

*(N/A= Not applicable, D= Dominant, CoD= Co-Dominant, O= Other)

NET TREE DENSITY= 590 trees/acre

NOTES:
1) This sample plot includes some portions of Planting Zones 4 (scrub shrub wetland), 5 (vernal pool), and 6 (native grassland), which do not include planted trees. Therefore, tree densities may be slightly lower in this plot than in the overall project area.
2) A small number of plants were installed after this sampling, so actual densities may be slightly higher than shown.
3) Where sufficient visual clues were not available to differentiate species, trees were identified to the Genus level.

Project: Brown Branch Stream Restoration
Monitoring Year: Post-Planting, Year 0
Sampling Date: 4 Feb 2003
Vegetation Plot: #4
Plot Size: 1/10 acre

BASELINE CONDITIONS, VEGETATION PLOT #4

Tree Species		Planting Plan Strata (or Volunteer)	# of Trees															TOTAL
			Saplings	2-5.9" dbh			6-11.9" dbh			12-19.9" dbh			20-29.9" dbh			>30" dbh			
Scientific Name	Common Name	Crown Position*	N/A	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	
Acer rubrum	Red maple	Tree	4																4
Amelanchier arborea	Downy serviceberry	Midstory Tree																	0
Betula lenta	Sweet birch	Midstory Tree																	0
Betula nigra	River birch	Midstory Tree																	0
Carpinus caroliniana	Ironwood	Midstory Tree	2																2
Carya sp.	Hickory	Volunteer																	0
Chionanthus virginicus	Fringetree	Midstory Tree	1																1
Cornus florida	Flowering dogwood	Midstory Tree	2																2
Fraxinus americana	White ash	Tree	5																5
Fraxinus pennsylvanica	Green ash	Tree																	0
Liriodendron tulipifera	Tulip poplar	Tree	2																2
Nyssa sylvatica	Black gum	Tree	1																1
Platanus occidentalis	American sycamore	Tree																	0
Prunus serotina	Black cherry	Tree																	0
Quercus falcata	Southern red oak	Tree	4																4
Quercus pagoda	Cherrybark oak	Tree																	0
TOTAL			21	0			0			0			0			0			21

*(N/A= Not applicable, D= Dominant, CoD= Co-Dominant, O= Other)

NET TREE DENSITY= 210 trees/acre

NOTES: 1) A small number of plants were installed after this sampling, so actual densities may be slightly higher than shown.
2) Where sufficient visual clues were not available to differentiate species, trees were identified to the Genus level.

Project: Brown Branch Stream Restoration
Monitoring Year: Post-Planting, Year 0
Sampling Date: 4 Feb 2003
Vegetation Plot: #5
Plot Size: 1/10 acre

BASELINE CONDITIONS, VEGETATION PLOT #5

Tree Species		Planting Plan Strata (or Volunteer)	# of Trees															TOTAL
			Saplings	2-5.9" dbh			6-11.9" dbh			12-19.9" dbh			20-29.9" dbh			>30" dbh			
Scientific Name	Common Name	Crown Position*	N/A	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	
Acer rubrum	Red maple	Tree	1																1
Amelanchier arborea	Downy serviceberry	Midstory Tree																	0
Betula lenta	Sweet birch	Midstory Tree	3																3
Betula nigra	River birch	Midstory Tree																	0
Carpinus caroliniana	Ironwood	Midstory Tree																	0
Carya sp.	Hickory	Volunteer																	0
Chionanthus virginicus	Fringetree	Midstory Tree	4																4
Cornus florida	Flowering dogwood	Midstory Tree	2																2
Fraxinus americana	White ash	Tree																	0
Fraxinus pennsylvanica	Green ash	Tree																	0
Liriodendron tulipifera	Tulip poplar	Tree									2			3			1		6
Nyssa sylvatica	Black gum	Tree																	0
Platanus occidentalis	American sycamore	Tree																	0
Prunus serotina	Black cherry	Tree	1																1
Quercus falcata	Southern red oak	Tree	1																1
Quercus pagoda	Cherrybark oak	Tree																	0
TOTAL			12	0			0			2			3			1			18

*(N/A= Not applicable, D= Dominant, CoD= Co-Dominant, O= Other)

NET TREE DENSITY= 180 trees/acre

NOTES:
1) This sample plot includes some portions of Planting Zones 4 (scrub shrub wetland), 5 (vernal pool), and 6 (native grassland), which do not include planted trees. Therefore, tree densities may be slightly lower in this plot than in the overall project area.
2) A small number of plants were installed after this sampling, so actual densities may be slightly higher than shown.
3) Where sufficient visual clues were not available to differentiate species, trees were identified to the Genus level.

Project: Brown Branch Stream Restoration
Monitoring Year: Post-Planting, Year 0
Sampling Date: 4 Feb 2003
Vegetation Plot: #6
Plot Size: 1/10 acre

BASELINE CONDITIONS, VEGETATION PLOT #6

Tree Species		Planting Plan Strata (or Volunteer)	# of Trees																TOTAL
			Saplings	2-5.9" dbh			6-11.9" dbh			12-19.9" dbh			20-29.9" dbh			>30" dbh			
Scientific Name	Common Name	Crown Position*	N/A	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	
Acer rubrum	Red maple	Tree	3																3
Amelanchier arborea	Downy serviceberry	Midstory Tree																	0
Betula lenta	Sweet birch	Midstory Tree																	0
Betula nigra	River birch	Midstory Tree	1																1
Carpinus caroliniana	Ironwood	Midstory Tree	2																2
Carya sp.	Hickory	Volunteer																	0
Chionanthus virginicus	Fringetree	Midstory Tree																	0
Cornus florida	Flowering dogwood	Midstory Tree	1																1
Fraxinus americana	White ash	Tree																	0
Fraxinus pennsylvanica	Green ash	Tree	5																5
Liriodendron tulipifera	Tulip poplar	Tree																	0
Nyssa sylvatica	Black gum	Tree																	0
Platanus occidentalis	American sycamore	Tree (+Volunteers)	50			5													55
Prunus serotina	Black cherry	Tree																	0
Quercus falcata	Southern red oak	Tree																	0
Quercus pagoda	Cherrybark oak	Tree																	0
TOTAL			62	5			0			0			0			0			67

*(N/A= Not applicable, D= Dominant, CoD= Co-Dominant, O= Other)

NET TREE DENSITY= 670 trees/acre

NOTES:
1) This sample plot includes some portions of Planting Zones 4 (scrub shrub wetland), 5 (vernal pool), and 6 (native grassland), which do not include planted trees. Therefore, tree densities may be slightly lower in this plot than in the overall project area.
2) A small number of plants were installed after this sampling, so actual densities may be slightly higher than shown.
3) Where sufficient visual clues were not available to differentiate species, trees were identified to the Genus level.

Project: Brown Branch Stream Restoration
Monitoring Year: Post-Planting, Year 0
Sampling Date: 4 Feb 2003
Vegetation Plot: #7
Plot Size: 1/10 acre

BASELINE CONDITIONS, VEGETATION PLOT #7

Tree Species		Planting Plan Strata (or Volunteer)	# of Trees																TOTAL
			Saplings	2-5.9" dbh			6-11.9" dbh			12-19.9" dbh			20-29.9" dbh			>30" dbh			
Scientific Name	Common Name	Crown Position*	N/A	D	C	O	D	C	O	D	C	O	D	C	O	D	C	O	
Acer rubrum	Red maple	Tree																	0
Amelanchier arborea	Downy serviceberry	Midstory Tree																	0
Betula lenta	Sweet birch	Midstory Tree																	0
Betula nigra	River birch	Midstory Tree	3																3
Carpinus caroliniana	Ironwood	Midstory Tree																	0
Carya sp.	Hickory	Volunteer																	0
Chionanthus virginicus	Fringetree	Midstory Tree																	0
Cornus florida	Flowering dogwood	Midstory Tree																	0
Fraxinus americana	White ash	Tree																	0
Fraxinus pennsylvanica	Green ash	Tree																	0
Liriodendron tulipifera	Tulip poplar	Tree																	0
Nyssa sylvatica	Black gum	Tree																	0
Platanus occidentalis	American sycamore	Tree	2																2
Prunus serotina	Black cherry	Tree	1																1
Quercus falcata	Southern red oak	Tree																	0
Quercus pagoda	Cherrybark oak	Tree	3																3
TOTAL			9	0			0			0			0			0			9

*(N/A= Not applicable, D= Dominant, CoD= Co-Dominant, O= Other)

NET TREE DENSITY= 90 trees/acre

NOTES: 1) A small number of plants were installed after this sampling, so actual densities may be slightly higher than shown.
2) Where sufficient visual clues were not available to differentiate species, trees were identified to the Genus level.

Project: Brown Branch Stream Restoration
Monitoring Year: Post-Planting, Year 0
Sampling Date: 4 Feb 2003

SUMMARY OF MEASURED TREE DENSITIES BASELINE MONITORING			
Vegetation Transect Number	**Plot Size**	**Stems/ 0.1 Acre**	**Stems/ Acre**
1	1/10 ac	45	450
2	1/10 ac	54	540
3	1/10 ac	59	590
4	1/10 ac	21	210
5	1/10 ac	18	180
6	1/10 ac	67	670
7	1/10 ac	9	90
Current Average Tree Stems/Acre =			**390**
Required Tree Density After 5 Years =			**320**
CONCLUSION: ***This project currently meets tree density requirements.***			

Appendix G
PLANTING SCHEDULES

BROWN BRANCH STREAM RESTORATION
AS-BUILT PLANT AND COMPOSITION SCHEDULE

Zone 1: Riparian Woodlands - Mesic

Size (acres): 3.54

Quantity per acre	Frequency (%)	Species Quantity	Vegetation Strata/ Species Name	Common Name	Unit	Size	Spacing Type
466			**TREES**				
	15	250	Acer rubrum	Red maple	Bare root	Whip	Random
	21	350	Fraxinus americana	White ash	Bare root	Whip	Random
	24	400	Liriodendron tulipifera	Tulip poplar	Bare root	Whip	Random
	24	400	Prunus serotina	Black cherry	Bare root	Whip	Random
	15	250	Quercus falcata	Southern red oak	Bare root	Whip	Random
	100	**1650**	**= Total**				
212			**MIDSTORY TREES**				
	33	250	Chionanthus virginicus	Fringetree	Bare root	Whip	Random
	33	250	Cornus florida	Flowering dogwood	Bare root	Whip	Random
	33	250	Ostrya virginiana	American hophornbeam	Bare root	Whip	Random
	100	**750**	**= Total**				
169			**SHRUBS and VINES**				
	42	250	Hydrangea arborescens	Wild hydrangea	Bare root	Whip	Random
	58	350	Viburnum dentatum	Southern arrowwood	Bare root	Whip	Random
	100	**600**	**= Total**				
40			**HERBACEOUS SEED**				
	15	21.2	Eragrostis spectabilis	Purple lovegrass	LB-76% P.L.S.	N/A	Seed
	20	28.3	Elymus canadensis	Canada wild rye	LB-76% P.L.S.	N/A	Seed
	25	35.4	Lolium multiflorum	Annual rye	LB-76% P.L.S.	N/A	Seed
	5	7.1	Rudbeckia hirta	Black-eyed Susan	LB-76% P.L.S.	N/A	Seed
	20	28.3	Schizachyrium scoparium	Little bluestem	LB-76% P.L.S.	N/A	Seed
	15	21.2	Tridens flavus	Purpletop	LB-76% P.L.S.	N/A	Seed
	100	**141.6**	**= Total**				

P.L.S.=Pure Live Seed

BROWN BRANCH STREAM RESTORATION
AS-BUILT PLANT AND COMPOSITION SCHEDULE

Zone 2: Riparian Woodlands - Lower Floodplain — Size (acres): 3.25

Quantity per acre	Frequency (%)	Species Quantity	Vegetation Strata/ Species Name	Common Name	Unit	Size	Spacing Type
469			**TREES**				
	20	300	Acer rubrum	Red maple	Bare root	Whip	Random
	20	300	Fraxinus pennsylvanica	Green ash	Bare root	Whip	Random
	26	400	Nyssa sylvatica	Black gum	Bare root	Whip	Random
	20	300	Platanus occidentalis	American sycamore	Bare root	Whip	Random
	15	225	Quercus pagoda	Cherrybark oak	Bare root	Whip	Random
	100	**1525**	**= Total**				
185			**MIDSTORY TREES**				
	58	350	Betula nigra	River birch	Bare root	Whip	Random
	42	250	Carpinus caroliniana	Ironwood	Bare root	Whip	Random
	100	**600**	**= Total**				
277			**SHRUBS and VINES**				
	17	150	Cornus amomum	Silky dogwood	Bare root	Seedling	Random
	17	150	Hamamelis virginiana	Common witch hazel	Bare root	Seedling	Random
	22	200	Itea virginica	Virginia sweespire	Bare root	Seedling	Random
	28	250	Lindera bezoin	Spicebush	Bare root	Seedling	Random
	17	150	Vaccinium corymbosum	Highbush blueberry	Bare root	Seedling	Random
	100	**900**	**= Total**				
30			**HERBACEOUS SEED**				
	3	2.9	Carex crinita	Fringed sedge	LB-76% P.L.S.	N/A	Seed
	25	24.4	Dichanthelium clandestinum	Deertongue grass	LB-76% P.L.S.	N/A	Seed
	25	24.4	Elymus virginicus	Virginia wild rye	LB-76% P.L.S.	N/A	Seed
	25	24.4	Lolium multiflorum	Annual rye	LB-76% P.L.S.	N/A	Seed
	20	19.5	Panicum virgatum	Switchgrass	LB-76% P.L.S.	N/A	Seed
	2	2.0	Vernonia noveboracensis	New York ironweed	LB-76% P.L.S.	N/A	Seed
	100	**97.5**	**= Total**				

P.L.S.=Pure Live Seed

BROWN BRANCH STREAM RESTORATION
AS-BUILT PLANT AND COMPOSITION SCHEDULE

Zone 3: Lower Floodplain - Meander Buffer

Size (acres): 0.69

Quantity per acre	Frequency (%)	Species Quantity	Vegetation Strata/ Species Name	Common Name	Unit	Size	Spacing Type
906			**TREES**				
	32	200	Acer rubrum	Red maple	Bare root	Whip	Random
	16	100	Fraxinus pennsylvanica	Green ash	Bare root	Whip	Random
	24	150	Nyssa sylvatica	Black gum	Bare root	Whip	Random
	16	100	Platanus occidentalis	American sycamore	Bare root	Whip	Random
	12	75	Quercus pagoda	Cherrybark oak	Bare root	Whip	Random
	100	**625**	**= Total**				
507			**MIDSTORY TREES**				
	57	200	Betual nigra	River birch	Bare root	Whip	Random
	43	150	Carpinus caroliniana	Ironwood	Bare root	Whip	Random
	100	**350**	**= Total**				
1123			**SHRUBS and VINES**				
	26	200	Cornus amomum	Silky dogwood	Bare root	Seedling	Random
	13	100	Hamamelis virginiana	American witch hazel	Bare root	Seedling	Random
	26	200	Itea virginica	Virginia sweetspire	Bare root	Seedling	Random
	19	150	Lindera bezoin	Spicebush	Bare root	Seedling	Random
	16	125	Vaccinium corymbosum	Highbush blueberry	Bare root	Seedling	Random
	100	**775**	**= Total**				
40			**HERBACEOUS SEED**				
	3	0.8	Carex crinita	Fringed sedge	LB-76% P.L.S.	N/A	Seed
	25	6.9	Dichanthelium clandestin	Deertongue grass	LB-76% P.L.S.	N/A	Seed
	25	6.9	Elymus virginicus	Virginia wild rye	LB-76% P.L.S.	N/A	Seed
	25	6.9	Lolium multiflorum	Annual rye	LB-76% P.L.S.	N/A	Seed
	20	5.5	Panicum virgatum	Switchgrass	LB-76% P.L.S.	N/A	Seed
	2	0.6	Vernonia noveboracensis	New York ironweed	LB-76% P.L.S.	N/A	Seed
	100	**27.6**	**= Total**				

P.L.S.=Pure Live Seed

BROWN BRANCH STREAM RESTORATION
AS-BUILT PLANT AND COMPOSITION SCHEDULE

Zone 4: Scrub-Shrub Wetland

Size (acres): 0.39

Quantity per acre	Frequency (%)	Species Quantity	Vegetation Strata/ Species Name	Common Name	Unit	Size	Spacing Type
756			**SHRUBS**				
	34	100	Cornus amomum	Silky dogwood	Bare root	Seedling	Random
	32	95	Rosa palustris	Swamp rose	Bare root	Seedling	Random
	34	100	Sambucus canadensis	Common elderberry	Bare root	Seedling	Random
	100	**295**	**= Total**				
30			**HERBACEOUS SEED**				
	20	2.3	Andropogon glomeratus	Bushy beardgrass	LB-76% P.L.S.	N/A	Seed
	8	0.9	Carex crinita	Fringed sedge	LB-76% P.L.S.	N/A	Seed
	25	2.9	Dichanthelium clandestinum	Deertongue grass	LB-76% P.L.S.	N/A	Seed
	20	2.3	Glyceria striata	Fowl mannagrass	LB-76% P.L.S.	N/A	Seed
	2	0.2	Lobelia cardinalis	Cardinal flower	LB-76% P.L.S.	N/A	Seed
	25	2.9	Panicum virgatum	Switchgrass	LB-76% P.L.S.	N/A	Seed
	100	**11.7**	**= Total**				

P.L.S.=Pure Live Seed

BROWN BRANCH STREAM RESTORATION
AS-BUILT PLANT AND COMPOSITION SCHEDULE

Zone 5: Vernal Pool - Emergent

Size (acres): 0.04

Quantity per acre	Frequency (%)	Species Quantity	Vegetation Strata/ Species Name	Common Name	Unit	Size	Spacing Type
2625			**SHRUBS**				
	95	100	Cephalanthus occidentalis	Buttonbush	Bare Root	Seedling	Random
	5	5	Rosa palustris	Swamp rose	Bare Root	Seedling	Random
	100	**105**	**= Total**				
4840			**HERBACEOUS**				
	10	19	Carex stricta	Tussock sedge	CON	Plug	Random
	15	29	Iris versicolor	Blue flag	CON	Plug	Random
	20	39	Juncus effusus	Softrush	CON	Plug	Random
	15	29	Peltandra virginica	Arrow arum	CON	Plug	Random
	20	39	Saururus cernuus	Lizard tail	CON	Plug	Random
	20	39	Scirpus validus	Softstem bulrush	CON	Plug	Random
	100	**194**	**= Total**				

CON=container
P.L.S.=Pure Live Seed

BROWN BRANCH STREAM RESTORATION
AS-BUILT PLANT AND COMPOSITION SCHEDULE

Zone 6: Native Grassland

Size (acres): 5.50

Quantity per acre	Frequency (%)	Species Quantity	Vegetation Strata/ Species Name	Common Name	Unit	Size	Spacing Type
30			**HERBACEOUS SEED**				
	25	41.30	Andropogon gerardii	Big bluestem	LB-76% P.L.S.	N/A	Seed
	15	24.80	Elymus canadensis	Canada wild rye	LB-76% P.L.S.	N/A	Seed
	10	16.50	Panicum virgatum	Switchgrass	LB-76% P.L.S.	N/A	Seed
	5	8.30	Rudbeckia hirta	Black-eyed Susan	LB-76% P.L.S.	N/A	Seed
	25	41.30	Schizchyrium scoparium	Little bluestem	LB-76% P.L.S.	N/A	Seed
	20	33.00	Sorghastrum nutans	Indiangrass	LB-76% P.L.S.	N/A	Seed
	100	**165.00**	**= Total**				

P.L.S.=Pure Live Seed