

Stricker Branch Stream Restoration Project

Contract #: D06054-G
County: Cabarrus
Cataloging Unit: Yadkin 03040105
Monitoring Firm POC: Mid-Atlantic Mitigation, LLC
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Mitigation Report



March 14th, 2008 (Revised April 14th, 2008)



Kimley-Horn
and Associates, Inc.



Mid - Atlantic
Mitigation, LLC
AN EARTHMARK COMPANY

EXECUTIVE SUMMARY

Pre-Construction Site Conditions

The Stricker Branch Stream Restoration Site (Stricker Branch Site) is located in the City of Concord, Cabarrus County, North Carolina on McGill Avenue next to the Gibson Mill redevelopment project on Highway 29. The project site is located in the HUC 03040105 and in the urbanized EEP Targeted Watershed 03040105020040. The Site consisted of a highly unstable, incised and straightened stream channel – except for the upper third of the project area, which was historically an impounded water supply for the former textile mill. This former textile mill has been purchased for redevelopment into a mixed use commercial and residential project, now known as Gibson Mill. The remaining stream on the mill property was a highly altered, degraded, and entrenched channel with almost no woody vegetation. Below Sign Drive, the stream was deeply entrenched/incised and highly unstable with strong visible evidence of actively failing banks. This area was sparsely wooded and contained invasive species such as Chinese Privet.

The project watershed is approximately 1.6 sq. mi. flowing into Irish Buffalo Creek, a 303(d)-listed stream.

Restoration Goals and Approach

The objective of the restoration approach was to restore the site to a naturally functioning stream system designed to address impairment issues typically associated with highly disturbed urban stream systems.

- The project will provide ecological, functional lift to the existing system by restoring the stream and riparian habitat to a stable stream type and vegetative community that is appropriate for its particular valley and watershed conditions.
- Water quality will be improved by reduced sediment load through stabilization, and nutrient and other pollutant input will be reduced through the addition of forested riparian buffers planted with native species.
- Forested buffers and reconnection with an active floodplain bench will improve channel hydraulics and system capacity.
- Improvements to the ecosystem include the addition of in-stream habitat using in-stream structures and bank revetments such as root wads and log vanes.
- By providing an appropriate mix of native forest vegetation to create an appropriate canopy and under story, the soil structure will improve, leaf litter will be established to support aquatic and terrestrial ecosystems, and shading and cooling will provide improved water quality.

Together, these improvements will provide functional uplift for the watershed as a whole.

The dimension, pattern, and profile were restored using Rosgen Priority I and II natural channel design techniques, which stabilized the banks and added flood storage and habitat diversity. The objective of using these techniques was:

- To create a stable bank full dimension and allow greater than bank full storm events to access the floodplain.

- To create a pattern that is appropriate and stable for the given stream and valley types.
- Stream profile was adjusted to decrease the slope by adding length. This improves the channel's ability to handle the sediment load without aggrading or degrading.
- The plan also incorporates the use of storm water BMPs located both outside and inside the conservation easement to attenuate and treat runoff from the surrounding development.

The stream restoration project and associated conservation easement are surrounded by a larger project involving the redevelopment of the old mill by South Paw Investors. The stream buffer design will help control access to the restored channel while allowing for some passive public access and visibility to the restored channel. A water quality detention pond located at the upstream end of the project site was constructed in conjunction with the stream restoration efforts. South Paw Investors will be responsible for the pond and its associated maintenance.

Stricker Branch was designed using Priority I restoration in the old pond bed and Priority II restoration for all existing stream channel. All designed channels are Rosgen C4/5.

Table 1. Timeline of Construction Sequences

EVENT	DATE
<p>Phase 1:</p> <ul style="list-style-type: none"> ~ Removal of concrete spillway and drainage of mill pond ~ 2000' of priority 1 restoration with grade control structures and BMP installation ~ Dewater lake bed ~ Bare root planting below Sign Drive ~ Temporary/permanent seeding below Sign Drive ~ Containerized planting below Sign Drive ~ Livestake new channel below Sign Drive 	<ul style="list-style-type: none"> April 2007 April 2007 to August 2007 April 2007 to November 2007 June 2007 April 2007 to November 2007 October 2007 June 2007 to October 2007
<p>Phase 2:</p> <ul style="list-style-type: none"> ~ 1000' of priority 2 restoration and BMP installation ~ Livestake new channel ~ Temporary/permanent seeding ~ Containerized planting ~ As-Built survey 	<ul style="list-style-type: none"> October 2007 to January 2008 November 2007 to February 2008 December 2007 to February 2008 January 2008 to February 2008 February 2008

Post Construction Site Conditions

The project is divided into three sections, the Lower Section below Sign Drive, the Middle Section between Sign Drive and the old pond spillway, and the Upper Section which includes the relic pond area.

Upper Section: The concrete spillway of the mill pond was removed and the remaining water drained from the pond. Priority I restoration was done on this section. There is a rip rap spillway between the storm water BMP pond outside of the easement and the new channel. Work on the pond area was completed in January 2008, completing the project.

Middle Section: Priority II stream restoration was done in this section. There are two rip rap areas protecting storm water out fall pipes. There is also a sewer line crossing upstream of the culvert and bridge at Sign Drive with two A-vane, step pool structures in this area, which are not part of the conservation easement or restoration. A runoff swale was incorporated as a storm water feature by digging a shallow channel for the runoff to enter the stream, which was then protected with matting, seeding and live stakes.

Lower Section: Work below Sign Drive was completed first, with completion in August of 2007. This section of the project has had ample time to stabilize and has already held up well through several bank full events. Priority II restoration was done in this section, with the exception of two sewer line crossings which are not included in the restoration or the conservation easement. A constructed swale diverts storm water from the parking lot to a stabilized outlet, before entering the stream.

Based on the Restoration Plan and As-built drawing, the Stricker Branch Site yields 2,910 stream mitigation units ($2,115 \times 1 = 2,115$; $795 \times 1 = 795$; $2,115 + 795 = 2,910$).

Table 2. Summary of Restoration Credits

MITIGATION SUMMARY					
RESTORATION TYPE		PRIORITY 1 (1:1)	PRIORITY 2 (1:1)	TOTAL MUs	% RESTORATION
STREAM	LENGTH (FEET)	795	2115	2910	100%
	MITIGATION UNITS	795	2115		

Monitoring Plan

The Monitoring Plan will be discussed in detail in Section 3 of this Mitigation Report. Strategies and methodologies laid out in the Monitoring Plan will be followed for a minimum of five years of monitoring. The stream will be monitored for stability of dimension, pattern, and profile using standard practices including permanent cross sections, longitudinal profile, and pebble counts. Standardized permanent vegetation plots will be monitored for species diversity and survival. Monitoring data will be analyzed to determine what remedial actions if any are required and any remedial actions proposed will be detailed in the annual monitoring reports.

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ATTACHMENT D: Initial Plant Counts

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1.0 INTRODUCTION

Project Background

The Stricker Branch Stream Restoration Site (Stricker Branch Site) is located in the City of Concord, Cabarrus County, North Carolina on McGill Avenue next to the Gibson Mill redevelopment project on Highway 29. A location map is included in Figure 1. The project site is located in the HUC 03040105 and in the urbanized EEP Targeted Watershed 03040105020040 of the Yadkin River Basin and the 03-07-12 sub-basin. The project watershed is approximately 1.6 sq. mi. flowing into Irish Buffalo Creek, a 303(d)-listed stream. The majority of the Site consisted of highly unstable, incised and straightened stream channel which had been highly altered, degraded, and entrenched with almost no woody vegetation. The upper section of the project area was historically an impounded water supply for the former textile mill. This former textile mill has been purchased for redevelopment into a mixed use commercial and residential project, now known as Gibson Mill. The lower section was deeply entrenched/incised and highly unstable with strong visible evidence of actively failing banks. This section was sparsely wooded and contained invasive species such as Chinese Privet.

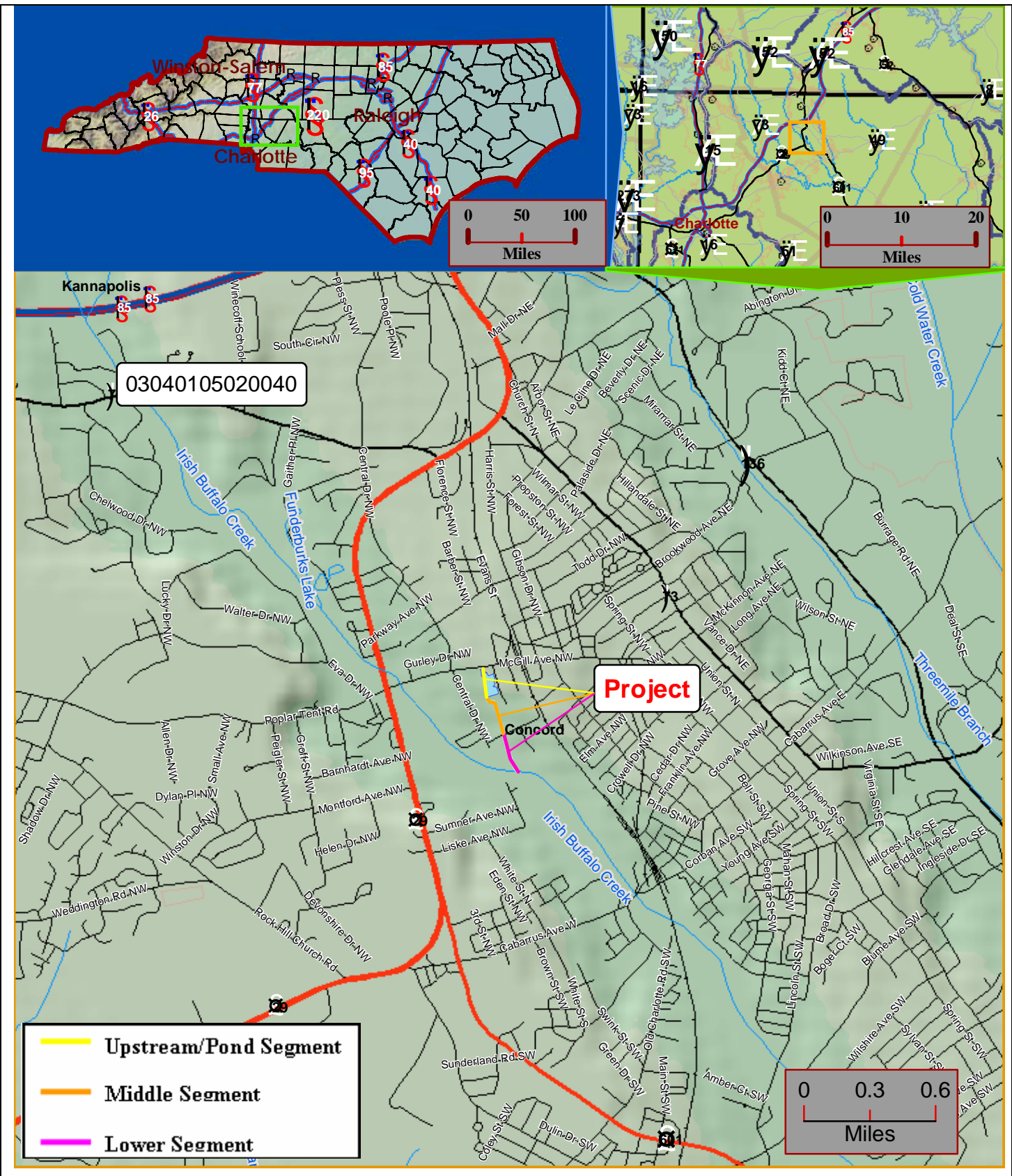
Restoration Summary

The Stricker Branch Site yields 2,910 stream mitigation units. The goals and objectives of the Stricker Branch Project were to restore the site to a naturally functioning stream system designed to address impairment issues typically associated with highly disturbed urban stream systems. The project will restore the stream and riparian habitat, improve water quality by reducing sediment load, and reduce nutrient and other pollutant input. Additionally, forested buffers and reconnection with an active floodplain bench will improve channel hydraulics and system capacity. All designed channels are Rosgen C4/5. A Project Map is provided in Attachment B.

The project was constructed in two phases.

Phase I: Pond Dewatering and Priority II Restoration of Lower and Middle Sections

The concrete spillway of the mill pond was removed and the remaining water drained from the pond. While the pond area was dewatering, construction began from the downstream end of the project and progressed upstream towards the pond area. All work was completed below Sign Drive by August of 2007. Approximately 200 bare roots were planted at this end of the project in June, and live staking was done throughout this section as construction progressed. 1000 containerized plants were installed below Sign Drive in October 2007. All the Priority II stream work below the pond area is part of Phase I, however planting of the area above Sign Drive was done in conjunction with the planting of the pond area and is considered part of Phase II. Priority II stream restoration was done in this section. The City of Concord concurrently constructed a new culvert and bridge over Sign Drive.



In the middle section of the project, boulder toe protection was added on the right bank to help protect a mature water oak from being further undercut. Boulder toe protection was also added to the left bank to stabilize a 42" RCP outlet. A storm water outfall pipe that was not identified on the survey at the time the Restoration Plan was prepared was uncovered during construction. An added storm water BMP and stabilized outlet to Stricker Branch was constructed at this outfall. The pre-formed scour hole was lined with type II filter fabric and a well graded mix of 2" to 12" rip rap. There is also a sewer line crossing upstream of the bridge which is not part of the conservation easement or restoration. The lower section, below Sign Drive, has had ample time to stabilize and has already held up well through several bank full events. Priority II restoration was done in this section, with the exception of two sewer line crossings which are not included in the restoration or the conservation easement. The smaller of these two sewer line crossings, belonging to the City of Concord, has been retired and is scheduled to be plugged and the aerial pipe crossing through the stream will be removed. MAM will be making an effort to add this section to our conservation easement. An approximately 260' swale was constructed to intercept overland flow from the adjacent parking lot. This flow is now intercepted and diverted to a stabilized outlet to Stricker Branch. Approximately 200' of the swale constructed to handle parking lot runoff is lined with erosion control matting due to the slope and the entire swale was seeded with temporary and permanent seed mix. The stabilized outlet is lined with type II filter fabric and a well graded mix of class A, B and 1 rip rap. This swale should provide some pre-treatment and a small amount of detention for storm water coming off of the parking lot before it enters Stricker Branch.

Phase II: Priority I Restoration of the Upper Section

The actual topography and nature of the soils within the old pond area were unknown until the pond was completely drained. The profile through the historic pond was redesigned to match the resultant topography and to remain as flat as possible based on the sediment transport of the materials that were revealed once the pond was drained. Channel work on the pond area began in December 2007 and was completed in January 2008. Despite having many months to dewater, the substrate was still unconsolidated and mucky. Therefore all in-stream structures were moved to the area of the old concrete spillway where a large system of step pools and riffles was constructed to eliminate grade. A large number of alders on site, along with several River Birch and Black Willow were saved and transplanted along the new stream channel in the pond area. Live staking and seeding of this area and the middle portion of the project above Sign Drive was on-going between November 2007 and February 2008. Final planting of another 1500 containerized plants began in late January 2008 and was completed in February 2008. Priority I restoration was done on this section. The spillway from the storm water BMP/pond outside of the easement was converted to a rock lined swale. This was done to provide a stable outlet from the riser barrel pipe outlet the owner of the BMP/pond installed under the new dam. Boulder toe protection was added at the first bend after the flow exits the culvert under McGill Avenue. This bend was experiencing high shear stresses and the toe protection helps to protect the bank from erosive pressures. This area is outside the easement. The beginning section of the project, starting at station 200 contains 61 feet of restoration that is also outside of the conservation easement. This area is under a Duke Power powerline easement and was therefore left out. MAM will be

making an effort to work with Duke Power to allow for permanent protection of this area as well so that it can be included in the linear footage of the project.

In order to stabilize the newly constructed stream channel and flood plain areas both temporary and permanent grass seed as well a southeastern wildflower mix were applied to all restored areas. The main seed types used were: *Lolium multiflorum* (Annual Rye) and *Panicum ramosum* (Browntop Millet) and a steep slope mix containing *Schizachyrium scoparium* (Little Bluestem); *Elymus canadensis* (Canada Wild Rye); and *Panicum virgatum* (Switchgrass) as the primary ingredients. Four hardwood planting zones were established as follows: Zone 1 – Stream Bank; Zone 2- Riparian/Bank full Bench; Zone 3 – Transitional; and Zone 4 – Upland. Live stakes were installed along the new constructed channel within Zones 1 and 2; and in some areas of Zone 3. Plantings were installed spaced approximately 3 feet apart and differed in sizes ranging from .25” to 2” in diameter and 2’ to 5’ in height. Zones 2 – 4 consist of bare root seedlings in the first half of the lower section and 1 gallon containerized plants, which were planted 3’ to 12’ apart throughout the project. A summary showing approximate number of species planted and types of plant material are presented in Table 3 below.

Table 3. Approximate Number of Planted Species Planted

Stricker Branch Stream Restoration Project			
Scientific Name	Indicator Status	Number of Species Planted	Type of Material
<i>Alnus serrulata</i>	FACW+	70/45	Gallon/Transplants
<i>Aronia arbutifolia</i>	FACW	50	Gallon
<i>Betula nigra</i>	FACW	300/100/10	Gallon/BR/Trans
<i>Celtis laevigata</i>	FACW	50	Gallon
<i>Cephalanthus occidentalis</i>	OBL	250	Gallon
<i>Cornus amomum</i>	FACW+	1488/375	Live stakes / Gallon
<i>Fraxinus pennsylvanica</i>	FACW	50	Gallon
<i>Hamamelis virginiana</i>	FACU	200	Gallon
<i>Lindera benzoin</i>	FACW	25	Gallon
<i>Liriodendron tulipifera</i>	FAC	160	Gallon
<i>Nyssa slyvatica</i>	FAC	205	Gallon
<i>Quercus michauxii</i>	FACW-	200/100	Gallon/Bare root
<i>Quercus nigra</i>	FAC	300	Gallon
<i>Quercus phellos</i>	FACW-	275	Gallon
<i>Salix nigra</i>	OBL	3077/10	Live stakes/Trans
		Total: 2510G/ 200BR/ 65T/ 4565LS Grand Total: 7340	

It is likely that there will be pockets of ponded and/or saturated areas that will remain throughout the initial growing season in both the relic pond area and some of the lower benches. These areas will be identified after the initial growing season and will likely

remain as herbaceous emergent wetlands. These emergent areas will increase the overall diversity of the restored ecosystem. Initial plant counts done for this plan are included in Appendix D. All plants were dormant, which made several species hard to identify. Until sufficient identification can be made all three oak species are listed as *Quercus michauxii*, re-identification of some other trees may change the composition of existing species within the plots, and any changes will be noted in the year 1 monitoring report.

2.0 MONITORING PLAN

The Stricker Branch Site will be monitored annually for the next five years (Fall 2008 through Fall 2012) by Mid-Atlantic Mitigation, LLC (MAM) and/or Kimley-Horn and Associates, Inc (KHA). The monitoring period should include two separate years with bank full events. MAM and Kimley-Horn and Associates, Inc. will submit a monitoring report to the NCEEP by December 31st of each calendar year. The Site will be monitored in regard to: overall channel stability (Dimension, Pattern, and Profile), bed material, and vegetative survival. Photo locations are included on the As-built plans (Attachment A) and these photos will be included in the annual monitoring reports.

The stream geometry will be considered successful if the cross section geometry, profile, and sinuosity are stable and reach a dynamic equilibrium as well as being in the geomorphic ranges of the reference reach. It is expected that there will be minimal changes in the resultant cross sections, profile, and/or substrate composition. Changes that may occur during the monitoring period will be evaluated to determine if they represent a movement toward a more unstable condition (e.g. down cutting, erosion, etc.) or are minor changes that represent an increase in stability (e.g. settling, vegetative changes, coarsening of bed material, etc.). An initial, though not exclusive, indicator of success will be adherence to design or reference ratios of stream geometry found in the morphological table (Attachment A) that are comparable to the stable reference system. Deviation from the design ratios will not necessarily denote failure as it is possible to maintain stability and not stay within the exact design geometry. The following key indicators of stability provide a more complete picture of stream restoration success:

Stream Type: Maintenance of the design stream type or progression or conversion to a stable stream type such as C or E will indicate stability;

Bank Height Ratio: Bank height ratio between 1.0 and 1.1 will indicate flood flows have access to the active floodplain and that higher flows do not apply excessive stresses to stream banks.

The nature of the watershed presents challenges to stream restoration. The contributing watersheds lie within a rapidly developing as well as already developed region. The urbanized watershed's runoff character will continue to change as the nature of the land cover shifts to less permeable surfaces. The hydrograph will shift such that bank full flooding events will become more frequent and peak discharges will be higher. The cross sections have been designed to account for some shifting in bank full discharges. Upstream construction activities driven by land development will likely lead to episodic

sediment pulses sent downstream through the stream and wetland network. Additionally, erosion of unstable stream banks upstream will persistently contribute sediment to the project reaches. The plan goals anticipate that the excess sediment will either be routed through the project area or deposited in target areas such as point bars and the floodplain. Minor sedimentation of pools and glides may occur. The pools were designed to be over dug to account for some sedimentation of pools and glides. Ultimately, stream success will be determined by stable channel geomorphology as well as structure integrity and riparian vegetative success.

MAM will ask the NCEEP for written concurrence of acceptance for each annual monitoring report and a final acceptance at the end of the monitoring period if all success criteria have been achieved.

Profile

A survey of the longitudinal profiles will monitor the riffle-run-pool-glide sequences and overall stability of the restored stream. The entire length of the restored stream will be surveyed using the current EEP surveying protocol and monitored for channel stability and in-stream structural integrity. The baseline Longitudinal Profile is included in the As-built plans and will be overlain each year with current survey data. Any evidence of channel instability will be identified, mapped and photographed.

Pattern

Evaluation of overall success and stability of the stream will include close observation and photo documentation of all in-stream structures, and any changes to stream pattern such as point bar formation, development of head-cutting, down-cutting, and significant bank degradation or aggradation. Photos of each structure will be included in the Photo Log as permanent photo reference points marked on the As-built plan and any additional photos of problem areas that may be taken during monitoring period.

Dimension

There are 3 sets of 2 permanent cross sections throughout the Site for a total of 6 sections. Cross sections represent 50% riffles and 50% pools. Each permanent cross section is shown on the As-built Plan and will be surveyed each year for inclusion in the monitoring report and compared with data from previous years. Each cross section will be photographed from left and right bank and from both the upstream and downstream direction for inclusion in the Photo Log.

Bed Material

A pebble count will be done in each cross section that contains a riffle and any unacceptable increase in sand or finer substrate material will be noted in the monitoring report.

Vegetation

A reduction in the percentage of nuisance vegetation in areas with existing vegetation to less than 15% will indicate establishment of native wetland vegetation. Study plots showing that the composition and density of vegetation in the restoration areas compares closely to the reference areas will indicate restoration success for vegetation. Success will be gauged by stem counts of planted species. Stem counts of over 320 trees per acre after 3 years and 260 trees per acre after 5 years will be considered successful. Photos taken at established photo points should indicate maturation of riparian vegetation community. Photographs will help to capture the health of the planted vegetation and the severity of the invasive or exotic species that establish within the site. Permanent vegetative plots have been established at 6 locations. The success of vegetation plantings will be measured through stems counts. These plots will be used to sample primarily Zones 1 through 3. Each plot covers 100 square meters for tree counts. Within each plot, a 1 meter plot will be sampled to measure herbaceous coverage. During the counts, the health of the vegetation will be noted. In addition to stem counts, the samples will inventory species diversity to allow for comparison between the reference and restoration wetlands and track the percent cover of nuisance species. The vegetation survey will occur during the growing season. Final Planting was complete in February of 2008; therefore vegetation monitoring will not be done before August of 2008 and will be done as close to the end of the growing season (Approx. October 31st) as possible, most likely late September or Early October. Vegetative plots are shown on the As-built Plan.

Bank Full Events

A crest stage gage was installed below Sign Drive to capture bank full events. Rainfall will also be monitored using a local, Concord State Climate Office rain gage station.

3.0 MAINTENANCE AND CONTINGENCY PLANS

Because streams are a dynamic system, restoration is achieved by restoring the channel to a stable dimension, pattern, and profile such that, over time, the stream features (riffle-run-pool-glide) are maintained and the channel does not aggrade or degrade significantly. Minor morphological adjustments from the designed stream are anticipated based on the correlation of reference reach data, excessive sediment deposition from upstream sources, and on-going changes in land use within the watershed. All of the proposed 3,000 linear feet of stream mitigation have been generated through project implementation. A summary of the deliverables are presented in Table 2 in the Executive Summary. If standards are not met as indicated in the Monitoring Plan of this Mitigation Report, appropriate remedial activities to satisfy USACE and NCEEP will be developed, approved, and performed. The site will be monitored for longer than five years should success criteria not be met within the original monitoring period. The site will be monitored for at least 5 years and through at least 2 bank full events in separate years.

4.0 REFERENCES

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A

AS-BUILT DRAWINGS FOR

STRICKER BRANCH

STREAM RESTORATION PROJECT

YEAR 0 - MONITORING DATA

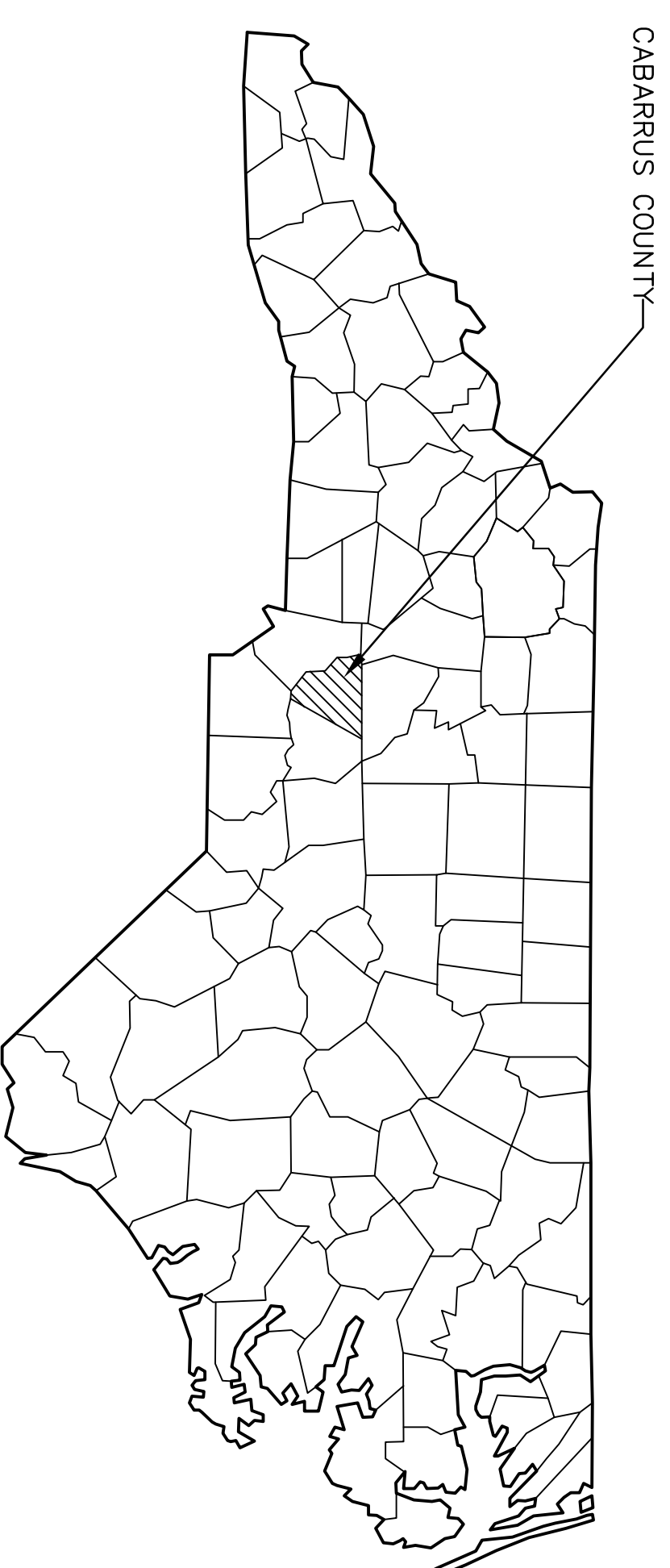
CABARRUS COUNTY, NORTH CAROLINA

LAT: 35.415787 LONG: -80.605460
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 CONTRACT NUMBER: D06054-G

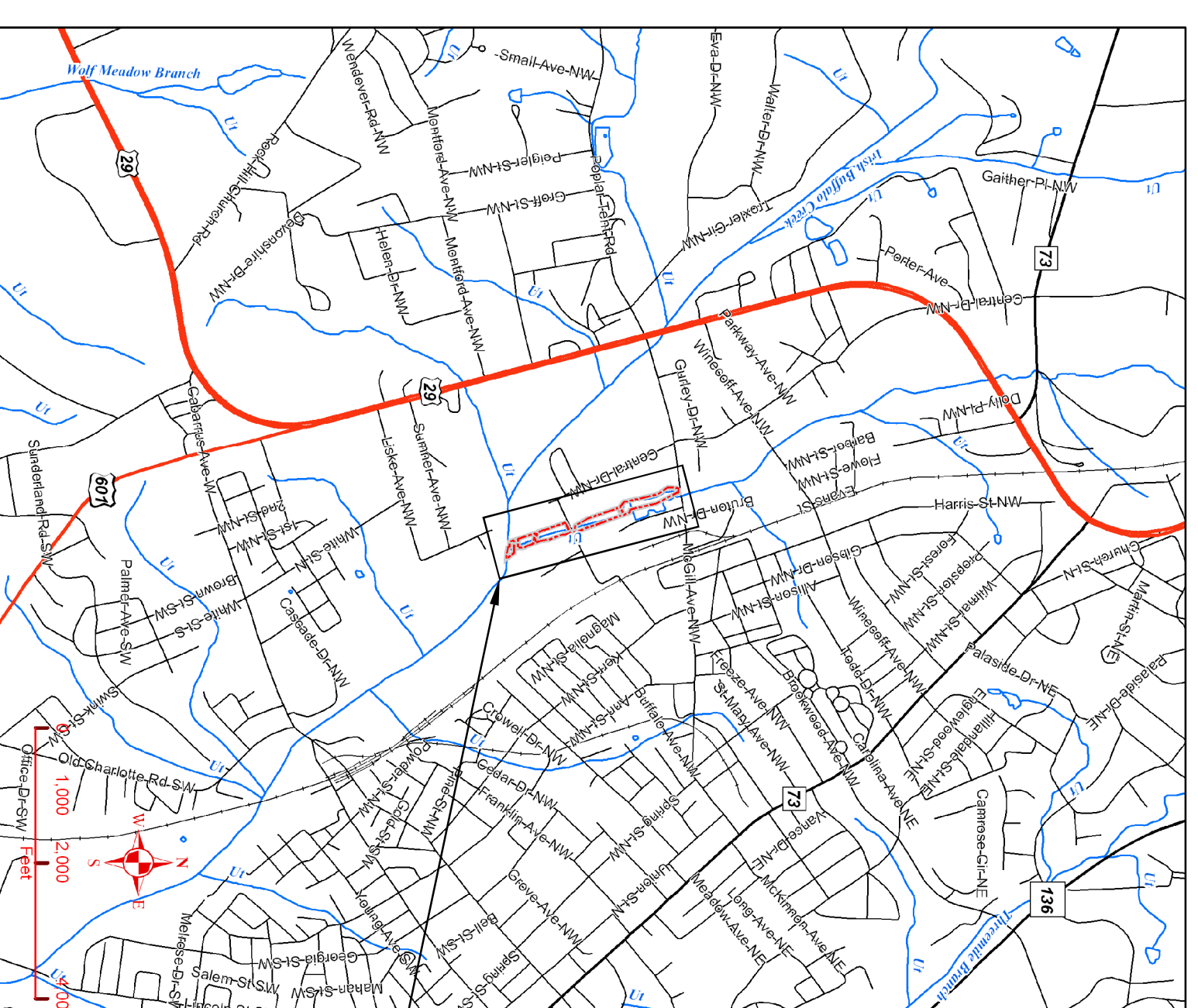
DESIGN LENGTH 3,170 LF
 AS-BUILT LENGTH 3,205 LF
 AS-BUILT SMU'S 2,910 LF

INDEX OF SHEETS

SHEET NO.	DESCRIPTION
1	COVER SHEET
2	KEY SHEET
3-5	PLAN/PROFILE SHEETS
6	VEGETATION NOTES
7-9	PLANTING PLAN



STATE OF NORTH CAROLINA



LOCATION MAP

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<p>REVISIONS:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>NO.</th> <th>DESCRIPTION</th> <th>DATE</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table> <p>DRAWN BY: _____</p> <p>CHECKED BY: _____</p>	NO.	DESCRIPTION	DATE										<p>PROVIDED IN THE OFFICE OF:</p> <p>Kimley-Horn and Associates, Inc. SUITE 300, 4691 CHARLOTTE PARK DRIVE, CHARLOTTE, NORTH CAROLINA 28217 PHONE (704) 333-5351 FAX (704) 333-0846</p>
NO.	DESCRIPTION	DATE											
<p>CLIENT:</p> <p>MID-ATLANTIC MITIGATION, LLC</p>	<p>TITLE:</p> <p>AS-BUILT COVER SHEET</p>												
<p>DATE: 03-12-08</p> <p>HORIZONTAL SCALE: _____</p> <p>VERTICAL SCALE: _____</p> <p>DRAWN BY: JOD</p> <p>DESIGNER: JOD</p> <p>CHECKED BY: WW</p>	<p>PROJECT:</p> <p>STRICKER BRANCH STREAM RESTORATION</p> <p>ATTACHED REFERENCE FILES:</p> <p>JOB NUMBER: 018285002</p> <p>SHEET NUMBER: 1 OF 9</p>												




SHEETS 3,7

SHEETS 4,8

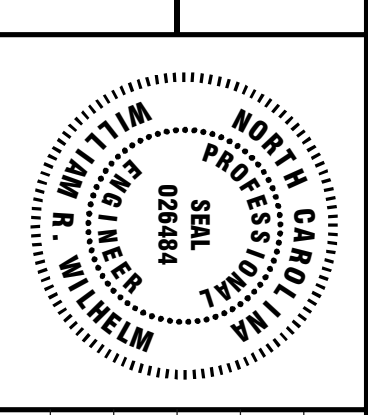
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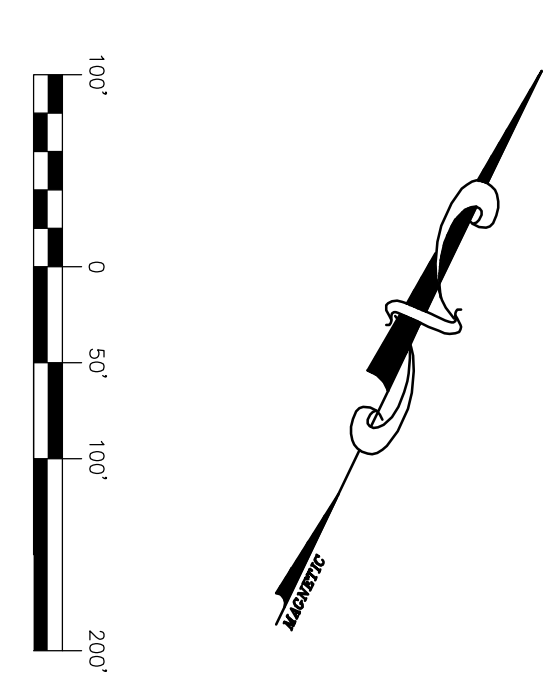
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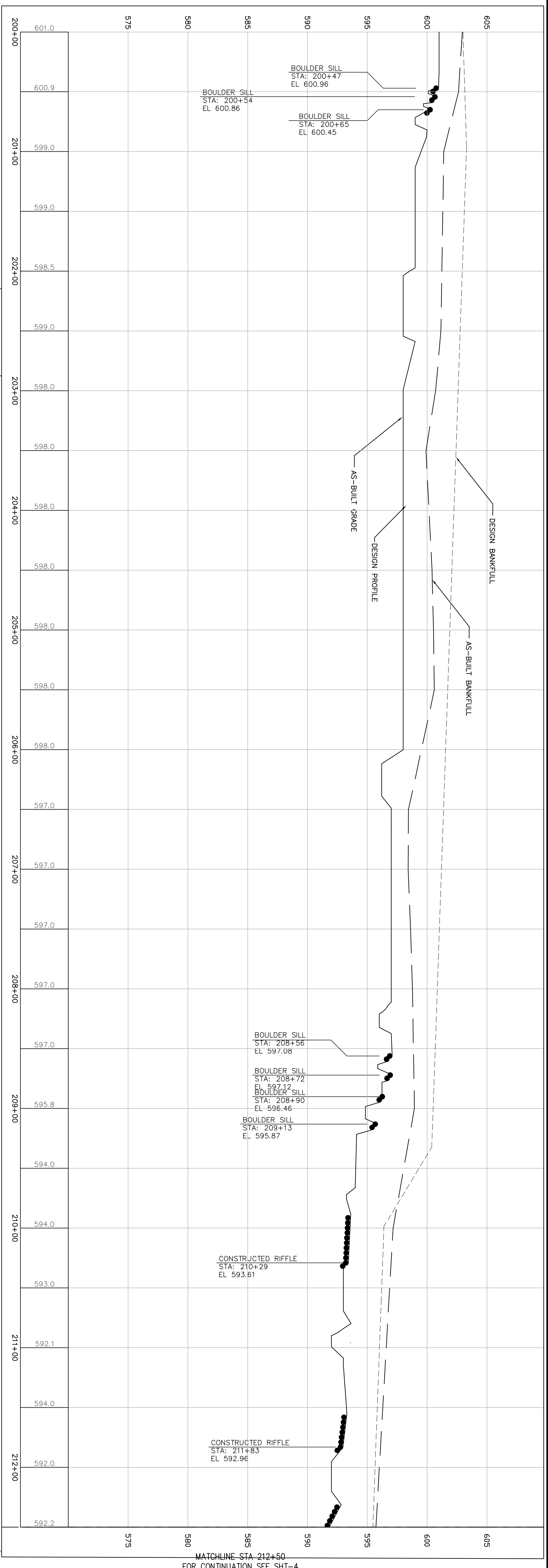
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 DESIGNER: JOD
 CHECKED BY: WW

PROJECT:
STRICKER BRANCH STREAM RESTORATION

ATTACHED REFERENCE FILES:
 JOB NUMBER: 018285002
 SHEET NUMBER: 2 OF 9



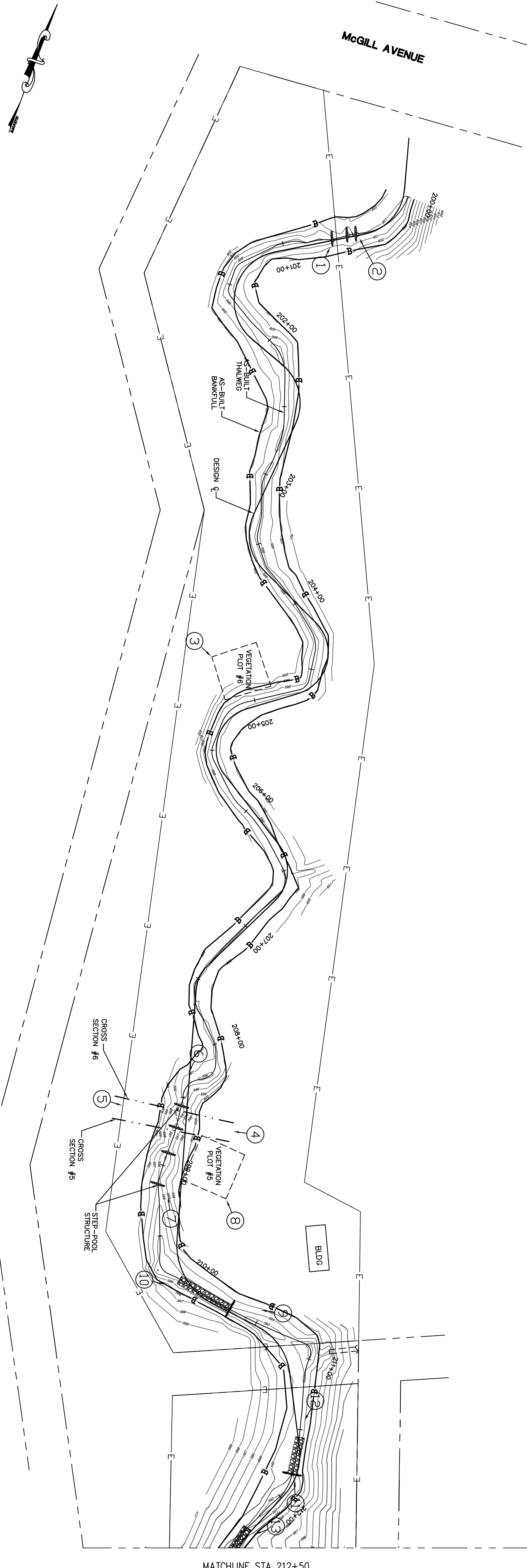
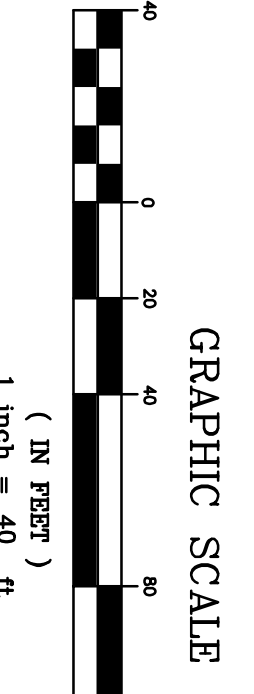
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DESIGN LENGTH 3120 L.F.
AS-BUILT LENGTH 2490 L.F.
AS-BUILT SMUGS 2380 L.F.
AS-BUILT SMUGS-AS-BUILT LENGTH MINUS LENGTH OUTSIDE OF EASEMENT

PLAN VIEW LEGEND:

- DESIGN CENTERLINE
- - - CONSERVATION EASEMENT
- AS-BUILT THALWEG
- - - AS-BUILT BANKFULL
- BOULDER SILL
- CONSTRUCTED RIFFLE
- GROSS VANE
- LOG VANE
- ROOTWAD
- PHOTO POINTS

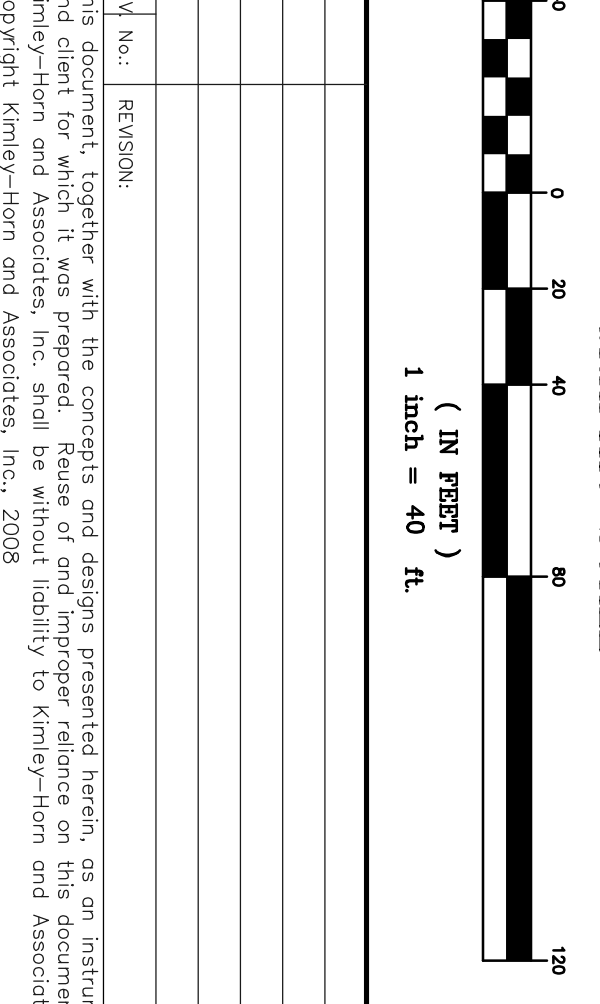
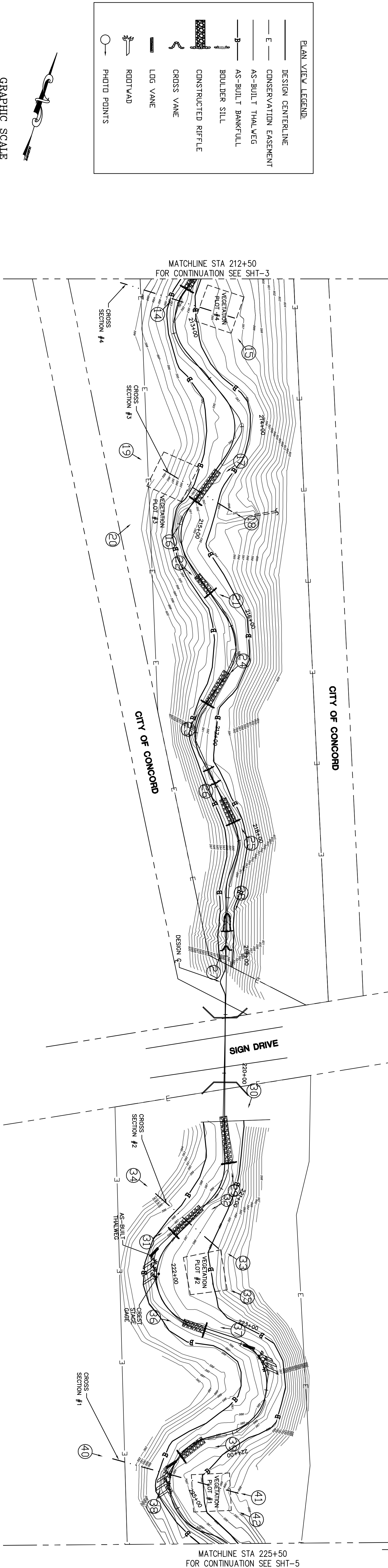
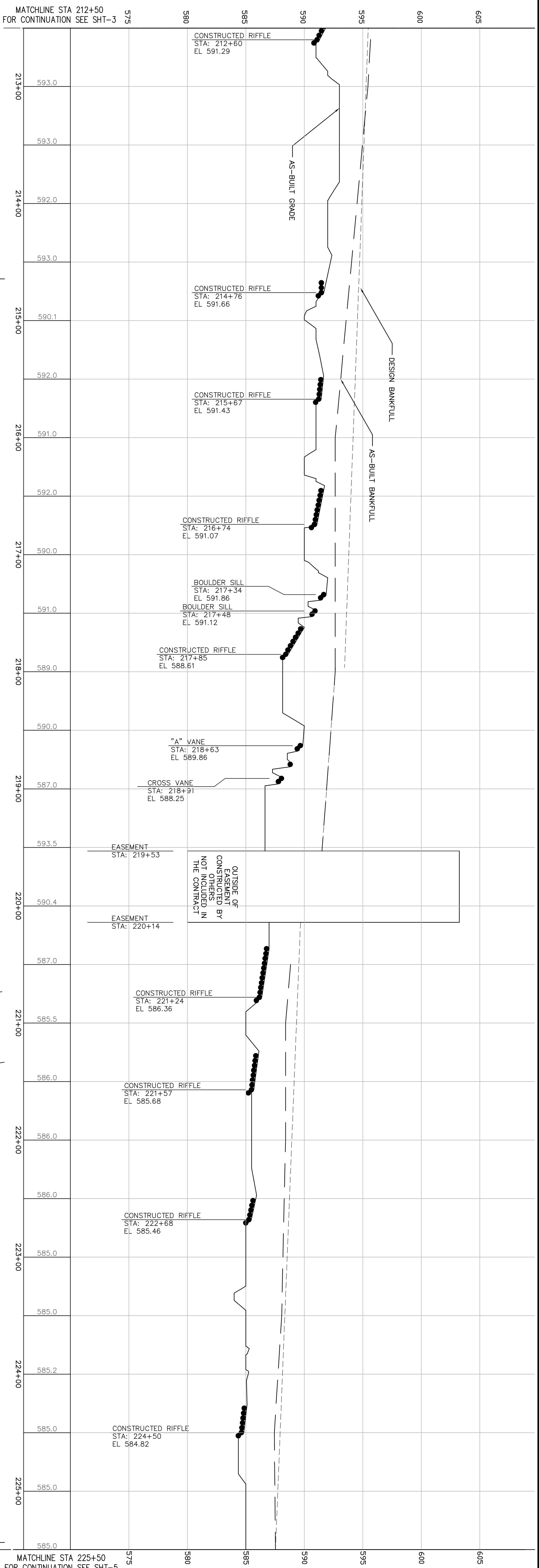


MATCHLINE STA 212+50
FOR CONTINUATION SEE SHT-4

MATCHLINE STA 212+50
FOR CONTINUATION SEE SHT-4

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<p>VERTICAL SCALE:</p> <p>HORIZONTAL SCALE:</p>		<p>PROFESSIONAL SEAL:</p>	<p>TITLE:</p>	<p>ATTACHED REFERENCE FILES:</p>
<p>JOB NUMBER:</p> <p>018285002</p>		<p>SHEET NUMBER:</p> <p>3 OF 9</p>		

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MID-ATLANTIC MITIGATION, LLC

TITLE:

AS-BUILT STA 212+50 TO STA 225+50

DATE: 03-12-08

VERTICAL SCALE: _____

HORIZONTAL SCALE: _____

DRAWN BY: JOD

CHECKED BY: WW

PROJECT:

STRICKER BRANCH STREAM RESTORATION

ATTACHED REFERENCE FILES:

JOB NUMBER: 018285002

SHEET NUMBER: 4 OF 9

General Notes:

Temporary planting will occur immediately after construction to stabilize areas of bare soil. Permanent plantings and seedings shall begin in season optimally between February 15 and April 15. However, the planting supervisor shall have final say when to begin planting.

Prior to permanent plantings and seedings, the site soils shall be prepared for planting. Where needed the soils should be plowed or ripped to improve compacted soils and eliminate channelized flow from non-target areas. Soils shall be amended to facilitate vigorous plant growth. Exotic and invasive plants shall be treated and removed inside the easement.

The site shall be planted by the zones depicted in the **Planting Zone Typical** and **Riparian Planting Plan** sheets with species listed in the accompanying **Planting Table**. The contractor shall use methods outlined in the **Vegetation Installation Notes and Details**.

Planting Zone Descriptions

Zone 1 - Stream Bank

The stream channel zone includes the stream channel from base flow to bankfull. The zone features the steep bank slopes (3:1-7:1) of the zones and highest saturation levels. This environment dictates the planting of fast-growing, obligate pioneer species, such as black willows and silky willows, to provide stability to areas at or below bankfull.

Zone 2 - Riparian/Bankfull Bench

The stream bank zone includes the area from the top of bank outward away from the stream approximately 8-feet from the outside of meander bends. It is an area exposed to regular stream flows and frequent soil deposition. The most stressed areas are located on the outside bends of meanders. The banks will be planted with fast-growing, deep-rooted canopy and understory species, such as silky dogwood, that will provide biostabilization and shading to the stream.

Zone 3 - Transitional

The transitional zone extends from the edge of the riparian zone to the upland at a 3:1 slope. This area will be planted with a mix of canopy and understory species.

Zone 4 - Upland

The upland zone extends from the edge of the transitional zone to the edge of the conservation easement. This area will provide a transition between the stream restoration project and the surrounding areas.

Zone 5 - Areas outside easement but inside limits of disturbance

This zone will be planted with temporary seed and vegetation per owners request.

Planting List Reference

Hall, Karen. 2001. North Carolina Stream Restoration Institute NCSI, "Recommended Native Plant Species for Stream Restoration in North Carolina."
Smith, Cheryl L., et al., 2004, North Carolina Department of Environmental and Natural Resources - Ecosystem Enhancement Program, "Guidelines for Riparian Buffer Restoration."

Stricker Branch Stream Restoration Project			
Scientific Name	Indicator Status	Number of Planted Species	Type of Material
<i>Alnus serrulata</i>	FACW	70/45	Gallon/Transplants
<i>Aronia arbutifolia</i>	FACW	50	Gallon
<i>Betula nigra</i>	FACW	300/100/10	Gallon/BRI/Trans
<i>Celtis laevigata</i>	FACW	50	Gallon
<i>Cephalanthus occidentalis</i>	OBL	250	Gallon
<i>Cornus amomum</i>	FACW+	1488/375	Livestakes/Gallon
<i>Fraxinus pennsylvanica</i>	FACW	50	Gallon
<i>Hamamelis virginiana</i>	FACU	200	Gallon
<i>Lindera benzoin</i>	FACW	25	Gallon
<i>Liriodendron tulipifera</i>	FACU	160	Gallon
<i>Nyssa sylvatica</i>	FAC	205	Gallon
<i>Quercus michauxii</i>	FACW-	200/100	Gallon/Bare root
<i>Quercus nigra</i>	FAC	300	Gallon
<i>Quercus phellos</i>	FACW-	275	Gallon
<i>Salix nigra</i>	OBL	3077/10	Livestakes/Trans
		Total: 2510G/ 200BR/ 65T/ 4565LS	
		Grand Total: 7340	

Plant Spacing and Distribution		
Zone	Spacing	# per 1,000 sq. feet
1	1.5'	2
2	6	10
3	6	10
4	6	8
		15
		25

Riparian Seed Mix		
Scientific Name	Common Name	%
<i>Leersia oryzoides</i>	Rice Cut Grass	5
<i>Juncus effusus</i>	Soft Rush	10
<i>Panicum clandeitium</i>	Deertongue	20
<i>Panicum virgatum</i>	Switchgrass	50
<i>Vernonia noveboracensis</i>	Ironweed	5
<i>Helianthus angustifolius</i>	Swamp Sunflower	5
<i>Eupatorium fistulosum</i>	Joe Pye Weed	5

TEMPORARY SEEDING FOR LATE WINTER AND EARLY SPRING

Seeding mixture
Species
Rate (lb./acre)
50

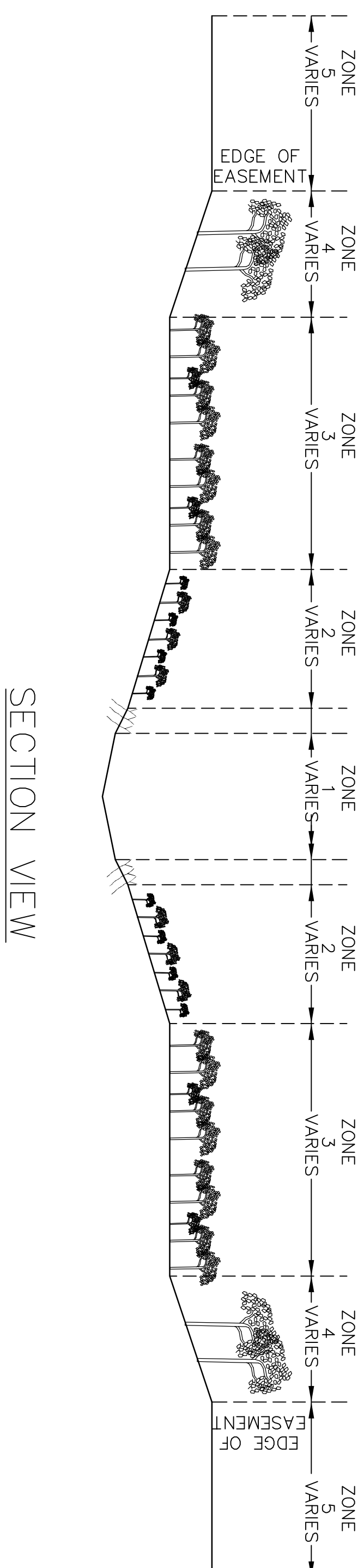
Rye (Secale cereale) 30%
Browntop Millet (Panicum romosum) 70%
Soil amendments
Apply soil amendments according to the following table:

Region	Amendment Addition (lbs/acre)		
	Lime	N	P ₂ O ₅ K ₂ O
Areas of Cut	0	90	80 60
Non-Cut Areas	0	90	60 30

Mulch
Apply 4,000 lb/acre straw. Anchor straw by tacking with asphalt, netting, or a mulch anchoring tool. A disk with blades set nearly straight can be used as a mulch anchoring tool.

Maintenance
Referertilize if growth is not fully adequate. Reseed, referertilize and mulch immediately following erosion or other damage per section 6.10 of NCDENR Erosion and Sediment Control Design Manual.

Note: Ground cover shall be established on exposed slopes within 21 working days following completion of any phase of grading.



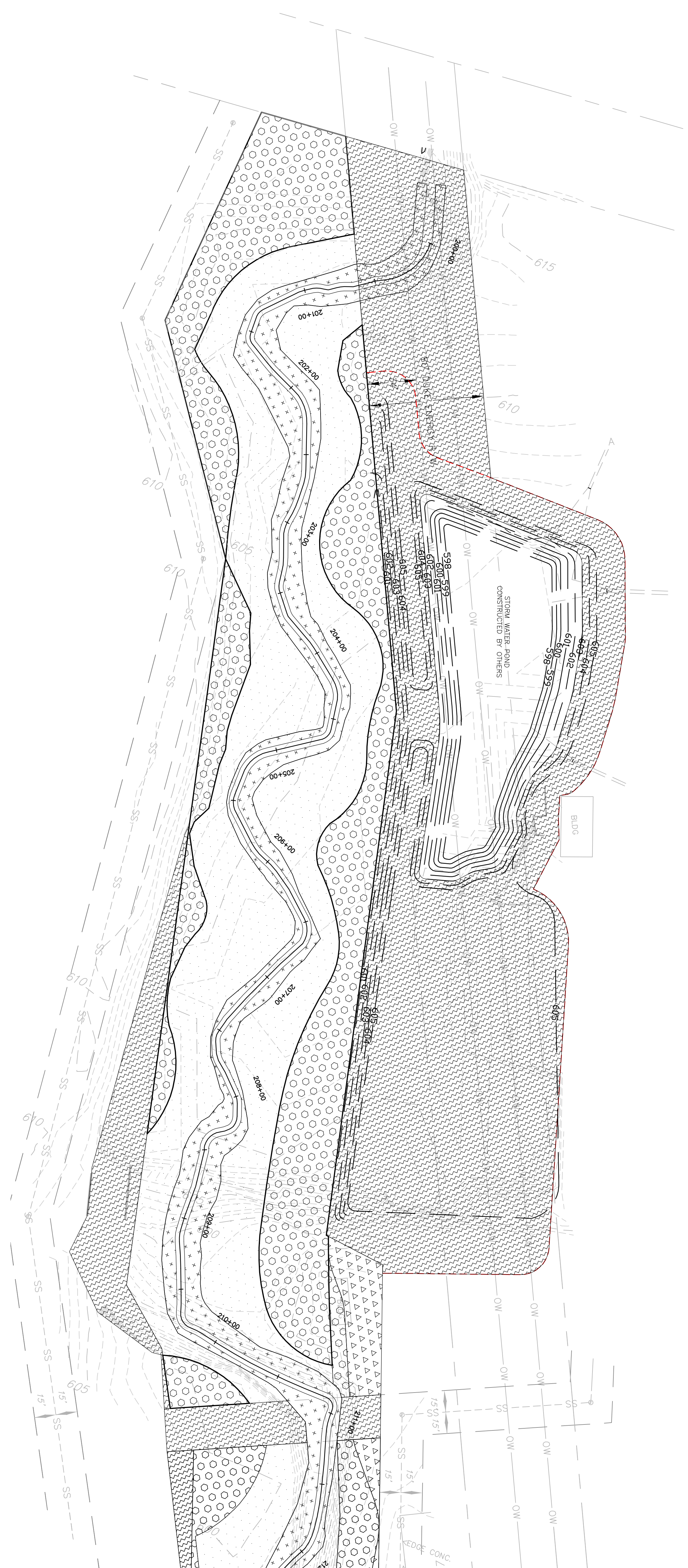
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MID-ATLANTIC MITIGATION, LLC
TITLE:
VEGETATION NOTES

PROFESSIONAL SEAL
NORTH CAROLINA
REGISTERED PROFESSIONAL
LANDSCAPE ARCHITECT
JASON DIAZ
02834

PROJECT:
STRICKER BRANCH STREAM RESTORATION
DATE: 03-12-08
VERTICAL SCALE:
HORIZONTAL SCALE:
DRAWN BY: JCD
DESIGNED BY: JCD
CHECKED BY: WW
ATTACHED REFERENCE FILES:
JOB NUMBER: 018285002
SHEET NUMBER: 6 OF 9



LEGEND

[Brick pattern]	ZONE 1 - STREAM BANK
[Diagonal line pattern]	ZONE 2 - RIPARIAN/BANKFULL BENCH
[Cross-hatch pattern]	ZONE 3 - TRANSITIONAL
[Dotted pattern]	ZONE 4 - UPLAND
[Dashed line]	ZONE 5 - OUTSIDE OF EASEMENT



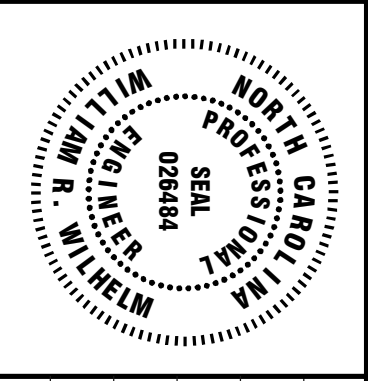
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TITLE: **PLANTING PLAN**



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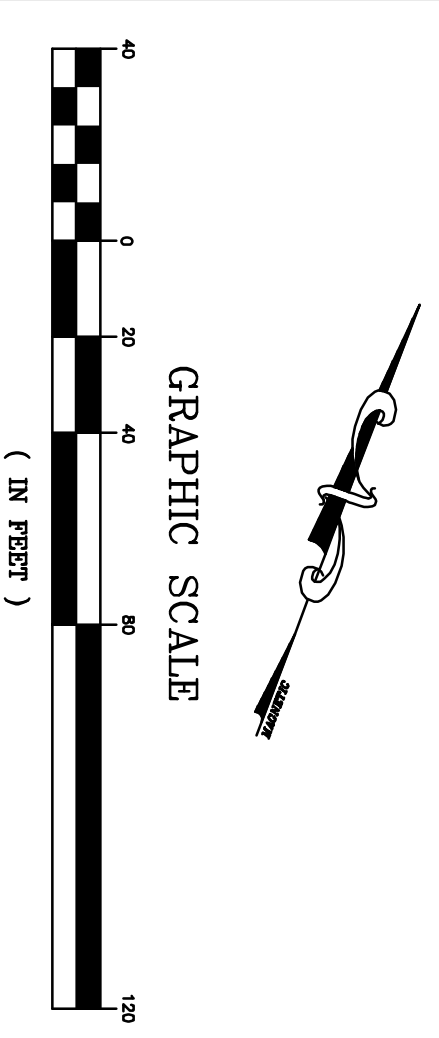
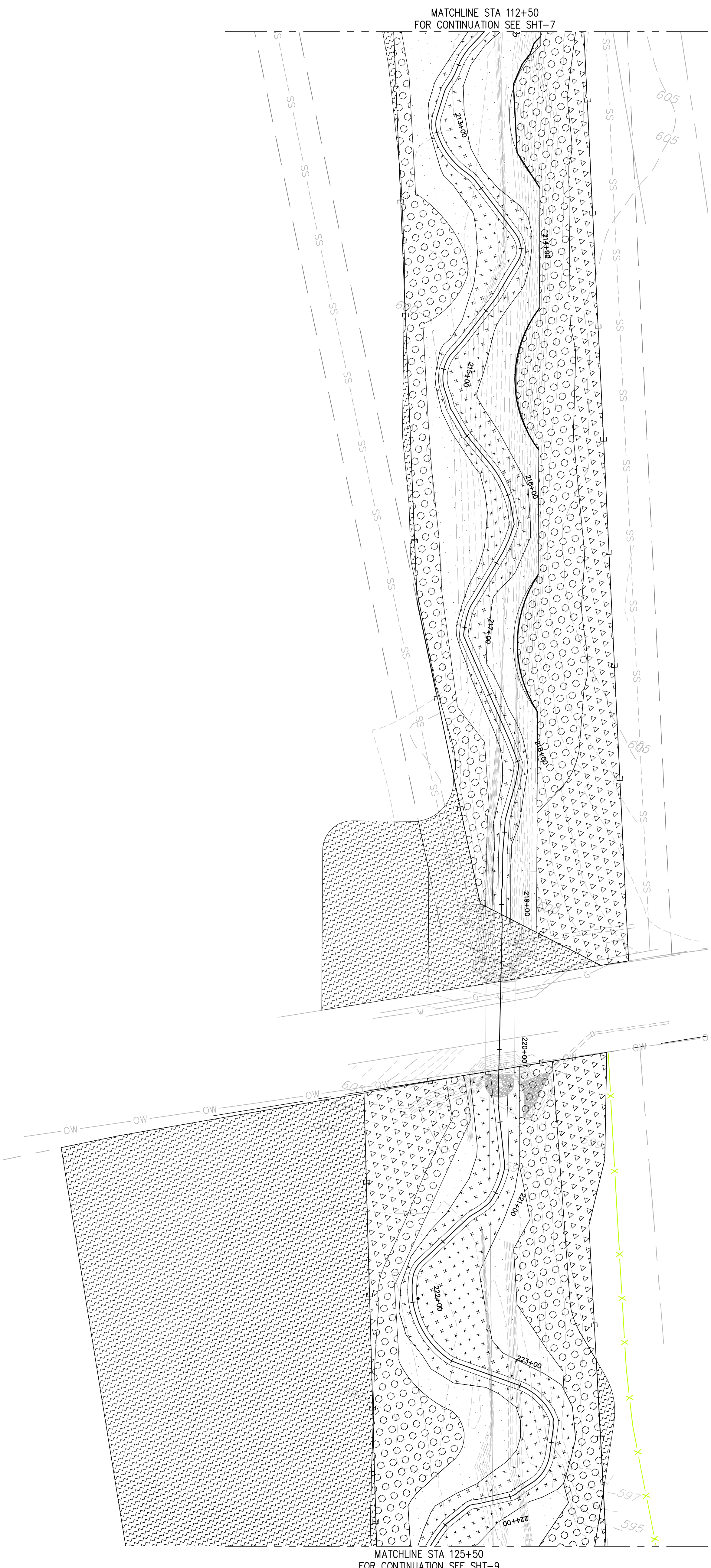
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ATTACHED REFERENCE FILES:

JOB NUMBER: 018285002
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LEGEND	
	ZONE 1 - STREAM BANK
	ZONE 2 - RIPARIAN/BANKFULL BENCH
	ZONE 3 - TRANSITIONAL
	ZONE 4 - UPLAND
	ZONE 5 - OUTSIDE OF EASEMENT



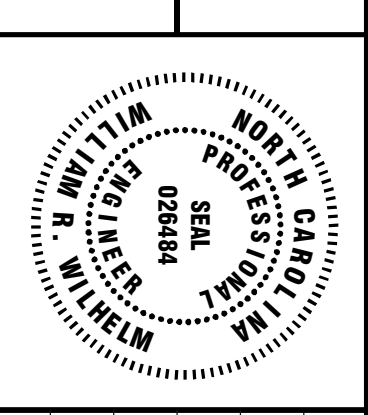
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TITLE: **PLANTING PLAN**



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




PROJECT: **STRICKER BRANCH STREAM RESTORATION**

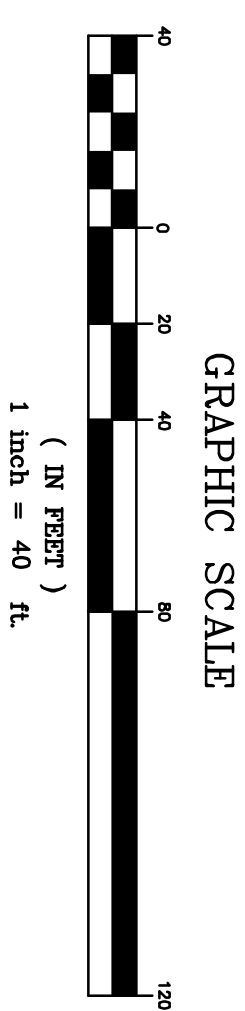
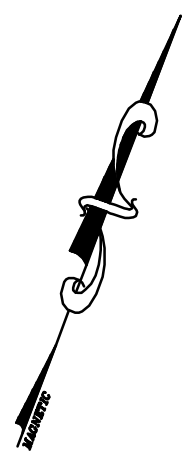
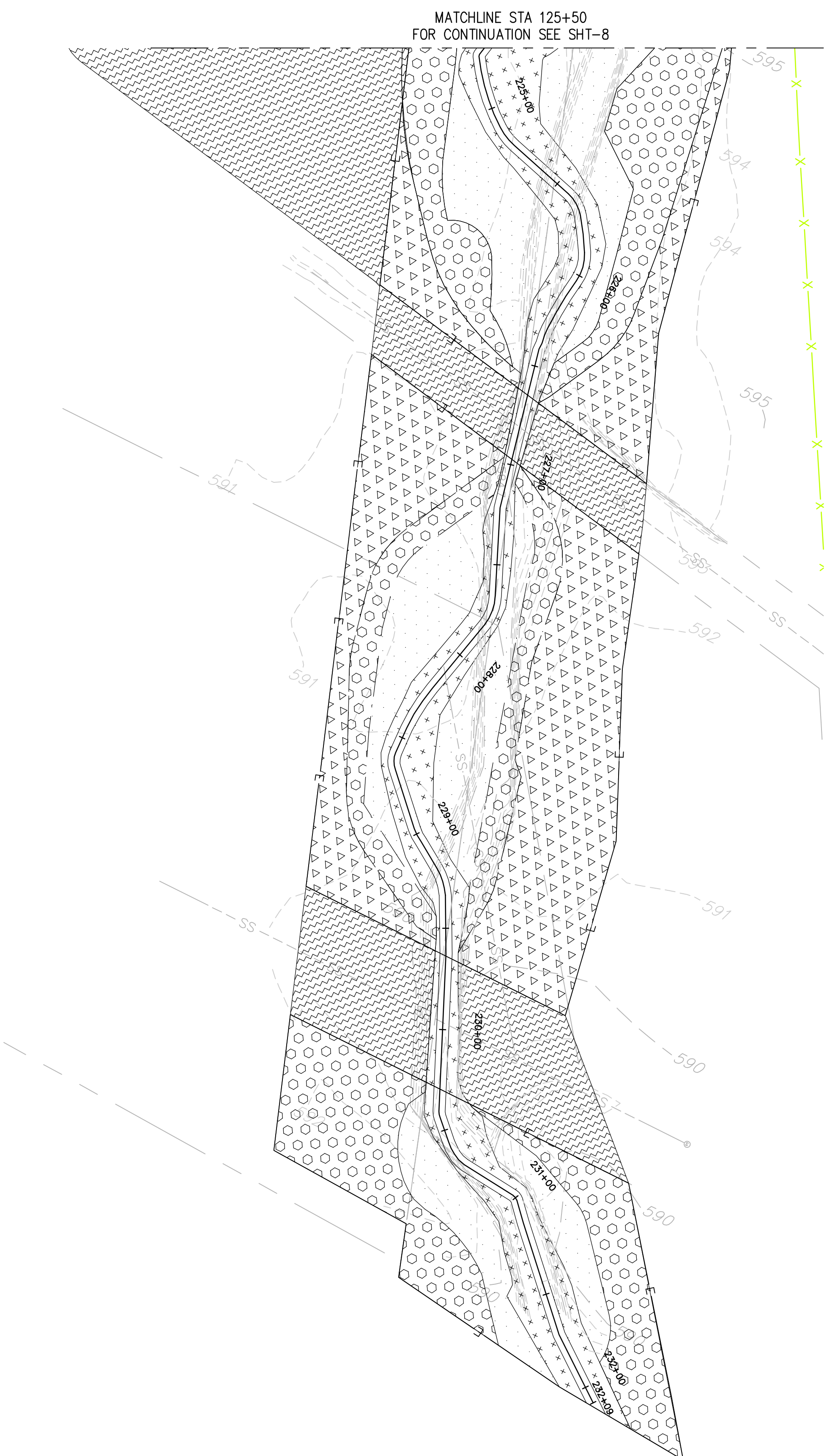
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LEGEND

-  ZONE 1 - STREAM BANK
-  ZONE 2 - RIPARIAN/BANKFULL BENCH
-  ZONE 3 - TRANSITIONAL
-  ZONE 4 - UPLAND
-  ZONE 5 - OUTSIDE OF EASEMENT




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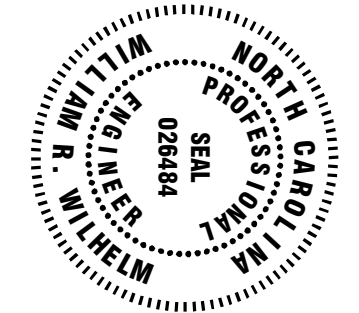
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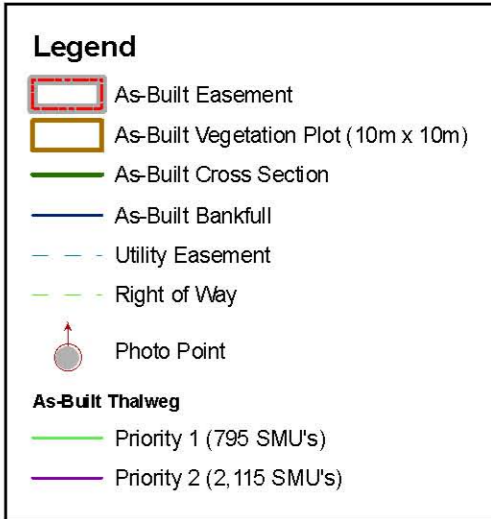
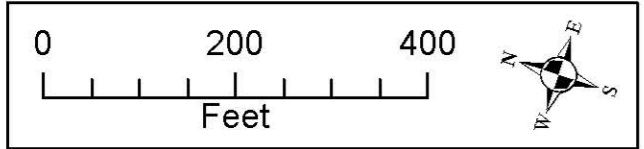
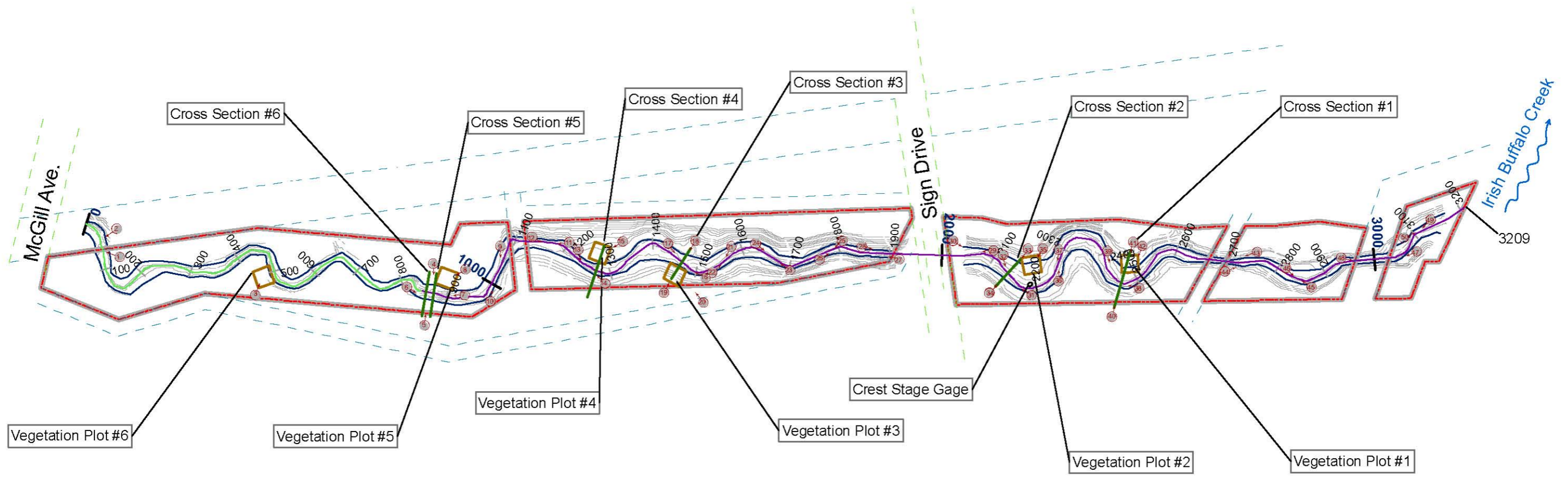
STRICKER BRANCH STREAM RESTORATION

ATTACHED REFERENCE FILES:

JOB NUMBER: 018285002

SHEET NUMBER: 9 OF 9

B



Title Stricker Branch Monitoring Map			
Prepared For: Mid-Atlantic Mitigation, LLC.	Project	Stricker Branch Stream Restoration Cabarrus County, North Carolina	
	Date	3/11/08	KHA Project Number 018285002
			Figure 1

C

Stricker Branch Mitigation Report Photo Log



Photo Point 42 – Veg Plot 1 facing North West



Photo Point 35 – Veg Plot 2 facing North West



Photo Point 31 – Root Wads at Station 222+00 facing downstream, from right bank



Project looking upstream near Photo Point 23



Photo Point 20 - Veg Plot 3 facing North East



Photo Point 15 - Veg Plot 4 facing North West



Photo Point 8 - Veg Plot 5 facing North West

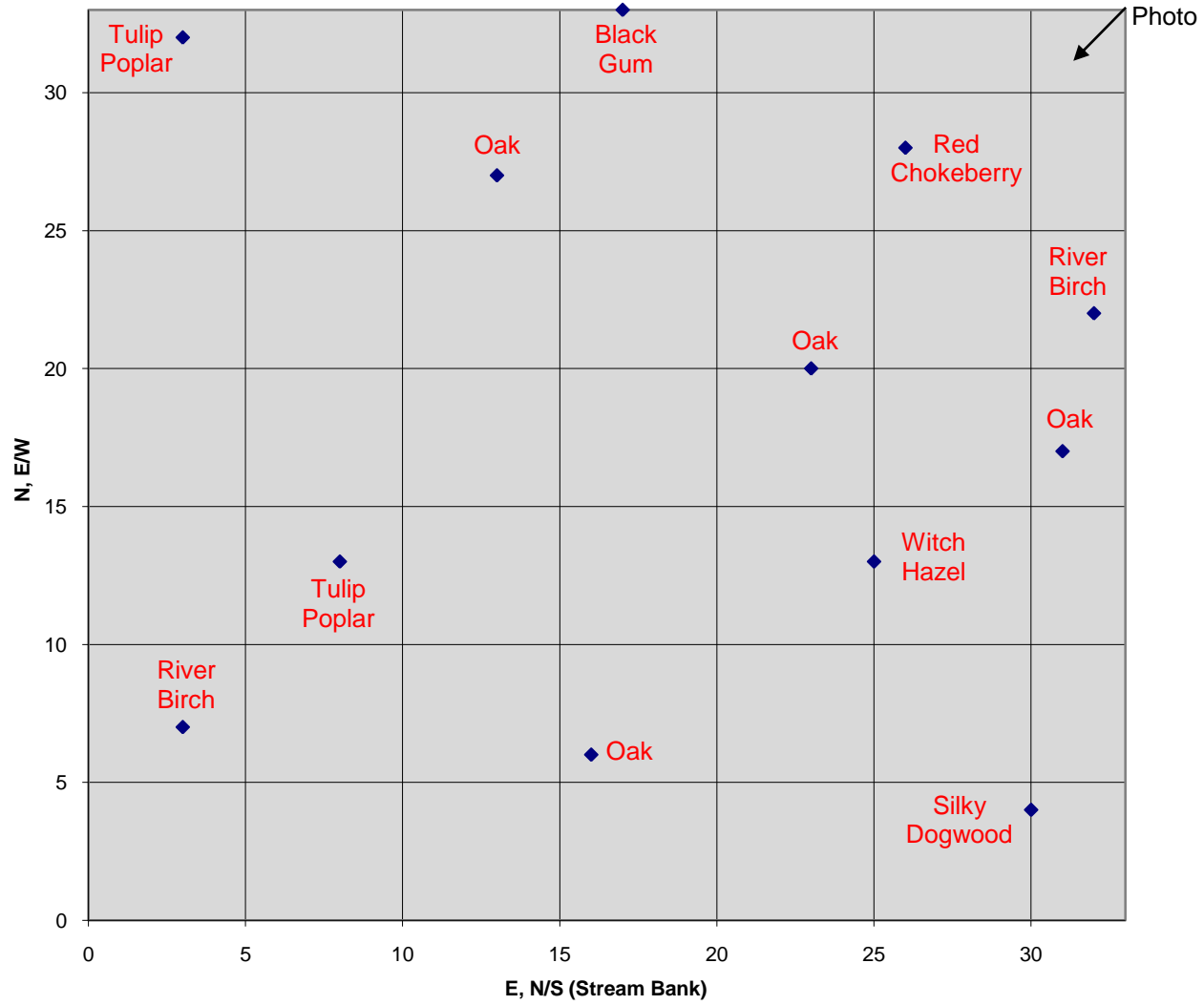


Photo Point 3 - Veg Plot 6 facing North East

D

X	Y	Species	Comments
	3	7 River Birch	
	3	32 Tulip Poplar	
	8	13 Tulip Poplar	
	13	27 Oak Sp.	
	16	6 Oak Sp.	
	17	33 Black Gum	
	23	20 Oak Sp.	
	25	13 Witch Hazel	
	26	28 Red Choke Berry	
	30	4 Silky Dogwood	
	31	17 Oak Sp.	
	32	22 River Birch	
		<hr/>	
		12 stems	
<hr/>	12 =		
1089		<div style="border: 1px solid black; padding: 2px; display: inline-block;">480</div>	43560

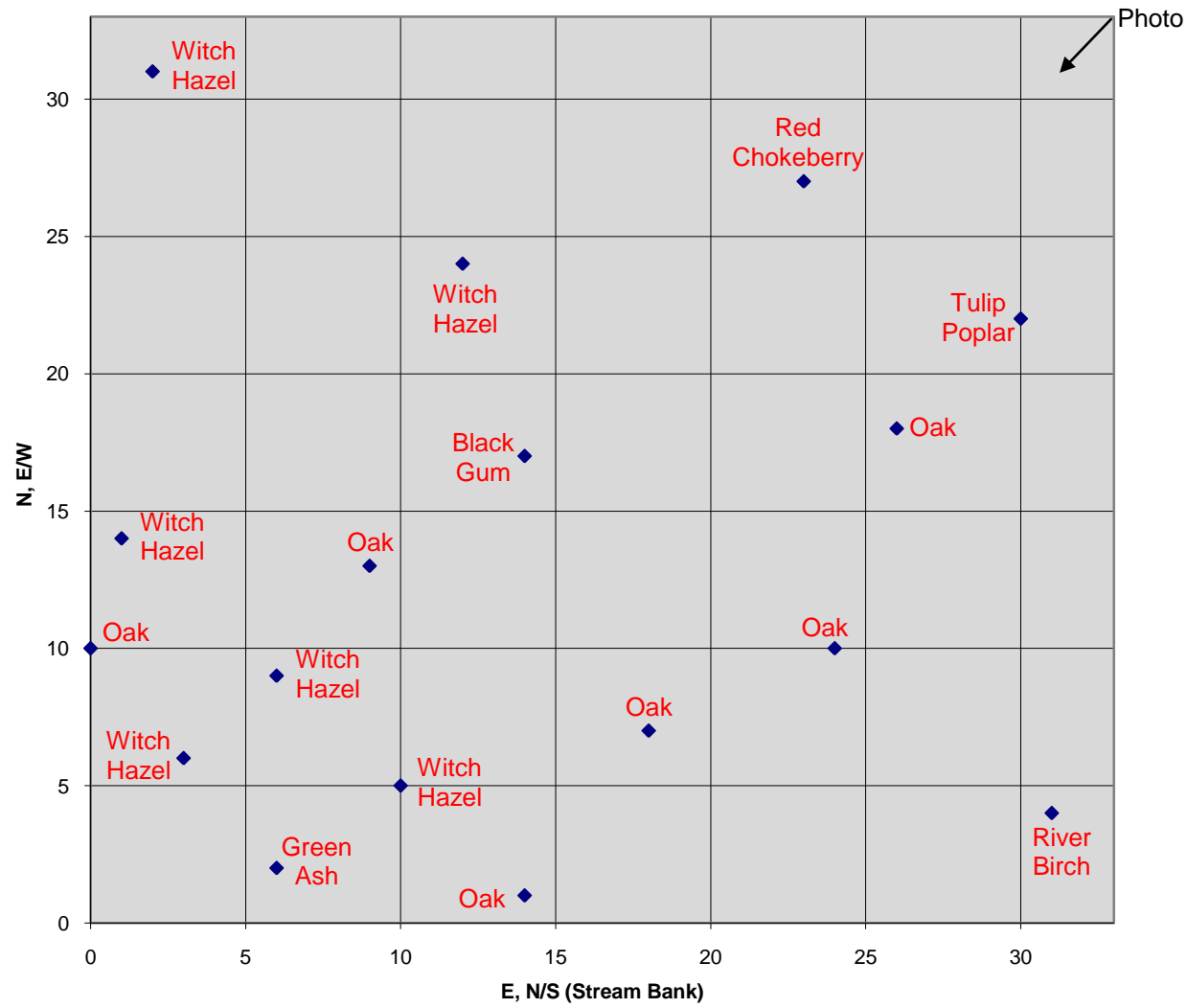
VP 1



◆ Base Line FEB 2008

X	Y	Species	Comments
	0	10 Oak Sp.	
	1	14 Witch Hazel	
	2	31 Witch Hazel	
	3	6 Witch Hazel	
	6	9 Witch Hazel	
	6	2 Green Ash	
	9	13 Oak Sp.	
	10	5 Witch Hazel	
	12	24 Witch Hazel	
	14	17 Black Gum	
	14	1 Oak Sp.	
	18	7 Oak Sp.	
	23	27 Red Chokeberry	
	24	10 Oak Sp.	
	26	18 Oak Sp.	
	30	22 Tulip Poplar	
	31	4 River Birch	
		<hr/> 17 stems	
	17 =	680	
<hr/>	1089		43560

VP 2



◆ Base Line FEB 2008

VP 3

X	Y	Species	Comments
18		2 River Birch	
5		8 Button Bush	
0		9 Silky Dogwood	Live Stake
0		11 Black Willow	Live Stake
33		11 Oak Sp.	
2		12 Black Willow	Live Stake
14		13 Oak Sp.	
2		16 Silky Dogwood	Live Stake
2		17 Silky Dogwood	Live Stake
33		23 Alder	
18		24 Oak Sp.	
5		27 Oak Sp.	
32		31 Alder	
24		33 Sugarberry	

9 stems 5 live stakes

$$\frac{9}{1089} =$$

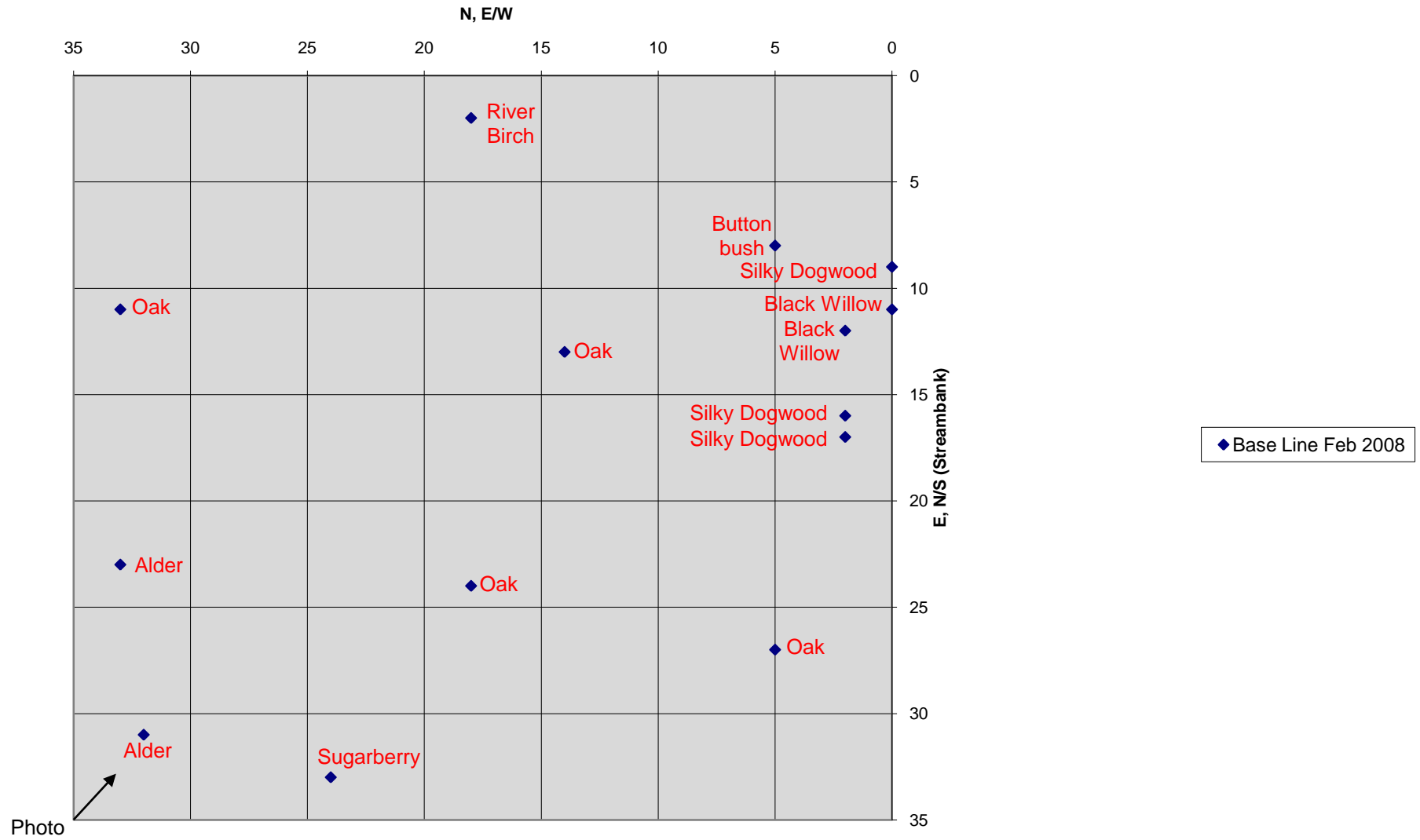
$$\frac{\boxed{360}}{43560}$$

w/ LS

$$\frac{14}{1089} =$$

$$\frac{\boxed{560}}{43560}$$

VP3



X	Y	Species	Comments
	0	6 Silky Dogwood	
	1	1 Silky Dogwood	Live Stake
	2	1 Black Willow	Live Stake
	3	1 Black Willow	Live Stake
	5	24 Tulip Poplar	
	5	1 Silky Dogwood	Live Stake
	6	1 Black Willow	Live Stake
	10	2 Silky Dogwood	Live Stake
	11	2 Silky Dogwood	
	12	1 Black Willow	Live Stake
	14	33 Black Gum	
	16	9 Aronia	
	16	6 Silky Dogwood	
	16	2 Silky Dogwood	Live Stake
	19	1 Black Willow	Live Stake
	23	18 Tulip Poplar	
	25	8 Silky Dogwood	
	33	23 Sugar berry	
	34	15 Silky Dogwood	Technically Out, not counted
		9 stems	9 Live Stakes

$$\frac{9}{1089} =$$

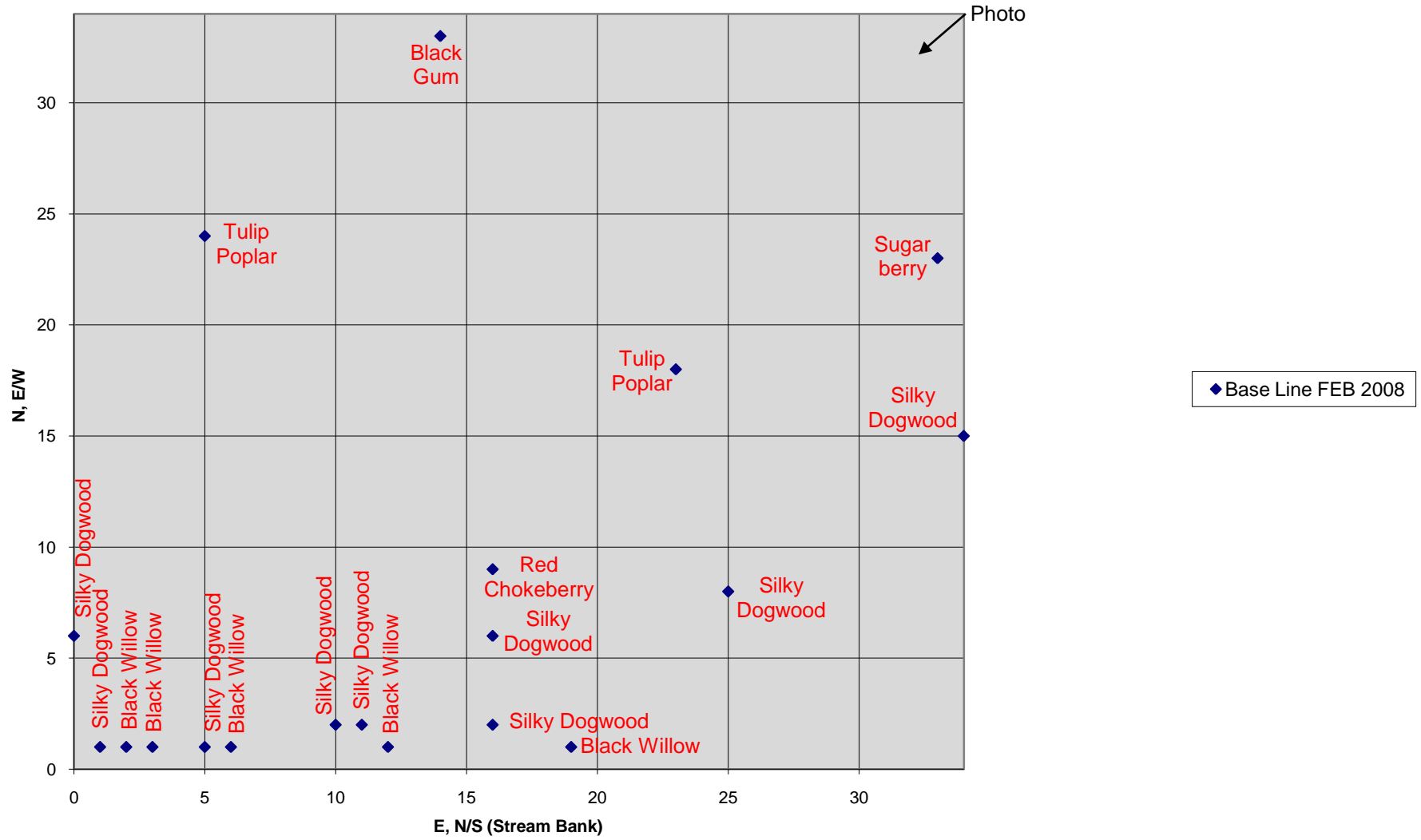
$$\frac{360}{43560}$$

W/ LS

$$\frac{18}{1089} =$$

$$\frac{720}{43560}$$

VP 4



X	Y	Species	Comments
	5	0 Black Willow	Live Stakes
	6	0 Black Willow	Live Stakes
	7	0 Silky Dogwood	Live Stakes
	8	0 Black Willow	Live Stakes
	9	0 Silky Dogwood	Live Stakes
	10	0 Silky Dogwood	Live Stakes
	11	24 Tulip Poplar	
	11	10 Oak Sp.	
	11	0 Silky Dogwood	Live Stakes
	13	0 Black Willow	Live Stakes
	15	0 Black Willow	Live Stakes
	20	26 Oak Sp.	
	22	0 Alder	Transplant
	25	6 Black Gum	
	25	0 Green Ash	Transplant
	26	0 Alder	Transplant
	28	0 Alder	Transplant
	31	19 Tulip Poplar	
		9 stems	9 Live Stakes

$$\frac{9}{1089} =$$

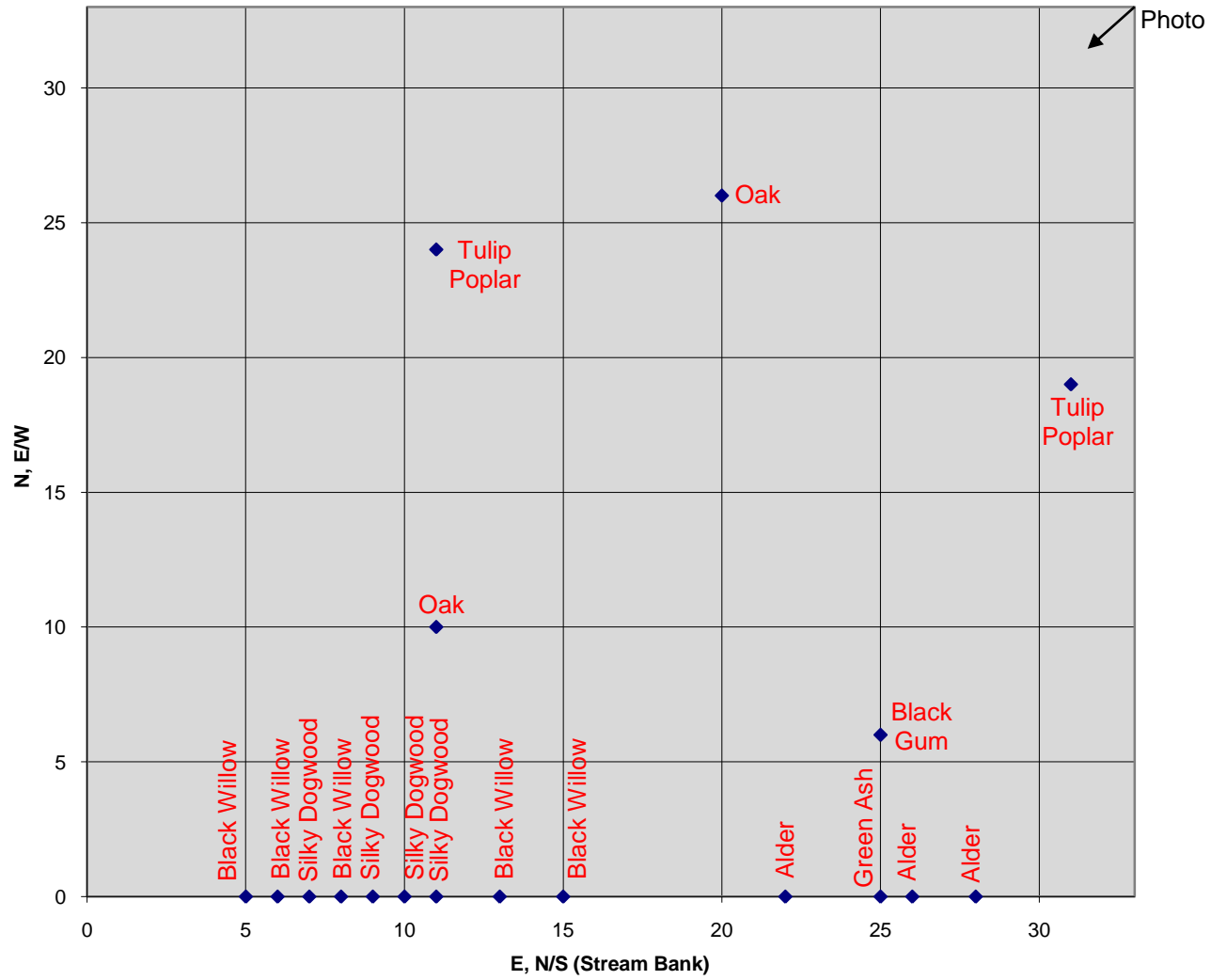
$$\frac{360}{43560}$$

W/ LS

$$\frac{18}{1089} =$$

$$\frac{720}{43560}$$

VP 5



X	Y	Species	Comments
	2	31 River Birch	
	1	23 Black Willow	Live Stake
	1	22 Silky Dogwood	Live Stake
	2	20 Silky Dogwood	Live Stake
	1	18 Silky Dogwood	Live Stake
	1	14 Black Willow	Live Stake
	3	11 Alder	Transplant
	4	5 Silky Dogwood	
	1	26 Silky Dogwood	Live Stake
	2	25 Silky Dogwood	Live Stake
	5	18 Silky Dogwood	
	5	25 Silky Dogwood	
	12	6 Alder	Transplant
	14	13 River Birch	
	14	19 Silky Dogwood	
	15	28 Oak Sp.	
	28	27 Oak Sp.	
	20	18 Sugarberry	
	24	10 River Birch	
	32	6 Red Chokeberry	
	33	16 Black Gum	
		14 stems	7 live stakes

$$\frac{14}{1089} =$$

560

43560

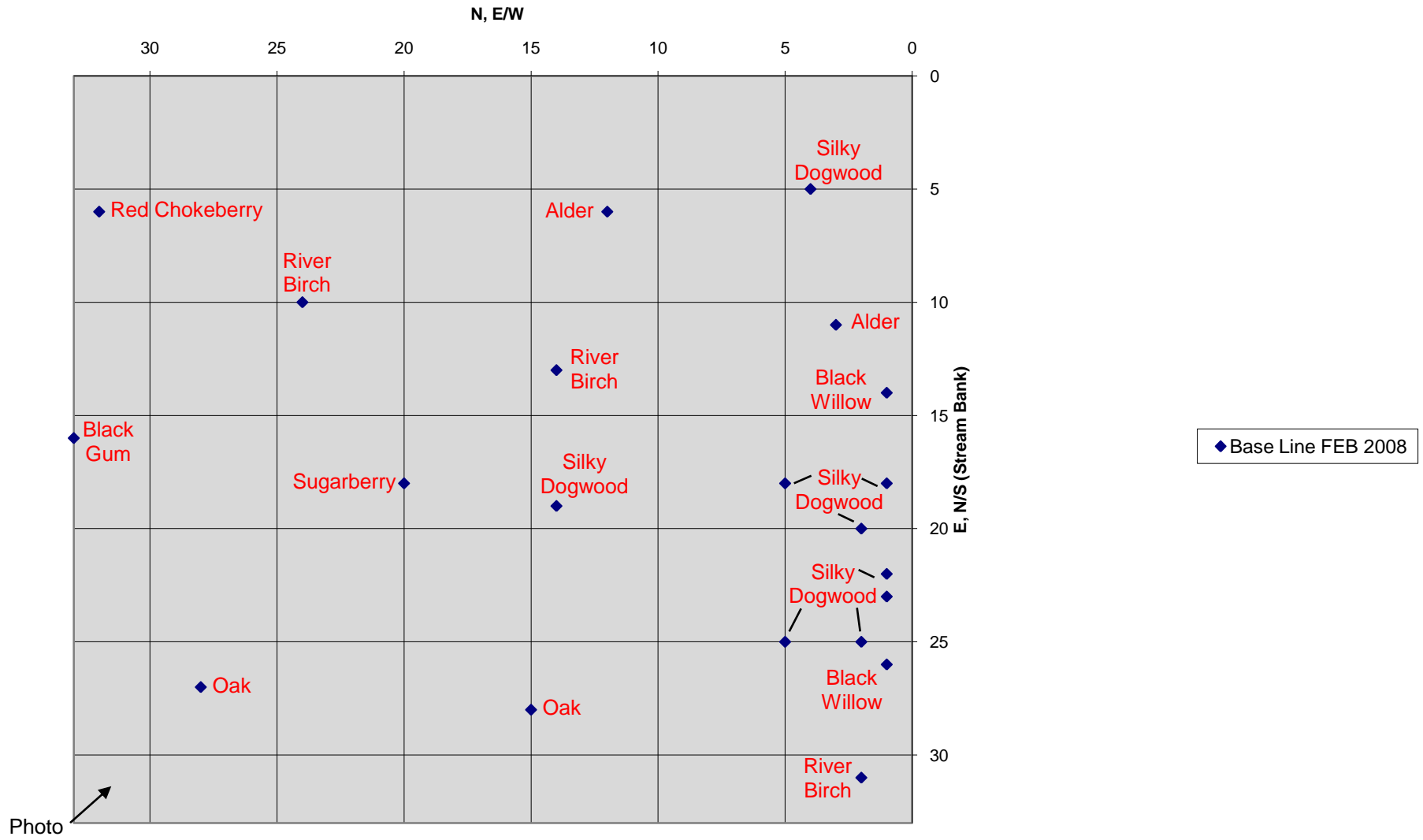
W/ LS

$$\frac{21}{1089} =$$

840

43560

VP 6



Hardwood Tree and Shrub Planting Baseline Initial Totals for Stricker Branch Stream Restoration Site

Scientific Name	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Species Total	
<i>Alnus serrulata</i>			2		3	2	7	
<i>Aronia arbutifolia</i>	1	1		1		1	4	
<i>Betula nigra</i>	2	1	1			3	7	
<i>Celtis laevigata</i>			1	1		1	3	
<i>Cephalanthus occidentalis</i>			1				1	
<i>Cornus amomum</i>	1		3	8	4	9	25	16 livestakes
<i>Fraxinus pennsylvanica</i>		1			1		2	
<i>Hamamelis virginiana</i>	1	6					7	
<i>Lindera benzoin</i>							0	
<i>Liriodendron tulipifera</i>	2	1		2	2		7	
<i>Nyssa sylvatica</i>	1	1		1	1	1	5	
<i>Quercus michauxii</i> *	4	6	4		2	2	18	
<i>Quercus nigra</i>							0	
<i>Quercus phellos</i>							0	
<i>Salix nigra</i>			2	5	5	2	14	14 livestakes
Total	12	17	14	18	18	21	100	
Stem Per Acre	480	680	560	720	720	840	667	
SPA w/o live stakes	480	680	360	360	360	560	467	

* All Oak Species listed as michauxii until identification can be made