Purlear Creek Phase II Mitigation Report

Wilkes County, North Carolina

USGS HUC: 03040101 10090

Project ID No. 010559701

EEP Project Manager: Julie Vann

Prepared for:

NCDENR-Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, North Carolina 27699-1652

June 2006

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Executive Summary

Phase II of the Purlear Creek Stream and Wetland Restoration project falls within the Hayes Property in Wilkes County, North Carolina approximately 8 miles northwest of the Town of Wilkesboro. All site streams and wetlands lie within USGS hydrologic unit **03040101**10090 in the Yadkin River Basin.

The site consists of two reaches: a 1,087 linear foot portion of Purlear Creek immediately downstream of Phase I (Reach 1; Drainage Area = 3.0 mi^2) and a 1,400 linear foot portion of a tributary to Purlear Creek (Reach 4; Drainage Area = 0.4 mi^2). Both reaches drain a watershed consisting of predominantly protected forest land (76% of total land cover) and agricultural land (24% of total land cover). Residential development has recently begun in the watershed. Pasture land surrounds the project reaches and the stream banks lack strong rooted vegetation (e.g. woody or deep rooted herbaceous vegetation). Due to the lack of bank protection, and denuded watershed, the stream channel has incised and entrenched. In this condition and with regular impacts due to cattle traffic, bank erosion has accelerated and the variety of bed features has diminished. The channel materials exhibit a bimodal distribution with peaks in silt and cobble. Bank erosion likely caused the abundance of silt.

Riverine wetlands lie adjacent to Reach 4. Groundwater seepage and over bank flooding make up the primary hydrologic inputs to these wetlands. Entrenchment of the adjacent channel (Reach 4) has reduced the duration and frequency of hydrologic inputs from overbank flow. Downcutting of the channel has reduced groundwater levels of the wetlands in a zone adjacent to the channel. The wetland areas (W-2) lacking hydrological inputs from groundwater seepage have been severely degraded. Woody vegetation covers a portion of the riverine wetlands. The remaining wetland areas consist of herbaceous wetland plants that have been overgrazed by cattle.

For most of the riparian buffer, a thin, 10 to 20 foot wide strip of woody vegetation surrounds the stream banks with the remaining width of buffer dominated by pasture grasses. Some portions of the riparian zone feature a wider strip of woody vegetation extending up to 40 feet from the stream bank and other portions of the riparian zone consists almost entirely of pasture grasses with scattered woody vegetation on the banks. Riparian zone woody vegetation includes red maple (*Acer rubrum*), sycamore (*Plantus occidentalis*), river birch (*Betula nigra*), and yellow poplar (*Liriodendron tulipifera*). Chinese privet (*Ligustrum sinense*) has invaded the understory of extant zones of woody vegetation.

The altered conditions of the stream, wetland, and the riparian buffer have reduced water quality and impaired habitat. Pasture derived nutrients flowing untreated through the riparian zone and fine silts sloughing from the incised banks have raised biological and chemical oxygen demand. This with the lack of sufficient reoxygenating riffle features has reduced dissolved oxygen within the water column. Water quality has also diminished due to raised turbidity from bank erosion and elevated water temperatures caused by the lack of tree shading. Habitat potential has been reduced by the diminished water quality and loss of physical habitat such as bed features, undercut banks, and a well developed vegetative community.

The reaches were restored using a combination of Priority I and Priority II approaches. Reach 1 was restored within the existing floodplain using the Priority II approach. For Reach 4, restoration proceeded thought a Priority I approach where a new channel was cut into the abandoned floodplain. The reconnection of Reach 4 to its historic floodplain should elevate local groundwater levels and increase the frequency and duration of overbank flooding. The increased flooding and raised groundwater levels should restore hydrology to the adjacent riverine wetlands. The unforested riverine and non-riverine wetlands and riparian buffer were replanted with native woody species to restore ecological function to the wetlands and buffer.

Site restoration work should result in the restoration of 2,487 linear feet of stream, the restoration of 1.05 acres of wetlands, and the restoration of 4.6 acres of riparian buffer. With the restoration, water quality should be improved due to a decrease in nutrients, turbidity, and moderation in water temperature. Biological and chemical oxygen demand should be reduced through filtering in the riparian buffer and riverine wetlands. Potential habitats have been added through the creation of bed features, stable undercut stream banks, and reestablishment of riparian vegetative community.

The monitoring plan will assess the sites streams, wetlands, and riparian area to determine restoration success. The monitoring plan will be set up based on guidance provided by The Stream Mitigation Guidelines disseminated by the United States Corps of Engineers – Wilmington District (McLendon, Scott, Fox, Becky et al. 2003).

Stream restoration will be considered successful through achievement of stable channel geometry, appropriate channel materials, and lack of significant erosion. Wetlands will be considered successful through a reestablishment of an appropriate duration and frequency of soil saturation. Both the wetlands and riparian buffer will be investigated for survivability of planted vegetation and exclusion of nuisance species.

The site will be maintained during the monitoring period to ensure accordance with success criteria. Repairs will be completed as necessary to reestablish channel stability and the site will be replanted if vegetation shows signs of significant failure.

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Attachment 1: As-Built Drawings

Narrative

Phase II of the Purlear Creek Stream and Wetland Restoration project lies within the Hayes Property in Wilkes County, North Carolina approximately 8 miles northwest of the Town of Wilkesboro. All site streams and wetlands fall within USGS hydrologic unit **03040101** in the Yadkin River Basin. The site watershed lies in the lower portion of the **03040101**10090 watershed and feeds into the North Prong Lewis Fork stream. This watershed is part of the water supply watershed for the W. Scott Kerr Reservoir. The site as defined by the protective conservation easement surrounding the streams, wetlands, and riparian buffers covers approximately 7.47 acres.

The site consists of two reaches: a 1,087 linear foot portion of Purlear Creek immediately downstream of Phase 1 (Reach 1; Drainage Area = 3.0 mi^2) and a 1,400 linear foot portion of a tributary to Purlear Creek (Reach 4; Drainage Area =0.4 mi^2). Both reaches drain a watershed consisting of predominantly protected forest land (76% of total land cover) and agricultural land (24% of total land cover). Residential development has recently begun in the watershed.

Pasture land that supports an ongoing cattle operation surrounded most of the length of project reaches. In Reach 4, a strip of woody vegetation 1 to 2 trees wide lined the stream. A portion of Reach 4 near an existing riverine wetland had a woody riparian buffer extending at least 20 feet from the left side of the stream. The woody vegetation lining Reach 1 extended outward further encompassing a width 2 to 4 trees wide. Overall, the stream banks lacked sufficient strong rooted vegetation (e.g. woody or deep rooted herbaceous vegetation). Due to the lack of sufficient bank protection and denuded watershed, the stream channel incised and entrenched. Entrainment calculations predicted that the reaches would continue to degrade the channel. The BEHI score for the reach was Very High. In this condition and with regular impacts due to cattle traffic, bank erosion accelerated and the riffle-pool sequence of the stream bed diminished. The channel materials exhibited a bimodal distribution with peaks in silt and cobble. Bank erosion likely caused the abundance of silt. With active cattle grazing in the area, the channel would have continued to receive impacts. The reach stream type was F4 and without restoration would have likely continued to widen, resulting in high sediment loads and impaired habitat.

Riverine wetlands lay adjacent to Reach 4. Groundwater seepage and over bank flooding make up the primary hydrologic inputs to these wetlands. Entrenchment of the adjacent channel (Reach 4) reduced the duration and frequency of hydrologic inputs from overbank flow. Downcutting of the channel reduced groundwater levels of the wetlands in a zone adjacent to the channel. Woody vegetation covered a portion of the riverine wetlands. The remaining riverine and groundwater seep wetlands consisted of a mix of pasture grasses and herbaceous wetland plants such as *Juncus spp.* and *Polygunum spp.* in the wetter areas. The wetland areas were severely disturbed by cattle intrusion and hoof shear.

A thin, 10 to 20 foot wide strip of woody vegetation surrounding the stream banks with the remaining width of buffer dominated by pasture grasses composed much of the riparian buffer. Some portions of the riparian zone featured a wider strip of woody vegetation extending up to 40 feet from the stream bank and other portions of the riparian

zone consisted almost entirely of pasture grasses with scattered woody vegetation on the banks. Riparian zone woody vegetation includes red maple (*Acer rubrum*), sycamore (*Plantus occidentalis*), river birch (*Betula nigra*), and yellow poplar (*Liriodendron tulipifera*). Chinese privet (*Ligustrum sinense*) has invaded the understory of extant zones of woody vegetation.

The goal of the restoration project is to improve the water quality and biological habitat of the site's streams, wetlands, and riparian buffers through the following:

- Restore (pattern, dimension, and profile) unstable streams using natural channel design techniques
- Restore wetlands through modifications to hydrology, vegetation, and soils
- Re-establish riparian buffers

A mix of Priority I and Priority II restoration approaches were used for this project. Where applicable the Priority I restoration approach returned the stream channels to relic channels to return water table levels to historic values. In all applicable areas both Priority I and Priority II were used to re-establish an active floodplain and stabilize the stream banks (Rosgen, David L. 1997). This method should: decrease stream bank erosion, establish an active floodplain, reduce channel stress during floods, improve aquatic habitat, and reduce fine sediments.

A Priority I approach was used for Reach 4 adjacent to the wetland. Through re-establishment of the historical channel bed elevation, the water table adjacent to the stream should rise so that the wetland hydrology is restored in the adjacent wetland areas. The wetland hydroperiod should be improved such that the degree and duration of saturation at the soil surface is extended during the growing season, supporting the restored wetland communities. In addition, with reduced bank heights and an active floodplain, the wetland hydrology in the adjacent wetlands should be supplemented periodically with more frequent over-bank flooding.

The raised water table and more frequent over bank flooding should alter the hydrology, rehabilitating existing wetlands and re-establishing other wet areas by expanding the existing wetland fringe. "Re-establishment" and "rehabilitation" are both defined by the Corp as "restoration" in Regulatory Guidance Letter No. 02-2 (United States Army Corps of Engineers 2002).

The restoration plan assumes that the long-term vegetation community of the wetland should be dominated by herbaceous wetland plants. Also, the site appears to have a significant seed bank available (existing wetland herbaceous plants, and upstream seed sources). Therefore, the planting plan for the wetland restoration used a supplemental planting/seeding plan for the area. The challenge for the wetland restoration site with regards to vegetation should not be the establishment of wetland species, but rather the control and management of the vegetation to produce a diverse herbaceous community without dominance of invasive species.

The riparian buffer was planted as three zones. Zone 1 is the stream bank zone consisting of tree and shrub species and native herbaceous seeding typically found along stream banks in the region. Zone 2 is a forested riparian area consisting of selected tree and

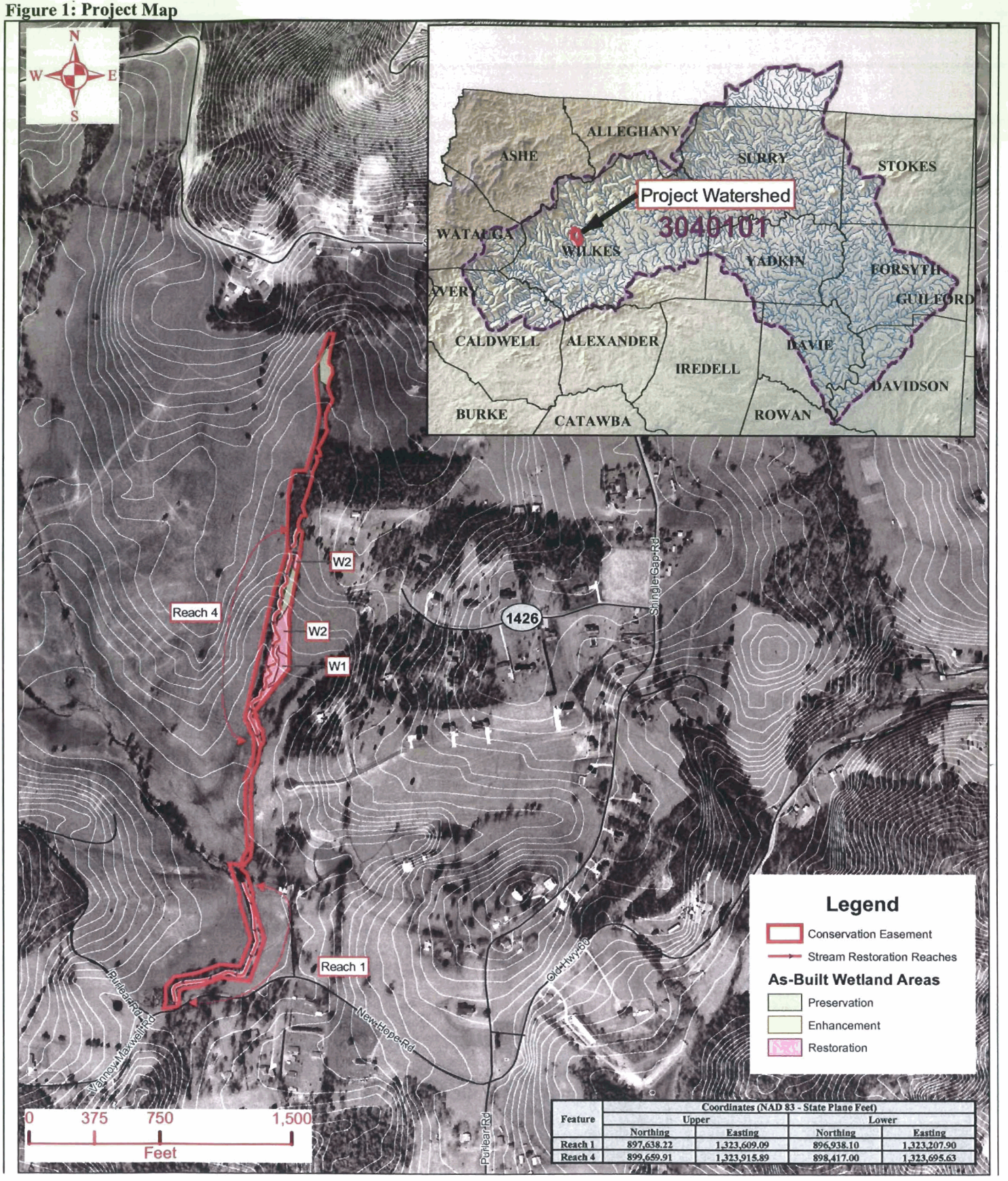
shrub species, with varying tolerances of inundation and saturation, that was selectively planted based on microtopography and moisture regime. Zone 3 is a grass filter strip designed to promote dispersed flow into the forested riparian zone (Zone 2).

Zones 1 and 2 were planted with transplants, livestakes, and bare root seedlings. Planting spacing was determined according to planting type. The entire easement was planted.

Table 1: Mitigation Summary Table

Feature	Pre Construction Length/Area	Proposed Length/Area	Mitigation Type	Mitigation Credit Ratio	Mitigation Credits
Reach 1	1,087 ft	1,087 ft	Restoration	1 : 1	1,087 ft
Reach 4	1,324 ft	1,400 ft	Restoration	1 : 1	1,400 ft
Tract W1	0.21 ac	0.21 ac	Restoration	2 : 1	0.21 ac
Tract W2	0.84 ac	0.84 ac	Restoration	2 : 1	0.84 ac
		Total Stream Credits (SMU)			**2,487 ft**
		Total Buffer Credits			**-- ac**
		Total Wetland Credits (WMU)			**1.05 ac**

Figure 1: Project Map



Feature	Coordinates (NAD 83 - State Plane Feet)			
	Upper		Lower	
	Northing	Easting	Northing	Easting
Reach 1	897,638.22	1,323,609.09	896,938.10	1,323,207.90
Reach 4	899,659.91	1,323,915.89	898,417.00	1,323,695.63

Monitoring Plan

The monitoring plan to evaluate the success of the stream restoration project is based on guidance provided by The Stream Mitigation Guidelines (McLendon, Scott, Fox, Becky et al. 2003) disseminated by the United States Corps of Engineers – Wilmington District and recommendations from the Ecosystem Enhancement Program. The collection and summarization of monitoring data will be conducted in accordance with the most current version of the EEP documents entitled "Content, Format, and Data Requirements for EEP Monitoring Reports"

The monitoring will occur annually for five years. The monitoring period should include two separate years with bankfull events. Bankfull events will be verified using an installed crest gauge that will be inspected during each monitoring visit. If a bankfull event has not been documented by the end of the second year of monitoring, a mandatory quarterly check will be required. If there are not two bankfull events, the monitoring period may be extended at the discretion of the Corps of Engineers, Raleigh Regulatory Field Office Project Manager and the 401-Wetlands Unit. Monitoring reports will be submitted during years 1-5.

Monitoring work will include reference photographs, materials sampling, site survey, and visual assessment and mapping of significant features. The success criteria and assessment methods for the sites streams, wetlands, and riparian buffer are provided below.

Stream Monitoring

Success Criteria

The stream geometry will be considered successful if the cross-section geometry, profile, and sinuosity are stable or reach a dynamic equilibrium. It is expected that there will be minimal changes in the designed 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, mid-channel bars, 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 Baseline Morphology and Hydraulic Summary table found in the included Year 0 monitoring report or in comparable and stable reference systems.

Deviation from the design ratios will not necessarily denote failure as it is possible to maintain stability and not stay within the design geometry. Additionally, determination of true bankfull will be difficult until the stream has had adequate flooding events to create strong bankfull indicators. The following key indicators of stability provide a more complete picture of stream stability:

- Stream Type: Maintenance of the design stream type or progression or conversion to stable stream type such as B, 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

Assessment Methods

The survey of channel dimension consists of 10 permanent cross sections placed at unique stream segments throughout the project extent. The cross sections represent 50% riffles and 50% pools. Annual photographs showing both banks and upstream and downstream views will be taken for each cross section.

The survey of the longitudinal profile covers the entire extent of the project reaches. The centerline of the channel should be used as a baseline and thalweg measures should be stationed relative to the centerline. Newly-constructed meanders will be surveyed to provide pattern measurements.

Channel material measurements will be collected by using pebble counts for four locations representing the upper and lower sections of each reach.

Eleven permanent photo stations have been set up to visually monitor stream and wetland conditions. These photo stations are mapped on the As-Built drawings.

The entire restored length of stream will be investigated for channel stability and in-stream structure functionality. Any evidence of channel instability will be identified, mapped, and photographed. All structures will be inventoried for functionality and photographed.

Wetland Monitoring

Success Criteria

The success of wetland restoration will be measured by: (1) comparing the restored wetlands with similar, more functional wetlands with respect to vegetation, soils, and hydrology; and (2) comparing hydrology to USACE criteria and vegetation to USACE mitigation success criteria. Success criteria are summarized in the following sections.

Hydrology

Hydrology monitoring should demonstrate that the degree and duration of saturation within the upper 12 inches of the soil has been raised by restoration of the base flow elevation of the adjacent stream channel and raising local water table elevations. Duration and frequency of flooding/inundation in the floodplain wetland should be increased through reconnecting the stream to the active floodplain and the adjacent wetland area.

The hydrologic success of the wetland restoration site will be determined by evaluation of water table data within the wetland area collected daily at the two monitoring locations and comparison the Basin Creek reference wetland and USACE guidelines. Success will be determined as:

- Saturation/inundation of the soil surface for 12.5 percent of the growing season
- Hydroperiod within 50 percent of the reference wetland during the first three years, and 20 percent during the fourth and fifth year of monitoring.

The first success criterion for hydrology is determined as achieving inundation and/or saturation within the upper 12 inches of the soil, for consecutive days totaling 12.5% of the growing season. According to the Wilkes County Soil Survey (Tuttle, John W. 1997), the growing season is determined as April 11 to October 26 (dates of 28° F in 5 of 10 years, approximating frost-free days). The 1987 Corps of Engineers Wetland Delineation Manual states that areas irregularly inundated or saturated for 5 to 12.5 percent of the growing season generally support wetland hydrology. Therefore, success criteria for hydrology of the wetland restoration will be to achieve 25 consecutive days (12.5%) of saturation in the upper 12 inches of soil.

Water table data collection of the reference wetland will continue (North Carolina State University) and will be compared to the restoration wetland data to evaluate seasonal conditions and fluctuations (hydroperiod) through the monitoring period. The second criterion will be to achieve a hydroperiod within 50 percent of the reference wetland within the first three years of monitoring, and within 20 percent within the fourth and fifth years.

Rainfall data from the W. Kerr Scott Reservoir weather station and the North Wilkesboro Airport weather station (approximately 5 and 7 miles from the restoration site) will be used to evaluate rainfall through the monitoring period.

Vegetation

The prevalent vegetation should consist of macrophytes that typically are adapted for life in saturated soil conditions. These species should have the ability to grow, compete, reproduce, and persist in anaerobic soil conditions. A reduction in the percentage of nuisance vegetation in wetlands areas with existing vegetation to less than 15% will indicate enhancement of wetland vegetation. For the restoration areas, study plots showing that the composition and density of vegetation in the restoration areas that compares closely to the reference areas will indicate restoration success for vegetation. Achievement of stems counts described in the riparian success criteria will also indicate restoration success.

Soil

A primary measure of the enhancement and restoration of wetlands soils will be the establishment of hydric character as defined by USACE guidelines (United States Army Corps of Engineers 1987). Soil enhancement and restoration also may be inferred based on successful enhancement and restoration of wetland hydrology and vegetation.

Assessment Methods

Wetland hydrology will be measured using groundwater wells that were set up before restoration efforts began. The wells will sample groundwater elevations continuously

throughout the monitoring period. Vegetation success will be assessed using methods described in the riparian buffer section.

Riparian Buffer

Success Criteria

The success of riparian and wetland vegetation planting will be gauged by stem counts of planted species. Stem counts of over 320 trees per acres after 3 years, 288 trees per acre after 4 years, and 260 trees per acre after 5 year will be considered successful. Photos taken at established photo points should indicate maturation of riparian vegetation community.

Assessment Methods

The success of vegetation plantings will be measured through stem counts. Eight (8) permanent quadrants will be used to sample the riparian buffer and restoration wetlands. Six (6) quadrants cover 100 square meters and two (2) cover 50 square meters. The area of the smaller quadrants was reduced to accommodate the narrow riparian buffer. During the counts, the health of the vegetation will be noted. In addition to stem counts, the samples will inventory species to allow for comparison between the reference and restoration wetlands and track the population of the nuisance species. The vegetation survey will occur during the growing season. Permanent photo points have been set up for each quadrant.

References

McLendon, Scott, Becky Fox, et al. (2003). Stream Mitigation Guidelines. United States Army Corps of Engineers - Wilmington District, United States Environmental Protection Agency, North Carolina Wildlife Resources Commission and North Carolina Department of Natrual Resources - Division of Water Quality.

Rosgen, David L. (1997). A Geomorphic Approach to Restoration of Incised Rivers. Management of Landscapes Disturbed by Channel Incision.

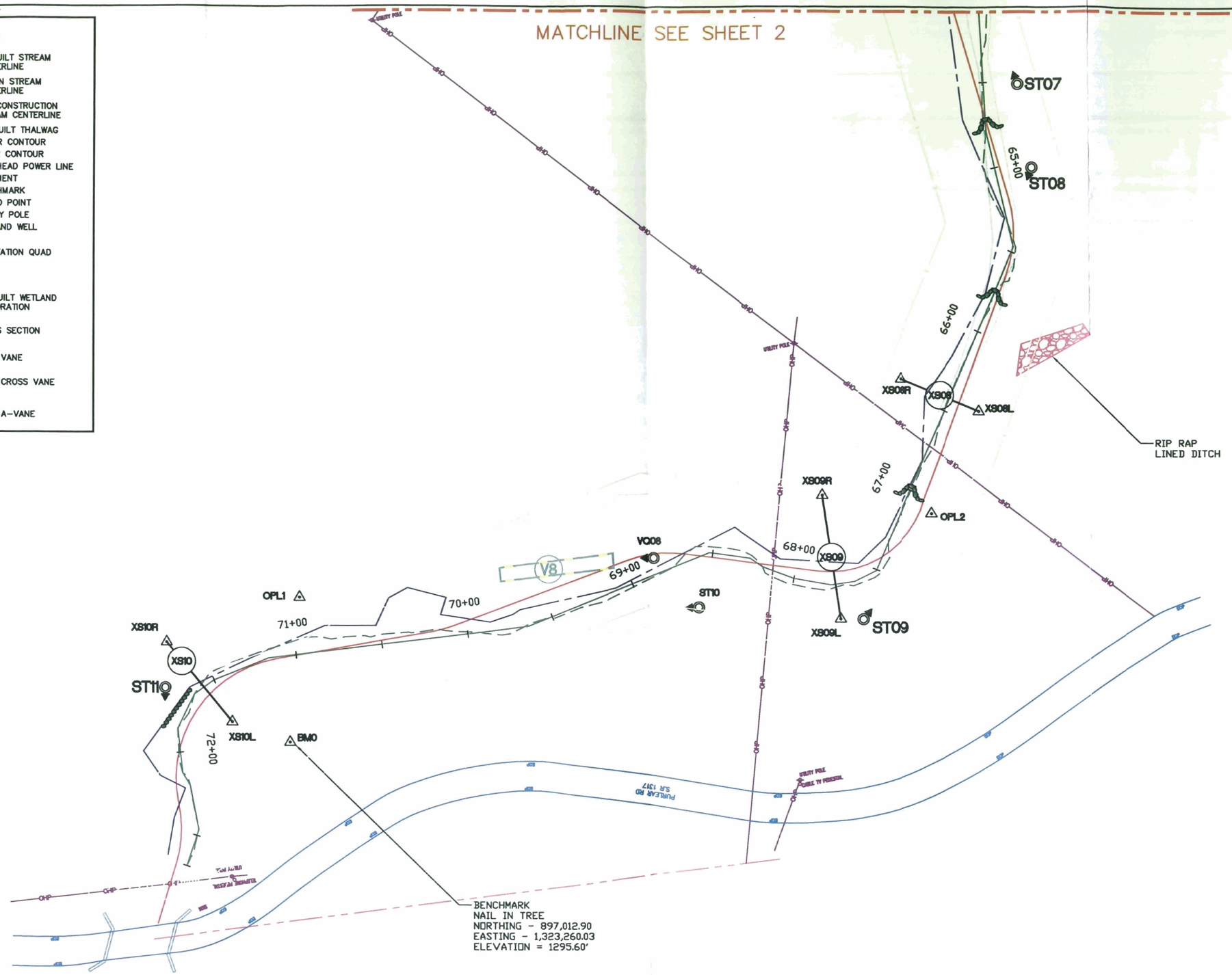
Tuttle, John W. (1997). Soil Survey of Wilkes County, North Carolina. Natural Resouces Conservation Service, United States Department of Agriculture.

United States Army Corps of Engineers (1987). Corps of Engineers Wetlands Delineation Manual. Waterways Experiment Station, Environmental Laboratory.

United States Army Corps of Engineers (2002). Regulatory Guidance Letter. Wilmington, United States Army Corps of Engineers - Wilmington.

LEGEND

- AS BUILT STREAM CENTERLINE
- DESIGN STREAM CENTERLINE
- PRE CONSTRUCTION STREAM CENTERLINE
- AS-BUILT THALWAG
- MAJOR CONTOUR
- MINOR CONTOUR
- OVERHEAD POWER LINE
- EASEMENT
- BENCHMARK
- PHOTO POINT
- UTILITY POLE
- WETLAND WELL
- VEGETATION QUAD
- AS-BUILT WETLAND RESTORATION
- CROSS SECTION
- ROCK VANE
- ROCK CROSS VANE
- ROCK A-VANE



GRAPHIC SCALE

30 0 15 30 60

(IN FEET)

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NCEEP

TITLE: AS-BUILT 0 YEAR DATA

SEAL:

DATE: 06/05/06
HORIZONTAL SCALE:
VERTICAL SCALE:
DRAWN BY: JIK
DESIGNED BY: ARK
CHECKED BY: WRW

PROJECT: WILKES COUNTY PURLEAR CREEK PHASE II

SCO I.D.#: 010559701
JOB NUMBER: 011795013
SHEET NO.: 1

MATCHLINE SEE SHEET 3

LEGEND

- AS BUILT STREAM CENTERLINE
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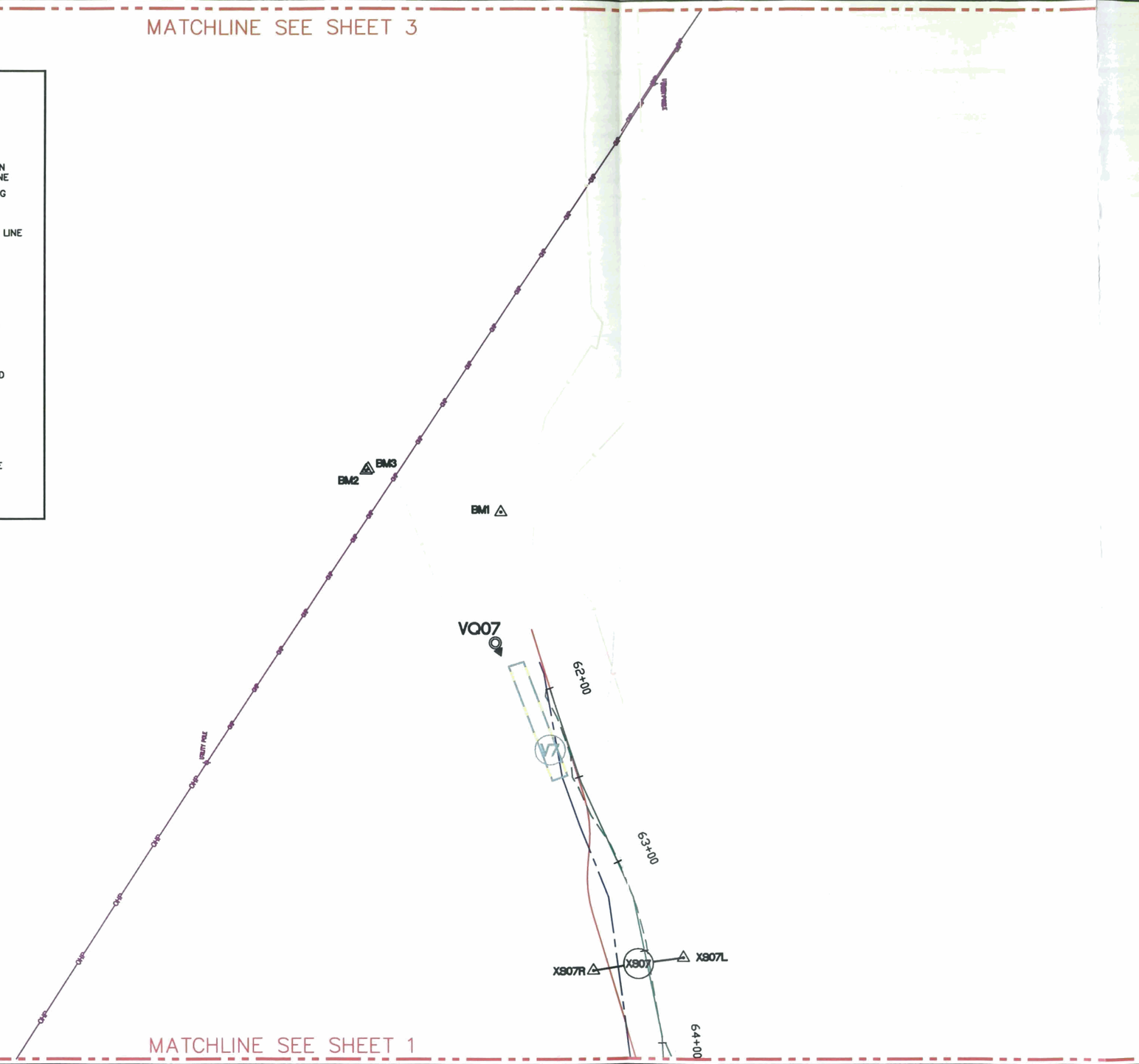

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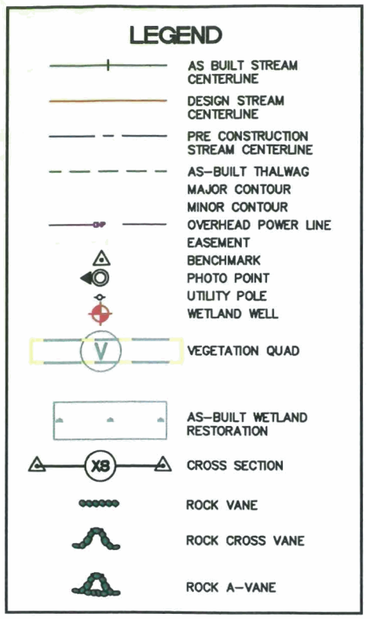
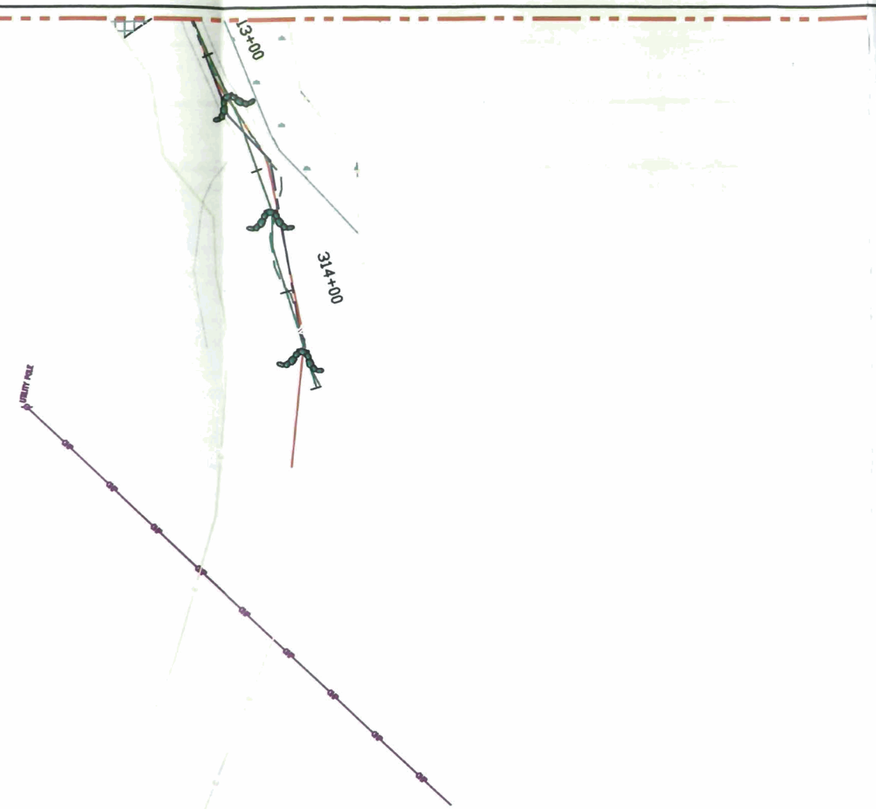
WILKES COUNTY
PURLEAR CREEK
PHASE II

SCO I.D.#	JOB NUMBER:	SHEET NO.:
010559701	011795013	2

MATCHLINE SEE SHEET 4





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SHEET NO.: 3

MATCHLINE SEE SHEET 5

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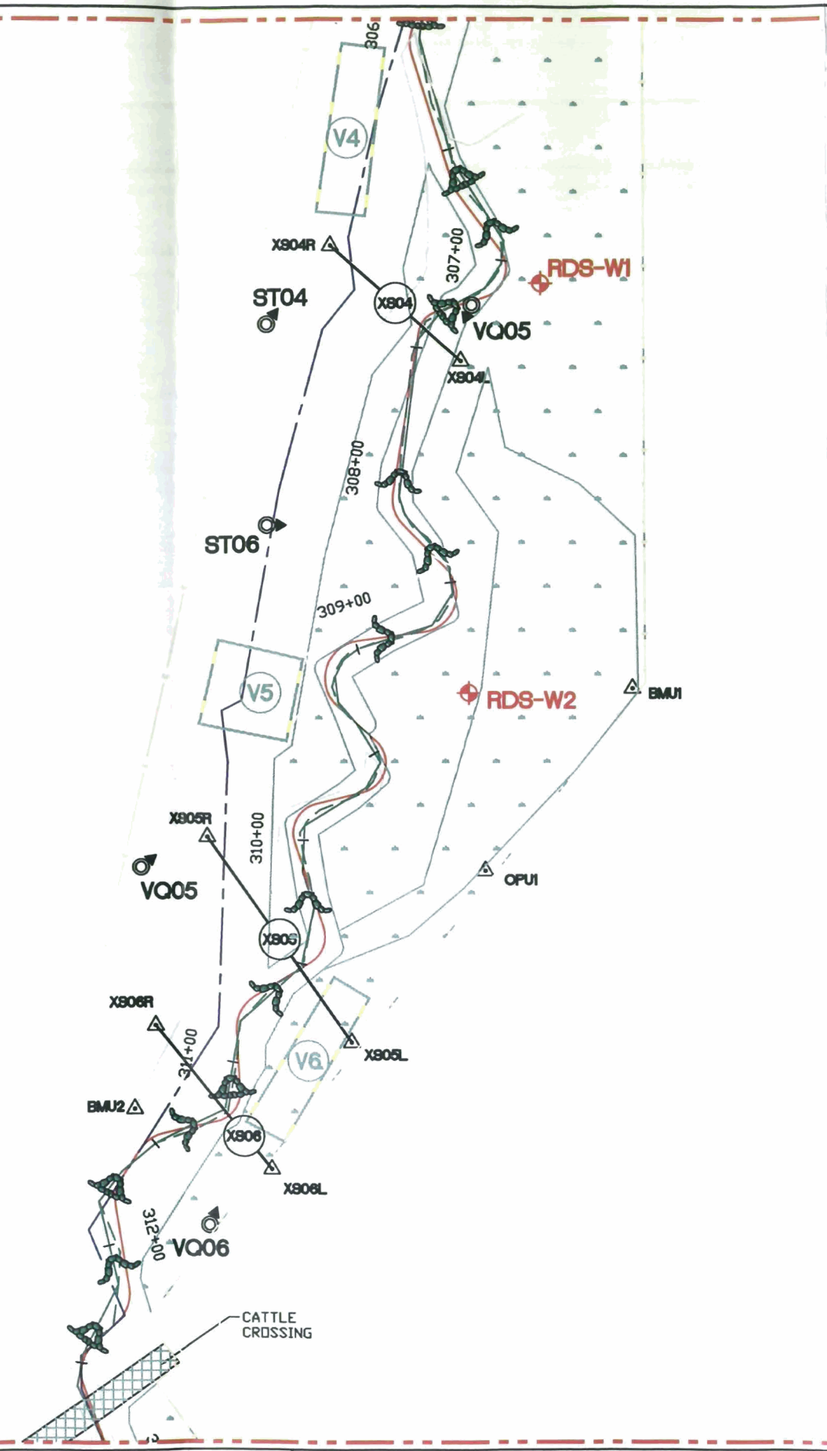

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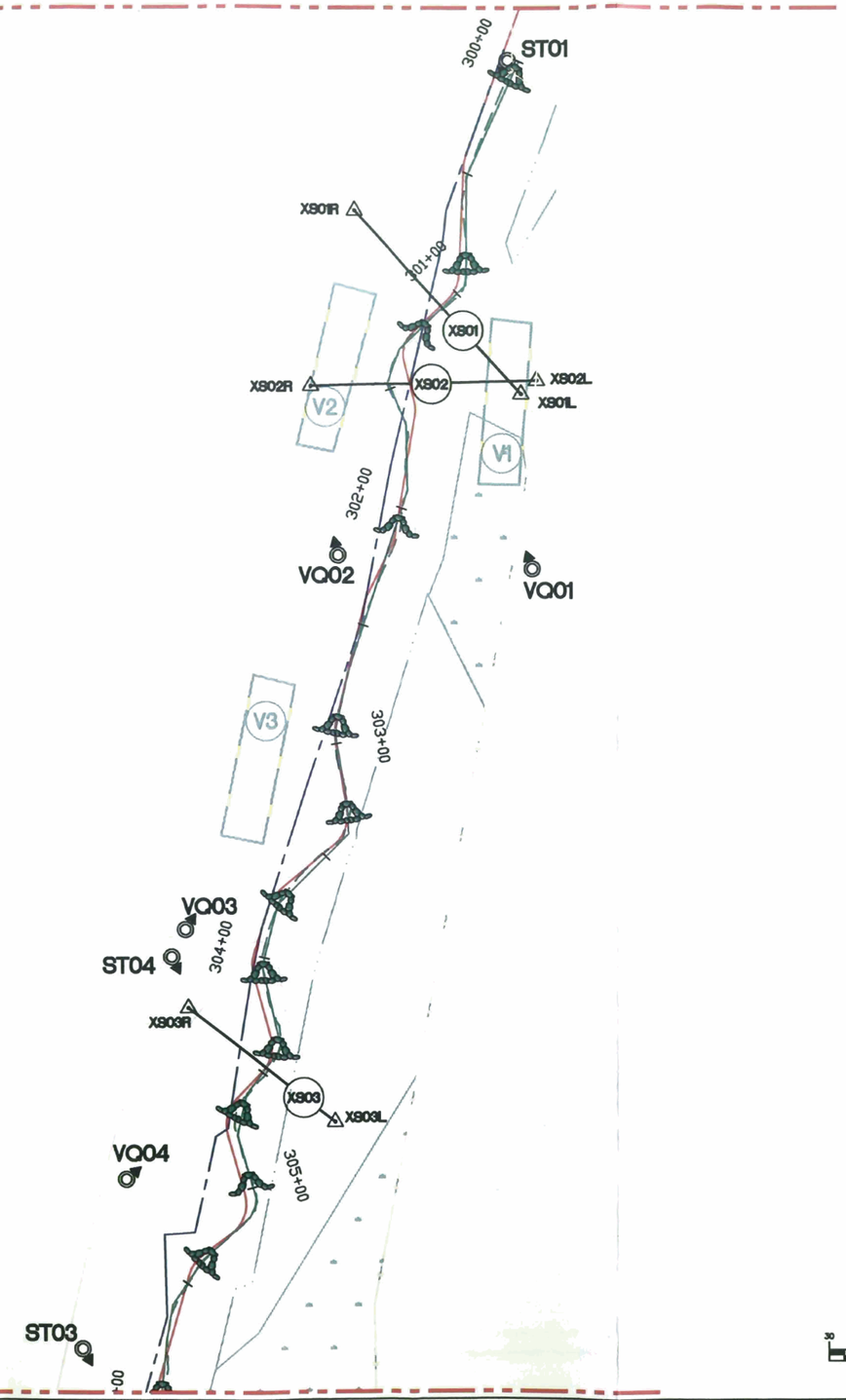
- ROCK CROSS VANE
- ROCK A-VANE



MATCHLINE SEE SHEET 4

GRAPHIC SCALE

30 0 15 30 60

(IN FEET)

REV. No.:	REVISION:	DATE:	DRAWN BY:	CHECKED BY:

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AS-BUILT
0 YEAR DATA

SEAL:

DATE: 06/05/06
HORIZONTAL SCALE:
VERTICAL SCALE:
DRAWN BY: JIK
DESIGNED BY: ARK
CHECKED BY: WRW

PROJECT: WILKES COUNTY PURLEAR CREEK PHASE II

SCO I.D.#: 010559701
JOB NUMBER: 011795013
SHEET NO.: 5

LEGEND

- AS BUILT STREAM CENTERLINE
- DESIGN STREAM CENTERLINE
- PRE CONSTRUCTION STREAM CENTERLINE
- AS-BUILT THALWAG
- MAJOR CONTOUR
- MINOR CONTOUR
- OVERHEAD POWER LINE
- EASEMENT
- BENCHMARK
- PHOTO POINT
- UTILITY POLE
- WETLAND WELL
- VEGETATION QUAD
- AS-BUILT WETLAND RESTORATION
- CROSS SECTION
- ROCK VANE
- ROCK CROSS VANE
- ROCK A-VANE

MATCHLINE SEE SHEET 5

GRAPHIC SCALE

30 0 15 30 60

(IN FEET)

REV. No.:	REVISION:	DATE:	DRAWN BY:	CHECKED BY:

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PROJECT: WILKES COUNTY PURLEAR CREEK PHASE II

SCO I.D.#: 010559701
JOB NUMBER: 011795013
SHEET NO.: 6