

WHITELACE CREEK STREAM ENHANCEMENT  
AND WETLAND RESTORATION SITE  
MONITORING REPORT (YEAR 3 OF 5)

Lenoir County, North Carolina  
EEP Project No. 420



Prepared for:  
North Carolina Ecosystem Enhancement Program  
1652 Mail Service Center  
Raleigh, NC 27699-1652



Status of Plan: Final  
Submission Date: April 2009

Monitoring Firm:



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**Stantec**

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## EXECUTIVE SUMMARY

The North Carolina Ecosystems Enhancement Program (EEP) enhanced 5,901 linear feet of the Whitelace Creek stream channel located west of Kinston, in Lenoir County, North Carolina. Additionally, 7.7 and 13.0 acres of wetland area were restored and enhanced, respectively. The site construction was completed in August of 2005, and planting occurred in March of 2006. This report provides the monitoring information for year three (3) of the stream enhancement and wetland restoration project.

The project consists of a tributary of the Neuse River Basin, located in Lenoir County, within an EEP-owned conservation easement 6.5 miles west of Kinston. The site is located adjacent to the Kennedy Home, approximately one mile south of US 70 and comprises approximately 37.0 acres.

Portions of the Whitelace Creek were identified as suitable for stream enhancement and wetland restoration by the NCEEP. Due to previous dredging and straightening which occurred to accommodate past land uses (i.e., a large dairy operation and other agricultural practices), the acreage of riverine wetlands in the area was reduced because of the lowering of the streambed elevation, adversely affecting wetland hydrology. Restoration activities for this project included excavation of the floodplain to provide Level 1 stream enhancement, riverine wetland enhancement and restoration, and Neuse River riparian buffer enhancement and restoration.

On September 18, 2008 the Year 3 monitoring survey was completed for the vegetation at the Whitelace Creek project site. As directed by NCEEP, stream stability measurements (i.e., cross-sections, longitudinal profile and pebble counts) were not taken, because the stream portion of the project was enhancement and, therefore, did not involve significant work on the stream channel. The general assessment of stream stability revealed excellent connection to the floodplain, with a bank height ratio of approximately one. Despite previous straightening there were no signs of bank erosion anywhere on the site. Several reaches of the stream had developed several mid-channel bars which were well vegetated. In some instances, these bars can lead to lateral migration and bank instability. No signs of instability were identified during the site visits, but these areas should be monitored in the future. Additionally, the crest gauge on-site was checked in February, July, and September of 2008. The February and September visits indicated that an overbank event had occurred since the previous visit.

Vegetative monitoring was performed using the Carolina Vegetation Survey Level 2 methodology on nine of the original 15 plots, as requested by NCEEP. Monitoring revealed that only 3 of the 9 plots (33%) met the 3-year vegetative success criteria of 320 planted stems or greater per acre. There are a number of issues causing the failure of the remaining 6 plots. The major issues included recent drought and previous localized flooding most likely caused by beaver activity. The beavers should be removed, thereby allowing the site hydrology to return to conditions outlined in the restoration plan. However, beaver activity is likely to continue. Therefore, the site should be replanted with trees of appropriate species and size to withstand periodic inundation. Other problems include the presence of invasive or exotic species such as *Typha latifolia*, *Murdannia keisak*, *Persicaria sagittata*, and *Lespedeza*. Unlike Year 2, *Persicaria* is not a major problem on-site currently. *Typha*, *Murdannia*, and *Lespedeza* will be watched throughout the monitoring period to ensure that they do not start causing harm to the planted species.

Groundwater data collected through November of 2008 was used to assess the compliance of the site with wetland hydrology criteria. Seven groundwater monitoring gauges are currently active on the project site.

A site is considered to meet the requirements for wetland hydrology if the groundwater level is within 12 inches of the ground surface for 12.5% of the growing season consecutively. All 7 of the gauges met the criteria during the growing season of 2008. Three reference gauges are also currently active. One of the reference gauges was observed to meet the success criteria in 2008 (RW3). It should be noted that a data gap exists from February 4<sup>th</sup> to May 10<sup>th</sup> for Reference Wells 1 and 2 due to a malfunction in the groundwater monitoring wells. The wells did not meet the success criteria for the remainder of the growing season. However, given that groundwater was above ground level before the malfunction, it is possible that the gauges met the criteria during the time period of malfunction.

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## **1.0 Project Background**

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### **1.1 PROJECT OBJECTIVES**

Previous dredging and straightening of Whitelace Creek had lowered the streambed elevation, thereby causing a reduction in the acreage of riverine wetlands due to a lowered water table. Restoration and enhancement objectives for this project included the restoration of historic stream and wetland functions that existed on-site prior to dredging and vegetation removal. Site alterations at Whitelace Creek included the excavation or reestablishment of the floodplain and in-situ stream channel modification to the existing stream. The goals of these activities were to reintroduce surface water flood hydrodynamics from a 10.1 square mile watershed along the restored length of stream and floodplain. Subsequent objectives were to restore wetland hydrology and to reforest the site with streamside and riparian forest communities.

### **1.2 PROJECT STRUCTURE**

The project area consists of a tributary of the Neuse River Basin, Whitelace Creek, located in Lenoir County, within an NCEEP-owned conservation easement west of Kinston, North Carolina. The project area comprises approximately 37.0 acres and has a watershed area of 10.1 square miles.

Restoration activities included the excavation of the floodplain to provide Level 2 stream enhancement, riverine wetland enhancement and restoration, and Neuse River riparian buffer enhancement and restoration. Stream pattern and profile were not altered. The 7.7 acres of riverine wetland restoration encompassed the excavated floodplain adjacent to approximately 3,500 linear feet of Whitelace Creek, including two closed hog waste lagoons. The sludge from these lagoons was removed during restoration. Additionally, 13.0 acres of riverine wetland enhancement was generated primarily within riparian areas within the eastern (downstream) portion of the site.

Exhibit Table I. Project Restoration Components Whitelace Creek Wetland Restoration Site/EEP Project No. 420						
Reach ID	Existing Feet/Acres	Type	Approach	Footage or Acreage	Stationing	Comment
Reach 1	3693	E1	P2	3693	0+35 - 37+58	Total accounts for 30 l.f. gap in easement at road crossing
Reach 2	2208	E2	P2	2208	37+58 - 59+66	
Riverine Wetland Restoration		R	NA	7.7 ac	NA	Stations 0+00 - 37+58 mark the extent of the floodplain grading
Riverine Wetland Enhancement		E	NA	13.0 ac	NA	
Neuse River Buffer Restoration		R	NA	27.1 ac	NA	
Neuse River Buffer Enhancement		E	NA	7.2 ac	NA	

*R = Restoration*

*E1 = Stream Enhancement 1*

*E2 = Stream Enhancement 2*

*S = Stabilization*

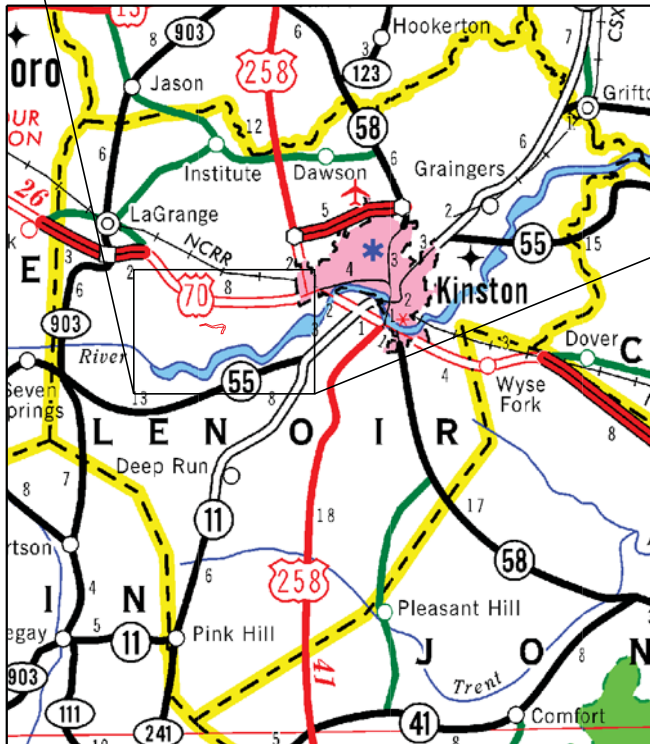
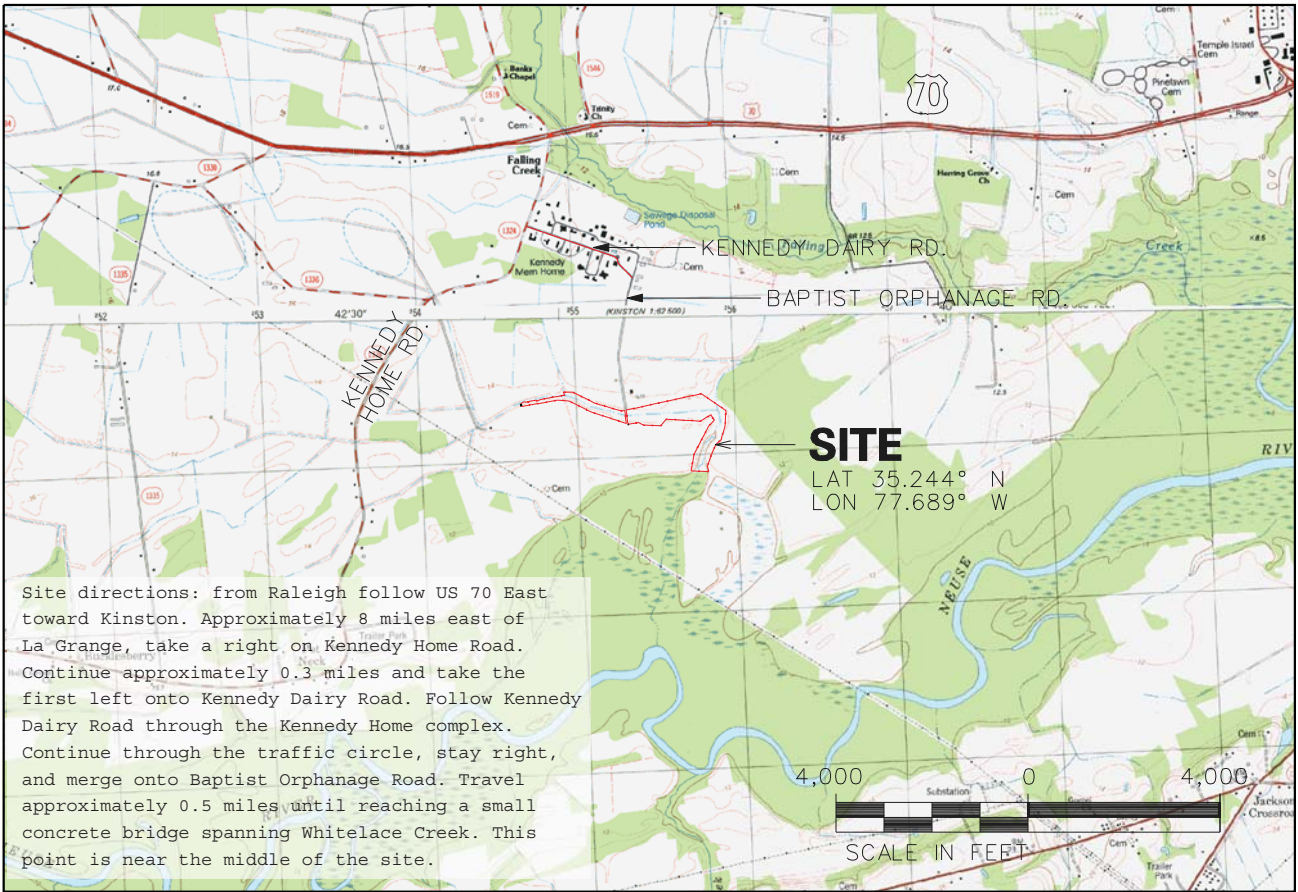
*P=Preservation*

### 1.3 LOCATION AND SETTING

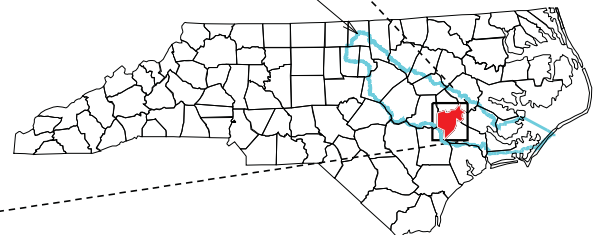
The restoration site is located 6.5 miles west of Kinston, in Lenoir County, North Carolina. The site is located in a rural area, adjacent to the Kennedy Home complex approximately one mile south of US 70. The site can be accessed from a bridge on Baptist Orphanage Road, which crosses Whitelace Creek (Figure 1).

Site directions: from Raleigh follow US 70 East toward Kinston. Approximately 8 miles east of La Grange, take a right on Kennedy Home Road. Continue approximately 0.3 miles and take the first left onto Kennedy Dairy Road. Follow Kennedy Dairy Road through the Kennedy Home complex. Continue through the traffic circle, stay right, and merge onto Baptist Orphanage Road. Travel approximately 0.5 miles until reaching a small concrete bridge spanning Whitelace Creek. This point is near the middle of the site. The stream enhancement reach begins approximately 2,400 feet upstream of the bridge and ends approximately 3,500 feet downstream. The 7.7 acres of riverine wetland restoration encompasses the excavated floodplain adjacent to approximately 3,500 linear feet of Whitelace Creek. The 13.0 acres of riverine wetland enhancement occurs primarily within the riparian areas within the eastern (downstream) portion of the project area.





NEUSE RIVER  
 BASIN (CU 03020202)



Client: Project:  
**SITE LOCATION MAP**  
**WHITELACE CREEK STREAM AND WETLAND RESTORATION SITE**  
 LENOIR COUNTY, NORTH CAROLINA

Dwn By:	Ckd By:
GWN	JWG
Date:	NOV 2006
Scale:	AS SHOWN
ESC Project No.:	02-111

FIGURE

**1**

## 1.4 PROJECT HISTORY AND BACKGROUND

<b>Exhibit Table II. Project Activity and Reporting History Whitelace Creek Wetland Restoration Site/EEP Project No. 420</b>			
<b>Activity or Report</b>	<b>Scheduled Completion</b>	<b>Data Collection Complete</b>	<b>Actual Completion or Delivery</b>
Restoration Plan	NA	NA	Feb 2004
Final Design - 90%	NA	NA	Nov 2004
Construction	Aug 2005	NA	Aug 2005
Temporary S&E mix applied to entire project area	NA	NA	Jul 2005
Permanent seed mix applied to entire project area	NA	NA	Aug 2006
<b>Bare Root Seedling Installation</b>	Mar 2006	NA	Mar 2005
Mitigation Plan / As-built (Year 0 Monitoring - baseline)	NA	NA	Apr 2005
Final Report	NA	NA	Apr 2005
Year 1 Monitoring	Nov 2006	Nov 2006	Nov 2006
Year 2 Monitoring	Nov 2007	Nov 2007	Dec 2007
Year 3 Monitoring	Nov 2008	Nov 2008	Nov 2008
Year 4 Monitoring	NA	NA	NA
Year 5 Monitoring	NA	NA	NA

NA = Not Applicable

<b>Exhibit Table III. Contacts</b> <b>Whitelace Creek Wetland Restoration Site/EEP Project No. 420</b>	
<b>Designer</b>	EcoScience Corporation 1101 Haynes Street Suite 101 Raleigh, NC 27604
<b>Construction Contractor</b>	Shamrock Environmental Corporation PO Box 14987 Greensboro, NC 27415
<b>Planting Contractor</b>	Emerald Forest Incorporated 4651 Backwoods Road Chesapeake, VA 23322-2456
<b>Seeding Contractor</b>	Wheat Swamp Landscaping 4675 Ben Dail Road LaGrange, NC 28551-8038
<b>Seed Mix Sources</b>	IKEX, Inc. PO Box 250 Middlesex, NC 27557
<b>Nursery Stock Suppliers</b>	Warren County Nursery 6492 Beersheba Highway McMinnville, TN 37110  Pinelands Nursery and Supply 323 Island Road Columbus, NJ 08022  Coastal Plain Conservation Nursery 3067 Connors Drive Edenton, NC 27932
<b>Monitoring Performers (Year 0-1)</b>	EcoScience Corporation 1101 Haynes Street, Suite 101 Raleigh NC 27604 (919)828-3433
<b>Monitoring Performers (Year 2-3)</b>	Stantec Consulting Services, Inc. 801 Jones Franklin Road, Ste 300 Raleigh, NC 27606
Stream Monitoring POC Vegetation Monitoring POC Wetland Monitoring POC	David Bidelspach (919)851-6866 Amber Coleman (919)851-6866 Amber Coleman (919)851-6866

<b>Exhibit Table IV. Project Background Table Whitelace Creek Wetland Restoration Site/EEP Project No. 420</b>	
Project County	Lenoir
Drainage Area	10.1 sq mi
Drainage impervious cover estimate (%)	< 1 percent
Stream Order	2 <sup>nd</sup> order
Physiographic Region	Coastal Plain
Ecoregion	Southeastern Floodplains and Low Terraces
Rosgen Classification of As-built	C/E
Cowardin Classification	R2UB23Cb (Riverine, Lower Perennial, Unconsolidated Bottom, Sand/Mud, Seasonally Flooded, Beaver)
Dominant soil types	
Riverine Wetland Restoration	Johnston, stream channels, 80% of Site
Riverine Wetland Enhancement	Johnston, stream channels, 80% of Site
Reference site ID	01-05471-01A
USGS HUC for Project	03020202040020
USGS HUC for Reference	03020202040020
NCDWQ Subbasin for Project	03-04-05
NCDWQ Subbasin for Reference	03-04-05
NCDWQ Classification for Project	C SW NSW
NCDWQ Classification for Reference	C SW NSW
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor	No
Percent of project easement fenced	No

## 1.5 MONITORING PLAN VIEW

A monitoring plan view map is provided in Figure 2. Figures 3 and 4 include plan views of the riverine wetland and Neuse buffer enhancement, respectively.



**EcoScience Corporation**

Raleigh, North Carolina

REVISIONS

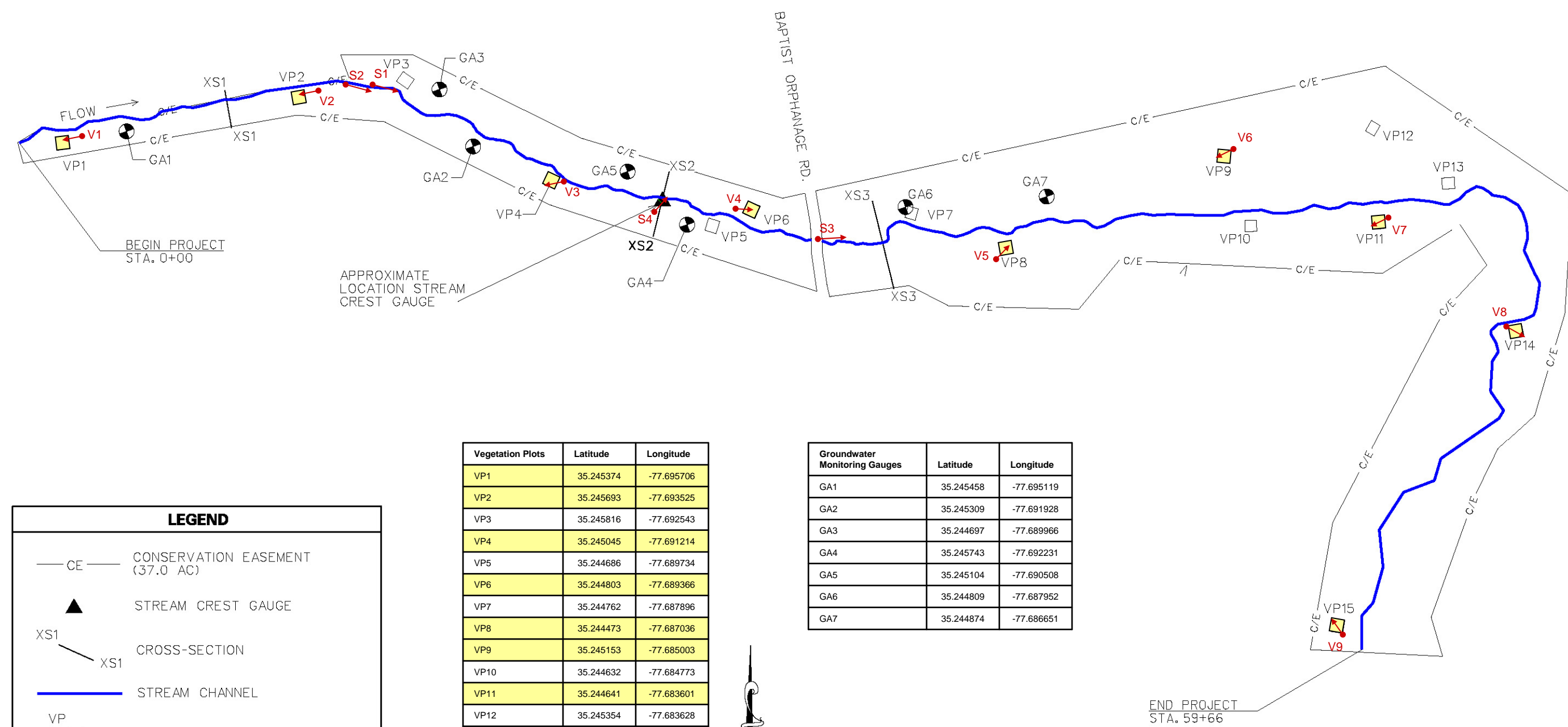
NO.	DATE	DESCRIPTION

Client:  
**NC DENR  
ECOSYSTEM  
ENHANCEMENT  
PROGRAM**

Project:  
**WHITELACE  
CREEK  
STREAM AND  
WETLAND  
RESTORATION  
SITE  
EEP Project No. 420  
LENOIR COUNTY,  
NORTH CAROLINA**

Title:  
**MONITORING  
PLAN  
VIEW**

Dwn By:	Date:
GWN	NOV 2006
Ckd By:	Scale:
GWN	AS SHOWN
ESC Project No.: 02-111	

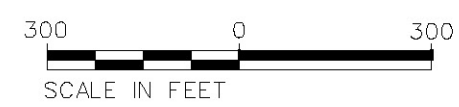
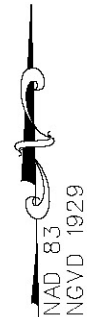


LEGEND	
— CE —	CONSERVATION EASEMENT (37.0 AC)
▲	STREAM CREST GAUGE
XS1	CROSS-SECTION
—	STREAM CHANNEL
VP	VEGETATION PLOT (10M X 10M)
GA1	GROUNDWATER MONITORING GAUGE
V1	VEGETATION PHOTO STATION
S1	STREAM PHOTO STATION

Vegetation Plots	Latitude	Longitude
VP1	35.245374	-77.695706
VP2	35.245693	-77.693525
VP3	35.245816	-77.692543
VP4	35.245045	-77.691214
VP5	35.244686	-77.689734
VP6	35.244803	-77.689366
VP7	35.244762	-77.687896
VP8	35.244473	-77.687036
VP9	35.245153	-77.685003
VP10	35.244632	-77.684773
VP11	35.244641	-77.683601
VP12	35.245354	-77.683628
VP13	35.244934	-77.682950
VP14	35.243818	-77.682330
VP15	35.241601	-77.684023

Groundwater Monitoring Gauges	Latitude	Longitude
GA1	35.245458	-77.695119
GA2	35.245309	-77.691928
GA3	35.244697	-77.689966
GA4	35.245743	-77.692231
GA5	35.245104	-77.690508
GA6	35.244809	-77.687952
GA7	35.244874	-77.686651

Vegetation plots highlighted in yellow were monitored in 2007 & 2008



FIGURE

**2**



EcoScience Corporation

Raleigh, North Carolina

REVISIONS

NO.	DATE	DESCRIPTION

Client:  
**NCDENR  
 ECOSYSTEM  
 ENHANCEMENT  
 PROGRAM**

Project:  
**WHITELACE  
 CREEK  
 STREAM AND  
 WETLAND  
 RESTORATION  
 SITE**  
**EEP Project No. 420**  
**LENOIR COUNTY,  
 NORTH CAROLINA**

Title:  
**STREAM AND  
 WETLAND  
 SITE  
 MITIGATION  
 UNITS**

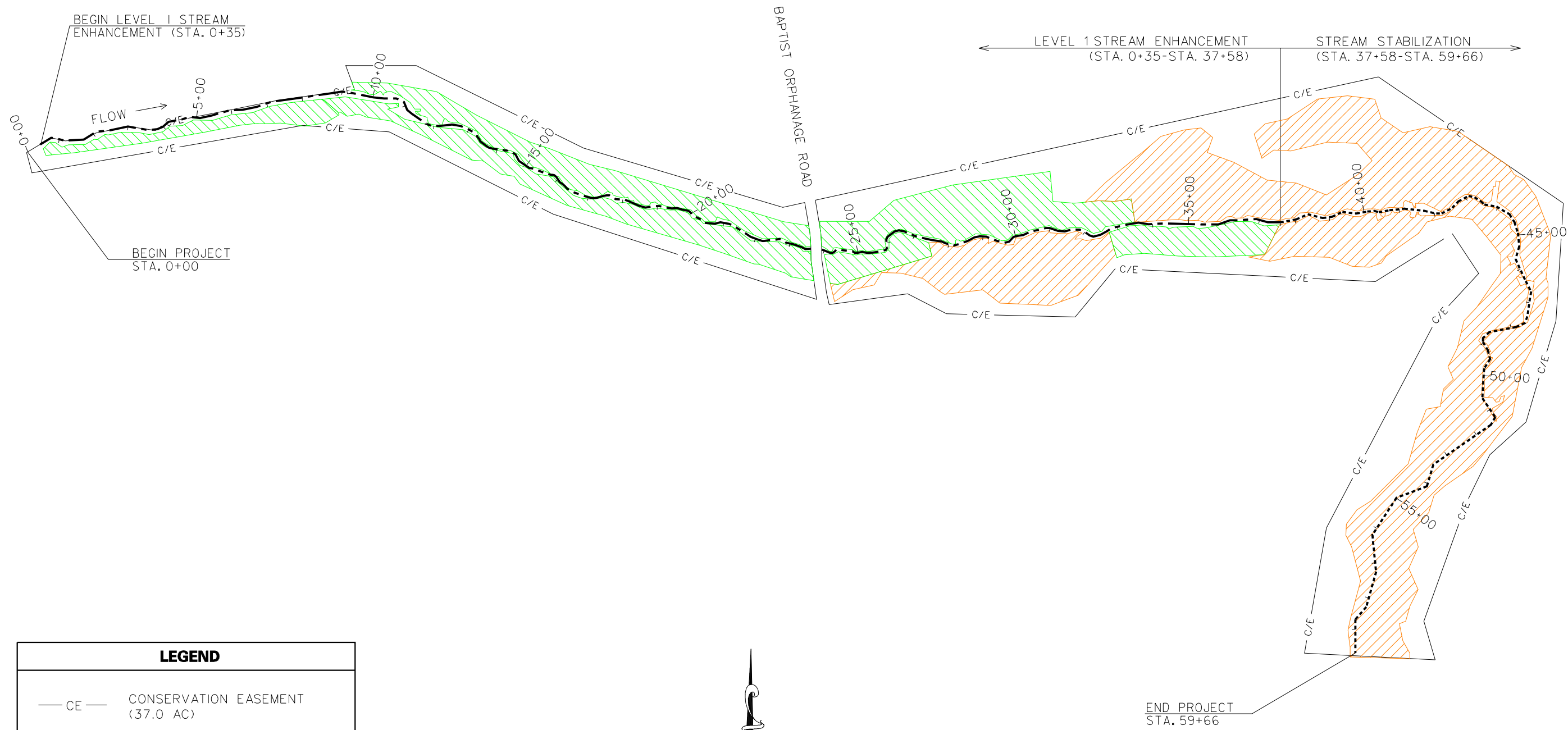
Dwn By: GWN Date: NOV 2006

Ckd By: JWG Scale: AS SHOWN

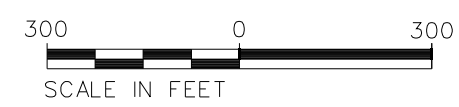
ESC Project No.: 02-111

FIGURE

**3**



LEGEND	
— CE —	CONSERVATION EASEMENT (37.0 AC)
	RIVERINE WETLAND ENHANCEMENT (13.0 AC)
	RIVERINE WETLAND RESTORATION (7.7 AC)
— — —	LEVEL 1 STREAM ENHANCEMENT (3,693 LF)
.....	STREAM STABILIZATION (2,208 LF)





EcoScience Corporation

Raleigh, North Carolina

REVISIONS

No.	Description

Client:  
**NCDENR  
 ECOSYSTEM  
 ENHANCEMENT  
 PROGRAM**

Project:  
**WHITELACE  
 CREEK  
 STREAM AND  
 WETLAND  
 RESTORATION  
 SITE**  
**EEP Project No. 420**  
**LENOIR COUNTY,  
 NORTH CAROLINA**

Title:  
**NEUSE RIVER  
 RIPARIAN  
 BUFFER SITE  
 MITIGATION  
 UNITS**

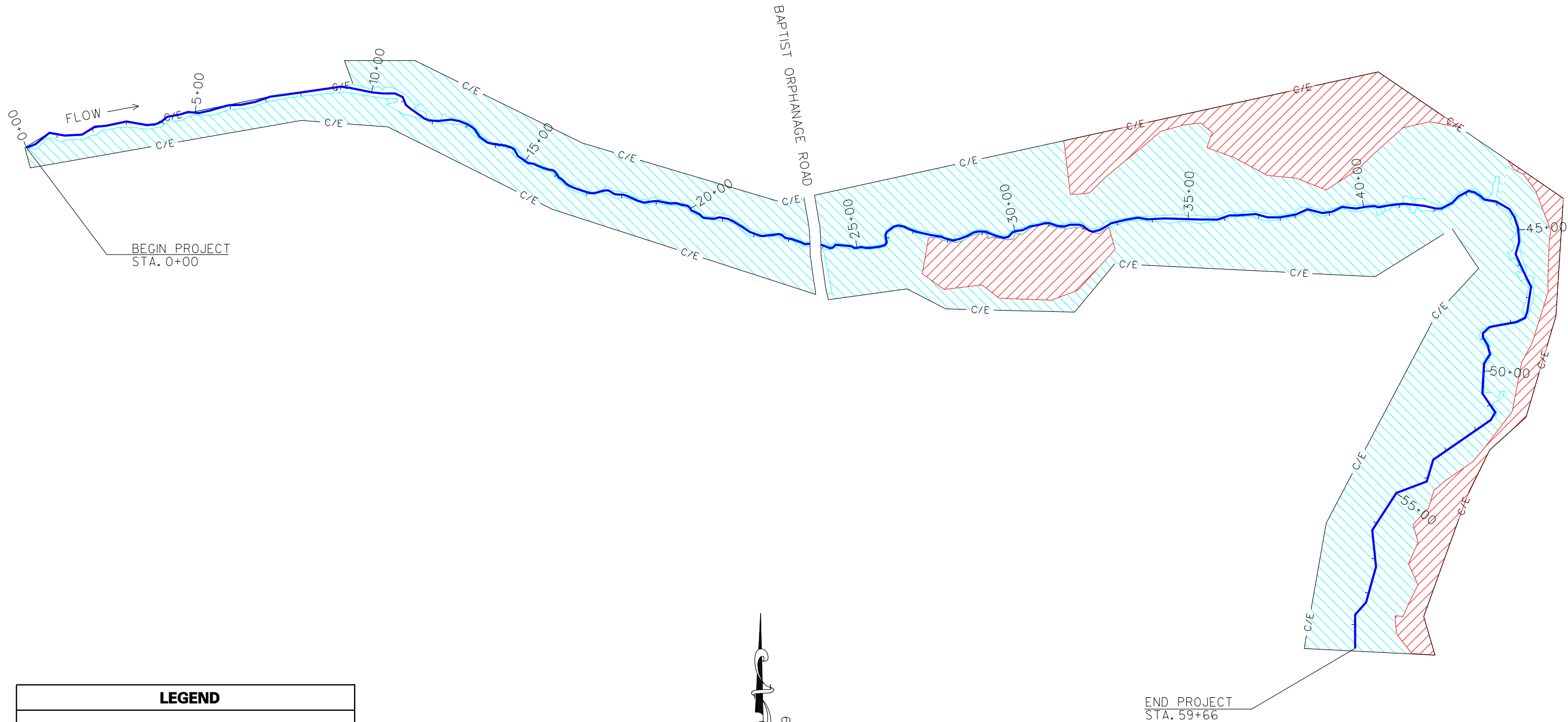
Dwn By: GWN Date: NOV 2006

Ckd By: JWG Scale: AS SHOWN

ESC Project No.: 02-111

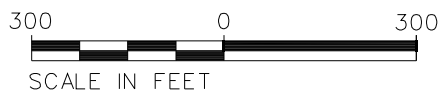
FIGURE

4



BEGIN PROJECT STA. 0+00

END PROJECT STA. 59+66



LEGEND

- CE — CONSERVATION EASEMENT (37.0 AC)
- STREAM CHANNEL
- NEUSE RIVER BUFFER ENHANCEMENT (7.2 AC)
- NEUSE RIVER BUFFER RESTORATION (27.1 AC)

Back of 11x17



## 2.0 Project Condition and Monitoring Results

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### 2.1 VEGETATION ASSESSMENT

Fifteen vegetative sample plots were quantitatively monitored during the first growing season. Species composition, density, and survival were monitored during Year 0 and Year 1. The number of plots was reduced to nine for monitoring in the second year, as requested by NCEEP. These plots include the original plots named VP1, VP2, VP4, VP6, VP8, VP9, VP11, VP14, and VP15. The Carolina Vegetation Survey (CVS) methodology was utilized for vegetative monitoring in Years 2 & 3. Level 2 (planted and natural stems) methodology was completed on all monitored plots.

As per the mitigation plan, the vegetative success criteria are based on the US Army Corps of Engineers Stream Mitigation Guidelines (USACE, 2003). The final vegetative success criteria will be the survival of 260 5-year old planted woody stems per acre at the end of the Year 5 monitoring period. An interim measure of vegetation planting success will be the survival of at least 320 3-year old planted woody stems per acre at the end of year 3 of the monitoring period.

The Year 3 stem counts within each of the nine vegetative monitoring plots are included in Exhibit Tables A1 through A5 in Appendix A1. Photos of the vegetative monitoring plots are included in Appendix A3. Stems per acre for each of the nine plots are reported in Table A5-A of Appendix A1.

#### 2.1.1 Vegetation Problem Areas

Monitoring revealed that 3 of the 9 plots (33%) met the 3-year vegetative success criteria of 320 planted stems or greater per acre (plots 4, 8, & 9). The remaining six plots failed to meet the success criteria in Year 3. These plots also failed to meet the criteria in Year 2 of monitoring. There are a number of issues causing the failure of these plots. There was a relatively low number of healthy plant species in vegetation plots 1 and 2, likely due to previous heavy flooding in 2006 as noted in the Year 1 monitoring report. In 2007, the higher areas onsite were adversely affected by an extreme drought while the lower areas onsite were flooded by beaver activity. In 2008, beaver activity continued to be an issue, as well as drought later in the growing season. Plot 15 is dry and may have poor soil conditions which led to the death of a number of plants this year during the drought. Resprouts were not observed in any plots, therefore vegetation numbers are not likely to improve.

Other problems included the presence of invasive or exotic species such as *Typha latifolia*, *Murdannia keisak*, *Persicaria sagittata*, and *Lespedeza*. *Persicaria* is currently not as abundant on-site as it was in Year 2. *Typha*, *Murdannia*, and *Lespedeza* will be watched throughout the monitoring period to ensure that they do not start causing harm to the planted species. There is also weak woody vegetation in and around Vegetation Plots 1, 2, and 15. See Exhibit Table A6 in Appendix A1, as well as accompanying photos provided in Appendix A2. However, there continues to be a large number of river birch and silverling volunteers throughout the site.

The major issue affecting the poor performance of the vegetation on the site is the previous localized flooding caused by beaver activity earlier in the year and recent drought. The beavers should be removed, thereby allowing the site hydrology to return to conditions outlined in the restoration plan. However, beaver activity is likely to continue. Therefore, the site should be replanted with trees of appropriate species and size to withstand periodic inundation.

### **2.1.2 Vegetation Current Condition Plan View**

Vegetative problem areas are shown on the Current Condition Plan View in Appendix D.

## **2.2 STREAM ASSESSMENT**

Changes in stream profile and pattern were not included in the stream enhancement project for Whitelace Creek. As such, cross-section and longitudinal profile surveys and pebble counts were not performed for the Year 3 monitoring, as directed by NCEEP. However, a general assessment of stream stability was performed during field reconnaissance. Additionally, the crest gauge on-site was checked.

Field reconnaissance noted that the stream is an E type channel (Rosgen Classification) which is common in the coastal plain, with a low width-to-depth ratio and flat slopes (Appendix B4, Photo 1 & 3). The stream has excellent connection to the floodplain, with bank height ratio being approximately one. The channel shows signs of past straightening, but all banks are stable with little to no signs of bank erosion over the entire stream reach. In a few sections (mostly downstream) the stream has developed several mid-channel bars which are well vegetated (Appendix B4, Photo 2). This would indicate that the channel width is too wide in these areas. Mid-channel bars in some instances can lead to lateral migration and bank instability. However, with the abundance of bank vegetation and low flows there are currently no signs of instability. These areas will continue to be monitored in the future.

The crest gauge was checked during multiple site visits to Whitelace Creek in February, July, and September of 2008. The February and September visits indicated that an overbank event had occurred since the previous visit (Appendix B4, Photo 4). Additionally, there is currently a beaver dam onsite, located near Vegetation Plot 3 (Appendix B4, Photo 5).

## **2.3 WETLAND ASSESSMENT**

### **2.3.1 Current Condition Plan View**

The plan view of the wetland problem areas is in Appendix D.

### **2.3.2 Wetland Criteria Attainment**

A site is considered to meet the requirements for wetland hydrology if the groundwater saturation is within 12 inches of the ground surface consecutively for 12.5% of the growing season. Seven groundwater monitoring gauges are currently active on the project site. All 7 of the gauges met the criteria during the growing season of 2008. The growing season in this area is from March 18<sup>th</sup> to November 8<sup>th</sup> for a total of 234 days (NRCS 2002).

Three reference gauges are located northwest of the project site. Reference gauges 1 & 2 are located near the intersection of Sutton Road with Moseley Creek. Reference gauge 3 is located between Hillcrest Road and Moseley Creek, approximately 5500 feet north of Route 70 (Figure 5). Exhibit Table V includes the latitude and longitude coordinates for the three reference gauges.

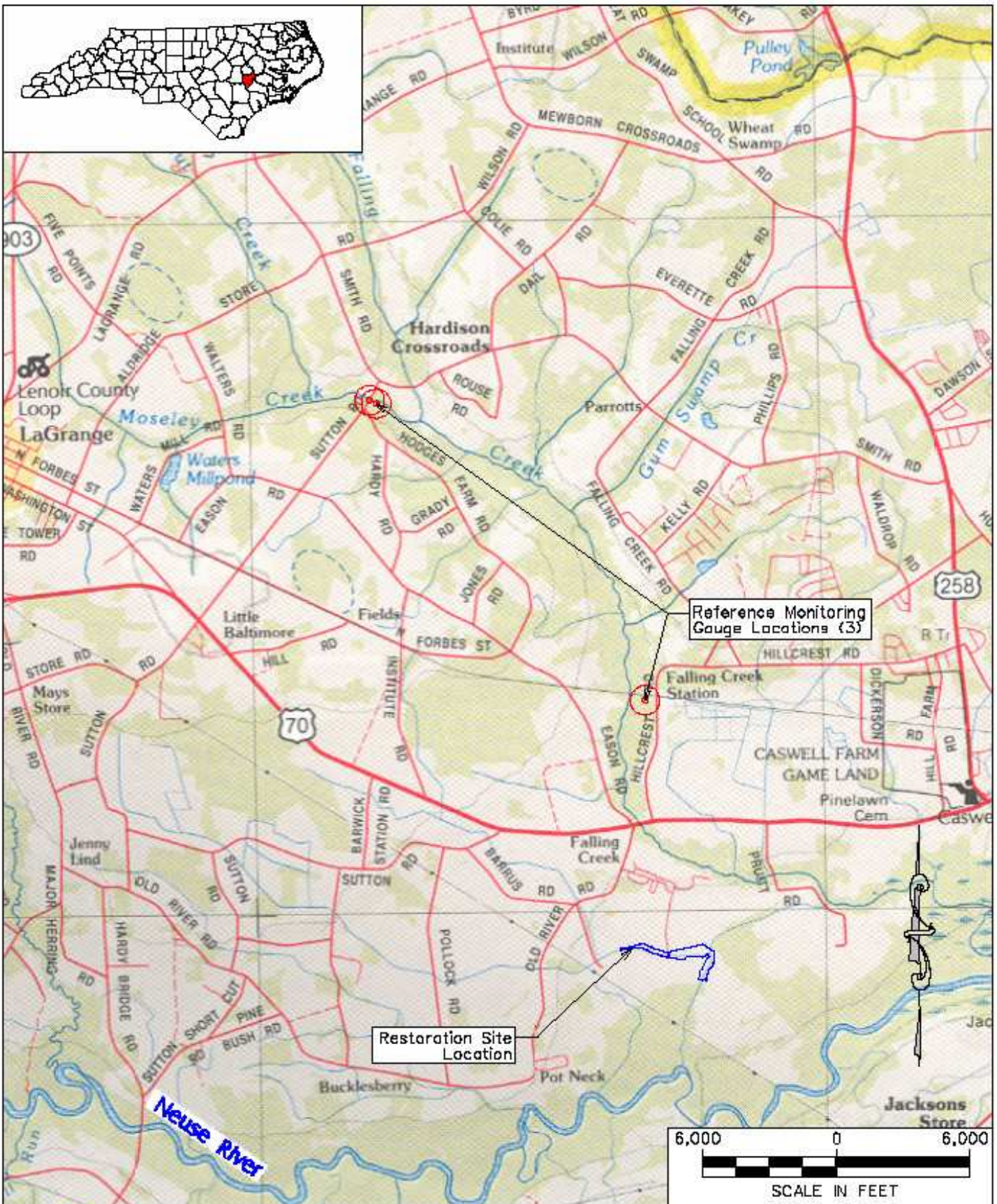
<b>Groundwater Reference Gauges</b>	<b>Latitude</b>	<b>Longitude</b>
RW1	35.313311	-77.731836
RW2	35.313736	-77.732833
RW3	35.276123	-77.691827

One of the reference gauges was observed to meet the success criteria of saturation within 12 inches for 12.5% or of the growing season in 2008 (RW3). Reference gauge 3 decreased from 159 to 112 days of consecutive saturation between 2007 and 2008. It should be noted that a data gap exists from February 4<sup>th</sup> to May 10<sup>th</sup> for Reference Gauges 1 and 2 due to a malfunction in the groundwater monitoring wells. The wells did not meet the success criteria for the remainder of the growing season. However, given that groundwater was above ground level before the malfunction, it is possible that the gauges met the criteria during the time period of malfunction.

An important observation from the 2008 data shows that the restoration site exhibits longer hydroperiods than the reference site. While the reference wetlands should serve as an accurate hydrologic model for the restored site, the riverine reference wetlands seem to have a different hydrologic regime than the riverine wetlands onsite. Factors such as floodplain elevation, beaver activity, floodplain width, evapotranspiration, and others likely contribute to the differences.

<b>Tract</b>	<b>Well ID</b>	<b>Well Hydrology Threshold Met?</b>	<b>Tract Mean</b>	<b>Vegetation Plot ID</b>	<b>Vegetation Density Met (320 stems/acre)</b>	<b>Tract Mean</b>
Site	1	Y	100%	VP1	N (243)	30%
	2	Y		VP2	N (121)	
	3	Y		VP4	Y (445)	
	4	Y		VP6	N (162)	
	5	Y		VP8	Y (364)	
	6	Y		VP9	Y (364)	
	7	Y		VP11	N (81)	
Reference	Ref Site 1	Unknown*	Unknown*	VP14	N (162)	(225 stems/acre)
	Ref Site 2	Unknown*		VP15	N (81)	
	Ref Site 3	Y				

\* Success criteria mean unknown due to malfunction of 2 of the reference site groundwater monitoring wells.



Client: **REFERENCE GROUNDWATER MONITORING GAUGE LOCATIONS**  
**WHITELACE CREEK STREAM AND WETLAND RESTORATION SITE**  
 EIP Project No. 422  
 LENOIR COUNTY, NORTH CAROLINA

Drawn By:	GWN	Checked By:	JWG
Date:	NOV 2006		
Scale:	AS SHOWN		
ESC Project No.:	02-111		

FIGURE  
**5**

### 3.0 References

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Harrelson, C.C., C.L. Rawlins and J.P. Potyondy. 1994. Stream Channel Reference Sites: An Illustrated Guide to Field Technique. United States Department of Agriculture, Fort Collins, CO.

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

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## Appendix A. Vegetation Raw Data

### A.1 VEGETATION DATA TABLES

<b>EXHIBIT TABLE A1. VEGETATION METADATA</b>	
<b>Database Name</b>	Copy of Project420Whitelace-2008Resampling-EntryTool-v2.2.5.mdb
<b>Database Location</b>	U:\171300168\300_Whitelace_Creek
<b>Computer Name</b>	WEIDNERK-SP1
<b>DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT</b>	
<b>Metadata</b>	Description of database file, the report worksheets, and a summary of project(s) and project data.
<b>Proj, planted</b>	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
<b>Proj, total stems</b>	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
<b>Plots</b>	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
<b>Vigor</b>	Frequency distribution of vigor classes for stems for all plots.
<b>Vigor by Spp</b>	Frequency distribution of vigor classes listed by species.
<b>Damage</b>	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
<b>Damage by Spp</b>	Damage values tallied by type for each species.
<b>Damage by Plot</b>	Damage values tallied by type for each plot.
<b>ALL Stems by Plot and spp</b>	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
<b>PROJECT SUMMARY</b>	
<b>Metadata</b>	Peet, R.K., T.R. Wentworth, M. P. Schafale & A.S. Weakley. 2004. Carolina Vegetation Survey database. Version 3.0. North Carolina Botanical Garden. Chapel Hill, NC 27599
<b>Project Code</b>	420
<b>Project Name</b>	Whitelace Creek
<b>Description</b>	Wetland restoration and enhancement
<b>River Basin</b>	Neuse
<b>Length(ft)</b>	5900
<b>Stream-to-edge Width (ft)</b>	100
<b>Area (sq m)</b>	80,937
<b>Required Plots (calculated)</b>	NA

**EXHIBIT TABLE A2. VEGETATION VIGOR BY SPECIES**

	<b>Species</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>Missing</b>	<b>Unknown</b>
	<i>Betula nigra</i>	2						
	<i>Carpinus caroliniana</i> var. <i>caroliniana</i>		1	1				
	<i>Carya aquatica</i>		2					
	<i>Chamaecyparis thyoides</i>	1	1			4		
	<i>Fraxinus pennsylvanica</i>	1	3					
	<i>Liriodendron tulipifera</i> var. <i>tulipifera</i>					2		
	<i>Nyssa biflora</i>	1	3	1		2		
	<i>Platanus occidentalis</i> var. <i>occidentalis</i>						1	
	<i>Quercus laurifolia</i>		3			1		
	<i>Quercus lyrata</i>	1	1					
	<i>Quercus michauxii</i>	2	1					
	<i>Quercus pagoda</i>	2		1		1		
	<i>Quercus phellos</i>	1	1					
	<i>Taxodium distichum</i>	9	5	2			1	
	<i>Ulmus americana</i> var. <i>americana</i>		1					
	<i>Quercus</i>	1	1			1		
	<i>Fraxinus</i>		1					
	<i>Unknown</i>						1	
<b>TOT:</b>	<b>18</b>	<b>21</b>	<b>24</b>	<b>5</b>		<b>11</b>	<b>3</b>	

**EXHIBIT TABLE A3. VEGETATION DAMAGE BY SPECIES**

Species	All Damage Categories	No Damage	Human Trampled	Site Too Dry	Unknown
<i>Betula nigra</i>	2	2			
<i>Carpinus caroliniana</i> var. <i>caroliniana</i>	2	1			1
<i>Carya aquatica</i>	2	2			
<i>Chamaecyparis thyoides</i>	6	4		2	
<i>Fraxinus</i>	1	1			
<i>Fraxinus pennsylvanica</i>	4	4			
<i>Liriodendron tulipifera</i> var. <i>tulipifera</i>	2	1		1	
<i>Nyssa biflora</i>	7	5	1		1
<i>Platanus occidentalis</i> var. <i>occidentalis</i>	1	1			
<i>Quercus</i>	3	3			
<i>Quercus laurifolia</i>	4	4			
<i>Quercus lyrata</i>	2	2			
<i>Quercus michauxii</i>	3	3			
<i>Quercus pagoda</i>	4	2		1	1
<i>Quercus phellos</i>	2	2			
<i>Taxodium distichum</i>	17	15	2		
<i>Ulmus americana</i> var. <i>americana</i>	1	1			
Unknown	1	1			
<b>TOT: 18</b>	<b>64</b>	<b>54</b>	<b>3</b>	<b>4</b>	<b>3</b>

**EXHIBIT TABLE A4. VEGETATION DAMAGE BY PLOT**

Plot	All Damage Categories	No Damage	Human Trampled	Site Too Dry	Unknown
420-Amber-0001-year:3	6	4	2		
420-Amber-0002-year:3	6	3		2	1
420-Amber-0004-year:3	13	11	1		1
420-Amber-0006-year:3	4	4			
420-Amber-0008-year:3	13	12			1
420-Amber-0009-year:3	11	11			
420-Amber-0011-year:3	2	2			
420-Amber-0014-year:3	4	4			
420-Amber-0015-year:3	5	3		2	
<b>TOT: 9</b>	<b>64</b>	<b>54</b>	<b>3</b>	<b>4</b>	<b>3</b>



**EXHIBIT TABLE A5-A. PLANTED STEMS BY PLOT AND SPECIES**

Species	Total Planted Stems		Plot 420-Amber-0001-year:3										
	# plots	avg# stems	Plot 420-Amber-0001-year:3	Plot 420-Amber-0002-year:3	Plot 420-Amber-0004-year:3	Plot 420-Amber-0006-year:3	Plot 420-Amber-0008-year:3	Plot 420-Amber-0009-year:3	Plot 420-Amber-0011-year:3	Plot 420-Amber-0014-year:3	Plot 420-Amber-0015-year:3		
<i>Betula nigra</i>	2	2	1	1	1								
<i>Carpinus caroliniana</i> var. <i>caroliniana</i>	2	2	1		1	1							
<i>Carya aquatica</i>	2	2	1					1	1				
<i>Chamaecyparis thyoides</i>	2	1	2			2							
<i>Fraxinus</i>	1	1	1	1									
<i>Fraxinus pennsylvanica</i>	4	3	1.33		1	1			2				
<i>Nyssa biflora</i>	5	3	1.67			3		1	1				
<i>Quercus</i>	2	2	1	1		1							
<i>Quercus laurifolia</i>	3	3	1				1	1					1
<i>Quercus lyrata</i>	2	2	1			1			1				
<i>Quercus michauxii</i>	3	3	1				1	1	1				
<i>Quercus pagoda</i>	3	3	1	1			1						1
<i>Quercus phellos</i>	2	2	1			1		1					
<i>Taxodium distichum</i>	16	7	2.29	2		1	1	3	3	2	4		
<i>Ulmus americana</i> var. <i>americana</i>	1	1	1					1					
<b>TOT: 15</b>	<b>50</b>	<b>15</b>		<b>6</b>	<b>3</b>	<b>11</b>	<b>4</b>	<b>9</b>	<b>9</b>	<b>2</b>	<b>4</b>	<b>2</b>	
<b>Stems per acre</b>				<b>243</b>	<b>121</b>	<b>445</b>	<b>162</b>	<b>364</b>	<b>364</b>	<b>81</b>	<b>162</b>	<b>81</b>	

**EXHIBIT TABLE A5-B. ALL STEMS BY PLOT AND SPECIES**

Species	Total Stems		avg# stems	420-Amber-0001-year:3																	
	# plots																				
<i>Acer saccharinum</i>	23	1	23																		23
<i>Betula nigra</i>	61	3	20	1	59																1
<i>Carpinus caroliniana var. caroliniana</i>	2	2	1		1	1															
<i>Carya aquatica</i>	2	2	1							1	1										
<i>Chamaecyparis thyoides</i>	6	4	2		2	2				1	1										
<i>Fraxinus pennsylvanica</i>	4	3	1		1	1															2
<i>Liquidambar styraciflua</i>	18	3	6	6	6																6
<i>Liriodendron tulipifera var. tulipifera</i>	2	1	2																		2
<i>Nyssa biflora</i>	7	3	2				4				1	2									
<i>Pinus taeda</i>	8	1	8																		8
<i>Quercus laurifolia</i>	4	3	1								1	1									2
<i>Quercus lyrata</i>	2	2	1								1										1
<i>Quercus michauxii</i>	3	3	1								1	1	1								
<i>Quercus pagoda</i>	4	4	1	1							1	1									1
<i>Quercus phellos</i>	2	2	1								1	1									
<i>Salix nigra</i>	18	5	4	4	1	3	4														6
<i>Taxodium distichum</i>	16	7	2	2							1	1	3	3	2	4					
<i>Ulmus americana var. americana</i>	1	1	1																		1
<i>Baccharis</i>	22	4	6		13	2	3														4
<i>Diospyros</i>	3	1	3	3																	
<i>Quercus</i>	3	2	2	1							2										
<i>Carya</i>	1	1	1																		1
<i>Fraxinus</i>	1	1	1	1																	
<i>Acer rubrum</i>	19	3	6	1	12																6
<b>TOT: 24</b>	<b>232</b>	<b>24</b>		<b>20</b>	<b>95</b>	<b>18</b>	<b>11</b>	<b>11</b>	<b>36</b>	<b>32</b>	<b>4</b>	<b>5</b>									

**EXHIBIT TABLE A6. VEGETATION PROBLEM AREAS**

Feature/Issue	Station # / Range	Probable Cause	Photo #
Weak numbers of healthy plant species	VP1, VP2 & VP 15	Flooding and drought	2
Invasive/exotic species	between VP7 and VP9, leftbank floodplain 30+00	Monoculture of <i>Typha latifolia</i>	n/a
Invasive/exotic species	VP11, right bank floodplain 40+00	Invasion of <i>Murdannia keisak</i>	4
Invasive/exotic species	VP1 and VP2, right bank floodplain	Invasion of <i>Lespedeza</i>	1
Flooding	throughout- primarily downstream of road and around crest gauge	Beaver activity	3

## A.2 VEGETATION PROBLEM AREA PHOTOS



Photo 1. Lespedeza near Vegetation Plot 2 (9/18/08)



Photo 2. Flooding (2/04/08)



Photo 3. Beaver dam near Vegetation Plot 3 (3/19/08)



Photo 4. *Murdannia* in Vegetation Plot 11 (3/19/08)

### A.3 VEGETATION MONITORING PLOT PHOTOS



Photo Station 1: Vegetation Plot 1 (9/18/08)



Photo Station 2: Vegetation Plot 2 (9/18/08)



Photo Station 3: Vegetation Plot 4 (9/18/08)



Photo Station 4: Vegetation Plot 6 (9/18/08)



Photo Station 5: Vegetation Plot 8 (9/18/08)



Photo Station 6: Vegetation Plot 9 (9/18/08)



Photo Station 7: Vegetation Plot 11 (9/18/08)



Photo Station 8: Vegetation Plot 14 (9/18/08)





Photo Station 9: Vegetation Plot 15 (9/18/08)

## **Appendix B. Geomorphologic Raw Data**

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### **B.1 CURRENT CONDITION PLAN VIEW (STREAM)**

The stream was only assessed visually during Monitoring Year 3. Problem areas were not found.

### **B.2 STREAM PROBLEM AREAS TABLE**

Stream Problem Areas were not found.

### **B.3 REPRESENTATIVE STREAM PROBLEM AREAS PHOTOS**

Stream Problem Areas were not found.

#### B.4 REPRESENTATIVE STREAM PHOTOS



Photo 1. Looking downstream near deerstand (9/18/2008).



Photo 2. Looking downstream near station 10+00 (9/18/08). Note formation of mid-channel bars. Stand of trees is near Vegetation Plot 4.



Photo 3. Looking downstream of road near Vegetation Plot 7 (9/18/08).



Photo 4. Crest gauge showing water above bankfull (7/03/08)

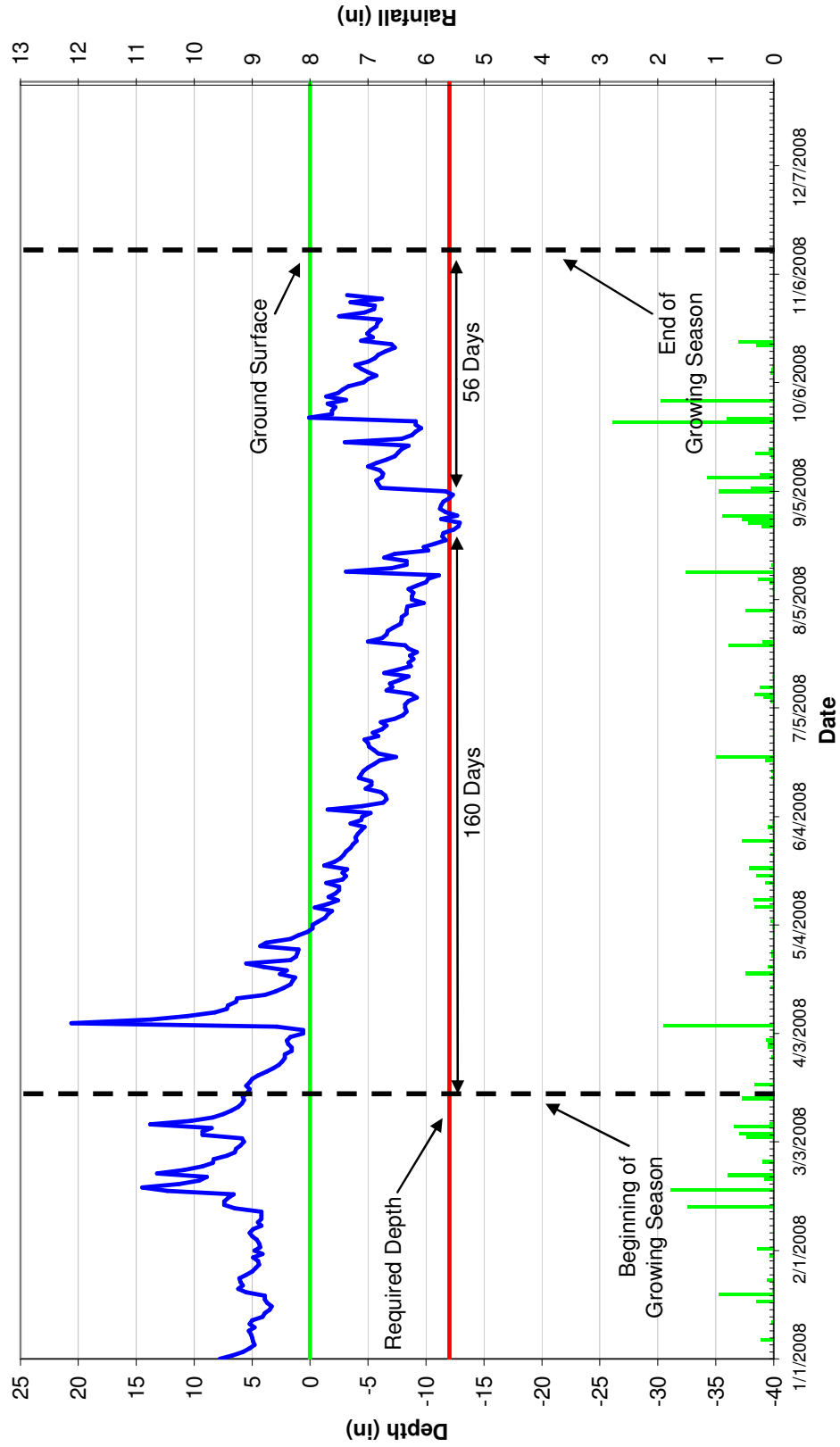


Photo 5. Beaver dam located near Vegetation Plot 3 (3/19/08)

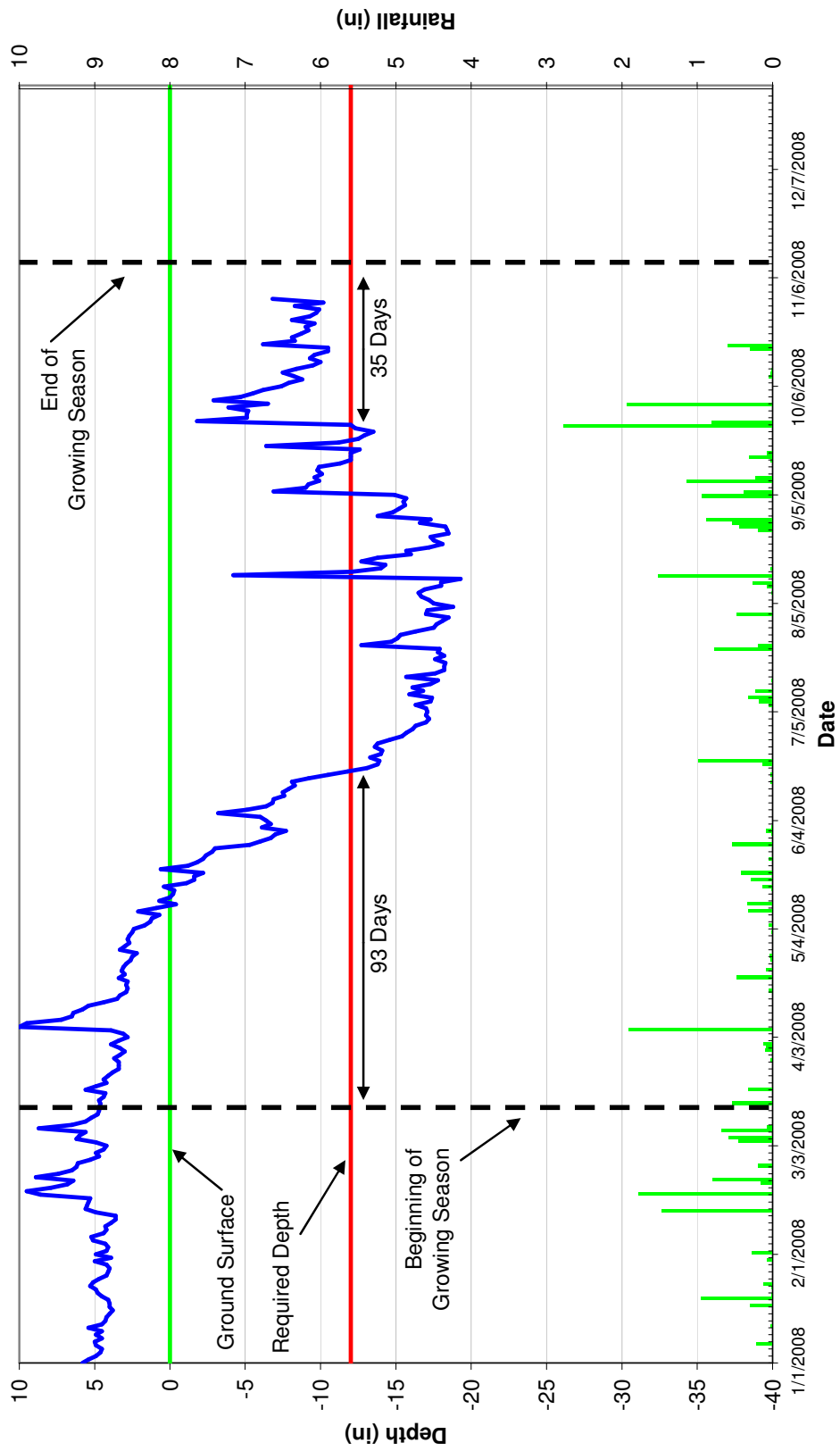
## Appendix C. Hydrology Data

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2008 Groundwater Data  
Well 1 (SN: 00000AB36017)

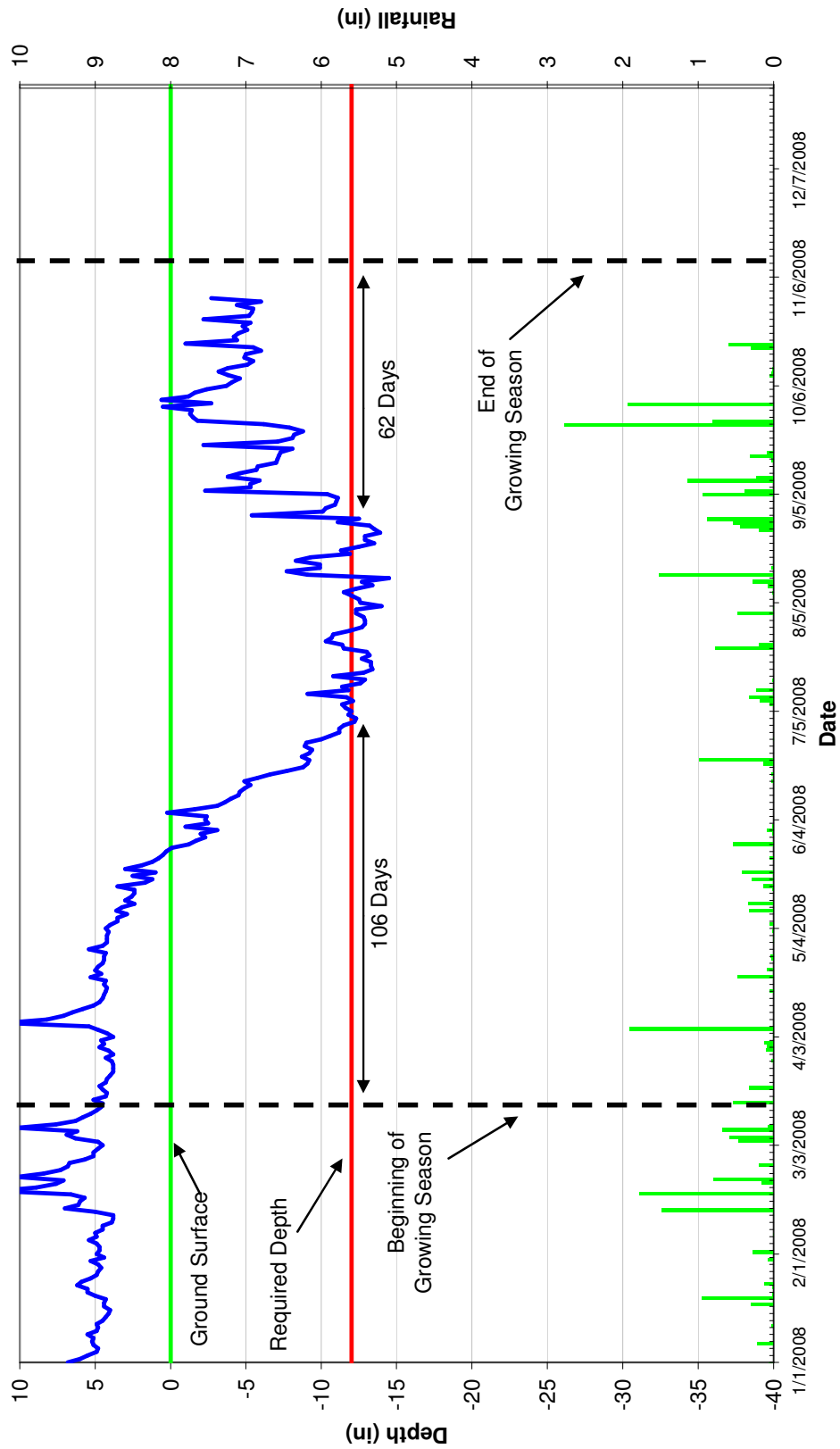


2008 Groundwater Data  
Well 2 (SN: N3D45EA7)

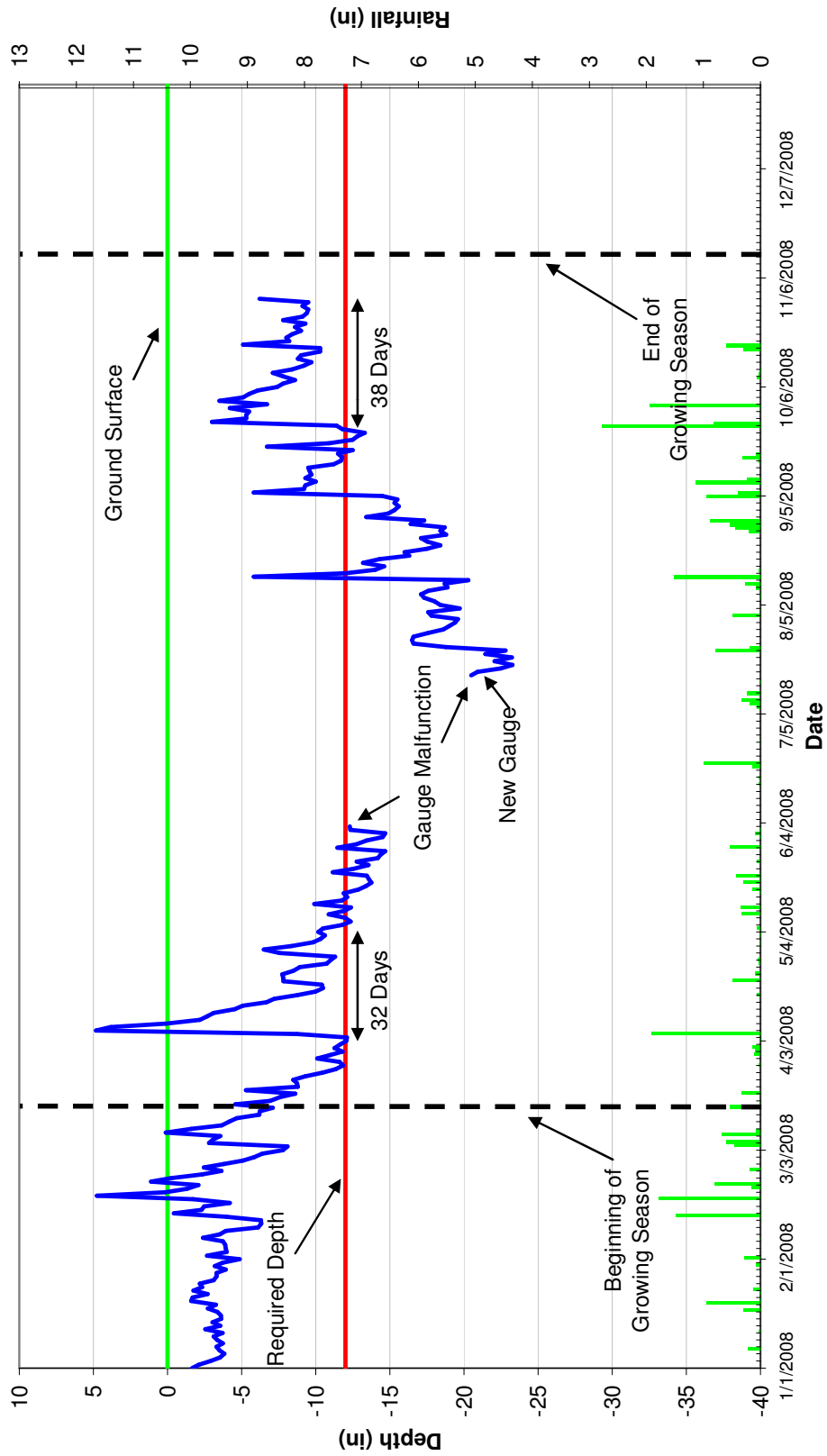




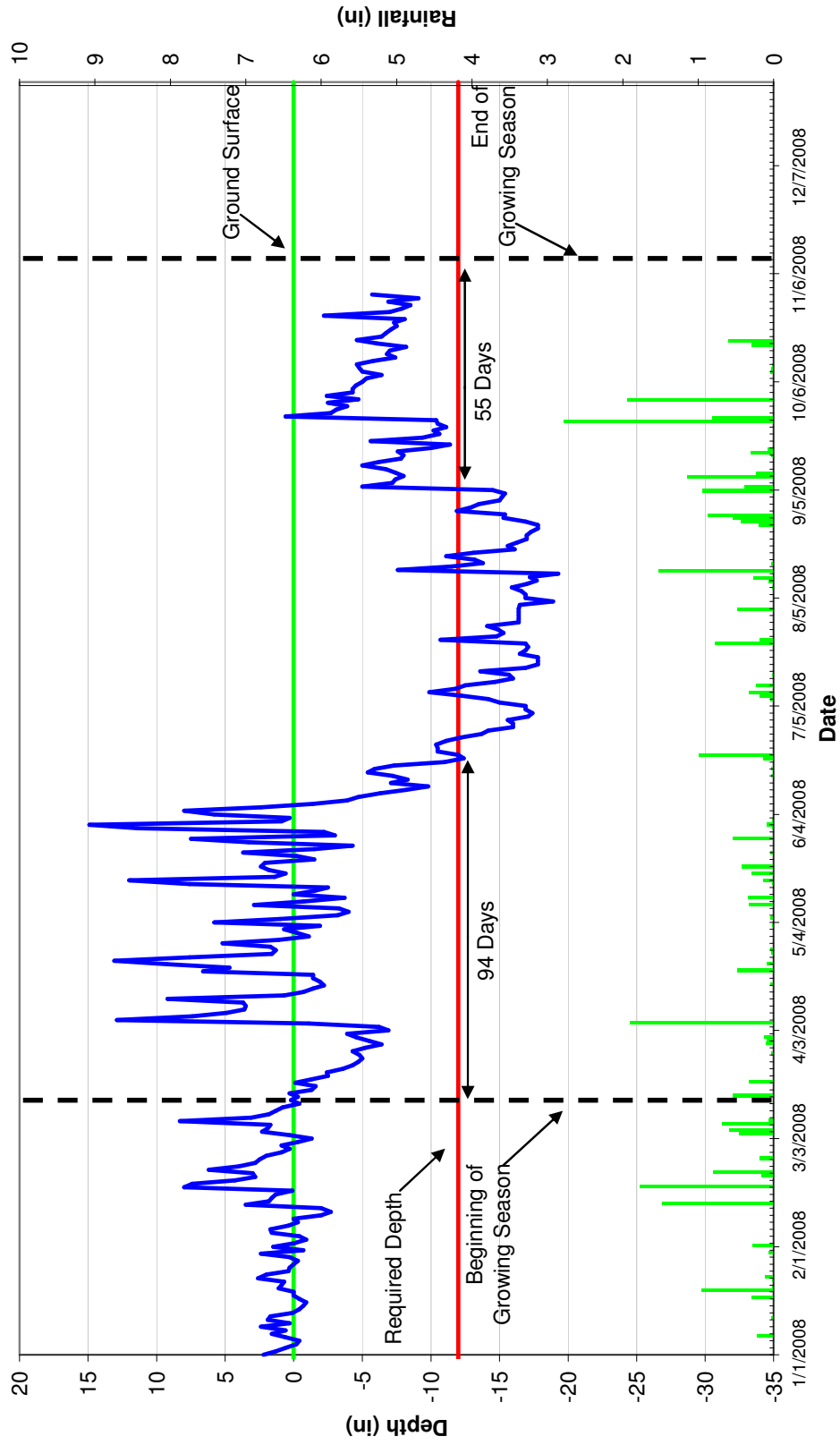
2008 Groundwater Data  
Well 3 (SN: 00000A287A2A)



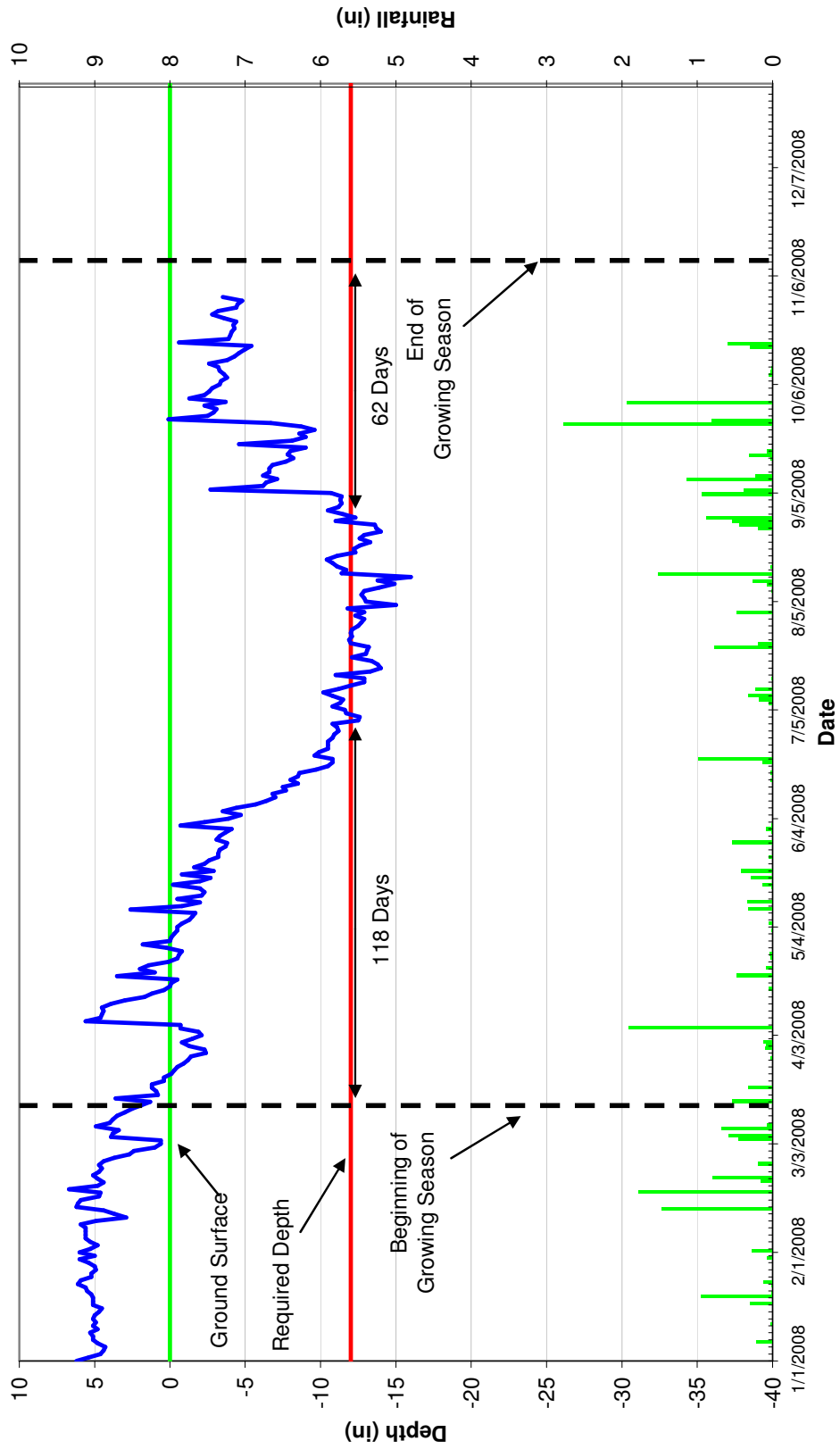
**2008 Groundwater Data  
Well 4 (SN: N3D45F5A & EBDA66C)**



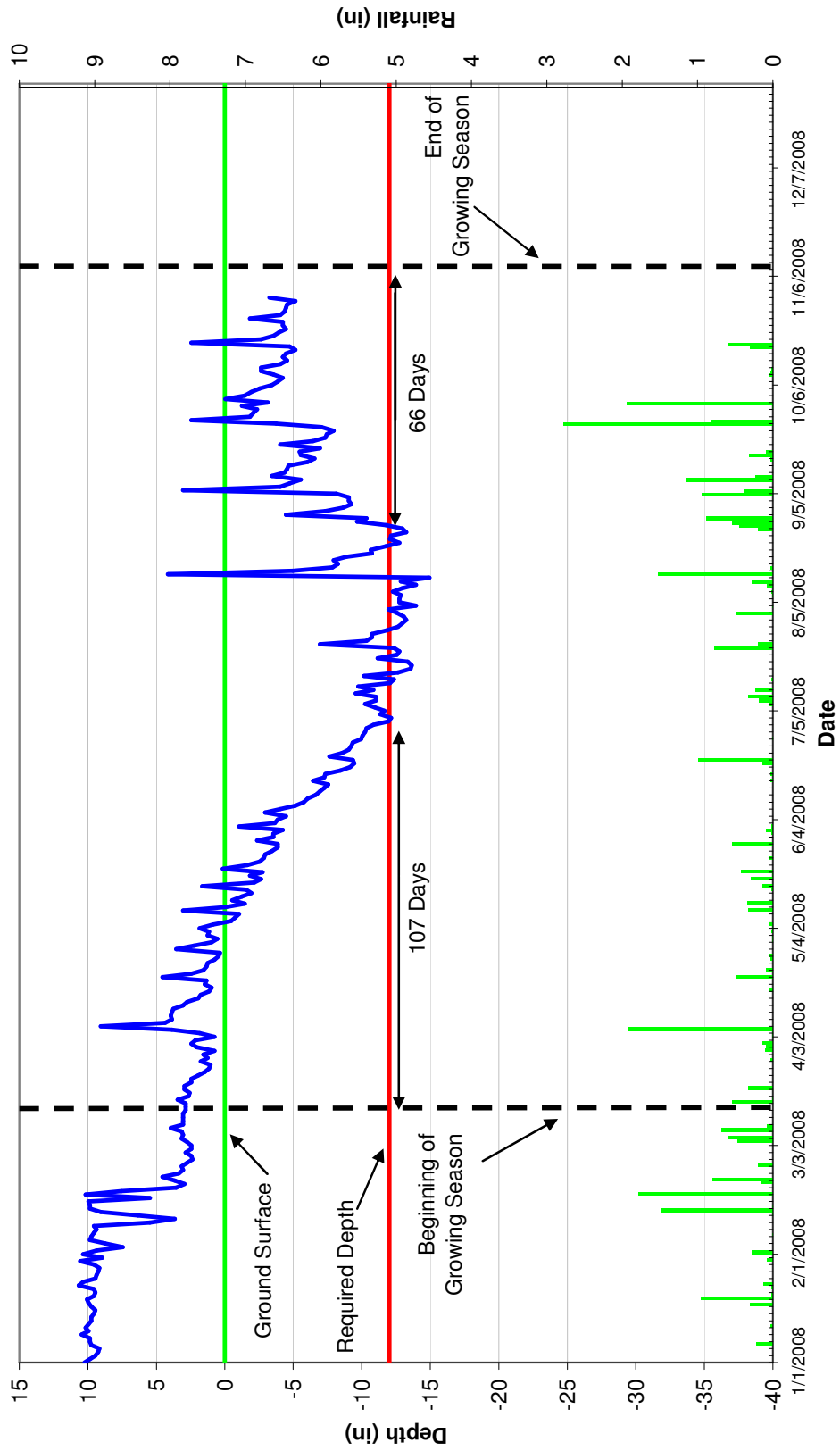
2008 Groundwater Data  
Well 5 (SN: 00000A27B888)



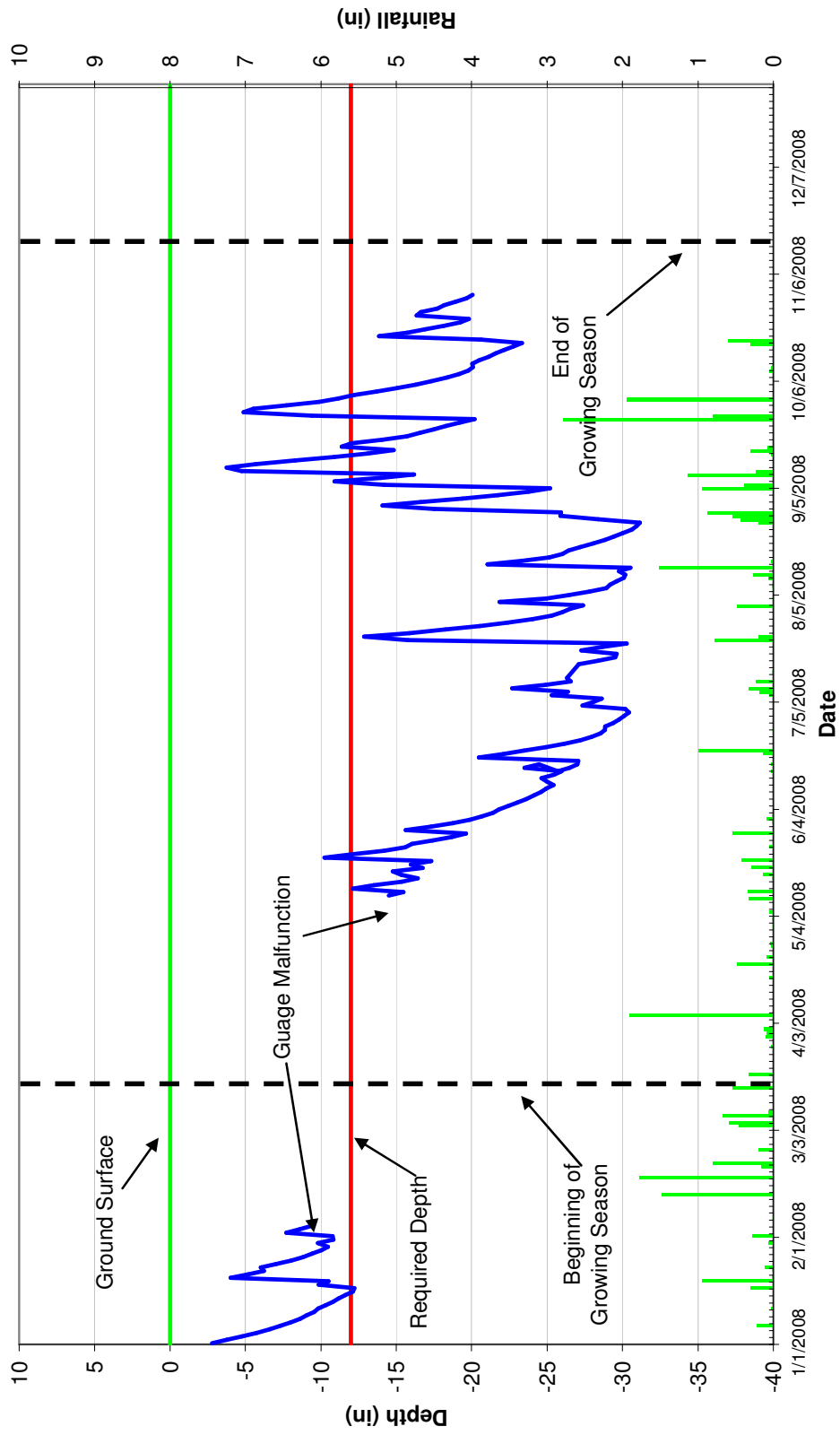
2008 Groundwater Data  
Well 6 (SN: 00000AB36333)



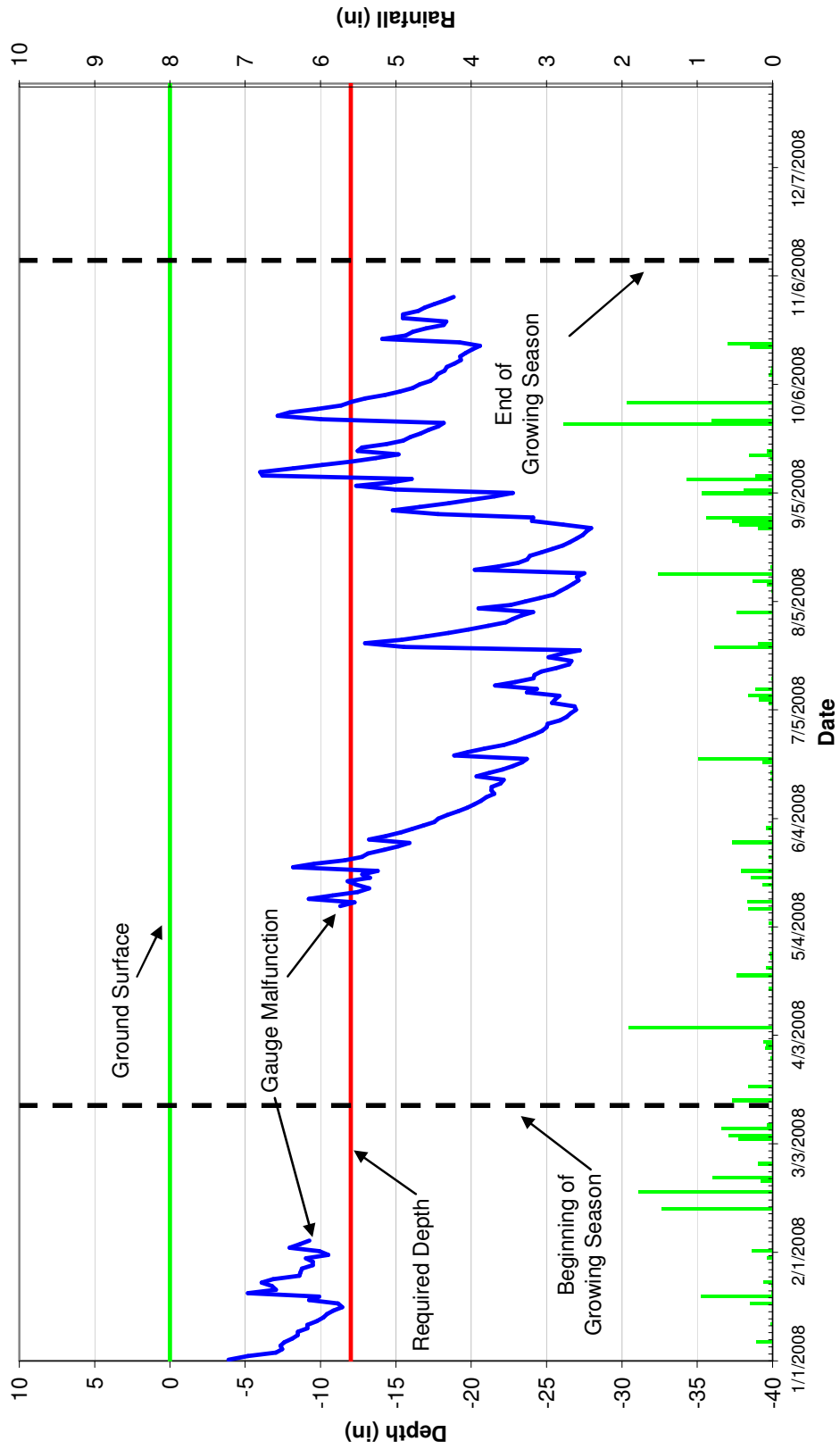
2008 Groundwater Data  
Well 7 (SN: 00000A28BC19)



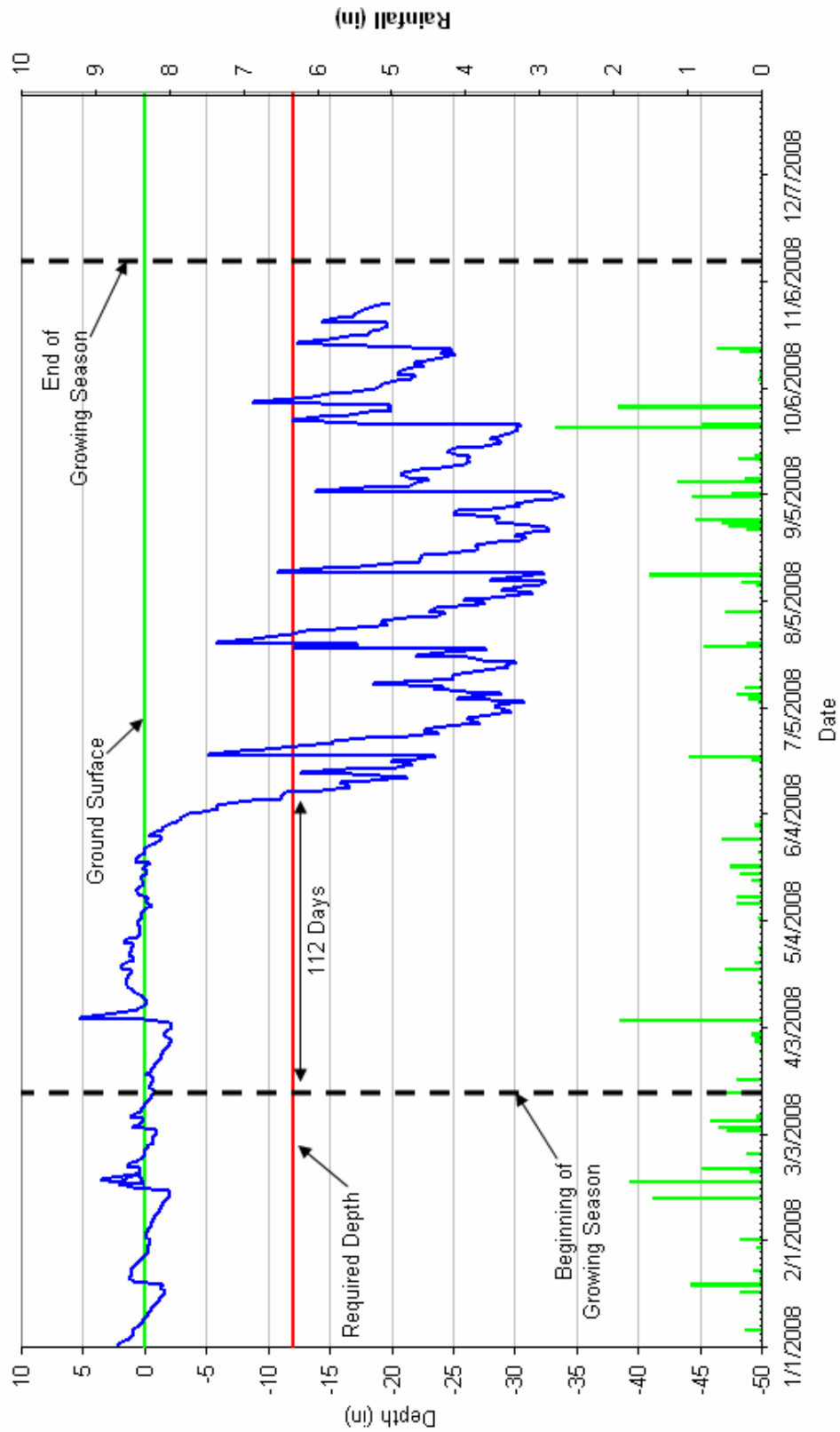
2008 Groundwater Data  
Well Ref-1 (SN: N3D44981)



2008 Groundwater Data  
Well Ref-2 (SN: N3D457A5)

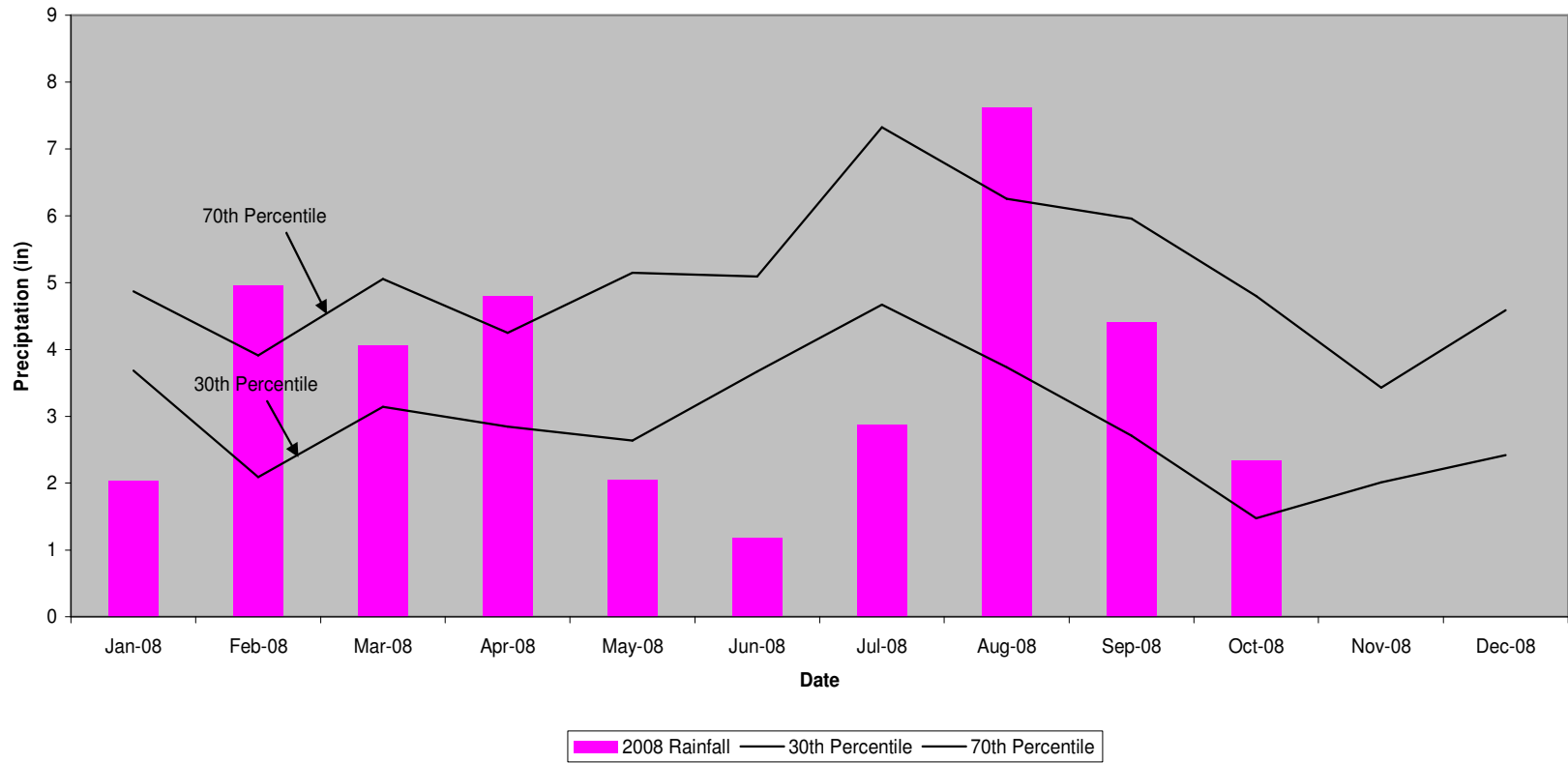


2008 Groundwater Data  
Well Ref-3 (SN: N3D448AB)





Whitlace Creek 30-70 Percentile Graph  
Lenoir County, NC



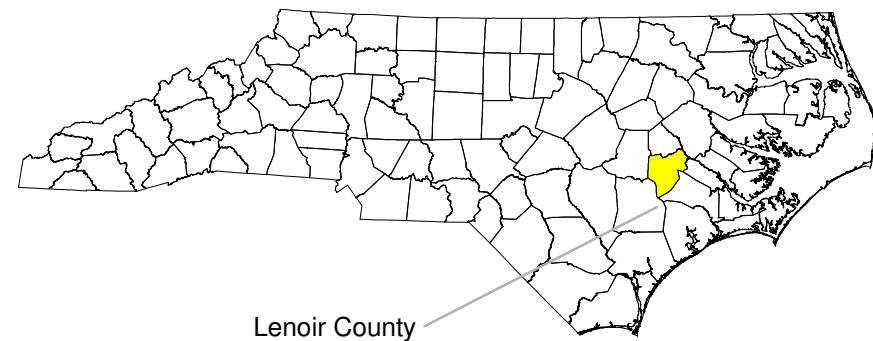
## Appendix D. Current Condition Plan View

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Aerial: 2006 USDA NAIP imagery



Lenoir County

**Legend**

- Stream
- Crest Gauge
- Located Beaver Dams
- Conservation Easement
- Vegetation Plots**
- Not Monitored
- <320 stems/acre
- >320 stems/acre
- Monitoring Gauges**
- Successful for MY3
- Approximate Veg Problem Areas**
- Lespedeza
- Murdannia
- Typha
- Weak woody vegetation

Appendix D. Current Condition Plan View Map MY3  
 Whitelace Creek Stream Enhancement and Wetland Restoration, EEP #420  
 Lenoir County, North Carolina  
 November 2008



0 150 300 600 Feet