

**FINAL  
ANNUAL MONITORING REPORT  
IRWIN CREEK  
RESTORATION SITE  
MECKLENBURG COUNTY, NORTH CAROLINA  
(EEP Project Number 192)**

Monitoring Year 2 of 5 (2011)



Submitted to:  
North Carolina Department of Environment and Natural Resources  
Ecosystem Enhancement Program  
Raleigh, North Carolina



December 2011

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Raleigh, North Carolina

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December 2011

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## 1.0 EXECUTIVE SUMMARY

The North Carolina Ecosystem Enhancement Program (NCEEP) has completed level II stream enhancement and wetland creation at the Irwin Creek Restoration Site (hereafter referred to as the “Site”) to assist in fulfilling stream and wetland mitigation goals in the area. The Site is located on the western side of the City of Charlotte, approximately 2 miles southeast of the Charlotte Douglas International Airport, in Mecklenburg County. The Site is located in United States Geological Survey Hydrologic Unit 03050103020020 (North Carolina Division of Water Quality [NCDWQ] Subbasin 03-08-34) of the Catawba River Basin and will service USGS 8-digit Cataloging Unit (CU) 03050103. This report (compiled based on EEP’s *Procedural Guidance and Content Requirements for EEP Monitoring Reports* Version 1.3 dated 1/15/10) summarizes data for year 2 (2011) monitoring.

The Site is located in an NCEEP Targeted Local Watershed within the Sugar Creek watershed; this watershed in conjunction with the Little Sugar, McMullen, and McAlpine Creek watersheds in CU 03050103 drain point and nonpoint sources of pollution from the metropolitan center of Charlotte severely impacting aquatic health of the watershed. The waters are listed as impaired for elevated levels of fecal coliform bacteria and turbidity; the main goal in this CU is to provide better stormwater management (NCEEP 2007).

Prior to construction, the Site was located within a FEMA buyout area where several homes were demolished and removed. Surrounding land uses include commercial and residential areas with narrow riparian corridors adjacent to streams; greater than 85-90 percent of the contributing watershed having been cleared and developed.

The goals and objectives of this project focus on improving local water quality, habitat, and stream stability. The project approach was designed to provide restoration-oriented improvements to maximize environmental benefits while working within Site constraints, technical guidelines, and availability of funds. These goals were accomplished by the following.

1. Creating a floodplain bench including off-line wetlands to reduce the amount of sediment entering the stream by acting as a repository for soils suspended in the water column during high flow events, providing water storage to further allow sediment to settle out, and slow recharge of stormwater into the groundwater subsurface network.
2. Enhancing vegetation to provide habitat/food sources, shade the stream, filter overland runoff, and remove soil particles and other nutrients from stormwater.
3. Protecting a Site identified in a watershed that is listed as impaired for elevated levels of fecal coliform bacteria and turbidity (NCEEP 2007).

This project was constructed between the spring and early winter of 2009. The project consisted of enhancement (level II) of 980 linear feet of stream by laying back stream banks, excavating an extensive 90- to 100-foot wide floodplain bench along the entire project stream length, creating 0.5 acres of wetlands within the floodplain bench, and planting with native forest species. Several structures were left at the downstream end of the Site rather than removing them to avoid disturbance to the wetland area and stream banks. In addition, it was verified by HDR Engineering that the structures will not cause an issues with FEMA and may provide aquatic habitat and grade control. Site activities provide 653 Stream Mitigation Units and 0.17 riparian riverine Wetland Mitigation Units. The Site will be protected by a permanent conservation easement held by the State of North Carolina.

Success criteria for stream enhancement will include 1) success of riparian vegetation and 2) documentation of two bankfull channel events. A crest gauge is located within the Site to assist with documentation of bankfull events (Figure 2, Appendix B). One bankfull event was documented to occur during the year 2 (2011) monitoring season for a total of four bankfull events.

Vegetation success criteria dictate that an average density of 320 stems per acre must be surviving in the first three monitoring years. Subsequently, 290 stems per acre must be surviving in year 4 and 260 stems per acre in year 5. Stem counts will be based on an average of the evaluated vegetation plots. Based on the number of stems counted, average densities were measured at 971 stems per acre surviving in year 2 (2011). On March 10, 2011, supplemental planting occurred at the Site and included the following.

- 3 red maple (*Acer rubrum*) (2-inch caliper ball and burlap)
- 2 river birch (*Betula nigra*) (2-inch caliper ball and burlap)
- 1000 bare-root seedlings of river birch (*Betula nigra*), green ash (*Fraxinus pennsylvanica*), sycamore (*Platanus occidentalis*), tag alder (*Alnus serrulata*), tulip poplar (*Liriodendron tulipifera*), and silky dogwood (*Cornus amomum*)

The dominant species identified at the Site were planted stems of silky dogwood (*Cornus amomum*), river birch (*Betula nigra*), sycamore (*Platanus occidentalis*), and green ash (*Fraxinus pennsylvanica*). In addition, each individual vegetation plot met success criteria when counting planted stems alone. In general herbaceous vegetation within the Site has been slow to establish, planted ball and burlap trees appear to be in poor health, and many of the planted trees died over the summer of 2010 as the result of dry conditions. These issues encompass the majority of the Site and should continue to be monitored closely in subsequent monitoring years.

Success criteria for wetland groundwater hydrology at the Site require inundation or saturation within 12 inches of the ground surface for a consecutive period of 10 percent of the growing season or greater than 23 consecutive days (the growing season in Mecklenburg County begins March 22 and ends November 11 [233 days]). Groundwater hydrology was not successful for either of the groundwater gauges for the year 2 (2011) growing season.

Summary information and data related to the occurrence of items such as beaver or encroachment and statistics related to performance of various project and monitoring elements can be found in tables and figures within this report's appendices. Narrative background and supporting information formerly found in these reports can be found in the mitigation and restoration plan documents available on EEP's website. All raw data supporting the tables and figures in the appendices is available from EEP upon request.

## 2.0 METHODOLOGY

### 2.1 Vegetation Assessment

Five vegetation plots were established and marked after construction with four foot metal U-bar post demarking the corners with a ten foot, three-quarter inch PVC at the origin. The plots are 10 meters square and are located randomly within the Site. These plots were surveyed in June for the year 2 (2011) monitoring season using the *CVS-EEP Protocol for Recording Vegetation, Version 4.0* (Lee et al. 2006) (<http://cvs.bio.unc.edu/methods.htm>); results are included in Appendix C. The taxonomic standard for vegetation used for this document was *Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas* (Weakley 2007).

## 2.2 Wetland Assessment

Two groundwater monitoring gauges were installed at the Site within off-line wetlands in June 2010 and have been maintained and monitored throughout the growing seasons. Graphs of groundwater hydrology and precipitation are included in Appendix D.

## 3.0 REFERENCES

- Lee, Michael T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2006. CVS-EEP Protocol for Recording Vegetation, Version 4.0. (online). Available: <http://cvs.bio.unc.edu/methods.htm>.
- National Oceanic and Atmospheric Administration (NOAA). 2004. Climatology of the United States No. 20; Monthly Station Climate Summaries, 1971-2000. National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Service, National Climatic Data Center, Asheville, North Carolina.
- North Carolina Ecosystem Enhancement Program (NCEEP). 2007. Catawba River Basin Restoration Priorities. Available: <http://www.nceep.net/services/restplans/RBRPCatawba2007.pdf> [June 2010]. North Carolina Department of Environment and Natural Resources, Ecosystem Enhancement Program. Raleigh, North Carolina.
- Weakley, Alan S. 2007. Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas (online). Available: <http://www.herbarium.unc.edu/WeakleysFlora.pdf> [February 1, 2008]. University of North Carolina Herbarium, North Carolina Botanical Garden, University of North Carolina, Chapel Hill, North Carolina.
- Weather Underground. 2011. Station at Charlotte Douglas International Airport (KCLT) in Charlotte, North Carolina. (online). Available: <http://www.wunderground.com/history/airport/KCLT/2011/11/09/CustomHistory.html> [November 9, 2011].

## APPENDIX A

### PROJECT VICINITY MAP AND BACKGROUND TABLES

Figure 1. Vicinity Map

Table 1. Project Components and Mitigation Credits

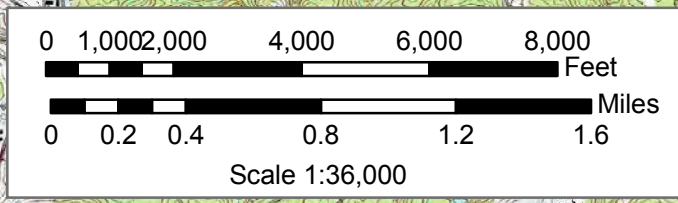
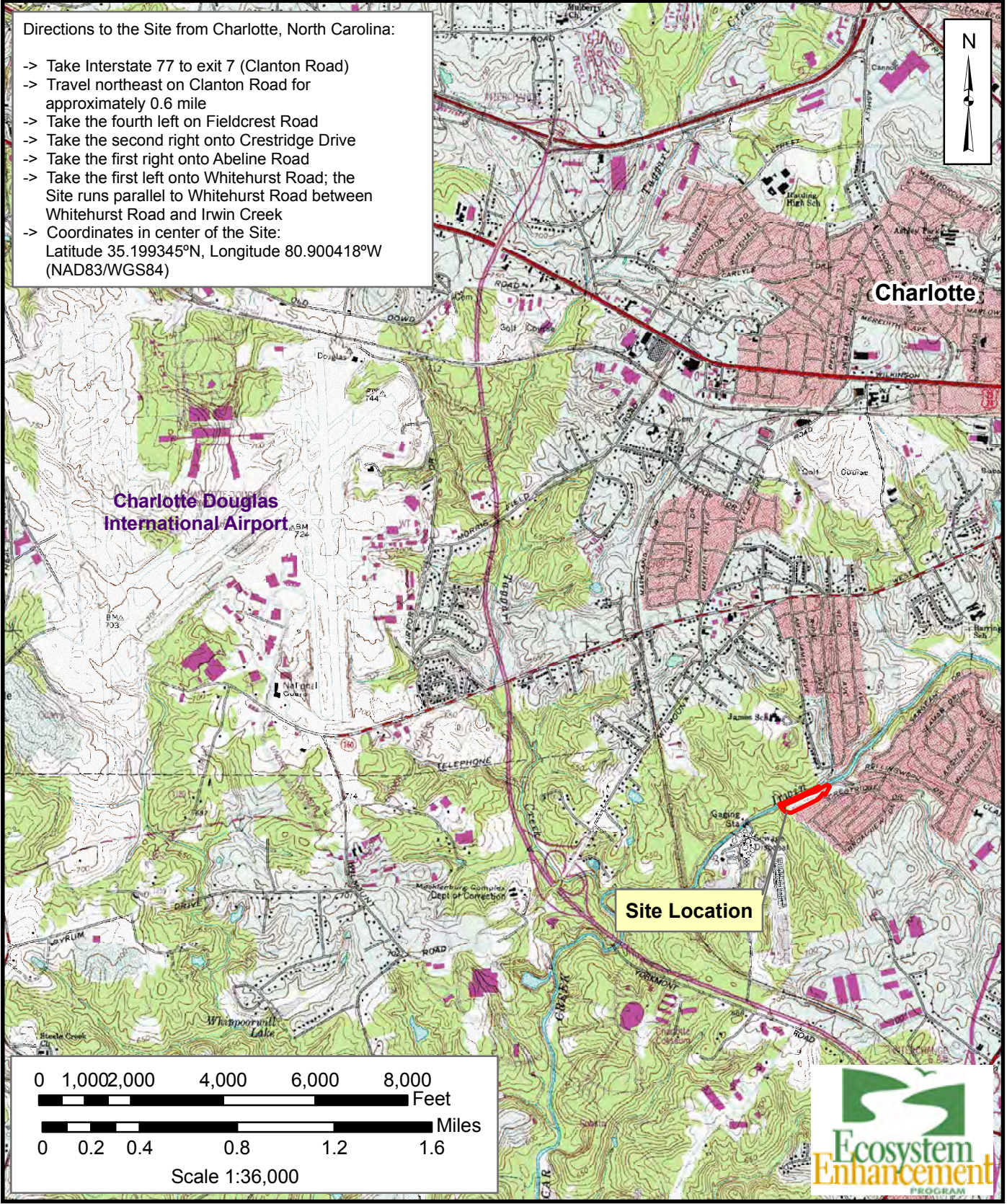
Table 2. Project Activity and Reporting History

Table 3. Project Contacts Table

Table 4. Project Baseline Information and Attributes

Directions to the Site from Charlotte, North Carolina:

- > Take Interstate 77 to exit 7 (Clanton Road)
- > Travel northeast on Clanton Road for approximately 0.6 mile
- > Take the fourth left on Fieldcrest Road
- > Take the second right onto Crestridge Drive
- > Take the first right onto Abeline Road
- > Take the first left onto Whitehurst Road; the Site runs parallel to Whitehurst Road between Whitehurst Road and Irwin Creek
- > Coordinates in center of the Site:  
Latitude 35.199345°N, Longitude 80.900418°W  
(NAD83/WGS84)




20 Enterprise Street  
Suite 7  
Raleigh, NC 27607  
(919) 215-1693

VICINITY MAP  
IRWIN CREEK STREAM RESTORATION SITE  
EEP PROJECT NUMBER 192  
Mecklenburg County, North Carolina

Dwn. by:	CLF	<b>1</b>
Date:	June 2010	
Project:	10-009	



**Table 1. Project Components and Mitigation Credits  
Irwin Creek Restoration Site/EEP Project Number 192**

Mitigation Credits								
Stream				Riverine Riparian Wetland				
Type	Restoration		Restoration Equivalent		Restoration		Restoration Equivalent	
Totals	--		653		--		0.17	
Projects Components								
Project Component/ Reach ID	Station Range	Existing Linear Footage/ Acreage	Priority Approach	Restoration/ Restoration Equivalent	Restoration Linear Footage/ Acreage	Mitigation Ratio	Comment	
Irwin Creek	--	980	Level II	Enhancement	980	1.5:1*	Laying back stream banks, excavation of a 90- to 100-foot wide floodplain bench along the entire project, creation of wetlands within the floodplain bench, and planting with native forest vegetation.	
Wetland	--	0	--	Creation	0.5	3:1	Excavation of depressional wetlands within the floodplain bench and planting with native forest vegetation.	
Component Summation								
Restoration Level		Stream (linear footage)			Riparian Wetland (acreage)			
Enhancement (Level II)		980			--			
Creation		--			0.5			
<b>Totals</b>		<b>980</b>			<b>0.5</b>			
<b>Mitigation Units</b>		<b>653 SMUs*</b>			<b>0.17 WMUs</b>			

\* A ratio of 1.5:1 was used due to the extensive excavation of a 90- to 100-foot wide floodplain bench along the entire project in addition to the incorporation of created wetlands within the floodplain bench area.

**Table 2. Project Activity and Reporting History  
Irwin Creek Restoration Site/EEP Project Number 192**

**Elapsed Time Since Grading Complete: 2.5 years**

**Elapsed Time Since Planting Complete: 2 years**

**Number of Reporting Years: 2**

<b>Activity or Deliverable</b>	<b>Data Collection Complete</b>	<b>Completion or Delivery</b>
Restoration Plan	--	October 2003
Site Construction and 1st Planting	--	Spring 2009
2nd Planting	--	Late fall/early winter 2009
3 <sup>rd</sup> Planting	--	March 2011
As-built Analysis Report	--	March 2010
As-built Record Drawings	--	March 2010
Baseline Monitoring Document	June 2010	October 2010
Year 1 (2010) Monitoring Document	November 2010	October 2010
Year 2 (2011) Monitoring Document	November 2011	December 2011

**Table 3. Project Contacts Table  
Irwin Creek Restoration Site/EEP Project Number 192**

<b>Designer</b>	HDR Engineering of the Carolinas, Inc. 3733 National Drive Raleigh, NC 27612 919-785-1118
<b>Construction and Seeding and Matting Contractor</b>	Blythe Development Company 1415 E. Westinghouse Charlotte, NC 28273
<b>Planting Contractor</b>	North State Environmental, Inc. 2889 Lowery Street, Suite B Winston Salem, NC 27101 336-725-2010
<b>Monitoring Performer</b>	Axiom Environmental, Inc. 218 Snow Avenue Raleigh, NC 27603 919-215-1693

**Table 4. Project Baseline Information and Attributes  
Irwin Creek Restoration Site/EEP Project Number 192**

<b>Project Information</b>	
Project Name	Irwin Creek Restoration Site
Project County	Mecklenburg County, North Carolina
Project Area	5.7 acres
Project Coordinates	35.199345°N, 80.900418°W
<b>Project Watershed Summary Information</b>	
Physiographic Region	Piedmont
Ecoregion	Southern Outer Piedmont
Project River Basin	Catawba
USGS 8-digit HUC	03050103
USGS 14-digit HUC	03050103020020
NCDWQ Subbasin	03-08-34
Project Drainage Area	20,000 acres
Project Drainage Area Impervious Surface	>30%
CGIS Land Use Classification	
<b>Reach Summary Information</b>	
Enhanced length	980 linear feet
Drainage Area	31 square miles
NCDWQ Index Number	11-137-1
NCDWQ Classification	C
Dominant Soil Series	Monacan
Drainage Class	Moderately well-somewhat poorly
Soil Hydric Status	Contains 5% hydric Wehadkee soils
<b>Wetland Summary Information</b>	
Size of Wetland	0.5 acres
Wetland Type	Riparian riverine
Mapped Soil Series	Monacan
Drainage Class	Moderately well-somewhat poorly
Soil Hydric Status	Contains 5% hydric Wehadkee soils
Source of Hydrology	Stormwater, stream overbank
<b>Regulatory Considerations</b>	
<b>Regulation</b>	<b>Applicable</b>
Waters of the U.S. –Sections 404 and 401	No
Endangered Species Act	No
Historic Preservation Act	No
CZMA/CAMA	No
FEMA Floodplain Compliance	No
Essential Fisheries Habitat	No

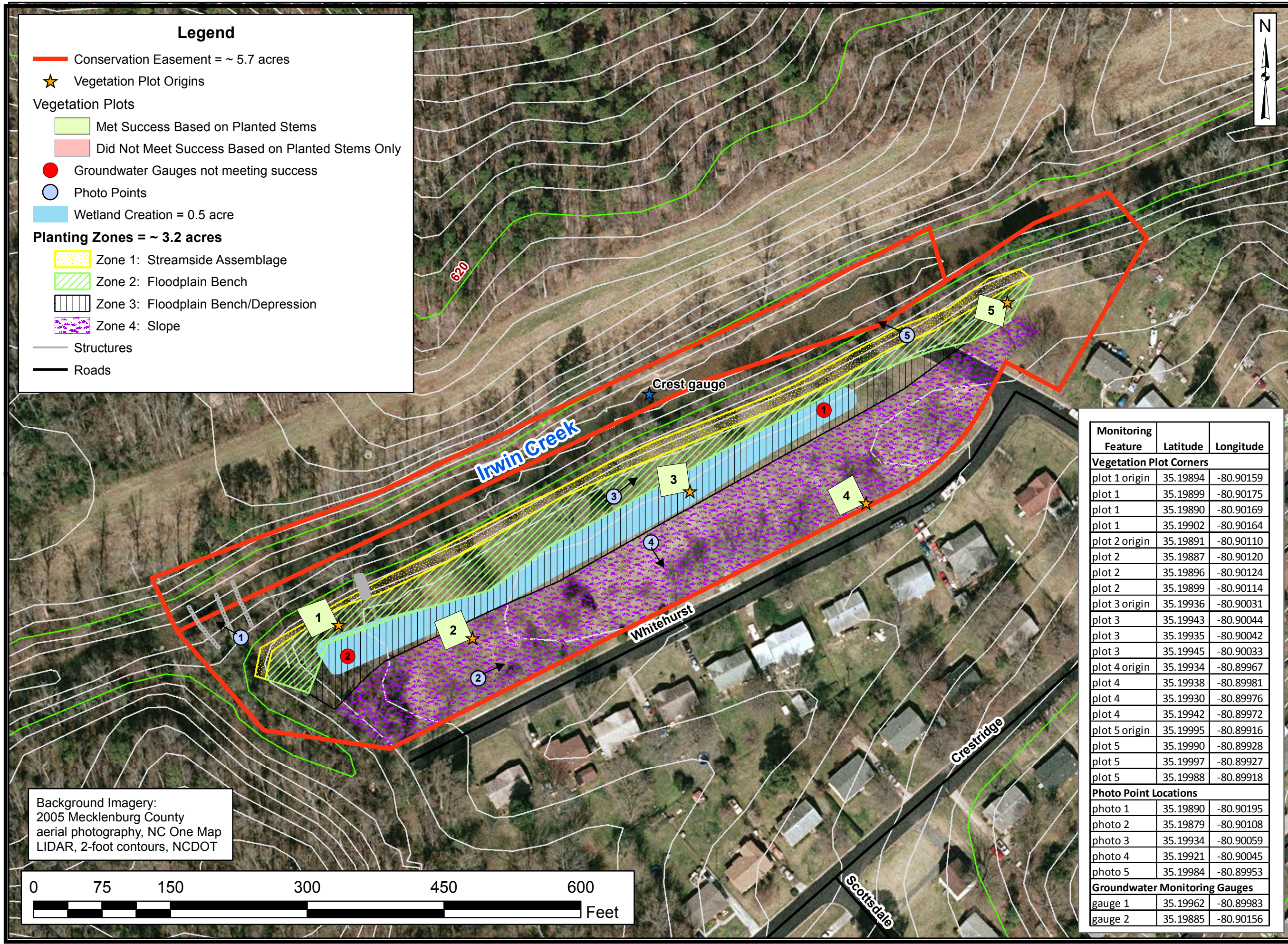
APPENDIX B

VISUAL ASSESSMENT DATA

Figure 2. Current Conditions Plan View

Table 5. Vegetation Condition Assessment Table

Vegetation Monitoring Plot Photos



**Legend**

- Conservation Easement = ~ 5.7 acres
- ★ Vegetation Plot Origins

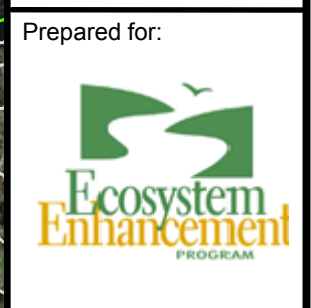
**Vegetation Plots**

- Met Success Based on Planted Stems
- Did Not Meet Success Based on Planted Stems Only
- Groundwater Gauges not meeting success
- Photo Points
- Wetland Creation = 0.5 acre

**Planting Zones = ~ 3.2 acres**

- Zone 1: Streamside Assemblage
- Zone 2: Floodplain Bench
- Zone 3: Floodplain Bench/Depression
- Zone 4: Slope

Structures  
Roads



Prepared for:

**IRWIN CREEK RESTORATION SITE**

EEP Project Number 192  
Mecklenburg County, NC

Title:

**CURRENT CONDITIONS PLAN VIEW**

Drawn by: CLF

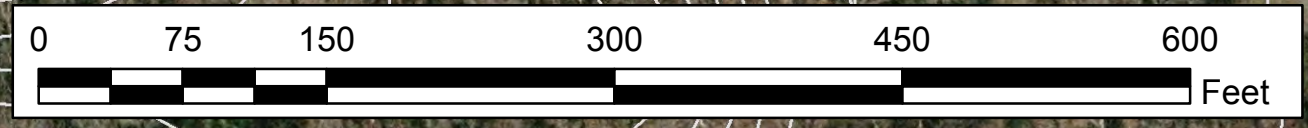
Date: DEC 2011

Scale: 1:1200

Project No.: 10-009

Monitoring Feature	Latitude	Longitude
<b>Vegetation Plot Corners</b>		
plot 1 origin	35.19894	-80.90159
plot 1	35.19899	-80.90175
plot 1	35.19890	-80.90169
plot 1	35.19902	-80.90164
plot 2 origin	35.19891	-80.90110
plot 2	35.19887	-80.90120
plot 2	35.19896	-80.90124
plot 2	35.19899	-80.90114
plot 3 origin	35.19936	-80.90031
plot 3	35.19943	-80.90044
plot 3	35.19935	-80.90042
plot 3	35.19945	-80.90033
plot 4 origin	35.19934	-80.89967
plot 4	35.19938	-80.89981
plot 4	35.19930	-80.89976
plot 4	35.19942	-80.89972
plot 5 origin	35.19995	-80.89916
plot 5	35.19990	-80.89928
plot 5	35.19997	-80.89927
plot 5	35.19988	-80.89918
<b>Photo Point Locations</b>		
photo 1	35.19890	-80.90195
photo 2	35.19879	-80.90108
photo 3	35.19934	-80.90059
photo 4	35.19921	-80.90045
photo 5	35.19984	-80.89953
<b>Groundwater Monitoring Gauges</b>		
gauge 1	35.19962	-80.89983
gauge 2	35.19885	-80.90156

Background Imagery:  
2005 Mecklenburg County  
aerial photography, NC One Map  
LIDAR, 2-foot contours, NCDOT



**FIGURE 2**

**Table 5** **Vegetation Condition Assessment**  
**Irwin Creek Restoration Site/EEP Project Number 192**

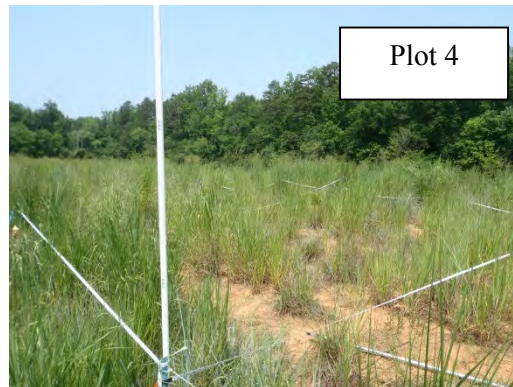
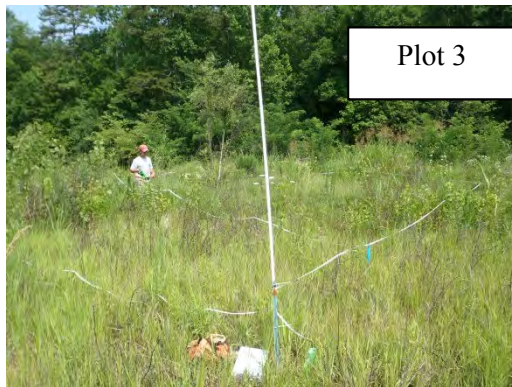
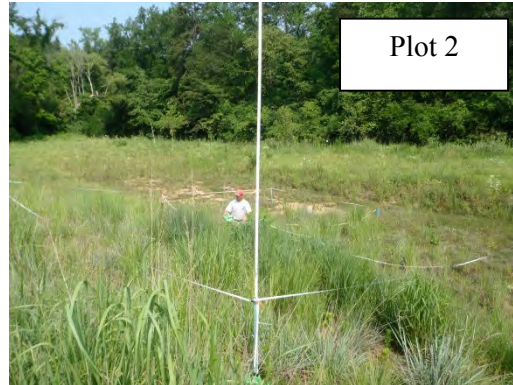
**Planted Acreage<sup>1</sup>** **3.2**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	NA	NA	NA	NA	NA	NA
2. Low Stem Density Areas	NA	NA	NA	NA	NA	NA
				<b>Total</b>	0	0.00
3. Areas of Poor Growth Rates or Vigor	In general herbaceous vegetation within the Site has been slow to establish, planted ball and burlap trees appear to be in poor health, and many of the planted trees died over the summer of 2010 as the result of dry conditions. This is difficult to quantify or depict on mapping since these observations were made scattered throughout the entire Site. Supplemental planting occurred in March 2011 with 5 ball and burlap trees and 1000 bare root seedlings.	NA	NA	NA	2.25	70.3%
				<b>Cumulative Total</b>	0	2.25

**Easement Acreage<sup>2</sup>** **14**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern <sup>4</sup>	NA	NA	NA	NA	NA	NA
5. Easement Encroachment Areas <sup>3</sup>	NA	NA	NA	NA	NA	NA

**Vegetation Monitoring Photographs  
Taken June 2011**



APPENDIX C

VEGETATION PLOT DATA

Table 6. Vegetation Plot Criteria Attainment

Table 7. CVS Vegetation Plot Metadata

Table 8. Total and Planted Stems by Plot and Species



**Table 6. Vegetation Plot Criteria Attainment  
 Irwin Creek Restoration Site (EEP Project Number 192)**

<b>Vegetation Plot ID</b>	<b>Vegetation Survival Threshold Met?</b>	<b>Tract Mean</b>
1	Yes	100%
2	Yes	
3	Yes	
4	Yes	
5	Yes	

**Table 7. CVS Vegetation Plot Metadata  
Irwin Creek Restoration Site (EEP Project Number 192)**

<b>Report Prepared By</b>	Corri Faquin
<b>Date Prepared</b>	6/17/2011 10:46
<b>database name</b>	Axiom-EEP-2011-B.mdb
<b>database location</b>	C:\Axiom\Business\CVS
<b>computer name</b>	CORRI-PC
<b>file size</b>	40574976
<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 PLANTED living stems of each species for each plot; dead and missing stems are excluded.
<b>PROJECT SUMMARY-----</b>	
<b>Project Code</b>	192
<b>project Name</b>	Irwin Creek Whitehurst Road
<b>Description</b>	
<b>River Basin</b>	Catawba
<b>length(ft)</b>	
<b>stream-to-edge width (ft)</b>	
<b>area (sq m)</b>	
<b>Required Plots (calculated)</b>	
<b>Sampled Plots</b>	5

**Table 8. Total and Planted Stems by Plot and Species**  
**EEP Project Code 192. Project Name: Irwin Creek Whitehurst Road**

Scientific Name	Common Name	Species Type	Current Plot Data (MY2 2011)															Annual Means								
			192-AXE-0001			192-AXE-0002			192-AXE-0003			192-AXE-0004			192-AXE-0005			MY2 (2011)			MY1 (2010)			MY0 (2010)		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer negundo	boxelder	Tree									11								11	1	1	34	1	1	368	
Acer rubrum	red maple	Tree			31			6			61				1	1	1	1	1	99	4	4	4	6	6	81
Alnus serrulata	hazel alder	Shrub Tree	2	2	2				1	1	1							3	3	3	5	5	5	6	6	6
Aronia arbutifolia	Red Chokeberry	Shrub	2	2	2				3	3	3				4	4	4	9	9	9	9	9	9	9	9	9
Baccharis halimifolia	eastern baccharis	Shrub Tree			1						1						1			3						
Betula nigra	river birch	Tree	13	13	13	2	2	2	1	1	1	1	1	1	2	2	2	19	19	19	7	7	7	6	6	21
Callicarpa americana	American beautyberry	Shrub	1	1	1				1	1	1				2	2	2	4	4	4	5	5	5	8	8	9
Cephalanthus occidentalis	common buttonbush	Shrub Tree	1	1	1				1	1	1				2	2	2	4	4	4	3	3	3	6	6	6
Cornus amomum	silky dogwood	Shrub	4	6	6	4	4	4	1	1	1	4	4	4	2	2	2	15	17	17	2	4	4	2	4	4
Fraxinus americana	white ash	Tree	1	1	1												1	1	1	1	1	1	1	1	1	
Fraxinus pennsylvanica	green ash	Tree	5	5	28	4	4	4	10	10	33	4	4	4	6	6	6	29	29	75	9	9	31	8	8	32
Itea virginica	Virginia sweetspire	Shrub																		1	1	1	2	2	2	
Liquidambar styraciflua	sweetgum	Tree				1	1	1									1	1	1	1	1	2	1	1	4	
Liriodendron tulipifera	tuliptree	Tree				7	7	7									7	7	7	5	5	5	8	8	8	
Pinus taeda	loblolly pine	Tree			1															1						
Platanus occidentalis	American sycamore	Tree	5	5	5	6	6	6	2	2	2	4	4	4				17	17	17	5	5	5	7	7	7
Populus deltoides	eastern cottonwood	Tree			2	7	7	12			25			1		2	7	7	42	2	2	32	2	2	59	
Quercus nigra	water oak	Tree																					1	1	1	
Quercus phellos	willow oak	Tree																					1	1	1	
Rhus glabra	smooth sumac	Shrub Tree																							1	
Salix nigra	black willow	Tree		4	4													4	4		4	4	2	7	7	
Salix sericea	silky willow	Shrub Tree		1	1													1	1		3	3		4	4	
Sambucus canadensis	Common Elderberry	Shrub Tree				1	1	1									1	1	1	1	1	1	2	2	2	
Unknown		unknown	1	1	1	1	1	1									2	2	2	1	1	1				
<b>Stem count</b>			35	42	100	33	33	44	20	20	141	13	13	14	19	19	22	120	127	321	62	71	157	79	90	633
<b>size (ares)</b>			1			1			1			1			1			5			5			5		
<b>size (ACRES)</b>			0.02			0.02			0.02			0.02			0.02			0.12			0.12			0.12		
<b>Species count</b>			10	12	16	9	9	10	8	8	12	4	4	5	7	7	9	15	17	20	17	19	19	19	20	21
<b>Stems per ACRE</b>			1416	1700	4047	1335	1335	1781	809.4	809.4	5706	526.1	526.1	566.6	768.9	768.9	890.3	971.2	1028	2598	501.8	574.7	1271	639.4	728.4	5123

**Color for Density**

- Exceeds requirements by 10%
- Exceeds requirements, but by less than 10%
- Fails to meet requirements, by less than 10%
- Fails to meet requirements by more than 10%

- PnoLS = Planted excluding livestakes
- P-all = All planted stems including livestakes
- T = All planted and natural recruit stems including livestakes
- Total includes natural recruit stems

APPENDIX D  
STREAM SURVEY DATA  
Fixed-Station Photos

**Irwin Creek  
Taken October 2011**



Photo Point 1: Downstream structure left in place to avoid disturbance to wetlands and stream banks in addition to provide potential aquatic habitat and channel grade control



Photo Point 2:  
Levee Area



Photo Point 3:  
Excavated bench area

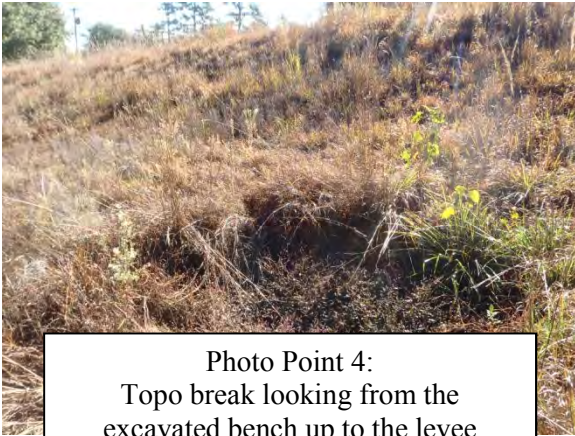


Photo Point 4:  
Topo break looking from the excavated bench up to the levee



Photo Point 5:  
Stream-side assemblage

APPENDIX E  
HYDROLOGY DATA

Table 9. Verification of Bankfull Events

Figure 3. Annual Climatic Data vs. 30-year Historic Data

2011 (Year 2) Groundwater Gauge Graphs

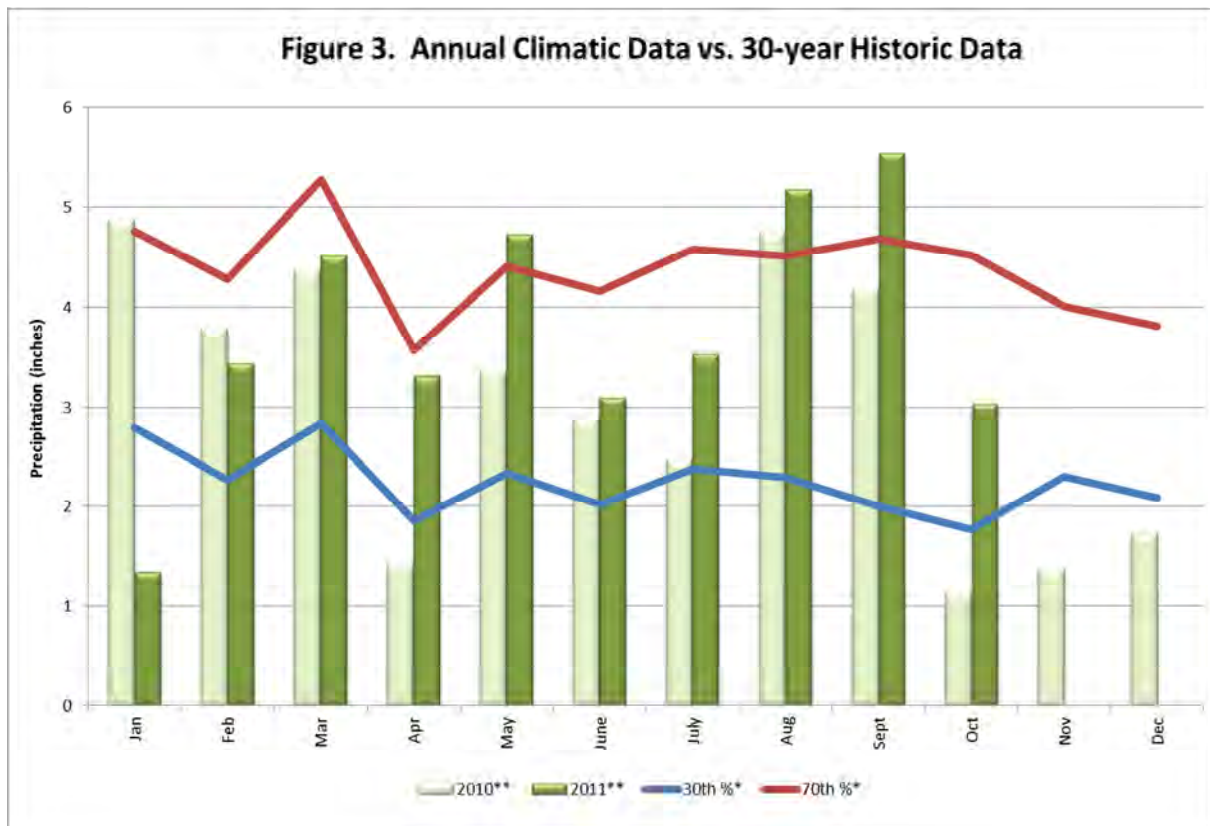
Table 10. Wetland Hydrology Criteria Attainment

**Table 9. Verification of Bankfull Events**

**Irwin Creek Restoration Site (EEP Project Number 192)**

Date of Data Collection	Date of Occurrence	Method	Photo (if available)
September 23, 2010	July 12, 2010	Total of 2.14 inches* of rain reported to fall over 2 days (July 11-12, 2010) as well as a brief spike in groundwater at groundwater gauge 2	--
September 23, 2010	August 19, 2010	Total of 1.1 inches* of rain reported to fall over 2 days (August 18-19, 2010) after a total of 4.43 inches* of rain the preceding 4 weeks as well as brief spike in groundwater at groundwater gauges 1 and 2	--
October 18, 2010	September 29, 2010	Total of 4.04 inches* of rain reported to fall over 6 days (September 25-30, 2010) as well as a brief spike in groundwater at groundwater gauge 2	--
October 21, 2011	August 5, 2011	Total of 2.50 inches* of rain reported to fall on August 5, 2011 as well as a brief spike in groundwater at groundwater gauge 2	--

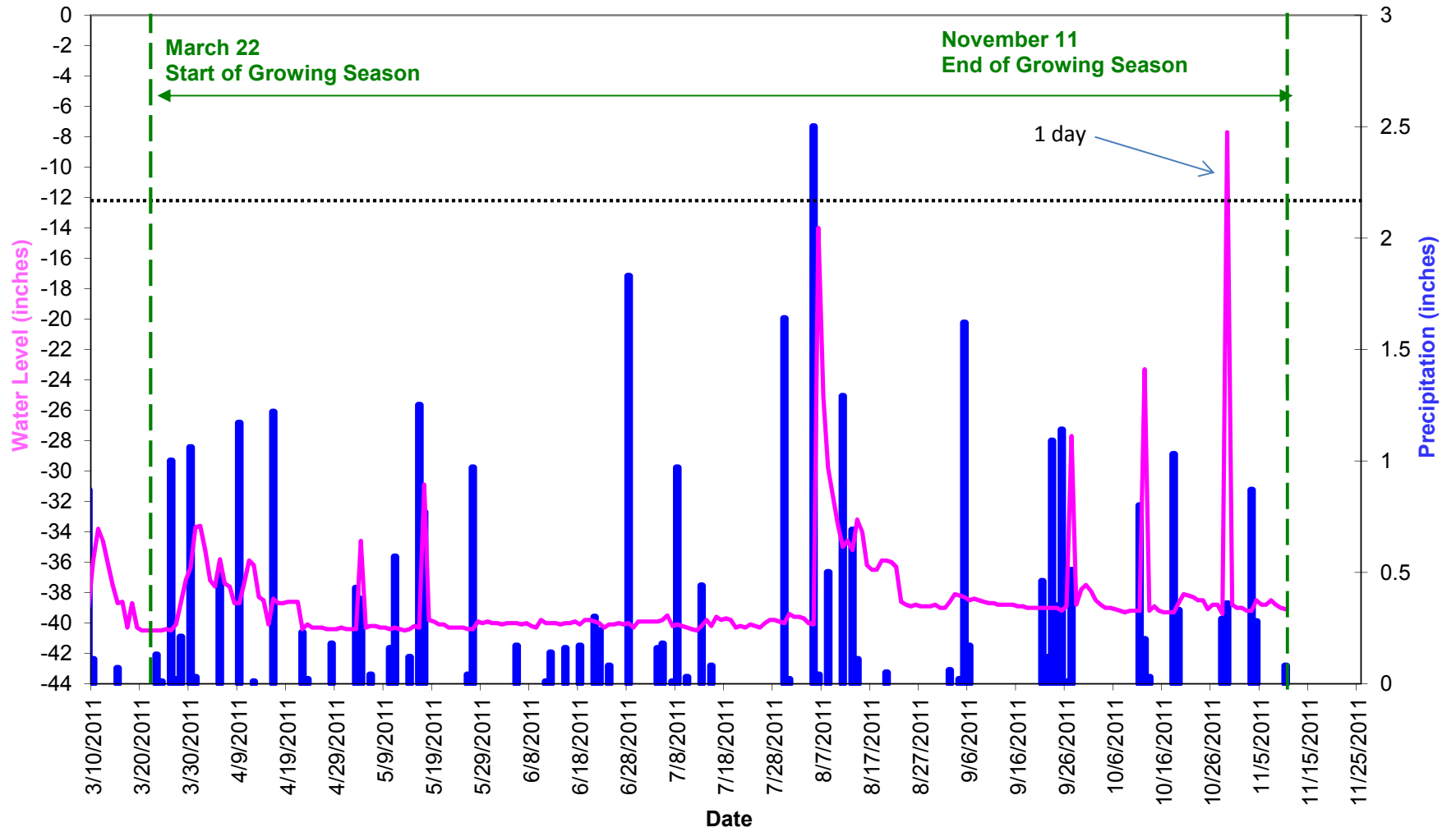
\* Reported at KCLT Weather Station at the Charlotte Airport (Weatherunderground 2011).



\*Charlotte Douglas International Airport 30-year historic data (NOAA 2004)

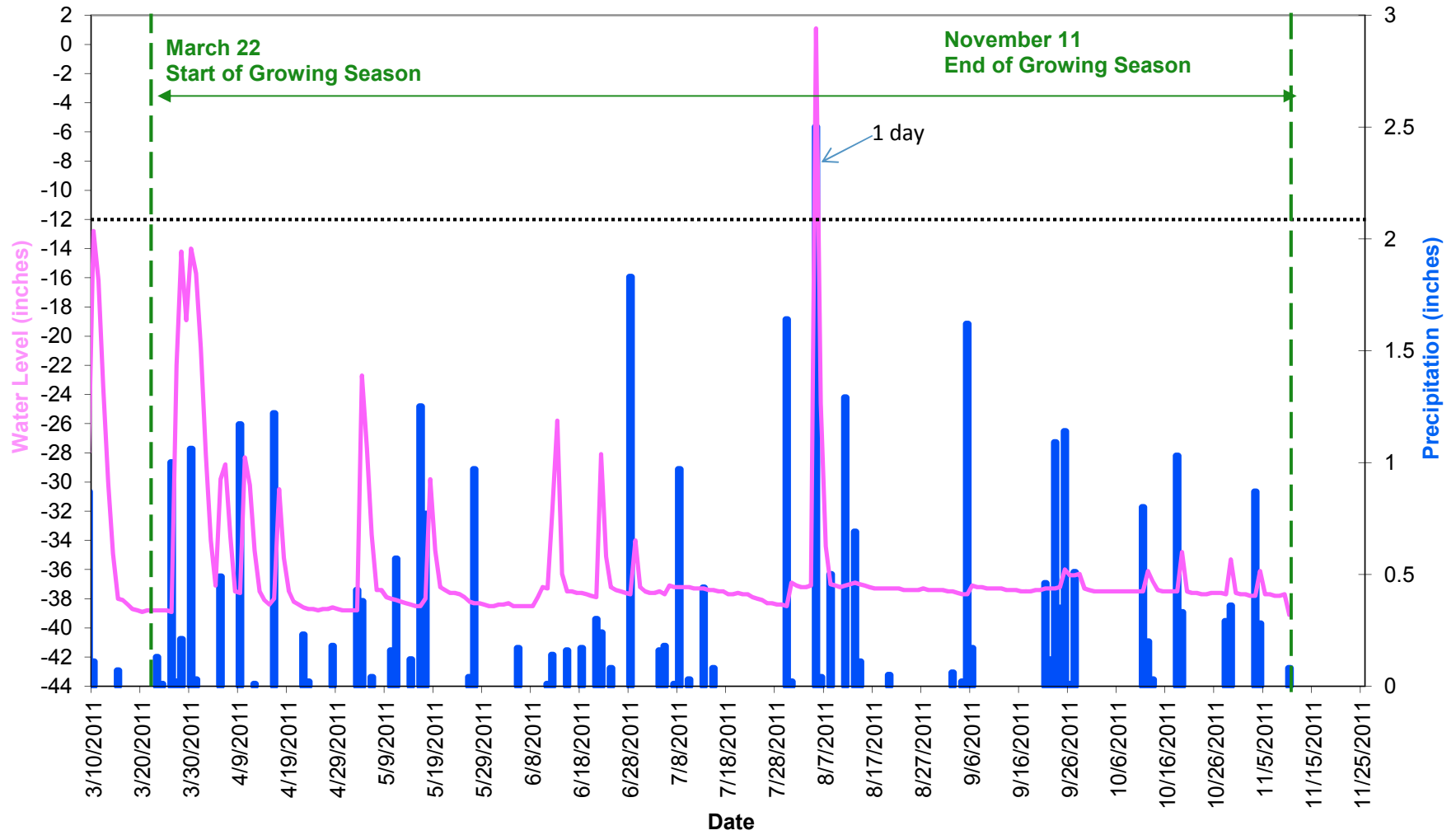
\*\*Charlotte Douglas International Airport rainfall data (Weatherunderground 2011)

### Irwin Creek - Groundwater Gauge 1 (Year 2-2011 Data)





### Irwin Creek - Groundwater Gauge 2 (Year 2-2011 Data)



**Table 10. Wetland Hydrology Criteria Attainment Summary  
Irwin Creek Restoration Site (EEP Project Number 192)**

Gauge	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)				
	Year 1 (2010)	Year 2 (2011)	Year 3 (2012)	Year 4 (2013)	Year 5 (2014)
1	No/1 day (0.004 %)	No/1 day (0.004 %)			
2	No/3 days (0.01 %)	No/1 day (0.004 %)			