ANNUAL MONITORING REPORT
YEAR 5 (2011)
CONTRACT D06003-1

LLOYD STREAM AND WETLAND RESTORATION SITE
ONSLOW COUNTY, NORTH CAROLINA

FULL DELIVERY PROJECT
WHITE OAK RIVER BASIN
CATALOGING UNIT 03030001

Prepared for:

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
RALEIGH, NORTH CAROLINA

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EXECUTIVE SUMMARY

Restoration Systems, L.L.C. has completed restoration of stream and wetlands (riverine and nonriverine) at the Lloyd Stream and Wetland Restoration Site to assist the North Carolina Ecosystem Enhancement Program in fulfilling stream and wetland mitigation goals in the region. The Site is located approximately 1 mile southeast of Richlands and 5 miles northwest of Jacksonville, in Onslow County. The Site is located in United States Geological Survey (USGS) Hydrologic Unit (HU) 03030001010030 (North Carolina Division of Water Quality Subbasin 03-05-02) of the White Oak River Basin and will service the USGS 8-digit CU 03030001. This report serves as the Year 5 (2011) annual monitoring report.

Primary activities at the Site included 1) stream restoration, 2) wetland restoration, 3) soil scarification, and 4) plant community restoration. Project restoration efforts provide a minimum of 4750 Stream Mitigation Units, 3.3 riverine Wetland Mitigation Units, and 3.1 nonriverine Wetland Mitigation Units as outlined in the June 2005 Technical Proposal.

Five vegetation plots (10 meters by 10 meters in size) were established and permanently monumented. These plots were surveyed in August 2011 for the Year 5 (2011) monitoring season. Based on the number of stems present, the average density of all plots was 680 planted stems per acre surviving in Year 5 (2011). The dominant species identified at the Site were planted stems of sycamore (*Platanus occidentalis*), sugarberry (*Celtis laevigata*), and green ash (*Fraxinus pennsylvanica*). In addition, each individual plot met success criteria with densities ranging from 486 to 850 planted stems per acre. A small area of poor vegetation growth is located near groundwater monitoring Gauge 4, most likely due to a lack of nutrients in the soil after construction. This area is expected to recover naturally. No other vegetation problem areas were noted during the Year 5 (2011) monitoring season.

Twelve cross-sections and longitudinal profiles within three reaches totaling 3442 linear feet were measured during Year 5 (2011) monitoring. As a whole, monitoring measurements indicate that there have been minimal changes in both the longitudinal profile and cross-sections as compared to as-built data. The as-built channel geometry compares favorably with the emulated, stable E/C type stream reach as set forth in the detailed mitigation plan and construction plans. Current monitoring has demonstrated dimension, pattern, and profile were stable over the course of the monitoring period. No stream problem areas were noted within the Site during the Year 5 (2011) monitoring year.

Nine restoration Site groundwater gauges and one reference groundwater gauge were maintained for the Year 5 (2011) monitoring season. Rainfall for the Year 5 (2011) growing season was below normal with 39.3 inches of rain occurring from January to October 2011 compared to the 30-year historic mean rainfall of 49.1 inches occurring from January to October. Therefore, success criteria of restoration gauges are based on comparisons to reference gauge data, analysis of growing season start date, and all gauges should be considered successful for Year 5 (2011).

Wetlands at the Site are developing well despite continued drought conditions with the development of hydrophytic herbaceous vegetation and a presence of recent oxidized rhizospheres within the upper 12 inches of soil. Based on recent field visits, gauge data, rain data, and analyses of growing season start dates, wetlands at the Site should be considered successful. Drought conditions compounded with an uncharacteristically late growing season start have led to data results that don't consistently meet success criteria; however, jurisdictional wetland delineations completed within the Site would undoubtedly find a surplus of wetlands at the Site beyond minimums outlined in the June 2005 Technical Proposal (3.3

Riparian WMUs and 3.1 Nonriparian WMUs). Based on the Site as constructed, restoration activities resulted in 8.2 acres of riparian wetland restoration, 3.1 acres of nonriparian wetland restoration, and 1.9 acres of riparian wetland creation.

In summary, the restoration Site achieved success criteria in Year 5 (2011) and should be considered successful over the five-year monitoring period.

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1.0 PROJECT BACKGROUND

1.1 Location and Setting

Restoration Systems, L.L.C. (Restoration Systems) has completed restoration of stream and wetlands (riverine and nonriverine) at the Lloyd Stream and Wetland Restoration Site (hereafter referred to as the "Site") to assist the North Carolina Ecosystem Enhancement Program (EEP) in fulfilling stream and wetland mitigation goals in the region. The Site is located approximately 1 mile southeast of Richlands and 5 miles northwest of Jacksonville, in Onslow County (Figure 1). The Site is located in United States Geological Survey (USGS) Hydrologic Unit (HU) 03030001010030 (North Carolina Division of Water Quality [NCDWQ] Subbasin 03-05-02) of the White Oak River Basin and will service the USGS 8-digit Cataloging Unit (CU) 03030001.

Directions to the Site from Richlands, North Carolina, are as follows:

- Travel east on Highway 24 for approximately 4 miles
- Turn left on Northwest Bridge Road and travel approximately 2 miles
- The Site is on the left

1.2 Project Objectives

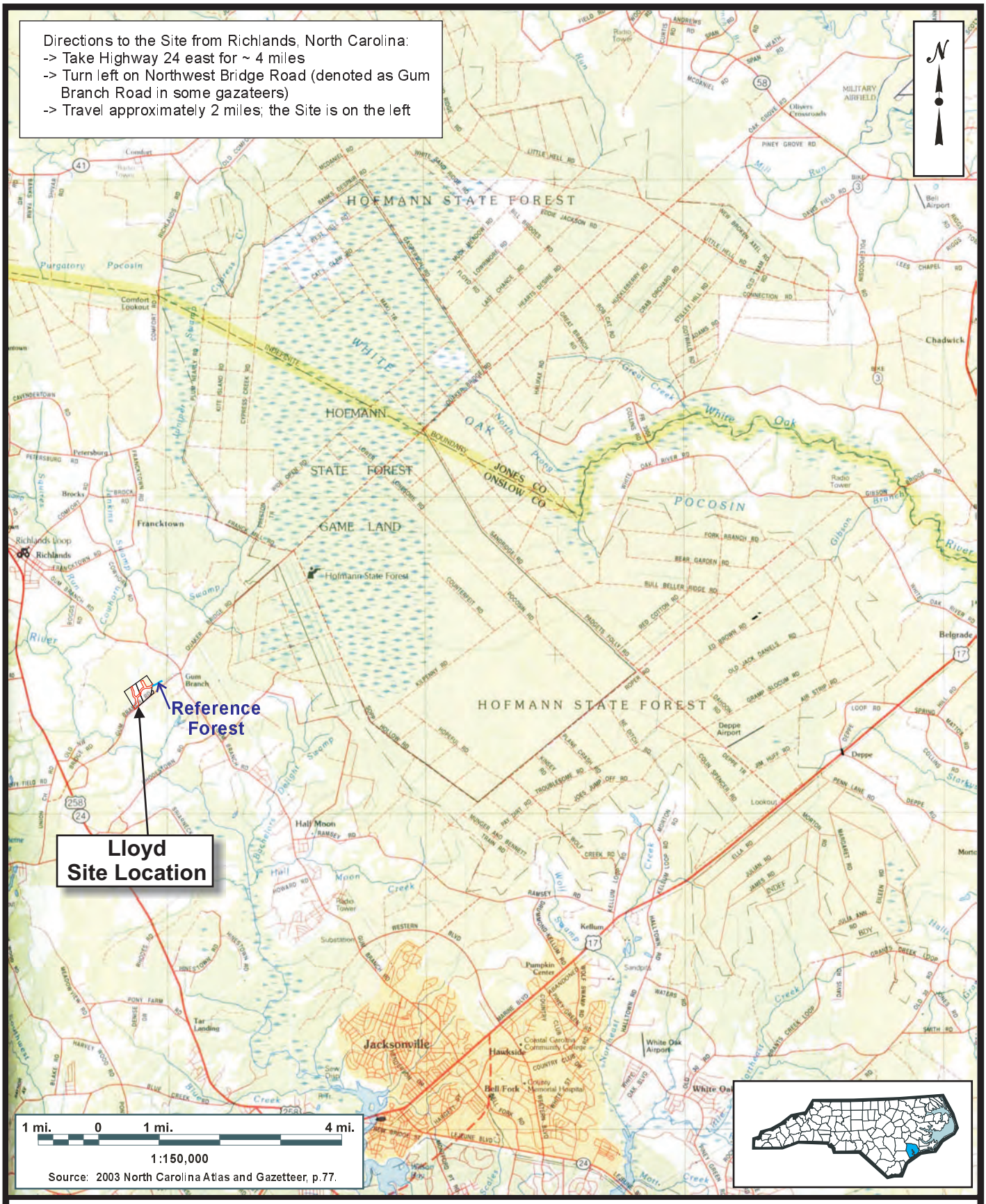
The primary components of the restoration project included 1) construction of a stable, riffle-pool stream channel; 2) enhancement of water quality functions within, upstream, and downstream of the Site 3) creation of a natural vegetated buffer along restored stream channels; 4) restoration of jurisdictional riverine and nonriverine wetlands in the Site; 5) improvement of aquatic habitat and species diversity by enhancing stream bed variability; and 6) restoration of wildlife functions associated with a riparian corridor/stable stream.

1.3 Project Structure, Restoration Type, and Approach

A 24.3-acre conservation easement has been placed on the Site to incorporate all restoration activities. The Site contains 22.5 acres of hydric soil, two unnamed tributaries (UTs) to the New River (main and eastern tributaries), riparian buffer, and upland slopes. The purpose of this project was to restore stable pattern, dimension, and profile to the UTs; restore hydrology to drained riverine and nonriverine wetlands; and revegetate streams, floodplains, and wetlands within the Site. The Site drainage area encompasses approximately 1.4 square miles of land at the downstream Site outfall that is characterized by agricultural land, forest, and low-density residential development.

Prior to construction, the entire Site was characterized by active pasture, fallow fields, and forest stands. Pasture was grazed by livestock including cattle and horses, and livestock had access to the entire Site. No exclusionary barriers were located adjacent to onsite streams or wetlands and livestock contributed to degradation of stream banks, unstable channel characteristics (stream entrenchment, erosion, and bank collapse), degraded water quality, compacted hydric soils, and decreased wetland function. In addition, the eastern tributary didn't receive natural stream flows. A berm had been placed near the eastern property/Site boundary to redirect stream flows into a linear ditch that drained south along the eastern property boundary into roadside ditches along the southern property boundary. The roadside ditch tied into the main tributary in the southwestern portion of the Site.

The primary goals of this stream and wetland restoration project focused on improving water quality, enhancing flood attenuation, and restoring aquatic and riparian habitat and were accomplished by:



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SITE LOCATION
LLOYD STREAM AND WETLAND RESTORATION SITE
Onslow County, North Carolina

Dwn. by: CLF	FIGURE
Date: NOV 2008	1
Project: 08-007	

- Removing nonpoint sources of pollution associated with agricultural production including a) removal of livestock from streams, stream banks, and floodplains; b) cessation of broadcasting fertilizer, pesticides, and other agricultural materials into and adjacent to Site streams and wetlands; and c) providing a vegetative buffer adjacent to streams and wetlands to treat surface runoff.
- Reducing sedimentation within onsite and downstream receiving waters by a) reducing bank erosion associated with hoof shear, vegetation maintenance, and agricultural plowing to Site streams and b) providing a forested vegetative buffer adjacent to Site streams and wetlands.
- Reestablishing stream stability and the capacity to transport watershed flows and sediment loads by restoring stable dimension, pattern, and profile.
- Promoting floodwater attenuation by a) reconnecting bankfull stream flows to the abandoned floodplain terrace; b) restoring secondary, entrenched tributaries thereby reducing floodwater velocities within smaller catchment basins; c) restoring depressional floodplain wetlands and increasing storage capacity for floodwaters within the Site; and d) revegetating Site floodplains to increase frictional resistance on floodwaters crossing Site floodplains.
- Improving aquatic habitat by enhancing stream bed variability.
- Providing wildlife habitat including a forested riparian corridor within a region of the state highly dissected by agricultural land use.

Primary activities at the Site included 1) belt-width preparation and grading, 2) floodplain bench excavation, 3) channel excavation, 4) installation of channel and ditch plugs, 5) backfilling of the abandoned channel and ditches, 6) ditch rerouting, 7) installation of in-stream structures and a Terracell drop structure at the Site outfall, 8) construction of a piped channel crossing, 9) floodplain soil scarification, and 10) plant community restoration.

Table 1 describes the Site restoration structures and objectives, which have provided a minimum of 4750 Stream Mitigation Units, 3.3 riverine Wetland Mitigation Units, and 3.1 nonriverine Wetland Mitigation Units as outlined in the June 2005 Technical Proposal. Site restoration activities included the following.

- Restored 5858 linear feet of stream within two UTs to the New River by constructing meandering, C/E-type channels.
- Restored 3.3 acres of riverine wetland through filling ditches, removal of spoil castings, eliminating agricultural practices, and/or planting with native forest vegetation.
- Restored 3.1 acres of nonriverine wetland through filling ditches, removal of spoil castings, eliminating agricultural practices, and/or planting with native forest vegetation.
- Reforested the entire floodplain with native forest species.

Table 1. Site Restoration Structures and Objectives

Restoration Segment/ Reach ID	Station Range	Restoration Type/Approach*	Designed Linear Footage/Acreage	SMU/WMUs
Tributary 1	0+00 – 27+96	Restoration/PI	2796	2796
Tributary 2	0+00 – 30+62	Restoration/PI	3062	3062
Riverine Wetlands	--	Restoration	3.3	3.3
Nonriverine Wetlands	--	Restoration	3.1	3.1
Mitigation Unit Summations				
Stream	**Riverine Wetland**	**Nonriverine Wetland**		
5858 SMU	3.3 WMU	3.1 WMU		

*PI=Priority 1

1.4 Project History and Background

Completed project activities, reporting history, completion dates, project contacts, and background information are summarized in Tables 2-4.

Table 2. Project Activity and Reporting History

Activity or Report	Data Collection Completion	Actual Completion or Delivery
Restoration Plan	May 2006	June 2006
Construction Completion	NA	March 2007
Site Planting	NA	March 2007
Mitigation Plan/As-builts	March 2007	May 2007 amended July 2007
Year 1 Monitoring (2008)	November 2007	December 2007
Year 2 Monitoring (2008)	November 2008	November 2008
Year 3 Monitoring (2009)	November 2009	August 2009
Year 4 Monitoring (2010)	November 2010	November 2010
Year 5 Monitoring (2011)	November 2011	November 2011

Table 3. Project Contacts Table

Full Delivery Provider	Restoration Systems 1101 Haynes Street, Suite 211 Raleigh, North Carolina 27604 George Howard and John Preyer (919) 755-9490
Construction Contractor	Backwater Environmental PO Box 1654 Pittsboro, North Carolina 27312 Wes Newell (919) 523-4375
Planting Contractor	Carolina Silvics 908 Indian Trail Road Edenton, North Carolina 27932 Dwight McKinney (252) 482-8491
Designer and Year 2-5 (2008-2011) Monitoring Performer	Axiom Environmental, Inc. 218 Snow Avenue Raleigh, North Carolina 27603 Grant Lewis (919) 215-1693
Year 1 (2007) Monitoring Performer	ARACDIS G&M of North Carolina, Inc. 801 Corporate Center Drive, Suite 300 Raleigh, NC 27607 Ben Furr and Keven Duerr (919) 854-1282

Table 4. Project Background Table

Project County	Onslow County, North Carolina
Drainage Area	1.4 square miles
Drainage impervious cover estimate (%)	< 5
Stream Order	First and Second
Physiographic Region	Coastal Plain
Ecoregion	Carolina Flatwoods
Rosgen Classification of As-built	E-/C-type
Cowardin Classification	Riverine: PFO1J Nonriverine: PF01A
Dominant Soil Types	Rains, Muckalee, Goldsboro, Grifton, Craven
Reference Site ID	Bullard Branch
USGS HUC	Site: 03030001 Reference: 03030007
NCDWQ Subbasin	Site: 03-05-02 Reference: 03-06-22
NCDWQ Classification	C NSW (Stream Index # 19-(1))
Any portion of any project segment 303d listed?	No
Any portion of project upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor	Not Applicable
% of project easement fenced	100%

1.5 Monitoring Plan View

Monitoring activities for the Site, including relevant structures and utilities, project features, specific project structures, and monitoring features are detailed in the monitoring plan view in Appendix D. Site features including vegetation, stream dimension (cross-sections), stream profile and pattern, wetland hydrology, and photographic documentation were monitored in Year 5 (2011).

2.0 PROJECT CONDITION AND MONITORING RESULTS

2.1 Vegetation Assessment

Following Site construction, five plots (10 meters by 10 meters in size) were established and monumented with metal fence posts at all plot corners and PVC at each plot origin. Sampling was conducted as outlined in 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 A. The taxonomic standard for vegetation used for this document was *Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas* (Weakley 2007). The locations of vegetation monitoring plots were placed to accurately represent the entire Site and are depicted on the monitoring plan view in Appendix D.

2.1.1 Vegetation Success Criteria

Success criteria have been established to verify that the vegetation component supports community elements necessary for forest development. Success criteria are dependent upon the density and growth of characteristic forest species. Additional success criteria are dependent upon density and growth of "Characteristic Tree Species." Characteristic Tree Species include planted species, species identified through inventory of a reference (relatively undisturbed) forest community used to orient the planting plan, and appropriate Schafale and Weakley (1990) community descriptions (Coastal Plain Small Stream Swamp and Nonriverine Wet Hardwoods Forest). All canopy tree species planted and identified in the reference

forest will be utilized to define "Characteristic Tree Species" as termed in the success criteria. Table 5 below outlines planted and reference forest species.

Table 5. Planted Species and Reference Forest Ecosystem

Planted Species	Reference Species
Pawpaw (*Asimina triloba*)	Red maple (*Acer rubrum*)
River birch (*Betula nigra*)	Ironwood (*Carpinus caroliniana*)
Mockernut hickory (*Carya alba*)	Pignut hickory (*Carya glabra*)
Water hickory (*Carya aquatica*)	Dogwood (*Cornus* sp.)
Sugarberry (*Celtis laevigata*)	Ash (*Fraxinus* sp.)
Buttonbush (*Cephalanthus occidentalis*)	American holly (*Ilex opaca*)
Green ash (*Fraxinus pennsylvanica*)	Sweetgum (*Liquidambar styraciflua*)
Black walnut (*Juglans nigra*)	Yellow poplar (*Liriodendron tulipifera*)
Black gum (*Nyssa sylvatica*)	White oak (*Quercus alba*)
Sycamore (*Platanus occidentalis*)	Water oak (*Quercus nigra*)
Cherrybark oak (*Quercus pagoda*)	Laurel oak (*Quercus laurifolia*)
Water oak (*Quercus nigra*)	Swamp chestnut oak (*Quercus michauxii*)
Willow oak (*Quercus phellos*)	Cherrybark oak (*Quercus pagoda*)
American elm (*Ulmus americana*)	

Success criteria dictate that an average density of 320 stems per acre of Character Tree Species must be surviving in the first three monitoring years. Subsequently, 290 Character Tree Species per acre must be surviving in year 4 and 260 Character Tree Species per acre in year 5.

2.1.2 Vegetative Problem Areas

Vegetation sampling across the Site was above the required average density with an overall average of 680 planted stems per acre. A small area of poor vegetation growth is located near groundwater monitoring Gauge 4, most likely due to a lack of nutrients in the soil after construction. This area is expected to recover naturally. Four small (less than 2 feet tall) privet bushes near Station 16+00 of Tributary 1 were treated with a 2% solution of glyphosate herbicide in July 2009 during the Year 3 (2009) monitoring season. No other vegetation problem areas were noted during the Year 5 (2011) monitoring season.

2.2 Stream Assessment

Twelve permanent cross-sections within three reaches totaling 3442 linear feet were established after construction was completed. Measurements of each cross-section include points at all breaks in slope including top of bank, bankfull, and thalweg. Riffle cross-sections are classified using the Rosgen stream classification system. Longitudinal profile measurements include thalweg, water surface, and bankfull; with each measurement taken at the head of facets (i.e. riffle, run, pool, and glide) in addition to the maximum pool depth.

2.2.1 Stream Success Criteria

Success criteria for stream restoration will include 1) successful classification of the reach as a functioning stream system (Rosgen 1996) and 2) channel variables indicative of a stable stream system.

The channel configuration will be measured on an annual basis in order to track changes in channel geometry, profile, or substrate. These data will be utilized to determine the success in restoring stream channel stability. Specifically, the width-to-depth ratio should characterize an E-type and/or a borderline E-type/C-type channel (≤ 18), bank-height ratios indicative of a stable or moderately unstable channel, and minimal changes in cross-sectional area, channel width, and/or bank erosion along the monitoring reach. In

addition, channel abandonment and/or shoot cutoffs must not occur and sinuosity values must remain at approximately 1.3 (thalweg distance/straight-line distance). The field indicator of bankfull will be described in each monitoring year and indicated on a representative channel cross-section figure. If the stream channel is down-cutting or the channel width is enlarging due to bank erosion, additional bank or slope stabilization methods will be employed.

Some areas within the design channel may be expected to form low-slope, braided, stream/swamp complexes similar to Muckalee swamps in the area. These stream/swamp complexes would not be considered unstable; however, footage of stream channel restoration in these reaches will be recalculated from distance along the thalweg (1.3 sinuosity) to distance along the valley (1.0 sinuosity).

Stream substrate is not expected to coarsen over time; therefore, pebble counts are not proposed as part of the stream success criteria.

Visual assessment of in-stream structures will be conducted to determine if failure has occurred. Failure of a structure may be indicated by collapse of the structure, undermining of the structure, abandonment of the channel around the structure, and/or stream flow beneath the structure.

2.2.2 Bankfull Events

Five bankfull events were documented during the Year 5 (2011) monitoring period to date for a total of twenty-one bankfull events.

Table 6. Verification of Bankfull Events

Date of Data Collection	Date of Occurrence	Method-State Climate Office of North Carolina Precipitation Data	
		Precipitation Total (inches)	Station
--	5/18/07	1.1	314471 - Jacksonville
--	6/3/07	1.25	
--	6/30/07	1.39	
--	7/21/07	2.05	
--	8/12/07	1.52	
--	8/22/07	1.26	
--	9/20/07	1.54	314144 – Hoffman Forest
--	9/21/07	1.54	
March 2009	Feb 28-Mar 2, 2009	2.28	Documented at a nearby rain gauge at Jarmans Oak Restoration Site
April 2009	April 14, 2009	3.01	
April 2009	May 16-18, 2009	3.05	
April 2010	November 11, 2009	5.0	Greater than 5 inches of rain documented between November 10-12, 2009 as the result of Tropical Storm Ida.
April 2010	February 5, 2010	1.65	Visual observations of overbank resulting from a 1.65 inch rainfall event on February 5, 2010 that occurred after numerous rainfall events, within the 3 weeks prior, that totaled 4.32 inches.
November 2011	May 16-19, 2010	2.67	Documented at an onsite rain gauge.
November 2011	June 29, 2010	2.61	
November 2011	July 10-14, 2010	4.59	
November 2011	February 4, 2011	1.69	
November 2011	July 23, 2011	1.73	
November 2011	July 28-31, 2011	3.12	
November 2011	August 6, 2011	2.2	
November 2011	August 26-27, 2011	7.74	

2.2.3 Stream Problem Areas

No stream problem areas were noted within the Site during the Year 5 (2011) monitoring year. Beaver continue to be controlled as necessary.

2.2.4 Categorical Stream Feature Visual Stability Assessment

Each stream reach was visually inspected during the Year 5 (2011) monitoring period using eight feature categories and various metrics within each category. Assessment features included riffles, pools, thalweg, meanders, channel bed, structures, and root wads/boulders. Tables for semi-quantitative assessements of each reach are included in Appendix B (Tables B1-B3). The mean percentage of performance for features within each reach are summarized in the tables below.

Table 7A. Categorical Stream Feature Visual Stability Assessment

Lloyd (Reach 1)

Feature	As-built	Year 1 (2007)	Year 2 (2008)	Year 3 (2009)	Year 4 (2010)	Year 5 (2011)
A. Riffles	100%	100%	99%	99%	99%	99%
B. Pools	100%	90%	100%	100%	100%	100%
C. Thalweg	100%	100%	100%	100%	100%	100%
D. Meanders	100%	100%	100%	100%	100%	100%
E. Bed General	100%	100%	100%	100%	100%	100%
F. Banks	100%	100%	100%	100%	100%	100%
G. Vanes / J. Hooks, Etc.	100%	100%	100%	100%	100%	100%
H. Wads and Boulders	NA	NA	NA	NA	NA	NA

Table 7B. Categorical Stream Feature Visual Stability Assessment

Lloyd (Reach 2)

Feature	As-built	Year 1 (2007)	Year 2 (2008)	Year 3 (2009)	Year 4 (2010)	Year 5 (2011)
A. Riffles	100%	100%	100%	100%	100%	100%
B. Pools	100%	100%	99%	99%	99%	99%
C. Thalweg	100%	100%	100%	100%	100%	100%
D. Meanders	100%	100%	100%	100%	100%	100%
E. Bed General	100%	95%	100%	100%	100%	100%
F. Banks	100%	100%	100%	100%	100%	100%
G. Vanes / J. Hooks, Etc.	100%	100%	100%	100%	100%	100%
H. Wads and Boulders	NA	NA	NA	NA	NA	NA

Table 7C. Categorical Stream Feature Visual Stability Assessment

Lloyd (Reach 3)

Feature	As-built	Year 1 (2007)	Year 2 (2008)	Year 3 (2009)	Year 4 (2010)	Year 5 (2011)
A. Riffles	100%	100%	100%	100%	100%	100%
B. Pools	100%	90%	98%	100%	100%	100%
C. Thalweg	100%	100%	100%	100%	100%	100%
D. Meanders	100%	100%	100%	100%	100%	100%
E. Bed General	100%	100%	100%	100%	100%	100%
F. Banks	100%	90%	100%	100%	100%	100%
G. Vanes / J. Hooks, Etc.	100%	100%	88%	88%	88%	88%
H. Wads and Boulders	NA	NA	NA	NA	NA	NA

2.2.5 Quantitative Stream Measurements

During the Year 5 (2011) monitoring period 12 cross-sections and longitudinal profiles within three reaches totaling 3442 linear feet were measured. Permanent cross-sections, longitudinal profiles, and photographs are included in Appendix B. As a whole, monitoring measurements indicate minimal changes in both the longitudinal profile and cross-sections as compared to as-built conditions. Although detailed surveys of as-built conditions weren't conducted immediately following construction, the monitored profiles and cross-sections in Year 1 (2007) match the designed stream channel. Therefore, comparisons for each subsequent year will be made with Year 1 (2007), which accurately represents the as-built/baseline conditions. The Year 5 (2011) channel geometry compares favorably with the emulated, stable E/C type stream reach as set forth in the detailed mitigation plan and as constructed. Current monitoring has demonstrated dimension, pattern, and profile were stable over the course of the monitoring period. Tables for quantitative assessments are included below; these tables include data from previous years.

2.3 Wetland Assessment

Five groundwater monitoring gauges and one reference groundwater gauge were maintained and monitored throughout the Year 5 (2011) growing season. Four additional gauges and a rain gauge were installed at the beginning of the Year 4 (2010) monitoring season and continue to be monitored. Graphs of groundwater hydrology and precipitation are included in Appendix C.

2.3.1 Wetland Success Criteria

Target hydrological characteristics include saturation or inundation for at least 10 percent within Rains soils (nonriverine wetlands) and 8 percent within Muckalee soils (riverine wetlands) of the growing season, during average climatic conditions. The growing season extends from April 8 to November 5 (212 days). This value is based on DRAINMOD simulations for 42 years of rainfall data in an old field stage. These areas are expected to support hydrophytic vegetation. If wetland parameters are marginal as indicated by vegetation and/or hydrology monitoring, a jurisdictional determination will be performed in these areas (Environmental Laboratory 1987).

In atypical dry years, the hydroperiod must exceed 75 percent of the hydroperiod exhibited by the reference gauges. Reference gauge data will be used to compare wetland hydroperiods between the restoration areas and relatively undisturbed reference wetlands. This data will supplement regulatory evaluation of success criteria and also provide information that shall allow interpretation of mitigation success in years not supporting "normal" rainfall conditions.

2.3.2 Wetland Problem Areas

No wetland problem areas were identified within the Site during Year 5 (2011) monitoring.

Table 8. Baseline Morphology and Hydraulic Summary
Entire Project - 5858 lf

Parameter	USGS Gage Data			Preproject Eastern Tributary			Preproject Main Tributary			Project Reference Stream			Design			As-Built		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
BF Width (ft)				4.6	7.2	6.5	6.3	8.4	7.1	N/A	N/A	9.3	7.7	11	9.4	7.9	7.9	8.9
Floodprone Width (ft)				7.8	10.2	9	8.7	10.8	9.3	150	250	225	150	250	225	N/A	N/A	N/A
BF Cross Sectional Area (ft2)				6.1	6.2	6.1	6.7	7.2	6.9	N/A	N/A	11.6	6.1	12.1	N/A	N/A	N/A	N/A
BF Mean Depth (ft)				0.8	1.3	1	0.8	1.1	1	N/A	N/A	1.2	0.8	1.2	1	N/A	N/A	N/A
BF Max Depth (ft)				1.2	1.7	1.4	0.9	1.3	1.3	N/A	N/A	2.3	1	2.3	1.6	1.2	1.6	1.3
Width/Depth Ratio				3.5	8.6	6.5	5.9	10.5	7	N/A	N/A	7.4	7	12	10	N/A	N/A	N/A
Entrenchment Ratio				1.3	1.8	1.5	1.1	1.5	1.4	16.1	26.9	24.2	16	27	24	N/A	N/A	N/A
Bank Height Ratio				4.5	9	6.4	4.9	5.2	5.1	N/A	N/A	1	1	1.3	1	N/A	N/A	N/A
Wetted Perimeter (ft)				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hydraulic Radius (ft)				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pattern																		
Channel Beltwidth (ft)				No distinctive pattern due			No distinctive pattern due			21	36	34	15	77	31	N/A	N/A	N/A
Radius of Curvature (ft)				to channel straightening			to channel straightening			13.7	18.6	16.1	15	44	21	18	53	23
Meander Wavelength (ft)				activities			activities			55	82	71	46	154	75	N/A	N/A	N/A
Meander Width Ratio										2.3	3.9	3.7	2	7	4	N/A	N/A	N/A
Profile																		
Riffle Length (ft)				No distinctive repetitive			No distinctive repetitive			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Riffle Slope (ft/ft)				pattern of riffles and pools			pattern of riffles and pools			0.007	0.016	0.0129	0.0007	0.0064	0.0033	N/A	N/A	N/A
Pool Length (ft)				due to channel			due to channel			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pool Spacing (ft)				straightening activities			straightening activities			32	55	43	31	77	47	N/A	N/A	N/A
Substrate																		
d50 (mm)				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
d84 (mm)				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Additonal Reach Parameters																		
Valley Length (ft)				N/A			N/A			N/A			N/A			N/A		
Channel Length (ft)				N/A			N/A			N/A			5,858			N/A		
Sinuosity				1.02			1.02			1.37			1.3-1.4			N/A		
Water Surface Slope (ft/ft)				0.0043			0.0032			0.004			0.0025			N/A		
BF Slope (ft/ft)				N/A			N/A			N/A			0.0025			N/A		
Rosgen Classification				G5/6			G5/6			E6			E5/6			N/A		

N/A = Not Available

Table 9A. Morphology and Hydraulic Monitoring Summary
Lloyd Reach 1 (1180 linear feet)

Parameter	Cross Section 5 Riffle						Cross Section 6 Max Pool						Cross Section 7 Max Pool						Cross Section 8 Riffle					
Dimension	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**
BF Width (ft)	8.1	8.6	8.2	7.6	8.4		11.5	11.2	10.8	12.2	11.6		13.4	14.6	14.7	16	17		7.4	11.2	6.9	8	7.9	
Floodprone Width (ft)	39	38	38	38	38		63	----	----	----	----		>100	----	----	----	----		>90	80	80	80	80	
BF Cross Sectional Area (ft2)	6.1	5.4	6.3	6.2	6.5		11.2	11.2	11.4	10.6	9.7		14.6	15.6	17.3	18	17		5.5	5.6	5.1	5.1	4.9	
BF Mean Depth (ft)	0.8	0.6	0.8	0.8	0.8		1	1	1.1	0.9	0.8		1.1	1.1	1.2	1.1	1		0.7	0.5	0.7	0.6	0.6	
BF Max Depth (ft)	1.1	1	1.1	1.1	1.1		2	1.8	1.9	1.7	1.7		2.1	2	2	2.1	1.8		1.1	1.1	1.1	1.1	1	
Width/Depth Ratio	10.7	13.5	10.8	9.2	11		11.8	----	----	----	----		12.3	----	----	----	----		9.9	22.3	9.3	13	13	
Entrenchment Ratio	4.8	4.4	4.6	5	4.5		5.5	----	----	----	----		7.5	----	----	----	----		12.2	7.2	12	10	10	
Bank Height Ratio	1.0	1.0	1.0	1.0	1.0		1.0	----	----	----	----		1.0	----	----	----	----		1.0	1.0	1.0	1.0	1.0	
Wetted Perimeter (ft)	8.7	9	8.7	8.2	8.9		12.4	12	11.7	12.9	12.3		14.3	15.1	15.4	17	18		7.9	11.5	7.4	8.4	8.3	
Hydraulic Radius (ft)	0.7	0.7	0.7	0.8	0.7		0.9	0.9	1	0.8	0.8		1	1	1.1	1.1	1		0.7	0.5	0.7	0.6	0.6	
Substrate																								
d50 (mm)	<0.1	----	----	----	----		<0.1	----	----	----			<0.1	----	----	----	----		<0.1	----	----	----	----	
d84 (mm)	<0.1	----	----	----	----		<0.1	----	----	----			<0.1	----	----	----	----		<0.1	----	----	----	----	

Parameter	MY-01 (2007)			MY-02 (2008)			MY-03 (2009)			MY-04 (2010)			MY-05 (2011)			MY-5+ (2012)		
	Min	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
Pattern																		
Channel Beltwidth (ft)	15	61	32	15	61	32	15	61	32	15	61	32	15	61	32			
Radius of Curvature (ft)	16	31	21	16	31	21	16	31	21	16	31	21	16	31	21			
Meander Wavelength (ft)	61	111	76	61	111	76	61	111	76	61	111	76	61	111	76			
Meander Width Ratio	2.5	10.2	5.3	2.5	10.2	5.3	2.5	10.2	5.3	2.5	10.2	5.3	2.5	10.2	5.3			
Profile																		
Riffle Length (ft)	7	32	18	12	32	78	3	38	17	3	30	15	5	39	14			
Riffle Slope (ft/ft)				0.00%	0.05%	0.39%	0.00%	0.00%	0.68%	0.00%	1.37%	0.00%	0.00%	3.63%	0.11%			
Pool Length (ft)	8	47	22	13	24	34	3	20	10	9	40	24	3	47	15			
Pool Spacing (ft)	25	66	48	25	66	48	25	66	48	25	66	48	25	66	48			
Additonal Reach Parameters																		
Valley Length (ft)	928			928			896			912			895					
Channel Length (ft)	1180			1180			1165			1186			1163					
Sinuosity	1.3			1.3			1.3			1.3			1.3					
Water Surface Slope (ft/ft)	no water in ch.			0.0002			0.0003			0.0008			0.008					
BF Slope (ft/ft)	0.0003			0.0003			0.0003			0.0003			0.0003					
Rosgen Classification	E5/6			E5/6			E5/6			E 5/6			E 5/6					

Table 9B. Morphology and Hydraulic Monitoring Summary
Lloyd Reach 2 (1345 linear feet)

Parameter	Cross Section 1 Max Pool						Cross Section 2 Riffle						Cross Section 3 Max Pool						Cross Section 4 Riffle					
Dimension	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**
BF Width (ft)	12.7	15	12.6	12.4	13.2		8.3	8.7	9.2	9.5	9.8		11.7	15.6	9.9	10	11		7.4	8	7.4	7.5	7.4	
Floodprone Width (ft)	>100	----	----	----	----		>100	150	150	150	150		>150	----	----	----	----		120	150	150	150	150	
BF Cross Sectional Area (ft2)	16.7	17.3	16.9	17.3	17.6		7.3	6.6	7.7	7.6	7		22.3	15.6	10.5	13	12		5.4	5.6	5.2	5.4	5.6	
BF Mean Depth (ft)	1.3	1.2	1.3	1.4	1.3		0.9	0.8	0.8	0.8	0.7		1.9	1	1.1	1.3	1.1		0.7	0.7	0.7	0.7	0.8	
BF Max Depth (ft)	2.7	2.4	2.5	2.5	2.3		1.4	1.2	1.3	1.2	1.2		3.3	2.1	1.7	2	1.9		1.2	1.2	1.2	1.2	1.2	
Width/Depth Ratio	9.6	----	----	----	----		9.5	11.4	11	11.7	14		6.1	----	----	----	----		10.2	11.6	11	10	9.3	
Entrenchment Ratio	7.9	----	----	----	----		12	17.3	16.3	15.9	15.31		12.8	----	----	----	----		16.2	18.6	20	20	20	
Bank Height Ratio	1.0	----	----	----	----		1.0	1.0	1.0	1.0	1.0		1.0	----	----	----	----		1.0	1.0	1.0	1.0	1.0	
Wetted Perimeter (ft)	14.3	16.3	13.9	13.9	14.4		8.9	9.1	9.7	10	10.2		14.1	16.4	10.9	12	12		7.9	8.7	7.9	8.1	8	
Hydraulic Radius (ft)	1.2	0.7	1.2	1.2	1.2		0.8	0.7	0.8	0.8	0.7		1.6	0.9	1	1.1	1		0.7	0.6	0.7	0.7	0.7	
Substrate																								
d50 (mm)	0.3	----	----	----	----		0.3	----	----	----	----		0.3	----	----	----	----		0.3	----	----	----	----	
d84 (mm)	6	----	----	----	----		6	----	----	----	----		6	----	----	----	----		6	----	----	----	----	

Parameter	MY-01 (2007)			MY-02 (2008)			MY-03 (2009)			MY-04 (2010)			MY-05 (2011)			MY-5+ (2012)		
	Min	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
Pattern																		
Channel Beltwidth (ft)	17	58	34	17	58	34	17	58	34	17	58	34	17	58	34			
Radius of Curvature (ft)	18	31	21	18	31	21	18	31	21	18	31	21	18	31	21			
Meander Wavelength (ft)	53	113	85	53	113	85	53	113	85	53	113	85	53	113	85			
Meander Width Ratio	2.8	9.7	5.7	2.8	9.7	5.7	2.8	9.7	5.7	2.8	9.7	5.7	2.8	9.7	5.7			
Profile																		
Riffle Length (ft)	6	44	20	11	26	54	4	46	20	2	37	17	4	45	21			
Riffle Slope (ft/ft)	0	0.04	0.01	0.00%	2.15%	0.84%	0.00%	3.05%	0.60%	0.00%	2.72%	0.42%	0.00%	3.12%	0.25%			
Pool Length (ft)	5	66	22	13	24	38	12	63	24	13	77	30	5	23	11			
Pool Spacing (ft)	24	100	54	24	100	54	24	100	54	24	100	54	24	100	54			
Additonal Reach Parameters																		
Valley Length (ft)	1005			1005			1056			1039			1044					
Channel Length (ft)	1343			1343			1373			1351			1357					
Sinuosity	1.3			1.3			1.3			1.3			1.3					
Water Surface Slope (ft/ft)	0.0033			0.0033			0.0032			0.0032			0.0029					
BF Slope (ft/ft)	0.0033			0.0033			0.0032			0.0032			0.0029					
Rosgen Classification	E5			E5			E5			E5			E5					

Table 9C. Morphology and Hydraulic Monitoring Summary
Lloyd Reach 3 (917 linear feet)

Parameter	Cross Section 9 Max Pool						Cross Section 10 Riffle						Cross Section 11 Max Pool						Cross Section 12 Riffle					
Dimension	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**
BF Width (ft)	14.7	17.3	15	15.7	17.1		10.9	9.9	9.7	9.3	10		13.1	16.9	12.2	13	13		10.1	12.2	11	12	9.3	
Floodprone Width (ft)	>200	----	----	----	----		>110	150	150	150	150		>230	----	----	----	----		>170	150	150	150	150	
BF Cross Sectional Area (ft2)	21.2	20.3	17.2	20.5	20.3		11.1	11.4	10.2	9.2	9.6		19.3	23.8	21.4	23	23		10.6	13.1	12	12	12	
BF Mean Depth (ft)	1.4	1.2	1.1	1.3	1.2		1	1.2	1.1	1	1		1.5	1.4	1.8	1.8	1.7		1	1.1	1.1	1	1.3	
BF Max Depth (ft)	2.9	2.4	2.4	2.4	2.3		1.7	1.6	1.7	1.6	1.6		2.9	3.2	3.2	3.3	3.2		1.7	2.1	2	2	2	
Width/Depth Ratio	10.1	----	----	----	----		10.8	8.6	9.2	9.5	10		8.8	----	----	----	----		9.6	11.3	10	11	7.2	
Entrenchment Ratio	13.6	----	----	----	----		10.1	15.2	15.5	16.1	15		17.6	----	----	----	----		16.9	12.3	13	13	16	
Bank Height Ratio	1.0	----	----	----	----		1.0	1.0	1.0	1.0	1.0		1.0	----	----	----	----		1.0	1.0	1.0	1.0	1.0	
Wetted Perimeter (ft)	16.1	18.1	16.2	16.6	17.9		11.5	10.9	10.6	10.2	10.7		14.6	18.8	14.5	15	16		11	13	12	13	10	
Hydraulic Radius (ft)	1.3	1.1	1.1	1.2	1.1		1.0	1.0	1.0	0.9	0.9		1.3	1.3	1.5	1.5	1.5		1.0	1.0	1.0	1.0	1.2	
Substrate																								
d50 (mm)	0.1	----	----	----	----		0.1	----	----	----	----		0.1	----	----	----	----		0.1	----	----	----	----	
d84 (mm)	1	----	----	----	----		1	----	----	----	----		1	----	----	----	----		1	----	----	----	----	

Parameter	MY-01 (2007)			MY-02 (2008)			MY-03 (2009)			MY-04 (2010)			MY-05 (2011)			MY-5+ (2012)		
	Min	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
Pattern																		
Channel Beltwidth (ft)	24	64	43	24	64	43	24	64	43	24	64	43	24	64	43			
Radius of Curvature (ft)	19	33	23	19	33	23	19	33	23	19	33	23	19	33	23			
Meander Wavelength (ft)	64	106	91	64	106	91	64	106	91	64	106	91	64	106	91			
Meander Width Ratio	2.2	5.8	3.9	2.2	5.8	3.9	2.2	5.8	3.9	2.2	5.8	3.9	2.2	5.8	3.9			
Profile																		
Riffle Length (ft)	12	33	19	11	24	54	7	60	19	7	35	18	8	53	18			
Riffle Slope (ft/ft)	0	0.03	0.01	0.00%	2.15%	0.91%	0.00%	1.65%	0.59%	0.00%	2.29%	0.94%	0.10%	1.86%	0.43%			
Pool Length (ft)	15	64	29	24	68	38	16	62	33	16	66	34	4	29	13			
Pool Spacing (ft)	38	83	56	38	83	56	38	83	56	38	83	56	38	83	56			
Additonal Reach Parameters																		
Valley Length (ft)	649			649			649			649			730					
Channel Length (ft)	917			917			917			917			1022					
Sinuosity	1.4			1.4			1.4			1.4			1.4					
Water Surface Slope (ft/ft)	0.0034			0.0032			0.0033			0.0037			0.0032					
BF Slope (ft/ft)	0.0029			0.0029			0.0029			0.0029			0.0029					
Rosgen Classification	E5			E5			E5			E5			E5					

2.3.3 Wetland Criteria Attainment

Monitoring results and factors that should be considered when evaluating Site wetlands are discussed below and include regional rainfall and drought analyses, Site landscape position, and the growing season.

Regional Rainfall and Drought Analyses

A thorough analysis of precipitation and drought conditions at the Site was completed by Restoration Systems (*Analysis of Issues Related to the Lloyd Stream and Wetland Mitigation Site*), Year 1 (2007) - Year 3 (2009). Based on the resulted of the analysis Year 1 (2007) - Year 3 (2009) are considered to be atypically dry years. In addition, rainfall for the Year 5 (2011) growing season was below normal with 39.3 inches of rain occurring from January to October 2011 compared to the 30-year historic mean rainfall of 49.1 inches occurring from January to October (Figures 2 and 3). Therefore, all restoration area gauges are compared to the reference gauge, which is located within a jurisdictional wetland. The value obtained for each restoration area gauge was compared to the value obtained for the reference gauge. If the restoration area gauge value exceeded 75 percent of the value exhibited for the reference gauge for that monitoring year, the restoration gauge was then considered successful.

Landscape Position

Site tributaries are first- and second-order streams that drain an approximately 1.4-square mile watershed at the Site outfall. Site physiography is characterized by a relatively broad, nearly level alluvial valley and an interstream divide located between Site streams. As a result of the relatively low slope, hydration of wetlands is primarily driven by stream overbank flooding and upland runoff within riparian wetlands, and direct precipitation within nonriparian wetlands. Lateral groundwater migration plays a lesser role than typical within riparian wetlands due to the low slope and a lack of springs and seeps. Therefore, all wetlands within the Site are highly dependent on rainfall and are affected to a greater extent by drought. As documented within *Analysis of Issues Related to the Lloyd Stream and Wetland Mitigation Site*, the Site has continued to be in a drought since before Site construction.

Growing Season

According to the *Soil Survey of Onslow County, North Carolina*, the growing season extends from April 8 to November 5 (212 days). However, the start date for the growing season is not typical for the Coastal Plain region and should start earlier as evidenced by bud development noted consistently in February. The following are photographs taken at the Site on February 15, 2011 showing leaf-out on buttonbush plants (*Cephalanthus occidentalis*). In addition, soil temperatures were taken on February 22, 2011 by digging multiple pits using a hand trowel. Recorded temperatures ranged from 50-55 degrees at a depth of 12 inches from the soil surface.

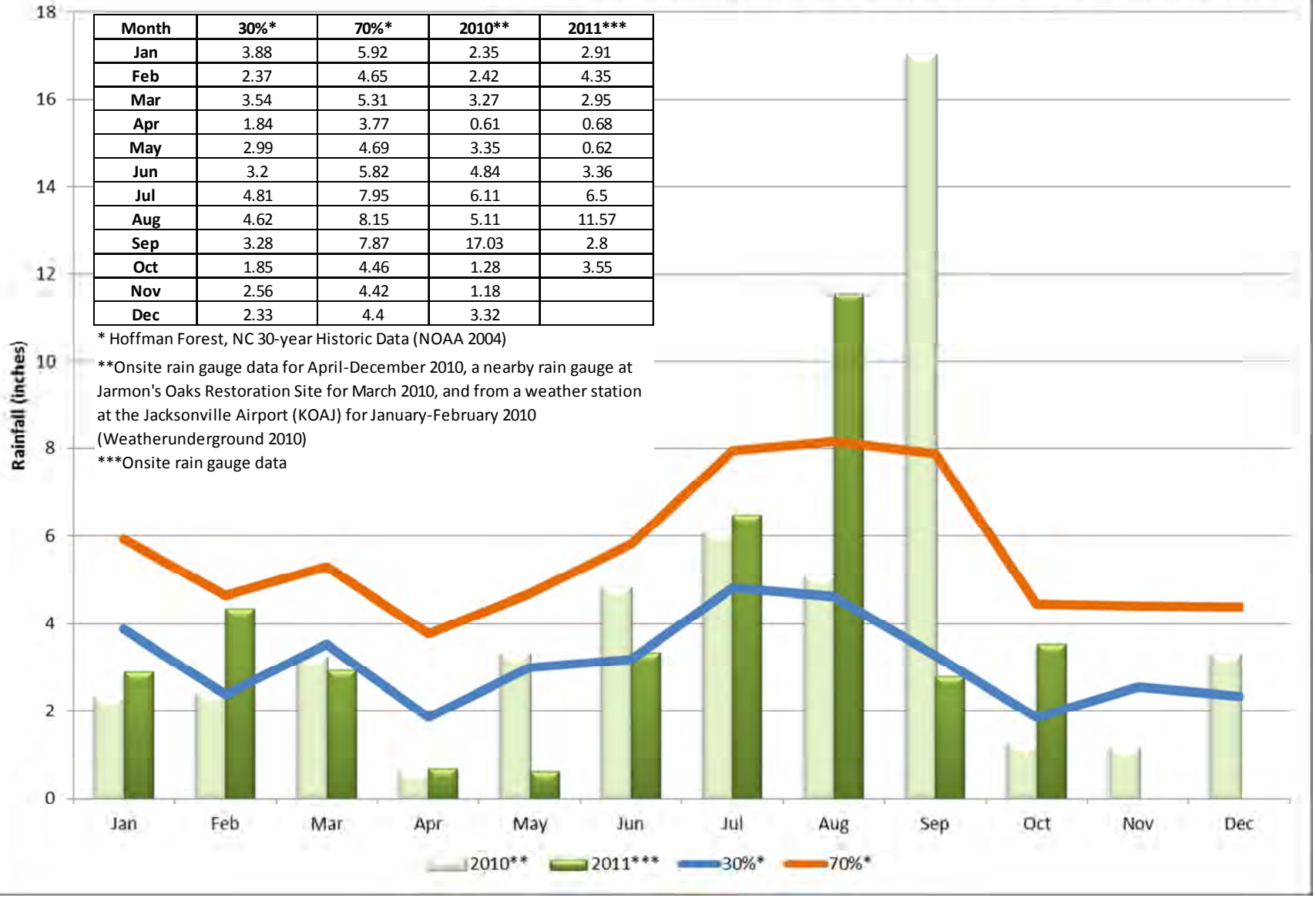
Figure 2. Annual Climatic Data vs. 30-year Historic Data

Month	30%*	70%*	2010**	2011***
Jan	3.88	5.92	2.35	2.91
Feb	2.37	4.65	2.42	4.35
Mar	3.54	5.31	3.27	2.95
Apr	1.84	3.77	0.61	0.68
May	2.99	4.69	3.35	0.62
Jun	3.2	5.82	4.84	3.36
Jul	4.81	7.95	6.11	6.5
Aug	4.62	8.15	5.11	11.57
Sep	3.28	7.87	17.03	2.8
Oct	1.85	4.46	1.28	3.55
Nov	2.56	4.42	1.18	
Dec	2.33	4.4	3.32	

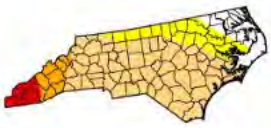
* Hoffman Forest, NC 30-year Historic Data (NOAA 2004)

**Onsite rain gauge data for April-December 2010, a nearby rain gauge at Jarmon's Oaks Restoration Site for March 2010, and from a weather station at the Jacksonville Airport (KOAJ) for January-February 2010 (Weatherunderground 2010)

***Onsite rain gauge data



March 13, 2007



May 29, 2007

July 17, 2007

September 4, 2007

October 23, 2007

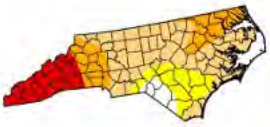
December 18, 2007

February 5, 2008

April 1, 2008

June 10, 2008

July 1, 2008



September 2, 2008

November 4, 2008

January 6, 2009

March 3, 2009

May 5, 2009

July 7, 2009

September 1, 2009

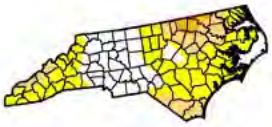
November 3, 2009

January 5, 2010

March 9, 2010

May 4, 2010

July 6, 2010



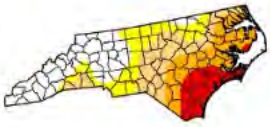
September 7, 2010

November 30, 2010

January 11, 2011

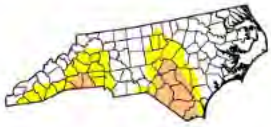
March 15, 2011

May 10, 2011



July 19, 2011

September 13, 2011



November 8, 2011

Therefore, we have analyzed the gauge data three different ways as follows.

1. Using the Onslow County start date of April 8
2. Based on an average regional start date of March 17 for adjacent counties including Pender, Lenoir, Carteret, Jones, and Duplin (see table below, which gives the growing season start dates for adjacent counties as reported in the corresponding county soil survey)
3. A start date of March 1, which occurred well-after the beginning of the actual growing season for 2011 as noted by bud development and soil temperatures

Table 10. Summary of Growing Season Start Dates

County	Growing Season Start Date (28 degrees 5 years in 10)
Onslow	April 8
Pender	March 19
Lenoir	March 12
Carteret	February 27
Jones	March 15
Duplin	April 9

Utilizing an earlier start date extends the length of the growing season and subsequently the number of days required for success. The following table gives the required number of consecutive days based on the growing season used, wetland type, and percent consecutive inundation/saturation required for success followed by a table outlining gauge results.

Table 11. Summary of Defined Success Criteria

Growing Season/Total Days	Riparian Wetland (8 percent)	Nonriparian Wetland (10 percent)
Onslow County/212 days	17 days	21 days
Regional/234 days	19 days	23 days
March 1/250 days	20 days	25 days

3.0 CONCLUSIONS

Stream monitoring has demonstrated dimension, pattern, and profile were stable over the course of the five-year monitoring period. In addition, all vegetation plots across the Site were above the required 260 stems per acre with an average of 680 tree stems per acre in the Fifth Monitoring Year (Year 2011) (Table 12).

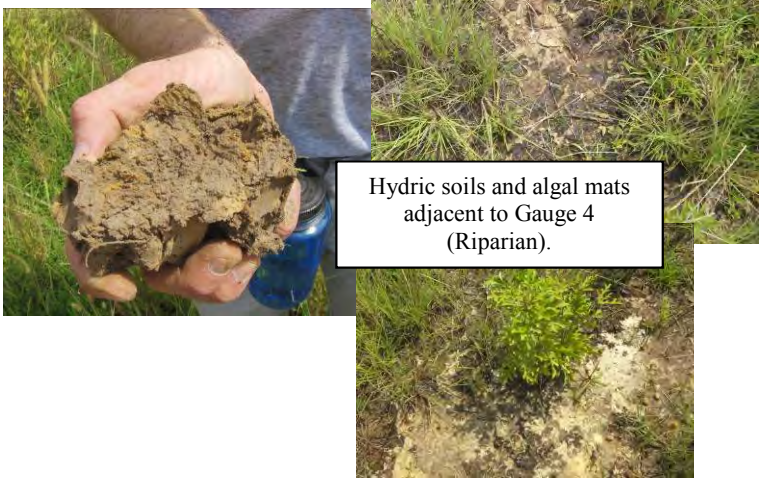
Table 12. Summary of Planted Vegetation Plot Results

Plot	Planted Stems/Acre Counting Towards Success Criteria				
	Year 1 (2007)	Year 2 (2008)	Year 3 (2009)	Year 4 (2010)	Year 5 (2011)
1	728	607	607	607	647
2	728	809	769	850	850
3	809	769	891	688	647
4	445	445	810	769	769
5	364	364	364	405	486
Average of All Plots (1-5)	**615**	**599**	**688**	**656**	**680**

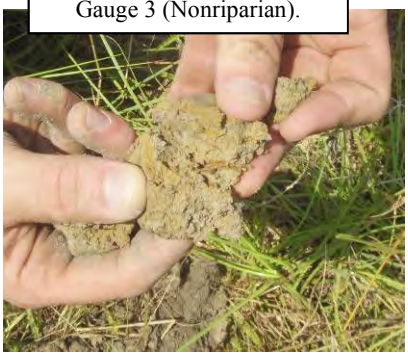
Success criteria of restoration gauges are based on comparisons to reference gauge data, analysis of growing season start date, and all gauges should be considered successful for Year 5 (2011). Hydrographs containing groundwater and precipitation data for each gauge can be found in Appendix C. A summary of groundwater gauge data is included in Table 13.

As documented in Section 2.3.3, all monitoring years are considered to be atypically dry; therefore, restoration area gauges are compared to the reference gauge located within a jurisdictional wetland. Consecutive inundation or saturation within 12 inches of the soil surface was analyzed for each gauge for three separate growing season start scenarios. The longest period of consecutive inundation/saturation during the growing season is reported in Table 12 as a number of days followed by a percentage of the total growing season. The value obtained for each restoration area gauge was compared to the value obtained for the reference gauge. If the restoration area gauge value exceeded 75 percent of the value exhibited by the reference gauge for that monitoring year, the restoration gauge was then considered successful. In addition, the success of each restoration gauge is given based on consecutive days alone followed by comparisons to the reference gauge.

Wetlands at the Site are developing well despite continued drought conditions with the development of hydrophytic herbaceous vegetation and a presence of recent oxidized rhizospheres within the upper 12 inches of soil. Based on recent field visits, gauge data, rain data, and analyses of growing season start dates, wetlands at the Site should be considered successful. Drought conditions compounded with an uncharacteristically late growing season start have led to data results that don't consistently meet success criteria; however, jurisdictional wetland delineations completed within the Site would undoubtedly find a surplus of wetlands at the Site beyond minimums outlined in the June 2005 Technical Proposal (3.3 Riparian WMUs and 3.1 Nonriparian WMUs). Based on the Site as constructed, restoration activities resulted in 8.2 acres of riparian wetland restoration, 3.1 acres of nonriparian wetland restoration, and 1.9 acres of riparian wetland creation.



Hydric soils and algal mats adjacent to Gauge 4 (Riparian).



Hydric soils with a presence of recent oxidized rhizospheres adjacent to Gauge 3 (Nonriparian).

Typical reduced soils with redoximorphic features within riparian wetland areas.

Table 13. Summary of Groundwater Gauge Results

Gauge	Success Criteria Achieved/**Success Criteria based on Reference Achieved** Max Consecutive Days During Growing Season **(% Max Consecutive Days of Growing Season)**														
	Year 1 (2007)[1]			**Year 2 (2008)[2]**			**Year 3 (2009)[3]**			**Year 4 (2010)[4]**			**Year 5 (2011)[5]**		
	March 1	**March 17**	**April 8**	**March 1**	**March 17**	**April 8**	**March 1**	**March 17**	**April 8**	**March 1**	**March 17**	**April 8**	**March 1**	**March 17**	**April 8**
1 Riverine	Gauges were installed on March 8, 2007; therefore, this data is not available.	No/**Yes** 8 days **(3.4 %)**	No/**No** 5 days **(2.3 %)**	No/**No** 17 days **(6.8 %)**	No/**Yes** 12 days **(5.1 %)**	No/**Yes** 12 days **(5.7 %)**	Yes/**Yes** 38 days **(15.2 %)**	No/**Yes** 22 days **(9.4 %)**	No/**Yes** 14 days **(6.6 %)**	Yes/**Yes** 37 days **(14.8 %)**	Yes/**Yes** 25 days **(10.7 %)**	Yes/**Yes** 25 days **(11.8 %)**	Yes/**Yes** 60 days **(24.0 %)**	Yes/**Yes** 44 days **(18.8 %)**	Yes/**Yes** 22 days **(10.4 %)**
2 Nonriverine		No/**Yes** 16 days **(6.8 %)**	No/**Yes** 10 days **(4.7 %)**	Yes/**Yes** 24 days **(9.6 %)**	No/**Yes** 12 days **(5.1 %)**	No/**Yes** 11 days **(5.2 %)**	Yes/**Yes** 24 days **(9.6 %)**	No/**Yes** 9 days **(3.8 %)**	No/**Yes** 9 days **(4.2 %)**	Yes/**Yes** 39 days **(15.6 %)**	Yes/**Yes** 23 days **(10.8 %)**	No/**No** 1 days **(0.5 %)**	Yes/**Yes** 45 days **(18.0 %)**	Yes/**Yes** 29 days **(12.3 %)**	No/**Yes** 7 days **(3.3 %)**
3 Nonriverine		No/**No** 2 days **(0.9 %)**	No/**No** 2 days **(0.9 %)**	No/**No** 11 days **(4.4 %)**	No/**No** 11 days **(4.7%)**	No/**No** 6 days **(2.8 %)**	No/**No** 3 days **(1.2 %)**	No/**No** 3 days **(1.3 %)**	No/**No** 3 days **(1.4 %)**	Yes/**Yes** 21 days **(8.4 %)**	Yes/**Yes** 18 days **(8.5 %)**	Yes/**Yes** 18 days **(8.4 %)**	No/**Yes** 16 days **(6.4 %)**	No/**Yes** 8 days **(3.4 %)**	No/**Yes** 8 days **(3.8 %)**
4 Riverine		Not available		No/**No** 12 days **(4.8 %)**	No/**Yes** 12 days **(5.1 %)**	No/**Yes** 8 days **(3.8 %)**	Yes/**Yes** 33 days **(13.2 %)**	No/**Yes** 17 days **(7.3 %)**	No/**Yes** 9 days **(4.2 %)**	No/**No** 10 days **(4.0 %)**	No/**No** 10 days **(4.3 %)**	No/**No** 10 days **(4.7 %)**	No/**Yes** 14 days **(5.6 %)**	No/**No** 6 days **(2.6 %)**	No/**Yes** 5 days **(2.4 %)**
5 Riverine		No/**Yes** 18 days **(7.7 %)**	No/**Yes** 18 days **(8.5 %)**	Yes/**Yes** 113 days **(45.2 %)**	Yes/**Yes** 97 days **(41.5 %)**	Yes/**Yes** 75 days **(35.4 %)**	Yes/**Yes** 64 days **(25.6 %)**	Yes/**Yes** 64 days **(27.4 %)**	Yes/**Yes** 64 days **(30.2 %)**	Yes/**Yes** 49 days **(19.6 %)**	Yes/**Yes** 33 days **(14.1 %)**	No/**Yes** 13 days **(6.1 %)**	Yes/**Yes** 48 days **(19.2 %)**	Yes/**Yes** 32 days **(13.7 %)**	Yes/**Yes** 23 days **(10.8 %)**
6 Riverine		These gauges were installed at the beginning of the Year 4 (2010) monitoring season.								Yes/**Yes** 36 days **(14.4 %)**	No/**No** 20 days **(8.5 %)**	Yes/**Yes** 20 days **(9.4 %)**	No/**Yes** 19 days **(7.6 %)**	No/**Yes** 13 days **(5.6 %)**	No/**Yes** 13 days **(6.1 %)**
7 Riverine										Yes/**Yes** 60 days **(24.0 %)**	Yes/**Yes** 44 days **(18.8 %)**	Yes/**Yes** 39 days **(18.4 %)**	Yes/**Yes** 69 days **(27.6 %)**	Yes/**Yes** 53 days **(22.6 %)**	Yes/**Yes** 31 days **(14.6 %)**
8 Riverine										Yes/**Yes** 67 days **(26.8 %)**	Yes/**Yes** 51 days **(21.8 %)**	Yes/**Yes** 41 days **(19.3 %)**	Yes/**Yes** 27 days **(10.8 %)**	Yes/**Yes** 27 days **(11.5 %)**	Yes/**Yes** 27 days **(12.7 %)**
9 Riverine										Yes/**Yes** 40 days **(16.0 %)**	Yes/**Yes** 24 days **(10.3 %)**	No/**Yes** 14 days **(6.6 %)**	Yes/**Yes** 24 days **(9.6 %)**	Yes/**Yes** 18 days **(7.7 %)**	No/**Yes** 7 days **(3.3 %)**
Reference		8 days **(3.4 %)**	8 days **(3.8 %)**	26 days **(10.4 %)**	15 days **(6.4 %)**	9 day **(4.3 %)**	13 days **(5.2 %)**	8 days **(3.4 %)**	8 day **(3.8 %)**	52 days** **(20.8 %)**	36 days** **(15.4 %)**	14 day** **(6.6 %)**	17 days **(6.8 %)**	9 days **(3.8 %)**	0 days **(0 %)**

1 Regional rainfall from January through October for the Year 1 (2007) was 33.04 inches, 17.94 inches (35.2%) below the WETS mean of **50.98**; therefore, success criteria are based on the reference gauge.

2 Regional rainfall from January through October for the Year 2 (2008) was 42.58 inches, 8.40 inches (16.4%) below the WETS mean; therefore, success criteria are based on comparisons to reference gauge data.

3 Regional rainfall from January through October for the Year 3 (2009) was 41.31 inches, 9.67 inches (19.0%) below the WETS mean; therefore, success criteria are based on comparisons to reference gauge data.

4 Site rainfall from January through October for the Year 4 (2010) was 46.37 inches, 4.61 inches (9.0%) below the WETS mean with > 17 inches occurring in September 2010; therefore, success criteria are based on comparisons to reference gauge data.

5 Site rainfall from January through October for the Year 4 (2010) was 39.29 inches, 11.69 inches (22.9%) below the WETS mean with > 11 inches occurring in August 2011; therefore, success criteria are based on comparisons to reference gauge data.

** The reference gauge malfunctioned at the beginning of the growing season; therefore, the maximum possible period of inundation/saturation was reported and is most likely greatly overestimated.

4.0 REFERENCES

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APPENDIX A
VEGETATION DATA

1. **Vegetation Survey Data Tables**
2. **Vegetation Monitoring Plot Photos**

Report Prepared By	Corri Faquin
Date Prepared	10/4/2011 9:02
database name	RestorationSystems-2011-A_Sept20.mdb
database location	C:\Axiom\Business\CVS
computer name	CORRI-PC
file size	70189056

DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------

Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	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.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp	A matrix of the count of totalliving stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.

PROJECT SUMMARY----------

Project Code	Lloyd
project Name	Lloyd Restoration Site
Description	Stream and Wetland Restoration Site in Onslow County
River Basin	White Oak

Living planted stems, excluding live stakes, per acre

Project Code	Project Name	River Basin	Year 5
Lloyd	Lloyd Restoration Site	White Oak	679.87

Total stems, including planted stems of all kinds (including live stakes) and natural/volunteer stems:

Project Code	Project Name	River Basin	Year 5
Lloyd	Lloyd Restoration Site	White Oak	1586.367721

plot	Plot Level	Year	Latitude/ Northing	Longitude/ Easting	Datum	Date Sampled	Planted Living Stems	Dead/Missing Stems	Natural (Volunteer) Stems	Total Living Stems	Total Living Stems EXCLUDING Live Stakes	Planted Living Stems per ACRE	Planted Living Stems EXCLUDING Live Stakes PER ACRE	Natural (Volunteer) Stems PER ACRE	Total Living Stems PER ACRE	Total Living Stems EXCLUDING Live Stakes PER ACRE	# species
LV1	2	5	34º 51.949'	77º 30.441'	NAD83/WGS84	7/2/2010	16	0	21	37	37	647	647	850	1497	1497	3
LV2	2	5	34º 52.036'	77º 30.531'	NAD83/WGS84	7/2/2010	21	2	51	72	72	850	850	2064	2914	2914	4
LV3	2	5	34º 51.877'	77º 30.697'	NAD83/WGS84	7/2/2010	16	5	29	45	45	647	647	1174	1821	1821	6
LV4	2	5	34º 51.794'	77º 38.651'	NAD83/WGS84	7/2/2010	19	1	4	23	23	769	769	162	931	931	4
LV5	2	5	34º 51.658'	77º 30.621'	NAD83/WGS84	7/2/2010	12	0	7	19	19	486	486	283	769	769	5

Vigor

vigor	Count	Percent
0	1	1.1
3	25	27.2
4	59	64.1
Missing	7	7.6

Damage

Damage	Count	Percent Of Stems
(no damage)	73	79.3
Deer	17	18.5
Insects	2	2.2

Vigor by Species

Species	CommonName	4	3	2	1	0	Missing
Betula nigra	river birch	6					
Celtis laevigata	sugarberry	6	6				1
Cephalanthus occidentalis	common buttonbush	5					
Fraxinus pennsylvanica	green ash	7	3				
Nyssa aquatica	water tupelo	1	6				
Nyssa sylvatica	blackgum	1					1
Quercus nigra	water oak	5					
Quercus pagoda	cherrybark oak	1	1				
Quercus phellos	willow oak	1				1	1
Salix nigra	black willow	1					2
Carya	hickory	8					1
Platanus occidentalis	American sycamore	12					
Ulmus	elm	3	5				1
Ulmus americana	American elm	2	4				
14	**14**	**59**	**25**			**1**	**7**

Damage by Plot

plot	Count of Damage Categories	(no damage)	Deer	Insects
LV1	6	10	6	
LV2	3	20	2	1
LV3	0	21		
LV4	5	15	5	
LV5	5	7	4	1
Total	**19**	**73**	**17**	**2**

Damage by Species

Species	CommonName	Count of Damage Categories	(no damage)	Deer	Insects
Betula nigra	river birch	0	6		
Carya	hickory	0	9		
Celtis laevigata	sugarberry	5	8	5	
Cephalanthus occidentalis	common buttonbush	0	5		
Fraxinus pennsylvanica	green ash	1	9	1	
Nyssa aquatica	water tupelo	3	4	3	
Nyssa sylvatica	blackgum	1	1	1	
Platanus occidentalis	American sycamore	1	11		1
Quercus nigra	water oak	0	5		
Quercus pagoda	cherrybark oak	1	1		1
Quercus phellos	willow oak	0	3		
Salix nigra	black willow	0	3		
Ulmus	elm	4	5	4	
Ulmus americana	American elm	3	3	3	
14	**14**	**19**	**73**	**17**	**2**

Planted Stems by Plot and Species

Species	CommonName	Total Planted Stems	# plots	avg# stems	plot Lloyd-BNF-LV1-year:3	plot Lloyd-BNF-LV2-year:3	plot Lloyd-BNF-LV3-year:3	plot Lloyd-BNF-LV4-year:3	plot Lloyd-BNF-LV5-year:3
Betula nigra	river birch	6	2	3			4		2
Carya	hickory	8	1	8		8			
Celtis laevigata	sugarberry	12	3	4	7		1		4
Cephalanthus occidentalis	common buttonbush	5	1	5				5	
Fraxinus pennsylvanica	green ash	10	1	10		10			
Nyssa aquatica	water tupelo	7	2	3.5	4			3	
Nyssa sylvatica	blackgum	1	1	1		1			
Platanus occidentalis	American sycamore	12	2	6			8		4
Quercus nigra	water oak	5	2	2.5				4	1
Quercus pagoda	cherrybark oak	2	1	2		2			
Quercus phellos	willow oak	1	1	1			1		
Salix nigra	black willow	1	1	1			1		
Ulmus	elm	8	2	4				7	1
Ulmus americana	American elm	6	2	3	5		1		
14	**14**	**84**	**14**		**16**	**21**	**16**	**19**	**12**

All Stems by Plot and Species

Species	CommonName	Total Stems	# plots	avg# stems	plot Lloyd-BNF-LV1-year:3	plot Lloyd-BNF-LV2-year:3	plot Lloyd-BNF-LV3-year:3	plot Lloyd-BNF-LV4-year:3	plot Lloyd-BNF-LV5-year:3
Acer rubrum	red maple	31	3	10.33		27	3		1
Baccharis halimifolia	eastern baccharis	8	3	2.67	3	2			3
Betula nigra	river birch	6	2	3			4		2
Carya	hickory	8	1	8		8			
Celtis laevigata	sugarberry	12	3	4	7		1		4
Cephalanthus occidentalis	common buttonbush	5	1	5				5	
Cercis canadensis	eastern redbud	1	1	1			1		
Fraxinus pennsylvanica	green ash	10	1	10		10			
Juglans nigra	black walnut	2	1	2	2				
Liquidambar styraciflua	sweetgum	33	5	6.6	13	11	5	3	1
Liriodendron tulipifera	tuliptree	4	1	4			4		
Nyssa aquatica	water tupelo	7	2	3.5	4			3	
Nyssa sylvatica	blackgum	1	1	1		1			
Pinus taeda	loblolly pine	15	3	5	3	11	1		
Platanus occidentalis	American sycamore	22	2	11			18		4
Prunus serotina	black cherry	1	1	1				1	
Quercus nigra	water oak	5	2	2.5				4	1
Quercus pagoda	cherrybark oak	2	1	2		2			
Quercus phellos	willow oak	2	1	2			2		
Salix nigra	black willow	6	1	6			6		
Ulmus	elm	10	2	5				7	3
Ulmus americana	American elm	6	2	3	5		1		
22	**22**	**197**	**22**		**37**	**72**	**46**	**23**	**19**

Lloyd Stream and Wetland Restoration Site
Year 5 (2011) Annual Monitoring
Vegetation Plot Photos
Taken August 2011

APPENDIX B
GEOMORPHOLOGIC DATA

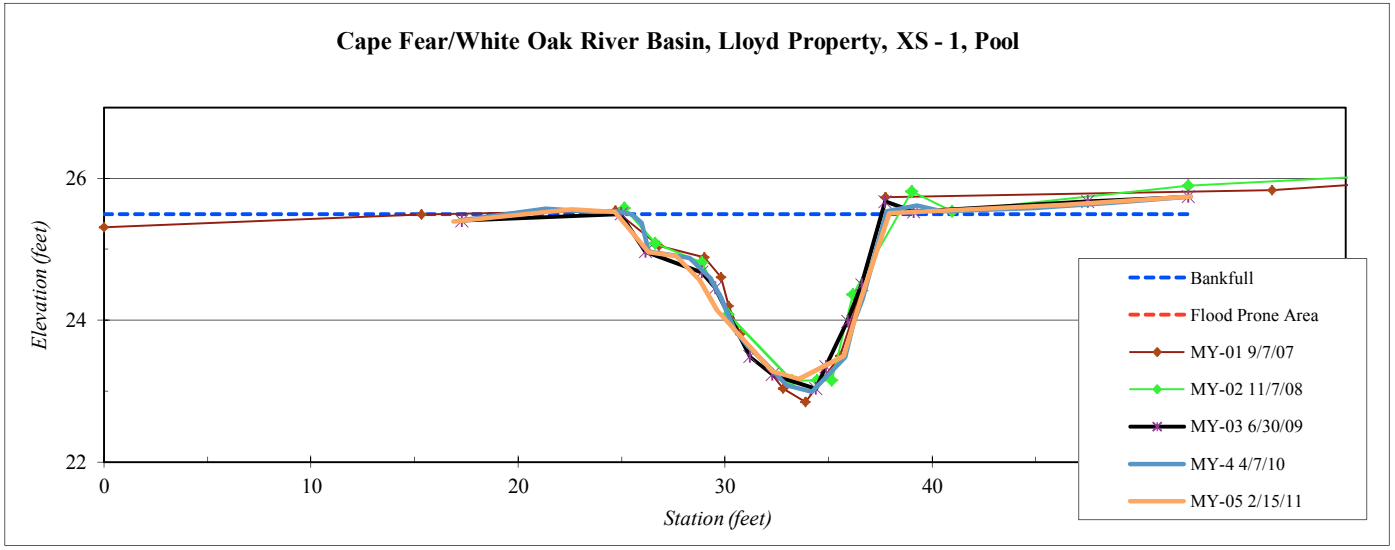
1. **Tables B1-B3. Qualitative Visual Stability Assessment**
2. **Cross-section Plots and Tables**
3. **Longitudinal Profile Plots**
4. **Stream Fixed Station Photos**

River Basin:	Cape Fear/White Oak
Watershed:	Lloyd Property
XS ID	XS - 1, Pool
Drainage Area (sq mi):	0.67
Date:	2/15/2011
Field Crew:	Dean, Perkinson

Station	Elevation
16.88	25.39
22.61	25.56
24.67	25.53
26.32	24.96
27.65	24.90
28.80	24.56
29.63	24.14
32.30	23.28
33.59	23.17
35.74	23.49
36.56	24.28
37.95	25.51
46.31	25.63
52.52	25.74

SUMMARY DATA	
Bankfull Elevation:	25.5
Bankfull Cross-Sectional Area:	17.6
Bankfull Width:	13.2
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.3
Mean Depth at Bankfull:	1.3
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	E/C

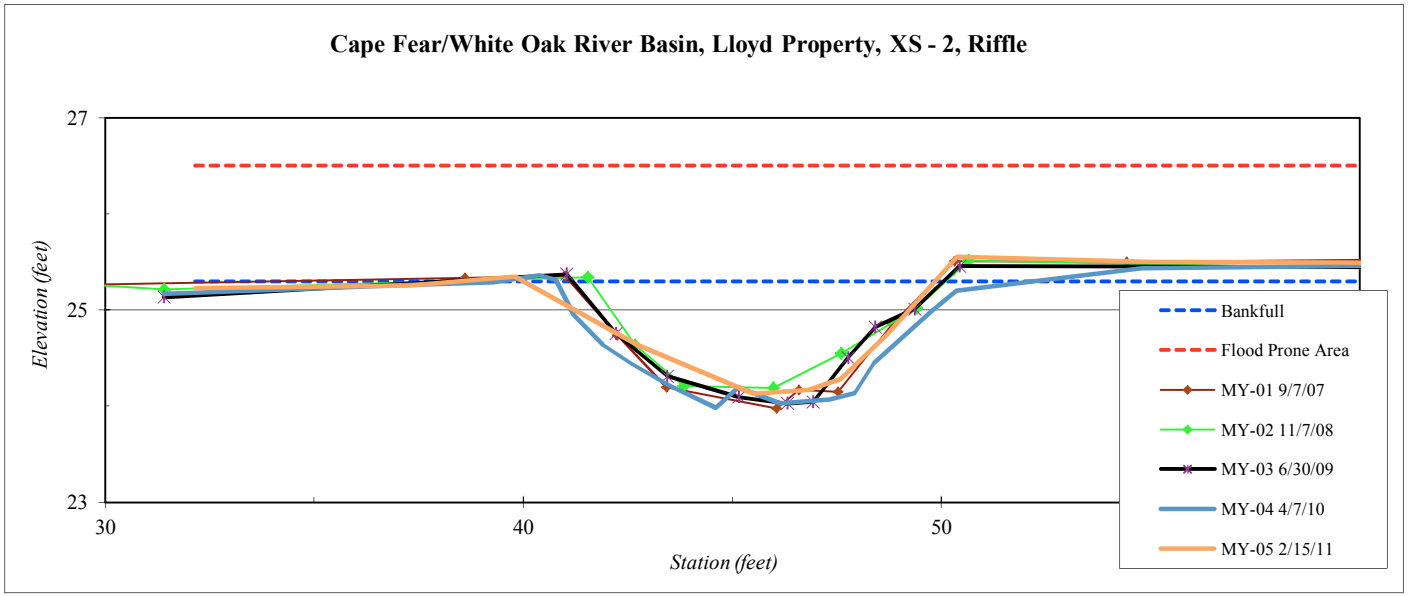


River Basin:	Cape Fear/White Oak
Watershed:	Lloyd Property
XS ID	XS - 2, Riffle
Drainage Area (sq mi):	0.67
Date:	2/15/2011
Field Crew:	Dean, Perkinson

Station	Elevation
32.16	25.23
37.26	25.26
39.80	25.35
42.73	24.64
45.52	24.13
46.83	24.17
47.60	24.29
48.71	24.75
50.37	25.55
55.01	25.50
59.63	25.49
62.13	25.48

SUMMARY DATA	
Bankfull Elevation:	25.3
Bankfull Cross-Sectional Area:	7.0
Bankfull Width:	9.8
Flood Prone Area Elevation:	26.5
Flood Prone Width:	150.0
Max Depth at Bankfull:	1.2
Mean Depth at Bankfull:	0.7
W / D Ratio:	13.7
Entrenchment Ratio:	15.3
Bank Height Ratio:	1.0

Stream Type	E/C

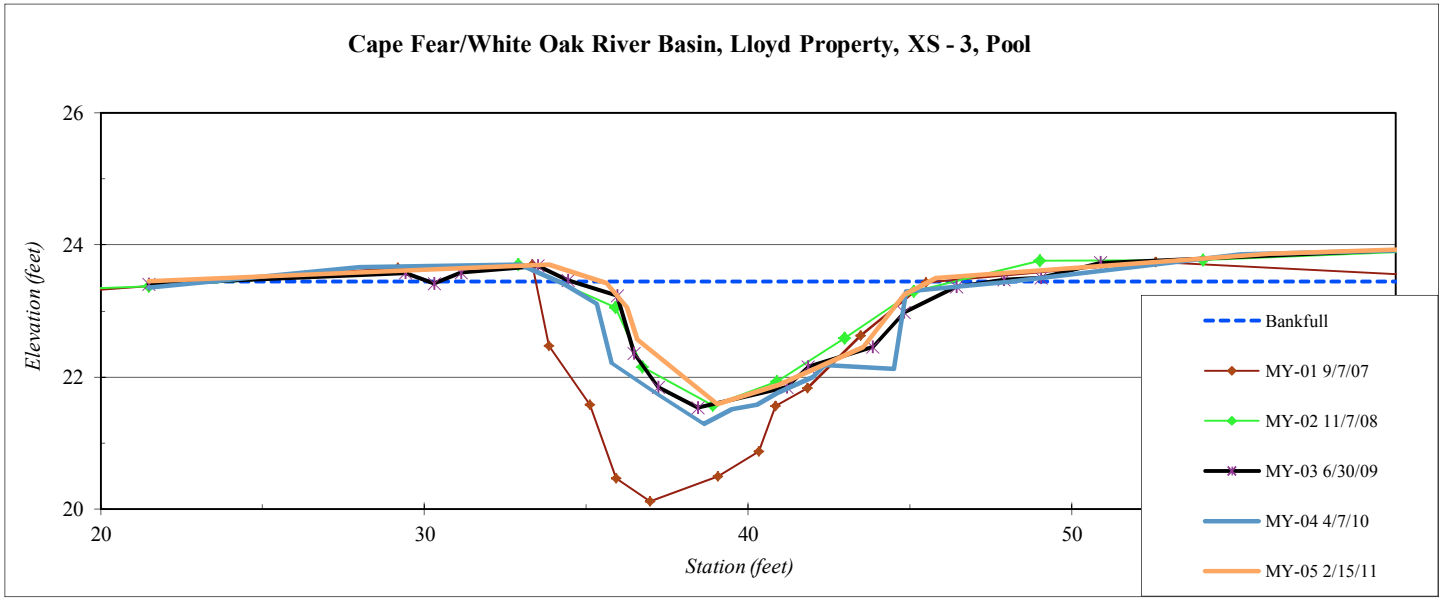


River Basin:	Cape Fear/White Oak
Watershed:	Lloyd Property
XS ID	XS - 3, Pool
Drainage Area (sq mi):	0.67
Date:	2/15/2011
Field Crew:	Dean, Perkinson

Station	Elevation
21.49	23.45
33.85	23.70
35.63	23.42
36.25	23.06
36.59	22.57
39.04	21.59
40.95	21.88
43.55	22.46
44.82	23.25
45.81	23.50
56.14	23.86
65.31	24.01

SUMMARY DATA	
Bankfull Elevation:	23.5
Bankfull Cross-Sectional Area:	11.7
Bankfull Width:	10.2
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	1.9
Mean Depth at Bankfull:	1.1
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	C

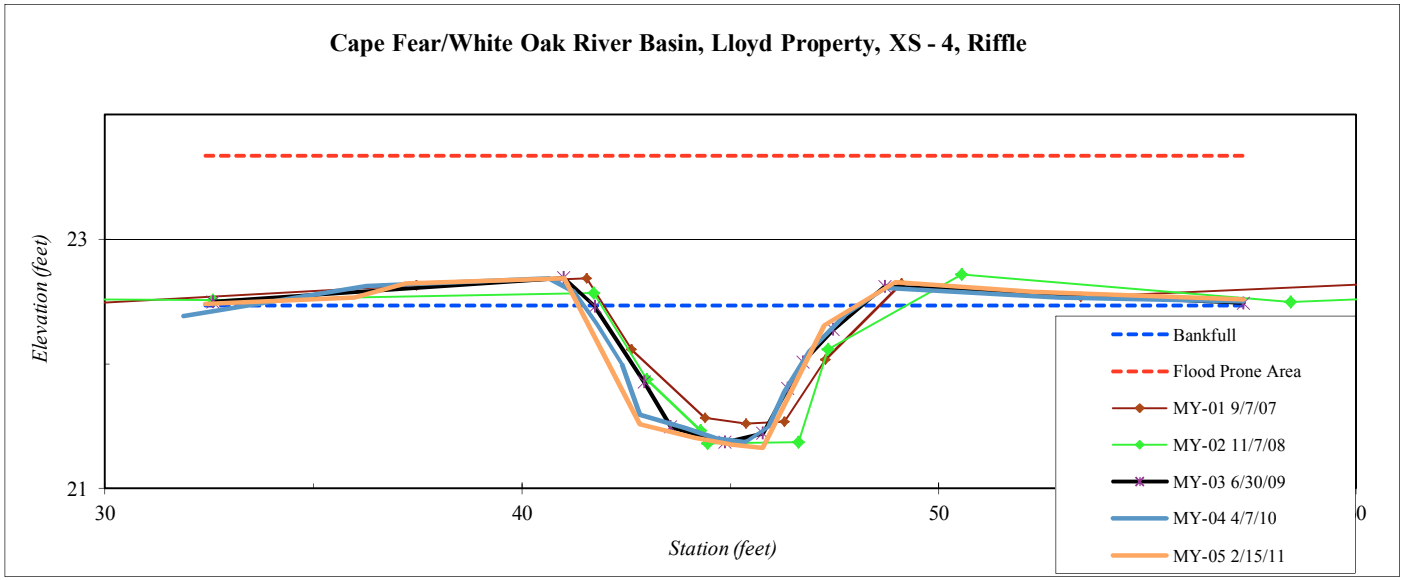


River Basin:	Cape Fear/White Oak
Watershed:	Lloyd Property
XS ID	XS - 4, Riffle
Drainage Area (sq mi):	0.67
Date:	2/15/2011
Field Crew:	Dean, Perkinson

Station	Elevation
32.41	22.48
35.98	22.53
37.21	22.65
41.01	22.69
42.83	21.52
44.13	21.41
45.05	21.35
45.78	21.33
47.24	22.30
48.96	22.65
52.24	22.58
57.30	22.52

SUMMARY DATA	
Bankfull Elevation:	22.5
Bankfull Cross-Sectional Area:	5.6
Bankfull Width:	7.4
Flood Prone Area Elevation:	23.7
Flood Prone Width:	150.0
Max Depth at Bankfull:	1.2
Mean Depth at Bankfull:	0.8
W / D Ratio:	9.8
Entrenchment Ratio:	20.3
Bank Height Ratio:	1.0

Stream Type	E/C

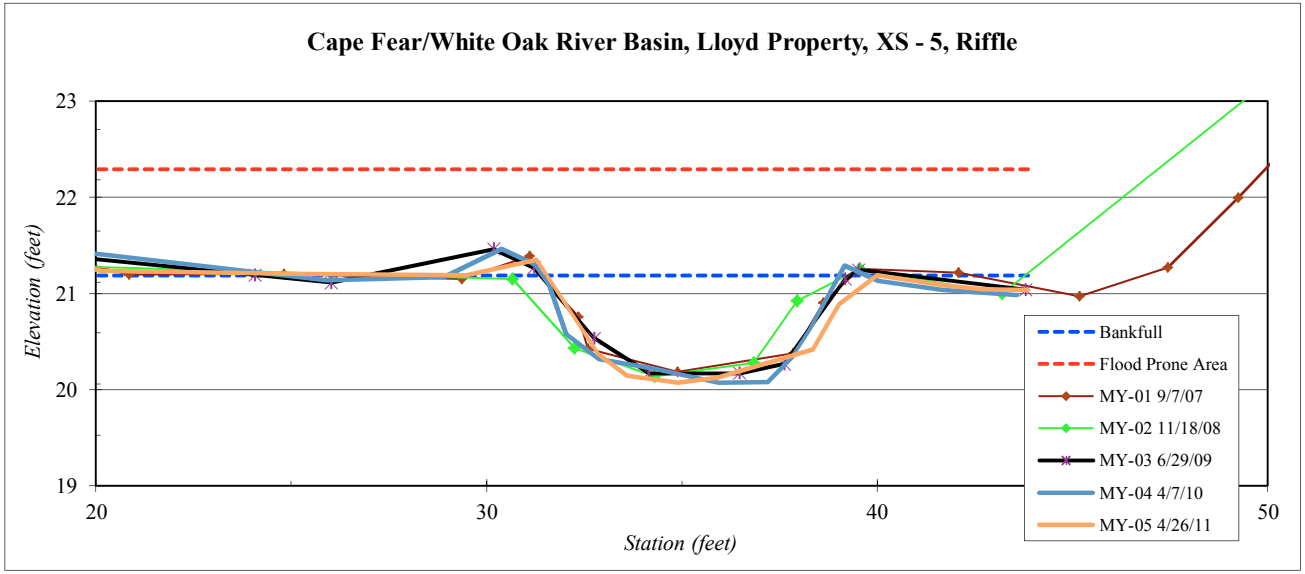


River Basin:	Cape Fear/White Oak
Watershed:	Lloyd Property
XS ID	XS - 5, Riffle
Drainage Area (sq mi):	0.55
Date:	2/15/2011
Field Crew:	Dean, Perkinson

Station	Elevation
4.5	22.86
6.6	22.65
11.9	22.03
16.3	21.57
20.1	21.24
25.3	21.21
29.5	21.19
31.3	21.35
32.9	20.37
33.6	20.14
34.9	20.07
35.9	20.12
37.2	20.27
38.4	20.42
39.0	20.89
40.0	21.19
41.7	21.1
42.7	21.0
43.9	21.0

SUMMARY DATA	
Bankfull Elevation:	21.2
Bankfull Cross-Sectional Area:	6.5
Bankfull Width:	8.4
Flood Prone Area Elevation:	22.3
Flood Prone Width:	38.0
Max Depth at Bankfull:	1.1
Mean Depth at Bankfull:	0.8
W / D Ratio:	10.9
Entrenchment Ratio:	4.5
Bank Height Ratio:	1.0

Stream Type	E/C

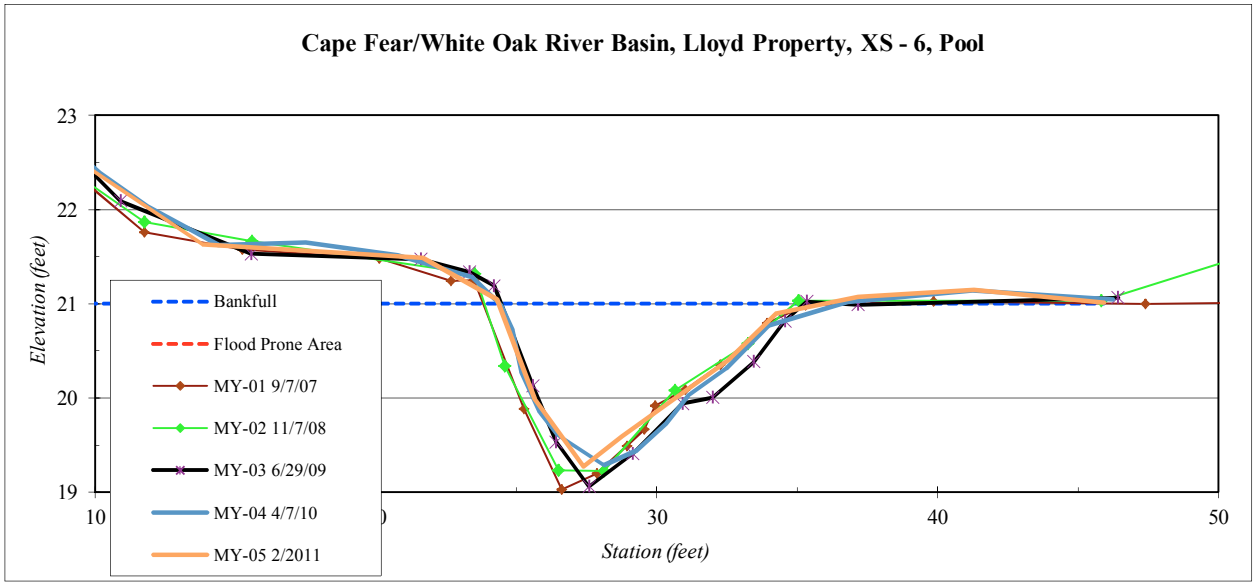


River Basin:	Cape Fear/White Oak
Watershed:	Lloyd Property
XS ID	XS - 6, Pool
Drainage Area (sq mi):	0.55
Date:	2/15/2011
Field Crew:	Dean, Perkinson

Station	Elevation
3.21	23.75
13.83	21.63
21.67	21.49
24.32	21.05
25.67	19.99
27.39	19.27
28.77	19.59
32.55	20.40
34.26	20.90
37.17	21.07
41.30	21.15
45.92	21.01

SUMMARY DATA	
Bankfull Elevation:	21.0
Bankfull Cross-Sectional Area:	11.6
Bankfull Width:	12.3
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	1.7
Mean Depth at Bankfull:	0.8
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	C/E

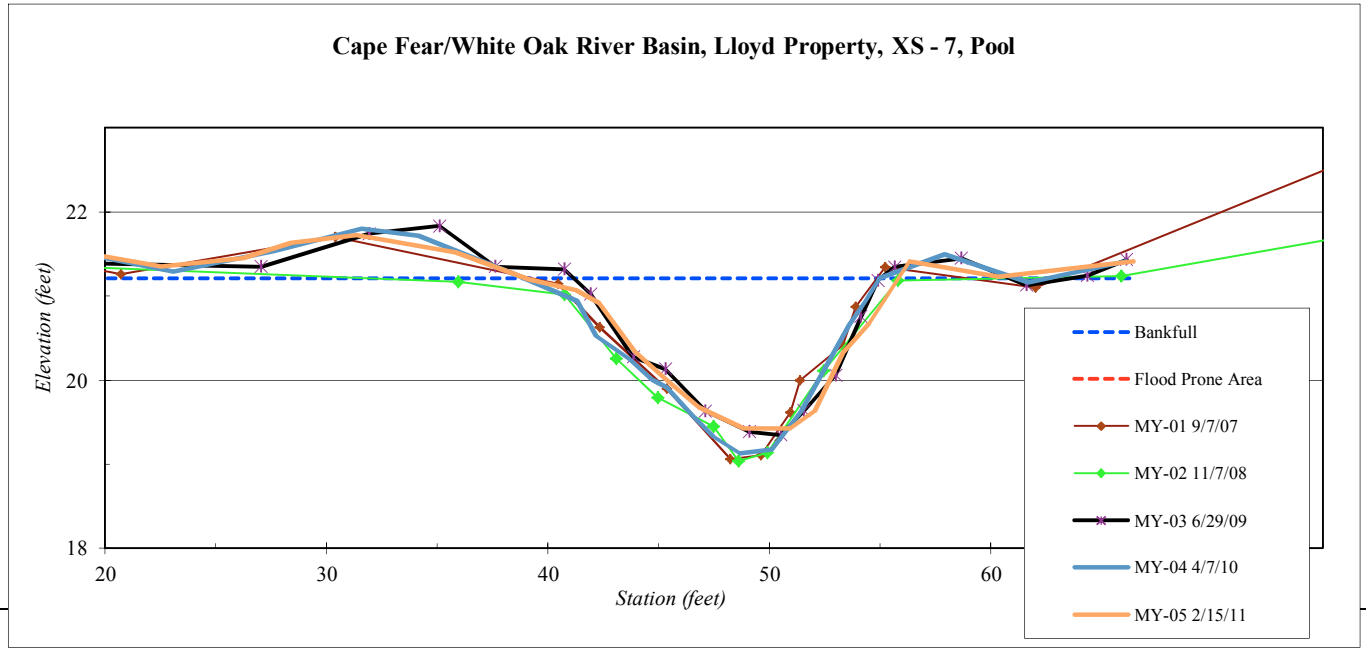


River Basin:	Cape Fear/White Oak
Watershed:	Lloyd Property
XS ID	XS - 7, Pool
Drainage Area (sq mi):	0.55
Date:	2/15/2011
Field Crew:	Dean, Perkinson

Station	Elevation
0.7	22.31
14.19	21.74
22.53	21.35
26.23	21.45
28.39	21.63
31.35	21.73
35.83	21.52
39.12	21.20
41.27	21.07
42.30	20.92
43.93	20.34
45.28	20.02
46.82	19.67
48.85	19.43
50.96	19.43
52.04	19.63
53.31	20.33
54.50	20.67
56.32	21.42
60.36	21.23
66.46	21.41

SUMMARY DATA	
Bankfull Elevation:	21.2
Bankfull Cross-Sectional Area:	16.9
Bankfull Width:	17.1
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	1.8
Mean Depth at Bankfull:	1.0
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	E/C

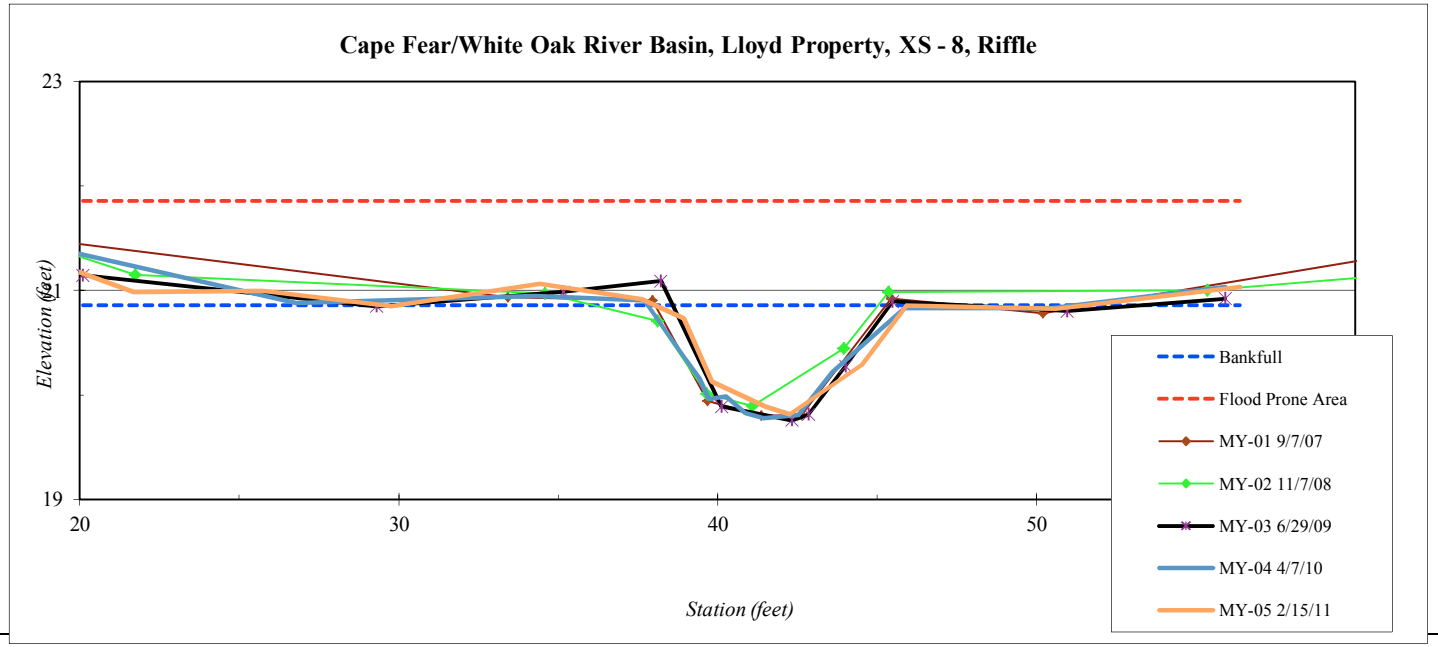


River Basin:	Cape Fear/White Oak
Watershed:	Lloyd Property
XS ID	XS - 8, Riffle
Drainage Area (sq mi):	0.55
Date:	2/15/2011
Field Crew:	Dean, Perkinson

Station	Elevation
16.26	21.59
21.69	20.99
25.74	20.99
29.77	20.85
34.42	21.07
37.61	20.92
38.94	20.73
39.82	20.13
41.50	19.89
42.27	19.82
44.51	20.29
45.44	20.66
45.93	20.86
50.61	20.82
56.37	21.03

SUMMARY DATA	
Bankfull Elevation:	20.9
Bankfull Cross-Sectional Area:	4.9
Bankfull Width:	7.9
Flood Prone Area Elevation:	21.9
Flood Prone Width:	80.0
Max Depth at Bankfull:	1.0
Mean Depth at Bankfull:	0.6
W / D Ratio:	12.7
Entrenchment Ratio:	10.1
Bank Height Ratio:	1.0

Stream Type	E

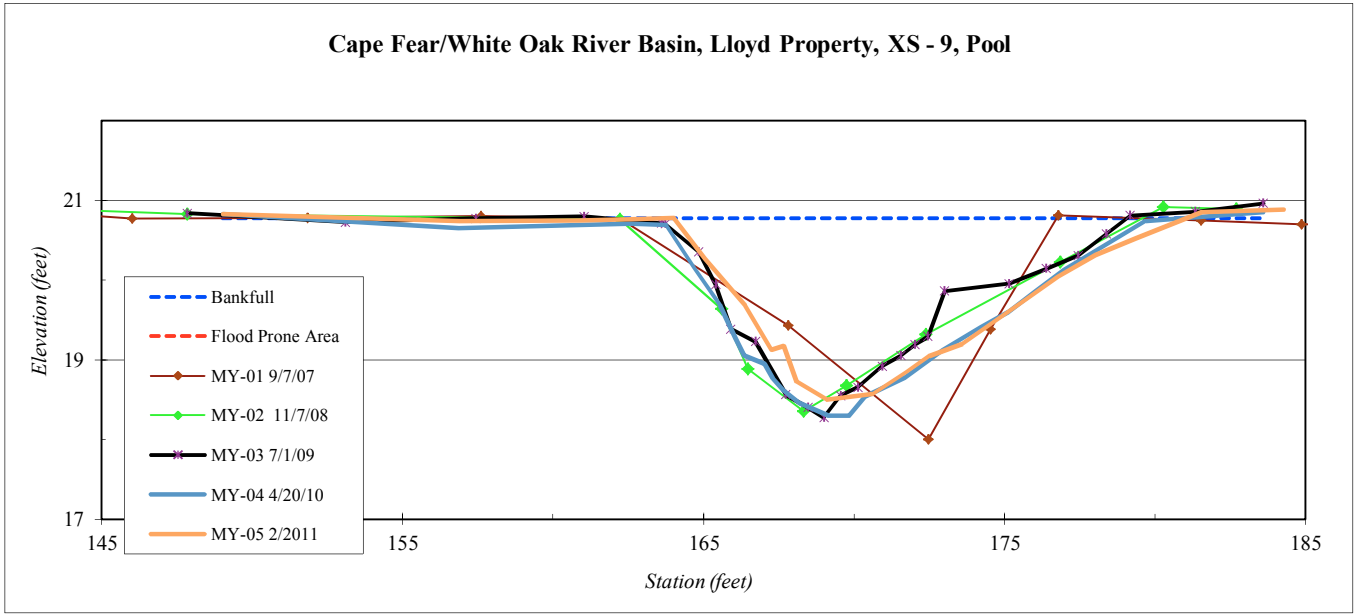


River Basin:	Cape Fear/White Oak
Watershed:	Lloyd Property
XS ID	XS - 9, Pool
Drainage Area (sq mi):	1.2
Date:	2/15/2011
Field Crew:	Dean, Perkinson

Station	Elevation
149.0	20.8
156.9	20.6
162.6	20.7
163.7	20.7
164.7	20.2
165.5	19.7
166.1	19.3
166.3	19.1
167.0	18.9
167.3	18.8
167.7	18.6
168.2	18.5
169.2	18.3
169.8	18.3
170.4	18.5
171.7	18.8
173.0	19.1
174.2	19.4
175.1	19.6
176.0	19.9
177.0	20.1
179.7	20.7
183.6	20.9

SUMMARY DATA	
Bankfull Elevation:	20.8
Bankfull Cross-Sectional Area:	20.3
Bankfull Width:	17.1
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.3
Mean Depth at Bankfull:	1.2
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	E/C

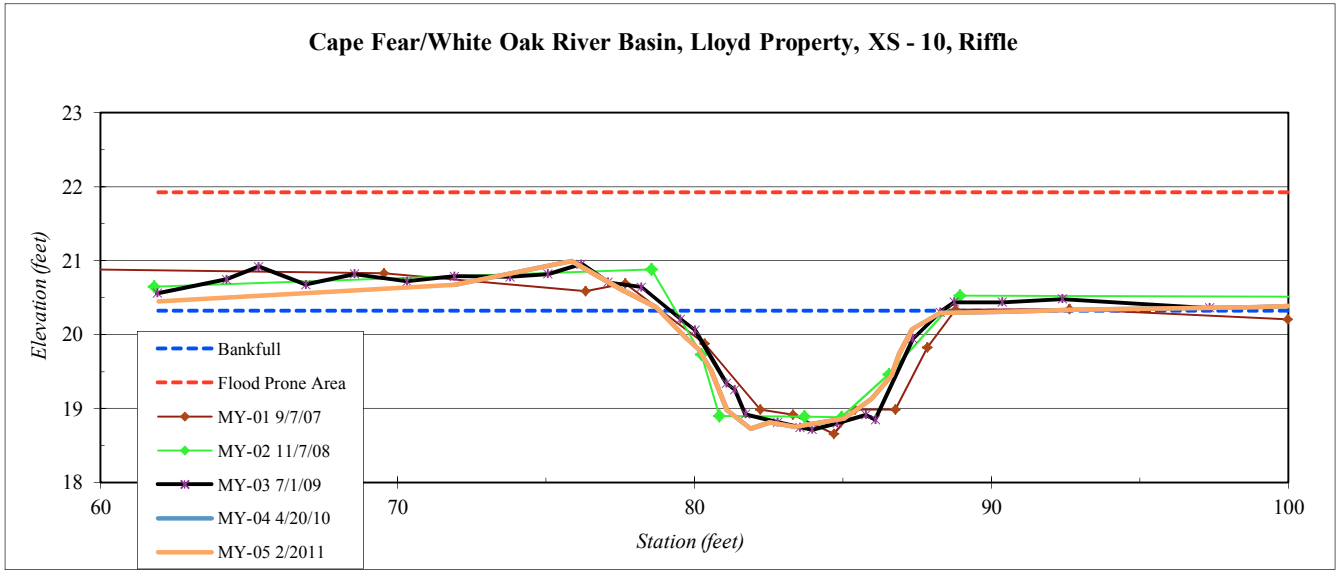


River Basin:	Cape Fear/White Oak
Watershed:	Lloyd Property
XS ID	XS - 10, Riffle
Drainage Area (sq mi):	1.2
Date:	2/15/2011
Field Crew:	Dean, Perkinson

Station	Elevation
61.95	20.45
71.94	20.68
75.85	20.99
77.56	20.61
78.70	20.37
79.71	19.96
80.18	19.79
80.53	19.54
81.09	18.97
81.90	18.73
82.54	18.81
83.39	18.75
85.04	18.86
85.97	19.14
86.63	19.45
86.90	19.74
87.32	20.06
88.30	20.29
90.62	20.31
92.79	20.34
98.85	20.37
104.64	20.45
109.48	20.60

SUMMARY DATA	
Bankfull Elevation:	20.3
Bankfull Cross-Sectional Area:	9.6
Bankfull Width:	10.0
Flood Prone Area Elevation:	21.9
Flood Prone Width:	150.0
Max Depth at Bankfull:	1.6
Mean Depth at Bankfull:	1.0
W / D Ratio:	10.4
Entrenchment Ratio:	15.0
Bank Height Ratio:	1.0

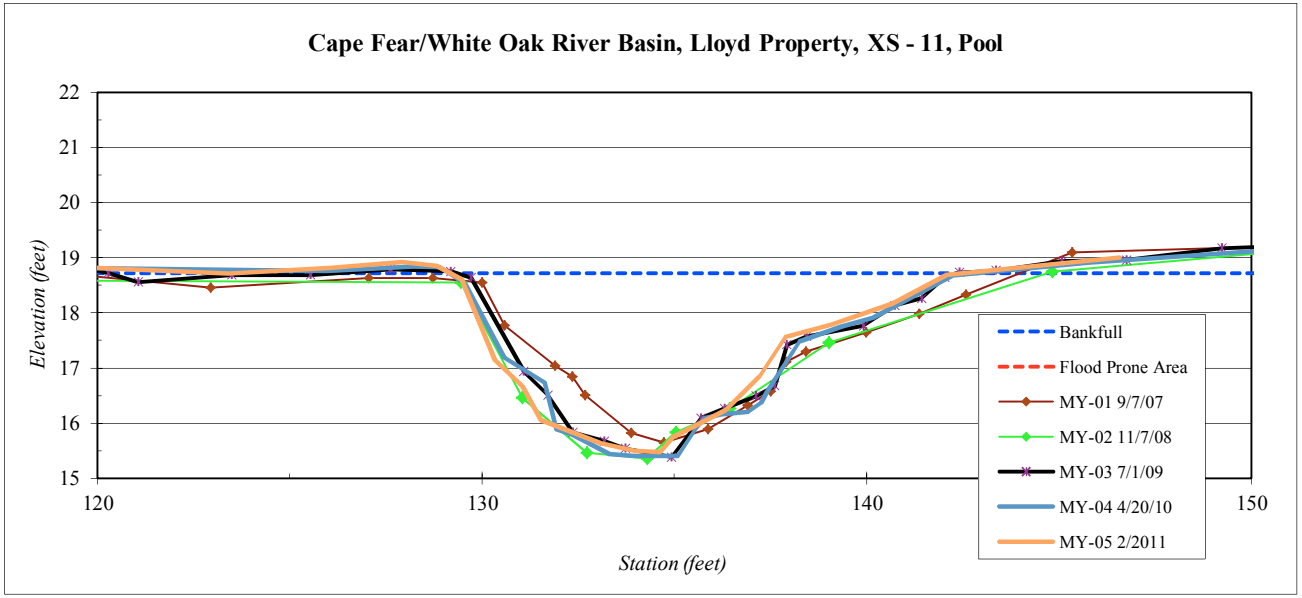
Stream Type	E/C



River Basin:	Cape Fear/White Oak
Watershed:	Lloyd Property
XS ID	XS - 11, Pool
Drainage Area (sq mi):	1.2
Date:	2/15/2011
Field Crew:	Dean, Perkinson

Station	Elevation
119.14	18.84
123.41	18.72
126.10	18.82
127.93	18.92
128.81	18.85
129.48	18.61
130.33	17.14
131.05	16.66
131.54	16.06
133.07	15.64
133.98	15.49
134.62	15.48
134.97	15.76
135.41	15.91
136.34	16.24
137.23	16.86
137.89	17.56
139.07	17.79
140.67	18.17
142.08	18.69
146.57	19.00
150.1	19.1
152.9	19.3

SUMMARY DATA	
Bankfull Elevation:	18.7
Bankfull Cross-Sectional Area:	23.1
Bankfull Width:	13.4
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	3.2
Mean Depth at Bankfull:	1.7
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

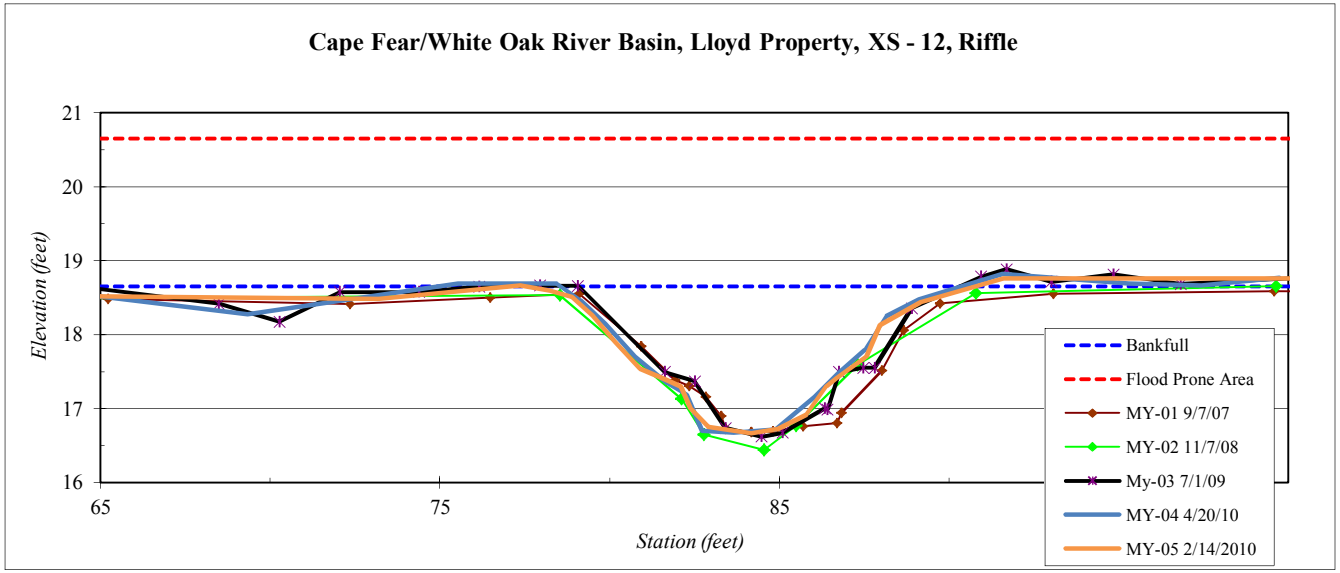


River Basin:	Cape Fear/White Oak
Watershed:	Lloyd Property
XS ID	XS - 12, Riffle
Drainage Area (sq mi):	1.2
Date:	2/15/2011
Field Crew:	Dean, Perkinson

Station	Elevation
65.0	18.5
73.2	18.5
77.4	18.7
78.2	18.6
78.9	18.5
79.5	18.3
80.2	17.9
80.9	17.5
81.7	17.4
82.1	17.3
82.4	17.0
82.9	16.8
84.2	16.7
85.0	16.7
85.8	16.9
86.4	17.3
86.7	17.4
87.6	17.7
88.0	18.1
89.2	18.4
91.6	18.8
94.8	18.8
100.1	18.8

SUMMARY DATA	
Bankfull Elevation:	18.7
Bankfull Cross-Sectional Area:	11.9
Bankfull Width:	9.3
Flood Prone Area Elevation:	20.7
Flood Prone Width:	150.0
Max Depth at Bankfull:	2.0
Mean Depth at Bankfull:	1.3
W / D Ratio:	7.3
Entrenchment Ratio:	16.1
Bank Height Ratio:	1.0

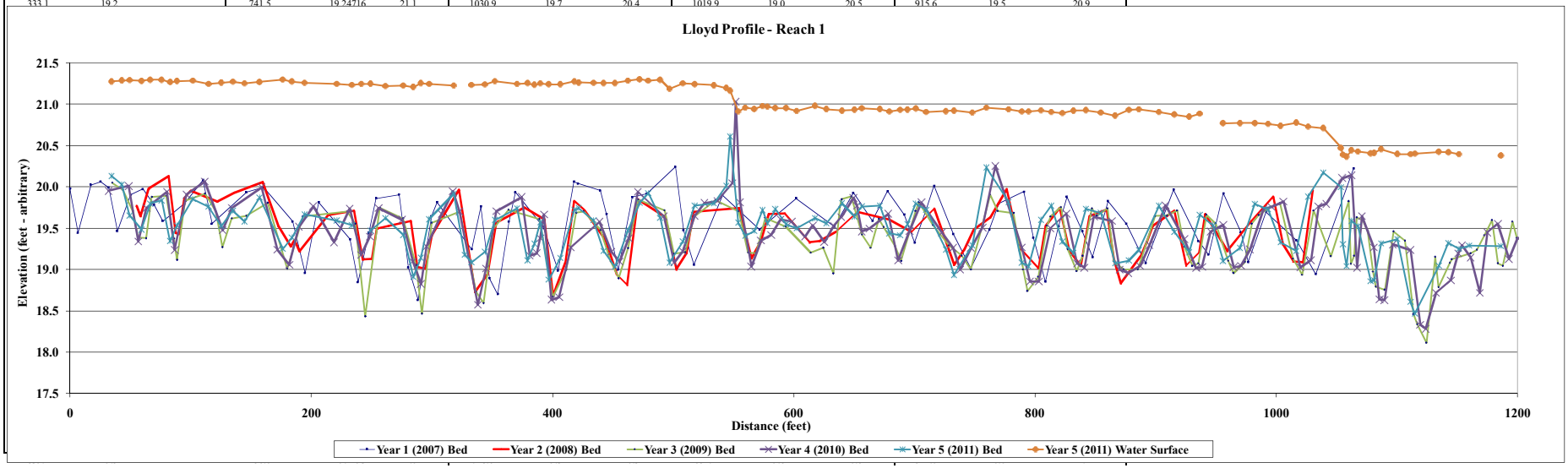
Stream Type	E/C



Project Name	Lloyd Property - Year 5 (2011) Monitoring
Reach	1
Feature	Profile
Date	3/22/11
Crew	Perkinson, Dean

2007 Year 1 Monitoring \Survey			2008 Year 2 Monitoring \Survey			2009 Year 3 Monitoring \Survey			2010 Year 4 Monitoring \Survey			2011 Year 5 Monitoring \Survey		
Station	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**
0.0	20.0		1030.4	19.957963		1199.4	19.4	20.0	1217.3	19.5	20.1	1186.3	19.3	20.4
6.5	19.4		1022.0	19.089303		1195.8	19.6	20.0	1211.4	19.2	20.1	1159.8	19.3	
17.2	20.0		1014.4	19.098657		1188.0	19.0	20.0	1205.8	19.3		1151.5	19.3	20.4
25.3	20.1		1005.5	19.306372	21.0	1183.8	19.1	20.0	1200.0	19.4	20.1	1142.7	19.3	20.4
31.9	20.0		997.6	19.880162	21.0	1178.9	19.6	20.1	1192.8	19.1	20.1	1134.7	19.0	20.4
39.3	19.5		979.5	19.586749		1172.6	19.4	20.0	1183.7	19.6	20.1	1114.9	18.5	20.4
50.1	19.9		959.4	19.224303		1166.5	19.2	20.0	1175.0	19.4	20.1	1111.3	18.6	20.4
60.3	20.0		941.2	19.67157	21.1	1161.2	19.2	20.0	1168.7	18.7	20.1	1100.4	19.4	20.4
69.6	19.8		936.3	19.210102	21.0	1145.5	19.1	20.0	1161.2	19.1	20.1	1086.9	19.3	20.5
76.7	19.6		925.3	19.049415	21.0	1144.0	19.1	20.1	1154.0	19.3	20.1	1081.1	18.9	20.4
94.9	19.8		915.6	19.711067	21.0	1134.7	18.8	20.0	1150.8	19.2	20.1	1078.2	18.9	20.4
110.2	20.1		897.7	19.527771		1131.8	19.2	20.0	1144.8	18.9	20.1	1067.7	19.5	20.4
117.7	19.6		892.8	19.332744	21.0	1124.4	18.1	20.0	1132.4	18.7	20.1	1062.3	19.6	20.4
146.3	19.9		888.0	19.171506	20.9	1117.0	18.3	20.0	1124.0	18.3	20.1	1058.3	19.0	20.4
160.1	20.0		871.3	18.833257		1113.7	18.5	20.0	1119.3	18.3	20.1	1055.3	19.3	20.4
184.4	19.6		865.3	19.127383	20.9	1106.9	19.3	20.0	1111.2	19.2	20.2	1053.6	20.0	20.5
194.6	19.0		859.3	19.724494	21.0	1097.4	19.5	20.0	1096.6	19.3	20.1	1039.0	20.2	20.7
206.2	19.8		845.3	19.648321	20.9	1089.9	18.8	20.0	1089.7	18.6	20.1	1026.5	19.9	20.7
232.2	19.4		837.9	19.043837	21.0	1082.6	18.8	20.0	1085.6	18.6	20.1	1016.6	19.2	20.8
238.6	18.8		828.5	19.229998	21.1	1080.2	19.0	20.0	1081.0	19.3	20.1	1003.6	19.3	20.7
247.7	19.4		820.4	19.746595	21.0	1076.0	19.5	20.0	1071.1	19.6	20.1	993.3	19.7	20.8
253.7	19.9		808.7	19.526244	21.0	1071.6	19.6	20.1	1067.0	19.0	20.2	982.2	19.8	20.8
272.8	19.9		802.8	19.01968	21.1	1066.9	19.6	20.1	1062.6	20.1	20.3	969.9	19.3	20.8
280.4	19.0		787.4	19.267396	21.1	1064.6	19.2	20.0	1054.7	20.1	20.4	955.9	19.1	20.8
288.5	18.6		776.7	19.971358	21.1	1062.0	19.1	20.0	1041.4	19.8	20.5	947.7	19.5	
299.7	19.6		763.0	19.629819		1060.1	19.8	20.1	1035.0	19.8		936.6	19.7	20.9
304.4	19.8		749.3	19.482602	21.1	1045.1	19.2	20.3	1028.8	19.1	20.5	927.7	19.2	20.8
333.1	19.2		741.5	19.24716	21.1	1030.9	19.7	20.4	1019.9	19.0	20.5	915.6	19.5	20.9

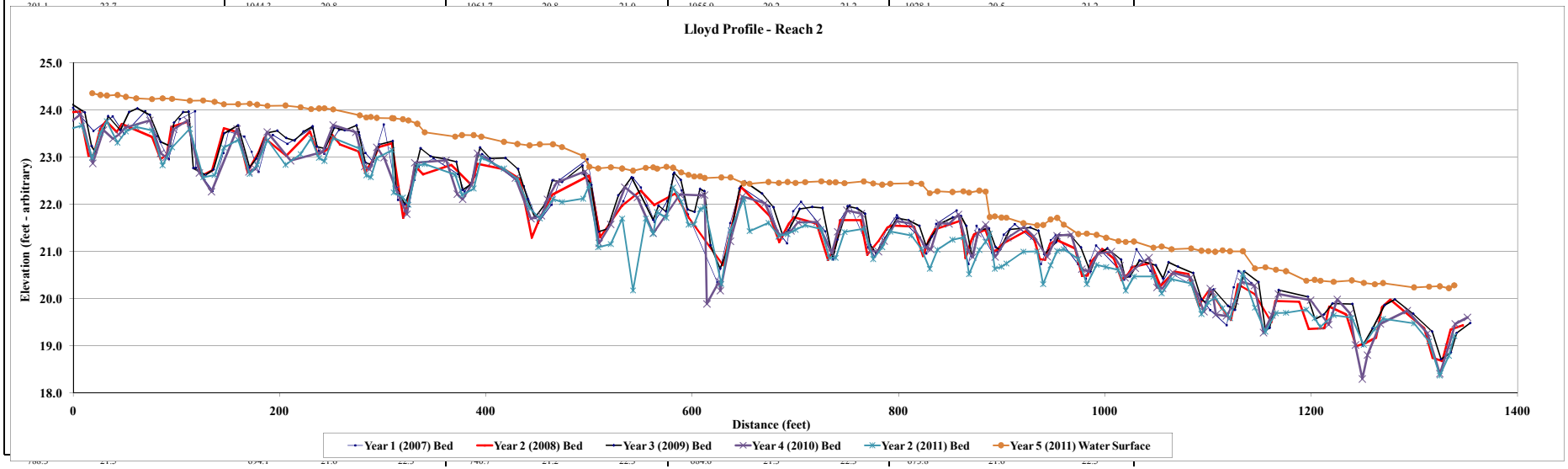
	2007	2008	2009	2010	2011
Avg. Water Surface Slope	----	0.0002	0.0003	0.0008	0.0008
Riffle Length	18.0	32.0	17.0	15.6	14
Avg. Riffle Slope	-----	0.0005	0.0000	0.0000	0.0011
Pool Length	22.0	24.0	10.0	25.8	15
Avg. Pool Slope	-----	0.0020	0.0022	0.0007	0



Project Name Lloyd Property - Year 5 (2011) Monitoring
Reach 2
Feature Profile
Date 3/23/11
Crew Perkinson, Dean

2007 Year 1 Monitoring \Survey			2008 Year 2 Monitoring \Survey			2009 Year 3 Monitoring \Survey			2010 Year 4 Monitoring \Survey			2011 Year 5 Monitoring \Survey		
Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation
0.0	24.0		1346.9	19.4	20.1	1353.9	19.5	20.2	1351.4	19.6	20.2	1338.6	19.2	20.3
19.7	23.6		1335.0	19.3	20.2	1340.8	19.3	20.2	1339.4	19.5	20.2	1333.3	18.8	20.2
38.4	23.9		1326.9	18.7	20.1	1335.2	18.9	20.2	1332.9	19.0	20.2	1324.7	18.4	20.3
49.4	23.5		1317.6	18.7	20.1	1325.7	18.7	20.2	1324.7	18.4	20.2	1314.2	19.1	20.3
69.9	24.0		1309.5	19.4	20.2	1317.1	19.3	20.2	1312.6	19.3	20.2	1299.5	19.5	20.2
81.1	23.4		1276.6	20.0		1298.7	19.7	20.2	1293.0	19.7	20.2	1269.6	19.6	20.3
92.7	23.0		1268.6	19.8	20.2	1280.9	20.0	20.2	1267.0	19.5	20.3	1261.6	19.4	20.3
103.2	23.8		1262.8	19.2	20.3	1271.0	19.9	20.3	1254.4	18.8	20.3	1250.9	19.0	20.3
118.1	24.0		1252.6	19.1		1259.5	19.4	20.4	1249.4	18.3	20.3	1239.2	19.6	20.4
118.7	22.8		1243.5	19.0	20.2	1249.9	19.0		1242.8	19.0	20.3	1221.7	19.6	20.4
135.2	22.3		1233.7	19.7	20.2	1239.8	19.9	20.3	1237.5	19.7	20.3	1208.9	19.4	20.4
145.5	23.1		1217.3	19.8	20.5	1220.5	19.9	20.5	1225.2	20.0	20.4	1203.3	19.6	20.4
150.6	23.5		1212.7	19.4	20.5	1212.2	19.7	20.5	1216.8	19.4	20.4	1195.2	19.8	20.4
165.8	23.4		1197.6	19.4	20.5	1203.7	19.6	20.5	1199.3	20.0	20.5	1175.5	19.7	20.6
173.0	23.1		1188.4	19.9	20.4	1196.6	20.0	20.5	1168.1	20.1	20.6	1165.7	19.7	20.6
179.8	22.7		1165.1	19.9	20.7	1168.4	20.2	20.7	1161.9	19.7	20.5	1155.5	19.3	20.7
187.8	23.3		1161.2	19.5		1159.7	19.4	20.7	1153.8	19.3	20.6	1145.4	19.8	20.6
193.6	23.5		1145.4	20.1	20.6	1155.7	19.3	20.7	1145.0	20.3	20.7	1133.7	20.5	21.0
207.7	23.3		1129.1	20.3	20.9	1148.8	20.3	20.7	1131.9	20.4	21.1	1121.2	19.6	21.0
231.8	23.6		1122.0	19.5	21.0	1134.9	20.6	21.0	1126.2	19.9	21.1	1114.0	19.8	21.0
238.1	23.1		1112.7	19.8	21.0	1125.9	19.8	21.0	1117.6	19.6	21.1	1106.9	20.0	21.0
243.3	23.1		1101.3	20.2	21.0	1119.3	19.8	20.9	1107.6	19.7	21.1	1100.3	19.9	21.0
249.4	23.3		1094.3	20.0	21.0	1105.3	20.2	21.0	1104.0	20.1	21.2	1093.5	19.7	21.0
257.7	23.6		1091.1	19.8	21.0	1097.8	19.9	21.0	1102.0	20.2	21.1	1083.5	20.3	21.1
276.9	23.5		1080.9	20.5	20.9	1093.7	20.0	21.0	1096.0	19.7	21.2	1064.6	20.4	21.0
283.3	23.1		1067.4	20.6		1085.5	20.5	21.0	1083.0	20.4	21.2	1055.0	20.1	21.1
290.7	22.9		1053.8	20.3		1070.7	20.7	21.0	1066.1	20.5	21.2	1046.9	20.5	21.1

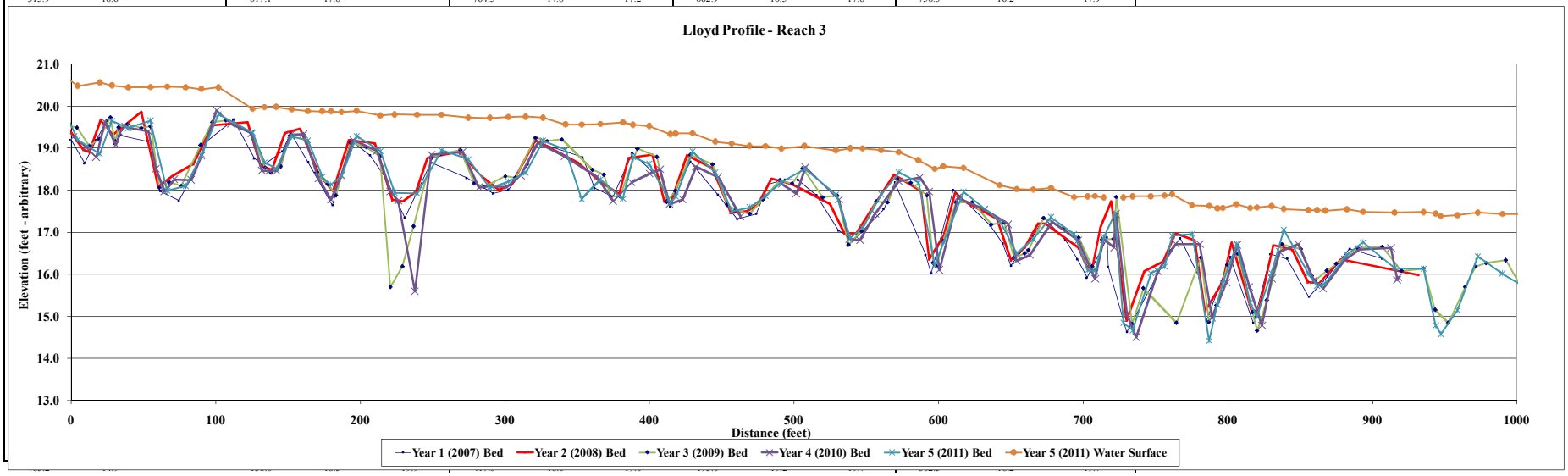
	2007	2008	2009	2010	2011
Avg. Water Surface Slo	0.0033	0.0033	0.0032	0.0032	0.0029
Riffle Length	20.0	26.0	19.7	18.6	21.0
Avg. Riffle Slope	0.0110	0.0084	0.0006	0.0067	0.0025
Pool Length	22.0	24.0	23.7	31.2	11.0
Avg. Pool Slope	-----	0.0014	0.0005	0.0019	0.0007



Project Name Lloyd Property - Year 5 (2011) Monitoring
Reach 3
Feature Profile
Date 3/23/11
Crew Dean, Perkinson

2007 Year 1 Monitoring \Survey			2008 Year 2 Monitoring \Survey			2009 Year 3 Monitoring \Survey			2010 Year 4 Monitoring \Survey			2011 Year 5 Monitoring \Survey		
Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation
0.0	19.2		932.0	16.0	17.0	1017.0	15.3	17.0	918.0	15.9		1021.7	16.5	
9.3	18.6		878.4	16.4	17.3	1009.4	15.3	16.9	917.1	15.9	17.0	1013.5	14.7	17.4
17.1	19.2		863.1	15.8	17.3	992.2	16.3	16.9	912.8	16.6	17.1	1011.2	14.6	17.5
24.6	19.7		855.2	15.8	17.3	978.7	16.3	17.0	891.0	16.6	17.1	1004.6	15.7	17.4
30.1	19.1		844.7	16.6	17.3	971.4	16.2	17.0	880.9	16.4	17.2	989.8	16.0	17.4
34.2	19.3		831.3	16.7	17.3	964.2	15.7	17.0	865.9	15.7	17.2	972.8	16.4	17.5
53.0	19.2		820.8	15.1	17.3	952.4	14.8	16.9	859.3	15.9	17.2	958.8	15.1	17.4
61.5	18.0		816.1	15.2	17.3	943.4	15.2	17.0	848.5	16.7	17.2	947.3	14.6	17.4
74.4	17.8		802.7	16.8	17.3	935.4	16.1	17.0	836.0	16.5	17.3	943.7	14.8	17.4
85.9	18.5		796.2	15.8	17.3	920.2	16.1	16.9	830.4	15.9	17.3	935.4	16.1	17.5
93.6	19.2		784.1	15.1	17.3	906.8	16.7	17.0	823.7	14.8		915.4	16.1	17.5
112.3	19.7		777.2	16.8	17.3	889.7	16.6	17.1	814.9	15.7	17.4	893.6	16.8	17.5
126.6	18.8		763.5	17.0	17.4	875.1	16.3	17.1	806.7	16.7	17.3	882.3	16.5	17.5
133.0	18.6		755.4	16.3	17.5	868.5	16.1	17.1	798.9	15.8	17.1	867.4	15.8	17.5
146.1	18.9		742.2	16.1		860.2	15.8	17.1	789.1	15.0	17.3	861.8	15.7	17.5
151.9	19.4		729.8	14.9	17.4	857.9	16.0	17.1	780.6	16.7	17.2	855.8	16.0	17.5
163.9	18.7		719.4	17.7		850.6	16.6	17.1	763.8	16.7	17.5	838.8	17.1	17.6
180.8	17.6		712.0	17.1	17.5	837.5	16.7	17.1	751.6	16.1	17.5	830.2	16.0	17.6
193.3	19.2		705.9	16.1	17.6	826.9	15.4	16.7	736.5	14.5	17.5	820.1	15.0	17.6
206.8	18.8		702.2	16.2	17.5	820.3	14.7	16.8	730.1	15.0	17.5	815.5	15.3	17.6
216.7	18.3		696.8	16.6	17.5	817.1	15.1	16.8	722.8	17.4	17.5	806.0	16.7	17.7
230.7	17.3		673.6	17.2		806.8	16.5	16.8	721.4	16.6	17.5	796.5	15.8	17.6
249.0	18.7		668.8	17.2	17.9	799.7	16.2	16.9	714.1	16.8	17.5	792.7	15.3	17.6
273.5	18.3		659.3	16.6	17.9	792.3	15.3	17.0	708.2	15.9	17.5	787.2	14.4	17.6
291.8	17.9		650.0	16.3	17.9	786.8	14.9	17.2	696.4	16.8	17.5	775.4	17.0	17.6
302.4	18.0		640.4	17.3	17.9	781.4	16.4	17.1	678.4	17.2	17.6	761.4	16.9	17.9
315.9	18.6		617.1	17.8		764.5	14.8	17.2	662.9	16.5	17.8	756.3	16.2	17.9

	2007	2008	2009	2010	2011
Avg. Water Surface Sl	0.0034	0.0036	0.0033	0.0037	0.0032
Riffle Length	19.0	24.0	19.2	18.0	18.0
Avg. Riffle Slope	0.0001	0.0091	0.0059	0.0063	0.0043
Pool Length	29.0	38.0	32.6	34.1	13.0
Avg. Pool Slope	-----	0.0011	0.0001	0.0014	0.0019



Appendix B: Preconstruction Photographs

Looking upstream on abandoned channel at Site infall.

Looking downstream on abandoned channel from Site infall.

Looking downstream on abandoned channel.

Looking upstream on abandoned channel.

Looking across the abandoned channel toward the main tributary adjacent to the tree line.

Appendix B: Preconstruction Photographs (continued)

Looking across the abandoned channel toward the area of Rains soils proposed for nonriverine wetland restoration.

Looking upstream at the main channel adjacent to the tree line.

Looking towards the abandoned channel near the location of the culverted crossing that will bisect the easement.

Looking downstream at the confluence of the main channel and the abandoned channel.

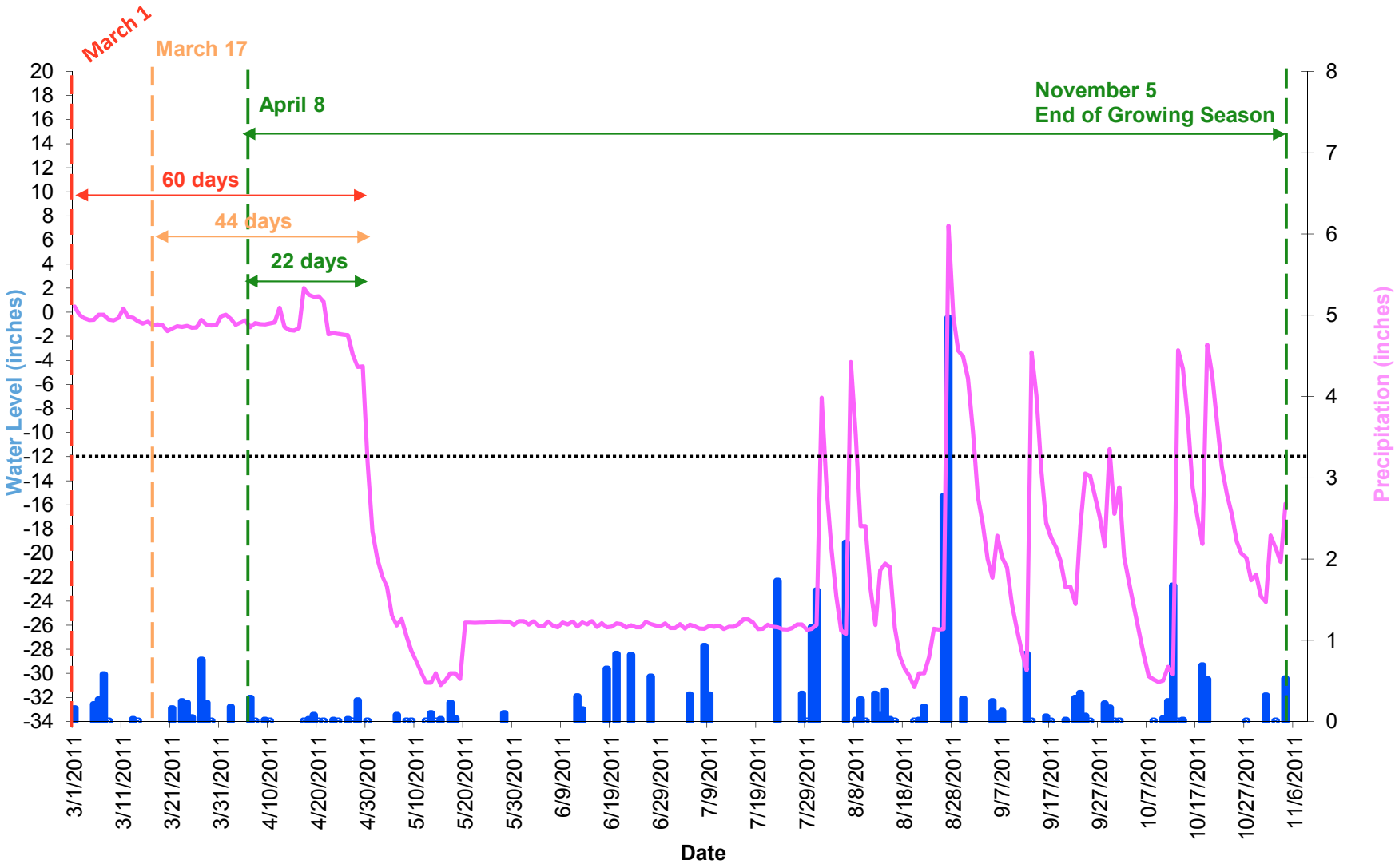
Looking upstream towards the confluence of the main channel and the existing eastern channel/roadside ditch.

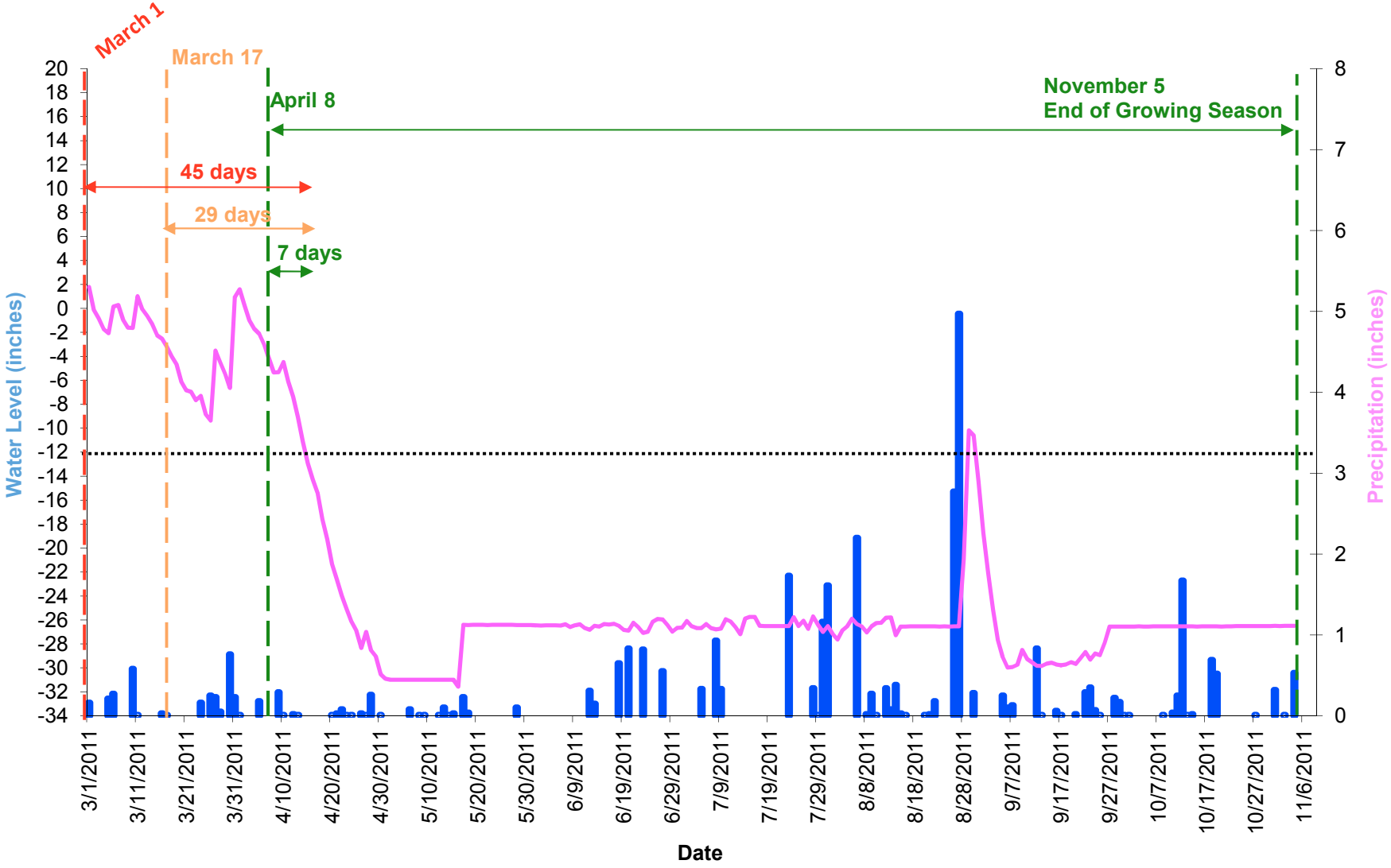
Lloyd Stream and Wetland Restoration Site
Year 5 (2011) Annual Monitoring
Stream Fixed Photo Stations
Taken November 22, 2011

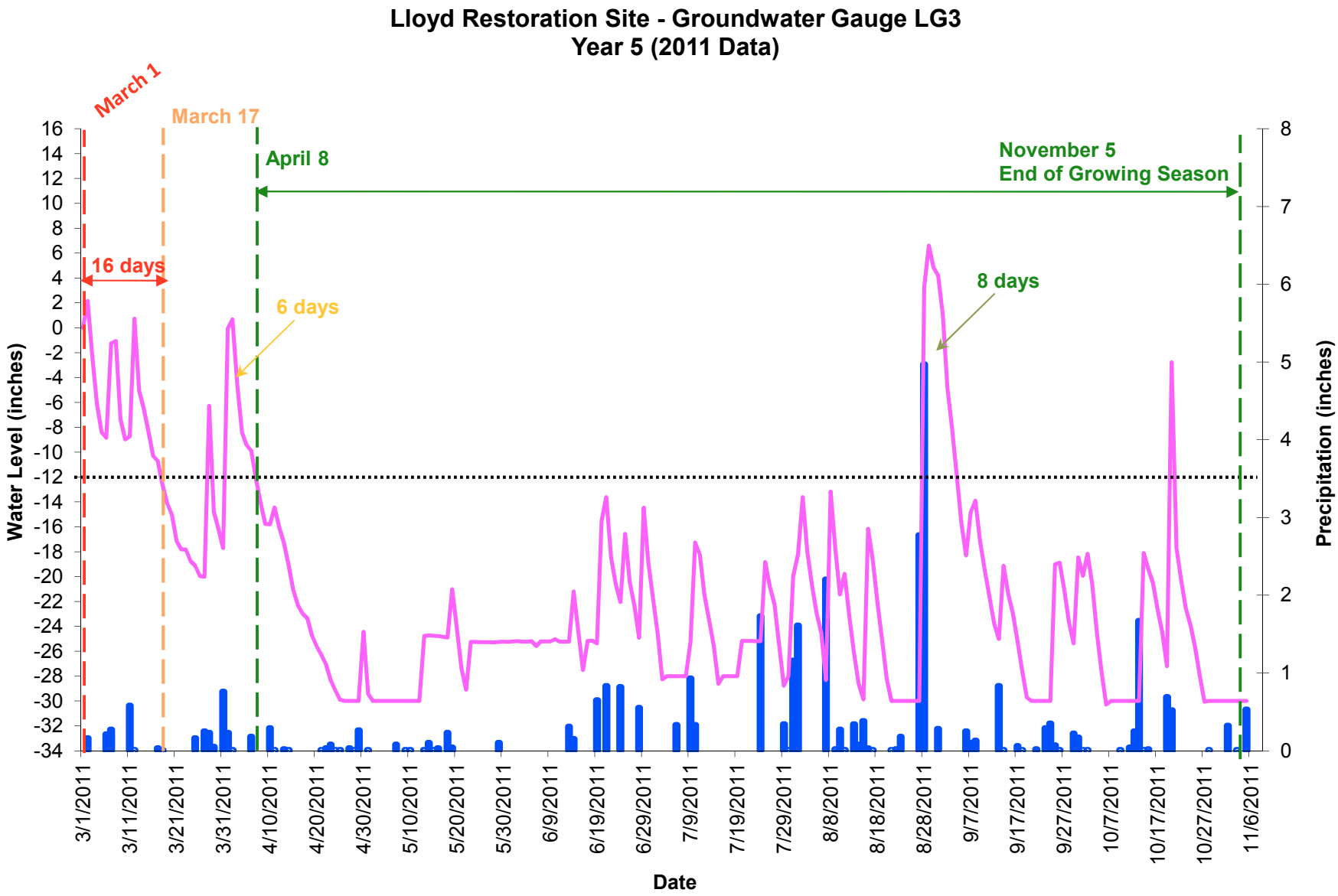
Lloyd Stream and Wetland Restoration Site
Year 5 (2011) Annual Monitoring
Stream Fixed Photo Stations
Taken November 22, 2011 (continued)

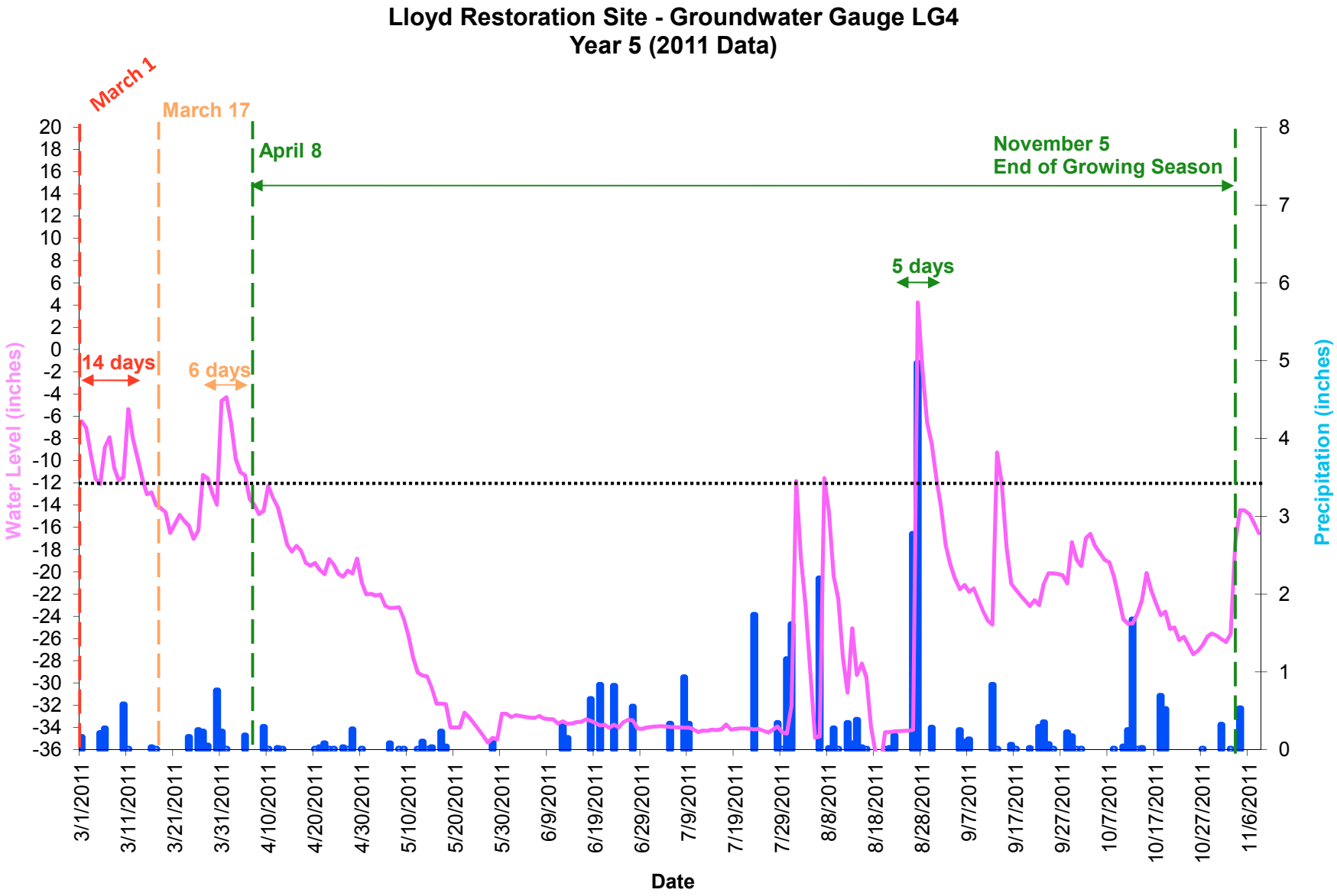
Photo from 4/12/10. No photo available for 2011.

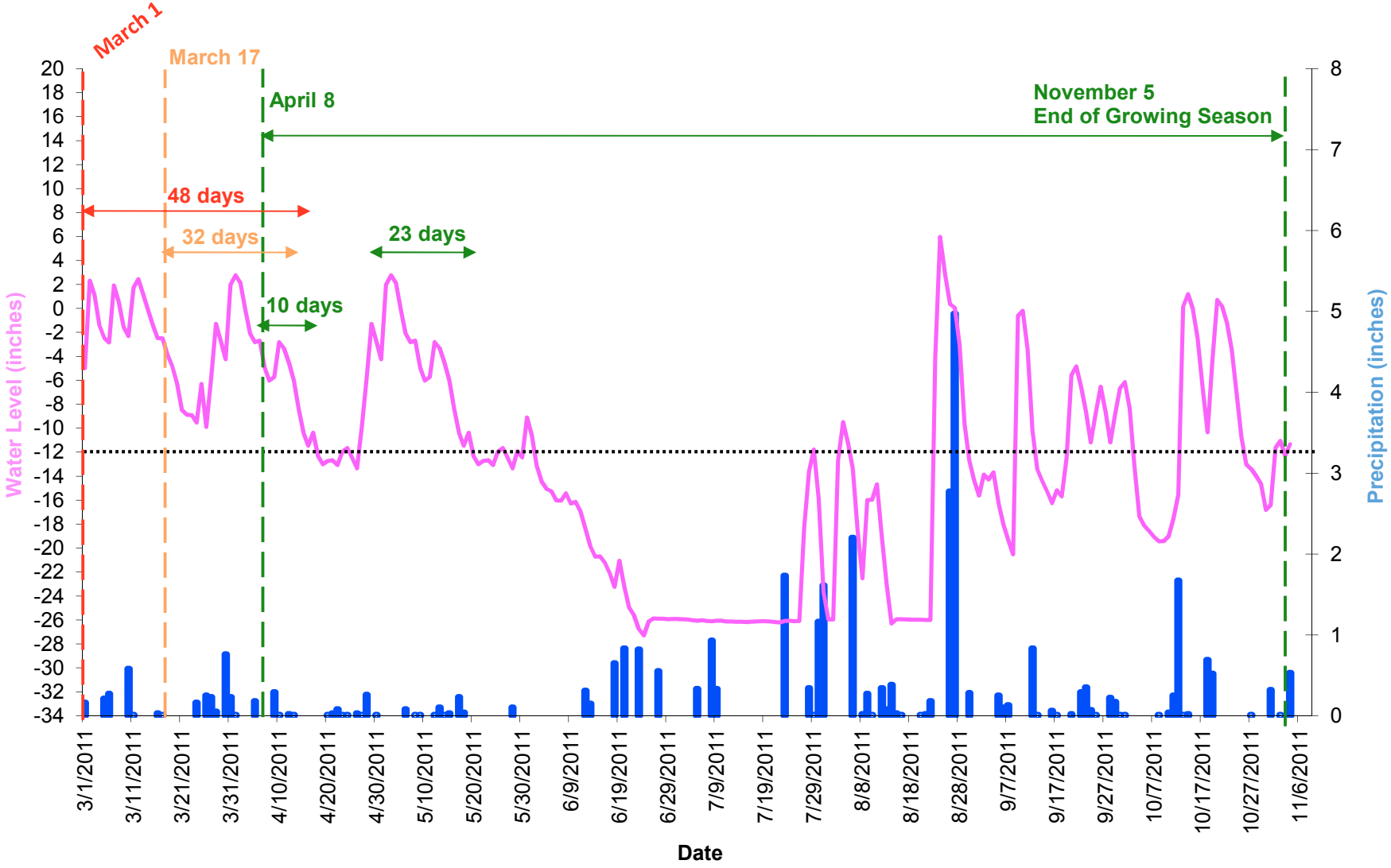
APPENDIX C
HYDROLOGY DATA
2011 Groundwater Gauge Graphs

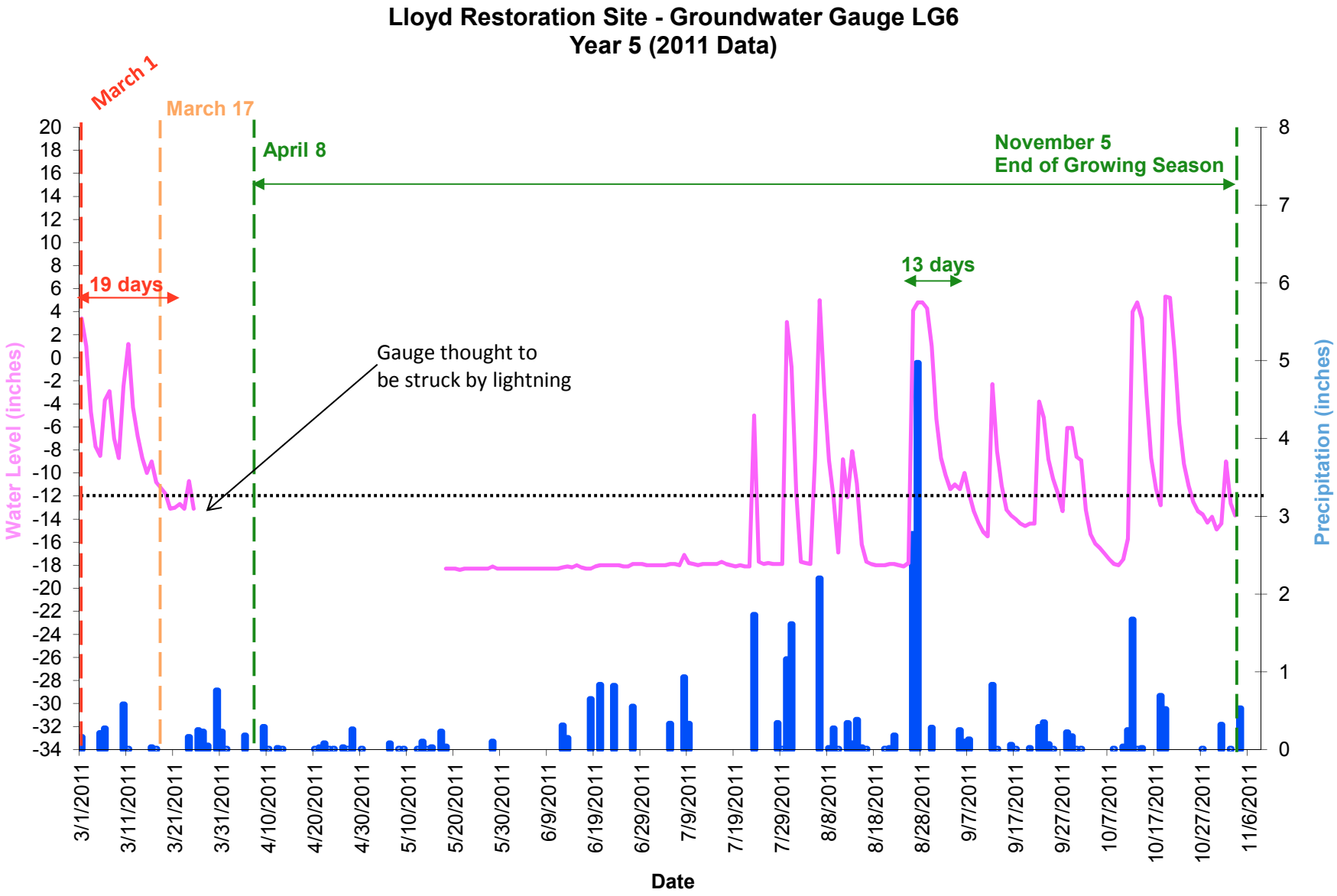

Lloyd Restoration Site - Groundwater Gauge LG1
Year 5 (2011 Data)
March 1
March 17
April 8
November 5
End of Growing Season
60 days
44 days
22 days
Water Level (inches)
Precipitation (inches)
Date
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
8
7
6
5
4
3
2
1
0
3/1/2011
3/11/2011
3/21/2011
3/31/2011
4/10/2011
4/20/2011
4/30/2011
5/10/2011
5/20/2011
5/30/2011
6/9/2011
6/19/2011
6/29/2011
7/9/2011
7/19/2011
7/29/2011
8/8/2011
8/18/2011
8/28/2011
9/7/2011
9/17/2011
9/27/2011
10/7/2011
10/17/2011
10/27/2011
11/6/2011

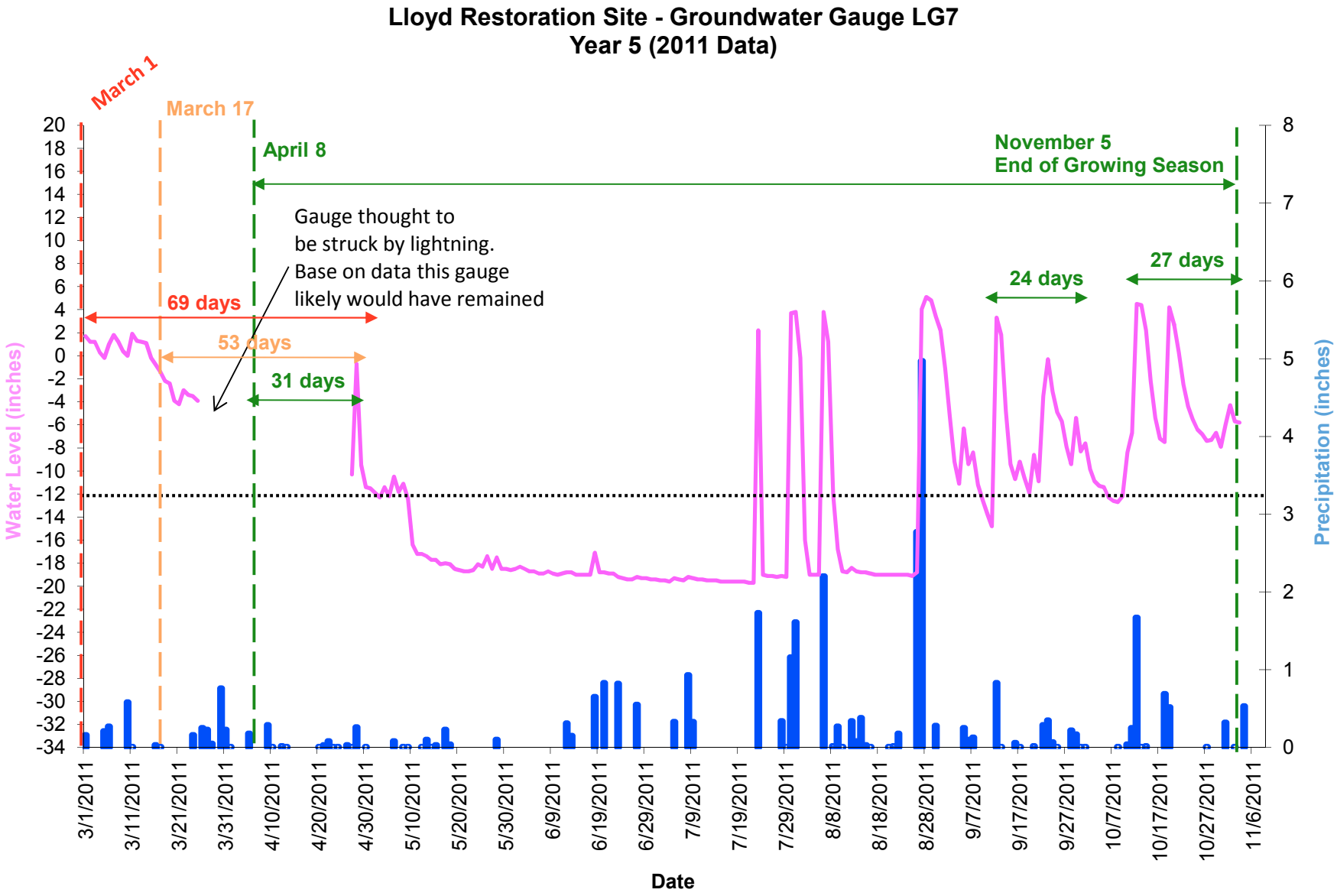

Lloyd Restoration Site - Groundwater Gauge LG2
Year 5 (2011 Data)
March 1
March 17
April 8
November 5
End of Growing Season
45 days
29 days
7 days
Water Level (inches)
Precipitation (inches)
Date
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
8
7
6
5
4
3
2
1
0
3/1/2011
3/11/2011
3/21/2011
3/31/2011
4/10/2011
4/20/2011
4/30/2011
5/10/2011
5/20/2011
5/30/2011
6/9/2011
6/19/2011
6/29/2011
7/9/2011
7/19/2011
7/29/2011
8/8/2011
8/18/2011
8/28/2011
9/7/2011
9/17/2011
9/27/2011
10/7/2011
10/17/2011
10/27/2011
11/6/2011

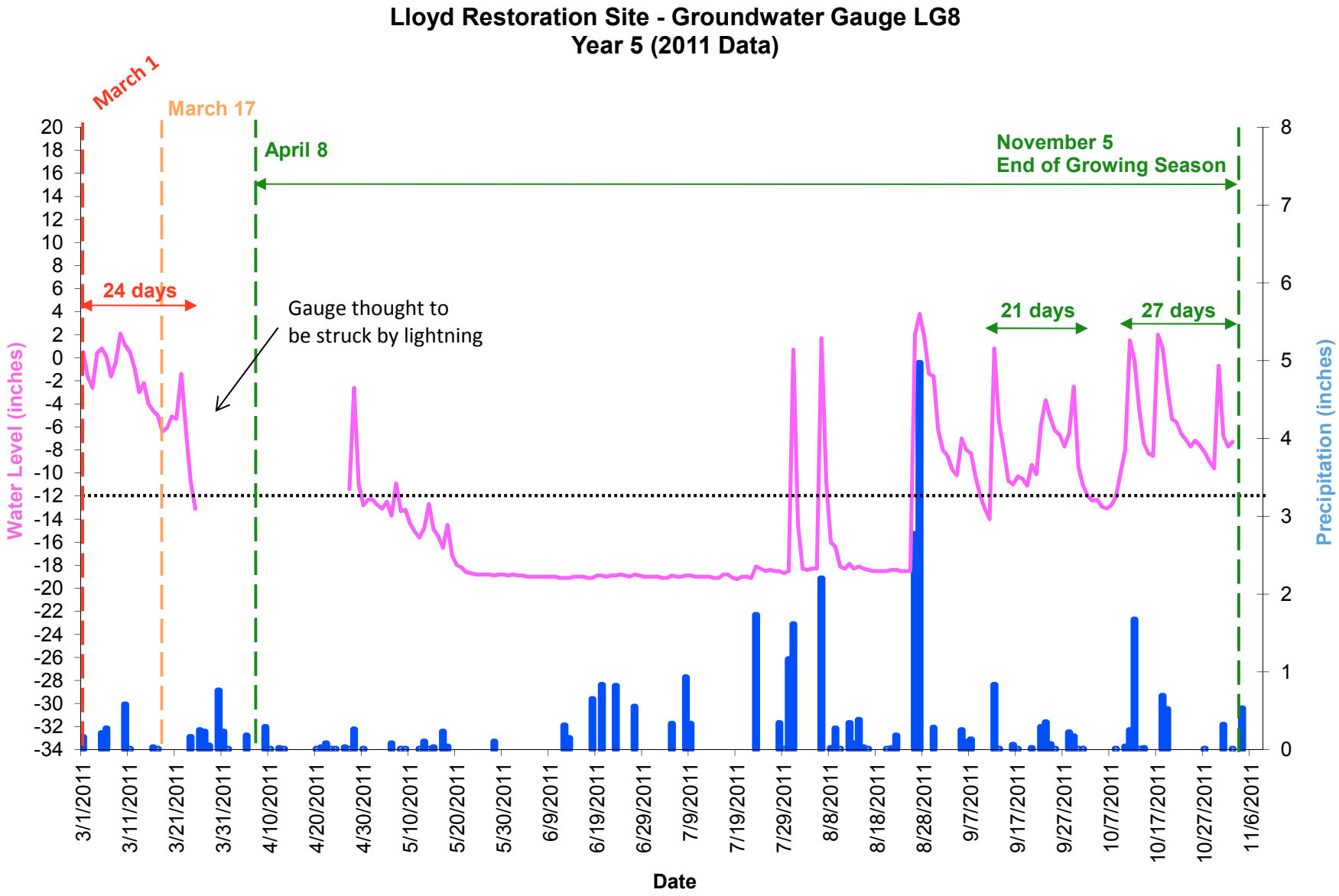

Lloyd Restoration Site - Groundwater Gauge LG3
Year 5 (2011 Data)
March 1
March 17
April 8
November 5
End of Growing Season
16 days
6 days
8 days
Water Level (inches)
Precipitation (inches)
Date
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
8
7
6
5
4
3
2
1
0
3/1/2011
3/11/2011
3/21/2011
3/31/2011
4/10/2011
4/20/2011
4/30/2011
5/10/2011
5/20/2011
5/30/2011
6/9/2011
6/19/2011
6/29/2011
7/9/2011
7/19/2011
7/29/2011
8/8/2011
8/18/2011
8/28/2011
9/7/2011
9/17/2011
9/27/2011
10/7/2011
10/17/2011
10/27/2011
11/6/2011

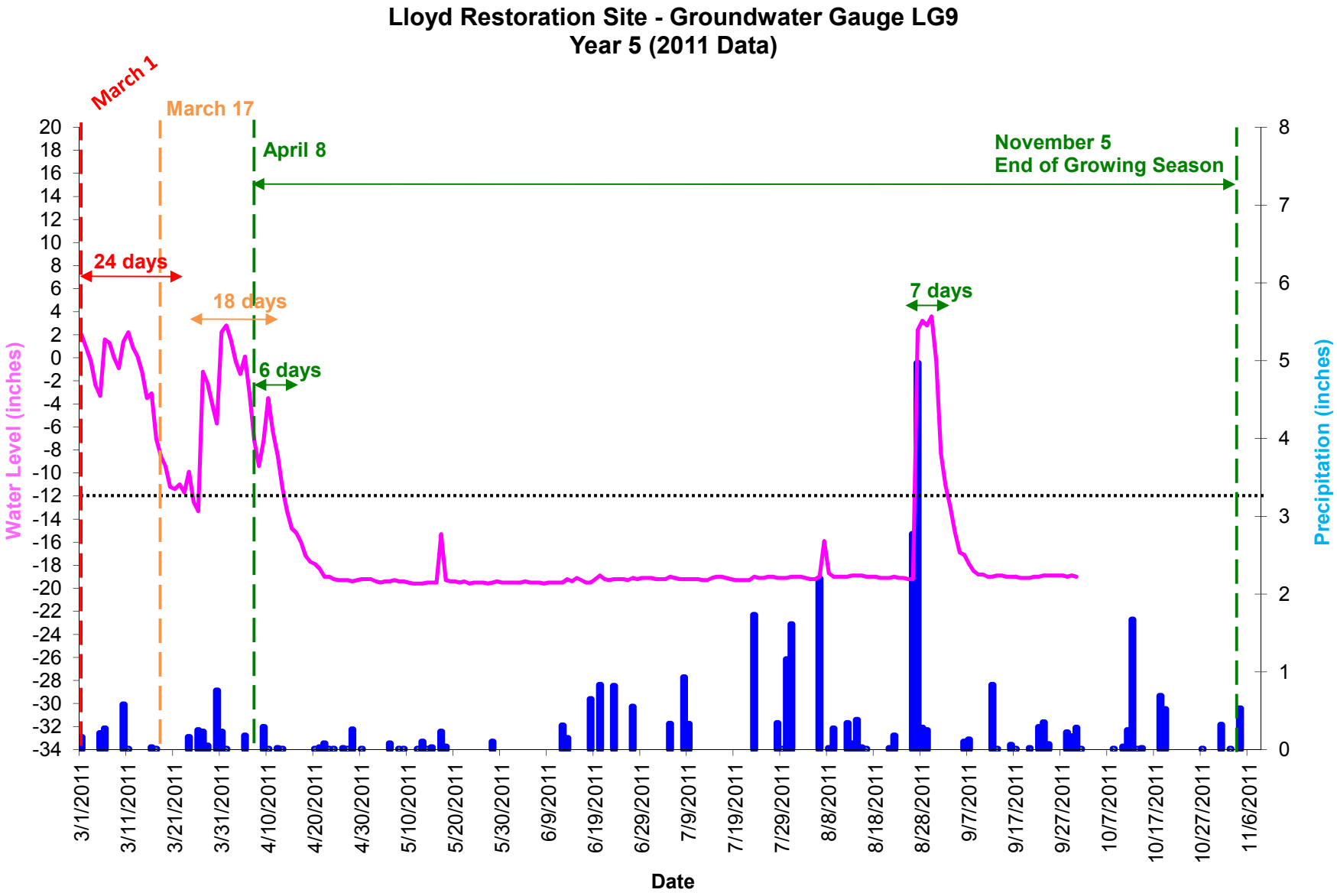

Lloyd Restoration Site - Groundwater Gauge LG4
Year 5 (2011 Data)
March 1
March 17
April 8
November 5
End of Growing Season
14 days
6 days
5 days
Water Level (inches)
Precipitation (inches)
Date
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
8
7
6
5
4
3
2
1
0
3/1/2011
3/11/2011
3/21/2011
3/31/2011
4/10/2011
4/20/2011
4/30/2011
5/10/2011
5/20/2011
5/30/2011
6/9/2011
6/19/2011
6/29/2011
7/9/2011
7/19/2011
7/29/2011
8/8/2011
8/18/2011
8/28/2011
9/7/2011
9/17/2011
9/27/2011
10/7/2011
10/17/2011
10/27/2011
11/6/2011

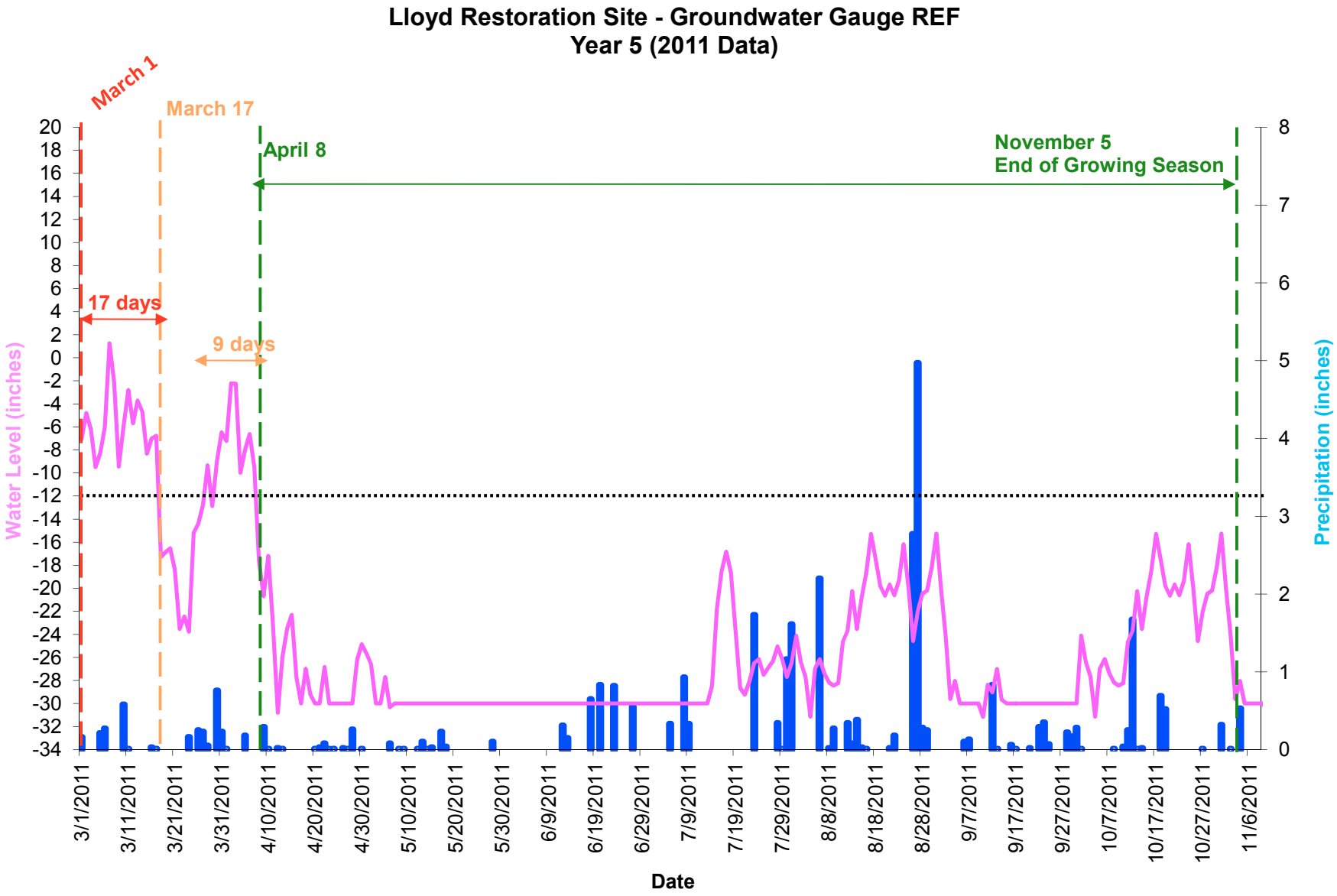

Lloyd Restoration Site - Groundwater Gauge LG5
Year 5 (2011 Data)
March 1
March 17
April 8
November 5
End of Growing Season
48 days
32 days
23 days
10 days
Water Level (inches)
Precipitation (inches)
Date
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
8
7
6
5
4
3
2
1
0
3/1/2011
3/11/2011
3/21/2011
3/31/2011
4/10/2011
4/20/2011
4/30/2011
5/10/2011
5/20/2011
5/30/2011
6/9/2011
6/19/2011
6/29/2011
7/9/2011
7/19/2011
7/29/2011
8/8/2011
8/18/2011
8/28/2011
9/7/2011
9/17/2011
9/27/2011
10/7/2011
10/17/2011
10/27/2011
11/6/2011


Lloyd Restoration Site - Groundwater Gauge LG6
Year 5 (2011 Data)
March 1
March 17
April 8
November 5
End of Growing Season
19 days
13 days
Gauge thought to
be struck by lightning
Water Level (inches)
Precipitation (inches)
Date
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
8
7
6
5
4
3
2
1
0
3/1/2011
3/11/2011
3/21/2011
3/31/2011
4/10/2011
4/20/2011
4/30/2011
5/10/2011
5/20/2011
5/30/2011
6/9/2011
6/19/2011
6/29/2011
7/9/2011
7/19/2011
7/29/2011
8/8/2011
8/18/2011
8/28/2011
9/7/2011
9/17/2011
9/27/2011
10/7/2011
10/17/2011
10/27/2011
11/6/2011


Lloyd Restoration Site - Groundwater Gauge LG7
Year 5 (2011 Data)
March 1
March 17
April 8
November 5
End of Growing Season
Gauge thought to
be struck by lightning.
Base on data this gauge
likely would have remained
69 days
53 days
31 days
24 days
27 days
Water Level (inches)
Precipitation (inches)
Date
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
8
7
6
5
4
3
2
1
0
3/1/2011
3/11/2011
3/21/2011
3/31/2011
4/10/2011
4/20/2011
4/30/2011
5/10/2011
5/20/2011
5/30/2011
6/9/2011
6/19/2011
6/29/2011
7/9/2011
7/19/2011
7/29/2011
8/8/2011
8/18/2011
8/28/2011
9/7/2011
9/17/2011
9/27/2011
10/7/2011
10/17/2011
10/27/2011
11/6/2011


Lloyd Restoration Site - Groundwater Gauge LG8
Year 5 (2011 Data)
March 1
March 17
April 8
November 5
End of Growing Season
24 days
Gauge thought to
be struck by lightning
21 days
27 days
Water Level (inches)
Precipitation (inches)
Date
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
8
7
6
5
4
3
2
1
0
3/1/2011
3/11/2011
3/21/2011
3/31/2011
4/10/2011
4/20/2011
4/30/2011
5/10/2011
5/20/2011
5/30/2011
6/9/2011
6/19/2011
6/29/2011
7/9/2011
7/19/2011
7/29/2011
8/8/2011
8/18/2011
8/28/2011
9/7/2011
9/17/2011
9/27/2011
10/7/2011
10/17/2011
10/27/2011
11/6/2011


Lloyd Restoration Site - Groundwater Gauge LG9
Year 5 (2011 Data)
March 1
March 17
April 8
November 5
End of Growing Season
24 days
18 days
6 days
7 days
Water Level (inches)
Precipitation (inches)
Date
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
8
7
6
5
4
3
2
1
0
3/1/2011
3/11/2011
3/21/2011
3/31/2011
4/10/2011
4/20/2011
4/30/2011
5/10/2011
5/20/2011
5/30/2011
6/9/2011
6/19/2011
6/29/2011
7/9/2011
7/19/2011
7/29/2011
8/8/2011
8/18/2011
8/28/2011
9/7/2011
9/17/2011
9/27/2011
10/7/2011
10/17/2011
10/27/2011
11/6/2011


Lloyd Restoration Site - Groundwater Gauge REF
Year 5 (2011 Data)
March 1
March 17
April 8
November 5
End of Growing Season
17 days
9 days
Water Level (inches)
Precipitation (inches)
Date
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
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-28
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-32
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8
7
6
5
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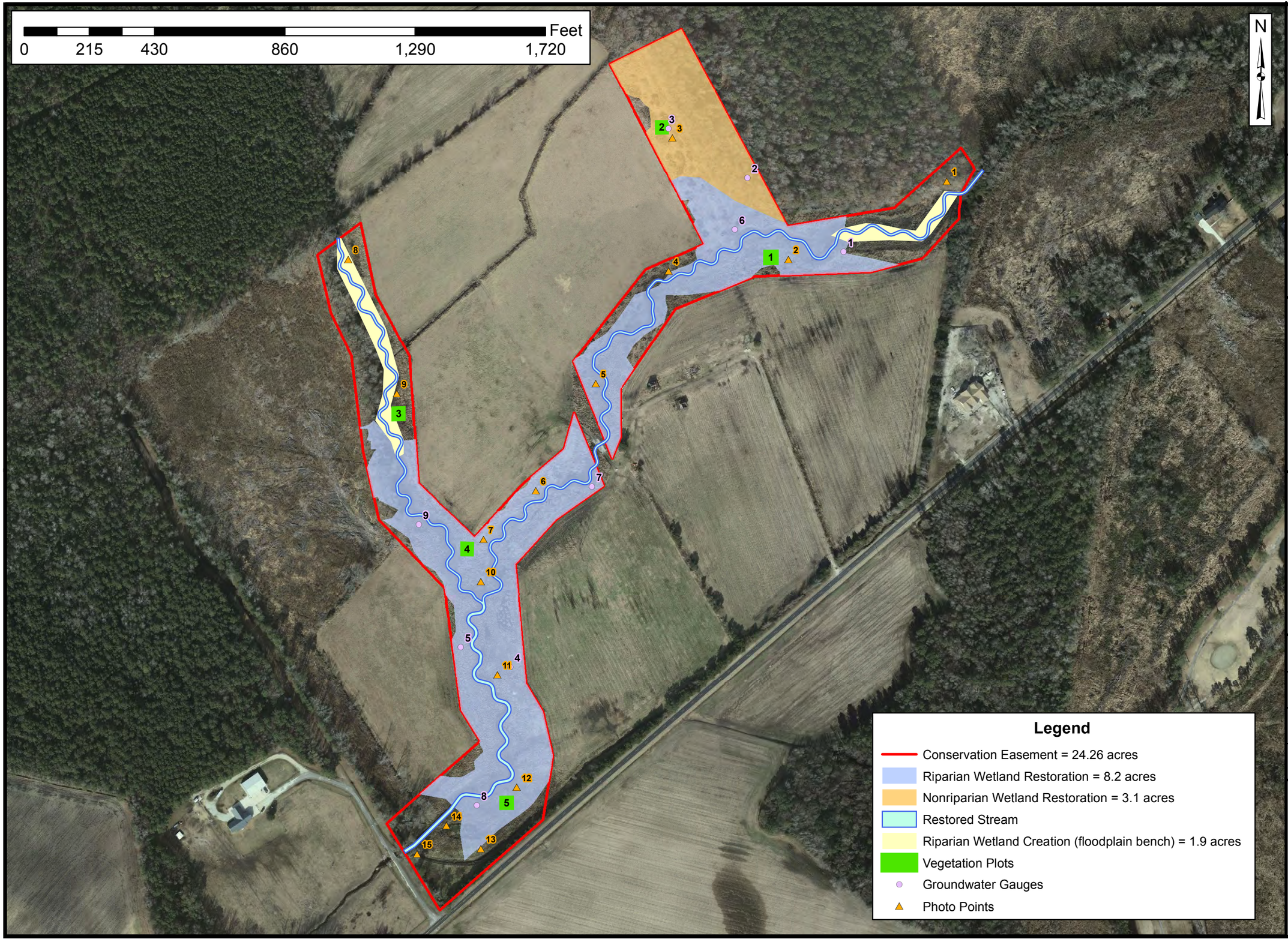
3/21/2011
3/31/2011
4/10/2011
4/20/2011
4/30/2011
5/10/2011
5/20/2011
5/30/2011
6/9/2011
6/19/2011
6/29/2011
7/9/2011
7/19/2011
7/29/2011
8/8/2011
8/18/2011
8/28/2011
9/7/2011
9/17/2011
9/27/2011
10/7/2011
10/17/2011
10/27/2011
11/6/2011

APPENDIX D
MONITORING PLAN VIEW



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

LLOYD STREAM AND WETLAND MITIGATION SITE

Onslow County, NC

Title:

MONITORING PLAN VIEW

Drawn by: CLF

Date: NOV 2011

Scale: 1:3600

Project No.: 10-001

FIGURE

D1