

ANNUAL MONITORING REPORT

YEAR 3 (2009)

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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October 2009

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 3 (2009) 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 late July and early August 2009 for the Year 3 (2009) monitoring season. Based on the number of stems present, the average density of all plots was 688 planted stems per acre surviving in Year 3 (2009). The dominant species identified at the Site were planted stems of sycamore (*Platanus occidentalis*) and sugarberry (*Celtis laevigata*).

Vegetation sampling across the Site was above the required average density with 688 planted stems per acre with individual plot densities ranging from 364 to 891 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 will continue to be monitoring; however, is expected to recover naturally. No other vegetation problem areas were noted during the Year 3 (2009) monitoring season.

Twelve cross-sections and longitudinal profiles within three reaches totaling 3442 linear feet were measured during Year 3 (2009) 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 3 (2009) monitoring year.

Four restoration Site groundwater gauges and one reference groundwater gauge were operated for the Year 3 (2009) monitoring season. One of the 4 groundwater gauges (Gauge 4) should be considered successful for the Year 3 (2009) monitoring period according to success criteria. Two additional gauges (Gauges 1 and 2) were comparable to the reference gauge, but were slightly below success criteria. In addition, Gauge 3 is located along the upland/wetland margin, which may be affecting its success.

In summary, the restoration site achieved success criteria for vegetation and stream attributes in the Third Monitoring Year (2009). Groundwater hydrology was lower than expected, possibly due to overall unusually dry conditions since construction (reference gauge slightly below success criteria), random placement of groundwater gauges along upland/wetland margins or on elevated hummocks within the floodplain.

TABLE OF CONTENTS

| | |
|--|----|
| EXECUTIVE SUMMARY | i |
| 1.0 PROJECT BACKGROUND | 1 |
| 1.1 Location and Setting | 1 |
| 1.2 Project Objectives | 1 |
| 1.3 Project Structure, Restoration Type, and Approach..... | 1 |
| 1.4 Project History and Background | 4 |
| 2.0 PROJECT CONDITION AND MONITORING RESULTS | 5 |
| 2.1 Vegetation Assessment..... | 5 |
| 2.1.1 Vegetation Success Criteria | 5 |
| 2.1.2 Vegetative Problem Areas | 6 |
| 2.2 Stream Assessment | 6 |
| 2.2.1 Stream Success Criteria | 6 |
| 2.2.2 Bankfull Events..... | 7 |
| 2.2.3 Stream Problem Areas | 8 |
| 2.2.4 Categorical Stream Feature Visual Stability Assessment | 8 |
| 2.2.5 Quantitative Stream Measurements..... | 9 |
| 2.3 Wetland Assessment | 9 |
| 2.3.1 Wetland Success Criteria | 9 |
| 2.3.2 Wetland Problem Areas..... | 9 |
| 2.3.3 Wetland Criteria Attainment..... | 14 |
| 3.0 CONCLUSIONS | 15 |
| 4.0 REFERENCES | 16 |

FIGURES

| | |
|-------------------------------|----|
| Figure 1. Site Location | 2 |
| Figure 2. Climatic Data..... | 14 |

TABLES

| | |
|---|-------|
| Table 1. Site Restoration Structures and Objectives | 3 |
| Table 2. Project Activity and Reporting History..... | 4 |
| Table 3. Project Contacts Table | 4 |
| Table 4. Project Background Table | 5 |
| Table 5. Planted Species and Reference Forest Ecosystem | 6 |
| Table 6. Verification of Bankfull Events..... | 7 |
| Table 7A-C. Categorical Stream Feature Visual Stability Assessment..... | 8-9 |
| Table 8. Baseline Morphology and Hydraulic Summary | 10 |
| Table 9A-C. Morphology and Hydraulic Monitoring Summary..... | 11-13 |
| Table 10. Wetland Criteria Attainment for Year 3 (2009)..... | 14 |
| Table 11. Summary of Groundwater Gauge Results | 15 |
| Table 12. Summary of Planted Vegetation Plot Results..... | 15 |

APPENDICES

APPENDIX A. VEGETATION DATA

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

APPENDIX B. GEOMORPHOLOGIC DATA

1. Tables B1-B3. Visual Morphological Stability Assessment
2. Cross-section Plots and Tables
3. Longitudinal Profile Plots
4. Stream Fixed Station Photos
5. Stream Problem Area Photos

APPENDIX C. HYDROLOGY DATA

2009 Groundwater Gauge Data

APPENDIX D. MONITORING PLAN VIEW

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 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.

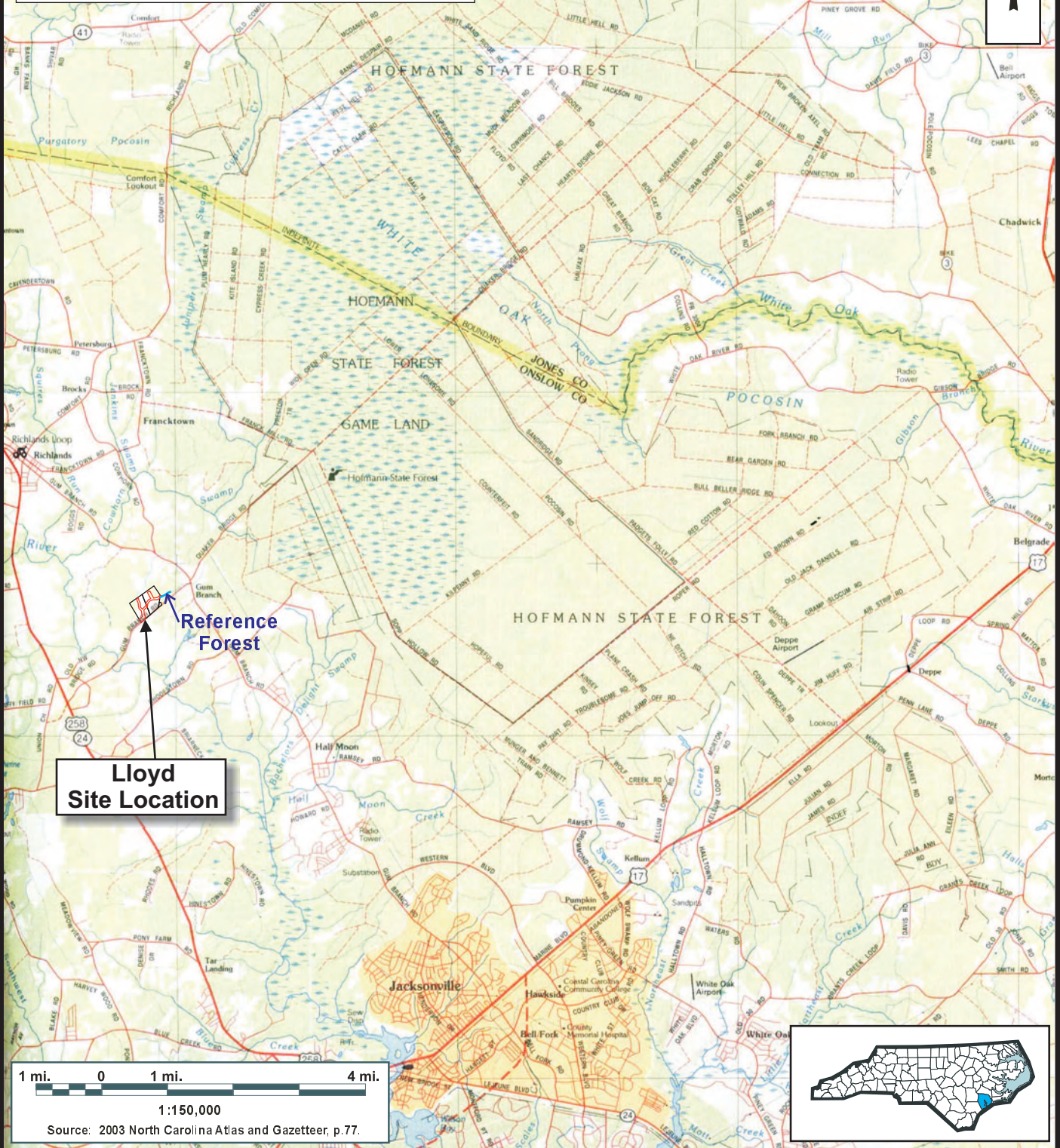
1.3 Project Structure, Restoration Type, and Approach

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:

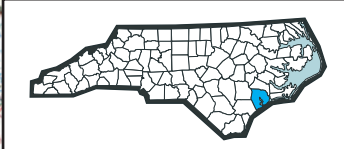
Directions to the Site from Richlands, North Carolina:
 -> Take Highway 24 east for ~ 4 miles
 -> Turn left on Northwest Bridge Road (denoted as Gum Branch Road in some gazateers)
 -> Travel approximately 2 miles; the Site is on the left



Lloyd Site Location

Reference Forest

1 mi. 0 1 mi. 4 mi.
 1:150,000
 Source: 2003 North Carolina Atlas and Gazetteer, p.77.



2126 Rowland Pond Drive
 Willow Spring, NC 27592
 (919) 215-1693
 (919) 341-3839 fax

Adam Environmental, Inc.

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

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

FIGURE
1

- 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 |

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 (919) 523-4375 |
| Designer and Year 2-3 (2008-2009) Monitoring Performer | Axiom Environmental, Inc. 2126 Rowland Pond Dr. Willow Spring, NC 27592 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 3 (2009).

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

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 688 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 will continue to be monitored; however, 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 3 (2009) 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

Three bankfull events were documented during the Year 3 (2009) monitoring period for a total of eleven 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 | 314471 - Jacksonville |
| -- | 6/30/07 | 1.39 | 314471 - Jacksonville |
| -- | 7/21/07 | 2.05 | 314471 - Jacksonville |
| -- | 8/12/07 | 1.52 | 314471 - Jacksonville |
| -- | 8/22/07 | 1.26 | 314471 - Jacksonville |
| -- | 9/20/07 | 1.54 | 314144 – Hoffman Forest |
| -- | 9/21/07 | 1.54 | 314144 – Hoffman Forest |
| March 2009 | February 28-March 2, 2009 | 2.28 | Documented between February 28-March 2, 2009 at a nearby rain gauge at Jarmans Oak Restoration Site |
| April 2009 | April 14, 2009 | 3.01 | Documented on April 14, 2009 at a nearby rain gauge Jarmans Oak Restoration Site |
| April 2009 | May 16-18, 2009 | 3.05 | Documented between May 16-18, 2009 at a nearby rain gauge Jarmans Oak Restoration Site |

2.2.3 Stream Problem Areas

No stream problem areas were noted within the Site during the Year 3 (2009) monitoring year.

2.2.4 Categorical Stream Feature Visual Stability Assessment

Each stream reach was visually inspected during the Year 3 (2009) 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 assessments 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% | | |
| B. Pools | 100% | 90% | 100% | 100% | | |
| C. Thalweg | 100% | 100% | 100% | 100% | | |
| D. Meanders | 100% | 100% | 100% | 100% | | |
| E. Bed General | 100% | 100% | 100% | 100% | | |
| F. Banks | 100% | 100% | 100% | 100% | | |
| G. Vanes / J. Hooks, Etc. | 100% | 100% | 100% | 100% | | |
| H. Wads and Boulders | 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% | | |
| B. Pools | 100% | 100% | 99% | 99% | | |
| C. Thalweg | 100% | 100% | 100% | 100% | | |
| D. Meanders | 100% | 100% | 100% | 100% | | |
| E. Bed General | 100% | 95% | 100% | 100% | | |
| F. Banks | 100% | 100% | 100% | 100% | | |
| G. Vanes / J. Hooks, Etc. | 100% | 100% | 100% | 100% | | |
| H. Wads and Boulders | 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% | | |
| B. Pools | 100% | 90% | 98% | 100% | | |
| C. Thalweg | 100% | 100% | 100% | 100% | | |
| D. Meanders | 100% | 100% | 100% | 100% | | |
| E. Bed General | 100% | 100% | 100% | 100% | | |
| F. Banks | 100% | 90% | 100% | 100% | | |
| G. Vanes / J. Hooks, Etc. | 100% | 100% | 88% | 88% | | |
| H. Wads and Boulders | NA | NA | NA | NA | | |

2.2.5 Quantitative Stream Measurements

During the Year 3 (2009) 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 3 (2009) 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

Four groundwater monitoring gauges and one reference groundwater gauge were maintained and monitored throughout the Year 3 (2009) growing season. Graphs of groundwater hydrology and precipitation from a nearby rain station in Kenansville (Weather Underground 2009) 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 3 (2009) monitoring.

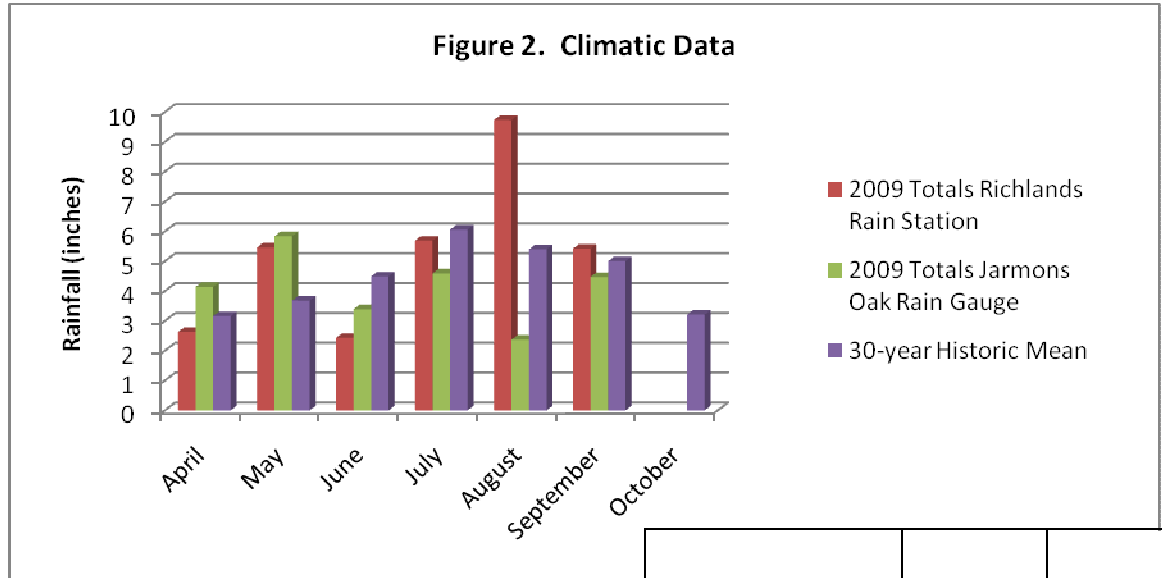
**Table 8. Baseline Morphology and Hydraulic Summary
Entire Project - 5858 If**

| Parameter | USGS Gage Data | | | Preproject Eastern Tributary | | | Preproject Main Tributary | | | Project Reference Stream | | | Design | | | As-Built | | |
|--|----------------|-----|-----|--|--------|--|---------------------------|--|-----|--------------------------|-------|--------|--------|---------|--------|----------|-----|-----|
| | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Dimension | | | | | | | | | | | | | | | | | | |
| BF Width (ft) | | | | 4.6 | 7.2 | 6.5 | 6.3 | 8.4 | 7.1 | 9.3 | 9.3 | 7.7 | 11 | 9.4 | 7.9 | 7.9 | 7.9 | 8.9 |
| Floodprone Width (ft) | | | | 7.8 | 10.2 | 9 | 8.7 | 10.8 | 9.3 | 225 | 250 | 150 | 250 | 225 | N/A | N/A | N/A | N/A |
| BF Cross Sectional Area (ft ²) | | | | 6.1 | 6.2 | 6.1 | 6.7 | 7.2 | 6.9 | 11.6 | N/A | 6.1 | 12.1 | N/A | N/A | N/A | N/A | N/A |
| BF Mean Depth (ft) | | | | 0.8 | 1.3 | 1 | 0.8 | 1.1 | 1 | 1.2 | N/A | 0.8 | 1.2 | 1 | N/A | N/A | N/A | N/A |
| BF Max Depth (ft) | | | | 1.2 | 1.7 | 1.4 | 0.9 | 1.3 | 1.3 | 2.3 | N/A | 1 | 2.3 | 1.6 | 1.2 | 1.6 | 1.6 | 1.3 |
| Width/Depth Ratio | | | | 3.5 | 8.6 | 6.5 | 5.9 | 10.5 | 7 | 7.4 | N/A | 7 | 12 | 10 | N/A | N/A | N/A | N/A |
| Entrenchment Ratio | | | | 1.3 | 1.8 | 1.5 | 1.1 | 1.5 | 1.4 | 16.1 | 26.9 | 16 | 27 | 24 | N/A | 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 | 1.3 | 1 | N/A | 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 Belwidth (ft) | | | | No distinctive pattern due to channel straightening activities | | No distinctive pattern due to channel straightening activities | | No distinctive pattern due to channel straightening activities | | 21 | 36 | 34 | 15 | 77 | 31 | N/A | N/A | N/A |
| Radius of Curvature (ft) | | | | | | | | | | 13.7 | 18.6 | 16.1 | 15 | 44 | 21 | 18 | 53 | 23 |
| Meander Wavelength (ft) | | | | | | | | | | 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 | | | | | | | | | | | | | | | | | | |
| Rifle Length (ft) | | | | No distinctive repetitive pattern of riffles and pools due to channel straightening activities | | No distinctive repetitive pattern of riffles and pools due to channel straightening activities | | No distinctive repetitive pattern of riffles and pools due to channel straightening activities | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Rifle Slope (ft/ft) | | | | | | | | | | 0.007 | 0.016 | 0.0129 | 0.0007 | 0.0064 | 0.0033 | N/A | N/A | N/A |
| Pool Length (ft) | | | | | | | | | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Pool Spacing (ft) | | | | | | | | | | 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 |
| Additional Reach Parameters | | | | | | | | | | | | | | | | | | |
| Valley Length (ft) | | | | | N/A | | | N/A | | N/A | N/A | | | N/A | | | N/A | N/A |
| Channel Length (ft) | | | | | N/A | | | N/A | | N/A | N/A | | | 5.858 | | | N/A | N/A |
| Sinuosity | | | | | 1.02 | | | 1.02 | | 1.37 | | | | 1.3-1.4 | | | N/A | N/A |
| Water Surface Slope (ft/ft) | | | | | 0.0043 | | | 0.0032 | | 0.004 | | | | 0.0025 | | | N/A | N/A |
| BF Slope (ft/ft) | | | | | N/A | | | N/A | | N/A | | | | 0.0025 | | | N/A | N/A |
| Rosgen Classification | | | | | G5/6 | | | G5/6 | | E6 | | | | E5/6 | | | N/A | N/A |

N/A = Not Available

2.3.3 Wetland Criteria Attainment

One of the monitored gauges (Gauge 4) within the riverine wetland restoration areas was inundated/saturated within 12 inches of the surface for greater than 8 percent of the growing season, which extends from April 8 to November 5 (212 days) (Table 10). Two additional gauges (Gauges 1 and 2) were comparable to the reference gauge, but were slightly below success criteria. In addition, Gauge 3 is located along the upland/wetland margin, which may be affecting its success. Hydrographs containing groundwater and precipitation data for each gauge can be found in Appendix B.



| Month | 2009 Totals Richlands | 2009 Totals Jarmans | 30-year Historic Mean |
|--------------|-----------------------|---------------------|-----------------------|
| April | 2.63 | 4.14 | 3.16 |
| May | 5.46 | 5.84 | 3.68 |
| June | 2.43 | 3.39 | 4.49 |
| July | 5.69 | 4.59 | 6.06 |
| August | 9.73 | 2.37 | 5.40 |
| September | 5.42 | 4.47 | 5.00 |
| Total | 31.36 | 24.80 | 27.79 |

Table 10. Wetland Criteria Attainment for Year 3 (2009)

| Gauge ID | Hydrology Threshold Met? | Hydrophytic Vegetation Criteria Met? | Site Mean | Vegetation Plot ID | Vegetation Survival Threshold Met? | Site Mean |
|----------|--------------------------|--------------------------------------|-----------|--------------------|------------------------------------|-----------|
| 1 | No | Yes | 25 % | 1 | Yes | 100 % |
| 2 | No | Yes | | 2 | Yes | |
| 3 | No | Yes | | 3 | Yes | |
| 4 | Yes | Yes | | 4 | Yes | |
| | | | 5 | Yes | | |

3.0 CONCLUSIONS

One of the 4 groundwater gauges (Gauge 4) within the Site should be considered successful for the Year 3 (2009) monitoring period. Two additional gauges (Gauges 1 and 2) were comparable to the reference gauge, but were slightly below success criteria. In addition, Gauge 3 is located along the upland/wetland margin, which may be affecting its success. A summary of groundwater gauge data is included in Table 11. All vegetation plots across the Site were above the required 320 stems per acre with an average of 688 tree stems per acre in the Third Monitoring Year (Year 2009) (Table 12).

Table 11. Summary of Groundwater Gauge Results

| Gauge | Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage) | | | | |
|------------------|--|-------------------------------|-------------------------------|---------------|---------------|
| | Year 1 (2007)* | Year 2 (2008)** | Year 3 (2009) | Year 4 (2010) | Year 5 (2011) |
| 1 Riverine | Yes/7 days (3.3 percent) | Yes/12 days (5.7 percent) | No/14 days (6.6 percent) | | |
| 2 Nonriverine | Yes/15 days (7.1 percent) | Yes/10 days (4.7 percent) | No/9 days (4.3 percent) | | |
| 3 Nonriverine | No/2 days (0.9 percent) | Yes/8 days (3.8 percent) | No/3 days (1.4 percent) | | |
| 4 Riverine | Yes/18 days (8.4 percent) | Yes/75 days (35.4 percent) | Yes/64 days (30.2 percent) | | |
| Reference | Yes/8 days (3.8 percent) | Yes/9 days (4.3 percent) | No/8 days (3.8 percent) | | |

*Annual precipitation to date of this data for the Year 1 (2007) monitoring period was 46.7 inches, 10 inches below the average of 56.4 according to a nearby station (SCONC 2007); therefore, success criteria are based on the reference gauge.

**Annual precipitation to date of this data for the Years 2 (2008) monitoring period was inconclusive at nearby rain stations; therefore, success criteria are based on comparisons to reference gauge data.

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 | | |
| 2 | 728 | 809 | 769 | | |
| 3 | 809 | 769 | 891 | | |
| 4 | 445 | 445 | 810 | | |
| 5 | 364 | 364 | 364 | | |
| Average of All Plots (1-5) | 615 | 599 | 688 | | |

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 8/6/2009 9:16

database name RestorationSystems-2009-A-v2.2.7.mdb
database location C:\Axiom\Business\CVSdatabase
computer name CORRILAPTOP
file size 42713088

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.
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.
Proj, total 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.
A matrix of the count of totalling 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 3 |
|--------------|------------------------|-------------|--------|
| Lloyd | Lloyd Restoration Site | White Oak | 687.97 |

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

| Project Code | Project Name | River Basin | Year 3 |
|--------------|------------------------|-------------|-------------|
| Lloyd | Lloyd Restoration Site | White Oak | 1108.838662 |

| 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 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 | 3 | 34° 51.949' | 77° 30.441' | NAD83/WGS84 | 8/3/2009 | 15 | 15 | 6 | 21 | 21 | 60 | 243 | 850 | 850 | 3 |
| LV2 | 2 | 3 | 34° 52.036' | 77° 30.531' | NAD83/WGS84 | 7/24/2009 | 19 | 19 | 1 | 31 | 31 | 76 | 486 | 1255 | 1255 | 3 |
| LV3 | 2 | 3 | 34° 51.877' | 77° 30.697' | NAD83/WGS84 | 7/24/2009 | 22 | 22 | 2 | 51 | 51 | 89 | 1174 | 2064 | 2064 | 5 |
| LV4 | 2 | 3 | 34° 51.794' | 77° 38.651' | NAD83/WGS84 | 7/24/2009 | 20 | 20 | 0 | 20 | 20 | 80 | 0 | 809 | 809 | 4 |
| LV5 | 2 | 3 | 34° 51.658' | 77° 30.621' | NAD83/WGS84 | 7/24/2009 | 9 | 9 | 5 | 14 | 14 | 36 | 202 | 567 | 567 | 4 |

| Vigor | vigor | Count | Percent |
|---------|-------|-------|---------|
| 2 | | 12 | 11 |
| 3 | | 33 | 30.3 |
| 4 | | 40 | 36.7 |
| Missing | | 24 | 22 |

| Damage | Count | Percent Of Stems |
|-------------|-------|------------------|
| (no damage) | 86 | 78.9 |
| Deer | 20 | 18.3 |
| Insects | 2 | 1.8 |
| Unknown | 1 | 0.9 |

Vigor by Species

| Species | CommonName | 4 | 3 | 2 | 1 | 0 | Missing |
|----------------------------------|-------------------|-----------|-----------|-----------|---|---|-----------|
| <i>Betula nigra</i> | river birch | 5 | 1 | | | | 1 |
| <i>Celtis laevigata</i> | sugarberry | 1 | 6 | 4 | | | 6 |
| <i>Cephalanthus occidentalis</i> | common buttonbush | 5 | 1 | | | | |
| <i>Cornus amomum</i> | silky dogwood | | | | | | 2 |
| <i>Fraxinus pennsylvanica</i> | green ash | 4 | 4 | 1 | | | 2 |
| <i>Nyssa aquatica</i> | water tupelo | | 3 | 4 | | | |
| <i>Nyssa sylvatica</i> | blackgum | | | | | | 5 |
| <i>Quercus nigra</i> | water oak | 2 | 3 | | | | |
| <i>Quercus pagoda</i> | cherrybark oak | | 1 | | | | |
| <i>Quercus phellos</i> | willow oak | 3 | | | | | 4 |
| <i>Salix nigra</i> | black willow | 5 | | | | | |
| <i>Carya</i> | hickory | 5 | 4 | | | | |
| <i>Platanus occidentalis</i> | American sycamore | 10 | 1 | | | | |
| <i>Ulmus</i> | elm | | 7 | | | | |
| <i>Ulmus americana</i> | American elm | | 2 | 3 | | | 1 |
| <i>Unknown</i> | | | | | | | 3 |
| Total: 16 | | 40 | 33 | 12 | | | 24 |

Damage by Plot

| plot | All Damage Categories | (no damage) | Deer | Insects | Unknown |
|--------------|-----------------------|-------------|-----------|----------|----------|
| LV1 | 11 | 7 | 11 | | |
| LV2 | 2 | 21 | | 1 | 1 |
| LV3 | 1 | 27 | 1 | | |
| LV4 | 6 | 18 | 6 | | |
| LV5 | 3 | 13 | 2 | 1 | |
| Total | 23 | 86 | 20 | 2 | 1 |

Damage by Species

| Species | CommonName | Count of Damage Categories | (no damage) | Deer | Insects | Unknown |
|----------------------------------|-------------------|----------------------------|-------------|-----------|----------|----------|
| <i>Betula nigra</i> | river birch | 0 | 7 | | | |
| <i>Carya</i> | hickory | 0 | 9 | | | |
| <i>Celtis laevigata</i> | sugarberry | 4 | 13 | 4 | | |
| <i>Cephalanthus occidentalis</i> | common buttonbush | 1 | 5 | 1 | | |
| <i>Cornus amomum</i> | silky dogwood | 0 | 2 | | | |
| <i>Fraxinus pennsylvanica</i> | green ash | 1 | 10 | | | 1 |
| <i>Nyssa aquatica</i> | water tupelo | 4 | 3 | 4 | | |
| <i>Nyssa sylvatica</i> | blackgum | 0 | 5 | | | |
| <i>Platanus occidentalis</i> | American sycamore | 1 | 10 | | 1 | |
| <i>Quercus nigra</i> | water oak | 2 | 3 | 2 | | |
| <i>Quercus pagoda</i> | cherrybark oak | 1 | | | 1 | |
| <i>Quercus phellos</i> | willow oak | 0 | 7 | | | |
| <i>Salix nigra</i> | black willow | 0 | 5 | | | |
| <i>Ulmus</i> | elm | 4 | 3 | 4 | | |
| <i>Ulmus americana</i> | American elm | 5 | 1 | 5 | | |
| <i>Unknown</i> | | 0 | 3 | | | |
| Total: 16 | 15 | 23 | 86 | 20 | 2 | 1 |

Planted Stems by Plot and Species

| Comment | 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 | 9 | 1 | 9 | | 9 | | | |
| | Celtis laevigata | sugarberry | 11 | 3 | 3.67 | 6 | | 2 | | 3 |
| | Cephalanthus occidentalis | common buttonbush | 6 | 1 | 6 | | | | 6 | |
| | Fraxinus pennsylvanica | green ash | 9 | 1 | 9 | | 9 | | | |
| | Nyssa aquatica | water tupelo | 7 | 2 | 3.5 | 4 | | | 3 | |
| | Platanus occidentalis | American sycamore | 11 | 2 | 5.5 | | | 8 | | 3 |
| | Quercus nigra | water oak | 5 | 2 | 2.5 | | | | 4 | 1 |
| | Quercus pagoda | cherrybark oak | 1 | 1 | 1 | | 1 | | | |
| | Quercus phellos | willow oak | 3 | 1 | 3 | | | 3 | | |
| | Salix nigra | black willow | 5 | 1 | 5 | | | 5 | | |
| | Ulmus | elm | 7 | 1 | 7 | | | | 7 | |
| | Ulmus americana | American elm | 5 | 1 | 5 | 5 | | | | |
| TOT: 0 | 13 | 13 | 85 | 13 | | 15 | 19 | 22 | 20 | 9 |

All Stems by Plot and Species

| Comment | 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 | 3 | 2 | 1.5 | | 2 | 1 | | |
| | Alnus serrulata | hazel alder | 1 | 1 | 1 | | | 1 | | |
| | Baccharis halimifolia | eastern baccharis | 6 | 3 | 2 | 1 | 1 | | | 4 |
| | Betula nigra | river birch | 6 | 2 | 3 | | | 4 | | 2 |
| | Carya | hickory | 10 | 2 | 5 | 1 | 9 | | | |
| | Celtis laevigata | sugarberry | 11 | 3 | 3.67 | 6 | | 2 | | 3 |
| | Cephalanthus occidentalis | common buttonbush | 6 | 1 | 6 | | | | 6 | |
| | Fraxinus pennsylvanica | green ash | 9 | 1 | 9 | | 9 | | | |
| | Liquidambar styraciflua | sweetgum | 6 | 3 | 2 | 2 | 3 | 1 | | |
| | Nyssa | tupelo | 1 | 1 | 1 | | 1 | | | |
| | Nyssa aquatica | water tupelo | 7 | 2 | 3.5 | 4 | | | 3 | |
| | Pinus | pine | 4 | 1 | 4 | | 4 | | | |
| | Pinus taeda | loblolly pine | 4 | 2 | 2 | 2 | | 2 | | |
| | Platanus occidentalis | American sycamore | 31 | 2 | 15.5 | | | 27 | | 4 |
| | Quercus nigra | water oak | 5 | 2 | 2.5 | | | | 4 | 1 |
| | Quercus pagoda | cherrybark oak | 2 | 1 | 2 | | 2 | | | |
| | Quercus phellos | willow oak | 3 | 1 | 3 | | | 3 | | |
| | Salix nigra | black willow | 9 | 1 | 9 | | | 9 | | |
| | Ulmus | elm | 8 | 2 | 4 | | | 1 | 7 | |
| | Ulmus americana | American elm | 5 | 1 | 5 | 5 | | | | |
| TOT: 0 | 20 | 20 | 137 | 20 | | 21 | 31 | 51 | 20 | 14 |

Lloyd Stream and Wetland Restoration Site
Year 3 (2009) Annual Monitoring
Vegetation Plot Photos
Taken July and August 2009



**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**

**Table B1. Visual Morphological Stability Assessment
Lloyd Reach 1**

| Feature Category | Metric (per As-built and reference baselines) | (# Stable Number Performing as Intended) | Total number | Number / feet in unstable state | % Perform in Stable Condition | Feature Perform. Mean or Total |
|---------------------------|--|--|--------------|---------------------------------|-------------------------------|--------------------------------|
| A. Riffles | 1. Present | 21 | 21 | NA | 100% | |
| | 2. Armor stable (e.g. no displacement)? | 21 | 21 | NA | 100% | |
| | 3. Facet grade appears stable? | 21 | 21 | NA | 100% | |
| | 4. Minimal evidence of embedding / fining? | 21 | 21 | NA | 100% | |
| | 5. Length appropriate? | 20 | 21 | NA | 95% | 99% |
| B. Pools | 1. Present? (e.g. not subject to severe aggrad. Or migrat.?) | 21 | 21 | NA | 100% | |
| | 2. Sufficiently deep (Max Pool D:Mean Bkt > 1.6:?) | 21 | 21 | NA | 100% | |
| | 3. Length appropriate? | 21 | 21 | NA | 100% | 100% |
| C. Thalweg | 1. Upstream of meander bend (run/inflection) centering? | 21 | 21 | NA | 100% | |
| | 2. Downstream of meander (glide/inflection) centering? | 21 | 21 | NA | 100% | 100% |
| | 1. Outer bend in state of limited/controlled erosion? | 21 | 21 | NA | 100% | |
| D. Meanders | 2. Of those eroding, # w/concomitant point bar formation? | NA | NA | 0 | 100% | |
| | 3. Apparent Rc within spec? | 21 | 21 | NA | 100% | |
| | 4. Sufficient floodplain access and relief? | 21 | 21 | NA | 100% | 100% |
| | 1. General channel bed aggradation areas (bar formation) | NA | NA | 0 | 100% | |
| E. Bed General | 2. Channel bed degradation – areas of increasing down-cutting or head cutting? | NA | NA | 0 | 100% | 100% |
| | 1. Actively eroding, wasting, or slumping bank | NA | NA | 0 | 100% | 100% |
| F. Bank | 1. Free of back or arm scour? | NA | NA | NA | NA | |
| | 2. Height appropriate? | NA | NA | NA | NA | |
| G. Vanes | 3. Angle and geometry appear appropriate? | NA | NA | NA | NA | |
| | 4. Free of piping or other structural failures? | NA | NA | NA | NA | NA |
| | 1. Free of scour? | NA | NA | NA | NA | |
| | 2. Footing stable? | NA | NA | NA | NA | NA |
| H. Wads / Boulders | | | | | | |
| | | | | | | |

**Table B2. Visual Morphological Stability Assessment
Lloyd Reach 2**

| Feature Category | Metric (per As-built and reference baselines) | (# Stable Number Performing as Intended) | Total number | Number / feet in unstable state | % Perform in Stable Condition | Feature Perform. Mean or Total |
|---------------------------|--|--|--------------|---------------------------------|-------------------------------|--------------------------------|
| A. Riffles | 1. Present | 26 | 26 | NA | 100% | |
| | 2. Armor stable (e.g. no displacement)? | 26 | 26 | NA | 100% | |
| | 3. Facet grade appears stable? | 26 | 26 | NA | 100% | |
| | 4. Minimal evidence of embedding / fining? | 26 | 26 | NA | 100% | |
| | 5. Length appropriate? | 26 | 26 | NA | 100% | 100% |
| B. Pools | 1. Present? (e.g. not subject to severe aggrad. Or migrat.?) | 26 | 26 | NA | 100% | |
| | 2. Sufficiently deep (Max Pool D:Mean Bkt> 1.6:?) | 25 | 26 | NA | 96% | |
| | 3. Length appropriate? | 26 | 26 | NA | 100% | 99% |
| C. Thalweg | 1. Upstream of meander bend (run/inflexion) centering? | 26 | 26 | NA | 100% | |
| | 2. Downstream of meander (glide/inflexion) centering? | 26 | 26 | NA | 100% | |
| | 1. Outer bend in state of limited/controlled erosion? | 26 | 26 | NA | 100% | |
| D. Meanders | 2. Of those eroding, # w/concomitant point bar formation? | NA | NA | 0 | 100% | |
| | 3. Apparent Rc within spec? | 26 | 26 | NA | 100% | |
| | 4. Sufficient floodplain access and relief? | 26 | 26 | NA | 100% | 100% |
| | 1. General channel bed aggradation areas (bar formation) | NA | NA | 0 | 100% | |
| E. Bed General | 2. Channel bed degradation – areas of increasing down-cutting or head cutting? | NA | NA | 0 | 100% | 100% |
| | 1. Actively eroding, wasting, or slumping bank | NA | NA | 0 | 100% | 100% |
| F. Bank | 1. Free of back or arm scour? | 1 | 1 | NA | 100% | |
| | 2. Height appropriate? | 1 | 1 | NA | 100% | |
| | 3. Angle and geometry appear appropriate? | 1 | 1 | NA | 100% | |
| | 4. Free of piping or other structural failures? | 1 | 1 | NA | 100% | 100% |
| H. Wads / Boulders | 1. Free of scour? | NA | NA | NA | NA | |
| | 2. Footing stable? | NA | NA | NA | NA | NA |

**Table B3. Visual Morphological Stability Assessment
Lloyd Reach 3**

| Feature Category | Metric (per As-built and reference baselines) | (# Stable Number Performing as Intended) | Total number | Number / feet in unstable state | % Perform in Stable Condition | Feature Perform. Mean or Total |
|---------------------------|---|--|--------------|---------------------------------|-------------------------------|--------------------------------|
| A. Riffles | 1. Present | 18 | 18 | NA | 100% | |
| | 2. Armor stable (e.g. no displacement)? | 18 | 18 | NA | 100% | |
| | 3. Facet grade appears stable? | 18 | 18 | NA | 100% | |
| | 4. Minimal evidence of embedding / fining? | 18 | 18 | NA | 100% | |
| | 5. Length appropriate? | 18 | 18 | NA | 100% | 100% |
| B. Pools | 1. Present? (e.g. not subject to severe aggrad. Or migrat.?) | 18 | 18 | NA | 100% | |
| | 2. Sufficiently deep (Max Pool D:Mean Bkt> 1.6:?) | 18 | 18 | NA | 100% | |
| | 3. Length appropriate? | 18 | 18 | NA | 100% | 100% |
| C. Thalweg | 1. Upstream of meander bend (run/inflection) centering? | 18 | 18 | NA | 100% | |
| | 2. Downstream of meander (glide/inflection) centering? | 18 | 18 | NA | 100% | 100% |
| | 1. Outer bend in state of limited/controlled erosion? 2. Of those eroding, # w/concomitant point bar formation? 3. Apparent Rc within spec? | NA | NA | 0 | 100% | |
| D. Meanders | 4. Sufficient floodplain access and relief? | 18 | 18 | NA | 100% | |
| | 1. General channel bed aggradation areas (bar formation) | NA | NA | 0 | 100% | |
| | 2. Channel bed degradation – areas of increasing down-cutting or head cutting? | NA | NA | 0 | 100% | 100% |
| | 1. Actively eroding, wasting, or slumping bank 1. Free of back or arm scour? 2. Height appropriate? 3. Angle and geometry appear appropriate? 4. Free of piping or other structural failures? | NA | NA | 0 | 100% | 100% |
| F. Bank | 1. Actively eroding, wasting, or slumping bank | 1 | 2 | NA | 50% | |
| | 2. Free of piping or other structural failures? | 2 | 2 | NA | 100% | |
| G. Vanes | 1. Free of scour? | 2 | 2 | NA | 100% | |
| | 2. Footing stable? | NA | NA | NA | NA | 88% |
| H. Wads / Boulders | 1. Free of scour? | NA | NA | NA | NA | |
| | 2. Footing stable? | NA | NA | NA | NA | NA |

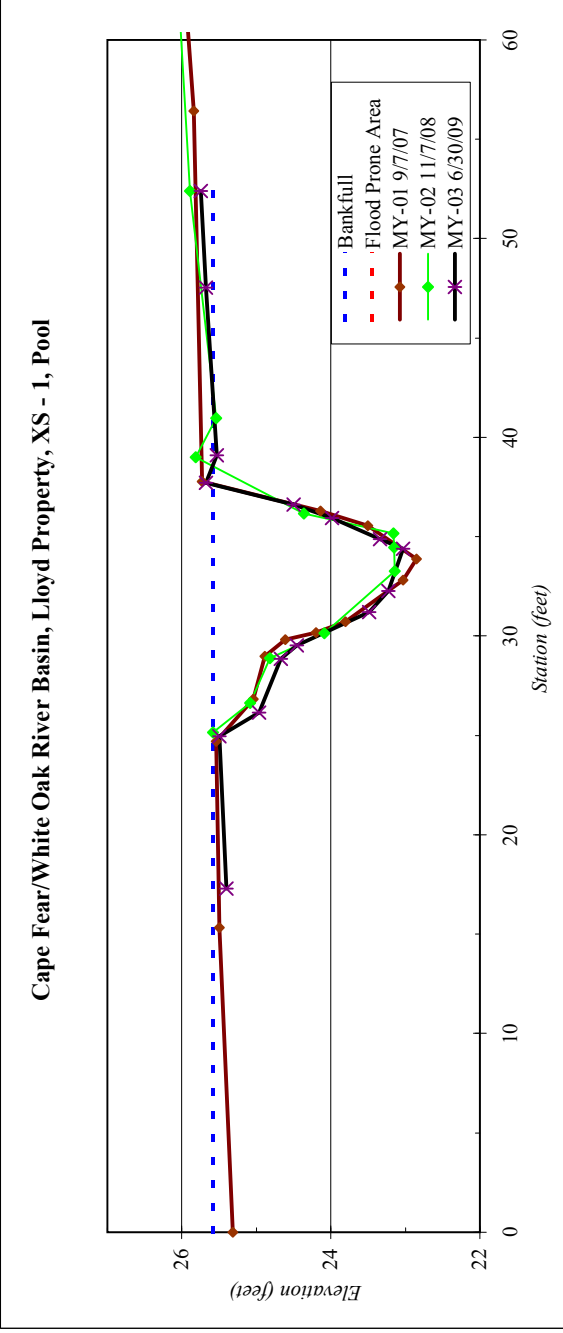
| | |
|-------------------------------|---------------------|
| River Basin: | Cape Fear/White Oak |
| Watershed: | Lloyd Property |
| XS ID | XS - 1, Pool |
| Drainage Area (sq mi): | 0.67 |
| Date: | 6/30/2009 |
| Field Crew: | Lewis, Dean |



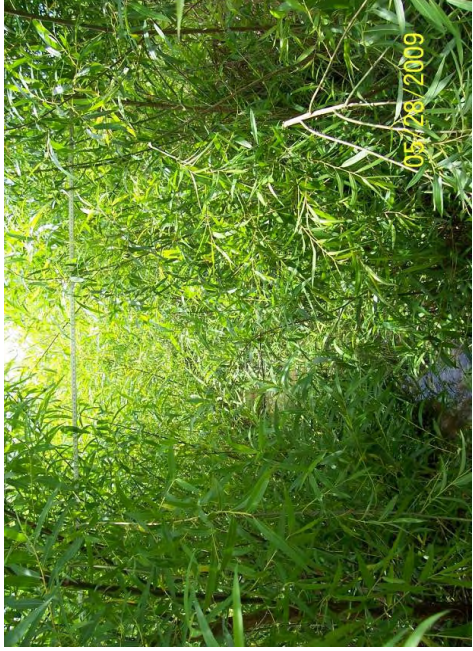
| Station | Elevation |
|---------|-----------|
| 17.3 | 25.4 |
| 25.0 | 25.5 |
| 26.2 | 25.0 |
| 28.9 | 24.7 |
| 29.5 | 24.5 |
| 31.2 | 23.5 |
| 32.3 | 23.2 |
| 34.4 | 23.0 |
| 34.9 | 23.3 |
| 35.9 | 24.0 |
| 36.6 | 24.5 |
| 37.7 | 25.7 |
| 39.1 | 25.5 |
| 47.5 | 25.7 |
| 52.4 | 25.7 |
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| SUMMARY DATA | |
|---------------------------------------|------|
| Bankfull Elevation: | 25.6 |
| Bankfull Cross-Sectional Area: | 16.9 |
| Bankfull Width: | 12.6 |
| Flood Prone Area Elevation: | - |
| Flood Prone Width: | - |
| Max Depth at Bankfull: | 2.5 |
| Mean Depth at Bankfull: | 1.3 |
| W / D Ratio: | - |
| Entrenchment Ratio: | - |
| Bank Height Ratio: | - |

Stream Type E/C



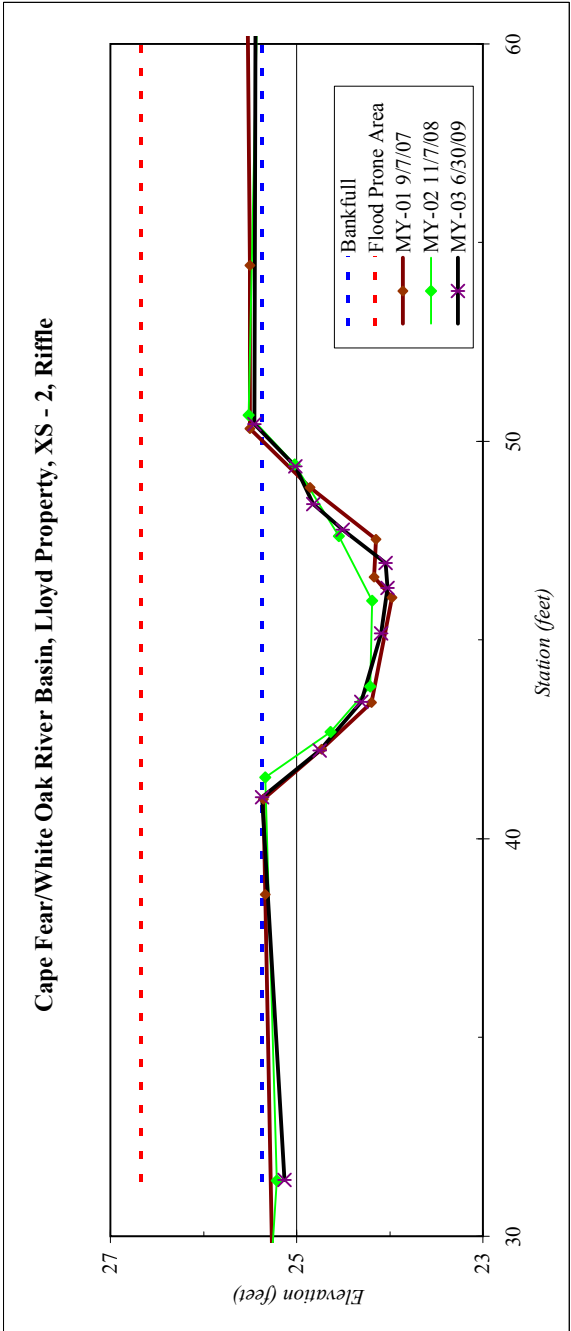
| | |
|-------------------------------|---------------------|
| River Basin: | Cape Fear/White Oak |
| Watershed: | Lloyd Property |
| XS ID | XS - 2, Riffle |
| Drainage Area (sq mi): | 0.67 |
| Date: | 6/30/2009 |
| Field Crew: | Lewis, Dean |



| Station | Elevation |
|---------|-----------|
| 31.4 | 25.1 |
| 41.0 | 25.4 |
| 42.2 | 24.8 |
| 43.4 | 24.3 |
| 45.2 | 24.1 |
| 46.3 | 24.0 |
| 46.9 | 24.0 |
| 47.8 | 24.5 |
| 48.4 | 24.8 |
| 49.4 | 25.0 |
| 50.4 | 25.5 |
| 62.0 | 25.4 |
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| SUMMARY DATA | | |
|--------------------------------|-------|------|
| Bankfull Elevation: | | 25.4 |
| Bankfull Cross-Sectional Area: | 7.7 | |
| Bankfull Width: | 9.2 | |
| Flood Prone Area Elevation: | 26.7 | |
| Flood Prone Width: | 150.0 | |
| Max Depth at Bankfull: | 1.3 | |
| Mean Depth at Bankfull: | 0.8 | |
| W / D Ratio: | 11.0 | |
| Entrenchment Ratio: | 16.3 | |
| Bank Height Ratio: | 1.0 | |

Stream Type: E/C



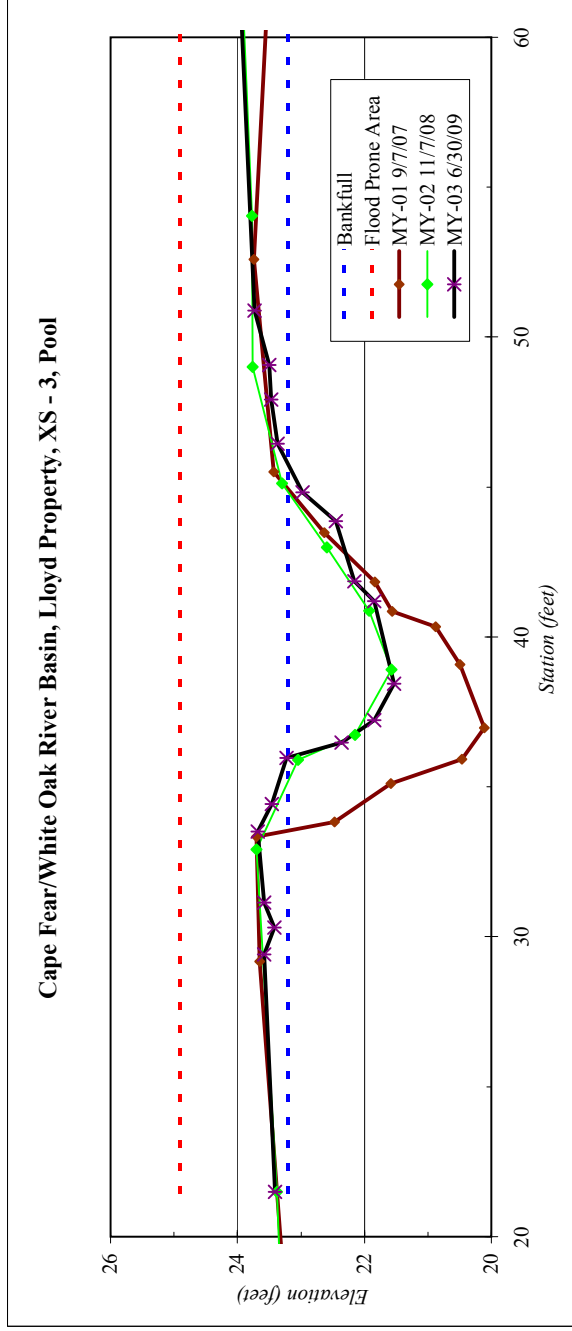
| | |
|-------------------------------|---------------------|
| River Basin: | Cape Fear/White Oak |
| Watershed: | Lloyd Property |
| XS ID | XS - 3, Pool |
| Drainage Area (sq mi): | 0.67 |
| Date: | 6/30/2009 |
| Field Crew: | Lewis, Dean |



| Station | Elevation |
|---------|-----------|
| 21.5 | 23.4 |
| 29.4 | 23.6 |
| 30.3 | 23.4 |
| 31.1 | 23.6 |
| 33.5 | 23.7 |
| 34.4 | 23.5 |
| 36.0 | 23.2 |
| 37.2 | 21.8 |
| 38.5 | 21.5 |
| 41.2 | 21.8 |
| 41.9 | 22.2 |
| 43.9 | 22.5 |
| 44.8 | 23.0 |
| 46.4 | 23.4 |
| 47.9 | 23.5 |
| 49.1 | 23.5 |
| 50.9 | 23.7 |
| 66.1 | 24.1 |
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| SUMMARY DATA | |
|---------------------------------------|------|
| Bankfull Elevation: | 23.2 |
| Bankfull Cross-Sectional Area: | 10.5 |
| Bankfull Width: | 9.9 |
| Flood Prone Area Elevation: | - |
| Flood Prone Width: | - |
| Max Depth at Bankfull: | 1.7 |
| Mean Depth at Bankfull: | 1.1 |
| W / D Ratio: | - |
| Entrenchment Ratio: | - |
| Bank Height Ratio: | - |

Stream Type C



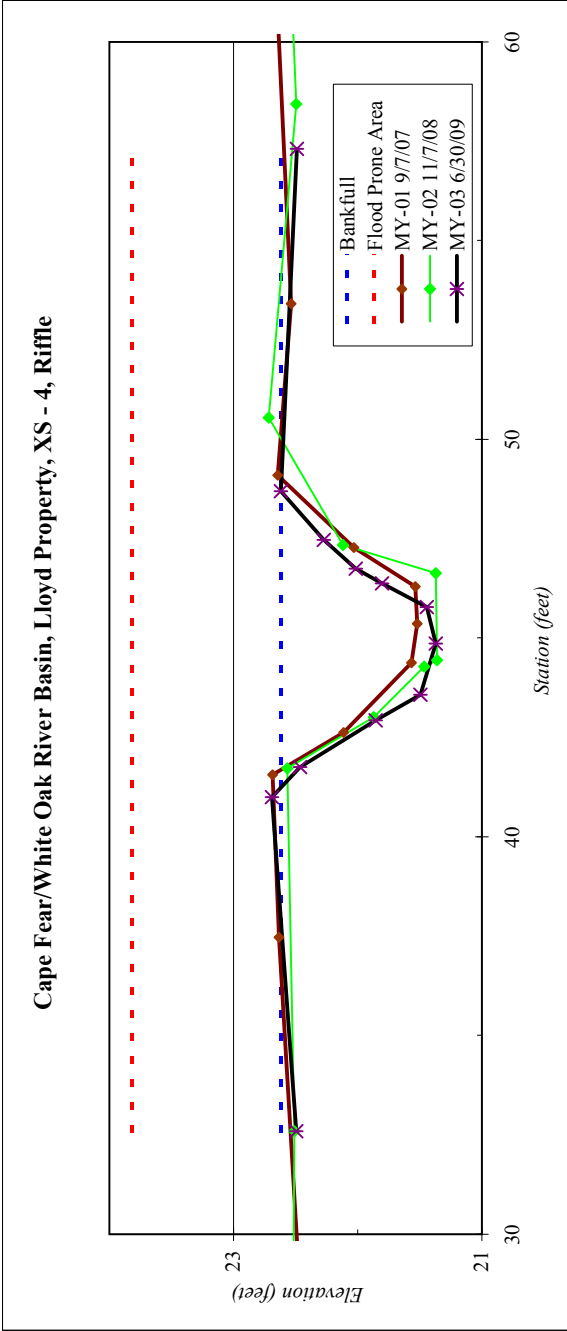
| | |
|-------------------------------|---------------------|
| River Basin: | Cape Fear/White Oak |
| Watershed: | Lloyd Property |
| XS ID | XS - 4, Riffle |
| Drainage Area (sq mi): | 0.67 |
| Date: | 6/30/2009 |
| Field Crew: | Lewis, Dean |



| Station | Elevation |
|---------|-----------|
| 32.6 | 22.5 |
| 41.0 | 22.7 |
| 41.7 | 22.5 |
| 42.9 | 21.9 |
| 43.6 | 21.5 |
| 44.9 | 21.4 |
| 45.8 | 21.4 |
| 46.4 | 21.8 |
| 46.7 | 22.0 |
| 47.5 | 22.3 |
| 48.7 | 22.6 |
| 57.3 | 22.5 |
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| SUMMARY DATA | |
|---------------------------------------|-------|
| Bankfull Elevation: | 22.6 |
| Bankfull Cross-Sectional Area: | 5.2 |
| Bankfull Width: | 7.4 |
| Flood Prone Area Elevation: | 23.8 |
| Flood Prone Width: | 150.0 |
| Max Depth at Bankfull: | 1.2 |
| Mean Depth at Bankfull: | 0.7 |
| W / D Ratio: | 10.5 |
| Entrenchment Ratio: | 20.3 |
| Bank Height Ratio: | 1.0 |

Stream Type: E/C



Appendix B4 - Cross-Section Plots

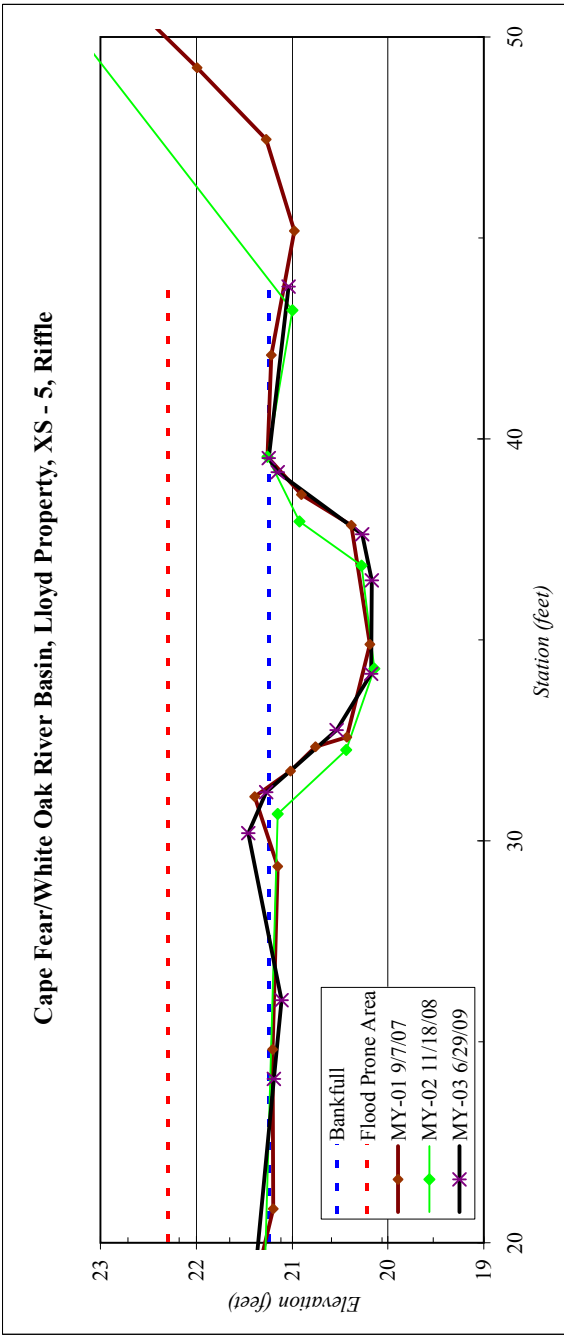
| | |
|-------------------------------|---------------------|
| River Basin: | Cape Fear/White Oak |
| Watershed: | Lloyd Property |
| XS ID | XS - 5, Riffle |
| Drainage Area (sq mi): | 0.55 |
| Date: | 6/29/2009 |
| Field Crew: | Lewis, Dean |



| Station | Elevation |
|---------|-----------|
| 3.9 | 22.85 |
| 15.0 | 21.70 |
| 18.8 | 21.41 |
| 24.1 | 21.19 |
| 26.0 | 21.11 |
| 30.2 | 21.46 |
| 31.2 | 21.27 |
| 32.8 | 20.53 |
| 34.2 | 20.17 |
| 36.5 | 20.17 |
| 37.6 | 20.27 |
| 39.2 | 21.15 |
| 39.5 | 21.25 |
| 43.8 | 21.0 |
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| SUMMARY DATA | |
|---------------------------------------|------|
| Bankfull Elevation: | 21.2 |
| Bankfull Cross-Sectional Area: | 6.3 |
| Bankfull Width: | 8.2 |
| 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: | 10.7 |
| Entrenchment Ratio: | 4.6 |
| Bank Height Ratio: | 1.0 |

Stream Type E/C



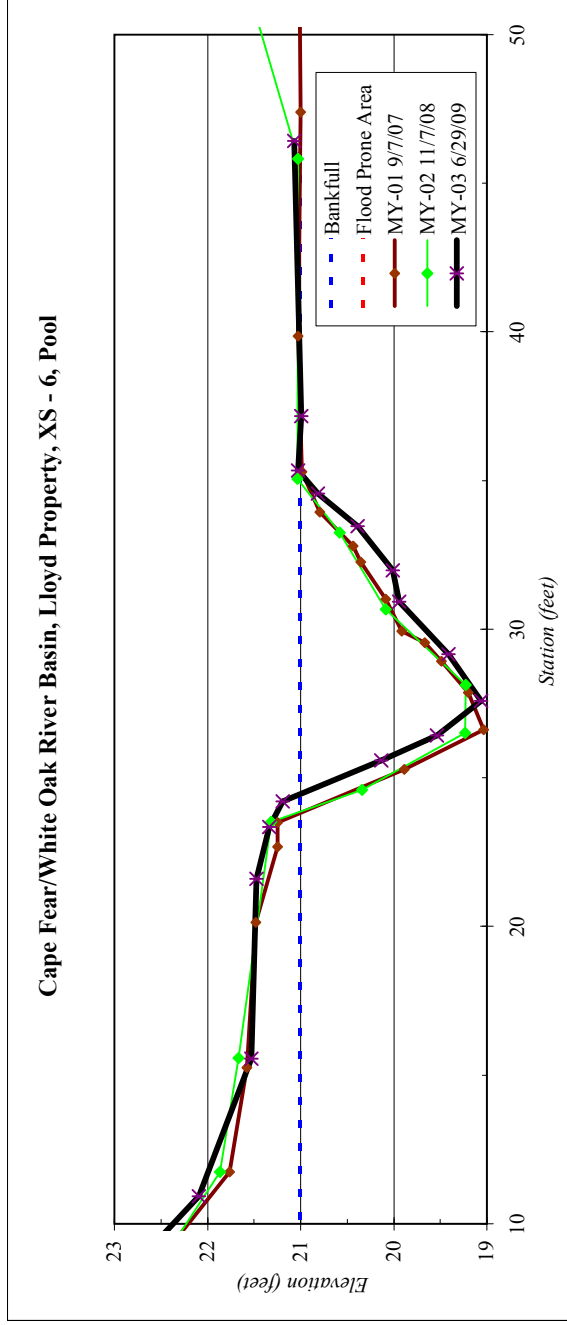
| | |
|-------------------------------|---------------------|
| River Basin: | Cape Fear/White Oak |
| Watershed: | Lloyd Property |
| XS ID | XS - 6, Pool |
| Drainage Area (sq mi): | 0.55 |
| Date: | 6/29/2009 |
| Field Crew: | Lewis, Dean |



| Station | Elevation |
|---------|-----------|
| 3.21 | 23.72 |
| 6.25 | 23.48 |
| 10.92 | 22.09 |
| 15.56 | 21.53 |
| 21.61 | 21.47 |
| 23.34 | 21.34 |
| 24.21 | 21.19 |
| 25.59 | 20.13 |
| 26.42 | 19.54 |
| 27.59 | 19.06 |
| 29.16 | 19.41 |
| 30.92 | 19.94 |
| 31.99 | 20.01 |
| 33.46 | 20.39 |
| 34.57 | 20.82 |
| 35.3 | 21.0 |
| 37.2 | 21.0 |
| 46.4 | 21.1 |
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| SUMMARY DATA | |
|---------------------------------------|------|
| Bankfull Elevation: | 21.0 |
| Bankfull Cross-Sectional Area: | 11.4 |
| Bankfull Width: | 10.9 |
| Flood Prone Area Elevation: | - |
| Flood Prone Width: | - |
| Max Depth at Bankfull: | 1.9 |
| Mean Depth at Bankfull: | 1.0 |
| W / D Ratio: | - |
| Entrenchment Ratio: | - |
| Bank Height Ratio: | - |

Stream Type C/E



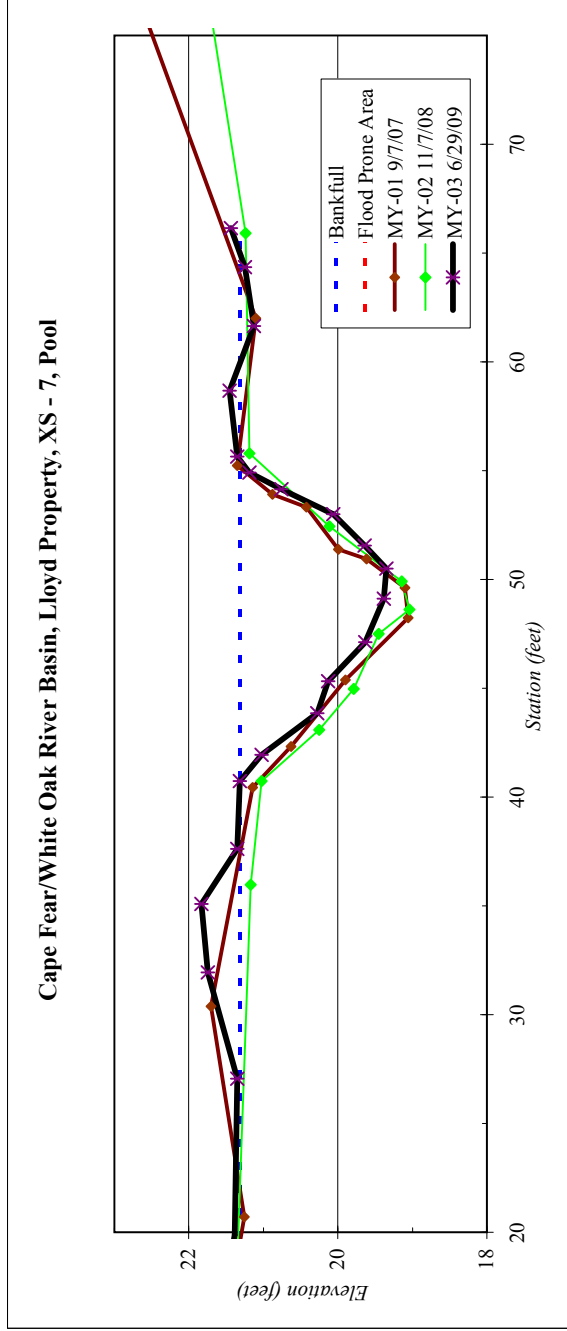
| | |
|-------------------------------|---------------------|
| River Basin: | Cape Fear/White Oak |
| Watershed: | Lloyd Property |
| XS ID | XS - 7, Pool |
| Drainage Area (sq mi): | 0.55 |
| Date: | 6/29/2009 |
| Field Crew: | Lewis, Dean |



| Station | Elevation |
|---------|-----------|
| 0.70 | 22.40 |
| 19.88 | 21.39 |
| 27.05 | 21.35 |
| 31.94 | 21.74 |
| 35.10 | 21.83 |
| 37.63 | 21.35 |
| 40.74 | 21.32 |
| 41.93 | 21.02 |
| 43.86 | 20.28 |
| 45.31 | 20.13 |
| 47.11 | 19.63 |
| 49.11 | 19.39 |
| 50.51 | 19.35 |
| 51.56 | 19.64 |
| 53.0 | 20.1 |
| 54.1 | 20.8 |
| 54.9 | 21.2 |
| 55.7 | 21.3 |
| 58.7 | 21.4 |
| 61.6 | 21.1 |
| 64.4 | 21.2 |
| 66.1 | 21.4 |

| SUMMARY DATA | |
|---------------------------------------|------|
| Bankfull Elevation: | 21.3 |
| Bankfull Cross-Sectional Area: | 17.3 |
| Bankfull Width: | 14.7 |
| Flood Prone Area Elevation: | - |
| Flood Prone Width: | - |
| Max Depth at Bankfull: | 2.0 |
| Mean Depth at Bankfull: | 1.2 |
| W / D Ratio: | - |
| Entrenchment Ratio: | - |
| Bank Height Ratio: | - |

Stream Type E/C



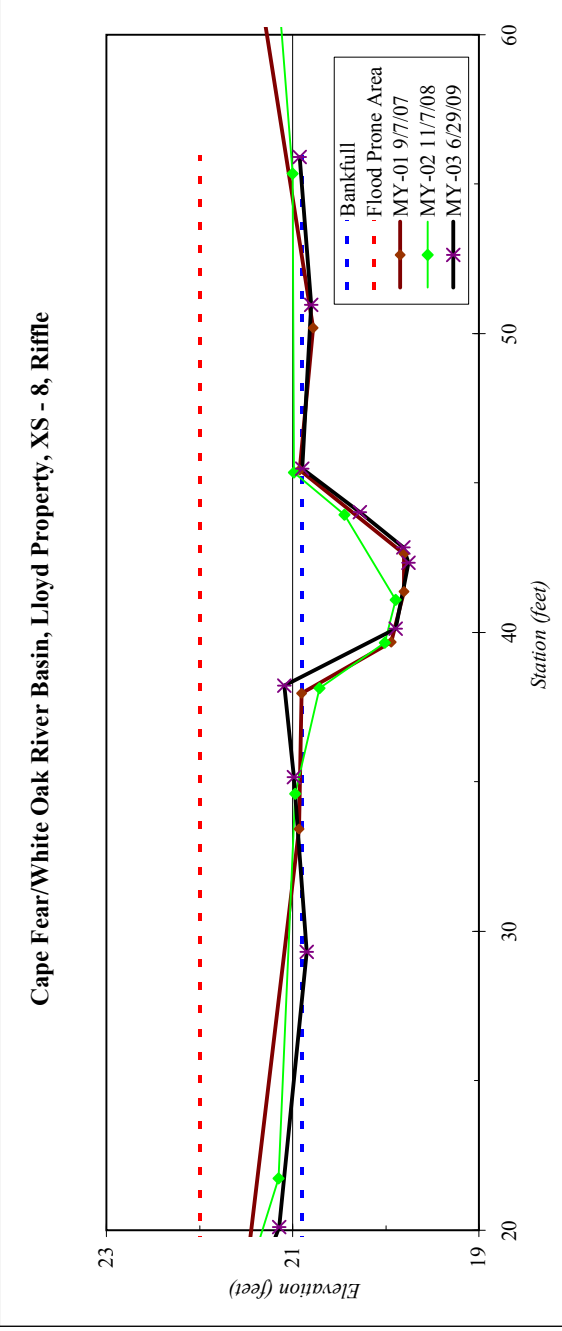
| | |
|-------------------------------|---------------------|
| River Basin: | Cape Fear/White Oak |
| Watershed: | Lloyd Property |
| XS ID | XS - 8, Riffle |
| Drainage Area (sq mi): | 0.55 |
| Date: | 6/29/2009 |
| Field Crew: | Lewis, Dean |



| Station | Elevation |
|---------|-----------|
| 15.8 | 21.7 |
| 20.1 | 21.1 |
| 29.3 | 20.8 |
| 35.2 | 21.0 |
| 38.2 | 21.1 |
| 40.1 | 19.9 |
| 42.3 | 19.8 |
| 42.9 | 19.8 |
| 44.0 | 20.3 |
| 45.5 | 20.9 |
| 51.0 | 20.8 |
| 55.9 | 20.9 |
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| SUMMARY DATA | |
|---------------------------------------|------|
| Bankfull Elevation: | 20.9 |
| Bankfull Cross-Sectional Area: | 5.1 |
| Bankfull Width: | 6.9 |
| Flood Prone Area Elevation: | 22.0 |
| Flood Prone Width: | 80.0 |
| Max Depth at Bankfull: | 1.1 |
| Mean Depth at Bankfull: | 0.7 |
| W / D Ratio: | 9.3 |
| Entrenchment Ratio: | 11.6 |
| Bank Height Ratio: | 1.0 |

Stream Type E



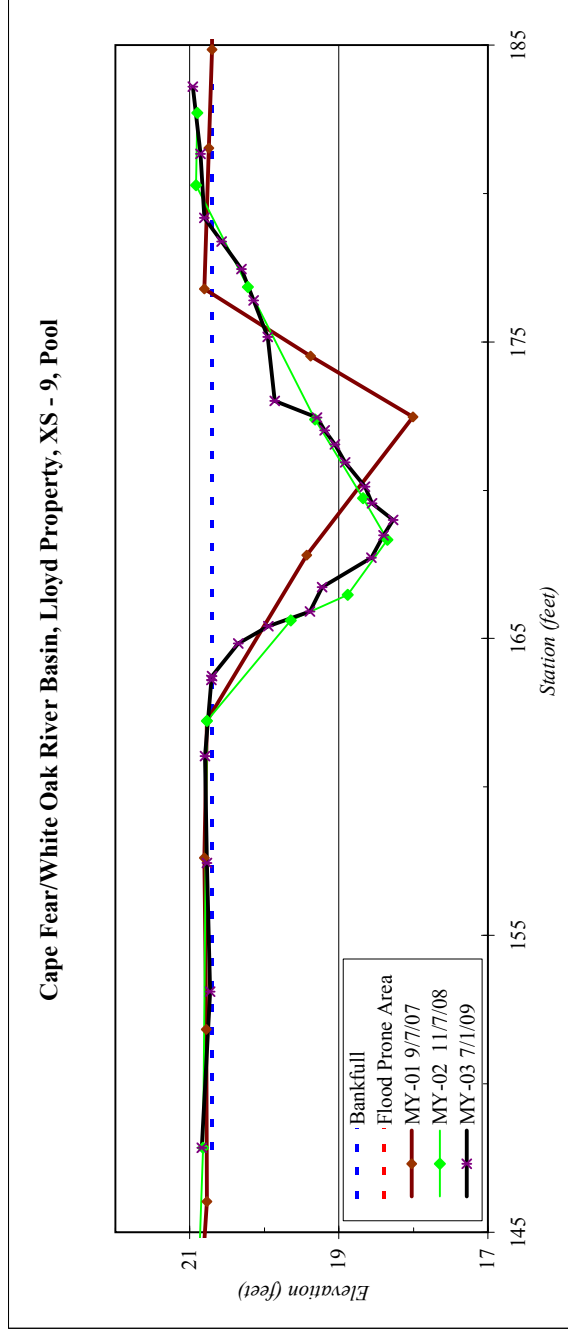
| | |
|-------------------------------|---------------------|
| River Basin: | Cape Fear/White Oak |
| Watershed: | Lloyd Property |
| XS ID | XS - 9, Pool |
| Drainage Area (sq mi): | 1.2 |
| Date: | 7/1/2009 |
| Field Crew: | Dean, Perkinson |



| Station | Elevation |
|---------|-----------|
| 147.9 | 20.8 |
| 153.1 | 20.7 |
| 157.4 | 20.8 |
| 161.0 | 20.8 |
| 163.6 | 20.7 |
| 163.7 | 20.7 |
| 164.8 | 20.4 |
| 165.4 | 19.9 |
| 165.9 | 19.4 |
| 166.7 | 19.2 |
| 167.7 | 18.6 |
| 168.5 | 18.4 |
| 169.0 | 18.3 |
| 169.6 | 18.6 |
| 170.1 | 18.7 |
| 170.9 | 18.9 |
| 171.5 | 19.0 |
| 172.0 | 19.2 |
| 172.5 | 19.3 |
| 173.0 | 19.9 |
| 175.2 | 20.0 |
| 176.4 | 20.1 |
| 177.5 | 20.3 |
| 178.4 | 20.6 |
| 179.2 | 20.8 |
| 181.3 | 20.9 |
| 183.6 | 21.0 |

| SUMMARY DATA | |
|---------------------------------------|------|
| Bankfull Elevation: | 20.7 |
| Bankfull Cross-Sectional Area: | 17.2 |
| Bankfull Width: | 15.0 |
| Flood Prone Area Elevation: | - |
| Flood Prone Width: | - |
| Max Depth at Bankfull: | 2.4 |
| Mean Depth at Bankfull: | 1.1 |
| W / D Ratio: | - |
| Entrenchment Ratio: | - |
| Bank Height Ratio: | - |

Stream Type E/C



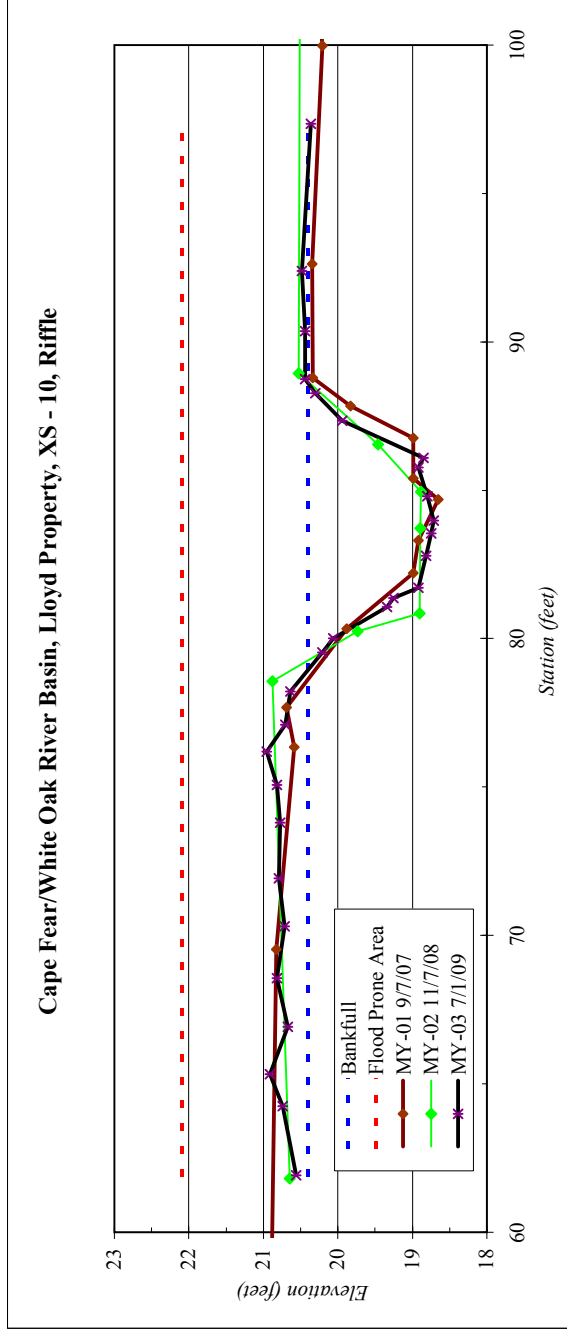
| | |
|-------------------------------|---------------------|
| River Basin: | Cape Fear/White Oak |
| Watershed: | Lloyd Property |
| XS ID | XS - 10, Riffle |
| Drainage Area (sq mi): | 1.2 |
| Date: | 7/1/2009 |
| Field Crew: | Dean, Perkinson |



| Station | Elevation |
|---------|-----------|
| 61.9 | 20.6 |
| 64.2 | 20.7 |
| 65.3 | 20.9 |
| 66.9 | 20.7 |
| 68.6 | 20.8 |
| 70.3 | 20.7 |
| 71.9 | 20.8 |
| 73.8 | 20.8 |
| 75.1 | 21.0 |
| 76.2 | 21.0 |
| 77.1 | 20.7 |
| 78.2 | 20.6 |
| 79.5 | 20.2 |
| 80.0 | 20.1 |
| 81.1 | 19.3 |
| 81.4 | 19.3 |
| 81.7 | 18.9 |
| 82.8 | 18.8 |
| 83.5 | 18.7 |
| 84.0 | 18.7 |
| 84.8 | 18.8 |
| 85.8 | 18.9 |
| 86.1 | 18.8 |
| 87.4 | 19.9 |
| 88.3 | 20.3 |
| 88.8 | 20.4 |
| 90.4 | 20.4 |
| 92.4 | 20.5 |
| 97.4 | 20.4 |

| SUMMARY DATA | |
|---------------------------------------|-------|
| Bankfull Elevation: | 20.4 |
| Bankfull Cross-Sectional Area: | 10.2 |
| Bankfull Width: | 9.7 |
| Flood Prone Area Elevation: | 22.1 |
| Flood Prone Width: | 150.0 |
| Max Depth at Bankfull: | 1.7 |
| Mean Depth at Bankfull: | 1.1 |
| W / D Ratio: | 9.2 |
| Entrenchment Ratio: | 15.5 |
| Bank Height Ratio: | 1.0 |

Stream Type: E/C



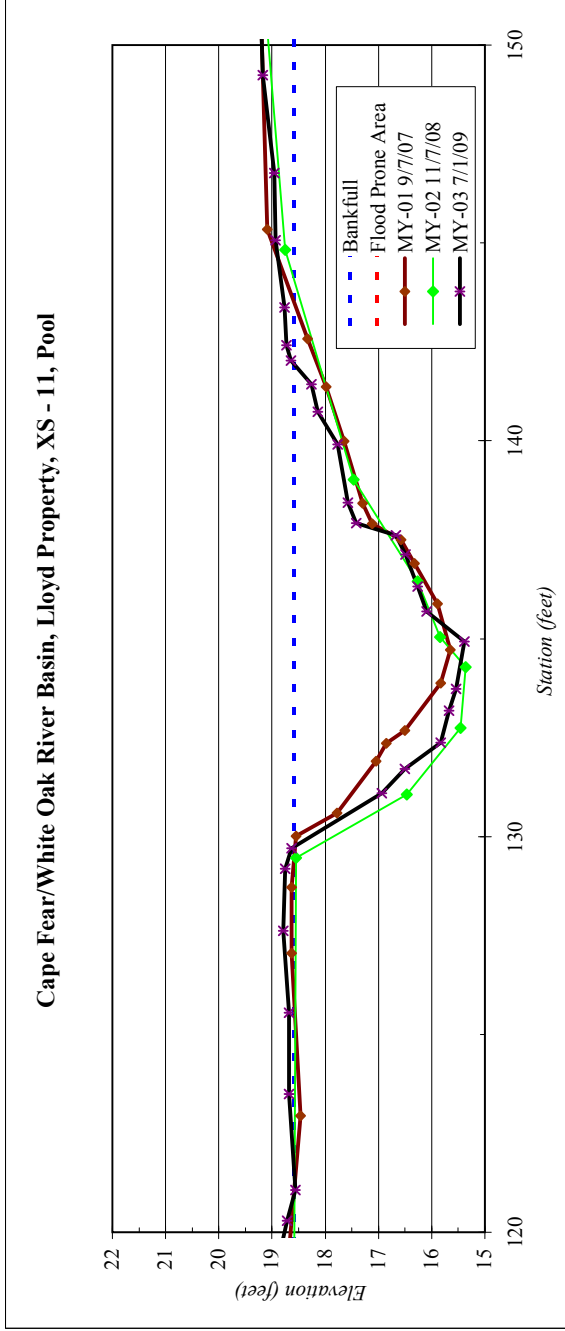
| | |
|-------------------------------|---------------------|
| River Basin: | Cape Fear/White Oak |
| Watershed: | Lloyd Property |
| XS ID | XS - 11, Pool |
| Drainage Area (sq mi): | 1.2 |
| Date: | 7/1/2009 |
| Field Crew: | Dean, Perkinson |



Stream Type E/C

| SUMMARY DATA | |
|---------------------------------------|------|
| Bankfull Elevation: | 18.6 |
| Bankfull Cross-Sectional Area: | 21.4 |
| Bankfull Width: | 12.2 |
| Flood Prone Area Elevation: | - |
| Flood Prone Width: | - |
| Max Depth at Bankfull: | 3.2 |
| Mean Depth at Bankfull: | 1.8 |
| W / D Ratio: | - |
| Entrenchment Ratio: | - |
| Bank Height Ratio: | - |

| Station | Elevation |
|---------|-----------|
| 119.1 | 18.9 |
| 120.3 | 18.7 |
| 121.1 | 18.6 |
| 123.5 | 18.7 |
| 125.5 | 18.7 |
| 127.6 | 18.8 |
| 129.2 | 18.7 |
| 129.7 | 18.6 |
| 131.1 | 16.9 |
| 131.7 | 16.5 |
| 132.4 | 15.8 |
| 133.2 | 15.7 |
| 133.7 | 15.5 |
| 134.9 | 15.4 |
| 135.7 | 16.1 |
| 136.3 | 16.3 |
| 137.1 | 16.5 |
| 137.6 | 16.7 |
| 137.9 | 17.4 |
| 138.4 | 17.6 |
| 139.9 | 17.8 |
| 140.7 | 18.1 |
| 141.4 | 18.3 |
| 142.0 | 18.6 |
| 142.4 | 18.7 |
| 143.4 | 18.8 |
| 145.1 | 18.9 |
| 146.8 | 19.0 |
| 149.2 | 19.2 |
| 153.0 | 19.3 |



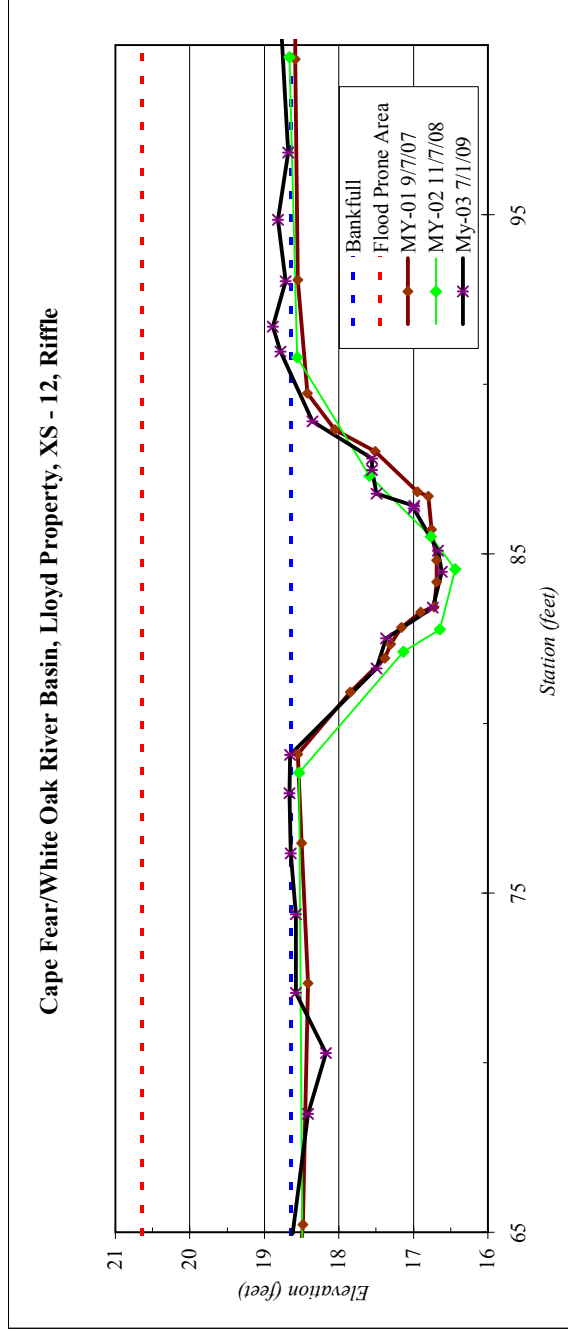
| | |
|-------------------------------|---------------------|
| River Basin: | Cape Fear/White Oak |
| Watershed: | Lloyd Property |
| XS ID | XS - 12, Riffle |
| Drainage Area (sq mi): | 1.2 |
| Date: | 7/1/2009 |
| Field Crew: | Dean, Perkinson |



| Station | Elevation |
|---------|-----------|
| 65.0 | 18.6 |
| 68.5 | 18.4 |
| 70.3 | 18.2 |
| 72.1 | 18.6 |
| 74.4 | 18.6 |
| 76.2 | 18.6 |
| 77.9 | 18.7 |
| 79.1 | 18.7 |
| 81.6 | 17.5 |
| 82.5 | 17.4 |
| 83.4 | 16.7 |
| 84.5 | 16.6 |
| 85.1 | 16.7 |
| 86.3 | 17.0 |
| 86.4 | 17.0 |
| 86.8 | 17.5 |
| 87.5 | 17.6 |
| 87.8 | 17.6 |
| 88.9 | 18.4 |
| 91.0 | 18.8 |
| 91.7 | 18.9 |
| 93.0 | 18.7 |
| 94.8 | 18.8 |
| 96.8 | 18.7 |
| 100.2 | 18.8 |

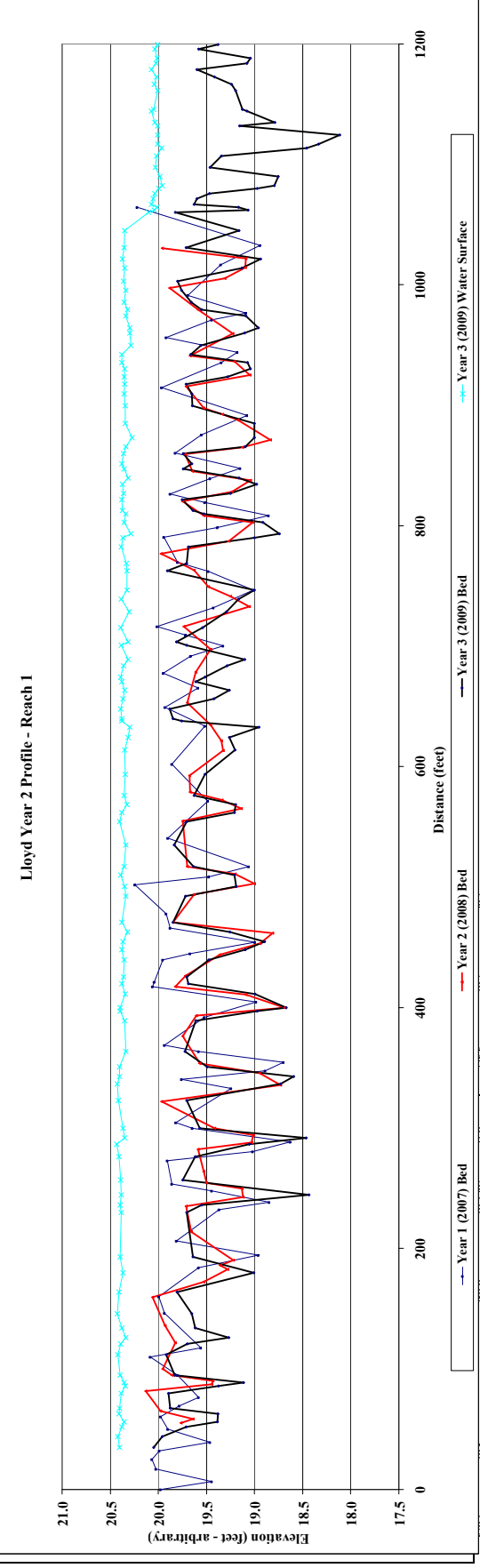
| SUMMARY DATA | |
|---------------------------------------|-------|
| Bankfull Elevation: | 18.7 |
| Bankfull Cross-Sectional Area: | 12.3 |
| Bankfull Width: | 11.2 |
| Flood Prone Area Elevation: | 20.7 |
| Flood Prone Width: | 150.0 |
| Max Depth at Bankfull: | 2.0 |
| Mean Depth at Bankfull: | 1.1 |
| W / D Ratio: | 10.2 |
| Entrenchment Ratio: | 13.4 |
| Bank Height Ratio: | 1.0 |

Stream Type: E/C



| 2007 | | 2008 | | 2009 | | 2010 | |
|---------|---------------|---------|---------------|---------|---------------|---------|---------------|
| Station | Bed Elevation | Station | Bed Elevation | Station | Bed Elevation | Station | Bed Elevation |
| 0.0 | 20.0 | 1030.4 | 19.957963 | 1199.4 | 19.4 | 1199.4 | 19.4 |
| 6.5 | 19.4 | 1022.0 | 19.089203 | 1195.8 | 19.6 | 1195.8 | 19.6 |
| 17.2 | 20.0 | 1014.4 | 19.089657 | 1188.0 | 19.0 | 1188.0 | 19.0 |
| 25.3 | 20.1 | 1006.5 | 19.06532 | 1183.8 | 19.1 | 1183.8 | 19.1 |
| 32.3 | 20.1 | 999.5 | 19.06542 | 1172.6 | 19.4 | 1172.6 | 19.4 |
| 39.3 | 19.5 | 979.5 | 19.58749 | 1166.5 | 19.2 | 1166.5 | 19.2 |
| 50.1 | 19.9 | 959.4 | 19.224303 | 1161.2 | 19.2 | 1161.2 | 19.2 |
| 60.3 | 20.0 | 941.2 | 19.67157 | 1145.5 | 19.1 | 1145.5 | 19.1 |
| 69.6 | 19.8 | 936.3 | 19.210102 | 1144.0 | 19.1 | 1144.0 | 19.1 |
| 76.7 | 19.6 | 925.3 | 19.049415 | 1134.7 | 18.8 | 1134.7 | 18.8 |
| 84.9 | 19.8 | 915.6 | 19.771067 | 1131.8 | 19.2 | 1131.8 | 19.2 |
| 102.2 | 20.1 | 897.7 | 19.527771 | 1124.5 | 19.2 | 1124.5 | 19.2 |
| 110.2 | 20.1 | 897.7 | 19.527771 | 1117.0 | 18.3 | 1117.0 | 18.3 |
| 128.6 | 19.4 | 888.0 | 19.175106 | 1113.7 | 18.5 | 1113.7 | 18.5 |
| 146.3 | 19.9 | 888.0 | 19.175106 | 1106.9 | 19.3 | 1106.9 | 19.3 |
| 160.1 | 20.0 | 871.3 | 18.833257 | 1097.4 | 19.5 | 1097.4 | 19.5 |
| 184.4 | 19.6 | 865.3 | 19.127383 | 1089.9 | 18.8 | 1089.9 | 18.8 |
| 194.6 | 19.0 | 859.3 | 19.724494 | 1082.6 | 19.0 | 1082.6 | 19.0 |
| 206.2 | 19.8 | 845.3 | 19.648321 | 1070.0 | 19.5 | 1070.0 | 19.5 |
| 232.2 | 19.4 | 837.9 | 19.043837 | 1066.9 | 19.6 | 1066.9 | 19.6 |
| 238.6 | 18.8 | 828.5 | 19.229988 | 1064.6 | 19.2 | 1064.6 | 19.2 |
| 245.7 | 19.4 | 828.4 | 19.229988 | 1062.0 | 19.1 | 1062.0 | 19.1 |
| 251.7 | 19.4 | 828.4 | 19.229988 | 1045.1 | 19.8 | 1045.1 | 19.8 |
| 257.7 | 19.4 | 808.8 | 19.510594 | 1045.1 | 19.2 | 1045.1 | 19.2 |
| 272.8 | 19.9 | 802.8 | 19.01968 | 1045.1 | 19.2 | 1045.1 | 19.2 |
| 280.4 | 19.0 | 787.4 | 19.267396 | 1045.1 | 19.2 | 1045.1 | 19.2 |
| 288.5 | 18.6 | 776.7 | 19.971338 | 1045.1 | 19.2 | 1045.1 | 19.2 |
| 299.7 | 19.6 | 765.0 | 19.629819 | 1045.1 | 19.2 | 1045.1 | 19.2 |
| 304.4 | 19.8 | 749.3 | 19.482602 | 1045.1 | 19.2 | 1045.1 | 19.2 |

| 2007 | 2008 | 2009 | 2010 |
|------|--------|--------|--------|
| 18.0 | 0.0002 | 0.0003 | 0.0003 |
| 22.0 | 0.0005 | 17.0 | 17.0 |
| --- | 24.0 | 0.0000 | 0.0000 |
| --- | 0.0020 | 24.0 | 10.0 |
| --- | --- | 0.0020 | 0.0022 |



Project Name: Lloyd Property - Year 3 (2009) Monitoring
 Reach: 1
 Profile: Lewis Dam
 Feature: Lewis Dam
 Date: 6/29/09
 Crew:

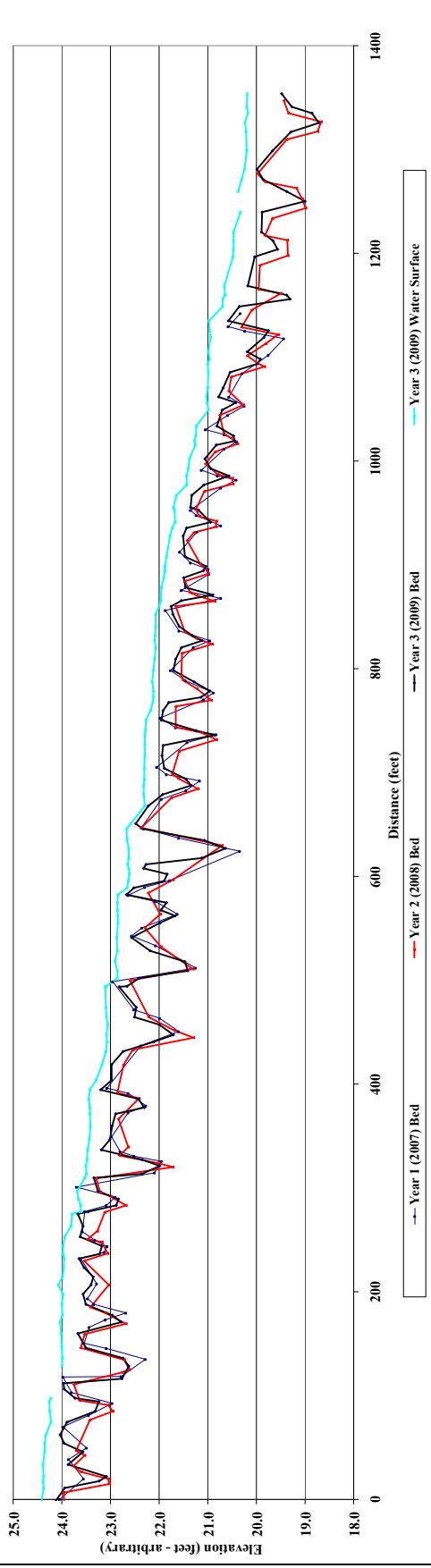
Lloyd Year 2 Profile - Reach 1

Project Name: Lloyd Property - Year 2 (2008) Monitoring
 Reach: 2
 Profile:
 Feature: 6/30/09
 Date:
 Crew: Lewis Dean

| Station | 2007 Year 1 Monitoring (Survey) | | 2008 Year 2 Monitoring (Survey) | | 2009 Year 3 Monitoring (Survey) | | 2010 Year 4 Monitoring (Survey) | |
|---------|---------------------------------|-----------------|---------------------------------|-----------------|---------------------------------|-----------------|---------------------------------|-----------------|
| | Bed Elevation | Water Elevation | Bed Elevation | Water Elevation | Bed Elevation | Water Elevation | Bed Elevation | Water Elevation |
| 0.0 | 24.0 | 19.4 | 20.1 | 20.2 | 19.5 | 20.2 | | |
| 19.7 | 23.6 | 19.4 | 20.1 | 20.2 | 19.3 | 20.2 | | |
| 38.4 | 23.9 | 19.3 | 20.1 | 20.2 | 18.9 | 20.2 | | |
| 60.4 | 24.5 | 18.7 | 20.1 | 20.2 | 18.7 | 20.2 | | |
| 81.1 | 23.4 | 19.4 | 20.2 | 20.2 | 19.7 | 20.2 | | |
| 92.7 | 23.0 | 19.8 | 20.2 | 20.2 | 19.9 | 20.2 | | |
| 103.2 | 23.8 | 19.2 | 20.3 | 20.3 | 19.9 | 20.3 | | |
| 118.1 | 24.0 | 19.1 | 20.4 | 20.4 | 19.4 | 20.4 | | |
| 118.7 | 22.8 | 19.0 | 20.2 | 20.2 | 19.0 | 20.3 | | |
| 135.2 | 22.3 | 19.7 | 20.2 | 20.2 | 19.9 | 20.3 | | |
| 145.5 | 23.1 | 19.8 | 20.5 | 20.5 | 19.9 | 20.5 | | |
| 158.8 | 23.4 | 19.4 | 20.5 | 20.5 | 19.6 | 20.5 | | |
| 165.8 | 23.4 | 19.4 | 20.5 | 20.5 | 19.6 | 20.5 | | |
| 173.0 | 23.1 | 19.9 | 20.4 | 20.5 | 19.6 | 20.5 | | |
| 179.8 | 22.7 | 19.9 | 20.7 | 20.7 | 19.6 | 20.5 | | |
| 187.8 | 23.3 | 19.5 | 20.6 | 20.7 | 19.4 | 20.7 | | |
| 193.6 | 23.5 | 20.1 | 20.6 | 20.7 | 19.3 | 20.7 | | |
| 207.7 | 23.3 | 20.3 | 20.9 | 20.7 | 19.3 | 20.7 | | |
| 231.8 | 23.6 | 19.5 | 21.0 | 21.0 | 20.6 | 21.0 | | |
| 238.1 | 23.1 | 19.8 | 21.0 | 21.0 | 19.8 | 21.0 | | |
| 249.4 | 23.3 | 20.0 | 21.0 | 21.0 | 19.8 | 21.0 | | |
| 257.7 | 23.6 | 19.8 | 21.0 | 21.0 | 19.9 | 21.0 | | |
| 276.9 | 23.5 | 20.5 | 20.9 | 21.0 | 20.0 | 21.0 | | |
| 283.3 | 23.1 | 20.6 | 20.9 | 21.0 | 20.5 | 21.0 | | |
| 290.7 | 22.9 | 20.3 | 20.6 | 21.0 | 20.7 | 21.0 | | |

| | 2007 | 2008 | 2009 | 2010 |
|--------------------------|--------|--------|--------|--------|
| Avg. Water Surface Slope | 0.0033 | 0.0033 | 0.0033 | 0.0033 |
| Riffle Length | 20.0 | 26.0 | 18.7 | 18.7 |
| Avg. Riffle Slope | 0.0110 | 0.0084 | 0.0084 | 0.0084 |
| Pool Length | 22.0 | 24.0 | 23.7 | 23.7 |
| Avg. Pool Slope | ----- | 0.0014 | 0.0014 | 0.0005 |

Lloyd Year 2 Profile - Reach 2



788.3

21.5

21.6

22.3

22.3

21.2

21.2

740.7

22.3

21.0

21.0

21.0

21.0

21.0

21.0

21.0

21.0

21.0

21.0

21.0

21.0

21.0

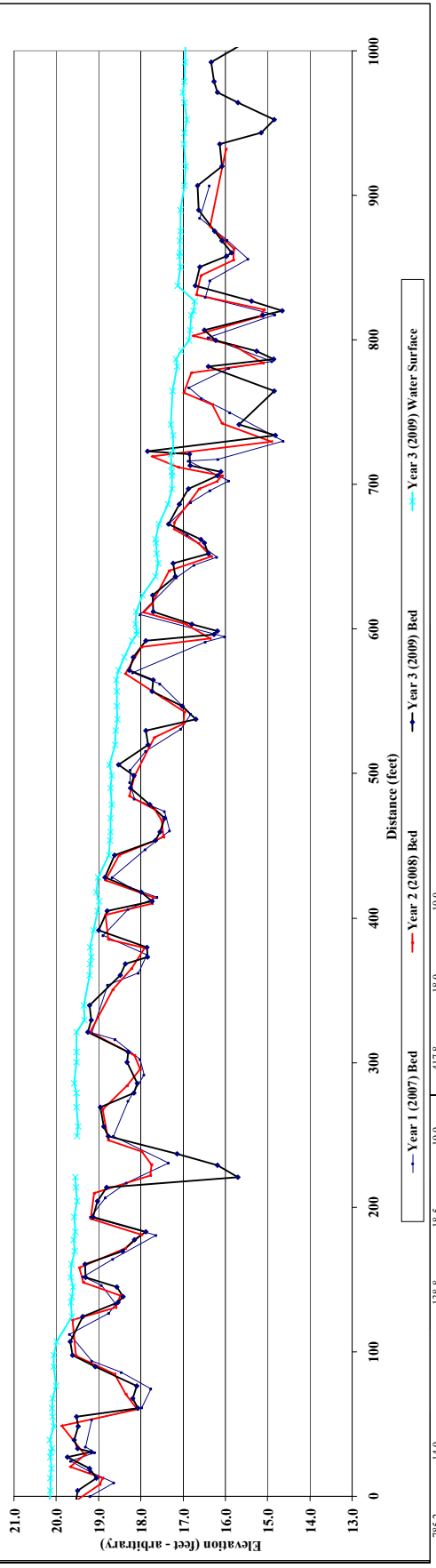
21.0

Project Name: Lloyd Property - Year 2 (2008) Monitoring
 Reach: 3
 Profile: 3
 Feature: 7/10/09
 Date: Dean, Parkinson
 Crew:

| Station | 2007 | | 2008 | | 2009 | | 2010 | |
|---------|---------------|-----------------|---------------|-----------------|---------------|-----------------|---------------|-----------------|
| | Bed Elevation | Water Elevation | Bed Elevation | Water Elevation | Bed Elevation | Water Elevation | Bed Elevation | Water Elevation |
| 0.0 | 19.2 | 17.0 | 16.0 | 17.0 | 1017.0 | 15.3 | 17.0 | |
| 9.3 | 18.6 | 17.3 | 878.4 | 16.4 | 1009.4 | 15.3 | 16.9 | |
| 17.1 | 19.2 | 17.3 | 863.1 | 15.8 | 992.2 | 16.3 | 16.9 | |
| 24.6 | 19.7 | 17.3 | 833.7 | 15.8 | 978.7 | 16.3 | 17.0 | |
| 32.0 | 19.7 | 17.3 | 833.7 | 16.7 | 978.7 | 16.3 | 17.0 | |
| 34.2 | 19.3 | 17.3 | 831.3 | 16.7 | 964.2 | 15.7 | 17.0 | |
| 38.0 | 19.2 | 17.3 | 820.8 | 15.1 | 952.4 | 14.8 | 16.9 | |
| 61.5 | 18.0 | 15.2 | 816.1 | 17.3 | 943.4 | 15.2 | 17.0 | |
| 74.4 | 17.8 | 16.8 | 802.7 | 17.3 | 935.4 | 16.1 | 17.0 | |
| 85.9 | 18.5 | 15.8 | 796.2 | 17.3 | 920.2 | 16.1 | 16.9 | |
| 93.6 | 19.2 | 15.1 | 784.1 | 17.3 | 906.8 | 16.7 | 17.0 | |
| 123.3 | 19.7 | 16.8 | 777.2 | 17.3 | 889.7 | 16.6 | 17.1 | |
| 125.7 | 19.7 | 16.8 | 777.2 | 17.3 | 889.7 | 16.6 | 17.1 | |
| 126.7 | 18.6 | 15.8 | 767.4 | 17.3 | 889.7 | 16.6 | 17.1 | |
| 133.0 | 18.6 | 15.3 | 755.4 | 17.5 | 868.5 | 16.3 | 17.1 | |
| 146.1 | 18.9 | 16.1 | 742.2 | 16.1 | 860.2 | 15.8 | 17.1 | |
| 151.9 | 19.4 | 14.9 | 729.8 | 17.4 | 857.9 | 16.0 | 17.1 | |
| 163.9 | 18.7 | 17.7 | 719.4 | 17.7 | 850.6 | 16.6 | 17.1 | |
| 180.8 | 17.6 | 17.1 | 712.0 | 17.5 | 837.5 | 16.7 | 17.1 | |
| 193.3 | 19.2 | 16.1 | 705.9 | 17.6 | 826.9 | 15.4 | 16.7 | |
| 206.8 | 18.8 | 16.2 | 702.2 | 17.5 | 820.3 | 14.7 | 16.8 | |
| 216.7 | 17.3 | 16.9 | 695.8 | 17.5 | 816.1 | 15.1 | 16.8 | |
| 220.0 | 17.3 | 17.2 | 695.8 | 17.2 | 806.1 | 15.1 | 16.9 | |
| 249.0 | 18.7 | 17.2 | 668.8 | 17.2 | 799.7 | 16.2 | 16.9 | |
| 273.5 | 18.3 | 16.3 | 659.3 | 17.9 | 792.3 | 15.3 | 17.2 | |
| 291.8 | 17.9 | 16.3 | 650.0 | 17.9 | 786.8 | 14.9 | 17.2 | |
| 302.4 | 18.0 | 17.3 | 640.4 | 17.3 | 781.4 | 16.4 | 17.1 | |
| 315.9 | 18.6 | 17.8 | 617.1 | 17.8 | 764.5 | 14.8 | 17.2 | |

| 2007 | 2008 | 2009 | 2010 |
|--------|--------|--------|--------|
| 0.0034 | 0.0034 | 0.0034 | 0.0033 |
| 19.0 | 24.0 | 19.2 | 19.2 |
| 0.0001 | 0.0091 | 0.0059 | 0.0059 |
| 29.0 | 38.0 | 32.6 | 32.6 |
| ----- | 0.0011 | 0.0001 | 0.0001 |

Lloyd Year 2 Profile - Reach 3



| Station | 2007 Bed Elevation | 2008 Bed Elevation | 2009 Bed Elevation | 2010 Bed Elevation | 2009 Water Surface |
|---------|--------------------|--------------------|--------------------|--------------------|--------------------|
| 0.0 | 19.2 | 16.0 | 1017.0 | 17.0 | 15.3 |
| 9.3 | 18.6 | 878.4 | 1009.4 | 16.9 | 15.3 |
| 17.1 | 19.2 | 863.1 | 992.2 | 16.9 | 16.3 |
| 24.6 | 19.7 | 833.7 | 978.7 | 17.0 | 16.3 |
| 32.0 | 19.7 | 833.7 | 978.7 | 17.0 | 16.3 |
| 34.2 | 19.3 | 831.3 | 964.2 | 17.0 | 15.7 |
| 38.0 | 19.2 | 820.8 | 952.4 | 16.9 | 14.8 |
| 61.5 | 18.0 | 816.1 | 943.4 | 17.0 | 15.2 |
| 74.4 | 17.8 | 802.7 | 935.4 | 17.0 | 16.1 |
| 85.9 | 18.5 | 796.2 | 920.2 | 16.9 | 16.1 |
| 93.6 | 19.2 | 784.1 | 906.8 | 17.0 | 16.7 |
| 123.3 | 19.7 | 777.2 | 889.7 | 17.1 | 16.6 |
| 125.7 | 19.7 | 777.2 | 889.7 | 17.1 | 16.6 |
| 126.7 | 18.6 | 767.4 | 889.7 | 17.1 | 16.6 |
| 133.0 | 18.6 | 755.4 | 868.5 | 17.1 | 16.3 |
| 146.1 | 18.9 | 742.2 | 860.2 | 17.1 | 15.8 |
| 151.9 | 19.4 | 729.8 | 857.9 | 17.1 | 16.0 |
| 163.9 | 18.7 | 719.4 | 850.6 | 17.1 | 16.6 |
| 180.8 | 17.6 | 712.0 | 837.5 | 17.1 | 16.7 |
| 193.3 | 19.2 | 705.9 | 826.9 | 16.7 | 15.4 |
| 206.8 | 18.8 | 702.2 | 820.3 | 16.7 | 14.7 |
| 216.7 | 17.3 | 695.8 | 816.1 | 16.8 | 15.1 |
| 220.0 | 17.3 | 695.8 | 806.1 | 16.9 | 15.1 |
| 249.0 | 18.7 | 668.8 | 799.7 | 16.9 | 16.2 |
| 273.5 | 18.3 | 659.3 | 792.3 | 17.2 | 15.3 |
| 291.8 | 17.9 | 650.0 | 786.8 | 17.2 | 14.9 |
| 302.4 | 18.0 | 640.4 | 781.4 | 17.1 | 16.4 |
| 315.9 | 18.6 | 617.1 | 764.5 | 17.2 | 14.8 |

Lloyd Stream and Wetland Restoration Site
Year 3 (2009) Annual Monitoring
Stream Fixed Photo Stations
Taken August 2009

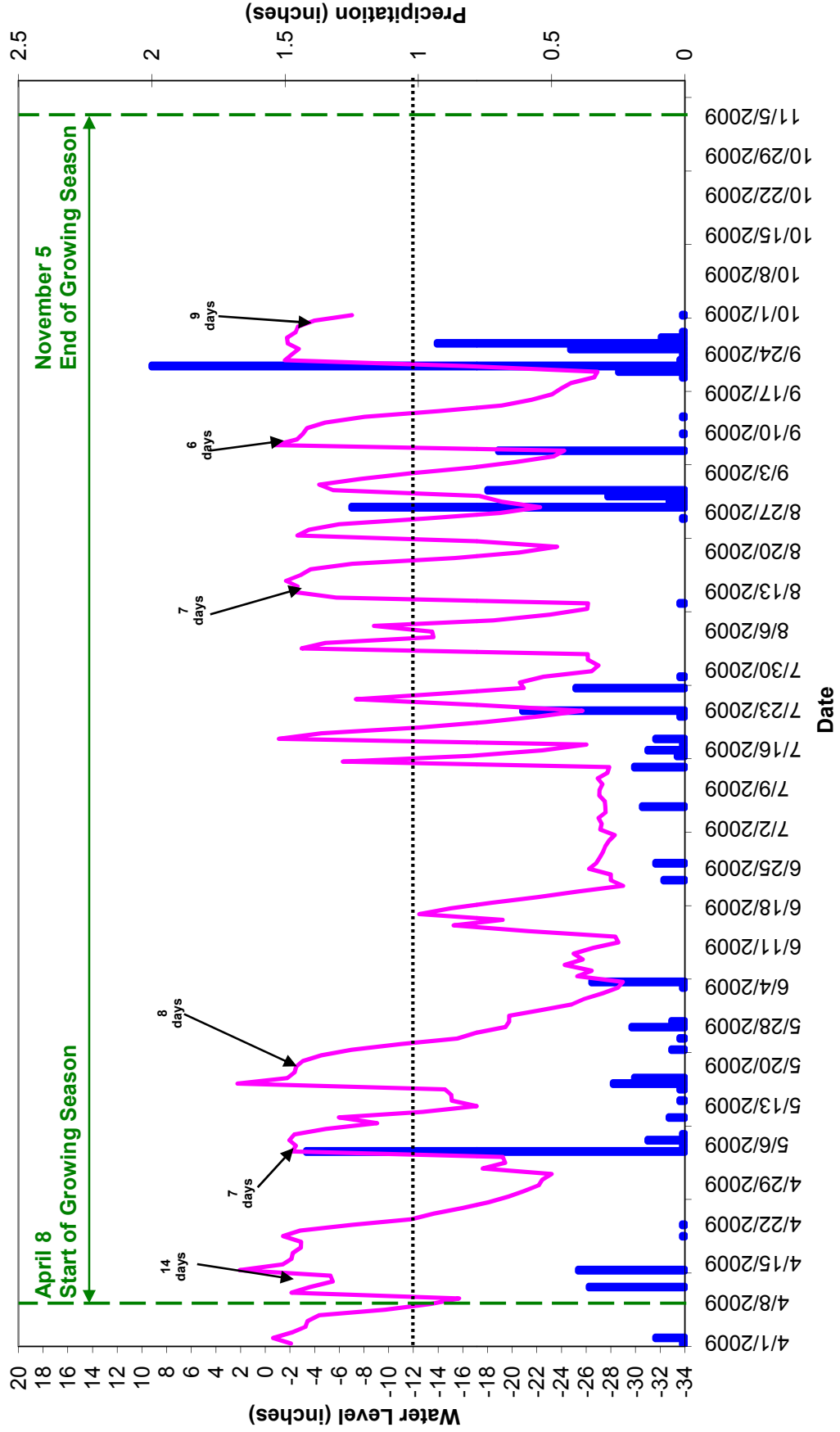


Lloyd Stream and Wetland Restoration Site
Year 3 (2009) Annual Monitoring
Stream Fixed Photo Stations
Taken August 2009 (continued)

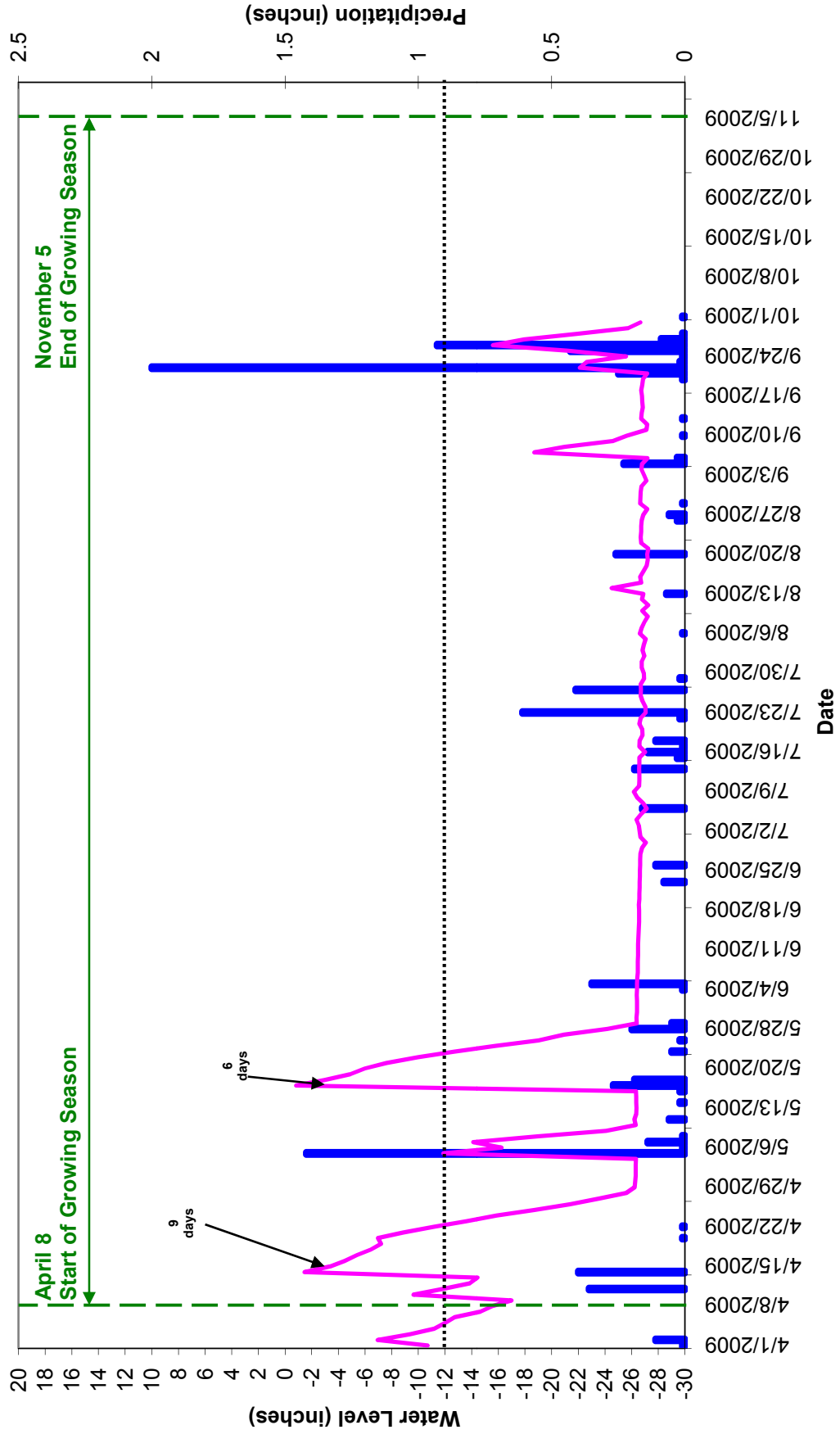


**APPENDIX C
HYDROLOGY DATA
2009 Groundwater Gauge Graphs**

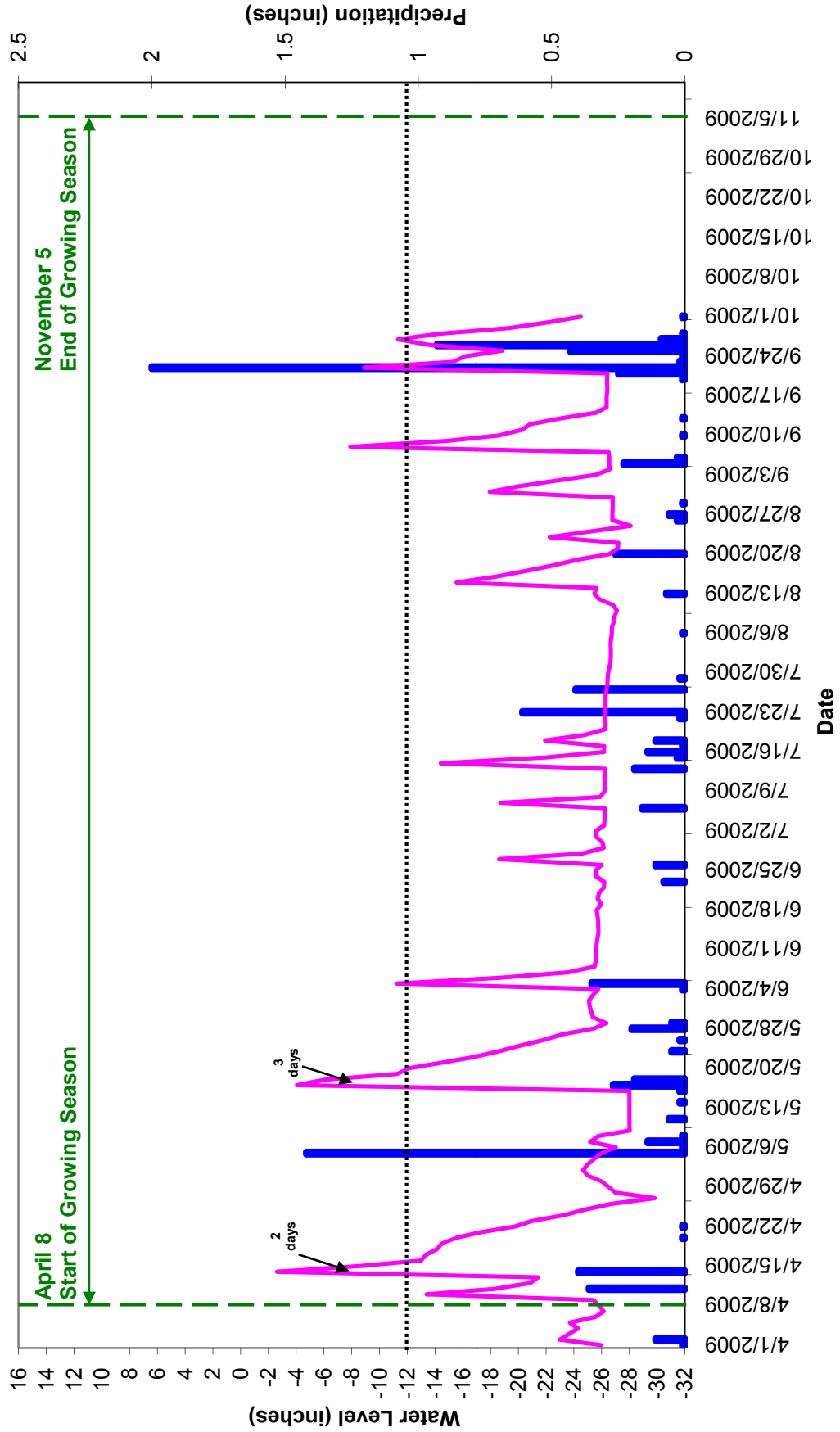
Lloyd Restoration Site - Groundwater Gauge LG1 Year 3 (2009 Data)



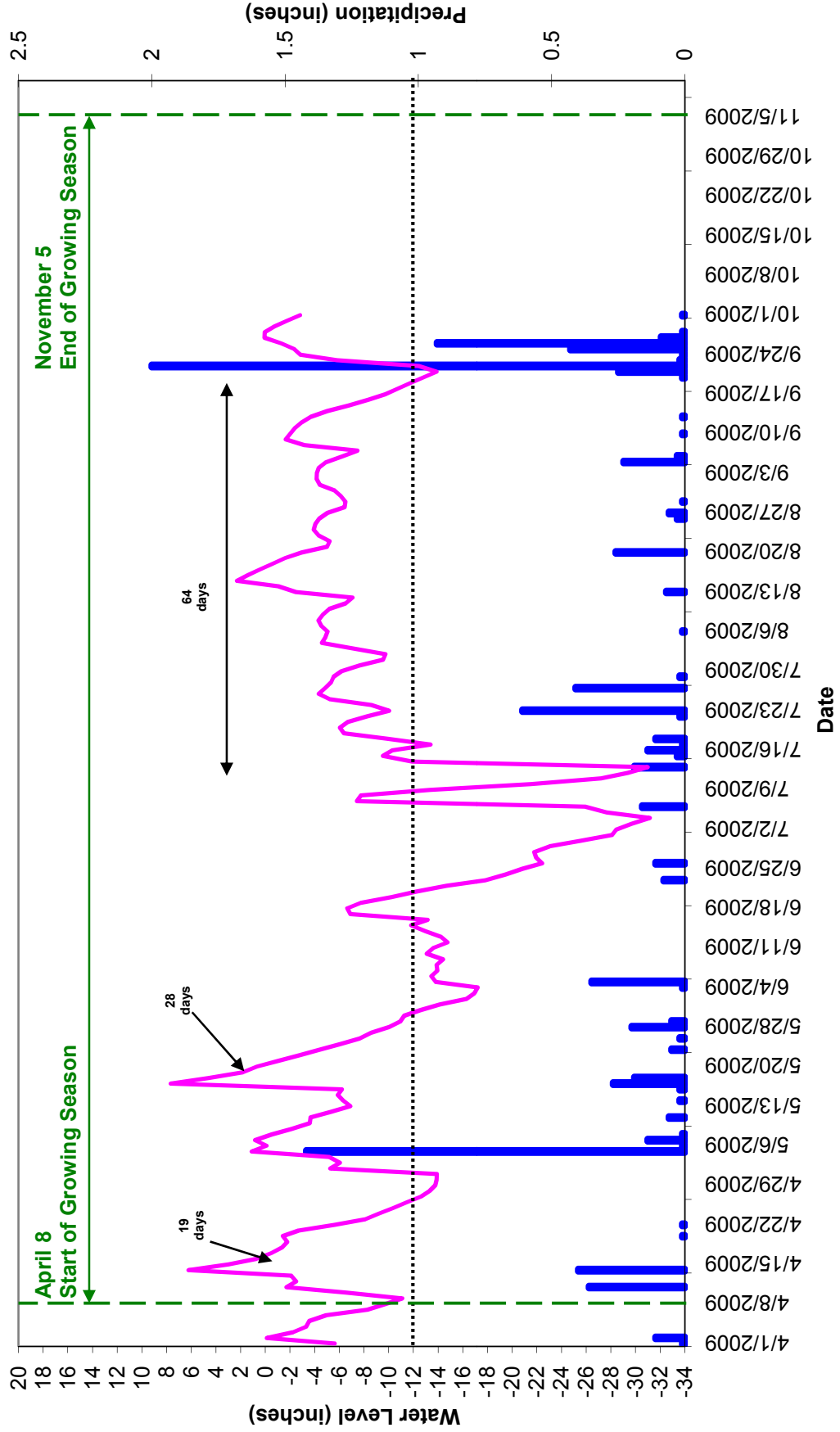
Lloyd Restoration Site - Groundwater Gauge LG2 Year 3 (2009 Data)



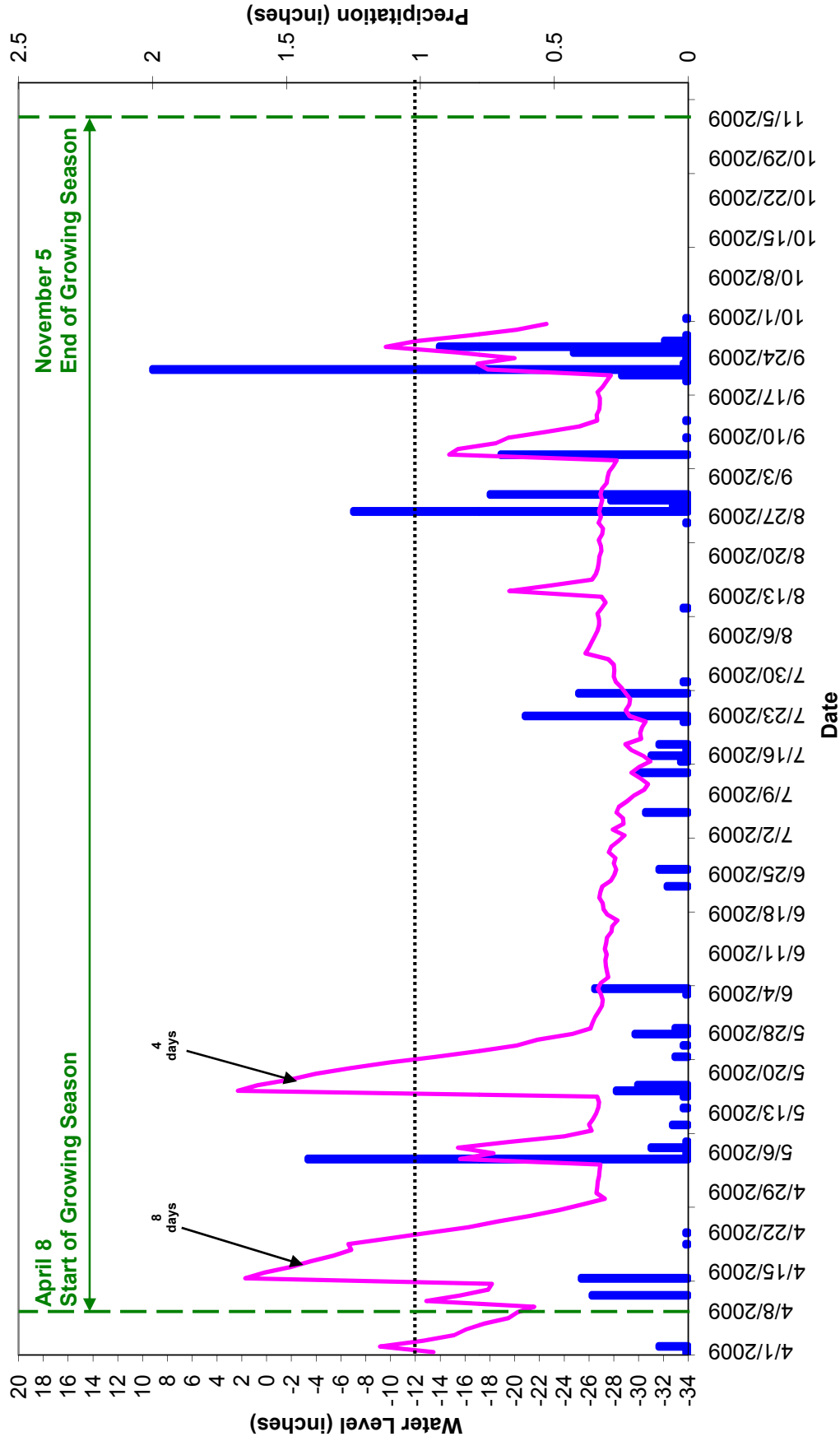
Lloyd Restoration Site - Groundwater Gauge LG3 Year 3 (2009 Data)



Lloyd Restoration Site - Groundwater Gauge LG4 Year 3 (2009 Data)



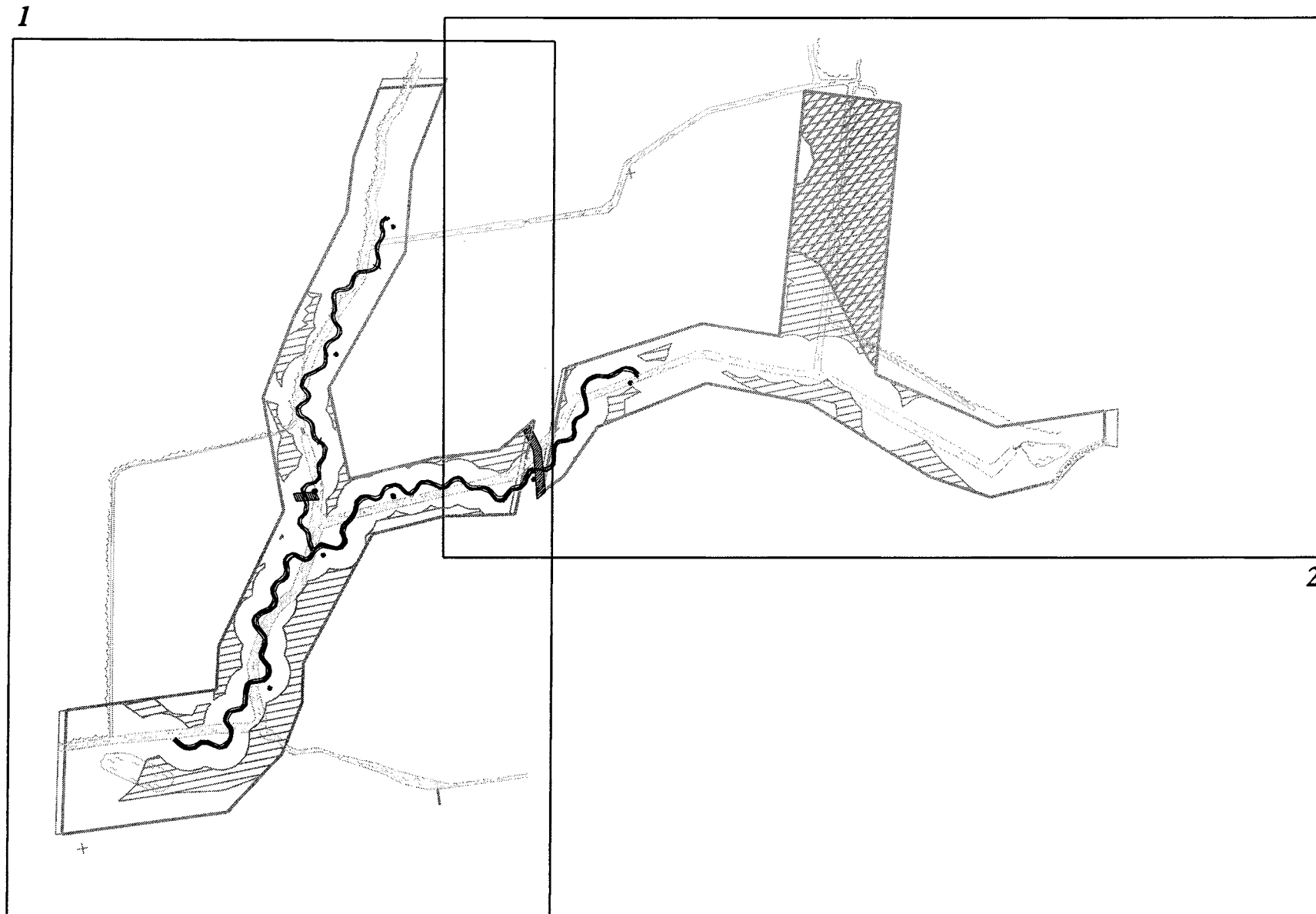
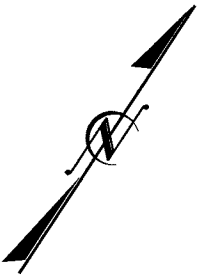
Lloyd Restoration Site - Groundwater Reference Gauge Year 3 (2009 Data)



APPENDIX D
MONITORING PLAN VIEWS

LLOYD STREAM AND RESTORATION RESTORATION SITE

ONslow COUNTY, NORTH CAROLINA
CONTRACT# 16-DO6003-1



G & M of North Carolina, Inc.
WWW.ARCADIS-US.COM
801 Corporate Center Drive, Suite 300
Raleigh, NC 27607-5073
Tel: 919/854-1282 Fax: 919/854-5448

BEN FURR
Project Manager

MONITORING PLANS

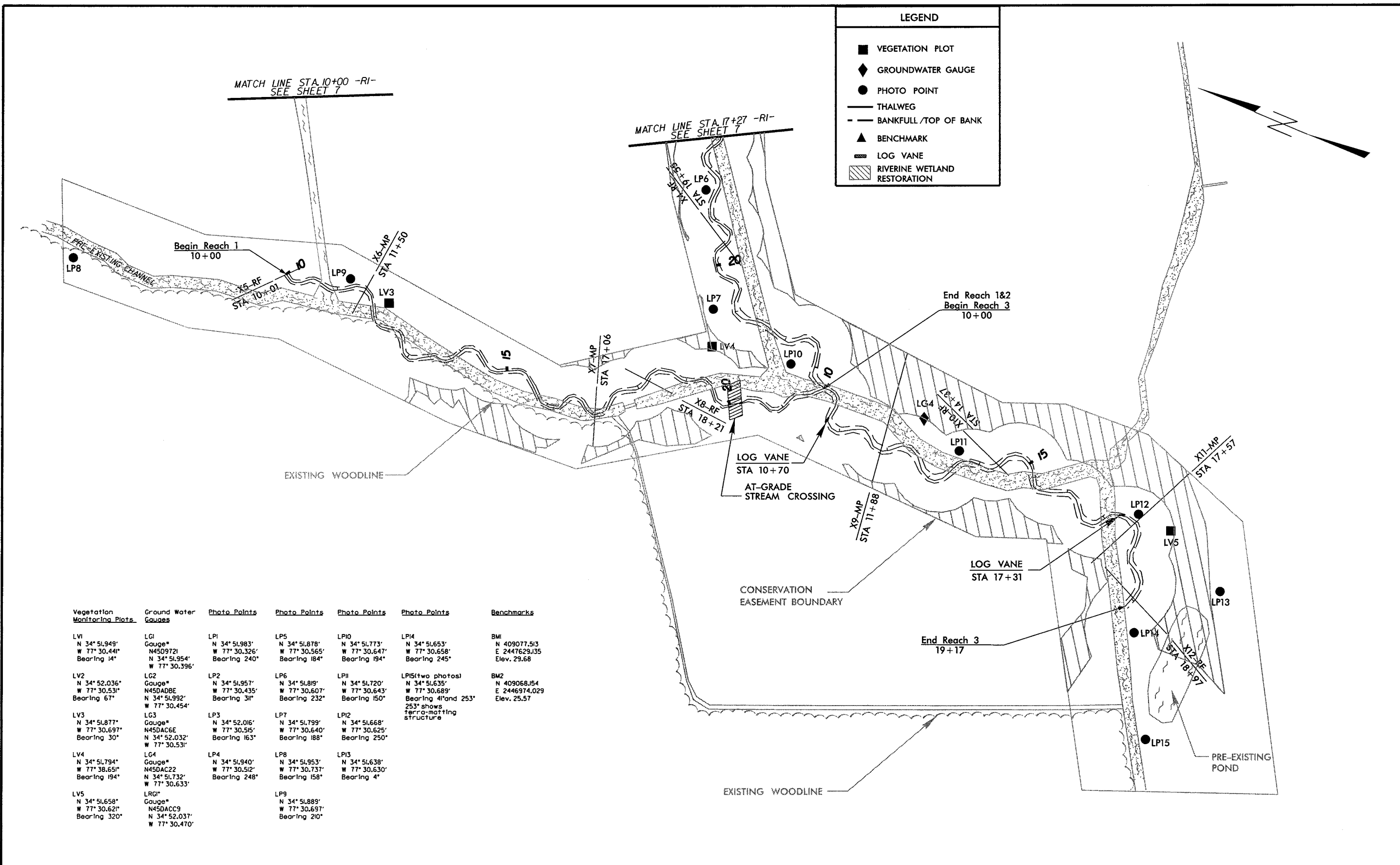
| NO. | BY | DATE | DESCRIPTION OF REVISION |
|-----|-----|----------|-------------------------|
| 5 | | | |
| 4 | | | |
| 3 | | | |
| 2 | | | |
| 1 | WMD | 12/31/07 | DATE OF COMPLETION |

Restoration Systems, LLC
1101 Haynes Street, Suite 107
Raleigh, NC 27604 (919) 755-9490

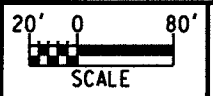
LLOYD STREAM AND WETLAND RESTORATION SITE
ONslow COUNTY, NORTH CAROLINA

Plan Map View

| LEGEND | |
|--------|------------------------------|
| ■ | VEGETATION PLOT |
| ◆ | GROUNDWATER GAUGE |
| ● | PHOTO POINT |
| — | THALWEG |
| - - - | BANKFULL /TOP OF BANK |
| ▲ | BENCHMARK |
| ▨ | LOG VANE |
| ▨ | RIVERINE WETLAND RESTORATION |



| Vegetation Monitoring Plots | Ground Water Gauges | Photo Points | Photo Points | Photo Points | Photo Points | Benchmarks |
|---|--|---|---|--|--|---|
| LV1 N 34° 51.949' W 77° 30.441' Bearing 14° | LG1 Gauge* N4509721 N 34° 51.954' W 77° 30.396' | LP1 N 34° 51.983' W 77° 30.326' Bearing 240° | LP5 N 34° 51.878' W 77° 30.565' Bearing 184° | LP10 N 34° 51.773' W 77° 30.647' Bearing 194° | LP14 N 34° 51.653' W 77° 30.658' Bearing 245° | BM1 N 409077.513 E 2447629.135 Elev. 29.68 |
| LV2 N 34° 52.036' W 77° 30.531' Bearing 67° | LG2 Gauge* N450ADBE N 34° 51.992' W 77° 30.454' | LP2 N 34° 51.957' W 77° 30.435' Bearing 31° | LP6 N 34° 51.819' W 77° 30.607' Bearing 232° | LP11 N 34° 51.720' W 77° 30.643' Bearing 150° | LP15(two photos) N 34° 51.635' W 77° 30.689' Bearing 41° and 253° 253° shows terra-matting structure | BM2 N 409068.154 E 2446974.029 Elev. 25.57 |
| LV3 N 34° 51.877' W 77° 30.697' Bearing 30° | LG3 Gauge* N45DAC6E N 34° 52.032' W 77° 30.531' | LP3 N 34° 52.016' W 77° 30.515' Bearing 163° | LP7 N 34° 51.799' W 77° 30.640' Bearing 188° | LP12 N 34° 51.668' W 77° 30.625' Bearing 250° | | |
| LV4 N 34° 51.794' W 77° 38.651' Bearing 194° | LG4 Gauge* N45DAC22 N 34° 51.732' W 77° 30.633' | LP4 N 34° 51.940' W 77° 30.512' Bearing 248° | LP8 N 34° 51.953' W 77° 30.737' Bearing 158° | LP13 N 34° 51.638' W 77° 30.630' Bearing 4° | | |
| LV5 N 34° 51.658' W 77° 30.621' Bearing 320° | LRG1 Gauge* N45DACC9 N 34° 52.037' W 77° 30.470' | | LP9 N 34° 51.889' W 77° 30.697' Bearing 210° | | | |



ARCADIS
 G & M of North Carolina, Inc.
 WWW.ARCADIS-US.COM
 801 Corporate Center Drive, Suite 300
 Raleigh, NC 27607-5073
 Tel: 919/854-1282 Fax: 919/854-5448

BEN FURR
 Project Manager

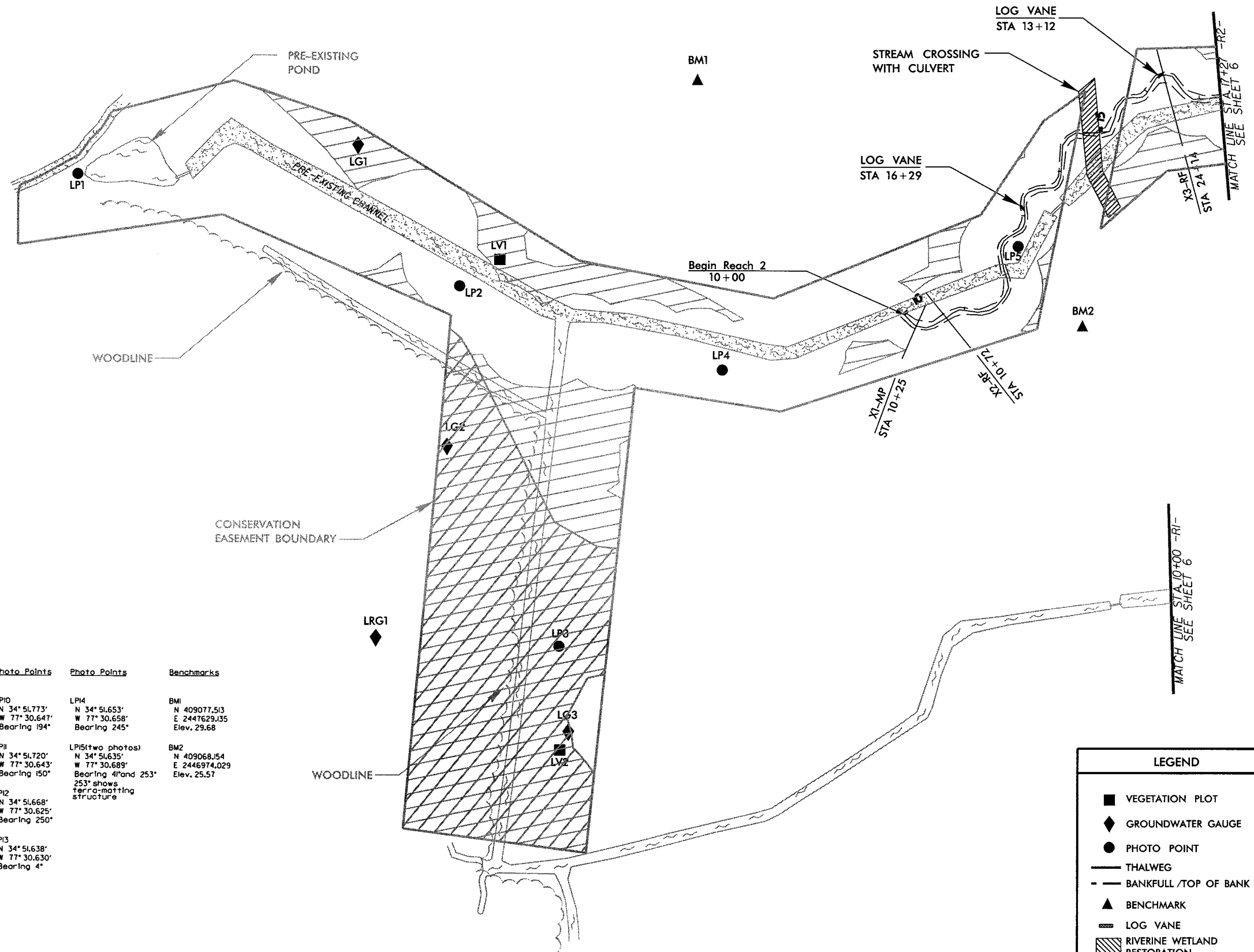
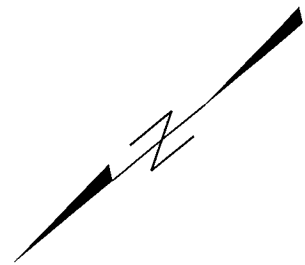
MONITORING PLANS

| NO. | BY | DATE | DESCRIPTION OF REVISION |
|-----|-----|----------|-------------------------|
| 5 | | | |
| 4 | | | |
| 3 | | | |
| 2 | | | |
| 1 | WMD | 12/31/07 | DATE OF COMPLETION |

Restoration Systems, LLC
 1101 Haynes Street, Suite 107
 Raleigh, NC 27604 (919) 755-9490

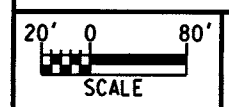
LLOYD STREAM AND WETLAND RESTORATION SITE
 ONSLOW COUNTY, NORTH CAROLINA

Monitoring Devices Sheet 1 of 2



| Vegetation Monitoring Plots | Ground Water Gauges | Photo Points | Photo Points | Photo Points | Photo Points | Benchmarks |
|---|---|---|---|--|--|---|
| LV1 N 34° 51.949' W 77° 30.441' Bearing 14° | LG1 Gauge* N45D9721 N 34° 51.954' W 77° 30.396' | LP1 N 34° 51.983' W 77° 30.326' Bearing 240° | LP5 N 34° 51.878' W 77° 30.565' Bearing 184° | LP10 N 34° 51.773' W 77° 30.641' Bearing 194° | LP14 N 34° 51.653' W 77° 30.658' Bearing 245° | BM1 N 409077.513 E 2447629.135 Elev. 29.68 |
| LV2 N 34° 52.036' W 77° 30.531' Bearing 67° | LG2 Gauge* N45DADBE N 34° 51.992' W 77° 30.454' | LP2 N 34° 51.957' W 77° 30.435' Bearing 31° | LP6 N 34° 51.819' W 77° 30.607' Bearing 232° | LP11 N 34° 51.720' W 77° 30.643' Bearing 150° | LP15 (two photos) N 34° 51.635' W 77° 30.689' Bearing 41 and 253° 253° shows terra-matting structure | BM2 N 409068.154 E 2446974.029 Elev. 25.57 |
| LV3 N 34° 51.877' W 77° 30.697' Bearing 30° | LG3 Gauge* N45DAC6E N 34° 52.032' W 77° 30.531' | LP3 N 34° 52.016' W 77° 30.515' Bearing 163° | LP7 N 34° 51.799' W 77° 30.640' Bearing 188° | LP12 N 34° 51.668' W 77° 30.625' Bearing 250° | | |
| LV4 N 34° 51.794' W 77° 38.651' Bearing 194° | LG4 Gauge* N45DAC22 N 34° 51.732' W 77° 30.633' | LP4 N 34° 51.940' W 77° 30.512' Bearing 248° | LP8 N 34° 51.953' W 77° 30.737' Bearing 158° | LP13 N 34° 51.638' W 77° 30.630' Bearing 4° | | |
| LV5 N 34° 51.658' W 77° 30.621' Bearing 320° | LRG1* Gauge* N45DACC9 N 34° 52.037' W 77° 30.470' | | LP9 N 34° 51.889' W 77° 30.697' Bearing 210° | | | |

| LEGEND | |
|--------|---------------------------------|
| | VEGETATION PLOT |
| | GROUNDWATER GAUGE |
| | PHOTO POINT |
| | THALWEG |
| | BANKFULL / TOP OF BANK |
| | BENCHMARK |
| | LOG VANE |
| | RIVERINE WETLAND RESTORATION |
| | NONRIVERINE WETLAND RESTORATION |



ARCADIS
 C & M of North Carolina, Inc.
 WWW.ARCADIS-US.COM
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| MONITORING PLANS | | | |
|------------------|-----|----------|-------------------------|
| 5 | | | |
| 4 | | | |
| 3 | | | |
| 2 | | | |
| 1 | WMD | 12/31/07 | DATE OF COMPLETION |
| | BY | DATE | DESCRIPTION OF REVISION |

Restoration Systems, LLC
 1101 Haynes Street, Suite 107
 Raleigh, NC 27604 (919) 755-9490

LLOYD STREAM AND WETLAND RESTORATION SITE
 ONSLOW COUNTY, NORTH CAROLINA

Monitoring Devices Sheet 2 of 2

BEN FURR
Project Manager