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Coastal Protection and Restoration Authority
Office of Coastal Protection and Restoration

2011 Operations, Maintenance, and Monitoring Report

for

Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26)

State Project Number TE-26
Priority Project List 3

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Terrebonne Parish

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Lake Chapeau Sediment Input and Hydrologic Restoration,
Point Au Fer Island
(TE-26)

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Preface

This report includes monitoring data collected through March 2011, and the annual maintenance inspection from May 2011.

The 2011 report is the 3rd report in a series of reports. For additional information on lessons learned, recommendations and project effectiveness please refer to the 2004 and 2007 Operations, Maintenance, and Monitoring Report on the LDNR web site.

I. Introduction

This report presents operations, maintenance, and monitoring data for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project. This is a 20-year Coastal Wetlands, Planning, Protection, and Restoration Act (CWPPRA, Public Law 101-646, Title III) project administered by the National Marine Fisheries Service (NMFS) and the Office of Coastal Protection and Restoration (OCPR). The project area contains 9,006 ac (3,645 ha) of brackish to intermediate marsh plus 4,543 ac (1,839 ha) of open water (NMFS 1994). This project, located on Point Au Fer Island, is bound to the northwest by Atchafalaya Bay, to the northeast by Four League Bay, and to the south by the Gulf of Mexico. It is located approximately 13 mi (20.9 km) southeast of the mouth of the Atchafalaya River in Terrebonne Parish (figure 1).

Marsh loss rates throughout Point Au Fer Island between 1932 and 1974 peaked at 45.45 ac/year (18.4 ha/yr) and occurred as a direct result of oil exploration activities (NMFS 1994). The rate of interior marsh loss has decreased since that time and is currently estimated to be 20.14 ac/yr (8.15 ha/yr) (1983-1990). Shoreline erosion along Lake Chapeau was estimated to be 3 ft/yr (0.91 m/yr) between 1932 and 1983. The land loss rate inside the TE-26 project boundary was approximately 106.9 ac/yr (43.3 ha/yr) between 1988 and 2000 (NMFS 1994). Oil and gas access canals cut into the interior of Point Au Fer Island have deteriorated the hydrologic separation between the Locust Bayou and Alligator Bayou watersheds and dramatically altered the island's natural drainage pattern (NMFS 1994). Sheet flow and over bank flow were drastically reduced by artificial levees, which in turn impounded marsh and led to degradation due to soil water logging. Due to unnatural hydrologic patterns the abundant sediment load generated by the Atchafalaya River circulating through the island's interior have not been effectively utilized. Additional assumed causes of land loss have been attributed to natural subsidence and natural shoreline erosion.

The objectives of the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project are to 1) convert approximately 168 ac (105 ha) of open water to marsh at final elevation of 0.5 ft (0.15 m) National Geodetic Vertical Datum of 1929 (NGVD29) or 0.346 ft (0.105 m) North American Vertical Datum of 1988 (NAVD88) west of Lake Chapeau between the Locust Bayou and Alligator Bayou watersheds using sediment mined from Atchafalaya Bay, and 2) restore natural sediment and hydrologic pathways by plugging canals in the project area. By plugging man-made canals the inland marshes would be preserved and protected from marine influences while reestablishing the original hydrologic regime (NMFS

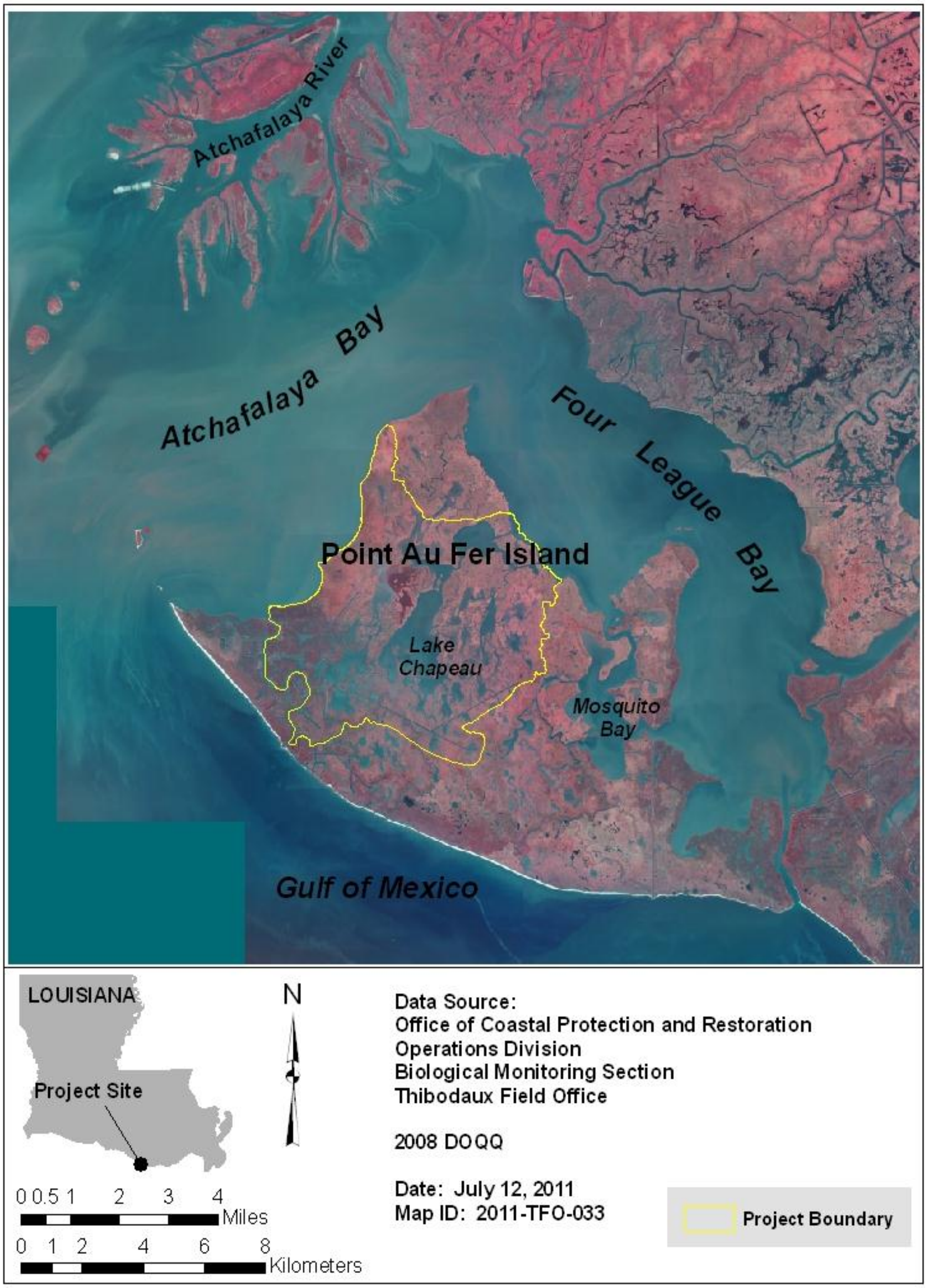


Figure 1. Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project boundary and features.

1998). Creating marsh north and west of Lake Chapeau would reestablish the hydrologic separation of the Locust Bayou and Alligator Bayou watersheds.

Construction for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project began on September 14, 1998, and was completed on May 18, 1999. The project has a 20-year life which began in May 1999.

The principal project features constructed include (figures 2 - 3):

- Dredging approximately 78 ac (32 ha) of Atchafalaya Bay water bottom to approximately -10.9 ft (-3.3 m) National Geodetic Vertical Datum of 1929 (NGVD29) or -11.1 ft (-3.4 m) North American Vertical Datum of 1988 (NAVD88) and pumping the 721,931 yd^3 (551,956 m^3) of sediment into a containment area approximately 193.6 ac (78 ha) in size to an initial target elevation of +1.5 ft (0.46 m) NGVD29 or 1.3 ft (0.40 m) NAVD88, with a final target elevation of 0.5 ft (0.15 m) NGVD29 or 0.346 ft (0.105 m) NAVD88 after consolidation.
- Construction of seven rock weirs across manmade oil access canals located along the fringes of the project area. Six of the weirs were built to a top elevation of -0.00 ft (0.0 m) NGVD29 or -0.15 ft (-0.05 m) NAVD88 with a crest width of 10 ft (3.0 m). One of the weirs included a boat bay constructed to an elevation of -4.0 ft (-1.2 m) NGVD29 or -4.17 ft (-1.27 m) NAVD88 with a fixed crest elevation of 0.0 ft (0.0 m) NGVD29 or -0.17 ft (-0.05 m) NAVD88. All of the weirs were constructed with a core of reef shell wrapped in a geotextile woven fabric layer, and then topped with 2 ft (0.61 m) of 250 lb (113.3 kg) class rock rip rap.
- Construction of a 167 ft (60 m) rock plug with a crest height of 5 ft (1.5 m) NGVD29 or 4.8 ft (1.5 m) NAVD88 along a shoreline breach created by the dredge pipeline along the east shoreline of the Atchafalaya Bay. The plug was built from 250 lb (113.3 kg) class rock rip rap core placed on top of a geotextile fabric layer.
- Dredging approximately 6,400 linear ft (1951 m) of Locust Bayou to a bottom elevation of -4.2 ft (-1.3 m) NGVD29 or -4.4 ft (-1.3 m) NAVD88 with an average width of 70 ft (21 m). Several 25 ft (7.62 m) gaps were cut into the spoil banks to allow for natural bank overflow and high water events.
- Note: All elevation conversions from NGVD29 to NAVD88 were calculated using Corpscon 6.0.

The following project feature was not part of the original project design but was added in May 1999, one growing season after dredge material placement, because of low natural recruitment of vegetation from the marshes surrounding the fill area:

- Installation of 46,980 vegetative plugs of *Spartina alterniflora* Loisel. (smooth cordgrass) throughout the fill area, placed on 5 ft (1.5 m) center spacings along randomly located paired rows also spaced 5 ft (1.5 m) apart (Coastal Environments 2000).

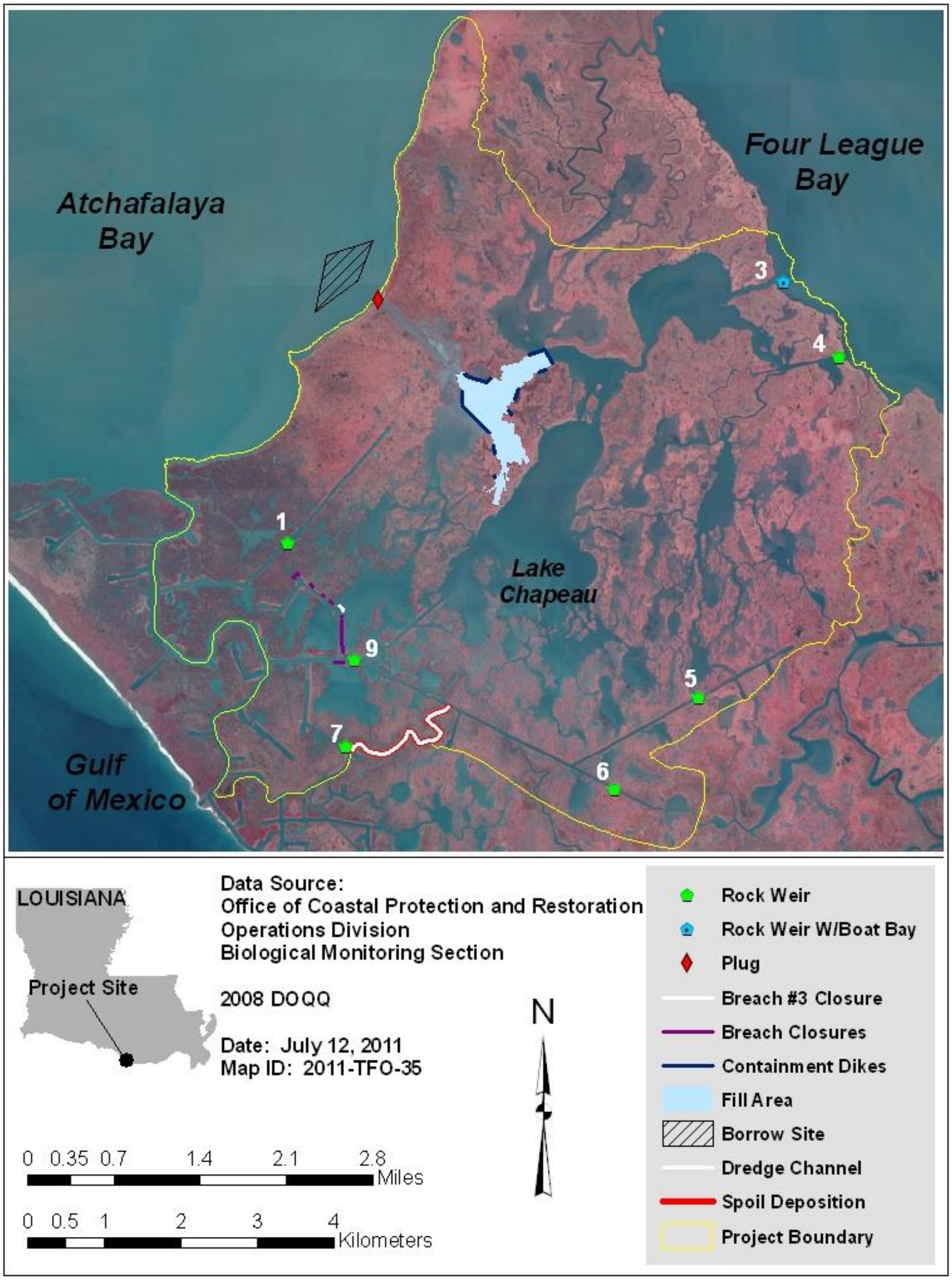


Figure 2. Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26), project boundary and features.

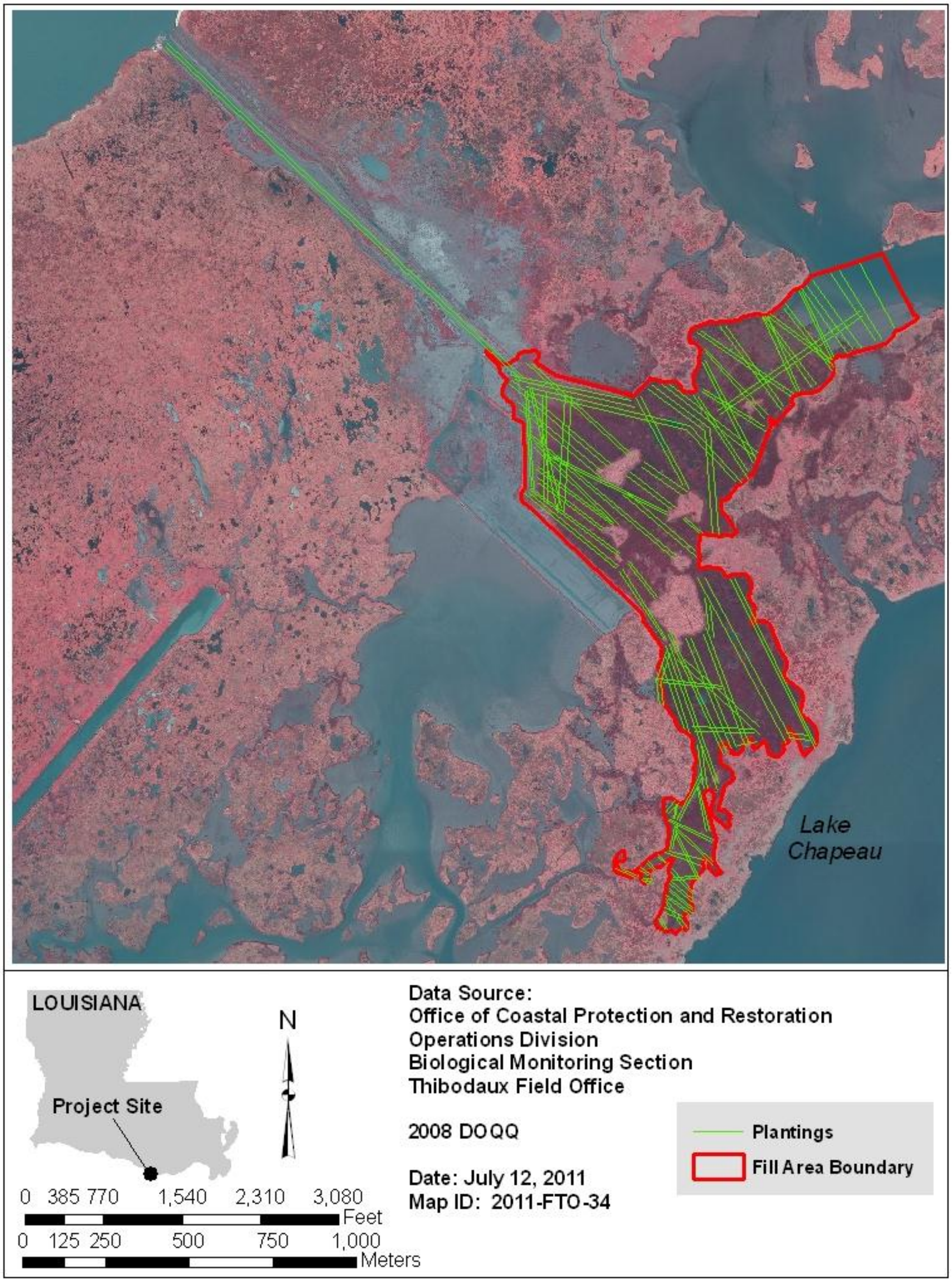


Figure 3. Location map indicating as-built plantings of *Spartina alterniflora* on the dredge material fill area for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.

II. Maintenance Activity

a. Project Feature Inspection Procedures

The purpose of the annual inspection of the Lake Chapeau Sediment Input and Hydrologic Restoration (TE-26) project is to evaluate the constructed project features and identify any deficiencies, prepare a report detailing the condition of project features, and recommended corrective actions needed. Should it be determined that corrective actions are needed, OCPR shall provide, in report form, a detailed cost estimate for engineering, design, supervision, inspection, construction, and contingencies, and an assessment of the urgency of such repairs (O&M Plan, 2002). The annual inspection report also contains a summary of past projects completed in the maintenance phase and an estimated projected budget for the upcoming three (3) years for operation, maintenance, and rehabilitation. The three (3) year projected operation and maintenance budget is shown in Appendix B. A summary of past operation and maintenance projects undertaken since the completion of the Lake Chapeau Project are outlined in Section II.c.

The annual inspection of the Lake Chapeau Sediment Input and Hydrologic Restoration Project (TE-26) took place on two separate days. The first trip was held on May 5, 2011 to inspect the weir sites located in the interior of the island (Site No. 1, 5, 6, 7 & 9) and the corridor closure along the east shoreline of the Atchafalaya Bay. In attendance were Shane Triche, Elaine Lear, and Adam Ledet from OCPR. The second trip was held on May 11, 2011 to inspect Site No.4 rock weir and observe the removal of the rock weir at Site No.3, which was in progress at the time of the inspection. In attendance for this trip were Shane Triche, Adam Ledet and Brian Babin with OCPR and Joy Merino with NMFS.

The field inspection included a complete visual inspection of the hydrologic restoration features of the project. The interior marsh creation feature of the project was not inspected due to the remote location of the fill area and difficulty in accessing the area. The crest elevations of the rock weirs on the interior of the island were not measured because the timber barricade system in front of the structures prevented access to the rock weirs. Where available, staff gauge readings were used to determine water elevations at the time of the inspection. Photographs taken during the inspection are compiled in Appendix A.

b. Project Description and History of Events

The final design of the Lake Chapeau project consisted of three (3) components, with additional project features added to address problems encountered during and after construction:

1. To re-establish a land bridge between Locust Bayou and Alligator Bayou, the first component was to hydraulically dredge approximately 721,931 cubic yards of material from the Atchafalaya Bay and spread to an average of two (2) feet thick to create

approximately 168 acres of marsh between these two bayous (D. Burkholder, Final Report n.d.).

2. The second component of the project (hydrologic restoration) consisted of the construction of seven (7) rock weirs in manmade canals around the perimeter of Lake Chapeau and gapping existing spoil banks in one channel. The rock weirs and spoil bank gappings are designed to help restore the natural circulation and drainage pattern within the central portion of Point Au Fer Island (D. Burkholder, Final Report n.d.). The principle project features of this component are:

   - Site No. 1 – Rock Weir – 150 linear feet (LF)
   - Site No. 3 – Rock Weir – 229 LF
   - Site No. 4 – Rock Weir – 174 LF
   - Site No. 5 – Rock Weir – 70 LF
   - Site No. 6 – Rock Weir – 145 LF
   - Site No. 7 – Rock Weir – 157 LF
   - Site No. 9 – Rock Weir – 240 LF

3. The third component of the project consisted of dredging a 6,700 foot long silted section of Locust Bayou to its original navigable depth. This was done to accommodate the increased flows resulting from the re-establishment of the island's natural drainage patterns. A total of 59,218 cubic yards of material was dredged and placed in 1.5 ft. high by 80 ft. wide spoil banks on both sides of the bayou. The spoil banks were gapped periodically so not to impede the flow of natural waterways and drainage (D. Burkholder, Final Report n.d.).

Engineering, Design and Construction administration for the Lake Chapeau project was performed by Burk-Kleinpeter (BKI) of New Orleans, LA under contract to the Louisiana Department of Natural Resources (LDNR). BKI utilized two subcontractors during the design phase of the project. T. Baker Smith, Inc. of Houma, LA performed the field surveys and Eustice Engineering Company, Inc. of Metairie, LA performed the geotechnical investigation of the weir sites. The sediment coring and geotechnical analysis of the borrow site in the Atchafalaya Bay were performed by C-K associates, Inc. of Baton Rouge, LA and was completed through an indefinite delivery contract with NMFS. Landrights necessary for construction of the project were obtained by the LDNR and included servitude agreements with three (3) landowners: Point Au Fer LLC/Archdiocese of New Orleans; Terrebonne Parish School Board; and the Louisiana Department of Wildlife and Fisheries. A letter of no objection was also obtained from the Louisiana State Lands Office for the dredging and placement of spoil material on state lands (D. Burkholder, Final Report n.d.).

Below is a timeline of significant events:

September 1995	Engineering design activities began
September 1996	Preliminary design report and deliverables submitted by BKI
June 1997	Final Design Completed

April 1998	All landrights necessary to proceed with construction completed
June 1998	Advertising for bids
July 1998	Bids for construction open
September 1998	Notice to proceed with construction issued to River Road Construction
January 1999	Breach 3 repaired/safety buoy installed (change order)
October 1999	Notice of Acceptance was issued by LDNR

c. Summary of Past Operation and Maintenance Projects

Below is a summary of maintenance projects completed since October 1999, the Notice of Acceptance date for the Lake Chapeau Sediment Input and Hydrologic Restoration Project (TE-26).

June 2000 – Repair of spoil bank breach by constructing a rock weir (breach site 3) and the repair and maintenance of five spoil bank areas by bucket dredging material in a canal located southwest of Lake Chapeau just west of plug Site No. 9. This work was performed by Johnny F. Smith Truck & Dragline Service, Inc. of Slidell, LA as part of the Point au Fer Project (TE-22) Phase III construction contract. Notice of Acceptance for this work was issued by LDNR in September 2000.

October 2004 – the first maintenance project on the Lake Chapeau project consisted of the removal and replacement of existing warning buoy system. The purpose of this project was to provide a more rigid barricade system at six (6) of the seven (7) weir sites for navigation safety and to prevent passage around the structure. The timber barricade system included timber piles driven every 20 ft across the existing channel with 4" diameter horizontal steel piping connecting the vertical timber piling. Each structure was marked with warning signs and reflective tape to allow visibility at night. The project was designed by Piciolla and Associates of Larose, La. and constructed by Dupre Brothers Construction Co., Inc. of Houma, LA. The project was completed in October 2004 at a total cost of $330,745.50 (Includes Engineering, Design, Bidding, Construction Administration, Inspection and Construction).

September 2005 – the second maintenance project included a breach repair on the south side of Structure No.3. The purpose of the project was to extend the rock weir by 50 linear feet on the south side of the structure. Articulated concrete mats were also used on the south side to slow future shoreline erosion and potential breaching. This work was perform in conjunction with maintenance work on the Point au Fer Project (TE-22), which consisted of breach closures adjacent to the rock dikes along Mobil and Transco Canals and the extension of the bulkhead at Structure No. 8. This work was performed by Luhr Bros., Inc. with construction oversight services provided by Picciola and Associates, Inc. of Cut Off, LA.

Other Non-Maintenance Projects constructed within the Lake Chapeau project area

November 2007 – Dedicated Dredge Program – Point au Fer Island

The Department of Natural Resources Dedicated Dredge Program was initiated in FY 98/99 and is funded 100% by the State of Louisiana through its statutorily dedicated Wetlands Conservation and Restoration Fund. The goal of this program is to use a small, mobile hydraulic dredge to move sediment from small inland waterways within the coastal zone of Louisiana and deposit the material to nourish and/or rebuild the threatened coastal marsh that are located immediately adjacent to those waterways.

The Point au Fer Island Dedicated Dredge Project is located on Point au Fer Island between the Atchafalaya Bay and Lake Chapeau in Terrebonne Parish. The project consisted of dredging approximately 295,000 cubic yards to fill a 60 acre site adjacent to the original Lake Chapeau dredge site and the linear corridor connecting the proposed fill area to the Atchafalaya Bay. Below is the construction cost estimate involved with the Point au Fer Island Dedicated Dredge Project:

Construction Cost: $2,461,650
Construction Administration: $ 107,000
Total: $2,568,650

d. Inspection Results

Site No. 1 – Rock Weir

A close inspection of Site No.1 was not possible due to a floating gate located approximately 500' southwest of the rock weir, preventing access to the canal. The rock weir appeared to be in good overall condition. There are no visible signs of erosion or breaching around the embankment tie-ins. The timber barricade system and warning signs also appeared to be in good overall condition. Two (2) timber piles were identified in the 2009 Annual Inspection to be missing their protective galvanized cap. Due to the floating gate, we were unable to get close enough to the structure to determine if these timber piles have experienced any deterioration due to weathering. The latest elevation data available from the 2004 survey profile of the structure indicates that the crest of the rock weir has settled approximately 1.39' since 1999. The newly set TE26-07 data recorder station, located approximately 600' from the structure, was reading a tide level of 1.0' NAVD88 at 10:25 AM, the time of the inspection of Site No. 1. (Appendix A, Photos 1 - 6)

Site No. 3 – Rock Weir with Boat Bay

As previously reported, there was a significant breach at the north embankment tie-in and a small breach developing on the southern embankment tie-in. It was determined this structure should not be repaired due to the excessive land loss occurring along the shoreline; with erosion rates exceeding 60 ft/year, it is no longer feasible to maintain the structure. It was decided to degrade the structure to an -8.0' NAVD88 elevation to remove the navigation hazard posed by the rock weir. At the time of the 2011 annual inspection, the degrading of the rock weir was in progress and subsequently completed at the completion of this report. (Appendix A, Photos 31 - 34)

Site No. 4 – Rock Weir

The rock weir appeared to be in good condition with no breaching around the ends. As in previous inspections, we found that the existing marsh connecting the structure to land on the south side of the weir was thin. However it didn't seem that there was any significant erosion since the last inspection. The timber barricade system appears to be in good condition. As previously reported, the two (2) center pilings are slightly unstable thought to be due to inadequate embedment and poor soil conditions. Also, a 10' section of pipe was cut by vandals on the northwest side of the structure. We do not believe the instability or cut section will have a detrimental effect to the structure, therefore there will be no recommendations for repair at this time, but will continue to monitor the situation on future inspections. (Appendix A, Photos 26 - 30)

Site No. 5 – Rock Weir

Site No.5 rock weir is in good overall condition. The embankment tie-ins showed no signs of marsh erosion or breaching. The barricade system and timber piles show no sign of damage or corrosion. The warning signs and supports are also in good condition. The latest elevation data from the 2004 survey profile of Structure No.5 indicates that the structure has settled on average of 0.14' from the designed elevation. (Appendix A, Photos 22 - 25)

Site No. 6 – Rock Weir

It was discovered during the 2008 Annual Inspection that the timber barricade system in front of the structure had been vandalized. Large sections (approximately 10 feet) on both of the steel pipe cross members had been cut with a torch and are missing. It remains our opinion that an attempt to repair the damage would be unsuccessful; therefore there are no recommendations for corrective actions at this time. Other than the cut sections, the barricade systems is in good condition with no signs of damage or corrosion. The rock weir appeared to be in good overall condition with no signs of erosion or breaching around the embankment tie-ins. The warning signs and supports are also in very good condition. From the 2004 profile survey of the structure, it was determined that the rock weir had settled an average of approximately 1.1 ft. (Appendix B, Photos 18 - 21)

Site No. 7 – Rock Weir

The Site No.7 rock weir was in good overall condition. There are no visual signs of erosion or breaching around the embankment tie-ins. The timber barricade system shows no signs of corrosion or deterioration due to weathering. The warning signs and supports have no apparent damage and appear to be in good condition also. Based on a survey profile of the rock weir in 2004, the structure has settled approximately 1.7' from its designed elevation. (Appendix A, Photos 13 - 16).

Site No. 9 – Rock Weir

The Site No.9 rock weir was in good overall condition. There are no visual signs of erosion or breaching around the embankment tie-ins. There is one timber supporting the pipe barricade that is missing its galvanized cap. At this time there is no recommendation for maintenance, however this area will continue to be monitored to determine if corrective actions are needed. The rest of the timber barricade system shows no sign of corrosion or deterioration due to weathering. The warning signs and supports have no apparent damage and appear to be in good condition. Based on a survey profile of the rock weir in 2004, the structure has settled approximately 1.7' from its designed elevation. (Appendix A, Photos 7 - 11). There is a small breach in the south canal bank near Site No.9 (located at point N29° 17m 4.4s W91° 17m 1.7s). Due to the location and the size of the breach, it not believed to be detrimental to the structure and that the rock weir is operating as designed. At this time there are no recommendations for corrective actions, but this site will continue to be monitored during future inspections to determine if the breach enlarges and requires maintenance.

e. Maintenance Recommendations

The structural components of the sites in the interior of the island (Site No. 1, 5, 6, 7 & 9) appear to be in overall good condition. The rock weirs appear to be in good condition with moderate settlement and displacement of the rock material and minor erosion at the bank tie-ins. The timber barricades and warning signs were in good condition, except for the two sections of pipe that were missing from Sites No.4 and 6.

Site No.4 rock weir appears to be in overall good condition. By comparing the current and past assessments, there seems to be no noticeable erosion along the shoreline. Based on the current short-term shoreline erosion rates, there is a chance Site No.4 will remain intact for the remainder of the project life, barring any extreme storm events. Based on these observations there are no recommendations for corrective actions at this time, but we will continue to monitor the condition of the marsh surrounding Site No.4 to determine the extent of the shoreline degradation.

At the time of the 2011 inspection, the degrading of Site No.3 rock weir was in progress. This structure was deemed ineffective due to the extreme erosion around the north end of the rock weir. It was decided the best course of action was to degrade the weir to a -8.0' NAVD88 so that it is no longer a navigational hazard. The degrading of the structure has been completed at the time of this report and Site No.3 will no longer be monitored or maintained as part of project TE-26.

III. Operation Activity

The Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project does not contain any features which require active operations.

III. Monitoring Activity

Pursuant to a CWPPRA Task Force decision on August 14, 2003 to adopt the Coastwide Reference Monitoring System-*Wetlands* (CRMS-*Wetlands*) for CWPPRA, updates were made to the TE-26 Monitoring Plan to merge it with CRMS-*Wetlands* and provide more useful information for modeling efforts and future project planning while maintaining the monitoring mandates of the Breaux Act. There are no CRMS sites located in the project area however, nearby sites CRMS0293, CRMS0305, and CRMS0309 will be used as references.

a. Monitoring Goals

The objectives of the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project are to convert approximately 168 ac* (67.98 ha) of open water to marsh at a mean elevation of 0.5 ft (0.15 m) National Geodetic Vertical Datum of 1929 (NGVD29) or 0.346 ft (0.105 m) North American Vertical Datum of 1988 (NAVD88) west of Lake Chapeau between the Locust Bayou and Alligator Bayou watersheds using sediment mined from Atchafalaya Bay, and to restore natural sediment and hydrologic pathways by plugging canals in the project area.

The following goals will contribute to the evaluation of the above objectives:

1. Create approximately 168 ac (67.98 ha) of marsh west of Lake Chapeau.
2. Decrease the water level variability within the project area.

* The monitoring plan (Lear 2003) states a goal of 168 ac (67.98 ha) of marsh creation; however, the polygon built for analyzing this data has an area of 193.6 ac (78.3 ha). This polygon is used for land:water analysis and for the topographic survey in the marsh creation portion of the project. The polygon used is the fill area boundary in figure 3 which uses the containment dikes and the marsh edge features built or used during construction.

b. Monitoring Elements

<u>Habitat Mapping</u>
Color-infrared aerial photography (1:24,000 scale) was obtained for project and reference areas in order to document vegetated and non-vegetated areas, changes in vegetative community type, and submerged aquatic vegetation (figure 4). The photography was photo-interpreted, scanned, mosaicked, geo-rectified, and analyzed by United States Geological Survey (USGS) National Wetlands Research Center (NWRC) personnel according to the standard operating procedure described in Steyer et al. (1995, revised 2000). Photography was obtained in 1994, 1997 (pre-construction), 2001 (post-construction), and in 2008. Habitat mapping was conducted on the 1994, 1997, and 2001 photography for the project and reference areas and land-water analysis was conducted on the fill area in the 1994 and 2001 photography (Appendix D; figures 1-6). Based upon recommendations when the Coastwide Reference Monitoring Station CRMS-*Wetlands* review was implemented, only a land-water analysis was conducted on the 2008 photography.

<u>Water Level</u>
To monitor water level variability, two continuous recorders were located within the project area and one continuous recorder was located in each of the two reference sites (figure 4).

Water level was recorded hourly. Hourly water level has been monitored continuously prior to construction in 1997-1998 and after construction in 1999 through 2011, and will continue through 2016. The locations of two of the four continuous recorder stations have been adjusted based upon requests from the federal sponsor following the CRMS-*Wetlands* review, and for logistical reasons.

Salinity

To monitor salinity variability, two continuous recorders were located within the project area and one continuous recorder was located in each of the two reference sites (figure 4). Salinity was recorded hourly. Mean daily water salinity has been monitored continuously prior to construction in 1997-1998 and after construction in 1999 through 2011, and will continue through 2016. The locations of two of the four continuous recorder stations have been adjusted based upon requests from the federal sponsor following the CRMS-*Wetlands* review, and for logistical reasons.

Vegetation

Dredge placement in the project area was completed in February 1999; however, vegetative plantings were not part of the original project design. Upon final inspection of the dredge material disposal area in May 1999, NMFS and LDNR personnel noted very little natural recruitment of vegetation and recognized the need for plantings. LDNR/CRD monitoring personnel randomly selected five 2 x 2 meter plots on the fill area and seven 2 x 2 meter plots in the natural marsh adjacent to the fill area in the fall of 1999 to begin monitoring vegetation. As a result of the May 1999 inspection, a total of 46,980 *Spartina alterniflora* Loisel. (smooth cordgrass) plugs were installed in April 2000 to establish vegetation on the exposed fill area (figure 5).

Species composition and percent cover were documented using the Braun-Blanquet method (Steyer et al. 1995; revised 2000) inside of 12 randomly selected 4 m^2 plots in order to monitor the plantings (figure 5). Seven reference plots and five project plots were sampled in 1999, 2001, 2004, 2007, 2008, and 2010 according to the standard operating procedure described in Folse et al. (2008). The plots were evaluated in the late summer or early fall, prior to plant senescence (from July 15 to September 15). Each plot was marked with a PVC pole on the southeast corner to allow personnel to revisit them over time. The 2008 data collection period was not part of the original monitoring plan however it was necessary to conduct damage assessment immediately after hurricane Katrina's landfall. Data collection will occur again in 2013 and 2016.

Topographic and Bathymetric Elevation Surveys

Originally, the monitoring plan included collection of sediment staff gauge data for the dredge material fill area; however, the gauges were never installed so monitoring for this variable was replaced with topographic and bathymetric elevation surveys. To document elevation changes in the dredge material fill area, the dredge borrow area, and a portion of the Locust Bayou channel bottom where dredging occurred, topographic and bathymetric elevation surveys were conducted twice in 1999 (pre-construction and as-built), and again in 2004 (five years post-construction).

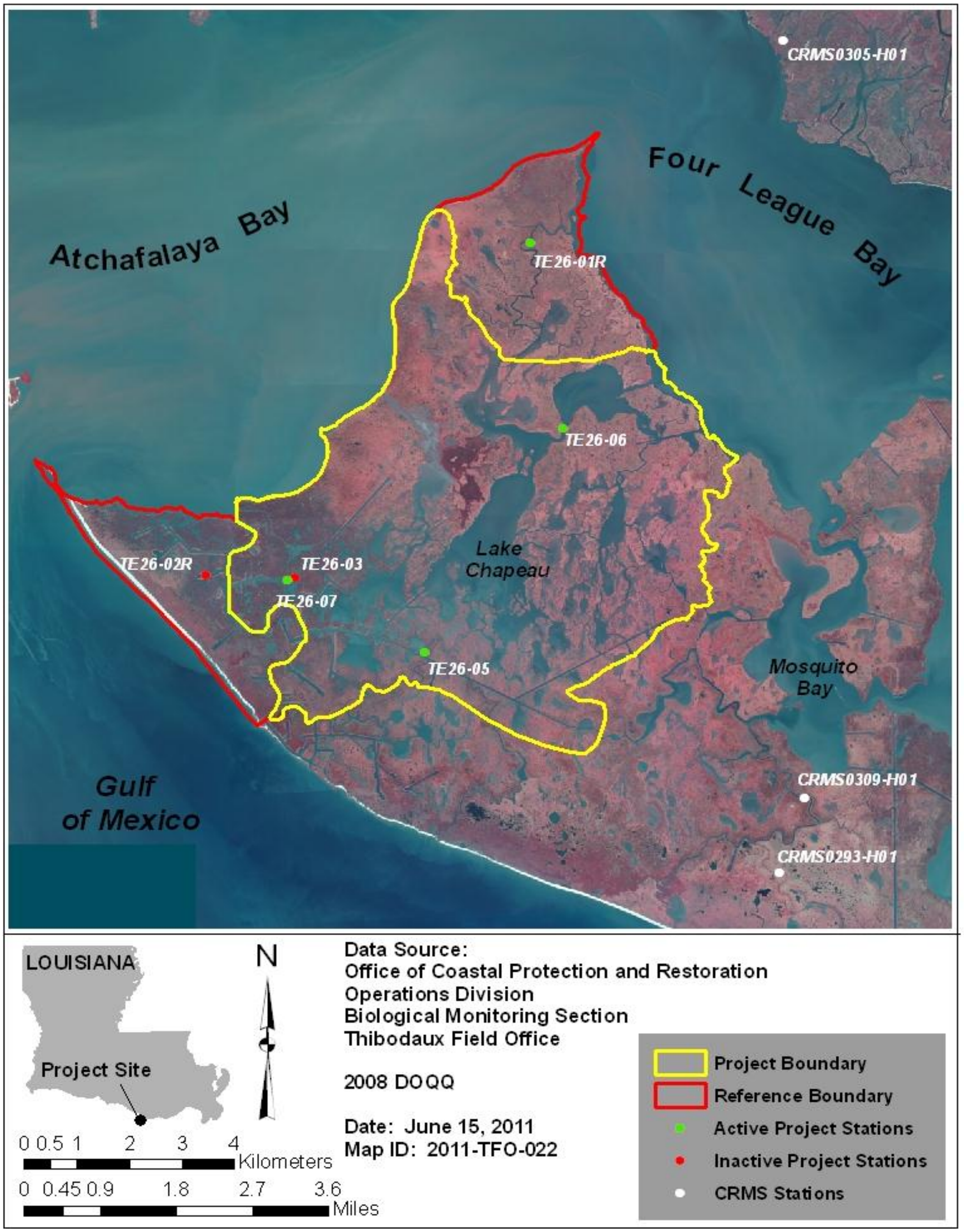


Figure 4. Location map of project-specific and CRMS-*Wetlands* continuous hydrographic stations, for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project. The project and reference boundaries were also used for the habitat and land-water analysis.

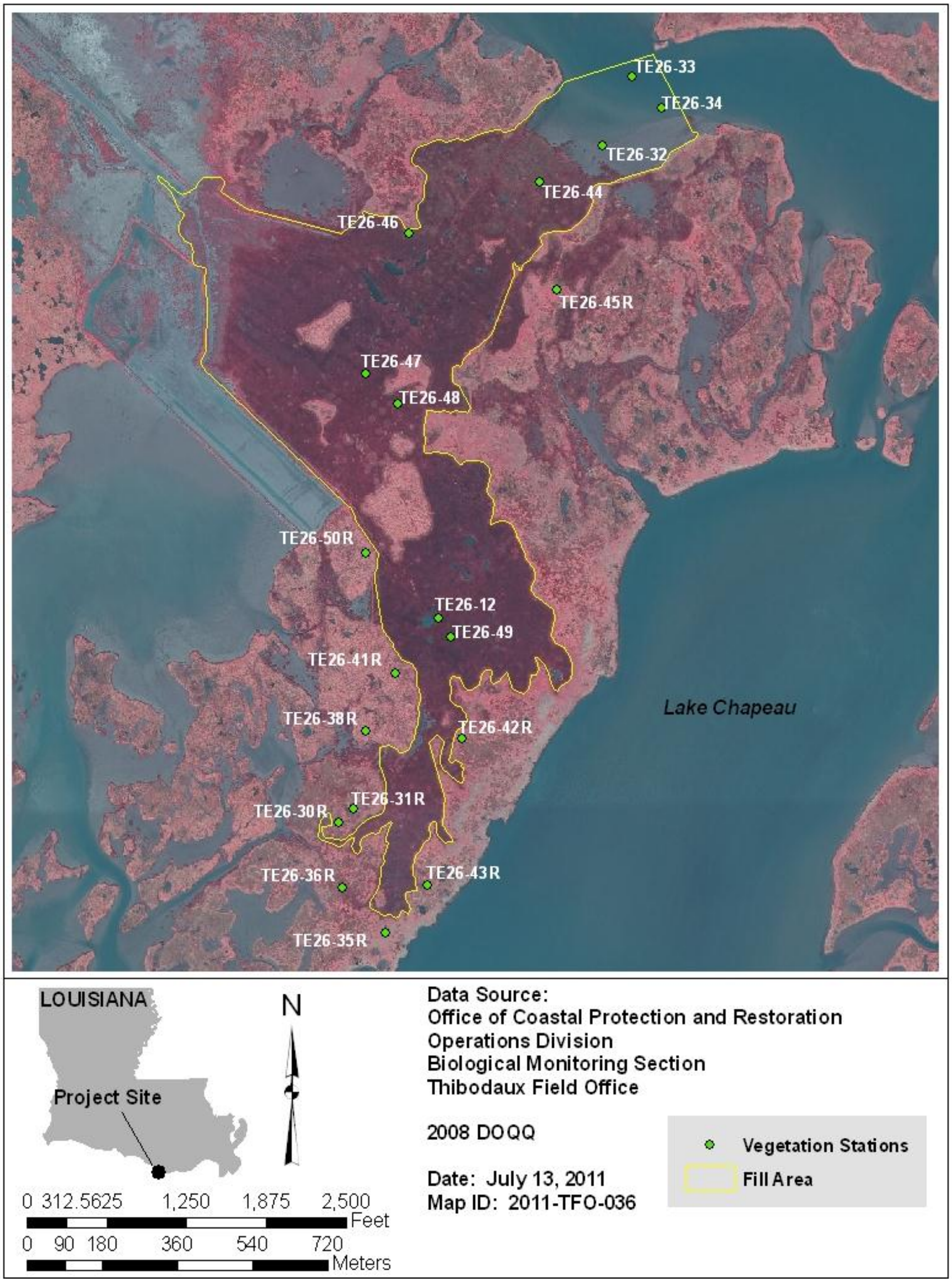


Figure 5. Vegetation Station locations for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.

CRMS Supplemental

In 2003, the CWPPRA Task Force adopted the Coastwide Reference Monitoring System CRMS-*Wetlands* program to evaluate the effectiveness of each constructed restoration project. CRMS-*Wetlands* provides a network or "pool" of reference sites that can be used to not only evaluate the effectiveness of individual projects but also hydrologic basins and entire coastal ecosystems. Each 1-km^2 CRMS-*Wetlands* site is monitored consistently according to a "Standard Operating Procedures" document with the following parameters collected at each site: hourly hydrographic (includes salinity, water level, and water temperature), monthly soil porewater salinity, semi-annual surface elevation and sediment accretion, annual emergent vegetation, land-water ratio estimated from aerial photography taken every three to four years, and soil properties collected once at each CRMS-*Wetlands* site.

CRMS-*Wetlands* is currently fully operational. Data collection has begun at all of the sites and data will be used to help support project-specific monitoring. The Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project does not have any CRMS-*Wetlands* monitoring sites within its project or reference boundaries however, there are three sites in the vicinity of the project (figure 4). Data collected from these CRMS-*Wetlands* sites along with future project-specific data collection efforts will provide a broader evaluation of project effectiveness. In this report, continuous recorder stations from three of the nearby CRMS-*Wetlands* sites will be used as references. They are CRMS0293-H01, CRMS0305-H01, and CRMS0309-H01. The water level and salinity data from these sites will be compared to the project-specific sites. Ancillary land-water data and vegetation data from these sites will also be presented in this report. In the future, data collected from the CRMS-*Wetlands* network over a sufficient amount of time to develop valid trends will be used to develop integrated data indices at different spatial scales (local, basin, coastal) to which we can compare project performance.

For the CRMS-*Wetlands* sites land-water analysis was performed on a 1.0 km^2 (0.4 mi^2) grid which encompassed each site. The U.S. Geological Survey's National Wetlands Research Center (USGS/NWRC) obtained 1.0 m (3.3 ft) resolution color infrared (CIR) aerial photography to delineate land and water habitats over time. An aerial image was captured between October and November 2005 for each site. This image was analyzed, interpreted, processed, and verified for quality and accuracy using protocols established in Folse et al. (2008). Specifically, habitats in the 1 km^2 (0.4 mi^2) were condensed to a land or water classification. Land was considered to be a combination of emergent marsh, scrub-shrub, wetland forested, and upland habitats. The open water, beach/bar/flat, and submerged aquatics (SAV) habitat classes were considered water. Once grouped into these two classes, the percentage of land and water and the land to water ratio for the pre-construction period were calculated. After the analysis was complete, the classification data and the photomosaic were mapped to spatially view the data.

Within each 1 km^2 (0.4 mi^2) site, vegetation stations were established in the marsh to document species composition and percent cover over time. Ten (10) plots were placed inside the 200 m^2 (239 yd^2) square, which is nested within the 1.0 km^2 (0.4 mi^2) square, as per Folse et al. (2008). Vegetation data were collected in the fall months in 2006, 2007, 2008, 2009, and 2010 via the semi-quantitative Braun-Blanquet method (Mueller-Dombois and Ellenberg 1974; Sawyer and Keeler-Wolf 1995; Barbour et al. 1999). Plant species inside each $4m^2$ plot were identified, and cover values were ocularly estimated using Braun-Blanquet units (Mueller-Dombois and Ellenberg 1974) as described in Folse et al. (2008). The cover classes used were: solitary, <1%, 1-5%, 6-25%, 26-50%, 51-75%, and 76-100%. After sampling the plot, the residuals within a 5 m (16 ft) radius were inventoried.

c. Preliminary Monitoring Results

Habitat Mapping

The USGS/NWRC personnel completed scanning, geo-rectification and production of photomosaics for aerial photography flown in 1994, 1997, 2001, and 2008 (Appendix D; figures 1-4). Habitat analysis was conducted on the 1994, 1997, and 2001 photography and yielded pre-construction and post-construction acreages for the habitat classes found in the project and reference areas. Fill area land-water analysis on the 1994 and 2001 photography indicates that the acreage of land increased by 139.5 (56.5 ha) acres between 1994 and 2001, while the acreage of water correspondingly decreased (Appendix D; figures 5-6). The increase can be attributed to the addition of dredge material. Habitat analysis was dropped as a result of the CRMS-*Wetlands* review, and it was replaced with land-water analysis beginning with the 2008 photography.

For this report, the 1994, 1997, and 2001 habitat classes were consolidated into land or water acreages using the Steyer et al. (1995) protocol so that comparisons could be made to the 2008 land-water data in both the project and reference areas. Land was considered to be a combination of non-fresh marsh, upland barren, agriculture/range, upland scrub-shrub, urban, non-fresh wetland scrub-shrub, and fresh wetland scrub-shrub. The non-fresh mud flat and non-fresh open water habitat classes were considered water. Once grouped into land or water classes, the acreages of land and water for each year of photography were calculated. The annual change rates were calculated using the acreages, the number of days between photography and the number of days in a year (tables 1-2).

Table 1. Land-water analysis inside the project area indicating change rates between each year of photography as well as between the first and last year of photography.

	Project Change Rates ac/yr^{-1} (ha/yr^{-1})			
	1994-1997	**1997-2001**	**2001-2008**	**1994-2008**
Land	-61.8 (-25.0)	52.9 (21.4)	-66.8 (-27.03)	-30.4 (-12.3)
Water	61.8 (25.0)	-52.9 (-21.4)	66.8 (27.03)	30.4 (12.3)

Table 2. Land-water analysis inside the reference areas indicating change rates between each year of photography as well as between the first and last year of photography.

	Reference 1 Change Rates ac/yr^{-1} (ha/yr^{-1})				**Reference 2 Change Rates ac/yr^{-1} (ha/yr^{-1})**			
	1994-1997	**1997-2001**	**2001-2008**	**1994-2008**	**1994-1997**	**1997-2001**	**2001-2008**	**1994-2008**
Land	-16.5 (-6.7)	1.7 (0.69)	-21.5 (-8.7)	-13.6 (-5.50)	-1.2 (-0.49)	-7.4 (-2.99)	-13.1 (-5.30)	-10.0 (-4.0)
Water	16.5 (6.7)	-1.7 (-0.69)	21.5 (8.7)	13.6 (5.50)	1.2 (0.49)	7.4 (2.99)	13.1 (5.30)	10.0 (4.0)

Prior to construction in 1999 there was land to water conversion inside the project and reference areas from 1994 through 1997. Conversely, there was a substantial change from water to land in the project area between 1997 and 2001, primarily due to the creation of the fill area in May 1999. Reference area 1 also experienced a conversion of water to land, but not as much as the project area, while reference area 2 continued to convert to open water. Between 2001 and 2008, conversion of land to water was still apparent in all areas. Although the TE-26 project and reference areas experienced declines in land habitat during the post-construction period, the fill area shows only minor signs of erosion.

Water level

Initially, four project-specific continuous recorder stations were established, TE26-01R, TE26-02R, TE26-03, and TE26-05 (figure 4). Two were located within the project boundary and the remaining two were located within the two reference areas to the west and east of the project boundary. Hourly raw water level readings were taken by each recorder. All of the water level data were adjusted to a new elevation survey conducted in 2003 in order to tie the data into the LDNR secondary network of monuments. Installation of four new staff gauges to replace the old ones at each of the continuous recorder stations was contracted and completed in 2003. The Global Positioning System (GPS) static survey scope for this contract required the adjustment of each staff gauge and nail elevation at each constant recorder station to the Louisiana Coastal Zone GPS network.

In recent years, two of the four continuous recorder stations have been inactivated and replaced. Continuous recorder station TE26-02R on the western side of the island was inactivated in response to requests from the federal sponsors to establish more stations inside of the weirs. Additionally, this station was located in a keyhole oil field canal that was silting in and could no longer be accessed during the winter months when tides were low. Continuous recorder station TE26-06 was established on the eastern portion of Point Au Fer Island to address these issues. Continuous recorder station TE26-03 was completely destroyed due to activity on the island by a recreational houseboat owner. The station location was gated off and Office of Coastal Protection and Restoration (OCPR) contractors no longer had access to it. Continuous recorder station TE26-07 was established in the adjoining canal to replace it. Date range data collection histories for these recorders are shown in table 3.

In addition to the six project-specific stations, three nearby *CRMS-Wetlands* continuous recorder stations were established in 2006; CRMS0293-H01, CRMS0305-H01, and CRMS0309-H01. In this report, the CRMS-*Wetlands* stations were used as reference stations for purposes of data analysis. Date range data collection histories for these recorders are shown in table 3.

Table 3. Project-specific and CRMS-*Wetlands* continuous recorder stations data collection date range histories, for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.

Station	Data Collection Period
Project-Specific Stations	
TE26-01R	04/14/1997 - Present
TE26-02R	04/24/1997 - 11/28/2007
TE26-03	04/24/1997 - 09/24/2008
TE26-05	01/20/1998 - Present
TE26-06	02/08/2008 - Present
TE26-07	02/12/2009 - Present
CRMS-*Wetlands* Stations	
CRMS0293-H01	06/07/2006 - Present
CRMS0305-H01	12/06/2006 - Present
CRMS0309-H01	06/15/2006 - Present

Results presented in the 2007 OM&M report for this project included data collected from the four original project-specific continuous recorders for the time period from April 1997 through December 2006 (Lear and Triche 2007). Continuous recorder hourly data was analyzed for mean weekly water levels and hourly water level variation. In this report, analysis will include continuous water level data from all project-specific and CRMS-*Wetlands* continuous recorders active from January 2007 through March 2011 (table 3).

Since Stations TE26-02R and TE26-03 were deactivated on November 28, 2007 and September 24, 2008 respectively, data from January 1, 2007 up to these deactivation points are included. Stations TE26-06 and TE26-07 were activated on February 8, 2008 and February 12, 2009, respectively. All other stations were continuously active during the report period. Hourly readings were averaged over each day and these daily means were averaged to obtain weekly means. Analysis of weekly means minimizes variation due to diurnal tides that occur in the project area. Tidal cycles often span more than one day; consequently, analyzing data on a daily basis does not account for the tidal cycle. Sites were split into two groupings based on geographical proximity, an East group (Group 1) and a South group (Group 2). Group 1 included stations TE26-01R, TE26-06, and CRMS0305-H01. Group 2 included stations TE26-02R, TE26-03, TE26-05, TE26-07, CRMS0293-H01, and CRMS0309-H01.

Analysis of mean weekly water levels indicate significant variation in water level among sites in both Group 1 and Group 2 (Group 1: $p<10^{-16}$; Group 2: $p<10^{-16}$). Within Group 1, mean water level is significantly different for all pairwise comparisons of stations. Site CRMS305-H01 had the highest average water level, but is closely followed by project site TE26-06 which is only 0.02 ft. lower. Compared with reference site TE26-01R, both CRMS305-H01 and TE26-06 show relatively larger differences in average water level; CRMS305-H01 was on average higher by 0.18 ft. and TE26-06 was higher by 0.16 ft. Variance in water elevation is similar at the three sites. TE26-06 has the highest variance (0.18 ft^2), but is closely followed by CRMS305-H01 (0.17 ft^2) and TE26-01R (0.16 ft^2).

Similarly, within Group 2 mean water level is significantly different for all pairwise comparisons, with the exception of the difference between site CRMS309-H01 and project site TE26-07 (0.013 ft). Except in this one insignificant result, the two CRMS reference sites, CRMS309-H01 and CRMS293-H01, have mean water levels significantly higher than all other sites (range: 0.05-0.3 ft.). Site CRMS293-H01 has the highest mean water level, exceeding CRMS309-H01 by 0.06 ft. The project reference site, TE26-02R, was on average lower than project sites TE26-05 (-0.11 ft.) and TE26-07 (-0.17 ft.), but marginally higher than TE26-03 (0.083 ft.). Within the project, TE26-03 has the lowest mean elevation and is lower than TE26-05 by 0.2 ft. and TE26-07 by 0.25 ft. TE26-05 and TE26-07 differ by only 0.06 ft.

Variances in elevation show no clear pattern, with CRMS309-H01 and project site TE26-07 having equally high variances (both 0.18 ft^2). Sites CRMS293-H01 and TE26-05 are slightly lower with variances of 0.16 and 0.15 ft^2 (respectively). The remaining two sites, reference site TE26-02R and project site TE26-03 both show substantially lower variances (both 0.10 ft^2).

<u>Salinity</u>
Station locations and data collection durations for salinity data are the same as those presented under the “Water Level” data collection section of this report (figure 4; table 3). The same project-specific and CRMS-*Wetlands* continuous recorder stations used to collect water level data were used to collect salinity data.

Results presented in the 2007 OM&M report for this project included data collected from the four original project-specific continuous recorders for the time period from April 1997 through December 2006 (Lear and Triche 2007). Continuous recorder hourly data was analyzed for mean weekly salinity which was adjusted for biofouling, and hourly salinity variation.

In this report, analysis will include adjusted salinity data from all project-specific and CRMS-*Wetlands* continuous recorders active from January 2007 through March 2011 (table 3). Hourly readings were averaged over each day and these daily means were averaged to obtain weekly means. The use of average weekly means helped to reduce the effects of diurnal tides. Sites were split into two groupings based on geographical proximity, an East group (Group 1) and a South group (Group 2). Group 1 included stations TE26-01R, TE26-06, and CRMS0305-H01. Group 2 included stations TE26-02R, TE26-03, TE26-05, TE26-07, CRMS0293-H01, and CRMS0309-H01.

As with mean weekly water elevation, significant variation was present within both Group 1 ($p<10^{-16}$) and Group 2 ($p<10^{-16}$) for mean weekly salinity. Within Group 1 salinity is significantly different for all pairwise comparisons. Both the TE-26 reference site (TE26-01R) and project site (TE26-06) are more saline than the CRMS305-H01 reference site (on average 2.0 and 2.2 ppt greater, respectively). In contrast, the two TE-26 sites are similar, with the project site TE26-06 having a slightly higher salinity than the reference site TE26-01R (on average 0.2 ppt).

Similarly, within Group 2 nearly all sites show significant differences in salinity, with the exception of CRMS0309-H01 and TE26-03 for which salinity differed by only 0.05 ppt. Reference site TE26-02R consistently shows higher salinities when compared with all other sites, the differences ranging from 1.9 to 4.4 ppt on average. On the other end of the spectrum, project sites TE26-05 and TE26-07 have consistently lower salinities than all other sites (average differences of 1.1-2.2 ppt), with TE26-05 exceeding TE26-07 by only 0.6 ppt. In between these two extremes are project site TE26-03 and CRMS sites CRMS293-H01 and CRMS309-H01. Project site TE26-03 has salinities greater than TE26-05 and TE26-07 (1.2 and 1.8 ppt, respectively), but slightly lower than CRMS293-H01 and CRMS309-H01 (0.4 and 0.05 ppt, respectively). Lastly, salinities for the two CRMS sites are greater than all other sites with the exception of the aforementioned TE26-02R.

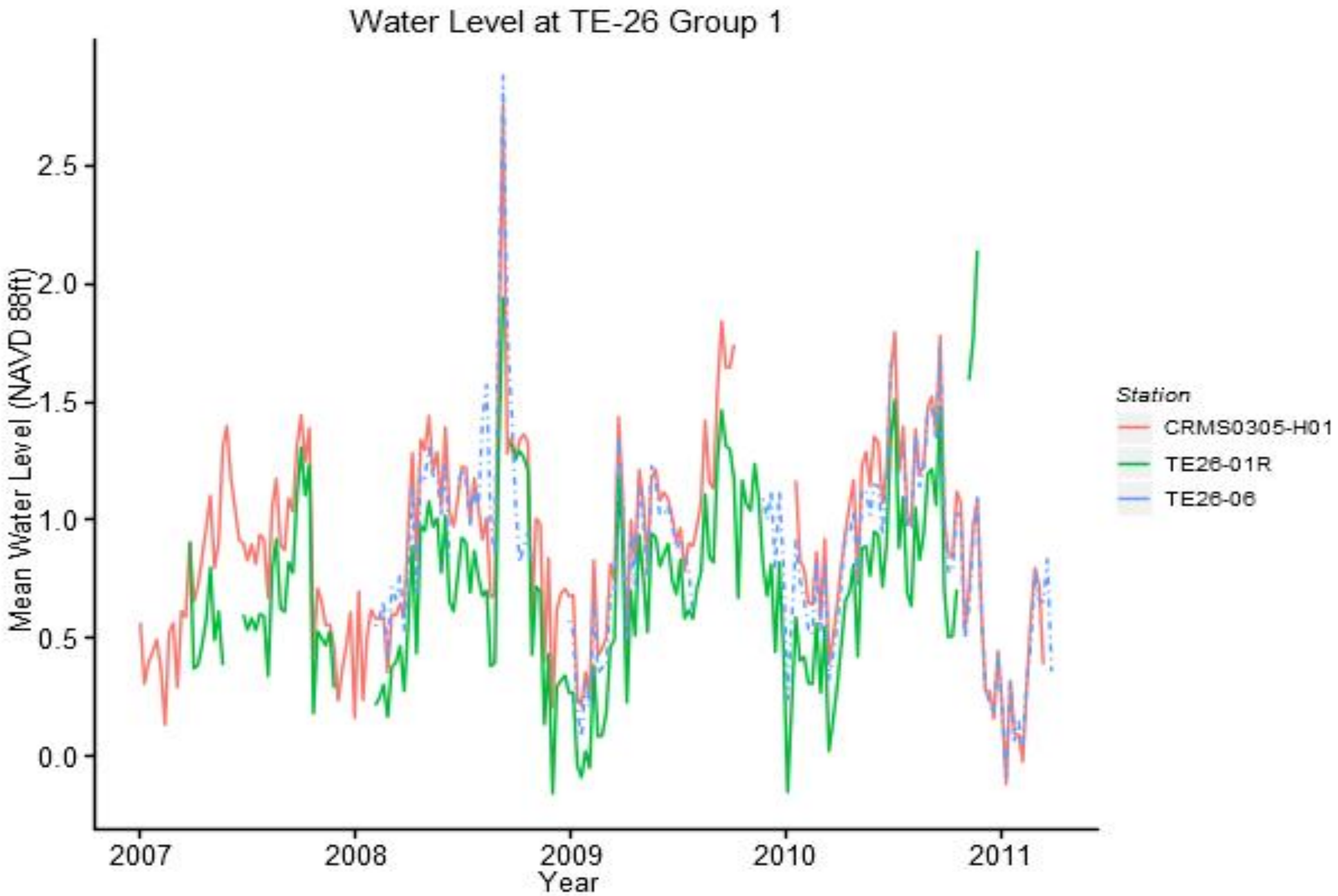


Figure 6. Comparative mean weekly water levels for project-specific and reference continuous recorders, as well as the CRMS-*Wetlands* reference continuous recorder in data analysis group 1. For the Lake Chapeau Sediment Input and Hydrologic Restoration , Point Au Fer Island (TE-26) project.

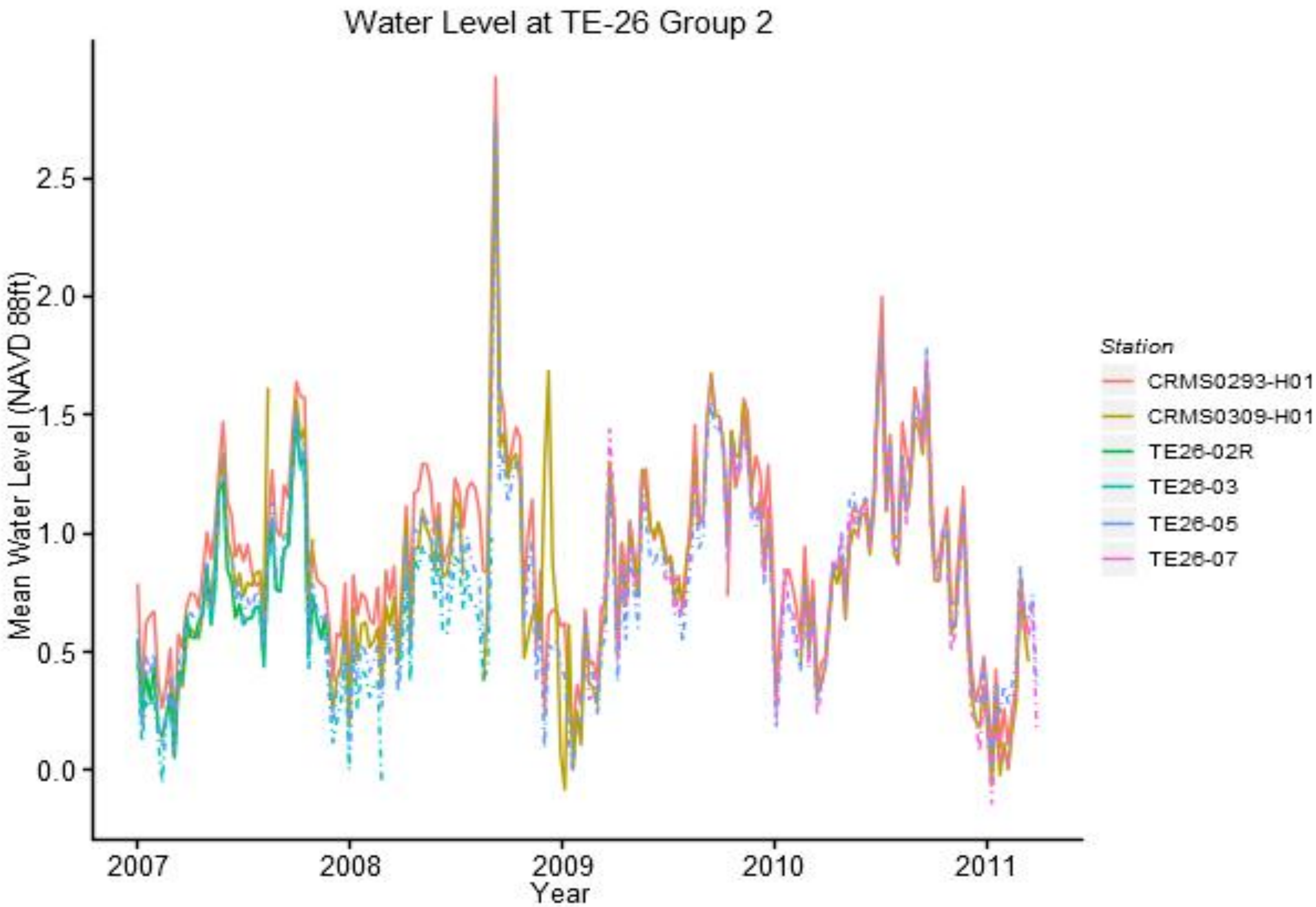


Figure 7. Comparative mean weekly water levels for project-specific and reference continuous recorders, as well as the CRMS-*Wetlands* reference continuous recorders in data analysis group 2. For the Lake Chapeau Sediment Input and Hydrologic Restoration , Point Au Fer Island (TE-26) project.

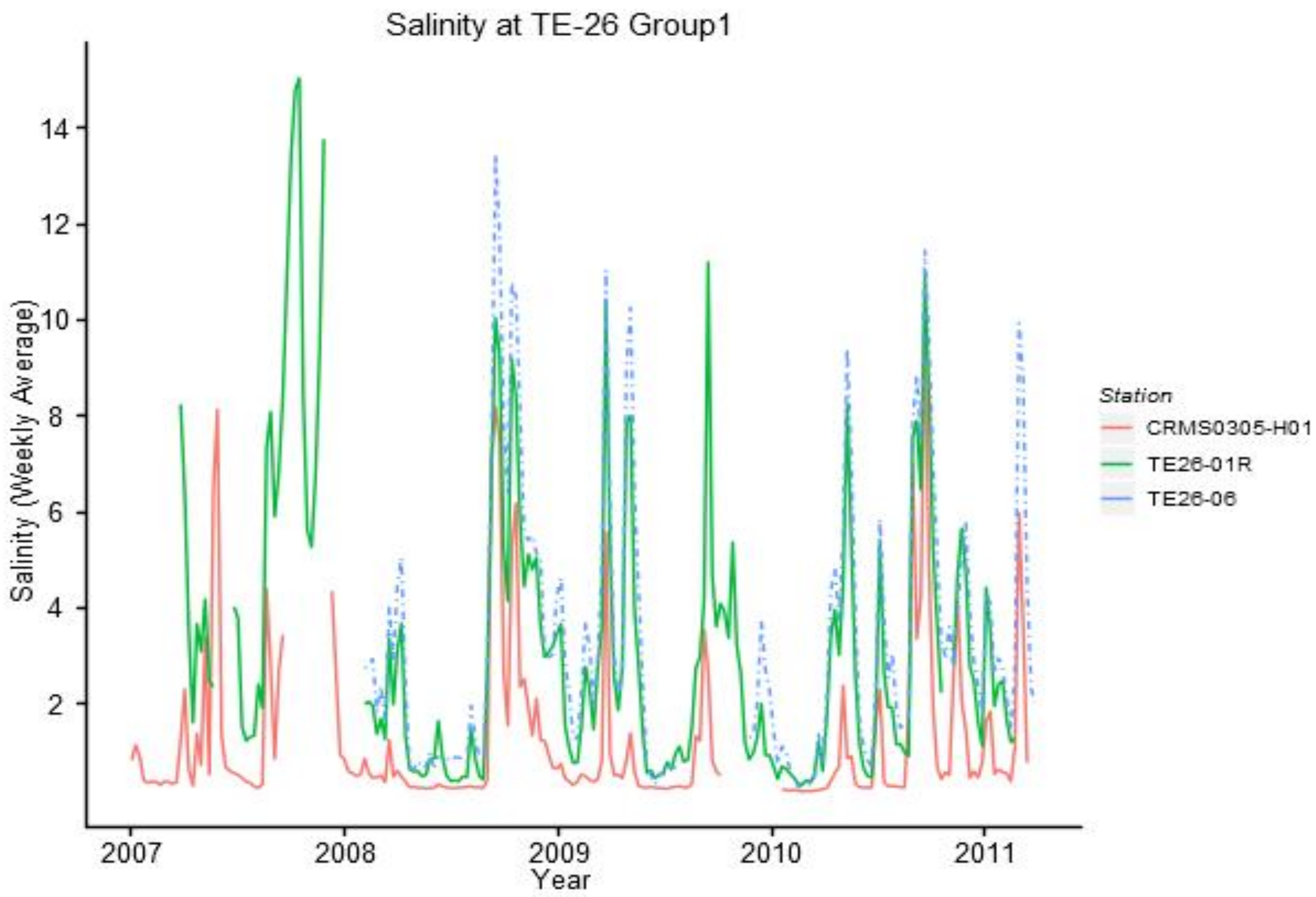


Figure 8. Comparative mean weekly salinities for project-specific and reference continuous recorders, as well as the CRMS-*Wetlands* reference continuous recorder in data analysis group 1. For the Lake Chapeau Sediment Input and Hydrologic Restoration , Point Au Fer Island (TE-26) project.

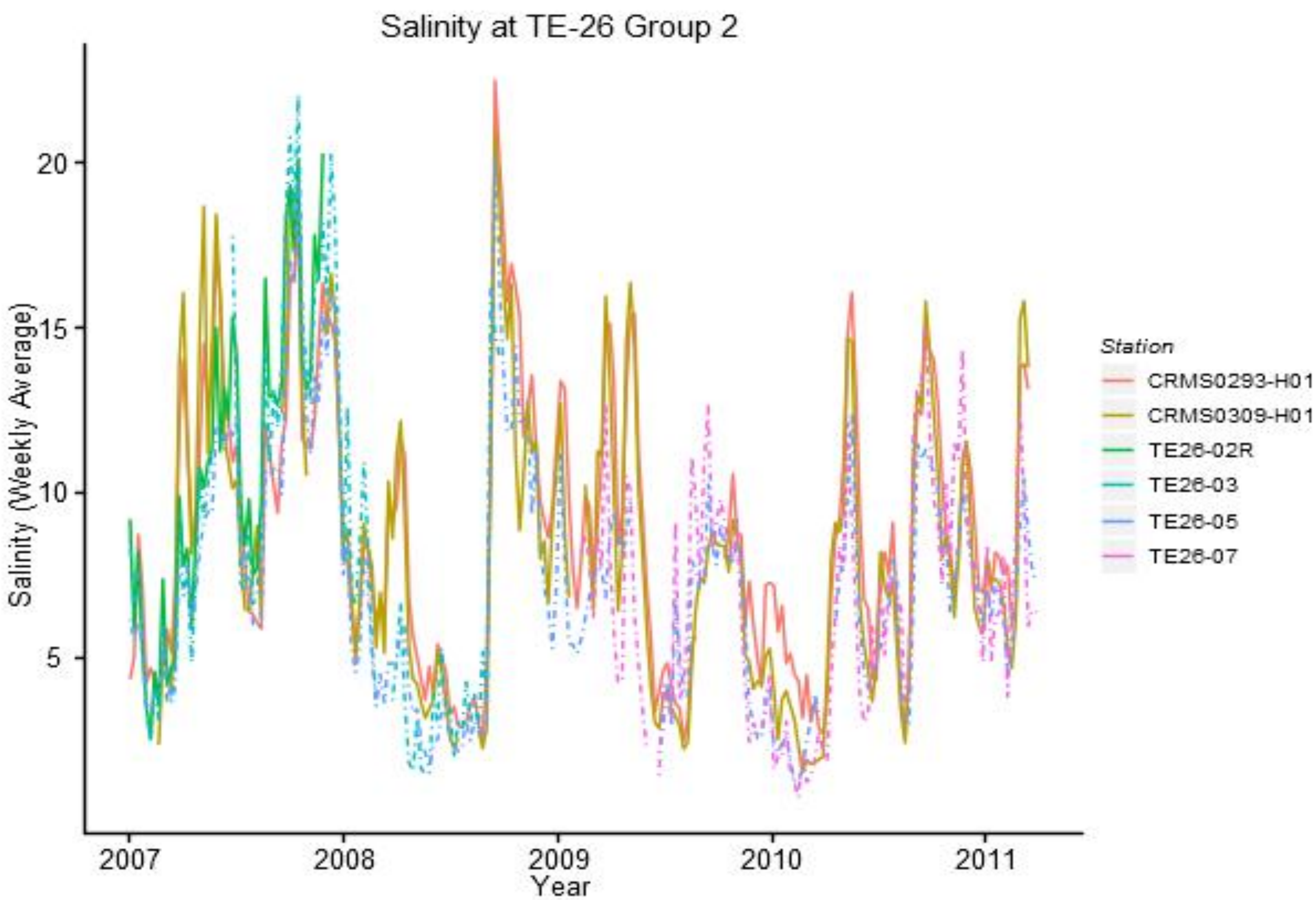


Figure 9. Comparative mean weekly salinities for project-specific and reference continuous recorders, as well as the CRMS-*Wetlands* reference continuous recorders in data analysis group 2. For the Lake Chapeau Sediment Input and Hydrologic Restoration , Point Au Fer Island (TE-26) project.

Vegetation

Project-specific vegetation data were collected during the fall of 1999, 2001, 2004, 2007, 2008, and 2010. The data were entered into an electronic format where OCPR/TFO personnel followed Quality Assurance/Quality Control (QA/QC) procedures prior to data analysis as stated in Folse et al. (2008) and then analyzed for relative cover and Florisitc Quality Index (FQI) following methods described in Cretini et al. (2009). Vegetation cover and composition data from the project and reference stations were used to determine the FQI over time (figure 10). During the 2010 vegetation data collection period five new project stations and five new reference stations were randomized in order to replace those with missing PVC corner poles and to increase the number of data collection stations for project monitoring.

The FQI is used to quantitatively determine the condition of a particular habitat using the plant species composition (Cretini et al. 2009). It has been regionally modified for coastal Louisiana by a panel of local plant experts in order to determine changes in wetland conditions based upon the presence of non-native, invasive and disturbance-prone species across community types. The coefficient of conservatism (CC) score is a score from 0 to 10 assigned by the panel to flora and is used to calculate the FQI (Appendix C). Species are scored higher if they are dominant (9-10) or common (7-8) in vigorous coastal wetland communities, not as high if they occur primarily in less vigorous coastal wetland communities (4-6), even lower if they are opportunistic users of disturbed sites (1-3), and lowest if they are invasive plant species (0). The panel did not assign CC scores to 1) submerged aquatic vegetation, 2) parasitic species, 3) plants identified only to genus or family, or 4) unidentifiable plants. Non-native species were assigned a score of 0 by the panel. Plants identified only to genus were assigned a CC score for the species if only one species was on the list for that genus. The mode of the species scores was assigned to a plant if it was identified only to genus and more than one species for the genus was listed, provided the CC scores for those species were within a 3 point range. No CC score was assigned to a plant within the genus if the CC scores for the species had a wider range than 3 points. If *Distichlis spicata* was present, it was assigned a community-specific CC score; a high score in healthy brackish and salt marshes where it is a codominant, and a low score in fresh and intermediate marshes where its presence is indicative of a disturbance. The TE-26 project area is predominately brackish marsh, although freshwater influx from the Atchafalaya River does moderate the salinity on the northeastern portion of Point Au Fer Island.

In 2001, the FQI for the project fill area plots as well as the reference plots were at their highest; 100 points and 82 points respectively (figure 10). The FQI scores followed similar downward trends for both the project and reference plots in 2004 and 2007. In 2008 the project FQI fell dramatically, likely due to the effects of hurricanes Gustav and Ike just two weeks prior to data collection. The reference stations in the surrounding natural marsh did not appear to be as impacted by the storms. FQI increased due to an increase in the mean percent cover for dominant species *Spartina patens* and codominant species *D. Spicata*. The project FQI increased by 2010 due to natural recruitment of *Schoenoplectus robustus* into the fill area, as well as a substantial increase in mean percent cover of the planted species *Spartina alterniflora*. The reference FQI decreased due to a decrease in cover of both *S. patens* and *S. alterniflora*, as well as an increase in *Vigna luteola*, a species with a very low cc score.

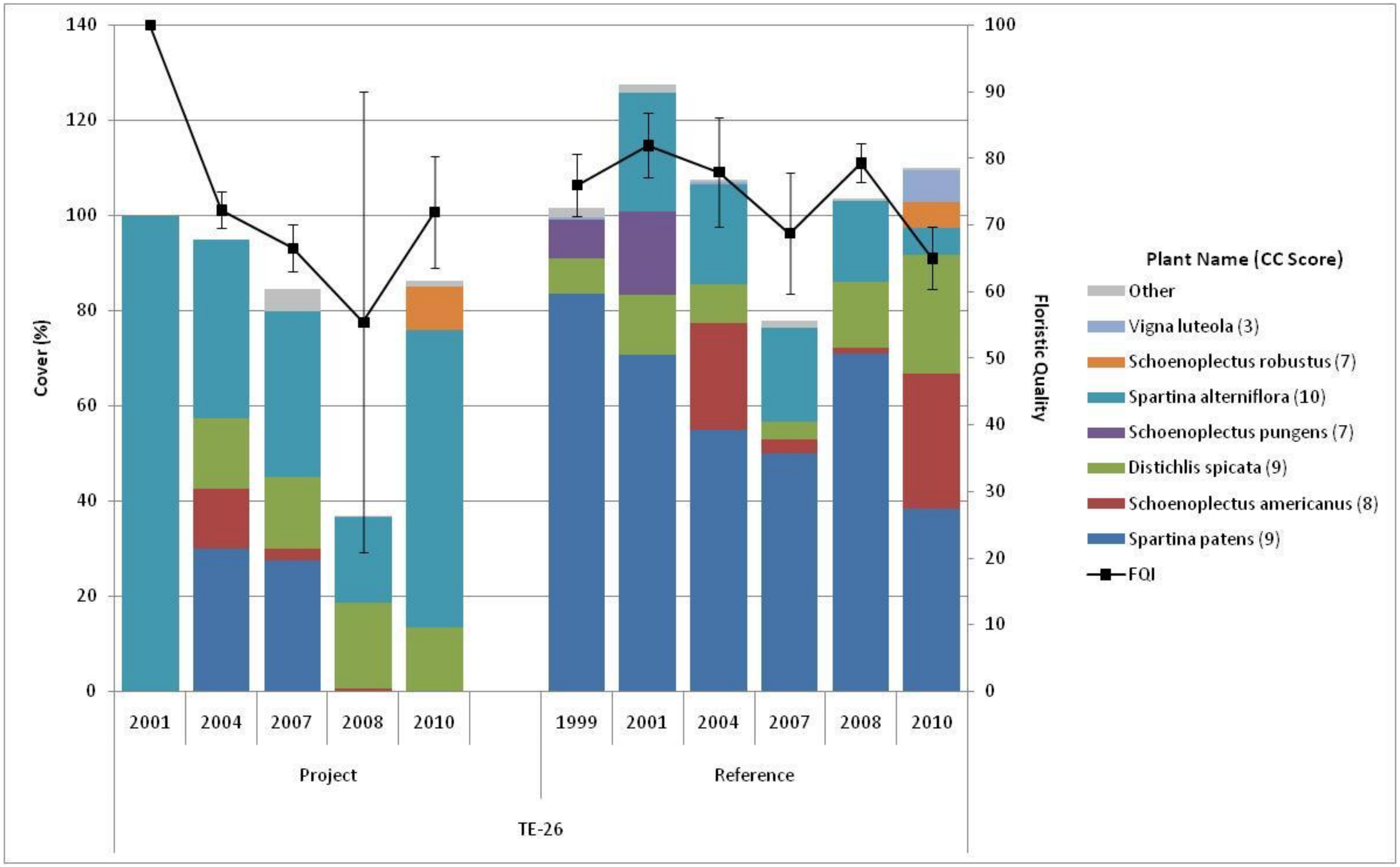


Figure 10. Mean percent cover and Floristic Quality Index (FQI) for selected species to date, inside of project and reference 4 m^2 Braun-Blanquet vegetation plots. For the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.

As noted earlier in this report, final inspection of the dredge material disposal area in May 1999 by NMFS and LDNR field personnel indicated very little natural recruitment of vegetation on the fill material. There was no vegetation in the project plots and the reference plots outside of the fill area were dominated by *S. patens* (figure 10). By 2001, two growing seasons post-planting, mean percent cover of the planted species *S. alterniflora* had reached 100% in the project plots and it was the only species present. By comparison, the reference area plots went from 0% mean cover of *S. alterniflora* in 1999 to 25%, which indicates natural recruitment of the planted species occurred outside of the fill area into the reference plots. The mean percent cover of *S. alterniflora* had substantially decreased by 2007 in the project fill area plots however, *S. patens* and *D. spicata* were also found in these plots, indicating that the fill area was becoming more similar to the surrounding reference area marsh in species composition. In 2008 the percent mean cover of all species combined was the lowest recorded in all years of post-planting monitoring for the project plots. Interestingly, *S. patens* was absent from the project plots altogether. The reference plots by comparison had a higher mean cover of the dominant species *S. patens* than the previous year. The percent mean cover of the planted species rebounded by 2010 in the project fill area plots, as well as the mean cover of all species combined. *S. patens* remained absent from the project plots. The reference plots experienced a substantial decrease in percent mean cover for *S. patens* and *S. alterniflora*, while percent mean cover for species such as *D. spicata* as well as *Schoenoplectus americanus* increased.

Topographic and Bathymetric Elevation Surveys

Elevation data from the topographic and bathymetric surveys taken in 1999 (pre-construction and as-built) by River Road Construction, Inc. were adjusted to the post-construction survey taken in 2004 by Acadian Engineers and Environmental Consultants, Inc. The data was entered into ArcMap® version 9.1 where grids were created for the borrow area, the fill area, and the Locust Bayou dredge channel. Elevation statistics were calculated from the grids for the areas inside the boundary polygons. Contour elevation maps were created in ArcViewGIS® version 3.2 and placed in Appendix C of this report. Change grids were produced in ArcViewGIS® version 3.2 by subtracting the contour grids produced in ArcMap® version 9.1. Elevation statistics were calculated from these change grids for the areas inside the boundary polygons and elevation change maps were produced in ArcViewGIS® version 3.2 (Appendix C; figures 1-9).

Contour Elevations

Locust Bayou Dredge Channel:

Contour elevation class statistics are presented in table 4 for the Locust Bayou dredge channel. Contour elevation maps are located in Appendix C of this report (figures 1-3).

Table 4. Comparative contour elevation statistics for the Locust Bayou dredge channel inside the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.

	NAVD88 ft (m)			
	Mean	**Minimum**	**Maximum**	**Standard Deviation**
Pre-construction	-1.581 (-0.481)	-5.216 (-1.589)	1.522 (0.463)	0.3963
As-built	-4.364 (-1.330)	-8.859 (-2.711)	-0.237 (-0.072)	0.7274
Post-construction	-5.254 (-1.601)	-9.930 (-3.026)	1.597 (0.486)	0.8284

The lowering of the mean elevation is a direct result of the dredging performed during construction. The five year post-construction survey shows the mean elevation was lowered by 0.89 ft (0.27 m) from the end of construction. This may be a result of more water flowing through the area from Lake Chapeau through the northern reaches of Locust Bayou and into the dredge portion of the bayou. More water may be funneling through Lake Chapeau as a result of the dredge material in the fill area.

Fill Area:

Contour elevation class statistics are presented in table 5 for the dredge material fill area. Contour elevation maps are located in Appendix C of this report (figures 4-6).

Table 5. Comparative contour elevation statistics for the dredge material fill area inside the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.

	NAVD88 ft (m)			
	Mean	**Minimum**	**Maximum**	**Standard Deviation**
Pre-construction	-0.839 (-0.255)	-3.260 (-0.993)	1.447 (0.441)	0.205
As-built	1.374 (0.418)	-2.111 (-0.643)	2.818 (0.858)	0.1672
Post-construction	0.815 (0.248)	-2.229 (-0.679)	1.967(0.599)	0.2003

The increase in mean elevation is a direct result of the placement of the fill material. The decrease of 0.559 ft (0.17 m) five years post-construction may be a result of dewatering, sediment compression, and loss of some sediment over the years as the sediment tries to stabilize. The mean post-construction elevation is 0.47 ft higher than intended at the time of the survey. Although the elevation is higher, the species composition is still emergent marsh species; therefore, this elevation is acceptable for the marsh creation aspect of the project.

Borrow Area:

Contour elevation class statistics are presented in table 6 for the borrow area. Contour elevation maps are located in Appendix C of this report (figures 7-9).

Table 6. Comparative elevation statistics for the borrow area for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.

Borrow Area (Contour Elevation Means) NAVD88

	NAVD88 ft (m)			
	Mean	**Minimum**	**Maximum**	**Standard Deviation**
Pre-construction	-5.002 (-1.524)	-5.798 (-1.767)	-4.33 (-1.351)	0.054
As-built	-11.100 (-3.383)	-21.327 (-6.500)	-4.402 (-1.341)	1.65
Post-construction	-5.364 (-1.634)	-6.615 (-2.016)	-4.031(-1.228)	1.244

The reduced elevation is a direct result of the dredge activity in the borrow area. The five year post-construction survey shows the borrow area has filled in with sediment from the bay.

<u>Change Class Statistics</u>

Locust Bayou:

Change class statistics for the Locust Bayou dredge channel are found in Appendix C figures 10-12 of this report. Figure 10 shows the elevation changes from the pre-construction survey in 1999 to the as-built survey in 1999. Figure 11 shows the elevation changes from the as-built survey in 1999 to the post-construction survey in 2004. Figure 12 shows the elevation changes from the pre-construction survey to the post-construction survey. The elevation changes are broken down into classes and the acreage is given for each change class. Also, the overall mean, maximum, and minimum elevation changes are given for the area within the Locust Bayou dredge channel boundary.

Dredging of the Locust Bayou channel created an overall mean elevation change of -3.693 ft between pre-construction and post-construction (figure 12). Change analysis indicates that the channel continued to deepen after the dredge event, though the mean elevation change (-0.924 ft) was not as pronounced between the as-built and post-construction surveys (figure 18) as the mean elevation change (-2.777 ft) between the pre-construction and as-built surveys (figure 10). Also, it appears from the analysis in figure 18 that once the dredge material was placed along the bank lines, some material sloughed off into the channel and was transported by the current and re-deposited in curves along the bayou, while the channel continued to deepen. Since the change analysis is limited to an area inside the channel fixed by the extent of where the three surveys overlap, it does not capture all of what is going on adjacent to the channel. The continued deepening of the channel five years after the dredge event may be the result of an increased flow of water from the north as a result of the marsh creation (fill area). Water from the northern portion of the project is now focused to Lake Chapeau and through Locust Bayou, having a velocity that has maintained and even deepened the dredge area. Since one of the objectives was to remove silt from the channel bottom in order to accommodate an increased flow due to the re-establishment of the island's natural drainage patterns, it appears that there may be some project effect in this regard.

Fill Area:
Change class statistics for the dredge material fill area are found in Appendix C figures 13-15 of this report. Figure 13 shows the elevation changes from the pre-construction survey in 1999 to the as-built survey in 1999. Figure 14 shows the elevation changes from the as-built survey in 1999 to the post-construction survey in 2004. Figure 15 shows the elevation changes from the pre-construction survey to the post-construction survey. The elevation changes are broken down into classes and the acreage is given for each change class. Also, the overall mean, maximum, and minimum elevation changes are given for the area within the dredge material fill area boundary.

The overall mean elevation change from pre-construction to post-construction was 1.655 ft (figure 15). The greatest mean elevation change was 2.219 ft, which occurred between the pre-construction and as-built surveys (figure 13), a direct result of dredge material placement. Figure 21 illustrates how most of the fill area elevation changes (132.70 ac) were in the negative range (-1.0 – 0 ft), indicating that the dredge material had dewatered and was subsiding five years after construction. Of particular note is the northeast portion of the fill area, where the most elevation change occurred (-2.0 - -3.0 ft). Field trips confirm that this area of the fill has remained flooded. Overall, however, the mean elevation of the fill area based upon post-construction contour elevations from the 2004 survey was 0.815 ft.

Borrow Area:
Change class statistics for the borrow area are found in Appendix C figures 16-18 of this report. Figure 16 shows the elevation changes from the pre-construction survey in 1999 to the as-built survey in 1999. Figure 17 shows the elevation changes from the as-built survey in 1999 to the post-construction survey in 2004. Figure 18 shows the elevation changes from the pre-construction survey to the post-construction survey. The elevation changes are broken down into classes and the acreage is given for each change class. Also, the overall mean, maximum, and minimum elevation changes are given for the area within the borrow area boundary.

From pre-construction to post-construction the overall mean elevation change was -0.3618 ft, with most of the change (51.91 ac) occurring in the -1 – 0 change class range (figure 18). The greatest mean elevation change of -6.092 ft occurred between the pre-construction and as-built surveys (figure 23), and is attributed to the dredging of the borrow area. Conversely, an almost equal mean elevation change (5.696 ft) occurred between the as-built and post-construction surveys, but in the positive range. It appears that the borrow area has filled in only five years after construction. The mean elevation change from pre-construction to post-construction was minimal and it appears the borrow area served as a natural sink where sediment was trapped. This has made it possible for the borrow area to be used again for future dredge events, depending on the fill material composition.

CRMS Supplemental

The TE-26 project does not have a CRMS-*Wetlands* site within its boundaries however, three nearby sites (CRMS0293, CRMS0305, and CRMS0309) were used for reference in some of the analyses in this report. Water level and salinity data from the continuous recorders at these sites were grouped with project-specific site data, analyzed and presented under their respective monitoring elements sections earlier in this report. Ancillary land-water and vegetation data analyses from these sites are presented in this section.

CRMS-Wetlands Land/Water Classification

The land-water analysis of CRMS0293 showed that the 1.0 km^2 (0.4 mi^2) square portion of the site lost land at a rate of -2.33 ac/yr^{-1} (-0.94 ha/yr^{-1}) between 2005 and 2008 (table 7). The 2005 classification of the area also revealed that the 1.0 km^2 (0.4 mi^2) square enclosed 225 acres (91 ha) of land habitats and 23 acres (9 ha) of water habitats (Appendix D; figure 7). The percentage of land in the 1.0 km^2 (0.4 mi^2) square was 91% in fall 2005 (figure 11). This percentage corresponds to a land to water ratio of 10:1. The 2008 classification of the area revealed that the square enclosed 218 acres (88 ha) of land habitats and 30 acres (12 ha) of water habitats (Appendix D; figure 8). The percentage of land in the 1.0 km^2 (0.4 mi^2) square was 88% in fall 2008. This percentage corresponds to a land to water ratio of 7:1.

Table 7. Land change rates between 2005 and 2008 for CRMS0293, CRMS0305, and CRMS0309.

CRMS0293 2005	CRMS0293 2008	Difference	Change Rates
ac (ha)	***ac (ha)***	***ac (ha)***	***ac/yr^{-1} (ha/yr^{-1})***
225 (91)	218 (88)	-7 (-2.8)	-2.33 (-0.94)
CRMS0309 2005	**CRMS0309 2008**	**Difference**	**Change Rates**
ac (ha)	***ac (ha)***	***ac (ha)***	***ac/yr^{-1} (ha/yr^{-1})***
209 (85)	206 (83)	-3 (-1.21)	-1 (-0.40)
CRMS0305 2005	**CRMS0304 2008**	**Difference**	**Change Rates**
ac (ha)	***ac (ha)***	***ac (ha)***	***ac/yr^{-1} (ha/yr^{-1})***
161 (65)	160 (65)	-1 (-0.40)	-0.33 (-0.13)

The land-water analysis of CRMS0305 showed that the 1.0 km^2 (0.4 mi^2) square portion of the site lost land at a rate of -1.0 ac/yr^{-1} (-0.40 ha/yr^{-1}) between 2005 and 2008 (table 7). The 2005 classification of the area also revealed that the 1.0 km^2 (0.4 mi^2) square enclosed 161 acres (65 ha) of land habitats and 87 acres (35 ha) of water habitats (Appendix D; figure 9). The percentage of land in the 1.0 km^2 (0.4 mi^2) square was 65% in fall 2005 (figure 11). This percentage corresponds to a land to water ratio of 2:1. The 2008 classification of the area revealed that the square enclosed 206 acres (83 ha) of land habitats and 42 acres (17 ha) of water habitats (Appendix D; figure 10). The percentage of land in the 1.0 km^2 (0.4 mi^2) square was 83% in fall 2008. This percentage corresponds to a land to water ratio of 5:1.

The land-water analysis of CRMS0309 showed that the 1.0 km^2 (0.4 mi^2) square portion of the site lost land at a rate of -0.33 ac/yr^{-1} (-0.13 ha/yr^{-1}) between 2005 and 2008 (table 7). The 2005 classification revealed that the 1.0 km^2 (0.4 mi^2) square enclosed 209 acres (85 ha) of land habitats and 39 acres (16 ha) of water habitats (Appendix D; figure 11). The percentage of land in the 1.0 km^2 (0.4 mi^2) square was 84% in fall 2005 (figure 11). This percentage corresponds to a land to water ratio of 5:1. The 2008 classification of the area revealed that the square enclosed 160 acres (65 ha) of land habitats and 88 acres (36 ha) of water habitats (Appendix D; figure 12). The percentage of land in the 1.0 km^2 (0.4 mi^2) square was 65% in fall 2008. This percentage corresponds to a land to water ratio of 2:1.

<u>*CRMS-Wetlands Vegetation*</u>
Mean percent cover was calculated to summarize the vegetation data and was grouped by year. Due to the differences in habitat types CRMS-*Wetlands* sites CRMS0293 and CRMS0309 were grouped in the analysis, while CRMS0305 was analyzed separately. CRMS0293 and CRMS0309 are in close proximity to each other (figure 4). Both are in mesohaline wiregrass marshes and are tidally influenced. CRMS0305 is located across Four League Bay just east of the Atchafalaya river delta and is a very slightly saline site which is tidally influenced with a deltaic mixture of vegetation due to the freshwater influence from the river. The FQI was calculated using methods described under the project-specific monitoring elements for vegetation in this report using the same CRMS-*Wetlands* sites groupings (figures 12 – 13). Since CRMS0293 and CRMS0309 are located in intermediate to brackish marshes, *D. spicata* was assigned a CC score of 9 because it is codominant in this marsh type. CRMS0305 is in a fresher deltaic habitat with heavy influences from the Atchafalaya river, therefore *D. spicata* was assigned a much lower CC score of 2.

Vegetation stations for CRMS-*Wetlands* sites CRMS0293 and CRMS0309 were grouped and analyzed for mean percent cover and FQI (figure 12). Although the mean cover of the dominant species *S. patens* increased in 2007, there was a decrease in *D. spicata*, which caused the FQI to dip slightly. In 2008 the FQI continued a slightly downward trend due to the large decrease in *S. patens* cover. The combined mean cover actually increased to due the presence of additional species such as *S. americanus* and *F. castanea*, however their CC scores contributed less weight to the FQI. Additionally, data collection in 2008 occurred approximately one month after hurricanes Gustav and Ike made landfall in the northern Gulf of Mexico. The FQI and the mean percent cover of *S. patens* and *D. spicata* increased slightly in 2009, and by 2010 the FQI was at its highest since 2006. The mean cover of *S. patens* decreased however *S. americanus* increased dramatically.

CRMS0305 experienced a similar dip in the FQI trendline between 2006 and 2008 as with CRMS0293 and CRMS0309, as well as an increase in 2009, but it dipped back down again in 2010 due to a decrease in *S. patens* and an increase in cover of less desirable species (figure 13). The dominant species was *S. americanus*, with *S. lancifolia* and *S. patens* as codominant. At this site *Alternanthera philoxeroides* contributed greatly to the mean percent cover, yet it contributed nothing to the FQI since it had a CC score of 0. Though mean percent cover for *S.*

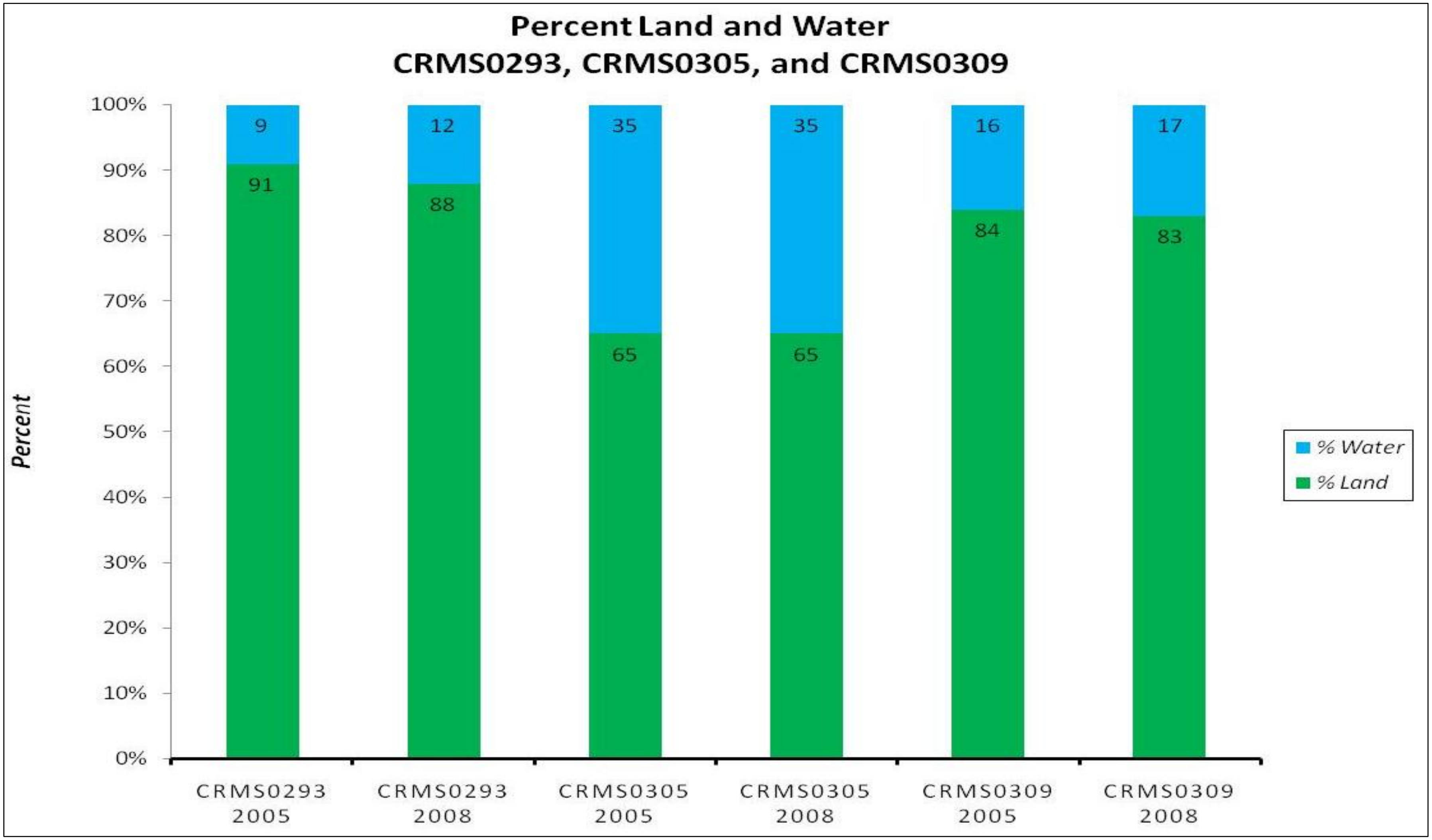


Figure 11. Percent land and water inside of the 1km^2 squares for CRMS-*Wetlands* sites CRMS0293, CRMS0305, and CRMS0309 for 2005 and 2008 aerial photography.

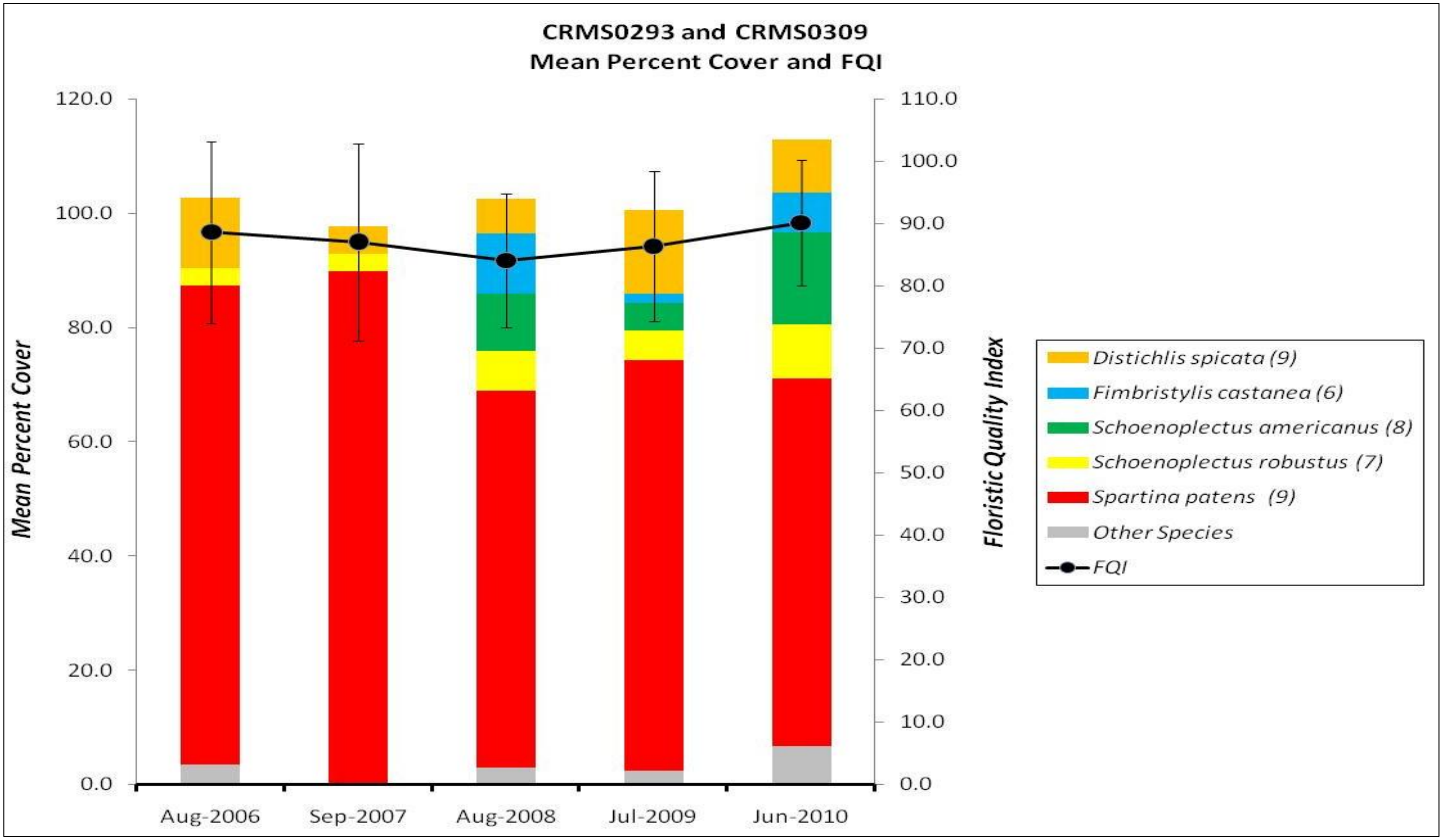


Figure 12. Mean percent cover of selected species inside of the 4 m^2 vegetation plots at CRMS-*Wetlands* sites CRMS0293 and CRMS0309. FQI for this site grouping is also indicated as a trendline on this chart.

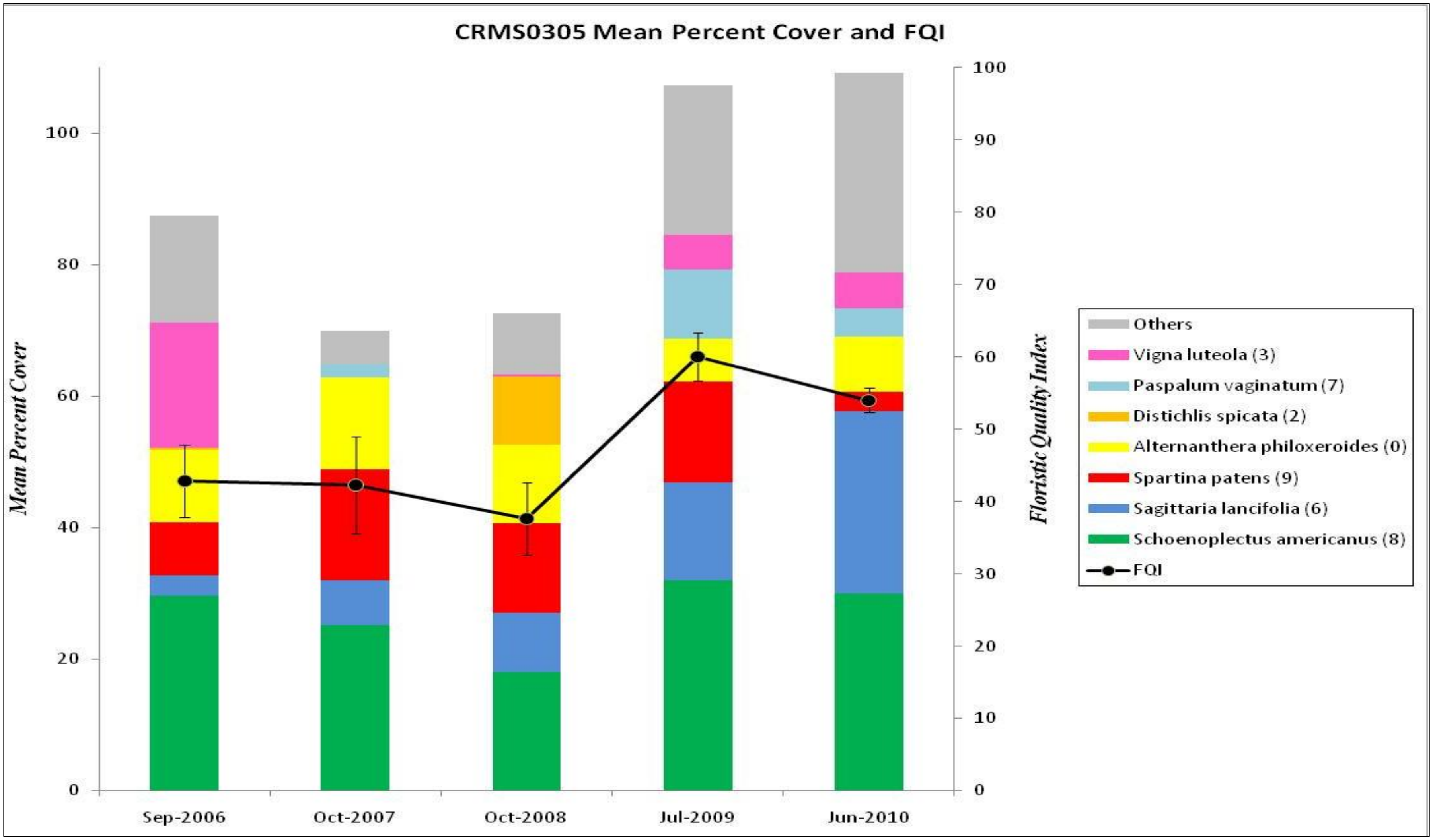


Figure 13. Mean percent cover of selected species inside of the 4 m^2 vegetation plots at CRMS-*Wetlands* site CRMS0305. FQI for this site grouping is also indicated as a trendline on this chart.

americanus trended downward between 2006 and 2008, by 2010 it recovered to near its 2006 value. An increase in the mean percent cover of less desirable species in the "others" category contributed to the slight decrease in the FQI score in 2010. Another aspect which contributed to the lower FQI was that *S. patens,* with its CC score of 9, had its lowest mean percent cover in the five years of data collection.

d. Discussion

Based upon the 2008 analysis, land to water conversion continued inside both the TE-26 project and reference areas nine years post-construction. The only time land gain was documented was in 2001, and this was attributed to the dredge disposal and plantings which occurred inside the project fill area in 1999. A small conversion of water to land also occurred inside of the project's reference area on the west side of the island in 2001. All three CRMS-*Wetlands* sites experienced minor land to water conversions between 2005 and 2008. While the TE-26 project area displayed land loss in the post-construction period, the fill area proved to be relatively resistant to erosion.

Vegetation monitoring has demonstrated that planted *S. alterniflora* has successfully colonized the project fill area, along with additional naturally occurring species from the surrounding marshes nine years post-planting. The surrounding marshes have in turn experienced the introduction of *S. alterniflora* as a result of natural recruitment of this species from the fill area. The mean percent cover and the FQI inside the project fill area steadily dropped through 2008. The dominant species *S. alterniflora* experienced its highest mean percent cover and FQI in 2001, only one growing season post-planting, and its lowest in 2008 due to the immediate impacts from hurricanes Gustav and Ike. By 2010 however, the mean percent cover and FQI recovered. The reference area plots located in the natural marshes adjacent to the fill area appear to have experienced a similar trend in progressively decreasing mean percent cover and FQI until 2008 when the dominant species *S. patens* and codominant species *D. spicata* and *S. alterniflora* increased in cover. It appears that the storms had no immediate impacts on the natural marshes. In 2010 the reference stations experienced a slight decrease in mean percent cover and FQI. The introduction of additional species such as *Vigna luteola* and *Schoenoplectus robustus* increased the diversity, but because they were not as desirable as *S. patens* and had lower CC scores, they contributed less to the overall FQI.

CRMS-*Wetlands* vegetation monitoring indicates that sites CRMS0293 and CRMS0309 in the southeastern portion of Point Au Fer Island are dominated by *S. patens* and *D. spicata* which is typical for intermediate to brackish tidally influenced marshes. Between 2006 and 2008 these sites experienced a slight downward trend in mean percent cover and FQI due to an increase in cover of less desirable species and a decrease in cover of the dominant species. The trend was reversed by 2009 and species diversity increased by 2010.

CRMS-*Wetlands* site CRMS0305 located just east of the Atchafalaya river delta is dominated by a deltaic mixture of *S. americanus, S. lancifolia*, and *S. patens*. Between 2006 and 2008 this site experienced a slight downward trend in FQI and mean percent cover of the dominant species. By 2010 both of these values increased as well as species diversity.

Contour elevation and change class analysis of the 1999 (pre-construction and as-built) and 2004 (post-construction) topographic and bathymetric surveys of the TE-26 Locust Bayou dredge channel, fill area, and borrow area were performed. The mean elevation of the Locust Bayou dredge channel was lowered as a result of construction and continued to lower post-construction, though not as pronounced. The additional drop in elevation could be attributed to the increased flow of water funneling through the area from the north as a result of the marsh creation (fill area). Some of the water may have been redirected through Lake Chapeau to the south and into Locust Bayou.

The mean elevation of the fill area increased by 2.219 ft (0.67 m) as a direct result of placement of the fill material during construction. Five years post-construction the mean elevation decreased by 0.559 ft (0.17m) as a result of dewatering, sediment compression, and sediment loss. Change class statistics indicate that the northeast portion of the fill area experienced the greatest subsidence and has remained flooded. The overall mean elevation of the fill area was 0.815 ft (0.248 m) five years post-construction.

The borrow area experienced its greatest elevation change immediately after construction (as-built) by -6.092 ft (-1.86 m). Five years post-construction the area had almost completely filled in to within -0.362 ft (-0.11 m) of its pre-construction elevation. This borrow area was re-mined for sediments in 2007 for the dedicated dredge project adjacent to the TE-26 fill area.

As a result, the habitat, vegetation, and elevation data presented in the preceding paragraphs reveal that the goal to create 168 ac (67.98 ha) of marsh was partially realized. Only 139.5 acres (56.5 ha) of marsh were created in the fill area during construction primarily due to the northeast corner of the fill area remaining subaqueous. However, the marsh that was created in the TE-26 fill area seems to be resistant to erosion and considerably above the target elevation. The fill area has proven to be fairly sustainable to date. Future data collection will determine if this sustainability trend continues.

Post-construction variation in salinity and water levels between January 2007 and March 2011 was significant among the TE-26 sites when grouped with nearby CRMS-*Wetlands* sites. An examination of hourly salinity for an arbitrary two week period in 2008 suggests that differences in salinity among sites are likely biologically relevant (figure 14), whereas differences in elevation are probably due to large statistical power (figure 15). Stations showed substantial and synchronized differences in salinity from September 30 to October 13 in 2008. These differences appear to be strongly influenced by the distance of each station from the mouth of the Atchafalaya River, with the closes site (CRMS305-H01) showing the lowest salinity and the furthest sites showing the highest salinities (CRMS293-H01 and CRMS309-H01). Consistent with the separation into groups, the three sites assigned to Group 1 (CRMS305-H01, TE26-01R and TE26-06) have consistently lower salinities than sites assigned to Group 2 (CRMS293-H01, CRMS309-H01 and TE26-05; data are not available for this time period for the remaining sites). In addition, there appears to be a strong "visual break" between the sites in Group 1 and Group 2, where a line can easily be drawn separating the two without intersecting the salinity plots for any sites.

In contrast, elevation appears to be strongly influenced by tidal cycles, with the minimal differences between sites easily swamped by diurnal tidal flow (figure 15). Given this pattern, the significant but small differences in average elevation between sites (≤0.4ft in all cases) is likely due to the strong statistical power resulting from the large number of observations. Thus, it appears that at these sites variation in salinity is dependent upon distance from the Atchafalaya River, whereas elevation is subject to the normalizing force of the tidal cycle. This interpretation is consistent with the variances in elevation, which show no clear patterns with respect to project boundaries. Therefore based upon the data analysis presented for the time period between January 2007 and March 2011, it does not seem that the goal of reducing water level variability within the project area has been attained as of this time. Future data collection will determine if this goal is achieved.

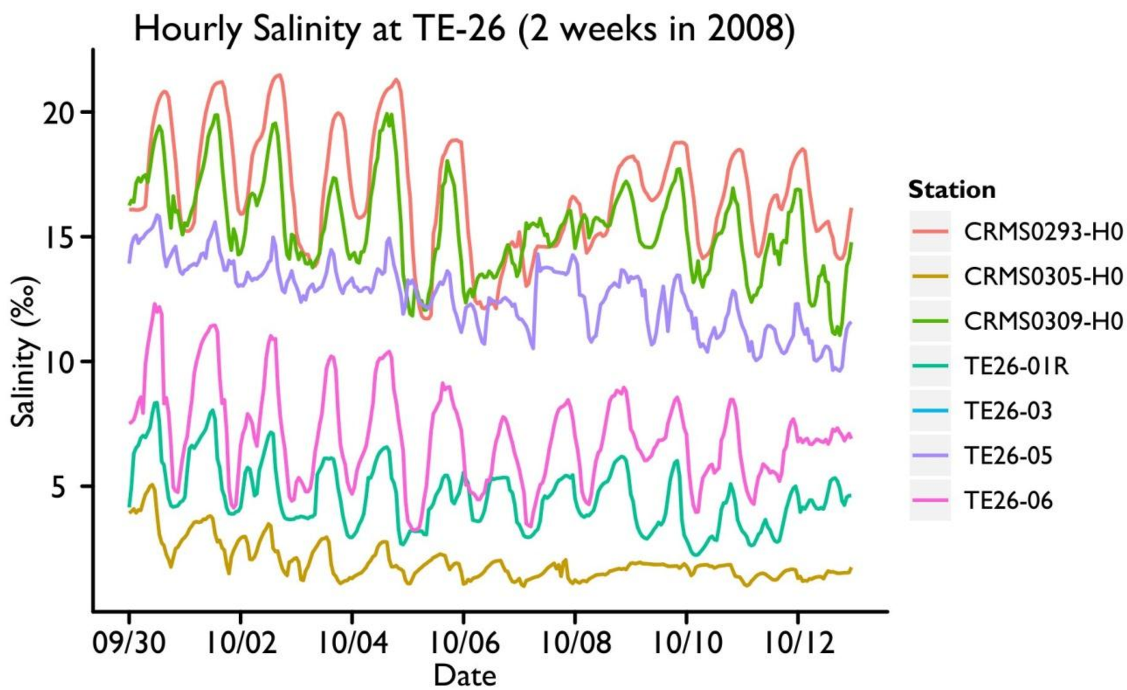


Figure 14. Hourly salinity at TE26 from September 30, 2008 to October 13, 2008.

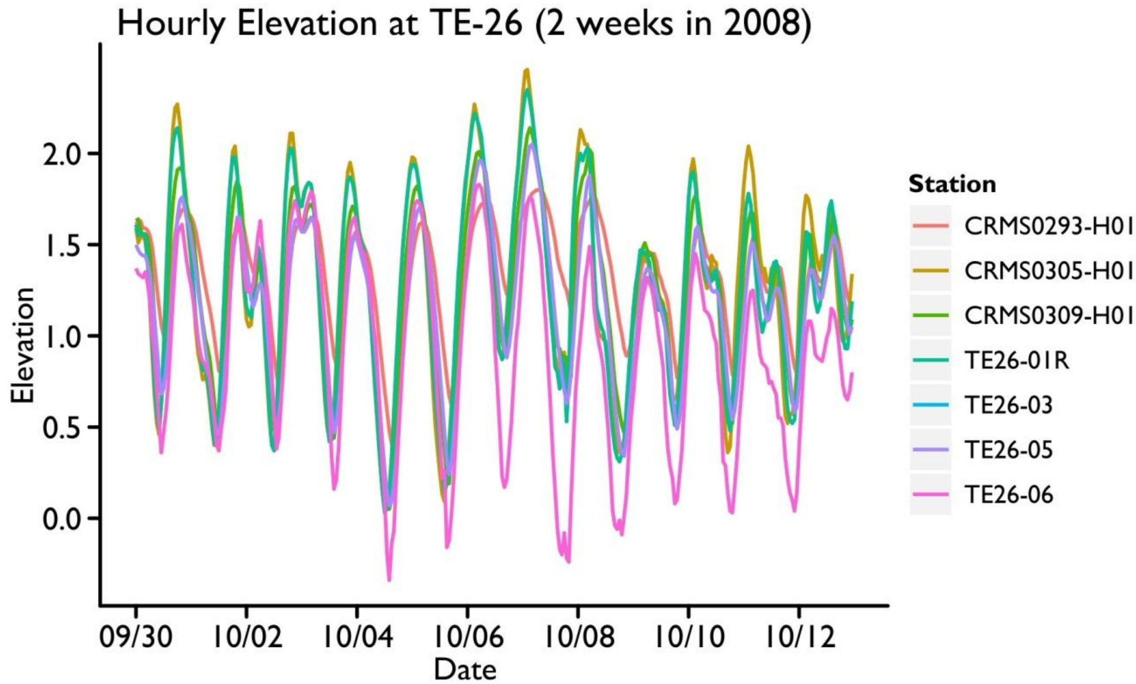


Figure 15. Hourly elevation at TE26 from September 30, 2008 to October 13, 2008.

V. Conclusions

a. Project effectiveness

Eleven years post-construction, land-water analysis indicated continued land loss inside the project and reference boundaries. A total of 139.5 acres of marsh was created as a direct result of the dredge material placement and the subsequent installation of *S. alterniflora* plantings. The project goal was to create 168 acres. Though a portion of the intended fill area remains open water, the goal to create marsh at a target elevation of 0.346 ft (0.105 m) NAVD88 has been partially successful. The mean fill area elevation in 2004, five years post-construction was 0.47 ft (0.14 m) higher than the target elevation. The fill area has proven to be fairly sustainable to date. Future data collection will determine if this sustainability trend continues. The acreage created in the fill area may have created enough of a hydrologic separation of the Alligator Bayou and Locust Bayou to restore the historical hydrology; however, this remains inconclusive. The nearby CRMS-*Wetlands* sites CRMS0293, CRMS0305, and CRMS0309 have experienced minor conversions of land to water between 2005 and 2008.

Between January 2007 and March 2011 the project stations were significantly different from each other in both mean weekly water level and salinity variation. They were also significantly different from the surrounding CRMS-*Wetlands* stations. The exceptions to this were 1) where TE26-07 and CRMS0309 experienced similar mean weekly water levels, and

2) where TE26-03 and CRMS0309 experienced similar mean weekly salinities. The differences could be attributed to freshwater influx from the Atchafalaya River and tidal influences from the Gulf of Mexico due to the distances between stations. At this time it appears that the structures are not meeting the goal of reducing variability in the water level elevations.

The installation of the *S. alterniflora* proved beneficial and effective in establishing rapid vegetative cover on the created marsh platform. The 1999 as-built vegetation data indicated an absence of vegetation in the marsh creation area; however in 2010, eleven years after planting, mean percent cover was approximately 86% and several species were present where the elevation is conducive for plant growth. Conversely, those areas that did not increase in elevation or meet the target elevation have no emergent vegetative growth, as evidenced at TE26-32, TE26-33, and TE26-34 where they remain in open water.

b. Recommended Improvements

Based on visual observations from the 2011 annual inspection, all of the rock weirs and barricade structures appeared to be in good condition with no obvious defects; however, we have noticed moderate settlement of several weir structures as indicated in the survey profiles and elevation data collected in 2004. Considering that this elevation data is now six (6) years old, it is very possible that settlement of the rock weirs have continued to increase. Until the actual settlement can be verified though additional field verifications, we are planning for a possible maintenance event in 2014 to recap the existing weir structures, repair damaged barricade systems and replace signage. If it is determined that weir settlement has stabilized and remains at 2004 levels, a joint decision between OCPR and NMFS can be made at that time whether to proceed with a maintenance event in 2014 or delay the event based on the available data and structural performance. The overall estimated cost for the scheduled 2014 maintenance event can be found in Appendix B – Three Year Budget Projections.

c. Lessons Learned

Engineering:

- A major concern during construction involved the damage to existing marsh located along the access corridor extending from the Atchafalaya Bay to the dredge disposal area causing a scour effect adjacent to the plug along the shoreline. Specifications should be written such that the contractor is clearly responsible for repairing damage to existing marsh that occurs due to his operations, including the placement of fill and planting of vegetation as needed to restore damaged areas of marsh (D. Burkholder, Final Report n.d.). As mentioned in Section II – Maintenance Activity, a proposed dedicated dredge project is currently underway to close this corridor to the Atchafalaya Bay, creating approximately 150 acres of marsh.
- Another unforeseen event during and after construction was the erosion of the spoil banks and breaching encountered following the installation of the rock weirs caused by rerouting of water flows in the project area. Surveys of the watershed tributaries to the project area and collection of sufficient water level

data prior to design should enable the development of a model capable of predicting these post-construction flow patterns (D. Burkholder, Final Report, n.d.).

- It is essential that adequate pre-project data are collected and a hydrologic model developed for future hydrologic restoration projects in order that the effects of plugging canals with weirs and channel liners may be better assessed and more precise design criteria established (D. Burkholder, Final Report, n.d.). Model development will also assist in determining the overall project effectiveness during post-construction evaluations.
- There were no as-builts for the project structures. Comparisons of what the intended elevations were and what they are now are impossible to make.

Monitoring:

- The budget should have included money for surveying the marsh creation and borrow area to conclusively determine if the target elevation was met. Surveying Locust Bayou would indicate how long the channel maintained the target depth, which was dredged to restore the historic hydrology of the area.
- Hourly continuous recorders are currently placed south (outside) of the weirs. Placing the recorders inside of the weirs and some distance away would have provided a more definitive answer about project effectiveness as it relates to the hydrology portion of the project.
- In order to accurately determine if the project has altered flow patterns to a more natural state, the proper instrumentation should have been deployed prior to construction and after construction. Flow meters would better determine the change in hydrology along with continuous water level recorders. The information from both instruments would have been used for a hydrologic model.

VI. References

Barbour, M. G., J. H. Burk, W. D. Pitts, F. S. Gilliam, and M. W. Schwartz. 1999. Terrestrial Plant Ecology. 3rd Edition. Benjamin/Cummings Publishing Company, Inc. 649 pp.

Burkholder, D. n.d. Lake Chapeau sediment input and hydrologic restoration, final report (PTE-23/26a) Grant No. NA57FZ0177. Unpublished document prepared by the Louisiana Department of Natural Resources, Engineering Design Section. Baton Rouge.

Coastal Environments. 2000. Lake Chapeau vegetation plantings state project NO: TE-26 federal project NO: PTE-23/26A final report. Unpublished document prepared for the Louisiana Department of Natural Resources. Baton Rouge.

Cretini, K.F., Visser, J.M., Krauss, K.W., and Steyer, G.D., 2009, CRMS Vegetation Analytical Team Framework: methods for collection, development, and use of vegetation response variables: U.S. Geological Survey National Wetlands Research Center, Lafayette, La., 64 p.

Folse, T. M., J. L. West, M. K. Hymel, J. P. Troutman, L. A. Sharp, D. Weifenbach, T. McGinnis, and L. B. Rodrigue. 2008. A Standard Operating Procedures Manual for the Coast-wide Reference Monitoring System-*Wetlands*: Methods for Site Establishment, Data Collection, and Quality Assurance/Quality Control. Louisiana Coastal Protection and Restoration Authority, Office of Coastal Protection and Restoration. Baton Rouge, LA. 191 pp.

Lear, E. 2003. Lake Chapeau sediment input and hydrologic restoration, Point Au Fer Island-monitoring plan. Louisiana Department of Natural Resources, Coastal Restoration Division, Thibodaux.

Lear, E. and S. Triche. 2007. 2004 Operations, maintenance, and monitoring report for Lake Chapeau sediment input and hydrologic restoration, (TE-26) Point Au Fer Island. Louisiana Department of Natural Resources, Coastal Restoration Division, Thibodaux. 38 pp.

Louisiana Department of Natural Resources 1997. Candidate Project Fact Sheet. Baton Rouge: Louisiana Department of Natural Resources, Coastal Restoration Division.

Louisiana Department of Natural Resources - Coastal Restoration Division and Pyburn and Odom, Inc. 2002. Operation, maintenance, and rehabilitation plan for Lake Chapeau marsh creation and hydrologic restoration project (TE-26). Louisiana Department of Natural Resources, Coastal Restoration Division. Baton Rouge.

Mueller-Dombois, D., and H. Ellenberg. 1974. Aims and Methods of Vegetation Ecology. J. Wiley and Sons, New York, NY. 547 pp.

National Marine Fisheries Service (NMFS). 1994. Coastal Wetlands Planning, Protection, and Restoration Act proposed project information sheet. Unpublished document prepared for the Louisiana Department of Natural Resources. Lafayette.

National Marine Fisheries Service (NMFS). 1998. Environmental assessment of Lake Chapeau sediment input and hydrologic restoration CWPPRA Project PTE-23/26a. Prepared by Gotech, Inc. and C-K Associates, Inc., Baton Rouge, Louisiana. 33 pp. plus appendices.

Sawyer and Keeler-Wolf. 1995. Manual of California Vegetation. California Native Plant Society, Sacramento, CA. 471 pp.

Steyer, G. D., R. C. Raynie, D. L. Steller, D. Fuller, and E. Swenson. 1995. Quality management plan for Coastal Wetlands Planning, Protection, and Restoration Act monitoring program. Open-file series no. 95-01. Louisiana Department of Natural Resources, CRD, Baton Rouge.

Visser, J. M. 2007. Analysis of the hydrologic data from CWPPRA hydrologic restoration projects. Draft Report, School of the Coast and Environment, Baton Rouge, Louisiana. 36 pp.

Appendix A
(Inspection Photographs)

Photo #1: Staff gauge TE26-07 located near Site No.1 used to determine water level during inspection

Photo #2: View of floating gate restricting access to Site No. 1, looking northeast

Photo #3: View of Site No. 1 in oil field access canal off of Locust Bayou, looking northeast

Photo #4: View of Site No. 1 in oil field access canal off of Locust Bayou, looking northeast

Photo #5: View of Site No. 1 embankment tie-in on southeast side of structure, looking northeast

Photo #6: View of Site No. 1 embankment tie-in on northwest side of structure, looking northeast

Photo #7: View of Site No.9 rock weir, looking east

Photo #8: close up view of Site No.9 rock weir, looking east

Photo #9: View of embankment tie-ins on the south side of Site No.9, looking southeast

Photo #10: View of embankment tie-ins on the north side of Site No.9, looking northeast

Photo #11: Close up view of missing piling cap on support timber of Site No.9, looking east

Photo #12: View of breach located on the south bank near Site No.9, looking south

Photo #13: View of Site No.7 from Locust Bayou, looking northwest

Photo #14: Close up view of warning signs and supports in Site No.7, looking northwest

Photo #15: View of embankment tie-in on southwest side of Site No.7, looking west

Photo #16: View of embankment tie-in on northeast side of Site No.7, looking north

Photo #17: Staff gauge TE26-05 located near Site No.6 used to determine water level during inspection

Photo #18: Overall view of Site No.6 rock weir and barricade system, looking east

Photo #19: Close up view of warning signs and supports of Site No.6, looking east

Photo #20: View of embankment tie-in on north end of Site No.6, looking northeast

Photo #21: View of embankment tie-in on south end of Site No.6, looking southeast

Photo #22: View of Site No.5 rock weir in oil field access canal, looking east

Photo #23: Close up view of Site No.5 rock weir in oil field access canal, looking east

Photo #24: view of embankment tie-in on the south side of Site No.5, looking southeast

Photo #25: View of embankment tie-in on the north side of Site No.5, looking northeast

Photo #26: Overall view of Site No.4 rock weir from Fourleauge Bay, looking west

Photo #27: View of embankment tie-in on south side of Site No.4, looking southwest

Photo #28: View of embankment tie-in on north side of Site No.4, looking northwest

Photo #29: View of missing section of pipe in barricade on northwest side of Site No.4

Photo #30: Close up view of warning signs and supports of Site No.4, looking southwest

Photo #31: View of Site No. 3 Weir Removal in progress at time of inspection

Photo #32: View of Site No. 3 Weir Removal in progress at time of inspection

Photo #33: View of Site No. 3 Weir Removal in progress at time of inspection

Photo #34: View of Site No. 3 Weir Removal in progress at time of inspection

Appendix B
(Three Year Budget Projection)

Lake Chapeau Marsh Creation/ Hydrologic Restortaion/ TE-26 / PPL 3

Three-Year Operations & Maintenance Budgets 07/01/2011 - 06/30/14

Project Manager	O & M Manager	Federal Sponsor	Prepared By
Brian Babin	*Shane Triche*	*NMFS*	*Shane Triche*

	2011/2012	2012/2013	2013/2014
Maintenance Inspection	$ 6,268.00	$ 6,456.00	$ 6,649.00
Structure Operation			
OCPR Administration			$ 20,000.00
Federal S&A	$2,251.00	$ 2,319.00	$ 12,000.00
Maintenance/Rehabilitation			

11/12 Description: Annual Inspection

	2011/2012
E&D	
Construction	
Construction Oversight	
Sub Total - Maint. And Rehab.	$ -

12/13 Description: Annual Inspection

	2012/2013
E&D	
Construction	$ -
Construction Oversight	
Sub Total - Maint. And Rehab.	$ -

13/14 Description: Annual Inspection, refurbishment of all rock plugs/sign replacement and barricade repairs.

	2013/2014
E&D	$ 115,334.00
Construction	$ 1,396,200.00
Construction Oversight	$ 46,200.00
Sub Total - Maint. And Rehab.	$ 1,557,734.00

	2011/2012	2012/2013	2013/2014
Annual O&M Budgets	**$ 8,519.00**	**$ 8,775.00**	**$ 1,596,383.00**

O &M Budget (3 yr Total)	**$ 1,613,677.00**
Unexpended O & M Funds	**$ 228,782.61**
Remaining O & M Budget (Projected)	**$ (1,384,894.39)**

OPERATIONS & MAINTENANCE BUDGET WORKSHEET

Project: TE-26 Lake Chapeau Marsh Creation and Hydrologic Restoration

FY 11/12 –

Administration	$ 2,251
O&M Inspection & Report	$ 6,268
Operation:	$ 0
Maintenance:	$ 0

Operation and Maintenance Assumptions:
2011/2012 Annual Inspection and Report
NMFS administration: $2,251 from Beast Report.

FY 12/13 –

Administration	$ 2,319
O&M Inspection & Report	$ 6,456
Operation:	$ 0
Maintenance:	$ 0

Operation and Maintenance Assumptions:
2012/2013 Annual Inspection and Report
NMFS Administration: $2,319 from Beast Report

FY 13/14 –

NMFS Administration	$ 12,000
OCPR Administration	$ 20,000
O&M Inspection & Report	$ 6,649
Operation:	$ 0
Maintenance:	$1,557,734

Operations and Maintenance Assumptions:
Proposed Maintenance Project to refurbish existing rock weirs (#'s 1, 4, 5, 6, 7 & 9) which have settled and degraded since the project was constructed in 1999. Construction includes recapping existing weir structures, access dredging for Weirs 5 &6, signage replacement and repair of existing timber barricade at Weir 6. Below is a detailed estimate of the overall project costs.

Lake Chapeau Hydrologic Restoration (TE-26) Project
Cost Estimate for Proposed Maintenance Project to refurbish existing rock plugs.

Quantities of rock riprap:

Weir #1:	- 1.39 Elevation	= 1,330 tons
Weir #4:	- 1.13 Elevation	= 2,560 tons
Weir#5:	-0.14 Elevation	= 390 tons
Weir #6:	-1.12 Elevation	= 710 tons
Weir #7:	-2.08 Elevation	= 960 tons
Weir #9:	-1.66 Elevation	= 2,450 tons
Total Estimated Quantities		8,400 tons

Estimated Construction Costs:

1. Mobilization/Demobilization: $ 250,000
2. Access Dredging(allowance): $ 150,000
3. Rock Rip Rap (8,400 tons@$90/ton): $ 756,000
4. Sign Replacement(5 @ $500/each): $ 2,500
5. Timber Barricade Repair (Est.): $ 5,000

Construction Contingency (20% of Construction): $ 232,700

Total Estimated Construction Cost: $1,396,200

Estimated E&D, Surveying and Construction Oversight:

1. Engineering & Design: $ 97,734
   (7% of Construction)
2. Surveying: $ 14,000
   (4 days @ $3,500/day)
   Coordination/Data Processing/report: $ 3,600
   (40 hrs @ $90/hr.)
3. Construction Administration: $ 7,200
   (90 hrs @ $80/hr.)
4. Inspection: $ 39,000
   (600 hrs @ $65/hr.)
5. OCPR Administration: $ 20,000
   (250 hrs @ 80/hr)
6. NMFS Administration: $ 12,000
   (150hrs @ $80/hr)

Total E&D/Construction Oversight **$ 193,534**

Total Overall Estimated Project Cost: $1,589,734

Unexpended funds from Lana Report (Thru 2/22/2010):	$	300,079.20
FY10 Expenditures by LDNR	$	71,296.59
Estimated Unexpended Funds:	$	228,782.61

Lake Chapeau Hydrologic Restoration (TE-26)
Federal Sponsor: NMFS
Construction Completed : May 1999
PPL 3

Previous O&M Funding Requests	Baseline Approved Funding	2009	2010	Currently Funded
State O&M	$429,720	$331,493	$0	$761,213
Corps Admin	$0	$4,977	$0	$4,977
Federal S&A	$0	$27,831	$0	$27,831
Total	$429,720	$364,301	$0	$794,021

Current Approved O&M Budget June 2009	Year 0 FY00	Year - 1 FY01	Year -2 FY02	Year -3 FY03	Year -4 FY04	Year -5 FY05	Year -6 FY06	Year -7 FY07	Year -8 FY08	Year -9 FY09	Year -10 FY10	Year -11 FY11	Year -12 FY12	Year -13 FY13	Year -14 FY14	Year -15 FY15	Year -16 FY16	Year - 17 FY17	Year -18 FY18	Year -19 FY19	Project Life Budget	Currently Funded
State O&M					$69,327	$322,823	$2,335	$8,846		$34,872	$310,658	$6,085	$6,268	$6,456	$1,009,811	$6,849	$7,055	$7,266	$7,484	$7,708	$1,813,843	$761,213
Corps Admin										$0	$1,225	$1,227	$1,245	$1,280	$1,338	$1,425	$1,544	$1,703	$1,913	$3,772	$16,672	$4,977
Federal S&A										$12,060	$9,080	$2,121	$2,251	$2,319	$26,520	$2,388	$2,459	$2,534	$2,610	$2,688	$67,030	$27,831
Total																					$1,897,545	$794,021

Projected O&M Expenditures	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	Remaining Project Life	Current 3 year Request
Maintenance Inspection													$6,268	$6,456	$6,649	$6,849	$7,055	$7,266	$7,481	$7,709	$55,733	$19,373
Structure Operation																						
Navigation Aid Maintenance																						
Routine Breach Repairs/Maint.																					$0	$0
Construction Administratoin																					$0	$0
NMFS Administration													$2,251	$2,319	$12,000	$2,388	$2,459	$2,534	$2,610	$2,688	$29,249	$16,570
OCPR Administration															$20,000						$20,000	$20,000
Maintenance/Rehabilitation																					$0	$0
E&D															$115,334						$115,334	$115,334
Construction															$1,396,200						$1,396,200	$1,396,200
Construction Oversight															$46,200						$46,200	$46,200
Total					$0	$0	$0	$0	$0	$0	$0	$0	$8,519	$8,775	$1,596,383	$9,237	$9,514	$9,800	$10,091	$10,397	$1,662,716	$1,613,677

O&M Expenditures from COE Report	$493,942
State O&M Expenditures not submitted for in-kind credit	$71,297
Federal Sponsor MIPRs (if applicable)	$0
Total Estimated O&M Expenditures (as of April 2010)	$565,238

Current O&M Budget less COE Admin	$789,044
Remaining Available O&M Budget	$223,806
Incremental Funding Request Amount FY12-FY14	**$1,389,871**

Current Project Life Budget less COE Admin	$1,880,873
Total Projected Project Life Budget	$2,227,954
Project Life Budget Request Amount	**$347,081**

Notes:

1. The year-by-year figures for the current Approved O&M Budget are based on the BEAST approved at the 10/28/09 Task Force meeting.

Appendix C
(Contour Elevation Maps)

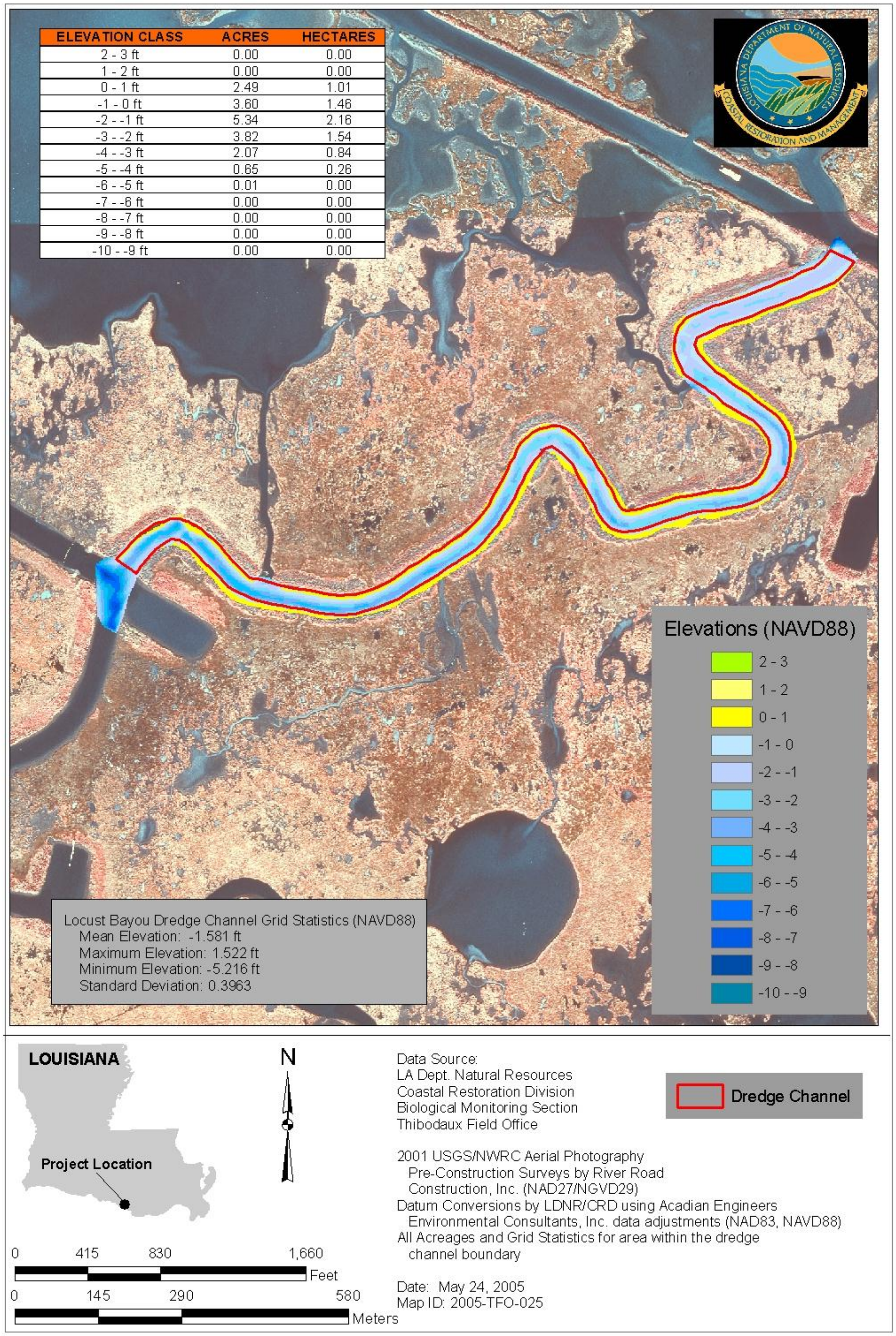
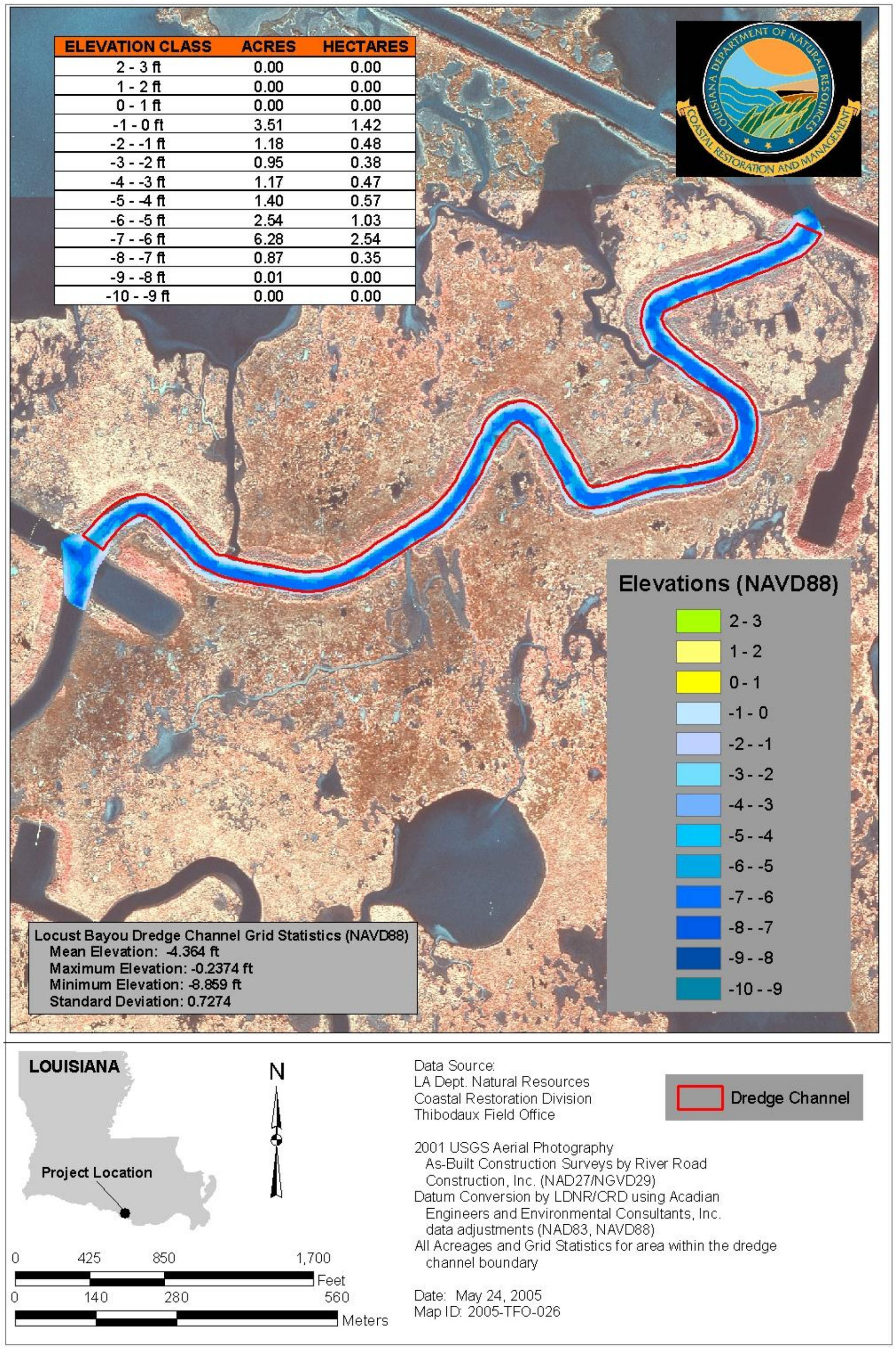
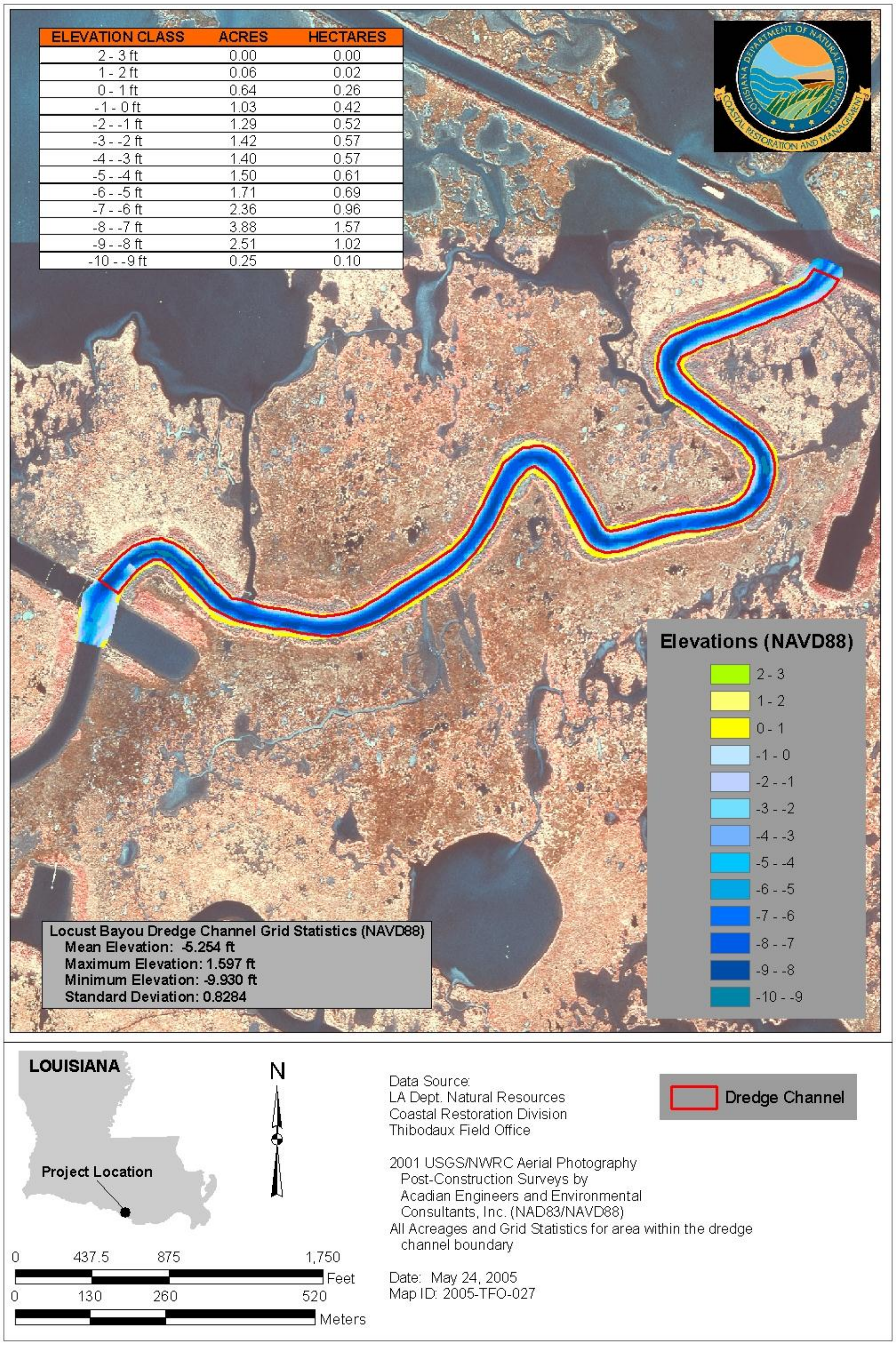


Figure 1. Contour elevation acreage for the pre-construction elevation survey of the Locust Bayou dredge channel for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.



ELEVATION CLASS	ACRES	HECTARES
2 - 3 ft	0.00	0.00
1 - 2 ft	0.00	0.00
0 - 1 ft	0.00	0.00
-1 - 0 ft	3.51	1.42
-2 - -1 ft	1.18	0.48
-3 - -2 ft	0.95	0.38
-4 - -3 ft	1.17	0.47
-5 - -4 ft	1.40	0.57
-6 - -5 ft	2.54	1.03
-7 - -6 ft	6.28	2.54
-8 - -7 ft	0.87	0.35
-9 - -8 ft	0.01	0.00
-10 - -9 ft	0.00	0.00

Figure 2. Contour elevation acreage for the as-built elevation survey of the Locust Bayou dredge channel for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.



ELEVATION CLASS	ACRES	HECTARES
2 - 3 ft	0.00	0.00
1 - 2 ft	0.06	0.02
0 - 1 ft	0.64	0.26
-1 - 0 ft	1.03	0.42
-2 - -1 ft	1.29	0.52
-3 - -2 ft	1.42	0.57
-4 - -3 ft	1.40	0.57
-5 - -4 ft	1.50	0.61
-6 - -5 ft	1.71	0.69
-7 - -6 ft	2.36	0.96
-8 - -7 ft	3.88	1.57
-9 - -8 ft	2.51	1.02
-10 - -9 ft	0.25	0.10

Figure 3. Contour elevation acreage for the post-construction elevation survey of the Locust Bayou dredge channel for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.

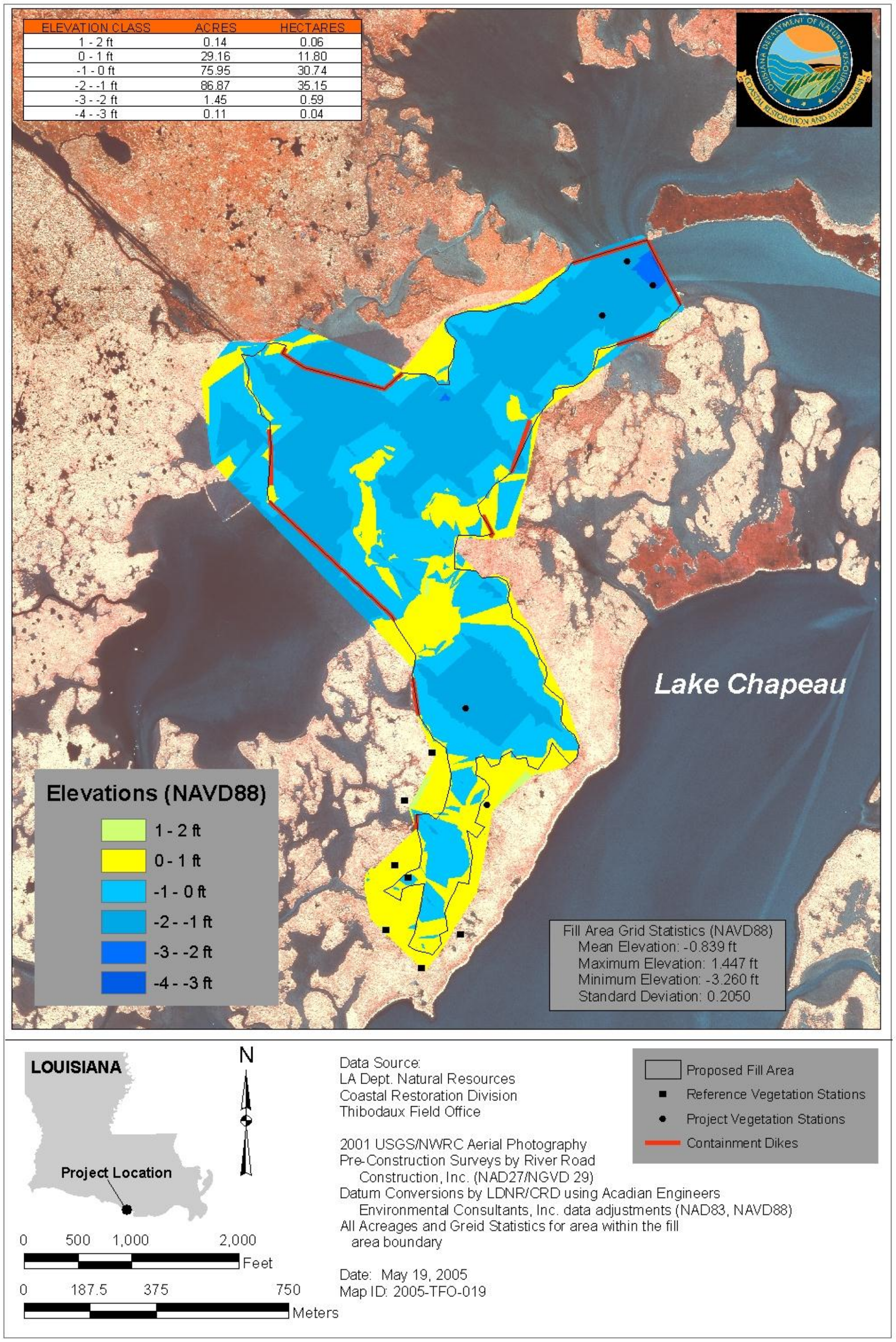


Figure 4. Contour elevation acreage for the pre-construction elevation survey of the fill area for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.

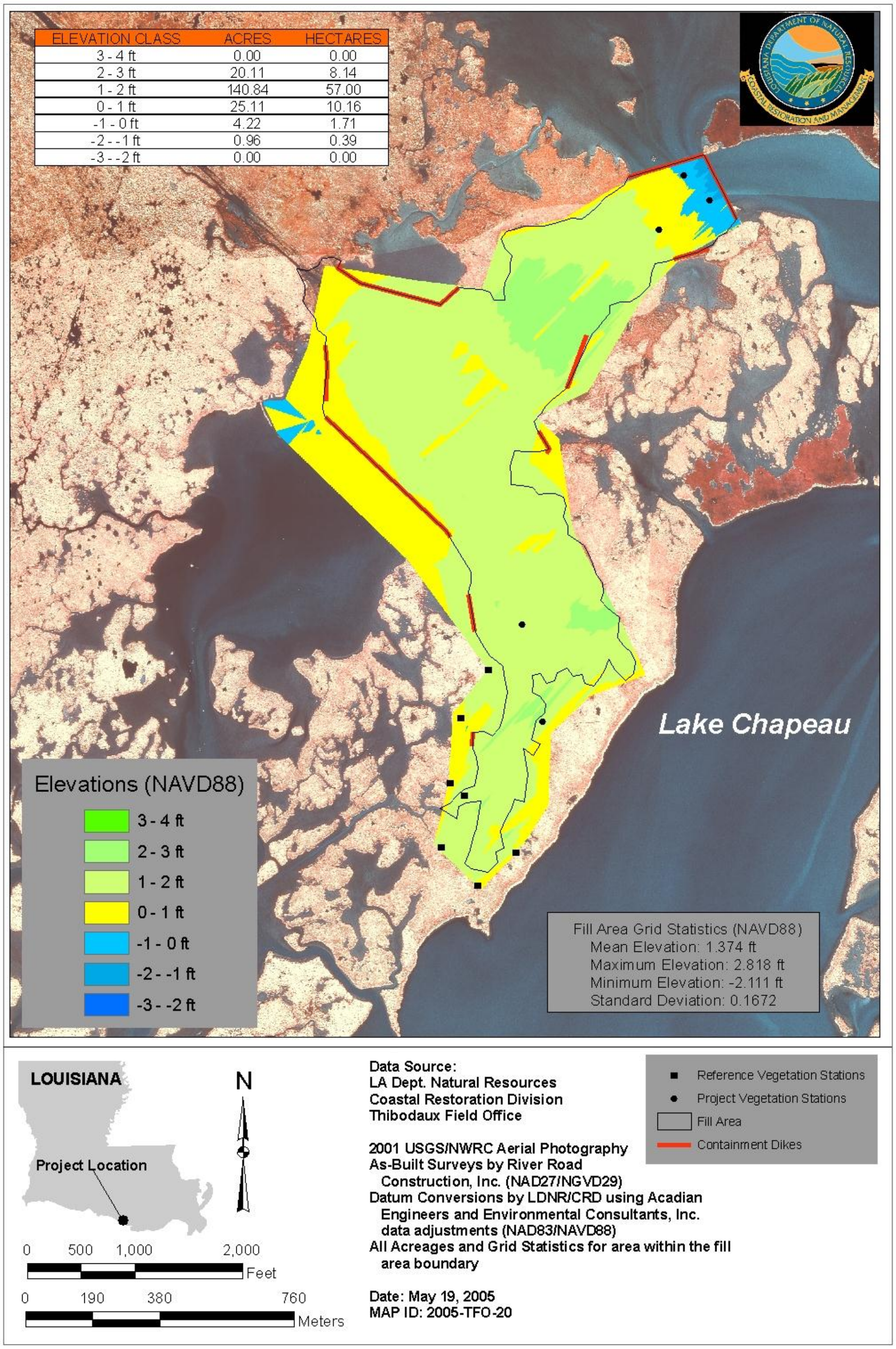


Figure 5. Contour elevation acreage for the as-built elevation survey of the fill area for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.

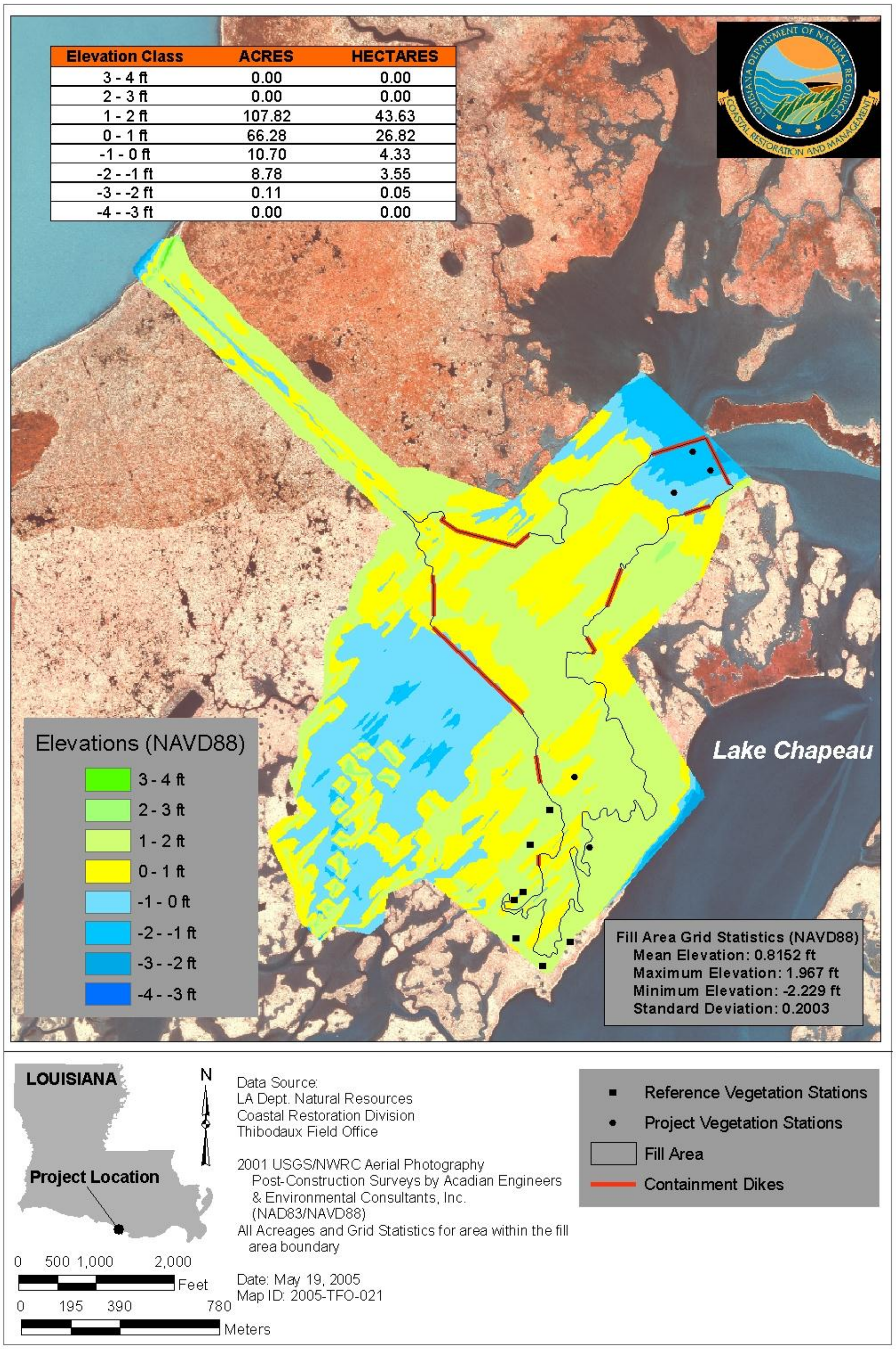


Figure 6. Contour elevation acreage for the post-construction elevation survey of the fill area for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.

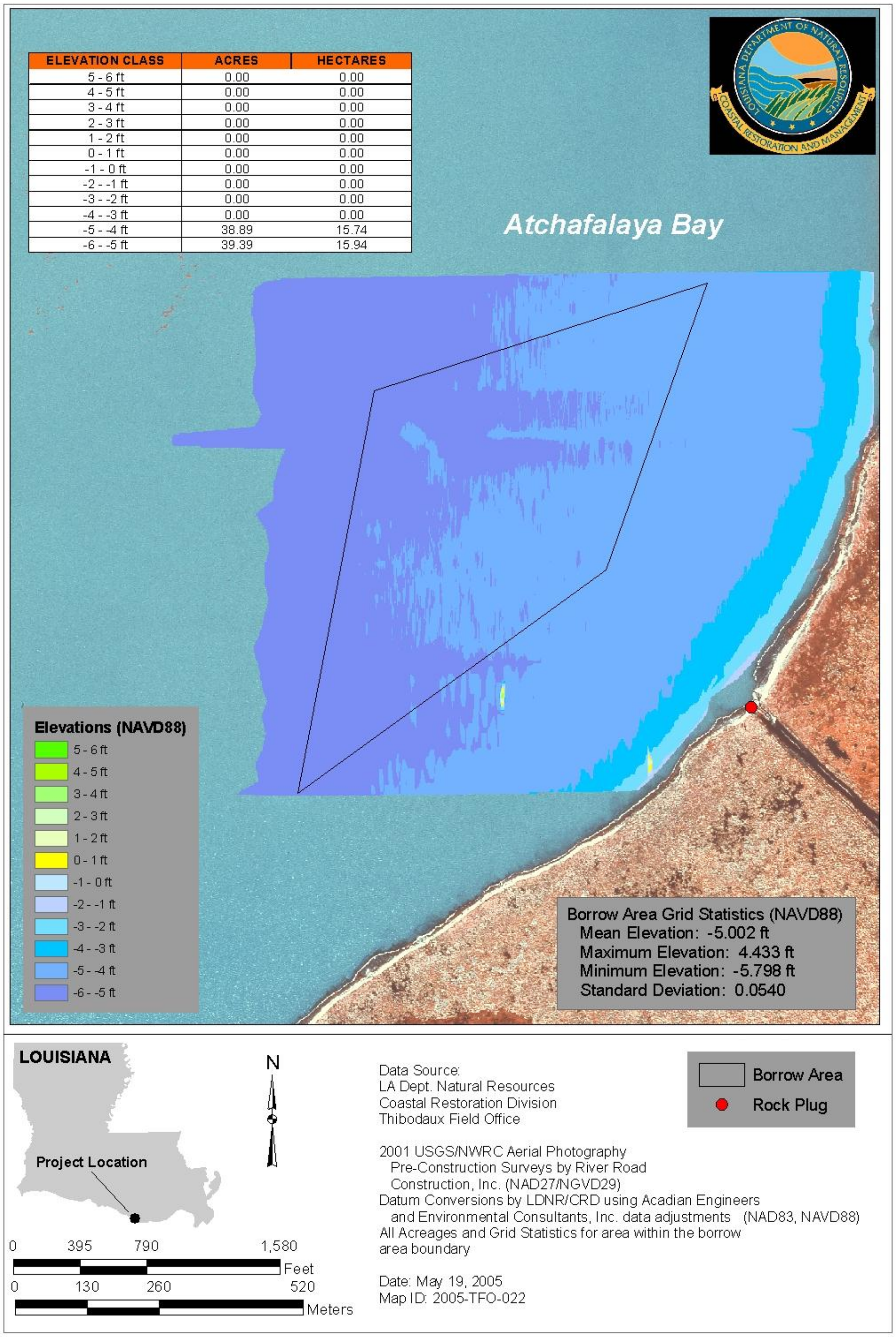


Figure 7. Contour elevation acreage for the pre-construction elevation survey of the borrow area for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.

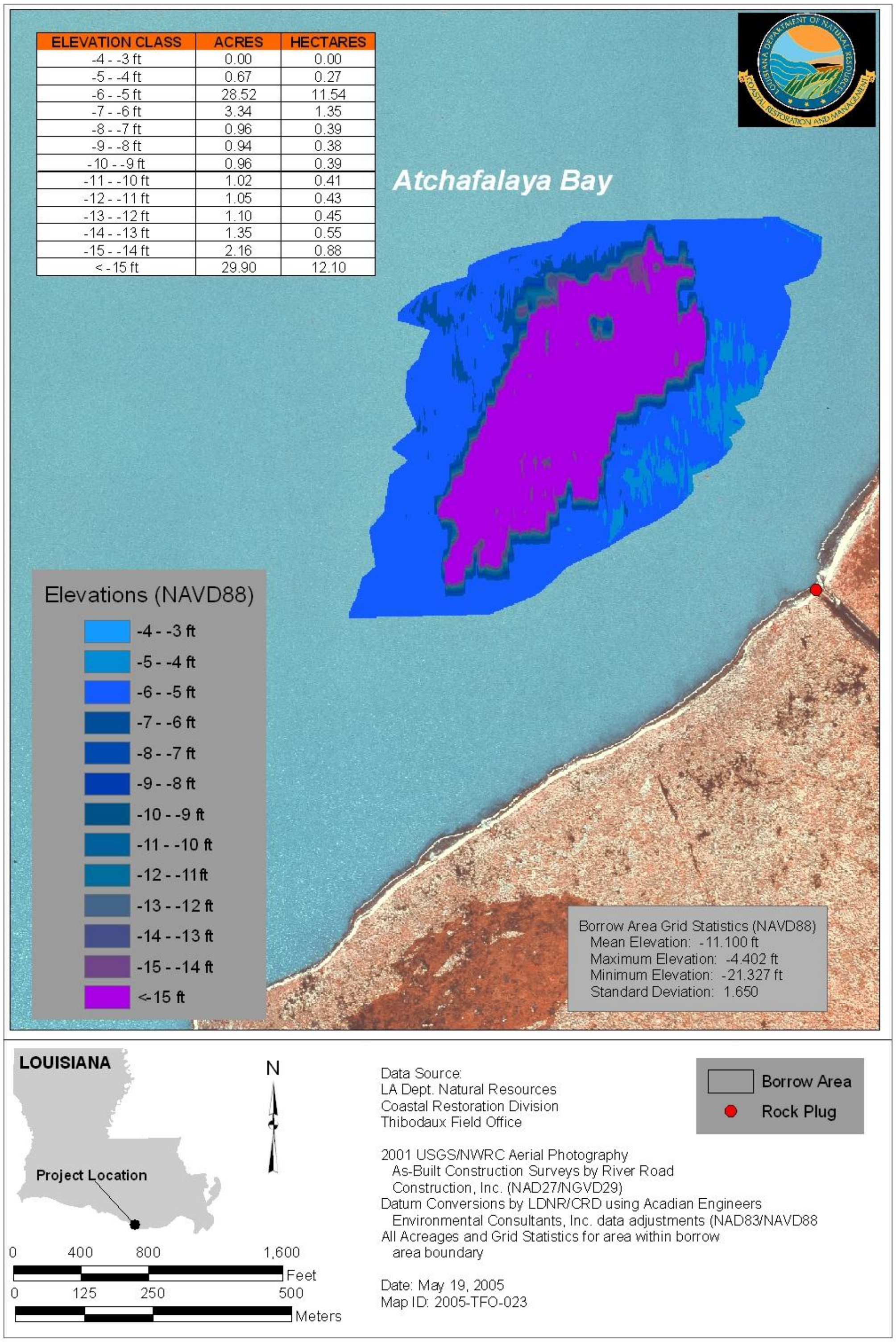


Figure 8. Contour elevation acreage for the as-built elevation survey of the borrow area for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.

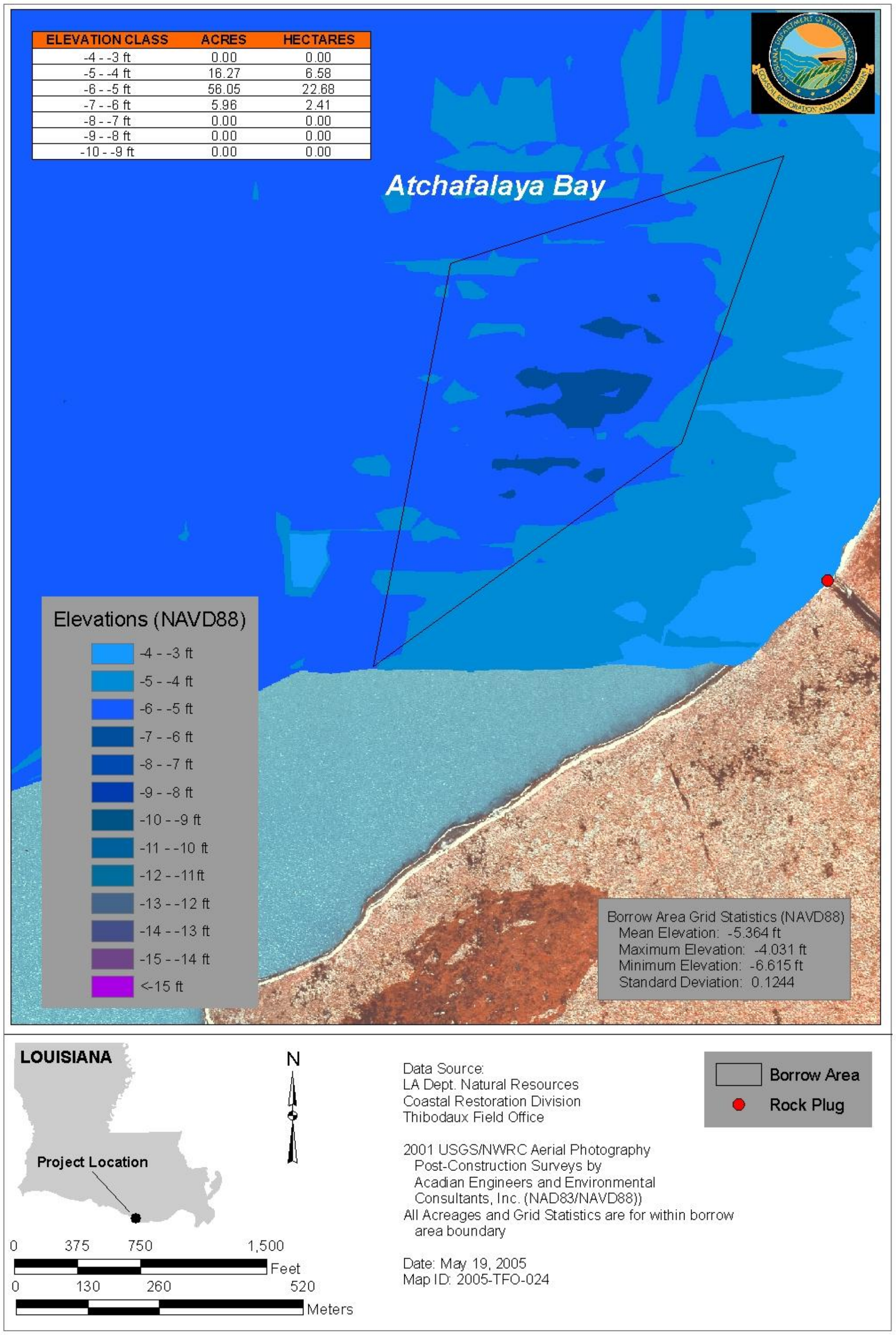


Figure 9. Contour elevation acreage for the post-construction elevation survey of the borrow area for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.

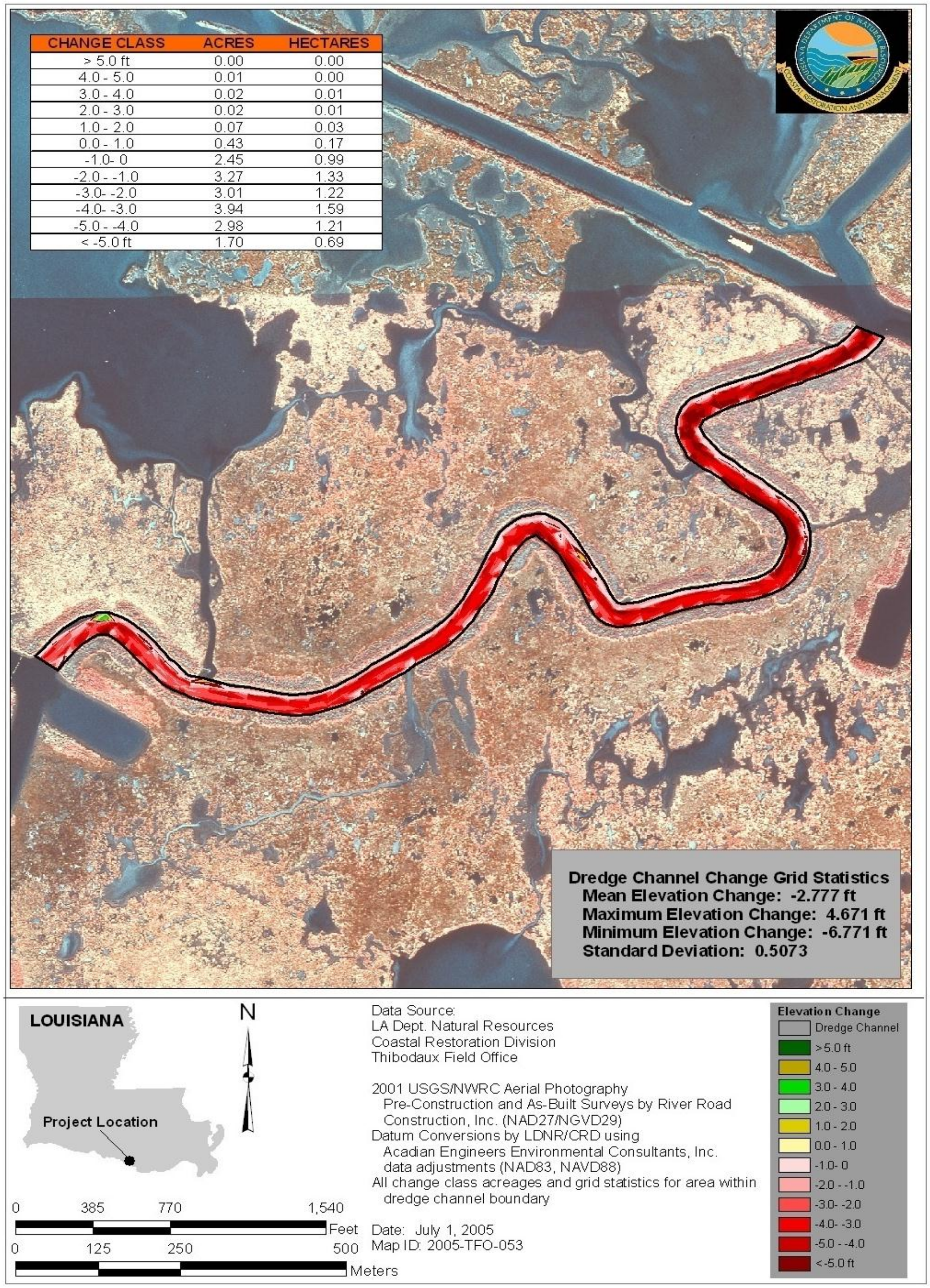
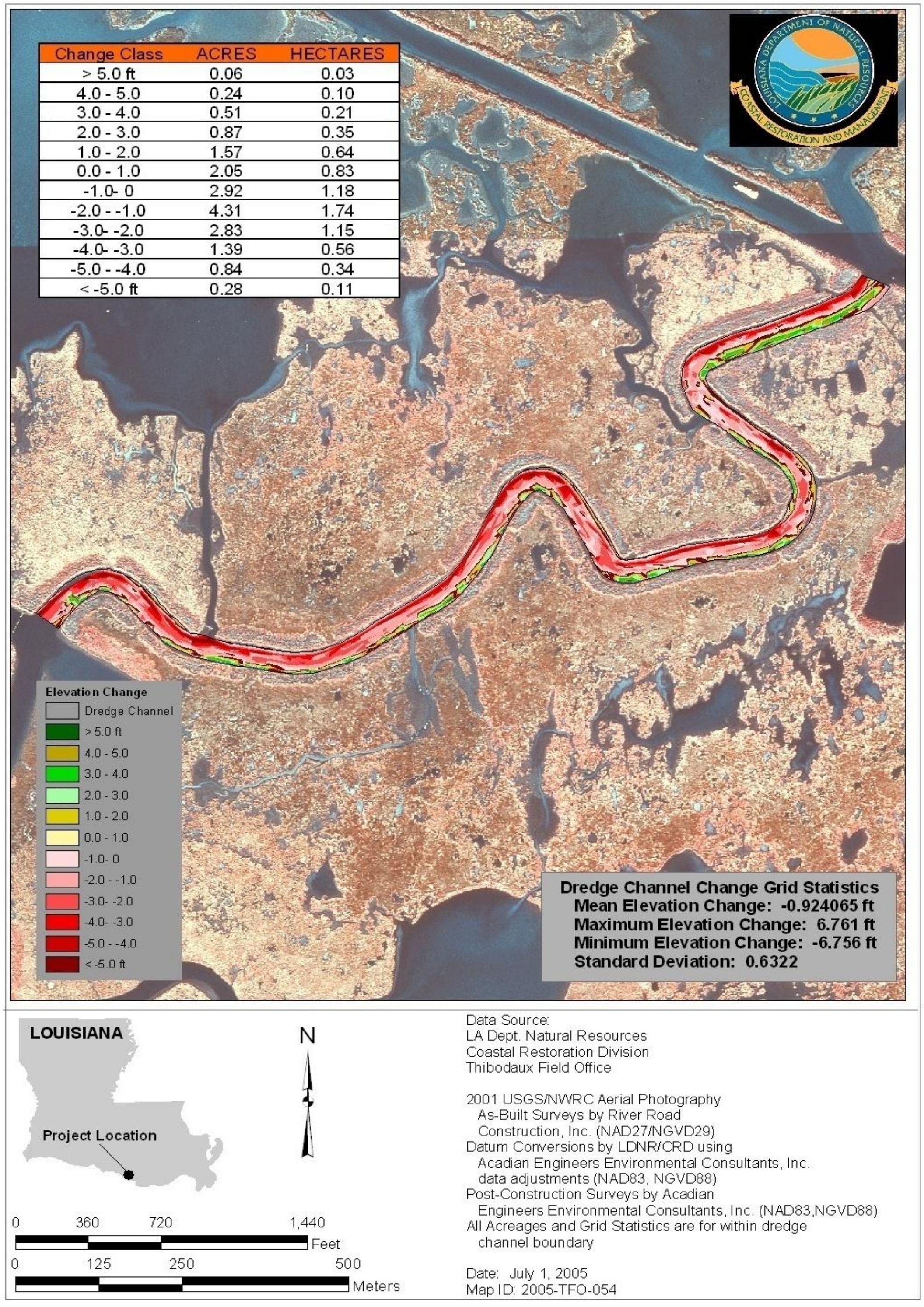
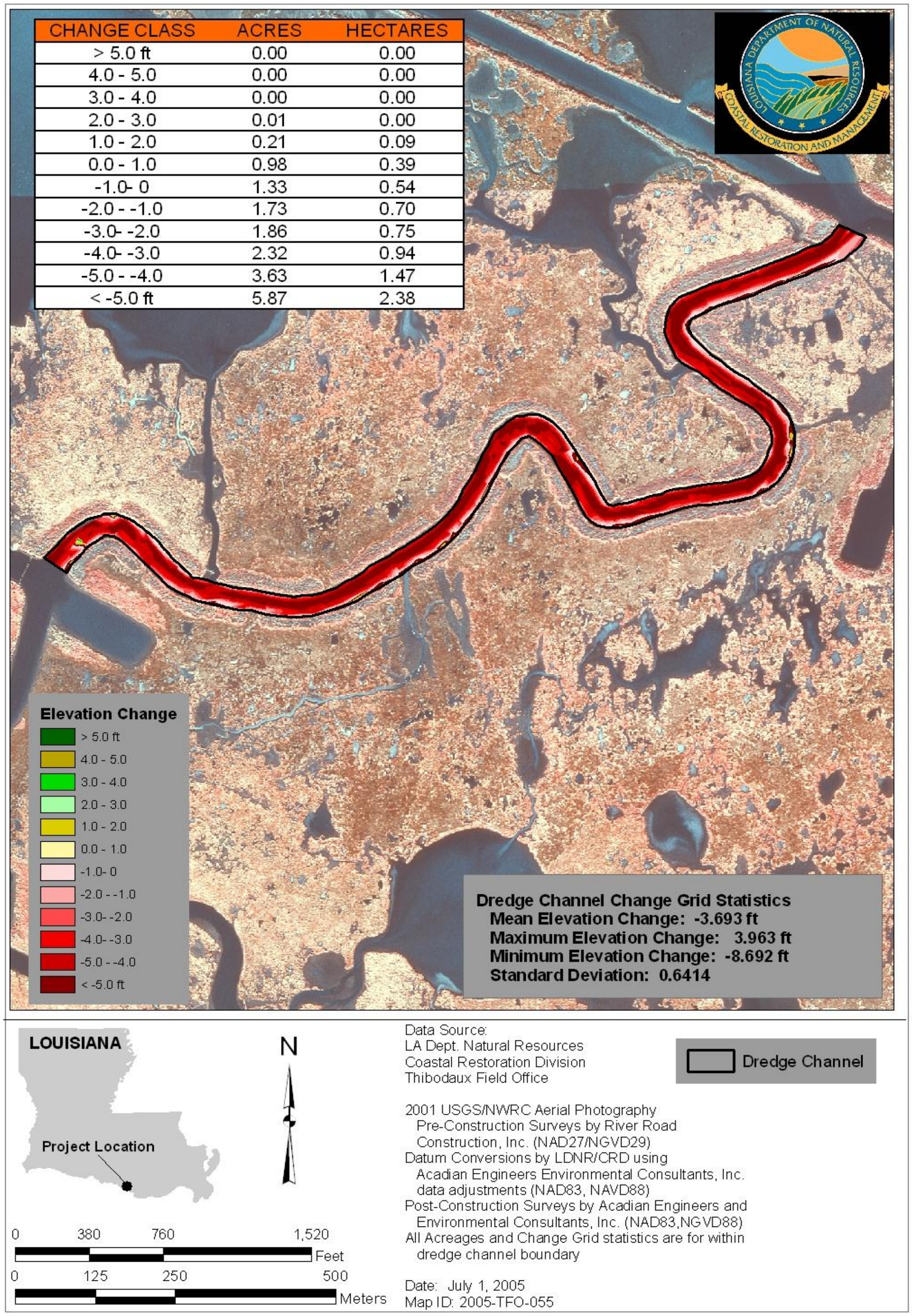


Figure 10. Change class acreages for the pre-construction (1999) versus as-built (1999) elevation surveys of the Locust Bayou dredge channel for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.



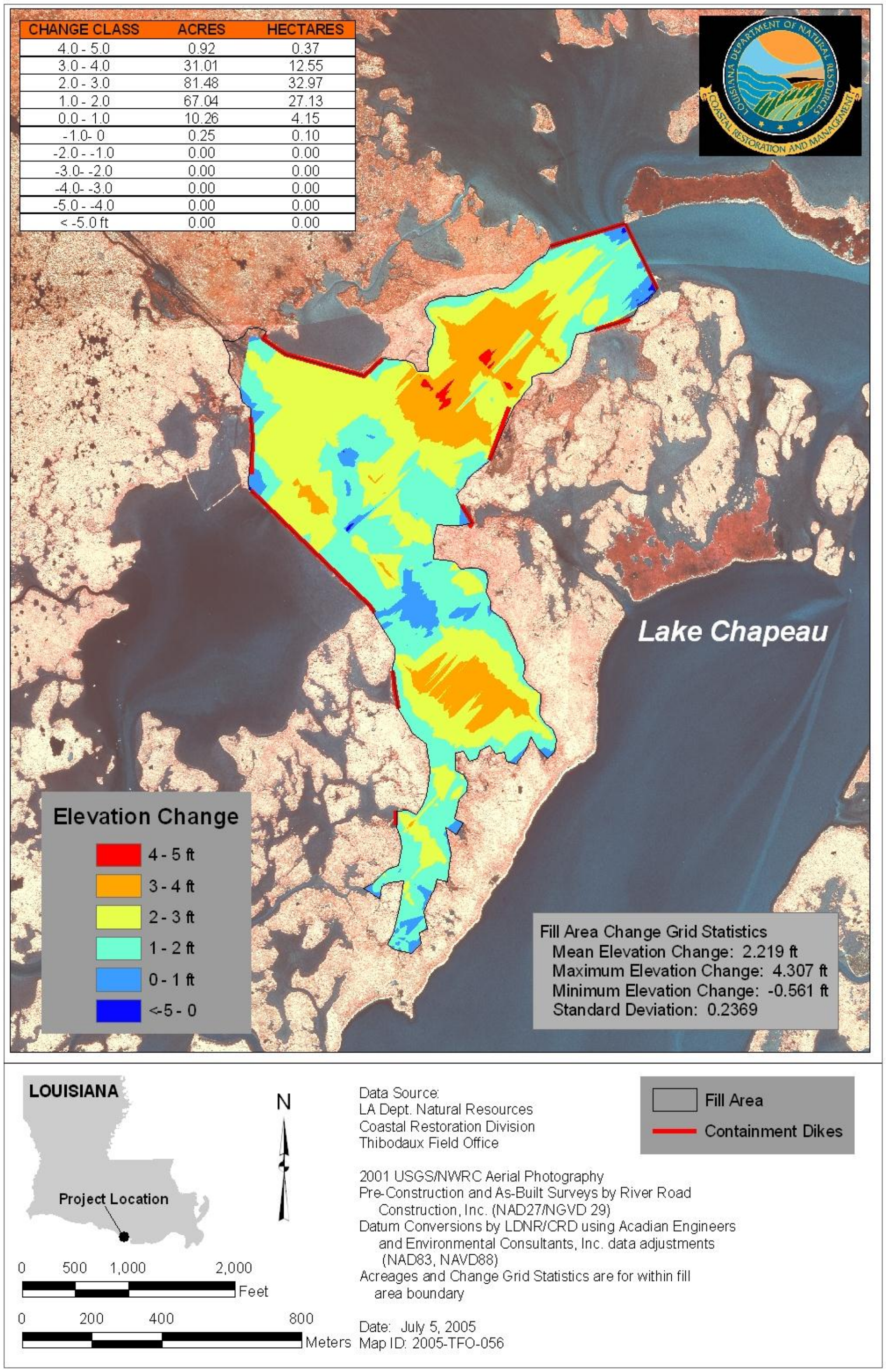
Change Class	ACRES	HECTARES
> 5.0 ft	0.06	0.03
4.0 - 5.0	0.24	0.10
3.0 - 4.0	0.51	0.21
2.0 - 3.0	0.87	0.35
1.0 - 2.0	1.57	0.64
0.0 - 1.0	2.05	0.83
-1.0- 0	2.92	1.18
-2.0 - -1.0	4.31	1.74
-3.0- -2.0	2.83	1.15
-4.0- -3.0	1.39	0.56
-5.0 - -4.0	0.84	0.34
< -5.0 ft	0.28	0.11

Figure 11. Change class acreages for the as-built (1999) versus post-construction (2004) elevation surveys of the Locust Bayou dredge channel for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.



CHANGE CLASS	ACRES	HECTARES
> 5.0 ft	0.00	0.00
4.0 - 5.0	0.00	0.00
3.0 - 4.0	0.00	0.00
2.0 - 3.0	0.01	0.00
1.0 - 2.0	0.21	0.09
0.0 - 1.0	0.98	0.39
-1.0- 0	1.33	0.54
-2.0 - -1.0	1.73	0.70
-3.0- -2.0	1.86	0.75
-4.0- -3.0	2.32	0.94
-5.0 - -4.0	3.63	1.47
< -5.0 ft	5.87	2.38

Figure 12. Change class acreages for the pre-construction (1999) versus post-construction (2004) elevation surveys of the Locust Bayou dredge channel for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.



CHANGE CLASS	ACRES	HECTARES
4.0 - 5.0	0.92	0.37
3.0 - 4.0	31.01	12.55
2.0 - 3.0	81.48	32.97
1.0 - 2.0	67.04	27.13
0.0 - 1.0	10.26	4.15
-1.0- 0	0.25	0.10
-2.0 - -1.0	0.00	0.00
-3.0- -2.0	0.00	0.00
-4.0- -3.0	0.00	0.00
-5.0 - -4.0	0.00	0.00
< -5.0 ft	0.00	0.00

Figure 13. Change class acreages for the pre-construction (1999) versus as-built (1999) elevation surveys of the fill area for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.

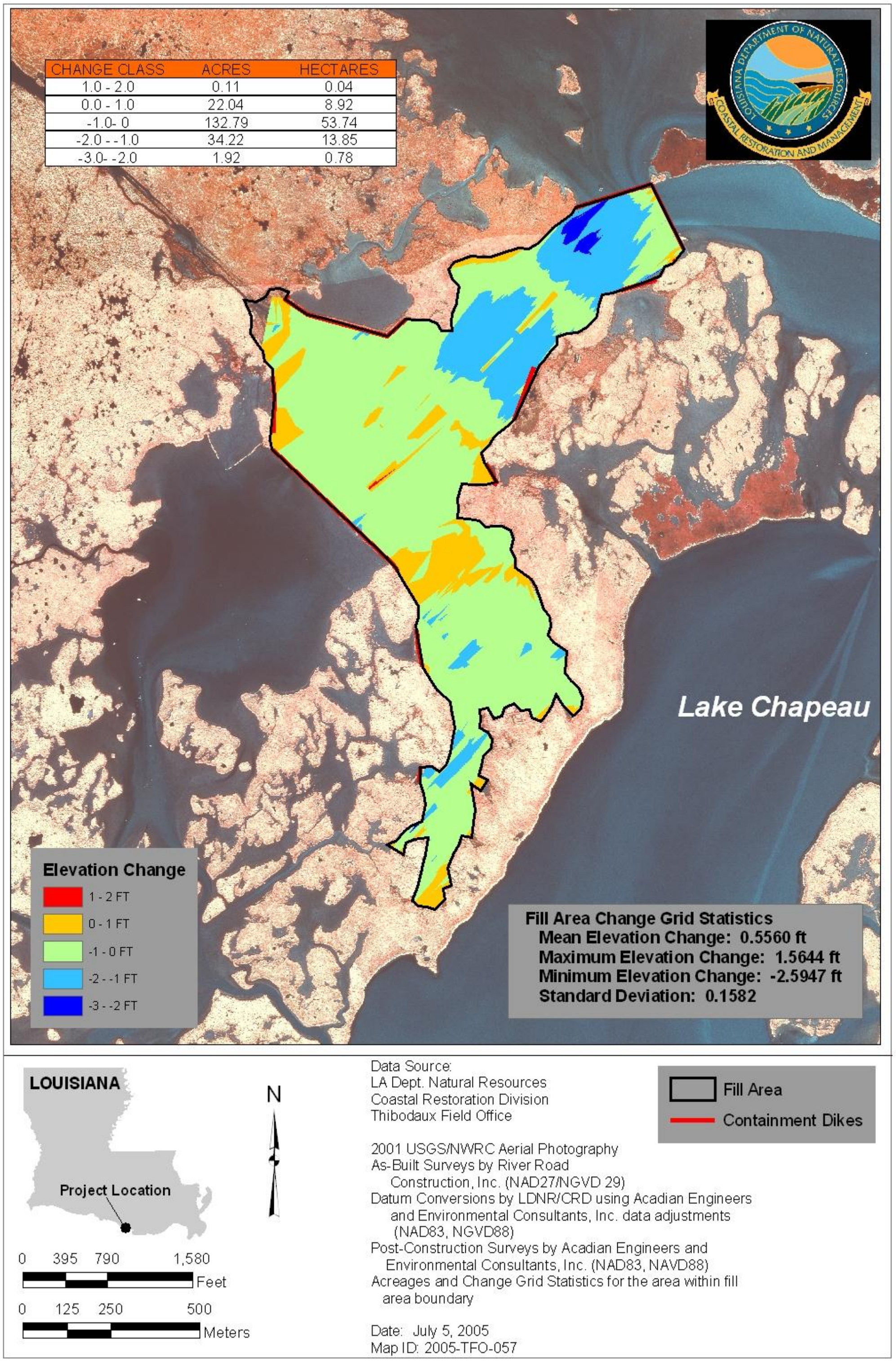


Figure 14. Change class acreages for the post-construction (2004) versus as-built (1999) elevation surveys of the fill area for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.

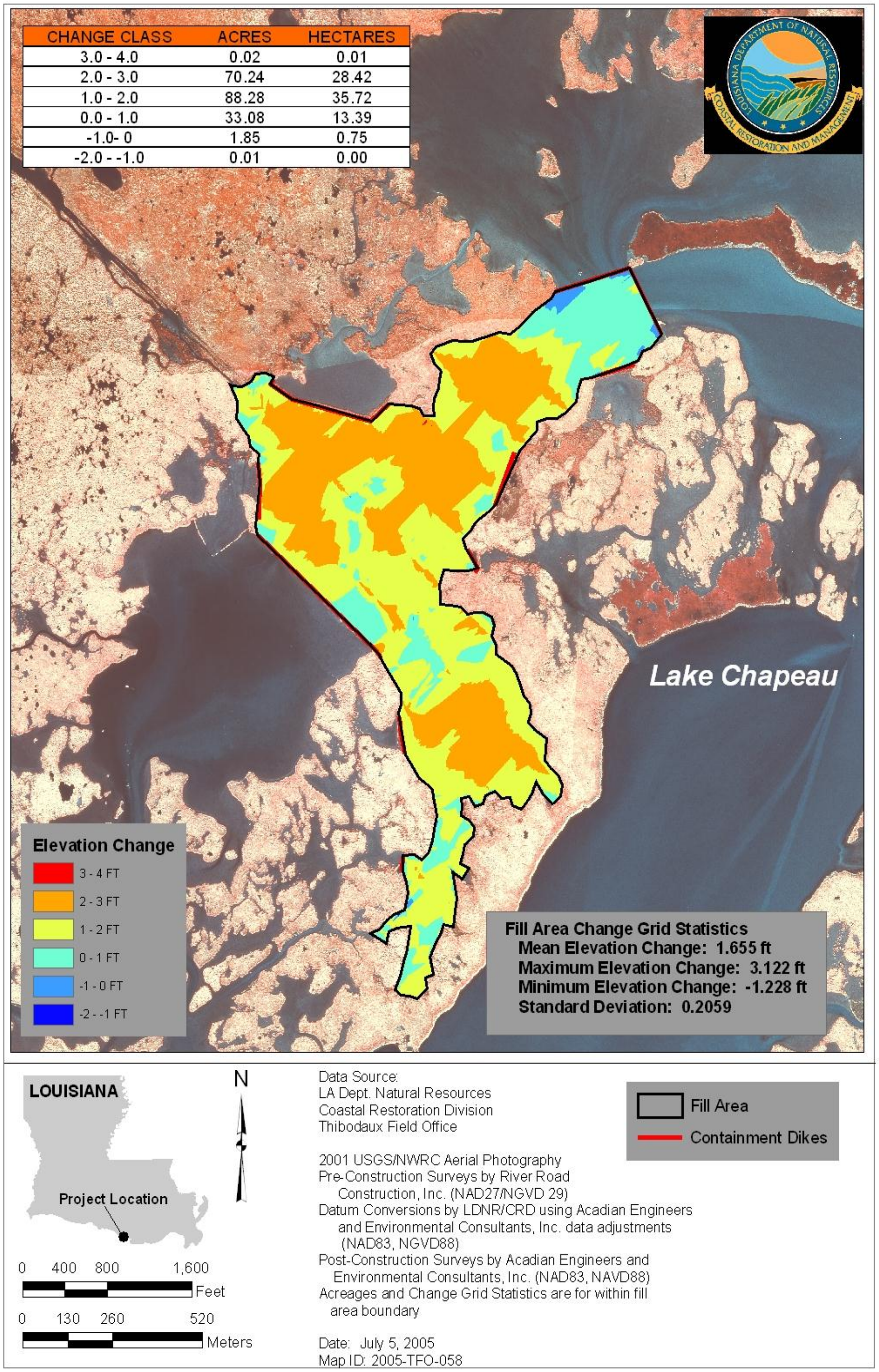
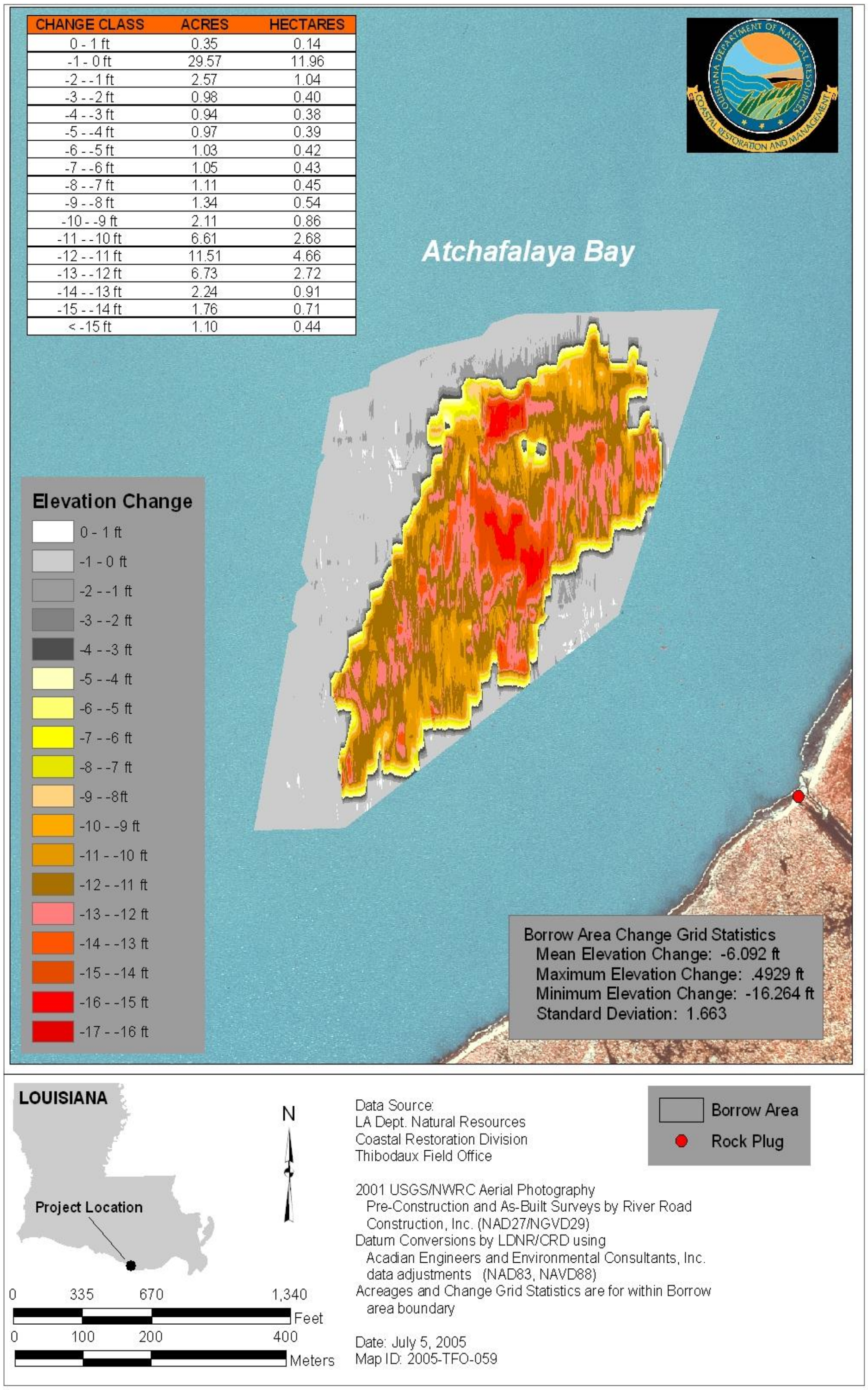
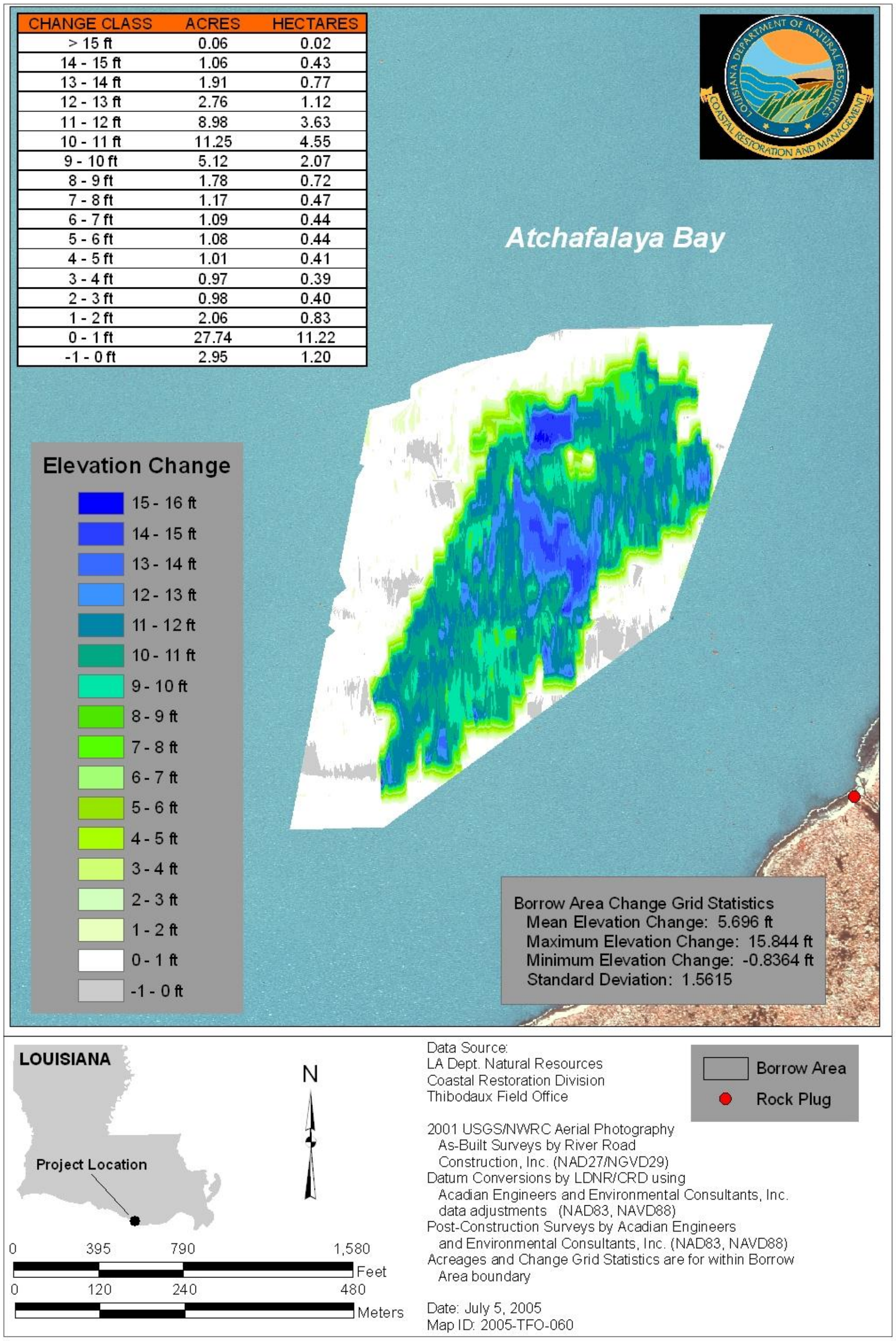


Figure 15. Change class acreages for the post-construction (2004) versus pre-construction (1999) elevation surveys of the fill area for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.



CHANGE CLASS	ACRES	HECTARES
0 - 1 ft	0.35	0.14
-1 - 0 ft	29.57	11.96
-2 - -1 ft	2.57	1.04
-3 - -2 ft	0.98	0.40
-4 - -3 ft	0.94	0.38
-5 - -4 ft	0.97	0.39
-6 - -5 ft	1.03	0.42
-7 - -6 ft	1.05	0.43
-8 - -7 ft	1.11	0.45
-9 - -8 ft	1.34	0.54
-10 - -9 ft	2.11	0.86
-11 - -10 ft	6.61	2.68
-12 - -11 ft	11.51	4.66
-13 - -12 ft	6.73	2.72
-14 - -13 ft	2.24	0.91
-15 - -14 ft	1.76	0.71
< -15 ft	1.10	0.44

Figure 16. Change class acreages for the pre-construction (1999) versus as-built (1999) elevation surveys of the borrow area for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.



CHANGE CLASS	ACRES	HECTARES
> 15 ft	0.06	0.02
14 - 15 ft	1.06	0.43
13 - 14 ft	1.91	0.77
12 - 13 ft	2.76	1.12
11 - 12 ft	8.98	3.63
10 - 11 ft	11.25	4.55
9 - 10 ft	5.12	2.07
8 - 9 ft	1.78	0.72
7 - 8 ft	1.17	0.47
6 - 7 ft	1.09	0.44
5 - 6 ft	1.08	0.44
4 - 5 ft	1.01	0.41
3 - 4 ft	0.97	0.39
2 - 3 ft	0.98	0.40
1 - 2 ft	2.06	0.83
0 - 1 ft	27.74	11.22
-1 - 0 ft	2.95	1.20

Figure 17. Change class acreages for the post-construction (2004) versus as-built (1999) elevation surveys of the borrow area for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.

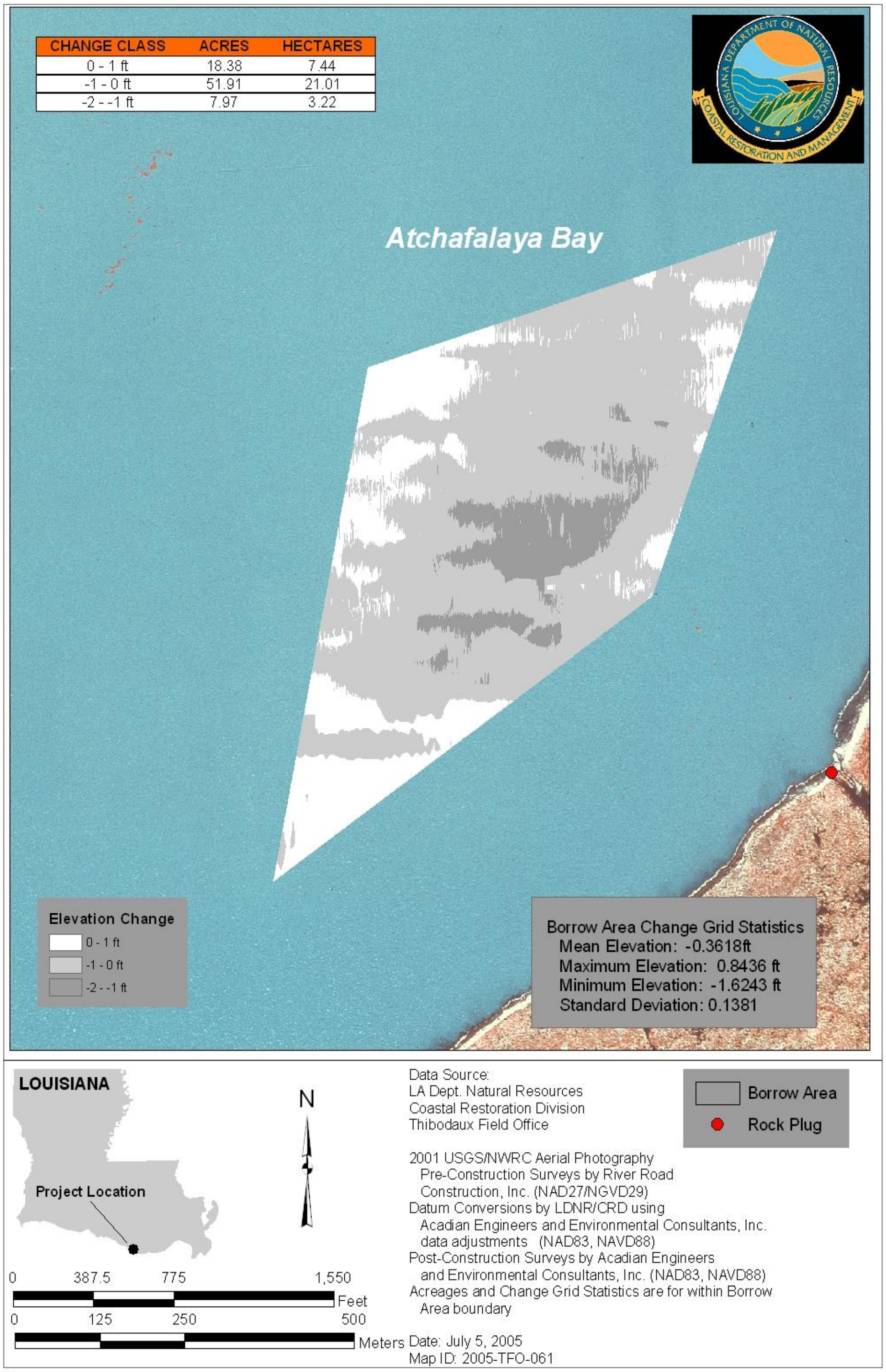
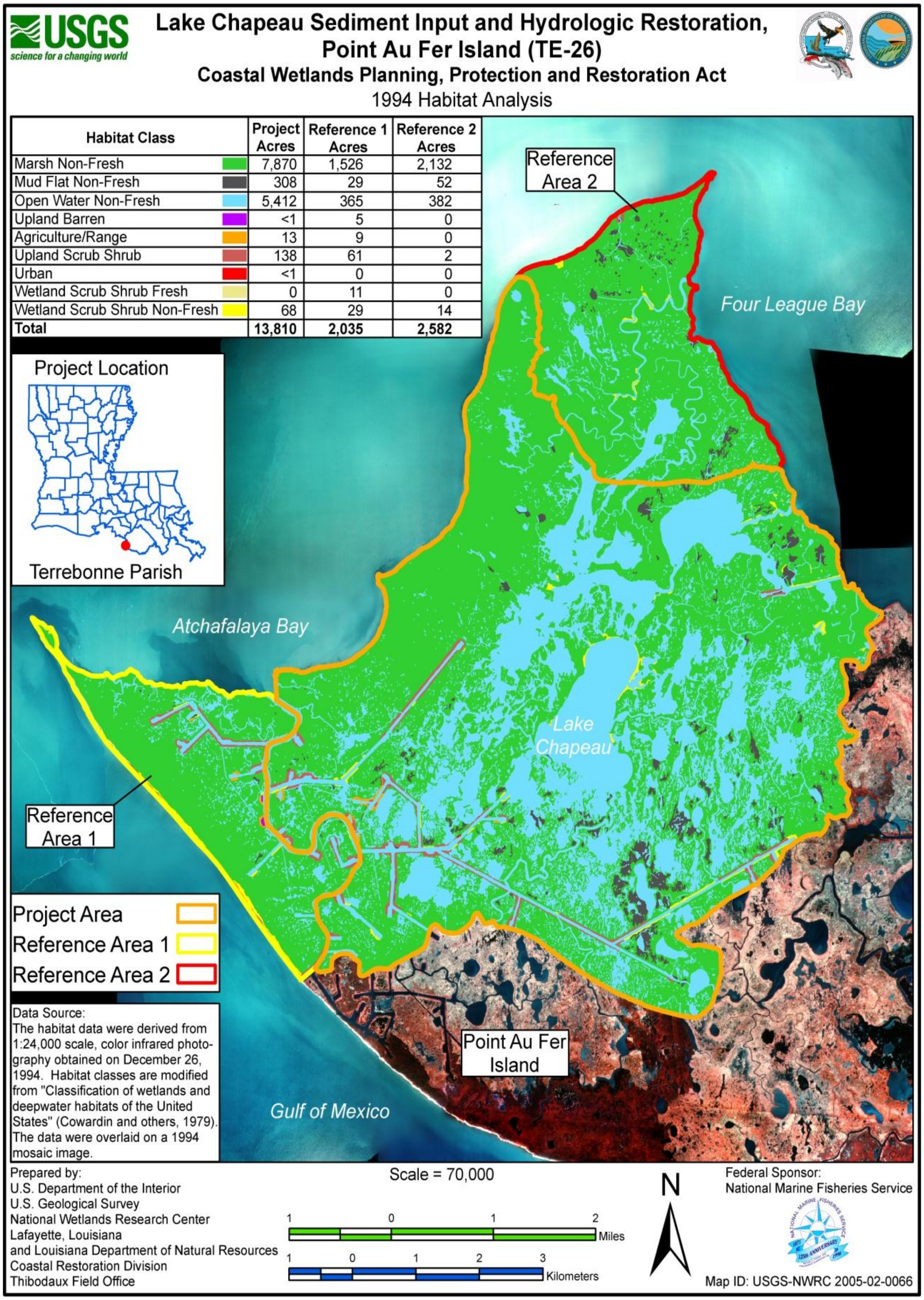


Figure 18. Change class acreages for the post-construction (2004) versus pre-construction (1999) elevation surveys of the borrow area for the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project.

Appendix D
(Habitat and Land-Water Maps)



Habitat Class	Project Acres	Reference 1 Acres	Reference 2 Acres
Marsh Non-Fresh	7,870	1,526	2,132
Mud Flat Non-Fresh	308	29	52
Open Water Non-Fresh	5,412	365	382
Upland Barren	<1	5	0
Agriculture/Range	13	9	0
Upland Scrub Shrub	138	61	2
Urban	<1	0	0
Wetland Scrub Shrub Fresh	0	11	0
Wetland Scrub Shrub Non-Fresh	68	29	14
Total	**13,810**	**2,035**	**2,582**

Figure 1. 1994 habitat analysis map of the TE-26 project and reference areas.

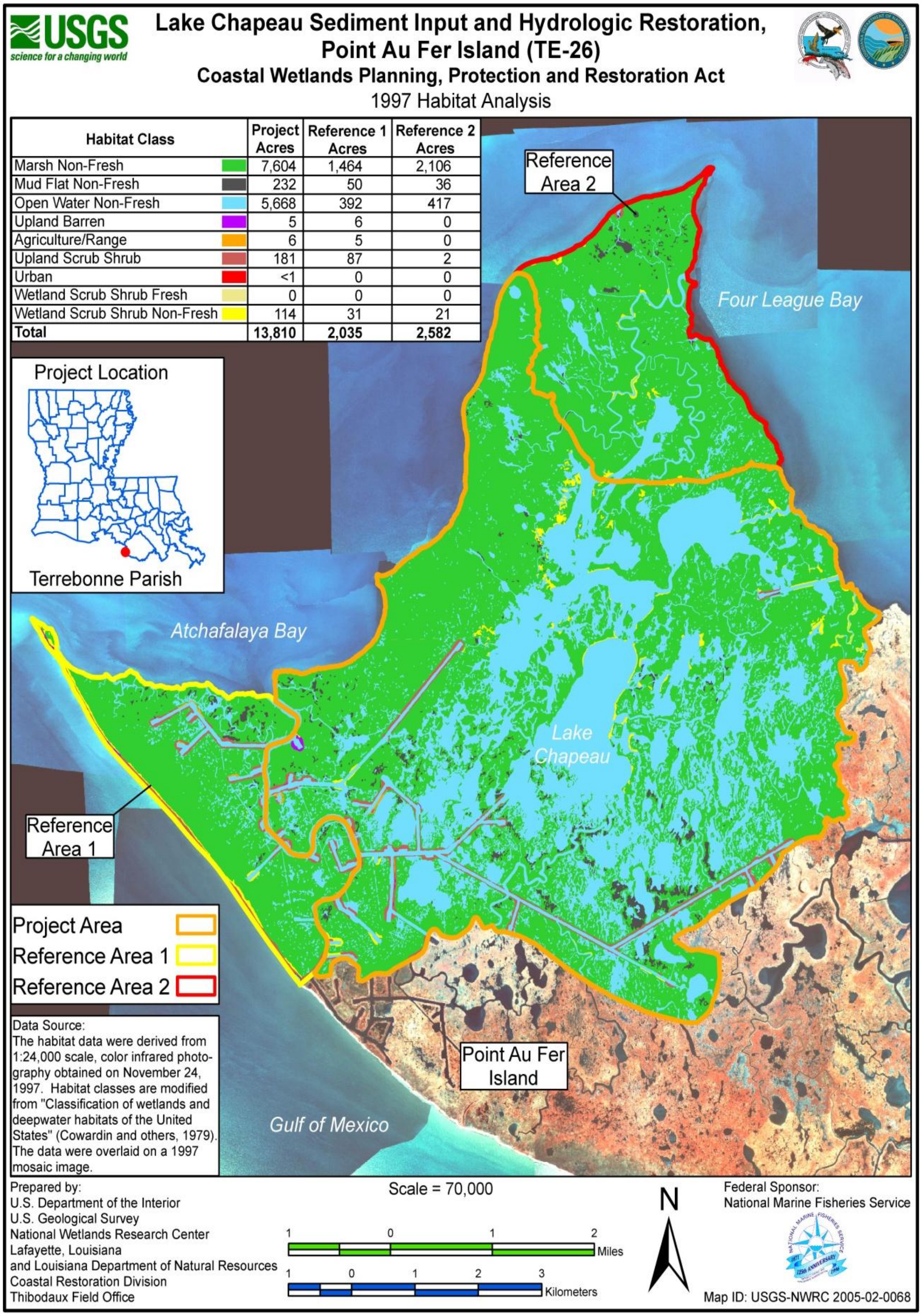
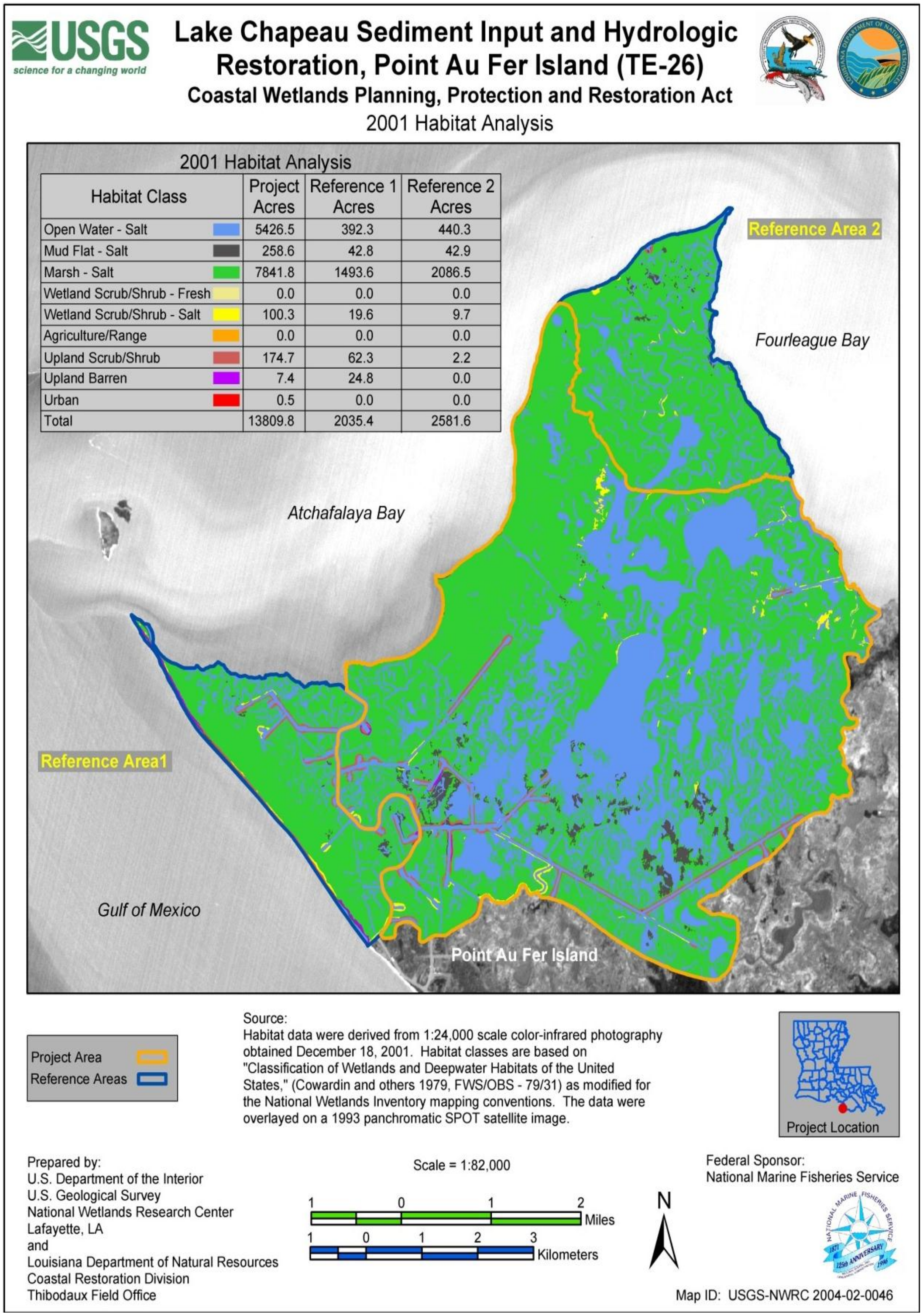


Figure 2. 1997 habitat analysis map of the TE-26 project and reference areas.



Habitat Class	Project Acres	Reference 1 Acres	Reference 2 Acres
Open Water - Salt	5426.5	392.3	440.3
Mud Flat - Salt	258.6	42.8	42.9
Marsh - Salt	7841.8	1493.6	2086.5
Wetland Scrub/Shrub - Fresh	0.0	0.0	0.0
Wetland Scrub/Shrub - Salt	100.3	19.6	9.7
Agriculture/Range	0.0	0.0	0.0
Upland Scrub/Shrub	174.7	62.3	2.2
Upland Barren	7.4	24.8	0.0
Urban	0.5	0.0	0.0
Total	13809.8	2035.4	2581.6

Figure 3. 2001 habitat analysis map of the TE-26 project and reference areas.

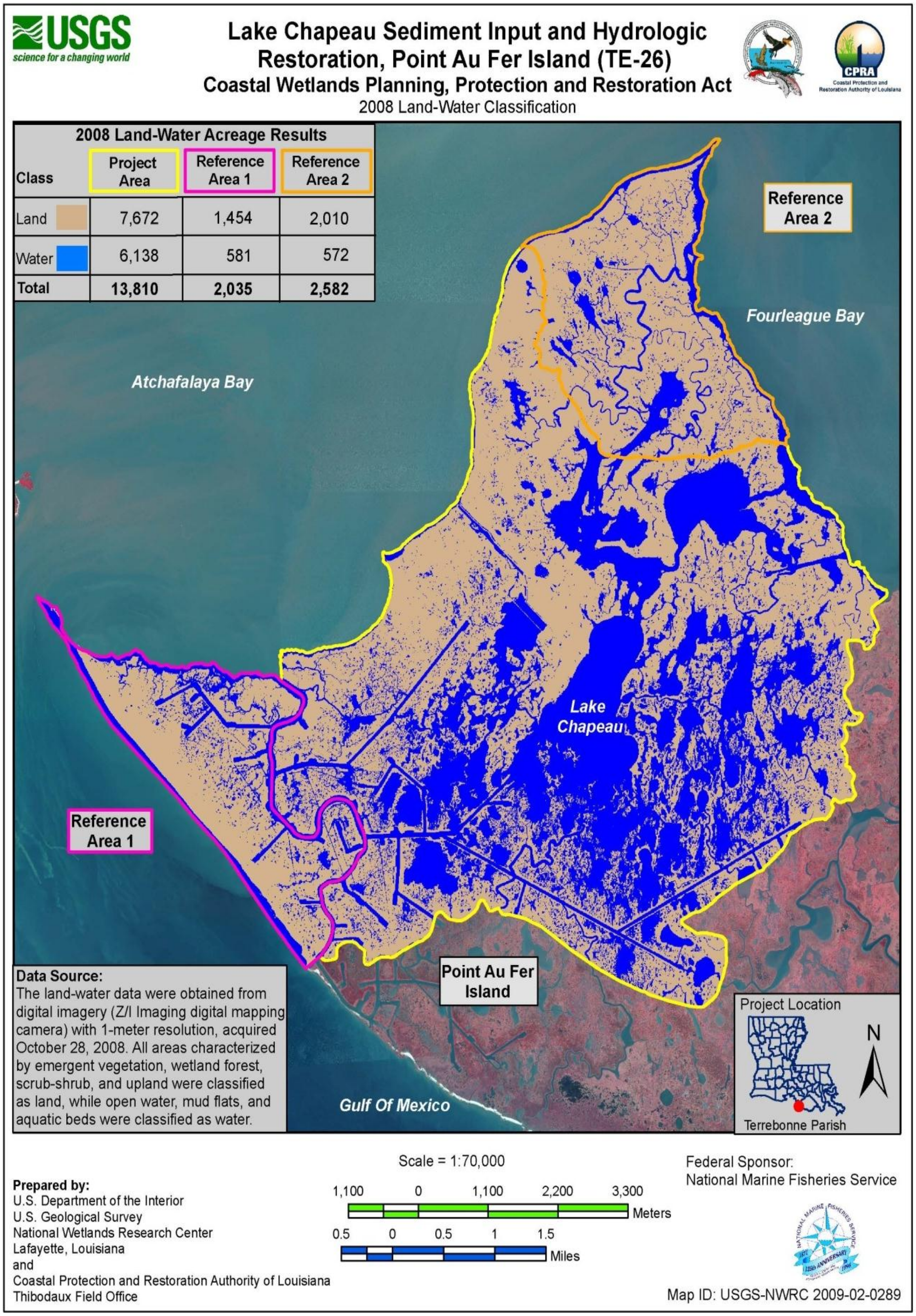
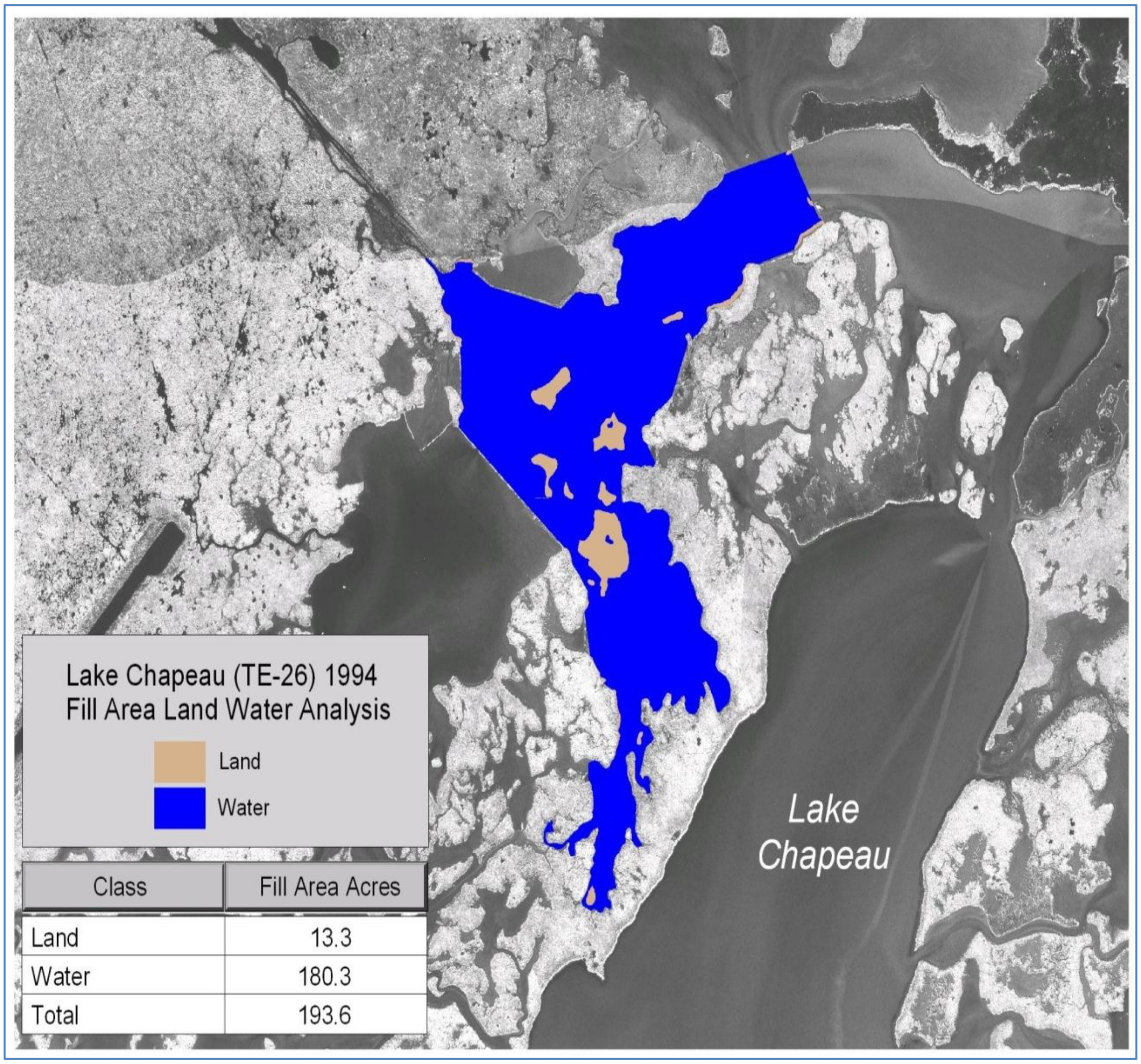
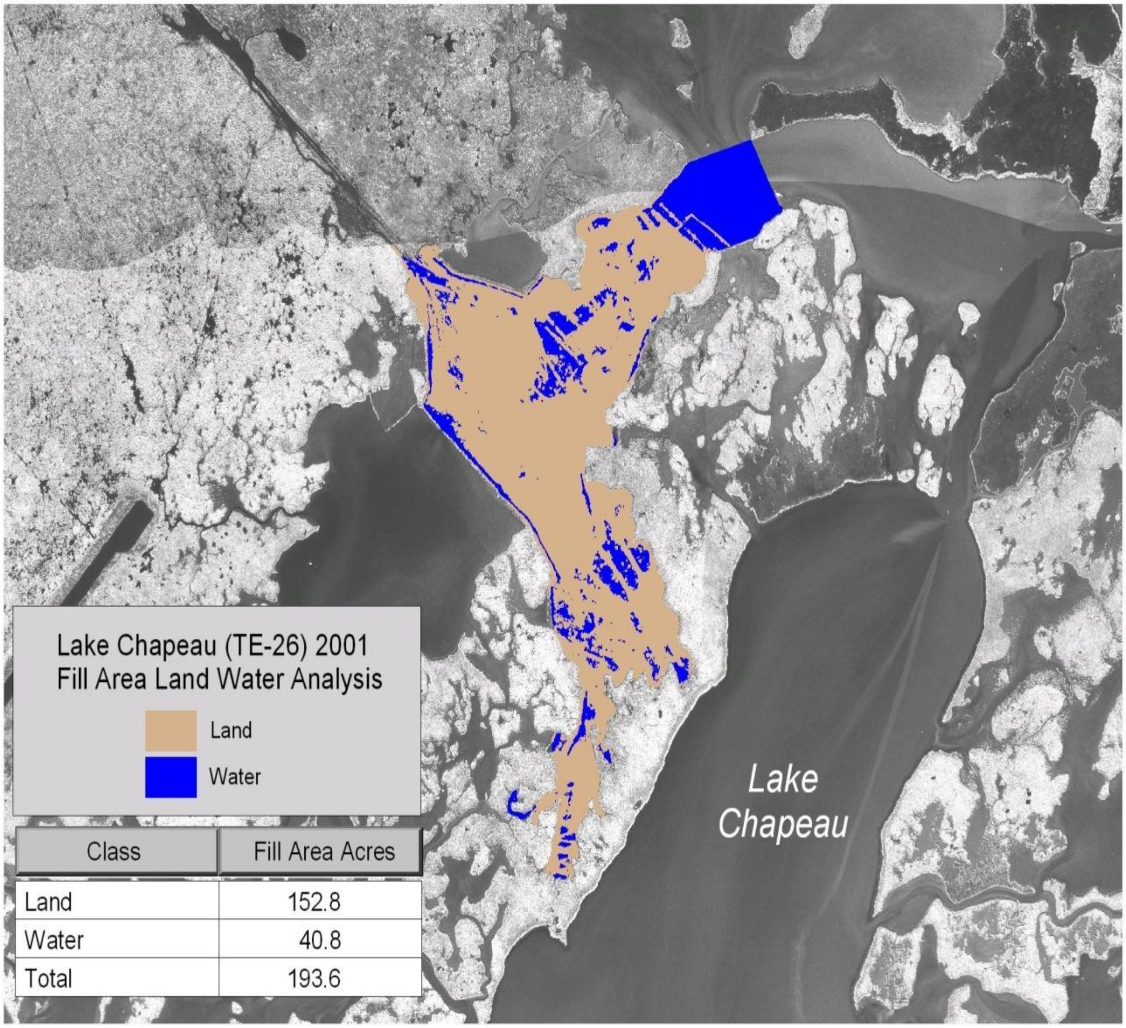


Figure 14. 2008 land-water analysis map of the TE-26 project and reference areas.



Class	Fill Area Acres
Land	13.3
Water	180.3
Total	193.6

Figure 5. 1994 land-water analysis map of the TE-26 fill area.



Class	Fill Area Acres
Land	152.8
Water	40.8
Total	193.6

Figure 6. 2001 land-water analysis map of the TE-26 fill area.

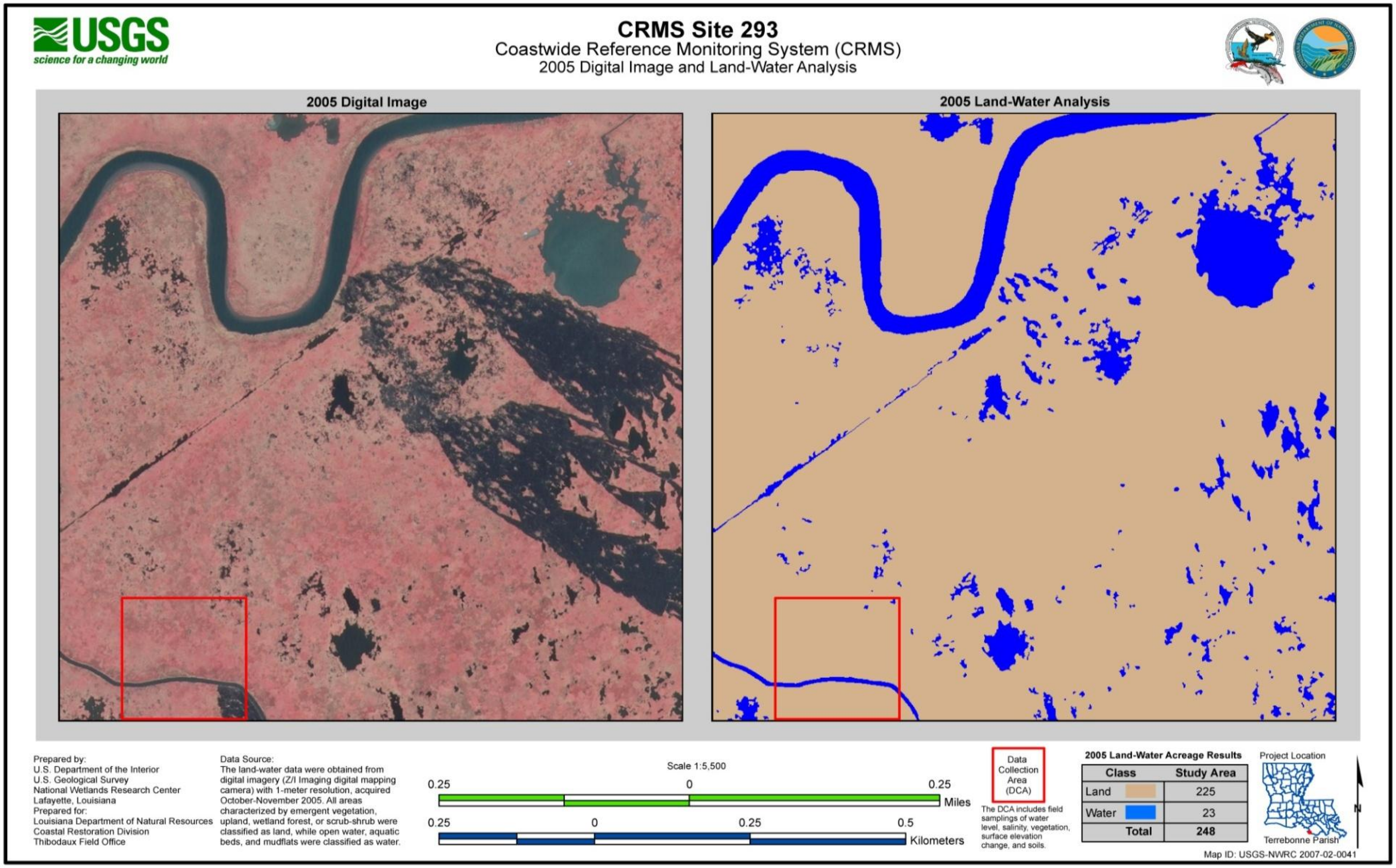


Figure 7. 2005 land-water analysis map for CRMS-*Wetlands* site CRMS0293 located in the southeast portion of Point Au Fer Island.

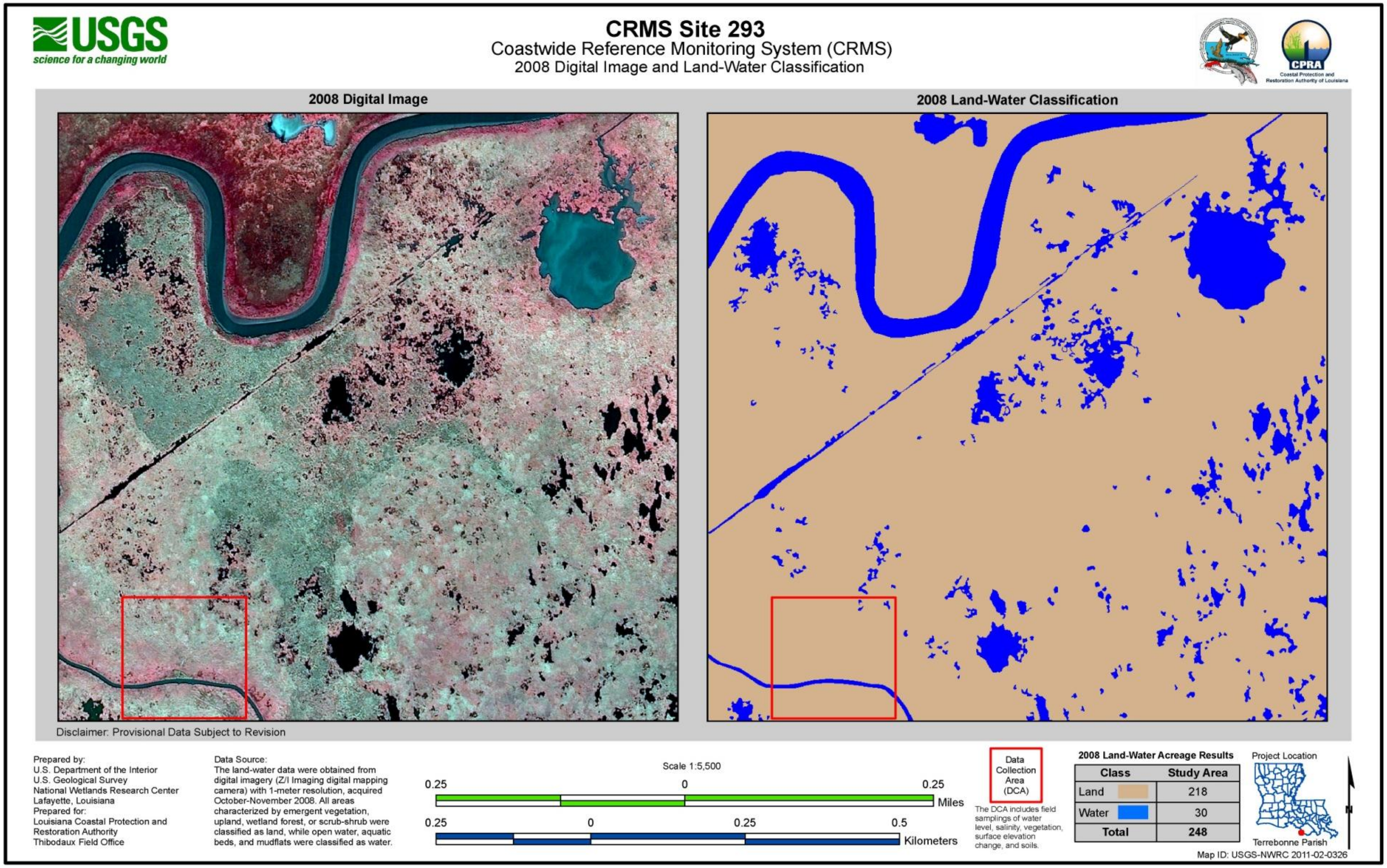


Figure 8. 2008 land-water map of the CRMS-*Wetlands* site CRMS0293 located in the southeast portion of Point Au Fer Island.

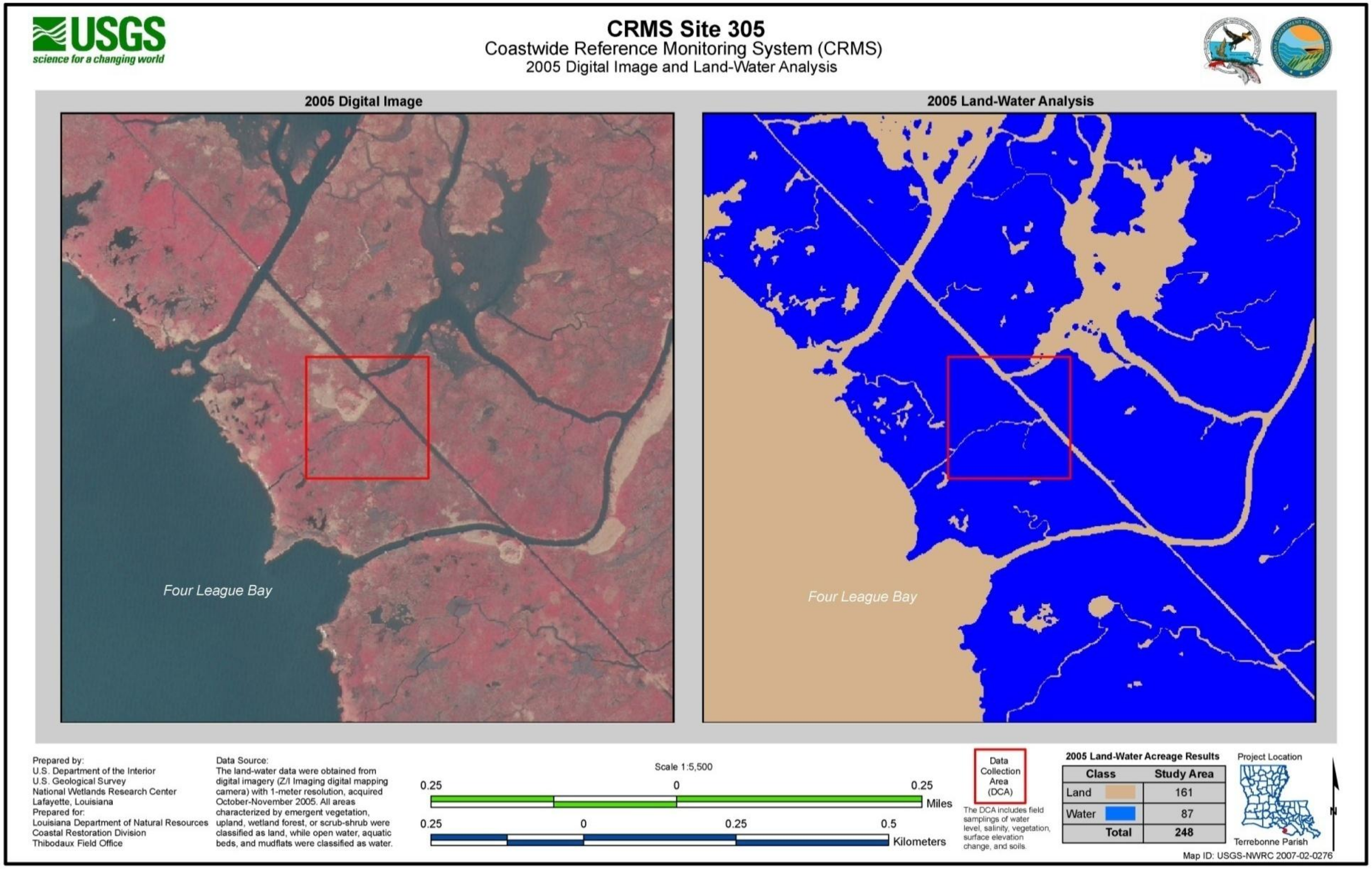


Figure 9. 2005 land-water analysis map of CRMS-*Wetlands* site CRMS0305 located just east of the Atchafalaya river delta on the northern shoreline of Four League Bay.

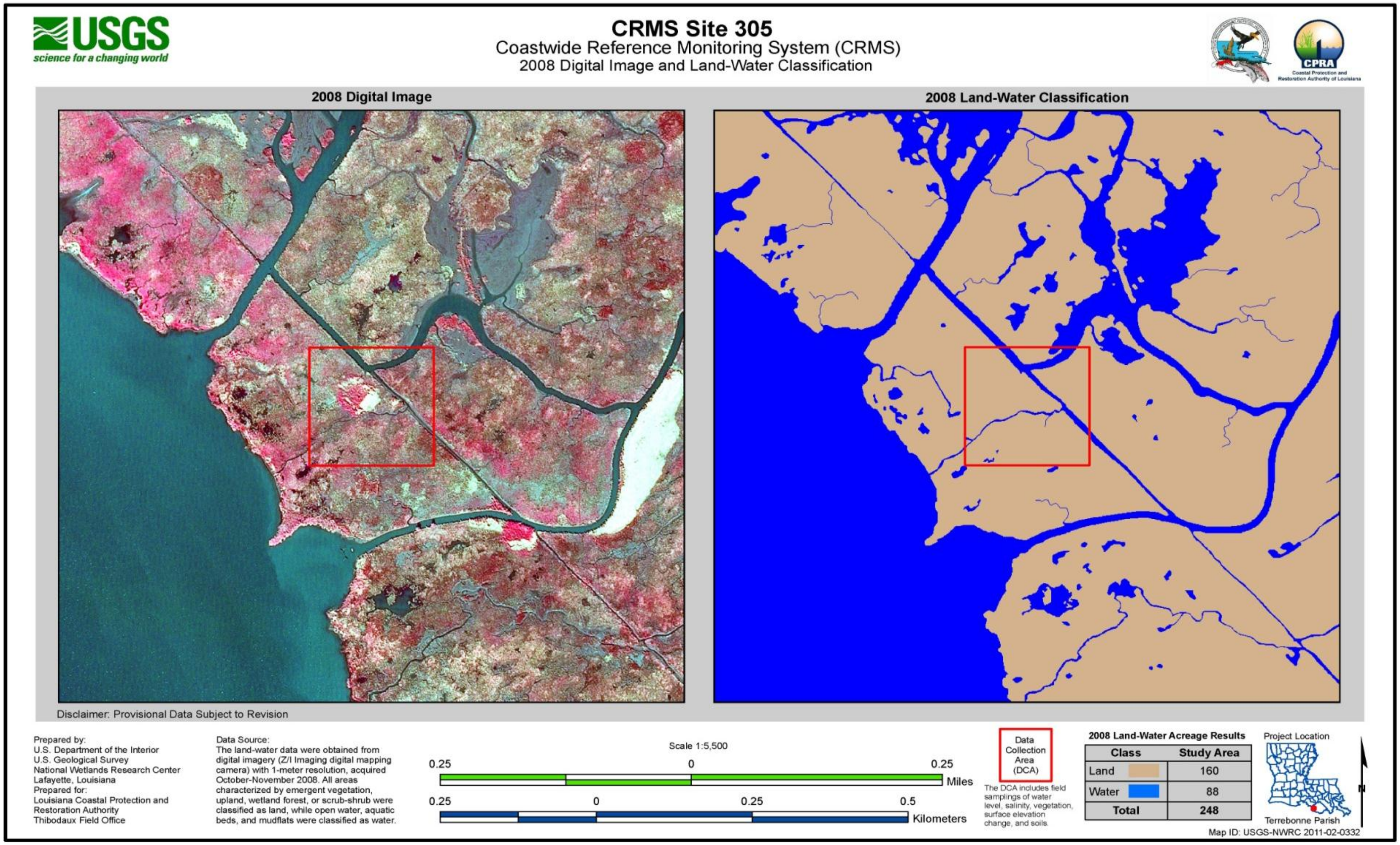


Figure 10. 2008 land-water analysis map of CRMS-Wetlands site CRMS0305 located just east of the Atchafalaya river delta along the northern shoreline of Four League Bay.

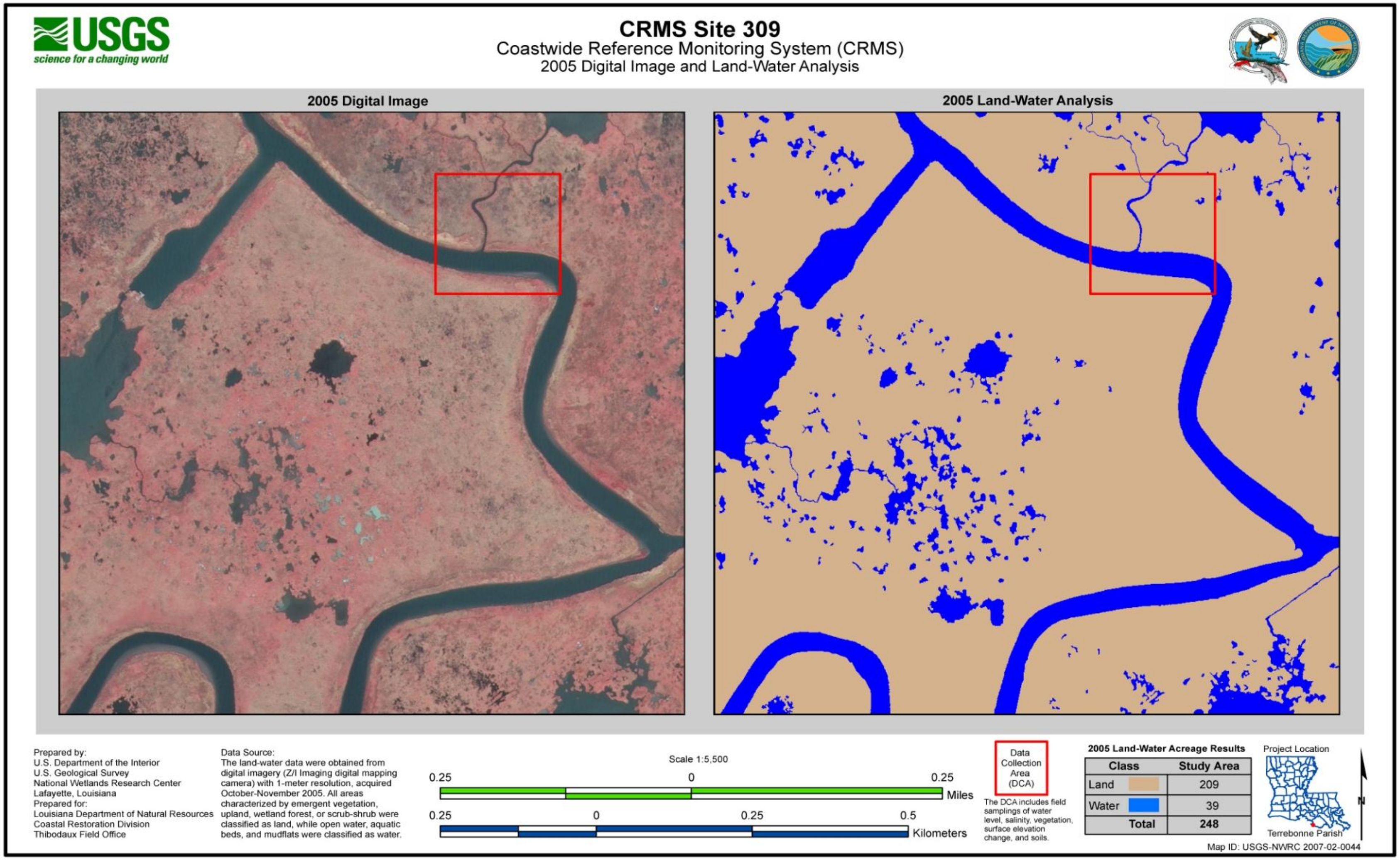


Figure 11. 2005 land-water analysis map for CRMS-*Wetlands* site CRMS0309 located in the southeast portion of Point Au Fer Island.

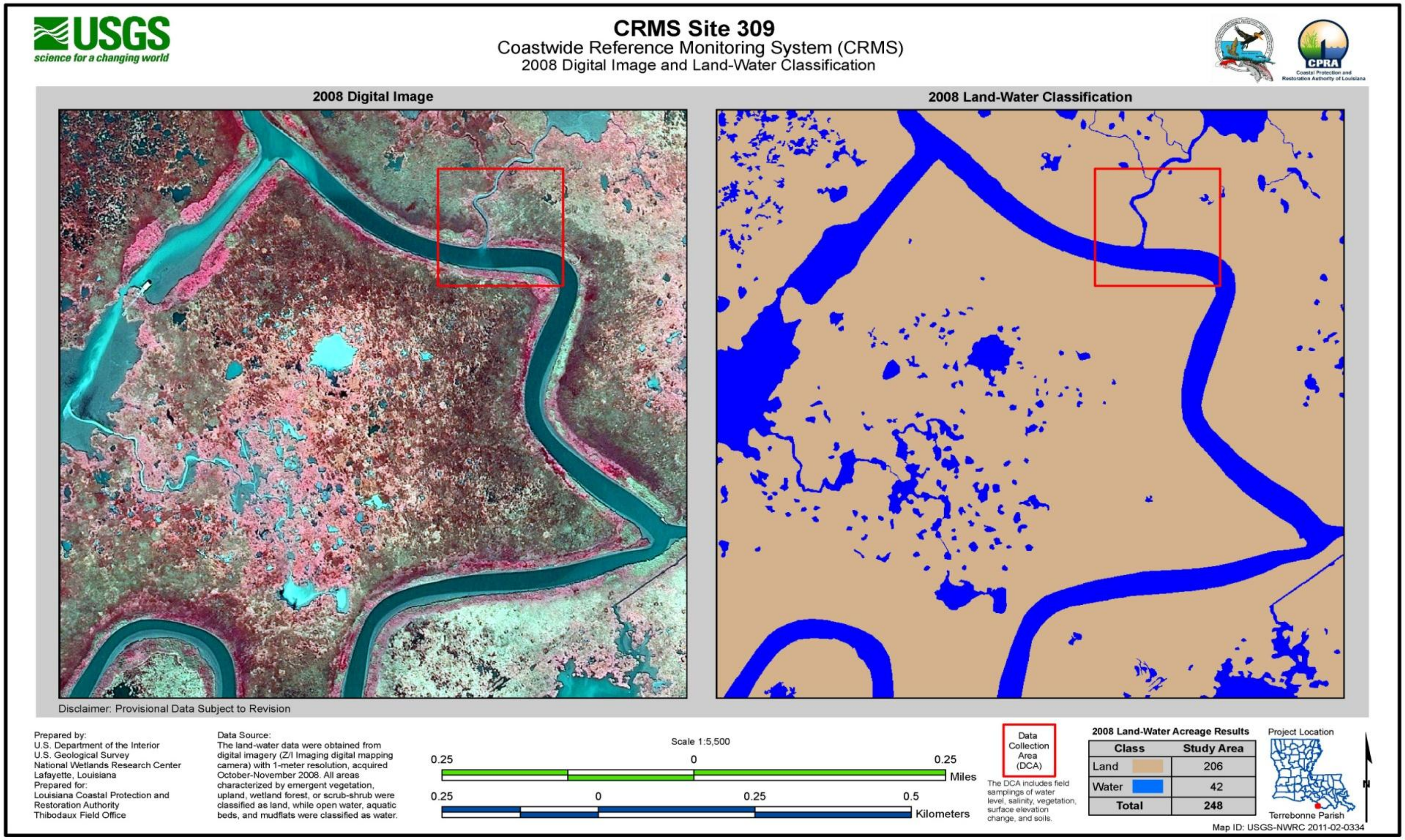


Figure 12. 2008 land-water analysis map of CRMS-*Wetlands* site CRMS0309 located in the southeastern portion of Point Au Fer Island.