State of Louisiana

Coastal Protection and Restoration Authority of Louisiana

2012 Operations, Maintenance, and Monitoring Report

for

Black Bayou Hydrologic Restoration

State Project Number CS-27
Priority Project List 6

June 2012
Calcasieu and Cameron Parishes

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For
Black Bayou Hydrologic Restoration (CS-27)

Table of Contents

Preface

This report includes monitoring data collected through December 2011, and annual Maintenance Inspections through May 2012.

The 2012 report is the 4th report in a series of reports. For additional information on lessons learned, recommendations and project effectiveness please refer to the 2004, 2005 and 2008 Operations, Maintenance, and Monitoring Report on the LDNR web site.

I. Introduction

The Black Bayou Hydrologic Restoration Project (CS-27) was proposed on the 6th priority list of the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) and is co-sponsored by the National Marine Fisheries Service (NMFS) and the Coastal Protection and Restoration Authority (CPRA). It is located in northwest Cameron and southwest Calcasieu Parishes. The project is bordered to the north by the Gulf Intracoastal Waterway (GIWW), to the south by Black Bayou, to the east by Gum Cove Ridge, and to the west by the Sabine River (Figure 1). Total project area is approximately 25,529 acres (10,336 ha) and is comprised of approximately 13,869 acres (5,615 ha) of intermediate/ brackish marsh and 11,660 acres (4,721 ha) of open water. The marshes are dominated by *Spartina patens* (marshhay cordgrass), *Phragmites australis* (Roseau cane), and *Panicum dichotomiflorum* (fall panicum) with associated species such as *Typha sp.* (cattail), *Cladium jamaicense* (sawgrass), *Schoenoplectus californicus* (California bullwhip), *Schoenoplectus robustus* (leafy three-square), and *Juncus roemerianus* (black needlerush).

Historically, the Black Bayou area was a northern watershed of Sabine basin collecting sheet flow from uplands to the north. Black Bayou provided a freshwater head which ran southwest from the uplands near Vinton to the northern rim of Sabine Lake. Beginning in the late 1800s, significant hydrologic changes in the Calcasieu/Sabine basin affecting water level fluctuation and water circulation patterns in the project area has inhibited the freshwater head from north to south and has diverted it to bidirectional, east/west flow (LCWCRTF 2002). Modifications to Calcasieu Pass such as the removal of the Calcasieu Pass oyster reef (1876) and maintenance of a deep (40 ft) and wide (400 ft) Calcasieu Ship Channel has increased the magnitude and duration of tidal fluctuations causing higher salinity and water level fluctuations throughout the lake and the surrounding marshes (LDNR 1993). Construction of the Gulf Intracoastal Waterway (GIWW), North Line Canal, Central Line Canal, and South Line Canal established an east-west hydrological connection between the previously distinct Calcasieu and Sabine basins, disrupting the natural north-south flow and allowing the saline waters of the Calcasieu Basin to encroach on the Sabine Basin. Water level fluctuations are also influenced by wind. A strong north wind can cause drastic de-watering of the marshes, while a strong sustained southerly wind can result in drastic increases in water levels blown in from the Gulf. The extensive system of navigation channels, natural drainage, bayous, oil exploration canals, and trenasses, have allowed increased water fluctuations and salinities to reach the fragile interior marshes in the absence of a strong freshwater head (USDA 1991).

Most of the land loss in this area occurred during between 1956 and 1978 (Barras et al. 2008), as both large and small scale changes have resulted in local hydrologic alterations. The construction of spoil levees along the GIWW disrupted the drainage of uplands to the north causing communities to create more efficient drainage via conversion of Black Bayou to the Vinton Drainage Ditch (Vinton Water Way) which empties into the GIWW and is diverted away from the project area. The east side of the project area gradually developed into an impoundment over time. In addition to the GIWW dredge levee along the north (originally 1913-14; current dimensions since 1941), an oil company access road running east-west along the southern boundary (1950s) and landowner boundary levee running north-south on the west side (1968) created the impoundment which is bordered on the east side by increasing marsh elevations grading into the uplands of the Gum Cove Ridge.

The Black Bayou Hydrologic Restoration Project includes structural and non-structural measures designed to allow freshwater from the GIWW near its confluence with the Vinton Drainage Canal into the wetlands south of the GIWW between the Sabine River, Gum Cove Ridge, and Black Bayou, and to create a hydrologic head that increases freshwater retention time and reduces salt water intrusion and tidal action in the Black Bayou watershed (Figure 1). Black Bayou structural features construction was completed in November 2001. Structural and non-structural features and their intended functions are listed below:

1. Approximately 22,600 linear ft. (6,889 m) of rock foreshore dikes along the GIWW west of the Gum Cove Ridge to repair breaches in the GIWW spoil bank.

2. A weir with a barge bay, 70 ft (21.3 m) wide, with a sill of -7.0 ft NAVD 88, made of graded stone was constructed at the GIWW in the Black Bayou Cut Off Canal to limit water exchange in and out of the project area.

3. A weir with a boat bay, 15 ft (4.6 m) wide with a sill of -4.0 ft NAVD 88, made of graded stone was constructed in the Burton Canal at its intersection with the Sabine River to limit water exchange in and out of the project area.

4. A rock weir with a 15 ft (4.6 m) wide boat bay at - 3 ft NAVD 88 bottom elevation was constructed at the intersection of Block's Creek with Black Bayou to limit water exchange in and out of the project area.

5. A self-regulating tide (SRT) gate, within a sheetpile weir, 40 ft (12.2 m) wide with a sill at + 0.6 ft NAVD was constructed where it connects to an existing canal that leads to Black Bayou Cutoff Canal to limit flow into the impoundment during and increase drainage after high water events. A hinged flap was installed over the weir on either side of the SRT gate in January 2006 to further limit flow into the impoundment while allowing water to drain out.

6. Two, 30 in (0.76 m) flap-gated culverts (Culvert 1/Culvert 2) were installed along the southeastern boundary of the impoundment in January 2006 to relieve excess waters from the impoundment while preventing water flow into the impoundment.

7. Vegetative plantings of *Schoenoplectus californicus* (bullwhip) in two phases. One gallon trade containers with a minimum of 5 stems per container were installed on 5 ft (1.5 m) centers. Phase I, east side of project area on either side of the Black Bayou Cut-off Canal, contained approximately 30,000 plantings spanning 150,000 linear ft (45,720.5 linear m). Phase II, west side of project area, contained approximately 25,570 plantings spanning 127,850 linear ft (38,969.1 linear m).

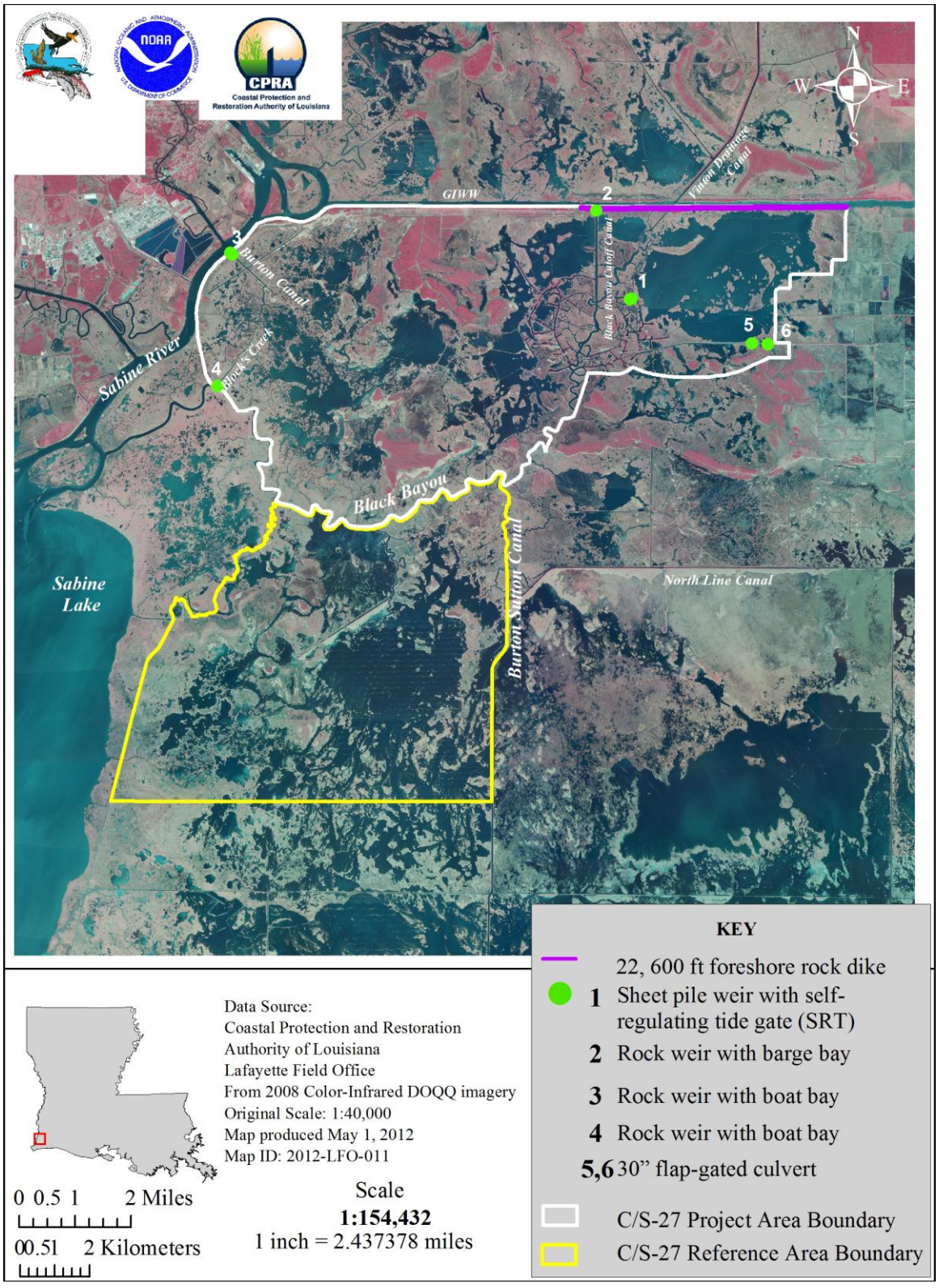

Figure 1. Black Bayou project and reference boundaries and project infrastructure.

II. Maintenance Activity

a. Project Feature Inspection Procedures

The purpose of the annual inspection of the Black Bayou Hydrologic Restoration Project (CS-27) is to evaluate the constructed project features to identify any deficiencies and prepare a report detailing the condition of project features and recommended corrective actions needed. Should it be determined that corrective actions are needed, CPRA shall provide, in the report, a detailed cost estimate for engineering, design, supervision, inspection, and construction contingencies, and an assessment of the urgency of such repairs. The annual inspection report also contains a summary of maintenance projects, if any, which were completed since completion of constructed project features 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.

An inspection of the Black Bayou Hydrologic Restoration Project (CS-27) was held on March 29, 2012 under mostly cloudy skies and warm temperatures. In attendance were Stan Aucoin, Jody White, and Troy Barrilleaux of CPRA. NOAA Fisheries was represented by John Foret. Parties met at the Lafayette Field Office of CED and proceeded to a boat launch in Vinton, LA. The annual inspection began at the structure on Blocks Creek at 11:30am.

The field inspection included a complete visual inspection of all features. Staff gauge readings were used to determine approximate elevations of water, rock weirs, earthen embankments, steel bulkhead structures and other project features. Photographs were taken at each project feature (see Appendix A) and Field Inspection notes were completed in the field to record measurements and deficiencies (see Appendix C).

b. Inspection Results

Blocks Creek Weir w/ Boat Bay

The rock weir is in excellent condition. Signage is stable. The erosion on the SE will continue to be monitored, but has stabilized. No need for maintenance at this structure. Conditions of the Navigational Aid Lights were last inspected on 03/13/12 (Appendix A, Photo 1)

Burton Canal Weir w/ Boat Bay

The weir is in good condition. The scouring along the canal banks inside of the weir at the end of the dike has stabilized. Arrow signs installed as part of the last maintenance event are working well. No need for any maintenance at this time. The Navigational Aid Lights were last inspected on 03/13/12. (Appendix A, Photo 2)

Self Regulating Tide Gate (SRT)

The structure itself is in very good condition. The pillow blocks replaced during the last maintenance event, signage, railings, wingwalls, etc. are in excellent condition. The railing along the top of the gate is showing fairly significant rust. The seams at the sheet piles are rusting also, however there is no need for maintenance at this time. (Appendix A, Photos 3-5)

Rock Plug near SRT Gate

The rock dike, as repaired with the concrete sacks is functioning as designed. Tie-ins are stable. No maintenance required. (Photos: Appendix A, Photo 6)

Black Bayou Cut-Off Canal Weir w/ Barge Bay

This component is in immediate post construction condition. No need for maintenance at this time. Conditions of the Navigational Aid Lights are inspected quarterly and were last inspected on 3/13/12. (Appendix A, Photo 7)

GIWW Foreshore Rock Dike

Tie-ins on both the east and west end of the dike are stable. As mentioned in previous inspections, the warning signs at both the Vinton and Black Bayou closures have been stolen. The spoil placed behind the rock dike at the Black Bayou Canal has washed away on the western end. There is also a gap in the dike in front of this area. Rock is still at the base, but exchange is taking place. Landowner repairs to the four C-stone closures have been completed. Small gaps were left at two of these repairs to allow high tidal events to pass around the plugs without continuing to wash away the banks. There are a few low spots on the rest of the main dike, apparently caused by barges but these areas are still functioning and not in need of repair. The repair to the dike across from the Vinton Canal with concrete sacks is working extremely well. (Photos: Appendix A, Photos 8-12)

Culvert 1/Culvert 2:

While these culverts were not directly inspected on this trip, they were assumed to be in very good, post construction condition and in no need of repair. No concerns have been expressed by the landowners.

c. Maintenance Recommendations

i. Immediate/ Emergency Repairs

None

ii. Programmatic/ Routine Repairs

Replace stolen warning signs at both the Vinton and Black Bayou closures.

d. Maintenance History

General Maintenance: Below is a summary of completed maintenance projects and operation tasks performed since December 2003, the construction completion date of the Black Bayou Hydrologic Restoration Project.

December 2003 - Construction Adjustments: Although construction of the original project components was completed in December 4, 2001, it was determined that leaks along the GIWW rock dike would have detrimental effects on the project. The rock dike along the GIWW was removed at four separate locations and plugs consisting of "C" stone were constructed at "water" connections between the marsh area and the GIWW existing to the north to reduce or eliminate tidal flow through these locations. The original signs installed at the Black Bayou Cut-Off Structure on timber pilings were either leaning or missing. Signage was relocated on concrete bases on top of the rock weir. Also, at the SRT gate, a railing was constructed on the sheet pile cap to reduce the chance of persons falling into the water in the area around the structure. This work was completed in December 2003 and construction was considered to have been complete after these adjustments.

July 2003 - Navigational Aid Light Repairs: A letter was received from the US Coast Guard in July 2003 reporting problems with the navigational lights at the Black Bayou Cut-Off Canal weir. The problem was investigated and repaired in October 2003 by Wet-Tech Energy, Inc. at a total cost of $1,250.00.

During March 2006, DNR/CED/LFE, via a Purchase Order employed WET TECH Energy, Inc. to inspect and report thereon on damages caused by Hurricane Rita to any of the Navigation Lights and support structures of the Black Bayou Project that were in place as appurtenant parts of the various structure features of the Project. The cost of the inspection/report was $2,000.00.

The damages reported were as follows:

(1) The Black Bayou CutOff Channel west Light needed a new battery box and the replacement of two batteries. The east Light of this site did not need was o.k. and needed no repair.
(2) The Block's Creek Structure Lights and supports did not need needed no repair work.
(3) The Burton Canal Structure Light experienced major damage and the entire Light Assembly, Solar Cell, and battery system needed to be replaced.

Later, during May 2006, the damages reported above were all corrected on each respective Structure of the Project by WET TECH Energy, Inc. by a separate Purchase Order for Hurricane Rita Repairs for a total of $3,842.00. The sum of the costs for the Inspection/Report and thence the repair efforts was $5,842.00. This entire sum was reimbursed by FEMA for reason of the storm damage.

July 2005 - SRT Gate modification and culvert installation: In the spring of 2005, it was determined that water was "stacking up" on the southeast corner of the project area. In order to correct the situation, the cross sectional area of the SRT Gate was increased by attaching a flap to the railing. Also, two 30" flapgated culverts on the southern boundary of the project will relieve excess waters. A Notice to Proceed dated July 20, 2005 was issued to Duphil, Inc. of Orange, Tx. Construction was accepted as complete on January 4, 2006 at a total construction cost of $84,976.87. Engineering & design, construction oversight, and as-built drawings were provided by C. H. Fenstermaker & Associates at a total cost of $39,856.77.

Navigational Light Maintenance: Automatic Power, Inc. inspects, and if needed, repairs the navigational aid lights at Burton Canal, Block's Creek, and Black Bayou Cut-Off Canal on a quarterly basis. Costs incurred include:

2007 TOTAL	**$8,000.00**
2008 TOTAL	**$6,625.00**
2009 TOTAL	**$6,375.00**
2010 TOTAL	**$7,340.00**
2011 TOTAL	**$1,785.00**
2012 TOTAL	**$1,885.00 (thru Mar. 2012)**

2009 Maintenance Event:
This maintenance event consisted of general repairs to the flap on the SRT Gate, installation of new, different signs at Burton Canal, and repairs to the closures behind the rock dike as well as a repair to the GIWW dike near Vinton Canal. The work was accomplished by Reeve's Development, Inc. at a total contract cost of $169,997.18. Engineering, design, and construction oversight was provided by Acadian Engineers & Environmental Consultants, Inc. at a cost of $46,292.90.

2012 landowner event:
In early 2012, the landowners in the area, under their own construction contract, repaired breaches which occurred around two of the four plugs behind the rock dike.

III. Operation Activity

a. Operation Plan

There are no water control structures associated with this project that require manual operation, therefore no Structural Operation Plan is required.

b. Actual Operations

There are no active structural operations associated with this project.

IV. Monitoring Activity

Pursuant to a CWPPRA Task Force decision on August 14, 2003 to adopt the Coastwide Reference Monitoring System-*Wetlands* (CRMS) for CWPPRA, updates were made to the CS-27 Monitoring Plan to merge it with CRMS and provide more useful information for modeling efforts and future project planning while maintaining the monitoring mandates of the Breaux Act. Recommended changes in monitoring stations and the schedule of data collection are listed under individual monitoring elements. In this report, six CRMS sites (4 inside and 2 outside the project) are merged into the monitoring activity.

a. Monitoring Goals

The objectives of the Black Bayou Hydrologic Restoration project are:

1. Increase freshwater retention that reduces salt water intrusion in the project area.
2. Establish emergent wetland vegetation in shallow open water areas.
3. Protect emergent marsh in project area by reducing erosion along GIWW.
4. Increase occurrence of SAV in project area.

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

1. Reduce mean salinities within the project area.
2. Increase the land to water ratio within the project area.
3. Reduce mean erosion rate of protected shoreline along GIWW.
4. Increase SAV in interior ponds within the project area.

b. Monitoring Elements

Aerial Photography

Near-vertical color-infrared aerial photography (1:24,000 scale) was used to measure vegetated and non-vegetated areas for the project and reference areas. The photography was obtained in November 2000 prior to project construction and post-construction in November 2004 and 2010. The original photography was checked for flight accuracy, color correctness, and clarity and was subsequently archived. Aerial photography was scanned, mosaicked, and georectified by U.S. Geological Survey at the National Wetlands Research Center (USGS/NWRC) personnel according to standard operating procedures to develop land:water analyses (Steyer et al. 1995, revised 2000). Differences in percent land over time within the project and between the project and reference areas are calculated from the land:water analyses. Aerial photography is scheduled to be obtained in 2016.

Salinity

Salinity data from both discrete (YSI 30) and continuous recorder (sonde) stations were monitored to characterize the spatial variation in salinity throughout the project area and to determine if salinity was reduced in the project area. Discrete salinities were monitored: (A)

monthly from June 1999 (preconstruction) through March 2004 (post construction) at designated stations throughout the project and reference area (Figure 2) and (B) during submerged aquatic vegetation surveys in the fall of 1999, 2003, 2005, and 2007. In addition, discrete surface water salinity data were collected inside and outside of project structures during the engineering inspection in March 2012.

Hourly salinity and water levels (ft, NAVD88) were monitored with a continuous recorder in the impoundment side of the SRT gate (station CS27-25) from May 2000 to present. Salinity data collection from the discrete stations and a continuous recorder (station CS27-22) was discontinued in March 2004 to be replaced by CRMS-*Wetlands* stations. Continuous recorders were deployed within the project area in February 2008 (CRMS0658 replaced CS27-22).

Vegetation Plantings

Schoenoplectus californicus (California bullwhip) plantings were installed in 2002 and 2003 to establish emergent wetland vegetation in shallow open water areas within the project area. These plantings took place in two phases; Phase I was completed in May 2002 in the east side of the project area (~ 7 acres), and Phase II was completed in May 2003 in the west side of the project (~ 6 acres). The percent survival of vegetative plantings in phase I was determined after one growing season post construction (2003) in approximately 3% of the vegetation plantings (53 sampling plots). Each sampling plot consisted of 16 plantings from one row with the sampling location determined by a random numbers table and marked with a labeled post. Planting survival was determined as a percentage of the number of live plants to the number initially planted (percent survival = (no. live plants/no. planted) × 100) (Mendelssohn and Hester 1988; Mendelssohn et al. 1991). No further monitoring of the plantings is scheduled.

Shoreline Change

To document the effectiveness of the foreshore rock dike to reduce erosion and protect the emergent vegetation in the breached areas of impoundment along the GIWW, we conducted shoreline surveys using a differentially corrected Global Positioning System (dGPS) to map the vegetated edge. The dGPS system used is considered to have sub-meter accuracy. Surveys were conducted 1 2/3 years preconstruction in March 2000, immediately (4 months) post-construction in March 2002, and 2 3/4 years post-construction in August 2004. Analyses of shoreline change was performed by digitally overlaying mapping clean line features for each dataset in a Geographic Information System (GIS, ArcGIS). Polygon features were then created for all areas within closed intersections of the two polyline datasets. The generated polygon features represent the total change in land area as defined by the difference in shoreline position during the sampling interval. The total area for all polygons between the line features was calculated and each polygon feature was defined as gain or loss. The total land area in acres of gain and loss was then calculated. The reference area shoreline was compromised because of another rock dike construction during the time between the 2000 and 2002 GPS surveys and, therefore, no meaningful comparisons can be made between project and reference; consequently, we evaluated shoreline change over time. The data is

presented in two increments, pre- to immediately post-construction (2000-2002) and post construction (2002-2004). No additional shoreline surveys are scheduled.

Submerged Aquatic Vegetation (SAV)

To document changes in the occurrence of SAV, project areas (1-6) and a reference area were monitored over time using the rake method (Chabreck and Hoffpauir 1962) (Figure 3). Three transects oriented northeast to southwest were established across open water (ponds or impoundments) in each area. Submerged aquatic vegetation was sampled repeatedly along each transect by dragging a garden rake on the pond bottom for one second. The presence or absence of vegetation was recorded for each sample to determine the percent occurrence on a transect (% occurrence = (number of samples with SAV/number of samples) × 100). When vegetation was present, the species present was recorded in order to determine the frequencies of individual species (Nyman and Chabreck 1996). SAV was monitored before construction in fall 1999 and after construction in fall 2003, 2005, 2007, and 2010. Monitoring will continue in fall of 2012, 2014, and 2017.

CRMS-*Wetlands* (CRMS) Supplemental

In addition to project specific monitoring elements, other data types are collected at CRMS sites which can be used as supporting or contextual information (Figure 2). Data types collected at CRMS sites include hydrologic from continuous recorders (mentioned above), vegetative, physical soil characteristics, discrete pore water, surface elevation, and land:water analysis of 1 km^2 area encompassing the station. For this report, data from four sites within the project area are compared to data from two sites outside the project area in a traditional project versus reference manner. Data collected from the CRMS network over time were used to develop integrated data indices (hydrology and plant productivity) at different spatial scales (local, basin, coastal) with which we compared project performance.

Discrete pore-water from the soil salinity at 10 and 30 cm was collected at five of the vegetation plots during vegetation sampling. Pore water was extracted with a sipper tube assembly (rigid aquarium tubing, flexible hose, and syringe), and salinity was measured using a hand held salinity meter (YSI 30 Salinity, Conductivity, Temperature Meter).

The Hydrologic Index (HI) assesses the relationship between mean salinity/percent time flooded and vegetation primary productivity for the 5 different marsh classifications in coastal Louisiana (swamp, fresh, intermediate, brackish, and saline). The index score ranges from 0 - 100, representing the percent of maximum vegetation productivity expected to occur if the separate effects of salinity and inundation on productivity interact in a multiplicative fashion.

Emergent vegetation parameters will be evaluated at each CRMS site using techniques described in Steyer et al. (1995) to describe species composition, richness, and relative abundance; in addition, overall percent cover and height of the dominant species will be monitored. Annually at each site, data will be collected and averaged from ten, 4-m^2 sample plots randomly established along a 282.8 m transect that crosses diagonally through a 200-m × 200-m vegetation plot in middle of the CRMS site. The percent cover of the plot and of each species was fed into a floristic quality index based on the marsh type the data was collected.

Floristic Quality Indices (FQIs) have been developed for several regions to determine the quality of a wetland based on its species composition (Cohen et al., 2004; Bourbaghs et al., 2006). This FQI was developed by Jenneke Visser and an expert panel on Louisiana coastal vegetation as part of CRMS analytical working group in 2007. The panel provided an agreed upon score (Coefficient of Conservatism or CC Score) from 0 to 10 for each species in a list of ~500 plant species occurring in Louisiana's coastal wetlands (Table 1). CC scores are weighted by percent vegetative cover and summed to determine the FQI for the CRMS site. CRMS sites inside and outside the project area were used for this report (Figure 2).

Table 1. Coefficient of Conservatism (CC) scores of different plant species used to develop of a Floristic Quality Index.

CC Score	General Description	Coastal Louisiana Description
0	Alien taxa or native invasive species	Invasive or non-native plants
1-3	Wide spread taxa found in sites with different levels of disturbance	Opportunistic plants of disturbed areas
4-6	Taxa that display fidelity to a community but can tolerate moderate disturbance	Occur primarily in less vigorous coastal wetland communities
7-8	Taxa that are typical of communities which have sustained only minor disturbance	Common plants in vigorous coastal wetland communities
9-10	Taxa that exhibit a high degree of fidelity to a narrow set of ecological conditions	Dominant plants in vigorous coastal wetland communities

Soil cores were collected to describe soil properties (bulk density and percent organic matter). Three, 4" (10.16-cm) diameter cores were collected to a depth of 24 cm and divided into 6, 4-cm sections at each site. The soil was processed by the Department of Agronomy and Environmental Management at Louisiana State University. Cores were collected at two sites inside the project area, and suitable cores (quality or same marsh type) were collected from 1 site outside the project area.

Soil surface elevation change utilizing a combination of sediment elevation tables (RSET) and vertical accretion from feldspar horizon markers were measured twice per year at each site. These data were used to describe general components of elevation change and establish accretion/subsidence rates. The RSET was surveyed to a known elevation datum (ft, NAVD 88) so it could be directly compared to other elevation variables such as water level. Currently, data has not been collected over enough time to calculate viable rates; therefore, elevation change is not included in this report.

Aerial photography (color infrared, CIR) of each 1 km^2 CRMS site and satellite imagery (Landsat Thematic Mapper, TM) of the entire hydrologic basin has been acquired every three years since 2005. In addition, the CS-27 project area was sub sampled from the basin-level, satellite imagery. The photography and satellite imagery were classified by land and water to track changes over time.

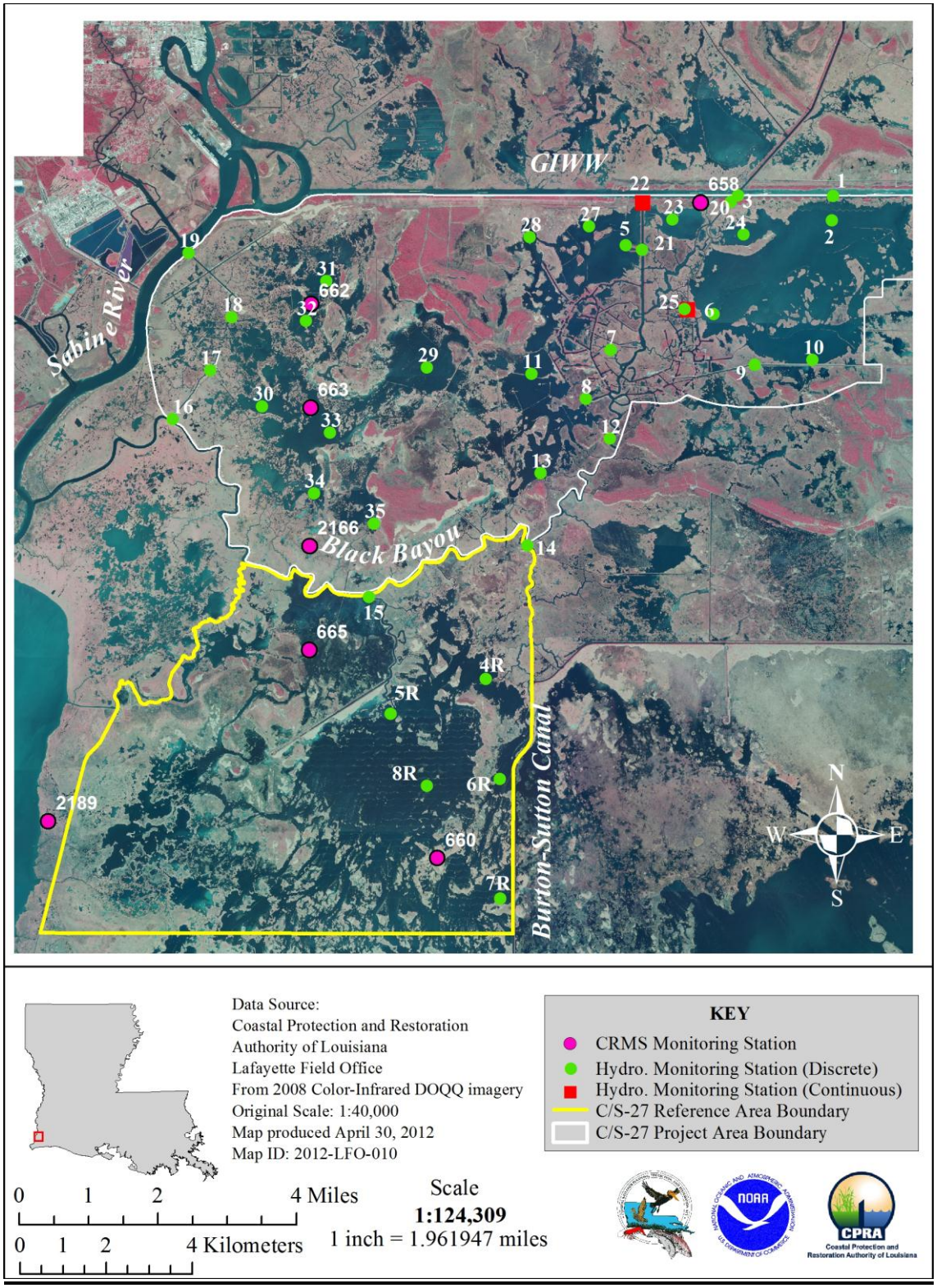

Figure 2. CS-27 continuous recorder station, discrete salinity stations, and CRMS-*Wetland* sites located within and in the vicinity of the project area.

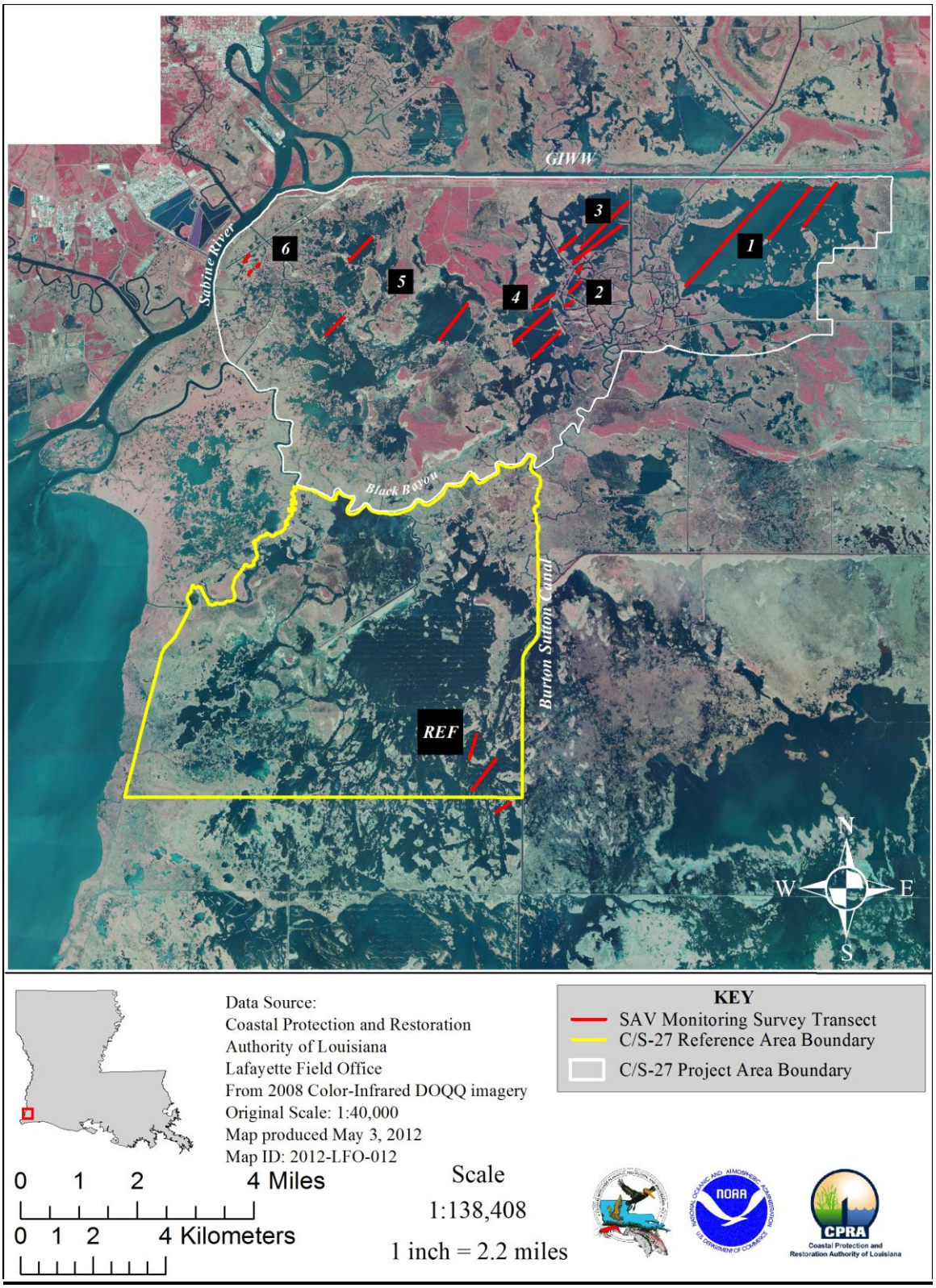

Figure 3. Location of SAV sampling in the project and reference areas.

IV. Monitoring Activity (continued)

c. Preliminary Monitoring Results and Discussion

Aerial Photography

Land:water analyses from aerial photography acquired before construction in November 2000 and after construction in November 2004 and November 2010 were performed by the U.S. Geological Survey (Figures 4a-c). The project area gained 153 acres (0.6%) of land from 2000 to 2004 (1 year pre-construction to 3 years post-construction) (Table 2). During this same time, the reference area gained 384 acres (2%) The difference in the 2000 to 2004 time period suggests the entire area was becoming more vegetated and the higher rate of land gain in the reference area suggests this change was not necessarily due to project features.

From 2004 to 2010, the project area lost 181 acres or -0.7% while the reference area lost 1163 acres or -6%. Landloss from 2004 to 2010 was almost certainly due to Hurricanes Rita (2005) and Ike (2008). Hurricane Rita was more associated with sediment deposition in the CS-27 project and reference areas, as well as the surrounding region. It is believed the Hurricane Rita did not significantly reduce land area in either the project or reference area due to the deposition of sediment removed from areas further south. Conversely, Hurricane Ike was associated with large areas of marsh scour, resulting in shallow open water (Figure 5). Field observations after Hurricane Ike in the CS-27 reference area showed areas of marsh scoured by the storm as observed on the ground (Pers. Comm. Mike Miller, CPRA) and, later, marsh die-off in fresher areas due to the influx and retention of high salinity water from the storm surge. A similar effect was not seen in the CS-27 project area. If most of the land loss in the reference area was due to storm surge scour from Hurricane Ike, the difference in the project area may be due to the greater distance from the Gulf of Mexico and the presence of the GIWW levee which, judging by the location of wrack fallout, appears to have greatly reduced the energy of the storm surge, thus reducing scour and sediment displacement. Project features may also have played a part in the months following the storms, as the reduction of rapid water exchange may have allowed for greater recovery of affected vegetation. The reduced exchange may have allowed vegetation to recover before the damaged marsh eroded. Overall, from 2000-2010, marsh loss was less in the project area than the reference area (Table 2).

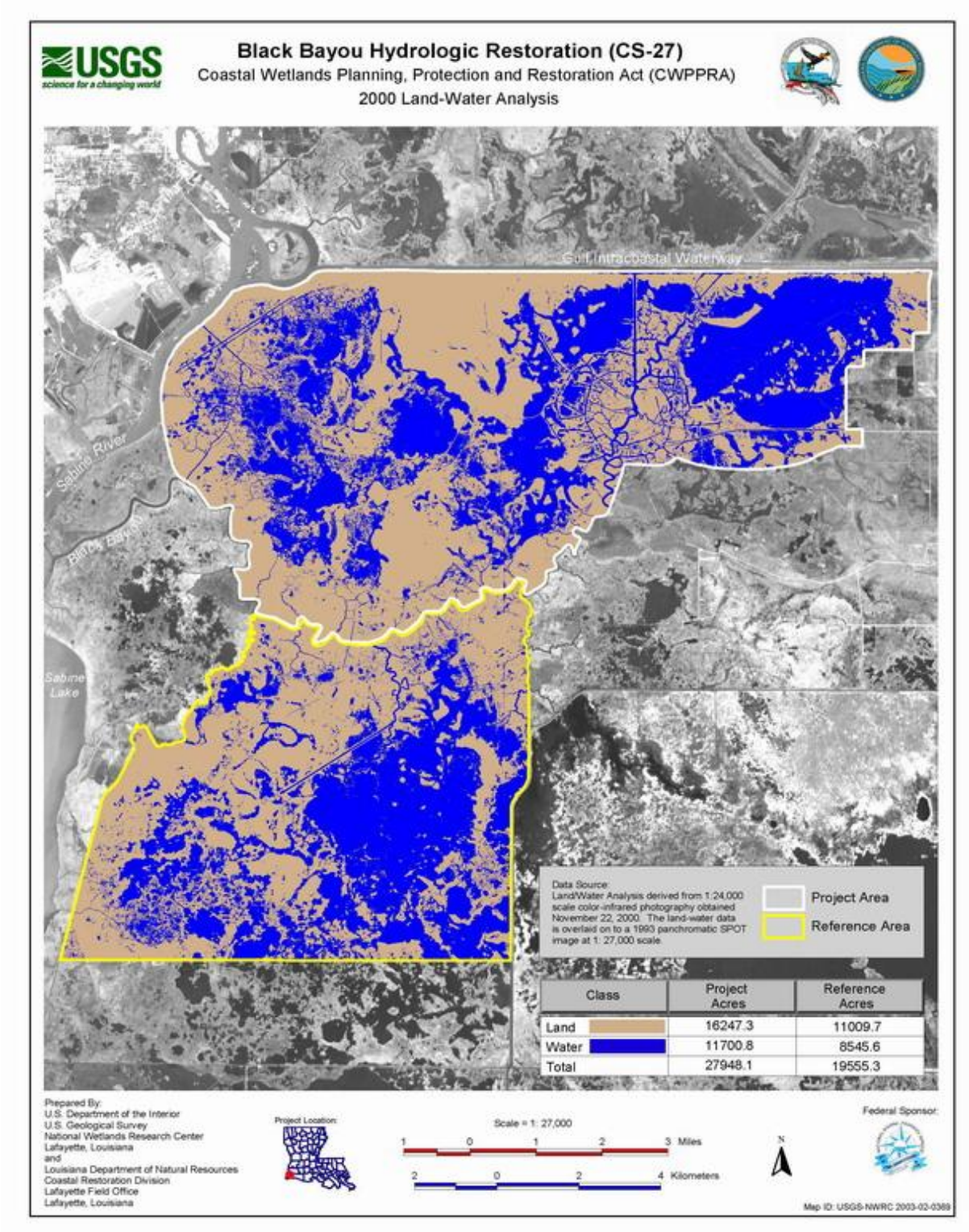

Figure 4a. Preconstruction land / water analysis of project and reference areas from photography taken November 20, 2000.

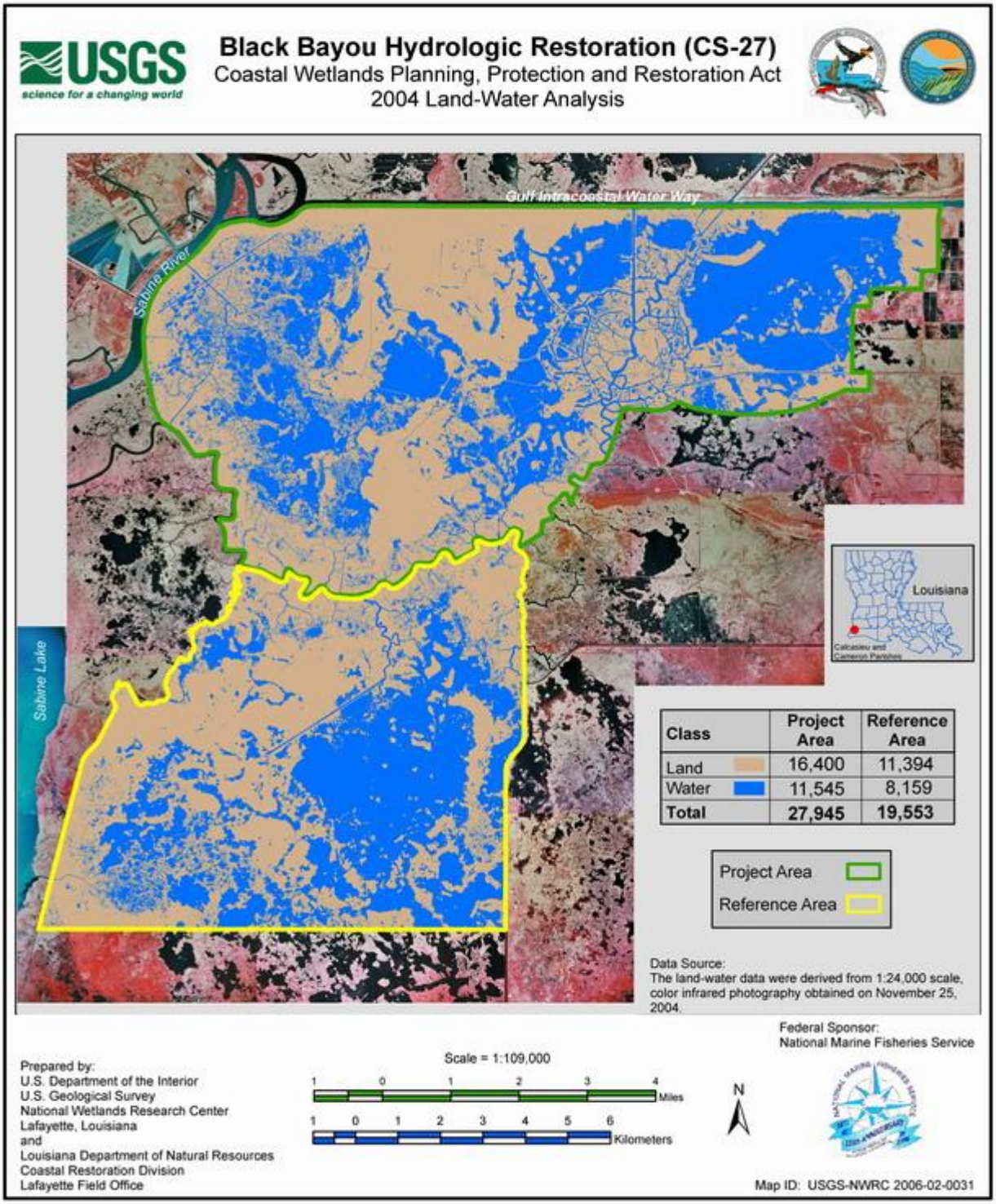

Figure 4b. Post construction land / water analysis of project and reference areas from photography taken November 25, 2004.

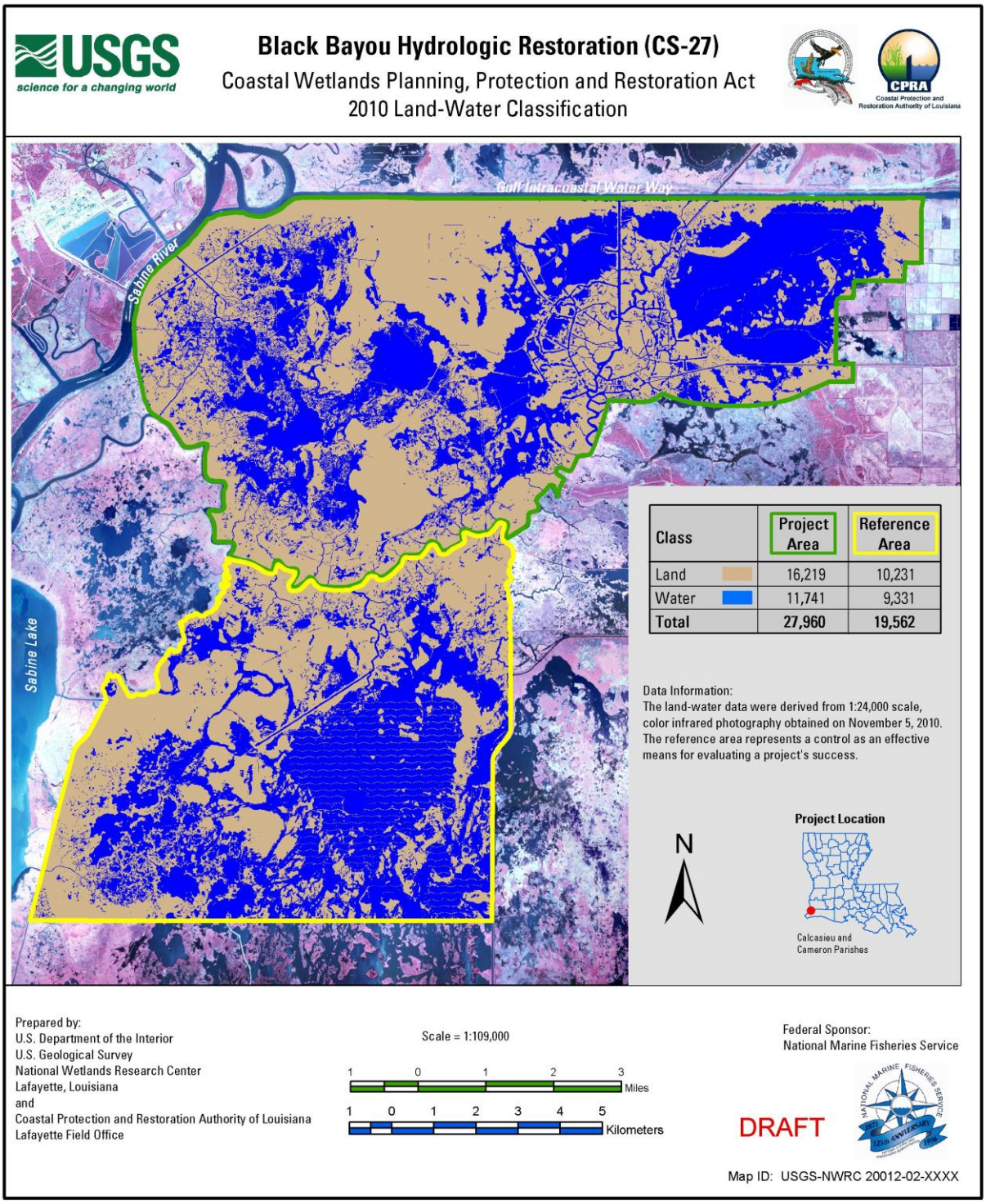

Figure 4c. Post construction land / water analysis of project and reference areas from photography taken November 5, 2010.

Figure 5. Area of marsh scour converted to open water in the region near CS-27.

Table 2. Land area and land area change rates compiled from high resolution imagery (1:24,000) collected by the USGS-National Wetlands Research Center pre- (2000) and post-construction (2004, 2010) of CS-27. Initial construction was completed in November 2001; Hurricane Lili occurred in October 2002, Hurricane Rita occurred in September 2005, and Hurricane Ike occurred in September 2008.

	Project Area					
	2000		2004		2010	
	acres	%	acres	%	acres	%
Land	16247.3	58.1	16400.0	58.7	16219.0	58.0
Water	11700.8	41.9	11545.0	41.3	11741.0	42.0
Total	27948.1		27945.0		27960.0	
	Reference Area					
	2000		2004		2010	
	acres	%	acres	%	acres	%
Land	11009.7	56.3	11394.0	58.3	10231.0	52.3
Water	8545.6	43.7	8159.0	41.7	9331.0	47.7
Total	19555.3		19553.0		19562.0	

Salinity

Discrete salinity data were collected monthly throughout the project and reference areas for the period 1999-2004. Data were divided by region (east and west of Black Bayou Cutoff Canal (BBCC)) in the project area (Figure 6). The east and west regions of the project areas were similar in salinity during the collection period. The reference area generally exhibited the same salinity pattern as the project. The salinity spike during 1999-2000 was due to drought conditions, reducing the influx of fresh water to the project and reference areas and allowing saltwater entry from Black Bayou, the GIWW, and the Sabine River. Most discrete salinity stations showed this salinity spike, with the spike reaching higher peak salinity in the west project area than the east project or reference areas. Salinity during 2001-2002 was highest in the western project area, followed by the reference area. Salinity was lowest in the eastern project area. In July of 2003, salinities were also higher in the western project area than the reference or eastern project areas. All other months were similar, though. Stations in close proximity to black bayou (CS27-14, 15, 16, 17) underwent periods of higher salinity than the other stations in the west section of the project.

Continuous salinity within the northeast portion of the project area, which is mostly influenced by the BBCC structure and foreshore dike along the GIWW, was monitored from 2000 to 2004 inside (Station CS27-25) and outside (CS27-22) of the impoundment controlled by the self-regulating tide gate (Figure 7). Weekly average salinity was not significantly different between the inside and outside of the impoundment either pre- or post-construction

(x^2=2.85, p=0.0927). Station CS27-22 was abandoned in March 2004 and was replaced by CRMS station 0658 in 2008. Station CS27-25 remains in place. For the period 2008-2011, station CS27-25 was compared to CRMS station 658 to determine if a difference in salinity occurred between the inside and outside of the impoundment by year. It was found that, in 2011, salinity in the impoundment was significantly higher than outside of it (x^2=40.59, p=<.0001) (Figure 8). All other years during this period were similar.

Project continuous salinity stations since 2008 have shown lower salinities than the reference sites during several salinity spikes, indicating the effectiveness of the project features in preventing saltwater intrusion (figure 9). The spike in 2008 was the result of Hurricane Ike and the increased salinities in 2011 were due to drought conditions.

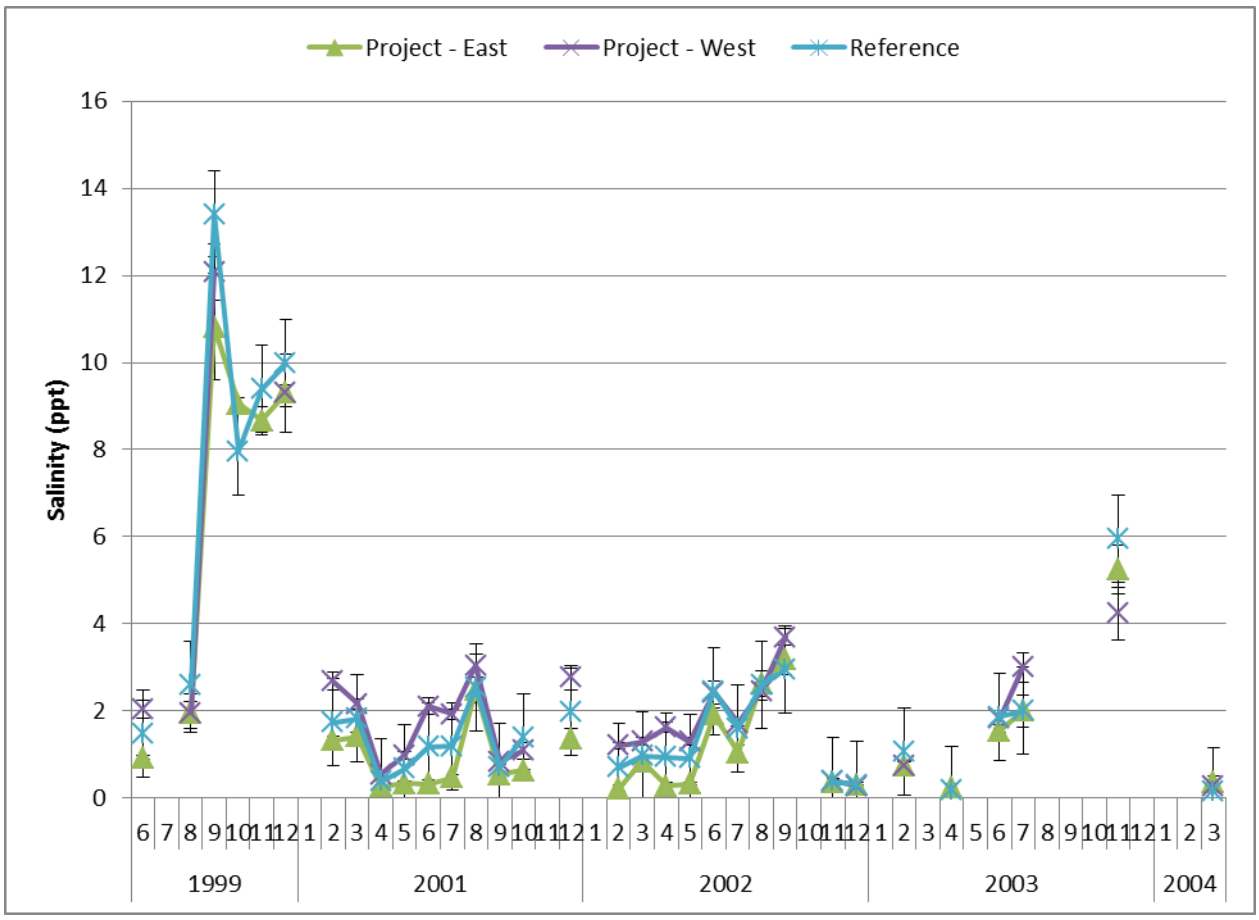

Figure 6. Mean discrete open water salinity measurements collected in the project (east and west) and reference areas during the period 1999-2004. The discrete salinity samples were collected monthly.

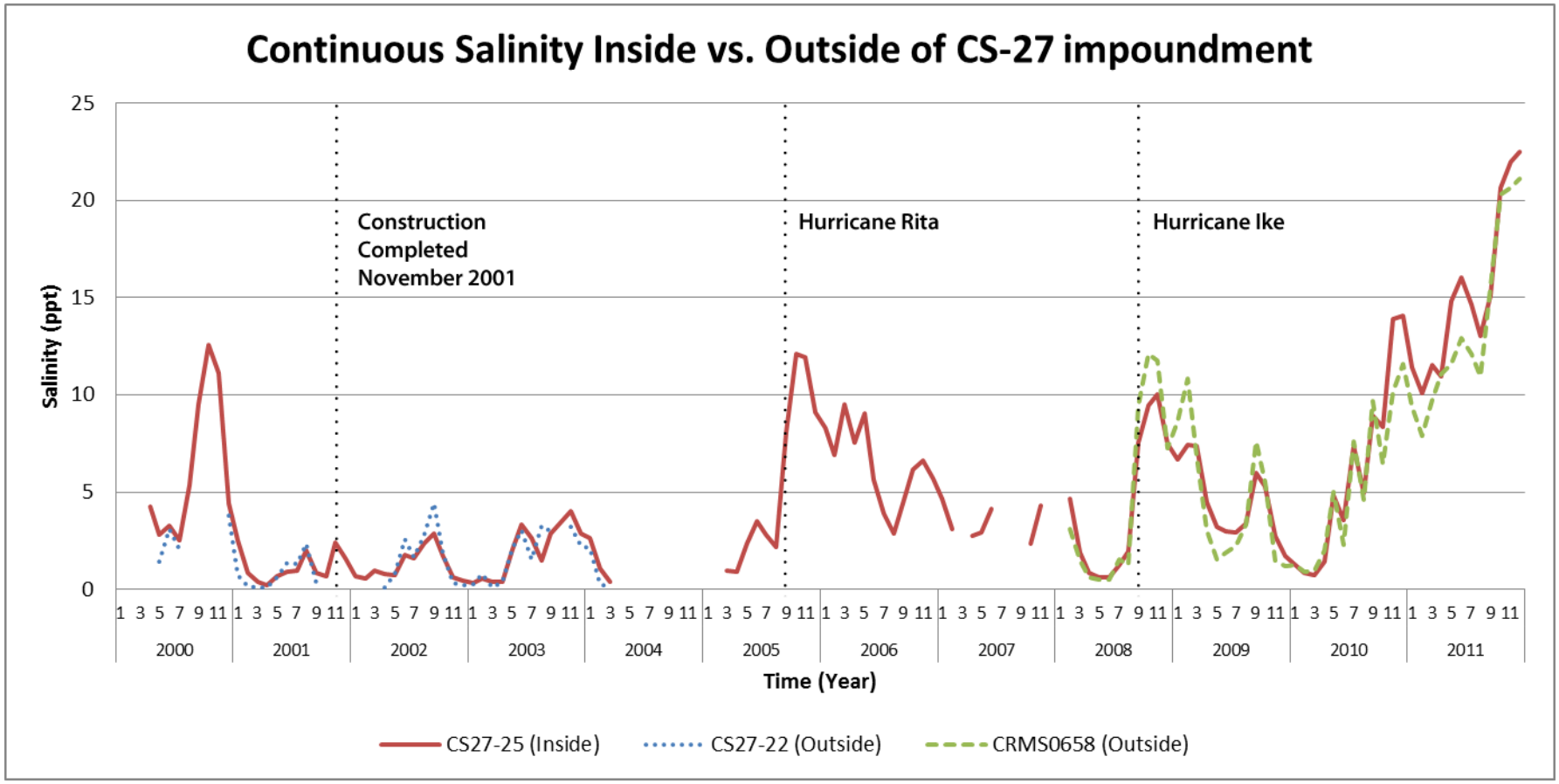

Figure 7. Monthly means of continuous salinity collected at stations CS27-22/CRMS0658 (outside impoundment) and CS27-25 (inside impoundment) within the project area from 2000-2011. Construction of structures to control water flow into the project area and to create the impoundment was completed in November 2001.

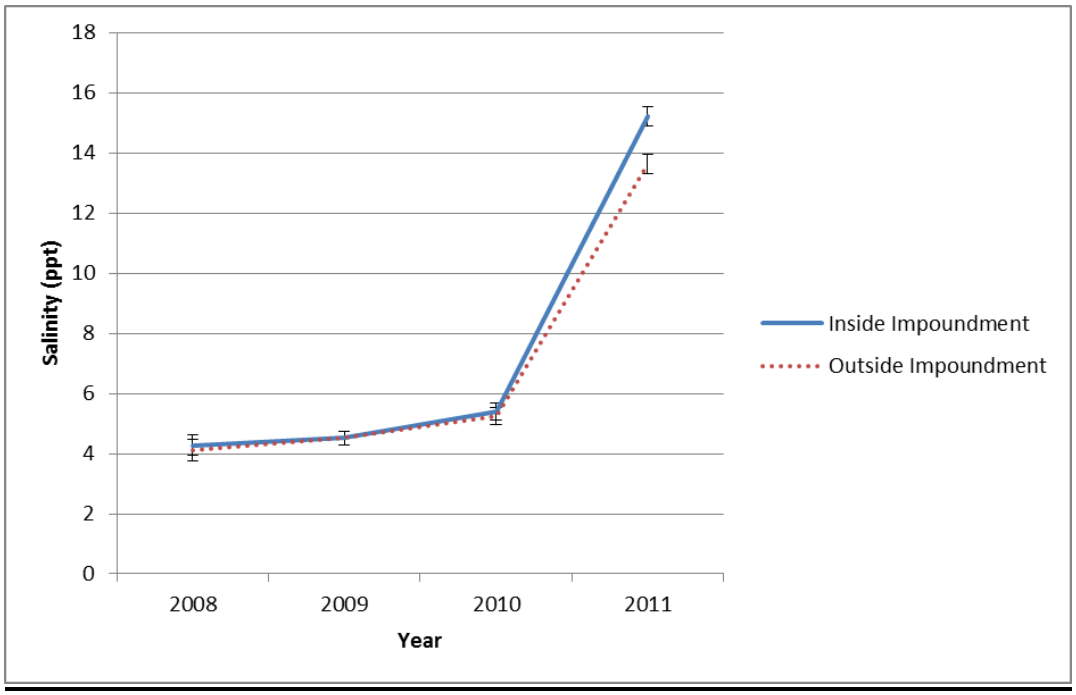

Figure 8. Yearly means and standard errors of continuous salinity collected at project stations CRMS0658 (outside impoundment) and CS27-25 (inside impoundment) from 2008-2011.

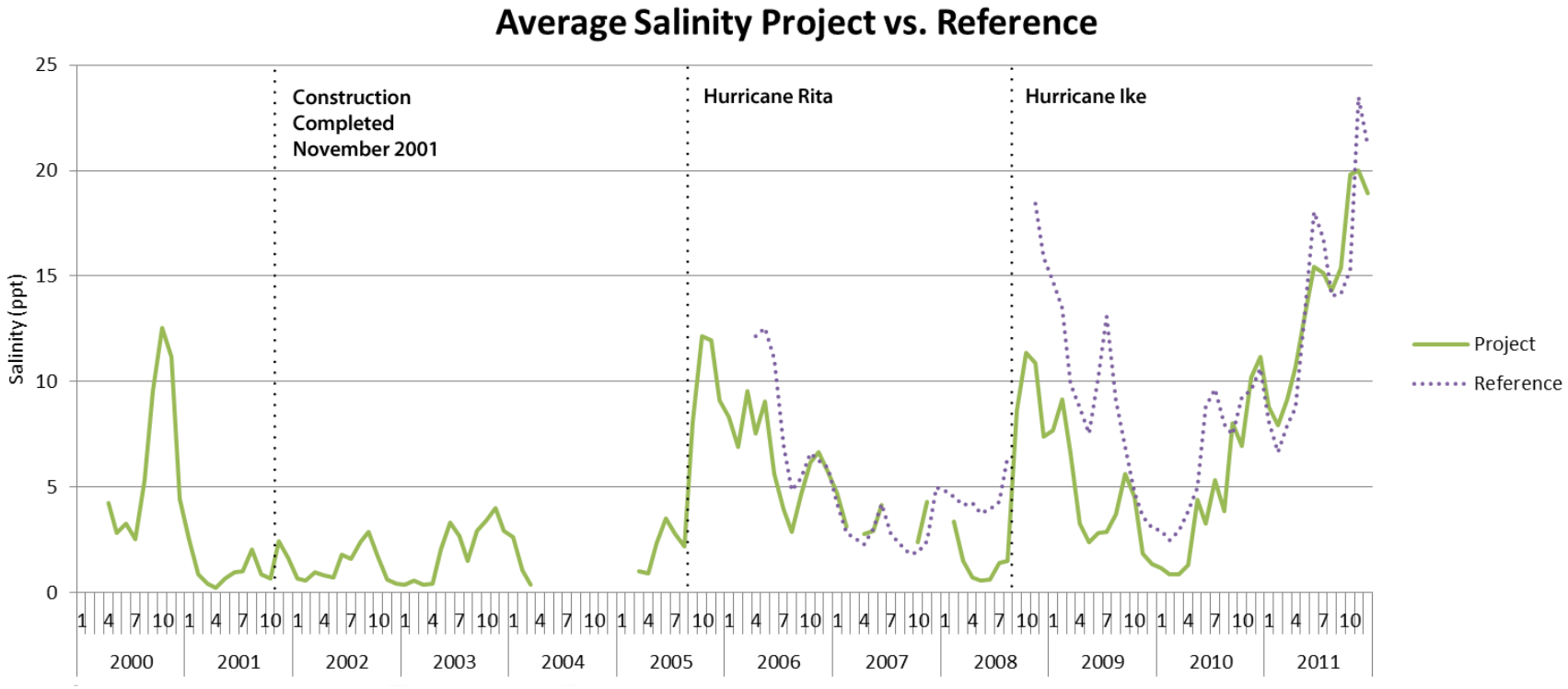

Figure 9. Monthly means of continuous salinity collected at stations in the project (CS27-25, 658, 662, 663) and reference (660, 665) areas from 2000-2011. Construction of structures to control water flow into the project area and to create the impoundment was completed in November 2001.

Vegetation Plantings

Schoenoplectus californicus (bullwhip) plantings were installed in the east side (Phase I – 2002) and the west side (Phase II – 2003) of the project area. Monitoring was conducted in September approximately 1 year after Phase I planting. Sample plots had varying survival success. Individual plantings were recorded as alive, absent, or dead. Except for a few, most plants counted as absent or dead were absent. A total of 53 plots containing 848 plants were sampled. The mean percentage found alive was 68% ranging from 100% to 6% survival. Some plots had robust, healthy plants almost indistinguishable, whereas, other plots had plants with few stems in deteriorated condition (LDNR 2004). Similar observations were noted about the Phase II planting in spring 2008.

Shoreline change

A foreshore rock dike was completed in November of 2001 along the southern shoreline of the GIWW on the western side of the project area between the Black Bayou Cut-off Canal and Gum Cove Ridge. To evaluate the effectiveness of the dike to decrease erosion, shoreline surveys (dGPS) of the breached portion of the GIWW shoreline along northern boundary of the impoundment were conducted before construction in March 2000, soon after the rock dike was constructed in March 2002, and about 3 years after construction in August 2004. Overall, the dike has been successful as this area gained land more than twice as fast during the post construction period than the predominantly preconstruction period (Table 3; Figures 10 a and b). Sediments are trapped and settling in the low energy area behind the dike and forming mud flats which are colonized by vegetation (Figure 11).

Table 3. Net land gain and rates along the GIWW shoreline/northern impoundment boundary protected by the foreshore dike

Time Period	Net Land Gain	Land Gain Rate
2000-2002 (mainly preconstruction)	0.125 acres	0.063 acres/yr
2002-2004 (post construction)	0.317 acres	0.131 acres/yr

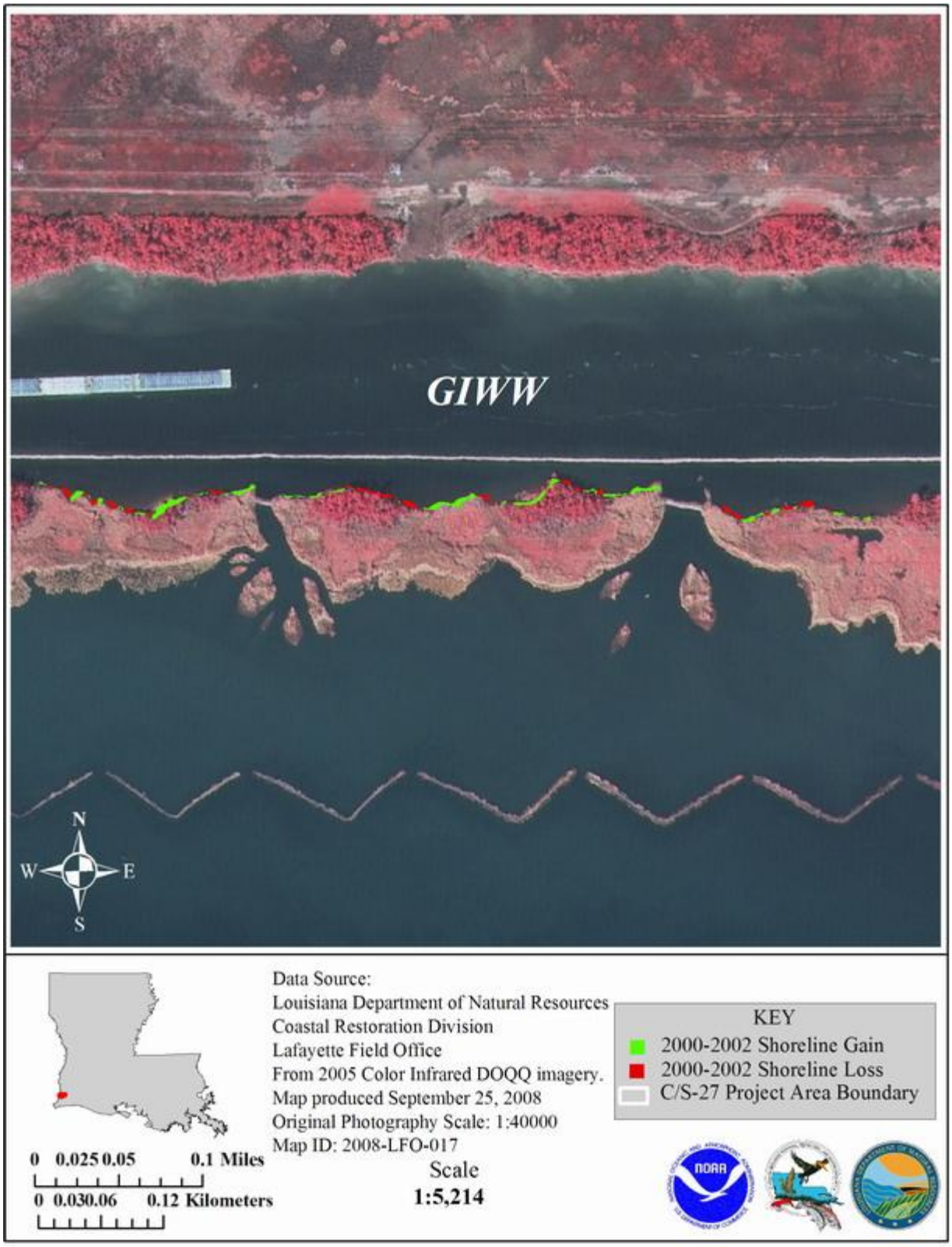

Figure 10a. Shoreline change from surveys conducted in March 2000 and March 2002.

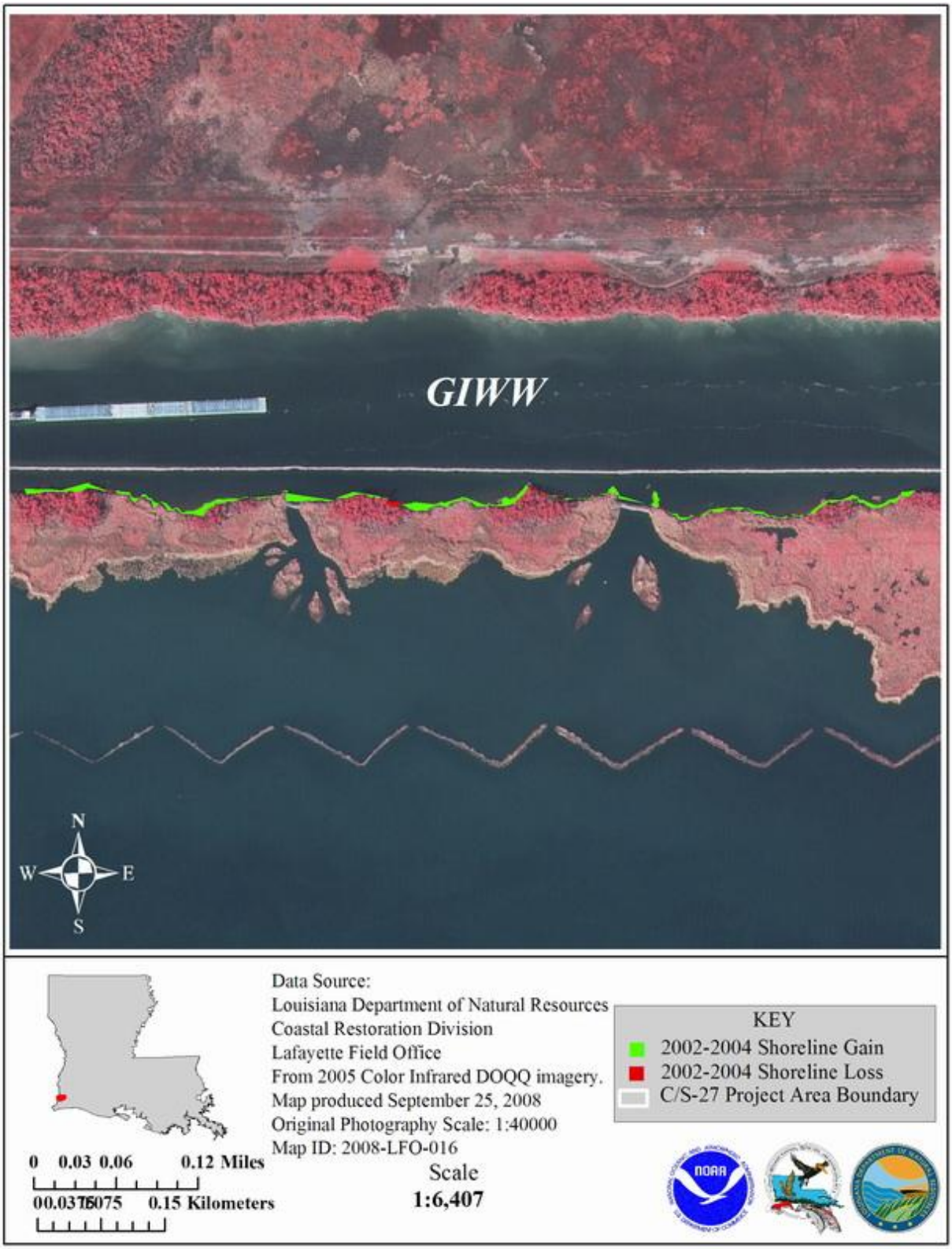

Figure 10b. Shoreline change from surveys conducted in March 2002 and August 2004.

Figure 11. Sedimentation and vegetative growth between the GIWW rock dike and dredge material levee along the north side of the impoundment.

Submerged Aquatic Vegetation (SAV)

Submerged aquatic vegetation was sampled in many ponds throughout the project and reference areas (Figure 3). Overall, SAV coverage has remained high (>50% occurrence) in most of the ponds sampled since pre-construction monitoring in 1999, with a reduction in occurrence in 2005 following Hurricane Rita (Figure 12). There is a significant interaction between area and year ($F_{24,65} = 2.80$; $p = 0.0005$) (Figure 13) where Area 1 and the reference area behaved differently than the other areas. In 2010, frequency of occurrence of SAV was more than 90% in all of the areas west of the BBCC (Areas 2-6) and less than 15% in the reference area and in the impoundment, Area 1. After Hurricane Rita, SAV was present in all areas although frequency of occurrence was only 12% in Area 6 which may have been due to the close proximity of this area to the Sabine Lake/River, a conduit for high salinity water during the storm. Collectively, frequency of occurrence of SAV in the project areas has been high except for immediately after Hurricane Rita while it has generally declined in the reference area (Figure 13) and project impoundment (Figure 12).

SAV has been diverse in the project areas throughout the project life and assemblages have shifted, becoming fresher from 1999 to 2003, saltier in 2005, and fresher in 2007 and 2010. In 2003, a decrease in *Ruppia maritima*, an indicator of more saline conditions, occurred and *Nymphaea odorata* and *Ottelia alismatoides* (fresh water species) were documented for the first time (Figure 14). Salinity data also showed a freshening of the project area from 2000 - 2003. *Chara spp.* occurrence began in 2003 following project construction in all areas. *Chara spp.* did not remain in the reference area after 2003, though. Species composition shifted in

2005 as *Ruppia maritima* increased, except in the reference area (Figure 14), concurrent with an increase in salinity levels due to the surge of Hurricane Rita. In 2007 and 2010, species composition again shifted to fresher habitat species with an absence of *Ruppia maritima* and, in 2010, occurrence of *Potamogeton pusillus* and *Ceratophyllum demersum* (Figure 14). *Myriophyllum spicatum* was also absent in the reference area during this time. Salinity levels during 2007 and 2010 appeared to have returned to pre-hurricane levels. Additional data in 2012 and subsequent years will give a better indication of what is happening in the reference area and project impoundment and will also show what effects low rainfalls during 2011 have had on SAV occurrence.

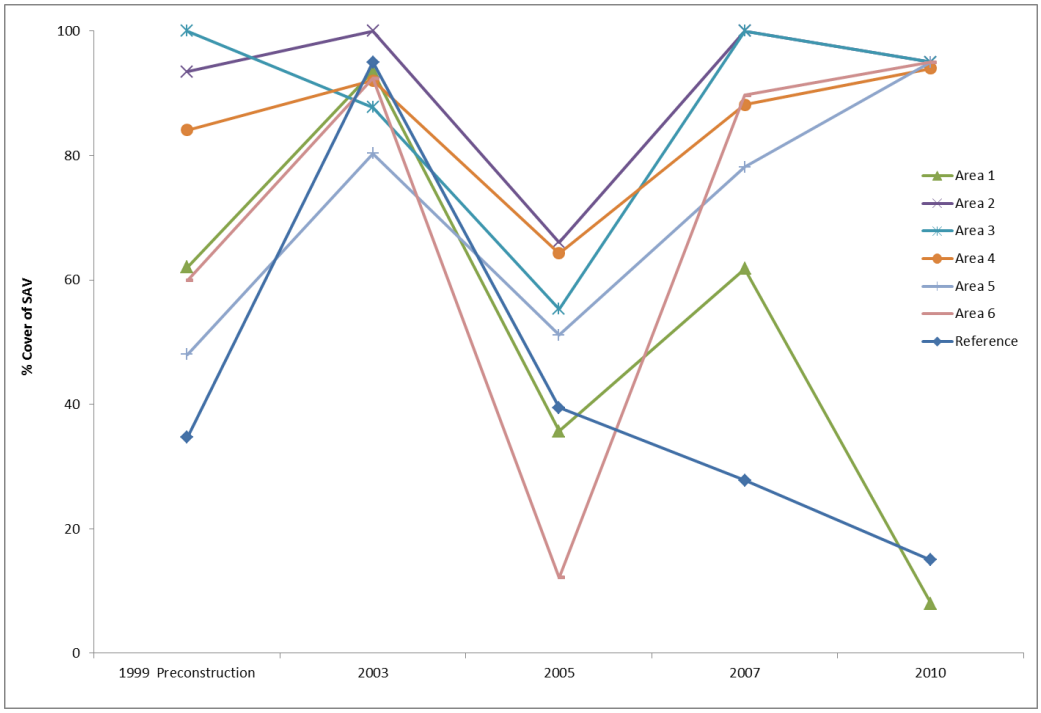

Figure 12. Total percent occurrence of SAV sampled by area and over time in late summer/ early fall. Values are means and standard errors of three transects (n=3) per area for each year except for area 2 in 2003 (n=1), 2005 (n=2), and 2007 (n=1).

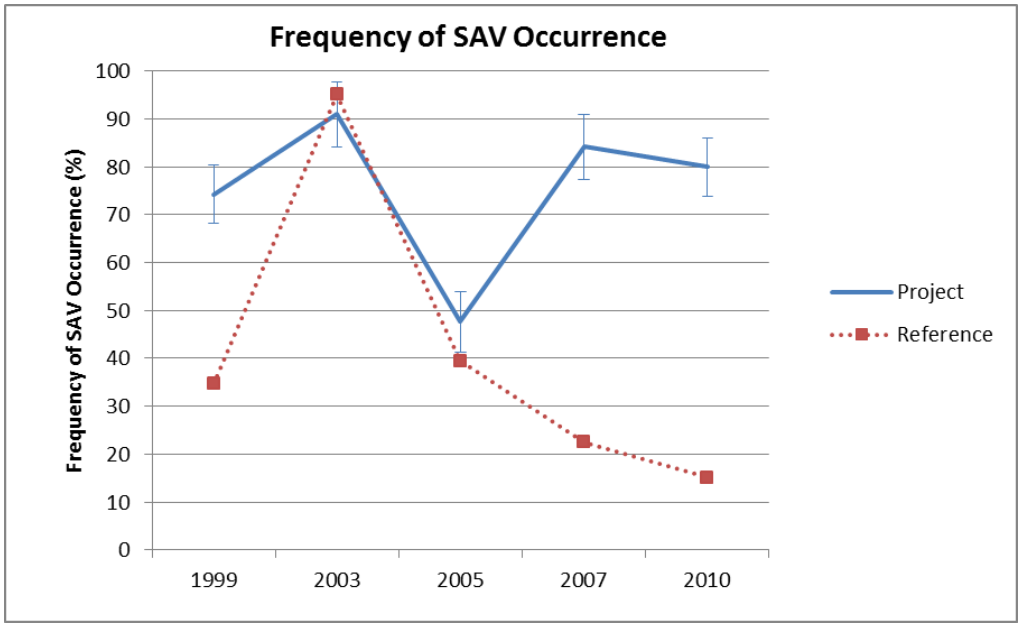

Figure 13. Frequency of Occurrence of SAV in the project and reference areas over time. Mean ± SE for the project areas.

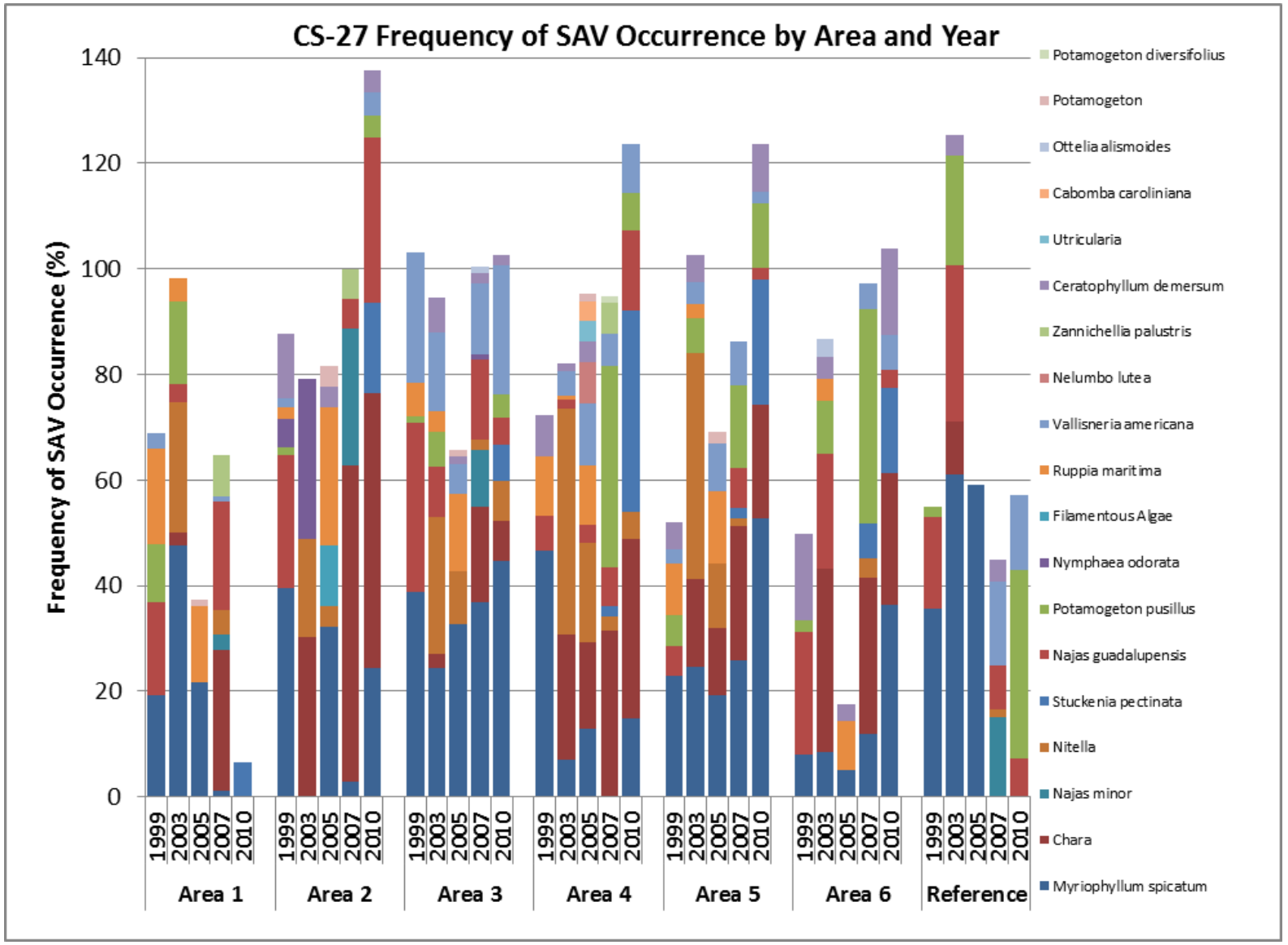

Figure 14. Percent occurrence of SAV species by sample area collected in 1999, 2003, 2005, 2007, and 2010. Values are the mean of transect values (n=3) per area for each year except for area 2 in 2003 (n=1), 2005 (n=2), and 2007 (n=1).

CRMS-*Wetlands* (CRMS) Supplemental

One purpose of hydrologic management in this project is to maintain low salinities in order to allow marsh vegetation to establish and flourish. Pore water collected from the soil at CRMS sites provide a direct measurement of the salinities that the plant roots are exposed to at 10 and 30 cm (~ 4 and 12 inches) below the soil surface. Pore water salinities were similar in the east and west sections of the project for time periods where both had data (Figures 15-16). Salinities peaked near the end of 2011, reaching more than 18 ppt at the 10 cm depth. Pore water salinities generally increased as 2011 progressed in the reference area at site CRMS0665 (Figure 17).

High Hydrologic Index (HI) scores indicate that flooding and salinity conditions are ideal for vegetation growth in a given marsh type. In 2010, HI scores were higher at CRMS sites within the CS-27 project (CRMS0658 and CRMS0663) than at CRMS sites outside CS-27 in the same basin and marsh type (Figure 18). In 2009 and 2011, HI scores in the project area were lower and were similar to other sites in the region. At both sites, the reason for the low scores was too high average annual salinity for the given marsh type. At both sites marsh type shifted from intermediate to brackish. The marsh was generally less salty in the east project area than the west.

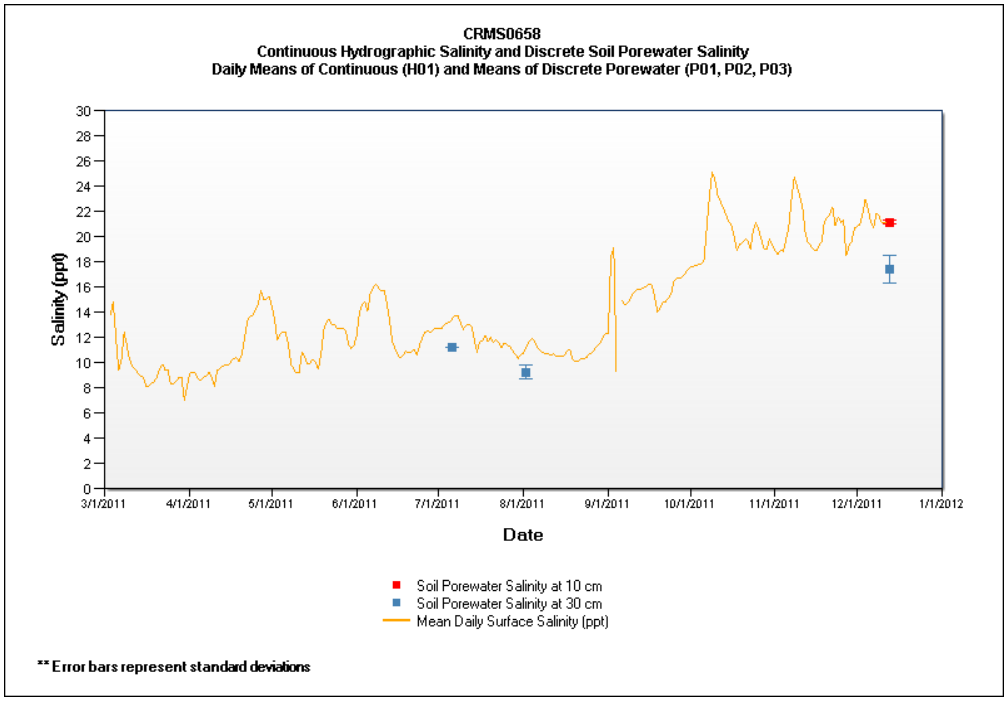

Figure 15. Pore-water salinities collected from CRMS0658 within the east project area between the BBCC and the impoundment for the year 2011. Values are means and standard errors from the sampling platform (n=3).

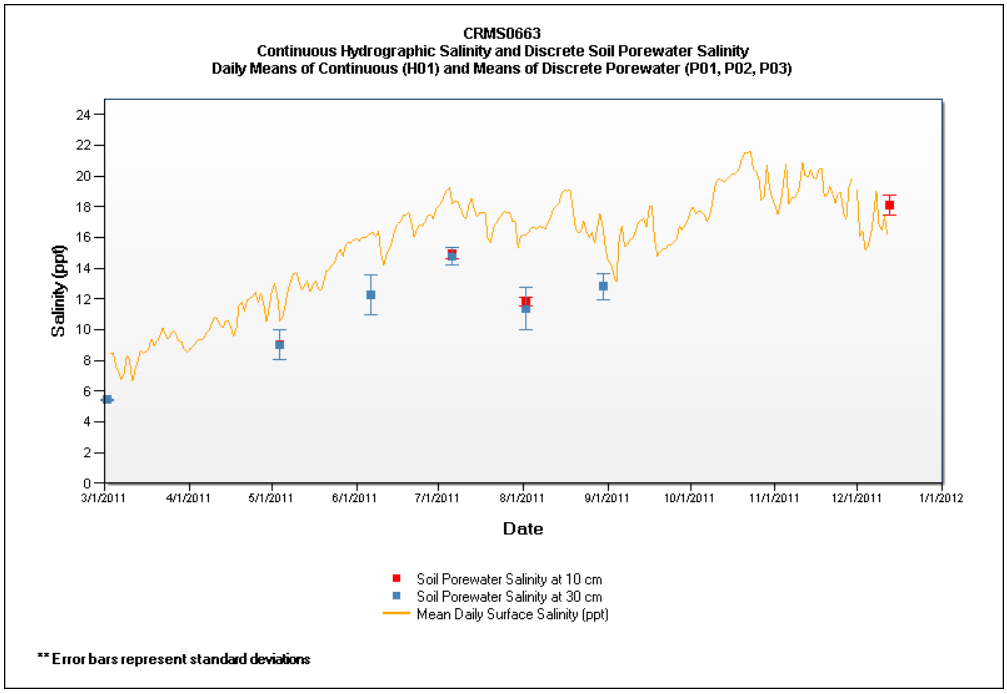

Figure 16. Pore-water salinities collected from CRMS0663 within the west project area for the year 2011. Values are means and standard errors from the sampling platform (n=3).

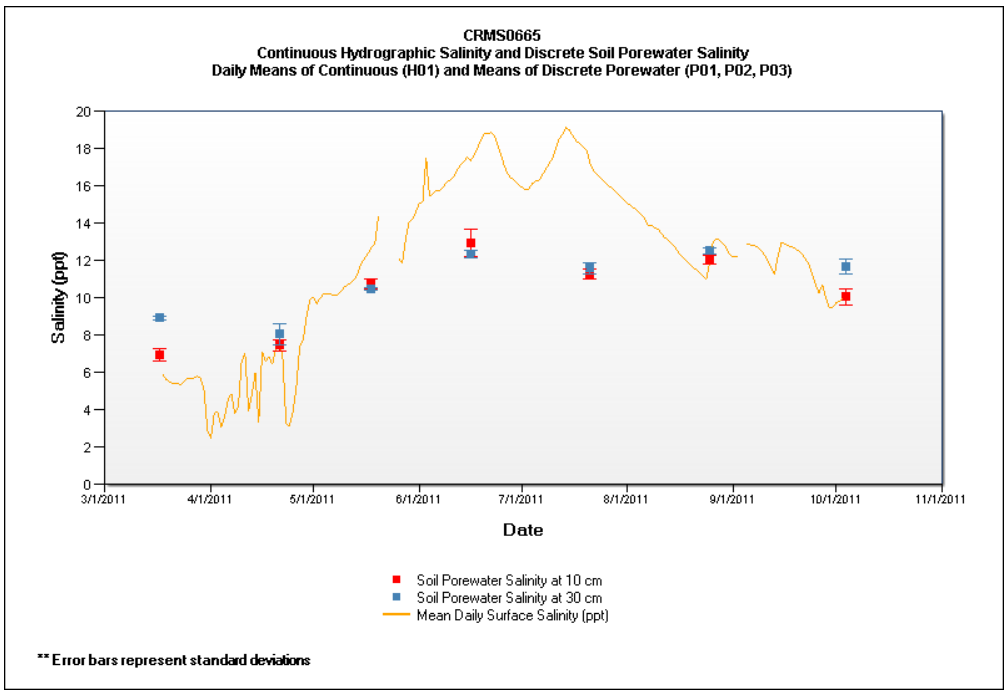

Figure 17. Pore-water salinities collected from CRMS0665 within the reference area south of the project for the year 2011. Values are means and standard errors from the sampling platform (n=3).

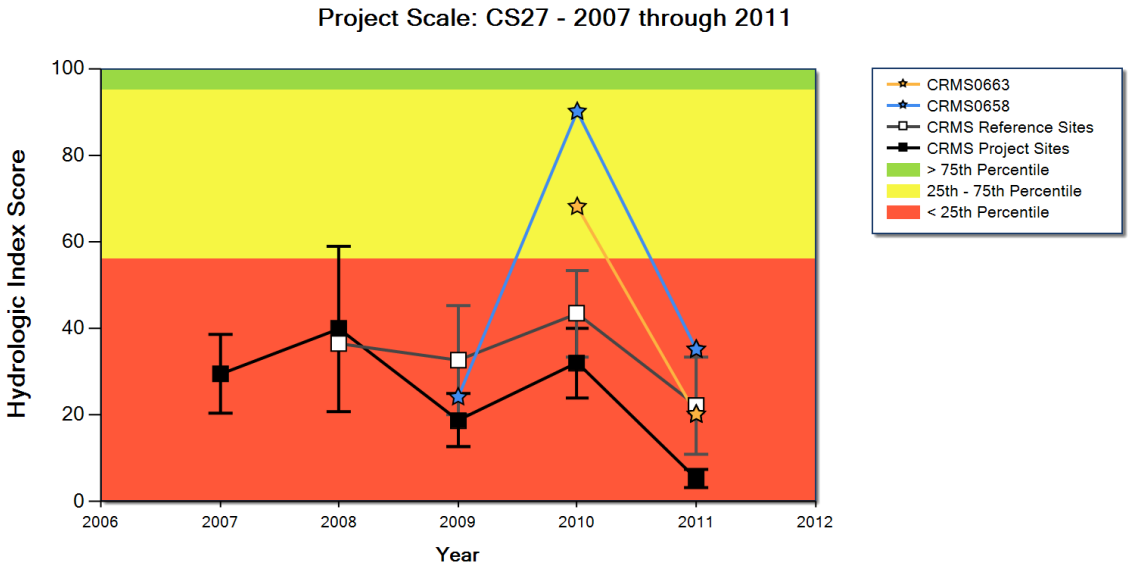

Figure 18. Hydrologic Index scores for CRMS sites in the east (658) and west (663) CS-27 project areas shown over time relative to all other CRMS sites (CWPPRA project and reference) within similar marsh types within the Calcasieu/Sabine Basin.

Floristic Quality Indices (FQI) of CRMS sites were utilized to assess differences in emergent vegetative condition. For 2011, the vegetative community in the west side of the project area was healthy for an intermediate/brackish marsh type as indicated by an average FQI of about 80 for the three sites that stretch north to south across the project area, as indicated by site CRMS0662 (figure 19a). During the same sampling period, the FQI (~85) was slightly higher in the site on the eastern side of the project between the BBCC and impoundment along the GIWW (CRMS0658). This indication of a slightly healthier vegetative community was primarily due to the large presence of *Spartina patens* (marshhay cordgrass), *Juncus roemerianus* (black needlerush), and *Ipomoea sagittata* (saltmarsh morning-glory) which are native perennial species appropriate for this marsh type (Figure 19b). Reference sites south of the project area that remained vegetated had lower FQI scores (~60-75) than the project areas. Site CRMS0660 converted to open water following Hurricane Ike, but re-vegetated by 2011 (Figure 19c). Over the entire sampling period, sites in the western project area generally became less healthy with lower percent cover following Hurricane Ike, eventually recovering by 2011. In the east project area, FQI scores also declined following the hurricane, but recovered to pre-storm levels by the following year. The reference area site that remained vegetated following Hurricane Ike followed the same pattern as the project.

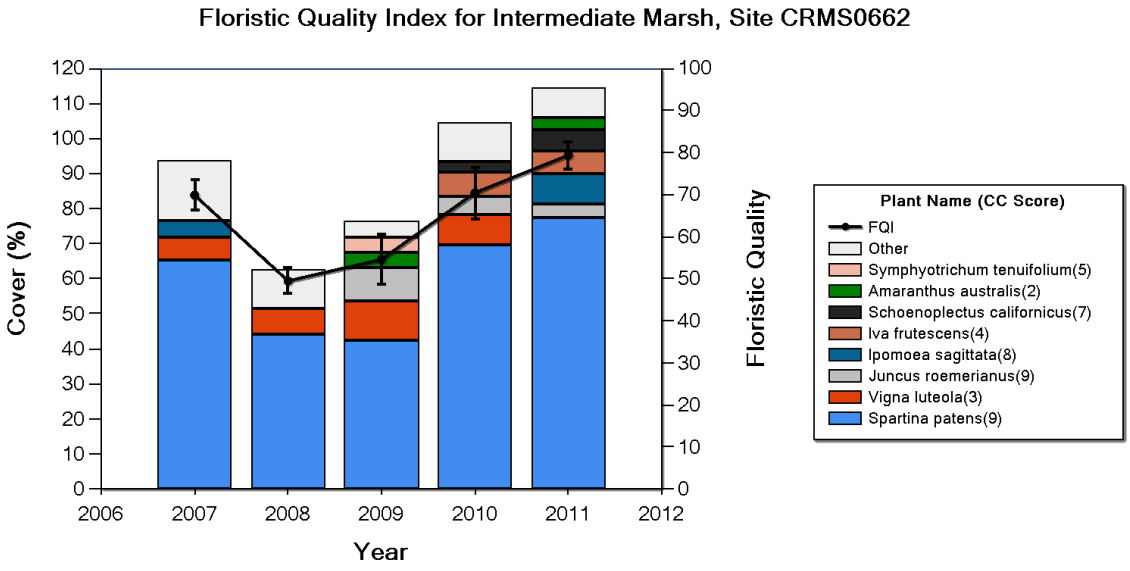

Figure 19a. Percent coverage of species and floristic quality index of emergent vegetation collected from within the west side of the project area (CRMS0662) for the period 2007-2011. Values are means of 10 stations within the site; therefore, the sum of % coverage of individual species can be greater than 100 %.

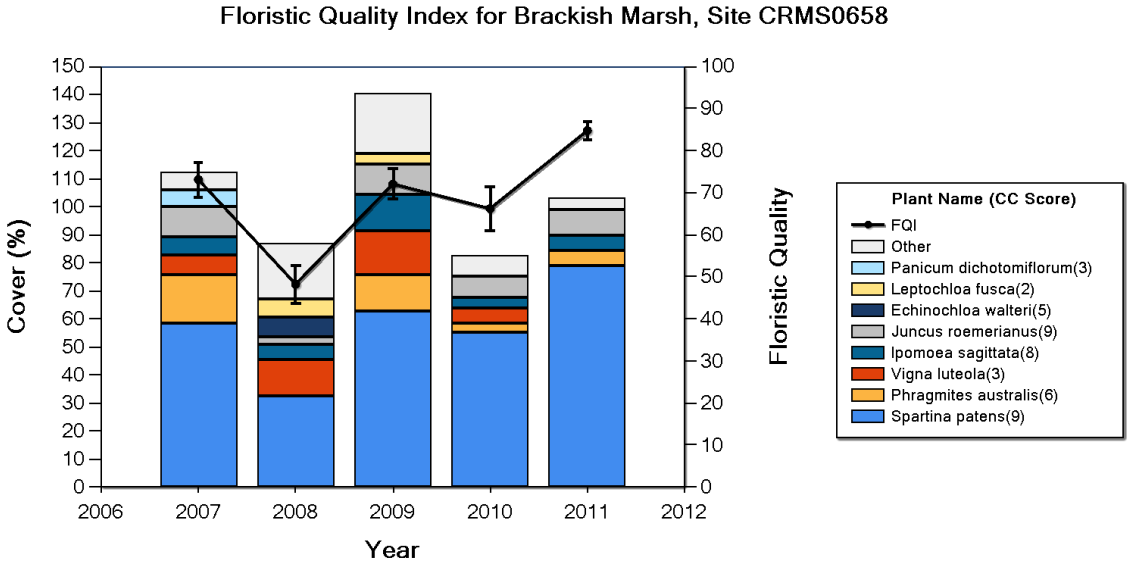

Figure 19b. Percent coverage of species and floristic quality index of emergent vegetation collected from CRMS0658 within the east project area between the BBCC and the impoundment for the period 2007-2011. Values are means of 10 stations within the site; therefore, the sum of % coverage of individual species can be greater than 100 %.

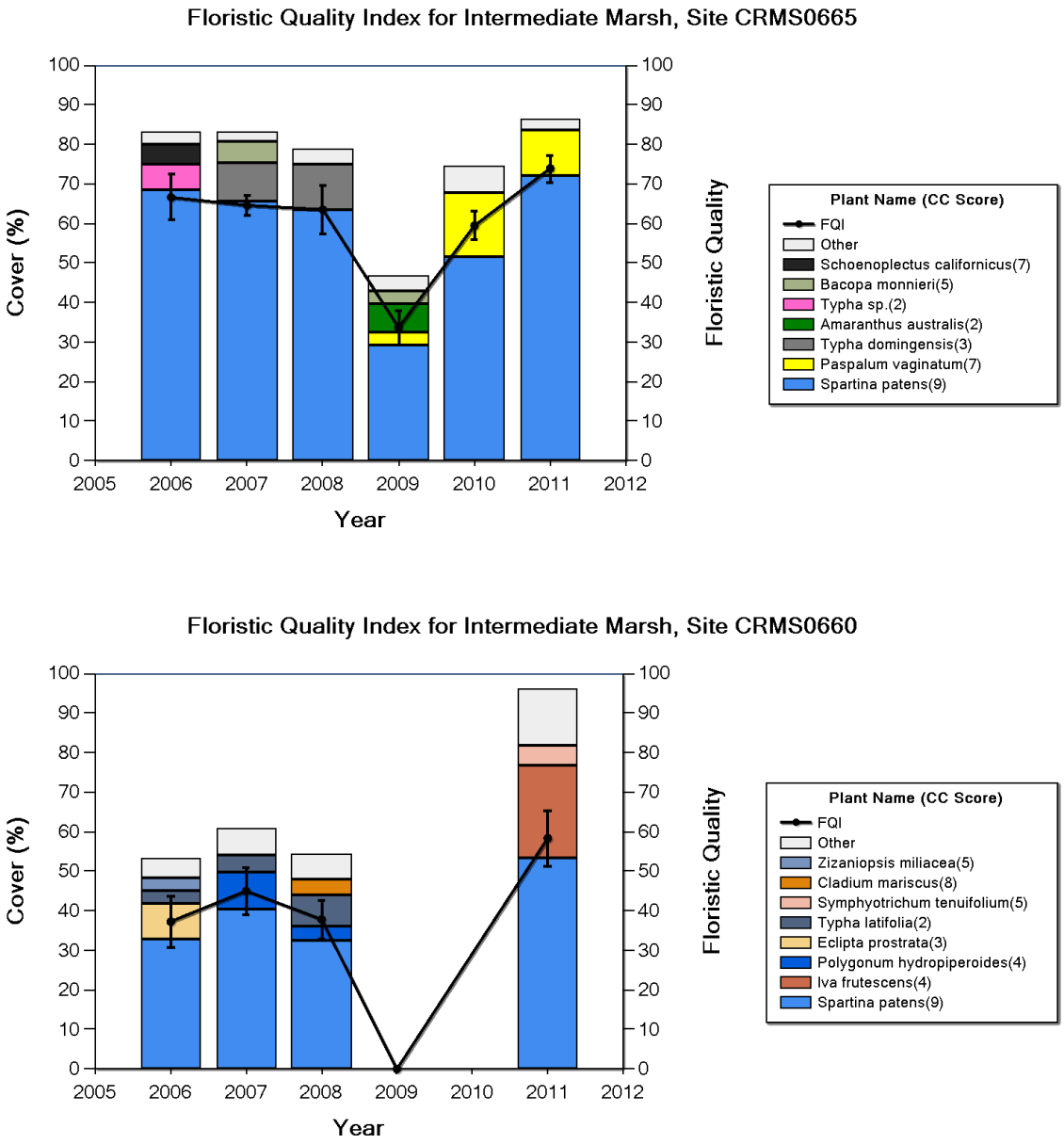

Figure 19c. Percent coverage of species and floristic quality index of emergent vegetation collected in the reference area south of the project area for the period 2006-2011. Values are means of 10 stations within the site; therefore, the sum of % coverage of individual species can be greater than 100 %. Reference site CRMS0660 converted to open water following Hurricane Ike.

Physical soil properties were analyzed from 24 cm (~ 10") deep soil cores collected from three CRMS sites. The soil from the west side of the project area (CRMS0663) and south of the project area (CRMS0660) were typical for an intermediate marsh, low to moderate bulk density (0.06 – 0.15 g/cm^3) and high organic content (> 50%), and soil from both sites were noted upon collection has having many roots throughout core (figure 20). The soil from CRMS0660 was very dark (humic) and denser than soils from CRMS0663. Soil from the site in the eastern side of the project area between the BBCC and impoundment along the GIWW (CRMS0658) was similar to the other sites in the top half of the core, but the bottom half was atypical for soil from an intermediate marsh. The bottom half of the core was very dense (> 0.2 g/cm^3) and had low organic content (< 30%) relative to the other sites (Figure 20), and upon collection the soil was noted to be very silty with few roots. This site is positioned along the GIWW and may be perched on dredged material.

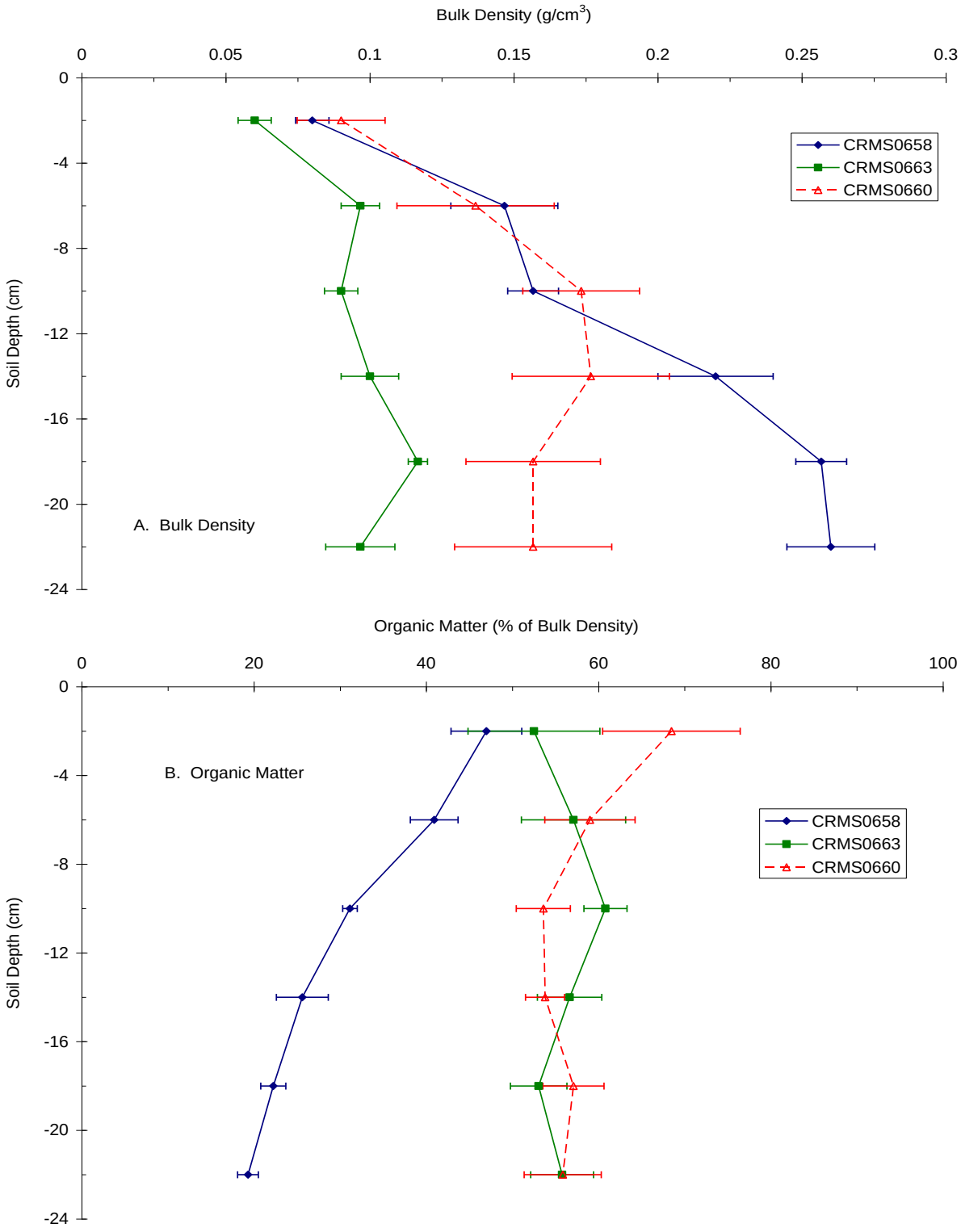

Figure 20. Soil properties (A. bulk density and B. organic matter) collected at CRMS sites inside (CRMS0658, east between BBCC and impoundment; CRMS0663, west) and outside (CRMS0660) the project area. Values are means and standard errors (n=3).

V. Conclusions

a. Project Effectiveness

The impoundment and SRT structure have not been successful at increasing freshwater retention in the project area. There were four breaches in the GIWW spoil bank that were repaired in August 2011 which allowed the impoundment to trap salt water. Overall the project has met the goal of reducing salt water intrusion as indicated by reduced salinities in the project area relative to the reference area during salinity spikes.

The goal to establish emergent wetland vegetation in the shallow open water areas has been partially attained. Most of the bullwhip (*Schoenoplectus californicus*) planted in 2002 and 2003 survived as some plantings were healthy whereas other plantings were deteriorated. Establishment of emergent wetland vegetation in the project area was slower than in the reference area from 2000 to 2004. However, from 2000 to 2011, the project land area has remained relatively stable (-0.1%), while the reference area has lost land area(4.0%), presumably due to Hurricanes Rita and Ike. Emergent vegetation in the project area was impacted by Hurricane Ike. Through 2011, the cover and quality of vegetation has recovered in both quality and coverage, and remained high at project area sites.

The foreshore dike has effectively reduced shoreline erosion along the GIWW. The widening of the shoreline along the northern boundary of the impoundment should provide protection to the emergent wetland vegetation within this portion of the project. However, at least one breach still exists which allows for hydrologic exchange and causes localized scouring.

The frequency of occurrence of SAV in the project areas has been high except for immediately after Hurricane Rita while it has generally declined in the reference area and in the project impoundment. Fluctuations over time are attributed to climatologic forcing functions on the region, such as drought (1999, 2005) and Hurricanes Rita and Ike (2005, 2008).

The constructed components of the project are in very good condition. Erosion at previously noted weir locations has stabilized. Repairs made during the last maintenance event are in good post construction condition. The breaches which occurred around two of the four plugs behind the GIWW rock dike have been addressed by landowners at no cost to the project. Observations made during this year's annual inspection such as rusting on the SRT Gate railing and noted sections of displaced rock on the GIWW rock dike do not require maintenance at this time and will continue to be monitored.

b. Recommended Improvements

The hydrodynamic model developed for project design should be rerun to assess the model validity, and the project validity.

For SAV analyses, larger, open-water areas should be avoided. Occurrence of SAV is typically lower in larger water bodies because of greater wave energy and turbulence and may not represent project effects.

Installation of staff gauges in convenient locations within the project area is still recommended.

c. Lessons Learned

Areas, such as the impoundment, designed to hold more water than surrounding areas are difficult to maintain because of the additional hydrodynamic forces. As such, breaches are difficult to stop with conventional measures. The culverts installed in the southeast corner of the impoundment in addition to the SRT gate proved helpful in relieving high water levels after Hurricane Rita.

Warning signs in areas of severe current caused by installation of rock or sheet pile weirs should always be included. These signs should be installed in concrete blocks out of the way of traffic since this has proven to be very effective.

Concrete sacks work extremely well in areas where small sections of rock dike need repair and should be considered in these situations.

Guard rails or fences around water control structures should be considered.

It has been learned that alligators will cross at the narrowest point, regardless of elevation. This may be useful in levee repair due to failure initiated by wear from alligator crossing.

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APPENDIX A
(Inspection Photographs)

Photo 1—Navigational Aids and Signage at Block's Creek

Photo 2—Burton Canal Structure

Photo 5—Pillow Block on SRT Gate Flap & Railing Rust

Photo 6—Plug Near SRT Gate

Photo 7—Black Bayou Cut-off Canal structure

Photo 8—Typical Section of Rock Dike

Photo 10—Low Area of Dike Displaced by Barge

Photo 11—Interior Levee as Repaired by Landowner

APPENDIX B
(Three Year Budget Projection)

BLACK BAYOU HYDROLOGIC RESTORATION/ CS27 / PPL 6

Three-Year Operations & Maintenance Budgets 07/01/2012 - 06/30/2015

Project Manager	O & M Manager	Federal Sponsor	Prepared By
Pat Landry	*Stan Aucoin*	*NMFS*	*Stan Aucoin*

	2012/2013 (-10)	2013/2014 (-11)	2014/2015 (-12)
Maintenance Inspection	$ 6,269.00	$ 6,457.00	$ 6,651.00
Navigational Aid Inspection	$ 5,000.00	$ 5,000.00	$ 5,000.00
State Administration		$ -	$ -
Federal Administration		$ -	$ -
Maintenance/Rehabilitation			

12/13 Description: Install staff gauge

E&D	
Construction	$ 7,500.00
Construction Oversight	
Sub Total - Maint. And Rehab.	$ 7,500.00

13/14 Description

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

14/15 Description:

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

	2012/2013 (-10)	2013/2014 (-11)	2014/2015 (-12)
Total O&M Budgets	**$ 18,769.00**	**$ 11,457.00**	**$ 11,651.00**

O &M Budget (3 yr Total)	**$ 41,877.00**
Unexpended O & M Budget	**$ 74,748.00**
Remaining O & M Budget (Projected)	**$ 32,871.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

BLACK BAYOU HYDROLOGIC RESTORATION PROJECT / PROJECT NO. CS-27 / PPL NO. 6 / 2012/2013

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$6,269.00	**$6,269.00**
General Structure Maintenance	LUMP	0	$0.00	**$0.00**
Engineering and Design	LUMP	0	$0.00	**$0.00**
Operations Contract/ Navigational Aid Inspec.	LUMP	1	$5,000.00	**$5,000.00**
Construction Oversight	LUMP	0	$0.00	**$0.00**

ADMINISTRATION

LDNR / CRD Admin.	LUMP	0	$0.00	$0.00
FEDERAL SPONSOR Admin.	LUMP	0	$0.00	$0.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$0.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:	Add staff gage.				
	Secondary Monument	EACH	0	$0.00	$0.00
	Staff Gauge / Recorders	EACH	1	$7,500.00	$7,500.00
	Marsh Elevation / Topography	LUMP	0	$0.00	$0.00
	TBM Installation	EACH	0	$0.00	$0.00
	OTHER				$0.00
				TOTAL SURVEY COSTS:	**$7,500.00**

GEOTECHNICAL

GEOTECH DESCRIPTION:					
	Borings	EACH	0	$0.00	$0.00
	OTHER				$0.00
				TOTAL GEOTECHNICAL COSTS:	**$0.00**

CONSTRUCTION

CONSTRUCTION DESCRIPTION:						
	Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE	
	Rock Rip rap	0	0.0	0	$0.00	$0.00
	Aggregate Surface Course	0	0.0	0	$0.00	$0.00
		0	0.0	0	$0.00	$0.00
	Filter Cloth / Geogrid Fabric		SQ YD	0	$0.00	$0.00
	Navigation Aid		EACH	0	$0.00	$0.00
	Signage		EACH	0	$0.00	$0.00
	General Excavation / Fill		CU YD	0	$0.00	$0.00
	Dredging		CU YD	0	$0.00	$0.00
	Sheet Piles (Lin Ft or Sq Yds)			0	$0.00	$0.00
	Timber Piles (each or lump sum)			0	$0.00	$0.00
	Timber Members (each or lump sum)			0	$0.00	$0.00
	Hardware		LUMP	0	$0.00	$0.00
	Materials		LUMP	0	$0.00	$0.00
	Mob / Demob		LUMP	0	$0.00	$0.00
	Contingency		LUMP	0	$0.00	$0.00
	General Structure Maintenance		LUMP	0	$0.00	$0.00
	OTHER				$0.00	$0.00
	OTHER				$0.00	$0.00
	OTHER				$0.00	$0.00
					TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$18,769.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

BLACK BAYOU HYDROLOGIC RESTORATION PROJECT / PROJECT NO. CS-27 / PPL NO. 6 / 2013/2014

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$6,457.00	**$6,457.00**
General Structure Maintenance	LUMP	0	$0.00	**$0.00**
Engineering and Design	LUMP	0	$0.00	**$0.00**
Operations Contract/Navigational Aid Inspec.	LUMP	1	$5,000.00	**$5,000.00**
Construction Oversight	LUMP	0	$0.00	**$0.00**

ADMINISTRATION

LDNR / CRD Admin.	LUMP	0	$0.00	$0.00
FEDERAL SPONSOR Admin.	LUMP	0	$0.00	$0.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$0.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:					
Secondary Monument	EACH	0	$0.00	$0.00
Staff Gauge / Recorders	EACH	0	$0.00	$0.00
Marsh Elevation / Topography	LUMP	0	$0.00	$0.00
TBM Installation	EACH	0	$0.00	$0.00
OTHER				$0.00
			TOTAL SURVEY COSTS:	**$0.00**

GEOTECHNICAL

GEOTECH DESCRIPTION:					
Borings	EACH	0	$0.00	$0.00
OTHER				$0.00
			TOTAL GEOTECHNICAL COSTS:	**$0.00**

CONSTRUCTION

CONSTRUCTION DESCRIPTION:					
Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE	
Rock Rip rap	0	0.0	0	$0.00	$0.00
Aggregate Surface Course	0	0.0	0	$0.00	$0.00
	0	0.0	0	$0.00	$0.00
Filter Cloth / Geogrid Fabric		SQ YD	0	$0.00	$0.00
Navigation Aid		EACH	0	$0.00	$0.00
Signage		EACH	0	$0.00	$0.00
General Excavation / Fill		CU YD	0	$0.00	$0.00
Dredging		CU YD	0	$0.00	$0.00
Sheet Piles (Lin Ft or Sq Yds)			0	$0.00	$0.00
Timber Piles (each or lump sum)			0	$0.00	$0.00
Timber Members (each or lump sum)			0	$0.00	$0.00
Hardware		LUMP	0	$0.00	$0.00
Materials		LUMP	0	$0.00	$0.00
Mob / Demob		LUMP	0	$0.00	$0.00
Contingency		LUMP	0	$0.00	$0.00
General Structure Maintenance		LUMP	0	$0.00	$0.00
OTHER				$0.00	$0.00
OTHER				$0.00	$0.00
OTHER				$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$11,457.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

BLACK BAYOU HYDROLOGIC RESTORATION PROJECT / PROJECT NO. CS-27 / PPL NO. 6 / 2014/2015

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$6,651.00	**$6,651.00**
General Structure Maintenance	LUMP	0	$0.00	**$0.00**
Engineering and Design	LUMP	0	$0.00	**$0.00**
Operations Contract/Navigational Aid Inspec.	LUMP	1	$5,000.00	**$5,000.00**
Construction Oversight	LUMP	0	$0.00	**$0.00**

ADMINISTRATION

LDNR / CRD Admin.	LUMP	0	$0.00	$0.00
FEDERAL SPONSOR Admin.	LUMP	0	$0.00	$0.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$0.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:					
Secondary Monument	EACH	0	$0.00	$0.00
Staff Gauge / Recorders	EACH	0	$0.00	$0.00
Marsh Elevation / Topography	LUMP	0	$0.00	$0.00
TBM Installation	EACH	0	$0.00	$0.00
OTHER				$0.00
			TOTAL SURVEY COSTS:	**$0.00**

GEOTECHNICAL

GEOTECH DESCRIPTION:					
Borings	EACH	0	$0.00	$0.00
OTHER				$0.00
			TOTAL GEOTECHNICAL COSTS:	**$0.00**

CONSTRUCTION

CONSTRUCTION DESCRIPTION:					
Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE	
Rock Rip rap	0	0.0	0	$0.00	$0.00
Aggregate Surface Course	0	0.0	0	$0.00	$0.00
	0	0.0	0	$0.00	$0.00
Filter Cloth / Geogrid Fabric		SQ YD	0	$0.00	$0.00
Navigation Aid		EACH	0	$0.00	$0.00
Signage		EACH	0	$0.00	$0.00
General Excavation / Fill		CU YD	0	$0.00	$0.00
Dredging		CU YD	0	$0.00	$0.00
Sheet Piles (Lin Ft or Sq Yds)			0	$0.00	$0.00
Timber Piles (each or lump sum)			0	$0.00	$0.00
Timber Members (each or lump sum)			0	$0.00	$0.00
Hardware		LUMP	0	$0.00	$0.00
Materials		LUMP	0	$0.00	$0.00
Mob / Demob		LUMP	0	$0.00	$0.00
Contingency		LUMP	0	$0.00	$0.00
General Structure Maintenance		LUMP	0	$0.00	$0.00
OTHER				$0.00	$0.00
OTHER				$0.00	$0.00
OTHER				$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$11,651.00**

APPENDIX C
(Field Inspection Notes)

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: CS-27 Black Bayou Hydrologic Restoration
Structure No. _____N/A_____

Structure Description: Blocks's Creek Weir w/ Boat Bay
Burton Canal Weir w/ Boat Bay
Black Bayou Cut-Off Canal w/ Barge Bay
Type of Inspection: Annual

Date of Inspection: March 29, 2012 Time: 11:30 am

Inspector(s):Stan Aucoin, Jody White, and Troy Barrilleaux (CPRA)
John Foret (NMFS)
Water Level Inside:_____ Outside: _____
Salinity: 1.9ppt at Block's Creek, 0.3ppt at Burton Canal
Weather Conditions: Sunny and Mild

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Block's Creek Weir	Good			1	Erosion on Southeast side has stabilized. No maintenance required at this time.
Burton Canal Weir	Good			2	Scouring along the canal banks inside of the wier has stabilized. No maintenance required at this time.
Black Bayou Cut-Off Canal Weir	Good			7	Good post construction condition.
Hardware					
Timber Piles	N/A				
Timber Wales	N/A				
Galv. Pile Caps	N/A				
Navigational Aid Lights	Good				Inspected quarterly.
Signage /Supports	Good				Intact
Rip Rap	Good				

What are the conditions of the existing levees?
Are there any noticeable breaches?
Settlement of rock plugs and rock weirs? No
Position of stoplogs at the time of the inspection?
Are there any signs of vandalism?

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: CS-27 Black Bayou Hydrologic Restoration

Date of Inspection: March 29, 2012 Time: 12:10 pm

Structure No. ___ N/A

Inspector(s): Stan Aucoin, Jody White, Troy Barrilleaux (CPRA)
John Foret (NMFS)

Structure Description: SRT Gate and Rock Plug

Water Level Inside:_____ Outside: _____
Salinity: 4.2ppt

Type of Inspection: Annual

Weather Conditions:sunny and mild

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	Good			3 & 4	Rusting at sheet pile seams. Will continue to monitor.
Steel Grating					
Stop Logs					
Hardware					
Timber Piles	Good			3	
Timber Wales					
Galv. Pile Caps	Good			3	
SRT Gate	Good		Moderate	3-5	Pillow blocks were replaced during last inspection. Gate is in good condition. The railing above the gate is showing signs of corrosion. No maintenance required at this time.
Signage /Supports Vinton Canal	Good			3	Good condition.
Rip Rap (fill)					
Rock Plug	Good			6	Repaired with concrete sacks.

What are the conditions of the existing levees?
Are there any noticeable breaches?
Settlement of rock plugs and rock weirs?
Position of stoplogs at the time of the inspection?
Are there any signs of vandalism?

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: CS-27 Black Bayou Hydrologic Restoration

Date of Inspection: March 29, 2012 Time: 12:35pm

Structure No. ___ N/A

Inspector(s):Stan Aucoin, Jody White, Troy Barrilleaux (CPRA)
John Foret (NMFS)

Structure Description: GIWW Rock Dike

Water Level Inside:_____ Outside: _____
Salinity: 0.1ppt at West End, 0.7ppt at East end

Type of Inspection: Annual

Weather Conditions:sunny and mild

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps					
Steel Grating					
Stop Logs					
Hardware					
Timber Piles					
Timber Wales					
Galv. Pile Caps					
Earthen Plugs					The spoil behind the rock dike at the natural Black Bayou has washed away on the western end. This will continue to be monitored.
Signage /Supports					Warning signs at the Vinton and Black Bayou closures are missing.
Rip Rap (fill) GIWW Rock Dike	Good			9 8 &10	There is a gap in the rock dike at the natural Black Bayou in front of the gap in the earthen plug. The rock is approximately 2-3 ft below the water surface. Landowner repairs to two of the four C-stone closures are complete. There are a few spots of displaced rock along the dike but it is still functioning and does not require repair. Tie-ins on both ends of the rock dike are stable.

What are the conditions of the existing levees?
Are there any noticeable breaches?
Settlement of rock plugs and rock weirs?
Position of stoplogs at the time of the inspection?
Are there any signs of vandalism?