State of Louisiana
Coastal Protection and Restoration Authority

2014 Operations, Maintenance, and Monitoring Report

for

Jonathan Davis Wetland Restoration (BA-20)

State Project Number BA-20
Priority Project List 2

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Jefferson Parish

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Operations, Maintenance, and Monitoring Report
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Table of Contents

Preface

The Jonathan Davis Wetland Restoration (BA-20) project was funded through the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) on the 2nd Project Priority List with the Natural Resources Conservation Service (NRCS) as the federal sponsor. The 2014 Operations, Maintenance, & Monitoring (OM&M) report for BA-20 is the third in a series that appends to monitoring data and analyses previously presented in the 2007 and 2011 OM&M reports (Barmore et al. 2007, Hymel and Richard 2011). This report includes monitoring data collected through December 2013 and Annual Maintenance Inspections through 2014. Additional documents pertaining to the BA-20 project may be accessed on the Coastal Protection and Restoration Authority (CPRA) website at http://coastal.la.gov/ resources/library/ .

I. Introduction

The Jonathan Davis Wetland Restoration (BA-20) project is located in Jefferson Parish within the Barataria Basin. The 7,462-acre (3,020 ha) project area is bounded on the north by the Pailet Canal, on the east by LA Hwy 301, on the south by Bayou Perot and Bayou Rigolettes, and on the west by the Gulf Intracoastal Waterway (GIWW) (Figure 1). Overall, 1,393 ac (557 ha) of land were converted to open water between 1945 and 1989 (Coastal Environments Inc. 1991). The average rate of change from marsh to non-marsh (including loss to both open water and commercial development) has increased since the 1940s. Marsh loss rates were 0.56 %/yr between 1939 and 1956, 0.60 %/yr between 1956 and 1974, and 0.73 %/yr between 1983 and 1990 (Dunbar et al. 1992). In the National Biological Survey (NBS) Geographic Information System (GIS) habitat data from 1956, the majority of the area was characterized as fresh marsh (NBS 1994a). However, the 1978 and 1990 data indicated that the area had become more saline. In 1978, 1988, and 1990, the area was classified as primarily intermediate marsh (NBS 1994b; NBS 1994c; Chabreck and Linscombe 1988).

Large-scale factors influencing degradation in the Barataria Basin included subsidence, lack of sedimentation, and reduced freshwater influx due to the levee system on the Mississippi River and its major distributaries. The subsidence rate based on the U.S. Army Corps of Engineers (USACE) tide gauge readings (1947–78) at Bayou Rigaud, Grand Isle, Louisiana, was 0.80 cm/yr (Penland et al. 1989). Although some sediment entered via the GIWW, there were no substantial sources allowing inorganic sediment into the project area. In addition, the increase in oil field canals led to the exportation of indigenous inorganic and organic sediment during storm surges (U.S. Department of Agriculture, Soil Conservation Service 1994).

Additional factors that influenced wetland loss within the project area were increased water exchange, saltwater intrusion, tidal scour, and shoreline erosion along Bayous Perot and Rigolettes (U.S. Department of Agriculture, Soil Conservation Service 1994). Shoreline erosion from 1945 to 1989, caused primarily by wave action along Bayou

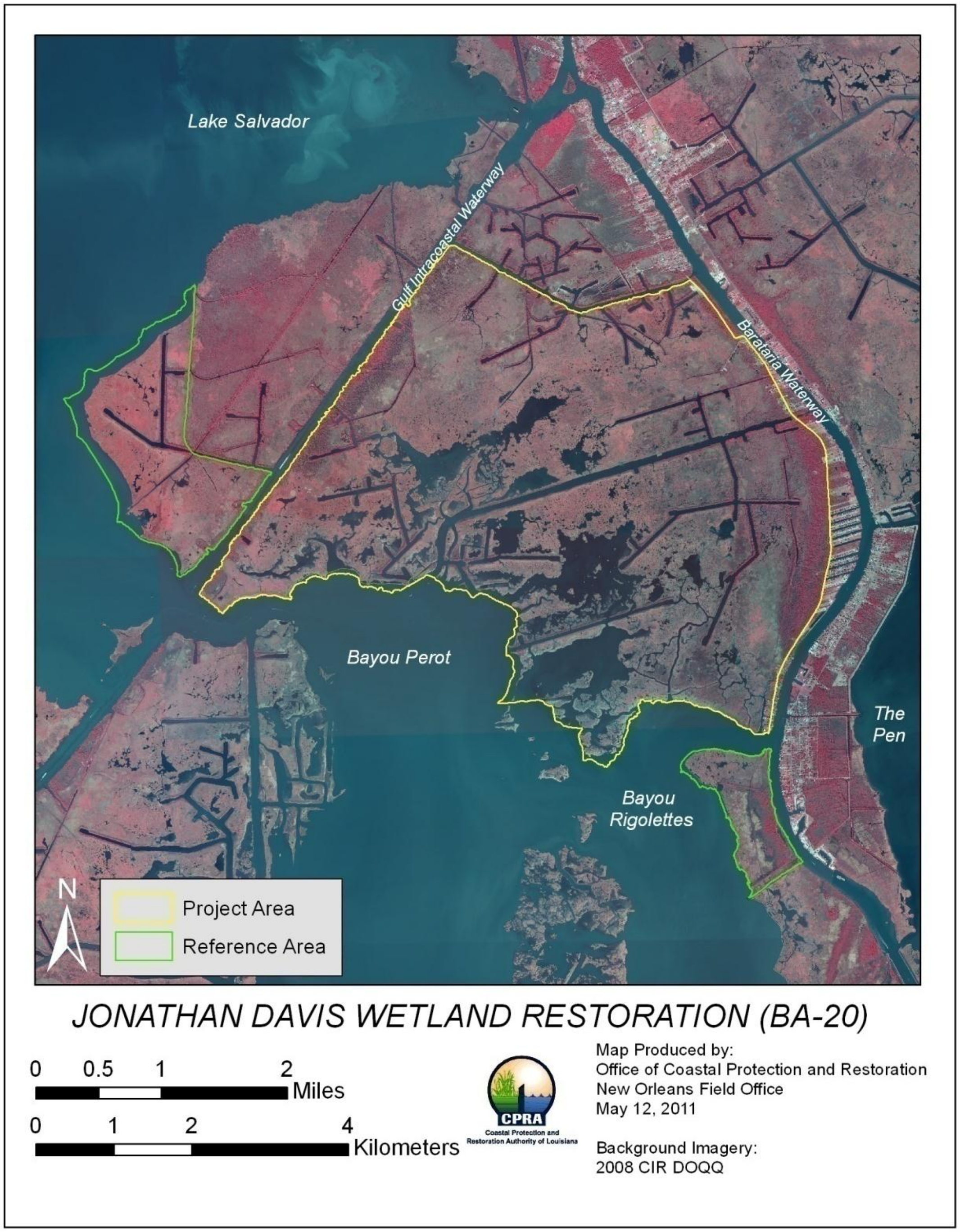


Figure 1. Jonathan Davis Wetland Restoration (BA-20) project and reference areas.

Perot, was measured at 20 ft/yr (6.1 m/yr) (Coastal Environments Inc. 1991). Saltwater intrusion and tidal scour were enhanced during the construction of oil field canals dredged in the 1940s. At the time, oil companies were not responsible for maintaining a continuous spoil bank along canals. The resulting breaches were not repaired and the interior marsh was exposed to increased salinity and tidal flows during storm surges (U.S. Department of Agriculture, Soil Conservation Service 1993).

The objectives of the BA-20 project were to: 1) use structural measures to restore hydrologic conditions that reduce water level and salinity fluctuations (variability) and allow freshwater retention to increase the quantity and quality of emergent vegetation, and 2) reduce wetland loss through hydrologic restoration and reduce erosion through shoreline protection. Constructed project features consist of shoreline protection, rock armored plugs, rock weirs, and sheetpile weirs with boat bays (Figure 2). Construction Unit 1 (CU1), which consists of structures 12, 13, 14, 15, 16, 17, 19, 20, and 21, was completed in September 1998. Construction Unit 2 (CU2), which consists of a weir at site 22 and 3,967 linear feet of rock riprap shoreline protection from structures 20 to 22, was completed in May 2001. Construction Unit 3 (CU3), which consists of 13,088 linear feet of rock riprap shoreline protection from structure 12 extending west to the Gulf Intracoastal Waterway and a smaller portion extending west from CU2, was completed on July 7, 2003. Construction Unit 4 (CU4), which consists of 18,703 linear feet of concrete panel and rock riprap shoreline protection connecting the eastern and western portions of CU3, was completed in 2011. Construction of additional breach armor and rock weir features in the northern project area has been deferred because: 1) the Davis Pond diversion may have transformed these sites into avenues for freshwater (including fine-grain sediments and nutrients) to enter the project area marshes from the north; 2) early attempts to secure land rights were unsuccessful; and 3) these sites did not appear to be causing any significant marsh erosion as a result of water exchange.

II. Maintenance Activity

a. Project Feature Inspection Procedures

An inspection of the Jonathan Davis Wetland Restoration (BA-20) project was held on July 2, 2014, by Barry Richard and Luke Prendergast of CPRA, along with Quin Kinler and Doug Baker of NRCS. Photographs and field notes taken during the inspection are included in Appendices A and B.

The purpose of the annual inspection of the Jonathan Davis Wetland Restoration (BA-20) project is to evaluate the constructed project features, to identify any deficiencies, and to prepare a report detailing the condition of project features and recommended corrective actions needed. Should it be determined that corrective actions are needed, the CPRA shall provide, in the report, a detailed cost estimate

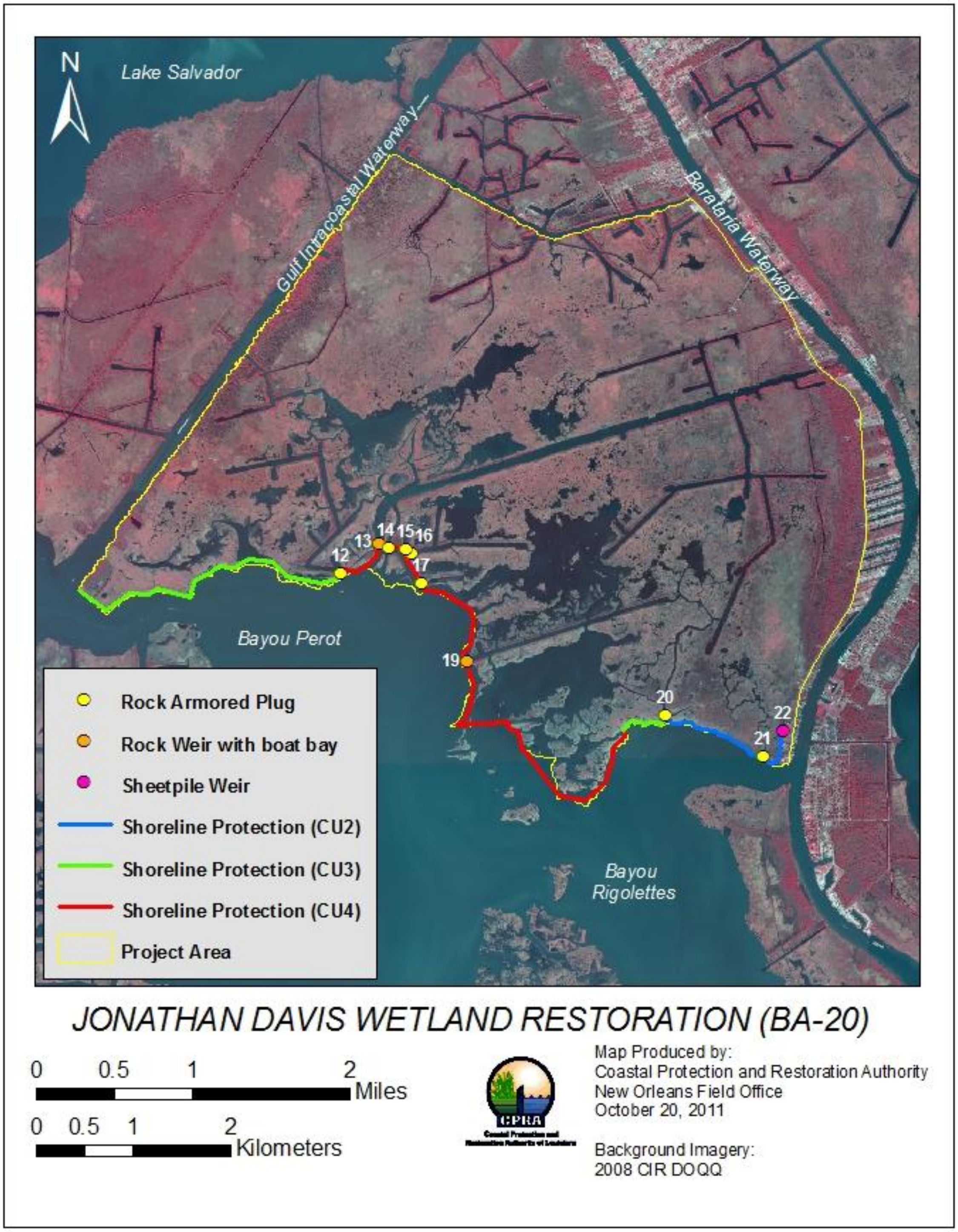


Figure 2. Constructed project features of the Jonathan Davis Wetland Restoration (BA-20) project.

for engineering, design, supervision, inspection, and construction contingencies, and an assessment of the urgency of such repairs (Babin 2002). The annual inspection report also contains a summary of maintenance projects and an estimated projected budget for the upcoming three (3) years for operations, maintenance and rehabilitation. The three (3) year projected operations and maintenance budget is shown in Appendix C.

b. Inspection Results

With the exception of a few locations where individual structures or the rock dike bank stabilization has experienced more rapid settlement, the structures have proven to be very stable. No significant structure maintenance is warranted at this time. Minor sign repair may be needed at a few isolated locations; if this is deemed necessary, CPRA and NRCS will discuss the timing and manner in which these repairs may be accomplished. If more settlement is noticed on a future inspection, then an assessment of needed maintenance will occur at that time.

Construction Unit 1

Structure 12 – Rock rip-rap armored plug

The structure was in good condition; some slight settling was observed. All of the signs and supports were in good condition. No maintenance needs were identified for this location at this time.

Structure 13 – Rock rip-rap armored weir w/ boat bay

Due to the water level and structure settlement, the structure was not visible. Signs and supports were generally in good condition. No maintenance will be required at this time.

Structure 14 – Rock rip-rap armored plug

The rock plug exhibited some minor settlement; however, the overall condition was good. There is currently no need for maintenance on this structure.

Structure 15 – Rock rip-rap weir w/ boat bay

All maintenance has been performed on this structure during construction of Construction Unit 4. The boat bay has been filled and everything was in good condition.

Structure 16 – Rock rip-rap channel plug

Structure 16 was inaccessible due to prolific growth of emergent vegetation in front of the structure. It is assumed that this structure has stabilized due to the conditions of the channel and the structure signage. No maintenance work is recommended at this time.

Structure 17 – Rock rip-rap channel plug

The structure was in good condition; no maintenance needs were identified here during the inspection.

Structure 19 – Rock rip-rap weir w/ boat bay

Structure 19 appeared to be in good condition. The tides and settlement prevented us from viewing the entire structure. The warning signs and supports were also in good condition. NRCS and CPRA agreed that this structure will not require maintenance at this time.

Structure 20 – Rock rip-rap armored plug

The structure appeared to be in good condition with no signs of settlement of the rock plug. The warning signs and supports were also in good condition. The structure was heavily vegetated at the time of inspection. NRCS and OCPR agree that this structure will not require maintenance.

Structure No. 21 – Rock rip-rap armored plug

The rock armored plug appeared to be in good condition with slight settlement on the east side of the structure. This was hard to fully assess due to the amount of vegetation on the structure. CPRA and NRCS agreed that the structure will not require maintenance at this time.

Construction Unit 2

Structure 22 A – Canal bank stabilization

The structure appeared to be in good condition, with little to no sign of settlement. Heavy vegetation growth was observed. The CPRA and NRCS agree that maintenance of this structure is not needed at this time.

Structure 22 – Steel sheet pile weir w/ boat bay

The structure appeared to be in good condition along with the signs, supports, and sheet pile caps. No maintenance requirements were identified at this location during the inspection.

Bayou Rigolettes Bank Stabilization

The rock dike along the northern shore of Bayou Rigolettes appears to be in good condition. There is some noticeable settlement near the western end of this feature, but the structure appears to be providing bank protection. Any maintenance work required will be completed in a future maintenance event.

Construction Unit 3

Bayou Perot Bank Stabilization

The Bayou Perot Bank Stabilization is in good condition. There was some erosion noticed at the westernmost portion of the West Reach of the structure. This will continue to be monitored. It is agreed that some maintenance work is needed for this structure during a future maintenance event.

Construction Unit 4

Concrete Panel Wall Shoreline Protection

The concrete panel wall sections along the north end of Bayou Perot and Bayou Rigolettes were in good condition. There was no observed damage to the concrete panels, piles, or stainless steel fastening hardware. Warning signs and support piles were also in generally good condition.

c. Maintenance Recommendations

There is no need for any maintenance activity at this time.

- **i. Immediate/ Emergency Repairs**
  None at this time.

- **ii. Programmatic/ Routine Repairs**
  Continue to monitor the condition of all structures.

d. Maintenance History

On January 30, 2002, Stone Energy Corporation was issued a Coastal Use Permit to plug and abandon existing wells within the Jonathan Davis Wetland Restoration project. This work was completed on 7/18/02 and consisted of removing and replacing structures 13 & 19 and to plug and abandon several existing wells located behind these structures. The cost associated with removing and replacing these structures was incurred entirely by Stone Energy Corporation. However, at the request of NRCS, CPRA was required to provide inspection services for this project. CPRA obtained the services of GSE Associates, Inc. to inspect construction activities and prepare a project completion report and as-built drawings. These services were performed for a total cost of $9,394.13.

As part of the construction documents prepared by NRCS for this project, Stone Energy Corporation was required to reconstruct structure 13, increasing the boat bay crest from 50’ to 100’ in width and raising the crest elevation from -5.0’ NGVD to -2.5’ NGVD.

As part of work for Construction Unit 4, maintenance was performed on structures 14, 15, and 17. Due to the location and activity of a pipeline in the vicinity of Structure 16, no work was performed there. However, due to the location and infilling in front of Structure 16, no work was required.

III. Operation Activity

There are no operations activities associated with the BA-20 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 BA-20 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. There are two CRMS sites located in the BA-20 project area, CRMS3985 and CRMS4245, which will be used to supplement existing project-specific data to further evaluate the effectiveness of the project. Further information on data collection methods at the CRMS sites can be obtained in Folse et al. 2012.

a. Monitoring Goals

The following measurable goals were established to evaluate the effectiveness of the project:

1. Reduce rate of emergent marsh loss.

2. Decrease variability in salinity within the project area.

3. Decrease variability in water level within the project area.

4. Stabilize or increase relative abundance of intermediate-to-fresh marsh plant species.

5. Reduce marsh edge erosion rate along southern project boundary.

b. Monitoring Elements

The following monitoring elements will provide the information necessary to evaluate the goals listed above. A timeline of data collection events associated with these monitoring elements is shown in Figure 3 along with completion dates of the four construction units (CU's).

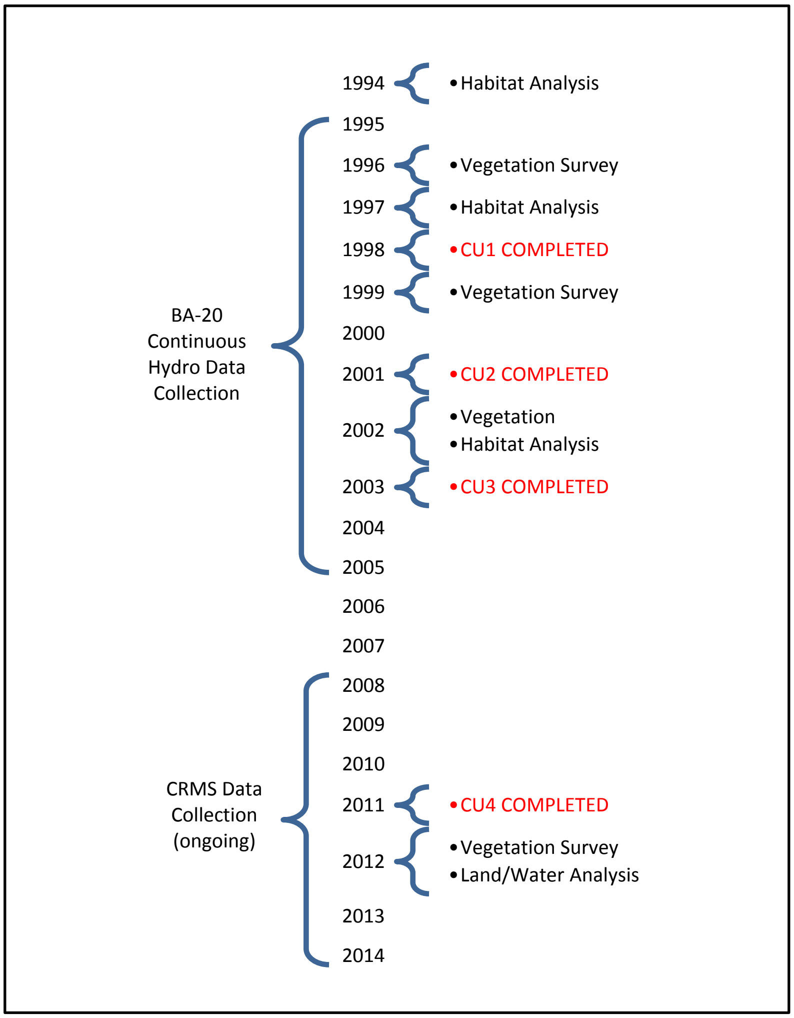


Figure 3. Timeline of monitoring and construction events associated with the Jonathan Davis Wetland Restoration (BA-20) project from 1994 to 2014.

Aerial Photography

Near-vertical, color-infrared aerial photography (1:12,000 scale, with ground control markers) was acquired and analyzed for marsh to open-water ratios and changes in habitat type within the project and reference areas in 1994, 1997, and 2002 (Steyer et al. 1995, revised 2000). In 2012, land to water ratios within the project and reference areas were derived from digital imagery with 1-meter resolution, acquired in October 2012 through the CRMS program. Although the original monitoring plan stated that habitat analyses would be conducted, these were changed to land/water analyses upon the implementation of CRMS in 2003. The implementation plan of CRMS included a review of monitoring efforts on currently constructed CWPPRA projects, which concluded that habitat analyses on these projects should be converted to land/water analyses. In addition to the BA-20 analyses of the project area, land change has also been evaluated at the two 1-km^2 CRMS sites within the project area, CRMS3985 and CRMS4245, between 1985–2010 using Landsat Thematic Mapper (TM) data (Couvillion et al. 2011).

Salinity

Salinity was sampled hourly using continuous recorders at three locations within the project area and at three reference sites (Figure 4) using methods described in Folse et al. 2012. The continuous recorder at each site was mounted on a wooden post in open water with sufficient water depths to inundate the recorder year round. Each continuous recorder station was serviced approximately once every month to clean and calibrate the recorder and to download the data. During processing, the data were examined for accuracy and loaded to the CPRA database, and are available for download from the CRMS website (http://www.lacoast.gov/crms2). Salinity was also sampled monthly at 17 discrete stations using a salinometer (Figure 5). Discrete data were used in concert with continuous salinity data to characterize the spatial variation of salinity throughout the project and reference areas.

Salinity monitoring began in December 1995 and ended in January 2005. A decision was made in September 2002 not to rebuild the northern reference station, BA20-91R, after it was damaged because the northern project features were not being constructed. Salinity monitoring also ended prematurely at BA20-90R in November 2003 because the station was destroyed. Hourly salinity data has also been collected at two CRMS stations, CRMS3985 and CRMS4245, from May 2008 to present (Figure 4).

Water Level

Water levels were also measured hourly at the continuous recorder stations using methods described in Folse et al. 2012 (Figure 4). A staff gauge was installed

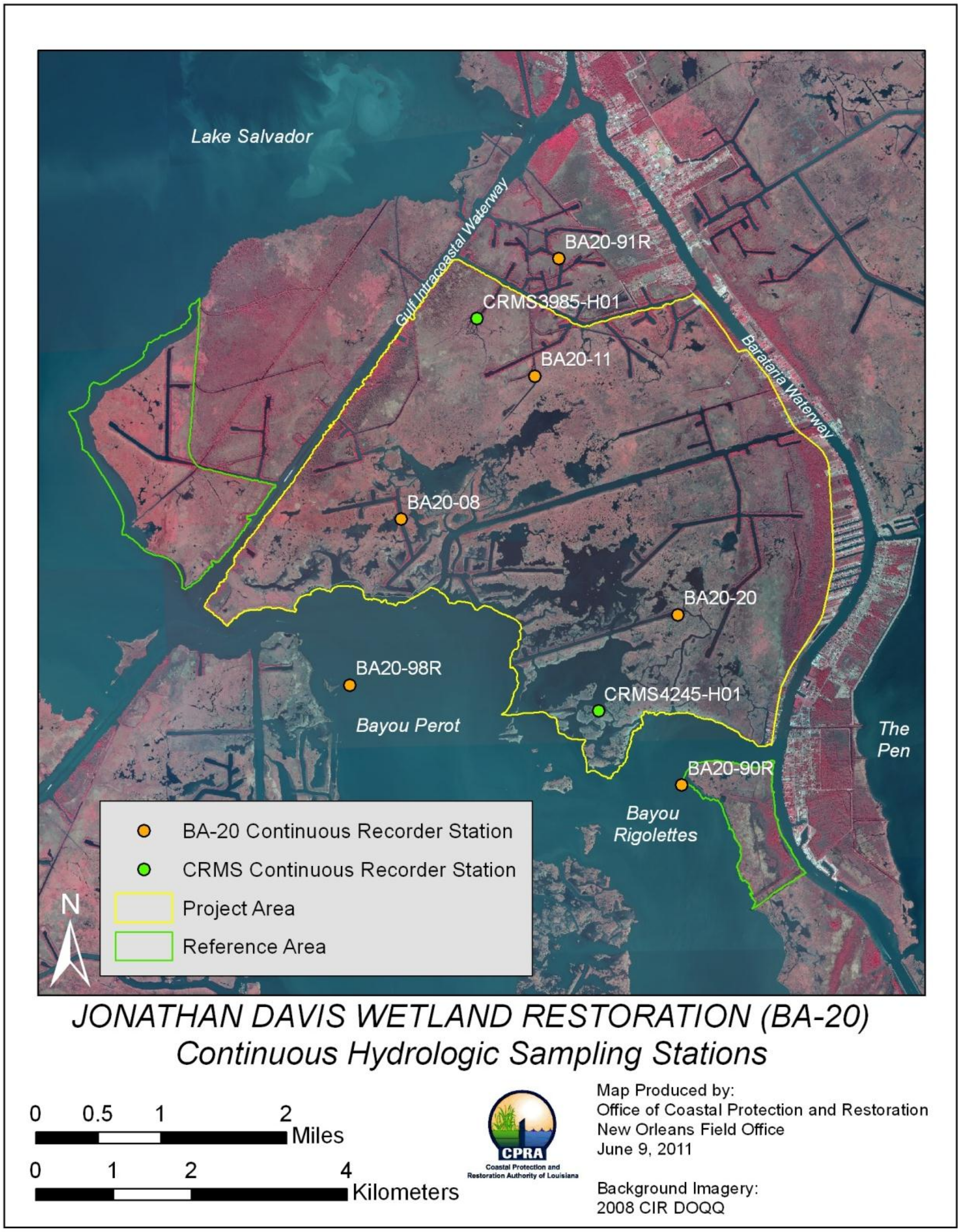


Figure 4. Continuous hydrologic recorder stations associated with the Jonathan Davis Wetland Restoration (BA-20) project.

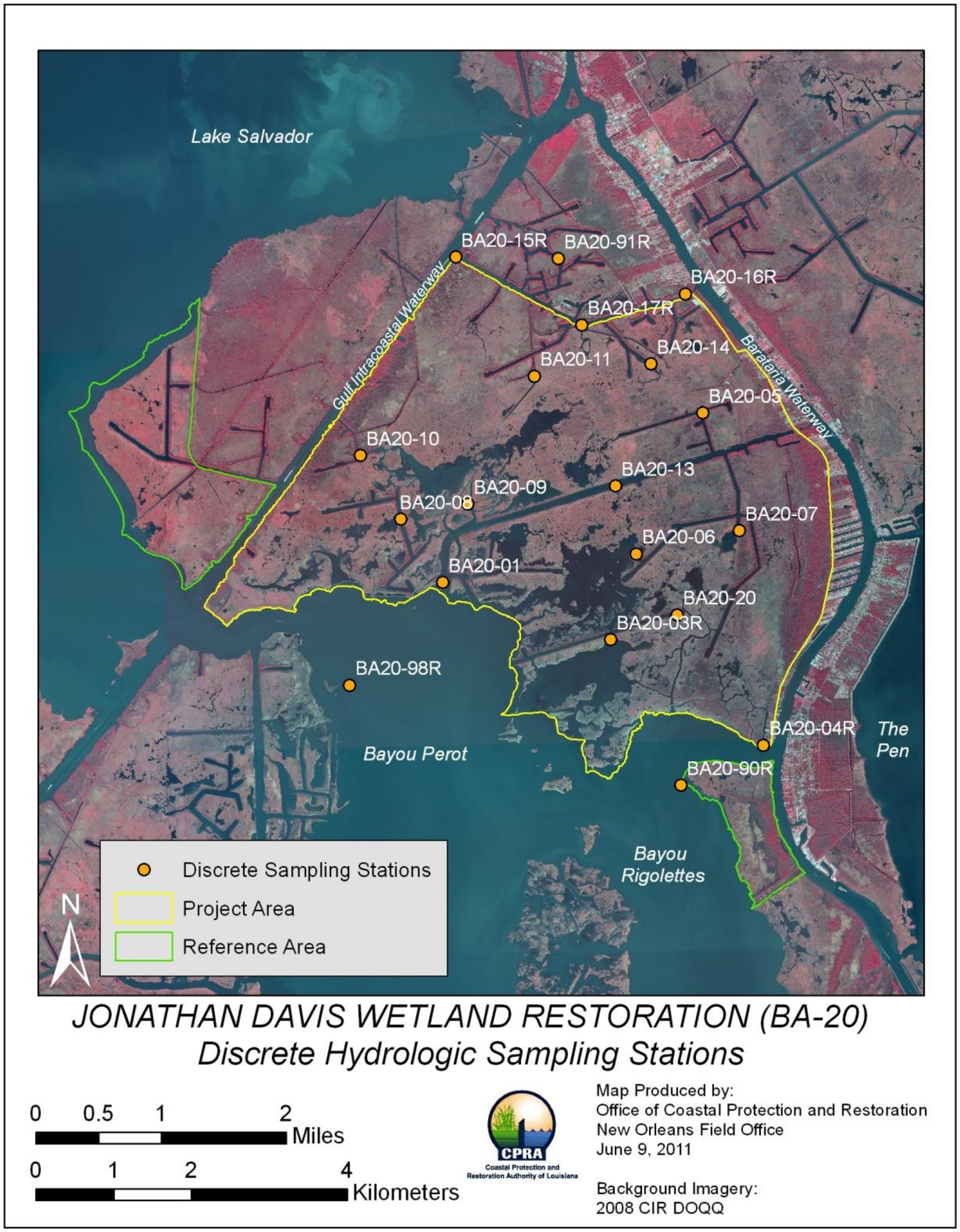


Figure 5. Discrete hydrologic sampling stations associated with the Jonathan Davis Wetland Restoration (BA-20) project.

next to each continuous recorder to compare recorded water levels to a known datum (NAVD88). Water level (ft NAVD88) is available from November 1997 to January 2005 at the sites within the project area. Water level data are not available past 2003 at BA20-90R and BA20-98R due to station damage and survey issues, which affected the length of post-construction analysis period. Hourly water level data has also been collected at two CRMS stations, CRMS3985 and CRMS4245, from May 2008 to present (Figure 4).

Shoreline Change

To evaluate shoreline change, a sub-meter Differential Global Positional Satellite (DGPS) system was used to document the position of the vegetated marsh edge in 2001, 2004, 2010, and 2012. The shoreline position was documented by manually taking a DGPS point every 5 to 10 feet along the vegetated edge of CU2 (as-built) and the eastern reference area in 2001 and of CU2 and CU3 (as-built) in 2004. Subsequently, shoreline position has been documented by continuously logging points every 1 second along the vegetated edge in 2010 (CU2 and CU3) and 2012 (CU4 as-built). GPS receiver settings were configured to use real time correction, and data were post-processed in order to achieve sub-meter accuracy. The eastern reference area has not been resurveyed since 2001 because it is now part of the Barataria Landbridge Shoreline Protection Project, Phase 4 (BA-27d) and has been protected with rock revetment since 2006. Shoreline position will be documented again at CU2, CU3, and CU4 in 2015.

Vegetation

Emergent marsh vegetation sampling stations were established in the project area along five transects running parallel to the GIWW (Figure 6). Stations were located along these transects at 0.8-km increments for a total of 27 stations within the project area. Four transects were established in the two reference areas yielding ten reference stations. Species composition, percent cover, and relative abundance were evaluated within 4-m^2 plots using a modified Braun-Blanquet sampling method (Mueller-Dombois and Ellenberg 1974) in 1996, 1999, 2002, and 2012. Emergent marsh vegetation was also sampled at two CRMS sites (CRMS3985 and CRMS4245) within the project area in 2008, 2009, and 2010, and will continue to be sampled annually. At each CRMS site, ten 2-m^2 sampling plots were randomly located along a 288-m transect and were sampled using the same method described above.

Percent coverage data from the BA-20 stations and CRMS stations were summarized according to the Floristic Quality Index (FQI) method utilized by CRMS (Cretini et al. 2011), where cover is qualified by scoring species according to their tolerance to disturbance and stability within specific habitat types.

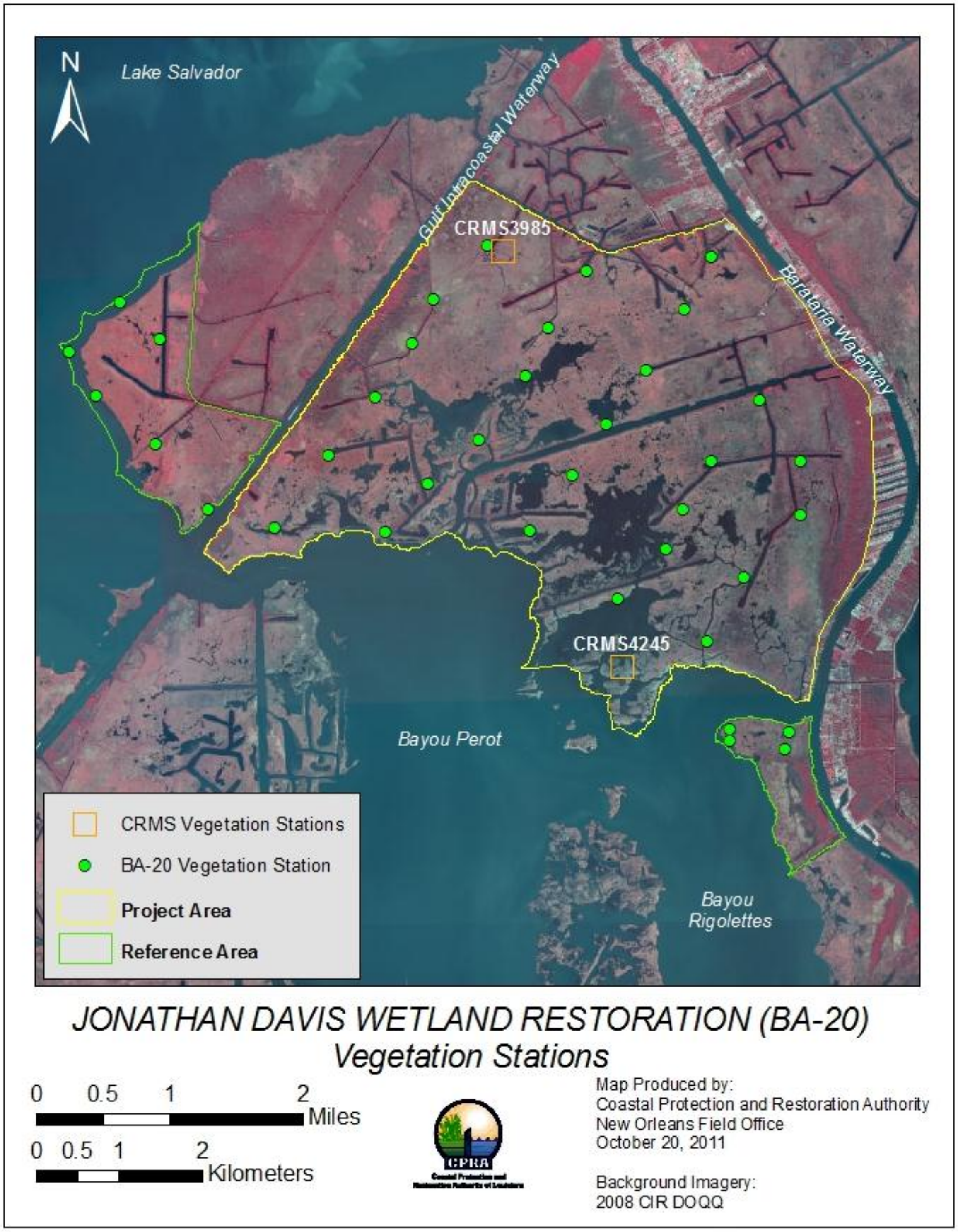


Figure 6. Vegetation stations within the Jonathan Davis Wetland Restoration (BA-20) project and reference areas.

c. Monitoring Results and Discussion

i. Aerial Photography

Habitat analyses of photography obtained in 1994, 1997, 2002, and a land/water analysis from 2012 are presented in Figures 7 through 10 with the caveat that the analyses should be used only for predicting trends. Recent and ongoing work by the U.S. Geological Survey (USGS) (John Barras and others) has revealed considerable variability in habitat and land:water classifications due to 1) clarity of image; 2) water level at time image was taken; 3) seasonality; 4) difficulty in distinguishing submerged, floating, and emergent vegetation; and 5) in the case of floating marshes, variable mat buoyancy and frequent vegetative changes. Photography was always acquired in fall to early winter which adjusts for some seasonality differences. However, floating marsh has been confirmed to exist in the BA-20 project area, particularly in the southern project area around CRMS4245, which may introduce additional error in acreage calculations.

One of the specific monitoring goals of the project was to reduce the rate of emergent marsh loss within the project area. The 1994 and 1997 analyses both occurred during the pre-construction period and the only construction unit which may have impacted the 2002 habitat analysis was CU1, which was constructed in September 1998 (Figure 3). All construction units were completed by the time of the 2012 land/water analysis; however, CU4 was completed only one year before. Trends were compared between the project and reference areas from 1997 to 2012 (Figure 11, Table 1). Land change for each sample year was expressed as a percent of the total acreage to account for the difference in size between project and reference areas. The 1994 analysis was excluded from the project/reference comparison because the 1994 photography did not cover the entire boundary of the reference areas.

Proportionally, the greatest land loss occurred in Reference Area 1 during both time periods, 1997-2002 and 2002-2012 (Figure 11, Table 1). Overall, from 1997 to 2012 the project area lost 3.2% of its total acreage (16 acres/yr), while Reference Area 1 lost 16.7% (11 acres/yr). Greater land loss occurred in Reference Area 1 from 2002 to 2012 (11.1%), a period in which the area was impacted by several high energy storms. During some of this period (2002-2012) the project area was receiving protective effects from shoreline protection structures associated with CU's 2 and 3. It is visually evident in the 2012 land/water analysis (Figure 10) that much of the loss in Reference Area 1 between 2002 and 2012 was due to shoreline erosion and less to interior loss. Although the land loss rate in the project area was higher from 2002 to 2012 than during the earlier period, the significant loss within Reference Area 2 from 2002 to 2012 implies that the project area loss may have been greater if the shoreline protection structures had not been in place. Reference Area 2, which was protected with rock riprap shoreline protection in 2006 through the Barataria Landbridge

Shoreline Protection project (BA-27) shows a similar, but slightly lower, land loss trend than the project area (Figure 11). In summary, it appears that the goal of reducing the rate of land loss in the project area was achieved primarily due to the installation of the shoreline protection structures.

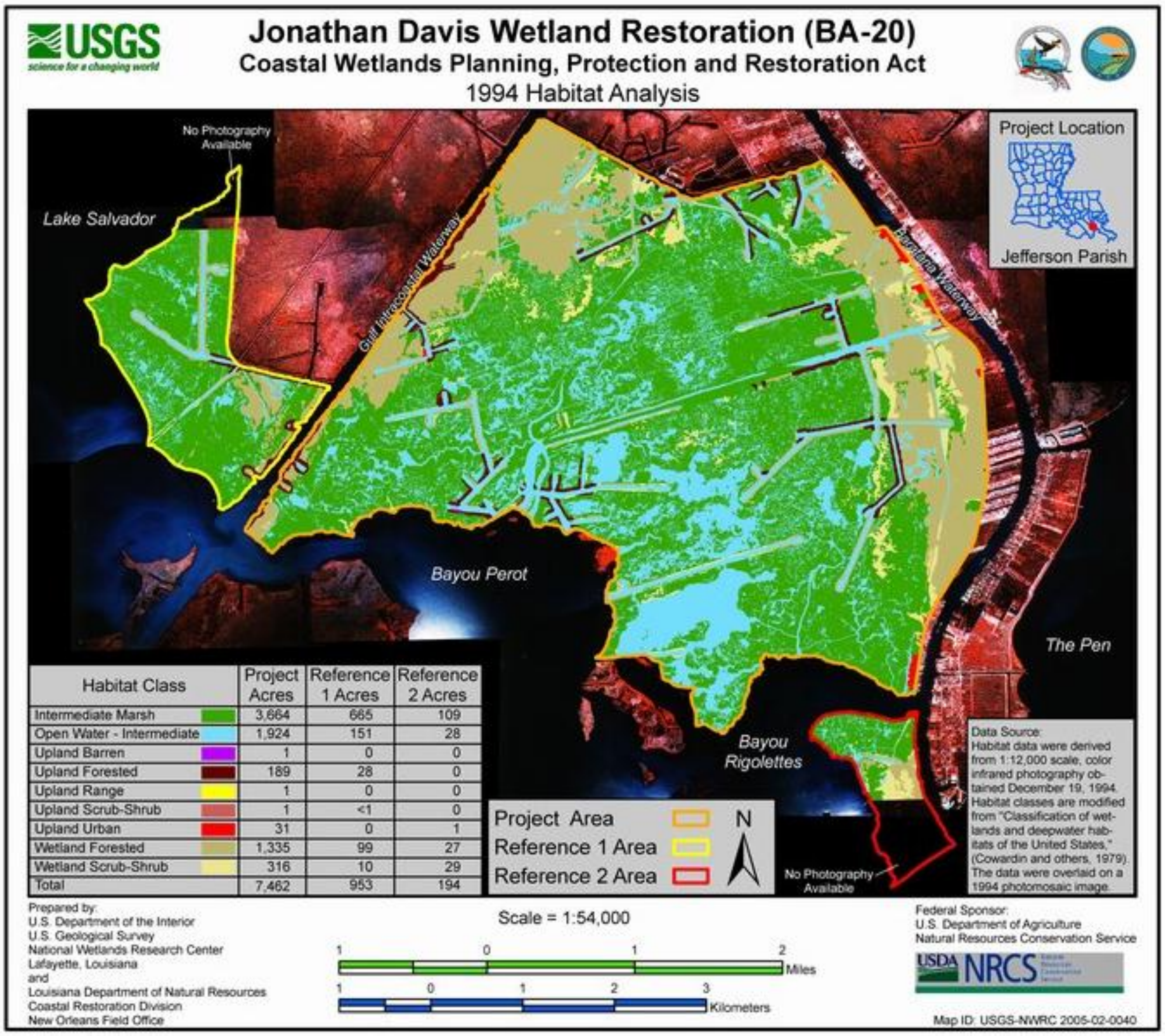


Figure 7. 1994 habitat analysis of the Jonathan Davis Wetland Restoration (BA-20) project and reference areas.

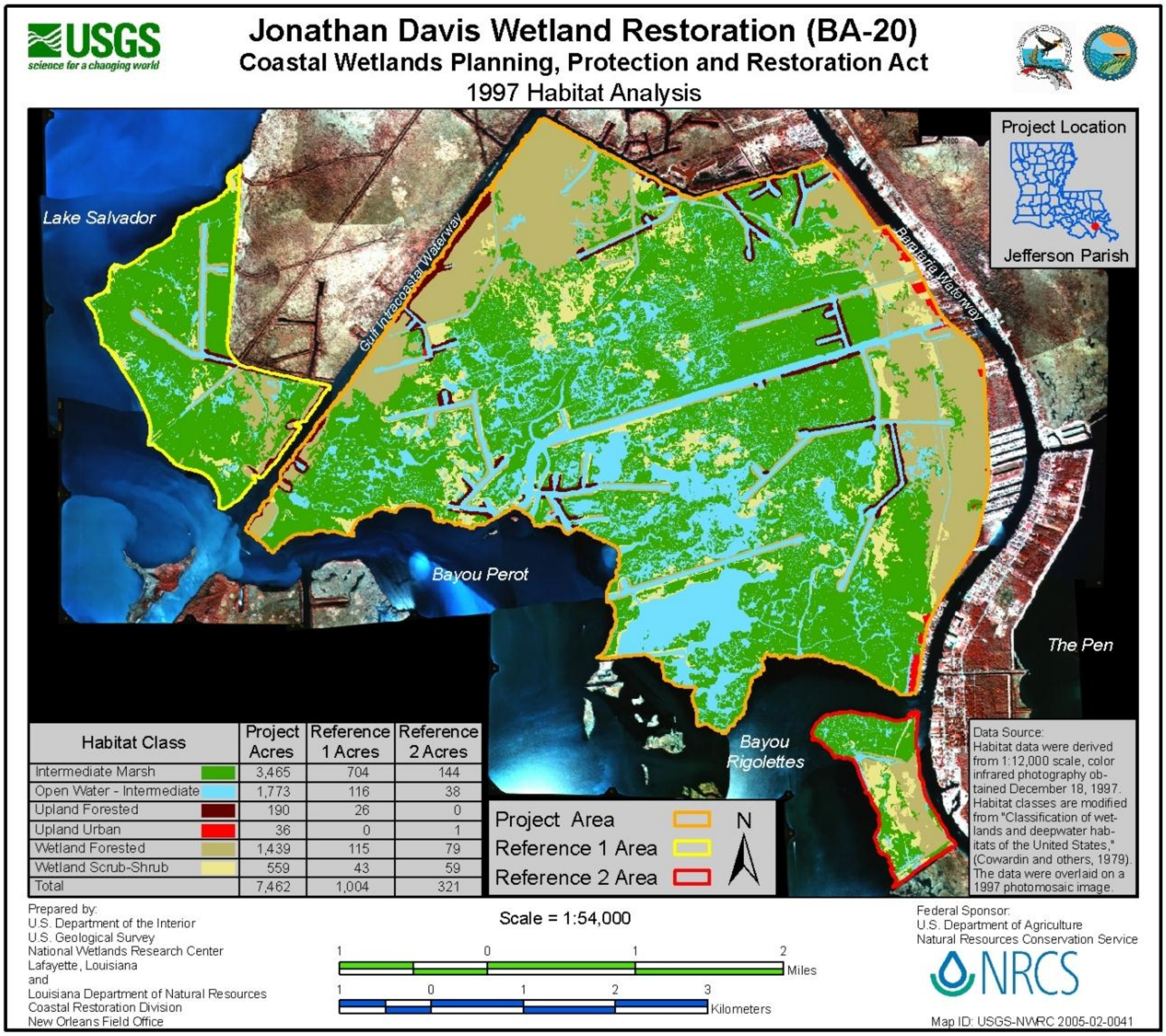


Figure 8. 1997 habitat analysis of the Jonathan Davis Wetland Restoration (BA-20) project and reference areas.

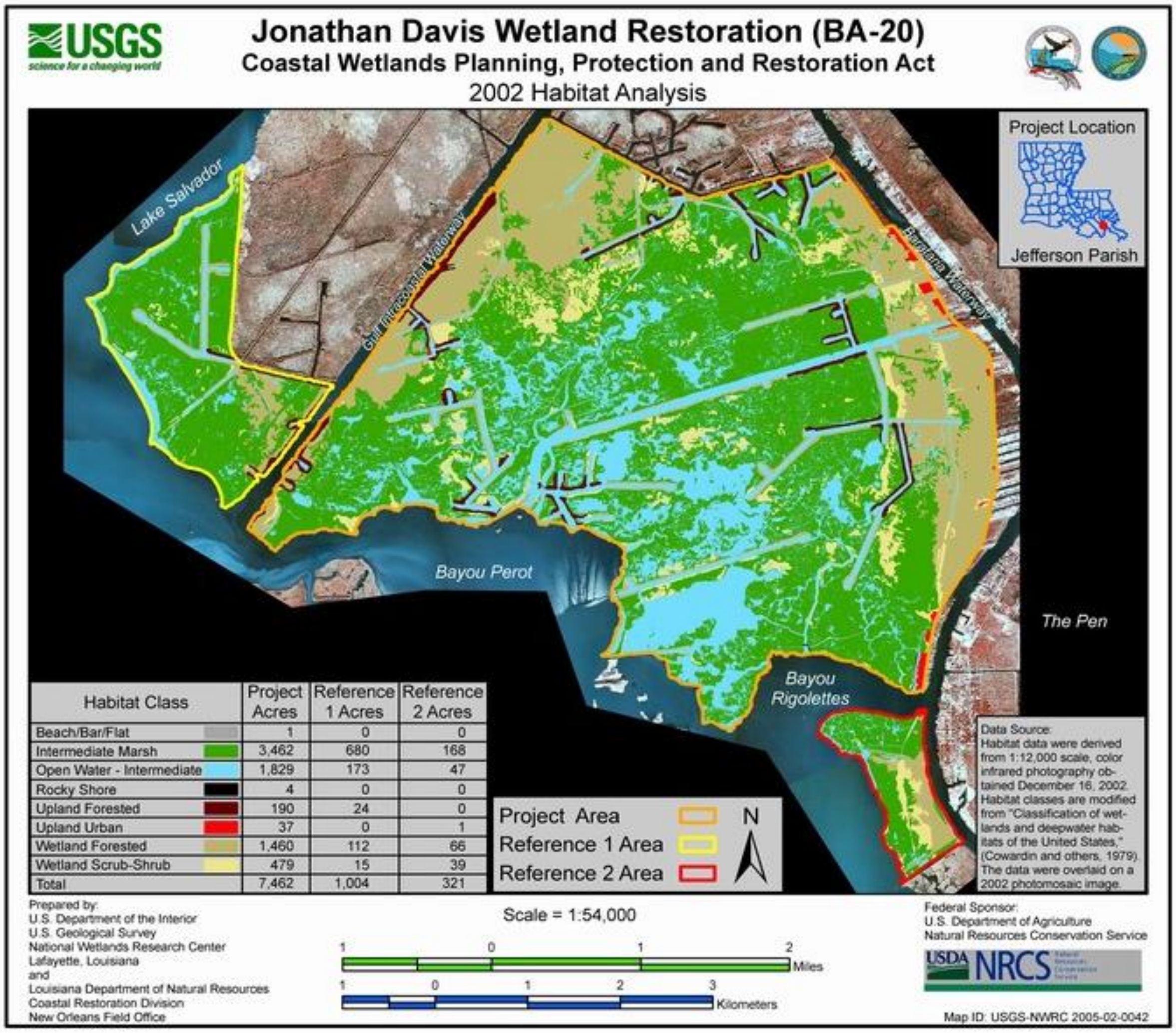
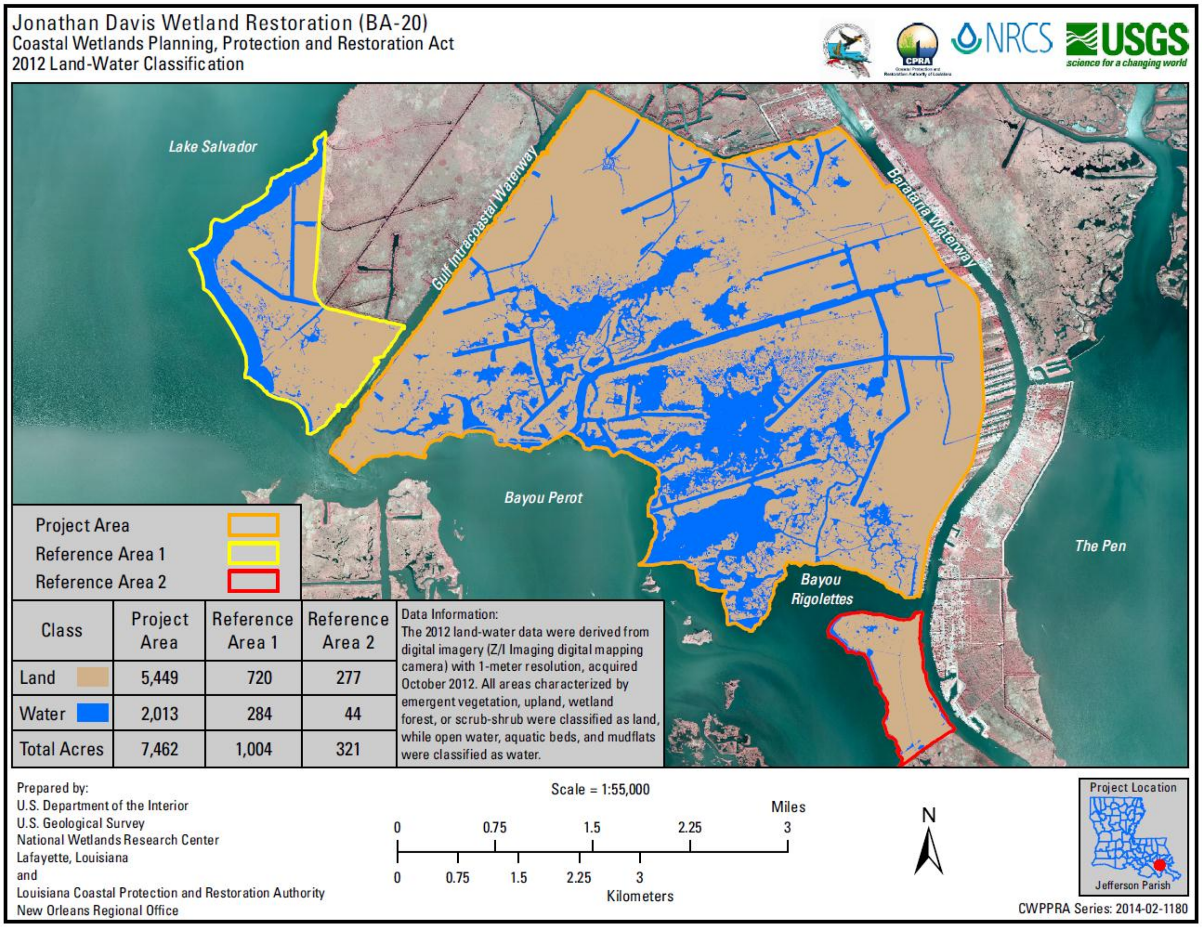


Figure 9. 2002 habitat analysis of the Jonathan Davis Wetland Restoration (BA-20) project and reference areas.



Class	Project Area	Reference Area 1	Reference Area 2
Land	5,449	720	277
Water	2,013	284	44
Total Acres	7,462	1,004	321

Figure 10. 2012 land-water analysis of the Jonathan Davis Wetland Restoration (BA-20) project and reference areas.

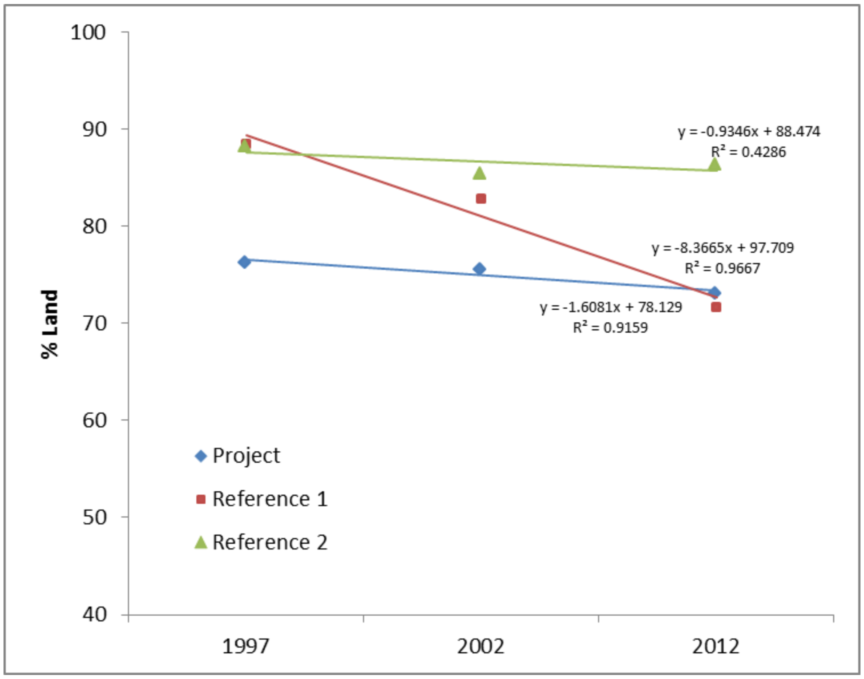


Figure 11. Trends in % land change within the Jonathan Davis Wetland Restoration project and reference areas from 1997 to 2012.

Table 1. Land acreage changes within the Jonathan Davis Wetland Restoration (BA-20) project and reference areas from 1994 to 2012.

Habitat Class	**Project Area**			**Ref Area 1**			**Ref Area 2**		
	Land Change (ac)	% Total Acreage Gained/ Lost	Change Rate (ac/yr)	Land Change (ac)	% Total Acreage Gained/ Lost	Change Rate (ac/yr)	Land Change (ac)	% Total Acreage Gained/ Lost	Change Rate (ac/yr)
1994-1997 (Pre-construction)	+151	+2.0%	+50	--	--	--	--	--	--
1997-2002 (Post CU1/CU2)	-57	-0.8%	-11	-57	-5.7%	-11	-9	-2.8%	-2
2002-2012 (Post CU4)	-183	-2.5%	-18	-111	-11.1%	-11	+3	+0.9%	+0.3
Overall (1997-2012)	-240	-3.2%	-16	-168	-16.7%	-11	-6	-1.9%	-0.4

ii. Salinity

Hourly salinity data was collected at the BA-20 continuous recorder stations (Figure 4) from December 1995 to January 2005, and has been collected at CRMS3985 and CRMS4245 from May 2008 to present (Figure 12). Monthly mean salinity at the different recorder stations displayed similar responses to seasonal influences and storm events. Salinity at BA20-90R was generally higher than salinity at the other project and reference stations. Salinity spikes resulted from several tropical events including Tropical Storm Frances/Hurricane George in 1998, and Hurricanes Gustave and Ike in 2008, but were generally not prolonged. A prolonged drought occurred from late 1999 through late 2000 with all stations experiencing elevated salinities during most of this period. A slight negative trend in daily mean salinity over time was observed in the project area using an average of stations BA20-11, BA20-20, CRMS3985 and CRMS4245 after removing the extreme drought period and Hurricanes Gustav, Ike and Isaac (Figure 13).

Delayed and staggered construction of the project features led to challenges in testing for project impacts on salinity levels. Construction of CU1, consisting of several rock weirs and plugs in the southwestern region of the project area (Figure 2), was finished in September 1998, while construction of CU2, consisting of a sheetpile weir and shoreline protection in the southeastern region of the project area, was not finished until May 2001. For this reason, separate tests were conducted on the eastern (BA20-20 vs BA20-90R) and western (BA20-08 vs BA20-98R) regions of the project area, each with separate, relative pre/post-construction units. CU3 was not completed until July 2003 and was not included in the salinity analysis.

The analysis of the western region (CU1: BA20-08 vs BA20-98R) had a pre-construction period from December 1995 to September 1998 and a post-construction period from October 1998 to January 2005. The analysis of the eastern region (CU2: BA20-20 vs BA20-90R) had a pre-construction period from December 1995 to May 2001 and a post-construction period from June 2001 to November 2003 (due to the loss of BA20-90R). A third analysis tested the southern project area as a whole by comparing three stages of construction: pre-construction (December 1995 – September 1998), during-construction (October 1998 – May 2001), and post-construction (June 2001 – January 2005). It should be noted that the drought period occurred during the ‘during-construction’ period and it would be expected that mean salinities would be highest during that time (Figure 14). However, one of the statistical assumptions would be that the drought is affecting all stations equally.

A special note must be made about BA20-11 and BA20-91R, which were located in the northern portion of the project area (Figure 4). The original project

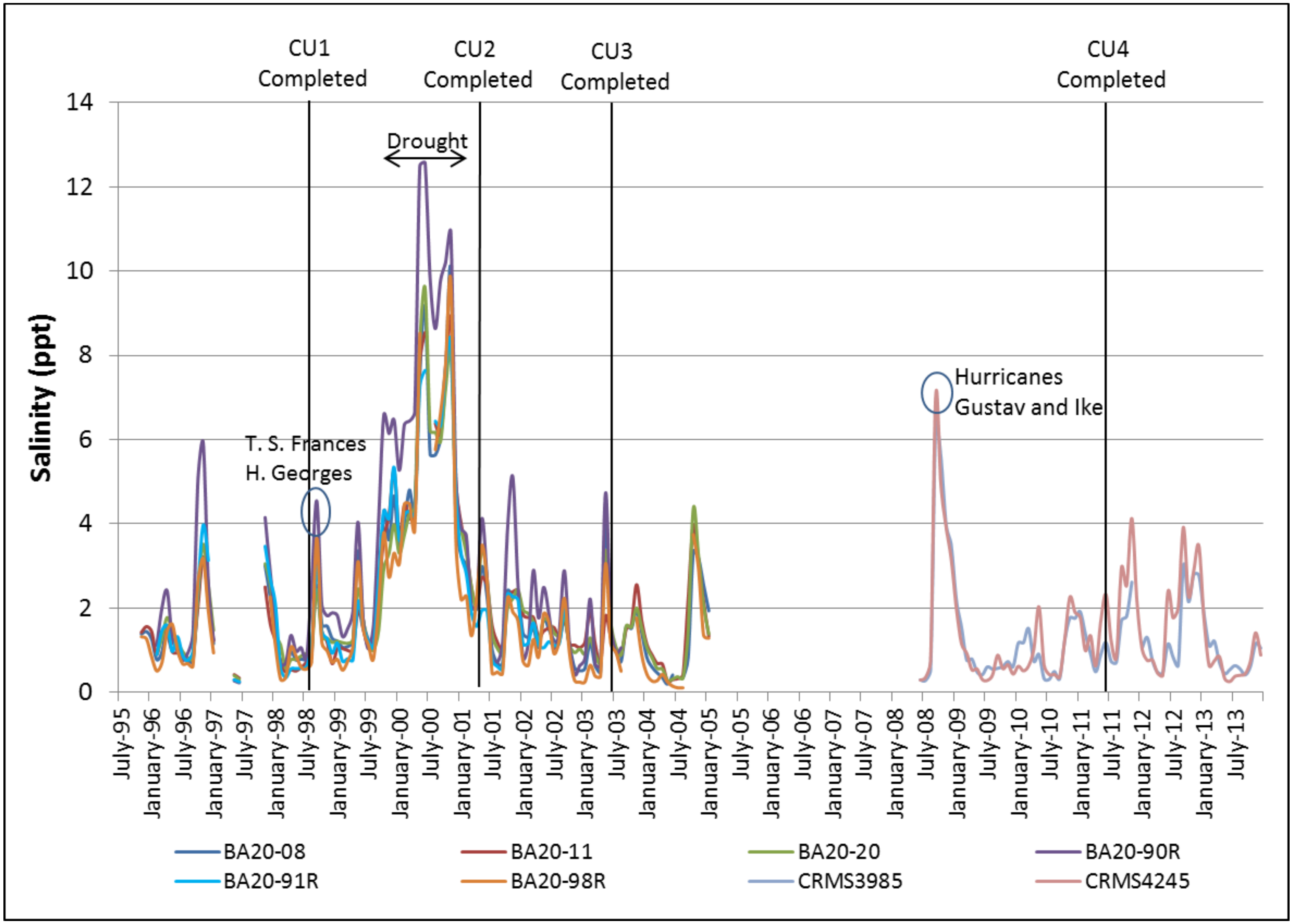


Figure 12. Monthly mean salinity data for all BA-20 and CRMS continuous recorder stations from 1995 through 2013.

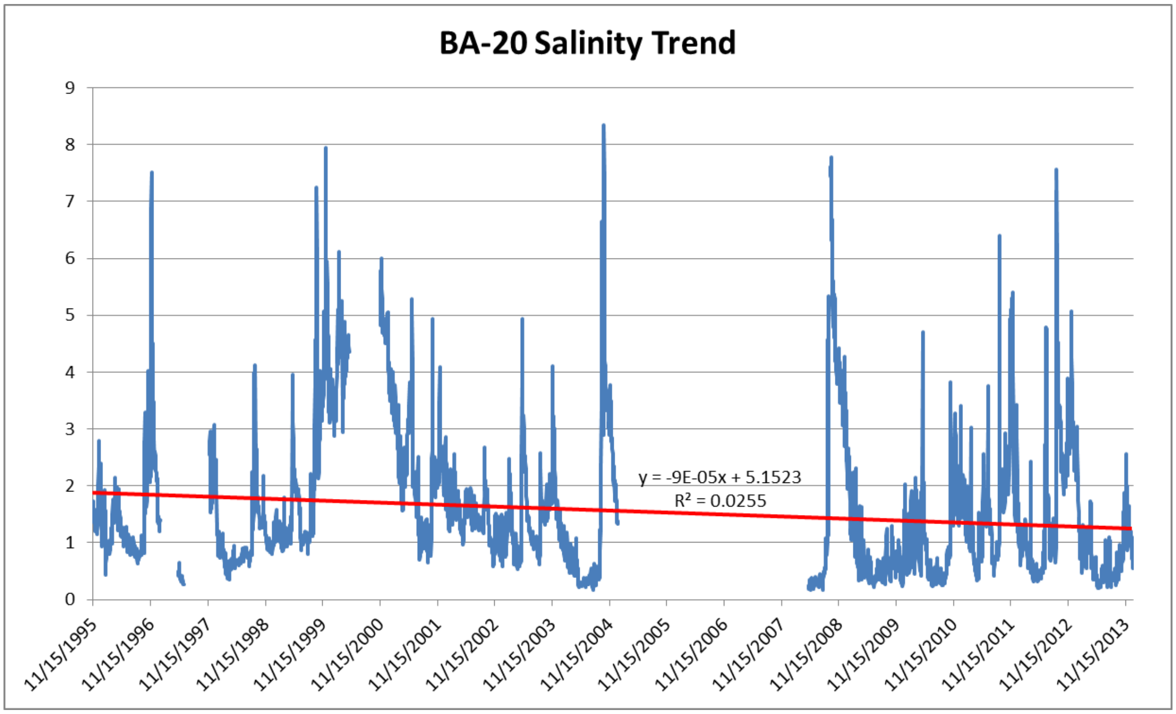


Figure 13. Trend in daily mean salinity within the BA-20 project area using BA20-11/BA20-20 (1995 to 2005) and CRMS3985/CRMS4245 (2008 to 2013). The extreme drought period in mid to late 2000 was removed, as well as Hurricanes Gustav, Ike, and Isaac.

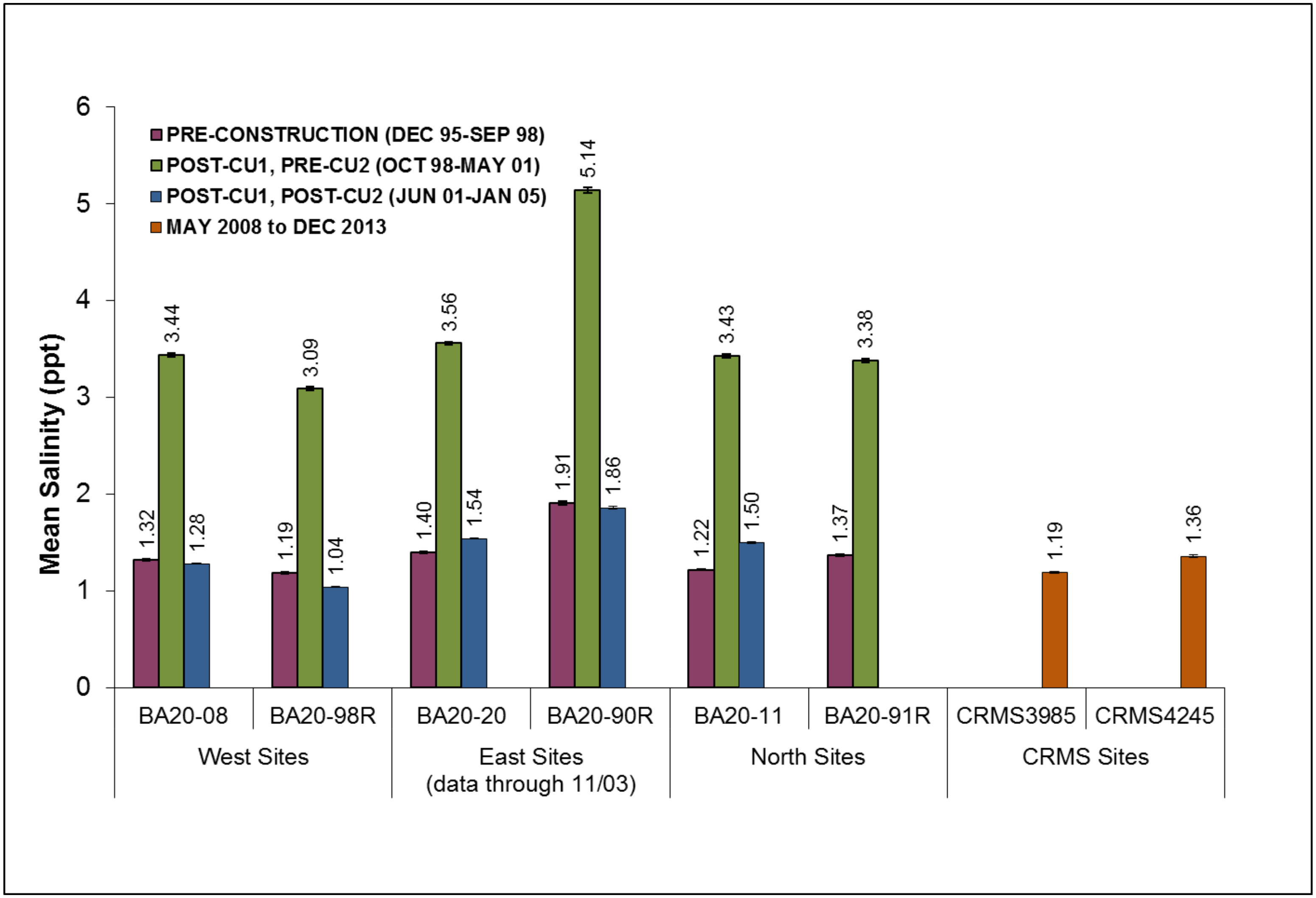


Figure 14. Mean salinity at each BA-20 continuous recorder station during different periods of construction and at each CRMS station from 2008 to 2013 calculated from hourly salinity readings.

specifications included plans for eight weir/breach armor structures in the northern area; however these structures were never built in order to allow sufficient ingress of water from the Davis Pond Diversion to the north. Because there are no structures between the project station (BA20-11) and the reference area station (BA20-91R), there is no reason to expect an environmental effect as a result of the project. Therefore, these stations were excluded from the salinity analyses.

The east and west analyses compared salinity between the pre- and post-construction periods using paired project and reference stations. The statistical model followed a 2X2 BACI factorial analysis of variance (ANOVA) in which a statistically significant interaction between the main effects (*period* and *location*) provides evidence for a project impact (Stewart-Oaten et al. (1986), Underwood (1994), and Smith (2002)). The third, overall analysis tested for impact using a 3X2 BACI ANOVA in which the variable *period* had three levels: pre-construction, during-construction, and post-construction. The statistical models depend on simultaneity of measurements among the various stations. For this reason, hourly salinity measurements were aggregated into weekly means, one week being enough time to average out temporal lags among the stations during tidal and meteorological events. Another advantage to using weekly means (versus hourly means) is that they exhibit less serial correlation, i.e., greater sample independence, which is an important underlying assumption of the statistical model. The hourly salinity measurements were first transformed into common logarithms in order to meet assumptions of normal distribution and uniform variance, and then aggregated into weekly means on which the statistics are based. The analyses were run using Proc GLM in SAS© Version 9 with *period* and *location* as fixed effects.

In the eastern project area, the '*period x location'* interaction showed a statistically significant impact (p=.0035) of the project on mean weekly salinity levels. This shows up graphically as lines out of parallel in Figure 15, which shows that salinity decreased slightly more at the reference station, BA20-90R, in the post-CU2 period than it did inside the project, a 51% and 42% reduction, respectively. The statistical significance reflects the size of the data set, not the size of the impact, which was modest, amounting to a difference of about one part per thousand from what would be expected if there were no impact. Although this was not the desired outcome, it should be noted that pre-construction salinity was already lower in the project area, and in order to see the same reduction as observed in the reference area, the salinity would have had to decrease to almost 0.5 ppt. In terms of percent reduction, the salinity would only have needed to decrease to 1.3 ppt in the project area to experience the same percent reduction as the reference area. The actual post-CU2 salinity in the project area was near that target at 1.5 ppt.

The western project area also experienced a slightly significant impact (*p*=.0355) of the project on mean weekly salinity levels at BA20-08. This shows up graphically as lines out of parallel in Figure 16, which shows that salinity increased slightly more in the project area in the post-CU1 period. Salinity increased by 71% and 60% in the project and reference areas, respectively. Again, the statistical significance corresponds to an impact with only modest biological significance, a departure of less than one part per thousand from what would be expected had there been no impact. It should be noted that the drought occurred during the pre-construction period for the eastern analysis and during the post-construction for the western analysis. The effects of the drought on salinity were extreme (Figures 12 and 14) and it may be possible that some stations could have been more adversely affected due to specific differences in geographic location. One of the assumptions of the analysis is that factors such as the drought would affect all stations equally.

The 3X2 BACI analysis of the complete southern project area (comprising sondes 08, 20, 90R, and 98R) also registered a statistically significant project impact ($p < .0001$) on mean weekly salinity levels. This shows up graphically in Figure 17 as lines out of parallel between the during-construction and post-construction periods. As in the other tests, the size of the impact was modest, representing a departure of less than one part per thousand from what would be expected had there been no impact. There was a greater decrease in reference mean salinity (67% vs 61%) between the during- and post-construction time periods, with the resulting project and reference mean salinities being nearly identical in the post-construction period.

One of the project objectives was to reduce salinity fluctuations, with the specific goal of decreasing salinity variability within the project area. Salinity variability was expressed in terms of daily range for each station by subtracting the minimum from the maximum hourly salinity reading within each 24 hour period. While the overall salinity range during the entire sampling period was around 20 ppt, the mean daily salinity range was less than 1 ppt at all sites except for BA20-90R (Table 2). To test for the effects of CU1 and CU2 on salinity variability, mean daily salinity range at BA20-08 and BA20-98R was calculated for the pre- and post-CU1 periods and at BA20-20 and BA20-90R for the pre- and post-CU2 periods. An analysis of variance (ANOVA) was then conducted separately for the western (BA20-08 vs BA20-98R) and eastern (BA20-20 vs BA20-90R) areas using *period* (pre- vs post-construction) and *station* as the dependent variables. Tukey-Kramer's post-hoc test was used to examine various station/period comparisons. In the western project area, the mean daily salinity range at both project and reference sites was significantly higher in the post-CU1 period ($F=38$, $p<.0001$), although this was only equivalent to a 0.1 ppt increase (Figure 18). The increase at the project and reference sites was nearly identical, which was

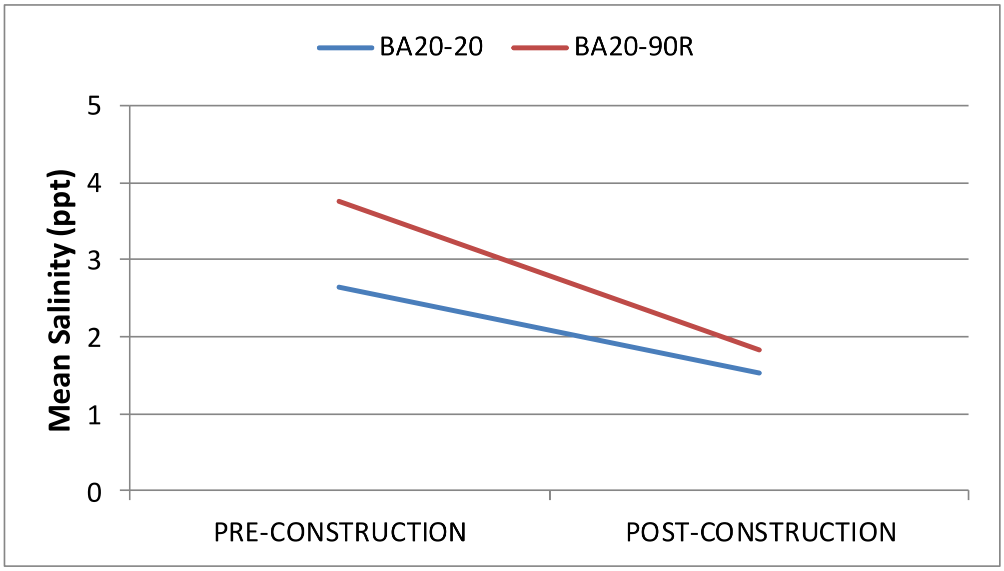


Figure 15. Comparison of mean weekly salinity of eastern sondes (BA20-20 and BA20-90R) during the pre- and post-CU2 periods.

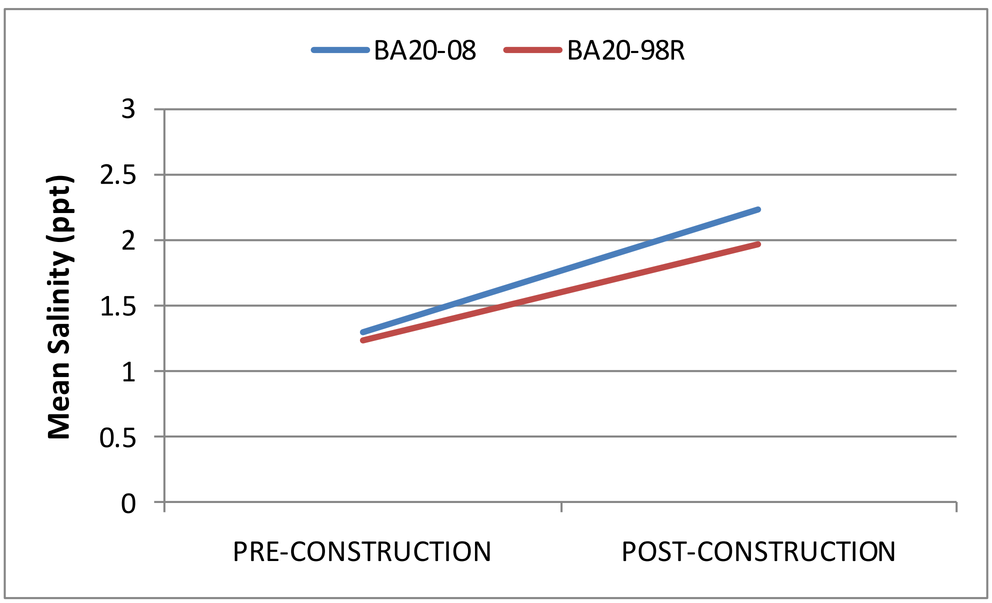


Figure 16. Comparison of mean weekly salinity of western sondes (BA20-08 and BA20-98R) during the pre- and post-CU1 periods.

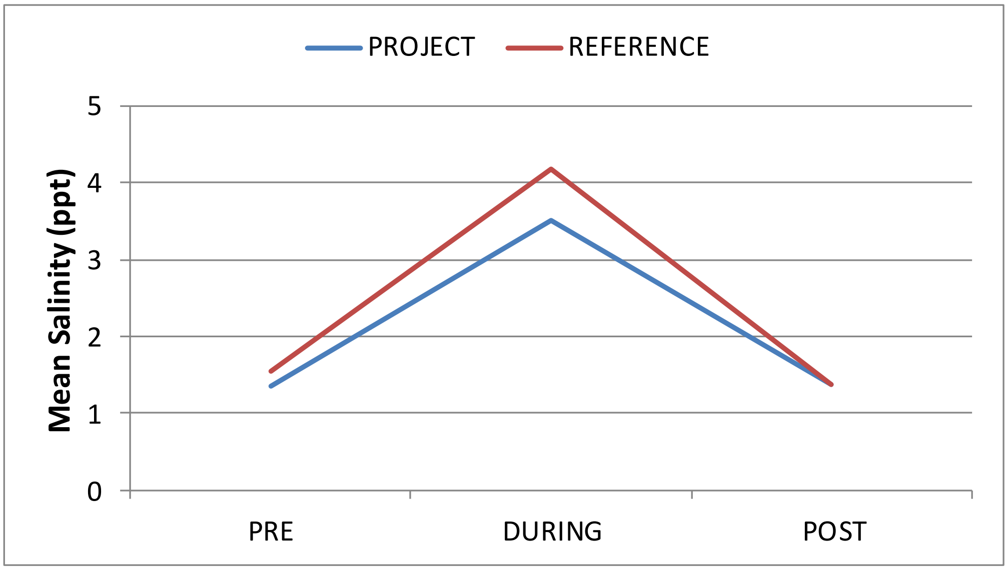


Figure 17. Comparison of mean weekly salinity of project stations (BA20-08 and BA20-20) vs reference stations (BA20-90R and BA20-98R) during three stages of project construction.

Table 2. Mean, minimum, and maximum salinity (ppt) over the entire sampling period, as well as the mean daily range in salinity, for all BA-20 project and reference sites.

	Time Period	Mean Salinity (ppt)	Minimum Salinity (ppt)	Maximum Salinity (ppt)	Mean Daily Salinity Range (ppt)
BA20-08	12/95-1/05	1.98	0.10	19.58*	0.30
BA20-20	12/95-11/03	2.27	0.13	17.83*	0.46
BA20-90R	12/95-11/03	3.08	0.20	24.61*	1.20
BA20-98R	12/95-1/05	1.74	0.10	22.7*	0.38
CRMS3985	5/08-12/13	1.19	0.14	14.58**	0.26
CRMS4245	5/08-12/13	1.36	0.15	18.75***	0.46

*occurred during drought in November 2000
**occurred 9/13/2008 during Hurricane Ike; CRMS4245 was not recording due to malfunction
***occurred 8/29/2012 during Hurricane Isaac

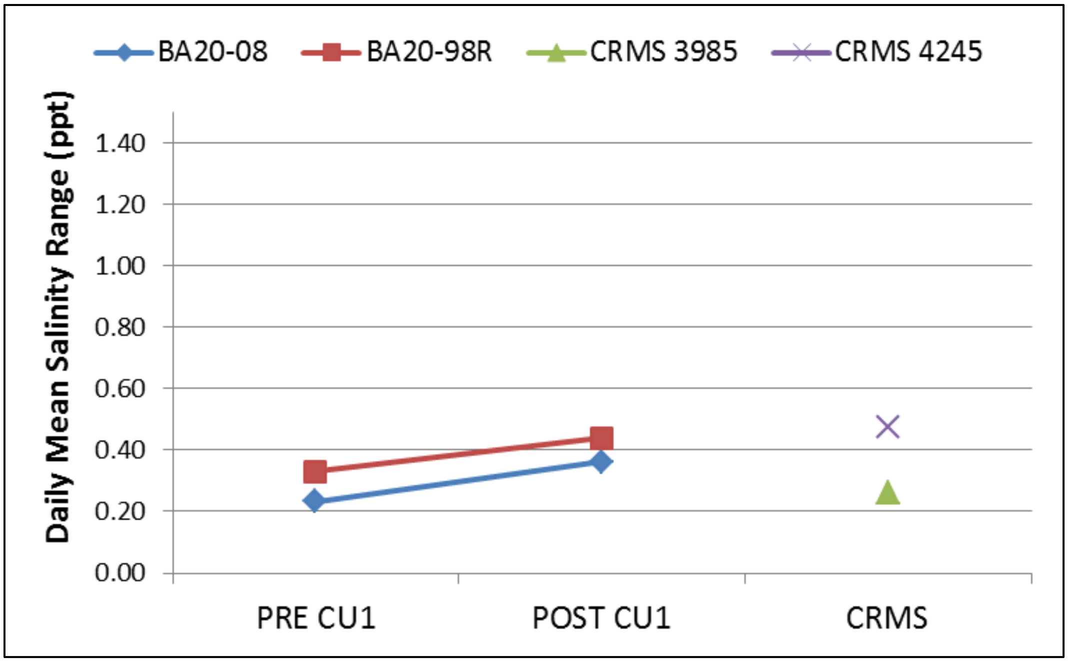


Figure 18. Daily mean salinity range (ppt) at the western project and reference sites (BA20-08, BA20-98R) before and after construction of CU1 and at the CRMS sites (3985, 4245) from 2008 through 2013.

confirmed by an insignificant '*station x period*' interaction (F=0.24, *p*=0.6261). Therefore, the changes appear to be a reflection of widespread conditions, and CU1 did not significantly affect mean daily salinity range within the project area at BA20-08.

In the eastern project area, there was a significant difference in mean daily salinity range between the pre- and post-CU2 periods (F=33, *p*<.0001); however, post-hoc comparisons reveal that this is only true for the reference site, which showed a significant decrease of 0.35 ppt (*p*<.0001) (Figure 19). The difference between the pre- and post-CU2 periods at BA20-20 was not significant (*p*=.7187), although a small decrease was observed. A significant '*station x period*' interaction (F=26, *p*<.0001) is likely due to the difference in magnitude of salinity range between the two sites rather than to any negative project effect. It would have been impossible to see a similar decrease in the project area because the mean daily salinity range at the project site was already much lower than the reference site. Therefore, CU2 did not appear to have a positive or negative affect on the mean daily salinity range within the project area at BA20-20.

Mean daily salinity range from 2008 to 2013 was also calculated for the two CRMS sites within the project area and is shown in Figures 18 and 19 for comparison. Mean daily salinity range was significantly higher in the southern project area at CRMS4245 (mean=0.46 ppt, S.E.=0.016) than at CRMS3985 (mean=0.26 ppt, S.E.=0.009) (paired $t(1764)=13.4$, $p<.0001$). Although the immediate goal of CU4 was to reduce shoreline loss, an ANOVA was conducted to see if CU4 construction had a buffering effect on salinity range at the CRMS sites. CU4 construction did not appear to buffer salinity range at CRMS4245 in the post construction period (6/1/11-5/31/13). Mean daily salinity range at CRMS4245 was significantly higher in the post-construction period at 0.70 ppt ($F=197$, $p<.0001$) than in the pre-construction period (0.31 ppt). At CRMS3985, there was only a marginal difference between pre (0.28 ppt) and post (0.24 ppt) CU4 salinity range ($F=6.6$, $p=0.0105$).

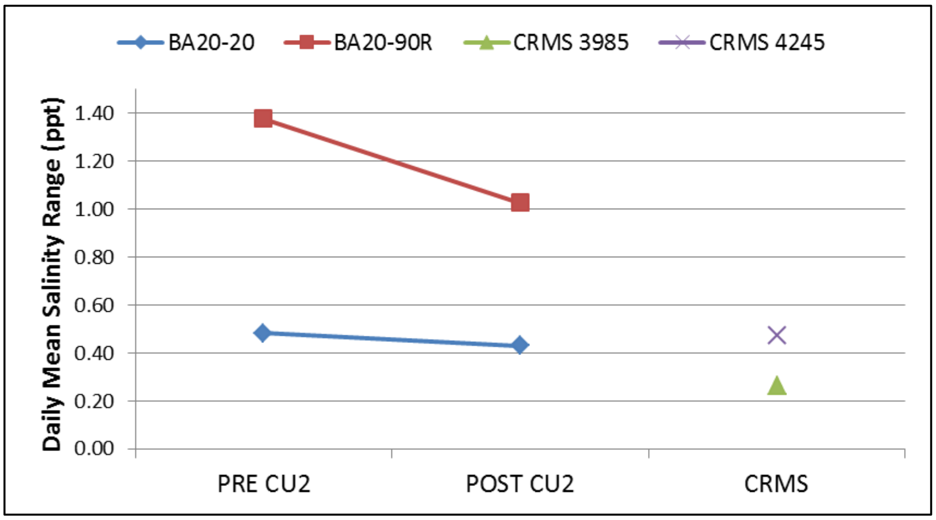


Figure 19. Daily mean salinity range (ppt) at the eastern project and reference sites (BA20-20, BA20-90R) before and after construction of CU2 and at the CRMS sites (3985, 4245) from 2008 through 2013.

iii. <u>Water Level</u>

Hourly water level data (ft NAVD88) was collected at the BA-20 continuous recorder stations (Figure 4) from November 1997 to January 2005, and has been collected at CRMS3985 and CRMS4245 from May 2008 to present (Figure 20). Water level at the different recorder stations displayed similar responses to seasonal influences and storm events. Water elevations were higher in spring, early summer, and fall, while lower levels occurred in late summer and winter. Two tropical storm events in September 1998 produced different effects on water levels in the project and reference areas. Tropical Storm Frances, which made landfall to the west of the project area, caused a sharp increase in water levels, while Hurricane Georges, which made landfall to the east, caused a decrease in water levels. Water level increases were also observed during Hurricanes Isidore and Lili in 2002 and during Hurricanes Gustav and Ike in 2008.

Mean water levels were lowest at all stations except BA20-98R in the period between construction of CU1 and CU2, which was most likely a result of the drought that occurred during this period (Figure 21). This was probably also the case for BA20-98R, however high water data during the 1998 storm season was lost at this site due to sonde malfunction. Water levels were the highest at all BA-20 project and reference sites during the post-CU2 period compared to the pre-CU1/CU2 periods. Mean water levels at the two CRMS sites since 2008 are also higher than mean water levels at the BA-20 stations for all construction periods. However, possible differences in elevation surveys between the BA-20 sites and CRMS sites, such as the reference benchmark used, may cause some error when comparing the NAVD water level between these two groups of stations.

One of the stated goals of the project was to reduce water level variability within the project area. In order to test for the effects of the project on water level variability, a tidal analysis was conducted. A program was written which identified the maximum (high tide) and minimum (low tide) water elevations for each tidal period. Figure 22 shows an example of the tidal periods at BA20-08 from November 25, 1997 to January 6, 1998. High tide (red) and low tide (blue) for each period were identified and any tidal period longer than 15 hours in length was excluded. Abnormally long tidal periods were excluded because these were presumably influenced by weather events. Tidal range was calculated by subtracting each minimum elevation from the preceding maximum elevation for each tidal period. Mean tidal range was then subjected to an analysis of variance (ANOVA) with construction period (pre- vs post-construction) and station as the dependent variables.

To test for the impacts of CU1 on water level variability, BA20-08 and BA20-98R (western project area) were compared using a pre-construction period from November 1997 to September 1998 and a post-construction period from October 1998 to November 2003. Mean tidal range in the western project area was significantly lower in the post-construction (CU1) period ($F=38$, $p<8.16\text{x}10^{-10}$), and the reduction of tidal range at reference station BA20-98R was significantly greater than the reduction in the project area (‘*period x station*’: $F=9.5$, $p<0.002$) (Figure 23). The reduction in tidal range appears to be a regional occurrence, and not a result of CU1 construction. The smaller reduction of tidal range in the project area is likely due to the fact that the pre-construction tidal range was comparatively lower in the project area, allowing more ‘room’ for reduction at the reference station. In order to experience the same reduction in tidal range as the reference area, post-CU1 mean tidal range in the project area would have needed to approach 0.18 ft, which may be an unrealistic expectation for the natural tidal range in the project area. Therefore, the smaller reduction in the project area is not due to any negative project affect.

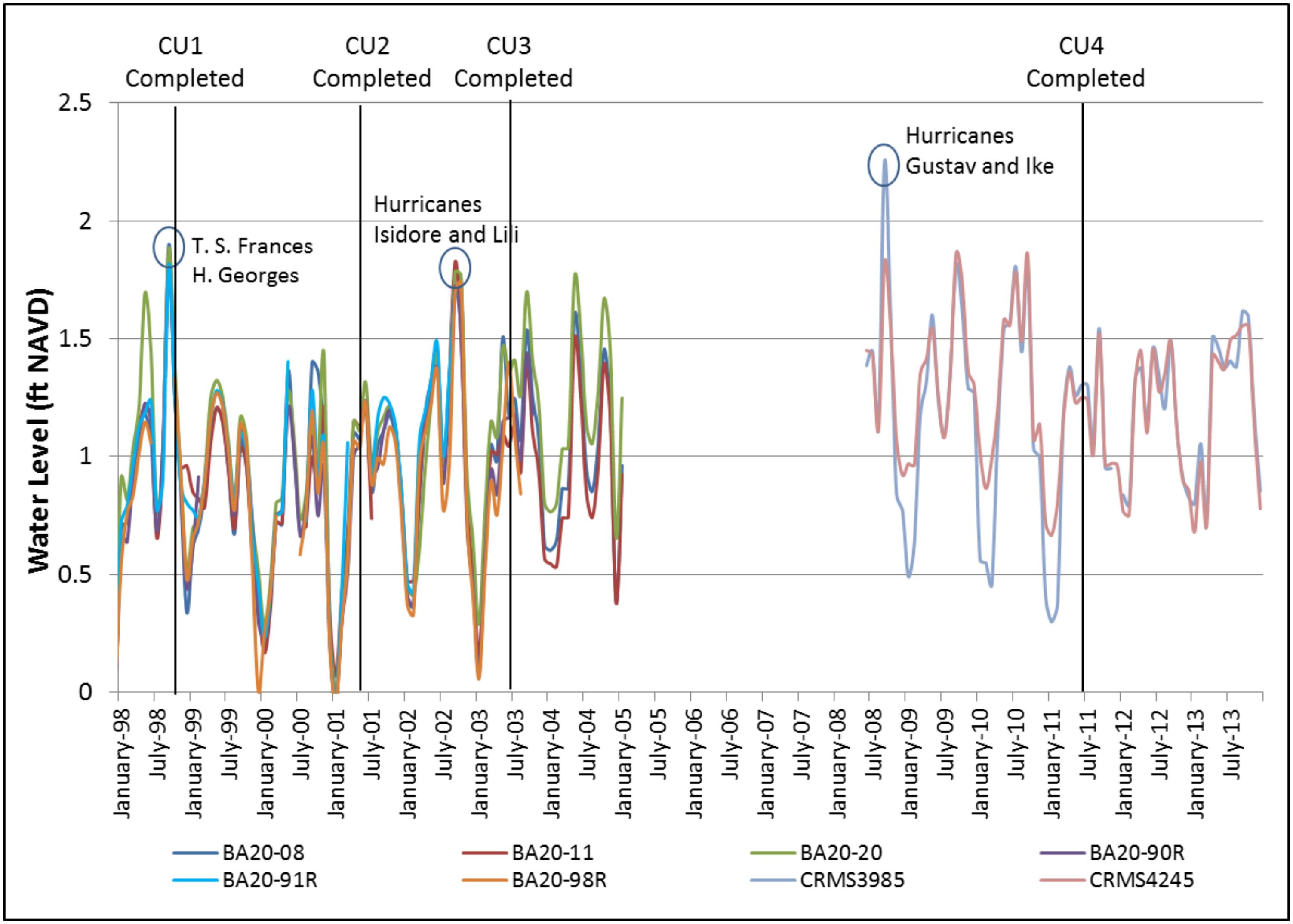


Figure 20. Monthly mean water level data (ft NAVD88) for all BA-20 and CRMS continuous recorder stations from 1995 to 2013.

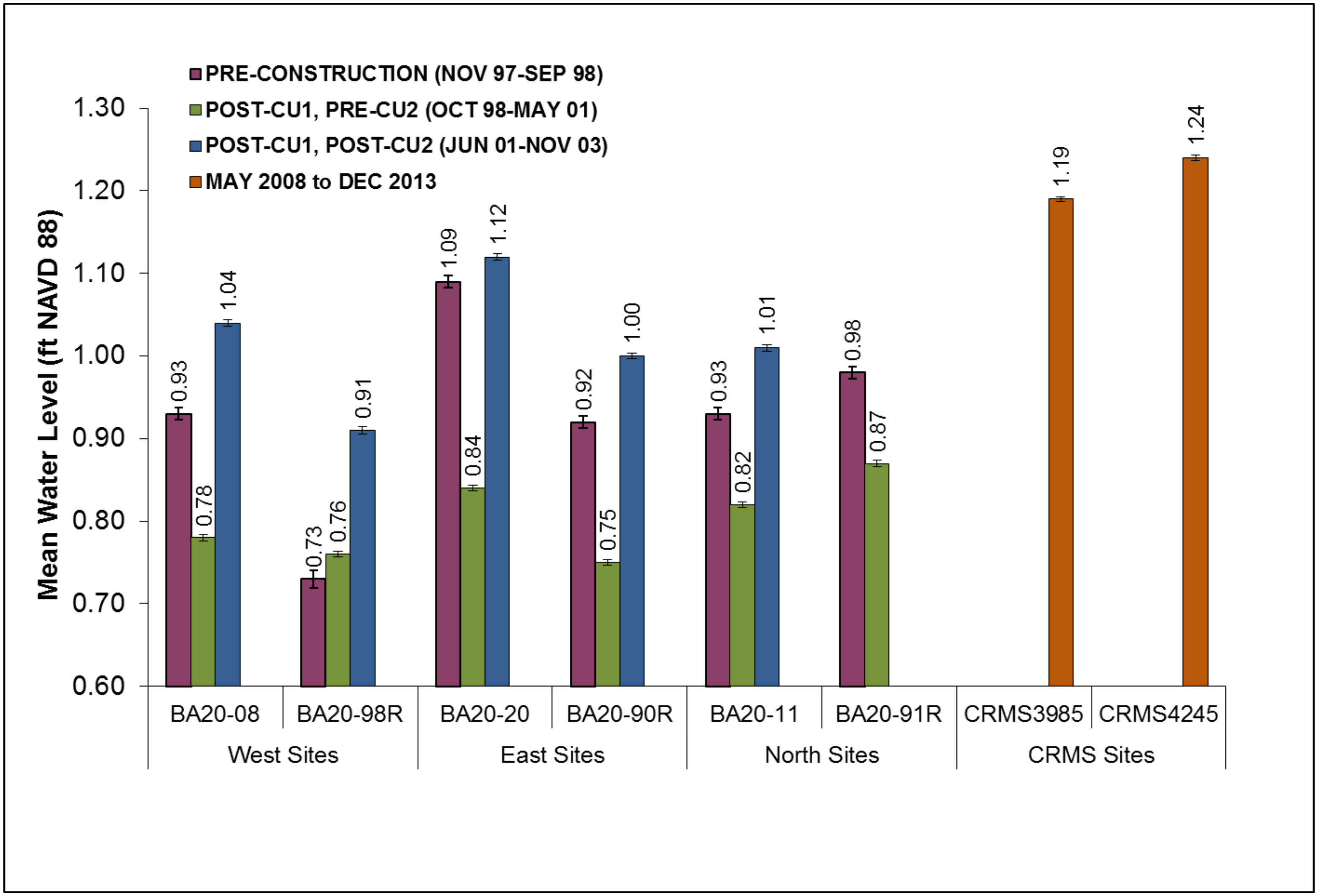


Figure 21. Mean water level at each BA-20 continuous recorder station during three different periods of construction and at each CRMS station from 2008 to 2013 based on hourly water level readings.

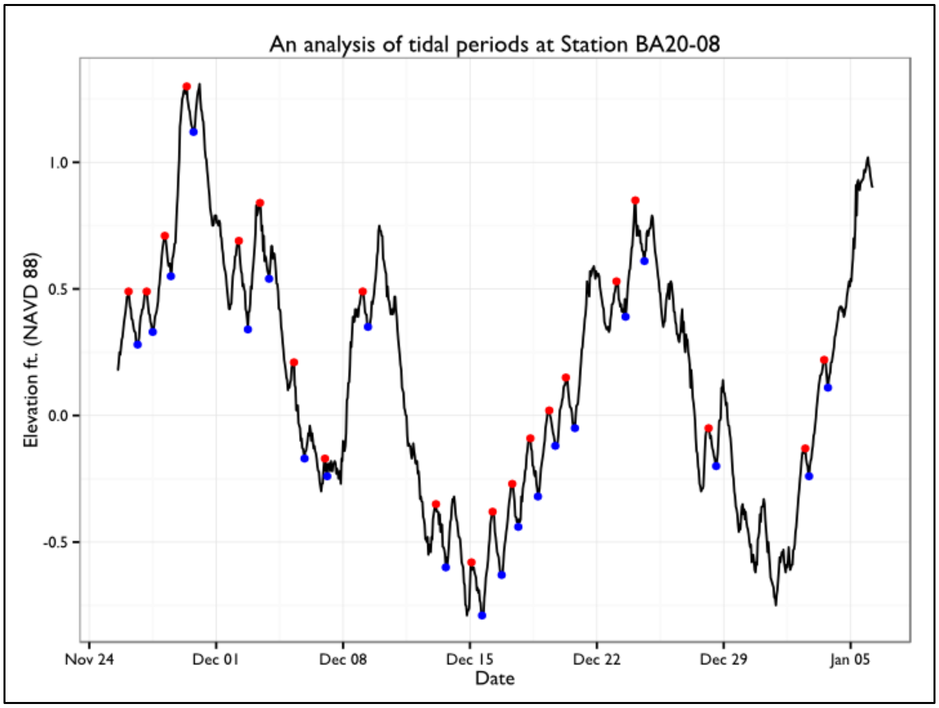


Figure 22. Tidal periods at BA20-08 from November 25, 1997 to January 6, 1998.

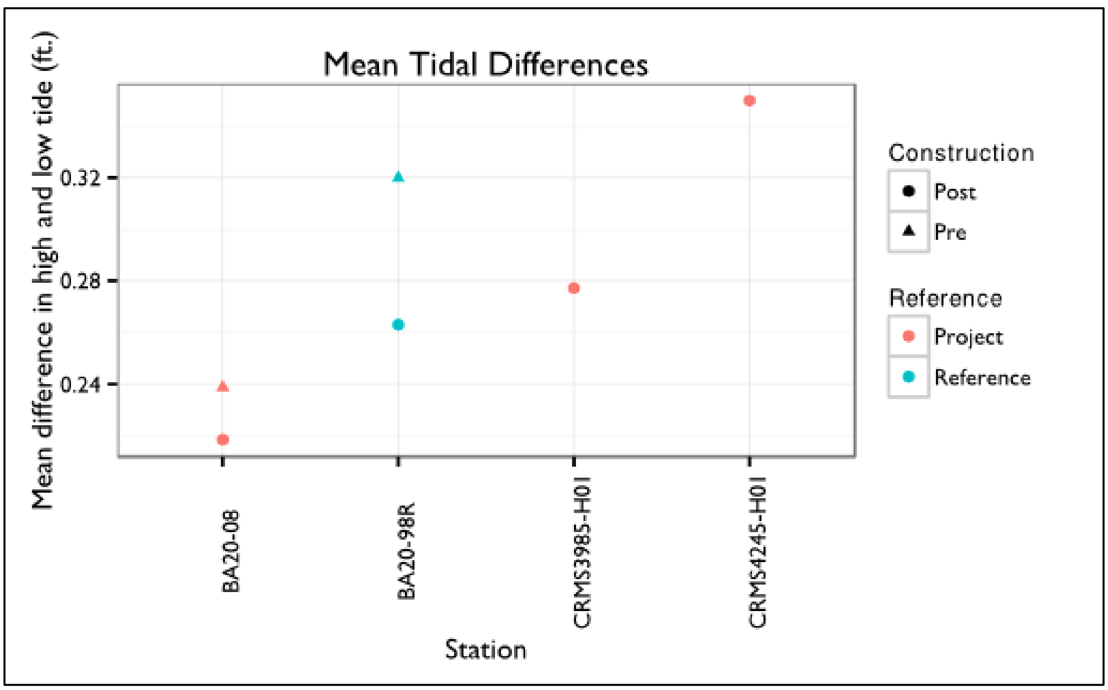


Figure 23. Mean tidal differences at the western project (BA20-08) and reference (BA20-98R) sites before and after construction of CU1 and at the CRMS sites (3985, 4245) from 2008 to 2013.

To test for the impacts of CU2 on water variability, BA20-20 and BA20-90R (eastern project area) were compared using a pre-construction period from November 1997 to May 2001 and a post-construction period from June 2001 to November 2003. Mean tidal range in the eastern project area was significantly higher in the post-construction (CU2) period (F=45, $p<2.58\times10^{-11}$) (Figure 24). In this case, the '*period x station*' interaction was not significant (F=1.9, $p<0.17$) which suggests that the tidal range increased by a similar magnitude at the project and reference sites. Based on the tidal analysis, we would reject the hypothesis that CU1 and CU2 significantly reduced water level variability in the project area.

Mean tidal range from 2008 to 2013 was also calculated using water elevation data from CRMS3985 and CRMS4245 within the project area. These data were not used in the analysis due to the difference in time periods, but the results are shown in Figures 22 and 23 for comparison. Mean tidal range at CRMS4245, which is located in an area of highly fragmented marsh at the southern end of the project area, was higher than all of the other sites, including the reference stations (Figures 25 and 26). Tidal range at this site was most similar to reference site, BA20-90R, which it is closest to geographically. In the northern project area, CRMS3985 displayed a more moderate tidal range, which was between the tidal ranges measured at BA20-08 and BA20-20 in the earlier time period. Although the direct goal of CU4 was to reduce shoreline loss, an ANOVA was conducted to determine if CU4 had an effect on reducing water level variability at CRMS4245. One extreme outlier which occurred during the winter of 2010 was omitted from the analysis (Figure 26). Results showed that there was no significant difference in tidal range at CRMS4245 before and after CU4 construction (F=0.67, $p=0.416$).

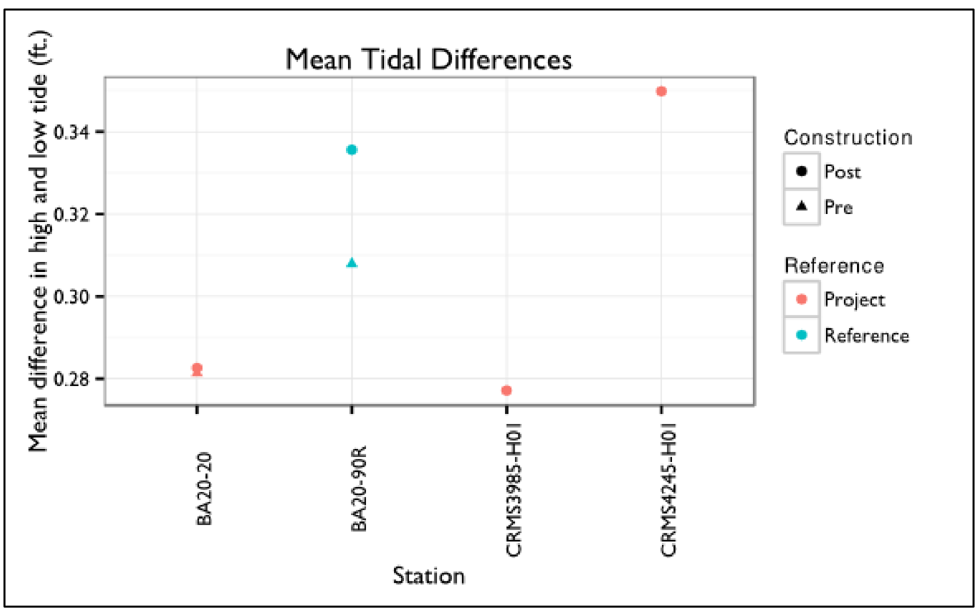


Figure 24. Mean tidal differences at the eastern project (BA20-20) and reference (BA20-90R) sites before and after construction of CU2 and at the CRMS sites (3985, 4245) from 2008 to 2013.

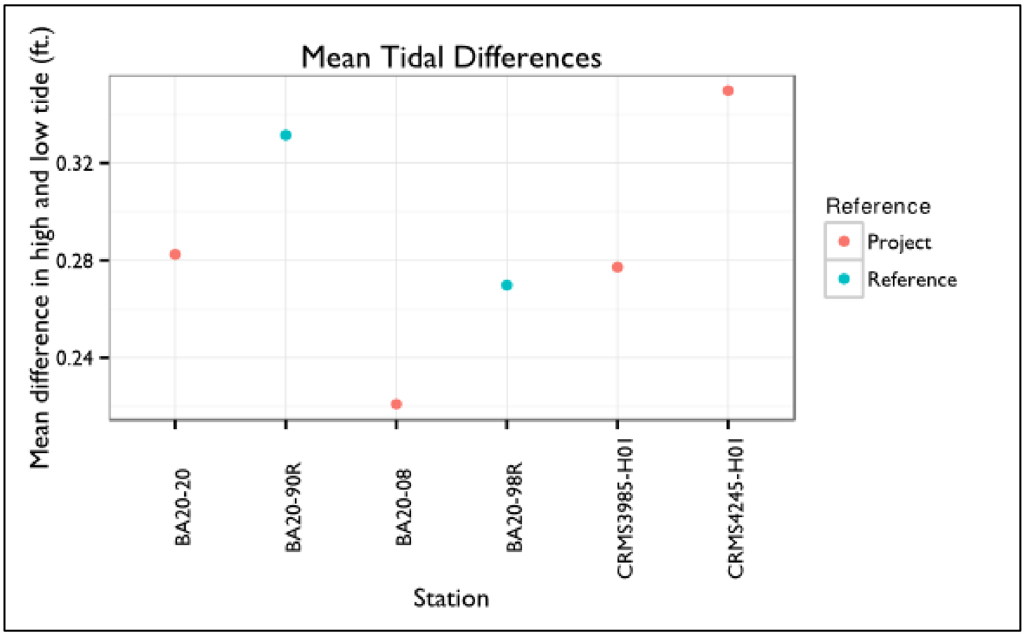


Figure 25. Mean tidal differences at BA-20 project and reference stations from November 1997 to November 2005, and at CRMS sites within the project area from 2008 to 2013.

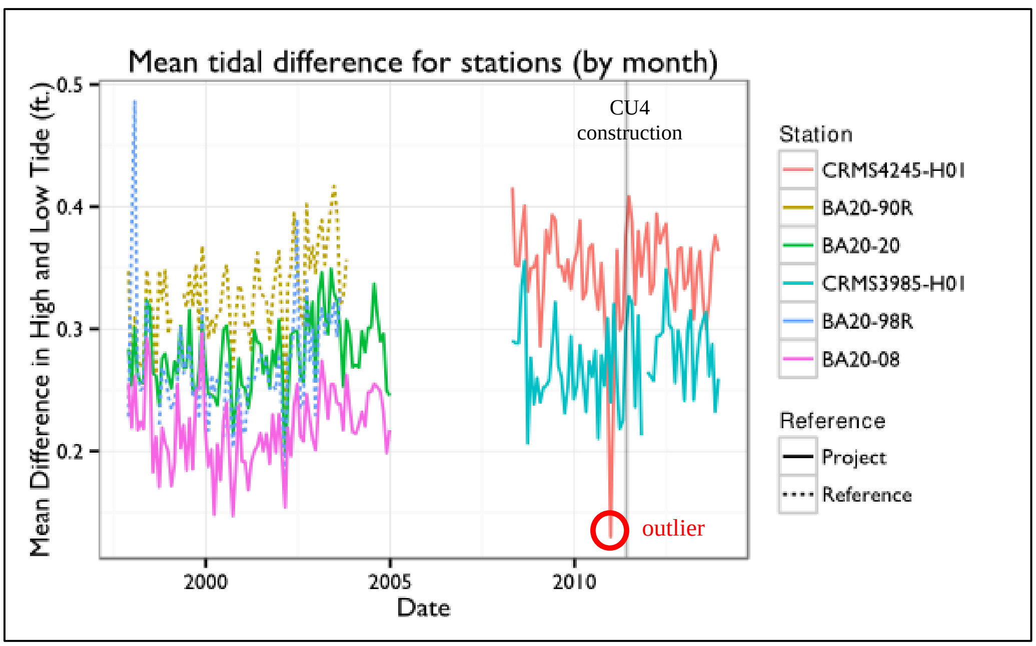


Figure 26. Mean monthly tidal differences at BA-20 project and reference stations from November 1997 to November 2005, and at CRMS sites within the project area from 2008 to 2013.

iv. Shoreline Change

Analyses of shoreline change rates were conducted for CU2 (Bayou Rigolettes Bank Stabilization), CU3 (Bayou Perot Bank Stabilization), and the reference areas using the change polygon method (Smith and Cromley 2012). To calculate the change rate (ft/yr) between two survey years, geo-rectified DGPS shoreline segments from each year were first converted to shapefiles. A polygon was then created from the two shoreline polylines to provide a total area (ft^2) of loss/gain between the two polylines. Next, the shoreline change rate was calculated by taking the area inside the polygon and dividing it by the average shoreline length between the two surveys.

Shoreline Change Rate (ft) = Area Change (ft^2) ÷ Average Shoreline Length (ft)

Finally, the shoreline change rate was divided by the number of years between the two survey events to determine shoreline change rate per year (ft/yr).

Shoreline Change Rate/Year (ft/yr) = Shoreline Change Rate (ft) ÷ # of Years between Surveys

Positive shoreline change rates were observed in CU2 and CU3 during the period of analysis (2001-2010), whereas shoreline loss occurred in each of the reference areas (Table 3). The shoreline analysis of CU2 from 2001 to 2004 showed an increase in land of 1.7 acres in the project area, and a loss of 3.6 acres in the adjacent eastern reference area (Figure 27). This corresponded to a shoreline change rate of +4 ft/yr in the project area and -8 ft/yr in the reference area from 2001 to 2004. The land gained in the project area can be attributed to the infilling of access dredged material between the rock structure and the original shoreline during construction. During the 2001 as-built survey of the shoreline, the infilled area was not included because it was unvegetated immediately post-construction, but by 2004 this area had become mostly vegetated. The eastern reference area has not been resurveyed since 2004 because it is now part of the Barataria Landbridge Shoreline Protection Project, Phase 4 (BA-27d) and has been protected with rock revetment since 2006.

A combined shoreline analysis of CU2 and the eastern portion of CU3 from 2004 to 2010 showed a net gain of 1.9 acres (+1.7 ft/yr) with negligible loss occurring (Figure 28). This increase in land occurred mostly in the CU3 area which had been constructed not long before the 2004 survey. As observed in the 2001-2004 analysis, the area between the rock structure and the original shoreline became vegetated, thereby causing an increase in shoreline acreage. The shoreline analysis of the western portion of CU3 exhibited a net land loss of 4.6 acres (+3.8 acres, -8.4 acres) (Figure 29). However, the major extent of the land loss occurred along a large section of interior marsh located within the central portion of the project area. Therefore, separate land area calculations were made to determine the land changes to the 'shoreline' and 'interior marsh' independently. The 'shoreline' component exhibited a net gain of 3.34 acres (+3.51 acres, -0.17

acres), and the ‘interior marsh’ exhibited a net loss of 8 acres (+0.29 acres, -8.25 acres). The gain of land along the ‘shoreline’ component was again due to the vegetating of areas between the rock structure and the original shoreline between the first and second surveys. The shoreline gain rate (with the interior marsh area excluded) was determined to be +2.2 ft/yr.

Although DGPS shoreline data was not collected in the western reference area (Reference Area 1), it was visually evident that significant shoreline loss was occurring in this area during the period of analysis. For comparison to the CU2/CU3 results from 2004-2010, an estimation of the shoreline change rate in Reference Area 1 was made by digitally delineating the vegetated shoreline using 2004 DOQQ and 2010 NAIP imagery. Using the same change polygon method, an approximate loss rate of -45 ft/yr was calculated for Reference Area 1 from 2004 to 2010 (Figure 30). Although it is possible that Reference Area 1 may have been exposed to slightly higher wave energies within Lake Salvador, it is evident that the CU2/CU3 shoreline structures have been successful at preventing potentially significant shoreline loss. Some interior land loss continues to occur as evidenced by the enlarging interior pond behind CU3; however, the interior loss may have been even greater if the structure had not been in place to reduce wave energies in ponds near the shoreline. Further analyses will be conducted following the next shoreline survey of CU’s 2, 3, and 4 in 2015. A baseline DGPS survey of CU4 was conducted following construction in 2012 (Figure 31).

Table 3. Summary of shoreline change (ft/yr) results for Construction Units 2-3 and two Reference Areas associated with the Jonathan Davis Wetland Restoration (BA-20) project.

Shoreline Location	Period	Shoreline Change (ft/yr)
CU 2	2001-2004	**+4**
Reference Area 2 (*East*)	2001-2004	**-8**
CU 2/3 East	2004-2010	**+1.7**
CU 3 West	2004-2010	**+2.2**
Reference Area 1 *(West)*	2004-2010	**-45**

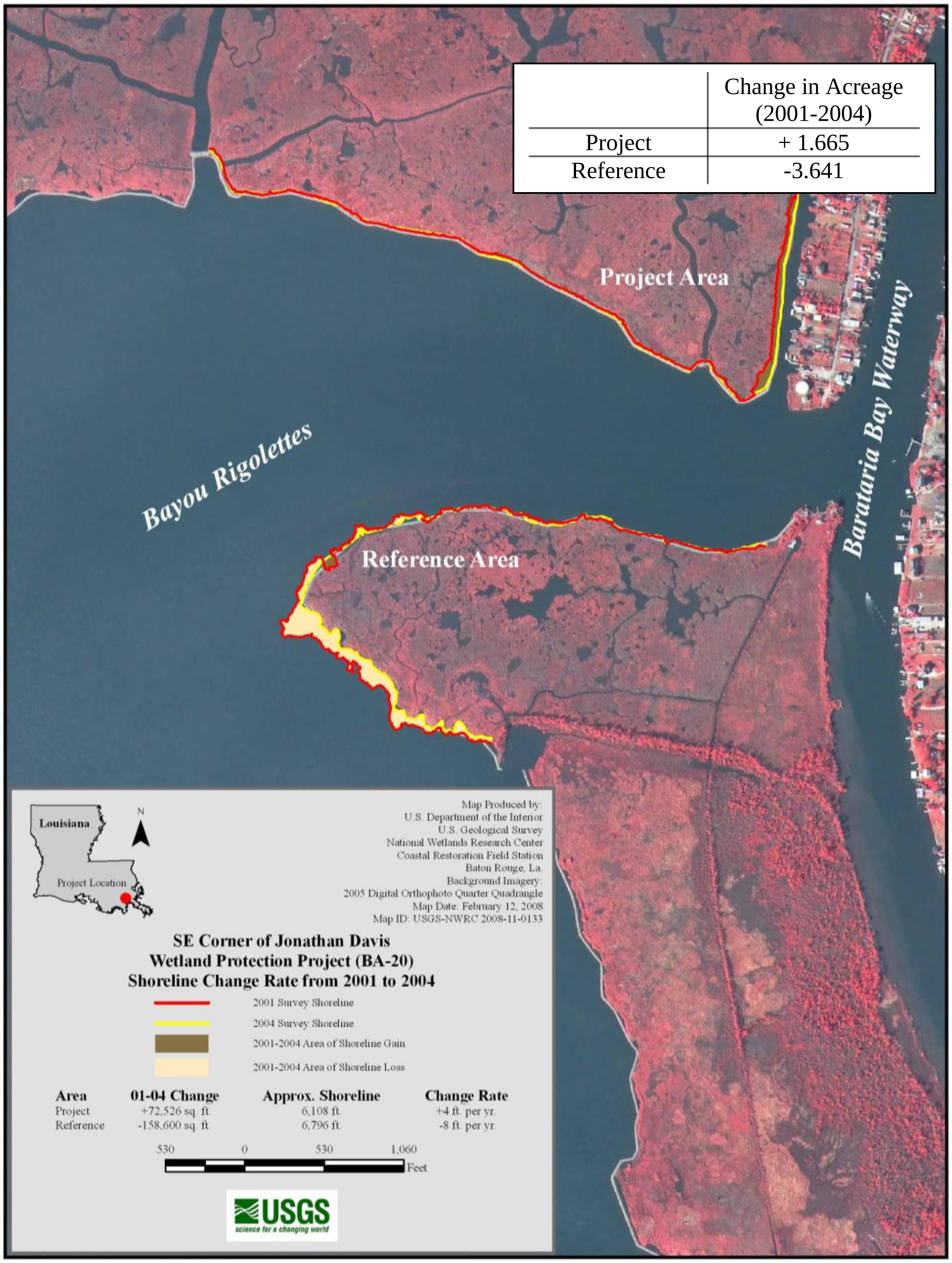


Figure 27. Shoreline change within Construction Unit 2 and the eastern reference area of the Jonathan Davis Wetland Restoration (BA-20) project from 2001 to 2004.

Figure 28. Shoreline change within Construction Unit 2 and the eastern portion of Construction Unit 3 of the Jonathan Davis Wetland Restoration (BA-20) project from 2004 to 2010.

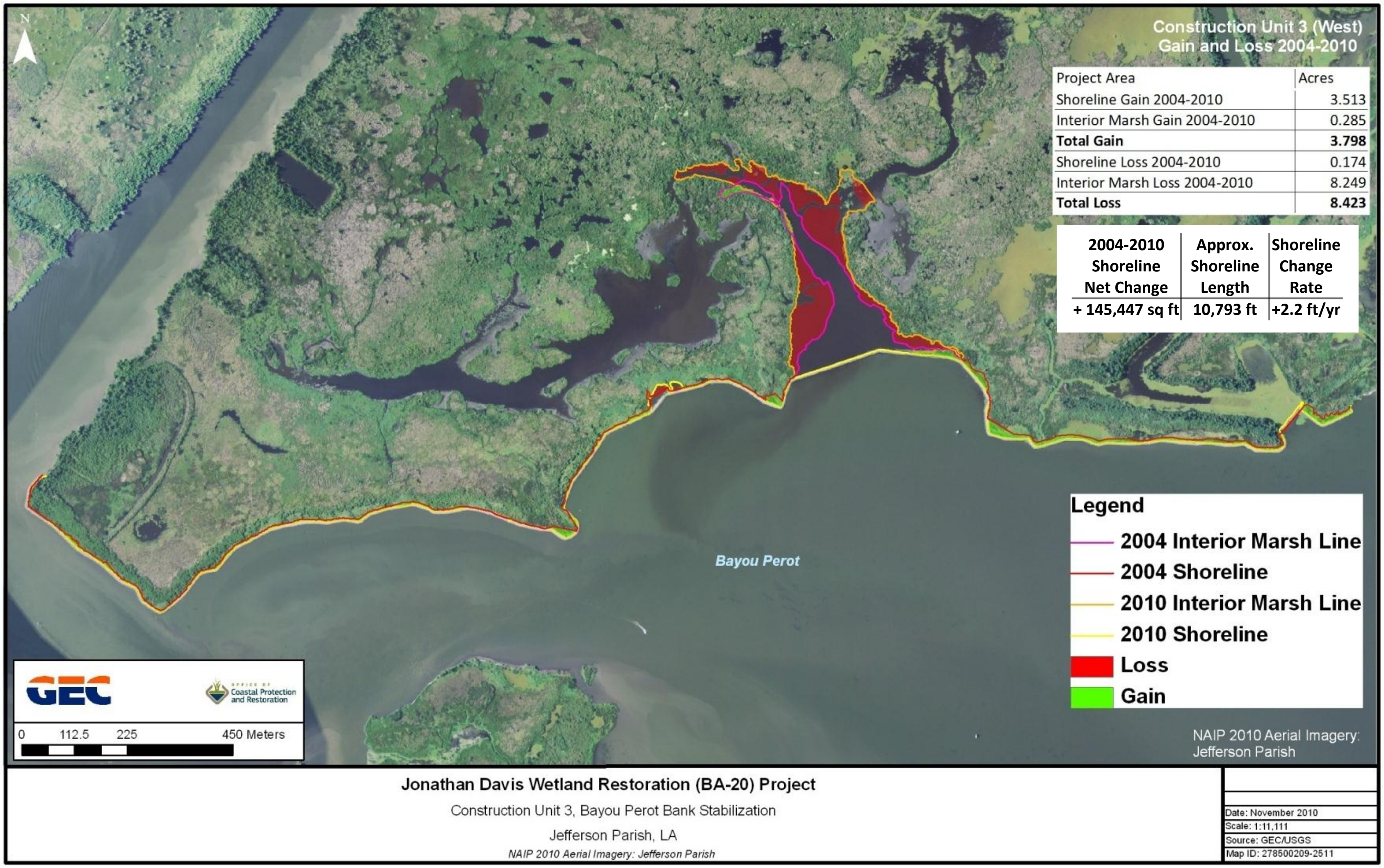


Figure 29. Shoreline change within the western portion of Construction Unit 3 of the Jonathan Davis Wetland Restoration (BA-20) project from 2004 to 2010.

Figure 30. Estimated shoreline loss within the western reference area of the Jonathan Davis Wetland Restoration (BA-20) project.

Figure 31. 2012 'as-built' shoreline position of Construction Unit 4 within the Jonathan Davis Wetland Restoration (BA-20) project.

v. <u>Vegetation</u>

Emergent vegetation surveys were conducted in 1996 (pre-construction), 1999 (1 year post-CU1), 2002 (4 years post-CU1, 1 year post-CU2) and 2012 (14 years post-CU1, 11 years post-CU2, 9 years post-CU3, 1 year post-CU4). By the time of the 2002 survey, CU1 was the only project phase that could have produced a measureable effect on vegetation. Vegetation response to CU1, CU2 and CU3 would be reflected in the 2012 survey, with CU4 being constructed only the previous year. In addition to the BA-20 surveys, annual CRMS vegetation surveys began at CRMS3985 and CRMS4245 in 2008, which will continue to provide a long term picture of the vegetation in the project area. However, it should be noted that the BA-20 sites provide broader coverage of the project area, and direct comparison to the CRMS sites may be confounded by localized differences in vegetation at those sites (Figure 6).

The vegetation structure within the BA-20 project area is a diverse, oligohaline community characterized by the presence of *Sagittaria lancifolia*, *Spartina patens*, and *Eleocharis spp* (Figure 32). Several changes in composition and abundance have occurred over the sampling period from 1996 to 2012. *S. lancifolia* was the dominant species in both the project and reference areas in 1996; however, percent cover of *S. lancifolia* has been steadily decreasing since that time (Figure 32). The project and reference areas exhibited a concurrent increase in *S. patens* cover until 2002, but a subsequent drop by 2012. By 2002 and 2012, the dominant species in the project area was *S. patens*. Although there is not an overall trend of increasing salinity in the project area (Figure 13) which may explain the decline of *S. lancifolia*, there have been frequent disturbance events (drought and hurricanes) over the sample period which caused periodic spikes in salinity levels. Baldwin and Mendelssohn (1998) observed a synergistic effect of salinity stress following disturbance on the reduction of biomass of *S. lancifolia*. Alternatively, *S. patens* was affected by flooding and disturbance but not salinity. The frequency of salinity stressor events during the sample period may not have allowed for the necessary recovery of *S. lancifolia* leading to its overall decline. Total % cover declined in both the project and reference areas from 1996 to 2002 (Figure 32), but increased slightly in the project area by 2012. Total % cover in the reference areas, however, continued to decline in 2012 and was exacerbated by the conversion of three sampling plots to open water (Figure 6).

One of the measureable goals of the project was to stabilize or increase the abundance of intermediate-to-fresh marsh plant species. Species were classified as fresh, fresh-intermediate, intermediate, etc. based on classifications provided by Jenneke Visser. Percent coverage data from the BA-20 and CRMS sites was then used to summarize changes in marsh classifications over time (Figures 33 and 34). The fresh, fresh/intermediate, and intermediate classifications were then grouped together for comparison to the intermediate/brackish and brackish classifications.

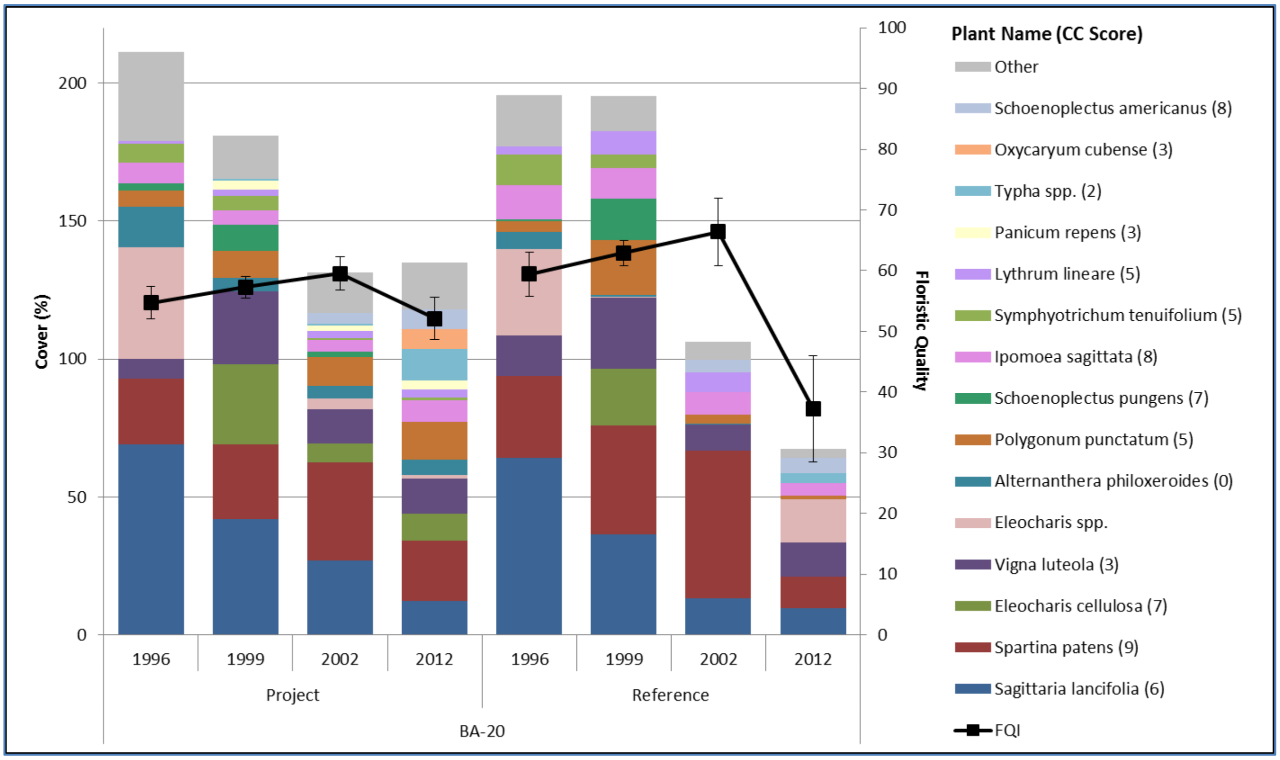


Figure 32. Mean percent cover of species within the BA-20 project and reference areas and the Floristic Quality Index (FQI) score for each year sampled. The CC Score represents the quality of the individual species on a scale from 1 to 10 where 1 represents disturbance species and 10 indicates stability.

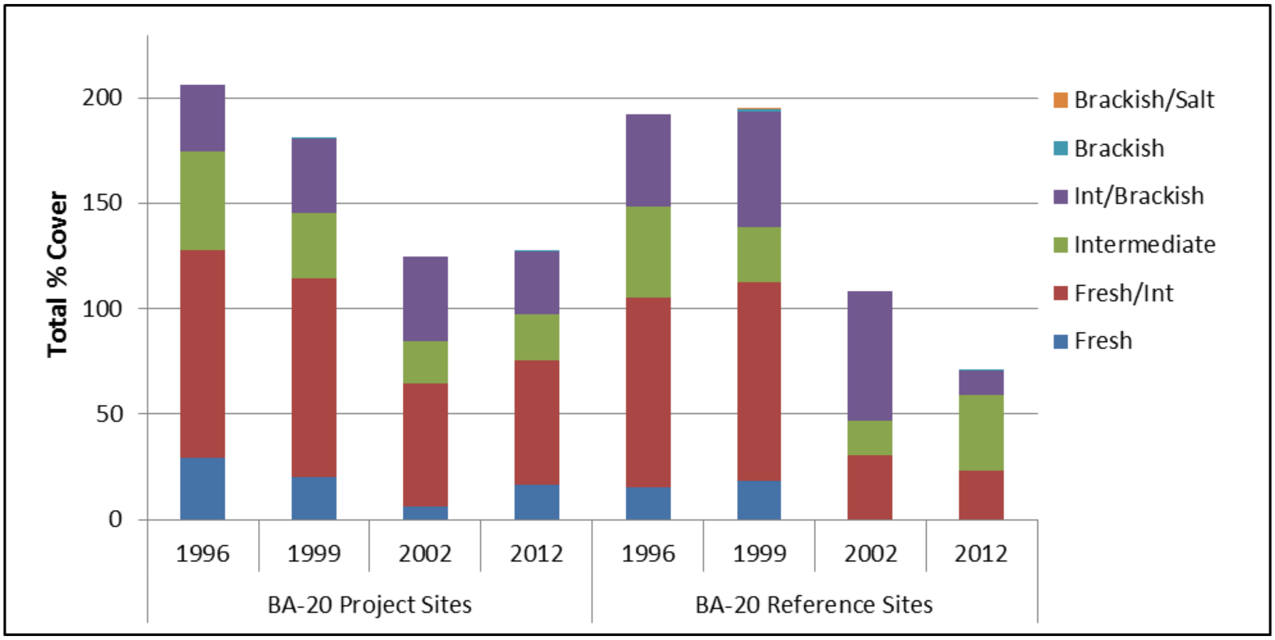


Figure 33. Total of mean % covers of all habitat classes at BA-20 project and reference sites in 1996, 1999, 2002 and 2012.

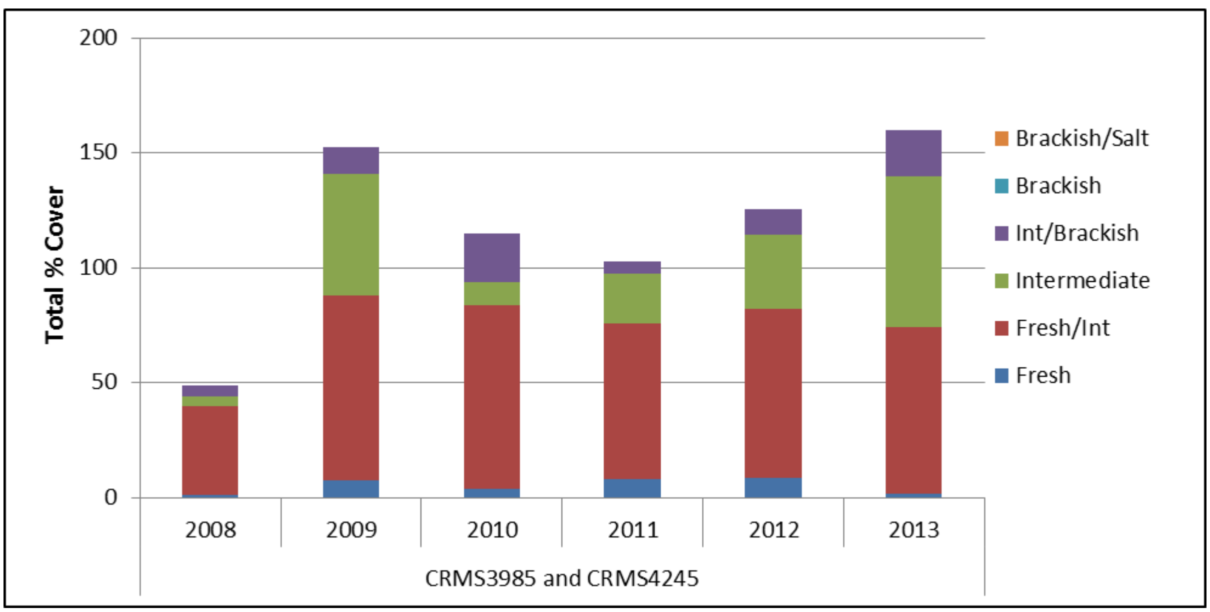


Figure 34. Total of mean % covers of all habitat classes at CRMS3985 and CRMS4245 from 2008 to 2013.

Brackish/salt and salt classifications were also included, but percent coverages in these categories were very low. Results showed a decrease in percent cover of fresh/intermediate species from 1996 to 2002 and an increase in fresh/intermediate species from 2002 to 2012 (Figure 35). A similar increase in fresh/intermediate species in the reference areas indicates that this is a region-wide occurrence and not due to project effects. The decrease in cover of fresh/intermediate species was pronounced between 1999 and 2002, which was most likely an effect of the drought that occurred from August 1999 to November 2000. The decrease was greater in the reference area than in the project area, however, which could indicate that the CU1 project features may have had a protective effect.

At CRMS3985 and CRMS4245, the total percent cover of all species was lowest in 2008 (Figures 36 and 37). This may be due to the fact that sampling occurred in October, only one month after Hurricanes Gustav and Ike. At CRMS3985, there was a subsequent increase in total percent cover each year through 2012. Total percent cover at CRMS4245 has shown much more annual variation but was higher in 2013 than in all previous years. The vegetation community at the fresher site, CRMS3985, is locally different from the overall project area due to the absence of *S. patens*. The dominant species at CRMS3985 are *S. lancifolia*, *Polygonum punctatum*, and *Alternanthera philoxeroides*. A decrease in cover of *S. lancifolia* and increase in *P. punctatum* has been observed since 2010. From year to year, the dominant species at CRMS4245 was either *S. lancifolia* or *Vigna luteola*. *V. luteola*, a species sometimes associated with disturbance, was dominant in post-hurricane years (2009 and 2013). The coverage of fresh/intermediate species at the CRMS sites was lowest in 2008, but rebounded in 2009 and 2013 to levels similar to those observed at the BA-20 sites in 1999 before the drought (Figure 35).

One tool that has been used to assess the quality of the vegetation community at the CRMS sites is the Floristic Quality Index (FQI) (Cretini et al. 2011). The FQI is calculated by assigning each species a CC score, or coefficient of conservatism, which is scaled from 1 to 10 and reflects a species' tolerance to disturbance and habitat specificity. A modified FQI was developed by the CRMS Vegetation Analytical Team, which assembled a team of experts to assign CC scores to Louisiana's wetland plant species. The modified FQI equation takes into account not only the CC scores, but also the percent covers of species at a site, and the resulting score is scaled from 0 to 100.

Mean FQI scores were calculated for the BA-20 project and reference areas for each of the sampling years. FQI scores in the project area were relatively stable from 1996 to 2012 and ranged from 52-60, which is below the ideal range of 80-100 for intermediate marsh, as estimated by the CRMS Vegetation Analytical Team (Cretini et al. 2011) (Figure 32). FQI scores in the project area mirrored the FQI scores in the reference area through 2002 with a small increase each sample year. The increase through 2002 is likely due to the drought-induced decrease in fresh/intermediate species, some of which are associated with disturbance and therefore have low CC scores, and also to the concurrent increase of *Spartina patens*, which has a high CC score of 9. FQI decreased in both the project and reference areas in 2012, but the decrease in the reference area was much greater, largely due to the conversion of three sampling plots to open water. The loss of these plots was caused by direct shoreline loss in the western reference area, so the higher FQI in the project area in 2012 was less due to enhanced quality of habitat in the project area, but more a factor of direct land loss in the reference area. There are a few plots near the shoreline within the project area that may have also been lost if the protective shoreline features of BA-20 had not been in place. FQI scores at the two CRMS sites were lowest in 2008, probably as a result of Hurricanes Gustav and Ike (Figures 36 and 37). FQI scores showed a subsequent increase and have remained stable, but were generally lower than those observed for the BA-20 sampling years. As mentioned previously, however, the CRMS sites provide a snapshot within a 200 x 200-m sampling area and may not reflect the project area as a whole.

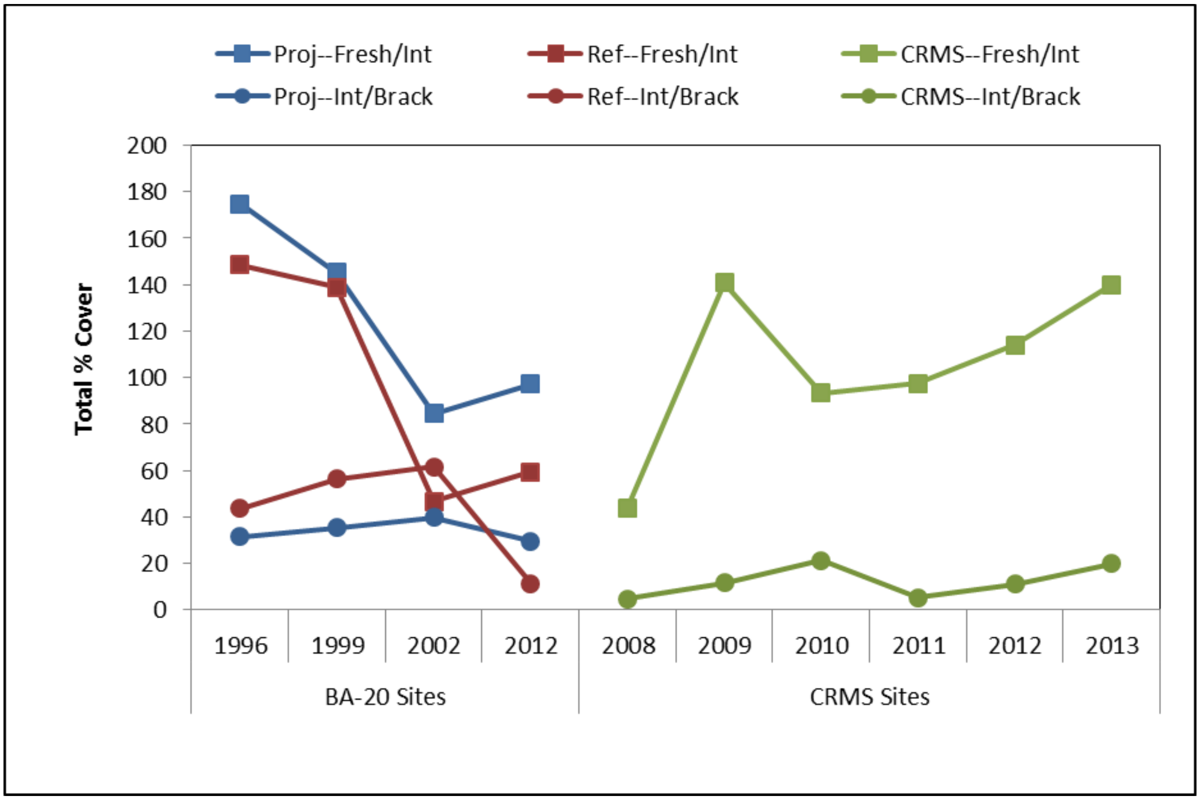


Figure 35. Total of mean % covers for fresh/intermediate species vs. intermediate/brackish species at BA-20 project and reference sites in 1996, 1999, 2002, and 2012, and at two CRMS sites (3985 and 4245) within the BA-20 project area from 2008 to 2013.

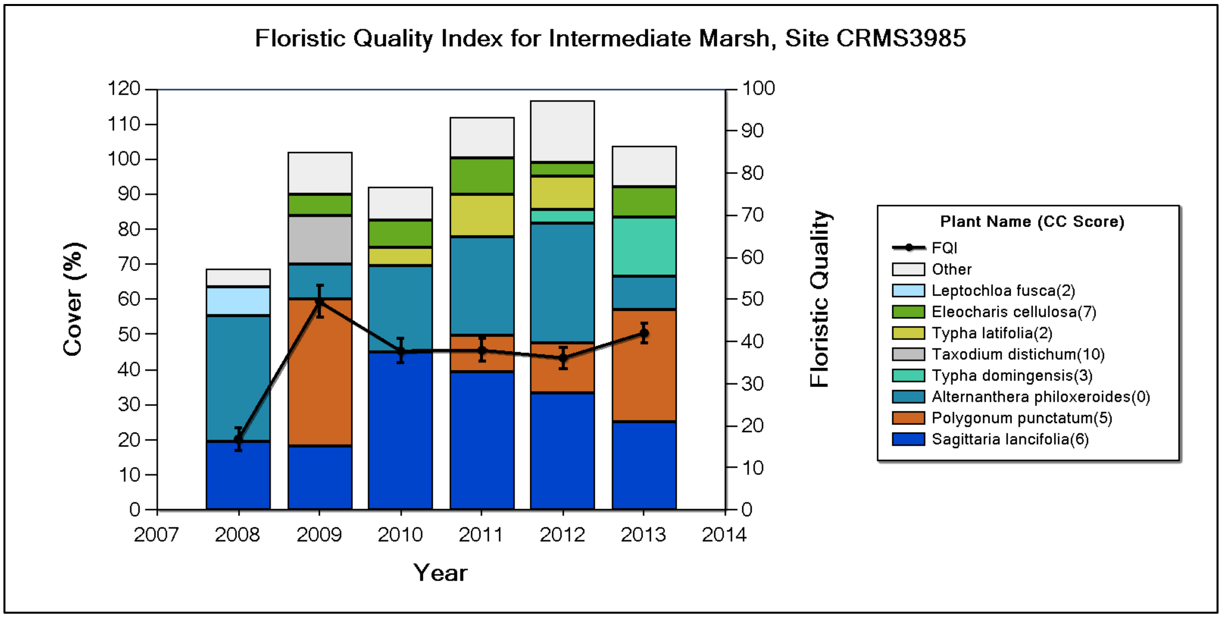


Figure 36. Mean % cover of major species and FQI score at CRMS 3985 in 2008, 2009, and 2010.

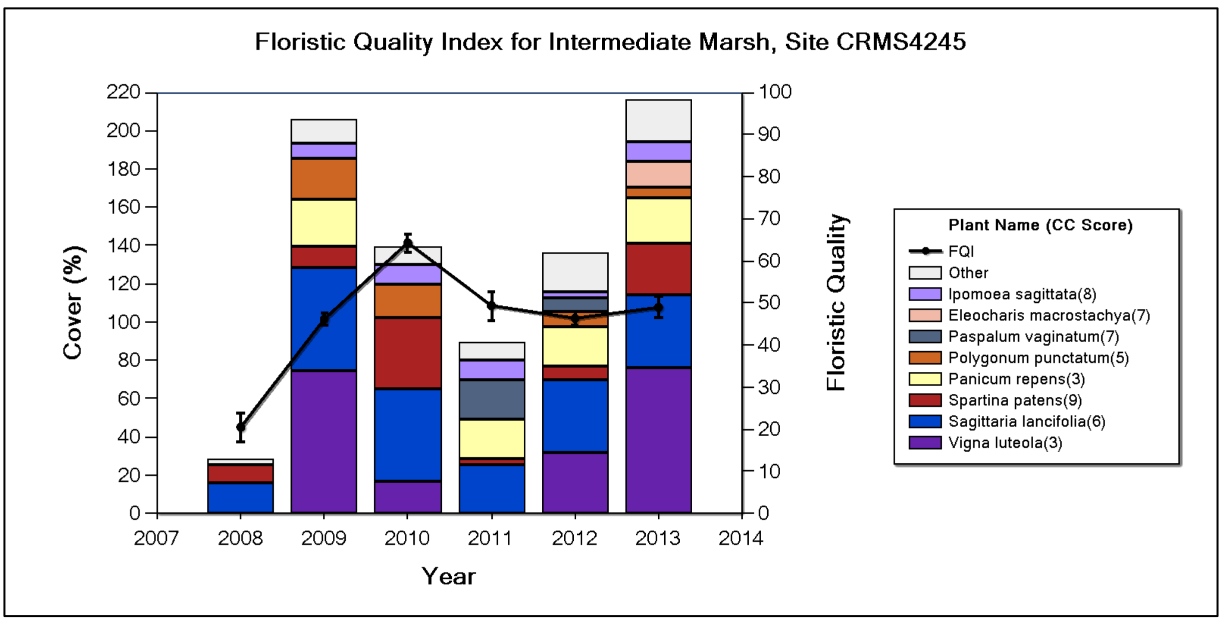


Figure 37. Mean % cover of major species and FQI score at CRMS 4245 in 2008, 2009, and 2010.

V. Conclusions

a. Project Effectiveness

The shoreline protection features associated with the BA-20 project were highly effective in achieving project goals. The goal of reducing erosion through shoreline protection has been achieved based on the 2012 land/water analysis and ongoing shoreline change analysis. Although some land loss continues to occur in the project area, the land/water analysis of the adjacent reference area showed significant shoreline loss and a higher corresponding land loss rate. The shoreline change analysis showed that there was no shoreline loss behind the shoreline structures CU2 and CU3 from 2004 to 2010, while the adjacent reference area lost approximately 45 ft/yr of shoreline.

The delayed and staggered construction regime combined with a strong environmental stress (the drought) led to difficulties in testing for hydrologic effects of the plugs and weirs. The drought caused a prolonged period of elevated salinity which may have confounded the analysis if all stations were not equally affected. Possible effects of the project on salinity were found, but the changes in salinity between the project area and the reference area are so minute that no definite conclusions can be made. The goal of decreasing variability in salinity and water level within the project area was evaluated for impacts from CU1 and CU2. Unfortunately, the CU1 and CU2 project features did not appear to have a measurable effect on salinity or water level variability, as indicated by daily salinity range or mean tidal range. There was also no reduction in salinity and water level variability at CRMS4245 following construction of CU4.

The goal of stabilizing or increasing the relative abundance of freshwater-intermediate vegetation has not been met at this time, although some positive project effects were observed. Unfortunately, the drought which occurred in the post-CU1 period caused a sharp decrease in freshwater-intermediate species coverage between 1996 and 2002, and has not rebounded to pre-drought levels. The decrease in coverage of freshwater-intermediate species was less pronounced in the project area versus the reference area, however, which may indicate some positive effect from the CU1 structures. While there was a subsequent increase in abundance of freshwater/intermediate species in the project area from 2002 to 2012, there was a similar increase observed in the reference area indicating this was system-wide and not due to project effects. The Floristic Quality Index (FQI) score, which indicates the relative health and stability of marsh communities, was more sharply reduced in the reference area than the project area due to the conversion of reference sample plots to open water. Positive indications from the CRMS sites show that coverage of freshwater/intermediate species in 2013 was at a level similar to 1999 before the drought.

b. Recommended Improvements

There are no recommendations at this time.

c. Lessons Learned

The most important lesson learned, in regards to biological monitoring, was that a staggered, long-term construction regime can have an adverse effect on data interpretation. In the future, monitoring of a project should be scheduled from 1-3 years pre-construction and 3-5 years post-construction, as determined by the final date of construction, not the start of construction. It is unrealistic to assume construction will always be completed at a single point in time. In addition, CWPPRA projects are normally monitored throughout a 20-year project life span. Further discussions are needed to determine the 'end of project' life span for the BA-20 project since the construction period spanned 13 years and O&M and monitoring budgets were calculated for a 20-year period.

Based on multiple O & M inspections, the rock dike has proven to be very effective in reducing shoreline erosion, while experiencing no deterioration and requiring no recommended maintenance. The foreshore rock dike on parts of the west reach of CU3 was constructed with zero crown width and 3:1 side slopes. This type typical section with zero crown width is impractical to construct due to the size of the stone. Future rock dike construction should specify a minimum crown top width. Parts of CU1 used a zero crown width. All subsequent project designs since that time used a specified minimum crown top width. Please refer to the as-built drawings in subsequent units and the adaptive management comments for this project, where this was a case example cited for changing current methods of design.

VI. References

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Appendix A
(Inspection Photographs)

Photo #1 – Structure #12

Photo #2 – Structure #14

Photo #3 – CU #4 Concrete Panel Wall

Photo #4 – Structure #22A

Appendix B
(Field Inspection Notes)

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: **BA-20 Jonathan Davis Wetland**

Date of Inspection: 7/2/2014 Time: 9:30 am

Structure No. Construction Unit No.1 -Site No. 12

Inspector(s): Richard, Prendergast, Kinler, Baker

Structure Description: Rock rip-rap armored plug

Water Level Inside: N/A Outside: 0.9'

Type of Inspection: Annual

Weater Conditions: Mostly sunny, light wind

Item	Condition	Pysical Damage	Corrosion	Photo #	Observations and Remarks
Signage and supports	Good			#1	
					Observations:
Armored Plug	Good			#1	There have been no changes since the last inspection. NRCS and CPRA agree that no maintenance is required at this time.
Earthen Embankment	Good				

Construction Unit No.1

Structure Description: 294 linear ft. rock rip-rap armored rock-filled plug located in a pipeline channel north of Bayou Perot, west of Bayou Barataria, and east of the GIWW The crest of the weir was set at an elevation of +3.9 ft. NGVD. The rock-filled plug contains 2,689 tons of rock filled with 2,518 tons of rip-rap armor. Aluminum warning signs are also located through the rock embankment.

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: **BA-20 Jonathan Davis Wetland**

Date of Inspection: 7/2/2014 Time: 9:30 am

Structure No. ____Construction Unit No.1 -Site No. 13____

Inspector(s): Richard, Prendergast, Kinler, Baker

Structure Description: Rock rip-rap armored weir

Water Level Inside: N/A Outside: 0.9'

Type of Inspection: Annual

Weater Conditions: Mostly sunny, light wind

Item	Condition	Pysical Damage	Corrosion	Photo #	Observations and Remarks
Signage and supports	Good				**Observations:** It is apparent this structure has settled. However, it is agreed that there is no need for maintenance at this time.
Armored Weir	Fair				
Earthen Embankment	Good				

Construction Unit No.1

Structure Description: 300 linear ft. rock rip-rap armored rock filled weir with a 50 ft. wide boat bay located north of Bayou Perot and Site 12, west of Bayou Barataria, and east of the GIWW. The crest of the weir is set at an elevation of +1.0 ft. NGVD. The invert of the boat bay is set at an elevation of -5.0 ft. NGVD. Rock wingwalls were constructed to an elevation of +3.6 ft. NGVD. On the west side and +4.0 ft. NGVD on the east side of the weir. The rock filled weir contains 1,093 tons of rock fill and 772 tons of rip-rap armor. Aluminum warning signs are located adjacent to the structure.

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: **BA-20 Jonathan Davis Wetland**

Date of Inspection: 7/2/2014 Time: 9:30 am

Structure No. Construction Unit No.1 -Site No. 14

Inspector(s): Richard, Prendergast, Kinler, Baker

Structure Description: Rock rip-rap armored plug

Water Level Inside: N/A Outside: 0.8'

Type of Inspection: Annual

Weater Conditions: Mostly sunny, light wind

Item	Condition	Pysical Damage	Corrosion	Photo #	Observations and Remarks
Signage and supports	Good			#2	**Observations:**
Armored Plug	Good			#2	Slight settlement noted, but no repairs needed at this time.
Earthen Embankment	Fair				

Construction Unit No.1

Structure Description: 138 linear ft. of rock rip-rap armored rock filled channel plug located in a pipeline channel north of Bayou Perot, west of Bayou Barataria and east of GIWW and Site 13. The crest of the plug was constructed to an elevation of +3.2 ft. NGVD. The rock filled plug contains 2,580 tons of rock fill and 1,346 tons of rock rip-rap armor. Aluminum warning signs are located through the rock embankment.

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: **BA-20 Jonathan Davis Wetland**

Date of Inspection: 7/2/2014 Time: 9:30 am

Structure No. ____Construction Unit No.1 -Site No. 15_____

Inspector(s): Richard, Prendergast, Kinler, Baker

Structure Description: Rock rip-rap armored weir w/ boat bay

Water Level Inside: N/A Outside: 0.9'

Type of Inspection: Annual

Weater Conditions: Mostly sunny, light wind

Item	Condition	Pysical Damage	Corrosion	Photo #	Observations and Remarks
Signage and supports	Good				**Observations:** The maintenance work is completed and this is now a channel plug structure.
Armored Plug	Good				
Earthen Embankment	Good				**Remarks:**

Construction Unit No.1

Structure Description: 132 linear ft. of rock rip-rap armored weir with a 50 ft. wide boat bay located in a pipeline channel north of Bayou Perot, west of Bayou Barataria and east of the GIWW and Site 14. The crest of the rock weir was constructed to an elevation of +4.0 ft. NGVD. The invert of the boat bay is at and elevation of -3.0 ft. The rock filled weir contains 1,248 tons of rock fill with and 728 tons of rock rip-rap armor. Two (2) aluminum warning signs are located through the rock armored embankment on each side of the boat bay.

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: **BA-20 Jonathan Davis Wetland**

Date of Inspection: 7/2/2014 Time: 9:30 am

Structure No. Construction Unit No.1 -Site No. 16

Inspector(s): Richard, Prendergast, Kinler, Baker

Structure Description: Rock rip-rap armored plug

Water Level Inside: N/A Outside: 0.9'

Type of Inspection: Annual

Weater Conditions: Mostly sunny, light wind

Item	Condition	Pysical Damage	Corrosion	Photo #	Observations and Remarks
Signage and supports	Good				
Armored Plug	Fair				**Observation:** There have been no changes since the last inspection. Maintenance not needed at this time.
Earthen Embankment	Good				
					Remarks:

Construction Unit No.1

303 linear ft. of rock rip-rap armored rock filled plug located in a pipeline channel north of Bayou Perot, west of Bayou Barataria, east of the GIWW and Site 15. The crest of the plug was constructed to an elevation of +4.0 ft. NGVD. The rock filled plug contains 6,483 tons of rock fill and 1,766 tons of rock rip-rap armor. Two (2) aluminum warning signs are located through the rock plug embankment.

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: **BA-20 Jonathan Davis Wetland**

Date of Inspection: 7/2/2014 Time: 9:30 am

Structure No. Construction Unit No.1 -Site No. 17

Inspector(s): Richard, Prendergast, Kinler, Baker

Structure Description: Rock rip-rap armored plug

Water Level Inside: N/A Outside: 0.9'

Type of Inspection: Annual

Weater Conditions: Mostly sunny, light wind

Item	Condition	Pysical Damage	Corrosion	Photo #	Observations and Remarks
Signage and supports	Good				
Armored Plug	Good				**Observation:** Structure is in good condition.
Earthen Embankment	Good				**Remarks:**

Construction Unit No.1

Structure Description: 197 linear ft. of rock rip-rap armored rock filled plug located in a pipeline channel north of Bayou Perot, west of Bayou Barataria, and east of the GIWW. The crest of the plug was constructed to an elevation of 3.8' NAVD. The rock filled plug contains2,253 tons of rock fill and 1,201 tons of rock rip-rap armor. Aluminum warning signs supported by galvanized pipe are located through the rock embankment.

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: **BA-20 Jonathan Davis Wetland**

Date of Inspection: 7/2/2014 Time: 9:30 am

Structure No. Construction Unit No.1 -Site No. 19

Inspector(s): Richard, Prendergast, Kinler, Baker

Structure Description: Rock rip-rap armored weir

Water Level Inside: N/A Outside: 0.9'

Type of Inspection: Annual

Weater Conditions: Mostly sunny, light wind

Item	Condition	Pysical Damage	Corrosion	Photo #	Observations and Remarks
Signage and supports	Good				**Observation:**
Armored Weir	Good				There have been no changes since the last inspection. NRCS and CPRA agree that this structure does not need maintenance at this time.
Earthen Embankment	Good				

Construction Unit No.1

Structure Description: 239 linear ft. of rock rip-rap armored rock filled fixed crest weir with a 60 ft. wide boat bay located in a pipeline channel east of the GIWW, north of Bayou Perot, and west of Bayou Barataria. The crest of the weir was constructed to an elevation of +1.9 ft. NGVD on the north side and +2.0 ft. NGVD on the south. The boat bay invert was constructed to an elevation of -2.5 ft. NGVD. The rock filled plug contains 1,014 tons of rock fill with 572 tons of rock rip-rap armor. Aluminum waring signs are located on each side of the barge bay through the rock embankment.

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: **BA-20 Jonathan Davis Wetland**

Date of Inspection: 7/2/2014 Time: 9:30 am

Structure No. Construction Unit No.1 -Site No. 20

Inspector(s): Richard, Prendergast, Kinler, Baker

Structure Description: Rock rip-rap armored plug

Water Level Inside: N/A Outside: 0.9'

Type of Inspection: Annual

Weater Conditions: Mostly sunny, light wind

Item	Condition	Pysical Damage	Corrosion	Photo #	Observations and Remarks
Signage and supports	Good				
Armored Plug	Good				**Observation:** There have been no changes since the last inspection. No maintenance required at this time. Will monitor this structure on future site visits.
Earthen Embankment	Good				This structure has become heavily vegetated and a closer inspection should be made to determine if any settlement has occurred.

Construction Unit No.1

Structure Description: 170 linear ft. of rock rip-rap armored rock filled plug located north of Bayou Rigolettes, west of Bayou Barataria, and east of Bayou Perot. The plug crest was constructed to an elevation of +4.0 ft. NGVD. The rock filled plug contains 1,829 tons of rock fill with 795 tons of rock rip-rap armor. Two (2) aluminum warning signs are located on each end of the structure through the armored rock plug embankment.

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: **BA-20 Jonathan Davis Wetland** Date of Inspection: 7/2/2014 Time: 9:30 am

Structure No. Construction Unit No.1 -Site No. 21 Inspector(s): Richard, Prendergast, Kinler, Baker

Structure Description: Rock rip-rap armored plug Water Level Inside: N/A Outside: 0.9'

Type of Inspection: Annual Weater Conditions: Partly Cloudy, Moderate Wind

Item	Condition	Pysical Damage	Corrosion	Photo #	Observations and Remarks
Signage and supports	Good				
Armored Plug	Good				**Observation:** There have been no changes since the last inspection. No maintenance will be required at this time.
Earthen Embankment	Good				

Construction Unit No.1

Structure Description: 83 linear ft. of rock rip-rap armored rock filled plug located north of Bayou Rigolettes, west of Bayou Barataria, and east of Bayou Perot. The plug crest was constructed to an elevation of +4.0 ft. NGVD. The rock filled plug contains 285 tons of rock fill and 220 tons of rock rip-rap armor. Two (2) aluminum warning signs supported by galvanized pipe are located on each end of the structure through the rock embankment.

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: **BA-20 Jonathan Davis Wetland** Date of Inspection: 7/2/2014 Time: 9:30 am

Structure No. Construction Unit No. 4 Inspector(s): Richard, Prendergast, Kinler, Baker

Structure Description: Concrete panel wall Water Level Inside: N/A Outside: 0.9'

Type of Inspection: Annual Weater Conditions: Mostly sunny, light wind

Item	Condition	Pysical Damage	Corrosion	Photo #	Observations and Remarks
Signage and supports	Good			#3	
Concrete wall panels, piles, hardware	Good			#3	**Observation:** There have been no changes since the last inspection. No repairs are necessary at this time.
Rock Dike	Good				

Construction Unit No.4

Structure Description: The wall consists of approx. 12,850 linear ft. of pre-cast concrete wall sections supported by 848 pre-cast concrete piles, in addition to approx. 4,290 linear feet of rock rip-rap bank stabilization/shoreline protection. C.U. #4 extends across the northern edge of Bayou Rigolettes and Bayou Perot, from just east of Structure #12 to Structure #20.

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: **BA-20 Jonathan Davis Wetland**

Date of Inspection: 7/2/2014 Time: 9:30 am

Structure No. Construction Unit No.2 -Site No. 22A

Inspector(s): Richard, Prendergast, Kinler, Baker

Structure Description: Canal Bank Stabilization

Water Level Inside: N/A Outside: 0.9'

Type of Inspection: Annual

Weater Conditions: Mostly sunny, light wind

Item	Condition	Pysical Damage	Corrosion	Photo #	Observations and Remarks
Signage and supports	Good			#4	
					Observation:
Rock Armored Bank	Good			#4	There have been no changes since the last inspection. No maintenance is required at this time.
Earthen Embankment	Good				

Construction Unit No.2

Structure Description: Canal bank stabilization consisting of 1,385 linear ft. of rock rip-rap protection on the west bank of the access channel at the Baltazaar Point Subdivision. The rip-rap was constructed to an elevation of +3.0 ft.

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: **BA-20 Jonathan Davis Wetland**

Date of Inspection: 7/2/2014

Time: 9:30 am

Structure No. Construction Unit No.2 -Site No. 22

Inspector(s): Richard, Prendergast, Kinler, Baker

Structure Description: Steel sheet pile structure w/ boat bay

Water Level Inside: N/A Outside: 0.9'

Type of Inspection: Annual

Weater Conditions: Mostly sunny, light wind

Item	Condition	Pysical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	Good				
Handrails Hardware, etc.	Good				**Observation:** There have been no changes since the last inspection. No maintenance required at this time.
Signage and supports	Good				
Earthen Wingwalls	Good				
Rock Armored Earthen Embankment	Good				

Construction Unit No.2

Structure Description: 58 linear ft. of steel sheet pile bulkhead with a crest elevation of +1.95 ft. and a 24' - 8-1/2" wide boat bay with a crest elevation of -0.93 ft. located off of Bayou Regolettes, west of Bayou Barataria and east of GIWW. The structure consists of a steel sheet pile weir with 1,426 square feet of sheet piling set at +1.95 ft. At the bottom the boat bay, is a 1.5 ft. thick rock rip-rap scour pad seciton with an invert of -0.93 ft. This structure ties into structure 22A on the west side. Aluminum warning signs supported by 12" diameter timber piles are located at the entrance of the boat bay.

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: **BA-20 Jonathan Davis Wetland**

Date of Inspection: 7/2/2014

Time: 9:30 am

Structure No. Construction Unit No.2

Inspector(s): Richard, Prendergast, Kinler, Baker

Structure Description: Rock dike along Bayou Rigolettes

Water Level Inside: N/A Outside: 0.9'

Type of Inspection: Annual

Weater Conditions: Mostly sunny, light wind

Item	Condition	Pysical Damage	Corrosion	Photo #	Observations and Remarks
Signage and supports	Good				
Armored Plug	Good				**Observation:**
Rock Dike	Good				Some settlement was noted, but structure was performing as designed. No maintenance will be required at this time.
Earthen Embankment	Good				

Construction Unit No.2

Structure Description: The rock dike consist of 3,967 linear ft. of rock dike with a 6 ft. top width and a crest elevation of +3.5 ft. The shoreline stabilization extends from Site 22A west to Structure No.20.

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: **BA-20 Jonathan Davis Wetland** Date of Inspection: 7/2/2014 Time: 9:30 am

Structure No. Construction Unit No.3 Inspector(s): Richard, Prendergast, Kinler, Baker

Structure Description: Rock dike along Bayou Perot Water Level Inside: N/A Outside: 0.9'

Type of Inspection: Annual Weater Conditions: Mostly sunny, light wind

Item	Condition	Pysical Damage	Corrosion	Photo #	Observations and Remarks
Signage and supports	Good				
Armored Plug	Good				**Observation:** There have been no changes since the last inspection. No repairs are necessary at this time.
Rock Dike	Good				
Earthen Embankment	Good				

Construction Unit No.3

Structure Description: The rock dike consist of 13,088 linear ft. of rock dike with a 6 ft. top width and a crest elevation of +3.5 ft. The shoreline stabilization extends from Site 12 west to the Gulf Intracoastal Waterway

Appendix C
(Three Year O&M Budget Projection)

Jonathan Davis Wetland Restoration Project (BA-20)
Federal Sponsor: NRCS
Construction Completed : 5/29/2001
PPL 2

Current Approved O&M Budget June 2009	Year 0 FY02	Year - 1 FY03	Year -2 FY04	Year -3 FY05	Year -4 FY06	Year -5 FY07	Year -6 FY08	Year -7 FY09	Year -8 FY10	Year -9 FY11	Year -10 FY12	Year -11 FY13	Year -12 FY14	Year -13 FY15	Year -14 FY16	Year -15 FY17	Year -16 FY18	Year - 17 FY19	Year -18 FY20	Year -19 FY21	Project Life Budget	Currently Funded
State O&M	$4,200	$4,309	$4,421	$4,536	$84,433	$504,924	$4,899	$5,027	$5,157	$111,609	$2,668,178	$5,570	$5,715	$218,766	$170,377	$3,462,144	$11,333	$11,498	$11,667	$11,840	$7,310,604	$7,310,604
Corps Admin																					$0	$0
Federal S&A																					$0	$0
Total																					$7,310,604	$7,310,604

Projected O&M Expenditures	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	Remaining Project Life	Current 3 year Request
Maintenance Inspection	$4,200	$4,309	$4,421	$4,536	$4,654	$4,775	$4,899	$5,027	$5,157	$5,291	$5,429	$5,570	$5,715	$5,864	$6,016	$6,172	$6,333	$6,498	$6,667	$6,840	$44,389	$18,052
General Maintenance																					$0	$0
Surveys					$75,000					$100,000					$150,000						$150,000	$150,000
Sign Replacement														$200,000							$200,000	$200,000
Federal S&A					$4,779	$19,420				$6,317	$102,622			$12,352	$9,361	$132,967					$154,680	$154,680
Maintenance/Rehabilitation																					$0	$0
E&D						$32,688					$155,327					$198,005					$198,005	$198,005
Construction						$430,809					$2,312,307					$3,000,000					$3,000,000	$3,000,000
Construction Oversight						$17,232					$92,492					$120,000					$120,000	$120,000
Total	$4,200	$4,309	$4,421	$4,536	$84,433	$504,924	$4,899	$5,027	$5,157	$111,609	$2,668,178	$5,570	$5,715	$218,215	$165,377	$3,457,144	$6,333	$6,498	$6,667	$6,840	$3,867,074	$3,840,737

O&M Expenditures from COE Report	$1,258,500	per Lana Report	Current O&M Budget less COE Admin	$7,310,604		Current Project Life Budget less COE Admin	$7,310,604
State O&M Expenditures not submitted for in-kind credit	$0		Remaining Available O&M Budget	$6,052,104		Total Projected Project Life Budget	$5,125,574
Federal Sponsor MIPRs (if applicable)	$0		**Incremental Funding Request Amount FY15-FY17**	**-$2,211,367**		**Project Life Budget Request Amount**	**-$2,185,030**
Total Estimated O&M Expenditures (as of June 2014)	$1,258,500						