State of Louisiana

Coastal Protection and Restoration Authority (CPRA)

2021 Operations, Maintenance, and Monitoring Report

for

Cameron Creole Maintenance

State Project Number CS-04a
Priority Project List 3

September 2021
Cameron Parish

Prepared by:

Mark Mouledous
And
Dion Broussard, P.E.

Operations Division
Lafayette Regional Office
635 Cajundome Boulevard
Lafayette, LA 70506

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For
Cameron Creole Maintenance (CS-04a)

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Preface

This report includes monitoring data collected through December 2020, and the annual maintenance inspections through May 2021. The Cameron Creole Maintenance (CS-04a) project is a 20-year Coastal Wetlands, Planning, Protection, and Restoration Act (CWPPRA, Public Law 101-646, Title III, Priority List 3) project that was authorized for a 20-year extension, administered by the Natural Resources Conservation Service (NRCS) and the Coastal Protection and Restoration Authority of Louisiana (CPRA).

The 2021 report is the 1st in a series of reports. These reports will be made available for download at the following website: http://cims.coastal.la.gov/.

I. Introduction

The Cameron Creole Maintenance (CS-04a) project area is located primarily in the East Cove Unit of the Sabine National Wildlife Refuge and on Miami Corporation property, approximately 6 miles northeast of Cameron in Cameron Parish, La (Figure 1). It is bounded by the Gulf Intracoastal Waterway on the north, Calcasieu Lake on the west, and by Louisiana Highway 27 to the east and south (LCWRTF 2008). The project encompasses 63,959 acres of fresh-to-saline marsh and open water. The project is co-sponsored by the Natural Resource Conservation Service (NRCS) and the Coastal Protection and Restoration Authority (CPRA).

Historically, marshes within the project area consisted primarily of vast, unbroken stands of fresh and low-salinity vegetation with brackish marshes occurring along the border of Calcasieu Lake (USDA 2007). Early accounts of the watershed marshes identify sawgrass (*Cladium jamaicense*) as a dominant vegetation type (Harris 2012). The watershed experienced marsh loss largely due to saltwater intrusion, resulting from construction and enlargement of the Calcasieu Ship Channel in 1941, 1951 and 1968 (Harris 2012), which weakened the fresher plant communities. Natural disturbances, such as drought and Hurricanes Audrey and Carla converted significant areas of the weakened marsh into open water.

The Cameron-Creole Watershed project was constructed to reduce saltwater intrusion and preserve the deteriorating marshes and consisted of two phases. Construction of the first phase began in 1981, consisting of a 16-mile protection levee and interior borrow canal along the eroding shoreline of Calcasieu Lake. The second phase involved the installation of five water control structures and was completed in 1989 (Harris 2012). The United States Fish and Wildlife Service (USFWS) was tasked with operation of the structures under the original Operation and Maintenance Agreement of 1981. In 1997, as part of the CS-17 project, two sheet metal plugs were installed in the borrow area inside of the levee in order to increase control of water flow, isolate management areas, and prevent further saltwater intrusion in the watershed (USFWS 1991).

The watershed operations are overseen by the Cameron Creole Advisory Committee composed of staff from NRCS, USFWS, Louisiana Department of Wildlife and Fisheries (LDWF), United States Army Corps of Engineers (USACOE), Cameron Parish Police Jury, Miami Corporation, National Oceanic and Atmospheric Administration (NOAA) and Cameron Parish

Gravity Drainage District 3. Operations are performed in accordance with the project's management plan (Appendix I). Prior to January 1st, 2012, water level and salinity monitoring and subsequent gate operations were performed by Cameron Prairie NWR staff. Thereafter, monitoring and gate operations have been performed by CPRA.

The project includes a 16-mile protection levee and five water control structures. There are two fixed crest weirs that allow for ingress and egress at Mangrove Bayou and NoName Bayou along with two adjustable crest weirs that allow for additional ingress and egress at Peconi Bayou and Lambert Bayou. The Grand Bayou Boat Bay has flaps that drain into the lake and a boat bay that allows for the passage of small boats into the Cameron Prairie NWR.

The project reached its 20-year project life in 2017. The CWPPRA Task Force Committee approved funding for a 20-year extension of the project and combined the remaining funds from CS-17 into CS-04a. It also provided funds for CPRA to generate monitoring reports (NRCS was responsible for monitoring reports during the first 20 years of the project).

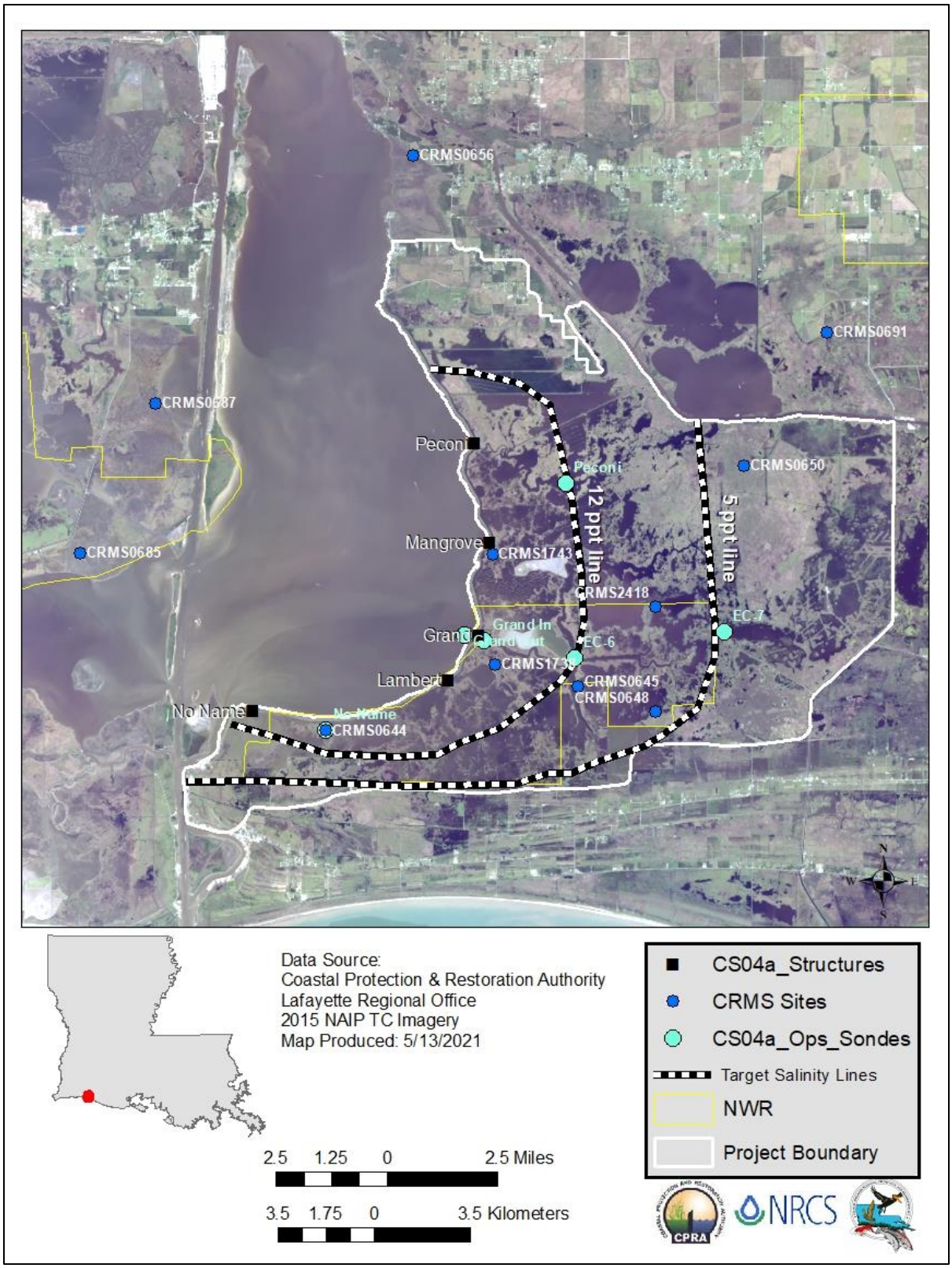

Figure 1. Cameron Creole Watershed Maintenance (CS-04a) project features, CRMS sites, and operation sonde locations.

II. Maintenance Activity

a. Project Feature Inspection Procedures

The purpose of the annual inspection of the Cameron Creole Maintenance Project (CS-04a) 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, 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.

CPRA performed a site inspection and damage assessment following Hurricane Laura on October 01, 2020, and again on December 10, 2020 following Hurricane Delta. The last annual inspection was conducted November of 2017.

The field inspection included a complete visual inspection of all project features. Staff gage readings and existing temporary benchmarks where available were used to determine approximate elevations of water, earthen terraces, rock dike, and other project features. Photographs were taken at each project feature (see Appendix A).

b. Inspection Results

The project consists of five (5) water control structures, a 16-mile protection levee, and six (6) monitoring stations.

Water Control Structures

Peconi Bayou Structure –	Storm debris on structure. No physical damage to structure.
Mangrove Bayou Structure –	Storm debris on structure. Southernmost gate not operating properly. The outlet (lakeside) is silted in following Hurricane Delta.
Grand Bayou Structure –	Storm debris on structure. Two (2) gate boards on one of the gates were detached from the gate. There was damage to the walkway. Boat bay guides were detached from anchors.
Lambert Bayou Structure -	Storm debris on structure. The handrails and fencing are detached from the structure. Stairs to the upper platform are damaged.

No-Name Bayou Structure - Storm debris on structure. The handrails and fencing are detached from the structure. There is scour on both ends of structure.

Protection Levee

The levee has a heavy deposit of storm-surge-carried marsh vegetation on it. It is estimated to be at least a foot or two in depth along most of the levee and possibly more in certain areas. There are numerous objects scattered about the levee over its entire length. Some of the larger items are automobiles and oil storage tanks.

There are two breaches in the levee as a result of scour from water flow from storm surge and/or drainage. The two breaches occurred at the 2007 Hurricane Rita breach repairs (sheet pile structures in levee). They are as follows:

Lambert Bayou breach repair – approximately 15-20 feet of levee has scoured at the northern end of the sheet pile structure. Pending further investigation, the depth of scour is unknown. It is also believed the levee connecting the breach repair and the water control structure has been reduced in elevation from the storm surge passing over it.

No Name Bayou breach repair – there is some significant scour on the eastern end of the sheet pile structure and minor scour on the western end. Rock along the entire length and ends of the structure has been displaced or washed away from storm surge. A landowner access road has been washed out along the entire length (350 feet) of the south side of the sheet pile structure.

Monitoring Stations

There are six (6) monitoring stations within the project boundary. They collect and transmit real-time data on salinity and water level, to aid in decision making for operation of the water control structures. One (1) monitoring station are still transmitting data and the other five (5) are damaged or completely missing. The monitoring stations and observations at each are below.

Peconi Bayou – monitoring equipment damaged and no longer transmitting data.
Grand Bayou Outside – still in place and transmitting data. Needs new telemetry.
Grand Bayou Inside – monitoring equipment missing and no longer transmitting data.
No Name Bayou – monitoring station damaged and no longer transmitting data.
EC-06 - monitoring equipment missing and no longer transmitting data.
EC-07 - monitoring equipment missing and no longer transmitting data.

Recommendations:

The entire length of the levee (16 miles) needs to be inspected for damage. A preliminary inspection will be made. However, more damage may be revealed after storm carried vegetation is cleared from the levee.

A FEMA claim has been submitted and CPRA is awaiting approval of funding for repairs.

Below is the overall estimated cost for the recommended repairs outlined above:

Estimated Repair Costs:

Storm debris cleanup/minor maintenance on water control structures		**$35,000**
Repair and replacement of monitoring stations		**$16,000**
Removal of vegetative debris from atop levee		**$160,000**
Repair of breeches and scour at water control structures		
Engineering, Design, Construction Admin & Insp.	$225,000	
CPRA Admin.	$40,000	
Construction	$1,947,500	
Total Estimated Construction Costs:		**$2,423,500**
15% Contingency:		**$363,525**
TOTAL COST TO GET PROJECT IN WORKING ORDER		**$2,787,025**

c. Maintenance Recommendations

i. Immediate/ Emergency Repairs

The monitoring stations have been replaced and are operational.

Some minor repair/maintenance has been done on the structures. All other work is pending FEMA approval of funding.

ii. Programmatic/ Routine Repairs

No maintenance work required at this time.

d. Maintenance History

General Maintenance: Below is a summary of completed maintenance projects and operation tasks performed since September 2006.

Repairs were done following Hurricanes Rita and Ike (2005 and 2008). Those repairs are listed below for years 2007-2011. The repair costs for these events were offset by a reimbursement of approximately $15 million from the Federal Emergency Management Agency (FEMA). The maintenance events listed from 2012-2017 were funded by the CWPPRA program.

2007/2008 – Levee Breach Repairs Post Hurricane Rita – This maintenance project included the placement of sheet pile structures supported by batter piles with rip rap placed at the base of each structure in the breaches.

- Mangrove Bayou - 52'-6" sheet pile wall, 265 tons rip rap
- Grand Bayou - 82'-8" sheet pile wall, 1760 tons rip rap
- Lambert Bayou - 203'-5" sheet pile wall, 7245 tons rip rap
- No Name Bayou - 203'-5" sheet pile wall, 4022 tons rip rap

This maintenance project was a result of damages sustained from Hurricane Rita's storm surge in September 2006.

Original Construction Contract	$4,727,999.00
Change Orders – Over/(Under Run)	($683,078.50)
Final Construction Contract	**$4,044,920.50**

2009 – Restoration of the Cameron-Creole Watershed Levee Phase I – This maintenance project included the refurbishment of the approximately 1.5 miles of protection levee south of the No Name Bayou Water Control Structure.

- Soil Quantities - 97,000 Cubic Yards
- Limestone - 2,312 Tons

This maintenance project was a result of both long-term subsidence/degradation and damages sustained from Hurricane Rita's storm surge in September 2006.

Original Construction Contract	$1,119,930.00
Change Orders – Over/(Under Run)	$6,678.00
Final Construction Contract	**$1,126,608.00**

2010/2011 – Restoration of the Cameron-Creole Watershed Levee Phase II – This maintenance project included the refurbishment of the approximately 15.5 miles of protection levee north of the No Name Bayou Water Control Structure.

- Soil Quantities - 536,136 Cubic Yards

This maintenance project was a result of both long-term subsidence/degradation and damages sustained from Hurricane Rita's storm surge in September 2006.

Original Construction Contract	$14,155,386.00
Change Orders – Over/(Under Run)	$258,486.00
Final Construction Contract	**$14,413,872.00**

2012/2013 – Cameron-Creole Maintenance (Vandalism Repair/Minor Maintenance) – This maintenance project included removing and disposing of all electrical components from each of the five (5) water control structures, as well as performing general maintenance tasks to the lifting mechanisms and handrails.

- Peconi Bayou Structure Repair - $22,869.00
- Mangrove Bayou Structure Repair - $14,157.00
- Grand Bayou Structure Repair - $25,047.00
- Lambert Bayou Structure Repair - $25,047.00
- No Name Structure Repair - $19,602.00
- Grand Bayou Water Barrier - $3,267.00

The water control structures had previously been automated in an effort to allow for remote operation of the gates, but never worked effectively. Storm surge from Hurricane Rita caused significant impacts to the automated operation equipment. This maintenance event returned the structures to manual operation.

Original Construction Contract	$109,989.00
Change Orders – Over/(Under Run)	$5,383.00
Final Construction Contract	**$115,372.00**

2017 – Cameron-Creole Levee Lakeshore Protection – This maintenance project added shoreline protection at the Peconi, Mangrove, and Grand Bayou Structures by the placement of rip rap on the -1.0 ft contour.

- Peconi Bayou Structure - 5,777 Tons
- Mangrove Bayou Structure - 4,125 Tons
- Grand Bayou Structure - 3,226 Tons

Original Construction Contract	$1,127,070.00
Change Orders – Over/(Under Run)	$67,464.00
Final Construction Contract	**$1,194,534.00**

III. Operation Activity

a. Operation Plan

a. Actual Operations

III. Monitoring Activity

Data to inform project operations comes from five real-time hydrology stations located inside the CCW and in Calcasieu Lake near Grand Bayou (Figure 1). CRMS data will be used to assess project performance. CRMS does not include fisheries or SAV data so we will not be able to directly assess items 2 and 5 below.

a. Monitoring Goals

The objective of the Cameron Creole Watershed Maintenance project is to restore the project area to approximate the 1972 vegetative communities and salinity regimes.

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

1. Curtail marsh erosion
2. Maintain and improve the marsh and open water ponds for high value fisheries nursery and production areas.
3. Reclaim some of the emergent marshes that have been recently converted to open water by saltwater intrusion and subsequent marsh erosion.
4. Improve plant species diversity in emergent marshes which would improve the potential for wildlife habitat.
5. Improve aquatic plant species coverage and diversity.
6. Establish two isohaline lines based on historical vegetative communities and salinities to aid in guiding management procedures (Figure 1).
    a. Isohaline line no.1 will be established at approximately 12 ppt.
    b. Isohaline line no. 2 will be established at approximately 5 ppt.
7. Maintain water levels within a range of 6 inches below marsh elevation up to 2 inches above marsh elevation at the 5 ppt isohaline.

b. Monitoring Elements

Aerial Photography

In order to evaluate land/water ratios in the watershed, land/water data were obtained from digital imagery with 1-meter resolution. The photography was georectified using standard operating procedures described in Steyer et al. (1995, revised 2000), and land/water ratios were determined. Aerial photography was captured in 2018 and will be captured when CRMS coastwide imagery becomes available near 2024 and 2030 (Folse et al. 2020).

In addition, land change of the project area as a whole was assessed from land/water data interpreted from TM satellite imagery (30 m^2 resolution) which is stored on the CRMS viewer website (http://www.lacoast.gov/crms_viewer/). Linear regressions were calculated for the period of record. The variability in percent land data points around the slope illustrate the influence of various sources of environmental variance or classification error. Positive slopes indicate increasing percent land or historical land gain, and negative slopes indicate decreasing percent land or historical land loss (Couvillion et al., 2017).

Salinity

Salinity is monitored hourly utilizing six CRMS-*Wetlands* sites (1743, 2418, 1738, 645, 648, 644) within the project area and selected reference site CRMS0685, within Calcasieu Lake. (Figure 1). Continuous data were used to characterize average annual salinities throughout the project and reference areas. At each servicing, a measurement of interstitial water salinity is collected adjacent to each gauge. Interstitial water salinity is also determined at the 10 vegetation plots, when vegetation is surveyed. Salinity data were used to determine if project area salinity is being maintained within the target range. Salinity was monitored hourly from 8/7/2007 - 12/31/2020.

Water Level

Water level within the marsh is measured at every CRMS-*Wetlands* site every hour with a water-level gauge installed within an area that is hydrologically connected to the surrounding water body. Water level data was monitored hourly from 8/7/2007 – 12/31/2020 and were used to determine if the project water level is being maintained within the target range. The gauge is surveyed relative to the top of the RSET (NAVD 88). Marsh elevations are correlated to the gauges and were used in determining marsh flooding events.

Vegetation

Vegetation composition and cover is estimated from 10 permanent 2x2 m plots that are randomly distributed along a transect in the emergent marsh within each of the 1 km^2 CRMS-*Wetlands* sites. Data were collected in early fall of 2006 through 2019 using the Braun Blanquet method.

Individual species' cover data are summarized according to the Floristic Quality Index (FQI) method (Cretini and Steyer 2011). A list of plants occurring in Louisiana's coastal wetlands (~500 species) was provided to all known Louisiana coastal vegetation experts and their input on scoring was requested. The panel then provided an agreed upon group score (Coefficient of Conservatism or CC score) for each species. CC scores are weighed based on cover in the FQI for Louisiana coastal wetlands. All species known to occur in the coastal zone were given a floristic quality score on a scale of 0 to 10. Species that scored the lowest were considered by the panel to indicate disturbance or unstable marsh environments. CRMS sites inside (599, 600, 609, 610) the project were used for this report.

Elevation Change

Soil surface elevation change utilizing a combination of sediment elevation tables (RSET) and vertical accretion from feldspar horizon markers are being measured twice per year at each CRMS-*Wetlands* 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, NAVD88) so it can be directly compared to other elevation variables such as water level. Data collected over at least 5 years were used to calculate rates for the project and reference areas; therefore, the displayed elevation change rates are an estimation of that temporal trend.

c. Monitoring Results and Discussion

Aerial Photography

The goals for land change are to curtail marsh erosion and to reclaim some of the emergent marshes that were converted to open water by saltwater intrusion. The project was meeting these goals prior to 2005 as the land change trend was positive (Figure 2). Hurricanes Rita and Ike in 2005 and 2008 caused extensive land loss in the project area as well as breaches in the lake shore levee that made hydrologic management impossible until 2009. The combination of this plus a prolonged drought from 2010-2011 caused elevated salinities in the watershed that further stressed the emergent vegetation. Due to active management and increased precipitation, the watershed has experienced significant land gain since then (approximately 9,000 acres) (Figure 2). Much of the gain occurred in the eastern side of the project area. The lower salinities enabled emergent vegetation (primarily *Phragmites australis*) to fill in shallow ponds in this area. However, it is likely that Hurricanes Laura and Delta in August 2020 will result in more land loss in the watershed.

Land:water analysis was completed for the 2018 aerial photography (Figure 3). Results indicated 50.8% land and 49.2% water within the project area. Future analyses will help to better determine the project's effect on land change as well as the extent of the damage from the 2020 hurricanes.

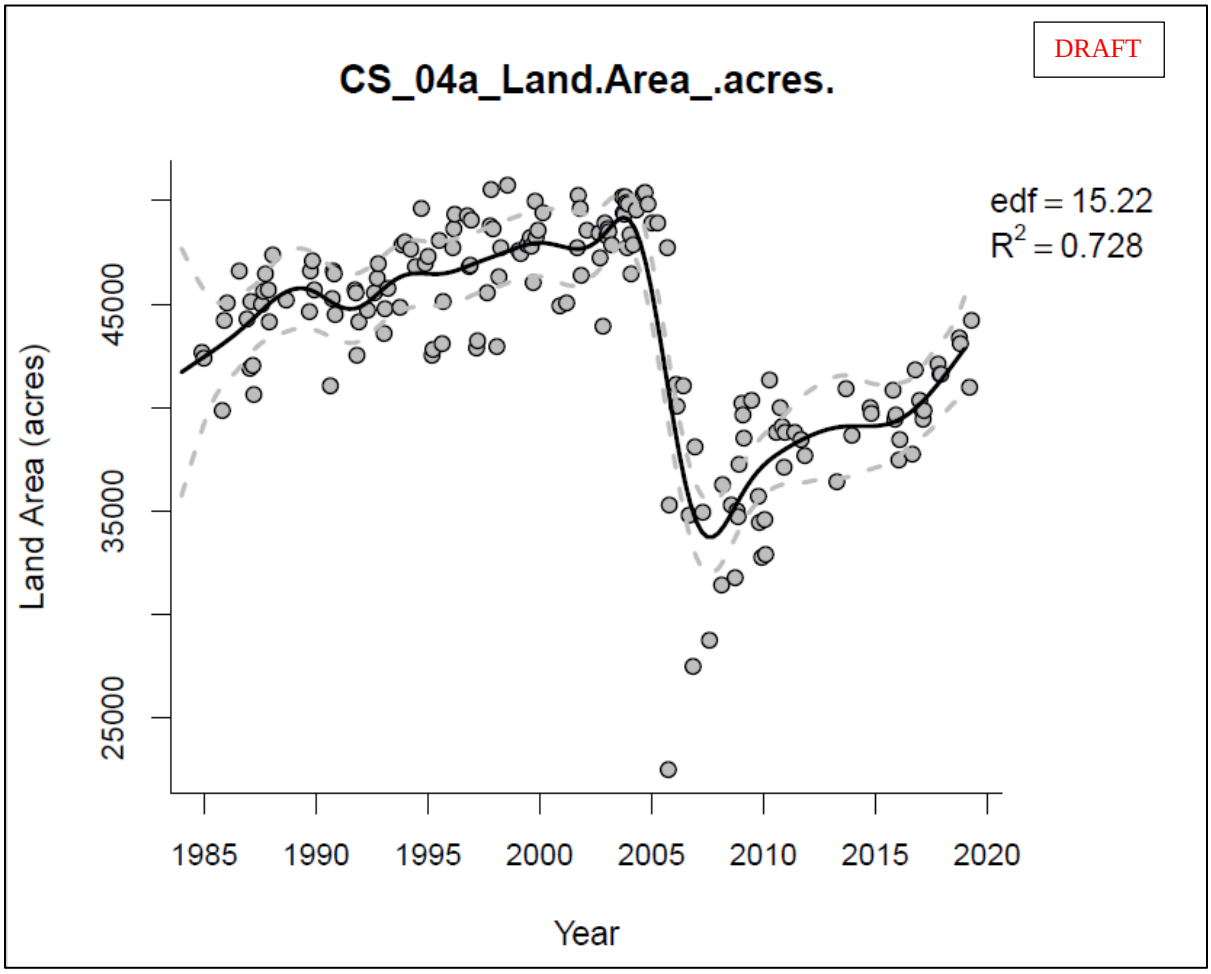

Figure 2. Project scale land change for CS-04a. Land acreages are displayed for all cloud free TM images available from 1985-2020. See Couvillion et al. 2017.

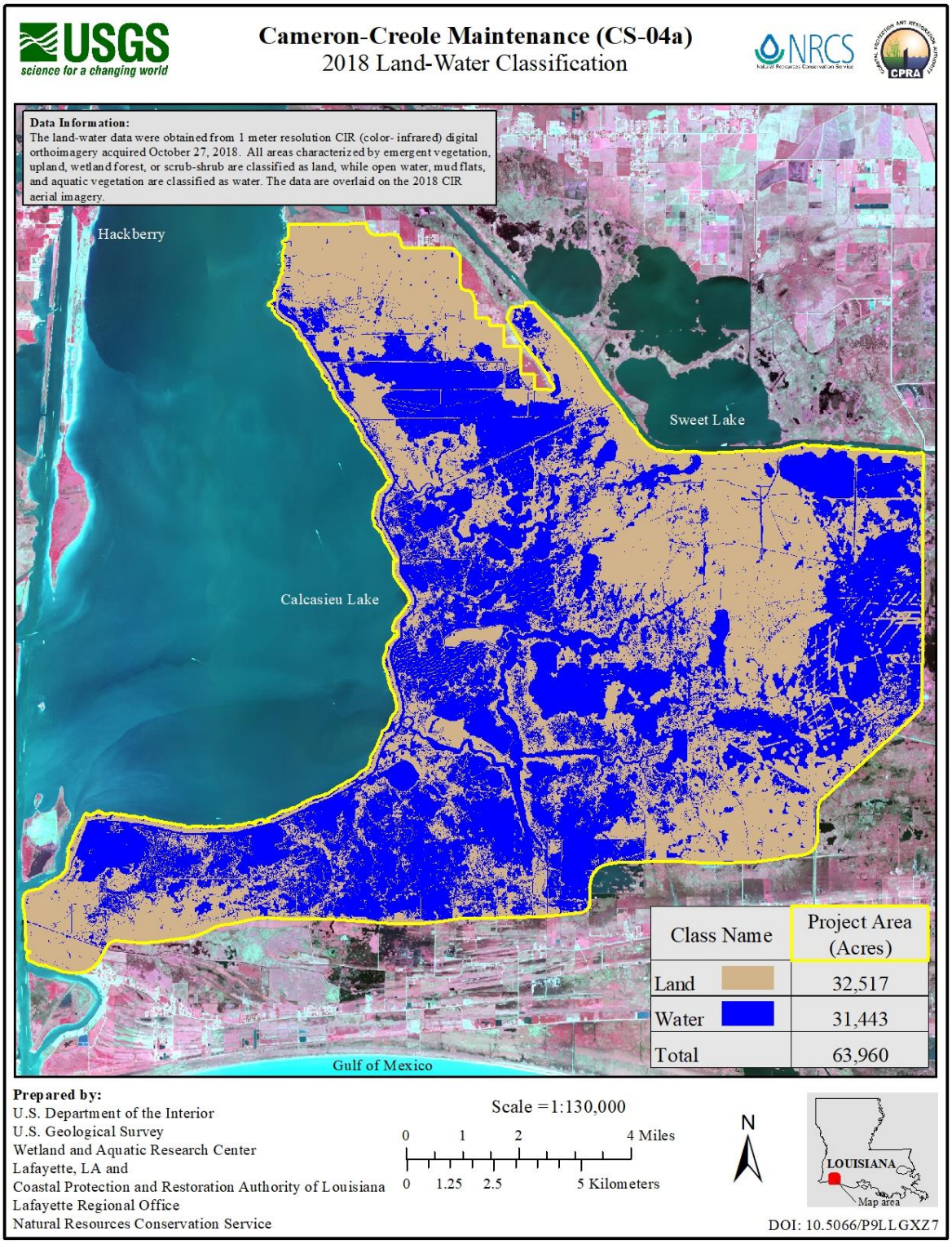

Figure 3. Cameron Creole Maintenance (CS-04a) project 2018 land/water analysis.

Salinity

The project's goal for salinity is to establish two isohaline lines to aid in guiding management procedures. Salinities are to be kept below 5 ppt east of Isohaline 2 (in the back of the watershed) and below 12 ppt east of Isohaline 1 (middle of the watershed, near the lake). Though CRMS2418 is physically located west of Isohaline 2, for the salinity analysis it is designated as being in Isohaline 2 as the recorder at this site reflects conditions at the 5 ppt operations recorder. Prior to 2012, when CPRA began active operations of the structures, salinity goals were rarely met, averaging less than 40% of the year in both the 5 ppt and 12 ppt isohalines (Figure 4a). During the severe drought of 2011, the target was not achieved throughout the entire year. The project has benefited greatly from active management, as well as increased precipitation in recent years (Figure 4d). Since 2013, the project has remained within target nearly 100% of the time, besides 2014 and 2018, which were drought years; during these years, the project was still within target ~ 70% of the year.

Salinities have also averaged below target for the entire year, since 2013, at both isohalines (Figure 4b), even with minor increases in the droughts of 2014 and 2018. Salinities peaked during the 2011 drought, averaging near 25 ppt in the project, with a maximum salinity recorded at CRMS0648 of 56 ppt, caused by evaporation leading to hypersaline conditions in parts of the watershed (Figure 4c).

The project area was impacted by storm surges from four major hurricanes since 2005: Rita (2005), Ike (2008), Laura and Delta (2020), inundating the watershed with high salinity water from the Gulf of Mexico. The impact from these storms was compounded by the damage they caused to the project infrastructure. Hurricane Rita caused breaches to the levee system that were not repaired until 2009, after Hurricane Ike. Hurricane Laura again caused a breach in the levee near Grand Bayou that is still allowing Calcasieu Lake to freely exchange with the watershed. Hydrologic control of the watershed is not possible until this breach is repaired. As such, it's impossible to meet the project's salinity goals when salinities increase in Calcasieu Lake.

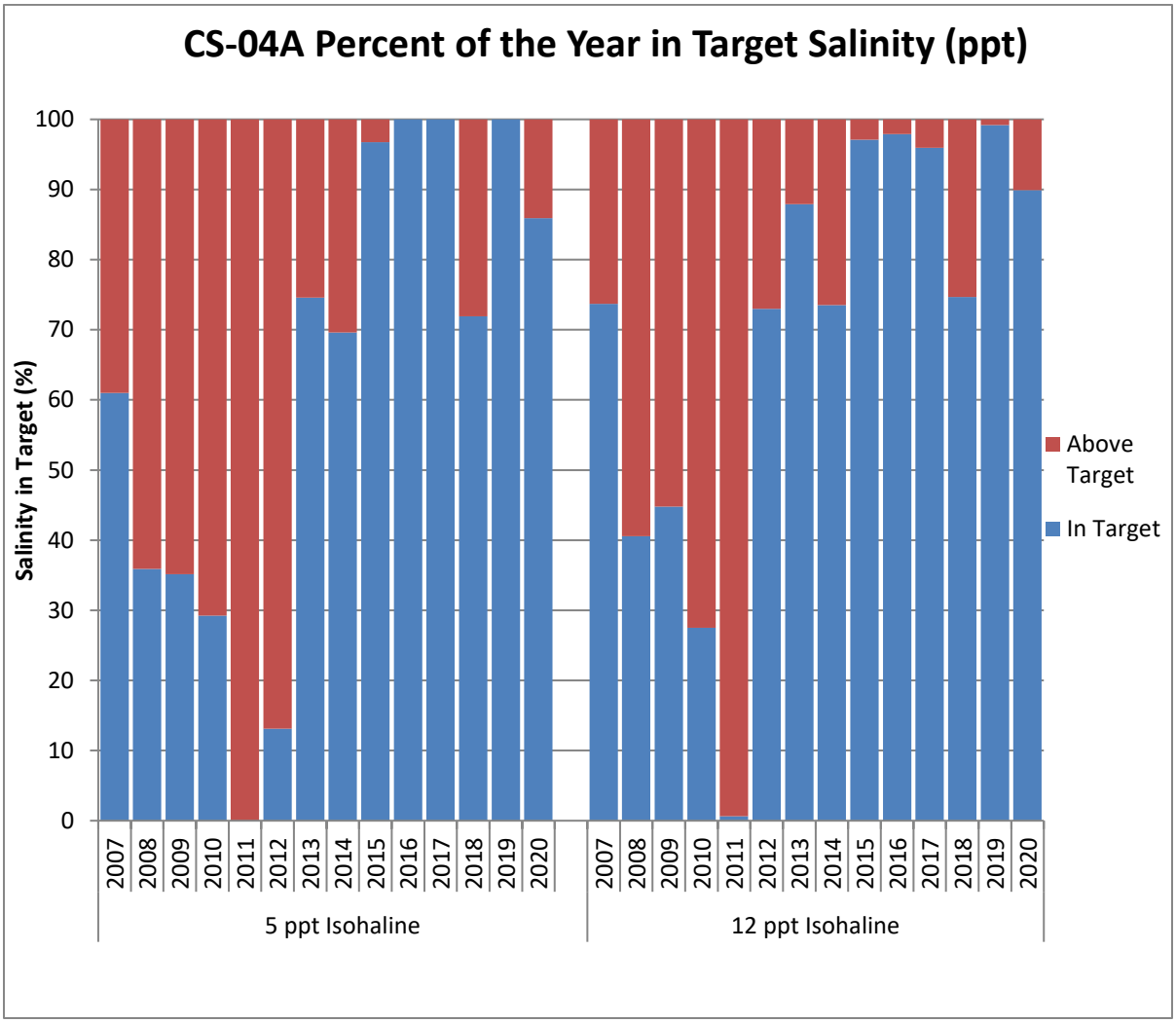

Figure 4a. Percentage of time salinities were inside target range for 5 ppt (CRMS0650, 2418) and 12 ppt isohalines (CRMS0645, 648), based on weekly means. Error bars represent standard error.

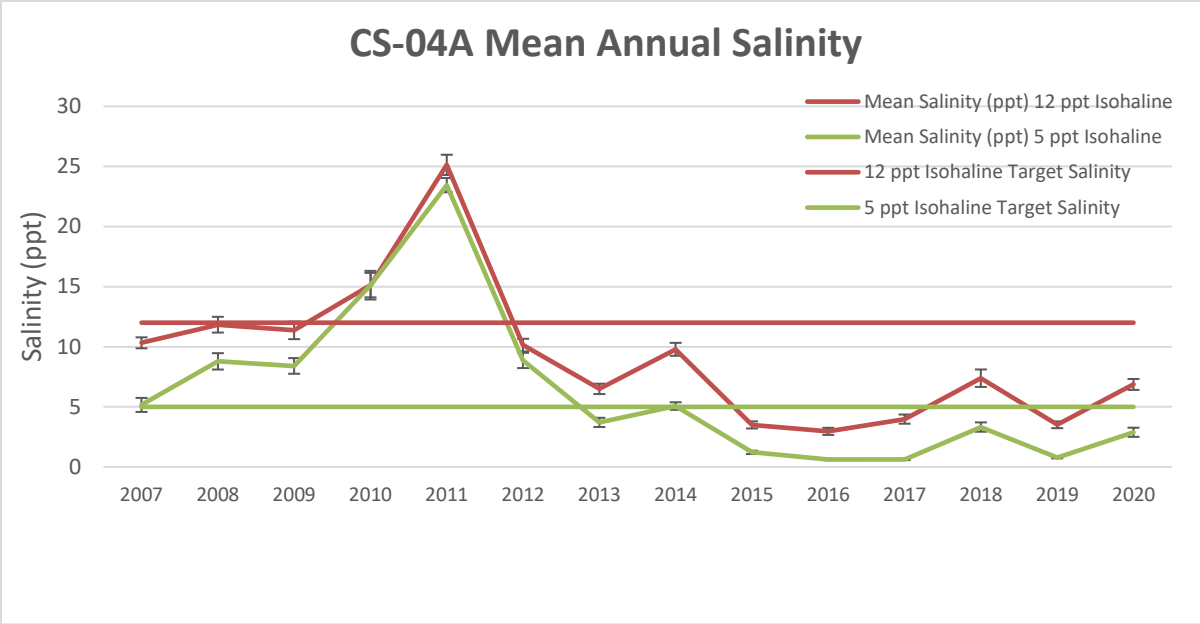

Figure 4b. Mean annual salinity at 5 ppt (CRMS0650, 2418) and 12 ppt (CRMS0645, 0648) Isohalines.

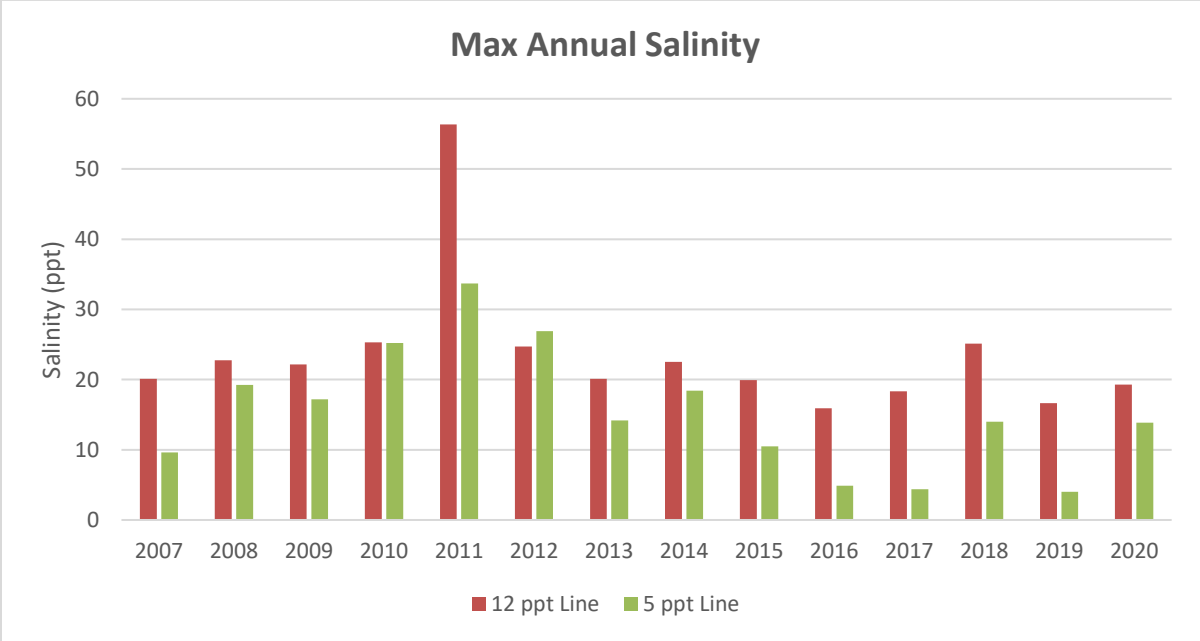

Figure 4c. Max salinity per year at 5 ppt (CRMS0650, 2418) and 12 ppt (CRMS0645, 0648) Isohalines.

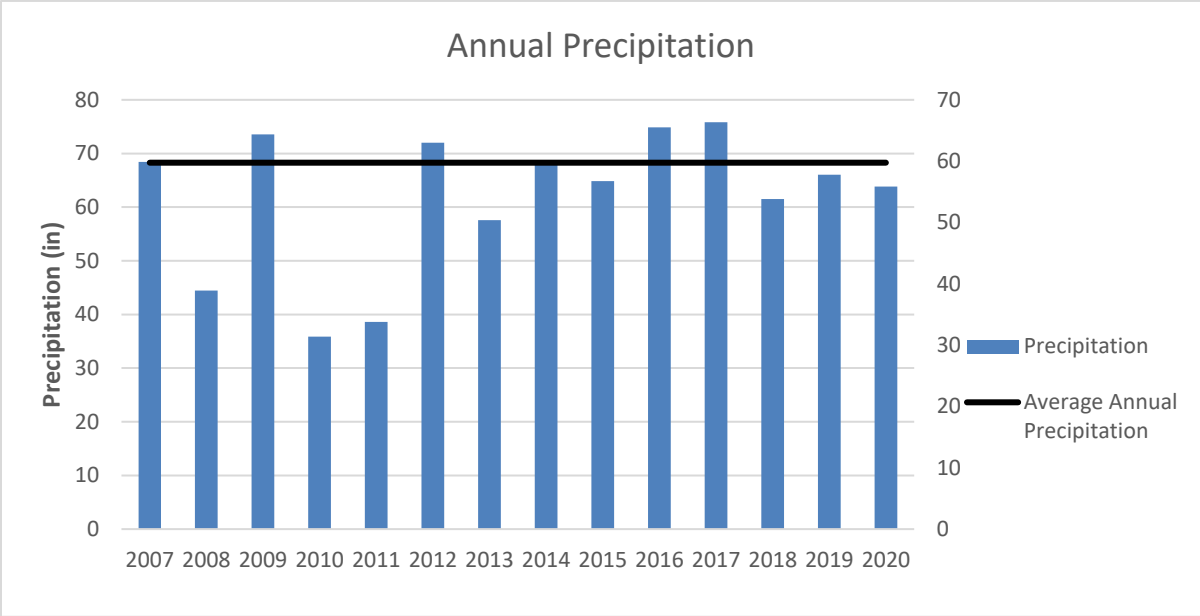

Figure 4d. Total annual precipitation collected at Lake Charles Regional Airport (SRCC 2021)

Means by month of interstitial water salinity are presented in Figures 5a and 5b. As would be expected, a salinity gradient exists, with highest salinities at the lake reference and conditions becoming fresher moving west to east across the project area. Similar to the surface water, porewater salinities peaked following the drought of 2010-2011, averaging over 20 ppt in the center of the project and westward and reaching over 10 ppt at the 5 ppt isohaline. Salinities have declined since, reaching target salinity in the upper 10 cm of the soil at the 12 ppt isohaline by 2013 and by 2016 at the 5 ppt isohaline, and remaining there through 2020. At the 30 cm depth, interstitial salinities didn't reach target levels until 2015 at the 12 ppt isohaline and 2019 at the 5 ppt isohaline. Salinities at the Lake Rim sites generally followed the same pattern as the 12 ppt isohaline sites but were ~ 5 ppt higher.

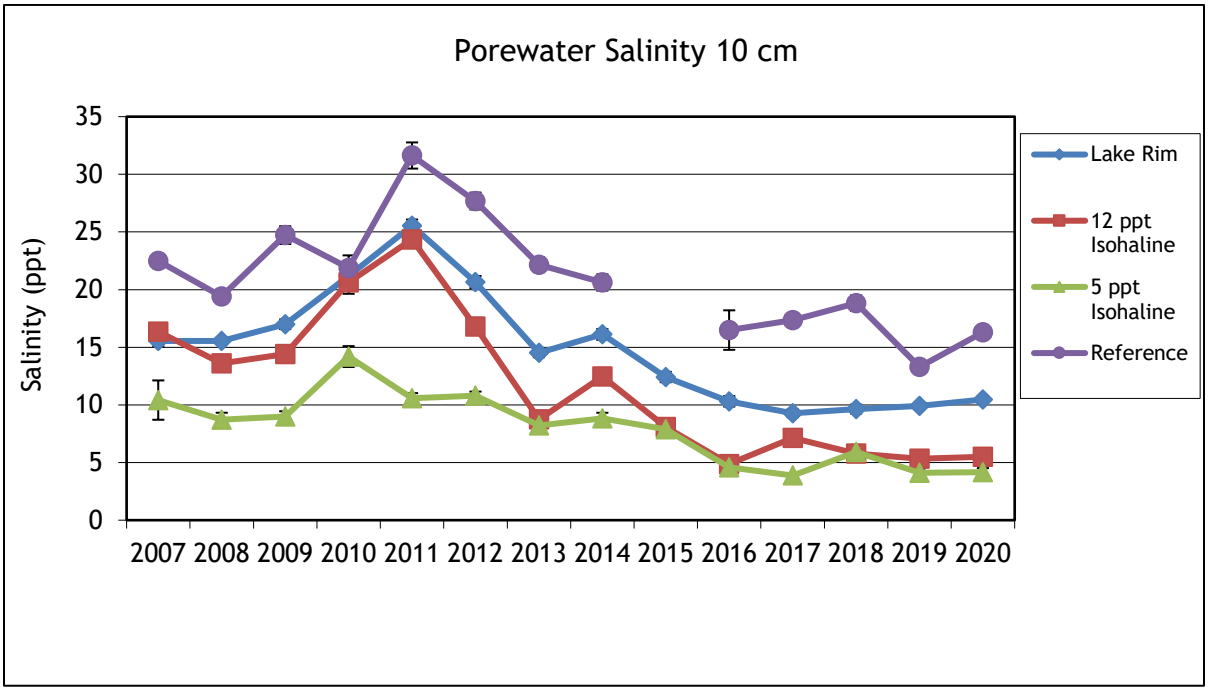

Figure 5a. Yearly Means of Interstitial water salinity at 10 cm below the soil surface within the Lake Rim (CRMS0644, 1738, 1743), 12 ppt Isohaline (CRMS0645, 648), and 5 ppt Isohaline (CRMS0650, 2418) inside the watershed and Calcasieu Lake Reference (CRMS0685). Error bars, where present, represent the mean of stations in that class for that month ± 1 Std Err.

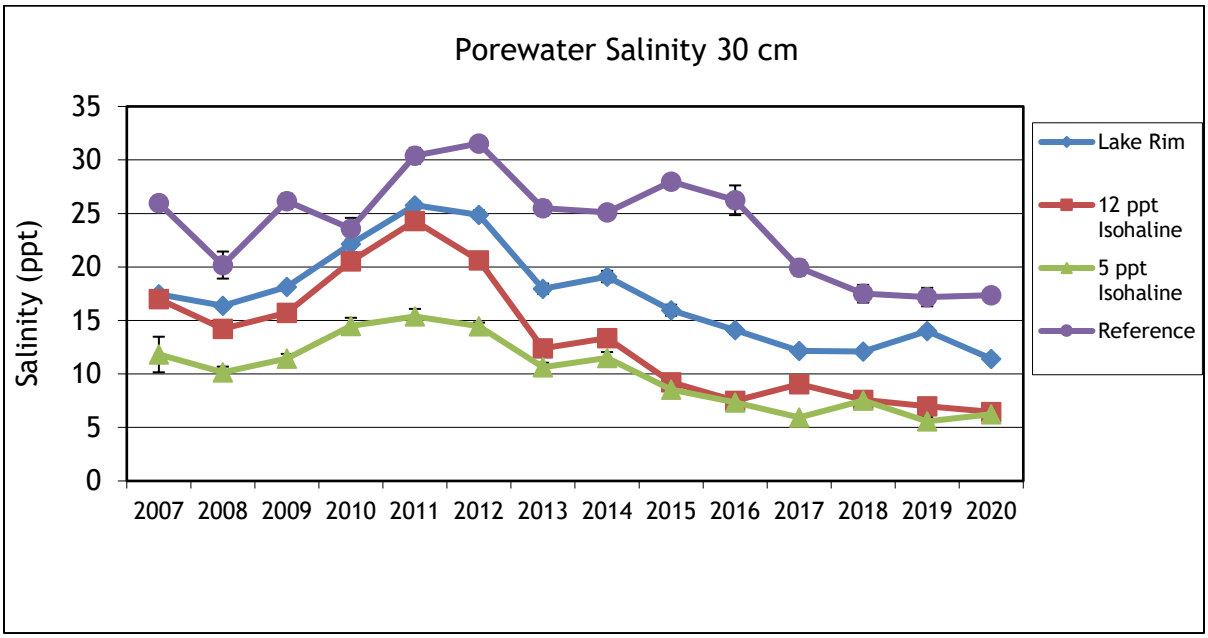

Figure 5b. Yearly Means of Interstitial water salinity at 30 cm below the soil surface within the Lake Rim (CRMS0644, 1738, 1743), 12 ppt Isohaline (CRMS0645, 648) and 5 ppt Isohaline (CRMS0650, 2418) inside the watershed and Calcasieu Lake Reference (CRMS0685). Error bars, where present, represent the mean of stations in that class for that month ± 1 Std Err.

Water Level

The project's goal for water level is to maintain water levels in a range of 6 inches below normal marsh elevation up to 2 inches above normal marsh elevation. In contrast to salinity, this goal has been more difficult to achieve through time, due to sea level rise and increased precipitation which has limited opportunities for drainage. Prior to 2012, damages from Hurricanes Rita and Ike as well as the prolonged drought from 2010-2011 resulted in water levels that were within target approximately 60% of the year on average, and occasionally below target (Figure 6a). From 2012 on, water levels have only been in target less than 40% of the time, except in the drought years of 2014 and 2018. These are also the only years that water levels have dropped below target since 2012.

Water levels have been trending higher since 2012 and have been primarily above marsh level in all years except the drought years (Figure 6b). The same pattern is seen in Calcasieu Lake (reference) and the lake is often higher than the watershed. The combination of high rainfall, high lake levels, and a low marsh elevation (0.4 ft NAVD88 Geoid 12a) causes water to be trapped in the watershed, resulting in chronic flooding, highlighting the need for additional structures to increase drainage capabilities when conditions do allow.

The CRMS sites within the project area were grouped within the degraded impounded sites in the Calcasieu/Sabine Basin report (McGinnis et. al 2019). These sites were defined as very little tidal amplitude, low elevation, elevation loss, chronically flooded, and disaggregated landscape. Because of this, this classification had the highest land loss rates in the basin.

Storm surges from the four major hurricanes temporarily inundated the project area with a large amount of Gulf of Mexico water. Hurricanes Rita and Ike made landfall west of the watershed, with maximum storm surges over 15 ft (Barras 2006, East et al. 2008). Hurricanes Laura and Delta made landfall in 2020 in almost the exact location, just south of the watershed. Laura is estimated to have had a storm surge over 18 ft (NOAA Hurricane Laura's Storm Surge 2021). Though not as catastrophic as Laura, Hurricane Delta was still a destructive storm that produced widespread flooding and compounded the damages from Hurricane Laura.

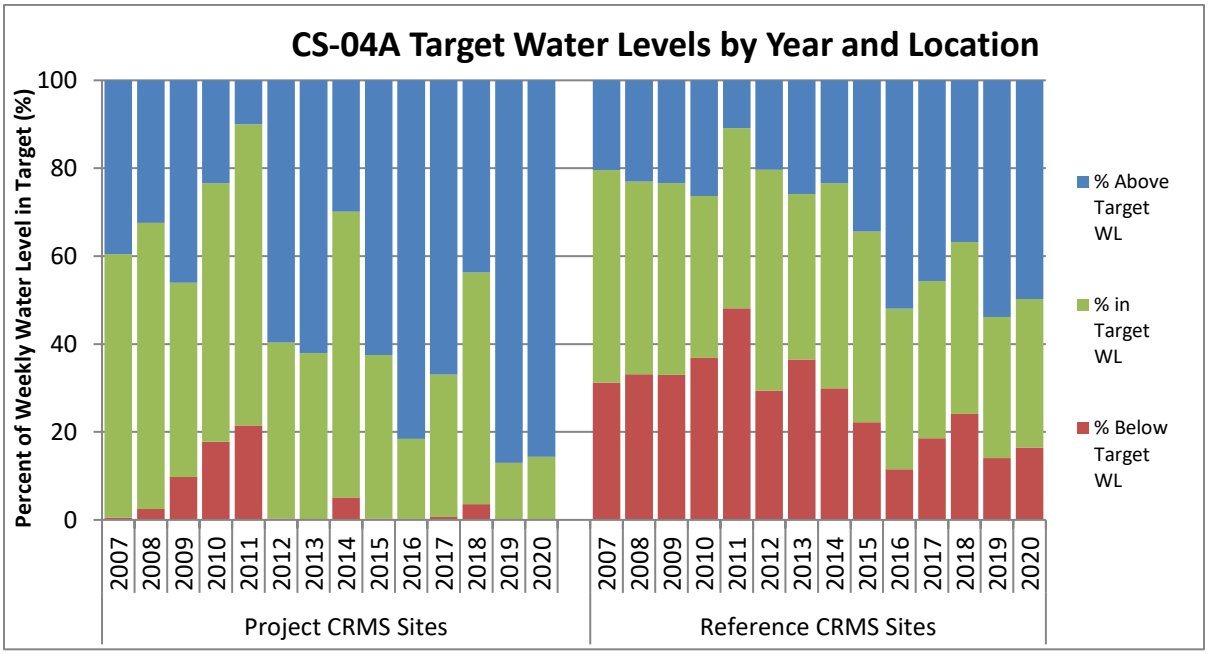

Figure 6a. Percentage of year water levels were inside target range at project (CRMS0644, 0645, 0648, 0650, 1738, 1743, 2418) and Calcasieu Lake reference (CRMS0685) sites.

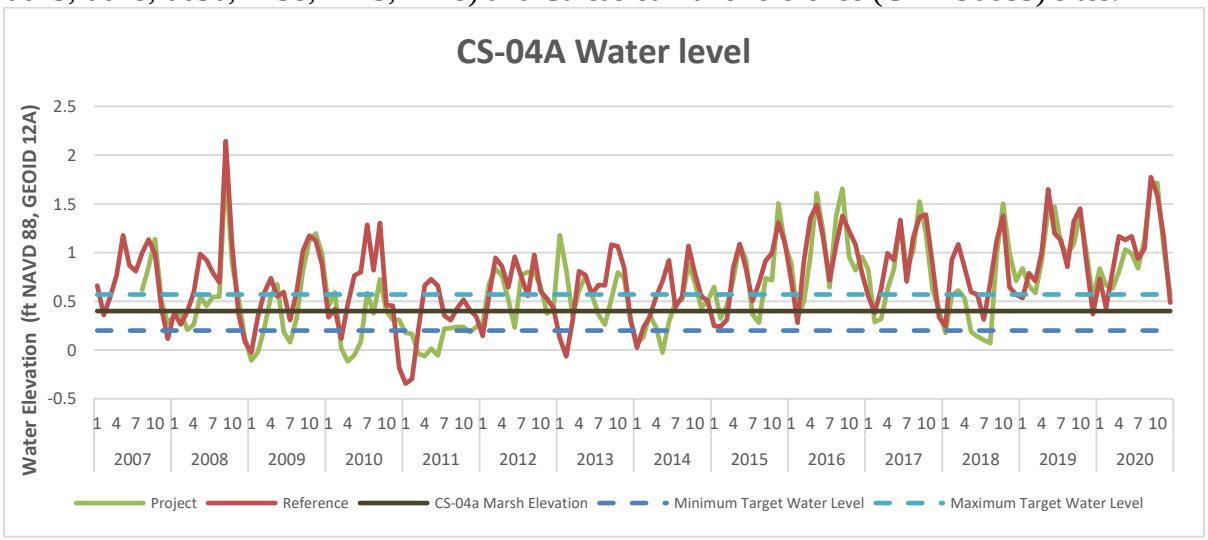

Figure 6b. Monthly means of water level data inside (CRMS0644, 0645, 0648, 0650, 1738, 1743, 2418) and outside (CRMS0685) of the CS-04a project area.

Vegetation

Emergent vegetation data has been collected at project area CRMS sites since 2006. The project's goal for vegetation is to improve plant species diversity in emergent marshes. This goal has been partially met, only because diversity dropped severely during the drought of 2010-2011 when salinities spiked in the project area (Figure 7h). Since then, with frequent rainfall and moderated salinities, the number of species observed has increased and remained consistent, with minor increases following the droughts of 2014 and 2018 that enabled new

species, such as *Amaranthus australis* and *Schoenoplectus americanus* to temporarily establish with lower water levels. Most of the sites also saw an increase in cover following these events.

FQI's for all project CRMS sites are presented in Figures 7a-7g. *Spartina patens* is the dominant species at all sites except CRMS0650, which is a fresher site in the northeastern corner dominated by *Cladium mariscus* and CRMS0644, which is a saline site dominated by *Spartina alterniflora* and *Distichlis spicata*. The lower salinities of recent years has shifted the species to a fresher cohort in the 12 ppt Isohaline. Species, such as *Distichlis spicata* have been replaced by *Typha domingensis* and *Schoenoplectus californicus*. As mentioned above in the aerial photography section, the fresher conditions have enabled vegetation expansion on the eastern side of the project area by *Phragmites australis* into shallow open water areas. Percent cover has dropped through time though, throughout the project area, since the 2010/2011 drought in response to the increased flooding. In addition, chronic flooding leaves the vegetation more vulnerable to hurricanes as the root systems are weakened.

Visual observation following Hurricanes Laura and Delta in 2020 revealed wide scale stress to the vegetation in the project area, particularly on the south end. The 2020 vegetation surveys were conducted prior to the storms and thus did not capture the post-storm impacts. Future reports will quantify the extent of the damage from these storms.

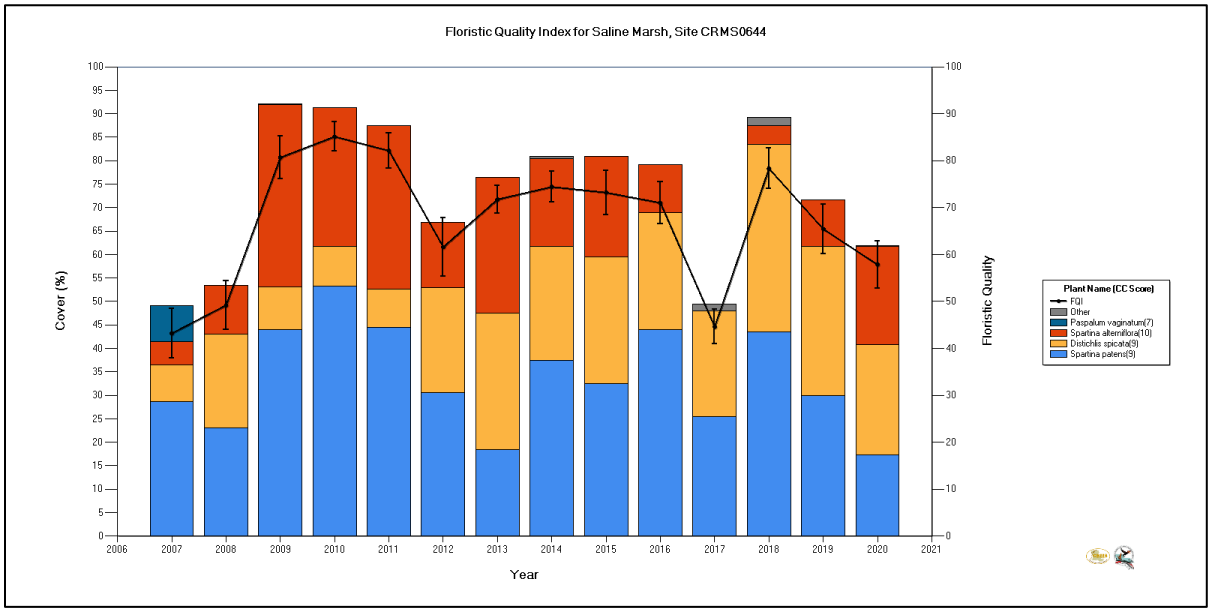

Figure 7a. Percent coverage and floristic quality index of species collected from CRMS0644, south project area near No Name Bayou structure, in years 2007 – 2020 (The 2020 data were collected prior to Hurricanes Laura and Delta). The Coefficient of Conservatism (CC) scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stable species.

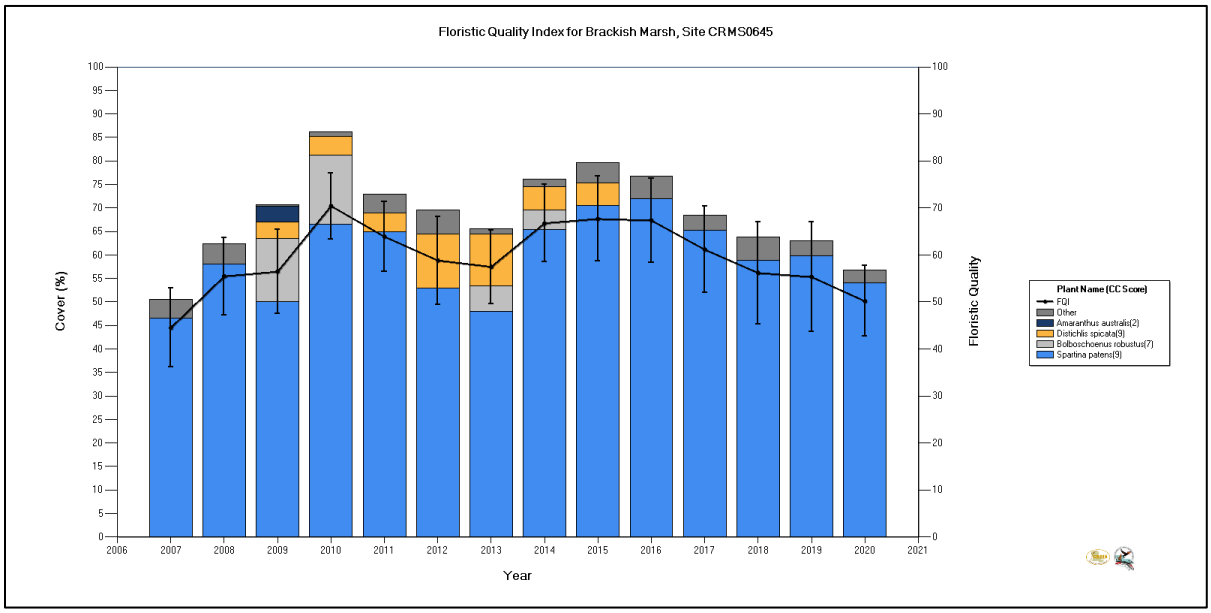

Figure 7b. Percent coverage and floristic quality index of species collected from CRMS0645, central project area near 12 ppt line, in years 2007 – 2020 (The 2020 data were collected prior to Hurricanes Laura and Delta). The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stable species.

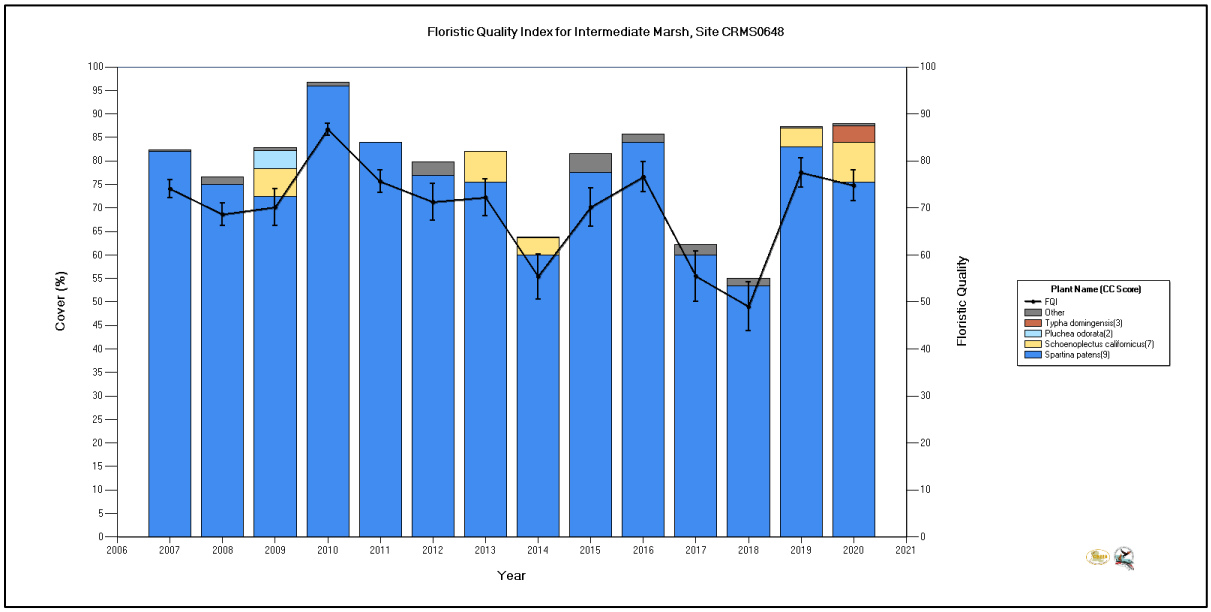

Figure 7c. Percent coverage and floristic quality index of species collected from CRMS0648, southeastern project area near 5 ppt line, in years 2007 – 2020 (The 2020 data were collected prior to Hurricanes Laura and Delta). The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance and 10 indicates stable species.

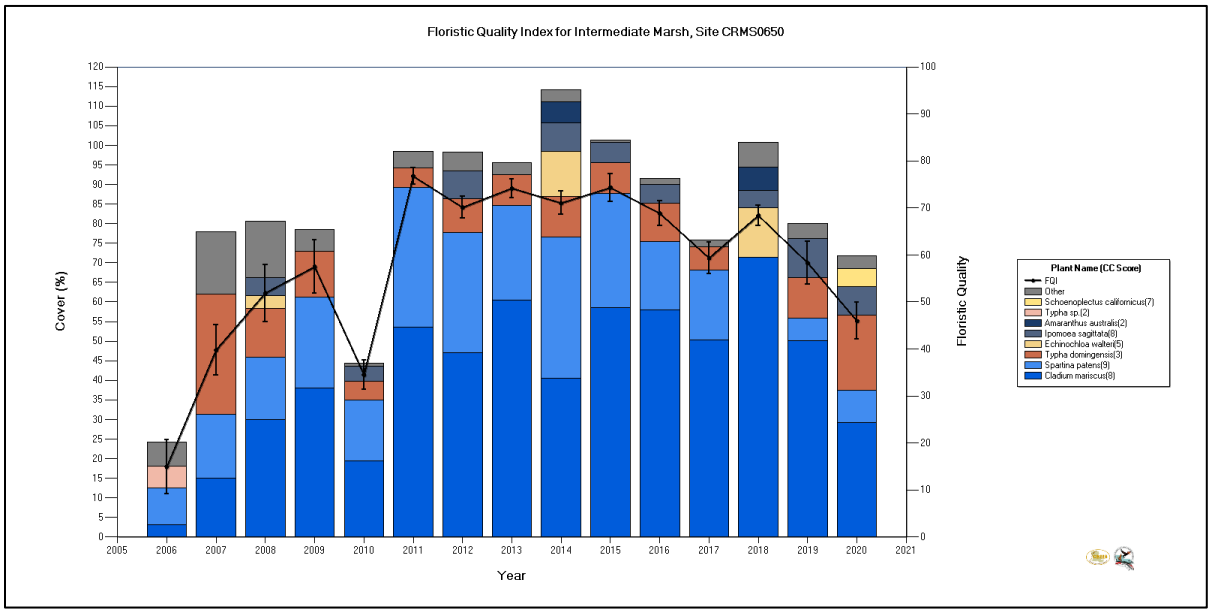

Figure 7d. Percent coverage and floristic quality index of species collected from CRMS0650, NE project area, in years 2006 – 2020 (The 2020 data were collected prior to Hurricanes Laura and Delta). The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance and 10 indicates stable species.

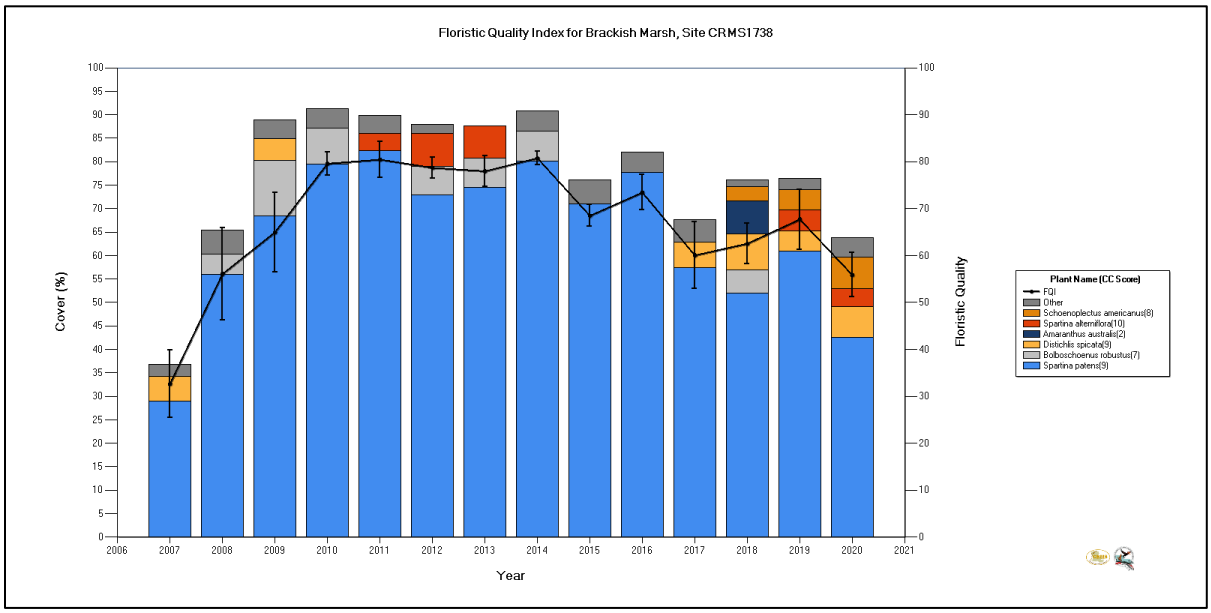

Figure 7e. Percent coverage and floristic quality index of species collected from CRMS1738, western project area near Grand Bayou structure, in years 2007 – 2020 (The 2020 data were collected prior to Hurricanes Laura and Delta). The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance and 10 indicates stable species.

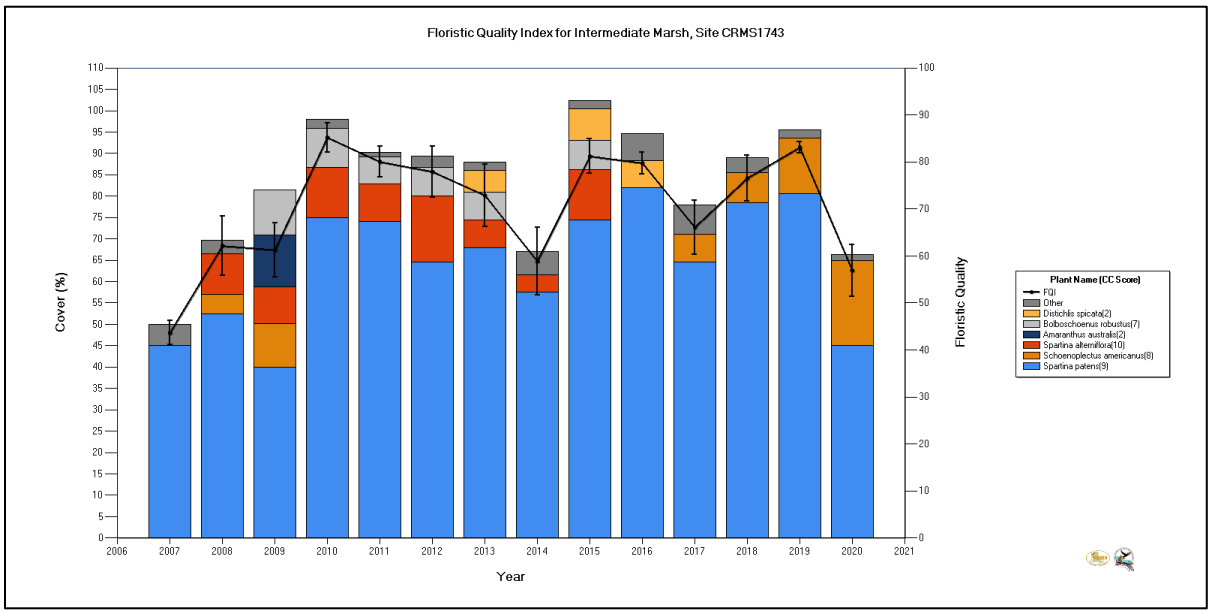

Figure 7f. Percent coverage and floristic quality index of species collected from CRMS1743, western project area near Mangrove structure, in years 2007 – 2020 (The 2020 data were collected prior to Hurricanes Laura and Delta). The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance and 10 indicates stable species.

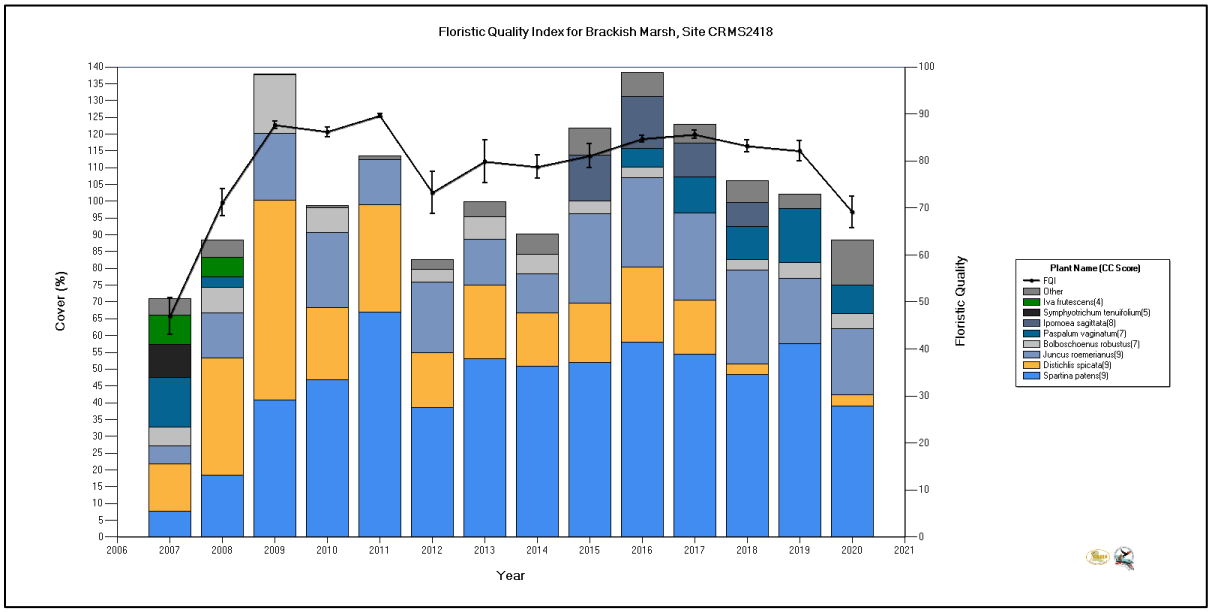

Figure 7g. Percent coverage and floristic quality index of species collected from CRMS2418, central project area near 5 ppt line, in years 2007 – 2020 (The 2020 data were collected prior to Hurricanes Laura and Delta). The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance and 10 indicates stable species.

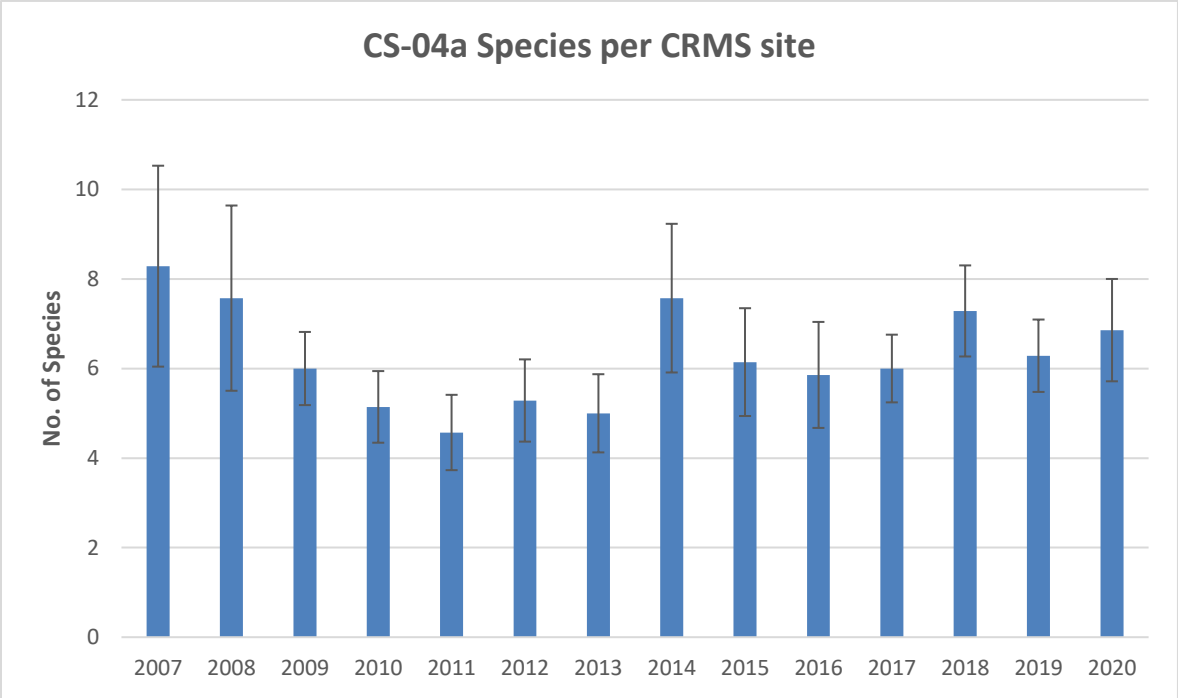

Figure 7h. Mean number of species observed at CS-04a project CRMS sites per year. Error bars represent standard error.

Elevation Change

The cumulative surface elevation change (SEC) rate at CS-04a CRMS sites show the project area had a slight gain at most sites (+0.17 cm/yr to +0.52 cm/yr) (Figure 8a). The only site that has averaged a net loss in elevation was CRMS2418, located in the 12 ppt Isohaline. This site has struggled to maintain elevation throughout its history, with losses occurring in 2011, 2015, 2017 and particularly in 2020 following Hurricane Laura (Figure 8b), even though vertical accretion (VA) rates are similar to the 5 ppt Isohaline; in contrast, the site in the 5 ppt isohaline (CRMS0650) has been progressively gaining elevation since 2016 (~6.5 cm over this time frame), showing a positive response to abundant precipitation. The soils at this site are more organic and may be swelling in response to the increased inundation. None of the sites, however, are maintaining elevation when compared to the Sabine Pass NOAA tide gauge sea level rise estimate of 0.6 centimeters per year (Zervas 2009).

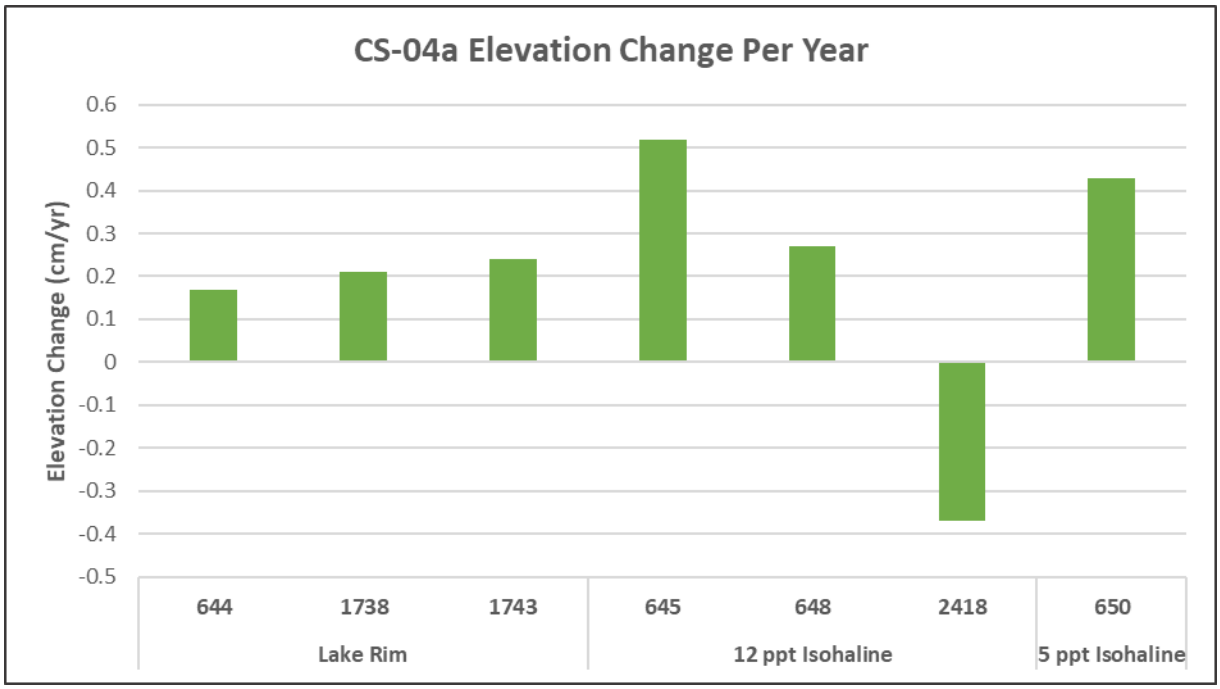

Figure 8a. Elevation change per year experienced in the CS-04a project.

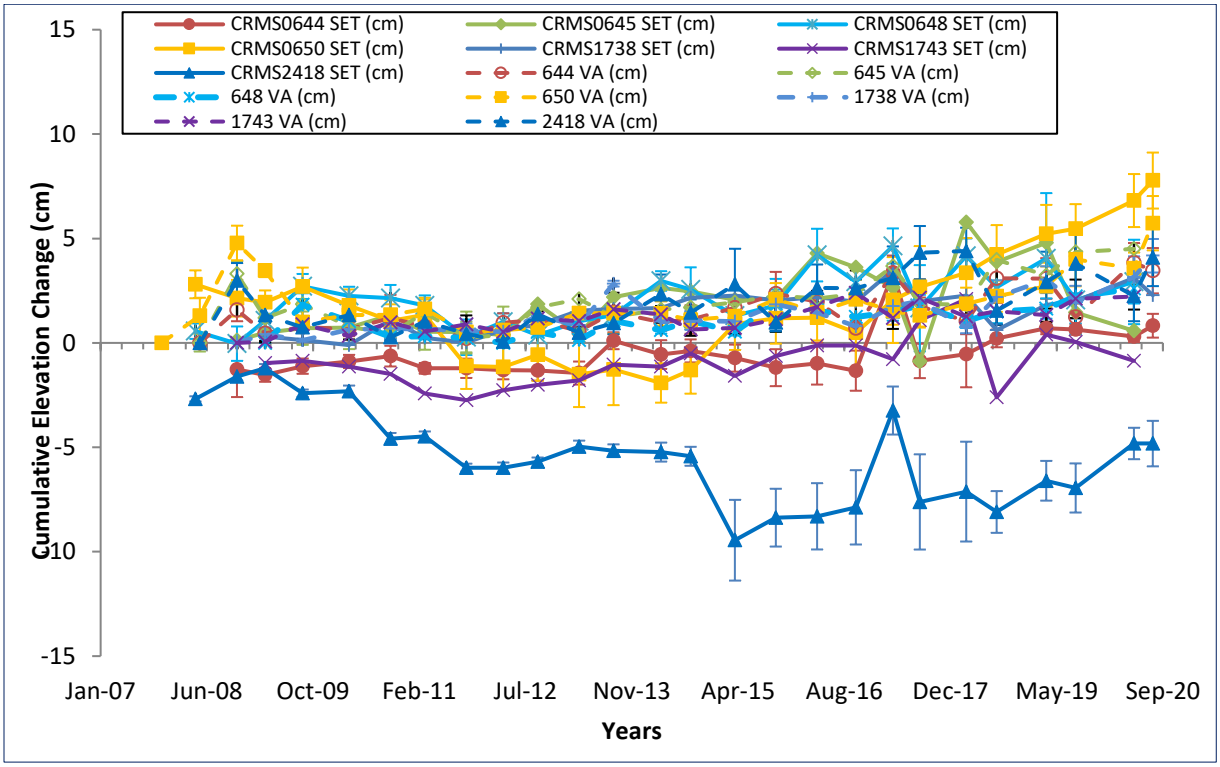

Figure 8b. Cumulative elevation change calculated from surface elevation measurements collected at rod-surface elevation tables (RSET) and vertical accretion measurements collected from horizon markers (VA) at CS-04a project sites (CRMS0644, 0645, 0648, 0650, 1738, 1743, 2418), over time. Mean ± SE

V. Conclusions

a. Project Effectiveness

The project achieved the goal to reclaim some of the emergent marshes that were converted to open water by saltwater intrusion. Land area has consistently increased within the watershed since 2005. However, the hurricanes of 2020 likely caused further land loss due to storm surge and disabling project features.

The project has been effective at reducing surface water and interstitial salinities in the project area. Above average rainfall and active marsh management have enabled project marshes to meet target salinity levels more frequently through time. Though the project features have successfully protected the marsh from the saltier waters of Calcasieu Lake, it also has trapped water on the landscape as sea level has risen, limiting drainage opportunities and leading to chronic flooding. Because of this, it has been difficult to achieve water level goals in recent years.

The project has achieved the goal to improve plant species diversity, since the drought of 2010/2011. Freshening conditions have also enabled vegetation expansion in areas of the project, reflected in the positive land change data. However extended flooding has caused a drop in percent cover, weakened roots and left the vegetation vulnerable to storm surge.

Elevation change data shows a slight gain at most sites within the project area through time, but they are not maintaining elevation in relation to sea level rise. Given this and the fact that these marshes are at a low elevation, makes them vulnerable to further submergence in the future.

b. Recommended Improvements

Repairs to the project infrastructure from Hurricane Laura damage are desperately needed. Hydrologic management is impossible at this time and there is full connectivity between the watershed and Calcasieu Lake, enabling high salinity water to enter, causing further marsh loss.

Even with the repairs, drainage will continue to be limited at the existing conditions. Additional structures along the lake rim are necessary to increase drainage, when conditions allow, and to prevent further landloss. In addition, marsh creation near the lake rim is needed to repair past hurricane damage, raise marsh elevation, and prevent further widening of marsh ponds.

c. Lessons Learned

When conditions have allowed the CS-04a structures to be operated in accordance with the operations plan, project area marshes have seen an increase in vegetated area. Active management has reduced salinities within the watershed and promoted land gain on the eastern end of the project.

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APPENDIX A
(Inspection Photographs)

Photo No. 1, Peconi Bayou Water Control Structure – No damage to structure.

Photo No. 2, Mangrove Bayou Water Control Structure – Siltation on outlet (lakeside) of the structure.

Photo No. 3, Mangrove Bayou Canal Plug – Failing railing and signage.

Photo No. 4. Mangrove Bayou Canal Plug – Erosion and scour on east side of structure.

Photo No. 5, Grand Bayou Water Control Structure – Minor erosion and scour around end of structure.

Photo No. 6, Grand Bayou Breach – Breach in levee at 2006 Rita repair.

Photo No. 7, Grand Bayou Canal Plug – Railings in need of repair. Erosion and scour on east side of plug.

Photo No. 8. Lambert Bayou Water Control Structure – some scour and erosion on the land bridge connecting the water control structure to the sheet pile breach.

Photo No. 9. Lambert Bayou Breach – Scour on northern end and along sheet pile structure.

Photo No. 10. No Name Bayou Water Control Structure – Significant scour on each end of the structure.

Photo No. 11. No Name Bayou Breach – Scour along and on ends of post Rita sheet pile repair.

APPENDIX B
(Three Year Budget Projection)

CAMERON-CREOLE MAINTENANCE/ CS-04a/ C.140004.8 / PPL 3

Three-Year Operations & Maintenance Budgets 07/01/2022 - 06/30/2025

Project Manager	O & M Manager	Federal Sponsor	Prepared By	
Dion Broussard	*Dion Broussard*	*NRCS*	*Jody White*	
	2022/2023 (-5)	**2023/2024 (-6)**	**2024/2025 (-7)**	
Annual Inspection	$ 15,708.00	$ 16,179.00	$ 16,664.00	
Structure Maintenance and O&M Contract	$ 110,000.00	$ 110,000.00	$ 110,000.00	
State Administration	$ 86,913.00	$ 137,267.00	$ 51,118.00	includes IDC
Federal Administration	$ 5,000.00	$ 1,000.00	$ 5,000.00	
Maintenance/Rehabilitation				
22/23 Description: Interior Canal Sheetpile Plugs Sign maintenance, E&D and surveying for Hurricane Damage Repair				
E&D	$ 235,000.00			
Construction	$ 17,000.00			
Construction Oversight				
Sub Total - Maint. And Rehab.	$ 252,000.00			
23/24 Description: Structure & Levee Repair (Storm Damage) pending FEMA application				
E&D			Reflects available budget. Actual repair cost estimate is greater than the current budget available.	
Construction		$ 1,615,000.00		
Construction Oversight		$ 109,000.00		
Sub Total - Maint. And Rehab.		$ 1,724,000.00		
24/25 Description:				
E&D				
Construction				
Construction Admin & Oversight				
Sub Total - Maint. And Rehab.			$ -	
	2022/2023 (-5)	**2023/2024 (-6)**	**2024/2025 (-7)**	
Total O&M Budgets	**$ 469,621.00**	**$ 1,988,446.00**	**$ 182,782.00**	
O &M Budget (3 yr Total)			**$ 2,640,849.00**	
Unexpended O & M Budget			**$ 2,641,848.96**	includes FY20 & 21 incremental budget increases
Remaining O & M Budget (Projected)			**$ 999.96**	

OPERATION AND MAINTENANCE BUDGET WORKSHEET

CAMERON-CREOLE MAINTENANCE/ PROJECT NO. CS-04a / C.140004.8 / PPL NO. 3/ 2022-2023

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$15,708.00	**$15,708.00**
General Structure Maintenance	LUMP	0	$0.00	**$0.00**
Engineering and Design	LUMP	1	$216,000.00	**$216,000.00**
Operations Contract & Minor Maitenance	LUMP	1	$110,000.00	**$110,000.00**
Other	LUMP	0	$0.00	**$0.00**

ADMINISTRATION

State Admin.	LUMP	1	$86,913.00	$86,913.00
FEDERAL SPONSOR Admin.	LUMP	1	$5,000.00	$5,000.00
SURVEY Admin.	LUMP	0	$2,000.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$91,913.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:					
Secondary Monument	EACH	0	$0.00	$0.00
Staff Gauge / Recorders	EACH	0	$0.00	$0.00
Bathymetry/ Topography	LUMP	1	$19,000.00	$19,000.00
TBM Installation	EACH	0	$0.00	$0.00
OTHER				$0.00
			TOTAL SURVEY COSTS:	**$19,000.00**

GEOTECHNICAL

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

CONSTRUCTION

CONSTRUCTION DESCRIPTION: Interior Canal sheetpile plug sign maintenance

Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE	
Bank Paving	7184	1.9	0	$85.00	$0.00
Rip Rap - Structures (LUMP)	0	0.0	0	$0.00	$0.00
Crushed Stone - Breaches	0	0.0	0	$0.00	$0.00
Filter Cloth / Geogrid Fabric		SQ YD	0	$9.00	$0.00
Navigation Aid		EACH	0	$0.00	$0.00
Signage		LUMP	1	$17,000.00	$17,000.00
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)		SQ FT	0	$0.00	$0.00
Batter Piles (each or lump sum)		LN FT	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 (25%)		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:	**$17,000.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$469,621.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

CAMERON-CREOLE MAINTENANCE/ PROJECT NO. CS-04a / C.140004.8 / PPL NO. 3/ 2023-2024

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$16,179.00	**$16,179.00**
General Structure Maintenance	LUMP	0	$0.00	**$0.00**
Engineering and Design	LUMP	0	$0.00	**$0.00**
Operations Contract & Minor Maitenance	LUMP	1	$110,000.00	**$110,000.00**
Other	LUMP	0	$0.00	**$0.00**

ADMINISTRATION

State Admin.	LUMP	1	$137,267.00	$137,267.00
FEDERAL SPONSOR Admin.	LUMP	1	$1,000.00	$1,000.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
Construciton Admin & Oversight		1	$109,000.00	$109,000.00
			TOTAL ADMINISTRATION COSTS:	**$247,267.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:					
Secondary Monument	EACH	0	$0.00	$0.00
Staff Gauge / Recorders	EACH	0	$0.00	$0.00
Bathymetry / 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:	Hurricane Damage Repairs to Structures & Levee				
Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE	
Bank Paving	7184	1.9	0	$85.00	$0.00
Rip Rap - Structures (LUMP)	0	0.0	0	$0.00	$0.00
Crushed Stone - Breaches	0	0.0	0	$0.00	$0.00
Filter Cloth / Geogrid Fabric		SQ YD	0	$9.00	$0.00
Navigation Aid		EACH	0	$0.00	$0.00
Signage		LUMP	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)		SQ FT	0	$0.00	$0.00
Batter Piles (each or lump sum)		LN FT	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 (25%)		LUMP	0	$0.00	$0.00
General Structure Maintenance		LUMP	1	$1,615,000.00	$1,615,000.00
OTHER				$0.00	$0.00
OTHER				$0.00	$0.00
OTHER				$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$1,615,000.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$1,988,446.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

CAMERON-CREOLE MAINTENANCE/ PROJECT NO. CS-04a / C.140004.8 / PPL NO. 3/ 2024-2025

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$16,664.00	**$16,664.00**
General Structure Maintenance	LUMP	0	$0.00	**$0.00**
Engineering and Design	LUMP	0	$0.00	**$0.00**
Operations Contract & Minor Maitenance	LUMP	1	$110,000.00	**$110,000.00**
Other	LUMP	0	$0.00	**$0.00**

ADMINISTRATION

State Admin.	LUMP	1	$51,118.00	$51,118.00
FEDERAL SPONSOR Admin.	LUMP	1	$5,000.00	$5,000.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
Construction Admin and Oversight	LUMP	0	$0.00	$0.00
			TOTAL ADMINISTRATION COSTS:	**$56,118.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:					
Secondary Monument	EACH	0	$0.00	$0.00
Staff Gauge / Recorders	EACH	0	$0.00	$0.00
Bathymetry/ 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	
Bank Paving	7184	1.9	0	$85.00	$0.00
Rip Rap - Structures (LUMP)	0	0.0	0	$0.00	$0.00
Crushed Stone - Breaches	0	0.0	0	$0.00	$0.00
Filter Cloth / Geogrid Fabric		SQ YD	0	$9.00	$0.00
Navigation Aid		EACH	0	$0.00	$0.00
Signage		LUMP	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)		SQ FT	0	$0.00	$0.00
Batter Piles (each or lump sum)		LN FT	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 (25%)		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: **$182,782.00**

Appendix D
Resource Management Plan

RESOURCE MANAGEMENT PLAN FOR CAMERON CREOLE
February 1987

BASIC OBJECTIVE:

Restore the project area to approximate the 1972 vegetative communities and salinity regimes.

SPECIFIC OBJECTIVES:

WEST OF 5 PPT ISOHALINE LINE

1. Curtail marsh erosion.

2. Maintain and improve the marsh and open water ponds for high value fisheries nursery and production areas.

3. Operate the water control structures to minimize reductions in access by estuarine organisms to nursery areas. Recruitment of estuarine dependent organisms will be accommodated to the greatest extent practicable to meet the overall basic objective.

4. Improve plant species diversity in emergent marshes which would improve the potential for wildlife habitat improvement.

5. Improve the aquatic vegetative component in the open water ponds.

EAST OF THE 5 PPT ISOHALINE LINE

1. Curtail marsh erosion.

2. Reclaim some of the emergent marshes that have benn recently converted to open water by saltwater intrusion and subsequent marsh erosion.

3. Improve plant species diversity in the emergent marshes which would improve the potential for wildlife habitat improvement.

4. Improve aquatic plant species diversity.

5. Improve the marshes and open water ponds for freshwater fisheries.

SALINITY AND WATER LEVEL MANAGEMENT CRITERIA

1. Establish two isohaline lines based on historical vegetative communities and salinities to aid in guiding management procedures.

   A. Isohaline line no. 1will be established at approximately 12 ppt (see attachment #1)

   B. Isohaline line no. 2 will be established at approximately 5 ppt (see attachment #1)

   C. Necessary salinity stations will be established and data gathered to monitor the salinity along these isohaline lines.

2. Water levels will be maintained in a range of 6 inches below normal marsh elevation up to 2 inches above normal marsh elevation based on water levels readings taken along the 5 ppt isohaline line monitoring stations.

3. Deviation from the normal planned operation of these structures will be allowed in the event of unusual weather conditions (hurricanes, abnormal rainfall, etc.) This would include utilizing the structures on Creole canal.

PHASE ONE - TWO YEAR PERIOD

GENERAL: Phase I of the management plan will place primary emphasis on curtailing marsh erosion and reclaiming some of the emergent marshes that have been converted to open water ponds east of the 5 ppt isohaline line. These shallow, open water ponds are a result or recent deteriorating marsh and offer the greatest potential for re-vegetation to emergent marshes. If not re-vegetated in the near future, these shallow open water ponds will become too deep to practically re-vegetate.

FEBRUARY 15 - JULY 15

1. Implement a partial drawdown of 6 inches below normal marsh elevation for the area east of the 5 ppt isohaline line. The open water ponds west of the 5 ppt isohaline line are mush deeper and would maintain shallow water during the drawdown period. The drawdown would be accomplished by manipulation fo the water control structures during winter and spring frontal passages. At least one of the vertical slots in each structure will remain open this entire time period.

JULY 15 - FEBRUARY 15

1. The partial drawdown will end on July 15 and water levels would be allowed to increase. On July 15 the crest of the variable structures will be set at 6 inches below normal marsh elevation and the vertical slots in all structures will be opened.

PHASE TWO

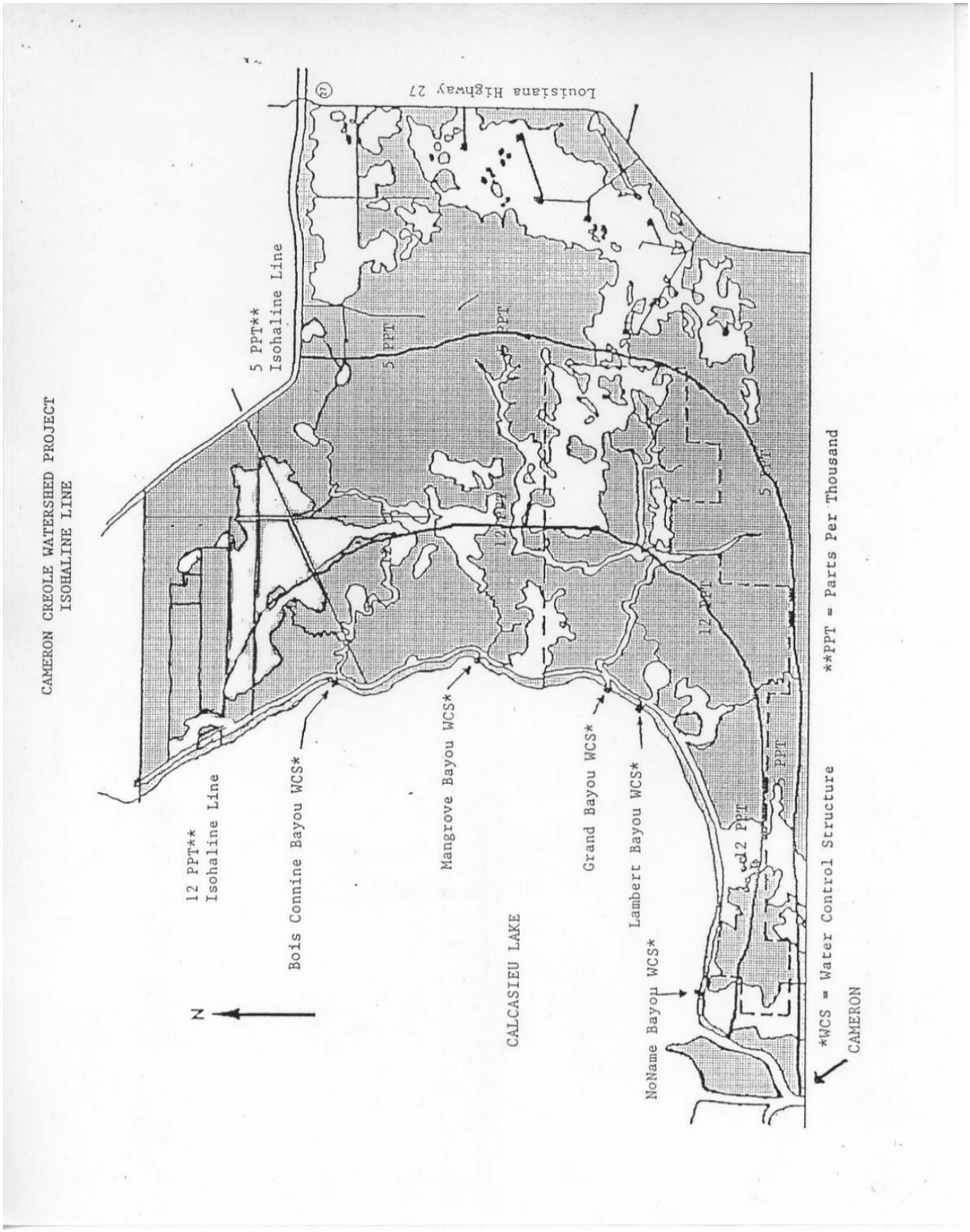
GENERAL: Phase II of the management plant will place primary emphasis on curtailing marsh erosion. Secondary emphases on Phase II will be (1) maintain and improve fisheries habitat, (2) maintain and improve wildlife habitat, (3) increase plant diversity in emergent marshes that have been converted to open water ponds east of 5 ppt isohaline line.

1. The Phase II basic management plan involves a "semi-static" water management scheme. The crests of all structures will be set at 6 inches below normal marsh elevations. The three, 6 inch slots in the structures will be left open. The boat bay on the Grand Bayou structure will be left open. (Boat Bay is serving same function as the slots for the Grand Bayou Structure). Additionally, another flapgate on the Grand Bayou structure can be opened for fisheries purposes in (a) late winter and spring, (b) late summer and fall, (c) night, (d) in the winter with the approach of weather fronts expected to cause significant decrease in temperature, or (e) other special circumstances when conditions favor recruitment of young into the nursery areas.

NOTE: Temporary closures of the boat bay and other bays will be allowed if salinities exceed the 5 ppt limit at isohaline line no. 2.

2. Periodic partial drawdowns, as outlined in Phase One, can be carried out dependent on the success of the drawdowns in Phase One and recommendations of the advisory committee.

NOTE: The advisory committee will meet annually to review the progress of the management plan, and make recommendation regarding any needed changes. More frequent meeting can be held if the need arises.


CAMERON CREOLE WATERSHED PROJECT
ISOHALINE LINE
Louisiana Highway 27
5 PPT**
Isohaline Line
5 PPT
5 PPT
12 PPT
12 PPT
5 PPT
12 PPT
12 PPT**
Isohaline Line
Bois Connine Bayou WCS*
Mangrove Bayou WCS*
Grand Bayou WCS*
Lambert Bayou WCS*
NoName Bayou WCS*
CALCASIEU LAKE
N
*WCS = Water Control Structure
CAMERON
**PPT = Parts Per Thousand