State of Louisiana

Coastal Protection and Restoration Authority (CPRA)

2022 Operations, Maintenance, and Monitoring Report

for

Freshwater Bayou Canal Wetland Protection and Freshwater Bayou Bank Stabilization

State Project Number ME-04 and ME-13
Priority Project List 2 and Priority Project List 5

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Vermilion Parish

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2022 Operations, Maintenance, and Monitoring Report
For
Freshwater Bayou Wetland Protection (ME-04) and Freshwater Bayou Bank Stabilization (ME-13)

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Preface

The 2022 OM&M Report format combines the Operations and Maintenance annual project inspection information with the Monitoring data and analyses for the projects. This report includes monitoring data collected through December 2021 and annual Maintenance Inspections through May 2022.

The 2022 report is the 5th in a series of OM&M reports for ME-04 and 4th for ME-13. For additional information on lessons learned, recommendations and project effectiveness please refer to previous OM&M reports, annual O&M inspection reports, progress reports and comprehensive monitoring reports on the CPRA web site (http://lacoast.gov/new/Projects/Info.aspx?num=ME-04).

I. Introduction

The Freshwater Bayou project areas encompass 38,097 ac (15,413 ha) of fresh, intermediate, and brackish marsh located between Intracoastal City and Pecan Island in Vermilion Parish, Louisiana. Centered approximately at Lat. 29E 40' 00" N and Long. 92E 18' 00" W, the area is bounded on the north by the old Intracoastal Waterway (Schooner Bayou), on the west by LA Hwy 82 and the Acadiana Marina Canal, on the south by Humble Canal (Acadiana Marina Canal), and on the east by Freshwater Bayou Canal. The ME-13 project area is adjacent to the ME-04 project boundary on the east side along Freshwater Bayou Canal (Figure 1).

The project plan for ME-04/13 (USDA/SCS 1994) divides the project area into three Conservation Treatment Units (CTU's), with CTU 1 and 3 benefiting directly from the shoreline protection work implemented under Phase 1 of the project which was completed in 1995. Phase 2 of this CWPPRA project authorized the installation of eight box-type water control structures with a single flapgate, a variable-crest weir, and two fixed-crest weirs (one with a 4 inch vertical slot) in the project area. Three structures are located in CTU 1, three in CTU 2, and two in CTU 3 and they were completed in June of 1998. A number of water control structures were already in place prior to the project. Additional structures were installed by the landowner at the landowner's expense, to enhance the operation of the eight CWPPRA structures.

At the time of construction of the rock dike the project area had shifted to mostly fresh marsh with intermediate areas to the south and east. The southernmost unit, CTU 1, consisted of 13,800 ac (5,585 ha) of predominantly fresh marsh with zones of intermediate and brackish marsh along its eastern and southern boundaries. It was predominantly a *Sagittaria lancifolia* (bull tongue) and *Spartina patens* (wiregrass) marsh. The Phase 1 dike was designed to protect the eastern edge of CTU 1 from wave erosion and possible salt water intrusion from Freshwater Bayou Canal. CTU 2 consisted of 9,300 ac (3,764 ha) of fresh marsh, dominated by *Echinochloa walteri* (Walter's millet) and *S. lancifolia*, located in the west central portion of the project area. The northern section of the project area comprises CTU 3, which consisted of 13,800 ac (5,585 ha) of predominantly fresh marsh dominated by *S. lancifolia*, *E. walteri*, and *Alternanthera philoxeroides* (alligatorweed), with intermediate and brackish marsh zones dominated by *Spartina patens* and *Schoenoplectus americanus* (Chairmaker's bulrush) along its eastern boundary along Freshwater Bayou Canal. Subsequently the project area has transitioned to largely an intermediate marsh with some brackish locations to the south and east along Freshwater Bayou Canal and fresh marsh creeping in along the western and northern border of the project area.

ME-13, which is located adjacent to CTU 3, is largely susceptible to tidal scour and saltwater intrusion associated with the erosion of the spoil banks along the west bank of Freshwater Bayou Canal. To prevent further wetland loss, approximately 23,193 linear ft (7,069m) of free-standing rock dike was constructed in shallow water along the west bank of FBC between its confluence with Sixmile Canal on its north end and North Prong Belle Ile Bayou Canal on its south end. Construction of the rock dike began on March 1, 1998 and was completed on June 1, 1998.

Reference areas R1 and R2 (Figure 1) were established to monitor shoreline erosion along two 0.5 mi (0.8 km) segments of unprotected shoreline located along the east bank of Freshwater Bayou Canal, opposite the south end (R1) and the north end (R2) of the ME-04/13 rock dike. These two reference areas were used for comparison with erosion rates along the section of canal bank protected by the ME-04 rock dike within CTU 1 and the section of canal protected by the ME-13 rock dike within CTU 3. The vegetation type is similar to the project area, and like the project area shoreline, the reference area R1 and R2 shorelines include both intact and deteriorated sections of spoil bank. Reference area R3 is representative of what much of the fresh marsh in the northwest section of the project area resembled prior to 2005, in terms of soil type, salinity, water levels, and the frequency and duration of inundation. Reference area R4 is a small tidally influenced area of brackish marsh just outside the boundary of CTU 1. Marsh loss rates were monitored by comparison of all four reference areas with all three CTUs.

Wetlands in the project area are adversely affected by the influence of high water levels from the Mermentau Lakes Sub basin to the west, where elevated water levels are artificially maintained by several locks and water control structures for navigation and agricultural purposes (LWCRTF 1993). Water flowing out of White Lake can enter the project area from the west via oil field canals, the borrow canals and culverts under LA Hwy 82, and from the north via natural openings along the south bank of Schooner Bayou.

Some wetland acreage in the project area was lost through the dredging of oil field access canals and localized erosion. However, most of the wetland loss in the project can be attributed to hurricane degradation in which fresh and intermediate marsh is converted to open water. The land loss was not linear but punctuated by several extreme periods of land conversion to open water.

The potential for tidal exchange between Vermilion Bay and the interior marshes in the project area has greatly increased since 1968 when the construction of Freshwater Bayou Canal was completed along with the numerous oil and gas exploration canals, the old GIWW, and the new GIWW. Initially, the fragile organic soils of the interior marshes were protected from saltwater intrusion and tidal scour by spoil banks along these channels. However, much of the spoil banks along Humble Canal and Freshwater Bayou Canal have been destroyed, largely by boat wake-induced shoreline erosion, exposing the interior wetlands to these detrimental forces.

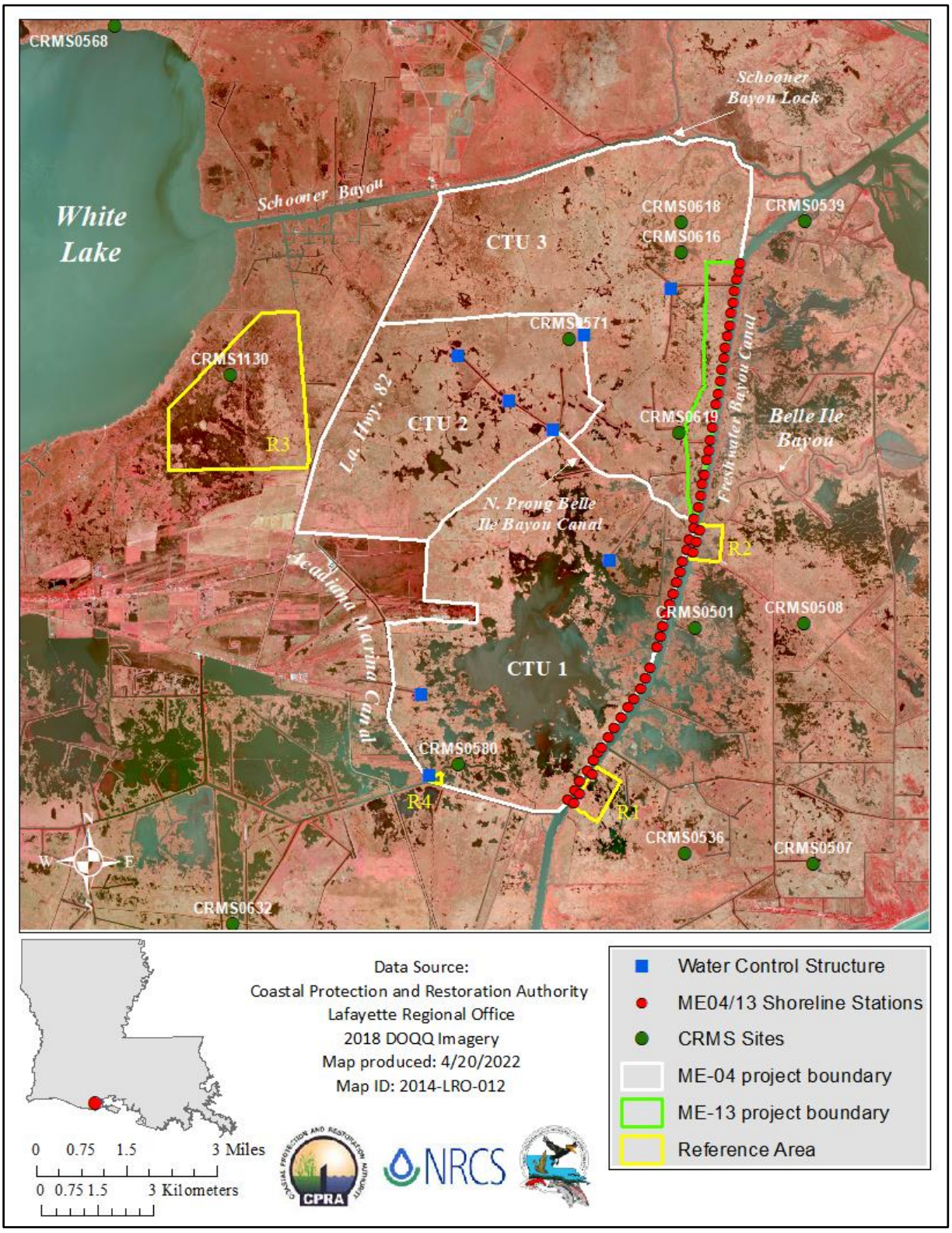

Figure 1. ME-04/13 project and reference areas with locations of continuous data recorders, discrete sampling stations and CRMS-*Wetlands* monitoring stations.

Based on data provided in a feasibility report by Brown and Root (1992), between 1968-1992, an average of 34,051 large vessels (crew boats, jack-up barges, supply boats, and fishing boats) travel through the Freshwater Bayou Canal lock and channel each year, contributing to an average shoreline erosion rate of 12.5 ft per year (3.8 m/yr) on each bank for this period.

Hurricane Rita struck the coast of southwestern Louisiana on September 24, 2005 with maximum storm surge of 8-9 ft (2.4 – 2.7 m) in the ME-04/13 project areas (FEMA 2006). USGS calculated the amount of land that changed to water resulting from the storm to be 98 square miles in southwestern Louisiana, 62 square miles in the Mermentau basin (Barras 2006). This loss can be attributed to several patterns. Shearing, which is ripping and removal of marsh vegetation in historically healthy marshes was observed in marshes bordering the east bank of Freshwater Bayou. The removal of remnant marsh from areas with historical land loss from the surge was observed due east of Pecan Island, south of Sweet Lake, and due east of Deep Lake. A large area of open water also formed within CTU 1 (Figure 2) during this storm event.

Hurricane Ike struck near Galveston, Texas on September 13, 2008. A maximum storm surge of 7 - 8 ft (2.1 – 2.4 m) NAVD 88 was reported for the ME-04/13 project areas (East et al. 2008). Hurricane Ike exacerbated the land loss in the ME-04/13 project area that begun during Hurricane Rita. The four year period from 2004-2008 approximately equaled the land loss experienced over the previous 50 years. However, the destructive capacities of the 2005 and 2008 hurricanes were enhanced by the anthropogenic alterations to the landscape and weakened marsh habitat as previously discussed.

Hurricane Barry made landfall as a Category 1 storm about 10 miles east-southeast of Pecan Island, Louisiana on July 13, 2019. The center of the storm passed directly over Intracoastal City which is directly northeast of the ME-04/13 project area. Storm tides were reported as 6.8 ft NAVD88 with inundation estimated as 5.6 ft based on a USGS gauge in Vermilion Bay near Intracoastal City. Approximately three miles south of the ME-04/13 project area are the Freshwater City Locks. A National Ocean Service site recorded storm surge to be 5.7 ft with estimated inundation at 3.7 ft (Cangialosi et al., 2019). CRMS sites located within the project area recorded water levels ranging from 2.7 ft to 4.6 ft. Water levels near the reference areas ranged from 1.7 ft to 3.5 ft.

In 2020 Hurricanes Laura and Delta made landfall along coastal the southwestern Louisiana coast near Cameron. Laura on August 27 and Delta on October 9. Laura hit the coast as a Category 4 storm near Cameron, Louisiana. Storm surges in the proximity of the ME-04/13 project area ranged from 3 to 5 feet along south-central Louisiana reaching as far inland as HWY 14 (Cangialosi et al., 2021). CRMS stations within the project area recorded water levels from 5.1 ft to 6.6 ft and near reference areas as 1.9 ft to 5.5 ft. Delta was also a Category 4 hurricane when it made landfall near Creole, Louisiana. NOAA estimated storm surges to be between 6 to 9 feet to the east, including the Vermilion Bay area. Project CRMS sites logged water levels ranging from 3.7 ft to 5.5 feet while CRMS stations near the reference areas ranged from 2.5 ft to 7.0 ft. More than likely, the areas of weakened, damaged, and eroding marsh prior to the 2020 hurricane season continued and this loss was expedited by Laura and Delta.

II. Maintenance Activity

a. Project Feature Inspection Procedures

The purpose of the annual inspection of the Freshwater Bayou Wetlands and Bank Stabilization Projects (ME-04 and ME-13) 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. A summary of past operation and maintenance projects completed since completion of the Freshwater Bayou Wetlands Project are outlined in Section IV.

An inspection of the Freshwater Bayou Wetlands and Bank Stabilization Projects (ME-04 and ME-13) was held on March 17, 2022, under sunny skies and mild temperatures. In attendance were Mel Guidry, Stan Aucoin and Phillip Parker from CPRA, along with Richard Evely representing NRCS. The inspection began at the northern end of the foreshore rock dike alignment at 10:30 am (ME-13) and 11:30 am (ME-04).

The field inspection included a complete visual inspection of the entire foreshore rock dike. Staff gauge readings were not available to determine approximate water level and foreshore rock dike elevation.

b. Inspection Results

Site 1—Foreshore rock dike

ME-04: The inspection revealed the entire 28,000 linear feet of foreshore rock dike is in good condition (Appendix B, Photos 1-3). Minimal maintenance should be required during the next 20 years of life extension. In addition, the 300 foot section of rock dike originally gapped when the project was constructed has now been filled in by the Vermilion Parish Police Jury using Interim Emergency Board funds. This work was completed prior to the last maintenance event in 2015.

ME-13: The inspection revealed the entire 23,193 linear feet of foreshore rock is in good condition (Appendix B, Photos 4-6). Minimal maintenance should be required during the next 20 years of life extension.

c. Maintenance Recommendations

i. Immediate/ Emergency Repairs

None

ii. Programmatic/ Routine Repairs

None

II. Maintenance Activity (continued)

d. Maintenance History – ME-04

General Maintenance: Below is a summary of completed maintenance projects and operation tasks performed since March 1995, the construction completion date of the Freshwater Bayou Wetlands Project (ME-04).

2002 - Freshwater Bayou Wetlands Maintenance Project – LDNR: This maintenance project included the installation of approximately 26,750 tons of 1000 lb gradation stone to repair fifteen thousand, two hundred and sixty-three linear feet of bank. Quantity limitations prevented the repair of all sections required. Construction was completed on 4/22/2002. The cost associated with the engineering, design and construction of the Freshwater Bayou Wetlands Maintenance Project is as follows:

Construction:	$615,900.00
Engineering & Design:	$ 46,882.86
Construction Administration:	$ 36,954.00
Construction Oversight/As builts:	$ 17,311.06
TOTAL CONSTRUCTION COST:	**$717,047.92**

2005 - Freshwater Bayou Wetlands Maintenance Project – LDNR (Luhr Bros. Contractor): This maintenance project included the installation of approximately 21,370 tons of 1,250 lb gradation stone to repair 11,426 linear feet of bank. Quantity limitations prevented the repair of all sections required. Construction was completed on 12/15/2005. The cost associated with the engineering, design and construction of the Freshwater Bayou Wetlands Maintenance Project is as follows:

Construction:	$472,660.50
Engineering & Design:	$ 1,282.84
Construction Administration:	$ 5,625.00
Construction Oversight/As builts:	$ 4,419.68
TOTAL CONSTRUCTION COST:	**$483,988.02**

2014 - Transcontinental Pipeline Breach in Foreshore Rock Dike – Vermilion Parish Police Jury (Luhr Bros. Contractor): During the original construction of ME-04 in 1995, the rock dike in the area of the Transcontinental Pipeline was gapped and tied into the marsh. Marsh loss from Hurricane Rita caused marsh loss and increased the exchange behind the rock dike. The VPPJ obtained $360,000 from the Interim Emergency Board to address a 300

foot section of rock dike which was originally gapped. This project was completed in June 2014.

2015 - Freshwater Bayou Wetlands Maintenance Project – CPRA (Luhr Bros. Contractor): This maintenance project included the installation of approximately 45,345 tons of 250 Lb Class Rock to repair the entire 28,000 linear feet of bank. Construction was completed on 3/4/2016. The cost associated with the engineering, design and construction of the Freshwater Bayou Wetlands Maintenance Project is as follows:

Construction:	$1,998,736.00
Engineering & Design:	$ 75,523.23
Construction Admin., Oversight, As-builts	$ 46,300.93
Project Total:	**$2,120,560.16**

e. Maintenance History – ME-13

General Maintenance: Below is a summary of completed maintenance projects and operation tasks performed since June 1998, the construction completion date of the Freshwater Bayou Canal Bank Stabilization Project (ME-13).

2005 - Freshwater Bayou Canal Bank Stabilization Maintenance Project – LDNR (Luhr Bros. Contractor): This maintenance project included the installation of approximately 20,987 tons of 1,250 lb gradation stone to repair 9,130 linear feet of bank. Quantity limitations prevented the repair of all sections required. Construction was completed on 12/15/2005. The cost associated with the engineering, design and construction of the Freshwater Bayou Canal Stabilization Maintenance Project is as follows:

Construction:	$464,368.55
Engineering & Design:	$ 2,234.46
Construction Administration:	$ 5,625.00
Construction Oversight/As builts:	$ 15,503.10
Project Total:	**$487,731.11**

2015 - Freshwater Bayou Canal Bank Stabilization Maintenance Project – CPRA (Luhr Bros. Contractor): This maintenance project included the installation of approximately 59,525 tons of 250 Lb Class Rock to repair the entire 23,193 linear feet of bank. Construction was completed on 3/4/2016. The cost associated with the engineering, design and construction of the Freshwater Bayou Canal Bank Stabilization Maintenance Project is as follows:

Construction:	$2,510,050.00
Engineering & Design:	$ 75,523.23
Construction Admin., Oversight, As-builts	$ 46,300.93
Project Total:	**$2,631,874.16**

III. Operation Activity

a. Operation Plan

There are no water control structures associated with this project under the direct responsibility of CPRA, therefore no Structural Operation Plan is required.

b. Actual Operations

There are no water control structures associated with this project under the direct responsibility of CPRA, therefore no required structural operations.

IV. Monitoring Activity

Pursuant to a CWPPRA Task Force decision on August 14, 2003 to adopt the Coastwide Reference Monitoring System-*Wetlands* (CRMS-*Wetlands*) for CWPPRA, updates were made to the ME-04 and ME-13 Monitoring Plans to merge it with CRMS-*Wetlands* and provide more useful information for modeling efforts and future project planning while maintaining the monitoring mandates of the Breaux Act (Folse et al., 2008). There are five CRMS sites located in the project area. CRMS0580 is located within CTU1 and is classified as intermediated marsh dominated by *Spartina patens* and *Typha latifolia*. CRMS0571, located within CTU2 is also categorized as intermediate marsh with *Spartina patens* and *Typha domingensis* being the most prominent vegetation. Lastly, CRMS0616, CRMS0618 and CRMS0619 are located within CTU3. This area is predominately intermediate marsh consisting of *Spartina patens* and *Schoenoplectus americanus* along with some *Typha domingensis*. There is one CRMS site located with a project reference area. CRMS1130 is located within Reference 3 and is majority fresh marsh defined by *Paspalum vaginatum* and *Sagittaria lancifolia*. This site will be used to compare marsh conditions such as soils, salinity, water levels, inundation as well as marsh loss to the CTU's.

a. Monitoring Goals

The objectives of the ME-04 Freshwater Bayou Wetlands Project are:

1. Protect the existing emergent wetlands along the west bank of Freshwater Bayou Canal and prevent their further deterioration from shoreline erosion and tidal scour.

2. Prevent the widening of the Freshwater Bayou Canal channel into the Freshwater Bayou Wetlands project area.

3. Reduce ponding and marsh loss in the project area wetlands.

4. Maintain target salinity levels in the project area wetlands.

5. Increase vegetation cover in shallow open water areas within the project area wetlands.

The following goals will contribute to the evaluation of the ME-04 project objectives:

1. Decrease the rate of spoil bank erosion along the west bank of Freshwater Bayou Canal using a rock breakwater.

2. Reduce water levels to within the target range for fresh to intermediate marsh vegetation, which is 6 in (15 cm) below to 2 in (5 cm) above marsh level.

3. Maintain salinity levels within the target range for fresh to intermediate marsh vegetation, which is 0-5 ppt.

4. Decrease the duration and frequency of flooding over the marsh.

5. Decrease the rate of marsh loss.

6. Increase the coverage of emergent vegetation in shallow open water areas within the project area.

The objectives of the ME-13 Freshwater Bayou Canal Bank Stabilization Project are:

1. Protect the existing emergent wetlands along the west bank of Freshwater Bayou Canal from further deterioration.

2. Prevent the widening of the Freshwater Bayou Canal channel into the project area wetlands.

The following goals will contribute to the evaluation of the ME-13 project objective:

1. Evaluate land/water ratios within the project and reference areas.

2. Determine the rate of shoreline change along the west bank of Freshwater Bayou Canal in the ME-13 project and reference areas.

b. Monitoring Elements

Aerial Photography:

For project specific data, near-vertical color-infrared aerial photography (1:12,000 scale) was used to document land and water areas, marsh loss rates, habitat and shoreline movement in the ME-04 and ME-13 project areas. Photography for ME-04 was obtained in 1997 (pre-construction) and in 2001 (post-construction). Pre-construction photography for ME-13 was obtained in December 1996 and January 1997. No post-construction photography was collected. The original photography was checked for flight accuracy, color correctness, and clarity and was subsequently archived. Aerial photography was scanned, mosaicked, and geo-rectified by USGS/NWRC personnel according to standard operating procedures (Steyer et al. 1995, revised 2000).

Aerial photography and satellite imagery has been collected for the entire coast through CRMS. This aerial photography will be analyzed for CRMS stations at one meter resolution. The satellite imagery will be analyzed to determine land and water areas for the entire coast. This imagery will be a subset and used to evaluate changes in land and water areas within the ME-04 and ME-13 project areas at a coarse (30m) resolution. The data provided by this tool is at a large spatial scale and is designed to show trends in land loss, not exact acreages.

Shoreline Change:

To document shoreline movement along Freshwater Bayou Canal, shoreline markers were placed at maximum intervals of 1,000 ft (305 m) on the marsh edge along the west bank of the canal between its confluence with the Humble Canal and with North Prong Belle Isle Bayou, at 31 points corresponding to the pre-construction survey cross-sections, and at 3 points along each of the two 0.5 mi (0.8 km) long reference areas located along the east side of the channel opposite the north and south ends of the proposed breakwater (Figure 1). Shoreline position relative to shoreline markers was documented in 1998, 2005, 2008, 2011, 2014 and 2021. Just north of the ME-04 shoreline markers are 24 settlement plates to document shoreline change in the ME-13 project area. Shoreline position for this project was obtained in 1998, 2003, 2009, 2015 and 2021. The ME-13 project is shoreline protection only.

Water Level:

To evaluate the extent of ponding within the ME-04/13 project area, water level relative to marsh level and NAVD was monitored at seven continuous data recorders. One in each of the project area CTUs, one in the reference area R2, one in reference area R3, one in N. Prong Belle Ile Bayou Canal between CTUs 1 and 3, and one in Acadiana Marina Canal south of CTU 1 (removed September 26, 2003). Water level data is used to document the variability in water level, and the frequency, duration, and range of marsh inundation in the project and reference areas. Water level was monitored in 1996-1998 (pre-construction) and in 1999-2006 (post-construction). The recorders were removed in September 2006. Discrete measurements were discontinued prior to 2003. CRMS monitoring in the project and reference area began in 2006 and goes through December 2021 for this report. To monitor water levels in CTU1, CRMS0580 was referenced, CRMS0571 for CTU2 and CRMS0616, 618 and 619 for CTU3. CRMS0580, 571, 616, and 619 are classified as intermediate marsh with CRMS0618 being brackish marsh. CRMS1130 was chosen as a reference site and is classified as fresh marsh.

Salinity:

Salinities were monitored with continuous data recorders in each CTU and in the reference areas. Salinity data is used to characterize the spatial variation in salinity throughout the project area, and to determine if project area salinity is being maintained within the target range. Salinity was monitored in 1996-1998 (pre-construction) and in 1999-2006 (post-construction). The recorders were removed in September 2006 when CRMS monitoring began.

Discrete monthly salinity and water depth were measured at 49 monitoring stations, including the seven recorder stations (Figure 1), 30 were located inside the project area and 19 were located outside the project area in reference areas R2 and R3, in exterior canals, and inside and outside of the eight CWPPRA structures). Staff gauge water level readings (in ft NAVD88) were also recorded monthly at the seven continuous recorder stations, inside and outside of the eight CWPPRA structures, and at the Vermilion Corporation boat house near the southeast corner of reference area R2. Salinity and water level were recorded by the USACE inside and outside of Schooner Bayou Lock. The discrete monthly salinity data were used to calculate a mean monthly salinity for the early growing season (March-June), the late growing season (July-October), and the dormant season (November-February) at each station, for the pre-construction (March 1996 through September 1998) and post-construction (October 1998 through December 2002) time periods. Discrete measurements were discontinued prior to 2003 and those data are included in previous reports.

Salinity is currently being monitored hourly utilizing 4 CRMS-*Wetlands* stations (CRMS0571, 580, 616, 618 and 619) within the project area and the selected reference site, CRMS1130. Continuous data were used to characterize average annual salinities throughout the project and reference areas.

At each servicing, a measurement of interstitial water salinity (porewater) is collected adjacent to each CRMS-*Wetlands* gauge. Porewater salinity is also collected at the vegetation plots when vegetation is surveyed.

Emergent Vegetation:

To document the condition of emergent vegetation in the ME-04/13 project area over the life of the project, vegetation was monitored at thirty-seven sampling stations established systematically in the project and reference areas (Figure 2). Six east-west transects were established uniformly across the project area. Sampling stations were established uniformly along each transect line to obtain an even distribution of sampling stations throughout the project area. Similar east-west transects were delineated across reference areas R2 and R3 to establish four sampling stations in each reference area. Percent cover, dominant plant heights, and species composition were documented in 2 m^2 sampling plots marked with two corner poles to allow for repeated sampling over time. Vegetation was evaluated at the sampling sites in the fall of 1996 and 1998 (pre-construction) and in the fall of 2001 (post-construction). A subset of the vegetation stations were sampled after Hurricane Rita in 2005, 2006, 2007 and 2008.

Individual species' cover data from project specific monitoring were summarized according to the Floristic Quality Index (FQI) method utilized by CRMS (Cretini and Steyer 2011) where cover is qualified by scoring species according to whether they are generally associated with habitat disturbance or stability.

Beginning in 2006 vegetation composition and cover was 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 was collected at five CRMS stations located within the ME-04/13 project area (CRMS0571, 580, 616, 618, 619) and one within reference area 3 (CRMS1130) and collection continues presently.

Soil Properties

Soil cores were collected to describe major soil properties such as bulk density and percent organic matter. Three, 4" (10.16-cm) diameter cores were collected to a depth of 24 cm and divided into 6, 4-cm sections at each site. The soil was processed by the Department of Agronomy and Environmental Management at Louisiana State University. Soil cores were collected at the ME-04 project and reference CRMS sites during station establishment in 2005-2007 and a second series of samples were collected in 2018.

Soil Surface 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 a year at each of the ME-04/13 project and reference CRMS sites. These data will be used to describe general components of elevation change and establish accretion/subsidence rates. The RSET was surveyed to a known elevation datum (ft, NAVD 88) so it could be directly compared to other

elevation variables such as water level. Data collected over at least 5 years was used to calculate rates for the project and reference area; therefore the displayed elevation change rates are an estimation of that temporal trend.

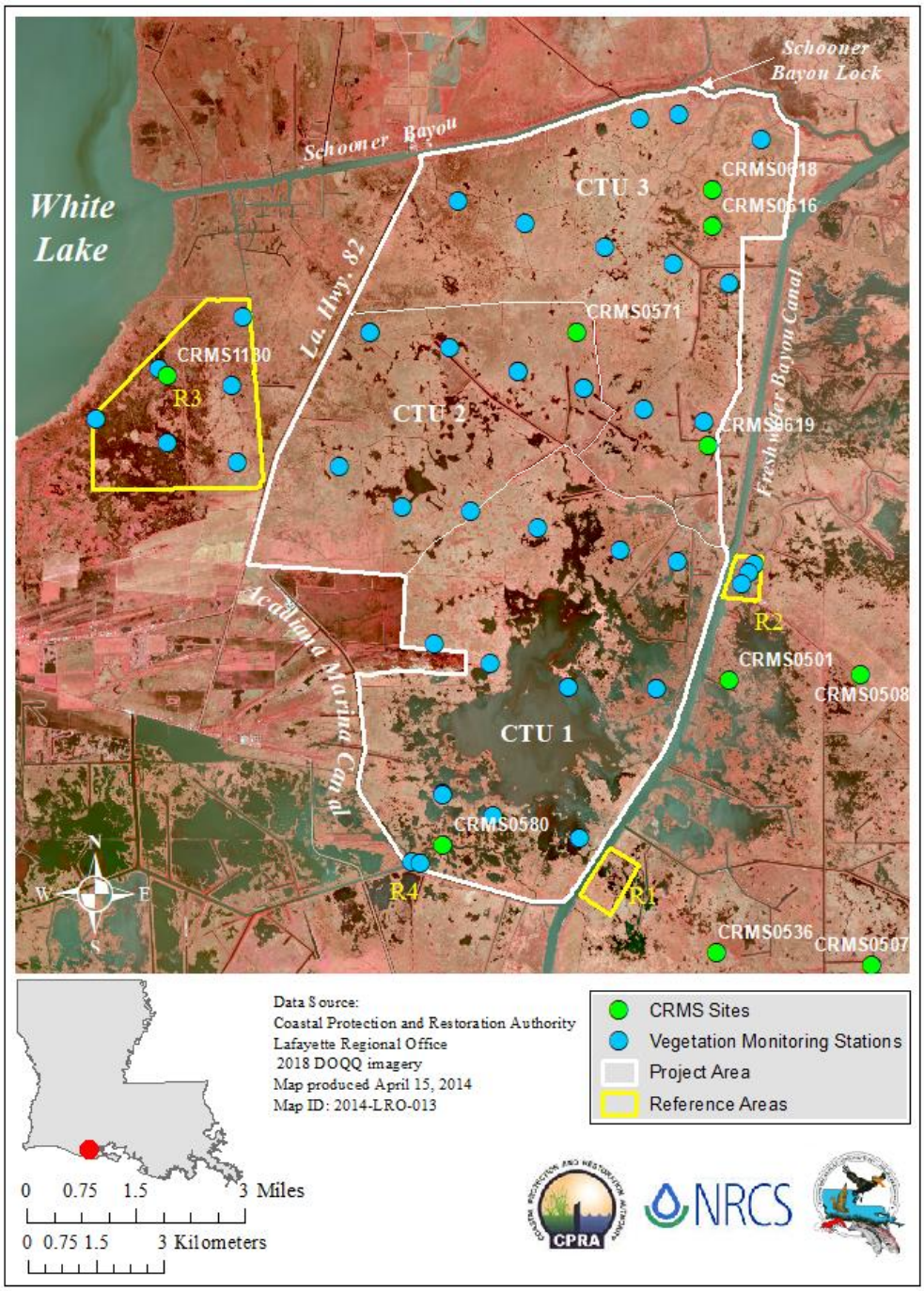

Figure 2. Locations of emergent vegetation sampling plots established in 1996 and 1997 in the ME-04/13 project and reference areas (R2, R3, and R4) and the associated CRMS stations.

IV. Monitoring Activity (continued)

c. Monitoring Results and Discussion

Aerial photography:

Pre-construction aerial imagery taken in 1997 by USGS/NWRC showed land area to be over 80% in the project area as well as Reference areas R1, R2 and R3, while R4 land area measured less than 45% (Figures 3 and 4). Post construction photography obtained in 2001 (Figure 5) indicated the project and reference land areas remained stable (Wood and Guidry, 2014).

The CRMS spatial viewer was utilized to provide subsequent information on land area change. Data is available through 2016. Since this assessment is on a larger scale than that used for the 1997 land-water classification by USGS/NWRC, the results are presented in terms of trends and provide a different perspective of the land to water changes over a period of decades. Prior to 2005 land change in the project area was trending slightly upwards. This changed after several hurricanes affected the area. The percentage of land in the project area then steadily declined overall from 1980-2016, showing a land change trend for the project area of -0.22%/yr or -65 ac/yr. (Figure 6). ME-13, however, has remained stable over the years. Land area trends between 1985 to 2016 show percent change to be -0.11%, which is approximately -1 acre/yr (Figure 7). ME-13 is a much smaller project area that experiences less tidal exchange because it is nestled directly behind the rock dike. This offers protection to the interior marshes from boat wake induced shoreline erosion along Freshwater Bayou Canal and tidal effects from Vermilion Bay.

There have also been fluctuations in marsh classification throughout the project's history. Pre-construction habitat analysis from 1997 classified marsh as mostly fresh with some intermediate marsh while post construction habitat analysis in 2001 reflected a shift to mainly intermediate marsh with a large decline in fresh marsh habitat (Figure 8). Aerial vegetation survey data available through CRMS was analyzed to report these changes over time. The ME-04 project area was classified as mostly fresh marsh when it was constructed. The significant shift from fresh marsh to intermediate marsh by 2007 can be attributed to effects from drought conditions around 1999-2000 and Hurricane Rita in 2005. Currently the project remains mostly intermediate marsh (80.19%) with some pockets of brackish marsh (16.77%). Fresh marsh has slowly been returning (3.04%) which is more than likely due to several years of average and above average rainfall which is reflected in the 2021 data.

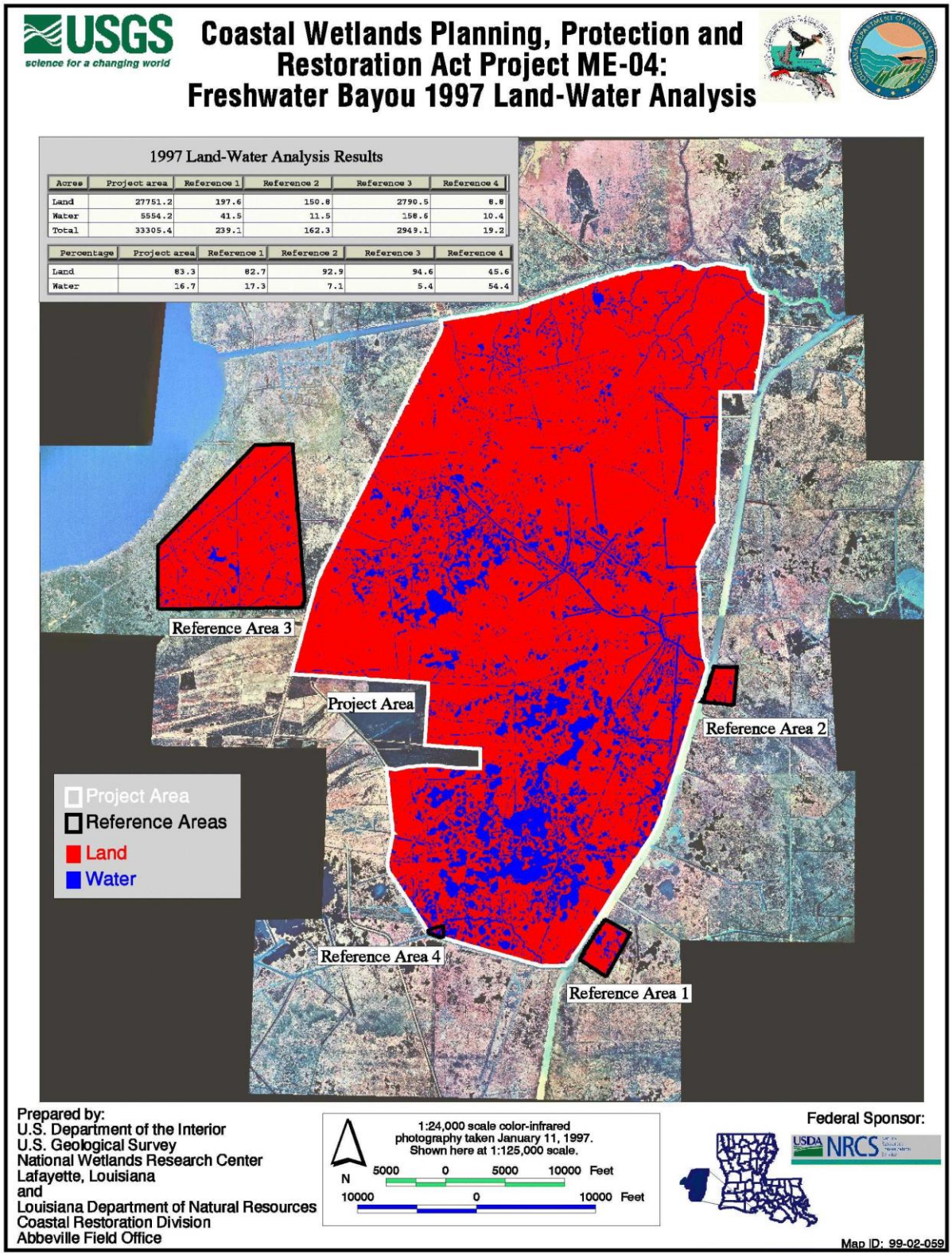

Figure 3. Pre-construction analysis showing the acreage of land and water in the project and reference areas of Freshwater Bayou Canal Wetland Protection in 1997.

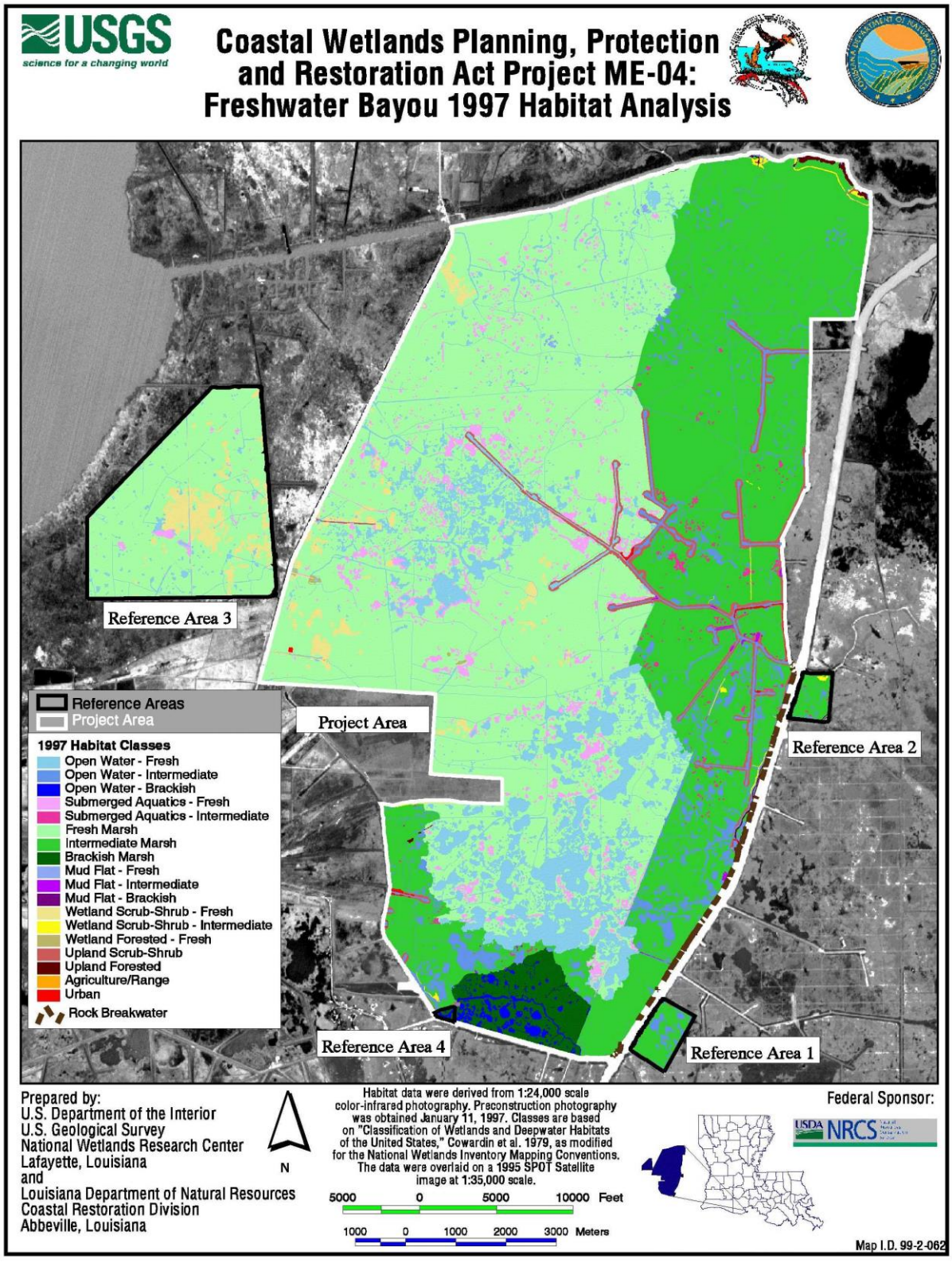

Figure 4. Pre-construction analysis showing acreage of habitats in the project and reference areas in Freshwater Bayous Canal Wetland Protection in 1997.

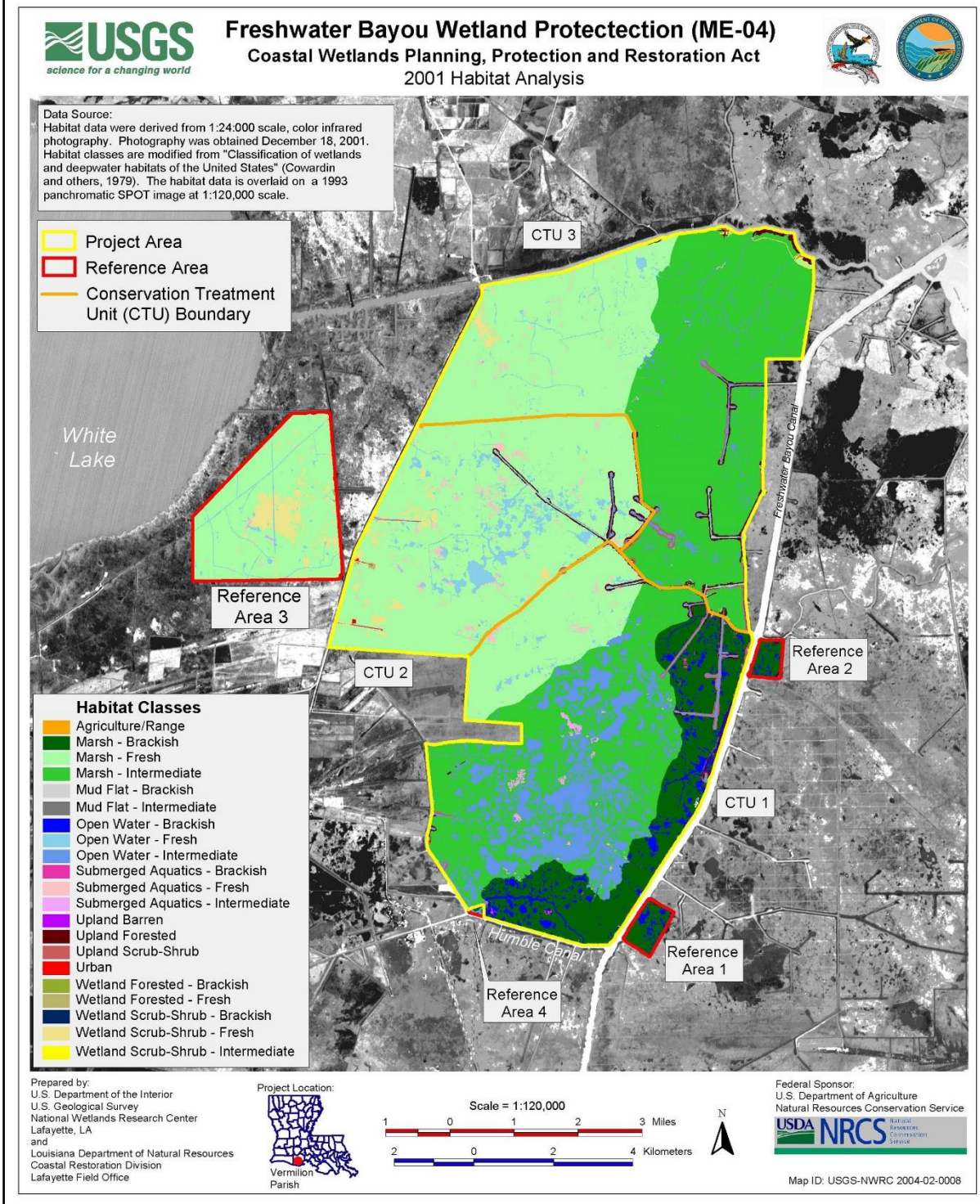

Figure 5. Post-construction analysis showing acreage of habitats in the project and reference areas in Freshwater Bayou Canal Wetland Protection in 2001.

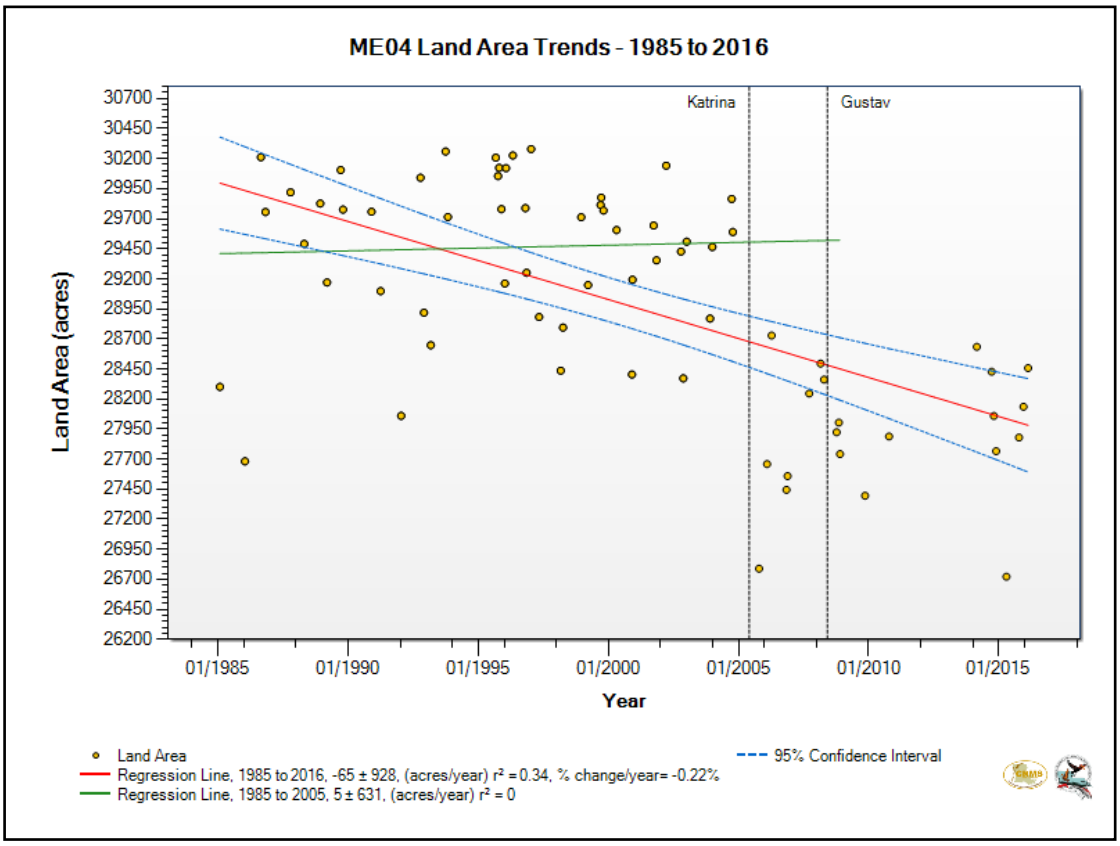

Figure 6. Project scale percent land analysis within the ME-04 project area for years 1985 to 2016.

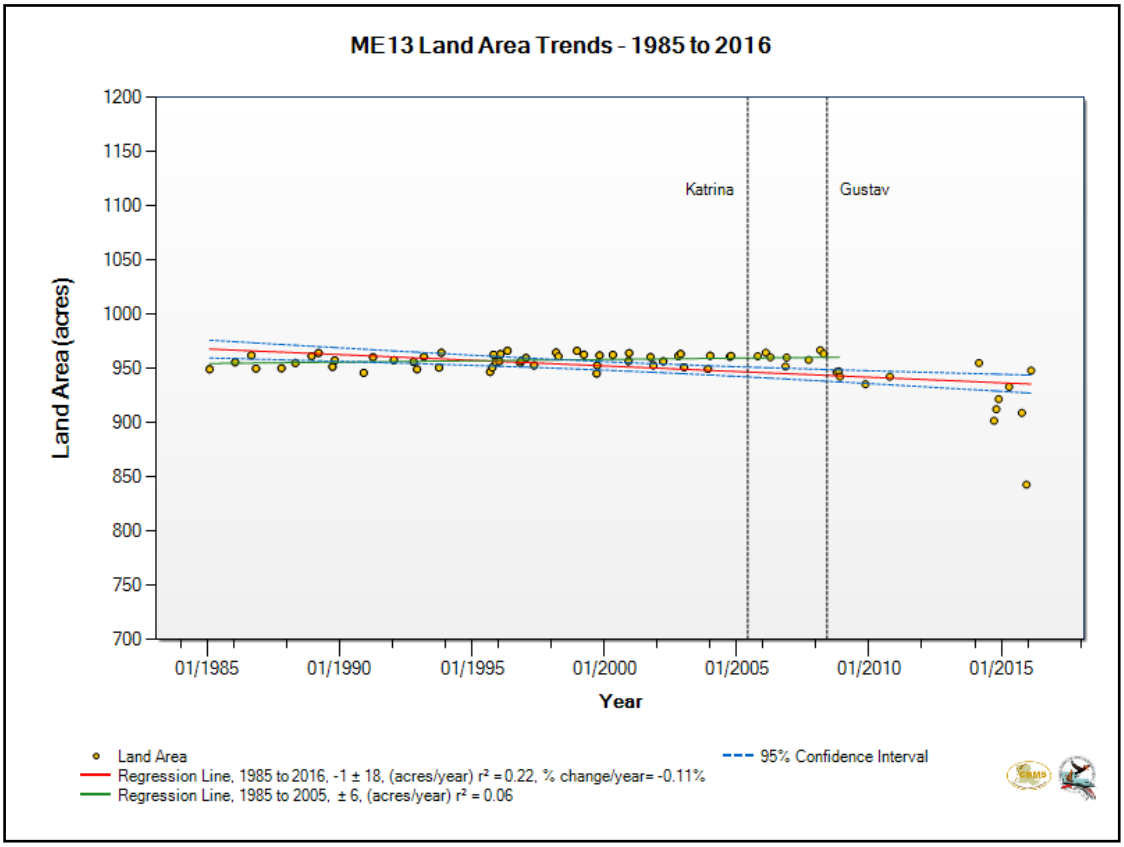

Figure 7. Project scale percent land analysis within the ME-13 project area for years 1985 to 2016.

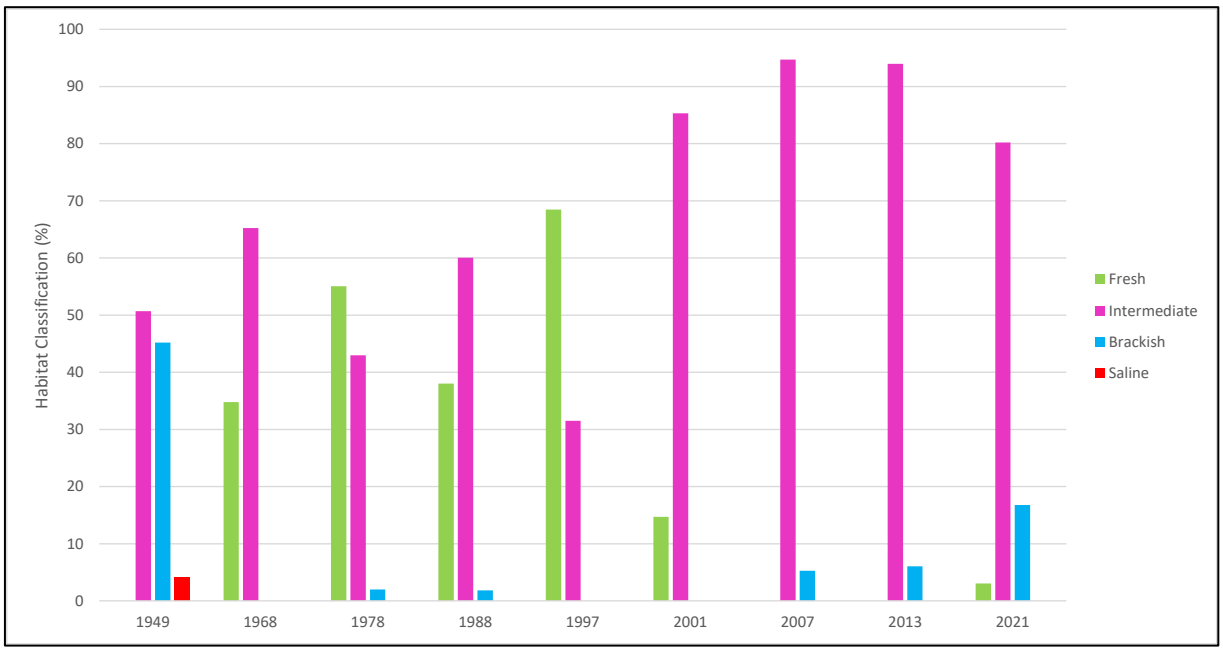

Figure 8. Marsh habitat classification from 1949 – 2021 for the ME-04 project area.

Shoreline change:

The ME-04 and ME-13 projects have successfully achieved the shoreline protection component of the project design by substantially reducing the shoreline erosion rate compared to an unarmored reference shoreline (Figures 9 and 10). From construction in 1998 through 2021, the erosion rate for the reference area was nearly six times greater than both project areas (ME-04: project -1.3 ft/yr; ME-13: project -0.7 ft/yr; reference -7.3 ft/yr).

The rocks effectively protected the project area shoreline from wake, wave, and tidal forces along Freshwater Bayou, while the shoreline in the reference area continued to erode significantly faster (Figures 11 and 12). Higher rates of erosion along the project area shoreline typically took place in and around areas where the rocks were low or breached. The most recent data collection effort in December 2021 revealed continued erosion in the project area although this is occurring at a much slower rate than the reference area.

The ME-04 rock dike has been repaired multiple times. Rock was added in 2002 and 2005 but material quantity was limited so only certain stretches were repaired. ME-13 also had a partial repair in 2005 but both shoreline dikes were repaired in their entirety in 2016. No breaches were observed during the 2021 data collection effort (Figure 13).

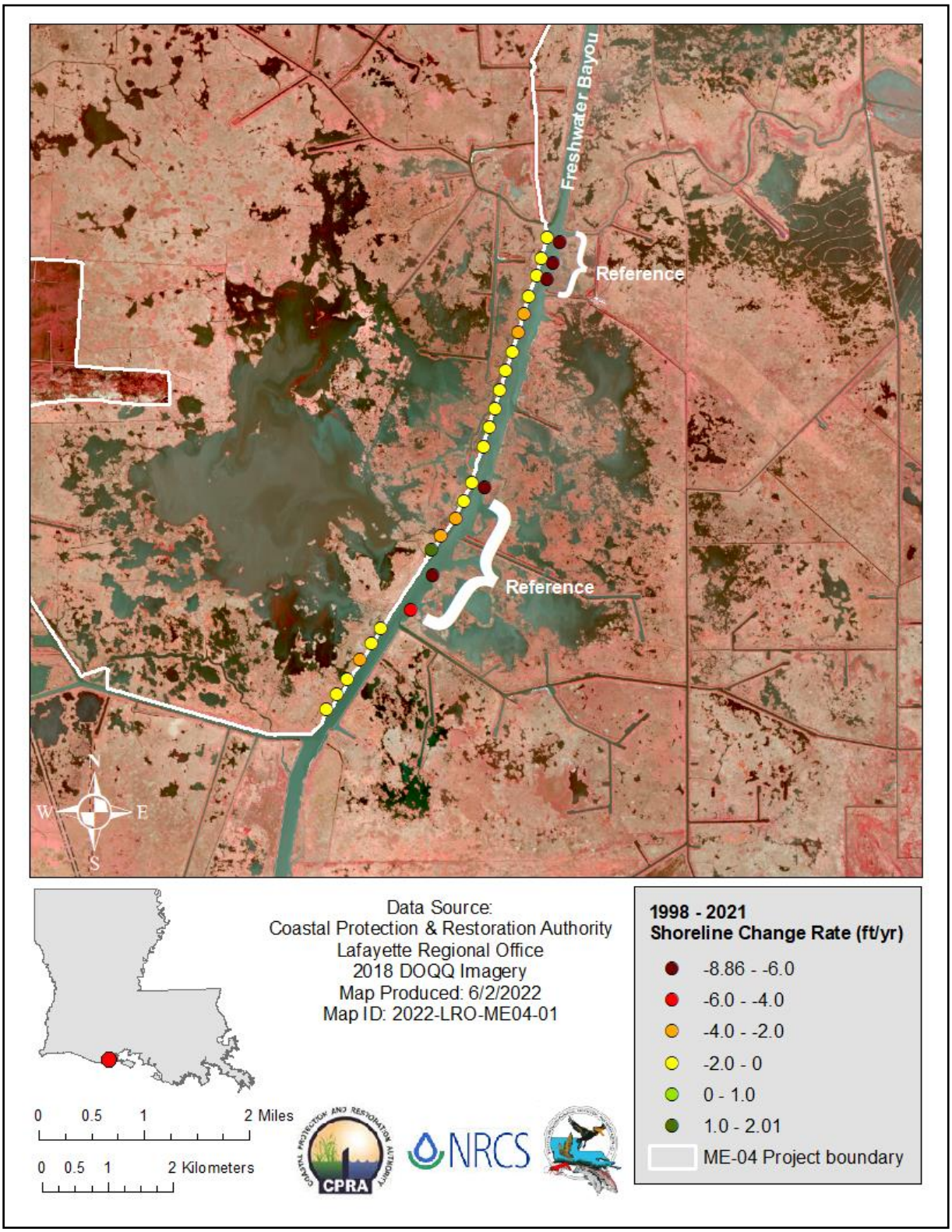

Figure 9. ME-04 shoreline change rates (ft/yr) from 1998 to 2021 within the Freshwater Bayou Wetland Protection project and reference areas. The project rock dike has reduced shoreline erosion while the reference shoreline has expanded as it connects to interior waterways increasing tidal exchange and scouring.

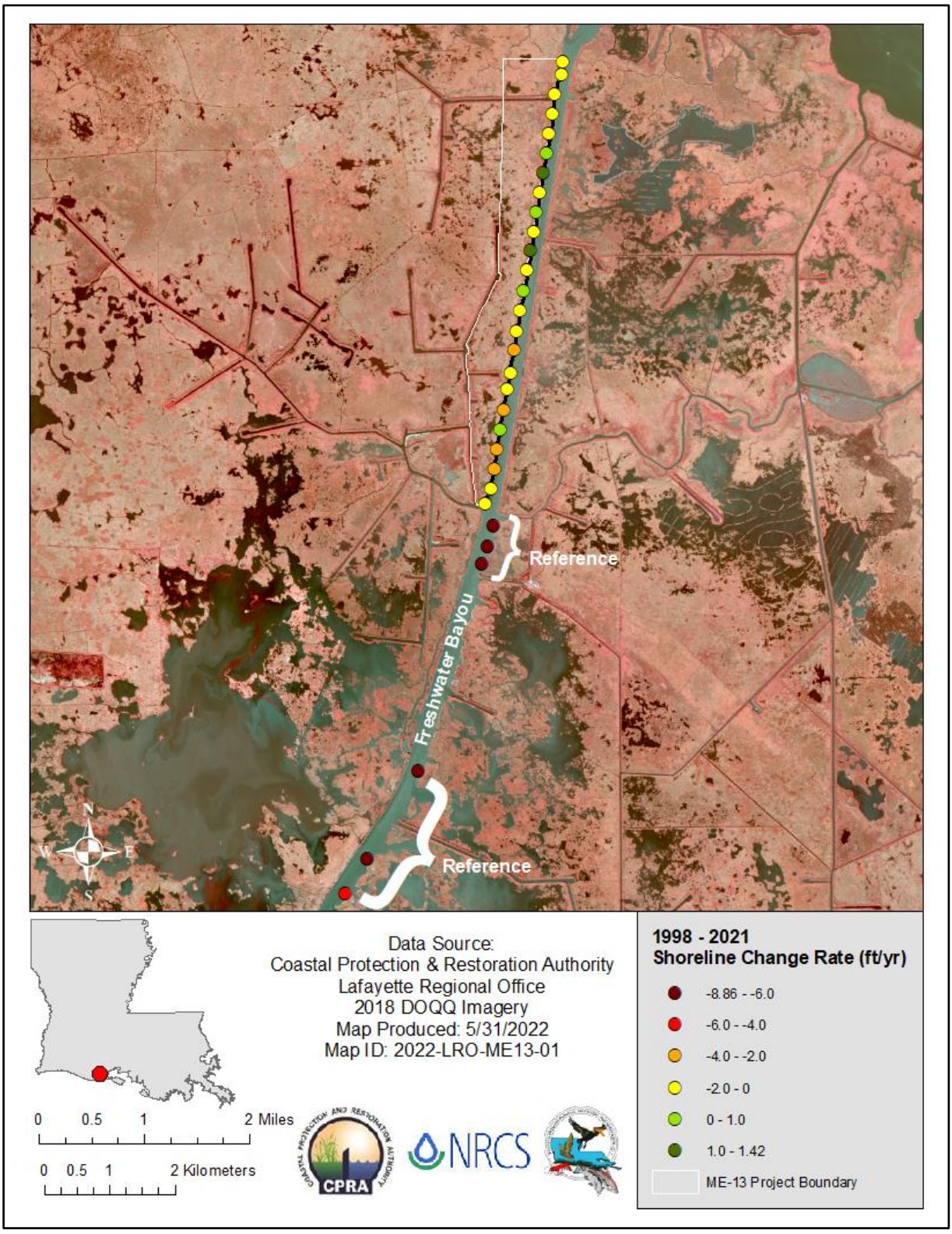

Figure 10. ME-13 shoreline change rates (ft/yr) from 1998 to 2021 within the Freshwater Bayou Wetland Protection project and reference area. The project rock dike has reduced shoreline erosion while the reference shoreline has expanded as it connects to interior waterways increasing tidal exchange and scouring.

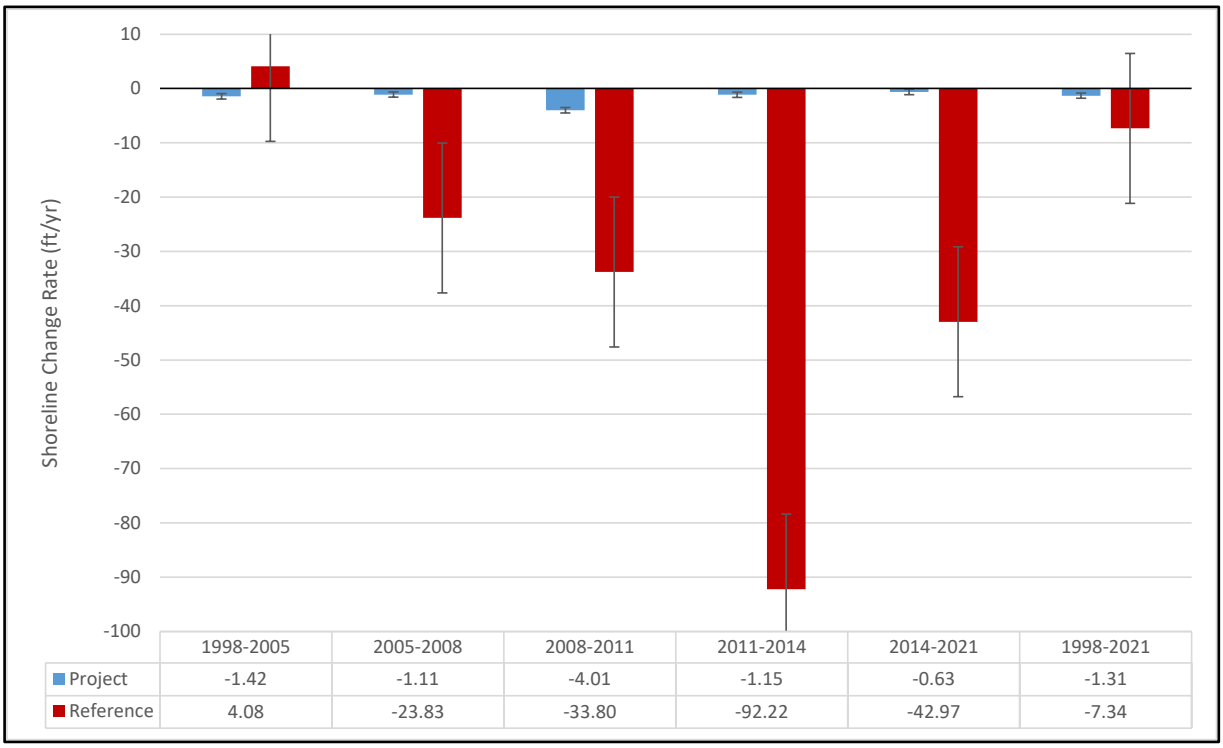

Figure 11. ME-04 shoreline change rates broken down between sampling periods over the life of the project.

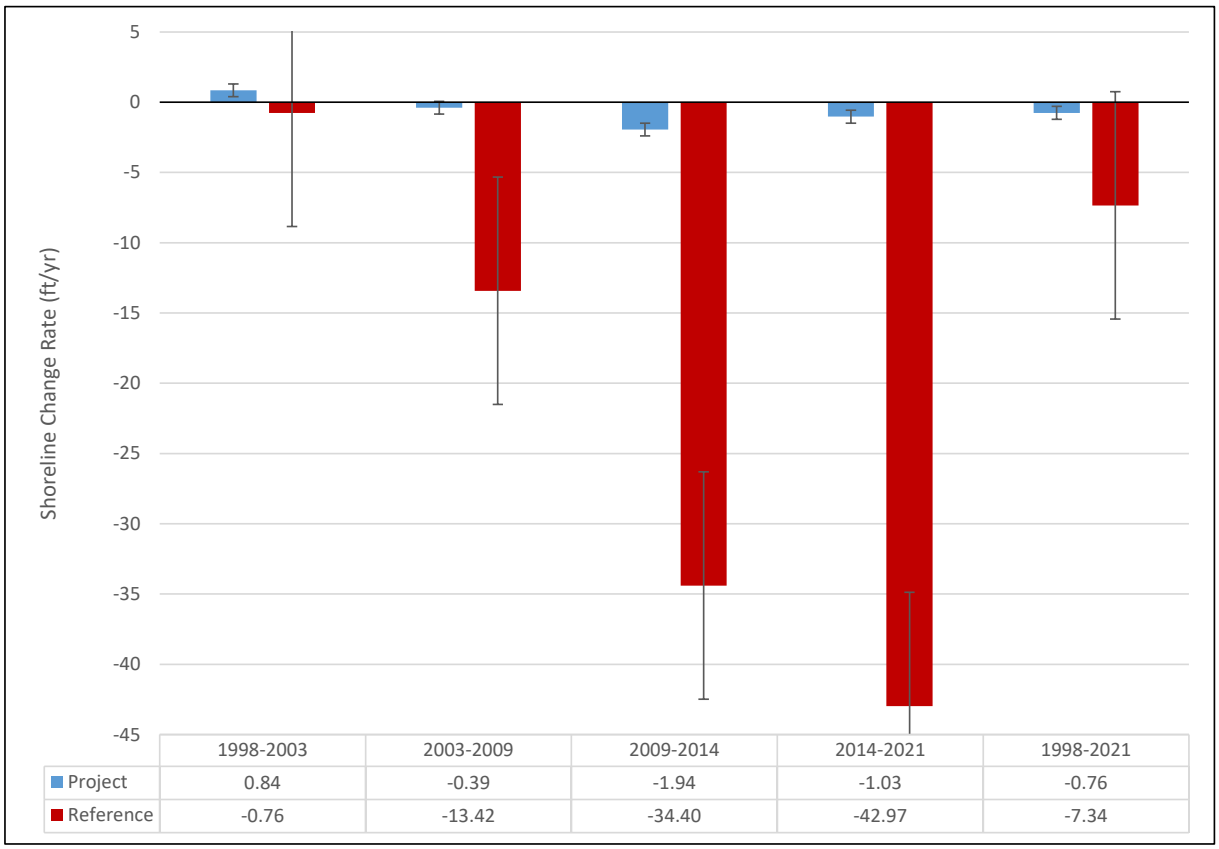

Figure 12. ME-13 shoreline change rates broken down between sampling periods over the life of the project.

Figure 13. A photograph representing the rock dock condition along the ME-04 and ME-13 shorelines during the most recent data collection effort in 2021.

Water level:

Hydrologic data collected for the ME-04/13 project indicates that overall, water levels were higher in the project areas than the reference areas with the exception of CTU1, which generally tracks at or below the reference areas. (Figure 14). There is also a dramatic increase in water level from project construction through the most current data collection in 2022. This is due to higher than normal Gulf of Mexico water levels along with consistent upland rains with the project area between these two opposing forces driving water elevation higher. This has had a homogenizing effect on project reference differences as the overall increased water level has reduced drainage and stratification, but the relationships between units has remained constant ($F_{4,1885}$=203.80, p=<0.0001). CTU1 (0.32ft) had the lowest project or reference water elevation due to its proximity and connectivity to the southern reach of Freshwater Bayou Canal, this is similar to R2 (0.53 ft) and R3 (0.46) which were not distinct from one another (Table 1). R3 would seemingly be higher than most of the project and reference areas because it is on the Mermentau Basin side of HWY82, but it is isolated from the GOM and Vermilion Bay thus periods of drought can maintain reduced water levels for longer periods of time. The highest water level was CTU3 (0.90 ft) with CTU2 (0.80 ft) distinct but similar comparatively. These locations likely receive high water from both the Mermentau basin drainage and the high GOM and Vermilion Bay with localized droughts offering only a marginal effect.

These effects can be seen when examining the differences between project and reference locations across temporal events that have affected the water level locally, such as hurricanes and droughts, and regionally like rising GOM levels. The project CTU's 2 and 3 are consistently higher than R2 and R3 across all time intervals. CTU 1 is similar or slightly lower than both reference locations (Figure 15). Pre-construction the project and reference area differences were near 1.0 ft, but hurricanes Rita and Ike and project construction vastly reshaped the landscape making the project reference differences truncated (~0.5 ft) but still staggered north to south and based on proximity and connectivity to drainage and tidal influence (Figure 16). These temporal effects had significant impact on water elevation across the region and specifically on ME-04/13 ($F_{11,1885}$=129.37, p=<0.0001). Statistically, three of the four most recent periods, approximately 2015-2022 had the highest water elevations recorded, all near 1.1 ft, with the exception of a summer drought in 2018. This equates to a foot of water higher on average than the 2000 drought post construction (0.01 ft) at both the project and reference areas (Table 2). Over the project life droughts have become less impactful with low water elevations quickly rebounding to pre drought levels or higher, 1999-2000 (0.1 ft), 2010-2011 (0.5 ft), and 2018 (0.6 ft). This lack of extended low water periods along with SLR has increased the impact of flooding as marsh elevation has not accelerated at the same rate as water elevation.

Flooded conditions have dominated the project area from 2016-2022, during those seven years the water elevation has rarely been below or even at marsh elevation except during winter months or the previously discussed drought conditions (Figure 17). One of the goals of this project is to maintain water levels between 6 inches below marsh level and 2 inches above marsh level. By and large, water levels in the CTU's were within target range more often than the reference area (Figure 18). However, water levels varied significantly over the years generally in both the project and reference area simultaneously, explained by location, connectivity, local and regional forces and are generally not related to project features. This is principally due to the lack of water control structure operations in the project area and that the rock dike is not a hydrologic barrier. Outside hydrologic forces have dominated the ME-04/13 project area and without more hydrologic control the project water level and flooding are likely to continue to get worse without elevation gains through sediment addition.

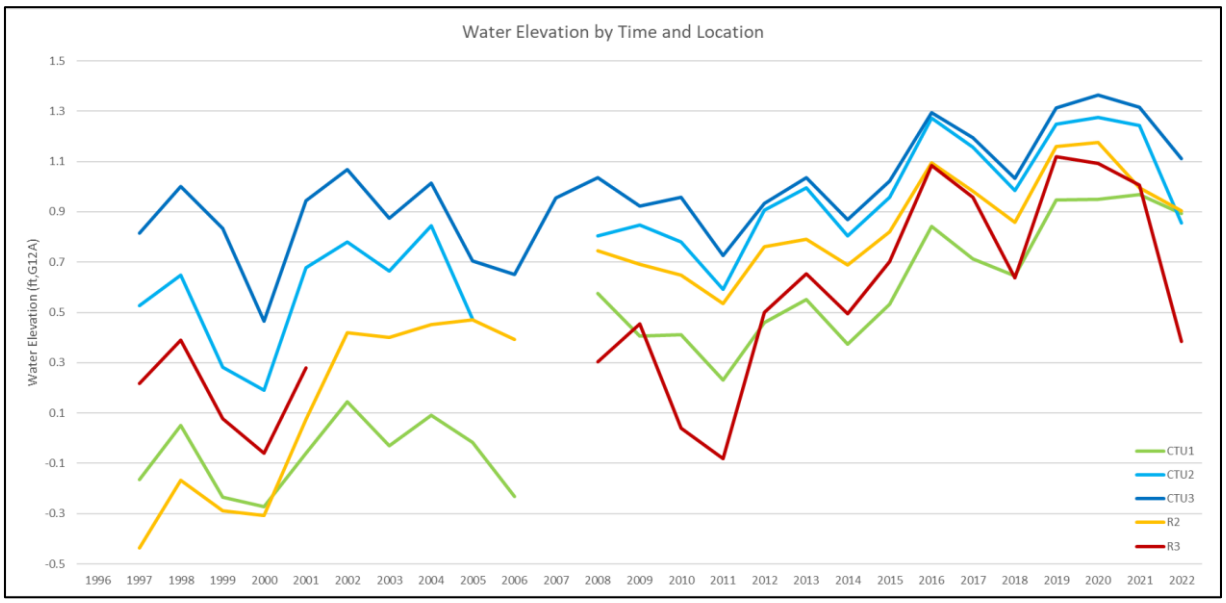

Figure 14. Annual project CTU's water elevations compared to R2 and R3, the reference area is generally always lower that the project area with the exception of the southern CTU1.

Table 1. Two way ANOVA analisis of project and reference areas water elevations (ft, Geoid12a).

Location	Least Sq Mean	Std Error	Mean	Level
CTU1	0.32	0.02	0.35	D
CTU2	0.80	0.02	0.83	B
CTU3	0.90	0.01	1.02	A
R2	0.53	0.02	0.56	C
R3	0.46	0.02	0.54	C

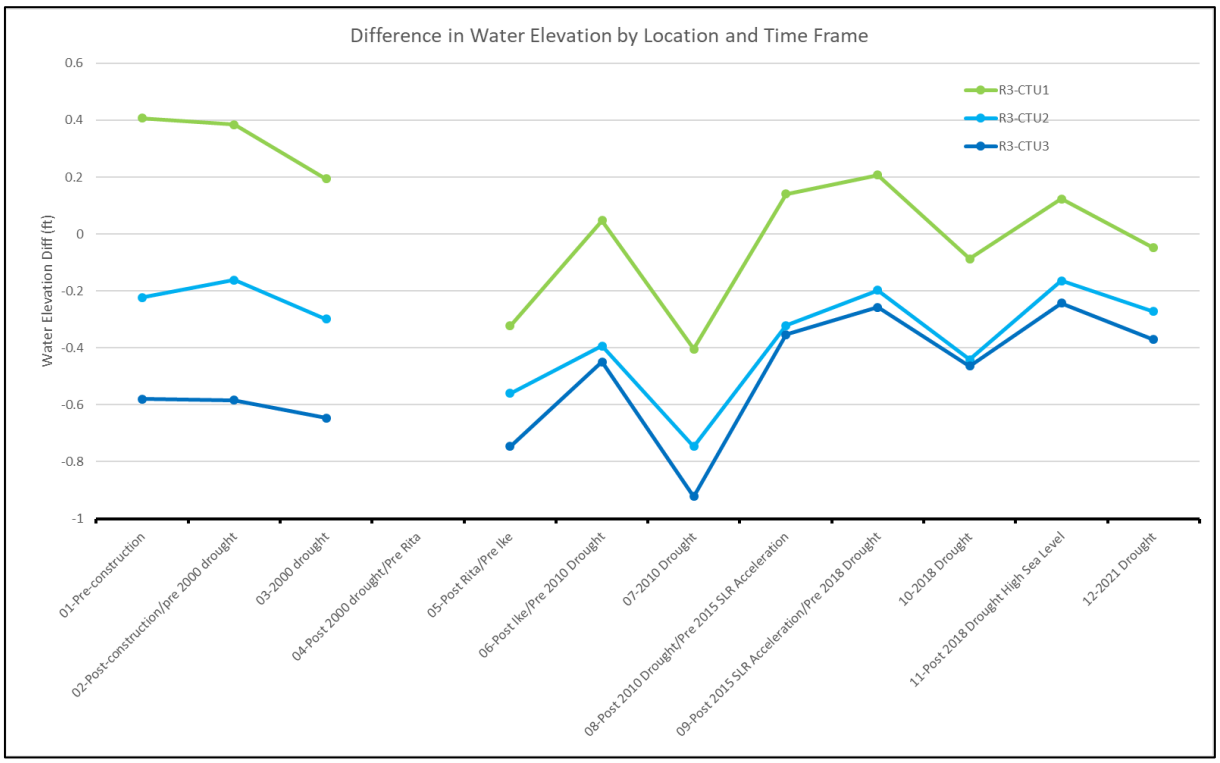

Figure 15. Difference in project CTU's water elevation Least Square Means compared to R3 through distinct temporal periods, the reference area is generally always lower that the project area with the exception of the southern CTU1.

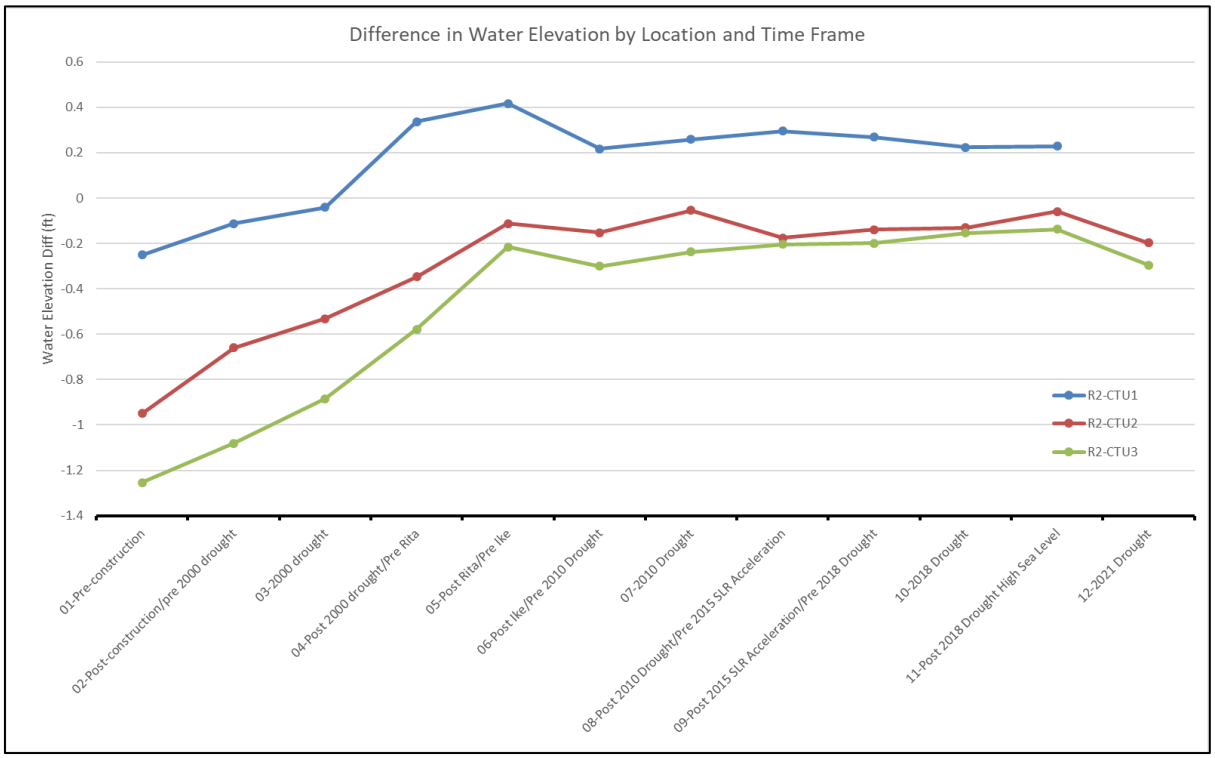

Figure 16. Difference in project CTU's water elevation Least Square Means compared to R2 through distinct temporal periods, the reference area is generally always lower that the project area with the exception of the southern CTU1.

Table 2. Two way ANOVA analisis of temporal events across project and reference water elevations (ft,G12A).

Temporal Period	Least Sq Mean	Level
11-Post 2018 Drought High Sea Level	1.08	A
12-2021 Drought	1.05	A
09-Post 2015 SLR Acceleration/Pre 2018 Drought	1.05	A
06-Post Ike/Pre 2010 Drought	0.71	B
08-Post 2010 Drought/Pre 2015 SLR Acceleration	0.68	B
10-2018 Drought	0.61	B,C
05-Post Rita/Pre Ike	0.51	C
07-2010 Drought	0.50	C
04-Post 2000 drought/Pre Rita	0.47	C
02-Post-construction/pre 2000 drought	0.27	D
01-Pre-construction	0.25	D
03-2000 drought	0.01	E

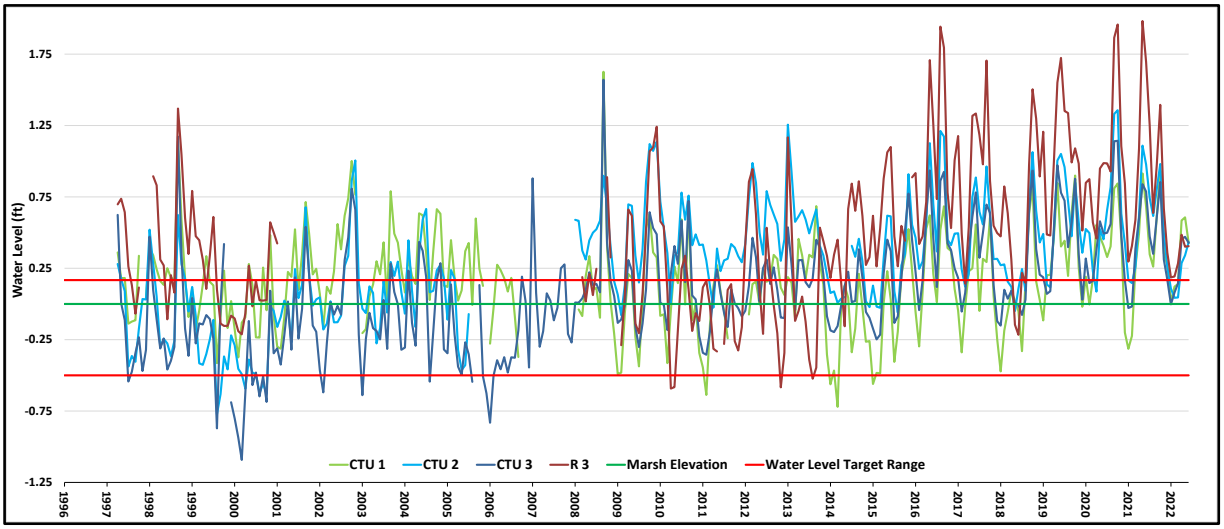

Figure 17. Mean monthly flooding within the project and reference area CRMS stations from 1996-2022.

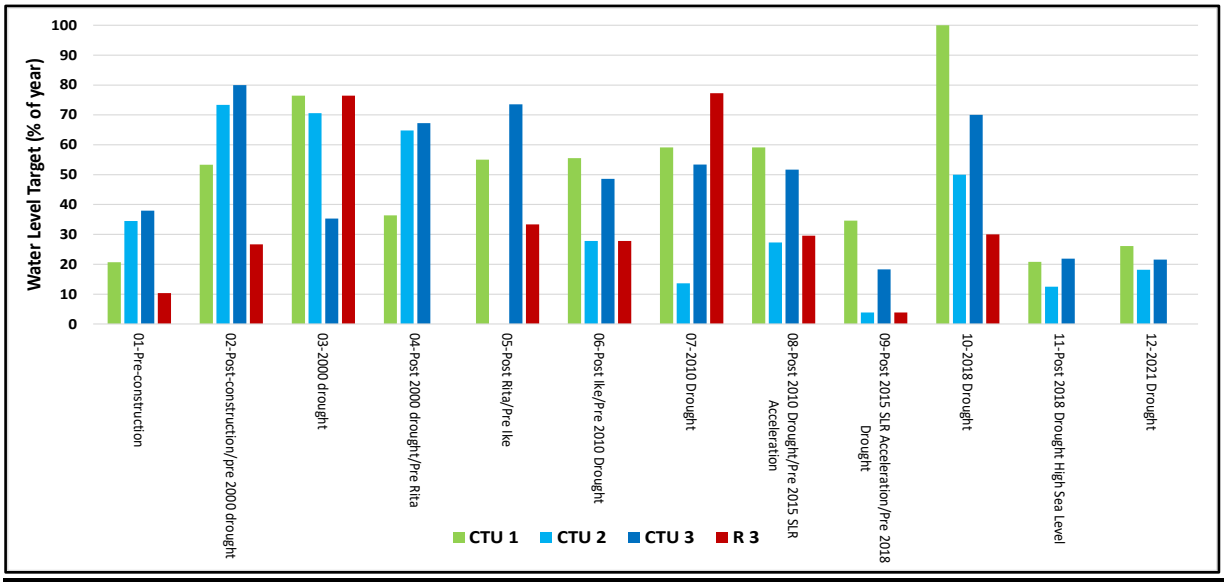

Figure 18. The percentage of the year water level was inside target range within the project and reference areas at project-specific stations through 2022.

Salinity:

Hourly hydrologic data collected for the ME-04/13 project shows that overall, salinities were lower in R3 than the project area, with R2 similar to the higher CTU1 on the southern end of the project (Figure 19). As there is no major project feature affecting salinities, the much lower salinities at R3 can be attributed to its location, which is between White Lake to the west and HWY 82 to the east and south in the Mermentau Basin. This results in a fresher upland influence and structure management plan affecting the reference area differently than the project CTU's. Spikes in salinity over the life of the project occurred during periods of drought or storm events but the project goal to keep salinities at or below 5 ppt has widely been accomplished across all locations ($F_{4,1953}$=88.63, p=<0.0001). As mentioned R3 (1.57 ppt) had the lowest project or reference salinity, while CTU1 (3.79 ppt) and R2 (3.97 ppt) had the highest salinity due to their proximity to the GOM and Vermilion Bay (Table 3).

These effects can be seen when investigating the differences between project and reference locations across temporal events that have altered salinity, such as hurricanes and droughts. The project CTU's are consistently more saline than R3 across all time intervals. There is a stratification where CTU2 is the freshest and CTU1 is the most saline and this relationship is static through all environmental events. (Figure 20). Salinity data was also compared to the unmanaged tidal marsh on the east side of Freshwater Bayou Canal outside of the project area, R2. This data comparison showed that this area is saltier than the project area except CTU1. This outside area experiences more tidal influence from nearby Vermilion Bay. CTU 1 also sees a difference when compared to this outside area. Pre-Rita, CTU 1 was fresher but after Rita CTU 1 was more saline. This indicates that the project is not preventing salt from entering CTU 1 as well as CTU 2 and CTU 3, which remained unaffected (Figure 21).

These temporal effects had significant impact on salinity across the region and specifically on ME-04/13 ($F_{11,1953}$=153.92, p=<0.0001). Statistically, salinity has been more closely linked to broader regional effects than project reference locations. Over the project life, droughts have caused salinity to increase as have hurricanes; 1999-2000 drought (6.5 ppt), 2005 hurricane Rita (3.8 ppt), 2007 hurricane Ike (5.0 ppt), 2010-2011 drought (5.0 ppt), and the 2021 drought (3.0 ppt) These periods of elevated salinity are ecologically meaningful and could cause mortality to freshwater plants while expanding the project areas already large intermediate community (Table 4). As stated the project area has generally kept salinity below the 5 ppt threshold a majority of the time excluding a few of the major events listed above, however these are generally outside the project features ability to control and are more the baseline of the local salinity gradient (Figure 22). Salinity in the CTU's varied significantly over the years in both the project and reference area concurrently, explained by local and regional forces and are generally not related to project features. After approximately 2012 through 2021 the project area has been within the target salinity, this corresponded to the increased local and upland rainfall through that decade (Figure 23). Mean yearly interstitial porewater salinity at the CRMS project sites and CRMS reference site were compared. Averages at CRMS project sites ranged from 3.5 ppt to 4.7 ppt while R3 averages were 2.8 ppt (Figure 24). Generally, porewater salinities in the project and reference areas tracked together and responded to stimuli similarly.

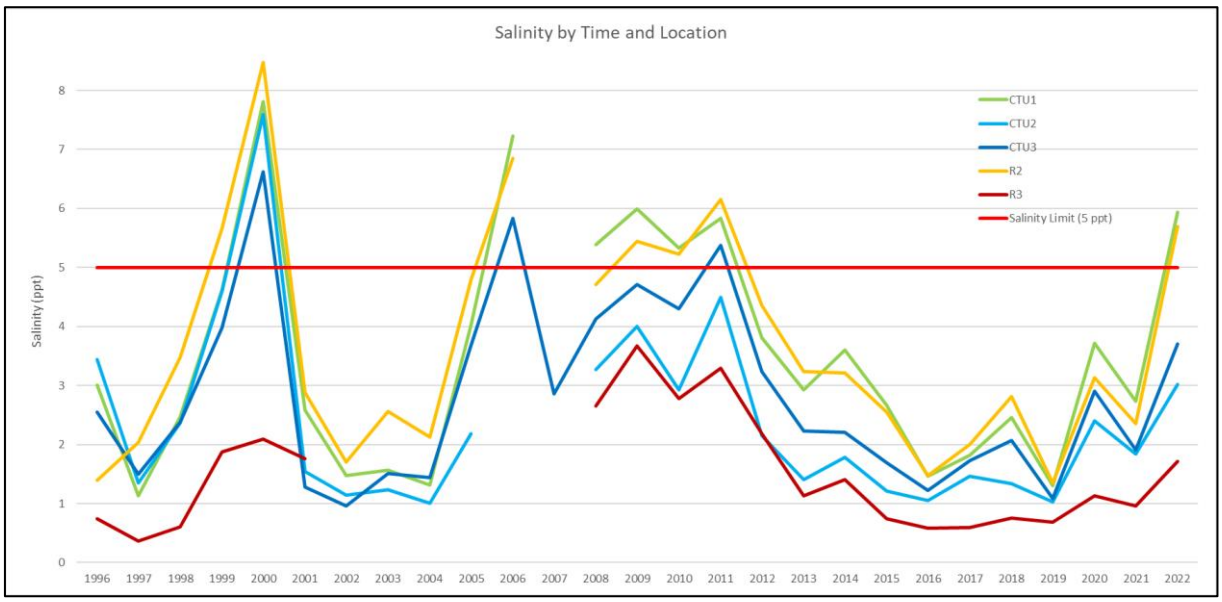

Figure 19. Annual project CTU's salinity compared to R2 and R3, the project area is bounded by the two reference areas with the exception of the southern CTU 1.

Table 3. Two way ANOVA analisis of project and reference areas salinity (ppt).

Location	Least Sq Mean	Std Error	Mean	Level
CTU1	3.79	0.09	3.44	A
CTU2	2.74	0.09	2.38	C
CTU3	3.06	0.05	2.87	B
R2	3.97	0.09	3.66	A
R3	1.57	0.10	1.47	D

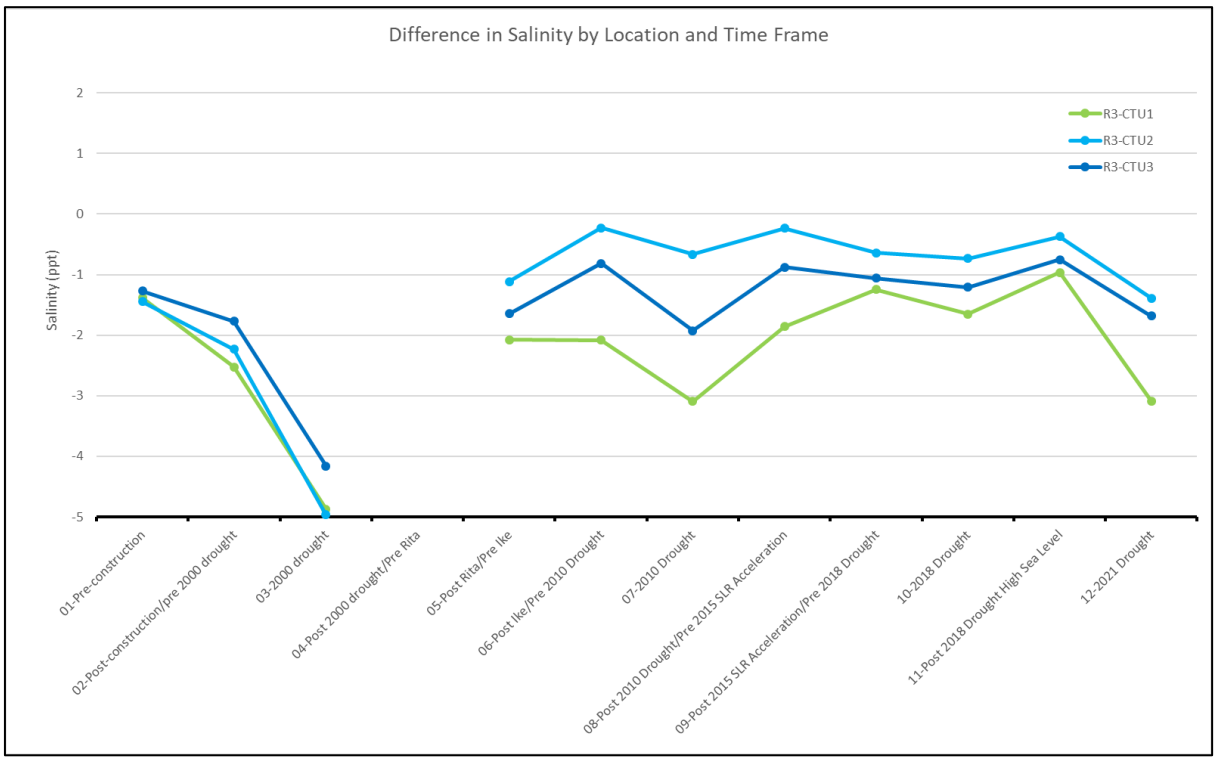

Figure 20. Difference in the project CTU's salinity Least Square Means compared to R3 through distinct temporal periods, the reference area is always less saline that the project area.

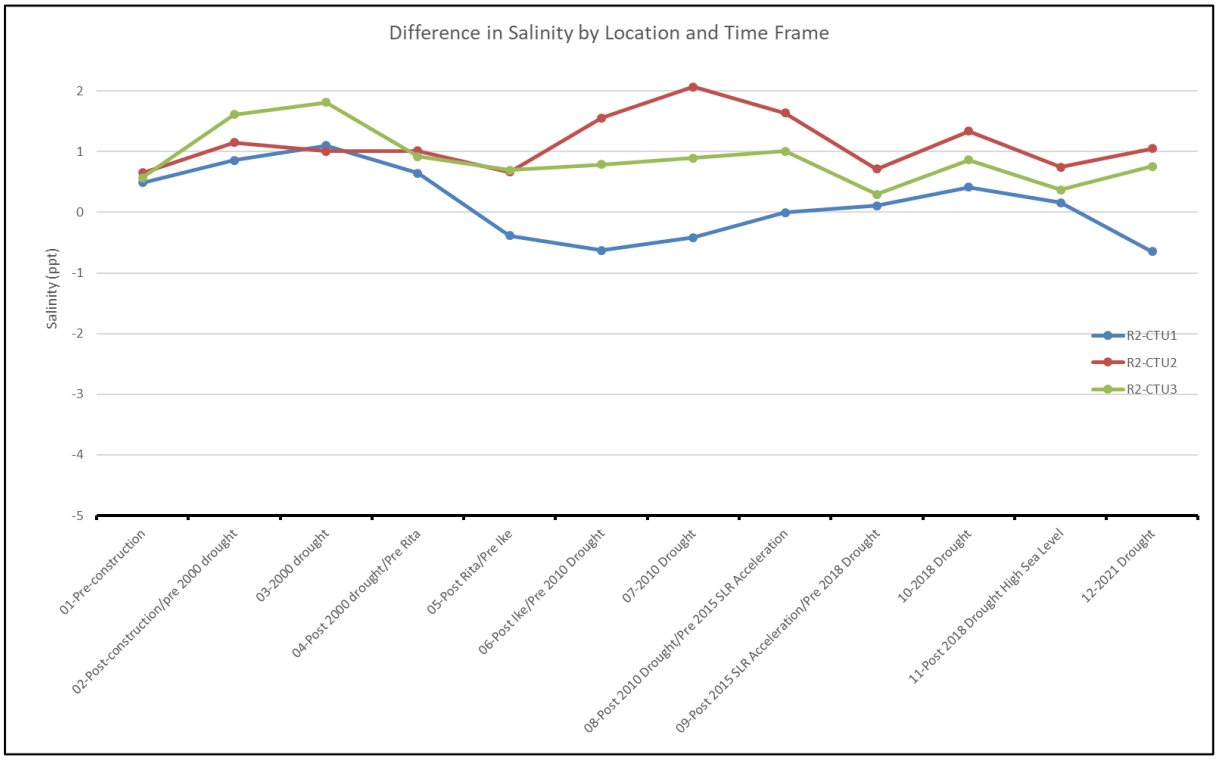

Figure 21. Difference in the project CTU's salinity Least Square Means compared to R2 through distinct temporal periods, the project area is fresher than the reference with the exception of the southern CTU1.

Table 4. Two way ANOVA analisis of temporal events across project and reference salinity (ppt).

Temporal Period	Least Sq Mean	Level
03-2000 drought	6.47	A
06-Post Ike/Pre 2010 Drought	5.03	B
07-2010 Drought	4.95	B
05-Post Rita/Pre Ike	3.82	C
12-2021 Drought	3.03	D
02-Post-construction/pre 2000 drought	2.82	D,E
08-Post 2010 Drought/Pre 2015 SLR Acceleration	2.35	E
10-2018 Drought	1.99	E,F
01-Pre-construction	1.65	F
09-Post 2015 SLR Acceleration/Pre 2018 Drought	1.53	F
04-Post 2000 drought/Pre Rita	1.37	F
11-Post 2018 Drought High Sea Level	1.33	F

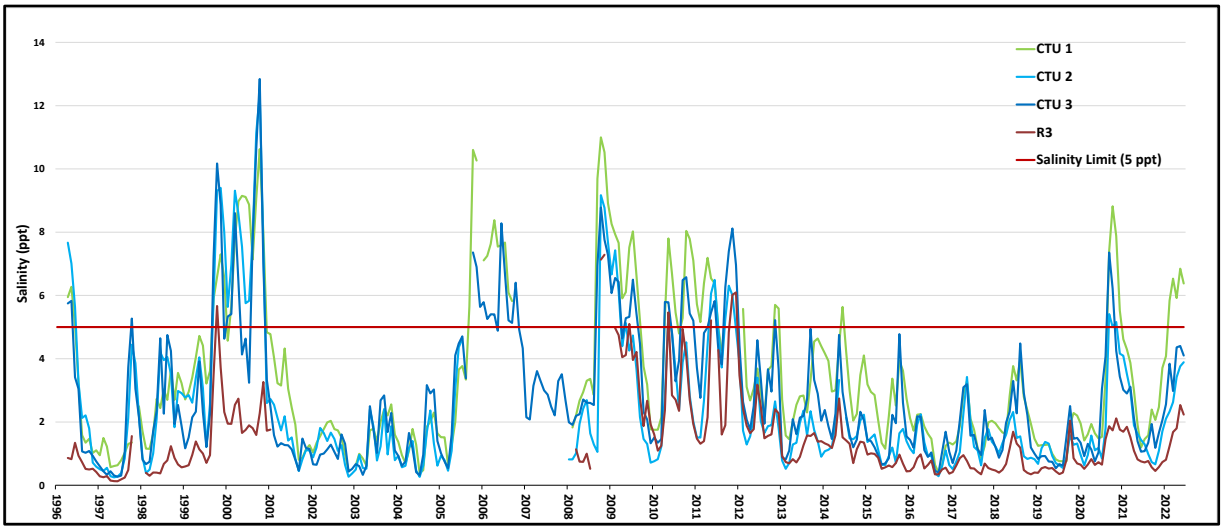

Figure 22. Mean monthly salinity levels within the project and reference areas.

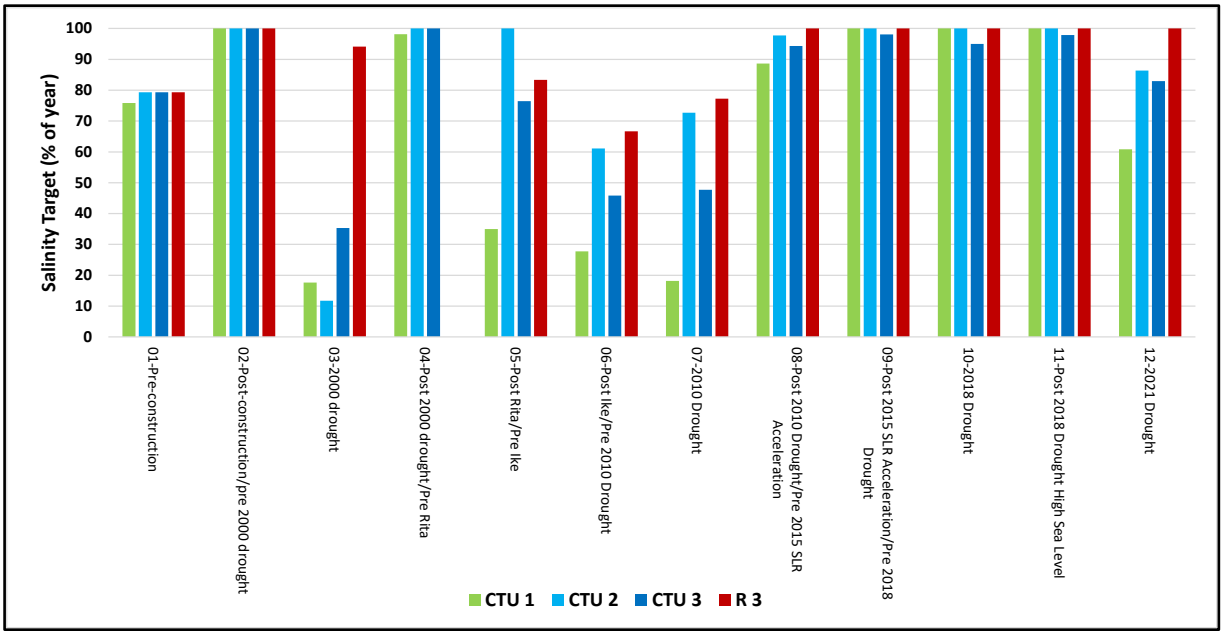

Figure 23. The percentage of the year project and reference area salinities were below the target range of 5 ppt.

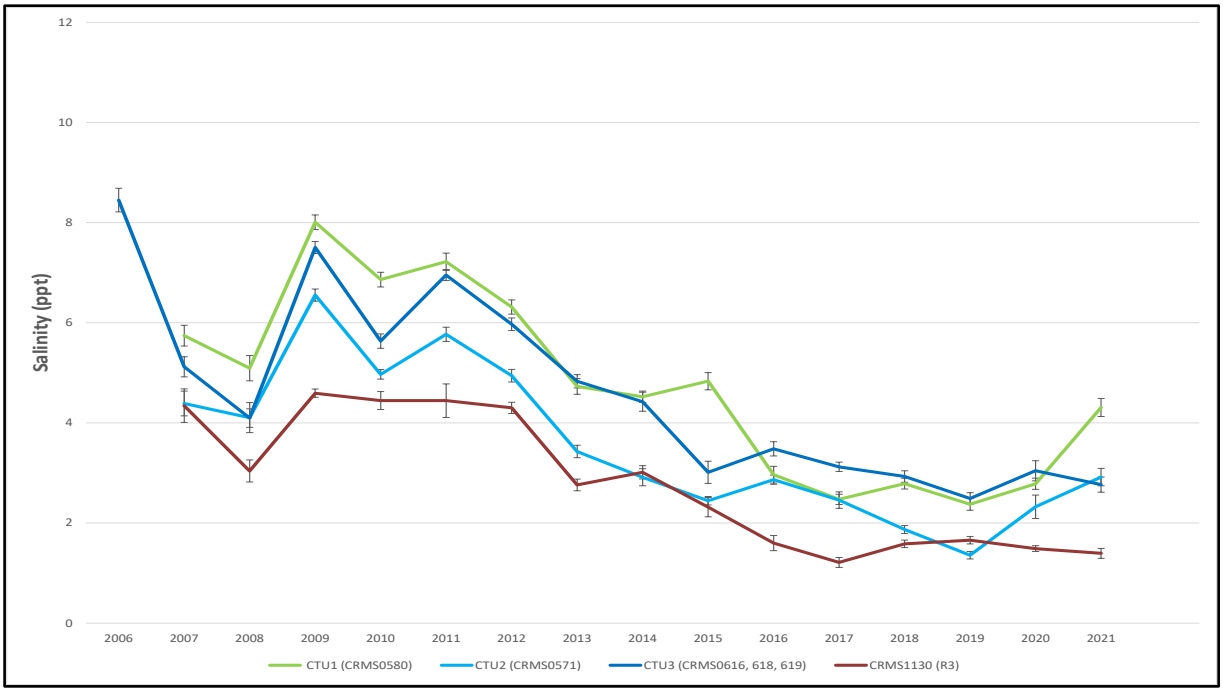

Figure 24. Mean yearly porewater salinity of the project and reference CRMS sites. Overall, the project and reference soil salinities were very similar to one another.

Vegetation:

Vegetation data collection at the ME-04/13 project areas, in general have had higher percent cover values than the reference area at CTU 1 and CTU 3. Hurricane Rita in 2005 affected CTU 2 and R3 the most causing percent cover to decrease, but both recovered fairly quickly and in 2010 percent cover in R3 surpassed all project areas due to drought conditions. Since then percent cover has been trending upward and R3 has had higher percent cover than the project areas in recent years (Figure 25). Vegetative cover changes over the life of the project occurred during periods of drought and storm events but have remained stable during recent high water conditions across all locations ($F_{4, 97}$ =1.421, p=0.2353). There was no significant difference across project and reference locations as they both respond to the same environmental parameters similarly and variability was quite extensive. As mentioned R3 has changed drastically between 0% cover post Hurricane Rita and near 100% cover during the drought, however this averages out somewhat equally to the other locations which have more inertia built into their plant communities and resist these extreme swings. Interestingly CTU 1 was the only location to have been negatively impacted by the drought in 2010 and it was also the most resilient to the hurricane. So there are clearly yearly differences at the locations that are evident when looking at the difference in percent cover change across year and location (Figure 26). There is general agreement in 2010/2011 and 2012 with the reference areas outperforming the project area in drought conditions and then underperforming as flooding conditions returned in 2012. Annually percent cover did differ by year ($F_{20, 97}$ =3.775, p=<0.0001), with 1996 (85.8%) and 2005 (26%) respectively having the most and least cover of any year in the project record. The years 2005, 2006 (46.8%), and 2007 (46.3%) post Rita were collectively the lowest period of cover while the highest were 1996, 2011 (80.4), and 2001(79.5). But due to considerable variability in the percent cover only the extremes are significantly different from all other years. The project and reference areas have both recovered from a significant denuding of marsh vegetation in 2005, recovering and maintaining vegetative cover though significant flooding in recent years successfully meeting the project goal to increase vegetative cover.

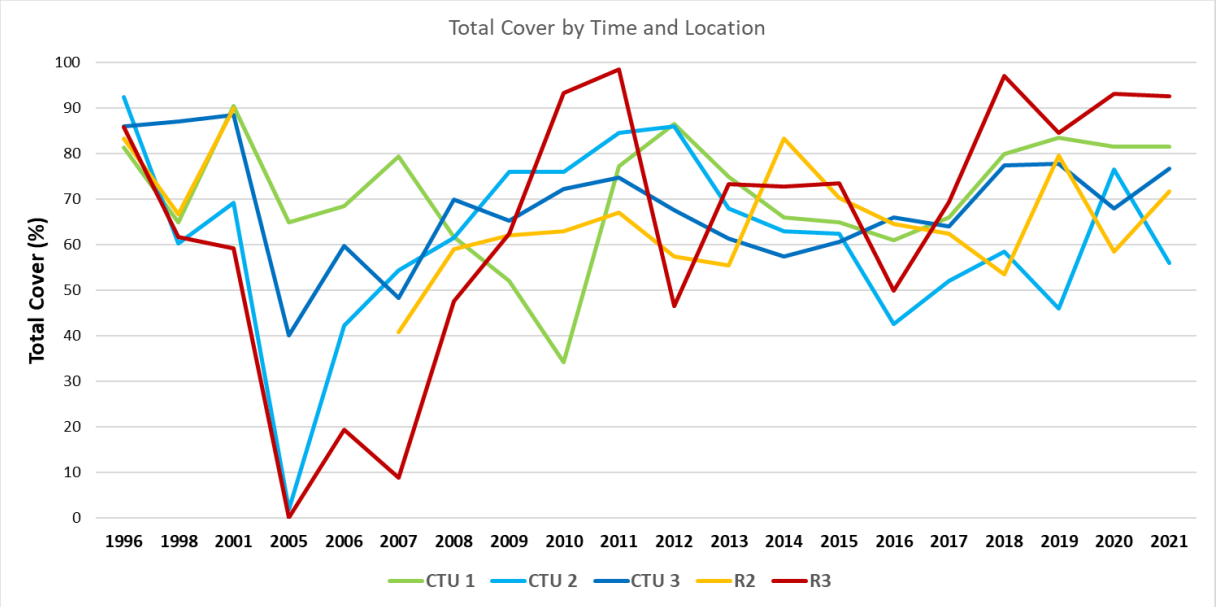

Figure 25. Annual project CTU's total cover compared to R2 and R3 from 1996 to 2021. Reference area three has varied extensively along with CTU2 throughout the project life.

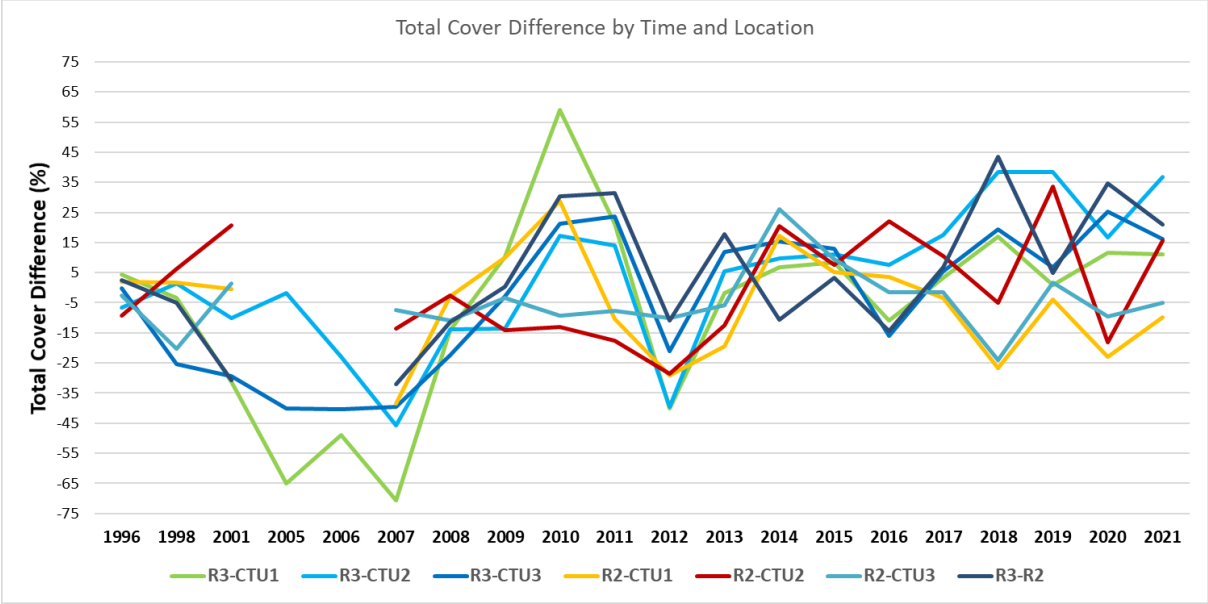

Figure 26. The differences in cover between project and reference locations in the ME-04/13 project area over time.

Soils:

Soil sampling efforts in 2018 did not show much change in bulk density and percent organic matter since initial sampling in 2008 (Figures 26 and 27). In general, the project sites had lower bulk density and higher percent organic matter values than those of the reference sites. CRMS0507 (Reference) however had a substantially higher bulk density and lower percent organic matter than all other sites suggesting this area may be located near a ridge or chenier.

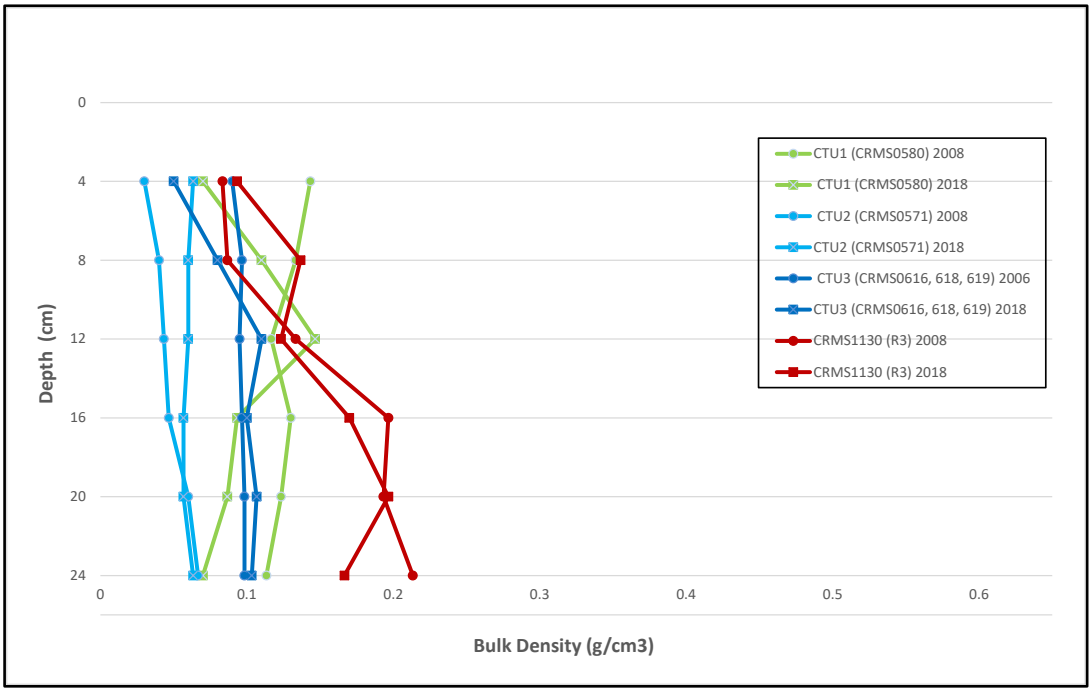

Figure 26. Mean soil bulk density collected at project and reference CRMS stations in 2008 and 2018.

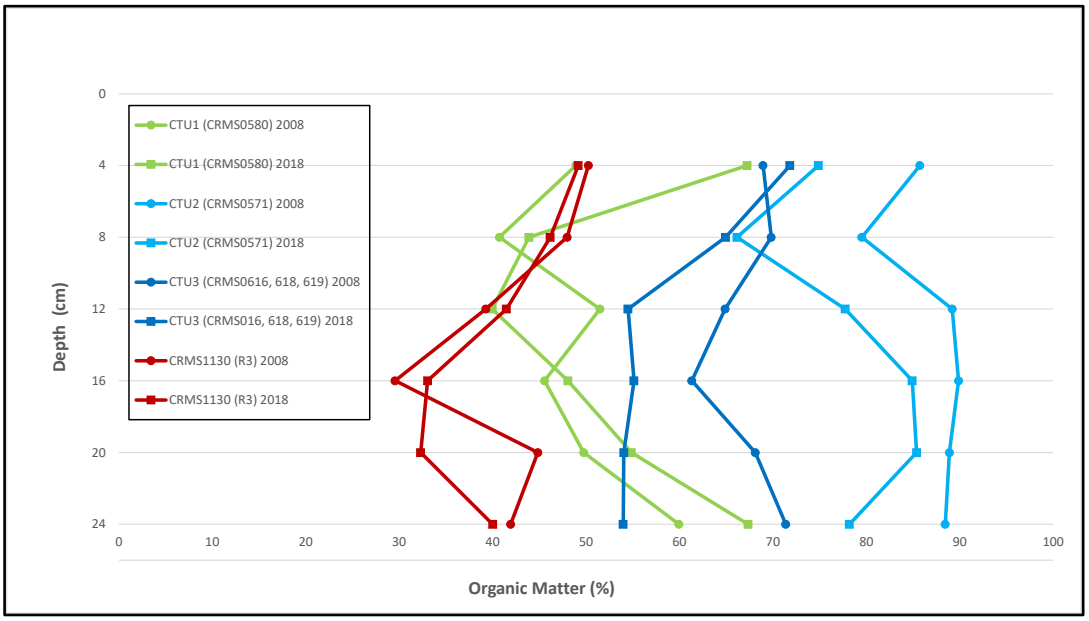

Figure 27. Mean soil organic matter (%) content collected at project and reference CRMS stations in 2008 and 2018.

Elevation Change:

Data collected through the CRMS network indicate positive elevation changes at all project areas and reference area (Figure 28). Elevation change rates ranged from 0.4 cm/yr to 0.7 cm/yr in the project areas. Elevation change is lower in the reference area, at 0.17 cm/yr. Actual elevations were higher in the project areas as well, ranging from 0.6 ft to 0.9 ft while elevation at the reference area was recorded at 0.1 ft (Figures 29-34). Furthermore, submerged vulnerability scores (SVI) were much higher in the project areas (41.1 – 69.7) than the reference area (10.7) (Table 5). SVI scores range from 0 – 100 and those values relate the susceptibility of a site to submergence. The higher the SVI score the less vulnerable a site is to submergence. Marshes with lower elevations tend to have lower SVI scores and thus are more vulnerable to submergence. All these factors indicate that the project areas ought to perform better than the reference area should sea level rise in the future. The rock dike that spans the eastern border of the ME-04/13 project area is one feature that protects the interior marshes from continued erosion along Freshwater Bayou Canal contributing to the better performance of the project area compared to the reference area.

Table 5. Elevation, Elevation Change and SVI values for the ME-04/13 project and reference areas.

	Elevation (ft)	Elevation Change (cm/yr)	SVI Score (0-100)
CTU 1 (CRMS0580)	0.58	0.62	69.66
CTU 2 (CRMS0571)	0.65	0.74	57.05
CTU 3 (CRMS0616, 618, 619)	0.85	0.39	41.12
R3 (CRMS1130)	0.06	0.17	10.66

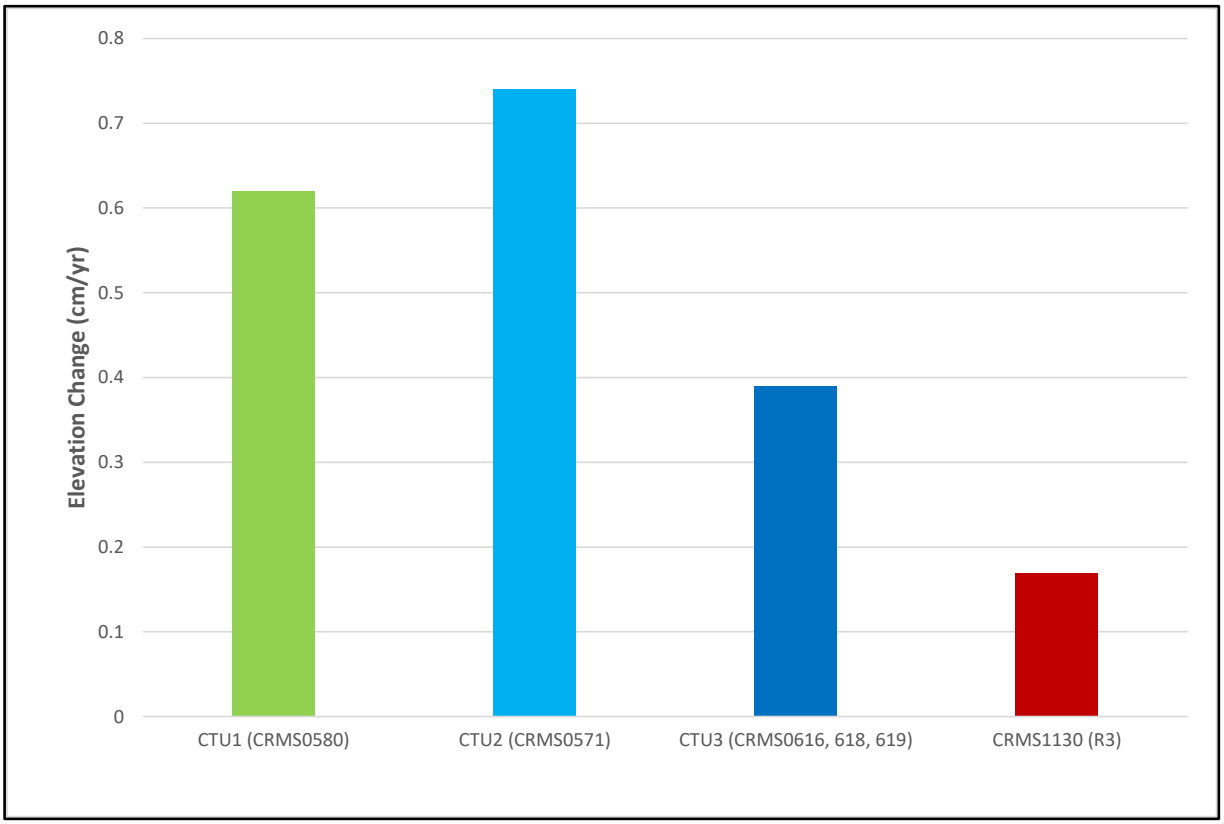

Figure 28. Elevation change per year (2008 – 2022) in the project CRMS sites and reference CRMS sites.

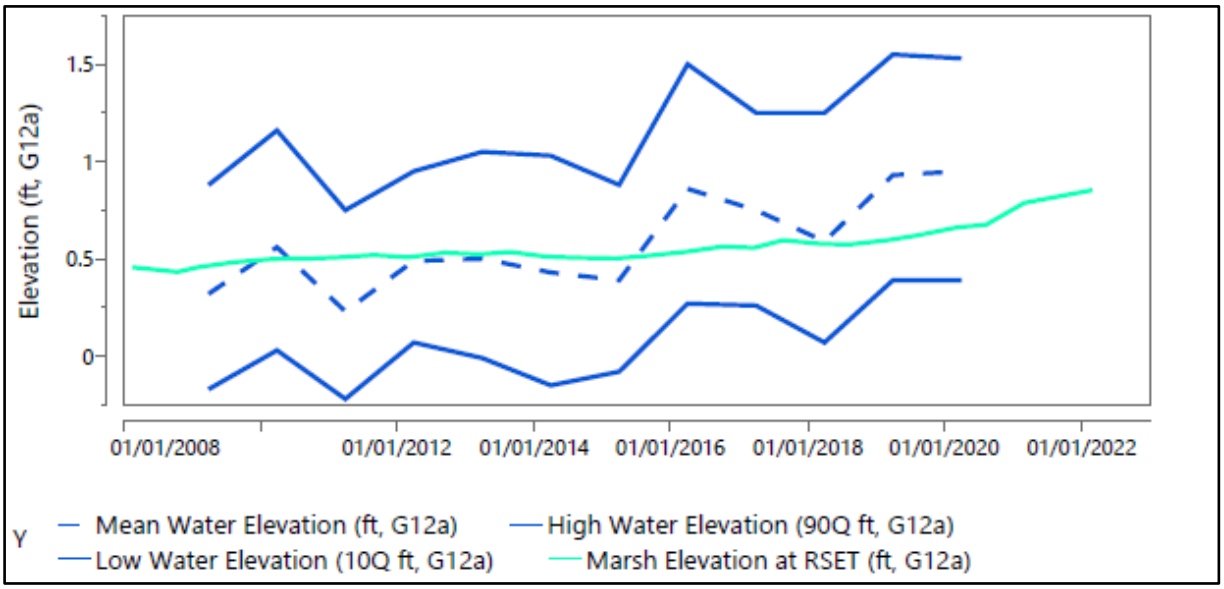

Figure 29. CRMS0580 (represents CTU 1) marsh elevation relative to mean water elevation from 2008 – 2022.

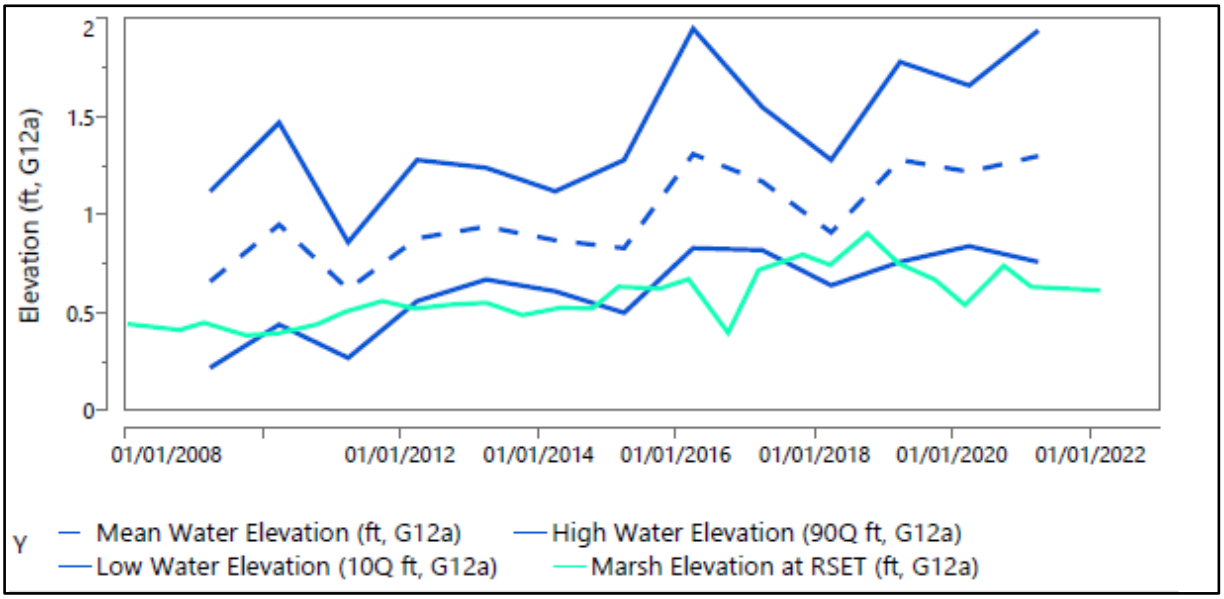

Figure 30. CRMS0571 (represents CTU 2) marsh elevation relative to mean water elevation from 2008 – 2022.

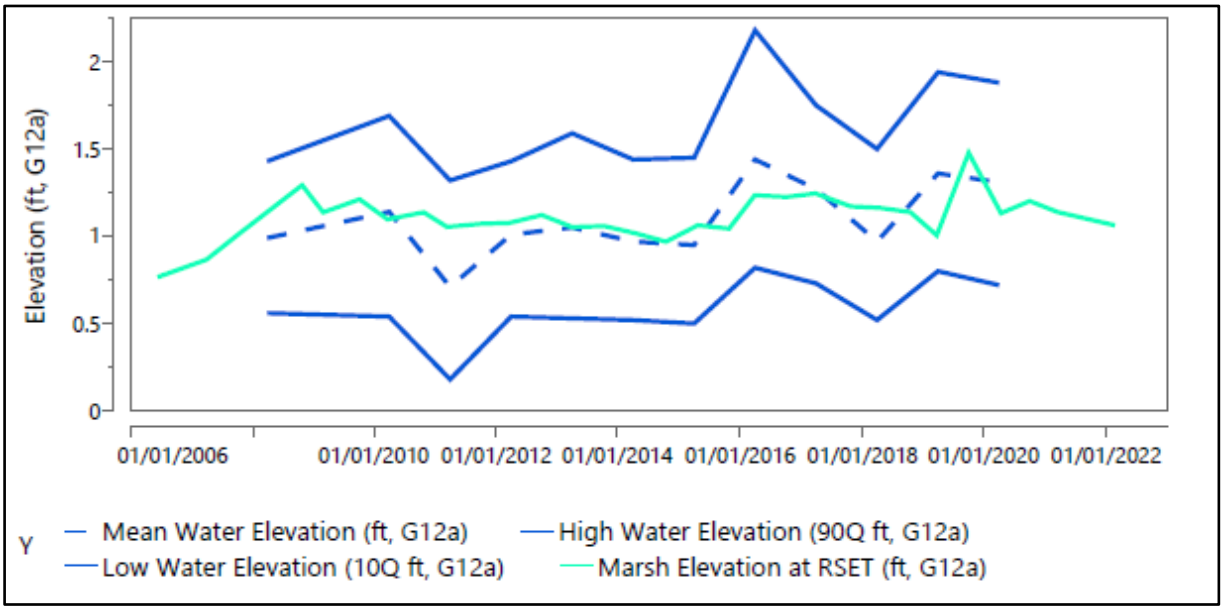

Figure 31. CRMS0616 (represents CTU 3) marsh elevation relative to mean water elevation from 2008 – 2022.

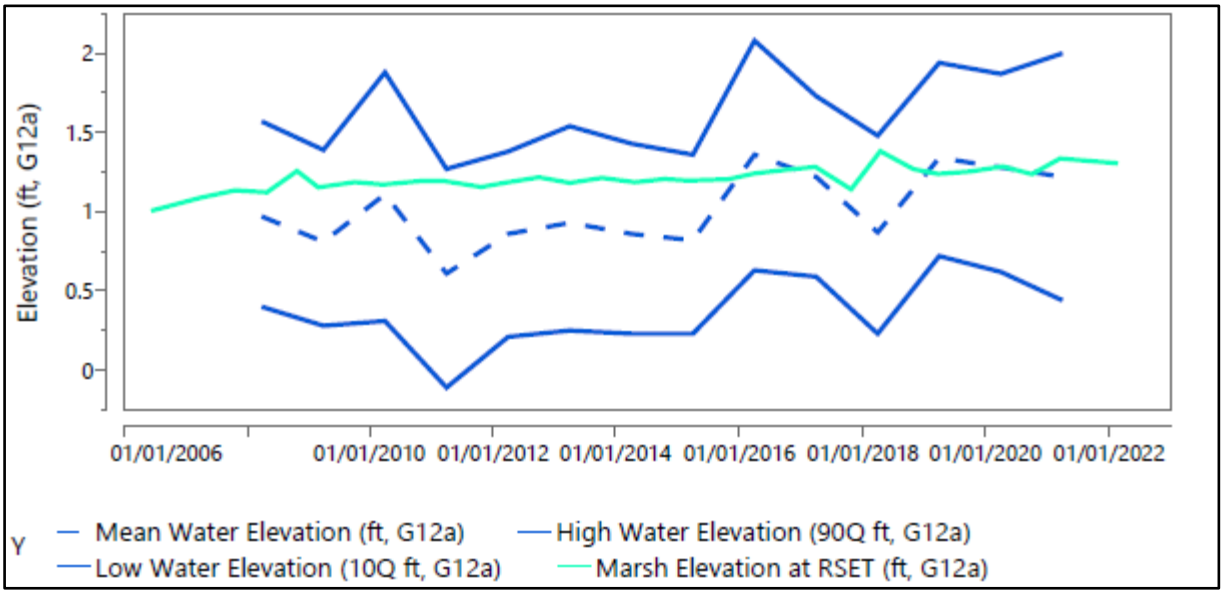

Figure 32. CRMS0618 (represents CTU 3) marsh elevation relative to mean water elevation from 2008 – 2022.

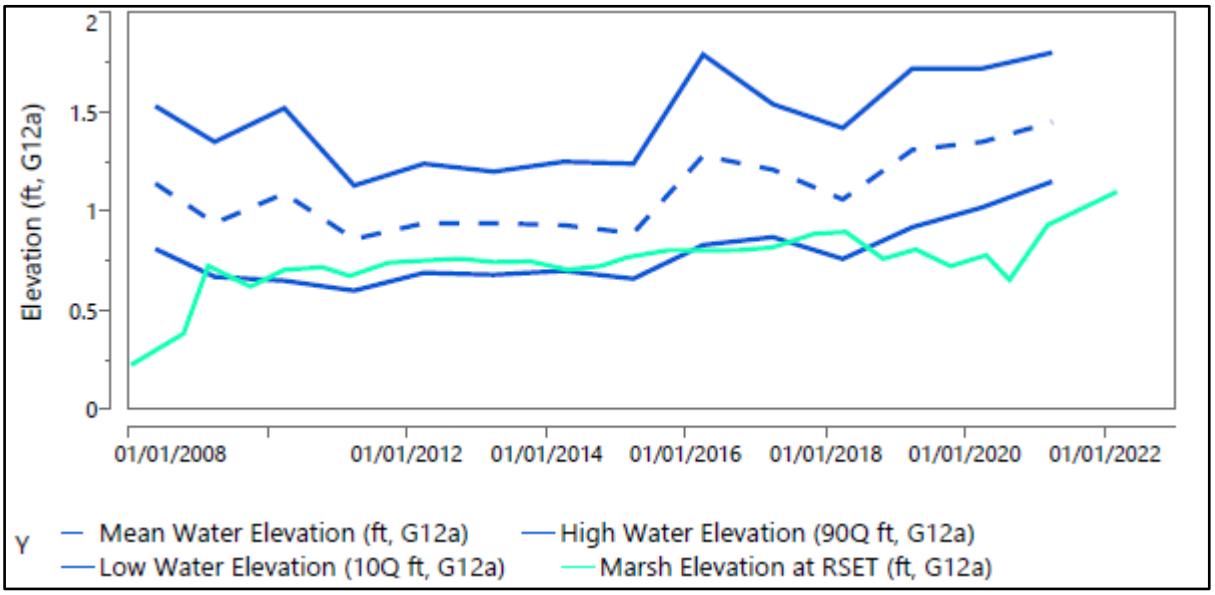

Figure 33. CRMS0619 (represents CTU 3) marsh elevation relative to mean water elevation from 2008 – 2022.

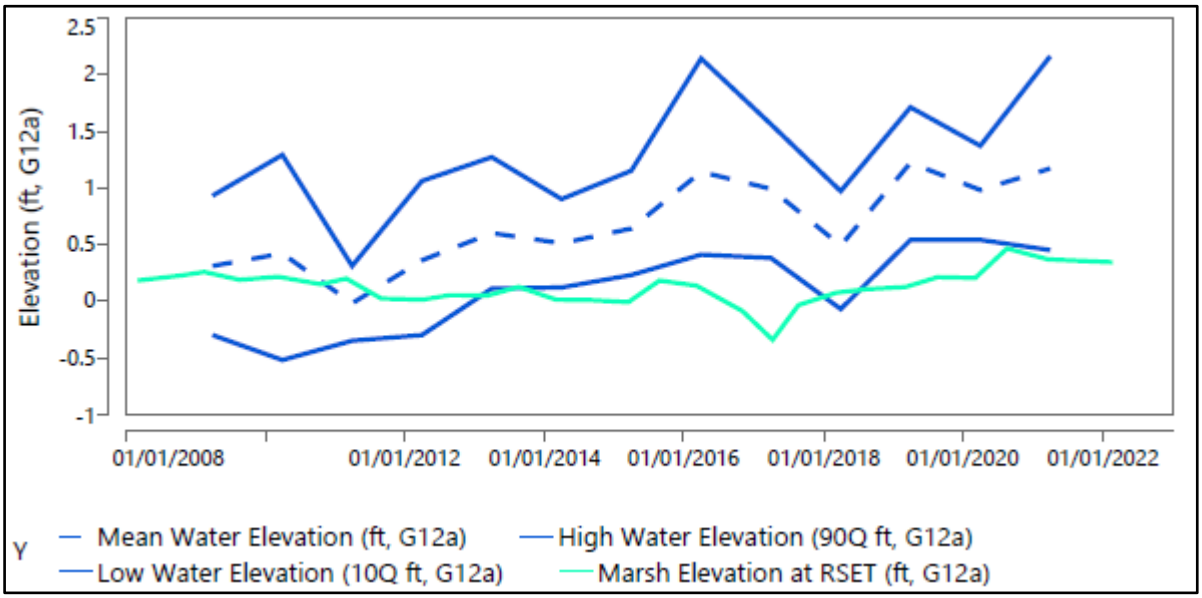

Figure 34. CRMS1130 (represents Reference 3) marsh elevation relative to mean water elevation from 2008 – 2022.

V. Conclusions

a. Project Effectiveness

The rock dike installed at the ME-04/13 wetland protection and bank stabilization project has been effective in protecting the emergent marsh along Freshwater Bayou Canal and preventing erosion of the shoreline. The rock dike has also been successful in preventing the widening of Freshwater Bayou Canal into the nearby interior wetlands. This is apparent by the significantly reduced erosion rates of the project areas relative to the reference area. As long as dike elevation continue to be maintained, the interior marshes will be protected from further erosion and tidal scour caused by heavy watercraft traffic on the canal.

Even though water levels varied greatly over the years, overall, water levels in the project areas were within target range more often than the reference area. In addition to no water control structures in operation, water levels in this area are affected by sea level rise with its close proximity to the Gulf of Mexico as well as tropical storm activity. Should sea level continue to rise and hurricane events become more frequent, the project area will be adversely affected.

Even though there are no project features directly influencing salinity, levels in the project areas ranged primarily between 0 and 5 ppt. Higher salinities were recorded in years where storm events or droughts occurred.

Vegetation in the project area, in recent years, has seen a shift towards a fresher environment and a trend upwards in percent cover. The goal to increase vegetative cover has been partially met.

b. Recommended Improvements

Overall the Freshwater Bayou Wetlands Project (ME-04) and the Freshwater Bayou Bank Stabilization Project (ME-13) rock dikes are in good operational condition. On May 14, 2015, the CWPPRA Task Force approved the ME-04 and ME-13 projects for a 20 year extension with budget increase.

c. Lessons Learned

The water control structures that were constructed, operated and maintained by the land owner are not included in the CPRA Operation and Maintenance Plan. Implementation of CWPPRA projects where the landowner has total control over the operation of existing water control structures, and over the installation and operation of additional structures as part of the features of a CWPPRA project, as was the case for ME-04, has been discontinued.

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Appendix A
(Inspection Photographs)

Photo No. 1, Typical Rock Dike ME-04

Photo No. 2, Typical Rock Dike ME-13

Photo No. 3, Typical Rock Dike ME-04

Photo No. 4, Typical Rock Dike ME-13

Photo No. 5, Typical Rock Dike ME-13

Photo No. 6, Typical Rock Dike ME-13

Appendix B
(Three Year Budget Projection)

FRESHWATER BAYOU / ME04 / PPL2

Three-Year Operations & Maintenance Budgets 07/01/2023 - 06/30/2026

Project Manager	O & M Manager	Federal Sponsor	Prepared By
	Mel Guidry	*NRCS*	*Mel Guidry*

	2023/2024 (-29)	2024/2025 (-30)	2025/2026 (-31)	20-Yr Ext
Maintenance Inspection	$ 9,767.00	$ 10,060.00	$ 10,362.00	
Structure Operation	$ -	$ -	$ -	
State Administration		$ -	$ -	
Federal Administration		$ -		
Maintenance/Rehabilitation				

23/24 Description:

E&D	$ -	
Construction		(Incl. 25% Contingency)
Construction Oversight		
Sub Total - Maint. And Rehab.	$ -	

24/25 Description:

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

25/26 Description:

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

	2023/2024 (-29)	2024/2025 (-30)	2025/2026 (-31)
Total O&M Budgets	**$ 9,767.00**	**$ 10,060.00**	**$ 10,362.00**

O &M Budget (3 yr Total)	**$ 30,189.00**	
Unexpended O & M Budget	**$ 111,865.21**	based on LANA unexpended & FY25 incremental request
Remaining O & M Budget (Projected)	**$ 81,676.21**	

OPERATION AND MAINTENANCE BUDGET WORKSHEET

FRESHWATER BAYOU / PROJECT NO. ME-04 / PPL NO. 2 / 2023-2024

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$9,767.00	**$9,767.00**
General Structure Maintenance	LUMP	0	$0.00	**$0.00**
Engineering and Design	LUMP	0	$0.00	**$0.00**
Operations Contract	LUMP	0	$0.00	**$0.00**
Construction Oversight	LUMP	0	$0.00	**$0.00**

ADMINISTRATION

CPRA Admin.	LUMP	0	$0.00	$0.00
FEDERAL SPONSOR Admin.	LUMP	0	$0.00	$0.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$0.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:					
Secondary Monument	EACH	0	$0.00	$0.00
Staff Gauge / Recorders	EACH	0	$0.00	$0.00
Bathymetry / Topography	LUMP	0	$0.00	$0.00
TBM Installation	EACH	0	$0.00	$0.00
Other	LUMP	0	$0.00	$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	
Rip Rap	0	0.0	0	$0.00	$0.00
	0	0.0	0	$0.00	$0.00
	0	0.0	0	$0.00	$0.00
Filter Cloth / Geogrid Fabric		SQ YD	0	$0.00	$0.00
Navigation Aid		EACH	0	$0.00	$0.00
Signage		EACH	0	$0.00	$0.00
General Excavation / Fill		CU YD	0	$0.00	$0.00
Dredging		CU YD	0	$0.00	$0.00
Sheet Piles (Lin Ft or Sq Yds)			0	$0.00	$0.00
Timber Piles (each or lump sum)			0	$0.00	$0.00
Timber Members (each or lump sum)			0	$0.00	$0.00
Hardware		LUMP	0	$0.00	$0.00
Materials		LUMP	0	$0.00	$0.00
Mob / Demob		LUMP	0	$0.00	$0.00
Contingency (25%) (1,795,650 x 0.25)		LUMP	0	$0.00	$0.00
General Structure Maintenance		LUMP	0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$9,767.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

FRESHWATER BAYOU / PROJECT NO. ME-04 / PPL NO. 2 / 2024-2025

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$10,060.00	**$10,060.00**
General Structure Maintenance	LUMP	0	$0.00	**$0.00**
Engineering and Design	LUMP	0	$0.00	**$0.00**
Operations Contract	LUMP	0	$0.00	**$0.00**
Construction Oversight	LUMP	0	$0.00	**$0.00**

ADMINISTRATION

CPRA Admin.	LUMP	0	$0.00	$0.00
FEDERAL SPONSOR Admin.	LUMP	0	$0.00	$0.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$0.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:					
Secondary Monument	EACH	0	$0.00	$0.00
Staff Gauge / Recorders	EACH	0	$0.00	$0.00
Bathymetry / Topography	LUMP	0	$0.00	$0.00
TBM Installation	EACH	0	$0.00	$0.00
Other	LUMP	0	$0.00	$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	
Rip Rap	0	0.0	0	$0.00	$0.00
	0	0.0	0	$0.00	$0.00
	0	0.0	0	$0.00	$0.00
Filter Cloth / Geogrid Fabric		SQ YD	0	$0.00	$0.00
Navigation Aid		EACH	0	$0.00	$0.00
Signage		EACH	0	$0.00	$0.00
General Excavation / Fill		CU YD	0	$0.00	$0.00
Dredging		CU YD	0	$0.00	$0.00
Sheet Piles (Lin Ft or Sq Yds)			0	$0.00	$0.00
Timber Piles (each or lump sum)			0	$0.00	$0.00
Timber Members (each or lump sum)			0	$0.00	$0.00
Hardware		LUMP	0	$0.00	$0.00
Materials		LUMP	0	$0.00	$0.00
Mob / Demob		LUMP	0	$0.00	$0.00
Contingency (25%) (1,795,650 x 0.25)		LUMP	0	$0.00	$0.00
General Structure Maintenance		LUMP	0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$10,060.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

FRESHWATER BAYOU / PROJECT NO. ME-04 / PPL NO. 2 / 2025-2026

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$10,362.00	**$10,362.00**
General Structure Maintenance	LUMP	0	$0.00	**$0.00**
Engineering and Design	LUMP	0	$0.00	**$0.00**
Operations Contract	LUMP	0	$0.00	**$0.00**
Construction Oversight	LUMP	0	$0.00	**$0.00**

ADMINISTRATION

CPRA Admin.	LUMP	0	$0.00	$0.00
FEDERAL SPONSOR Admin.	LUMP	0	$0.00	$0.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$0.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:					
	Secondary Monument	EACH	0	$0.00	$0.00
	Staff Gauge / Recorders	EACH	0	$0.00	$0.00
	Bathymetry / Topography	LUMP	0	$0.00	$0.00
	TBM Installation	EACH	0	$0.00	$0.00
	Other	LUMP	0	$0.00	$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	
	Rip Rap	0	0.0	0	$0.00	$0.00
		0	0.0	0	$0.00	$0.00
		0	0.0	0	$0.00	$0.00
	Filter Cloth / Geogrid Fabric		SQ YD	0	$0.00	$0.00
	Navigation Aid		EACH	0	$0.00	$0.00
	Signage		EACH	0	$0.00	$0.00
	General Excavation / Fill		CU YD	0	$0.00	$0.00
	Dredging		CU YD	0	$0.00	$0.00
	Sheet Piles (Lin Ft or Sq Yds)			0	$0.00	$0.00
	Timber Piles (each or lump sum)			0	$0.00	$0.00
	Timber Members (each or lump sum)			0	$0.00	$0.00
	Hardware		LUMP	0	$0.00	$0.00
	Materials		LUMP	0	$0.00	$0.00
	Mob / Demob		LUMP	0	$0.00	$0.00
	Contingency (25%) (1,795,650 x 0.25)		LUMP	0	$0.00	$0.00
	General Structure Maintenance		LUMP	0	$0.00	$0.00
				0	$0.00	$0.00
				0	$0.00	$0.00
				0	$0.00	$0.00
					TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$10,362.00**

FRESHWATER BAYOU CANAL BANK STABILIZATION / ME13 / PPL5

Three-Year Operations & Maintenance Budgets 07/01/2023 - 06/30/2026

Project Manager	O & M Manager	Federal Sponsor	Prepared By
	Mel Guidry	*NRCS*	*Mel Guidry*

	2023/2024 (-26)	2024/2025 (-27)	2025/2026 (-28)	20-Yr Ext
Maintenance Inspection	$ 9,767.00	$ 10,060.00	$ 10,362.00	
Structure Operation	$ -	$ -	$ -	
State Administration		$ -	$ -	
Federal Administration		$ -		
Maintenance/Rehabilitation				

23/24 Description:

E&D	$ -	
Construction		(Incl. 25% Contingency)
Construction Oversight		
Sub Total - Maint. And Rehab.	$ -	

24/25 Description:

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

25/26 Description:

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

	2023/2024 (-26)	2024/2025 (-27)	2025/2026 (-28)
Total O&M Budgets	**$ 9,767.00**	**$ 10,060.00**	**$ 10,362.00**

O &M Budget (3 yr Total)	**$ 30,189.00**	
Unexpended O & M Budget	**$ 194,074.40**	based on LANA unexpended & incremental request
Remaining O & M Budget (Projected)	**$ 163,885.40**	

OPERATION AND MAINTENANCE BUDGET WORKSHEET

FRESHWATER BAYOU CANAL BANK STABILIZATION / PROJECT NO. ME-13 / PPL NO. 5 / 2023-2024

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$9,767.00	**$9,767.00**
General Structure Maintenance	LUMP	0	$0.00	**$0.00**
Engineering and Design	LUMP	0	$0.00	**$0.00**
Operations Contract	LUMP	0	$0.00	**$0.00**
Construction Oversight	LUMP	0	$0.00	**$0.00**

ADMINISTRATION

CPRA Admin.	LUMP	0	$0.00	$0.00
FEDERAL SPONSOR Admin.	LUMP	0	$0.00	$0.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$0.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:					
Secondary Monument	EACH	0	$0.00	$0.00
Staff Gauge / Recorders	EACH	0	$0.00	$0.00
Bathymetry / Topography	LUMP	0	$0.00	$0.00
TBM Installation	EACH	0	$0.00	$0.00
Other	LUMP	0	$0.00	$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	
Rip Rap	0	0.0	0	$0.00	$0.00
	0	0.0	0	$0.00	$0.00
	0	0.0	0	$0.00	$0.00
Filter Cloth / Geogrid Fabric		SQ YD	0	$0.00	$0.00
Navigation Aid		EACH	0	$0.00	$0.00
Signage		EACH	0	$0.00	$0.00
General Excavation / Fill		CU YD	0	$0.00	$0.00
Dredging		CU YD	0	$0.00	$0.00
Sheet Piles (Lin Ft or Sq Yds)			0	$0.00	$0.00
Timber Piles (each or lump sum)			0	$0.00	$0.00
Timber Members (each or lump sum)			0	$0.00	$0.00
Hardware		LUMP	0	$0.00	$0.00
Materials		LUMP	0	$0.00	$0.00
Mob / Demob		LUMP	0	$0.00	$0.00
Contingency (25%) (1,795,650 x 0.25)		LUMP	0	$0.00	$0.00
General Structure Maintenance		LUMP	0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$9,767.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

FRESHWATER BAYOU CANAL BANK STABILIZATION / PROJECT NO. ME-13 / PPL NO. 5 / 2024-2025

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$10,060.00	**$10,060.00**
General Structure Maintenance	LUMP	0	$0.00	**$0.00**
Engineering and Design	LUMP	0	$0.00	**$0.00**
Operations Contract	LUMP	0	$0.00	**$0.00**
Construction Oversight	LUMP	0	$0.00	**$0.00**

ADMINISTRATION

CPRA Admin.	LUMP	0	$0.00	$0.00
FEDERAL SPONSOR Admin.	LUMP	0	$0.00	$0.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$0.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:					
Secondary Monument	EACH	0	$0.00	$0.00
Staff Gauge / Recorders	EACH	0	$0.00	$0.00
Bathymetry / Topography	LUMP	0	$0.00	$0.00
TBM Installation	EACH	0	$0.00	$0.00
Other	LUMP	0	$0.00	$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	
Rip Rap	0	0.0	0	$0.00	$0.00
	0	0.0	0	$0.00	$0.00
	0	0.0	0	$0.00	$0.00
Filter Cloth / Geogrid Fabric		SQ YD	0	$0.00	$0.00
Navigation Aid		EACH	0	$0.00	$0.00
Signage		EACH	0	$0.00	$0.00
General Excavation / Fill		CU YD	0	$0.00	$0.00
Dredging		CU YD	0	$0.00	$0.00
Sheet Piles (Lin Ft or Sq Yds)			0	$0.00	$0.00
Timber Piles (each or lump sum)			0	$0.00	$0.00
Timber Members (each or lump sum)			0	$0.00	$0.00
Hardware		LUMP	0	$0.00	$0.00
Materials		LUMP	0	$0.00	$0.00
Mob / Demob		LUMP	0	$0.00	$0.00
Contingency (25%) (1,795,650 x 0.25)		LUMP	0	$0.00	$0.00
General Structure Maintenance		LUMP	0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$10,060.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

FRESHWATER BAYOU CANAL BANK STABILIZATION / PROJECT NO. ME-13 / PPL NO. 5 / 2025-2026

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$10,362.00	**$10,362.00**
General Structure Maintenance	LUMP	0	$0.00	**$0.00**
Engineering and Design	LUMP	0	$0.00	**$0.00**
Operations Contract	LUMP	0	$0.00	**$0.00**
Construction Oversight	LUMP	0	$0.00	**$0.00**

ADMINISTRATION

CPRA Admin.	LUMP	0	$0.00	$0.00
FEDERAL SPONSOR Admin.	LUMP	0	$0.00	$0.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$0.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:					
Secondary Monument	EACH	0	$0.00	$0.00
Staff Gauge / Recorders	EACH	0	$0.00	$0.00
Bathymetry / Topography	LUMP	0	$0.00	$0.00
TBM Installation	EACH	0	$0.00	$0.00
Other	LUMP	0	$0.00	$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	
Rip Rap	0	0.0	0	$0.00	$0.00
	0	0.0	0	$0.00	$0.00
	0	0.0	0	$0.00	$0.00
Filter Cloth / Geogrid Fabric		SQ YD	0	$0.00	$0.00
Navigation Aid		EACH	0	$0.00	$0.00
Signage		EACH	0	$0.00	$0.00
General Excavation / Fill		CU YD	0	$0.00	$0.00
Dredging		CU YD	0	$0.00	$0.00
Sheet Piles (Lin Ft or Sq Yds)			0	$0.00	$0.00
Timber Piles (each or lump sum)			0	$0.00	$0.00
Timber Members (each or lump sum)			0	$0.00	$0.00
Hardware		LUMP	0	$0.00	$0.00
Materials		LUMP	0	$0.00	$0.00
Mob / Demob		LUMP	0	$0.00	$0.00
Contingency (25%) (1,795,650 x 0.25)		LUMP	0	$0.00	$0.00
General Structure Maintenance		LUMP	0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
			0	$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$0.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$10,362.00**

APPENDIX C
(Field Inspection Notes)

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name:	ME-04 Freshwater Bayou Wetland Protection				Date of Inspection: May 17, 2022 Time: 11:30 am
Structure No.	N/A				Inspector(s): Mel Guidry, Stan Aucoin, Phillip Parker (CPRA) Richard Evely (NRCS)
Structure Description:	Foreshore Rock Dike				
					Water Level : N/A
Type of Inspection:	Annual				Weather Conditions: sunny and mild temperatures

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	N/A				
Steel Grating	N/A				
Stop Logs	N/A				
Hardware	N/A				
Timber Piles	N/A				
Timber Wales	N/A				
Galv. Pile Caps	N/A				
Cables	N/A				
Signage /Supports	N/A				
Rip Rap (fill) (foreshore dike)	Excellent			1,2,3	Foreshore Rock Dike is in good Condition
Earthen Embankment	N/A				
What are the conditions of the existing levees?					
Are there any noticeable breaches?					
Settlement of rock plugs and rock weirs?					
Position of stoplogs at the time of the inspection?					
Are there any signs of vandalism?					

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name:	ME-13 Freshwater Bayou Canal Bank Stabilization Project				Date of Inspection: May 17, 2022 Time: 10:30 am
Structure No.	N/A				Inspector(s): Mel Guidry, Stan Aucoin, Phillip Parker (CPRA) Richard Evely (NRCS)
Structure Description:	Foreshore Rock Dike				Water Level : N/A
Type of Inspection:	Annual				Weather Conditions: sunny skies and mild temperatures

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	N/A				
Steel Grating	N/A				
Stop Logs	N/A				
Hardware	N/A				
Timber Piles	N/A				
Timber Wales	N/A				
Galv. Pile Caps	N/A				
Cables	N/A				
Signage /Supports	N/A				
Rip Rap (fill) (foreshore dike)	Good			1,2,3	Foreshore Rock Dike is in good condition.
Earthen Embankment	N/A				
What are the conditions of the existing levees?					
Are there any noticeable breaches?					
Settlement of rock plugs and rock weirs?					
Position of stoplogs at the time of the inspection?					
Are there any signs of vandalism?					