



**State of Louisiana**

**Coastal Protection and Restoration  
Authority (CPRA)**

## **2022 Operations, Maintenance, and Monitoring Report**

for

### **East Marsh Island Marsh Creation**

State Project Number TV-21  
Priority Project List 14

June 2022  
Iberia Parish

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## Preface

This report includes monitoring data collected through December 2021, and the annual maintenance inspections from May 2022.

The 2022 report is the 4<sup>th</sup> report in a series of reports. For additional information on lessons learned, recommendations and project effectiveness please refer to the previous reports on the CPRA web site at <http://coastal.Louisiana.gov/>. This report and others are available for download at the following website: <http://cims.coastal.la.gov>.

## I. Introduction

The East Marsh Island Marsh Creation Project (TV-21) was proposed on the 14<sup>th</sup> project priority list of the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) and is co-sponsored by the U.S. Environmental Protection Agency (EPA), the Natural Resources Conservation Service (NRCS), and the Coastal Protection and Restoration Authority (CPRA). It is located in southeast Iberia Parish on the Marsh Island Wildlife Refuge. The project is bordered to the north by West Cote Blanche Bay, to the south and east by East Cote Blanche Bay, and to the west by the Marsh Island Hydrologic Restoration project (TV-14) (Figure 1). The total area of the project is approximately 1,159 acres (469 ha) and is comprised of 362 levee-contained acres (146 ha) of marsh and 797 acres (323 ha) of non-contained marsh.

Marsh Island is economically and biologically important as a haven for wintering waterfowl (CPRA 2008), as well as a sanctuary for juvenile and adult saltwater fish and shrimp species, and blue crabs (*Callinectes sapidus*). The island also functions as a barrier island, buffering the effects of hurricane storm surges on coastal communities. The project area is a brackish, *Spartina patens* (marshhay cordgrass) dominated marsh which has historically been relatively stable, exhibiting a low land loss rate of -0.29% per year for the period 1974-2000 (Natural Resources Conservation Service [NRCS] 2004). Marsh loss was again calculated for the period 1988-2007 by the U.S. Environmental Protection Agency (EPA) in 2008 to include loss due primarily to Hurricane Lili in 2002. This marsh loss rate was found to be -1.31% per year, much higher than the previous determination. With Hurricane Gustav in 2008 and future hurricanes, this land loss rate will likely increase. Nyman et al. (1994) confirmed the role of hurricanes in marsh loss in this area by determining disturbance as the driving force behind marsh loss in the interior of Marsh Island. This form of lateral erosion is fundamentally different from the more rapid form of marsh loss associated with vegetation stress due to saltwater intrusion and low marsh elevation. Lateral marsh erosion progresses through the undercutting of the marsh substrate below the root zone and can be prevented by filling in the previously eroded marsh areas with new sediments.

The primary purpose of the marsh creation component of the TV-21 project is to restore areas that were previously lost due to this lateral marsh erosion. The project was designed to target the areas of the island exhibiting the most land loss due to Hurricane Lili (EPA 2008). The marsh nourishment component of the TV-21 project was designed to deposit new sediments into uncontained marsh areas in the project and provide an influx of nutrients, as well as the benefits of increased elevation.

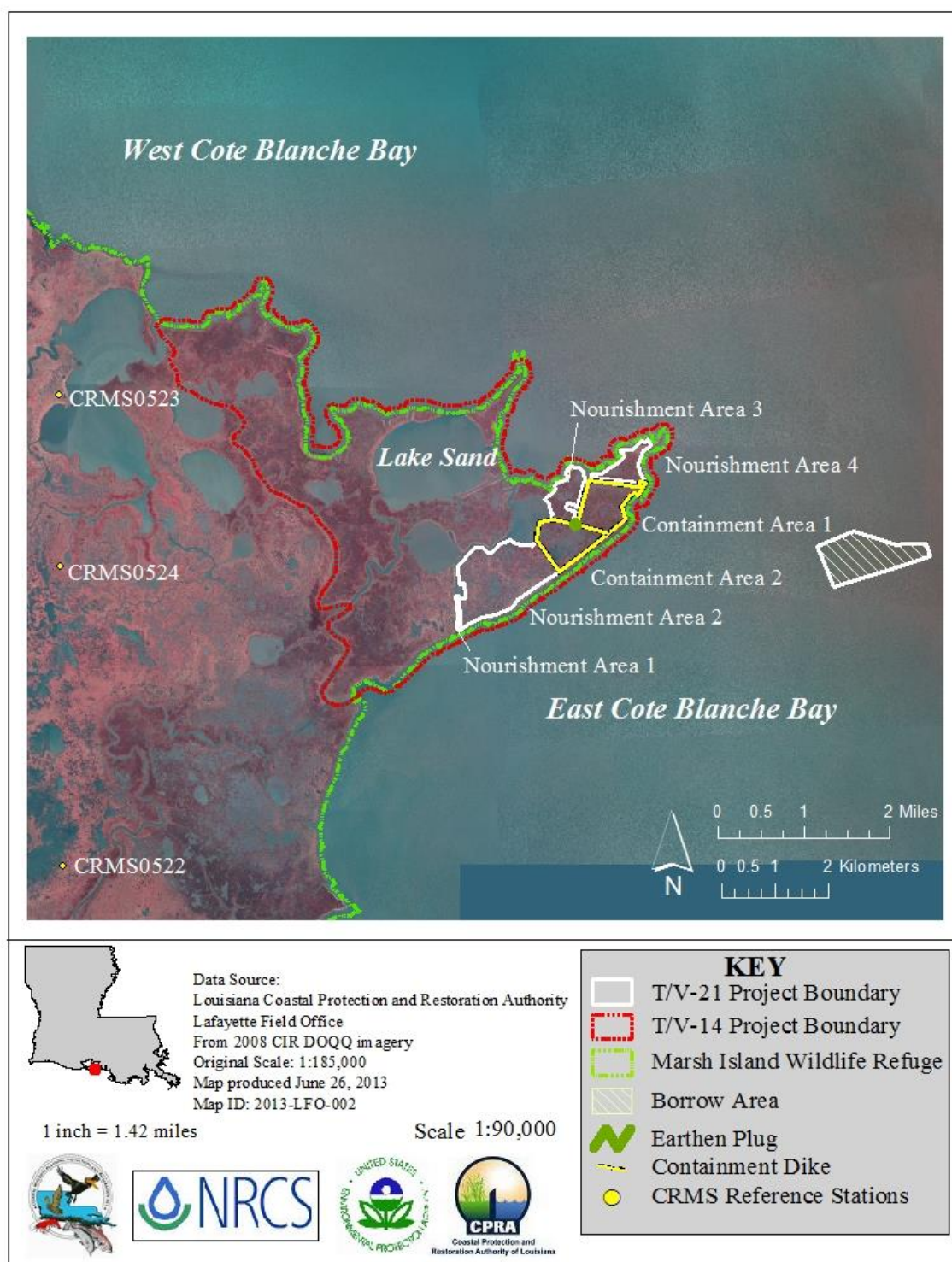
The project consists of the addition of 3,836,209 yd<sup>3</sup> (2,933,000 m<sup>3</sup>) of sediment hydraulically dredged from a borrow location in East Cote Blanche Bay directly east of the project area, creating



362 acres (146 ha) of emergent marsh within 14,000 linear ft (4,267 m) of containment levees. Construction of the containment areas began on March 27, 2010 and was completed on September 20, 2010. The interior containment dike was degraded and gaps were created in some of the perimeter levees in December 2010 to facilitate the natural sheet flow of water and nutrients. Construction of an additional 797 acres (323 ha) of created/nourished marsh, outside of the contained areas, was completed on November 4, 2010. Dr. Herry Utomo established an aerial seeding trial using different application rates of Poly C15 *Spartina alterniflora* seed on April 25, 2011. A 10 acre plot in containment area 2 was reserved for the trial and consisted of three planting strips with three different seeding rates along each strip. In July 2011, 3,257 plants (*Spartina alterniflora*, *Spartina patens*, *Paspalum vaginatum*, *Distichlis spicata*, *Spartina cynosuroides*) were installed in containment area 1. However, due to contracting issues, the plantings were discontinued.

The State of Louisiana's Master Plan (CPRA 2012) identified marsh restoration using dredged material at Marsh Island as a method for restoring and maintaining critical landscape features and providing hurricane protection to coastal Louisiana west of the Atchafalaya River. The TV-21 project will contribute to that goal.

Multiple hurricanes have affected the project area in recent years. Hurricane Barry made landfall as a Category 1 storm on Marsh Island in July, 2019. Inundation levels of 4 to 6 ft, due to the combined effect of the storm surge and tide, were estimated around Vermilion and Atchafalaya Bays. A maximum water level of 7.79 ft NAVD88 was recorded at a USGS gauge at Cypremort Point (Cangialosi et al. 2019). In 2020, Hurricanes Laura and Delta made landfall near Cameron, Louisiana. As a strong Category 4 storm, Hurricane Laura struck the coast on August 27. Estimated inundation in the Vermilion Bay area was 6 to 12 ft, with a storm surge value of 9.45 ft NAVD88 recorded near Cypremort Point (Pasch et al. 2020). Hurricane Delta made landfall on October 9 as a Category 4 storm as well with estimated storm surges between 6 to 9 feet east of the storm, including the Vermilion Bay area (Cangialosi and Berg 2020). The USGS gauge recorded a peak water level of 9.28 ft in the Cypremort Point area.



**Figure 1.** East Marsh Island Marsh Creation (TV-21) project boundary and project features.



## **II. Maintenance Activity**

### **a. Project Feature Inspection Procedures**

The purpose of the annual inspection of the East Marsh Island Marsh Creation Project (TV-21) 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 C. A summary of past operation and maintenance projects completed since completion of the East Marsh Island Marsh Creation Project are outlined in Section IV.

An inspection of the East Marsh Island Marsh Creation Project (TV-21) was held on November 17, 2021 under sunny skies, mild temperatures, and choppy seas. In attendance were Jody White, Stan Aucoin, Glenn McNeese and Phillip Parker from CPRA, Tyson Crouch and Cody Foster from LDWF, Richard Evelyn, Carol Clement, Michael Harry and Kyle Cappotto from NRCS. Parties met at the Quintana Boat launch at Cypremort Point at 10:30 AM and traveled to the Northeast corner of Marsh Island. WLF and CPRA provided boat transportation.

The field inspection included a visual inspection of the project site. Staff gauge readings were not available to determine approximate elevations of water level. Photographs were taken at project feature (see Appendix A) and Field Inspection notes were completed in the field to record measurements and deficiencies (see Appendix C).

### **b. Inspection Results**

#### **Site 1—Marsh Creation Cells (Containment Areas No. 1&2)**

Unlike previous inspections, due to the siltation in the North-South Canal, MC area cell No. 2 was not observable from the plug at the end of the canal. However both MC Areas 1 and 2 were observable from the southeast shoreline. As observed during the previous 2016-2017 O&M Inspection, the two marsh creation containment areas are in good condition since constructed in 2010. Vegetation is thriving since curbing the nutria population.

The most recent, available Topographic Survey completed in 2017 by T. Baker Smith provided a good comparison of elevation data from 2011 to 2017 within the marsh creation areas. The containment areas were surveyed on transect line spaced 500ft apart with shots taken every 50ft. Survey data showed that the average marsh elevation within the

containment areas was approximately +1.33 ft NAVD88. This is a decrease in marsh elevation of an average of 1.73 ft, from construction completion, which is consistent with the original settlement curve projections.

The 2017 survey revealed that the remnant containment dike is at an average elevation of +3.37ft NAVD88 with 15 gaps to allow tidal exchange. Vegetation had expanded on the dikes which negated the need to plant.

In addition, from 2017 topographic survey information the borrow channel on the interior of the containment dike which was excavated to repair the breach has infilled to -2.5ft NAVD88.

The concrete articulated mats placed in March 2015 on the Northeast corner of the island in Marsh Creation Containment Area No. 1 at the East-West Pipeline Canal have continued to settle at the original breach location since the 2016-2017 O & M inspection. However, those remaining above the waterline continue to break the wave action approaching the shoreline. Also, the PVC sheet pile wall installed by the LDWF on the interior of the containment dikes around the same time as the mats were installed has been breached.

(Photos: Appendix A, Photo 3-8)

#### **Site 2—Nourished Areas (Additional Fill Areas No. 1-4)**

Only Nourished Areas No. 3 & 4 were visible during the site visit. Located on the Northeast tip of the island, shoreline erosion continues to degrade the point. The vegetation is thriving since the nutria population is under control.

The 2017 Topographic Survey, previously mentioned, incorporated elevation data at specific points within each Nourished Area, rather than along transect lines at incremental spacing. The locations observed were repeated sites from the prior survey tasks in order to make comparisons over time. Nourished Area No. 1 being relatively small had three (3) point surveys taken. In Nourished Area No. 2, nineteen (19) points were surveyed. Nourished Area No. 3 had three (3) point locations, and Nourished Area No. 4 had four (4) locations.

Comparing the 2011 and the 2017 Topographic Surveys, Nourished Area No.1 has seen a minor decrease in elevation ranging from 0 in. to 6 in. Note that Nourished Area No. 1 was a prior oilfield canal infilled during construction. After the initial fill material consolidated, this area drained poorly and was holding water. During the post construction maintenance event (2014), gaps were constructed to allow proper drainage.

Nourished Area No. 2 showed a positive elevation trend in the nineteen locations ranging from a 1 in. to a 7 in. increase and an average of 3.8 in. increase between observations taken in 2011 and 2017.

Nourished Areas No. 3 & 4 experienced relatively minor net change. Despite one location with a 10 in. decrease, each other location observed in Nourished Area No. 3 had a 1.2 in.



elevation increase. Nourished Area No. 4 had an elevation change ranging from -2.4 in. to +2.4in.

(Photos: Appendix A, Photo 1-2)

### **Site 3—Earthen Plug**

Due to the water levels on the day of the inspection and the siltation at the mouth of the North-South Pipeline Canal, the earthen plug at its southern end could not be closely observed. However viewed from afar, this plug appears to remain intact.

### **Site 4—Vegetation plantings**

The vegetation in the marsh creation cells and containment dikes has propagated well despite the nutria damage seen in prior years. The Nutria Program implemented by LADWLF has effectively controlled the nutria population giving the vegetation time to reestablish itself. At this time, no additional plantings are planned.

## **c. Maintenance Recommendations**

### **i. Immediate/ Emergency Repairs**

None

### **ii. Programmatic/ Routine Repairs**

None

## **d. Maintenance History**

**General Maintenance:** Below is a summary of completed maintenance tasks performed since December 2010.

### **2011-2014 Survey and Maintenance Event –**

#### **T. Baker Smith Year 1 Survey (2011-2012):**

Elevation Survey of the marsh creation areas, borrow area, and CRMS-like stations

#### **Professional Construction Services, Inc.**

Post Construction Maintenance Event (2014-2015):

-Excavation of four interior plugs left from original construction in Marsh Nourishment Areas No.1 & 2

- Removal of a timber mat plug in the Marsh Creation Cell No. 2 containment dike near Hawkins Lake with creation of a 100 foot gap
- Degrading of an existing Gap “N” between Marsh Creation Cell No. 2 and Nourishment Area No. 3
- Repair and installation of articulated concrete mat armoring of 890ft of containment dike on the East End of the East-West Pipeline Canal along the Gulfward shoreline.

In conjunction with this maintenance event, the existing rock plug at the West end of the East-West Canal was removed and replaced with improvements to repair erosion occurring around the plug as part of TV-14 maintenance. In addition, LADWLF installed a PVC sheetpile plug on the interior containment dike at the East end of the East-West Canal. This coinciding work was not paid out of the CWPPRA TV-21 budget.

Construction	\$1,260,374.32
Year 1 Surveying, E&D, Construction Oversight, Asbuilts	\$250,774.45
<b>Project Total</b>	<b>\$1,511,148.77</b>

#### **2017 Year 5 Survey – T. Baker Smith**

The task included topographic surveys of the marsh creation containment areas and containment dikes, nourishment areas, and bathymetric surveys of the borrow area. The survey was a duplicate of the 2011 Survey where elevations could be compared and changes could be documented.

<b>Project Total</b>	<b>\$ 88,535.80</b>
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### **III. Operation Activity**

#### **a. Operation Plan**

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

#### **b. Actual Operations**

There are no active operations associated with this project.

### **IV. Monitoring Activity**

Pursuant to a CWPPRA Task Force decision on August 14, 2003 to adopt the Coastwide Reference Monitoring System-*Wetlands* (CRMS) for CWPPRA, the TV-21 Monitoring Plan was written to merge it with CRMS and provide more useful information for modeling efforts and future project planning while maintaining the monitoring mandates of the Breaux Act. In this report, three CRMS

sites (outside of the project area) are to be used to assess the effectiveness of the project along with the project-specific monitoring.

#### **a. Monitoring Goals**

The objectives of the East Marsh Island Marsh Creation project are:

1. Create approximately 362 acres of emergent marsh in shallow open water and mud flats.
2. Create/nourish an additional 797 acres of brackish marsh with unconfined dredged sediment.
3. Reduce the future loss rate of new and existing marsh in the project area by 50%.

#### **b. Monitoring Elements**

##### **Aerial Photography**

Near-vertical color-infrared aerial photography (1:24,000 scale) will be used to measure vegetated and non-vegetated areas for the levee-contained creation and uncontained nourishment areas of the project. The photography will be obtained post-construction in the fall of 2012 and again in 2021 and 2029. The original photography will be checked for flight accuracy, color correctness, and clarity and will subsequently be archived. Aerial photography will be scanned, mosaicked, and georectified by USGS/NWRC personnel according to standard operating procedures to develop land:water analyses (Steyer et al. 1995, revised 2000).

Aerial photography will be collected for the entire coast through CRMS-*Wetlands* and will be used to evaluate TV-21 along with project specific photography. Land:Water analysis of the 1 km CRMS-*like* sites will be done using an automated classification methodology using only minimal manual delineation. Photography for the CRMS-*like* sites within the project area was acquired in 2016 and 2018.

Percent land trends were calculated using Landsat Thematic Mapper (TM) data for 1985 – 2016. 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 data from both continuous recorder and discrete soil porewater stations are monitored to characterize the spatial variation in salinity throughout the project area. Hourly salinity and water levels (ft, NAVD88) are monitored with continuous recorders in one containment area and one nourishment area at two CRMS-like sites (TV21CR01 and TV21CR02). The CRMS-like sites were installed in September 2011 (Adequate settlement of the containment areas was required prior to construction) and remained deployed until 2017. TV21CR02 was re-deployed for one year in 2018 and again in 2021. Future salinity recording will take place in 2023 and 2025. TV21CR01 will no longer be deployed as a cost saving measure as it was determined the two sites were not statistically different from one another. CRMS0523 was selected to be the hydrologic reference site. At each

RSET/accretion data collection, a measurement of interstitial water salinity is collected at the boardwalk in the marsh at 10 and 30 cm. Interstitial water salinity is also determined at each of the vegetation plots, when vegetation is surveyed.

### **Water Level**

Water level within the marsh is measured at the CRMS-like sites and reference sites listed above every hour with a water-level gauge installed within an area that is hydrologically connected to the surrounding water body. The gauge is surveyed relative to the top of the RSET (NAVD 88). Water level data is used to document the variability in water levels and duration of inundation in project and reference areas.

Average annual salinity and percent time flooded are used to develop a Hydrologic Index (HI) score (Snedden and Swenson 2012) based on the suitability of the site in maximizing vegetation productivity according to its specific marsh class (swamp, fresh, intermediate, brackish, and saline). The HI score (between 0 and 100) corresponds to the percent of maximum vegetation productivity expected to occur if the separate effects of salinity and inundation interact in a multiplicative fashion on vegetation productivity.

### **Emergent Vegetation**

Emergent vegetation parameters are evaluated at each CRMS-like site using techniques described in Folse et al. (2012) to describe species composition, richness, and relative abundance. Annually in late summer at each site, data are collected from ten, 4-m<sup>2</sup> sample plots randomly established along a 282.8 m transect that crosses diagonally through a 200-m × 200-m sampling area in the middle of the site.

Individual species' cover data were summarized according to the Floristic Quality Index (FQI) method (Cretini et al. 2011). The FQI assigns a low score to invasive species indicative of disturbance and a high score to native species indicative of stability. The two CRMS-like sites inside and 3 CRMS sites outside (522, 523, 524) the project area were used for this report. Data from 2011 - 2016 will be presented.

### **Submerged Aquatic Vegetation (SAV)**

To document changes in the occurrence of SAV, two ponds adjacent to the project area were monitored using the rake method to determine if a breach into the northernmost pond had an effect on SAV abundance (Chabreck and Hoffpauir 1962) (figure 2). No ponds were monitored within the project area. Three transects (minimum 20 samples/transect) were established across open water in each pond. Submerged aquatic vegetation was sampled repeatedly along each transect by dragging a garden rake on the pond bottom for one second. The presence or absence of vegetation was recorded for each sample to determine the percent occurrence on a transect (% occurrence = (number of samples with SAV/number of samples) × 100). When vegetation was present, the species present was recorded in order to determine the frequencies of individual species (Nyman and Chabreck 1996). SAV was monitored post-construction in the fall of 2012 and 2013.

### **Soil Properties**

Soil cores were collected to describe soil properties (soil pH, salinity (EC), bulk density, moisture, % organic matter, wet/dry volume, and texture (Particle Size Distribution) analysis. 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 6 sites, one within each contained site and 4 in the surrounding uncontained deposition sites. Suitable reference cores (same quality or marsh type) were collected from 3 nearby CRMS sites outside the project area. Cores were collected for the project sites in 2011 and 2016 and will be collected again in 2020 and 2030. Soil cores were only collected at the nearby CRMS sites during station establishment in 2005-2007. The samplings in 2011 and 2016 will be presented for the project sites in this report.

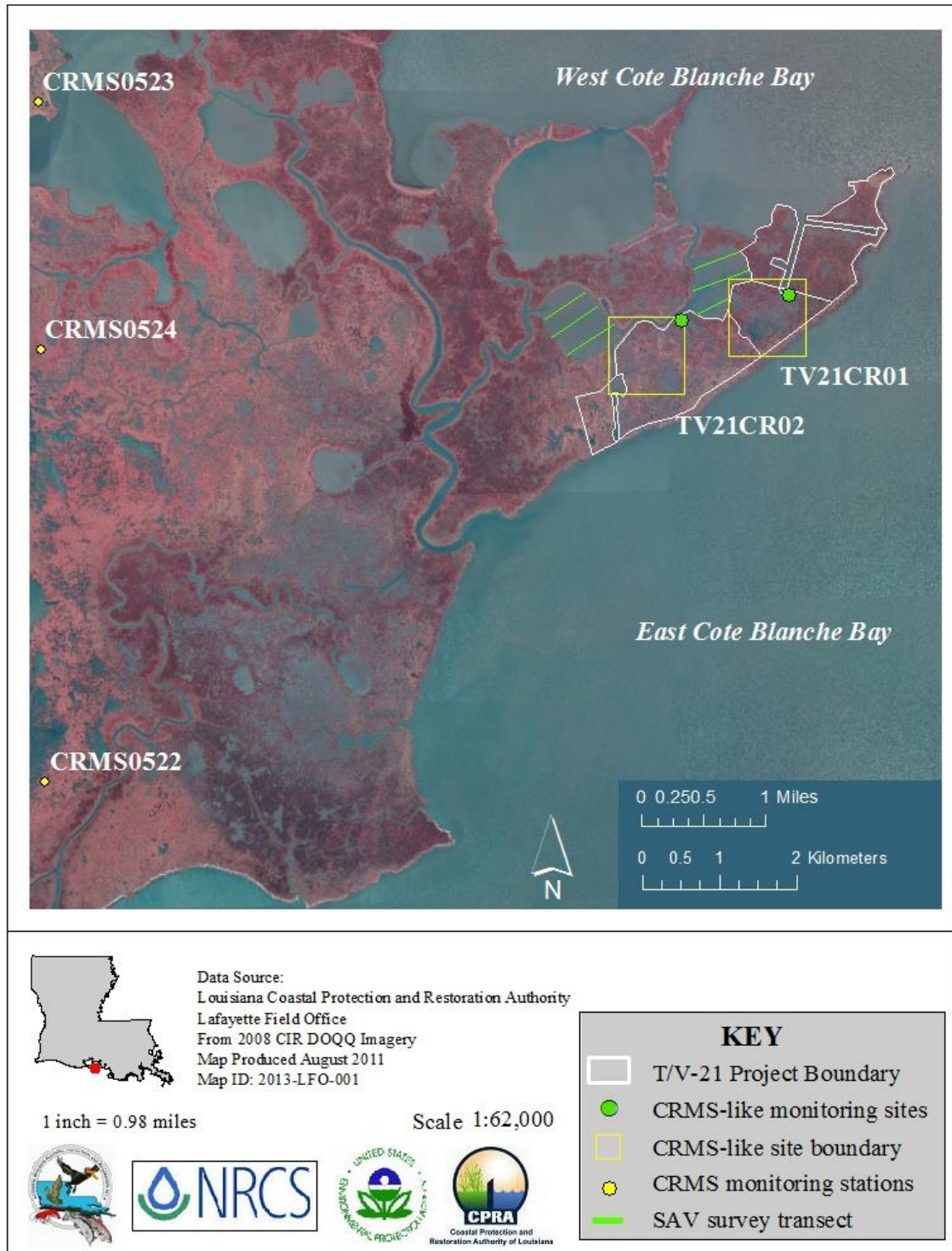
### **Soil Surface Elevation Change**

Soil surface elevation change utilizing a combination of rod-surface elevation tables (RSET) and vertical accretion from feldspar horizon markers are being measured twice a year at each site. 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 sites and reference CRMS sites; therefore the displayed elevation change rates are an estimation of that temporal trend.

### **Borrow Area (Dissolved O<sub>2</sub>)**

Dissolved oxygen level monitoring in the East Cote Blanche Bay borrow area and a reference area (located within one-quarter to one-half mile of the borrow site and between the borrow site and the east end of Marsh Island) was performed post-construction to determine if hypoxic conditions occurred in the borrow area during the refill period. Monitoring was to be performed in years 2011, 2012, 2013 and 2016 unless prior refill of the borrow area occurred. The ratio of the dissolved oxygen content (ppm) to the potential capacity (ppm) will give the percent saturation, which is an indicator of water quality. A sampling period consisted of systematic monitoring of the borrow and reference areas for hypoxia (dissolved oxygen <2 mg l<sup>-1</sup>) in bottom waters for 60 days in the summer from late July through September. This was accomplished by installing a continuous recorder adjacent to a buoy in the borrow area and in the nearby reference area. This information will help to provide recommendations on borrow area design in the future.





**Figure 2.** Location of CRMS-like monitoring sites within the East Marsh Island Marsh Creation (TV-21) project area, SAV transects and nearby CRMS sites to be used for comparison.



#### IV. Monitoring Activity (continued)

##### c. Monitoring Results and Discussion

###### Aerial Photography

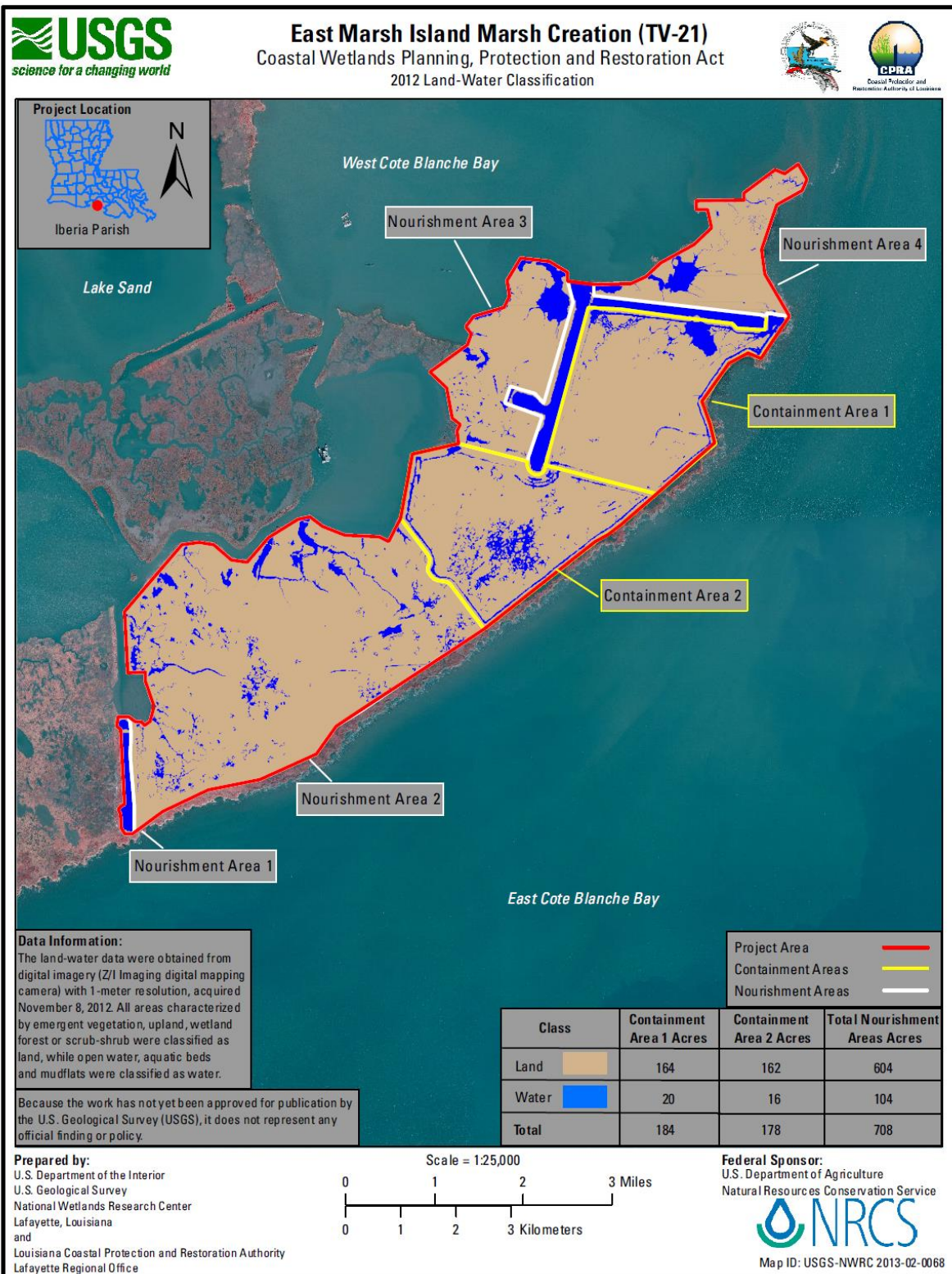
Post-construction land/water analysis was completed for the 2012 aerial photography (Figure 3). The project's objectives were to create 362 acres of emergent marsh and nourish an additional 797 acres. The project was successful in creating 362 acres of marsh, with ~11% of it classified as water as of the 2012 land/water analysis mentioned above. The actual acreage of nourished marsh was 708 acres with ~15% classified as water. The constructed project boundary was modified slightly from the original project boundary, accounting for the difference in acreage. Future analyses will enable a determination of the project's objective to reduce the loss rate by 50%.

For the two CRMS-like sites in the project area, land/water analysis was completed for the 2016 and 2018 digital imagery (Table 1). A slight loss of land occurred at TV21-CR01 between the two imagery years, primarily due to Gulf of Mexico shoreline erosion. This is apparent in Google Earth Imagery (Figures 3b and 3c). Particularly note the erosion that has taken place on the eastern tip of the island. A gain of approximately three acres occurred at TV21-CR02 due to infilling of some of the small interior ponds. Future imagery will quantify the damage from the hurricanes of 2019 and 2020.

**Table 1.** Land:Water acreages for 2016 and 2018 at CRMS-like sites in the project area.

CRMS-like Site		2016		2018		Change 2016 to 2018
		acres	%	acres	%	acres
TV21-CR01	Land	210.2	85.07	208.6	84.42	-1.6
	Water	36.9	14.93	38.5	15.58	
	Total	247.1		247.1		
TV21-CR02	Land	208.1	84.22	211.5	85.59	3.4
	Water	39.0	15.78	35.6	14.41	
	Total	247.1		247.1		
<b>Total change</b>						<b>1.8</b>

The general land change trend within the project area prior to construction was slightly negative (-0.07% per year) from 1985-2010 (Figure 3d). Incorporating the 2010-2016 data, which includes the post-construction satellite imagery, causes the general trend to become slightly positive (0.06% per year), reflecting the positive impact of the marsh creation and nourishment in the project area.



**Figure 3a.** East Marsh Island Marsh Creation (TV-21) project 2012 land/water analysis.



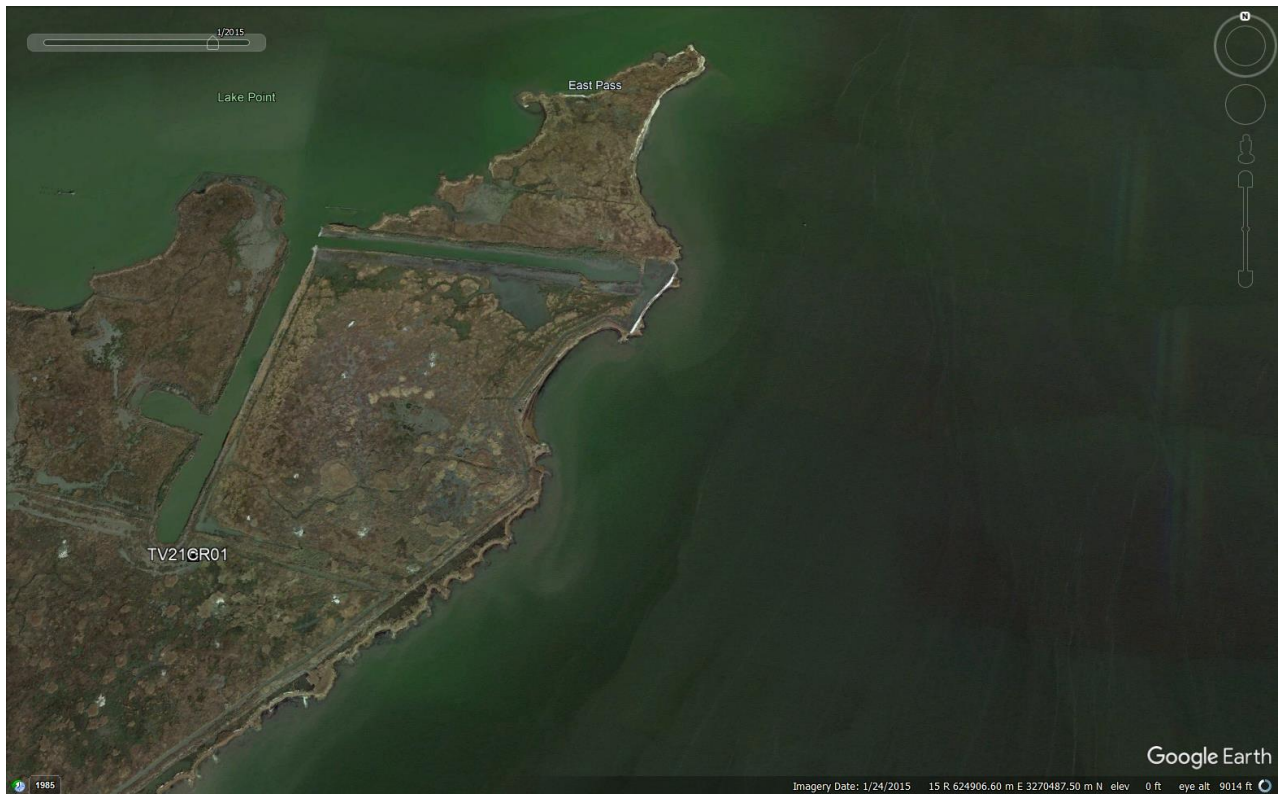


Figure 3b. 2015 Google Earth Imagery of TV-21 shoreline.

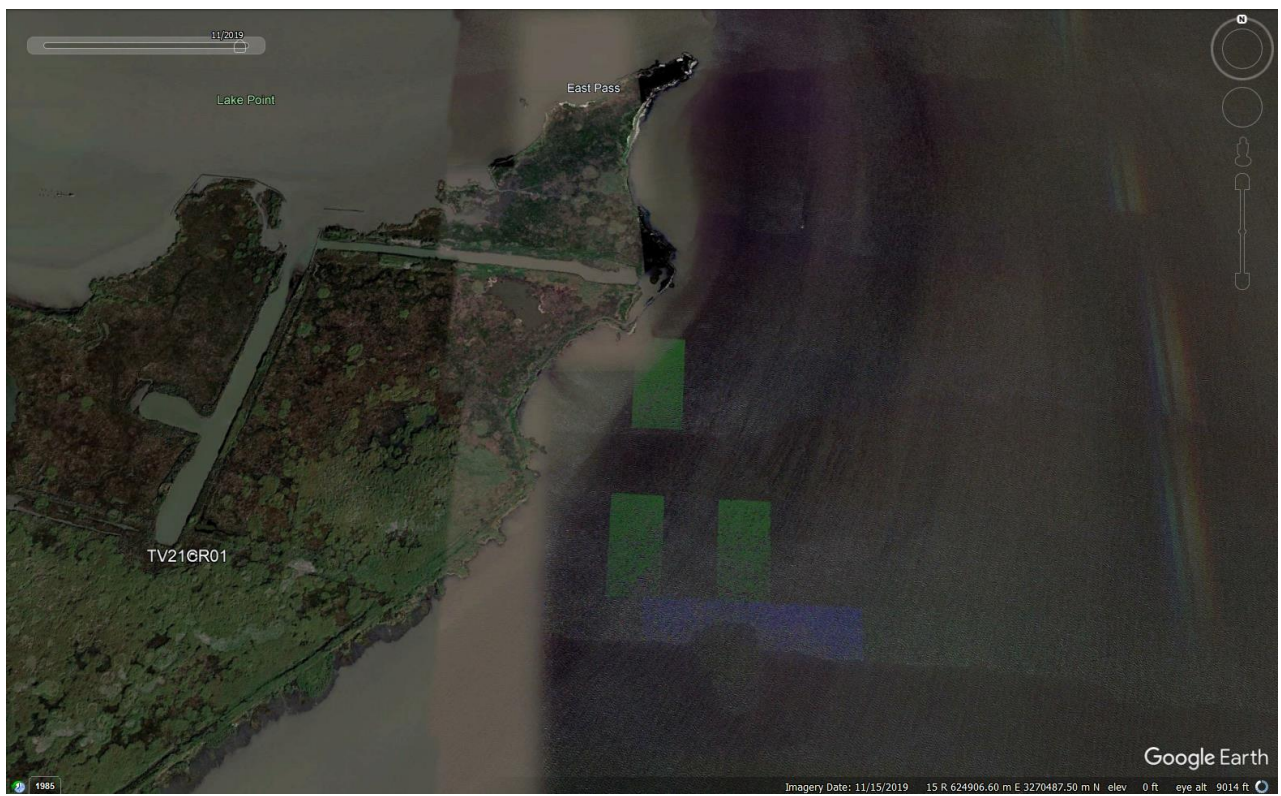
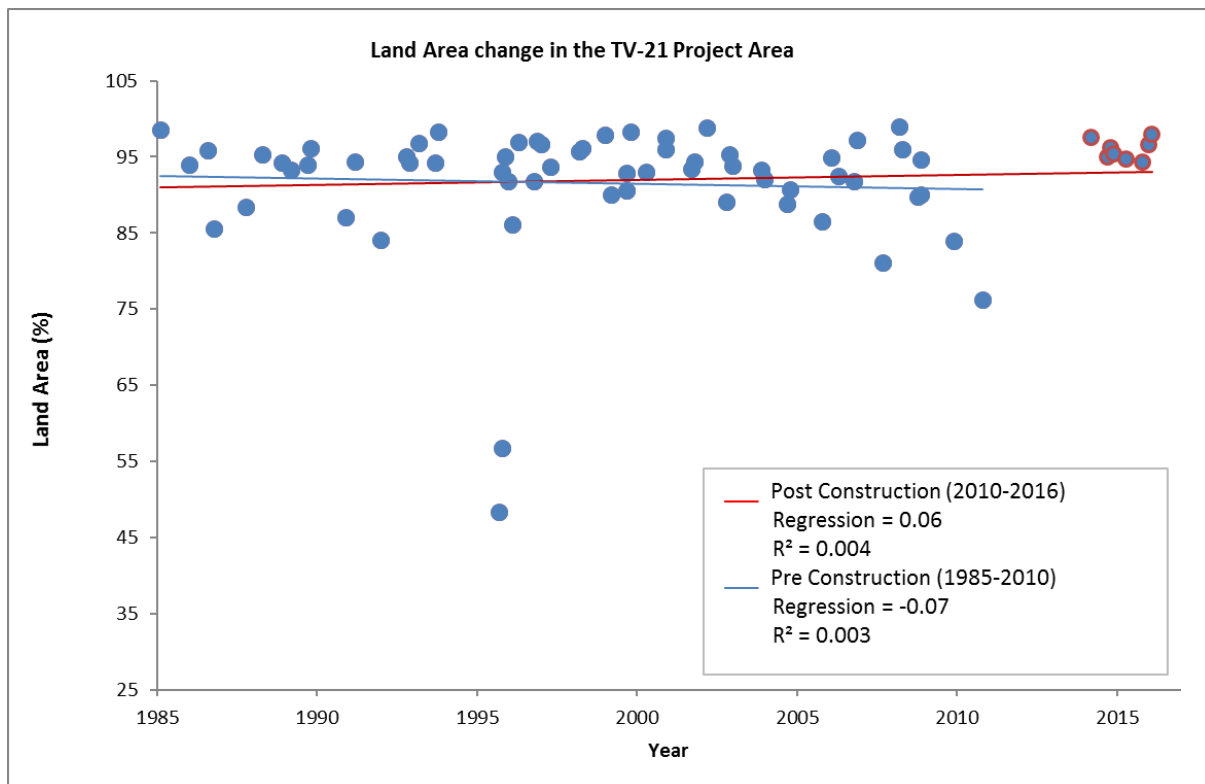


Figure 3c. November 2019 Google Earth Imagery of TV-21 shoreline.



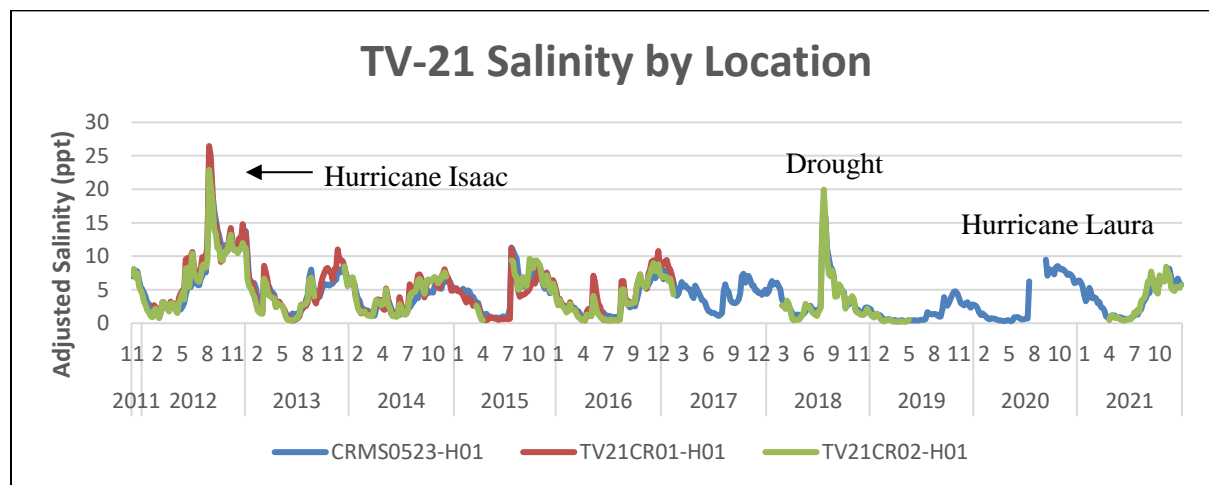
**Figure 3d.** Project scale percent land change for TV-21. Percent land values are displayed for all cloud free TM images available for 1985-2016. The red line depicts the percent land trend for the entire period of record. The blue line depicts the percent land trend for the pre-construction time period only. Percent land calculated as percent land of total project area. See Couvillion et al. 2017.

## Salinity

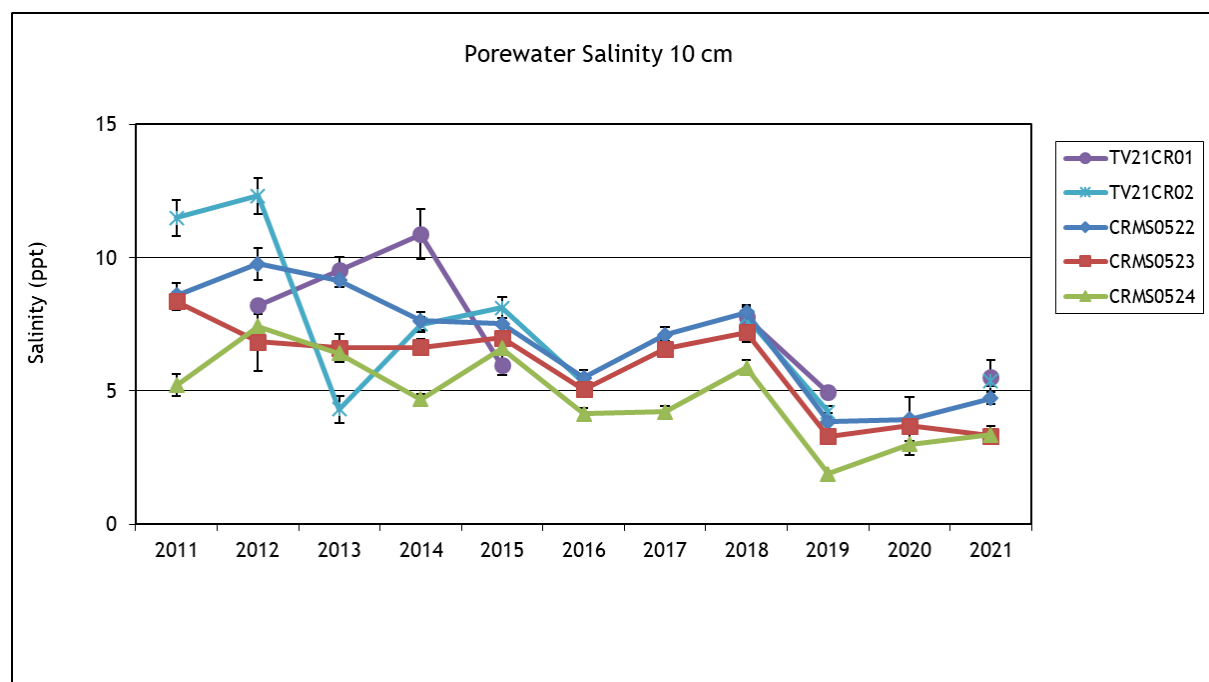
Salinities at the project and reference area recorders were very similar in 2012-2021, averaging around 4.3 ppt and falling within the intermediate to brackish range (Figure 4a). Seasonal spikes in salinity ~~occured~~ occurred in the late summer/fall months occasionally elevating salinities in the project area to 7-10 ppt, but otherwise, salinities primarily remained below 5 ppt. The highest recorded salinities occurred in August of 2012 when Hurricane Isaac made landfall near the mouth of the Mississippi River and during the drought in the summer of 2018, elevating salinities above 20 ppt in the project area. Hurricane Barry made landfall on Marsh Island in 2019. There was not a project-specific recorder deployed at the time, but the recorder at CRMS0523 did not detect an increase in salinity during this event. In 2020, Hurricanes Laura and Delta caused storm surges in the project area. The CRMS0523 recorder did not log during Hurricane Laura, but other Marsh Island sites recorded a spike in salinities up to 15 ppt during the event. Salinities slowly receded until the end of the year, but did not differ significantly from other years during the fall months. In fact, salinities in 2021 approximated the same pattern without a direct storm surge.

Yearly means of interstitial water salinity for the project stations and CRMS reference sites 522, 523 and 524 are presented in Figures 1b and 1c. Porewater salinities have consistently been

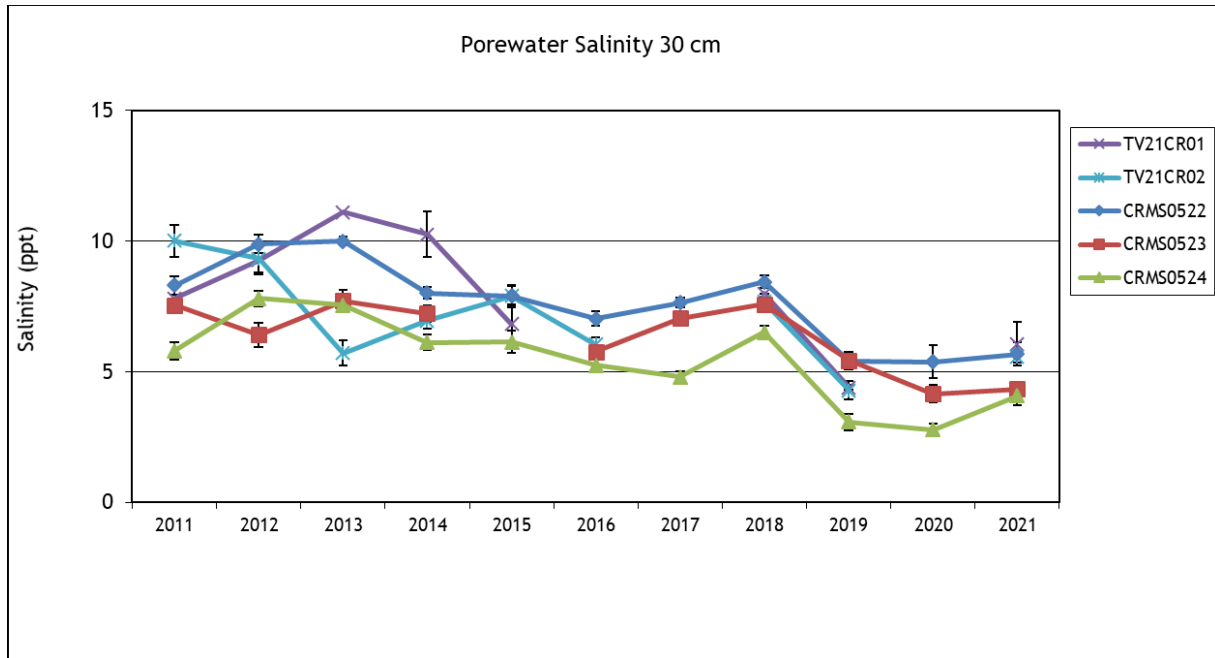
between 5 and 10 ppt through all years at the reference CRMS sites and at the project sites since 2014, again reflecting the intermediate to brackish range seen at the surface. Increased rainfall in recent years has benefited the project area and worked to freshen the porewater salinities. Soil salinities rose slightly due to the drought in 2018, but dropped to below 5 ppt within the project and reference sites in 2019 for the first time since monitoring began. Following the active storm season of 2020, soil salinities rose very little, still averaging around 5 ppt at project and reference sites.



**Figure 4a.** Weekly means of salinity data collected at project and CRMS reference sites.



**Figure 4b.** Yearly Means of Interstitial water salinity at 10 cm below the soil surface at project and CRMS reference sites. Mean  $\pm$  SE.

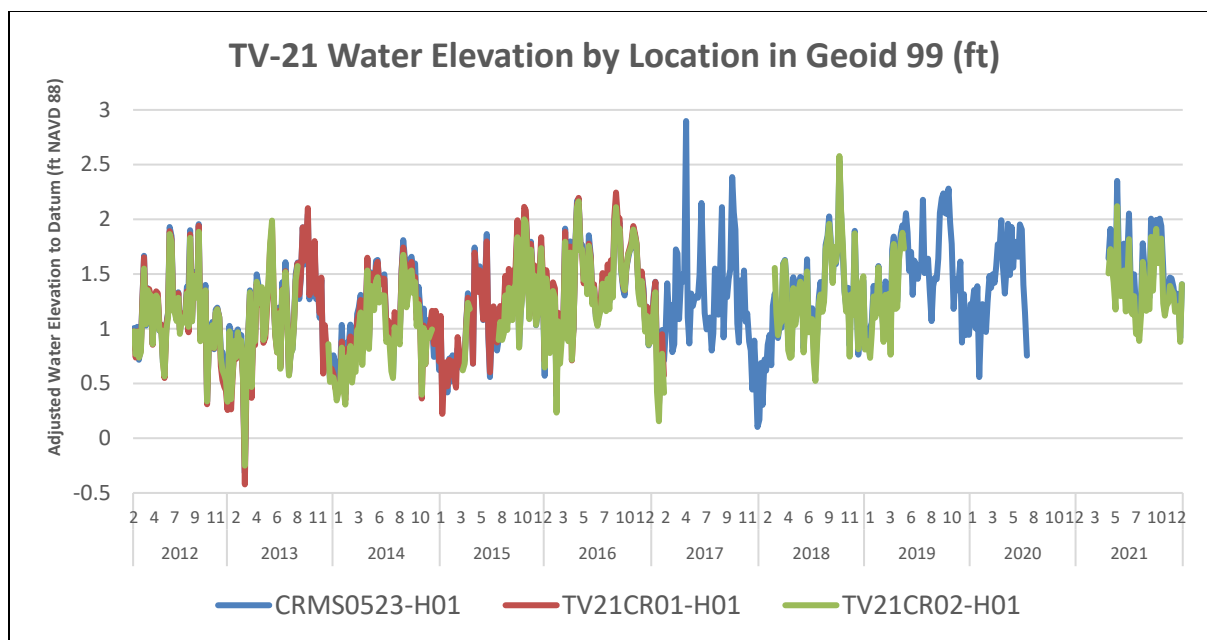


**Figure 4c.** Yearly Means of Interstitial water salinity at 30 cm below the soil surface at project and CRMS reference sites. Mean  $\pm$  SE

### Water Level

The project area was affected by storm surges from multiple hurricanes during the period of record. Significant surges occurred in 2019 for Hurricane Barry and 2020 for Hurricanes Laura and Delta. The TV-21 recorders were not deployed for any of the storms, but the recorder at CRMS0523 recorded a maximum water level of ~7 ft NAVD 88 during Hurricane Barry's landfall. For the 2020 storms, the recorder was damaged and stopped recording at CRMS0523, but nearby sites recorded over 7 ft of surge for Hurricane Laura and nearly 7 ft for Delta.



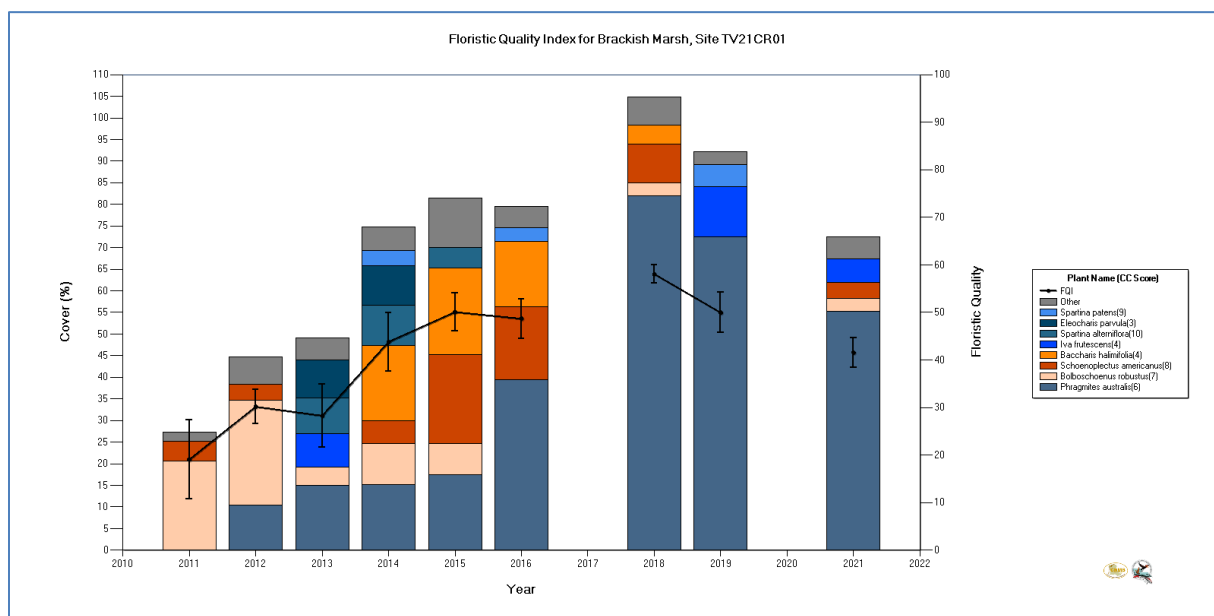


**Figure 5a.** Weekly means of water level data collected at project and CRMS reference sites.

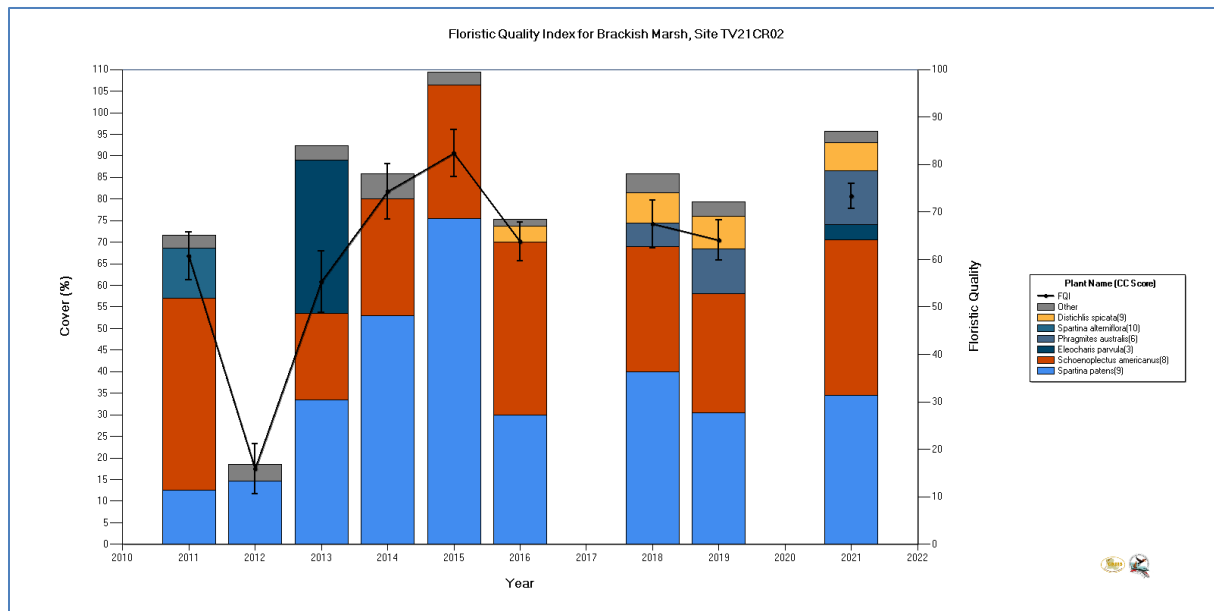
### **Emergent Vegetation**

Containment area 2 (TV21-CR01) slowly vegetated through 2013, then increased in cover to above 70% in 2014-2019 (Figure 6a). A subset of the vegetation stations was surveyed in 2019 following Hurricane Barry. The presence of large amounts of wrack from the storm prevented access to some of the plots. Other than the wrack, though, the storm did not appear to have a negative impact on the vegetation. Again, on the 2021 survey, large amounts of wrack was noted from the 2020 hurricanes. Cover dropped significantly in the containment area compared to the 2019 survey. The storm surges did more damage from the force of the water and the associated wrack that was piled upon the vegetation than the temporary increase in salinity or water levels, particularly on *Phragmites australis*. The wrack either smothered existing vegetation or uprooted it, resulting in the thinning out of much of the dense stands of *P. australis*. This was very notable during the RSET survey in April 2021 (Figure 6f). By the time of the vegetation survey in October 2021, the vegetation had recovered but was thinner than in previous years, as all of the vegetation plots were accessible on this survey (Figure 6g). The vegetation in the containment area is transitioning from a brackish assemblage of *Schoenoplectus americanus*, *Bolboschoenus robustus* and *Bacharis halimifolia* into a monoculture of *P. australis*. Vegetation in nourishment area 2 (TV21-CR02) has been consistently above 70% vegetated since construction other than the nutria herbivory damage in 2012 (Figure 6b). Minor decreases in cover and FQI occurred in 2016, due to the heavy flooding in August and 2019 following Hurricane Barry. Vegetation within the nourishment area was impacted less by the 2020 hurricanes than in the containment area and actually showed an increase in cover over the 2019 survey, not being affected by the wrack of the containment area. This area is dominated by *Spartina patens* and *Schoenoplectus americanus*. Muskrat herbivory and nesting activity were noted in both the 2019 and 2021 surveys at the nourishment area, but was not widespread or heavily impactful.

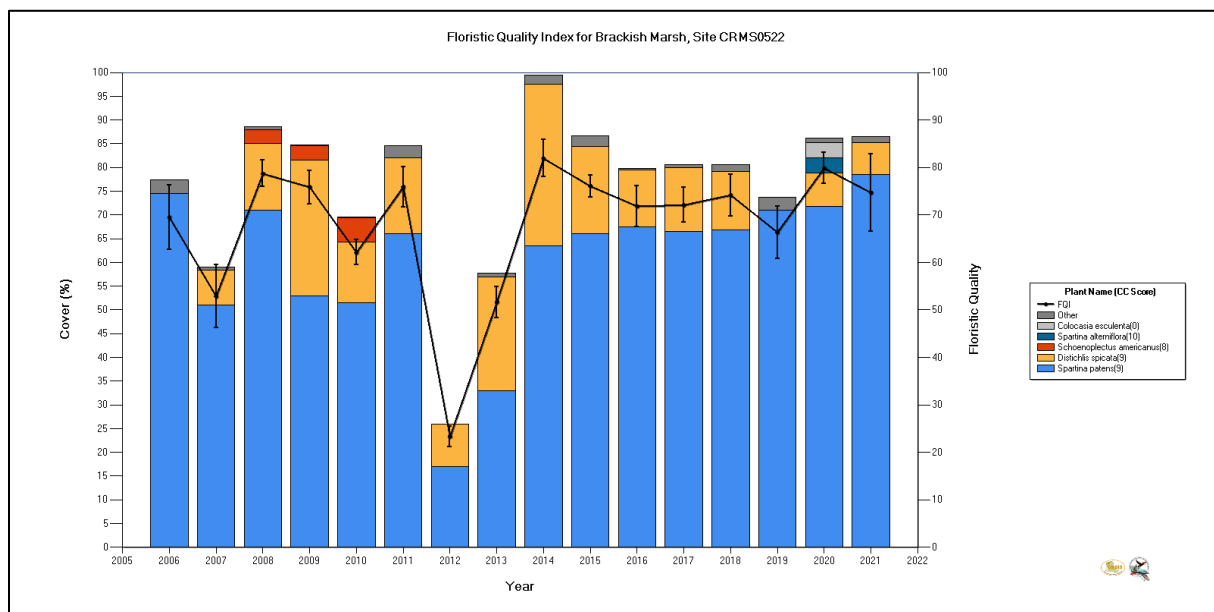
Vegetation at the reference stations has been mostly stable since 2008, with cover values above 70% through most years sampled (Figures 6c – 6e). Like the project nourishment area site, nutria did considerable damage to the CRMS reference sites in 2012. CRMS0524 saw a large drop in cover and FQI score in 2017. Large amounts of standing dead vegetation were noted on the survey and was likely a delayed response to the flooding in 2016, though none of the other reference sites experienced this. Hurricane Barry appeared to have an effect on all sites in 2019, with reduced cover, though the impacts were very minimal. As was the case at TV21-CR02, the CRMS sites appeared to have fully recovered from the 2020 storms with percent cover increasing at all three in 2021. The vegetation assemblages at the reference sites are similar to the vegetation at TV21-CR02 and are reflective of the intermediate to brackish salinities, being dominated by *S. patens* and *S. americanus* with small amounts of *Distichlis spicata*.



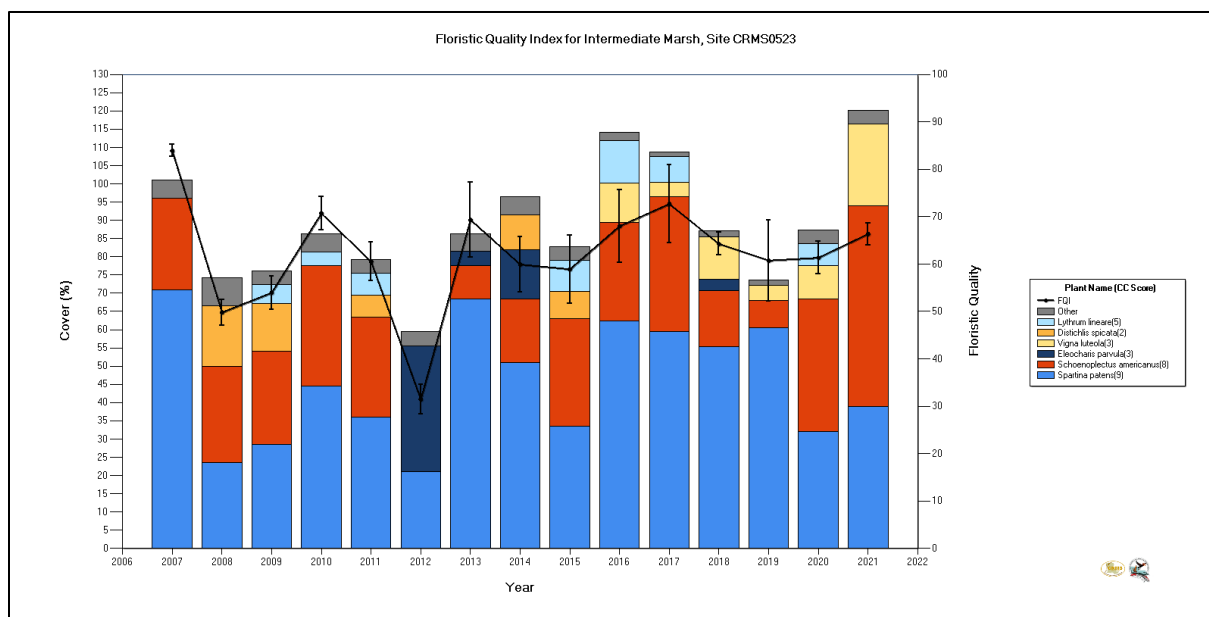
**Figure 6a.** Percent coverage and floristic quality index of species collected from station TV21-CR01 within the project area in years 2011-2021. The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stability.



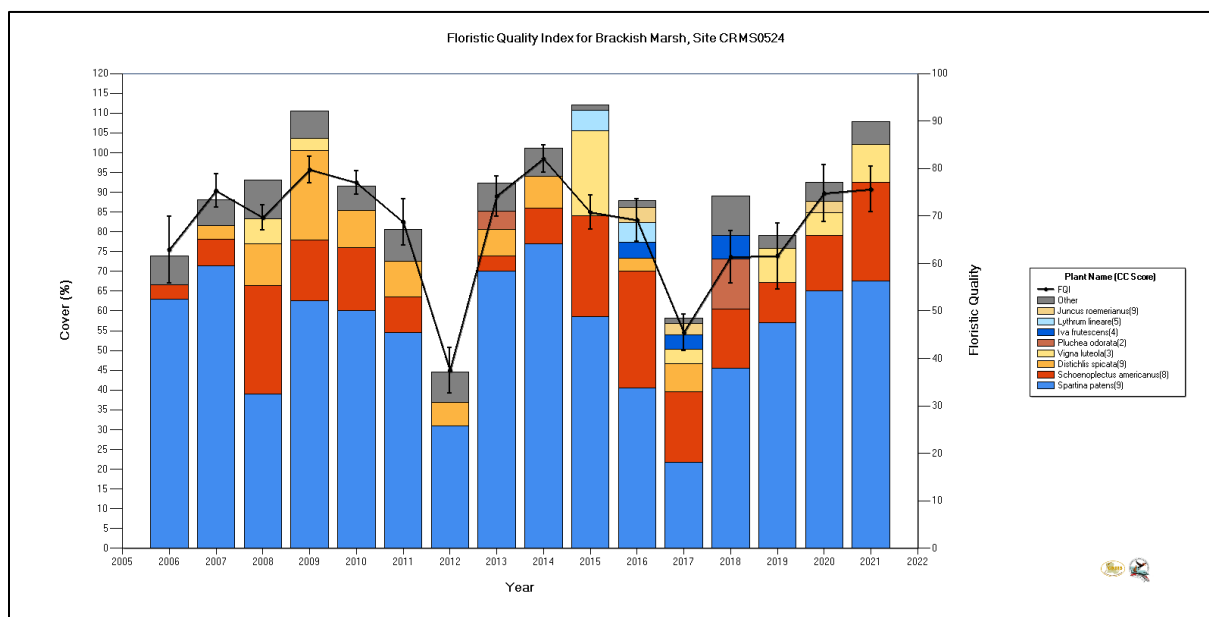
**Figure 6b.** Percent coverage and floristic quality index of species collected from station TV21-CR02 within the project area in years 2011-2021. The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stability.



**Figure 6c.** Percent coverage and floristic quality index of species collected from reference site CRMS0522 in years 2006 - 2021. The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stability.



**Figure 6d.** Percent coverage and floristic quality index of species collected from reference site CRMS0523 in years 2007 - 2021. The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stability.



**Figure 6e.** Percent coverage and floristic quality index of species collected from reference site CRMS0524 in years 2006 - 2021. The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stability.





**Figure 6f.** View of stressed/dead *Phragmites australis* in containment area 2 in April 2021.



**Figure 6g.** View of *Phragmites australis* in containment area 2 in October 2021.

## **Vegetation Plantings**

Shortly after construction, vegetation was successfully established through an aerial seeding trial and could show promise as a revegetation technique for future projects (Mouldous and White, 2018). However, planting was unnecessary as the containment areas vegetated on their own and the vegetation that was established through the trial was overtaken by *Phragmites australis*.

## **Submerged Aquatic Vegetation (SAV)**

Post-construction sampling surveys did not detect SAV, just as on the surrounding TV-14 project and reference area surveys, suggesting that the project did not have a detrimental effect on abundance, but rather unrelated influences (Mouldous and White, 2018).

## **Soil Properties**

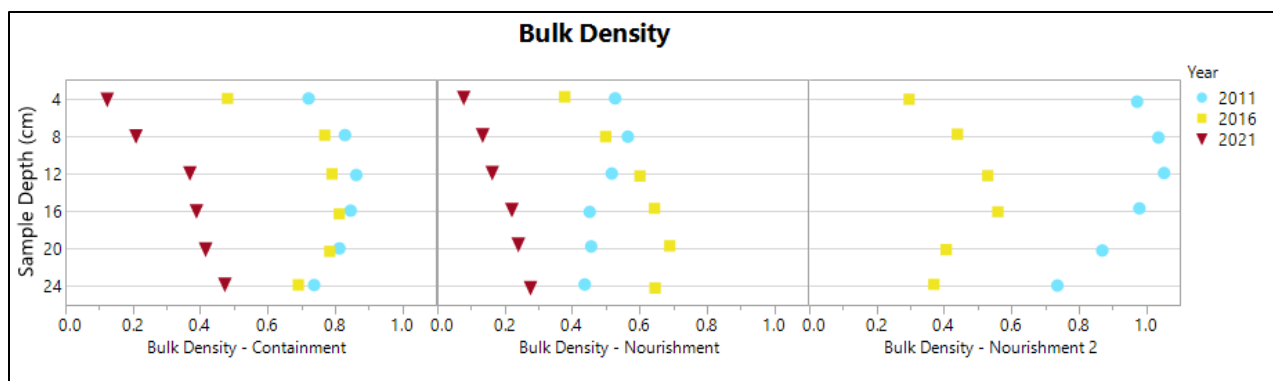
Soil samples were collected in each of the containment and nourishment areas, except nourishment area 1, in September 2011, 2016 and 2021 (Figures 8a and 8b). The soil properties data were sampled in 4 cm increments. Soil properties were averaged by area type for the containment and nourishment areas, except for nourishment area 2 due to the site's proximity to the Gulf of Mexico shoreline which distorted the 2011 sample. This site was analyzed separately from the other nourishment areas.

The containment and nourishment areas were highly mineral early on but have become more organic, particularly at the surface, as natural marsh processes have taken over. As of the 2021 survey, bulk densities have dropped below  $0.2 \text{ g/cm}^3$  at the surface in both the containment and nourishment areas. Bulk densities increase with depth to nearly  $0.5 \text{ g/cm}^3$  in the containment area. Percent organic matter (OM) is beginning to increase in both areas but is still below 20% at the surface and below 15% at the bottom of the soil profile reflecting the mineral sediments from the dredge material becoming buried.

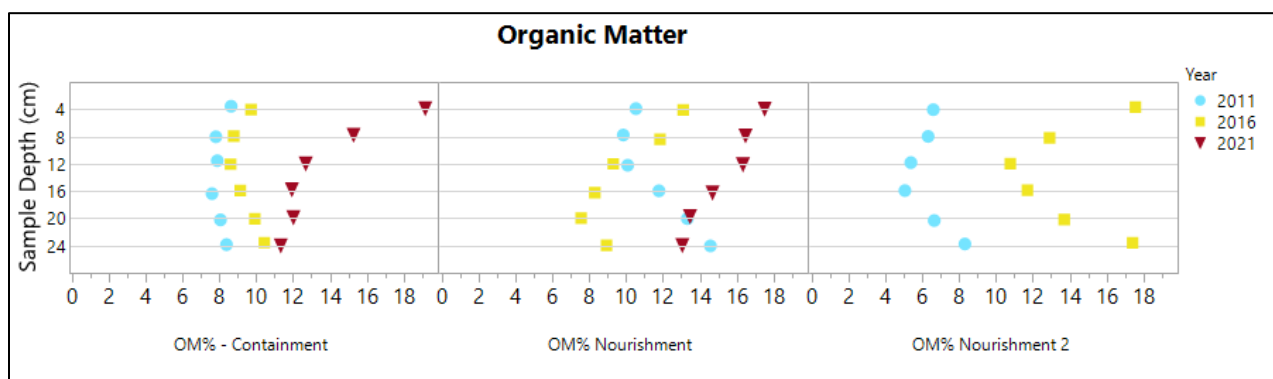
For comparison, figures for mean bulk density and percent organic matter at the 3 reference CRMS sites, collected in 2007/2008 and 2018 are presented in figures 8c and 8d. Bulk density profiles were similar for all 3 sites for both years sampled. Bulk density values are actually higher than the 2021 project readings at the surface, but are still lower as you get deeper in the profile with values below  $0.2 \text{ g/cm}^3$ . The reference CRMS sites are still more organic than the project area sites throughout the soil profile. On average, OM was around 35% at the reference sites.

For the most part, pH readings were slightly basic throughout all of the soil profiles in the project area during the initial sampling (Figure 8e). As the soils have become more organic over time, the pH of the soils has become more acidic due to the release of organic acids during decomposition, particularly in the upper portion of the soil profile. For the 2021 soil cores, pH was not analyzed.

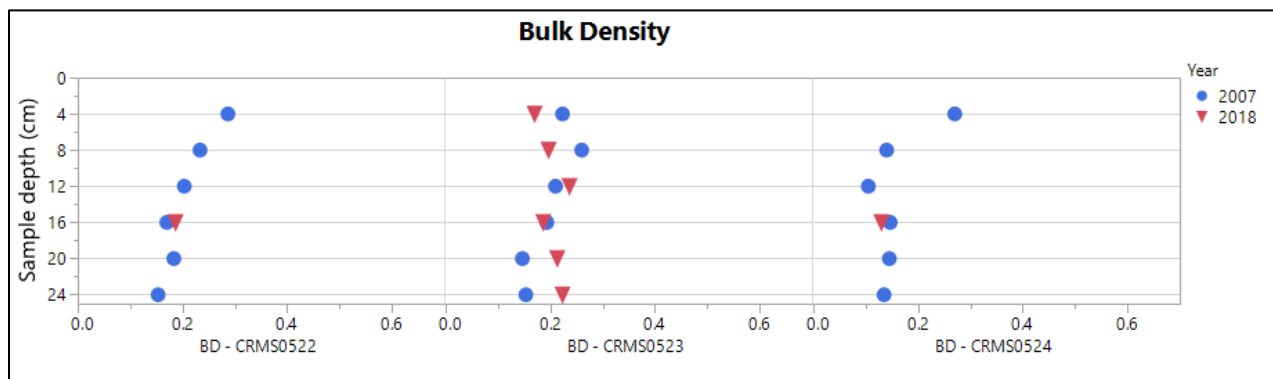




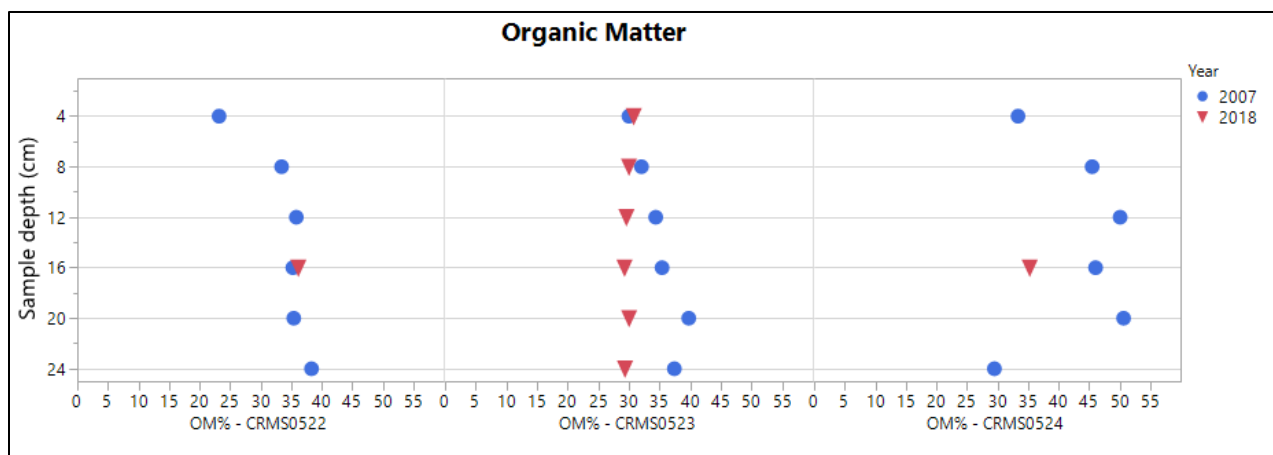
**Figure 8a.** Mean soil bulk density at containment and nourishment areas collected in TV-21 project area in 2011, 2016 and 2021.



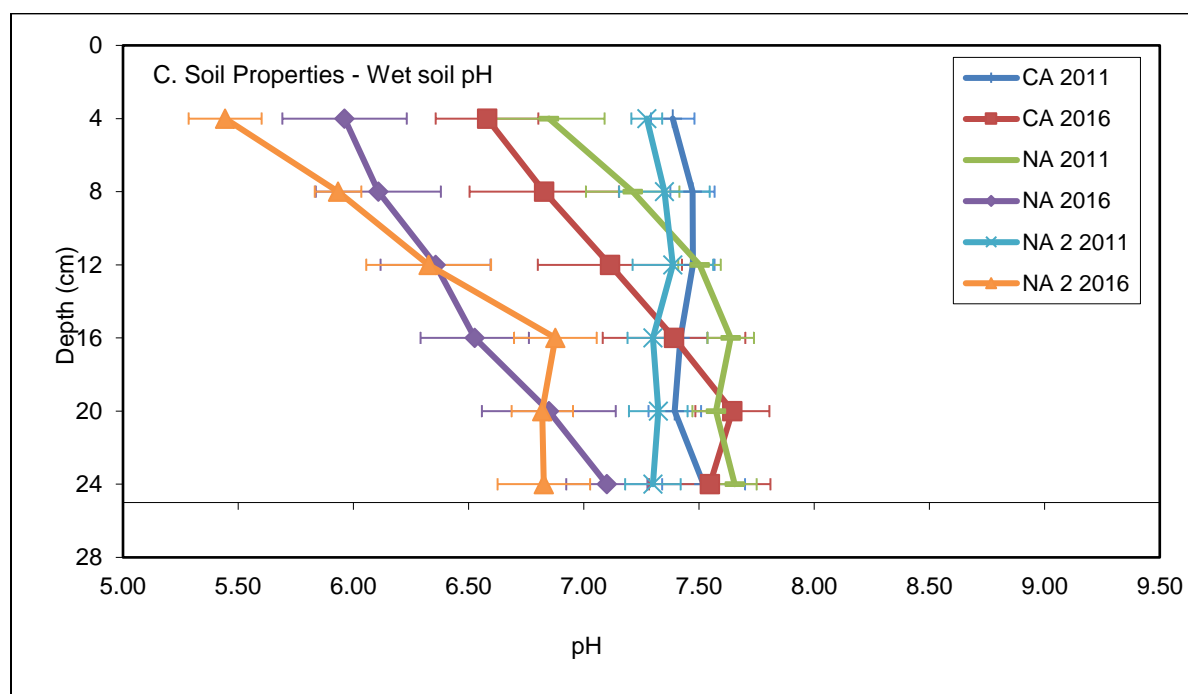
**Figure 8b.** Mean soil organic matter at containment and nourishment areas collected in TV-21 project area in 2011, 2016 and 2021.



**Figure 8c.** Mean soil bulk density collected at reference CRMS-Wetlands stations.



**Figure 8d.** Mean soil organic matter collected at reference CRMS-Wetlands stations.



**Figure 8e.** Wet soil pH at containment and nourishment areas collected in TV-21 project area in 2011 and 2016 Mean  $\pm$  SE.

### Soil Surface Elevation Change

The cumulative surface elevation change (SEC) rate within containment area 2 (TV21CR01), is negative for the monitoring period as a whole, but has shown positive gain since 2018 as natural marsh processes have replaced the initial settlement of the marsh platform (Table 2)(Figure 9.1). The settlement period lasted 6 years through the spring of 2016, with overall settlement being approximately 12 cm (Figure 9.1). Elevation gain within the area has been very large since the fall of 2018 at nearly 2 cm/year. SEC within nourishment area 2 (TV21CR02) has nearly mirrored

average rates at the three reference CRMS sites (Figure 4). Cumulative SEC, VA, and shallow subsidence rates are also very similar to the average rates of the three CRMS sites (Table 1), as the nourishment area is behaving functionally like the surrounding area marshes. An elevation gain was noted at both project sites following Hurricane Barry as well as the hurricanes of 2020, whereas the reference sites actually saw a slight dip in elevation following 2020.

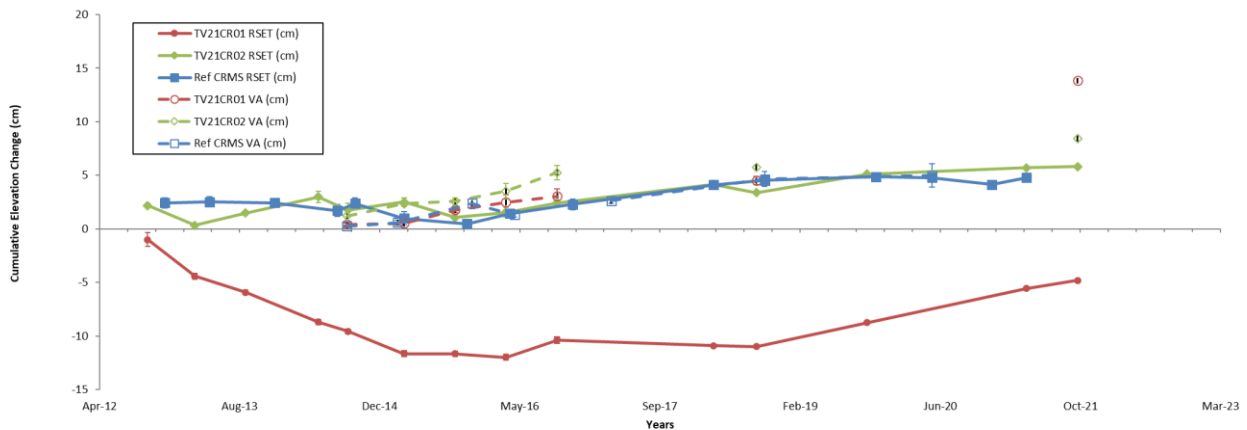
The elevations from the as-built (2010), 2012 and 2017 topographic surveys of the containment and nourishment areas were compared to the settlement curve for the containment areas that was developed pre-construction to compare actual settlement to the predicted values (Figure 9.2). In addition, the data from the RSETs at TV21CR01 and TV21CR02 were converted to NAVD88 and plotted on the chart. The actual settlement of the containment areas according to the surveys followed the predicted values closely, arriving at near identical values as of 2017. The nourishment area's as-built elevation was nearly a foot lower than the containment area and also showed greater settlement within the first year after construction. However, a 0.25 ft gain in elevation occurred by year five that wasn't seen in the containment area. This may be related to a reduction in nutria that were prolific in 2012. Interestingly, the RSET data at TV21CR01 showed the marsh platform settling at a much higher rate compared to the survey data (over half of a foot of difference), but in recent years has displayed accelerated accretion that, given its current trajectory, will reconnect with the predicted settlement curve. The location of the site settled more rapidly than the rest of the containment area which promoted ponding and increased nutria activity. Vegetation colonization and potentially storm deposition are likely contributors to the accretion. The RSET data at TV21CR02 does not reflect the large elevation gain shown in the post-construction surveys of the nourishment area but has shown a modest gain cumulatively.

The converted RSET data were compared to the water level range and mean water levels of the project to examine flooding at the sites (Figure 9.3). Following construction, through the first few years of the project, TV21CR01 was in the upper part of the water level range, even as the containment area site was rapidly settling. This changed in the high water year of 2016. Since then, the marsh elevation at the site has been below the mean water elevation for the majority of years, even as the surface is rapidly accreting. However, with increased vegetation production the site is out-pacing sea level rise. The marsh surface at the nourishment area site TV21CR02 has been above the mean water level in all years but the gap between the two is getting smaller with sea level rise. However, the elevation at the sites thus far has been suitable for vegetative growth and production, besides impacts from hurricanes and herbivory, and has enabled elevation gain.

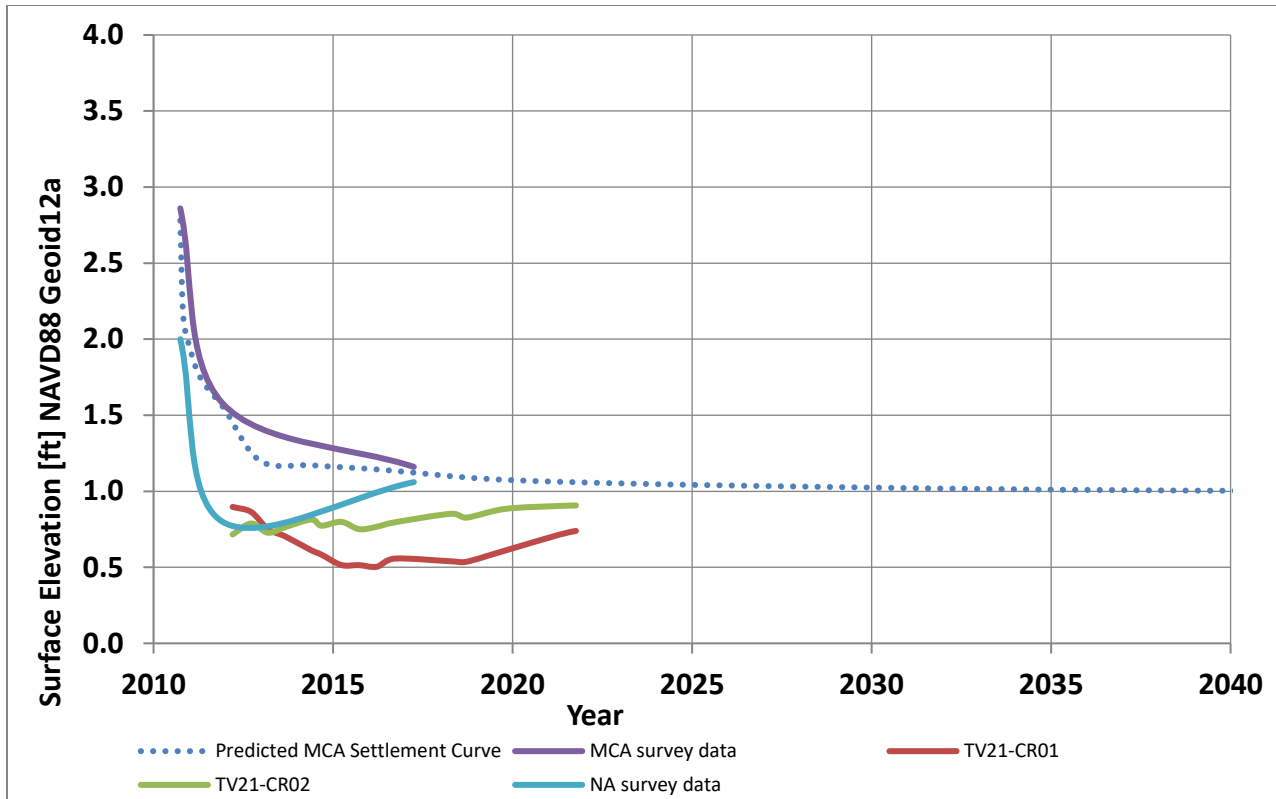
There is the potential for a future topographic survey within the containment areas in upcoming years that would further inform the actual settlement vs the predicted pre-construction values.

**Table 2.** Vertical accretion, surface elevation, and shallow subsidence change rates collected at TV-21 project sites and reference CRMS sites (Rates were averaged for CRMS0522, 523, and 524  $\pm$  1 SE).

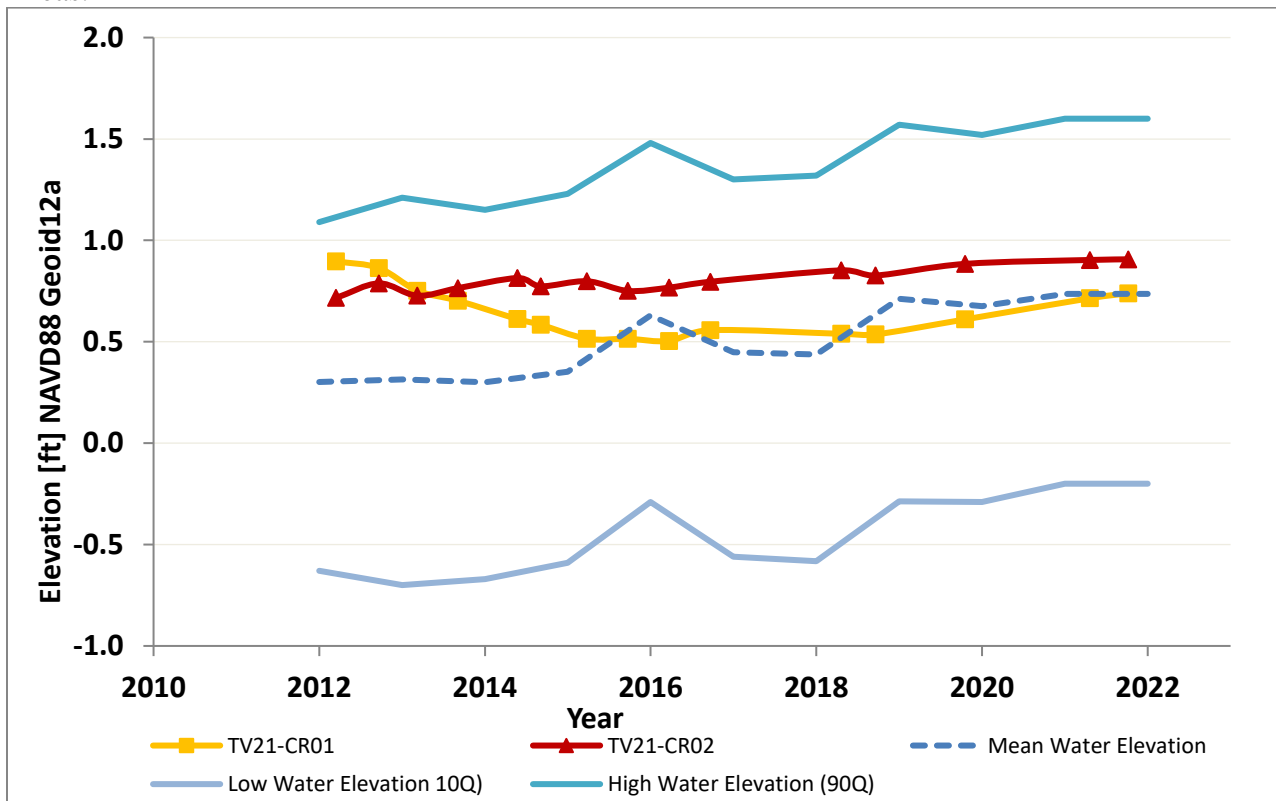
Site	Data Collection Period	Rates of Change (cm/yr)		
		Surface Elevation	Vertical Accretion	Shallow Subsidence
<b>TV21CR01</b>	Mar 2012–Oct 2021	-0.15	1.77	1.92
<b>TV21CR02</b>	Mar 2012 - Oct 2021	0.52	1.05	0.53
<b>Average of Ref CRMS sites</b>	April 2007-Apr 2021	$0.34 \pm 0.14$	$1.08 \pm 0.15$	$0.74 \pm 0.03$



**Figure 9.1** Cumulative elevation change calculated from surface elevation measurements collected at rod-surface elevation tables (RSET) and vertical accretion measurements collected from horizon markers (VA) collected at TV-21 project and reference sites (CRMS0522, 523, 524) over time. Mean  $\pm$  SE.



**Figure 9.2.** Predicted vs. observed settlement for the TV-21 Marsh Creation and Nourishment Areas.



**Figure 9.3** TV-21 RSET elevation plotted against annual water level range.

**ix. Borrow Area (Dissolved O<sub>2</sub>)**

Dissolved oxygen (DO) levels were monitored in the borrow area in 2012 and 2013 and did not indicate that the project had an adverse impact on DO levels in the area (Mouldous and White 2018).



## **V. Conclusions**

### **a. Project Effectiveness**

Land change, based on land/water analyses at the 1 km CRMS-like sites, showed the containment and nourishment areas to be stable from 2016-2018. Future analyses of the entire project area will allow us to determine if the project is meeting the objective of reducing the marsh loss rate by 50%. Significant storm surges in recent years impacted the vegetation of the project area, particularly in the containment area which is slowly recovering. The species assemblages reflect the salinity range and are similar to the surrounding natural marshes of the island. Soil surveys in 2016 and 2021 showed percent organic matter is starting to increase over the initial surveys after construction, while bulk density is starting to decrease, reflecting the increased vegetation production in the project area which has had a positive effect on elevation change in concert with storm deposition.

### **b. Recommended Improvements**

An additional topographic survey of the marsh creation and nourished areas is included in the project O&M plan. Funding will determine when this task will take place and dictate a slightly reduced scope of work compared to prior surveys.

### **c. Lessons Learned**

Without protection, earthen dikes and fill material cannot withstand the effects of direct wave action from the bay or gulf long term. Well established vegetation can reduce the wave energy but has shown to succumb over time to high energy weather events. Armoring has been the resolution chosen for this particular project in those areas where the most direct impact has occurred and rapid erosion has taken place.

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## **Appendix A**

### **Photographs**



**Photo No. 1,** MC Cell No.1 & Nourished Area No. 4 (Plug, TV-14 Project, West end of East-West Canal)



**Photo No. 2,** Nourished Area No. 4, (Plug, TV-14 Project - West End of East West Canal Looking Northeast)





**Photo No. 3,** MC Area No. 1, (Plug tie in, TV-14 Project - West End of East West Canal Looking Southeast)



**Photo No. 4,** MC Cell No. 1, Articulated Concrete Mat (2015 Maintenance Event)



**Photo No. 5**, MC Cell No. 1, Articulated Concrete Mat (2015 Maintenance Event) & LDWF PVC Sheet Pile Wall



**Photo No. 6**, MC Cell No. 1, Viewed from the Southeast Side of the Island





**Photo No. 7**, MC Cell No. 2, Viewed from the Southeast Side of the Island



**Photo No. 8**, MC Cell No. 2, Viewed from the Southeast Side of the Island

## **Appendix B**

### **Three Year Budget Projection**

**EAST MARSH ISLAND MARSH CREATION/ TV-21 / PPL 14**  
**Three-Year Operations & Maintenance Budgets 07/01/2022 - 06/30/2025**

<u>Project Manager</u>	<u>O &amp; M Manager</u>	<u>Federal Sponsor</u>	<u>Prepared By</u>
Phillip Parker	Phillip Parker	NRCS	Jody White

	2022/2023(-11)	2023/2024 (-12)	2024/2025 (-13)
<i>Maintenance Inspection</i>			\$ 8,148.00
<i>Structure Operation</i>			
<i>State Administration</i>	\$ 2,500.00	\$ 10,000.00	\$ 7,560.00
<i>Federal Administration</i>	\$ 1,000.00	\$ 2,000.00	\$ 2,000.00
<i>Maintenance/Rehabilitation</i>			

**22/23 Description:**

<i>E&amp;D</i>	
<i>Construction</i>	
<i>Construction Oversight</i>	
<i>Sub Total - Maint. And Rehab.</i>	\$ -

**23/24 Description: Final Survey of MC Area**

<i>Survey</i>	\$ 55,000.00
<i>Construction</i>	
<i>Construction Oversight</i>	
<i>Sub Total - Maint. And Rehab.</i>	\$ 55,000.00

**24/25 Description:**

<i>E&amp;D</i>	
<i>Construction</i>	
<i>Construction Oversight</i>	
<i>Sub Total - Maint. And Rehab.</i>	\$ -

	2022/2023(-11)	2023/2024 (-12)	2024/2025 (-13)
<b><u>Total O&amp;M Budgets</u></b>	<b>\$ 3,500.00</b>	<b>\$ 67,000.00</b>	<b>\$ 17,708.00</b>

<b><u>O &amp; M Budget (3 yr Total)</u></b>	<b>\$ 88,208.00</b>
<b><u>Unexpended O &amp; M Budget</u></b>	<b>\$ 88,819.07</b>
<b><u>Remaining O &amp; M Budget (Projected)</u></b>	<b>\$ 611.07</b>



# **OPERATION AND MAINTENANCE BUDGET WORKSHEET**

EAST MARSH ISLAND MARSH CREATION / PROJECT NO. TV-21 / PPL NO. 14 / 2022/2023

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	0	\$0.00	\$0.00
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	1	\$2,500.00	\$2,500.00
FEDERAL SPONSOR Admin.	LUMP	1	\$1,000.00	\$1,000.00
SURVEY Admin.	LUMP	0	\$0.00	\$0.00
OTHER				\$0.00
TOTAL ADMINISTRATION COSTS:				<b>\$3,500.00</b>

## **MAINTENANCE / CONSTRUCTION**

### **SURVEY**

SURVEY DESCRIPTION:	Finalize Survey of Borrow Area and Project Area				
	Secondary Monument	EACH	0	\$0.00	\$0.00
	Staff Gauge / Recorders	EACH	0	\$0.00	\$0.00
	Marsh Elevation / Topography	LUMP	0	\$0.00	\$0.00
	TBM Installation	EACH	0	\$0.00	\$0.00
	OTHER				\$0.00
	TOTAL SURVEY COSTS:				\$0.00

### **GEOTECHNICAL**

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

### **CONSTRUCTION**

CONSTRUCTION DESCRIPTION:					
	Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE
	Rock Dike	0	0.0	0	\$0.00
	Bank Paving	0	0.0	0	\$0.00
		0	0.0	0	\$0.00
	Filter Cloth / Geogrid Fabric		SQ YD	0	\$0.00
	Navigation Aid		EACH	0	\$0.00
	Signage		EACH	0	\$0.00
	General Excavation / Fill		CU YD	0	\$0.00
	Dredging		CU YD	0	\$0.00
	Sheet Piles (Lin Ft or Sq Yds)			0	\$0.00
	Timber Piles (each or lump sum)			0	\$0.00
	Timber Members (each or lump sum)			0	\$0.00
	Hardware		LUMP	0	\$0.00
	Materials		LUMP	0	\$0.00
	Mob / Demob		LUMP	0	\$0.00
	Contingency		LUMP	0	\$0.00
	General Structure Maintenance (25%)		LUMP	0	\$0.00
	Vegetative Plantings		LUMP	0	\$0.00
	OTHER		LUMP	0	\$0.00
	OTHER				\$0.00
	TOTAL CONSTRUCTION COSTS:				
	\$0.00				

**TOTAL OPERATIONS AND MAINTENANCE BUDGET:** \$3,500.00

### OPERATION AND MAINTENANCE BUDGET WORKSHEET

EAST MARSH ISLAND MARSH CREATION / PROJECT NO. TV-21 / PPL NO. 14 / 2023-2024

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	0	\$0.00	\$0.00
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

STATE Admin.	LUMP	1	\$10,000.00	\$10,000.00
FEDERAL SPONSOR Admin.	LUMP	1	\$2,000.00	\$2,000.00
SURVEY Admin.	LUMP	0	\$0.00	\$0.00
OTHER				\$0.00
TOTAL ADMINISTRATION COSTS:				\$12,000.00

#### MAINTENANCE / CONSTRUCTION

##### SURVEY

SURVEY DESCRIPTION:	Survey project area			
Secondary Monument	EACH	0	\$0.00	\$0.00
Staff Gauge / Recorders	EACH	0	\$0.00	\$0.00
Marsh Elevation / Topography	LUMP	1	\$55,000.00	\$55,000.00
TBM Installation	EACH	0	\$0.00	\$0.00
OTHER				\$0.00
TOTAL SURVEY COSTS:				\$55,000.00

##### GEOTECHNICAL

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

##### CONSTRUCTION

CONSTRUCTION DESCRIPTION:	Vegetative plantings, and engineering monitoring.				
Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE	
Rock Dike	0	0.0	0	\$0.00	\$0.00
Bank Paving	0	0.0	0	\$0.00	\$0.00
	0	0.0	0	\$0.00	\$0.00
Filter Cloth / Geogrid Fabric	SQ YD	0		\$0.00	\$0.00
Navigation Aid	EACH	0		\$0.00	\$0.00
Signage	EACH	0		\$0.00	\$0.00
General Excavation / Fill	CU YD	0		\$0.00	\$0.00
Dredging	CU YD	0		\$0.00	\$0.00
Sheet Piles (Lin Ft or Sq Yds)		0		\$0.00	\$0.00
Timber Piles (each or lump sum)		0		\$0.00	\$0.00
Timber Members (each or lump sum)		0		\$0.00	\$0.00
Hardware	LUMP	0		\$0.00	\$0.00
Materials	LUMP	0		\$0.00	\$0.00
Mob / Demob	LUMP	0		\$0.00	\$0.00
Contingency	LUMP	0		\$0.00	\$0.00
General Structure Maintenance (25%)	LUMP	0		\$0.00	\$0.00
Vegetative Plantings	LUMP	0		\$0.00	\$0.00
OTHER	LUMP	0		\$0.00	\$0.00
OTHER				\$0.00	\$0.00
TOTAL CONSTRUCTION COSTS:					\$0.00

TOTAL OPERATIONS AND MAINTENANCE BUDGET: \$67,000.00

### OPERATION AND MAINTENANCE BUDGET WORKSHEET

EAST MARSH ISLAND MARSH CREATION / PROJECT NO. TV-21 / PPL NO. 14 / 2024-2025

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	\$8,148.00	\$8,148.00
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

STATE Admin.	LUMP	1	\$7,560.00	\$7,560.00
FEDERAL SPONSOR Admin.	LUMP	1	\$2,000.00	\$2,000.00
SURVEY Admin.	LUMP	0	\$0.00	\$0.00
OTHER				\$0.00
TOTAL ADMINISTRATION COSTS:				\$9,560.00

#### MAINTENANCE / CONSTRUCTION

##### SURVEY

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

##### GEOTECHNICAL

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

##### CONSTRUCTION

CONSTRUCTION DESCRIPTION:	Vegetative plantings, and engineering monitoring.				
Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE	
Rock Dike	0	0.0	0	\$0.00	\$0.00
Bank Paving	0	0.0	0	\$0.00	\$0.00
	0	0.0	0	\$0.00	\$0.00
Filter Cloth / Geogrid Fabric	SQ YD	0		\$0.00	\$0.00
Navigation Aid	EACH	0		\$0.00	\$0.00
Signage	EACH	0		\$0.00	\$0.00
General Excavation / Fill	CU YD	0		\$0.00	\$0.00
Dredging	CU YD	0		\$0.00	\$0.00
Sheet Piles (Lin Ft or Sq Yds)		0		\$0.00	\$0.00
Timber Piles (each or lump sum)		0		\$0.00	\$0.00
Timber Members (each or lump sum)		0		\$0.00	\$0.00
Hardware	LUMP	0		\$0.00	\$0.00
Materials	LUMP	0		\$0.00	\$0.00
Mob / Demob	LUMP	0		\$0.00	\$0.00
Contingency	LUMP	0		\$0.00	\$0.00
General Structure Maintenance (25%)	LUMP	0		\$0.00	\$0.00
Vegetative Plantings	LUMP	0		\$0.00	\$0.00
OTHER	LUMP	0		\$0.00	\$0.00
OTHER				\$0.00	\$0.00
TOTAL CONSTRUCTION COSTS:					\$0.00

TOTAL OPERATIONS AND MAINTENANCE BUDGET: \$17,708.00

## **Appendix C**

### **Field Inspection Form**



## MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: TV-21 East Marsh Island Marsh Creation

Date of Inspection: November 17, 2021      Time: Approximately 10:30am

Structure No. N/A

Inspector(s): Phillip Parker, Jody White (CPRA), Stan Aucoin and Glenn McNeese  
Tyson Crouch and Cody Foster (LDWF),  
Richard Evely, Carol Clement, Michael Harry and Kyle Cappotto (NRCS)

**Structure Description:** Marsh Creation Cells, Nourishment Areas, Earthen Plug

Water Level:  
Salinity Readings:  
Weather Conditions: Partly Cloudy, Breezy and Mild

Type of Inspection: Annual

[illegible]

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?

The articulated mats placed along the gulfward shoreline have settled.

The replaced rock plug has settled slightly in the center.

N/A

N/A

