State of Louisiana

Coastal Protection and Restoration Authority of Louisiana (CPRA)

2013 Operations, Maintenance, and Monitoring Report

for

East Marsh Island Marsh Creation

State Project Number TV-21
Priority Project List 14

June 2013
Iberia Parish

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For
East Marsh Island Marsh Creation (TV-21)

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Preface

This report includes monitoring data collected through December 2012, and annual Maintenance Inspections through May 2013.

The 2013 report is the 1st report in a series of reports. Reports will be produced every three years during the 20 year economic life of the project.

I. Introduction

The East Marsh Island Marsh Creation Project (TV-21) was proposed on the 14th 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^3 (2,933,000 m^3) 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.

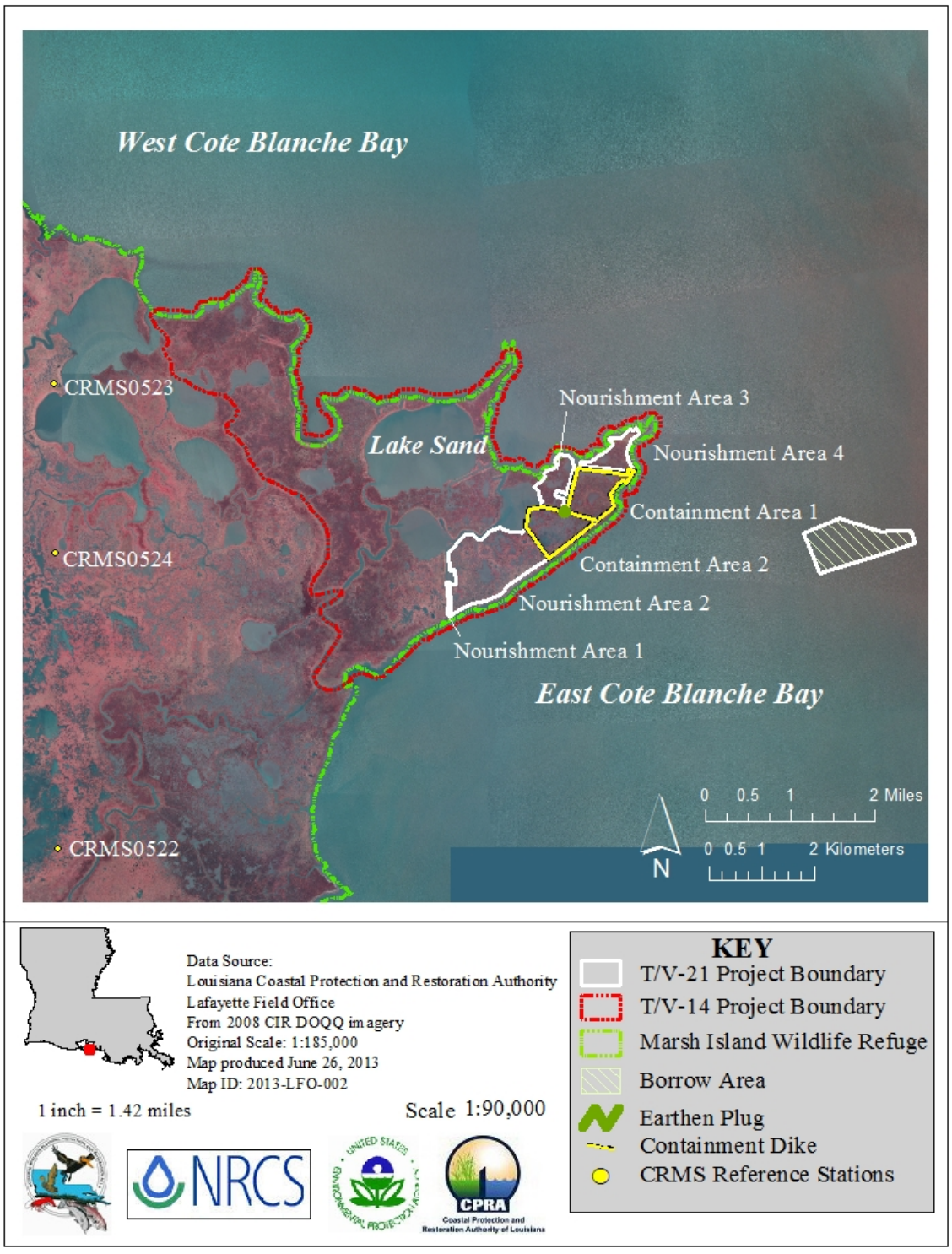

Figure 1. East Marsh Island Marsh Creation (TV-21) project boundary and project features**.**

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 B. 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 June 6, 2013 under partly cloudy skies, scattered showers, mild temperatures, and calm seas. In attendance were Darrell Pontiff, Mark Mouledous, and Jody White from CPRA, Cassidy Lejeune from LDWF, Adrian Chavarria from EPA, and Cindy Steyer, Macandol Parker, and Justin Meaux from NRCS. Parties met at the Quintana Boat launch at Cypremort Point and traveled to the Northeast corner of Marsh Island. The annual inspection began at the North-South Canal near Marsh Creation Cell No. 1.

The field inspection included a visual inspection of the project site. Staff gauge readings were not available to determine approximate elevations of water level; however, it was observed that there were higher than normal levels. In addition, NOAA tide data indicated higher than predicted water levels at the Amerada Pass station by as much as one foot increase at high tide. Photographs were taken at each project feature (see Appendix A) and Field Inspection notes were completed in the field to record measurements and deficiencies (see Appendix C).

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b. Inspection Results

<u>Site 1—Marsh Creation Cells (Fill Areas No. 1&2)</u>

The two marsh creation cells are in good condition since the project was completed in 2010. (Photos: Appendix B, Photo 1, 4, 5 & 7) It is estimated that there is seventy per cent (70%) natural vegetation cover despite the large nutria population. The one year post construction surveys completed by T. Baker Smith in December 2011 indicated

that the marsh platform is settling as expected and is near the target healthy marsh elevation of +1.7 NAVD88 on average. The northern end of the Marsh Creation Cell No. 1 appears to be settling at a greater pace than the remainder of the cell. The majority of the containment dikes are stable and the natural vegetation continues to expand. However, there are two areas of concern which are in need of repair. They are identified by orange ovals in Appendix B, Photo No. 7. One location is along the North-South Canal at its intersection with the East-West Canal adjacent to the rock plug. The second is on the Gulf ward shoreline near the East-West Canal. These areas are experiencing erosion at a fairly rapid rate. (Photos: Appendix B, Photo 2-3 & 7-9)

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

The vegetation in Nourished Areas No. 3 & 4 appears to be in good condition. (Photos: Appendix B, Photo 5) Nourished Areas No. 1 & 2 were not visited during this inspection. However, site visits performed by CPRA monitoring staff indicate that the vegetation in Nourished Area No 2. has been drastically affected by nutria damage.

The December 2011 survey data from T. Baker Smith indicated that the marsh platform was settling as follows: Area No. 1 + 0.54, Area No. 2 +0.92, Area No. 3 +1.11, and Area No. 4 +1.04. Site visits in 2012 by Louisiana Wildlife and Fisheries have identified four interior plugs which need to be cut to allow water exchange.

Site 3—Earthen Plug

The earthen plug at the end of the North-South Pipeline Canal is holding up well with no differential settlement taking place. There are some bare spots remaining where vegetation has not taken hold. (Photos: Appendix B, Photo 6)

Site 4—Vegetation plantings

NRCS prepared plans and specifications to install 55,000 vegetative plants (five different species) which was bid in December 2010, awarded in January 2011, and mobilization to the project site on July 2011; however, only 3,257 plants were actually installed before the contractor defaulted on the project. No further planting project was pursued within the two Marsh Creation Cells No. 1 & 2 such that the natural vegetation was flourishing. NRCS is currently looking at planting a woody species on the remnant containment dike. (Photos: Appendix B, Photo 1 &4)

c. Maintenance Recommendations

i. Immediate/ Emergency Repairs

Repair and armor the two areas of erosion at each end of the East-West Canal located on the North boundary of Marsh Creation Cell No. 1. These breaches

in the containment dike will allow the exchange of gulf water into an interior oilfield canal making the northeast corner of the project vulnerable to deterioration.

ii. Programmatic/ Routine Repairs

- Perform the planned gap degrading at the Timber Mat location and Gap "N" in the Marsh Creation cell No. 2 containment dike to allow tidal exchange into that cell.
- Degrade four existing plugs left by the contractor in the interior marsh of Nourishment Area No. 1 and Nourishment Area No. 2 to allow drainage and prevent stagnation.
- NRCS will re-evaluate the vegetation on the containment dikes for a potential Spring 2015 planting (woody species) for those reaches which are bare.

d. Maintenance History

General Maintenance: Below is a summary of completed maintenance projects and operation tasks performed since July 2011, the construction completion date of the East Marsh Island Marsh Creation Project.

None as yet required.

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

a. Monitoring Goals

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.

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 2020. 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 Teche/Vermilion basin was acquired in 2005, 2008, and 2012.

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). CRMS 523 was selected to be the hydrologic reference site. At each servicing, 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 5 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^2 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 and 2012 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. Monitoring will continue in the fall of 2013 and 2015.

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 will be collected again in 2015, 2020, and 2030. Soil cores were only collected at the nearby CRMS

sites during station establishment in 2005-2007. The sampling in 2011 will be presented for the project sites in this report.

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 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. Currently, data have not been collected over enough time (5 years) to calculate viable rates for the project area; therefore, elevation change for these sites is not included in this report.

Borrow Area (Dissolved O_2)

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 occured in the borrow area during the refill period. Monitoring was performed in years 2011 and 2012, and will be performed again in 2013 and 2015 unless prior refill of the borrow area occurs. 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-1) 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.

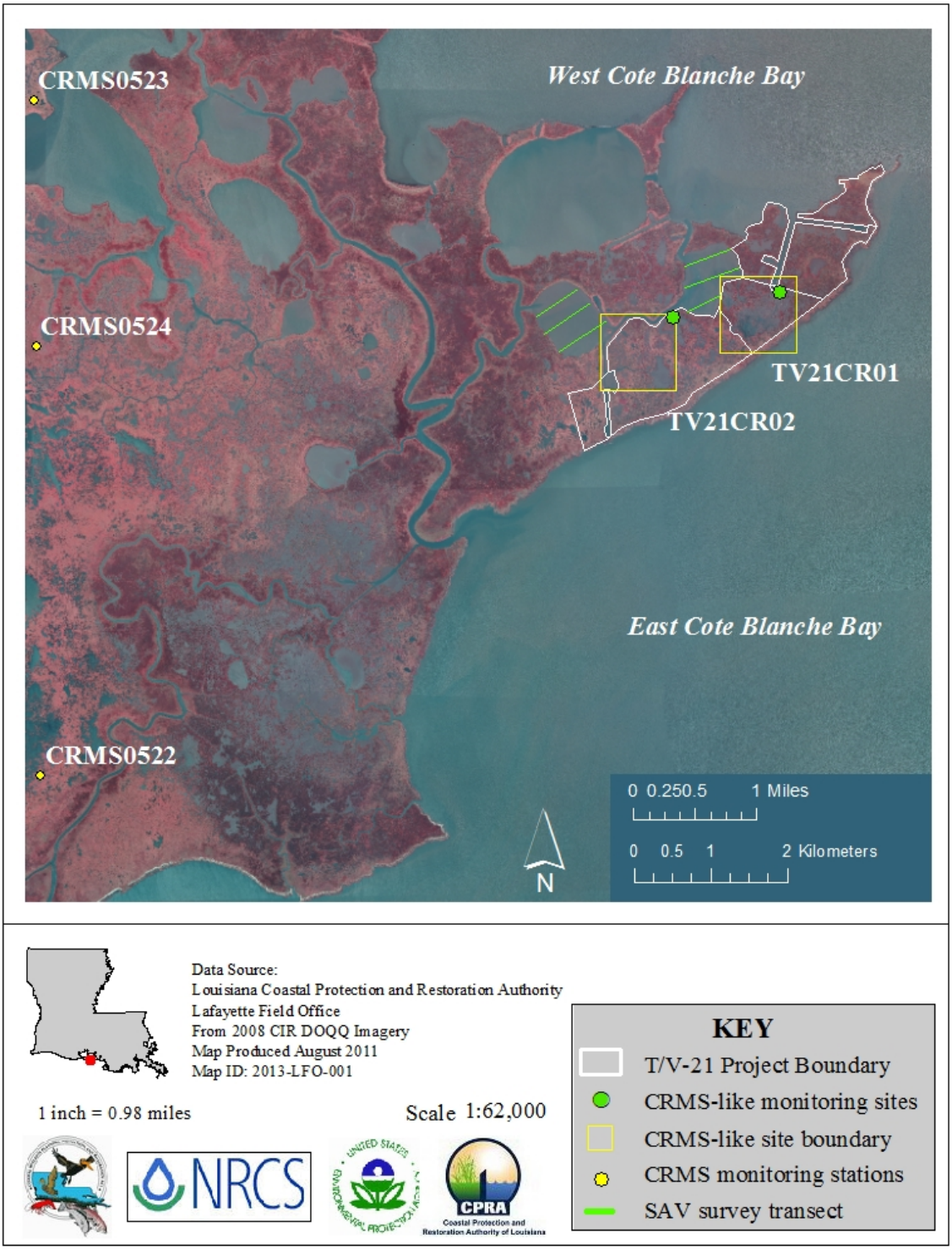

Figure 2. Location of CRMS-like monitoring sites within the East Marsh Island Marsh Creation (TV-21) project area, SAV transects and nearby CRMS sites to be used for comparison.

IV. Monitoring Activity (continued)

c. Preliminary Monitoring Results and Discussion

Aerial Photography

Post-construction land/water analysis was completed for the 2012 aerial photography (figure 3). Results indicated 89.13% land and 10.87% water within containment area 1, 91.01% land and 8.99% water within containment area 2, and 85.31% land and 14.69% water within the nourishment areas. Future analysis will help to determine the project's effect on land change.

Salinity

Recorders were deployed in the project area in late November of 2011. Salinities in the project and reference areas were very low (less than 5 ppt) through May of 2012 (figure 4a). Several spikes in salinity occurred in the late spring/early summer which elevated salinities in the project area, but otherwise, salinities remained below 10 ppt until Hurricane Isaac made landfall in late August. Even though the storm made landfall near the mouth of the Mississippi River, salinities during this event still rose above 25 ppt in the project area. By mid-September, salinities dropped down to below 15 ppt.

Average weekly salinities were compared between the project stations to determine if a difference in salinity occurred between the two. A non-parametric one way median analysis showed that salinities were not statistically different across the period of record between TV21CR01 and TV21CR02 (x^2=1.365, p=0.243). This same test also showed there was not a significant difference between salinities in the project area recorders and the recorder at the reference station CRMS0523 (x^2=0.132, p=0.72).

Means by month of interstitial water salinity for the project stations and CRMS reference stations 522, 523 and 524 are presented in figures 4b and 4c. Salinities at all stations remained below 10 ppt the majority of the time through both 2011 and 2012. Near the end of 2012, salinities at stations TV21CR02 and CRMS stations 522 and 523 rose slightly at both the 10 and 30 cm levels, but remained below 15 ppt. The project area is under the influence of the Atchafalaya River and Wax Lake Outlets, and much of the dredging activity occurred in the spring of 2010, which was an unusually long flood period for the Mississippi and Atchafalaya Rivers. This may have buffered the salinity of the sediment slurry that was deposited into the nourishment and containment areas and helped to prevent hypersaline conditions from forming.

Water Level

Water levels were nearly identical in both project sites and CRMS0523, differing only during extreme low water events, such as the landfall of Hurricane Isaac (figure 5a). A non-parametric one way median analysis determined there was not a significant difference in water

level between the two project sites (x^2=0.042, p=0.837) nor between the project and reference site CRMS0523 (x^2=1.094, p=0.296).

TV21CR02 and CRMS0523 both scored high on the Hydrologic Index (93 and 89, respectively), while TV21CR01 only had an HI score of 58 (figures 5b – 5d). Though the 3 sites had very similar annual salinities and water levels, TV21CR01 has a higher marsh elevation, resulting in a much lower percent time flooded then the other two stations and thus a lower HI score.

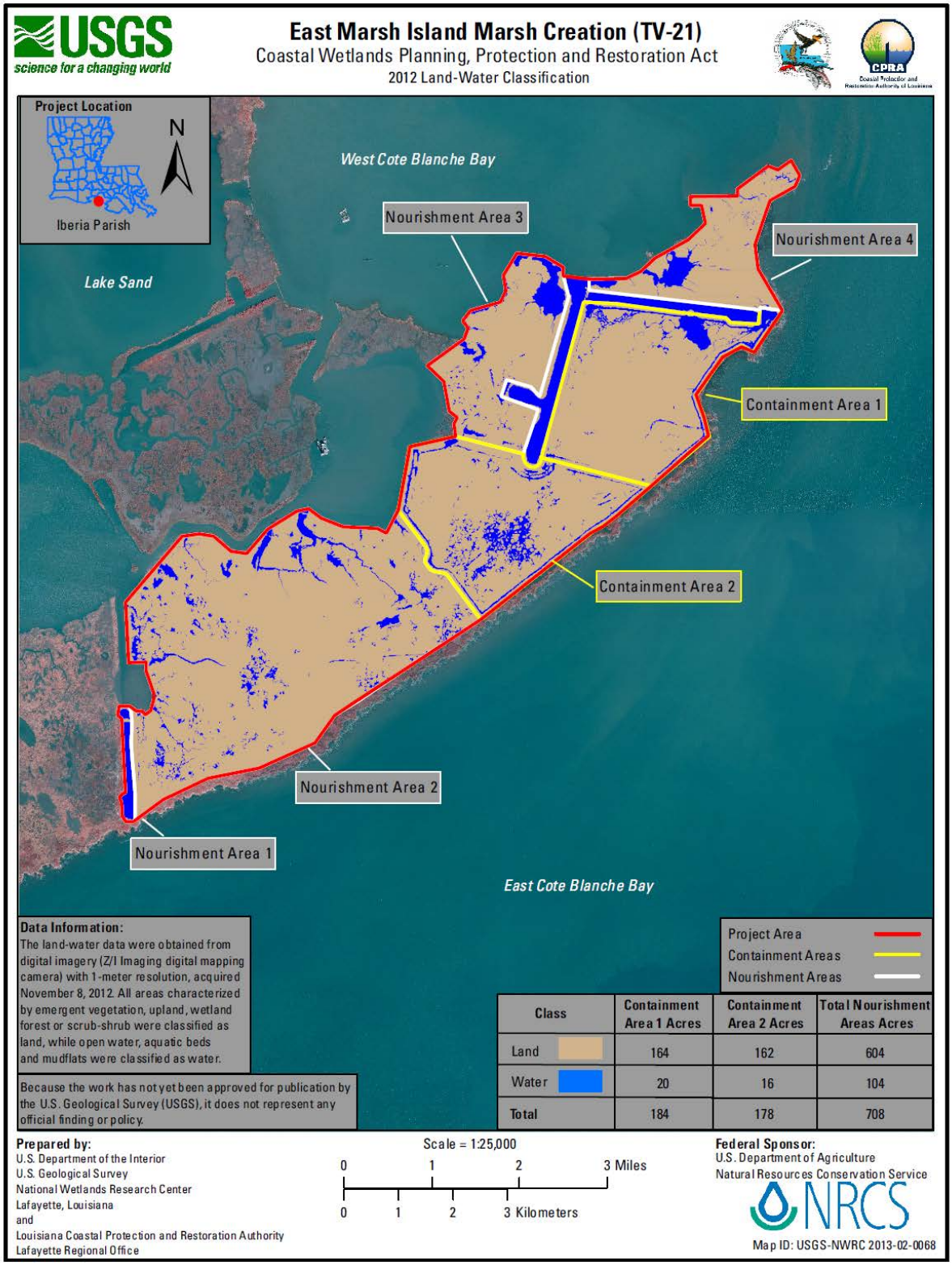

Figure 3. East Marsh Island Marsh Creation (TV-21) project 2012 land/water analysis.

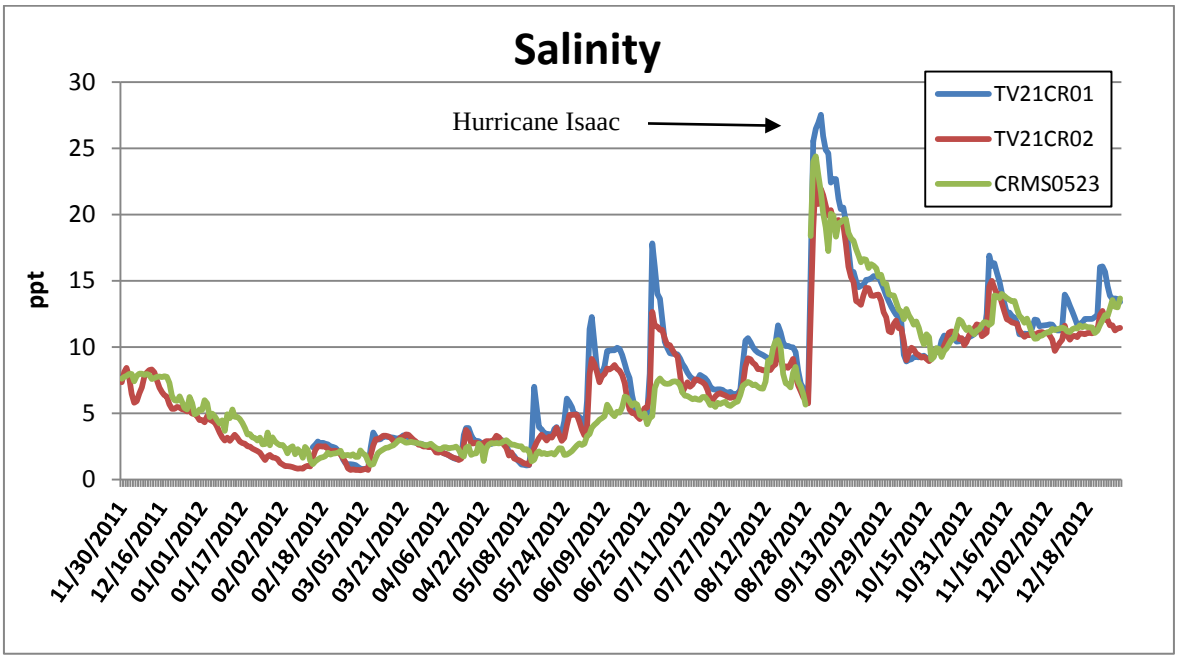

Figure 4a. Daily means of salinity data collected at project and CRMS reference sites.

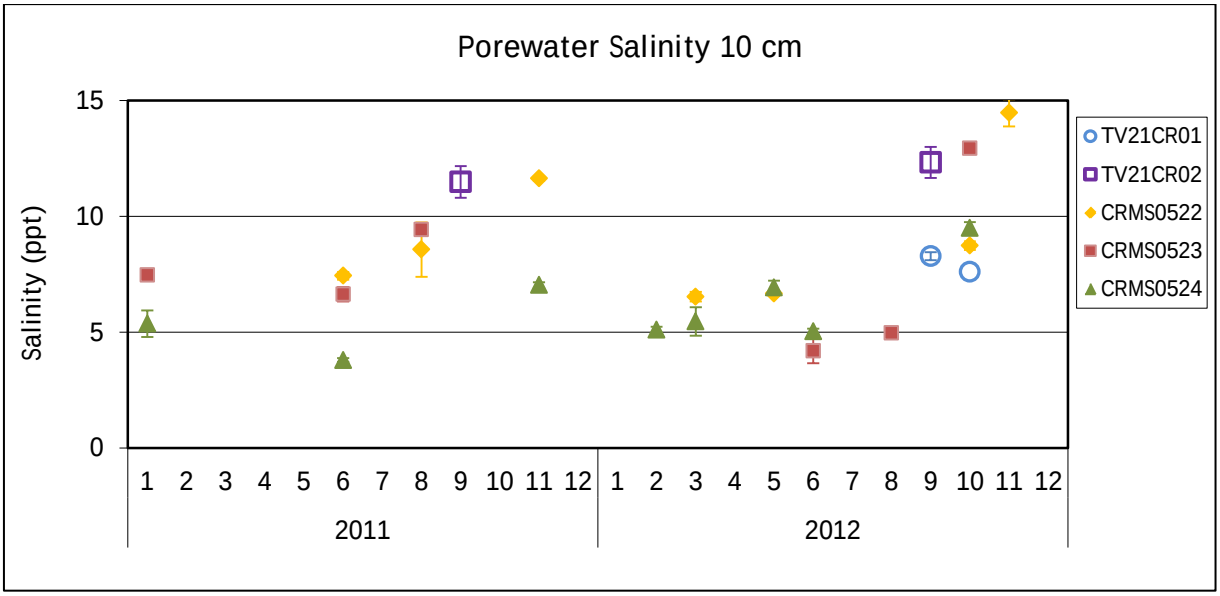

Figure 4b. Interstitial water salinity at 10 cm below the soil surface. Error bars, where present, represent the means of stations for that month ± 1 Std. Err.

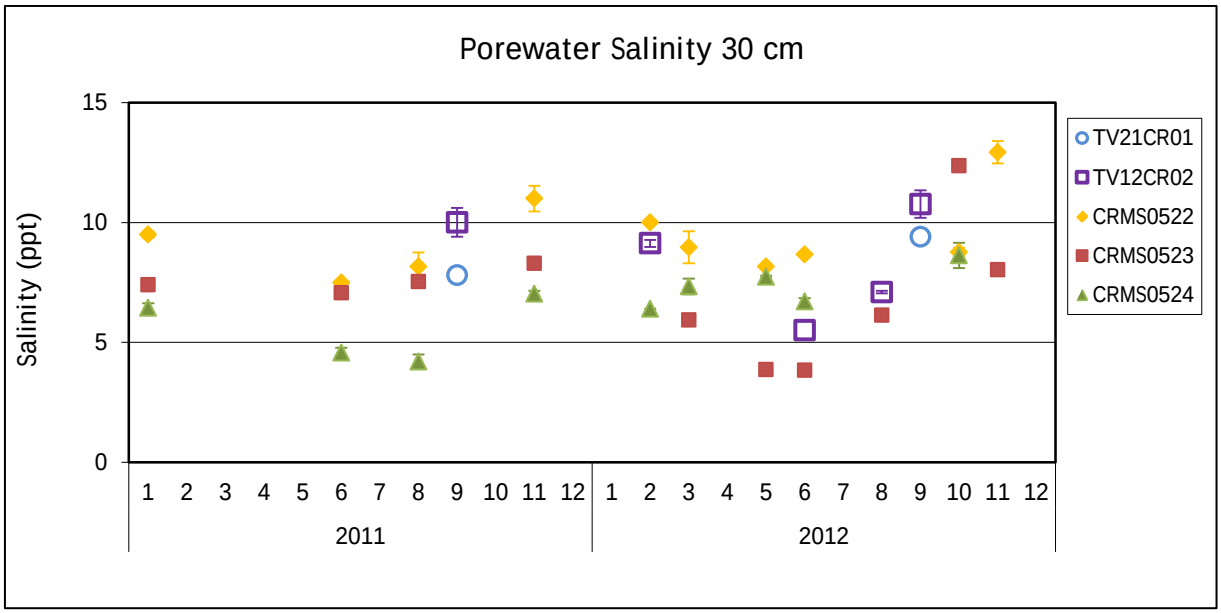

Figure 4c. Interstitial water salinity at 30 cm below the soil surface. Error bars, where present, represent the mean of stations for that month ± 1 Std. Err.

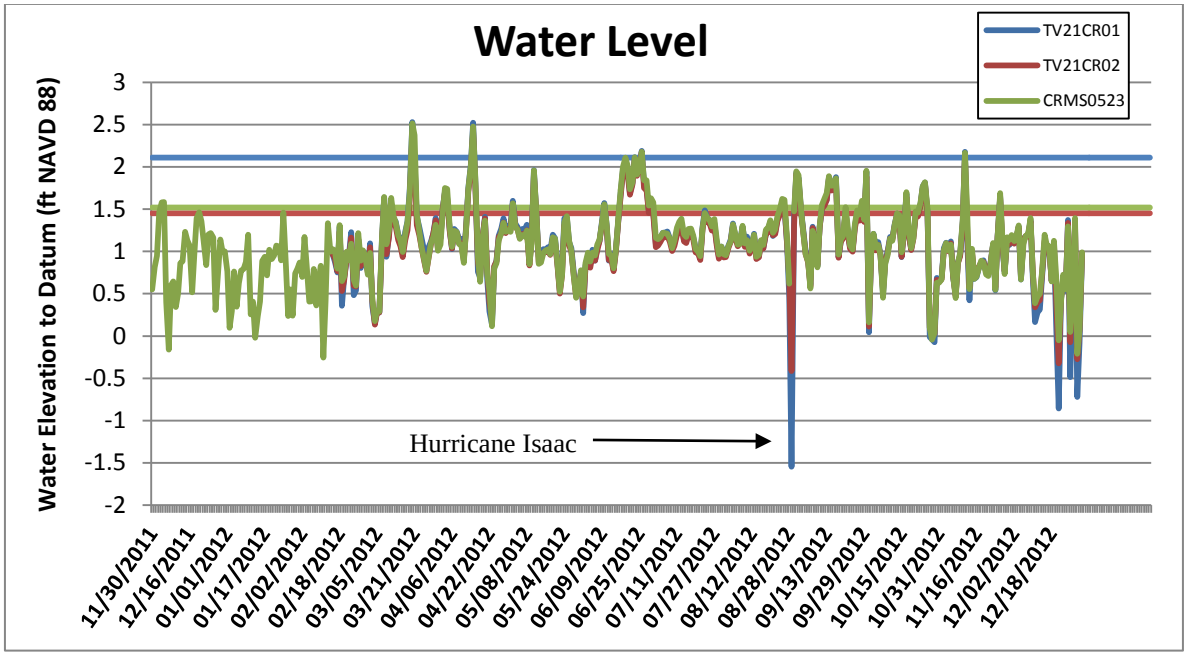

Figure 5a. Daily means of water level data collected and marsh elevations at project and CRMS reference sites.

*The associated marsh elevation of each station is shown as a straight line in the same color as the daily means for that station.

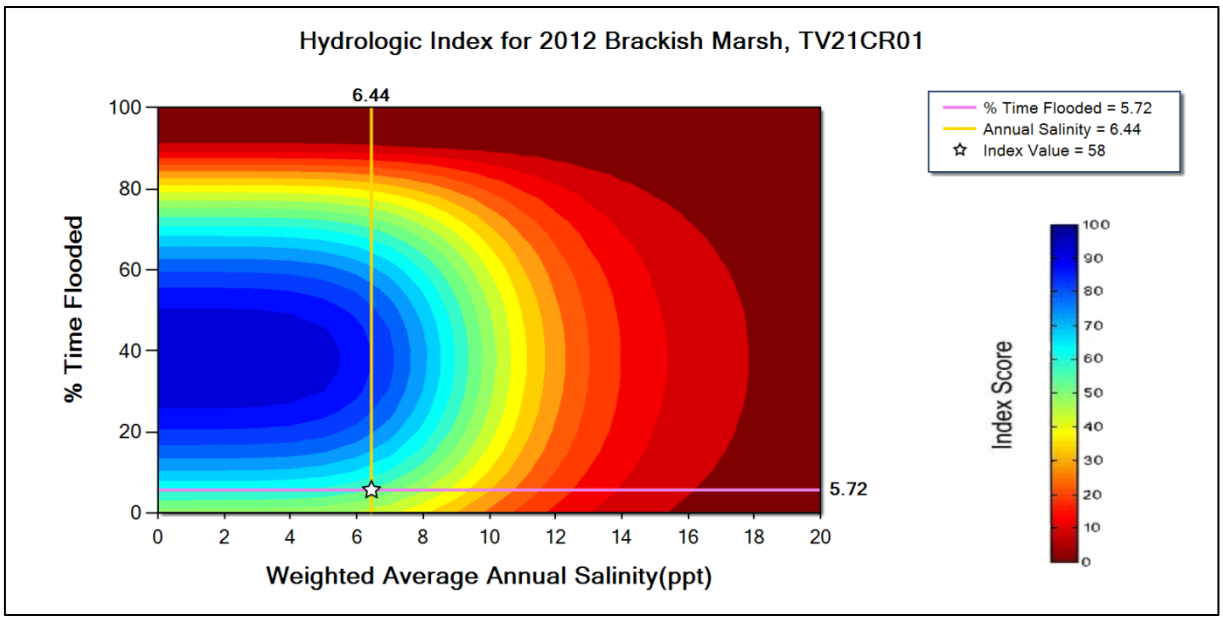

Figure 5b. Hydrologic index score for TV21CR01 based on the combined influences of average annual salinity (horizontal axis) and flood duration (vertical axis).

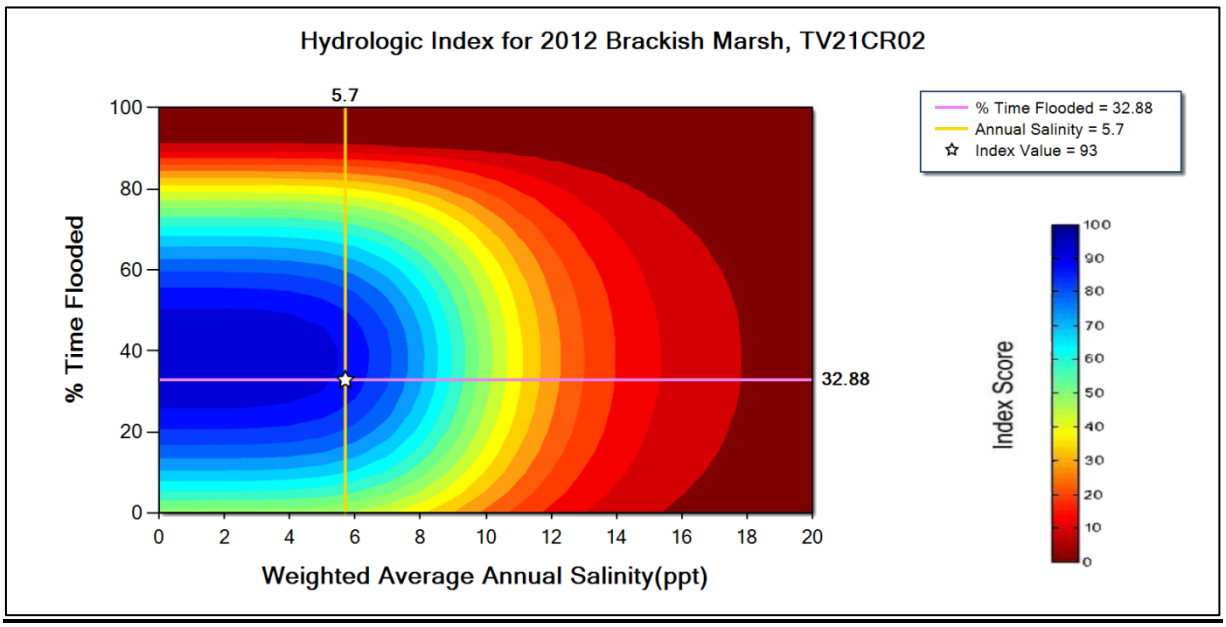

Figure 5c. Hydrologic index score for TV21CR02 based on the combined influences of average annual salinity (horizontal axis) and flood duration (vertical axis).

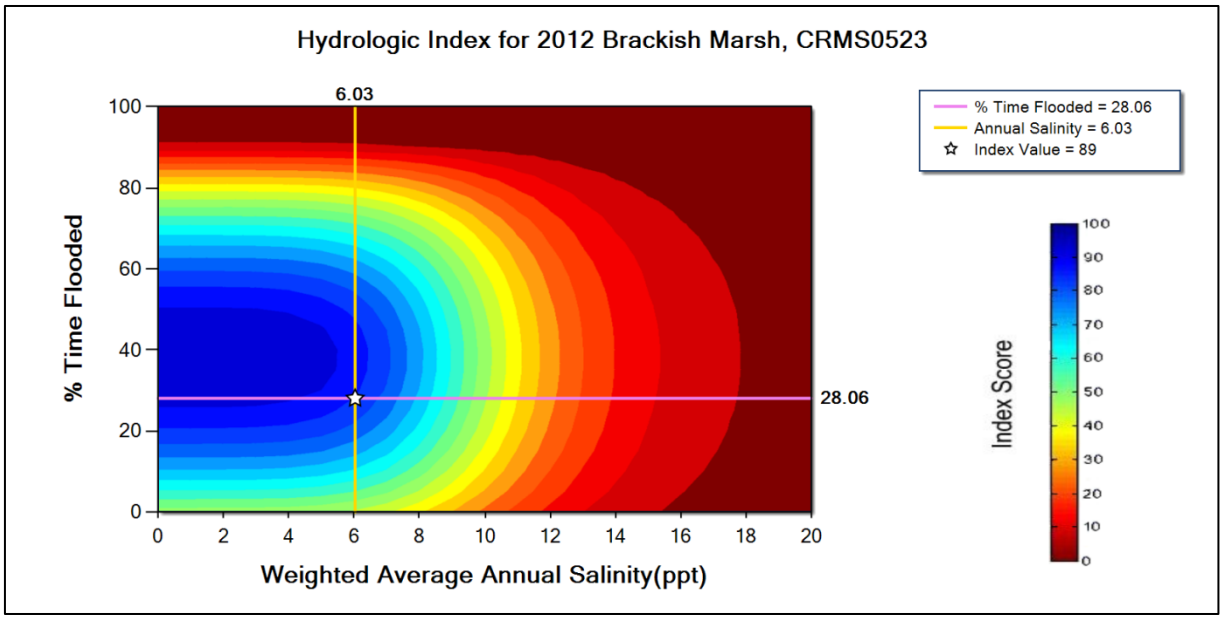

Figure 5d. Hydrologic index score for CRMS0523 based on the combined influences of average annual salinity (horizontal axis) and flood duration (vertical axis).

Emergent Vegetation

Containment area 2 had begun to vegetate by late summer of 2011 (TV21-CR01) and increased in cover to near 50% by 2012 (figure 6a). Vegetation in nourishment area 2 (TV21-CR02) was doing quite well in the first year after construction, but declined drastically in both cover and FQI in 2012 due to heavy hervivory damage from nutria. By 2012, the nutria had eliminated almost all of the *Schoenoplectus americanus* (a preferred food source) and *Spartina alterniflora* from the area, which were dominant species in the 2011 survey. Minor herbivory was noted in containment area 2, but the nutria weren't as prolific as in the nourishment area. This could be due to a smaller percentage of *S. americanus*.

Vegetation at the reference stations has been stable since 2008, with cover values above 70% through most years sampled prior to 2012 (figures 6b – 6d). Like the project sites, nutria have done considerable damage to the CRMS reference sites as well, with the largest impacts to *S. americanus* and *Spartina patens*.

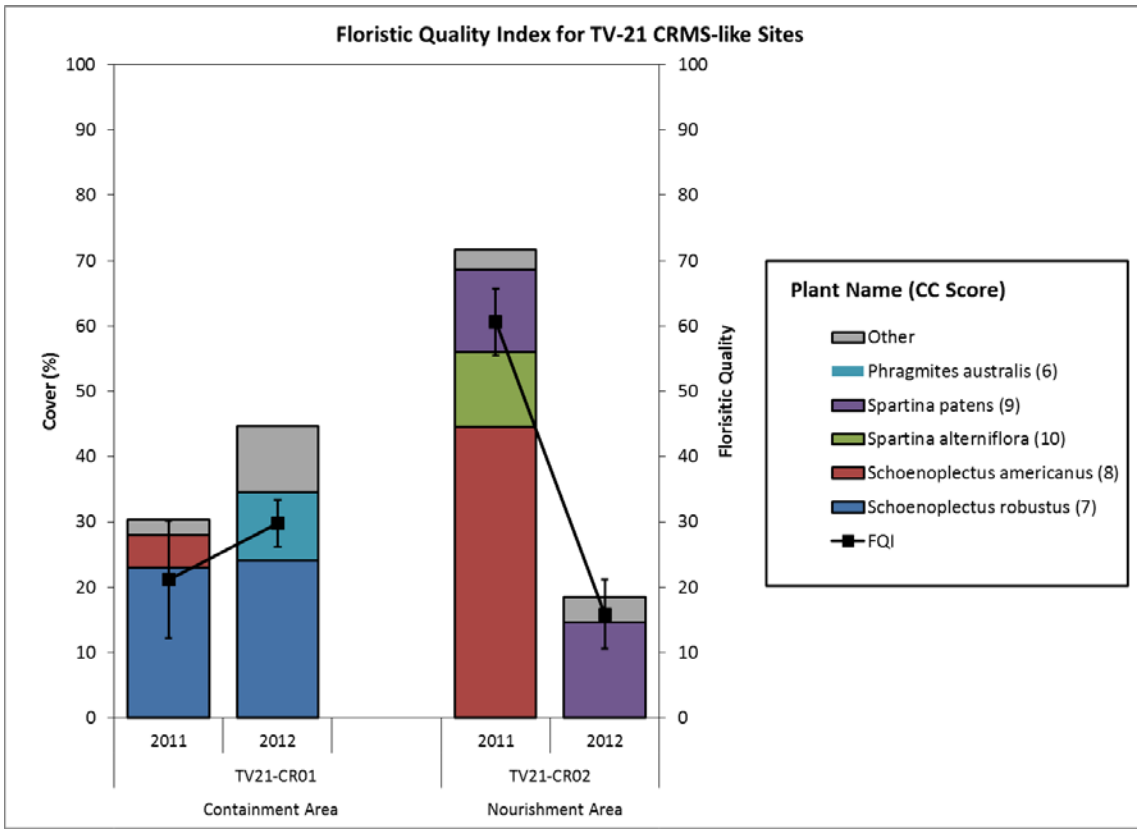

Figure 6a. Percent coverage and floristic quality index of species collected from stations TV21-CR01 and TV21-CR02 within the project area in years 2011 and 2012. The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stability.

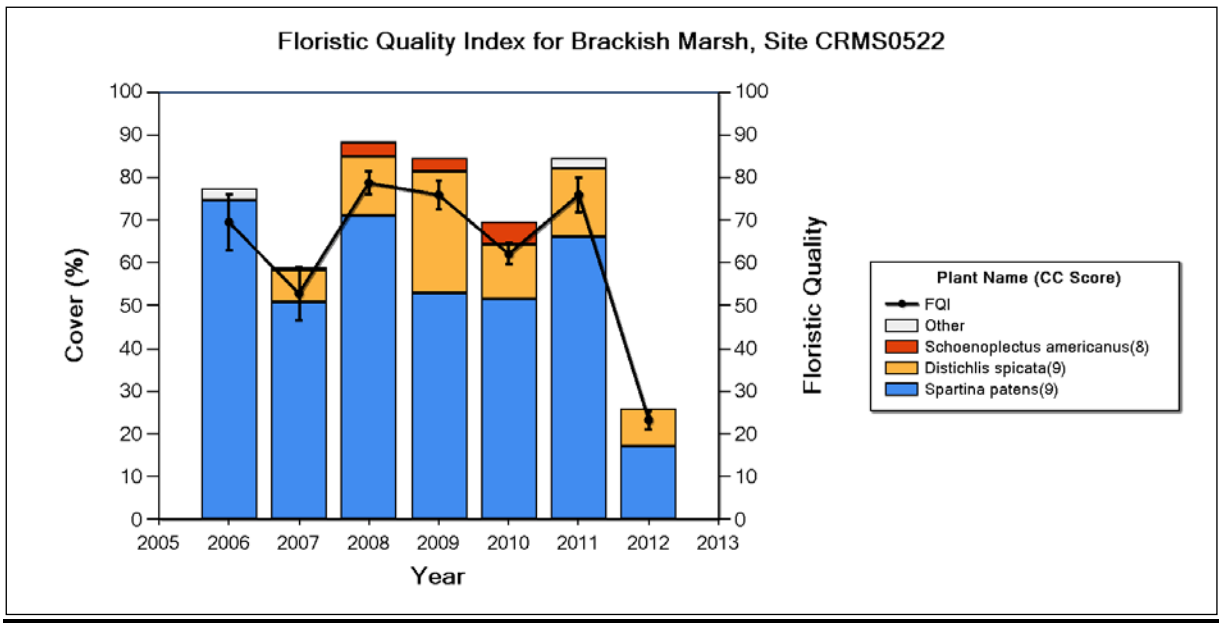

Figure 6b. Percent coverage and floristic quality index of species collected from CRMS reference site 522 in years 2006 - 2012. The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stability.

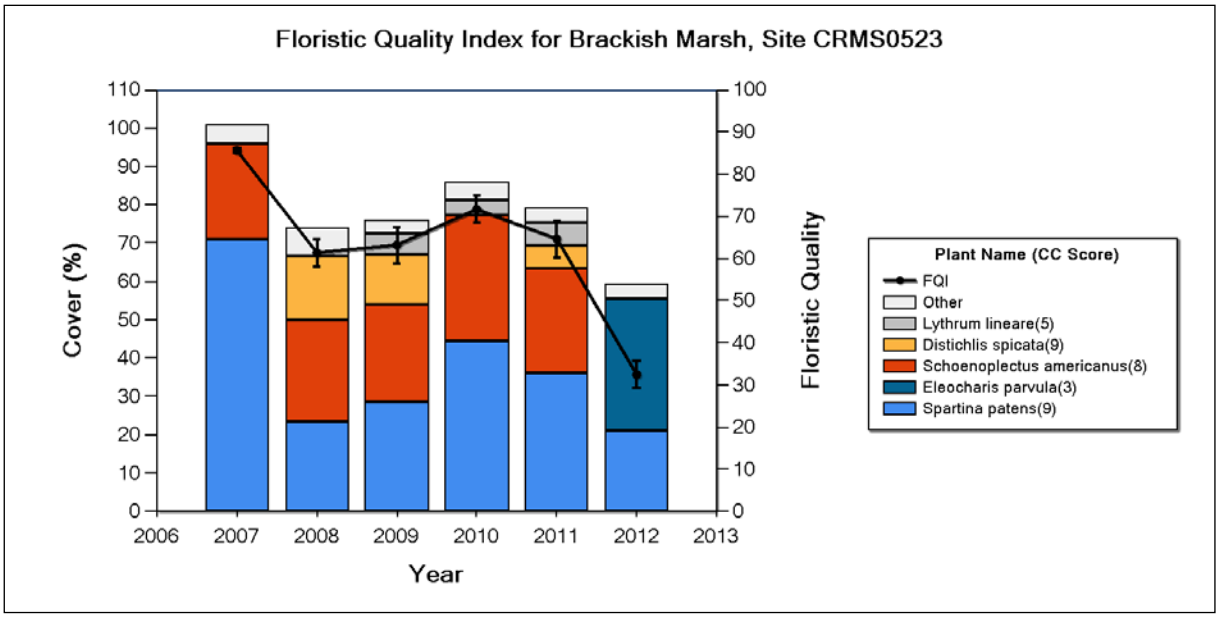

Figure 6c. Percent coverage and floristic quality index of species collected from CRMS reference site 523 in years 2007 - 2012. The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stability.

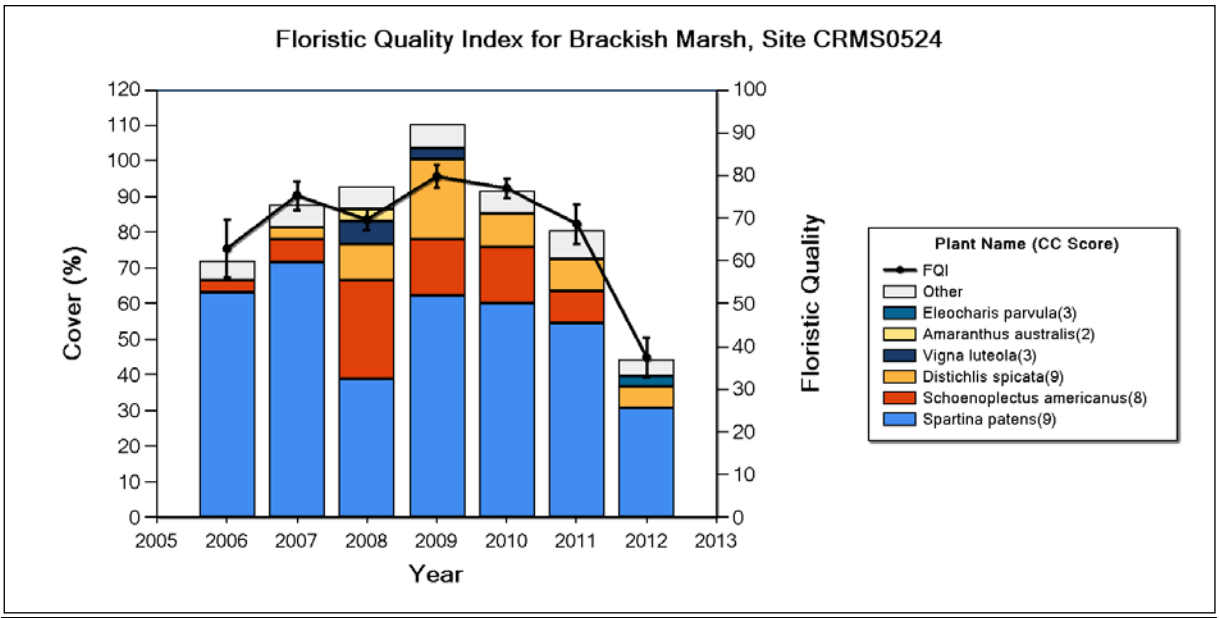

Figure 6d. Percent coverage and floristic quality index of species collected from CRMS reference site 524 in years 2006 - 2012. The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stability.

Vegetation Plantings

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 (figure 7). Dr. Utomo was able to identify clumps of thriving *S. alterniflora* from the trial in September 2011, based on plant type, stem color, plant height and heading time, indicating that the seedings were successful.

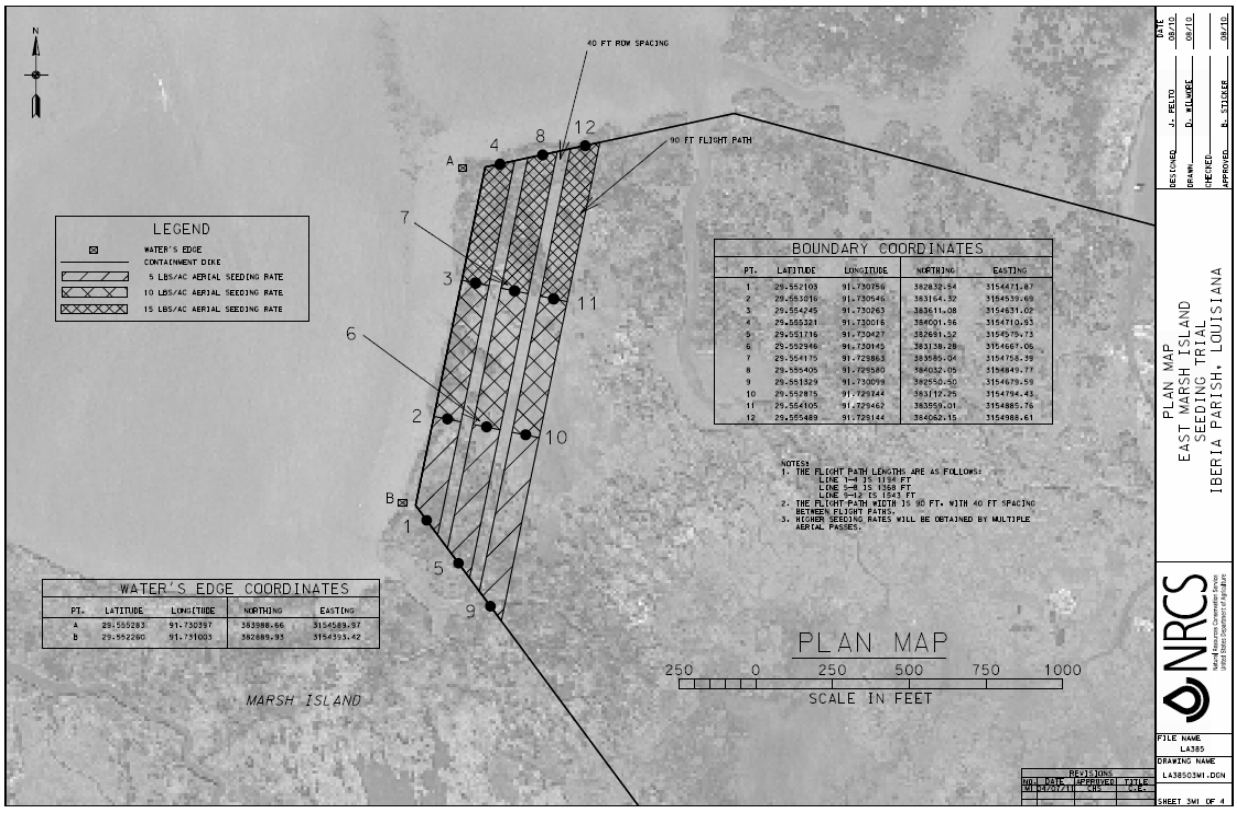

Figure 7. Dr. Herry Utomo's aerial seeding plan to test different application rates of Poly C15 *Spartina alterniflora.*

Submerged Aquatic Vegetation (SAV)

The initial post-construction SAV sampling survey was performed on September 20, 2012. A total of 6 transects in two ponds (3 each) near the project area were sampled as described in the monitoring elements section. There were 40 samples collected per transect. Average pond depth was 0.4 ft. No SAV were present at any sampling station. The absence of SAV could be due to the shallow pond depth, as the ponds could become mudflats at low tides as well as the effects of wind, which could cause high turbidity. This turbidity could reduce light levels in the ponds, inhibiting SAV growth. The absence of SAV could also be related to yearly variations caused by climate, although SAV populations have been very low as well in the surrounding TV-14 project and reference areas in recent years.

Soil Properties

Soil samples were collected in each of the containment and nourishment areas, except nourishment area 1, on 9/28/11 and 2/7/12 (figures 8a and 8b). The soil properties data were sampled in 4 cm increments.

As would be expected, higher bulk densities occurred in both containment areas, due to the high mineral content of the spoil, which was deposited more heavily in the containment areas. The higher bulk density at NA2, which was collected from the southern end of nourishment area 2 near the gulf shoreline, was probably due to overwash events from the gulf which deposited new mineral material. Percent organic matter (OM) was slightly higher in the lower half of the cores in the nourishment areas, but was still less than 20%, possibly due to leaching of mineral sediments from the dredge material. OM was less than 10% throughout the entire profile in the containment area soils and NA2.

For comparison, figures for mean bulk density and percent organic matter at the 3 reference CRMS sites are presented in figures 8c and 8d. Bulk density profiles were similar for all 3 sites and were less than the project area sites (<0.3 g/cm^3). The reference CRMS sites were also much more organic than the project area sites. CRMS site 524, located in the interior of marsh island, had the highest organic matter content out of the 3 sites (~50% at 4-20 cm).

For the most part, pH readings were slightly basic throughout all of the soil profiles in the project area (figure 8e). The soils in the upper 8 inches of the cores at TV21CR02 (located in nourishment area 2), were slightly acidic, but still acceptable for vegetation establishment.

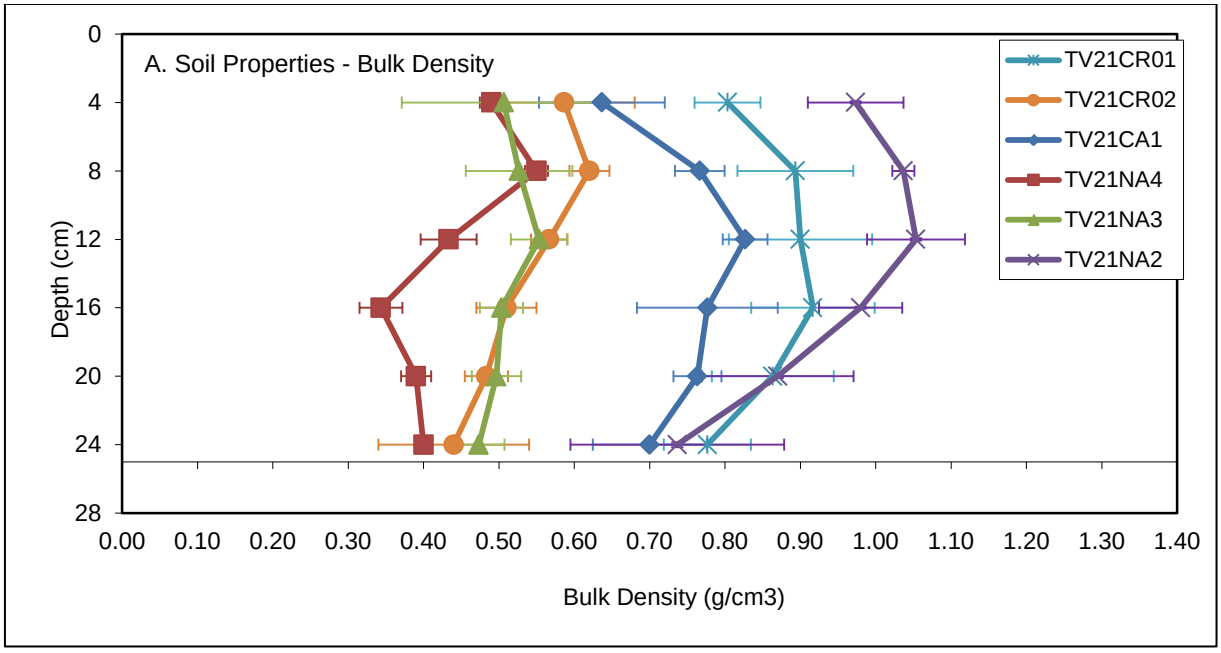

Figure 8a Mean ± 1 Standard error of soil bulk density for project sites.

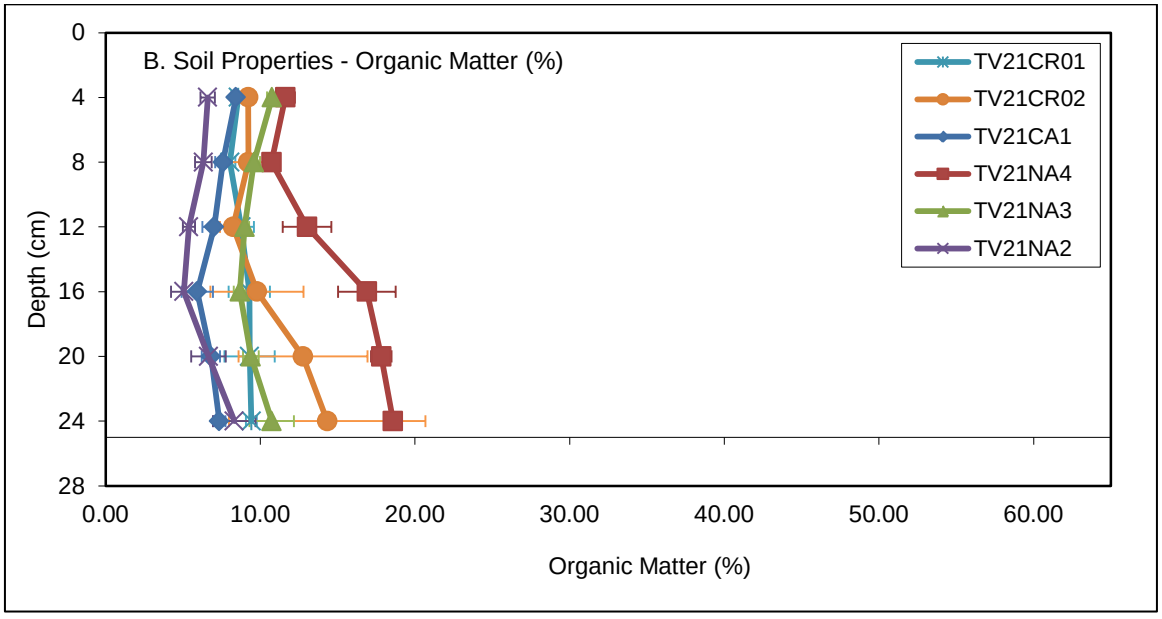

Figure 8b. Mean ± 1 Standard error of soil organic matter collected at project sites.

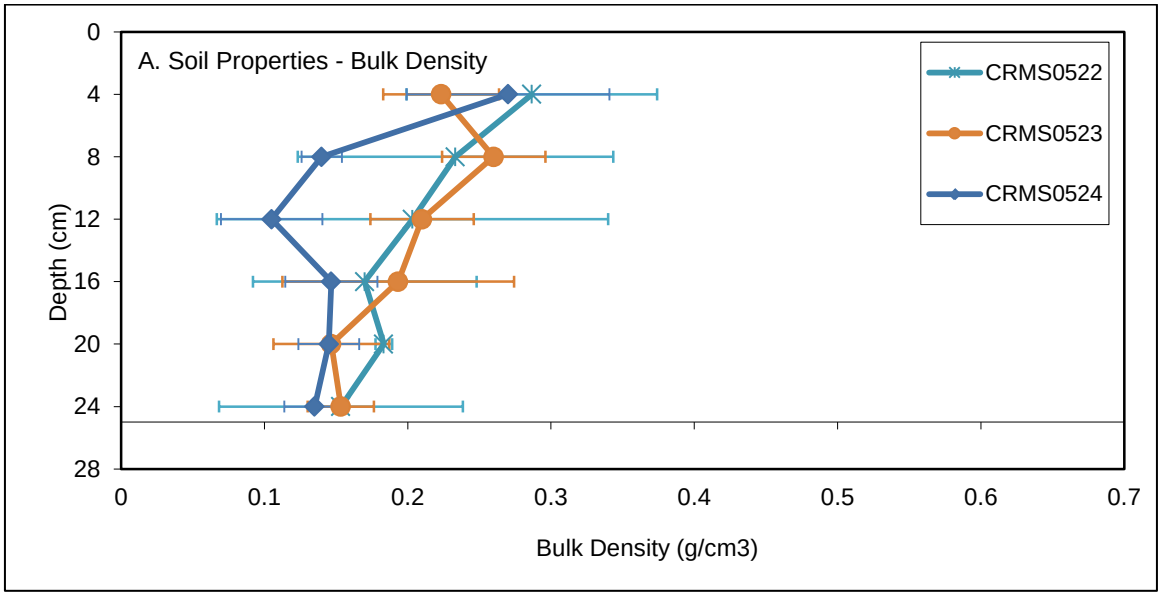

Figure 8c. Mean ± 1 Standard error of soil bulk density collected at reference CRMS-*Wetlands* stations.

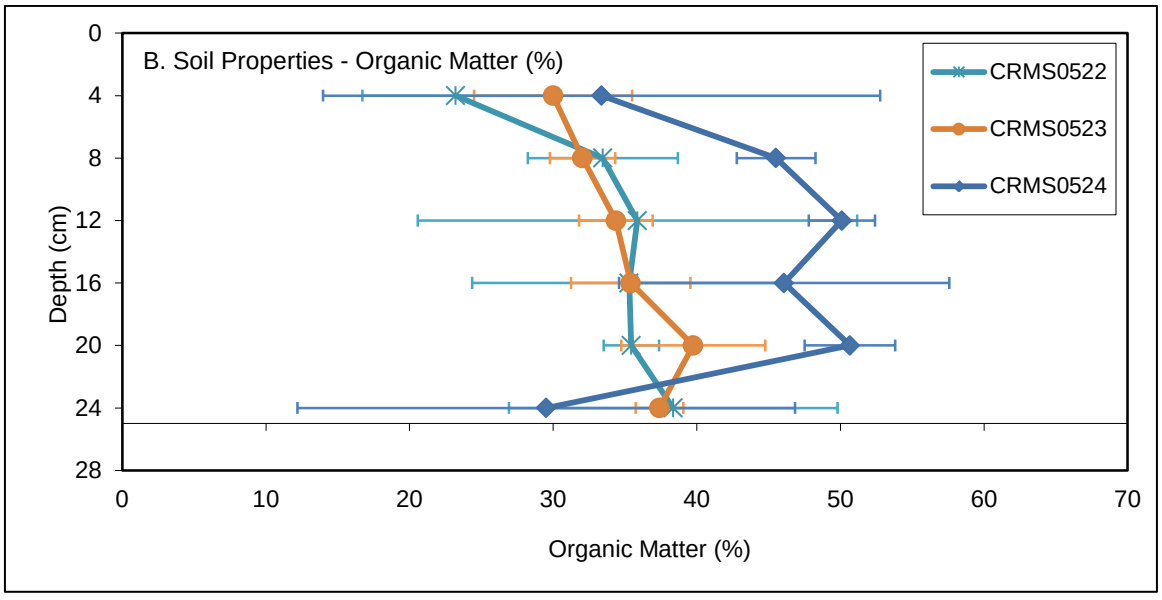

Figure 8d. Mean ± 1 Standard error of soil organic matter collected at reference CRMS-*Wetlands* stations.

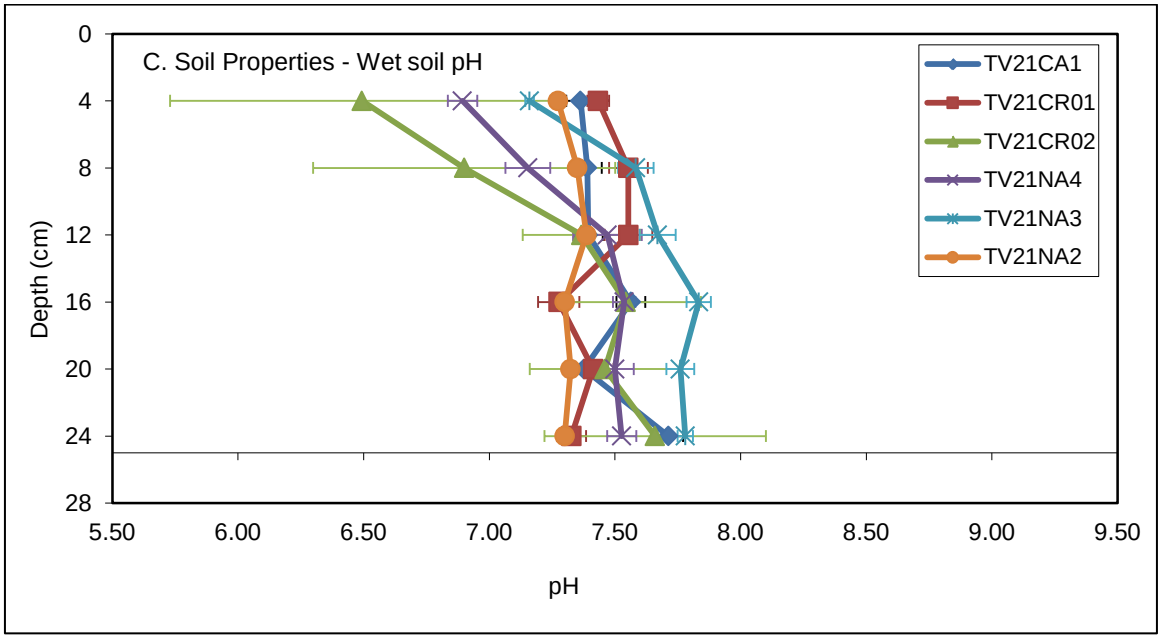

Figure 8e. Mean ± 1 standard error of soil pH collected at project sites.

Borrow Area (Dissolved O_2)

Dissolved oxygen levels were monitored in the borrow area and a reference area, just outside of the borrow area, in July through September 2012 (figure 9). Data was not collected in 2011 due to an equipment malfunction. A non-parametric one way median analysis was run to compare the 2012 data from both areas. It was found that dissolved oxygen levels were significantly lower in the borrow area than the reference area, particularly during the beginning of the sampling period (x^2=10.54, p=0.0012). Slightly higher water temperatures were recorded during the beginning of the sampling period, when compared to mid-August through September which may have caused this effect. Hypoxic conditions <2 mg/L) did not occur in either area, though. The lowest dissolved oxygen levels occurred on July 28 in the borrow area and were 2.24 mg/L. The post-construction surveys completed in March 2012 showed significant infilling of the borrow area during the first year since construction.

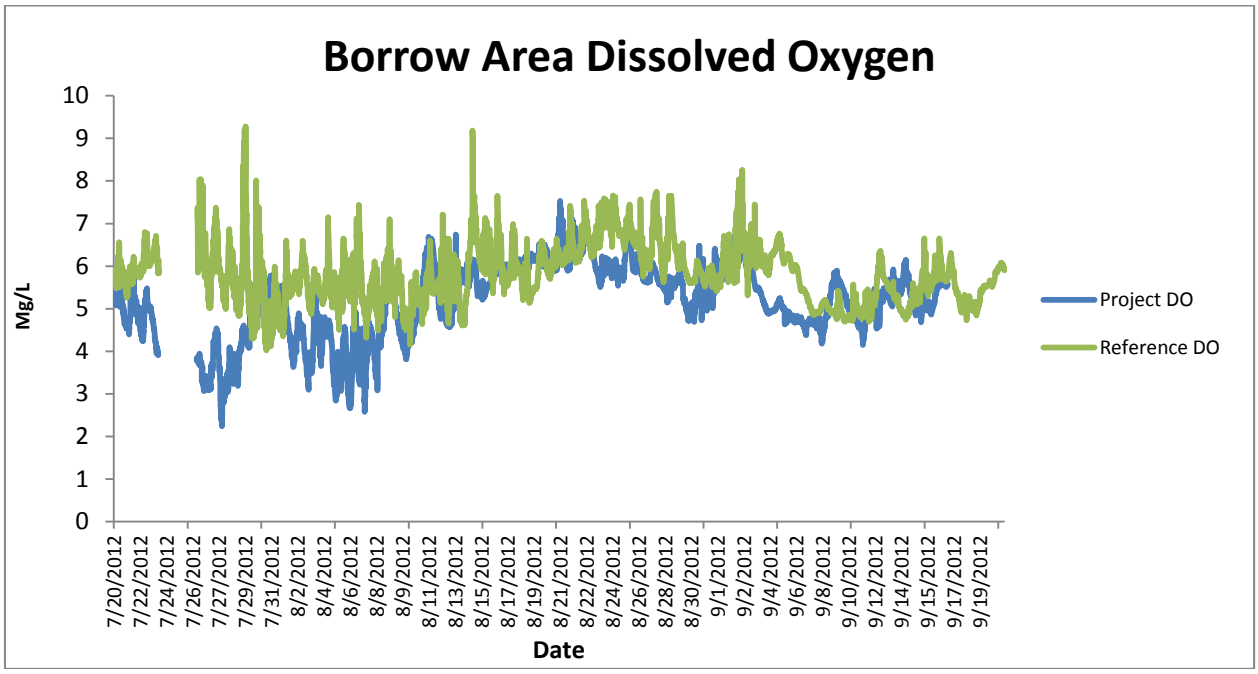

Figure 9. Dissolved oxygen levels (Mg/L) in the TV-21 borrow and reference areas from July-September 2012.

V. Conclusions

a. Project Effectiveness

The project has met the objectives of creating 362 acres of emergent marsh and creating/nourishing 797 acres of brackish marsh based on analysis on 2012 photography. Future analyses will allow us to determine if the project is meeting the objective of reducing the marsh loss rate by 50%.

Salinity levels in the project area remained within the targeted intermediate to brackish range in both surface and interstitial water readings. Water levels in the project area did not differ from reference area water levels, but the containment area had a lower percent time flooded than the reference area due to a higher marsh elevation. This elevation will settle over time, which will be documented in future surface elevation change surveys.

Vegetation in the project area was beginning to thrive following construction, but has been impacted heavily by nutria, especially in the nourishment area. Nutria have been prolific on other parts of Marsh Island as well, as evidenced by CRMS reference site vegetation surveys. Vegetation was successfully established through an aerial seeding trial and could show promise as a revegetation technique for future projects.

Submerged aquatic vegetation was not found on the initial post-construction survey. This doesn't necessarily mean the project has had a detrimental effect on SAV abundance, however, since the surrounding TV-14 project has had a low occurrence of SAV as well on recent surveys.

Dissolved oxygen level monitoring in the East Cote Blanche borrow area did not detect hypoxic conditions during the summer of 2012. Future monitoring will determine if hypoxic condition occur during the natural refill period of the borrow area. Surveys done in 2012 showed significant filling of the borrow area has taken place since construction.

Soil surveys within the project area indicated a higher bulk density in the containment area soils compared to the nourishment areas, though percent organic matter was low in both. The soil pH values in the project area are suitable for vegetation establishment. The organic matter content can be expected to increase with the growth of marsh vegetation.

The East Marsh Island Marsh Creation Project is in good condition and functioning as intended. There is some concern with the erosion taking place at each end of the East-West Canal, i.e. at its intersection with the North-South canal adjacent to the existing rock plug and on the Gulf ward shoreline near the eastern end of the East-West Canal. Steps to shore up these areas are included in an upcoming maintenance event to prevent future marsh loss in this section of the project area. Nutria damage has also become a concern and has had a negative impact on the freshly emergent vegetation in portions of the project area.

b. Recommended Improvements

The following recommendations have been discussed by the team for future maintenance and repairs. CPRA is in the process of preparing final plans and bid documents to move this project to construction. (See Appendix D):

- Lower an existing gap labeled "Gap N" in the Marsh Creation Cell No. 2 containment dike.
- Remove the timber mats used during the original project construction to repair a containment dike breach and create an additional gap at this location at Hawkins Lake (mats will be removed and disposed of off-site).
- Cut gaps in two remaining interior plugs in the Nourished Area No. 2 as well as two plugs in the abandoned Oil and Gas Pipeline Canal in the Nourished Area No.1 to allow tidal exchange.
- Armor a 920 foot section of the containment dike along the Gulfward shoreline at the Northeast corner of the Marsh Creation Cell No. 1 near "Gaps A & B" and the East-West Canal.
- Rebuild a section of containment dike along the North-South pipeline canal near the existing rock plug at its intersection with the East-West Canal and add additional armoring at this location as well.
- Implement a nutria eradication for the duration of the project.

Per the O&M plan, additional surveys should be performed in Year 3 post construction to determine the settlement of the marsh creation and marsh nourishment areas as well as the accumulation of material in the borrow area.

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.

VI. Literature Cited

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Appendix A

Photographs

Photo No. 1, Containment Dike and Marsh Creation Cell No.1 (Looking North)

Photo No.2, Containment Dike along North-South Canal at Rock Plug

Photo No. 3, Containment Dike along North-South Canal near Rock Plug

Photo No. 4, Marsh Creation Cell No.2 (Looking South)

Photo No. 5, Marsh Creation Cell No. 2, Borrow Channel, Containment Dike, Timber Mats, and Nourished Area No. 3 (Looking West)

Photo No. 6, Earthen Plug at End of North-South Pipeline Canal

Photo No. 7, Aerial view (March 2012), Looking Southwest at Project Area

Photo No. 8, Containment Dike along Gulfward Shoreline at NE Corner of MC Cell No. 1 (Northern Most Section of Intended Armor Area)

Photo No. 9, Containment Dike along Gulfward Shoreline at NE Corner of MC Cell No. 1
(Original Breach near Southern Section of Intended Armor Area)

Appendix B

Three Year Budget Projection

EAST MARSH ISLAND MARSH CREATION/ TV-21 / PPL 14

Three-Year Operations & Maintenance Budgets 07/01/2013 - 06/30/2016

Project Manager	O & M Manager	Federal Sponsor	Prepared By
Pat Landry	*Darrell Pontiff*	*NRCS*	*Darrell Pontiff*

	2013/2014(-2)	2014/2015 (-3)	2015/2016 (-4)
Maintenance Inspection	$ 6,457.00	$ 6,651.00	$ 6,851.00
Structure Operation			
State Administration	$ 12,051.00	$ 10,397.00	$ -
Federal Administration	$ 24,102.00	$ 20,794.00	$ -
Maintenance/Rehabilitation			

13/14 Description: Dike degrading and shoreline protection.

E&D	$ -	
Construction	$ 591,250.00	Includes 25% Contingency
Construction Oversight	$ 78,500.00	
Sub Total - Maint. And Rehab.	$ 669,750.00	

14/15 Description: Vegetative plantings, engineering monitoring.

E&D	Incl. $197,522 of Engineering Monitoring	$ 236,731.00
Construction		$ 200,000.00
Construction Oversight		$ -
	Sub Total - Maint. And Rehab.	$ 436,731.00

15/16 Description:

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

	2013/2014(-2)	2014/2015 (-3)	2015/2016 (-4)
Total O&M Budgets	**$ 712,360.00**	**$ 474,573.00**	**$ 6,851.00**

O &M Budget (3 yr Total)	**$ 1,193,784.00**
Unexpended O & M Budget	**$ 1,318,353.00**
Remaining O & M Budget (Projected)	**$ 124,569.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

EAST MARSH ISLAND MARSH CREATION / PROJECT NO. TV-21 / PPL NO. 14 / 2012/2013

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$6,457.00	**$6,457.00**
General Structure Maintenance	LUMP	0	$0.00	**$0.00**
Engineering and Design	LUMP	1	$0.00	**$0.00**
Operations Contract	LUMP	0	$0.00	**$0.00**
Construction Oversight	LUMP	1	$78,500.00	**$78,500.00**

ADMINISTRATION

CPRA Admin.	LUMP	1	$12,051.00	$12,051.00
FEDERAL SPONSOR Admin.	LUMP	1	$24,102.00	$24,102.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$36,153.00**

MAINTENANCE / CONSTRUCTION

SURVEY

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

GEOTECHNICAL

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

CONSTRUCTION

CONSTRUCTION DESCRIPTION: Degrade dikes and remove timber mats and shoreline protection.

Rip Rap	LIN FT	TON / FT	SQ YD	UNIT PRICE	
Rock Dike	0	0.0	0	$0.00	$0.00
Bank Paving	0	0.0	0	$0.00	$0.00
Articulated Concrete Mats	0	0.0	2,000	$120.00	$240,000.00
Filter Cloth / Geogrid Fabric		SQ YD	2,000	$5.00	$10,000.00
Navigation Aid		EACH	0	$0.00	$0.00
Signage		EACH	0	$0.00	$0.00
General Excavation / Fill		CU YD	3,000	$6.00	$18,000.00
Access and Flotation		LUMP	1	$30,000.00	$30,000.00
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	1	$135,000.00	$135,000.00
Contingency (25%)		LUMP	1	$118,250.00	$118,250.00
General Structure Maintenance (25%)		LUMP	0	$0.00	$0.00
Remove timber mats		LUMP	1	$25,000.00	$25,000.00
Vegetative Plantings		LUMP	0	$0.00	$0.00
Construction Layout and Surveying		LUMP	1	$15,000.00	$15,000.00
				TOTAL CONSTRUCTION COSTS:	**$591,250.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$712,360.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

EAST MARSH ISLAND MARSH CREATION / PROJECT NO. TV-21 / PPL NO. 14 / 2014/2015

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$6,651.00	**$6,651.00**
General Structure Maintenance	LUMP	0	$0.00	**$0.00**
Engineering and Design	LUMP	1	$236,731.00	**$236,731.00**
Operations Contract	LUMP	0	$0.00	**$0.00**
Construction Oversight	LUMP	0	$0.00	**$0.00**

ADMINISTRATION

CPRA Admin.	LUMP	1	$10,397.00	$10,397.00
FEDERAL SPONSOR Admin.	LUMP	1	$20,794.00	$20,794.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$31,191.00**

MAINTENANCE / CONSTRUCTION

SURVEY

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

GEOTECHNICAL

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

CONSTRUCTION

CONSTRUCTION DESCRIPTION: 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	$10.00	$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	1	$200,000.00	$200,000.00
OTHER		LUMP	0	$0.00	$0.00
OTHER				$0.00	$0.00
				TOTAL CONSTRUCTION COSTS:	**$200,000.00**

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$474,573.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

EAST MARSH ISLAND MARSH CREATION / PROJECT NO. TV-21 / PPL NO. 14 / 2015/2016

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$6,851.00	**$6,851.00**
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
	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	$10.00	$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: **$6,851.00**

Appendix C

Field Inspection Form

MAINTENANCE INSPECTION REPORT CHECK SHEET

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

Date of Inspection: June 6, 2013 Time: Approximately 10:00am

Structure No. N/A

Inspector(s): Darrell Pontiff, Mark Mouledous, and Jody White (CPRA) Cassidy Lejeune (LDWF), Cindy Steyer, Macandol Parker, and Justin Meaux (NRCS), Adrian Chavarria (EPA)

Structure Description: Marsh Creation Cells, Containment Dikes, and Nourishment of Adjacent Marsh , Earthen Plug

Water Level: Higher than normal levels/ No staff gauge reading available

Salinity Readings: 0.2ppt in the North-South Canal, 5.0 ppt in MC Cell No. 1

Type of Inspection: Annual

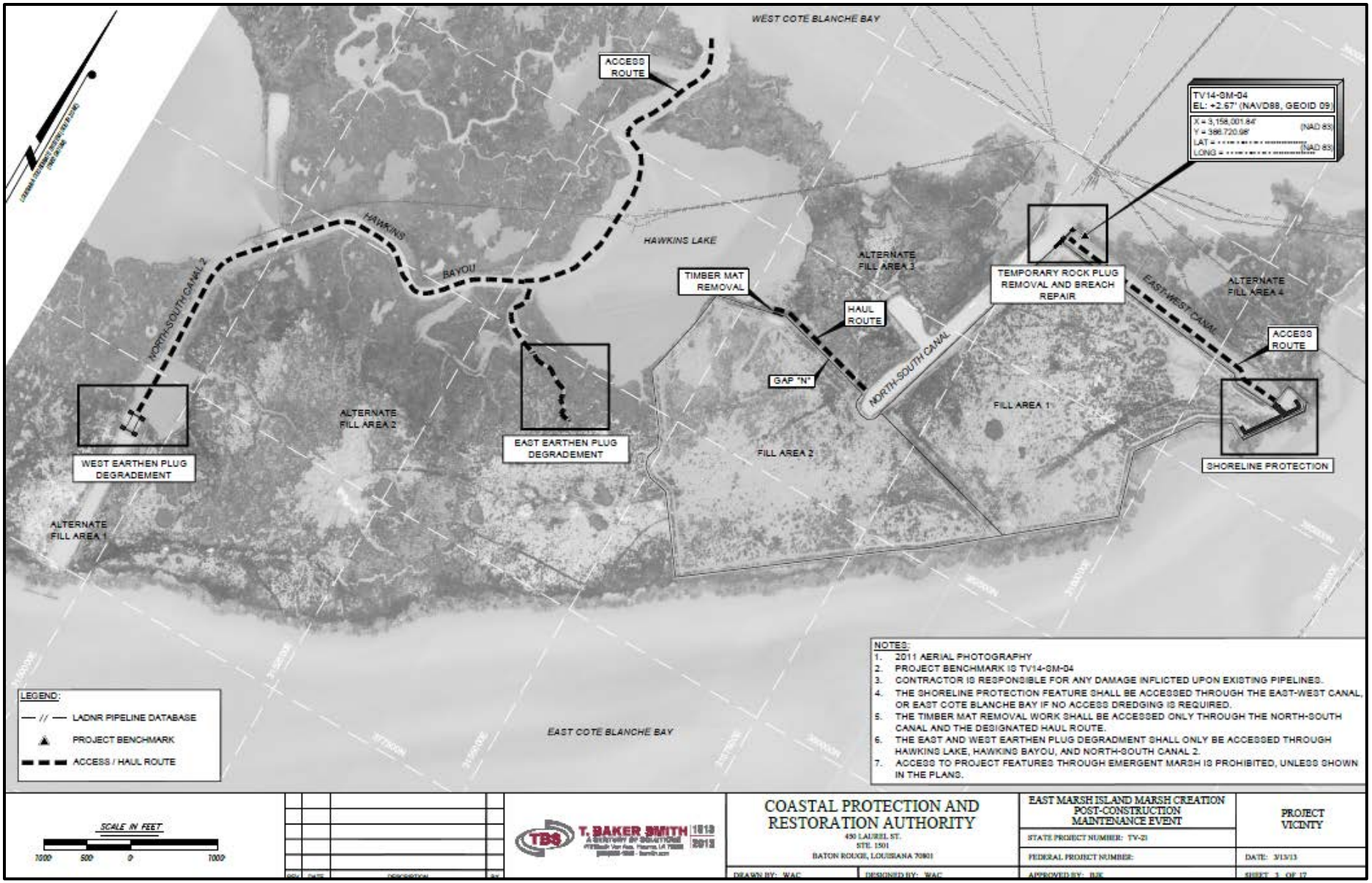
Weather Conditions: Partly Cloudy and Mild

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Earthen Plug (End of N-S Canal)	Good	No		6	Good Condition. Still some bare areas without vegetation.
Nourised Areas (1-4)	Good	Yes		5	Nourished Areas No. 3 &4 are in good condition. Previous visits by CPRA monitoring staff indicated that Nourished Area No. 2 was greatly impacted by nutria damage.
Vegetation	Good			1,4,5,9	Vegetation continues to expand within the cells and on the containment dikes. Large nutria population.
Settlement Plates	Good				
Marsh Creation Cells (1 & 2)	Good			1,4,5	In good condition. The north end of Marsh Creation Cell No. 1 appears to have settled more than Cell No. 2.
Containment Dikes	Good			1-5,8,9	Majority of the containment dikes are in good condition. Vegetation has spread over several areas. Some bare spots remaining. Two areas of erosion have progressively worsened in the past 8 months (N-S Canal at the rock plug and two sections of the Gulfward Shoreline in the area proposed for armoring).

What are the conditions of the existing levees?	
Are there any noticeable breaches?	There are three breaches in the containment dike at critical areas which could allow exposure of the interior of the northeast tip of the island to the East Cote Blanche Bay and the gulf.
Settlement of rock plugs and rock weirs?	
Position of stoplogs at the time of the inspection?	N/A
Are there any signs of vandalism?	N/A

Appendix D

Upcoming Maintenance Event Site Map


WEST COTE BLANCHE BAY
ACCESS ROUTE
TV14-GM-04
EL: +2.67' (NAVD88, GEOID 09)
X = 3,158,001.64' (NAD 83)
Y = 398,720.98'
LAT = (NAD 83)
LONG =
HAWKINS BAYOU
HAWKINS LAKE
NORTH-SOUTH CANAL 2
ALTERNATE FILL AREA 3
TIMBER MAT REMOVAL
TEMPORARY ROCK PLUG REMOVAL AND BREACH REPAIR
EAST-WEST CANAL
ALTERNATE FILL AREA 4
HAUL ROUTE
ACCESS ROUTE
GAP "N"
NORTH-SOUTH CANAL
FILL AREA 1
ALTERNATE FILL AREA 2
EAST EARTHEN PLUG DEGRADEMENT
FILL AREA 2
SHORELINE PROTECTION
WEST EARTHEN PLUG DEGRADEMENT
ALTERNATE FILL AREA 1
EAST COTE BLANCHE BAY
LEGEND:
LADNR PIPELINE DATABASE
PROJECT BENCHMARK
ACCESS / HAUL ROUTE
NOTES:
1. 2011 AERIAL PHOTOGRAPHY
2. PROJECT BENCHMARK IS TV14-GM-04
3. CONTRACTOR IS RESPONSIBLE FOR ANY DAMAGE INFLICTED UPON EXISTING PIPELINES.
4. THE SHORELINE PROTECTION FEATURE SHALL BE ACCESSED THROUGH THE EAST-WEST CANAL, OR EAST COTE BLANCHE BAY IF NO ACCESS DREDGING IS REQUIRED.
5. THE TIMBER MAT REMOVAL WORK SHALL BE ACCESSED ONLY THROUGH THE NORTH-SOUTH CANAL AND THE DESIGNATED HAUL ROUTE.
6. THE EAST AND WEST EARTHEN PLUG DEGRADMENT SHALL ONLY BE ACCESSED THROUGH HAWKINS LAKE, HAWKINS BAYOU, AND NORTH-SOUTH CANAL 2.
7. ACCESS TO PROJECT FEATURES THROUGH EMERGENT MARSH IS PROHIBITED, UNLESS SHOWN IN THE PLANS.
SCALE IN FEET
1000 500 0 1000
T. BAKER SMITH
COASTAL PROTECTION AND RESTORATION AUTHORITY
450 LAUREL ST.
STE. 1501
BATON ROUGE, LOUISIANA 70801
EAST MARSH ISLAND MARSH CREATION POST-CONSTRUCTION MAINTENANCE EVENT
PROJECT VICINTY
STATE PROJECT NUMBER: TV-21
FEDERAL PROJECT NUMBER:
DATE: 3/13/13
DRAWN BY: WAC
DESIGNED BY: WAC
APPROVED BY: BJE
SHEET 3 OF 17