



State of Louisiana

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

2024 Operations, Maintenance, and Monitoring Report

for

Cole's Bayou Marsh Restoration

State Project Number TV-0063
Priority Project List #21

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Vermilion Parish

Prepared by:

Mark Mouledous,
Stuart Hebert
And
Brent Bouy, P.E.



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

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For
Cole’s Bayou Marsh Restoration (TV-0063)

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Preface

This report includes monitoring data collected through January 2024, and the annual maintenance inspections through March 2025. The Cole’s Bayou (TV-0063) project is a 20-year Coastal Wetlands, Planning, Protection, and Restoration Act (CWPPRA, Public Law 101-646, Title III, Priority List 3) project administered by the National Oceanic and Atmospheric Administration / National Marine Fisheries Service (NMFS) and the Coastal Protection and Restoration Authority of Louisiana (CPRA).

The 2024 report is the first in a series of reports. These reports will be made available for download at the following website: <http://cims.coastal.la.gov/>.

I. Introduction

The Cole’s Bayou Marsh Restoration Project (TV-0063) is located in Vermilion Parish between Little Vermilion Bay and Freshwater Bayou Canal and on state water bottoms of nearby Little Vermilion Bay (Figure 1). The project encompasses 3,840 acres and is located east of Intracoastal City and Freshwater Bayou Canal, west of Little Vermilion Bay and just south of the Gulf Intracoastal Waterway (GIWW). The project is co-sponsored by the National Oceanic and Atmospheric Administration / National Marine Fisheries Service (NMFS) and the Coastal Protection and Restoration Authority of Louisiana (CPRA).

Within the project area, wetlands are undergoing loss rates of -16.13 acres per year based on United States Geological Survey (USGS) data from 1983 to 2011 within the extended project boundary. Wetland loss processes in this area include subsidence/sediment deficit, interior ponding and pond enlargement, and storm impacts resulting in rapid episodic losses. In addition, significant interior marsh loss has resulted from salt water intrusion and hydrologic changes associated with increasing tidal influence. As hydrology in this area has been modified, habitats have shifted to more of a detached floating brackish marsh, resulting in increased susceptibility to tidal energy and storm damages. Habitat shifts and hydrologic stress reduce marsh productivity, a critical component of vertical accretion in wetlands.

The purpose of the project is to create sustainable emergent marsh through the use of dredged sediments from a borrow site in nearby Little Vermilion Bay and to improve the project area hydrology by reestablishing the historic freshwater and sediment patterns into the interior wetlands through the installation of a series of one-way culverts. Although Little Vermilion Bay is not considered an “external” source of material, significant sediment inflows into this area may result in some borrow area infilling. In order to create a functional brackish marsh (10% - 65% inundated) that is comparable to the healthiest marsh within the project area and surrounding marshes, +1.3ft NAVD88 has been identified as the final target 20 year life marsh elevation.

Approximately 3.2 million cubic yards of dredge material is available from a borrow site located nearby in Little Vermilion Bay (Figure 1). The dredged material was placed into three marsh creation cells east of Freshwater Bayou and west of Little Vermilion Bay, to create approximately 418 acres of brackish marsh. The borrow site was chosen to avoid and minimize



impacts to inshore infrastructure and sensitive aquatic habitats. Retention levees were minimally gapped after construction to drainage of the MCA's and to support tidal exchange at limited locations. The project also proposes to restore the hydrology in the project area by installing 8 water control structures in the northern boundary, 4 water control structures in the southern boundary and dredging a conveyance channel around the largest marsh creation cell. The water control structures were fitted with a check valve that allows water to only flow one-way through the water control structure. The water control structures in the northern part of the project area will be operated to allow the ingress of water and fisheries organisms into the semi-impounded project area but avoid backflow of water and potential loss of interior marsh sediment (i.e., north to south flow only). The southern structures were planned, designed and constructed to allow water to drain out of the marsh. The project will result in approximately 398 net acres of brackish marsh over the 20-year project life. Construction was completed in November 2019.



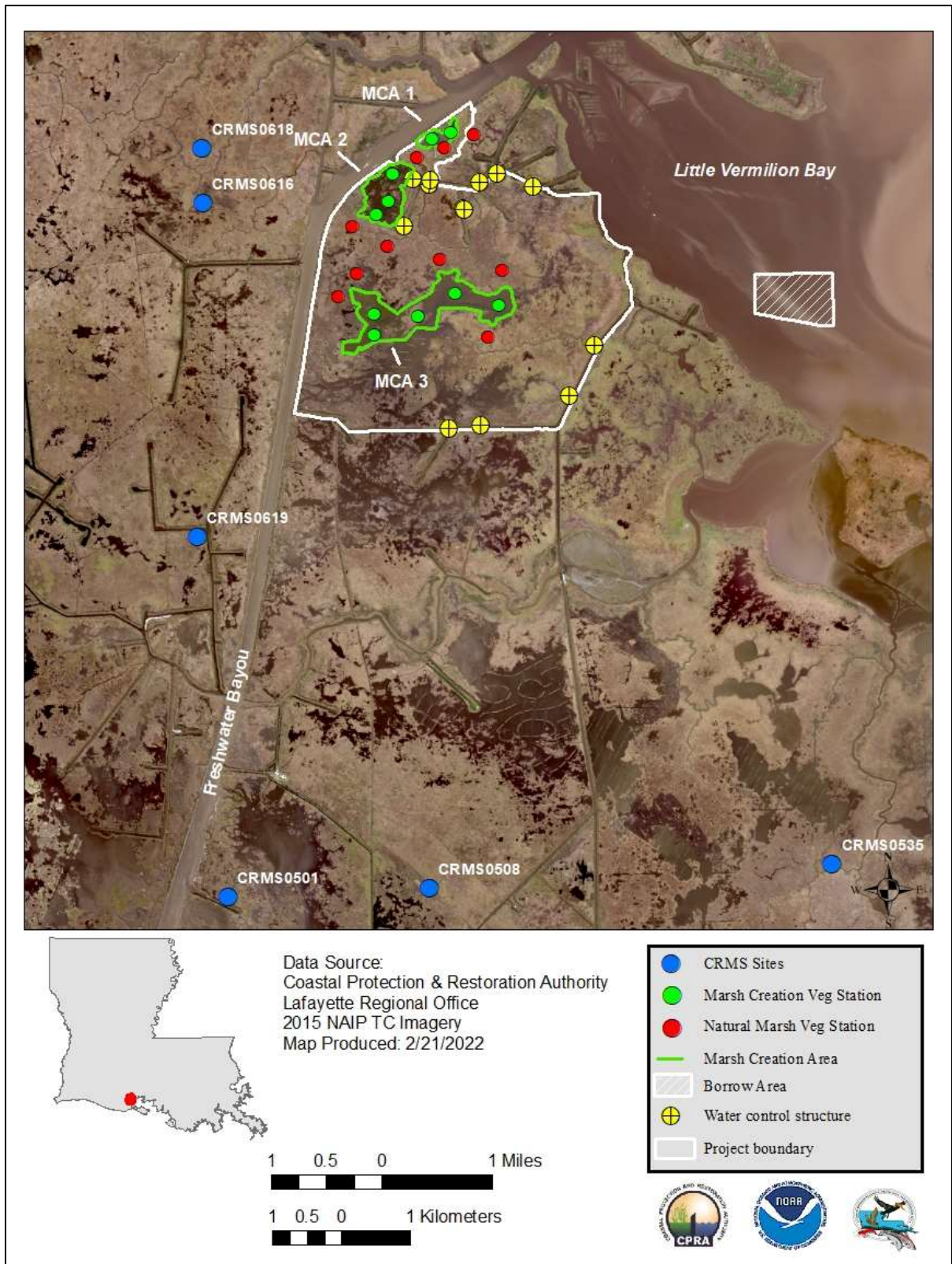


Figure 1. Cole's Bayou Marsh Restoration (TV-0063) project area, features, and area CRMS sites.

II. Maintenance Activity

a. Project Feature Inspection Procedures

An inspection of TV-63 was conducted on March 20, 2025, under clear skies with moderate to strong wind conditions. Attending the inspection were Jacques Boudreaux, Mark Mouldous, and Stuart Hebert of CPRA. Patrick Williams of NOAA was unable to attend. The team was met by local landowner representatives and other stakeholders who accompanied the CPRA team in a separate vessel for a portion of the inspection.

The purpose of the annual inspection of TV-63 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.

The project includes 415 acres of restored marsh, constructed across three marsh creation areas: MCA1 (25 acres), MCA2 (109 acres), and MCA3 (281 acres). The average as-built fill elevations are +2.1 feet NAVD88 for MCA1, +2.5 feet for MCA2, and +2.4 feet NAVD88 for MCA3. Additionally, the project features nine water control structures (WCSs), each utilizing 42-inch corrugated metal piping (CMP) equipped with an in-line check valve. These structures are supported by timber pilings and framing, include earthen fill material, and are protected with articulated concrete mats (ACMs).

b. Inspection Results

Marsh Creation Areas

MCA1 appears to be functioning properly, with dense and consistent vegetation indicating successful restoration. No visible signs of the articulated concrete mats (ACMs) were noted on the Freshwater Bayou (FWB) side, suggesting full vegetation growth through the concrete openings. However, due to its proximity to the eroding edge of the FWB federal navigation channel, no future containment dike gapping should occur on the western or northern sides of MCA1 to avoid potential breaches that could compromise the project.

MCA2 also demonstrates healthy vegetation and ecological function, consistent with the other MCAs. The remnant earthen containment dikes exhibit shrub-like upland species due to their elevated relief, forming linear vegetation patterns along the dike alignments. Similar to MCA1, no dike gapping is recommended along the FWB-adjacent sides of MCA2 due to erosion concerns.

MCA3 shows strong vegetation establishment and appears to support various ecological functions depending on seasonal water levels. While no ponding or retained water was



observed during this inspection—conducted during very low water conditions—potential interior ponding during higher water levels has been previously noted.

Water Control Structures

WCS1 through WCS5 are not functioning properly, with significant siltation observed along the head works and around the corrugated metal pipe (CMP) and check valve inlets. In five of the nine total WCSs—primarily these structures—silt was deposited at elevations higher than the check valve inlets, effectively blocking any flow through the culverts and compromising the project’s hydrologic goals. During this inspection, conducted during very low water conditions, these structures showed stagnating, non-flowing water within the CMPs, indicating they are non-functional in their current state.

WCS6 through WCS9, located on the southeastern and exterior portions of the site, appeared to be in generally good condition and operational. However, a pinhole leak—likely caused by corrosion—was observed at WCS7.

Additional Observations

At the request of the Rainey Conservation Alliance and private landowners in and around the project site, six (6) landowner-identified breach locations were observed. Some of these locations do appear to have a possible impact on long-term TV-63 success. Survey data should be collected to assist with determining if future O&M work is needed in these areas as part of TV-63.

c. Maintenance Recommendations

MCA1 through MCA3 are in good condition with full vegetation and only minor issues, such as erosion along the Freshwater Bayou (FWB) side of MCA1 and potential ponding within MCA3 during high water. While the earthen containment dikes (ECDs) show no major concerns, those along the FWB side of MCA1 and MCA2 should be monitored. CPRA recommends a site visit with the Federal Sponsor during high water to identify potential dike gapping locations.

Water control structures WCS1 through WCS5 exhibit moderate to severe siltation. All five structures require operations and maintenance. WCS6 through WCS9 are functioning properly but show minor issues, including a leak at WCS6 and fabric displacement beneath the articulated concrete mats (ACMs) at WCS8; these structures also require minor maintenance.

CPRA advises desilting, replacing check valves, and making repairs during the next O&M event. Existing breaches are compromising project functionality by allowing salinity intrusion and reducing drainage efficiency, which threatens the project’s success. CPRA recommends completing a survey and engineering and design to determine whether an O&M action is necessary at this time. Additional data is needed to determine whether the project is experiencing a loss in projected benefits.



i. Immediate/ Emergency Repairs

None.

ii. Programmatic/ Routine Repairs

None.

d. Maintenance History

None.

III. Monitoring Activity

The Coastwide Reference Monitoring System (CRMS) - Wetlands is a network of 392 monitoring sites distributed throughout the coastal zone of Louisiana. Hydrographic, vertical accretion, elevation change, vegetation, soils, and aerial photography data are collected at each CRMS site. Although no CRMS monitoring stations are located in the TV-63 project area, there are several CRMS stations located nearby which can be used as references to determine project effectiveness.

a. Monitoring Goals

The Cole's Bayou Marsh Restoration Project (TV-0063) was designed to restore areas that were previously lost due to storm impacts and salt water intrusion. In addition, the project will encourage additional freshwater nutrient and sediment inflow through the installation of culverts.

The specific goals of the Cole's Bayou Marsh Restoration project are:

1. Create 418 acres of brackish marsh in recently formed shallow open water.
2. Increase freshwater and sediment inflow into interior wetlands by improving project area hydrology.

b. Monitoring Elements

Aerial Photography

In order to evaluate land/water ratios in the fill areas, land/water data will be obtained from digital imagery with 1-meter resolution. The photography will be georectified using standard operating procedures described in Steyer et al. (1995, revised 2000), and land/water ratios will be determined. Aerial photography was collected in 2018 (pre-construction) and will be captured post-construction when CRMS coastwide imagery becomes available near 2024, 2033, and at a later date if deemed necessary.

Water Level



Water level (ft) readings will be recorded hourly at two project specific locations within the project area and multiple CRMS sites within the vicinity of the project area. Water level readings will be used to determine the frequency, depth, and duration of flooding in the project area relative to the marsh elevation determined by the fill area surveys. Water level will be monitored post construction in 2025 and 2037 concurrent with fill area surveys.

Salinity

Salinity data will also be recorded at the two project specific and CRMS sites as well as discrete soil porewater stations at each of the vegetation plots, when vegetation is surveyed, to characterize salinities throughout the project and reference areas.

Fill Area Surveys

To monitor the settlement of the marsh surface, relative to target elevations, a cross sectional survey is required across the unit. Survey transects will be laid out every 500 feet at a minimum in the created marsh and extending into the open water and marsh adjacent to the marsh creation cells. Position, elevation, and water depth will be recorded every 100 feet along each transect. There are fifteen vegetation monitoring stations within the area that are marked with ¾ inch PVC poles. The surveyor will have to give those areas a 30 foot buffer. A Fill elevation survey was completed in December 2020 and June 2023 and will be conducted in 2025 and 2037.

Borrow Area Surveys

To determine fill rates within the borrow area, bathymetric, side-scan sonar, and high resolution seismic surveys in the Gulf of Mexico borrow area will be performed along the same transects as the As-Built Surveys. Survey transects shall be spaced 1000 feet apart and extend 500 feet past the limit of cut. All bathymetric surveys must be corrected for tidal fluctuations and wave action to the NAVD88 vertical datum. All surveys shall be performed to CPRA standards. A bathymetric survey of the borrow area was completed in December 2020 and June 2023 and will be conducted in 2025 and 2037.

Vegetation

To document the condition of the emergent vegetation in the project area over the life of the project, vegetation will be monitored at 20 sampling stations using a modified Braun Blanquet sampling method as outlined in (Folse et al. 2020). Stations will be established uniformly across the created and natural marsh in the project area and the location of the stations will be such that they coincide with at least some of the elevation transects or settlement plates within the containment areas. Twenty stations with replicate plots will be established within the dredged areas and natural marsh (10 stations within each). Percent cover, dominant plant heights, and species composition will be documented in 2m x 2m sampling plots marked with a corner pole to allow for revisiting the sites over time. Vegetation data from the relevant CRMS sites within the area will be used as reference stations to compare species composition over time. Data were collected in the fall of 2020 and 2022 and will be collected in 2024, 2029 and 2037.

Individual species' cover data are summarized according to the Floristic Quality Index (FQI) method (Cretini and Steyer 2011). A list of plants occurring in Louisiana's coastal wetlands



(~500 species) was provided to all known Louisiana coastal vegetation experts and their input on scoring was requested. The panel then provided an agreed upon group score (Coefficient of Conservatism or CC score) for each species. CC scores are weighed based on cover in the FQI for Louisiana coastal wetlands. All species known to occur in the coastal zone were given a floristic quality score on a scale of 0 to 10. Species that scored the lowest were considered by the panel to indicate disturbance or unstable marsh environments.

Soil Properties

Project specific soil cores will be collected using a McCaulay peat corer (24 cm deep) at 6 sites (2 replicates per site) representing both the created and natural marsh areas of the project. Soil data were collected in 2022 and will be collected in 2024, 2029 and 2037, and at a later date if deemed necessary. Analysis of soil properties will include but not necessarily be limited to bulk density, moisture, and percent organic matter.

c. Monitoring Results and Discussion

Aerial Photography

Land:water analysis was completed for the 2018 pre-construction aerial photography (Figure 2). Results indicated 37.93% land and 62.07% water within MCA 1, 34.55% land and 65.45% water within MCA 2 and 25.71% and 74.29% water within MCA 3. Overall, the project area was 70.50% land and 29.51% water prior to construction. Future analyses will determine land/water ratios in the project area through time as the marsh creation areas settle.



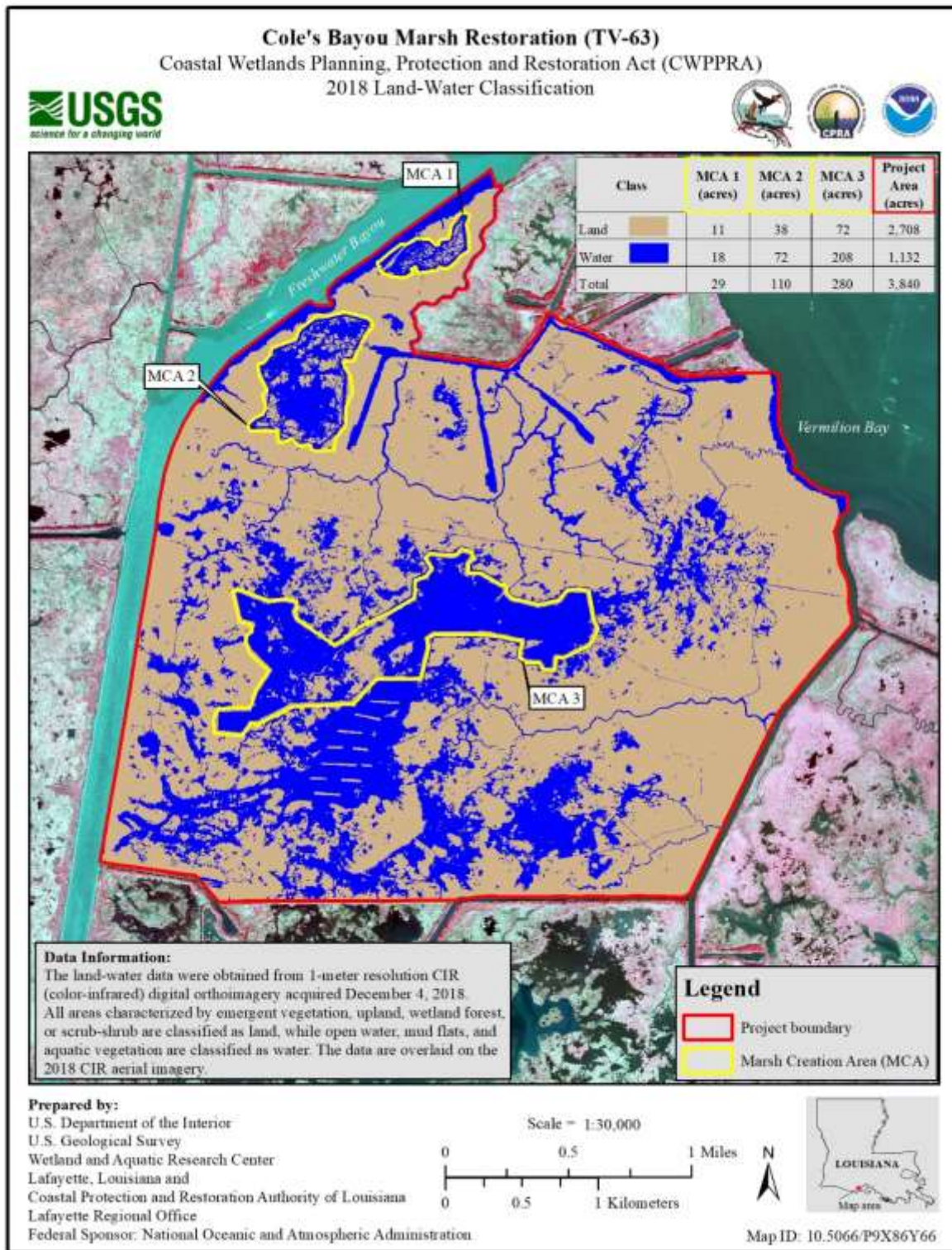


Figure 2. Cole's Bayou Marsh Restoration (TV-63) project 2018 land/water analysis pre-construction.



Water Level

Post construction, we saw multiple tropical systems develop in the Gulf of Mexico during the 2020 Hurricane season that had an effect on regional water levels. The largest, Hurricanes Laura and Delta made landfall in southwestern Louisiana in August and September 2020, and are labeled on both hydrology and salinity graphs (Figures 3 & 5). Reference CRMS sites outside of the project area recorded a tidal surge of over 5 ft for Laura and over 4 ft for Delta (Figure 3). After the storm surges in late 2020 we saw typical water levels at the CRMS sites in comparison to pre-construction water levels.

CRMS0618 is located west of Freshwater Bayou (FB) in an area that is impounded and managed by water control structures, similar to the Coles Bayou project area, while CRMS0501 is located south of the project area in an unmanaged marsh with a direct hydrologic connection to FB (Figure 1). Though water level patterns were similar between the two sites, water levels were quicker to recede following these storm events in the unmanaged marsh where CRMS0501 is located. This is important considering the project area has similar conditions to CRMS0618 (managed by water control structures) and thus is slower to drain than unmanaged areas, potentially leading to interior ponding. A more accurate evaluation of hydrology will be available once in-situ recorders are installed in the project area in 2025 and again in 2037. These will run concurrent with anticipated elevation surveys, which will allow for a more precise description of how the marsh creation areas are hydrologically affected.

When comparing water elevation to datum to the marsh platform elevation (Figure 4), all three MCA's are in the upper region of the tidal frame. MCA 2 experiences less inundation being slightly higher than MCA 1 and 3.

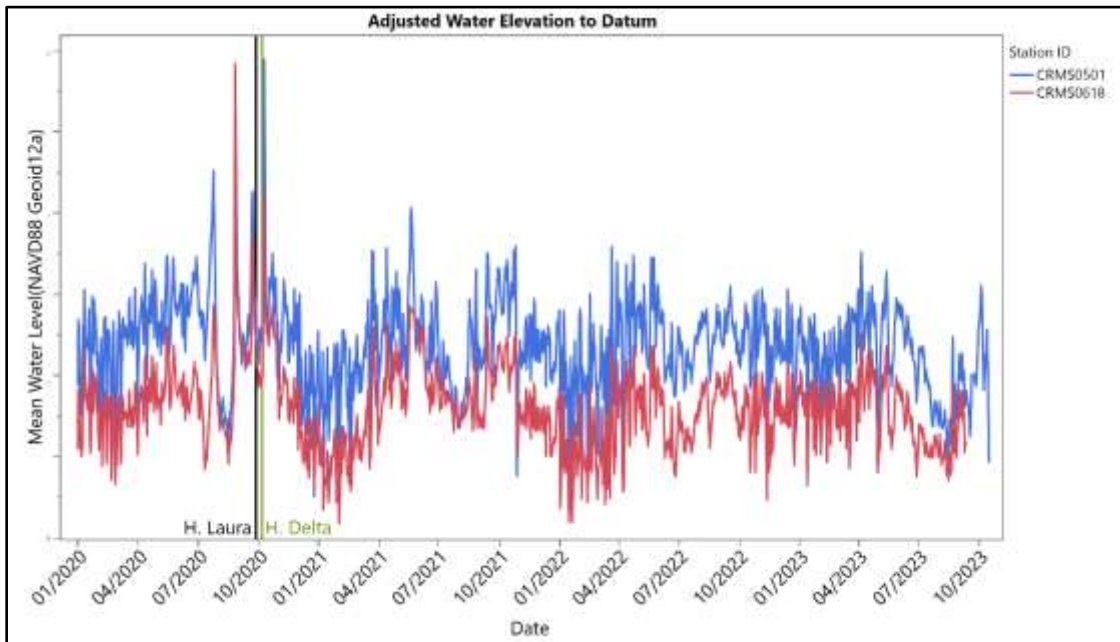


Figure 3. Hourly water elevations (NAVD88 Geoid 12a) from January 2018 through January 2024 of the referenced CRMS sites. Data was taken from CIMS Data portal.

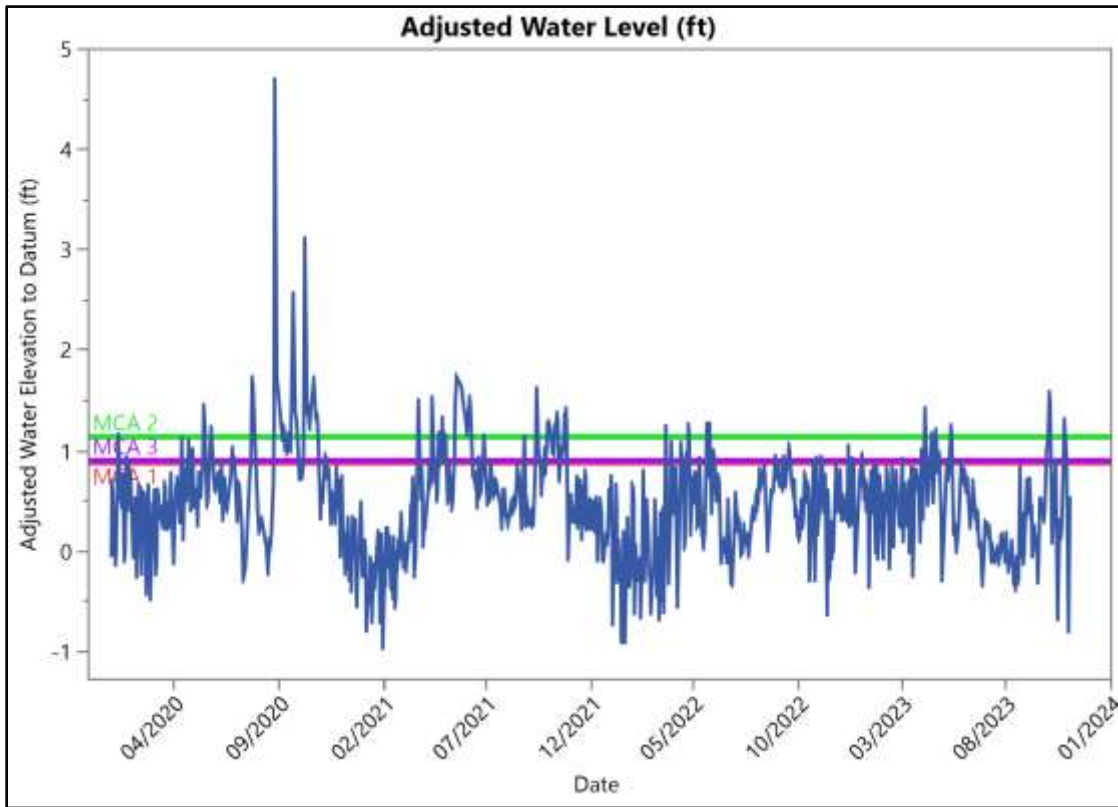


Figure 4. 2018-2024 adjusted water elevation to datum from CRMS0618 compared to 2023 settled elevations at the TV-63 marsh creation areas. The average height of MCA 1 (red), MCA 2 (green) and MCA 3 (purple) all shown on the maps.

Salinity

The reference CRMS sites also recorded salinity levels throughout 2023 (Figure 5). Salinities throughout the first half of 2020 were typically less than 2 ppt in the marshes where the reference sites are located. Following Hurricanes Laura and Delta, salinities spiked to over 10 ppt at the sites. Salinities were slower to recede than water levels following the storms and were still slightly elevated by the end of 2020. Salinities dropped and remained low throughout 2021 with only a slight uptick due to Hurricane Nicholas that made landfall in southeast Texas in September. Salinities stayed relatively low averaging around 4 ppt through 2022. In late 2023 we saw a large spike in salinity that was the result of a prolonged severe drought that kept salinities elevated through early 2024.



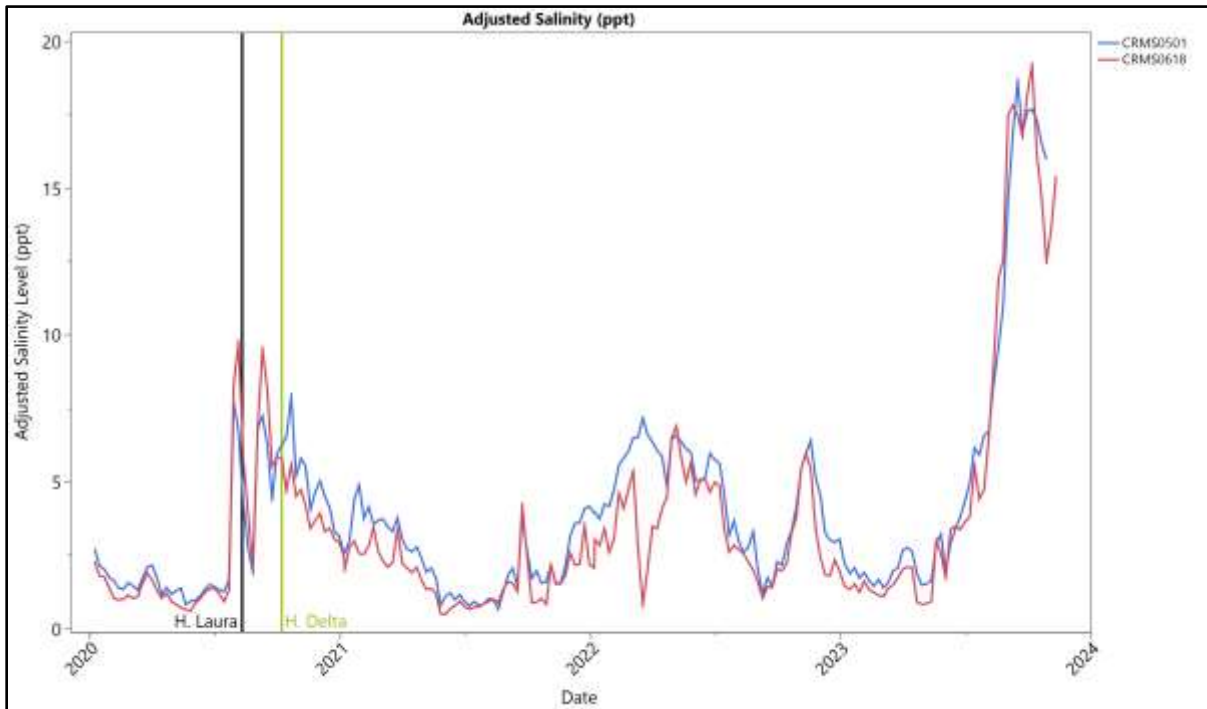


Figure 5. Hourly salinity levels from January 2020 through October 2023 of the reference CRMS sites. Data was taken from CIMS Data portal.

Interstitial water salinity was collected in the TV-63 project area (Figures 6 and 7). Porewater salinities in the marsh creation areas ranged from 6-8 ppt, which fall within the intermediate to slightly brackish range. Salinities in the natural marsh (pre-existing marsh in the project area) were similar at ~6ppt at both 10 and 30 cm, indicating the salinity of the borrowed sediments was similar to the existing surrounding marsh. After the two major hurricanes of 2020 (H. Laura and H. Delta) soil salinities dropped until the end of 2021, then rose back into the 4 – 6 ppt in response to the drought of 2022-23. This trend is seen in both the created marsh and in the natural marsh areas.

For reference, the CRMS sites, which had readings collected throughout 2020 and 2021, showed porewater salinities that were similar to the project area and each other, though the sites differ by management type. Salinities were below 5 ppt for the beginning of 2020 until July when they increased to the level observed within the MCA's and natural marsh of the project area, reflecting the trend seen in the surface water readings. Salinities slowly declined in 2021 to pre-storm conditions at 10 cm by July but were still slightly elevated at 30 cm.

After 2021, pore water saw a slight uptick for salinities at both CRMS0501 and CRMS0618 in response to the drought of 2022 through 2023. Both sites at the 10cm and the 30cm levels followed similar trends.

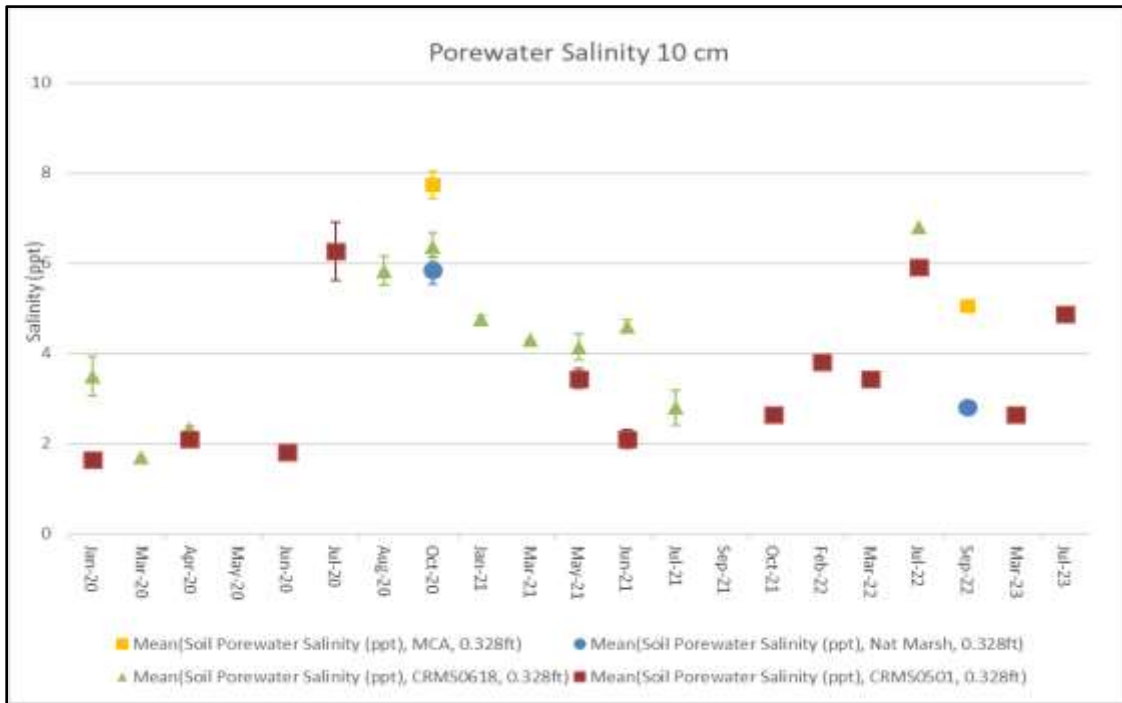


Figure 6. Porewater salinities within the TV-63 marsh creation areas, natural marsh and select CRMS sites from January 2020 to July 2023 at 10 cm below the soil surface. Error bars represent standard error.

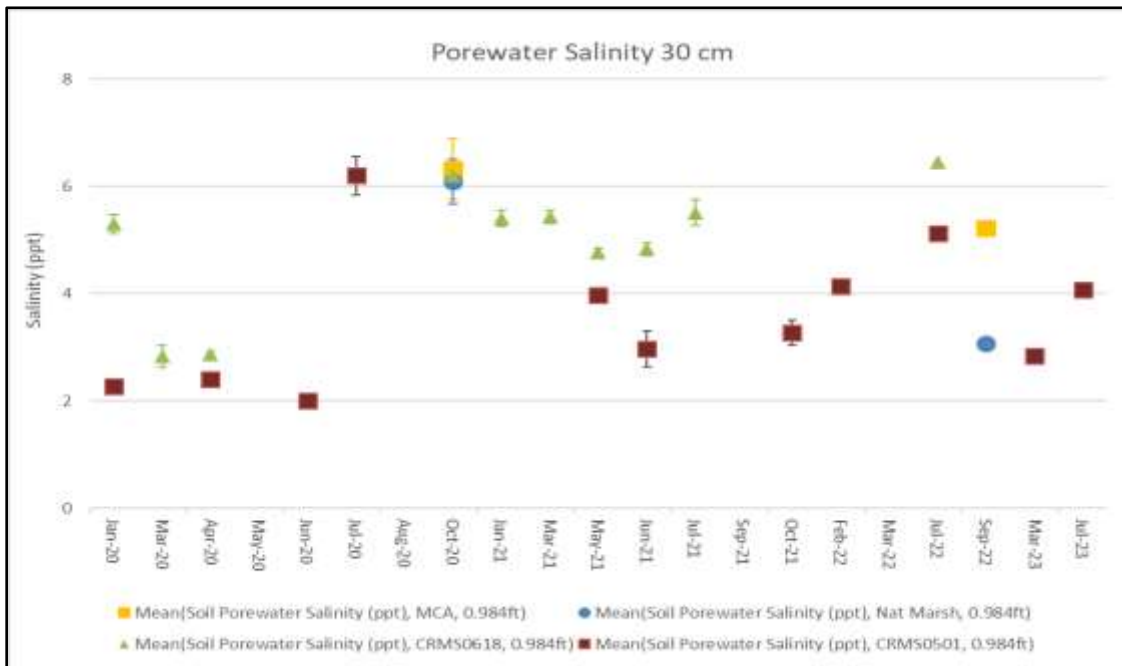


Figure 7. Porewater salinities within the TV-63 marsh creation areas, natural marsh and select CRMS sites from January 2020 to July 2023 at 30 cm below the soil surface. Error bars represent standard error.

Elevation Surveys

During TV-63 project design, target construction marsh fill elevations were determined through an investigation of several factors including existing healthy marsh elevation, percent inundation, the physical properties of the borrow material, and the bearing capacity of the foundation soils in each marsh creation area (Taylor et. al 2017). Ideally, the final marsh elevation would be expected to be inundated 50% of the time at the end of the 20-year project life and would spend the majority of the project life within the functional brackish marsh range (10% - 65% inundated). To aid in this determination, settlement curves were developed to compare different marsh fill elevations in relation to mean high water and mean low water using local subsidence and relative sea level rise rates through time.

For this project, +1.3 ft NAVD88 (Geoid12B) was selected as the final target marsh elevation. In order to achieve this final target elevation, the marsh platform initially had to be pumped outside of the functional brackish marsh range and settle into the range over the design life. To reach the final target marsh elevation, an initial constructed marsh fill elevation of +2.0 ft was determined for MCA's 1 & 2 and +2.5 ft was determined for MCA 3.

An as-built survey was completed in the summer of 2019 (Figure 8). MCA 1 was constructed to the target elevation of 2.0 ft while MCA 2 was slightly above target at 2.34 ft. MCA 3 was also surveyed at 2.34 ft, but was below the target elevation of 2.5 ft for the area, which is roughly 54% of the MCA.

A survey of the fill areas was completed one year post-construction in December 2020 (Figure 8). MCA's 1 and 2 settled to approximately the same elevation of ~1.45 ft. MCA 3 settled a bit more to 1.24 ft. The elevations from the 2020 survey were compared to the settlement curves that were developed pre-construction to compare actual settlement to the predicted values as well as observed water levels during that time frame (Figures 9-11). MCA's 1 and 2 are slightly higher than the predicted elevation at 1 year post construction while MCA 3 is approximately 0.5 ft lower.

The most recent elevation and bathymetry survey was completed in late 2023 and showed lower elevations across the MCAs but showed the rate of settlement slowing down. MCA 1 settled to 0.891 ± 0.103 ft., which is 0.53 ft. lower than the 2020 survey. Comparatively, MCA 2 lost less elevation between the two surveys, dropping to 1.14 ± 0.049 ft. a decrease of 0.327 ft. between the 2020 survey and the 2023 survey. MCA 3 had an average elevation of 0.907 ± 0.027 ft. in 2023 which was 0.333 ft. lower than its elevation in 2020.

Elevation grid models for the MCA's were also developed using the 2023 survey (Figure 12). All MCAs saw a decrease in elevation due to the sediment compacting and settling.

In MCA 1, we saw the development of a lower area along Freshwater Bayou on the southwest side of the area. This could be due to regular over wash from large ships' wakes or other wave actions as well as possibly from building containment dikes along FWB using interior borrow sources.



MCA 2 had elevation changes comparable to typical settling seen in recently created areas. Otherwise, the area has performed well and has not had any low spots arise between the first survey and the 2023 survey.

MCA 3 has a few low spots across the project area, specifically on the western and eastern edges. These areas held more water after construction and have taken longer to vegetate due to a lower starting elevations.

Future surveys will further determine the MCAs' settlement through time and how they compare to the predicted elevations and the effects on inundation.

Elevations across all MCAs are significantly lower than the final 20-year target elevations. MCAs 1 and 2 should be around 1.795 ft at the 2020 survey but were closer to 1.45 ft. The elevations continued to drop for the 2023 survey that expected elevations of 1.710 ft, yet recorded elevations of the two areas that averaged 1.02 ft). We see the same decrease in settlement in MCA 3 with the expected elevation for the 2020 survey being around 1.5 ft when the recorded actual elevation was 1.24 ft, and again the same decrease in 2023 when the expected elevation was 1.494 ft but had an average elevation of 0.907 ft). All areas are seeing this rapid settlement and decrease in elevation across the entire project area.

Bathymetric surveys of the borrow area within Little Vermilion Bay were completed at the time of the as-built survey in August 2019 and one year post-construction in December 2020 (Figure 13). Average elevation in the borrow area at the time of the as-built survey was around -7 ft. Significant infilling occurred in the first year following construction. Average elevation increased by ~2ft to -5.15 ft. More significantly, the minimum elevation increased from -18.52 ft to -7.75 ft. Depths within the borrow area increase from west to east with the deepest portion in the southeast corner. In the 2023 survey, the borrow area saw further infilling to an elevation of -4.99 ± 0.002 ft. on average. The borrow area saw an increase of 0.151 ft. between the 2020 and the 2023 survey but a measurable decrease in growth due to encroaching on local water bottom average elevations of around -4 – -6 ft. (Figure 14). Future bathymetric surveys, with the next scheduled for late 2025, will further document the infilling of the borrow area through time.



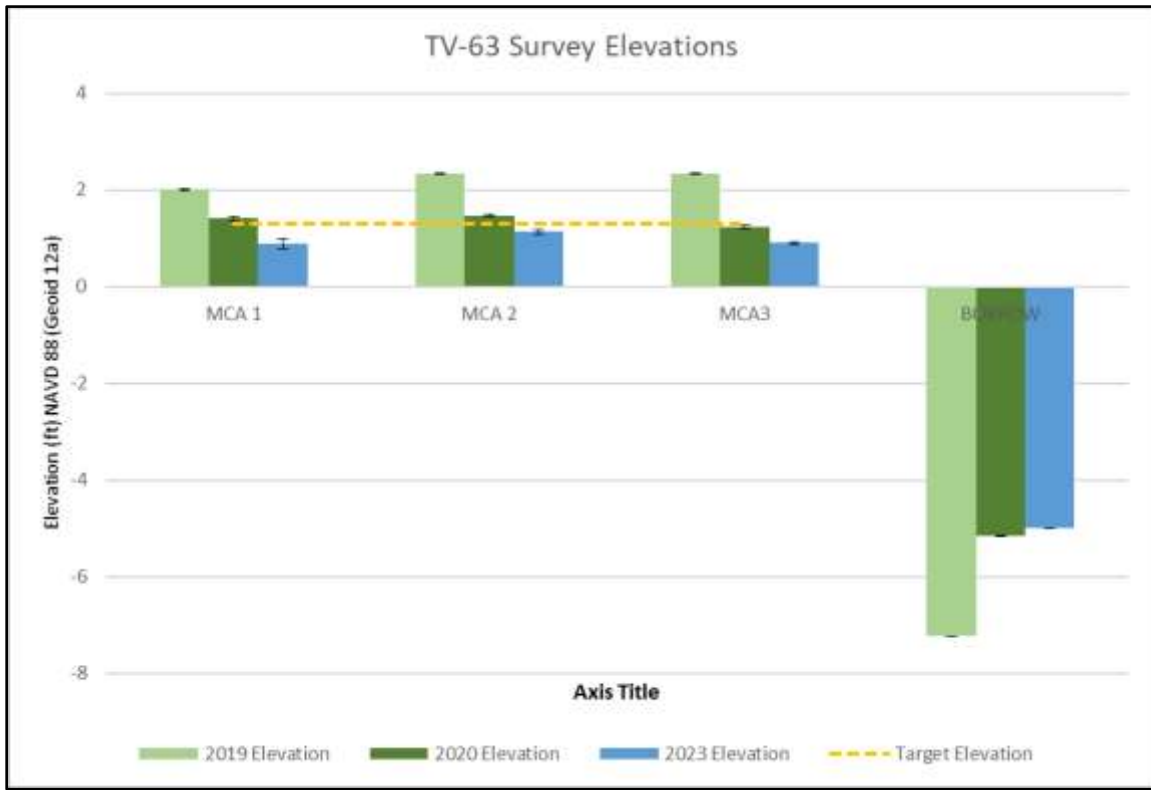


Figure 8. Survey Elevation data and target elevation data from 2019 (as-built), 2020, and 2023 for TV-63 marsh creation areas and borrow area.

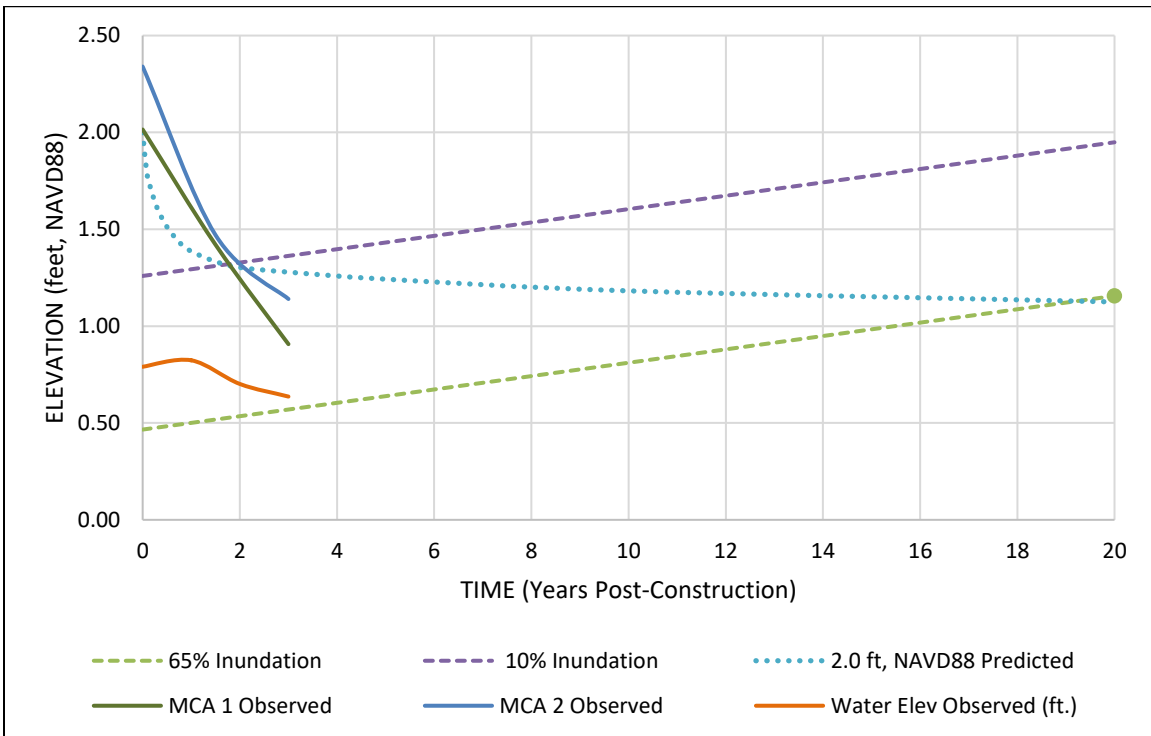


Figure 9. Predicted vs. observed settlement for the TV-63 Marsh Creation Areas 1 and 2 through 2023.



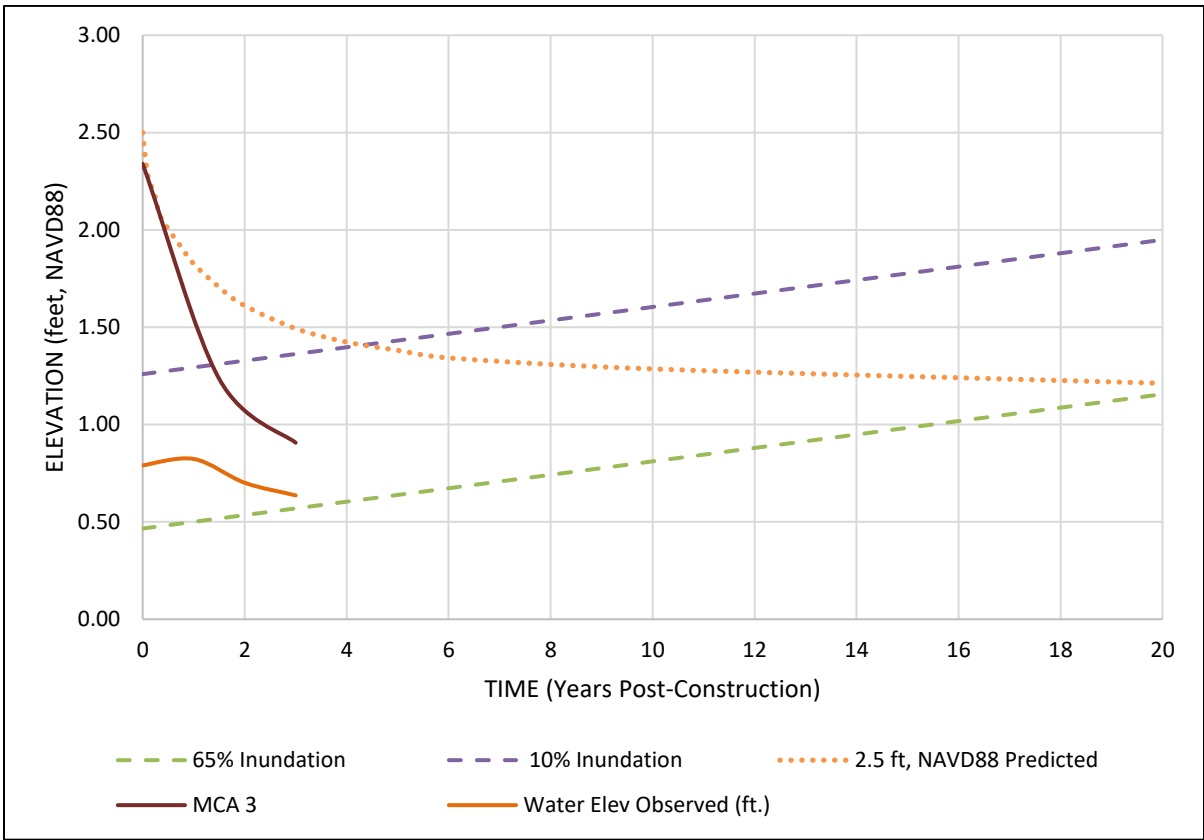


Figure 10. Predicted vs. observed settlement for the TV-63 Marsh Creation Area 3 through 2023.



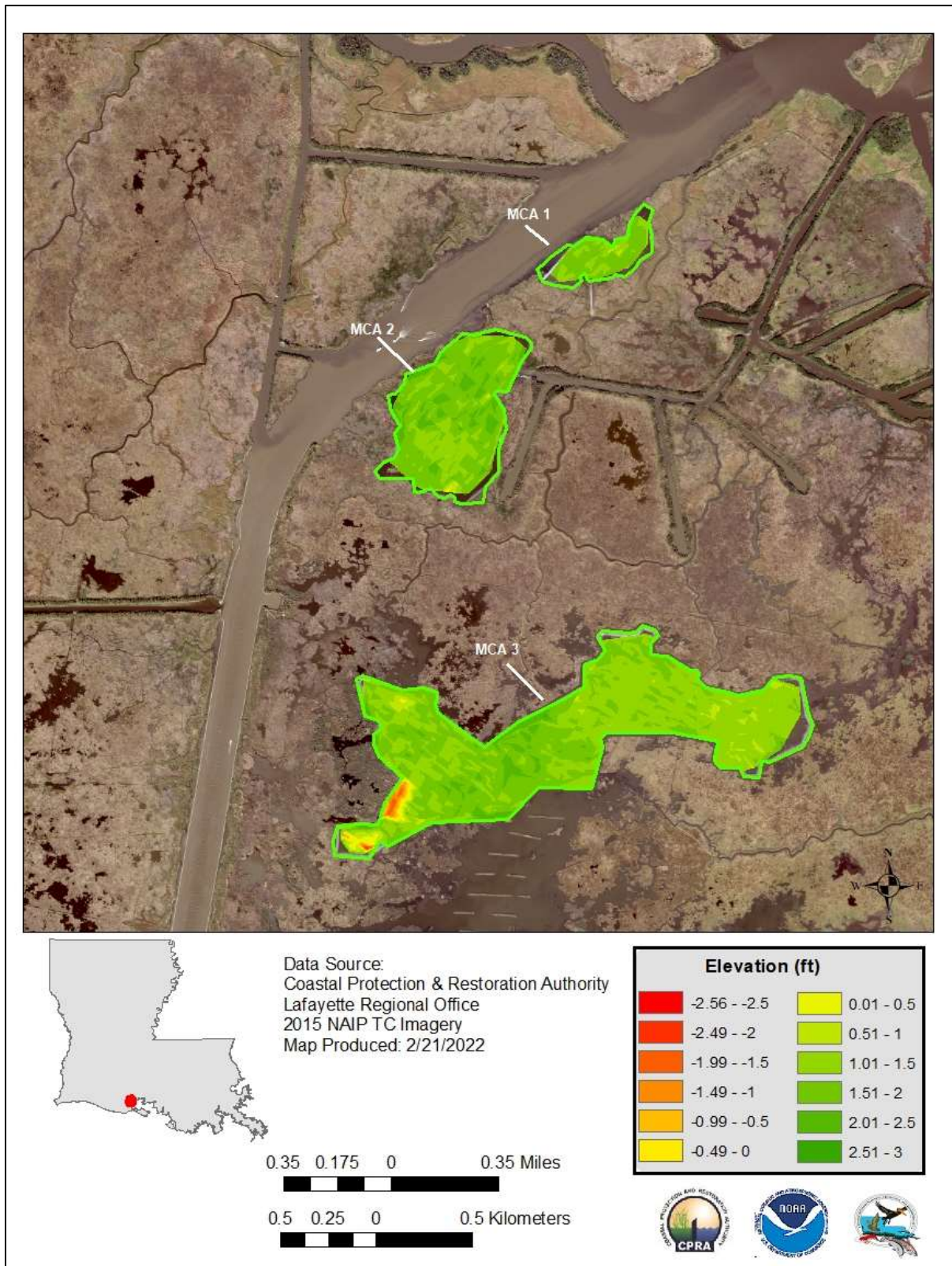


Figure 11. Elevation grid models for the TV-63 marsh creation fill areas from the December 2020 Survey.

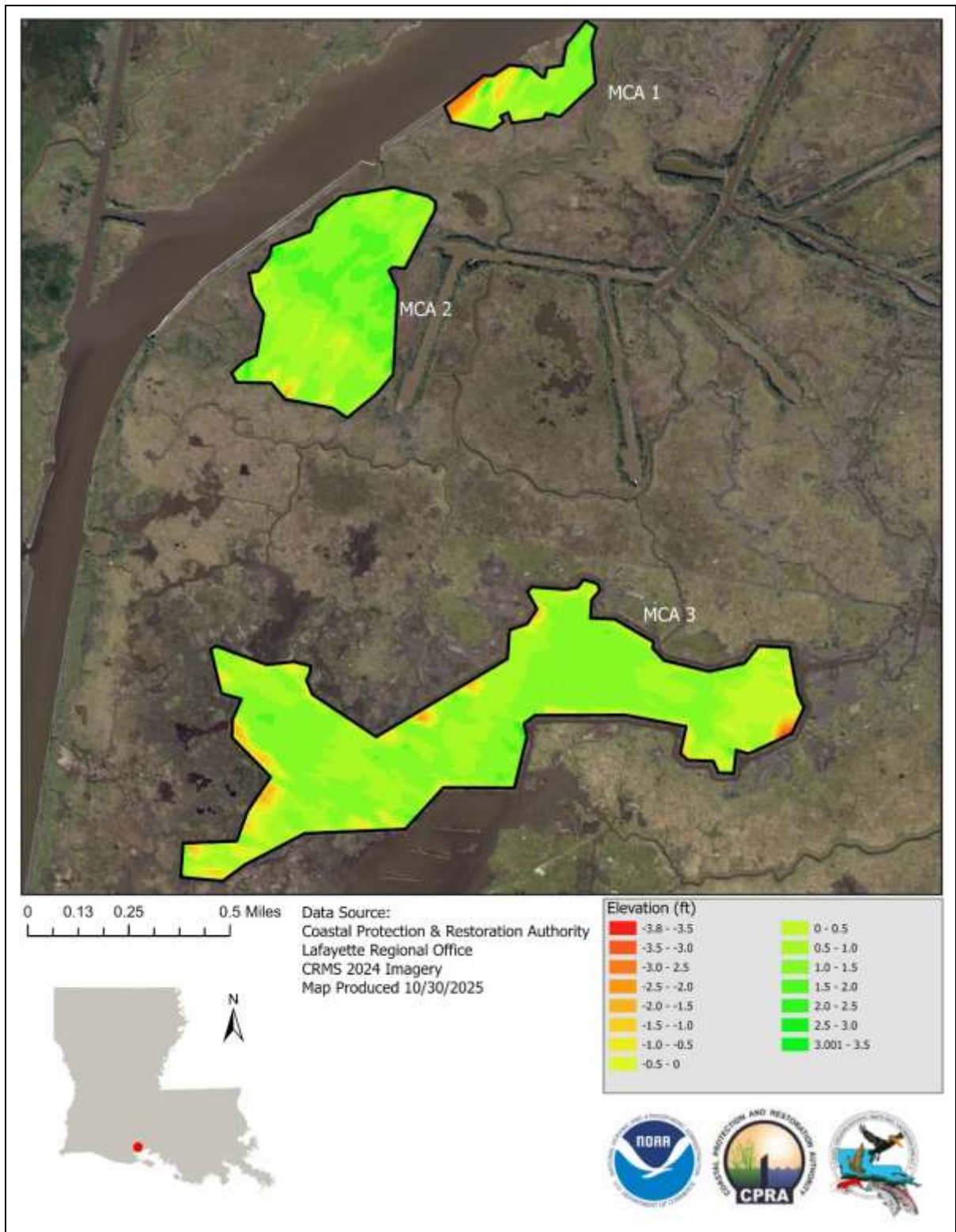


Figure 12. Elevation grid models for the TV-63 marsh creation fill areas from the June 2023 Survey.

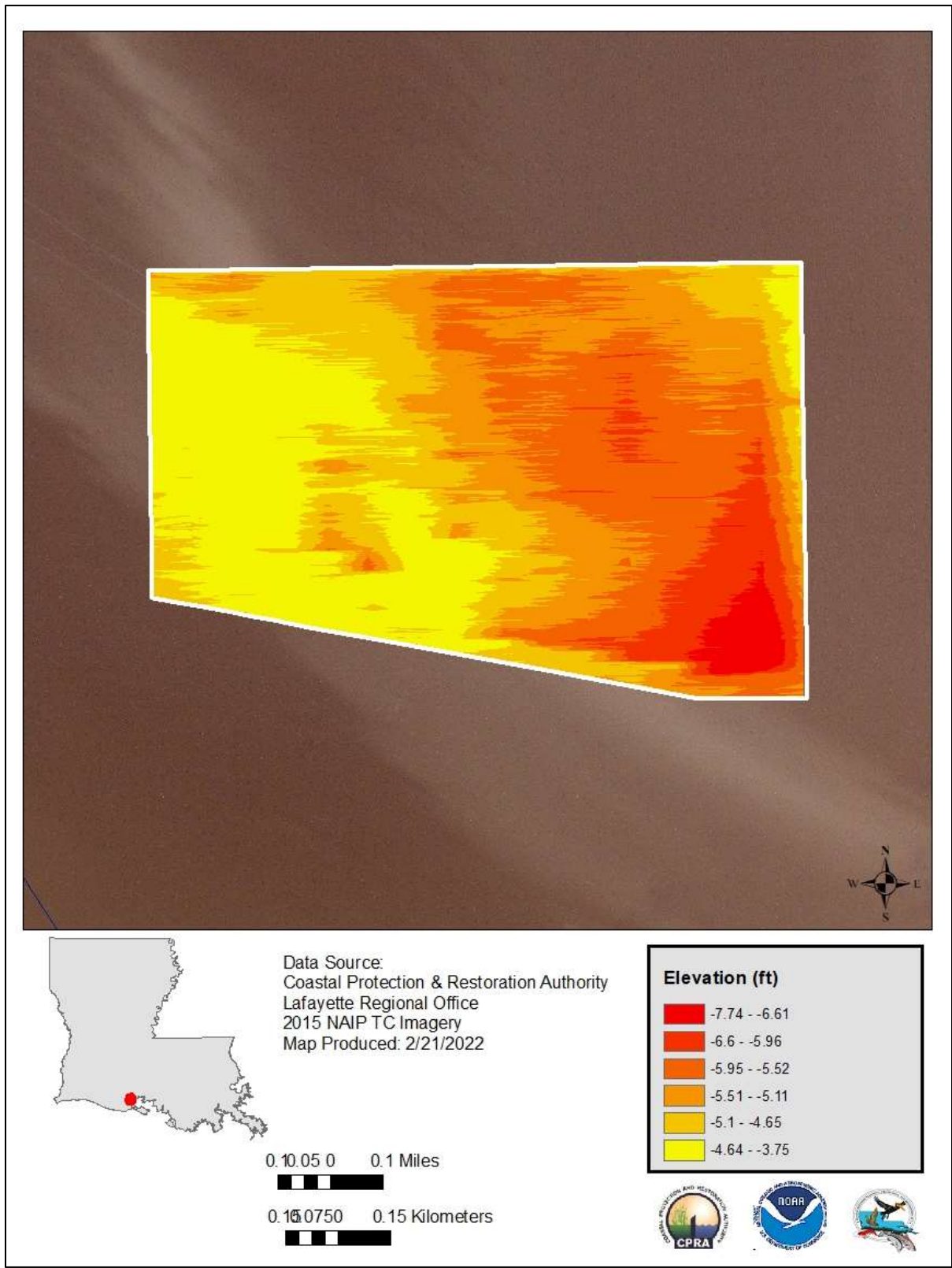


Figure 13. Elevation grid model for the TV-63 borrow area from the December 2020 Survey.

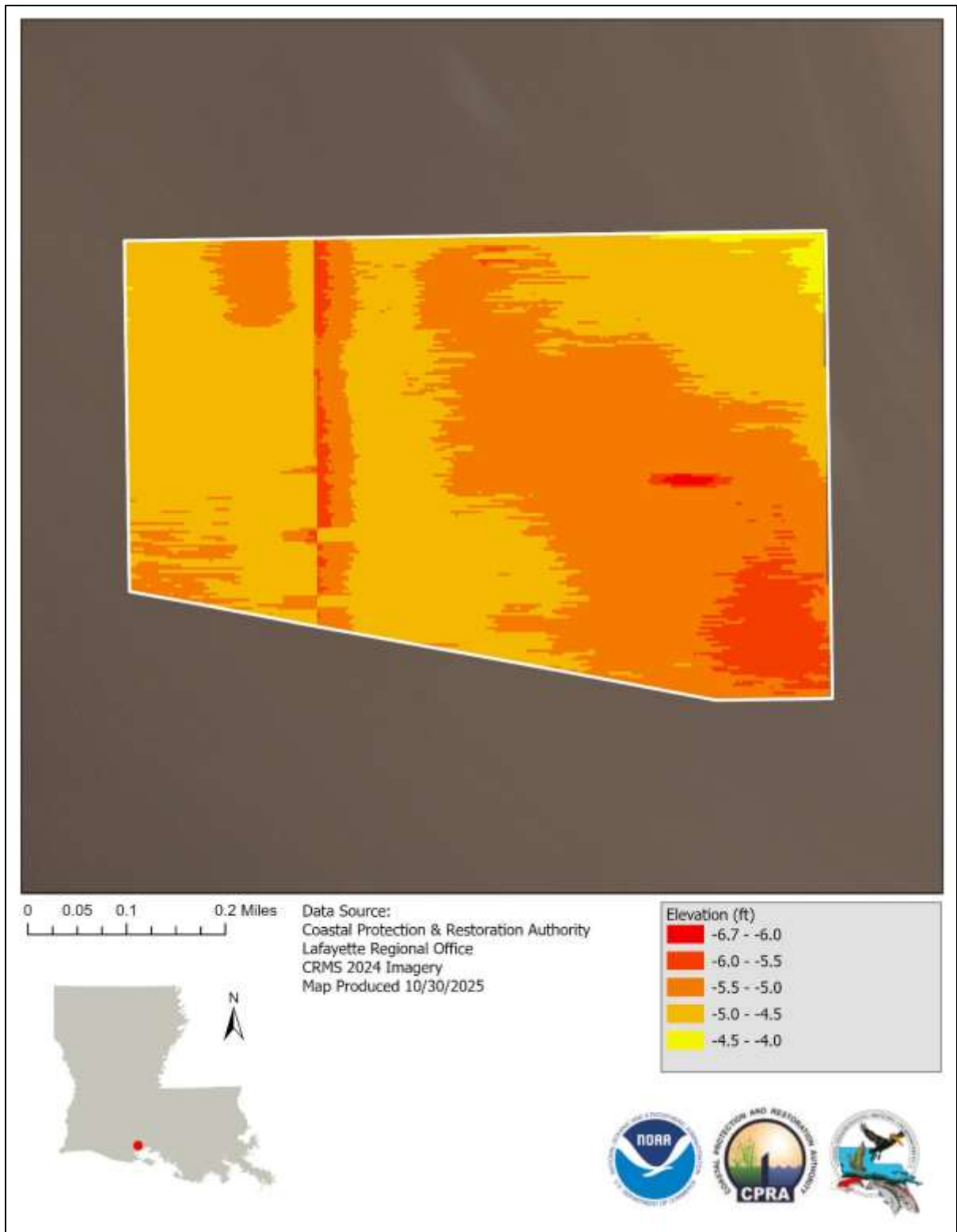


Figure 14. Elevation grid model for the TV-63 borrow area from the June 2023 Survey.

Vegetation

Emergent vegetation data was collected in 2020. The project’s goal for vegetation is to create and nourish new and existing brackish marsh. The marsh class, according to species observed on the initial post-construction 2020 vegetation survey was intermediate at all stations except two, which were brackish, in both the created and natural areas. The classifications are based on the species observed, which are nearly identical within the two areas (Figure 15). Dominant species are *Spartina patens* and *Schoenoplectus americanus*, which are reflective of an intermediate marsh. Occasionally occurring species, such as *Bolboschoenus robustus* and *Juncus roemerianus* sway the classifications toward brackish. Species diversity is greater in the created areas with *Typha* sp., *Alternanthera philoxeroides*, *Spartina alterniflora* among others occurring in trace amounts, which differs from other marsh creation projects within the region that are typically dominated by *S. alterniflora* and salt-tolerant succulents such as *Salicornia depressa*. This reflects the fresher conditions of the borrow source in Little Vermilion Bay as porewater salinities within the MCAs were similar to the surrounding marshes one year after construction. Though the species observed are alike between the two areas of the project, the percent cover is nearly double within the natural area owing to the fact that the newly-created marsh creation areas are still in the process of vegetating post-construction. As mentioned above, significant ponding was noted in the eastern section of MCA 3. As of the first vegetation survey in 2020, this area was very sparsely vegetated (Figure 16).

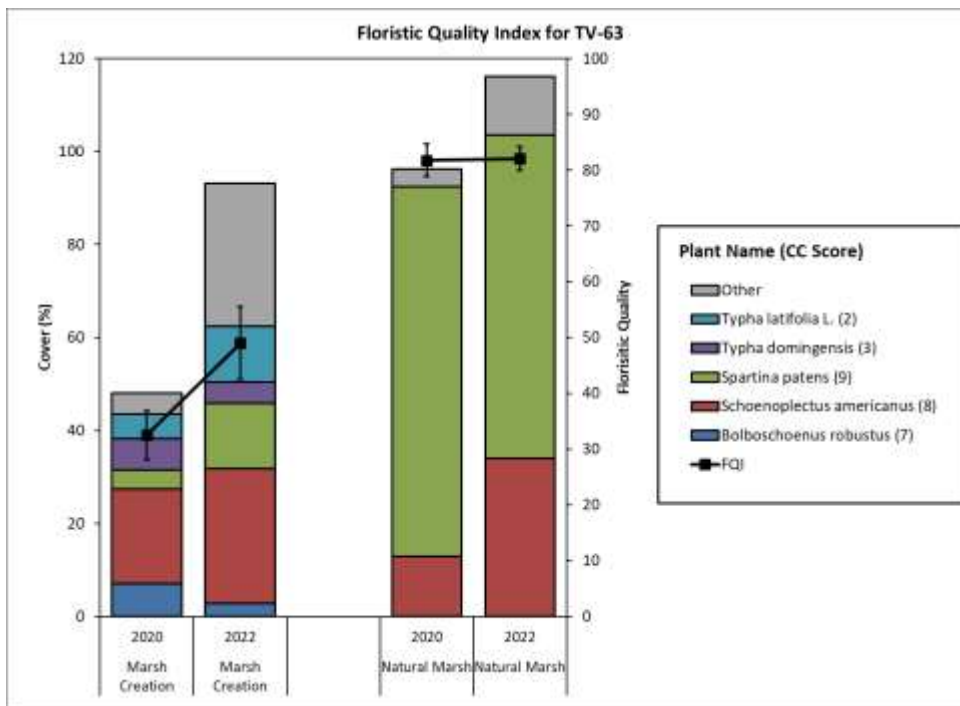


Figure 15. Percent coverage and floristic quality index of species collected from the TV-63 marsh creation and natural marsh areas in 2020 and 2022. The Coefficient of Conservatism (CC) scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stable species.

The vegetation survey was conducted in October following the hurricanes. Though salinities had spiked during the storms, only minor salinity stress to the vegetation was observed,

particularly on fresher species such as *Typha latifolia* and *Vigna luteola*. More significantly, the natural marsh stations exhibited signs of flood stress and were quaking/floating due to prolonged flooding throughout the fall of 2020. It was estimated that the marsh surface had popped up ~0.5 ft in response to the flooding and was difficult to walk on. Between clumps of vegetation, the surface was extremely soft down to two feet before reaching a firm substrate. In addition, there were isolated incidents of *Spartina patens* laying over or perched from becoming detached from the substrate (Figure 17). This is concerning as the intent of the water control structure modifications was to relieve interior ponding that leads to these floating habitats. However, the vegetation survey was conducted following a very active storm season that produced prolonged flooding from storm surge. Further surveys will determine the project's effect on vegetation in the future.

The project area saw the FQI increase in overall total plant coverage in the MCAs (Fig 15). We saw an increase of more than 30% between the first vegetation survey in 2020 and the second one that was completed in 2022. Project areas are typically vegetated around year three post construction of the MCA. TV-63 was completed in 2019 and a majority vegetated before 2022. As mentioned we saw low coverage percentages in the MCA area in 2020 with the area mainly being composed of *Schoenoplectus americanus*, *Bolboschoenus robustus* and both species of *Typha*. We didn't see an increase in the main vegetation seen between 2020 and 2022 other than a boom in the percentage of *Spartina patens*, along with an increase in multiple smaller flora species which were classified in the Other portion of the percentage. In addition, the eastern section of MCA3 saw significant vegetation colonization compared to the 2020 survey (Figure 18).

CRMS0618 is located within a managed marsh across Freshwater Bayou from the project, but has a similar species assemblage to the project area (Figure 19). The site is dominated by *S. patens* and *S. americanus* but is classified as brackish, due to the presence of *Distichlis spicata* and *Juncus roemerianus*. The site saw a drop in cover in 2020 but rebounded in 2021 due to an increase in *S. americanus*, even though the cover of *S. patens* dropped slightly. This is a positive sign that the busy hurricane season of 2020 did not have lasting impacts on the vegetation of the area. For the 2021 survey we saw a boom of *Schoenoplectus americanus* that took over as one of the main species in the area alongside *S. patens* that historically has thrived in the area. The same trend was observed through 2023 at CRMS618; *Schoenoplectus americanus* and *Spartina patens* were together as the majority of flora in the area. CRMS0501 is located within a brackish marsh south of the project area that is unmanaged and has a direct connection to Freshwater Bayou (Figure 20). This site didn't see the drop in cover during 2020 that CRMS0618 did, but saw a slight decrease in 2021. The drop in cover is primarily related to a reduction in the fresher species *T. latifolia*, *V. Luteola* and *Ipomoea sagittata* with an increase in *B. robustus*. After 2021 the CRMS site saw an increase in total cover through 2022 due to increased growth of *Schoenoplectus americanus* and *S. patens* in the 2022 vegetation season. Again, a jump in total cover was recorded due to the appearance of *Vigna luteola* across the CRMS site in 2023.





Figure 16. Detached *Spartina patens* within the natural marsh of the project area in October 2020.



Figure 17. Open water area on the east side of MCA 3 taken during the October 2020 site visit.



Figure 18. View of the same area on the east side of MCA 3 taken during the September 2022 site visit showing vegetation colonization.

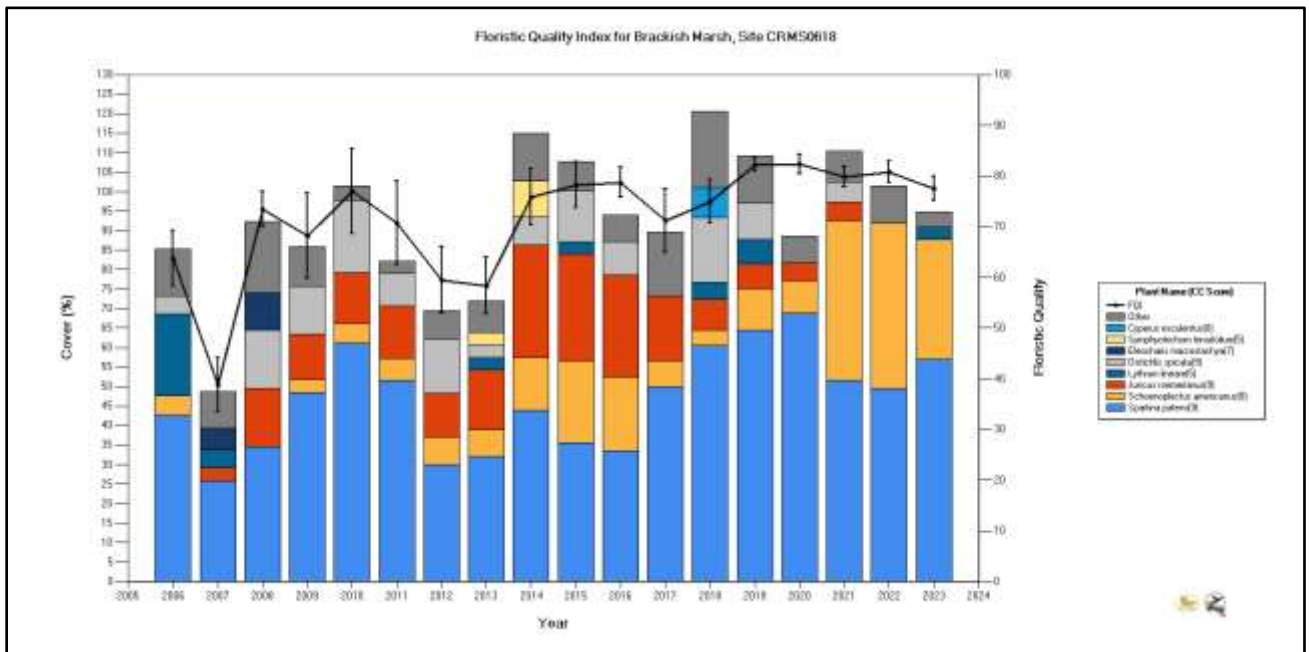


Figure 19. Percent coverage and floristic quality index of species collected from CRMS0618 2006-2023. The Coefficient of Conservatism (CC) scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stable species.

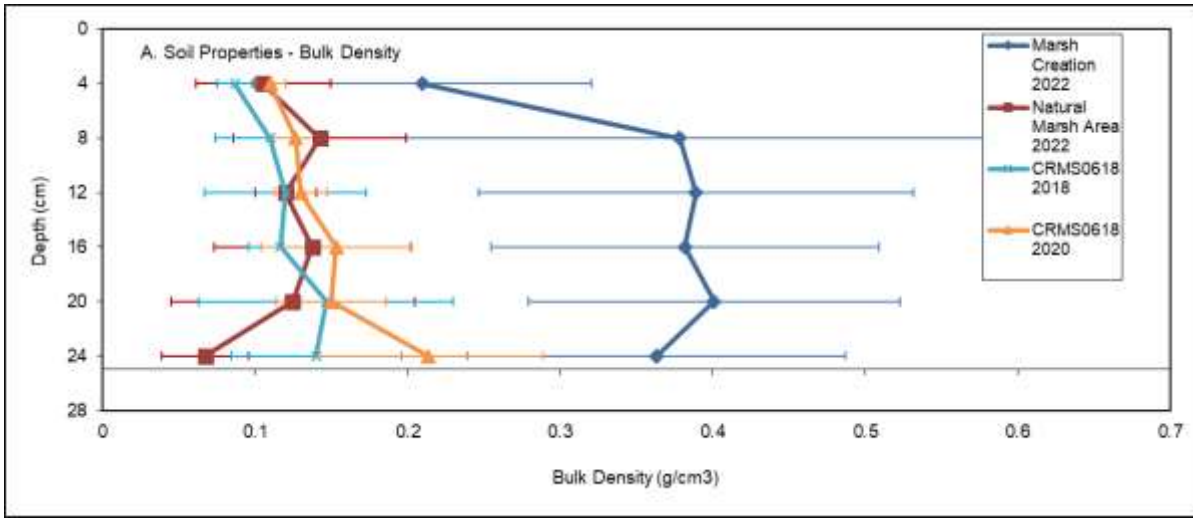


Figure 21. Bulk Density measurements collected from the Marsh Creation area (2022), Natural Marsh Area (2022), and CRMS0618 (2018 and 2020)

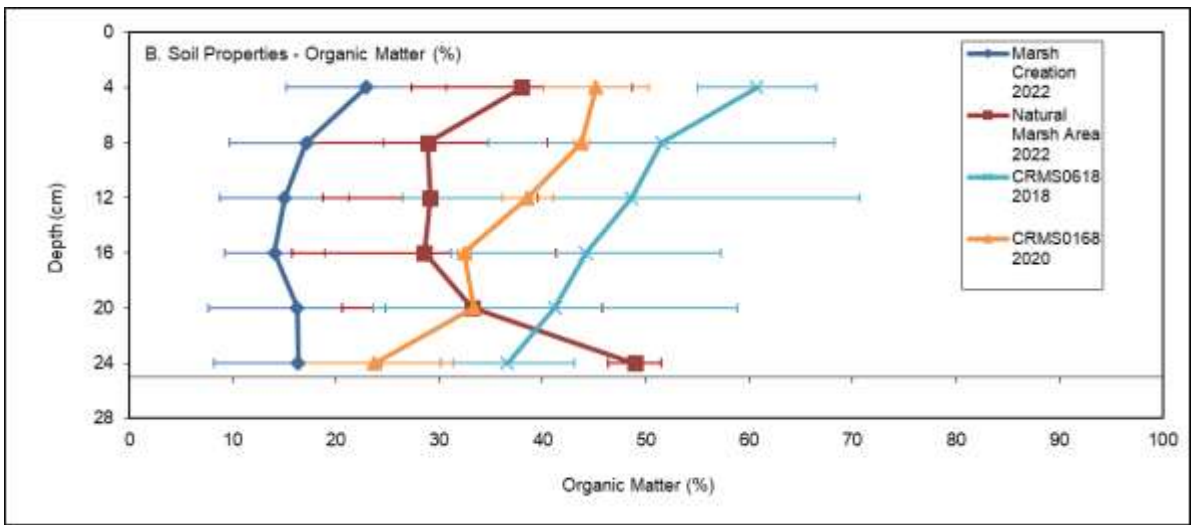


Figure 22. Percent Organic Matter measurements collected from the Marsh Creation Area (2022), Natural Marsh Area (2022), and CRMS0618 (2018 and 2020)

IV. Conclusions

a. Project Effectiveness

The TV-63 project area has effectively reintroduced sediment into the MCA areas as well as allowed for improved flow of water across the project area from the north to south as the project was designed to do. There has been a steep decline in MCA elevation as the sediment settles in the creation areas, yet the vegetation continues to increase coverage. As it pertains to the specific goals of the project, we have successfully created more than 400 acres of marsh inside the three MCAs that have all successfully vegetated and flourished for multiple seasons. As mentioned prior, the decrease in elevation leaves the MCAs lower than the predicted settlement curve and may settle lower than they are presently. Natural accretion of the marsh may help offset some settlement and potentially play a part in elevation gain. This could be inferred from future elevation surveys.

Along with the created marsh area, the introduction of culverts throughout the project area has allowed for more effective flow of water and sediment from the north end of the project to the south end where water can exit the project. Culverts have visibly moved sediment across the projects and into designated areas.

b. Recommended Improvements

Some of the water control structures on the north end have silted in, reducing or eliminating their functionality. This should be addressed with an O&M event. The project has also lost hydrological control due to breaches to the impoundment surrounding the project area that was not part of the project. While these breaches may be effective for drainage, it exposes the project area to saltwater intrusion as well as increased tidal flow from Vermilion Bay. The project does not have the O&M funds to complete these repairs as these were not project features, but other funding streams should be explored. Increased gapping of the MCA3 dike could potentially help with ponding on the east side of the cell, which holds water throughout the year.

c. Lessons Learned

The borrow area located in Little Vermilion Bay filled in rapidly to near pre-construction levels within 4 years of dredging. Geotechnical properties of the infill should be investigated to determine suitability for future marsh creation borrow material. The survey that will be completed in 2025 will confirm the borrow area's fill and elevation relative to the surrounding bay bottom.



V. Literature Cited

- Cretini, K.F., and Steyer, G.D. 2011, Floristic Quality Index-An assessment tool for restoration project and monitoring sites in coastal Louisiana: U.S. Geological Survey Fact Sheet 2011-3044, 4p.
- Steyer, G.D., R.C. Raynie, D.L. Steller, D. Fuller, and E. Swenson. 1995 (revised 2000). Quality management plan for the Coastal Wetlands Planning, Protection, and Restoration Act monitoring program. Open-file series no. 95-01 (Revised June 2000). Baton Rouge: Louisiana Department of Natural Resources, Coastal Restoration Division. 97 pp.
- Taylor, A.M., S.M. Haynes, F. Cuccio, J.D. Foret. Cole's Bayou Marsh Restoration (TV-63) Final Design Report, November 2017. Louisiana Coastal Protection and Restoration Authority. Baton Rouge, LA. 40 pp, plus Appendices.
- Todd M. Folse, Thomas E. McGinnis, Leigh A. Sharp, Jonathan L. West, MelissaK. Hymel, John P. Troutman, Dona Weifenbach, William M. Boshart, Laurie B. Rodrigue, Danielle C. Richardi, W. Bernard Wood, C. Mike Miller, Elizabeth M. Robinson, Angelina M. Freeman, Camille L. Stagg, Brady R. Couvillion, and Holly J. Beck. 2023. [A Standard Operating Procedures Manual for the Coastwide Reference Monitoring System-Wetlands and the System-Wide Assessment and Monitoring Program: Methods for Site Establishment, Data Collection, and Quality Assurance/Quality Control.](#) Louisiana Coastal Protection and Restoration Authority. Baton Rouge, LA. 252 pp.



APPENDIX A
(Inspection Photographs)



APPENDIX B
(Three Year Budget Projection)



**Cole's Bayou Marsh Restoration/ TV63 / PPL 21
Three-Year Operations & Maintenance Budgets 07/01/2022 - 06/30/2025**

Project Manager	O & M Manager	Federal Sponsor	Prepared By
	Mel Guidry	NMFS	Jody White

	2022/2023 (-3)	2023/2024 (-4)	2024/2025 (-5)
Maintenance Inspection	\$ 9,600.00	\$ 9,600.00	\$ 9,600.00
Structure Operation			
State Administration	\$5,000.00	\$ 18,000.00	\$ 5,000.00
Federal Administration	\$7,400.00	\$ 3,400.00	\$ 3,400.00

Maintenance/Rehabilitation

22/23 Description: E&D

E&D	\$74,000.00
Construction	
Construction Oversight	
Sub Total - Maint. And Rehab.	\$ 74,000.00

23/24 Description: Dike Gapping & Ponding relief

E&D	\$ -
Construction	\$ 375,000.00
Construction Oversight	\$ 40,000.00
Sub Total - Maint. And Rehab.	\$ 415,000.00

24/25 Description:

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

	2022/2023 (-3)	2023/2024 (-4)	2024/2025 (-5)
Total O&M Budgets	\$ 96,000.00	\$ 446,000.00	\$ 18,000.00

O & M Budget (3 yr Total)	\$ 560,000.00	Sept 1, 2022
Unexpended O & M Budget	\$ 176,629.38	Incr. request
Remaining O & M Budget (Projected)	\$ (383,370.62)	\$530,251
		\$146,880



OPERATION AND MAINTENANCE BUDGET WORKSHEET
 Cole's Bayou Marsh Restoration/ PROJECT NO. TV-63/ PPL NO. 21 / 2022-2023

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	\$9,600.00	\$9,600.00
General Structure Maintenance	LUMP	0	\$0.00	\$0.00
Engineering and Design	LUMP	1	\$36,000.00	\$36,000.00
Operations Contract	LUMP	0	\$0.00	\$0.00
Construction Oversight	LUMP	0	\$0.00	\$0.00

ADMINISTRATION

CPRA Admin.	LUMP	1	\$5,000.00	\$5,000.00
FEDERAL SPONSOR Admin.	LUMP	1	\$7,400.00	\$7,400.00
SURVEY Admin.	LUMP	0	\$0.00	\$0.00
OTHER				\$0.00
TOTAL ADMINISTRATION COSTS:				\$12,400.00

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:	DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
	Secondary Monument	EACH	0	\$0.00	\$0.00
	Staff Gauge / Recorders	EACH	0	\$0.00	\$0.00
	Bathymetry / Topography	LUMP	1	\$38,000.00	\$38,000.00
	TBM Installation	EACH	0	\$0.00	\$0.00
	Other	LUMP	0	\$0.00	\$0.00
TOTAL SURVEY COSTS:					\$38,000.00

GEOTECHNICAL

GEOTECH DESCRIPTION:	DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
	Borings	EACH	0	\$0.00	\$0.00
	OTHER				\$0.00
TOTAL GEOTECHNICAL COSTS:					\$0.00

CONSTRUCTION

CONSTRUCTION DESCRIPTION:	DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
	Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE
	Rip Rap	0	0.0	0	\$0.00
		0	0.0	0	\$0.00
		0	0.0	0	\$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	\$4.00	\$0.00
	Dredging	CU YD	0	\$0.00	\$0.00
	Sheet Piles (Lin Ft or Sq Yds)		0	\$0.00	\$0.00
	Timber Piles (each or lump sum)		0	\$0.00	\$0.00
	Timber Members (each or lump sum)		0	\$0.00	\$0.00
	Hardware	LUMP	0	\$0.00	\$0.00
	Materials	LUMP	0	\$0.00	\$0.00
	Mob / Demob	LUMP	0	\$0.00	\$0.00
	Contingency (25%) (1,795,650 x 0.25)	LUMP	0	\$0.00	\$0.00
	General Structure Maintenance	LUMP	0	\$0.00	\$0.00
			0	\$0.00	\$0.00
			0	\$0.00	\$0.00
			0	\$0.00	\$0.00
TOTAL CONSTRUCTION COSTS:					\$0.00

TOTAL OPERATIONS AND MAINTENANCE BUDGET: \$96,000.00



OPERATION AND MAINTENANCE BUDGET WORKSHEET
 Cole's Bayou Marsh Restoration/ PROJECT NO. TV-63/ PPL NO. 21 / 2023-2024

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	\$9,600.00	\$9,600.00
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	1	\$40,000.00	\$40,000.00

ADMINISTRATION

CPRA Admin.	LUMP	1	\$18,000.00	\$18,000.00
FEDERAL SPONSOR Admin.	LUMP	1	\$3,400.00	\$3,400.00
SURVEY Admin.	LUMP	0	\$0.00	\$0.00
OTHER				\$0.00
TOTAL ADMINISTRATION COSTS:				\$21,400.00

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:					
Secondary Monument	EACH	0	\$0.00	\$0.00	
Staff Gauge / Recorders	EACH	0	\$0.00	\$0.00	
Bathymetry / Topography	LUMP	0	\$0.00	\$0.00	
TBM Installation	EACH	0	\$0.00	\$0.00	
Other	LUMP	0	\$0.00	\$0.00	
TOTAL SURVEY COSTS:				\$0.00	

GEOTECHNICAL

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

CONSTRUCTION

CONSTRUCTION DESCRIPTION:					
Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE	
Rip Rap	0	0.0	0	\$0.00	\$0.00
	0	0.0	0	\$0.00	\$0.00
	0	0.0	0	\$0.00	\$0.00
Filter Cloth / Geogrid Fabric	SQ YD	0	\$0.00	\$0.00	
Navigation Aid	EACH	0	\$0.00	\$0.00	
Signage	EACH	0	\$0.00	\$0.00	
General Excavation / Fill	CU YD	89,063	\$4.00	\$356,250.00	
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	1	\$18,750.00	\$18,750.00	
Contingency (25%) (1,795,650 x 0.25)	LUMP	0	\$0.00	\$0.00	
General Structure Maintenance	LUMP	0	\$0.00	\$0.00	
		0	\$0.00	\$0.00	
		0	\$0.00	\$0.00	
		0	\$0.00	\$0.00	
TOTAL CONSTRUCTION COSTS:				\$375,000.00	

TOTAL OPERATIONS AND MAINTENANCE BUDGET: \$446,000.00



OPERATION AND MAINTENANCE BUDGET WORKSHEET

Cole's Bayou Marsh Restoration/ PROJECT NO. TV-63/ PPL NO. 21 / 2024-2025

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	\$9,600.00	\$9,600.00
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	\$5,000.00	\$5,000.00
FEDERAL SPONSOR Admin.	LUMP	1	\$3,400.00	\$3,400.00
SURVEY Admin.	LUMP	0	\$0.00	\$0.00
OTHER				\$0.00
TOTAL ADMINISTRATION COSTS:				\$8,400.00

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
Secondary Monument	EACH	0	\$0.00	\$0.00
Staff Gauge / Recorders	EACH	0	\$0.00	\$0.00
Bathymetry / Topography	LUMP	0	\$0.00	\$0.00
TBM Installation	EACH	0	\$0.00	\$0.00
Other	LUMP	0	\$0.00	\$0.00
TOTAL SURVEY COSTS:				\$0.00

GEOTECHNICAL

GEOTECH DESCRIPTION:	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
Borings	EACH	0	\$0.00	\$0.00
OTHER				\$0.00
TOTAL GEOTECHNICAL COSTS:				\$0.00

CONSTRUCTION

CONSTRUCTION DESCRIPTION:	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL	
Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE	ESTIMATED TOTAL
Rip Rap	0	0.0	0	\$0.00	\$0.00
	0	0.0	0	\$0.00	\$0.00
	0	0.0	0	\$0.00	\$0.00
Filter Cloth / Geogrid Fabric	SQ YD	0	\$0.00	\$0.00	
Navigation Aid	EACH	0	\$0.00	\$0.00	
Signage	EACH	0	\$0.00	\$0.00	
General Excavation / Fill	CU YD	0	\$4.00	\$0.00	
Dredging	CU YD	0	\$0.00	\$0.00	
Sheet Piles (Lin Ft or Sq Yds)		0	\$0.00	\$0.00	
Timber Piles (each or lump sum)		0	\$0.00	\$0.00	
Timber Members (each or lump sum)		0	\$0.00	\$0.00	
Hardware	LUMP	0	\$0.00	\$0.00	
Materials	LUMP	0	\$0.00	\$0.00	
Mob / Demob	LUMP	0	\$0.00	\$0.00	
Contingency (25%) (1,795,650 x 0.25)	LUMP	0	\$0.00	\$0.00	
General Structure Maintenance	LUMP	0	\$0.00	\$0.00	
		0	\$0.00	\$0.00	
		0	\$0.00	\$0.00	
		0	\$0.00	\$0.00	
TOTAL CONSTRUCTION COSTS:				\$0.00	

TOTAL OPERATIONS AND MAINTENANCE BUDGET:

\$18,000.00

