State of Louisiana

Coastal Protection and Restoration Authority (CPRA)

2020 Operations, Maintenance, and Monitoring Report

for

Freshwater Introduction South of Highway 82

State Project Number ME-16
Priority Project List 9

June 2020
Calcasieu Parish

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Suggested Citation:

Mouledous, M. and Broussard, D. 2020. *2020 Operations, Maintenance, and Monitoring Report for Freshwater Introduction South of Highway 82 (ME-16),* Coastal Protection and Restoration Authority of Louisiana, Lafayette, Louisiana. 35 pp and appendices.

2020 Operations, Maintenance, and Monitoring Report
For
Freshwater Introduction South of Highway 82 (ME-16)

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Preface

This report includes monitoring data collected through December 2019, and the annual maintenance inspections through May 2017. A damage assessment inspection was conducted following Hurricane Laura in September 2020. The Freshwater Introduction South of LA Hwy 82 (ME-16) project is a 20-year Coastal Wetlands, Planning, Protection, and Restoration Act (CWPPRA, Public Law 101-646, Title III, Priority List 9) project administered by the United States Fish and Wildlife Service (USFWS) and the Coastal Protection and Restoration Authority of Louisiana (CPRA).

The 2020 report is the 5th in a series of reports. For additional information on lessons learned, recommendations and project effectiveness please refer to the 2004, 2007, 2011 and 2015 Operations, Maintenance, and Monitoring Reports on the CPRA web site at http://coastal.Louisiana.gov/. These reports will be made available for download at the following website: http://cims.coastal.la.gov/.

I. Introduction

The Freshwater Introduction South of LA Hwy 82 project area is located in the central and eastern portions of Rockefeller State Wildlife Refuge, and Miami Corporation on the eastern end of the Grand Chenier ridge, approximately 10 miles (16.09 km) east of the community of Grand Chenier in Cameron and Vermilion Parishes, La (Figure 1). It is bounded to the west by a canal west of Little Constance Bayou south of Deep Lake, to the south by the Gulf shoreline of the unmanaged marsh south of Unit 6, to the east by Rollover Bayou to a line from Flat Lake to the western boundary of Unit 15 and to the north by Louisiana LA Hwy 82. The project will benefit some 19,988 acres (8,088.87 ha) of which 15,835 acres (6,408.21 ha) are marsh and the remaining 4,153 acres (1,680.66 ha) are open water (USGS 1999).

The “Lakes” subbasin of the Mermentau Basin is experiencing high water levels (>2 ft MLG) due to the existence of locks and gates that control water levels and prevent saltwater intrusion into Grand and White Lakes. The “Chenier” subbasin of the Mermentau Basin is experiencing saltwater intrusion due to lack of freshwater flow caused by the presence of the hydrologic barriers consisting of LA Hwy 82 and the Lakes subbasin gates and locks. Marsh loss is occurring in the Chenier subbasin due to saltwater intrusion and in the Lakes subbasin due to high freshwater water levels which stress *Spartina patens* (marshhay cordgrass) and certain fresh marsh species and cause increased shoreline erosion along White Lake and Grand Lake (Clark 1999).

Most of the soils in the project area are classified as either Clovelly muck, Scatlake mucky clay or Bancker muck, which are level, poorly drained fluid soils (U.S. Department of Agriculture [USDA] 1995). Clovelly muck and Bancker muck are organic and mineral soils respectively, found in brackish marsh, whereas Scatlake mucky clay, prevalent at the southern end of the project area, is a mineral soil found in saline marshes.

The habitats in the project and adjacent areas are brackish and intermediate emergent marsh with saline marsh along the edge of the Gulf of Mexico (Chabreck et al., 1968, Chabreck and Linscombe, 1978, 1988). Dominant emergent vegetation species present in and adjacent to the

project include *Spartina patens* (marshhay cordgrass), *Schoenoplectus americanus* (chairmaker's bullrush), *Distichlis spicata* (inland saltgrass), *Phragmites australis* (Roseau cane) and *Bulboschoenus robustus* (leafy three-square) (USDA-NRCS 2002).

The project is co-sponsored by the United States Fish and Wildlife Service (USFWS) and the Coastal Protection and Restoration Authority (CPRA) and is designed to move water from Grand and White Lakes (when adequate head differential exists) to marsh areas south of LA Hwy 82, in order to moderate elevated salinities in Areas A, B and C. In addition 14 acres (5.67 ha) of marsh were created through the construction of terraces in Area B (Figure 1).

A model was prepared by Fenstermaker and Associates and a report was submitted to evaluate the effects of the project (C.H. Fenstermaker and Associates [CHFA] 2003). The modeling software used was MIKE 11, a one-dimensional model used for simulating flows, sediment transport, and water quality in estuaries, rivers, irrigation systems, and similar water bodies. The model showed that, overall, the project would reduce salinities in Area A. The magnitude of salinity reduction varied from each location with variances from 1-2 ppt to 3-4 ppt. The flap gates of the proposed structures at Little Constance Bayou, Dyson Bayou, Cop Cop Bayou, and structures No. 10 and 12 in the Boundary Line Levee should protect Unit 6 and Areas B and C from salinity spikes.

The construction phase of the project consisted of the following components:

1. The borrow canal along Hwy 82 and the trenasse connecting Superior Canal to the borrow canal was widened and deepened.
2. The Grand Volle Ditch was widened and deepened on both sides of Hwy 82 and a conveyance channel was constructed into Grand Volle Lake from Grand Volle Ditch. A barricade was also placed at the intersection of Grand Volle Ditch and Grand Volle Lake
3. Approximately 26,000 linear ft of vegetated "duck-wing" terraces were constructed in the shallow open water between Units 6 and 14.
4. The plug in the Superior Canal branch that forms the eastern boundary of Rockefeller Refuge Unit 13 at the NE portion of Unit 13/Unit 6 Boundary line canal was removed.
5. The existing Little Constance Bayou water control structure was replaced with 4 – 4'-8" X 6'-8" flap gates on the south side and stop logs on the north side.
6. A new structure with four 48 in diameter culverts with flapgates and stoplogs was installed north of the existing Dyson Bayou structure near the NW portion of a small lake in the Unit 6 Boundary Line levee.
7. A new structure with four 48 in diameter culverts with flapgates and stoplogs was installed near the plugged Cop Cop Bayou adjacent to the existing Cop Cop Bayou structure.
8. Two new structures (10 and 12) with three 48 in diameter culverts with flapgates and stoplogs were installed in the Boundary Line Levee south of Unit 14.
9. The existing boundary line channel near the Cameron-Vermilion Parish line was widened and deepened.

Construction of the project features was completed in October 2006.

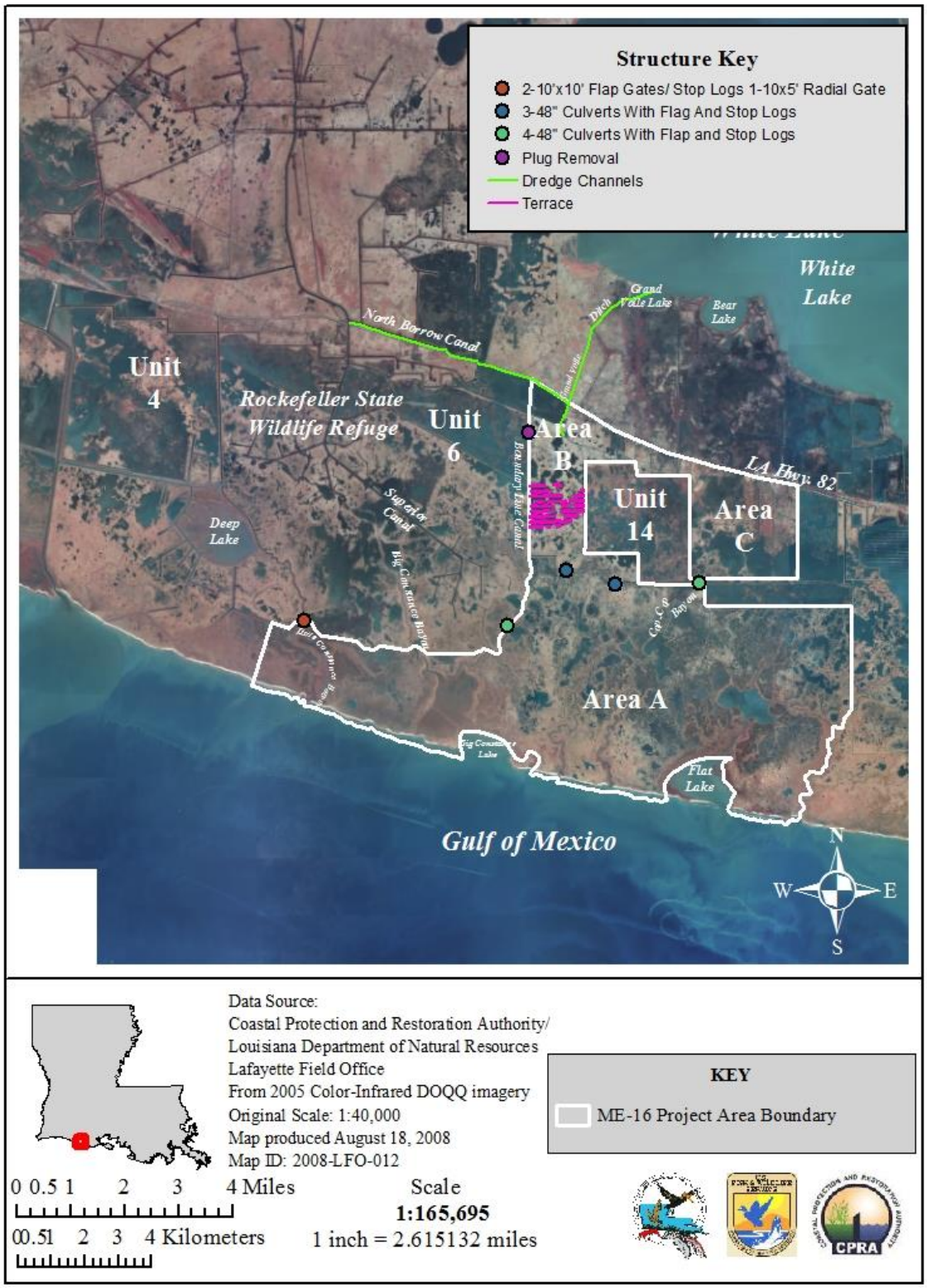

Figure 1. Freshwater Introduction South of Hwy 82 (ME-16) project area and construction features.

II. Maintenance Activity

a. Project Feature Inspection Procedures

The purpose of the annual inspection of the Freshwater Introduction South of Highway 82 Project (ME-16) 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.

An inspection of the Freshwater Introduction South of Hwy 82 Project (ME-16) was held on September 09, 2020, following Hurricane Laura, which made landfall on the Louisiana coast August 29, 2020.

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

b. Inspection Results

New Cop-Cop Structure

The inlet side of the structure received considerable damage. The corrugated aluminum wing walls and all four (4) half-round aluminum risers, along with the variable crest weir inlet and framing hardware were damaged beyond repair. Approximately 20 percent of the soil and rock armoring between the structure inlet and outlet sides has been washed away.

With water levels elevated, it was not possible to assess damage below the water line.

The outlet side of the structure (aluminum backflow gates and timber bulkhead) appeared to be in working order as water could be seen flowing out. The backflow gates were not manually operated to determine condition or operability. (Photos: Appendix A, Photo 1)

Perry Bayou Structure (Formerly Structure No. 12)

The inlet side of the structure received considerable damage. The corrugated aluminum wing walls and all three (3) half-round aluminum risers, along with the variable crest weir inlet were damaged beyond repair. Approximately 80 percent of the soil and rock armament above the structure has been washed away.

With water levels elevated, it was not possible to assess damage below the water line.

The outlet side of the structure (aluminum backflow gates and timber bulkhead) appeared to be in working order as water could be seen flowing out. The backflow gates were not manually operated to determine condition or operability. (Photos: Appendix A, Photo 2)

McNeese Bayou Structure (Formerly Structure No. 10)

The inlet side of the structure received considerable damage. The corrugated aluminum wing walls and all three (3) half-round aluminum risers, along with the variable crest weir inlet and framing hardware were damaged beyond repair. Approximately 30 percent of the soil and rock armament above the structure has been washed away. There was further erosion of the levee directly adjacent to the structure.

With water levels elevated, it was not possible to assess damage below the water line. The first set of timber piles back from inlet were visible above the water line and appear to be sound and plumb.

The outlet side of the structure (aluminum backflow gates and timber bulkhead) appeared to be in working order as water could be seen flowing out. The backflow gates were not manually operated to determine condition or operability. (Photos: Appendix A, Photo 3)

Hess Structure (Formerly New Dyson Structure)

The inlet side of the structure received considerable damage. The corrugated aluminum wing walls and all four (4) half-round aluminum risers, along with the variable crest weir inlet and framing hardware were damaged beyond repair. Approximately 30 percent of the soil and rock armament above the structure has been washed away.

With water levels elevated, it was not possible to assess damage below the water line. The first set of timber piles back from inlet were visible just below the water line and appear to be sound and plumb.

The outlet side of the structure received some minor damage. Three (3) aluminum grating platforms are detached from the outlets and are lifted. One (1) aluminum grating platform has broken free of the bulkhead. Water could be seen flowing out of the backflow gates. The backflow gates were not manually operated to determine condition or operability. (Photos: Appendix A, Photo 4)

Little Constance Structure

Some minor damage to structure and erosion of embankment adjacent to the structure. Minor damage to the structure included detached ladders and spalling of concrete. Spalling of the concrete is most likely a long term aging of the structure and not due to the storm. Some concrete appeared to be broken off due to force and could be storm related. Some rock armament and soil have been washed away on embankment around the structure.

Weir inlets are below water line and were unable to be assessed. Backflow gates appeared to be in the fully closed position below the water line. Therefore, backflow gates could not be assessed. The backflow gate lifting mechanism was not operated, therefore it is unknown if there are any damages to the lifting system. (Photos: Appendix A, Photo 5 & 6)

Earthen Terraces

One segment of terrace in the southernmost area of the terrace field experienced some erosion. Generally, the terrace field is in good condition. (Photos: Appendix A, Photo 7)

Grand Volle South Channel Enlargement

This area was not inspected during this field trip.

Louisiana Highway 82 Channel Enlargement

This area was not inspected during this field trip.

Grand Volle North Channel Enlargement and Marine Barrier

This area was not inspected during this field trip.

Boundary Line Channel Enlargement and Earthen Plug Removal

This area was not inspected during this field trip.

c. Maintenance Recommendations

i. Immediate/ Emergency Repairs

The LRO will make a second site visit to assess the water control structures further, when water levels recede, to allow for a better visual inspection.

All flashboard risers have been damaged beyond repair. All 48 inch corrugated aluminum culverts, timber piles and outlet side of structure are believed to be intact and functional. Until further assessment, the LRO assumes repair will consist of new fabricated flashboard risers with variable crest weir inlet and framing hardware attached to the existing culverts, inlet wing walls replacement, soil fill replacement above and adjacent to structures, rock armament placed above soil fill and adjacent to structures.

A request for FEMA claims has been made, as all damages documented are a result of Hurricane Laura storm surge. A CWPPRA funding increase request will most likely need to be made even with a potential FEMA reimbursement, as FEMA does not generally reimburse at 100% of repair costs.

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

Estimated Repair Costs:

Repair of water control structures, replacement of fill and rock armament

Engineering, Design, Construction Admin & Insp.	$225,000	
CPRA Admin.	$40,000	
Construction	$1,342,000	
Total Estimated Construction Costs:		**$1,607,000**
25% Contingency:		**$401,750**
TOTAL COST TO GET PROJECT IN WORKING ORDER		**$2,008,750**

ii. Programmatic/ Routine Repairs
No maintenance work required at this time.

d. Maintenance History

General Maintenance: Below is a summary of completed maintenance projects and operation tasks performed since December 2006, the construction completion date of the Freshwater Introduction South of Hwy 82 Project (ME-16).

2011 – Hurricane Ike Repairs to New Cop Cop, Structure 12, Structure 10, New Dyson, and Little Constance water control structures – B & J Marine Services – This maintenance project included placing rock revetment at all five water control structures within the project boundary.

- New Cop Cop – approximately 94 tons of rip rap placed
- Structure 12 – approximately 377 tons of rip rap placed
- Structure 10 – approximately 159 tons of rip rap placed
- New Dyson – approximately 198 tons of rip rap placed
- Little Constance – approximately 467 tons of rip rap placed

At the time of construction, the contractor uncovered sinkholes above pipes at the New Cop Cop and New Dyson structures. The sinkholes were created by water infiltrating through breeches in the seal between the pipe and headwall. A change order was issued and the contractor repaired the breeches by excavating soil around the pipe, sealing the pipe and headwall with Wet Dry 700 and redi-mix concrete, and then backfilling.

This maintenance project was a result of damages sustained from Hurricane Ike's storm surge in September 2008. The state was reimbursed for this maintenance project by FEMA in 2011.

Construction Costs	$300,484.44
Engineering and Design, Construction Oversight	$79,202.27
Total Cost	**$379,686.71**

III. Operation Activity

a. Operation Plan

Operation Plan Control Structure	Structure Type	Area Controlled	Salinity Target Level	Water Target Level	Operation
Little Constance Control Structure Note: no change to Big Constance Structure	Existing structure modified from 3 - 10 ft wide X 8 ft deep radial arm gates to flapgates on the south side and stoplogs on the north side.	Unit 6 and Area A Unmanaged-ed unit	5/10 ppt @ Superior Canal-Hwy 82 Bridge	3" below marsh level (0.75 feet NAVD88)	Maintenance – All flapgates open and stop logs removed when target levels not exceeded. Salinity Target – 2 bays closed (i.e., flapgates lowered) when 5 ppt salinity target level reached, stoplogs removed; all bays closed (all 3 flapgates lowered) when 10 ppt salinity reached, stoplogs removed. Water Level Target – Stoplogs set at marsh level to 0.5 feet below marsh level when water levels reach target levels (3 inches BML or 0.75 ft NAVD88) or less.
Existing Dyson Bayou and Bayou Josephine WCSs	4 – 48 inch diameter culverts with flapgates on south and stop logs on north (Unit 6) side.	Unit 6 and Area A	5/10 ppt @ Superior Canal-Hwy 82 Bridge	3" below marsh level (0.75 feet NAVD88)	Maintenance – All gates flapping, stop logs at 2 ft below marsh level Water Level Target – Stop logs set at marsh level to 0.5 ft below marsh level when water levels approach target levels (0.75 ft NAVD88) @ Superior Canal.
New Dyson Bayou WCS	4 – 48 inch diameter culverts with flapgates on south and stop logs on north (Unit 6) side.	Unit 6 and Area A	5/10 ppt @ Superior Canal-Hwy 82 Bridge	3" below marsh level (0.75 feet NAVD88)	Maintenance – All gates flapping, stop logs at 2 ft below marsh level Water Level Target – Stop logs set at marsh level to 0.5 ft below marsh level (1.0 ft to 0.5 ft) when water levels approach target levels (0.75 ft NAVD88) @ Superior Canal.
Existing Cop-Cop Bayou WCS	4 – 48 inch diameter culverts with flapgates on south and stop logs on north side.	Area A and Areas B and C	6 ppt @ Area A at Unit 14 station	3" below marsh level (0.75 feet NAVD88)	Maintenance – All gates flapping, stop logs at 2 ft below marsh level Ingress Period (May-June) – Flapgates raised; Stop logs at 2 ft below marsh level or lower Water Level Target – Stop logs set at marsh level to 0.5 ft below marsh level (1.0 ft to 0.5 ft) when water levels approach target levels (0.75 ft NAVD88) @ Superior Canal.
New Cop-Cop Bayou, New Structures 10 and No. 12 WCS	4 – 48 inch diameter culverts with flapgates on south and stop logs on north side.	Area A and Areas B and C	6 ppt @ Area A at Unit 14 station	3" below marsh level (0.75 feet NAVD88)	Maintenance (Always) – All gates flapping, stop logs at 2 ft or greater below marsh level Water Level Target – Stop logs set at marsh level to 0.5 ft below marsh level (1.0 ft to 0.5 ft) when water levels approach target levels (0.75 ft NAVD88) @ Superior Canal.

Note: The above operational plan submitted by Darryl Clark with USFWS.

a. Actual Operations

In accordance with the operation schedule outlined in the Operation and Maintenance Plan and as shown above, the structures were manipulated by Louisiana Department of Wildlife and Fisheries personnel. See the summary below of operations performed annually for the freshwater introduction structures.

- **2006 -** Water control structures became operational in October, 2006. Stop-logs were set at marsh level at that time (approximately 1.0 NAVD). Stop logs were removed to -1.0 NAVD on October 23, 2006 due to a late tropical weather event that caused high tides and flooding from rainfall. Water levels rose to +2.0 NAVD in the Mermentau Basin in November and receded to +0.7 by the end of December.

- **2007** – Stop-logs in all structures remained at -1.0 NAVD throughout the year. Water levels ranged from 1.90 NAVD in January to 0.74 in November. Stop logs were replaced in December 2007 and set at +0.5 NAVD

- **2008** – Stop-logs were set at approximate marsh level (+1.0 NAVD). At the Old Cop-Cop structure, stop logs were removed between January and April. By June 2008, the structure was damaged and water control was compromised. In June 2008, stop-logs were removed from all remaining structures. After the heavy rainfall events, the stop-logs were replaced and set at +0.80 NAVD.

- **2009 –** Stop-logs were removed in May 2009 and replaced in June 2009 (+0.80 NAVD). The stop-logs were again removed in October 2009.

- **2010 –** Stop-logs were replaced in March 2010 and set at +0.80 NAVD.

- **2011** – Throughout the year, the stop logs were set at +0.80 NAVD due to low water levels and higher salinity.

- **2012 –** In January 2012 the stop logs were removed. The stop-logs were replaced in April 2012 and set at +0.80 NAVD. The stop-logs were removed in July 2012 and again replaced and set at +0.80 NAVD in October 2012.

- **2013 –**The stop-logs were removed in January 2013. In March 2013, the stop-logs were replaced and set at +0.80 NAVD. In May 2013, Chad Courville, manager of Miami Corporation, requested the stop logs be raised to 1.2 feet NAVD (0.2 feet above marsh level) from May until July 15th, 2013. This was requested because of observed lower water levels in Miami's marshes north of the Rockefeller-Miami Boundary Line Levee. The stop-logs were set to +1.20 ft NAVD in June 2013 and remained at that level until July 2014.

- **2014** – All stop-logs were removed in July 2014 but were replaced and set to +1.20 ft NAVD in August for the remainder of the year.

IV. Monitoring Activity

CWPPRA projects authorized for construction after August 14, 2003 will be monitored only with Coastwide Reference Monitoring System-*Wetlands* (CRMS) stations and other existing data collection. At the request of the federal sponsor (USFWS) one additional continuous recorder was specifically added to the project and will be funded through project-specific monitoring funds. There are 4 CRMS-*Wetlands* sites in the project area (Figure 2).

a. Monitoring Goals

The objective of the Freshwater Introduction South of Hwy 82 project is to protect and restore intermediate and brackish marshes within the project area over the 20-year project life.

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

1. Reduce the rate of marsh loss in Area A saline marshes from 0.16%/yr to 0.11%/yr, in Area A brackish marshes from 0.16%/yr to 0.10%yr, in Area B marshes from 0.24%/yr to 0%/yr and Area C marshes from 0.56%/yr to 0.39%/yr.
2. Reduce mean salinity levels in Area A saline marshes from 20 ppt to 17 ppt, in Area A brackish marshes from 15 ppt to 11 ppt, and in Areas B and C, from 5 to 4 ppt.
3. Increase the coverage of emergent wetland vegetation within Areas A, B and C.
4. Increase the coverage of submerged aquatic vegetation (SAV) in the shallow open water areas within Areas A, B and C.

b. Monitoring Elements

Aerial Photography

For project specific data, near-vertical color-infrared aerial photography (1:12,000 scale) was used to measure vegetated and non-vegetated areas for the project area. The photography was obtained in post-construction years 2008 and 2018 and will be collected again in 2024. The original photography was checked for flight accuracy, color correctness and clarity and was subsequently archived. Aerial photography was scanned, mosaicked, and geo-rectified by USGS/NWRC personnel according to standard operating procedures (Steyer et al. 1995, revised 2000).

Aerial photography is collected for the entire coast through CRMS-*Wetlands* and will be used to evaluate ME-16 along with project-specific photography. Land:Water analysis of the 1 km CRMS sites will be done using an automated classification methodology using only manual delineation. Photography for the CRMS sites was collected and analyzed in 2005, 2008, 2012 and 2015.

In addition, land change of the project area as a whole will be assessed from land/water data interpreted from TM satellite imagery (30 m^2 resolution) which is stored on the CRMS viewer website (http://www.lacoast.gov/crms_viewer/); pre- and post-construction comparisons will

be made. Linear regressions were calculated for the period of record. The variability in percent land data points around the slope illustrate the influence of various sources of environmental variance or classification error. Positive slopes indicate increasing percent land or historical land gain and negative slopes indicate decreasing percent land or historical land loss (Couvillion et al., 2017).

Salinity

Salinity is monitored hourly utilizing three CRMS-*Wetlands* sites (599, 609, 610) within the project area and selected reference site CRMS0600. A project-specific continuous recorder (ME16-06) was installed within Muskrat Bayou southeast of Cop-Cop Bayou to further measure project effects on salinity levels (Figure 2). Salinity is measured every hour with a salinity gauge that is attached to the water-level gauge. The gauges are serviced at the same time. Continuous data will be used to characterize average annual salinities throughout the project and reference areas. At each servicing, a measurement of interstitial water salinity is collected adjacent to each gauge. Interstitial water salinity is also determined at the 10 vegetation plots, when vegetation is surveyed. Salinity data will be used to characterize the spatial variation in salinity throughout the project area and to determine if project area salinity is being maintained within the target range. For this report, data were available pre-construction at stations ME16-01, ME16-02, ME16-03, ME16-04R, ME16-05R, and pre- and post-construction at station ME16-06 and CRMS sites inside (599, 609) and outside (600) the project area. Though the boardwalk for CRMS0600 is located within the project area, the recorder is located outside of the project area at the mouth of Rollover Bayou where the reference station ME16-04R was previously located.

Station	Location	Data Collection Period
ME16-01	No. of Cop Cop WCS	5/21/01 – 2/19/04
ME16-02	So. of Cop Cop WCS	5/21/01 – 2/19/04
ME16-03	Area A south of Boundary Line Canal	6/21/01 – 2/19/04
ME16-04R	Rollover Bayou mouth	1/9/02 – 2/19/04
ME16-05R	SW White Lake	2/7/02 – 2/19/04
ME16-06	Area A so. of Cop Cop	3/3/05 – present
CRMS0599	SW Area A	11/14/06 – present
CRMS0609	NE Area A	12/11/07 – present
CRMS0610	SW Area A	1/15/18 – present
CRMS0600	SE Area A	7/7/11 – present

Vegetation

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

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

Water Level

Water level within the marsh is measured at every salinity station 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). The water-level gauge is serviced on approximately a monthly basis. Water level data is used to document the variability in water level in the project and reference areas.

Submerged Aquatic Vegetation (SAV)

SAV coverage was not measured as SAV monitoring was outside the scope of the monitoring plan. Visual observations were made during routine O&M inspections.

Soil Properties

Soil cores were collected one time (within a year of site establishment) to describe soil properties (bulk density and percent organic matter). Three, 4" (10.16-cm) diameter cores were collected to a depth of 24 cm and divided into 6, 4-cm sections at the site. The soil was processed by the Department of Agronomy and Environmental Management at Louisiana State University.

Elevation Change

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

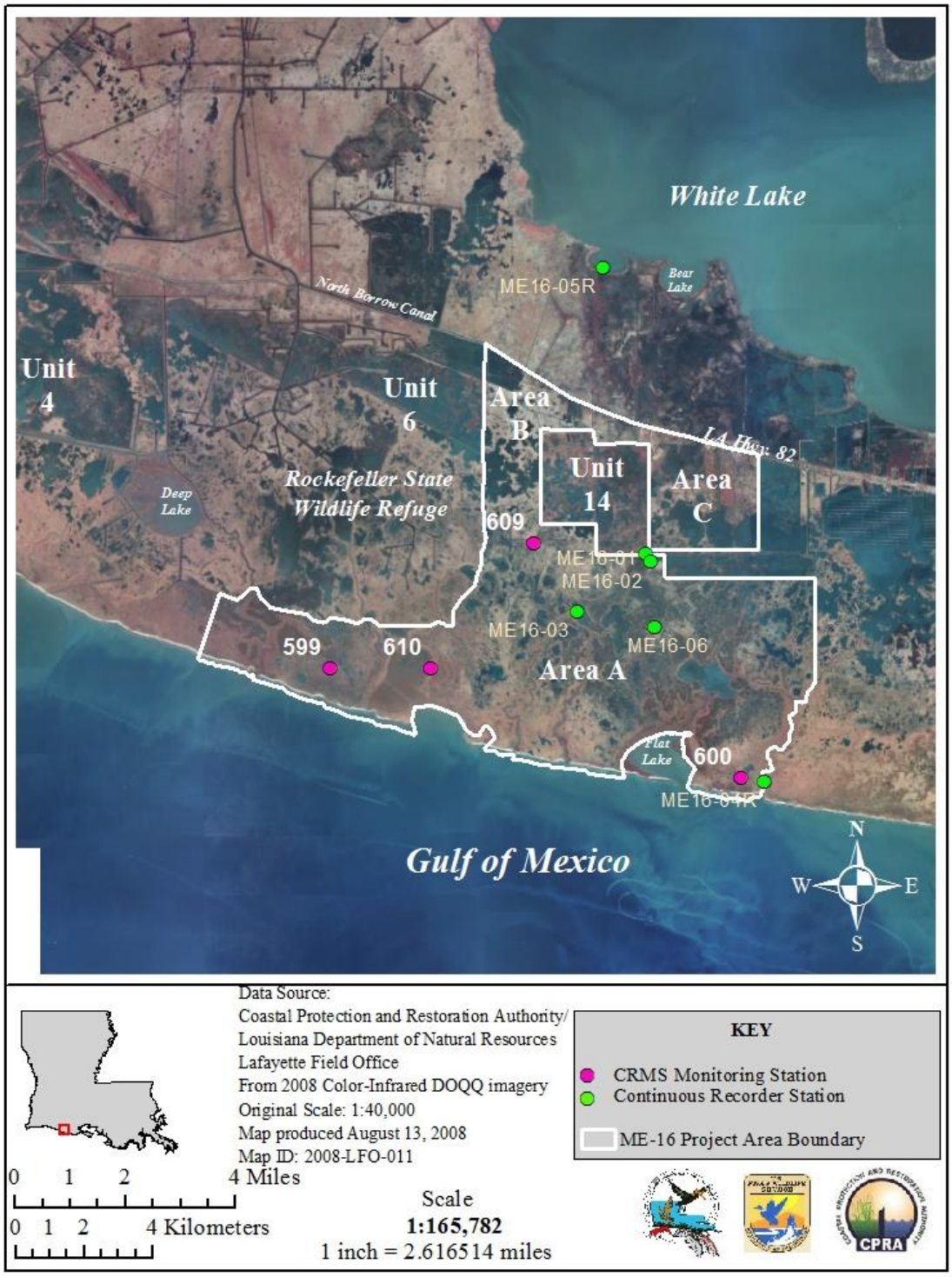

Figure 2. Location of project-specific monitoring stations and CRMS-*Wetlands* sites within Freshwater Introduction South of Hwy 82 (ME-16) project area and surrounding marsh.

c. Monitoring Results and Discussion

Aerial Photography

Post-construction land:water analysis was completed for the 2008 and 2018 aerial photography (Figures 4a and 4b). Results from the 2008 photography indicated 74.15% land and 25.84% water within the project area compared to 73.07% land and 26.92% water in 2018. This results in a loss rate of -0.11%/yr for the project over that time frame, which accomplishes the project's goal to reduce the historical rate of marsh loss, which ranged from 0.16%/yr in Area A to 0.56%/yr in Area C prior to construction.

For the four CRMS-*Wetlands* sites within the project area, the 2005, 2008, 2012, and 2015 digital imagery was collected (Figure 3). Land loss is increasing at CRMS0600 (~30 acres between 2012 and 2015). This site is located on the Gulf of Mexico shoreline and is experiencing high rates of shoreline erosion. CRMS0599 and CRMS0609 had been gaining land prior to 2015, but saw minor losses on the most recent analysis. CRMS0610 again saw small gains.

The general land change trend within the project area prior to construction was slightly positive (0.06% per year) for the 1985 to 2005 time period (the majority of the interior marsh loss within the project occurred prior to this period)(Figure 5). Incorporating the 2005 to 2016 data, which includes the post-construction satellite imagery, causes the general trend to become slightly negative (-0.11% per year). Land loss occurred in 2005, 2008 and 2009 following Hurricanes Rita and Ike, and the project area never recovered. The project area is seeing recurring gulf shoreline erosion as well as high water in recent years due to heavy rainfall, which likely was classified as new water on the most recent analysis.

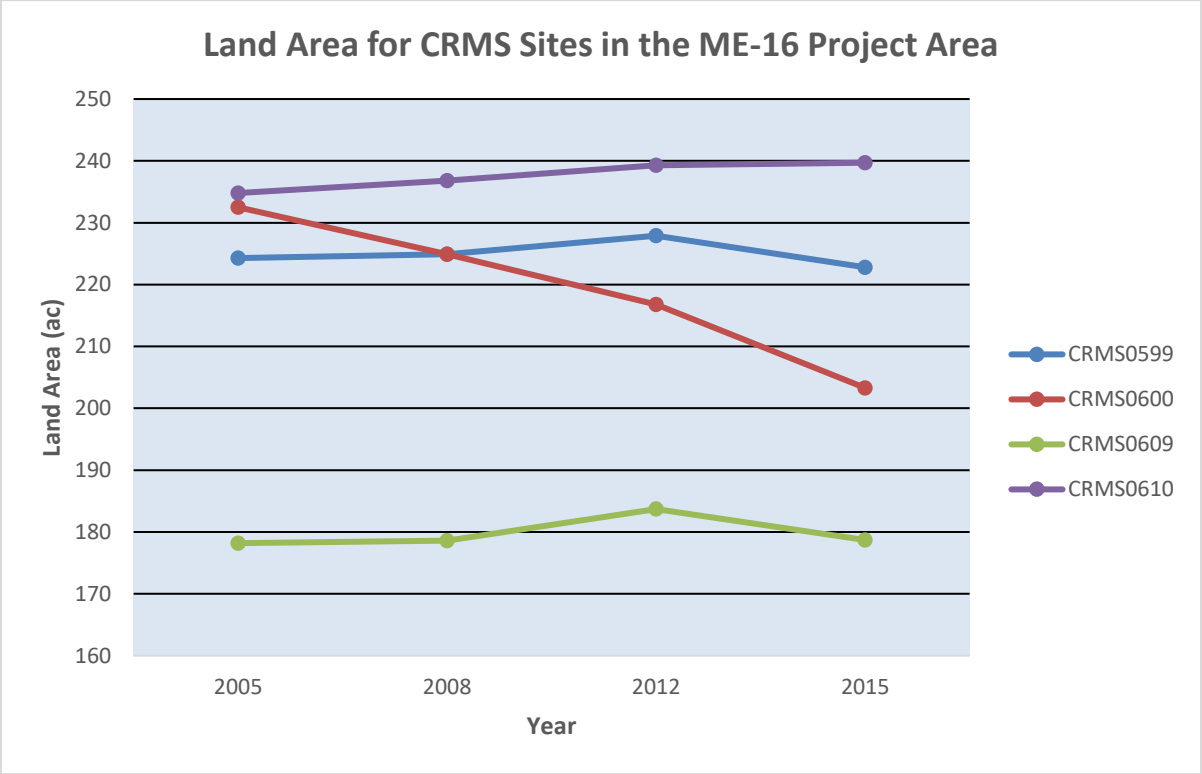

Figure 3. Land Area at CRMS site in the project area for 2005, 2008, 2012 and 2015.

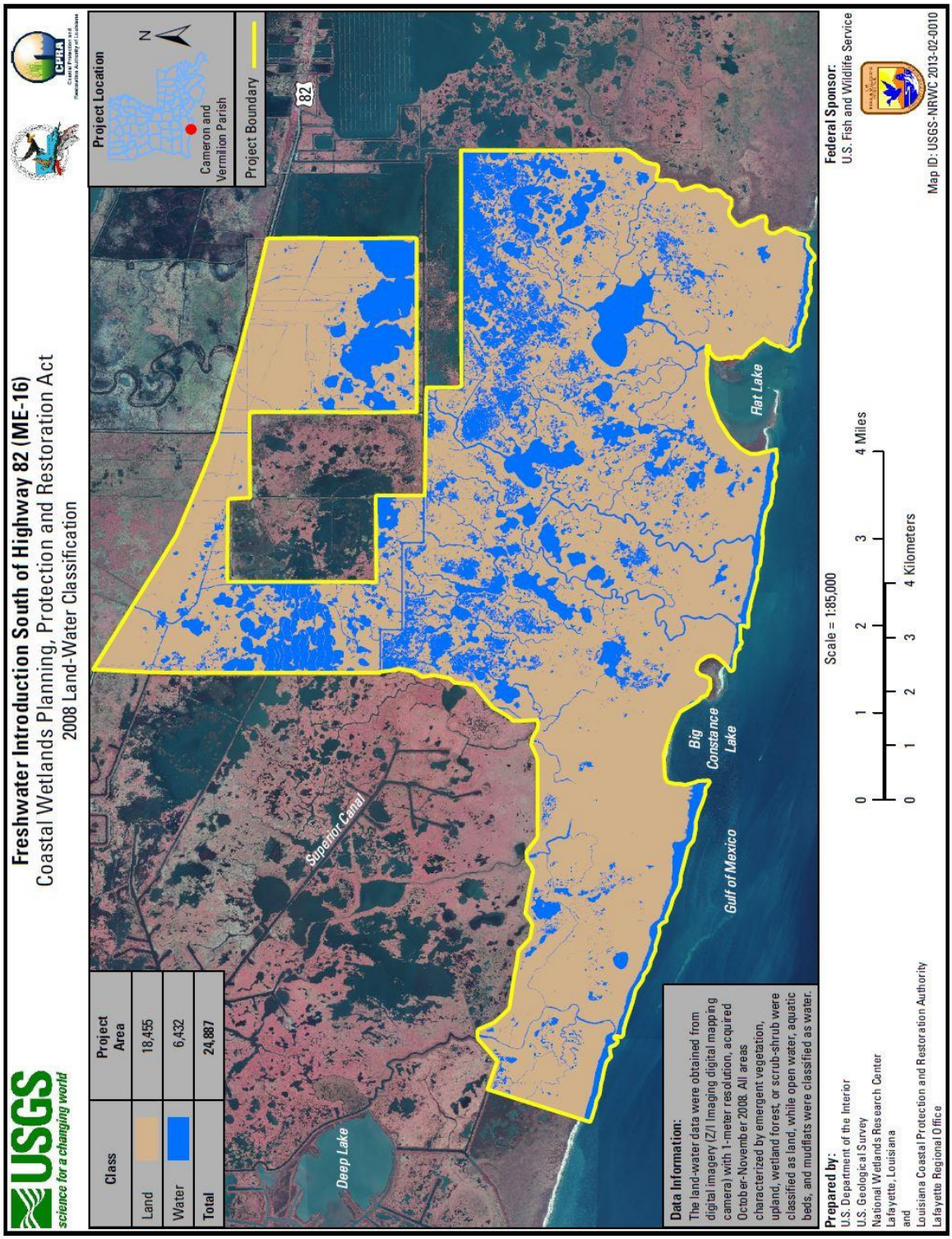

Figure 4a. Freshwater Introduction South of Highway 82 (ME-16) project 2008 land/water analysis.

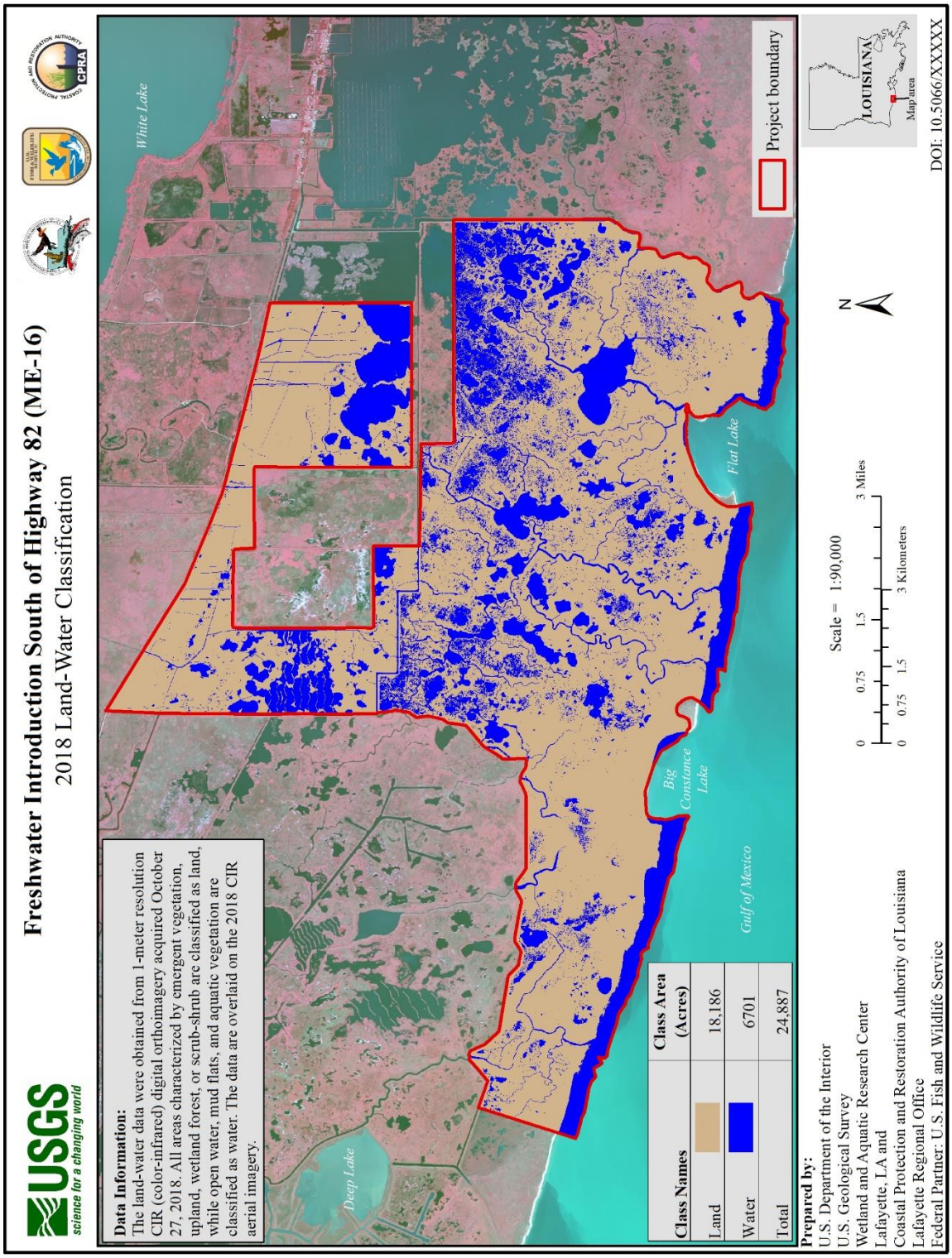

Figure 4b. Freshwater Introduction South of Highway 82 (ME-16) project 2018 land/water analysis.

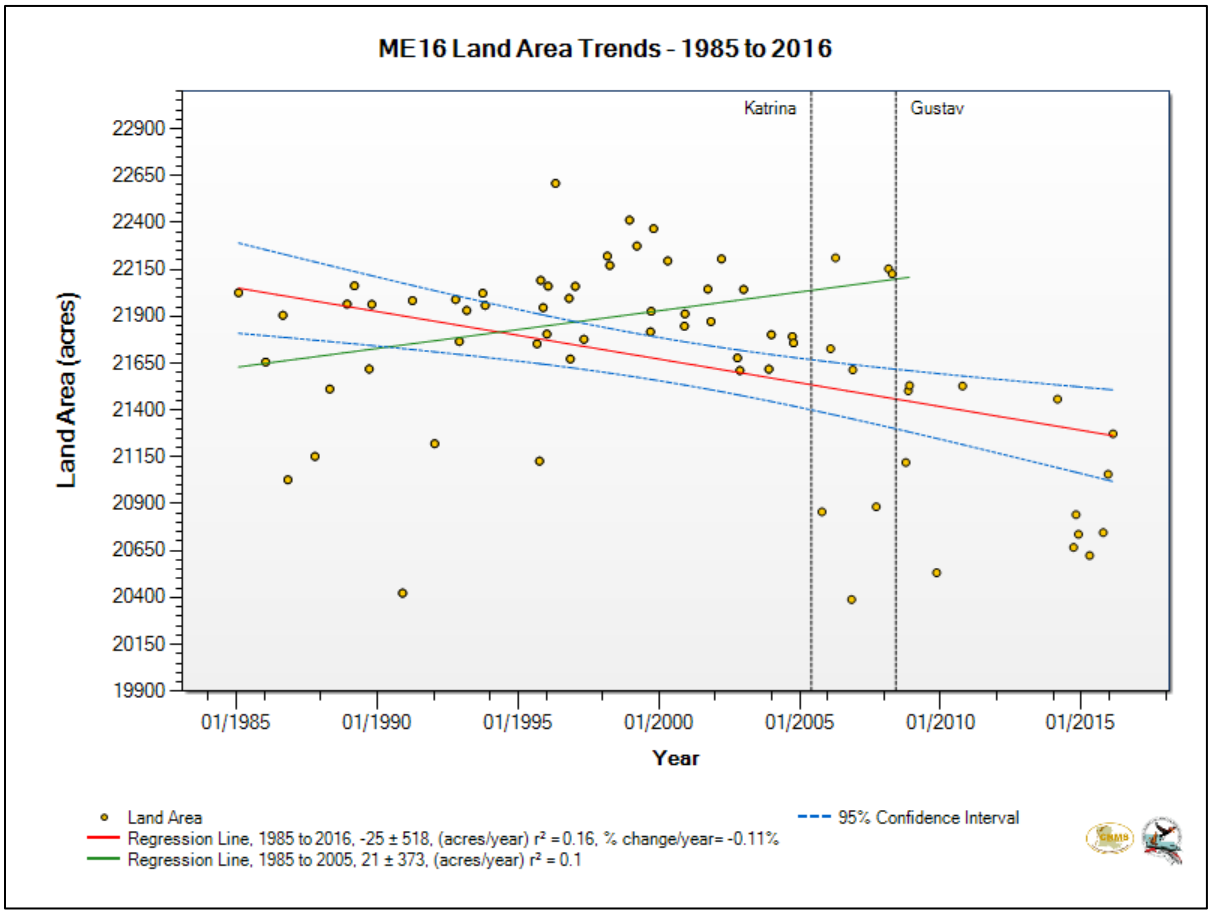

Figure 5. Project scale percent land change for ME-16. Percent land values are displayed for all cloud free TM images available from 1985-2016. The green and red lines depict the pre- and post- construction percent land trends, respectively. Percent land calculated as percent land of total project area. See Couvillion et al. 2017.

Salinity

The project's goal for salinity is to reduce mean salinity levels in Area A saline marshes from 20 ppt to 17 ppt, in Area A brackish marshes from 15 ppt to 11 ppt, and in Areas B and C, from 5 to 4 ppt. Data was collected May 2001 through February 2004 at project and reference sites to document pre-construction conditions in Areas A, B and C (Mouledous and Broussard 2015) and to supply information for the hydrodynamic model (C.H. Fenstermaker and Associates 2003). The model showed that operation of the project structures would enable the project to meet the salinity goals.

Pre- and Post-construction data were collected at site ME16-06, allowing a long term analysis of Central Area A brackish marshes. Annual salinities were compared using a two-way analysis of variance (ANOVA) by combining data from project stations ME16-03 and ME16-06, both located in Central Area A (Figure 6a). The analysis showed the project was significantly fresher pre-construction (12.1 ppt) than post-construction (13.4 ppt); however, this was an unfair comparison of 4.5 years to 14 years of data. More meaningful was the

comparison between years that showed 2011-2019 as an ongoing cycle of wet and dry conditions. Annual precipitation for the area is displayed in Figure 6b, with significant events occurring in 2005 (Hurricane Rita), 2008 (Hurricane Ike), 2011 (year long drought), 2016 (flood), and 2018 (summer drought). The annual salinity is reflective of this precipitation pattern. 2011 had the highest yearly salinity and 2016 had the lowest, but neither were statistically different from other years. Annual salinities have also been decreasing in Area A since project construction, due to multiple years of above average rainfall.

Average weekly salinities at Area A brackish sites (ME16-06, CRMS0609), Area A saline sites (CRMS0599, CRMS0610) and reference saline site CRMS0600 for the period 2011-2019 were also compared using ANOVA. A longer comparison was not possible, since data was not collected at the reference site until 2011. The model tested the effects of year, project, and the interaction of year and project (Figure 6c). All effects were significant with year being vastly more influential than location or the interaction. Due to a drought, 2011 was more saline than all other years ($F_{8,1604} = 35.3$, $p < 0.0001$). Conditions were much fresher in 2016 due to heavy rains, but were not significantly different than 2019. The project and reference areas behaved very similarly during this time period, though the saline locations were slightly saltier than the brackish stations ($F_{2,1604} = 5.9$, $p < 0.0027$) by approximately 1 ppt, though this is not environmentally significant. The interaction of year and project was significant, but weak ($F_{16,1604} = 2.4$, $p < 0.0014$), and likely points to the continued freshening in the saline project locations in 2018 as the other locations spike during a brief drought in the summer of that year, indicating the southwestern corner of Area A did not respond as quickly to the drought as the rest of Area A did. Overall, though, salinities have been trending downward since the drought of 2011. However, this pattern is not unique to the project as the reference area displayed the same trend during this time frame. Mean salinities at the saline sites met the salinity goal of 17 ppt in all of these years except the drought year while the brackish sites only met the salinity goal of 11 ppt in 2016, 2017 and 2019.

The percentage of time within salinity target was then calculated for the brackish and saline project stations (Figure 6d). The results again reflect the continued freshening in recent years as the sites have been within target more often through time. Comparing percentage of time within target to structure status shows the project is very effective at reducing salinity levels in Area A when adequate water levels exist to open the structures (Table 1). During these maintenance operations, the project met the target salinity goals 70% of the time at CRMS0609 and 57% of the time at ME16-06. Benefits are reduced once the structures are closed. When the stop logs are in place (closed), target salinities in Area A were reached nearly half as often as when the stop logs are removed (32% at CRMS0609 and 17% at ME16-06). Within the southwestern portion of Area A, the results are just as significant. When the structures are open, salinities at CRMS0599 were within target 84% of the time, compared to 51% when closed.

Therefore, the project has met the goal of reducing salinities in Area A post-construction, but is largely dependent on climate to do so. Climatic conditions in recent years have increased water levels north of the water control structures, allowing structure openings more often and fresh water to flow, subsequently enabling project marshes to meet target salinity levels more frequently. However, the project is not nearly as effective during low rainfall years. Post-

construction data was not collected in Areas B and C, but we can infer from the results in Area A, that these areas benefited as well from the climate pattern.

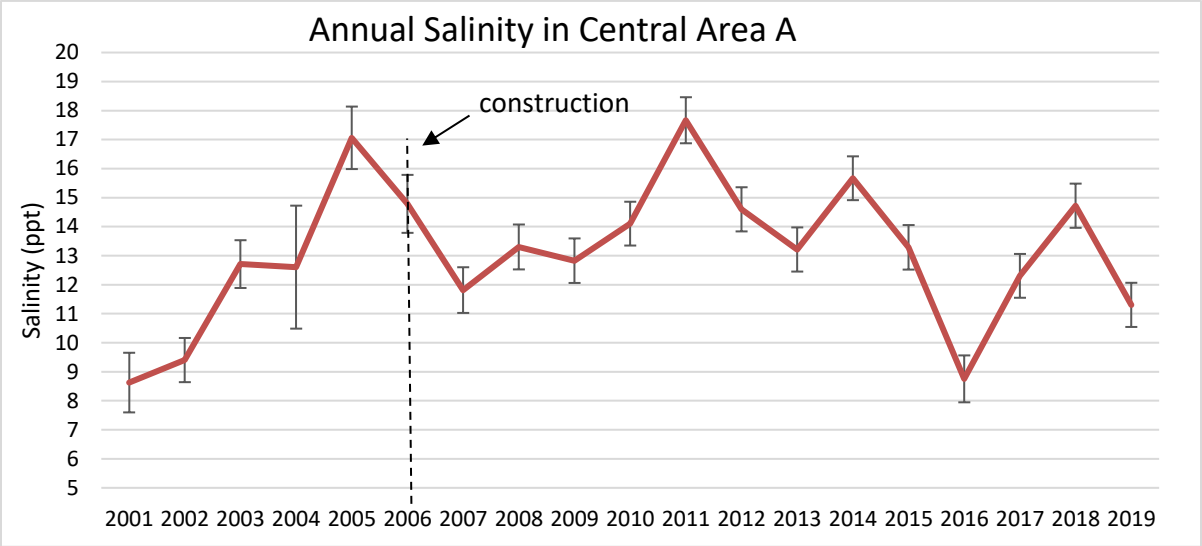

Figure 6a. Annual salinity, calculated from weekly means, and standard errors of continuous salinity data, collected at combined brackish project stations ME16-03 and ME16-06, in Central area A.

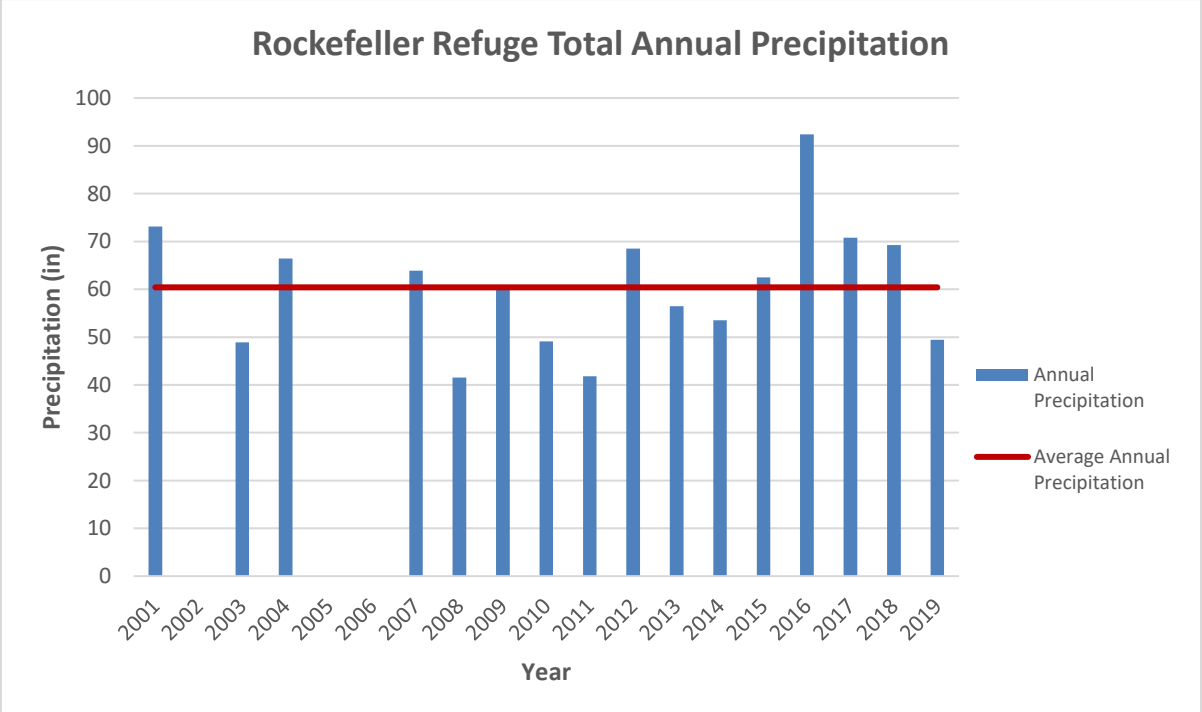

Figure 6b. Annual precipitation for 2001-2019 as collected at Rockefeller Wildlife Refuge (SRCC 2020).

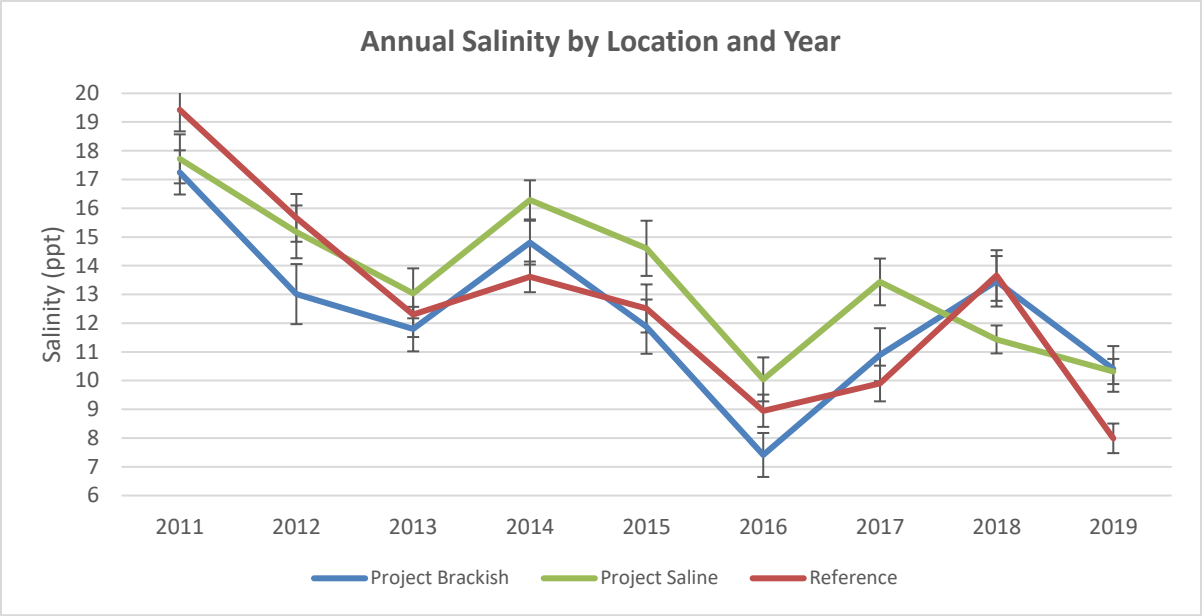

Figure 6c. Annual salinity, calculated from weekly means, and standard errors of continuous salinity collected at project brackish stations (ME16-06, CRMS0609), project saline stations (CRMS599, CRMS0610) and reference saline station CRMS0600 from 2011-2019.

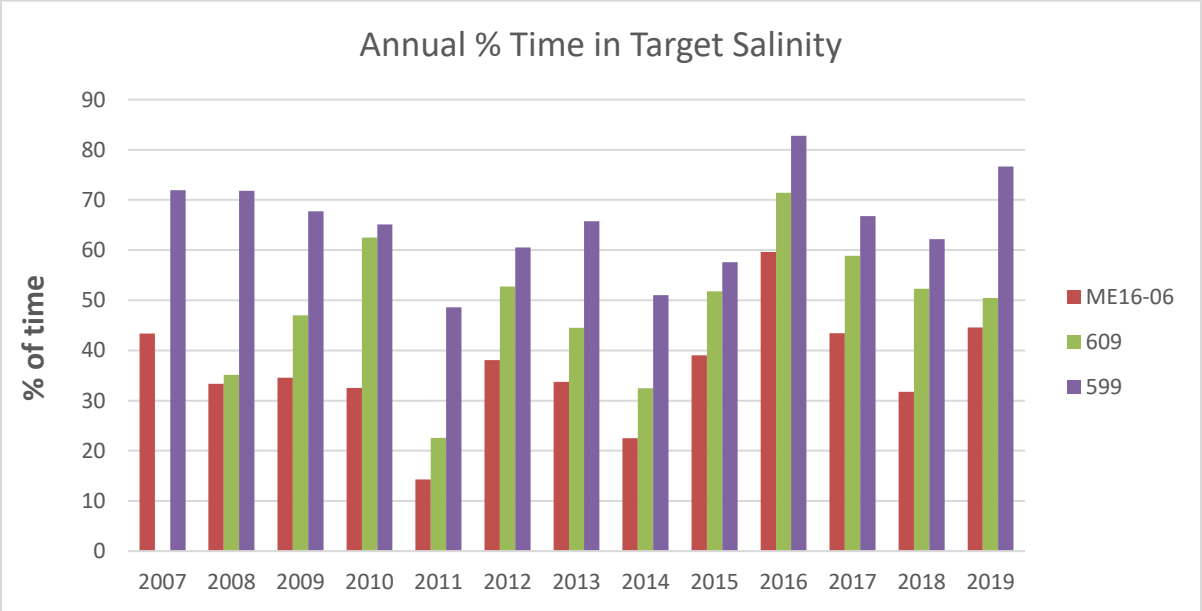

Figure 6d. Percentage of year salinities were inside target range for project brackish stations (ME16-06, CRMS0609) and project saline station CRMS0599.

Table 1. Percentage of time salinities were inside and outside of brackish target range for project brackish stations CRMS0609 and ME16-06 and saline station CRMS0599 at open/closed stop log positions.

Station	Salinity Classification	Stop Log Position	Average Salinity	% Time within Target Salinity
CRMS0609	Brackish	Open	6.83	69.6
		Closed	14.39	32.26
ME16-06	Brackish	Open	9.83	56.67
		Closed	16.63	16.63
CRMS0599	Saline	Open	10.15	84.38
		Closed	16.72	51.40

Means by month of interstitial water salinity is presented in Figures 7a and 7b. The highest salinities occurred in project sites 599 and 600, reflecting the influence of the Gulf of Mexico on these sites. CRMS0600 has averaged over 20 ppt for the entire period of record. Porewater salinities rose above 20 ppt at CRMS0599 after the 2011 drought, but have dropped following the heavy rains of 2016. Project station CRMS0609 (NE Unit A) saw an increase in salinities in 2011 and remained high for a few years before dropping below 10 ppt at the 10 cm level in 2016. Salinities spiked again during the summer drought of 2018, but dropped in 2019. Salinities at the 30 cm level have hovered around 15 ppt since 2014. Project site CRMS0610 (SW Unit A) has seen a steady decline in salinities since 2011, dropping to around 12 ppt at the 10 cm level and dropping from 20 ppt to below 15 ppt at the 30 cm level.

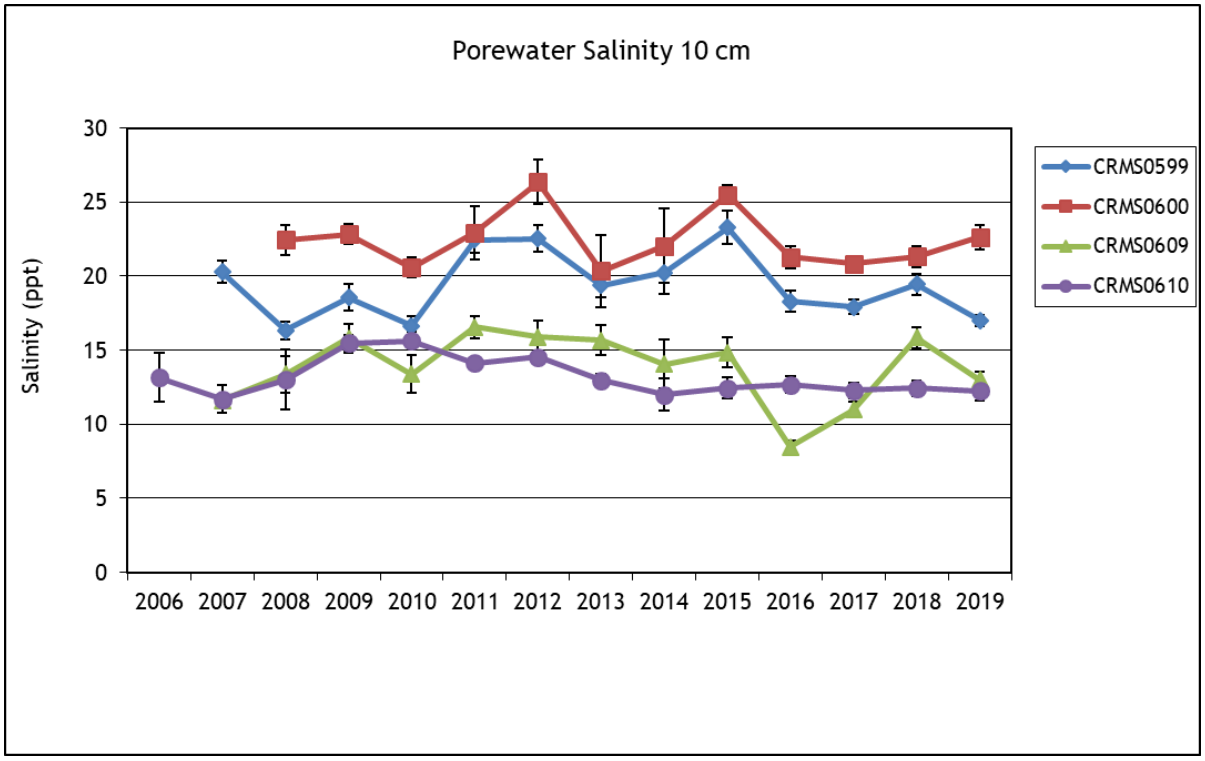

Figure 7a. Yearly Means of Interstitial water salinity at 10 cm below the soil surface. Error bars, where present, represent the mean of stations in that class for that month ± 1 Std Err.

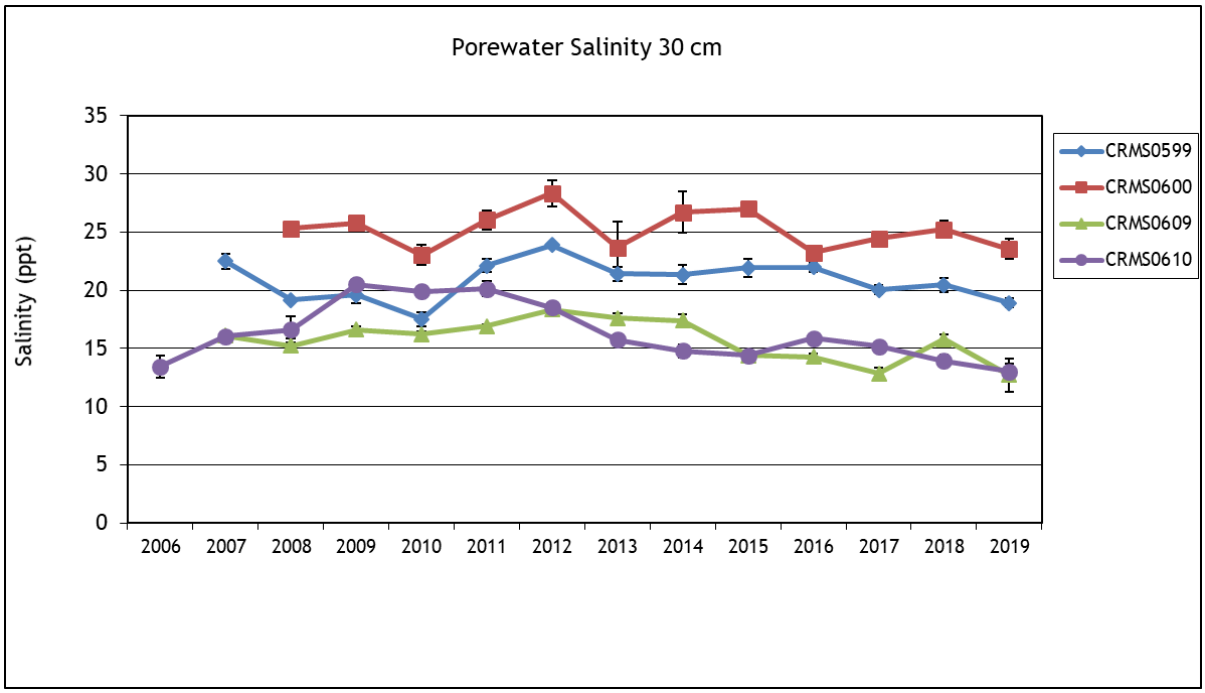

Figure 7b. Yearly Means of Interstitial water salinity at 30 cm below the soil surface. Error bars, where present, represent the mean of stations in that class for that month ± 1 Std Err.

Vegetation

Emergent vegetation data has been collected at project area CRMS sites since construction was completed in 2006. The project's goal for vegetation is to increase the coverage of emergent wetland vegetation within the project area. The coverage of vegetation within the project area was increasing prior to the drought of 2011. All stations showed an increase in cover and floristic quality after recovering from the effects of Hurricanes Rita and Ike, but were then impacted in some way by the drought (Figures 8a – 8d). Brackish site 609, located in the northern part of Area A, showed a steady decrease in cover and FQI from 2011 – 2014, presumably due to lingering effects of the drought, but increased in 2015 and has since remained steady at around 80% cover. This site has been largely dominated by *Spartina patens* through all years sampled, with traces of *Bolboschoenus robustus* and *Distichlis spicata*. In 2014, the appearance of *Spartina alterniflora* at the site resulted from higher soil salinities over the several years prior and has remained at the site.

The three CRMS sites within the southern part of the project area (599, 600, 610) are traditionally considered to be saline sites. The 2019 vegetation survey classified these sites as brackish and they've been trending more brackish through time. Site 610 showed a minor impact from the drought in 2012 and appeared to recover by 2013, but again showed a drop in cover and CC score in 2014. The site saw a larger impact from the flood of 2016 in combination with a fire and was recovering before seeing impacts from the drought in the summer of 2018 as well as high rainfall in 2019. Sites CRMS0599 and CRMS0600 showed only minor impacts from the 2011 drought, both recovering by 2014 to near pre-drought levels. CRMS0599 showed a large increase in cover and quality in 2015-2017, but also showed an effect from the drought in the 2018 and high rainfall in 2019. The high rainfall years of 2016 and 2019 were not noticed at CRMS0600 as cover and CC score have increased and remained high since 2015, likely due to the site's higher elevation in relation to the other sites. These sites all have similar species assemblages to the brackish site CRMS0609 above (*S. patens*, *D. spicata*, *B. robustus)*. The difference appears to be larger concentrations of *D. Spicata*, a more salt tolerant species. In 2011, *Batis maritima*, a saline species, appeared at CRMS0600 and has remained since.

The coverage of vegetation, overall, has increased since construction, meeting the project goal, particularly since percent cover was low following Hurricane Rita (Figure 8e). Project features have enabled project vegetation to recover from storm and drought impacts during normal rainfall years.

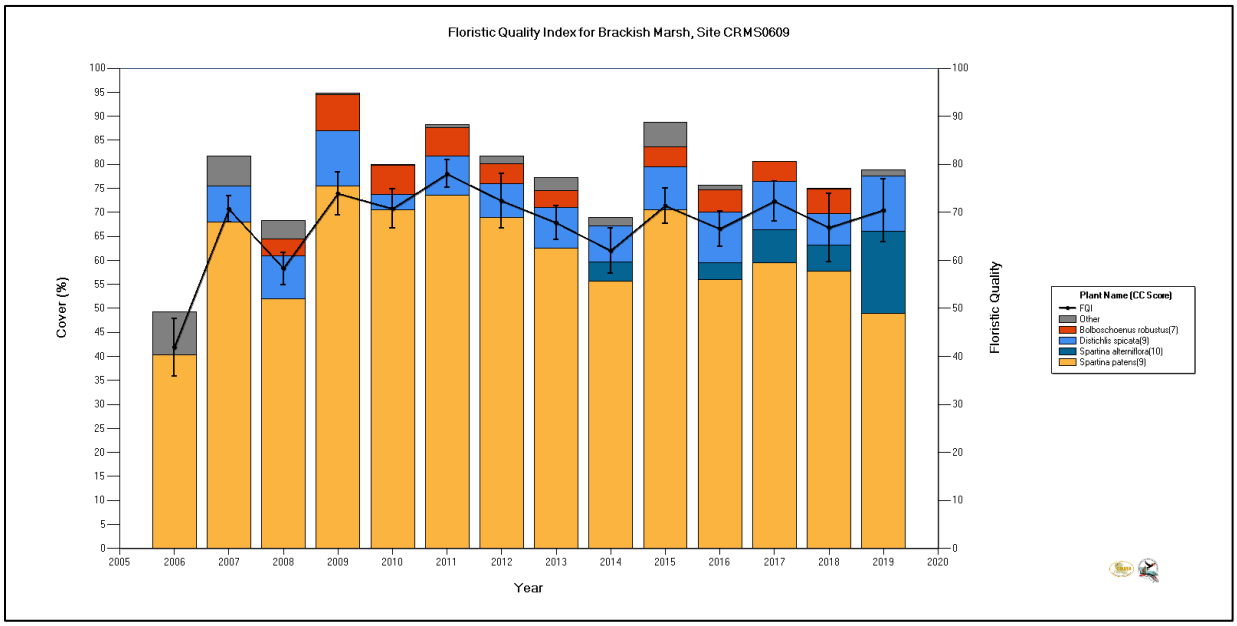

Figure 8a. Percent coverage and floristic quality index of species collected from CRMS0609, NE Area A, within the project area in years 2006 – 2019. The Coefficient of Conservatism (CC) scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stable species.

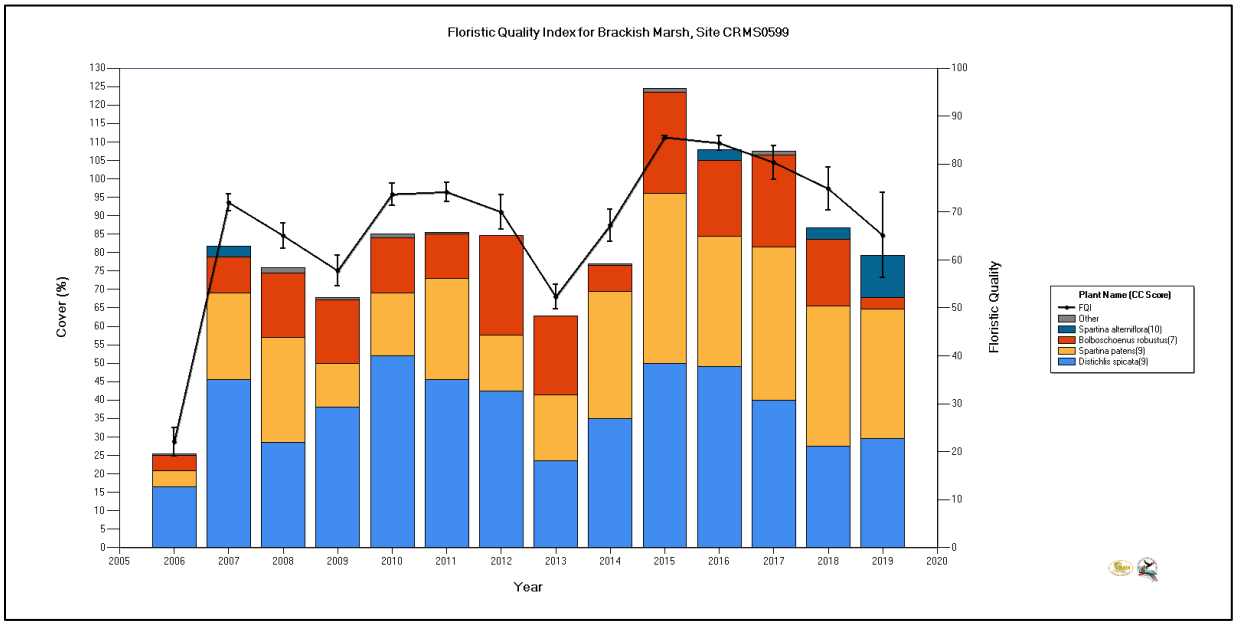

Figure 8b. Percent coverage and floristic quality index of species collected from CRMS0599, SW Area A, within the project area in 2006 - 2019. The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stable species.

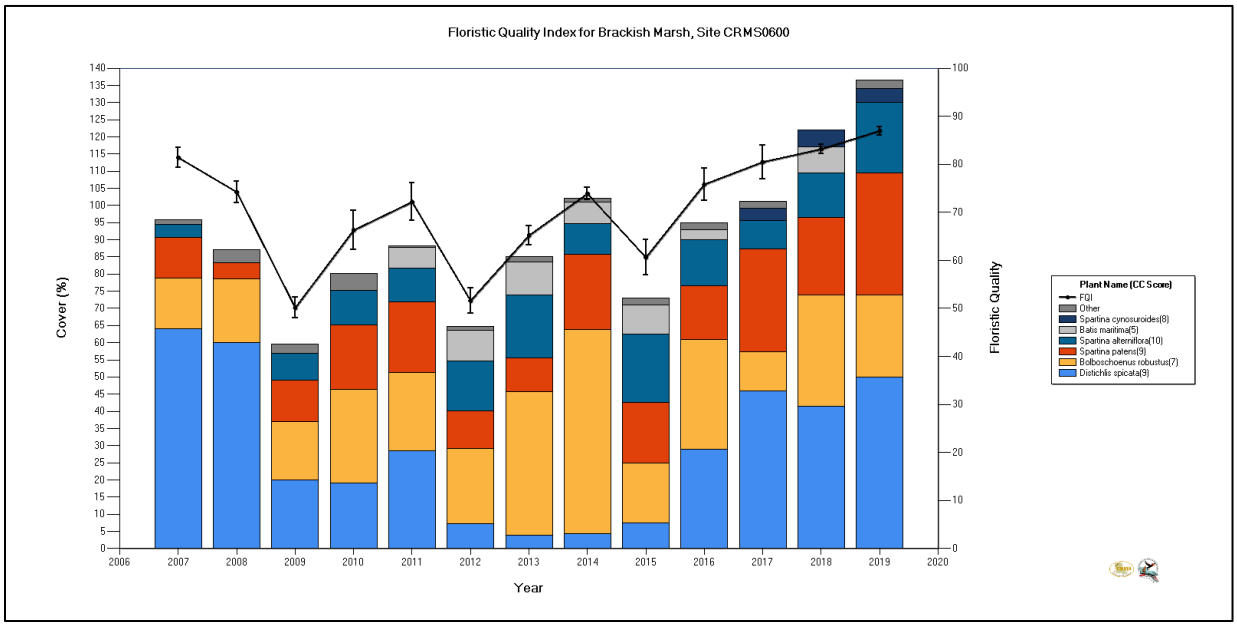

Figure 8bc. Percent coverage and floristic quality index of species collected from CRMS0600, SE Area A, within the project area in years 2007 – 2019. The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance and 10 indicates stable species.

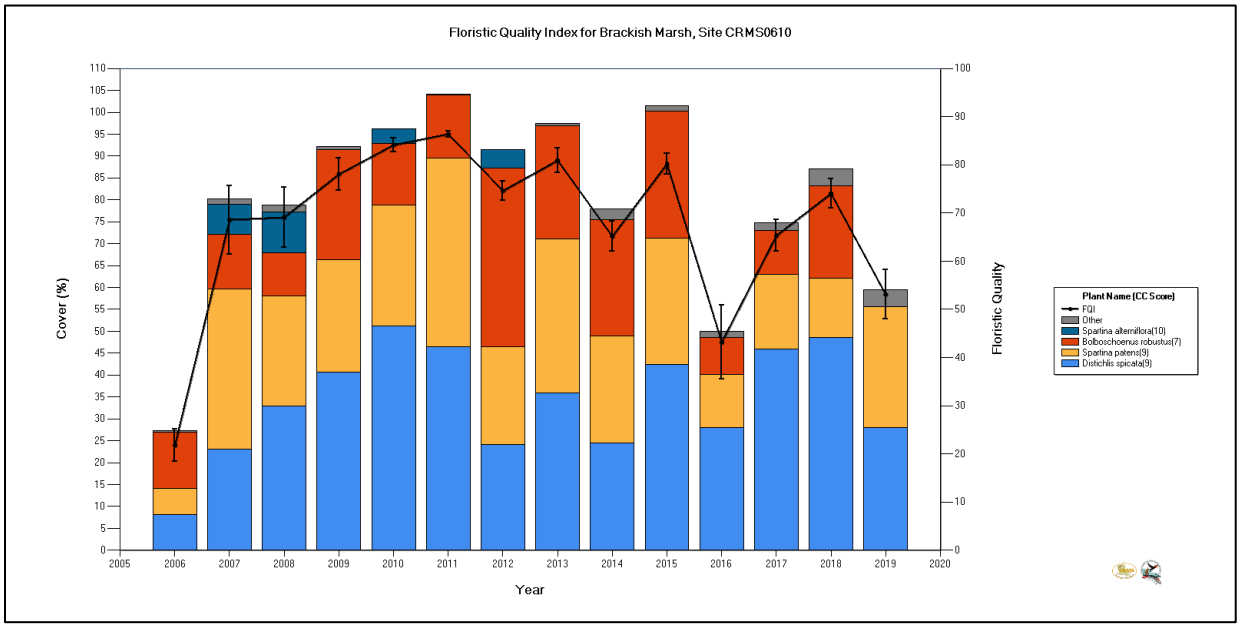

Figure 8d. Percent coverage and floristic quality index of species collected from CRMS0610, SW Area A, within the project area in years 2006 - 2019. The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance and 10 indicates stable species.

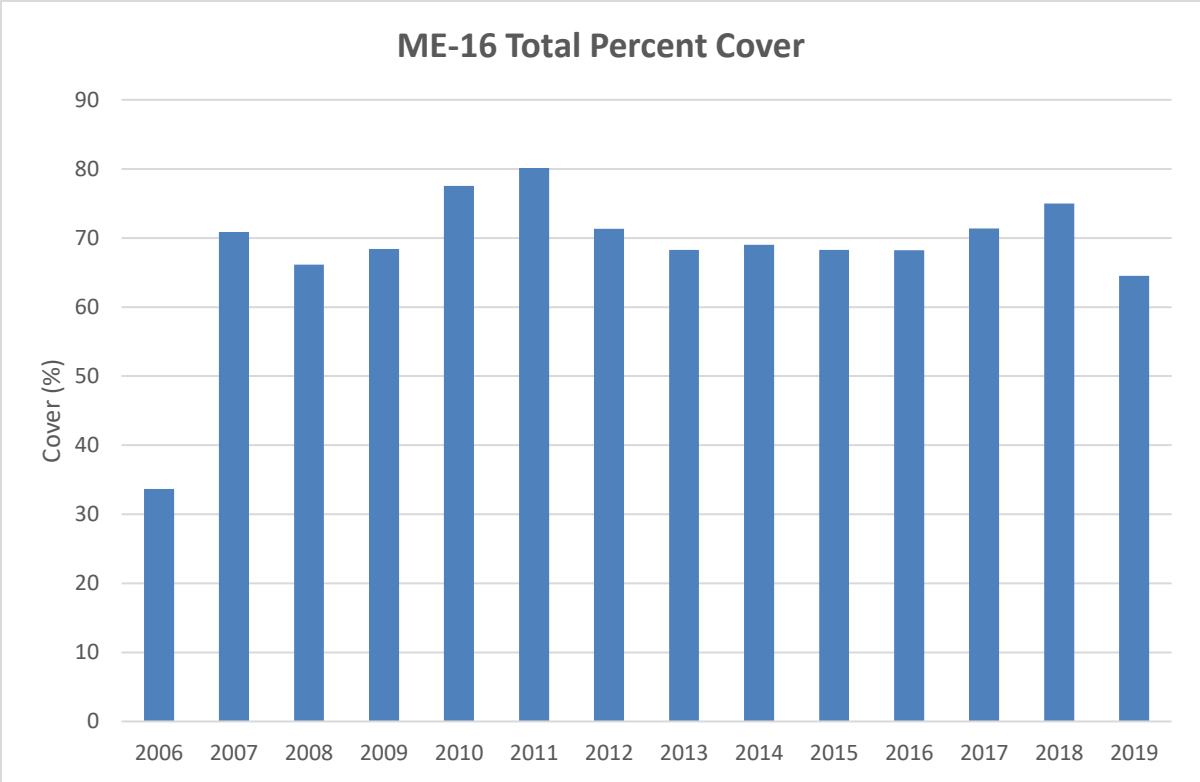

Figure 8e. Percent cover through time for ME-16 averaged across project CRMS sites.

Submerged Aquatic Vegetation (SAV)

Submerged aquatic vegetation has not been monitored on the ME-16 project, so it's not possible to quantify SAV coverage. Visual observation during O&M inspections, however have shown an increase in SAV colonization in the area of the project terraces since construction (see photos 11 and 12 in Appendix B).

Water Level

Water level was collected pre-construction as part of the modeling effort and showed a suitable gradient existed to flow water into the project area from the north, particularly during high water events (Figure 9a). Water levels were generally higher at ME16-05R, the northernmost site and lowest at ME16-04R near the Gulf of Mexico. Post-construction, water levels have oscillated through time, seasonally, but persistent rainfall in recent years has increased water levels and reduced salinities throughout the project and reference areas. A north-south gradient in water levels is still visible between CRMS0609, just south of the water control structures, and CRMS0600 at the mouth of Rollover Bayou near the Gulf. Three major hurricanes have impacted the area through the monitoring period, temporarily flooding the project area with up to 9 ft of water during Hurricanes Rita and Ike (McGee et al. 2006; East et al. 2008). The project area recorders (ME16-06, CRMS0609) tracked very well with the water levels at CRMS0600, showing the influence of the Gulf of Mexico on the project area.

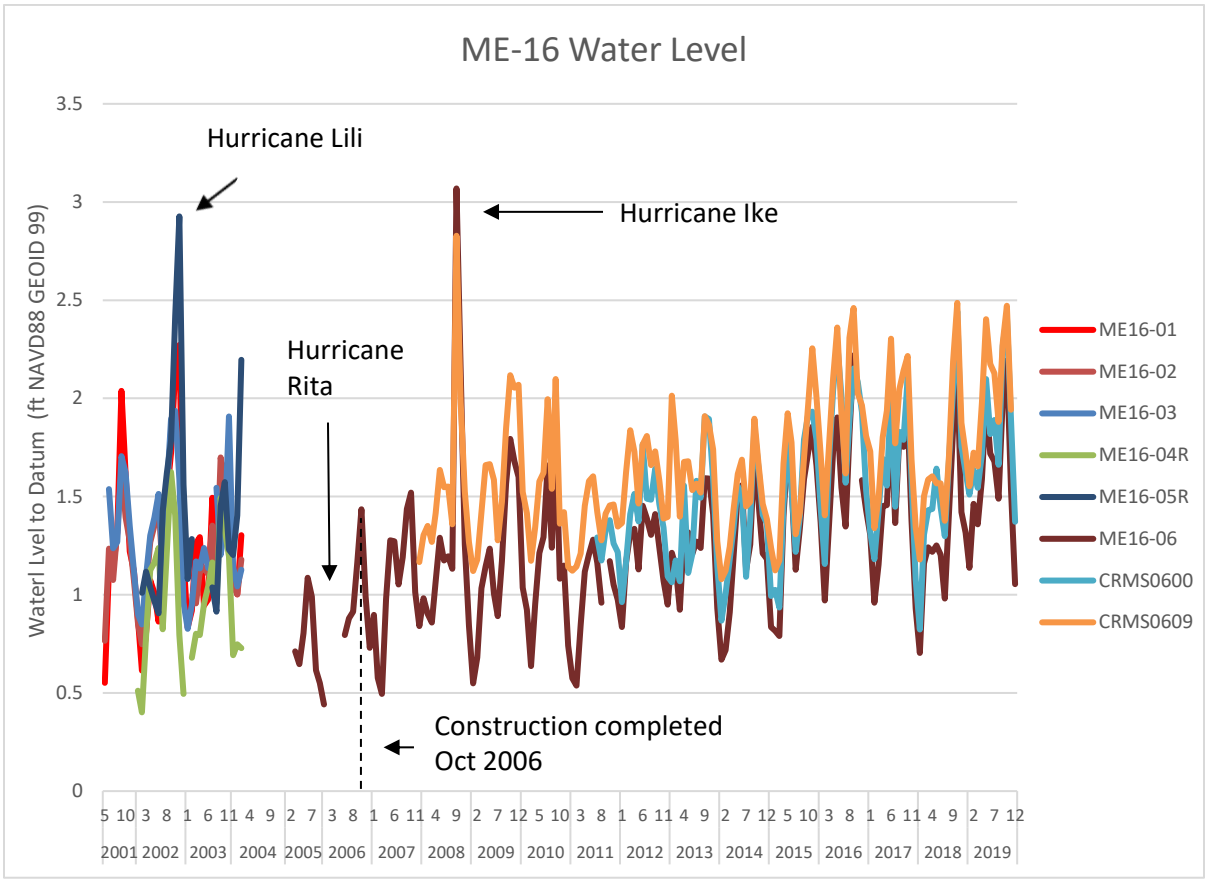

Figure 9a. Monthly means of water level data collected pre- and post-construction inside (ME16-01, ME16-02, ME16-03, ME16-06, CRMS0609) and outside (ME16-04R, ME16-05R, CRMS0600) of the ME-16 project area.

Soil Properties

Soil samples were collected at each of the CRMS-*Wetlands* sites in the project area (599, 600, 609, 610). The soil properties data were sampled in 4 cm increments. All cores were sampled after Hurricane Rita. Figures for mean bulk density and percent organic matter (OM%) by CRMS site are presented in Figures 10a and 10b. Higher bulk densities occurred at project area sites CRMS0610 and CRMS0600 near the Gulf of Mexico, which would be expected since denser soils tend to occur in salt marshes. These sites also had the lowest OM% (<20% throughout the core). Lower bulk densities and higher OM% were found in the bottom half of the core at CRMS0609.

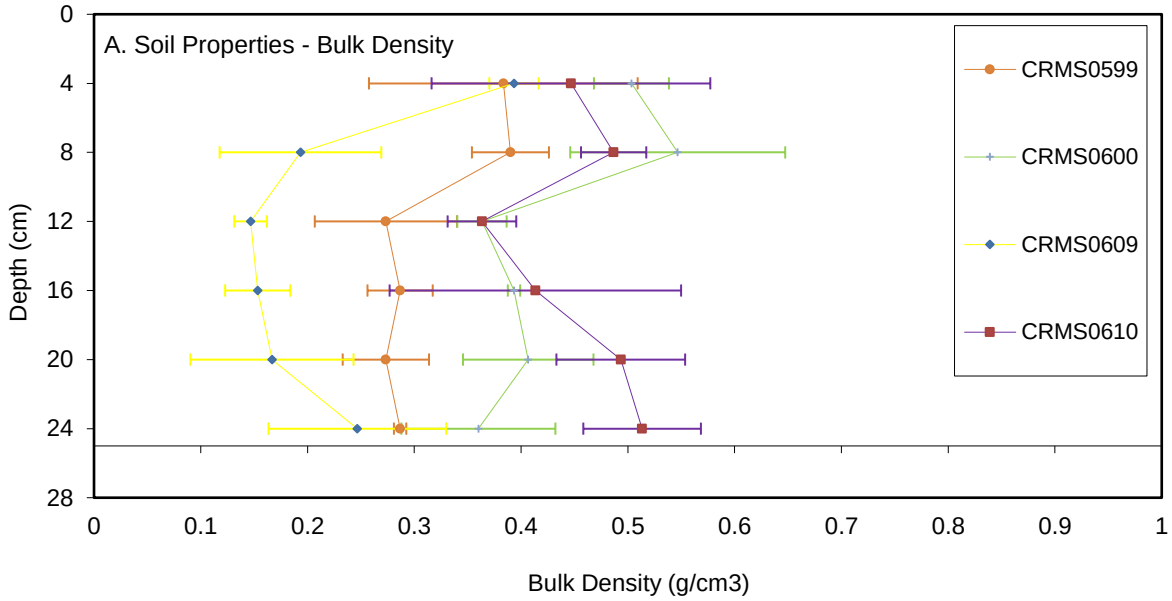

Figure 10a. Mean ± 1 Standard error of soil bulk density collected at project and reference CRMS sites.

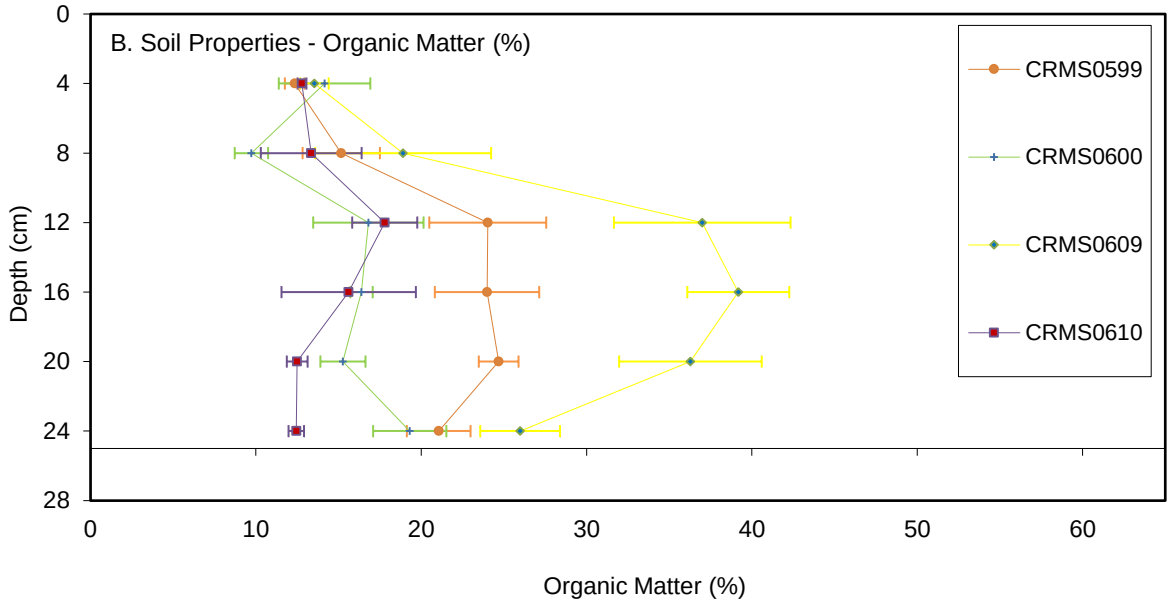

Figure 10b. Mean ± 1 Standard error of soil organic matter collected at project and reference CRMS-*Wetlands* sites.

Elevation Change

Subsidence and accretion data at ME-16 CRMS sites 599, 600, 609 and 610 show the project area had a slight gain to slight loss (+0.22 cm/yr to -0.14 cm/yr) (Figure 11). The only positive gain in elevation occurred at CRMS0609, located in close proximity to a water control structure, and likely receiving sediment input through the structure. The site is not, however, maintaining elevation when compared to the Sabine Pass NOAA tide gauge sea level rise estimate of 0.6 centimeters per year (Zervas 2009). CRMS sites 599, 600 and 610 showed minor negative elevation change rates (-0.11 - 0.06 and -0.14 cm/yr, respectively). This is likely due to their isolation from any sediment source and a high subsidence rate.

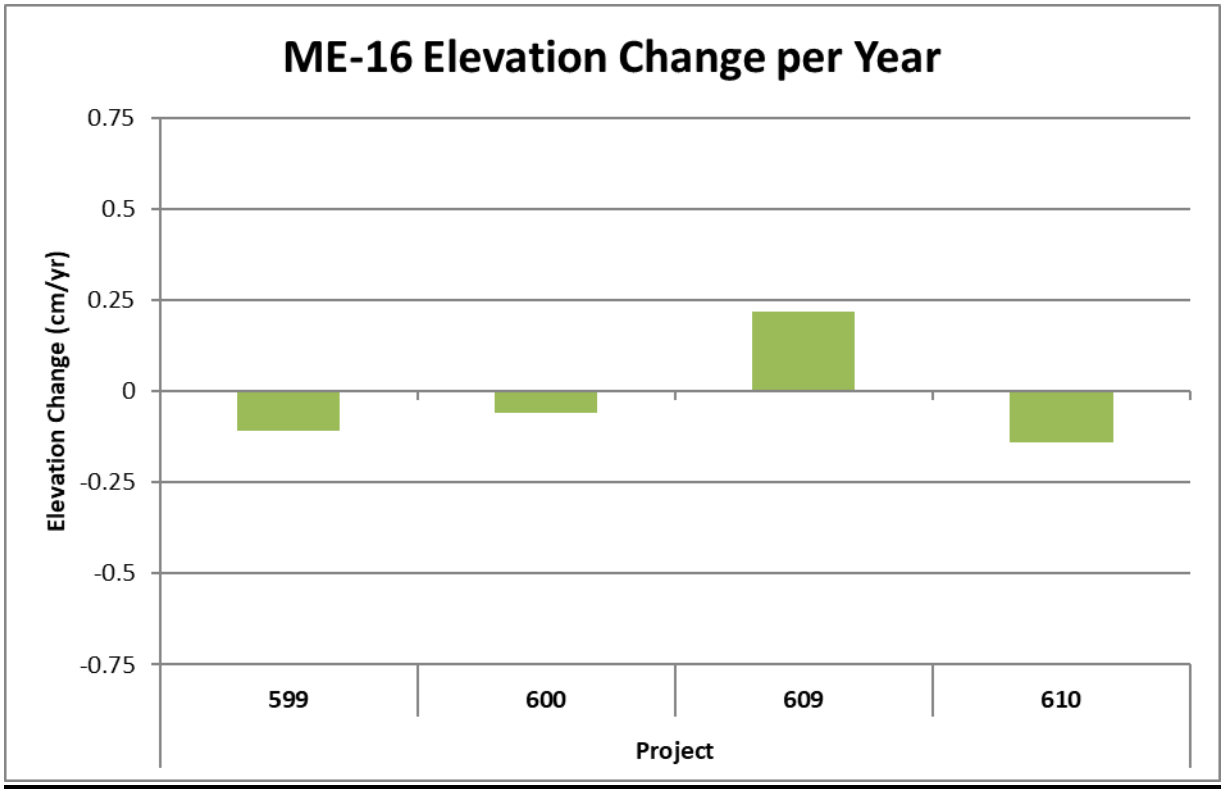

Figure 11. Elevation change per year experienced in the ME-16 project CRMS sites.

V. Conclusions

a. Project Effectiveness

The project saw a reduction in the marsh loss rate between the 2008 and 2018 land water analyses. However, recurring Gulf shoreline erosion continues to be a problem. Land:Water analyses conducted within the 1 km CRMS sites in 2015 showed minimal change at all sites except CRMS0600 which continues to see high loss rates due to the shoreline erosion.

The project has been effective at reducing surface water salinities in Area A thanks to recent heavy rainfall years. Climatic conditions have enabled project marshes to meet target salinity levels more frequently through time. Interstitial salinities have been slower to decline, but are trending downward as well since the drought of 2011.

Consistent rainfall has also benefited the vegetation in the project area. Emergent wetland vegetation has increased in coverage since project construction, particularly in the marshes in the eastern half of Area A, which are thriving in recent years. The saline sites in the southwestern portion of Area A have shown good coverage and quality of vegetation through time and have been trending to more brackish species. Fresh water, along with the project terraces reducing wave fetch, has resulted in increased SAV colonization since construction.

Overall the structural components of the Freshwater Introduction South of Hwy 82 Project are in good condition and functioning as intended. The 2011 post Hurricane Ike maintenance event of placing additional rip rap repaired hurricane damage and provided added armament for the structures.

b. Recommended Improvements

The below maintenance items have not been completed since being identified as needs in the 2015 OM&M report as it would be more cost effective if these items were included in a larger future maintenance event.

- Lifting chains should be provided on the flapgates at the Hess' Cut (formerly New Dyson), New Cop Cop, and Structure No. 10.
- Rock rip rap should be filled in closer to the structure at Structure No. 10.
- Concrete on the Little Constance Structure which was damaged by the rock placement during the maintenance event needs repair.

c. Lessons Learned

The use of spray dredge technology in performing the enlargement of Grand Volle Channels and Highway 82 Channel enlargement was very beneficial in that the spoil material from these areas was thinly spread out over the existing marsh and did not have any adverse effects as compared to conventional bucket dredging with built up spoil bank. Within a few months'

time, the spray dredge disposal areas were barely visible and the marsh was in pre-construction condition.

The ME-16 operation plan has benefitted the project area marshes in Area A. When conditions allow (water levels above target range), the project has shown reduced salinities when water control structures are open allowing freshwater flow to Area A to the south.

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APPENDIX A
(Inspection Photographs)

Photo No. 1, New Cop Cop Structure - Risers and wing wall destroyed. Portion of Levee and armament washed away.

Photo No. 2, Perry Bayou Structure - Risers and wing wall destroyed. Portion of Levee and armament washed away.

Photo No. 3, McNeese Bayou Structure - Risers and wing wall destroyed. Portion of Levee and armament washed away.

Photo No. 4, Hess Structure - Risers and wing wall destroyed. Portion of Levee and armament washed away.

Photo No. 5, Little Constance Structure – Erosion and scour around end of structure.

Photo No. 6, Little Constance Structure – Vegetative rack on structure.

Photo No. 7, Earthen terrace.

APPENDIX B
(Three Year Budget Projection)

FRESHWATER INTRODUCTION S. OF HWY 82/ ME-16 / PPL 9
Three-Year Operations & Maintenance Budgets 07/01/2020 - 06/30/2023

Project Manager	O & M Manager	Federal Sponsor	Prepared By
Dion Broussard, P.E.	*Dion Broussard, P.E.*	*USFWS*	*Dion Broussard, P.E.*

	2020/2021 (-15)	2021/2022 (-16)	2022/2023 (-17)
Maintenance Inspection	$ 6,420.00	$ 6,420.00	$ 6,420.00
Structure Operation	$ 10,000.00	$ 10,000.00	$ 10,000.00
State Administration	$10,000.00	$ 24,367.00	$ 24,367.00
Federal Administration		$ -	$ -
Maintenance/Rehabilitation			

15/16 Description:

E&D	$0.00
Construction	$0.00
Construction Oversight	$0.00
Sub Total - Maint. And Rehab.	$ -

16/17 Description

E&D		$ 110,000.00
Construction		$ 650,000.00
Construction Oversight		$ -
	Sub Total - Maint. And Rehab.	$ 950,000.00

17/18 Description:

E&D			$ 40,000.00
Construction			$ 650,000.00
Construction Oversight			$ 75,000.00
		Sub Total - Maint. And Rehab.	$ 956,250.00

	2020/2021 (-15)	2021/2022 (-16)	2022/2023 (-17)
Total O&M Budgets	**$ 26,420.00**	**$ 990,787.00**	**$ 997,037.00**

O &M Budget (3 yr Total)	**$ 2,014,244.00**
Unexpended O & M Budget	**$ 114,257.00**
Remaining O & M Budget (Projected)	**$ (1,899,987.00)**

APPENDIX C
(Field Inspection Notes)

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: ME-16 Freshwater Intro. S of Hwy 82

Date of Inspection: September 17, 2020

Structure No. Earthen Terraces

Inspector(s): Jody White and Mark Mouledous (CPRA)

Structure Description: 26,000 LF "duck wing" earthen terraces

Type of Inspection: Annual

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	N/A				
Steel Grating	N/A				
Stop Logs	N/A				
Hardware	N/A				
Timber Piles	N/A				
Timber Walkway					
Timber Wales	N/A				
Galv. Pile Caps	N/A				
Cables	N/A				
Signage /Supports	N/A				
Staff Gages					
Rip Rap (fill)	N/A				
Earthen Terraces	Good			7	Terraces generally look good. One segment of terrace in the southernmost area of the terrace field has eroded.

What are the conditions of the existing levees?

Are there any noticeable breaches?

Settlement of rock plugs and rock weirs?

Position of stoplogs at the time of the inspection?

Are there any signs of vandalism?

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: ME-16 Freshwater Intro. S of Hwy 82

Date of Inspection: September 17, 2020

Structure No. Little Constance

Inspector(s): Jody White and Mark Mouledous (CPRA)

Structure Description: Variable crest concrete control structure
Four 4'-8" X 6'-8" flapgates w/ stop logs

Type of Inspection: Annual

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Concrete Control Structure	Good			6	Vegetative rack on structure, but generally faired well. Ladders detached.
Flap Gates	Good				
Stop Logs	Good				
Hardware	Good				
Timber Piles	N/A				
Timber Walkway					
Timber Wales	N/A				
Galv. Pile Caps	N/A				
Cables	Good				
Signage /Supports Staff Gages	N/A				
Rip Rap (fill)	Good			5	Some scour around structure. Some light soil and rock placement needed.
Earthen Embankment	N/A				

What are the conditions of the existing levees?	
Are there any noticeable breaches?	
Settlement of rock plugs and rock weirs?	
Position of stoplogs at the time of the inspection?	
Are there any signs of vandalism?	

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: ME-16 Freshwater Intro. S of Hwy 82

Date of Inspection: September 17, 2020

Structure No. Hess' Cut

Inspector(s): Jody White and Mark Mouledous (CPRA)

Structure Description: Variable crest aluminum culverts
Four 48" diameter culvs. w/ flapgates and stop logs

Type of Inspection: Annual

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Flapgates	Good				
Steel Grating	Fair				Three (3) aluminum grate platforms on the outlet side of structure are detached from the outlets. One (1) aluminum grating platform has broken free.
Stop Logs	Gone				
Hardware	Good				
Timber Piles	Good				
Timber Walkway					
Timber Wales	Good				
Galv. Pile Caps	Good				
Culverts	Gone			4	All aluminum riser inlets are destroyed.
Signage /Supports Staff Gages	N/A				
Rip Rap (fill)	Gone			4	All rip rap on the inlet side of the structure has washed away.
Earthen Embankment	Bad			4	Approximately 30% of the earthen embankment has washed away.

What are the conditions of the existing levees?
Are there any noticeable breaches?
Settlement of rock plugs and rock weirs?
Position of stoplogs at the time of the inspection?
Are there any signs of vandalism?

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: ME-16 Freshwater Intro. S of Hwy 82

Date of Inspection: September 17, 2020

Structure No. New Cop Cop

Inspector(s): Jody White and Mark Mouledous (CPRA)

Structure Description: Variable crest aluminum culverts
Four 48" diameter culvs. w/ flapgates and stop logs

Type of Inspection: Annual

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Flapgates	Good				
Steel Grating	Good				
Stop Logs	Gone				
Hardware	Good				
Timber Piles	Good				
Timber Walkway					
Timber Wales	Good				
Galv. Pile Caps	Good				
Culverts	Gone				Aluminum riser inlets are destroyed.
Signage /Supports Staff Gages	N/A				
Rip Rap (fill)	Gone			1	All rip rap on inlet side of structure has washed away.
Earthen Embankment	Bad			1	Approximately 20% of the earthen embankment on the inlet side of the structure has washed away.

What are the conditions of the existing levees?
Are there any noticeable breaches?
Settlement of rock plugs and rock weirs?
Position of stoplogs at the time of the inspection?
Are there any signs of vandalism?

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: ME-16 Freshwater Intro. S of Hwy 82 — Date of Inspection: September 17, 2020

Structure No. McNeese Bayou — Inspector(s): Jody White and Mark Mouledous (CPRA)

Structure Description: Variable crest aluminum culverts
Three 48" diameter culvs. w/ flapgates and stop logs

Type of Inspection: Annual

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Flapgates	Good				
Steel Grating	Good				
Stop Logs	Good				
Hardware	Good				
Timber Piles	Good				
Timber Walkway					
Timber Wales	Good				
Galv. Pile Caps	Good				
Culverts	Gone			3	All riser inlets have been destroyed.
Signage /Supports Staff Gages	N/A				
Rip Rap (fill)	Gone			3	All rip rap on the inlet side of the structure has washed away.
Earthen Embankment	Bad			3	Approximately 30% of the earthen embankment on the inlet side of the structure has been washed away.

What are the conditions of the existing levees?
Are there any noticeable breaches?
Settlement of rock plugs and rock weirs?
Position of stoplogs at the time of the inspection?
Are there any signs of vandalism?

Project No. / Name: ME-16 Freshwater Intro. S of Hwy 82					Date of Inspection: September 17, 2020
Structure No.	Perry Bayou				Inspector(s): Jody White and Mark Mouledous (CPRA)
Structure Description: Variable crest aluminum culverts					
Three 48" diameter culvs. w/ flapgates and stop logs					
Type of Inspection: Annual					

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	N/A				
Steel Grating	Good				
Stop Logs	Gone				
Hardware	Good				
Timber Piles	Good				
Timber Wales	Good				
Galv. Pile Caps	Good				
Culverts	Gone			2	All riser inlets are destroyed.
Signage /Supports Staff Gages	N/A				
Rip Rap (fill)	Gone			2	All rip rap on the inlet side of the structure has washed away.
Earthen Embankment	Bad			2	Approximately 80% of the earthen embankment on the inlet side of the structure has washed away.

What are the conditions of the existing levees?					
Are there any noticeable breaches?					
Settlement of rock plugs and rock weirs?					
Position of stoplogs at the time of the inspection?					
Are there any signs of vandalism?					

Appendix D
(Rockefeller Refuge Operations & Monitoring Report)
Provided by Wildlife and Fisheries Staff

Hwy. 82 Water Control Structure Management Summary

Table 1.

Water Control Structure	Description
Old Cop-Cop Bayou	Four-pipe stop-log flap-gate
New Cop-Cop Bayou	Four-pipe stop-log flap-gate
Perry Bayou	Three-pipe stop-log flap-gate
Bayou McNeese	Three-pipe stop-log flap-gate
Hess's Cut	Four-pipe stop-log flap-gate
Josephine	Four-pipe stop-log
Dyson Bayou	Four-pipe stop-log flap-gate
Little Constance	Three 10'X 8' stop-log flap-gate

Note: See map for structure locations.

Table 2.

Monitoring Stations
Superior Bridge
South of Lake 14
South of Lake 15

Note: See map for monitoring station locations

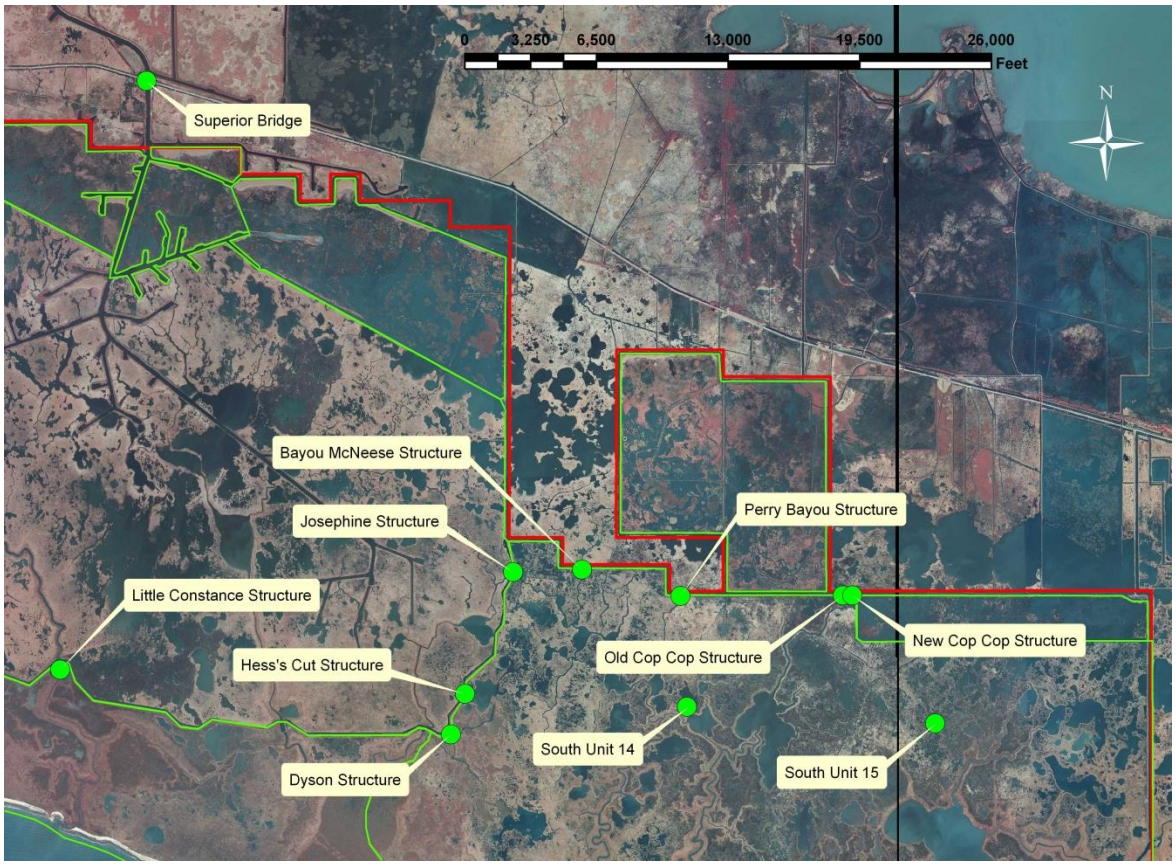

Figure 1. Structure and Monitoring Station Locations.

Table 3.

Date	Superior Bridge Water Level (Navd 88)	Superior Bridge Water Salinity (PPT)	Structure Name	Hwy 82 Freshwater Introduction Project Water Control Structure Operation and Observations.
10/23/2006	1.42	5.8	Old Cop-cop	Removed all stop-logs from structure to remove flood waters.
12/5/2006	0.7	3.1	Old Cop-cop	Added stop-logs in all pipes to current water level to retain water in the Mermentau Basin.
1/28/2008	0.84	1.4	Old Cop-cop	Three inches of water flowing over stop-logs.
4/7/2008	0.82	0.8	Old Cop-cop	Stop-logs were removed from two bays between January and April to increase water flow to Project Area A.
6/2/2008	1.26	0.1	Old Cop-cop	Structure is washed out and in need of repairs. Water control is compromised. Repairs scheduled for August 2008.
10/23/2006	1.42	5.8	New Cop-Cop	Removed two feet of stop-logs from structure to remove flood waters.
1/8/2007	1.42	0.8	New Cop-Cop	Removed all stop-logs from structure to remove flood waters.
1/28/2008	0.84	1.4	New Cop-Cop	Stop-logs were replaced and set at 0.5 NAVD Nov./Dec. 2007.
4/7/2008	0.82	0.8	New Cop-Cop	Stop logs were placed in structure Feb./March 2008 to retain water in the Mermentau Basin. Logs are 2" to 3" above current water level.
6/2/2008	1.26	0.1	New Cop-Cop	Removed three stop-logs from structure to increase water flow into Project Area A.
10/23/2006	1.42	5.8	Perry Bayou	Removed two feet of stop-logs from structure to remove flood waters.
1/8/2007	1.42	0.8	Perry Bayou	Removed all stop-logs from structure to remove flood waters.
1/28/2008	0.84	1.4	Perry Bayou	Stop-logs were replaced and set at 0.5 NAVD Nov./Dec. 2007.
4/7/2008	0.82	0.8	Perry Bayou	Stop logs were placed in structure Feb./March 2008 to retain water in the Mermentau Basin. Logs are 2" to 3" above current water level.
6/2/2008	1.26	0.1	Perry Bayou	Removed three stop-logs from structure to increase water flow into Project Area A.
10/23/2006	1.42	5.8	Bayou McNeese	Removed two feet of stop-logs from structure to remove flood waters.
1/8/2007	1.42	0.8	Bayou McNeese	Removed all stop-logs from structure to remove flood waters.
1/28/2008	0.84	1.4	Bayou McNeese	Stop-logs were replaced and set at 0.5 NAVD Nov./Dec. 2007.

Date	Superior Bridge Water Level (Navd 88)	Superior Bridge Water Salinity (PPT)	Structure Name	Hwy 82 Freshwater Introduction Project Water Control Structure Operation and Observations.
4/7/2008	0.82	0.8	Bayou McNeese	Stop logs were placed in structure Feb./March 2008 to retain water in the Mermentau Basin. Logs are 2" to 3" above current water level.
6/2/2008	1.26	0.1	Bayou McNeese	Removed three stop-logs from structure to increase water flow into Project Area A.
10/19/2006	1.42	5.8	Hess's Cut	Removed of stop-logs from structure to remove flood waters. Twenty inches of water flowing over logs.
1/3/2007	1.42	0.8	Hess's Cut	Removed all stop-logs from structure to remove flood waters.
2/21/2007	0.9	0.9	Hess's Cut	Stop logs were placed in structure Feb./March 2008 to retain water in the Mermentau Basin. Logs are 2" to 3" above current water level.
9/13/2007	1.8	0.6	Hess's Cut	Removed all stop-logs from structure to remove flood waters.
1/28/2008	0.84	1.4	Hess's Cut	Stop-logs were replaced and set at 0.5 NAVD Nov./Dec. 2007. Seven inches of water over stop-logs increasing water flow into Area A
6/3/2008	1.26	0.1	Hess's Cut	Removed three stop-logs from structure to increase water flow into Project Area A. Approximately 14" to 15" of water over stop-logs increasing water flow into Area A.
10/19/2006	1.42	5.8	Little Constance	Removed stop-logs to 3.5' below current water level to remove flood waters.
1/3/2007	1.42	0.8	Little Constance	Removed all stop-logs to remove flood water from the Mermentau Basin.
1/28/2008	0.84	1.4	Little Constance	Stop-logs are currently 10" below current water level. Stop-logs were replaced between Jan. 2007 and Jan. 2008
6/3/2008	1.26	0.1	Little Constance	Stop-logs were set 13" below current water level in west gate; 10' in center gate; and 5" in east gate. Removing excess water from the Mermentau Basin.
6/5/2008	0.96	0.7	Little Constance	All stop-logs were removed from east and center gates. Two logs were removed from west gate. The water column is approximately 3' in the east and center gates and 2' in the west gate. The flap was opened in the center gate to allow ingress and egress of estuarine organisms. The center gate will remain open until water levels or water salinities are compromised.

Date	Superior Bridge Water Level (Navd 88)	Superior Bridge Water Salinity (PPT)	Structure Name	Hwy 82 Freshwater Introduction Project Water Control Structure Operation and Observations.
10/19/2006	1.42	5.8	Josephine	Removed all but one stop-log to remove flood water from the Mermentau Basin
1/28/2008	0.84	1.4	Josephine	No action. Fifteen to 21" of water was running over stop-logs.
4/7/2008	0.82	0.8	Josephine	No action.
6/3/2008	1.26	0.1	Josephine	No action.
10/23/2006	1.42	5.8	Dyson	Removed all but one stop-log to remove flood water from the Mermentau Basin
1/3/2007	1.42	0.8	Dyson	Stop-logs were replaced sometime after 10/19/2006. Stop-logs were removed on 1/3/07. Twenty-four inches of water was running over stop-logs.
1/28/2008	0.84	1.4	Dyson	None.
4/7/2008	0.82	0.8	Dyson	None.
6/3/2008	1.26	0.1	Dyson	None.

Date	Hwy 82 Freshwater Introduction Project Water Control Structure Operation and Observations.
01/01/2009	Stop logs set at 0.80 NAVD for all structures.
05/04/2009	Removed stop logs in freshwater introduction structures.
06/09/2009	Put all stop logs back in which is set at 0.80 NAVD
10/05/2009	Removed all stop logs in freshwater introduction structures
03/18/2010	Put all stop logs in and set at 0.80 NAVD
01/26/2012	Opened all freshwater introduction structures
04/30/2012	Closed all freshwater introduction structures
07/24/2012	Opened all freshwater introduction structures
10/10/2012	Put all stop logs in and set at 0.80 NAVD
01/2/2013	Pulled all stop logs at Hess's Cut, Little Constance, New Cop Cop and Perry Bayou Structures
03/21/2013	Stop logs set to 0.80 NAVD at Hess's Cut and Little Constance Structures
03/26/2013	Stop logs set at 0.80 NAVD at New Cop Cop and Perry Bayou Structures
06/18/2013	Stop logs set at 1.20 NAVD at all structures.

Date	Hwy 82 Freshwater Introduction Project Water Control Structure Operation and Observations.
07/21/2014	Pulled all stop logs at Hess's Cut, Little Constance, New Cop Cop and Perry Bayou Structures
08/19/2014	Put all stop logs in and set at 1.20 NAVD
04/20/2015	Removed stop logs at all structures
6/30/2015	Put all stop logs in and set at 1.20 NAVD
11/2/2015	Pulled stop logs at all structures and closed flapgates
2/1/2016	Put all stop logs in and set at 1.20 NAVD
4/21/2016	Pulled stop logs at all structures
7/5/2016	Put all stop logs in and set at 1.20 NAVD
8/15/2016	Pulled stop logs at all structures
11/16/2016	Put all stop logs in and set at 1.20 NAVD
12/6/2016	Pulled stop logs at all structures
2/6/2017	Put all stop logs in and set at 1.20 NAVD
5/4/2017	Pulled stop logs at all structures
10/31/2017	Put all stop logs in and set at 1.20 NAVD
9/26/2018	Pulled stop logs at all structures
2/4/2019	Put all stop logs in and set at 1.20 NAVD
4/16/2019	Pulled stop logs at all structures
12/19/2019	Put all stop logs in and set at 1.20 NAVD

Note: There were low water levels and higher salinity levels from July 2011 to January 2012.