State of Louisiana
Coastal Protection and Restoration Authority of Louisiana (CPRA)

2013 Operations, Maintenance, and Monitoring Report

for

Humble Canal Hydrologic Restoration (ME-11)

State Project Number ME-11
Priority Project List 8

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Lafayette Parish

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Preface

The 2013 OM&M Report format combines the Operations and Maintenance annual project inspection information with the Monitoring data and analyses for the project. This report includes monitoring data collected through December 2012, and annual Maintenance Inspections through June 2012.

The 2013 report is the 3nd report in a series of reports. For additional information on lessons learned, recommendations and project effectiveness please refer to the 2003 and 2010 Operations, Maintenance, and Monitoring Reports on the CPRA web site.

I. Introduction

The Humble Canal Hydrologic Restoration project (ME-11) was part of CWPPRA PPL 8 and is sponsored by the Natural Resources Conservation Service (NRCS). The project encompasses 4,030 acres (1,228 ha) of intermediate marsh in Cameron Parish, Louisiana (figure 1). The project area is bounded by Little Chenier Ridge to the south, the Mermentau River to the east, and oilfield canals to the north and west. Project construction was completed in March 2003. The area has experienced Hurricanes Rita (2005) and Ike (2008), a severe drought (2011) and most recently a heavy rain year in 2012.

Historically the marshes within the ME-11 project area were intermediate and contiguous with the large fresh to intermediate interior marshes of the Mermentau Lakes sub basin (O'Neil 1949). During the intervening decades the project area transitioned between fresh and intermediate vegetation as the overall quantity of marsh acreage was drastically reduced by Hurricane Audrey's storm surge of over 12 ft in 1957 (NOAA SLOSH Model), oilfield exploration and production, and multiple saline pulses due to changes in the hydrologic landscape (Chabreck et al. 1968) (Chabreck and Linscombe 1978, 1988, 1997, and 2001, and Sasser and Visser 2008). Land loss data indicate that from 1932 to 1990, approximately 826 acres (334 ha) of land were converted to open water in the Humble Canal project area, which represents approximately one fifth of the project area. Hydrologic alterations were both local for oil and gas exploration and regional for greater shipping transportation and flood control, which increased flooding and saltwater intrusion into the project area (Good et al. 1995). This simultaneously subdivided the landscape into smaller often impounded hydrologic units and created deep water conduits to the saline waters of the Gulf of Mexico. This ecological change increased flooding and salinity in fresh and intermediate marshes leading to their transformation to more flooding and saline tolerant marsh vegetation or shallow open water habitat (CRMS spatial viewer land/water, Barras et al. 2008). These landscape alterations included the construction of Humble Canal in the 1950's and the repeated dredging of the Mermentau River resulting in excessive water levels in some areas and saltwater intrusion from the south and east.

To aid in the removal of excess water without permitting saline water into the project area, a water control structure as well as all associated access channels, embankments and timber bulkheads were constructed in an oilfield access canal north of Marseillais Bayou (Figure 1). Construction began in September 2002 and ended with implementation in March 2003.

The principle constructed project features of the Humble Canal Hydrologic Restoration Project include the following:

A. **Water Control Structure:**
- Five - 48" x 50' corrugated aluminum pipe with weir type drop inlets and flap gated outlets.
- One - 18" x 50' corrugated aluminum pipe with screw gate
- Embankments and timber bulkhead

B. **Water Hyacinth Fence:** Approximately 88 linear feet of hyacinth fence.

C. **Marine Barrier Fence:** Approximately 100 linear feet of marine vessel barrier fence.

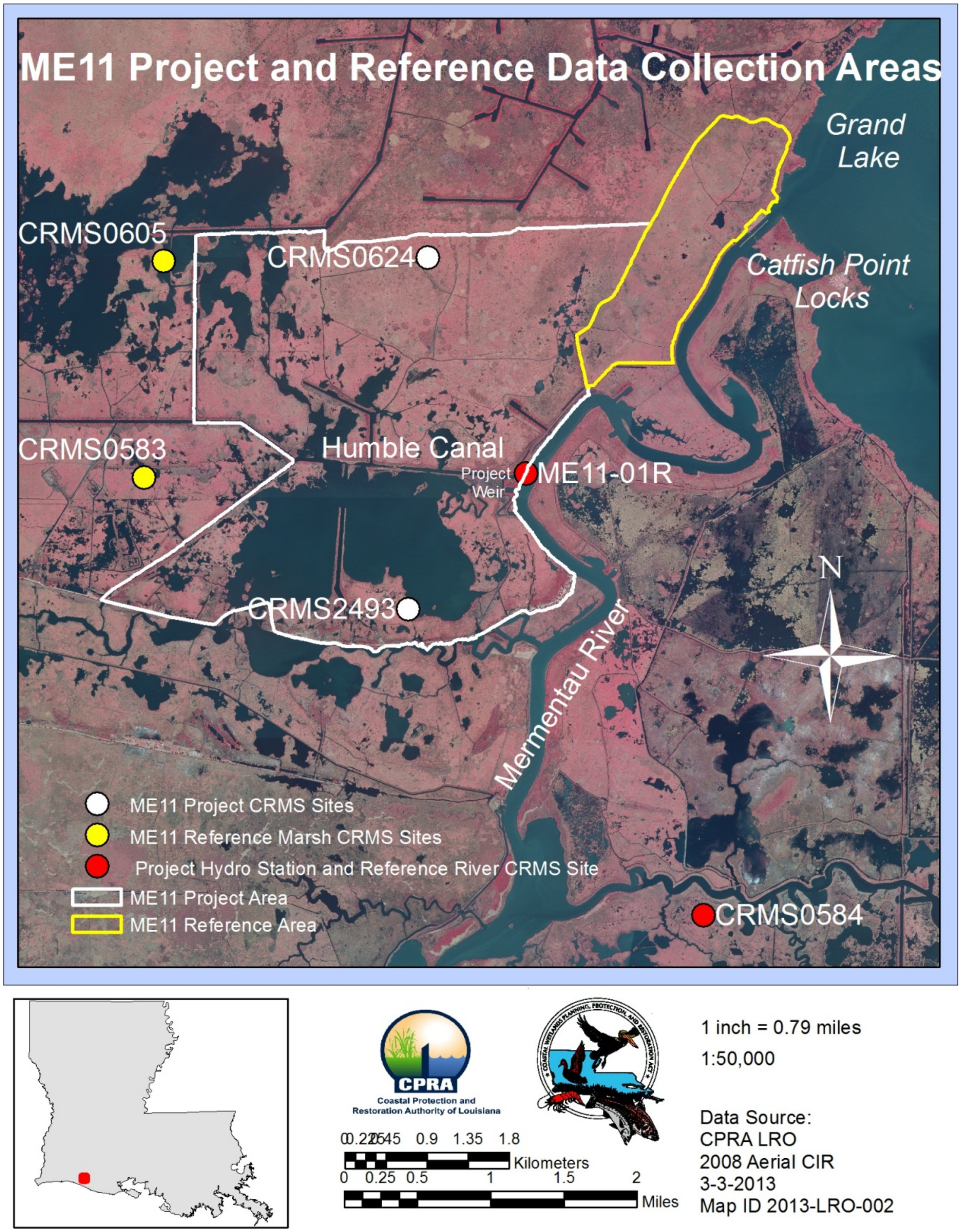

Figure 1. Humble Canal Hydrologic Restoration Project (ME 11); project and reference areas, CRMS sites, and project specific hydrologic station.

II. Maintenance Activity

a. Project Feature Inspection Procedures

The purpose of the annual inspection of the Humble Canal Hydrologic Restoration Project (ME-11) is to evaluate the constructed project features, 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 (O&M Plan, 2003). The annual inspection report also contains a summary of maintenance projects, if any, 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 Humble Canal Hydrologic Restoration Project (ME-11) was held on June 13, 2013 under sunny skies and warm temperatures. In attendance were Mel Guidry, Stan Aucoin, and Dion Broussard from CPRA, along with Frank Chapman and Brandon Samson representing NRCS. All parties met at the Lafayette Field Office. The boat was launched off of Little Chenier Road at the Mermentau River and traveled north to the Humble Canal Project Site. The annual inspection began at approximately 12:30 p.m. at the marine barrier fence on the juncture of the Humble Canal Project Outfall Channel and the Mermentau River.

The field inspection included a complete visual inspection of all project features. Staff gauge readings where available were used to determine approximate elevations of water, earthen embankments, water control structure 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 any notable deficiencies (see Appendix C).

b. Inspection Results

<u>Marine barrier fence</u>

The structure is in excellent condition and the warning signs were intact. (Photos: Appendix A, Photo 1)

Hyacinth guard

This feature is in good condition. The wire fence material, wooden pilings, and bracing replaced during the last maintenance event are in working order. (Photos: Appendix A, Photo 2 & 3)

Water control structure

The structure is in good condition. The stoplogs, flap gates, and screw gate appear to be functioning as intended. The wingwall rock armor on the inlet and outlet side of the structure and the crushed stone aggregate on the top of the structure are intact. (Photos: Appendix A, Photos 2 & 4)

c. Maintenance Recommendations

i. Immediate/ Emergency Repairs

There are no repairs required at this time.

ii. Programmatic/ Routine Repairs

There are no repairs required at this time.

d. Maintenance History

General Maintenance: Below is a summary of completed maintenance projects and operation tasks performed since March 2003, the construction completion date of the Humble Canal Hydrologic Restoration Project (ME-11).

2009 M & M Electric – Repairs were made to the structure to repair storm damage as well as routine maintenance repairs. Forty five (45) tons of rock rip rap were placed around the wingwalls. Sixty tons (60) tons of crushed stone aggregate were placed on top of the structure along with five-hundred (500) square yards of geotextile fabric. Repairs were made to the hyacinth guard, flap gates, locking arms and stop logs. Two warning signs were replaced at the marine vessel barrier. The costs associated with this maintenance event were as follows:

E & D, Construction Oversight, As Builts	$15,314.00
Construction Contract (Incl. C.O. # 1)	$59,300.00
TOTAL	**$74,614.00**

III. Operation Activity

a. Operation Plan

CWPPRA funding for this project includes dedicated monies to operation and maintenance. CPRA is responsible for the maintenance, monitoring, and replacement of project elements through the 20-year life of the project. Operations of the structures are performed in accordance with the salinity and water levels noted below.

Excerpt from the Operation, Maintenance, and Monitoring Plan

Structure Operational Scheme

18" diameter marine ingress structure with screwgate	< 6 ppt at structure	Screw gate open
	≥ 6 ppt at structure	Screw gate closed
Five 48" diameter water control structures with stoplogs and flap gates	1.2' NA VD88 (marsh elevation)	Flaps operating stoplogs adjusted to achieve water level at marsh elevation

Safety Factors:

1) If interior *Panicum hemitomon* marsh has salinity reading exceeding 2 ppt, the 6 ppt structure closing criteria will be adjusted downward accordingly to insure protection of the marsh resource.
2) If excessive water levels occur as a result of rainfall or other event, the stoplogs will be lowered as necessary to allow excess water to be removed until water level reaches 1.2' NA VD88 (marsh level).

b. Actual Operations

Effective July 2012, CPRA has contracted the structure operations to Simon and Delany, LLC. The structure has been operated in accordance with the Operation, Maintenance and Monitoring Plan.

IV. Monitoring Activity

Pursuant to a CWPPRA Task Force decision on August 14, 2003 to adopt the Coastwide Reference Monitoring System-*Wetlands* (CRMS-*Wetlands*) for CWPPRA, updates were made to the ME-11 Monitoring Plan to merge it with CRMS-*Wetlands* and provide more useful information for modeling efforts and future project planning while maintaining the monitoring mandates of the Breaux Act. There are two CRMS sites located in the project area (CRMS0624 and CRMS2493), two located in similar marsh habitat outside the project area (CRMS0605 and CRMS0583), and one CRMS site (CRMS0584) located near the Mermentau River in a similar habitat to the project specific SONDE (ME11-01R).

a. Monitoring Goals

The objective of the Humble Canal Hydrologic Restoration Project is to improve removal of excess water without permitting saline water into the project area.

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

1. Increase present (yr 2000) land to water ratio.

2. Maintain mean water levels in the project area between 6 in below and 2 in above marsh level.

3. Maintain mean monthly salinity (0–3 ppt) in the project area after construction and prevent salinities from exceeding 7 ppt.

4. Increase or maintain the occurrence and cover of fresh marsh vegetation species in the project area.

5. Increase frequency of occurrence of submerged aquatic vegetation (SAV) in the project area.

b. Monitoring Elements

Aerial Photography:
Near-vertical color-infrared aerial photography (1:12,000 scale) was used to measure land to open water ratios and land change rates for the project and reference areas. The photography was obtained in 2000 prior to project construction and post construction in 2005. Closeout photography will be obtained in 2017. Aerial photography was checked for flight accuracy, color correctness, and clarity, and was scanned, mosaicked, and geo-rectified by USGS/NWRC personnel according to standard operating procedures (Steyer et al. 1995, revised 2000). The CRMS spatial viewer provided historic data for land water quantification in the project area starting in 1956. The years analyzed for land water quantities through the CRMS viewer were 1956, 1978, 1988, 2004, 2006, and 2008. The data provided by this tool is at a large spatial scale and is designed to show trends in land change, not exact acreages.

Water level:
To monitor water levels prior to CRMS implementation in 2006, two continuous data recorder and staff gauge stations were deployed; one in the project area and one in the Mermentau River (figure 2). Water level data was used to determine if the project area water level was being maintained within the target range (Sharp and Guidry 2011). Project specific monitoring ceased in April, 2004 except for the continuous recorder ME11-01R, located at the confluence of Humble Canal and the Mermentau River, which has been active from 2000 through 2012. CRMS monitoring in the project area began in November, 2006 and five CRMS sites were used to monitor project, reference and Mermentau River water level along with ME11-01R.

Salinity:
Salinity was monitored monthly at permanent discrete sampling stations within the project area until 2003 and with continuous data recorders in the project and reference areas as well as at CRMS sites. Discrete salinity data was used to characterize the spatial variation in salinity throughout the project area, and to determine if project area salinity was being maintained within the target range. The continuous recorder ME11-01R has been actively collecting data from 2000-2012 and is located at the confluence of Humble Canal and the Mermentau River. This project specific recorder and five CRMS sites were used to monitor project, reference and Mermentau River salinity after November, 2006.

Emergent Vegetation:
To assess the impact of the project on vegetation, vegetation monitoring stations were established systematically along transects throughout the project and reference area (figure 2). Stations were monitored using a modified Braun-Blanquet sampling method as outlined in (Steyer et al. 1995). Percent cover, height of dominant species, and species richness was documented in 4 m^2 sampling plots. Vegetation was evaluated at the sampling sites in the fall of 2000 (pre construction) and in the fall of 2003 (post construction). A subset of the vegetation stations were sampled after Hurricane Rita in 2005, 2006, 2007 and 2008. Beginning in 2006 vegetation was monitored at five CRMS sites inside and outside of the project boundaries. Individual species' cover data from project specific monitoring and CRMS stations were summarized according to the Floristic Quality Index (FQI) method utilized by CRMS (Cretini et al. 2011) where cover is qualified by scoring species according to whether they are generally associated with disturbance or stability. Vegetation data was also assigned a salinity category based on what marsh type the individual species were most commonly found, e.g. fresh, intermediate, brackish, and saline, along with transitional classes such as fresh-intermediate, intermediate-brackish, and brackish-saline using the Visser classifications. This approach examines marsh type transitions and trends as the process of changing classifications takes place.

Submerged Aquatic Vegetation (SAV):
The effect of the project on SAV abundance was determined by comparing SAV abundance before and after project construction. Three ponds were sampled in the project area and three in the reference with two transects sampled in each pond (figure 2). Frequency of SAV occurrence was determined by methods described in (Chabreck and Hoffpauir 1962) and Nyman and Chabreck (1995). SAV was evaluated in the fall of 2000 (pre-construction) and in the fall of 2003 (post construction) (Sharp and Guidry 2011).

CRMS Supplemental

In addition to the project specific monitoring elements listed above, a variety of other data is collected at CRMS-*Wetlands* stations which can be used as supporting or contextual information (figure 1). Data types collected at CRMS sites include hydrologic from continuous recorders, vegetative, physical soil characteristics, discrete porewater salinity, surface elevation change, vertical accretion and land-water analysis of a 1 km^2 area encompassing the station (Folse et al. 2012). For this report, hydrologic and vegetation data were used to assess project goals and physical soil characteristics, discrete porewater salinity, surface elevation change, and land-water analysis were used to provide contextual information for the project. Data was utilized from two sites within the project area (CRMS0624 – northern project area and CRMS2493 – southern project area) and from two CRMS reference sites adjacent to the project area (CRMS0583 and CRMS0605) and a CRMS reference site in an area under similar hydrologic conditions to the project specific recorder ME11-01R which is still active (CRMS0584).

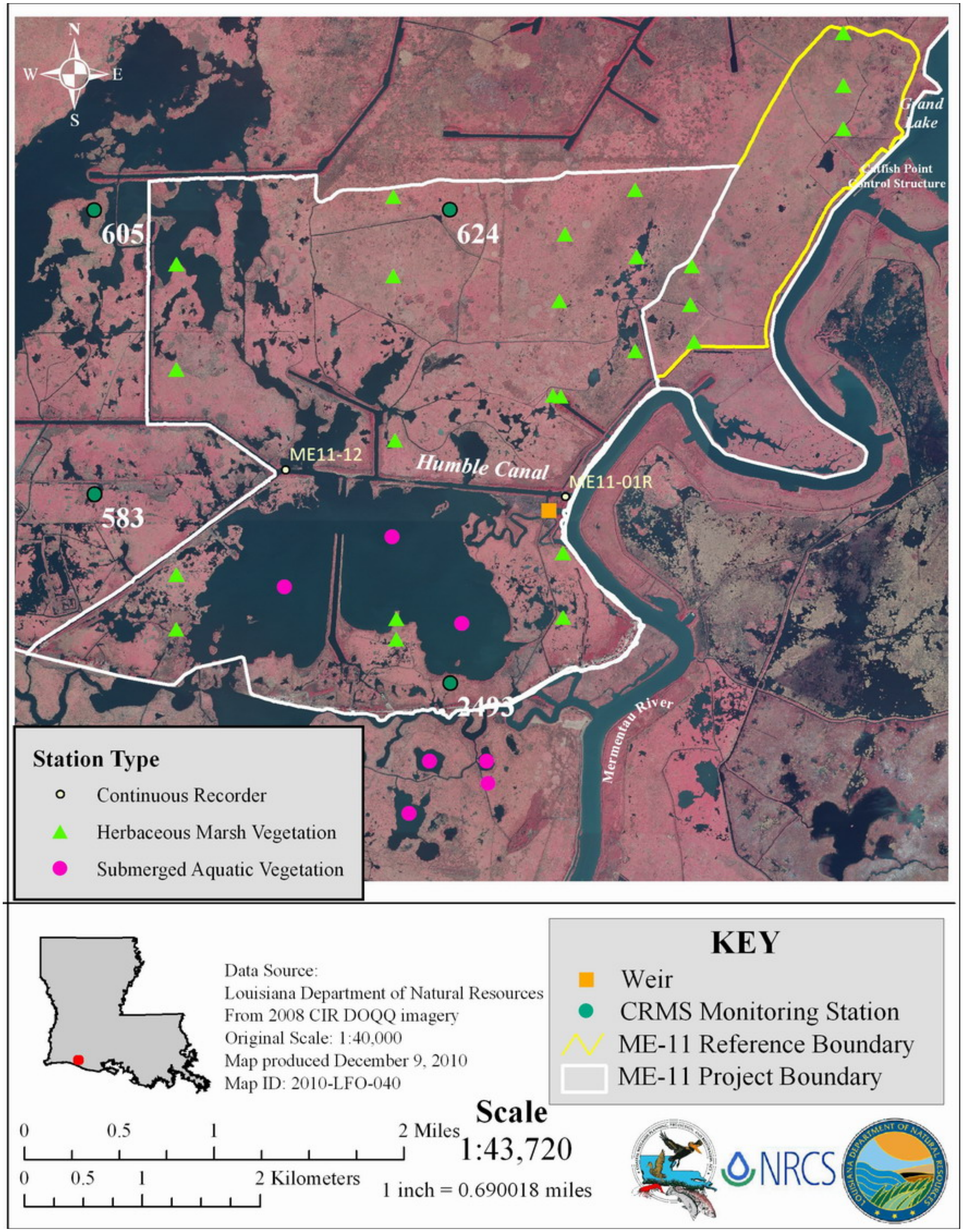

Figure 2. ME-11 project specific project and reference area with locations of continuous data recorders, vegetation and SAV stations, and CRMS sites.

IV. Monitoring Activity (continued)

c. Preliminary Monitoring Results and Discussion

<u>Aerial photography:</u>

Land:Water analysis of project and reference areas was conducted on November 20, 2000 (figure 3) and October 25, 2005 (figure 4). The project goal was to increase the Land:Water ratio from 2000 to 2005 but the project area lost 7 acres of land and the reference area lost 2 acres (Table 1). Both values represent less than 1% of the respective areas. Note that the post construction photography was taken right after Hurricane Rita which could have affected the values. The land to water ratio in the project area was almost unchanged from 2000 to 2005 as the majority of the land loss in the northern part of the project was offset by land gain in the southern project area (figure 5). The more widespread land loss impacts of Hurricane Rita were seen to the west and north of the project area causing extensive damage to area marshes (Couvillion et al 2011).

Analysis of moderate scale multi-temporal photography at CRMS sites was used to view a longer temporal scale of land change in and around the ME-11 project area. The historic large scale land to water conversion at the project CRMS site 2493 and the Mermentau River reference CRMS site 584 took place during the time period 1956 to 1978 with both locations land mass shrinking 27 and 5.75 percent respectively (figure 6). The largest land loss event at the reference CRMS sites was at 605 which dramatically lost land later during the 1978 to 1985 time frame, losing over 50 percent of the marsh. Reference CRMS site 605 rebounded, gaining back much of the surrendered land between 1988 and 2004, just to again lose much of that land via Hurricane Rita. The project and reference CRMS sites 624 and 583 varied only marginally throughout the entire course of record from 1956 to 2008, reference CRMS site 583 did undergo a post Rita land loss of between seven and eight percent. None of the five CRMS sites changed substantially after 2006, with the largest change coming from the reference CRMS site 605 gaining four percent land.

Table 1. Land:Water acreages of the project and reference areas from 2000 (pre construction) and 2005 (post construction) in the project and reference areas.

Year		Project			Reference		
		Acres	Hectares	%	Acres	Hectares	%
2000	Land	2993	1211	68	683	276	99
2000	Water	1401	567	32	9	4	1
2005	Land	2986	1208	68	681	276	98
2005	Water	1408	570	32	11	4	2

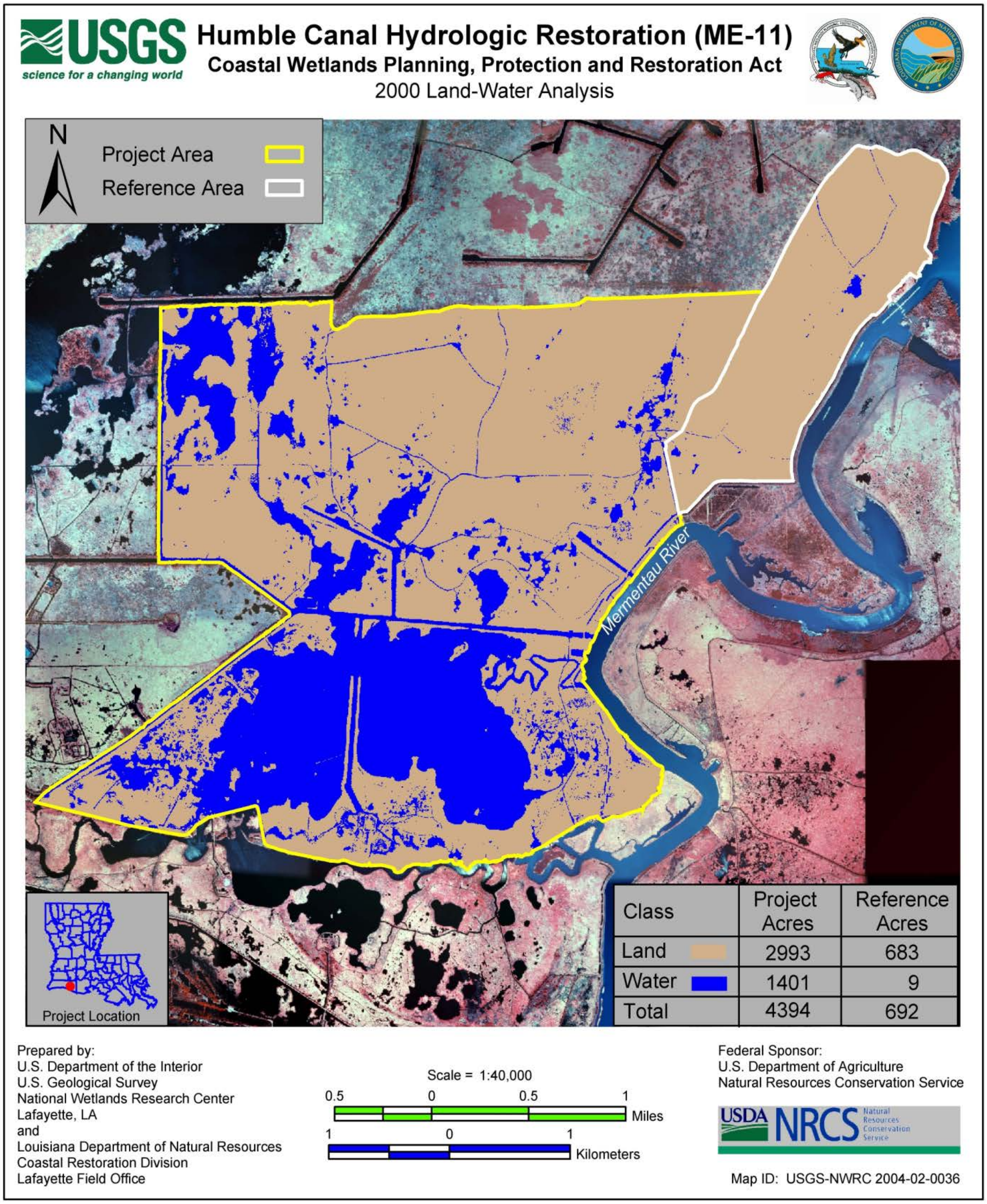

Figure 3. Land:Water analysis of aerial photography collected November 20, 2000.

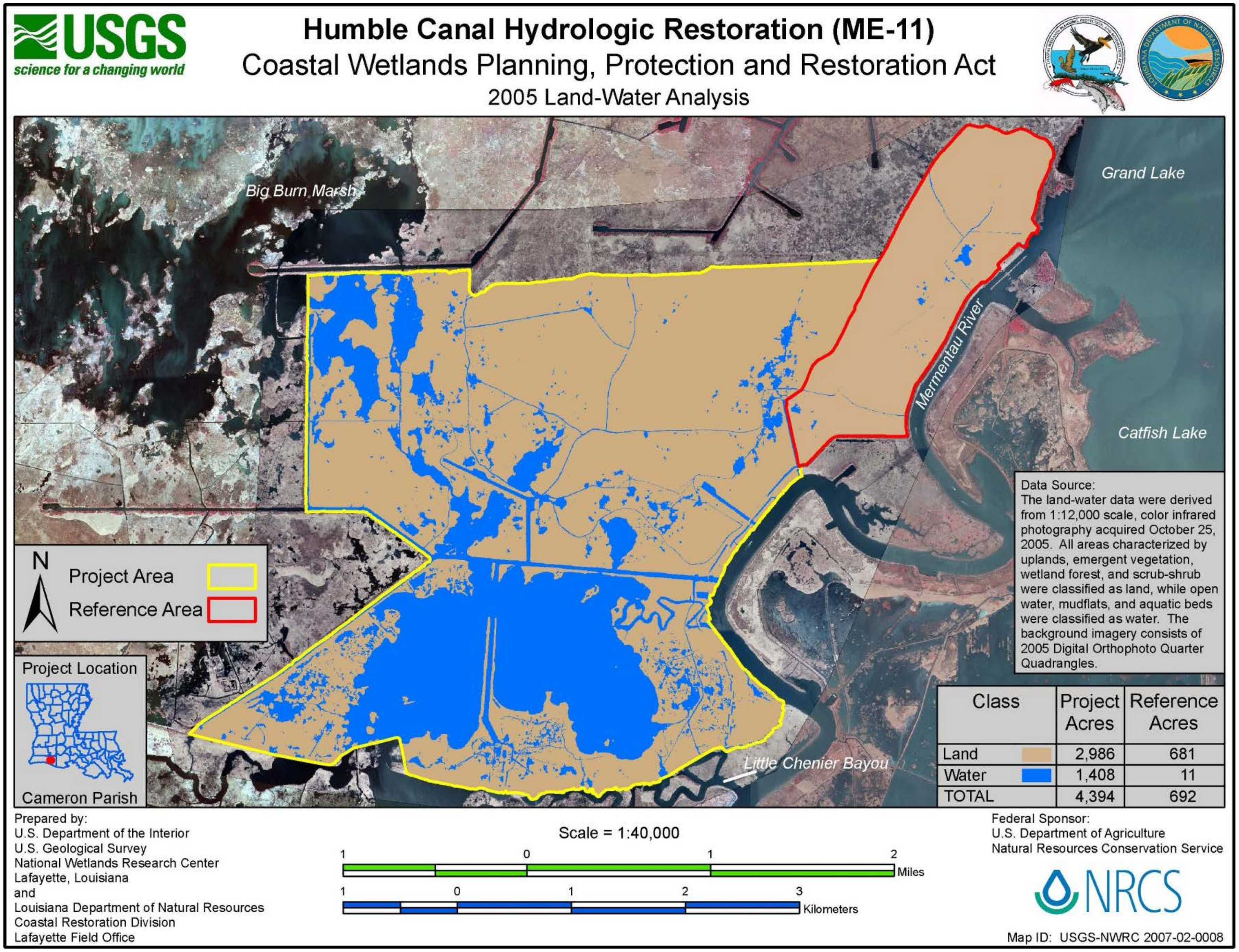

Figure 4. Land:Water analysis of aerial photography collected October 25, 2005.

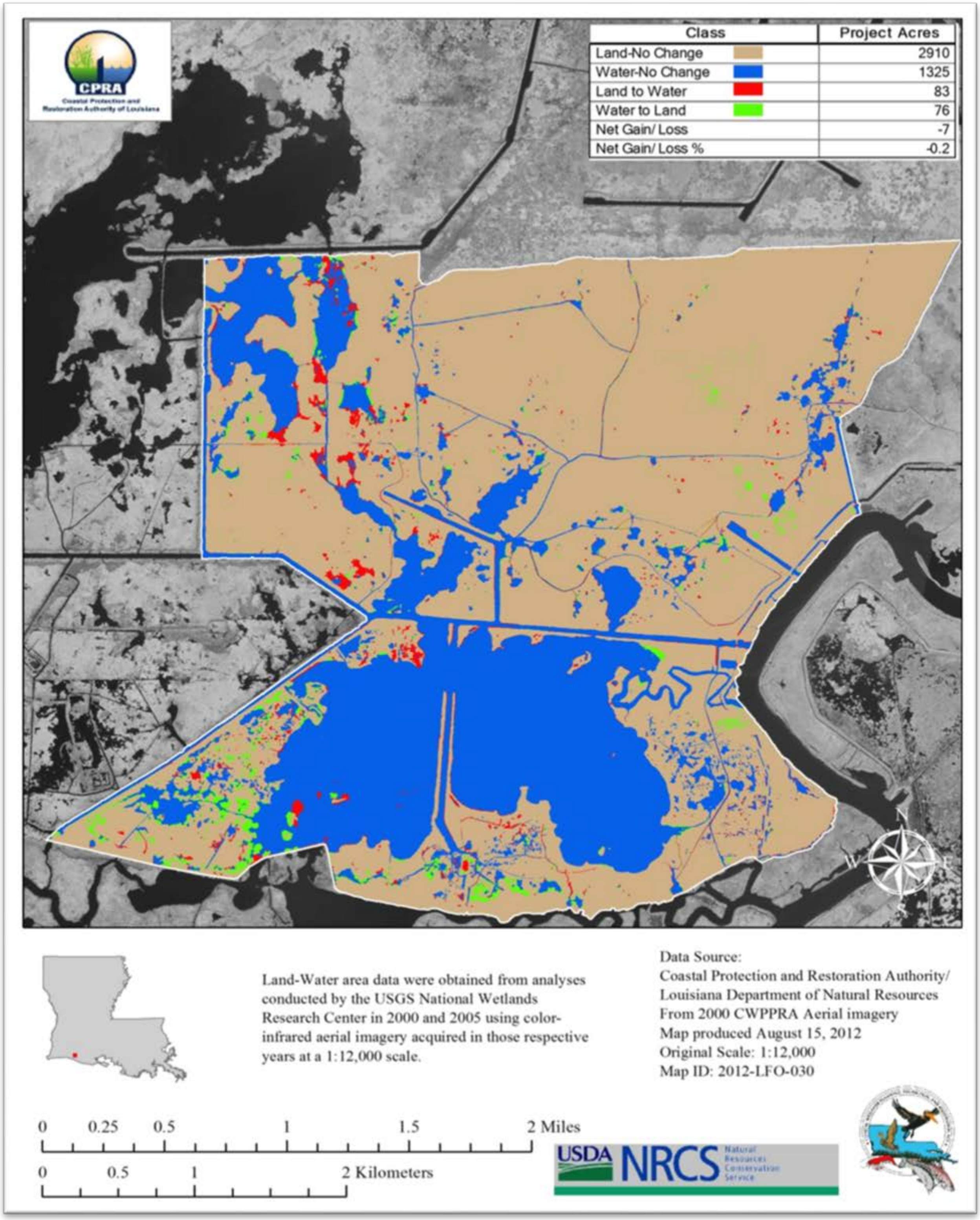

Figure 5. Land: Water analysis change between 2000 and 2005 in the ME-11 project area, there was very little total change between these two sample dates. The northern project area lost land while the southern project area gained land.

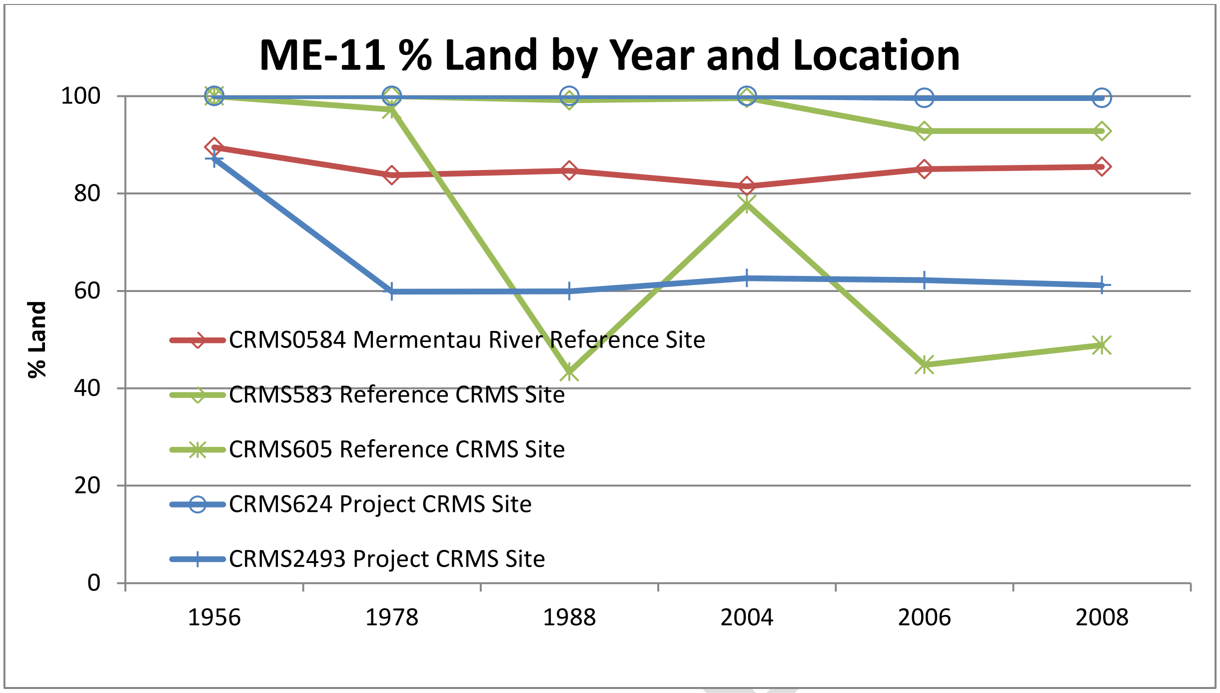

Figure 6. Percent land by year in project CRMS sites (CRMS 2493 and CRMS 624), reference CRMS sites (CRMS 605 and CRMS 583), and Mermentau River reference CRMS site (CRMS 584). Note that the data displayed above is on a different spatial scale than the data in the above two figures and is for trend examination (CRMS spatial viewer land/water, Barras et al. 2008).

Water Level:

The goal for water level was to maintain flooding between six inches below and two inches above marsh elevation. The overall water level trends from 2006 through 2012 show that in general the three locations respond similar on a monthly time scale (figure 7). However large environmental stimuli effect these locations differently. Hurricane Ike in late 2008 pushed large amounts of water into the upper Mermentau basin but the project CRMS sites (1.91 ft) received less peak flooding than either the reference CRMS sites (2.96 ft) or Mermentau River reference recorder (2.73 ft). This trend continued during the extreme drought of 2011 when on two separate occasions the project and reference CRMS sites dropped well below the Mermentau River reference recorders (ME11-01R) average for several months. Overall the project and reference CRMS sites tracked similarly on a yearly basis, maintaining in target water levels approximately equal percentages of the year. The Mermentau River reference recorder was generally in target more than these two locations with the exception of 2009 and 2012 (figure 8). The monitoring plan called for BACI analysis of whether the proportion of time water levels were within the target range varied pre and post construction in the project and reference area. The proportion of each week within the target range was calculated from project and reference recorders from 2000 to 2004. Concurrent data were used in non-parametric one-way ANOVA tests which revealed that there was no significant difference between the areas pre and post construction ($\chi^2 = 0.3205$, $p<0.5713$) (Sharp and Guidry 2011). Water level was beyond the target range around 70% of the time in the project area and 60% of the time in the reference area both pre and post construction. A similar analysis between the project CRMS sites, reference CRMS sites, and the Mermentau River reference recorder ME11-01R was conducted on weekly average water level during 2007 to 2012. Water level was within the target range approximately 47% of the time in the reference CRMS sites while the project CRMS sites were within target 41% of the time, these differences were not significantly different based on a non-parametric Median test ($\chi^2 = 0.558$, $p<0.454$). This model was conducted on weekly averages across the years 2007-2012 to use only concurrent data. The Mermentau River reference recorder ME11-01R was significantly within target more than the project CRMS sites. Concurrent data was used in a non-parametric Median test which showed a significant difference between locations ($\chi^2 = 7.609$, $p<0.0058$). The Mermentau River reference recorder averaged 58.5% within target while the project CRMS sites were again in target 41% of the time.

In the project CRMS sites, water levels were consistently at or below the target in the dry years (2010 and 2011) and were generally above target in wetter years (2007, 2008, and 2012), suggesting the weirs were not sufficient to maintain target water levels. In the project CRMS sites during 2009 water levels were above or below target 54 % of the time but neither flooding nor drought was the dominant condition. The reference CRMS sites were in the target more often during the dry years (2006, 2010, and 2011), mostly above the target range in wet years (2007 and 2012), and at or above target during 2008 and 2009. A plug in an oilfield canal just north of the weirs in the project area was cut by the gravity drainage district at least four times; once for Hurricane Rita, for Hurricane Ike, and for at least two other large rain events. The Mermentau River reference recorder was generally in the target range of water level most years due to the tidal connectivity and cross sectional volume of the water bodies associated with this site; this however comes at the expense of saline waters regularly penetrating the contiguous marshes. This trend is radically reversed during the very wet year of 2012 when the river recorder was over target water level 68.3% of the year (figure 9). Overall the trend in the project CRMS sites was very similar to the reference CRMS sites; with water levels at or above marsh elevation dominating the flooding regime. The Mermentau River reference recorder ME11-01R was on target most of the time indicating that the project and reference CRMS sites are hydrologically isolated from the river. This coincides with several instances of intentional levee breaching during this period which indicates that during intense rainfall events the cross sectional area of the drainage features is not sufficient to remove excess runoff. If these breaches had not occurred there would have been larger differences between the project CRMS sites and the Mermentau River.

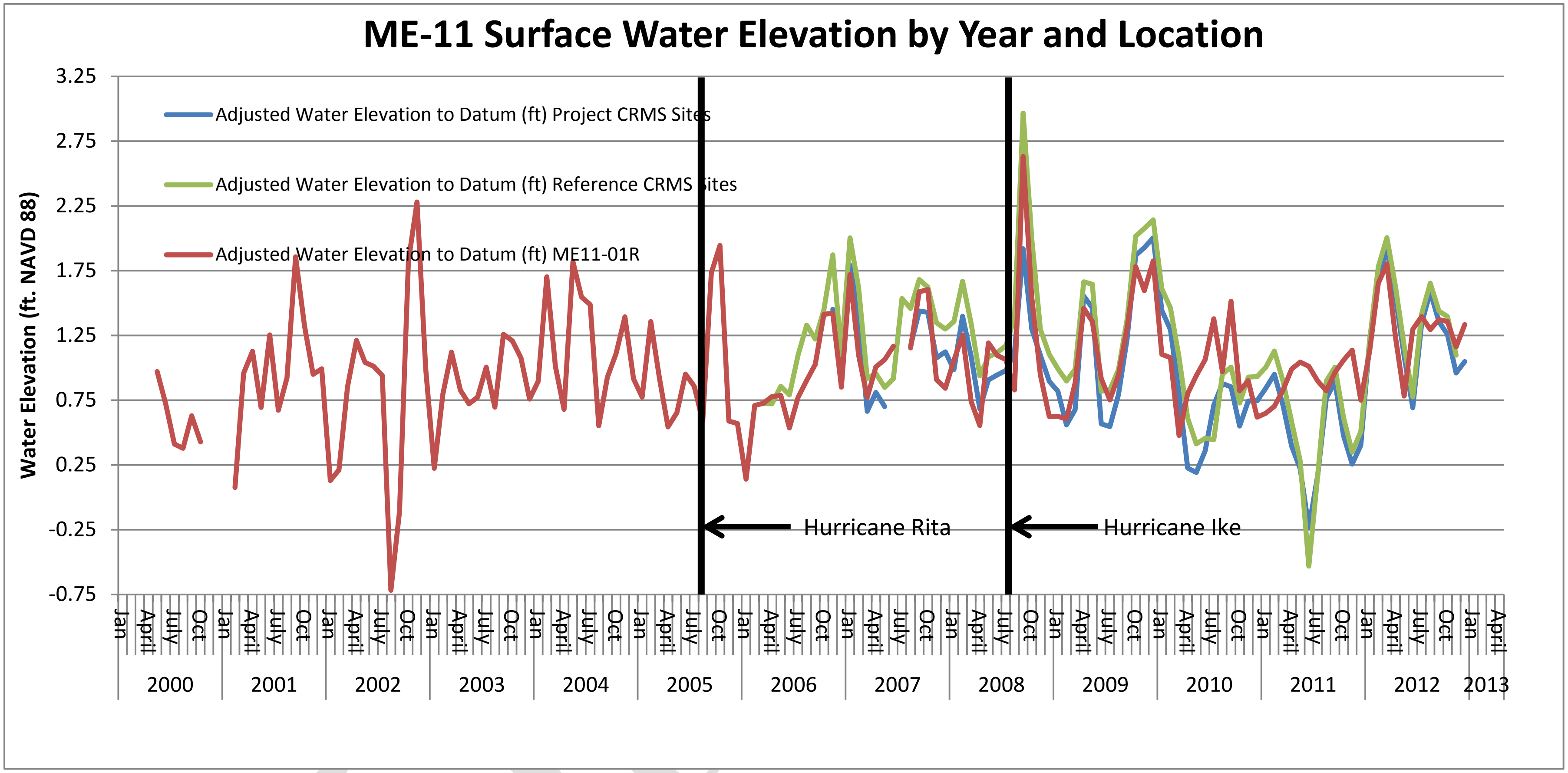

Figure 7. Monthly mean water levels in the project CRMS sites (CRMS 2493 and CRMS 624), reference CRMS sites (CRMS 605 and CRMS 583) and the Mermentau River reference recorder (ME11-01R), the three locations generally track similarly to one another except during extreme events. The 2011 drought shows the hydraulic separation of the project and reference marsh from the Mermentau River as water levels in the project marsh dropped below -0.5 ft. while the river remained near one foot.

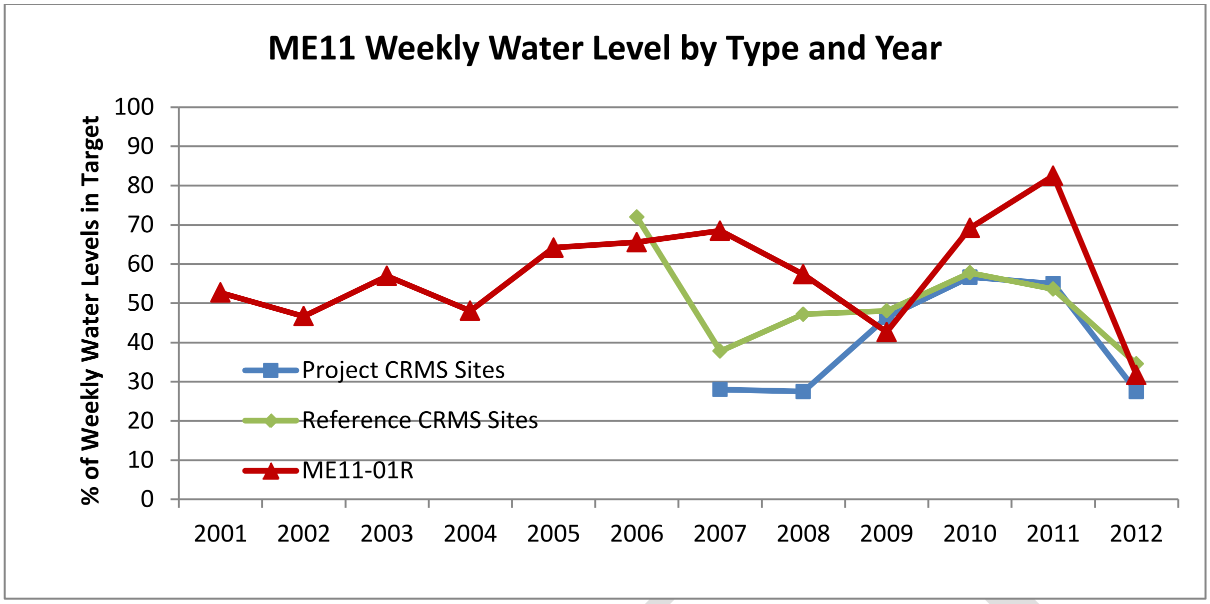

Figure 8. Percent of the year the project CRMS sites (CRMS 2493 and CRMS 624), reference CRMS sites (CRMS 605 and CRMS 583) and the Mermentau River reference recorder (ME11-01R) were within six inches below marsh and two inches above marsh elevation. ME11-01R was consistently within target more often than either the project CRMS sites or the reference CRMS sites.

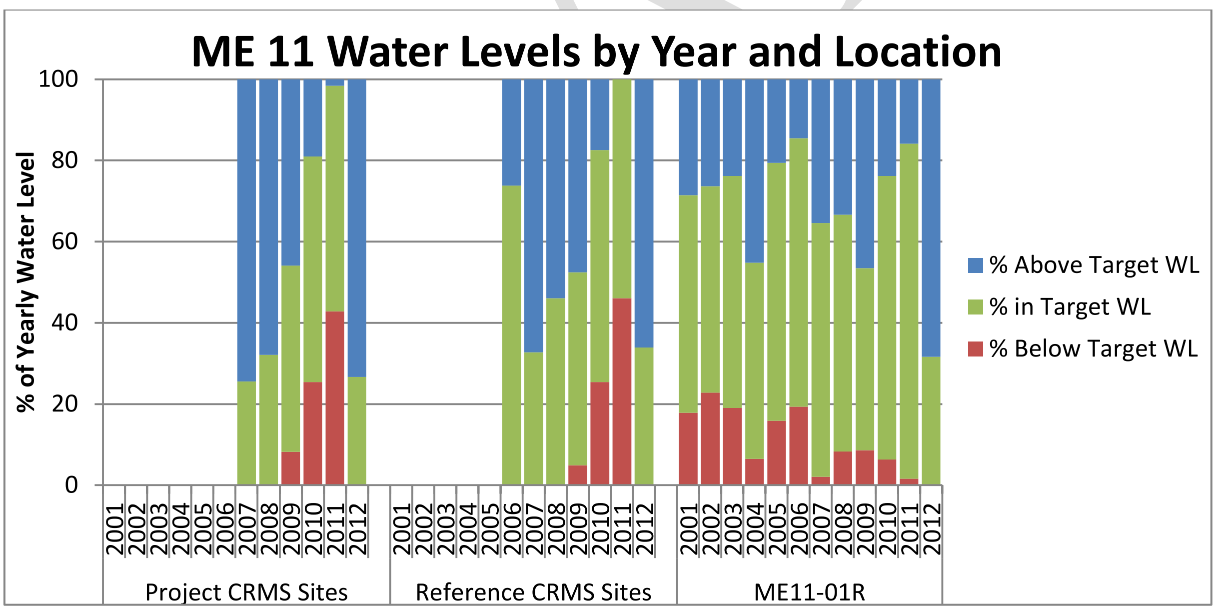

Figure 9. Percentage of the year that weekly average water levels were below target, in target, and above target range in project CRMS sites (CRMS 2493 and CRMS 624), reference CRMS sites (CRMS 605 and CRMS 583) and the Mermentau River reference recorder (ME11-01R). Note that only sites with greater than 50% of the weekly averages present were used in yearly averages.

Water Salinity:
The distribution of salinities in the project area was mapped for one month (July – September) from 2000 to 2003 (Sharp and Guidry 2011). The recorders in the project and reference area showed that salinities were rarely above two ppt from September 2001 through 2004 in the project area while spikes near 10 ppt regularly occurred at the reference station. From construction through Hurricane Rita in 2005, the project weirs appear to have effectively prevented saltwater intrusion into the project area.

The surface water salinity at the project CRMS sites, reference CRMS sites, and Mermentau River reference recorder was measured concurrently from 2007 through 2012, salinity spikes above 15ppt were common in the river and salinity's rarely reached above 10 ppt in the project and reference CRMS sites (figure 10). The project was compromised by Hurricanes Rita and Ike, along with several other events. A plug in the eastern levee was mechanically breached after each storm and two other high water events leaving the area open to tidal saltwater exchange. The gravity drainage district is working towards installing a permanent spillway structure to prevent the need to cut the plug during high water which should allow salinities to be more effectively controlled in the project area.

The interstitial soil porewater salinity in the project CRMS sites, reference CRMS sites, and Mermentau River CRMS reference site locations were measured at 10 and 30 cm from 2006 through 2012 (figure 11). The yearly average porewater salinity in the project CRMS site and reference CRMS site locations varied from 5-8 ppt across the period of record, and were generally very stable across hurricanes, droughts, and heavy upland rain. The Mermentau River CRMS reference site soil salinity increased from 2007 through 2011, only decreasing after the extremely wet year 2012. During the drought of 2011 the average soil salinity at the Mermentau River CRMS reference site was 16 ppt, and was considerably more saline than the other two locations even with repeated degradations to the project area perimeter for flood control purposes.

The salinity goals were to maintain salinity in the project area under 3 ppt and to prevent peaks over 7 ppt. Specific tests prescribed in the monitoring plan called for BACI analysis of salinities and the proportion of time salinities were beyond the target range in the project and reference areas pre and post-construction. Weekly mean salinities were compared in the project and reference area pre and post construction using nonparametric one-way ANOVA. Differences in weekly project and reference salinities from continuous data recorders deployed concurrently from 5/2000 to 4/2004 were compared pre and post construction. There was a significant difference where project area salinities were 1.3 ppt higher than reference area salinities pre construction and were 2.3 ppt lower than reference salinities post construction (χ^2 = 52.16, $p<0.0001$) (Sharp and Guidry 2011). Similarly, the percent of hourly data per week outside the target range of 3 ppt was 10% higher in the project area than in the reference area pre construction and 24% lower than the reference post construction (χ^2 = 23.47, $p<0.0001$). These tests indicate that the project had the desired effects of reducing salinities in the project area relative to the reference area from May, 2000 through April, 2004. In fact, salinities weren't beyond the 3 ppt target range in the project area from 2002 to 2004 but they were occasionally above the target at the reference recorder in 2002 and 2003 suggesting the project did successfully limit saltwater access before Hurricane Rita.

A comparison of current CRMS project sites, reference sites, and the Mermentau River reference recorder ME11-01R average weekly salinities in excess of the target range of 3 ppt were tested via a nonparametric one-way Median test across the years 2007-2012 comparing concurrent data in these locations. The project CRMS sites were over the 3 ppt target range approximately 51% of the time where the reference CRMS sites were over the 3 ppt target range 46% of the time, these differences were not significant based on a non-parametric Median test (χ^2 = 0.1756, $p<0.6752$). The Mermentau River reference recorder ME11-01R was over the 3 ppt threshold 49% of the time compared to the project CRMS sites 51% which did not differ from one another (χ^2 = 0.0905, $p<0.7635$). The overall trend displays salinities increasingly over 3ppt in all three locations with the exception of 2006 in the reference area and all areas in 2012 (figures 12). This pattern of increased salinity was reversed in 2012 in which both the reference and project CRMS sites were below 3 ppt over 90% of the time. The Mermentau River reference recorder also reversed its previous trajectory but not to the extent of the other locations; however it was still fresher than 3 ppt 68% of the time (figure 13).

The higher salinity threshold of 7 ppt was rarely observed in the project and reference CRMS sites, even during the extreme drought of 2011 and never during the wet year 2012 (figure 14). The project and reference CRMS site average weekly salinities in excess of the target range of 7 ppt was tested via a nonparametric one-way Median test across the years 2007-2012 comparing concurrent data in these two locations (χ^2 = 0.8199, $p<0.3652$), there was no difference, and the two locations averaging 14.33% and 11.31% respectively. The Mermentau River reference recorder was over the 7 ppt threshold significantly more of the time (31.57%) than the project CRMS sites (14.33%), as shown by a nonparametric one-way Median test across the years 2007-2012 comparing concurrent data in these two locations (χ^2 = 11.86, $p<0.0006$). The project features appear to be very effective at reducing salinity greater than 7 ppt in the project marsh while this higher salinity water regularly enters the upper Mermentau River, especially in drought years (figures 15). However due to the lack of hydrologic exchange at low water levels the project CRMS sites can maintain salinity's above the 3 ppt level longer than the Mermentau River reference recorder as seen in 2011. This is due to evaporation of surface waters and the concentration of salts held within those waters, overall the project weir does not permit high salinity water from entering the project area under most hydrologic conditions.

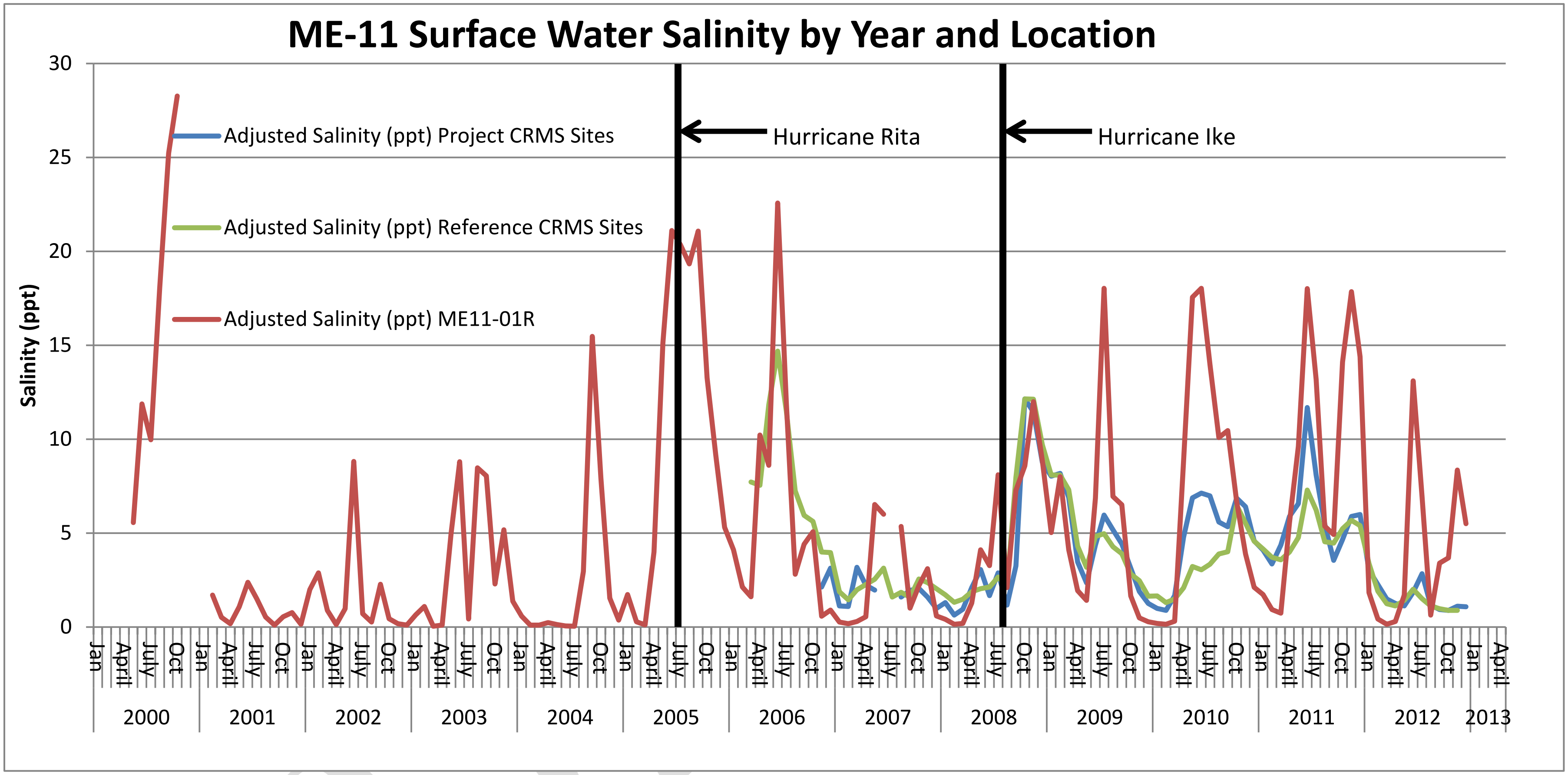

Figure 10. Monthly mean salinity in the project CRMS sites (CRMS 2493 and CRMS 624), reference CRMS sites (CRMS 605 and CRMS 583) and the Mermentau River reference recorder (ME11-01R), the Mermentau River reference reorder consistently has higher and more variable salinity than the project CRMS sites and the reference CRMS sites.

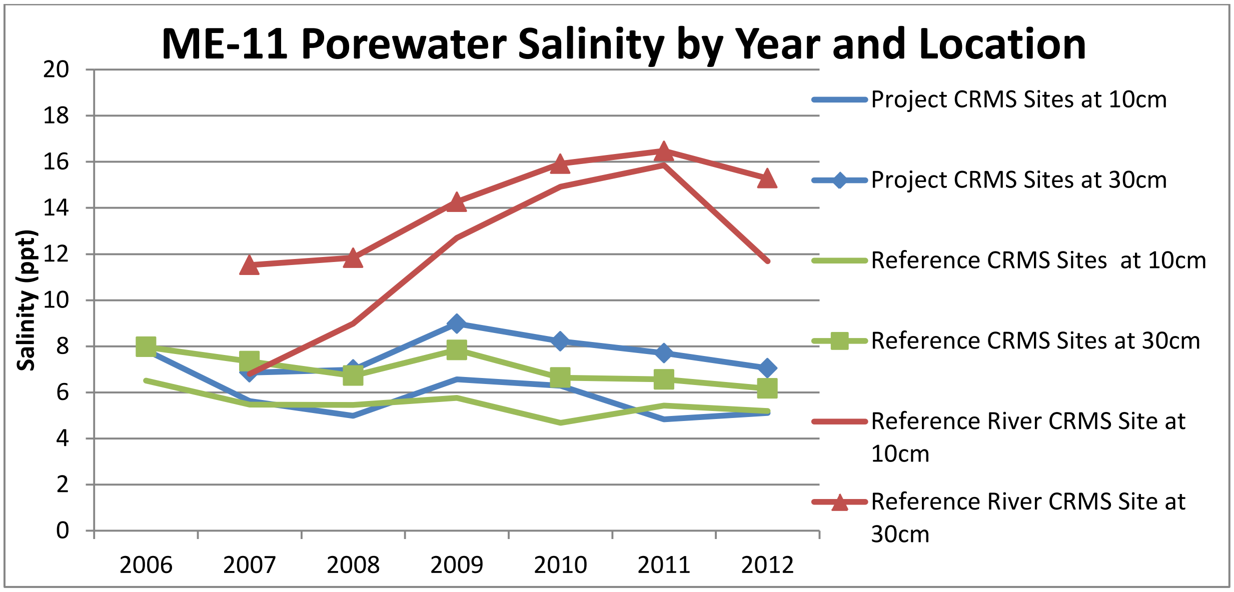

Figure 11. Yearly mean porewater salinity in the project CRMS sites (CRMS 2493 and CRMS 624), reference CRMS sites (CRMS 605 and CRMS 583) and Mermentau River CRMS reference site (CRMS 584). The Mermentau River CRMS reference site was uniformly higher in salinity than the project or reference marsh sites which typically followed a very similar pattern of porewater salinity between 5 and 8 ppt annually.

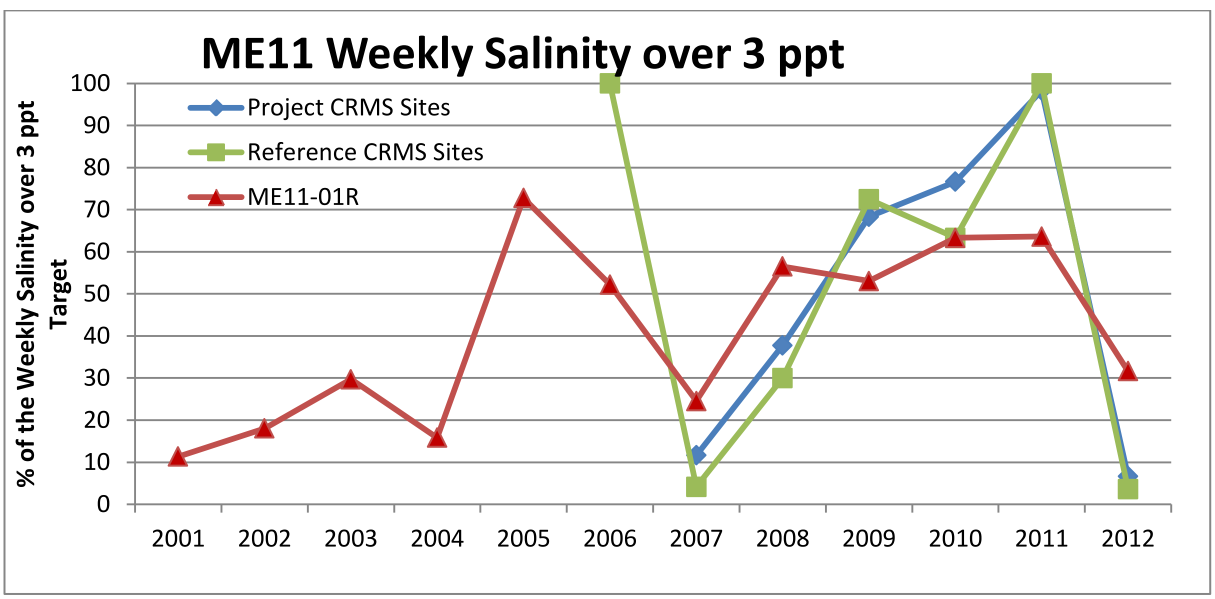

Figure 12. Percent of the year that weekly average salinity levels were over the 3 ppt target range in project CRMS sites (CRMS 2493 and CRMS 624), reference CRMS sites (CRMS 605 and CRMS 583) and Mermentau River reference recorder (ME11-01R).

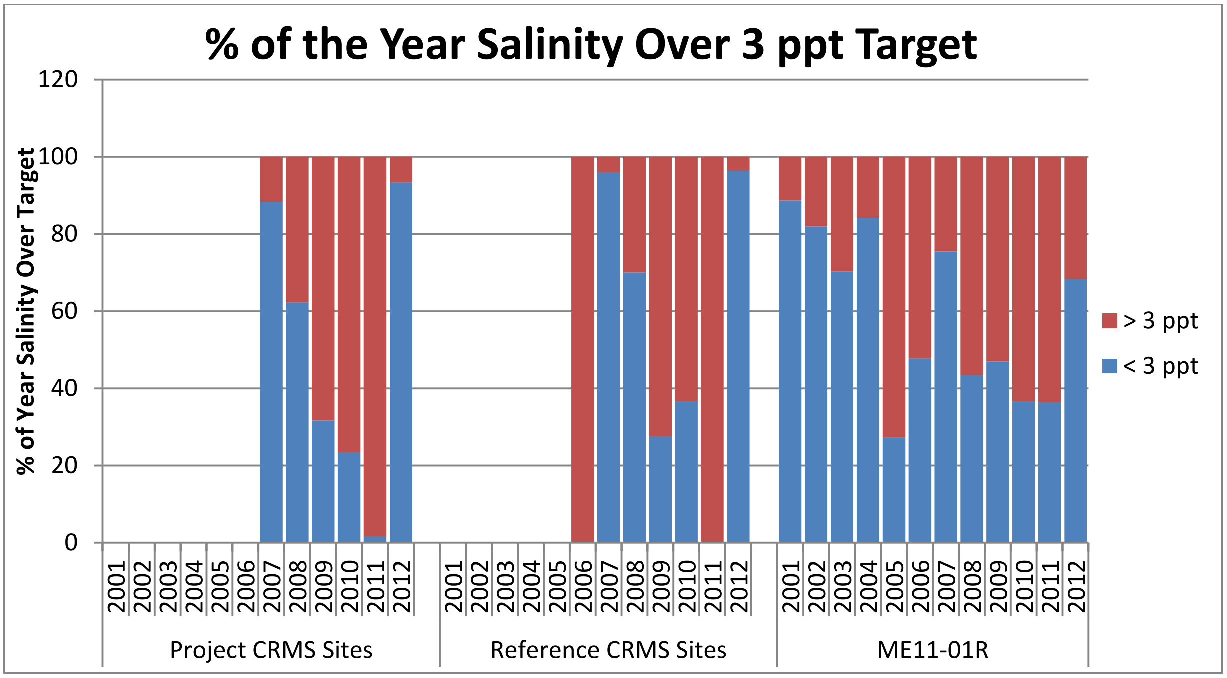

Figure 13. Percent of the year that weekly average salinity levels were over the 3 ppt target range in project CRMS sites (CRMS 2493 and CRMS 624), reference CRMS sites (CRMS 605 and CRMS 583) and Mermentau River reference recorder (ME11-01R). Note that only sites with greater than 50% of the weekly averages present were used in yearly averages.

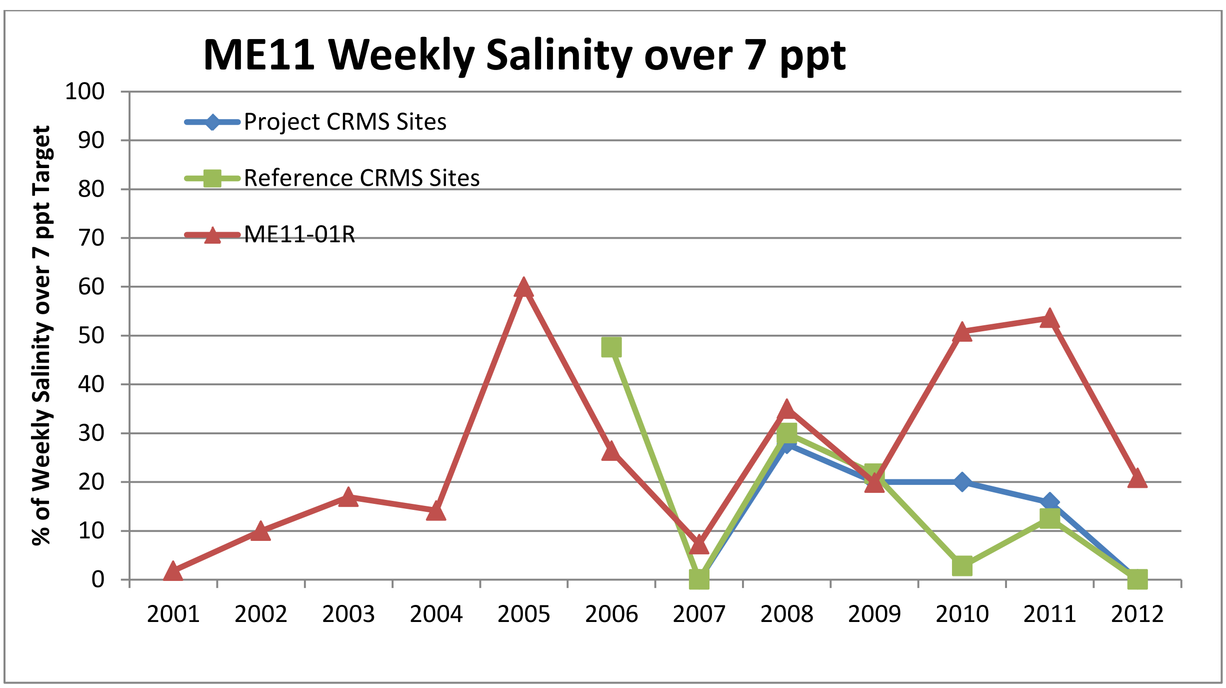

Figure 14. Percent of the year that weekly average salinity levels were over the 7 ppt target range in project CRMS sites (CRMS 2493 and CRMS 624), reference CRMS sites (CRMS 605 and CRMS 583) and Mermentau River reference recorder (ME11-01R).

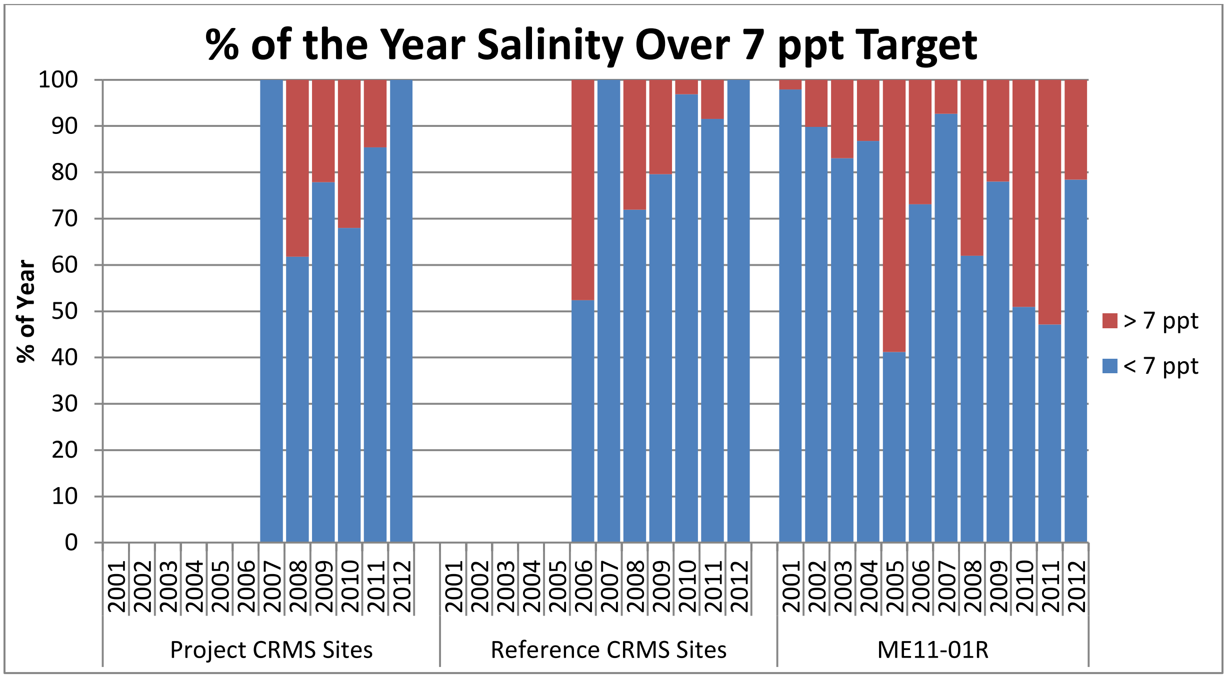

Figure 15. Percent of the year that weekly average salinity levels were over the 7 ppt target range in project CRMS sites (CRMS 2493 and CRMS 624), reference CRMS sites (CRMS 605 and CRMS 583) and Mermentau River reference recorder (ME11-01R). Note that only sites with greater than 50% of the weekly averages present were used in yearly averages.

Emergent vegetation:

Project specific emergent vegetation data was collected pre construction in 2000, post construction in 2003 and as part of a broader post Hurricane Rita assessment at half of the vegetation stations in 2005, 2006, 2007, and 2008. The project goals were to increase the cover and occurrence of fresh marsh species in the project area. Species were classified as fresh, fresh-intermediate, intermediate and so on using classifications provided by Jenneke Visser. The 2000 and 2003 data were tested for project effects on the occurrence and cover of fresh species as per the monitoring plan. Cover of fresh and fresh-intermediate species increased between 2000 and 2003 but there was not a significant difference in the rate of increase between the project and reference area ($F_{1,42}$=1.80, p=0.1874). The number of fresh species occurring in the project and reference area both declined between 2000 and 2003 and did so at the same rate ($F_{1,42}$=0.05, p=0.8256) (Sharp and Guidry 2011). It is not surprising that there was no vegetation effect between 2000 and 2003 considering project construction was completed in March 2003. A similar analysis was performed on the project, reference, and Mermentau River CRMS sites between 2006 and 2012. The project and reference CRMS sites were nearly identical with respect to the amount of fresh and fresh-intermediate vegetation present ($F_{1,26}$=0.001, p=0.975) in a one-way ANOVA. However the project CRMS sites were less variable and were increasing in intermediate vegetation while the reference CRMS sites varied depending on rainfall and were losing intermediate marsh species. The results of the project CRMS sites compared to the Mermentau River CRMS site showed a significantly larger quantity of fresh and fresh-intermediate vegetation in the project, where those classes had been completely lost to the Mermentau River CRMS site starting in 2010 and continuing through 2012 ($F_{1,21}$=5.668, p=0.027).

All available vegetation data from ME-11 project specific sites and project specific reference sites were summarized according to marsh type classifications over time for a similar vegetation salinity assessment. The subset of ME-11 stations sampled through 2008 showed that after Hurricane Rita there was higher percent cover in the project area than the reference but the project area wasn't necessarily composed of fresher species than the reference area (figure 16). This assessment is in agreement with the findings of the more current CRMS data which shows different trajectories inside and outside the project area after 2008.

The project CRMS sites (CRMS0624 and CRMS2493) have similar cover and vegetation type to the reference CRMS sites (CRMS0583 and CRMS0605); however the long term trend in vegetation type appears to be diverging. The project CRMS sites are transitioning to fresher species at the expenses of intermediate-brackish species. The reference CRMS sites are transitioning to more intermediate-brackish through saline species at the expenses of the intermediate through fresh species. The Mermentau River CRMS site (CRMS0583) has converted to a majority of intermediate-brackish through saline vegetation following 2008 as overall vegetation cover has receded. The project CRMS sites have recovered from the hurricanes of 2005 and 2008 and appear to be increasingly fresh to intermediate in vegetation coverage. The reference CRMS sites have also recovered to pre hurricane levels but have done so with a saltier cohort of vegetation while the Mermentau River CRMS site is approaching a brackish marsh even under the influence of the heavy local and upland rains of 2012. It appears that the project does effectively shelter the marsh from conditions that would encourage the growth of more brackish and saline species and promote fresh and intermediate vegetation survival (figure 17).

Using the Floristic Quality Index (Cretini et al., 2011) it is possible to assess the quality of species that inhabit sites and to interpret what specific species might indicate about site stability. The ME-11 project specific sites and reference areas had modest FQI values before Hurricane Rita (around 70), fell in 2006, and recovered to the pre-Rita levels in the project area but not in the reference area (figure 18). Both locations held storm surge water from Hurricane Rita for several months after the storm allowing more damage to occur.

The project CRMS sites (CRMS0624 CRMS 2493) had similar percent cover and FQI values to the reference CRMS sites (CRMS0584 and CRMS0603) and both were superior in each category to the Mermentau River CRMS site (CRMS 583) (figure 19). The reference CRMS sites mimicked the FQI score of the project CRMS sites but appeared to reach an apex of hurricane recovery in 2010 and trended lower in recent years while the project percent cover and FQI score reached its peak in 2011. At the Mermentau River CRMS site (CRMS0584) percent cover and FQI was lower in both parameters than either the project or reference CRMS sites, but the ecological pattern of post hurricane recovery and regression to the mean is shared. The FQI values between the project CRMS sites and reference CRMS sites were essentially identical to one another and the Mermentau River CRMS site was markedly lower. The percent cover difference among the project and reference CRMS sites were similar to one another and the Mermentau River CRMS site was again lower.

It appears that the project does effectively shelter the marsh from conditions that would reduce overall percent cover and FQI score, namely large frequent salinity spikes that are present in the Mermentau River from the Catfish point locks to the Gulf of Mexico.

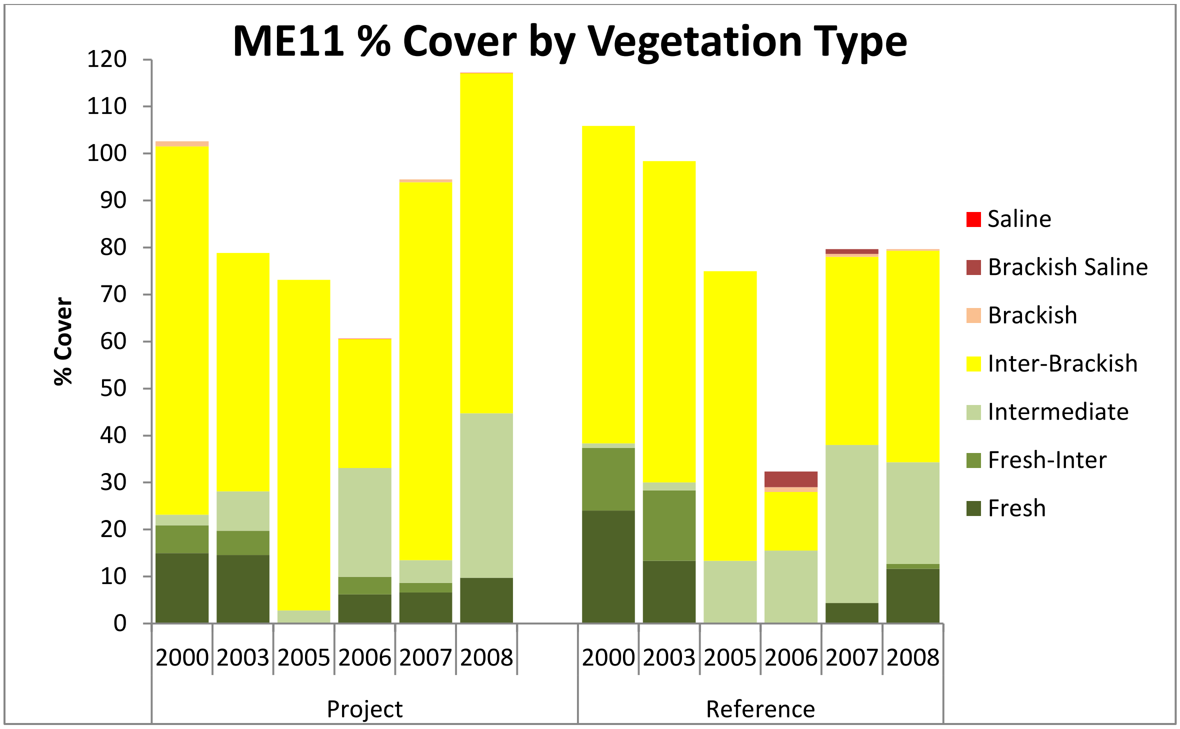

Figure 16. Percent cover by vegetation type in the project and reference area over all years of sampled cover. Data represent a subset of ME-11**project specific** vegetation stations.

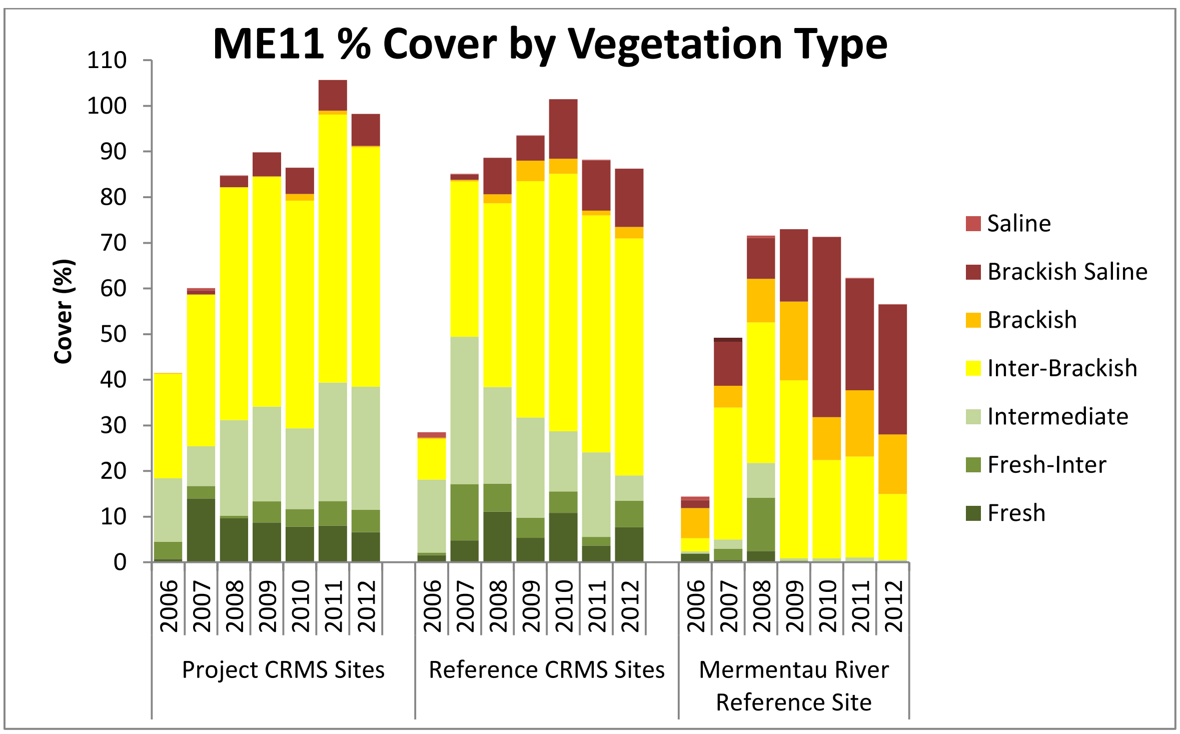

Figure 17. Percent cover by vegetation salinity type in project CRMS sites (CRMS 2493 and CRMS 624), reference CRMS sites (CRMS 605 and CRMS 583) and Mermentau River CRMS reference site (CRMS 584).

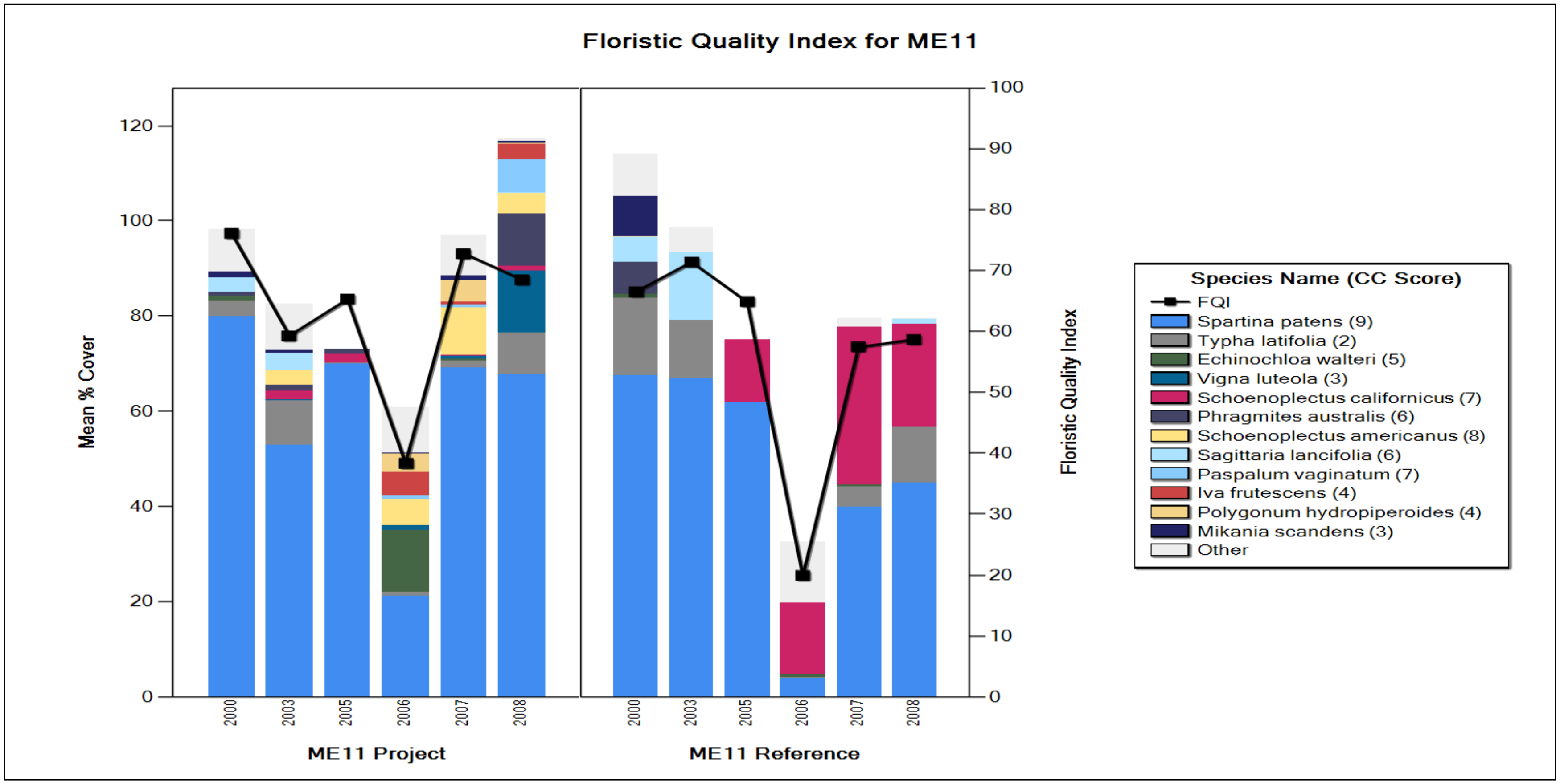

Figure 18. Percent cover of species in the ME-11 **project specific** project and reference areas and FQI score for each year. The CC Scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stability.

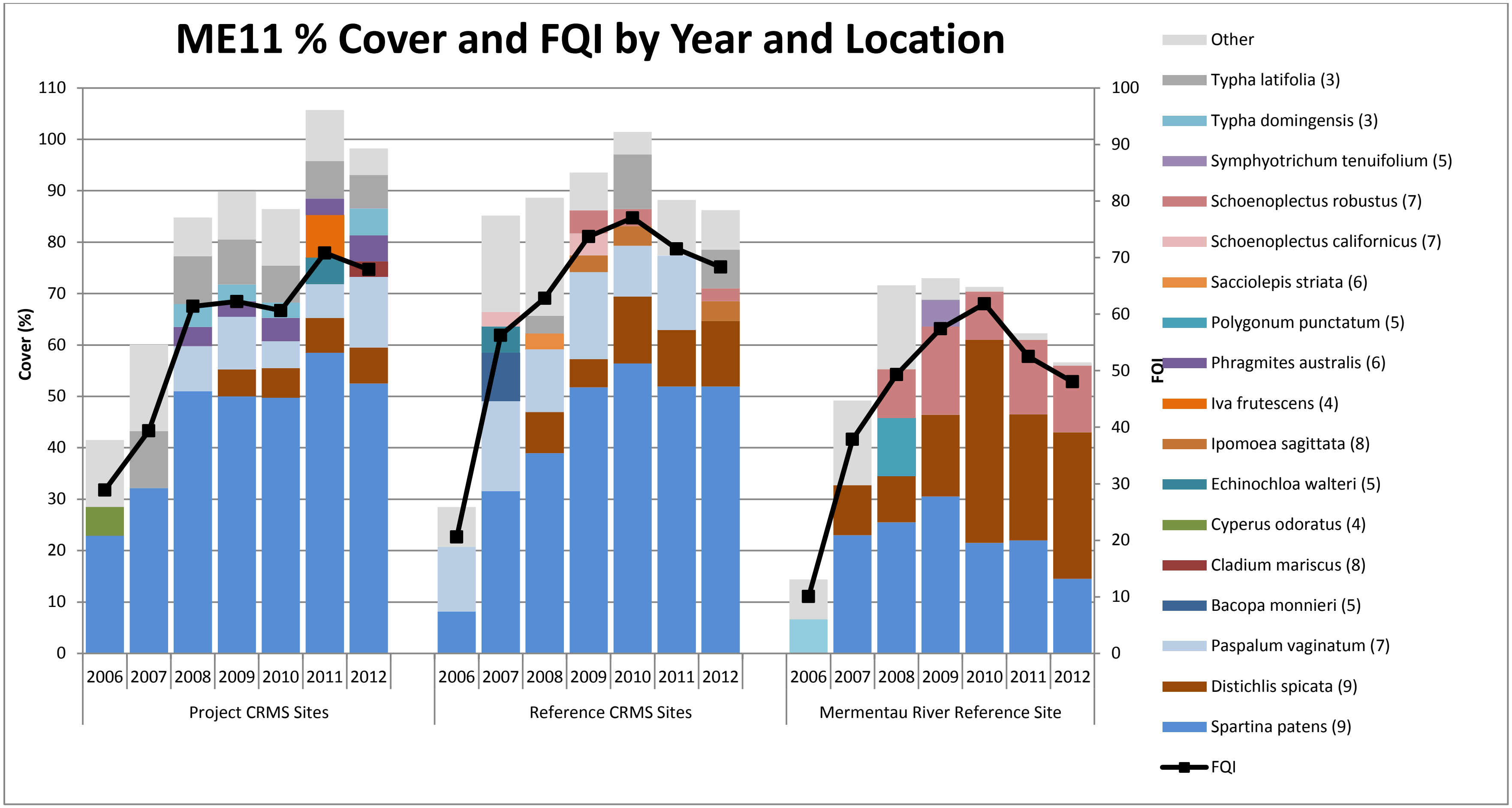

Figure 19. Percent cover and FQI in project CRMS sites (CRMS 2493 and CRMS 624), reference CRMS sites (CRMS 605 and CRMS 583) and Mermentau River reference CRMS site (CRMS 584), FQI and % cover are both much higher in project and reference CRMS sites than the Mermentau River.

Submerged aquatic vegetation:

Frequency of occurrence of SAV was quantified pre and post construction in September 2000 and October 2003. Frequency of occurrence is defined as the percent of samples SAV was found in per transect. From 2000 to 2003, frequency of occurrence of SAV increased in the project area from 0% to around 50% and in the reference area from 70% to 100%. As per the monitoring plan, Analysis of Variance was used to determine whether there was a significant difference in the interaction of project/reference area and time and there was not ($F_{1,16}$=1.56, p=0.2260). SAV frequency of occurrence increased in both areas at approximately the same rate (figure 20).

SAV species richness increased from 0 to 7 species in the project area and from 2 to 6 species in the reference area (excluding Algae). The difference in SAV presence between sampling years can be attributed to salinity, which was around 20 ppt during sampling in both areas in 2000 (a drought year) and was less than 5 ppt in 2003. The SAV that was present in the reference area in 2000 was mostly salt tolerant *Ruppia maritima* with some *Ceratophyllum demersum* (figure 21). In 2003, the project area was dominated by *Najas guadalupensis* while the reference area was co-dominated by Potamogeton spp., *Najas guadalupensis*, *Vallisineria americana*, and *Chara* spp. *Cabomba caroliniana* and *Nelumbo lutea* were found in the project area and not the reference area.

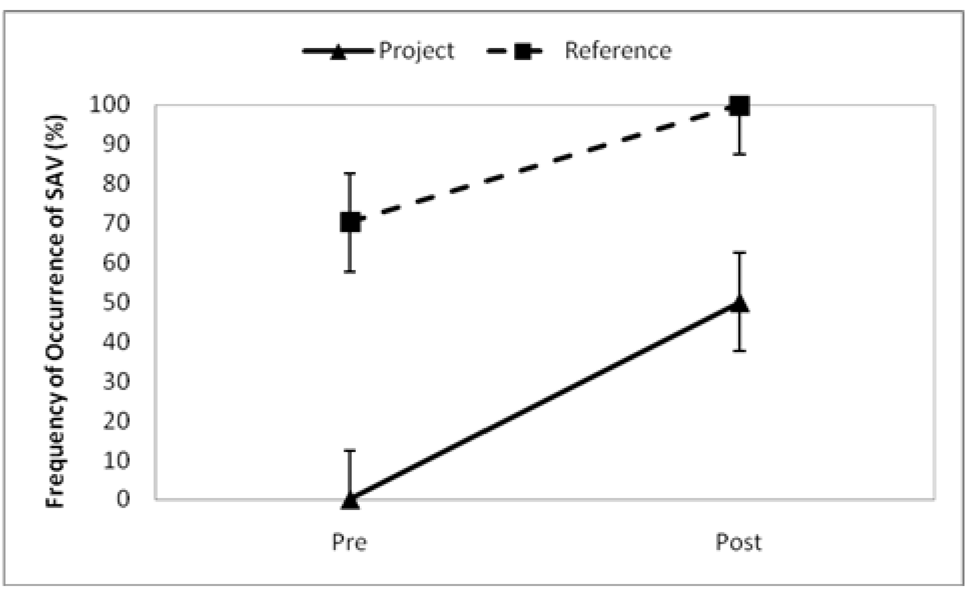

Figure 20. Mean frequency of occurrence of SAV in project and reference ponds pre and post construction. LSMean ± SE.

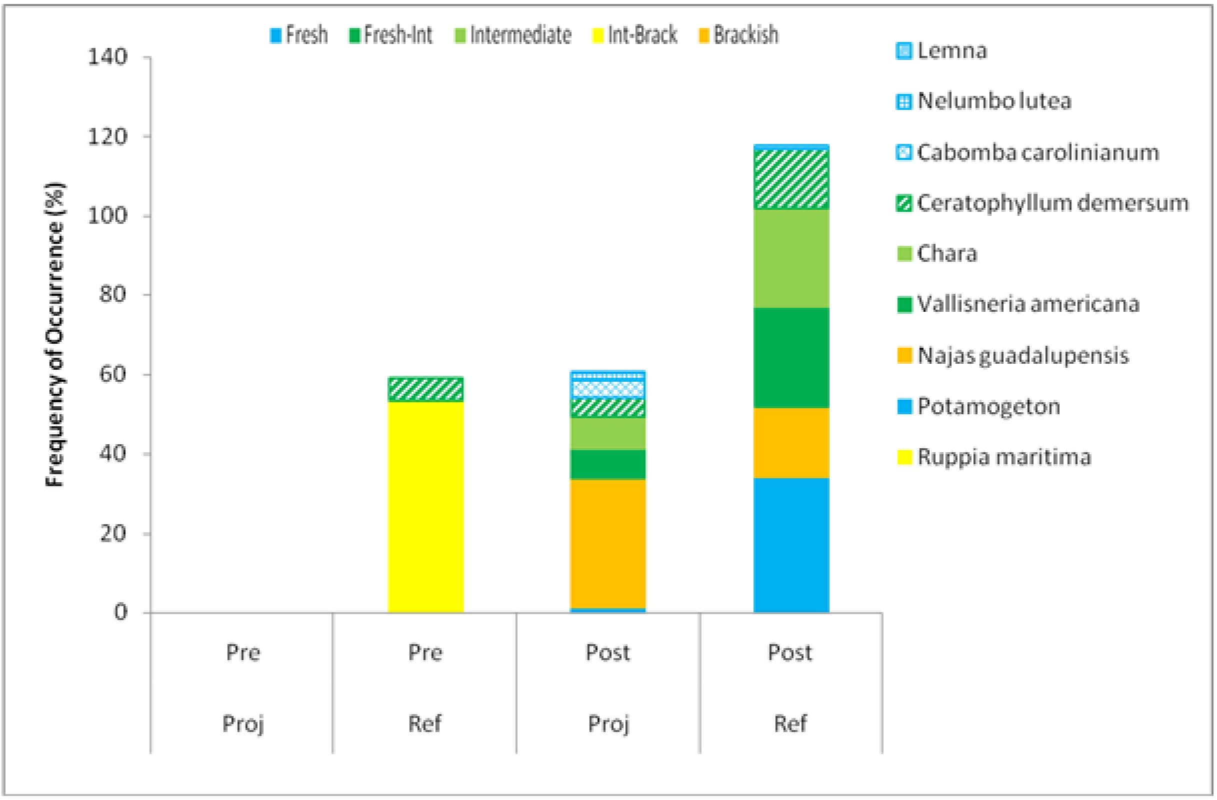

Figure 21. Mean frequency of occurrence of SAV species in the project and reference area pre and post construction. Frequency for transects averaged by area and year.

CRMS Supplemental Data:

Soil Properties:

Three soil cores were extracted from each site sometime during construction (mostly in 2006) and were analyzed in four cm increments down to 24 cm. For this summary, bulk density and percent organic matter will be displayed as depth profiles (figures 22 and 23). Bulk density was higher in the Mermentau River reference CRMS site (CRMS 584) than the project CRMS sites or the reference CRMS sites in the 0-4 cm and 4-8 cm segments of the core. This is likely due to the availability of alluvial sediments under high flow conditions in the Mermentau River; however it is similar to the other CRMS sites below the 8 cm mark. Both the reference and project CRMS sites had low and similar measurements for bulk density, possible as a result of being intentional cutoff from the Mermentau River to prevent salt water intrusion into the area. Percent organic matter was lower in the Mermentau River reference CRMS site than the project CRMS sites or reference CRMS sites as it is generally inversely related to bulk density. The reference CRMS site 583 had the highest percent organic content and the lowest bulk density of any of the 5 sites but was similar to the project CRMS site 624. Most of the sites display a lack for mineral sediment accumulation on or near the surface; this suggests a highly peaty system with little input of mineral sediment over a decadal time frame.

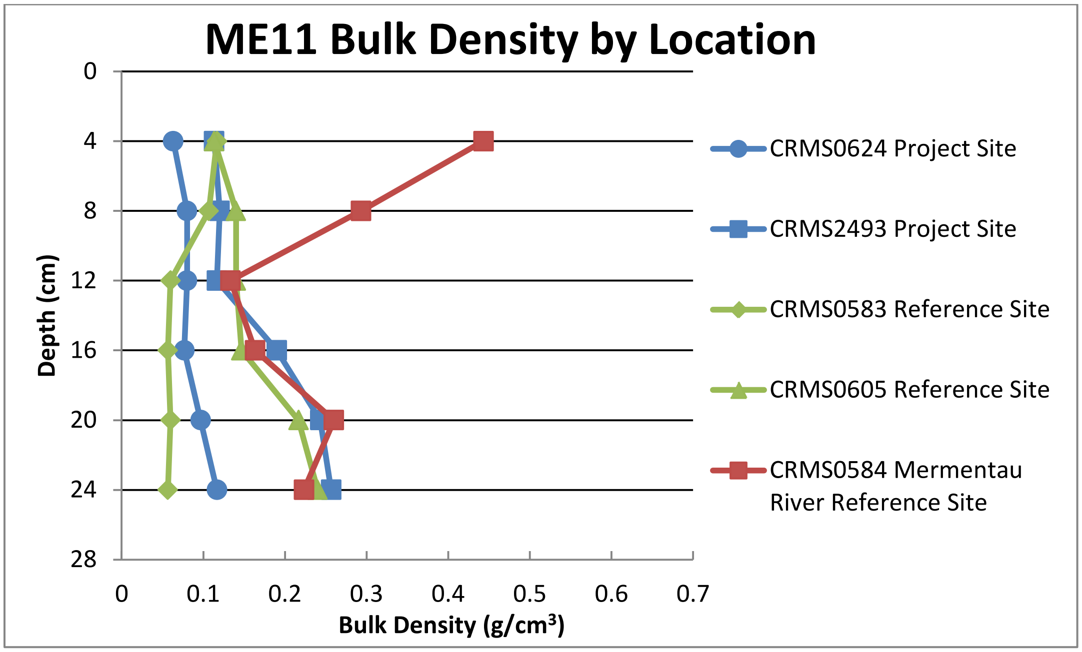

Figure 22. Mean soil bulk density along the depth profile of cores taken in project CRMS sites (CRMS 2493 and CRMS 624), reference CRMS sites (CRMS 605 and CRMS 583) and Mermentau River reference site (CRMS 584).

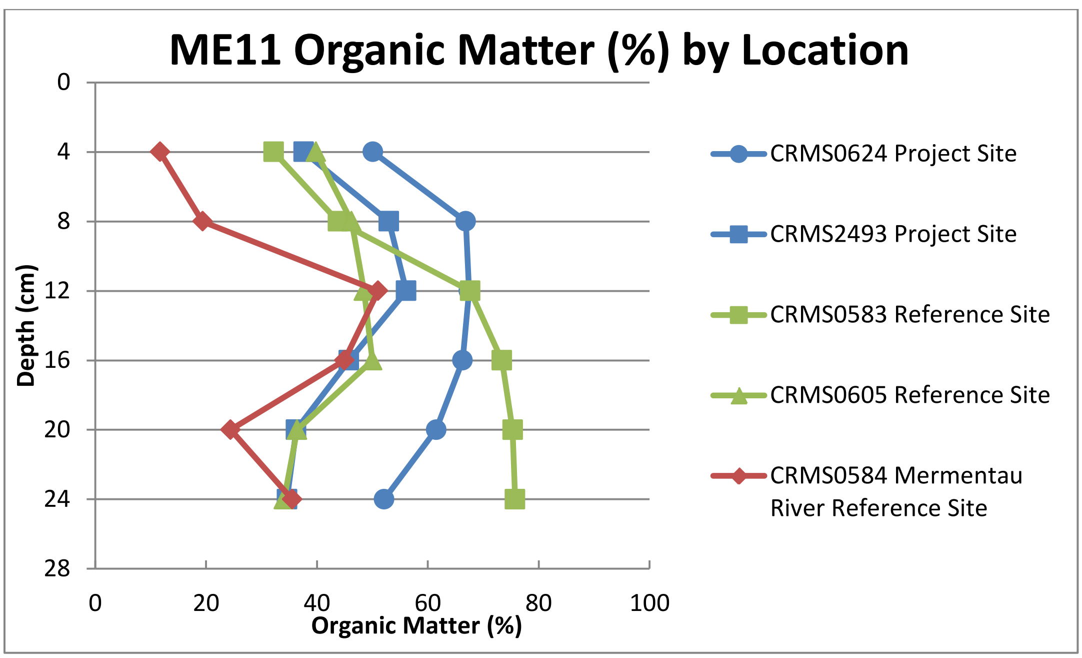

Figure 23. Mean soil percent organic matter along the depth profile of cores taken in project CRMS sites (CRMS 2493 and CRMS 624), reference CRMS sites (CRMS 605 and CRMS 583) and Mermentau River reference site (CRMS 584).

Marsh Elevation Change:

Subsidence and accretion data collected at CRMS 624, 2493, 583, 605, and 584 from site installation through the end of 2012 yields some insight as to the nature of land loss in the vicinity of ME-11 (figure 24). The reference CRMS sites and the southern project CRMS site (2493) are all losing elevation at a substantial rate compared to relative sea level rise (RSLR) which indicates land loss is likely to be dominated by marsh collapse due to inundation and then wave erosion of pond rims and ridges in the future. The Mermentau River CRMS site (584) and the northern project CRMS site (624) are subsiding at a slower rate and are likely to remain productive marshes although different process are driving these rates. The Mermentau River CRMS site elevation change rate is guided by riverine and tidal forces and the northern project CRMS site is likely maintaining its elevation through organic deposition and below ground production. The elevation change rates ranged from -0.67 cm/yr to -0.08 cm/yr, but generally were closer to -0.42 cm/yr on average. The estimate for relative sea level rise at Sabine Pass is 0.57 cm/yr which only exacerbates the negative or static elevation change at all of these CRMS sites. These values indicate elevation change rates along the interior of the Mermentau lakes sub basin are problematic in sustaining the long term productivity of the areas marshes. CRMS site 584 had the least negative elevation change rate (- 0.08 cm/yr). This is likely due to its proximity to the shoreline of the Mermentau River. This location could receive sediment distribution from the Mermentau River during both heavy upland rain events and strong southerly wind and tides. The typical cycle in these locations is accretion building up the marshes contiguous to the river channel as interior areas are cut off and undergo sedimentation starvation.

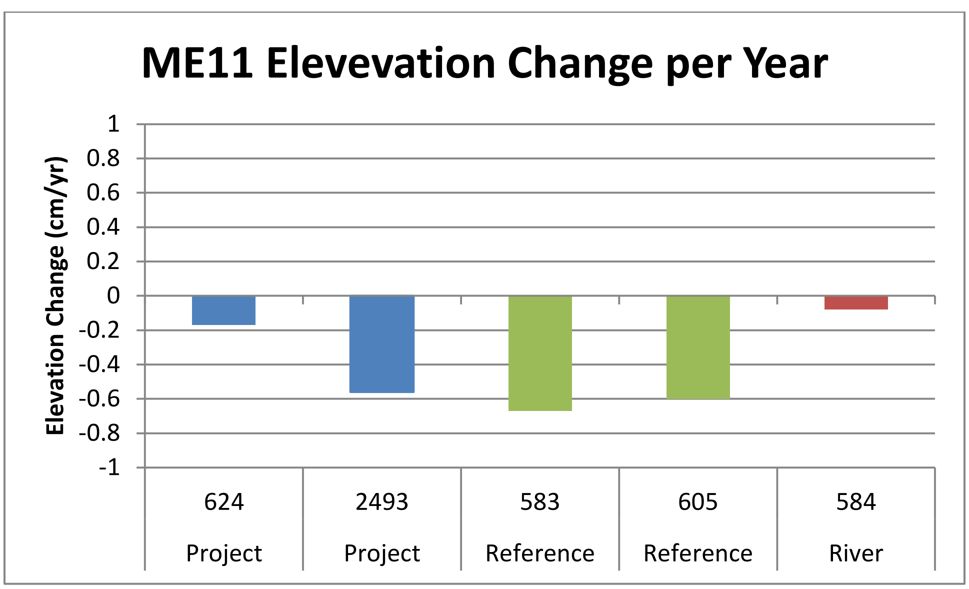

Figure 24. Elevation change per year in the project CRMS sites (CRMS 2493 and CRMS 624), reference CRMS sites (CRMS 605 and CRMS 583) and Mermentau River reference site (CRMS 584) based on data collected from site installation through 2012.

V. Conclusions

a. Project effectiveness

1. **Increase present (yr 2000) land to water ratio.** While the project did not meet the goal of increasing land to water ratios above pre project levels, the project land to water ratios have remained stable while the project area has being separated from the Mermentau River, a potential sediment source. The project area has also maintained a consistent land to water ratio despite experiencing major environmental disturbances which caused substantial marsh loss in the region.

2. **Maintain mean water levels in the project area between 6 in below and 2 in above marsh level.** The project to date has been unsuccessfully maintaining water level between six inches below and two inches above marsh level. The alterations to the regions hydrology as a whole has reduced the speed and depth at which drainage can occur, this affects the entire Mermentau Lakes sub basin. The project has also experienced excessive flooding which resulted in multiple intentional openings of the project dikes to discharge high water conditions resulting from hurricanes and high localized rainfall. The separation of the river from the marsh also causes very low water levels during drought conditions, restricting water flow into the project at times of low local rain fall. The project CRMS sites are no different in maintaining target water level than the reference CRMS sites which also fail to maintain a high percentage of in target water level which suggests that the Mermentau Lakes sub basin may be flooded a majority of the time leaving little opportunity for drainage.

3. **Maintain mean monthly salinity (0–3 ppt) in the project area after construction and prevent salinities from exceeding 7 ppt.** The project features did not meet the goal of maintaining salinity between 0 and 3 ppt more consistently inside the project area than outside the project area. The project CRMS sites were consistently within the salinity target the same amount of time as the Mermentau River reference recorder and the reference CRMS sites. The reduction of salinities greater than 7 ppt entering the project area was highly successful; during 2007 and 2012 this threshold was rarely breached. This lead to the freshening of the project area and the emergent vegetation responded by becoming increasingly fresh and increasing in overall coverage.

4. **Increase or maintain the occurrence and cover of fresh marsh vegetation species in the project area.** The vegetative cover as seen in the CRMS and project specific data shows that the marsh has rebounded post Hurricane Rita both in and out of the project, but has performed better in the project. The complementary species composition at the project CRMS sites are trending toward fresher marsh species such as *Typha latafolia*, *Typha domingensis*, and *Phragmites australis*. The reference CRMS sites and Mermentau River CRMS site show the opposite trend with fresh to intermediate species being replaced by a brackish and saline cohort. This was achieved even as the plug was cut for Hurricanes Rita, Ike, and two other high water events. The project weirs were functioning properly when the plug had to be cut suggesting the

need for additional drainage capacity in the project area. That stated the project is promoting a fresher plant community as the marsh around the project area become more saline.

5. **Increase frequency of occurrence of submerged aquatic vegetation (SAV) in the project area.** The Submerged Aquatic Vegetation increased in occurrence from 2000 to 2003 in the project area from 0% to near 50%. While not monitored, it would be expected that this SAV coverage would drop or become absent post Hurricane Rita and begin a slow rebound toward pre storm levels. Based on the increase in occurrence of SAV prior to Hurricane Rita in 2005, the project appeared to be effectively preventing saltwater intrusion and SAV responded accordingly.

In order to completely achieve flooding, and Land: Water goals, the intentional and repeated levee breaching issue needs to be resolved with a permanent relief spillway to remove excess water without potentially introducing saline water. The gravity drainage district's proposed spillway should help solve the problem.

b. Recommended improvements

The ME-11 project features are functioning properly but all project goals are not being met. The Cameron Parish Gravity Drainage District plans to create a permanent spillway north of the project structures which should help reduce flooding in the project area while eliminating the need for dike cutting in the future.

c. Lessons learned

The current design of five 48" culverts and one 18" screw gate is not sufficient to remove excess water from the 4000 acre ME-11 project area during large storm events. Separating the project wetlands from the Mermentau River has been successful in reducing saline waters entering into the project area and transforming the marshes to a more saline habitat. This also reduces the possibility of mineral input from the river entering the project marshes which could help to offset sea level rise.

Specific to the structure operations and inspections, grass control for land access portion to the structure should be included in the operations contract. Hyacinth fencing has proven to be effective in preventing debris and floating vegetation from obstructing the culverts and interfering with structure operations.

Continuous Monitoring Recorders should be included in future designs of water control structures such as this.

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APPENDIX A
(Inspection Photographs)

Photo No. 1, Marine barrier with signage.

Photo No. 2, Inlet side of structure

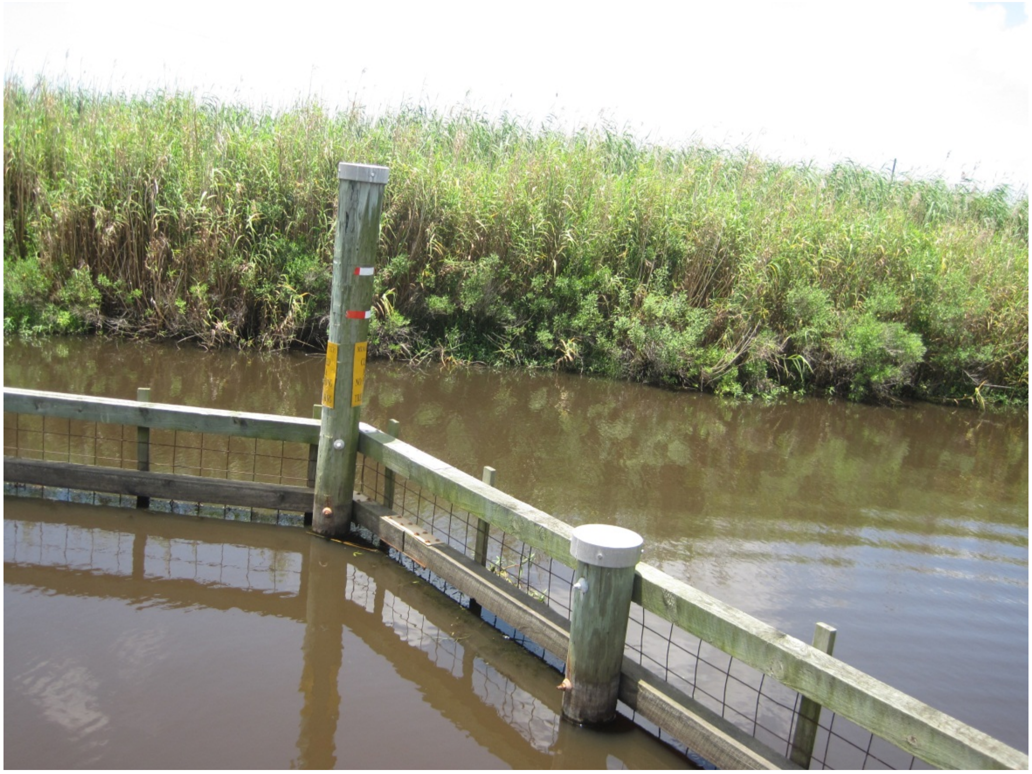

Photo No. 3, Inlet side of structure

Photo No. 4, Outlet side of structure

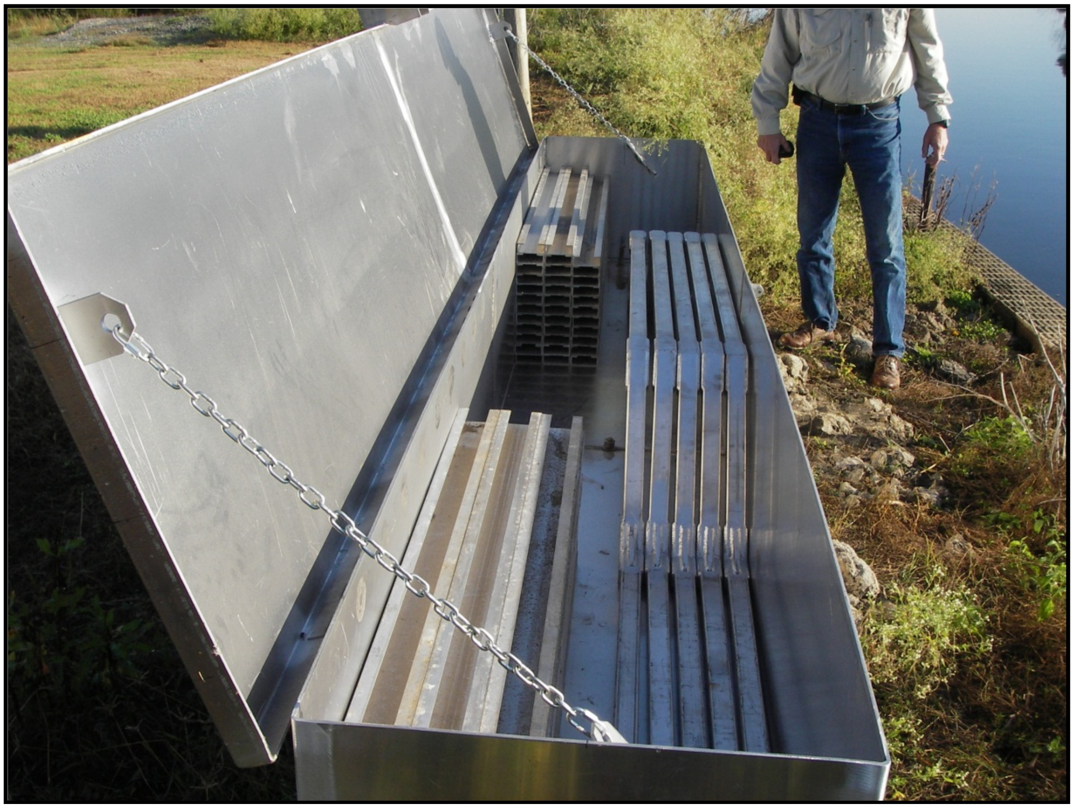
Photo No. 5, Storage box for locking arms and stop logs

Appendix B
(Three Year Budget Projection)

HUMBLE CANAL / ME-11 / PPL8

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

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

	2013/2014 (-11)	2014/2015 (-12)	2015/2016 (-13)
Maintenance Inspection	$ 6,457.00	$ 6,651.00	$ 6,851.00
Structure Operation	$ 11,000.00	$ 12,000.00	$ 13,000.00
State Administration			$ -
Federal Administration			$ -

Maintenance/Rehabilitation

13/14 Description:

	2013/2014 (-11)
E&D	
Construction	
Construction Oversight	
Sub Total - Maint. And Rehab.	$ -

14/15 Description:

	2014/2015 (-12)
E&D	
Construction	
Construction Oversight	
Sub Total - Maint. And Rehab.	$ -

15/16 Description:

	2015/2016 (-13)
E&D	
Construction	$ -
Construction Oversight	$ -
Sub Total - Maint. And Rehab.	$ -

	2013/2014 (-11)	2014/2015 (-12)	2015/2016 (-13)
Total O&M Budgets	**$ 17,457.00**	**$ 18,651.00**	**$ 19,851.00**

O &M Budget (3 yr Total)	**$ 55,959.00**
Unexpended O & M Budget	**$ 121,610.00**
Remaining O & M Budget (Projected)	**$ 65,651.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

HUMBLE CANAL HR PROJECT / PROJECT NO. ME-11 / PPL NO. 8 / 07/01/2013 - 06/30/2014

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$6,457.00	**$6,457.00**
General Structure Maintenance	LUMP	0	$0.00	**$0.00**
Engineering and Design	LUMP	0	$0.00	**$0.00**
Operations Contract	LUMP	1	$11,000.00	**$11,000.00**
Construction Oversight	LUMP	0	$0.00	**$0.00**

ADMINISTRATION

LDNR / CRD Admin.	LUMP	0	$0.00	$0.00
FEDERAL SPONSOR Admin.	LUMP	0	$0.00	$0.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$0.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:

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

GEOTECHNICAL

GEOTECH DESCRIPTION:

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

CONSTRUCTION

CONSTRUCTION DESCRIPTION:

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

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$17,457.00**

OPERATION AND MAINTENANCE BUDGET WORKSHEET

HUMBLE CANAL HR PROJECT / PROJECT NO. ME-11 / PPL NO. 8 / 07/01/2014 - 06/30/2015

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$6,651.00	**$6,651.00**
General Structure Maintenance	LUMP	0	$0.00	**$0.00**
Engineering and Design	LUMP	0	$0.00	**$0.00**
Operations Contract	LUMP	1	$12,000.00	**$12,000.00**
Construction Oversight	LUMP	0	$0.00	**$0.00**
ADMINISTRATION				
LDNR / CRD Admin.	LUMP	0	$0.00	$0.00
FEDERAL SPONSOR Admin.	LUMP	0	$0.00	$0.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$0.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:

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
Marsh Elevation / Topography	LUMP	0	$0.00	$0.00
TBM Installation	EACH	0	$0.00	$0.00
OTHER				$0.00
			TOTAL SURVEY COSTS:	**$0.00**

GEOTECHNICAL

GEOTECH DESCRIPTION:

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:

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

TOTAL OPERATIONS AND MAINTENANCE BUDGET: $18,651.00

OPERATION AND MAINTENANCE BUDGET WORKSHEET

HUMBLE CANAL HR PROJECT / PROJECT NO. ME-11 / PPL NO. 8 / 07/01/2015 - 06/30/2016

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	$6,851.00	**$6,851.00**
General Structure Maintenance	LUMP	0	$0.00	**$0.00**
Engineering and Design	LUMP	0	$0.00	**$0.00**
Operations Contract	LUMP	1	$13,000.00	**$13,000.00**
Construction Oversight	LUMP	0	$0.00	**$0.00**

ADMINISTRATION

LDNR / CRD Admin.	LUMP	0	$0.00	$0.00
FEDERAL SPONSOR Admin.	LUMP	0	$0.00	$0.00
SURVEY Admin.	LUMP	0	$0.00	$0.00
OTHER				$0.00
			TOTAL ADMINISTRATION COSTS:	**$0.00**

MAINTENANCE / CONSTRUCTION

SURVEY

SURVEY DESCRIPTION:

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

GEOTECHNICAL

GEOTECH DESCRIPTION:

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

CONSTRUCTION

CONSTRUCTION DESCRIPTION:

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

TOTAL OPERATIONS AND MAINTENANCE BUDGET: **$19,851.00**

APPENDIX C
(Field Inspection Notes)

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: ME-11 Humble Canal

Date of Inspection: June 13, 2013 Time: 12:30 pm

Structure No. N/A

Structure Description: 5 - 48" x 50' corrugated aluminum pipe with weir type drop inlets and flap gated outlets/ 1 1 - 18" x 50' corrugated alum.pipe with screw gate

Type of Inspection: Annual

Inspector(s): CPRA- Mel Guidry, Stan Aucoin, Dion Broussard
NRCS- Frank Chapman, Brandon Sampson

Water Level :

Weater Conditions: Sunny and warm

Item	Condition	Pysical Damage	Corrosion	Photo #	Observations and Remarks
Timber Bulkhead / Caps	good				
Steel Grating	good			2 & 4	
Stop Logs Storage Box	good good				
Hardware	good			2	
Timber Piles	good			2&4	
Timber Wales	good				
Galv. Pile Caps	good			2&4	
Lifting device	good				
Signage /Supports	N/A				
Rip Rap (fill)	good				
Structure Embankmen (Crushed Stone)	good			1, 2 &4	Recommend grass control in future operation contract.
Eathern Embankment Inlet Channel	good good			1 & 4	

What are the conditions of the existing levees?	Stable on both the inlet and outlet channels.
Are there any noticable breaches?	No
Settlement of rock plugs and rock weirs?	N/A
Position of stoplogs at the time of the inspection?	Unkown
Are there any signs of vandalism?	No

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: ME-11 Humble Canal

Date of Inspection: June 13, 2013 Time: 12:30 pm

Structure No. N/A

Inspector(s): CPRA- Mel Guidry, Stan Aucoin, Dion Broussard
NRCS- Frank Chapman, Brandon Samson

Structure Description: Marine Barrier Fence

Water Level :
Weater Conditions: Sunny and warm

Type of Inspection: Annual

Item	Condition	Pysical Damage	Corrosion	Photo #	Observations and Remarks
Timber Bulkhead / Caps	N/A				
Steel Grating	N/A				
Stop Logs	N/A				
Hardware	good				
Timber Piles	good				
Timber Wales	good				
Galv. Pile Caps	good				
Cables	N/A				
Signage /Supports	good			1	
Rip Rap (fill)	N/A				
Eathern Embankment	N/A				

What are the conditions of the existing levees?
Are there any noticable 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-11 Humble Canal

Date of Inspection: June 13, 2013 Time: 12:30 pm

Structure No. : N/A

Inspector(s): CPRA- Mel Guidry, Stan Aucoin, Dion Broussard
NRCS- Frank Chapman, Brandon Sampson

Structure Description: Hyacinth Fence

Water Level :

Type of Inspection: Annual

Weater Conditions: Sunny and warm

Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Timber Bulkhead / Caps	N/A				
Steel Grating	N/A				
Stop Logs	N/A				
Hardware Wire Fence	good			2&3	
Timber Piles	good			2&3	
Timber Wales	good			2&3	
Galv. Pile Caps	good				
Cables	N/A				
Signage /Supports	N/A				
Rip Rap (fill)	N/A				
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?