



**State of Louisiana
Department of Natural Resources
Coastal Restoration Division and
Coastal Engineering Division**

**2007 Operations, Maintenance,
and Monitoring Report**

for

**Freshwater Bayou Wetland
Protection**

State Project Number ME-04
Priority Project List 2

August 2007
Vermilion Parish

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For
Freshwater Bayou Wetland Protection (ME-04)

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I. Introduction

The Freshwater Bayou Wetland Protection project area encompasses 36,928 ac (14,945 ha) of fresh, intermediate, and brackish marsh located between Intracoastal City and Pecan Island in Vermilion Parish, Louisiana (figure 1). Centered approximately at Lat. 29° 40' 00" N and Long. 92° 18' 00" W, the area is bounded on the north by the old Intracoastal Waterway (Schooner Bayou), on the west by Louisiana Highway (La. Hwy) 82 and the Acadiana Marina Canal, on the south by Humble Canal (Acadiana Marina Canal), and on the east by Freshwater Bayou Canal (FBC).

The project plan (USDA/SCS 1994) divides the project area into three Conservation Treatment Units (CTUs), with CTUs 1 and 3 benefiting directly from the shoreline protection work implemented under Phase 1 of the project. Phase 2 of this Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) project authorized the installation of eight (8) box-type water control structures with a single flapgate, a variable-crest weir, and two fixed-crest weirs (one with a 4 inch vertical slot) in the project area. Three structures are located in CTU 1, three in CTU 2, and two in CTU 3.

The southernmost unit, CTU 1, consists of 13,800 ac (5,585 ha) of predominantly fresh marsh with zones of intermediate and brackish marsh along its eastern and southern boundaries. It is predominated by *Sagittaria lancifolia* (bulltongue) and *Spartina patens* (wiregrass). Ponds range in depth from 1.7 to 2.0 ft (0.52 - 0.61 m), and contain over 50% cover with aquatic plants (USDA/SCS 1994). The Phase 1 dike is now protecting the eastern edge of CTU 1 from wave erosion and saltwater intrusion from Freshwater Bayou Canal. CTU 2 consists of 9,300 ac (3,764 ha) of fresh marsh, dominated by *Echinochloa walteri* (Walter's millet) and *S. lancifolia*, located in the west central portion of the project area. Pond depths range from 1.7 to 2.3 ft (0.52 - 0.70 m). The northern section of the project area comprises CTU 3, which consists of 13,800 ac (5,585 ha) of predominantly fresh marsh dominated by *S. lancifolia*, *E. walteri*, and *Alternanthera philoxeroides* (alligatorweed), with intermediate and brackish marsh zones dominated by *S. patens* and *Scirpus americanus* (Olney's bulrush) along its eastern boundary along Freshwater Bayou Canal. Pond depths range from 2.2 to 3.0 ft (0.67 - 0.91 m) in CTU 3.

Reference areas R1 and R2 (figure 1) were established to monitor shoreline erosion along two 0.5 mi (0.8 km) segments of unprotected shoreline located along the east bank of Freshwater Bayou Canal, opposite the south end (R1) and the north end (R2) of the ME-04 dike. These two reference areas were used for comparison with erosion rates along the section of canal bank protected by the ME-04 rock dike within CTU 1. The vegetation type is identical to the project area, and like the project area shoreline, the reference area R1 and R2 shorelines include both intact and deteriorated sections of spoil bank. Reference area R3 is representative of much of the fresh marsh in the northwest section of the project area today, in terms of soil type, salinity, water levels, and the frequency and duration of inundation. Reference area R4 is a small, tidally influenced area of brackish marsh just outside the



boundary of CTU 1. Marsh loss rates were monitored by comparison of all four reference areas with all three CTUs.

Wetlands in the project area are adversely affected by the influence of high water levels from the Grand/White Lake system to the west, where elevated water levels are artificially maintained by several locks and water control structures for navigation and agricultural purposes (LCWCRTF 1993). Water flowing out of White Lake can enter the project area from the west via oil field canals and the borrow canals and culverts under La. Hwy 82, and from the north via natural openings along the south bank of Schooner Bayou.

Some wetland acreage in the project area has been lost through the dredging of oil field access canals. However, most wetland loss in the project area has resulted from the gradual degradation and conversion of fresh marsh to open water, mainly between 1956 and 1978. In 1956, wetlands accounted for 97.9% of the project area and only 1.3% of the area was open water. By 1978, wetlands accounted for only 88.9% of the project area, the open water areas having increased to 8.3% of the area. By 1990, wetlands accounted for only 87.5% of the project area, while the open water area had increased to 8.9% of the project area. Thus, between 1956 and 1990, approximately 7.6% (3,720 ac [1,514 ha]) of the emergent wetlands in the project area were lost.

The potential for tidal exchange between Vermilion Bay and the interior marshes in the project area has greatly increased over the past 40 years through the construction of numerous oil and gas exploration canals, the old Gulf Intracoastal Waterway (GIWW), and Freshwater Bayou Canal. Initially, the fragile organic soils of the interior marshes were protected from saltwater intrusion and tidal scour by spoil banks along these channels. However, much of the spoil banks along Humble Canal and Freshwater Bayou Canal have been destroyed, largely by boat wake-induced shoreline erosion, exposing the interior wetlands to these detrimental forces.

Based on data provided in a feasibility report by Brown and Root (1992), between 1968 and 1992, an average of 34,051 large vessels (crew boats, jack-up barges, supply boats, and fishing boats) traveled through the Freshwater Bayou Canal lock and channel each year, contributing to an average shoreline erosion rate of 12.5 ft per year (3.8 m/yr) on each bank for this period.

Phase 1 construction, which included the placement of rock breakwaters along FBC, was completed in January 1995. Phase 2 construction, which included earthen plugs and water control structures, was completed in October 1998.

Hurricane Rita struck the coast of southwestern Louisiana on September 24, 2005, with maximum storm surge of 8-9 ft (2.4 – 2.7 m) in the ME-04 project area. The U.S. Geological Survey (USGS) calculated the amount of land that changed to water resulting from the storm to be 98 square miles in southwestern Louisiana, with 62 square miles in the Mermentau basin (Barras 2006). This loss can be attributed to shearing, which is ripping and removal of marsh



vegetation in historically healthy marshes; shearing was observed in marshes bordering the east bank of Freshwater Bayou. The removal of remnant marsh from areas with historical land loss from the surge was observed due east of Pecan Island, south of Sweet Lake, and due east of Deep Lake.



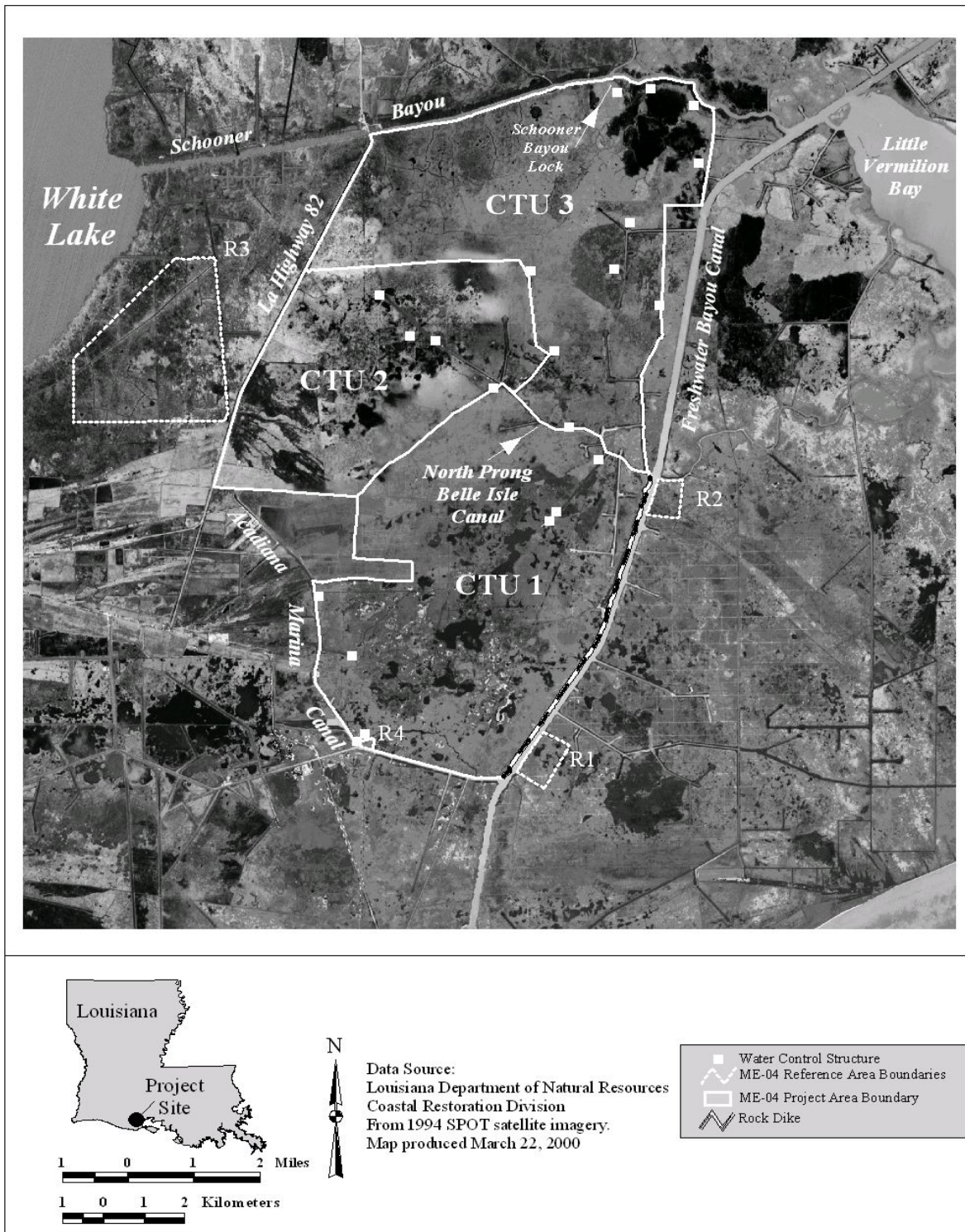


Figure 1: Freshwater Bayou Wetland Protection (ME-04) project and reference areas.



II. Maintenance Activity

a. Project Feature Inspection Procedures

The purpose of the annual inspection of the Freshwater Bayou Wetland Protection Project (ME-04) is to evaluate the constructed project features, identify any deficiencies, prepare a report detailing the condition of those features and the recommended corrective actions needed. Should it be determined that corrective actions are needed, Louisiana Department of Natural Resources (LDNR) shall provide, in the report, a detailed cost estimate for engineering, design, supervision, inspection, and construction contingencies, and an assessment of the urgency of such repairs. The annual inspection report also contains a summary of maintenance projects which were completed since completion of constructed project features and an estimated projected budget for the upcoming three (3) years for operation, maintenance, and rehabilitation. The three (3) year projected operation and maintenance budget is shown in Appendix C.

An inspection of the Freshwater Bayou Wetland Protection Project (ME-04) was held on May 01, 2007, under sunny skies and mild temperatures. In attendance were Stan Aucoin, Mel Guidry, Herb Juneau and Garrett Broussard of LDNR and Dale Garber representing the Natural Resources Conservation Service (NRCS).

The field inspection included a complete visual inspection of the entire project site. Staff gauge readings when available and existing temporary benchmarks were used to determine approximate water level and foreshore rock dike elevation. (See Appendix D).

b. Inspection Results

Site 1—Foreshore rock dike

The inspection revealed the 11,420 linear feet of foreshore dike repaired in the 2005 maintenance project is in good condition. The additional 2,000 linear feet of foreshore rock dike (identified in the 2003/2004 O & M Inspection as being below elevation 4.0' NAVD, but above elevation 2.0' NAVD), has not deteriorated further and was not addressed due to budget limitations. (Photos: Appendix B, Photos 1 and 2)

c. Maintenance Recommendations

i. Immediate/ Emergency Repairs

None at this time.

ii. Programmatic/ Routine Repairs

None at this time.



II. Maintenance Activity (continued)

d. Maintenance History

General Maintenance: Below is a summary of completed maintenance projects and operation tasks performed since March 1995, the construction completion date of the Freshwater Bayou Wetland Protection Project (ME-04).

2002 - Freshwater Bayou Wetlands Maintenance Project – LDNR: This maintenance project included the installation of approximately 26,750 tons of 1000 lb gradation stone to repair 15,263 linear feet of bank. Quantity limitations prevented the repair of all sections required. Construction was completed on 4/22/2002. The cost associated with the engineering, design, and construction of the Freshwater Bayou Wetlands Maintenance Project is as follows:

Construction:	\$615,900.00
Engineering & Design:	\$ 46,882.86
Construction Administration:	\$ 36,954.00
Construction Oversight/As built:	<u>\$ 17,311.06</u>

TOTAL CONSTRUCTION COST: \$717,047.92

2005 - Freshwater Bayou Wetlands Maintenance Project – LDNR (Luhr Bros. Contractor): This maintenance project included the installation of approximately 21,370 tons of 1,250 lb gradation stone to repair 11,426 linear feet of bank. Quantity limitations prevented the repair of all sections required. Construction was completed on 12/15/2005. The cost associated with the engineering, design, and construction of the Freshwater Bayou Wetlands Maintenance Project is as follows:

Construction:	\$472,660.50
Engineering & Design:	\$ 1,282.84
Construction Administration:	\$ 5,625.00
Construction Oversight/As built:	<u>\$ 4,419.68</u>

TOTAL CONSTRUCTION COST: \$483,988.02



III. Operation Activity

a. Operation Plan

There are no water control structures associated with this project under the direct responsibility of LDNR, therefore no Structural Operation Plan is required.

b. Actual Operations

There are no water control structures associated with this project under the direct responsibility of LDNR, therefore no required structural operations.



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-04 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 5 CRMS-*Wetlands* stations in the ME-04 project area. Data collected from these stations will be used in future reports to determine marsh response to project features and environmental variables.

In response to Hurricane Rita in 2005, 163 LDNR emergent vegetation stations were sampled in the late summer/early fall of 2005 and 2006. The stations represented a subset of the LDNR vegetation stations established on the Chenier Plain to monitor CWPPRA projects, including sites in the ME-11 project area (Appendix A).

a. Monitoring Goals

The objectives of the Freshwater Bayou Wetland Protection Project are:

1. Protect the existing emergent wetlands along the west bank of Freshwater Bayou Canal and prevent their further deterioration from shoreline erosion and tidal scour.
2. Prevent the widening of the Freshwater Bayou Canal channel into the Bayou Wetlands Protection Project area.
3. Reduce ponding and marsh loss in the project area wetlands.
4. Maintain target salinity levels in the project area wetlands.
5. Increase vegetation cover in shallow open water areas within the project area wetlands.

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

1. Decrease the rate of spoil bank erosion along the west bank of Freshwater Bayou Canal using a rock breakwater.
2. Reduce water levels to within the target range for fresh to intermediate marsh vegetation, which is 6 in (15 cm) below to 2 in (5 cm) above marsh level.
3. Maintain salinity levels within the target range for fresh to intermediate marsh vegetation, which is 0-5 ppt.



4. Decrease the duration and frequency of flooding over the marsh.
5. Decrease the rate of marsh loss.
6. Increase the coverage of emergent vegetation in shallow open water areas within the project area.

b. Monitoring Elements

Aerial Photography:

Near-vertical color-infrared aerial photography (1:12,000 scale) was used to document land and water areas, marsh loss rates, and shoreline movement in the ME-04 project area. Photography was obtained in 1997 (pre-construction) and in 2001 (post-construction). 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/National Wetlands Research Center (NWRC) personnel according to standard operating procedures (Steyer et al. 1995, revised 2000). No additional project specific aerial photography will be flown due to the implementation of CRMS-Wetlands. Five CRMS stations are located within the ME-04 project area. Aerial photography of each 1 km² station will be obtained every 3 years.

Shoreline Change:

To document shoreline movement along Freshwater Bayou Canal, shoreline markers were placed at maximum intervals of 1,000 ft (305 m) on the marsh edge along the west bank of the canal between its confluence with the Humble Canal and with North Prong Belle Isle Bayou, at 31 points corresponding to the pre-construction survey cross-sections, and at 3 points along each of the two 0.5 mi (0.8 km) long reference areas located along the east side of the channel opposite the north and south ends of the proposed breakwater (figure 2). Shoreline position relative to shoreline markers was documented by direct measurement in 1995, 1996, 1998, and 2001.

Water Level:

To evaluate the extent of ponding within the project area, water level relative to marsh level and NGVD was monitored at seven continuous data recorders (figure 3): one in each of the project area CTUs, one in the reference area R2, one in reference area R3, one in N. Prong Belle Ile Bayou Canal between CTUs 1 and 3, and one in Acadiana Marina Canal south of CTU 1 (removed September 26, 2003). Water level data is used to document the variability in water level, and the frequency, duration, and range of marsh inundation in the project and reference areas. Water level was monitored in 1996-1998 (pre-construction) and in 1999-2006 (post-construction). The recorders were removed in September 2006. Discrete measurements were discontinued prior to 2003.

Salinity:



Salinities were monitored at continuous data recorders in each CTU and in reference areas (figure 3). Salinity data is 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



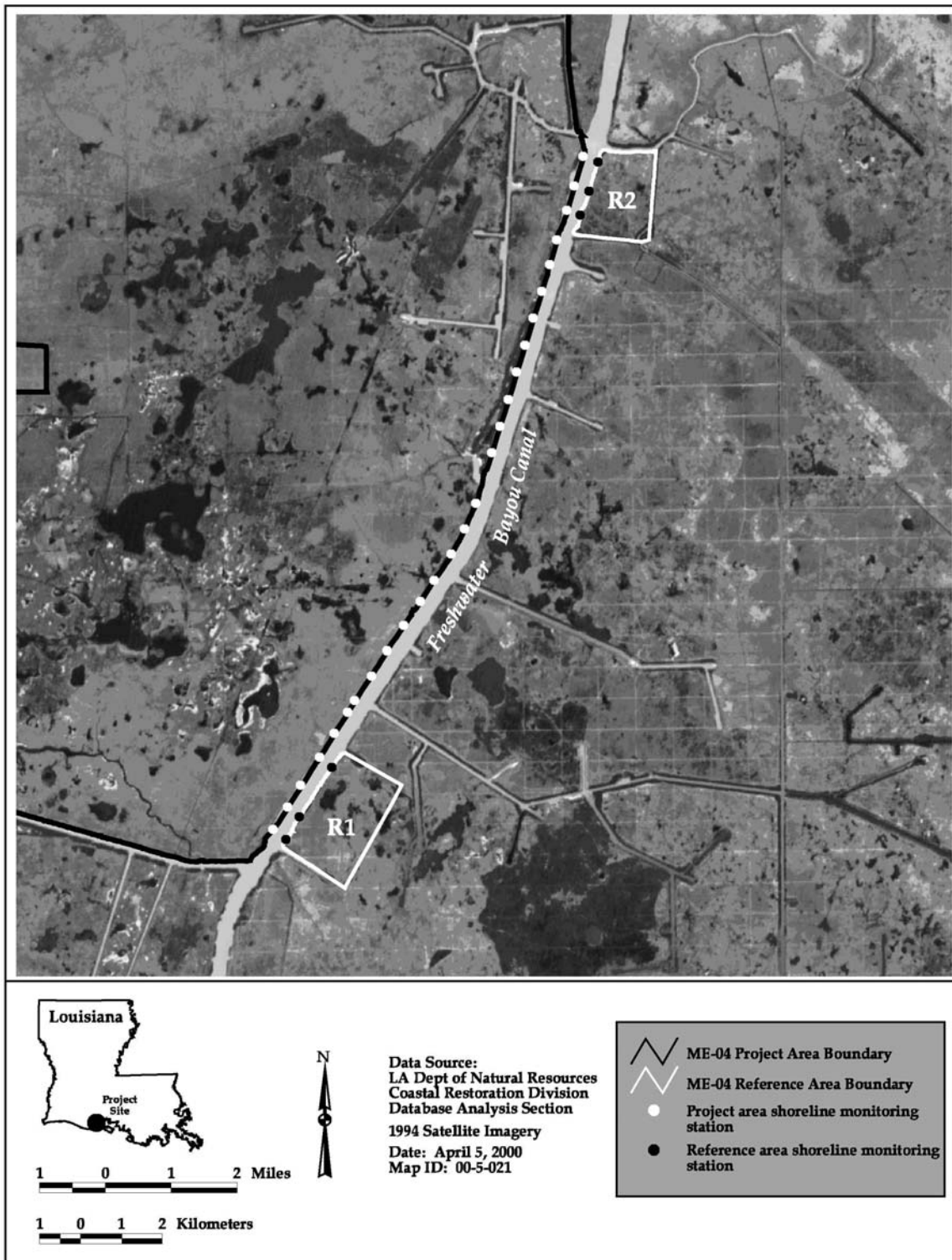


Figure 2. Approximate locations of the project and reference area shoreline monitoring stations.

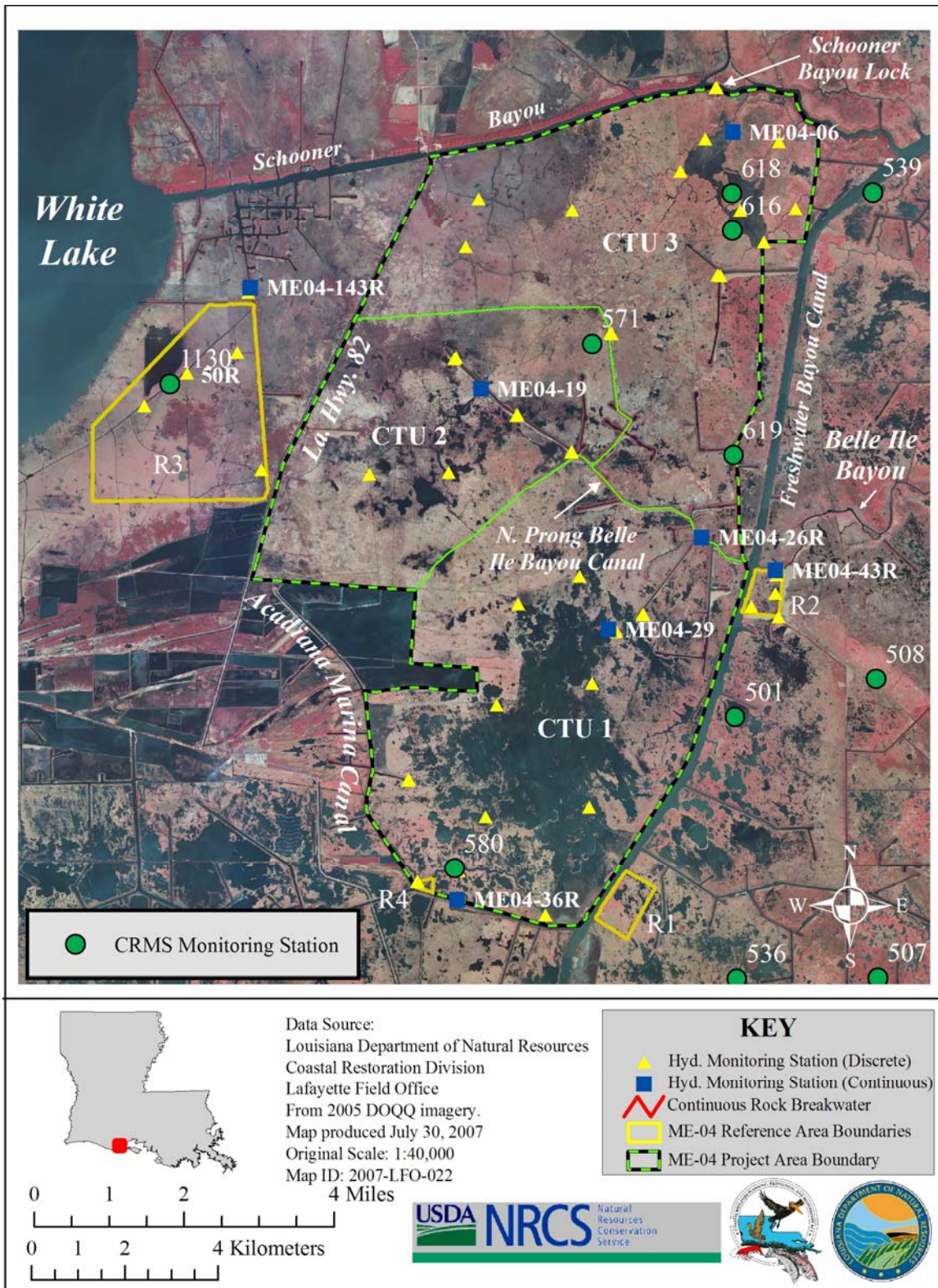


Figure 3. ME-04 project area with locations of continuous data recorders, discrete sampling stations, and CRMS-Wetlands monitoring stations.

range. Salinity was monitored in 1996-1998 (pre-construction) and in 1999-2006 (post-construction). The recorders were removed in September 2006.

Discrete monthly salinity and water depth were also measured at 49 monitoring stations, including the 7 recorder stations (figure 3): 30 located inside the project area and 19 located outside the project area (in reference areas R2 and R3, in exterior canals at two recorder stations, and inside and outside of the eight CWPPRA structures). Staff gauge water level readings (in ft NAVD88) were also recorded monthly at the seven continuous recorder stations, inside and outside of the eight CWPPRA structures, and at the Vermilion Corporation boat house near the southeast corner of reference area R2. Salinity and water level readings taken by the USACE inside and outside of Schooner Bayou Lock were also recorded once a month during the same week that monthly discrete data were collected by CRD personnel. The discrete monthly salinity data were used to calculate a mean monthly salinity for the early growing season (March-June), the late growing season (July-October), and the dormant season (November-February) at each station, for the pre-construction (March 1996 through September 1998) and post-construction (October 1998 through December 2002) time periods. These data are used to produce figures showing the spatial distribution of water salinity by season during the pre- and post-construction time periods. Discrete measurements were discontinued prior to 2003.

Emergent Vegetation:

To document the condition of emergent vegetation in the project area over the life of the project, vegetation was monitored at sampling stations established systematically in the project and reference areas (figure 4). Six east-west transects were established uniformly across the project area. Sampling stations were established uniformly along each transect line to obtain an even distribution of sampling stations throughout the project area. Similar east-west transects were delineated across reference areas R2 and R3 to establish four sampling stations in each reference area. Percent cover, dominant plant heights, and species composition were documented in 2 m² sampling plots marked with two corner poles to allow for revisiting the sites over time. Vegetation was evaluated at the sampling sites in the fall of 1996 and 1998 (pre-construction) and in the fall of 2001 (post-construction). Vegetation data will be collected at five CRMS stations located within the ME-04 project area beginning in the late summer of 2007.



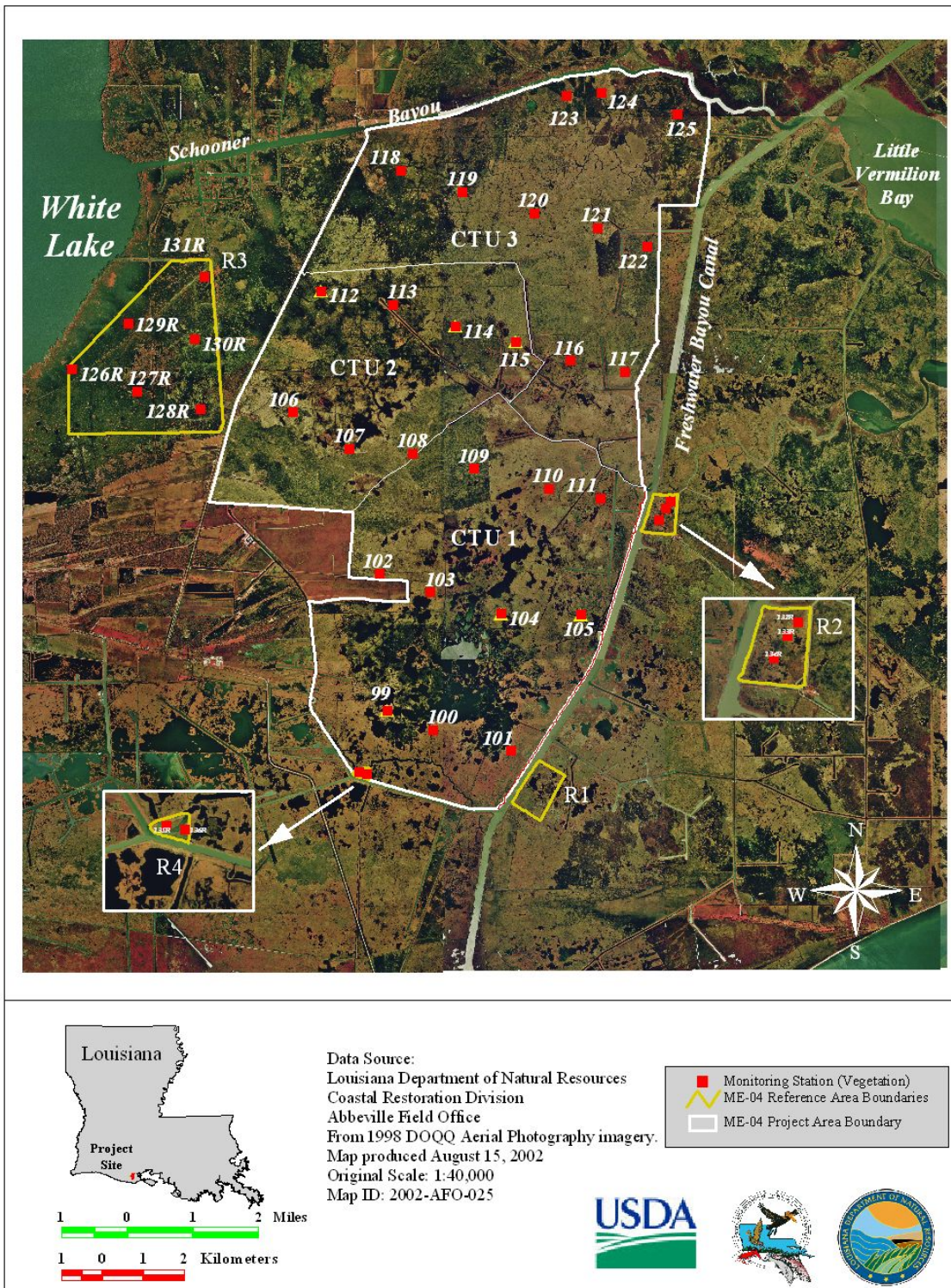


Figure 4. Locations of emergent vegetation sampling plots established in 1996 and 1997 in the ME-04 project and reference areas (R2, R3, and R4).

IV. Monitoring Activity (continued)

c. Preliminary Monitoring Results and Discussion

Aerial Photography:

Pre-construction land/water analysis was completed for 1997 aerial photography (figure 5). Habitat analysis was completed for 1997 pre-construction aerial photography (figure 6) and for 2001 post-construction aerial photography (figure 7). Land to water analyses of the pre-construction imagery taken on 11 January 1997 indicate that over 80% of the project area, and reference area units R1, R2, and R3, was classified as land, while less than 45% of reference area R4 was classified as land. The post-construction imagery taken on December 18, 2001, was not formally classified as land and water; however, by adding land and water acreages from the 1997 and 2001 analyses of habitat types, informal comparisons can be made. Between 1997 and 2001, the percentage of land area remained stable within the total project area, with 85.4% land area in 1997 and 85.1% land area in 2001. The reference areas also remained stable, with land area 94.2% to 93.6% from 1997 to 2001.

Overall, the project area experienced a decrease of fresh marsh, especially prevalent in CTU 1. The decrease of fresh marsh in CTU 1 was marked by a change to intermediate and brackish marsh, and to a lesser extent by conversion to open water. In contrast, CTU 2 and CTU 3 experienced increases of fresh marsh, while CTU 3 also showed a decrease of intermediate marsh. Overall, the reference areas showed an increase of fresh marsh, a complete loss of intermediate marsh, and an increase in brackish marsh. Only R1 and R2 experienced significant changes, both showing conversion of intermediate marsh to brackish marsh with some loss to open water.

Shoreline Change:

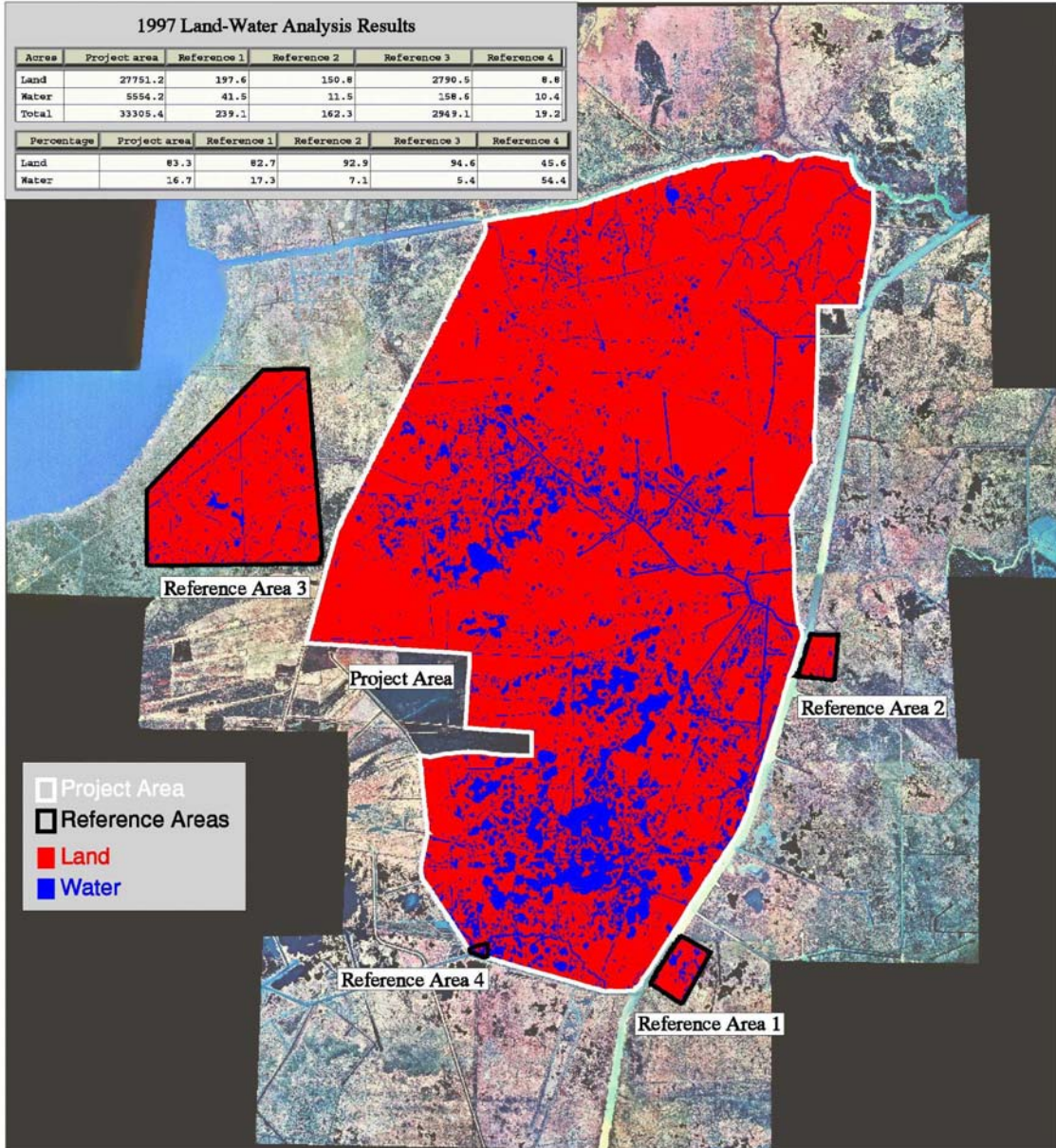
The project area shoreline prograded an average of 2.17 ft/yr (0.66 m/yr) between June 1995 and July 1996 (figure 8), and an average of 0.89 ft/yr (0.27 m/yr) between August 1996 and February 1998, but eroded an average of -2.62 ft/yr (-0.80 m/yr) between March 1998 and May 2001 (figure 8). Overall, the average shoreline change rate on the west canal bank behind the rock dike was -0.83 ft/yr (-0.25 m/yr) between June 1995 and May 2001.

Conversely, erosion was documented at all six reference area monitoring stations on each survey conducted, averaging -6.69 ft/yr (-2.04 m/yr) between April 1995 and July 1996, -11.15 ft/yr (-3.40 m/yr) between August 1996 and February 1998, and -9.99 ft/yr (-3.05 m/yr)

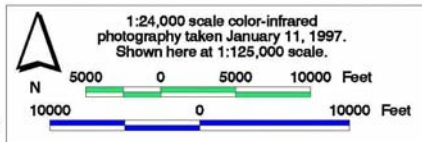




Coastal Wetlands Planning, Protection and Restoration Act Project ME-04: Freshwater Bayou 1997 Land-Water Analysis



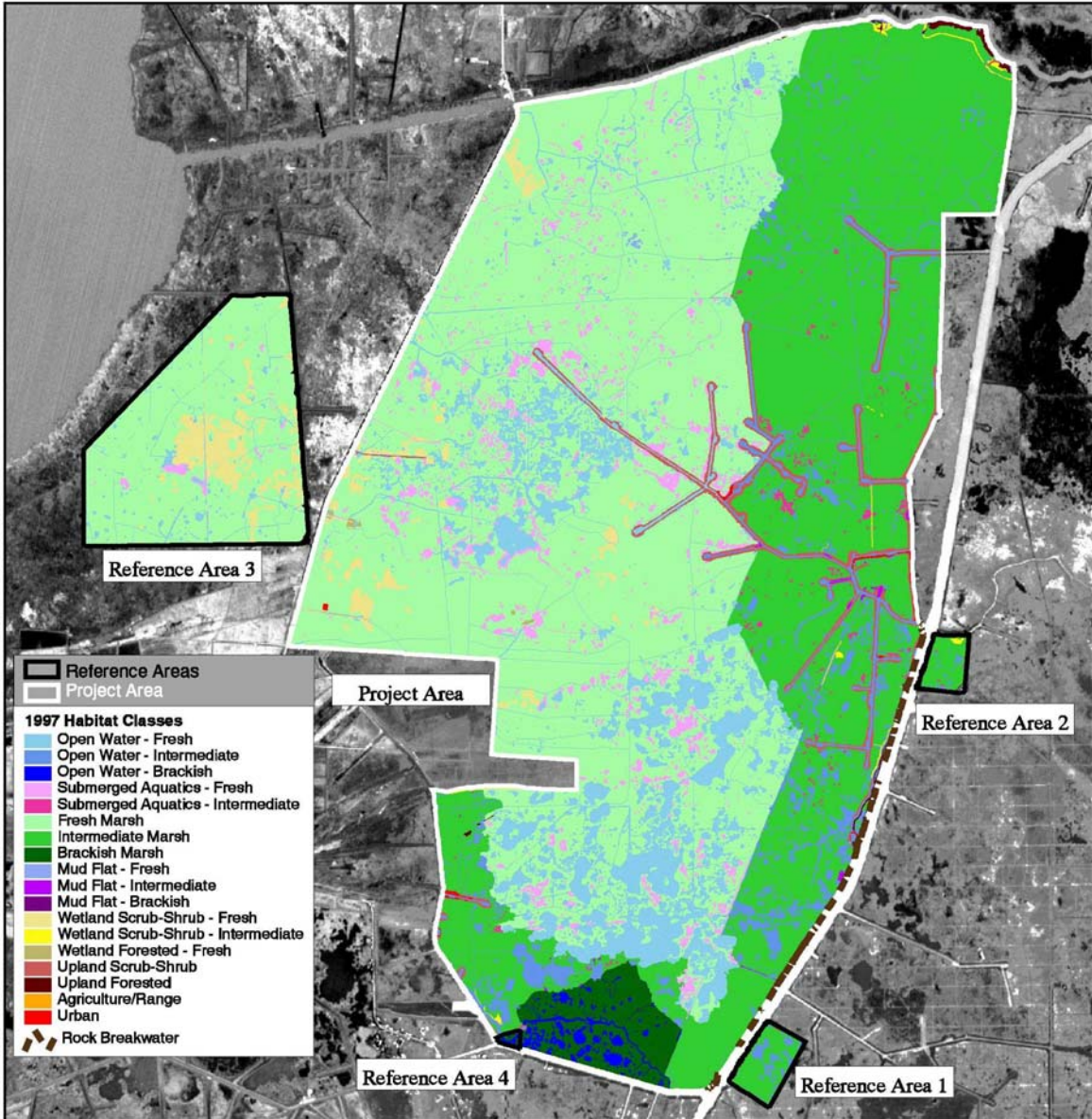
Prepared by:
 U.S. Department of the Interior
 U.S. Geological Survey
 National Wetlands Research Center
 Lafayette, Louisiana
 and
 Louisiana Department of Natural Resources
 Coastal Restoration Division
 Abbeville Field Office



Map ID: 99-02-059

Figure 5. Pre-construction analysis showing the acreage of land and water in the project and reference areas of Freshwater Bayou Wetland Protection.

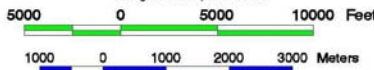




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U.S. Department of the Interior
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Louisiana Department of Natural Resources
Coastal Restoration Division
Abbeville, Louisiana



Habitat data were derived from 1:24,000 scale color-infrared photography. Preconstruction photography was obtained January 11, 1997. Classes are based on "Classification of Wetlands and Deepwater Habitats of the United States," Cowardin et al., 1979, as modified for the National Wetlands Inventory Mapping Conventions. The data were overlaid on a 1995 SPOT Satellite image at 1:35,000 scale.



Federal Sponsor:



Map I.D. 99-2-062

Figure 6. Pre-construction analysis showing acreage of habitats in the project and reference areas in Freshwater Bayou Wetland Protection.

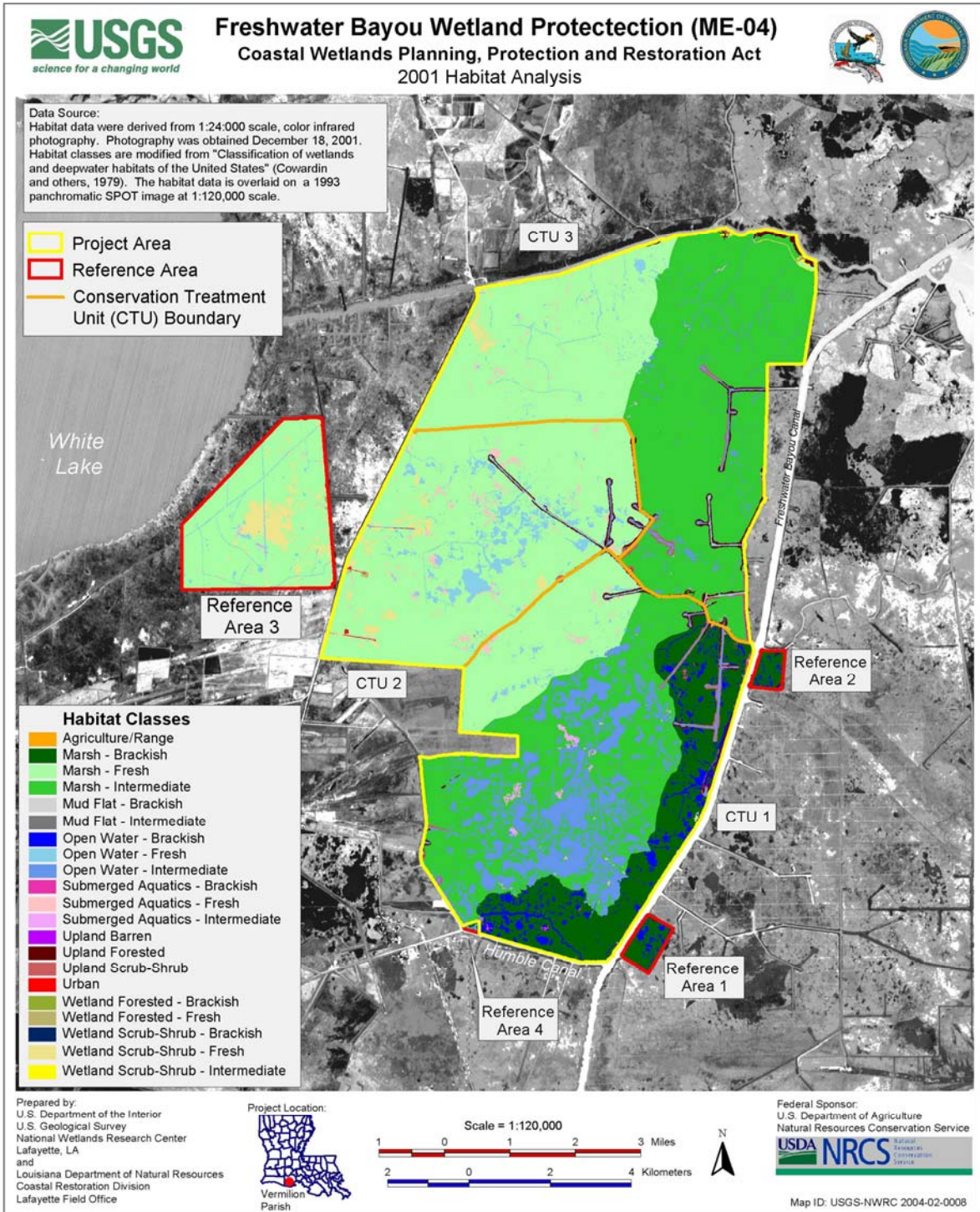


Figure 7. Post-construction analysis showing acreage of habitats in the project and reference areas in Freshwater Bayou Wetland Protection.



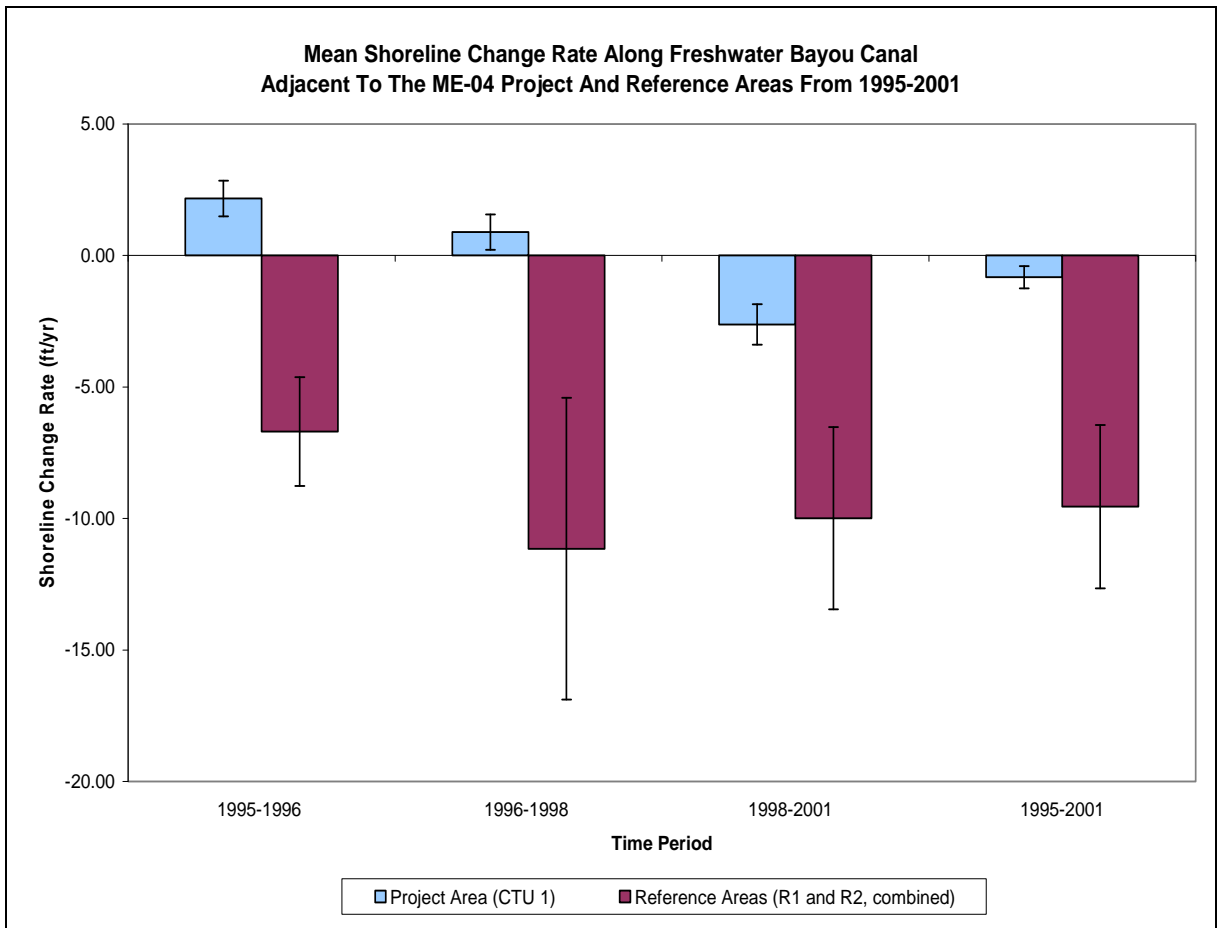


Figure 8. Mean shoreline change rate along Freshwater Bayou Canal adjacent to the ME-04 project and reference areas from 1995 to 2001.



between March 1998 and May 2001 (figure 8). Overall, the average shoreline change rate along the two reference areas on the east canal bank was -9.55 ft/yr (-3.03 m/yr) between June 1995 and May 2001.

Water Level:

The goal to reduce water levels to within the target range of 6 in (15 cm) below to 2 in (5 cm) above marsh level was not met. Water levels in the project area were within the target range less than 50% of the year during 10 years of data collection. However, project area water levels were within the target range a greater percentage of time than the reference area in all post-construction years except 2001, 2005, and 2006 (figure 9).

In general, when reference area water levels were out of the target range, they tended to be greater than 2" above the marsh surface. Project area water levels were greater than 6" below marsh surface more often than reference stations. This would be expected since two of the reference area stations are located along major waterways and are subject to higher tidal amplitude, while the three project area stations are located in interior marsh areas influenced by water control structures. Water levels were higher during all years in the project area compared to the reference area.

Salinity:

The goal to reduce salinity levels to within the target range of less than 5 ppt for fresh to intermediate marsh vegetation was partially met, however, since reference area salinities remained within the target range 10% of the time, this cannot be attributed to the project. Prior to construction, salinities within the project area were greater than 5 ppt about 13% of the time, compared to around 8% within the reference area (figure 10). In years 1998, 2001, 2002, 2003, and 2004, salinities were outside of the target range less than 10% of the time in both the project and reference areas. High salinities were prevalent within both project and reference areas in 1999 and 2000 due to drought conditions. In part of 2005 and all of 2006, the target range was exceeded more than 70% of the time. This is likely due to aftereffects of Hurricane Rita's storm surge and was reflected in both project and reference areas.

Mean monthly water salinity (ppt) calculated from discrete monthly salinity readings taken at monitoring stations throughout the project area, surrounding canals, and reference areas R2 and R3 shows a general trend of increasing salinity from west to east (figures 11, 12, and 13). Discrete monthly water salinity readings taken at the eight CWPPRA structure sites do show that water salinity "inside" and "outside" of the structures was higher during the post-construction period than during the pre-construction period at all eight structures (figure 14).

Vegetation:

Emergent vegetation was monitored at 37 2 m² sampling plots established across the project area and reference areas R2, R3 and R4 for percent cover, dominant plant mean heights, and species composition. Vegetation was evaluated at the sites in the fall of 1996 and 1998 (pre-construction), and in the fall of 2001 (post-construction).



Total percent cover decreased from 1996 to 1998 in all units except CTU 3, where cover remained about the same (figure 15a). Total percent cover then increased from 1998 to 2001 in all units except R3 where cover continued to decrease. Mean height of the tallest dominant increased from 1996 to 2001 in all units in the project area (CTU 1, CTU 2, and CTU 3) and in R4 (figure 15b). Mean height decreased between 1996 and 2001 in R3 and remained about the same in R2. The dominant species in each unit remained the same for all years throughout the project. In CTU 1, CTU 3, R2, and R4 the dominant species was *Spartina patens*. In CTU 2 the dominant species was *Panicum hemitomon*, with *Spartina patens* and *Sagittaria lancifolia* as co-dominants. In R3 the dominant species was *Sagittaria lancifolia*.



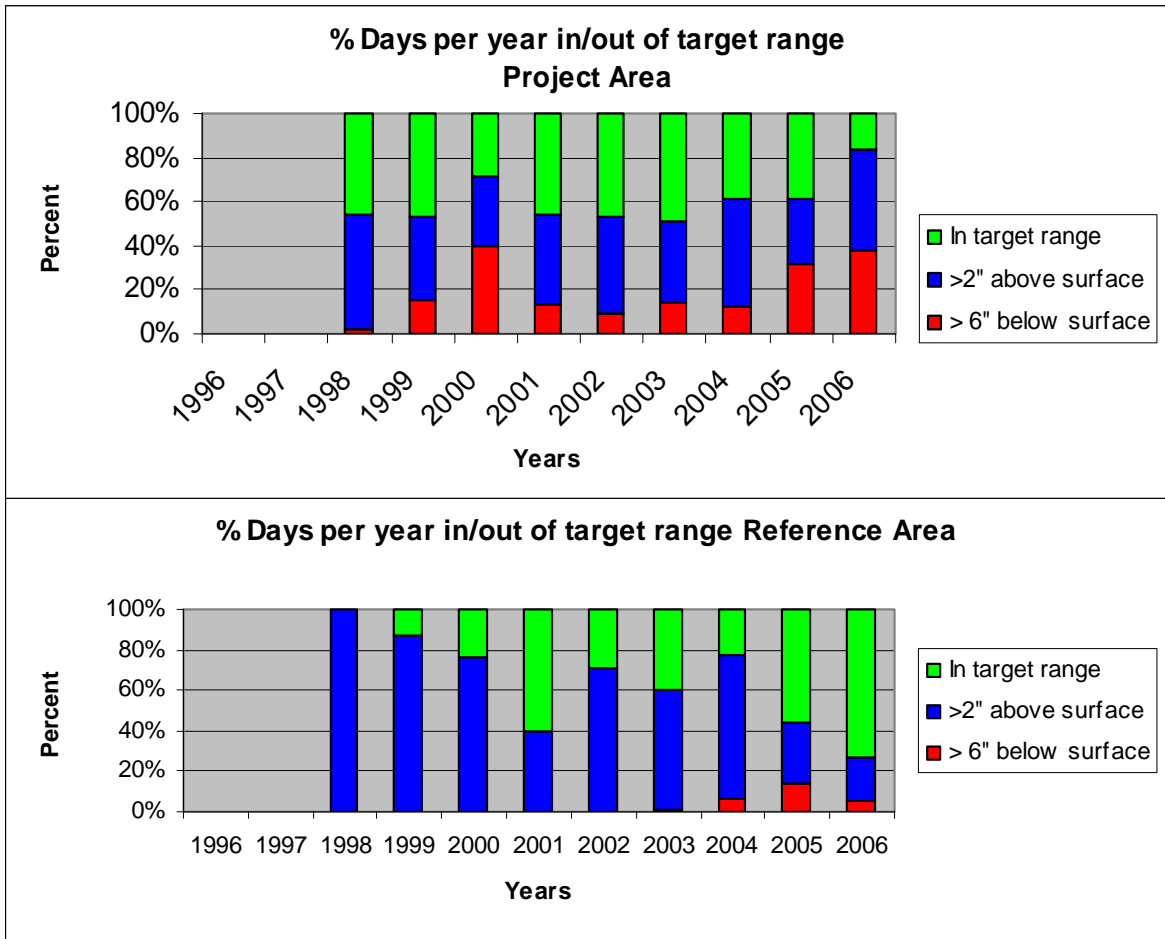


Figure 9. Percentage of days per year water levels were inside and outside of target range within the project and reference areas.



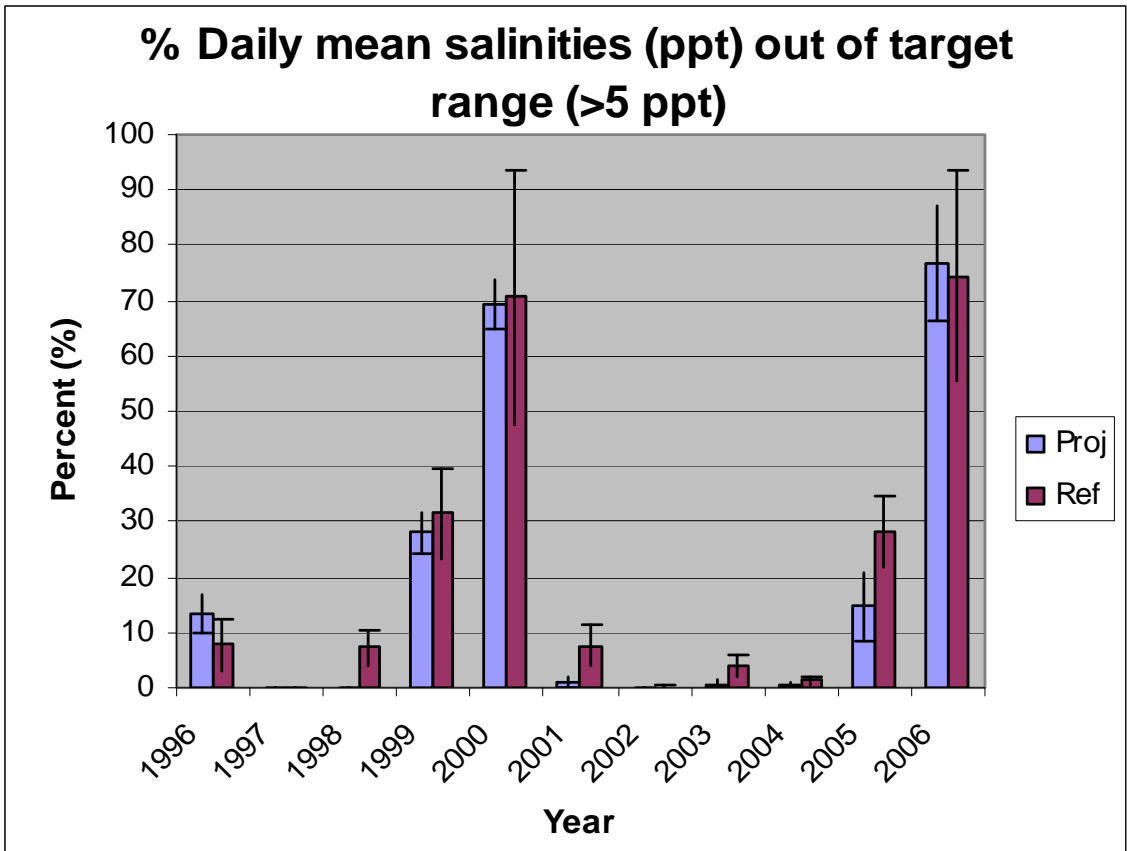


Figure 10. Percentage of time that project and reference area salinities were above the target range of 5 ppt.



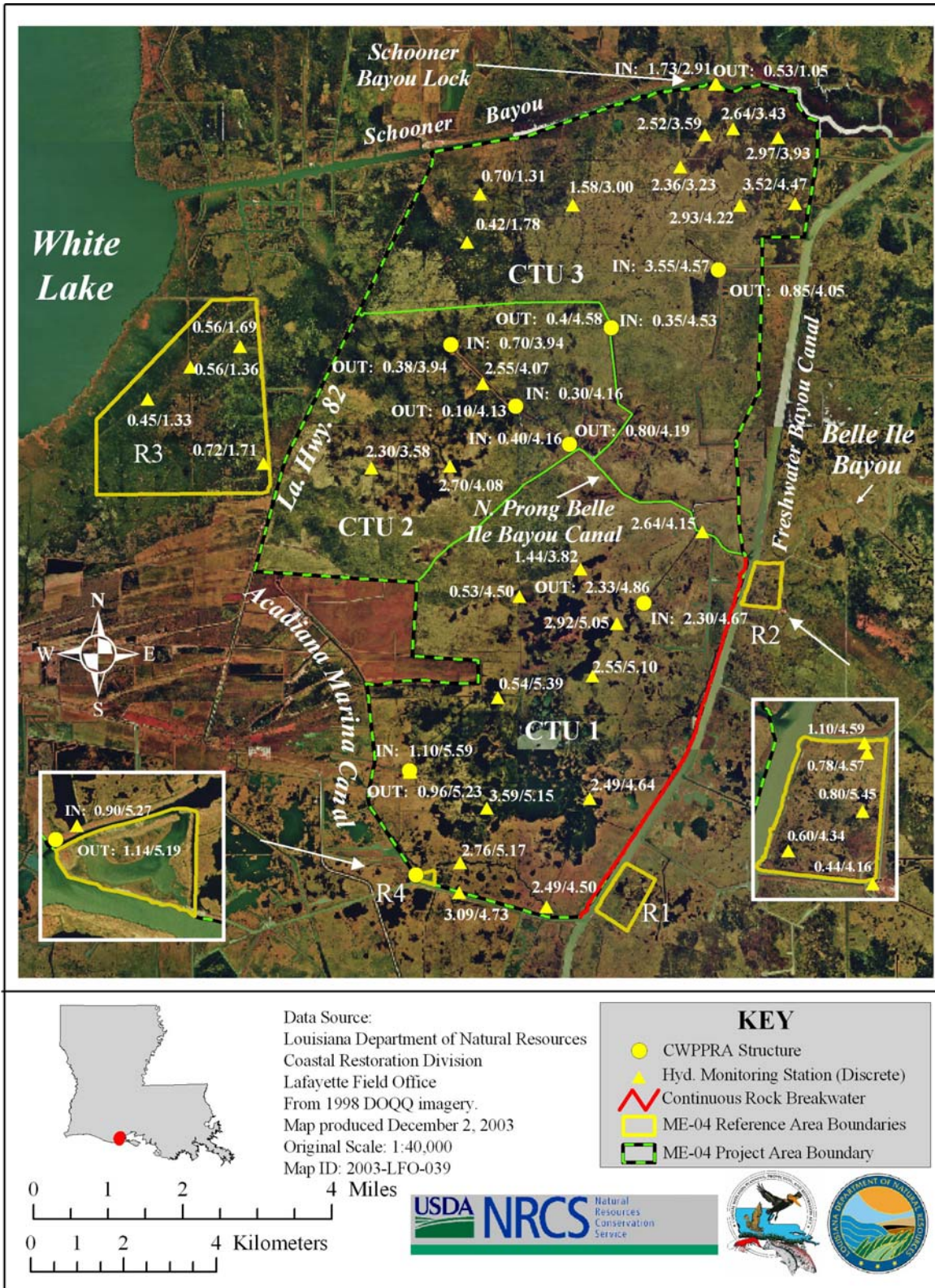


Figure 11. Spatial distribution of pre- and post-construction mean monthly water salinity in the ME-04 project and reference areas for the early growing season (March-June), based on discrete monthly readings taken at 51 monitoring stations.

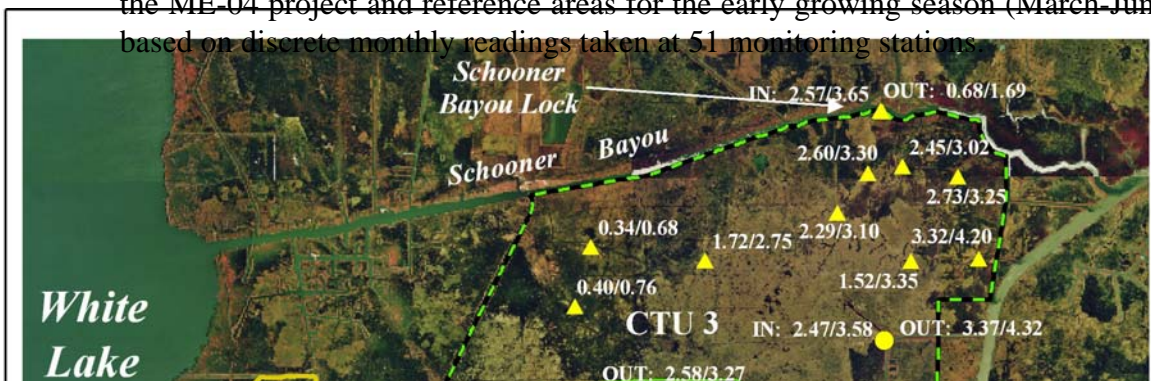


Figure 12. Spatial distribution of pre- and post-construction mean monthly water salinity in the ME-04 project and reference areas for the late growing season (July-October), based on discrete monthly readings taken at 51 monitoring stations.



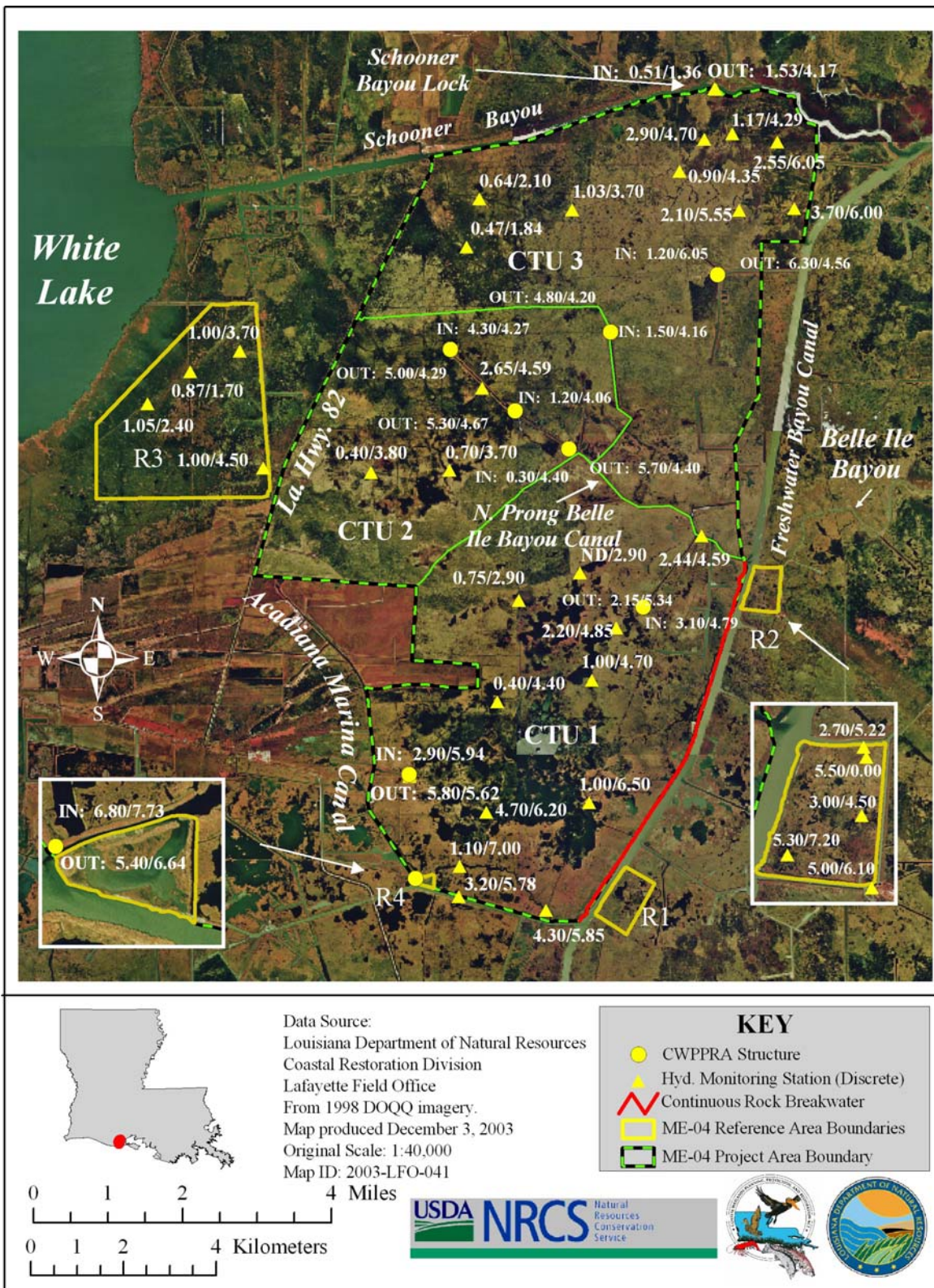


Figure 13. Spatial distribution of pre- and post-construction mean monthly water salinity in the ME-04 project and reference areas for the dormant season (November-February), based on discrete monthly readings taken at 51 monitoring stations.



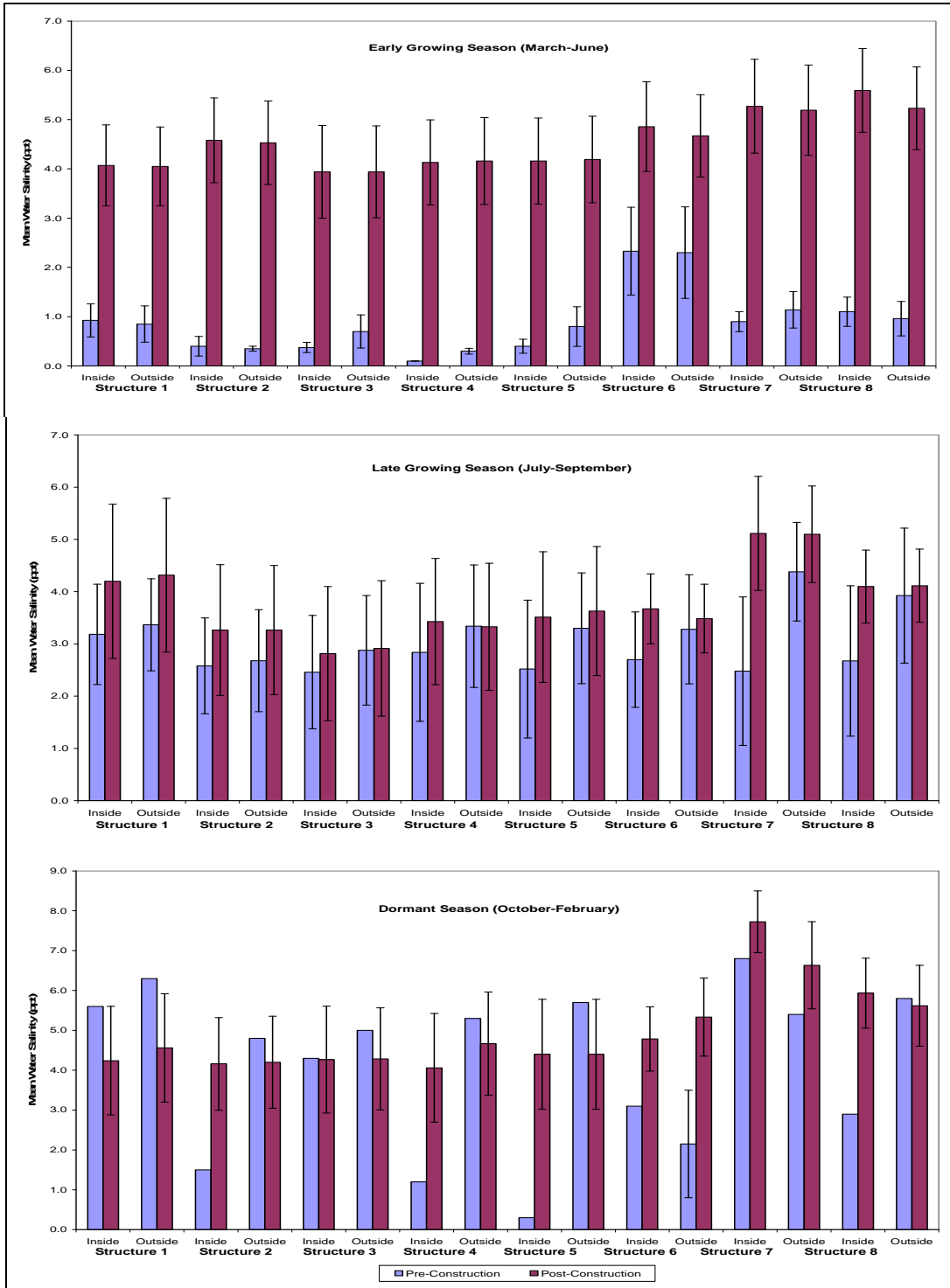
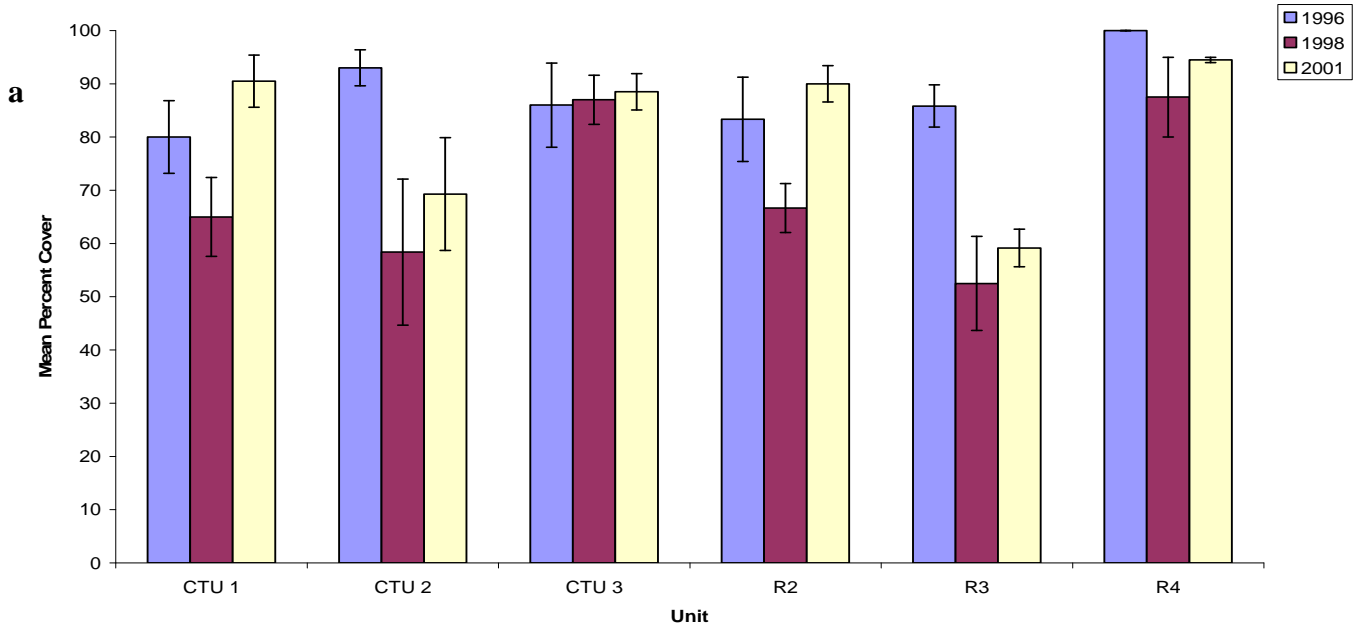


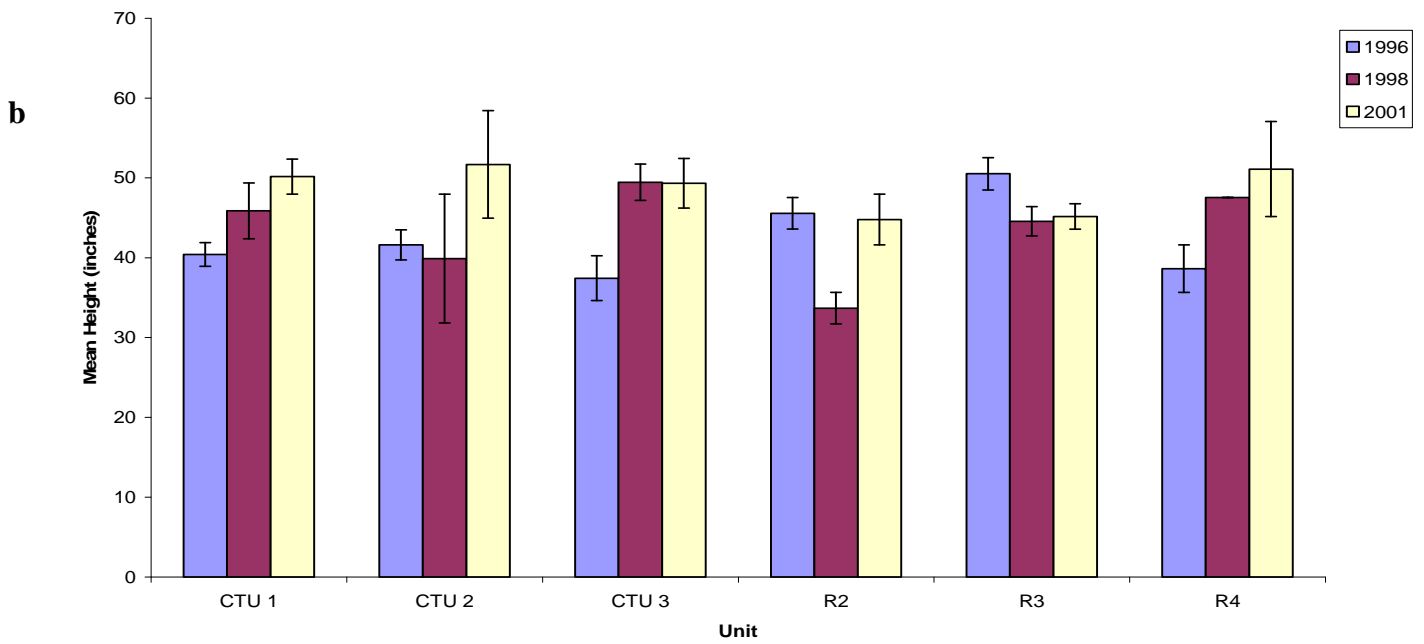
Figure 14. Comparison of mean seasonal water salinity (ppt) inside and outside of the eight CWPPRA structures at ME-04 during the pre-construction (March 1996-September 1998) vs. the post-construction (October 1998-May 2002) time periods. Error bars represent ± 1 standard error.



**Mean Total Percent Cover in the Project and Reference Areas
1996, 1998, and 2001**



**Mean Height of Dominant Species in the Project and Reference Areas
1996, 1998, and 2001**



Figures 15a-b. a) Mean total percent cover in the project and reference areas, separated by unit. b) Mean plant height in the project and reference areas, separated by unit.

Post-Hurricane Rita Emergent Vegetation:



In the ME-04 project area, 18 stations were randomly chosen from the available stations. In the last sampling before Rita (2001), the vegetation was vigorous and only slightly stressed (figure 16). The slightly stressed category dropped to 10% in 2005, but recovered to 58 % in 2006. In 2005, 25% of the stations were severely stressed and 50 % were stressed. By 2006, the percent of severely stressed stations had dropped to 10% (one station) and the stressed category dropped to 21%. Species richness was lower in 2005, but essentially recovered to pre-storm levels by 2006 (figure 17). Total cover was reduced from 75% in 2001 to 35% in 2005, and had not recovered by 2006 with 51% (figure 18).

Although the stations were recovering in cover and richness by 2006, the species assemblages had shifted for sites codominated by mostly Fresh Bulltongue (*Sagittaria lancifolia*) before Rita to a mixture of Oligohaline Wiregrass and Oligohaline Paspalum (*Paspalum vaginatum* and *Spartina patens* co-dominated), which are more salt tolerant species (figure 19). There was an increase in disturbance species in all plots.



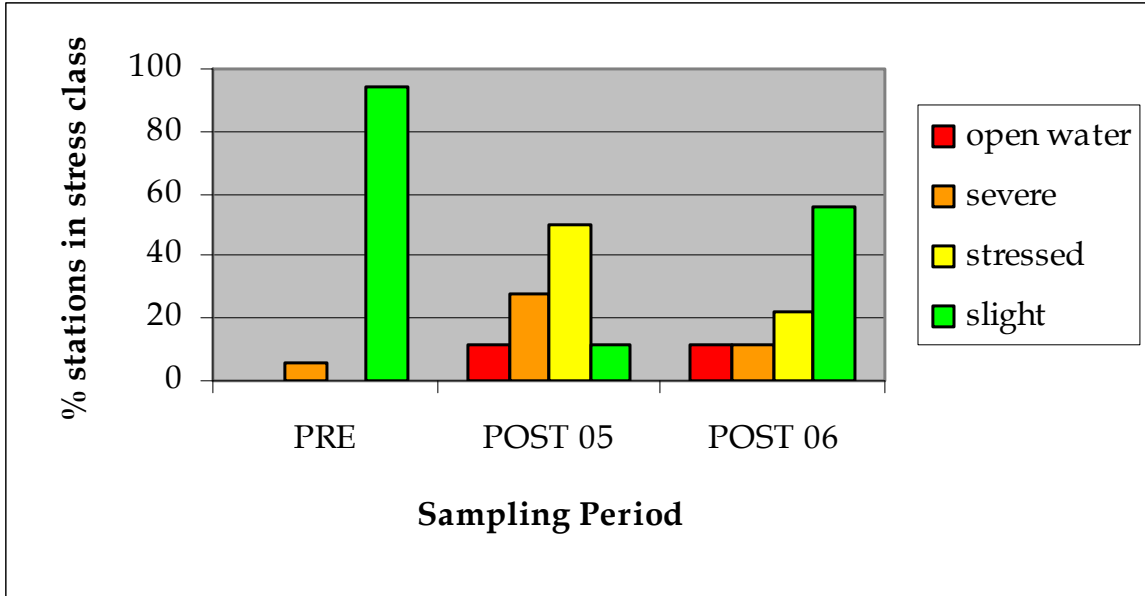


Figure 16. Percent of ME-04 vegetation stations in each stress class before and after Hurricane Rita (n=23).

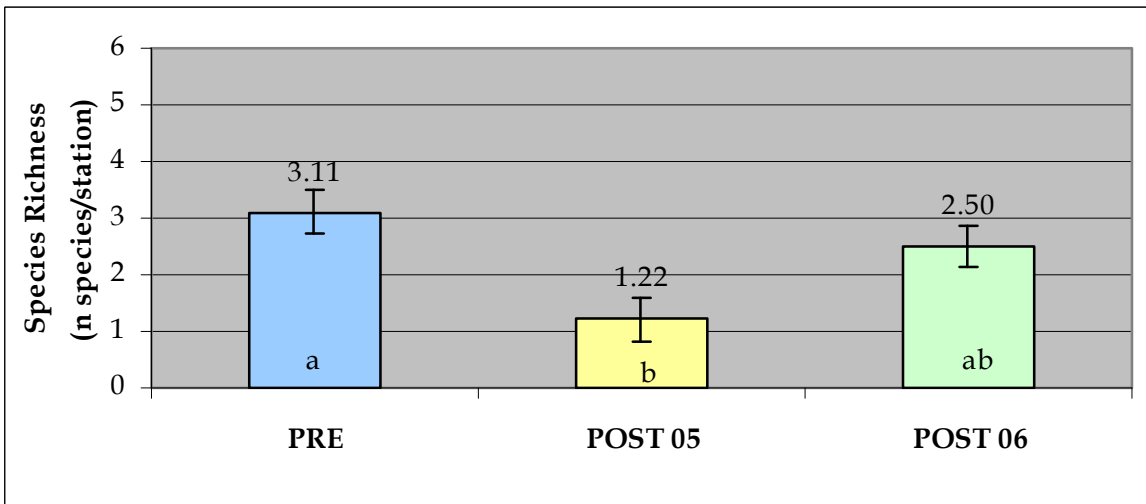


Figure 17. Species Richness at ME-04 pre- and post-Hurricane Rita. LS Mean \pm SE (n=23 stations). $F_{2, 68}=6.30$, $p=0.0036$. Levels connected by the same letter are not significantly different.

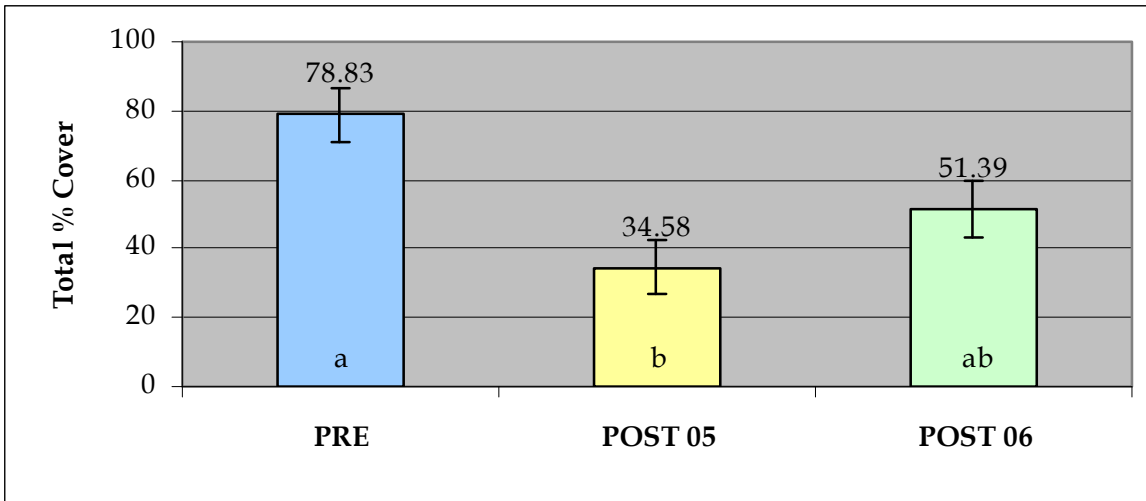


Figure 18. Total % Cover of vegetation at ME-04 Pre and Post Hurricane Rita. LS Mean ± SE (n=23 stations). $F_{2, 68}=7.68$, $p=0.0012$. Levels connected by the same letter are not significantly different.

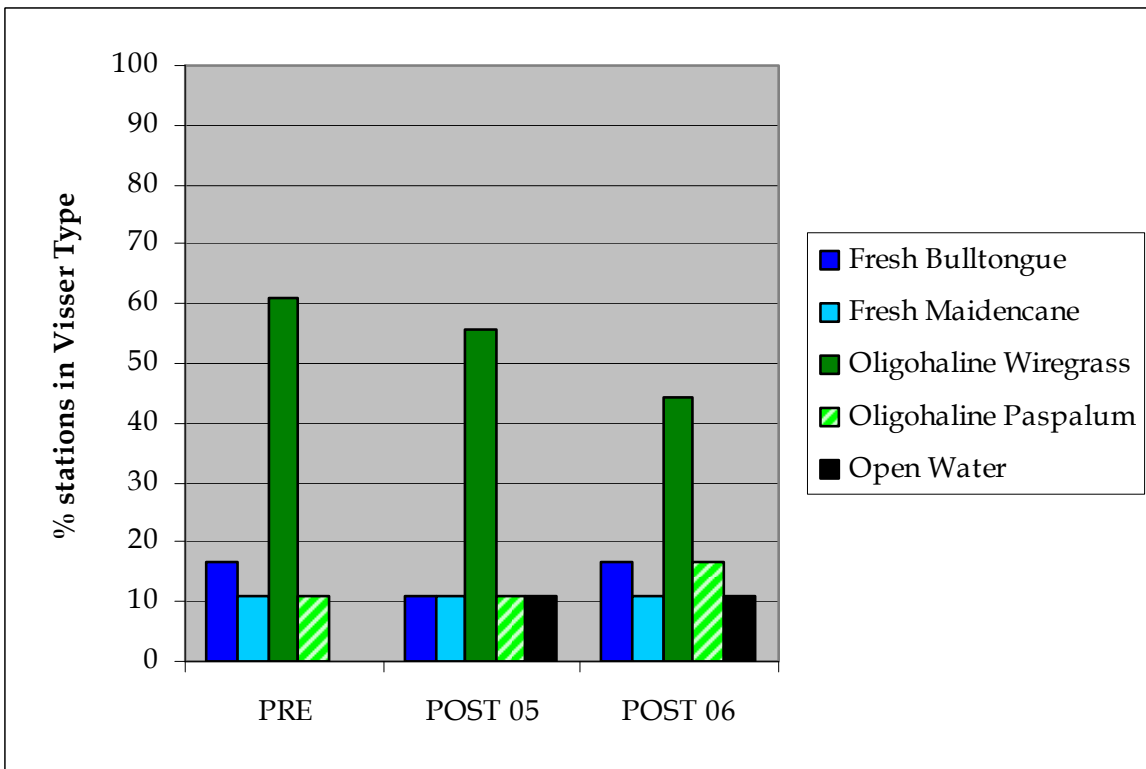


Figure 19. Percent of ME-04 Vegetation stations in each Visser vegetation type before and after Hurricane Rita (n=23).

V. Conclusions

a. Project Effectiveness

Shoreline along the west bank of FBC in the project area has benefited from the construction of the rock dike, as indicated by the significantly reduced erosion rates relative to the reference areas. However, the rate of erosion increases when the elevation of the rock material sinks below the originally constructed top elevation, as noted in 2001. Maintenance events in 2002 and 2005 lifted the rock dike back to the prescribed elevations.

The ME-04 project does not appear to be effective in keeping water levels within the desired range since project area stations stayed within range less than half the time during all years, and project area water levels were higher than the reference area. Salinity stayed within the target range at project area stations for most years, but this cannot be attributed to project features since the reference stations were generally within 10% of project stations. Salinity spikes observed have been associated with periods of droughts and tropical storm or hurricane activity.

Between 1996 and 2001 there was little or no increase of total vegetation cover or height at monitoring stations within the project area. Habitat analysis indicates that intermediate and brackish marsh has overtaken former areas of fresh marsh in the southeastern part of the ME-04 project area. Vegetation does not appear to be benefiting from the ME-04 project.

Vegetation in the project area was severely impacted by Hurricane Rita and is slowly recovering, although species assemblages are reverting to more salt tolerant species.

b. Recommended Improvements

Overall the Freshwater Bayou Wetland Protection Project structural components are in good condition. The 2,000 linear feet of foreshore dike mentioned above will continue to be monitored for deterioration during future annual inspections.

c. Lessons Learned

The water control structures that were constructed, operated and maintained by the land owner are not included in the LDNR Operation and Maintenance Plan. Implementation of CWPPRA projects where the landowner has total control over the operation of existing water control structures, and over the installation and operation of additional structures as part of the features of a CWPPRA project, as was the case for ME-04, has been discontinued.



In order to prevent further wetland degradation along FBC, especially in the ME-04 project and reference areas and adjacent marshes, and to prevent increased saltwater intrusion into this part of the Chicot Aquifer, any deepening and widening of the Freshwater Bayou Canal to Port of Iberia Canal shipping lane must be mitigated by the installation and maintenance of canal embankments, preferably armored with rock or protected by rock dikes. The proposed deepening and widening of FBC, Gulf Intracoastal Waterway, and Port of Iberia Canal on the ME-04 project and reference areas and adjacent marsh areas would introduce additional saltwater into fresh and intermediate marshes. It appears unlikely that, with the low elevation, the fresh bulltongue marsh would convert to a mesohaline wiregrass marsh habitat. It is more likely that these marshes will convert to a less productive shallow pond habitat (LCWCRTF 2002). The Cameron-Creole Wetlands and Sabine National Wildlife Refuge Freshwater Impoundment (Unit 5) are historically similar in soils and marsh types to those in the Freshwater Bayou project and reference areas. Navigation channel-induced saltwater intrusion due to widening and deepening of the Calcasieu Ship Channel in the 1950's caused major land loss by killing vegetation in the fresh sawgrass marsh and converting it to shallow open water ponds (LCWCRTF 2002).



VI. Literature Cited

- Barras, J. A. 2006. Land area change in coastal Louisiana after the 2005 hurricanes-a series of three maps: U.S. Geological Survey Open-File Report 06-1274.
- Brown and Root, Inc. 1992. Conceptual engineering report for Freshwater Bayou Canal bank stabilization, Vermilion Parish, Louisiana. Prepared for Louisiana Department of Natural Resources, Coastal Restoration Division. Belle Chase, La.: Brown and Root, Inc.
- Louisiana Coastal Wetlands Conservation and Restoration Task Force (LCWCRTF). 1993. Coastal Wetlands Planning, Protection, and Restoration Act. Louisiana Coastal Wetlands Restoration plan. Appendix H. Mermentau Basin plan. Baton Rouge: LCWCRTF. 127 pp.
- Steyer, G. D., R. C. Raynie, D. L. Steller, D. Fuller, and E Swenson. 1995. Quality management plan for Coastal Wetlands Planning, Protection, and Restoration Act monitoring plan. Open-File Series 95-01. Baton Rouge: Louisiana Department of Natural Resources, Coastal Restoration Division.
- United States Department of Agriculture (USDA), Soil Conservation Service. 1994. Freshwater Bayou Wetlands, Vermilion Parish, Louisiana, Marsh Conservation Plan. Alexandria, Louisiana: Water Resources Office. 22 pp, plus 5 figures and 2 appendices.



APPENDIX A
Response of Emergent Vegetation to Hurricane Rita



METHODS

In response to Hurricane Rita in 2005, 163 LDNR emergent vegetation stations were sampled in the late summer/early fall of 2005 and 2006. The stations represented a subset of the LDNR vegetation stations established on the Chenier Plain to monitor CWPPRA projects including CS-20 (40 stations), CS-17 (24 stations), CS-31 (30 stations), CS-28 (18 stations), ME-04 (18 stations), and ME-11 (12 stations) (figure 1).

After the 2005 data collection, the stations were classified according to the level of disturbance/stress they had experienced and the resulting vegetation response. Stations were classified as either Open Water, Severely Stressed, Moderately Stressed (also classified as “Stressed”), or Slightly Stressed (Table 1). Data collected in 2006 and the last CWPPRA data available from before Hurricane Rita were also classified by stress.

At each station, a marker had been previously established. A 2m x 2m square was placed on the marsh and Total % Cover, % Cover of each species present in the plot, and height of the dominant species were collected. Presence of other species that were not in the plot, depth of surface water, salinity, and sometimes porewater salinity were noted.

The compiled vegetation data from the three sampling periods were utilized to classify each site according to Visser’s vegetation types of the Chenier Plain (Visser et al. 2000). The pre-storm types were determined with photographs and Visser Type definitions. The stations were reclassified after the 2005 and 2006 sampling. Stations that did not fit into any Visser Type after the storm maintained their pre-storm types. If the dominant species shifted to an identifiable Visser Type, the station was reclassified.

The data were analyzed to determine the impact of the storm on Total % Cover and Species Richness at three levels; overall by year (all 163 stations), by CWPPRA restoration project (7 projects), and with Visser vegetation type (6 types).



Table 1. Vegetation Stress Classifications used in this survey.

Vegetation Classification	Description
Open Water	Vegetation has been ripped out. 100% of plot is open water.
Severely Stressed	>50% of plot is open water. Vegetation is weak.
Stressed	Perennial grasses and herbs are mostly dead (>50%) or >25% open water. Often dominated by annual shrubs.
Slightly Stressed	Perennial grasses are healthy and vigorous.

RESULTS

COASTWIDE

Prior to Hurricane Rita, most of the vegetation stations utilized for this survey were healthy and intact (>80%). Following the hurricane in 2005, most of the stations were stressed (67%) or worse (20%). A year later in 2006, over 50% of the stations were back to pre-storm stress levels. Severely stressed stations either converted to open water or recovered to a less stressed state. Most stations that had been converted to open water in 2005 did not recover (figures 1 and 2).

ANOVA was utilized to test for differences in Total % Cover (% of plot covered by living vegetation) and Species Richness (n species per plot) over the three sampling periods, by CWPPRA Project, and with Visser Vegetation Type classifications.

Total % Cover was significantly different over time (figure 3). Post-ANOVA comparisons (Tukey's HSD) revealed that all three sampling periods were significantly different, meaning Total % Cover for 2006 is still significantly lower than Pre-Rita levels. Species Richness was also significantly different over the three sampling periods (figure 4). The number of species present before Rita and in 2006 were statistically the same.

Most of the projects had significant differences over time for both Total % Cover and Species Richness, with trends similar to the overall model (figures 3 and 4). Post-ANOVA comparisons were utilized to determine whether the projects had recovered to pre-storm levels for both Cover and Richness (Table 2).

Visser Type was added to the overall model and the interaction between Visser Type and time was analyzed. Both models had significant differences in Visser Type over time (figures 5 and 6). Post-ANOVA contrasts of Cover and Richness pre-Rita and post-06 for each Visser Type revealed that all Visser Types were the same in Total Cover (had recovered to pre-storm



levels) and in Richness, except Fresh Bulltongue (mostly in the ME-04 project area), which had not recovered, and in Oligohaline Wiregrass, which had significantly more species per plot post-Rita than before (up from 2.83 to 3.22 species).

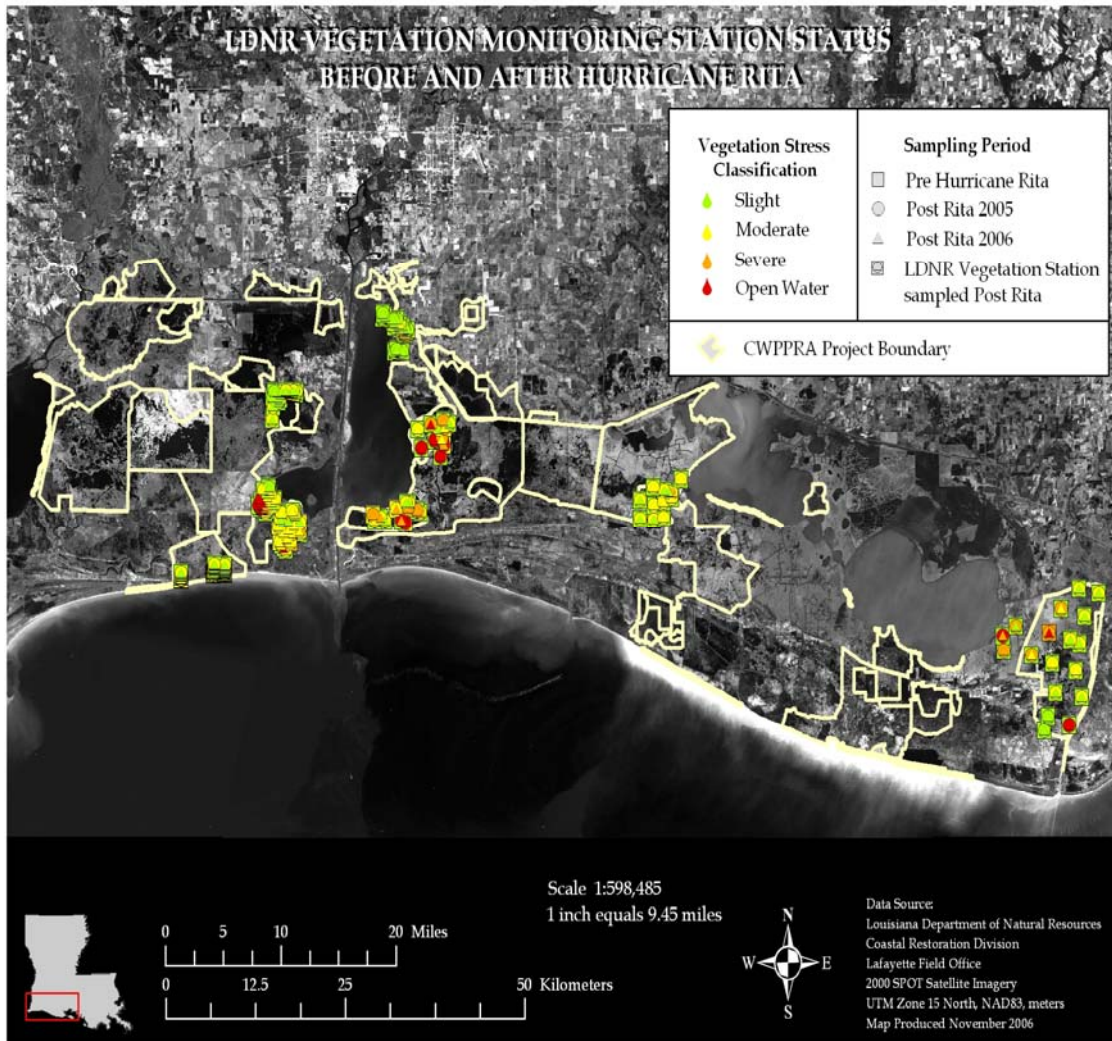


Figure 1. Location and status of LDNR vegetation stations sampled after Hurricane Rita. Stations were classified according to storm-induced stress as described in Table 1.

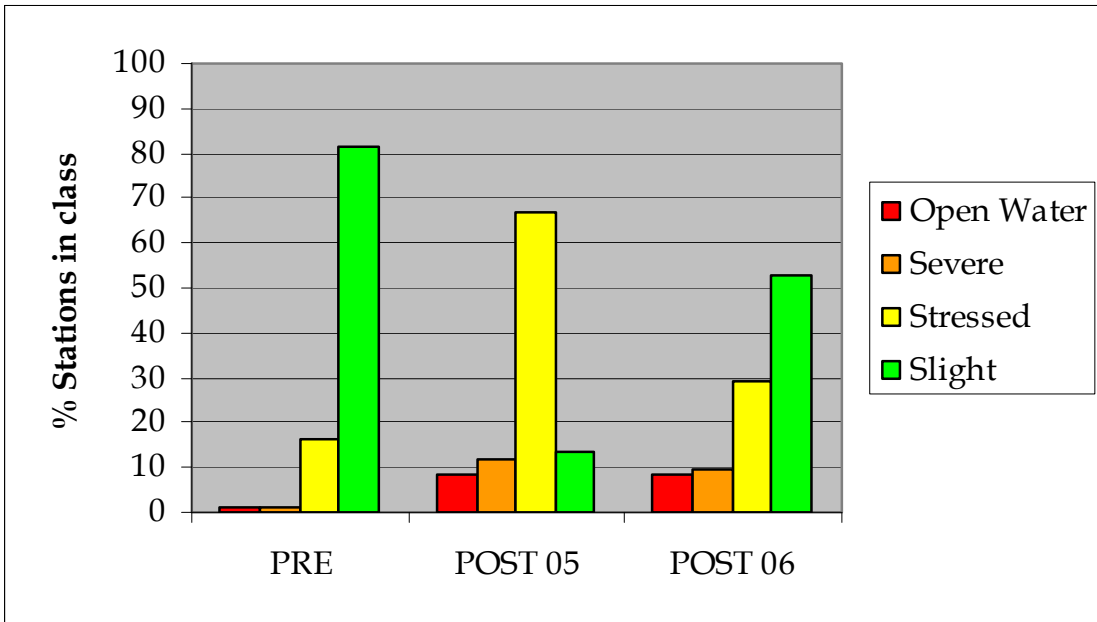


Figure 2. Percent of LDNR vegetation stations in each stress class before and after Hurricane Rita (n=163).

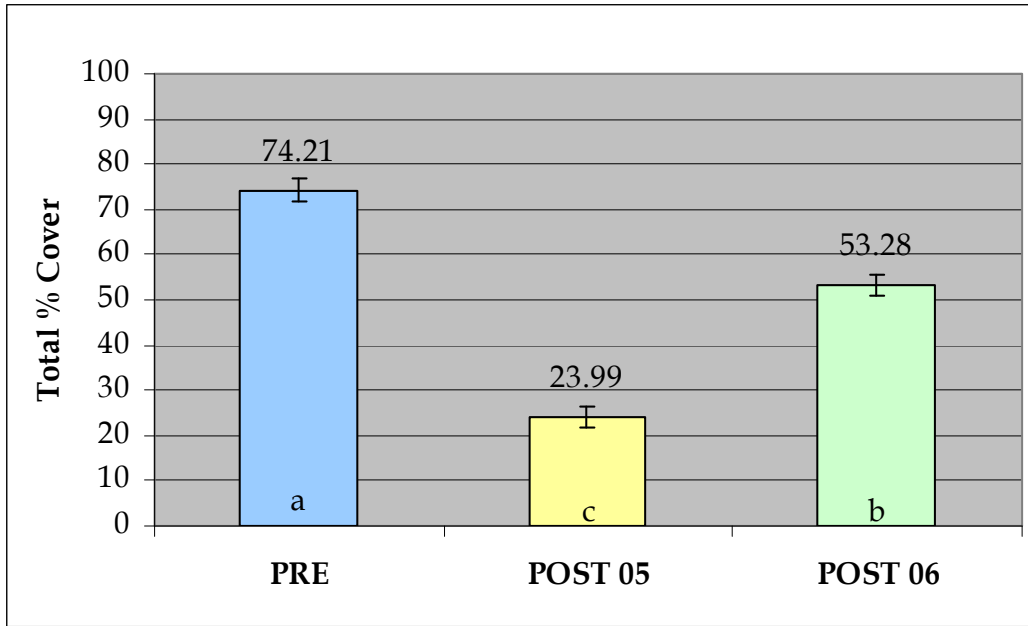


Figure 3. Total % Cover pre- and post-Hurricane Rita. LS Mean \pm SE, n=163 stations, $F_{2, 488}=109.7$, $p<0.0001$. Levels not connected by same letter are significantly different.

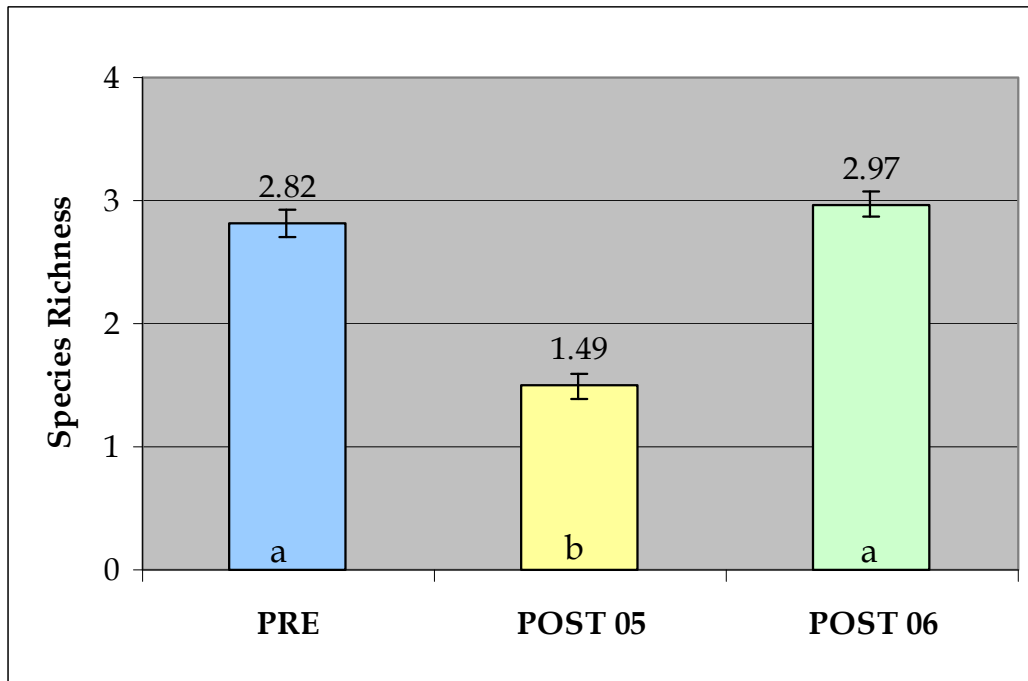


Figure 4. Species Richness pre- and post-Hurricane Rita. LS Mean \pm SE, n=163 stations, $F_{2, 488}=56.8$, $p<0.0001$. Levels not connected by same letter are significantly different.

Table 2. CWPPRA Project ANOVA Results

Results of Post-ANOVA comparisons by CWPPRA Project Summary of 2006 levels relative to Pre-Hurricane Rita and 2005		
Project	Total Cover	Species Richness*
CS-17	Not Recovered	Recovered
CS-20	Not Recovered	Recovered
CS-21	Recovered	Recovered
CS-28	Recovered	No Rita Impact.
CS-31	Not Recovered	Recovered
ME-04	Not Recovered	Recovered
ME-11	No Rita Impact	Recovered

*Although the number of species present returned to Pre-Rita levels at most projects, many of the species present were disturbance species.



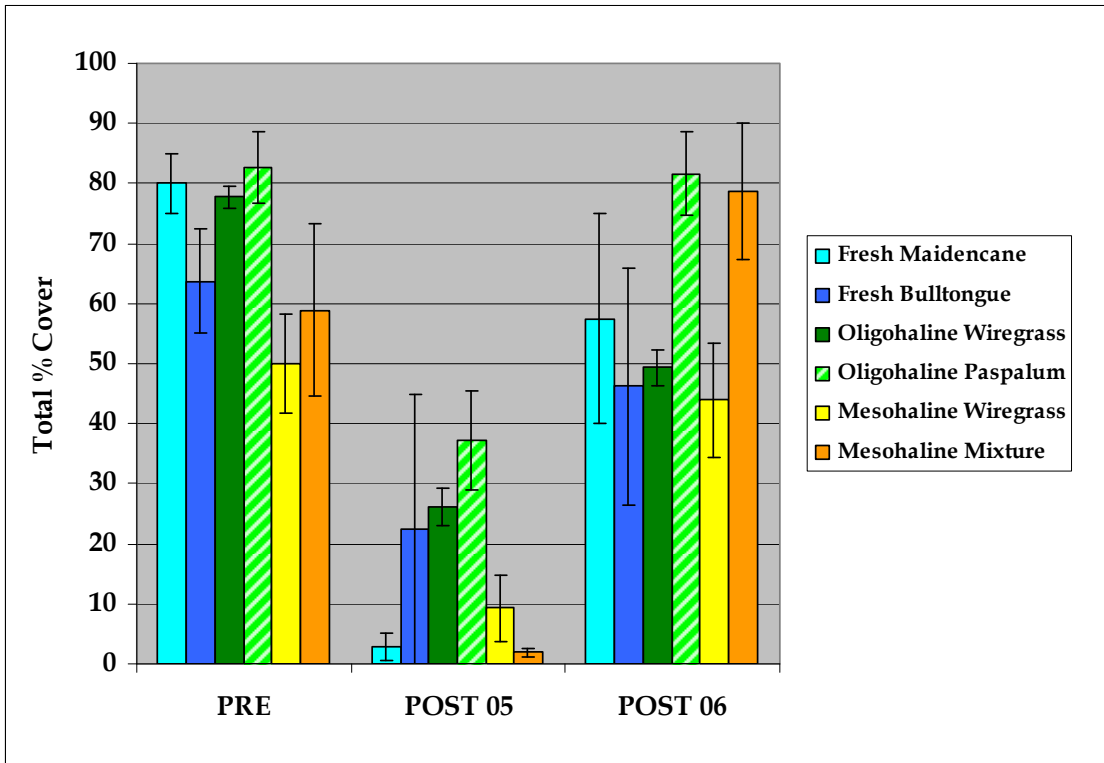


Figure 5. Total % Cover by Visser Vegetation Type. LS Mean \pm SE, n=163 stations, $F_{17, 488}=17.0$, $p<0.0001$.

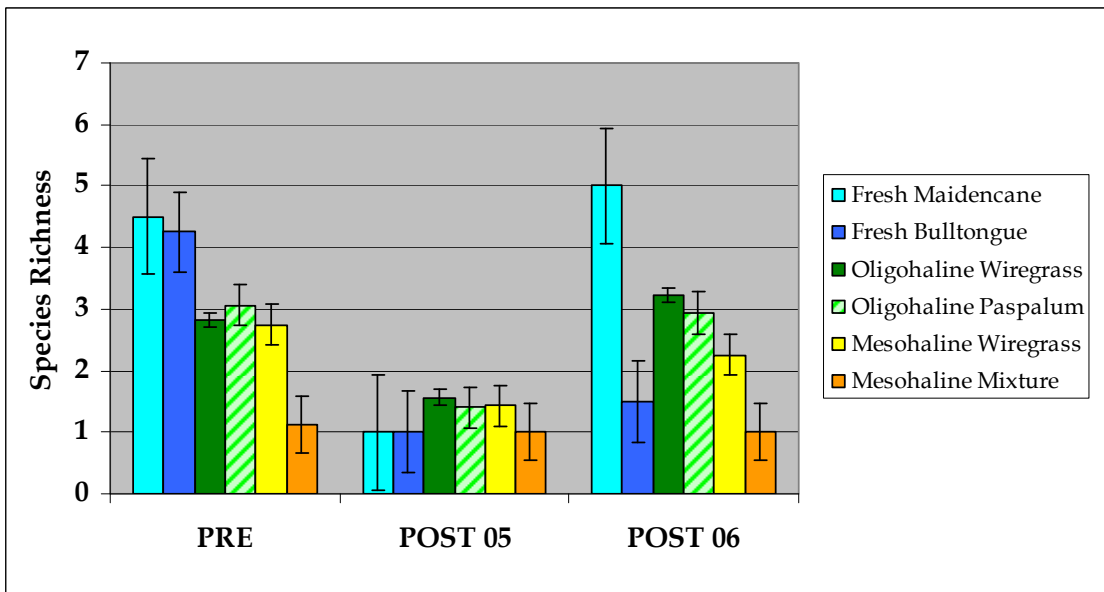


Figure 6. Species Richness by Visser Vegetation Type. LS Mean \pm SE, n=163 stations, $F_{17, 488}=10.9$, $p<0.0001$.



REFERENCES

Visser, J. M., C. E. Sasser, R. H. Chabreck, and R. G. Linscombe. 2000. Marsh vegetation types of the Chenier Plain, Louisiana, USA. *Estuaries* 23(3):318–327.



APPENDIX B
(Inspection Photographs)

Appendix B
(Inspection Photographs)





Photo 1, Typical rock dike



Photo 2, Typical rock dike.

APPENDIX C
(Three Year Budget Projection)

Appendix C
(Three Year Budget Projection)



FRESHWATER BAYOU / ME04 / PPL2
Three-Year Operations & Maintenance Budgets 07/01/2007 - 06/30/10

<u>Project Manager</u> Mel Guidry	<u>O & M Manager</u> Mel Guidry	<u>Federal Sponsor</u> NRCS	<u>Prepared By</u> Mel Guidry
--------------------------------------	--	--------------------------------	----------------------------------

	2007/2008	2008/2009	2009/2010
Maintenance Inspection	\$ 5,407.00	\$ 5,570.00	\$ 5,737.00
Structure Operation	\$ -	\$ -	\$ -
Administration	\$ -	\$ -	\$ -
Maintenance/Rehabilitation			

07/08 Description:

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

08/09 Description:

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

09/10 Description:

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

	2007/2008	2008/2009	2009/2010
<u>Total O&M Budgets</u>	\$ 5,407.00	\$ 5,570.00	\$ 5,737.00

<u>O & M Budget (3 yr Total)</u>	\$ 16,714.00
<u>Unexpended O & M Budget</u>	\$ 11,333.81
<u>Remaining O & M Budget (Projected)</u>	\$ (5,380.19)



OPERATION AND MAINTENANCE BUDGET 07/01/2007-06/30/2008
FRESHWATER BAYOU/ME-04/PPL2

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	\$5,407.00	\$5,407.00
General Structure Maintenance	LUMP	1	\$0.00	\$0.00
Engineering and Design	LUMP	1		\$0.00
Operations Contract	LUMP	1	\$0.00	\$0.00
Construction Oversight	LUMP	1	\$0.00	\$0.00

ADMINISTRATION

LDNR / CRD Admin.	LUMP	1	\$0.00	\$0.00
FEDERAL SPONSER Admin.	LUMP	1	\$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:	DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
	Rip Rap	LIN FT	0	\$0.00	\$0.00
		TON / FT	0.0	\$0.00	\$0.00
		TONS	0	\$0.00	\$0.00
			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	1	\$0.00	\$0.00
	Materials	LUMP	1	\$0.00	\$0.00
	Mob / Demob	LUMP	1	\$0.00	\$0.00
	Contingency	LUMP	1	\$0.00	\$0.00
	General Structure Maintenance	LUMP	1	\$0.00	\$0.00
	OTHER				\$0.00
	OTHER				\$0.00
	OTHER				\$0.00
TOTAL CONSTRUCTION COSTS:				\$0.00	

TOTAL OPERATIONS AND MAINTENANCE BUDGET: \$5,407.00



OPERATION AND MAINTENANCE BUDGET 07/01/2008-06/30/2009
FRESHWATER BAYOU/ME-04/PPL2

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	\$5,570.00	\$5,570.00
General Structure Maintenance	LUMP	1	\$0.00	\$0.00
Engineering and Design	LUMP	1	\$0.00	\$0.00
Operations Contract	LUMP	1	\$0.00	\$0.00
Construction Oversight	LUMP	1	\$0.00	\$0.00

ADMINISTRATION

LDNR / CRD Admin.	LUMP	0	\$0.00	\$0.00
FEDERAL SPONSER 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:	DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
	Rip Rap	LIN FT	0	\$0.00	\$0.00
		TON / FT	0.0	\$0.00	\$0.00
		TONS	0	\$0.00	\$0.00
			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	1	\$0.00	\$0.00
	Materials	LUMP	1	\$0.00	\$0.00
	Mob / Demob	LUMP	1	\$0.00	\$0.00
	Contingency	LUMP	1	\$0.00	\$0.00
	General Structure Maintenance	LUMP	1	\$0.00	\$0.00
	OTHER				\$0.00
	OTHER				\$0.00
	OTHER				\$0.00
TOTAL CONSTRUCTION COSTS:				\$0.00	

TOTAL OPERATIONS AND MAINTENANCE BUDGET: \$5,570.00



OPERATION AND MAINTENANCE BUDGET 07/01/2009-06/30/2010
FRESHWATER BAYOU/ME-04/PPL2

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	\$5,737.00	\$5,737.00
General Structure Maintenance	LUMP	1	\$0.00	\$0.00
Engineering and Design	LUMP	1	\$0.00	\$0.00
Operations Contract	LUMP	1	\$0.00	\$0.00
Construction Oversight	LUMP	1	\$0.00	\$0.00

ADMINISTRATION

LDNR / CRD Admin.	LUMP	1	\$0.00	\$0.00
FEDERAL SPONSER Admin.	LUMP	1	\$0.00	\$0.00
SURVEY Admin.	LUMP	1	\$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:	DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
	Rip Rap	LIN FT	0	\$0.00	\$0.00
		TON / FT	0.0	\$0.00	\$0.00
		TONS	0	\$0.00	\$0.00
			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	1	\$0.00	\$0.00
	Materials	LUMP	1	\$0.00	\$0.00
	Mob / Demob	LUMP	1	\$0.00	\$0.00
	Contingency	LUMP	1	\$0.00	\$0.00
	General Structure Maintenance	LUMP	1	\$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: **\$5,737.00**



APPENDIX D
(Field Inspection Notes)



Appendix D (Field Inspection Notes)

MAINTENANCE INSPECTION REPORT CHECK SHEET

Project No. / Name: ME-04 Freshwater Bayou

Date of Inspection: May 1, 2007 Time:

Structure No. N/A

Inspector(s): Stan Aucoin, Mel Guidry, Herb Juneau
Garrett Broussard (LDNR), Dale Garber (NRCS)

Structure Description: Foreshore Rock Dike

Water Level
Weather Conditions: Sunny and mild

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 Wales	N/A				
Galv. Pile Caps	N/A				
Cables	N/A				
Signage / Supports	N/A				
Rip Rap (fill) (foreshore dike)	Good			1 & 2	Recent maintenance work to restore dike to constructed elevation still in good condition. Approx. 2,000 LF still below +4.0 NAVD88 and will be monitored on future inspections.
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?

