E C O L O G I C A L R E V I E W

South White Lake Shoreline Protection
CWPPRA Priority Project List 12
State No. ME-22

September 17, 2004

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This document reflects the project design as of the 95% Design Review meeting, incorporates all comments and recommendations received following the meeting, and is current as of September 17, 2004.

ECOLOGICAL REVIEW
South White Lake Shoreline Protection (ME-22)

In August 2000, the Louisiana Department of Natural Resources (LDNR) initiated the Ecological Review to improve the likelihood of restoration project success. This is a process whereby each restoration project's biotic benefits, goals, and strategies are evaluated prior to granting construction authorization. This evaluation utilizes environmental data and engineering information, as well as applicable scientific literature, to assess whether or not, and to what degree, the proposed project features will cause the desired ecological response.

I. Introduction

The proposed South White Lake Shoreline Protection (ME-22) project is located in the Mermentau Basin in Vermilion Parish, Louisiana (Figure 1). The project area encompasses the southern shore of White Lake from Will's Point to the western shore of Bear Lake. The total area of the South White Lake Shoreline Protection project is approximately 5,222 acres and is primarily composed of fresh emergent marsh (2,314 acres) and open water (2,908 acres) habitats (United States Army Corps of Engineers [USACE] 2002).

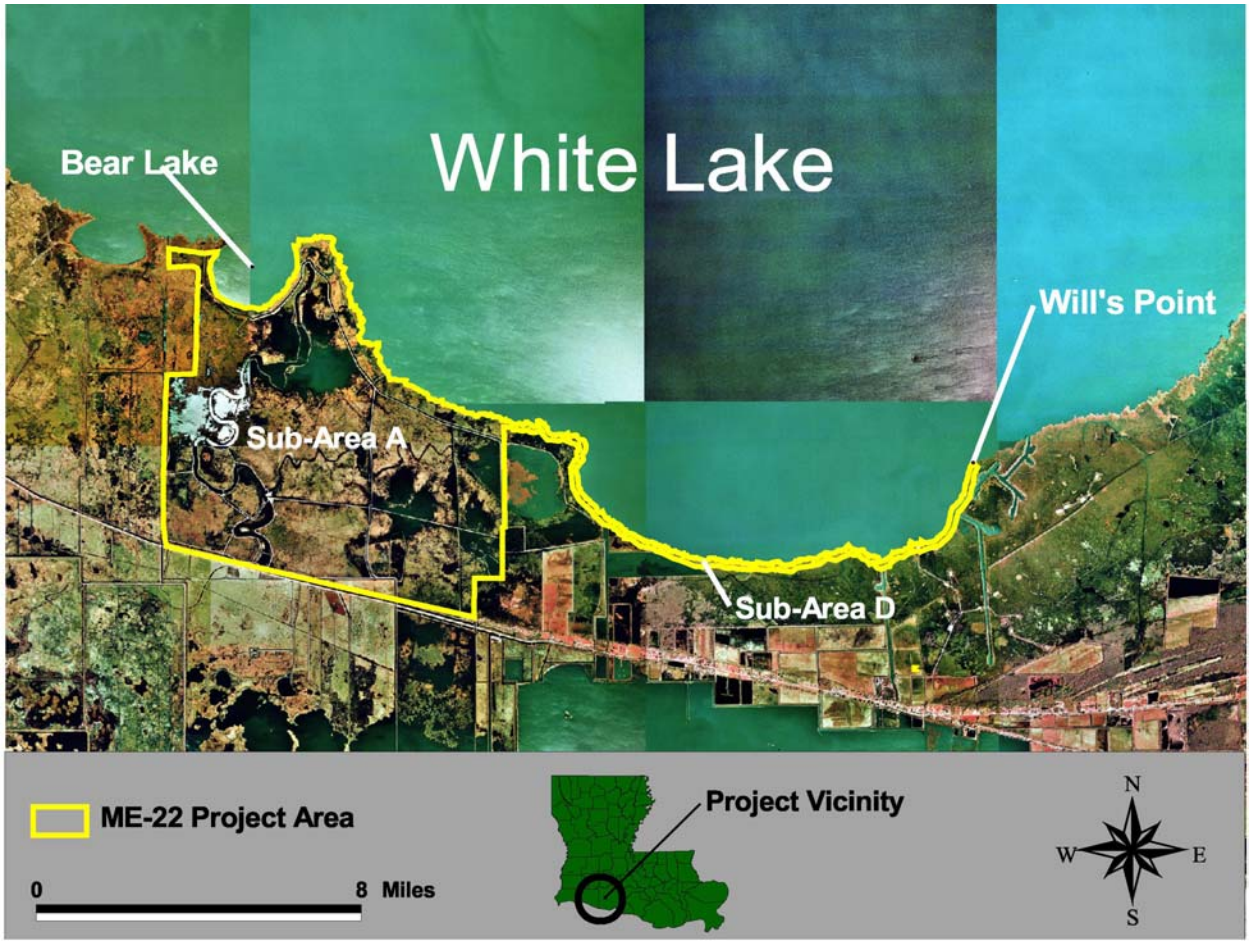

Figure 1. South White Lake Shoreline Protection (ME-22) project area.

Coast 2050 identified wave erosion, high water levels, and altered hydrology as the major factors contributing to the rapid erosion of the southern shore of White Lake (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority [LCWCRTF & WCRA] 1999). Between 1932 and 1990 an estimated 6,525 acres of marsh south of White Lake were lost (LCWCRTF & WCRA 1999). Future land loss projections predicted an additional loss of 4,220 acres of fresh marsh by 2050 or nearly 14% of the remaining 30,270 acres of marsh.

The South White Lake Shoreline Protection project area was originally subdivided into four sections (Sub-Areas A-D) in the project planning and selection process. However, Sub-Area B and C have since been deleted from the project area. It was determined that the marsh in these two Sub-Areas was not experiencing high enough rates of erosion to warrant protection (USACE 2002) (Figure 1). In contrast, Sub-Area D which is located along the shoreline of White Lake from Will's Point to Bear Lake is experiencing erosion rates of approximately 15 feet per year (USACE 2002). Sub-Area A encompasses the western interior section of the project area (Figure 1). As the shoreline of White Lake and Bear Lake erodes, a low levee separating the area from the lakes is anticipated to breach, which is expected to increase the rate of interior marsh loss. Protection of the shoreline will prevent this from occurring.

Protection of the White Lake shoreline will be accomplished through the construction of a 61,500 linear foot foreshore rock dike. The foreshore rock dike will protect interior marsh, which without the structure will be subjected to elevated water levels and increased wave energies (LCWCRTF & WCRA 1999). This project is in keeping with *Coast 2050* Region 4 Ecosystem Strategies which are to promote the stability and protection of bay, lake, and gulf shorelines for the preservation of interior wetlands and the maintenance of favorable hydrologic conditions (LCWCRTF & WCRA 1998).

The Shoreline Protection Foundation Improvement Demonstration (LA-06) project will be incorporated into ME-22 project designs in order to determine the feasibility of constructing rock shoreline protection structures where a relatively poor soil foundation exists.

II. Goal Statement

- Stop shoreline erosion in Sub-Area D and as a result save 379 acres of emergent marsh that is expected to be lost over the 20 year project life.
- Stop the breaching of the levee protecting Sub-Area A and as a result save 263 acres of emergent marsh that would otherwise be lost over the 20 year project life.
- Create 157 acres of emergent marsh between the White Lake shoreline and the foreshore rock dike in Sub-Area D over the 20 year project life.
- Increase submerged aquatic vegetation (SAV) coverage in the open water areas of Sub-Area D from a baseline of 1% to 40% over the 20 year project life.
- Maintain SAV coverage in Sub-Area A over the 20 year project life.

III. Strategy Statement

The project goals will be achieved through the construction of an approximately 61,500 linear foot foreshore rock dike along the southern shore of White Lake from Will's Point to the western end of Bear Lake.

IV. Strategy-Goal Relationship

The construction of a foreshore rock dike will effectively stop erosion along the southern White Lake shoreline by damping wind generated waves. By stabilizing the southern White Lake shoreline, the interior marsh will be maintained at or near current levels. Emergent marsh will be created through the beneficial use of dredged material from the digging of the flotation canal.

The construction of the foreshore rock dike is expected to increase the overall percentage of SAV coverage in the area behind the shoreline protection structure from 1% to 40% in Sub-Area D. Submerged aquatic vegetation habitat creation is expected to occur due to the reduction of turbidity in the shallow open water areas and the resulting increase in overall light penetration.

V. Project Feature Evaluation

Foreshore Rock Dike

The foreshore rock dike will be constructed at the -1.5 foot NAVD-88 contour. The breakwater will have a mean crest elevation of +3.5 feet NAVD-88 (with a +/-0.5 foot tolerance) upon construction completion (Figure 2). The current structure elevation design was determined through the addition of the White Lake mean water level (+1.12 feet NAVD-88), 90% wind setup (+0.50 feet) and the wave height of the 90th percentile wave (+1.70 feet), which will result in 0.18 feet of the rock dike remaining above water in storm conditions (USACE 2004). The dike will be constructed with a 4.0 foot wide crown and 1.0(V) on 1.5(H) side slopes. All stone sizing will correspond to the standard 24-inch rock gradation and be placed on geotextile fabric that will have a 200 pounds per inch minimum tensile strength. Fish dips will be built at approximately 1,000-foot intervals with a top width of 50 feet and the toe will be lined completely with a layer of rock (Figure 3).

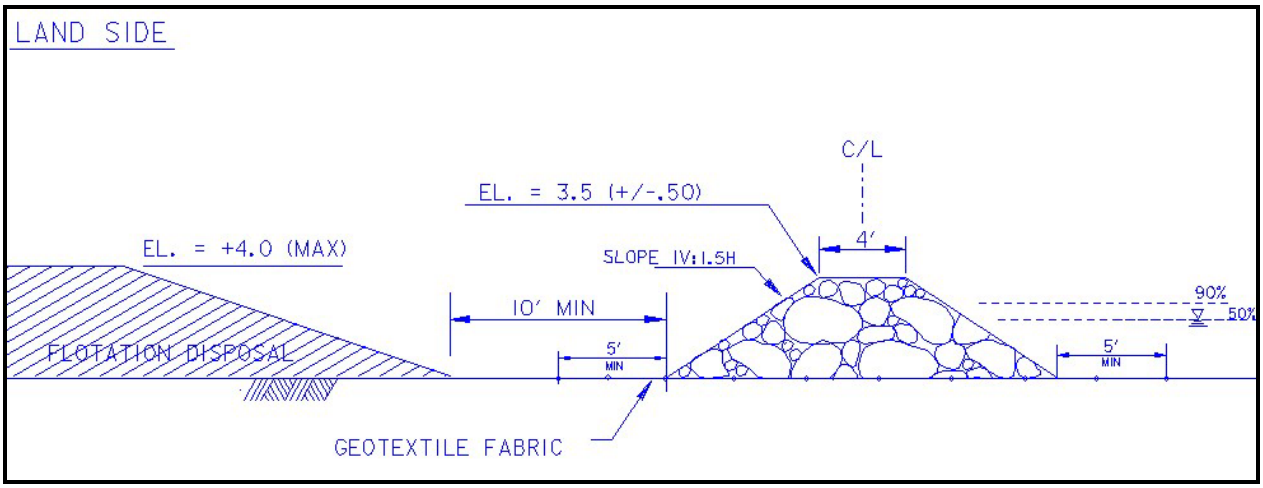

Figure 2. Typical dike section (USACE 2004, updated file from design report).

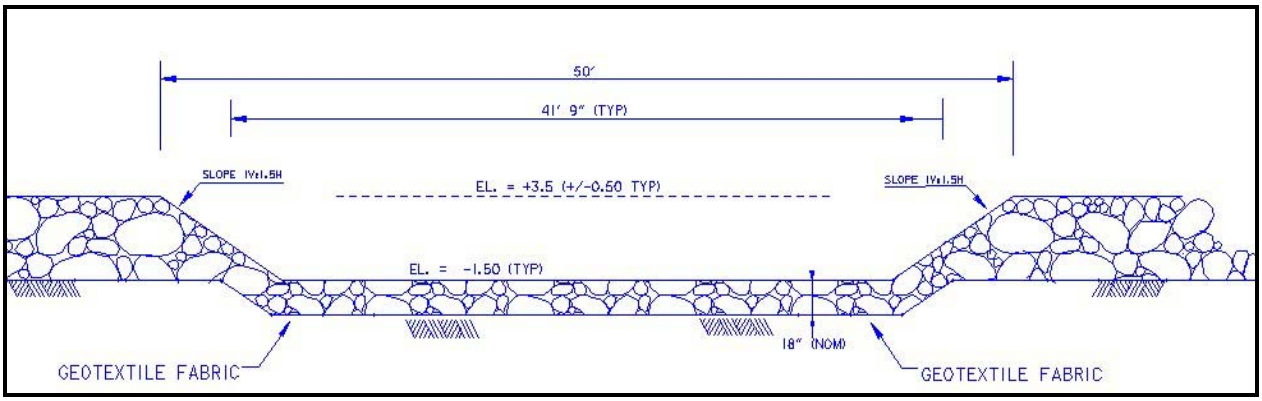

Figure 3. Typical fish dip section (USACE 2004, updated file from design report).

The geotechnical analysis revealed a favorable soil foundation composed of marsh, swamp, Lacustrine, and Pleistocene deposits in the White Lake project area (USACE 2004). With a subsidence rate of 1.25 foot per century included in the settlement calculations, the settlement of the rock dike ranges from 0.7 to 1.3 feet over the life of the project (USACE 2004). However, the relatively high crest elevation (+3.5 feet NAVD-88) will allow the dike to maintain its effectiveness as a wave break despite significant settlement. As a safeguard, maintenance funds will be requested for scheduled lifts, if needed, in years 7 and 15 post-construction in order to ensure that an effective crest height is maintained over the 20 year project life.

The construction of a flotation canal to allow access for barges and equipment will produce a significant amount of dredged spoil. The flotation canal will be dredged 50 feet from the centerline of the dike and the spoil material will be stacked at maximum height of +4.0 feet NAVD-88 and at a target elevation of +3.0 feet NAVD-88 behind the structure for additional marsh creation benefits. The +3.0 feet NAVD-88 target stack elevation was selected based on settlement curves which estimated that the dredge spoil would achieve a height ranging between +1.5 to +1.85 feet NAVD-88 at year 20. Approximately 157 acres of marsh will be created between the shoreline and the breakwater though the beneficial use of this dredged material. Material will be placed at least 10 feet behind the toe of the dike and at least 50 feet from the existing shoreline. Maximum allowable dredging depth for the flotation channel will be -6.0 feet NAVD-88.

Demonstration Project

The Shoreline Protection Foundation Improvement Demonstration (LA-06) project, authorized on the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) 13th priority project list, will be incorporated into the ME-22 project design plan. The goal of this demonstration project is to determine the feasibility of shoreline protection structures where a relatively poor soil foundation exists. The strategy of the Shoreline Protection Foundation Improvements Demonstration is to use sand as a foundation beneath rock dike structures as a means to achieve increased bearing capacity and consolidation settlement design tolerances in a manner that lessens 20-year shoreline protection project costs.

The demonstration project experimental design will include two sub-reaches. Each sub-reach will be divided into two 900-foot treatment sections and one 900-foot control section. Fish dips will be built at approximately 900-foot intervals with a top width of 50 feet. Treatment A

will be administered by placing sand directly on top of soil and then placing the rock material on top of the sand foundation. Treatment B will include dredging out the soil foundation, filling the cavity with sand. Rock will then be placed on top of the sand foundation. The treatments (A or B) were randomly assigned to each of the two sub-reaches (Figure 4).

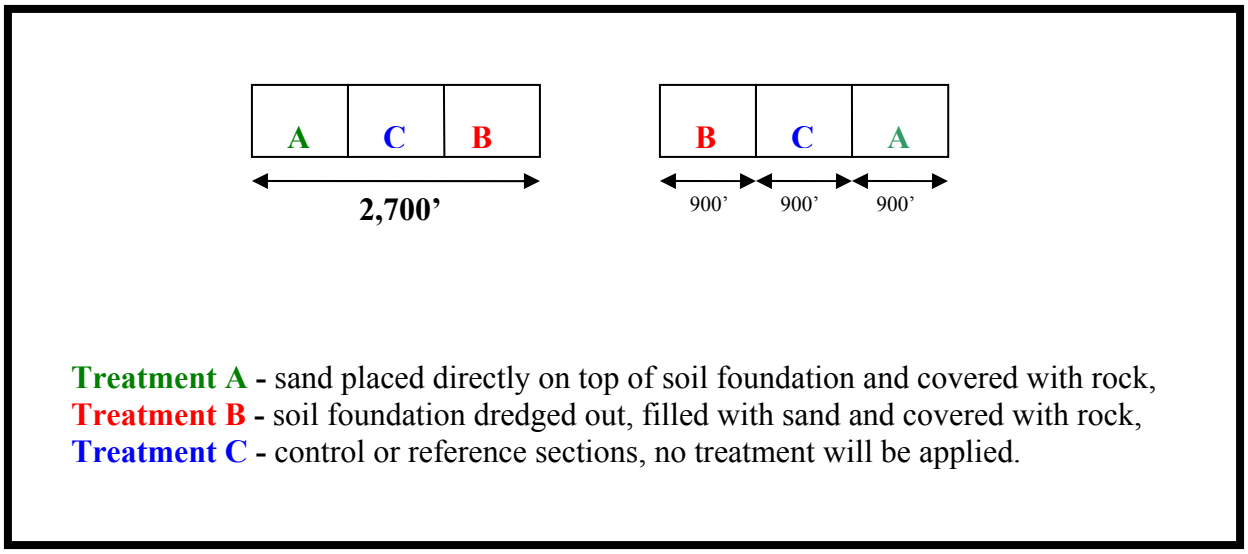

Figure 4. Shoreline protection foundation improvement demonstration (LA-06) layout and treatment regime.

The two sub-reaches will be placed in reach 5 of the ME-22 project area (Figure 5). The geotechnical investigation indicated that this region has a relatively unfavorable soil foundation. All sections will be instrumented with settlement plates, inclinometers, and extensometers at 180 foot intervals to determine the effectiveness of the foundation improvements. Geotechnical borings will be taken at each of the six sample sections during the construction of the demonstration project to determine underlying soil conditions. The benefits of this project may include a more effective and economical method for the design and construction of rock shoreline protection structures. The demonstration test sections will be maintained as part of the operations and maintenance plan for the ME-22 project.

Figure 5. Reach 5 of the South White Lake Shoreline Protection (ME-22) project area (USACE 2004, updated file from design report).

VI. Assessment of Goal Attainability

Environmental data and scientific literature documenting the effects of the proposed project features in field application are evaluated below to assess whether or not, and to what degree the project features will cause the desired ecological response.

Armor Shoreline Protection

A number of projects using traditional shoreline protection structures have been implemented in Louisiana coastal areas to protect lake, bay, and navigational channel shorelines (Table 1). Published results of projects funded under CWPPRA and through the State of Louisiana that have used rock shoreline protection structures constructed in environments similar to the South White Lake Shoreline Protection project are discussed below.

Table 1. Design parameters of constructed shoreline protection projects (sorted by construction date).

Project Name	Project Number	Coast 2050 Region	Construction Date	Depth Contour (NAVD-88)	Length of Structure (feet)	Height	Distance From Shoreline (feet)
Blind Lake	N/A* (State)	4	1989	N/A	2,339	4.0 ft NAVD-88	70
Cameron Prairie National Wildlife Refuge Shoreline Protection	ME-09	4	1994	-1.0 ft	13,200	3.7 ft NAVD-88	0-50
The Freshwater Bayou Bank Protection	TV-11 (State)	3	1994	N/A	25,800	4.0 ft NAVD-88	N/A
Turtle Cove	PO-10 (State)	1	1994	N/A	1,640 (rock gabion)	3 ft (MWL)	300
Bayou Segnette	BA-16 (State)	2	1994,1998	N/A	6,800	3.0-5.0 ft NAVD-88	N/A
Boston Canal/Vermilion Bay Bank Protection	TV-09	3	1995	N/A	1,405	3.8 ft NGVD-29	N/A
Clear Marias Bank Protection	CS-22	4	1997	-1.2 ft	35,000	3.0 ft NGVD-29	0-50
Freshwater Bayou Wetlands Protection	ME-04	4	1998	-1.0 ft	28,000	4.0 ft NAVD-88	0-150
Freshwater Bayou Bank Stabilization	ME-13	4	1998	N/A	23,193	3.7-4.0 ft NAVD-88	N/A
Lake Salvador Shoreline Protection Demonstration	BA-15 Phase II	2	1998	-1.0 to 1.4 ft	8,000	Designed at 4.0 ft NAVD-88 built at 2.75 ft NAVD-88	100
Perry Ridge Shore Protection	CS-24	4	1999	N/A	12,000	3.7 to 4.0 ft NAVD-88	60
Jonathan Davis Wetland Protection	BA-20	2	2001	N/A	34,000	3.5 ft NAVD-88	N/A
Bayou Chevee Shoreline Protection	PO-22	1	2001	N/A	5,690	3.5 ft NGVD-29	300

***N/A indicates that information was not available.**

- The Boston Canal/Vermilion Bay Bank Protection (TV-09) project was designed to abate wind-driven wave erosion along Vermilion Bay and at the mouth of Boston Canal (Thibodeaux 1998). To accomplish that goal a 1,405 foot foreshore rock dike was constructed in 1995 at an elevation of +3.8 feet NGVD-29 along the bank of Boston Canal extending into Vermilion Bay. In 1997, two years after construction, the project was estimated to have protected 57.4 acres of marsh and 1.4 to 4.5 feet of sediment was deposited behind the breakwater while the reference area continued to erode. The rock breakwater at the mouth of Boston Canal was successful in stabilizing the shoreline (Thibodeaux 1998).

- Lake Salvador Shoreline Protection Demonstration (BA-15) project evaluated a series of shoreline protection measures at Lake Salvador, St. Charles Parish, Louisiana. Phase two of this project was conducted in 1998 and evaluated the effectiveness of a rock berm to protect the lake shoreline from higher energy wave erosion. The rock structure itself appears to be holding up well, showing little sign of deterioration and subsidence. Recent surveys of the area revealed that the rock dike was successful in stabilizing the shoreline and some accretion is occurring behind the structure (Curole et al. 2001). However, the effectiveness of the structure over the long term may be in question since it was not built according to design specifications. The rock dike was designed to be constructed with a crest elevation of +4.0 feet NAVD-88. A 2002 survey of the rock dike determined that the average height of the structure was +2.51 feet NAVD-88. The average settlement of the structure, measured from 1998 to 2002, was approximately 0.26 feet. It was concluded that the rock dike was built to an inadequate crest elevation of +2.75 feet NAVD-88 (Darin Lee, Personal Communication 2002).

- Intracoastal Waterway Bank Stabilization and Cutgrass Planting project at Blind Lake was a state wetland restoration project constructed to prevent the Gulf Intracoastal Waterway (GIWW) and Sweet Lake from coalescing with Blind Lake (LDNR 1992). A limestone foreshore rock dike built at an elevation of +4.0 feet NGVD-29 was placed 70 feet from the edge of the main channel along 2,339 feet of bank on a six-inch layer of shell and filter cloth. Large stones were used to prevent movement of rocks and to allow sediments and organisms passage. In 1991, two years after project completion an average increase in elevation of 0.32 feet in the area behind the dike was observed along transects from the deposition of suspended sediments. Data indicate that the project was successful in protecting the shoreline at Blind Lake and maintaining the hydrology of the Cameron-Creole watershed.

- The Turtle Cove Shoreline Protection (PO-10) was initiated in 1993 to protect a narrow strip of land in the Manchac Wildlife Management Area which separates Lake Pontchartrain from an area known as “the Prairie” (O’Neil and Snedden 1999). Wind induced waves contributed to a shoreline erosion rate of 12.5 feet per year. A 1,642 foot rock filled gabion was constructed 300 feet from shore at an elevation of 3 feet above mean water level with the goal of reducing erosion and increasing sediment accretion behind the structure. Post construction surveys conducted during the period of October 1994 to December 1997 revealed that the shoreline had

prograded at a rate of 3.47 feet per year in the project area. The rate of sediment accretion, as determined from elevation surveys conducted in January 1996 and January 1997, was 0.26 feet per year.

The soils in The Prairie and Turtle Cove area consist of Allemands-Carlin peat which is described as highly erodible organic peat and muck soils (USDA 1972). Due to the weak and compressible nature of the subsurface soils, the gabions settled 0.59 feet in just over two years (October 1994 to January 1997) (O'Neil and Snedden 1999). Also, five years after construction the rock filled gabion structure exhibited numerous breaches and required extensive maintenance in August 2000 (John Hodnett, LDNR, Personal Communication August 2004).

There are also several examples of successful projects involving the use of shoreline protection to stop erosion along navigation channel banks.

- The Freshwater Bayou Wetlands Protection (ME-04) project is positioned on the western bank of Freshwater Bayou Canal across from the proposed TV-11b project (Vincent et al. 1999). Construction of this project was initiated in January 1995 and includes construction of water control structures and a 28,000 linear foot foreshore rock dike designed with a crown elevation of +4.0 feet NAVD-88. Analysis of initial monitoring data suggests that the rock dike reduced wave-induced shoreline erosion after construction. The average rate of shore progradation between June 1995 and July 1996 was measured at 2.2 feet per year while the reference area continued to erode at an average rate of 6.7 feet per year (Raynie and Visser 2002). In contrast, between March 1998 and May 2001, the protected shoreline eroded an average of 2.6 feet per year while the reference area eroded at an average of 10.0 feet per year (Raynie and Visser 2002). Substandard recycled construction material and inadequate funds for maintenance of the structure, which were not disbursed in a timely manner, are believed to be the reason for the increase in erosion rates in the project area (Raynie and Visser 2002).

- The Cameron Prairie National Wildlife Refuge Shoreline Protection (ME-09) project, constructed in 1994, is located in north-central Cameron Parish and includes 350 acres of freshwater wetlands (Barrilleaux and Clark 2002). A 13,200-foot rock breakwater was constructed at an elevation of +3.7 feet NAVD-88, 50 feet from (and parallel to) the northern shore of the GIWW to prevent wave action from eroding the bank and breaching into the interior marsh. Aerial photography and survey points were used to monitor any changes in land to water ratio and shoreline position. Three years after construction results indicate that the project area shoreline advanced 9.8 ± 7.1 feet per year while the reference area retreated 4.1 ± 3.1 feet per year. A two-sample t-test reveled a significant difference was detected between the shoreline change rate and the project reference areas ($P < 0.001$).

- The Clear Marais Bank Protection (CS-22) project was constructed in 1997 at an elevation of +3.0 feet NGVD-29 to prevent breaches in the GIWW shoreline and subsequent erosion of the interior marsh while preventing saltwater intrusion (Miller

2001). Approximately 35,000 linear feet of rip-rap was placed 50 feet from the northern shoreline of the GIWW. Results indicate that the foreshore rock dike has been effective in preventing erosion of the GIWW shoreline. A net gain of 13 feet per year occurred behind the rock structure while the reference area continued to erode (Raynie and Visser 2002).

Submerged Aquatic Vegetation

Submerged Aquatic Vegetation plays a crucial role in the littoral zone of aquatic ecosystems (Wetzel 1983). Submerged aquatic vegetation dissipates the energy of wind and wave action, reduces the amount of bottom sediment resuspension, serves as effective traps for inorganic and organic particulates, and provides suitable forage for ducks, invertebrates and larval fish (Spence 1982, Foote and Kadlec 1988, Lodge 1991). It is widely understood that the limiting factor controlling the recovery of SAV in lakes is light attenuation (Sager et al. 1998). Submerged aquatic vegetation habitat creation is expected to occur behind the shoreline protection structure in White Lake due to the reduction of turbidity in the shallow open water areas and the resulting increase in overall light penetration.

CWPPRA's Environmental Workgroup estimated that the South White Lake Shoreline Protection structure would increase SAV cover in the open water areas of Sub-Area D from a baseline of 1% to a target of 40% over the 20 year project life (USACE 2002). The structure is also expected to maintain current levels of SAV cover in Sub-Area A over the 20 year project life (USACE 2002). Due to limited availability of monitoring data from previously constructed CWPPRA shoreline protection projects in the Mermentau Basin, attempts to correlate these established targets or to better quantify the effect of the project features on SAV cover within White Lake have been ineffectual.

Summary/Conclusions

Projects including TV-09, BA-15, CS-22, PO-10, and ME-09 which were designed to an adequate elevation and located in areas with relatively good soil foundations were successful in reducing shoreline erosion and promoting accretion behind the structure. Projects such as ME-04 and PO-10 were successful in reducing shoreline erosion but experienced some structural failures due to poor soil foundations, the use of recycled materials, and/or inadequate maintenance funds. In contrast, the South White Lake Shoreline Protection project is located in an area where soil bearing capacity is favorable. In addition, a detailed operations and maintenance schedule has been prepared in order to assure that the structure sustains an effective elevation over the entire twenty-year project life.

According to the geotechnical report (USACE 2004), the proposed White Lake foreshore rock dike will experience 0.7-1.3 feet of settlement over the life of the project. However, a maintenance lift, which will help to maintain the structure elevation at +3.5 feet NAVD-88, may be conducted, if needed, at years 7 and 15 post-construction. Despite initial and post-construction settlement, the currently proposed rock dike should provide adequate protection against wind-driven waves and ultimately prevent breaches in the southern White Lake shoreline.

A demonstration project will be incorporated into the South White Lake project design to test the effectiveness of two foundation improvement strategies in relatively poor soil foundations. Detailed design plans for the demonstration project will be available before the project is presented to the Louisiana Coastal Wetlands Conservation and Restoration Task Force for funding.

VII 95% Design Review Recommendations

Based on information gathered from similar restoration projects, engineering designs and related literature, the proposed strategies in the South White Lake Shoreline Protection project will likely achieve the desired goals. At this time, the Louisiana Department of Natural Resources, Coastal Restoration Division recommends that the South White Lake Shoreline Protection project be considered for CWPPRA Phase 2 authorization.

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