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

Lake Hermitage Marsh Creation
CWPPRA Priority Project List 15
State No. BA-42

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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 November 17, 2008.

ECOLOGICAL REVIEW
Lake Hermitage Marsh Creation

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 monitoring 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 Lake Hermitage Marsh Creation (BA-42) project encompasses 1,581 acres of brackish/intermediate marsh and open water near Lake Hermitage. Lake Hermitage (also known as Lake Judge Perez) is a shallow water body located in Barataria Basin four miles west of the town of Magnolia on the west bank of the Mississippi River. The lake and project area are located in the West Pointe a la Hache Mapping Unit, which is delineated by the Plaquemines Parish flood protection levees on the north and the Bayou Grand Chenier Ridge on the south (Figure 1).

Marshes in this mapping unit have been severely degraded, with an estimated 5,040 acres lost between 1932 and 1990 (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1999). Much of this loss has been attributed to anthropogenic modifications that have occurred over the last century. Levees constructed for flood protection have prevented riverine sediment and nutrients from reaching adjacent marsh, thus impairing the marsh's ability to keep pace with relative sea level rise (Baumann et al. 1984). In addition, extensive canal dredging has increased the number of tidal connections across the Bayou Grand Chenier Ridge, resulting in saltwater intrusion and the conversion of large areas of low-salinity marsh to open water (Sasser et al. 1986).

Significant marsh loss has also occurred along the shorelines of Lake Hermitage due to erosion from wind-generated waves. This loss has been particularly acute along the eastern shoreline, where erosion rates as high as 16 feet per year have been measured for the time period of 1988 to 2007 (U.S. Fish and Wildlife Service [USFWS] 2008). As the lake rim has deteriorated, interior marsh has been exposed to erosion from wave action and tidal currents.

In an effort to protect remaining marsh from further degradation, the state of Louisiana constructed the West Pointe a la Hache siphons (Project Number BA-04) in 1992 to reintroduce Mississippi River water into the mapping unit. The siphons have been effective in reducing salinities, but have not stopped marsh loss in the unit (Boshart and Cook 2007). Therefore, the BA-42 project will create marsh around Lake Hermitage using sediment dredged from the Mississippi River. River sediment will also be used to restore the lake's eastern shoreline. These strategies are consistent with the *Coast 2050* plan, which identified dedicated dredging to create marsh and maintenance of lake shoreline integrity as Region 2 ecosystem strategies (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1999). The project is also consistent with Louisiana's Comprehensive Master Plan for a Sustainable Coast (Coastal Protection and Restoration Authority of Louisiana 2007).

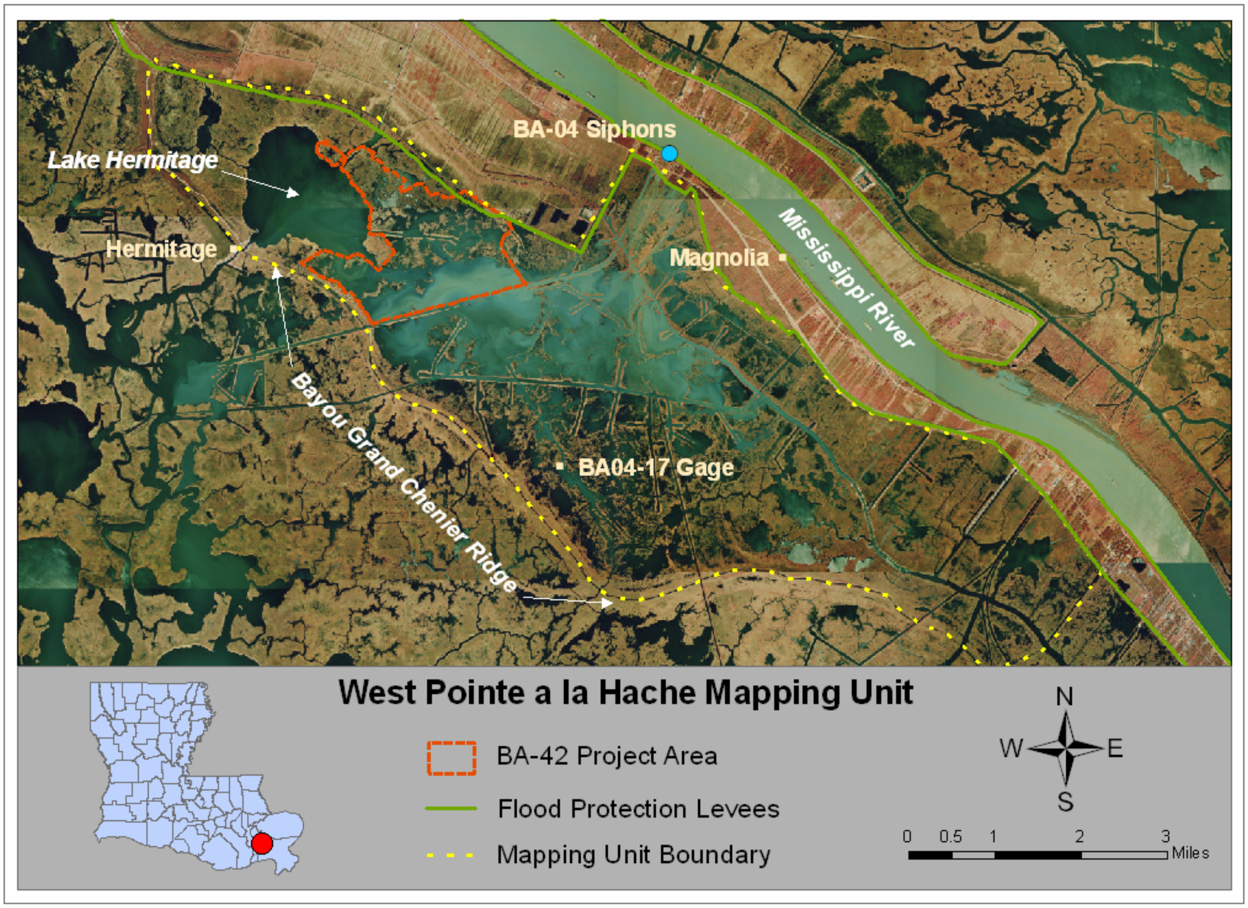

Figure 1. Location of the BA-42 project within the West Pointe a la Hache Mapping Unit.

II. Goal Statement

- Create 456 acres and nourish 93 acres of marsh by the end of project construction.
- Restore 7,400 linear feet (52 acres of marsh created) of Lake Hermitage's eastern shoreline.
- Create 6.5 acres of wetland habitat from 7,300 linear feet of earthen terraces.

III. Strategy Statement

- Marsh creation will be achieved by hydraulically dredging sediment from the Mississippi River and transporting it via pipeline to fill open water and deteriorated marsh.
- Dredged river sediment will be used to construct a berm along the eastern shoreline.
- Terraces will be constructed using material dredged from adjacent water bottoms.

IV. Strategy-Goal Relationship

Sediment dredged from the river will be pumped into two marsh creation areas, Area A which encompasses 352 acres and Area B which encompasses 182 acres (Figure 2), to create/nourish 534 acres of marsh. An additional 15 acres of marsh will be nourished during the construction of the shoreline berm. Marsh acreage will also be created by the construction and planting of the shoreline berm and terrace features. The berm will reinforce the deteriorated eastern shoreline, and should attenuate wave action and thereby reduce rates of shoreline erosion.

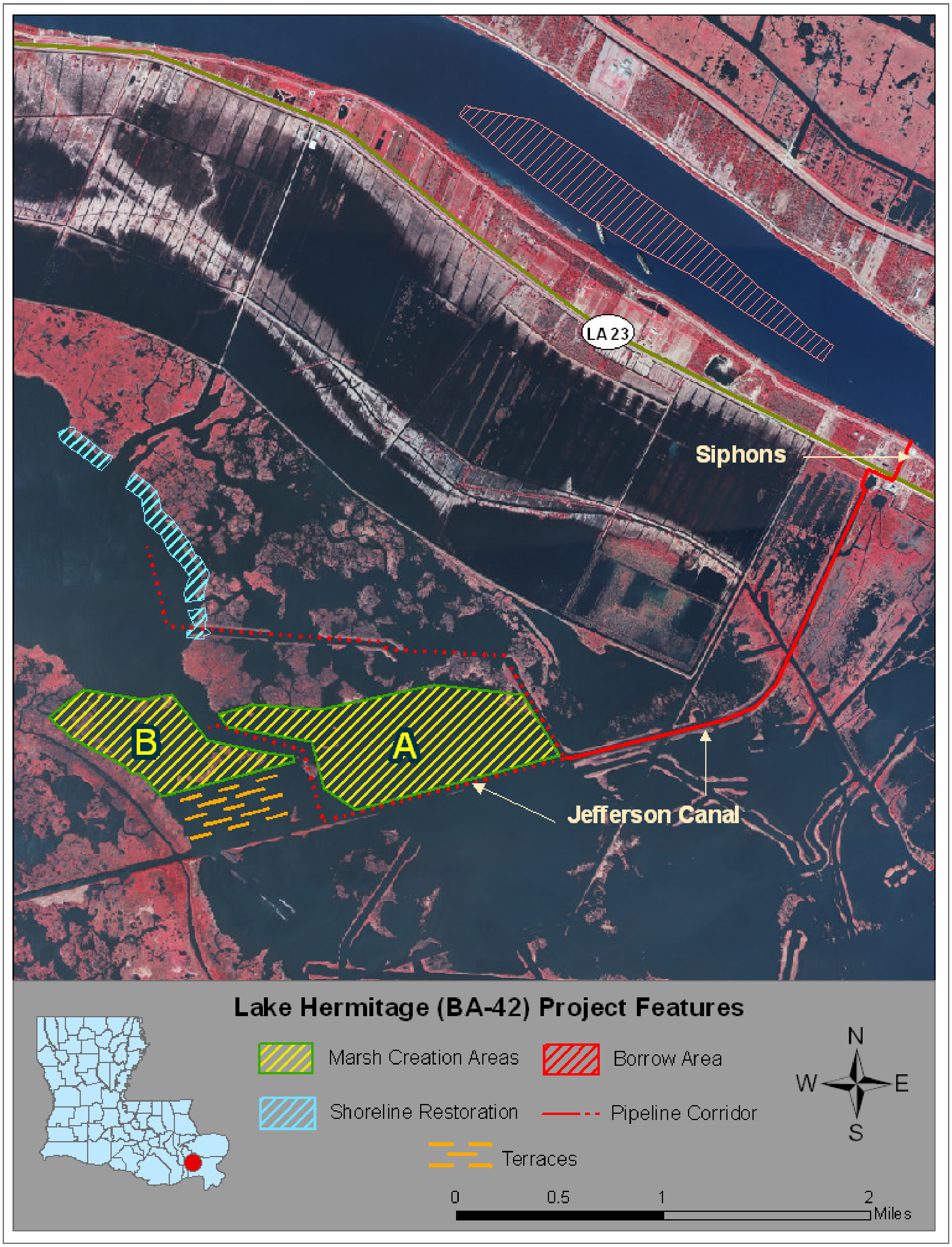

Figure 2. Lake Hermitage Marsh Creation (BA-42) project features.

V. Project Feature Evaluation

Borrow Area and Dredge Pipeline Corridor

The borrow area for this project is located between Mississippi River miles 49 and 52 in water depths of 37 to 55 feet (Figure 2). Channel deposits in this area are predominantly medium and fine sand with some silt and clay (generally <10%; Eustis Engineering Services [EES] 2007). The borrow area was delineated in accordance with U.S. Army Corps of Engineers' Mississippi River dredging restrictions, which are designed to protect bridges, navigation channels, and the adjacent levee system.

Sediment will be hydraulically dredged from the borrow area and transported to the project area via pipeline. The pipeline will cross the Mississippi River levee in Plaquemines Parish's tract of land surrounding the West Pointe a la Hache siphons (Figure 2). From there the pipeline will pass through a culvert installed underneath Highway 23, over the Plaquemines Parish flood protection levee, and then enter Jefferson Canal near the outfall of the siphons. The pipeline will continue down Jefferson Canal and then through various unnamed canals before reaching the marsh creation and shoreline restoration areas (Figure 2) (Simoneaux 2008).

Marsh Creation Design

The average elevation of marsh near the project area was determined to be +1.16 feet NAVD 88 (Sigma Consulting Group 2007). Although the surveyed marsh appeared to be relatively healthy, it was decided that the created marsh should be slightly higher in elevation. To determine the appropriate construction fill elevation, foundation settlement and self-weight consolidation tests were performed using soil samples collected from the marsh creation and borrow areas, respectively (EES 2007). After evaluating a range of potential elevations, a fill elevation of +2.0 feet NAVD 88 was chosen because it would yield desirable marsh elevations for most of the project life. Filling to this elevation, the created marsh platforms will settle to approximately +1.5 feet NAVD 88 at year 10, and approximately +1.3 feet NAVD 88 at the end of the 20-year project life (EES 2007).

Containment dikes will be constructed using material mechanically dredged from within the marsh creation areas. The dikes will have a crown elevation of +3.0 feet NAVD 88 (allowing one foot of freeboard above the marsh fill), a crown width of 5 feet, and side slopes of 1(V):6(H). The dikes will be breached at undetermined locations at the end of construction and, if necessary, during future maintenance events (Rudy Simoneaux, LDNR, Personal Communication, May 21, 2008).

Shoreline Restoration

The shoreline berm will be constructed over the crest of the lake's eastern shoreline, with gaps included to accommodate natural hydrologic features (Figure 2). The berm will have a crown width of 50 feet, side slopes of 1(V):50(H) on the lake side and 1(V):25(H) on the marsh side, and a crown elevation of approximately +2.2 feet NAVD 88 after 20 years (Figure 3) (Simoneaux 2008). River sediment will initially be contained by training dikes and pumped to an elevation of +4.0 feet NAVD 88. Once the sediment has sufficiently dewatered, the dikes will be removed and the berm will be shaped to the aforementioned dimensions and planted with native vegetation. Effluent from the dewatering process will be allowed to flow into the adjacent marsh (Rudy Simoneaux, LDNR, Personal Communication, July 10, 2008). Sediment in the effluent will be deposited over, and thus nourish, approximately 15 acres of marsh.

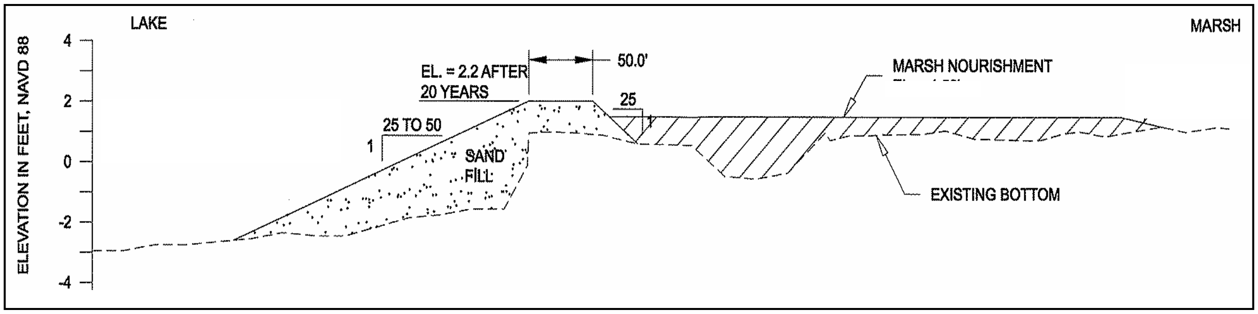

Figure 3. Details of the shoreline restoration feature after construction (from EES 2007).

<u>Terraces</u>

Thirteen terraces will be constructed in open water in the southwest corner of the project area (Figure 2). Nine of these terraces will be 500 feet in length and the remaining four will be 700 feet in length. Otherwise, the terraces will have a crown width of 20 feet, side slopes of 1(V):3(H), an initial constructed elevation of +3.5 feet NAVD 88, and a final settled elevation of +2.3 feet NAVD 88 (Simoneaux 2008). The sediment used to construct the terraces will be dredged from borrow areas no less than 25 feet from the toe of the terrace. Once shaped, the terraces will be planted with native vegetation.

VI. Assessment of Goal Attainability

When addressing the likelihood that the proposed project features will provide the desired ecological response, it is important to evaluate the lessons learned from scientific research and previous projects that are similar in scope to the Lake Hermitage Marsh Creation (BA-42) project. The findings of this review follow.

<u>Marsh Creation Projects</u>

There have been a number of marsh creation projects constructed in Louisiana under such programs as CWPPRA, the U.S. Army Corps of Engineers' dredged material beneficial use program (USACE 1995), and the LDNR Dedicated Dredging program (LDNR 2000). Design parameters of some of these projects are summarized in Appendix A, and selected projects are discussed below.

- The Bayou LaBranche Wetland Creation (PO-17) project, located on the southwestern shore of Lake Pontchartrain, was the first project constructed through the CWPPRA program, with construction completed on April 1, 1994. The project was designed to reach a minimum 70% emergent marsh to 30% open-water ratio five years after construction. In 1997, the project area was approximately 82% land and 18% water; however, only 51% of the land was emergent marsh with the rest being scrub-shrub and upland habitats (Boshart 2004). The low amount of emergent marsh was attributed to sediment elevations being higher than suitable for emergent vegetation. The target range of sediment elevation for this project, after five years of consolidation, was estimated at +0.65 to 1.62 feet NAVD (Boshart 2004). As of August 2002, elevations at 11 of the 19 staff gauge stations were within this target range. In addition, soil properties and vegetation communities have continued to develop toward characteristic wetland habitats for the region.

- The Barataria Bay Waterway Wetland Restoration (BA-19) project intended to enlarge Queen Bess Island by creating nine acres of marsh using sediment from maintenance dredging of the waterway. The elevation of the marsh platform was projected to be +1.22 feet NGVD 29 after settlement and consolidation; however, two years after construction the elevation was +0.79 feet NGVD 29 (Curole 2001). This was because the project area was filled to an elevation lower than the design elevation (Smith 2003). As a result, the project area is constantly flooded and no appreciable vegetation growth has occurred.

- The Atchafalaya Sediment Delivery (AT-02) project was designed to utilize sediment dredged from two channels in the Atchafalaya Delta to create islands suitable for the establishment of emergent marsh vegetation. However, inaccurate elevation surveys made prior to construction caused the dredged material to be piled too high (Raynie and Visser 2002). As a result, the created islands have become dominated by wetland forest vegetation rather than the targeted emergent marsh species that colonized nearby natural crevasse splays. This was attributed to the greater elevation, and therefore lower flooding frequency and duration, of the created islands.

- The goal of the West Belle Pass Headland Restoration (TE-23) project was to reduce the encroachment of Timbalier Bay into the headland by creating 184 acres of marsh using sediment dredged from Bayou Lafourche. Failed containment dikes, though, allowed a large quantity of sediment to be washed out of the marsh creation sites before the material had settled/consolidated. Furthermore, large sections of the project area were filled to levels significantly higher or lower than the targeted +1.7 feet NAVD 88 elevation. As a result, only 31 acres of saline marsh were created by this project, with the remainder being upland, beach/bar/flat, and subaqueous habitats (Curole and Huval 2005).

- The goal of the Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project was to create 260 acres of marsh, which would act as a hydrologic barrier between two watersheds in the project area. The marsh platform was designed to have an elevation of +1.5 feet NGVD 29 at construction, and +0.5 feet NGVD 29 (or existing marsh elevation) after settlement/consolidation. However, portions of the project area were not filled to the correct elevation, and some of the sediment was removed by tidal flow coming through failed containment dikes and the dredge pipeline corridor (Raynie and Visser 2002). Consequently, the created marsh has a lower elevation than adjacent natural marsh, leading to more frequent and longer inundation than optimal for healthy marsh. The TE-26 project only created approximately 139.5 acres of new land (Lear and Triche 2004).

- The Sabine Refuge Marsh Creation, Cycle 1 (CS-28-1) project is part of an overall effort to create approximately 1,120 acres of emergent marsh using sediment from maintenance dredging of the Calcasieu Ship Channel. The goal of the first cycle, completed in February 2002, was to create approximately 125 acres. The marsh platforms were designed to have an elevation of +3.08 feet NAVD 88 at construction, and an elevation of +1.08 feet NAVD 88 after five years (Sharp and Juneau 2005). Although post-construction elevation surveys have not been conducted, vegetation surveys found that the marsh platforms were densely covered by emergent vegetation within two years of construction (Sharp and Juneau 2005).

Marsh Terracing Projects

Marsh terracing is a relatively new restoration technique used to create intertidal wetlands from shallow subtidal bottoms (Turner and Streever 2002). Terraces also reduce wave energy and current speed, and consequently have been used to protect nearby marsh shorelines, promote the deposition and retention of suspended sediment, and improve growing conditions for submerged aquatic vegetation (SAV) by reducing turbidity. Design parameters of previous terracing projects are summarized in Appendix B, and selected projects are discussed below.

- The Sabine Terraces (CS-ST) project, constructed in the Sabine National Wildlife Refuge in October 1990, was the first terracing project built in the United States. The terraces were constructed in a checker-board fashion in two adjacent marsh ponds and planted with *Spartina alterniflora* sprigs and plugs soon after construction. Survival of the plantings was good and after two years the terraces had 100% vegetation coverage, with no difference between sprig and plug plantings (Steyer 1993). During the ten years following construction, the terraces increased in size by an average of 46% and the pond shorelines prograded a total of 5 acres (Good et al. 2005). These results suggest that the terraces successfully promoted the deposition and retention of sediment.

- The primary goal of the Little Vermilion Bay Sediment Trapping (TV-12) project is to optimize the retention of sediment delivered by the Gulf Intracoastal Waterway and Freshwater Bayou Canal to create new wetlands in Little Vermilion Bay. Although the terraces have not significantly increased in size, there has been increased sediment deposition in the terrace field resulting in a 0.5 feet increase in bay-bottom elevation (Castellanos and Aucoin 2004). It is believed that, with continued sedimentation, newly-formed mudflats will eventually become vegetated wetlands. The TV-12 terraces themselves were quickly colonized by the vegetative plantings as well as naturally recruiting vegetation within two to three years post-construction (Castellanos and Aucoin 2004).

- The terraces constructed for the Sweet Lake/Willow Lake Hydrologic Restoration (CS-11b) project were intended to reduce shoreline erosion and increase the acreage of emergent vegetation within the project area. However, high water events and a lack of consolidated material caused the project's open water terraces to deteriorate rapidly (Miller and Guidry 2005). As a result, plantings were unable to become established prior to the loss of these features. The terraces and plantings installed along the shorelines fared better, however high water during construction caused some deterioration of the terrace crowns.

- The main objective of the Pecan Island Terracing (ME-14) project is to increase the acreage of emergent marsh in open water areas south of Highway 82 near Pecan Island. Although this project has been constructed for only a short time, early survey results suggest that both planted and unplanted terraces have been quickly colonized by several naturally recruiting vegetation species (Thibodeaux and Guidry 2004).

Shoreline Restoration Projects

Most shoreline restoration projects have used hardened structures, such as rock breakwaters or dikes, to eliminate erosion and promote accretion. However, there have been a number of projects on the East Coast that have restored shorelines using non-structural methods (i.e., sand fill followed by vegetation plantings). These projects, termed "living shorelines", have been implemented to reduce shoreline erosion while maintaining normal ecological functions and processes such as wildlife habitat, sediment transport, and nutrient assimilation. Although there is little scientific research or monitoring data available, anecdotal evidence indicates that these projects have been successful primarily in low wave energy environments (Burke and Hardaway 2007). In areas with greater wave energy (i.e., shorelines exposed to a fetch >1 mile), the non-structural method has been replaced with a "hybrid" approach that includes a limited amount of rock to anchor and protect the sand fill and vegetation (Burke et al. 2005, Burke and Hardaway 2007).

Summary and Conclusions

Achieving proper elevation is critical to the success of marsh creation projects. The elevation of the marsh surface determines its frequency and duration of flooding, which in turn affects vegetation composition and productivity. Marsh platforms built too high may become dominated by upland vegetation, whereas platforms built too low may be excessively inundated and therefore unsuitable for marsh vegetation. Regarding the BA-42 project, the elevation of the marsh platforms will be around +1.3 to +1.5 feet NAVD 88 for much of the project life. At these elevations, the platforms would be inundated approximately 20 to 30% of the time, based on five years of water level data from the nearby BA04-17 gage (29°32'00.97"N, 89°49'07.87"W) (Figure 4). Although this level of inundation is lower than optimal for many species of marsh vegetation, it would be suitable for locally-dominant *Spartina patens*, which is less tolerant of flooding and more productive in irregularly-inundated habitats (Burdick and Mendelssohn 1987, Broome et al. 1995).

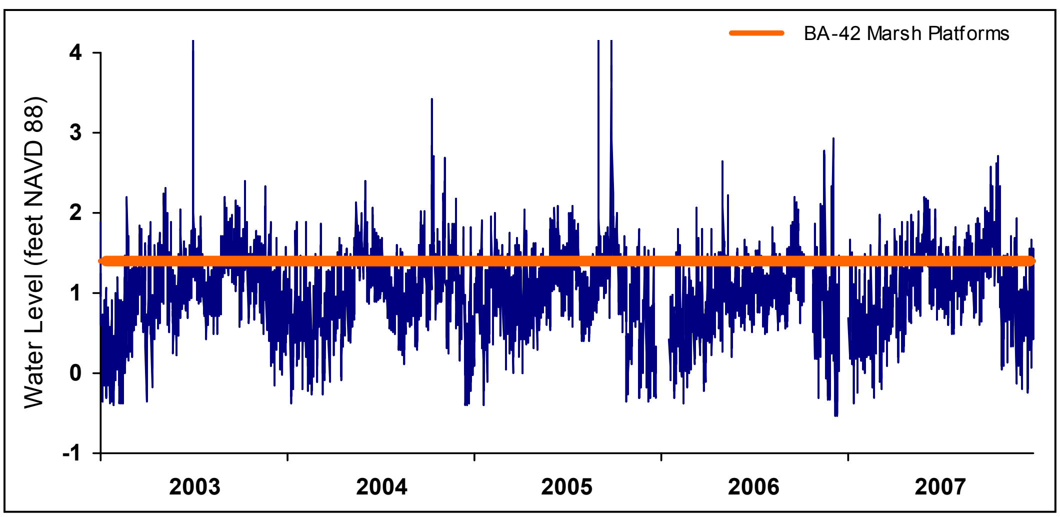

Figure 4. **Water level at the BA04-17 gage for the years 2003 to 2007 (from LDNR data).**

The long-term sustainability of the created marsh is dependent on maintaining natural hydrologic exchange between the marsh and adjacent water bodies. Levees and canal spoil banks interrupt this exchange resulting in prolonged flooding and drying events, reduced sediment and nutrient inputs, and ultimately marsh degradation and loss (Swenson and Turner 1987, Kuhn et al.

1999). The containment dikes constructed for the BA-42 project will be breached to allow hydrologic exchange. These breaches should be strategically located to allow flow from the West Pointe a la Hache siphons to pass through the marsh creation areas. Nutrients and sediment from the siphon flow should nourish the marsh over time and allow it to keep pace with relative sea level rise (Lane et al. 2006).

It is important to quickly establish vegetation on the project features to stabilize the sediment and prevent its loss to erosive processes. The rate that marsh vegetation naturally colonizes bare sediment is partly dependent on substrate characteristics and the availability of recruits (Broome et al. 1988). The borrow material that will be used for the marsh creation and shoreline berm portions of the BA-42 project is predominantly medium and fine sand. Such material typically does not have the nutrient concentrations necessary for rapid plant establishment (Broome et al. 1988, Streever 2000). Under these circumstances, plantings can greatly accelerate vegetative establishment and development. While plantings have been proposed for the shoreline berm, they should also be considered for the created marsh platforms, particularly along the edges that border open water. These edges do not abut existing marsh vegetation and therefore would not have an immediate source of propagules (seeds or plant fragments) to colonize the created marsh.

The terraces, on the other hand, will be constructed of fine-grained sediment, and consequently natural vegetative establishment should occur at a faster rate. In fact, the rapid colonization observed during previous terracing projects suggests that an intensive planting scheme may be unnecessary (Thibodeaux and Guidry 2004). Limited plantings, though, will still be useful for protecting the terrace side-slopes from erosion prior to natural recruitment. Although the BA-42 terrace field will not be exposed to much fetch/wave action, boat wakes and tidal currents coming from the adjacent Jefferson Canal could damage the outer terraces if left unprotected.

The project's shoreline berm has the potential to significantly reduce, but not stop, shoreline erosion. The berm will be exposed to wave action propagated across 1 to 1.5 miles of fetch in the direction of the prevailing south and southwest winds. Under these conditions, the nonstructural approach of sand fill followed by plantings may be insufficient to fully control erosion (Burke et al. 2005, Burke and Hardaway 2007). However, the berm's effectiveness can be improved by ensuring a gentle lakeside slope and facilitating vegetation establishment. A gentle slope (1:50 or less) will provide a greater amount of shallow nearshore water to dissipate incoming waves. It will also provide a wider intertidal area for marsh vegetation, which when established can dissipate wave energy roughly proportionate to the width of the created marsh (Burke and Hardaway 2007). Prior to becoming established, however, marsh plantings are vulnerable to extreme wave action (Knutson et al. 1981). Therefore, the berm plantings should be given ample time to take root before they are exposed to high wind/wave action (e.g. during winter cold front passage).

In addition to reducing shoreline erosion, the berm will have a number of other ecological benefits. For example, the berm will re-establish the lake rim function of protecting vulnerable interior marsh from erosive tidal flow by effectively closing breaches in the shoreline. The berm will also replace the vertical, eroded shoreline with a gently-sloping shoreline, which is a more productive habitat for fishery species such as brown and white shrimp (LaPeyre and Birdsong 2008). Furthermore, the berm, when vegetated, will provide a variety of intertidal and supratidal habitats that will attract a corresponding diversity of birds. Although this non-structural shoreline restoration alternative clearly has many advantages, it has rarely been implemented. The BA-42 project, therefore, will provide an opportunity to evaluate this approach in coastal Louisiana.

VII. Recommendations

Based on the evaluation of available ecological, geological, and engineering information, and a review of scientific literature and similar restoration projects, the proposed strategies of the Lake Hermitage Marsh Creation project will likely achieve the desired ecological goals. At this time, it is recommended that this project be considered for Phase 2 authorization. However, the following recommendations should improve project success:

- Consider plantings around perimeter of the marsh creation areas.
- A planting scheme needs to be developed that will allow plantings sufficient time to become established prior to periods of high wave action. This scheme could apply to both the shoreline berm and terraces.

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Appendix 1. Previously constructed marsh creation projects (sorted by construction date).

Project Name	Program	Project Number	Coast 2050 Region	Year Constructed	Marsh Area* (acres)	Dredged Material (cubic yards)	Fill Elevation (feet)	Vegetation Planted
Queen Bess	State	BA-05b	2	1990	8	152,000	+2 to +3 NGVD29	*Avicennia germinans*
Bayou LaBranche Wetland Creation	CWPPRA	PO-17	1	1994	305	2,700,000	+2.44 ± 0.19 NAVD 88	Aerially-seeded with *Echinocloa crusgali* var. *frumentacea*
Barataria Bay Waterway Wetland Restoration	CWPPRA	BA-19	2	1996	9		+3.72 NGVD29	
Atchafalaya Sediment Delivery	CWPPRA	AT-02	3	1998	230	720,000	+1 to +3 NGVD29	
West Belle Pass Headland Restoration	CWPPRA	TE-23	3	1998	184	2,700,000	+2.0 NAVD 88	
Big Island Sediment Mining	CWPPRA	AT-03	3	1998	850	3,400,000	+1.5 to 3.0 NGVD29	
Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island	CWPPRA	TE-26	3	1999	260	850,000	+1.5 NGVD29	*Spartina alterniflora*
Barataria Bay Waterway, Mile 31 to 24.5	WRDA	NA	2	1999				
Brown Lake	WRDA	NA	4	1999	315	1,600,000		
MRGO, Mile 14 to 11	WRDA	NA	1	1999		3,500,000		
Dedicated Dredging Program - Lake Salvador	State	LA-01a	2	1999	26	114,089		
Calcasieu River & Pass Phase I-III	WRDA	NA	4	1992, 1996, 1999		4,000,000		
Barataria Bay Waterway, Grand Terre Island (Phase I and II)	WRDA	NA	2	1996, 1999		500,000		*Spartina alterniflora* and *Avicennia germinans* planted during CWPPRA project BA-28

Appendix 1 (continued). **Previously constructed marsh creation projects (sorted by construction date).**

Project Name	Program	Project Number	Coast 2050 Region	Year Constructed	Marsh Area* (acres)	Dredged Material (cubic yards)	Fill Elevation (feet)	Vegetation Planted
Dedicated Dredging Program - Bayou Dupont	State	LA-01b	2	2000	60	448,725		
Sabine Refuge Marsh Creation, Cycles 1-3	CWPPRA	CS-28	4	2002 - Cycle 1 2007 - Cycle 3	214 232	1,000,000 828,767	+3.08 NAVD 88 +2.03 to 2.71	*Spartina alterniflora*
MRGO, Mile 14 to 12 (2002)	WRDA	NA	1	2002		1,600,000		
Dustpan Maintenance Dredging Operations for Marsh Creation in the Mississippi River Delta Demonstration	CWPPRA	MR-10	2	2002	40	222,000		
MRGO, Mile 14 to 12 (2003)	WRDA	NA	1	2003		4,300,000		
Dedicated Dredging Program - Pass a Loutre	State	LA-01c	2	2005	26			
Dedicated Dredging Program - Terrebonne Parish School Board	State	LA-01d	3	2006	40			
Little Lake Shoreline Protection/Dedicated Dredging near Round Lake	CWPPRA	BA-37	2	2007	551	2,500,000	+2.1 NAVD 88	*Spartina alterniflora*
Dedicated Dredging Program - Grand Bayou Blue	State	LA-01e	3	2007	38			
Dedicated Dredging Program - Point Au Fer	State	LA-01f	3	2007	67			

Appendix 2. Previously constructed terracing projects (sorted by construction date).

Project Name	Program	Project Number	Coast 2050 Region	Year Constructed	Number of Terraces	Total Terrace Length (linear ft)	Length of Each Terrace (ft)	Top Width (ft)	Elevation (ft NAVD 88)	Side Slopes (ft)	Vegetation Planted
Sabine Terraces	State	CS-ST	4	1990	128	26,000	180	2			*Spartina alterniflora*
Little Vermillion Bay Sediment Trapping	CWPPRA	TV-12	3	1999	23	21,300	500-2000	23 - 27	+4.6		*Spartina alterniflora*
Plowed Terraces Demonstration	CWPPRA	CS-25	4	1999	38	54,000	500	3			*Spartina alterniflora*
Sweet Lake/Willow Lake Hydrologic Restoration	CWPPRA	CS-11b	4	2002	31	76,444					*Schoenoplectus californicus*
GIWW - Perry Ridge West Bank Stabilization	CWPPRA	CS-30	4	2002	40	22,952	200-800	4	+2.5	3:1	*Schoenoplectus californicus*
Pecan Island Terracing	CWPPRA	ME-14	4	2003	344	196,800	500	10	+3.75	4:1	*Spartina alterniflora* *Schoenoplectus californicus*
Four Mile Canal Terracing and Sediment Trapping	CWPPRA	TV-18	3	2004	90	66,600		15 - 20	+5.0	4:1	*Spartina alterniflora*
Grand-White Lakes Landbridge Protection	CWPPRA	ME-19	4	2004	92	19,544	200	8 - 10	+3.0	3:1 or 6:1	*Paspalum vaginatum* *Echinochloa esculenta* *Urochloa ramosa* *Zizaniopis miliacea*
Sediment Trapping at "The Jaws"	CWPPRA	TV-15	3	2004		40,100		6	+4.0		*Schoenoplectus californicus* *Zizaniopsis miliacea*
East Sabine Lake Hydrologic Restoration	CWPPRA	CS-32	4	2005	125	171,000	980	15	+1.3		*Spartina alterniflora*
Delta Management at Fort St. Philip	CWPPRA	BS-11	2	2006	164	32,800	200	10	+3.5	6:1	*Paspalum vaginatum* *Spartina alterniflora*
Freshwater Introduction South of Highway 82	CWPPRA	ME-16	4	2006	26	26,000	100	10	+2.5	4:1	*Spartina alterniflora*