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

Dedicated Dredging on the Barataria Basin Landbridge
CWPPRA Priority Project List 11
State No. BA-36

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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 August 12, 2004.

ECOLOGICAL REVIEW
Dedicated Dredging on the Barataria Basin Landbridge

In August 2000, the Louisiana Department of Natural Resources 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 Dedicated Dredging on the Barataria Basin Landbridge project is located in the southern portion of Bayou Rigolettes and Bayou Perot (Figure 1), in Jefferson Parish, Louisiana. The project area consists primarily of intermediate marsh and open water habitat (Chabreck and Linscombe 1997).

The Dedicated Dredging on the Barataria Basin Landbridge project, in conjunction with the Barataria Basin Landbridge Shoreline Protection project, is intended to stabilize a critical landmass which runs southwest/northeast across the basin. The landmass hereafter referred to as the landbridge (Figure 1), has historically separated the freshwater dominated system of the upper basin from the marine and tidally dominated system of the lower basin. Bayou Perot and Bayou Rigolettes are the primary waterways connecting Lake Salvador in the upper Barataria Basin with the Little Lake system in the lower Barataria Basin. These two bayous, divided by a long peninsula of marsh, were historically narrow meandering water bodies typical of riverine flows (Reed 1995). With the closing of Bayou Lafourche and the leveeing of the Mississippi River, the basin shifted from a river dominated to a tidally dominated system. Subsequently, the shores of the two bayous have eroded. This erosion was accelerated as the shoreline retreated into a complex of oil field canals (Reed 1995). Today, the hydrologic connections between the upper basin and the lower basin are much greater due to the dredging of waterways and the enlargement of both Bayou Perot and Bayou Rigolettes.

Marsh loss in the Barataria Basin landbridge is occurring from the erosion of the shorelines of Bayou Perot and Bayou Rigolettes, and from interior marsh loss caused by high subsidence (0.3-0.35 inches/year) (National Research Council 1987; Penland and Ramsey 1990). This interior marsh loss will be addressed by the Dedicated Dredging on the Barataria Basin Landbridge project, described herein, co-sponsored by the United States Fish and Wildlife Service (USFWS) and the Louisiana Department of Natural Resources (LDNR), which proposes to create and nourish marshes using dredged material in the southern portion of Bayou Rigolettes. The project is anticipated to create 1,245 acres of marsh and reduce the land loss rate of 2.0% per year by 50% (Roy 2001). The high rate of shoreline erosion will be addressed through the construction of the Barataria Basin Landbridge Shoreline Protection Project, sponsored by the Natural Resources Conservation Service (NRCS) (NRCS 2000).

Dedicated dredging to create marsh on the landbridge was proposed to maintain the hydrologic and ecological integrity of the Barataria Basin. *Coast 2050* identified dedicated dredging to create marsh on the landbridge as a regional ecosystem strategy which would

stabilize the landbridge and protect the freshwater marshes of the upper basin (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1998).

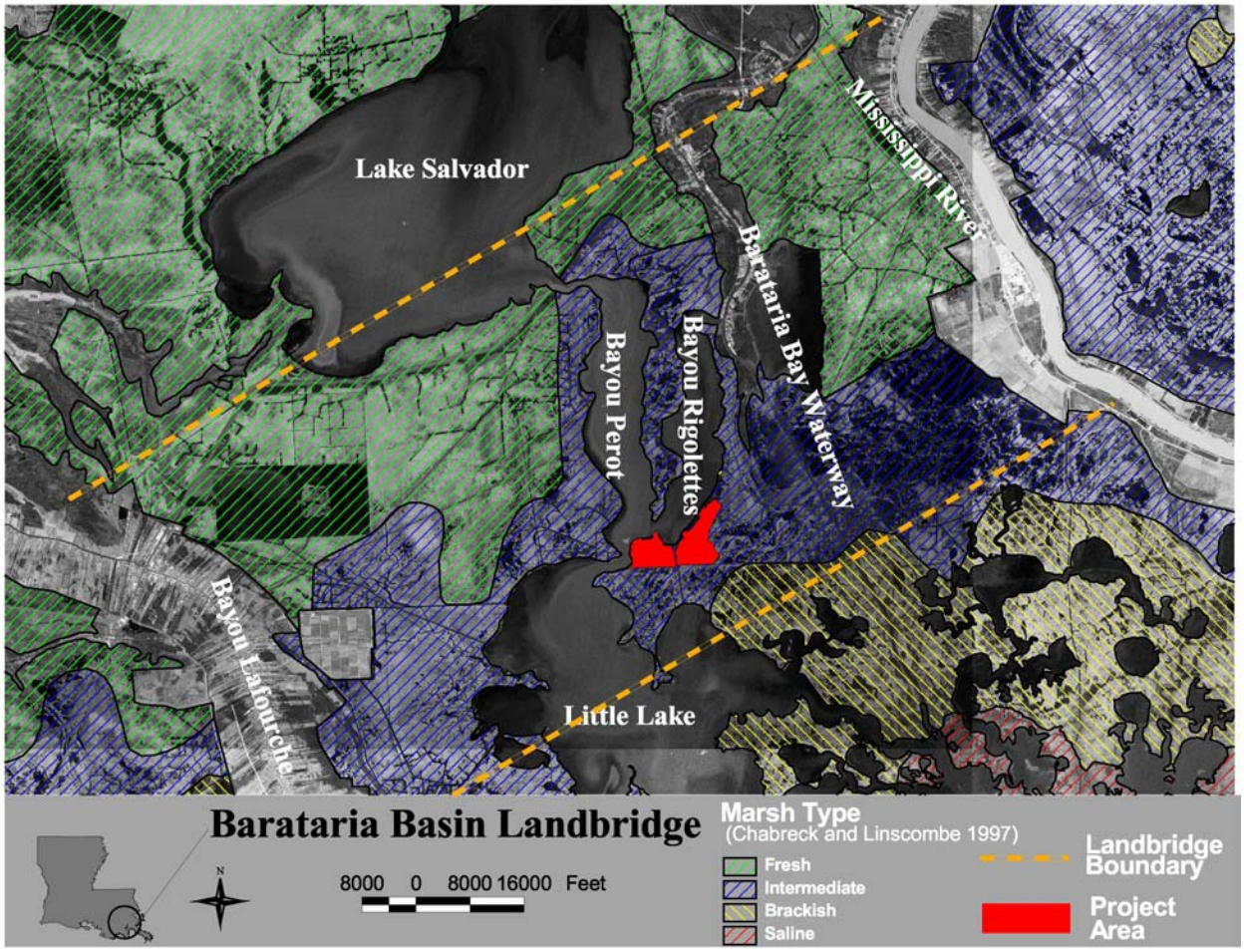

Figure 1: Barataria Basin Landbridge.

II. Goal Statement

- Create 1,245 acres of intertidal habitat suitable for marsh establishment at construction.
- Of the original 1,245 acres created, maintain 996 acres of emergent marsh at the end of the 20 year project life.

III. Strategy Statement

The creation of 1,245 acres of intermediate marsh will be achieved through the confined placement of dredged material at an average elevation of +2.5 feet NAVD-88.

IV. Strategy-Goal Relationship

The placement of dredged material, and subsequent establishment of vegetation in open water areas of the project, will result in the direct creation of marsh habitat at an initial elevation of +2.5 feet NAVD-88; this will subside to an elevation of +1.2 feet NAVD-88 by year 5 post-

construction. The strategy is expected to maintain a minimum of 996 acres of emergent marsh by the end of the 20 year project life, by reducing the land loss rate of 2.0% per year by 50% (Roy 2001).

V. Project Feature Evaluation

The material dredged from Bayou Perot and Bayou Rigolettes will be placed on 1,245 acres, divided into two areas, site 1 and site 2. Site 1 is 504 acres and is bounded by Harvey Cutoff to its east, a spoil bank to its south, and Bayou Perot to its north and west. Site 2 is 741 acres and is bounded by Bayou Rigolettes to the north, by Harvey Cutoff to the west, by a spoil bank to the south, and by broken intermediate marsh to the east (Figure 2).

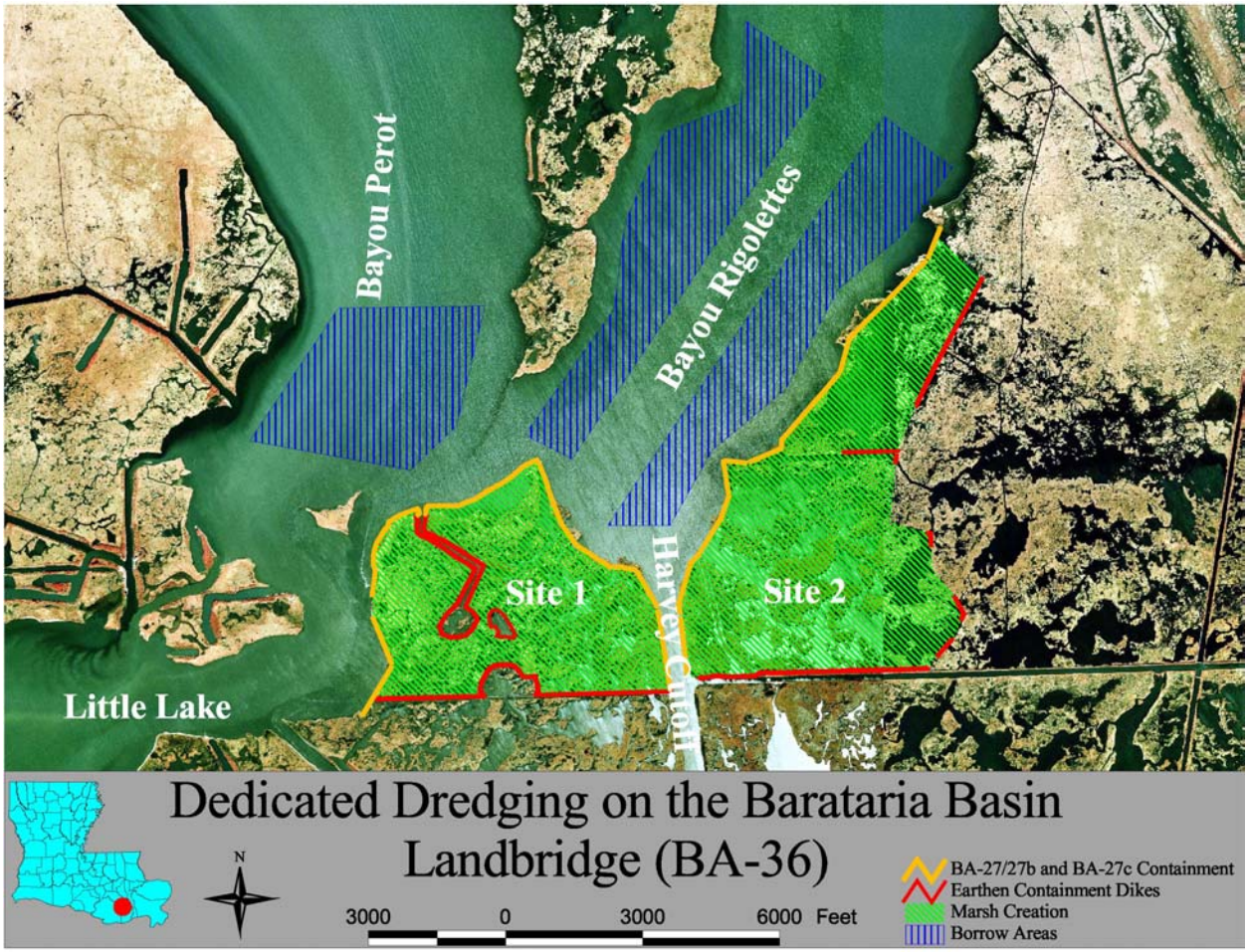

Figure 2: Dedicated Dredging on the Barataria Basin Landbridge.

Borrow Area

Soil types from the sediment surface to -20 feet in the Bayou Perot/Bayou Rigolettes borrow areas are classified as very soft peat/organic clay, and very soft clay (Soil Testing Engineers, Inc. 2003). The dredged material will be excavated and pumped into the project area using hydraulic methods.

Containment Structures

A combination of structures will be used as containment for the dredged material. Along the shorelines of Bayou Perot, Bayou Rigolettes, and Harvey Cutoff, the structures (foreshore rock dike and concrete panel wall) that will be constructed by NRCS under the Barataria Basin Landbridge Shoreline Protection project (BA-27/BA-27b and BA-27c) will serve as containment for the dredged material (Figure 3). The structures are designed with an elevation of +3.5 feet NAVD-88. The organism access openings of the future NRCS structures will be temporarily blocked with internal earthen training dikes built to an elevation of +2.5 feet NAVD-88 with side slopes of 4(H):1(V) using *in situ* material, to retain the material during construction (Figure 3).

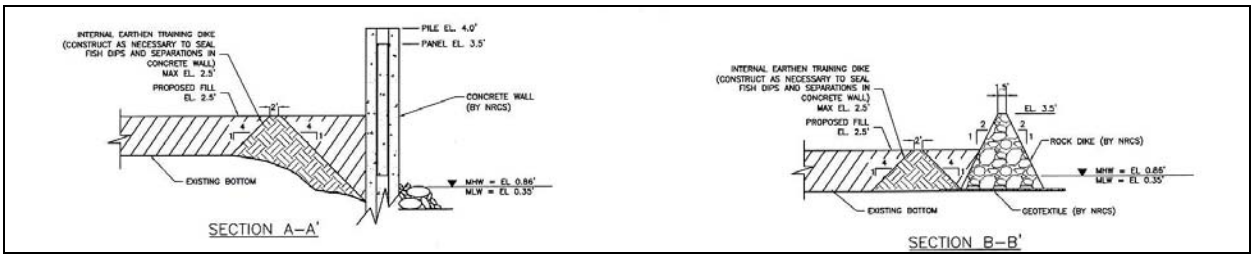

Figure 3: Detail of earthen training dike and NRCS containment structures (LDNR 2004).

Along the remaining boundary of the project, a total of 28,326 linear feet of earthen containment dikes will be built to an elevation of +4.0 feet NAVD-88 with side slopes of 4(H):1(V) using *in situ* material, to contain the dredged material (Figures 2 and 4). In order to keep the material as consolidated as possible it will be excavated and placed by bucket dredge.

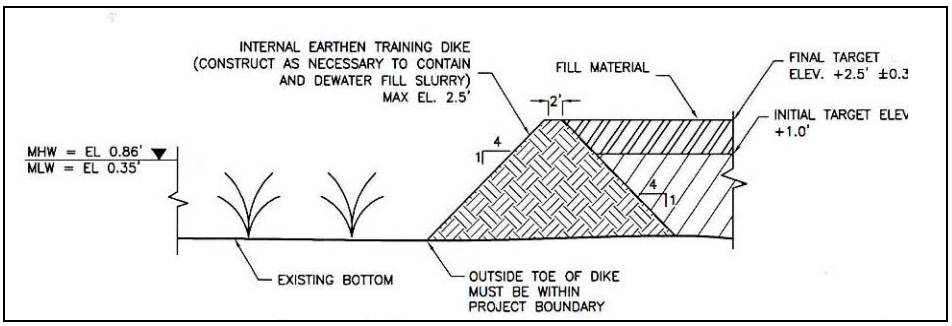

Figure 4: Details of earthen containment dike (LDNR 2004).

The analysis of 13 soil borings taken in site 1 indicate that the soils are composed of a two foot layer of very soft peat, underlain with eight feet of very soft organic clay and ten feet of very soft clay. The soils in site 2, as indicated by 12 borings taken in the area, are composed of very soft peat to a depth of one foot, underlain by very soft organic clay to a depth of fifteen feet, and very soft clay and silty clay to a depth of thirty-eight feet (Soil Testing Engineers, Inc. 2003). The results of the geotechnical investigation estimate an anticipated levee settlement of 0.8-2.6 feet during the 20 year project life, and established a minimum acceptable safety factor of 1.3-1.5 for slope stability (Soil Testing Engineers, Inc. 2003). The accepted measure of a slope's stability is its safety factor which is the ratio of the forces or moments tending to prevent failure (soil strength, primarily) to those that cause failure (soil and surcharge weights plus seepage forces, primarily). A side slope safety factor of 1.2-2.0 with 1 foot of freeboard, and 0.9-1.5 with 2 feet of freeboard was found for the soil conditions found within the project area. The results of

the geotechnical investigation indicate that the 2 feet of freeboard design has less safety factors than desirable, necessitating the use of reinforcing geotextile with an allowable tensile strength of at least 980 pounds per linear foot (measured perpendicular from the levee centerline) (Soil Testing Engineers, Inc. 2003).

Marsh Creation

The average elevation range for existing unbroken marsh in the project area is +1.0 to +1.1 feet NAVD-88 (SJB Group, Inc. 2003), though the target elevation for healthy marsh is higher (+1.4 feet NAVD-88) (Kevin Roy, USFWS, Personal Communications, July 7, 2004). Mean low water is +0.35 feet NAVD-88, and mean high water is +0.86 feet NAVD-88. Material dredged from the borrow areas will be used to fill approximately 1,245 acres of open water and broken marsh to an elevation of +2.5 feet NAVD-88. The placement of the dredged material will be accomplished in two lifts to accommodate for initial dewatering. During the first lift the material will be placed at an elevation of +1.0 feet NAVD-88 and allowed to dewater. During the second lift the dredged material will be placed to an elevation of +2.5 feet NAVD-88. The created marsh platforms will initially be above mean marsh elevation. However, this elevation will decrease over time because of subsidence, as well as volume loss brought on by settlement, shrinkage, and dewatering of the dredged material. According to the geotechnical investigation (Soil Testing Engineers, Inc. 2003), it is expected that these factors will lead to the created marsh reaching existing healthy marsh elevations (+1.4 feet NAVD-88) between year 3 and year 4 of the project life (Figure 5). The project design had initially included placement of the dredged material at an elevation of +3.0 feet NAVD-88, however the design was modified because of the higher cost involved and because the results of the geotechnical investigation revealed no significant long term benefit to placing the material at a higher elevation (Figure 5).

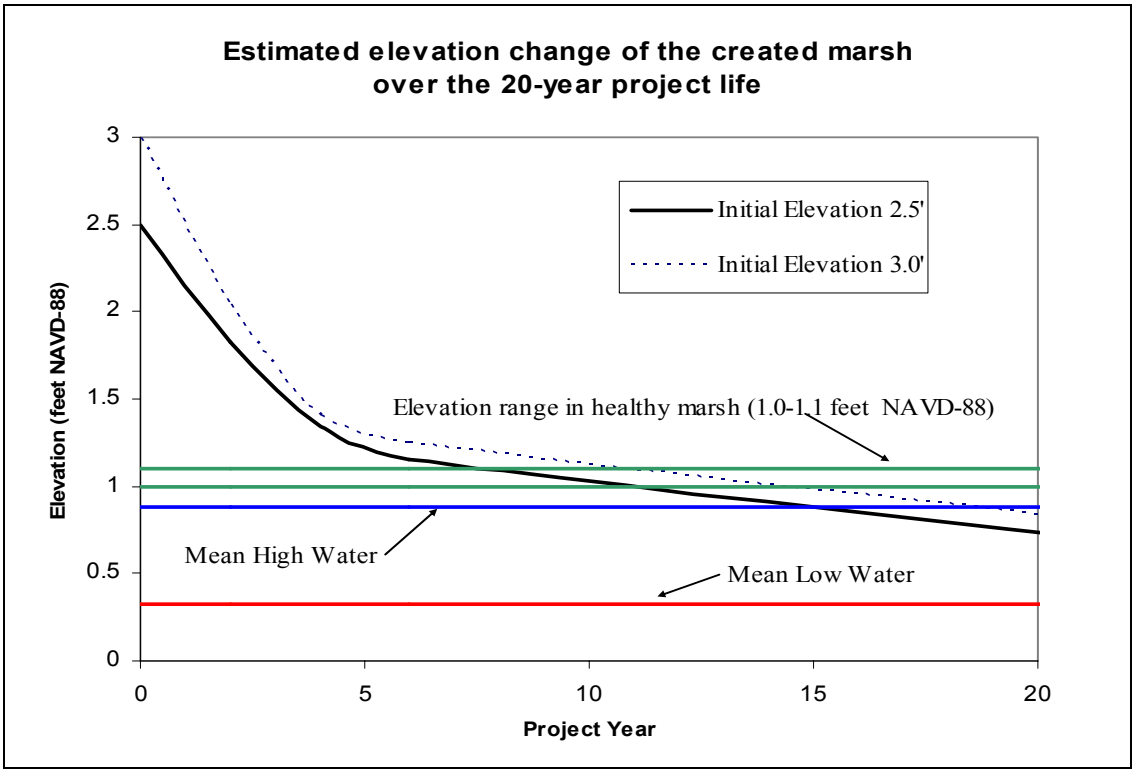

Figure 5: Estimated elevation change of the created marsh over the 20-year project life.

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.

Marsh creation through the use of dredged material has been practiced in the U.S. for decades. Despite years of experience with this technique, there is still ongoing debate in the scientific literature on the "success" of the created marsh, and whether created marshes are functionally equivalent to natural marshes (Streever 2000; Moy and Levin 1991). Research conducted in Galveston Bay, Texas comparing natural and created *Spartina alterniflora* marshes indicates that there are significant differences in physical parameters such as marsh-water edge ratios, area perimeter ratio, marsh edge angle of exposure and elevation (Delaney et al. 2000). Another study conducted in Galveston Bay indicates that densities of both fishes and decapod crustaceans are also lower in created marsh 3-15 years in age (Minello and Webb 1997). In a study conducted in a tidal marsh in Virginia, a 12 year old constructed marsh showed significant differences in habitat function in 3 areas: sediment organic carbon at depth, saltbush density, and bird utilization (Havens et al. 2002).

However, some research indicates that as marshes age, they progress to a general level of habitat function similar to that of natural marshes. A study conducted in North Carolina suggests that after 20-25 years constructed marshes are similar to natural marshes in vegetation productivity, benthic infaunal density and organic carbon accumulation, but that soil nutrient reservoirs are lower in constructed *Spartina* marshes (Craft et al. 1999).

In addition to the United States Army Corps of Engineers' dredged material beneficial use program (U.S. Army Corps of Engineers 1995), and the Louisiana Department of Natural Resources Dedicated Dredging program (LA-01; LDNR 2000), several marsh creation projects have been constructed in coastal Louisiana with Breaux Act funding.

- The Bayou Labranche Wetland Creation (PO-17) project was designed to create approximately 305 acres of marsh at a ratio of 70% emergent marsh to 30% open water in 5 years. The target elevation for the created marsh was estimated at +0.65 to +1.62 feet NAVD-88. The target elevation was generally met during construction; however, most of the project area was constructed at an elevation in the upper range, which was not a suitable elevation for the establishment of marsh. In addition, one of the water control structures had been tampered with, which affected the dewatering of the dredged material. It is expected that with time the constructed marsh will achieve the desired marsh-water ratio and that as the sediments continue to consolidate, the present upland vegetation will be supplanted by more wetland species (Troutman 1998). The results of vegetation surveys conducted in 1996, 1997, 1998, 2001, and 2002 indicate that the dominant vegetation in the project area is in fact changing from upland to wetland types (Boshart 2003).

- The Barataria Bay Waterway Wetland Restoration (BA-19) project was intended to create 9 acres of vegetated wetlands and increase the marsh surface elevation on Queen Bess Island through the deposition of dredged material. The target marsh

surface elevation in the design of the project was +1.22 feet NGVD-29. Three years post construction, the average surface elevation in the project area was +0.79 feet NGVD-29, well below the target elevation, and no appreciable vegetation growth had occurred (Curole 2001).

- The Lake Chapeau Sediment Input and Hydrologic Restoration, Point Au Fer Island (TE-26) project was designed for an elevation at construction of +1.5 feet NGVD-29. This would result in a final elevation of +0.5 feet NGVD-29 after dewatering and consolidation, which is the average marsh elevation as determined by cross section surveys of the fill area. The dredged material was planted with *S. alterniflora* plugs, though some natural recruitment of *S. alterniflora* and *S. patens* had already occurred. Some areas in the project area were filled below the target elevation, and there were construction problems with containment levees and the dredge discharge pipeline corridor. The project was originally intended to create 260 acres of marsh; however, the dredged material was deposited on only 168 acres at construction (Raynie and Visser 2002).

Summary/Conclusions

In view of the shrinkage, settlement and subsidence rates, the created marsh design initially included placement of the dredged material at an elevation of +3.0 feet NAVD-88. However, the design was modified because of the higher cost involved and because there was no significant long term benefit to placing the material at a higher elevation (Figure 5). As currently designed, and according to the geotechnical investigation (Soil Testing Engineers, Inc. 2003), it is expected that the created marsh will reach healthy marsh elevations (+1.4 feet NAVD-88) between year 3 and year 4 of the project life (Figure 5), and will continue to subside over time. The marsh platform is expected to remain above the intertidal range until approximately year fifteen, and remain intertidal for the remainder of the 20 year project life.

A review of the results from the restoration projects referenced above demonstrates the importance of identifying the optimal dredge material elevation for the establishment of marsh vegetation, and the importance in achieving that targeted elevation. By using the results of the geotechnical investigation to predict the settlement of the dredged material, by using the results of the survey conducted by SJB Group, Inc. (2003) to identify existing healthy marsh elevation, and by phasing the construction in two lifts, the LDNR project team feels that the placement of dredged material, and subsequent establishment of vegetation will likely achieve the project goals.

The earthen containment dike is expected to degrade to marsh elevation, thereby eliminating the need for it to be manually breached. However, if this does not occur naturally, breaks will be made so that the created marsh does not become impounded. Breaks in the containment dikes will promote a more natural hydrologic flow within the project area, thereby allowing movement of organisms to and from the marsh, and allowing for sediment and nutrient transport (Shafer and Streever 2000).

VII. Recommendations

Based on the investigation of similar restoration projects and a review of engineering principles, the LDNR project team feels that the proposed strategies of the Dedicated Dredging on the Barataria Basin Landbridge project will likely achieve the desired ecological goals for the majority of the 20 year project life. At this time, the Louisiana Department of Natural Resources, Coastal Restoration Division recommends that the Dedicated Dredging on the Barataria Basin Landbridge project be considered for CWPPRA Phase 2 authorization.

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