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

Goose Point/Point Platte Marsh Creation
CWPPRA Priority Project List 13
State No. PO-33

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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 22, 2006.

ECOLOGICAL REVIEW

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 Goose Point/Point Platte Marsh Creation (PO-33) project is located along the northern rim of Lake Pontchartrain near Big Branch National Wildlife Refuge (Figure 1). In 2000, the project area consisted of 715 acres of brackish marsh and 669 acres of open water for a total of 1,384 acres (Segura 2003). This area has experienced substantial loss of emergent wetlands largely due to hydrologic alterations as a result of the construction of Lake Road and two large pipeline canals, which have allowed saltwater to penetrate into the interior marsh areas. Marsh loss rates were highest from 1956 to 1978 and estimated at 31.3 acres/year and 10.42 acres/year, respectively for Goose Point and Point Platte (McCarty 2001). More recent loss rates for the areas (1978 to 1995) were estimated to be 6.42 acres/year and 5.54 acres/year respectively (McCarty 2001).

Shoreline erosion rates in the area are relatively low but only a narrow strip of land separates the interior ponds from Lake Pontchartrain. Conner *et al.,* 2004, reports shoreline loss in the area to range from 0 to 10 feet per year. The objectives of this project are to recreate marsh in open water ponds, to nourish existing marsh areas surrounding those ponds, and to prevent breaching of the lake rim shoreline. If breaching were to occur, higher energy waves and tidal functions would accelerate loss rates of the interior marsh (Simoneaux 2006). Coast 2050 has identified the dedicated delivery of sediment for marsh building as a Region 1 ecosystem strategy that is projected to create a moderate amount of marsh (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation Restoration Authority 1999).

II. Goal Statement

- Create 417 acres of intertidal habitat suitable for marsh establishment at construction.
- Nourish 149 acres of existing emergent marsh.

III. Strategy Statement

- Approximately 2,078,280 cubic yards of material will be hydraulically dredged from Lake Pontchartrain and placed in open water areas to create a total of 417 acres of emergent marsh in the Goose Point and Point Platte project areas. After compaction, settlement, and dewatering, the marsh platform is anticipated to reach an elevation of +1.08 feet NAVD-88 approximately three years post-construction and remain above the mean low water elevation of +0.48 feet NAVD-88 for the remainder of the 20-year project life (Simoneaux 2006). Created marsh areas will be planted with *Spartina alterniflora* one growing season after settlement and dewatering for the purpose of stabilizing the marsh platforms.

- Marsh nourishment will be achieved through the placement of approximately 214,547 cubic yards of material on 149 acres of existing marsh to an elevation of +1.5 feet NAVD-88.

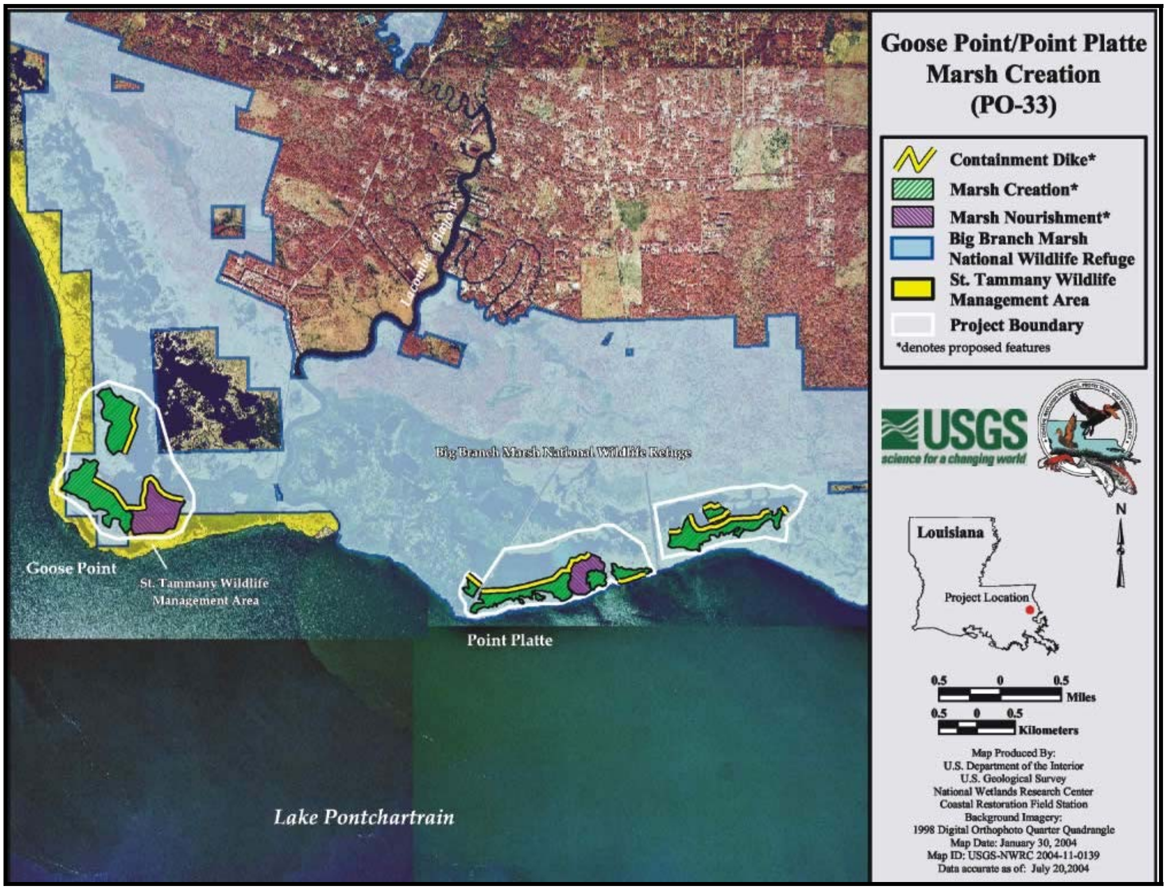

Figure 1. Goose Point/Point Platte Marsh Creation project area.

IV. Strategy-Goal Relationship

The placement of dredge material and subsequent vegetation planting will result in the direct creation of marsh habitat at an elevation of +2.5 feet NAVD-88, which will settle to an elevation of +1.08 feet NAVD-88 by year 3. The creation of marsh habitat in previously open water areas will reduce ponding, attenuate wind-induced wave erosion, and prevent breaching of the lake rim shoreline. Adding dredged material on top of existing marshes would nourish those low-lying marshes by raising their elevation to heights more commensurate with healthy marsh vegetation propagation.

V. Project Feature Evaluation

Hydraulically dredged material from Lake Pontchartrain will be placed in open water ponds and over low-lying adjacent marsh within the Goose Point and Point Platte project areas. The Goose Point area will receive 968,737 cubic yards of material to create 189 acres of emergent marsh and 124,720 cubic yards of material to nourish 100 acres of existing marsh. The Point Platte area will receive 1,109,543 cubic yards of material to create 228 acres of emergent marsh and 89,827 cubic yards of material to nourish of 49 acres of existing marsh in the area.

Material utilized for marsh creation will be pumped to an elevation of +2.5 feet NAVD-88 and is projected to settle to an elevation of +1.08 feet NAVD-88 by year 3, and anticipated to maintain that elevation throughout the duration of the 20-year project life (Simoneaux 2006). The initial fill elevation for marsh nourishment was designed in order to minimize negative impacts to the marsh from the placement of an excessive amount of material. The material used for nourishment will be stacked no higher than +1.5 feet NAVD-88 and is anticipated to follow a similar settlement curve as the constructed marsh platform and should remain in the intertidal range for the duration of the project life.

Soil Testing Engineers (STE), Inc. (2006) recommended that the containment dikes be built with a crown elevation of +3.5 feet NAVD-88, a 5.0 foot crown width, and 1(V):3(H) side slopes. The designed elevation would allow for 1.0 feet of freeboard above the constructed marsh platform elevation. The newly created marsh should maintain natural hydrologic conditions since the majority of the fill cells are uncontained (no containment dikes) or semi-contained (containment dikes on one side of the fill cell), although additional O&M funds could be used to degrade or gap the containment dikes where needed. Libersat and Simoneaux (LDNR, Personal Communications, June 13, 2006) suggested per the request of the landowner, that the dikes remain at the constructed elevation and that additional operations and maintenance (O&M) funds be requested.

In areas of unconfined placement, the existing marsh vegetation will serve as natural containment along with several sand berms along the lakeshore rim that will prevent dredged material flows from entering Lake Pontchartrain. A "natural containment buffer" was incorporated into the marsh creation (150 feet) and marsh nourishment (50 feet) designs to minimize potential impacts to the natural containment as a result of material placement. The buffer ensures the contractor will cease pumping material and allow it to gradually grade down to existing marsh elevations at a minimum of 150 feet or 50 feet away from the natural containment depending on the designation of the pumping area (Simoneaux 2006).

Results of the settlement analyses for the PO-33 Project (Simoneaux 2006) were derived using a computer software package developed by the United States Army Corps of Engineers (USACE) called VSTRESS, which calculates one-dimensional settlement based on Boussinesq stress distributions. A total of eleven subsurface borings were obtained from the project area; six borings (borings 1, 2, 8, 9, 10, and 11) were obtained from Lake Pontchartrain and five borings were obtained from the interior ponds (Figure 2). The soil samples were tested in the laboratory for classification, strength, and compressibility. Borings 3, 4, 5, 6, and 7 (obtained from the interior ponds) were used in the marsh settlement calculations.

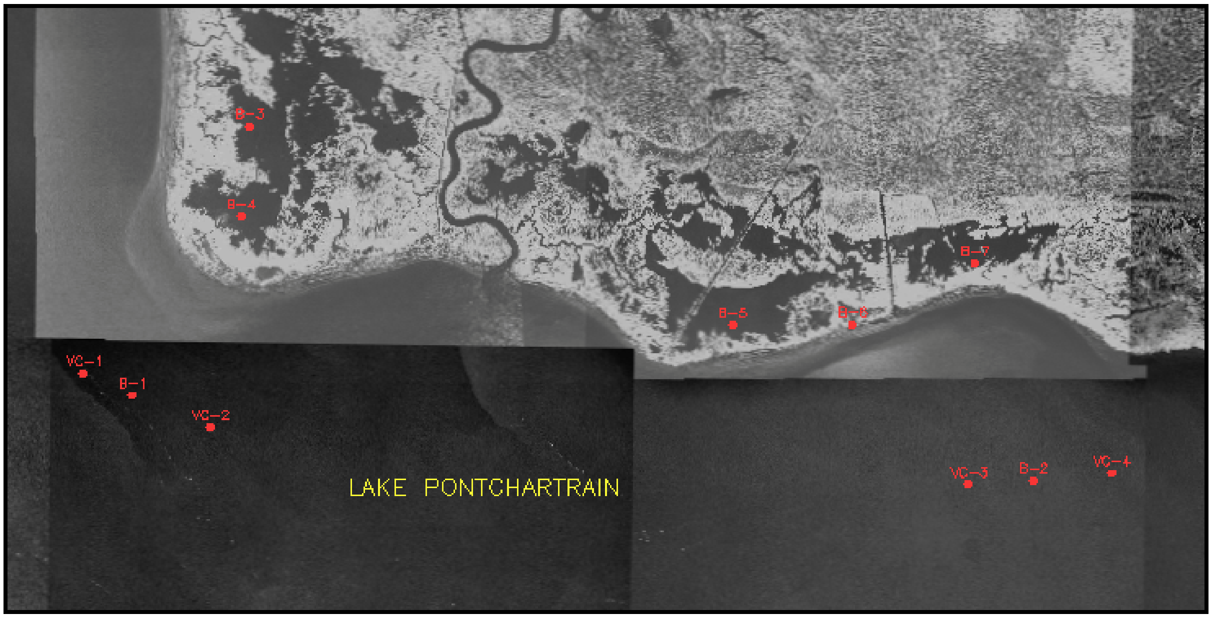

Figure 2. Locations of bores taken within the Goose Point/Point Platte project area and in Lake Pontchartrain (Simoneaux 2006).

Settlement calculations for the marsh fill were based on two components: (1) foundation settlement (within the deposition area) and (2) self-weight consolidation within the created marsh. Target marsh fill elevations of +2.0 feet NAVD-88 and +3.0 feet NAVD-88 were evaluated in the settlement analysis. The +2.0 feet NAVD-88 fill elevation would settle 1.23 feet to an elevation of +0.77 feet NAVD-88 while the +3.0 feet NAVD-88 fill elevation would settle 1.56 feet to an elevation of 1.44 feet NAVD-88. The analysis showed that most of the settlement of the foundation soils of the marsh fill area would occur within the first year after construction. Figure 3 summarizes the settlement values (foundation, self-weight consolidation, and total) for the various proposed fill elevations (Simoneaux 2006).

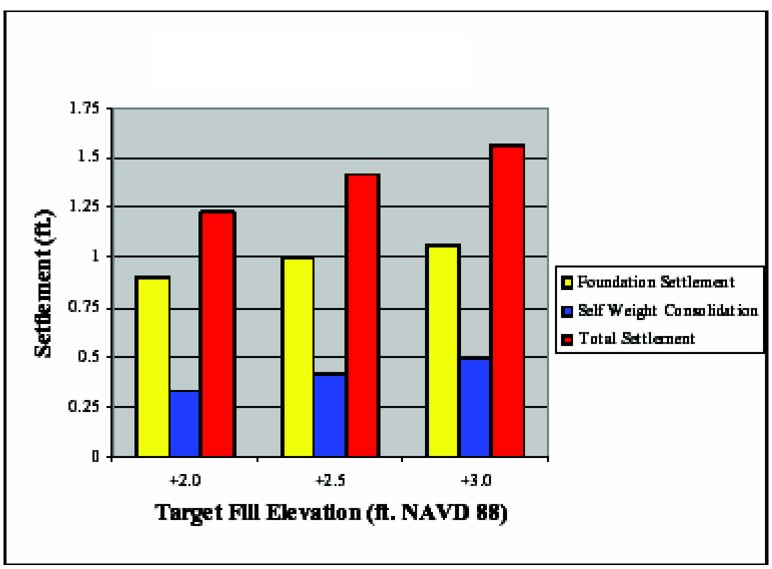

Figure 3. Summary of 20 Year Marsh Fill Settlement (Simoneaux 2006).

In order to estimate how much settlement will occur within the mass of marsh fill itself due to self-weight consolidation, LDNR tasked STE, Inc. to run additional settlement tests on the borrow area material (Simoneaux 2006). Using a composite sample of borings 1, 2, 8, 9, 10, and 11 taken in Lake Pontchartrain, the time-rate of settlement for this test was calculated for both the +2.0 feet NAVD-88 and +3.0 feet NAVD-88 fill elevations (Simoneaux 2006). The results showed that the self-weight consolidation of the borrow material would be approximately 3 inches for a +2.0 feet NAVD-88 fill elevation and approximately 5 inches for a +3.0 feet NAVD-88 fill elevation (Figures 4 and 5 [STE, Inc. 2006]).

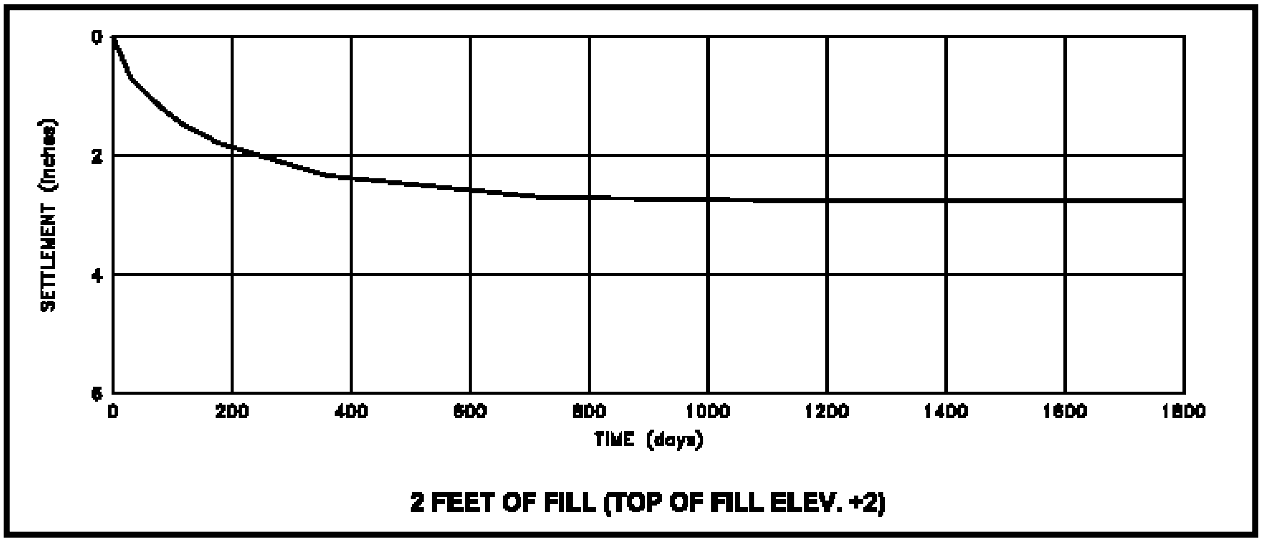

Figure 4. Self-weight settlement if a +2.0 feet NAVD-88 fill elevation is constructed (STE, Inc. 2006).

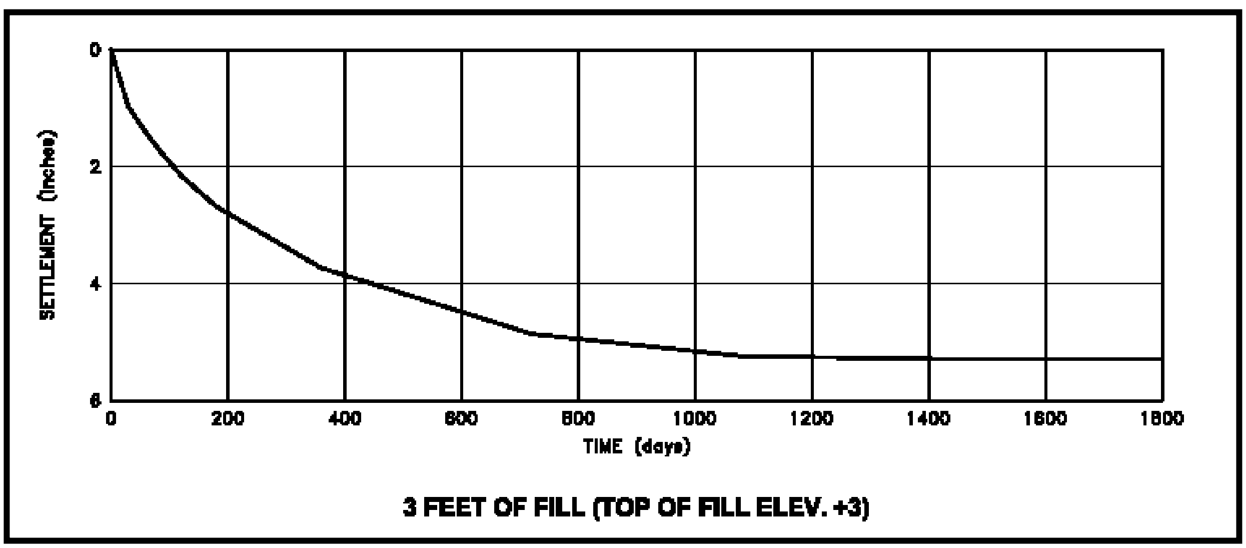

Figure 5. Self-weight settlement if a +3.0 feet NAVD-88 fill elevation is constructed (STE, Inc. 2006).

By interpolating between the settlement values for the 2 fill elevations, +2.0 and +3.0 feet NAVD-88, it was estimated that a fill elevation of +2.5 feet NAVD-88 would settle 1.42 feet to an elevation of +1.08 feet NAVD-88 which is close to the existing intertidal marsh elevation (0.96 – 1.0 feet NAVD-88) (C & C Technologies, Inc. 2005). Because the subsidence rates of the project area are relatively low, LDNR requested that STE not include subsidence in the settlement calculations. However, the design elevation algorithms were determined using boring 3, or the worst case scenario. This was to maximize the length of time the platform stays in the intertidal range, by providing a conservative target elevation for the constructed marsh platform (Rudy Simoneaux, LDNR, Personal Communications, July 5, 2006).

VI. Assessment of Goal Attainability

This section focuses on the likelihood that the proposed project features will provide the desired ecological response. It details the findings from a review of scientific literature and monitoring results of projects similar in scope to the Goose Point/Point Platte Marsh Creation project. Several constructed CWPPRA and state-funded marsh creation projects include the design and implementation of marsh platforms as means of restoring degraded marsh areas. These projects are discussed below.

- The Bayou La Branche Wetland Creation (PO-17) project encompasses 436 acres and is located in St. Charles Parish, near the southwestern shore of Lake Pontchartrain, east of the Bonnet Carré Spillway (Boshart 2004). A combination of events, dating back to the 1800's, had contributed to an almost complete loss of marsh in the area and subsequent conversion into open water (Pierce et al. 1985). Due to significant land loss, the project area prior to construction was mostly shallow, open-water habitat, and only a narrow band of marsh along the shoreline separated the project area from the lake (Boshart 2004). This project was the first constructed through the CWPPRA program with construction completed on April 1, 1994.

  Six temporary staff-gauges were installed post-construction and monitored from 1994-1995. Sediment elevation that was measured from the temporary staff gauges in October 1994 ranged from +1.33 to +2.80 feet NAVD-88. In June 1995, the sediment elevation ranged from +0.82 to +1.62 feet NAVD-88. The target range of sediment elevation for this project, after five years of consolidation, was estimated at +0.65 to +1.62 feet NAVD-88; as of August 2002, elevation at 11 of the 19 staff gauges was within this target range (Boshart 2004).

  The project has benefited the La Branche wetlands by creating marsh habitat in open water ponds in an area of critical need along the Lake Pontchartrain shoreline. As of 1997, the project area was approximately 82% land and 18% water, which was higher than the minimum goal of 70% marsh to 30% water (Boshart 2004). The consolidation of dredged material over time has reached an elevation than appears to sustain the 70% (land and marsh) component of the project area based on survey data collected in 2002 (Boshart 2004). In addition, the soil properties and the vegetation community of the project have continued to develop towards characteristic wetland habitat for the region (Boshart 2004).

- 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 was the average marsh elevation as determined by cross section surveys of the fill area. The dredged material was planted with *Spartina. 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).

Marsh creation through the use of dredged material has been practiced in the United States 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 *S. 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 three 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 USACE dredged material beneficial use program (USACE 1995), and the Louisiana Department of Natural Resources Dedicated Dredging program (LDNR 2000), several marsh creation projects have been constructed in coastal Louisiana with Breaux Act funding that should provide an opportunity to further study created marsh systems and better determine the success potential of the technique.

Marsh nourishment is a new restoration concept that has not been widely used in Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) funded projects. The concept behind marsh nourishment is that the increase in elevation provided by the addition of sediment would increase plant growth by improving the conditions within the growing environment. Interest in marsh nourishment as a coastal restoration technique began with studies evaluating the environmental effect of thin layer disposal of dredged material in marshes as an alternative to bucket dredging (Cahoon and Cowan 1988; Wilber 1993). These early studies concluded that dredged material disposed in thin layers in existing healthy marshes did not negatively impact healthy marshes, though they also did not provide any benefits. Immediately post-disposal there was some plant die-off; however, revegetation occurred within a few years. The model for marsh recovery varies according to the thickness of sediment placement and extent of soil modification, and will occur either through the new shoots from the surviving rhizomes, or through reseeding (Wilber 1993).

Several other studies have been conducted to determine the effects of sediment additions on marsh health. *S. alterniflora* transplanted in dieback areas of Caminada Bay, Louisiana at higher elevations had more than twice the above ground and belowground biomass (Wilsey et al 1992). Ford et al. (1999) found that increased elevation through the deposition of a one-inch layer of dredged material increased percent cover in a deteriorated *S. alterniflora* marsh in Louisiana three-fold. Another study conducted in a deteriorated *S. alterniflora* marsh near Venice, Louisiana evaluated the effect of varying thicknesses of sediment addition from minimal to more than twelve inches. Plant biomass was 30-50% greater in the areas that received the most addition (greater than 6 inches), and cover increased by 50% in the nourished areas, compared to the reference areas (Kuhn and Mendelssohn 1999). A study conducted in North Carolina evaluated the effect of the addition of a 0-4-inch layer of sediment to deteriorated and non-deteriorated *S. alterniflora* marshes. The study concluded that the non-deteriorated marshes did not benefit from the soil addition, but a two-fold increase in vascular plant stem density was observed in the deteriorated marsh (Leonard 2002). Although the correlation between increased stem density and total thickness of sediment added was not statistically significant, there was a strong positive relationship between the amounts of sediment received and stem density in the deteriorated sites.

<u>Summary/Conclusions</u>

In view of the shrinkage and settlement rates, the created marsh design includes placement of the dredged material at an elevation of +2.5 feet NAVD-88. As currently designed, and according to the geotechnical investigation (STE, Inc. 2006), it is expected that the created marsh will reach healthy marsh elevations (+1.08 feet NAVD-88) (C&C Technologies, Inc. 2005) between year 3 and year 4 of the project life and would maintain those elevations throughout the project life.

A review of the results from the restoration projects referenced above demonstrates the importance of identifying the optimal target elevations of the dredged material 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 and by using the results of the survey conducted by C&C Technologies, Inc. (2005) to identify existing healthy marsh elevation (+0.96 to +1.0 feet NAVD-88) the LDNR project team feels that the placement of dredged material, and subsequent establishment of vegetation will likely achieve the project goals.

Approximately 0.5 foot to 1.0 foot of dredged material will be placed over existing marsh areas for nourishment. The amount of dredged material that will be placed over existing marsh is consistent with the range of material placement attempts found in the literature cited. The marsh nourishment component as currently designed is likely to accomplish the stated goals.

At the request of the landowner, any earthen containment dikes that were constructed would be left in place (Rudy Simoneaux, LDNR, Personal Communications, June 13, 2006). Breaks in the containment dikes would promote a more natural hydrologic flow within the project area by allowing movement of organisms to and from the marsh, and allowing for sediment and nutrient transport (Shafer and Streever 2000). However, the United States Department of the Interior Fish and Wildlife Service feels the existing hydrologic openings via existing channels, trenasses, and canals would suffice.

Penland and Ramsey (1990) state that the historical rates of Relative Sea Level Rise (eustatic sea level rise + subsidence) in areas near our project are relatively low. They calculated a RSL rate of approximately 0.45 cm/year from 1908 – 1988 or approximately 9 cm of RSL over the 20-year project life. Since project feature designs were derived using the worst case soil conditions in a conservative approach to calculate target marsh platform elevation at construction, and historical subsidence rates of the project area are relatively low, it is not likely that the design would benefit significantly from the inclusion of subsidence rates. Even if subsidence rates were included, the designed marsh platform is anticipated to be intertidal for the entirety of the 20-year project life.

VII. Recommendations

Based on the evaluation of similar projects, a review of engineering principles, and an evaluation of the revised design report including comments received at the 30% Design Review meeting (held July 20, 2006), the LDNR project team feels that the conceptual design for the Goose Point/Point Platte Marsh Creation project would likely achieve the desired ecological goals for the majority of the 20-year project life and concurs that the current level of design warrants continued progress toward the Phase II funding request.

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