

## Restoration of the Barataria Basin Barrier Islands

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### Abstract

Barataria Bay is located on the coast of the Gulf of Mexico, immediately south of New Orleans, LA. The southern half of the basin consists of approximately 1,900km<sup>2</sup> of marshland and 600km<sup>2</sup> of swampland. These wetlands are all connected to a large bay system, which is protected from the ocean via a system of four barrier islands. The basin has been experiencing significant losses of wetland habitat. Monitored loss from 1974 to 1990 is estimated at roughly 25km<sup>2</sup> a year. These losses have been traced to two main contributing factors. The construction of flood water dykes along the Mississippi River has almost eliminated fresh water input into the wetlands, depriving the ecosystem of vital sediments, nutrients, and hydrologic influence. The other factor is the natural erosion of the barrier islands in the bay, as well as rising sea levels. This is resulting in an increase of salinity in the southern region of the basin. Following an ecological assessment and feasibility study in 2011, the government of Louisiana set a project in motion to restore and reinforce the integrity of the barrier islands in Barataria Bay. This paper will highlight the necessity of the project as well as the social and economic advantages. It shall also provide a description of the project, which involves the creation of protective ridges to resist natural erosion and the expansion of the diminished island areas. Such work has already been carried out on several of the barrier islands, with plans to complete similar projects within the basin. With the new barrier system intact it is hoped that the salinity of the wetlands can be maintained, and that the marsh ecosystem can be protected.

### 1.0 Introduction

Louisiana's coastal wetlands encompass thousands of square kilometers. By 2050 it is estimated that the coastal marches will have lost 2082km<sup>2</sup> of habitat. Barataria Bay, which encompasses a large part of the South Eastern Louisiana wetlands, is one area facing rapid deterioration. The vast marshlands support 30% of the states massive fishing industry. [1] Based on land loss measurements taken from 1974 to 1990, it is estimated that the marsh habitat of the Barataria Bay is diminishing by 25km<sup>2</sup> every year. One source of the continual destruction of the marsh habitat is the erosion of the barrier island system (Fig 1) that shields the bay from the Gulf of Mexico. [2] The barrier island system also shelters the coastal wetland from storm damages. The continued degradation of the barrier islands will subject the wetlands to increasingly adverse conditions and greatly increase the threat posed by ocean storms towards coastal communities. As the cost of storm damages to infrastructure (e.g levees and roads) increases it may become necessary for the coastal residents to move further inland, leaving

communities abandoned. It is of great importance to maintain the natural barriers in order to protect the coastal Louisiana ecosystem, economy, and culture.

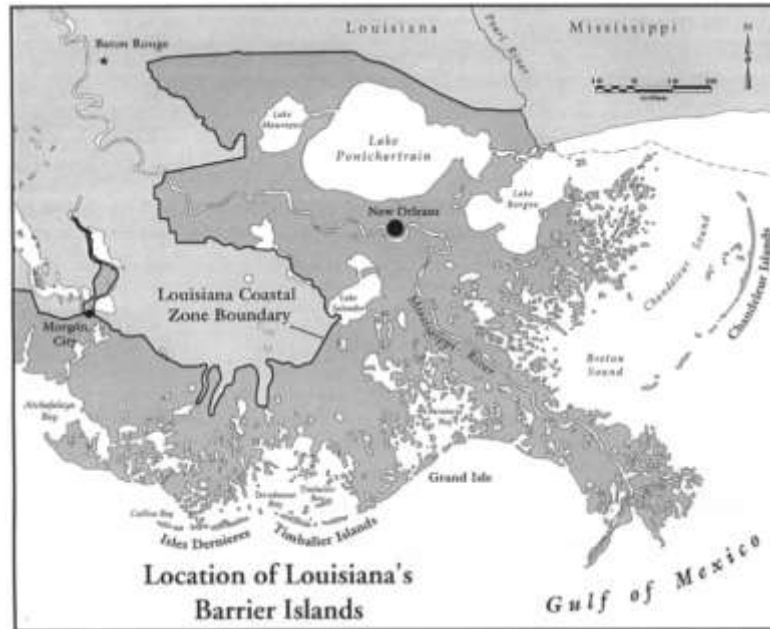


Figure 1: Location of the Barrier Islands [1, p2]

## 2.0 Loss History and Projections

In a 100 year period the total barrier island area of Louisiana declined by 55%. (Fig 2) The four main islands that protect Barataria Bay are West Grand Terre, East Grand Terre, Grand Pierre, and Cheniere Ronquille. In 1990 they had a combined area of just over 7km<sup>2</sup>. In 2015 they are expected to be diminished to 4km<sup>2</sup> and it is expected that in 2045 the four islands will have a total area of only 1.6km<sup>2</sup>. [2]

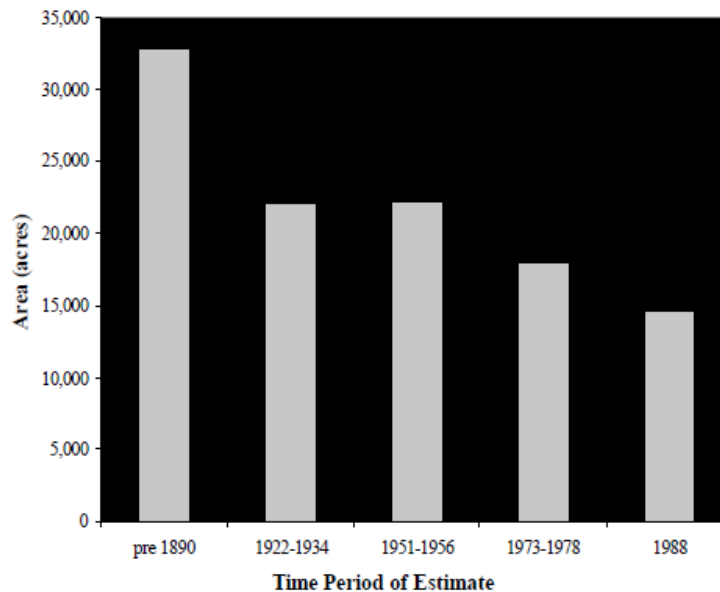


Figure 2: Barrier Island Area Loss [3, p. 44]

### **3.0 Cause of Deterioration**

The largest contributor to the losses of the barrier island system is storm events. Hurricane impact is undoubtedly the single most important factor, but lesser storms are also a contributing cause. The winter months often see numerous storm fronts passing through the region. The second highest contributor to the barrier island deterioration is wave erosion. While not as immediately identifiable as storm damage, wave erosion of the barrier islands is a constant source of loss. [3]

### **4.0 Impact of Deterioration**

#### **4.1 Economic Impact**

The Louisiana fishing industry is one of the largest in the United States. The combined commercial and recreational fishing industries of the state of Louisiana as well as the associated tourism industry account for roughly \$2.5 billion income per year. The continued diminishing of the wetland area and natural estuaries is deviating to the wildlife which fuels this industry. If the barrier islands continue to degrade, the estuaries shrink, which could result in a total collapse of the fishing industry for the State. The coastal wetlands are also a source of oil and gas production. Operations in the wetlands produce 15-20% of U.S oil and 30% of U.S natural gas. The harvesting of oil and gas from the coastal wetlands produces over \$7 billion per year in income. As the barrier islands deteriorate, the cost of these operations will significantly increase due to the increased wave energy and storm surge that will affect the marshlands. The costs of rebuilding/strengthening platforms and the increased cost of exploration could be detrimental to producers. The reduction in storm protection would also be devastating to isolated bayou communities and even the New Orleans Metropolitan area. [1]

#### **4.2 Cultural Impact**

The wetlands are also more than just a source of income for the area. The coastal wetlands area is the center of the “Cajun” culture. Before the rapid expansion of the oil and gas industry the people of Louisiana were almost entirely an agrarian people. They mostly sustained themselves on the fishing and trapping opportunities provided within the wetlands. Agriculture has also been an important part of the livelihood of many Louisiana natives. Rice, sugar cane, soy beans, and cattle have long been important commodities produced in the region. More recently, aquaculture has become a staple activity. Since the 1970’s pond aquaculture of various crawfish, shrimp, and other invertebrates has become increasingly prevalent. [3] The people of Louisiana have built their lives and their industry around the bounty of the marsh. The destruction of the habitat would be a crushing blow to the cultural identity regions inhabitants.

#### **4.3 Ecological Impact**

The Louisiana wetlands are home to 682 different species of birds, mammals, fish, reptiles, and amphibians. The wetlands also contain numerous species of oysters, shrimp, and crabs. As the marshland diminishes these species will lose their habitat and will ultimately die off. The barrier island themselves also have a more direct ecological importance. The islands serve as a resting spot for mammals and migratory birds. Water fowl also rely on them as feeding and nesting areas. [4]

## 5.0 Project outline

In September of 2011 the state of Louisiana was awarded a \$102 million for three projects aimed at restoring the barrier island systems. The projects were located in Barataria Bay and its neighbour to the West, Terrebone Bay. Engineering and environmental impact assessment for the projects was completed by the United States Army Corp of Engineers (USACE). Two of the projects set for construction will be summarized here. The Caminada Headland is located in Lafourche Parish on the South-Western edge of Barataria Bay. The Headland is approximately 21km long, reaching from Belle Pass to Caminada Pass (Fig 3). The other project is located on Shell Island (Fig 4), in Plaquemines Parish. The small, shallow, series of shoals and islands was once a continuous shoreline. The area suffered heavy loss during hurricane Bob (1979) and has continued to erode since. The goal of both projects is to restore both areas to a continuous shoreline, as well as install measures to mitigate sediment losses, and to replace the losses expected over the next 40 years. [5]



Figure 3: Caminada Pass Area. [5, p.2]



Figure 4: Shell Island Area [5, p.7]

## 6.0 Project details

### 6.1 Caminada

The Caminada Headlands project will restore the shoreline via the creation of approximately 3.5km<sup>2</sup> of beach dunes and 4.8km<sup>2</sup> of marsh. Various possible beach fill cross sections were evaluated using the Storm-induced Beach Change (SBEACH) model. Initially, 5 section templates were used:

1. Existing beach profile
2. Marsh fill only
3. Beach fill with a low and wide dune crest
4. Beach fill with a high and wide dune crest
5. Landward beach fill (A significant volume of the fill places on the landward side of the profile)

From templates 2-5, further analysis yielded 10 possible alternative templates. Based on upon technical, fiscal, environmental, and institutional constraints the 10 alternatives were evaluated and one was tentatively selected. The selected templates consist of a 2.1m high dune with a 88m width. The slopes on landward and seaward sides will be 20:1 with marsh fill placed on the landward side up to the 0.6m height of the dune. [5] (Fig 5)

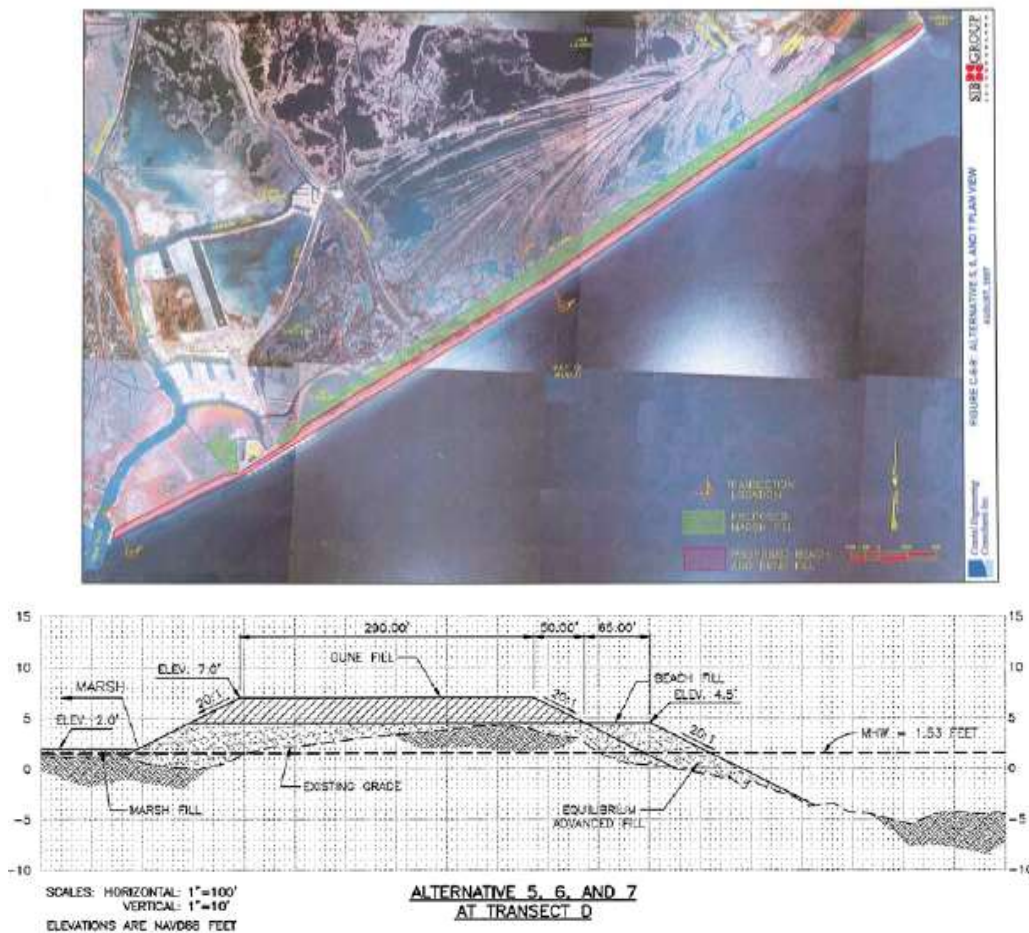


Figure 5: Caminada Headland Restoration Plan and Section [5, p 4-5]

Material for the marsh and beach/dune restoration will be dredged from off shore sources and pumped to the construction site. Beach/dune material will be placed first and be worked into place by

heavy machinery. The marsh material will then be placed, with the dunes acting as a dike along its southern edge. Additional dikes will be constructed around the remaining perimeter of the newly created marsh area. Sand fence installation and vegetation planting will be conducted in order to stabilize the new dunes and protect against environmental damages. [5]

Losses due to erosion will be renourished via sediment replacement and wave action distribution. Operations and maintenance dredging of nearby Bayou Lafourche produces nearly 500,000m<sup>3</sup> of suitable material every 2 years. This material will be placed on the shore in such a way that long shore transport and wave action to spread the sediments over the headland. It is estimated that 3 million cubic meters of material can be returned to the Headland every 10 years. [5]

## 6.2 Shell Island

The Shell Island project is tentatively set to restore the battered area into a single island. The island will be 378m long and consists of 1.3km<sup>2</sup> of beach/dunes and 1.9km<sup>2</sup> of marsh area. Various alternatives were analyzed using SBEACH, similar to the Caminada Headland. The selected cross-section template features a 1.8m dune elevation with a uniform width of 58m and a 0.6m marsh elevation with a uniform width of 224m. [5] (Fig6)

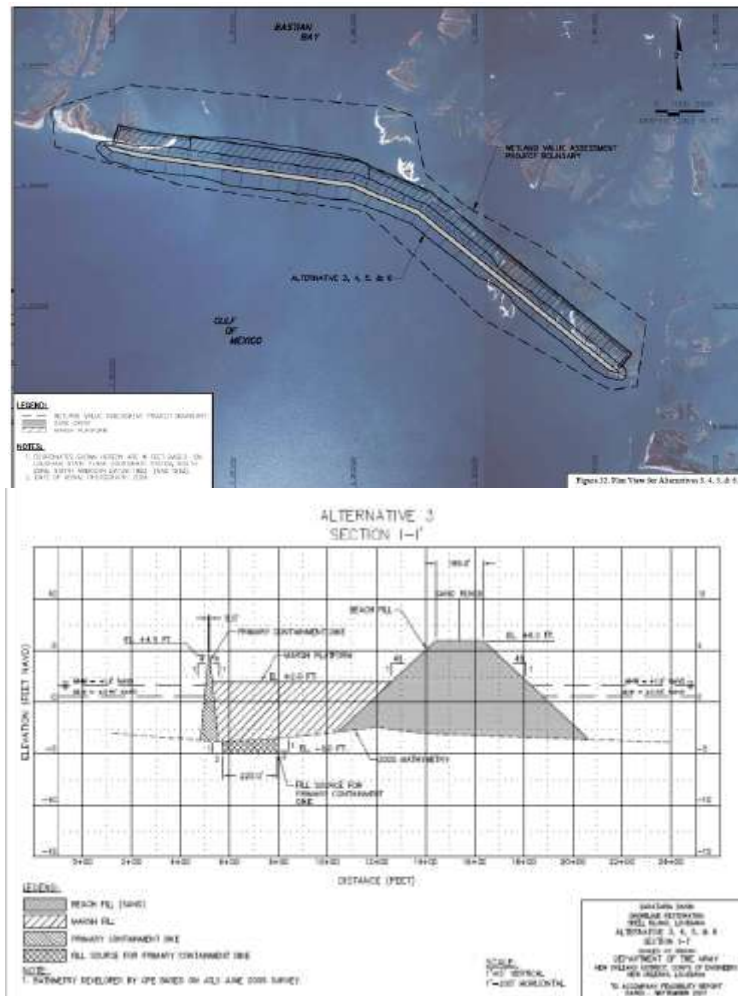


Figure 6: Shell Island Restoration Plan and Section [5, p 8-9]

The beach/dune material will be borrowed from 3km section of the Mississippi River, where a meander in the river course produces increased sediments. The material will be piped 17 km to the construction site. Marsh material will be dredged from an offshore area and pumped to the construction site. The material will be placed in a similar manner as the Caminada Headland, with sand fence and vegetation placed in a similar fashion. [5]

The project will be renourished to the original template at 20 and 40 years after project completion. Borrow sources for the renourishing material will be the same as the construction sources. [5]

### **6.3 Total Cost**

The final estimate for the cost of both projects is \$25 million. This estimate was based off 2007 pricings and adjusted for inflation over the construction span, and the renourishment projects spans. [6]

### **Conclusions**

Barataria Bay is part of the largest and most rapidly deteriorating marshland ecosystems in the United States. The Marshlands are a significant source of biodiversity, recreation, and income for the state of Louisiana. If the barrier islands that protect the animal and human environment from the ocean are allowed to continue to deteriorate it could result in a complete ecological and economic collapse. The Caminada Headland and Shell Island projects are aimed at restoring and maintaining the integrity of this barrier system. These projects, and future projects like them, are integral in protecting the livelihoods of millions of people, and the habitat of hundreds of species of animals.

## References

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