

Final Report
on
East Bay Wetland Habitat and Water Quality Protection Project

TCEQ Contract # 582-5-65098

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Prepared for:



A PROGRAM OF THE TCEQ

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Executive Summary

The Galveston Bay Estuary Program (GBEP) and Galveston Bay Foundation (GBF) both have named habitat loss as the number one priority problem in the Galveston Bay system. One of the systems most important habitats -coastal wetlands- have decreased in size by approximately 30,000 acres since the mid-1950s. According to GBEP's *The Galveston Bay Plan*, the Comprehensive Conservation and Management Plan for Galveston Bay, the primary causes for these losses are subsidence and erosion. *The Plan* names the restoration, creation, and protection of wetlands throughout Galveston Bay as the highest priority within the Habitat Protection Action Plan.

The project also implements the *Habitat Conservation Blueprint*, a document developed by the Galveston Bay Foundation in conjunction with state and federal resource agencies, conservation non-profit groups, academia, industry, and citizens, identifying high priority conservation sites. The *Blueprint* inventories 170 sites around Galveston bay, many of them wetlands, in need of restoration or conservation. The *Blueprint* identifies erosion control in East Bay as one of its highest priority conservation actions, citing erosion rates up to 8 feet per year along the north shoreline of East Bay.

Introduction

The North Shoreline of East Bay, among many other similar areas around the Bay, is experiencing rapid erosion of up to 10 feet per year along its entire 20 mile length. The erosion has resulted in scouring that has left much of the shoreline with erosive bluffs and very patchy remnants of intertidal wetlands. Continued erosion of the shoreline would also pose a significant threat the present ecological diversity of the area. Salt water intrusion would be allowed to alter the ecology of brackish and freshwater wetlands and coastal prairie, breach shallow freshwater and intermediate lakes and depressions, altering hydrology and salinity gradients.

With the above in mind GBF and its project partners set out to start the tedious task to protect the delicate ecosystem along the north shoreline of East Bay. Realizing that protecting the entire 20 mile length of shoreline would not be feasible at this point the project team decided to concentrate our efforts along the approximately 7 miles of shoreline of Anahuac National Wildlife Refuge. The project site stretches from Robinson Bayou on the West to Oyster Bayou on the East.

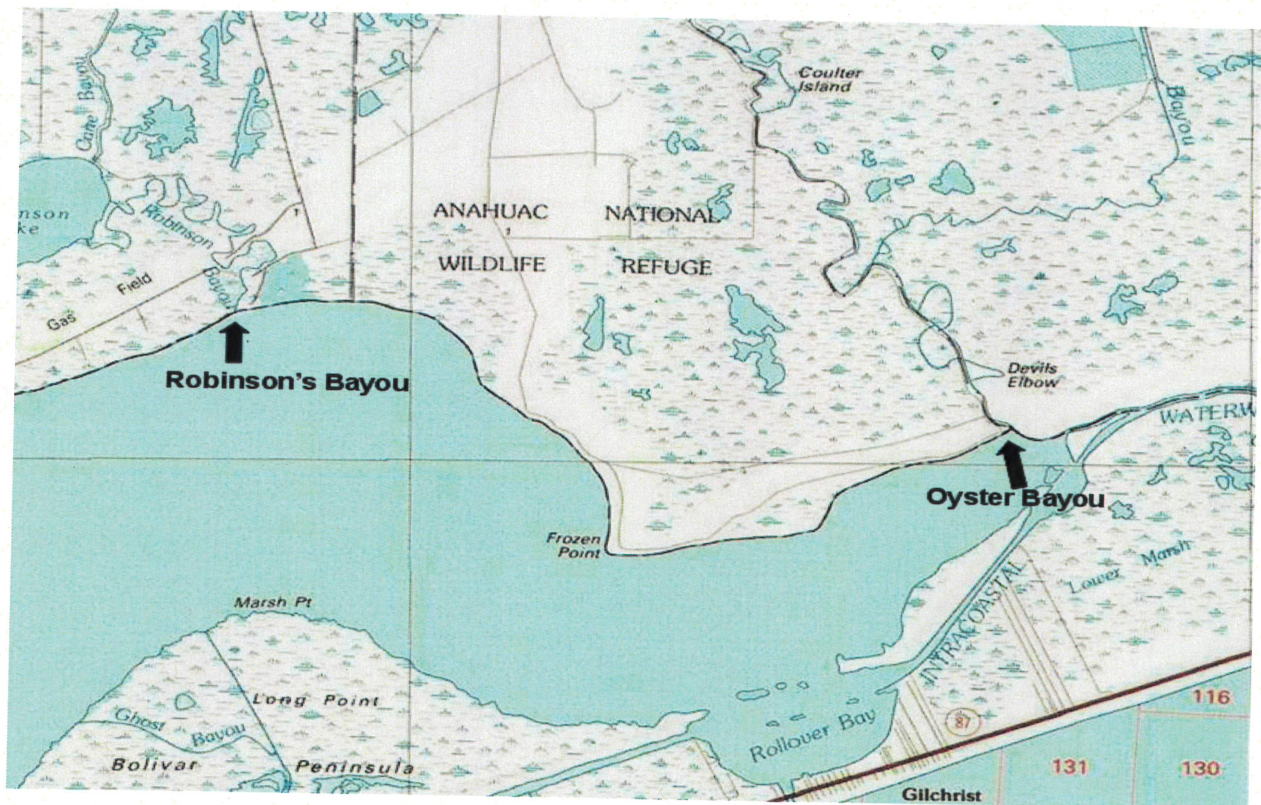


Figure 1. Site Map

In an effort to meet the goals of the project as well as those set forth in *The Galveston Bay Plan*, GBEP awarded to GBF \$230,000 to be used to install an offshore erosion control structure to reduce wave energy impacting the shoreline, to promote shoreline stabilization, and to protect remaining intertidal marsh within the project area. Throughout the project period these funds were used for: 1) purchase and delivery of crushed concrete rip-rap material used in the breakwater's construction and 2) partially pay for the concrete material to be placed offshore of the shoreline (breakwater actual construction) by selected contractor. Below is a list of additional partners for the project. Table 1 shows the overall contributors and amounts of cash awards and in-kind donations secured to this project.

A portion of the awarded amount was used in support of GBF's Marsh Mania 2006 events. Marsh Mania is a community-based project that recruits local residents to participate in area habitat restoration projects. Started in 1999, Marsh Mania is a yearly event in which GBF coordinates hundreds of volunteers in the transplanting of wetland plants at several habitat restoration sites around Galveston Bay. Over the years, more than 31 sites have benefited from their Marsh Mania designation.

Additional Partners

Advisory and funding partners include: TCEQ Galveston Bay Estuary Program, EPA Gulf of Mexico Program, NOAA Restoration Center, Restore America's Estuaries, National Fish and Wildlife Foundation, Shell Oil Company, U.S. Fish and Wildlife Service Texas Coastal Program, Anahuac National Wildlife Refuge, NOAA Fisheries, USDA Natural Resources Conservation Service, NRG Texas, and Galveston Bay Foundation.

Table 1: Contributors and amounts of cash awards and in-kind donations or services secured for the East Bay Wetland Habitat and Water Quality Protection Project.

Contributors: cash	Amount	
TCEQ-GBEP – EPA Gulf of Mexico Program	\$230,000	
USFWS Texas Coastal Program	\$60,000	
USFWS Anahuac National Wildlife Refuge	\$50,000	
NFWF – Shell Oil Company	\$75,000	
Restore America's Estuaries – NOAA Partnership	\$10,050	
TOTAL	\$430,050	
Contributors: In-Kind	Amount	Donation/Services
NRG Texas (formerly TexasGenco)	TBD	Wetland Plants

The specific goals identified for the East Bay Wetland Habitat and Water Quality Protection project were:

- Protect a rapidly eroding segment of shoreline in East Bay
- Evaluate innovative and experimental approaches to erosion protection
- Re-establish intertidal marsh vegetation behind erosion control structures
- Involve local communities in habitat restoration and stewardship and
- Promote awareness of the values of and threats to wetlands and associated habitats in the Galveston Bay system
- Support Marsh Mania 2006

Tasks associated with these goals included:

- Conducting activities consistent with *The Galveston Bay Plan*
- Establishing a steering committee
- Installing offshore erosion control structures to protect an estimated 1,000 acres of marsh, prairie, and upland habitat on the northern side of the structure
 - Delivering and staging construction materials (rip-rap, reef dome molds, and concrete) at the ANWR shoreline
 - Constructing offshore breakwater
 - Placing approximately 200 feet of reef domes to allow for evaluation of this innovative technique *in situ*.
- Planting smooth cordgrass in the protected shallow water behind the structure using local volunteers and
- Communicating progress and results

Project Methodology

A steering committee was formed consisting of project partners and experts from the U.S. Fish and Wildlife Service (Texas Coastal Program and ANWR), Galveston Bay Estuary Program, NOAA Restoration Center, NOAA Fisheries, Natural Resources Conservation Service, NRG Texas (formerly TexasGenco), and Galveston Bay Foundation. The steering committee met several times over the project period to discuss project planning, implementation and progress. ANWR staff was on hand to oversee materials delivery and project construction activities.

USFWS received the two required permits/leases for the project. This included Texas General Land Office Coastal Lease CL20030005, issued March 1, 2004, and the U.S. Army Corps of Engineers Permit No. 23050, issued October 6, 2003. Amendments to these agreements were pursued by USFWS and granted as needed for the project (e.g. modified for the use of Reef Balls).

The steering committee assisted in the selection and preparation of three Marsh mania sites for 2006. The sites selected represented Galveston Bay (Armand Bayou), East Bay (Anahuac National Wildlife Refuge), and West Bay (Pierce Marsh) portions of the Galveston Bay system.

Shoreline Protection

Materials including 18" crushed concrete rip-rap, reef ball molds, and constructed reef balls were ordered and delivered to the ANWR. The rip-rap materials were transported by the supplier's trucks to the ANWR shoreline access road and staged along the shoreline prior to construction. A construction contractor was selected based on a competitive bidding process to place the rip-rap using heavy equipment during the low tides of fall 2005/winter and fall 2006. The staged rip-rap was loaded onto a large metal sled and pulled to the shoreline with a crawler dozer. Once the material was placed near the shoreline the rip-rap was placed offshore using a hydraulic excavator (trackhoe). Reef Balls were placed along the shoreline on April 26, 2007. The reef balls were staged and deployed in a similar fashion to the rip-rap. Reef balls were loaded into the metal sled and pulled to deployment shoreline by a crawler dozer. Using a combination of tow straps and a steel pipe the reef balls were deployed via trackhoe two (2) at a time. Reef ball molds were purchased with the intentions of having volunteers or local companies pour the reef balls using the molds. This turned out to not be feasible (addressed in lessons learned section below) and constructed reef ball were ordered from Reef Innovations in Sarasota, Florida.

Planting

Intertidal marsh has been restored in the shallow, protected waters behind the newly-constructed breakwater by planting smooth cordgrass (*Spartina alterniflora*). The cordgrass was planted by Marsh Mania 2006 volunteers in an effort to involve and educate the public regarding habitat issues and the need for restoration. A series of small plantings and Marsh Mania events will be conducted in the future with volunteers from project partner entities, local schools, community organizations, and user groups. GBF will ensure the recruitment and education of the participants and will coordinate the restoration and volunteer support aspects of the plantings. The construction contractor has also been transplanting small areas behind the breakwater as it is constructed.

Project Results

Accomplishments

The East Bay Wetland Habitat and Water Quality Protection Project directly addressed action items HP-1 (restoring, creating and protecting wetlands) and HP-9 (reducing habitat erosion) from *The Galveston Bay Plan*. In addition, the project contributed and will contribute action item PPE-5 (developing volunteer opportunities).

At the time of writing a total of 16,802 feet of refuge shoreline has been protected using concrete rip-rap material. Additionally, 200 feet of shoreline has been protected by concrete reef balls. The reef balls are placed in line (adjacent) with rip-rap protected shoreline. This placement will allow GBF and its partners to monitor and compare the effectiveness of the rip-rap and reef ball shoreline protection techniques.

The constructed breakwater has successfully stopped shoreline erosion along 16,802 feet of project shoreline protected by the rip-rap technique. Future site monitoring will determine the effectiveness of the reef balls in stopping erosion along an additional 200 feet of shoreline. The reef balls were placed April 26, 2007 and too soon at the time of writing to determine their effectiveness. The breakwater has protected 301 acres of brackish marsh, 5,675 acres of intermediate marsh, and 1,601 acres of salty prairie from saltwater intrusion (excluded short term storm events) and habitat conversion. Additionally 400 acres of salt marsh have been protected from erosion (excluding short term storm events).

Of the 17,002 feet of protected shoreline it is estimated that 6.8 acres is available for planting smooth cordgrass; 90% of the protected shoreline has some vegetation behind it. 82 volunteers have worked 249.5 hours transplanting smooth cordgrass behind 1,500 linear feet of the breakwater. The contractor and refuge staff also transplanted large clumps of cordgrass using the excavator during the breakwater construction. Additionally some portions of the newly protected shoreline smooth cordgrass naturally recruited behind the breakwater.

Marsh Mania (MM) 2006 was held at three sites around Galveston Bay, Armand bayou Nature Center, Anahuac National Wildlife Refuge (ANWR) and Pierce Marsh (West Bay). The three sites combined hosted 147 volunteers working a total of 649 hours to restore 4 acres of wetlands. Smooth Cordgrass (*Spartina alterniflora*) was transplanted at both ANWR and Pierce Marsh sites while California Bulrush (*Scirpus californicus*) was planted along the shoreline at Armand Bayou Nature Center.

The Pierce Marsh site also hosted several small scale mini-Marsh Mania events throughout the summer of 2006. The mini-MM events hosted an additional 142 volunteers whom worked 552 hours restoring an additional 4.5 acres within the Pierce Marsh complex. Volunteer groups comprised of students from Rice University and University of Houston Clear Lake, sailors from the US Naval submarine USS Texas, and local employees of Aramco Services, Anheuser Busch (Houston Brewery and Galveston Distributing), and Sea World of San Antonio.

At each volunteer event/site GBF staff and its partners took time to educate each volunteer on the importance of wetlands within the Galveston Bay ecosystem. Discussions

include the role wetlands have in flood and pollution control and their value as habitat for juvenile fish and invertebrate species important to the economy of the Galveston Bay region. Also discussed are the dramatic wetlands losses that have occurred throughout Galveston Bay and the importance of their roles in helping restore and protect this valuable habitat. Lastly site specific information is relayed to the volunteers.

Looking Ahead

The East Bay Wetland habitat and Water Quality Protection Project to date has been a great success. However, an additional 10,000 feet of ANWR shoreline is left to protect along East Bay and approximately 34,700 feet of shoreline of which 18,000 is considered high priority for protection along the ANWR shoreline along the Gulf Intracoastal Waterway (GIWW). GBF and its partners will continue to seek funding from all funding resources to continue this highly successful project.

2006 marked the 8th annual Marsh Mania event. GBF will continue to host Marsh Mania on an annual basis. In planning for Marsh mania 2007 four event sites have been selected. GBF will continue to use this event to restore wetlands and educate the public throughout the Galveston Bay complex.

Project Conclusions and Lessons Learned

The East Bay Wetland Habitat and Water Quality Protection Project experienced a few problems that were overcome and also used lessons learned from previous projects along ANWR to enhance the success of the current project.

A lesson learned from previous shoreline protection work at the refuge was useful in selecting the best distance from the shoreline to construct the breakwater. In a past project a concrete breakwater was constructed at a distance of 20 feet or greater from the existing shoreline. While this distance was successful in protecting the shoreline from erosion sediment has accumulated at a slow pace behind the breakwater. The slow sediment accretion rate translates into elevations behind the breakwater that will not fully support the establishment of smooth cordgrass behind the breakwater. Cordgrass has established itself in these zones but the cordgrass expansion has been slow to non-existent. Using this information the breakwater installed during this project was placed 15 to 20 feet from the existing shoreline. By placing the breakwater closer to shore sediment accumulation rates are higher allowing cordgrass to establish quickly and expand at a faster pace.

The first obstacle to overcome was the fact that the marsh adjacent to the project shoreline would not support the weight of large construction equipment needed to place the concrete rip-rap. To overcome this obstacle GBF had a 16'X8'x2' metal skid constructed to assist in the shoreline staging process for the concrete. The constructed skid displaced the concrete materials weight over a larger surface area in which enabled the marsh to support the weight. The skid would be loaded with concrete and pulled to the shoreline with a small crawler dozer. From here a hydraulic excavator was able to deploy the concrete.

The use of the skid did pose a problem in itself. Sliding the skid from the access road to the shoreline did temporarily affect the marsh it traveled over. However, any damaged marsh habitat quickly rebounded to its previous state. The construction contractor was able to minimize the paths the skid traveled over during project construction. For example, with the use of one path the contractor was able to construct 1,400 feet of breakwater. Additionally, portions of the breakwater were able to be completed from the access road itself in which case the skid was not used.

The biggest lesson learned from the project revolved around the construction of the reef ball structures. GBF and the project partners initially planned to purchase several reef ball molds and recruit local volunteers and/or local concrete contractors to construct the reef balls. After purchasing the reef ball molds it became apparent the task to construct the reef balls was very labor intensive and not conducive to volunteers constructing them. The project team then visited several local concrete companies in hopes of contracting with them to construct the reef balls using our already purchased molds. After visiting upwards of 6 different companies only one showed any interest in the reef ball construction. We received a bid of \$140 per reef ball delivered to the refuge, constructed using our molds. After doing some research GBF discovered a company from Florida, Reef Innovations, Inc (RI), which specializes in the construction of reef balls. RI is an authorized reef ball contractor that has been constructing reef balls of all sizes for projects around the world since 1995. GBF was able to purchase and have shipped pre-constructed reef domes (they did not use our molds) for \$70 each plus freight charges. Factoring in freight charges (\$1,560) the total cost per reef ball delivered through RI was \$89.50. GBF was able to save a total of \$4,040 by purchasing the reef balls from RI. However, this savings does not make up for the costs of the reef ball molds purchased. The molds will be used by GBF and its partners to potentially pour additional reef balls for the project in slower times of the year.

The remote location of the site has posed problems with volunteer recruitment to assist in the planting phase of the project. The Anahuac area is sparsely populated limiting the local number of volunteers available for planting events. GBF will continue to plan planting events at the site through the spring and summers over the next few years. GBF will hold Marsh Mania events at the site as well as use other GBF programs such as Hip-to-Habitat to recruit volunteers and school groups from around the region to assist in restoring intertidal wetland habitat behind the breakwater.

Marsh Mania presents several challenges from year to year. These include site selection, site logistics, volunteer safety, weather, and quantity of plants needed for each site. MM 2006 was no exception.

The Pierce Marsh site posed a logistical problem in that the restoration site was only accessible via very shallow draft boats. GBF rented 2 airboats and Texas Parks and Wildlife Game Wardens provided an additional airboat. The airboats were used to shuttle 8-12 volunteers at a time to the restoration site. Late in the event one of the airboats experienced mechanical difficulties leaving only two airboats left to ferry volunteers back to the mainland for lunch. Due to high volunteer numbers at Pierce Marsh, insufficient quantities of plants were harvested for the event. This resulted in volunteers returning to the sign in tent earlier than anticipated and prior to the arrival of the provided lunches. As a result of this circumstance GBF is considering having contractors harvest plants for future events in which high volunteer numbers are expected. Currently GBF utilizes a small staff, volunteer and partner base to harvest plants which limits the quantity of plants that can be harvested in the short time window prior to a restoration event.

The ANWR site experienced a lower than expected volunteer turnout due to inclement weather conditions the day of the event. The 30 volunteers who braved the conditions had to wait in sheltered cover for several hours for the thunderstorms to leave the project area. Once the weather cleared the volunteers deployed to the project site for the events activities. Due to the late start and lower than expected turnout, not all of the harvested plants were planted the day of the event. ANWR staff and volunteers planted the remaining plants the following week.

In all 289 volunteers participated for 1,201 hours in MM and mini-MM events in 2006. One lone injury occurred over this time period at the Pierce Marsh location. A volunteer received a cut on his foot which required stitches. As with all MM events EMT staff was located on-site and administered treatment to the cut and transported the volunteer to a local hospital to receive stitches.

These lessons will be of particular value for continued work at the refuge, and for work planned at a very similar site at Virginia Point in West Bay. Virginia Point's 2.5 miles of southern shoreline is experiencing rapid erosion due to fetch across West Bay, and proximity to the Gulf Intracoastal Water Way (GIWW). Access problems due to extremely shallow water will likely force project partners to work from land, very similar to the situation at the Refuge. And, limited resources will require innovative and cost-effective techniques. This project serves as a perfect model for future work at Virginia Point.

Project images (Digital)

Photographs and outreach activities are included as digital files on the enclosed CD.

Folder: 1-Articles, etc.

- GBF April/May 06 newsletter Gazette, featuring article on Marsh mania 2006 events.
- Presentation given to GBEP's NRU subcommittee by GBF's Philip Smith on February 14, 2007.
- PDF aerial showing portions of ANWR shoreline protected within this project, provided by ANWR staff.

Folder: Armand Bayou MM; Photos from Marsh Mania 5-6-06 at Armand Bayou

- Volunteers preparing to stage plants at project site via canoes.
- Volunteers get ready to plant.
- A job well done, area planted by volunteers.
- Volunteers take a break under the tent, MM sponsor sign .

Folder: East Bay MM; Marsh Mania 5-6-06 ANWR, volunteers plant behind East Bay shoreline protection provided through this grant!

- East Bay Marsh Maniacs pose for a group shot after a job well done.
- GBF's Courtney Miller stages plant to project site.
- Boy Scouts hard at work.
- NRCS' Eddie Seidensticker lends a hand.
- GBF's Vanessa Mintzer joins in on the fun.
- After photo taken of the MM planting site taken 12-5-06 (1-5).
- After photo taken of the MM planting site taken 12-5-06 (6-7). Showing the expansion of cordgrass over the breakwater, growing bayward. The bayward side of the breakwater was NOT planted at the MM event.

Folder: East Bay Shoreline; Photos showing construction of breakwater

- Marsh Mania 5-6-06 planting site, photo taken 12-5-06. Notice the rip-rap being delivered and staged in the background.
- Sediment accumulation behind breakwater and example of Contractor "spot planting".
- Results of Chinquapin School planting 4-16-07.
- Chinquapin students hard at work planting cordgrass.
- Cordgrass planted by Chinquapin students 4-16-07.
- Chinquapin using teamwork to plant pots of cordgrass.
- Results of Chinquapin School planting 4-16-07.
- This Chinquapin Student is all smiles.
- Results of Chinquapin School planting 4-16-07.
- Students transport potted cordgrass plants to planting site.
- Before photo of East Bay shoreline to be protected by Reef balls 4-26-07.
- Reef Balls in metal sled ready for transport to shoreline.
- Crawler dozer pulling sled of reef balls to staging area.
- Dozer and sled of reef ball staged at ANWR shoreline.
- Contractor readies reef balls for deployment
- Excavator used to deploy reef balls.
- Excavator used to deploy reef balls.

- Excavator used to deploy reef balls.
- Excavator used to deploy reef balls, showing progress.
- Excavator used to deploy reef balls, showing progress.
- Reef Balls in the water.
- Close up of technique used to lift reef balls.
- Contractor positions reef balls.
- Line of reef balls.
- Excavator re-positions mats to re-locate and minimize habitat impacts.

Folder: Pierce Marsh MM; Photos from 6-3-06 Marsh Mania Event at Pierce Marsh

- Airboats are ready to transport volunteers to planting site.
- Airboats taking first volunteer groups to plant.
- TCEQ staff participates in MM event.
- Muddy volunteers take a break from planting.
- A volunteer group led by Reliant Energy's Bill Baker is all smiles.
- Planting view.
- Teaming up to make a difference.
- Planting view.
- View of the volunteer staging area from a returning airboat.
- GBF president thanks volunteers.
- TCEQ's Commissioner Soward addresses the volunteers.
- GBF's MM Coordinator Lee Anne Wilde, Great Job!
- Planting pals.
- Mud Bath anyone?
- Volunteers enjoy lunch and entertainment after a day of planting.
- Restore America's Estuaries President and CEO, Mark Wolf-Armstrong lends a helping hand.
- TCEQ's Commissioner Soward and GBEP Program Director Helen Drummond doing there part!



East Bay Shoreline Protection Projects
Anahuac National Wildlife Refuge
Chambers County, Texas
7 February 2007

Legend

completed shoreline protection

Proposed shoreline protection projects

1st priority

3rd priority

2nd priority

4th priority

