ENVIRONMENTAL ASSESSMENT
FOR
RESTORATION OF DEER ISLAND, HARRISON COUNTY, MISSISSIPPI
--
GRAND BAYOU MARSH, SOUTHERN SHORELINE RESTORATION, AND THE WESTERN BREACH

A RESTORATION PROJECT

1 INTRODUCTION

This Environmental Assessment (EA) presents impacts that would potentially result from restoring eroded areas located at Deer Island, Harrison and Jackson Counties, Mississippi (Figure 1.1). The following three (3) restoration sites are evaluated in this EA:

(1) the western breach of Deer Island;
(2) Grand Bayou Marsh restoration; and
(3) the overall restoration of Deer Island back to its historic 1850s shoreline.

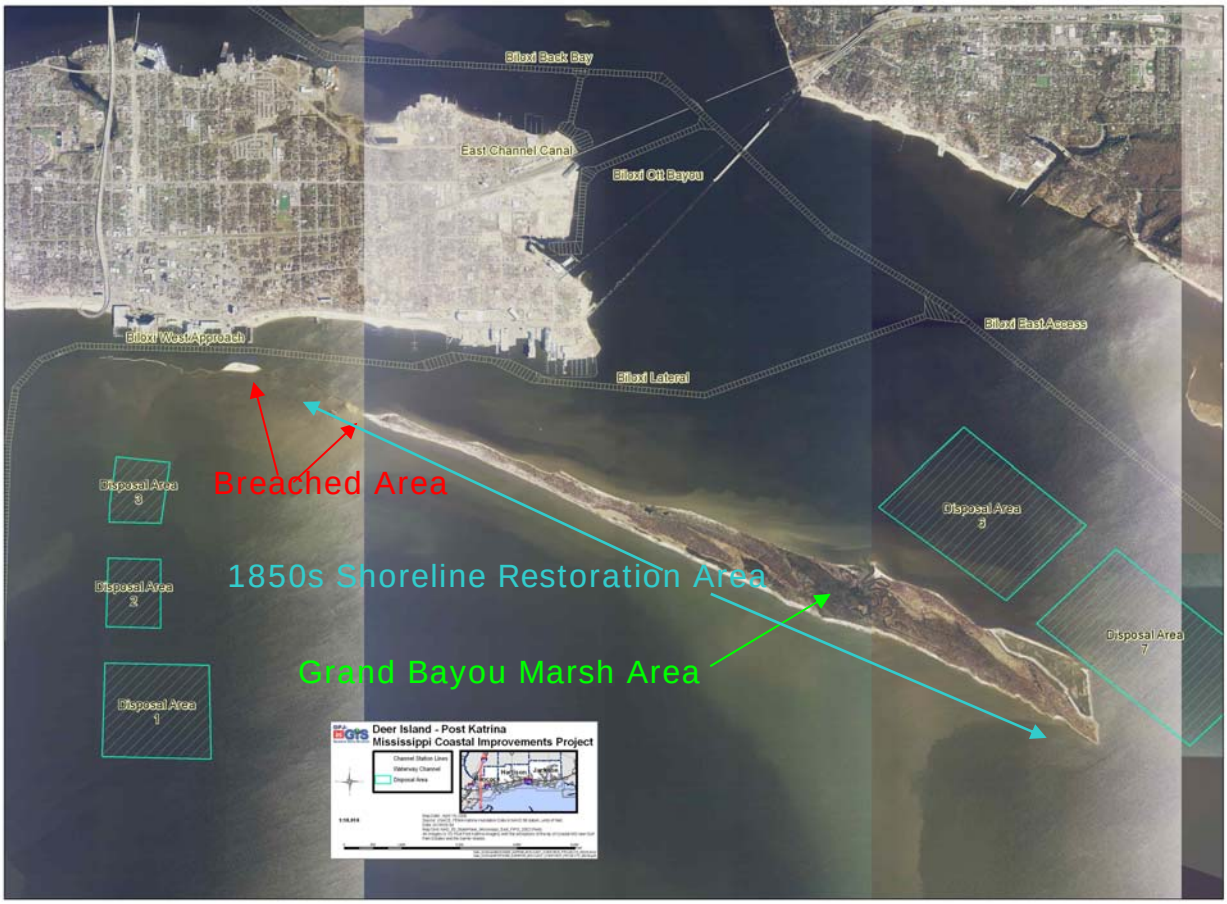

Figure 1.1: Deer Island Breach, Jackson & Harrison Counties, MS

The breach is located along the western side of Deer Island. The Grand Bayou Marsh restoration site is located in the center portion of the island on the southern shoreline. Finally, the overall restoration of the island focuses on restoring the remaining portion of the southern shoreline. The purpose of this EA is to determine whether or not the proposed action has the potential for creating significant impacts to the environment and would thereby warrant a more detailed study on possible impacts, mitigation, and alternative courses of action.

2 PURPOSE AND NEED FOR THE PROPOSED ACTION

The purpose of this proposed action is to restore and prevent future erosion to Deer Island. The first site is a breached area located on the western end of Deer Island. Unfortunately, Deer Island was divided into two parts after Hurricane Camille in 1969 and that breached area was increased by Hurricane Elena on Labor Day in 1985. Additional storms throughout the years have greatly increased the breach's size. The last round of storms during 2005, i.e. Hurricanes Katrina and Rita, really exasperated the breach's size. The second area, Grand Bayou Marsh, consists of a small winding tidal creek moving through the island in a winding north-south direction. It is located towards the center-eastern portion of the island. The recent 2005 storm activity caused the creek to cut all the way through the island. The Mississippi Department of Marine Resources (MDMR), the non-Federal partner in this effort, has great concern that the small breached area may increase in size resulting in another large cut through in Deer Island. The final restoration effort at Deer Island is to restore the shoreline back to its historic 1850s footprint. Wave action and past storm activity have eroded the shoreline northward approximately 300 feet. Essentially, this effort would enhance the Grand Bayou Marsh restoration project.

This uninhabited island is one of the last natural islands along the Gulf Coast. It was designated as part of the Mississippi Coastal Preserve by the MDMR. Although commonly misidentified, Deer Island is *not* a barrier island. Despite first appearances, the island's geological character is inherited from multiple environments that have existed reaching back over 120,000 years. Accordingly, the shoreline is evolving uniquely at small spatial scales even though the physical processes, by and large, do not vary at these small scales. Deer Island provides the mainland, i.e. the City of Biloxi, with hurricane/storm protection. This uninhabited island absorbs a high amount of wave energy before it reaches the mainland. This feature was evident during Hurricane Katrina by those structures landward being somewhat more protected from storm forces compared to those without the island's protection. The Mississippi Coastal Preserve site provides various species, such as blue herons, osprey, and deer, with necessary habitat which is hard to find due to high development in the coastal Mississippi areas.

By restoring Deer Island, erosion along the island (i.e. southern, eastern, and western end) would be reduced and a vital link between the two island parts would be restored. Additionally, protecting these areas would also provide hurricane/storm protection to the City of Biloxi. The most recent number of hurricanes and tropical storms in 2005 has greatly accelerated the loss of Deer Island's shoreline. Thus, any protection to the island would benefit the City of Biloxi and the natural resources of the Mississippi Coastal Preserve site.

WESTERN BREACH AREA RESTORATION - Revetment dikes would be constructed to confine the breach area on the western side of Deer Island. Fill material would be placed and eventually covered in a geotextile material and then covered in rip rap rock. The two dikes would serve as the

containment structures for the fill material to be used to fill the breach in the western portion of Deer Island. Approximately 4,000 linear feet and 4,500 linear feet of revetment dikes would be required on the northern and southern side, respectively. The northern and southern containment dikes would encompass an area approximately 6.4 and 7.2 acres, respectively, while the interior of the revetments would be approximately 95 acres, to be filled with material from multiple private dredging projects in the Biloxi area [Commercial Docking Facility (~5,700 cys), Lighthouse Fishing Dock (~50,000 cys), Small Craft Harbor (~35,000 cys), Point Cadet Marina (~75,000 cys)] and also from an identified offshore borrow area adjacent to the island used in the southern shoreline restoration project. The U.S Army Corps of Engineers (Corps), Mobile District and the MDMR are committed to beneficially using dredged material wherever possible. The site would contain between approximately 675,000 and 700,000 cubic yards (cys) of material consisting primarily of clays/silts and sands.

GRAND BAYOU MARSH RESTORATION - The purpose of this project is to restore, opposite of the Grand Bayou area, a portion of the seaward shoreline that has been lost through erosion over time to the point that a small breach has formed in to the Grand Bayou and is allowing tidal flow through the island. Without intervention, the small breach that has formed will continue to enlarge through erosion and sensitive marsh/wetland areas will be destroyed in the process. Restoration of the shoreline would permit the establishment of beach and dune, maritime forest, and emergent marsh areas within the project area as well as eliminate the small breach and protect interior marsh and wetland areas.

1850s SHORELINE RESTORATION - The purpose of this project is to restore the entire length of the southern (seaward) shoreline of Deer Island to closely match its historic limits. The shoreline has been reduced over time through erosion and restoration of the shoreline will permit the establishment of beach and dune, maritime forest, and emergent marsh areas within the project area and protect interior marsh, wetland, and maritime forest areas.

This action is in the vicinity of the federally authorized Biloxi Harbor navigation project, Harrison County, Mississippi. The Corps, Mobile District maintains this navigation channel, which was authorized by 1966 River and Harbor and Section 107 River and Harbor Act of 1960. A map of the Biloxi Harbor navigation project is provided in **Figure 2.1**.

The federally authorized Biloxi Harbor, Mississippi navigation project consists of the following dimensions:

Lower Harbor:

a. The East Access Channel extends from mile 88.0 on the Gulf Intracoastal Waterway in Mississippi Sound to its junction with the West Access Channel and the Biloxi Back Bay Channel (**Figure 2.2**). The channel is approximately 9.2 miles in length. Authorized dimensions are 12 feet deep by 150 feet wide.

b. The West Access Channel, which includes the 4.8 mile West Approach, which measures 10 feet deep by 150 feet wide, and the easternmost 2.2 mile Biloxi Lateral segment, which measures 12 feet deep by 150 feet wide and is approximately 7 miles in length.

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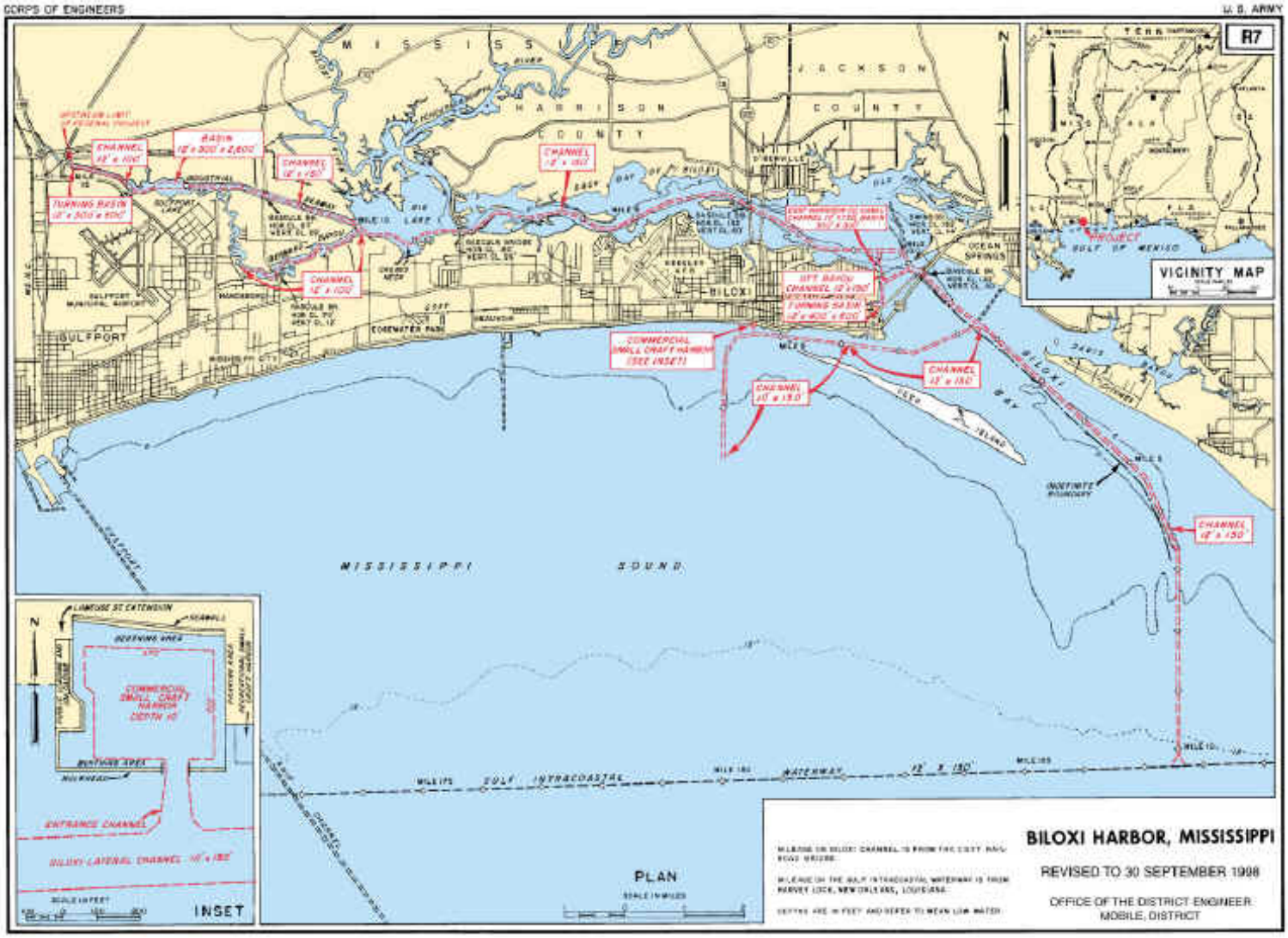


Figure 2.1: Biloxi Harbor Navigation Project, MS

c. Harrison County Industrial Seaway is approximately 5 miles in length extending from Big Lake to the western terminus of the channel, including turning basins in Gulfport Lake and at the western terminus. The dimensions of the channel vary from 12 feet deep by 150 feet wide from the Back Bay channel to the turning basin in Gulfport Lake and then 12 feet deep by 100 feet wide to the western terminus.

d. The 12 feet deep by 100 feet wide Bernard Bayou Channel that extends 2.6 miles up Bernard Bayou from the main channel to the Keesler Air Force Terminal.

Upper Harbor:

a. The 12 feet deep by 150 feet wide main Back Bay Channel from the U.S. Highway 90 Bridge to the D-Iberville Bridge area.

b. The 12 feet deep by 150 feet wide Ott Bayou Channel, which extends from a 400 feet by 600 feet turning basin at the junction with the main Back Bay Channel for a distance of 1.2 miles and terminating at a 12 feet deep by 600 feet turning basin located opposite Ott Bayou.

c. The 12 feet deep by 150 feet wide by 2100 feet long East Harrison County Industrial Canal channel, which extends from its junction with the main Back Bay Channel in a southerly direction and terminating in a turning basin which fronts the northeast shore of the Biloxi Peninsula.

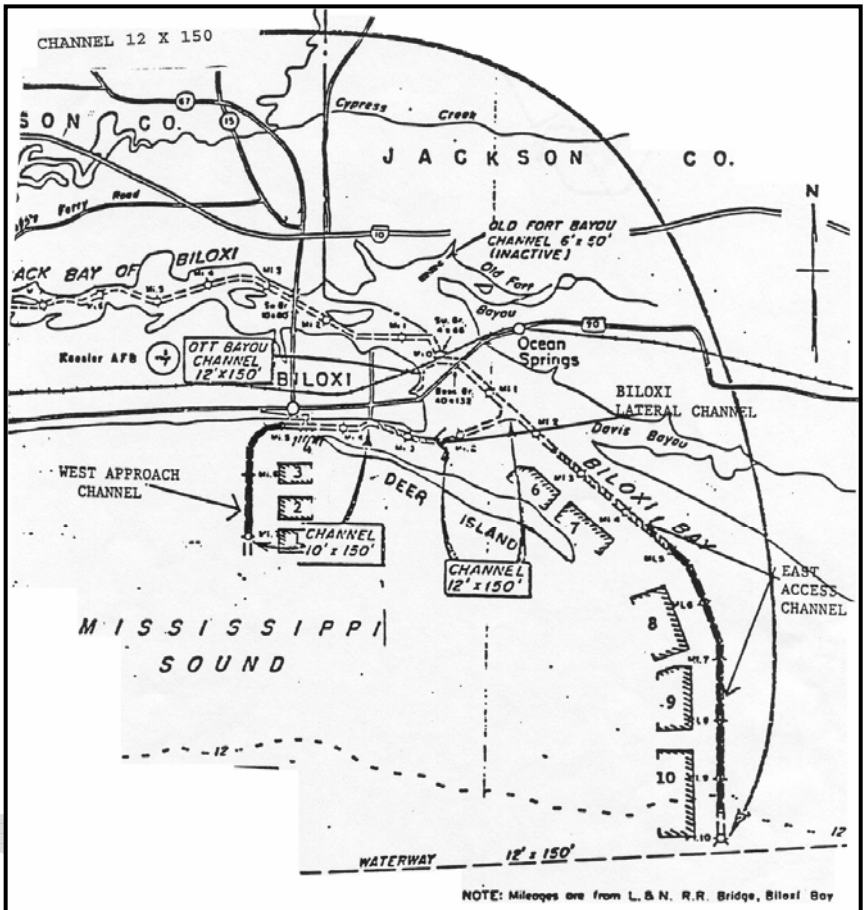


Figure 2.2: Biloxi Harbor, MS

2.1 Authority and Scope. The Corps, Mobile District is conducting this study and its construction under Section 528 of the Water Resources Development Act (WRDA) of 2000. Section 528 provides the following guidance:

> ***SEC. 528. COASTAL MISSISSIPPI WETLANDS RESTORATION PROJECTS.***
> (a) *IN GENERAL*.—In order to further the purposes of Section 204 of the WRDA of 1992 (33 U.S.C. 2326) and section 206 of the WRDA of 1996 (33 U.S.C. 2330), the Secretary shall participate in restoration projects for critical coastal wetlands and coastal barrier islands in the State of Mississippi that will produce, consistent with existing Federal programs, projects, and activities, immediate and substantial restoration, preservation, and ecosystem protection benefits, including the beneficial use of dredged material if such use is a cost-effective means of disposal of such material.
> (b) *PROJECT SELECTION*.—The Secretary, in coordination with other Federal, tribal, State, and local agencies, may identify and implement projects described in subsection (a) after entering into an agreement with an appropriate non-Federal interest in accordance with this section.
> (c) *COST SHARING*.—Before implementing any project under this section, the Secretary shall enter into a binding agreement with the non-Federal interests. The agreement shall provide that the non-Federal responsibility for the project shall be as follows:

(1) To acquire any lands, easements, rights-of-way, relocations, and dredged material disposal areas necessary for implementation of the project.
(2) To hold and save harmless the United States free from claims or damages due to implementation of the project, except for the negligence of the Federal Government or its contractors.
(3) To pay 35 percent of project costs.

(d) *NONPROFIT ENTITY*. — For any project undertaken under this section, a non-Federal interest may include a nonprofit entity with the consent of the affected local government.
(e) *AUTHORIZATION OF APPROPRIATIONS*.—There is authorized to be appropriated to carry out this section $10,000,000.

The National Environmental Policy Act (NEPA) of 1969, as amended, excuses or excludes the Corps from the preparation of any formal environmental analysis with respect to actions that result in minor or no environmental effects, which are known as "categorical exclusions." An intermediate level of analysis, an EA, is prepared for an action that is not clearly categorically excluded, but does not clearly require an Environmental Impact Statement (EIS) [40 Code of Federal Regulations (CFR) §1501.3 (a) and (b)]. Based on the EA, the Corps either prepares an EIS, if one appears warranted, or issues a "Finding of No Significant Impact" (FONSI), which satisfies the NEPA requirement. This EA is prepared according to the Engineer Regulation (ER) 200-2, Procedures for Implementing NEPA, and the Council of Environmental Quality (CEQ) Regulations (40 CFR § 1508.27) for Implementing the Procedural Provisions of NEPA (40 CFR § 1500-1508).

3 DESCRIPTION OF THE PROPOSED ACTION

3.1 Introduction. The project sites (i.e. western breached area, Grand Bayou Marsh, and 1850s southern shoreline) are all highly exposed and vulnerable to wind and wave energy from the southeast. A long distance of open-water exist between the barrier islands out in the Gulf of Mexico and Deer Island; thus, allowing a high amount of wave energy. On April 10, 1987, the Corps, Mobile District issued a permit to the Biloxi Port Commission authorizing use of material from the Biloxi Lateral Channel to fill the breach on Deer Island. Material – both dredged material and rip rap - has been placed at the breached site in the past but unfortunately the material did not stay due to several hurricane events. With more scientific information allowing us to understand circulations, wave, etc., in the surrounding area, the Corps, Mobile District proposes the following restoration projects.

3.2 Proposed Plan.

3.2.1. Deer Island Breach Restoration. The proposed western end breach restoration project at Deer Island consists of two revetment containment dikes, one on the south side of the island and one on the north side. Sandy fill material taken from within the breached area would be stacked and eventually covered in a geotextile material and then covered in rock (i.e. rip rap) to form the revetment containment dikes. The two dikes would serve as the containment structures for the fill material to be used to fill the breach in the western portion of Deer Island. The northern and southern containment dikes would encompass an area approximately 6.4 and 7.2 acres, respectively, while the interior of the revetments would be approximately 95 acres in total area to be filled with material from multiple private dredging projects in the Biloxi area [Commercial Docking Facility (~5,700 cys), Lighthouse Fishing Dock (~50,000 cys), Small Craft Harbor (~35,000 cys), Point Cadet Marina (~75,000 cys)] and also from the offshore borrow area adjacent to the island used in the southern shoreline restoration project.

The revetment dikes would be filled to an elevation of +3 feet from the existing ground level. The current water depth at the breach ranges between -0.5-foot and -3 feet. Approximately 4,000 linear

feet and 4,500 linear feet of revetment dikes would be required on the northern and southern side, respectively. Floatation channels would be constructed along the northern (4,000 feet) and southern (4,500 feet) dike interior portions in order to allow heavy equipment to access the site for operations. These channels would be approximately 6 feet deep by 50 feet wide. An interior channel would also be constructed in order to provide the required sandy material for the northern revetment containment dike. Approximately 55,000 and 50,000 cubic yards of sandy material from the southern access channel and the interior borrow area would be required to build the northern and southern dikes, respectively. Approximately 5,000 and 6,500 cys of rip rap material from commercial sources would be required to build the northern and southern dikes, respectively. The entire width of each dike, including the slopes and crest, would be between 60 and 70 feet. Rip rap would be placed along the exterior portions of the dikes covering the sandy and geotextile material for protection. The site would cover a total of approximately 110 acres (95 acres within the site and 14 acres for the revetment dike structure). The site would contain between approximately 675,000 and 700,000 cys of material consisting primarily of clays/ silts and sands. Appropriate maritime and dune species would be planted at the breached area.

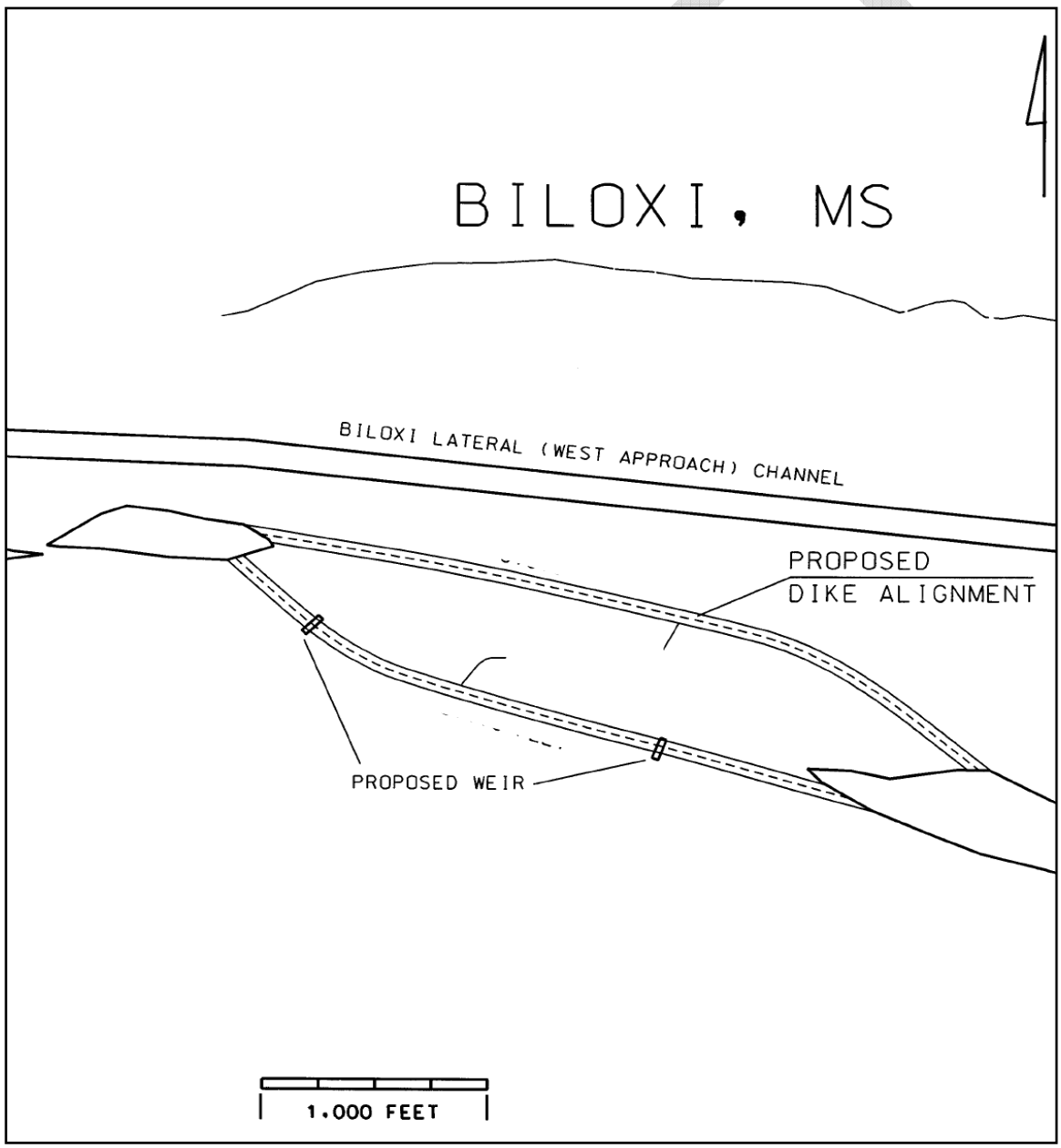


Figure 3.2.1-1: Deer Island Breached Restoration Site

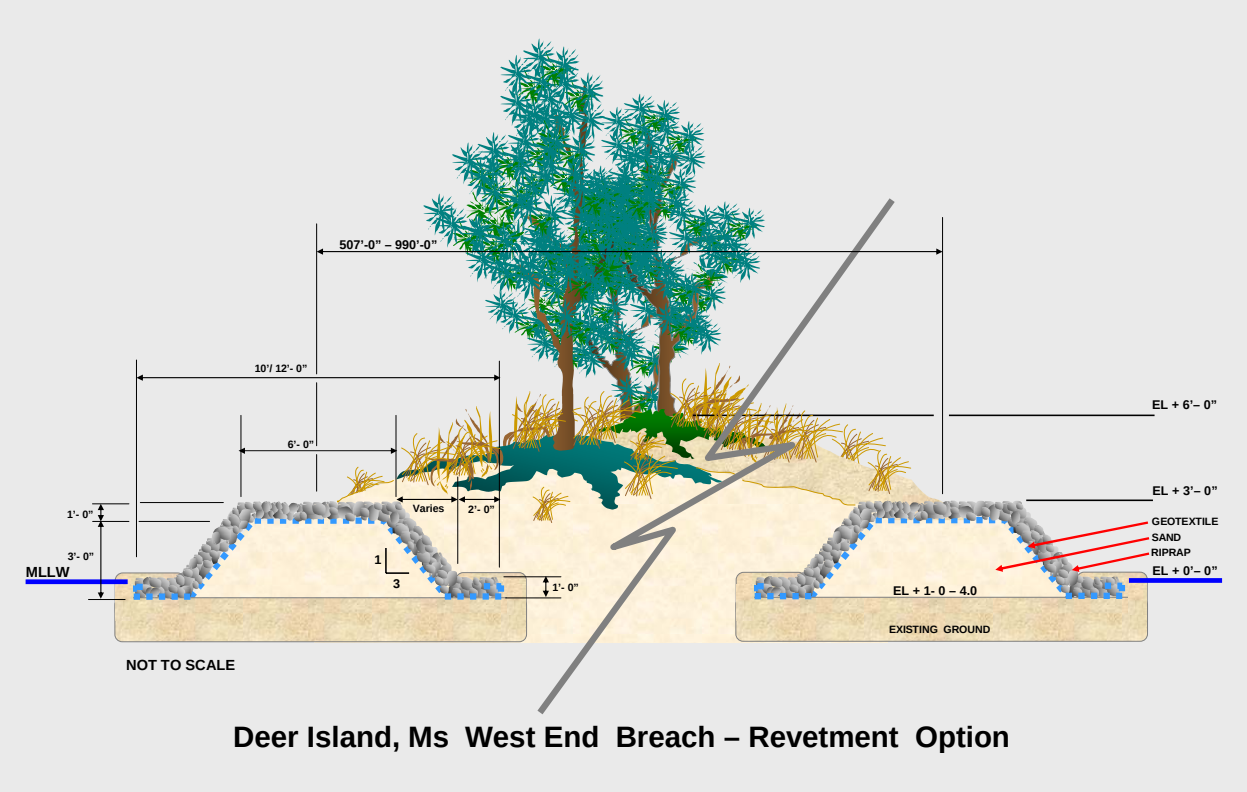


Figure 3.2.1-2: Deer Island -West End Breach

3.2.2 Deer Island Grand Bayou Marsh Restoration and the Southern 1850s Shoreline Footprint Restoration. The proposed 1850s southern shoreline restoration project would extend the entire Deer Island length, including the Grand Bayou Marsh and western end breached area, from Station 44+84.39 to Station 243+00. The restoration project would require approximately 1.3 million cys of material obtained from a local borrow source near to the island and upland disposal sites, Buena Vista and Sunflower, located in Alabama. The restored features would include approximately 100 feet of flat beach, approximately 75 feet of dunes and maritime forest, and a tidal marsh that would naturally tie into the existing marsh on the island. The area adjacent to the island that would provide the fill material is located approximately 500 feet off the southern shoreline of Deer Island. This offshore borrow area would be approximately 50 feet wide, 6 feet deep, and run the entire length of the island. This material would be cast on the existing shoreline for beach nourishment via a hydraulic dredge. Land equipment, such as a bulldozer and marsh buggy, would then shape the material on the island to form the maritime, beach, tidal marsh, and dune systems. Appropriate flora species would be planted in each specified area. The proposed restoration of the entire southern shoreline, including the Grand Bayou Marsh area, would facilitate the placement of approximately 1.3 million cys of material over a total of 273 acres. At its widest point, the restored beach would be approximately 650 feet wide, and at its narrowest only 200 feet wide. The proposed project would restore approximately 273 acres at Deer Island. Approximately 126 acres would be new beach that would be placed south of the current shoreline, while approximately 147 acres would be on the existing land mass of Deer Island.

3.3 Quantity of Material. For the breached area, the anticipated quantity of sediment to be used for each of the revetment dike structures would be between approximately 7,500 and 9,300 cys from an adjacent sand source approximately 500 feet off the southern side of the island. Approximately 3,570 linear feet and 3,170 linear feet of gravel for the revetment dikes would be required on the northern and southern side, respectively. Approximately 50,000 and 55,000 cys of sandy material taken from within the

breached area would be used to construct the dikes (i.e. from the floatation channel and an interior channel). Approximately 5,000 and 6,500 cubic yards of rip rap material from commercial sources would be required to build the northern and southern dikes, respectively. This material would be taken from the specified borrow area adjacent to the island and from the local Biloxi dredging project.

For the shoreline restoration and Grand Bayou Marsh projects, an anticipated 1.3 million cys of material would be taken from upland sites in Alabama as well as a borrow area adjacent to the island running the entire length of the island (6 feet deep by 50 feet wide). The area adjacent to the island that would provide the fill material is located approximately 500 feet off the southern shoreline of Deer Island. The offshore borrow area adjacent to the island would be approximately 50 feet wide, 6 feet deep, and run the entire length of the island. This material would be cast on the existing shoreline via a hydraulic dredge for beach nourishment.

3.4 Quality of Material. The material dredged from private dredging projects [Commercial Docking Facility (~5,700 cys), Lighthouse Fishing Dock (~50,000 cys), Small Craft Harbor (~35,000 cys), Point Cadet Marina (~75,000 cys), and other immediate projects] consists of primarily silts and clays with some sands. Material from the upland borrow sources in Alabama consists solely of sandy material previously dredged from a river source. Material dredged from the adjacent borrow area located 500 feet south of the island would consist predominantly of sandy material.

4 ALTERNATIVES TO THE PROPOSED ACTION

4.1 Introduction. In addition to the 'No Action' alternative, several alternatives were evaluated to determine the most environmentally and engineeringly suitable means of restoring Deer Island. A thorough discussion of the alternatives is presented below, including comparative evaluations leading to the recommended alternative for the proposed restoration of Deer Island (i.e. western breach, Grand Bayou Marsh, and 1850s shoreline footprint).

4.2 Measures – Containment Structures.

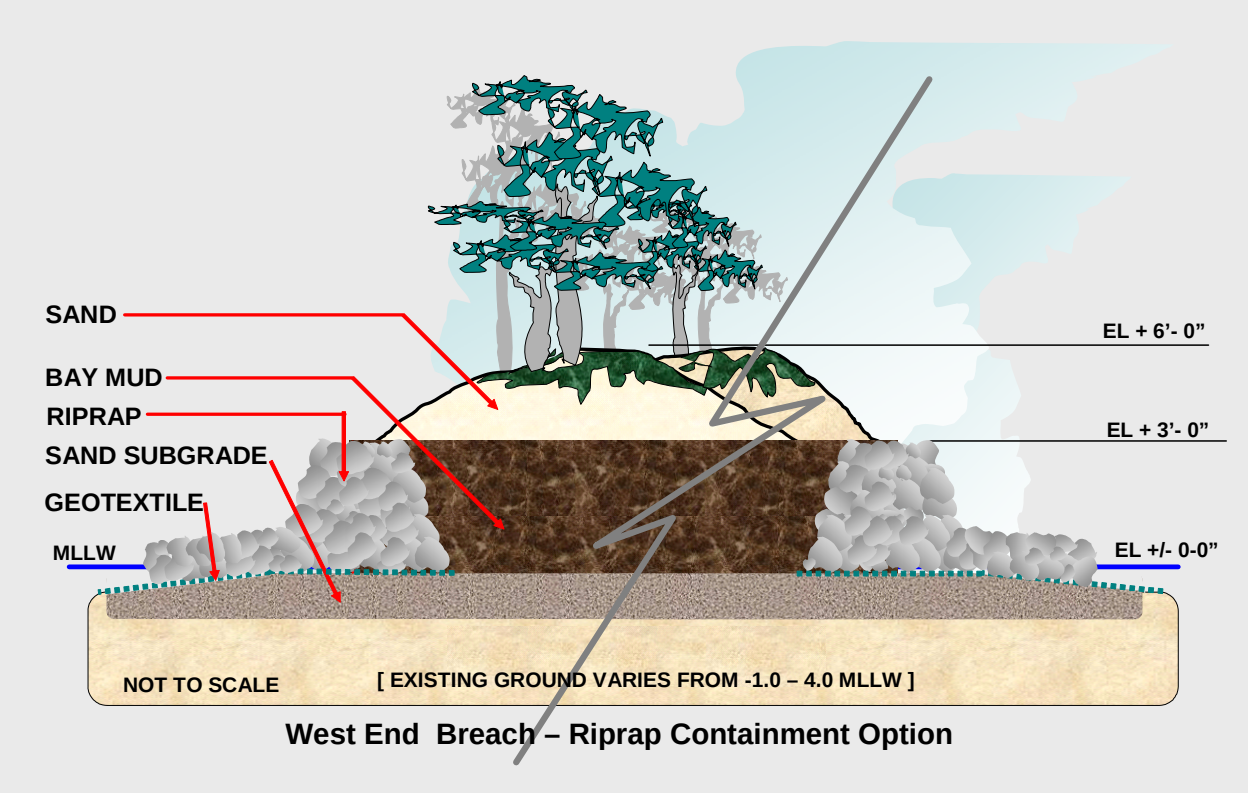
4.2.1 Breached Site. Field and laboratory subsurface testing was conducted on potential subsurface areas located on the breach alignment. Preliminary data showed that the southern portion of the island consisted predominantly of sandy material while the northern half was composed mostly of fine material. Thus, the northern alignment would have to be closely evaluated to ensure the stability of the containment structure.

4.2.1.1 Measure One - No Action. The implementation of the 'No Action' measure would result in the breached area not being restored at Deer Island. The implementation of this measure would result in continued degradation and erosion of the island. The City of Biloxi would continue to be exposed to high wave energy during storm events. In addition, nothing would be implemented to protect the Mississippi Coastal Preserve. Therefore, the 'No Action' measure was deemed unacceptable and not considered further.

4.2.1.2 Measure Two - Rip Rap Revetment. Rip rap revetment is a surface layer of natural stones (or processed concrete rubble) that depends on their individual weights to remain stable and provide protection from wave action (**Figure 4.2.1.2-1**). This structure is considered to be flexible in its response to waves because some of the stones may move without degrading the protection of the layer as a whole. The Shore Protection Manual guidelines suggest that the design wave height for flexible structures usually range from Hs to H5. For the condition at the Deer Island site, a design wave height of H5 is recommended.

Rip rap was used at Deer Island back in the late 1980s at the breached site. Sole use of this did not provide ample level of protection to adequately contain the dredged material. All dredged material washed out of the breached site in the late 1980s to early 1990s. Furthermore, the proposed dredged material consists of silts and clays with sandy material laid on top of it. Rip rap consists of large stones that have openings between each rock allowing for possible seepage into the adjacent open-water. Use of only rip rap would not provide a feasible measure. The team evaluated this alternative based on economic, engineering, and environmental principles and determined it to be not the most suitable alternative. [Rip rap was not completely eliminated from the evaluation process because it could be combined with another alternative to provide an optimal alternative.]

Figure 4.2.1.2-1:



4.2.1.3 Measure Three - Revetment. Revetment refers to a thick layer of rip rap (natural, processed stone, or processed concrete rubble) covering the sandy dike slope to be protected (**Figure 4.2.1.3-1**). The rip rap layer conforms to the sandy surface of the dike. The Shore Protection Manual guidelines suggest that the design wave height for flexible structures usually range from Hs to H5. This revetment measure is a cost-effective proposal, which would allow containment of the material via the sandy dike while also providing the armored protection via the rip rap. Thus, the team concluded that use of rip rap with a sandy center would be a feasible option to constructing dikes at the western end Deer Island breach. Measure Three – Revetment is the preferred plan.

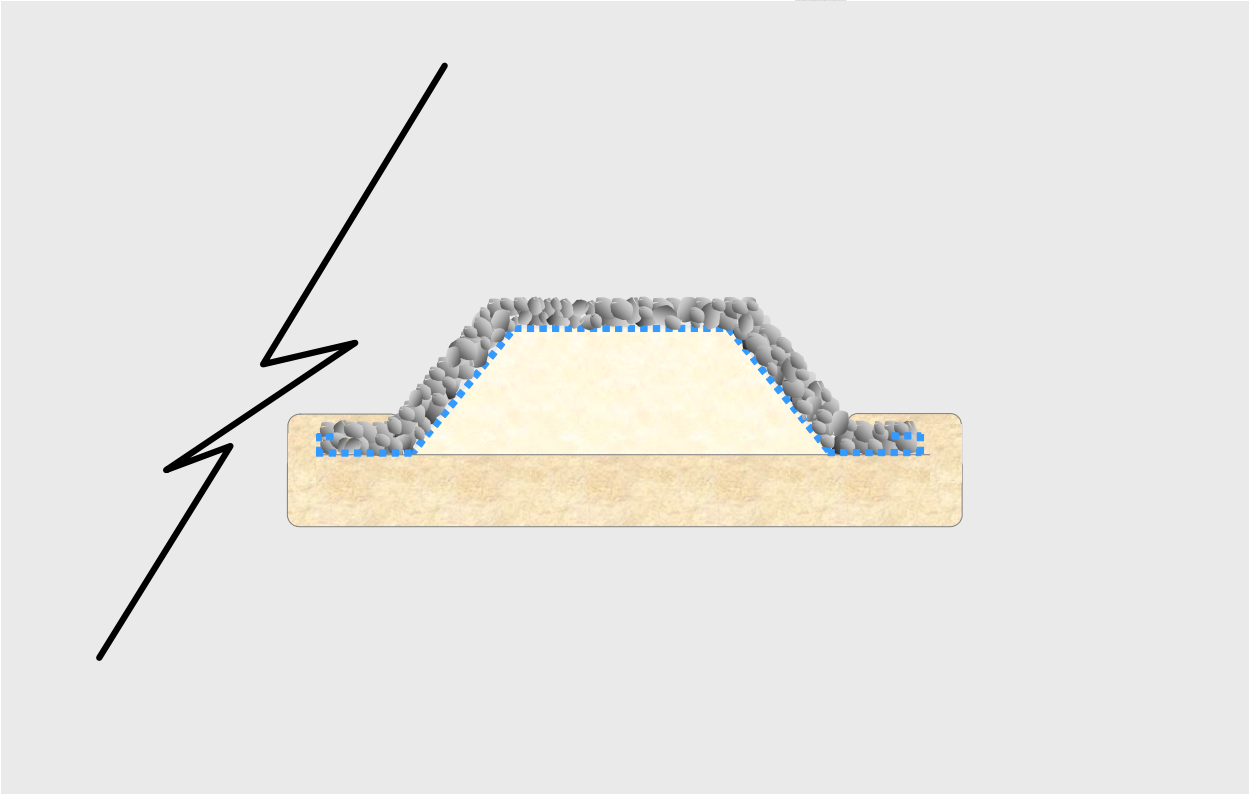
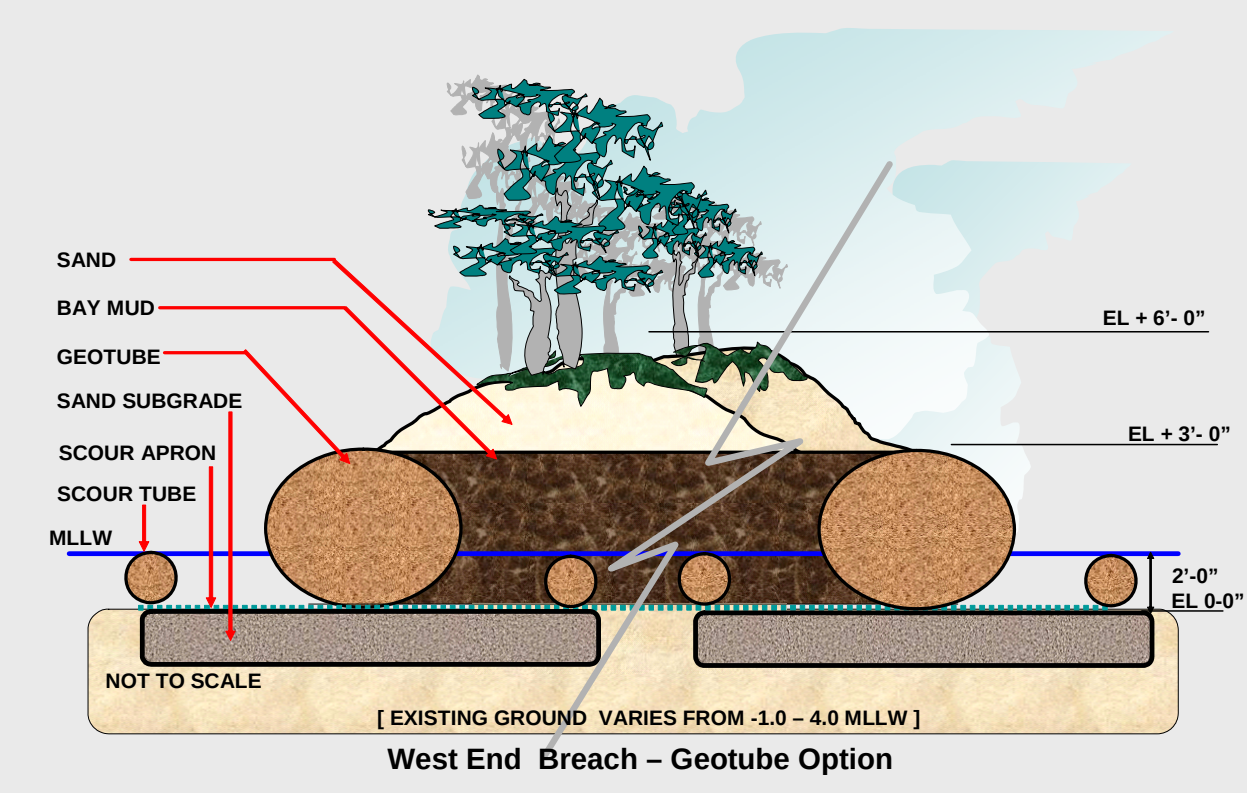


Figure 4.2.1.3-1: Revetment Containment Structure Profile

4.2.1.4 Measure Four - Geotubes. The geotube is a sausage-shaped bag made of geotextile fabric and filled with sand (**Figure 4.2.1.4-1**). The geotube relies on the weight of the sand-filled bag and the strength of the fabric to retain the sand as protection from wave action. This structure is considered to be semi-rigid in its response to waves because the bag is not expected to move but the fabric may flex and deform after exposure to waves. The Shore Protection Manual guidelines suggest that the design wave height for semi-rigid structures usually range from H10 to H1. For the conditions at the Deer Island site, a design wave height of H5 is recommended. Although this measure would provide a stable containment structures, the team identified several reasons that precluded its use. It has been the experience from other Corps Districts that these structures are subject to vandalism by the public, such as knife cuts, bonfires, etc. This would increase the cost of using these containment structures for the non-Federal sponsor. Due to the possibility of tearing and cost, this measure was not selected by the team.



4.1.2 Filling of Western Breach

4.1.2.1 Measure One – No Action. The implementation of the 'No Action' measure would result in the breached area not being filled at Deer Island. This would result in only having the containment structure without any fill material. Implementation of this measure would result in continued degradation and erosion of the island because there would not be any stability to the containment structure without the fill material reinforcing it. The City of Biloxi would continue to be exposed to high wave energy during storm events. Therefore, the 'No Action' measure was deemed unacceptable and not considered further.

4.1.2.2 Measure Two - Dredged material from multiple private dredging projects in the Biloxi area - Commercial Docking Facility (~5,700 cys), Lighthouse Fishing Dock (~50,000 cys), Small Craft Harbor (~35,000 cys), Point Cadet Marina (~75,000 cys), and other immediate projects - would be used as some of the fill material source for the western breach in Deer Island.

4.1.2.3 Measure Three – The upland disposal sites from the Black Warrior and Tombigbee Waterway, Buena Vista and Sunflower, in Alabama would be used as borrow areas for additional fill material to the western end of Deer Island.

4.2.2 Grand Bayou Marsh & 1850's Shoreline Restoration.

4.2.2.1 Containment Structures.

4.2.2.1.1 Containment Measure One - No Action. The implementation of the 'No Action' measure would result in the Grand Bayou marsh area (i.e. winding tidal creeks) and the southern shoreline

not being restored at Deer Island. The implementation of this measure would result in continued degradation and erosion of the island. The City of Biloxi would continue to be exposed to high wave energy during storm events. In addition, nothing would be implemented to protect the Mississippi Coastal Preserve. Therefore, the 'No Action' measure was deemed unacceptable and not considered further.

4.2.2.1.2 Containment Measure Two - Rip Rap Revetment. Rip rap revetment is a surface layer of natural stones (or processed concrete rubble) that depends on their individual weights to remain stable and provide protection from wave action. This structure is considered to be flexible in its response to waves because some of the stones may move without degrading the protection of the layer as a whole. The Shore Protection Manual guidelines suggest that the design wave height for flexible structures usually range from Hs to H5. For the condition at the Deer Island site, a design wave height of H5 is recommended. Sandy material would then be pumped into the containment site in order to reestablish th eroded Deer Island footprint.

Use of only rip rap would not provide a feasible measure because this would armor the entire southern shoreline and Grand Bayou, which has historically been a sandy beach. Ultimately changing the look of Deer Island. The Mississippi Coastal Preserve team requested the Corps to minimize the use of hardened structures. Implementation of this measure would not meet their expectations. The team evaluated this alternative based on economic, engineering, and environmental principles and determined it to be not the most suitable alternative.

4.2.2.1.3 Containment Measure Three - Gravel Revetment. Gravel revetment refers to a thick layer of gravel (natural, processed stone, or processed concrete rubble) covering the slope to be protected. The gravel layer conforms to the surface of the dike. The gravel is somewhat similar to the rip rap except that the stone sizes are much smaller, the layer is thicker, and the gravel is not only considered more flexible but is expected to deform in response to the wave energy. The Shore Protection Manual guidelines suggest that the design wave height for flexible structures usually range from Hs to H5. A design wave height of Hs is recommended for gravel at the Deer Island sites. Sandy material would then be pumped into the containment site in order to reestablish th eroded Deer Island footprint. Again this would harden the southern shoreline. Thus, the team concluded that use of gravel would not be a feasible option to constructing dikes at Deer Island.

4.2.2.1.4 Containment Measure Four - Geotubes. Geotubes were described above in Section ???. Sandy material would then be pumped into the containment site in order to reestablish th eroded Deer Island footprint. Use of the structures along the southern shoreline were eliminated for the same reason as above.

4.2.2.1.5 Containment Measure Five – Sandy Material. The team worked closely with the MDMR team to determine what would be and would not be acceptable to construct at Deer Island. Upon evaluating several restoration options along the southern shoreline, the team then began assessing use of sandy material borrowed from an adjacent site to be placed on the shoreline and also on the island. This material would be shaped to mimic the natural topography of the island. The team selected use of this measure with the understanding that Deer Island is a very dynamic environment and this placement of sandy would most likely be reworked by the wave energy.

4.2.2.2 Project Dimensions.

4.2.2.2.1 Measure - Option 1. This option is the proposed placement of approximately 200,000 cys of material over approximately 4,000 linear feet of shoreline across from the mouth of the Grand

Bayou tidal creek system from Station 157+75 to Station 182+25. The fill material would be obtained from upland disposal areas from the Black Warrior and Tombigbee Waterway, Sunflower and Buena Vista, in Alabama. The restored beach would be constructed via land equipment to have a natural topography that would tie into the already existing features of the island. These features would include approximately 100 feet of flat beach, approximately 75 feet of dunes and maritime forest, and a tidal marsh that would naturally tie into the existing marsh on the island.

4.2.2.2.2 Measure - Option 2. This option is the proposed placement of approximately 267,000 cys of material over approximately 5,800 linear feet of shoreline across from the mouth of the Grand Bayou tidal creek system from Station 154+00 to Station 186+00. The fill material would be obtained from upland disposal areas from the Black Warrior and Tombigbee Waterway, Sunflower and Buena Vista, in Alabama and also from local sources close to the island. The area adjacent to the island that would provide the fill material is located approximately 500 feet off the southern shoreline of Deer Island. The offshore borrow area adjacent to the island would be approximately 1,000 feet wide, 6 feet deep, and 24,000 feet in length (the entire length of Deer Island). This material would be cast on the existing shoreline for beach nourishment via a hydraulic dredge. Land equipment, such as a bulldozer and marsh buggy, would then shape the material on land. These features would include approximately 100 feet of flat beach, approximately 75 feet of dunes and maritime forest, and a tidal marsh that would naturally tie into the existing marsh on the island.

4.2.2.2.3 Measure - Option 3. This option is the proposed placement of approximately 375,000 cys of material, being obtained from previously described upland disposal areas in Alabama and a local borrow source adjacent to the island, over approximately 7,800 feet of shoreline across from the mouth of the Grand Bayou tidal creek system from Station 147+75 to Station 192+25. In addition to the Alabama upland disposal sites, the fill material would be obtained from local sources close to the island. The area adjacent to the island that would provide the fill material is located approximately 500 feet off the southern shoreline of Deer Island. The offshore borrow area adjacent to the island would be approximately 1,000 feet wide, 6 feet deep, and 24,000 feet in length (the entire length of Deer Island). This material would be cast on the existing shoreline for beach nourishment via a hydraulic dredge. Land equipment, such as a bulldozer and marsh buggy, would then shape the material on land. The island would be shaped to the existing topography as described in Section 4.2.2.2.2.

4.2.2.2.4 Measure - Option 4: This option is the proposed placement of approximately 442,000 cys of material over approximately 9,600 feet of shoreline across from the mouth of the Grand Bayou tidal creek system from Station 144+25 to Station 196+00. The fill material would be obtained from local sources close to the island and from previously described upland disposal sites in Alabama. The area adjacent to the island that would provide the fill material is located approximately 500 feet off the southern shoreline of Deer Island. The offshore borrow area would be approximately 1,000 feet wide, 6 feet deep, and 24,000 feet in length (the entire length of Deer Island). This material would be cast on the existing shoreline for beach nourishment via a hydraulic dredge. Land equipment, such as a bulldozer and marsh buggy, would then shape the material on land. These features would include approximately 100 feet of flat beach, approximately 75 feet of dunes and maritime forest, and a tidal marsh that would naturally tie into the existing marsh on the island.

4.2.2.2.5 Measure - Option 5: This option is the proposed restoration, to the pre 1850's shoreline, of the entire southern shoreline of Deer Island, including the Grand Bayou Marsh area, that extends from the breach on the western end of the island to the far eastern side, Station 44+84.39 to Station 243+00, with approximately 1.3 million cys of material obtained from local sources near to the island, and upland disposal sites, Buena Vista and Sunflower, in Alabama. These features would include approximately 100 feet of flat beach, approximately 75 feet of dunes and maritime forest, and a tidal marsh that would naturally tie into the existing marsh on the island. The area adjacent to the island that

would provide the fill material is located approximately 500 feet off the southern shoreline of Deer Island. The offshore borrow area adjacent to the island would be approximately 50 feet wide, 6 feet deep, and 1,000 feet in length. This material would be cast on the existing shoreline for beach nourishment via a hydraulic dredge. Land equipment, such as a bulldozer and marsh buggy, would then shape the material on the island to form the maritime, beach, tidal marsh, and dune systems. The proposed restoration of the entire southern shoreline would facilitate the placement of approximately 1.3 million cys of material over a total of 273 acres. At its widest point the restored beach would be approximately 650 feet wide, and at its narrowest only 200 feet wide. The total affected area of the proposed restoration would be approximately 273 acres (approximately 11,895,000 sq. feet). Approximately 126 acres would be new beach that would be placed south of the current shoreline, while approximately 147 acres would be on the existing land mass of Deer Island. Option 5 is the proposed measure that the team selected.

5 AFFECTED ENVIRONMENT

5.1 History. Local and congressional interest requested Federal Action to address restoration of Deer Island. Particular concern has been expressed from the resource agencies that any improvements be constructed in a manner that minimizes adverse impacts to the area's resources.

5.2 Climate. The coastal area is a humid, warm-temperature to sub-tropical climate. Occasional subfreezing temperatures occur in the area. The Gulf of Mexico greatly influences air temperatures of the coastal counties. During the spring months of March through May, synoptic scale weather systems, highlighted by very active frontal passages, move through the region on an average of every 5 to 7 days. The average temperature during these months is 67° Fahrenheit (F) with a mean minimum of 57° F and a mean maximum of 77° F. The prevailing wind direction is typically east-southeast to southeast at 6 to 12 knots outside of thunderstorms. Passage of frontal systems is significantly reduced during the summer months of June through August. Hot and hazy conditions are normal with an average temperature of 81.7° F while the mean minimum temperature is 72.8° F and the mean maximum is 91.2° F. The prevailing wind direction maintains a southerly component at 4 to 8 knots, outside of thunderstorms. Thunderstorms and rain showers diminish during the September to November time period. The average temperature is 69° F with a mean minimum temperature of 58.5° F and a mean maximum temperature of 78.5° F. A 4 to 7 knot north-northwest prevailing wind is dominant during this period. From December to February, synoptic scale weather systems pass through the region with a northerly prevailing wind direction of 5 to 11 knots. The average temperature is 52° F with a mean minimum of 41.5° F and a mean maximum of 62.1° F. The record low temperature for the region, 5° F, was recorded during this period. Annual rainfall is between 55 and 64 inches per year (Corps, Mobile District 1984).

5.3 Topography. Mississippi Sound is 81 miles long, 7 to 15 miles wide and averages 9.9 feet in depth (Eleuterius 1976). Its seaward limit is formed by five barrier islands, and on the southwest, between Half Moon (Grand) Island and Isle au Pitre, by marsh island remnants of the St. Bernard subdelta. The five barrier island system is comprised of Cat, East Ship, West Ship, Horn, Petit Bois and Dauphin Island.

5.4 Geology. Geologic processes have shaped the present configuration and geomorphology of the Mississippi Gulf Coast for the past 1.6 million years, particularly in the past 18,000 years, and efforts of man to stabilize an eroding shoreline with structures and artificial fill. The Biloxi Formation is a transgressive unit deposited in marine and brackish water both nearshore and offshore. This formation is not exposed along the coast, but is visible in the excavated banks of the Industrial Seaway in Gulfport. It consists of clays, fine sands, and sandy clays with abundant fossils, including both shells and microscopic

fossils called foraminifers, which help to identify its environment of deposition (Otvos 1985). It ranges from 15 to 45 feet in thickness in Harrison County to as much as 120 feet thick in Jackson County.

The Prairie Formation is the alluvial (river system) equivalent of the marine Biloxi Formation. It was deposited in the river channels and inter-channel swamps, which formed where the rivers met the coast marine environment. It is composed of primarily sands and muddy sands with fossil tree trunks, leaves, and occasionally pine cones. The Prairie Formation ranges from 15 to 40 feet thick, and is visible in the Industrial Seaway cut in Harrison County.

The Gulfport Formation is the most prominent and probably the most exploited geologic formation on the coast. It is a regressive sand unit deposited during the highest sea level stage of the Pleistocene. It forms the high ridge upon which the cities along the Harrison County coast are built (i.e. Pass Christian – Long Beach – Gulfport – Biloxi). The Gulfport Formation beach ridges probably extended several miles south from the present shoreline immediately after they were deposited, but subsequent erosion has resulted in their current geographic extent. All sand on the mainland beaches of Mississippi comes indirectly from the Gulfport Formation. Two islands in the Mississippi Sound, Round Island in Jackson County and Deer Island in Harrison County, are remnant Gulfport Formation sand ridges, which were once connected to the ancient mainland (Otvos 1985).

5.5 Soils. Harrison County is dominated by the following soils:

- Eustis loam sand, 0 to 5 percent slopes (hydric inclusions)
- Lakeland fine sand (not hydric)
- Sulfaquepts (hydric inclusions)
- Poarch fine sandy loam, 2 to 5 percent slope (hydric inclusions)
- Atmore silt loam (hydric)
- Latonia loamy sand (hydric inclusions)
- Harleson fine sandy loam, 0 to 2 percent slopes (hydric inclusions)

5.6 Surface Water. Mississippi Sound is 140 miles long and about 13.5 miles in width; however, the Sound averages only 9.9 feet in depth. Mississippi Sound is less salty than that of the Gulf of Mexico due to the constant freshwater influx from the surrounding rivers. This mixing of fresh and saltwater produces the brackish water of the Sound that ranges between 3 and 27 parts per thousand (ppt). The Gulf of Mexico keeps Mississippi's three coastal counties warmer in winter and cooler in summer. The average surface temperatures are provided in Table 5.6.1 below.

TABLE 5.6.1:

Month	Average Sea Surface Temperature (F°)	Month	Average Sea Surface Temperature (F°)
January	56.8	July	84.4
February	57.7	August	84.7
March	62.2	September	82.2
April	68.5	October	75.0
May	76.5	November	67.3
June	82.2	December	60.8

Mississippi Sound is classified for recreational uses except in areas that are approved for shellfish harvesting. These areas carry more stringent bacteria standards than that of recreation waters.

Mississippi Sound has high fecal coliform concentrations and has once been classified as "the most serious water quality problem in the state." Nutrients within the Mississippi Sound reflect the influence of the freshwater discharges from the Mobile, Pascagoula, and Pearl River systems. During spring, nitrate concentrations increased and orthophosphate concentrations decreased through the Sound due to high freshwater discharge. The reverse relationship was confirmed for the low summer freshwater inflow period (June-September).

5.7 Flora. Coastal Mississippi is in the Temperate Deciduous Forest Biome (Eleuterius 1998). Hancock, Harrison, Jackson counties are in the Coastal Pine Meadows physiographic region, sometimes referred to as the Coastal Terraces. Hot summers, mild winters, and abundant rainfall (usually 40 to 60 inches per year) falling mostly during the spring and summer months support a diverse assemblage of herbaceous plants, shrubs, and trees (Eleuterius 1998). Delineating geographic boundaries of forest types and natural communities is made difficult due to natural variation and is of limited utility for planning purposes except on a very small scale (for example, on-site wetland delineation to protect wetlands). Upland deciduous forests occur in generally cool and moist areas, and they burn much less frequently than pine forests or mixed forests. Deciduous forests can be found on upper river terraces, slopes, and coves, and infrequently on flooded stream bottoms. Some deciduous forests support tree species that are in the extreme southern portions of their ranges. Scattered pockets of forest dominated by American beech (*Fagus grandifolia*) and southern magnolia (*Magnolia grandiflora*) are thought to be relicts of Pleistocene ice age conditions in the East Gulf Coastal Plain, and they contain many species found in northern forests in addition to species endemic to southern Mississippi. Oaks (*Quercus* spp.), maples (*Acer* spp.), blueberry shrubs (*Vaccinium* spp.), greenbriar vines (*Smilax* spp.), and many spring wildflower species are common in beech and magnolia forest communities (Natureserve Explorer 2002).

Seepage areas in pine-dominated uplands also can support deciduous forest. The tree canopy in these areas is variable with tulip poplar (*Liriodendron tulipifera*), swamp black gum (*Nyssa biflora*), and southern magnolia (*Magnolia virginiana*) in the overstory, but sweetgum (*Liquidambar styraciflua*), loblolly pine (*Pinus taeda*), and red maple (*Acer rubrum*) can make up a significant portion of the canopy. Seepage areas often have well-developed shrub and herbaceous layers (Natureserve Explorer 2002). Oak forests are often found on moist slopes in the East Gulf Coastal Plain. Tree species often dominant in the canopy are white oak (*Quercus alba*), water oak (*Quercus nigra*), laurel oak (*Quercus hemisphaerica*), tulip poplar, sand hickory (*Carya pallida*), white ash (*Fraxinus americana*), and American elm (*Ulmus americana*) (Natureserve Explorer 2002). Shade-tolerant species persist as medium and small trees in the mid-story. Magnolias (*Magnolia* spp.), American beech, paw paw (*Asimina triloba*), American holly (*Ilex opaca*), and flowering dogwood (*Cornus florida*) are often found in oak forests. Shrubs and woody vines are numerous. Woody vines represented are grapevine (*Vitis rotundifolia*), Virginia creeper (*Parthenocissus quinquefolia*), poison ivy (*Toxicodendron radicans*), greenbriar, and cross-vine (*Bignonia capreolata*). Herbaceous vegetation is usually sparse and not well developed.

Upland mixed forests are mostly mid-successional secondary forests found on drier sites that have been subject to timber harvest and fire suppression. The canopy is a mix of loblolly pine (*Pinus taeda*) and assorted hardwoods, such as southern red oak (*Quercus falcata*), white oak, post oak (*Quercus stellata*), and black oak (*Quercus velutina*). Small trees are well represented in this forest type. Flowering dogwood, hop-hornbeam (*Ostrya virginiana*), black cherry (*Prunus serotina*), winged elm (*Ulmus alata*), and sourwood (*Oxydendrum arboreum*) are commonly observed. Shrubs include witch hazel (*Hamamelis virginiana*), wax myrtle (*Myrica cerifera*), and blueberry. Grapevine and longleaf spikegrass (*Chasmanthium sessiliflorum)* are often dominant in the understory (Natureserve Explorer 2002). Slash pine (*Pinus elliottii*) upland flatwoods are found on barrier islands and also in mainland locations very near the water. Most remaining examples of this community are considered threatened by fragmentation, development, and fire suppression (Natureserve Explorer 2002). The canopy varies from

open to closed, and may support a mix of slash pine and longleaf pine (*Pinus palustris*). Live oak (*Quercus virginiana*), sand live oak (*Quercus geminata*), laurel oak (*Quercus hemisphaerica*) are common in the subcanopy. Typical understory species are similar to those found in coastal shrublands and include yaupon (*Ilex vomitoria*), saw palmetto (*Serenoa repens*), wax myrtle (*Myrica cerifera*), greenbriar, blueberry, and grapevine.

Dry longleaf pine sandhill woodland is found on well-drained sandy soils. Lakeland soils often support dry longleaf pine forests. Fire suppression, development, and conversion to pine plantation have degraded or destroyed most of this forest type in the Southeast (Natureserve Explorer 2002). In the presence of prescribed fire or natural wildfires, longleaf pine covers from 10 to 30 percent of the overstory. The size and density of understory oaks, such as turkey oak (*Quercus laevis*), blue-jack oak (*Quercus incana*), sand live oak, and sand post oak (*Quercus margaretta*), are variable and would be expected to depend on the effects of periodic fires. Herbaceous species include little bluestem (*Schizachyrium scoparium*), three-awn grass (*Aristida* spp.), and broom snoutbean (*Rhynchosia cytisoides*).

Areas with wetter soil conditions can support forests dominated by longleaf pine and southern red oak. This forest type occurs on somewhat poorly drained to well-drained loamy soils with clay layers in the B horizon, such as Benndale, Cahaba, Smithdale, Petal, and Susquehanna. Species more common in wetlands can occur in patches where clay content in the soil is high. Longleaf pine is the canopy dominant. Beneath the pine canopy, some hardwoods can be co-dominant in the canopy depending on the frequency and intensity of the fire regime. Hardwood trees can include southern red oak, water oak, flowering dogwood, black gum (*Nyssa sylvatica*), and red bay (*Persea borbonia*). Shrubs are blueberries, hollies (*Ilex* spp.), wax myrtle, and horse sugar (*Symplocos tinctoria*). The herbaceous layer is very diverse and often well developed with grasses (*Aristida* spp., *Schizachyrium* sp.), forbs, sunflowers (Asteraceae), and meadow-beauty (*Rhexia alifanus*) (Natureserve Explorer 2002).

Wet scrub-shrub plant communities include shrublands dominated by black willow (*Salix nigra*) and buttonbush. This plant community type is found on the wet shorelines of lakes and ponds, particularly reservoirs and farm ponds, and is dominated by fast-growing species such as black willow, sweetgum, and red maple (*Acer rubrum*). The shrub layer features dense, almost pure stands of buttonbush and little else (Natureserve Explorer 2002).

Gulf Coast barrier islands and barrier spits can support stunted oak and yaupon shrublands. These scrub-scrub habitats are most often located on rises surrounded by black needlerush (*Juncus roemarianus*) salt marshes and have been reported from the Gulf Islands National Seashore (Natureserve Explorer 2002). Stunted slash pine may be present in the overstory, but most cover will be in a shrub layer dominated by yaupon, live oak, sand live oak, wax myrtle, saw palmetto, and salt bush (*Baccharis halimifolia*).

One common wetland shrub community is the black titi (*Cliftonia monophylla*)–shining fetterbush (*Lyonia lucida*)–blaspheme-vine (*Smilax laurifolia*) shrubland. This shrub community occurs in wetlands larger than 741 acres that remain flooded for extensive periods of time (Natureserve Explorer 2002). Peat soils between 1 to 2 meters deep form in these shrublands. Black titi is the dominant shrub, but occasional longleaf or slash pine trees may be present, especially in transition zones. Herbaceous cover is patchy and not well developed. Herb species might include pitcher plants (*Sarracenia* spp.), bladderwort (*Utricularia* sp.), and beakrush (*Rhynchospora* sp.). Peat moss is common in the ground layer and is an important component of peat soils. Fire is not common in this community, although shrublands are probably more common because of logging and fire suppression in recent years (Natureserve Explorer 2002).

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Upland areas that have been cutover or burned are identified by remote sensing as having been recently subject to removal of vegetation because of timber harvest or wildfire. Under normal conditions, these areas would be expected to undergo succession from herbaceous and shrub species to mature forest as the landscape naturally revegetates or is manually replanted. These areas have been identified as having significant amounts of exposed mineral soil. Naturally occurring beaches are common near the coast and may support some dune grasses and scattered small shrubs. Disturbed areas in inland habitats not yet supporting vegetative cover might also appear as this land use type.

Bottomland hardwoods are tree species that grow vigorously in frequently flooded and saturated soils. Swamps are wetlands in which large and medium-sized trees are dominant. Away from the coast, extensive areas of bottomland hardwoods are found along the Pearl and Pascagoula Rivers.
Water tupelo (*Nyssa aquatica*)–swamp blackgum forests are found in swamps and floodplains. Bald cypress (*Taxodium distichum*) can also be present, but it seldom occupies more than 25 percent of the canopy (Natureserve Explorer 2002). Other tree species are green ash (*Fraxinus pennsylvanica*), black willow, and ironwood (*Carpinus caroliniana*). These swamp forests are submerged at least several months of the year. Shrubs and herbs are not common. Fetterbush (*Leucothoe racemosa*) and titi are sometimes present in the shrub layer Lizard's tail, poison ivy, crossvine, planer tree (*Planera aquatica*), and pepper-vine (*Ampelopsis arborea*) are found in the ground layer.

Smaller patches of bottomland hardwood forest occur in swampy habitats along small, seepage-fed streams. Swamp blackgum-sweetbay (*Magnolia virginiana*)–bayberry (*Morella* spp.) communities dominate dense swamp forests in these habitats. Slash pine may be present, although it has often been removed by timber harvest. Canopy species often include red maple, sweetgum, tulip poplar, and loblolly pine. Shrubs are fetterbush (*Lyonia lucida*), titi (*Cyrilla racemiflora*), and pepperbush. The herbaceous layer is scattered and features clumps of ferns (*Osmunda* spp. and *Woodwardia* spp.). Other herbaceous species are sedges (*Carex* spp.), beakrushes, and lizard's tail. The endangered plant species Louisiana quillwort (*Isoetes louisianensis*) is known from this plant community (Natureserve Explorer 2002).
The canopy of this wet pine savannah plant community contains longleaf pine and slash pine. The shrub stratum features clumps of gallberry (*Ilex glabra*) or other wetland shrub species. The ground layer is dominated by a well-developed community of diverse carnivorous plants such as pitcher plants (*Sarracenia alata, Sarracenia psittacina*) and sundews (*Drosera* sp.) that trap and digest insects to obtain nutrition not otherwise available in highly acidic wetland soils. Because pitcher plant bogs are generally found in wet pine savannahs, the names are used somewhat interchangeably. Other plants known from this community are toothache grass (*Ctenium aromaticum*), beakrush (*Rhynchospora chapmanii*), gulf chaffhead (*Carphephorus pseudoliatris*), numerous sunflowers (Asteraceae), milkworts (*Polygala* spp.), forbs, and sedges. (Natureserve Explorer 2002). The Mississippi sandhill crane is found in this habitat type in its wildlife refuge in coastal Jackson County.

Wetlands lacking trees or dominant woody vegetation are frequently called marshes. Marshes are dominated by emergent vegetation, which is herbaceous vegetation that grows above the waterline most of the year. Freshwater marshes are found in the lower portions of river systems, usually between forested wetlands and deepwater habitats. Spikerushes (*Eleocharis* spp.), bullrushes (*Scirpus* spp.), sedges, wild rice (*Zizania aquatica*), lizard's tail, marsh fleabane (*Pluchea purpurascens*), and knotweeds (*Polygonum* spp.) are found there (Eleuterius 1998). Marshes studied by Eleuterius (1973) "showed a progressive increase in vascular plants from saline to freshwater."

Intermediate and brackish marshes are found in tidal areas with higher concentrations of salt. Saltwater concentrations vary over the course of the year. Brackish marshes have higher salt concentrations than intermediate marshes. In the brackish zone there is some overlap between species characteristic of freshwater and saltwater marshes, although some plants are found in this zone exclusively (Eleuterius 1998). These plants include black needlerush (*Juncus roemerianus*), common

reed (*Phragmities communis*), sawgrass (*Cladium jamaicense*), knotweed (*Sagittaria lancifolia*), and cordgrass (*Spartina patens*, *Spartina alterniflora*). The most common tidal marsh in coastal Mississippi consists of extensive stands of black needlerush (MDMR 1998a).

Salt marsh (saline marsh) is found in areas with nearly full-concentration seawater. These marshes have black needlerush, various cordgrass species, sea lavender (*Limonium carolinianum*), and salt marsh aster (*Aster tenuifolius*). Hypersaline salt flats have only the most salt-tolerant vegetation. Annual glasswort (*Salicornia bigelovii*), sea blites (*Suaeda linearis*), and saltwort (*Batis maritimus*) are known from these areas.

High turbidity and lack of suitable substrate have limited distribution of submerged aquatic vegetation (SAV) in Mississippi. SAVs have been restricted to relatively quiet waters along the mainland and barrier island shores. Isolated patches occur only several hundred acres in size north of Horn and Petit Bois Islands. Freshwater SAVs are found along the edge and bottom of the river tributaries of Mississippi; however, these SAVs are more abundant in more inland portions of the estuarine areas. In turbid waters of the Sound, seagrass beds are typically found in shallow water less than six feet in depth, most in two or less. With the exception of shoal grass (*Halodule wrightii*), which grows on hard sand bottoms, the species characteristic of Mississippi Sound area prefer soft muddy substrates. A study of the Mississippi portion of Mississippi Sound by Eleuterius in 1969 indicated that about 20,000 acres of SAVs were present including turtle grass (*Thalassia testudinum*), manatee grass (*Cymodocea manatorum*), shoal grass, *Halophilia engelmanni* (no common name), and widgeon grass (*Ruppia maritima*). In 1969, Hurricane Camille destroyed the majority of SAVs along the Mississippi Gulf coast (Eleuterius 1973). Moncreiff et al. (1998) identified the northern shorelines of Ship, Horn, and Petit Bois Islands as potential habitat for seagrass beds. These areas have historically supported populations of shoal grass, *Halophila engelmannii*, manatee grass, and turtle grass. Currently, these locations only appear to support beds of shoal grass. Seagrass beds were also identified in the Grand Batture area south of the marshes in eastern Jackson County and along the Mississippi-Alabama border. In areas where SAVs are present, significant quantities of benthic and epibenthic macroalgae are found, such as red, brown, and green species.

5.8 Fauna. Many species of invertebrates and vertebrates make up the various fauna population along the Gulf coast. Invertebrate populations in Mississippi Sound and the nearshore area of the Gulf of Mexico transfer energy through the coastal food web. Microscopic estuarine zooplankton live throughout the water column with limited mobility. Larval stages of benthic forms and eggs and larval stages of many fish species are often interspersed throughout zooplankton. Many important commercial species feed upon zooplankton.

Vittor and Associates (1982) investigated the macrofauna of Mississippi Sound and selected areas in the Gulf of Mexico. Over 532 taxa from offshore Mississippi and Alabama and 437 taxa from the Mississippi Sound were identified. Densities of individuals varied from 910 to 19,536 individual/ yard^2 for the offshore and 1,200 and 38,863 individual/ yard^2 for the Sound area. Abundance of macrofauna is temporal with greatest densities occurring from fall to spring.

Oyster production in Mississippi depends on public reefs managed by the MDMR. The State of Mississippi accounts for about 13% to 17% of Gulf oyster landings. Reefs are located along the coast across the entire state with the largest reefs near the western boundary. According to a 1966 survey by W.J. Demoran, there were 9,934 acres of oysters. At that time, there were 582 acres of planted oyster beds. Additional acreage has been planted. A few small areas of oyster bottom have been leased for private development; however, production from these areas has been negligible. There have been considerable annual variations in size of productive areas due to natural environmental fluctuations, such as freshwater flow into the oyster beds. Many of Jackson County's most productive areas have been closed to harvest due to increased pollution associated with coastal development.

Many commercially important species of crustaceans are harvested in Mississippi Sound and the nearshore of the Gulf of Mexico. Brown shrimp (*Penaeus aztecus*) is the main shrimp species harvested by commercial fishermen in the Gulf of Mexico and is the most important commercial species in the Mississippi Sound and Mobile Bay area. White shrimp and blue crab are also harvested within the study area. In addition to those commercial species, there is a very diverse community of crustaceans within Mississippi Sound and adjacent waters including a wide variety of forms and habitat preferences. Epibenthic crustaceans dominate the diet of flounder, catfish, croaker, porgy, and drum.

Christmas and Waller (1973) reported 138 fish species in 98 genera and 52 families taken from areas across Mississippi Sound. The major fisheries landed along the Mississippi Gulf coast are anchovies, menhaden, mullet, croakers, shrimp, and oyster. Jackson County, primarily the ports of Pascagoula and Moss Point, receives greater than 85% of all Mississippi landings, including all industrial fish (menhaden), 95% of the mullet, trout, and red snapper, and 74% of the croaker landed (Corps 1992). Coastal wetlands of Mississippi Sound, St. Louis Bay, Biloxi Bay, Pascagoula Bay, and the tidal Pascagoula River provide the resource base for commercial and marine recreational fishing and tourism in Mississippi. The dockside value of commercial fish landings in Mississippi was almost $42 million in 1995. Recreational fisheries also play an important role in the state's economy. In 1991, 500,000 people spent more than $236 million fishing in Mississippi's waters, generating almost $14 million in state sales tax, resulting in $131 million in earnings, and supporting more than 8,000 jobs. Approximately one-quarter of the recreational fishing occurs in coastal waters. Communities such as Moss Point, Pascagoula, Gautier, Ocean Springs, Biloxi, Long Beach, Gulfport, Pass Christian and Bay St. Louis all depend on fishing to support their local economies (NMFS, 2002).

Coastal Mississippi supports an array of reptiles, amphibians, birds, and mammals. Reptiles and amphibians found in the area include snakes, turtles, lizards, toads, frogs, salamanders, and crocodilians. Coastal Alabama and Mississippi have a great diversity of reptiles including 23 species of turtles, 10 species of lizards, 39 species of snakes, and the alligator. Eighteen species of salamanders and 22 species of frogs and toads are indigenous to the coastal region.

Mammals found within the area include marsupials, moles and shrews, bats, armadillos, rabbits, rodents, carnivores, even-toed hoofed mammals, and dolphins. Mammals occur within all habitats of the system, using underground burrows, the soil surface, vegetative strata, the air, and the water for feeding, resting, breeding, and bearing and rearing young. There are 57 species of mammals found in the area. Several species of mammals include the raccoon, river otter, gray fox, striped skunk, mink, whitetailed deer, bottlenose dolphin, beaver, possum, and nine-banded armadillo. A number of whales are known to occur offshore Mississippi and Alabama and occasionally are sighted within the Mississippi Sound. Over 300 species of birds have been reported as migratory or permanent residents within the area, several of which breed there as well. Shorebirds include osprey, great blue heron, great egret, piping plover, sandpiper, gulls, brown and white pelicans, American oystercatcher, and terns. Birds of the area eat a great variety of foods, are also food to many predators, and exhibit a diversity of nesting behaviors.

5.9 Endangered and Threatened Species. Table 5.9.1 provides a list of endangered and threatened species identified in Harrison and Jackson Counties, Mississippi by the U.S. Fish and Wildlife Service (USFWS). The National Oceanic and Atmospheric Administration (NOAA) Fisheries also lists the blue whale (*Balaenoptera musculus*), finback whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), sei whale (*Balaenoptera borealis*), sperm whale (*Physeter macrocephalus*), green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricata*), Kemp's ridley sea turtle (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), loggerhead sea turtle (*Caretta caretta*), and the Gulf sturgeon (*Acipenser oxyrinchus*).

Table 5.9.1
Federally Listed Rare, Threatened, And Endangered Species

Common Name	Scientific Name	Status	County	Habitat
Bald eagle	*Haliaeetus leucocephalus*	LT	Harrison, Jackson	Shorelines near open water
Black pine snake	*Pituophis melanoleucus ssp. lodingi*	C	Harrison	Fire-dependent, upland longleaf pine forests
Brown pelican	*Pelecanus occidentalis*	LE	Harrison, Jackson	Feeds over water in coastal areas, nests on small islands.
Eastern indigo snake	*Drymarchon corais couperi*	LT	Harrison, Jackson	Fire-dependent, upland longleaf pine forests
Gopher tortoise	*Gopherus polyphemus*	LT	Harrison, Jackson	Fire-dependent, upland longleaf pine forests
Green sea turtle	*Chelonia mydas*	LT	Harrison	Shallow coastal waters with SAV and algae, nests on open beaches.
Gulf sturgeon,	*Acipenser oxyrhynchus desotoi*	LT	Harrison, Jackson	Migrates from large coastal rivers to coastal bays and estuaries
Kemp's ridley sea turtle	*Lepidochelys kempii*	LE	Harrison, Jackson	Nearshore and inshore coastal waters, often in salt marshes
Loggerhead sea turtle	*Caretta caretta*	LT	Harrison, Jackson	Open ocean; also inshore areas, bays, salt marshes, ship channels, and mouths of large rivers
Louisiana black bear	*Ursus americanus luteolus*	LT	Harrison, Jackson	Bottomland hardwood forest; frequently ranges into other habitats
Louisiana quillwort	*Isoetes louisianensis*	LE	Harrison, Jackson	Small blackwater streams with sand and gravel substrate and forest cover
Mississippi gopher frog (proposal under review)	*Rana capito sevosa*	PE	Harrison	Fire-dependent, upland longleaf pine forests; open, ephemeral upland pools
Mississippi sandhill crane	*Grus canadensis pulla*	LE	Jackson	Wet pine savannah
Pearl darter (Pascagoula River System)	*Percina aurora*	C	Jackson	Rivers and large creeks with sand and gravel bottoms and flowing water.
Piping Plover	*Charadrius melodus*	LT	Harrison, Jackson	Barrier islands and coastal beaches
Red-cockaded woodpecker	*Picoides borealis*	LE	Harrison, Jackson	Fire-dependent, upland longleaf pine forests
Yellow-blotched map turtle	*Graptemys flavimaculata*	LT	Jackson	Rivers and large creeks with habitat suitable for basking

LT = listed threatened, LE = listed endangered, C = candidate for listing, PE = proposed endangered

Source: Mann, 2000.

Of these species listed, those most likely to be found within the project vicinity include the bald eagle, brown pelican, Gulf sturgeon, Kemp's ridley and loggerhead sea turtles, and the piping plover. The bald eagle is a familiar bird of prey with a wingspan of 6 to 7 feet. Adult birds feature a black body with a distinctive white head and tail, while juvenile birds are mostly brown with lighter patches on the wings and tail. The bald eagle's primary food is fish, but it will also feed opportunistically on rodents, birds, and carrion. Bald eagles nest in trees near large bodies of water. Some nests are used year after year. Bald eagles are known throughout most of the United States and Canada. Bald eagles have been observed in Back Bay of Biloxi and St. Louis Bay on the Mississippi Gulf Coast (Mann 2000). The bald eagle is currently listed by the USFWS as threatened and has been proposed for delisting. Before it was banned in the United States, the pesticide DDT was responsible for weakening the shells of eagle eggs and dramatically reducing reproductive success for the species. In recent years, the bald eagle population

has rebounded in the lower 48 states. Bald eagles are vulnerable to human disturbance while nesting and rearing young.

The brown pelican is a large brown and gray seabird with a characteristic long bill attached to an expandable pouch used for capturing prey. Brown pelicans can reach up to 8 pounds and have wingspans of more than 7 feet. These birds are known from marine environments in coastal areas of the United States; they feed by diving for small fish. Breeding pairs use small coastal islands for nesting, building nests in trees or on the ground. The brown pelican suffered dramatic population losses during the middle of the 20th century because DDT poisoning impaired reproductive success. Since DDT use was banned in the United States, brown pelican populations have increased or stabilized. In the Southeastern United States, the brown pelican is considered endangered only in Mississippi and Louisiana. Threats to brown pelicans include disturbance of nesting colonies, entanglement in fishing gear, oil and toxic chemical spills, severe storms, heavy tick infestations, and unpredictable food availability.

The Gulf sturgeon, considered a subspecies of the Atlantic sturgeon, is an anadromous fish, migrating from saltwater into large coastal rivers. Historically, the Gulf sturgeon occurred in rivers from the Mississippi River to the Suwanee River, and in bays and estuaries from Florida to Louisiana. Little is known about current population levels outside the Suwanee, Apalachicola and Pearl Rivers, but they are thought to have declined from historic levels (Corps, Mobile District 2000).

Adult fish spend 8 to 9 months each year in rivers and 3 to 4 of the coolest months in estuarine Gulf rivers. Adult fish tend to congregate in deeper waters of rivers with moderate currents and sandy and rocky bottoms. Seagrass beds with mud and sand substrates appear to be important marine habitats (Mason and Clugston 1993). The adult Gulf sturgeon is known to spend the fall and winter months in the estuary of the Mississippi Sound and migration routes extend from the Sound to the Back Bay of Biloxi. Occurrences of the Gulf sturgeon have been documented by the Mississippi Natural Heritage Program (MSNHP) database within the Mississippi Sound, Biloxi River, and Pascagoula River area. The Gulf sturgeon is known to spawn in the Pearl River system. Major threats to this rare, primitive species include physical barriers (e.g., locks and dams) to spawning grounds, habitat loss, and poor water quality.

On March 19, 2003, USFWS and NOAA Fisheries designated 14 geographic areas among the Gulf of Mexico rivers and tributaries as critical habitat for the Gulf sturgeon (FR Vol. 68, No. 53). These 14 geographic areas encompass approximately 2,783 river kilometers (1,739 river miles) and 6,042 square kilometers (2,333 square miles) of estuarine and marine habitat. In Mississippi, the critical habitat includes 632 kilometers of the Pearl River, including Bogue Chitto, and 203 kilometers of the Pascagoula River, including the Leaf, Bouie, Chickasawhay, and Big Black Creek tributaries (FR Vol. 68, No. 53).

The Kemp's ridley population has declined since 1947 (when an estimated 42,000 females nested in one day) to a nesting population of approximately 1,000 in the mid-1980s. The decline of this species was primarily due to human activities including collection of eggs, fishing for juveniles and adults, killing adults for meat and other products, and direct take for indigenous use. In addition to these sources of mortality, Kemp's ridley turtles have been subject to high levels of incidental take by shrimp trawlers. Kemp's ridley turtles are occasionally caught on fishing hooks and incidentally injured by recreational anglers and boaters (Mann, personal communication 2003). Today, under strict protection, the population appears to be in the earliest stages of recovery. The increase can be attributed to two primary factors: full protection of nesting females and their nests in Mexico, and the requirement to use turtle excluder devices (TEDs) in shrimp trawls both in the United States and Mexico (NMFS 2001). The major habitat for Kemp's ridley sea turtle is the nearshore and inshore waters of the northern Gulf of Mexico, especially Louisiana waters outside of the nesting season. Kemp's ridley sea turtles are usually found in water with low salinity, high turbidity, high organic content, and where shrimp are abundant. This species of sea turtle is the most commonly found species along the Mississippi coast. The continual influx of freshwater

and high organic content associated with the northern Gulf of Mexico provides ideal foraging habitat for this species.

The loggerhead sea turtle is widely distributed throughout its range and may be found hundreds of miles out to sea as well as in inshore areas such as bays, lagoons, salt marshes, creeks, ship channels, and the mouths of large rivers (Corps, Mobile District 2000). Loggerheads are seen annually inshore in the Mississippi Sound, but are more commonly seen offshore in the proximity of oil rigs (Mann, personal communication 2003). Most recent evidence suggests that the number of nesting females in South Carolina and Georgia may be declining, while the number of nesting females in Florida appears to be stable. Until the 1970s, loggerhead turtles were commercially harvested for their meat, eggs, leather, and fat. Because of their feeding behavior and their habit of wintering in shallow waters, loggerheads, along with Kemp's ridley sea turtles, are more likely to be caught in large shrimp trawl nets and drown. Today, TEDs pulled by shrimp boats help reduce mortality from net entanglement by allowing turtles to escape from the nets. However, loggerhead turtles are hooked by recreational fishermen offshore near oil rigs and are frequently injured by being struck by boats and boat propellers (Mann, personal communication 2003). As of 1981, there was no record of loggerhead turtles nesting in Mississippi, although a small group of these turtles were seen swimming off the western end of Horn Island in 1976. MS Heritage Program data includes a record for loggerhead turtle southeast of Deer Island (Mann 2000). Loggerheads are know to nest annually in small numbers on the Gulf Island National Seashore in Mississippi, with one nest being documented on the mainland beach and one nest several years ago on Round Island (Mann, personal communication 2003).

The piping plover is a small, stocky, sandy-colored bird resembling a sandpiper. The adult has yellow-orange legs, a black band across the forehead from eye to eye, and a black ring around the base of its neck. Like other plovers, it runs in short starts and stops. When still, the piping plover blends into the pale background of open, sandy habitat on outer beaches where it feeds and nests. The piping plover breeds on sandy or pebble coastal beaches of Newfoundland and southeastern Quebec to North Carolina. Decline in piping plover populations has been linked to loss of breeding habitat. Shoreline development, river flow alteration, river channelization, and reservoir construction have all led to loss of breeding habitat. The piping plover winters along the Gulf coast but does not nest in Mississippi. The MSNHP database indicates three over-wintering sightings of piping plovers: one along the beaches of Gulfport, one on Deer Island, and one on Ship Island.

Piping plovers begin arriving on the wintering grounds in July, with some late-nesting birds arriving in September. Behavioral observations of piping plovers on the wintering grounds suggest that they spend the majority of their time foraging (Nicholls and Baldassarre 1990; Drake 1999a, 1999b). Of the birds located on the United States wintering grounds during these two censuses, 89 percent were found on the Gulf Coast and 8 percent were found on the Atlantic Coast.

On August 9, 2001, the USFWS designated 137 areas along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas as critical habitat for the wintering population of the piping plover. This includes approximately 1,798.3 miles of mapped shoreline and approximately 165,211 acres of mapped area along the Gulf and Atlantic coasts and along margins of interior bays, inlets, and lagoons.

The primary constituent elements for the piping plover wintering habitat are those habitat components that are essential for the primary biological needs of foraging, sheltering, and roosting, and only those areas containing these primary constituent elements within the designated boundaries are considered critical habitat. The primary constituent elements are found in coastal areas that support intertidal beaches and flats (between annual low tide and annual high tide) and associated dune systems and flats above annual high tide.

5.10 Essential Fish Habitat (EFH). The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established a new requirement to describe and identify "EFH" in each fishery management plan. This act sets forth a new mandate for the National Marine Fisheries Service (NMFS), regional fishery management councils (FMCs), and other Federal agencies to identify and protect important marine and anadromous fish habitat. The EFH provisions of the act support maintenance of sustainable fisheries, which is one of the overall management goals for the nation's marine resources.

As defined in the interim final rule (62 Federal Register 66551), "EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." For the purpose of interpreting the definition of EFH: 'Waters' include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include aquatic areas historically used by fish where appropriate; 'substrate' includes sediment, hardbottom, structures underlying the waters, and associated biological communities; 'necessary' means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and 'spawning, breeding, feeding, or growth to maturity' covers a species' full life cycle." (Table 5.10-1)

EFH includes all waters and substrates (mud, sand, shell, rock, and associated biological communities) within these estuarine boundaries, including the sub-tidal vegetation (seagrasses and algae) and adjacent tidal vegetation (marshes). Estuaries provide essential habitat for many species, serving primarily as nursery areas for juveniles and also as seasonal habitat for adults. Emergent vegetation found in marsh is an integral part of the estuarine ecosystem, serving as nursery grounds for larvae, postlarvae, juveniles and adults of many species, most notably the brown shrimp (NMFS 1998). Marshes also export nutrients to adjacent waters; provide an important water quality function in the form of secondary and tertiary waste treatment through removal and recycling of inorganic nutrients; serve as an important buffer against storms by absorbing energy of storm waves and acting as a water reservoir, thus reducing damage farther inland; and serve an important role in global cycles of nitrogen and sulfur (Gosselink et al. 1974; Turner 1977; Thayer et al. 1975; Zimmerman et al. 1984).

In 2000, there were approximately 55,226 acres of emergent wetlands in the three coastal Mississippi counties (Corps, Mobile District 2005). Wetlands of south Mississippi, are dominated by *Juncus roemerianus* (black needlerush) (NMFS 1998). *Spartina alterniflora* (oyster grass), *Spartina patens* (wiregrass) and *Scirpus olneyi* (threecorner grass) composed the remaining acreage. Tidal marsh is most extensive in the Pascagoula and Pearl River areas of Jackson and Hancock counties, respectively. As with emergent vegetation, SAVs are extremely important to fisheries production and is often populated by diverse and abundant fish faunas (NMFS 1998). The relative abundance and diversity of submerged vegetation, which is found along most of the Gulf coast, depends mainly on bottom type, turbidity, salinity, water temperature, bottom slope, and tidal range (NMFS 1998). Seagrasses and the epiphytic algae, benthic fauna and flora associated with seagrasses provide shelter and food to fishes, and are also used by many species as nursery grounds. Turner (1977) related shrimp yield to total acreage of intertidal vegetation present in adjacent estuaries.

Discontinuous beds of shoal grass (*Halodule wrightii*), turtle grass (*Thalassia testudinum*), and manatee grass (*Syringodium filiform*) can be found north of the islands, and shoal grass has also been found in the sandy substrates east of Pascagoula (Point-aux-Chenes Bay) and near Bayou Caddy in western Mississippi Sound. Widgeon grass (*Ruppia maritime*) dominates the area near the mainland, and is also found in low-salinity ponds and lagoons on Horn and Cat Islands. Stands of benthic algae occur north and south of Cat Island, and tape grass (*Vallisneria americana*) can be found throughout the Sound.

Marshland is being lost through subsidence, erosion, sediment and freshwater deficits, channelization, and rising mean sea level. Aggravating factors contributing to marshland losses include management for agriculture, flood control, and wildlife habitat. Pollution from agricultural, municipal, and industrial activities (including widespread oil and gas production) produces additional habitat degradation.

Port development and gaming development are two of the most significant factors affecting the loss of EFH and wetlands in the coastal Mississippi (GMFMC, 1998). The gaming industry has stimulated economic and population growth in coastal Mississippi. Pre-Hurricane Katrina, State law required that specific gaming facilities be located in navigable waters or within 800 feet of such; therefore estuarine resources are typically directly and indirectly impacted. Mississippi's major port at Gulfport involves major estuarine resources issues for maintenance and expansion. Maintenance issues involve open-water and diked disposal, and expansion issues involve impact to bottomland hardwoods, Mississippi Sound bottoms, and wetland fringe areas (GMFMC, 1998).

The major fisheries landed along the Mississippi and Alabama Gulf coast are menhaden (*Brevoortia patronus*), mullet (*Mugil cephalus*), croaker (*Micropogonias undulatus* and *Leiostomus xanthurus*), shrimp (*Penaeus azetecus*, *P. setiferus*, and *P. duorarum*), blue crab (*Callinectes sapidus*), and oyster (*Crassostrea virginica*). In addition, the following would be expected to utilize the project area: red drum (*Sciaenops oellatus*), dolphin (*Coryphaena hippurus*), spanish mackerel (*S. maculatus*), and king mackerel (*Scomberomorus cavalla*).

Table 5.10-1.
Fishery Management Plans and Managed Species for the Gulf of Mexico.
(NMFS 1999)

Shrimp Fishery Management Plan	**Red Drum Fishery Management Plan**
Brown shrimp (*Penaeus aztecus*)	Red drum (*Sciaenops oellatus*)
Pink shrimp (*P. duorarum*)	
Rock shrimp (*Sicyonia brevirostris*)	**Golden Crab Fishery Management Plan**
Royal Red Shrimp (*Pleoticus robustus*)	Golden crab (*Chaceon fenneri*)
White Shrimp (*P. setiferus*)	
Snapper Grouper Fishery Management Plan	
Blackfin snapper (*Lutjanus buccanella*)	Silk snapper (*L.vivanus*)
Blueline tilefish (*Caulolatilus microps*)	Snowy grouper (*E. niveatus*)
Gray snapper (*L.griseus*)	Speckled hind (*E. drummondhayi*)
Greater amberjack (*Seriola dumerili*)	Yellowedge grouper (*E. flavolimbatus*)
Jewfish (*Epinephelus itajara*)	Warsaw grouper (*E. nigritus*)
Mutton snapper (*L.analis*)	White grunt (*Haemulon plumieri*)
Red porgy (*Pargrus pargrus*)	Wreckfish (Polyprion americanus)
Red snapper (*L. campechanus*)	Scamp (*Mycteroperca phenax*)
Vermillion snapper (*Rhomboplites aurorubens*)	
Coastal Migratory Pelagics Fishery Management Plan	
Dolphin (*Coryphaena hippurus*)	
Cobia (*Rachycentron canadum*)	
King mackerel (*Scomberomorus cavalla*)	
Spanish mackerel (*S. maculatus*)	
Spiny Lobster Fishery Management Plan	
Spiny lobster (*Panulirus argus*)	
Calico Scallop Fishery Management Plan	
Calico scallop (*Argopecten gibbus*)	
Coral and Coral Reef Fishery Management Plan	
Varied coral species and coral reed communities	
Comprised of several hundred species	
Sargassum Habitat Fishery Management Plan	
Sargassum (and associated fauna) where it occurs in the EEZ and state waters	

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5.11 Cultural Resources. Cultural resources in the Mississippi Gulf Coast area considered eligible for listing on the National Register of Historic Places include historic standing structures, submerged shipwrecks, historic cemeteries, and prehistoric and historic archaeological sites. Many of the cultural resource sites contain shell middens, which are mounds of discarded shells that offer evidence of the early use of certain shellfish (mollusks). Some of the sites are prehistoric Indian mounds. The development along the Mississippi coast has affected both archaeological sites and standing structures, including individual structures and historic districts in the project area.

In compliance with the National Historic Preservation Act and other authorities, previous consultation indicates that the National Register of Historic Places has been consulted and there are no properties listed on, being nominated to or that have been determined eligible for the National Register located at Deer Island. Ongoing coordination efforts are still occurring. A copy of the Public Notice has been sent to the Mississippi State Historic Preservation Officer and the U.S. Department of the Interior, National Park Service, Atlanta, Georgia.

5.12 Protection of Children. The Executive Order (EO) 13045, *Protection of Children from Environmental Health Risks and Safety Risks* (April 21, 1997), recognizes a growing body of scientific knowledge demonstrating children may suffer disproportionately from environmental health risks and safety risks. These risks arise because children's bodily systems are not fully developed; because children eat, drink, and breathe more in proportion to their body weight; because their behavior patterns may make them more susceptible to accidents. Based on these factors, the President directed each Federal agency to make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children. The President also directed each Federal agency to ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.

5.13 Environmental Justice. On February 11, 1994, President Clinton issued EO 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Populations*. The EO is designed to focus attention of Federal agencies on the human health and environmental conditions in minority communities and low-income communities. Environmental Justice analyses are performed to identify potential disproportionately high and adverse impacts from proposed actions and to identify alternatives that might mitigate these impacts. Data from the U.S Department of Commerce 2000 Census of Population and Housing were used for this Environmental Justice analysis. Minority populations included in the census are identified as Black or African American, American Indian and Alaska Native, Asian, Native Hawaiian and other Pacific Islander, Hispanic, of two or more races, and other. Poverty status, used in this EA to define low-income status, is reported as the number of persons with income below poverty level. The 2000 Census defines the poverty level as $8,794 of annual income, or less, for an individual, and $17,603 of annual income, or less, for a family of four.

Coastal Mississippi has a lower percentage of minority residents than the State of Mississippi and the United States. In 2000, 79.6 percent of the population was white and 16.3 percent was black. All other racial groups combined totaled approximately 4.1 percent of the population, while 2.2 percent were of Hispanic origin. In Mississippi, 61.4 percent of the population was white, 36.3 percent was black, 2.3 percent was of another minority racial group, and 1.4 percent was of Hispanic origin. For the United States, 75.1 percent of the population was white, 12.3 percent was black, and 12.6 percent was of other minority racial groups. Approximately 12.5 percent of the U.S. population was Hispanic.

The Census Bureau bases the poverty status of families and individuals on 48 threshold variables, including income, family size, number of family members under the age of 18 and over the age of 65, and amount spent on food. In 1997, approximately 14.6 percent of the residents were classified as living in

poverty, lower than the state of Mississippi but slightly higher than the poverty rate for the United States as a whole.

The proposed restoration project at Deer Island is not designed to create a benefit for any group or individual. The project does not create disproportionately high or adverse human health or environmental impacts on minority or low income populations of the surrounding community. Review and evaluation of the proposed project have not disclosed the existence of identifiable minority or low income communities that would be adversely impacted by the proposed project.

5.14 Hazardous, Toxic, and Radioactive, Waste (HTRW). Statewide, the Mississippi Department of Environmental Quality, Office of Pollution Control (MDEQ-OPC), Hazardous Waste Division (HWD) regulates hazardous wastes. The HWD oversees the assessment and remediation of both abandoned and responsible party sites where hazardous or toxic substances have been released to the environment. The restoration project at Deer Island has been evaluated to ensure that no adverse HTRW issues will occur. Furthermore, dredged material is not considered under HTRW issues.

6 ENVIRONMENTAL EFFECTS

6.1 Introduction. The proposed restoration action at Deer Island would have minor adverse environmental impacts on the existing environment. The proposed restoration sites at Grand Bayou Marsh, the southern shoreline (1850s), and the western breached area will provide additional upland and aquatic habitat, which would support additional species of fauna and flora at Deer Island. In addition, the restored areas at the western breach and Grand Bayou Marsh would prevent further degradation to the island. In fact, the proposed projects would also provide more protection to Deer Island from current erosion. The impacts of the proposed restoration are discussed in the following paragraphs.

Impacts associated with the use of a hydraulic pipeline dredge to remove material from the borrow areas and place it onto Deer Island include: 1) temporary water quality degradation during operations; 2) minor loss of bottom dwelling organisms; 3) avoidance of the operation area by wildlife, pelagic, and benthic fauna; and 4) a temporary reduction in air quality due to exhaust emissions.

Environmental benefits associated with restoring Deer Island to re-establish a maritime forest, beach and dune system, and emergent tidal marsh habitat include: 1) provide protection to larvae and juvenile fish/benthic species within the emergent habitat; 2) offset erosion along the southern shoreline and at the breached areas; 3) improve water quality; 4) possibly re-establish the once-supported commercial fisheries; 5) provide additional aquatic habitat for associated flora and fauna; 6) restore the flora community devastated by the hurricane season of 2005; 7) provide storm protection to the mainland and 8) re-establish flora and fauna species in areas that have eroded area . In light of these environmental benefits that are anticipated to occur as a result of the proposed action implementation, these described adverse impacts are minor, short-duration, and insignificant impacts that are typical of these operations.

6.2 Benthos, Motile Invertebrates, and Fishes. The 'No Action' plan would result in no restoration actions occurring at Deer Island; therefore, the benthos, motile invertebrates, and fishes would not be affected by its implementation. However, over time, these species would be adversely impacted due to the island's continued degradation. No impacts would occur to benthos, motile invertebrates, and fishes as a result of material being removed from the upland borrow area sites along the Black Warrior and Tombigbee Waterway. Nor would any impacts occur to these species as a result of the heavy equipment moving the borrow material on land at Deer Island to shape the natural topography of the island (i.e. beach and dune system, maritime forest, and emergent tidal marsh habitat). There would be temporary disruption of the aquatic community at the offshore borrow area located 500 feet south of the island in

open-water. In addition, the seaward area of Deer Island's southern shoreline to be filled with sandy material or dredged material and at the western breached area would be impacted. Non-motile benthic fauna within the area may be destroyed by the proposed operations, but should repopulate within several months. Those areas along the southern shoreline and western breach that would be restored to a beach/dune, maritime forest, and emergent marsh habitat would repopulate with a somewhat different species of fauna, such as crabs, due to it not being submerged and/or emergent. Some of the motile benthic and pelagic fauna, such as crabs, shrimp, and fishes, are able to avoid the disturbed area and should return shortly to the vicinity after the activity is completed. Larval and juvenile stages of these forms may not be able to avoid the activity due to limited mobility. The overall impact to these organisms is expected to be minimal. In addition, in light of these adverse impacts, the re-establishment of Deer Island's historic footprint and the filling of the breached areas would benefit various motile and non-motile benthic fauna by providing additional upland and aquatic habitat. Deer Island's environmental habitat following the proposed activities would provide suitable conditions for benthic fauna, motile invertebrates, and fishes within the emergent tidal marsh habitat.

6.3 Wildlife/Wildlife Habitat. The 'No Action' plan would result in no restoration actions occurring at Deer Island. Initially, there would be no adverse impacts to wildlife and its associated habitat; however, overtime, the island would continue to degrade and erode resulting in negative impacts to these species.

Upon implementing the proposed restoration plan, there would be a temporary disruption to the wildlife and its habitat due to the presence of heavy equipment and its associated activities. The overall impact to these organisms is expected to be minimal because the wildlife is anticipated to avoid this activity. The large population of passerine birds, waterfowl, wading birds, and shore birds along the coast of Mississippi would benefit from the proposed restoration projects at Grand Bayou Marsh, along the southern shoreline (1850s), and the western breach. In addition, coastal mammals, which are primarily restricted to terrestrial or semi-terrestrial habitats of the barrier islands and mainland, would have also benefit by the additional habitat for shelter and food supply.

6.4 Esthetics. Implementing the 'No Action' plan would result in a continued degradation of the island's esthetics. Esthetics will be temporarily reduced in the immediate vicinity of the proposed restoration project operations. Some residents and visitors to the area may be disturbed by the presence of the heavy equipment. However, this action is temporary in nature so the disturbance will be minimal. Upon completion of the proposed restoration projects, Deer Island would provide residents and visitors with a more esthetically pleasing habitat to view. The proposed project would provide additional aquatic, emergent, and upland habitat to numerous species of marine birds. From an environmental viewpoint, this proposed restoration projects are anticipated to enhance the existing aquatic, emergent, and upland habitat at Deer Island, Mississippi. Esthetic benefits associated with the implementation of the proposed project include: 1) increased marsh habitat in Harrison County; 2) additional beach/dune, maritime, and emergent habitat for flora and fauna, 3) preventing larger breaches of the island, 4) increasing the sandy beach along the southern end, and 4) providing a natural protection from storms.

6.5 Water Quality. Water quality would not be adversely impacted if the 'No Action' plan were to be implemented. Water quality would not be impacted by removal of borrow material from the upland sites in Alabama. However, subsequent placement of this material on the island, if in the open-water, would impact water quality for short period of time. Water quality in the immediate vicinity of the restoration sites would be slightly impaired for a short period of time due to the removal of material by the hydraulic dredge and its associated placement at the island. Operations would not significantly impact water quality because these operations are minor, short-duration, and insignificant impacts that are typical of these operations. Best management practices (BMP) would be implemented to reduce disturbance to the area. Water quality is anticipated to improve by the additional aquatic marsh plants filtering runoff before it enters into the Sound. In light of the described environmental benefits that are anticipated to occur, the

described adverse impacts are minor, short-duration, and insignificant impacts that are typical of these operations.

6.5.1 Turbidity. Implementing the 'No Action' plan would result in no impacts to turbidity. Minor increases in turbidity will occur from the proposed project operations in the vicinity. Hydraulic pipeline dredges result in lower turbidity levels, in comparison, to that of mechanical dredges. Turbidity increases from operations and the pumping of that material to the proposed restoration project sites will reduce light penetration through the water column, thereby reducing photosynthesis, surface water temperatures, and esthetics. These conditions could potentially alter visual predator-prey relations in the immediate project vicinity. In addition, sediment adheres to fish gills, resulting in respiratory stresses, and natural movement of eggs and larvae could be potentially altered as a result of the sediment adherence. Removal of material from the borrow site immediately south of the island could result in all of the above-described adverse impacts. Borrowing material from the upland sites would have no impacts on turbidity. Material dredged from the Biloxi vicinity would impact turbidity upon its placement. Subsequent placement of this material from the borrow areas would impact turbidity. However, as a result of this assessment, the short duration of these operations would minimize the described adverse impacts and would result in additional aquatic habitat for various species of flora and fauna. In addition, the proposed project would also abate erosion along the northeastern portion of Deer Island.

6.5.2 Suspended Sediment. Implementing the 'No Action' plan would result in no impacts to suspended sediments. Although, upon implementing the proposed project, resuspension of sediments will likely occur within the vicinity of the proposed operations, these described impact will be typically minor and of short duration.

6.6 Noise. No impacts would occur to noise if the 'No Action' plan were to be implemented. Upon constructing the proposed project, noise from the engine and other job-related equipment is expected to increase during the proposed operations in the project vicinity. Noise levels will resume to prior conditions once the removal of sediment is completed. Noise is not anticipated to be a significant impact.

6.7 Navigation. No impacts would occur to navigation if the 'No Action' plan were to be implemented. Navigation will be temporarily affected due to restoration activities at the Deer Island. The restricted maneuverability of the equipment may result in incoming/outgoing vessels waiting for short periods of time. While the presence of the dredge and other heavy equipment is expected to be a slight inconvenience, no adverse impacts are expected to occur to navigation due to these operations being of a short duration.

6.8 Air Quality. No impacts would occur to air quality if the 'No Action' plan were to be implemented. Harrison County has been designated in attainment with the National Ambient Air Quality Standards. Upon constructing the proposed project, air quality in the immediate vicinity of the heavy equipment would be slightly affected for a short period of time by the fuel combustion and resulting engine exhausts. The standards would not be violated by the implementation of the proposed project. In light of prevailing winds in the area, these emissions are insignificant.

6.9 Implementation of Mitigation Action. No mitigation actions will be implemented during the proposed project.

6.10 Environmental Justice. EO 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Populations* (February 11, 1994) requires that Federal agencies conduct their programs, policies, and activities that substantially affect human health or the environment in a manner that ensures that such programs, policies, and activities do not have the effect of excluding persons (including

populations) from participation in, denying persons (including populations) the benefits of, or subjecting persons (including populations) to discrimination under such programs, policies, and activities because of their race, color, or national origin. On February 11, 1994, the President also issued a memorandum for heads of all departments and agencies, directing that U.S. Environmental Protection Agency (EPA), whenever reviewing environmental effects of proposed actions pursuant to its authority under Section 309 of the Clean Air Act (CAA), ensure that the involved agency has fully analyzed environmental laws, regulations, and policies.

If the 'No Action' plan were to be implemented, no adverse impacts would occur. The proposed project is not designed to create a benefit for any group or individual. The restoration projects at Deer Island does not create disproportionately high or adverse human health or environmental impacts on minority or low-income populations of the surrounding community. Review and evaluation of the proposed project have not disclosed the existence of identifiable minority or low-income communities that would be adversely impacted by the proposed project.

6.11 Protection of Children. The EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks* (April 21, 1997), recognizes a growing body of scientific knowledge that demonstrates that children may suffer disproportionately from environmental health risks and safety risks. These risks arise because children's bodily systems are not fully developed; because children eat, drink, and breathe more in proportion to their body weight; because their behavior patterns may make them more susceptible to accidents. Based on these factors, the President directed each Federal agency to make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children. The President also directed each Federal agency to ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.

If the 'No Action' plan were to be implemented, no adverse impacts would occur. Deer Island is uninhabited; thus, no changes in demographics, housing, or public services would occur as a result of the proposed project. With respect to the protection of children, the likelihood of disproportionate risk to children is not significant. Restoring Deer Island does not involve activities that would pose any disproportionate environmental health risk or safety risk to children.

6.12 Cultural Resources. No adverse impacts to cultural resources would result if the 'No Action' plan were carried out. The Corps, Mobile District is consulting with the National Register of Historic Places regarding if there are any properties listed on, being nominated to, or that have been determined eligible for the National Register located in the vicinity of the proposed work.

6.13 Endangered and Threatened Species. No adverse impacts to threatened and/or endangered species would result if the 'No Action' plan were carried out. The Corps, Mobile District is currently consulting with the USFWS and the NOAA Fisheries regarding the District's determination that no federally listed species would be adversely impacted as a result of the proposed restoration projects.

6.14 Hazardous, Toxic, and Radioactive Waste. An evaluation by the Corps, Mobile District determined that a Preliminary Assessment Screening is not required.

6.15 Essential Fish Habitat. EFH is defined by Congress as "those waters and substrates necessary to fish for spawning, breeding, feeding or growth to maturity," the designation and conservation of EFH seeks to minimize adverse effects on habitat caused by fishing and non-fishing activities. The NMFS has identified EFH habitats for the Gulf of Mexico in its Fishery Management Plan Amendments. These habitats include estuarine areas, such as estuarine emergent wetlands, seagrass beds, algal flats, mud,

sand, shell, and rock substrates, and the estuarine water column. In addition, marine areas, such as the water column, vegetated and non-vegetated bottoms, artificial and coral reefs, geologic features, continental shelf features, and the Mississippi shelf, have also been identified. Table 5.10-1 lists the species managed by the Gulf of Mexico Fishery Management Council. Of these, the following would be expected to utilize the project area: brown shrimp (*Penaeus aztecus*), pink shrimp (*P. duorarum*), and white shrimp (*P. setiferus*).

No impacts would occur to EFH if the 'No Action' plan were to be implemented. The upland sites (i.e. beach/dune and maritime forest) would not benefit EFH. Some of the open-water considered to be EFH would be covered by the proposed restoration projects. This EFH would be lost but other degraded areas, such as the emergent tidal marsh, would be restored. The restoration projects at Deer Island would provide some habitat (i.e. emergent tidal marsh) that has been lost due to coastal erosion. Erosion along the eastern end of the island occurs at a rate of about 6.6 feet per year (Schmid personal communication). This re-establishment of emergent marsh habitat would benefit many of the juvenile and larval stages listed by NMFS as managed species. As a result, it is anticipated that providing a nursery ground for juvenile fish and crustaceans would enhance EFH. In addition, the proposed marsh project is anticipated to increase nutrient processing through plant detrital mass influx. Transfer of this nutrient supply to higher trophic levels would further benefit the described managed species. It is anticipated that finfish and shellfish production would be re-established several years following the completion of the emergent tidal marsh project. Although, the re-establishment of this marsh would result in the temporary disruption of the aquatic community, non-motile benthic fauna within the area should repopulated within several months after the completion of the activities. Some of the motile benthic and pelagic fauna, such as crab, shrimp, and fish, are able to avoid the disturbed area and should return shortly after the activity is completed. The long-term impact of benefits gained by these organisms is anticipated to outweigh the short-term impact. The re-establishment of the tidal marsh habitat would provide protection to larvae and juvenile species, offset erosion, and possibly re-establish the once-supported commercial fisheries present in the area. The long-term impact from proposed marsh project is anticipated to enhance EFH by providing these described environmental benefits at Deer Island.

The Corps, Mobile District is currently coordinating with the NMFS regarding our determination that EFH would not be adversely affected as a result of the proposed marsh re-establishment project.

6.16 Coastal Zone Management. The Corps, Mobile District has determined that the proposed restoration projects at Deer Island are consistent with Mississippi Coastal Program. The Corps, Mobile District anticipates concurrence from the MDMR.

6.17 State Water Quality Certification. The Corps, Mobile District has determined that the proposed restoration projects at Deer Island would be consistent with the MDEQ-OPC's water quality requirements. Concurrence is anticipated following completion of the public notice. .

7 CONCLUSION

The implementation of the proposed restoration action would not have a significant adverse impact on the quality of the environment and an EIS is not required.

8 LIST OF AGENCIES, INTERESTED GROUPS AND PUBLIC CONSULTED

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Mississippi Department of Environmental Quality, Office of Pollution Control
Mississippi Department of Marine Resources
Mississippi State Historic Preservation Officer
National Marine Fisheries Service
National Oceanic and Atmospheric Administration Fisheries
National Register of Historic Places
U.S. Environmental Protection Agency, Region 4
U.S. Fish and Wildlife Service, Jackson Field Office, Mississippi

9 ACRONYMS

BMP	Best Management Plan
CAA	Clean Air Act
CEQ	Council of Environmental Quality
CFR	Code of Federal Regulations
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ER	Engineer Regulation
EFH	Essential Fish Habitat
F	Fahrenheit
FONSI	Finding of No Significant Impact
MDEQ	Mississippi Department of Environmental Quality
MLLW	Mean Lower Low Water
MLW	Mean Low Water
MDMR	Mississippi Department of Marine Resources
NAAQS	National Ambient Air Quality Standard
NEPA	National Environmental Policy Act
NGVD	National Geodetic Vertical Datum
NMFS	National Marine Fisheries Service
O&M	Operations and maintenance
PAS	Preliminary Assessment Screening
ppt	parts per thousand
SMA	Special Management Area
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WRDA	Water Resources Development Act

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