ATTACHMENT 3

STAN GRAVES' LETTER AND REFERENCE DOCUMENTS

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Stan Graves
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Mountain Brook, Alabama 35213

June 25, 2020

Chris Blankenship, Commissioner
Alabama Department of
Conservation & Natural Resources
64 North Union Street, suite 468
Montgomery, Al. 36130

Cc: US Army Corps of Engineers, Mobile District: ABIRA@usace.army.mil
US Geological Survey: hsweyers@usgs.gov

Re: Comments for the Alabama Barrier Island Restoration Assessment Final Report

I participated by remote in the June 9, 2020 presentation of the Alabama Barrier Island Restoration Assessment Report (ABIRAR). I was extremely interested in learning what would be presented, especially the results of the study, and its role in the resolution for the erosion to Dauphin Island's shoreline that has occurred, at least, from 1980. This project study is extremely important and could have significant benefits to Dauphin Island or consequences if not implemented. The report states that the models that were developed were based on the effects of three key components, and that these factors could have an effect on erosion of Dauphin Island's shoreline. The three factors considered were: Sea Level Rise, Severe and Frequent Storms, and Engineering Activities. Unfortunately, the report does not effectively define Engineering Activities so that the public could understand what engineering activities meant.

But, a May 1, 2013, O&M Justification for Coastal Inlets Research Program (page 1579) states: Coastal Inlet navigation channels must be maintained in a complex environment of waves, tidal and wave-induced currents**, sediment transport**, and vessel-induced flow and wake....This applied research and development is necessary to provide quantitative and practical predictive tools and data to reduce the cost of **dredging Federal navigation projects**, maintain inlet jetties, identify potential unintended consequences, **mitigate for engineering activities** related to navigation channels....)

Critically missing from the contributing factors (Engineering Activities) is the Corps of Engineers Maintenance of the Mobile Navigation (Ship) channel and the effects of the maintenance dredging that causes a deficit in the sediment budget and the Littoral Sand System. This deficit of sand in the sediment budget affects the shorelines of Dauphin Island. In other words, the **maintenance dredging is a critical Engineering Activity** factor that results in Dauphin Island's shoreline erosion.

Dr. Robert Morton, US Geologic Survey, stated in his 2007 & 2008 reports on the Historical Changes in the Mississippi-Alabama Barrier Islands and the Roles of Extreme Storms, Sea Level, and Human Activities that the principal causes of barrier island land loss are frequent intense storms, a relative rise in sea level, and a deficit in the sediment budget. The deficit in the sediment budget is a key factor not addressed in the ABIRA Report. Dr. Morton stated: "The only factor that has a historical trend that coincides with the progressive increase in rates of land loss is the progressive reduction in sand supply associated with nearly simultaneous deepening of channels dredged across the outer bars of the three tidal inlets maintained for deep-draft shipping." It is therefore very perplexing that the U.S. Geological Survey (USGS), a partner, in the development of the ABIRA, did not include this important and critical factor in their analysis and evaluations, unless there was some unjustifiable coercion to not do so. It appears that the involvement of the Corps of Engineers, as a defendant in the 2000 Lawsuit, could be that coercion/influence.

I also believe the Corps of Engineers has a major conflict of interest related to being the responsible party for the GRR/SEIS, a defendant in the Dauphin Island Property Owners Lawsuit against the Corps of Engineers, specifically to its dredging practices, and now its Role in the ABIRA. The Mobile District must answer this question: Has its being a defendant in the 2000 Lawsuit influenced its decision making to not acknowledge that the Corps maintenance dredging of the Mobile Ship Channel is a contributing Engineering Activity affecting the sediment budget and therefore is a contributing cause for the erosion of Dauphin Island's shoreline? In fact, the Mobile District stated in one of its slides a study concern to get Public Acceptance of the Corps position in the "litigation regarding cause of material loss to island shoreline." (See attached Corps of Engineers slide).

At the January 12, 2016 Public Scoping Justin McDonald and Elizabeth Godsey, both Corps' representatives, stated that the GRR/SEIS does not and will not consider or address the historic sand losses/sand deficit caused by the Corps maintenance dredging practices of the Mobile Harbor Shipping Channel. So there was a predisposed position of the Mobile District to oppose having the Corps maintenance dredging of the Mobile Ship Channel as an Engineering Activity/causal factor leading to the deficit in the Sediment Budget and therefore the erosion of Dauphin Island's shoreline.

Reputable Coastal Engineers, such as Scott Douglass and Robert Morton (who are referenced in this report) and other professionals, have stated that there is a direct correlation between maintenance dredging, a reduction in the sand system budget, and shoreline erosion.

Comments and Deficiencies of ABIRA Report:
As stated above, the report fails to address the effects of the Corps of Engineers' maintenance dredging of the Mobile Navigation channel (Ship Channel) and the impact that it has for creating a deficit in the sediment budget: the impact of the Navigation Channel/Outer Bar has become a sink trap for the sand. As the channel has continued to be widened and deepened, the Outer Bar has become an even larger sink trap for the sand moving east to west and prevents its entering the littoral sand system on the downward/west side of the Mobile Ship Channel. Previous information states clearly the relationship of the Corps maintenance dredging and Dauphin Island's shoreline erosion:

1. The Mobile District's Commander and District Engineer, Colonel Drake Wilson, in a July 9, 1975 letter to Congressman Jack Edwards stated that Maintenance Dredging a cause of erosion of Dauphin Island. See attached letter and comments below.

2. Of significance is the Corps of Engineer's Mobile District's 1978 report conclusively stated maintenance of the Outer Bar Channel is contributing to the erosion of Dauphin Island. Yet, for at least the last almost 42 years, the Mobile District has consistently ignored this report and the relationship of the maintenance dredging to the erosion of Dauphin Island's shoreline. The Mobile District has continued to deny a causative relationship exists and not recognizing the report. In fact, disparaging remarks have been made about the engineers responsible for the report. See attached excerpt.

3. **1980 Survey & Environmental Impact Statement:** Another specific concern is related to the content of the Mobile District's 1980 survey report and EIS that was considered by Congress in its decision to authorize deepening and widening of Mobile Harbor in the Water Resources Development Act of 1986. The 1980 EIS gave no consideration at all to the potential impacts of enlarging the channel on Dauphin Island. The EIS was completely silent on the erosion issue altogether and did not address the impact of the maintenance dredging of the adjacent shores, which would be Dauphin Island's shoreline.

In summary of the above, the Corps dredging practice of the Mobile Harbor Outer Bar Channel has resulted in extreme shoreline erosion to Dauphin Island. This dredging practice has resulted in a sand deficit, by dumping the sand in the open Gulf, of over 20 million cubic yards is non-retrievable and lost forever from the littoral system. If this sand had been deposited closer to Dauphin Island, as stated in the Mobile District's 1978 Feasibility Report for Beach Erosion Control and Hurricane Protection, it would have remained in the littoral system and helped to mitigate the excessive shoreline erosion that has occurred over the past 40-50 years. What is significant about the Mobile District's 1978 report is that it estimated that maintenance of the Outer Bar Channel was contributing 10.3 feet per year erosion on Dauphin Island. If you project the 10.3/yr. erosion forward, 42 years, the total amount of erosion for the west end would be 432.6 ft.

Col Drake Wilson, in his July 9, 1975 letter to Honorable Jack Edwards, stated "The prospect for satisfactorily alleviating erosion problems on Dauphin Island by depositing the sandy material dredged from the Mobile Bay entrance channel upon the Gulf shoreline of the island appears promising and will be pursued. The viability of depositing future "new work" material dredged from the ship channel within Mobile Bay upon the western shoreline cannot he determined without estuarian and other environmental impact studies but is considered meritorious of further consideration. Under the above concepts the eroding shorelines would be nourished by the dredged material primarily as disposal areas in support of the maintenance and modification of the Mobile Harbor navigation project...."

1980 Survey & Environmental Impact Statement: In regard to this study, the Corps of Engineers did not comply with Section 5 of the River and Harbors Act of 1935 which requires all Corps reports recommending modifications to coastal inlets to consider the effects of erosion and accretion "...for a distance of not less than ***ten miles on either side of the said entrance*** [emphasis added]" (33 U.S. Code § 546a). The Corps is also obligated by the National Environmental Act of 1969 (NEPA) to fully disclose ALL potential impacts (e.g., direct, and indirect, primary, and secondary, irreversible, irretrievable, cumulative, etc.)

4. **February 22, 2018 Town Hall**: The Corps admitted that 50%+ of the sands dredged from the Outer Bar Channel and placed in the so-called Sand Island Beneficial Use Area (SIBUA) remained within the SIBUA instead of being moved by currents in the littoral sand system to Dauphin Island as the Corps has claimed occurred for the last two decades. Thus, more than half of all sands dredged since 1999 have been effectively removed from the natural littoral drift system. That means, since 1999, around 7 million cubic yards of naturally provided sands have been prevented from reaching and nourishing Dauphin Island. That represents a significant cumulative loss of beach quality sands, which is contributing to the sand-starved nature of Dauphin Island and its observed erosion – **an impact that is made worse each time the Outer Bar Channel is dredged**.

5. If you include the dredged sands that were historically dumped into the open Gulf prior to 1999 when the Corps began use of the SIBUA, the total amount of dredged sands that did not enter the littoral sand system and would re-nourish the shoreline would total 27+million cubic yards of sand. Despite the Corps' acknowledging of the Mobile Harbor project has created a sand deficit, the Corps has NOT established a plan to mitigate the erosion problem. (See attached Corps Dredging History)

6. **Endangered Species Act**: The ABIRA report does not address the Endangered Species Act. The Maintenance Dredging of the Mobile Harbor Ship Channel has caused a significant loss of a vital resource, beach quality sand, that would normally enter the littoral sand system and migrate to the shoreline of Dauphin Island. As a result, the loss of over 21 million cubic yards of sand since 1980 has caused significant erosion of Dauphin Island's shoreline which affects the Loggerhead Sea Turtle and the Piping Clover. **The recent tropical storm Christobal resulted in the loss of 15 sea turtle nests, and resulted in over 5 feet of sand being deposited on Bienville Blvd.**

   The Corps of Engineers, therefore, I believe is in violation of the Endangered Species Act associated with Dauphin Island. **The Corps of Engineers, Mobile District, does not demonstrate in the ABIRA that it has effectively developed a mitigation plan that will addresses the loss of the sand that would nourish the shoreline of Dauphin Island therefore restore the nesting shoreline for the sea turtles.**

   Question: What is the Corps of Engineers mitigation plan in the ABIRA report to address and protect shoreline to provide for a sanctuary for the sea turtle to return and nest and lay their eggs?

7. **Historic Preservation: The Sand Island Lighthouse** is historically registered and listed on the Lighthouse Digest Doomsday List, as one of the most endangered lighthouses in the country. This 1873 tower is considered the last great masonry lighthouse to be built on the Gulf Coast. The lighthouse is now owned by the town of Dauphin Island. The Corps of Engineers has guidelines for Compliance with Section 106 of the Historical Preservation Act that determines the requirements the Corps of Engineers need to follow. Section 106 of the National Preservation Act, as amended by (NHPA), requires Federal agencies to consider the effects of their undertakings (such as the Mobile Harbor Widening and Deepening Project) on Historic Properties. Since the Sand Island Lighthouse is a historical landmark, the GRR/SEIS must address the impacts of the Corps maintenance dredging and new work dredging on the lighthouse. The GRR/SEIS is void of any reference to any impacts to the lighthouse or how the GRR/SEIS will mitigate for any impacts. The GRR/SEIS must address the impacts of their maintenance dredging and new work on the Sand Island Lighthouse.

   Question: What is the Corps of Engineers mitigation plan in the ABIRA report to address and protect the Historic Sand Island Lighthouse?

8. **Stakeholders:** The ABIRA report references "stakeholder" in the following paragraph: "The results of this study support existing natural resource management and restoration plans prepared by a number of stakeholders such as: (1) the Dauphin Island Strategic Plan funded by the Town of Dauphin Island; (2) the plan developed by the Mississippi-Alabama Sea Grant Consortium and the University of Southern Mississippi; and (3) plans prepared by the Alabama Department of Conservation and Natural Resources, the Dauphin Island Sea Lab, and the Mobile Bay National Estuary Program."

   Provide: The names of stakeholders and who/organizations that they represent need to be listed in the report. Please provide the public with this information.

10. **Good Money After Bad:** to waste money by spending more money on something you have already spent money on that is no good. There are recommendations being presented to make various land acquisitions, but until the appropriate shoreline restorations have been made to protect the Island and indicated in #9, no land acquisitions should be made. The Town of Dauphin Island is

moving forward with its Aloe Bay Project, but if the southern shoreline is not restored and protected going forward, this could be wasted money.

11. ABRIA Report and GRR/SEIS: The ABIRA report was a collaborative effort between the U.S. Geological Survey (USGS), U.S. Army Corps of Engineers (USACE), and the State of Alabama. The results of this study were important input into the Corps of Engineers' (Mobile District) Mobile Navigation Channel (GRR/SEIS) as indicated by the attached Mobile District "Mobile Harbor PACR Schedule – Risk Buy Down Plan. the Final ABIRA was not completed until its release in May 2020, but the GRR/SEIS was completed in May 2019. Therefore, this discrepancy in completion dates begs for answers to the following questions especially what was the ABIRA input that went into the Corps of Engineers GRR/SEIS? The following questions are pertinent:

1. What input and how was the input from the ABIRA used and integrated into the GRR/SEIS?

2. Where is the actual and final documentation and location in the GRR/SEIS that shows how the input was utilized?

3. What records, such as charts, correspondence, e-mails, etc. and input from the ABIRA that became the Corps of Engineers recommended decision for the GRR/SEIS?

4. Will the person submitting comments about the ABIRA Report receive a direct response to his/her questions? Will the comments be "posted", and the responses be "posted" so that the public will understand the questions being asked and the responses to the questions? Also, how long do you think it will be before a person will receive a response?

Answers to these questions are important to provide full transparency by the Corps of Engineers and the Alabama Department of Conservation and Natural Resources. Where the USGS had participated in the ABIRA, their responses should also be included and posted.

RECOMMENDATIONS & Comments: In reviewing the various projects and land acquisition information, it is important to recognize that each project cannot stand on its own and there is a need to implement multiple recommendations to provide the necessary shoreline restoration for the entire length of the Island. Some comments about three of the recommendation:

- the **Pelican Island Southeast Nourishment** states on page 46: "During the 10-year model simulation, there was **no** noticeable **change in the rates of sediment transport** from Pelican Island to Dauphin Island."..."Nor were there significant documented differences in the patterns or magnitude of erosion or deposition around the main portions of Dauphin Island." In essence, this recommendation would do nothing for the West End of the Island.
- In the **West End Beach and Dune Restoration (with Voluntary Buyout)**, it states and additional cost of $90,000,000 to purchase beach front property. The $90,000,000 equates to an average cost of $400,000. Checking with real estate companies, the average cost of properties on the West End is more like $550,000 which the total for the 225 properties would equate to $123,7560,00, substantially more ($33,750,000) for the West End and Dune Restoration with Voluntary Buyout. In some cases, houses would value more than $750,000 or even $1,000,000 so the probably of agreements being reached to sell would be difficult.
- **The West End Beach and Dune Restoration (No Buyout):** This study references a 2011 Town of Dauphin Island Study. This study is actually the Town of Dauphin Island's Beach and Barrier Island Restoration Project, April 13, 2011, conducted by Dr. Scott Douglass, Coastal

Enclosures: Scott Douglass 2011 Dauphin Island Study Report
Corps of Engineers Dredging History
2007 Excerpts USGS Robert Morton Study
2008 Excerpts USGS Robert Morton Study
1978 Drake Wilson Letter
Corps of Engineers Risk By Down schedule
2020-06-10 News 5 article Christobal Impacts on Sea Turtle Nests
2013-05-01 Excerpt O&M Justification for a Coastal Inlets Research Program (page 1579)

Planning & Engineering, Inc. The study considered restoration for both East End and West with the East End being completed, though there is now a need to further restore that area.

If there was a need to implement just one recommendation, the recommendation I would make is to proceed with Scott Douglass' 2011 Town of Dauphin Island Restoration project. If this had been done in 2011, and the money became available from the Horizon Oil Spill, we would not be at this juncture again spending money for a study.

Recommendation: After review of the projects and issues as stated above, it is evident to accomplish the restoration of Dauphin Island's shoreline, it is necessary to recommend for implementation all the following projects as part the restoration and protection for the future:

- Ebb Tidal Shoal Restoration
    1. Pelican Island Southeast Nourishment
    2. Sand Island Platform Nourishment and Sand Bypassing
- Gulf Beach Restoration
    1. West End and Katrina Cut Beach and Dune Restoration (with No Buyouts)
    2. East End Beach and Dune Restoration
- Back-Barrier and Marsh Restoration
    1. Marsh Habitat Restoration Behind Katrina Cut

Implementing these projects will enable **Dauphin Island to fulfill its role as the First Line of Defense:** As an Alabama Resident, a property owner on Dauphin Island, and a former member of the Dauphin Island Property Owners Board of Directors (2010-2014) who has spoken often for the property owners who have lost their property to erosion, as well as for the important role that Dauphin Island plays as a first line of defense for Bayou La Batre, Coden, Alabama Port, and Mobile Bay Area Communities, barrier islands, I believe it is necessary to move forward with the above recommendation. Doing so will enable Dauphin Island, Alabama's only barrier island, to become a stable barrier island, fulfill it first line of defense role and also accomplish:

- Contribute to maintaining the integrity of Mississippi's neighboring barrier islands through sand moved westward via littoral drift
- Protect Alabama's largest continuous salt marsh habitat in Mississippi Sound
- Protect Alabama's most significant oyster reefs occurring in Mississippi Sound
- Contribute to the protection of Mississippi's neighboring marsh and oyster habitats
- Protect the shallow inshore estuarine habitats of Mississippi Sound that serve as important nursery areas for a wide range of commercially and recreationally valuable species that dependent upon this habitat
- Provide imp
- roved habitats for endangered and threatened nesting sea turtles on Dauphin Island
- Enhance shoreline habitats required by the endangered piping plover and other shore birds

I look forward to receiving the responses to this letter of comments about the Alabama Barrier Island Restoration Assessment Report.

Sincerely,

Mobile Harbor Outer Bar Channel Dredging History (1980-2016)

(Source: USACE for the period 1980-2009 and estimated for the period 2010-2016 based on the average annual maintenance quantities reported for the preceding 30 years)

Dredging Date	Gross Quantity Dredged (yd^3)	Disposal Area Used [1]
Feb-Dec 1980	1,129,337	Ocean DA
Jan-Mar 1981	610,623	Ocean DA
Dec 1982-Jan 1983	312,408	Ocean DA
Jan-Nov 1984	559,607	Ocean DA
Aug-Oct 1985	1,386,536	Ocean DA
Jan-Feb 1987	656,089	Nearshore Feeder Berm
Feb 1989-May 1990	[2] 6,755,352	Ocean DA
Aug-Sep 1992	466,607	Ocean DA
Nov-Dec 1995	621,172	Ocean DA
Aug-Dec 1997	710,996	Ocean DA
Sep-Oct 1998	1,279,780	Ocean DA
Aug-Sep 1999	71,380	Ocean DA
	54,600	SIBUA
May-Sep 1999	[3] 3,061,598	SIBUA
Apr-Jul 2000	758,280	Ocean DA
Mar 2002-May 2002	92,820	SIBUA
Jun 2004	230,110	SIBUA
Oct 2004-Nov 2004	1,184,817	SIBUA
Oct 2004-Jan 2005	1,808,765	SIBUA and at Lighthouse
Aug 2005	67,555	SIBUA
Apr-Jun 2006	487,975	SIBUA
Aug 2007	1,083,860	SIBUA
Nov-Dec 2008	585,430	SIBUA
Sept-Nov 2009	942,817	SIBUA
2010-2016 (estimated)	3,523,698	SIBUA
Total Dredged from Outer Bar Channel	**29,442,209**	For 37 years 1980-2016
Total Placed in Ocean DA	**14,672,078**	For 37 years 1980-2016
Total Placed at Nearshore Feeder Berm	**656,089**	For 1987 only
Total Placed in SIBUA or at Lighthouse	**13,124,045**	For 37 years 1980-2016

[1] Ocean DA – EPA approved open water disposal site in the offshore Gulf of Mexico
SIBUA – Sand Island Beneficial Use Area

[2] New work deepening from 42 to 47 feet

[3] New work deepening from 47 to 49 feet.

[4] Excludes new work deepening in 1989-1990 and 1999

<u>Method used to estimate maintenancedredging quantities 2010-2016 and total dredged 1980-2016</u>:

Step 1: 24,918,514 - (6,755,352 + 3,061,598) = 15,101,564 (O&M dredging only for 1980 through 2009)

Step 2: 15,101,564 ÷ 30 = 503,385 yd^3/year average OM for 30-year period between 1980 and 2009

Step 3: 503,385 × 7 = 3,523,695 yd^3 estimated as being dredged for 7-year period between 2010 and 2016

Step 4: 24,918,514 + 3,523,695 = 29,442,209 yd^3 estimated dredged from Outer Bar Channel (1980 to 2016)

MOBILE HARBOR PACR SCHEDULE - Risk Buy-Down Plan

Date: 31 August 2015

	Task	Duration (calendar days)	Start Date	End Date	Predecessors	FY
	FY14 ACTIONS					
1	Scoping funds received	0	10-Nov-14	10-Nov-14		15
2	Charrette Meeting	1	28-Jan-14	29-Jan-14		15
3	3x3 Compliance - Create draft PMP, review plan, budget, schedule, risk register, draft Agreement	171	11-Nov-14	1-May-15	1	15
4	**Finalize & Execute Amendment to Design Agreement**	182	1-Apr-15	30-Sep-15	3	15
5	Obtain and set-up Sponsor Funds	21	1-Oct-15	22-Oct-15	4	16
6	Prepare for NEPA/Scoping Meeting	14	23-Oct-15	6-Nov-15	5	16
7	NEPA/Scoping Meeting	7	9-Nov-15	16-Nov-15	6	16
8	Identify Problems and Opportunities and objectives/constraints	14	23-Oct-15	6-Nov-15	5	16
9	Determine Existing and baseline condition	75	9-Nov-15	23-Jan-16	8	16
10	Develop SOW for Bathymetric Surveys	30	23-Oct-15	22-Nov-15	5	16
11	Develop SOW for Wave and Current Data Collection	30	23-Oct-15	22-Nov-15	5	16
12	Collect Automatic Identification System (AIS) data from the Coast Guard	90	23-Oct-15	21-Jan-16	5	16
13	Initiate development of SEIS and 404(b)(1) Eval	30	23-Oct-15	22-Nov-15	5	16
14	Request Fish and Wildlife Coordination Act report	90	23-Oct-15	21-Jan-16	5	16
15	Preliminary Formulation and Screening (incl NEPA scoping)	45	23-Oct-15	7-Dec-15	5	16
16	In-Progress Review Meeting	1	8-Dec-15	9-Dec-15	15	16
17	Prepare read-ahead package (update risk reg, DMP, report syn.) & submit to vertical team	21	8-Dec-15	29-Dec-15	15	16
18	Vertical team review of AM materials	7	30-Dec-15	6-Jan-16	17	16
19	Alternatives Milestone Meeting	0	7-Jan-16	7-Jan-16	18	16
20	**Alternatives Milestone**	0	8-Jan-16	8-Jan-16	19	16
21	Alternatives Milestone Memorandum for Record	14	8-Jan-16	21-Jan-16	19	16
22	Bathymetric Survey Complete	60	23-Nov-15	22-Jan-16	10	16
23	Preliminary Real Estate Evaluation	90	11-Jan-16	10-Apr-16	20	16
24	Preliminary coordination with Resource Agencies (BA, T & ES, EFH, etc.)	365	23-Nov-15	22-Nov-16	13	16
25	Archeological / Cultural Resources Evaluation	90	23-Nov-15	21-Feb-16	13	16
26	Analyse disposal / beneficial use alternatives	90	23-Nov-15	21-Feb-16	13	16
27	Wave and Current data collection complete	70	23-Nov-15	1-Feb-16	11	16
28	Existing condition hydrodynamic modeling (incl. wave modeling)	140	2-Feb-16	21-Jun-16	27	16
29	Existing condition Sediment Transport modeling (Estuarine and Coastal)	70	22-Jun-16	31-Aug-16	28	16
30	Existing condition water quality modeling	160	22-Jun-16	29-Nov-16	28	16
31	Existing Condition Wave and Vessel Impact Analysis	90	22-Jan-16	21-Apr-16	12	16
32	In-Progress Review Meeting	1	30-Nov-16	1-Dec-16	30	16
33	Future Without Project Condition hydrodynamic modeling	60	22-Jun-16	21-Aug-16	28	16
34	Future Without Project Condition Sediment Transport modeling (Estuarine and Coastal)	45	22-Aug-16	6-Oct-16	33	16
35	Future Without Project Condition water quality modeling	45	30-Nov-16	14-Jan-17	30	16
36	Future Without Wave and Vessel Impact Analysis	90	22-Apr-16	21-Jul-16	31	16
37	Develop commodity forecast	90	25-Jan-16	24-Apr-16	9	16
38	Develop Fleet Forecast	150	25-Apr-16	22-Sep-16	37	16
39	Build HarborSym Model	75	23-Sep-16	7-Dec-16	38	16/17
40	Develop ROM & Construction Costs for HarborSym Alternatives	90	23-Sep-16	22-Dec-16	38	16/17
41	Analyze and compare future "with" & "without" Project Conditions	60	8-Dec-16	6-Feb-17	39	17
42	Intermediate Review and Screening of Alternatives	30	7-Feb-17	9-Mar-17	41	17
43	In-Progress Review Meeting	1	10-Mar-17	11-Mar-17	42	17
44	Geotechnical Investigation	90	10-Mar-17	8-Jun-17	42	17
45	Sediment Testing data collection	120	10-Mar-17	8-Jul-17	42	17
46	Results of sediment testing complete	120	10-Jul-17	7-Nov-17	45	17
47	Develop Hydrodynamics for Shipsym	120	23-Sep-16	21-Jan-17	38	17
48	On-site Ship Simulation Testing	30	23-Jan-17	22-Feb-17	47	17
49	Ship Simulation Report Complete	60	23-Feb-17	24-Apr-17	48	17
50	Vertical Ship Motion Analysis Using CADET	60	9-Dec-16	7-Feb-17	47	17
51	Alternative Model Run (NED) - Hydrodynamics	60	10-Mar-17	9-May-17	42	17
52	Alternative Model Run (NED) - Water quality modeling	40	10-May-17	19-Jun-17	51	17
53	Alternative Model Run (NED) - Sediment transport modeling (Estaurine & Coastal)	40	10-May-17	19-Jun-17	51	17
54	Habitat Impact Assessment	60	20-Jun-17	19-Aug-17	53	18
55	Mitigation evaluation (coord. with resource agencies)	60	20-Jun-17	19-Aug-17	53	18
56	Disposal area LTFATE/STFATE modeling (ODMDS)	70	10-May-17	19-Jul-17	51	17
57	Prepare Modeling Report	30	20-Jun-17	20-Jul-17	53	17
58	Alternative Model Run (NED) - Wave and vessel wake impact analysis	90	23-Sep-16	22-Dec-16	38	17
59	Preliminary design of Alternative Plans	30	21-Aug-17	20-Sep-17	55	17
60	Final Screening of Alternatives to final array	90	21-Sep-17	20-Dec-17	59	18
61	Evaluation of final array	30	21-Dec-17	20-Jan-18	60	18
62	In-Progress Review Meeting	1	22-Jan-18	23-Jan-18	61	18
63	Prepare read-ahead package (update risk reg, DMP, etc) & submit to vertical team	7	22-Jan-18	29-Jan-18	61	18
64	Vertical team review of TSP materials	14	30-Jan-18	13-Feb-18	63	18
65	Tentatively Selected Plan Milestone Meeting	0	14-Feb-18	14-Feb-18	64	18
66	**Tentatively Selected Plan (TSP) Milestone**	0	15-Feb-18	15-Feb-18	65	18
67	TSP Memorandum for Record	14	15-Feb-18	1-Mar-18	65	18
68	Econ Risk & Uncertainty Analysis	30	15-Feb-18	17-Mar-18	65	18
69	Econ Regional Impact Analysis	7	15-Feb-18	22-Feb-18	65	18
70	Econ Multiport Analysis	7	15-Feb-18	22-Feb-18	65	18
71	Develop Real Estate Gross Appraisal Report	45	22-Jan-18	8-Mar-18	61	18
72	Complete Cost Risk Analysis and VE Study	40	22-Jan-18	3-Mar-18	61	18
73	Develop Detailed Costs for TSP (TCPS, MCASES, etc)	14	5-Mar-18	19-Mar-18	72	18
74	Complete draft report with NEPA	10	20-Mar-18	30-Mar-18	73	18
75	DQC of Draft Report (incl legal)	21	2-Apr-18	23-Apr-18	74	18
76	Incorporate DQC Comments	14	24-Apr-18	8-May-18	75	18
77	In-Progress Review Meeting	1	9-May-18	10-May-18	76	18
78	Update DMMP (coord with EPA)	90	15-Feb-18	16-May-18	63	18
79	Receive biological opinion	650	23-Nov-16	4-Sep-18	24	17/18
80	Prepare for IEPR Start	1	20-Mar-18	21-Mar-18	73	18
81	Release for concurrent public, technical, policy and legal review	30	9-May-18	8-Jun-18	76	18
82	Public Review of Draft Report and Draft EIS	45	11-Jun-18	26-Jul-18	81	18
83	Agency Technical Review (ATR) Conducted by PCX - Draft Report	30	11-Jun-18	11-Jul-18	81	18
84	SAD/HQ Policy and Legal Review Draft Report	45	11-Jun-18	26-Jul-18	81	18
85	IEPR team review of Draft Report	60	11-Jun-18	10-Aug-18	81	18
86	Update policy guidance memorandum and commence finalizing report per reviews	30	13-Aug-18	12-Sep-18	85	18
87	In-Progress Review Meeting	1	13-Sep-18	14-Sep-18	86	18
88	Create read-ahead package (update risk reg, DMP, report Syn.) & submit to vertical team	14	13-Sep-18	27-Sep-18	86	18
89	Vertical team review of ADM materials	14	28-Sep-18	12-Oct-18	88	19
90	Agency Decision Milestone Meeting	0	15-Oct-18	15-Oct-18	89	19
91	**Agency Decision Milestone (ADM)**	0	16-Oct-18	16-Oct-18	90	19
92	ADM Memorandum for Record	14	16-Oct-18	30-Oct-18	87	19
93	Finalize details on TSP, complete final report	30	16-Oct-18	15-Nov-18	87	19
94	DQC of Final Report	21	16-Nov-18	7-Dec-18	90	19
95	Incorporate DQC Comments	21	10-Dec-18	31-Dec-18	91	19
96	Cost Certification / Cost ATR	30	1-Jan-19	31-Jan-19	95	19
97	Agency Technical Review (ATR) - Final Report/NEPA	30	1-Jan-19	31-Jan-19	95	19
98	Incorporate ATR Comments	21	1-Feb-19	22-Feb-19	97	19
99	Submit Final Report package to SAD	7	25-Feb-19	4-Mar-19	98	19
100	SAD Review Final Report	21	5-Mar-19	26-Mar-19	99	19
101	Provide responses to SAD comments and revise Final Report	14	27-Mar-19	10-Apr-19	100	19
102	**Division Engineer Transmittal Letter**	0	11-Apr-19	11-Apr-19	101	19
103	CECW (HQ) Review Final Report	30	12-Apr-19	13-May-19	102	19
104	Provide responses to CECW (HQ) comments and revised Final Report	30	14-May-19	13-Jun-19	103	19
105	Publish Notice in Federal Register	14	14-Jun-19	28-Jun-19	104	19
106	Final SEIS and Public Review Period	30	1-Jul-19	1-Aug-19	105	19
107	Revise Final Report for public comments	30	2-Aug-19	1-Sep-19	106	19
108	HQ routing of final report	21	3-Sep-19	24-Sep-19	107	19
109	**PACR Approval**	0	25-Sep-19	25-Sep-19	108	19
110	Rod Signed	30	26-Sep-19	26-Oct-19	109	19
				Subtotals		
				15% Contingency		
				Total		

Assumptions:

Notes:

1. PD Contract costs includes PD support from other districts
2. EN Contract costs includes support from ERDC
3. Pink cells denote tasks that are on the critical path
4. Blue cells denote In-progress Review Meetings
4. About $4M in data collection, modeling, & analyses from separate studies will be applied towards this effort

3 year check 4.0 years

Subtotal check $6,786,233

SAMPD-N 9 July 1975

Honorable Jack Edwards
House of Representatives
Washington, DC 20513

Deaf Mr. Edwards:

For your information I am inclosing a copy of the transcript of the Workshop Meeting on Beach Erosion Control and Hurricane Protection for Mobile County held at Bayley's Ranch on 31 March 1975. I appreciate your attendance at the meeting, and interest you have demonstrated in this study.

As you recall, little interest was exhibited at the meeting for structural velars that could be implemented under existing Federal authorities for beach erosion control. These authorities require the establishment of public property and public access to the shoreline *as* a condition for any significant Federal financial participation in a beach erosion control project. As indicated at the meeting, the establishment of public shoreline property would be strongly opposed by existing waterfront property owners. Furthermore, preliminary studies indicate that protection of the sparsely developed shoreline would not result in the necessary economic benefits to justify the construction of costly structures for beach erosion control and hurricane protection.

While structural measures specifically for beach erosion control are indicated to be economically unjustified and to have unacceptable social and coca unity impacts, the need for protection of the shoreline was emphasized. Substantial interest was indicated in the concept of deposition of unconfined dredged material from the ship channel along the west bay shoreline and Dauphin Island for the abatement of erosion.

The prospect for satisfactorily alleviating erosion problems on Dauphin Island by depositing the sandy material dredged from the Mobile Bay entrance channel upon the Gulf shoreline of the island appears promising And will be pursued. The viability of depositing future "new work" material dredged from the ship channel within Mobile Bay upon the western shoreline cannot he determined without estuarian and other environmental impact studies but is considered meritorious of further consideration. Under the above concepts the eroding shorelines would be nourished by the dredged material primarily as disposal areas in support of the maintenance and modification of the Mobile Harbor navigation project. This plan would preserve any accreted land as the property of adjoining land owners and limit local costs resulting from the accreted land, to the amount required for necessary stabilization and a portion of the cost allocated to land enhancement, Therefore, the options for nourishment of the eroding shorelines with material dredged from the ship channel could be more appropriately considered under our ongoing study of navigation modifications for Mobile Harbor rather than under the study for beach erosion control and hurricane protection.

In view of the indications of the workshop meeting, further consideration for deposition of the dredged material, from the ship channel along the eroding shorelines under the ongoing survey study for modification of the existing Federal project for Mobile Harbor is indicated to be warranted in lieu of the authorized beach erosion control and hurricane protraction study. Since our study has not indicated any other likely structural alternatives for beach erosion control and hurricane protection, and in accordance with Corps' policy to apply our limited study funds where they can be most productive, I am proposing to conclude our beach erosion and hurricane protection study for Mobile County. A concise report which will address the foregoing considerations along with the finding that no additional Federal structural improvements are warranted at this time in the interest of beach erosion control and hurricane protection can be completed with programmed fiscal 1976 study funds. Any remaining surplus funds could be transferred to other studies. In lieu of this option, deferral of future studies into an inactive study category is indicated.

I plan to notify the Mobile City and County Commissions of our proposal to terminate the study in the near future, but, in the interim, would appreciate any views or comments you may have regarding the study and proposed course of action.

Sincerely yours,

1 Incl
As stated

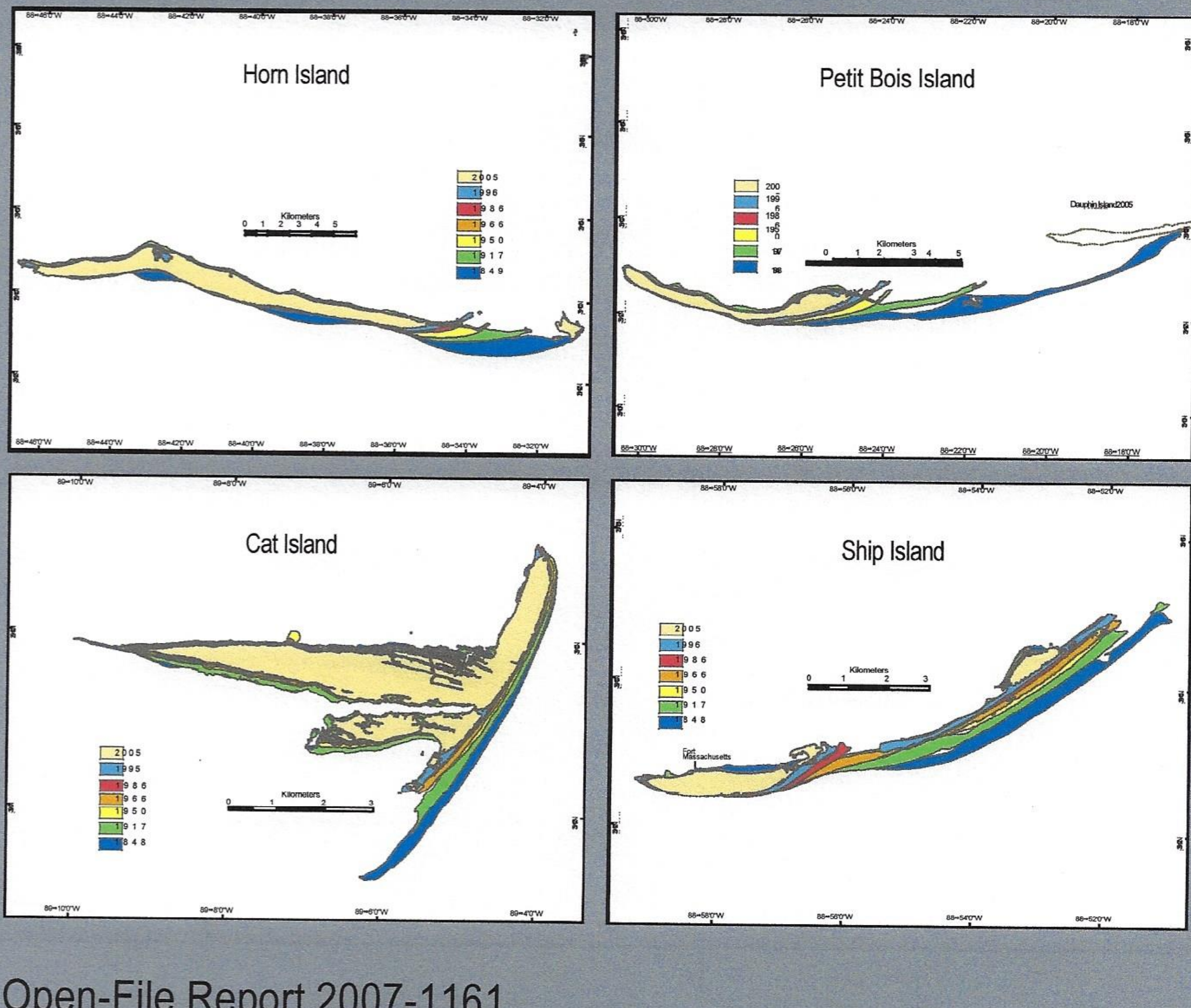
DRAKE WILSON
Colonel, CE
District Engineer

USGS
science for a changing world

#7

HISTORICAL CHANGES IN THE MISSISSIPPI-ALABAMA BARRIER ISLANDS AND THE ROLES OF EXTREME STORMS, SEA LEVEL, AND HUMAN ACTIVITIES

Robert A. Morton



Open-File Report 2007-1161

U.S. Department of the Interior
U.S. Geological Survey

HISTORICAL CHANGES IN THE MISSISSIPPI-ALABAMA BARRIER ISLANDS AND THE ROLES OF EXTREME STORMS, SEA LEVEL, AND HUMAN ACTIVITIES

By Robert A. Morton

U.S. Geological Survey
Florida Integrated Science Center
Coastal and Watershed Science Team
St. Petersburg Florida 33701

U.S. Geological Survey
Coastal and Marine Geology Program

Open File Report 2007-1161

U.S. Department of the Interior
U.S. Geological Survey

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SUMMARY

An historical analysis of images and documents shows that the Mississippi-Alabama (MS-AL) barrier islands are undergoing rapid land loss and translocation. The barrier island chain formed and grew at a time when there was a surplus of sand in the alongshore sediment transport system, a condition that no longer prevails. The islands, except Cat, display alternating wide and narrow segments. Wide segments generally were products of low rates of inlet migration and spit elongation that resulted in well-defined ridges and swales formed by wave refraction along the inlet margins. In contrast, rapid rates of inlet migration and spit elongation under conditions of surplus sand produced low, narrow, straight barrier segments.

Since the mid 1800s, average rates of land loss for all the MS islands accelerated systematically while maintaining consistency from island to island. In contrast, Dauphin Island, off the Alabama coast, gained land during the early 20th century and then began to lose land at rates comparable to those of the MS barriers. There is an inverse relationship between island size and percentage of land reduction for each barrier such that Horn Island lost 24% and Ship Island lost 64% of its area since the mid 1800s. Ship Island is particularly vulnerable to storm-driven land losses because topographic and bathymetric boundary conditions focus wave energy onto the island. The three predominant morphodynamic processes associated with land loss are: (1) unequal lateral transfer of sand related to greater updrift erosion compared to downdrift deposition, (2) barrier narrowing resulting from simultaneous erosion of the Gulf and Sound-side shores, and (3) barrier segmentation related to storm breaching. The western three fourths of Dauphin Island are migrating landward as a result of storms that erode the Gulf shore, overwash the island, and deposit sand in Mississippi Sound. Petit Bois, Horn, and Ship Islands have migrated westward as a result of predominant westward sediment transport by alongshore currents, and Cat Island is being reshaped as it adjusts to post-formation changes in wave and current patterns associated with deposition of the St. Bernard lobe of the Mississippi delta.

The principal causes of barrier island land loss are frequent intense storms, a relative rise in sea level, and a deficit in the sediment budget. The only factor that has a historical trend that coincides with the progressive increase in rates of land loss is the progressive reduction in sand supply associated with nearly simultaneous deepening of channels dredged across the outer bars of the three tidal inlets maintained for deep-draft shipping. Neither rates of relative sea level rise nor storm parameters have long-term historical trends that match the increased rates of land loss since the mid 1800s. The historical rates of relative sea level rise in the northern Gulf of Mexico have been relatively constant and storm frequencies and intensities occur in multidecadal cycles. However, the most recent land loss accelerations are likely related to the increased storm activity since 1995.

Considering the predicted trends for storms and sea level related to global warming, it is clear that the barrier islands will continue to lose land area at a rapid rate without a reversal in trend of at least one of the causal factors. The reduction in sand supply related to disruption of the alongshore sediment transport system is the only factor contributing to land loss that can be managed directly. This can be accomplished by placing dredged material so that the adjacent barrier island shores receive it for island nourishment and rebuilding.

INTRODUCTION

Barrier island chains in the northern Gulf of Mexico extending from Mobile Bay, Alabama to Atchafalya Bay, Louisiana are disintegrating rapidly as a result of combined physical processes involving sediment availability, sediment transport, and sea level. The cumulative areas and rates of land loss from these ephemeral features are, to some extent, expected because present physical conditions are different from those that existed when the islands first formed. For example, during the past few thousand years sediment supply has diminished, rates of relative sea level rise have increased, and hurricanes and winter storms have been frequent events that generate extremely energetic waves capable of permanently removing sediment from the islands. These processes continuously act in concert, increasing rates of beach erosion and reducing the area of coastal land.

At greatest risk of further degradation are the barrier islands associated with the Mississippi delta that include the Chandeleur-Breton Island, Timbalier Island, and Isle Dernier chains in Louisiana. These chains of individual transgressive barrier island segments have progressively diminished in size while they migrated landward (McBride and others, 1992). In contrast are the Mississippi-Alabama (MS-AL) barrier islands (Fig. 1) that are not migrating landward as they decrease in size. Instead, the centroids of most of the islands are migrating westward in the direction of predominant littoral drift through processes of updrift erosion and downdrift deposition (Richmond, 1962; Otvos, 1970). Although the sand spits and shoals of the MS-AL barriers are being transferred westward, the vegetated interior cores of the islands remain fixed in space. Rucker and Snowden (1989) measured the orientations of relict forested beach ridges on the MS barriers and concluded that the ridges and swales were formed by recurved spit deposition at the western ends of the islands.

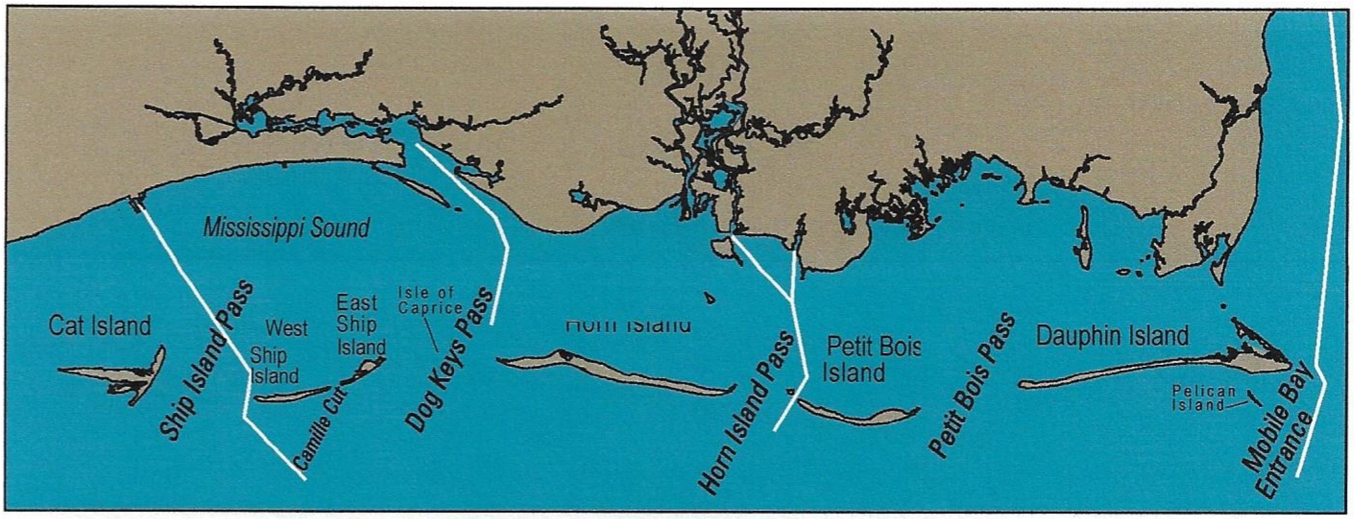

Figure 1. Locations of the Mississippi-Alabama barrier islands and associated tidal inlets. Deep draft shipping channels maintained by periodic dredging are shown as white lines.

Journal of Coastal Research	24	6	1587–1600	West Palm Beach, Florida	November 2008

Historical Changes in the Mississippi-Alabama Barrier-Island Chain and the Roles of Extreme Storms, Sea Level, and Human Activities

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ABSTRACT

MORTON, R.A., 2008. Historical changes in the Mississippi-Alabama barrier-island chain and the roles of extreme storms, sea level, and human activities. *Journal of Coastal Research,* 24(6), 1587–1600. West Palm Beach (Florida), ISSN 0749-0208.

Barrier-island chains worldwide are undergoing substantial changes, and their futures remain uncertain. An historical analysis of a barrier-island chain in the north-central Gulf of Mexico shows that the Mississippi barriers are undergoing rapid systematic land loss and translocation associated with: (1) unequal lateral transfer of sand related to greater updrift erosion compared to downdrift deposition; (2) barrier narrowing resulting from simultaneous erosion of shores along the Gulf and Mississippi Sound; and (3) barrier segmentation related to storm breaching. Dauphin Island, Alabama, is also losing land for some of the same reasons as it gradually migrates landward. The principal causes of land loss are frequent intense storms, a relative rise in sea level, and a sediment-budget deficit. Considering the predicted trends for storms and sea level related to global warming, it is certain that the Mississippi-Alabama (MS-AL) barrier islands will continue to lose land area at a rapid rate unless the trend of at least one causal factor reverses. Historical land-loss trends and engineering records show that progressive increases in land-loss rate correlate with nearly simultaneous deepening of channels dredged across the outer bars of the three tidal inlets maintained for deep-draft shipping. This correlation indicates that channel-maintenance activities along the MS-AL barriers have impacted the sediment budget by disrupting the alongshore sediment transport system and progressively reducing sand supply. Direct management of this causal factor can be accomplished by strategically placing dredged sediment where adjacent barrier-island shores will receive it for island nourishment and rebuilding.

ADDITIONAL INDEX WORDS: *Sediment budget, barrier restoration, channel dredging, human modifications.*

INTRODUCTION

Barrier-island chains worldwide are being recognized as finite natural resources with high social value for recreation and storm protection, but with uncertain futures (Pilkey, 2003). The uncertainty comes from the fact that some barrier-island chains are disintegrating rapidly as a result of combined physical processes involving sediment availability, sediment transport, and rising sea level. Accelerated rates of land loss and decreases in area should be expected for these ephemeral features, because present physical conditions are different from those that existed when many of the barrier islands first formed (Bird, 2003). In many coastal areas during the past few thousand years, sediment supply has diminished, rates of relative sea-level rise have increased, and hurricanes and winter storms have been frequent events that generate extremely energetic waves capable of permanently removing sediment from the island chains.

Recent attention has focused on the accelerated land loss and morphological changes of barrier-island chains in the north-central Gulf of Mexico that resulted from impacts of Hurricane Katrina (Sallenger *et al.,* 2006). Barrier islands at greatest risk of further degradation, the Chandeleur-Breton Island, Grand Terre Island, Timbalier Island, and Isle Dernieres chains in Louisiana, are associated with the Mississippi River delta (McBride and Byrnes, 1997). These chains of transgressive barrier islands have progressively diminished in size as they migrated landward and/or disintegrated in place (McBride *et al.,* 1992; McBride and Byrnes, 1997). In contrast, the MS-AL barrier islands (Figure 1) are not migrating landward as they decrease in size. Instead, the centroids of most of the islands are migrating westward in the direction of predominant littoral drift through processes of updrift erosion and downdrift deposition (Byrnes *et al.,* 1991; Otvos, 1970; Richmond, 1962). Although the sand spits and shoals of the MS-AL barriers are being transferred westward, the vegetated interior cores of the islands remain fixed in space.

The objectives of this investigation were to document the historical changes in position and land area of the MS-AL barrier islands, examine the physical factors that are most

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bile Bay to intersect with the tidal inlet that separates Dauphin Island and Fort Morgan Peninsula. In 1857, the original controlling depth of the outer bar at the Mobile Bay Entrance was 5.4 m. Dredging enlarged the outer-bar channel to 9 m deep and 90 m wide in 1902, 9.9 m deep and 135 m wide by 1917, 10.8 m deep and 135 m wide by 1930, 11.4 m deep and 180 m wide by 1957, and 12.6 m deep and 180 m wide by 1987 (Ryan, 1969). From the time of initial entrance-channel dredging, the controlling depth of the outer bar was exceeded, and by 1930 the natural thalweg depth of the outer bar had been exceeded. At its maintained depth of 14.3 m, the entrance channel exceeds the original outer-bar controlling depth by 8.9 m. As dimensions of the Mobile Ship Channel steadily increased, so did the average annual maintenance dredging requirements (Bisbort, 1957).

Horn Island Pass (Pascagoula Channel)

In 1853, the natural controlling depth across the outer bar at Horn Island Pass was 4.5 m, and average depths of the inlet thalweg were about 5.1 m. Deepening of Horn Island Pass and modifications that would later become part of the ship channel to Pascagoula began as early as 1880 (U.S. Army Corps of Engineers, 1935). At that time, a channel across the outer bar was dredged to a width of 60 m and a depth of 6 m, but the channel subsequently shoaled to a depth of 5.4 m (U.S. Army Corps of Engineers, 1904). By 1935, the dredged channel across the outer bar was 5.7 m deep and 90 m wide (U.S. Army Corps of Engineers, 1935). In 2005, maintained dimensions of the outer-bar channel were 13.2 m deep and 135 m wide, and maintained dimensions of the Horn Island Pass Channel were 12.6 m deep and 180 m wide. The dredged bar-channel depth in 2005 was 7.8 m below the original controlling depth of the outer bar. Perhaps of greatest importance, with regard to sediment-transport alterations, is the channel adjacent to the western end of Petit Bois Island. There a segment was dredged to 16.8 m with the intent of trapping sediment (Bunch *et al.,* 2003) that likely would have bypassed around the ebb-delta shoals under natural conditions (Fitzgerald, Kraus, and Hands, 2001).

Ship Island Pass (Gulfport Harbor)

In 1899, the federal government began work on a channel through the Ship Island Pass outer bar, which had a natural controlling depth of about 5.7 m (U.S. Army Corps of Engineers, 1935). Between 1901 and 1903, private investors interested in the economic development of Gulfport, Mississippi, dredged the Gulfport Ship Channel across Mississippi Sound to connect with the Ship Island Pass channel, which borders the western end of Ship Island. The initial dredged dimensions of the ship channel across the sound were 90 m wide and 5.7 m deep (U.S. Army Corps of Engineers, 1935). By 1921, the shipping channel had been deepened to 7.8 m (Knowles and Rosati, 1989). In 1934, the channel across the outer bar was about 90 m wide and 8.1 m deep (U.S. Army Corps of Engineers, 1935). By 1950, the channel through Ship Island Pass and the outer bar was 90 m wide and 9.6 m deep (Knowles and Rosati, 1989). These channel dimensions remained unchanged until at least 1988 (Grandison, 1988). In 2005 the channel through Ship Island Pass and the outer bar was 122 m wide and it had been deepened to 11.6 m, or double the natural controlling depth of the outer bar.

Ship Island Restoration

After Fort Massachusetts was constructed on Ship Island in the 1860s, beach erosion near the western end of the island eventually exposed the fort to periodic flooding, and waves from Mississippi Sound threatened to undermine the structural integrity of the fort (Henry, 1976). To protect the fort from frequent inundation and destruction, approximately 382,000 m^3 of sand dredged for maintenance of Ship Island Pass (Gulfport Ship Channel) was used to rebuild approximately 1.5 km of the northwestern side of the island in 1974 (Henry, 1976). When sound-side beach erosion continued, more than 280,000 m^3 of sand was added through periodic dredge and fill events in 1980 (76,460 m^3), 1984 (160,566 m^3), and 1991 (44,346 m^3). The repeated fill projects advanced the shore into Mississippi Sound as much as 125 m and to a depth of 2–2.5 m (Chaney and Stone, 1996). Ineffective erosion-mitigation structures placed along the sound-side shore near the fort included two sunken barges to act as a breakwater and a rock seawall, which was undermined and failed (Chaney and Stone, 1996).

Impacts on Sediment Transport

Four prior studies evaluated the impacts of dredged navigation channels on sediment transport and sediment budget of the MS-AL barrier islands. Knowles and Rosati (1989) estimated sediment-transport rates in the vicinity of Ship Island between 1848 and 1986. They reported that sediment transported westward was deposited in the Ship Island Pass navigation channel, which increased periodic maintenance dredging and prevented sediment accumulation on the western tip of Ship Island at rates ranging from 31,000 to 121,000 m^3/y.

Douglass (1994) calculated sediment-transport rates along Dauphin Island and compiled dredging records for the ebb-delta segment of the Mobile Ship Channel between 1974 and 1989. The total volume of sediment dredged from the ebb-delta segment during the 15-year period was nearly 12 million m^3, and the sediment volume removed for maintenance averaged more than 450,000 m^3/y. On the basis of these large sediment volumes and their position with respect to the former outer bar, Douglass (1994) concluded that the Mobile Channel served as a sediment trap that disrupted the littoral transport system.

Cipriani and Stone (2001) examined textural trends of the gulf shore beaches and calculated net alongshore sediment-transport rates for the region. The results of their study indicated zero sediment exchange across most of the tidal inlets. They also concluded that the dredged channel at Horn Island Pass acted as a sediment sink.

Rosati *et al.* (2007) showed that sediment volumes dredged from Horn Island Pass and Ship Island Pass increased exponentially since the early 1900s when systematic channel modifications began. The rates of sediment removed from the navigation channels separating the barrier islands accelerated between 1950 and 1960 such that average annual dredging from Horn Island Pass increased from about 26,000 m^3/y to about 394,000 m^3/y; average annual sediment volumes removed from Ship Island Pass increased from 33,000 m^3/y to about 443,000 m^3/y. The order of magnitude increases in dredging rates partly reflect increased channel dimensions, but they also indicate enhanced ability of the enlarged channels to impound sand in transport. Rosati *et al.* (2007) concluded that the dredged channels at Horn Island Pass and Ship Island Pass were probably total traps for sediment transported in the littoral drift zone.

These studies provide strong direct evidence that the overdeepened channels through the former outer bars prevent sediment bypassing around the ebb-tidal deltas that would have supplied the shores of downdrift barrier islands.

Management of Dredged Sediment

Sediment dredged from the MS-AL shipping channels typically has been placed in designated disposal sites along the margins of the channels or in unconfined open-water disposal sites offshore from the barrier islands (Knowles and Rosati, 1989). These practices conducted around the tidal inlets between the barrier islands permanently removed large volumes of beach-quality sand from the sediment-transport system that otherwise would have nourished the adjacent barrier islands and mitigated land losses. Although most of the disposal practices contributed to a reduction in the sediment budget of the barrier islands, several have been beneficial. These include direct placement of dredged material on Ship Island to protect Fort Massachusetts (Henry, 1976), enlargement of a shoal using a disposal area between Petit Bois Island and Horn Island, and construction of submerged berms on the ebb-tidal delta at the entrance to Mobile Bay (Hands and Allison, 1991).

ASSESSMENT OF FACTORS CONTROLLING BARRIER-ISLAND LAND LOSS

The remarkable temporal similarity of generally accelerated rates of land loss for each of the MS-AL barrier islands (Figure 7) indicates that one or more of the primary regional factors causing land loss has changed substantially since the mid-1800s. The three most likely causes of land loss in the Gulf Coast region are frequent intense storms, a relative rise in sea level, and a reduction in sediment supply (Morton, 2003).

Storm Cycles

Most of the intense hurricanes that make landfall in the Gulf of Mexico originate in the North Atlantic Basin, although a few originate in the Caribbean Sea. Tropical cyclone activity in the North Atlantic occurs in multidecadal cycles that are controlled by fluxes in global atmospheric patterns (El Niño-Southern Oscillation), sea-surface temperatures, and other climatic factors (Emanuel, 1987; Goldenberg *et al.,* 2001; Gray, 1990). Records for statistical analyses of North Atlantic storms are incomplete before the early 1900s (Landsea *et al.,* 1999); therefore, any results of statistical analyses using storm counts or metrics from the mid-to-late 1800s period could be misleading. It is generally recognized that periods of high storm activity in the North Atlantic extended from the late 1940s through the late 1960s and since 1995, but the 1970s through the early 1990s was a period of low storm activity (Goldenberg *et al.,* 2001; Gray, 1990). The trends of historical land losses for the Mississippi barrier islands collectively illustrate a progressive increase with time, which correlates partly with the periods of high storm activity (Figure 7). However during the period of low storm activity, land-loss rates continued to increase, calling into question a predominant causal relation between storm activity and a progressive increase in land-loss rates. The post-1995 acceleration in rates of barrier-island land loss may be partly a result of the increased storm activity since 1995.

Winter storms affecting the MS-AL barrier islands are substantially more frequent than tropical cyclones. North winds and the cumulative wave energy that they generate and dissipate on the islands are largely responsible for erosion of the Mississippi Sound shores of the islands (Chaney and Stone, 1996). The systematic erosion of the sound-side shores also contributes to island narrowing and the associated land loss.

Sea Level

The longest sea-level record in the northern Gulf of Mexico is for Galveston, Texas, where average annual measurements are available since 1910 (National Oceanic and Atmospheric Administration,, 2008). The sea-level record for Pensacola, Florida, extends back to 1923. Both of these records, which cover the periods of increased rates of barrier-island land loss, are highly correlated and show the same trends in the relative rise in sea level and the same details of the short-term secular variations. Neither of these tide-gauge records, which together characterize the region of the MS-AL barrier islands, shows a historical accelerated rise in sea level that would explain the rapid increase in barrier-island land loss rates. Taking into account the differences in vertical land movement at Galveston (subsiding) and Pensacola (relatively stable), the tide-gauge records show a relatively uniform rate of relative sea-level rise for the periods of record. The historical tide-gauge record at Dauphin Island (1966–1997) showed a rate of relative sea-level rise (2.9 mm/y) that is comparable to the rate recorded at Pensacola (2.1 mm/y). Both of these rates of relative sea-level rise are only slightly greater than the eustatic rise in sea level of about 1.8 mm/y (Douglas, 2001).

Sand Supply

Historically, large volumes of sand have been released to the alongshore sediment-transport system as a result of erosion of the MS-AL barrier islands, but much of that sand has not benefited downdrift island segments or adjacent barriers. The volume of sand supplied to the MS-AL barrier islands by alongshore currents has been reduced progressively since the late 1800s as the outer bars at the entrance to Mobile Bay, Horn Island Pass, and Ship Island Pass were dredged to increasingly greater depths (Figure 7; Byrnes *et al.,* 1991; Douglass, 1994; Rosati *et al.,* 2007; Waller and Malbrough, 1976). In the mid-1800s, the natural controlling depths of tidal inlets connecting Mississippi Sound with the Gulf of Mexico were from 4.5 to 5.7 m. Since then, the outer-bar channels have been repeatedly dredged to depths well below their natural depths and that of the surrounding seafloor. The initial shallow dredging would have had minimal effect on sediment transport, but the cumulative effects of nearly simultaneous deepening of the navigation channels through the outer bars would eventually prevent the sediment-transport system from transferring sand to the downdrift barriers. This temporal progression is consistent with observations at Ship Island Pass that shoaling was substantially greater than maintenance dredging by the 1950s (Knowles and Rosati, 1989), and at Horn Island Pass and Ship Island Pass that trapped sediment volumes increased exponentially as channel dimensions increased (Rosati *et al.,* 2007).

The channel modifications eventually disrupted the littoral system and rendered it incapable of transferring sand across the ebb-tidal deltas. Most of the sand in transport along the Gulf shores of the MS-AL barriers became trapped in the navigation channels (Cipriani and Stone, 2001). The impounded sand was then removed by dredging and placed mostly in disposal sites (Knowles and Rosati, 1989) where it was unavailable for barrier-island nourishment. The temporal increase in sand volume removed from the littoral system as a result of channel dredging (Bisbort, 1957; Rosati *et al.,* 2007) generally matches the historical trend of progressive increases in barrier-island land loss (Figure 7).

Each of the MS-AL barrier islands is affected by one of the navigation channels that compartmentalize the alongshore sediment-transport system and reduce sand supply. The navigation channels act as sediment sinks, removing sand that otherwise would have been available for beaches immediately downdrift of the channel if the ebb-tidal delta had not been modified (east Dauphin Island, east Horn Island, Cat Island spits). Sand also goes into the channel instead of constructing a platform and spit for island extension at the downdrift ends of some barriers (Petit Bois Island and Ship Island). Dauphin Island is probably least affected by the induced reduction in sand supply, because the large volume of sand stored in the ebb-tidal delta is still available for remobilization and barrier nourishment.

Sea-level rise is the primary driver of coastal land loss over geological time scales (centuries, millennia), whereas storms are the agents of sediment redistribution and land loss for short time scales (years, decades). However, land-loss potential associated with these processes can be offset or at least minimized if sediment supply is abundant. But when sediment supply is reduced, then land loss is exacerbated because the sediment redistributed by storms is not replenished by the sediment-transport system.

FUTURE BARRIER-ISLAND TRENDS

Accurately predicting the future sizes, configurations, and positions of the MS-AL barrier islands depends on an accurate record of geological and historical changes to the islands and knowledge of future conditions. The future conditions would include sand supply rates, sediment transport rates, relative sea-level rise rates, regional storm frequency and intensity, and the likely responses of the barrier islands to future storms compared to those of the past. Without this extensive knowledge base, even limited qualitative predictions would require assumptions of future conditions. Such assumptions include: (1) no additional modifications to the littoral system that would alter wave energy and sand supply; (2) rates of sea-level rise will be at least as high if not higher than those of the past century; and (3) storms will have similar tracks and be at least as frequent and intense as they were during the 20th century.

The uncertainty of the ages and origins of the MS-AL barrier islands also inhibits accurate predictions of their fate. Clearly the extant oceanographic and geological conditions are substantially different from those when the barrier islands first formed and accumulated sand. Although it is a well-known fact that short-term rates of change of natural systems commonly exceed long-term, time-averaged rates of change, the historical rates of land loss of the MS-AL barriers greatly exceed the geological rates of land loss. Considering the size (land area) of each barrier island in the mid-1800s and the comparable land loss rates during the past century and a half (Figure 7), each island has been reduced in area to the mid-1800 size of the next smallest island. Only Dauphin Island experienced a period of net land gain that delayed its reduction in land area to that of the next smallest island.

Under low to moderate rates of relative sea-level rise, barrier islands typically do not lose their entire land mass, because eventually they become so low and narrow that surficial processes are dominated by storm overwash. For these conditions, sand eroded from the open-ocean shore is transported entirely across the barrier island and deposited in the adjacent marsh or lagoon. In this transgressive state, the barrier is able to maintain a minimum volume as it migrates landward across the marsh surface or shallow water. Although the western three-fourths of Dauphin Island is presently a transgressive landform (Figure 2), it is not clear that Petit Bois, Horn, or Ship Islands will eventually enter a transgressive phase, wherein the predominant sand-transport direction is onshore rather than alongshore. The predominance of westward alongshore sand transport both at geological and historical time scales indicates that this motion will likely prevail in the future, being driven by the prevailing winds, storm waves, and associated currents. Even the low, narrow, updrift spits of the Mississippi barrier islands that were predisposed to overwash and landward migration were constrained by the adjacent beach-ridge interior cores to the extent that the spits became shorter as they progressively moved landward, but the cores remained stationary (Figures 3–5). Wave energy in Mississippi Sound has kept the sound-side of the barrier chain relatively deep. A substantial volume of overwash sand would be necessary to extend the platform into deeper water while maintaining a subaerial barrier island instead of a subaqeous shoal. Thus, water depths in the sound also inhibit onshore barrier migration.

The future of the Mississippi barrier islands depends largely on the future of their cores and whether sufficient sand is land loss are remarkably similar considering the individual locations, orientations, and histories of the islands. Because the rates of land loss have been temporally consistent for each of the islands, an inverse relation exists between island size and percent reduction in land area (Table 3). Consequently, Horn Island has lost the smallest percentage of land area (19%), and Ship Island has lost the greatest percentage of land area (60%). The low percentage of land area reduction for Dauphin Island (4%) is an anomaly related to the initial period of land gain. In 2007, Dauphin Island was 16% smaller than in 1958, when it achieved its greatest historical land area since it was separated from Petit Bois Island. The long-term historical trends (Figure 7) also show that no particular period uniquely defines the island areas and configurations. Consequently, barrier-island restoration to a template for a particular time, such as pre-Hurricane Camille conditions, is arbitrary.

The predominant mechanism of land loss for Petit Bois, Horn, and Ship Islands has been unequal updrift erosion and downdrift deposition. The second most important mechanism was island narrowing. Recently, island segmentation has contributed to land loss on Ship and Dauphin Islands. Both of these islands were breached previously, but their beaches and barrier flats were subsequently restored naturally. The historical record for Ship Island indicates that its vulnerability to breaching progressively increased with time. Because of its diminished state, the Camille Cut inlet will not shoal naturally, and the East and West Ship Island segments will not become reattached as they have in the past. Whether the western end of Dauphin Island will receive enough sand in the next few years to fill the breach and restore the beach and barrier flat is uncertain.

Out of the three primary causes of land loss, sediment-budget deficiencies have been responsible for the greatest historical changes in the MS-AL barrier-island chain. Historical trends of increasing land loss, for each of the five islands, show a remarkable temporal correlation to dredging activities within the region. This correlation indicates that sediment-budget deficits stem from long-term reductions in sand supply caused by progressively deeper dredging of navigation channels across the outer bars of three tidal inlets. The channels have compartmentalized and interrupted the alongshore sediment-transport system, acting as sediment sinks and trapping sand that normally would have bypassed around the ebb-tidal delta and fed the barrier islands downdrift. The other two primary factors also contribute to barrier-island land loss, but their temporal trends are either constant (sea-level rise) or cyclical (storm activity) and cannot easily explain the observed accelerated rates of land loss. Not all of the historical land loss can be attributed to sand trapped in the navigation channels, and it is certain that the barrier islands would be losing land even if the outer bars had never been modified by dredging. For example, some of the sand removed from the islands during storms is deposited in Mississippi Sound and is dispersed over shoals or in deeper water as accommodation space is created by the eustatic rise in sea level.

The natural future trends for the MS-AL barrier islands will be continued rapid land loss as a result of rising sea level, frequent intense storms, and reduced sand supply. Both theory and modeling predict that storm intensity (Emanuel, 2005) and the rate of sea-level rise (Meehl *et al.,* 2005) will likely increase in the future as a result of global warming. If these predictions hold true, then the rates of barrier-island land loss would also increase; however, the magnitudes of the increases are uncertain. Despite uncertainties regarding the likely magnitudes of the effects of global warming, the potential for increased storm activity and rates of sea-level rise should be taken into consideration when management and restoration plans for the islands are formulated. Sand supply is the only factor contributing to barrier-island land loss that can be managed directly, and further increases in land-loss rate can be mitigated by the strategic placement of dredged material so that adjacent barrier-island shores receive it for island nourishment and rebuilding.

Most human activities on barrier islands have direct impacts on island morphologies and surficial processes (Stutz and Pilkey, 2005). However, disruption of the sand-transport system in the central Gulf of Mexico as a result of dredging had an indirect effect on the historical changes of the MS-AL barrier-island chain. Indirect anthropic impacts on barrier islands are sometimes more significant than direct impacts because they can remain undetected for long periods of time.

ACKNOWLEDGMENTS

Barbara Yassin of the Mississippi Office of Geology provided the digital files used to construct the prelidar Mississippi barrier-island positions and land areas. Lidar surveys of the MS-AL barriers were joint activities of the USGS and NASA. Russell Peterson, Kristy Guy, Bryan Rogers, and Kathryn Smith provided GIS support, and Noreen Buster and Betsy Boynton assisted with figure preparation. The study benefited from comments by Wayne Baldwin, Randy McBride, and an anonymous reviewer.

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ATTACHMENT H
30% ENGINEERING DESIGN REPORT

TOWN OF DAUPHIN ISLAND
BEACH AND BARRIER ISLAND RESTORATION PROJECT

Prepared for:

Town of Dauphin Island, Alabama

Prepared by:

Coastal Planning & Engineering, Inc.

And

South Coast Engineers, LLC

June 2011

TOWN OF DAUPHIN ISLAND
BEACH AND BARRIER ISLAND RESTORATION PROJECT

EXECUTIVE SUMMARY

Dauphin Island is a barrier island located on the western side of the entrance to Mobile Bay. The west end of the island is low in elevation and suffers from overwash while the east end has a limited sediment supply. The objective of the restoration project is to increase island longevity and prevent overwash by nourishing the beach and dune system. It is proposed to widen the beach at its natural elevation and install a dune system using an offshore sediment source. The project has been specifically designed to take advantage of the presently ongoing migration of the sands of Pelican Island onto Dauphin Island.

The center section of Dauphin Island is stable to accretional due to the sediment supply and sheltering provided by Pelican Island. Beach restoration alternatives were developed for the western and eastern portions of the island that are suffering from erosion. The western project area extends approximately 4.25 miles from the general vicinity of the park at the western end of Bienville Blvd ("Katrina Cut") to the Pelican Island attachment location near the fishing pier (profiles DI-2 and DI-18), as shown in Figure 1. The eastern project area under consideration extends approximately 0.92 miles west from Fort Gaines.

The western part of Dauphin Island is a low-relief barrier that is flooded and overwashed during tropical storms and hurricanes. It has a maximum elevation of about 7 feet, NAVD, except for dune features in the vicinity of the fishing pier that reach above 10 feet, NAVD (January 2010 CPE Survey). It is susceptible to high storm impacts because of its low elevation, narrow width, limited wave sheltering from Pelican Island, and no maritime forest. Historic shoreline change measurements suggest a shoreline retreat rate of approximately 13 feet/year, though the large portion of this retreat occurs during low frequency storm events. The western project area is populated with numerous homes south of Bienville Blvd. The eastern project area is less populated. The eastern project is mostly located along the Dauphin Island Sea Lab, the old Coast Guard R&D facility, the Dauphin Island Audubon Bird Sanctuary, and the Audubon Place development. The primary intent of the eastern project is to protect the remaining upland area and minimize salinity intrusion into the fresh water lake.

A single design alternative is presented for the east end. This alternative includes the placement of 240,000 cubic yards of fill extending 4,800 feet west from Fort Gaines. The berm crest is at +5.5 feet, NAVD with an irregular dune system placed behind it to an elevation of +8.0 feet, NAVD. The cost of constructing the east end alternative as a standalone project is between $5.1 M and $5.6M, as compared to between $3.1M and $4.0M if constructed in conjunction with one of the west end alternatives. If budget allows, it is also recommended that three shore parallel breakwaters be constructed using the stone from the existing groins. This would increase the construction cost by approximately $1.25M.

Three alternatives are presented for the western project area and bracket a variety of solutions and costs. Alternative 1 restores the volume of sand that was there in 1990 and adds a large protective stepped dune in front of the houses. The dune crest is 25 feet wide with a +12-foot NAVD elevation and side slopes of 1V:5H down to +5.5 feet NAVD. The beach fill moves the shoreline position an average of 340 feet seaward and has a constructed berm elevation of +5.5 feet NAVD with a seaward slope of 1V:12H to the toe of fill. It is estimated that the project will have a 40-foot wide expanse of dry sand in front of the dune 10 years after construction. Alternative 1 has a fill volume of 3,589,000 cubic yards. The cost is estimated between $63M and $71M, including the construction of the east end alternative.

Given the cost of Alternative 1, the dune for Alternatives 2 and 3 was moved north toward Bienville Blvd in order to reduce the fill volume. The goal with Alternative 2 was to have 40 feet of dry sand in front of the dune 12 years following construction, assuming that a 10-year storm event had not impacted the project by then. The dune will be scraped up to an elevation of +12.0 feet, NAVD and have a width of 25 feet and side slopes of 1V:5H, where dune construction is possible. In areas where construction of the dune is restricted due to the location of houses, the beach will be pumped to an elevation of +7 feet, NAVD. While this will not provide the same level of protection as the full dune, increasing the beach elevation should reduce the frequency of overtopping. The beach fill will move the shoreline position an average of 220 feet seaward, and has a constructed berm elevation of +5.5 feet NAVD with a seaward slope of 1V:12H to the toe of fill. The cost of Alternative 2 is estimated between $40M and $48M, including the construction of the east end alternative.

Alternative 3 is the lowest cost option, with an approximate cost between $26M and $29M, including the construction of the east end alternative. The dune details for Alternative 3 are identical to Alternative 2. In order to provide a less expensive option, the renourishment interval has been reduced to 5 years (at which time the equilibrated natural berm is expected to be approximately 40 feet from the toe of the dune). The beach fill moves the shoreline position an average of 150 feet seaward, and has a constructed berm elevation of +5.5 feet NAVD with a seaward slope of 1V:12H to the toe of fill.

Multiple fill sources to construct the project were considered including two offshore borrow areas that have been identified that contain 7,844,000 cubic yards of beach compatible material. The borrow areas are located south southwest of the Sand Island Lighthouse on the western lobe of the Mobile Pass ebb-tidal shoal. Borrow Area 1 is located approximately 6 miles south of the eastern project area and 7 miles southeast of the center of the western project area. Borrow Area 2 is located approximately 1.5 miles south of Borrow Area 1.

TOWN OF DAUPHIN ISLAND
BEACH AND BARRIER ISLAND RESTORATION PROJECT

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TOWN OF DAUPHIN ISLAND
BEACH AND BARRIER ISLAND RESTORATION PROJECT

1 INTRODUCTION

This design report submittal was prepared for the Town of Dauphin Island by Coastal Planning & Engineering, Inc. (CPE) and South Coast Engineers, LLC (SCE). The purpose of this study was to develop design alternatives for a barrier island restoration project along Dauphin Island, Alabama. This work was funded by a grant from NOAA (NA10NOS4630126).

Barrier islands such as Dauphin Island are critical to the protection of island-based and coastal mainland ecosystems and represent regionally significant economic drivers. Dauphin Island has experienced some of the highest shoreline recession rates in the United States during the past 30 years and suffered economic damage in several hurricanes.

Coastal engineering design and modeling conducted as part of this study included a review of historic shoreline, profile and bathymetric data with incorporation of recently collected data into the analysis. A sediment budget was developed to determine major sediment transport pathways. Wave transformation modeling was performed using SWAN. Cross-shore modeling was performed using SBEACH based on SWAN modeling results to determine a conceptual design cross-section of the beach restoration project. Beach profile survey data collected during the field investigations was incorporated into the analysis and modeling efforts. The data and analyses were also used to assess past erosion trends, potential overwash volumes and anticipated impacts of sea level rise.

Related activities include detailed beach and nearshore surveys and an extensive search for beach quality sand. Those activities are reported on in separate documents and the results are incorporated as needed here. Some of the beach and nearshore surveys, the initial reconnaissance sand search efforts, and some of the preliminary coastal engineering design and modeling efforts focused on the eastern project area (the east end beaches) were funded by another NOAA grant (NA09NOS4630236), and those results are also incorporated in the overall design and analysis as needed here.

2 PROJECT AREAS AND LOCATION

Coastal Alabama stretches approximately 56 miles from Perdido Pass to Petit Bois Pass. Dauphin Island is about 15.5 miles long and is located in the western side of coastal Alabama adjacent to the entrance to Mobile Bay, a large natural inlet that has been improved by dredging since 1904. Dauphin Island is the easternmost island in the Gulf Coast Barrier chain that extends from Mobile Bay to the Mississippi-Louisiana border (Schramm *et al*., 1980).

There are two specific project areas on the southern beaches of Dauphin Island (see Figure 1). The two areas are essentially separated by the area on Dauphin Island where Pelican Island is presently migrating onshore. The 0.92 mile eastern project area extends from approximately the

Fort Gaines/Dauphin Island Sea Lab beach to the west side of the Dauphin Island Audubon Bird Sanctuary. The western project area extends approximately 4.25 miles from the Pelican Island attachment location to the area of the Katrina Cut breach (profiles DI-18 to DI-2) as shown in Figure 1.

The east end of the island is more protected due to the wave sheltering provided by Pelican Island and the Mobile Bay ebb shoal (Dixie Shoal and Sand Island shoal). The portion of the Gulf of Mexico that is in the lee of Pelican Island is sometimes referred to as Pelican Bay. The beach transitions into hummocky dunes and some very high dunes with elevations over 30 feet that protect a mature maritime forest and a freshwater lake. The majority of the eastern project area is the south-facing beaches fronting the Dauphin Island Sea Lab, the former Coast Guard R&D facility, and the Dauphin Island Audubon Bird Sanctuary.

The western part of Dauphin Island is a low-relief barrier that is flooded and overwashed during tropical storms and hurricanes. It has a maximum elevation of about 7 ft, NAVD, except for sand-dune-like features that reach above 10 feet, NAVD (January 2010 CPE Survey). The west end of Dauphin Island is more susceptible to high storm impacts than the east end because of its low elevation, narrow width, low dune features, lack of protection from Pelican Island, and no maritime forest. The island is vulnerable to overwash, which creates channels and fans that transfer sand from the Gulf shoreline onto the barrier island or into the adjacent Mississippi Sound. The island maintains its general shape and sand volume as it overwashes and migrates northward (Morton, 2004).

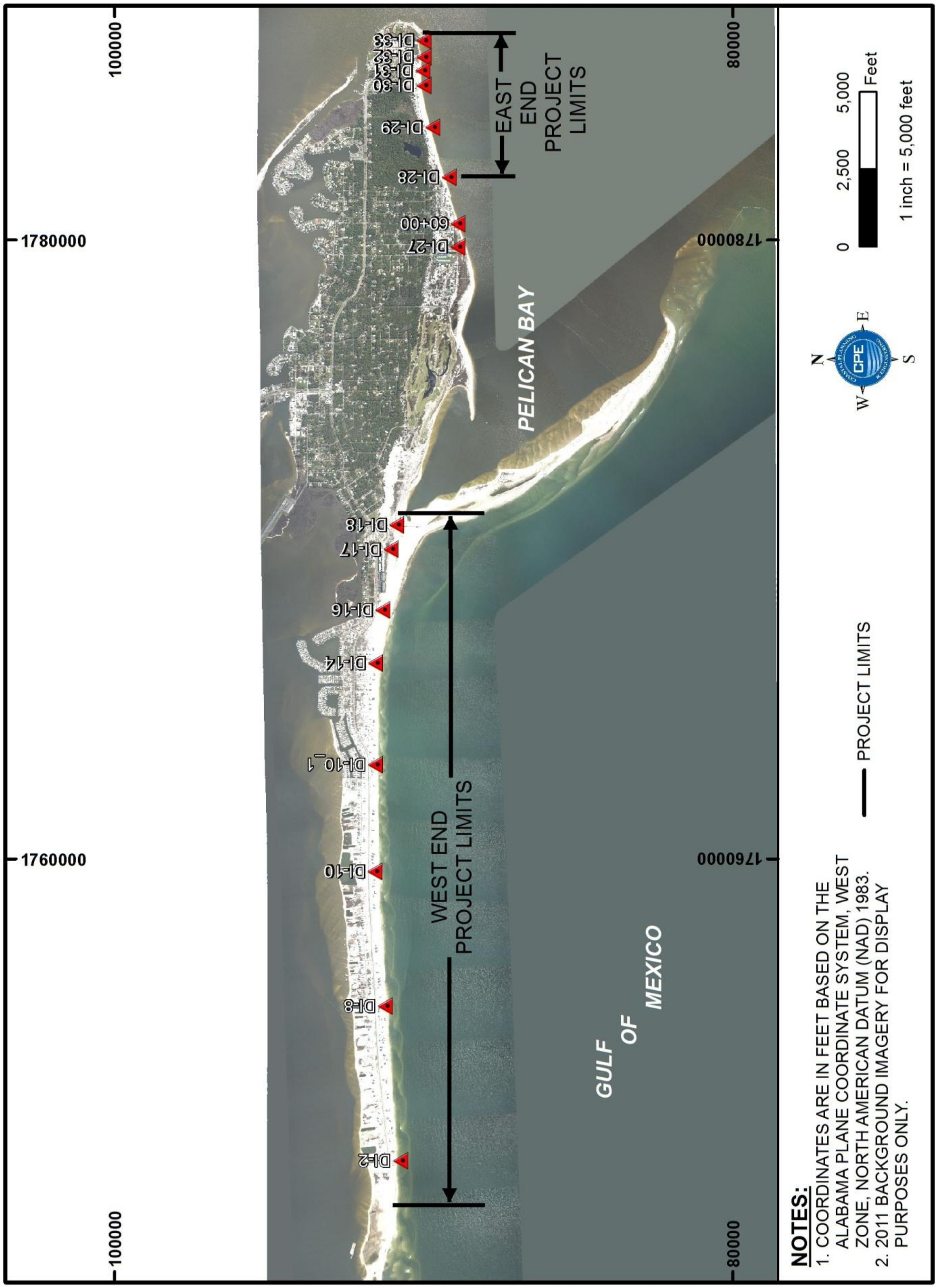

Figure 1. Location Map

3 PROJECT AREA HISTORY

Dauphin Island is a barrier island approximately 15.5 miles long located south of the Alabama mainland. Formed during the Holocene, the west end of the island is a spit-like feature with poorly developed dunes. Settlement on the eastern, protected end of the island dates back to 1699. Most of the roads that exist today were established in the 1950's following construction of the first bridge to the island (Schramm *et al*., 1980).

The west end of Dauphin Island has suffered impacts from many historic storms that have resulted in breaching or cuts in the island and overwash fans that spread sand northward behind the island. Before any major settlement of the western portion of the island in the 1950's, the area about 3.5 miles west of the eastern end of Dauphin Island was breached multiple times. The island was separated into two halves between 1909 and 1917, and again in September 1948. More recently, the following storms created multiple breaches in the low-lying western ridge: Hurricanes Camille (1969), Frederic (1979), Elena (1985) (Stout, 1998), Opal (1995), Georges (1998) (Froede, 2006), Ivan (2004), and Katrina (2005) (USGS, 2010). In many cases, driveways, back-barrier marina entrances, or similar features in developed areas acted like channel-ways for overwash. Also, increased turbulence around the support pilings of beach houses initiated scour (Schramm *et al*., 1980). The most recent hurricane to strike the region was Hurricane Ida (November 4-11, 2009). Although this storm did not generate any new breaches, it caused overwash of the western project area. The western project area overwashed repeatedly in small wind events and high tides after Hurricane Ida including several times as late as early May 2010. In May and June 2010 two long, linear sand piles were built south of Bienville Blvd as emergency structures to keep oil from the BP/Deepwater Horizon oil spill from washing onto and over the island.

Figure 2 is a comparison of aerial photographs and LiDAR surveys pre- and post-storm of Ivan and Katrina, which show erosion along the western project area beaches and deposition of sand inland (USGS, 2010). The impacts of Ivan (2004) and the major storms of the prior decade caused the shoreline to recede landward of the first row of homes in some places and buried the main road, Bienville Blvd., with overwashed sand at depths as much as 2.5 feet (Froede, 2006). Multiple breaches caused by Hurricane Ivan were localized over a 0.84 mile long area of the island. This area breached again during Hurricane Katrina with deeper channels which remained open through late 2010. This breach is commonly referred to as "Katrina Cut." It was closed with a rock structure in 2010-2011 in response to the BP/Deepwater Horizon oil spill. Hurricane Katrina destroyed most of the houses and pushed sand from the front of the island into the Mississippi Sound forming large overwash fans and shifting the island northward. Comparisons between the June 2007 and post-Gustav LiDAR surveys also reveal erosion along the Gulf shoreline and overwashed sand inland (USGS, 2010).

The continuous breaching and overwashing results in "rollover" of the island, or migration of the island to the north. Comparison of the 1850 and 2006 shorelines indicates that the island has migrated back more than its width from breaches and repeated overwashing during storm events. In the future, it is anticipated that the west end will continue to overwash during significant storm events.

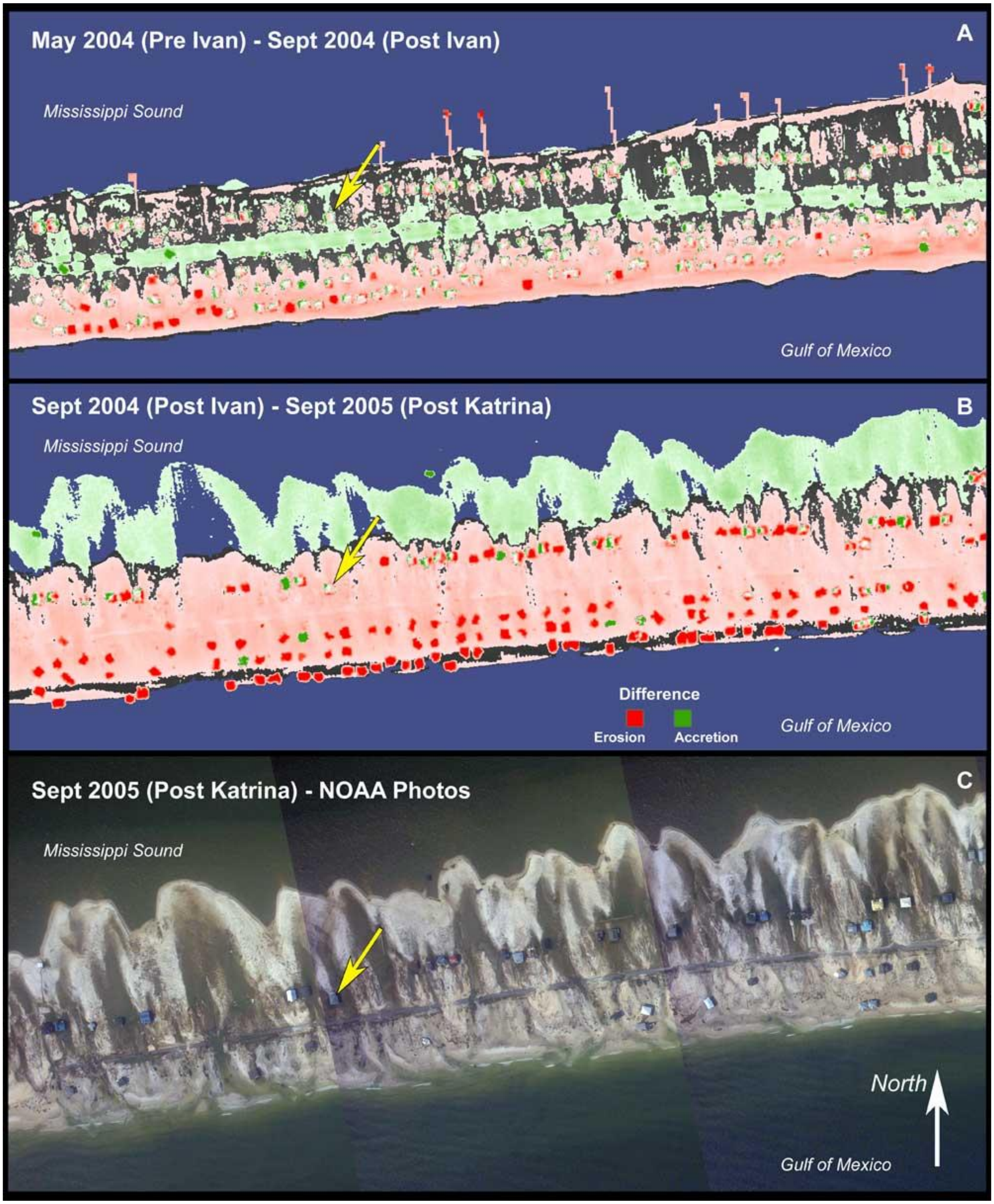

Figure 2. Post-storm impacts from Hurricanes Ivan (2004) and Katrina (2005), courtesy of USGS. (http://coastal.er.usgs.gov/hurricanes/katrina/lidar/dauphin-island.html)

The western project area of the island is at risk for inundation during elevated tides and storm events due to its low elevation. Island lowering, like that caused by Hurricane Frederic, makes western Dauphin Island more susceptible to damage by storms to follow. During Hurricane Frederic (1979), 70% of Dauphin Island was inundated with storm surge (Schramm *et al*., 1980). Although shoreline recession on the western 11 miles of the island during Hurricane Frederic was small, receding about 20 to 49 feet, the height of the island was lowered about 2.4 to 4.9 feet (Stout, 1998). The island can flood during a high tide event if the tide is accompanied with strong southeast winds. One such example of this occurred in May 2010 (Figure 3), when the predicted maximum tide was +2.14 feet, NAVD.

Figure 3. May 2, 2010 West end of Dauphin Island overwashed due to high tides and strong southeast winds.

On June 6, 2006, the Town of Dauphin Island adopted the Flood Damage and Prevention Ordinance, No. 55. This document recognized the island's flood hazards and set forth regulations, mainly structural, to minimize losses due to flood conditions in Areas of Special Flood Hazard identified by the Federal Emergency Management Agency in its Flood Insurance Study. The special flood hazard areas were generated for storm surges and designated on the Flood Insurance Rate Maps (FIRMs).

Sand has been placed along the beaches on the island in both project areas in the past three decades. In the western project area, the so-called "FEMA berms" were constructed in 2000 and

2007, as well as some significant level of sand placement in May-July 2010 in response to the BP/Deepwater Horizon oil spill. The eastern project area has occasionally been used since 1981 to dispose of some of the sand dredged from the Fort Gaines Channel, as well as occasional truck haul disposal of small amounts of sand dredged from different areas on the island.

In 1991, 15,700 cubic yards of sandy material was placed in a dune-like feature directly on the beach around the fishing pier and extending several hundred feet to the west to recreate a dune that had recently eroded (Douglass, 1994). This material was mechanically dredged from a location in Mississippi Sound north of Dauphin Island to clear a spot for a gas rig and donated to the Town to address the critical erosion problem which was then threatening the landward end of the fishing pier and a bathhouse which was located then immediately west of the pier. The sandy material had limited bearing capacity, i.e. it was very soft, for the first few weeks after placement due to the presence of fines (estimated at 10-20%). It also had a small fraction of oyster shells which lagged on the surface as rain and waves eroded the constructed dune. The project was essentially gone within several months. A seawall was subsequently constructed to stop the island recession there. Presently, the pier is completely land-locked due to the migration of Pelican Island onto Dauphin Island.

The first "FEMA berm" was built in 2000 along 14,000 feet (approximately DI-2 to DI-14) of the Gulf beaches in the western project area. The "berm" was a linear sand pile constructed in a trapezoidal shape with a crest elevation of +10 feet and a crest width of 9 feet. It was built along or just north of the existing waterline. It included approximately 330,000 cubic yards of sand dredged from Mississippi Sound located just north of Dauphin Island. The borrow area was essentially the north side of the overwash fans deposited by Hurricanes Opal and Georges. The Town of Dauphin Island adopted Ordinance No. 66 on August 15, 2000 to prohibit pedestrian and vehicular traffic on the protective sand berm. Structural walkways were constructed to allow beach access over the berms. The berm was progressively washed over the next 27 months after construction and was completely reduced after Tropical Storm Isidore made landfall in Louisiana in September 2002 (Henderson, 2007).

A second "FEMA berm" was built in 2007 along 21,000 feet (approximately DI-2 to DI-17) of the Gulf beaches in the western project area. FEMA granted funds to rebuild a protective berm in 2002, after Tropical Storm Isidore, but construction was stalled for several reasons including several subsequent major storm events. The funds were eventually reallocated to relieve the impacts of Hurricane Katrina in 2005 instead (Henderson, 2007). In 2007, the second protective berm of 562,000 cy (Jones, 2009) was finally completed. The sand again was dredged from from the overwash fan deposits in Mississippi Sound north of Dauphin Island. The berm was similar in shape and height to its year 2000 predecessor: a linear sand pile constructed in a trapezoidal shape with a crest elevation of +10 ft NAVD. The berm was built along or near the existing waterline and extended into the water along much of its length; some additional sand was placed seaward of the berm cross-section.

Ordinance No. 66-A, an ordinance to amend and repeal in part Ordinance No. 66 relating to the protective berms, was adopted by the Town on June 17th, 2008 for the new berms constructed on the Gulf beaches. Portions of the constructed feature began eroding during construction and it was essentially gone after Hurricanes Gustav and Ike (September 2008).

Dauphin Island requested funds from FEMA to rebuild the protective sand “berm” after Hurricanes Gustav and Ike. FEMA officials denied the request in part because of the poor performance of the previous two “berms” that were constructed right along the waterline. Some consideration was given to building the feature farther landward on the island so that it would survive longer but nothing was funded or constructed.

After the temporary relief and soon after failure of the series of “FEMA berms,” the residents of Dauphin Island sought to make the beaches public in order to qualify for state and federal funding for a full-scale beach nourishment project. In December 2008, ownership of the Dauphin Island beach in the western project area was transfered from the Dauphin Island Property Owners Association, the entity which owned the beach since 1954, to the Town of Dauphin Island (Mobile Register, 2008). Specifically, the portion of land south of the individual lots on the west end of the island, called West Surf Beach, has been deeded to the Town. There are stretches of the West Surf Beach area and portions of a number of individual properties that were entirely submerged in 2010 due to island migration. There are provisions in the deed transfer to rescind the transfer if a beach nourishment project is not constructed within seven years.

Within a year after becoming qualified for state and federal funding, Tropical Storm Ida made landfall along the Alabama coast in November 2009. Three months after, in February 2010, FEMA authorized a cleanup process which involved redistributing of overwashed sand along the Gulf shoreline. Approximately 150,000 cubic yards of sand deposited in the vicinity of Bienville Blvd. was screened to remove debris, transported, and placed on the existing Gulf beach.

In an effort to prevent overwash and oil contamination from the BP/Deepwater Horizon oil spill, the Town constructed a two-part emergency sand barrier between approximately DI-2 and DI-10_1 in May 2010 (see Figure 1 for reference). One pile of sand was placed along the south side of Bienville Blvd., and another was placed on the beach in front of the homes. The first barrier was constructed on the south side of the Bienville Blvd. from the Town park at the west end of the road to St. Stephens Street to keep the island from overwashing completely during the next overwash event (Figure 4). It was not constructed across streets or driveways. It was constructed about 6-8 feet tall and 15-20 feet wide at the base. A couple of weeks after initial construction, more sand was added to the pile where there was room, increasing the crest height to 7 to10 feet tall and the crest width to 15-20 feet wide. It is expected that this northern sand pile will survive a small tropical storm. This northern pile of sand has been planted with vegetation and is now being kept by the Town as a sand dune feature to reduce the level of island overwash in future small storms.

A second sand pile barrier was constructed south of the homes in June 2010 along the beach to keep oil on the beach face during normal tide conditions (Figure 5). It spanned from the public fishing pier to the west end of Dauphin Island (DI-17 to DI-2), with a height of 7 to 10 feet and a crest width of 15 to 20 feet. It was initially expected to erode in a matter of days or weeks after construction under storm conditions. While there was some initial repair done on the pile, it survived the summer and fall of 2010 primarily due to the mildness of the wave climate. It should be noted that this pile of sand was successful in keeping oil on the beachface and out from under the elevated homes. This second, southern sand pile barrier was mechanically dismantled in the winter of 2010-2011 when the sand was sifted and spread out in the same general area immediately north of the shoreline with a much wider footprint.

The sand placed in piles along the length of the western project area in the summer of 2010 as an emergency response to the BP/Deepwater Horizon oil spill came from a variety of readily available sources. Initially during construction, the sand in the northern pile just south of Bienville Blvd. came from four different upland pits in south Mobile County and south Mississippi. However, those pits had limited quantities of clean sand of an adequate quality for beach or dune construction. Most of the sand was mined from the north side of the island where pits were dug in some of the properties on the north side of Bienville Blvd. and moved south to construct the emergency sand piles. The pits were dug from the ground elevation, typically about +3 feet, NAVD down to varying depths, some to -7 feet, NAVD. Some of this sand was likely sand that had moved north across Bienville Blvd during the overwashing events of the past several decades including Hurricanes Ivan and Katrina. There are two potential problems with the pits: (1) they may be a public safety hazard due to their depths, and (2) their presence may facilitate island breaching in those locations during the next major hurricane.

Figure 4. First emergency sand pile constructed south of Bienville Blvd. in response to the BP/Deepwater Horizon oil spill to keep oily water from overwashing the entire island into Mississippi Sound (photo date: June 24, 2010).

Figure 5. Second emergency sand pile constructed along the beach in response to the BP/Deepwater Horizon oil spill to keep oil on the beachface (photo date: May 12, 2010). This feature was mechanically removed by February 2011.

4 PHYSICAL CHARACTERISTICS OF THE PROJECT AREA

4.1 Tides

Tides in the study area can be quantified based on water level measurements at the Dauphin Island tide gage (NOAA Station 8735180, Figure 6) which is located at the northeast end of the island on a pier just east of Little Billy Goat Hole. The tides at Dauphin Island are diurnal, with an average tidal period of roughly 24 hours and a mean tide range of 1.17 feet. Tidal datum elevations appear in Table 1.

Table 1. Tidal Datums, NOAA Tidal Benchmark 8735180, Dauphin Island, AL

DATUM	(feet NAVD)
MEAN HIGHER HIGH WATER (MHHW)	0.97
MEAN HIGH WATER (MHW)	0.95
MEAN TIDE LEVEL (MTL)	0.37
MEAN SEA LEVEL (MSL)	0.33
NORTH AMERICAN VERTICAL DATUM-1988 (NAVD)	0.00
NATIONAL GEODETIC VERTICAL DATUM-1929 (NGVD)	-0.05
MEAN LOW WATER (MLW)	-0.22
MEAN LOWER LOW WATER (MLLW)	-0.23

Source: http://tidesandcurrents.noaa.gov (NOAA, 2003).

4.2 Waves

An extensive collection of offshore wave data is available from NOAA (2010a, 2010b) and the U.S. Army Corps of Engineers (2003, 2004). The data collection includes both hindcast wave data and observed wave data. The locations of these data sets appear in Figure 6 and Table 2.

The primary sources of wave data for this engineering report were the deep water wave measurements at NOAA Buoy 42040 from 1996 to 2008 (see Figure 6 and Table 2). Gaps in the record after 1999 were filled using the NOAA (2010a) WAVEWATCH hindcast. Earlier gaps in the record were filled using the Wave Information System (WIS) hindcast at WIS Station 350 (USACE, 2003).

Figure 6. Alabama Wave Gages and Hindcast Locations.

Table 2. Alabama Hydrodynamic Data Catalog.

Name	Latitude (deg. N)	Longitude (deg. W)	AL-West NAD83 E (feet)	AL-West NAD83 N (feet)	UTM 16 NAD27 E (m)	UTM 16 NAD27 N (m)	Depth (feet NAVD)	Period(s) Covered
WAVES:								
AL001	30.2600000	87.5700000	1946401	94561	445165	3347530	-27	Nov. 2001 - Jan. 2004
42012	30.0650000	87.5550000	1951102	23642	446503	3325915	-90	Nov. 1983 - Jan. 1984, April 2009 - Present
42040*	29.2050000	88.2050000	1743583	-288420	382858	3231098	-792	Dec. 1995 - Dec. 2008
42015	30.1000000	88.2000000	1747146	37045	384372	3330270	-64	Oct. 1987 - Sep. 1990
42016	30.2000000	88.1000000	1778960	73233	394115	3341255	-28	April 1988 - Sep. 1990, May - June 1995
42018	30.0000000	88.2000000	1746923	677	384256	3319189	-91	Feb. - March 1990
42042	29.8800000	88.3200000	1708626	-42713	372528	3306018	-113	August - Nov. 2000
42007	30.0900000	88.7690000	-N/A-	-N/A-	329523	3329875		Oct. 1996 - Dec. 2009
WIS Station 350	29.2500000	88.0000000	1809055	-272393	402830	3235897	-857	Jan. 1980 - Present Hindcasts
WIS Station 152	30.0000000	88.1700000	1756420	620	387150	3319159	-88	Jan. 1980 - Present Hindcasts
WIS Station 153	30.0800000	88.1700000	1756590	29714	387240	3328024	-68	Jan. 1980 - Present Hindcasts
WIS Station 163	30.0800000	87.5800000	1943198	29102	444102	3327589	-87	Jan. 1980 - Present Hindcasts
CURRENTS:								
AL002	30.6500000	88.0500000	1795551	236817	399391	3391080	-8	Sep. - Nov. 2001
mb0101	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	Present
mb0301	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	1984 - Present
mb0401	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	1984 - Present
WATER LEVELS:								
Dauphin Island Hydro	30.2500000	88.0750000	1786949	91377	396574	3346773	-N/A-	Jan. 1996 - Present
Weeks Bay	30.4166667	87.8250000	1866059	151679	420761	3365042	-N/A-	June 2007 - Present
Coast Guard Sector Mobile	30.6483333	88.0583333	1792927	236223	398591	3390903	-N/A-	Aug. 2007 - Present
Mobile State Docks	30.7083333	88.0433333	1797750	258023	400090	3397539	-N/A-	Aug. 2002 - Present

* NOTE: 42040 has since been relocated. See http://www.ndbc.noaa.gov/station_page.php?station=42040 for its new location.

The average, deep water wave propagates from the southeast with a root-mean-square wave height (H_{rms}) of 4.1 feet, which corresponds with a significant wave height (H_s) of 5.8 feet, and a peak period of 5.6 seconds. The seasonality of the wave climate is shown in Figure 7 for average conditions and in Figure 8 for maximum storm conditions. The waves are, on average, smaller during the summer months. The highest waves in the period of record occurred in hurricane season. The southeast and south-southeasterly direction bands are the principal wave direction bands (see Figure 9). The Mississippi River delta tends to block or reduce wave energy coming in from the west, southwest, or south-southwest. During average conditions, the highest waves occur between September and February, and tend to originate from the east (Figure 10). During storm conditions, the highest waves occur in August and September during hurricane season, and can come from a wide variety of direction bands (see Figure 11). The largest observed waves occurred during Hurricanes Katrina (2005) (56 feet) and Ivan (2004) (52 feet).

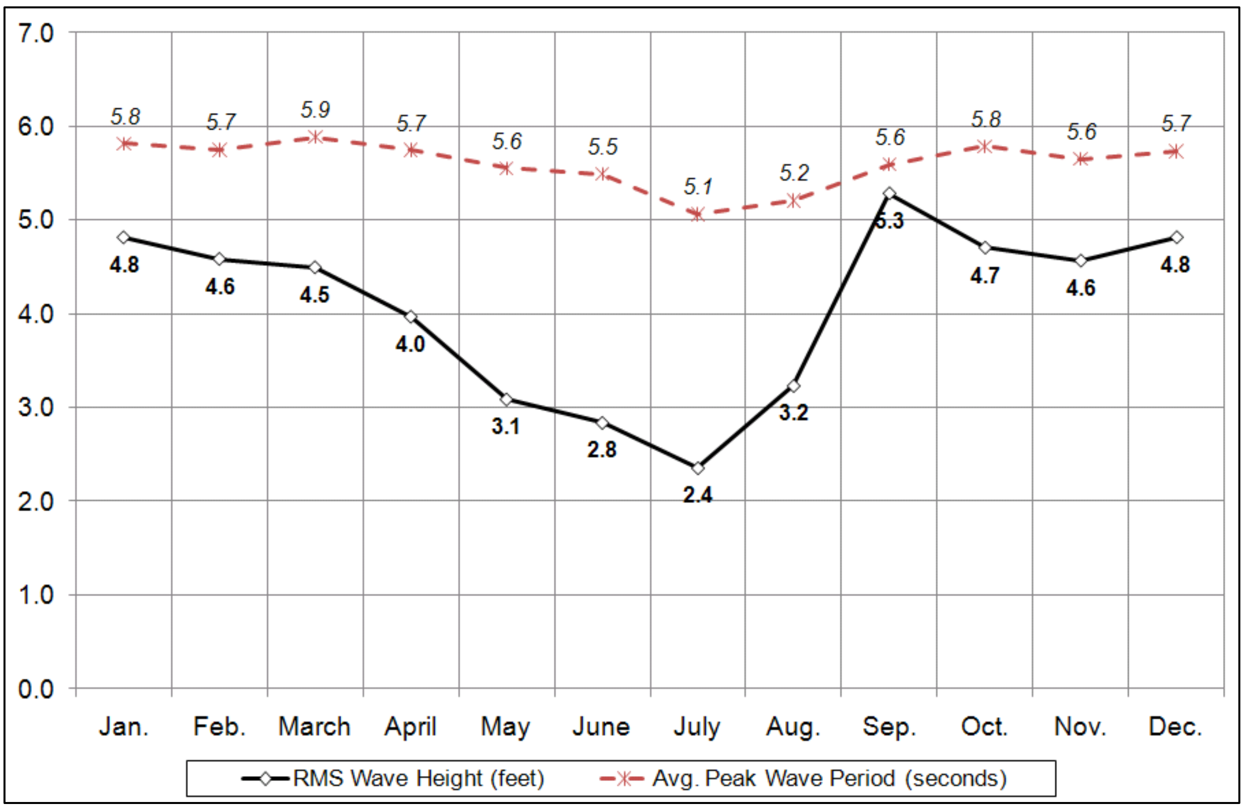

Figure 7. Monthly Wave Statistics, Average Conditions.

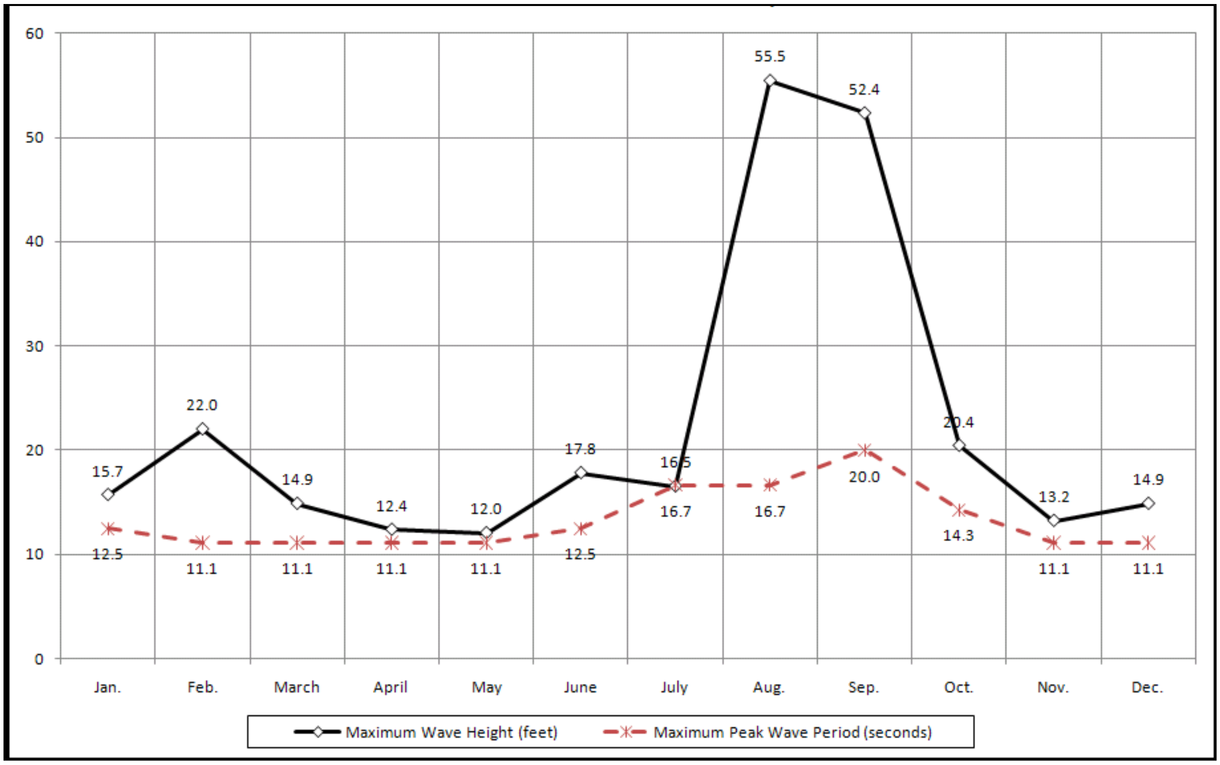

Figure 8. Monthly Wave Statistics, Storm Conditions.

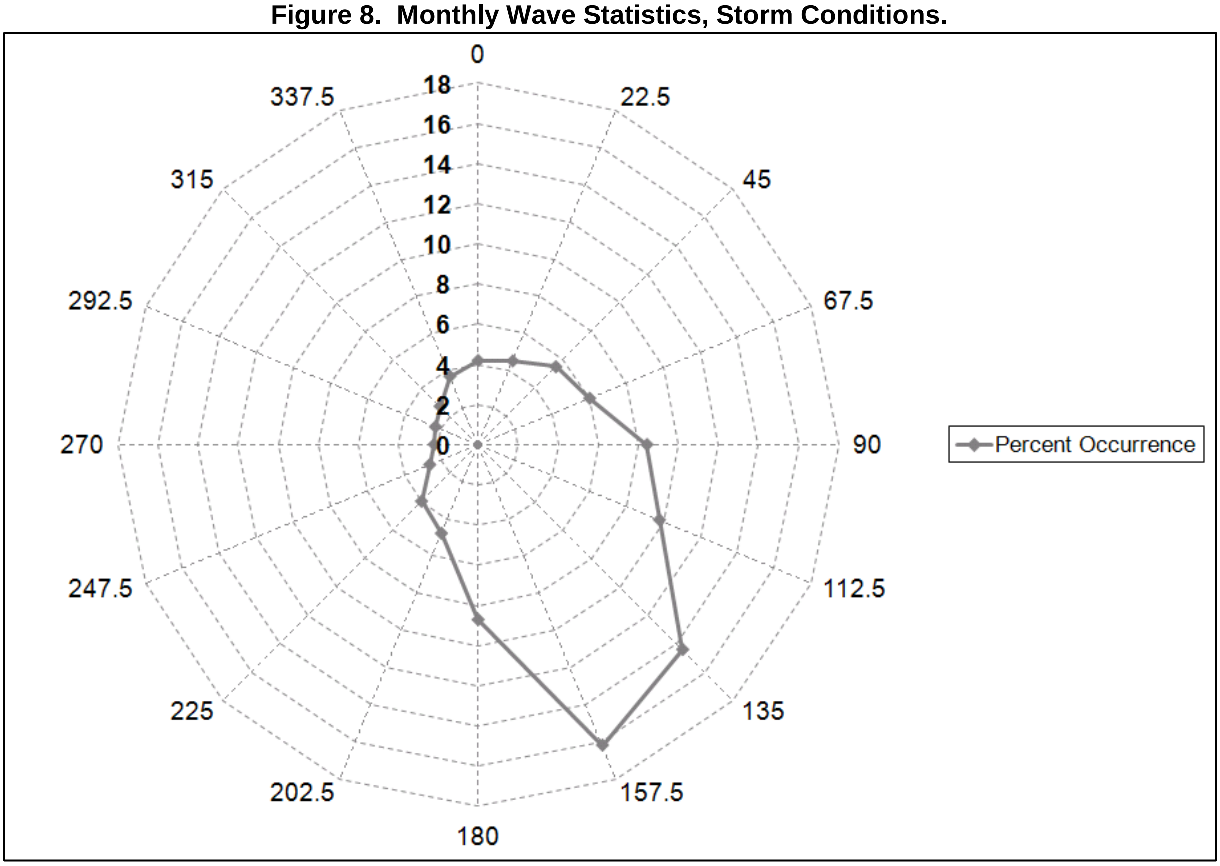

Figure 9. Directional Distribution of Deep Water Waves.

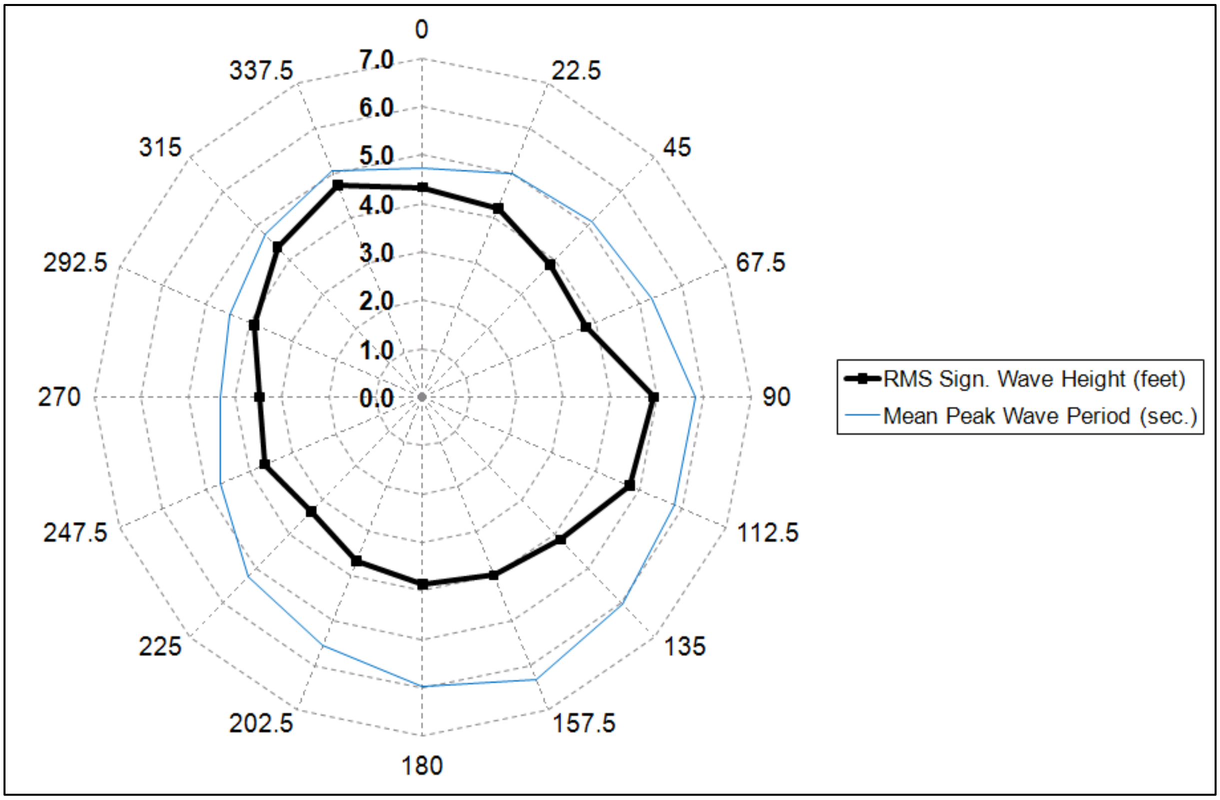

Figure 10. Deep Water Directional Wave Statistics during Average Conditions.

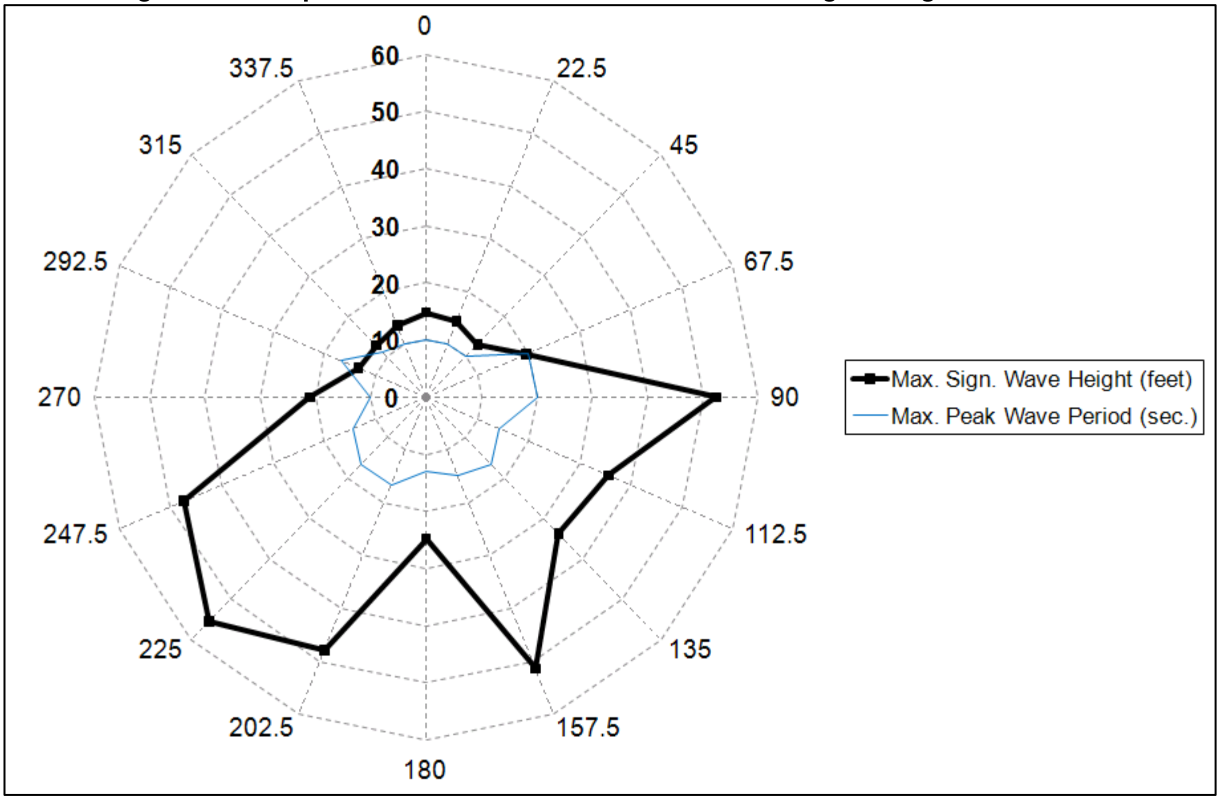

Figure 11. Deep Water Directional Wave Statistics during Storm Conditions.

Extremal wave statistics describe the waves that rarely occur, but are extreme conditions. The 10-year wave has a 1 in 10 chance of occurring in a given year, and the 50-year wave has a 1 in 50 chance of occurring in a given year. However, it should be noted that it is possible to have two such wave events occur within the space a few year years, due to decadal variations in storm activity. Extremal wave statistics are based on the observed wave record at NOAA Buoy 42040. To provide a longer data set for analysis (1980-2008), the wave record at the buoy (1996-2008) was extended back to 1980 using the wave hindcast at WIS Station 350. Extremal wave statistics offshore appear in Table 3, Figure 12 and Figure 13.

Table 3. 1980-2008 Extremal Wave Statistics, South of Dauphin Island, AL, NOAA Buoy 42040 & WIS Station 350

Return Period (years)	Sign. Wave Height (feet)		Peak Wave Period (seconds)	
	Mean	± σ	Mean	± σ
1	16.2	1.8	9.1	0.4
2	20.2	2.4	10.4	0.4
3	23.6	3.4	11.1	0.5
4	26.3	4.3	11.7	0.6
5	28.5	5.1	12.1	0.7
6	30.4	5.8	12.5	0.8
7	32.1	6.4	12.7	0.9
8	33.5	7.0	13.0	0.9
9	34.9	7.4	13.2	1.0
10	36.1	7.9	13.4	1.0
15	40.9	9.7	14.2	1.2
20	44.4	11.1	14.7	1.4
25	47.2	12.1	15.2	1.5
30	49.6	13.1	15.5	1.6
35	51.6	13.8	15.8	1.6
40	53.4	14.5	16.1	1.7
45	55.0	15.1	16.3	1.8
50	56.5	15.7	16.5	1.8
60	59.0	16.7	16.8	1.9
70	61.1	17.5	17.1	2.0
80	63.0	18.2	17.4	2.0
87	64.2	18.7	17.5	2.1

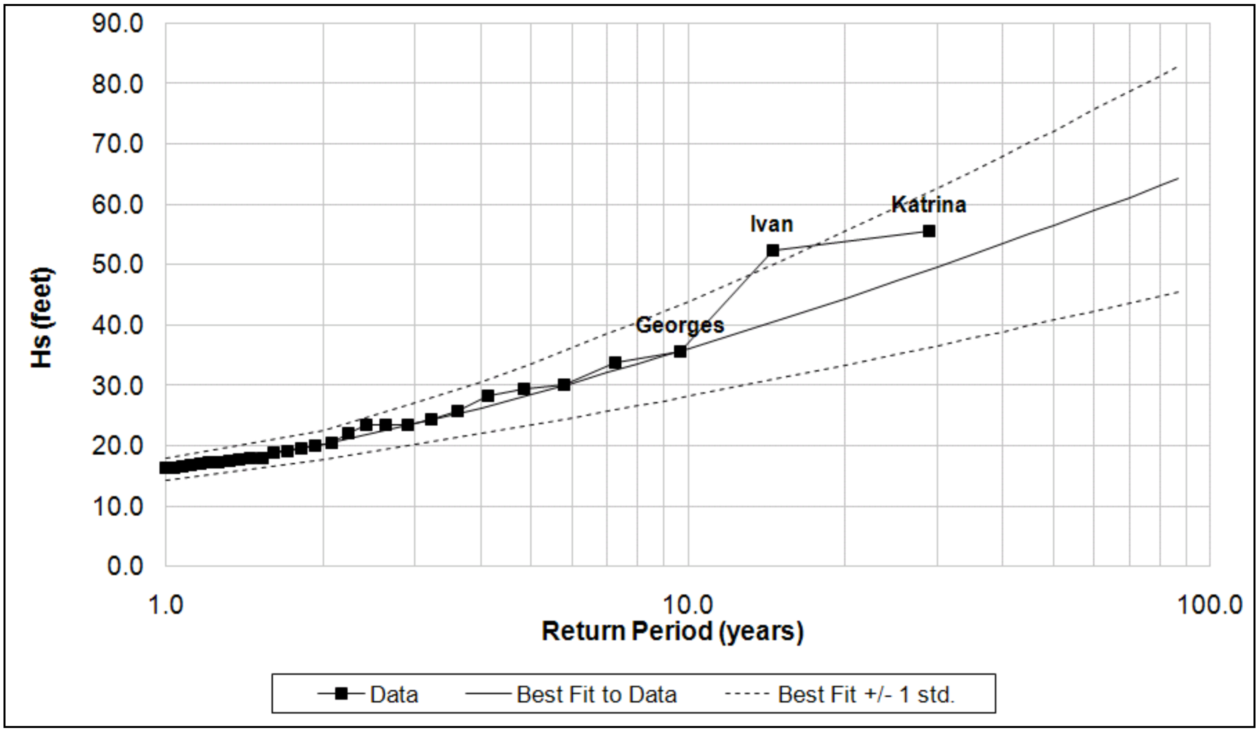

Figure 12. Extremal Wave Height.

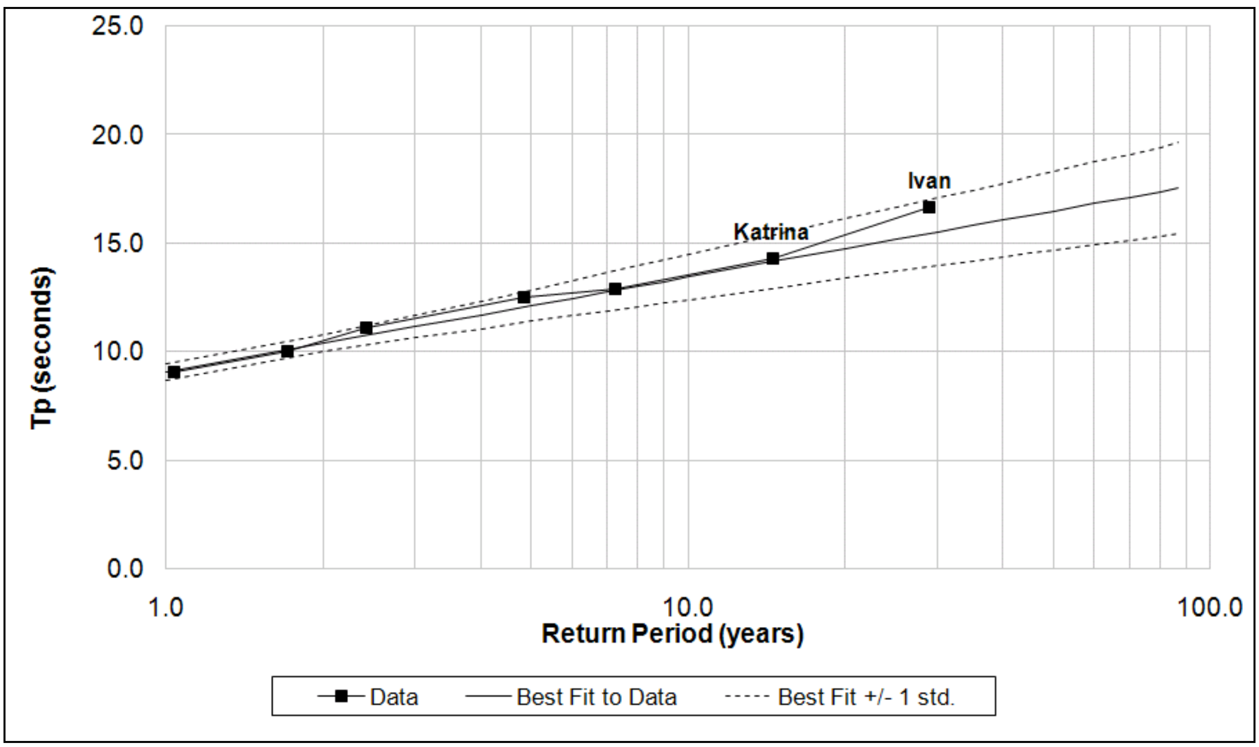

Figure 13. Extremal Wave Period.

To evaluate storm wave conditions closer to the shoreline, the SWAN model was applied for the 1, 5, 10, 25, and 50 year wave conditions. Details of this work appear in the *Dauphin Island*

East End Coastline Restoration, Appendix C (CPE, 2010). Nearshore estimates of extremal wave statistics based on the SWAN model transformations appear in Table 4. There is some variation in wave height along the western project area as would be expected due to the transformation across the bathymetry.

Table 4. Nearshore Extremal Wave Statistics, Dauphin Island, AL.

Return Period (years)	Significant Wave Wave Height (feet) at -22' NAVD DI-2	DI-8	DI-10	DI-14	DI-17
1	7.1	6.9	6.9	6.6	6.0
5	11.0	10.9	10.7	10.3	9.9
10	11.5	11.5	11.2	10.9	10.5
25	12.4	12.6	12.2	11.6	11.1
50	12.5	12.8	12.5	12.1	11.5

4.3 Winds

The prevailing winds at NOAA Buoy 42040 are from the east (85°), with an average wind speed of 13 mph (see Table 5). Wind speeds at the Dauphin Island tide gage are similar. The seasonality of the winds shown in Table 5 is controlled by the seasonality in weather patterns with summer months dominated by southeast winds due to a combination of high pressure systems and seabreeze effects and winter months dominated by frontal passages with strong north and northeast winds. Under average conditions, the highest winds tend to occur in December and January.

Table 5. Monthly Wind Statistics, 1996-2008, NOAA Buoy 42040, 29.205ºN, 88.205ºW

Month	Wind Velocity (mph)	(deg.)
Jan.	15.5	44
Feb.	14.4	44
March	13.6	79
April	13.3	114
May	10.9	142
June	9.9	167
July	9.2	228
Aug.	9.3	164
Sep.	12.4	83
Oct.	14.1	61
Nov.	14.8	49
Dec.	15.6	45
AVERAGE	12.7	85

Wind conditions during storms are based on the "Estimates of Hurricane Winds for the East and Gulf Coasts of the United States" (CETN I-36, USACE, 1985). The 10, 25, 50, 100, and 200 year wind speeds listed in this source are 65, 81, 91, 101, and 134 mph, respectively.

4.4 Storm Surge

Storm surge is an abnormal rise of water generated by a storm, over and above the predicted astronomical tides. Storm surge should not be confused with storm tide or storm stage, which is defined as the water level rise due to the combination of storm surge and the astronomical tide (http://www.nhc.noaa.gov/ssurge/ssurge_overview.shtml, NOAA, 2010b). Storm surge is produced by water being pushed toward the shore by the force of the winds moving cyclonically around the storm. The impact on surge of the low pressure associated with intense storms is minimal in comparison to the water being forced toward the shore by the wind. Other factors which can impact storm surge are the width and slope of the continental shelf. A shallow slope will potentially produce a greater storm surge than a steep shelf (NOAA, 2010b). Although storm surge is commonly associated with hurricanes, extratropical storms can also generate small (~1-2 feet) storm surges (NOAA, 2010c). Storm stage elevations for Dauphin Island (Table 6) are taken from the FEMA (2010) Flood Insurance Study for Mobile County. These values include both storm surge and astronomical tide, but do not include an analysis of the added effects associated with much finer scale wave phenomena, such as wave heights or runup.

Table 6. Storm Stage, Dauphin Island, AL (FEMA, 2010)

Return Period (years)	Storm Stage (feet NAVD)
10	4.8
50	6.9
100	7.8
500	10.3

4.5 Relative Sea Level Rise

Relative sea level rise consists of the following two components (NRC, 1987):

1. Eustatic sea level change. Eustatic sea level change is defined as the global change in oceanic water level relative to a fixed datum (e.g. North American Vertical Datum of 1988).

2. Subsidence. Subsidence is defined as the local change in land elevation relative to a fixed vertical datum.

There are widely varying estimates for future relative sea level rise (RSLR). The method for estimating future sea level rise at the project area was taken from the 1987 National Research Council (NRC) publication. The NRC equation (Equation 1) is based on three possible eustatic sea level rises by the year 2100 of 0.5 m, 1.0 m, and 1.5 m. The NRC suggests the total relative sea level rise (T) at time (t) is equal to:

$$T(t) = (0.0012 + M/1000)t + bt^2 \qquad \text{[Equation 1]}$$

where M represents the local subsidence rate.

The subsidence rate for Dauphin Island was estimated using the NRC value of 1.1mm/year (NRC, 1987) at Pensacola, FL. The values of the coefficient, *b*, for each estimated eustatic sea level rise are 0.000028 m/yr^2, 0.000066 m/yr^2, and 0.000105 m/yr^2, respectively. Table 7 is an estimate of the total sea level rise using Equation 1 relative to 1986.

Table 7. NRC Estimate of Relative Sea Level Rise

Eustatic Sea Level Rise	Eustatic Coefficient (b)	Total Relative Sea Level Rise			
		Per Year		By 2100	
(m)	m/yr2	m	ft	m	ft
0.5	0.000028	0.00233	0.0076	0.6261	2.0542
1	0.000066	0.00237	0.0078	1.1199	3.6745
1.5	0.000105	0.00241	0.0079	1.6268	5.3375

Note: Sea level rise based on calculation start date of 1986.

The annual sea level rise for Pensacola, FL using the NRC 1987 Equation 1, is 2.4 mm/yr (0.0079 ft/yr) in the worst case scenario of a eustatic sea level rise of 1.5 m by 2100.

In 2007, NOAA calculated a mean sea level trend based on monthly mean sea level data from 1966 to 2006 (NOAA, 2011). For Dauphin Island, station 8735180, NOAA calculated a mean sea level rise of 2.98 mm/yr (0.0098 ft/yr), with a standard error of 0.87 mm/yr (0.001 ft/yr).

The NOAA annual sea level rise rate is larger (more conservative) than the NRC annual rate. The data used in the NOAA study to calculate the sea level rise rate is more recent (up to 2006), and the studied station is much closer to the project area. Therefore, the NOAA estimate of 2.98 mm/yr (0.0098 ft/yr) was used in the development of the project design.

5 COASTAL PROCESSES ANALYSIS

5.1 Shoreline Changes

Historical shorelines and bathymetry have been evaluated in previous reports (Douglass, 1994; Byrnes *et al.*, 2008). This previous data and analysis was reviewed and augmented with survey data collected in January and July 2010 by Coastal Planning & Engineering, Inc.

The Mean High Water (MHW) elevation measured at each profile is used to represent the shoreline location. At Dauphin Island, the MHW elevation is +0.95 ft, NAVD88 (Section 4.1). The July 2010 shoreline (CPE, 2010) was compared to shorelines from 1981 (USGS), October 1990, November-December 1998, and November 2005 (LiDAR). The shoreline changes take into account the emergency berm placements that occurred in 2000 and 2007. Table 8 summarizes the shoreline changes in the western project area. Figure 14 highlights the shoreline retreat in the western project area with time and the impact of Hurricanes Ivan and Katrina.

Table 8. Historic Annual Shoreline Changes for Western Dauphin Island, Alabama.

Profile	Effective Distance	1981-2010	1990-2010	1998-2010	2005 - 2010	Added Fill* 2000	Added Fill* 2007	1981-2010	1990-2010	1998-2010	2005-2010
	(ft)	(ft/yr)	(ft/yr)	(ft/yr)	(ft/yr)	(ft)	(ft)	(ft/yr)	(ft/yr)	(ft/yr)	(ft/yr)
DI-2	2,502	-9.2	-18	-21.2	-4.7	37.7	33.2	-11.7	-21.3	-27.5	-12.7
DI-8	4,677	-2.5	-8	-6.6	-8.9	12.8	55.2	-4.9	-11.5	-12.7	-22.2
DI-10	3,897	-3.0	-9	-4.2	9.9	9.9	30.2	-4.4	-10.8	-7.8	2.6
DI-10_1	3,365	-3.8	-10	-4.7	-28.4	20.8	47.6	-6.2	-13.1	-10.8	-39.8
DI-14	2,504	-3.3	-7	-3.5	-11.5	-	28.3	-4.3	-8.3	-6.1	-18.3
DI-16	1,838	1.3	2	0.8	31.7	-	25.6	0.4	0.9	-1.5	25.5
DI-17	978	17.8	26	48.6	112.1	-	-	17.8	25.7	48.6	112.1
Erosional Area DI-2 to DI-14	16,944	-4.0	-9.7	-7.4	-8.2	18.2	40.7	-5.9	-12.6	-12.4	-18.0
Accretional Area DI-16 to DI-17	2,817	7.0	10.4	17.4	59.6	-	16.7	6.4	9.5	15.9	55.6
Study Area DI-2 to DI-17	19,761	-2.4	-6.9	-3.8	1.4	18.2	37.3	-4.2	-9.5	-8.4	-7.5

*Note: Estimated average shoreline changes from emergency berm projects (USACE, 2000; Trembanis & Pilkey, 2000; Rowe Surveying and Engineering, Inc. Survey Drawings, USACE, 2007).

Average annual shoreline changes are weighted by reach length.

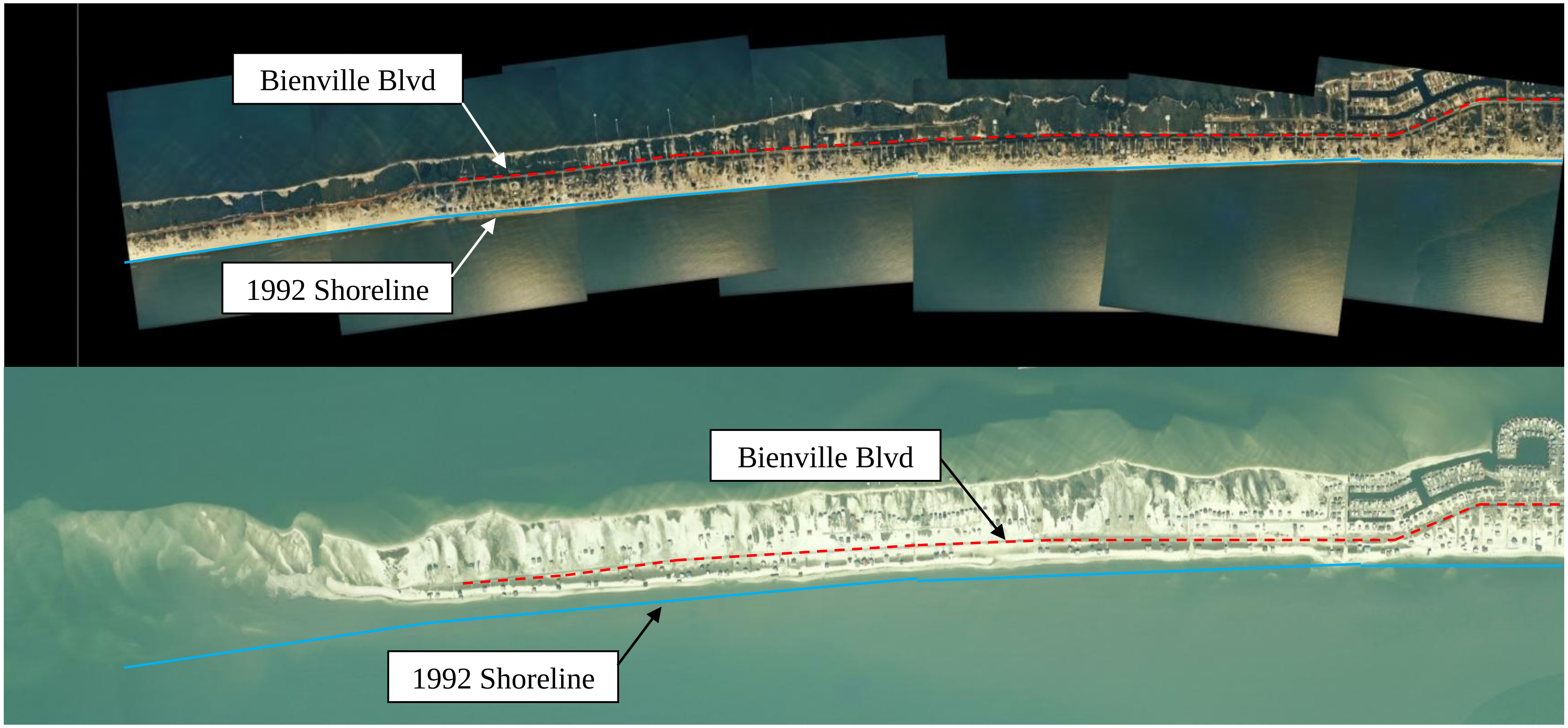

Figure 14. Shoreline retreat on West Dauphin Island shown by comparison of aerial photographs in 1992 (upper) and 2008 (lower). Red dashed line indicates Bienville Blvd and blue solid line indicates 1992 shoreline position.

The shoreline change rates on the left side of Table 8 are from the measured shoreline data. The shoreline change rates shown on the right side (4 columns) of Table 8 are estimates of the shoreline change which would have taken place without the 2000 and 2007 "FEMA berms".

The Gulf shoreline can be divided into two sections for analysis – the portion that is dominated by shoreline advance or accretion near the pier and the portion to the west that is dominated by shoreline retreat or recession. At the east end of the western project area, the shoreline near Pelican Island has been advancing, particularly at profiles DI-16 and DI-17 (Table 8). From east to west between profiles DI-16 and DI-14, shoreline advance transitions to shoreline retreat. Shoreline retreat continues west from DI-14 to the western end of the island near Katrina Cut west of DI-2. Therefore, the recessional area extends from DI-2 to DI-14, and the accretional area includes DI-16 and DI-17.

Shoreline changes between 2005 and 2010 were typically greater than those in any of the longer time periods. Figure 15 shows an accretional wave moving into the western project area as Pelican Island migrates onshore and begins to spread to the west. In the accretional area, profiles DI-16 and DI-17 advanced approximately 55.6 ft/yr; the next highest annual shoreline change was 15.9 ft/yr occurring between 1998 and 2010. Also, the shoreline in the erosional area retreated 18.0 ft/yr; the closest retreat rate was 12.6 ft/yr between 1990 and 2010 (Table 8). Lastly, the spike in Figure 15 at profile DI-10_1 indicates a shoreline retreat at least 3 times greater than losses occurring over any other time period.

Within the accretional area, shoreline advance at profile DI-17 increases as the comparison time periods shorten, starting from 17.8 ft/yr over the long term period of 1981-2010 and increasing to 112.1 ft/yr in the short term period from 2005-2010. The increase in advance at DI-17 spills over to the shoreline at DI-16 between 2005 and 2010. During the other comparison periods, the shoreline at DI-16 appears stable, only experiencing small gains or losses (less than 2 ft/yr).

Shoreline changes along the middle of the study area are steady for 1981-2010, 1990-2010, and 1998-2010, shown in Figure 15 between profiles DI-8 and DI-14. However, shoreline changes along the island from 2005 to 2010 are exaggerated, capturing spikes of retreat and advance, in the short term due to above average hurricane events (Katrina).

Shoreline advance is captured at profile DI-10 in the comparison of the 2005 and 2010 shoreline where the shoreline appeared to be erosional during the other comparison periods. This may be due to recovery from severe overwash during Hurricane Katrina as the westerly sediment transport deposited sand in the shallow breach. This trend differs from the other three analysis periods which indicate erosion at all profiles DI-2 through DI-14.

Erosion at the end of the study area (DI-2) increases with more recent time periods, except from 2005-2010. The widening of Katrina Cut occurred prior to the survey date of the 2005 shoreline. The large shoreline retreat due to the storm is therefore excluded in these shoreline changes between 2005 and 2010, which may have caused the smaller shoreline retreat than other time periods. Construction of a seawall around a home near DI-2 between 2005 and 2010 may have also biased the data.

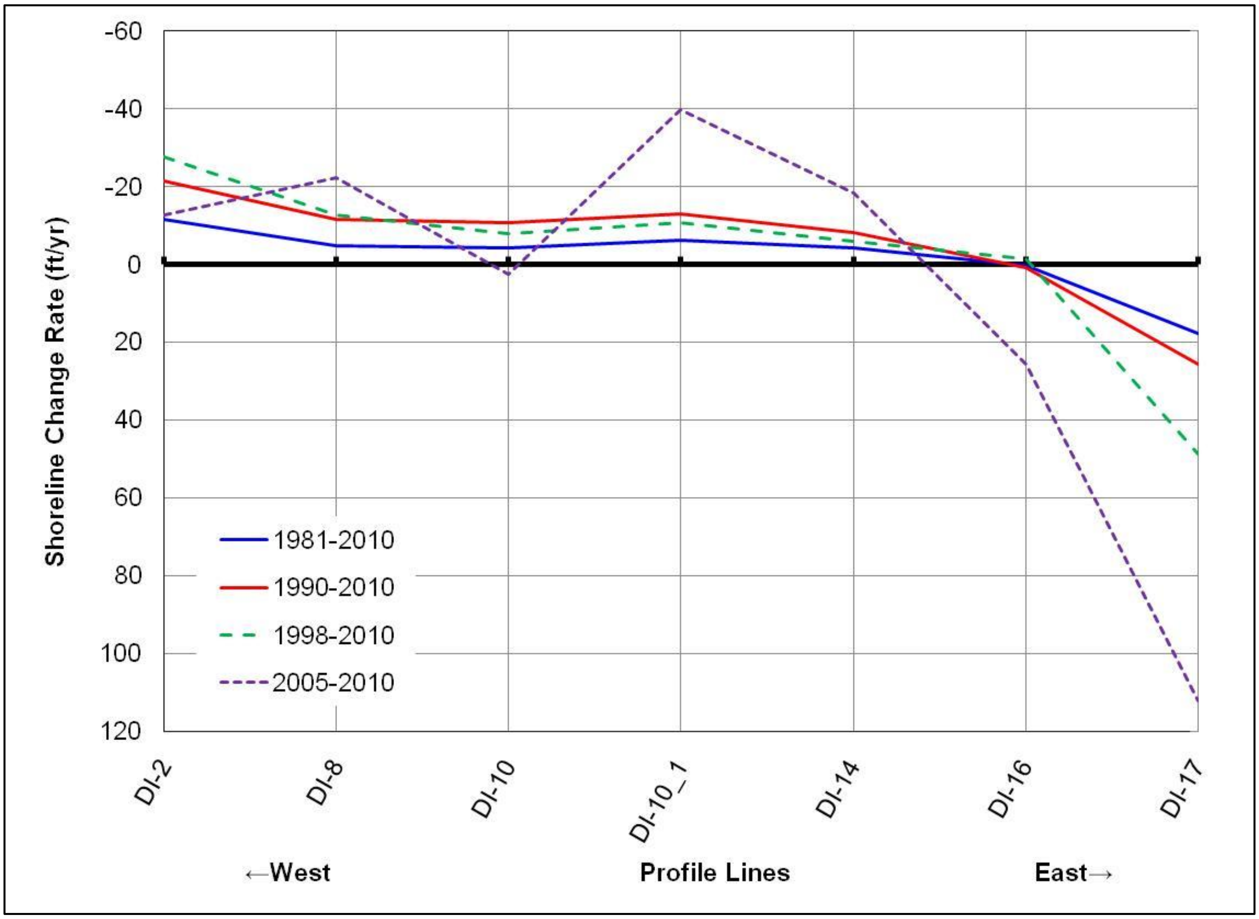

Figure 15. Annual Historic Shoreline Changes 1981 through 2010.

5.2 Active Profile

Volume changes can be estimated by multiplying the shoreline change by the active profile height and the longshore distance. The active profile extends from the berm crest to the depth of closure, where the depth of closure is defined as "the most landward depth seaward of which there is no significant change in bottom elevation and no significant net transport between the nearshore and offshore for a given or characteristic time period" (Kraus, Larson and Wise, 1998). The depth of closure is typically estimated by either comparing historic profiles and observing where the profiles close (pinch out and have no elevation difference) or using empirical equations, such as the ones developed by Hallermeier (1978) or Birkemeier (1985).

The preferred method of estimating the depth of closure is to compare cross-sections over numerous years. Where the profiles "close" or overlap with no vertical difference is typically taken as the depth of closure. The average depth of closure on the west side of Dauphin Island was estimated to be -18 ft, NAVD by comparing 1998, 2006 and 2010 profiles.

Empirical equations were also used to estimate the depth of closure for the project area. The Hallermeier (1978) and Birkemeier (1985) empirical equations are based on the significant wave event that is exceeded 12 hours per year (H_e and T_e) and are shown below as Equation 2 and Equation 3, respectively.

Hallermeier's equation:

$$h_* = 2.28H_e - 68.5\left(\frac{H_e^{\ 2}}{gT_e^{\ 2}}\right) \quad \text{[Equation 2]}$$

Birkemeier's equation:

$$h_* = 1.75H_e - 57.9\left(\frac{H_e^{\ 2}}{gT_e^{\ 2}}\right) \quad \text{[Equation 3]}$$

Kraus, Larson, and Wise (1998) investigated these equations further and recommend using the 12-hour wave event expected during the life of the project (5-years for this project). The 12-hour wave event at WIS Station 350 (between 1980 and 1999) propagated to the -33-foot contour was found to have a significant wave height (He) of 15.5 feet and a period (Te) of 9.1 seconds. Application of Hallermeier's equation suggests that the depth of closure is -29 feet, MLW while Birkemeier's equation suggests that the depth of closure is -22 feet, NAVD. However, the preferred method of reviewing profile data suggests that the depth of closure is shallower so a value of -18 feet, NAVD was used. Observational evidence from SCUBA diving and from surveying with a rod indicates that this depth of about 18 feet, where the sand bar feature flattens out offshore, roughly corresponds with a transition from surface sands to surface muds.

The average berm elevation along the western side of Dauphin Island was estimated to be +5.5 ft, NAVD by examining recent profiles (January 2010, CPE). The elevation of the berm varies by approximately 2 feet along the project length. It should be noted that this report typically uses the term "berm" in the traditional coastal science terminology sense meaning the relatively flat area of the natural, subaerial beach seaward of the sand dunes and landward of the swash zone or beachface. This is different from the so-called "FEMA berms" constructed in 2000 and 2007 commonly known on Dauphin Island.

The resulting profile based active profile height is 23.5 feet from the berm at an elevation of +5.5 ft, NAVD to the depth of closure at an elevation of -18 ft, NAVD.

5.3 Volume Changes

Volumetric changes discussed in this report represent the change in the quantity of sediment estimated from comparison of the 2010 shoreline position to the 1981, 1998, and 2005 shoreline positions. Shoreline based volume changes can be approximated by multiplying the shoreline change by the active profile height and the alongshore distance between profiles (USACE, 2001). All volumes are shown in cubic yards calculated for the active profile, which is defined by the beach berm elevation and the estimated offshore depth of closure. The depth of closure is defined as the seaward limit of the active beach profile. Based on comparisons of individual profiles and review of historical data, the natural berm on Dauphin Island is located at approximately +5.5 ft NAVD and the depth of closure is assumed to be -18 ft, NAVD. The volume changes account for the emergency berm placement projects that occurred in 2000 and 2007. The results are presented in Table 9 and graphically in Figure 16.

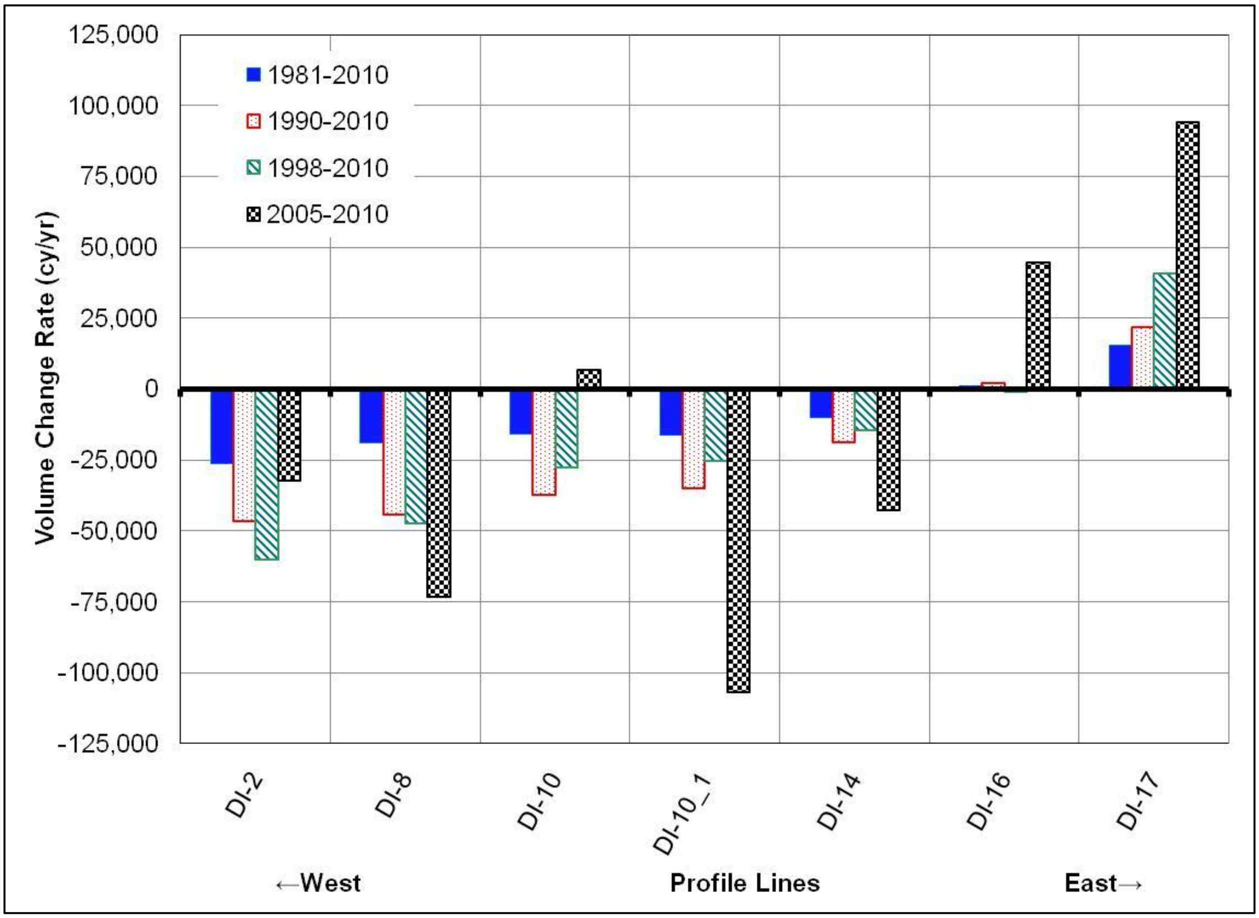

Figure 16. Historical Volume Change Rates for Western Dauphin Island.

The shoreline is grouped into two sections representing the accretional and erosional areas, and is divided by the transition from accretion to erosion occurring from east to west between profiles DI-16 and DI-14. The erosional area extends from DI-2 to DI-14, and accretional area includes DI-16 and DI-17.

In the more recent comparison periods, annual volume changes are more drastic. Between 2005 and 2010, DI-16 and DI-17 gained approximately 138,640 cy/yr; the next largest gain of 39,840 cy/yr occurred between 1998 and 2010. Losses in the erosional area were highest (-248,770 cy/yr) between 2005 and 2010 as compared to any other comparison period (Table 9). Also, a large spike in volume loss at profile DI-10_1 occurs. The loss is at least 3 times greater than annual volume losses calculated over any other time period.

Table 9. Annual Volume Changes for West Dauphin Island, Alabama.

Profile	Effective Distance (ft)	1981-2010	1990-2010	1998-2010	2005 - 2010	Added Fill* 2000	Added Fill* 2007	Adjusted 1981-2010	Adjusted 1990-2010	Adjusted 1998-2010	Adjusted 2005-2010
		(cy/yr)	(cy/yr)	(cy/yr)	(cy/yr)	(cy)	(cy)	(cy/yr)	(cy/yr)	(cy/yr)	(cy/yr)
DI-2	2,502	-20,640	-38,420	-46,130	-10,330	40,200	91,310	-26,140	-46,460	-59,990	-32,240
DI-8	4,677	-10,630	-32,470	-26,810	-36,350	47,510	154,180	-18,760	-44,370	-47,340	-73,360
DI-10	3,897	-10,520	-29,580	-14,260	33,410	24,010	110,880	-15,800	-37,310	-27,580	6,800
DI-10_1	3,365	-11,450	-27,980	-13,660	-83,100	20,550	99,830	-16,150	-34,850	-25,510	-107,060
DI-14	2,504	-7,490	-14,970	-7,740	-24,960	-	74,760	-10,140	-18,860	-14,430	-42,910
DI-16	1,838	2,060	3,530	1,240	50,690	-	26,010	1,140	2,180	-1,080	44,450
DI-17	978	15,560	21,920	41,390	95,450	-	-	15,380	21,650	40,920	94,190
Erosional Area DI-2 to DI-14	16,944	-60,730	-143,420	-108,600	-121,330	132,270	530,960	-86,990	-181,850	-174,850	-248,770
Accretional Area DI-16 to DI-17	2,817	17,620	25,450	42,630	146,140	-	26,010	16,520	23,830	39,840	138,640
Study Area DI-2 to DI-17	19,761	-43,110	-117,970	-65,970	24,810	132,270	556,970	-70,470	-158,020	-135,010	-110,130

*Note: Estimated average volume changes from emergency berm projects (USACE, 2000; Trembanis & Pilkey, 2000; Rowe Surveying and Engineering, Inc. Survey Drawings, USACE, 2007).

Within the accretional area, volume gain at profile DI-17 significantly increases as the comparison time periods shorten, starting from 15,380 cy/yr during the long term period of 1981-2010 and increasing to 94,190 cy/yr in the short term period from 2005-2010. A spike in volume gain also occurs at DI-16 between 2005 and 2010. During the other comparison periods, DI-16 appears stable, experiencing accretion of less than 3,000 cy/yr.

Volume changes for 1981-2010, 1990-2010, and 1998-2010 along the middle of the western project area generally increase from east to west, shown in Figure 16 between profiles DI-8 and DI-14. However, volume changes along the island from 2005 to 2010 are irregular, capturing spikes of retreat and advance in the short term.

Between 2005 and 2010, a volume gain of 6,800 cy/yr was observed at profile DI-10, while the remainder of the profiles revealed noticeable volume losses. This trend differs from the other three analysis periods, which indicate volume losses at all profiles from DI-2 through DI-14. This may be due to recovery from severe overwash during Hurricane Katrina as the westerly sediment transport deposited sand in the shallow breach. In addition, the localized area of accretion may be due to natural processes coupled with sand management projects that were completed during this time period. These projects include the second FEMA berm constructed in 2007, the FEMA cleanup process completed in February 2010 following Tropical Storm Ida, and the emergency sand barrier constructed in May 2010 in response to the BP/Deepwater Horizon oil spill.

Volume losses at the end of the study area (DI-2) increase in more recent time periods, except from 2005-2010. The 2005 survey was conducted after Hurricane Katrina, therefore the effects of the storm are excluded in the volume change analysis period between 2005 and 2010. The other survey comparisons include the effects of Katrina and thus indicate higher loss rates.

5.4 Overwash

The island in the western project area is typically low in elevation (+5.5 feet to +7 feet, NAVD excluding the mechanically constructed dune features). This low elevation leads to overtopping in relatively high frequency storm events. Low frequency storm events, such as Hurricane Katrina, resulted in significant volumes of overwash. While sufficient data was not available to estimate the volume of overwash due to particular storm events, an average annual estimate of the overwash volumes was made based on comparison of the Mississippi Sound shoreline position and assumed depth of overwash. This estimate is summarized in Table 10.

Table 10. Estimate of Overwash Volume (1992 – 2010)

Profile		Overwash
From	To	(cy/yr)
DI-14	DI-10_1	20,000
DI-10_1	DI-10	30,700
DI-10	DI-8	37,800
DI-8	DI-2	53,600
	Total	**142,100**

Figure 17 shows the annualized volumetric gains and losses within the various cells used to develop the sediment budget between 1990 and 2010. Overwash is shown as a positive value as it is a gain of sediment into that cell. The cells along the Gulf shoreline show a volumetric loss.

Figure 17. Sediment Budget Cells Showing Volume Changes (cy/yr) between 1990 and 2010.

5.5 Sediment Transport Evaluation

The littoral drift of beach sediments in the nearshore region was evaluated by calculating the sediment transport based on historical shoreline changes. The shoreline positions were converted to volume changes since repeated full-length profile surveys were not available for older time periods, as described in the previous section.

Sediment transport curves were developed based on volumetric changes for the analysis period from 1990 to 2010. The conservation of sand principle was used to estimate the volume of sand transported in a longshore direction. The conservation of sand equation allows for the littoral transport to be estimated using Equation 4.

$$LT_{out} = \Delta V_{total} - V_{overwash} + LT_{in} \qquad \text{[Equation 4]}$$

where:

LT_{out} = Longshore transport out of the reach
ΔV_{total} = Volume change calculated based on shoreline change
$V_{overwash}$ = Volume change associated with overwash
LT_{in} = Longshore transport into the reach

Note that Equation 4 does not account for sediment added to the system through the placement of material. The longshore transport will be derived by using volumetric changes that have already accounted for the input of the material into the system.

Table 11 summarizes the various components of volume change along the west end of Dauphin Island between 1990 and 2010. The total volume lost from the Gulf face is based on shoreline recession rates. Overwash is based on the shoreline changes on the north side of the island and an estimate of the average vertical thickness of the sediment deposit. These various components can be added in order to determine a net volume change within each cell. The net longshore transport rate along the western project area can then be estimated by integrating the volumes in a longshore direction (Equation 4). Given that the net longshore transport is towards the west, the integration starts at the eastern cell.

Table 11. Sediment Budget and Longshore Transport Rate for 1990 to 2010.

Profile	Distance Alongshore (ft)	Annual Volume Lost from Gulf Face (cy/yr)	Overwash (cy/yr)	Alongshore Volume Changes Adjusted for Overwash (cy/yr)	Littoral Transport (cy/yr)
DI-17	0				70,000
DI-16	1,956	22,800		22,800	47,200
DI-14	3,677	-5,500		-5,500	52,700
DI-10_1	6,965	-29,400	-20,000	-9,400	62,100
DI-10	10,407	-34,300	-30,700	-3,600	65,700
DI-8	14,758	-41,500	-37,800	-3,700	69,400
DI-2	19,761	-70,200	-53,600	-16,600	86,000
Total		-158,100	-142,100	-16,000	

Pelican Island is an emergent sand bypassing bar that transports sediment westward from the ebb shoal at the mouth of the Mobile Ship Channel. Located at the eastern end of the western project area, it has been accretional during the 1990 and 2010 time period. The Dauphin Island shoreline in the vicinity of Pelican Island and immediately to the west has advanced due to sediment transport westward from Pelican Island, which is indicated by an average shoreline gain of approximately 183.2 feet at profiles DI-17 and DI-16. It was assumed that the transport off of Pelican Island towards the west end shoreline was approximately 70,000 cubic yards/year. Thus, a gain of 70,000 cubic yards/year was taken as the start of the integration of alongshore volume changes in order to develop the longshore sediment transport rate (Table 11).

A positive longshore transport rate indicates that sand is transported from east to west. The slope of the longshore transport curve indicates whether erosion or accretion is occurring and the severity of this erosion or accretion (Figure 18). Greater erosion or accretion will result in a steeper slope of the longshore transport curve. Therefore, the longshore transport curve suggests that accretion occurs at the eastern end of the western project area, transitions to erosion after DI-16 and gradually increases along the remainder of the project length. The severity of the erosion dramatically increases towards the western end where the island nears Katrina Cut. Figure 18 shows that the net longshore transport rate estimated for the west end of Dauphin Island reaches a maximum of approximately 86,000 cubic yards/year near the western extent of the study area between 1990 and 2010.

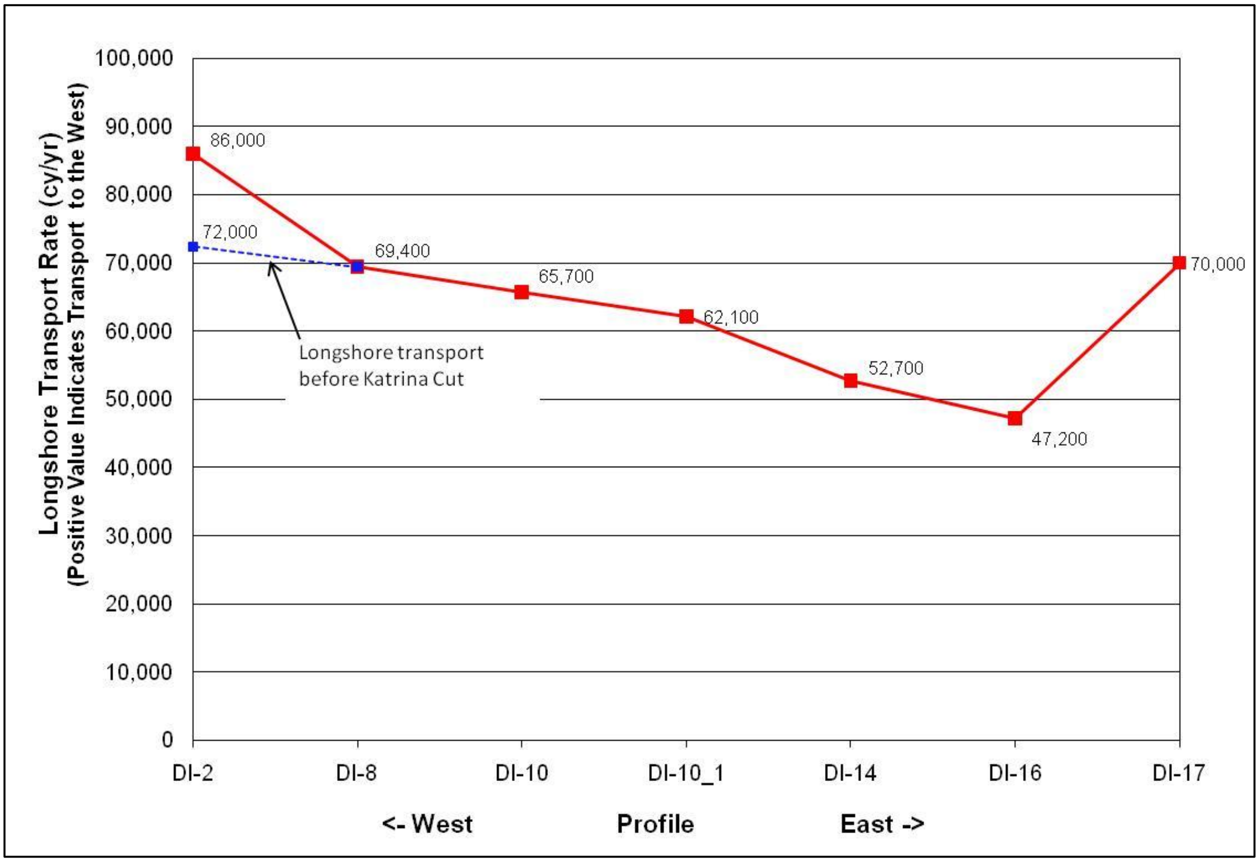

Figure 18. West Dauphin Island Littoral Transport Curve for 1990-2010.

Note that the assumption of 70,000 cubic yards/year entering at the eastern end of the project area does not affect the total longshore loss within the project area. An increase or decrease in this value would result in an identical increase or decrease in the longshore transport at the western end of the project area. Modeling of sediment transport rate along the western side of Dauphin Island suggested that the longshore loss at DI-2 was 110,000 cubic yards/year.

Katrina Cut began to form in 2004 after the passage of Hurricane Ivan and expanded in 2005 due to Hurricane Katrina. The opening and growth of an inlet typically results in increased sediment losses from the shoreline adjacent to the inlet due to tidal currents and wave action. This was observed at the west end of Dauphin Island with higher than average shoreline retreat rates at DI-2 following Hurricane Katrina. Figure 18 highlights the increase in longshore transport as a result of Katrina Cut. The increase in longshore transport is relatively uniform at 8,600 cubic yard/year increase every 5,000 feet from DI-16 to DI-8 before the rate changes to an increase of 17,000 cubic yards/year over the last mile between DI-8 and DI-2. Extrapolating the longshore transport between DI-10 and DI-8 to the reach between DI-8 and DI-2, suggests that the longshore transport at DI-2 prior to Katrina Cut was approximately 72,000 cubic yards/year. The impact of Katrina Cut on the project area is thus approximated at 14,000 cubic yards/year when it is averaged over the 20 year time period.

The closure of Katrina Cut means the tidal currents are reduced. However, the northward position of the rock closure relative to the shoreline position along the west project area suggests that sand from these beaches will move to and remain south of the rocks. There will be a greater net transport rate to the west from DI-2 until the shoreline planform straightens.

5.6 Losses Due to Relative Sea Level Rise

Shoreline recession rates can be estimated using Bruun's (1962) rule (Equation 5) once the relative sea level rise rate is established. Bruun showed that beach profiles should adjust to the increased water elevation with a recession of the shoreline and deposition of sand in the offshore area (Figure 19). Bruun's rule for shoreline recession (x) in feet is:

$$x = \frac{rb}{h + d} \qquad \text{[Equation 5]}$$

where:

b = the horizontal distance from MLW to the depth of closure = 2,500 feet
d = the depth of closure = -23.5 feet, NAVD
h = the height of the berm = +5.5 feet, NAVD
r = the rate of relative sea level rise (RSLR) = 0.0098 feet/yr,
x = shoreline recession due to Relative Sea Level Rise.

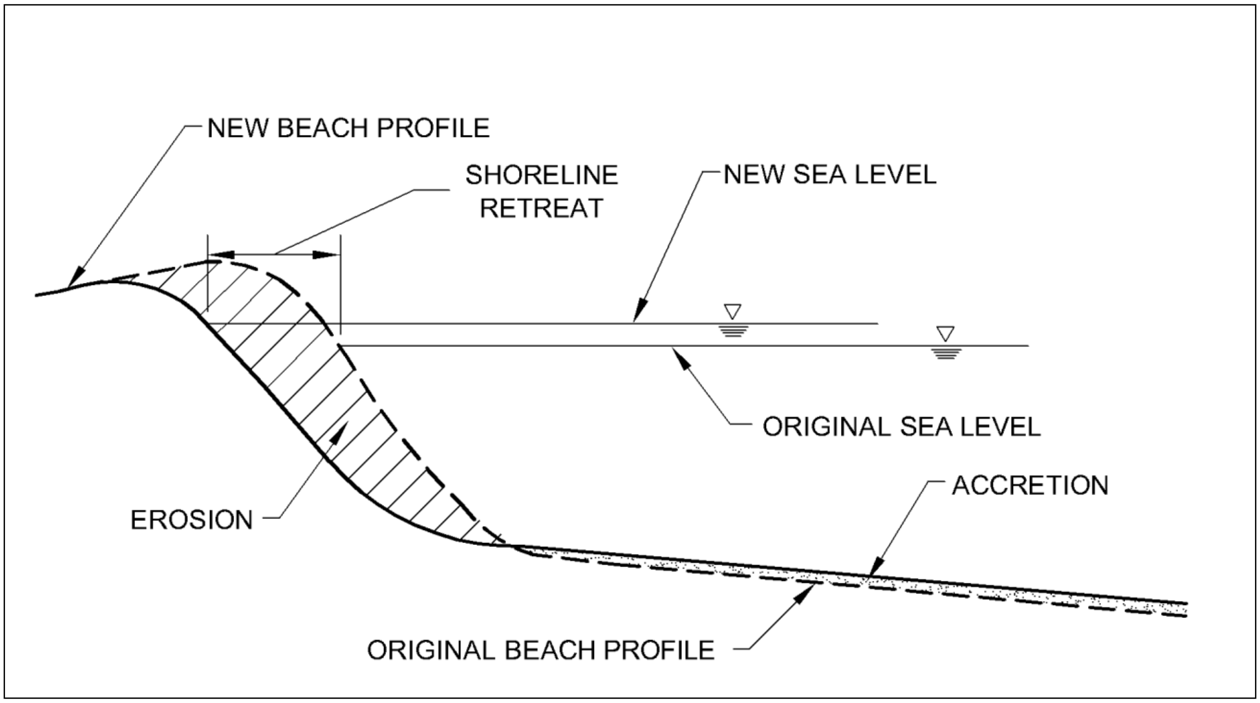

Figure 19. Impact of Sea Level Rise upon Shoreline (after Bruun, 1962)

The distance from the mean low water to the depth of closure was estimated to be an average of 2,500 feet based on the 2010 survey. The average annual shoreline recession required to maintain the island elevation with respect to relative sea level rise is approximately 1.0 feet/year. This is equivalent to approximately 0.9 cubic yards/foot/year.

5.7 Summary of Coastal Processes – Western Project Area

The net sediment transport is towards the west and increases through the western project area from approximately 70,000 cubic yards/year to 86,000 cubic yards/year. The net loss due to longshore sediment transport is therefore on the order of 16,000 cubic yards/year.

Shoreline recession due to overwash is a more dominant process than longshore transport in the western project area and is estimated at 142,000 cubic yards/year though an average annual value is slightly misleading as overwash is more episodic in nature and limited to storm events.

Shoreline recession due to relative sea level rise is estimated at 1 foot/year, which is equivalent to approximately 0.9 cubic yards/foot/year.

6 PROJECT DESIGN

Design consideration included various beach fill designs, structural stabilization options for the beach fill, and a floodwall design

6.1 Beach Fill Design

This section discusses the development of the beach design for four alternatives, including the fill limits, design section, advanced fill volume, construction template, and profile equilibration.

Three alternative designs, with different cost levels, were developed for the western project area and are referred to as Alternatives 1, 2, and 3. They each include dune and beach sand placement with the differences being the volume of sand and the size and location of the dunes. Alternative 4 is the recommended design for the eastern project area. As part of Alternative 4, realignment of the remnant groin structures into breakwaters at the east end of the island was considered to support the beach nourishment fill section on the eastern tip of Dauphin Island. The eastern project area design, Alternative 4, is included in the cost estimates for all three western project area alternatives.

The western project area for Alternatives 1, 2, and 3 is located along the west side of Dauphin Island. The eastern extent of the fill is located 450 feet east of the fishing pier (400 feet east of DI-18). From this point to the curve in Bienville Blvd (DI-16), it is proposed to only construct a dune feature. In this area, the beach is sufficiently wide and the shoreline has been advancing due to the influence of Pelican Island's collapse and migration onto Dauphin Island. Therefore, only a dune is required to provide protection from storm surge. The length of the dune only portion of the fill is approximately 0.6 miles.

A full beach section (extending the water line and building a dune) is proposed to extend from DI-14 to the public park at the west end of Bienville Blvd. The dune ends 600 feet west of DI-2 with a beach fill taper stretching the next 1,000 feet. The beach and dune section is 3.6 miles long.

The eastern project area, described as Alternative 4 but included in Alternatives 1-3, is located along the east end of Dauphin Island. The western extent of the fill is located 145 feet west of DI-28 (approximately 200 feet east of Audubon Street at the western limit of the Audubon Bird Sanctuary property). In the area west of the project, the beach is sufficiently wide and the shoreline has been advancing due to the westerly longshore transport and sediment impoundment at the weldpoint of Pelican Island onto Dauphin Island. The beach to the west will further benefit due to diffusion and longshore transport of the additional sediment introduced to the system by the project. Therefore, fill placement is only required in the erosional area to the east. The length of the fill portion is approximately 0.92 miles.

A full beach section backed by a hummocky dune is proposed to extend from DI-28 to DI-33. Between DI-31 and DI-33, fill will be placed in the lee of the realigned shore-parallel structures, extending the beach to the structures.

6.1.1 Design Cross-Section

A standard beach nourishment cross-section consists of two primary components:

1. The design section, which is the fill volume required at the end of the project life to meet applicable project goals.

2. Advanced nourishment, which is the sacrificial portion of the fill that will erode over the project life. Sufficient advanced nourishment can be added during construction or replaced periodically during nourishment projects.

This two-section design is in accordance with the National Research Council (1995) recommendations.

Two methodologies were used to determine a design section for the alternatives. The first was an analysis of storm surge while the second was SBEACH modeling.

A storm surge analysis was used to evaluate the performance of the cross-sections with respect to overtopping. The goal of the analysis was to determine a cross-section that would resist breaching and maintain a sufficient dune elevation to prevent overtopping by more frequent storm events. This critical storm event was a 10-year storm event. The water level at the shore will be raised until the slope of the water survey counteracts the shear stress, which is expressed in Equation 6.

[Equation 6]

Where S = setup

x = direction perpendicular to the shore

$\zeta = 3.2 \times 10^{-6}$

W = wind speed

ϕ = angle between the wind direction and the X axis

D = d+S

It was determined that a dune crest at +12 feet, NAVD had an appropriate elevation to prevent overtopping.

Cross-shore modeling (SBEACH) was used to confirm this as a suitable elevation and evaluate the performance of the cross-sections with respect to overtopping and post-storm dune elevation. SBEACH modeling suggested that the alongshore location of the profile was as important as the dune elevation in affecting whether the dune was overwashed or not (the eastern profiles had a wider beach and resisted overtopping while the western lines had a narrower beach profile and overwashed under similar storm input parameters). Rather than have a varying dune elevation and width, a uniform +12 feet, NAVD dune with 25-foot crest width was chosen as the design dune. A narrower dune width was chosen for Alternatives 2 and 3 due to constructability and footprint restrictions. A detailed discussion of the cross-shore modeling is provided in Appendix B.

6.1.2 Advanced Nourishment

The advanced nourishment is the sacrificial portion of the beach fill design and will erode over the project life time due to natural ongoing processes. Once erosion begins to impact the design storm profile, the beach will not provide its intended level of protection to landward resources, and the beach renourishment project should be reconstructed as soon as possible. The renourishment project in this scenario would only encompass the replacement of the advanced fill portion of the project. Therefore, future fill volumes should be lower than the initial construction.

The advanced fill will be placed with the same slope and elevation as the design section. A review of existing profiles suggested that the natural beach berm elevation for the project area is approximately +5.5 ft, NAVD and the slope is 1V:12H.

The advanced fill volume will erode over the project life. There are 4 primary components of the advanced fill:

1. Longshore Loss
2. Diffusion Loss
3. Loss due to Relative Sea Level Rise (RSLR)
4. Overwash

6.1.2.1 Longshore Loss

Longshore losses are due to the net loss of sediment from the beach fill area (DI-2-400 to DI-14) because of wave transport. The advanced fill volume required to counteract the effects of longshore transport was calculated using the longshore transport rates discussed in Section 5.5. The littoral budget suggests that the total loss out of the project area due to longshore transport is approximately 34,000 cy/yr. Therefore, the advanced fill volume required to counteract the effects of longshore transport for the 10-year project is 340,000 cubic yards.

6.1.2.2 Diffusion Loss

Diffusion is the movement of beach nourishment sediment from the project area to the adjacent beaches due to the bulge in the shoreline created by construction of the project. While diffusion losses occur in a longshore direction and sand is transported to the east and west, diffusion losses are in addition to background longshore transport losses. Diffusion requires wave action to move the material. However, the wave angle (a major component of longshore sediment transport) is not a consideration when calculating diffusion loss.

The proportion of fill still remaining in the project area after a given number of years is dependent on the diffusivity of the fill sediment and the length of the project area. The project length used for the diffusion analysis was 16,484 feet, which is the total length excluding the tapered sections (from DI-2-400 to DI-14). The longshore diffusivity, G, is calculated using the Pelnard-Considère equation with dimensions of $(\text{length})^2/\text{time}$ (Equation 7).

$$G = \frac{K H_b^{5/2} \sqrt{g/\kappa}}{8(s-1)(1-p)(h_* + B)}$$ [Equation 7]

where:
K = the alongshore transport coefficient = 1.24
H_b = the average breaking wave height = 0.55 feet
κ = the wave breaking ratio = 0.78
s = the specific gravity of the sediment = 2.65
p = the in-place sediment porosity = 0.35
h_* = the depth of closure = -18 ft NAVD
B = is the design construction elevation = +5.5 ft NAVD.

The breaking wave height was found by calculating the weighted average offshore wave height from historical data at NOAA buoy 42040. Seventy-seven wave cases were used to develop the root mean square an inshore wave height of 0.55 feet directed onshore.

It is expected that diffusion at the eastern extent of the project will be negligible as the shoreline is accretional due to sediment transport off of Pelican Island. Therefore, diffusion at the western extent of the project was estimated to be half of the total calculated using a mean grain size of 0.27mm and a project length of 16,484 feet. The diffusion losses for each of the Alternatives can be found in the fill summary Sections 6.3, 6.4, 6.5, and 6.6.

6.1.2.3 Loss due to Relative Sea Level Rise (RSLR)

As described in Section 5.6, expected future loss due to relative sea level rise along the western project area is 0.9 cy/yr. The total effective volume loss within the project area is 14,900 cy/yr. Total losses for each Alternative are given in the fill summary tables in Sections 6.3, 6.4, 6.5, and 6.6. Note that while it is termed a volumetric loss due to relative sea level rise loss, the sand does not leave the system, but there is a shoreline retreat as the sand is redistributed across the profile.

6.1.2.4 Overwash

Following project construction, it is assumed that the presence of the dune and wider beach will prevent overwash. However, it is not possible to prevent overwash under all conditions and once overwash occurs and lowers the dune, overwash will start to occur more frequently (assuming that no repairs to the dune are made).

SBEACH modeling was used to estimate whether a dune for a given elevation would overwash and the overwash distance was calculated for 1, 5, 10, 25 and 50-year storm events. Through cross-shore analysis (Appendix B), it was determined that the 10-year storm was the critical overwash event for the design cross-sections. There is a 50% probability that a 10-year storm event will occur by the end of the seventh year following construction. Therefore, it was assumed that Alternatives 1 and 2 will experience dune lowering within the project life. Once the dune is overwashed (assumed to be in year 7), it was further assumed that overwash would return to its pre-construction condition. Since the annualized overwash developed in Section 5.4 would include the 10-year event, this is an overestimate of losses due to overwash but provides a conservative estimate of losses.

The advanced fill for Alternative 3 does not include losses for overwash because it is assumed that the project does not experience the 10-year storm event prior to the first scheduled renourishment five years after initial construction. Advanced fill for Alternatives 1 and 2 includes overwash in the years following the 10-years storm event (assumed to occur in year 7).

The annual overwash volume is based on Mississippi Sound shoreline changes between 1992 and 2010. The estimated annual overwash volume is 127,200 cy/yr. The overwash volumes included in the advanced fill for each of the Alternatives can be found in the fill volume summary tables in Sections 6.3, 6.4, 6.5, and 6.6.

6.2 Western Project Area Alternative 1

The design basis for Alternative 1 is to approximately restore the volume of sand south of Bienville Blvd that was present in 1990. The actual shoreline position of 1990 may not be re-established. The project will provide a 40-foot beach in front of the dune 10 years after construction. The dune will have a 25-foot crest width at an elevation of +12 feet, NAVD. The dune will be located in front of the seaward-most houses along the island. The design section requires approximately 2,549,300 cubic yards to construct, based on the July 2010 survey.

A 10-year renourishment interval is proposed because this tends to be the most cost effective renourishment interval for projects of this size. Table 12 summarizes the various volumetric needs to account for longshore loss, overwash, diffusion, and relative sea level rise over the 10-year period. Note that the overwash loss assumes no overwash for the first 7 years and then an average of 127,200 cubic yards/year thereafter. The western taper for Alternative 1 contains approximately 113,700 cubic yards. Rather than place all of the volume to account for diffusion loss within the main fill section, it can be considered that the taper sections contain some of the diffusion loss volume.

Table 12. Fill Volume Summary for Alternative 1

Fill Type	Fill Volume (cy)
Design Fill	2,549,300
Advanced Fill	
Longshore Loss	340,000
Overwash loss	381,600
Diffusion Loss	169,100
RSLR Loss	149,000
Total	3,589,000

6.2.1 Construction Template

The construction template includes a dune, beach, and advanced fill. The following design details were incorporated:

1.	Landward Dune Slope:	1V:5H above existing profile
2.	Seaward Dune Slope:	1V:5H above +5.5 feet, NAVD
3.	Dune Elevation:	+12.0 feet, NAVD
4.	Dune Crest Width:	25 feet
5.	Offshore slope:	1V:12H below +5.5 feet, NAVD
6.	Flat Beach Elevation:	+5.5 feet, NAVD

Fill for Alternative 1 will first be hydraulically pumped onto the beach and then manipulated into the construction template using bull-dozers to scrape a landward dune with a higher elevation. A portion of the template will be constructed hydraulically such that there will be sufficient material available to scrape the dune and redistribute the fill with bull-dozers to achieve the designed beach and dune elevations.

A 1V:5H construction slope was adopted for the seaward and landward sides of the dune. The landward toe of the dune will be placed seaward of existing homes. The seaward slope will toe into the beach at +5.5 feet, NAVD.

The constructed dune elevation is +12.0 feet, NAVD. This follows typical elevations for Alabama and Florida panhandle dune heights constructed for nearby projects, which can range from about +12 to +14 feet, NAVD. The lower constructed dune height more closely reflects the natural elevation of historic dunes. Overwash and lowering of dune heights is discussed in Appendix B.

The 25-foot dune width for Alternative 1 is the largest dune width proposed for the west end project. Dune widths for constructed projects nearby range from 20 to 30 feet (Pensacola Beach, FL and Navarre Beach, FL).

A 1V:12H offshore slope approximates the existing slope on Dauphin Island and thus is proposed as the slope for the offshore construction template. The beach construction template will shift the MHW shoreline an average of 427 feet seaward of its existing condition along the western project area (July 2010). Plan views and cross sections of Alternative 1 are shown in Appendix A.

6.2.2 Post-Construction Profile Equilibration

It is expected that the constructed beach template will readjust to an equilibrium beach profile in the year or two following construction. The equilibration process assumes that there is only cross-shore redistribution of sediment and the sand volume is conserved. The berm crest is expected to translate such that the sand volume is conserved. The profile will naturally equilibrate into a shape and shoreline position similar to the pre-project condition. The average equilibrated shoreline advance throughout the western project area is 205.6 feet from 2010 conditions.

The July 2010 profile, construction template, and equilibrium beach profile at DI-8 for Alternative 1 is shown in Figure 20. The shoreline for Alternative 1 is expected to translate approximately 221.5 feet landward assuming that volume is conserved during the equilibration process.

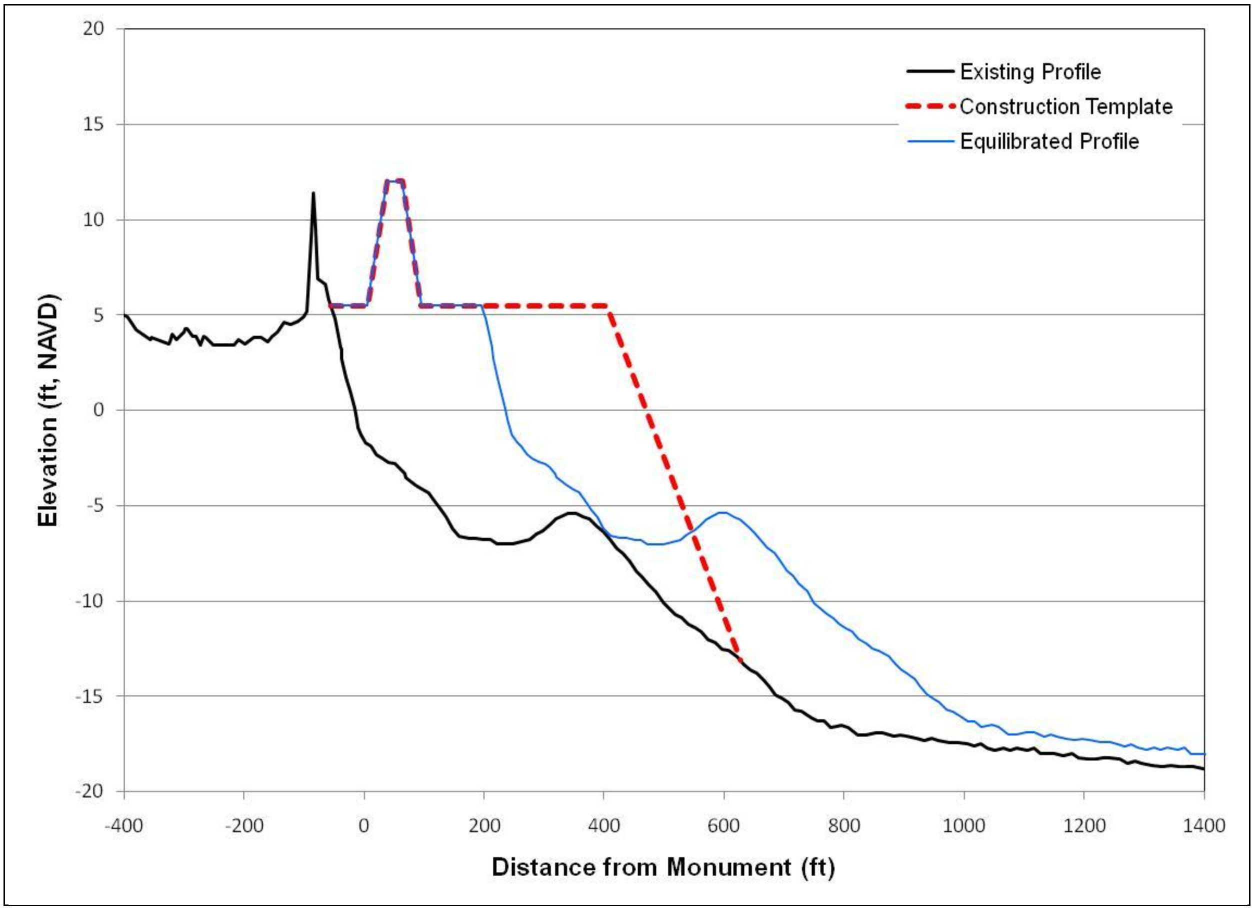

Figure 20. Equilibrium Beach Profile for Alternative 1.

6.3 Western Project Area Alternative 2

The design basis for Alternative 2 is to maintain the 2010 shoreline position along the western erosional portion of Dauphin Island. The design section is a 40-foot wide beach in front of the dune. The dune for Alternative 2 is set back farther than for Alternative 1 and is closer to Bienville Blvd. The design section contains approximately 835,300 cubic yards of fill.

The project will provide 12.5 years of advanced nourishment. A 12.5 year renourishment interval was chosen to provide an alternative with a cost that was approximately the average of Alternative 1 and Alternative 3. Alternative 2 assumes that the 10-year storm event will impact the project area at the end of year 7 and that an average annual overwash of 127,200 cubic yards/year will start in year 8. The volume in the western taper for Alternative 2 contains approximately 78,300 cubic yards, so again some of the advanced fill volume to account for diffusion loss is placed in the main fill section. Table 13 summarizes the volume breakdown for Alternative 2, separating the fill volume into design and advanced fill components.

Table 13. Fill Volume Summary for West End Alternative 2

Fill Type		Fill Volume (cy)
Design Fill		835,300
Advanced Fill		
	Longshore Loss	425,000
	Overwash loss	699,600
	Diffusion Loss	104,850
	RSLR Loss	186,250
Total		2,251,000

6.3.1 Construction Template

The construction template includes a transitional dune and beach, and advanced fill. The following design details were incorporated:

1.	Landward Dune Slope:	1V:5H above existing profile
2.	Seaward Dune Slope:	1V:5H above berm elevation
3.	Dune Elevation:	+12.0 feet, NAVD
4.	Dune Crest Width:	5 feet
5.	Offshore slope:	1H:12V below berm elevation
6.	Upper Berm Elevation:	+7.0 feet, NAVD
7.	Lower Berm Elevation:	+5.5 feet, NAVD

Fill for Alternative 2 will first be hydraulically pumped onto the beach and then manipulated into the construction template using bull-dozers to scrape a landward dune with a higher elevation. The hydraulically placed template will be a stepped construction. The upper, landward step will be 120 feet wide, placed at +7.0 feet, NAVD underneath and between existing homes. The upper step will be fronted by a lower elevation 275-foot wide seaward step at +5.5 ft, NAVD. After hydraulic placement, the +7.0-foot sand placement will be scraped into a +12.0 feet, NAVD dune where possible between homes.

A 1V:5H construction slope was chosen for the seaward and landward sides of the dune. The landward toe of the dune will be placed north of the majority of properties on the south side of Bienville Blvd. This template is closer to the road and the landward toe of fill is landward of Alternative 1. The landward toe varies from about 10 to 100 feet south of Bienville Blvd. on the island west of DI-10_1 (in the proximity of St. Stephens Street). The seaward slope of the dune will toe into the beach section at +5.5 feet, NAVD.

The constructed dune elevation is +12.0 feet, NAVD. This follows typical elevations for Alabama and Florida panhandle dune heights constructed for nearby projects, which can range from about +12 to +14 feet, NAVD. The lower constructed dune height more closely reflects the natural elevation of historic dunes. Overwash and lowering of dune heights is discussed in Appendix B.

The crest width of the dune is smaller than Alternative 1. A tolerance of ±1-foot for the dune elevation will result in greater variability in the elevation of the dune.

A 1V:12H offshore slope approximates the existing slope on Dauphin Island and thus is proposed as the slope for the offshore construction template. The beach construction template will shift the MHW shoreline 295.1 feet seaward of its existing condition (July 2010). The profile will naturally equilibrate into a shape and shoreline position similar to the 2010 condition. The average equilibrated shoreline advance throughout the western project area is 132 feet from 2010 conditions. Plan views and cross sections of Alternative 2 are shown in Appendix A.

6.4 Western Project Area Alternative 3

The design basis for Alternative 3 is to maintain the 2010 shoreline position along the west erosional portion of Dauphin Island. The design section will be similar to Alternative 2 with a 40-foot flat beach fronting the dune and thus the design volume is identical at 835,300 cubic yards.

To provide a project within a manageable cost range, a renourishment period of 5 years was selected. It was assumed that the dune would not overwash within the renourishment interval and thus there would be no losses due to overwash. Table 14 summarizes the various components making up the fill volume.

Table 14. Fill Volume Summary for West End Alternative 3

Fill Type		Fill Volume (cy)
Design Fill		835,300
Advanced Fill		
	Longshore Loss	170,000
	Overwash loss	0
	Diffusion Loss	40,200
	RSLR Loss	74,500
Total		1,120,000

6.4.1 Construction Template

The construction template includes a transitional dune and beach, and advanced fill. The dune placement is the same as Alternative 2. The following design details were incorporated:

1.	Landward Dune Slope:	1V:5H above existing profile
2.	Seaward Dune Slope:	1V:5H above berm elevation
3.	Dune Elevation:	+12.0 feet, NAVD
4.	Dune Crest Width:	5 feet
5.	Offshore slope:	1H:12V below berm elevation
6.	Upper Berm Beach Elevation:	+7.0 feet, NAVD
7.	Lower Berm Beach Elevation:	+5.5 feet, NAVD

Fill for Alternative 3 will first be hydraulically pumped onto the beach and then manipulated into the construction template using bull-dozers to scrape a landward dune with a higher elevation. The hydraulically placed template will be a stepped construction. The upper, landward step will be 120 feet wide, placed at +7.0 feet NAVD underneath and between existing homes. The upper step will be fronted by a lower elevation 120-foot wide seaward step at +5.5 ft, NAVD. After hydraulic placement, the +7.0-foot sand placement will be scraped into a +12.0 feet, NAVD dune where possible between homes.

The erosion rate at DI-14, the eastern-most profile of beach fill, is significantly lower than those along the rest of the project area. The reduced construction width reflects the smaller change rate.

A 1V:5H construction slope was chosen for the seaward and landward sides of the dune. The landward toe of the dune will be placed north of the majority of properties on the south side of Bienville Blvd. This template is closer to the road and is further landward than Alternative 1. The landward toe varies from about 10 to 100 feet south of Bienville Blvd. on the island west of DI-10_1 (in the proximity of St. Stephens Street). The seaward slope of the dune will toe into the constructed beach at +5.5 feet, NAVD.

The constructed dune elevation is +12.0 feet, NAVD. This follows typical elevations for Alabama and Florida panhandle dune heights constructed for nearby projects, which can range from about +12 to +14 feet, NAVD. The lower constructed dune height more closely reflects the natural elevation of historic dunes. Overwash and lowering of dune heights is discussed in Appendix B.

The crest width of the dune is smaller than Alternatives 1 and 2. An increased construction tolerance for the dune elevation will create a more natural variability in the elevation of the dune.

A 1V:12H offshore slope approximates the existing slope on Dauphin Island and thus is proposed as the slope for the offshore construction template. The beach construction template will shift the MHW shoreline approximately 152 feet seaward of its existing condition (July 2010). The profile will naturally equilibrate into a shape and shoreline position similar to the 2010 condition. The average equilibrated shoreline advance throughout the western project area is 69 feet from 2010 conditions. Plan views and cross sections of Alternative 3 are shown in Appendix A.

6.5 Structural Considerations for the Western Project Area Design

Coastal structures were considered to stabilize the beach fill, extend the project life, and improve project performance. Groins, a terminal groin, and offshore segmented breakwaters were considered and a discussion of each of these options follows.

6.5.1 Groins

Groins are shore perpendicular structures that intercept sand being transported in a longshore direction. Sand builds up on the updrift side of the structure (the east side in the case of Dauphin Island) resulting in saw tooth shoreline patterns as the shoreline reorients to minimize the incident wave angle. As with any effective coastal structure, the retention of sand in one area can cause a deficit in another. Thus, the property immediately west of a groin, will experience shoreline retreat. The groin design is based on this critical design location.

It was determined that groins would not be an effective solution at Dauphin Island because the dominant coastal process is overwash and groins have limited effect on counteracting overwash.

Groins may also face concerns from permitting agencies. Since groins hold sand within the project area, sand would not flow to downdrift beaches. While Katrina Cut was open, this sand was flowing into the breach and developing an ebb and flood shoal. Closure of Katrina Cut should result in sand transport to the west along the structure, which could benefit the far western end of Dauphin Island. Lastly, groins are sometimes viewed as degrading the aesthetic quality of the beach, which is a consideration for a tourist destination such as Dauphin Island.

6.5.2 Terminal Groin

A terminal groin would function in a similar manner as groins. It would impede the longshore transport of sediment, thus helping to contain sand within the project footprint. Although longshore transport is not the dominant process in the island’s erosion, by retaining sand and reducing transport, the shoreline to the west would be deprived of sediment causing increased erosions above the historical average. This would likely reestablish Katrina Cut isolating the far western reach of Dauphin Island.

In addition to retracting from the aesthetic quality of the region, vital habitats to the west of the project area could not be sustained. As the island to the west erodes, nesting, foraging, rookery, and marine habitats would continue to be lost. The intent of the project is not only to provide storm protection to existing homes and infrastructure, but to also preserve the natural habitats that are unique to the region.

6.5.3 Breakwaters

Offshore segmented breakwaters are shore parallel structures typically composed of large rock. A typical design would be a 300-foot long breakwater with a 300-foot gap between the breakwaters, each located approximately 300 to 500 feet offshore. They would extend a few feet above mean high water.

Breakwaters slow longshore transport by limiting waves breaking against the shoreline. Breakwaters can also help to reduce overwash by causing waves to break as the waves pass over the crest of the structure, damping the wave energy. However, as the water level rises and the breakwaters become submerged during large storm events, their effectiveness is reduced.

Breakwaters are more expensive than groins because they are constructed in deeper water and are trapezoidal in shape, so the base is much wider than the crest. Each breakwater would cost approximately $800,000 to construct (excluding mobilization and demobilization) and approximately 25 breakwaters would be needed to extend the project length of the western alternatives. It is more cost effective to place additional sand than to construct breakwaters in this scenario. Therefore, it was decided to eliminate breakwaters from further consideration.

6.6 Eastern Project Area Design

The purpose of the East End fill portion is to restore the storm protection provided by a wider beach south of the large dunes fronting the Dauphin Island Audubon Bird Sanctuary, freshwater lake, and maritime forest. The design of this project was partially based on the findings from the Dauphin Island East Beach Nourishment, Conceptual Design Report (CPE, 2010). Four alternatives were developed in the CPE 2010 report with volumes varying from 468,900 cubic yards to 1,423,900 cubic yards. The projects described in the previous report extended from the western end of Fort Gaines to DI-19, a distance of 2.9 miles.

Given the cost considerations and limitations by potential funding sources, it was decided to scale the project back in both length and volume. The eastern alternative therefore extends 0.92 miles west from Fort Gaines to 145 feet west of DI-28. The area previously included within the project limits will still benefit due to diffusion and longshore transport, which will transport sediment to the west.

CPE (2010) estimated that average annual losses from the project area due to longshore transport are 49,100 cubic yards/year, based on average annual shoreline changes between 1981 and January 2010.

Losses due to relative sea level rise were approximated at 8,600 cubic yards/year, though CPE (2010) stated that the flat offshore slope could exaggerate the results given that Bruun's rule is very sensitive to offshore slopes. The flat offshore slopes at the eastern end are a function of the sheltering by Pelican Island and thus Bruun's Rule may not be the best method to estimate the effects of relative sea level rise.

Overwash was considered to be minimal because waves will break crossing Pelican Island before impacting the project area. Unlike the west end, the exact location of the shoreline is not critical because the project does not have an infrastructure protection component.

Diffusion losses were ignored in the volumetric design due to the adjacent conditions. The east end of the project is stabilized by structures, and the west end of the fill tapers into a shoreline protrusion formed due to historic sediment transport and geographic conditions of Pelican Island, therefore diffusion losses will be minimal.

Budget constraints limited the renourishment interval to 5 years with the design section being considered the volume required to reform a +5.5 feet, NAVD berm. The design section contains negligible volume. Given that the annual losses (advanced fill) is approximately 46,700 cubic yards/year, the volume placed on the east end is 233,500 cubic yards. This volume was increased by approximately 6,500 cubic yards to provide a wider public beach at the Fort Gaines parking area. Thus, the total fill volume is 240,000 cubic yards. Table 15 summarizes the fill components that comprise the construction volume.

Table 15. Fill Volume Summary for the East End Alternative

Fill Type	Fill Volume (cy)
Design Fill	6,500
Advanced Fill	
Longshore Loss	199,500
Overwash loss	0
Diffusion Loss	0
RSLR Loss	34,000
Total	240,000

6.6.1 Construction Template

The construction template includes a transitional dune and beach, and advanced fill. The following design details were incorporated:

1. Landward Dune Slope: No landward dune slope – ties into existing grade
2. Seaward Dune Slope: Hummocky dune – no stated slope
3. Dune Elevation: Varies up to +8 feet, NAVD
4. Dune Crest Width: Not applicable
5. Offshore slope: 1H:12V below berm elevation
6. Lower Berm Elevation: +5.5 ft, NAVD

The constructed beach berm width is approximately 136 feet wide on average with an elevation of +5.5 feet, NAVD. The beach slopes down on a constructed slope of 1V:12H until it intercepts exiting grade. Given that this project is being constructed primarily for environmental purposes, it is proposed to construct a hummocky dune feature on the landward side of the berm crest. While this will not have set dimensions, it will be constructed to resemble the surrounding dune features and be irregular in nature. Plan views and cross sections of East End Alternative are shown in Appendix A.

6.6.2 Breakwater Construction

A second alteration to the previous east end report is that three offshore segmented breakwaters will be constructed in the vicinity of the Fort Gaines public beach. These breakwaters will act to retain the sand in the vicinity of the pubic beach. It is proposed to deconstruct the existing groins and reuse the stone to construct the breakwaters. The two easternmost breakwaters will have an elevation of approximately +4 feet, NAVD and be approximately 250 feet long. The westernmost breakwater will have a crest elevation of +3 feet, NAVD and be approximately 140 feet long.

The easternmost breakwater will tie into the existing groin that is attached to the shoreline. It will extend 250 feet east-southeast, as shown in Figure A1-2. There will be a 210-foot gap between the first and second breakwater and a 125-foot gap between the second and third breakwaters. It is expected that a tombolo will form behind the first breakwater given its proximity to shore. While the beach will be constructed so that the fill extends out to the breakwaters, it is expected that a salient will eventually develop in the lee of the third breakwater and provide a quiescent area for swimming.

Note that the longshore loss estimate was not revised due to the proposed construction of the breakwaters. It was assumed that the existing groins have some effect in reducing the longshore transport. Rather than trying to quantify the effect of the stranded groin field, it was decided to use the historic longshore transport rate developed in the previous east end design report (CPE, 2010). Since the breakwaters should be more effective at lowering sediment transport than the stranded groin field, the estimated longshore losses should be higher than will occur and thus provides a conservative design.

6.7 Seawall Design

An alternative to beach nourishment is to construct a seawall to prevent undermining of houses and destruction of infrastructure. The seawall was designed based on standard practices as outlined by Braja Das's "Principle of Foundation Engineering" (Das, 1984). It was assumed that the soil has a unit weight of 100 pcf, a saturated unit weight of 110 pcf. An angle internal of friction of 25 degrees was used based on prior experience and to be conservative as the material was assumed to be dense silt or silty sands which range from 25 to 30 degrees (Bowles, 1996). The grade elevation of the profile landward of the structure is +7.0 feet, NAVD and seaward is -2.0 feet, NAVD with a water elevation equal to MWH (0.95 feet, NAVD). To provide a conservative design, the grade elevation seaward of the structure was assumed to be lower than that which currently exists (but could be experienced during the life of the structure) coupled with the water level at the upper end of the tidal range.

The seawall design includes interlocking steel sheet piles with a reinforced concrete cap. The crest of the structure is at +7.0 feet, NAVD and backfilled with beach compatible material from upland sources to be at a similar elevation as the existing beach and dune system. To support the load of the retained material and seawall, sheet piles 35 feet in length are driven to approximately -29.0 feet, NAVD and tied back with anchor plates. The sheet piles are driven below the depth of closure (-18.0 feet, NAVD), which assumes that the seawall will become exposed and profile deepening will occur.

The seawall cap extends from the top of the sheet piles to -2.0 feet, NAVD which is below the existing grade elevation. It is constructed of concrete 1.0 feet thick reinforced with steel reinforcing bars to encase the top portion of the sheet pile.

The anchor plates are positioned at +4.0 feet, NAVD and spaced 12 feet on center. The anchor rods securing the plates to the wall are 0.75 feet nominal diameter and extend approximately 30 feet landward from the structure.

An extensive permitting effort is expected if the seawall solution is chosen. Permitting agencies have indicated during project meetings that a seawall option would not be viewed favorably due to environmental concerns, specifically impacts to nesting sea turtles and shore birds.

The Town must also consider the impact of a seawall on island tourism. An armored shoreline tends to have a greater "seasonal variability of sand volume" as compared to an unarmored shoreline (USACE, 2006a). It is expected that once the seawall is exposed to waves on a semi-regular basis, the beach in front of it will rapidly start to disappear due to scour. Scour is mostly due to local sediment transport gradients that develop and return flows of water through the structure or, in this case, beneath the seawall during overtopping events (USACE, 2006a). In addition, the return flows and elevated water elevations during storm events can cause rip current to develop at the ends of the structure. The rip currents are a hazard to the public and can lead to flanking of the structure. Once the material behind the structure is eroded, the structural stability of the seawall is compromised.

7 BORROW AREAS

This section discusses potential sand sources and the development of final borrow areas for the project. Six potential sand source areas were considered in the development of the borrow areas. A summary of these is provided below in addition to an analysis of the sand along the existing beach.

7.1 Existing Beach Conditions

Project performance is reliant on the quality of the fill source used to construct the project. In turn, the suitability of a sand source for beach nourishment is dependent upon the characteristics of the recipient beach. State and federal regulatory agencies require that sand resources for nourishment be "beach compatible", that is, "similar" to sand existing in the project area. Qualities such as grain size, silt content, color, and mineralogical content are considered in this comparison. It is, therefore, important to accurately characterize existing beach sediments during a sand search investigation. This allows targeting of potential sand resources that are most similar to the recipient beach. In addition to meeting the state and federal regulatory agency standards described above, the Town may have preferences about the quality of sand being placed on their beach (i.e. color, shell content).

On February 1, 2010, CPE collected samples on the east side of Dauphin Island at monuments DI-10, DI-21, DI-27 and DI-32. On October 20 and 21, 2010, CPE collected beach samples and nearshore sediment samples from four additional transects on the west side of Dauphin Island, at monuments DI-2, DI-8, DI-10 and DI-14. Samples were collected across the profile extending from the dune out to the depth of closure. Appendix D contains the locations and elevations of these samples. Results were composited by transect as well as by elevation. These composites were used to characterize the existing beach.

It was important to collect samples across the entire profile because finer grained sands tend to be moved offshore while coarser sands concentrate within the surf zone. However, the borrow material should provide the range of grain sizes observed, not just an average.

Summary composites indicate that the sediment on the west end of Dauphin Island has a mean grain size range of 0.27 mm and an average dry Munsell color value of 7. Average silt content is 1.6%.

7.2 Borrow Area 1 (South Southwest of Sand Island Lighthouse)

Borrow area 1 is located about a mile south southwest of the Sand Island Lighthouse on the western lobe of the ebb-tidal delta of Mobile Pass (Figure 21). This is one of the two borrow areas recommended for use in this project. Borrow area 1 is located in water depths greater than 16 feet. Figure 22 provides greater detail of the proposed borrow areas.

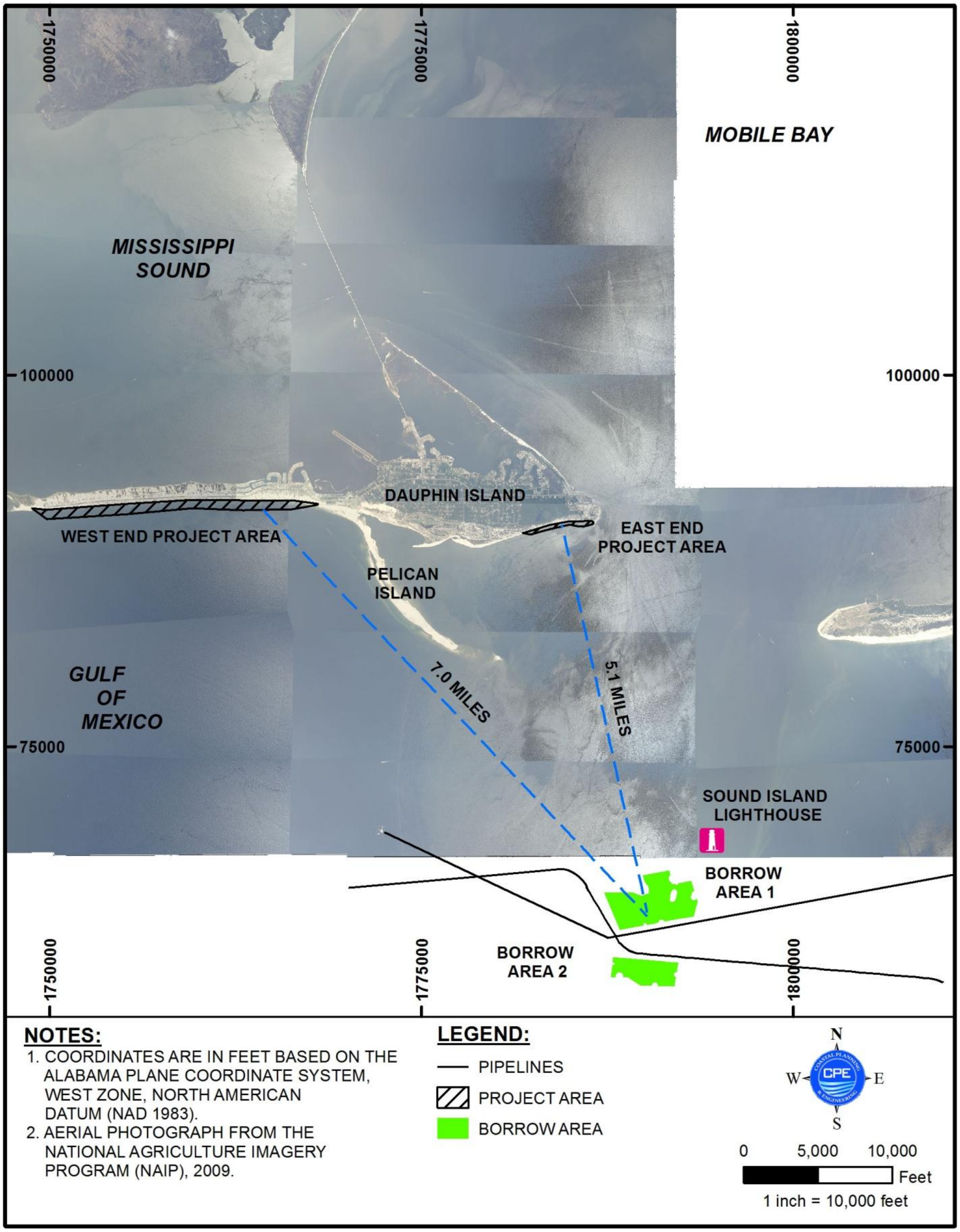

Figure 21. Location of Proposed Borrow Areas

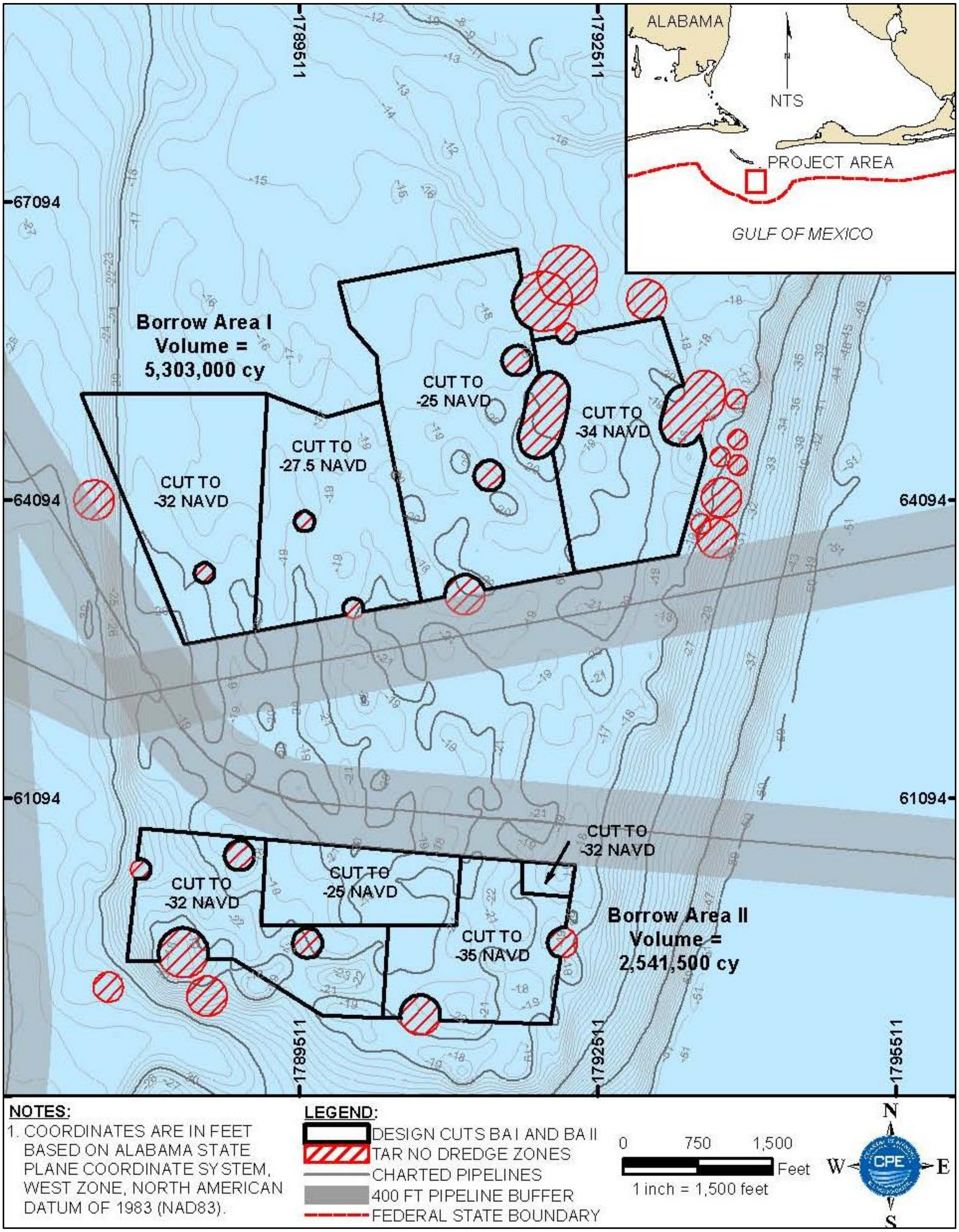

Figure 22. Borrow Area 1 and Borrow Area 2 Detailed Map.

The borrow area contains surficial sands that can be easily mined for beach construction. Geotechnical investigations revealed that the borrow area contains a mean composite grain size of 0.26 mm and a silt content of 1.3%, which was deemed to be compatible with the existing beach characteristics. Four cut depth elevations have been specified that range from -25.0 feet to -34 feet, NAVD. Beach fill material contained in this lens is approximately 5 to 14 feet thick with the thinnest portion of the lens located near the center of the borrow area limits within the -25.0 feet, NAVD cut depth boundary. Borrow area 1 contains a total of approximately 5,303,000 cubic yards of beach compatible material.

7.3 Borrow Area 2 (South of Borrow Area 1)

Borrow Area 2 is located on the same geomorphic feature (western ebb shoal of Mobile Pass) as Borrow Area 1 (Figure 21). A pipeline separates the two borrow areas and since borrow area 2 is further south it is located in deeper water depths (greater than 18 feet).

The borrow area characteristics are similar to those identified in Borrow Area 1 with surficial sands. Investigations revealed a mean composite grain size of 0.23 mm and a silt content of 1.4%. Excavation within the borrow area has been confined by three cut depth elevations ranging from -25 feet to -35 feet, NAVD. The thickness of beach compatible material is approximately 4 to 13 feet thick with the thinnest portion of the lens located near the center of the borrow area within the -25.0 feet, NAVD cut depth boundary. Borrow area 2 contains a total of approximately 2,541,500 cubic yards of beach compatible material.

7.4 Offshore Investigation Area (Southwest of Western Project Area)

CPE investigated state waters south and west of Dauphin Island including the western lobe of the ebb-tidal shoal for Mobile Pass; south of the historic locations of Sand/Pelican Island (the southwest flank of the ebb-tidal delta); south of the western project area; and southwest of the western project area to the vicinity of the eastern shoals at Petit Bois Pass (Figure 23). These searches did not include the federal waters south of the federal/state boundary or the shallows of Pelican Bay between the east end of Dauphin Island and the Sand/Pelican Island shoal complex location.

Geophysical surveys conducted in this area included concurrent magnetometer, seismic reflection profiling, and bathymetric survey totaling approximately 62 statue line miles. In addition, 12 reconnaissance level vibracores were collected to characterize the in situ material. These investigations revealed that the sediments were not compatible for beach construction and the area was abandoned as a potential borrow source.

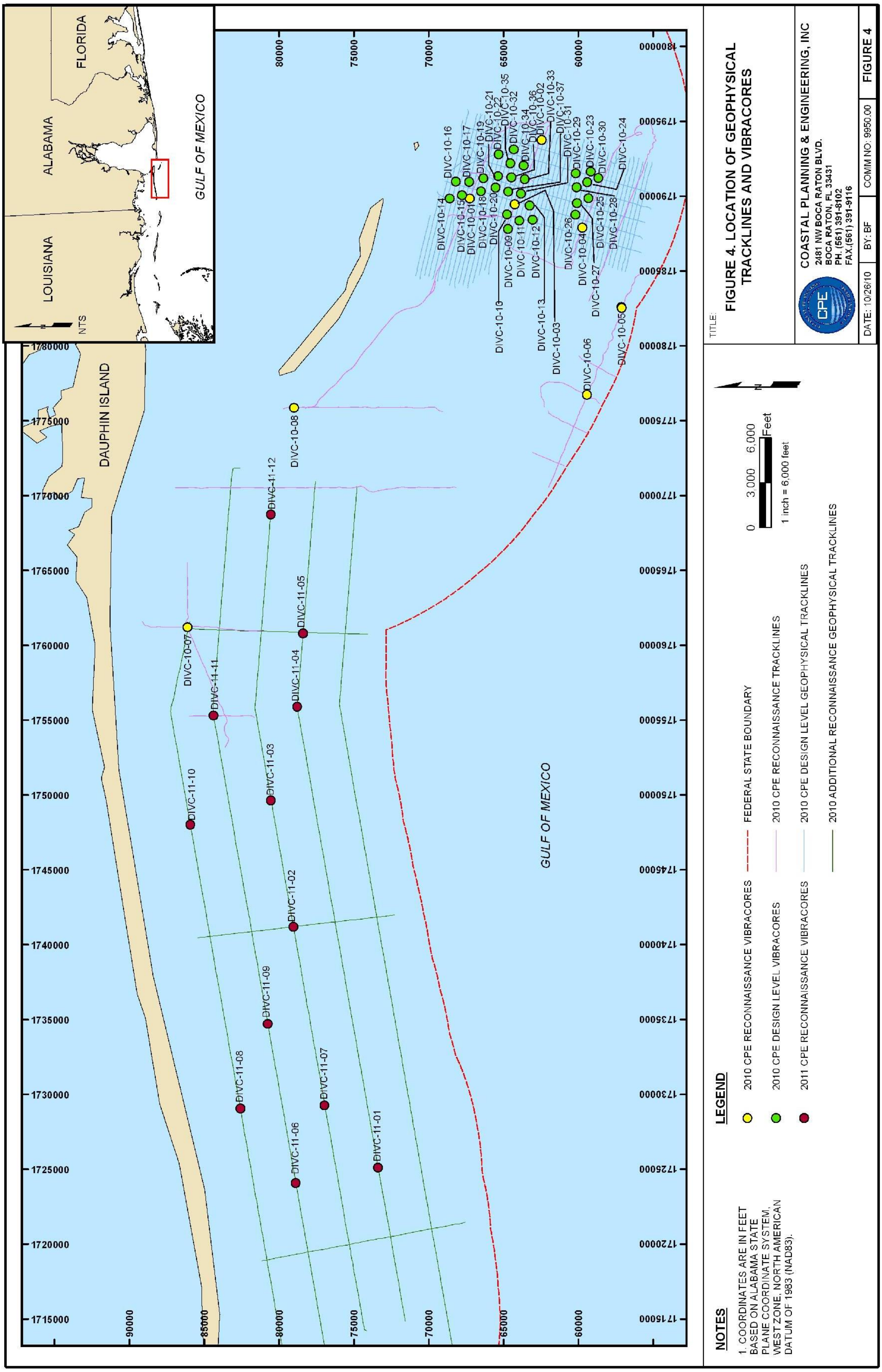

Figure 23. Geotechnical Investigation Area

7.5 Petit Bois Shoal

CPE investigated the Petit Bois Shoal area, located approximately 8 miles west of the western project area, as part of the sand resource investigation. There were some promising sand deposits in this area. However, given the distance to the Eastern Alternative (more than 15 miles), and the known quantity and quality of sand contained in borrow areas 1 and 2, it was decided not to expand investigations in the Petit Bois Shoal area. Details of this investigation are included in Appendix D.

7.6 Upland Borrow Sources

The Alabama State Port Authority has a stockpile of sand dredged from some recent expansions in the Port of Mobile that it has indicated could be available for the nourishment project if the Town pays to transport the sand to the island. The quantity of sand has been roughly estimated as several hundred thousand cubic yards. While this sand was not tested as part of this study, preliminary indications are that it is clean sand. Given the quantity is too small for this project, it is recommended that Town consider this as a potential post-storm source of sand for future emergency work.

7.6.1 Mississippi Sound

The so-called "FEMA berms" constructed in 2000 and 2007 used sand mined from the waters of Mississippi Sound north of the west end of Dauphin Island. The cost of this sand was estimated at $17/cy. Given that Dauphin Island has a history of northward island migration due to rollover it is expected that the material on the north side of the island is similar to the native beach. However, dredging this sediment does not reintroduce new sediment into the coastal system, but instead creates a sediment sink for any future overwash. From an environmental and geomorphic perspective this is not a preferable sediment source. The volume of sand in this area is limited in quantity.

7.6.2 The Former Pelican Passage Area (Fishing Pier)

The area around the main fishing pier on Dauphin Island, operated by the Dauphin Island Park & Beach Board, has been suggested as a potential borrow area by others. This area is now uplands due to the migration of Pelican Island onto Dauphin Island. It could be mined with upland equipment (draglines, cranes, trucks, etc.) and moved to either project area. This would re-establish Pelican Passage, the flow of water between Dauphin Island and Pelican Island. This passage has been here consistently since 1900 but shoaled in the 2005-2010 time frame. From an environmental and geomorphologic perspective, this is not a preferable sediment source. Environmentally, upland sandy flats, intertidal pools, and small dunes would be destroyed to establish the constructed beach and dune system. Geologically, re-establishing Pelican Pass would alter the movement of sand onto Dauphin Island that occurs due to wave driven longshore sand transport along the west side of the former Pelican Island. As noted for the Mississippi Sound borrow source, this would not introduce new sediment into the littoral system, but rather redistribute existing sediments. Thus, it would not provide the long term storm protection and environmental benefits that would otherwise be realized by introducing sediment from an offshore borrow source.

7.7 Borrow Area Dredging Impact Analysis

Dredging offshore material can alter the wave conditions behind the borrow area due to the change in water depth. Since water depth can affect wave refraction, damping and shoaling, a borrow area impact analysis was performed for Borrow Area 1 and Borrow Area 2 to quantify the effects on waves and sediment transport. This analysis determined that complete dredging of borrow areas 1 and 2 would have no impact on Dauphin Island or Pelican Island. Minor impacts to the wave climate at Sand Island (if it were to be rebuilt by the USACE could occur but typically the difference in wave height was less than 0.1 feet. A complete discussion of the modeling effort can be found in Appendix C.

7.7.1 Additional Borrow Area Considerations

The vibracores collected in Borrow Areas 1 and 2 were collected prior to the Deepwater Horizon Oil Spill. Prior to commencement of bidding, it is recommended that the offshore borrow areas be tested for the presence of hydrocarbons. It should be noted that similar tests have been conducted elsewhere in the Gulf of Mexico (and closer to the spill site). These borrow areas were found to be free of contaminants. Therefore, oil contamination is not a pressing concern but one that must be addressed.

If oil is found to be present in the surface sediments, then vibracore subsurface testing will be done to determine the vertical extent of the oil in the sediment cores. A plan will be developed to remove and treat the contaminated sediments and pump the underlying, uncontaminated sediments to the island.

Measures will also be taken to ensure that the project does not bury oil on the beach and cause long-term environmental impacts. Clearance from the local SCAT (Shoreline Cleanup Assessment Team) will be required prior to commencement of construction.

8 CONSTRUCTION

8.1 Construction Methodology

Beach nourishment projects larger than 100,000 cubic yards are typically constructed via hydraulic placement because mechanical placement of sediment is less efficient than hydraulic placement. It is proposed to construct all of the alternatives via hydraulic placement of beach fill. The previous section discussed possible sediment sources. This section discusses the transport of the material to the project site assuming Borrow Areas 1 and/or 2 are used for this project.

Construction can be divided into two components, the offshore dredge area and the disposal area. The offshore component includes the excavation and transportation of beach fill material from the offshore borrow areas to the project site. The land-based component includes the placement of the fill material to achieve the designed beach template.

8.1.1 Cutterhead Dredge

Dredging for this project could be performed using either a cutterhead dredge or a hopper dredge. A cutterhead dredge (also termed cutter suction dredge) has a cutterhead attached to the end of the suction pipe. The cutterhead spins and stirs the material into suspension, which allows the slurry (water and sand mixture) to be sucked into the intake pipe. A large pump aboard the dredge then pumps the slurry material to shore. The cutterhead dredge will move through the borrow area slowly swinging from side to side by pivoting around a spud located at the back of the dredge. Anchors are deployed on either side and in front of the dredge so that it can pull itself through the borrow area.

Cutterhead dredges are usually the most cost effective means of beach nourishment if the borrow area is within 6 to 8 miles of the disposal area because they can operate on a continuous basis with high production rates (up to 50,000 cubic yards/day with a short pipeline). As the pumping distance increases production rates fall, and a booster pump may be required in the pipeline to maintain flow through the pipe. Eventually the pumping length is too long and a hopper dredge is required. Borrow Areas 1 and 2 are located approximately 7 to 8 miles southeast of the western project area site. Given that the borrow areas are located a distance that is close to the threshold of switching from one dredge to another, both type of dredges are considered.

The use of a cutterhead dredge for the Dauphin Island project will require a maximum pipeline length of approximately 11 miles to transport material excavated from the borrow area to the western project site. This includes 0.4 miles of rubber floating pipeline extending from the dredge to the submerged line, 7.5 miles of submerged steel pipeline to the sub aerial portion of the project, and 3.2 miles of steel shore pipeline to construct the beach to its western extent. The floating and submerged pipes are delivered to the project area on pontoons in approximately 500 foot sections. Once in the vicinity of the project area, the various sections of submerged pipeline are joined together into lengths up to 2,500 feet. Once sufficient lengths of submerged pipeline are assembled (the pieces are connected by ball joints), the pipeline is floated into position, the 2,500-foot sections are connected stretching from the project site to the borrow area, and the pipeline is then allowed to sink to the bottom. The floating line is attached to the submerged line at the borrow area while steel shore pipe is added to the discharge pipe during construction as the beach fill progresses alongshore.

8.1.2 Hopper Dredge

A hopper dredge is a self propelled vessel that sails back and forth between the borrow area and the fill site. When at the borrow area, the hopper dredge lowers its dragarms to the bottom of the borrow area and sucks material from the borrow area into its hold. Once full, the hopper dredge sails to a pumpout station located as close to the fill site as possible. The material in the hold is jetted back into a slurry and pumped ashore through a submerged pipeline and onto the beach.

With a hopper dredge, cost is the only consideration with respect to the distance of the borrow area from the fill area. Production rates for a hopper dredge project are typically lower than a cutterhead dredge project due to the discontinuous nature of a hopper dredge project (periodic discharge to the beach rather than continuous discharge). A hopper dredge also has a smaller pump on board compared to a cutterhead limiting the pumping distance. Last, the borrow area is typically located further away than with a cutterhead dredge borrow area.

It is anticipated that construction at the western project area of Dauphin Island would utilize two pumpout locations. The pumpout locations would be situated approximately one mile offshore of the project site in approximately 25 feet of water to provide adequate draft for the hopper dredge. The submerged lines would come onshore approximately 5,500 feet from the extents of the beach fill. Half the beach would be constructed from one pumpout station by extending the shore pipe about 5,500 feet in either direction. Then the pumpout station and submerged line would be relocated so that the hopper dredge could construct the second half of the beach.

8.1.3 Fill Area

The construction of the beach will require the use of heavy machinery to manage the pipeline and construct temporary containment dikes. The existing infrastructure (roads and bridges) provides adequate access to the island for the mobilization of land-based equipment with the use of 18-wheel trucks. The equipment would included bulldozers to work the fill material into the designed template, steel shore pipe to extend the discharge line along shore, front loaders to transport shore pipe delivered to the project site, and other supporting equipment.

It is anticipated that 3.5 miles (approximately 18,500 feet) of shore pipe would be delivered by barge or truck. If barges were used, the contractor would need to secure a landing area at one of the marinas on the bay side of Dauphin Island where a crane could offload the shore pipe. Trucks or front loaders would then be required to transport the pipe across Bienville Blvd to the project site along the Gulf shoreline. If trucks were used, the 40-foot long sections of pipe would be delivered by 18-wheelers with approximately 6 pipes per truck load. This would equate to approximately 80 loads utilizing the roadways and infrastructure to access the project site and mobilize adequate length of pipe for construction.

The contractor will be required to construct temporary containment dikes extending in a shore parallel direction to contain the discharge of beach fill material and minimize offshore losses during construction. The sand will settle out while the water returns to the Gulf of Mexico at the end of the dikes. The dikes are construction features made of sand that has already been pumped to the beach and extend several hundred feet from the discharge location. Once the beach fill has been filled to grade, the shore pipe will be extended by adding additional pipe onto the end. The dikes will be leveled and the beach graded to the required construction slope. While the contractor has some control of the fill above the mean low water, where the bulldozers can manage the sand, the contractor has limited control of the fill below mean low water. The only method to control the beach slope below mean high water is to alter the length of the dikes.

8.2 Construction Sequence

The construction sequence will be at the discretion of the contractor. However, this section presents a construction scenario to evaluate the feasibility of the project in the western project area as construction for the eastern end project will be similar but smaller in scale.

If a cutterhead dredge is utilized, it is expected that the contractor will begin constructing the beach at the eastern extent of the western portion of the restoration. The submerged line would come onshore near the pier (DI-18) and shore pipe would be added to extend the outfall westward along shore to the western extent of the beach (DI-2). During construction, temporary containment dikes would be constructed from the placed material to control the fill. Once sufficient volume of material was placed, bulldozers would work the fill grading dikes and spreading the fill placed above the mean low water line to achieve the designed template.

If a hopper dredge was utilized, it is expected that the beach would be constructed from two pumpout locations to limit the length the discharge line. From the first pumpout station, approximately 5,500 feet west of the eastern extent of the beach fill, the eastern half of the beach would be constructed. The second half would be constructed from the second pumpout station located approximately 5,500 feet east of the western extent of the beach fill. From each pumpout station the beach would be constructed about 5,500 feet in either direction by extending the shore pipe to the east and then flipping the elbow at the submerged line to construct the beach to the west. The beach would be constructed from one pumpout location prior to repositioning to the second location.

If West End Alternatives 2 or 3 are constructed, the dune elevation would be achieved by scraping material placed between +5.0 and +7.0 feet (NAVD) up to an elevation of +12.0 feet (NAVD) using bulldozers. Due to the location of the fill area with respect to existing homes, the dune would be constructed between, landward, and seaward of homes in an attempt to create a continuous dune system. The beach would be scraped during construction as sections of the beach were completed.

During construction, pedestrian ramps and access points across the discharge pipe will be constructed. Areas of construction would be fenced off from the public to prevent pedestrians from entering areas were heavy machinery is operating.

8.3 Construction Timeline

It generally takes two to three weeks following the Notice to Proceed for the contractor to mobilize to the project site and start performing the pre-construction survey. The pre-construction survey will require approximately 18 line miles of surveys to be performed, which will require 3 weeks to complete. Therefore, construction could commence within 6 weeks (42 days) of the Notice to Proceed.

Once the surveys are complete, it is assumed that beach fill will begin immediately. Mobilization of equipment to the project area and placement of the submerged line can occur while survey is ongoing. A production rate of 18,400 cubic yards/day was assumed for a 30" cutterhead dredge. A production rate of 10,600 cubic yards/day was estimated for a single medium sized (2,000 to 2,800 cy) hopper dredge. Actual pumping rates may be different given the variety of equipment available to perform the work and unforeseeable delays due to weather and maintenance. Table 16 summarizes the number of days for the dredge to complete the work.

Table 16. Estimated Dredging Duration by Dredge Type

	Dredge Duration (days)	
	Cutterhead	Hopper
West End Alternative 1	195	339
West End Alternative 2	123	213
West End Alternative 3	61	106
East End Alternative	14	23

After completion of dredging activities for beach construction, it was estimated that demobilization would require an additional 40 days. During this time, the contractor would demobilize construction equipment and address any deficiencies.

Finally, an additional 60 days of contract time should be included in the contract time to allow some flexibility in starting time for the contractor. This additional contract time will potentially reduce the bid costs because the contractor has less risk of encountering liquidated damages and can better stage his work between various projects. Delays due to significant weather events will be addressed in the specifications to allow an extension in contract time and is not considered as part of the contract time discussed in this paragraph.

9 CONSTRUCTION COST ESTIMATE

This section discusses the development of a construction cost estimate for the various alternatives. The construction cost estimates are based on costs for similar barrier island projects.

9.1 Mobilization Cost

Mobilization and demobilization expenses include the cost to prepare and transport all equipment to and from the project site. Assuming a cutterhead dredge was utilized, this would include towing the dredge and transporting other supporting vessels, transporting and installing several miles of pipeline, and bringing personnel and land-based equipment to the project site.

Given the size of the various alternatives, a 30” cutterhead dredge would be used to construct the project. The long pump distance will also likely require a booster be installed in the pipeline. The contractor would have to bring approximately 11 miles of pipeline (shore pipe and submerged pipeline). The dredge will also be shut down while the equipment, shore pipe and submerged line are moved from the east end to the west end of the project (or vice versa). Table 17 shows the basis for the mobilization cost estimate. The unit costs are based on estimates from other similar projects.

Table 17. Estimate of Cutterhead Dredge Mobilization Costs

	Unit	Unit Price	Quantity	Total Price
Dredge	L.S.	$750,000	1	$750,000
Booster	L.S.	$275,000	1	$275,000
Pipeline	Mile	$200,000	11	$2,200,000
Relocate to East End	L.S.	$200,000	1	$200,000
			Subtotal:	$3,425,000

The water depths within the borrow areas are less than 30 feet. This restricts the project to using small or medium sized hopper dredges. The large project volumes and timeline concerns will likely require that medium sized hopper dredges be used on this project. While it may be possible to employ two hopper dredges and only one pumpout station to increase production rates, the mobilization cost assumes only one hopper dredge is brought to the site. One booster pump would likely be required, assuming that a medium sized dredge was used for construction. Given the limited pipeline length that a hopper is capable of pumping through, it is anticipated that the pumpout station will be moved once during the construction of a western project area alternative. The mobilization cost also includes a cost to relocate from the eastern project area to the western project area. Table 18 shows the basis for the mobilization cost estimate.

Table 18. Estimate of Hopper Dredge Mobilization Costs

	Unit	Unit Price	Quantity	Total Price
Dredge	L.S.	$500,000	1	$500,000
Pumpout Station	L.S.	$150,000	1	$150,000
Booster	L.S.	$275,000	1	$275,000
Pipeline	Mile	$200,000	4	$800,000
Relocate Pumpout	L.S.	$100,000	1	$100,000
Relocate to East End	L.S.	$200,000	1	$200,000
			Subtotal:	$2,025,000

Mobilization costs are difficult to predict because there are several variables involved. The biggest cost is the transport of pipeline to the project site. This is dependent upon where the contractor has their pipe at the time the project is due to be constructed. Obviously, the more scattered and further away the pipe, the higher the mobilization cost. It is recommended that the mobilization cost be reviewed prior to final bidding.

9.2 Beach Fill Dredging Unit Costs

Unit costs for dredging sand with a cutterhead dredge from the borrow areas approximately 7.5 miles southeast of the project site were developed using the USACE CEDEP cost estimating spreadsheets, which were calibrated with other projects that have been constructed on the Gulf coast of Florida. The unit cost for dredging Borrow Areas 1 or 2 with a cutterhead dredge was estimated at $15.91 per cubic yard for each western alternative. Calibrating the CEDEP output provided a unit cost of $14.75/cubic yard for a cutterhead pumping to the western project area. The unit cost for a cutterhead to construct the eastern project was $8.50/cubic yard.

Unit costs for dredging sand with a hopper dredge from the borrow areas were also developed using the USACE CEDEP cost estimating spreadsheets. The costs were calibrated with a recent hopper dredge project in Longboat Key, FL. The unit cost for dredging Borrow Areas 1 or 2 with a hopper dredge was estimated at $12.96 per cubic yard for the western alternatives. After calibrating the CEDEP spreadsheets to the Longboat Key project, a unit cost of $13.00/ cubic yard was applied to the western end alternatives. The beach fill unit cost for the eastern project was estimated at $11.00/cubic yard.

Non-pay losses were assumed to be 10% based on the measured cut-to-fill ratios documented at similar projects in Florida. The cost of marine fuel was estimated at $3.49/gallon within the USACE spreadsheets, based on guidance EP 1110-1-8 Vol.3 published November 2009.

The estimated unit cost shown here represents an opinion and is subject to market forces, such as the availability of equipment, backlog of work, permitting restrictions, time of year restrictions, cost of fuel, cost of steel, etc.

9.3 Other Costs

Costs for pre- and post-construction surveys were based on costs for similar projects that have been bid recently.

Hopper dredging activities for this project will have to follow regulations contained within the Gulf of Mexico Regional Biological Opinion. This requires a turtle exclusion device be attached to the hopper dredge drag arms, that the borrow area be trawled to relocate any turtles prior to the start of hopper dredging (this doesn't apply to a cutterhead dredge) and protected species observers check every hopper load. A cost for this was included and is partially dependent upon the duration of dredge operations. Other fixed environmental monitoring costs were included for the cutterhead dredge operations.

To qualify for FEMA funding, beach access must be provided for the general public. A dune over walk consisting of a pile supported staircase and walkway was estimated to cost $35,000 each. To be eligible for funding, there must be ADA (Americans with Disabilities Act) compliant beach access points. An ADA compliant access must have a ramp for wheelchair access. Based on a square footage of 2,000 s.f. and cost per square foot of $75, the cost for an ADA compliant ramp was $150,000. The ramps must also have a staircase so the total cost for an ADA complaint beach access was estimated at $185,000. Dune overwalks are only proposed for the western alternatives because the beach on the eastern project has only one public access, which will be level with the beach.

Beach fill material placed during construction is particularly susceptible to aeolian (wind) transport. To stabilize the constructed dune, vegetative planting was included in the cost estimates as a lump sum. Given the square footage of the dune and the density of the plantings (0.44 plants per square foot), a unit cost of $0.40 per plant was applied.

Administrative costs associated with engineering and design (E&D) and operation and maintenance (O&M) was estimated as a lump sum based on the construction duration. A rate of $2030/day was assumed based on prior projects.

9.4 Cost Estimates

Construction cost estimates for the three alternatives are shown in Table 19 through Table 24. The east end alternative could be constructed as a stand alone project, but the west end will only be constructed if the east end is also constructed. Therefore, the west end alternatives all include the cost of constructing the east end project. The construction cost estimates for the East end only project are shown in
Table 25 and Table 26. A contingency of 15% has been included in the estimates to account for variability of market forces.

Table 19. Cutterhead Dredge Cost Estimate for West End Alternative 1

	Unit	Unit Price	Quantity	Total Price
Mob/Demobilization	L.S.	$3,425,000	1	$3,425,000
Beach Fill (West End)	C.Y.	$14.75	3,589,000	$52,938,000
Beach Fill (East End)	C.Y.	$8.50	240,000	$2,040,000
Environmental Monitoring	L.S.	$15,000	1	$15,000
Pre-Construction Survey	L.S.	$120,000	1	$120,000
Post-Construction Survey	L.S.	$120,000	1	$120,000
ADA Dune Over walks	Each	$185,000	2	$370,000
Dune Over walks	Each	$35,000	4	$140,000
Breakwater Reconstruction	L.S.	$1,250,000	1	$1,250,000
Dune Vegetation	L.S.	$453,000	1	$453,000
E&D and O&M	L.S.	$686,000	1	$686,000
Subtotal (rounded)				$61,557,000
15% Contingency (rounded)				$9,234,000
Total Project Cost (rounded)				$70,791,000

Table 20. Hopper Dredge Cost Estimate for West End Alternative 1

	Unit	Unit Price	Quantity	Total Price
Mob/Demobilization	L.S.	$2,025,000	1	$2,025,000
Beach Fill (West End)	C.Y.	$13.00	3,589,000	$46,657,000
Beach Fill (East End)	C.Y.	$11.00	240,000	$2,640,000
Environmental Monitoring	L.S.	$75,000	1	$75,000
Pre-Construction Survey	L.S.	$120,000	1	$120,000
Post-Construction Survey	L.S.	$120,000	1	$120,000
ADA Dune Over walks	Each	$185,000	2	$370,000
Dune Over walks	Each	$35,000	4	$140,000
Breakwater Reconstruction	L.S.	$1,250,000	1	$1,250,000
Dune Vegetation	L.S.	$453,000	1	$453,000
E&D and O&M	L.S.	$997,000	1	$997,000
Subtotal (rounded)				$54,847,000
15% Contingency (rounded)				$8,228,000
Total Project Cost (rounded)				$63,075,000

Table 21. Cutterhead Dredge Cost Estimate for West End Alternative 2

	Unit	Unit Price	Quantity	Total Price
Mob/Demobilization	L.S.	$3,425,000	1	$3,425,000
Beach Fill (West End)	C.Y.	$14.75	2,251,000	$33,203,000
Beach Fill (East End)	C.Y.	$8.50	240,000	$2,040,000
Environmental Monitoring	L.S.	$15,000	1	$15,000
Pre-Construction Survey	L.S.	$120,000	1	$120,000
Post-Construction Survey	L.S.	$120,000	1	$120,000
ADA Dune Overwalks	Each	$185,000	2	$370,000
Dune Overwalks	Each	$35,000	4	$140,000
Breakwater Reconstruction	L.S.	$1,250,000	1	$1,250,000
Dune Vegetation	L.S.	$373,000	1	$373,000
E&D and O&M	L.S.	$540,000	1	$540,000
Subtotal (rounded)				$41,596,000
15% Contingency (rounded)				$6,239,400
Total Project Cost (rounded)				$47,835,400

Table 22. Hopper Dredge Cost Estimate for West End Alternative 2

	Unit	Unit Price	Quantity	Total Price
Mob/Demobilization	L.S.	$2,025,000	1	$2,025,000
Beach Fill (West End)	C.Y.	$13.00	2,251,000	$29,263,000
Beach Fill (East End)	C.Y.	$11.00	240,000	$2,640,000
Environmental Monitoring	L.S.	$75,000	1	$75,000
Pre-Construction Survey	L.S.	$120,000	1	$120,000
Post-Construction Survey	L.S.	$120,000	1	$120,000
ADA Dune Overwalks	Each	$185,000	2	$370,000
Dune Overwalks	Each	$35,000	4	$140,000
Breakwater Reconstruction	L.S.	$1,250,000	1	$1,250,000
Dune Vegetation	L.S.	$373,000	1	$373,000
E&D and O&M	L.S.	$741,000	1	$741,000
Subtotal (rounded)				$35,092,000
15% Contingency (rounded)				$5,264,000
Total Project Cost (rounded)				$40,356,000

Table 23. Cutterhead Dredge Cost Estimate for West End Alternative 3

	Unit	Unit Price	Quantity	Total Price
Mob/Demobilization	L.S.	$3,425,000	1	$3,425,000
Beach Fill (West End)	C.Y.	$14.75	1,120,000	$16,520,000
Beach Fill (East End)	C.Y.	$8.50	240,000	$2,040,000
Environmental Monitoring	L.S.	$15,000	1	$15,000
Pre-Construction Survey	L.S.	$120,000	1	$120,000
Post-Construction Survey	L.S.	$120,000	1	$120,000
ADA Dune Overwalks	Each	$185,000	2	$370,000
Dune Overwalks	Each	$35,000	4	$140,000
Breakwater Reconstruction	L.S.	$1,250,000	1	$1,250,000
Dune Vegetation	L.S.	$373,000	1	$373,000
E&D and O&M	L.S.	$414,000	1	$414,000
Subtotal (rounded)				$24,787,000
15% Contingency (rounded)				$3,719,000
Total Project Cost (rounded)				$28,506,000

Table 24. Hopper Dredge Cost Estimate for West End Alternative 3

	Unit	Unit Price	Quantity	Total Price
Mob/Demobilization	L.S.	$2,025,000	1	$2,025,000
Beach Fill (West End)	C.Y.	$13.00	1,120,000	$14,560,000
Beach Fill (East End)	C.Y.	$11.00	240,000	$2,640,000
Environmental Monitoring	L.S.	$50,000	1	$50,000
Pre-Construction Survey	L.S.	$120,000	1	$120,000
Post-Construction Survey	L.S.	$120,000	1	$120,000
ADA Dune Overwalks	Each	$185,000	2	$370,000
Dune Overwalks	Each	$35,000	4	$140,000
Breakwater Reconstruction	L.S.	$1,250,000	1	$1,250,000
Dune Vegetation	L.S.	$373,000	1	$373,000
E&D and O&M	L.S.	$524,000	1	$524,000
Subtotal (rounded)				$22,172,000
15% Contingency (rounded)				$3,326,000
Total Project Cost (rounded)				$25,498,000

Table 25. Cutterhead Dredge Cost Estimate for East End Alternative Only

	Unit	Unit Price	Quantity	Total Price
Mob/Demobilization	L.S.	$2,425,000	1	$2,425,000
Beach Fill	C.Y.	$8.50	240,000	$2,040,000
Environmental Monitoring	L.S.	$5,000	1	$5,000
Pre-Construction Survey	L.S.	$25,000	1	$25,000
Post-Construction Survey	L.S.	$25,000	1	$25,000
Dune Vegetation	L.S.	$90,000	1	$90,000
E&D and O&M	L.S.	$247,000	1	$247,000
Subtotal (rounded)				$4,857,000
15% Contingency (rounded)				$728,600
Total Project Cost (rounded)				$5,585,600

Table 26. Hopper Dredge Cost Estimate for East End Alternative Only

	Unit	Unit Price	Quantity	Total Price
Mob/Demobilization	L.S.	$1,250,000	1	$1,250,000
Beach Fill	C.Y.	$11.00	240,000	$2,640,000
Environmental Monitoring	L.S.	$50,000	1	$50,000
Pre-Construction Survey	L.S.	$25,000	1	$25,000
Post-Construction Survey	L.S.	$25,000	1	$25,000
Dune Vegetation	L.S.	$90,000	1	$90,000
E&D and O&M	L.S.	$266,000	1	$266,000
Subtotal (rounded)				$4,346,000
15% Contingency (rounded)				$652,000
Total Project Cost (rounded)				$4,998,000

For completeness and comparison purposes, a cost estimate was developed to construct a seawall the length of the western project area (Table 27). The shore parallel length of the wall was assumed to be the same as that of the west end beach fill alternatives.

Table 27. Floodwall Cost Estimate for West End Only

	Unit	Unit Price	Quantity	Total Price
Mob/Demobilization	L.S.	$150,000	2	$300,000
Surveys	L.S.	$30,000	1	$30,000
Trucked Back Fill	CY	$15	28,000	$420,000
Sheet Pile w/ Tie Backs, Cap	LF	$2,500	22,350	$55,875,000
E&D and O&M	L.S.	$2,831,000	1	$2,831,000
Subtotal (rounded)				$59,456,000
15% Contingency (rounded)				$8,918,400
Total Project Cost (rounded)				$68,374,400

9.5 Cost Minimization Options

Mobilization cost can be minimized by bidding in advance of when the work is to be completed, and being flexible with the contractor as to when they must begin the work. A two month window has been included in the proposed contract time to allow the contractor some additional time to schedule work.

Specifications that minimize risk to the contractor will result in lower bids, all other items being equal. Some concepts that minimize their risks are:

1. Allow a change in the constructed offshore slope. If the contractor has trouble meeting the offshore slope and knows that they can request a variation, they may reduce the expected loss built into the bid saving cost.

2. Allow compensating slope payment. This allows fill placed above or below the template to be offset by fill placed elsewhere on the profile. This is typically limited to below the mean high water line where the contractor has limited control over the fill.

3. Allow at least a 0.5-foot tolerance on the beach fill template.

4. Relax the tolerance for the dune portion of the template above +5.5 feet, NAVD and base payment on the volume of fill placed. This will reduce the working of the fill that is required.

5. Allow the contractor to demobilize the dredge from the project site to perform other work. This allows the contractor greater flexibility. However, this alternative is not recommended as it exposes an unfinished project to weather events and slows project momentum.

Lower unit bid costs for the beach fill could be obtained by paying for the project based on the volume of material removed from the borrow area rather than paying for the volume placed within the template. Contractors have indicated a preference to this method. However, it shifts the risks from the contractor to the government and removes incentive for the contractor to limit losses during construction. Beach nourishment projects are typically paid for based on the volume placed rather than the cut volume and it is recommended that this project follow typical payment method for beach nourishment. This alternative is not recommended.

10 ENVIRONMENTAL CONCERNS

10.1 Threatened and Endangered Species

Table 28 lists all federally listed threatened and endangered species that have the potential to occur within the project area based on each species' distribution and habitat preference, as determined by U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). Any designated critical habitat in the vicinity of the project area is also noted. In order to satisfy Section 7 Consultation requirements in compliance with the Endangered Species Act, A Biological Assessment (BA) is being prepared in order to provide federal agencies with the information they need to consult on potential project impacts to listed species. If USFWS and/or NMFS determine that the proposed project is likely to adversely affect listed species or designated critical habitat, they will issue a Biological Opinion (BO). The BA will be submitted to the U.S. Army Corps of Engineers (USACE) who will provide the BA to USFWS and NMFS along with the permit application submittal.

Table 28. Federally endangered and threatened species and critical habitat which may occur in the vicinity of the Dauphin Island Project Area

Common Name	Scientific Name	Status
SEA TURTLES		
Loggerhead	*Caretta caretta*	T
Kemp's ridley	*Lepidochelys kempii*	E
Green	*Chelonia mydas*	T[1]
Leatherback	*Dermochelys coriacea*	E
Hawksbill	*Eretmochelys imbricata*	E
FISH		
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	T
MAMMALS		
West Indian manatee	*Trichechus manatus*	E
BIRDS		
Piping plover	*Charadrius melodus*	T/CH
Least tern	*Sterna antillarum*	E[2]

E=Endangered; T=Threatened, CH=Critical Habitat Present

[1]Green turtles are listed as threatened, except for breeding populations of green turtles in Florida and on the Pacific Coast of Mexico, which are listed as endangered.

[2]Only the least tern interior population is listed as endangered; however, occasionally individuals of the listed population may be incidental additions to the local nesting (non-listed) population for a short period of time. This is important since there is no way to differentiate transient birds from resident (nesting) birds (LeBlanc, pers. comm., 2010).

10.1.1 Sea Turtles

Five species of sea turtle are known to occur within Alabama, nesting on beaches and/or swimming in the nearshore waters of the Gulf of Mexico (Table 28). The USFWS lists two species as potential nesting species on Mobile County, Alabama beaches: the loggerhead and Kemp's Ridley. These species have been confirmed as nesting in Alabama. The green sea turtle does not nest in Alabama (Ingram, pers. comm., 2011). All five sea turtle species are listed by NMFS as potentially occurring offshore in Alabama waters. Share the Beach conducts sea turtle nesting surveys on public and private lands along the 47-mile Alabama Gulf coast, from Dauphin Island at the western boundary east to the Florida state line.

10.1.1.1 Loggerhead

The loggerhead sea turtle (*Caretta caretta)* accounts for nearly all nesting in Alabama each year (USFWS, 2008). Statewide annual sea turtle nesting for loggerheads has ranged from 37-78 nests with an average of 53 nests over a 6-year period (2005-2010). Share the Beach conducts sea turtle surveys during nesting season along 16.0 mi (25.8 km) of Dauphin Island shoreline.

Table 29 presents loggerhead sea turtle nesting data in Alabama collected between 2005 and 2010 (Share the Beach, 2010).

Table 30 provides the loggerhead nesting data on Dauphin Island between 2005 and 2010 (Share the Beach, 2010). Three nests were laid on Dauphin Island in 2010: one was laid west of Katrina Cut, one was laid east of Katrina Cut (under a house built on pilings) within the proposed west end project area, and one was laid on Pelican Island. The nest laid west of Katrina Cut was left in place, but the other two nests were relocated to an area just west of the pier, in front of the public beach, in order to avoid tidal inundation. Share the Beach commonly relocates nests farther back on the beach (north) to avoid tidal inundation due to the low elevation of Alabama beaches. However, the west end of Dauphin Island is so flat that moving the nests straight back from the shoreline does not remove the threat of inundation, so most nests laid on the island must be moved east, to higher ground near the pier (Reynolds, pers. comm., 2010).

Table 29. Loggerhead sea turtle nests in Alabama, 2005-2010 (Share the Beach, 2010)

Year	Loggerhead Nests
2005	37
2006	45
2007	54
2008	78
2009	64
2010	41

Table 30. Loggerhead sea turtle nests on Dauphin Island, AL, 2005-2010 (Share the Beach, 2010)

Year	Loggerhead Nests
2005	2[1]
2006	0
2007	0
2008	0
2009	0
2010	3[2]

[1]One nest was destroyed by Hurricane Katrina.
[2]Two nests were relocated to avoid inundation.

10.1.1.2 Kemp's Ridley

Based on stranding records, juvenile Kemp's ridleys (*Lepidochelys kempii*) are the most common sea turtles in the bays and estuaries of Alabama's inshore waters (USFWS, 2008). There are three nesting records of Kemp's ridley which were confirmed by hatchling identification in 2001 (Laguna Key), 2006 (Alabama Point, Gulf State Park), and 2007 (Bon Secour NWR). Two other records (Bon Secour NWR, 2003; Alabama Point, 2005) are suspected Kemp's ridley nests based on daytime nesting behavior and small crawl widths, however, both clutches were infertile and species identification could not be confirmed (USFWS, 2008). Table 31 presents the Kemp's ridley nesting data collected in Alabama by Share the Beach between 2005 and 2010 (Share the Beach, 2010).

Table 31. Kemp's ridley sea turtle nests in Alabama, 2005-2010 (Share the Beach, 2010)

Year	Kemp's Ridley Nests
2005	1
2006	1
2007	1
2008	1
2009	2
2010	2

10.1.1.3 Green

Total population estimates for the green turtle are unavailable, and trends based on nesting data are difficult to assess because of large annual fluctuations in numbers of nesting females. Small numbers of green turtles, most often subadults, occur in state waters, but feeding areas of submerged grass beds are limited in Alabama (ADCNR, 2010). There have been no documented green turtle nests on Dauphin Island (Share the Beach, 2010) and green sea turtles are not thought to nest in Alabama (Ingram, pers. comm., 2011).

10.1.1.4 Leatherback

In Alabama, adult leatherbacks have been documented by strandings and are regular visitors to the Alabama coast as they follow jellyfish in the Gulf of Mexico. Though no leatherback nests have been documented on Alabama beaches, the possibility of a leatherback nest in Alabama exists each season due to the proximity of a confirmed nest in nearby Gulf Islands National Seashore, Florida, in 2000 (USFWS, 2008; ADCNR, 2010).

10.1.1.5 Hawksbill

The hawksbill does not nest in Alabama, but may rarely occur off the coast; its status in this area is unclear (USFWS, 2008).

10.1.2 Gulf Sturgeon

Historically, the subspecies occurred in most major rivers from the Mississippi River to the Suwannee River and marine waters of the central and eastern Gulf of Mexico to Florida Bay (USFWS and GSMFC, 1995). The present range for Gulf sturgeon extends from Lake Pontchartrain and the Pearl River system in Louisiana and Mississippi respectively, east to the Suwannee River in Florida (NMFS and USFWS, 2009). Given the variety in methods, Gulf sturgeon population estimates are relatively imprecise. Gulf sturgeon reproduction is not known to currently occur in several basins (e.g., Mobile Basin) where it most likely occurred historically. A recent survey collected two Gulf sturgeon in Mobile Bay near Fairhope, Alabama (Mettee *et al.*, 2009) after intensive netting. Recent collection and detection records suggest Gulf sturgeon still utilize marine and freshwater habitats in southwestern Alabama. Twenty-one fish were collected or observed in nearshore areas of the Gulf of Mexico, Mobile Bay, Perdido River, and Perdido Bay from 2000 to 2008. Twenty additional individuals were detected along Gulf beaches between Mobile and Perdido Bays from 2004 to 2005 (Mettee *et al.*, 2009).

Although critical habitat Unit 8 does not include the portion of Mississippi Sound adjacent to Dauphin Island, coastal regions and nearshore areas along the northern Gulf of Mexico provide important staging and feeding grounds for Gulf sturgeon. Gulf sturgeon have been located in the Mississippi Sound, Mobile Bay near Fairhope, Alabama, and the Gulf of Mexico near Gulf Shores, Alabama, and studies have documented use of barrier-island passes in Mississippi Sound for winter feeding (USFWS and GSMFC, 1995; Mettee *et al.*, 2009; NMFS and USFWS, 2009).

No Gulf sturgeon have been documented in the project area; however, it is likely that this species utilizes the Mississippi Sound north of Dauphin Island, and possibly the nearshore Gulf waters to the south, for feeding and/or as a travel corridor.

10.1.3 West Indian Manatee

Florida manatees (*Trichechus manatus latirostris*), a subspecies of the West Indian Manatee (*Trichechus manatus*), have been observed as far north as Rhode Island on the Atlantic coast and as far west as Texas on the Gulf Coast (USFWS, 2001; 2007). The Florida manatee population appears to be divided into at least two somewhat isolated areas, one on the Atlantic coast and the other on the Gulf of Mexico coast of Florida and into two regional groups on each coast: Northwest, Southwest, Atlantic, and Upper St. Johns River (USFWS, 2001). Florida manatees from the northwest population can be observed in Alabama waters. Manatees can be observed in small numbers in the waters surrounding Dauphin Island (Ingram, pers. comm., 2010).

10.1.4 Piping Plover

Piping plovers (*Charadrius melodus*) are small, migratory shorebirds that breed in only three geographic regions of North America: on sandy beaches along the Atlantic Ocean, on sandy shorelines throughout the Great Lakes region, and on the river-bank systems and prairie wetlands of the Northern Great Plains. The number of piping plovers on the Gulf of Mexico coastal wintering grounds may be declining as indicated by Christmas Bird Count data. Independent counts of piping plovers on the Alabama coast indicated a decline in numbers between the 1950s and early 1980s (USFWS, 2009). At sites where in the past more than 200 piping plovers had been seen, the maximum number of wintering birds at any one time is now typically fewer than 40. Little Dauphin Island, Pelican Island, and parts of Dauphin Island are traditional wintering sites. Critical habitat Unit AL-2 is located on Dauphin, Little Dauphin, and Pelican Islands, with a total area of 880 ha (2,174 ac) in Mobile County. This unit includes all of Dauphin Island where primary constituent elements occur from St. Stephens Street approximately 17.6 km (10.9 mi) west to the western tip of the island to MLLW and all of Little Dauphin and Pelican Islands to MLLW. The area is mostly privately owned but also includes State and Federal lands (USFWS, 2010d). Currently, piping plovers are occasionally found feeding and loafing on either side of Katrina Cut, depending on the state of the washover areas (Clay, pers. comm., 2010).

Results from four International Piping Plover Winter Censuses conducted in Alabama at five-year intervals starting in 1991 are summarized in Table 32 (USFWS, 2009). Local fluctuations may reflect the quantity and quality of suitable foraging and roosting habitat which vary over time in response to natural coastal formation processes as well as anthropogenic habitat changes (e.g., inlet relocation, dredging of shoals and spits). Changes in wintering numbers may also be influenced by growth or decline in the particular breeding populations that concentrate their wintering distribution in a given area. Hurricane Katrina also created a new inlet (Katrina Cut) and improved habitat conditions on some areas of Dauphin Island. Conversely, localized storms since Katrina have induced habitat losses on Dauphin Island (USFWS, 2009). In 2010, an emergency permit was issued to the State of Alabama to close Katrina Cut to protect Mississippi Sound, Portersville Bay and Grand Bay estuaries from the Deep Water Horizon Oil Spill, (USACE 2010). The closing of Katrina Cut altered the habitat use of this area from areas of washover used for feeding to areas for roosting and preening. It is unknown how the closing of Katrina Cut and alteration of Piping Plover habitat have impacted the species.

Table 32. Piping plovers in Alabama: results of the 1991, 1996, 2001, and 2006 International Piping Plover Winter Censuses (USFWS, 2009)

Year	Piping Plovers
1991	12
1996	31
2001	30
2006	29

10.1.5 Least Tern

The interior population of the least tern (*Sterna antillarum*), a breeding migratory bird in mid-America, was listed as endangered on June 27, 1985 (50 Federal Register 21,784-21,792) (USFWS, 1990). Only the least tern interior population is listed as endangered; however, according to Darren LeBlanc, USFWS, occasionally individuals of the listed population may be incidental additions to the local nesting (non-listed) population in Alabama for a short period of time. Since there is no way to differentiate transient birds from resident (nesting) birds, this species is included in the assessment (LeBlanc, pers. comm., 2010). In Alabama the primary threat to least terns comes from coastal development, which has reduced the amount of clean sandy beach habitat available for nesting. According to the USFWS, there have been least terns nesting on portions of Dauphin Island for the last few years, with the majority of the nesting occurring on the northwestern end of the island. There has also been some tern nesting between the end of Bienville Blvd and Katrina Cut (LeBlanc, pers. comm., 2010). No nesting has been observed in the proposed west end project area (between Katrina Cut and Pelican Island) because the human and pet traffic is too great in that area, and there may not be enough beach habitat (Dindo, pers. comm., 2010; Clay, pers. comm., 2010).

10.2 Beach-Nesting Birds In the Vicinity of Dauphin Island

Several bird species have been observed nesting on Dauphin Island and Pelican Island. According to Roger Clay, Alabama Department of Conservation and Natural Resources (ADCNR), ever since Pelican Island has migrated to intersect the beach on Dauphin Island, a lot of black skimmer nesting has moved from Pelican Island to West Dauphin Island (west of Katrina Cut) (Clay, pers. comm., 2010). According to John Dindo, Ph.D., of Dauphin Island Sea Lab, there are large black skimmer colonies (as many as 5-6 different colonies, with 10-20 birds or more per colony site) beyond Katrina Cut, in addition to least and common tern nests and an occasional Caspian tern nest. American oystercatchers nest as individuals, and 8 or 10 pairs were observed in 2009 on the Gulf side of the island (Dindo, pers. comm., 2010). On the north side of the island, adjacent to Katrina Cut, Wilson's and snowy plover nesting has been observed (Clay, pers. comm., 2010). No nesting has been observed in the proposed western project area (between Katrina Cut and Pelican Island) because the human and pet traffic is too great in that area, and there may not be enough beach habitat (Dindo, pers. comm., 2010; Clay, pers. comm., 2010).

Table 33 includes nest totals collected by Roger Clay, ADCNR, for Dauphin Island and Pelican Island. In 2005 the active tropical storm season wiped out the nesting for that season. Nesting habitat was actually improved after the 2005 storms, particularly on the undeveloped western portions of Dauphin Island. Of note was the nesting of sooty terns in 2008, which was the first documentation of this species nesting in Alabama (Clay, pers. comm., 2010).

Table 33. Total nests observed on Dauphin Island and Pelican Island, 2001-2009 (Clay, pers. comm., 2010)

Common Name	2001	2002	2003	2004	2006	2007	2008	2009
Black skimmer	480	250	UNK	240	245	223	291	335
Gull-billed tern	82	50	UNK	70	17	57	43	67
Common tern	90	50	UNK	50	35	90	80	70
Caspian tern			~25	2		1		1
Sooty tern							5	3
Sandwich tern			~300	1500			5	
Least tern	125	100		27	50	3		
Royal tern			~50	450				
Laughing gull			1					
Wilson's plover						12	9	6
Snowy plover						9	4	4
American oystercatcher							3	5

The Audubon Coastal Bird Conservation Program (CBCP) 2007 census and study area covered all known and potential beach-nesting bird habitats in coastal Alabama, including Bon Secour National Wildlife Refuge, Dauphin Island, West Dauphin Island, Isle Aux Herbes, Pelican Island, Cat Island, Gulf State Park, and Barton Island Peninsula in Baldwin and Mobile counties. Data were collected on abundance, distribution and habitat use of snowy plovers, Wilson's plovers, least terns, common terns, gull-billed terns and American oystercatchers and black skimmers. The 2007 CBCP Alabama census and monitoring spanned the peak-nesting periods for all beach-nesting species surveyed. Repeat surveys were conducted at all sites throughout the breeding season to account for variation in species nesting peaks.

Table 34 and Figure 24 show the number and location of beach-nesting breeding pairs, respectively, in the vicinity of Dauphin Island (Zdravkovik, 2008).

Table 34. Coastal Alabama 2007 beach-nesting bird breeding pairs (from Zdravkovik, 2008)

Common Name	Dauphin Island, West End (6.5 km)	West Dauphin Island (11 km)	Pelican Island (3.5 km)
Snowy plover	5	2	2
Wilson's plover	3	9	1
Least tern	16	3	0
Common tern	0	5	85
Gull-billed tern	0	12	45
American oystercatcher	0	3	1
Black skimmer	0	0	175

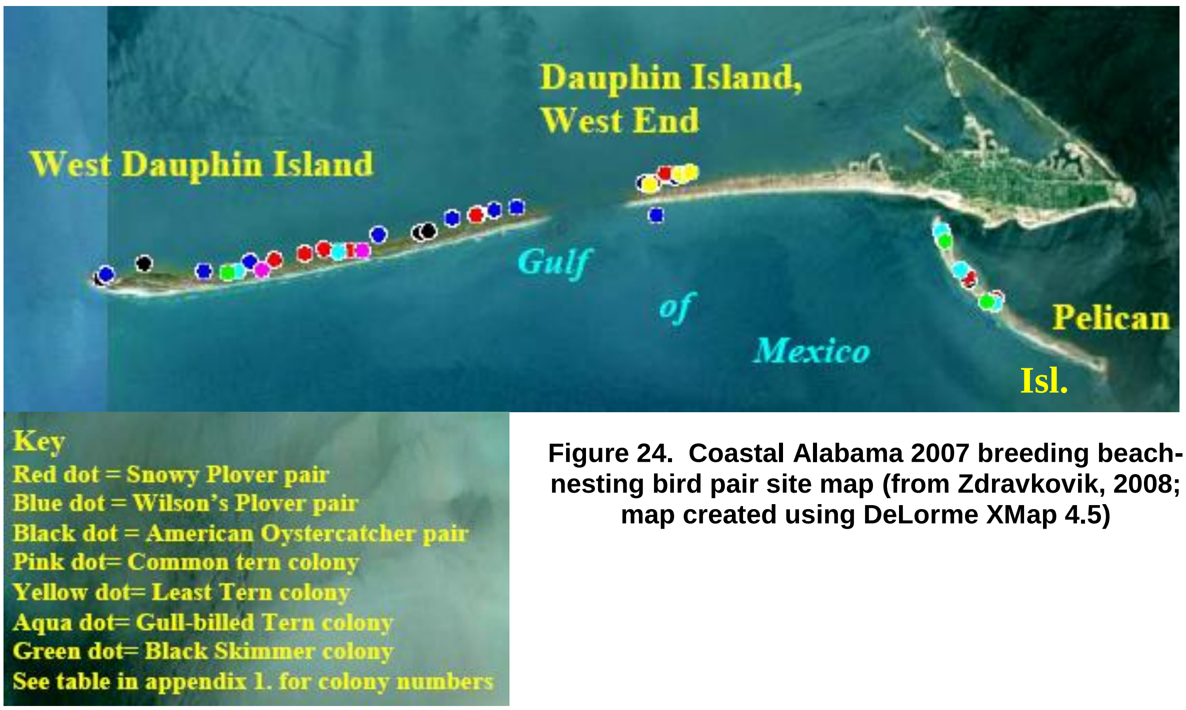

Figure 24. Coastal Alabama 2007 breeding beach-nesting bird pair site map (from Zdravkovik, 2008; map created using DeLorme XMap 4.5)

10.3 Migratory Birds In the Vicinity of Dauphin Island

Though not federally listed as threatened or endangered species, there are many bird species that utilize Dauphin Island for nesting, overwintering, or as a stopover on their migratory routes. These species are protected by the Migratory Bird Treaty Act (MBTA) of 1918. The MBTA makes it illegal to "take" migratory birds, their eggs, feathers or nests. Take is defined in the MBTA to include by any means or in any manner, any attempt at hunting, pursuing, wounding, killing, possessing or transporting any migratory bird, nest, egg, or part thereof. In total, 836 bird species are protected by the MBTA, 58 of which are currently legally hunted as game birds. A migratory bird is any species or family of birds that lives, reproduces or migrates within or across international borders at some point during their annual life cycle (USFWS, 2010).

Hundreds of millions of migrating birds must cross the Gulf of Mexico each spring and fall. The northbound spring trans-Gulf migration generally involves flight from the Yucatan Peninsula to the upper Gulf Coast, with migrants often altering routes according to weather patterns to minimize the time or energy expenditure required for crossing (Russell, 2005). According to Jake Walker (Grand Bay National Estuarine Research Reserve (NERR)), the peak spring migratory season is late March through early May, and the peak southbound fall migratory season typically extends from August through late October. Shorebirds tend to migrate slightly earlier than the rest of the migratory birds in both seasons, including all of March in the spring, and July in the summer/fall (Walker, pers. comm., 2010).

Dauphin Island, Alabama is a unique and valuable habitat for birds, as it provides important stopover habitat for bird migrations. The Dauphin Island Audubon Bird Sanctuary, located at the eastern end of Dauphin Island, provides the first landfall for neo-tropical migrant birds after their long flight across the Gulf from Central and South America each spring. These migratory birds, often exhausted and weakened from severe weather during the long flight, find their first food and shelter on Dauphin Island. It is also their final feeding and resting place before their return flight each fall (DIABS, 2010). Though not federally listed as threatened or endangered species, migratory birds are included in the Biological Assessment (BA) which is being prepared for the proposed project.

10.4 Essential Fish Habitat

An Essential Fish Habitat (EFH) Assessment is being prepared in order to identify all EFH and managed species within the proposed Dauphin Island Beach Restoration Project area, and to examine potential adverse effects on EFH for these managed species as required by the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) as amended through 2007. The consultation requirements in the Magnuson-Stevens Act direct federal agencies to consult with NOAA's National Marine Fisheries Service (NMFS) when any of their activities may have an adverse affect on EFH. Thus, the objective of the EFH Assessment is to determine how the actions of the proposed project may affect EFH designated by NMFS and the Gulf of Mexico Fisheries Management Council (GMFMC) for the area of influence of the project, and to provide a vehicle for consultation between the U.S. Army Corps of Engineers (USACE) and NMFS. The EFH Assessment includes a description of the proposed action, a description of EFH and managed fish species located within the project area, and an analysis of the potential impacts to EFH that may occur as a result of this project. The EFH assessment will be submitted to the USACE, who will then provide the EFH assessment to NMFS along with the permit application submittal.

The area of influence of the project will extend along the western portion of Dauphin Island, a distance of approximately 4.25 miles between the breach in the west end of the island (locally known as "Katrina Cut") to the Pelican Island/Peninsula attachment location. Data provided by the Mobile Bay National Estuary Program (NEP) indicates that oyster reefs and submerged aquatic vegetation (SAV) are located in the vicinity of Dauphin Island; however, these resources are not located near the project area. Oyster reefs are found in Mississippi Sound at the entrance to Mobile Bay, north of the eastern end of Dauphin Island. There is some SAV located in Mississippi Sound at the westernmost end of Dauphin Island, beyond Katrina Cut; however most seagrass is located farther north, deep into Mobile Bay. There are no oyster reefs or SAV located in the vicinity of the project area; therefore, there are no anticipated project-related impacts to these habitats.

Impacts from dredging of the borrow area and placement of sediment in the nearshore marine environment will likely include temporary turbidity in the water column and removal/burial of infauna in the softbottom, unvegetated habitat. The similarity of the dredged sediment to the native sediment will aid in the recovery of the benthic communities impacted by the placement of the fill material. Impacts to the marine non-vegetated bottom EFH as a result of placement of beach-compatible sediment in the nearshore marine habitat will be temporary, with recovery of the benthic community expected to occur within nine months to four years following the beach nourishment project (Nelson, 1993; Bolam and Rees, 2003). Based upon the project design and the minimal short-term impacts associated with dredging and fill placement, adverse effects to EFH from this project will not be significant.

11 CONCLUSIONS AND RECOMMENDATIONS

It is recommended that Alternative 1 be constructed to best fulfill the project goals. The design follows standard coastal engineering design principles of including a design section and advanced fill. The fill along the west end project area was designed to restore the sand volume present in 1990 and maintain it for 10 years, while the fill along the east end project area was design to maintain the 2010 shoreline for 5 years before renourishment would be required. This includes construction of a +12 feet, NAVD dune seaward of the existing houses and infrastructure along the Gulf shoreline of the western project area and a hummocky dune constructed to approximately +8.0 feet, NAVD along the Gulf shoreline of the eastern project area. Both beach fills include a berm constructed to an elevation of +5.5 feet, NAVD advancing the MHW shoreline seaward from its current location. Alternative 1 involves the construction of a 3.59 million cubic yard and 240,000 cubic yard beach fill for the west and east end project areas, respectively. The total fill volume required to construct the project is 3.83M cubic yards at a total construction cost between $63,100,000 and $70,800,000 including a 15% contingency.

Borrow areas to construct the project are located approximately 7.5 miles south of the project areas. Borrow Area 1 and Borrow Area 2 contain sufficient fill material to construct any of the proposed alternatives.

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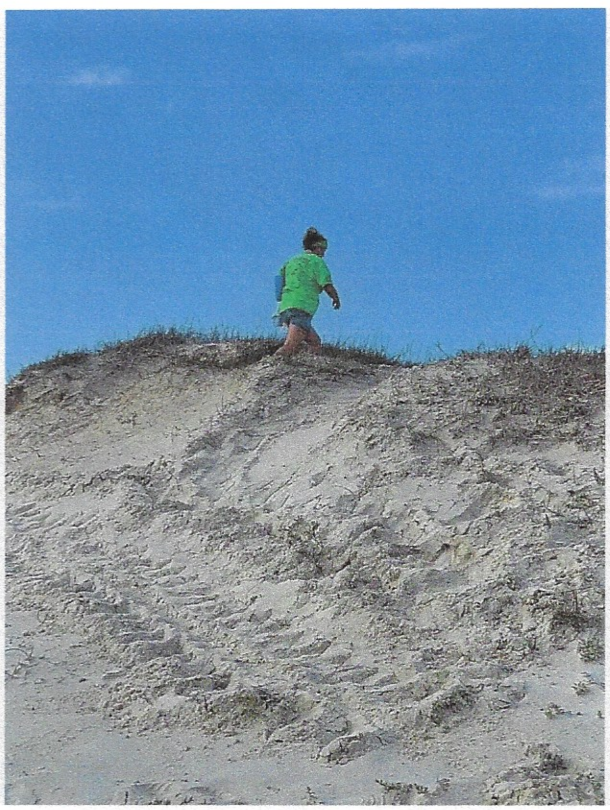
Your Pet Pics & Videos

A TURTLE'S JOURNEY

A Turtle's Journey: Impacts of Cristobal on Alabama nests

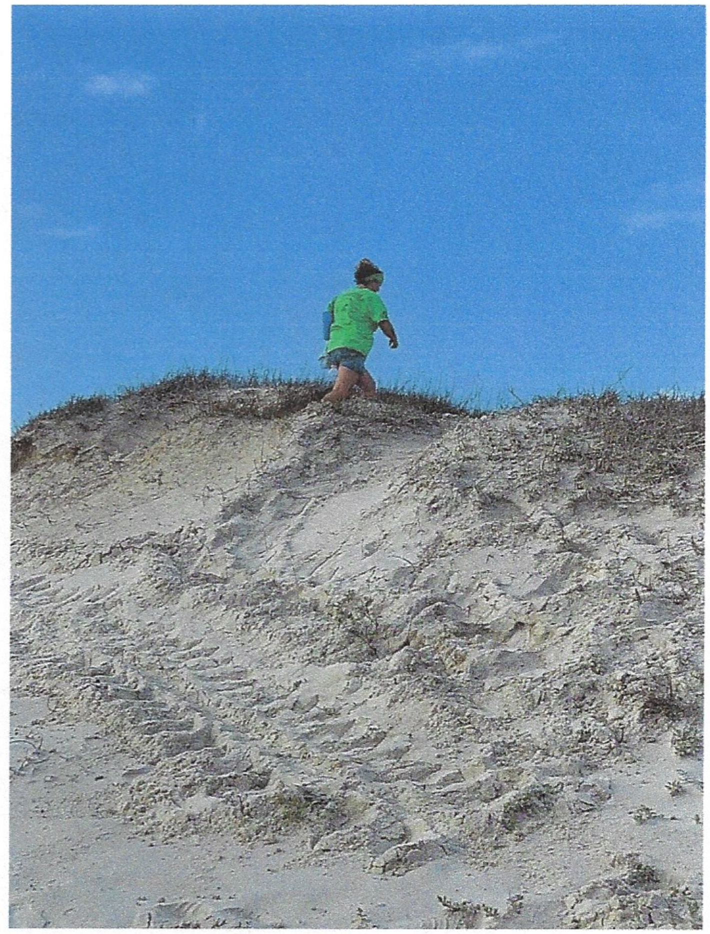


by: Kimber Collins

Posted: Jun 10, 2020 / 06:51 PM CDT / Updated: Jun 19, 2020 / 05:40 PM CDT

DAUPHIN ISLAND, Ala. (WKRG) — All 15 sea turtle nests on the Alabama coast were washed out or severely flooded after Tropical Storm Cristobal.

Stakes, screens, and other markers on these nests were gone or found far away. Volunteers this week are working hard to secure and remark the nests that can still be reached but many were total losses.



During the storm, the Laguna Key team found a new nest that was made in high elevation away from the waves. There have been four new nests since the storm made landfall in Louisiana.

Sunset Capital of Alabama

THE TOWN CRIER

INCORPORATED 1988
ISSUE 253 JULY 2020

THE "OFFICIAL" NEWS OF DAUPHIN ISLAND

In an effort to keep the citizens of Dauphin Island better informed, the Mayor and Town Council are pleased to distribute the Town Crier on a monthly basis. Our goal is to highlight council meetings and other newsworthy events. However, this is not intended as a substitute for attending public meetings.

CALENDAR OF EVENTS

June 25 Aloe Bay Kickoff Meeting @ Rodeo Site 8:30am, 1:30 pm & 6pm

July 4 DIVA Ceremony WaterTower Plaza 11am

July 4 Fireworks Show! Public Beach 9pm

July 6 Agenda Meeting 5pm

July 7 Council Meeting 6pm

July 7 Planning Commission Public Hearings 3pm & 3:15pm

July 7-21 Municipal Election Qualification Period for Candidates

July 11 DI Young Anglers Tournament

July 14 Primary Election Run-off

July 14 Planning Commission Meeting 6pm

July 17-19 ADSFR

July 20 Agenda Meeting 5pm

July 21 Council Meeting 6pm

Aug 3 Agenda Meeting 5pm

Aug 4 Council Meeting 6pm

Aug 11 Planning Commission 6pm

Aug 15 Stripers Rodeo

Aug 17 Agenda Meeting 5pm

Aug 18 Council Meeting 6pm

Aug 25 Municipal Election

Aug 31 Agenda Meeting 5pm

Sept 1 Council Meeting 6pm

****Events subject to change****

CORONAVIRUS UPDATE Last month, Governor Ivey unveiled a new statewide "Safer at Home" order which included the reopening of all Alabama beaches and a greater number of businesses and other public places/venues. Restaurants are now allowed to offer dine-in service (50% capacity) with proper spacing of tables/seating and other safety precautions. The latest order also does away with the previous restriction limiting gatherings to groups of ten or less. She is expected to provide an update on the pandemic and possibly announce additional guidelines on July 3. However, emphasis remains on social distancing (6 feet apart), staying at home (when you can), practicing good personal hygiene and wearing masks/face coverings (strongly recommended by the Mobile County Health Dept.) when out in public. All of these actions can help prevent the spread of the virus and it is very important that we all do our part! Town buildings may soon reopen with enhanced safety precautions although customers are asked to continue conducting business via phone, fax or email when possible. Public Meetings are going on as scheduled and we respectfully request your "attendance" be limited to Zoom and Face Book Live to limit crowd size.

July 4 Fireworks Show is a GO! On behalf of the Dauphin Island community, the Town Council expresses its heartfelt appreciation to Tyler Reinhard (Sicklefin Charters) for sponsoring the 2020 Fourth of July Fireworks Show on Saturday, July 4 at 9pm at the Public Beach next to DI School! The town is also pleased to share his personal message as follows; **Sicklefin's Boomin' Benefit**: With the COVID-19 pandemic putting financial strain on towns and businesses alike, the Fourth of July fireworks, and other hometown events, had been put in jeopardy. The fireworks not only celebrate our nation's history, but the holiday plays a role in building community bonds, boosting morale, and benefiting local businesses. It is something we personally look forward to every July. During these trying times, our conclusion was as a small town/island, we need fireworks. Not only is it something to look forward to, but every single business in Dauphin Island depends on tourists in some form. What is better than to welcome tourists by lighting up the gulf sky with a pyrotechnics display! And so the story of Sicklefin's Boomin' Benefit begins. To take this opportunity to do more for our community, a "Fill The Boat" campaign will take place in front of the Public Beach before the fireworks to benefit local area food banks. The fireworks will remain at no cost to the public, but we are asking all spectators to bring a non-perishable food item to fill the boat. Please keep in mind expired food is unable to be distributed. A donation is not mandatory, but greatly appreciated. While the benefit is in its infancy, we will make sure to make announcements through our business website, Mayor Collier, and our business social media accounts. This is our island's opportunity to set the precedence for overcoming a pandemic by helping others. If any local businesses would like to be involved, please contact us directly. www.sicklefincharters.com (251)207-8500. **About Sicklefin:** In a world so dependent on social media and lacking face to face interaction, we have set out to be different. Through life experiences, we have learned there is no greater happiness than doing something yourself. Whether you are able to harvest a bounty of vegetables from a garden, or reel in a 200lb. Yellowfin tuna they are moments to be enjoyed, not stopped for a "selfie". We were drawn to the island because of its wonderful weather, fishing , and the opportunities to enjoy the outdoors. The lack of consistent cell/ internet signal can make "normal" hard, but we weren't looking for "normal". Sicklefin Charters was established in 2020, and calls Dauphin Island, AL its port home. We have set off to stand apart from other charter companies, and become the best available in the Gulf of Mexico. We believe community outreach and conservation both play a vital role in protecting the Gulf fishery. Without this natural resource, those that are drawn to the island would lose out on the bounty of world class fishing that is available. Our 35' Marlago and 45' Seahunter are outfitted with the lastest offerings in Simrad electronics, custom rods, spinning and conventional reels, safety equipment, as well as top of the line terminal tackle. We want to ensure you have the greatest opportunity to catch and enjoy landing your fish of a lifetime. All our charters are guided by USCG credentialed captains, and safety is a main priority. Whether you are a seasoned fisherman looking to expand skillset, you'll feel safe and supported by our captains and mates. Note: Attendees must adhere to the Governor's recent "SAFER AT HOME" order!

DIVA July 4 Ceremony The DI Veterans Association will host its annual Independence Day ceremony at Water Tower Plaza on Saturday July 4 at 11am and all are invited and encouraged to attend. Appriopriate measures will be taken to ensure proper social distancing is maintained during the event. See you there!

Planning Commission Sets Public Hearings Two required public hearings have been scheduled by the Planning Commission on Tuesday, July 7 to receive comments on proposed re-subdivisions of properties. The first hearing is at 3pm and involves the combining of two adjoining lots located at 407 Chenault & 402 Bienville Blvd. The second hearing follows at 315pm and would establish new lot lines (boundaries) on Lots A, 1 & 2 on Osprey Lane. For additional information or to submit comments please contact Wanda Sandagger at 861-5525 X225.

Aloe Bay Projects Visioning Meeting! Rodeo Site on June 25 at 8:30am*, 1:30pm & 6pm. Come offer your input and vision for the proposed Aloe Bay projects! *This time is reserved for senior citizens and "at risk individuals".

News From Dauphin Island Heritage and Arts Council THERE IS A HEALING POWER TO ART, and we want to help bring that healing to our small part of the world. After careful consideration and planning, we are happy to announce that Dauphin Island Gallery is now open to the public on its normal days and business hours -- Thursday-Saturday, 10am-4pm; and Sunday, 12:30pm-4:30pm. SAFETY MEASURES are in place to help decrease the possibility of spreading the COVID-19 virus, including the following: (1) Gallery visitors and workers will be required to wear face masks while inside the Gallery. In case a visitor does not have a mask, we will have disposable masks available at the door; (2) No more than 10 people will be allowed in the Gallery at a time; (3) We will sanitize surfaces after each group of visitors exits the Gallery, inside and outside the Gallery; (4) Six (6) ft. social distancing will be required at all times; and (5) Hand sanitizing stations will be available inside and outside the Gallery. We are excited about seeing our friends and helping our Island on its way back to normal! CHILDREN'S ART KITS. We are excited to be offering creative opportunities for elementary school children this summer! We are making a variety of art kits available free of charge for children in K-5th grade. The pick-up dates for the next round of art kits will be announced on DIHAC's Facebook page and through email. If you would like to be added to our email list, send a message to info@dauphinislandarts.org. CLAY KIT PROGRAM! We are excited to announce our "at home" pottery projects! The first Clay Kit #1 sold out almost immediately! STAY TUNED for Clay Kit #2!! Preparations are by Kathy Jones, Chair of DIHAC's Pottery Program. The kit will include all materials, tools, instructions, and templates for you to create small pottery pieces. The cost is $30 per kit, including glazing and firing your pieces. To add your name to the waiting list for Clay Kit #2, message us through Facebook or send an email to info@dauphinIslandarts.org with your name and contact info. THE NEEDS IN OUR SERVICE AREA are great and the pandemic has created a major setback for us. Please consider giving today and supporting our efforts, which include free children's art education, the Dauphin Island Native American Festival, adult art classes, Last Friday Art Night (LFAN), and so much more! You can make a tax-deductible donation by mailing a check payable to DIHAC to P.O. Box 114, Dauphin Island, AL 36528, or donate through our website at www.dauphinislandarts.org. Dauphin Island Heritage and Arts Council is a charitable, non-profit organization, providing educational opportunities in the arts, and working to preserve our coastal heritage. Memberships, donations, and purchases at our Gallery help support our programs.

The ABC's of DI Whether you've lived on the island for most of your life, moved here recently or visit occasionally, you'll have to admit Dauphin Island is a truly unique spot. Unfortunately, it can also be a bit confusing when you try to understand the complex make up of the various island entities, their roles and responsibilities, property holdings (including public beaches) and more. Here's a simplified summary that should allow you to spend more time enjoying all that the island has to offer and less time scratching your head. **Town of Dauphin Island** The town incorporated in 1988 and provides many of the services you would expect from a municipality such as public works, police/EMT, court, building inspection and more. The town owns several public parks, Billy Goat Hole boat ramps (next to ferry landing) and West End Beach. **DI Park & Beach** Formed in the 1970's, DI Park & Beach owns and operates multiple public facilities including historic Fort Gaines, Ft. Gaines Campgrounds, Little Billy Goat Hole boat ramps, Bird Sanctuary, Cadillac Square several pocket parks and two public beach sites---East End Beach & Public Beach (next to DI School). **DI Property Owners' Association** As the name would suggest, the DIPOA's primary responsibility is to serve the more than 3000 property owners of Dauphin Island. Formed in the early 1950's, the Association owns vast tracts of property throughout the island such as the Isle Dauphine (golf course) complex (also includes the adjacent Gulf-fronting beach), much of the primary dune system that stretches from the east end to the main public beach, West Surf Beach (from Pirates Cove Street west to end of Bienville Blvd.), numerous pockets parks, etc. Other entities include **DI Water & Sewer Authority** (Responsible for providing potable water and sanitary sewer service throughout the island), **DI Fire & Rescue** (This dedicated group of volunteers offers emergency fire & medical response services in addition to those provided by town personnel), **DI Chamber of Commerce** and **DI Foundation**. Note: This is not intended to represent a full and complete list of entities and/or associated information.

Committee Volunteers Needed The town of Dauphin Island has applied for a grant that, if approved, would fund a project to identify and map wetlands scattered throughout the island while recommending beach and dune preservation guidelines and best practices for the island's west end. Developing an inventory and associated overlay of wetlands (large and small) will provide pertinent information to prospective property owners, developers/contractors and town staff among others as the island continues to grow and develop in future years. The beach & dune portion of the project would help to build upon the recently adopted Dune Protection Overlay District to include areas west of Pirates Cove Street. Environmental engineers would work with the town to identify best management practices relating to dunes and critical habitats creation, protection and more. If you'd like to submit your name for consideration to serve as a volunteer committee member, please contact Town Clerk Wanda Sandagger. A core group of 5-6 individuals make up the existing committee but new members are encouraged to become more involved in these types of matters going forward.

Alabama Deep Sea Fishing Rodeo Ever wonder what the rodeo would be like with (let's say) no Liars Contest, no free concerts, no cold beer for sale and no hoards of spectators? Well, we'll all find out soon as members of the Mobile Jaycees have taken these and other extreme measures in response to the Coronavirus pandemic. Speaking via cell phone to the town council at a recent agenda meeting, Rodeo President Cory Quint said "we're going back to our roots" and essentially having a fishing tournament this year. The group is already making plans to ensure proper social distancing recommendations are met on rodeo grounds whether you're stopping in to purchase this year's T-shirt or standing in line at the weigh station. The 2020 rodeo will likely look and sound a lot different this year and the town expresses its gratitude for putting a premium on personal safety during these challenging times. The 87th ADSFR will be held July 17-19 with the Roy Martin Young Anglers Tournament taking place a week prior on July 11.

Tropical Storm Cristobal Although Cristobal remained a modest tropical storm and made landfall west of New Orleans, our stretch of the Gulf coast took an extended beating from strong winds, heavy surf and high tides. As usual, the bulk of the impacts on the island were felt along portions of the west end where salt water flooding washed sand and debris across numerous side streets, Bienville Blvd. and West End Beach. Some streets were buried under 3-5 feet of sand making the clean up process a bit more challenging and time consuming. Other parts of the island also saw flood waters encroaching into neighborhoods and roadways along and near Salt Creek, Billy Goat Hole and Audubon Place to name a few. In addition, the causeway leading to the island was compromised (and closed by ALDOT) when wind driven waves coupled with higher than normal tides covered the island's only ingress and egress with rocks, logs and other debris. A major shout out to the town's Public Works Dept. and DI Water & Sewer (Thanks Davy Gibbs!) for jumping into action to assist ALDOT in clearing the roadway allowing for traffic to resume (via pilot car) within a few hours! Without the collective support of all involved, it is all but certain Hwy. 193 would have remained closed for a much longer period of time. WTG Team!

Pay-As-You-Go Street List Submitted Town officials have submitted a list of island streets for the upcoming Pay-As-You-Go resurfacing program sponsored by Mobile County. The streets include; Mallard, Sandpiper, Quivira, Polaris, Port Royal (north and south of Cadillac), Pineda, Cadillac (east of Pascagoula Street), Olive Lane, Carolyn Circle, Conti, Pensacola (north and south of Cadillac) and Pelican (north and south of Cadillac). Ultimately, county engineers will make the final selection of streets to be paved based on the total cost of the project. We greatly appreciate Commissioner Jerry Carl and Mobile County for allowing the town to participate in this annual infrastructure enhancement program!

Local Legislation Sought The town council recently approved a measure to seek state legislation that would provide future councils with the ability to further strengthen the island's Tree Ordinance through increased mitigation fees and penalties. Currently, state statutes limit such fees to $500. Emphasis is being placed on Heritage Trees such as oaks, pines, and other varieties exceeding a prescribed diameter at breast height. These trees provide protection during storm events and serve as critical nesting habitat for certain species. Legislative review and action is not expected until the 2021 session which starts in January.

Arts of Dauphin Island WE ARE OPEN FOR BUSINESS!! Thursdays, Fridays and Saturdays from 11am-5pm. Please come by and check out our newly renovated art gallery, inside and out!. Our beautiful front lawn was landscaped by the terrific Master Gardening Women of Dauphin Island and it looks incredible. We have two new artists that have joined our gallery. Elmer Sellers who does remarkable wood working and Ann Rose who does amazing things with her hand built pottery. Since we are still in the midst of the Corona Virus pandemic, no open house is planned for this month. We are planning a "Children's Art Camp" starting August 3-6 from 2pm-4pm. Ms. Margie Delcambre, art instructor for our adult classes, will also be the instructor for the Children's Art Camp. We ask that you **pre-register** for the Children's Art Camp by calling Mrs. Delcambre at 251-402-0266 or Marsha Barnett at 251-401-0230. We will be taking in consideration the Corona Virus as the Children's Art Camp date gets closer. If for some reason we feel it is still not safe the classes will be cancelled. Are you interested in taking art classes? Our adult art classes are held every Monday morning from 10am-1pm. $10.00 per class. If you would like to join our gallery, become a volunteer or need any information about Arts of Dauphin Island, please call Marsha Barnett at the above number or by emailing us at artsofdauphinisland@gmail.com. Note: The Town of Dauphin Island expresses its sincere appreciation to DI Art's own Celia Smith for the outstanding job she did painting the small building at West End Beach!

Alabama Barrier Island Restoration Assessment- Final Report Now Available The Alabama Barrier Island Restoration Assessment (ABIRA) Final Report is now available on the ABIRA website and can be viewed by clicking on the following link: https://gom.usgs.gov/DauphinIsland/Reports.aspx. This project is a collaborative effort between the U.S. Geological Survey (USGS), U.S. Army Corps of Engineers (USACE), and the State of Alabama funded by the National Fish and Wildlife Foundation (NFWF) to investigate viable, sustainable restoration options that protect and restore the natural resources of Dauphin Island, Alabama. The study is focused on restoration options that protect and restore habitat and living coastal and marine resources, as well as protect the coastal resources of the Mississippi Sound/Mobile Bay and the southern portion of Mobile County including the expansive Heron Bay wetlands. Two reports have been prepared as part of this effort — an Interim Report and a Final Report. A public meeting was held in December 2017 to present the results of the interim report and a virtual meeting (webinar) was held in June 2020 to discuss the Final Report. NOTE: A recording of the virtual meeting is available on the ABIRA website. The Final Report includes the methodology applied, data collected and analyzed, models applied and their results, detailed description of all alternatives evaluated, and the impact and benefit of each alternative towards preserving and enhancing the ecological functions and values of the island and the associated estuarine resources the island helps to maintain. The results of this study will provide decision-makers with information on the benefits and tradeoffs for different restoration alternatives, including the long-term restoration and protection of the habitats and resources affected by the Deepwater Horizon oil spill. **Note: The State is requesting public comments on the report by June 26th be emailed to ABIRA@usace.army.mil.**

OPEN FOR BUSINESS! Many of our locally-owned and operated businesses are back up and running under the new "Safer at Home" guidelines (Social distancing, sanitizing and more) and the town is pleased to share the following information (all store front Island businesses were invited to participate) for your convenience. Let's all do our part to support our businesses during these challenging times! **Beached Café** 1610 Bienville Blvd. 251-861-2022. www.beached.cafe FB: Beached Café Open Thursday - Sunday 11am-7pm Smoothies and Frozen Daquiris Full Lunch Menu 11am-3pm Smoked Meats by the lb. and sides 3pm-7pm Convenient call in orders. Screened porch dining area **Beach Planet** 200 Lemoyne Dr. 251-706-6418 Mon.-Thurs. 8am-7pm, Fri.-Sat. 8am-9pm, and Sun. 8am-8pm **BGH Café** 114 Bienville Blvd. 251-861-GOAT (4628) "At the ferry boat landing" Open 7 Days a week 9am-5pm (if bad weather call ahead) Take out orders, limited seating by the water Old fashioned shakes and malts, soft serve ice cream, wraps, sandwiches, paninis, fountain drinks, full menu available on our FB page. Call in orders can be picked up at the side door if the front window is busy, please call when you arrive. **Capt. Mike's Deep Sea Fishing**: We are fishing 7 days per week! Business phone: 251-861-5302.We are taking precautions & keeping the boats clean, sanitized and disinfected during the trips. **Dinner's Ready** 918 Bienville Blvd. 251-861-0120 Serving made from scratch meals ready to take home and heat up in your microwave or oven. We have a large selection of desserts and deli salads - including our famous cupcakes, Key Lime Pies, and Lemon Icebox Pies. We also have lunch boxes and sandwich wraps which are perfect to take on the boat or for a picnic on the beach. Open Tuesday thru Friday (11am til 6pm) and Saturday (11am-3pm). Follow us on Facebook - Dinner's Ready Dauphin Island. Everything we make is always homemade.... always delicious!! **Dolphin Fitness & Health** 1606 Bienville blvd 251-861-3050 open 24/7 with membership, staff hours Mon-Fri 9am-5pm. **Foxy's** Open Tuesday-Saturday 9am-330pm (Closed Sundays and Mondays) phone number 251-861-LOVE (5683) 202 Lemoyne Drive Media info @foxyswafflebar on facebook and Instagram. **The Gulf Breeze Motel** is open 24/7, newly renovated dock, Double and Suites available, select Pet friendly rooms, boat launch free to guests. All rooms cleaned and disinfected after use for your safety. Call the office for reservations at 251-861-7344 Check us out on Facebook or our website! www.gulf-breeze-motel.com **The Happy Octopus** Open Monday thru Saturday 10am-5pm, Sunday Noon-5pm. Business phone: 251-454-6933 In store shopping is open but we are limiting the number of shoppers to 6 at any one time. Hand sanitizer is available and store clerks are continually wiping surface areas. The entrance/exit door is being left open during operating hours to limit repeated touching of the door handles. **The Hippie Fish** 1008 Desoto Ave Open Monday thru Saturday 10am-5pm, Sunday Noon-5pm 251-656-5696 **Island Rainbow** Open Tuesday thru Saturday 11am-8pm, Sunday 11am -6pm. Business phone: 251- 861-0060 Limited outdoor seating available and carryout. Indoor dining remains closed until further notice. Our employees are wearing masks and gloves in the food prep area. At this time public restrooms remain closed. **Isle Dauphine Golf Course** 100 Orleans Drive Business Phone: 251-861-3176. Open to the Public Wednesday-Monday, 8am-dusk (Closed Tuesday) Offering Golf & Foot Golf! **JT's Sunset Grill** Open daily 1130am-8pm (closed Thursday) Indoor and outdoor (waterfront) seating. Full menu available 251-861-2829 **MIGUEL'S BEACH N' BAJA** Open Tuesday-Saturday 11am-4pm (closed Sundays and Mondays but subject to change) phone number 251-861-LOVE (5683) 202 Lemoyne Drive. (next to Beach Planet). Call in orders are strongly encouraged. No on-site dining. All orders will be prepared To-Go. Media info @beachnbaja on Facebook and Instagram. **Pelican Nest Campground & Beach Store** 1510 Bienville Blvd. 251-861-2338 Open daily 8:30am-730pm Hand Scooped Ice Cream and Shaved Ice,.Tee Shirts, Gifts, Beach Supplies Bike and Kayak Rentals with Free Delivery. We Clean and Sanitize after every customer. **Pelican Pub**, 1102 Desoto Avenue, Open seven days a week from noon until! Telephone: 251-861-7180 Rear deck available. Food available from "JT's Sunset Grill" on ground level; phone 251-861-2829. Restaurant personnel will deliver to Pub customers after order is placed and paid for. Safety Guidelines posted on door. No smoking or vaping, Bartenders are required to wear face masks when serving customers. Hand held Infrared forehead thermometer available from bartender. **Pirates Bar & Grill** 100 Orleans Dr. 251-861-2969 open 7 days a week Sun-Thurs. 10am-9pm. Fri & Sat. 10am-10pm. **Pirates Pizza & Wings** 100 Orleans Dr. 251-861-2969 open 7 days a week Sun-Thurs. 11am-9pm. Fri & Sat. 11am-10:30pm. **The Reel Deal BBQ** 1612 Bienville 251-861-RIBS (7427) Open 7 days a week 11am-8:30pm. Specializing in BBQ, Seafood and the best egg rolls in the state! **Salty Dog Watersports** 251- 623-2203 Open 7 days a week 6am-10pm. Locally owned and operated, We provide delivery and roadside service for our rental equipment; Jet Skis, Bikes, paddle boards, kayaks and more. **The Silver Pearl Gifts** is open from 10am-5pm 7 days a week. Featuring local art, tshirts, and nautical home decor. Masks and gloves worn by workers, shared items disinfected between parties, and occupancy is monitored.

DI SEA LAB INFO The Aquarium at the Dauphin Island Sea Lab is open to visitors seven days a week once again with adjusted hours of 12-4pm each day. Visitors need to purchase tickets in advance and face coverings are required to tour the aquarium. For those who need them, masks are available for purchase at the front desk. You can also take the lesson outside with the Aquarium's Summer Excursion Program. Reserve your spot today. Discovery Hall Programs welcomes campers to campus at the end of June. There are a few spaces remaining in the popular Gulf Island Journey camp for middle school students (July 5-10) and one spot left in Marine DeTECHtives, a three day camp for the middle school tech enthusiast (June 28-July 1). Meet our DHP marine educators at Bellingrath Gardens Kids Discovery Day on July 15. You can also take a virtual field trip with DISL with Alabama Public Television's Gulf Detectives Series. The rebroadcast on July 8 includes a chance to get your questions answered live by DHP marine educators. Get more information and details on purchasing tickets to the aquarium at disl.edu.

Primary Election Run-off July 14 Due to the ongoing Coronavirus concerns, Governor Kay Ivey postponed the previously scheduled March 31 run-off election until **July 14**. Key races on the ballot include (but not limited to); US Senator (R) Jeff Sessions / Tommy Tuberville US Representative 1st Congressional District (R) Jerry Carl / Bill Hightower & US Representative 1st Congressional District (D) James Averhart / Kiani A. Gardner. Polls will once again be open 7am-7pm. Please plan to get out and vote! NOTE: Election officials are encouraging voters to participate in the election process via Absentee Ballots during the ongoing pandemic. For more information please contact the Alabama Secretary of State and/or Mobile Probate Court offices.

2020 Municipal Election Info The town of Dauphin Island municipal elections will be held on Tuesday, August 25, 2020 (7am-7pm) and the mayor and all five council positions will be on the ballot. Individuals interested in running for a stated position must be; (1) a minimum of 18 years of age, (2) a resident of Dauphin Island for a minimum of 90 days prior to the election, and (3) a registered voter on Dauphin Island. Candidates are required to register at town hall from July 7-21, 2020, choose a position to seek (Mayor or Council Place 1-5), pay a $50 fee and fill out/sign related paperwork. Note: For more detailed candidate information please visit the Secretary of States Office website at www.sos.alabama.gov/alabama-votes. The Mayor & Council Members each serve four-year terms and the monthly compensation for the 2020-24 term will be as follows; Mayor $5,000 / Council Member $400. Please note that Council positions DO NOT come with a pre-determined area of responsibility (ex. Police Dept., Public Works, Building Inspection, etc.). In fact, such liaison positions are not required at all. Instead, they are created at the discretion of the Mayor.

Are You Registered To Vote? With all of the elections coming up this year, now is the time to make sure you are properly registered to vote. It's actually very simple. For more information visit www.AlabamaVoterID.com or call the Elections Division at 800-274-8683. On-line registration and printable forms are available. Voter registration and updating of voter records is closed during the fourteen (14) days prior to each election in Alabama. Why wait? Register today!

Political Signs Regulations With several upcoming elections scheduled between now and this fall, political signs will likely start popping up in a front yard near you very soon. While we encourage citizens to take part in the political process and support the candidate(s) of their choice, we also want to remind you that such signage is regulated by town ordinance. Political signs; (a) can only be displayed 45 days PRIOR to the election, (b) shall not exceed two sides with three (3) square feet per side, (c) are limited to one sign per candidate per lot, (d) cannot be placed on public property, and (e) must be removed within 72 hours after the election. As always, your cooperation is greatly appreciated!

DIPOA NEWS The Annual Membership Meeting and Board of Directors Election was held Saturday, June 13th at 11am at the Isle Dauphine Clubhouse. Incumbents Earle Walkley and Richard Brewer were re-elected to the Board for three-year terms. Domenic Carlucci was elected to the third available seat. Congratulations to all three! Following the election results, the Board voted for Officers and selected Domenic Carlucci as President, Earle Walkley as Vice-President, Barry Zetsch as Treasurer, and Victoria Helm as Secretary. Please join us for the July meeting on Wednesday, July 15th at 6pm for our regular monthly meeting. If you are a new property owner or are not sure the POA has your correct mailing address, please contact the POA Administrative Assistant, Melissa Taylor. You can come by the office, call (251) 861-3144, or email us at dipoaoffice@gmail.com, to confirm or change your contact information. Once again, membership dues are the POA's main source of revenue. Without your support, the Board would not be able to do the things we are doing for you. If you have not paid your annual dues, you may pay in person at the POA office, mail a check to P.O. Box 39, or pay on the POA web site, with a credit card. Our office hours are Mon, Tues, Thurs, and Friday from 11am-4pm.

Dauphin Island
Sunset Capital of Alabama

1011 Bienville Boulevard
Dauphin Island, Alabama 36528
Phone: 251-861-5525
Fax: 251-861-2154
Website: townofdauphinisland.org
Monday-Friday 7:30am - 4:00pm

***ARE YOU SIGNED UP TO RECEIVE TOWN EMAILS?** In order to keep our property owners, citizens and visitors better informed, the Town maintains a mass email list for the prompt and convenient distribution of upcoming events and matters of importance to our community. If you are not already on the list please contact Jenniffer Ploeger at jploeger@townofdauphinisland.org.

HURRICANE RE-ENTRY PASSES!
Check your hurricane re-entry passes to make sure they are current.

DEPARTMENTAL LISTING

Town Clerk
Wanda Sandagger
861-5525 Ext 225

Bldg Official/Coastal Project Manager
Ext 224
Cell No 251-234-7466/Corey Moore
Cell No 251-257-6707/Terry Sheffield

Code/Zoning Enforcement
251 861-5525 Ext 229

Superintendent Public Works Dept.
Sharron Yommer Ext 230

DUMPSTERS
Fridays & Saturdays
7:00am until 2:30pm

Building Department Admin. Asst.
Business License/ Permit Clerk
Jenniffer Ploeger Ext 222

Event Coordinator/Office Asst.
Maggie Godwin Ext 223

Court Clerk
Stacy Mallon Ext 221

Admin. Clerk /Magistrate
Joyce Wentworth Ext 227

Animal Control Ext 230

Dauphin Island Police Dept.
Chief of Police
Chief Kym Claw 861-5523

TOWN & PUBLIC MEETINGS

Agenda Meetings: Mondays prior to Council Meetings at 5:00 pm

Town Council Meetings: 1st & 3rd Tuesday of each month at 6:00 pm

Meetings: July 7th & 21st

Planning Commission Meetings: 2nd Tuesday of each month 6:00 pm

Board of Adjustment Meetings: 4th Monday of each month or as needed

DI Court: 2nd Wednesday of each month **July 8 @ 4pm**

DI Park & Beach Board Meeting: call 861-3607 for date & time

DI Water & Sewer Authority Meetings: 3rd Wednesday of each month at 8:00 am at the Authority Office, 908 Alabama Ave. (861-2363)

Property Owners' Assoc. Meetings: Board meets at 6pm on the third Thursday of each month, except December, at Isle Dauphine. For specific information call 861-3144.

O&M Justification Sheet

PROJECT NAME. Coastal Inlets Research Program

AUTHORIZATION. Authorization for the Corps of Engineers' Engineer Research and Development Center (ERDC) to conduct R&D is codified in 10 U S C 2358 "The Secretary of Defense or the Secretary of a military department may engage in basic research, applied research, advanced research, and development projects that are necessary to the responsibilities of such Secretary's department in the field of research and development "

CONFERENCE AMT. FOR FY 2013: $2,700,000 2/

BUDGETED AMT. FOR FY 2014: $2,700,000 1/

DESCRIPTIONS OF WORK AND JUSTIFICATION FOR FY 2014:

The Corps operates and maintains more than 1000 coastal navigation projects that cover 13,000 miles of coastal navigation channels, with a limited O&M budget Coastal inlet navigation channels must be maintained in a complex environment of waves, tidal and wave-induced currents, sediment transport, and vessel-induced flow and wake. In FY 2010, the Corps spent approximately $1 2 billion in maintenance dredging of 202 million cubic yards from Federal navigation channels. Adjusted for inflation, dredging costs have increased approximately $12 8 million/year (from $1 53 to $4 62 per cubic yard) from FY 1963 through FY 2010[1]. Dredging costs are likely to increase in the future because of increasing fuel, mobilization, and demobilization prices. Additionally, to remain competitive, harbors and ports must deepen and widen navigation channels to accommodate larger vessels; however, deeper and wider channels are more efficient sediment traps, therefore increasing shoaling and O&M costs. Modifications to coastal inlet channels and jetties can have a profound effect on the integrity of the navigation structures, adjacent beaches, estuaries, ecosystems and regions Demand for regional sediment management practices and mitigation for engineering activities includes innovative creation of nearshore berms with dredged sediment intended as a source to nourish neighboring beaches. Renewable, cost-effective placement sites for dredging must also be designed such that sand moves onshore, fine sediments are dispersed offshore, and re-deposition into the navigation channel is minimized. Such projects require characterization of hydrodynamics, wave forcing, sediment transport, and morphology change, as well as geomorphologic approaches. Thus, navigation project O&M, structure integrity and implications of ongoing and future dredging actions must be considered within a sediment-sharing inlet system The Corps needs to advance knowledge and tools to better predict future channel shoaling, and to make transparent and uniform decisions on prioritization of funding. This applied research and development is necessary to provide quantitative and practical predictive tools and data to reduce the cost of dredging for Federal navigation projects, maintain inlet jetties, identify potential unintended consequences, mitigate for engineering activities related to navigation channels, prioritize maintenance options within budget constraints, and support national security efforts to protect waterways and ports. The Coastal Inlets Research Program provides tools to engineers and decision makers for developing reliable solutions and practices to reduce the cost of maintenance and operation of Federal navigation projects.

<u>PROPOSED ACTIVITIES FOR FY 2014</u>:

Structures and Navigation Focus Area

- Continue development of the Channel Portfolio Tool (CPT), especially formal, seamless linkages to other Navigation Business Line tools, applications, and databases such as Automated Identification System (AIS) vessel transit data, tide and wave buoy data, and HydroSurvey bathymetric data. Produce documentation of conceptual framework and how-to guidance in online help and technical notes. Continue maintaining the public version of CPT. Provide

[1] http //www iwr usace army mil/ndc/dredge/ddhisMsum pdf .