01/06/98

FACT SHEET
DAUPHIN ISLAND EROSION ISSUES

HISTORY: Shoreline change on Dauphin Island is an ongoing process characteristic of all barrier islands. Comparison of historic maps of the island indicate a general trend of erosion along the gulf shoreline and accretion on the western end. The earliest known maps indicate that around 1717 Dauphin and Petit Bois Islands were connected. At some later date, this island was breached and the two separate entities were formed. Between 1909 and 1917, Dauphin Island was breached by a hurricane (1916) and it was not until 1942 that maps indicated the breach was filled. The island was again breached by a hurricane in September 1948 and aerial photos taken in March 1950 indicate the island was rejoined. Hurricanes Frederic in 1979 and Elena in 1985 caused massive washover of the west end but total breaching did not occur. Hurricane Opal in 1995 also caused washover with the majority of the sands being transported via non-vegetated (i.e. streets) pathways. Studies of the shoreline change between the period 1942 and 1974 indicate gulf shore erosion rates of 6.3 feet per year. Accretion of the west end between 1917 and 1974 accounted for the addition of 1.8 miles of gulf shoreline. Recent investigations by Douglass (1992) indicate that this general trend is continuing.

The erosion/accretion of Dauphin Island is controlled in large part by geologic and physical forces. The entrance to Mobile Bay is not jettied, in contrast to many of those in Florida such as Pensacola and Panama City. A large ebb tidal shoal extends along the east side of the bar channel from Fort Morgan along 'Dixie Bar' seaward to the vicinity of the Sand Island Lighthouse. On the west side, the shoal extends along the remnants of the Sand Island-Pelican Island complex to the vicinity of the public fishing pier. In fact, Sand and Pelican Islands are subaerial portions of the shoal. This large shoal forms a natural 'sand by-passing plant' for littoral material with a predominantly east to west drift. Material passes across the inlet at a point where the seaward flowing currents are reduced in velocity. The material is then deposited on the western shoulder of the shoal and eventually returned to the nearshore littoral drift system of western Dauphin Island. All of the islands fronting the Mississippi Sound tend to migrate to the west in the direction of the predominant littoral drift. The east ends of Petit Bois and Ship Islands have in fact eroded at much higher rates than Dauphin Island, and there are no dredged channels immediately updrift of these islands. The erosion of the eastern end of Dauphin Island is probably a result of a combination of factors including waves generated from offshore as well as currents associated with the outflow of waters from Mobile Bay.

Mans' activities obviously play some role in modifying the sand transport system. In the early 1900's the eastern end of Dauphin Island was armored to prevent the erosion/destruction of Fort Gaines. This has prevented the sand resource which is the eastern end of Dauphin Island from entering the sand transport system and has artificially fixed the eastern end to a point in space. It has been estimated that one-half mile or more of the east end of the island would currently be open water had the armoring not taken place.

In addition, the maintenance of the bar channel portion of the Mobile Harbor project removes sand which would naturally be distributed along the western portion of the ebb tidal shoal and places it in water depths which are greater than that required for littoral sand transport. Although the 1902 River and Harbor Act provided for a 32-foot channel across the bar, it is believed that only limited dredging in this area was required until the channel was deepened in the late 1950's in response to the 1954 Act which provided for a 42-foot channel.

Much of the Mobile inlet is naturally deep water as evidenced by the fact that no dredging is required in the channel from just south of the Gulf Intracoastal Waterway in Mobile Bay to a point approximately one-half mile north of the Sand Island Lighthouse in the Gulf of Mexico. The maintenance requirement for the bar channel is restricted to a one and one-half mile reach at the lighthouse and southward. Approximately 420,000 cubic yards of sandy material is removed from this area every other year by hopper dredge and transported to the ocean disposal site approximately 3 miles south of Dauphin Island in water depths in excess of 30 feet. Our records indicate that since 1970 approximately 8.3 million cubic yards of maintenance material has been removed from the bar channel and 6.7 million cubic yards of new work was removed from channel between 1988-90. The maintenance material would be that material which would have been in the littoral drift system and trapped in the channel. Movement of this material without and with the Mobile Harbor entrance channel is depicted on the attached schematic. To put these quantities in perspective, it has been estimated that the ebb tidal shoal contains approximately 1.2 billion cubic yards of sand and that the net annual littoral transport to the west is about 196,000 cubic yards/year. Although the Corps is removing the entire net annual littoral transport quantity, the significance of this activity is not known due to the large amount of material in the ebb tidal shoal and the natural variability of the coastal system.

The construction and subsequent maintenance of the Fort Gaines Channel (a man made cut through the east end of Dauphin Island) has also interrupted the transport of sandy sediments along the western side of Mobile Bay to the east end of Dauphin Island. This activity has also been interpreted by some to play a role in the erosion process. Since the late 1980's the Corps has routinely placed the maintenance material along the

southeastern shore of the island, however the quantity is very small and the dredging requirement infrequent.

In 1978, the Mobile District completed a feasibility report entitled "Mobile County, Alabama Beach Erosion Control and Hurricane Protection". The results of this report indicated that with one exception, there were no alternatives which were either economically feasible or would be supported by the general public. The one exception was the modification of the current (at that time) practice for the maintenance of the Mobile Harbor bar channel. A number of unsupported assumptions were used to determine that the erosion of the 11 westernmost miles of Dauphin Island (beginning at the location of the public fishing pier) were the result of increasing sea level and the removal of sand from the littoral drift system through maintenance dredging. The conclusion of the report that the authority for this modification rested with the Chief of Engineers and that since no areas of local responsibility for the project would be affected that total responsibility for implementation and associated costs were a Federal responsibility. According to our files the report was returned to the District by South Atlantic Division for inclusion of the impacts of Hurricane Frederic. Division also indicated that any change in the maintenance practices for Mobile Harbor should be studied as part of that project not the Mobile County study. Further funding for the Mobile County study was not forthcoming and the study was subsequently deauthorized by Congress in 1987.

In 1980, the Mobile District improved the Fort Gaines channel from the Billy Goat Hole on Dauphin Island eastward to the main ship channel under a request from the Federal Emergency Management Agency. This channel was required to accommodate ferry service to Dauphin Island while the bridge was under construction. Approximately 500,000 cubic yards of sandy material was placed in the groin field at the eastern end of the island. In the intervening 15 years this material has been removed from this area as part of the littoral drift and distributed westward along the island and southward into Pelican Bay. The shoreline fronting property owned by the Marine Environmental Sciences Consortium (Sea Lab), the US Coast Guard, and the Audubon Bird Sanctuary are now showing loss due to the erosion of this material.

In 1986 the National Underwater Berm Demonstration Program was initiated by the Corps to investigate the feasibility and effectiveness of constructing underwater berms with dredged material for providing shore protection. In March 1987, a "feeder" berm was constructed with 656,000 cubic yards of material from the bar channel. This berm was placed in an area on the southern flank of the Sand Island shoal in 14 to 18 feet of water. The demonstration had three purposes: 1) determine the safety and effectiveness of shallow draft split-hull hopper dredges in maintaining this channel; 2) determine the costs associated with the action; 3) determine whether placement of

material in these depths of water would be beneficial in supplying sand to the littoral system. Results of the monitoring showed that over time the 'structure' melded into the Sand Island shoal so that it was no longer identifiable. Shallow draft split-hull dredges can perform the required activities, however there are only 2 in operation in the U.S. and they are owned by the same company. Increase in costs over that currently expended for this part of the channel would be approximately $294,000.00 per dredging cycle.

In 1992/93, the Mobile District in partnership with the Dauphin Island Park and Beach Board and the State refurbished the armor protection around Fort Gaines and placed hard protective structures around the public fishing pier under Section 14 authority. In addition to these activities, the suggestion was made to also reorient the detached offshore breakwaters parallel to the shoreline (currently they are perpendicular) in an effort to provide protection to the Sea Lab and Coast Guard property. A cost sharing partner was not forthcoming, however and this activity was not constructed. Both the Section 14 activities undertaken at this time have been successful at their intended purpose of protecting existing public facilities.

**** Costs presented above have been updated per the attached table.**

CURRENT STATUS: Based on Corps regulations for operation and maintenance of Civil Works projects (33CFR335), the baseline for maintenance of the channel is the *Federal Standard* which is roughly the least costly, environmentally acceptable, engineeringly feasible alternative. The *Federal Standard* for Mobile Harbor is the transport of all dredged material to the ocean disposal site as authorized by the Water Resources Development Act (WRDA) of 1986 (P.L. 99-662).

Section 933 of WRDA 86 provides that placement of dredged material on downdrift beaches is a viable alternative to the *Federal Standard* provided that a non-Federal entity pick up 50% of the additional costs and that the incremental increase in cost is offset by national economic development benefits. Based on the results of the feeder berm demonstration, the non-Federal entity would be responsible for approximately $147,000 per dredging cycle for the placement of material on the Sand Island shoal. This would allow the resumption of the natural transport of sand in the littoral system but would not provide immediate (or possibly even long-term) relief to the erosive areas on the eastern end of the island. What is not certain however is whether we could find economic benefits to offset the increase in costs as per our regulations, however recent developments indicate that non-quantifiable environmental benefits may be utilized. Other authorities, such as Section 111 or Section 204 are not as attractive - to either the Corps or the locals due to cost sharing or future maintenance requirements.

A separate but equally important factor to consider it that placement of maintenance material on the Sand Island shoals is not going to solve the erosion problem on the east end of Dauphin Island, but will merely over the long term allow the resource to migrate in the littoral transport system as if the channel were not in place. As an effort to help alleviate the erosion of the east end of the island, the District has suggested to the Mayor of Dauphin and the Alabama Department of Economic and Community Affairs staff the possibility of a Section 22 study (Planning Assistance to States) as a means of determining the best alternative means of providing relief for existing eroded areas and some protection for the future. To date, however, there has been no response from any local entity.

In consultation with the Alabama Department of Environmental Management, the District has recently proposed the designation of a large area of the subtidal delta as the *Sand Island Beneficial Use Area.* This area would be utilized for the placement of materials dredged from the entrance channel when suitable equipment, i.e. hopper dredge with draft requirements shallow enough to transit the area safely, were being utilized for the maintenance of the Mobile Ship Channel. During the public notice advertisement period, concerns were raised about the possibility of cultural or historic resources being in the area and also about less than pure sand being placed in the site. We are

currently conducting an underwater survey of the area to locate possible historic resources. This information will be furnished to the State Historic Preservation Officer upon completion of the survey.

Regarding the physical quality of the material to be placed in the site, there may be opportunities to place 'mixed' materials, i.e. dredged materials with >50% sand but containing quantities of silts and clays in the beneficial use area. It is the opinion of the District and ADEM that placement of such material in the beneficial use area may be appropriate. This area naturally receives freshwater laden with silts during certain time periods, therefore placement of 'mixed' materials during these time periods may not result in adverse water quality impacts. We are currently coordinating with the Waterways Experiment Station the conduct of research on the placement of 'mixed' materials under the Dredging Operations and Environmental Research (DOER) program at Mobile.

As a result of shoaling caused by the passage of Hurricane Danny in September 1997, there was a requirement to dredge portions of the entrance channel. In cooperation with ADEM we were granted a one-time use of a small portion of the Sand Island Beneficial Use Area. Approximately 54400 cubic yards of sandy dredged material was placed in the site in late 1997.

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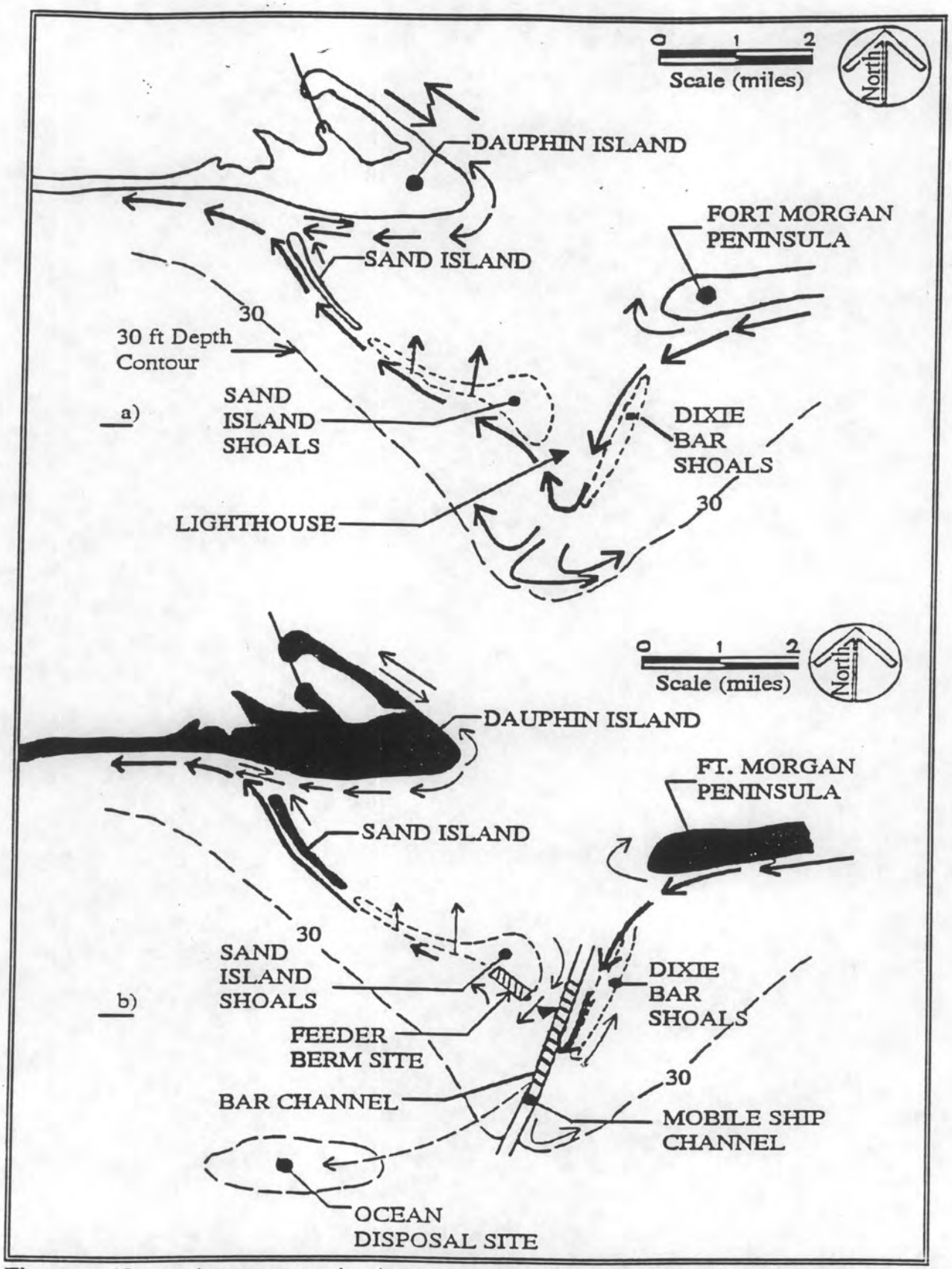

Figure 1: Net sand transport path: a) pre-dredging, b) present conditions (Modified from Douglass and Haubner (1992))

Dredging Quantity & Cost Data
Mobile Bar Channel

(Historical Average Annual Basis)

Alternative	Dredging Quantity Cubic Yards	Preliminary Estimates				
		Unit Cost $ /CY	Total Cost	Federal Cost	Local Cost	
Ocean Site via Hopper Dredge	210,000	$1.30	$273,000	$273,000	$0	1
Littoral Zone via Hopper Dredge	210,000	$2.00	$420,000	$346,500	$73,500	2
Dauphin Is. via Hopper Dredge	210,000	$5.50	$1,155,000	$714,000	$441,000	3
Littoral Zone via Pipeline Dredge	210,000	$4.75	$997,500	$635,250	$362,250	4
Dauphin Is. via Pipeline Dredge	210,000	$6.50	$1,365,000	$819,000	$546,000	5

Actual Quantity and Frequency is 402,270 cubic yards on 23 month frequency

1 CURRENT OPERATION UTILIZES A DEEP DRAFT HOPPER DREDGE AS PART OF TOTAL MAINTENANCE OF THE MOBILE HARBOR PROJECT

2 PLACEMENT OF BAR CHANNEL MATERIAL ON SAND ISLAND SHOALS USING AN SMALL CLASS HOPPER DREDGE

3 PLACEMENT OF BAR CHANNEL MATERIAL DIRECTLY ON EASTERN END OF DAUPHIN ISLAND USING DEEP DRAFT HOPPER DREDGE AND A SINGLE POINT MOORING DISCHARGE SYSTEM

4 PLACEMENT OF BAR CHANNEL MATERIAL ON SAND ISLAND SHOALS USING A PIPELINE DREDGE RIGGED FOR OPERATION IN DEEP WATER

5 PLACEMENT OF BAR CHANNEL MATERIAL DIRECTLY ON EASTERN END OF DAUPHIN ISLAND USING A PIPELINE DREDGE RIGGED FOR OPERATION IN DEEP WATER