The influence of the Mobile Pass ebb-tidal shoal elevations on Dauphin Island's beach erosion.

report to

Alabama Department of Environmental Management
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from

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UNIVERSITY OF SOUTH ALABAMA

DEPARTMENT OF
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January 6, 1998

Brad Gane
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2204 Perimeter Road
Mobile, AL 36615-1131

Dear Mr. Gane:

Enclosed are three copies of the final report entitled "The influence of the Mobile Pass ebb-tidal shoal elevations on Dauphin Island's beach erosion" by myself and Tina Sanchez. This cover letter will serve as an Executive Summary.

> About 400,000 cubic yards or 30,000 cubic yards per year of sand has shifted from the easternmost mile of Gulf beaches to the next mile of beaches to the west on Dauphin Island since 1984. The probable cause of this shift is a change in longshore sand transport rates due to changes in the wave climate caused by the northwestward migration of Sand/Pelican Island and the loss of elevation of the shoals around the outer portion of the ebb-tidal delta.
>
> A wave-driven longshore sand transport model is developed and used to evaluate the sensitivity of the beach shift to the shoal elevations. A two foot increase in the elevation of the shoals would have reduced the longshore sand transport rate, and thus the shift of sand along the beaches, to roughly 50% of the rate experienced (Figure 8).
>
> An estimate of such an impact on the 1996 shoreline position is shown in Figure 9. One implication of these results is that the most landward erosion experienced to date on the east end of Dauphin Island is the portion of the erosion most attributable to the removal of sand for the ship channel. Several management recommendations are made at the end of the report.

This report better develops and clarifies the technical linkage between the coastal engineering for navigation and the Dauphin Island beaches. These results should contribute to the policy decision-making process in a positive way.

Sincerely yours,

Scott L. Douglass, Ph.D., P.E.
Associate Professor

The influence of the Mobile Pass ebb-tidal shoal elevations
on Dauphin Island's beach erosion.

Background

Shoreline change analysis has shown that the Gulf of Mexico beaches of the east end of Dauphin Island (figure 1) have been receding along their easternmost mile while accreting along the next mile to the west (Sanchez, et al. 1996). Douglass (1994) argued that this pattern is due primarily to a shift in sand from the eastern beaches to the western beaches. The pattern of this shift of sand is consistent with one due to wave driven longshore sand transport along the beaches. The probable cause of this shift is a change in longshore sand transport rates due to changes in the wave climate caused by the northwestward migration of Sand/Pelican Island and the loss of elevation of the shoals around the outer portion of the ebb-tidal delta during the past few decades. Douglass (1994) concluded that the shoreline changes on the eastern end of Dauphin Island have been affected by coastal engineering activities including seawalls, groins, beachfills and dredging.

One of the engineering works identified by Douglass (1994) that has affected the coastal processes of Dauphin Island is the removal of sand from the littoral system where the Mobile Ship Channel crosses the outer bar of Mobile Pass. Perhaps as much as 50,000,000 cubic yards of sand have been removed from this area during this century. From 1974 to 1989 over 15,000,000 of material was dredged from this area and dumped offshore in depths beyond the active littoral zone. These volumes of sand can be envisioned several ways. The 50,000,000 cubic yards is about the same magnitude of sand removed from all of the federally maintained navigation channels in Florida. The 15,000,000 cubic yards is enough sand to build a 1000 ft. wide beach along the developed portion of Dauphin Island. It is more than 100 times the above sea level portion of Sand/Pelican Islands. The rate of removal is much greater than the rate at which sand moves along the Alabama coast and thus the pass has been acting as a sand "sink" along the beaches of the coast for decades. One of the management suggestions of Douglass (1994) was to study the correlation between the erosional-depositional patterns on Dauphin Island and the dredging history of Mobile Pass.

There have been significant natural fluctuations of the shoals and beaches in this area historically. Other investigators have described some of those fluctuations with historic navigation charts. Figures 2a and 2b show some reproductions of some of these data since 1849. US Army (1978) shows most of these historic shoreline positions in a figure that was reproduced in Douglass (1991b). Charts prior to 1849 also show significant changes but the horizontal

Figure 1 Location map.

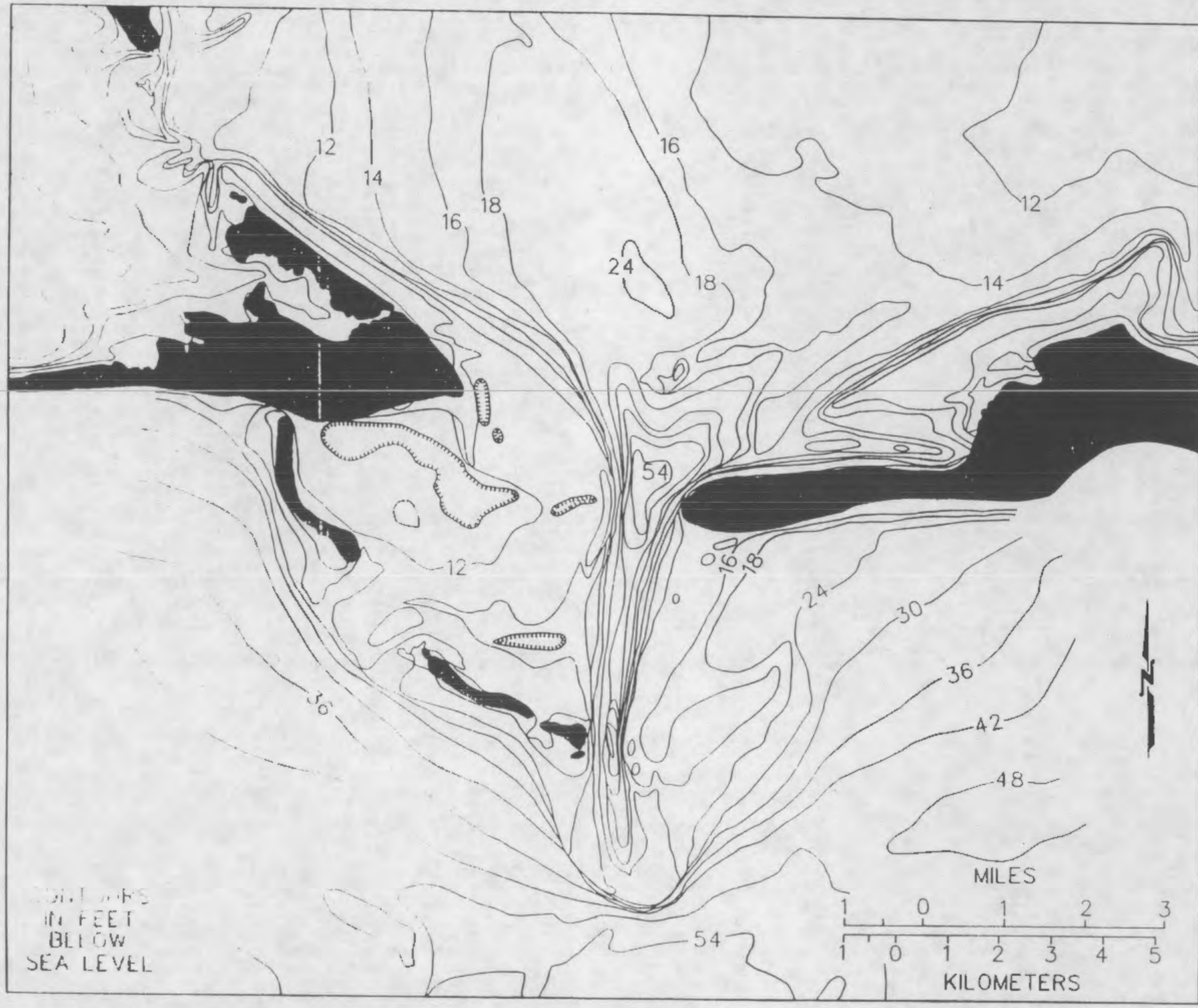

Figure 2a. Historic bathymetry and island shorelines of the Mobile Pass ebb-tidal delta: 1849 (from Hummel 1990)

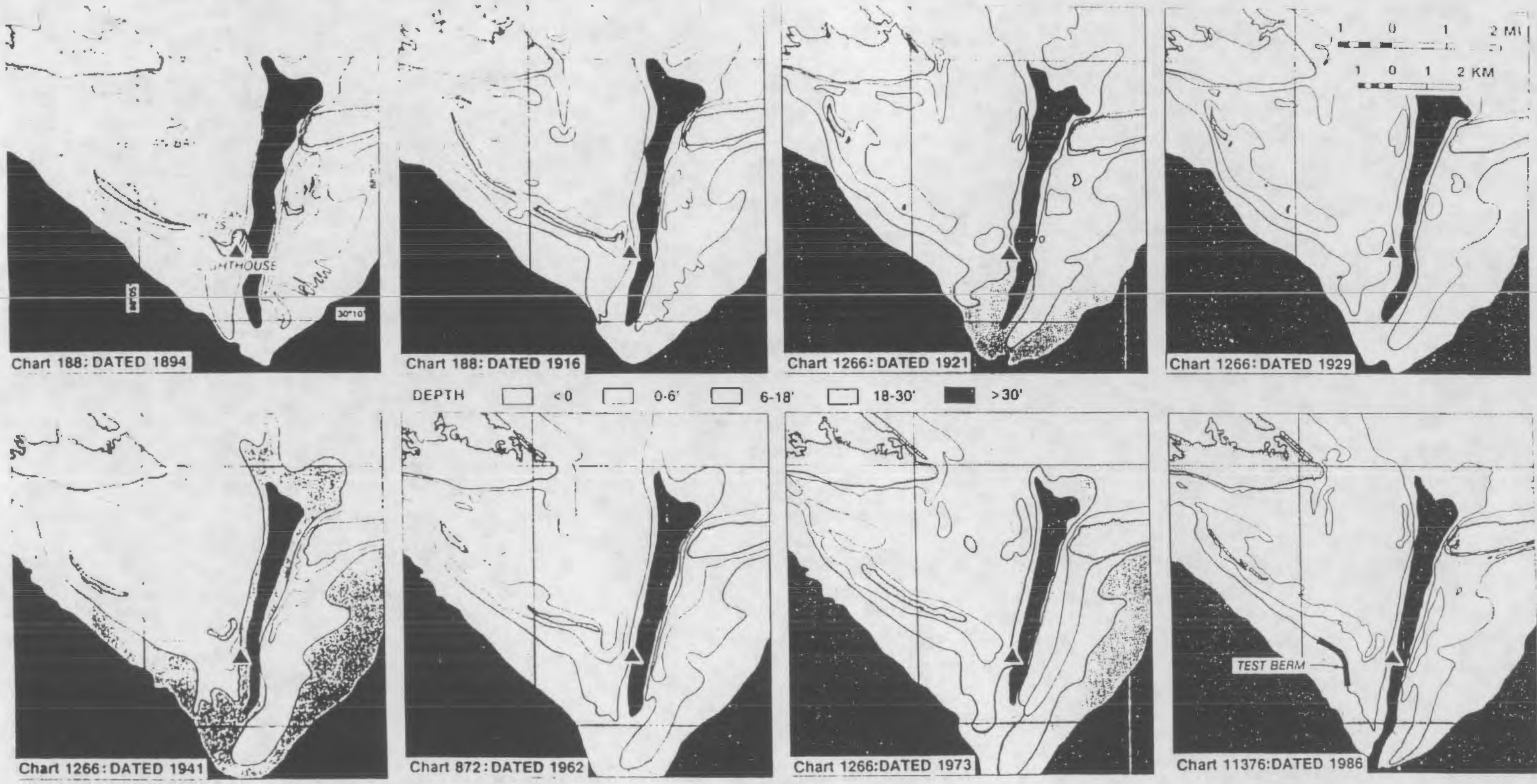

Figure 2b. Historic bathymetry and island shorelines of the Mobile Pass ebb-tidal delta: 1894-1986 (from Hands and Bradley, 1990)

control on surveys prior to this time frame was not as good as on later surveys and the locations of the shoreline are not as accurate (Shalowitz 1964). The old French charts of the early 1700's show a Pelican/Sand Island very far to the northwest as it was in 1849 and is today. Douglass (1994) speculates that the sand in these islands migrated onto Dauphin Island after those two surveys (1707 and 1849) in episodic events that caused a breach in Sand/Pelican Island and relocation of Pelican Passage to the south.

Separating out the natural beach fluctuations from man-induced beach fluctuations in the vicinity of inlets is difficult. Nonetheless, it is established in the coastal engineering community that engineering works at inlets such as jetties and dredging have impacts on the adjacent beaches.

This report investigates the linkage between the removal of sand from the littoral system on the outer bar and the beaches of the east end of Dauphin Island. It assumes that the removal of this much sand has lowered the elevations of the shoals in the immediate area of the outer bar. It then uses accepted oceanographic and engineering principles to evaluate the effect of higher shoal elevations on the beaches of Dauphin Island.

The influence of the sand removal on shoal elevations

One underlying assumption of this study is that the removal of sand from the outer bar of the ebb-tidal delta (in the vicinity of the Sand Island Lighthouse) has reduced the shoals in that area. Of the 15,000,000 cubic yards of sand removed from this area between 1974 and 1989, about half was for the deepening of the channel and half was for maintenance. Considering only the maintenance half, that volume of sand would raise the elevation of 4 square miles of ocean floor by about 2 feet. The shoals in the outer bar portion of the ebb-tidal delta (i.e. the vicinity of the lighthouse) include roughly 3 square miles of ocean floor. This is defined as the area landward of the 12 foot contour half a mile along 1½ miles of shoal on each of the Sand Island side and the Dixie Bar side of the ship channel. This is the area that has the greatest influence on waves approaching the east end of Dauphin Island from the southeast. This is also the area of the littoral system that is adjacent to the ship channel. It is the actively changing, outer portion of the ebb-tidal delta where the depths historically shoal up the most. Landward of this area, the depths across the rest of the ebb-tidal delta are about a constant 10 feet.

There are no clearly more appropriate, quantitative, engineering or oceanography methods for estimating the influence of the removal of sand from the ship channel on the adjacent shoals. However, given the large volume of removal in light of the total area of the outer shoals as described above, it is logical that the removal has reduced the elevations of these shoals. Removal of sand has been clearly linked to downdrift erosion at many other inlets. The usual mechanism is simple sand starvation of the downdrift beaches. Here, the downdrift areas are the shoals adjacent to the ship channel. It is reasonable to assume that both shoals, Sand Island Lighthouse and Dixie Bar, have been starved by the long-term removal of sand since sand is driven both ways by the variable wave climate.

Beach sediment budget

A sediment budget has been developed for the east end of Dauphin Island. The focus has been on the Dauphin Island beaches in the direct lee of the sheltering provided by the ebb-tidal shoal. The sediment budget is based on four sets of historic air photos of the east end from 1984 to 1996. Mosaics of these photos are shown in Figure 3.

The changes in land area due to shoreline changes in three reaches of shoreline are shown in Figure 4. The values in Figure 4 were computed for each of the sub-reaches shown and added together. Table 1 shows the land area change results by sub-reach. These land area change estimates were made from shoreline overlays (not shown) that were corrected for the scale differences of the air photos.

Figure 4 shows that Reach 1, the easternmost beaches, lost 23 acres of land between 1984 and 1996. Of this, 12 acres were lost from 1984 to 1990. Reach 2, the beaches to the immediate west that include the two accretionary hulge-like formations, gained less than 10 acres of land from 1984 to 1996. Thus, there is not a one-to-one relationship between the area losses in Reach 1 and the area gain in Reach 2. However, the depths of water where the beaches were accreting in Reach 2 was much greater than the depths of water offshore of where the beaches were receding in Reach 1.

Volume change estimates were made for each sub-reach and reach by assuming that beach profiles maintained a constant shape from the depth of profile closure to the top of the sand dune. Thus, the volumetric changes can be estimated by multiplying the area change by the assumed vertical extent of the profile change. The volume change estimates are shown in Figure 5 and given in Table 2. The assumed vertical changes used to estimate the volume changes are given in Table 3. The vertical change assumptions are based on a combination of beach profiles, the 1994 NOS bathymetric chart, and some bathymetric data observations collected in 1996 and 1997.

Figure 5 shows there was close to a one-to-one relationship between the volume of sand eroded from Reach 1 and the volume of sand deposited in Reach 2. Between 300,000 and 400,000 cubic yards of sand shifted from Reach 1 to Reach 2 in these 12 years. Reach 3 changes are small compared to the other two reaches. It is assumed that sand movement past the east end of Reach 1 in either direction is negligible because of the groins and seawall. The average rate of the shift of sand was about 30,000 cubic yards of sand per year from Reach 1 to Reach 2. Of course, the rate was not constant in time.

Several small beachfills placed at the east end of Reach 1 have not been directly accounted for in this sediment budget. The fills have been disposal of sand dredged from the small-craft navigation projects on the northeast side of Dauphin Island. Efforts to obtain information concerning the volumes of sand placed in this area have been unsuccessful. This is coastal engineering information that should be gathered and evaluated in terms of its impact on the beaches.

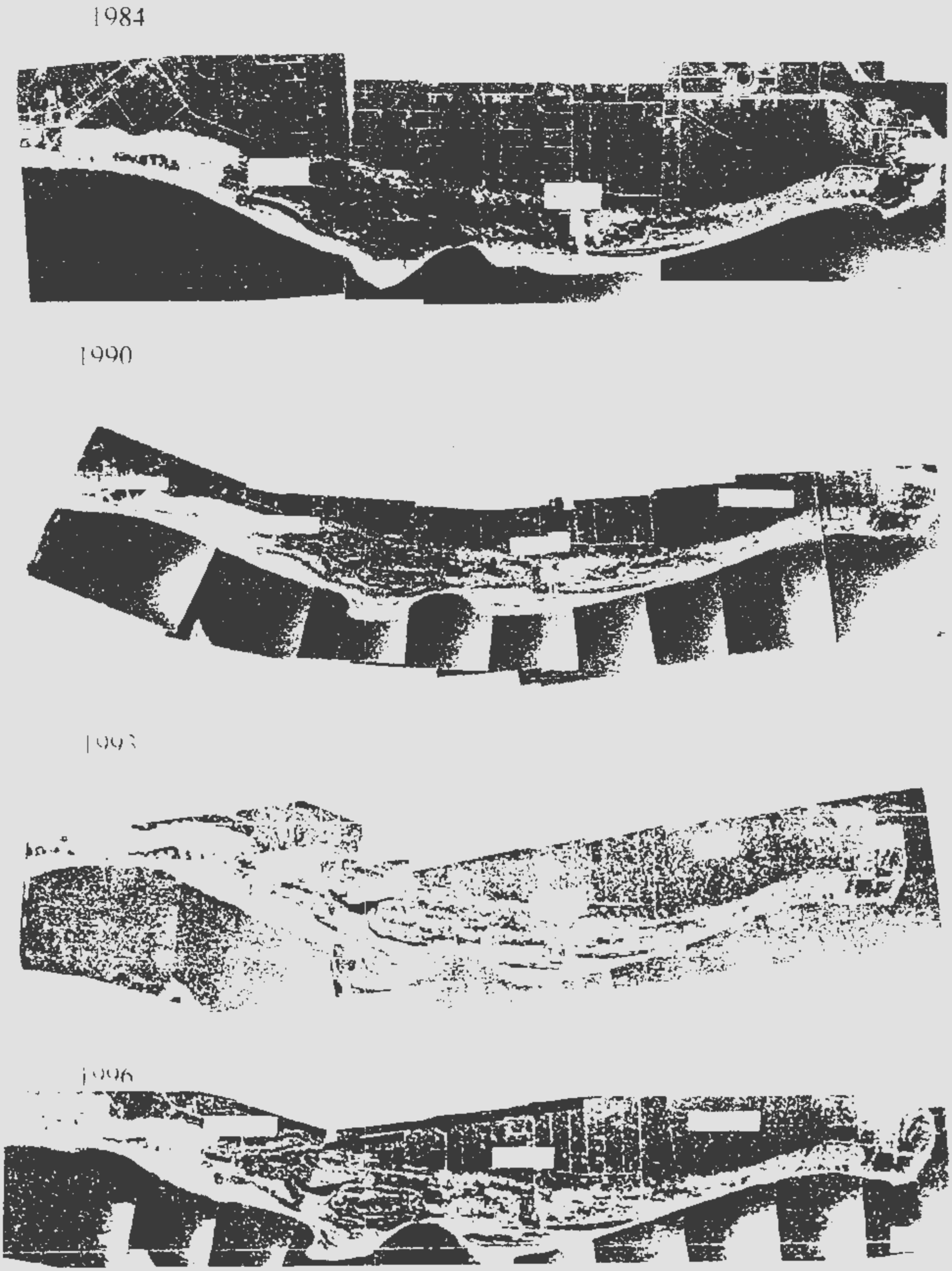

Figure 3 Air photo mosaics of the east end of Dauphin Island in a) 1984, b) 1990, c) 1993, and d) 1996

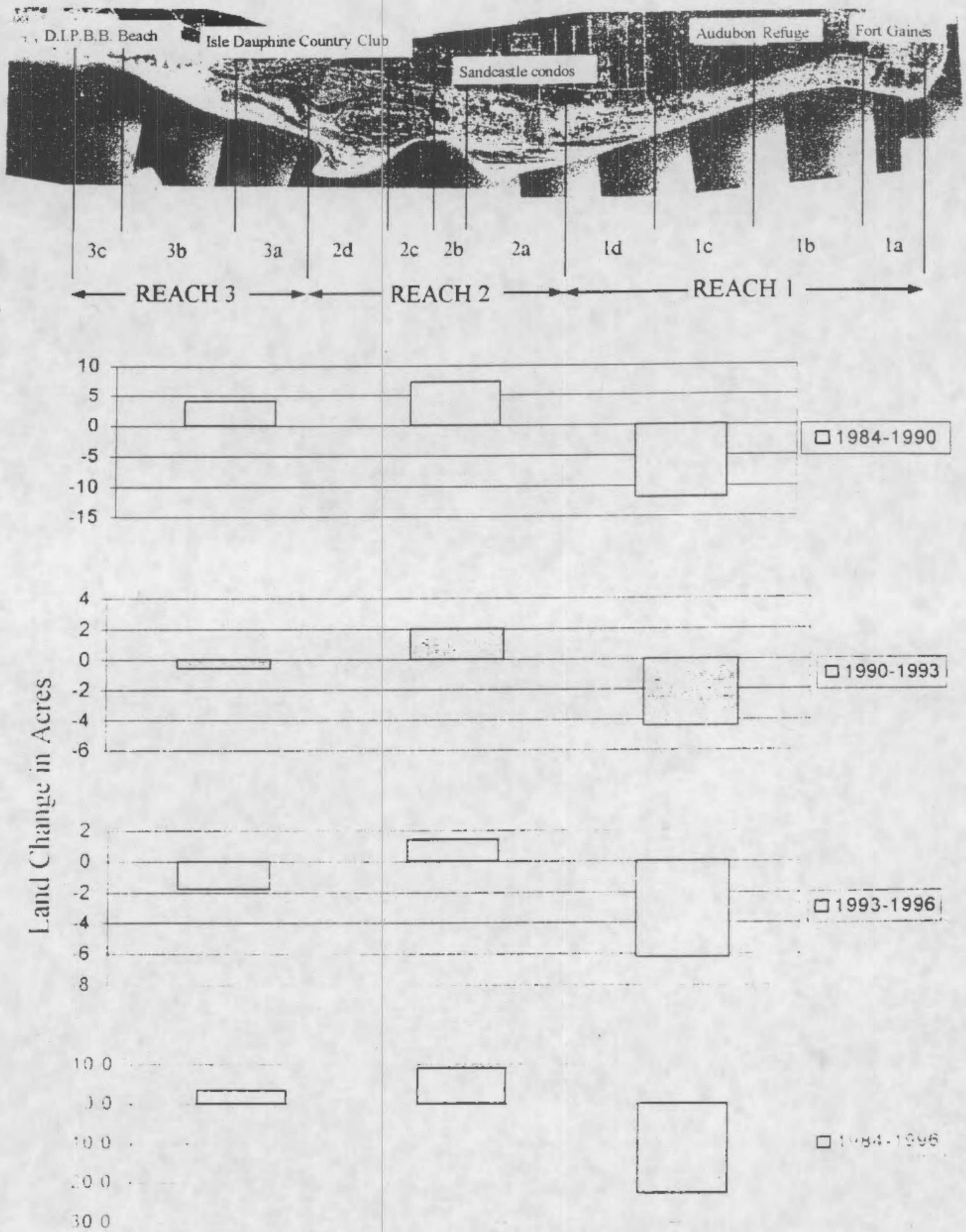

Figure 4. Land area change on the east end of Dauphin Island. 1984 to 1996. Values are acres.

Table 1. Land area change on the east end of Dauphin Island, 1984 to 1996. Values are in acres.

SUBREACH	TIME PERIOD			
	1984-1990	1990-1993	1993-1996	1984-1996
Subreach 1a:	-3.2	-0.9	1.6	-2.5
Subreach 1b:	-3.7	-2.3	1.4	-7.4
Subreach 1c:	-3.7	-1.1	-4.1	-8.9
Subreach 1d:	-1.4	-0.1	-2.3	-3.8
Total for reach 1	-12.0	-4.4	-6.2	-22.6
Subreach 2a:	3.4	1.1	0.5	5.0
Subreach 2b:	0.0	0.0	0.0	0.0
Subreach 2c:	0.0	0.0	0.0	0.0
Subreach 2d:	3.0	0.9	0.9	4.8
Total for reach 2	6.4	2.0	1.4	9.8
Subreach 3a	0.5	-0.9	-1.6	-2.0
Subreach 3b:	3.9	0.9	1.1	5.9
Subreach 3c:	-0.3	-0.6	-1.4	-2.3
Total for reach 3:	4.1	-0.6	-1.9	1.6

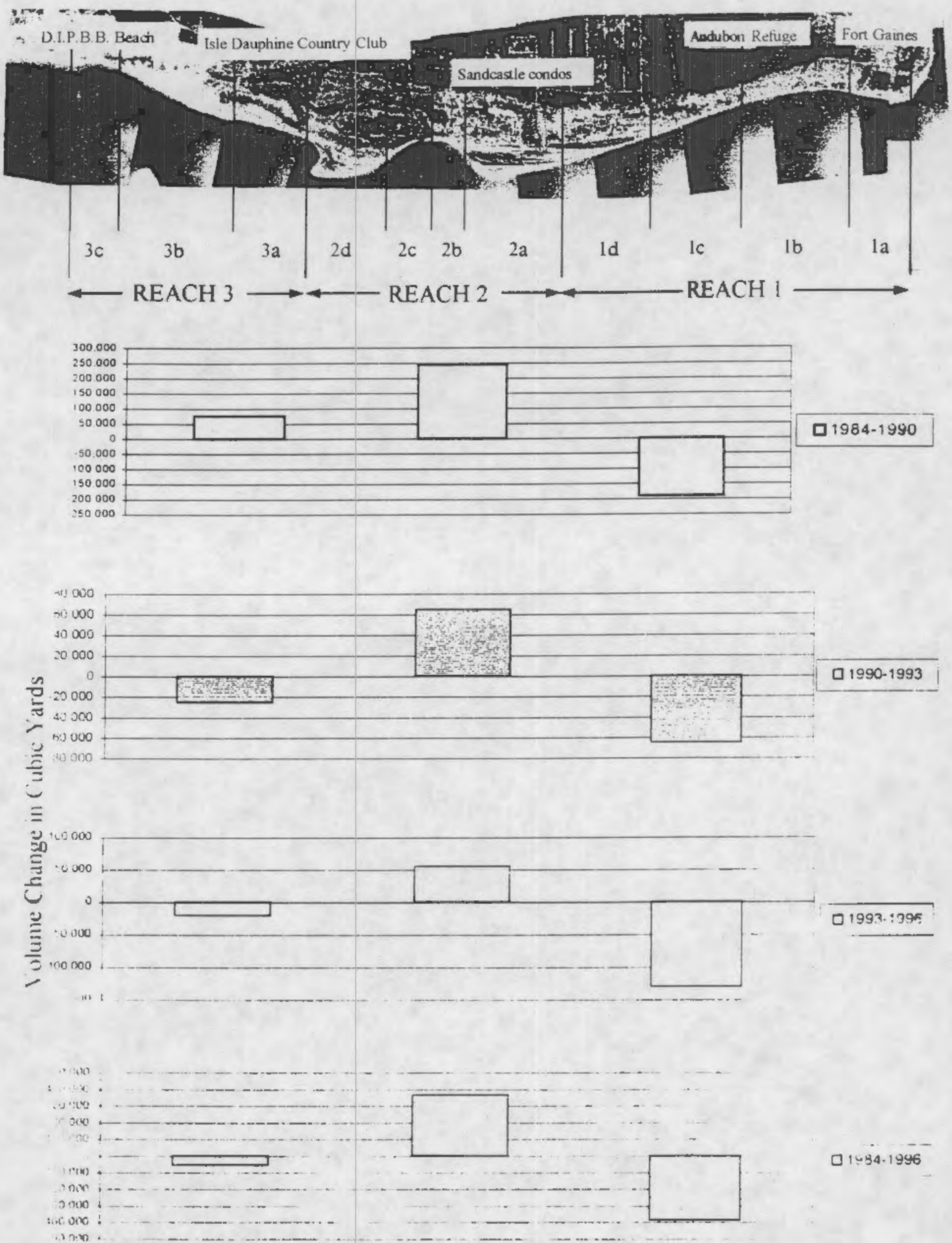

Figure 5. Sand volume change estimates on the east of Dauphin Island, 1984 to 1996. Values are cubic yards.

Table 2. Sand volume change estimates on the east of Dauphin Island, 1984 to 1996. Values are in cubic yards.

SUBREACH	TIME PERIOD			
	1984-1990	1990-1993	1993-1996	1984-1996
Subreach 1a:	-35,000	-10,000	20,000	-30,000
Subreach 1b:	-60,000	-35,000	-25,000	-120,000
Subreach 1c:	-60,000	-20,000	-65,000	-140,000
Subreach 1d:	-35,000	-2,000	-60,000	-96,000
Total for reach 1	-190,000	-67,000	-130,000	-386,000
Subreach 2a:	125,000	45,000	20,000	190,000
Subreach 2b:	0	0	0	0
Subreach 2c:	0	0	0	0
Subreach 2d:	110,000	30,000	35,000	175,000
Total for reach 2.	235,000	75,000	55,000	365,000
Subreach 3a:	15,000	-30,000	-30,000	-40,000
Subreach 3b:	65,000	15,000	20,000	10,000
Subreach 3c:	-5,000	-10,000	-10,000	-25,000
Total for reach 3	75,000	-25,000	-20,000	-55,000

Table 3. Assumed vertical extent of sand changes used for volume change computations. This is the sum of the height of the beach or dune system and the depth of closure on the offshore profile.

Reach	Sub-reach	length (ft)	Avg Berm Height (B) (ft)	d (ft)	Ass[illegible] (B+d)
1	1a	1075	4	3	7
	1b	1950	4	6	10
	1c	1825	4	6	10
	1d	1725	3	12	15
2				20	23
	2a	1525	3	6	10
	2b	600	4	6	10
	2c	950	4	20	23
	2d	1550	3		
3				18	22
	3a	1200	4	6	10
	3b	2200	4	6	10
	3c	1000	4		

of the energy from the WSW, SW and SSW directional bands on Figure 6 will have a significant impact of the longshore sand transport on Dauphin Island. This energy will be blocked by the present-day location of Sand/Pelican Island (see Figure 7). Subsequent regeneration of waves in the lee of Pelican Island is small.

Wave energy from the S, SSE, SE, and ESE will be significantly reduced by wave breaking and other attenuation across the ebb-tidal shoals. Waves driving longshore sand transport on Dauphin Island have crossed the shoals on the outer edge of the ebb-tidal delta and several miles of relatively flat bottom in Pelican Bay (Figure 7). The larger waves will have broken and reduced their height before reaching Dauphin Island.

A depth-limited height reduction can be modeled as

$$H_{max} = c\ d \qquad (1)$$

where H_{max} = the maximum spectral significant wave height that will propagate across a depth d, and c= an empirical coefficient. The empirical coefficient c is set at 0.5 for this work. Higher values of c are typical for wave height definitions based on individual waves or statistical definitions for heights in an irregular sea state. The WIS data are given in terms of the spectral significant wave height and this value is appropriate.

One implication of these assumptions is that the maximum wave heights on Dauphin Island will be about 3 to 4 feet. This seems reasonable and agrees with the limited, available wave observations on the Dauphin Island beaches. The water depth, d, in Equation (1) will be considered a variable in the section below that evaluates the impact of different shoal depths on the beach erosion.

CERC's sand transport model

The so-called "CERC equation" (US Army 1984) relates the breaking wave height and direction to the potential volumetric longshore sand transport rate as

$$Q = K\ H^{5/2} \sin(2\theta) \qquad (2)$$

where Q = volumetric longshore sand transport rate, H = wave height at breaking, θ = angle of the wave crest relative to the shore, and K = an empirical coefficient. In this study, K is set, or calibrated to roughly match the longshore sand transport implied by the sediment budget on the east end of Dauphin Island. Equation (2) provides an order-of-magnitude estimate of transport rate.

The wave heights in Figure 6 for the three directions east of south are used in Equation (2). The wave angle for all the energy in each band is assumed to be at the center of the

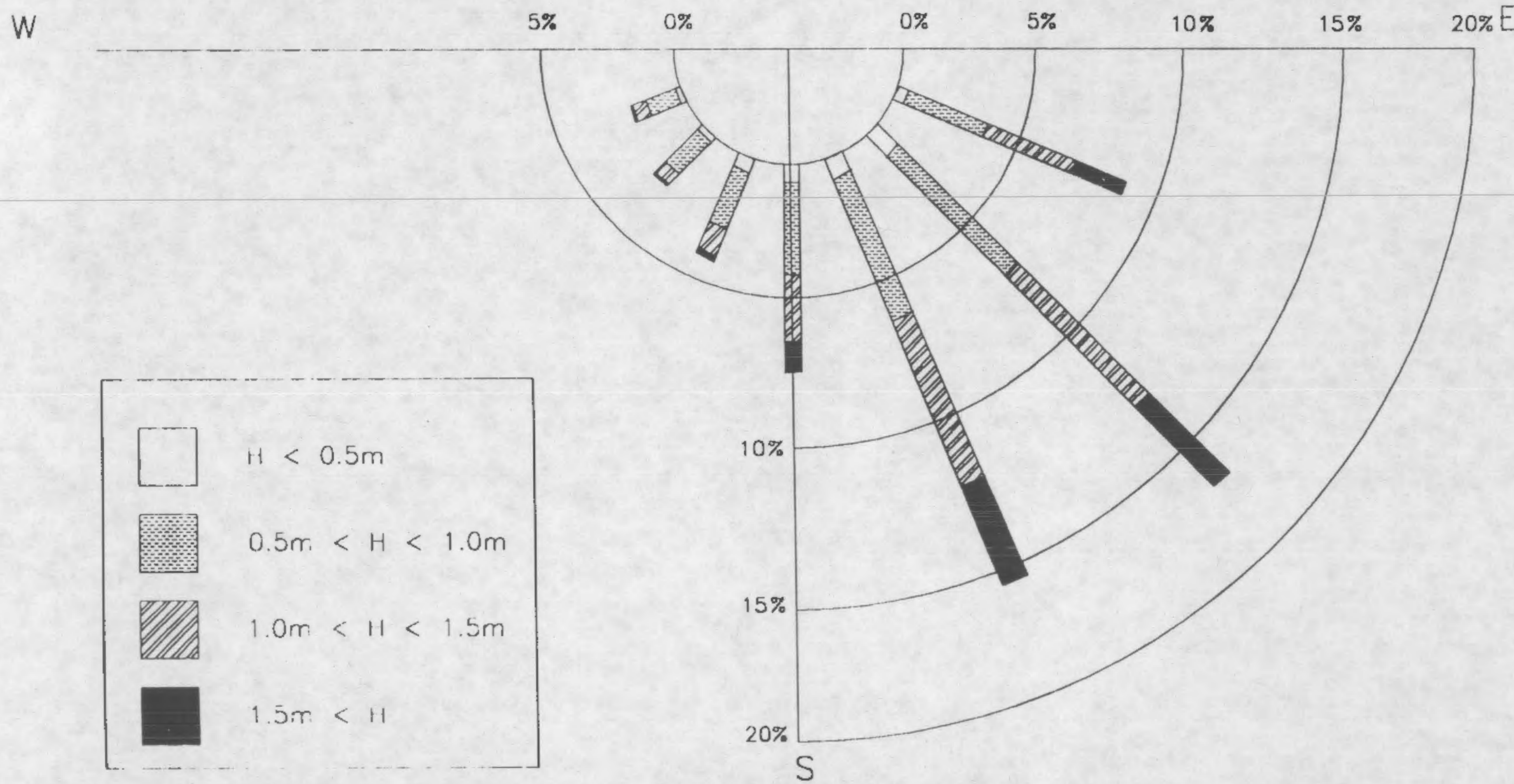

Figure 6. Offshore wave climatology for Dauphin Island. Estimate of percentage of occurrence of wave height, [redacted] and direction for 1956-1975 based on US Army Corps of Engineers Wave Information Study wave hindcasts (onshore components of W.I.S. station 27 from Hubertz and Brooks, 1989)

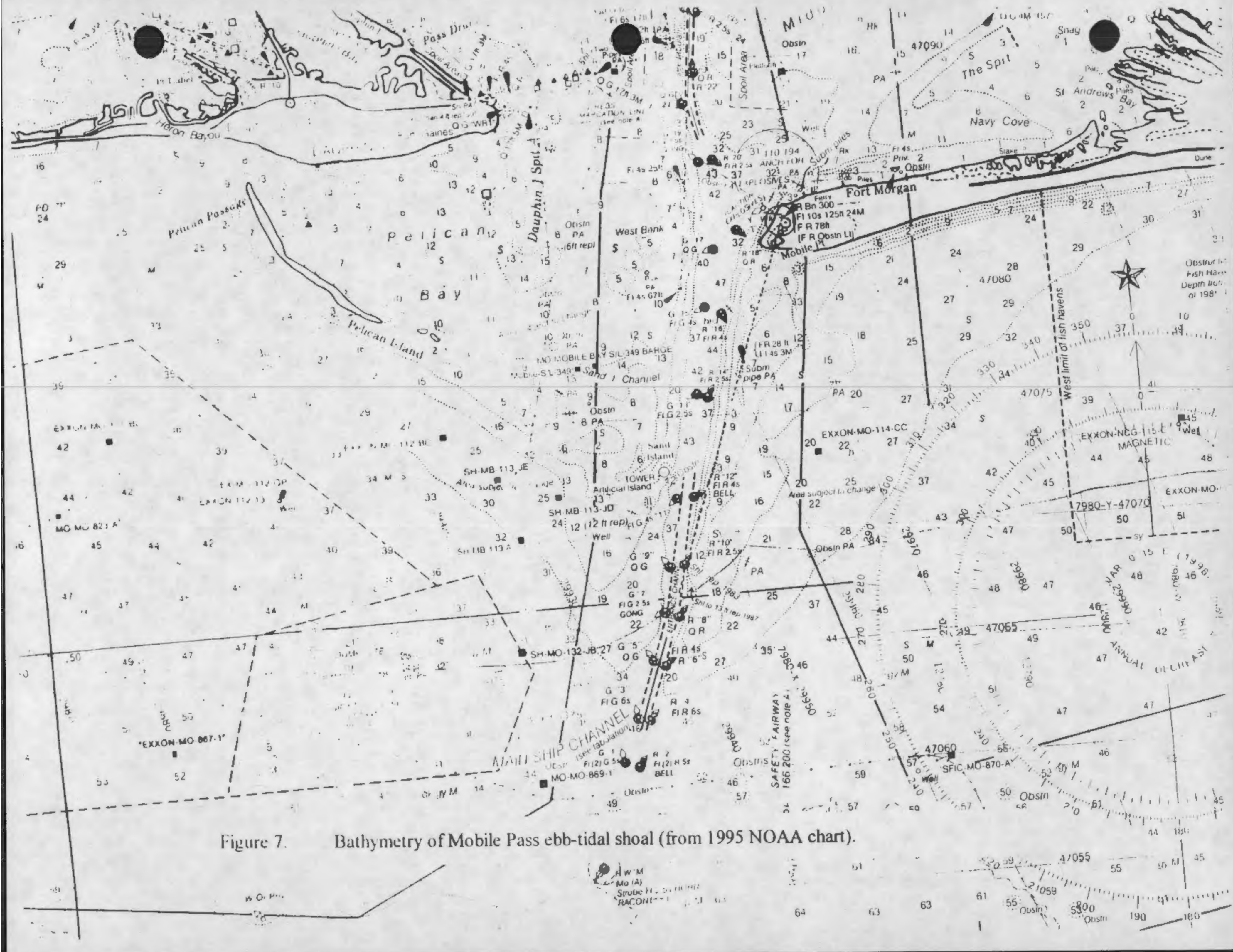

Figure 7. Bathymetry of Mobile Pass ebb-tidal shoal (from 1995 NOAA chart).

band. Waves from the south directional band are not used in the longshore sand transport calculation since they are assumed to approach from directly onshore and will thus result in no transport in Equation (2). The middle height for each height band is used in Equation 2. This will underestimate the transport somewhat from the bands that have an even distribution of wave energy by height but overestimate the transport rate from the bands that have more energy in the lower portions of the band. The full height bands provided by WIS include energy at heights of up to 5 m in increments of 0.5 m. The full data were used in the computation, not the reduced form that lumps all wave heights over 1.5 m into one band as shown in Figure 6.

The transport rate from the sediment budget was used to calibrate the model. The depth-limit imposed on the waves reduces the larger wave heights according to Equation (1). A single controlling depth across all three contributing bands was assumed as 7 ft. This is an average depth assumed for the directions that are contributing energy to these beaches. It is intended as a single approximate mean water level depth and is based on inspection of the bathymetry of Figure 7. The transport coefficient, K, in Equation (2) was set so that Q=30,000 cubic yards per year.

Influence of shoal elevations on beach erosion

The longshore sand transport model can be used to evaluate the influence of additional shoal elevation on the beaches of Dauphin Island. By varying the assumed controlling elevation of the shoals, the sand transport rate varies significantly. Figure 8 shows the results of different assumed elevations. Increasing the elevation of the shoals one foot will reduce the volumetric transport rate on the beaches of Dauphin Island to roughly 75% of the rate experienced. Increasing the elevation of the shoals by 2 feet would reduce the transport rate to roughly 50% of the rate experienced. The transport coefficient, K, was not varied in Figure 8.

The impact of the reduced longshore sand transport rates on the beaches is a reduction in the volumetric shift of sand. An estimate of the impact of only 50% of the actual volumetric shift on the shoreline position is shown in Figure 9. Figure 9 was created by assuming the volumetric changes that occurred in Reaches 1 and 2 of Figure 5 would have been 50% less. The shoreline position change estimate was developed directly from this volumetric reduction by converting the volume changes in each sub-reach to shoreline position changes assuming the beach profile would remain of a constant shape. This is consistent with the procedure used to estimate the volume changes in the sediment budget above. The same assumptions of depth of closure and height of dune crest were used. The shoreline change was plotted in the center of each sub-reach and the remainder of the shoreline position was determined by mimicking the general shape of the 1996 shoreline.

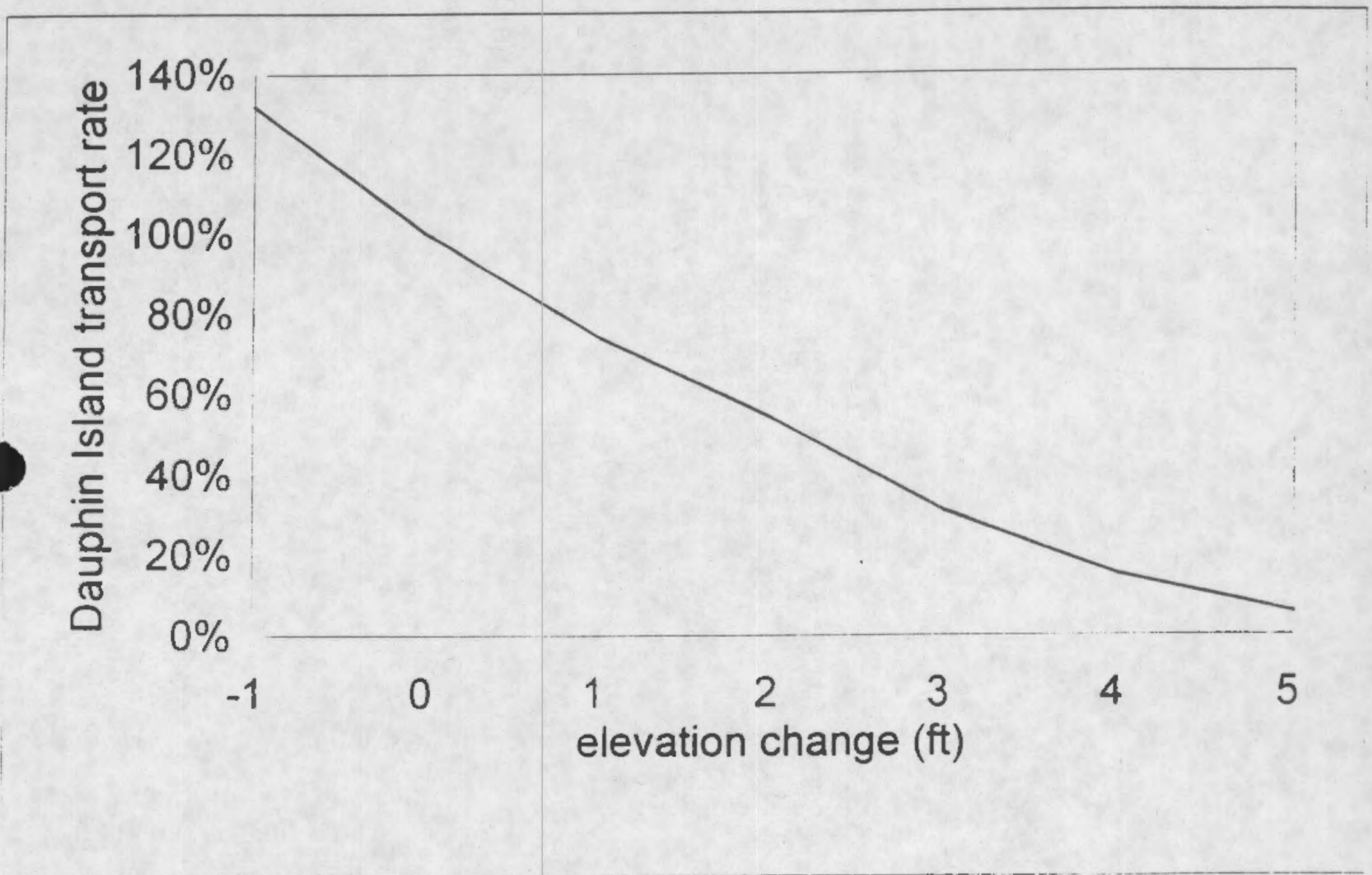

Figure 8. Influence of a change in elevation of the outer shoals of the ebb-tidal delta on the westerly longshore sand transport rate along the east end of Dauphin Island.

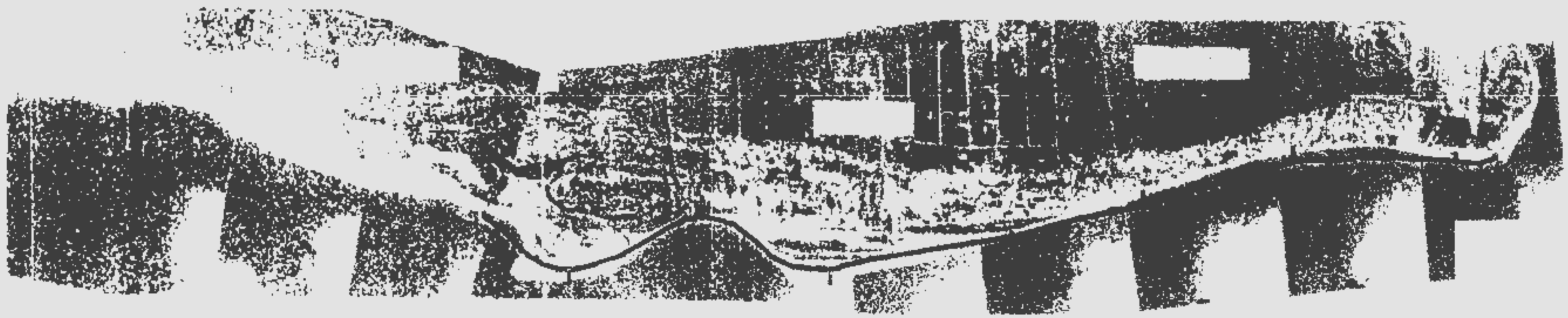

Figure 9. Estimate of the influence of two more feet of elevation of the outer shoals of the ebb-tidal delta on the 1996 shoreline position along the east end of Dauphin Island. This analysis is based on the 1984 shoreline as a starting position.

Discussion

The quantitative model

The model results show that the beaches of the east end of Dauphin Island are sensitive to the elevations of the shoals around the lighthouse. This sensitivity, shown in Figure 8, is due to the sensitivity of the processes modeled by equations (1) and (2). These model equations were used for their simplicity. The actual physical processes of wave transformations across these shoals and the longshore sand transport in response to the waves are much more complex. More complex models of these phenomena exist and could be developed for this area. However, the most important aspects of these complex phenomena are scaled correctly here and the simplicity was chosen to highlight the relationship between the shoals and the beaches most clearly. The fundamental result will not change with more complex models. Specifically, coastal science and engineering principles indicate that the beaches of Dauphin Island are sensitive to the offshore shoal elevations.

The results presented above quantify the relationship between the beaches and the shoals for this one inlet. These quantitative results are rather original from the perspective of the international coastal science community. Similar qualitative relationships between ebb-tidal shoal effects on waves have been discussed by some investigators but the quantitative modeling has been limited. These results imply that shoreline change modeling can be used within the immediate vicinity of inlets as originally suggested by Douglass (1991a).

Removal of sand from Mobile Pass

Figures 8 and 9 show quantitative estimates of the relationship between the beaches at the east end of Dauphin Island and the shoals along the outer margin of the ebb-tidal delta. These results are an indication of the indirect effects of the long-term removal of sand from the area around the lighthouse. One implication of these results is that the most landward erosion experienced to date on the east end of Dauphin Island is the portion of the erosion most attributable to the removal of sand near the lighthouse.

It was noted above that the effect investigated in this study is not the usual effect of dredging removals on adjacent beaches. Although all such cases are complex, the usual signature of such removals is one of sand starvation and erosion on the downdrift beaches. Such starvation effects are probably present on Dauphin Island but they are partially masked by the natural variability of the system and the large amount of sand in the ebb-tidal shoal. Also, for Mobile Pass, the most immediate downdrift area is not Dauphin Island, but the shoals around the old Sand Island lighthouse (and the Dixie Bar shoals during times of transport reversal). It is the lowering of these shoals that is indirectly exacerbating the erosion on Dauphin Island by changing the wave climate.

There are other effects of the ship channel and other coastal engineering works on the coastal processes in the study area beyond the one effect studied here. Douglass and Haubner (1992) identified several of these. All of these likely effects should be considered as environmental and societal impacts of the engineering. As such, the more important ones should be understood and if necessary mitigated.

Policy implications

This study focussed on technical issues. The technical result is that the removal of sand from the vicinity of the lighthouse has probably had an impact on the beach erosion along the eastern end of Dauphin Island. Two technical responses could be considered. One, dredged sand could be placed in the adjacent shoals to mimic the natural bypassing that would occur without the ship channel. Two, the sand could be placed directly on the beaches of the east end of Dauphin Island. Costs are an issue. The first alternative should actually reduce the costs of the navigation project maintenance since sand would not have to be moved as far. Regardless, the true costs of the removal have not been evaluated in terms of the overall benefits to society including Dauphin Island. The second alternative may be the most appropriate since sand is needed on these beaches and large amounts of sand are being handled several miles away.

Since policy is a balance of other important considerations beyond the technical issues, the response to these findings could reasonably and significantly vary. In fact, Mobile Pass is an example that policy response is not solely driven by technical issues. In 1987, the Mobile District of the Corps of Engineers placed the sand removed from the ship channel's outer bar on the ebb-tidal shoals. This project demonstrated that the sand could be retained in the littoral system. It was technically a success at demonstrating a beneficial use of dredged material. However, sand dredged since then has been dumped offshore outside the littoral system.

Although the specific mechanisms detailed in this study may be unique, the general recognition that the littoral system is connected is well established. Specifically, navigation projects have impacts on the adjacent beaches. While navigation projects and beaches are clearly technically linked; government policies, laws and structures do not clearly link them. A recent study by a committee of coastal experts appointed by the Marine Board of the National Research Council (1995) made some specific recommendations concerning this issue. The following is some discussion and three recommendations from that report:

"<u>*Coordination of Navigation and Shore Protection Projects*</u>

The USACE (US Army Corps of Engineers) constructs and maintains both navigation and beach nourishment projects. The implementation of one type of project can have significant impacts on the other; yet the costs and benefits of the two types of activities have not been considered jointly insofar as the committee can determine.

Construction and maintenance of navigation projects that result in the trapping of sand from adjacent beaches often cause erosion of those beaches. Although the USACE has authority to address cause and effect on specific projects, current practice does not encourage coordination and correlation of the effects of navigation projects with the erosion mitigation and nourishment needs of nearby beaches. The occasional placement of beach-quality sand obtained from navigation projects on eroding beaches is more a matter of economic convenience as a least-cost disposal option rather than a planned action to minimize disruption of the littoral system. The many instances in which dredged beach-quality sand has been disposed of offshore rather than on adjacent beaches does not recognize the economic value of the sand. The cost of offshore disposal is greater than estimated in the past when only the direct cost of offshore disposal was considered.

Recommendation: Beach-quality sand dredged from federal navigation projects should be used for beach nourishment projects where the benefits to the latter exceed the extra direct costs to the navigation projects. Implementing such an approach requires that a navigation project be "charged" the cost of any sand budget deficit that it might impose on the adjacent shoreline.

Recommendation: The U.S. Army Corps of Engineers should modify its policies to require both consideration of the economic value of the sand and the placement of beach-quality sand dredged from federal navigation projects in the littoral system from which it was removed. The U.S. Army Corps of Engineers should coordinate and correlate the construction and maintenances of coastal navigation projects with erosion mitigation along adjacent beaches.

Recommendation: The U.S. Army Corps of Engineers should revise its procedures for cost-benefit analysis of navigation and beach nourishment projects in which there is federal involvement to require calculation of both the benefits provided and the cost that one type of project imposes on another."

These recommendations by the National Research Council are appropriate for Dauphin Island and Mobile Pass and should be pursued. Specifically, this means the federal economic analysis should be modified to include the true cost of offshore sand disposal. This includes the cost of the loss of that sand on the beaches of Dauphin Island as well as the actual hauling costs. Typical unit costs for beach quality sand are roughly $10 per cubic yard. This is greater than the hauling costs. The inclusion of this true cost would probably change the least-cost disposal option to one of beach nourishment.

State and local policies that treat the sand as a valuable resource should also continue to be pursued. One such policy that Florida has is a clear statement in their coastal management plan that sands dredged from the inlets should be placed back in the littoral system. Such a statement should be included in the Alabama Coastal Area Management Plan. Although federal/state jurisdictional issues may be raised during any future attempts to apply such a policy at Mobile Pass, Alabama should have the policy statement because the beaches of the state are so valuable to the economic strength, environmental well-being, and the general quality-of-life in Alabama.

Also, when sand is dredged from or placed in the littoral system of the state, the proponent should be required to clearly state where the sand is coming from, where it is being placed, how much sand is being moved, and document its grain size distribution. Such projects should then be monitored after construction to document how the engineering has behaved. Since the technical tools for predicting the fate and impacts of coastal engineering are so limited, one of the most valuable tools for management of the beaches is ongoing and post-project monitoring. Specific examples where such information would be valuable are the dredging of Mobile Pass and the disposal of sand on the east end of Dauphin Island. There are similar issues at the other passes in Alabama. Some of this information should be available yet it is not being adequately collocated or made public. Some of it is not available because it is not being collected.

It is hoped that this present study further develops and better clarifies the technical linkage between the engineering for Mobile Pass navigation and the Dauphin Island beaches. It is further hoped that these results will contribute to the policy decision-making process.

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