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Shoreline Process ~~Study~~

Texas Gulf Shoreline From the Rio Grande Northward  
To the Mansfield Jetties

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INTRODUCTION

The Texas shoreline lying between the Rio Grande and the Mansfield Jetties is in a zone of rainfall deficiency. It is also in an area where predominant onshore winds are from the southeast quadrant. This coastal segment is also in a state of rapid erosion with exception of shoreline segments immediately adjacent to the Brazos Santiago and Mansfield Jetties. Two dominant processes operate along south Padre Island. First, because of the predominant southeast wind, waves strike the coast at a high angle thereby setting up longshore currents that moves sand northward. The Texas coast is wave-dominated (meaning wind-generated waves are the dominant geologic agent in the nearshore zone) and in the absence of sand influx into the beach and near-shore areas, these waves became highly erosive agents. Secondly, the predominant southeast wind in conjunction with rainfall deficiency, becomes the dominant geologic agent on the emergent parts of Padre Island. Plant cover on south Padre Island is sparse as a consequence of low rainfall, and since vegetation is required to stabilize subaerial sand the winds are able to transport much of the backbeach sand northwest across Padre Island into Laguna Madre. The result of these two dominant processes, in conjunction with compactional subsidence and frequent hurricanes, is (1) erosion of Gulf beaches, (2) lagoonward

migration of the backside of Padre Island, (3) a sparse vegetation cover and an overall low profile island, (4) numerous storm channels across the island, and (5) only local development of fore-island dunes.

Historical monitoring and on-the-ground measurements by the Bureau of Economic Geology indicates that south Padre Island, from the mouth of the Rio Grande to the Mansfield Jetties is erosional. The time intervals used for monitoring were 1934-1955 and 1955-1960. South of Brazos Santiago Pass to the mouth of the Rio Grande the shoreline is erosional with exception to the area immediately south of the jetties at Brazos Santiago Pass. Erosion increased from 33 feet per year at the mouth of the Rio Grande for the period 1934-1955 to 40 feet per year for the 1955-1960 interval. An average erosional rate of 8.5 feet per year typifies the remainder of south Padre Island (to Mansfield Jetties) for the time interval 1934-1955. This same coastal segment had an average erosional rate of 12.6 feet per year for the period 1955-1960. These data indicate that erosional rates along south Padre Island have increased over the 25-year period for which we have record.

#### EFFECTS OF MAN-MADE STRUCTURES

There are two types of man-made structures, in the area of south Padre Island, that influence the accretionary or erosional tendencies of shorelines. First, there are the jetty systems at Brazos Santiago Pass and the Mansfield Pass. Because the dominant drift direction is to the north sand is trapped along the south jetty of each of these systems, the result being rapid accretion to the south and erosion to the north of the jetties.

Other man-made structures that have a significant effect on shoreline conditions are Falcon Dam (water impounded in 1953) and Amistad Dam (water impounded in 1968). Falcon Dam is nearest the Gulf of Mexico and it is the one that has exerted the most influence on shoreline changes.

Water discharge data and suspension sediment data collected at the Brownsville Gauging Station indicate that following impoundment of water at Falcon Dam (1953) that the volume of water discharged in the reach between the dam and the Gulf of Mexico had been drastically reduced and that suspension sediment load was virtually nil. The date of impoundment of water and sediment by Falcon Dam coincides almost exactly with accelerated erosion of the beaches of south Padre Island for the period 1955-1960.

#### STORM EFFECTS

Because of the absence of a well developed fore-island dune chain hurricanes often produce dramatic and lasting effects on south Padre Island. In addition to eroding the beaches, which have the ability to restore their prestorm profile, hurricanes scour channels across the island. These channels serve as conduits through which large volumes of water and sediment move from the Gulf of Mexico, across the island, and into Laguna Madre. Sand that moves through these channels is stored along the back side of Padre Island as lobate features called "washover fans." This activity removes sand from the beach area and stores it in the lagoon; this sand is lost from the beach area and therefore the sand budget for beaches is reduced. Erosion of beaches by

hurricanes along south Padre Island is permanent because there is virtually no new sand being contributed to that coastal segment.