# A COMPARISON OF CHANGES BETWEEN NATURAL AND RE-NOURISHED BEACHES - THE 1997-2000 INTERVAL BETWEEN SAND REPLENISHMENT AT EASTERN JONES BEACH ISLAND AND WESTERN FIRE ISLAND, NEW YORK

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**Overview:**

With the completion of the winter (January-April,1997) dredging and mapping of Fire Island Inlet by the U.S. Army Corps of Engineers (USACE), a sequential set of monthly beach surveys were undertaken to determine the seasonal effects of the natural processes on the replenished beaches. The surveys ended in January, 2000 once a new cycle of dredging and beach nourishment by the USACE was re-initiated. During the dredging and deepening of the inlet channel 718,000 cubic yards of sand was pumped westward onto West Gilgo and Gilgo beaches. These are referred to as the "feeder" beaches because it is assumed that the dominant westward-flowing littoral current will move the accumulating sand down the coast and onto the eroding beaches of Jones Beach State Park (Figure 1). Surveys were made at Tobay Beach, Gilgo Beach, and West Gilgo Beach.

Sand was also pumped eastward along the first 3 km. of Robert Moses State Park (opposite the direction of littoral drift) to re-nourish those beaches (Figure 1). The dredging ended near the Field #3 Parking Lot. It could not be continued eastward to the sand-starved beaches near the water tower (and traffic circle) because of the obligation to end dredging at the start of the piping plover nesting season (April 1$^{st}$). Surveys were made at Parking Field #2, Parking Field #3, near the water tower, and at Parking Field #4. The beach at Parking Field #4, was our most eastern survey line and, since it was not nourished, represented, our only "natural" beach.

This abstract includes a summary of the results of the 1997-2000 survey. The more detailed 6-month seasonal comparisons from the lines of section in the beach surveys, as well as **beach profile animations** showing month-by-month changes over the three year study interval will be made available as an appendix at:
http://people.hofstra.edu/faculty/J_B_Bennington/research/beaches.html

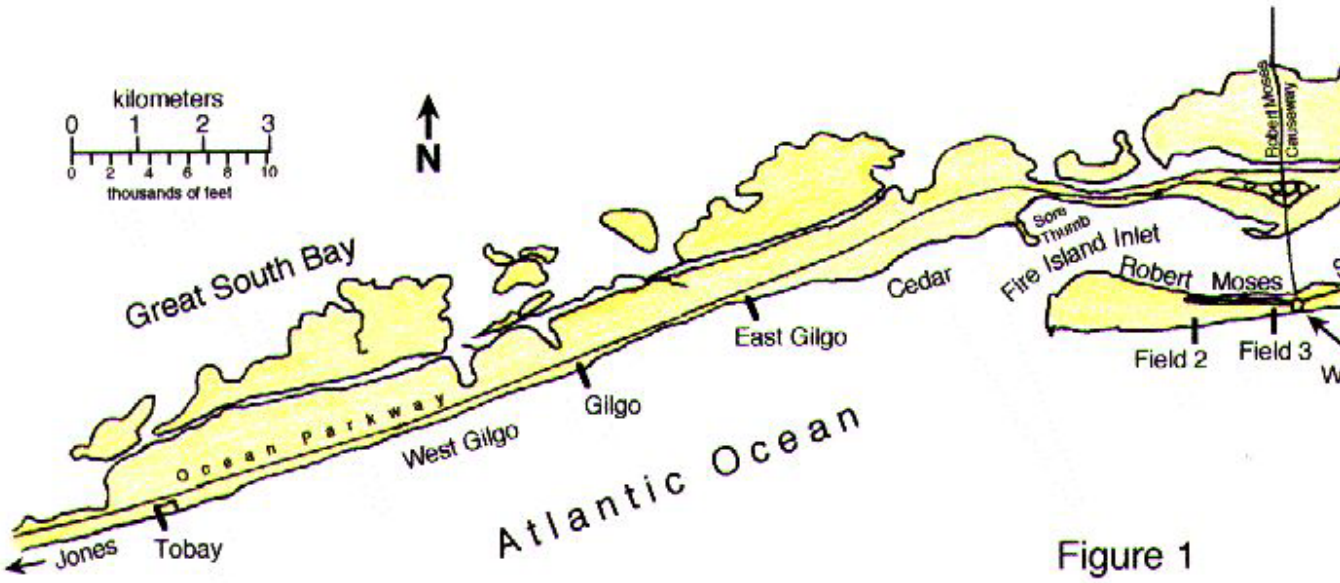


Figure 1. Location of measured profiles along the beaches near Fire Island Inlet, Long Island, N.Y.

## Introduction

Since the construction of the massive jetty at the western end of Fire Island in 1951, the sand that threatened to close the inlet became trapped behind the jetty–but only temporarily. The huge volume of sand that was moved westward along the 32 miles (51 Km.) of Fire Island by the littoral current quickly filled-in behind, and then by-passed the jetty until it again threatened to close Fire Island Inlet (Figure 2). The result, since 1955, has been periodic maintenance of the inlet by the USACE through inlet dredging and sand bypassing to the adjacent western beaches.

To prevent beach erosion at the east end of Cedar Beach on the adjacent Jones Beach Barrier Island, a reveted sand dike (known locally as the "Sore Thumb") was added in 1963. As planned, the structure prevented scour and erosion by the flood tidal currents on the northwest side of the inlet - but it also prevented the return of the sand gradually being pushed across the inlet by the tidal currents. Instead, that sand was now pushed westward by the littoral and ebb tidal currents, producing a 100-200 meter increase in the width of Cedar Beach (Figure 2).

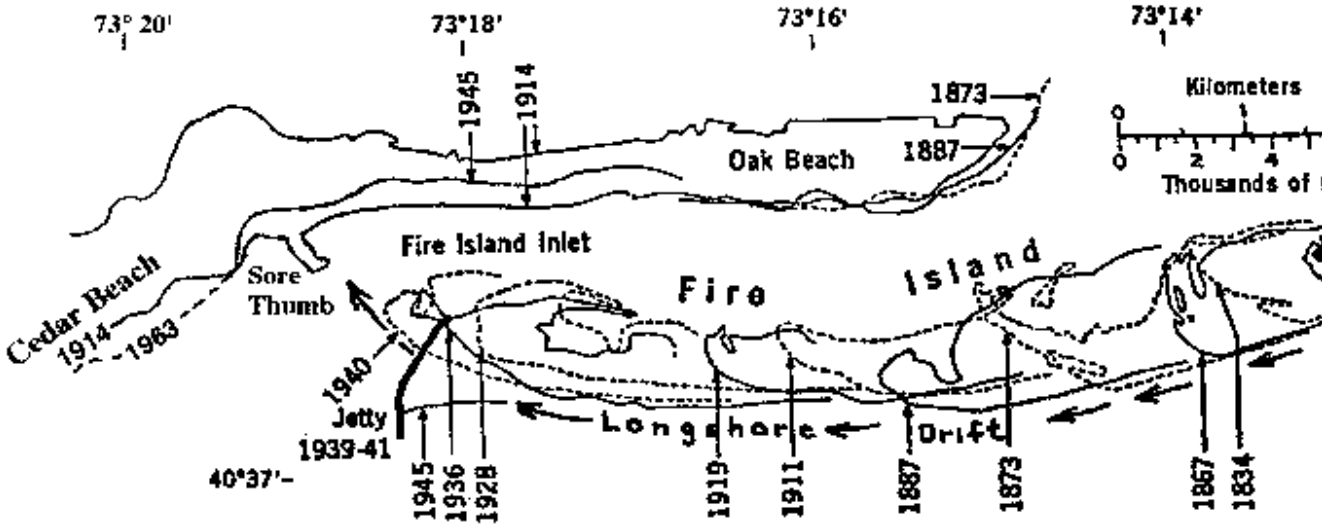


Figure 2

Figure 2. History of coastal changes at Fire Island Inlet, 1825-1965.

**Methods:**

During a three-year period from 1997-2000, four beach transects were measured at Robert Moses State Park (Fire Island) and three transects were measured along the Gilgo and Tobay Beaches (Jones Beach Barrier Island). All transects were measured monthly, on or near the middle of the month whenever possible. Using measuring tape, sight levels and rods the height and width of the beach sections were determined in feet, plotted on graph paper, and then 3-month overlays were completed to note changes in beach volume. These volumetric changes are described in cubic yards instead of cubic meters because of common usage. To consider the influence of only the longshore currents (not tidal currents) on the beaches receiving dredged sand, those within 2 km. of either side of Fire Island Inlet were not used in this study. By using the edges of roadways or public parking lots as surveying reference points, the authors had rapid access to known reference points for the measured sections. These features were also located very close to the landward edge of the primary dunes and, based on local benchmarks, were assigned a reference elevation of 14 feet. The three-year summary (1997-2000) of changes in the beach profiles are shown in Figures 3A-3B and are described in the next section.

**Summary of Changes in the Beach Profiles, 1997-2000: (see also Figure 3A and 3B)**

ROBERT MOSES STATE PARK

At Field #4, our "control" beach and most eastern section, the largest accretion occurred during the summer of 1997 (as occurred at the re-nourished East Gilgo Beach on the opposite side of the inlet). While adding 5,600 yards that summer, a nearly similar amount was eroded that winter. This pattern of "dynamic equilibrium" was also

maintained the following year with a gain and loss of over 2000 cubic yards of sand in 1998-99. Since then the changes have remained minor. Over the thirty-three-month interval the shoreline has receded 50 feet, the volume of sand on the beach backshore has decreased by 275 cubic yards, and the volume of sand on the beach foreshore has increased by about 165 cubic yards/100 feet of beach.

At the water tower most of this period saw the presence of a 3-4' escarpment cut into the terrace at the base of the dunes. The beach remained relatively stable with a berm crest about 200 feet from the roadway (110 feet from the slat fence at the edge of the meadow near the traffic circle). The sloping beach foreshore witnessed most of the changes, and varied in width from 40 to 150 feet. Thanks to the influence of the westward littoral current the shoreline has remained 275 feet from the Ocean Parkway and the beach has accreted 965 cubic yards per100 feet of beach since the summer of 1998.

The beach at Field #3 was never nourished with dredged sand nor did it receive any sand from the upcurrent natural beach at Field #4. Other than the summer of 1998, this was an area of continual erosion - the summer of 1999 saw over 1,600 cubic yards of erosion. During the period of study the shoreline has receded 125 feet with a loss of 2,750 cubic yards of sand/100 feet of beach.

At Field #2 the summers were characterized by small amounts of accretion (500 cubic yards) but winters were times of extensive erosion (about 3,000 cubic yards/100 feet of beach). Though re-nourished, the volume of sand lost during this interval was about 610 cubic yards - the dredging of sand from Fire Island Inlet was a critical factor in protecting this area from further erosion.

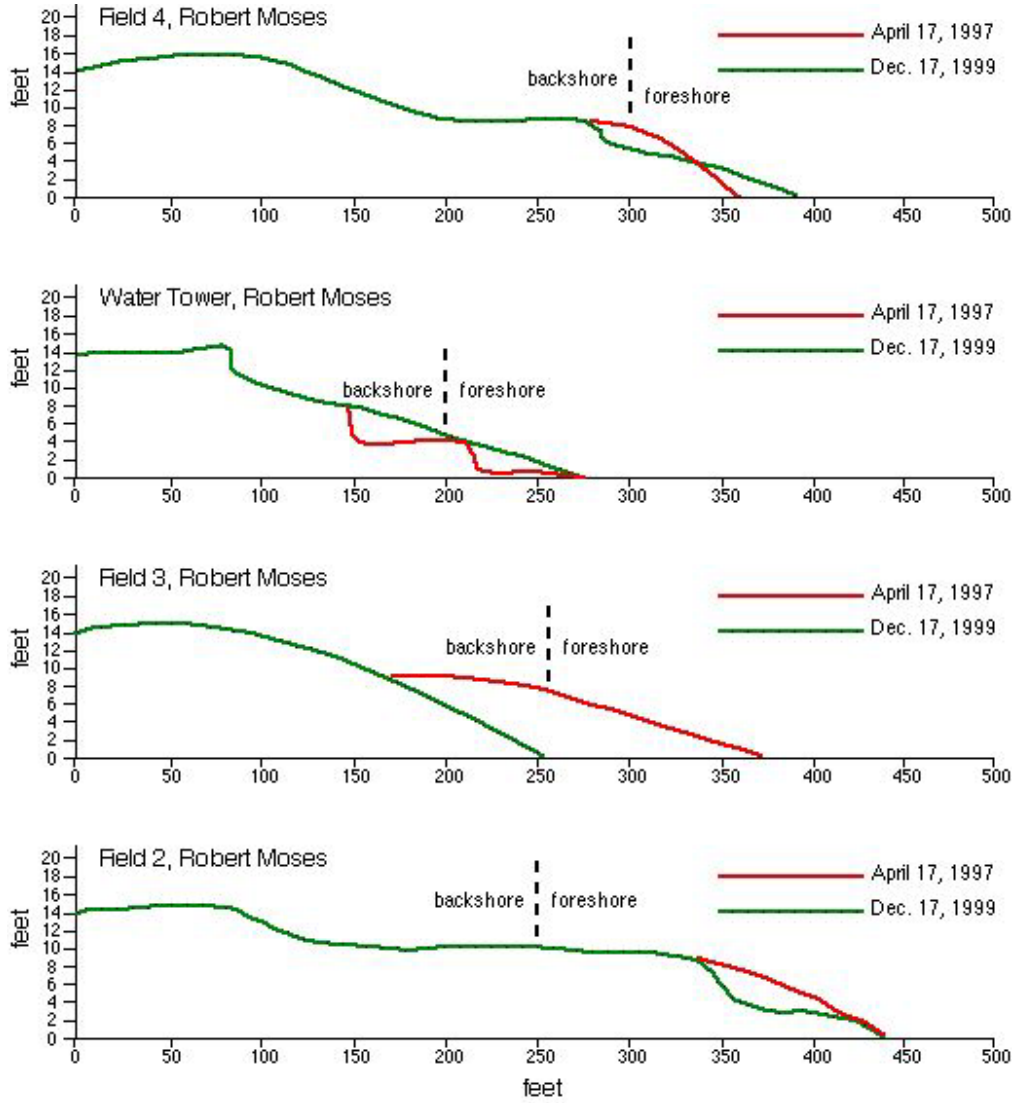


Figure 3A. 1997-2000 Changes in profiles along the beaches of Robert Moses State Park.

In summary, the rhythmic pattern of summer accretion/winter erosion that appeared at our "control" beach at Field #4 (and somewhat at the water tower) did not persist westward, and Fields #2 & #3 even lost sand over the summer. With this long pattern of erosion, the sand pumped onto the beaches from Fire Island Inlet was crucial in not preventing further loses. The losses here were even larger than those along the downdrift beaches of the Jones Beach barrier island (see below). This suggests that this area, rather than the beaches on the west side of Fire Island Inlet, should be given higher priority in any renewed dredging operations.

JONES BEACH BARRIER ISLAND

East Gilgo Beach saw a large accumulation of sand over the summer of 1997, but 70% of this sand was lost over the winter of 1997 and all through 1998. There was no recuperation of losses until the summer of 1999. Overall, there has been no change in the position of the shoreline (at 400 feet from the Ocean Parkway) since the renourishment, but the beach has gained a volume of 1,800 cubic yards/100 feet of beach.

Gilgo Beach witnessed its largest gain over the summer of 1997 - just after the completion of the dredging project. There was 2,700 cubic yards of accretion/100 feet of beach with the shoreline 250-300 feet from the parkway. Since then there has been a unique pattern of winter growth and summer erosion, but these have averaged less than 500 cubic yards. The annual gains and losses are nearly equal - an equilibrium beach. While the beach has receded 60 feet, through vertical accretion, there has been an increase in volume to 1,000 cubic yards/100 feet of beach.

At Tobay Beach, the expected changes in beach volume were inconsistent. After renourishment at the "feeder" beach (Gilgo Beach) the downcurrent littoral drift led to an accretion of 1575 cubic yards per 100 feet of beach. But a similar pattern of accretion didn't reappear until the winter of '98-'99 when an additional 1,800 cubic yards were added. The losses in the alternate seasons averaged only 500 cubic yards, yet the shoreline remained about 300 feet from the parkway during the study period. The net vertical accretion was about 575 cubic yards/100 feet of beach.

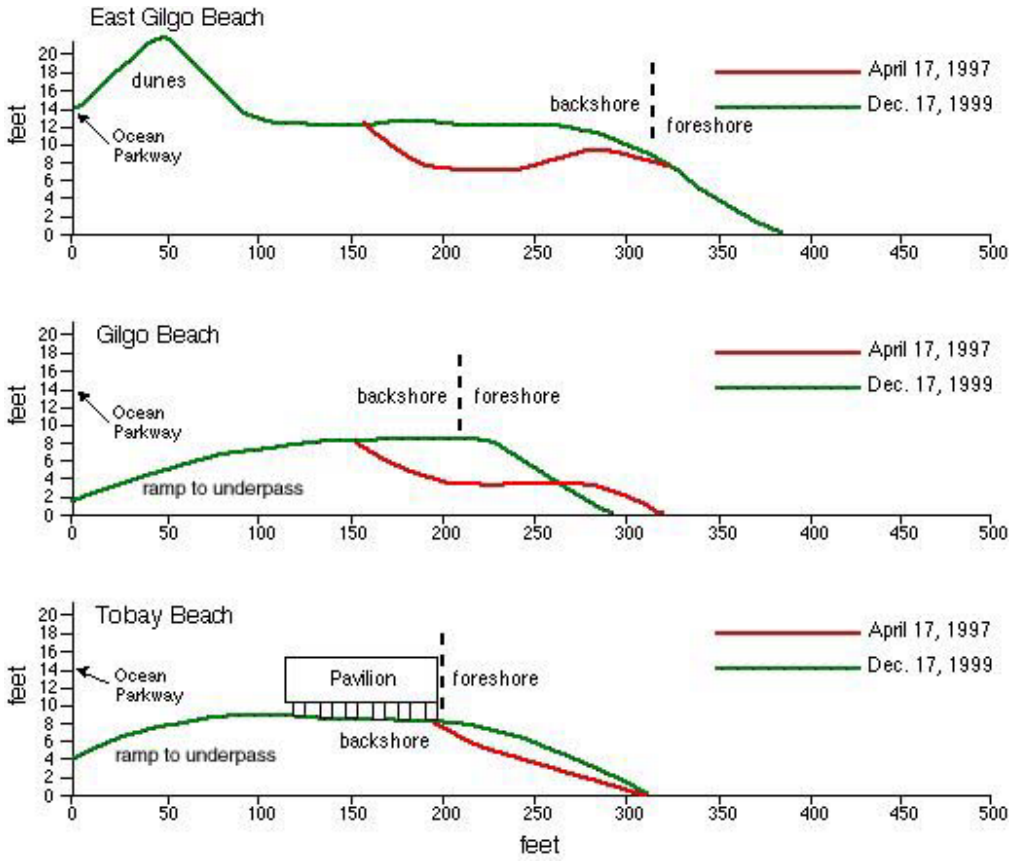


Figure 3B. 1997-2000 Changes in profiles along the beaches of the Jones Beach barrier island.

In summary, during the thirty-three-month interval between the dredging operations, each of the surveyed beaches now have somewhat more sand than initially present. Assuming the 575 cubic yards at Tobay as **1 unit**, Gilgo Beach has retained about **2 units**, and East Gilgo Beach has **4 units**. These are not large volumes (except perhaps at East Gilgo) but they do indicate, with beach widths narrowing or remaining the same, that, even without the renewed dredging, the volume of sand on the beaches has increased. The re-nourishment of 2000 was important and appreciated, but not an emergency!

**Acknowledgments:** We would like to thank Brian Feeley, Robert Marino and the many other students that periodically assisted in the measurements of these beach surveys. This was an outgrowth of similar student-oriented projects conducted earlier (Wolff, 1975).

**References:**

Wolff, M.P., 1975, Natural and man-made erosional and depositional features associated with the stabilization of migrating barrier islands, Fire Island Inlet, Long Island, N.Y. in: N.Y. State Geological Association Guidebook, Hofstra University, Hempstead, N.Y., pp. 213-258.