MARINE SCIENCES RESEARCH CENTER
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Stability of the East Rockaway Inlet and the adjacent shoreface

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Approved for Distribution

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Introduction

A pipeline from the vicinity of J.F. Kennedy Airport is intended to pass under Rockaway Beach in the vicinity of Edgemere. An alternate route would bring the pipeline across the East Rockaway Inlet, under Atlantic Beach, and the adjacent shoreface of the New York Bight Apex. This report discusses the stability of the inlet and of the sea floor in this vicinity.

East Rockaway Inlet

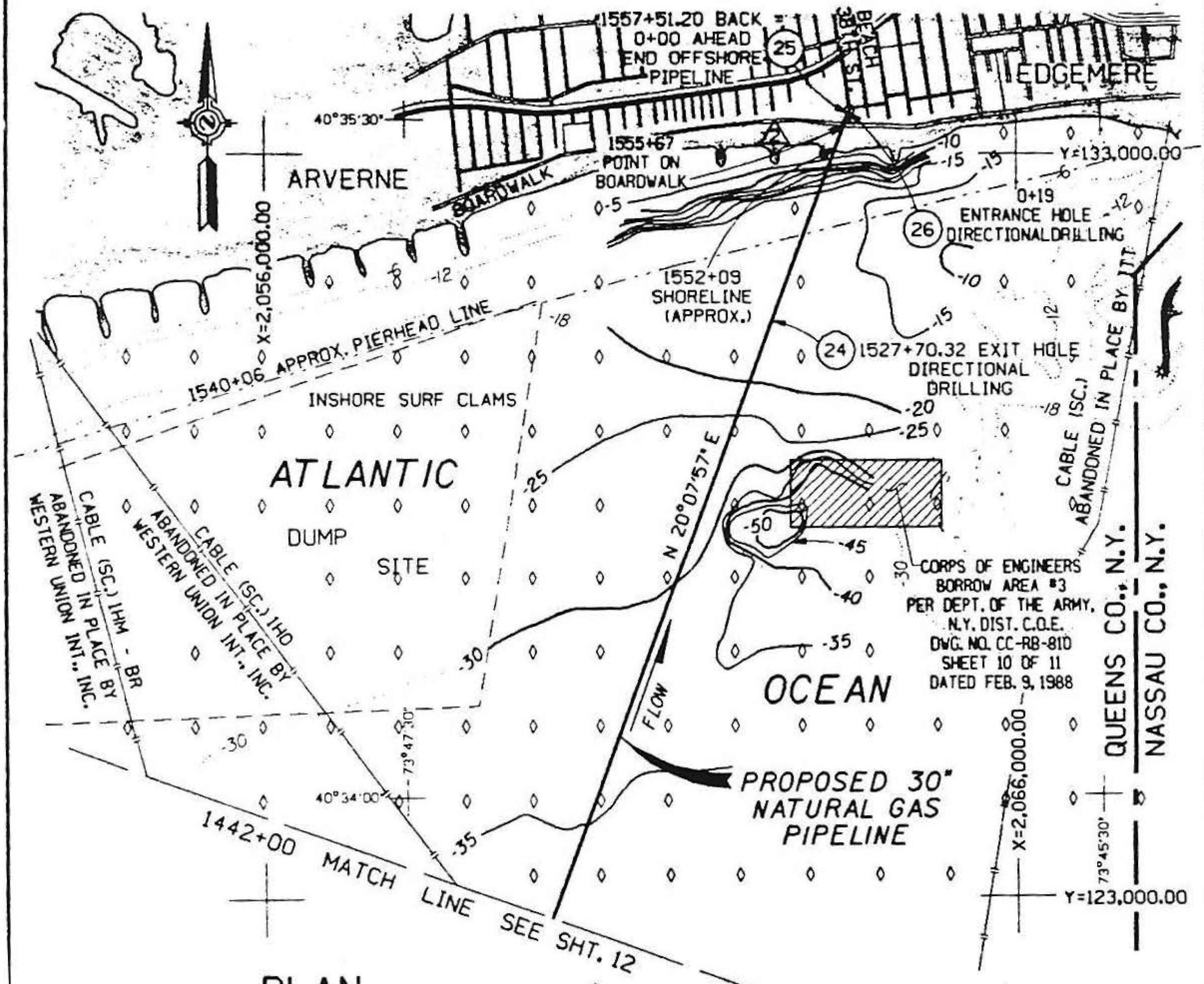
East Rockaway Inlet is between 750 and 1,400 feet wide. It is connected via Reynolds Channel to a series of small bays and channels rather than to a single large bay. Over a tidal cycle about 6.5×10^8 cubic feet of water drain through its cross-section of 1.2×10^4 square feet resulting in maximum tidal velocities of about 92 cm/sec. This current speed is capable of transporting the median grain size of sand on the channel floor (0.3 mm). This combination of characteristics, however, make the inlet a stable one, although perhaps marginally so (Mehta and Heu, 1974).

The inlet contains a federally-authorized navigation channel which must be dredged to be maintained at a depth of 12 feet (U.S. Army Corps of Engineers, 1975). Reynolds Channel is heavily used by boaters. Table 1 shows the dredging activity in East Rockaway Channel. Prior to 1979, dredging was confined to the seaward leg of the channel; it was presumably filled from the east-to-west longshore transport off Atlantic Beach at a rate of about 50,000 cubic yards per year. In 1976, a periodic renourishment program was initiated on Rockaway Beach to the west (U.S. Army Corps of Engineers, 1993). Some of the sand used in this renourishment program was mined from a borrow area offshore of East Rockaway Inlet (borrow area 3, Figure 1); in 1976, 1,490,000 cubic yards of sand was removed from this site. Sand has been provided to the Rockaway shoreline approximately at two-year intervals. At least three additional renourishment episodes are planned, but samples from this borrow area (i.e., borrow area 3) taken in 1986 were of material that was unsuitable for application to the beach. As a result, the site is an inactive one.

Since 1979, volumes in excess of 100,000 cubic yards have been removed and dredging has included the northern reaches of the channel; presumably additional sand is entering the channel from the west at an increased rate. A computer model of wave refraction around the shoals at East Rockaway Inlet indicated conditions favoring an eastward drift of sand towards the inlet along the Rockaway shoreline immediately to the west of the inlet, as opposed to the general westward transport along Long Island's south shore (Dobson, 1967).

When the U.S. Coast and Geodetic Survey mapped this area in 1835, East Rockaway Inlet was approximately three miles east of its present location. The inlet had migrated two miles westwardly to about one mile east of its present location by 1855, but it closed sometime after 1860 and was replaced by two inlets further east by 1879. One inlet persisted to the time of the 1909 Coast and Geodetic Survey and continued to migrate to the

QUEENS COUNTY, NEW YORK



PLAN

2,000' 0 2,000'

SCALE IN FEET

NOTE: BASE TRACED FROM U.S.G.S. QUADRANGLE MAP, FAR ROCKAWAY, N.Y., DATED 1969.
SEE SHEET 26 OF 26 FOR LEGEND

2 LANDS OF THE CITY OF NEW YORK

RoG

No.	Date	Revision	By
4	7/16/93	ADJUSTED ROUTE TO MEET ONSHORE SURVEY	S.L.
3	4/1/93	ADDED BATHYMETRY AND INSHORE SURF CLAMS	S.L.
2	2/16/93	REVISED W.O. NO.	S.L.
1	10/23/92	GENERAL REVISION	S.L.

Reference Drawing — Dwg. No.

LIBERTY Pipeline Company

PROPOSED 30" NATURAL GAS PIPELINE
FROM MORGAN, N.J. TO EDGEMERE, N.Y.
CROSSING
RARITAN BAY, LOWER N.Y. BAY & ATLANTIC OCEAN
NEW JERSEY & NEW YORK

Drawn By LAURIA	Date 8/31/92	APPROVED BY RoG	DATE 11-9-93
Checked By MK	Date 11/9/93	R.O. Greaman	
Approved By Drafting M.S.	Date 11/9/93	Approved By Engineer	
W.O. No. 5600.01	Scale SHOWN	DWG. NO.	24-1946
Approved By Design	Sheet 13 of 26		CE-3A-001

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west toward its present location (Taney, 1961, City of New York, 1987). The location of the inlet has now been stabilized with rock jetties. The east jetty is 4,250 long and it was completed in July 1934. Both shores of the inlet are stabilized by numerous groins and extensively bulkheaded (Figure 2). The bridge crosses at an elevation of 25 feet, so it seems unlikely that flooding would pose a problem.

The barrier island is densely developed. The ocean beach directly south of the bridge has been stabilized by a series of substantial, long, rock groins (Figure 1). It is unlikely to undergo significant migration although overwashing and deflation of the beach can occur during severe storms. The stretch of beach between the westernmost groin and the eastern jetty of the inlet is less protected and would be subject to more variation (Figure 1). Within a few hundred feet of the shoreline, the beach and shoreface elevation may change by 10 to 20 feet under the influence of a severe storm, as illustrated by observations further to the east. Further to the east, on Jones Island, a sewer outfall crosses the shoreline at Cedar Island Beach. The 72-inch pipe was buried at an elevation of about -12 feet at the shoreline, but erosion and migration of the shoreline had reduced that cover to about 7 feet (Figure 3, Dravo Van Houten, 1987). This magnitude of erosion is less likely on a stabilized beach.

Shoreline Vulnerability

Wave conditions along this stretch of shoreline have been hindcasted from meteorological data by the U.S. Army Corps of Engineers. Seventy percent of the time wave heights are less

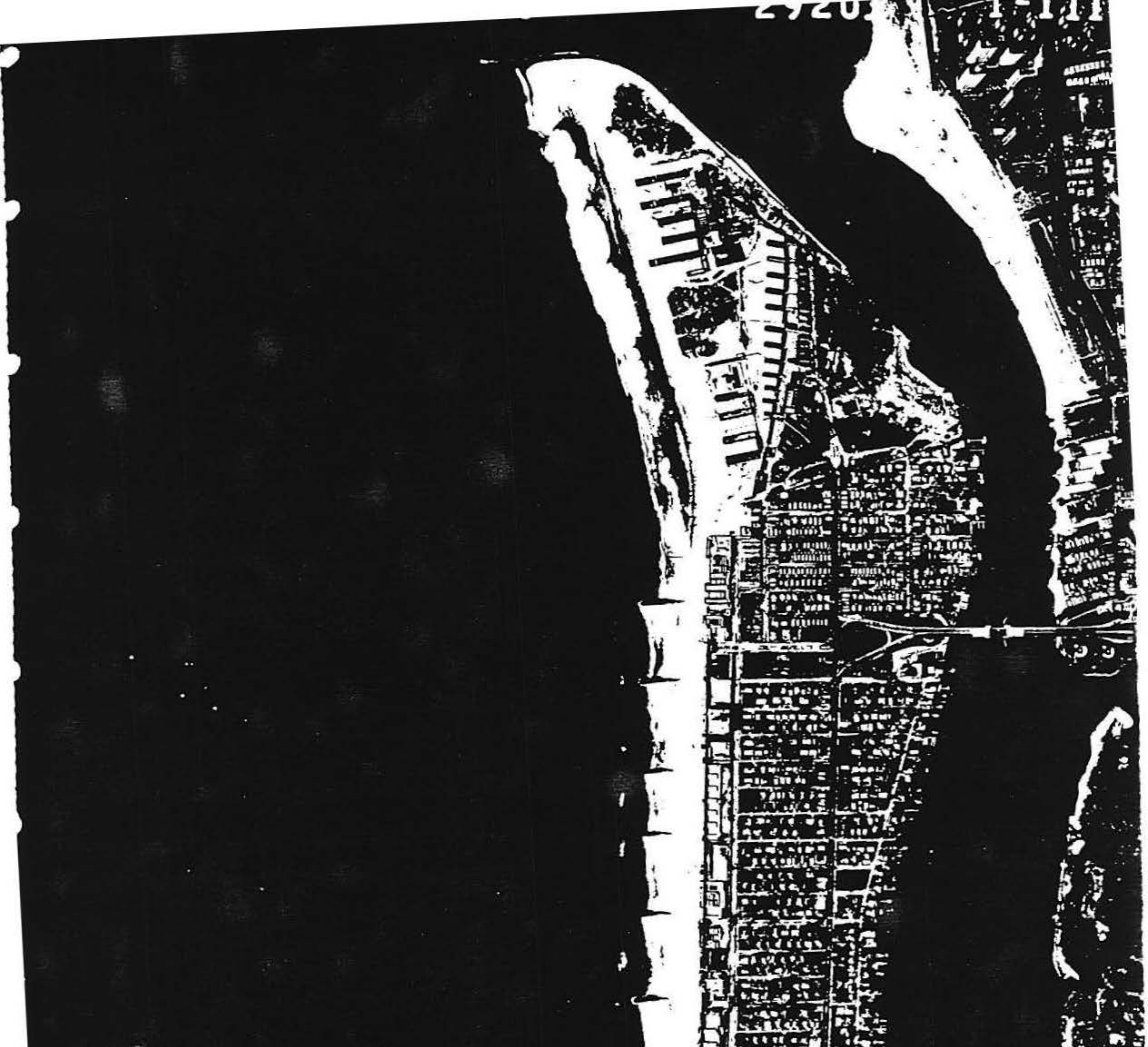
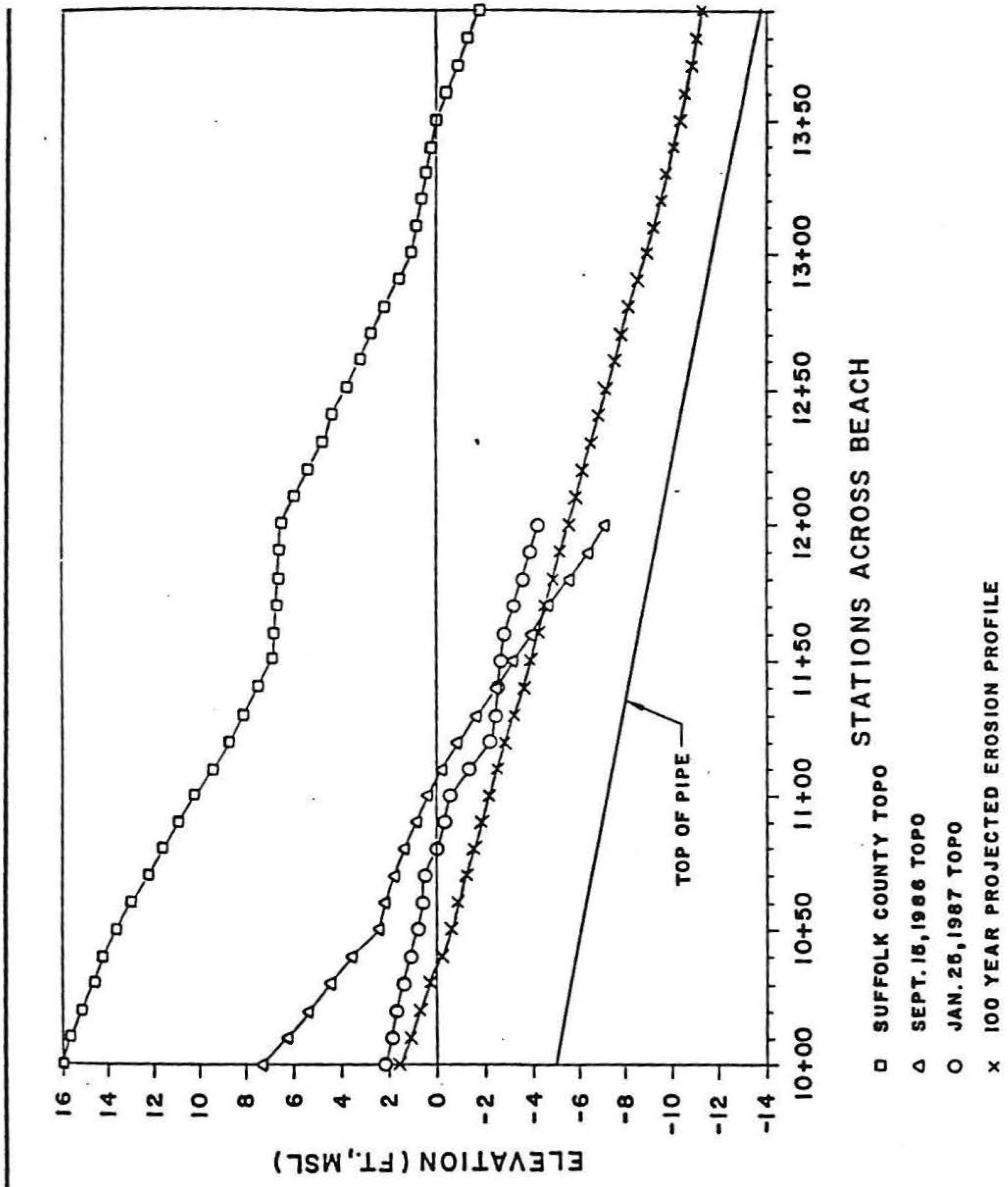


Figure 2



SUFFOLK COUNTY SEWER OUTFALL

PROFILES AT CEDAR BEACH

Figure 3

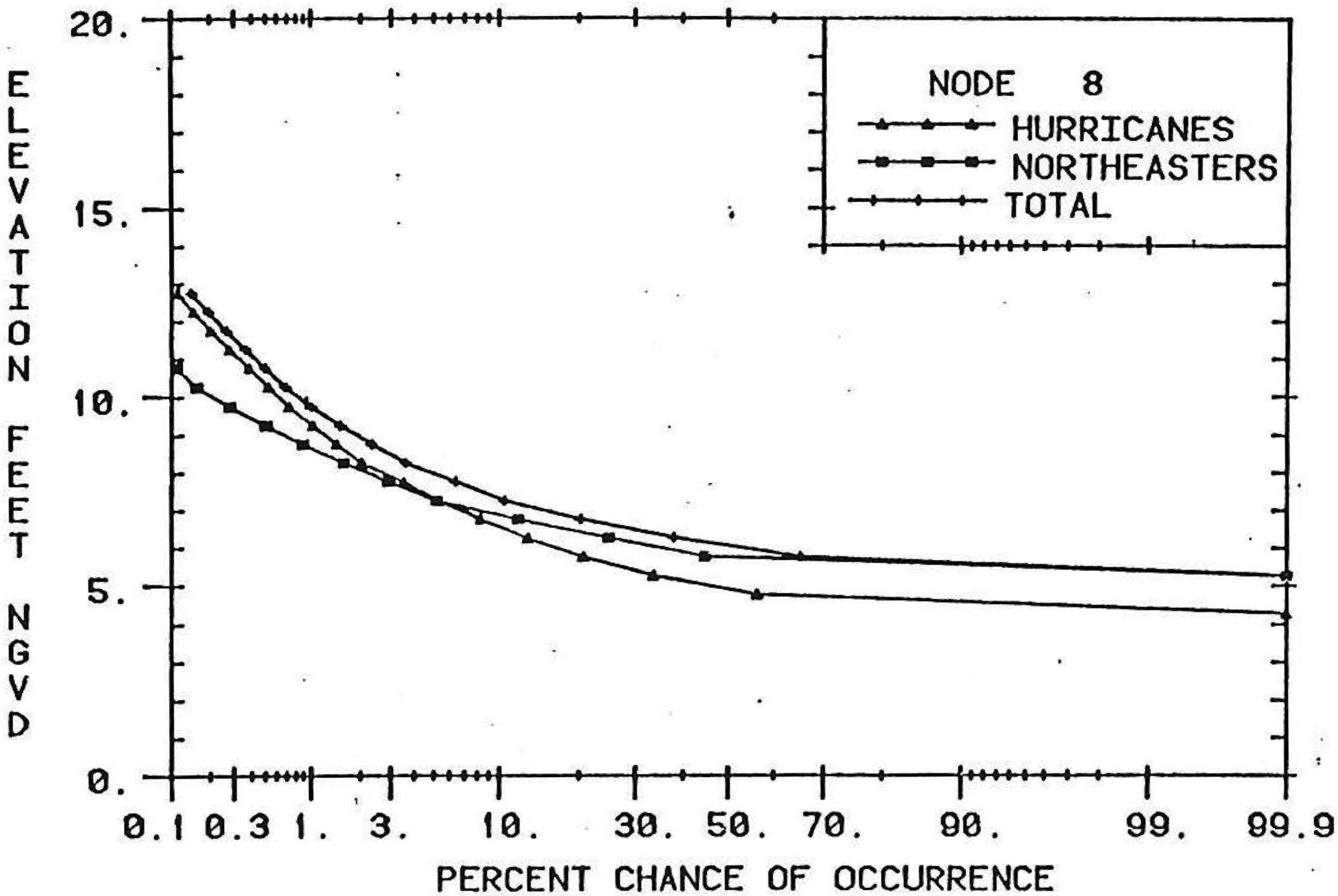
Dravo
Van Houten

than four feet high and waves exceeding eight feet high occurred less than ten percent of the time. Visual observations were done under the Corps' Littoral, Environmental Observation (LEO) Program on Jones Beach about 10 miles to the east between 1968 and 1974. The average breaker height was observed to be 2.6 feet and the average period was 6.3 seconds.

The largest predicted deep-water waves were between 25 and 30 feet high. A Corps of Engineers' wave gage off Jones Beach recorded a maximum wave height of 13.4 feet and storm waves with heights of 20-feet have been reported (U.S. Army Corps of Engineers, 1977). An offshore wave gage about 70 miles east of this area recorded waves exceeding 15 feet in height for periods of a few days a month.

The probability of at least one tropical storm occurring at this site in any ten-year period is 0.85 and the probability of a hurricane is 0.50 in the same interval (Neuman and Pryslak, 1981). Storm tides raised by extra-tropical storms (northeasters) can be as severe as hurricane tides and, in this region, often persist for longer periods of time (several tidal cycles). A predicted stage-frequency curve for the vicinity of East Rockaway Inlet is reproduced in Figure 4 for both hurricane and northeasters (Camp, Dresser and McKee, 1983) as cited by the City of New York, 1987). The predicted 10-year still-water storm water level elevation was 7.4 feet (NGVD) and the predicted 100-year flood level was 9.7 feet.

As mentioned earlier, the shoreline has been stabilized in the face of these conditions. If erosion protection measures were abandoned and deteriorated in this area, however, shoreline



NODE 8
HURRICANES
NORTHEASTERS
TOTAL
ELEVATION FEET NGVD
20.
15.
10.
5.
0.
0.1
0.3
1.
3.
10.
30.
50.
70.
90.
99.
99.9
PERCENT CHANCE OF OCCURRENCE

Figure 4

recession rates as high as 400 feet over a thirty-year period have been predicted (City of New York, 1987).

Stability of the Shoreface

There are four lines of evidence available relating to the stability of the sea floor in this area. These are:

a. the calculation of sediment transport based on wave characteristics

b. comparisons of bathymetric surveys from different dates

c. the interpretation of geochemical tracers in the sediments, and

d. the interpretation of geological facies in cores.

Hallermeier (1981) developed criteria for significant wave-induced sediment transport along the beach and shoreface, including parameters applicable to the Bight Apex from wave-gage measurements at Atlantic City, N.J. In water depths shallower than 21.5 feet, intense wave-induced sand transport occurs and interannual changes in bathymetry exceeding one foot should be expected. In water depths of between 16 and 46 feet, cores have been recovered off the south shore of Long Island with storm layers between one and two feet thick (33 cm to 70 cm; Sanders and Kumar, 1975). Evidence from changes in bathymetry over a 42-year period from 1936 to 1978 yields the same result (Freeland and Merrill, 1977). Changes in bathymetry indicate predominantly less than 0.6 m of erosion (Figure 5).

Below 82 feet, the annual cycle of wave activity is of insufficient strength of cause significant transportation of the

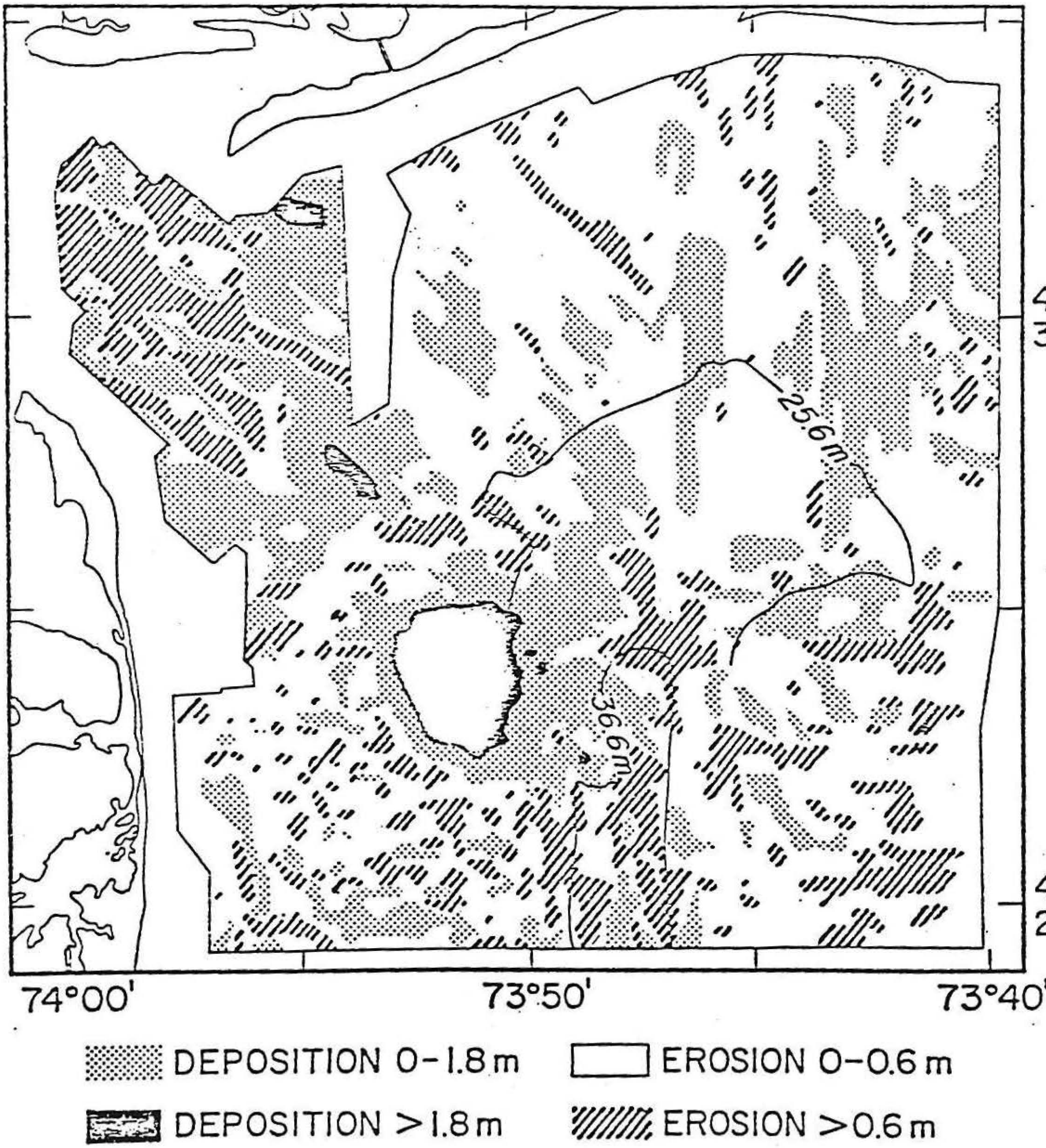


Figure 5. Distribution of erosion and deposition. From Freeland et. al., in preparation

bottom sediment although the sea floor can be disturbed by severe storms. Between these two depths (i.e., 21.5 feet and 82 feet) lies a shoal zone in which the bottom sediments are periodically disturbed by typical wave activity but measurable changes in the bathymetry are not expected. There is some anecdotal evidence that the borrow area offshore of East Rockaway Inlet, previously mentioned, has refilled somewhat since it was last used, but the amount of infilling has not been estimated. Since transport at these depths is dependent on storms, the rate of infilling is uncertain.

The thickness of the sediment layer disturbed by storm wave activity can be estimated from other evidence. In cores recovered from this area, storm layers can be seen in the sediment that were 9 to 10 inches. These events are likely to be extreme storm events with recurrence intervals of several hundred years. Such an event has probably been documented in 1992. On December 11 of that year, an unusually severe northeaster occurred. Bathymetric surveys before and after the storm at the Mud Dump Site in the Bight (approximately $73^{o}51'$W, $40^{o}22''$N) showed detectable erosion (at least about 6 inches) from broad areas where the depths ranged between 58 and 75 feet (Science Applications International Corporation, 1993). An analysis of that event by the U.S. Army Corps of Engineers (Scheffner, Borgman, and Vemulakonda, 1993) suggests that this was an event with a 200- to 300-year recurrence interval and that erosional disturbances might be 0.2 feet (6 cm) in water depths of 75 to 83 feet.

Radionuclides have also been used to estimate the disturbance of bottom sediments in the deep waters of the Hudson Shelf Valley. Lead-210 is a radioactive element associated with the fine-grained fraction of the sediment through organic material. It has a half-life of 22 years. In box cores from the Bight, Lead-210 was found, in excess of supported background levels to a depth of 20 to 30 centimeters in the sediments in water depths up to 62 m (205 feet; Benninger and Krishnaswama, 1981). This indicates that fine-grained sediment that was in the water column less than 100 years ago (i.e., 4 or 5 half-lives) is present throughout the upper 20 to 30 centimeters of sediment. While this may indicate rapid sedimentation, it is more likely due to physical mixing with rare events mixing sediment to many centimeters and more frequent mixing at shallower depths. Physical processes active in the Hudson Shelf Valley may not be the same as those acting to disturb broader areas of the Bight, but the geochemical evidence at least suggests the potential of sediment disturbances in deep waters.

TABLE 1

Dredging Activity in East Rockaway Inlet

Year	Amount Recovered (cubic yards)
1969	62,000
1970	54,485
1971	74,553
1972	52,024
1973	22,952
1973	24,864
1973	21,850
1974	89,400
1974	39,400
1975	20,477
1976	34,860
1976	16,593
1976	36,687
1976	3,657
1976	19,825
1977	15,560
1978	15,560
1979*	132,083
1982	197,743
1985*	318,343
1988	230,000
1989*	226,000
1990	153,000
1990*	582,000
1991	157,081

* entire channel dredged

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