SHORELINE SURVEY:
GREAT PECONIC, LITTLE PECONIC, GARDINERS, AND NAPEAGUE BAYS

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A SHORELINE SURVEY:
GREAT PECONIC, LITTLE PECONIC, GARDINERS AND NAPEAGUE BAYS

M. T. Eisel

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and the Nassau-Suffolk Regional Planning Board*

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J.R. Schubel

J. R. Schubel, Director

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ABSTRACT

The beaches and bluffs along Great Peconic, Little Peconic, Gardiners and Napeague Bays have attained their present form through a long erosional history. Changes in shoreline configuration have been determined by comparing nautical charts from the mid-1800's with those of today. This comparison has shown significant land loss especially for those areas east of Shelter Island. These areas, unprotected by a land mass in the path of wind and waves, receive the full impact of these erosional forces.

A field survey of the shore area within the eastern forks of Long Island was completed in the fall of 1973. Particular attention was given to the natural earth processes (slides, subsidence and rain run-off) and their effect on shoreline characteristics as well as the influence of storms, wind and waves. Information pertaining to storms, ownership and population statistics have been updated through 1976.

This preliminary study is intended to provide a data base for future investigations in this area.

CHAPTER I
THE EASTERN FORKS

Description of the Area

Between Orient Point on the north fork and Montauk Point on the south fork, lie approximately 202 km (125 miles) of coastline (exclusive of islands). The physical features of the area consist of a highly convoluted shoreline described by Shepard (1963) as a glacial deposition coast modified by marine erosion; four bays ranging in width from a few meters at the mouth of the Peconic River to 23 km (14 miles) near Gardiners Island; bluffed headlands generally less than 6 m (20 ft) above mean sea level on the north fork but ranging up to 73 m (240 ft) above mean sea level on the south fork.

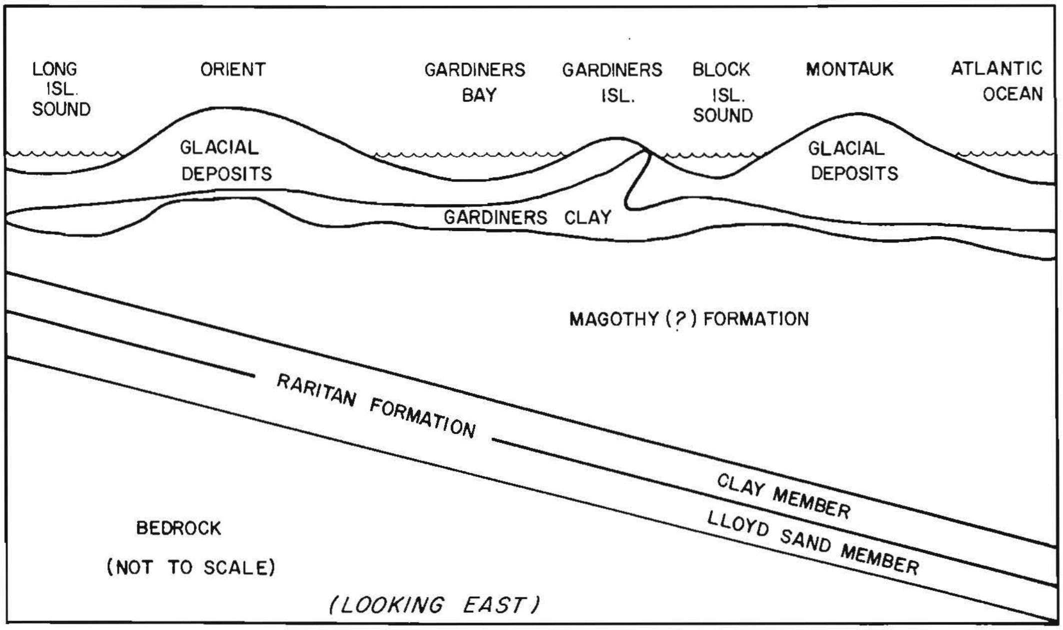
Geologic History

Long Island has a land area of approximately 3,626 km^2 (1400 mi^2), and is, geographically, a large, detached segment of the Atlantic Coastal Plain (Tank, 1973). The island is composed of consolidated rocks with a southeasterly dip, overlain by unconsolidated sediments which attain a maximum thickness of 610 m (2,000 ft). The sediments consist of Upper Cretaceus and Pleistocene sands, gravels and clays. These deposits (Fig. 1-1) can be divided into six stratigraphic units (Suter, de Laguna and Perlmutter, 1949):

1. Lloyd sand member of the Raritan formation,
2. Clay member of the Raritan formation,
3. Magothy (?) formation,
4. Jameco gravel,
5. Gardiners clay, and
6. Glacial deposits.

The oldest of the Cretaceous deposits on Long Island is the Lloyd sand member of the Raritan formation. The coarse sand and pebbles, which form much of the Lloyd, suggest fairly rapid deposition by swiftly moving streams or currents (Suter et al., 1949). Conditions were not constant during its formation; locally there are layers of clay interbedded with layers of sand and gravel.

The Lloyd sand grades upward into the Raritan clay formation. The change



STRATIGRAPHIC COLUMN

CENOZOIC ERA	PLEISTOCENE EPOCH	UNDIFFERENTIATED WISCONSIN GLACIAL DEPOSITS	
		GARDINERS CLAY	
		JAMECO GRAVEL *	
MESOZOIC ERA	CRETACEOUS PERIOD	MAGOTHY FORMATION	
		RARITAN FORMATION	CLAY MEMBER OF RARITAN
			LLOYD SAND MEMBER OF RARITAN
PRE-MESOZOIC ERAS	UNDIFFERENTIATED METAMORPHIC AND IGNEOUS ROCKS		

* NOT REPRESENTED IN EASTERN SUFFOLK

Fig. 1-1. Geologic Cross Section of Long Island (adapted from Cohen, Franke and Foxworthy, 1968).

may possibly be due to a shift in the relative heights of sea and land, but the plant fossils in the clay suggest strongly that the Lloyd sands were also deposited on land (Suter et al., 1949).

The Magothy (?) formation shows no consistent composition. Locally there are thick beds of clay which can be traced for short distances, but then they blend with successive layers of sand and clay. The complexity of the interbedding and the character of the fossils it contains suggest the formation was mainly laid down under subaerial conditions.

Near the north and south shores of Long Island, the Magothy (?) formation is locally overlain by the Jameco gravel. The maximum thickness of the Jameco is about 61 m (200 ft) and consists mainly of medium to coarse sand, but locally it contains abundant gravel and some silt and clay. The Jameco is believed to be of glacial origin (Suter et al., 1949).

The Gardiners clay overlies the Jameco gravel. If the Jameco is glacial in origin, then the Gardiners clay was presumably formed during the following interglacial period (Suter et al., 1949). The surface of Gardiners clay lies about 20 m (65 ft) below sea level at the Brookhaven National Laboratory, and 30 m (100 ft) below sea level in the shore areas to the south. The Gardiners clay outcrops on Gardiners Island but is so folded and distorted due to ice shove that its relation to other formations is not clear (Suter et al., 1949).

The surface of Long Island is composed mostly of material deposited either directly by Pleistocene continental ice sheets or by meltwater from the ice sheets. These glacial deposits consist mainly of sand and gravel outwash in the central and southern parts of the Island, and mixed till and outwash atop and between the hills in the northern part of the Island.

The Harbor Hill moraine, which runs along the coast on the north shore of the north fork, diminishes in height in an eastward direction. In the vicinity of Orient Point, only low bluffs and scattered hills are found. On the south fork, the headlands of the Ronkonkoma moraine follow the trend of the north shore and are similar to the eroding headlands on the north shore of Long Island, although the Ronkonkoma moraine characteristically contains fewer glacial erratics than its northern counterpart.

CHAPTER II
SHORELINE FEATURES AND PROCESSES

Kukal (1971, p. 209) defines a beach as the zone of unconsolidated material (sand size or coarser) extending landward from the mean low water line to the place where there is a change in material or physiographic form, as, for example, a zone of permanent vegetation, or a zone of dunes or a sea cliff. Although beaches appear stable under conditions of small waves, they are eroded so rapidly when attacked by heavy surf and storm waves, that they may completely change character or even disappear in a few hours (Shepard, 1963). It is this highly variable nature of the beach that has prompted man to build structures in an attempt to protect investments threatened by changes in shoreline configuration.

Long-term changes in the formation and configuration of beaches are affected by regional geomorphology and type of available beach material (Don Wong, 1970). Short-term periodic changes (hourly, daily or seasonal) are due primarily to the quantity and size composition of beach material available and the characteristics of waves delivering energy to the shoreline. There are two major beach forms created by waves: berms and bars. Berms are flat, above water features (Fig. 2-1). Bars are underwater ridges of sand that parallel the shoreline and are seldom seen except at unusually

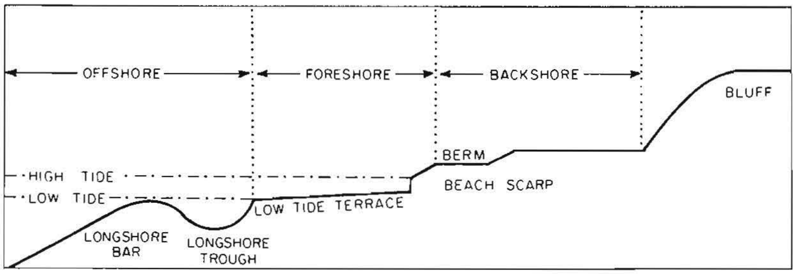


Fig. 2-1. Typical Beach Profile.

low tides (Bascom, 1964). On most beaches there is a constant exchange of sand between these two features, the direction of transport depending on the character of the waves.

Waves are characterized by their height, length and period (the amount of time for two successive wave crests or other wave feature to pass a given point). A wave is considered steep if the height exceeds the length (Fig. 2-2). When a

closer to the shore than higher waves might, before breaking. Hence these waves may form plunging breakers (Saunders and Ellis, 1961). A plunging breaker is formed when the swiftly moving backwash (of a preceding wave) collides with the undeformed incoming wave and causes it to break. Such interaction between backwash and incoming wave results in the energy of the incoming wave being transferred largely to backwash with little or no

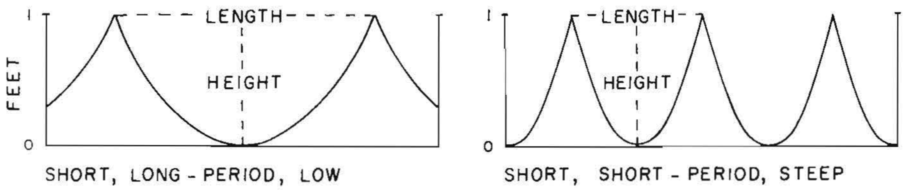


Fig. 2-2. Wave Characteristics.

wave's length is short, relative to its height, successive waves are closer together so that in a given time period more waves will pass a given point (short-period).

Within the study area, waves generated by local winds predominate (Saunders and Ellis, 1961). Furthermore, these winds blow over limited fetches and shallow water. In shallow water areas for a given wind and fetch, wave heights and periods tend to be short (U.S. Army Coastal Engineering Research Center, 1966). Therefore, for the most part, the study area is subjected to short, steep, short-period waves which are able to come much

uprush. The higher the wave frequency, the less time sand has to drain. The water absorption capability of the beach, which is an important dissipator of wave energy, is decreased, resulting in increased backwash energy. Because succeeding waves meet the same fate, backwash predominates and the net sediment movement is seaward (Saunders and Ellis, 1961).

In addition, incoming waves are rarely parallel to the shore, thus sand motion up and down the beach tends to be zigzag, resulting in a net motion along shore (Fairbridge, 1968).

Beach materials may be supplied to

eastern fork beaches in three ways:

1. discharge of sediment by the Peconic River and numerous creeks into the bays;
2. erosion of bay bottoms; and
3. erosion of bordering bluffs.

Of the three, the major source is the erosion of bordering bluffs, although erosion of glacial deposits beneath beaches and of nearshore bars plays an important role as well (Davies et al., 1973). It has been estimated that the Peconic River discharges 11,245 tons of sediment per year into the study area (U.S.D.A., Soil Conservation Service, 1974, p. 106). How much of this sediment supply is deposited within the area has yet to be determined.

In relation to sediment supply, beaches can be:

1. accreting--the total quantity of sediment brought into a given shore segment exceeds the amount of sediments removed, resulting in a progressively wider beach;
2. stable--the total quantity of sediments brought into a given shore area equals the amount of sediment removed; or,
3. eroding--the rate of sediment removal exceeds the rate of supply to the shore segment.

A given beach segment can be eroding at one time of the year and accreting at another. In addition to short-term seasonal variations, there is the long-term trend toward erosion as a result of eustatic rise in sea level.

Littoral Transport

In those areas not backed by eroding bluffs, littoral transport is the sole means of sediment supply. Littoral transport can be defined as the movement of material along the shore in the littoral zone by waves and currents. This movement directed parallel (longshore) to the shoreline is responsible for long-term accretion or erosion (U.S. Army CERC, 1973). Due to the shoreline configuration of the study area (numerous necks), and the limited fetches, there is no one predominant direction of littoral transport (U.S. Army COE, 1971).

Sediments in motion along shorelines, under the influence of wind and waves, may encounter natural obstructions and entrapments (Villianos, 1970). Thus, sediments can be denied to adjacent shores, and erosion occurs. Man-made protective structures (groins, jetties) can also act as obstructions producing similar results. A map of littoral transport direction at various points within the study area is given in Fig. 2-3. The predominate direction of littoral transport can be determined in several ways. Two methods were used in this study (U.S. Army CERC, 1966):

1. Observations of erosion and accretion effects at existing shore structures is the most reliable means of determining the direction of littoral transport. However, care must be taken not to confuse short-term effects with the long-term situation. The erosion and accretion associated with significant shore structures, such as jetties, can be generally taken to indicate the predominant transport direction.
2. The migration of a tidal inlet or stream delta over long periods of time will tend in the direction of littoral transport. Unprotected channels are offset in a downdrift direction.

Wind and Waves

Wind direction, speed and duration are important factors in determining wave characteristics and setup (elevation from still-water level caused by transport of surface water by winds). As discussed

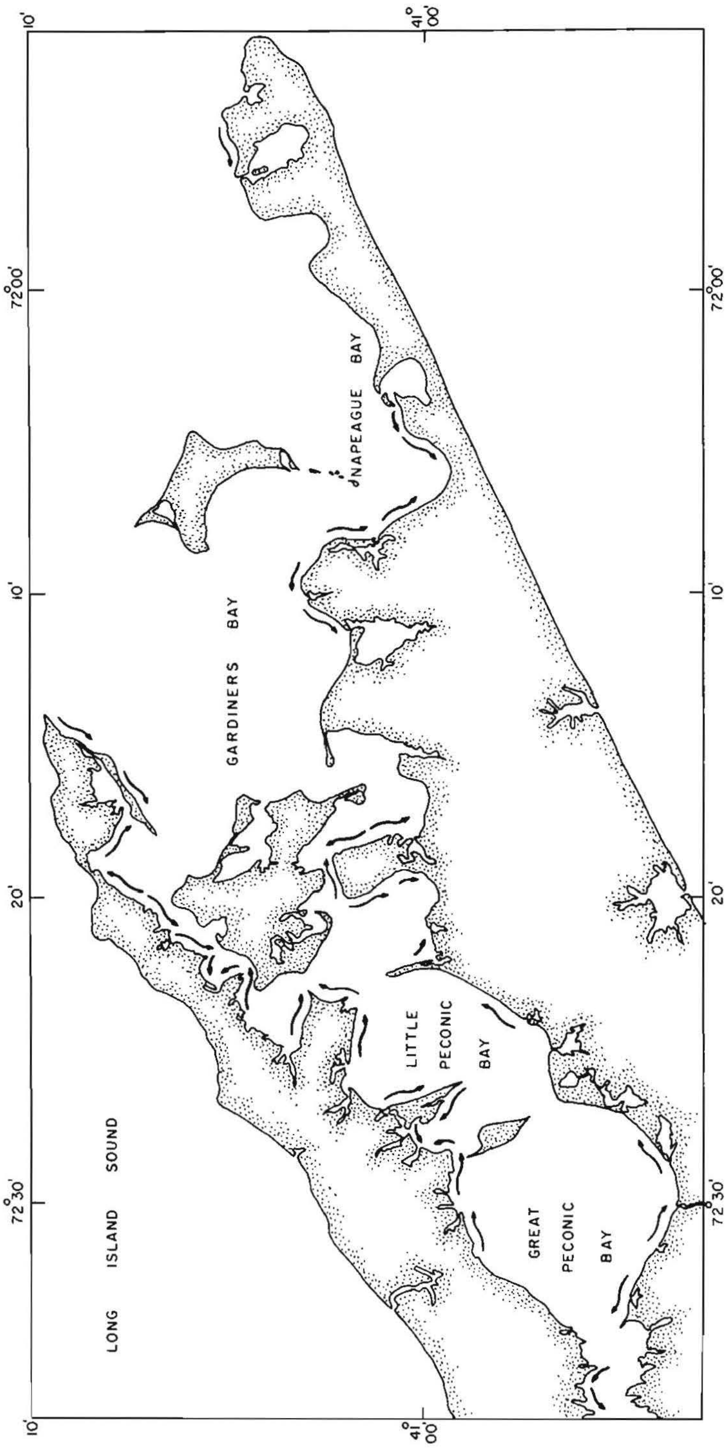


Fig. 2-3. Littoral Transport Directions as Determined by Aerial Reconnaissance.

earlier, the limited fetches and the shallow areas within bays prevent the build up of large waves but generate short-period waves which are erosive in nature. The directional distribution of winds at Montauk, N.Y. and Westhampton, N.Y. are given in Table 2-1 (Frizzola, 1974). Saunders and Ellis have determined that for winds from each segment blowing toward a particular shore, the fetch x wind activity = the erosive potential of the waves generated. Using this index of wind effectiveness, we can predict which areas within the eastern forks will be most severely damaged by different wind and wave regimes. The erosive potentials for selected areas based on a prevailing NNE wind are given in Table 2-2. We can easily see from this that Montauk Point will be most greatly affected by NE winds. Surprisingly, Shinnecock will also be greatly affected in spite of its interior and seemingly protected location. All things being equal, that part of the shoreline facing the greatest open water will receive the largest amount of wave energy. But it must be remembered that the prevailing winds may come across a shorter stretch of open water, with the result that less exposed areas may suffer more rigorous attack (Saunders and Ellis, 1961). Also, a moderate wind blowing over several high tides may cause as much or more damage than a severe storm occurring at low tide.

In general, storms generating winds from the north sectors will produce the greatest setup and tidal inundation on the north shore of the south fork and storms generating winds from the south sectors will have the greatest effect on the south shore of the north fork.

Tides and Tidal Currents

Tides are the periodic rise and fall of the seas caused by the gravitational attraction of the sun and moon occurring unequally on different parts of the earth; two highs and two lows occurring

TABLE 2-1

Direction from which wind blows	% total wind activity Montauk	% total wind activity Westhampton
N	5.3	7.3
NNE	5.4	7.0
ENE	6.3	6.4
E	4.9	4.3
ESE	5.7	5.3
SSE	7.3	4.8
S	12.4	5.3
SSW	10.4	13.2
WSW	7.8	15.0
W	13.0	8.0
WNW	13.4	10.8
NNW	8.1	12.6

TABLE 2-2

Area	Fetch (n. miles)	% Wind Activity	Erosive Potential
Montauk Point	26.0	5.4	140.4
Threemile Harbor	16.2	5.4	87.5
Shinnecock	10.0	7.0	70.0
Red Ceder Point	4.9	7.0	34.3
Nassau Point	2.9	7.0	20.3
Orient Point	13.0	5.4	70.2

TABLE 2-3

Mean and Spring Tidal Ranges[1]

Location	Mean Range m	Mean Range (ft)	Spring Range m	Spring Range (ft)
Orient	0.76	2.5	0.91	3.0
Greenport	0.73	2.4	0.88	2.9
Southold	0.70	2.3	0.82	2.7
Noyac Bay	0.70	2.3	0.82	2.7
Sag Harbor	0.76	2.5	0.91	3.0
Cedar Point	0.76	2.5	0.91	3.0
New Suffolk	0.79	2.6	0.94	3.1
South Jamesport	0.82	2.7	0.97	3.2
Shinnecock Canal	0.73	2.4	0.88	2.9
Threemile Harbor Entrance, Gardiners Bay	0.73	2.4	0.88	2.9
Promised Land, Napeague Bay	0.70	2.3	0.82	2.7
Montauk Harbor Entrance	0.58	1.9	0.70	2.3
Montauk, Fort Pond Bay	0.64	2.1	0.76	2.5
Montauk Point, North Side	0.61	2.0	0.73	2.4

[1]Based on Tide Tables, 1976, National Ocean Survey

approximately every twenty-four hours. When the earth, sun and moon fall along the same straight line, spring tides result. When the sun and moon are at right angles relative to the earth, neap tides result. The tidal ranges for the study area are given in Table 2-3. The predicted, astronomical tide and the observed tide may vary in that many factors can affect tidal height. For example, the surface of the ocean will rise in an area of low atmospheric pressure. Sea level rises approximately one foot for a pressure drop of one inch of mercury (Pore and Barrientos, 1976). Water transport by wind will also exaggerate the tidal height. During a storm, many of these factors (phase of the moon, barametric pressure, wind setup, rainfall, etc.) will occur together, producing extremely high tidal conditions. Table 2-4 lists the highest tides of record for the study area and Fig. 2-4 shows the tidal bench mark locations.

The study area is a roughly V-shaped tidal estuary. When the tide begins to rise, a wall of water proceeds to flow rapidly in through the mouth of the estuary. The even paced rise of the tide is impeded by Shelter Island which forces the incoming water through constricted channels to the north and south. In order to get a given volume of water past Shelter Island and into Little Peconic Bay, the rate of flow in the constricted channels is accelerated; thus creating tidal currents or races. This occurs to a lesser extent when water moving from Little Peconic Bay into Great Peconic Bay must flow around Nassau Point and Robins Island. The tidal current velocities for these areas are given in Fig. 2-5.

Since the tidal current velocities for the area are high, they play a role in determining the volume and direction of sediment transport. The competence (sediment carrying capacity) of moving water increases with increasing speed. Therefore, on the flood, beach sediment would be moved into the study area; at slack, the competence would be negligible, and thus the larger sediment particles would be deposited on the bay bottoms; at ebb, the particles would be picked up and moved out of the area to become part of the Atlantic Coast or North Shore's littoral transport system. This is probably the case for the areas east of

TABLE 2-4

Highest Tides of Record: Eastern Forks[4]

Number	Location	Highest tide (above MLW) m	(ft)
1	Orient Point (New London Ferry Co. Dock), Gardiners Bay	3.57	11.7[1]
2	Long Beach Bar Lighthouse, Gardiners Bay	3.20	10.5[2]
3	Orient, Orient Harbor	3.14	10.3[1]
4	Greenport, Greenport Harbor	2.23	7.3[1]
5	Southold, Southold Bay	2.44	8.0[2]
6	New Suffolk, Cutchogue Harbor	2.44	8.0[2]
7	So. Jamesport, Great Peconic Bay	2.37	7.8[1]
8	Meetinghouse Creek Entrance, Flanders Bay	2.44	8.0[2]
9	Riverhead, Peconic River	2.31	7.6[1]
10	Shinnecock Canal (No. Entrance), Great Peconic Bay	[3]	
11	Cold Spring Pond, Great Peconic Bay	2.28	7.5[2]
12	West Neck, Great Peconic Bay	2.59	8.5[2]
13	Scallop Pond, Great Peconic Bay	2.44	8.0[2]
14	North Sea Harbor, Shelter Island Sound	2.59	8.5[2]
15	Noyac Bay, Shelter Island Sound	2.59	8.5[2]
16	Sag Harbor Cove, Shelter Island Sound	2.59	8.5[2]
17	Sag Harbor, Shelter Island Sound	2.59	8.5[2]
18	Cedar Island Lighthouse, Shelter Island Sound	2.90	9.5[2]
19	Threemile Harbor (East side, 1/4 mi. north of Threemile Harbor)	2.74	9.0[2]
20	Threemile Harbor Jetty, Threemile Harbor Entrance	2.74	9.0[2]
21	Promised Land, Napeague Bay	2.90	9.5[2]
22	Montauk, Fort Pond Bay	3.20	10.5[2]
23	Montauk Harbor Entrance, Montauk Point	3.20	10.5[2]

[1]Highest tide recorded during hurricane 21 Sept. 1938.

[2]Estimated ± 0.5 ft.

[3]not available.

[4]U.S. Dept. of Commerce, Environmental Science Services Administration Coast & Geodetic Survey. Tidal Bench Mark Data, N.Y. II, Long Island

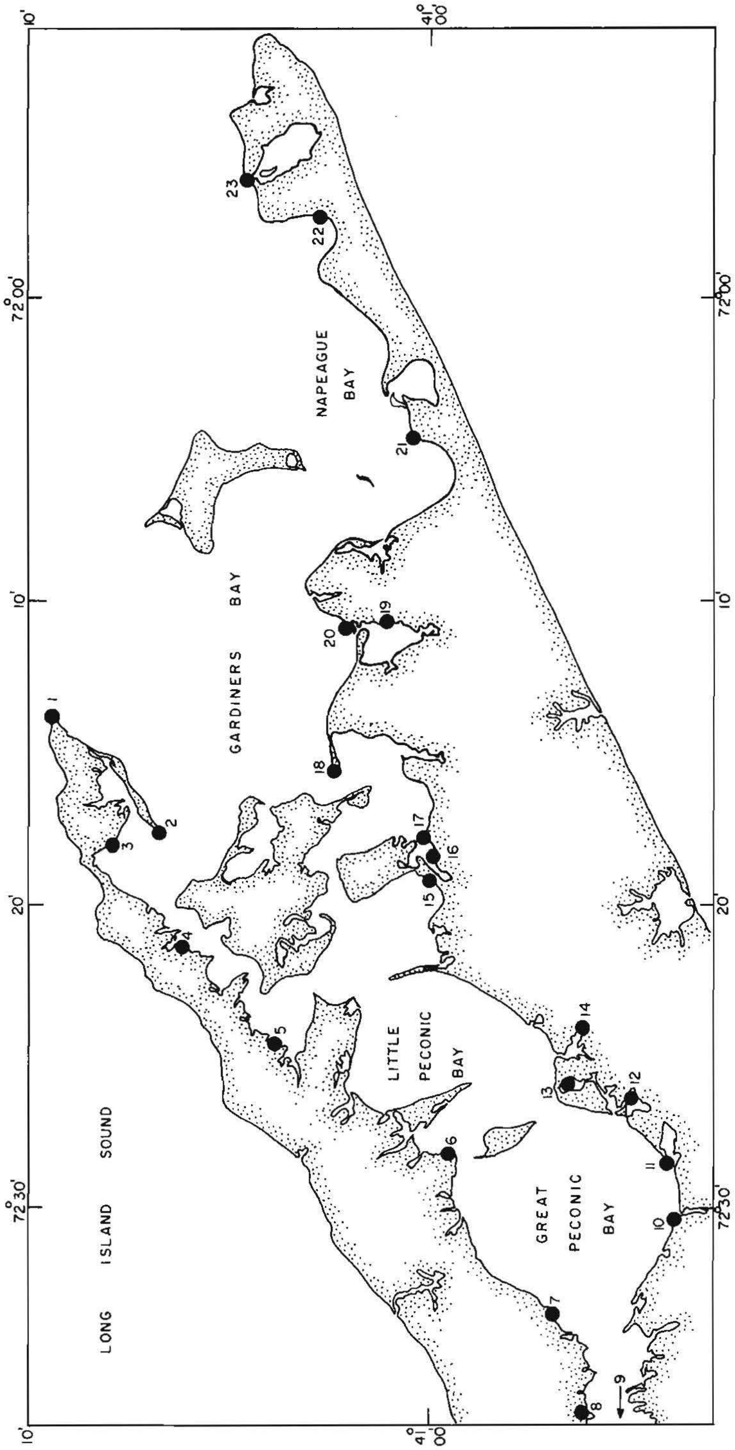


Fig. 2-4. Locations for Tidal Bench Mark Data.

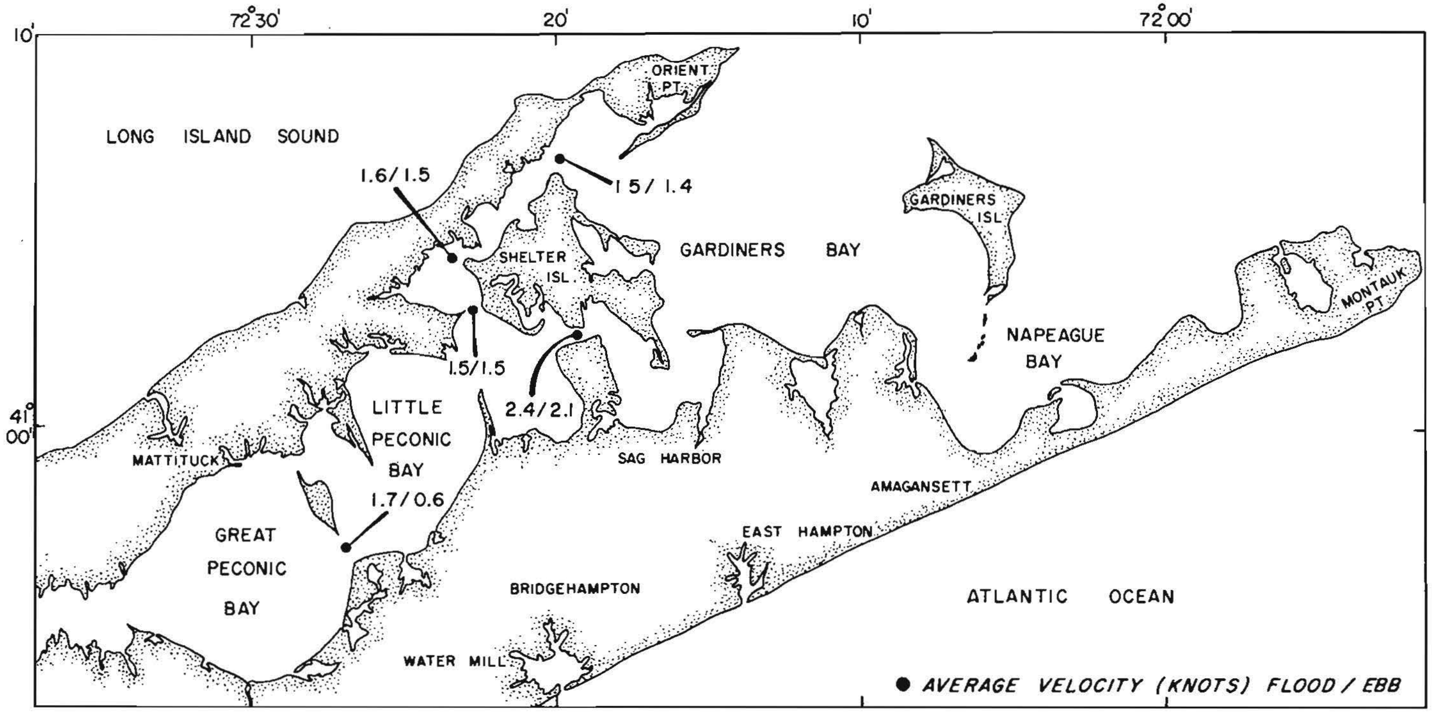


Fig. 2-5. Tidal Current Velocities.

Robins Island where the flood and ebb tidal velocity are almost equal. However, in the areas west of Robins Island the ebb velocity is less than half of the flood velocity, so that all but the finest particles should remain deposited on the bay bottom. Perhaps this accounts for the formation of a small sill between Red Ceder Point on the south fork and Miamogue Point and Simmons Point on the north fork. Fig. 2-6 shows the deposition which has occurred since 1960. Further investigations are necessary to determine if, in fact, net movement of sediment is toward the western end of Great Peconic Bay.

Sea Level Changes[1]

Disney (1955) found that for the 60 year period from 1893 to 1953, mean sea level at New York City rose at the average rate of 3.3 mm (0.13 in) per year, for a total change of about 20 cm (8 in). During the period 1940 through 1960, mean sea level for stations along the Atlantic Coast rose at an average rate of 2.4 mm (0.10 in) per year (Donn and Shaw, 1963). More recent observations suggest that there has been a marked increase in the rate of sea level rise during the last decade (Hicks, 1972). A rising sea level creates deeper water offshore, allowing waves to penetrate farther into the beach zone. The greater amount of energy expended by the waves at the beach zone could lead to increased erosion (King, 1969).

Storms

Tropical cyclones and extratropical storms have caused extensive damage to the Long Island shoreline including the eastern forks within historical times. Tropical cyclones can be divided into two categories:

1. tropical storms with winds of 18 m/sec to 33 m/sec (40 to 73 mph), and
2. hurricanes with winds greater than 33 m/sec (over 73 mph).

Extratropical storms (northeasters) occur mainly during winter and develop in the mid-latitudes as a result of interaction between warm and cool air masses. Extratropical storms are discussed in the next section.

Since 1900, several major hurricanes have hit Long Island: the storm of September 21, 1938, which caused the highest tides of record within the study area; the storm of September 15, 1944, with observed tides and damage lower than that of the 1938 storm as the peak storm surge occurred at normal low tide (Pore and Barrientos, 1976); Hurricane Carol of August 31, 1954; Hurricane Donna of September 12, 1960, considered to be one of the most destructive hurricanes to affect the east coast, with gusts of 51 m/sec (115 mph) or greater reported at Montauk (Dunn, 196); and the most recent, Hurricane Belle of August 9-10, 1976.

The occurrence, descriptions and related damage of the earlier storms is well documented. Therefore, I will restrict myself to a brief discussion of the storms since 1970.

Hurricanes

The first effects of Hurricane Belle were felt when the wind velocity started to pick up late on August 9. The wind velocity at John F. Kennedy Airport was approximately 17 m/sec (38 mph) at midnight and blowing from the northeast with gusts up to 36 m/sec (80 mph). The eye crossed Long Island's shoreline in the area of Jones Beach early on August 10. Within the study area, winds ranged between 9 m/sec (20 mph) and 13 m/sec (30 mph). Wind direction varied but blew predominantly from the western sectors (NW, W, SW). In addition, Belle struck on a falling tide, nullifying the effect of the full moon, and, as a result, the storm surge (observed minus predicted) at Montauk was only about 1 m (3 ft). Therefore, little coastal inundation and

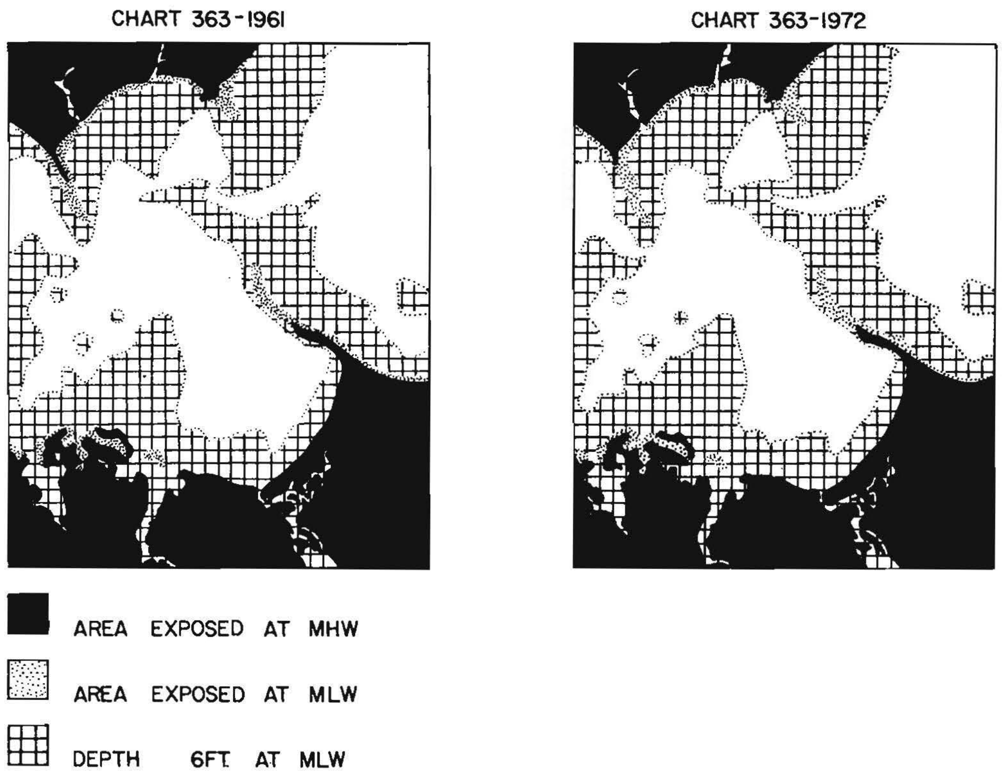


Fig. 2-6. Area of Sediment Deposition: Red Ceder Point on the South Fork and Miamogue Point and Simmons Point on the North Fork.

damage resulted from Belle.

Tropical Storms

Three tropical storms have occurred since 1970; Doria (August 28, 1971), Agnes (June 22, 1972) and Gilda (October 26, 1973), all of which caused some damage to coastal areas within the eastern forks.

Extratropical Storms

There have also been three moderate to severe extratropical storms: the storm of February 3, 1972, the storm of February 19, 1972, and the storm of December 1, 1974. The February 3, 1972 storm resulted in storm surges in excess of 1 m (3.5 ft) at Montauk (Pore and Barrientos, 1976). It was followed shortly thereafter by the storm of February 19, 1972, which occurred near the time of normal high tide and caused a storm surge at Montauk of approximately 1 m (4 ft). This storm caused considerable erosion with sediment being moved off-shore to form bars. The storm of December 1, 1974, with winds in excess of 27 m/sec (60 mph) and accompanying heavy rains, caused some minor flooding within the area.

Statistics show that, based on 204 storms which occurred between 1800 and 1962, the Long Island area experiences a storm which causes moderate damage about once every two years, and an unusually severe storm, three times every century (Davies, 1972). Since 1970 we are averaging one moderate storm per year.

Storms as Geologic Agents[2]

Hurricanes and northeasters have played important roles in the modification of the shoreline. The present shoreline is, in fact, mainly the result of erosion and deposition caused by these storms.

A severe northeaster or a hurricane can cause as much damage to the shore in a matter of a few hours as it would take normal weather conditions to produce in a hundred years. Observations indicate that "most energy is expended in present-day nearshore-marine environments, not in a uniform constant manner but rather in sporadic bursts, or spurts, as a series of minor catastrophes" (Hayes, 1967, p. 52). Such a catastrophe occurred on September 21, 1938. In a few hours the storm surge of this hurricane leveled 6 m dunes on the Rhode Island Coast that had been building up since the occurrence of a hurricane of similar magnitude on September 22, 1815 (Brown, 1939). The 1938 hurricane also caused glacial cliffs 15 m (49 ft) in height to recede over 10 m (33 ft).

Investigators of beaches in the New England area (Zeigler, Hayes, and Tuttle, 1959; Hayes and Boothroyd, 1969) have concluded that beach profile development is largely the result of the severity and frequency of storms affecting the area within the previous few months. Storm activity does not necessarily cause all beaches to erode. Wind direction and coastal configuration can cause littoral drift to accumulate in areas downstream from those that are eroding (Zeigler, Hayes and Tuttle, 1959).

The effects of the northeasters differ from those of hurricanes in that the latter produce higher tides. However, northeasters are much more frequent than hurricanes, and the combined effect of two or more storms in a short period of time on beaches that have not achieved full post-storm beach build-up, can be just as devastating. Therefore, similar shoreline changes could be expected from a hurricane, a severe northeaster, or several northeasters.

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[1]From Davies, et al., 1973.

[2]From Davies, 1972.

CHAPTER III
EXAMINATION OF EROSION PROBLEMS

Erosion, the wearing away of land masses by geological processes, is a natural phenomenon. It is not inherently good or evil, it is inexorable. It is viewed negatively, however, because very often it jeopardizes the land holdings or structures of man. This is nowhere truer than in the coastal zone, a tenuous environment at best.

Shoreline Erosion

The condition of any shoreline environment depends upon its capacity to moderate the powerful forces of storm waves and winds. The beach acts as a natural defense against wave attack, altering its profile in response to stress, as was discussed in Chapter II. This is a short-term erosional trend associated with seasonal weather variations. There is also long-term erosion, which occurs when high tide levels associated with severe storms submerge the forebeach and allow wave attack of the highly erodible back beach and bluff toe. The eroded material is moved offshore and redistributed by waves and wave-generated currents. It is this long-term trend in shore erosion in association with rising sea level which causes concern. Historically, man has taken structural measures to stabilize beaches and bluffs. These structures include groins, jetties and seawalls, all of which alter the focus of wave energy, thereby providing protection for specific sites.

Bluff Erosion

There are a number of earth processes that play a role in the continuing erosion of bluffs. These include slides, creep, and movement of surficial earth material in water-, ice-, and wind-transport systems. In all these cases, gravity is the motive force. The type of earth movement is controlled by the earth materials involved, friction, and the slope over which the mass is moving. Movement is triggered by an event which upsets previously established equilibrium conditions. The triggering events commonly include: heavy rains or large amounts of meltwater that reduce internal friction; unloading or undercutting of stable slopes by natural erosion; and destruction of natural equilibria by the works of man (Flawn, 1970).

The bluffs bordering the eastern forks, like their counterparts on the north shore of Long Island, are composed of glacial debris with sediment particles ranging in size from clay and silt to boulders. Occasionally, layers of clay will outcrop at the bluff face, as they do at Jessup Neck (Fig. 3-1) and Cow Neck (both on the

Fig. 3-1. Exposed Clay Layer at Jessup Neck.

south fork). The location of the layer within the bluff is of some importance. If the layer is at the toe of the bluff, it will retard erosion because clay is more coherent than sands and gravels. If it occurs elsewhere within the bluff, it can act as an impervious layer allowing water to be channeled along its surface. When the water discharges at the bluff face it will often carry overlying soil with it. The clay, itself, can also be set in motion causing the bluff to slump.

Clays behave differently from sand and silt with changes in moisture content. These changes in physical character of the soil versus water content are described by Atterberg limits (Flawn, 1970):

1. the *liquid limit* expressed in terms of the water content at which soil cohesion or resistance to shear approaches zero; water content is maximum at this limit,
2. the *plastic limit* expressed in terms of the water content at which the soil becomes plastic, and
3. the *shrinkage limit* which is the water content below which the soil ceases to shrink on drying.

When water is added to a soil aggregate, the air is displaced; then, if the aggregate contains a substantial amount of clay, the clay becomes plastic. The coherence of the soil decreases as water is added. After all the pore space is filled with water, any additional water will convert the aggregate to a liquid and it may begin to flow.

It would seem that the natural water content of solid earth material must, in all cases, be less than the liquid limit; otherwise, the material would, by definition, be a flowing mud. There are, however, some fine-grained soils that do naturally contain more water than their liquid limit. These are mostly found in glacial deposits. This phenomenon is due to the soil structure in which the individual particles are arranged in a "honeycomb" that permits the soil to hold large quantities of moisture while remaining in the solid state (Flawn, 1970).

While occurrence of large-scale slides have not been documented within the study area, there are a number of places on the north shore of Long Island where extensive slides have occurred. The largest reported slide on Long Island, the Broken Ground Slide, is located on the Sound shore three miles northeast of Northport and one mile north of Fort Salonga. Slides produced by the flowage and slipping of clays are by far the most conspicuous slides on the Island. Among the locations where more or less definite slides have been observed are the west shore of Eatons Neck (where Cretaceous clays outcrop), Woodhull Landing near Miller Place, west of Hulse Landing, Jacobs Point, Luce Landing, and Jacob Hill (Gardiners clay), Oregon Hills and Mulford Point (Till) (U.S. Army Corps of Engineers, 1969).

In addition to slumping and slides caused by clay movements, slides can also occur due to wave action at the base of the bluff, and seepage of water at the bluff face may cause sections of the bluff face to slide. A less dramatic motion, creep, is the slow movement of soil down a slope. In a number of places within the study area, vegetation and its supporting soil can be seen "creeping" down the bluff (Fig. 3-2).

Fig. 3-2. Vegetation "Creeping" Down Bluff Face.

Bluffs can also be eroded by rain-water running down the surface, by freeze-thaw cycles with accompanying runoff, and by particles wind-blown off the bluff face.

Ice is considered an erosional agent, but it is also a depositional agent. When ice in the bays starts to break up, it is pushed up on shore by wave action (Fig. 3-3). The ice carries

Fig. 3-3. Ice Pushed Up Against Base of Bluff.

along with it sand and gravel. When it melts, a mound of sand and gravel is left just forward of the bluffs. This mound will serve as a temporary deterrent to erosion of the bluff toe. Table 3-1 gives the bluff recession rates for selected points within the eastern forks.

People Induced Erosion

On the east side of the entrance to North Sea Harbor, there is a dune approximately 33.5 m (110 ft) high. Almost all the slope vegetation has crept down off the dune under the influence of gravity accompanied by mechanical weathering. On the dune face there also are many tracks created by people taking a short cut to the shorefront (Fig. 3-4).

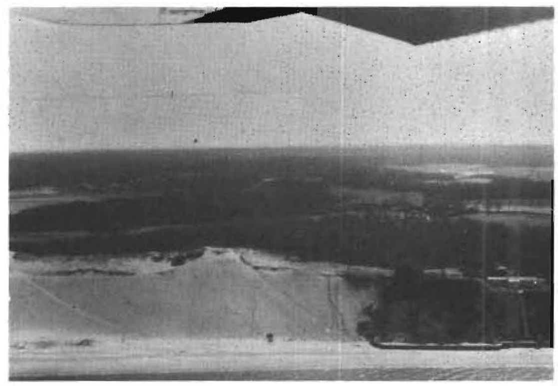


Fig. 3-4. People Induced Erosion: Walking on Bluff Face Creates First Inroads to Vegetation Loss.

People erosion represents a substantial portion of dune and bluff erosion, because this erosion often starts the first inroads to vegetation loss on the slope

TABLE 3-1

Bluff Recession Rates, Eastern Forks, Long Island, N.Y.

Location	Period of Record	Recession Rate (m/yr	(ft/yr)
Sebonac Neck	1933 - 1961[1]	.31	1.0
Paradise Point	1933 - 1960[1]	.37	1.2
E. Side North Haven Peninsula	1933 - 1970	0	0[2]
E. Side Jessup Neck	1934 - 1970	.31	1.0
W. Side Jessup Neck	1934 - 1970	.40	1.3

[1]McClimons, R. J. 1970. Suffolk County bluff and shore recession. U.S. Dept. of Agriculture, Soil Conservation Service, Riverhead, N.Y. Unpublished manuscript. 2 p.

[2]Zero or negligible at present because these low bluffs are almost entirely bulkheaded.

face. This allows the destructive forces of nature, wind and rain runoff, to continue their erosive work. People erosion plays a part in the erosion of bluffs and dunes almost anywhere they occur along the shoreline. One would be hard-pressed to find a dune or bluff area untouched by human activity.

In addition, man also creates erosional problems by building structures which obstruct the natural movement of sediments. Groins and jetties may restrict sediment movement and thus deprive downdrift areas of sediment supply. An example can be seen at Lake Montauk on the north shore of the south fork. The jetties at the entrance to the harbor were built to prevent the movement of sediments into the harbor mouth. However, residents on the down-drift (west) side claim that they also restrict sediment supply to their beaches. Some estimates of beach loss by residents ranged as high as 1.5 m (5 ft) per year. While the estimates may be high, there is no doubt that significant erosion is occurring in that area. Also, the jetties at the harbor entrance may or may not be the major cause of the erosional problems to the west. A more detailed study of this area would be required to determine the cause, or causes, as well as possible methods for eliminating the problem.

Another structure common in the study area which causes erosional problems is the vertical wall or bulkhead. Vertical walls reflect almost all the impinging wave energy; this energy then acts to displace the sand which may be fronting the walls (Vallianos, 1970). The result can be seen at stations where there is no longer a beach fronting the bulkhead.

From these few examples, it can be seen that bluff and shore erosion are closely related. If one chooses to stabilize the bluff then the beach suffers either by:

1. loss of sediment supplied by eroding bluffs to the shore, or
2. by erosion caused by increased hydraulic energy expended on the beach as described in the above section on vertical walls.

If one chooses to stabilize the beach in one area, the beach in another is sacrificed which in turn sacrifices its backing bluff. Can we realistically expect to stabilize both the shore and bluff? Can we realistically or economically expect to do either?

CHAPTER IV
SOLVING THE EROSION PROBLEM

Protective Structures

Erosion is sometimes dealt with by eliminating or reducing the hydraulic energy acting on the unconsolidated sediments comprising the shore (Vallianos, 1970). This is often done structurally with offshore walls or breakwaters, which prevent wave energy from encroaching on the beach; and onshore seawalls or sloping walls (revetments) which protect the base of bluffs from wave attack. Within the study area, the most prevalent structure is the short, low stone groin, which provides protection at specific sites and is most useful in areas of high littoral transport.

Structural methods are not the only ones of use in controlling coastal erosion. Of great value is beach stabilization--the artificial addition of sediments to the beach. The beaches are widened and in some cases, the berm is built up. The estimated first cost of beach restoration for shore protection by sandfill for the study area is $59,400,000 (U.S. Army Corps of Engineers, 1971).

Federal Flood Insurance

Of increasing importance in

controlling losses due to coastal erosion is the implementation of land use restrictions. These restrictions would prevent placement of structures in vulnerable locations and prevent the destruction of the natural protective features of the shoreline (Vallianos, 1970).

This can be accomplished, first, by determining which areas are most prone to damage from accelerated erosion and tidal inundation caused by storms; and, second, by then restricting the use of such areas for continued development.

The National Flood Insurance Act of 1968 and the Flood Disaster Protection Act incorporate both of these concepts. Once it is determined that a community is eligible for flood insurance, it is accepted under the emergency program. Then flood frequency analysis of these communities is conducted to specify flood zones. The community is given six months in which it must enact these land use regulations to comply with FIA regulations to become part of the regular program. Currently East Hampton Town, East Hampton Village, North Haven, Riverhead, Sag Harbor, Southampton Town, Southampton Village and Southold Town have been determined as eligible under the emergency program. And of these, East Hampton Town, North Haven, Southampton Town and Village have been accepted into the regular program. However, these FIA regulations do not prevent or even retard building in such high hazard areas, but concentrate on improving structural elements such as building elevation, flood proofing and anchoring. The net result is that the risks to property owners within the flood zone are minimized, increasing the value of the property and structures within these areas. Thus, management techniques to make these areas less attractive for development have also been minimized.

It would be more effective in protecting life, property and the shore zone to eliminate or at least retard future residential development within the 100 year flood zone, or 500 ft from MHW, whichever is greater; to restrict business development within the area to only those which are shore dependent (e.g. LILCO facilities) or shore enhanced (e.g. boatyards, restaurants); and to provide for structural improvement for existing structures. In addition, if any residential, business or nôn-shore related structures are destroyed during a hurricane or resultant flood, rebuilding should not be permitted within the flood zone. The overall effect will be the removal of unnecessary structures from the shore zone.

Coastal Zone Management

The coastline from Orient Point to Riverhead and Riverhead to Montauk Point (exclusive of islands) is approximately 202 km (125 mi) in length (Table 4-1).

TABLE 4-1

Eastern Fork Shoreline Lengths by Town

Location	km[1]	Statute Miles
Eastern Forks	201.6	125.3
Southold	81.6	50.7
Riverhead	8.2	5.1
Southampton	54.0	33.6
East Hampton	57.8	35.9

[1] 1 km = .6214 Statute miles

There are four townships (Riverhead, East Hampton, Southampton and Southold) with a combined population estimated at 96,635 (Hagstrom Atlas, Suffolk County, N.Y., 1976). This represents an average increase of 17% over the 1970 census. The projected 1985 population for these townships is 161,000, an increase of 87% over 1970. The demand for recreational facilities available to the public will increase accordingly. The coastal zone, which provides the bulk of Long Island's recreational needs as well as its attraction as a tourist area (particularly the East End) should be managed in such a way as to keep development of all but essential facilities from the shore. Conversely, what is currently located in the coastal zone that can be moved elsewhere?

In addition, the Federal Coastal Zone Management Act of 1972 specifies that the aesthetic value of the coastline should be given full consideration. It is difficult, however, to put an objective evaluation on aesthetics just as it is difficult, if not impossible, to place a dollar and cents evaluation on it. Yet, there are some generalizations which can be made:

1. a shore area in its natural state is more aesthetically pleasing than one which has been altered in some way, and
2. shoreline protective structures which have symmetry are less jarring to the eye than debris placed on the shore or at the base of bluffs.

Coastal Inventory

A survey of the shoreline within the eastern forks was conducted from May through September, 1972. The shoreline was divided into 181 stations approximately 1 km apart, of these 92 were randomly selected as field stations. At each station, the beach was profiled by the method of Emery (1966). This involved two poles attached by 5 ft of wire which were moved progressively down the beach. Changes in beach elevation were determined by sighting on the horizon and reading where the horizon intersected the forward pole. In this way both the beach width and changes in elevation were determined. Time and date were also noted to make adjustments for tide level. Sediment samples were collected from both the forebeach and backbeach where possible. In addition, replicate samples were collected to insure the statistical integrity of grain-size analysis. Sediment samples were analyzed to determine % sand and % larger particles (pebbles, gravel, cobbles, boulders) as this provides a more useful parameter than median diameter in characterizing a specific beach (Table 4-2). The information gathered during this survey is contained in the following series of maps and graphs (Figs. 4-1 - 4-12).

TABLE 4-2

Beach Sediment Classification System

100% sand	to	80%	sand	= Excellent
79% "	"	60%	"	= Good
59% "	"	50%	"	= Fair
49% "	"	30%	"	= Poor
29% "	"	0%	"	= Unsatisfactory

This classification is based on two parameters:

1. Creature comfort--a 100% sand beach is far more comfortable than a 100% cobble beach.
2. The cobble beaches within this study area tend to be narrow so that at mean high water they all but disappear. Therefore, these beaches would be poor areas for acquisition and development other than for limited recreational development which could withstand occasional storm damage.

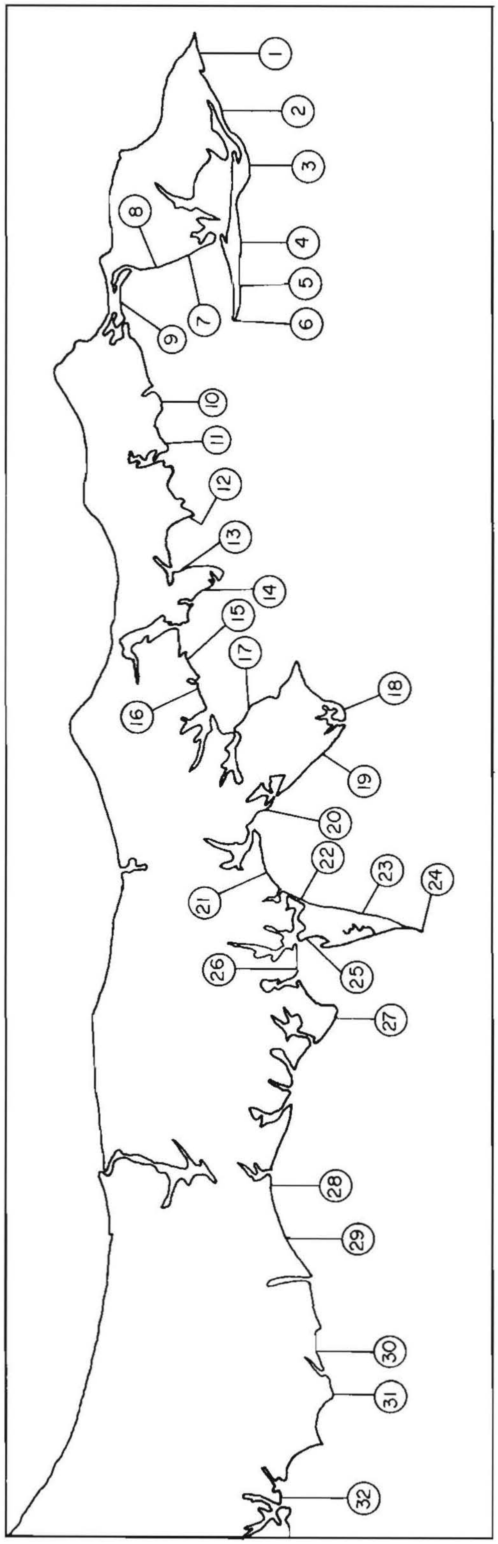


Fig. 4-1. North Fork Station Locations.

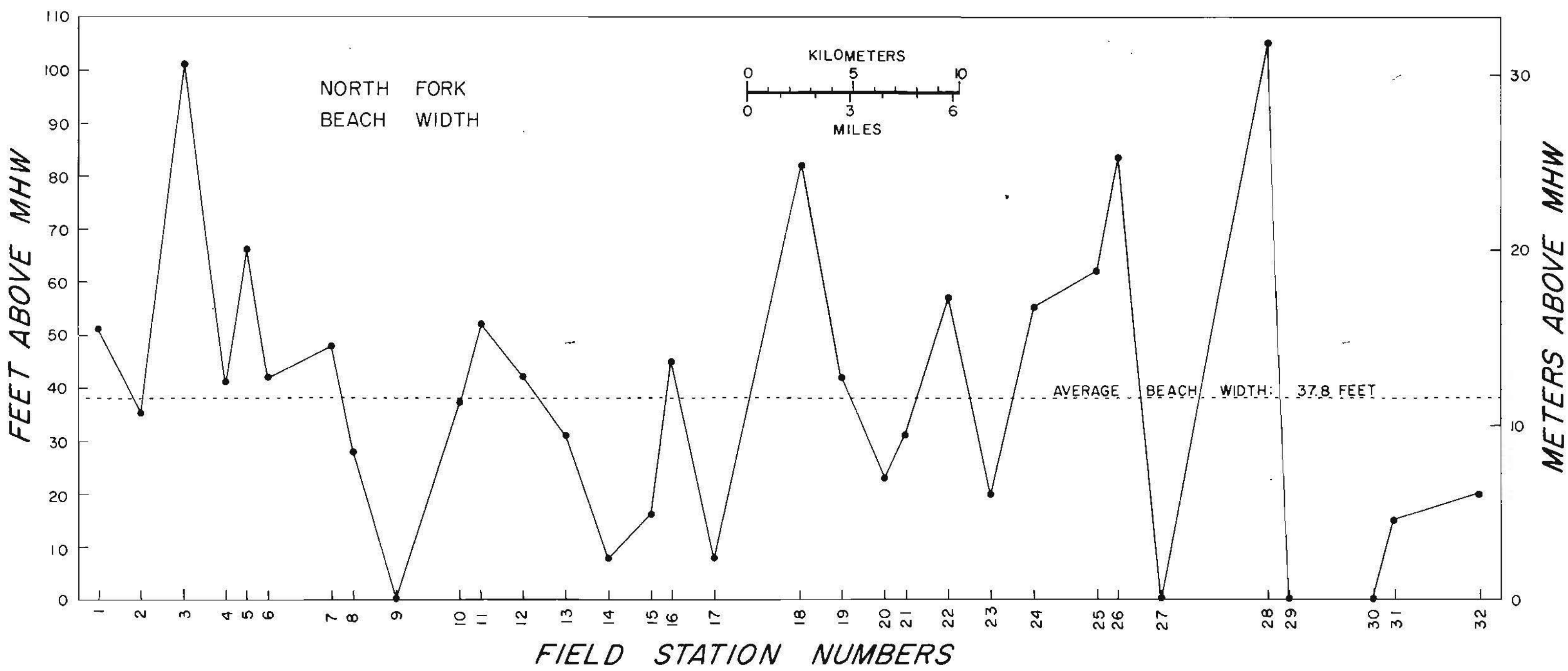


Fig. 4-2. North Fork Beach Widths.

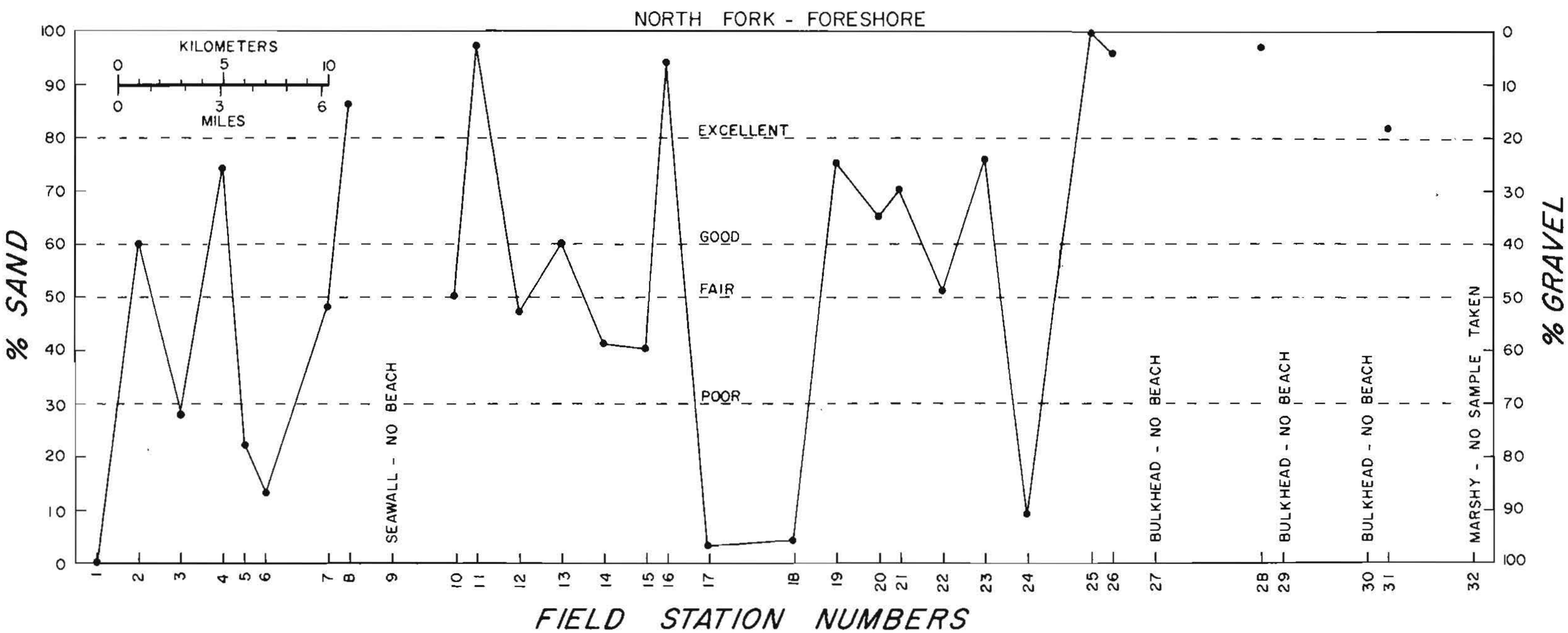
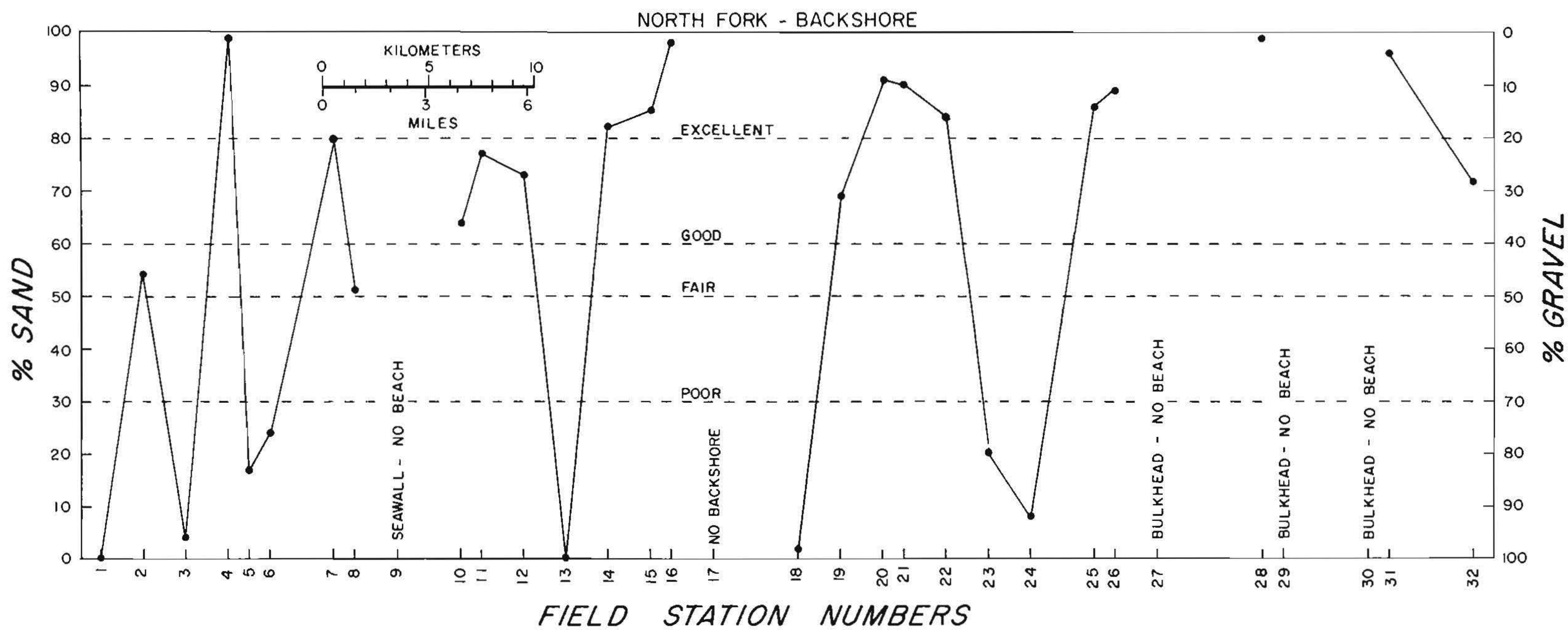

NORTH FORK - FORESHORE
KILOMETERS
0 5 10
0 3 6
MILES
% SAND
% GRAVEL
EXCELLENT
GOOD
FAIR
POOR
SEAWALL - NO BEACH
BULKHEAD - NO BEACH
BULKHEAD - NO BEACH
BULKHEAD - NO BEACH
MARSHY - NO SAMPLE TAKEN
FIELD STATION NUMBERS

Fig. 4-4. North Fork Backshore Sediment Size Distribution.



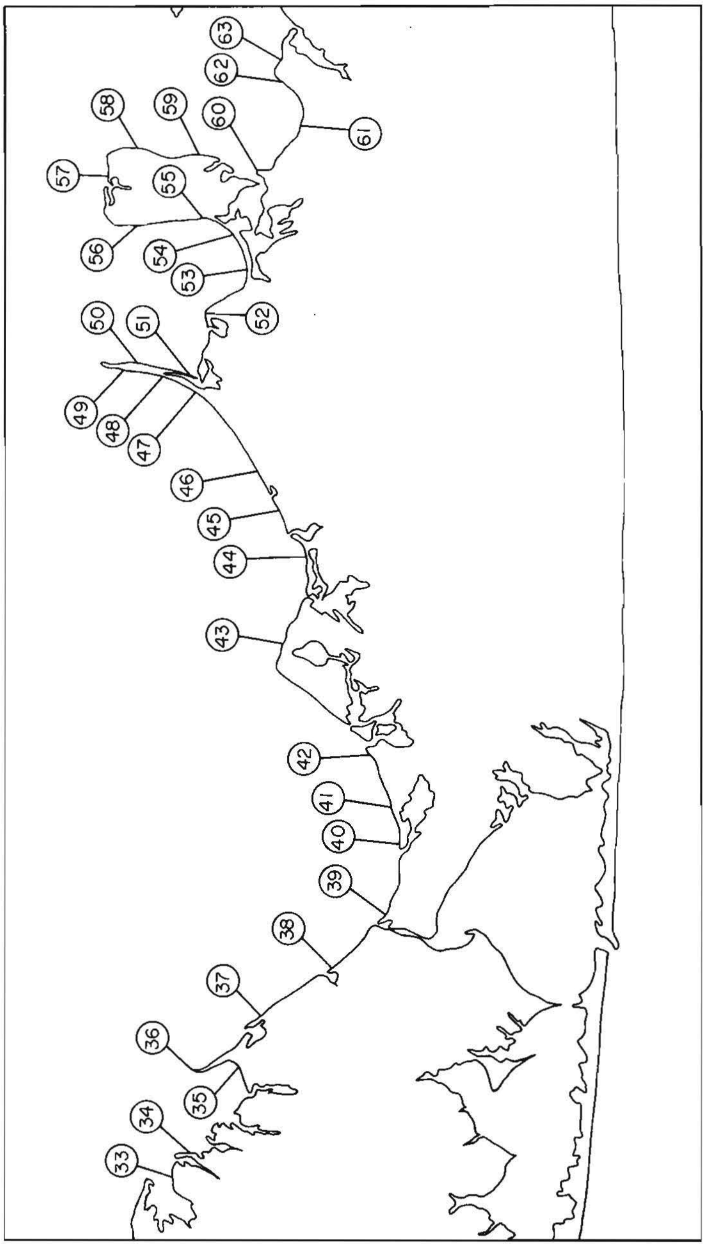


Fig. 4-5. Western South Fork Station Locations.

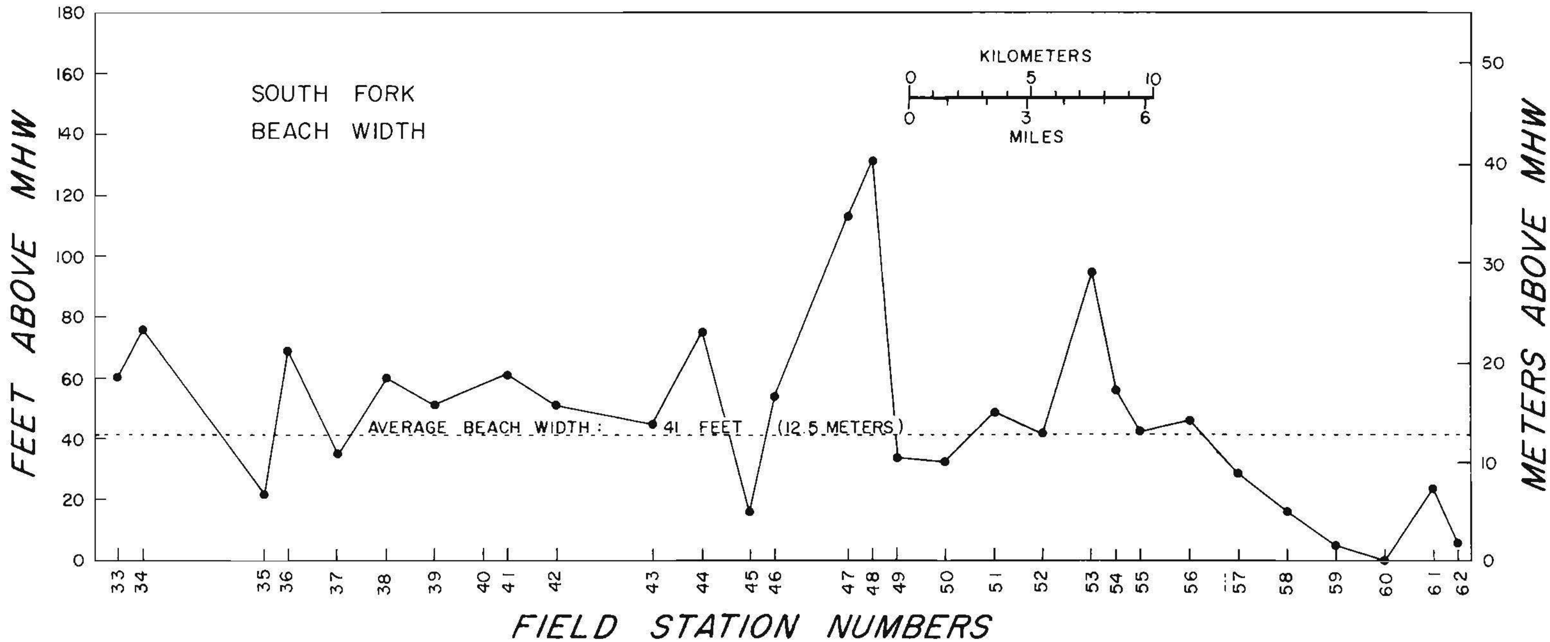


Fig. 4-6. Western South Fork Beach Widths.

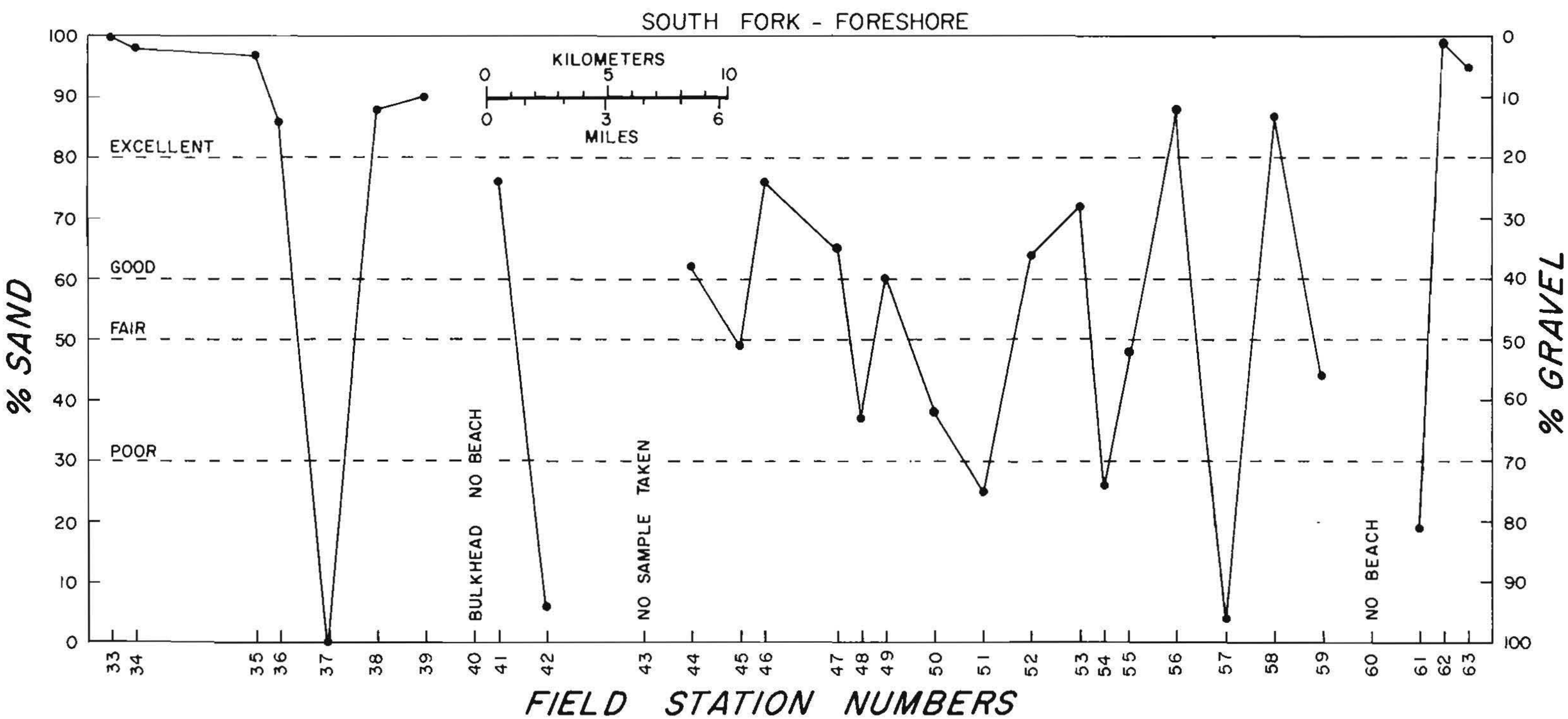
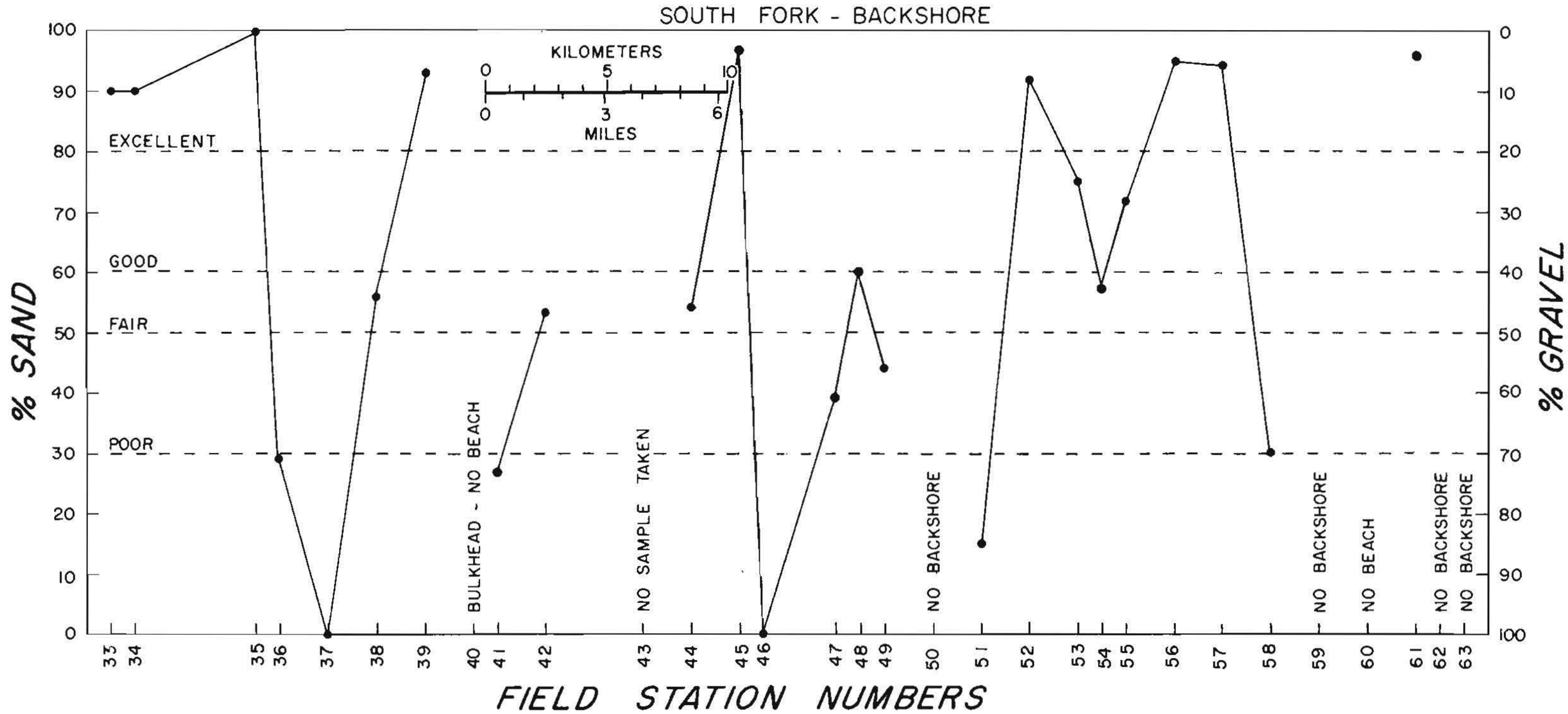


Fig. 4-7. Western South Fork Foreshore Sediment Size Distribution.


SOUTH FORK - BACKSHORE
KILOMETERS
0 5 10
0 3 6
MILES
EXCELLENT
GOOD
FAIR
POOR
BULKHEAD - NO BEACH
NO SAMPLE TAKEN
NO BACKSHORE
NO BACKSHORE
NO BEACH
NO BACKSHORE
NO BACKSHORE
% SAND
% GRAVEL
100 90 80 70 60 50 40 30 20 10 0
0 10 20 30 40 50 60 70 80 90 100
33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63
FIELD STATION NUMBERS

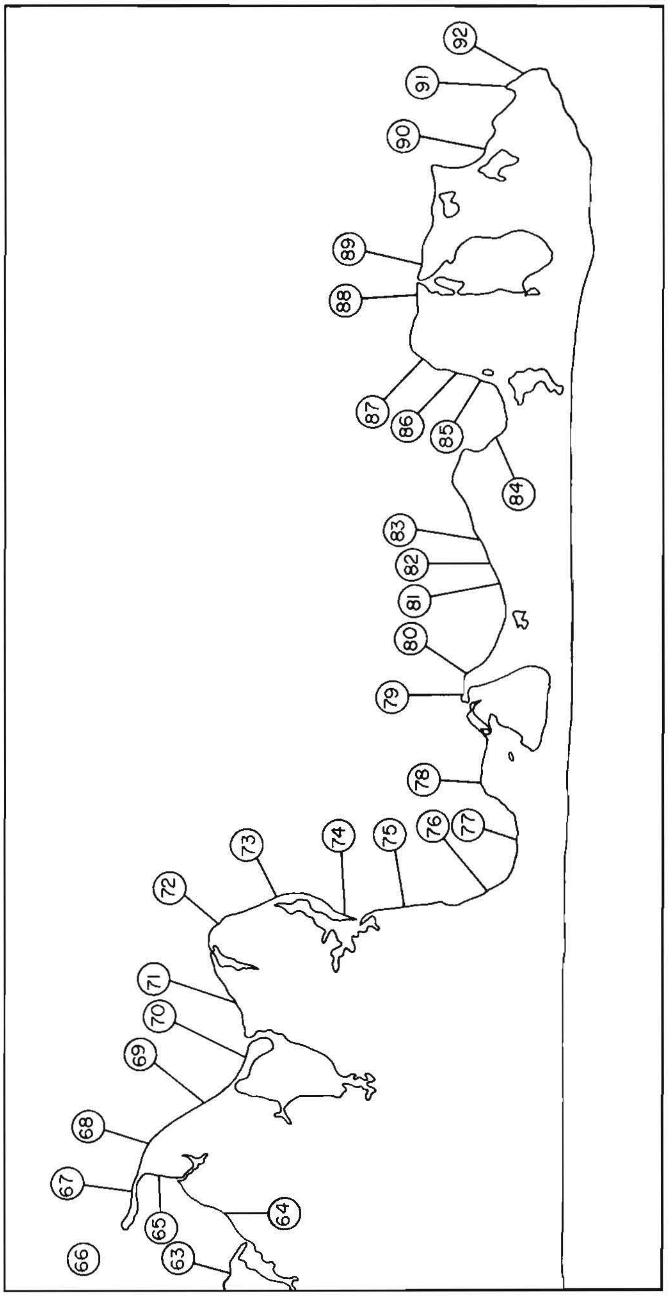


Fig. 4-9. Eastern South Fork Station Locations.

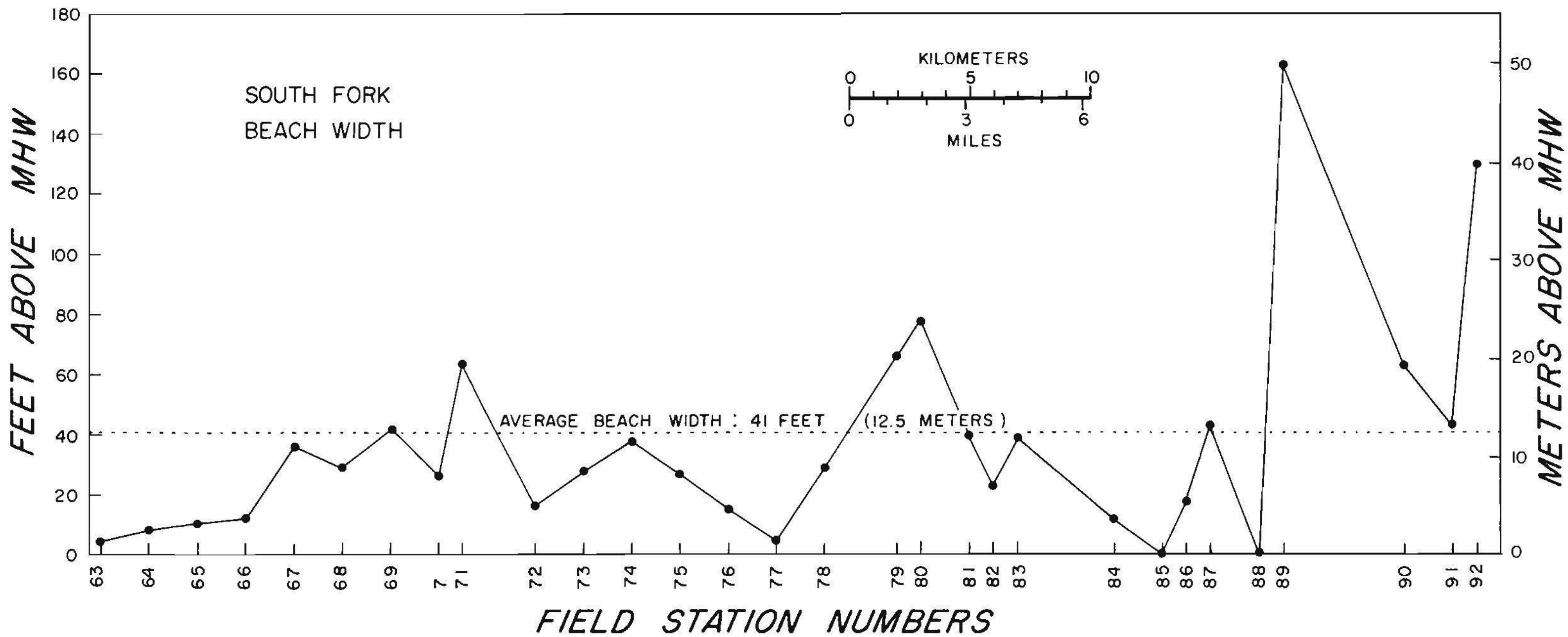


Fig. 4-10. Eastern South Fork Beach Widths.

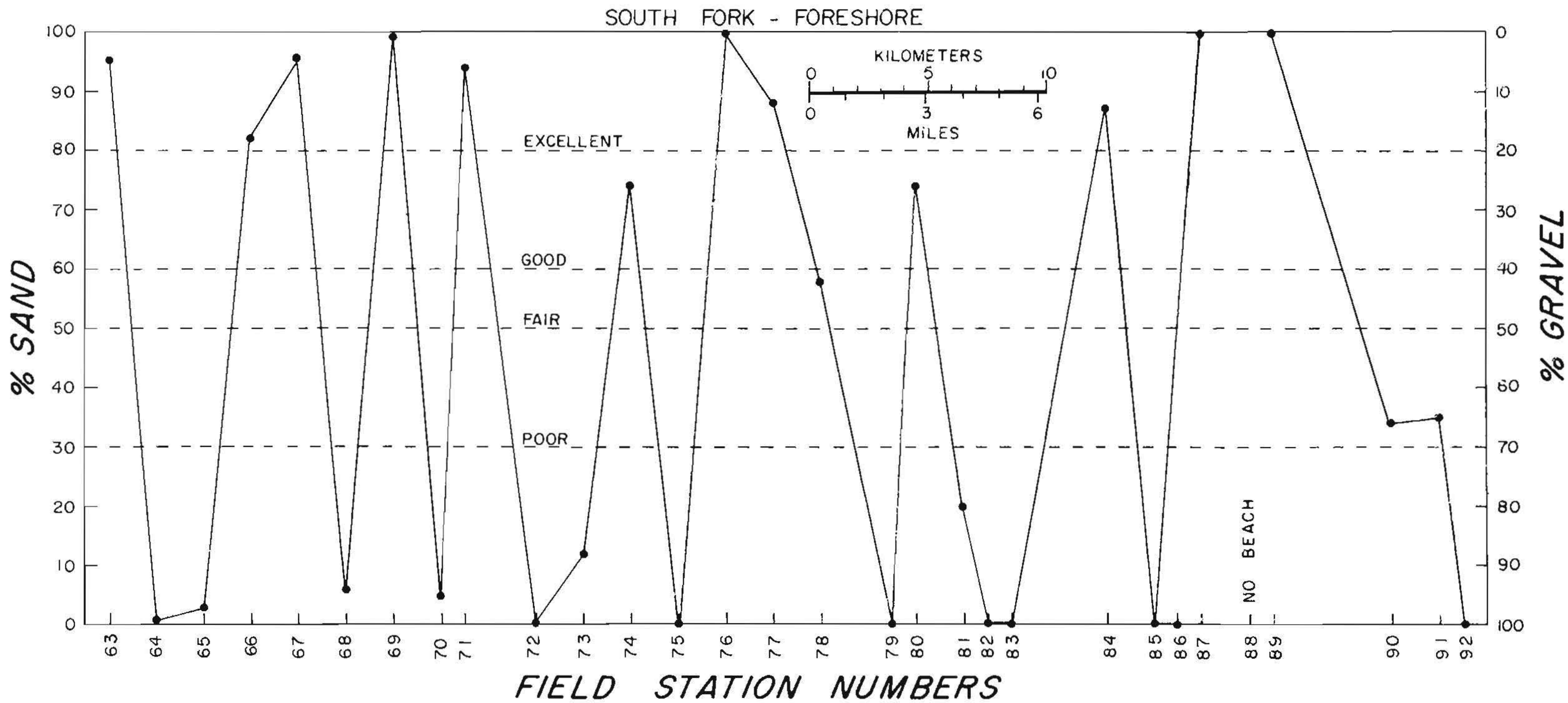


Fig. 4-11. Eastern South Fork Foreshore Sediment Size Distribution.

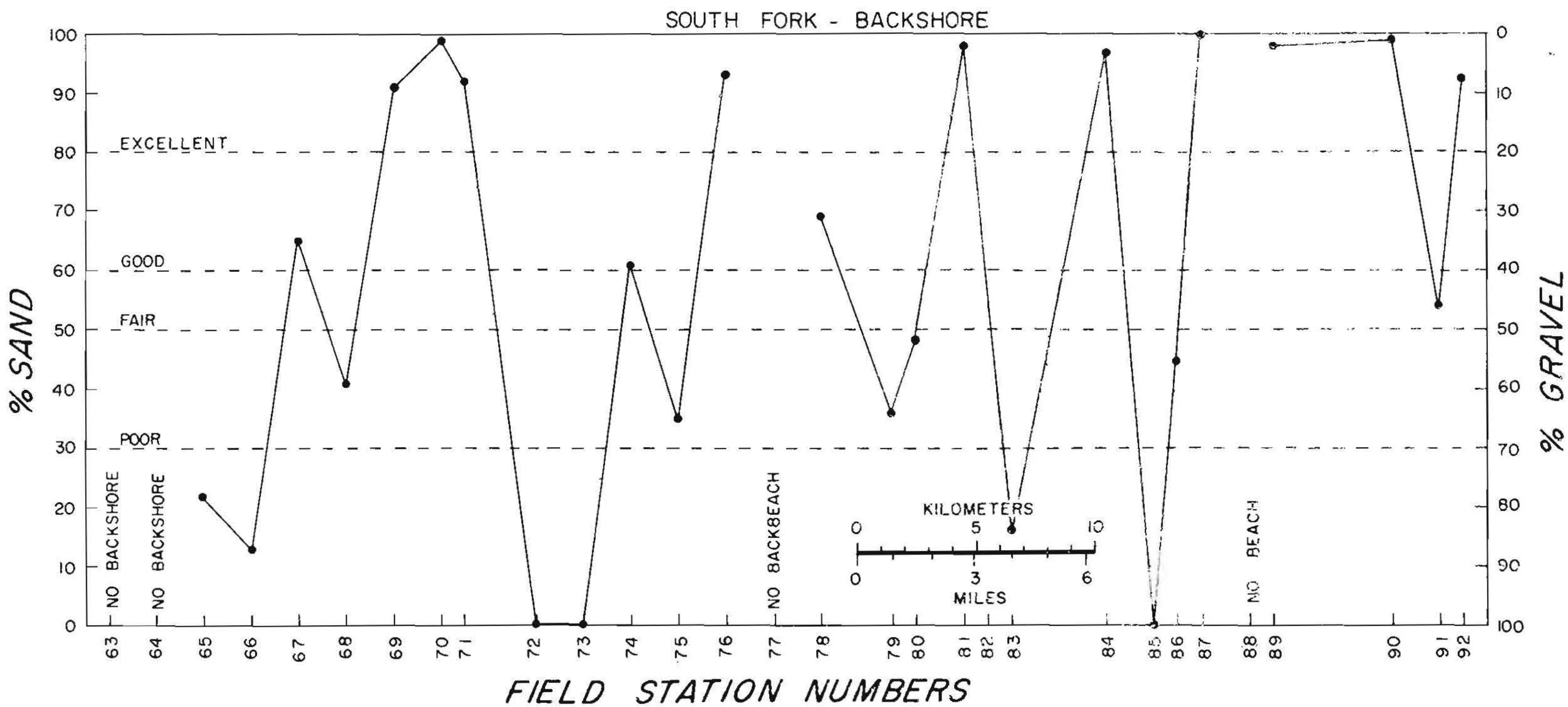


Fig. 4-12. Eastern South Fork Backshore Sediment Size Distribution.

TABLE 4-3

Shore Descriptive Index

Station #	Natural Protection Barriers Elevation m (ft)	Beach Width m (ft)	Erosion or Accretion m/yr (ft/yr)	Shoreline[1] Erosion: Critical or Non-Critical	Foreshore % Sand / % Gravel	Backshore % Sand / % Gravel	Ownership
1	≤ 3 m (10')	16 m (51')	---	Non-Critical	0/100	0/100	Private
2	≤ 3 m (10')	11 m (35')	---	Non-Critical	60/ 40	54/ 46	Private
3	≤ 3 m (10')	31 m (101')	---	Non-Critical	28/ 72	4/ 96	State
4	None	13 m (41')	---	Non-Critical	74/ 26	99/ 1	State
5	None	20 m (66')	---	Non-Critical	22/ 78	17/ 83	State
6	None	13 m (42')	---	Non-Critical	13/ 87	24/ 76	State
7	None	14 m (46')	---	Critical	48/ 52	80/ 20	Private
8	None	9 m (28')	---	Critical	86/ 14	51/ 49	Private
9	None	No Beach	---	Critical	--	--	Private
10	None	11 m (37')	---	Non-Critical	50/ 50	64/ 36	Private
11	None	16 m (52')	---	Non-Critical	97/ 3	77/ 23	Southold Town
12	None	13 m (42')	---	Non-Critical	47/ 53	73/ 27	Private
13	≤ 3 m (10')	9 m (31')	---	Non-Critical	60/ 40	0/100	Private
14	≤ 3 m (10')	2 m (8')	---	Non-Critical	41/ 59	82/ 18	Private
15	None	5 m (16')	---	Non-Critical	40/ 60	85/ 15	Private
16	None	14 m (45')	---	Non-Critical	94/ 6	98/ 2	Private
[17	None	2 m (8')]	.28 m/yr E	Non-Critical	3/ 97	None	Private
18]	None	25 m (82')]	(.90'/yr)	Non-Critical	4/ 96	2/ 98	Private
[19	None	13 m (42')]	.17 m/yr E	Non-Critical	75/ 25	69/ 31	Private
20]	None	7 m (23')]	(.56'/yr)	Non-Critical	65/ 35	91/ 9	Private
[21	None	9 m (31')]		Non-Critical	70/ 30	90/ 10	Private
22	None	16 m (51')	.26 m/yr E	Non-Critical	51/ 49	84/ 16	Southold Town
23]	12 m (40')	6 m (20')]	(.86'/yr)	Non-Critical	76/ 24	20/ 80	Private
24	None	17 m (55')		Critical	9/ 91	8/ 92	Private
[25	None	19 m (62')]	.22 m/yr E	Critical	100/ 0	86/ 14	Private
26]	6 m (20')	26 m (85')]	(.71'/yr)	Critical	96/ 4	89/ 11	Private
[27	≤ 3 m (10')	No Beach]	.23 m/yr E	Critical	--	--	Private
28]	≤ 3 m (10')	32 m (105')]	(.74'/yr)	Critical	97/ 3	99/ 1	Private
29	6 m (20')	No Beach		Critical	--	--	Private
30	≤ 3 m (10')	No Beach	---	Critical	--	--	Private
[31	None	5 m (15')]	.25 m/yr E	Critical	82/ 18	96/ 4	Private
32]	≤ 3 m (10')	6 m (20')]	(.82'/yr)	Critical	--	72/ 28	Private
[33	None	18 m (60')]		Critical	99/ 1	90/ 10	Private
34	None	23 m (76')	.05 m/yr A	Critical	98/ 2	90/ 10	Private
35]	None	7 m (22')]	(.17'/yr)	Critical	97/ 3	100/ 0	Private
36	None	29 m (69')		Critical	86/ 14	29/ 71	Private
37	≤ 3 m (10')	11 m (35')	---	Critical	0/100	0/100	Private
38	None	18 m (60')	---	Critical	88/ 12	56/ 44	Private
39	None	19 m (61')	---	Critical	90/ 10	93/ 7	Southampton Town

TABLE 4-3
(continued)

Station #	Natural Protection Barriers Elevation m (ft)	Beach Width m (ft)	Erosion or Accretion m/yr (ft/yr)	Shoreline[1] Erosion: Critical or Non-Critical	Foreshore % Sand / % Gravel	Backshore % Sand / % Gravel	Ownership
40	None	No Beach	---	Critical	--	--	Private
41	None	19 m (61')	---	Critical	76/ 24	27/ 72	Private
42	None	16 m (51')	.26 m/yr E	Critical	6/ 94	53/ 47	Private
43	≤ 3 m (10')	14 m (45')	(.85'/yr)	Critical	--	--	Private
44	None	23 m (75')	---	Critical	62/ 38	54/ 46	Private
45	≤ 3 m (10')	5 m (16')	---	Critical	49/ 51	97/ 3	Private
46	≤ 3 m (10')	16 m (54')	---	Critical	76/ 24	0/100	Private
47	None	34 m (113')	---	Critical	65/ 35	61/ 39	Federal
48	None	40 m (131')	---	Critical	37/ 63	60/ 40	Federal
49	18 m (60')	10 m (34')	.13 m/yr E (.44'/yr)	Critical	60/ 40	44/ 56	Federal
50	15 m (50')	10 m (33')	.01 m/yr E .04'/yr	Critical	62/ 38	No Backshore	Federal
51	None	15 m (49')	.19 m/yr A (.58'/yr)	Critical	25/ 75	15/ 85	Federal
52	None	13 m (42')	.25 m/yr E (.82'/yr)	Critical	64/ 36	92/ 8	Private
53	None	29 m (95')	---	Critical	72/ 28	75/ 26	Southampton Town
54	None	17 m (56')	---	Critical	26/ 74	57/ 43	Southampton Town
55	None	13 m (43')	---	Critical	49/ 51	72/ 28	Private
56	6 m (20')	14 m (46')	---	Critical	88/ 12	95/ 4	Private
57	None	9 m (29')	.26 m/yr	[2]	4/ 96	95/ 6	Private
58	None	5 m (17')	(.85'/yr)	[2]	87/ 13	30/ 70	Private
59	6 m (20')	2 m (5')		[2]	44/ 56	--	Private
60	None	No Beach	---	[2]	--	--	Private
61	≤ 3 m (10')	7 m (24')	.24 m/yr E	[2]	19/ 81	96/ 4	Private
62	None	2 m (6')	---	Critical	99/ 1	--	Private
63	12 m (40')	2 m (6')	.35 m/yr E (1.15'/yr)	Critical	95/ 5	--	Private
64	None	2 m (8')	---	[2]	0/100	--	Private
65	≤ 3 m (10')	3 m (10')	---	[2]	3/ 97	22/ 78	County
66	≤ 3 m (10')	4 m (12')	---	[2]	82/ 18	13/ 87	County
67	≤ 3 m (10')	11 m (36')	---	Critical	96/ 4	65/ 35	County
68	15 m (50')	9 m (29')	---	Critical	6/ 94	41/ 51	County
69	6 m (20')	13 m (42')	---	Critical	99/ 1	91/ 9	Private
70	3 m (10')	8 m (26')	---	Critical	5/ 95	99/ 1	Private
71	6 m (20')	21 m (63')	.34 m/yr E	Critical	94/ 6	92/ 8	Private
72	6 m (20')	5 m (16')	(1.13'/yr)	Critical	100/ 0	100/ 0	Private
73	None			Critical	12/ 88	100/ 0	East Hampton Town
74	None	12 m (38')	---	Critical	72/ 26	61/ 39	East Hampton Town

TABLE 4-3
(continued)

Station #	Natural Protection Barriers Elevation m (ft)	Beach Width m (ft)	Erosion or Accretion m/yr (ft/yr)	Shoreline[1] Erosion: Critical or Non-Critical	Foreshore % Sand / % Gravel	Backshore % Sand / % Gravel	Ownership
75	15 m (50')	1 m (3')	---	Critical	--	35/ 65	Private
76	≤ 3 m (10')	5 m (15')	.26 m/yr E (.85'/yr)	Critical	100/ 0	93/ 7	East Hampton Town
77	≤ 3 m (10')	2 m (5')		Critical	88/ 12	--	Private
78	≤ 3 m (10')	9 m (29')		Critical	58/ 42	69/ 31	Private
79	None	20 m (66')		Critical	--	36/ 64	State
80	≤ 3 m (10')	24 m (78')		Critical	74/ 25	48/ 52	State
81	9 m (30')	12 m (39')	.35 m/yr E (1.16'/yr)	Critical	20/ 80	98/ 2	State
82	6 m (20')	7 m (23')		Critical	--	--	State
83	12 m (40')	12 m (39')		Critical	0/100	16/ 84	State
84	24 m (80')	4 m (12')		Critical	87/ 13	97/ 3	Private
85	3 m (10')	2 m (5')	---	Critical	0/100	0/100	Private
86	9 m (30')	5 m (18')	---	Critical	0/100	45/ 55	Private
87	6 m (20')	13 m (43')	---	Critical	100/ 0	100/ 0	Private
88	≤ 3 m (10')	No Beach	---	Critical	--	--	Private
89	≤ 3 m (10')	50 m (163')	---	Critical	100/ 0	98/ 2	Private
90	≤ 3 m (10')	19 m (63')	---	Critical	34/ 66	99/ 1	State
91	≤ 3 m (10')	13 m (46')	---	Critical	35/ 65	54/ 46	State
92	≤ 3 m (10')	40 m (130')	---	Critical	0/100	93/ 7	State

No Beach--Anything less than 2 m (5') at MHW.

[1]National Shoreline Study, No. Atlantic Region, Vol. II, 1971.

[2]This area is represented in the National Shoreline Study as having no beach.

Shoreline erosion rates were determined by comparing topographic survey charts from 1838 with those of 1957. There are many problems associated with this type of evaluation:

1. based on the technology of the day, how accurate are the 1838 charts;
2. how accurately can one measure at a scale of 1:10,000 or 1:24,000; and
3. is the information for the period 1838 to 1957 necessarily indicative of current erosional trends?

These are important considerations, and one might well ask are the resultant erosion rates of any real value? They are, if considered only as indications of what one segment of coast is doing relative to another. For example, if the erosion rate at point A is .26 m/yr (.85 ft/yr) and at point B, .38 m/yr (1.25 ft/yr), it is obvious that point B has experienced a slightly more serious erosion problem. And, barring intervention by man, probably still does. The erosion/accretion rates for selected areas within the eastern forks are given in Table 4-3. In sections where the erosion rates were similar, the results were averaged over that coastal segment.

CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

The beaches within Long Island's eastern forks, while similar in composition and form to those on the Sound, are somewhat narrower (Table 5-1). Because of their narrowness, they will not serve as adequate buffer sones between the sea and man-made structures during any significant storm. If a storm comparable to the hurricane of September 21, 1938 were to strike the eastern forks, all but perhaps one (station 26) of the 92 beaches measured would be breached, causing severe erosion of the beaches and their backing bluffs, and considerable flooding throughout the area. Therefore, present and future shoreline development must be scrutinized in an effort to minimize the damage caused by future changes in shoreline configuration.

From information gathered during this survey, the following were concluded:

1. the beaches within Long Island's eastern forks are narrow, with an average width of approximately 12.2 m (40 ft),
2. the overall trend within the area is toward erosion due primarily to wave characteristics and rising sea level,
3. bluffs backing these narrow beaches are subject to wave attack and thus accelerated erosion. In the absence of frequent wave attack, bluffs will still erode due to mechanical weathering. Rain run-off and changes in moisture content of bluff soils can

TABLE 5-1

North Shore Beaches	Beaches < 15 m (50') 50.6%		
	Beaches > 15 m (50') 49.4%	of which	33% > 23 m (75')
			18% > 30 m(100')
			10% > 38 m(125')
			6% > 46 m(150')
Eastern Fork Beaches	Beaches < 15 m (50') 68.1%		
	Beaches > 15 m (50') 31.9%	of which	12% > 23 m (75')
			6% > 30 m(100')
			3% > 38 m(125')
			0% > 46 m(150')

cause significant bluff erosion,

4. extensive walking and climbing on the bluffs often initiate the process of vegetation loss on bluff face slopes,
5. eroded material is being deposited offshore, extending land points such as Red Ceder.

Recommendations

1. Construction of dwellings on eroding bluffs should not be permitted within 100 ft of the bluff face.
2. Those areas within the flood plain of a 100-year storm should be designated flood hazard zones. Only structures which are either shore dependent, or shore enhanced, should be permitted there. These structures should be flood-proofed, if possible.
3. The laws regarding people induced erosion should be enforced.
4. A more thorough study of this area should be made, employing ERTS - 1 satellite imagery to determine sediment movement.
5. Maps of the area of a scale 1:200 should be maintained and updated every 10 years to keep abreast of changes in coastal configuration as well as updating erosional information.
6. In sections already extensively developed, a system for determining which areas would most benefit from shoreline protective structures should be established. As discussed, earlier, some forms of shore protection are more environmentally compatible than others. These should be the methods of choice whenever possible.

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