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BEACH EROSION CONTROL ON THE NEW JERSEY COAST

Interim report on investigative work done prior to August 31, 1956. This report, which accompanies a letter of September 5th to the Commissioner of Conservation and Economic Development, deals primarily but not exclusively with the control of erosion between the Sandy Hook Military Reservation and Barnegat Inlet.

W. Mack Angas

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SYNOPSIS

The beaches of New Jersey, particularly the beaches of the northern resorts, have for many years been eroding so severely as to cause grave concern to the residents of coastal communities and to the State authorities responsible for giving them assistance in controlling erosion and preventing storm damage. Though more than \$18,000,000 have been spent since the turn of the century on the construction of shore protective facilities which would probably cost more than \$40,000,000 to reproduce at present day prices, the destructive erosion of the beaches continues and New Jersey's resort communities are subjected to periodic heavy storm damage. Until recently no comprehensive plan has been formulated for the control of erosion of any considerable portion of the New Jersey coast though effective plans were formulated by cognizant **D**istrict **E**ngineers in cooperation with the New Jersey Navigation Bureau and local agencies for necessary work at Atlantic City, Ocean City and Cape May. In early 1954, however, a comprehensive plan for the control of erosion between Sandy Hook and Barnegat Inlet was prepared by the District Engineer of the New York District in cooperation with the Navigation Bureau, local agencies and the Beach Erosion Board and presented to cognizant authorities in the form of an Erosion Control Report. This Report recommends as primary measures the restoration of beaches to a minimum width of 100

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feet at an elevation 10 feet above mean low water and the construction and extension of a number of groins. The Report also recommends the periodic placement of sand on feeder beaches in the average annual amount of 625,000 cubic yards in order that the beach width of 100 feet necessary to preserve the upland from storm damage may be maintained. Though a number of local engineers have expressed disagreement with the recommendations of the Report, these recommendations are in my opinion sound and should be implemented.

The principal difficulty to be overcome in formulating a feasible plan for implementing the recommendations of the Report is the difficulty of securing appropriations in large enough annual increments to permit the beach filling program to be undertaken economically. Nevertheless it is believed that a worthwhile start on the implementation of the recommendations of the Report might be made by devoting State funds currently available to a program the primary objective of which would be the provision of protective measures at locations where the upland is most vulnerable to attack by storm waves. A substantial but not extensive increase in State annual appropriations in the fiscal year 1957-58 and subsequent years would then permit the initiation of beach filling at feeder beaches recommended by the Report and at the same time provide for the construction of such emergency protective devices as might be found necessary in view of the impossibility of immediately increasing the width of all

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the beaches to 100 feet. It is recommended that this legislative action be taken to permit the initiation of such a program.

INTRODUCTION

This interim report is submitted in compliance with the request of Director T. J. Langan of the Division of Planning and Development, Department of Conservation and Economic Development of the State of New Jersey. It covers a necessarily brief study made by me in August 1956 of the problem of controlling erosion of the New Jersey Coast and particularly that part of the coast lying between Sandy Hook and Barnegat Inlet. A complete study of such a complicated problem cannot be made by one man in a month. Therefore, in no small degree, this report is necessarily the result of a study of the work of others supplemented by what may be called "spot checks" of the accuracy of data obtained from previous reports and the soundness of the conclusions and recommendations contained therein. Specifically this interim report is based upon information obtained in the following way.

A study was made of recent Beach Erosion Control Reports prepared by cognizant District Engineers in cooperation with the New Jersey Navigation Bureau and local agencies. A study was further made of the comment offered on these reports by Division Engineers, the Beach Erosion Board, and the Chief of Engineers. The Erosion Control Report on the area between Sandy Hook and Barnegat Inlet was given specially careful study. Consideration

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was also given to comment on this Report offered by Governor Meyner, the Bureau of the Budget, and local engineers. It was noted that several of the latter are far from being in agreement with the conclusions and recommendations of the Report. The State Beach Erosion Commission's Report to Governor Meyner of June 1954 was considered. Correspondence between Chief Engineer James K. Rankin, of the State Navigation Bureau, and the office of the District Engineer, New York District, and a "memorandum for the record" of a conference on groin design, held at Point Pleasant on May 31, 1956, yielded valuable information. Finally, technical memoranda prepared by the Beach Erosion Board relevant to New Jersey erosion control problems were read.

Conferences with administrators, executives and engineers familiar with the erosion control problems of New Jersey yielded information of value. Personnel of the Department of Conservation and Economic Development who should be mentioned as the sources of extremely valuable data are: Commissioner Joseph E. McLean and his Executive Assistant, K. C. Creveling; Director T. J. Langan of the Division of Planning and Development; Chief of the Navigation Bureau, Peter J. Gannon and his Executive Assistant, S. P. Giannetti; Chief Engineer James K. Rankin of the Navigation Bureau, the Bureau's Designing Engineer, Clayton King, and its Chief of Operations, F. B. Cogan.

Information and advice of great value were also obtained from Mr. Samuel Gofseyeff of the District Engineer's office,

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Mr. L. J. Mauriello of the Division Engineer's office, and the City Engineers of numerous coastal municipalities. Among the latter special mention should be made of Messrs. O. W. Morris, William L. Birtwell, Claude W. Birdsall, Otis Seaman, George Henn, Frank Sleeper, Lester Kiger, and George Swinton.

The entire New Jersey coast from Sandy Hook to Cape May was carefully examined from the air in a flight of about six hours duration. The aerial photographs accompanying this Report were taken during this flight. Field inspections were made by automobile and on foot where critical conditions were believed to exist including places at which local authorities have requested State aid in the construction of protective facilities. Finally, existing aerial photographs of the coast between Sandy Hook and Barnegat Inlet were studied.

HISTORY OF THE NEW JERSEY BEACH EROSION CONTROL PROBLEM

Progressive erosion of the beaches of New Jersey has long been a matter of grave concern to the residents and property owners of the coastal communities of the state. These communities are primarily summer resorts the major activities of which are the provision of amusement, relaxation and health promoting vacations to visitors from inland areas of New Jersey and other states. The fundamental attractions which bring visitors to these resorts are cool weather and the opportunities afforded by beaches for sea bathing, surf fishing and other amusements. Their beaches

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are essential to the business and economic health of such communities. A successful solution of the problem of controlling the erosion of their ocean frontages must therefore do more than prevent the destruction of boardwalks, ocean front streets, structures and buildings whether they be publicly or privately owned. It must also preserve their most important vacationers' playgrounds - their beaches.

Over thirty years ago the erosion of the beaches of the State had become a problem of such well recognized importance that the State began giving technical and financial assistance to communities undertaking erosion control and in 1922 the New Jersey Board of Commerce and Navigation, the forerunner of the present Navigation Bureau of the Department of Conservation and Economic Development, published a "Report on Erosion and Protection of New Jersey Beaches" which contained recommended criteria for shore protection structures. A supplement to this Report was published in 1924 and in 1930 a final report was published to bring the whole matter up to date. These early attempts to formulate reliable procedures for controlling erosion were not completely successful. A number of rock groins and considerable lengths of rock seawall were built which undoubtedly benefited the properties they were intended to protect. Many stand today and are useful but it is unfortunately true that some of the groins, especially those inclined to the southward, accelerated and promoted the erosion of adjacent properties to the north of

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them. Large sums were furthermore wasted, often by the owners of privately held ocean front property, in the construction of ineffective protective structures many of which were experimental and some worse than useless. Photograph 1 shows the remains of such a structure.

More recently the Corps of Engineers and the Beach Erosion Board, an agency of the Corps, have issued a number of publications dealing with the control of erosion of the New Jersey beaches. These are based on studies made in cooperation with the New Jersey Navigation Bureau. Those more relevant to the situation now confronting the State are four Erosion Control Reports and three Technical Memoranda. The Erosion Control Reports are:

Atlantic City	House	Document	No.	538,	81st	Congress
Ocean City	Ft	tt	No.	184,	83rd	11
Cold Spring Inlet (Cape May)	11	n	No.	206,	83rd	11
Sandy Hook to Barnegat Inlet	. FT	81	No.	361,	84th	" (2nd Session)

The Technical Memoranda, all publications of the Beach Erosion Board, are:

Test of Nourishment of the Shore Technical Memorandum No. 17 by Offshore Deposition of Sand, Long Branch, New Jersey

Restudy of Test - Shore Nourishment by Offshore Deposition of No. 62 Sand, Long Branch, New Jersey

Behavior of Beach Fill at Ocean City, New Jersey

Technical Memorandum

Technical Memorandum No. 77



Photo 1. Remains of an ineffective seawall at Deal. Huge sums have been wasted in building such structures.

A comprehensive study of the control of erosion on the New Jarsey beaches from Barnegat Inlet to Cape May is now understood to be nearing completion by the Beach Erosion Board. The anticipated forthcoming Report on this area should be of great interest and value.

Steps taken to implement the recommendations of the four Erosion Control Reports have been, insofar as determined by the investigation leading to the preparation of this interim report which deals primarily with the Sandy Hook to Barnegat Inlet, as follows:

At Atlantic City the State Navigation Bureau in cooperaction with the City has built a rock jetty on the north side of Absecon Inlet in partial fulfillment of the Board's recommendations. The cost of the work was shared equally by the State and City. Repairs have been similarly made to a seawall at the northwest end of Maine Avenue which is the marginal street facing Absecon Inlet at the north end of Absecon Island. Two of eight rock groins have also been built to hold sand on the Maine Avenue beach and a quantity of sand fill has been placed on the northerly part of the ocean front beach and Maine Avenue beaches. Much of this work can be seen in photographs 2 and 3. The City is requesting an allocation of State funds during the current fiscal year, which will be matched with an equal appropriation by the City, to extend the Absecon Inlet jetty to the initial length of about 2500 Teet recommended by the Board and to further implement the

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Photo 2. In the foreground, Absecon Inlet. A crane can be seen working on the jetty at the north side of the Inlet. Note the accretion of sand forming at the north side of this jetty. Atlantic City is in the background.



Photo 3. The north end of Absecon Island. The beach filling on the ocean front and the rock groins on the Maine Avenue waterfront can be plainly seen. Board's recommendations for protective measures along the Maine Avenue waterfront. The City Engineer, Mr. George Swinton, is enthusiastic over the success of all work thus far done in accordance with the recommendations of the Atlantic City Erosion Control Report and proposes to continue recommending its use as a guide for the effective expenditure of funds which become available in the future for such work.

At Ocean City the State Navigation Bureau in cooperation with the municipality pumped 2,550,000 cubic yards of sand, as measured at the borrow area in the bay behind the City from which the material was dredged, on the beach from the Atlantic Boulevard groin to 13th Street. The fill berm varied from 80 to 300 feet in width and its minimum elevation was 8 feet above mean low water. The berm was leveled to meet the existing beach berm and the seaward face of the fill was permitted to take a natural slope.

The results of this somewhat extensive operation have been disappointing inasmuch as the rate of loss of the filled material has greatly exceeded the estimated rate. In Technical Memorandum No. 77, Behavior of Beach Fill at Ocean City, New Jersey, the Beach Erosion Board concludes "...that the rate of loss of the beach fill has exceeded the estimated rate because of the following conditions:

a. The fineness of the beach fill material placed relative to the sand native to the beach of the problem shore;

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b. The extensive movement of material associated with shifting of the inlet channel and bars, within and adjacent to the primary problem area; and

c. The advanced position of the problem shore line relative to the adjacent shore line to the southwest.

"It is further concluded that:

a. Although the loss of sand fill from the primary problem area was rapid, the material so lost has benefited adjacent shores.

b. The rate of loss of any beach fill placed between Surf Road and 12th Street will be high until the adjacent shore to the southwest has built out sufficiently to provide a more suitable shore alignment of the island or suitable retaining structures have been built."

An inspection of the Ocean City beaches made from the air by me on August 23rd leads to agreement with the above quoted conclusion of the Board as to material lost from the filled area having benefited adjacent shores. Photograph 4 shows an encouraging accretion of sand at the north side of a groin a considerable distance south of the filled area. The rapid loss of material from ocean beach fill is nevertheless most unfortunate as it gives ammunition to opponents of important beach filling projects recommended by the Beach Erosion Board Reports in other areas.



Photo 4. Ocean City. Beach filling at the north end of the waterfront - to the right of the picture - has not remained in place but the material has benefitted other parts of the shore - note the accretions at the north side of the groins and near the left margin of the picture.

At Cold Spring Inlet (Cape May) shortage of funds has, according to my admittedly slight present knowledge of the problem here, prevented any extensive implementation of the Beach Erosion Board's recommendations. The policy of requiring benefited communities to pay half the cost of erosion control projects toward the total cost of which State funds are contributed makes it difficult if not impossible for some of the smaller communities to secure approval of urgently needed protective measures. Photograph 5, Cold Spring Inlet with its large accretion of sand trapped on the north side of the north jetty and the starved beach south of the south jetty; and photograph 6, the "beachless" ocean front before a Cape May hotel; show clearly the urgent need for remedial action. Photograph 7, a picture taken a little further south on the Cape May ocean front shows how effective a properly designed and well built rock groin can be in a location where there is a littoral drift of sand that it can trap.

Between Sandy Hook and Barnegat Inlet, the stretch of coast with which this interim report is primarily concerned, nothing effective has been done to implement the recommendations of the Beach Erosion Control Report. The reasons for this are various and will be dealt with after the report, which I consider to be of great importance and value, has been summarized and commented on. The principal difficulty to be overcome before effective steps can be taken to implement the recommendations

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Photo 5. Cold Spring Inlet. Note the big accretion of sand at the north side of the north jetty and the "starved" eroding beach at the south side of the south jetty.



Photo 6. The "beachless" ocean front before a Cape May hotel. Heavy seavalls can protect the upland at least temporarily but they cannot provide the beaches upon which the prosperity of resorts depend.



Photo 7. An effective groin at Cape May. This photograph of the shore south of the area shown on Photo 6 shows an encouraging accretion behind a rock groin.

of the report is, however, almost undoubtedly the difficulty of financing work that can be most advantageously undertaken in large increments. In the meantime the State and local communities have jointly financed the construction of a number of groins and seawalls which are preventing, or at least delaying, serious erosion in critical locations. This work, which was handled by the Navigation Bureau, was in my opinion fully justified. Similar work should undoubtedly be done in the near future to prevent the destruction of property which would otherwise be lost before any such comprehensive program of erosion control as that recommended by the Erosion Control Report can be made effective.

At Brigantine, Ship Bottom, and other communities, the erosion control problems of which have not been reported on by the Beach Erosion Board, considerable sums have been spent recently on effective protective measures. Photograph 8 shows a recently constructed creosoted timber groin with a rock filled crib at its outer end which stands among the ruins of less effective structures and is beginning to collect sand in a critical location near the Brigantine Hotel. Photograph 9 shows a similar groin near the north end of the town of Brigantine which, however, appears to be catching no sand. But if a little money has recently been well spent at Brigantine much has been wasted in the past twenty or thirty years. The beaches of the town are cluttered with the remnants of bulkheads and groins which have proved ineffective as shown in photographs 10, 11 and 12.

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Photo 8. Timber groin near the Brigantine Hotel. This new creosoted timber structure is beginning to accumulate an encouraging accretion of sand. It stands amidst the ruins of ineffective bulkheads and groins.



Photo 9. Timber groin near north end of Brigantine. This groin does not appear to be accumulating any sand.



Photo 10. Brigantine. The beaches of Brigantine are cluttered with the remains of ineffective bulkheads, seawalls and groins.



Photo 11. Brigantine. The remains of a seawall, of a bulkhead and of an ineffective groin.



At Ship Bottom on Long Beach Island which lies south of Barnegat Inlet some beach filling has been done very recently. In March, April, May and June 1956 a hydraulic dredge pumped 300,000 cubic yards of sand, as measured in the borrow area from which it was taken behind the island, onto the beach of the town of Ship Bottom between 31st and 47th Streets. In the same operation 115,000 cubic yards were placed on the adjacent beach south of Ship Bottom in Long Beach Township between 31st and 47th Streets. These fills have been made too recently to permit worthwhile evaluation of their merit. Obviously, however, they have restored a beach that had been narrowed alarmingly by the storms of the past few years. They were not seriously eroded by high tides and a moderate northeasterly gale in mid-August that caused marked erosion on the beach at Lavallette.

Recent legislative and executive actions that affect the problem of erosion control are:

a. The passage and approval by the President of the Auchineloss Bill permits the use of federal funds for participation in the periodic nourishment of beaches by filling. This bill also provides that: "Shores other than public shall be eligible for Federal assistance if there is benefit such as that arising from public use or from the protection of nearby public property or if the benefits to those shores are incidental to the project, and the Federal Contribution to the project shall be adjusted in accordance with the degree of such benefits."

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b. The President vetoed the so called River and Harbor Act, H. R. 12080 which included authorization of a project for beach erosion control work between Asbury Park and Manasquan in accordance with the recommendations of the previously mentioned Report at an estimated total cost of \$5,239,200 of which \$1,677,000 was to be contributed by the federal government. It should be noted that this was an "authorization" and not an "appropriation" bill.

c. The State of New Jersey has appropriated for the fiscal year ending June 30, 1957 the sum of \$1,000,000 for beach protection and allied work. None of the funds are available unless matched by a municipality or county participating except that a total of \$255,000 may be spent without matching by municipality or county for specified purposes.

BEACH EROSION CONTROL REPORT - SANDY HOOK TO BARNEGAT INLET

This report is summarized herein because it formulates the first comprehensive plan presented to cognizant authorities for the control of erosion of the entire coastline between Sandy Hook and Barnegat Inlet. The report divides the area into three sections of differing geological characteristics. On the basis of present need for shore restoration and protection the report then further divides the area into five sections the boundaries of which do not coincide with the boundaries of the three geologically differentiated sections. The three geologically differentiated sections are:

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Sandy Hook Peninsula is a narrow barrier beach 11 miles long which separates the Atlantic Ocean from Sandy Hook Bay and the Shrewsbury River. The peninsula is from 100 to 1500 feet wide and its elevation above mean sea level varies between 10 and 15 feet. The northerly 6 miles of this stretch of barrier beach is occupied by Fort Hancock Military Reservation and the southerly 5 miles by Sea Bright and the northern part of Monmouth Beach. The ocean has broken through the barrier beach more than once in historic times. Massive seawalls of jetty rock have been built in the locations considered most vulnerable to prevent further breakthroughs.

The headland or middle section extends about 19 miles from the center of Monmouth Beach to Bayhead. This section is a headland of the coastal plane the bluffs of which stand from 10 to 25 feet above mean sea level. This headland has probably eroded several miles in the recent geologic past and is still eroding severely. The mouths of two small rivers, the Shark and Manasquan, lie within this headland area. Both rivers are navigable for small craft and the jetties built to maintain their entrances in navigable condition complicate erosion control by interfering with the normal northward littoral drift of sand that occurs along this part of the New Jersey Coast.

The southern section extends from Bayhead to Barnegat Inlet, a distance of 21 miles. It is geologically a barrier beach varying in width from 500 feet to a mile. Its elevation

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above mean sea level is from 3 to 12 feet and there are many high dunes along much of the ocean frontage.

The problem. The primary problem is the control of erosion of the bluff frontages in the headland section. Photographs 13 and 14 show how serious this erosion is. Developments along the barrier beach of Sandy Hook Peninsula have also suffered severe storm damage because of low elevation and lack of protective beach to absorb wave energy. In the southern barrier beach section erosion has been less severe than in the northern sections, but recent storm damage and continuing economic and recreational development have created a demand for stabilization of the shore line.

<u>The estimated storm damages</u> caused directly and indirectly by erosion and wave action in the entire stretch of ocean front from Sandy Hook to Barnegat Inlet during five fairly recent heavy storms have been:

Hurricane of 1938	\$ 533,000
Hurricane of 1944	7,127,000
Storm of Nov.1950	5,877,000
Storm of Nov.1953	7,650,000
Total	\$ 21,187,000

The character of the individual items of damage that led to these impressive figures include both damage to and total destruction of ocean front structures, seawalls, groins, boardwalks, sidewalks, street pavements, drainage facilities, buildings used for

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Photo 13. Headland erosion. Headland erosion of the Deal shore is threatening valuable property.



Photo 14. Headland erosion - this time at the north end of Long Branch - is beginning to undermine a large dwelling.

business purposes and dwellings. Much of the damaged property was publicly owned.

The erosion caused by the most destructive of these storms, the one of November 1953, was as indicated in the following table.

RECESSION OF CONTO (storm of November	OURS 1953)
Contour Elevation (feet above mean low water)	Landward Retreat of <u>Contour</u> in Feet
0	65
+ 5	63
+10	98
+15	53

Perhaps these data might be summarized by saying that the beach was eroded about 100 feet.

The coastal physiography, meteorology and wave action patterns on this part of the New Jersey Coast show that waves and currents cause steady littoral drifts of sand northward and southward respectively from a nodal point in the southern barrier beach section. The location of this nodal point probably shifts somewhat. The northward drift is the one now causing serious trouble. It is removing about 440,000 cubic yards of sand annually from the beaches lying between the nodal point and the Fort Hancock Military Reservation on Sandy Hook. Much of this sand is being deposited in unwanted accretions near the tip of Sandy Hook and some is undoubtedly being carried into Sandy Hook Channel from which it must be removed by maintenance dredging. The southerly drift is less serious, principally because it promotes erosion of areas which are much less developed than the areas affected by the northerly drift. The southerly drift is, however, probably carrying 375,000 cubic yards of sand annually out of the study area, 125,000 cubic yards of which is taken from the developed area and 250,000 cubic yards from the undeveloped area of Island Beach.

Prior corrective action and the effectiveness of existing structures. In the early stages of the development of the New Jersey coast shore protection initiated by individuals and local groups resulted in the provision of a wide variety of structures ranging from inadequate groins and seawalls to well engineered systems of protective structures. The federal government since 1900 has spent considerable sums for the protection of the shore along the Fort Hancock Military Reservation on Sandy Hook and between 1930 and 1940 built jetties, groins and bulkheads in connection with navigation projects at Manasquan and Barnegat Inlets. There are now 117 groins, 6 jetties, and 7 seawalls with respective aggregate lengths of 43,000, 12,000 and 38,000 feet in the problem area. About \$18,000,000 have been spent in the past thirty years by the State, counties, municipalities and private property owners for the construction of shore protective facilities which at present day prices would probably cost more than \$40,000,000. At no time, however, has

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there been a comprehensive plan for the protection of the entire coast from Sandy Hook to Barnegat Inlet.

Restoration of the northern beach of Long Branch was attempted in 1948 by experimentally dumping about 602,000 cubic yards of material from hopper dredges as close to the shore as the dredges could safely operate. The material was sand removed from Ambrose Channel. It was dropped in 38 feet of water about one half mile from the shore forming a stock pile some 3,700 feet long, about 7 feet high and 750 feet wide. The experiment was unsuccessful inasmuch as the material has not been moved in by wave action to replace sand lost from the beach by erosion.

At Lavallette approximately 200,000 cubic yards of sand were pumped onto the beach from Barnegat Bay by a hydraulic dredge to replace part of the material lost during the storm of November 1953.

<u>Corrective methods considered</u> were those normally used for the stabilization of shorelines. They include the construction of seawalls, bulkheads, or revetments capable of withstanding the wave forces to which they will be subjected and the provision of beaches to absorb wave energy. Where a suitable volume of littoral drift is available groins may be used to build up a beach. But beach building by means of groins causes erosion in the down drift area beyond the groins as has occurred in the Sea Bright-Loch Arbour section due to groins in the Asbury Park-Manasquan section.

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Stabilization of the shoreline by means of seawalls, bulkheads and revetments would result in the eventual loss of the beaches upon which the economy of the area is dependent. "Consideration of all alternative methods indicates that the most suitable plan is the provision of an adequate protective beach, supplemented by groins in such localities as their use may be found justifiable to reduce annual costs."

The program of control and shore restoration recommended by the report divides the area into five sections. These, and a brief description of the remedial work recommended in each, are:

a. Sandy Hook which is occupied by Fort Hancock Military Reservation and should not be confused with the geological area previously designated as Sandy Hook Peninsula. No work is recommended in this section by the report. If shore protection becomes necessary it can be undertaken later as a federal project, the entire area being owned by the federal government.

b. Ocean Township to Sea Bright. This area comprises the headland section of the coast stretching from Asbury Park to the center of Monmouth Beach and the barrier beach forming the southern part of the Sandy Hook Peninsula. The area is occupied by the municipalities known as Loch Arbour, Allenhurst, Deal, Long Branch, Monmouth Beach and Sea Bright. In this area the beaches should be restored by filling to a minimum width of 100 feet at elevation 10 above mean low water. The construction of

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twenty-three rock groins and the extension of fourteen groins are also recommended.

c. Manasquan to Asbury Park. This section of the coast contains the greater part of the geological section designated as headland. Its southern boundary is the mouth of the Manasquan River and it is occupied by the towns of Manasquan, Sea Girt, Avon-by-the-Sea, Bradley Beach, Ocean Grove and Asbury Park. The program contemplates restoration of the beach by filling to a minimum width of 100 feet at elevation 10 above mean sea level.

d. Seaside Park to Point Pleasant Beach. This area consists of the southern tip of the geological headland section and the barrier beach stretching southward to the State owned property known as Island Beach. The area is occupied by the municipalities of: Point Pleasant, Bay Head, Mantoloking, Brick Township, Dover Township, Lavallette, Seaside Heights, Seaside Park, and Berkeley Township. The plan is to restore beaches by beach filling to a minimum width of 100 feet at elevation 10 above mean sea level.

e. Island Beach which is a strip of practically undeveloped barrier beach lying between Berkeley Township and Barnegat Inlet. The property is owned by the State and no announcement has been made as to the uses to which it will ultimately be put. No work is recommended at present in view of the

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undeveloped character of the area. It is recognized, however, that the shore is eroding, see photographs 15 and 16. Protective measures may be and maintenance filling will almost certainly be necessary when development of the area demands stabilization of the shoreline.

The general locations of all recommended items of work are shown in Plate 1.

The estimated costs of the initial programs of work proposed by the Board in the areas in which protective measures are recommended may be summarized as follows:

Section	Beach Fill	Groins	Total	Federal Share	Non-Federal Share
Sea Bright to Ocean Township	15,455,000	2,360,000	17,815,000	\$1,383,600	\$16,431,400
Asbury Park to Manasquan	4,720,000		4,720,000	1,511,900	3,208,100
Pt.Pleasant Beach to Seaside Park	2,212,000		2,212,000	185,100	2,026,900
Totals	22.387.000	2,360,000	24,747,000	\$3,080,600	\$21,666,400

<u>Maintenance work and its estimated cost</u>. The above outlined plan of beach restoration and shore protection will be ineffective without proper maintenance of beaches by periodic nourishment. The report proposes that this necessary periodic nourishment of beaches be accomplished by the establishment of



Photo 15. Erosion at Island Beach. Another house once stood outboard of this threatened structure.



Photo 16. The southward littoral drift of sand at Island Beach caused this big accretion of sand at the north jetty. When the jetty was built the foreground area was water.

feeder beaches at the north end of Long Branch, Ocean Township, Manasquan, and Mantoloking upon which an annual average of 565,000 cubic yards of sand should be placed. Groins will also require maintenance. The annual cost of necessary maintenance work including both beach filling and groin maintenance will, it is estimated, be:

SUMMARY OF ESTIMATED ANNUAL MAINTENANCE COSTS

Section	Annual Cost
Sea Bright to Ocean Township	\$280,000.00
Asbury Park to Manasquan	350,000.00
Pt. Pleasant Beach to Seaside Park	200,000.00
Total	\$830,000.00

Economic Justification. The report submits evidence and estimates showing that the annual costs of the recommended program of initial protective and annual maintenance work, including interest and amortization, will be \$1,703,600 and that the evaluated annual benefits are \$2,593,100. The ratio of estimated benefit to estimated cost is therefore 1.52. All reviewing authorities are in agreement that this ratio makes the program worthwhile.

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CRITICISM OF THE REPORT

Criticism of the report by city engineers of beach communities may be summarized by saying that the following objections to its conclusions have been made:

- a. The report fails to distinguish between:
 - (1) Preventing beach erosion, and
 - (2) Preventing damage from high tides and
 - waves during severe storms.

The critic who takes exception to the report on these grounds admits that the problems are related and that they are considered by the public to be a single problem. That the control of beach erosion and the prevention of storm damage are a single problem this critic, however, categorically denies with a statement that preventing beach erosion does not prevent damage from tides and waves. This criticism of the report goes on to say that the proposed restoration of the beaches of northern New Jersey to a minimum width of 100 feet at an elevation 10 feet above mean low water and the maintenance of the beaches at this width will not **prevent** damage by storms in which destructive waves accompany exceptionally high tides. The attitude of another experienced man appears to be that beach filling should be considered only as a desirable supplement to seawall and groin construction.

b. That groins are needed between Asbury Park and Manasquan as well as between Sea Bright and Asbury Park. c. That notched groins, of the type developed locally, are preferable to the groins proposed by the report. Preference for the local type of groin is that it can be maintained and repaired by equipment - a crawler crane and trucks - operating on top of the groin. This obviates the necessity of a permanent trestle for the accommodation of maintenance equipment.

d. That the program should include the removal or at least the straightening of inclined groins such as the one at the north end of Asbury Park, referred to in the report as the "Loch Arbour groin," and the Allenhurst groin. It is argued that beach filling without straightening these groins would be futile. This was demonstrated, it is claimed, by the rapid loss of material pumped onto the beach at the north side of the Loch Arbour groin when Lake Deal was dredged a few years ago.

e. The source of the 16,069,100 cubic yards of sand needed for the initial program of beach filling is not specified and the 500,000 cubic yards required each year for the maintenance of the beaches will be increasingly difficult to find in a region developing as rapidly as Monmouth County.

f. That unless the State is prepared to finance the nonfederal portion of the entire project, or at least the non-federal portion of any one of the three sections into which the project is divided, there are insurmountable difficulties which will prevent municipalities from paying their share of the cost. Difficulties which appear to be considered fundamental are:

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- Municipalities cannot or should not incur bonded indebtedness to pay the cost of an improvement of such doubtful permanence as a beach fill.
- (2) The State's policy of requiring benefited communities to pay one-half the cost of shore protection and maintenance work toward which the State contributes will place an intolerable burden on some of the smaller communities. Much of the initial beach filling and most of the maintenance work of replenishing feeder beaches would benefit neighboring communities to the north fully as much as the communities upon beaches of which the fills are to be made.

CONCLUSIONS

The beaches of northern New Jersey, like many other beaches, are being subjected to two types of erosion - erosion by storms and erosion produced by littoral drift.

The first of these - erosion by storms - can be and often is accompanied by spectacular destruction of property and may even cause loss of life. This type of erosion is caused by the high, relatively short "angry" and destructive waves produced by a storm in the immediate vicinity of the coast. Waves of this type pull beach sand down into the ocean rapidly and if the beach is not wide enough they destroy upland property. If, however, the beach is of sufficient width to absorb the energy of a single severe storm by letting it tear down the beach without attacking the upland, little permanent harm is done because most if not all the sand pulled into the ocean by storm waves will be returned to the beach by the surf of the long waves or swells which occur in prolonged periods of good weather.

Littoral drift, or the erosion caused by slight currents flowing along the beach in a preponderant direction, is not spectacular but nevertheless is almost invariably a very serious matter. The current is not swift enough to cause erosion by virtue of its own velocity but each grain of sand disturbed by a wave is returned to the beach a trifling distance away from its former position - and in the direction of the drift. Such erosion goes on insidiously and almost unnoticed week after week, month after month, and year after year. No one gets very excited about what seems to be an unfortunate but nevertheless rather inconsequential narrowing of the beach until a big storm occurs. Then the narrowed beach proves of insufficient width to absorb the wave energy of the storm, waves reach the upland and the result is spectacular damage. At once there is a hue and cry for protection from storm damage whereas the real need is for means of dealing with the littoral drift problem and the maintenance of a beach of reasonably safe width.

The Beach Erosion Control Report shows that those who prepared it are fully cognizant of the fact that progressive

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erosion by littoral drift of beach sand northward and southward form a nodal point between Manasquan and Barnegat Inlets is the fundamental problem that must be dealt with. If beaches 100 feet wide at elevation +10 are maintained and if the protection afforded the upland by these beaches is supplemented by rock walls or revetments at places which prove or have proved highly vulnerable to attack, the resort communities of northern New Jersey will, in my opinion, be protected reasonably well from storm damage and at the same time will be provided with the attractive beaches upon which their prosperity depends. They will not and cannot be "perfectly protected" by any financially achievable measures. Some calculated risk must be taken.

A massive seawall or rock revetment might conceivably be built along the upland ocean frontage of northern New Jersey to protect coastal communities from storm damage. Even though the cost of such a wall would be enormous the protection afforded would not be really permanent. Progressive erosion at the foot of the wall would be continued by littoral drift and sooner or later the foundations of the wall would be undermined and it would fail. In the meantime the communities protected by the wall would be robbed of the beaches essential to their prosperity.

I am in complete agreement with the conclusions of the Beach Erosion Control Report as to the character of the erosive processes at work and am in almost complete agreement with the recommendations of the report insofar as the physical

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characteristics of proposed initial protective measures and maintenance work are concerned. It should be noticed that the report does not recommend an attempt to stop littoral drift completely but to minimize its effects in certain locations with groins and primarily to maintain the necessary widths of the beaches by the periodic placement of sand on so-called feeder beaches. This method of dealing with erosion caused by littoral drift has in general proved more satisfactory and economical than attempts to stop such drift.

The fact must be faced that the northern beaches of New Jersey, like many other valuable properties, require maintenance. There is no solution of the problem of controlling the erosion of these beaches which can be accomplished once and for all and then dismissed as finished business. The beaches must be maintained and the cheapest and most satisfactory way to do it is by periodic replacement of sand removed by littoral drift.

It is therefore my considered opinion that the recommendations of the Beach Erosion Board are fundamentally sound and should be implemented. The three points upon which I take exception to details of the recommendations of the Board are:

a. The types of notched groins developed at Belmar and Long Branch have demonstrated that they meet local conditions admirably and should, I believe, be adopted in preference to a

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design which, while it may have proved satisfactory elsewhere, is more or less untried locally. Notched groins can be maintained by equipment - a crawler crane and trucks - working on the tops of the groins. This obviates the necessity of expensive floating equipment or the cost of maintaining or periodically building trestles at the groins.

b. Groins inclined or curved to the southward which are obviously causing heavy erosion of the beaches to the north of them should be straightened or removed. This has actually been done by the Navigation Bureau in case of the worst offender, the so-called Loch Arbour groin at the north end of Asbury Park, see photograph 17. Other inclined groins should be studied and a number of them straightened. The one at Allenhurst, for example, is almost certainly promoting serious erosion of the Deal shore.

c. Sand by-passing plants at both Manasquan and Shark River Inlets are now, in my opinion, definitely rather than possibly desirable as intimated by the report. Large unnecessary accretions of sand have formed on the south side of the south jetties at both these inlets, see photographs 18 and 19. At both inlets the sand will soon be - and probably already is working around the end of the jetty and shoaling the channel. This and the starving of down drift beaches on the north sides of the inlets could be minimized by the installation of bypassing plants.

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Photo 17. Straightening the so-called Loch Arbour groin at the north end of Asbury Park. The work is nearing completion, the crane on the outboard end of the groin is commencing the construction of a short T head.





Photo 18. Manasquan Inlet, showing the big accretion of sand at the south side of the south jetty. Further accretion should be dealt with by bypassing sand across the Inlet.



Photo 19. Shark River Inlet. A by-passing plant here is also indicated.

Preliminary estimates indicate that the Manasquan Inlet plant should have an annual capacity of 75,000 cubic yards and the Shark River plant should be able to handle at least 125,000 cubic yards of sand per year. Both figures are subject to revision after a thorough study of the project of installing these plants has been made. Possibly a single trailermounted plant which could be moved back and forth between the inlets and work from the tops of the jetties or from trestles alongside the jetties might prove practicable. Even if two plants are built it may well prove advisable, in the interests of standardization, to have them alike and either one capable of handling the amount of sand to be by-passed at Shark River. In this event the essential unit of the plants should probably be a 10 inch dredge pump driven by a 360 to 400 horsepower motor or Diesel engine. Plate 2 is a photostat of a sand bypassing plant recently installed at Rudee Inlet near Virginia Beach. The plate is merely indicative of the type of installation proposed at Manasquan and Shark River Inlets and should not be considered as showing a plant the design of which is directly applicable to conditions at the mouths of the New Jersey rivers.

POSSIBLE METHODS OF IMPLEMENTING THE REPORT

From the point of view of the engineer and construction man the most economical and therefore best method of implementing

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the report would be to secure appropriations totaling some \$24,500,000 to \$26,000,000 which would permit the placement of the beach fills required in one, or at most a few large-scale operations. This would minimize the unit cost of the beach fills, especially if the material had to be brought from inland borrow pits, and in this event would make it feasible to use hydraulic methods for transporting the sand and very probably reduce the unit cost of the initial fills to less than \$1.00 per cubic yard - perhaps as little as \$0.80. It would also stimulate industry to develop equipment with which sand could be obtained from the ocean beyond the -30 feet contour and placed on the beach at even lower cost.

But the difficulty of securing appropriations totaling the amount required to implement the recommendations of the Erosion Control Report in a single fiscal year - or even in two or three fiscal years - is recognized. The possibility of solving the problem of financing a highly desirable large-scale implementation of the recommendations of the Beach Erosion Control Board's Report by some such device as including the project as a supplementary item in a big program of constructing improved roads to the beaches should not, however, be overlooked. The increase in the size of the federal contribution made possible by the Auchincloss Bill should, furthermore, be of some assistance in financing an extensive beach erosion control program. In the meantime it is believed possible that a worthwhile start might

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be made toward implementing the recommendations of the report in the following way.

a. Use the State funds now available for erosion control work to provide the more urgently needed emergency protective measures requested by communities offering to match State allocations with equal allocations of their own funds.

With enlarged, but not unreasonably enlarged, State b. appropriations in fiscal year 1957-1958 and subsequent years continue to provide urgently needed protective measures to communities able to match State allocations for their construction with equal allocations from their own funds. At the same time place, establish and maintain by annual nourishment, feeder beach fills at the north sides of Manasquan and Shark River Inlets and possibly at the north end of Long Branch in the approximate locations of feeder beaches recommended by the Beach Erosion Control Report. Sand for at least the initial establishment of these beaches could probably be dredged from the Manasquan, Shark and Shrewsbury Rivers but confirmation of this opinion by a thorough investigation and the making of borings is necessary. Worthwhile quantities of sand might further be obtained from relatively small bodies of inland water such as Stockton Lake and Wreck Pond if small hydraulic dredges with sectional hulls which make them capable of transportation by truck were used. Such dredges are by no means uncommon - photograph 29. Again, however, a thorough investigation

*Such fills have been suggested informally by Mr. Gofseyeff of the District Engineers Office.33 _



Photo 29. "Portable" 10" hydraulic dredges. Dredges of this type have sectional hulls and can be moved by truck to waters inaccessible to older types of dredges.

of all practicable sources of sand is indicated. At least 1,000,000 cubic yards per year should be placed on the beaches if annual accretions appreciably greater than annual losses by erosion are to be produced. All filling should be done in "off season" months so as not to interfere with the use of the beaches by vacationers. State appropriations for this beach filling should not require contributions by the communities upon the beaches of which the sand is to be placed. It should be recognized that these feeder beaches benefit the entire coast and should therefore be paid for by the State.

The proponents of such an appropriation will of course have to face the problem of convincing inland communities that the beaches of New Jersey are assets of value to the entire State and not merely to shore resort communities. An alternative would be to induce shore communities to abandon restrictive practices which alienate the sympathy of inland communities, the residents of which object to being taxed for work on public beaches which they do not feel are in fact open to the public.

As this progressive program of beach filling went on the need for emergency protective measures, such as groins at Deal and seawalls at Long Branch would become less acute and more money could be used each year for beach filling, groin construction, and for the installation of same hy-passing plants at Manasquan and Shark River Inlets. It is further believed that

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under the terms of the Auchincloss Bill financial assistance toward such a program of progressive beach filling might be secured. This possibility should be explored by contacting the District and Division Engineers. However, at best it would be several years before a federal appropriation could be secured to assist the State in the beach filling program suggested above and the work should, in my opinion, be started at the earliest possible time by the State in order that erosion control and beach maintenance may be put on a sound footing without further postponement and delay.

Recommendations for implementing such a program are outlined in the following section of this report.

RECOMMENDATIONS

To prepare for a future program of progressive beach filling and the construction of protective structures at points which have proved to be highly vulnerable to storm damage and erosion it is recommended that the funds now available be used for the purposes indicated below.

For shore protection, erosion control and allied work, the State Appropriation Act makes available in the current fiscal year (1956-57) "new money" in the amount of \$1,000,000. It also reappropriates unexpended balances, the sum of which is approximately \$250,000, thus making currently available a total of about \$1,250,000.

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The Act also sets up or implies obligations against this fund by providing that certain projects are to be undertaken without requiring local communities or counties to "match" State contributions with equal sums. These projects are:

Repair and maintenance of the Shark River jetties	\$ 40,000
Protection of beach and property of Barnegat Light State Park (photographs 20 and 21 show the urgent need of protecting this historic landmark from destruction	
by erosion)	180,000
Replacement of motor vehicles and equipment	10,000
State's share of cooperative study in conjunction with the Federal	05 000
Government	 25,000
Total obligations created or implied by appropriation	\$ 255,000

The balance available for general shore and beach protection work is, therefore, \$1,250,000 - \$255,000 = \$995,000.

It is recommended that this balance be allocated to projects in approximately the amounts indicated below. The exact amount of each allocation should be determined after further study of some of the projects. Each allocation must be matched by an equal appropriation made by the benefited community or county.

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Photo 21. Barnegat Light Foundation. The necessity of protecting this historic structure from further erosion is clearly indicated.

Location	Project	State Allocation
Atlantic City	Extend Absecon Inlet jetty and continue program of groin con- struction recommended by the Beach Erosion Board.	\$ 250, 000
Belmar	Repair the 8th, 16th and 19th Avenue groins. (Possibly omit this item if further field in- spection of the groins at low tide indicates the work to be unnecessary this year.)	37,500
Brigantine	Groin construction or beach fill- ing, preferably the latter. This project demands further study. Observation of Brigantine Island from the air indicates the littoral drift to be erratic. Of the \$45,000 tentatively setup, \$30,000 is "old money" previously allocated and \$15,000 is "new money" to be allocated from the 1956-57 appropriation.	45,000
Deal	Reconstruct the Brighton Avenue groin. This project should also receive further study before a definite allocation is made. The groin is intended to protect the extensive additions to the public bathing facilities now being built by the municipality at a cost of about \$500,000 (see photograph 22) It is questionable, however, that a groin will be of much use. Groin to the south of Deal are intercept ing littoral drift so effectively that little or no accumulation of sand can be reasonably anticipated at the proposed groin.	87,500 s
Fairfield Twp.	Bulkhead construction.	7,500
Highland	Timber bulkhead.	33,000
Lavallette	Build two creosoted timber groins to prevent erosion in the vicinity of the sewage disposal plant (see photograph 23).	50,000



22. Deal Beach. This is the site of an extensive addition to the community's public bath house. Protection of Deal's \$500,000 investment is desired in the form of the reconstruction of the wrecked groin shown in the central foreground.



Photo 23. Lavallette. A bulkhead to protect the sewage disposal plant can be seen under construction in the right foreground. Groins are desired to provide further protection.

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Location	Project	<u>A1</u>	State location
Long Branch	Extend seawall toward N. Bath and reconstruct groins to pro- tect the upland pending exten- sive beach filling. The upland has proved highly vulnerable to erosion at this point which is in an area that will not benefit materially for some years from the proposed progressive beach filling program.	\$	200,000
Longport	Extend south jetty (see photo- graph 24).		15,000
Lower Penns Neck	Bulkhead construction.		50, 000
Manasquan	Repair groin #15 to protect sewage disposal plant (see photographs 25 and 26).		25,000
Perth Amboy	Construct bulkhead.		75,000
Sayreville	Construct bulkhead.		12,500
Sea Girt	Extend creosoted timber bulkheads shoreward to provide adequate "anchorage" of the inboard ends in the bluff which is now being eroded heavily by scour around the exposed inboard ends of the groins. Photograph 27 shows this condition. Also make such repair to the outboard ends of the groin as may be urgently needed.	S S	60, 000
Ship Bottom	Continue program of beach filling	•	20,000
South Amboy	Reserve for work on bulkhead.		25,000
	Total	\$	995,000

It is further recommended that State appropriations of \$1,500,000 be obtained in the fiscal year 1957-58 and subsequent years for shore protection and erosion control work and that the bill set up the following general allocations.

Photo 24. Longport Jetty. A further extension of the south jetty is proposed.

Photo 25. Timber groin at Manasquan. The reconstruction of this groin has been recommended to promote accretion and thus protect the sewage disposal plant which is at the shore end of the groin.

Photo 26. Typical timber groin with rock filled crib at the outboard end. Such groins give good service but are not as durable as rock groins, locally known as "jetties."

Photo 27. Sea Girt. Inshore extension of groins. Timber groins here should be extended shoreward to prevent heavy scour by water running around the ends of the groin. In their present condition these groins promote rather than inhibit erosion. a. For urgently needed items of groin construction, shore protection and erosion control work, half the cost of which will be borne by benefited communities in accordance with established practice; and for work of such nature as has in the past been charged exclusively to State funds. \$1,00

b. For the initial establishment of feeder beaches at the north side of Manasquan and Shark River Inlets and possibly at Long Branch, including \$25,000 for investigative and exploratory work including borings in the ocean bottom, rivers, lakes, ponds and in the upland, the purpose of which is to locate borrow areas from which material for beach fills may be secured; the entire cost of the work to be borne by the State with such federal aid as may be obtainable.

<u>500,000</u> \$1,500,000

\$1,000,000

The item of \$25,000 for investigative work to locate sources of sand for beach filling is of the utmost importance. Borings should be made in the sea to determine definitely whether or not sand is available off the eroding headland between Bay Head and Monmouth Beach in sufficient quantity to make

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the initial beach fills and supply the feeder beaches which should be established in this area. It is appreciated that existing types of dredges are not capable of pumping sand economically from the open sea to the beach, but if the sand is known to be there it is believed highly probable that equipment could be developed to do the job. If the sand is not there, the possibility of obtaining beach filling material from the sea must be dropped.

Borings should of course be made in inland waters and upland sources of sand should be thoroughly explored. Large quantities of beach filling material will have to come from the upland if it proves impracticable to get material from the ocean and inland waters. To this end the necessity of utilizing upland sources of sand should be determined. If upland areas are the only possible sources of sand no time should be lost in locating the areas in which the borrow pits must be located and either acquiring the land or permission to take sand from it.

It is also recommended that cognizant District Engineers be requested to review existing erosion control reports for Atlantic City, Ocean City, Cold Spring Inlet (Cape May) and the area between Sandy Hook and Barnegat Inlet - particularly the latter - to determine the amount of additional federal aid for shore protection and erosion control work that may be made possible by the Auchincloss Bill. The possibility of obtaining federal aid for items of groin construction between Asbury Park
and Sea Girt which were recommended by the Erosion Control Report should also be taken up with the District Engineer.

Finally it is recommended that a by-passing plant or plants for installation at Manasquan and Shark River Inlets be designed with a view to making the installations in the fiscal year 1958-59. The question of obtaining federal aid toward the cost of the installations should also be taken up with the District Engineer.



Photo 28. The beach at Seaside Heights. Beaches like this or wider than this afford protection to the upland and at the same time form attractive playgrounds for visitors.

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Photo 30. Ineffective groins collecting no accretions of sand. Material which would otherwise be furnished by the littoral drift has been trapped by groins and jetties "updrift" of this area.