BEACH EROSION CONTROL REPORT ON COOPERATIVE STUDY OF CONNECTICUT

AREA 1

ASH CREEK TO SAUGATUCK RIVER

7 FEBRUARY 1949

CORPS OF ENGINEERS, U. S. ARMY

OFFICE OF THE DIVISION ENGINEER

NEW ENGLAND DIVISION, BOSTON, MASSACHUSETTS

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CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DIVISION ENGINEER
NEW ENGLAND DIVISION
BOSTON 10, MASS.

NEDVN 7 February 1949

SUBJECT: Beach Erosion Control Report on Cooperative Study of Connecticut, Area 1, Ash Creek to Saugatuck River, Connecticut.

TO: The Chief of Engineers, Department of the Army, Washington 25, D. C.

SYLLABUS

This report, the first of eleven to cover the entire coast of Connecticut, covers study of the shore line from Ash Creek, Fairfield to the Saugatuck River, Westport. The purpose of the study was to determine the most suitable methods of stabilizing and improving the shore line in this area.

The Division Engineer finds that the entire area constitutes a resort development, that major extents of the entire shore constitute desirable locations for beach improvements, and that improvement of the shore requires artificial replenishment of the sand beaches. The Division Engineer also finds that the hydraulic pumping of sand on the shore from offshore depths is entirely practicable.

The Division Engineer recommends adoption of projects authorizing Federal participation to the extent of one-third of the first cost of the proposed improvement of the following publicly-owned shores.

a. Jennings Beach and Ash Creek, Fairfield. - Construction of an impermeable jetty 800 feet long, and if necessary, dredging of an inlet channel and jetty foundation through the outer bar, all at a cost of $66,000 for new work and $500 annually for maintenance. The estimated amount of Federal participation is $22,000.

b. Sasco Hill Beach, Fairfield. - Widening to a 100-foot width, 900 feet of beach by direct placement of sand, and construction of one impermeable groin 400 feet long all at a cost for new work of $42,000 and $700 annually for maintenance. The estimated amount of Federal participation is $14,000.

c. Southport Beach, Fairfield. - Widening to a 100-foot width, 700 feet of beach by direct placement of sand and construction of one impermeable groin 400 feet long all at a cost for new work of $30,000 and $385 annually for maintenance. The estimated amount of Federal participation is $10,000.

d. Burial Hill Beach, Westport. - Widening to a 100-foot width, 500 feet of beach by direct placement of sand at a cost for new work of $16,500 and $265 annually for maintenance contingent upon the construction by others of a 400-foot training wall on the east bank of Burial Hill Creek. The estimated amount of Federal participation is $5,500.

e. Sherwood Island State Park, Westport. - Widening to a 150-foot width, 6000 feet of beach by the direct placement of sand, the creation of a stockpile by the direct placement of sand for an additional width of 100 feet for a distance of 1000 feet east and 1000 feet west of Sherwood Point, the construction of two impermeable training walls 400 and 500 feet long at Burial Hill Creek and the construction of an impermeable groin 500 feet long all at a cost for new work of $342,000 and $5300 annually for maintenance. The estimated amount of Federal participation is $114,000.

f. Compo Beach, Westport. - Widening to a 100-foot width the beaches east and west of Cedar Point, 2600 and 1100 feet long respectively, by direct placement of sand, construction of two impermeable groins 500 feet long all at a cost for new work of $114,000 and $1940 annually for maintenance. The estimated amount of Federal participation is $38,000.

The total estimated amount of Federal participation in all the above projects is $203,500 and the estimated total cost is $610,500.

The Division Engineer recommends adoption by local interests of projects for improvement of the following privately-owned shores:

a. Fairfield Beach, Fairfield (between Jennings Beach and Pine Creek Point).

b. Pine Creek Beach Area, Fairfield (between the mouth of Pine Creek and Kensie Point).

c. Compo Mill Beach Association, Westport (between Sherwood Island State Park and Sherwood Pond).

BEACH EROSION CONTROL REPORT ON COOPERATIVE STUDY OF CONNECTICUT

AREA 1

ASH CREEK TO SAUGATUCK RIVER

I. GENERAL

AUTHORITY

1. Basic Agreement. - A formal application dated 22 July 1947 from the State of Connecticut, acting through the Connecticut State Flood Control and Water Policy Commission, for a cooperative study of the problems of beach erosion and shore protection along the entire coast of Connecticut by the United States and the Connecticut State Flood Control and Water Policy Commission was approved by the Chief of Engineers, Department of the Army, 28 August 1947, in accordance with the authority conferred by the provisions of Section 2 of the River and Harbor Act approved 3 July 1930, and Public Law 166, 79th Congress, approved 31 July 1945. The approved application provided that the studies of specific areas and problems be defined in appendices; that separate reports be issued for each shore town; and that a composite report be issued for the State of Connecticut summarizing the recommendations contained in the individual reports.

2. Modification of Basic Agreement. - A request of the State of Connecticut dated 3 October 1947, approved by the Chief of Engineers on 20 October 1947, modified the basic agreement to permit separate reports on physiographical bases rather than on political boundaries.

In accordance with this modification, the shore line of the State of Connecticut was divided into the following physiographical areas:

1. Ash Creek to Saugatuck River (Fairfield, part of Westport)
2. Hammonasset River to East River (Madison)

3. New Haven Harbor to Housatonic River (West Haven and Milford)

4. Connecticut River to Hammonasset River (Old Saybrook, Westbrook and Clinton)

5. Pawcatuck River to Thames River (Stonington and Groton)

6. Niantic River to Connecticut River (East Lyme and Old Lyme)

7. Housatonic River to Ash Creek (Stratford and Bridgeport)

8. Noroton River to Byram River (Stamford and Greenwich)

9. East River to New Haven Harbor (Guilford, Branford, East Haven and New Haven)

10. Thames River to Niantic River (New London and Waterford)

11. Saugatuck River to Noroton River (part of Westport, Norwalk, and Darien)

The location of these areas are shown on Plate 1.

3. Appendices. - Appendix I to the basic agreement was approved by the Chief of Engineers on 20 October 1947. Appendices II and III were approved by the Chief of Engineers on 16 December 1947, and Appendices IV, V, VI, and VII on 9 September 1948. Preparation of Appendices VIII, IX, X, and XI is in progress. The subject of this report is Area 1, as defined by Appendix I.

PURPOSE

4. General. - The purpose of the study was to determine the most suitable methods of stabilizing and improving the shore line between Ash Creek and Saugatuck River.

5. Scope. - The scope of the study was as follows:

a. Determine the essential characteristics of littoral drift.

b. Determine the source and disposition of littoral material within the area.

c. Determine which sections of the shore line are now subject to undesirable changes, and the most suitable remedial measures for insuring reasonable stability of the shore line in these areas.

d. Analyze the effect of existing structures upon the shore line and determine the most suitable remedial measures where necessity for such measures is indicated.

e. Determine which sections of the shore line are desirable locations for beach improvements, and the most effective measures for accomplishing the desired improvements.

f. Analyze the shore line improvements and protective measures considered, determine the advisability of adopting projects for such work, the public interest therein, and the share of the cost, if any, to be borne by the United States.

PRIOR REPORTS

6. The Physical History of the Connecticut Shore Line. - Bulletin No. 46 of the State Geological and Natural History Survey of Connecticut published in 1929 is a paper by Henry Staats Sharp, A.M., titled "The Physical History of the Connecticut Shore Line." This paper describes the geological history of Connecticut and the various topographical features of the shore line. The geological history discussed in Paragraphs 14 to 18 is based principally upon this report.

7. Beach Erosion at Compo Beach, Westport, Connecticut. - A study of beach conditions at Compo Beach, Westport, Connecticut, was made by the Beach Erosion Board and a report, dated 18 April 1935 was published as House Document No. 239, 74th Congress, 1st Session. This study determined that the principal problem was the deterioration of a good sandy beach into a coarse gravelly beach. It was recommended that a breakwater be constructed at the eastern end of the beach at Hills Point to trap sand moving in a northeasterly direction along the shore, and to prevent southwesterly move-

ment and deposit of heavy gravel and cobbles along the beach. The recommended size of the breakwater was as follows: length 1090 feet, height 10 feet above mean low water, top width 8 feet, and side slopes of 1 vertical on 1.5 horizontal. In addition to this breakwater it was recommended that 16,000 cubic yards of clean sand be placed artificially on the beach. In 1948, a short groin was built at the site of the recommended breakwater, and 3,000 cubic yards of sand were placed along the beach.

8. Effect of Federal Structures on Adjacent Shore Lines. - A report, "Effect of Federal Structures on Adjacent Shore Lines", dated 11 July 1938 and a supplement thereto dated 3 February 1939, were submitted to the Shore Protection Board describing the conditions in the vicinity of Southport before and after construction of a breakwater and dike authorized under River and Harbor Act of March 2, 1829. The breakwater and dike were constructed to confine the tidal prism to the main channel and to prevent sand drifting in from the eastward. It was concluded that the breakwater prevented excessive drifting of sand and reduced maintenance of the channel.

DESCRIPTION

9. Connecticut. - Connecticut is aptly termed the gateway to New England, and itself is among the most popular vacation and tourist areas of the country. Connecticut is approximately 100 miles long in an east-west direction, and 50 miles broad in a north-south direction. The entire southern boundary of the State is the shore of Long Island Sound, a rather narrow, sheltered arm of the Atlantic Ocean. Only that part of the shore facing open water of Long Island Sound or tributary bays is considered in these reports. This shore is quite irregular and is about 165 miles long. The bulk of the population of Connecticut, which in 1940 was over 1,700,000 people, is in close proximity to the shore. About 40,000,000 of the country's

population live within 300 miles of Connecticut's shore with the result that there is considerable use of the Connecticut shore. The fact that Connecticut is located in a temperate latitude and that the waters of Long Island Sound are generally calmer and warmer than along the exposed ocean shores of the neighboring States further has induced intensive development of water-front activities. A further attribute of the State is that the flat plain which extends generally a mile or more inland is well suited to resort development. The Connecticut shore is also very irregular, dotted with bays, coves, promontories and near-lying islands, all adding variety to the area, and adding to its value for resort and other purposes. The existence of United States Route 1 along the site of the Old Kings Highway, following the shore entirely across the State, closely paralleled by the main line of the New York, New Haven and Hartford Railroad, has encouraged more intensive development of the Connecticut shore areas through the past generations than is the usual case.

10. Area 1. - The area of the Connecticut shore considered in this report is an extent of some 9.2 miles from Ash Creek to Saugatuck River, consisting of the entire 4.5 mile stretch of the Town of Fairfield shore, and the easterly 4.7 miles of the Town of Westport shore. This shore area is adjacent to and west of Bridgeport, and is about 40 to 50 miles east of New York City. The entire Fairfield County in the southwestern part of Connecticut, in which this area is located, is strongly influenced by its proximity to metropolitan New York. The centers of population in this area are located along United States Route 1, about one mile inland and parallel to the shore, and consist of the Town of Fairfield, population 20,000 in 1940, including the village of Southport in the western part of Fairfield, and the eastern part of the Town of Westport, population 8,000 in 1940. This area is particularly noteworthy in that it includes Sherwood

Island Park, the westernmost of three State-owned beaches on the Connecticut shore. The remaining area bordering the shore is nearly continuously developed as a resort and shore residential area. This development ranges from modest cottage areas to extensive estates. In general the area is suburban or semi-rural in nature, but neighboring metropolitan and industrial areas cause some pollution of parts of the shore, notably at Fairfield Beach between Ash Creek and Shoal Point, and along the Southport shore west of Southport Harbor. The location of the area included in this study is shown on Plate 1.

11. Shore Physiography. - The entire shore area from Ash Creek to a point half way between Shoal Point and Pine Creek Point is a barrier beach in front of marsh areas extending a quarter of a mile or more inshore. Shoal Point is the inshore end of Penfield Reef, a cobble tombolo projecting some 6,000 feet offshore. A sand spit extends around Pine Creek Point and serves as a narrow bar separating Pine Creek from the Sound. That portion of the spit east of Pine Creek Point joins the barrier beach mentioned above. Kensie Point is a glacial hill of moderate height extending from Pine Creek Inlet to Kensie Beach, or Sasco Hill Beach. Sasco Hill Beach is a barrier type beach fronting marsh areas extending from Kensie Point to Southport Harbor. West of Southport Harbor is the only locality where significant ledge outcrops are found, and these are minor and scattered for about a mile and are separated by small pockets of marsh or relatively coarse beach material. The remainder of the Southport shore to Sasco Brook is of low glacial till fronted by a cobbly moraine and marsh areas. The area known as Greens Farms extends generally from Sasco Brook to Sherwood Island State Park. This area is generally one of low glacial hills extending to the shore. Sherwood Island Park is made up largely of marsh areas fronted by a barrier beach running east from Sherwood Point. At Sherwood Point large boulders offshore indicate the nature of this low glacial deposit. West of Sherwood Point marsh areas to Sherwood Pond are bordered by narrow beaches of relatively coarse material. West of

Sherwood Pond, Compo Hill slopes to the shores, which here is of a pronounced coarse and cobbly nature. West of Hills Point, Compo Beach is a cuspate bar springing from Cedar Point, the arms stretching east and north. From Compo Beach marsh areas bordered by narrow beaches extend to the Saugatuck River.

12. Beach Use. - In Connecticut private title exists only to the mean high water line; seaward the title rests in the State. Technically this means that the public has access to the entire stretch of shore line below high water. Legally no restrictions are allowed against such public usage of the beaches below high water. Actually, limited accessibility restricts the public to beaches where the adjacent backshore area is publicly-owned or open to the public on a commercial basis. Even where the beach areas are publicly-owned, use may be limited to area residents or town residents by parking restrictions, preferential admission rates or omission of facilities for travelers.

13. Description and Composition of Beaches. - Detailed descriptive data concerning the entire shore line of Area 1 was obtained by field inspection. The shore line was then divided consecutively from Ash Creek to Saugatuck River generally in accordance with the physical character of shore features. A description based on these subdivisions is included as Appendix A. This description includes the name, location and extent of the area, the width of beach above high water and from low to high water, the ownership and use (whether public or private), facilities available to the public and composition of sand below and above the high water line. The beach area above high water along the entire shore line of Area 1 is narrow, averaging not more than 50 feet in width. One-half of this shore is protected by sea-walls and bulkheads and the high water line is generally at the foot of or less than 50 feet in front of these structures. The composition of beach material is

poor, consisting largely of gravel, cobbles and coarse sand. Samples of beach material were taken at selected locations along the shore. A mechanical analysis of these samples was made to determine median diameter and classification. The results of this analysis indicate that on an average approximately 50 percent of the beach material consists of gravel and cobbles, 30 percent is coarse sand and the remainder medium or fine sand. Tabulation of results and locations of samples are shown on Plates 15-17. A complete photographic record was made of the shore. Selected photographs are shown on Plates 23-31. The shore area in accordance with present development consists of 3.4 miles of public beaches, and 5.8 miles of private beaches consisting of 2.7 miles of large estates, 2.5 miles of cottages and 0.6 miles of commercial beaches. The public beaches are Sherwood Island State Park (1.2 miles) owned and operated by the State and open to the general public, and Jennings, Sasco Hill, Old Mill, Southport, Canal, Burial Hill, and Compo Beach, all town-owned and restricted in whole or in part to town residents. The large estate areas receive limited use. The use of cottage areas is generally limited to residents. The private or commercial beaches are used by the public on a fixed-fee basis or are restricted to members of clubs. The development and character of the area is shown on Plates 15-17, and on United States Coast and Geodetic Survey Charts 220 and 221.

GEOLOGY

14. General. - The present Connecticut shore line is the result of submergence following the lowering of the earth's surface in relation to the water surface of the ocean. The geological processes which effected this condition and the formation of Long Island Sound are discussed in Appendix B.

15. Origin of Beaches. - The headlands are composed of unconsolidated glacial drift materials and the lowlands are composed of unconsolidated material of glacial and fluvio glacial origin. These materials erode easily and have contributed to the beaches in this area. Offshore islands, now lying beneath the waters of Long Island Sound, have also contributed material used in the formation of these beaches.

16. Fairfield-Stratford Plain. - The eastern portion of Area 1, from Kensie Point to Ash Creek is a part of the Fairfield-Stratford Plain, the largest area of flat land along the shore of the State. This plain is eight miles long and averages a mile in width. It is composed of sand and gravel probably formed by the deposits of streams from the melting of a glacier, and with infrequent inconspicuous outcrops of bed-rock. The larger part of the shore consists of low and narrow bars which are cut and filled very rapidly by waves and often change its shape within a few years. An example of this is seen at Pine Creek Point where the addition of sand to the outerbar has caused the inlet to Pine Creek to move westward at an average rate of 42 feet per year over a period of 38 years. At present the process has reversed itself and the western end of the bar is being eroded.

17. Hills. - Two high hills, Sasco Hill and Compo Hill, occur near the shore in Area 1. Sasco Hill is elongated in shape and ends at Kensie Point. Compo Hill is somewhat circular and lies in Westport. Surficially they are composed of drift although a few outcrops of crystalline rock occur on Compo Hill and it is likely that rock lies near the surface of Sasco Hill. These hills have no pronounced effect on the coastal configuration.

18. Cuspate Bars. - Cuspate bars are found in this area at Shoal Point, Pine Creek Point and Cedar Point. A long, narrow submarine bar known as Penfield Reef, extends from Shoal Point seaward to the Cows, where islands now vanished under wave attack are believed to have formerly existed. Opposite

Pine Creek Point are minor shoals beyond which lie the remains of Flat Island with a bar trailing landward. These cusps may represent either uncompleted "Y" tombolos or parts of such tombolos which existed for a time, but which were soon destroyed after the former islands were removed by the waves. Cedar Point is a very acute cuspate bar, one side of which is uncompleted, while the apex is prolonged seaward in a slender spit connecting with a shoal or former island.

II. FACTORS AFFECTING SHORE PROCESSES

WIND

19. Wind Data. - Wind diagrams compiled from observations of the United States Weather Bureau at Block Island, Rhode Island; New Haven, Connecticut; and New York City, New York, are shown on Plates 3, 4, and 5. The periods covered by these observations are as follows: Block Island 1921-1939, New Haven 1932-1942, New York City 1921-1942. The wind diagrams show the percentage of wind movement and percentage of wind duration from the various directions averaged for the entire period of record and averaged for each of the 12 months of the year for the entire period of record. In addition to the above, wind diagrams showing the yearly cumulative average winds compiled from records of the United States Navy Hydrographic Office for the 5 degree squares nearest the shore line of Connecticut are shown on Plate 2.

20. Prevailing Winds. - At Block Island the prevailing wind is from the southwest from April through September, from the northwest during October to February and from the west during March. On an annual basis there is a slight predominance of southwest winds, while those from the west and northwest are approximately the same.

At New York the prevailing wind is from the northwest from October to May, from the south from June to August and equally from the southwest and northwest during September. On an annual basis there is a definite predominance of northwest winds. From the wind diagrams for the 5 degree squares it is apparent that winds from the westerly quadrants prevail, which is in agreement with the records for Block Island and New York.

At New Haven the prevailing wind is from the south from May to August, from the north from September to February, from the northwest in March and from the north in April. On an annual basis there is a predominance of north and south winds, the greatest wind movement being from the

north. The prevailing winds at New Haven are distinctly different from those found in any of the adjoining areas. New Haven lies in a lowland which runs generally north and south through Connecticut. Winds in this lowland are evidently affected by the topography so that at New Haven the winds are funneled in a north-south direction. It appears that the prevailing winds at New Haven should therefore affect only that portion of the shore line lying at the foot of this lowland east and west of New Haven, which might be defined approximately as extending from Pond Point in Milford to Branford River in Branford.

East of Branford River the wind data from Block Island represent the best available information applicable to the shore. West of Pond Point the wind data from New York represent the best available data applicable to the shore. Area 1, located west of Pond Point, is therefore probably under the influence of winds with a prevailing direction similar to New York City where the direction is predominantly northwest.

TIDES

21. Range of Tide. - Tidal range data for points near the east and west ends of Area 1 are available from "Tide Tables, Atlantic Ocean," published by the United States Department of Commerce, Coast and Geodetic Survey. Near the east end of the study area, at the entrance to Black Rock Harbor, the mean range of tide is 6.9 feet and the spring range of tide is 8.1 feet. At the west end of the study area, at the entrance to the Saugatuck River, the mean range of tide is 7.0 feet and the spring range is 8.3 feet.

22. Storm Tides. - No continuous record of storm tides is available for any location within Area 1. A primary tide station is maintained by the United States Coast and Geodetic Survey at New London, Connecticut. A summary of extreme tides occurring at New London for a ten-year period is

given in Appendix C. High water elevations which occurred during the hurricane of 21 September 1938 were determined at locations along the shore of Connecticut and they are listed in Appendix C. During this hurricane, near the eastern end of the area, at Bridgeport, the high water was 13.8 feet. Within the area, at Southport, the high water was 13.4 feet. West of the area, at South Norwalk, the high water was 11.6 feet. The above storm tides of September 1938 are the highest tides of record for this area.

WAVES

23. General. - Wave sizes are markedly less in Long Island Sound than along shores completely exposed to the ocean. This is a result of the shelter afforded by Long Island, which acts as a natural breakwater shielding practically the entire shore of Connecticut. Wave sizes are dependent on wind velocity and on fetch or expanse of water over which the wave may travel. It is evident from the storm data tabulated in Paragraph 26 that the frequency of storm winds at New Haven is considerably less than at Block Island and New York, which are more directly exposed to the ocean. The close proximity of Long Island to the Connecticut shore limits the fetch over which the winds may act to produce waves. These factors should and do act favorably in reducing wave action. The absence of surf bathing in Connecticut is an indication of the natural protection afforded this area.

24. Wave Study. - During the review of work items to be included in this study, consideration was given to the collection of wave data. Upon the request of the Beach Erosion Board, the State of Connecticut was consulted concerning their willingness to include in the study agreement a supplementary generalized appendix covering the study of wave form, energy and height in Long Island Sound, based on a special wave study estimated to cost $10,000. The State of Connecticut felt that in order to determine

whether the funds which have been allocated are adequate, it would be advisable to delay any decision in this matter until the detailed studies already agreed upon had been completed to an extent where it would be possible to figure accurately the cost of completing the study. At the time of the writing of this report no decision has been made concerning the proposed wave study.

STORMS AND THEIR EFFECTS

25. Tropical Storms. - Tropical storms of hurricane intensity occasionally pass across or near the Connecticut shore. Ivan Ray Tannehill, in his book "Hurricanes," lists ten such storms which have been particularly severe in the New England area. The dates of these storms and the known paths of five of them are shown on Plate 2. The paths of many more hurricanes are known to have passed over New England but their strength has been largely dissipated before reaching this area so that their effects on the shore have not been severe in New England. Two recent hurricanes of exceptional violence have struck across the Connecticut shore. These occurred on 21 September 1938 and 14-15 September 1944. A description of hurricanes in general, and of these two in particular, is given in Appendix D.

26. Storm Data. - Summaries of records of winds equal to or greater than 40 miles per hour at New York City, New York, and of winds equal to or greater than 32 miles per hour at New Haven, Connecticut, and Block Island, Rhode Island, compiled from United States Weather Bureau data covering the periods indicated, are tabulated below:

Winds Equal To or Greater Than 40 Miles Per Hour
New York City, N. Y., 1911 - 1947

Direction	Number	Percent of Total	Probable Number in 100 Years
N	73	5	197
NE	29	2	80
E	15	1	40
SE	44	3	118

Winds Equal To or Greater Than 40 Miles Per Hour
New York City, N. Y., 1911 - 1947 (continued)

Direction	Number	Percent of Total	Probable Number in 100 Years
S	117	8	316
SW	88	6	236
W	161	11	434
NW	934	64	2527
TOTAL	1461	100	3948

Winds Equal To or Greater Than 32 Miles Per Hour
New Haven, Connecticut, 1905 - 1947

Direction	Number	Percent of Total	Probable Number in 100 Years
N	38	15	88
NE	41	15	90
E	12	5	28
SE	24	9	56
S	40	15	93
SW	25	10	58
W	34	13	79
NW	46	18	107
TOTAL	260	100	599

Winds Equal To or Greater Than 32 Miles Per Hour
Block Island, Rhode Island, 1936 - 1945

Direction	Number	Percent of Total	Probable Number in 100 Years
N	78	10	780
NE	102	13	1020
E	63	8	630
SE	45	6	450
S	24	3	240
SW	35	4	350
W	117	14	1170
NW	341	42	3410
TOTAL	805	100	8050

27. Analysis of Storm Data. - From the observed data the probable frequency of occurrence of storm winds from various directions has been computed on the basis of a 100 year period and the results are shown in the last column of the above tabulations. It should be noted that the storm winds occurring at New York and Block Island are similar in that they show a high preponderance in a northwest direction. The frequencies

of occurrence at these stations are not comparable since 40 mile per hour winds are listed for New York and 32 mile per hour winds are listed for Block Island. At New York City during 1947 there were 110 winds of 32 miles per hour or greater, as against only 42 winds equal to or greater than 40 miles per hour. Applying the ratio (110/42 = 2.6) determined between 32 and 40 m.p.h. winds in 1947 to the total number of winds listed in the table above for New York City (2.6 x 3948), it appears that approximately 10,300 winds of intensity equal to or greater than 32 miles per hour can be expected during a 100 year period as against 8050 at Block Island.

Due to the location of New Haven about midway between New York City and Block Island, it would be natural to expect the wind frequency and direction at New Haven to be somewhere between those for New York City and Block Island. This is definitely not so. Storm winds occur here without any marked differences in frequency from the west clockwise around to northeast and from the south. It is the stated opinion of weather bureau officials that winds at New Haven are peculiar to that area alone and do not indicate winds which can be expected along Long Island Sound. An explanation of this phenomenon has been given in Paragraph 20. Records for Block Island and New York City give a more accurate picture of the direction of wind expectancy in Long Island Sound. It should be borne in mind that the Connecticut shore is well sheltered by Long Island, Fishers Island and other islands extending to the east. Therefore, neither the frequency nor intensity of winds occurring at Block Island and New York City can be expected to occur along the Connecticut shore.

28. Storm Damage. - Storm damage along the Connecticut shore from Ash Creek to Saugatuck River results from storms from the northeast, southeast and southwest directions. Due to the configuration of the shore,

winds from the northeast blow offshore and only a small fetch of water across inlets exists for the formation of waves. Fron an east, northeast direction, however, there is an open fetch of water from 23 to 32 miles along Long Island Sound. From the southeast there is a fetch of from 14 to 17 miles and from the southwest there is a fetch of from 19 to 20 miles. The wind diagrams for New York and Block Island (Plates 3 and 5) indicate that wind movement from the northeast and southeast is comparatively small in comparison to the prevailing directions. Winds from the southwest prevail at Block Island and such winds constitute a high percentage of the total winds at New York City where the prevailing direction is northwest. Storm wind data indicate that the frequency of winds from the directions causing damage along this portion of the Connecticut shore are in a definite minority. At Block Island there is a slight preponderance of northeast gales over those from the southwest and southeast. At New York City there are more gales from the southwest than from the southeast or northeast. It is evident that the area under study is favorably situated in so far as frequency of destructive storms is concerned. Condensed accounts which follow of storm damage as reported by the press in recent years indicate the type of storm damage likely to occur in this area.

Location	Account
Fairfield	6 February 1920. Northeast storm, heavy sea and heavy snow. Tides "Highest recorded in 33 years." Pallisades dance hall and 3 cottages destroyed by seas. Trolley track bed badly washed out on shore line.
Fairfield	1 October 1920. Southeast storm, heavy sea. Beach dwellers evacuated. Sea destroys 3 cottages.
Fairfield	12 March 1924. - Northeast storm, heavy seas. Two buildings destroyed.

Location	Account
Fairfield	23 August 1930. Northerly storm, high seas. Pine Creek channel course changed 20 feet by scouring seas.
Fairfield	6 March 1932. Northeast storm, high tides, heavy seas. Cottage destroyed.
Fairfield	1-2 November 1932. Southeast storm, heavy seas, high tides. Several cottages destroyed.
Fairfield	26 January 1933. Northerly storm, 40 m.p.h. gusts. Cottages flooded and undermined.
Fairfield	17-18 November 1935. Northeast storm, 30-foot seas, tides above normal. Beach roads flooded. One-half of Sturgis pier destroyed. One cottage destroyed.
Westport	17-18 November 1935. Same storm as above. Cottages at Compo Beach undermined and collapsed. Damages at least $5000.
Fairfield	22 February 1937. Southeast storm, tides above normal. Minor damage along shore.
Fairfield	25 January 1938. Southeast storm, heavy rain, heavy seas. Property damage in thousands.
Pine Creek and Fairfield Beach	22 September 1938. Tropical hurricane. Heavy seas lash beach and Pine Creek Section. Highest tide in memory of townspeople. Shore homes swept out to sea. Residents desert dwellings. Thousands of dollars damage to summer cottages and year round residences.
Fairfield	23 September 1938. Tropical hurricane as above. Thirty cottages at extreme western end of Fairfield Beach Peninsula destroyed. Penfield Reef bathing pavilion damaged. Large section of beach torn out.
Pine Creek and Fairfield Beach	24 September 1938. Tropical hurricane as above. Hundreds of cottages damaged. Over one hundred cottages entirely destroyed or damaged beyond repair. Pine Creek widened at mouth and beach west of old pier enlarged.

Location	Account
Fairfield	15 February 1940. Northerly storm. Waves over sand spit at west end. Cottages surrounded by tide waters.
Fairfield	15 September 1944. Southeast and north tropical hurricane. Shore dwellers evacuated. Tide at 1938 height.
Fairfield	1 December 1944. East and northeast storm, huge waves, tides five feet above normal. Beach roads under water.
Fairfield	29 November 1945. Northeast storm, huge waves, extreme high tides. Beach areas under foot of water.

III. EFFECTS OF SHORE PROCESSES

SHORE LINE AND OFFSHORE DEPTH CHANGES

29. General.- Plans showing the location of the shore line and the 6, 12 and 18-foot depths have been prepared from United States Coast and Geodetic Survey data by the Beach Erosion Board for the period 1835 to 1934. For this study a survey during 1948 located the entire shore line, and offshore depths on selected profiles spaced about 500 to 1500 feet apart. Shore line changes are shown on Plates 7 and 8 and offshore depth changes are shown on Plates 9 through 14 and Plate 18. Detailed descriptions of the principal changes which have occurred since 1835 are given in Appendix E. In general the entire shore line of Area 1 presents a picture of erosion during the past century, the amount being in the order of 1 to 2 feet per year. The only notable accretion now occurring along the shore is found at Shoal Point and along the east side of the Southport breakwater. Growth of about 300 feet has occurred at Shoal Point since 1909 and about 100 feet at the Southport breakwater since 1933, this latter process being a continuation of a total growth of over 500 feet occurring since 1835. In recent years the construction of numerous shore structures has altered the effects of erosion, resulting in the lowering of beach levels or disappearance of beaches rather than in recession of the shore line. This construction has interrupted the broad natural process which gradually wore away the land and today the changes vary along short stretches of shore and can only be determined by careful and detailed study. The mouths of all inlets in the area exhibit the same characteristic - the growth of a spit from the east bank toward the west, the lengths of these spits varying from 500 feet to over 6000 feet. Since 1835 these spits have caused inlets to move westward as follows: Ash Creek, 400 feet; Pine Creek, 2800 feet; Alvord Creek, 200 feet and Sherwood Pond, 400 feet. Sasco Brook is the only exception to

this movement, little change being evident during this period. In recent years there have been no large changes at inlets except at Pine Creek where the once spectacular growth has ceased and erosion has worn back about 150 feet of the sand spit since 1909 and at Sherwood Pond where the spit has grown about 100 feet since 1933. In general, offshore depths along the entire area increased between 1835 and 1948. In recent years there is some indication that this deepening is continuing at many places but the amount of change is too small to permit of reliable interpretation.

30. Comparative Profiles. - Forty-three selected profiles were run along the shore of Area 1, spaced about 500 to 1500 feet apart, extending from above the high water line seaward to the 18-foot depth contour in Long Island Sound. Their locations are shown on Plates 15-17. These lines varied in length from about 2000 to 5000 feet. They were run to determine depth changes which have occurred offshore by comparison with data previously obtained by the United States Coast and Geodetic Survey and also to serve as a basis for comparison with any depth determinations which may be obtained in the future. In order to determine the character and extent of any seasonal changes which may be occurring along the shore, it was planned that periodic check surveys be made along some of the profiles at intervals a few months apart. Twelve of the profiles and the check surveys run on them are shown on Plate 18. Also shown on this plate are the locations of the 6, 12 and 18-foot depths as determined in 1835, 1883-85, 1916 and 1933-34. The description of offshore changes which have occurred from 1835 to 1948 are included in Appendix E. At present insufficient data are available to determine the extent and character of seasonal changes which might be occurring along the shore.

In addition to their use in determining offshore depth changes, the profiles have served as a basis for the design of the plans of improvement.

LITTORAL DRIFT

31. Direction of drift. - The littoral currents in the Ash Creek to Saugatuck River area, as in the rest of the Connecticut shore, vary in direction and intensity from place to place, and vary seasonally. The drift, or material moved by the littoral current, also varies, dependent on the sources of supply. There is no question but that the littoral drift is much less than formerly due to loss of natural supply, although the littoral currents are probably of about the same magnitude as before. Throughout most of the area, sand spits trail westward and creek inlets are turned to the west. However, this is a general observation as to the net effect of the littoral drift and does not hold true at all points throughout the area. Compilation of various indices of drift are tabulated below.

Area	Indicated Direction of Drift	Evidence	Authority
East of Ash Creek	Westward	Movement of mouth of Ash Creek.	Shore line changes.
Ash Creek to Shoal Point	Inconclusive. (Either entirely westward, or westward on west half and eastward on east half)	1. Accretion just west of Ash Creek.	1. Shore line changes.
		2. Deposition of sand in offshore bar at Ash Creek.	2. Survey.
		3. Erosion 2,000' west of Ash Creek.	3. a. Exposed fence foundation. b. Local testimony.
		4. Erosion 4,000' west of Ash Creek.	4. Local testimony.
		5. Erosion at Rowland Road and accretion at Shoal Point.	5. Shore line changes.
Penfield Reef to Pine Creek Point.	Inconclusive.	Groins indicate no net drift.	Visual inspection.

Area	Indicated Direction of Drift	Evidence	Authority
Pine Creek Point to Pine Creek Inlet	Westward	1. Groins catch sand on east side 2. Growth of Pine Point 1855-1916	1. Visual inspection 2. Shore line changes
Pine Creek to Kensie Point	Eastward	1. Groins catch sand on west side 2. Trailing bars 3. Offshore bar at Pine Creek 4. Sorting of beach materials	1. Visual inspection 2. Visual inspection 3. Survey 4. Visual inspection and sample analyses
Kensie Point to Southport Harbor	Westward	1. Sorting of beach materials 2. Accretion at Southport breakwater and erosion just west of Kensie Point	1. Visual inspection and sample analyses 2. Shore line changes
Southport Harbor to projecting point quarter mile west	Eastward	Groins catch sand on west side	Visual inspection
From that point to Sasco Brook	Westward	1. Sasco Brook empties to west 2. Groins catch sand on east side	1. Survey 2. Visual inspection
One-quarter mile west of Sasco Brook	Eastward	Deposition of sand on Canal Beach	Visual inspection
From that point to Burial Hill	Westward	1. Direction creek mouth at Burial Hill 2. Groins catch sand on east side	1. Survey 2. Visual inspection
Burial Hill to Sherwood Point	Inconclusive	-	-

Area	Indicated Direction of Drift	Evidence	Authority
Sherwood Point to Sherwood Pond	Westward	1. Groins catching sand on east side. 2. Westward direction of outflow	1. Visual inspection. 2. Visual inspection.
One quarter mile west of Sherwood Pond	Eastward	1. Deposition of sand at Old Mill Beach. 2. Lack of sand beach to westward.	1. Survey and visual inspection. 2. Visual inspection.
From that point to Hills Point	Inconclusive	-	-
Compo Beach - Hills Point to Cedar Point	Both	-	Beach Erosion Board Report 1935
Compo Beach - Cedar Point to Yacht Basin	Westward	1. Accretion south side previous groins	1. Shore line change map

IV. EXISTING PROTECTIVE STRUCTURES

32. General. - In this area, as is generally true of the whole of Connecticut, much of the shore line has been influenced by the construction of protective structures. Over one-half, or approximately 25,000 feet, of the entire shore line is protected by sea walls and bulkheads, varying in type from lightly constructed timber to massive concrete and masonry. There are about 175 groins in existence, having an aggregate total linear length of about 10,000 feet. There is a large shore-connected stone breakwater extending 700 feet offshore at the mouth of Mill River (Southport Harbor), and short jetties elsewhere.

In addition to the above, revetment, usually stone riprap in front of or above sea walls, has been placed in many areas along the shore to provide additional protection. A description of each structure in detail would be repetitious and of doubtful value. Therefore, typical structures have been selected for analysis. Twelve structures or systems of protection have been chosen and their description and analysis is included in Appendix F. The existence of shore structures has destroyed, diminished or interrupted the natural processes of supply of beach material formerly obtained from erosion of undeveloped areas and transmitted alongshore by littoral currents. This has resulted in diminishing the effectiveness of the numerous groins along the Connecticut shores - structures primarily designed to improve a shore area by interception of littoral drift. These groins are now effective only in holding existing beach material rather than in improving the area. In general, all groins in Area 1 have a common fault; namely, that of being too low and too short. It is notable that one really large structure of this type, the breakwater at Southport Harbor, has resulted in accretion of the shore of over 500 feet

since its construction a century ago. The sea walls and bulkheads have undoubtedly stopped or retarded the recession of the shore line, a process which was generally occurring all along the shore before their construction. From observation it is evident that erosion is continuing in front of these structures, resulting in the disappearance of beaches or the lowering of the level of the shore with the consequent exposure of the footings of structures which in time can result in their destruction. Only by constant maintenance will it be possible to preserve the shore against the attacks of Long Island Sound.

V. PLANS OF IMPROVEMENT

IMPROVEMENTS DESIRED

33. Connecticut-General. - The problem involved along the Connecticut shore line as a whole, and the area included in this report results in part from storm damage but is more particularly that of gradual deterioration caused by ordinary wave attack. The problem is not of recent origin but has become of increasing importance with increased use of the shore as a summer and permanent residential or resort and vacation area and has been aggravated by the deterioration and disappearance of protective beaches as a result of direct wave attack on the extensive development along the Connecticut shore. The problem has been further intensified by general lack of knowledge of shore processes and changes to be expected and the resultant lack of control, planning and foresight. Increased widespread development has accelerated the deterioration of the shore as a whole by removing natural sources of supply through protection of formerly eroding undeveloped areas. The problem is, therefore, to stabilize and improve the shore line so that existing and future developments on the shore front may benefit from restored beach conditions and also to prevent future damages and losses which will otherwise inevitably result from the present deterioration. Local interests throughout the State have become increasingly aware of the growing problem. Evidence of this widespread concern is seen in the application for Federal studies at Compo Beach, Westport in 1935, and at Hawks Nest Beach, Old Lyme in 1939. Studies by private engineering firms at Ocean Beach, New London in 1938, and at Shippan Point, Stamford in 1941, further indicate this interest. In addition, preliminary discussions have been initiated in the past by many towns, beach associations and other interests concerning the conduct of cooperative studies. These various local movements toward separate studies were unified as a result of the State-wide

destruction experienced in the 1938 and 1944 hurricanes. At a conference at Clinton in July 1946 attended by 250 representatives of all shore towns and inland interests, a Beach Erosion Control Committee was appointed to initiate a State-wide study of the problems affecting the entire State shore line. Variation in degree of damage suffered was recognized in the resulting State appropriation for this study by enumeration of seven towns critically affected by shore erosion. The area covered in this report includes one of the towns named.

34. Area 1 - General. - In general, throughout the entire area considered in this report the problem is principally one of deterioration and gradual loss of beaches. This condition is fundamentally caused by the loss of natural sources of supply for these beach areas. This loss of natural sources of supply is a result of the nearly continuous development of the entire water-front, and resultant protection of areas previously eroding and furnishing material to the littoral drift supplying neighboring areas. Of particular note in this area is the condition at Pine Creek Point, where the problem has been intensified by residential development on a sand spit, subject to rapid and extreme change. In general, the plans of improvement are based on artificial restoration of beach losses. Plentiful sources of sand have been determined to exist offshore within practicable distance for hydraulic dredging and pumping to shore. Construction of groins to prevent alongshore erosion of restored beaches is, in general, considered advisable in view of losses due to erosion in the past. Bulkheads and seawalls have not been considered where beach restoration has been found to be practicable since such restoration would offer equivalent protection in addition to furnishing the shore recreational area so important to the Connecticut shore. Offshore breakwaters have not been considered to offer a solution for this area in view of the extreme expense involved and limited

benefit to be derived therefrom as the problem is more one of gradual losses from ordinary wave attack than one of damage by violent ocean waves. The plans are considered for each specific area in the following paragraphs.

35. Jennings Beach and Ash Creek. - The problem at Jennings Beach is (1) that the swift ebb and flow currents in Ash Creek now sweep along the easterly part of Jennings Beach, creating a steep foreshore and bathing hazard, and (2) that sand eroded from the west bank of the inlet and from neighboring shores is carried by littoral and inlet currents to an offshore bar which by concentrating the flow along the shore is aggravating the initial problem and threatening to cause eventual closure of the inlet. Ash Creek drains a considerable area and its closing would create serious flooding. Bathing at the public beach adjoining the inlet has become so hazardous that is has become necessary to post warning signs restricting its use. Plans of improvement considered are (1) dredging an inlet channel offshore through the bar to a depth comparable to that of the natural offshore bottom, and (2) construction of a jetty to regulate and direct the inlet currents offshore. Consideration has also been given to plans for prevention of the erosion occurring along the western part of Jennings Beach, but it is expected that construction of the jetty at Ash Creek will so deflect and slow down the littoral currents alongshore that no further erosion will occur in that area. The rate of change of the Jennings Beach shore line is not sufficient to necessitate a supplementary groin system. The shore along the east end of the beach will tend to build out as a result of the trapping of sand drift toward the jetty. The storage capacity of the jetty sufficient to deflect the Ash Creek currents will not be exhausted during the life of the project. The jetty recommended would extend 700 feet from the Fairfield shore. It would be of sand-tight

construction built to a top elevation of two feet above mean high water. Study has been made of the possibility of adopting a stage construction program for the building of the jetty wherein it would be built seaward in sections at different periods. The purpose of the stage construction would be to allow the directed inlet current to dig its own channel through the offshore bar. It is felt that the occurrence of such a result is not sufficiently certain to justify modifying the plan of improvement to eliminate dredging the proposed channel and jetty foundations.

Present and possible future small boat navigation is considered to motivate against consideration of any plan to inclose Ash Creek inlet in a culvert and offshore drain, thereby allowing the beach to cover the inlet.

36. Fairfield Beach. - There is a problem of erosion of the shore and loss of beaches through lack of natural sources of supply between Beach Road, the west limit of Jennings Beach, and Pine Creek Point. Two stretches of shore now have no beach at high water and are protected by sea-walls. They are the Rowland Road area, an extent of about 1000 feet located about a third of a mile east of Shoal Point, and most of the shore between Shoal Point and Pine Creek Point. The only areas within this entire extent of shore not confronted by immediate and serious erosion extend a distance of about one-quarter of a mile on each side from Shoal Point and about 600 feet of shore from Pine Creek Point eastward. The reason for this condition in the vicinity of Shoal Point is the existence of Penfield Reef, a rocky shoal extending some 6000 feet offshore. This shoal acts as a breakwater and groin, trapping drift on both sides, depending on the direction of littoral currents induced by southwesterly and southeasterly winds and protecting the entrapped material from

wave attack and erosive drift induced by winds from either direction. East of Pine Creek Point the favorable condition is due to groins which are catching and holding littoral drift. The plan of improvement considered consists of (1) artificial restoration of the beach by the placement of sand fill along approximately 9000 feet of shore to build a beach area 100 feet wide above mean high water, and (2) construction of a system of seven groins alongshore to retard erosion of the restored beaches. The plan is shown on Plate 20. This plan is possible of adoption by small groups of shore front interests or in its entirety, and will result in immediate benefit to the interests involved. Consideration was given to a plan of improvement involving the placement of stockpiles of beach material within reach of wave wash in this area and to rely on distribution by littoral currents. The probable interference by the submarine bar at Shoal Point to the distribution of sand to the beaches east and west of it and the lack of conclusive evidence of littoral drift, particularly east of Shoal Point, rule against reliance on such a plan to build up the shore.

37. Pine Creek Sand Spit. - The most critical problem in Area 1 exists at the Pine Creek sand spit west of Pine Creek Point. This spit is now closely built up with cottages which are in danger of imminent destruction due to the serious erosion now in progress. This erosion is attributed to the loss of natural sources of supply which in the past served to feed and build the spit. Underground gas and water mains serving the area have already been exposed and destroyed by the erosion of the shore. No road exists along this spit west of Pine Creek Point and the single road east of the point is low and flooded during storms. The area is extremely unstable and should never have been developed as a residential area. Two plans of improvement have been considered; the first plan based on the con-

tinuing existence of the present residential development; the other involving the abandonment of the area. Under the first plan the seaward shore would be built outward by the placement of a sand barrier beach along its entire extent up to an elevation of 5 feet above mean high water. The sand would be placed to increase the width of the bar from its present width of 60 to 150 feet to a final width of about 250 feet. The barrier beach would be 2 feet higher than the general elevation of the bar and sufficient additional material could be placed here to be rehandled for eventual raising of the elevation of the present spit. A system of three stone groins are included in the plan to hold the restored area from the forces which would undoubtedly attempt to erode the beach built here. However, it is considered that this plan, while improving this area, is not justifiable of recommendation in that the area would still be hazardous. The recommended plan envisions the abandonment of the spit and the removal of all structures therefrom. The open beach would tend to recede towards the mainland and would eventually be breached by Pine Creek. Rather than wait for this to happen, it might be preferable to dredge a channel through the sand spit just west of Pine Creek Point and to fix this channel by the construction of two jetties firmly anchored at their inshore ends. Adoption of this plan would tie in closely with any possible future development of a small-boat anchorage in the marshes bordering Pine Creek at this location. The abandoned area could be developed as a bathing beach. Construction of a bulkhead to protect the shore area behind the spit may eventually prove necessary.

38. Pine Creek Beach Area. - The problem in this area is (1) erosion of the shore, (2) the formation of extensive offshore flats at the entrance to Pine Creek, tending to close the inlet and causing the channel to twist circuitously, and (3) insufficient area at a public beach receiving intensive

recreational use. The public beach in question, referred to as Pine Creek Beach, is about 50 feet long and is located at the foot of Pine Creek Road. This area, and the shore adjoining it to the east, is exposed to southwest storms and is subject to serious erosion. Heavy riprap has been placed east of Pine Creek Beach to protect the shore. West of Pine Creek Beach for about 500 feet towards Kensie Point erosion has worn back the shore and is cutting into the bank forming the foot of Sasco Hill. The remains of a jetty formerly constructed at the west limit of Pine Creek Beach, and a short concrete groin are the only protective structures in this westerly 500-foot section of shore. The plan of improvement considered most feasible is (1) construction of a training wall at the mouth of Pine Creek on the site of the remains of the existing jetty, and (2) placement of sand fill along 500 feet of shore west of this proposed training wall to provide a beach 100 feet wide above mean high water. The details of the plan are shown on Plate 21. The proposed training wall would serve as a breakwater to protect the shore to the east from southwest storms now causing damage to that shore. Protection from southeast storms is already afforded by the Pine Creek sand spit. Secondly, the training wall would act as a groin to trap eastward littoral drift, and thirdly, this training wall would regulate and direct the inlet channel offshore, thereby protecting the shore to the west and incidentally serving the navigational uses of Pine Creek. The placement of sand west of the training wall would make possible the extension of recreational beach area.

39. Kensie Point. - The problem involved is the protection of 2000 feet of shore in the vicinity of Kensie Point. This area comprises the seaward face of Sasco Hill, a bluff projecting slightly into Long Island Sound. It is bordered on the east by Pine Creek, a tidal inlet, and on the west by Sasco Hill Beach. The area is exposed to all southerly

storms. This entire stretch of shore except 200 feet at its east end is protected by sea-walls and groins. Since 1933 the shore line has eroded about 200 feet landward at Kensie Point to the foot of an existing sea-wall. This point is exceptionally exposed due to its projection. Riprap has been placed against the bank above the wall for protection at higher elevations. The area is developed as private estates not requiring extensive beaches. Under such conditions maintenance of the present sea-walls and riprap is considered adequate. The existing sea-walls are in good condition except at the exposed eastern end where a wall has been flanked by erosion and several sections have collapsed.

40. Sasco Hill Beach (Kensie Beach). - The problem involved is the widening and improvement of 900 feet of publicly-owned shore now developed as a town beach. This shore is located at Sasco Hill Beach (Kensie Beach), a barrier bar fronting a low-lying backshore formerly all or partly marsh, extending 2650 feet eastward from the breakwater at Southport Harbor. All but 650 feet at the west end adjacent to the breakwater is publicly-owned. The east end of the beach is narrow and consists of shingle and cobbles in front of a low dune. This area is used as a town beach and has parking areas, bathhouses, fireplaces and life-guards. The western part of the beach is wide and consists of fine sand resulting from the accretion of the shore, which has built outward over 500 feet since construction of the breakwater at Southport Harbor. This accretion and the gradation of the beach material is proof that the littoral drift is westward. The plan of improvement considered most practicable for the improvement of the town beach is (1) artificial placement of sand along 900 feet of shingle and cobble shore at the easterly end of Sasco Hill Beach, and (2) construction of a 400-foot

impermeable groin at the westerly limit of this fill to hold the sand and catch littoral drift. This plan of improvement is shown on Plate 21.

41. Southport Harbor to Southport Beach. - The problem involved is protection of 2400 feet of shore extending southwestward from Southport Harbor towards Frost Point. The area is generally developed as large estates. The elevations back of the shore are 25 feet or more above mean low water, sloping sharply down to the beach which is characterized by scattered minor outcrops of ledge rock separated by small pockets of marsh or cobbles and coarse material except for narrow stretches of fine sand towards the western end of the area. The entire extent of shore has been subject to serious erosion and is now protected by sea-walls, located at or near the high water line. Present beach use does not appear to warrant any extensive improvement of the shore for bathing. The present system of sea-wall protection should be adequate, if maintained.

42. Southport Beach. - The problem involved is the widening and improvement of 700 feet of publicly-owned shore now developed as a town beach. The area is located east of the inlet to Sasco Brook. Parking areas, bathhouses, sanitary facilities, refreshment stands, life-guards and fireplaces are provided for public use. About 200 feet of the western part of the area is usable at high water and the remainder consists of low water flats bordering a revetted State highway. The western end has a moderate width of sand but near Sasco Brook sedge grass interferes with full beach use. This grass is valuable as a wild life feeding ground and any plan of improvement considered should include preservation of the growth. The westward growth of the spit

on which this beach is located and the accumulation of littoral drift at groins is proof that littoral currents are westward. The method of improvement considered most practicable is (1) artificial placement of sand along the shore to widen the beach to 100-foot width above mean high water, and (2) construction of a groin at the west limit of the sand fill to hold the beach, catch littoral drift and prevent sand from drifting onto the wild life feeding ground. This groin should be located about 200 feet east of the inlet to Sasco Brook in order not to cover the sedge grass. It is felt that increase in usable beach area to the east will more than offset the prevention of use at the extreme west end. The plan of improvement is shown on Plate 21.

43. Canal Beach. - Canal Beach is publicly-owned and is located at the eastern end of the Westport shore. This beach extends about 500 feet southwest from Sasco Brook inlet, and its existence is due to accretion of a medium sand beach caused by an eastward littoral drift. The beach is immediately bordered on the land side by a State highway, but there is no development of the immediate area and the location is such as not to draw attendance from the center of population in Westport. There are no facilities for beach use and there is no evident desire to develop this beach at this time. Therefore, the major benefit of this beach is the protection it affords the State highway. The present beach is and should remain adequate for this limited purpose.

44. Greens Farms. - The problem involved is the protection of about 7800 feet of shore between Canal Beach and Burial Hill. The area is now developed as extensive private estates. It is exposed to all southerly storms and has been subject to erosion, necessitating the construction of a continuous line of sea-walls. Due to the character of the development as

private estates, there is no particular need for extensive beaches. At places along the front of the walls small beaches exist, usually created and held by the numerous groins which have been built for this purpose. From these groins it is evident that the littoral drift is westward except at the easterly quarter mile of shore, where it is eastward. The existing sea-walls should offer adequate protection if maintained. Erosion has occurred in front of some sections to such an extent that the footings of the walls are now exposed and appear to be in danger of undermining. For this reason consideration has been given to a plan of protection consisting of (1) artificial placement of sand in front of walls to create a beach 100 feet wide at high water, and (2) the construction of a system of groins to hold this sand and catch littoral drift. This plan is shown on Plate 21. The plan could be adapted to the protection of critical sections of shore needing immediate additional protection as desired. For such an adaptation it would be necessary to construct groins at the limits of the development to insure against erosion.

45. Burial Hill. - The problem involved is the widening and improvement of a public beach owned by the Town of Westport, located east of and adjoining a creek marking the east limit of Sherwood Island State Park. This shore is 500 feet long, situated in front of a small hill on which public facilities are located. These facilities are sanitary, parking and bathhouses. Lifeguards are employed for the protection of bathers. In general, the area is low-lying land and marshes. There is no extensive population development in the immediate vicinity. The beach is about 50 feet wide at high water and is composed of sand above and shingle below high water. Littoral drift is westward but groins constructed here have not entrapped any sizable amount of material. The plan of improvement considered most practicable is shown on Plate 21, and consists of widening the beach to a 100-foot width at high

water by the artificial placement of sand. This improvement is dependent on the construction of a training wall at the west limit of the sand fill as provided in the plan of improvement considered for Sherwood Island State Park.

46. Sherwood Island State Park. - The problem involved is the development of a large beach at a State park. This development includes widening the available shore bathing area, improvement of the composition of the beach material and the stabilization in so far as possible of the shore so improved. The area in question is located at Sherwood Island State Park and extends 6000 feet from Burial Hill westward along Alvord Beach to Sherwood Point and thence further westward to and along Elwood Beach to a point about 1600 feet east of Sherwood Pond. The park at present provides limited facilities to the public as follows: bathhouses, parking areas, sanitaries, life-guards, fireplaces and tables. The State proposes to make extensive improvements at the park to consist of a pavilion, large bathhouses, self-service bathhouses, large parking areas, roads connecting to the main highway, a pleasure boating development, and a fishing pier. The scope of these improvements is such as to require a bathing area to accommodate thousands of people. The shore area at present is in general low-lying land and marshes. East of Sherwood Point it consists of a narrow barrier beach of mixed sand and cobbles lying in front of a low dune. Within the tidal range the beach is entirely shingle and cobbles, but below low water the bottom is fine sand. There are no shore structures along this section and no strong indication of drift. Sherwood Point itself is characterized by numerous large boulders on and offshore. West of Sherwood Point for a distance of about 1600 feet the beach consists of very coarse material ranging from shingle to cobbles. A series of short groins indicates a strong drift to the northwest. This area merges into Elwood Beach which is about 1000 feet long and consists of medium sand. The

plan of improvement considered most satisfactory is (1) the artificial placement of sand along the entire shore of the park to create a beach 150 feet wide at mean high water, widened to 250 feet at Sherwood Point, and (2) the construction of an impermeable groin at the west limit of the park, and (3) the construction of two training walls to stabilize the creek at the east end of the park. The widening at Sherwood Point is considered desirable to act as a stockpile to feed the beach area east and west of it. The groin and training walls would catch and hold littoral drift material. Intermediate structures have not been included since it was felt that they would interfere with the natural movement and feeding of sand from the point. In this respect, the proposed fishing pier should be an open pile structure. The plan of improvement is shown on Plate 22.

47. Compo Mill Beach Association. - Compo Mill Beach Association extends some 2000 feet from Sherwood Island State Park to Sherwood Pond. The shore is sparsely settled at the east end. There are no roads to this area, and access is gained over the dam at Sherwood Pond. The beach throughout is narrow and ranges from coarse material at the east end to a medium sand at the west end. A concrete sea-wall 1000 feet long extends in front of the residential development. This wall is low, projecting less than a foot above the beach to a top elevation of 11 feet above mean low water. Along the western 150 feet of this wall, short groins at each wall section buttress the wall and serve to hold a narrow beach. The littoral drift in this area is westward. Shore line changes, although not pronounced, bear out this direction of drift. The problem involved in this area is the narrow width of beach. The coarse nature of the eastern part of the beach is also undesirable. The plan of improvement considered most feasible for this area is (1) the widening of the beach to a width of 100 feet at mean high water by artificial placement of sand, and (2) construction of a groin at the west end of the sea-

wall to prevent loss of beach material by littoral drift. The sand spit projecting west from this limit of the wall is not an area that should be developed, and will probably erode slowly after the source of supply of beach material is cut off by the groin proposed above. Slight recession, or at the minimum, cessation of further westward growth of this sand spit should improve conditions at the inlet to Sherwood Pond. The inlet channel, now forced to the west along the opposite shore, should gradually straighten out and thereby lessen the erosion of that shore. The plan of improvement is shown on Plate 22.

48. Old Mill Beach. - Old Mill is a public beach owned by the Town of Westport. There are no public facilities at this beach except parking area. Use of the beach is therefore restricted to residents of Westport. This beach extends about 600 feet west of the inlet to Sherwood Pond, but only about 400 feet of this frontage is accessible for bathing. The beach is now about 100 feet wide at high water. Above high water the beach is composed of fine sand, but below high water it is mostly shingle and fine sandflats extending about 1000 feet offshore. The area is generally sheltered due to its location but suffers some erosion near its west end from inlet currents sweeping along the shore. The jetty just west of the inlet prevents erosion of the beach immediately adjacent. No improvement is considered necessary for this beach under present conditions of use. The limitied extent and facilities make impracticable any plan for widening the beach.

49. Old Mill Beach to Hills Point. - This portion of the shore is about 2400 feet long, of which the westerly 700 feet is owned by the State of Connecticut. A State highway closely borders this entire shore, and is protected by riprap along the westerly 700 feet of the area. A sea-wall extends along the remainder of the shore. The beach above high water is

narrow, and consists of fine sand in the eastern part of the area and riprap in the western part. Below high water the beach consists of fine sand in the eastern part and shingle in the west part. The problem in this area under present conditions of development and use is one of maintenance and repair of existing protective works. Consideration of construction of a beach for this restricted protective purpose does not appear warranted. If future development creates a demand for a recreational beach area, a dual purpose protective beach 100 feet wide could then be constructed by artificial placement of sand and construction of a groin 400 feet long at the rather prominent point of land located a bit more than halfway up the shore from Hills Point. This alternate plan is shown on Plate 22.

50. Compo Beach. - Compo Beach is a municipal park open to the public with preferential rates for town residents. Full public facilities are available at the park. The shore line of this park extends about 3050 feet in a southwesterly direction from Hills Point to Cedar Point, and then about 1550 feet in a northwesterly direction from Cedar Point to the entrance to the Compo Yacht Basin. The presently developed bathing area is located east of Cedar Point.

The presently developed beach is 50 feet wide at high water at its east end, widening to about 100 feet at the west end, and is about 150 feet wide at low water. The beach in general above high water consists of a medium sand, with some scattered deposits of gravel or shingle. Below high water there is considerable shingle, especially near the western end of the beach. A thin layer of 3000 cubic yards of a sharp granular Long Island sand was spread over this beach above high water in 1948; a partial accomplishment of the recommendation in the Beach Erosion Board Report of 1935 that 16,000 cubic yards of sand be so placed. The beach has a top

elevation of 13 feet and then slopes steeply to the low water elevation. At the east end of the beach a riprap groin constructed in 1948 extends about 100 feet out from high water. This groin is an initial step in conformance with an 1100-foot breakwater recommended for this location by the Beach Erosion Board in 1935. The groin as built is too short to produce any appreciable effects. The southwesterly 400 feet of the shore consists of the Cedar Point breakwater, built by the Federal government in 1837. This breakwater, about 460 feet long and with a top elevation of 10 feet, has settled or washed down at its outer end, but has served to hold Cedar Point. Some sand passes over the top, but with the development of the west shore beach area this is no longer an important factor. There is no strong indication of net littoral drift in either direction, the drift probably varying with the southeast and northeast storms. The shore line itself appears to be fairly stable. The problem on the developed beach is the unsatisfactory nature of beach material. The plan of improvement considered most feasible for this area is similar to that recommended by the Beach Erosion Board in 1935, but has been broadened in scope from that considered in the prior report. The plan now considered envisions the placement of 75,000 cubic yards of sand to build the beach out to a 100-foot width, with flatter foreshore slopes, and the construction of an impermeable groin 500 feet long at Hills Point.

The new west beach is the result of building out this shore 100 to 400 feet in 1948 by hydraulic placement of fill dredged from the Campo Yacht Basin. The material so placed is on a flat slope but is unsatisfactory for bathing purposes, being very fine and silty in composition. A riprap groin about 70 feet long, also built in 1948, near the north end of this new beach area has been unsuccessful in stopping erosion.

Measures were underway at the time of writing of this report to prevent the erosion occurring near the north end of this beach by extending the groin inshore and bulkheading the shore. The plan of improvement considered most practicable for this area comprises the placement of a more suitable sand on the beach built in 1948, and the prevention of loss of beach material from northward littoral drifting by construction of a 500-foot groin, well anchored into the backshore, at the site of the existing groin. The plan of improvement is shown on Plate 22.

VI. ECONOMIC ANALYSIS

GENERAL

51. Statutory Authorization. - Public Law 727, 79th Congress, approved August 13, 1946, established a policy of Federal participation in the cost of protecting the shores of public-owned property. It provides in part that:

> "With the purpose of preventing damage to public property and promoting and encouraging the healthful recreation of the people, it is hereby declared to be the policy of the United States to assist in construction, but not the maintenance, of works for the improvement and protection against erosion by waves and currents of the shores of the United States that are owned by States, municipalities, or other political subdivisions: Provided, That the Federal contribution toward the construction of protective works shall not in any case exceed one-third of the total cost."

As Federal contribution toward construction of shore protective works is limited to publicly-owned shores, economic analyses sufficiently detailed to serve as a basis for fund appropriations have been restricted to such shores. No privately-owned shores need be or have been considered in connection therewith. The public shore areas for which improvements are recommended are as follows:

	Improvements Recommended For Federal Projects	
Area	Par. Ref.	Plate
Jennings Beach and Ash Creek	35	20
Sasco Hill Beach	40	21
Southport Beach	42	21
Burial Hill Beach	45	21
Sherwood Island State Park	46	22
Compo Beach	50	22

Other publicly-owned shores in Area 1 not included in the above classifications are as follows:

a. Pine Creek Beach, an undeveloped public beach 50 feet long, considered too small to warrant consideration for a Federal project.

b. Canal Beach, an undeveloped public beach, considered to be impracticable for improvement at this time.

c. Old Mill Beach, an undeveloped public beach considered to be satisfactory for the present limited use, and for which no improvements have been considered.

In view of the fact that the cooperative study of which this report is one part has determined that the major problem involved is one of general deterioration and loss of beaches along the entire shore, and that the improvement considered most efficacious therefor is general restoration of the shore on a widespread scale by hydraulic pumping of sand from offshore depths, a general analysis of the costs and benefits of such a program has been made to determine the practicability of large scale improvements of this type. This general analysis is given in detail in Appendices I and J.

COSTS

52. First Costs. - The first costs of the projects considered for Federal participation, computed in detail in Appendix G, are as follows:

Project	Quantity	Cost
Jennings Beach and Ash Creek		$ 66,000
Jetties	5,100 tons riprap	
Dredging	6,500 cubic yards	
Sasco Hill Beach		$ 42,000
Sand fill	25,000 cubic yards	
Groin	1,950 tons riprap	
Southport Beach		$ 30,000
Sand fill	17,500 cubic yards	
Groin	1,200 tons riprap	
Burial Hill Beach		$ 16,500
Sand fill	17,500 cubic yards	

Project	Quantity	Cost
Sherwood Island State Park		$ 342,000
Sand fill	460,000 cubic yards	
Training Walls	18,700 square feet steel sheet piling	
Groin	2,750 tons riprap	
Compo Beach		114,000
East of Cedar Point		69,000
Sand fill	76,000 cubic yards	
Groin	2,300 tons riprap	
West of Cedar Point		45,000
Sand fill	20,600 cubic yards	
Groin	2,900 tons riprap	
Total for all Federal Projects		$ 610,500

BENEFITS

53. Theory. - The benefits anticipated from the plans of improvement for the various shore areas are estimated solely on the recreational value of increased public beach area. Indirect benefits or benefits not susceptible of direct evaluation have not been used. Such indirect and unevaluated benefits include increased earning power of land and property not directly affected due to increased attendance at the beach areas, and the prevention of the loss of human life, by removal of bathing hazards. No benefits have been assumed for protection of property against direct damage, although such secondary benefits are unquestionably existent.

54. Basis of Benefit Evaluations. - The basis of benefit evaluations used is a careful estimate of the value of recreational use of the shore to those attending the beaches. This estimate includes actual expenditures now made by those using the beaches, and excludes additional values received. Beach attendance at public beaches existent in Area 1 is at substandard levels of space requirements for such attendance. The recommended improvements will raise these standards more nearly to the optimum recreational

beach area standard. The major benefits for town public beaches are from this raising of the beach space standards, and secondary benefits are from an expected ten percent increase in attendance. The major benefits to Sherwood Island State Park, on the other hand, are from expected increased attendance, and secondary benefits are from raising the beach space standards.

55. Allocation of Costs. - The benefits from proposed improvements are divided into Federal interest, non-Federal public interest and private interest. Federal interest is defined as the benefit secured by the United States as a land owner. The United States is not a land owner in the areas considered, so there is no Federal interest. Non-Federal public interest is defined as (a) the benefits accruing to a State or political subdivision thereof, as a land owner, and (b) the benefits accruing to the general public. Private interest is defined as the benefits derived by individuals or non-public groups of individuals on account of the ownership of lands and business enterprises affected. No private ownership is involved in the areas concerned, and no indirect benefits have been evaluated on any marginal private lands. Therefore, there is no private interest involved. The entire interest in these projects is non-Federal public interest. The Federal share of the costs of these projects is therefore set at the allowable maximum of one-third of the cost of the improvements, excluding costs of lands, easements, or rights-of-way, which must be furnished by local interests. Maintenance costs are allocated to local interests in accordance with the policy set forth in Public Law 727, 79th Congress.

56. Benefits. - Benefits used herein are due solely to additional recreational area. These benefits computed in detail in Appendix H, may be summarized as follows:

Jennings Beach and Ash Creek	$ 5,165
Sasco Hill Beach	$ 4,135
Southport Beach	$ 3,790
Burial Hill Beach	$ 1,380
Sherwood Island State Park	$250,000
Compo Beach	
a. East of Cedar Point	$ 8,955
b. West of Cedar Point	$ 7,575
c. Total for Compo Beach	$ 16,530

Assessed values of land directly affected by the improvement are tabulated below:

Jennings Beach and Ash Creek	$ 70,200
Sasco Hill Beach	$ 35,000(1)
Southport Beach	$ 22,950
Burial Hill Beach	$ 12,200
Sherwood Island State Park	$490,000
Compo Beach	
a. East of Cedar Point	$237,000
b. West of Cedar Point	$ 13,000
c. Total for Compo Beach	$250,000

(1) Limited to the 900 feet of shore for which improvement considered.

Present sale values are about 1.8 times the assessed values for Fairfield and Westport. There is no tax income from these public lands. Total grand lists in Fairfield and Westport are $66,000,000, and $48,000,000. The tax rates are $28.80 and $21.00 per thousand

ANNUAL CHARGES

57. Estimates of Annual Charges. - The Federal and non-Federal annual charges are summarized herein. Federal investment is computed as one-third of the first cost of each improvement (See Paragraph 55). Interest has been computed at the rate of 3 percent on Federal funds and 3.5 percent on non-Federal funds. A useful life of 50 years has been assumed in computing

amortization charges. An item for maintenance costs is included in the non-Federal annual charges. Detailed computations are included in Appendix G.

Project	Federal	Non-Federal	Total
Jennings Beach and Ash Creek	$ 850	$ 2,380	$ 3,230
Sasco Hill Beach	545	1,895	2,440
Southport Beach	400	1,235	1,635
Burial Hill Beach	215	735	950
Sherwood Island State Park	4,410	15,050	19,460
Compo Beach			
a. East of Cedar Point	900	3,350	4,250
b. West of Cedar Point	580	1,830	2,410
c. Total for Compo Beach	1,480	5,180	6,660

JUSTIFICATION OF IMPROVEMENTS

58. Ratio of Benefits to Costs. - The estimated annual benefits and charges for the several improvements are summarized and compared in the following table, and the ratios of benefits to costs are given below:

Project	Estimated Annual Benefits	Estimated Annual Costs	Ratio of Benefits to Costs
Jennings Beach and Ash Creek	$ 5,165	$ 3,230	1.6
Sasco Hill Beach	4,135	2,440	1.7
Southport Beach	3,790	1,635	2.3
Burial Hill Beach	1,380	950	1.5
Sherwood Island State Park	250,000	19,460	12.8
Compo Beach			
a. East of Cedar Point	8,955	4,250	2.1
b. West of Cedar Point	7,575	2,410	3.1
c. Total for Compo Beach	16,530	6,660	2.5

COORDINATION WITH OTHER AGENCIES

59. General Coordination. - Close coordination has been maintained with the Connecticut State Flood Control and Water Policy Commission, the official agency representing the State of Connecticut in this cooperative study. The Connecticut Beach Erosion Advisory Committee appointed by the Governor to report to the State Legislature has in like manner been advised and consulted. The Selectmen of the towns concerned have been contacted and their views sought. The Connecticut Development Commission, State Park Department, State Highway Department and State Board of Fisheries and Game have been contacted as to aspects of the study pertaining to their interests. In addition, widespread personal contact has been made with the shore residents to ascertain data concerning the problem.

60. Comments by Local Interests. - Preliminary sketch plans of improvements being considered have been furnished to the Connecticut State Flood Control and Water Policy Commission and to the Connecticut Beach Erosion Advisory Commission. Discussion with these agencies as to the final findings and recommendations of the study have met with their general approval and concurrence.

61. Responsibilities of Local Interests. - The State of Connecticut through the Connecticut State Flood Control and Water Policy Commission has furnished assurances that any requirements of local cooperation which may be imposed by Congress in authorizing any such project will be met. It is understood that Congress may require local interests to:

a. Adopt the projects recommended in the reports.

b. Assure maintenance of the improvements during their useful life as may be required to serve their intended purpose.

c. Provide, at their own expense, all necessary lands, easements, and rights-of-way.

d. Hold and save the United States free from all claims for damages that may arise either before, during or after prosecution of the work.

e. Assure continued public ownership of the beach and its administration for public use only.

f. Assure that water pollution that would endanger the health of bathers will not be permitted.

g. Agree to approval by the Chief of Engineers, prior to commencement of work, of detailed plans, specifications, arrangements for prosecuting the work, adequacy of the proposed work, and the assurances as listed above.

VII. DISCUSSION

62. General. - Discussion of the proposed plans of protection and improvement is limited to those areas for which adoption of a Federal project has been considered. The discussions for the specific proposed projects are included in the following paragraphs.

63. Jennings Beach and Ash Creek. - The plan of improvement considered most suitable for Jennings Beach and Ash Creek consists of the construction of a jetty at the inlet to Ash Creek. The proposed jetty from the Jennings Beach shore is 800 feet long. The dredging of 6,500 cubic yards of material from the offshore bar may be required to provide an inlet channel and jetty foundation. It is considered that this plan of improvement will make available additional bathing area by (1) eliminating the existing bathing hazard due to swift inlet currents scouring Jennings Beach, (2) stabilize the inlet against future migration, and (3) stabilize the shore line by deflecting littoral and inlet currents offshore. The estima ted ratio of benefits to costs of 1.6 to 1, although favorable, does not reflect the true value of this improvement. The major benefit will be the elimination of the present bathing hazard. Regardless of warning signs and precautions now being taken, the danger of loss of life will continue unless this condition is corrected.

64. Sasco Hill Beach. - The plan of improvement considered most suitable for Sasco Hill Beach consists of widening to a 100-foot width 900 feet of the beach by direct placement of sand, and construction of one impermeable groin 400 feet long at the west end of this improved area to prevent loss of the beach by westward littoral drift. Comparison of estimated benefits and costs indicates a favorable ratio of 1.7 to 1.

65. Southport Beach. - The plan of improvement considered most suitable for Southport Beach consists of widening the beach to a 100-foot width by direct placement of sand and construction of one impermeable groin 400 feet long at the west end of this improved area to hold the sand and protect wild life feeding grounds at Sasco Brook inlet. Comparison of estimated benefits and costs indicate a favorable ratio of 2.3 to 1.

66. Burial Hill Beach. - The plan of improvement considered most suitable for Burial Hill Beach consists of widening the beach to a 100-foot width by direct placement of sand, contingent upon the construction of an impermeable training wall at the west limit of the beach to prevent loss of the beach by westward littoral drift, and to maintain the Burial Hill Creek inlet opening. The construction of this training wall has been included in the recommendations for Sherwood Island Park in view of the proposed development of that park, including use of Burial Hill Creek for recreational boating. The ratio of benefits to costs for Burial Hill Beach, exclusive of costs of co nstruction of the training wall is favorable at 1.5 to 1. If for any reason the Sherwood Island Park development does not materialize, the Burial Hill improvement would necessarily include the costs of the training wall and the ratio of benefit to costs would become unfavorable.

67. Sherwood Island State Park. - The plan of improvement considered most suitable for Sherwood Island Park consists of widening the beach area, by direct placement of sand, to a 150-foot width; creation of a stockpile by direct placement of sand on the beach foreshore to an additional width of 100 feet for a distance of 1000 feet east and 1000 feet west of Sherwood Point; construction of one impermeable groin 500 feet long at the west limit of the park to hold sand and catch the littoral drift; and the construction of two training walls 400 and 500 feet long at Burial Hill Creek to stabilize

the shore and inlet. Comparison of estimated benefits and costs indicates a favorable ratio of 12.8 to 1.

68. Compo Beach. - The plan of improvement for Compo Beach consists of improving the town beaches to the east and west of Cedar Point by widening them to a 100-foot width by the direct placement of sand; the construction of an impermeable groin 500 feet long at Hills Point at the east limit to protect the east beach area, to stop westerly littoral drift and to trap easterly littoral drift; and the construction of an impermeable groin 500 feet long at the west limit of the west beach area to hold the sand and trap westerly littoral drift. This improvement may be accomplished as one project or as two separate projects. A comparison of estimated benefits to costs indicates a favorable ratio of 2.5 to 1 if both areas are improved simultaneously. If the projects are separated, a comparison of estimated benefits and costs for the eastern section indicates a favorable ratio of 2.1 to 1, whereas a comparison of estimated benefits to costs in the western section indicates a favorable ratio of 3.1 to 1. The improvement may be accomplished either as a whole or either part with favorable results.

VIII. CONCLUSIONS

69. General. - The purpose of this study was to determine the most suitable methods of stabilizing and improving the shore line between Ash Creek and Saugatuck River. One of the items of the study was to determine the source of littoral material within the area. Another item of the study was to determine which sections of the shore line are desirable locations for beach improvements, and the most effective measures for accomplishing the desired improvements. The study reveals that the entire area constitutes a resort development, that no source of littoral material exists within the area itself, and therefore no proposed improvements can be based on use of such littoral material which presupposes continuance of deterioration of other points within this shore area. The inevitable conclusion is that improvement of the shore requires artificial replenishment of the sand beaches from outside the area itself. The logical source of this sand is the offshore depths where the sand from the shores now rests. Feasibility of pumping this sand back on the shore has been proved by projects of that nature in Westport, Bridgeport, West Haven and New London. The existence of oyster beds along this offshore area complicates the problem. However, it is considered that offshore sand areas can be used which will cause no damage or minor damage to that industry (See Appendix G). The study further reveals that major extents of the entire shore constitute desirable locations for beach improvements, and that areas not now so considered may become so with future development. It is not considered advisable for the United States at this time to adopt projects authorizing Federal participation in the cost of improvement of shores except at public beach areas as described in Paragraphs 71 and 73.

70. Pine Creek Sand Spit. - The study reveals that Pine Creek Sand Spit is a problem area largely as a result of lack of knowledge, foresight,

and control at the time of development of this spit. An inevitable pertinent conclusion is that, with the present knowledge of shore processes, planning and control seem warranted to prevent further occurrence of such problems. Despite the development now existent, the logical conclusion would be to abandon that part of the spit west of Pine Creek Point, and allow nature to take its course. A plan of improvement premised on the acceptance of the accomplished development on the spit, comprising construction of a foreshore beach and barrier dune, strongly held by a groin system cannot be recommended in view of the continued hazardous nature of the area.

71. Public Beach Areas. - The study reveals that beach areas available to the public are insufficient for the demand, and that the beaches so used are of relatively coarse material, in certain cases consisting entirely of cobbles. The conclusion naturally follows that increased public beach area is justified to relieve the existing congestion and to encourage and allow additional use of this recreational area now and in the future, and that improvement of beaches of unsatisfactory material by replacing the sand lost from their surface is in like manner justified. The study further reveals that at present certain small public beach areas, either relatively inaccessible or now satisfactory for the present use, justify no improvement at this time. With the exception of these beaches, all the public beaches are considered to justify improvement. The interest involved in all the beaches for which Federal projects have been considered is 100 percent public interest. Therefore, the share of expense to be borne by the United States is considered to be justified at the maximum limit of one-third of the costs of the improvements, exclusive of costs of lands, easements or rights-of-way. The Burial Hill Beach project is considered to be justified only in the event that planned development of Sherwood Island

State Park materializes and includes construction of the recommended training wall on the east shore of Burial Hill Creek. It is considered advisable that the United States adopt projects for all the public beaches in Area 1, with the exceptions described above, all as described in Paragraph 73.

It is finally concluded that no cases of pollution exist to prohibit any of the improvements considered for Federal projects, although certain areas can be bettered in that respect.

IX. RECOMMENDATIONS

72. General. - It is recommended that the most suitable methods of stabilizing and improving the shore line between Ash Creek and Saugatuck River consist of general restoration of the shore by hydraulic pumping of sand from offshore depths, and that retention of the sand so placed be effected in so far as possible by construction of impermeable groins, all in accordance with specific plans of improvement discussed in Paragraphs 35-50, and as shown on Plates 19-22 herewith. It is further recommended that future development and use of the shore be planned and controlled on the basis of the fullest knowledge of shore processes and probable changes, and probable costs and benefits to be incurred thereby.

73. Public Beaches. - The following public beaches are recommended for adoption of separate projects by the United States authorizing Federal participation by the contribution of Federal funds in an amount equal to one-third of the costs of the proposed improvements, generally as shown on Plates 20-22, the projects to be accomplished in their entirety or such integral part thereof as may be approved by the Chief of Engineers upon application therefore by local interests:

a. Jennings Beach and Ash Creek, construction of an impermeable jetty 800 feet long, and if experience indicates the necessity, dredging of an inlet channel and jetty foundation through the outer bar.

b. Sasco Hill Beach, widening to a 100-foot width, 900 feet of beach by direct placement of sand, and construction of one impermeable groin 400 feet long at the west end of the improvement.

c. Southport Beach, widening to a 100-foot width, 700 feet of beach by direct placement of sand, and construction of one impermeable groin 400 feet long at the west end of the improvement.

d. Burial Hill Beach, contingent upon the construction by others of a 400-foot training wall on the east bank of Burial Hill Creek, widening to a 100-foot width 500 feet of beach by direct placement of sand.

e. Sherwood Island State Park, widening to a 150-foot width 6,000 feet of beach, by direct placement of sand, the creation of a stockpile by direct placement of sand for an additional width of 100 feet for a distance of 1000 feet east and 1000 feet west of Sherwood Point, the construction of two training walls 400 and 500 feet long at Burial Hill Creek, and the construction of an impermeable groin 500 feet long at the west end of the improvement.

f. Compo Beach, widening to a 100-foot width the beaches east and west of Cedar Point, 2600 and 1100 feet long respectively, by direct placement of sand, construction of an impermeable groin 500 feet long at Hills Point, and construction of an impermeable groin 500 feet long at the west end of the improvement.

The recommendations are subject to the conditions that local interests will:

(1) Adopt the projects named herein;

(2) Assure maintenance of the improvement for their useful life as may be required to serve their intended purpose;

(3) Provide, at their own expense, all necessary lands, easements, and rights-of-way;

(4) Hold and save the United States free from all claims for damages that may arise either before, during, or after prosecution of the work;

(5) Assure that water pollution that would endanger the health of bathers will not be permitted;

(6) Assure continued public ownership of the beach and its administration for public use only.

The recommendations are further subject to the conditions that the adequacy of the work proposed by local authorities, detailed plans, specifications, assurances that the requirements of local cooperation will be met and arrangements for prosecuting the work be approved by the Chief of Engineers prior to commencement of work.

The estimated amounts of Federal participation, in accordance with the foregoing recommendations, are as follows:

Jennings Beach and Ash Creek	$ 22,000
Sasco Hill Beach	14,000
Southport Beach	10,000
Burial Hill Beach	5,500
Sherwood Island State Park	114,000
Compo Beach	38,000
TOTAL	$203,500

JAMES H. STRATTON
Colonel, Corps of Engineers
Division Engineer

42 Inclosures:
11 Appendices
31 Plates

BEACH EROSION CONTROL REPORT ON COOPERATIVE STUDY OF CONNECTICUT

AREA 1

Ash Creek to Saugatuck River

Appendices A - K

TABLE OF CONTENTS

APPENDIX A

DESCRIPTION AND COMPOSITION OF BEACHES

1. General. - Detailed descriptive data of the entire shore line of Area 1 was obtained by field inspections. The shore line was then divided consecutively from Ash Creek to Saugatuck River generally in accordance with the physical character of the shore features. Descriptions of these subdivisions are presented below. In addition to visual inspection, samples of beach material were obtained at selected locations throughout the area and a mechanical analysis of these samples was made to determine median diameter and classification. Beach sample analysis results and locations are shown on Plates 15-17. A complete photograhic record was made of the shore. Selected photographs are shown on Plates 23-31.

FAIRFIELD

A. Jennings Beach

(1) Location: Ash Creek to Beach Road.

(2) Extent: 1900 feet.

(3) Width - above H.W.: 100-200 feet, plus 150 feet of low dunes, plus parking area east end of beach 500 feet.

- L.W. to H.W.: 200 feet.

(4) Ownership: Town of Fairfield.

(5) Use: Public (restricted in part to town residents).

(6) Public Facilities: Parking, bathhouse, sanitary, refreshments, fireplaces, lifeguard, planned development of playground.

(7) Composition: Above H.W.: Coarse sand.

Below H.W.: Medium sand.

B. Fairfield Beach (East Part)

(1) Location: Jennings Beach to 2000 feet North of Shoal Point.

(2) Extent: 2000 feet.

(3) Width - above H.W.: 25 to 75 feet plus dunes where not destroyed.

- L.W. to H.W.: 100 feet.

(4) Ownership: Private

(5) Use: Public at varying degrees - clubs, commercial baths, etc.

(6) Public Facilities: Parking, clubhouses, bathhouses, refreshments, sanitary.

(7) Composition: Above H.W.: Coarse sand.

Below H.W.: Medium sand.

C. Fairfield Beach (West Part)

(1) Location: 2000 feet North of Shoal Point to Pine Creek Inlet.

(2) Extent: 11,400 feet.

(3) Width - above H.W.: 0 to 70 feet, except at Shoal Point 150 feet.

- L.W.to H.W.: 200 to 600 feet, except west of Pine Creek Point, 100 feet.

(4) Ownership: Private

(5) Use: Private - cottages

(6) Public Facilities: None

(7) Composition: Above H.W.: Medium sand north of Shoal Point, coarse sand to gravel west of Shoal Point.

Below H.W.: Medium to fine sand (Some boulders and gravel at Shoal Point.)

D. Pine Creek Beach Area

(1) Location: Pine Creek Inlet to Kensie Point.

(2) Extent: 700 feet.

(3) Width - above H.W.: 25 to 50 feet.

- L.W.to H.W.: 150 to 700 feet.

(4) Ownership: Private except for 50-foot street end.

(5) Use: Major part of shore, only minor use by private owners.
50-foot street end, intensive use by public (restricted to town residents.)

(6) Public Facilities: None

(7) Composition: Above H.W.: Shingle at west end to coarse sand at east end.

Below H.W.: Fine sand.

E. Kensie Point

(1) Location: Pine Creek Beach Area to Sasco Hill Beach (Kensie Beach).

(2) Extent: 2000 feet.

(3) Width - above H.W.: 0 to 40 feet.

- L.W. to H.W.: 150 to 500 feet.

(4) Ownership: Private

(5) Use: Private estates.

(6) Public Facilities: None

(7) Composition: Above H.W.: Seawall

Below H.W.: Boulders, cobbles and gravel.

F. Sasco Hill Beach (Kensie Beach) (East Part)

(1) Location: Kensie Point to Southport Golf Club.

(2) Extent: 2000 feet.

(3) Width - above H.W.: 25 feet to low dune.

- L.W.to H.W.: 300 to 500 feet.

(4) Ownership: Town of Fairfield[(a)].

(5) Use: Public (restricted to town residents).

(6) Public Facilities: Parking, bathhouse, fireplaces, life-guard.

(7) Composition: Above H.W.: Shingle at east end grading to coarse sand at west end.

Below H.W.: Shingle at east end grading to medium sand at west end.

(a) Eastern 650 feet leased in 1917 for 200 years to Town of Fairfield, in return for similar lease of 650 feet at Southport Golf Club. For purposes of this report, the long term leases are considered as ownership.

G. Sasco Hill Beach (Kensie Beach) (West Part)

(1) Location: Southport Golf Club (East shore Southport Harbor).

(2) Extent: 650 feet

(3) Width - above H.W.: 100 feet.

- L.W.to H.W.: 500 feet.

(4) Ownership: Private (a).

(5) Use: Public on club membership basis.

(6) Public Facilities: Parking, club facilities, life-guard.

(7) Composition: Above H.W.: Coarse sand.

Below H.W.: Medium sand.

(a) See note under F above.

H. Southport Shore

(1) Location: Southport Harbor to Southport Beach.

(2) Extent: 2400 feet.

(3) Width - above H.W.: 0 to 25 feet.

- L.W.to H.W.: 150 feet on east end, widening to 1,000 feet on west end.

(4) Ownership: Private

(5) Use: Private Estates

(6) Public Facilities: None

(7) Composition: Above H.W.: Ledge, marsh, cobbles, seawalls.

Below H.W.: Ledge, marsh, cobbles grading westward to fine sand, and mud.

I. Southport Beach

(1) Location: Just east of Sasco Brook.

(2) Extent: 900 feet.

(3) Width - above H.W.: 0 to 100 feet.

- L.W. to H.W.: 1,000 feet.

(4) Ownership: Town of Fairfield.

(5) Use: Public (restricted to town residents).

(6) Public Facilities: Parking, bathhouses, sanitary, refreshments, life-guard, fire-places.

(7) Composition: Above H.W.: Riprap along eastern part to coarse sand along western part.

Below H.W.: Shingle, mud, marsh.

WESTPORT

J. Canal Beach

(1) Location: Just west of Sasco Brook.

(2) Extent: 500 feet.

(3) Width - above H.W.: 20-75 feet.

- L.W. to H.W.: 100 feet.

(4) Ownership: Town of Westport.

(5) Use: Not used to any great extent.

(6) Public Facilities: None

(7) Composition: Above H.W.: Shingle and coarse sand.

Below H.W.: Gravel, marsh.

K. Greens Farms

(1) Location: Canal Beach to Burial Hill.

(2) Extent: 7800 feet.

(3) Width - above H.W.: 0 - 100 feet.

- L.W. to H.W.: 150-250, east of Frost Point
200-300, west of Frost Point.

(4) Ownership: Private

(5) Use: Private estates.

(6) Public Facilities: None

(7) Composition: Above H.W.: Eastern 1800 feet; coarse sand, boulders. West to Frost Point; medium sand. West of Frost Point; medium sand, seawalls.

Below H.W.: Eastern 1800 feet; shingle, marsh. West to Frost Point, shingle grading westward to medium sand. West of Frost Point; ledge, shingle and marsh grading westward to fine sand then to shingle again at Burial Hill.

L. Burial Hill

(1) Location: Just east of Creek at east end of Sherwood Island.

(2) Extent: 500 feet.

(3) Width - above H.W.: 50 to 100 feet.

- L.W. to H.W.: 200 to 400 feet.

(4) Ownership: Town of Westport.

(5) Use: Public (restricted to town residents).

(6) Public Facilities: Parking, bathhouse, sanitary, life-guard.

(7) Composition: Above H.W.: Medium sand, seawalls.

Below H.W.: Gravel to shingle.

M. Alvord Beach

(1) Location: Sherwood Island Park east of Sherwood Point.

(2) Extent: 3500 feet.

(3) Width - above H.W.: 50 to 75 feet.

- L.W.to H.W.: 200 feet at east end
50 feet at mid point
250 feet at Sherwood Point.

(4) Ownership: State of Connecticut.

(5) Use: Public

(6) Public Facilities: Bathhouses, parking, sanitary, life-guards, fireplaces and tables.

(7) Composition: Above H.W.: Coarse sand and gravel.

Below H.W.: Cobbles to shingle, some boulders, fine sand off-shore.

N. Sherwood Point to Elwood Beach

(1) Location: Sherwood Island Park west of Sherwood Point.

(2) Extent: 1500 feet.

(3) Width - above H.W.: 0 - 50 feet.

- L.W.to H.W.: 50 - 200 feet.

(4) Ownership: State of Connecticut.

(5) Use: Public

(6) Public Facilities: Bathhouses, parking, sanitary, life-guards, fireplaces and tables.

(7) Composition: Above H.W.: Boulders, cobbles.

Below H.W.: Shingle, marsh.

O. Elwood Beach

(1) Location: Sherwood Island Park, 1500 to 2500 feet west of Sherwood Point.

(2) Extent: 1000 feet.

(3) Width - above H.W.: 50 - 75 feet.

- L.W.to H.W.: 100 - 300 feet.

(4) Ownership: State of Connecticut.

(5) Use: Public

(6) Public Facilities: Bathhouses, parking, sanitary, life-guards, fire-places and tables.

(7) Composition: Above H.W.: Fine sand.

Below H.W.: Shingle to fine sand.

P. Compo Mill Beach Association

(1) Location: Elwood Beach to Sherwood Pond.

(2) Extent: 2000 feet.

(3) Width - Above H.W.: 0 - 50 feet.

L.W.to H.W.: 150 feet at east end, widening to 1000 feet at west end.

(4) Ownership: Private

(5) Use: Private cottages.

(6) Public Facilities: None

(7) Composition: Above H.W.: Eastern part - boulders, shingle.
Western part - medium sand.

Below H.W.: Eastern part - boulders, shingle, marsh.
Western part - fine sand, some shingle.

Q. Old Mill Beach

(1) Location: Just west of Sherwood Pond.

(2) Extent: 600 feet.

(3) Width - Above H.W.: 50 - 100 feet.

- L.W. to H.W.: 200 feet to inlet bed, and off-shore flats.

(4) Ownership: Town of Westport.

(5) Use: Public (restricted to town residents).

(6) Public Facilities: Parking.

(7) Composition: Above H.W.: Medium sand.

Below H.W.: Fine sand.

R. Old Mill Beach to Compo Beach

(1) Location: 600 to 3000 feet west of Sherwood Pond.

(2) Extent: 2400 feet.

(3) Width - Above H.W.: 0 - 50 feet.

- L.W.to H.W.: 200 to 700 feet.

(4) Ownership: Eastern 1500 feet - private.
Western 700 feet - public.

(5) Use: Eastern 1500 feet - private estates.
Western 700 feet - State highway.

(6) Public Facilities: None

(7) Composition: Above H.W.: Eastern part - medium to coarse sand.
Western part - boulders, riprap.

Below H.W.: Eastern part - shingle, marsh, fine sand.
Western part - shingle, some sand.

S. Compo Beach

(1) Location: Hills Point to Compo Yacht Basin.

(2) Extent: 4600 feet.

(3) Width - Above H.W.: 25 - 100 feet.

L.W.to H.W.: 50 to 100 feet, east of Cedar Point.
100 to 300 feet northwest of Cedar Point.

(4) Ownership: Town of Westport.

(5) Use: Public (preferential rates to town residents).

(6) Public Facilities: Parking, bathhouses, life-guard, sanitary, refreshments.

(7) Composition[(a)]: Above H.W.: Medium to coarse sand.
Below H.W.: Fine sand to shingle.

(a) Artificially placed Long Island sand also present - a sharp, granular sand.

APPENDIX B

GEOLOGY

1. General. - The coastal formation in Connecticut is the result of a complicated series of geological changes. That portion of the geological history which is significant in explaining the physiography of the area is discussed briefly in chronological sequence.

2. Pre-Cambrian and Paleozoic Period. - During this period, through endless ages, series after series of sediments were deposited, injected by liquid magmas and under the influence of heat and mountain making pressures, were folded, broken and profoundly altered so that their original character can no longer be recognized. The only semblance of unity in the rocks underlying the New England Province seems to be the general presence of a north, northeast trend in the direction of the rock structure.

3. Triassic Period. - At the end of the Paleozoic Period, this complex structure was worn down at least in part to a peneplane and deposits of Triassic clastic sediments were laid down. Simultaneously with this deposition of great thicknesses of Upper Triassic shales and limestones, the intrusion and extrusion of massive layers of trap occurred. Faulting took place throughout this period and was pretty well distributed over the area. By means of great north-south boundary faults, which to this day separate the sediments from the crystallines on the east, the net result in Connecticut was to lower all strata differentially and give them a regional dip of 5 to 20 degrees east.

4. Fall Zone Cycle. - After this period of disturbance an era of great quiet prevailed during which for countless centuries erosion worked on the highlands, reducing them to a low and rolling country just a few feet above sea level. Regardless of geologic structure and differences in rock hardness, a peneplane was formed across the great faults which separate the

sediments from the harder crystallines. Great thicknesses of Triassic rock were removed. That which is still preserved in the Connecticut Valley lowland owes its existence to the faulting which dropped it below the base level of erosion. The extensive surface formed at this time is called the Fall Zone peneplane.

5. Burial of the Fall Zone Peneplane. - The long period of quiet drew to a close and the great peneplane was slowly covered by a thick series of deposits derived from the waste of the land. In Connecticut these deposits were apparently of Upper Cretaceous age, probably largely marine in origin. Earth movements resulted in uplift in the north and northwest, while seaward the surface was depressed to near or below sea level. In Connecticut the depression carried the peneplane below sea level. Thus toward the north a new cycle of erosion was started by the streams rejuvenated by uplift and the Fall Zone surface began to be destroyed, while the wastes from this destruction with the aid of marine sediments buried the lower surface in the south. When the submergence in the Connecticut area had reached its greatest extent, the streams once emptying into the ocean considerably to the south found that their mouths had moved to the north with the advancing shore line. This shore line was probably even more irregular than that of today.

6. The New England Upland Cycle. - At or near the end of the tilting which started the destruction of the Fall Zone peneplane, a new movement of the earth's surface occurred, resulting in uplift. Coincident with the movement raising the land above sea level, the shore line retreated toward the southeast and the streams extended their lower courses across the young coastal plain thus exposed. At this early date the Connecticut River left its course across the soft Triassic rocks in the vicinity of Middletown and made a sharp bend to the southeast over the newly uncovered sediments of the coastal plain, assuming the course which, with few exceptions, it follows to this day. The

uplift initiated a new cycle of erosion which wore down the land mass and a peneplane, the most extensive of any in New England, was formed. Today the remnants of this surface are known as the New England Upland peneplane.

7. The Connecticut Valley Lowland Cycle. - Another uplift accompanied by tilting terminated the Upland cycle of erosion. This tilting appears to have been to the southeast about 15 feet per mile. The uplift started another cycle of erosion, during which the Coastal Plain deposits were removed most rapidly, while the Triassic shales and limestones, being more resistant, remained somewhat longer. The Upland, underlain by the more resistant crystalline rocks, were still far from total destruction when the Coastal Plain and Triassic areas were reduced almost to sea level. It was during this period that the Connecticut Valley lowland was formed by the erosion of the Triassic rocks. This lowland, which now follows the Connecticut River to about Middletown and enters Long Island Sound at New Haven, is essentially the same as when originally formed.

8. The Sound Valley Cycle. - The Lowland cycle was terminated by another uplift, by which the land was raised in reference to the sea. This uplift raised the surface of the Connecticut Lowland peneplane, which continued as a Coastal Plain along the entire southern edge of the State in a belt about as wide as the present Long Island Sound. The forces of erosion renewed their work and cut a valley in the inner lowland, called the Sound Valley, which was eventually to become the present Long Island Sound.

9. Formation of Long Island Sound. - The cutting of the inner lowland was interrupted by a climatic change which resulted in the formation of a great ice sheet covering the northeastern United States and Canada. This glacier, moving under the impulse of gravity, carried a tremendous amount of debris gathered from the country over which it passed. In passing over Connecticut, the glacier scraped away practically every bit of the thick

mantle of soil and decomposed rock in its path. All the material was not carried to its terminal moraine, which followed a line from the northern fluke of Long Island, through Fishers Island to Watch Hill and the southern coast of Rhode Island. Much of the material was strewn over the surface of Connecticut as the glacier advanced and retreated, and forms the present unevenly distributed soil of Connecticut which varies in depth from 0 to 20 or more feet. In addition to eroding and depositing of materials, a sinking of this region occurred which might have been due to the enormous weight of the ice sheet. The exact amount of submergence occurring is not known but when the ice disappeared, the inner lowland or Sound Valley was below sea level. These waters are what now constitute Long Island Sound, while Long Island is that part of the cuesta and glacial drift which remained above sea level.

10. Postglacial Changes of Level. - Since the withdrawal of the glacier from Connecticut, one small diastrophic movement has occurred. This resulted in the submergence of land masses for a depth generally determined and accepted to be 20 feet. After this movement, authorities generally agree that movements of the land and sea ceased and the relation of the elevation of the waters in Long Island Sound and Connecticut have remained constant. Minor local changes in water elevation may have occurred in restricted areas due to localized conditions. This last lowering of the land masses resulted in the present day shore line of Connecticut being a shore line of submergence, having all the irregularities of such a shore line due to the drowning of coastal valleys.

11. Present Day Trends. - Connecticut at present is in the period of sub-aerial erosion which follows a diastrophic change. During this period erosional forces will work to the reduction of land masses to another penelane with the streams transporting materials from the uplands to the lowlands.

Along the coast, waves attacking the shore line will tend to cut back all headlands, building and rebuilding bars and spits of materials from eroded headlands until a regular, even shore line is produced. This regular shore line will be landward of the present day shore line since the beaches, bars and spits will recede landward as the headlands are lost.

APPENDIX C

TIDES

1. General Characteristics. - The tides along the shore of the State of Connecticut are of two types. The eastern sector from Watch Hill Point, Rhode Island, to Cornfield Point, Connecticut, is subject to the normal ocean or progressive wave type of tide which causes high water to occur at increasingly later times as it progresses from east to west. The western sector from Cornfield Point, Connecticut, to the entrance to East River, New York, is subject to the stationary wave type of tide which causes high and low waters to occur almost simultaneously at all points within this sector, while the range of tide increases in a fairly uniform manner from east to west.

2. Tidal Range. - Tidal range data for points along the shore of Connecticut are given in "Tide Tables, Atlantic Ocean," published by the United States Department of Commerce, Coast and Geodetic Survey. These are as tabulated below:

Location	Mean Range	Spring Range	Reference Station	Time Interval
Stonington, F. Is. Sd.	2.7	3.2	New London	-0 35
Noank, Mystic R. Entrance	2.6	3.1	" "	-0 30
New London, State Pier	2.6	3.1	" "	0 00
Millstone Point	2.7	3.2	" "	+0 05
Saybrook Jetty	3.5	4.2	" "	+1 00
Duck Island	4.5	5.3	Bridgeport	-0 35
Madison	4.9	5.8	"	-0 30
Falkner Island	5.4	6.4	"	-0 25
Money Island, The Thimbles	5.6	6.6	"	-0 20
Branford Harbor	5.9	7.0	"	-0 15
New Haven Harbor, Entrance	6.2	7.3	"	-0 15
Milford Harbor	6.6	7.8	"	-0 10
Stratford, Housatonic River	5.5	6.5	"	+0 40
Bridgeport	6.8	8.0	"	0 00
Black Rock Harbor, Entrance	6.9	8.1	"	-0 05
Saugatuck River, Entrance	7.0	8.3	"	-0 05
South Norwalk	7.1	8.4	"	+0 10

Location	Mean Range	Spring Range	Reference Station	Time Interval
Greens Ledge	7.2	8.5	Bridgeport	-0 05
Stamford	7.2	8.5	"	0 00
Coscob Harbor	7.2	8.5	"	0 05
Greenwich Harbor	7.4	8.7	"	0 00

3. Tidal Observations - New London. - A primary tide station is maintained by the United States Coast and Geodetic Survey at New London, Connecticut. A summary of the highest tide observed at this station during each month for the period from June 1938 to April 1948 is tabulated below. When the highest monthly tide occurred on more than one day in any month, it has been included in the tabulation for each day of its occurrence.

Height and Frequency of Highest Monthly Tides
New London, Connecticut. June 1938 - April 1948

Month	Height of Tide (feet) 3.6-3.9	4.0-4.4	4.5-4.9	5.0-5.4	5.5-5.9	6.0-6.4	Over 6.5	Total
January		3	6					
February		9	2					
March	1	6	1	1	1	1		
April	2	6	4					
May	2	4	3					
June	6	8						
July	11	5						
August	11	4						
September	3	9					2	
October	1	5	3	1	1			
November	1	3	3	1	1	2		
December		5	4	3	2			
TOTAL	38	67	26	6	5	3	2	147

The two tides listed in the tabulation as being in excess of 6.5 feet occurred during the hurricanes of September 21, 1938 and September 14-15, 1944.

In September 1938 the recorded height of tide at New London was 11.1 feet and in September 1944 the height was 7.6 feet.

4. Extreme Hurricane Tides - September 1938. - Elevations of high water marks referred to the plane of mean low water occurring during the hurricane of 21 September 1938 at selected locations along the shore of Connecticut are tabulated below:

Location	Actual High Water	Predicted High Water
Stonington	11.0	3.2
Mystic	10.8	
Noank	10.3	3.1
New London	11.1	3.0
Saybrook	13.4	4.1
Branford	11.8	6.9
New Haven	13.0	7.2
Bridgeport	13.8	7.8
Southport	13.4	
South Norwalk	11.6	8.1
Rowayton	14.3	
Stamford	15.6	8.2
Greenwich	15.0	8.4

5. Extreme Hurricane Tides - September 1944. - Elevations of high water marks referred to the plane of mean low water occurring during the hurricane of 14-15 September 1944 were reported as follows:

Location	Actual High Water
Stonington	7.7
Saybrook	8.0

APPENDIX D

HURRICANES

1. Characteristics. - Hurricanes can be defined as tropical cyclones with a central barometric pressure of 29.0 inches or less and winds near the center of more than 60 miles per hour in some points in the path. In the northern hemisphere they are known to consist of winds revolving in a counter-clockwise direction about a calm center or "eye". This calm center has an average diameter of approximately 14 miles. The diameter of hurricanes varies considerably, some being 50 to 75 miles; the majority greater than this - in many instances exceeding 500 miles. Winds at the outer limits are usually light, increasing to moderate and gusty toward the center, and they blow with great fury adjacent to the "eye." Hurricanes move bodily along a path in a motion of translation at an average speed of approximately 12 miles per hour. The greatest damage caused by these tropical cyclones is due to the inundation which usually accompanies them. This is especially true where there is a bay to the right of the point where the hurricane center moves inland. The rise of water in Narragansett Bay, Rhode Island, which accompanied the hurricane of September 1938, which moved inland west of this bay is an example of the devastating effect which such a condition can engender. The strong currents created by hurricanes is another important factor in the destruction caused by such storms.

2. Severe Hurricanes in New England. - Only a few hurricanes which have passed through the New England area are known to have caused considerable destruction. Ivan Ray Tannehill, in his book "Hurricanes," mentions ten such tropical cyclones as occurring between 1635 and 1944. The paths of some of these are shown on Plate 2. The 1944 hurricane has been described as the most violent in history but it did not cause as much destruction in New England as the one which struck in 1938. A comparison of

these storms indicates certain attendant characteristics which can be expected to result in great damage. The 1938 hurricane struck about normal to the shore line at a time when tides were high. The 1944 hurricane struck obliquely to the shore at low tide. The later hurricane did not produce the inundation and consequent destruction which occurred during the former. Very little information is available concerning the damage caused by most of the hurricanes which have passed through or near New England. This lack of detailed information makes it difficult, if not impossible, to draw conclusions concerning probable shore damage which can be expected from such storms.

3. Hurricane of 21 September 1938. - On 21 September 1938 the New England area was struck by a devastating hurricane which originated around the Cape Verde Islands. It traveled in a curved path in a northwesterly and then northerly direction, arriving in the New England area during mid-afternoon of the 21st of September. The hurricane entered the State of Connecticut with its center just west of New Haven at 3:30 p.m. E.S.T. and continued its progress northward at the rate of 50 to 60 miles per hour. The eye of the storm was clearly observed at New Haven. Winds that were easterly since noon died down between 3:00 and 4:00 p.m., and were then followed by increasing southwesterly winds. The region of strongest wind lay in the dangerous semi-circle at a distance of about 75 miles to the right of the storm center. Barometric pressures reported indicate the severity of the storm along the Connecticut shore. Minimum pressures were reported as follows: at Bridgeport 28.30 inches, at New Haven 28.11 inches at 3:50 p.m., at Hartford 28.04 inches at 4:17 p.m. Barometric pressures dropped gradually until 12:00 noon, and then dropped rapidly until about 4:00 p.m., when the lowest pressures were reached. Pressures then rose rapidly until 8:00 p.m., when the 12:00 noon pressure was attained; thence

rose gradually. Wind velocities were observed as follows: maximum for a five minute period, 38 miles per hour at New Haven, 46 miles per hour at Hartford, 70 to 90 miles per hour over an area 80 miles wide from Saybrook, Connecticut, to Marthas Vineyard, Massachusetts; maximum gust velocities, 46 miles per hour at New Haven, 59 miles per hour at Hartford, probably in excess of 100 miles per hour in the area from Saybrook to Marthas Vineyard. The amount of precipitation directly attributable to the hurricane is difficult to determine due to the fact that it rained for 2 days prior to the storm. The total precipitation ranged from 2 to 5 inches along the Connecticut shore, the major portion of which was probably directly due to the storm. The hurricane increased tidal heights above their predicted ranges. Its approach was manifested in the higher water levels of the preceding low and high water. During these preceding tides, tidal heights were increased more to the east of the hurricane center than to the west because of the counter-clockwise wind rotation. Reported high tide during the hurricane occurred 2 to 2-3/4 hours before the time of predicted tide. The effect of the hurricane was an addition of about 9 to 10 feet to the predicted high tide at the entrance to Long Island Sound, this addition decreasing to 7 feet at Bridgeport and increasing to 9 feet at the west end of the Sound. Wave action accompanying the storm produced a devastating effect upon the shore line, pounding it mercilessly and resulting in widespread damage. Wave heights ranged from 9 feet at New Haven to 22 feet at Saybrook Light and 30 feet at Bridgeport.

4. Hurricane of 14-15 September 1944. - On 14 September 1944, the New England area was struck by a tropical hurricane which originated in the West Indies. This hurricane traveled in a northwesterly then northerly direction to Cape Hatteras, thence swerved north, northeast across Long Island, reaching the mainland in the vicinity of Westerly, Rhode

Island. From there it proceeded northeastward across Providence, Rhode Island, and thence followed closely along the New England coast and passed over Newfoundland and out to sea. The hurricane reached Westerly, Rhode Island, about 11:00 p.m. E.W.T. The greatest wind intensities occurred to the east of the storm center. The calm during the passage of the "eye" of the storm, with the shift in the wind direction after its passage, was clearly noted at Westerly and Providence, Rhode Island. The following minimum barometric pressures were reported in the Connecticut area on 14 September; at New Haven, Connecticut, 28.86 inches at 9:50 p.m.; at Hartford, Connecticut, 28.94 inches at 10:50 p.m.; at Fishers Island, New York, 28.41 inches at 10:45 p.m.; at Groton, Connecticut, 28.40 inches at 11:00 p.m.; at Westerly, Rhode Island, 28.30 inches at 11:00 p.m.; at Block Island, Rhode Island, 28.34 inches at 11:09 p.m. Wind velocities reported for the Connecticut area are as follows: New Haven, maximum five minute wind, N 33 m.p.h. and extreme wind NE 38 m.p.h.; Hartford, maximum five minute wind, N 50 m.p.h. and extreme wind, N 62 m.p.h.; New London, extreme wind 70 m.p.h.; Westerly, Rhode Island, extreme wind, 75 m.p.h.; Block Island, Rhode Island, maximum five minute wind, SE 82 m.p.h. and extreme wind, SE 88 m.p.h. Extreme winds were mostly estimated. Heavy rainfall was reported practically throughout the coastal portion of the Providence District, which extended from New York State to Cape Cod. In Providence, a total of 4.49 inches fell from 5:55 p.m. to midnight on 14 September. The following elevations of high water in feet above mean high water were reported: Saybrook, Connecticut, 4.5; New London, Connecticut, 5.0; Stonington, Connecticut, 5.0; Watch Hill, Rhode Island, 6.9; Providence, Rhode Island, 8.0. The hurricane effect occurred on the ebb tide from about 3 to 5 hours after predicted gravitational high water in the area from Watch Hill, Rhode Island, to Wood's Hole, Massachusetts.

APPENDIX E

SHORE LINE AND OFFSHORE DEPTH CHANGES

1. Basic Data. - Plans showing the location of the shore line and the 6, 12 and 18-foot depths have been prepared from United States Coast and Geodetic Survey data by the Beach Erosion Board for the period from 1835 to 1934. For this study a survey during 1948 located the entire shore line and offshore depths on selected profiles spaced about 500 to 1500 feet apart. Shore line changes are shown on Plates 7 and 8, and offshore depth changes are shown on Plates 9 through 14. The principal shore line and offshore depth changes are described below. Due to the scale (1:10,000) used on these plans it is obviously difficult to measure small changes with accuracy. Descriptions of change are therefore limited to those which are large enough to permit reliable reading. Amounts of accretion, erosion or movement of inlets when given in feet are necessarily scaled distances and therefore approximate. The changes described can be considered accurate in so far as they indicate trends and are approximate only in indicating the actual quantitative alteration.

2. Jennings Beach. - This area comprises the east limit of Area 1, and includes Ash Creek and about 1900 feet of shore west of Ash Creek, referred to as Jennings Beach. The inlet to Ash Creek has migrated westward about 400 feet since 1835 and results from the building of a sand spit from the east bank and the erosion of the shore on the west bank. The 1948 survey indicates that this movement is continuing. The eastern third of Jennings Beach has eroded several hundred feet as a result of the westward migration of Ash Creek Inlet, and this erosion is continuing. The central third of the beach has alternated between erosion and accretion, the latest survey indicating accretion. The western third of the beach has also alternately eroded and built outward, with little apparent change from 1933 to

1948. Observations during the course of this study show some erosion occurring at the west limit of the beach.

The 6, 12 and 18-foot offshore depths have varied several hundred feet shoreward between 1833 and 1885. From 1885 to 1934 the trend of change has been generally seaward in an irregular manner. From the depths on the selected 1948 profiles it appears that deepening is occurring offshore, the 6 and 12-foot contours are moving shoreward, while little change is apparent in the position of the 18-foot contour.

3. Fairfield Beach (East Part). - This stretch of beach, approximately 2400 feet long, is located west of and adjacent to Jennings Beach. Here the shore line has eroded almost continuously from 1835 to 1885, resulting in a movement of the high water line of 50 feet at its eastern end and 150 feet at its western end. Comparison of the 1933 and 1948 shore lines indicates that little change has occurred during this period except at the western end where erosion has continued.

The 6, 12 and 18-foot offshore depth curves moved hundreds of feet shoreward between 1835 and 1885. From 1885 to 1933 there was, in general, a movement of these same depth curves seaward. The selected profiles run in 1948 indicate that the offshore contours are again moving towards the land.

4. Fairfield Beach (West Part). - This portion of the shore extends from a point about 2000 feet east of Shoal Point westward approximately 11,000 feet to the entrance to Pine Creek. East of Shoal Point the overall picture is one of erosion, with the high water line moving landward 200 feet since 1835.

Shoal Point moved 200 to 300 feet westward since 1835. This westward movement was accompanied by a recession of the high water line up to 1909. Since that time the point has built out over 200 feet. West of Shoal

Point for a distance of about 2100 feet a small amount of erosion occurred between 1835 and 1885. Accretion then occurred up to 1933 and continued up to 1948, this building up apparently occurring simultaneously with the growth of Shoal Point. A stretch of shore extending from 2100 to 3000 feet west of Shoal Point exhibits no noticeable change from 1835 to 1933. Between 1933 and 1948 this section of shore eroded landward about 50 feet. West of this section of shore is a sand spit which has built out rapidly over a long period of years to its present length of approximately 6000 feet. In 1835 the end of this spit was located about 300 feet east of the present position of Pine Creek Point. Between 1835 and 1885 this spit grew westward about 1400 feet, bending around Pine Creek Point and following the general shape of the existing shore. From 1885 to 1909 an additional 1300 feet were added. The spit receded about 150 feet between 1909 and 1933. The end of the spit today is substantially in the same position which it occupied in 1933. As the sand spit grew westward, changes occurred in its size and shape. Between 1835 and 1885, as it grew around Pine Creek Point, the shore line east of Pine Creek Point moved shoreward and the spit was narrowed down at its widest part from over 400 feet to about 250 feet. In 1933 the width here was about 100 feet, and in 1948 widening had occurred so that at present this portion of the spit is 250 or more feet wide. In 1885 the spit west of Pine Creek Point was narrow and sinuous, varying in width from 50 to 100 feet. In 1909, when the spit had built out to its greatest length, its width varied from 100 to over 200 feet. In 1933 the bar had straightened out somewhat and varied in width from 100 to 150 feet. At present the seaward shore of the spit has generally eroded shoreward of its 1933 position and has become sinuous and narrow, in places not exceeding 60 feet in width. Some widening has occurred near its outer end where its greatest width is about 150 feet. The offshore depth curves east of Shoal Point

moved hundreds of feet shoreward between 1835 and 1885, and in general moved seaward between 1885 and 1933. Between 1933 and 1948 the 6-foot depth curve has again moved landward while little change is apparent in the position of the 12-foot contour. Between Shoal Point and Pine Creek Point, the 6, 12 and 18-foot offshore depth curves moved generally landward from 1835 to 1885. Then up to 1933 these contours have assumed a position generally seaward. The selected profiles run in 1948 indicate little change since 1933. Some movement of depth curves has apparently occurred in a shoreward direction, but the extent of change is not large enough to permit a reliable interpretation. From Pine Creek Point to the inlet to Pine Creek the following offshore changes in depth have occurred: from 1835 to 1885 the 6, 12 and 18-foot depth curves moved generally landward; from 1885 to 1933 the 18-foot depth curve continued to move landward except opposite Pine Creek Point where it advanced seaward; and the 6 and 12-foot depth curves advanced irregularly seaward. The selected profiles run in 1948 show very little change has occurred in offshore depths since 1933.

5. Kensie Point. - This stretch of shore extends from the inlet to Pine Creek westward about 2700 feet around Kensie Point to Sasco Hill Beach. The easterly 400 feet of this shore eroded continuously from 1835 to 1909, at which time the high water line had moved over 100 feet. From 1909 to 1948 erosion appears to have continued although the change in the position of the shore is small. West of this section of shore and extending about 600 feet to Kensie Point a small amount of accretion occurred from 1835 to 1933. Since 1933 erosion up to about 50 feet has occurred here. Observations made during 1948 indicate that erosion is still taking its toll. Kensie Point and the shore west of it up to Sasco Hill Beach have, with minor exceptions, continuously built outward by accretion from

1835 to 1933. During this period the growth exceeded 200 feet at Kensie Point and was generally 150 feet wide to Sasco Hill Beach. The 1948 survey shows that extensive erosion has occurred since 1933, moving the shore line back over 150 feet at Kensie Point and lesser amounts west of the point so that high water is now at the foot of existing concrete and masonry walls which have been built along this entire area to protect the land from the attacks of the Sound.

The 6, 12 and 18-foot offshore depths moved hundreds of feet shoreward between 1835 and 1885. Since that time up to 1933 these same depth curves moved irregularly seaward about one-third of the distance of their original shoreward movement. Profiles run during 1948 indicate that the 6-foot depth contour is again moving landward, while little change is evident further offshore.

6. Sasco Hill Beach (East Part). - This section of shore lies between points approximately 650 feet and 2650 feet east of the breakwater at Southport Harbor. From 1835 to the present, with minor exceptions, accretion occurred along this area, the greatest accretion of 200 feet occurring at the westerly end; the amount of accretion being progressively less further east from the breakwater.

Changes in offshore depths were generally as follows; deepening of offshore areas between 1835 and 1885 with shoaling occurring up to 1933 and no evident change up to 1948.

7. Sasco Hill Beach (West Part). - This area consists of the shore approximately 650 feet long adjacent to and east of the breakwater at Southport Harbor. Here accretion has occurred continuously from 1835 to 1948 as a result of the construction of the breakwater at the entrance to Southport Harbor in 1832. The shore adjacent to the breakwater has built out over 500 feet during this period and progressively smaller amounts further east

of the breakwater.

Offshore depths of water increased between 1835 and 1885, and decreased irregularly between 1885 and 1933 at the location of 12 and 18-foot depth curves, and alternated between deepening and shoaling at the locations of the 6-foot depth curves. No change is evident between 1933 and 1948.

8. Southport Harbor to Southport Beach. - This stretch of shore, located immediately west of Southport Harbor, is approximately 2400 feet long. The general picture here is one of accretion up to about 100 feet along the easterly half of the area and erosion of a similar amount along the westerly half. A continuous series of existing groins and walls offers mute evidence of man's struggle to arrest the ravages of the Sound.

Offshore, the 6, 12 and 18-foot depth curves moved shoreward between 1835 and 1885. Between 1885 and 1933 these depth curves moved irregularly landward and seaward. Selected profiles run during 1948 indicate that little change has occurred.

9. Southport Beach. - Southport Beach consists of a spit of land which has built westward from the east side of Sasco Brook. It is approximately 900 feet long. In 1835 the point of this spit had reach a point as far west as during any subsequent period. In 1885 this point had receded slightly and swung landward and a similar condition existed in 1933. In 1948 this spit had widened, accretion of about 50 feet having occurred since 1933. The inlet to Sasco Brook moved slightly eastward during this period.

Offshore, the 6, 12 and 18-foot depth curves moved several hundreds of feet landward between 1835 and 1885. From 1885 to 1933 these depth curves moved irregularly landward and seaward. Selected profiles run during 1948 indicate that some shoaling has probably occurred at the 6-foot depth since 1933, but there is no evident change in the location of the 12 and 18-foot contours.

10. Canal Beach. - This stretch of shore runs in a north-south direction for approximately 500 feet and lies immediately west of the inlet to Sasco Brook. From 1835 to 1885 accretion occurred and this was particularly large adjacent to the inlet to Sasco Brook. From 1885 to 1933 changes alternated as follows: accretion next to the inlet along about 100 feet, thence erosion along the next 250 feet and accretion for the most southerly 150 feet. From 1933 to 1948 accretion of from 50 to 100 feet occurred along this entire area.

Conditions offshore are the same as described in the preceding paragraph.

11. Greens Farms (Canal Beach to Burial Hill). - This section of shore extends about 7800 feet westward from Canal Beach to Burial Hill, and is continuously protected by sea walls and groins. Along the easterly 1200 feet of this area some accretion, probably not exceeding 50 feet, occurred between 1835 and 1933. Between 1933 and 1948 this shore line moved from 25 to 50 feet seaward. The next section of shore, extending westward to Frost Point, presents a picture of erosion along the east half and accretion along the west half between 1835 and 1933. From 1933 to 1948 there was little change in the shore line except for small amounts of accretion along short stretches in the vicinity of groins. Frost Point built seaward about 150 feet and moved slightly westward between 1835 and 1885. From 1885 to 1933 the point appears to have shifted about 50 feet eastward. The shore west of Frost Point, extending to the beach at Burial Hill, has generally eroded back from 1835 to 1933, this erosion being as much as 100 feet in places. Between 1933 and 1948 a small amount of material has been restored in front of some of the walls and is held there by closely spaced groins; while at other places the water is at the foot of the walls or exposing their footings.

Offshore, east of Frost Point the 6, 12 and 18-foot depth curves moved generally landward between 1835 and 1885. Since 1885, these depth curves show change alternately landward and seaward. West of Frost Point, between 1835 and 1885, the 6 and 18-foot depth curves moved generally seaward and the 12-foot depth curve generally landward. Since that time the changes in depth do not follow any definite pattern.

12. Burial Hill. - This section of shore about 500 feet long consists of a spit which has built westward from the east bank of Alvord Creek. From 1835 to 1885 growth of the spit occurred, adding 200 feet to its length. This westward growth continued to 1933 and was accompanied by erosion at the easterly or shore end. Between 1933 and 1948 the inlet to Alvord Creek shifted about 100 feet eastward, shortening the spit by that amount. A small amount of erosion occurred along the seaward shore of the tip of the spit during this period. Existing groins give evidence of attempts to stop the erosion and restore the shore to its previous location.

Offshore depth contours present a confusing picture, the predominent trends consisting of shoaling from 1835 to 1885, and deepening to 1933. A profile run across this area in 1948 indicates that deepening has occurred since 1933, but the amount of change is too small to permit of accurate interpretation.

13. Alvord Beach (Sherwood Park). - Alvord Beach is about 3500 feet long and extends from the inlet to Alvord Creek westward to Sherwood Point. As the previously described spit grew westward and seaward from the east bank of Alvord Creek between 1835 and 1885, the west bank likewise grew seaward, resulting in accretion of 100 to 150 feet along 1000 feet of shore west of Alvord Creek. From 1885 to 1933 the course of the creek swung westward and this shore line eroded back to about its 1835 position. Between 1933 and 1948 the position of the inlet had shifted eastward, accretion had

occurred adjacent to the inlet and erosion had eaten back the central part of this 1600-foot section of shore, and a small amount of accretion occurred along the western end. Between points from 600 to 2500 feet east of Sherwood Point, erosion continued from 1835 to 1933, pushing back the shore line about 50 feet. Between 1933 and 1948 a small amount of accretion occurred along the eastern half of this section and no change is apparent along the western part. From Sherwood Point to a point about 600 feet eastward, a small amount of accretion occurred. This is particularly evident at Sherwood Point, which built out about 100 feet between 1835 and 1933. No change is apparent between 1933 and 1948.

Depth changes offshore from Alvord Beach present a confusing picture. In general shoaling occurred opposite the east half and deepening opposite the west half of Alvord Beach from 1835 to 1885. From 1885 to 1933 the 6 and 12-foot depth curves had shifted predominantly shoreward, while the 18-foot depth curve had moved irregularly seaward and shoreward. Profiles run during 1948 do not show enough change since 1933 to permit of reliable interpretation.

14. Elwood Beach (Sherwood Park). - This stretch of shore extends from Sherwood Point westward for about 2500 feet. From 1835 to 1885 accretion occurred, building out the shore line as much as 100 feet in places. A small amount of erosion occurred from 1885 to 1933. Since 1933 little change is apparent, some small amount of erosion having occurred along the west end of this shore.

Offshore water depths generally increased between 1835 and 1885 and decreased from 1885 to 1933. Profiles run in 1948 indicate no major change in depths since 1933.

15. Compo Mill Beach Association. - This beach consists of approximately 2000 feet of shore adjacent to and east of Sherwood Pond. From 1835

to 1885 accretion generally equal to or in excess of 100 feet occurred along this entire area. From 1885 to 1933 a small amount of erosion took place along the eastern half of the beach and accretion continued adjacent to Sherwood Pond. Since 1933 the eastern end has eroded slightly, the central portion shows no change and the spit at the west end of the area has increased in length about 200 feet.

Offshore depths changed in an irregular manner during the years with no definite trend apparent. Profiles run during 1948 indicate that a small amount of deepening has occurred since 1933.

16. Old Mill Beach. - This beach is about 600 feet long and lies west of and adjacent to the entrance of Sherwood Pond. The general picture here is one of accretion between 1835 and 1885, erosion between 1885 and 1933, during which period the shore line retreated approximately to its 1835 position, and accretion of about 50 feet between 1933 and 1948 along the west side of the jetty adjacent to Sherwood Pond.

No definite trend of change in depths is apparent offshore.

17. Old Mill Beach to Compo Beach. - This stretch of shore is approximately 2400 feet long and runs generally in a north-south direction. The northerly 800 feet of this shore eroded continuously from 1835 to 1933. The total change in the position of the high water probably did not exceed 40 feet. The shore line appears to have moved seaward since 1933, its present location being approximately the same as in 1835. Further south along about 500 feet the shore reverses its direction, forming a small point of land. This point receded over 50 feet from 1835 to 1885, and between 1885 and 1933 it had built out about 100 feet. In 1948 the small point of land was located slightly south of its 1933 position and projected about 50 feet further seaward. Along the next 1100 feet of shore no major changes have occurred. A small amount of seaward growth appears to have occurred here between 1885

and 1948. At present this section is largely protected by riprap.

Offshore changes in general were as follows: between 1835 and 1885 deepening occurred in the position of the 12 and 18-foot depths and shoaling at the 6-foot depth; between 1885 and 1933 no definite trend is apparent, offshore areas having deepened in some places and shoaled in others. Little change is apparent from 1933 to 1948.

18. Campo Beach. - This section of shore, approximately 4600 feet long, extends from Hills Point to Cedar Point, and thence to the entrance to Cedar Point Yacht Basin. Little change has occurred in the position of the high water line between Hills Point and Cedar Point. Between 1835 and 1933 along 500 feet adjacent to Hills Point erosion occurred, while the rest of the shore to Cedar Point built seaward. This movement of the shore was generally less than 50 feet. Since 1933 the northern half of the beach has built slightly seaward, while the southerly half eroded an equal amount. The movement during this period was about 20 feet. Between Cedar Point and the entrance to Cedar Point Yacht Basin, fairly large irregular changes have occurred; in some places landward, in others seaward. In 1948 this section of shore was built out several hundred feet by the deposition of hydraulically dredged fill. It appears that the largest changes in this area are due to man's efforts rather than to natural processes.

In general, offshore changes opposite the beach east of Cedar Point are as follows: deepening between 1835 and 1916, shoaling from 1916 to 1933, deepening from 1933 to 1948 except near the tip of Cedar Point where considerable shoaling has occurred, this latter being probably due to building up of the point by artificial fill.

APPENDIX F

EXISTING PROTECTIVE STRUCTURES

1. Significant Shore Structures. - In this area, as is generally true of the Connecticut shore, much of the shore line has been under the influence of artificial structures. A description of each structure in detail would be of doubtful value. Therefore, typical structures have been selected for analysis. The existence of shore structures has destroyed, diminished or interrupted natural processes of supply of beach material obtained from erosion of undeveloped areas and transmission along shore by littoral currents. An important effect of the shore structures has been to diminish effectiveness of the numerous groins along the Connecticut shores, as groins are designed primarily to improve a shore area by interception of littoral drift. Groins in such an area have been found effective only in holding existing beach material rather than in improving the area. Structures affecting a shore are (1) seawalls or bulkheads, (2) revetments, (3) groins, (4) jetties and offshore breakwaters, and (5) artificial fill. There are no offshore breakwaters in this area of Connecticut. Examples of shore structures are described below in geographic order of occurrence from east to west.

2. Ash Creek Jetty. (See Plate 23) - Ash Creek jetty is a structure of dumped massive riprap on the west shore of Ash Creek. The jetty is about 120 feet long, of which 100 feet is above the high water line. The top of the jetty is two to three feet above the beach level, and follows the beach slope. The purpose of the jetty undoubtedly was to deflect the erosive ebb and flow currents of Ash Creek from the west bank. The jetty has only been partially successful, being too low and short, and, having been built of ungraded stone, being too porous.

3. Fairfield Beach Walls. (See Plate 23) - A generally uniform and continuous system of concrete seawalls runs for about 2000 feet easterly from Shoal Point, or Penfield Reef. From 700 to 1500 feet east of Shoal Point in the Rowland Road area these walls are about 30 feet from the high water line. East of this area the walls are set back about 25 feet, and west of the same area the high water line curves seaward until it is about 150 feet from the walls at Shoal Point. The walls are vertically faced, about a foot thick, and buttressed by steps leading down to the beach. The tops of the walls are at an elevation about four feet above mean high water. The walls are in good condition and serve the purpose for which they were intended - that of prevention of wave attack and erosion of the backshore area. Those walls to the west, near Shoal Point, now seem largely unnecessary, the widening of the beach in that area surplanting the protection formerly afforded by the wall system.

4. New Groins 3000 Feet West of Shoal Point. - A series of eight timber groins built in 1948 are located about one-half mile west of Shoal Point, or one-third of the way from Shoal Point to Pine Creek Point, where the high water line coincides with the existing seawalls. These groins are from 30 to 75 feet long, spaced about 75 to 200 feet apart, sloping from 9 feet above mean low water at the inner end and to 4 feet above mean low water at the outer end, and projecting about three feet above the beach. The groins have not built up the beach noticeably, but do catch drift material on alternate sides, depending on the temporary direction of the drift. The groins are probably successful to some degree in prevention of more rapid recession of the shore line in this area.

5 Projecting Seawalls East of Pine Creek Point. (See Plate 24) - About a quarter of a mile east of Pine Creek Point a group of sea-

walls stretching for about 250 feet project about 25 feet seaward of the general line of walls running from Pine Creek Point to halfway to Shoal Point. These walls, one of timber and one of concrete, with top elevations 13 feet above mean low water, are only significant to the extent that this projection exposes the walls to concentrated wave attack, necessitating heavier buttressing and deep returns or wing walls back to the more general line of walls. Any such irregularity in sea-wall alignment tends to expose such areas to more destructive attack than would otherwise be the case.

6. Pine Creek Point Groins (See Plate 24). - A series of about 20 timber groins projecting an average distance of 50 feet seaward of the mean high water line has been built at various periods along the entire seaward face of the Pine Creek sand spit west of Pine Creek Point. Some of these groins are as close as 50 feet apart, some as far apart as 450 feet. The groins are quite high, extending 3 or 4 feet above the beach surface. The groins give evidence of a strong littoral current to the westward, the sand piling up sharply on the eastward side of the groins. Groins projecting farther than the average, and those spaced more widely, have been more effective in building out the beach immediately to the east. It is doubtful if the groins are trapping any sand coming in to the area, but are slowing down loss of beach sand from the area. Despite the close groin spacing, the erosion continues, the high water line now receding under the buildings.

7. Kensie Point Wall (See Plates 25-26). - A sea-wall extends about 2000 feet along the southwestern face of Kensie Point. The wall is a vertically faced concrete wall with a sloping back, and is about seven feet high including the foundation. This foundation is at an elevation about two feet below mean high water. At the eastern end of the wall where the beach has eroded below that elevation, several wall sections have overturned. Along the southern and western face of Kensie Point a shingle and cobble beach protects the wall foundation. Along the southwestern tip of Kensie Point, riprap has been placed against

the sloping bank for two or three feet above the wall, indicating that the top elevation of wave attack in this area is six or seven feet above mean high water.

8. Southport Stone Breakwater. (See Plate 26) - The breakwater is located at the east side of the mouth of Mill River. It was built as a Federal project authorized by the River and Harbor Act of March 2, 1829. Construction was begun in 1829 and was substantially completed in 1832. It was built of long and large stones laid as headers, with a core of small stone of varying sizes. The structure was capped and raised with large stones reaching entirely across the breakwater in 1875. The dimensions of the breakwater were as follows: length 1320 feet, top width 8 feet, bottom width 14 feet, top elevation 8-1/2 feet above mean low water. The structure has served its original purpose by assisting in maintenance of the channel and preventing excessive drifting of sand. Since its construction over 500 feet of accretion has occurred along the shore adjacent to the east side of the breakwater. At present the shore end of the structure is in need of repairs to make it sand tight. Inspection indicates that sand overtops the inshore end.

9. Southport Seawalls. - There is practically a continuous line of massive concrete or masonry seawalls stretching from Southport Harbor to Southport Town Beach, a distance of about 2400 feet. The wall is built generally about on the high water line to an elevation about six feet above mean high water, and the foundation is protected in some areas by cobble and shingle shores and offshore marsh, in some by riprap, and in other areas by narrow sand beaches held by widely spaced groins.

10. Greens Farms Wall System. (See Plates 27-28) - Seawalls exist entirely around the Greens Farms shore, a distance of some 7,800 feet from near Sasco Brook to the Sherwood Island State Park. Several variations in types of wall are included in this system. There are vertically faced walls, slope faced walls surmounted by vertical secondary walls directly above the main wall, curved faced walls, walls surmounted by sloped bank paving or revetment, by flat splash aprons and by graded and seeded banks. The walls are of masonry or concrete. The walls vary in height, depending on the beach elevation, but are all built to an elevation about five to eight feet above high water, although in the area of greatest exposure, the southwest face of Frost Point, additional wave splash protection extends up to twelve feet above mean high water. Groins and stepways down to the beach serve as buttresses against the wall toe. In general the walls are in very good condition, no one particular design appearing to have served its protective purpose better than the others. The walls appear to be well maintained, a more important consideration than the particular variation of adequate design.

11. Burial Hill Jetty. - The Burial Hill jetty is a dumped riprap structure two to three feet high and about one hundred feet long. No grading of stone, shaping of jetty section or maintenance program is evident. All except the inshore end of the jetty is on a shingle base. The major purpose of this jetty is undoubtedly as a training wall to direct the currents of the Burial Hill Creek offshore. A sand-tight high timber groin 120 feet long and about 120 feet east of the jetty shows no indication of littoral sand movement. Under such present conditions,

the usefulness of the jetty is restricted to its present inlet fixing effect.

12. Compo Mill Beach Association Wall and Groins. (See Plate 30) - About 1000 feet of the Compo Mill Beach Association property is protected by a low concrete wall of which the westerly 150 feet is featured by an integrated system of low, short concrete groins spaced at each wall section. The wall and groins project about a foot above the beach surface and the wall has a top elevation of about four feet above mean high water. The wall and groin system appear to be holding stable a sandy beach, which, although narrow at high water offers some protection to the property fronting the beach.

13. Compo Beach Sanding and Jetties. (See Plates 30 and 31) - Compo Beach is partially protected by three riprap groins or jetties extending seaward 100 feet, 400 feet, and 70 feet, respectively, from the east limit, southwest promontory and northwest limit of the park. The groin at the east limit of the park, at Hills Point, was built in 1948 and was evidently intended as an initial step in accordance with the recommendation in the Compo Beach Report issued by the Beach Erosion Board in 1935 for an 1100-foot breakwater at this site. The groin as yet is too short to produce the desired effect. The section of groin built has a top elevation of about four feet above mean high water, but the direction of the groin appears to be slightly too much to the southwest to benefit by the rocky shoal extending out to Hill Island if the groin is to be further extended to the 1100-foot length. It is also doubtful if the present section, about eight feet wide on top but with sides nearly vertical, will prove stable. From this groin to Cedar Point and some distance northwestward of the point, 3,000 cubic yards of Long Island sand was placed on the beach during 1948. Again this may be considered an initial step in accordance with the recommendation of the report referred to above for artificial placement of 16,000

cubic yards of sand. The thin covering of sand spread over some 3000 feet of beach improved the beach condition temporarily, but additional fill will be required to realize in full the possible improvement of the beach. The Cedar Point breakwater extending 400 feet from the southwest corner of the park area, has a top elevation sloping seaward from four feet above mean high water to three feet below. Movement of sand westward over this breakwater, formerly considered a total loss, now results in feeding the newly built beach area along the west side of Cedar Point. In addition to this placement on the beach of imported sand, the western shore line of the park was built out about one hundred to four hundred feet during 1948 by hydraulic disposal of material dredged from the Compo Yacht Basin and its approach channel. This material is not too satisfactory as beach material, being a mixture of gravel, gray sand and silt. However, it does provide a base for surface improvement to effect a fine beach area. The filled land on the west shore of the park is partially protected near its north limit just south of the Yacht Basin by a riprap groin about 70 feet long, extending 30 feet seaward from the mean high water mark at that level, and sloping up the beach about 20 feet to the eroding bank of fill. The erosion of this bank during storms indicates that the groin is not sufficiently anchored at the landward end; in fact the groin is flanked or cut off from land at extremely high tides. Correction of this condition was being attempted at the time of this report by construction of bank protection. Railroad ties were being placed on end and embedded a couple of feet in the beach, sloping back slightly from the vertical.

APPENDIX G

ESTIMATES OF COSTS OF IMPROVEMENTS CONSIDERED FOR FEDERAL PROJECTS

The estimated costs of placement of sand on the beaches is based on hydraulic dredging from nearby offshore areas. Consideration has been given to the possible effect of such a program on the oyster beds existing offshore in western Connecticut. Oyster beds are assessed at $15.00 an acre. Valuations based on court awards allowed in past cases of oyster industry damages sustained indicate a possible $75.00 an acre figure. However, study reveals that for all the improvements considered for Federal projects and for most of the other improvements considered, sand can be obtained from areas outside or mainly outside of oyster ground areas. Contact with the Connecticut State Shellfish Commission to determine possible value of oyster grounds and location of such grounds under cultivation or suitable for cultivation revealed that such information is nonexistent. With the data therefore at hand, it is considered probable that no damage or only minor damage would be occasioned the oyster industry. No allowance has been made in this estimate for such improbable damage.

The estimated life of the considered projects is 50 years. The rate of interest on Federal investments is computed at 3 percent, and on non-Federal investments at 3.5 percent. Beach fill annual maintenance requirements have been estimated at one percent of initial volumes placed. The basis for this determination is as follows:

a. Present average annual recession of shore line....1 to 2 feet

b. Based on consideration that hurricanes of 1938 and 1944 caused a large percentage of the above recession, not reasonably expected to be repeated within the assumed 50 year life of the projects, and that recommended groin construction will retard beach losses, estimated future annual recession.....0.5 feet

c. Average recommended widening of beach..... 50 feet

d. Percent of initial volume annually lost..... 1

1. Jennings Beach and Ash Creek. - The plan of improvement for Jennings Beach and Ash Creek consists of construction of an impermeable jetty, including the necessary dredging of an inlet channel and jetty foundation through the outer bar.

A. FIRST COSTS

Jetty Construction

Jennings Beach Jetty 800 feet long 5100 tons riprap at $10.00	$51,000
Engineering and Contingencies	7,500
	$58,500

Dredging Inlet Channel and Jetty Foundation (If Necessary)

6,500 cubic yards at $1.00	$ 6,500
Engineering and Contingencies	1,000
	$ 7,500
TOTAL COST	$66,000

B. ANNUAL CHARGES

First costs are allocated as follows:

Federal cost - one-third of total cost	$22,000
Non-Federal cost - two-thirds of total cost	44,000
	$66,000

Federal Annual Charges

Interest	$ 660
Amortization	190
	$ 850

Non-Federal Annual Charges

Interest	$ 1,540
Amortization	340
Annual Maintenance: Repairs to jetty, 50 tons riprap @ $10.00	500
	$ 2,380
TOTAL ANNUAL CHARGES	$ 3,230

Note: These costs may be reduced about 9 percent if the inlet currents dig a channel through the outer bar as the jetty construction proceeds, eliminating dredging costs.

2. Sasco Hill Beach. - The plan of improvement for Sasco Hill Beach consists of widening to a 100-foot width, 900 feet of the beach and the construction of one impermeable groin.

A. FIRST COSTS

Beach Construction

25,000 cu. yds. sand @ $0.70	$17,500
Engineering and Contingencies	2,500
	$20,000

Groin Construction

1950 tons riprap @ $10.00	$19,500
Engineering and Contingencies	2,500
	$22,000
TOTAL COST	$42,000

B. ANNUAL CHARGES

First costs are allocated as follows:

Federal cost - one-third of total cost	$14,000
Non-Federal cost - two-thirds of total cost	28,000
	$42,000

Federal Annual Charges

Interest	$ 420
Amortization	125
	$ 545

Non-Federal Annual Charges

Interest		$ 980
Amortization		215
Annual Maintenance		
Replenishment of beach losses, 250 cubic yards sand at $2.00	$500	
Repairs to groin, 20 tons riprap at $10.00	200	700
		$ 1,895

TOTAL ANNUAL CHARGES.....$ 2,440

3. Southport Beach. - The plan of improvement for Southport Beach consists of widening 700 feet of the beach to a 100-foot width and the construction of one impermeable groin.

A. FIRST COSTS

Beach Construction

17,500 cu. yds. sand @ $0.80	$14,000
Engineering and Contingencies	2,000
	$16,000

Groin Construction

1200 tons riprap @ $10.00	$12,000
Engineering and Contingencies	2,000
	$14,000
TOTAL COST	$30,000

B. ANNUAL CHARGES

First costs are allocated as follows:

Federal cost - one-third of total cost	$10,000
Non-Federal cost - two-thirds of total cost	20,000
	$30,000

Federal Annual Charges

Interest	$ 300
Amortization	100
	$ 400

Non-Federal Annual Charges

Interest	$ 700
Amortization	150

Annual Maintenance

Replenishment of sand losses, 175 cubic yards of sand at $1.50	$265	
Repairs to groin, 12 tons riprap at $10.00	120	$ 385
		$1,235
TOTAL ANNUAL CHARGES		$1,635

4. Burial Hill Beach. - The plan of improvement for Burial Hill Beach consists of widening the beach to a 100-foot width, contingent upon construction by others of an impermeable jetty at Burial Hill Creek.

A. FIRST COSTS

Beach Construction

17,500 cub. yds. sand @ $0.80	$14,000
Engineering and Contingencies	2,500
	$16,500
TOTAL COST	$16,500

B. ANNUAL CHARGES

First costs are allocated as follows:

Federal cost - one-third of total cost	$ 5,500
Non-Federal cost - two-thirds of total cost	11,000
	$16,500

Federal Annual Charges

Interest	$ 165
Amortization	50
	$ 215

Non-Federal Annual Charges

Interest	$ 385
Amortization	85

Annual Maintenance

Replenishment of sand losses, 175 cubic yards sand @ $1.50	$ 265
	$ 735
TOTAL ANNUAL CHARGES	$ 950

5. Sherwood Island State Park. - The plan of improvement for Sherwood Island State Park consists of widening the beach to a 150 to 250-foot width, the construction of two training walls at Burial Hill Creek and the construction of one impermeable groin.

A. FIRST COSTS

Beach Construction

460,000 cubic yards sand @ $0.50	$230,000
Engineering and Contingencies	30,000
	$260,000

Training Walls at Burial Hill Creek

18,700 square feet steel sheet piling @ $2.25	$ 42,075
Engineering and Contingencies	7,925
	$ 50,000

Groin Construction

2750 tons riprap @ $10.00	$ 27,500
Engineering and Contingencies	4,500
	$ 32,000
TOTAL COST	$342,000

B. ANNUAL CHARGES

First costs are allocated as follows:

Federal costs - one-third of total cost	$114,000
Non-Federal costs - two-thirds of total cost	228,000
	$342,000

Federal Annual Charges

Interest		$ 3,400
Amortization		1,010
		$ 4,410

Non-Federal Annual Charges

Interest		$ 8,000
Amortization		1,750
Annual Maintenance.,		
Replenishment of sand losses, 4600 cubic yards sand @ $1.00	$4,600	
Repairs to groin 30 tons riprap @ $10.00	$ 300	
Repairs to training walls	400	5,300
		$ 15,050
TOTAL ANNUAL CHARGES		$ 19,460

6. Compo Beach. - The plan of improvement for Compo Beach consists of widening the beaches east and west of Cedar Point to a width of 100 feet and the construction of a groin at Hills Point and a groin at the western limit of the area.

A. FIRST COSTS

Beach Construction

96,600 cu. yds. sand @ $0.50	$ 48,300
Engineering and Contingencies	6,200
	$ 54,500

Groin Construction

5200 tons riprap @ $10.00	$ 52,000
Engineering and Contingencies	7,500
	$59,500
TOTAL COST	$114,000

B. ANNUAL CHARGES

First costs are allocated as follows:

Federal cost - one-third of total cost	$ 38,000
Non-Federal cost - two-thirds of total cost	76,000
	$114,000

Federal Annual Charges

Interest	$ 1,140
Amortization	340
	$ 1,480

Non-Federal Annual Charges

Interest		$ 2,660
Amortization		580
Annual Maintenance		
Replenishment of sand losses, 960 cubic yards sand at $1.50	$1,440	
Repairs to groins 50 tons @ $10.00	500	1,940
		$ 5,180
TOTAL ANNUAL CHARGES		$ 6,660

6A. Compo Beach (East). - That integral part of the plan of improvement for Compo Beach east of Cedar Point, consists of widening the beach to a 100-foot width, and the construction of an impermeable groin at its east limit, known as Hills Point.

A. FIRST COSTS

Beach Construction

76,000 cu. yds. of sand @ $0.50	$ 38,000
Engineering and Contingencies	5,000
	$ 43,000

Groin @ Hills Point

2300 tons riprap @ $10.00	$23,000
Engineering and Contingencies	3,000
	$26,000
TOTAL COST	$69,000

B. ANNUAL CHARGES

First costs are allocated as follows:

Federal cost - one-third of total cost	$23,000
Non-Federal cost - two-thirds of total cost	46,000
	$69,000

Federal Annual Charges

Interest	$ 690
Amortization	210
	$ 900

Non-Federal Annual Charges

Interest		$ 1,600
Amortization		360
Annual Maintenance		
Replenishment of sand losses, 760 cubic yards sand at $1.50	$1,140	
Repairs to groin, 25 tons riprap @ $10.00	250	1,390
		$ 3,350
TOTAL ANNUAL CHARGES		$ 4,250

6B. Compo Beach (West). - That integral part of the plan of improvement for Compo Beach west of Cedar Point consists of widening the beach to a 100-foot width and the construction of one impermeable groin.

A. FIRST COSTS

Beach Construction

20,600 cu. yds. sand @ $0.50	$10,300
Engineering and Contingencies	1,200
	$11,500

Groin Construction

2,900 tons riprap @ $10.00	$29,000
Engineering and Contingencies	4,500
	$33,500
TOTAL COST	$45,000

B. ANNUAL CHARGES

First costs are allocated as follows:

Federal cost - one-third of total cost	$15,000
Non-Federal cost - two-thirds of total cost	30,000
	$45,000

Federal Annual Charges

Interest	$ 450
Amortization	130
	$ 580

Non-Federal Annual Charges

Interest		$ 1,060
Amortization		220
Annual Maintenance		
Replenishment of sand losses, 200 cubic yards sand at $1.50	$300	
Repairs to groin 25 tons @ $10.00	250	550
		$ 1,830
TOTAL ANNUAL CHARGES		$ 2,410

APPENDIX H

ESTIMATES OF BENEFITS FROM IMPROVEMENTS CONSIDERED FOR FEDERAL PROJECTS

GENERAL

1. Theory. - Public Law 727, 79th Congress, authorizing Federal participation, states that--"with the purpose of preventing damage to public property and promoting and encouraging the healthful recreation of the people, it is hereby declared to be the policy of the United States to assist in the construction, but not the maintenance, of works for the improvement and protection against erosion by waves and currents of the shores of the United States that are owned by States, municipalities, or other political subdivisions--". The problem in Connecticut is primarily the loss and deterioration of its beaches, and secondarily, the protection of shore structures from direct damage. The benefits computed herein are based entirely on the promotion and encouragement of the healthful recreation of the people by improvement and restoration of the beaches. Indirect benefits, such as increased earning power or value of adjacent or indirectly affected private lands, have not been estimated although known to exist. (A purchasing power survey of Fairfield, made in 1939 and expanded to 1948, indicates $500,000 business dependent solely on summer increase in population.) Intangible benefits, such as prevention of loss of life by elimination of hazardous bathing conditions, similarly have not been estimated. No benefits have been assumed for protection of property against direct damage, although such effect will be realized by the improvements.

2. Standards of Public Beach Space. - Established standards of recreational beach area indicate 75 square feet per person as an optimum. In a densely settled section of the country such as Connecticut, attainment of that optimum is very doubtful. Present operating standards of peak beach use in Area 1 indicate recreational beach area on the town public

beaches of about 25 square feet per person and on Sherwood Island State Park beach of 60 square feet per person over the entire beach, or 37.5 square feet per person over the more desirable part of the beach. The improvements recommended for public beaches in Area 1 are expected to raise this operating recreational beach area standard to 50 square feet per person for Sherwood Island State Park and 42.5 square feet per person for the town public beaches.

3. Sherwood Island State Park. - Sherwood Island State Park is availto the public without restriction. This park draws directly on a population reservoir of the western half of Connecticut and the metropolitan area of New York. The State parks draw but little on the population reservoir in the immediate vicinity. In comparison to Hammonasset State Park, located on the Connecticut shore 50 miles to the east, and in comparison with town public beaches in Area 1, Sherwood Island State Park receives a very small attendance. This small attendance is due to the coarse nature of most of the beach which cannot compare with the town beaches and Hammonasset Beach.

4. Town Public Beaches. - Although the town public beaches in Area 1 are more or less restricted in theory to town residents, in practice the restriction is not enforced unless the beaches become overcrowded. Present operating standards of 25 square feet of recreational beach area per person indicates that these public beaches are drawing on other than the town population. The only restriction appears to be the capacity of the beach area.

5. Beach Attendance Formulae. - Study of existing beach attendance figures along the Connecticut shore indicates approximate formulae which have been used in this estimate for determination of annual and peak attendance figures. The estimates are based on a summer season of ten weeks, of which only seven are taken as effective weeks, to allow for weather and

other factors.

Town or local public beach formula

Day of Week	Attendance	Number of Weeks	Annual Attendance	Peak (1) Attendance
Sundays	3 X	7	21 X	1.5 X
Saturdays	2 X	7	14 X	1.0 X
Weekdays	X	7	35 X	0.5 X
		Total attendance	70 X	

(1) 50% of attendance for that day.

State Park beach formula

Day of Week	Attendance	Number of Weeks	Annual Attendance	Peak (1) Attendance
Sundays	5 X	7	35 X	2.5 X
Saturdays	3 X	7	21 X	1.5 X
Weekdays	X	7	35 X	0.5 X
		Total attendance	91 X	

(1) 50% of attendance for that day.

Sherwood Island State Park

6. Present beach use. -

a. Total beach area, 300,000 square feet.

b. Beach area of satisfactory quality, 50,000 square feet.

c. Annual attendance, 250,000 persons.

d. Peak attendance, 7,000 persons.

e. Operating standard of recreational beach area provided for peak use, 37.5 square feet per person.

(Based on area of satisfactory quality beach material, plus 50% of remaining area.)

7. Expected increased beach use. -

a. Total proposed beach area, 800,000 square feet.

b. Expected annual attendance, 550,000 persons.

c. Expected peak attendance, 16,000 persons.

d. Proposed standard of recreational beach area provided for peak use, 50 square feet per person.

(Based on entire present beach area plus proposed widening, as entire beach will be covered with sand of satisfactory quality).

8. Economic value of increased beach attendance. - The recreational value of beach use per person may be assumed to equal at least the expenditure he makes for it. It may also be assumed he receives added value above the cost to him which cannot be evaluated. It may be assumed that the average person using the beach at Sherwood Island State Park arrives by automobile with three others. The cost of transportation may be estimated at 60 miles (round trip) at $0.05 per mile. This cost of $3.00 divided by four persons equals $0.75 per person. The fee charged for use of park facilities would increase this value to $1.00 per person. Assuming that half of this expenditure is for other than the bathing benefit, the total annual benefit from increased attendance is therefore 300,000 persons x $0.50 = $150,000.

9. Economic value of improved beach use standards. - Present attendance at the beach in excess of 1000 persons at any one time results in lower than the proposed standard of recreational beach use area. This is equivalent to raising the beach-use standards for 200,000 of the present 250,000 annual attendance. It is considered that this proposed standard, less than the optimum standard, is justified as "improvement of the shore to encourage healthful recreation." Using the same value of $0.50 per person for improving the beach area for 200,000 of the present attendance, yields a benefit of $100,000. Total Recreational Benefit - $250,000.

Town Public Beaches

10. Present use of beaches for which improvements recommended. -

a. Total beach area:

Jennings Beach	1400(a)	x 150 =	210,000	sq. ft.
Sasco Hill Beach	800	x 25 =	20,000	" "
Southport Beach	500(b)	x 30 =	15,000	" "
Burial Hill Beach	500	x 60 =	30,000	" "
Compo Beach				
(1) East of Cedar Point	2600	x 50 =	130,000	" "
(2) West of Cedar Point	(c)		0	" "
		Total =	405,000	" "

(a) Eastern 500 feet posted against bathing due to current hazards. (1900-500=1400)

(b) 200 feet not usable at each end of 900-foot beach.

(c) Not used to any great extent at present; beach material unsatisfactory.

b. Annual attendance* 850,000 persons
c. Peak attendance 18,000 "
d. Operating standard of recreational beach area provided for peak use - 22.5 square feet per person.

*(Based on known figures at Compo Beach and assumption that intensity of use at Compo is typical of other town beaches.)

11. Expected increased beach use. -

a. Total proposed beach areas:

Jennings Beach	1900 x 150 =	285,000 sq. ft.
Sasco Hill Beach	800 x 100 =	80,000 " "
Southport Beach	700 x 100 =	70,000 " "
Burial Hill Beach	500 x 100 =	50,000 " "
Compo Beach		
(1) East of Cedar Point	2600 x 100 =	260,000 " "
(2) West of Cedar Point	1100 x 100 =	110,000 " "
	Total =	855,000 " "

b. Expected annual attendance 935,000 persons
c. Expected peak attendance 20,000 "
d. Proposed standard of recreational beach use area provided for peak use - 42.5 square feet per person.

Note - Although this beach use standard is not as high as that set for Sherwood Island State Park, it is not considered probable that the State Park will draw off those now using local convenient beaches. The park draws mainly on more distant populations.

12. Economic value of increased beach attendance. - The value of beach attendance to persons using town beaches may be computed in similar fashion as in Paragraph 7. The average round trip for persons using town beaches may be conservatively set at 8 miles, or a person cost of $0.10. Those driving to town beaches are assumed to have that sole purpose and no other benefit in mind. An average beach use fee of $0.10 yields a valuation of

$0.20 per person. The total annual benefit would be 85,000 persons x $0.20 or $17,000.

13. Economic value of improved beach use standards. - Present attendance at the beach in excess of 10,000 persons at any one time (405,000 square feet divided by 42.5 square feet per person) results in lower than the proposed standard of recreational beach use area. Present week-end peak attendances are 10,000 in excess of that figure, or about 70,000 persons per season. This is equivalent to raising the beach use standards for 70,000 of the present 850,000 annual attendance. Using the same value of $0.20 per person yields an annual benefit of $14,000. Total Recreational Benefit - $31,000.

14. Proportion of benefit to particular beaches. - The proposed improvements for all the town public beaches for which improvements are recommended will result in a total annual benefit of $31,000. This annual benefit is proportioned according to the increases in beach area provided.

Town Beach	Additional Area in Square Feet		Annual Benefit	
Jennings Beach		75,000		$ 5,165
Sasco Hill Beach		60,000		4,135
Southport Beach		55,000		3,790
Burial Hill Beach		20,000		1,380
Compo Beach				
a. East of Cedar Point	130,000		8,955	
b. West of Cedar Point	110,000		7,575	
c. Total for Compo Beach		240,000		16,530
Total additional area		450,000		$31,000

APPENDIX I

ESTIMATES OF COSTS OF IMPROVEMENTS CONSIDERED FOR NON-FEDERAL PROJECTS

The estimated life of the considered projects is 50 years. The rate of interest on Non-Federal investments is computed at 3.5 percent. Beach fill annual maintenance requirements have been estimated at one percent of initial volumes placed. The basis for this determination is as follows:

a. Present average annual recession of shore line...1 to 2 feet

b. Based on consideration that hurricanes of 1938 and 1944 caused a large percentage of the above recession, not reasonably expected to be repeated within the assumed 50 year life of the projects, and that recommended groin construction will retard beach losses, estimated future annual recession.....0.5 feet

c. Average recommended widening of beach..... 50 feet

d. Percent of initial volume annually lost..... 1

1. Fairfield Beach. - The plan of improvement for Fairfield Beach consists of widening 9000 feet of the beach to a 100-foot width and the construction of seven impermeable groins 400 to 500 feet long.

a. First Costs. -

Beach Construction

350,000 cubic yards of sand at $0.50.....	$ 175,000
Engineering and Contingencies.....	26,000
	$ 201,000

Groin Construction

12,000 tons riprap at $10.00.....	$ 120,000
Engineering and Contingencies.....	19,000
	$ 139,000
Total Costs.....	$ 340,000

b. Annual Charges. -

Non-Federal Annual Charges

Interest.....	$ 12,000
Amortization.....	2,600

Annual Maintenance

Replenishment of sand losses, 3,500 cubic yards of sand at $1.00	$3,500	
Repairs to groins, 120 tons riprap at $10.00	1,200	$ 4,700
Total Non-Federal Annual Charges		$19,300

2. Pine Creek Sand Spit. - The recommendation for Pine Creek Sand Spit is to abandon the spit west of Pine Creek Point. An alternative plan considered widening to a 250-foot width the sand spit west of Pine Creek Point, 2300 feet long, the construction of two impermeable groins 400 and 450 feet long and one training wall 550 feet long. It was considered that the hazardous nature of this area, even after such improvement, prevented recommendation of this construction. The costs of such improvement would probably exceed the benefits therefrom. No specific estimate of cost of this alternative plan is included in this report.

3. Pine Creek Beach. - The plan of improvement for Pine Creek Beach consists of widening 500 feet of the beach to a 100-foot width and the construction of one training wall 450 feet long at Pine Creek Inlet.

a. First Costs. -

Beach Construction

40,000 cubic yards of sand at $0.60		$ 24,000
Engineering and Contingencies	3,500	
		$ 27,500

Training Wall Construction

3,200 tons of riprap at $10.00		$ 32,000
Engineering and Contingencies	4,500	
		$ 36,500
Total Costs		$ 64,000

b. Annual Charges. -

Non-Federal Annual Charges

Interest		$ 2,250
Amortization		500
Annual maintenance		
Replenishment of sand losses, 400 cubic yards of sand at $1.50	$600	
Repairs to jetty, 30 tons of riprap at $10.00	$300	900
Total Non-Federal Annual Charges		$ 3,650

4. Kensie Point. - The plan of improvement for Kensie Point consists of maintaining the existing walls and revetment along 2000 feet of shore.

5. Southport Harbor to Southport Beach. - The plan of improvement for this beach area consists of maintaining the existing walls.

6. Greens Farms. - The plan of improvement for Greens Farms consists of maintenance of existing wall system. An alternate plan of improvement considered consists of widening about 6,500 feet of the beach to a 100-foot width and the construction of six impermeable groins 400 and 500 feet long.

a. First Costs. -

Beach Construction

300,000 cubic yards of sand at $0.50		$150,000
Engineering and Contingencies		18,000
		$168,000

Groin Construction

12,000 tons of riprap at $10.00		$120,000
Engineering and Contingencies		17,000
		$137,000

Total Costs.....$ 305,000

b. Annual Charges. -

Non-Federal Annual Charges

Interest		$ 10,700
Amortization		2,300
Annual maintenance		
Replenishment of sand losses, 3,000 cubic yards of sand at $1.00	$3,000	
Repairs to groins, 120 tons of riprap at $10.00	1,200	4,200
Total Non-Federal Annual Charges		$ 17,200

7. Compo Mill Beach Association. - The plan of improvement for this area consists of widening 1700 feet of the beach to a 100-foot width and the construction of one impermeable groin 450 feet long.

a. First Costs. -

Beach Construction

89,000 cubic yards of sand at $0.50	$ 44,500
Engineering and Contingencies	5,500
	$50,000

Groin Construction

2,000 tons of riprap at $10.00	$20,000
Engineering and Contingencies	3,000
	$23,000
Total Costs	$73,000

b. Annual Charges. -

Non-Federal Annual Charges

Interest	$ 2,550
Amortization	550

Annual maintenance

Replenishment of sand losses, 900 cubic yards of sand at $1.50	$1,350	
Repairs to groin, 20 tons of riprap at $10.00	200	1,550

Total Non-Federal Annual Charges ..... $ 4,650

8. Old Mill Beach to Hills Point. - The plan of improvement for this area consists of maintaining the existing walls and revetment. An alternate plan of improvement considered consists of widening 2400 feet of the beach to a 100-foot width, and the construction of one impermeable groin 400 feet long.

a. First Costs. -

Beach Construction

45,000 cubic yards of sand at $0.60		$27,000
Engineering and Contingencies		4,000
		$31,000

Groin Construction

1,600 tons of riprap at $10.00		$16,000
Engineering and Contingencies		2,000
		$18,000
Total Costs		$49,000

b. Annual Charges. -

Non-Federal Annual Charges

Interest		$ 1,700
Amortization		400
Annual maintenance		
Replenishment of sand losses, 450 cu.yds. of sand at $2.00	$900	
Repairs to groin 15 tons of riprap at $10.00	150	1,050

Total Non-Federal Annual Charges ..... $ 3,150

9. Summary. -

	Type of Project	Total Cost of Considered Improvement	Total Non-Federal Annual Charges	Total Cost of Alternate Improvements Considered	Total Non-Federal Annual Charges of Alternate Improvements
Fairfield Beach	Beach Construction	340,000	19,300	-	-
Pine Creek Sand Spit	Abandonment of beach	-	-		
Pine Creek Beach Area	Beach Construction	64,000	3,650		
Kensie Point	Wall maintenance	-	-		
Southport Harbor to Southport Beach	Wall maintenance	-	-		
Greens Farms	Wall maintenance	-	-		
Greens Farms	Beach Construction			305,000	17,200
Compo Mill Beach Association	Beach Construction	73,000	4,650		
Old Mill Beach to Hills Point	Wall maintenance	-	-		
Old Mill Beach to Hills Point	Beach Construction			49,000	3,150
	Totals	$477,000	27,600	354,000	20,350

Total Costs of All Improvements Considered.....$831,000

Total Non-Federal Annual Charges of All Improvements Considered $ 47,950

APPENDIX J

ESTIMATES OF BENEFITS FROM IMPROVEMENTS CONSIDERED FOR NON-FEDERAL PROJECTS

Additional benefits, not necessary of computation in this report to show a favorable ratio of benefits to costs, to be included in succeeding and final report. These benefits will result from a more comprehensive analysis of data now being collected.

1. Estimate of Increased Land Values. -

a.	Assessed value Fairfield shore property (Excluding buildings)	$1,090,000
b.	Ratio assessed value to real value	0.40
c.	Real value Fairfield shore property (a/b)	2,725,000
d.	Assessed value Westport shore property (excluding buildings)	2,100,000
e.	Ratio assessed value to real value	0.80
f.	Real value Westport shore property (d/e)	2,625,000
g.	Real value of combined Fairfield and Westport shore property (excluding buildings) (c + f)	5,350,000
h.	Combined length Fairfield and Westport shore	63,000 ft.
i.	Real value per linear foot of shore property (g/h)	84.90
j.	Estimated increase in value per linear foot for 11,000 feet of shore property due to proposed improvement (100% x i)	84.90
k.	Estimated increase in value per linear foot for 10,000 feet of shore property due to proposed improvement (50% x i)	42.45
l.	Length of shore included in proposed improvements	21,000
m.	Total estimated increase in value of shore property	1,358,000

n. Estimated annual benefit (3.5% of m)..... $47,530

2. Estimate of Savings in Maintenance Costs of Existing Protective Structures. -

Structure	Length in Feet	Estimated Value	Estimated Annual Maintenance Cost
Sea-walls	18,000	$ 600,000	$ 30,000
Bulkheads	2,000	50,000	2,500
Groins	9,000	54,000	2,700

Total estimated annual maintenance cost.....$ 35,200

The proposed improvements would eliminate this maintenance cost. Therefore,

Total estimated annual benefit.....$ 35,200

3. Estimate of Savings Effected by Elimination of Need for New Protective Structures at Unprotected or Inadequately Protected Shores. -

a. Cost of new construction.....$100,000

b. Annual investment charges..... 4,200

c. Annual maintenance charges..... 2,000

d. Total annual charges = benefit..... 6,200

4. Estimate of Benefits from Increased Business. -

a. Survey in 1939 indicated purchasing power $5,000,000

b. Purchasing power in 1948 on 1938 price levels due to 50% increase in population since 1939.....7,500,000

c. Purchasing power present population due to increase in prices of 60% since 1939.12,000,000

d. Summer population / permanent population $= \frac{35,000}{30,000}$..... 1.16

e. Estimated present summer soason purchasing power.....3,360,000

f.	Estimated purchasing power due to increase of population in summer (1/7 x 3,360,000)....	480,000
g.	Improvement estimated to attract additional purchasing power indicated by doubling of land values at cottage type developed areas or.....	480,000
h.	An estimated 50% of this purchasing power will be a benefit not directly connected to the shore property values or.....	240,000
i.	Profit on this increased business estimated at 10% or.....	24,000
j.	Annual indirect business benefit.....	24,000

5. Justification. -

a.	Annual charges total proposed improvements.....	47,950
b.	Annual benefits.....	112,930
c.	Ratio benefits to costs.....	2.4

APPENDIX K

POLLUTION ALONG THE CONNECTICUT SHORE

1. Pollution Study. - A sanitary study of shore bathing waters was carried out by the State of Connecticut, Department of Health, during the summers of 1945, 1946 and 1948. The purpose of the study was to obtain specific information concerning the sanitary condition of bathing areas and to notify local authorities and interested persons about "danger spots" along the shore which are seriously affected by sewage pollution. The entire shore line of the State of Connecticut, including a number of small coves and the lower part of some tidal streams, was examined during this period.

2. Bacterial Survey. - A bacterial survey was made consisting of water samples taken at approximately 1000-foot intervals along the shore at over 1000 stations in water depths of from 2 to 6 feet, such depths covering most of the areas used for bathing. These samples were taken at four stages of the tide; namely, high, low, mean ebb and mean flood. Wind direction at the time of sampling was recorded. No attempt was made to take samples under different wind conditions as it was believed that the run of the tide was the principal factor influencing the travel of pollution along the shore. A laboratory analysis in each of three dilutions of 10 ml., 1.0 ml. and 0.1 ml. was made for each sample obtained. From this analysis the most probable number of coliform organisms per 100 ml. was computed. The final result for each sampling station was obtained by averaging the computed most probable numbers for the four samples at each station.

3. Sanitary Survey. - In addition to the bacterial survey described above, a sanitary survey of shore areas was conducted. This included the location of sewer outlets, with data as to flows and character of untreated

and treated sewage. Much of this data was already available from previous detailed studies. The nearness of polluting influences and possibilities of shifting direction of travel of pollution under different wind conditions were taken into account in this part of the study. In connection with studies of shellfish areas in many harbors, floats had been set out to measure the rapidity of water travel and these data were available in considering bathing waters in these localities.

4. Comparison of Bacterial and Sanitary Surveys. - The entire shore area was divided into sections varying in length from 1000 feet to one or more miles for the purpose of classification. The shore was classified as A, B, C or D, representing good, fair, doubtful to poor, and poor conditions, respectively. From the bacterial survey, Class A was considered to include samples containing from 0 to 50 coliform organisms per 100 ml.; Class B, 51 to 500; Class C, 501 to 1000; and Class D, over 1000. From the sanitary survey data the shore sections were also classified into the four groups described above. A tabulation of the results of these two classifications is given below.

	Bacterial Analysis Classification		Sanitary Survey Classification	
	Mileage	Percentage	Mileage	Percentage
Class A	90.7	35.9	65.1	25.8
Class B	103.6	41.1	75.9	30.1
Class C	15.1	6.0	65.7	26.0
Class D	42.9	17.0	45.6	18.1
	252.3	100.0	252.3	100.0

A comparison of the bacterial analysis and sanitary survey classifications shows that 61.1 percent of the shore was graded the same in both classifications; 34.3 percent of the shore falls into one grade lower according to the sanitary survey classification than according to the bacterial analysis classification; 3.6 percent of the shore falls into one

grade higher and 1.0 percent of the shore falls into two grades lower according to the sanitary survey classification. In general, then, it can be said that with minor exceptions the bacterial analysis classification grades the shore the same as or one class higher than the sanitary survey classification.

5. Spread of Disease at Bathing Places. - The Joint Committee on Bathing Places of the American Public Health Association and the Conference of State Sanitary Engineers published a comprehensive report in which is reviewed the possibilities of the spread of disease through the use of bathing places. This review was prepared after a comprehensive survey of reported cases of illness attributed to such waters. Although recognizing the possibilites of transmission of disease at bathing places, the Joint Committee concludes that there is little known evidence that this has occurred. They point out that careful surveillance and proper sanitary control should be exercised and recommend against bathing in grossly polluted waters.

6. Polluted Shore Areas in Connecticut. - In general, from the Connecticut study it was found that pollution existed principally in harbor waters and in waters in close proximity to harbors. This pollution is rapidly dissipated by dilution in Long Island Sound so that many miles of Connecticut shore line are in excellent condition. Considerable progress has been made in the improvement of conditions in harbors through sewage treatment plant installations. Due to a tendency toward extensive use of bathing beaches near urban centers, a few bathing places are located in areas close to the border line of safety. Although this condition is undesirable and indicates a need for improvement, no alarm is felt at present in view of the absence of reported cases of illness acquired at these localities. Many individual cases of local pollution have been disclosed by the

survey. These sources though small in magnitude are considered more dangerous due to their proximity to bathing areas than larger sources of pollution at a greater distance. The two principal rivers entering Long Island Sound, the Connecticut and the Housatonic, receive a large amount of pollution. Due to self-purification and later dilution in Long Island Sound, these rivers cause very little pollution load on the Sound. Within a distance of 1000 feet on either side of the Housatonic River no pollution effect was noted. The bacteria counts of samples along the mouth of the Connecticut River were all relatively low. The following areas in Connecticut were classified as being in poor condition:

a. Vicinity of sewer outlets at New London and Groton

b. Localized areas at Bridgeport, Norwalk and New Haven

c. Byram River between Portchester, N. Y., and Greenwich

d. The upper part of Cos Cob Harbor in Greenwich

e. The Saugatuck River section of Westport

f. The Mill River section of Fairfield

g. The mouth of the Branford River

h. The vicinity of Grove Beach in Westbrook

i. Stonington Harbor

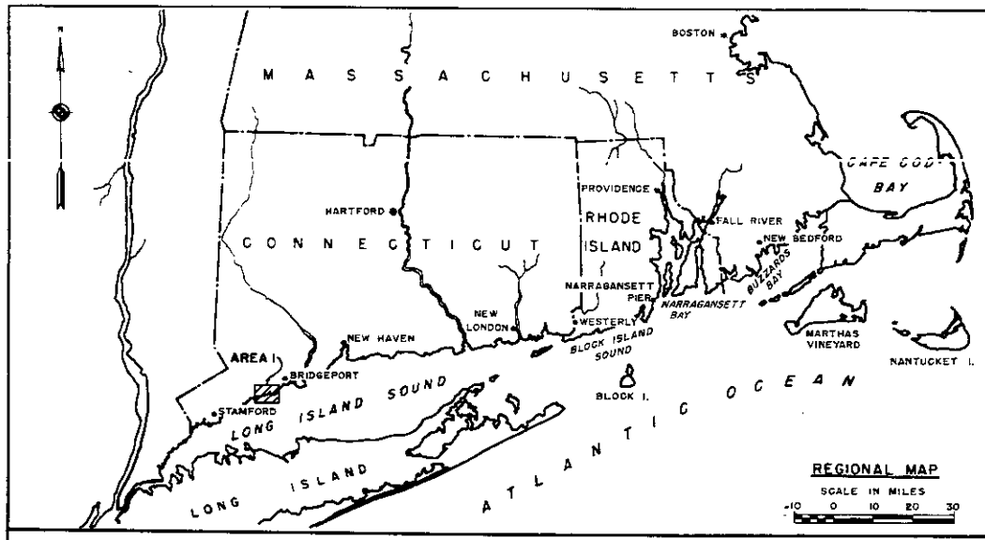
j. The easterly section of Stonington, particularly the vicinity of the mouth of the Pawcatuck River

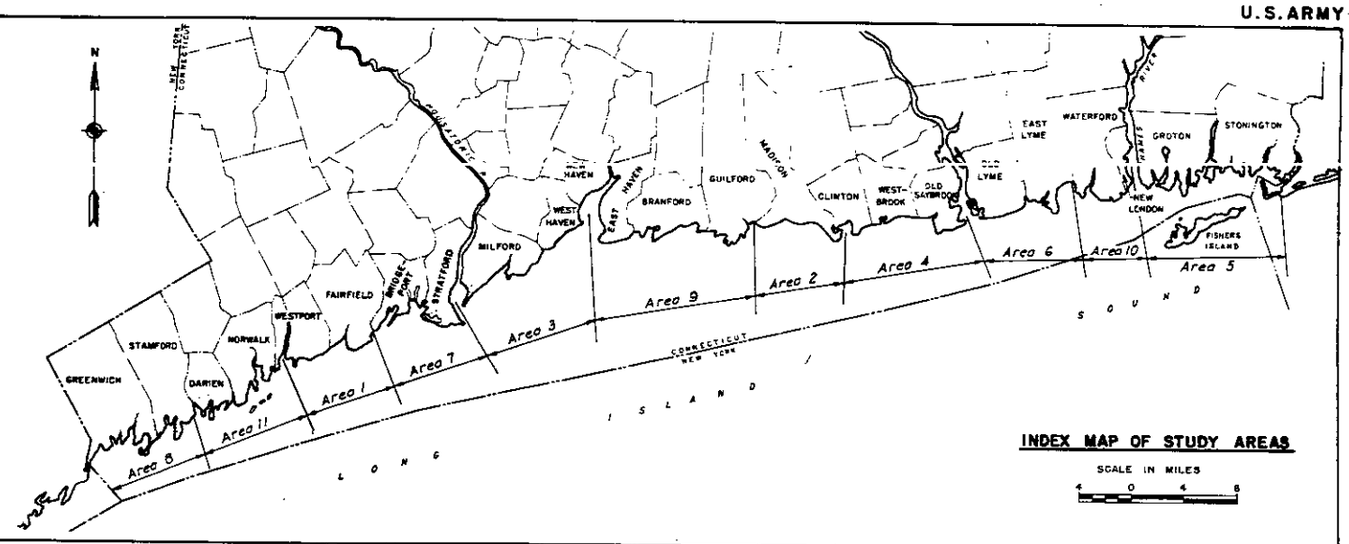
k. Many sewer outlets in Mystic

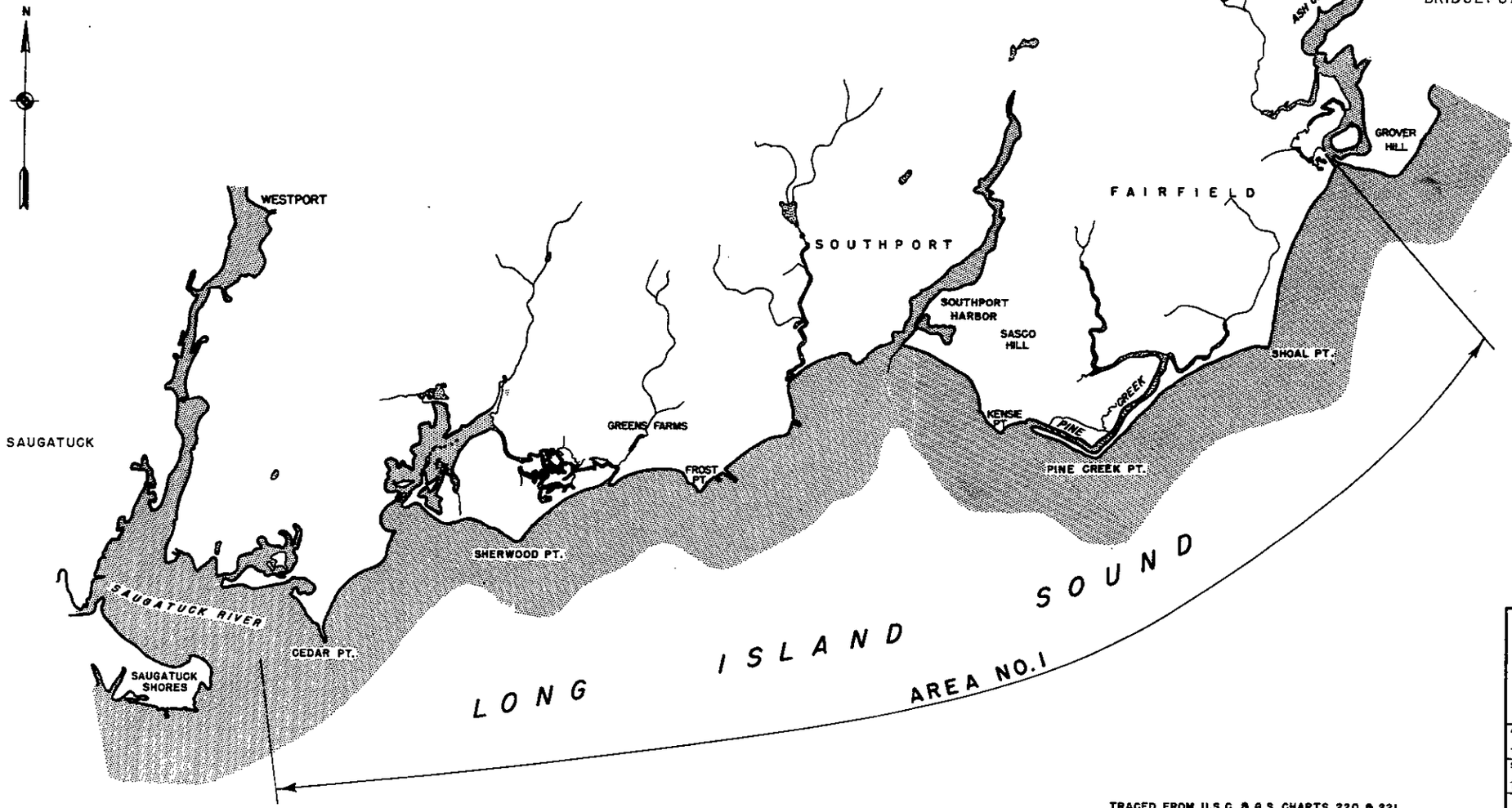
The pollution in the above areas is very local with little pollution effect noticeable at relatively short distances away, with the exception of the Pawcatuck River area where the pollution carries for a considerable distance.

CORPS OF ENGINEERS

U.S. ARMY







TRACED FROM U.S.C. & G.S. CHARTS 220 & 221

CONNECTICUT BEACH EROSION CONTROL STUDY

LOCATION MAP AREA I

ASH CREEK TO SAUGATUCK RIVER

IN 1 SHEET SCALE IN FEET 2000 0 2000 4000

NEW ENGLAND DIVISION, BOSTON, MASS. JAN. 20, 1949

APPROVAL RECOMMENDED: Henry A. Whitcomb, CHIEF, N.E.D. OPERATIONS DIVISION

APPROVED: [signature], LT. COL., C.E., ASST. DIVISION ENGINEER

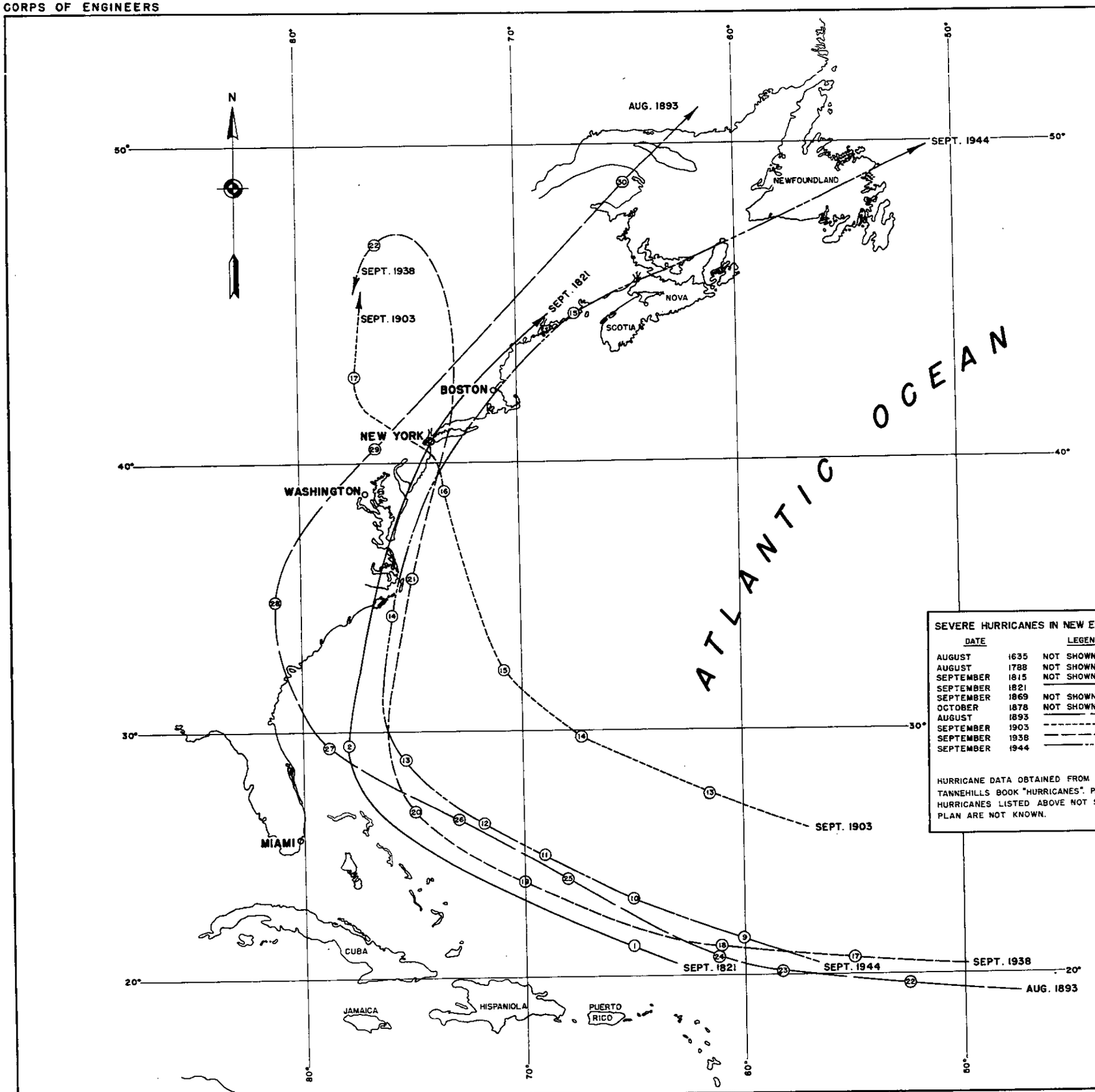
SUBMITTED: [signature], N.E.D. PROJECTS AND REPORTS BRANCH

TRANSMITTED WITH REPORT DATED FEBRUARY 7, 1949.

DR. BY H.S.P. TR. BY A.S.P. CH. BY [illegible]

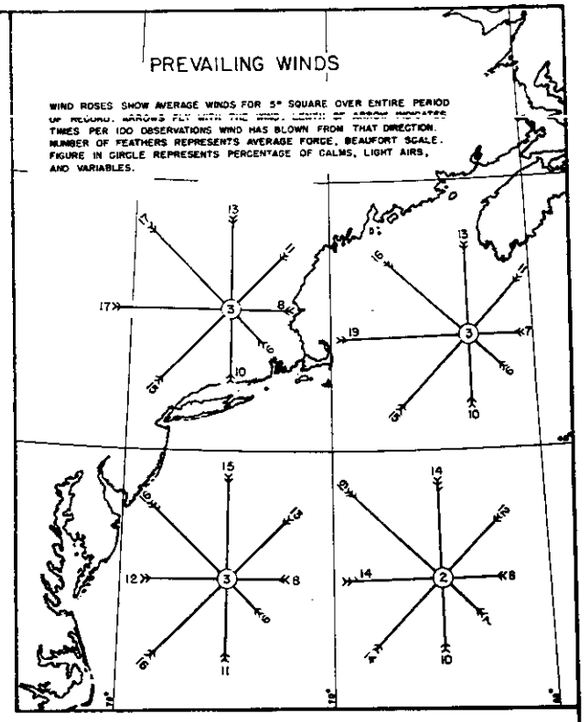
FILE NO. B.E. Ct. 1

PLATE 1



PREVAILING WINDS

WIND ROSES SHOW AVERAGE WINDS FOR 5° SQUARE OVER ENTIRE PERIOD OF RECORD. ARROWS FLY WITH THE WIND. LENGTH OF ARROW INDICATES TIMES PER 100 OBSERVATIONS WIND HAS BLOWN FROM THAT DIRECTION. NUMBER OF FEATHERS REPRESENTS AVERAGE FORCE, BEAUFORT SCALE. FIGURE IN CIRCLE REPRESENTS PERCENTAGE OF CALMS, LIGHT AIRS, AND VARIABLES.



SEVERE HURRICANES IN NEW ENGLAND

DATE		LEGEND
AUGUST	1635	NOT SHOWN
AUGUST	1788	NOT SHOWN
SEPTEMBER	1815	NOT SHOWN
SEPTEMBER	1821	
SEPTEMBER	1869	NOT SHOWN
OCTOBER	1878	NOT SHOWN
AUGUST	1893	
SEPTEMBER	1903	
SEPTEMBER	1938	
SEPTEMBER	1944	

HURRICANE DATA OBTAINED FROM IVAN RAY TANNEHILLS BOOK "HURRICANES". PATHS OF HURRICANES LISTED ABOVE NOT SHOWN ON PLAN ARE NOT KNOWN.

NOTE

Figures in circles shown thus (13) represent location of the center of hurricane on the day of month of its occurrence.

CONNECTICUT BEACH EROSION CONTROL STUDY

HURRICANES AND PREVAILING WINDS

NEW ENGLAND DIVISION, BOSTON, MASS. JAN. 20, 1949.

APPROVAL RECOMMENDED
Henry A. Whitehouse
CHIEF, R&H OPERATIONS DIVISION

APPROVED
LT COL., C.E., ASST. DIVISION ENGINEER

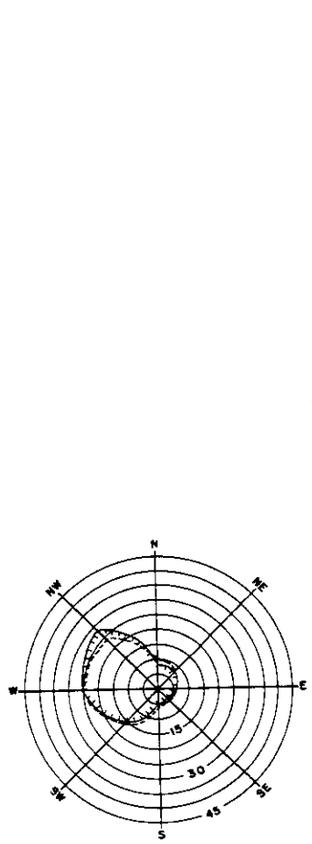
SUBMITTED
R&H PROJECTS AND REPORTS BRANCH

TRANSMITTED WITH REPORT DATED FEBRUARY 7, 1949.

DR. BY W.S.P.
TR. BY R.S.
CH. BY JWC

FILE NO. B.E.Ct. 2

PLATE 2



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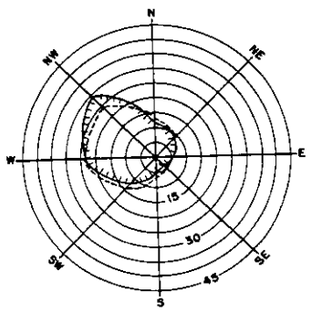

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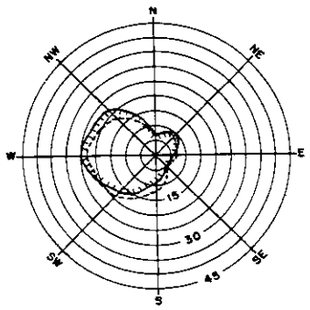

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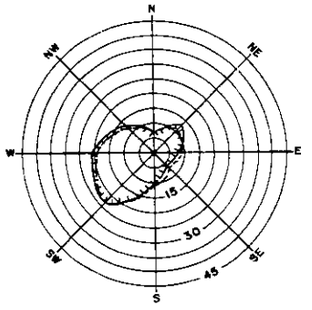

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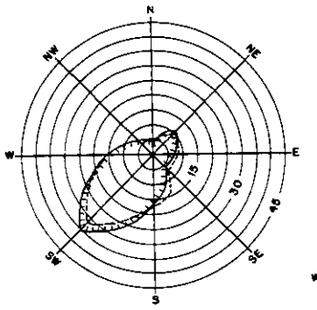

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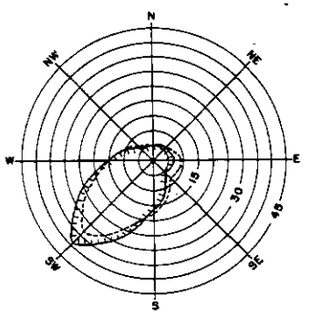

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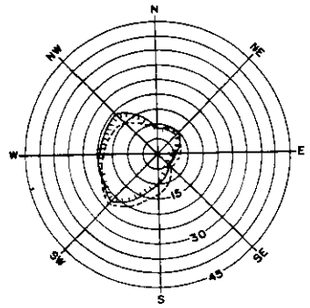

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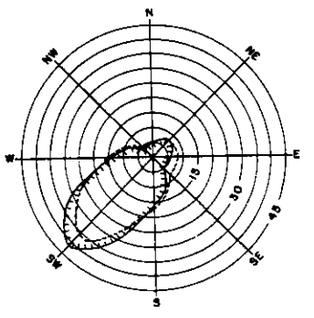

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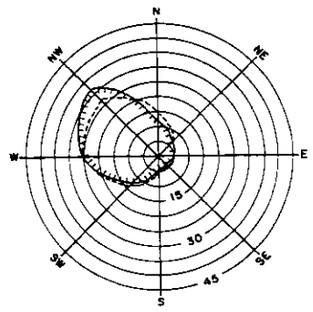

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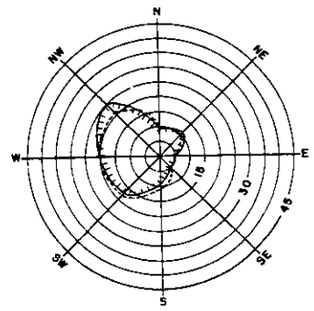

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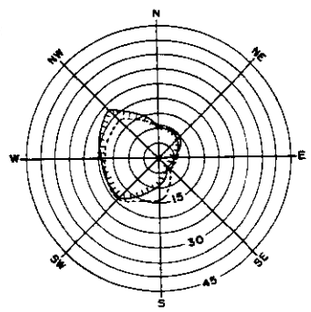

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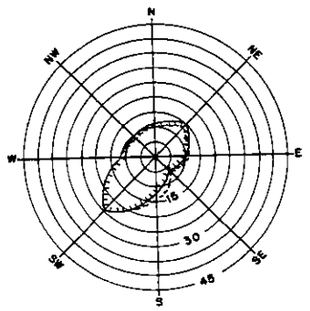

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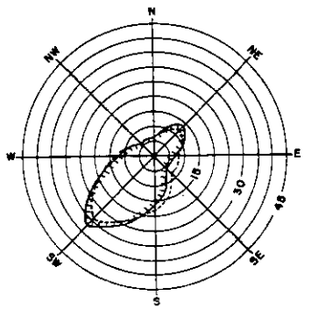


AUGUST

LEGEND

PERCENTAGE OF TOTAL WIND MOVEMENT

PERCENTAGE OF TOTAL WIND DURATION

NOTES

EACH CONCENTRIC CIRCLE STARTING AT THE CENTER REPRESENTS FIVE PERCENT OF THE TOTAL WIND MOVEMENT OR TOTAL WIND DURATION.

THE WIND DIAGRAMS REPRESENT PERCENTAGE OF TOTAL WIND MOVEMENT OR WIND DURATION AVERAGED FOR A PERIOD FROM 1921 TO 1939.

THE ANNUAL DIAGRAM REPRESENTS AVERAGES COMPUTED FOR THE ENTIRE PERIOD. THE MONTHLY DIAGRAMS REPRESENT AVERAGES COMPUTED FOR EACH MONTH OF THE YEAR FOR THE ENTIRE PERIOD.

BASIC DATA COMPILED FROM OBSERVATIONS OF THE U.S. WEATHER BUREAU AT BLOCK ISLAND, RHODE ISLAND.

CONNECTICUT BEACH EROSION CONTROL STUDY

WIND DATA

BLOCK ISLAND, RHODE ISLAND

1921 - 1939

IN 1 SHEET

NEW ENGLAND DIVISION BOSTON, MASS. JAN. 20, 1949

APPROVAL RECOMMENDED

CHIEF, A & H OPERATIONS DIVISION

APPROVED

LT. COL., C.E., ASST. DIVISION ENGINEER

SUBMITTED

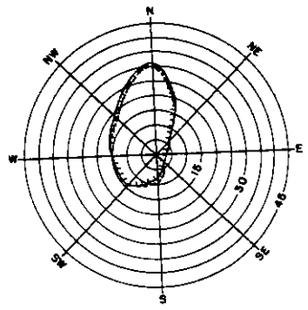
H & H PROJECTS AND REPORTS BRANCH

DR BY H.S.P.
TR BY R.S.
CH BY [illegible]

TRANSMITTED WITH REPORT DATED FEBRUARY 7, 1949.

FILE NO. B.E.C1.3

PLATE 3



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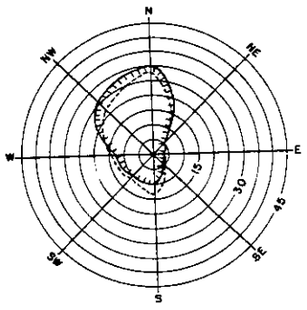
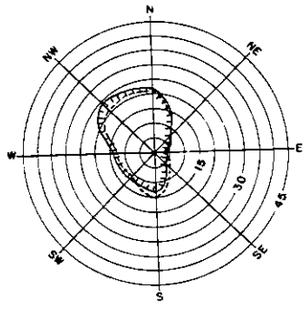


FEBRUARY



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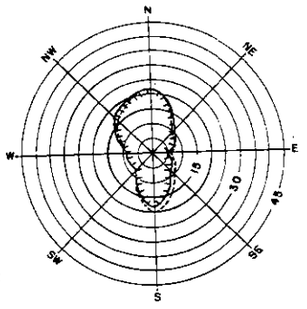

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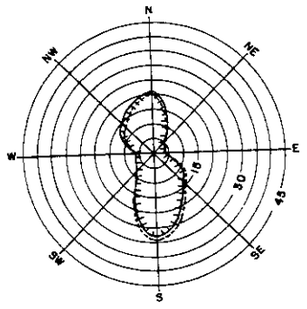

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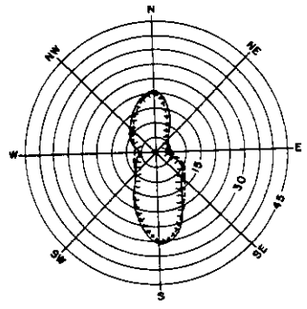

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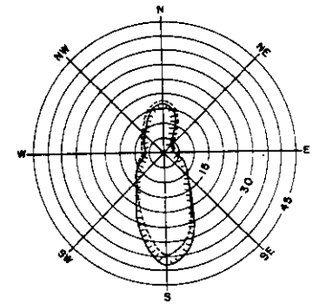

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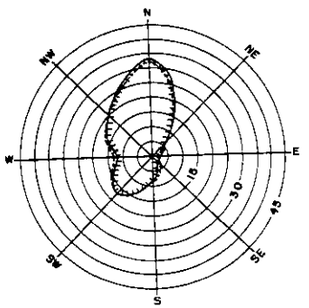

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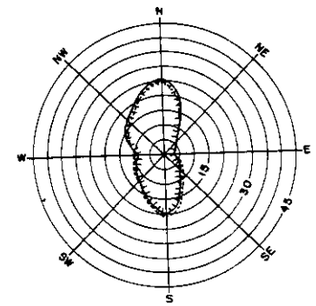

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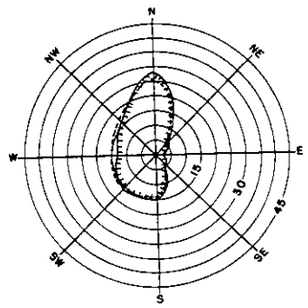

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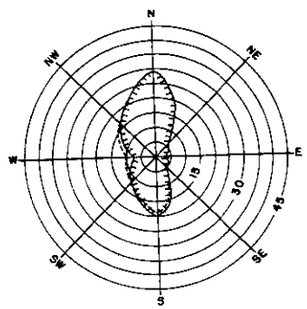

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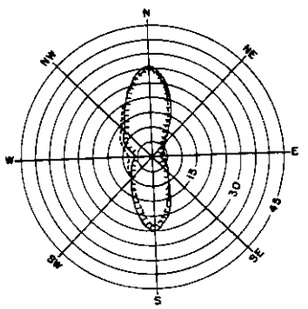

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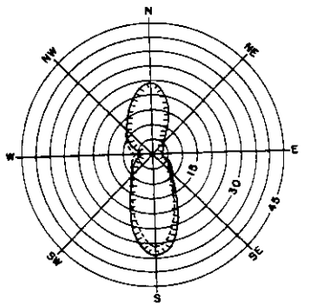


AUGUST

NOTES

EACH CONCENTRIC CIRCLE STARTING AT THE CENTER REPRESENTS FIVE PERCENT OF THE TOTAL WIND MOVEMENT OR TOTAL WIND DURATION.

THE WIND DIAGRAMS REPRESENT PERCENTAGE OF TOTAL WIND MOVEMENT OR WIND DURATION AVERAGED FOR A PERIOD FROM 1932 TO 1942.

THE ANNUAL DIAGRAM REPRESENTS AVERAGES COMPUTED FOR THE ENTIRE PERIOD. THE MONTHLY DIAGRAMS REPRESENT AVERAGES COMPUTED FOR EACH MONTH OF THE YEAR FOR THE ENTIRE PERIOD.

BASIC DATA COMPILED FROM OBSERVATIONS OF THE U.S. WEATHER BUREAU AT NEW HAVEN, CONNECTICUT.

LEGEND

PERCENTAGE OF TOTAL WIND MOVEMENT

PERCENTAGE OF TOTAL WIND DURATION

CONNECTICUT BEACH EROSION CONTROL STUDY

WIND DATA

NEW HAVEN, CONNECTICUT

1932 - 1942

IN 1 SHEET

NEW ENGLAND DIVISION BOSTON, MASS. JAN. 20, 1949

APPROVAL RECOMMENDED
Howard A. Whitcomb
CHIEF, N.E.D. OPERATIONS DIVISION

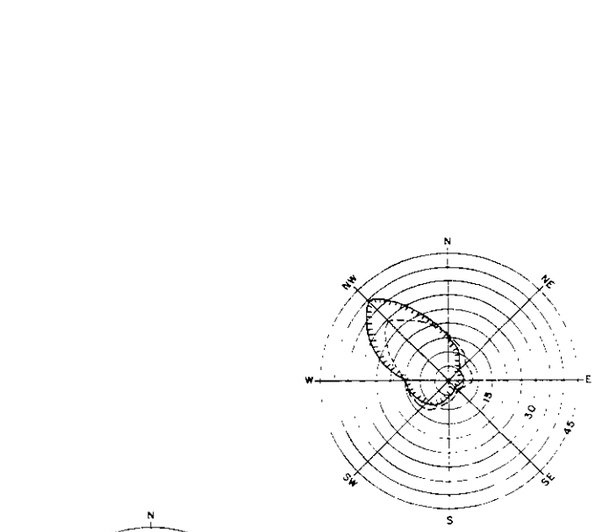
APPROVED
Lt. Col. C.E., ASST. DIVISION ENGINEER

SUBMITTED
R.D.H. PROJECTS AND REPORTS BRANCH

TRANSMITTED WITH REPORT DATED FEBRUARY 7, 1949.

DR. BY H.S.P.
TR. BY K.W.
CH. BY J.A.P.

FILE NO. B.E.C1.4



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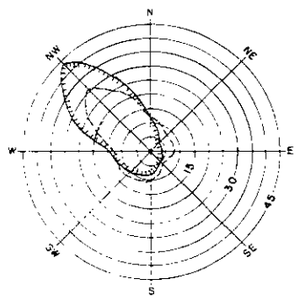

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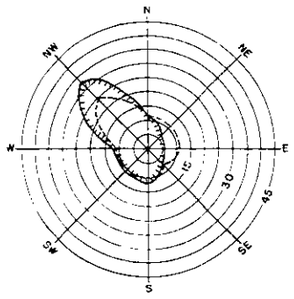

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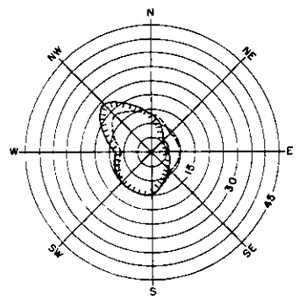

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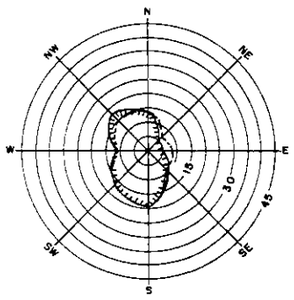

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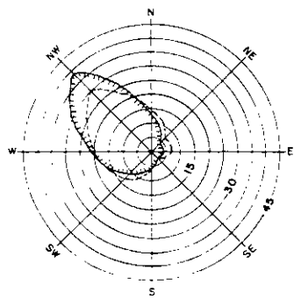

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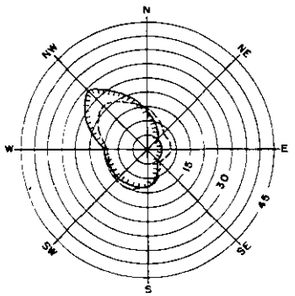
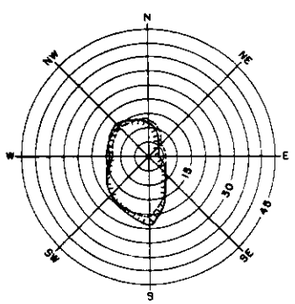


ANNUAL



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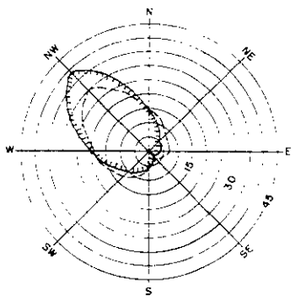

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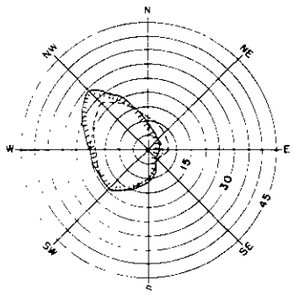

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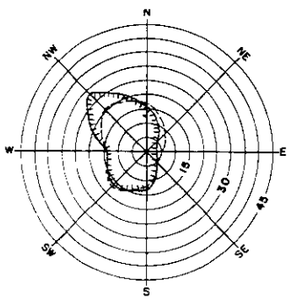

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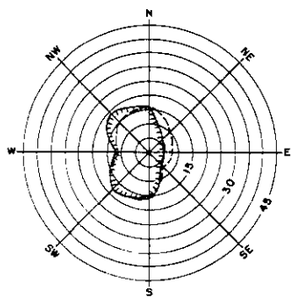

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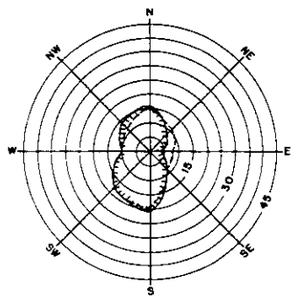


AUGUST

NOTES

EACH CONCENTRIC CIRCLE STARTING AT THE CENTER REPRESENTS FIVE PERCENT OF THE TOTAL WIND MOVEMENT OR TOTAL WIND DURATION.

THE WIND DIAGRAMS REPRESENT PERCENTAGE OF TOTAL WIND MOVEMENT OR WIND DURATION AVERAGED FOR A PERIOD FROM 1921 TO 1942

THE ANNUAL DIAGRAM REPRESENTS AVERAGES COMPUTED FOR THE ENTIRE PERIOD. THE MONTHLY DIAGRAMS REPRESENT AVERAGES COMPUTED FOR EACH MONTH OF THE YEAR FOR THE ENTIRE PERIOD.

BASIC DATA COMPILED FROM OBSERVATIONS OF THE U.S WEATHER BUREAU AT NEW YORK CITY, NEW YORK.

LEGEND

PERCENTAGE OF TOTAL WIND MOVEMENT

PERCENTAGE OF TOTAL WIND DURATION

CONNECTICUT BEACH EROSION CONTROL STUDY

WIND DATA

NEW YORK CITY, NEW YORK

1921 - 1942

IN 1 SHEET

NEW ENGLAND DIVISION BOSTON, MASS. JAN. 20, 1949

APPROVAL RECOMMENDED
Henry A Whitcomb
CHIEF, R & H OPERATIONS DIVISION

APPROVED
LT COL, C.E., ASST DIVISION ENGINEER

SUBMITTED
R & H PROJECTS AND REPORTS BRANCH

TRANSMITTED WITH REPORT DATED FEBRUARY 7, 1949.

DR. BY H.S.P.
TR. BY R.S.
CH. BY H.A.C.

FILE NO. B.E.Ct.5

CORPS OF ENGINEERS

U.S. ARMY

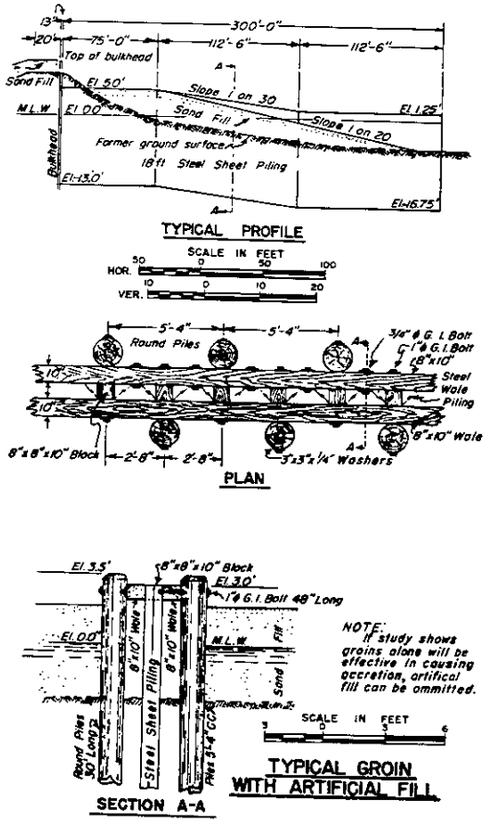


FIGURE 1

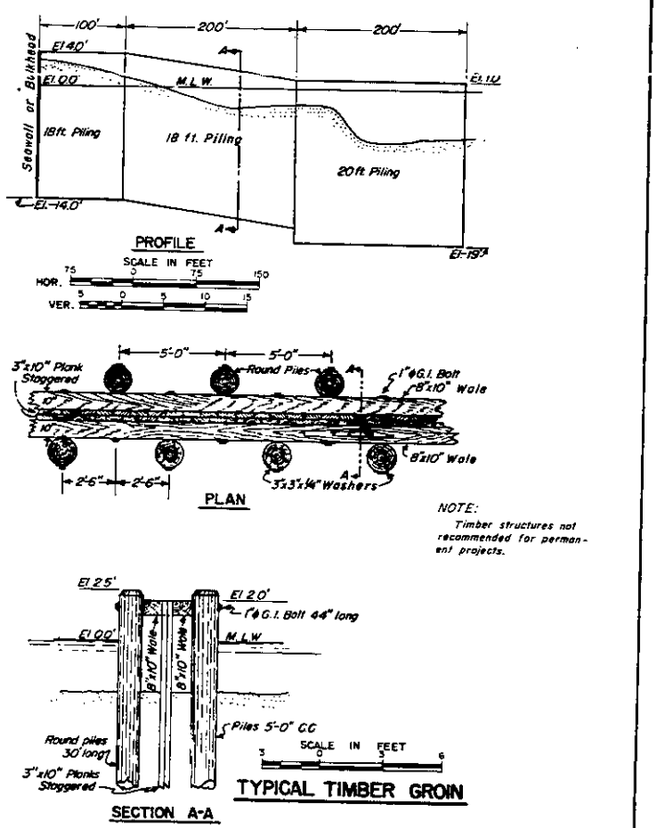


FIGURE 2

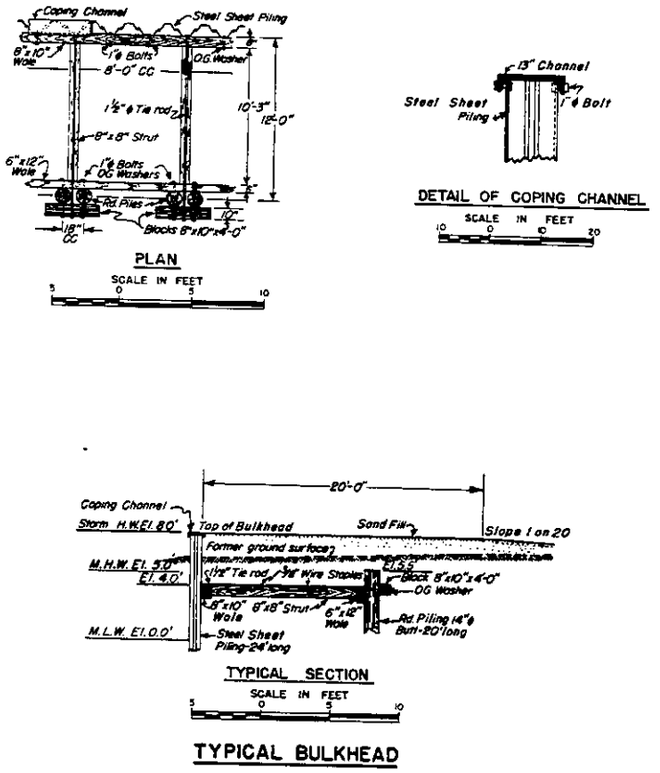


FIGURE 3

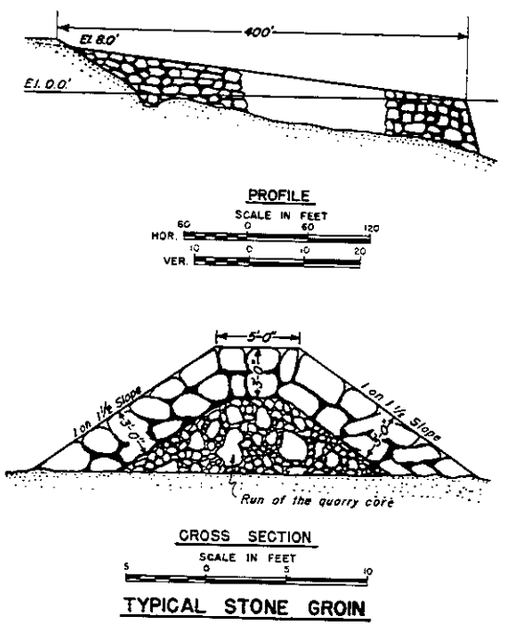


FIGURE 4

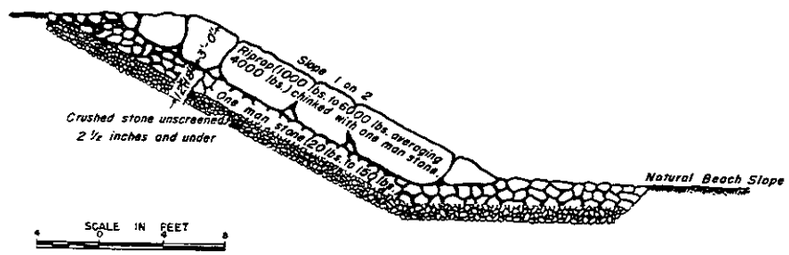


FIGURE 5

NOTE

Typical construction details reproduced from "Engineering Manual for Civil Works, Beach Erosion Studies," Part CXXXIII dated April 1947.

CONNECTICUT BEACH EROSION CONTROL STUDY

SHORE STRUCTURES

TYPICAL CONSTRUCTION DETAILS

IN 1 SHEET — SCALE AS SHOWN

NEW ENGLAND DIVISION BOSTON, MASS. JAN. 20, 1949

APPROVAL RECOMMENDED — Chief, R. & H. Operations Division

APPROVED — Lt. Col., C.E., Asst. Division Engineer

SUBMITTED — R. & H. Projects and Reports Branch

TRANSMITTED WITH REPORT DATED FEBRUARY 7, 1949.

DR. BY W.S.P.
TR. BY R.E.
CH. BY

FILE NO. B.E.C. 1. 6

PLATE 6

CORPS OF ENGINEERS

U.S. ARMY

73° 18' 73° 17' 73° 16' 73° 15' 73° 14' 73° 13' 73° 12'

41° 09'

41° 08'

41° 07'

41° 06'

N

ASH CREEK

JENNINGS BEACH

FAIRFIELD BEACH

SHOAL PT.

SOUTHPORT HARBOR

SASCO HILL BEACH

KENSIE PT.

FAIRFIELD

PINE CREEK

PINE CREEK PT.

BEACH

LONG ISLAND SOUND

Polyconic Projection. 1927 North American Datum.

NOTES

Shorelines prior to 1948 traced from drawings prepared by the Beach Erosion Board, Washington, D.C. from U.S.C.&G.S. Data.

The 1948 shoreline is the Mean High Water line located for this study.

LEGEND

M.H.W. SHORELINES

1948	———	U.S.E.D.
1933-34	—//—//—//—	U.S.C.&G.S.
1909	—•—•—•—	"
1883-85	– – – – –	"
1835	.....	"

CONNECTICUT BEACH EROSION CONTROL STUDY

SHORELINE CHANGES FOR AREA I

ASH CREEK TO SAUGATUCK RIVER

IN 2 SHEETS SCALE IN FEET SHEET 1

1000 0 1000 2000

NEW ENGLAND DIVISION, BOSTON, MASS. JAN. 20, 1949.

APPROVAL RECOMMENDED: Henry A. Whitworth
CHIEF, R & H OPERATIONS DIVISION

APPROVED:
LT. COL., C.E., ASST. DIVISION ENGINEER

SUBMITTED: J. M. Rice
R & H PROJECTS AND REPORTS BRANCH

TRANSMITTED WITH REPORT DATED FEBRUARY 7, 1949.

DES. BY A.E.E.
TR. BY J.J.D.
CH. BY J.G.P.

FILE NO. B. E. Ct. 7

PLATE 7

CORPS OF ENGINEERS

U.S.ARMY

73° 23' 73° 22' 73° 21' 73° 20' 73° 19' 73° 18' 73° 17'

41° 07'

41° 06'

41° 05'

N

SAUGATUCK RIVER

HENDRICKS PT.

SHERWOOD POND

HILLS POINT

COMPO BEACH

COMPO BEACH

CEDAR PT.

SHERWOOD ISLAND STATE PARK

COMPO MILL BEACH ASSOCIATION

ELWOOD BEACH

SHERWOOD PT.

ALVORD BEACH

ALVORD CREEK

BURIAL HILL BEACH

GREENS FARMS

FROST PT.

CANAL BEACH

SASCO BROOK

SOUTHPORT BEACH

LONG ISLAND SOUND

Polyconic Projection. 1927 North American Datum.

73° 22' 73° 21' 73° 20' 73° 19' 73° 18'

NOTES

Shorelines prior to 1948 traced from drawings prepared by the Beach Erosion Board, Washington, D.C. from U.S.C.& G.S. Data.

The 1948 shoreline is the Mean High Water line located for this study.

LEGEND

M.H.W. SHORELINES

1948	———	U.S.E.D.
1933-34	—//—S—//—S—	U.S.C.&G.S.
1909	—•—•—•—•—	"
1883-85	– – – – – –	"
1835	.....	"

CONNECTICUT BEACH EROSION CONTROL STUDY

SHORELINE CHANGES FOR AREA I

ASH CREEK TO SAUGATUCK RIVER

IN 2 SHEETS SCALE IN FEET SHEET 2

1000 0 1000 2000

NEW ENGLAND DIVISION, BOSTON, MASS. JAN. 20, 1949.

APPROVAL RECOMMENDED:
Harvey A. Hickerson
CHIEF, R & H OPERATIONS DIVISION

APPROVED:
LT. COL., C.E., ASST. DIVISION ENGINEER

SUBMITTED:
R & H PROJECTS AND REPORTS BRANCH

DR. BY A.E.C.
TR. BY
CH. BY

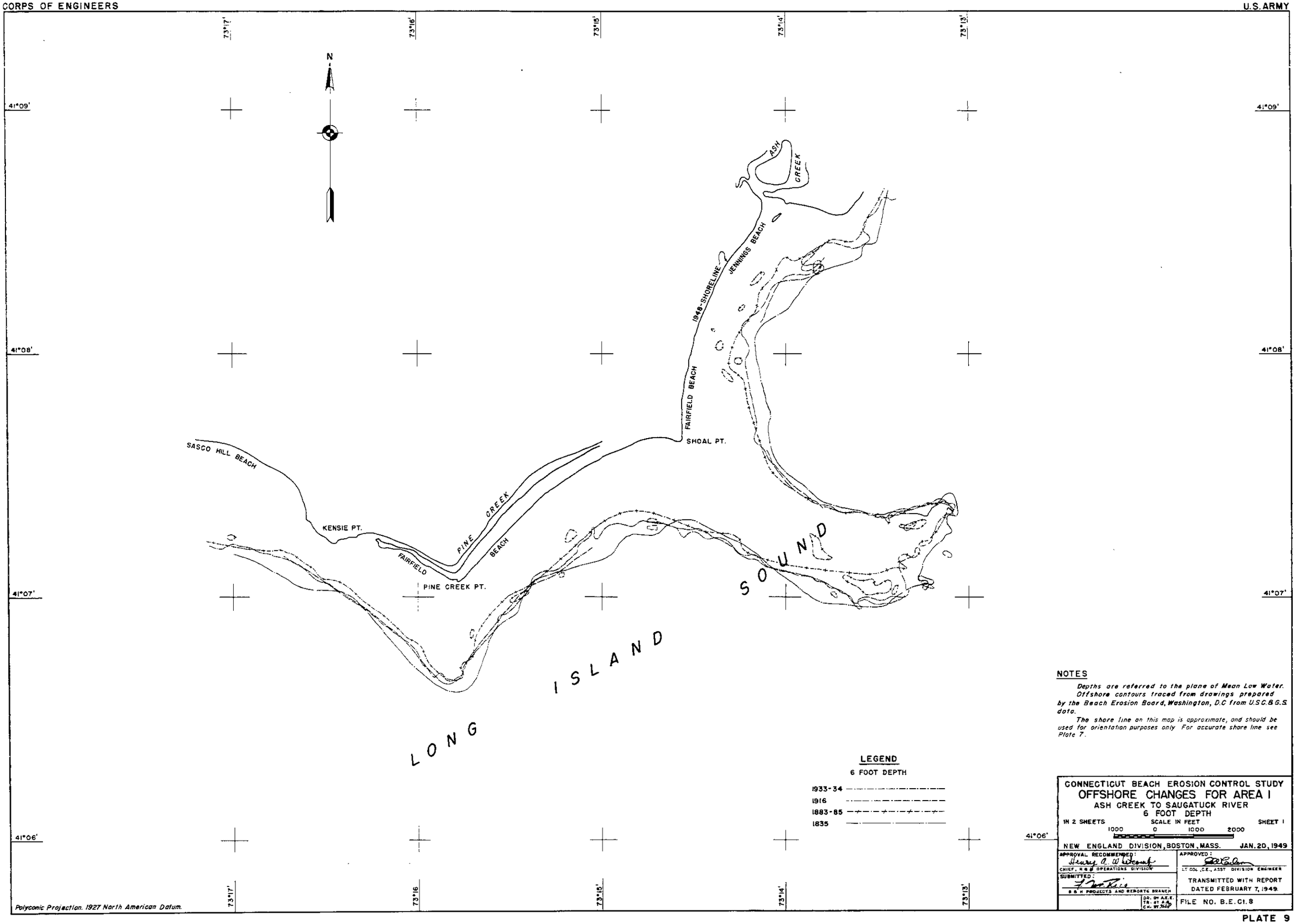
TRANSMITTED WITH REPORT DATED FEBRUARY 7, 1949.

FILE NO. B. E. Ct. 7

PLATE 8

CORPS OF ENGINEERS

U.S. ARMY



LEGEND

6 FOOT DEPTH

1933-34

1916

1883-85

1835

NOTES

Depths are referred to the plane of Mean Low Water.

Offshore contours traced from drawings prepared by the Beach Erosion Board, Washington, D.C. from U.S.C.&G.S. data.

The shore line on this map is approximate, and should be used for orientation purposes only. For accurate shore line see Plate 7.

CONNECTICUT BEACH EROSION CONTROL STUDY

OFFSHORE CHANGES FOR AREA I

ASH CREEK TO SAUGATUCK RIVER

6 FOOT DEPTH

IN 2 SHEETS — SCALE IN FEET (1000 0 1000 2000) — SHEET 1

NEW ENGLAND DIVISION, BOSTON, MASS. JAN. 20, 1949

APPROVAL RECOMMENDED: Henry A. Whitcomb, CHIEF, R & H OPERATIONS DIVISION

APPROVED: [illegible], LT. COL. C.E., ASST. DIVISION ENGINEER

SUBMITTED: [illegible], R & H PROJECTS AND REPORTS BRANCH

DR. BY A.E.E.
TR. BY [illegible]
CH. BY [illegible]

TRANSMITTED WITH REPORT DATED FEBRUARY 7, 1949.

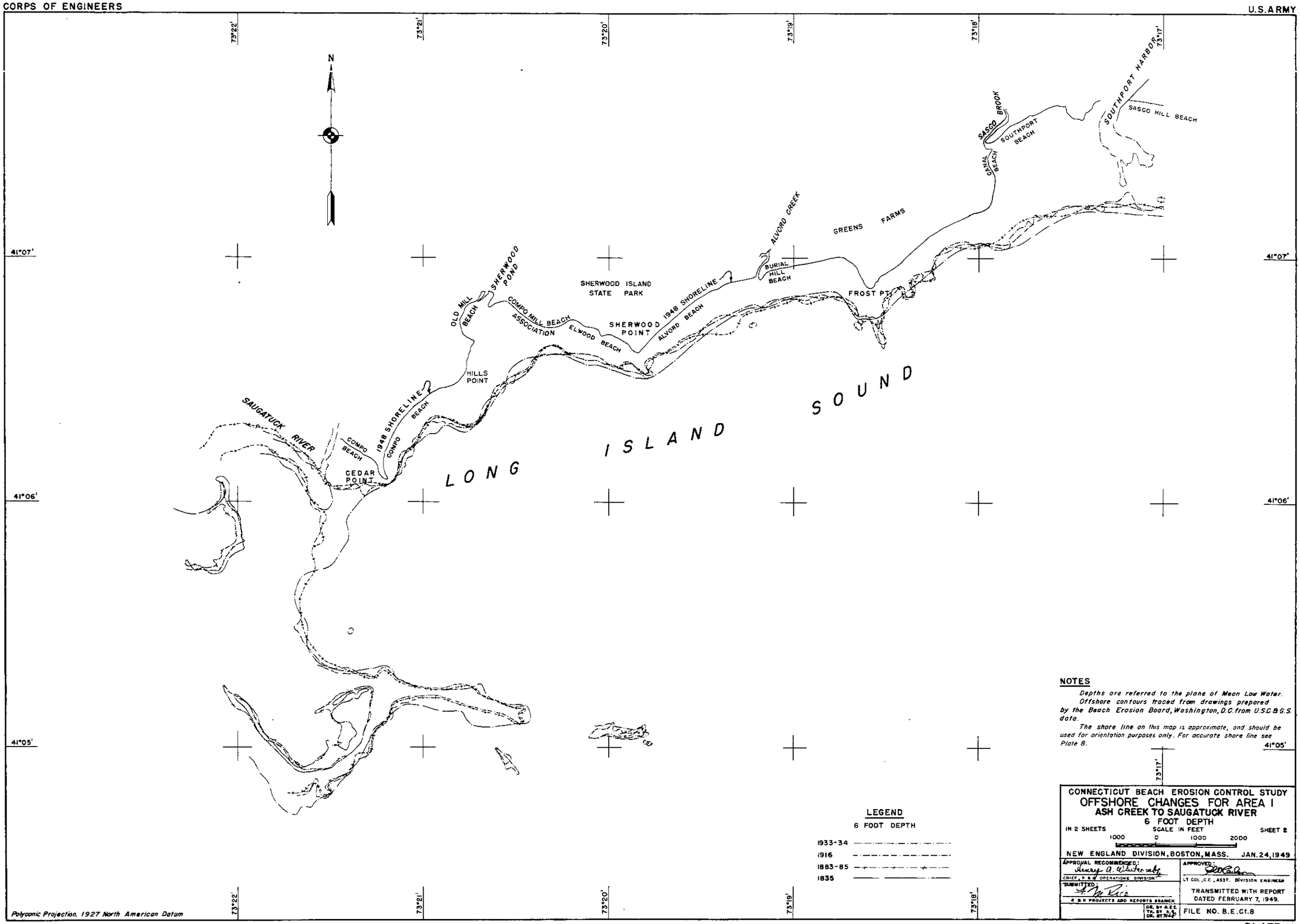
FILE NO. B.E.Ct.8

Polyconic Projection. 1927 North American Datum.

PLATE 9

CORPS OF ENGINEERS

U.S. ARMY



NOTES

Depths are referred to the plane of Mean Low Water.

Offshore contours traced from drawings prepared by the Beach Erosion Board, Washington, D.C. from U.S.C.&G.S. data.

The shore line on this map is approximate, and should be used for orientation purposes only. For accurate shore line see Plate 8.

LEGEND

6 FOOT DEPTH

1933-34

1916

1883-85

1835

Polyconic Projection. 1927 North American Datum

CONNECTICUT BEACH EROSION CONTROL STUDY

OFFSHORE CHANGES FOR AREA I

ASH CREEK TO SAUGATUCK RIVER

6 FOOT DEPTH

IN 2 SHEETS — SCALE IN FEET — SHEET 2

1000 0 1000 2000

NEW ENGLAND DIVISION, BOSTON, MASS. JAN. 24, 1949

APPROVAL RECOMMENDED: Henry A. Winston Jr. by — CHIEF, R & H OPERATIONS DIVISION

APPROVED: — LT COL., C.E., ASST. DIVISION ENGINEER

SUBMITTED: — R & H PROJECTS AND REPORTS BRANCH

TRANSMITTED WITH REPORT DATED FEBRUARY 7, 1949.

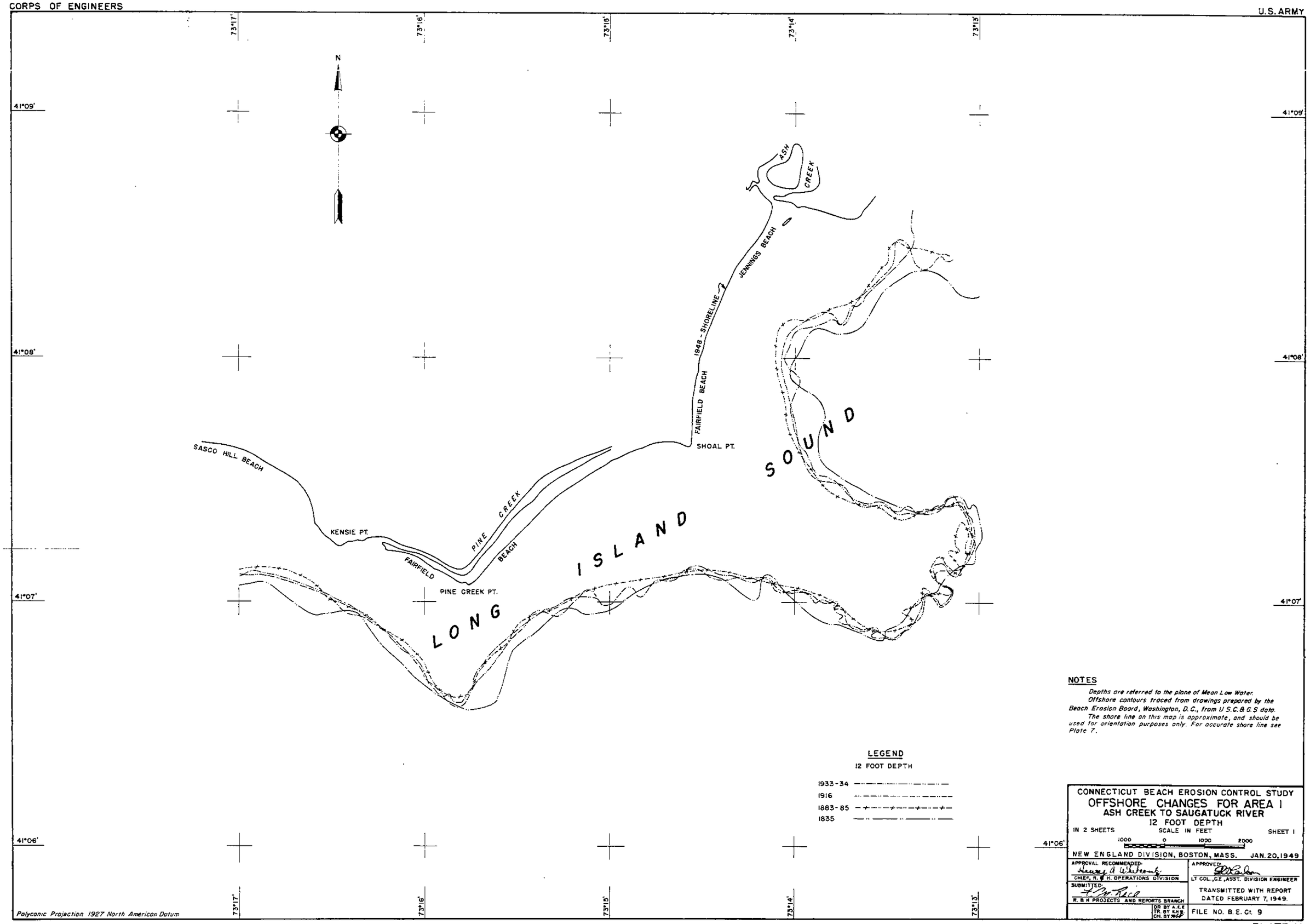
DR. BY A.E.Z. TR. BY A.S. CH. BY [illegible]

FILE NO. B.E.C1.8

PLATE 10

CORPS OF ENGINEERS

U.S. ARMY



NOTES

Depths are referred to the plane of Mean Low Water.

Offshore contours traced from drawings prepared by the Beach Erosion Board, Washington, D.C., from U.S.C.&G.S data.

The shore line on this map is approximate, and should be used for orientation purposes only. For accurate shore line see Plate 7.

LEGEND

12 FOOT DEPTH

1933-34

1916

1883-85

1835

CONNECTICUT BEACH EROSION CONTROL STUDY

OFFSHORE CHANGES FOR AREA 1

ASH CREEK TO SAUGATUCK RIVER

12 FOOT DEPTH

IN 2 SHEETS — SCALE IN FEET (1000 0 1000 2000) — SHEET 1

NEW ENGLAND DIVISION, BOSTON, MASS. JAN. 20, 1949

APPROVAL RECOMMENDED: Henry A. Whitcomb, CHIEF, R. & H. OPERATIONS DIVISION

APPROVED: [signature], LT COL., C.E., ASST. DIVISION ENGINEER

SUBMITTED: [signature], R. & H. PROJECTS AND REPORTS BRANCH

TRANSMITTED WITH REPORT DATED FEBRUARY 7, 1949.

DR BY A.E.E
TR BY [illegible]
CH. BY [illegible]

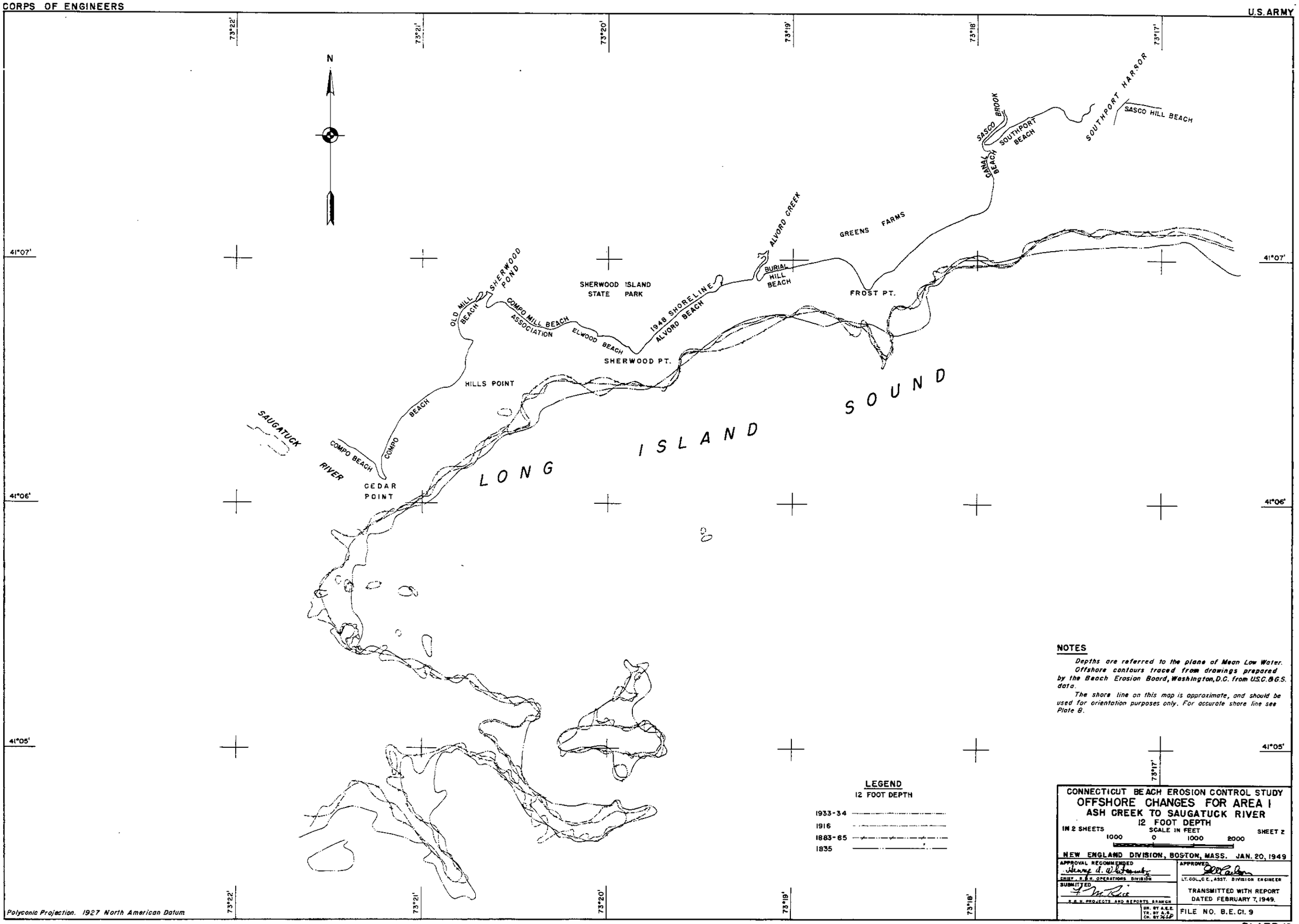
FILE NO. B.E. Ct. 9

Polyconic Projection 1927 North American Datum

PLATE 11

CORPS OF ENGINEERS

U.S. ARMY



Polyconic Projection. 1927 North American Datum

LEGEND

12 FOOT DEPTH

1933-34

1916

1883-85

1835

NOTES

Depths are referred to the plane of Mean Low Water.

Offshore contours traced from drawings prepared by the Beach Erosion Board, Washington, D.C. from U.S.C.&G.S. data.

The shore line on this map is approximate, and should be used for orientation purposes only. For accurate shore line see Plate 8.

CONNECTICUT BEACH EROSION CONTROL STUDY

OFFSHORE CHANGES FOR AREA I

ASH CREEK TO SAUGATUCK RIVER

12 FOOT DEPTH

IN 2 SHEETS — SCALE IN FEET (1000 0 1000 2000) — SHEET 2

NEW ENGLAND DIVISION, BOSTON, MASS. JAN. 20, 1949

APPROVAL RECOMMENDED: Henry D. Whitcomb, CHIEF, R.&H. OPERATIONS DIVISION

APPROVED: Lyle Carlton, LT. COL., C.E., ASST. DIVISION ENGINEER

SUBMITTED: F. M. Rice, R.&H. PROJECTS AND REPORTS BRANCH

TRANSMITTED WITH REPORT DATED FEBRUARY 7, 1949.

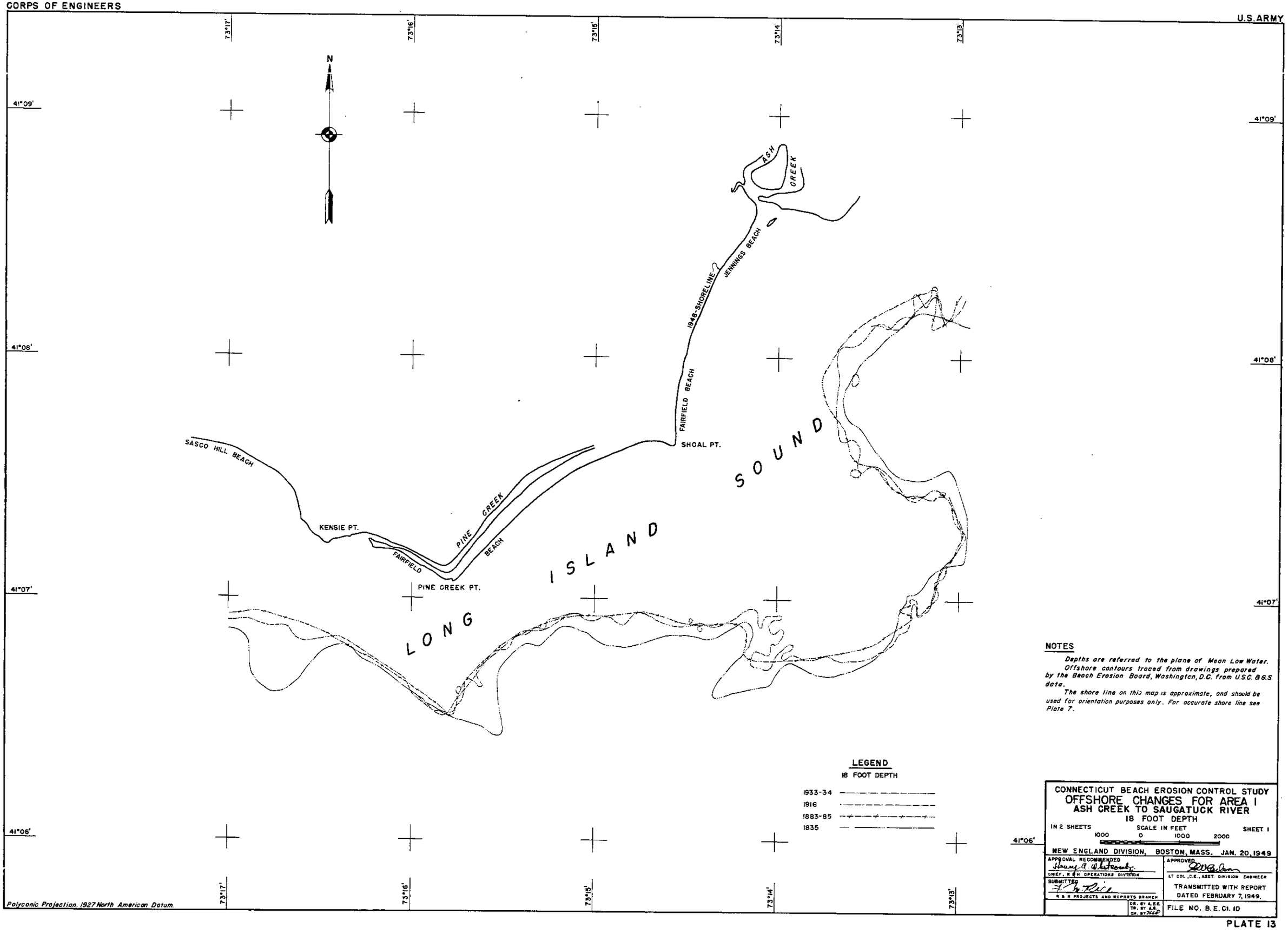
DR. BY A.G.E.
TR. BY A.G.
CH. BY F.M.R.

FILE NO. B.E.Ct. 9

PLATE 12

CORPS OF ENGINEERS

U.S. ARMY



NOTES

Depths are referred to the plane of Mean Low Water.

Offshore contours traced from drawings prepared by the Beach Erosion Board, Washington, D.C. from U.S.C. & G.S. data.

The shore line on this map is approximate, and should be used for orientation purposes only. For accurate shore line see Plate 7.

LEGEND

18 FOOT DEPTH

1933-34

1916

1883-85

1835

CONNECTICUT BEACH EROSION CONTROL STUDY

OFFSHORE CHANGES FOR AREA I

ASH CREEK TO SAUGATUCK RIVER

18 FOOT DEPTH

IN 2 SHEETS — SCALE IN FEET — SHEET 1

1000 0 1000 2000

NEW ENGLAND DIVISION, BOSTON, MASS. JAN. 20, 1949

APPROVAL RECOMMENDED: Harry A. Whitcomb, CHIEF, R & H OPERATIONS DIVISION

APPROVED: LT COL., C.E., ASST. DIVISION ENGINEER

SUBMITTED: R & H PROJECTS AND REPORTS BRANCH

TRANSMITTED WITH REPORT DATED FEBRUARY 7, 1949.

DR. BY A.E.E. TR. BY A.S. CH. BY ?

FILE NO. B.E.Ct. 10

Polyconic Projection. 1927 North American Datum.

PLATE 13

CORPS OF ENGINEERS

U.S. ARMY

73°22'
73°21'
73°20'
73°19'
73°18'
73°17'

41°07'
41°06'
41°05'

N

SAUGATUCK RIVER

COMPO BEACH

CEDAR PT.

COMPO BEACH

HILLS POINT

OLD MILL BEACH

SHERWOOD POND

COMPO MILL BEACH ASSOCIATION

ELWOOD BEACH

SHERWOOD PT.

SHERWOOD ISLAND STATE PARK

1948 SHORELINE

ALVORD BEACH

ALVORD CREEK

BURIAL HILL BEACH

GREENS FARMS

FROST PT.

CANAL BEACH

SASCO BROOK

SOUTHPORT BEACH

SOUTHPORT HARBOR

SASCO HILL BEACH

LONG ISLAND SOUND

LEGEND

18 FOOT DEPTH

1933-34

1916

1883-85

1835

NOTES

Depths are referred to the plane of Mean Low Water.

Offshore contours traced from drawings prepared by the Beach Erosion Board, Washington, D.C. from U.S.C.&G.S. data.

The shore line on this map is approximate, and should be used for orientation purposes only. For accurate shore line see Plate B.

CONNECTICUT BEACH EROSION CONTROL STUDY

OFFSHORE CHANGES FOR AREA I ASH CREEK TO SAUGATUCK RIVER

18 FOOT DEPTH

IN 2 SHEETS — SCALE IN FEET: 1000 0 1000 2000 — SHEET 2

NEW ENGLAND DIVISION, BOSTON, MASS. JAN. 20, 1949

APPROVAL RECOMMENDED: Chief, R B M Operations Division

APPROVED: Lt. Col., C.E., Asst. Division Engineer

SUBMITTED: R B M Projects and Reports Branch

TRANSMITTED WITH REPORT DATED FEBRUARY 7, 1949.

DR. BY A.E.E.
TR. BY A.S.
CH. BY P.C.D.

FILE NO. B.E. Ct. 10

Polyconic Projection. 1927 North American Datum.

PLATE 14

CORPS OF ENGINEERS

U.S.ARMY

F A I R F I E L D

BRIDGEPORT

GROVER HILL

ASH CREEK

JENNINGS BEACH

FAIRFIELD BEACH

LITTLE DANBURY

FAIRFIELD BEACH

SHOAL POINT

NATURAL OYSTER BEDS

OYSTER GROUNDS

L O N G I S L A N D S O U N D

TOWN JURISDICTION
STATE JURISDICTION

MATCH LINE SHEET NO. 2 OF 3

PROFILE 1 · PROFILE 2 · PROFILE 3 · PROFILE 4 · PROFILE 5 · PROFILE 6 · PROFILE 7 · PROFILE 8 · PROFILE 9 · PROFILE 10 · PROFILE 11

P1 · P2 · P3 · P4 · P5 · P6 · P7 · P8 · P11 · P12 · P13 · P14 · P15 · P16 · P17 · P18

S1 · S2 · S3 · S4 · S5 · S6 · S7 · S8

N112,000 · N114,000 · N110,000 · N108,000 · N106,000 · N104,000 · N102,000

E465,000 · E467,000 · E469,000 · E471,000 · E473,000 · E461,000 · E463,000

73°15' · 73°14' · 41°08' · 41°07'

LIST OF PROBINGS

NUMBER	DEPTH OR ELEVATION	TOTAL DEPTH	MATERIAL AS INDICATED BY PROBINGS
1	+ 2.6	5.3	3.7' Hard packed sand, 1.5' Soft sand, 0.5' Hard packed sand, 2.2' Soft sand.
2	+ 7.4	2.4	2.3' Mud, 2.2' Sand, 5.3' Stiff sand.
3	14.2	19.8	3.5' Small stone (probably gravel) - clay - silt (soft) 1.1' Sand (soft), 1.0' Thru stiff material (clay) to rock.
4	13.3	21.6	0.3' Silt, 0.7' Gravel (soft), 6.4' Sand (soft), 0.9' Clay & sand (stiff).
5	15.1	18.2	0.2' Small stones, 1.4' Fine sand (soft), 1.5' Fine sand (stiff). Underlying material probably clay.
6	14.3	22.7	8.4' Fine sand (soft).
7	13.9	21.9	Start thru 0.1' very soft, 0.9' Coarse sand (soft), 7.0' Fine sand (soft) to hard bottom (clay).
8	13.4	18.9	2.8' Coarse sand (soft), 0.8' Gravel (stiff), 1.9' Sand (stiff). Some silt mixed with fine sand showing on anchor.
11	+ 2.0	4.5	6.5' Coarse gravel. Unable to penetrate further.
12	+ 2.0	2.5	4.5' Coarse gravel to rock.
13	+ 2.6	4.9	1.5' Sand & silt, 4.0' Stiff sand & gravel, 2.0' Gravel.
14	+ 7.4	2.1	2.0' Marsh mud, 3.0' Clay, 2.5' Fine sand, 2.0' Sand & gravel.
15	+ 7.0	11.2	5.7' Marsh mud (soft), 3.8' Gravel, 2.6' Stiff sand & gravel, 2.4' Soft sand, 3.7' Stiff sand.
16	+ 7.2	11.0	6.0' Marsh mud (soft), 2.5' Coarse sand (soft), 2.5' Gravel (stiff), 7.2' Sand.
17	+ 7.3	11.2	7.8' Marsh mud, 6.9' Sand (soft), 0.6' Clay (stiff), 3.2' Sand (stiff).
18	+ 6.3	12.0	18.3' Marsh mud (soft).

NOTE:

Probings are in feet and tenths, and are referred to the plane of Mean Low Water. Probe Numbers 9 & 10 are shown on Sheet No. 2.

Probings were taken May to Aug. 1948 by H. Tongen, using a 1" iron pipe with a chisel shaped steel point.

Probings are shown thus: ● P1

Depths below the plane of Mean Low Water are shown thus: 14.2.

Elevations above the plane of Mean Low Water are shown thus: +2.6.

BEACH SAMPLE ANALYSIS

SAMPLE NUMBER	GRAIN SIZE IN MILLIMETER		CHARACTER OF MATERIAL IN PERCENT			
	RANGE	MEDIAN DIAMETER	FINE SAND	MED. SAND	COARSE SAND	GRAVEL
S 1	0.15-26.8	3.75	1	7	26	66
S 2	0.15- 9.5	1.25	1	14	66	19
S 3	0.15-13.5	2.00	5	21	24	50
S 4	0.15-13.5	1.40	5	21	33	41
S 5	0.15-13.5	0.27	29	62	3	6
S 6	0.072-3.7	0.29	11	67	14	8
S 7	0.15-19.0	1.17	1	28	34	37
S 8	0.15-19.0	2.45	1	8	37	54

Note: All samples taken at Mid Tide Elevation, and are shown thus: S1○

NOTES

Soundings and elevations are in feet and tenths and are referred to the plane of Mean Low Water.

Shoreline is Mean High Water. Land contours are referred to the plane of Mean High Water. The mean tidal range is 7.0 feet.

Hydrography, shoreline and shore structures determined by 1948 survey. Other topography and contours from U.S.C.&G.S. Chart No. 220.

Oyster grounds are from State of Connecticut Oyster Maps.

Plane coordinates are on the Lambert Grid System for the State of Connecticut.

CONNECTICUT BEACH EROSION CONTROL STUDY

SURVEY MAP FOR AREA I

ASH CREEK TO SAUGATUCK RIVER

IN 3 SHEETS · SCALE IN FEET (500 0 500 1000) · SHEET 1

NEW ENGLAND DIVISION, BOSTON, MASS. JAN. 27, 1949

APPROVAL RECOMMENDED: Henry A Whitcomb, CHIEF, R & H OPERATIONS DIVISION

APPROVED: LT COL., C.E., ASST DIVISION ENGINEER

SUBMITTED: R. & H. PROJECTS AND REPORTS BRANCH

TRANSMITTED WITH REPORT DATED FEBRUARY 7, 1949.

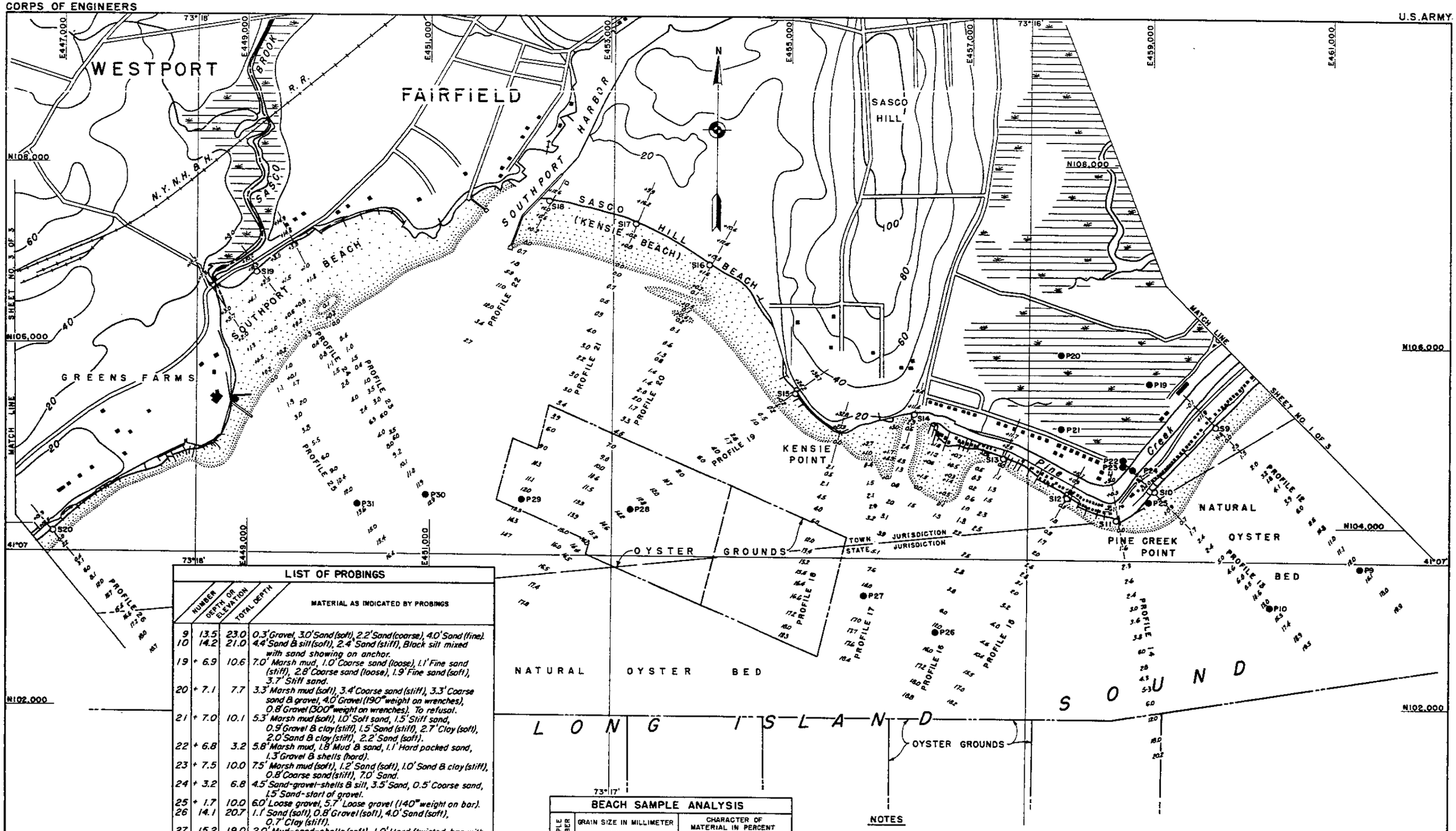
DR. BY A.K.B. TR. BY C.S.J. CH. BY

FILE NO. B.E. Ct. 11

PLATE 15

CORPS OF ENGINEERS

U.S.ARMY



LIST OF PROBINGS

NUMBER	DEPTH OR ELEVATION	TOTAL DEPTH	MATERIAL AS INDICATED BY PROBINGS
9	13.5	23.0	0.3' Gravel, 3.0' Sand (soft), 2.2' Sand (coarse), 4.0' Sand (fine).
10	14.2	21.0	4.4' Sand & silt (soft), 2.4' Sand (stiff), Black silt mixed with sand showing on anchor.
19	+ 6.9	10.6	7.0' Marsh mud, 1.0' Coarse sand (loose), 1.1' Fine sand (stiff), 2.8' Coarse sand (loose), 1.9' Fine sand (soft), 3.7' Stiff sand.
20	+ 7.1	7.7	3.3' Marsh mud (soft), 3.4' Coarse sand (stiff), 3.3' Coarse sand & gravel, 4.0' Gravel (190" weight on wrenches), 0.8' Gravel (300" weight on wrenches). To refusal.
21	+ 7.0	10.1	5.3' Marsh mud (soft), 1.0' Soft sand, 1.5' Stiff sand, 0.9' Gravel & clay (stiff), 1.5' Sand (stiff), 2.7' Clay (soft), 2.0' Sand & clay (stiff), 2.2' Sand (soft).
22	+ 6.8	3.2	5.8' Marsh mud, 1.8' Mud & sand, 1.1' Hard packed sand, 1.3' Gravel & shells (hard).
23	+ 7.5	10.0	7.5' Marsh mud (soft), 1.2' Sand (soft), 1.0' Sand & clay (stiff), 0.8' Coarse sand (stiff), 7.0' Sand.
24	+ 3.2	6.8	4.5' Sand-gravel-shells & silt, 3.5' Sand, 0.5' Coarse sand, 1.5' Sand-start of gravel.
25	+ 1.7	10.0	6.0' Loose gravel, 5.7' Loose gravel (140" weight on bar).
26	14.1	20.7	1.1' Sand (soft), 0.8' Gravel (soft), 4.0' Sand (soft), 0.7' Clay (stiff).
27	15.2	19.0	2.0' Mud-sand-shells (soft), 1.0' Hard (twisted bar with 150" weight on bar), 0.8' Hard (twisted bar with 200" weight on bar). Unable to penetrate further, material probably clay.
28	13.8	20.8	3.3' Sand (soft), 3.7' Sand (stiff).
29	13.5	19.8	0.5' Soft silt, 1.4' Sand (soft), 1.9' Sand (stiff), 1.4' Sand (soft), 1.1' Clay (stiff). Refusal, probably clay.
30	12.2	20.6	0.7' Silt & sand, 1.2' Sand (soft), 1.2' Gravel (soft), 1.0' Sand (soft), 4.3' Coarse sand (stiff).
31	12.8	21.0	3.0' Sand (soft), 5.2' Sand (stiff).

NOTE:

Probings are in feet and tenths, and are referred to the plane of Mean Low Water. Probings are shown thus: ● P 9 .

Probings were taken May to Aug. 1948 by H. Tangen, using a 1" iron pipe with a chisel shaped steel point.

Depths below the plane of Mean Low Water are shown thus: 13.5. Elevations above the plane of Mean Low Water are shown thus: + 6.9 .

BEACH SAMPLE ANALYSIS

SAMPLE NUMBER	GRAIN SIZE IN MILLIMETER		CHARACTER OF MATERIAL IN PERCENT			
	RANGE	MEDIAN DIAMETER	FINE SAND	MED. SAND	COARSE SAND	GRAVEL
S 9	0.15-19.0	1.55	1	23	32	44
S 10	0.15-19.0	1.55	3	22	33	42
S 11	0.15-38.0	2.45	2	20	25	53
S 12	0.15-27.0	1.45	3	20	35	42
S 13	0.15-19.0	1.50	2	21	34	43
S 14	0.30-19.0	1.60	0	2	59	39
S 15	0.23-38.0	3.20	0	13	28	59
S 16	0.15-19.0	2.30	1	16	31	52
S 17	0.15-19.0	2.85	1	14	28	57
S 18	0.60-13.5	2.95	0	0	29	71
S 19	0.15-19.0	1.10	2	22	40	36
S 20	0.15-19.0	1.10	4	14	54	28

Note: All samples taken at Mid Tide Elevation, and are shown thus: OS 9.

NOTES

Soundings and elevations are in feet and tenths and are referred to the plane of Mean Low Water.

Shoreline is Mean High Water. Land contours are referred to the plane of Mean High Water. The mean tidal range is 7.0 feet.

Hydrography, shoreline and shore structures determined by 1948 survey. Other topography and contours from U.S.C. & G.S. Chart No. 220.

Oyster grounds are from State of Connecticut Oyster Maps.

Plane coordinates are on the Lambert Grid System for the State of Connecticut.

CONNECTICUT BEACH EROSION CONTROL STUDY

SURVEY MAP FOR AREA I

ASH CREEK TO SAUGATUCK RIVER

IN 3 SHEETS — SCALE IN FEET (500 0 500 1000) — SHEET 2

NEW ENGLAND DIVISION, BOSTON, MASS. JAN. 28, 1949

APPROVAL RECOMMENDED: Harry A. Winslow, CHIEF, R. & H. OPERATIONS DIVISION

APPROVED: LT. COL., C.E., ASST. DIVISION ENGINEER

SUBMITTED: R. & H. PROJECTS AND REPORTS BRANCH

TRANSMITTED WITH REPORT DATED FEBRUARY 7, 1949

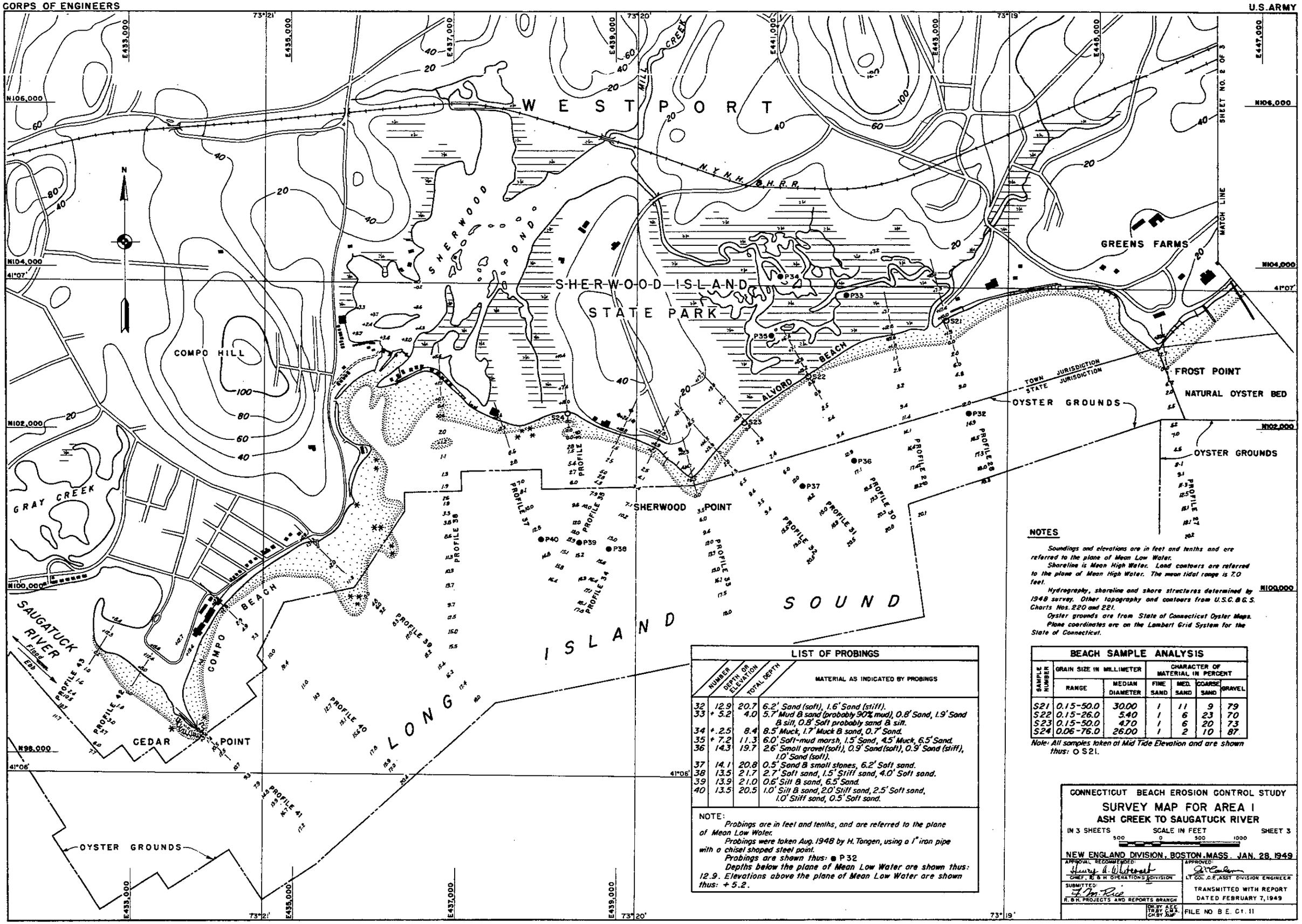
DR. BY A.E.K. TR. BY R.W. CH. BY

FILE NO. B.E. Ct. 11

PLATE 16

CORPS OF ENGINEERS

U.S.ARMY



LIST OF PROBINGS

NUMBER	DEPTH OR ELEVATION	TOTAL DEPTH	MATERIAL AS INDICATED BY PROBINGS
32	12.9	20.7	6.2' Sand (soft), 1.6' Sand (stiff).
33	+ 5.2	4.0	5.7' Mud & sand (probably 90% mud), 0.8' Sand, 1.9' Sand & silt, 0.8' Soft probably sand & silt.
34	+ 2.5	8.4	8.5' Muck, 1.7' Muck & sand, 0.7' Sand.
35	+ 7.2	11.3	6.0' Soft-mud marsh, 1.5' Sand, 4.5' Muck, 6.5' Sand.
36	14.3	19.7	2.6' Small gravel (soft), 0.9' Sand (soft), 0.9' Sand (stiff), 1.0' Sand (soft).
37	14.1	20.8	0.5' Sand & small stones, 6.2' Soft sand.
38	13.5	21.7	2.7' Soft sand, 1.5' Stiff sand, 4.0' Soft sand.
39	13.9	21.0	0.6' Silt & sand, 6.5' Sand.
40	13.5	20.5	1.0' Silt & sand, 2.0' Stiff sand, 2.5' Soft sand, 1.0' Stiff sand, 0.5' Soft sand.

NOTE:
Probings are in feet and tenths, and are referred to the plane of Mean Low Water.
Probings were taken Aug. 1948 by H. Tangen, using a 1" iron pipe with a chisel shaped steel point.
Probings are shown thus: ● P32
Depths below the plane of Mean Low Water are shown thus: 12.9. Elevations above the plane of Mean Low Water are shown thus: + 5.2.

NOTES

Soundings and elevations are in feet and tenths and are referred to the plane of Mean Low Water.

Shoreline is Mean High Water. Land contours are referred to the plane of Mean High Water. The mean tidal range is 7.0 feet.

Hydrography, shoreline and shore structures determined by 1948 survey. Other topography and contours from U.S.C.&G.S. Charts Nos. 220 and 221.

Oyster grounds are from State of Connecticut Oyster Maps.

Plane coordinates are on the Lambert Grid System for the State of Connecticut.

BEACH SAMPLE ANALYSIS

SAMPLE NUMBER	GRAIN SIZE IN MILLIMETER		CHARACTER OF MATERIAL IN PERCENT			
	RANGE	MEDIAN DIAMETER	FINE SAND	MED. SAND	COARSE SAND	GRAVEL
S21	0.15-50.0	30.00	1	11	9	79
S22	0.15-26.0	5.40	1	6	23	70
S23	0.15-50.0	4.70	1	6	20	73
S24	0.06-76.0	26.00	1	2	10	87

Note: All samples taken at Mid Tide Elevation and are shown thus: ○ S21.

CONNECTICUT BEACH EROSION CONTROL STUDY

SURVEY MAP FOR AREA I
ASH CREEK TO SAUGATUCK RIVER

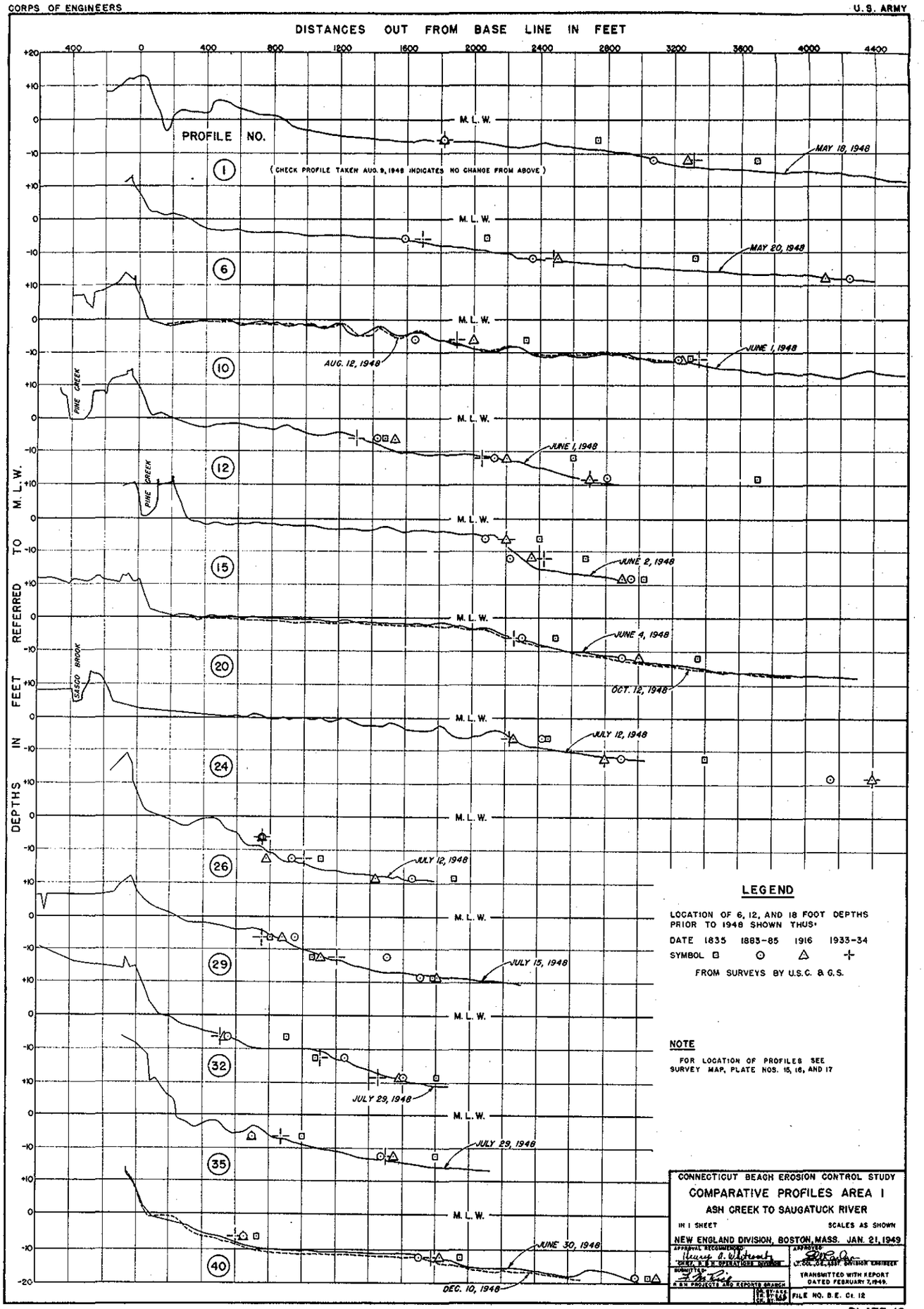
IN 3 SHEETS — SCALE IN FEET (500 0 500 1000) — SHEET 3

NEW ENGLAND DIVISION, BOSTON, MASS. JAN. 28, 1949

APPROVAL RECOMMENDED: Henry A. Whitcomb, CHIEF, R. & H. OPERATIONS DIVISION
APPROVED: J. J. Carlson, LT. COL., C.E., ASST. DIVISION ENGINEER
SUBMITTED: F. M. Rice, R. & H. PROJECTS AND REPORTS BRANCH
TRANSMITTED WITH REPORT DATED FEBRUARY 7, 1949
DR. BY A.E.C. TRY. C.B.S. CH. BY J.W.P.
FILE NO. B.E. Ct. 11

PLATE 17

CORPS OF ENGINEERS U.S. ARMY



LEGEND

LOCATION OF 6, 12, AND 18 FOOT DEPTHS PRIOR TO 1948 SHOWN THUS:

DATE	1835	1883-85	1916	1933-34
SYMBOL	□	○	△	+

FROM SURVEYS BY U.S.C. & G.S.

NOTE

FOR LOCATION OF PROFILES SEE SURVEY MAP, PLATE NOS. 15, 16, AND 17

CONNECTICUT BEACH EROSION CONTROL STUDY

COMPARATIVE PROFILES AREA I

ASH CREEK TO SAUGATUCK RIVER

IN 1 SHEET SCALES AS SHOWN

NEW ENGLAND DIVISION, BOSTON, MASS. JAN. 21, 1949

APPROVAL RECOMMENDED: Henry A. Whitcomb, CHIEF, B.E.D. OPERATIONS DIVISION

APPROVED: [signature], LT. COL., C.E., ASST. DIVISION ENGINEER

SUBMITTED: [signature], B.E.D. PROJECTS AND REPORTS BRANCH

TRANSMITTED WITH REPORT DATED FEBRUARY 7, 1949.

FILE NO. B.E. Ct. 12

PLATE 18

CORPS OF ENGINEERS

U.S.ARMY

73°22'

73°18'

73°14'

41°-10'

41°-08'

41°-06'

N

WESTPORT

FAIRFIELD

BRIDGEPORT

SAUGATUCK RIVER

SOUTHPORT HARBOR

BLACK ROCK HARBOR

ASH CREEK

Mill River

Sasco Brook

Southport Beach

Sasco Hill Beach

Old Mill Beach

Sherwood Pond

Compo Mill Beach Association

Sherwood Island State Park

Alvord Beach

Burial Hill

Greens Farms

Frost Point

Elwood Beach

Sherwood Point

Compo Beach

Hills (Schlaets) Point

Bluff Point

Cedar Point

Seymour Point

Sprite Id.

Gregory Point

Calfposture Point

Calfposture Id.

Cockenoe Id.

Betts Id.

Grassy Id.

Goose Id.

Chimon Id.

Jennings Beach

Grover Hill

Black Rock

Cedar Creek

Fayerweather Id.

Fairfield Beach

Shoal Point

Pine Creek

Kensie Point

Pine Creek Point

MAINTAIN EXISTING WALLS.

SAND FILL TO WIDEN AND IMPROVE TOWN BEACH.

GROIN TO HOLD SAND AND PROTECT WILDLIFE FEEDING GROUND.

MAINTAIN EXISTING WALLS AND REVETMENT.

MAINTAIN EXISTING WALLS AND REVETMENT.

SAND FILL TO IMPROVE TOWN BEACH.

GROIN TO HOLD SAND.

JETTY TO CONTROL ASH CREEK CURRENTS FOR SHORE PROTECTION AT JENNINGS BEACH AND ELIMINATION OF BATHING HAZARD.

SAND FILL TO WIDEN BEACH FOR PROTECTION OF SHORE DWELLINGS AND TO PROVIDE ADDITIONAL RECREATIONAL AREA

GROINS TO HOLD SAND.

ABANDON SPIT WEST OF PINE CREEK POINT. REMOVE HOUSES PROVIDE PROTECTION FOR SHORE AREA BEHIND ABANDONED SPIT.

MAINTAIN EXISTING WALLS.

TRAINING WALLS TO STABILIZE SHORE AND INLET.

SAND FILL TO WIDEN AND IMPROVE TOWN BEACH.

SAND FILL TO WIDEN AND IMPROVE EXISTING TOWN BEACH.

GROIN TO HOLD SAND AND TRAP LITTORAL DRIFT.

SAND FILL TO WIDEN BEACH FOR DEVELOPMENT OF STATE PARK BATHING AREAS. FILL WIDER AT SHERWOOD POINT TO ACT AS STOCKPILE.

GROIN TO HOLD SAND AND CATCH LITTORAL DRIFT.

GROIN TO PROTECT BEACH AREA, STOP WESTERLY DRIFT, AND TRAP EASTERLY DRIFT.

SAND FILL TO WIDEN BEACH FOR PROTECTION OF SHORE DWELLINGS AND TO PROVIDE ADDITIONAL RECREATIONAL AREA.

GROIN TO HOLD SAND.

SAND FILL TO WIDEN BEACH AND PROVIDE ADDITIONAL RECREATIONAL AREA.

TRAINING WALL TO CONTROL PINE CREEK CURRENTS AND PROTECT SAND FILL.

NOTES

Construction plans not to scale.
Shoreline and grids traced from U.S.C. & G.S. Charts 220 and 221.
Only recommended plans of improvement shown on this sheet.

CONNECTICUT BEACH EROSION CONTROL STUDY

PLANS OF IMPROVEMENT AREA I

(SCHEMATIC)

ASH CREEK TO SAUGATUCK RIVER

IN 1 SHEET SCALE IN FEET

2000 0 2000 4000

NEW ENGLAND DIVISION, BOSTON, MASS. JAN. 24, 1949

APPROVAL RECOMMENDED: Henry A. Whitehouse, CHIEF, R. & H. OPERATIONS DIVISION

APPROVED: [signature], LT. COL., C.E., ASST. DIVISION ENGINEER

SUBMITTED: [signature], R. & H. PROJECTS AND REPORTS BRANCH

TRANSMITTED WITH REPORT DATED FEBRUARY 7, 1949

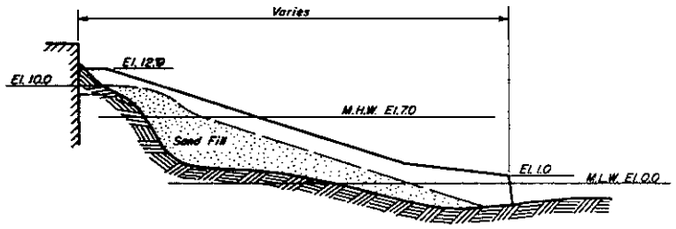
DR. BY A.E.E. TR. BY R.H.S. CH. BY [illegible]

FILE NO. B.E.Ct.13

PLATE 19

CORPS OF ENGINEERS

U. S. ARMY



GROIN PROFILE AT FAIRFIELD BEACH

SCALE IN FEET

HOR. 100 0 100 200

VERT. 10 0 10 20

IMPROVEMENTS RECOMMENDED FOR FEDERAL PROJECT

JETTY AT ASH CREEK INLET
800 FEET LONG

IMPROVEMENTS RECOMMENDED

WIDEN BEACH TO 100 FOOT WIDTH
7 GROINS 350-500 FEET LONG

IMPROVEMENTS RECOMMENDED

REMOVE ALL STRUCTURES AND USE AREA FOR BATHING BEACH
CONSTRUCT BULKHEAD TO PROTECT SHORE AREA BEHIND SPIT IF NEEDED

ASH CREEK

JENNINGS BEACH

Grover Hill

800'

PROPOSED JETTY

PROPOSED M.H.W.

FAIRFIELD BEACH

500'

400'

PROPOSED GROINS

Shoal Point

ISLAND

SOUND

LONG

PINE CREEK SAND SPIT

PINE CREEK

PROPOSED M.H.W.

400'

400'

400'

450'

350'

PROPOSED GROINS

Kensie Point

Pine Creek Point

E.485,000

E.467,000

E.469,000

E.437,000

E.459,000

E.461,000

E.463,000

N114,000

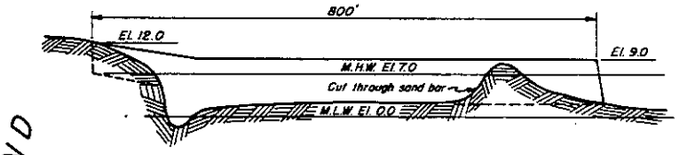
N112,000

N110,000

N108,000

N106,000

N104,000



WEST JETTY PROFILE AT ASH CREEK

SCALE IN FEET

HOR. 100 0 100 200

VERT. 10 0 10 20

NOTES

Shoreline is Mean High Water. The mean tidal range is 7.0 feet.

Shoreline and shore structures determined by 1948 survey.

Coordinates are on the Lambert Grid System for the State of Connecticut.

For additional construction details for shore structures see Plate 6.

CONNECTICUT BEACH EROSION CONTROL STUDY

PLANS OF IMPROVEMENT AREA I
ASH CREEK TO SAUGATUCK RIVER

IN 3 SHEETS SCALE IN FEET SHEET 1

500 0 500 1000

NEW ENGLAND DIVISION, BOSTON, MASS. JAN. 24, 1949

APPROVAL RECOMMENDED: Henry A. Whitehurst, CHIEF, R.B.H. OPERATIONS DIVISION

APPROVED: [illegible], LT COL., C.E., ASST. DIVISION ENGINEER

SUBMITTED: [illegible], R.B.H. PROJECTS AND REPORTS BRANCH

TRANSMITTED WITH REPORT DATED FEBRUARY 7, 1949

DR. BY A.E.C. TR. BY K.H.W. CH. BY [illegible]

FILE NO. B. E. Ct. 14

PLATE 20

IMPROVEMENTS RECOMMENDED
MAINTAIN EXISTING WALLS
NO NEW CONSTRUCTION

IMPROVEMENTS RECOMMENDED
FOR FEDERAL PROJECT
WIDEN BEACH TO 100 FOOT WIDTH
GROIN 400 FEET LONG

NO IMPROVEMENTS RECOMMENDED

IMPROVEMENTS RECOMMENDED
MAINTAIN EXISTING WALLS
NO NEW CONSTRUCTION

IMPROVEMENTS RECOMMENDED
IF DESIRED
WIDEN BEACH TO 100 FOOT WIDTH
6 GROINS 400-500 FEET LONG

IMPROVEMENTS RECOMMENDED
FOR FEDERAL PROJECT
WIDEN BEACH TO 100 FOOT WIDTH

IMPROVEMENTS RECOMMENDED
FOR FEDERAL PROJECT
WIDEN EASTERN 900 FEET OF BEACH
TO 100 FOOT WIDTH
GROIN 400 FEET LONG

IMPROVEMENTS RECOMMENDED
MAINTAIN EXISTING WALLS
AND REVETMENT

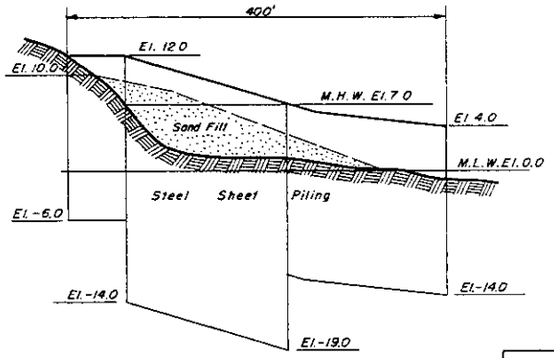
IMPROVEMENTS RECOMMENDED
WIDEN BEACH TO 100 FOOT WIDTH
TRAINING WALL AT PINE CREEK INLET
450 FEET LONG

N.

SOUTHPORT BEACH
SOUTHPORT HARBOR TO SOUTHPORT BEACH
SOUTHPORT HARBOR
SASCO HILL BEACH
CANAL BEACH
Sasco Brook
PROPOSED GROINS
PROPOSED GROIN
KENSIE POINT
PINE CREEK BEACH AREA
Pine Creek
Kensie Point
PROPOSED TRAINING WALL
FARMS
GREENS
BURIAL HILL
PROPOSED GROINS
PROPOSED M.H.W.
PROPOSED TRAINING WALL
(SEE SHEET 3)
Frost Point

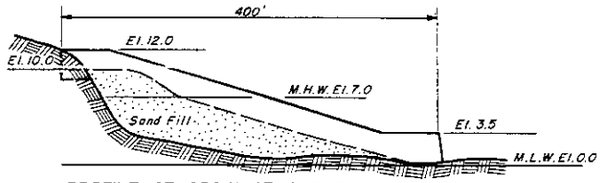
N108,000
N106,000
N104,000
N102,000
E443,000
E445,000
E447,000

400'
500'
450'



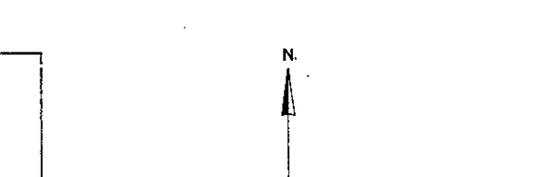
PROFILE OF TRAINING WALL AT BURIAL HILL

SCALE IN FEET
HOR. 100 0 100 200
VERT. 10 0 10 20



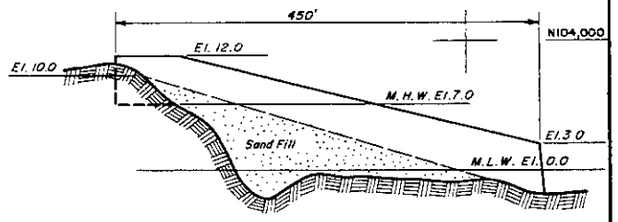
PROFILE OF GROIN AT SASCO HILL BEACH

SCALE IN FEET
HOR. 100 0 100 200
VERT. 10 0 10 20



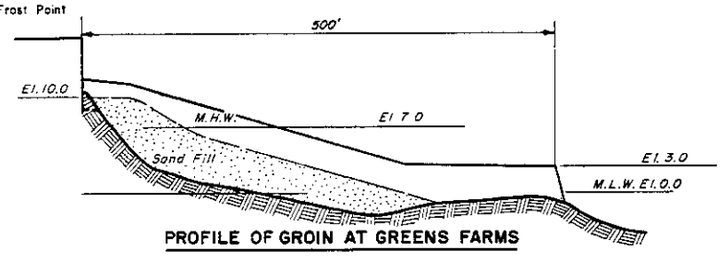
PROFILE OF GROIN AT SOUTHPORT BEACH

SCALE IN FEET
HOR. 100 0 100 200
VERT. 10 0 10 20



PROFILE OF TRAINING WALL AT PINE CREEK INLET

SCALE IN FEET
HOR. 100 0 100 200
VERT. 10 0 10 20



PROFILE OF GROIN AT GREENS FARMS

SCALE IN FEET
HOR. 100 0 100 200
VERT. 10 0 10 20

NOTES

Shoreline is Mean High Water. The mean tidal range is 7.0 feet.

Shoreline and shore structures determined by 1948 survey.

Coordinates are on the Lambert Grid System for the State of Connecticut.

For additional construction details for shore structures, see plate 6.

CONNECTICUT BEACH EROSION CONTROL STUDY

PLANS OF IMPROVEMENT AREA I
ASH CREEK TO SAUGATUCK RIVER

IN 3 SHEETS SCALE IN FEET SHEET 2

500 0 500 1000

NEW ENGLAND DIVISION, BOSTON, MASS. JAN. 24, 1949

APPROVAL RECOMMENDED: Henry A Whitcomb
CHIEF, R & H OPERATIONS DIVISION

APPROVED: [illegible]
LT. COL., C.E., ASST. DIVISION ENGINEER

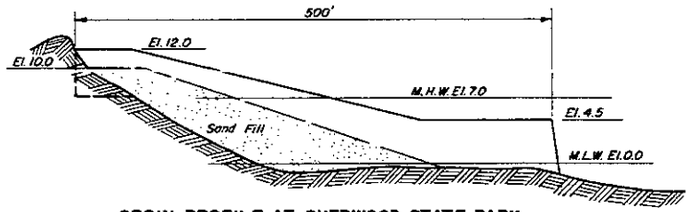
SUBMITTED: [illegible]
R & H PROJECTS AND REPORTS BRANCH

TRANSMITTED WITH REPORT DATED FEBRUARY 7, 1949

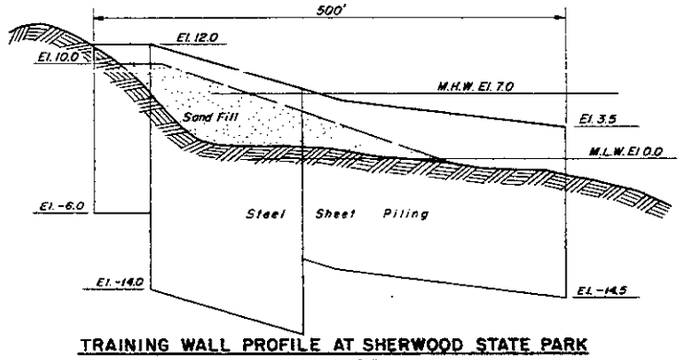
DR. BY A.E.F.
TR. BY K.H.W.
CH. BY [illegible]

FILE NO. B.E.C.I. 14

PLATE 21



GROIN PROFILE AT SHERWOOD STATE PARK
SCALE IN FEET
HOR. 100 0 100 200
VERT. 10 0 10 20



TRAINING WALL PROFILE AT SHERWOOD STATE PARK
SCALE IN FEET
HOR. 100 0 100 200
VERT. 10 0 10 20

N

E445,000

N106,000

N104,000

N102,000

N100,000

N98,000

E431,000

NO IMPROVEMENTS RECOMMENDED

IMPROVEMENTS RECOMMENDED
WIDEN BEACH TO 100 FOOT WIDTH
GROIN 450 FEET LONG

IMPROVEMENTS RECOMMENDED
MAINTAIN EXISTING WALLS AND REVETMENT

ALTERNATE IMPROVEMENTS CONSIDERED
WIDEN BEACH TO 100 FOOT WIDTH
GROIN 400 FEET LONG

IMPROVEMENTS RECOMMENDED FOR FEDERAL PROJECT
WIDEN BEACH TO 150-250 FOOT WIDTH.
2 TRAINING WALLS 400 AND 500 FEET LONG. GROIN 500 FEET LONG.

IMPROVEMENTS RECOMMENDED FOR FEDERAL PROJECT
WIDEN BEACH TO 100 FOOT WIDTH.
TWO GROINS 500 FEET LONG.

OLD MILL BEACH

SHERWOOD POND

COMPO MILL BEACH ASSOCIATION

SHERWOOD ISLAND STATE PARK

OLD MILL BEACH TO HILLS POINT

COMPO BEACH

Elwood Beach

Alvord Beach

Sherwood Point

Hills (Schlaets) Point

Cedar Point

Frost Point

450'

400'

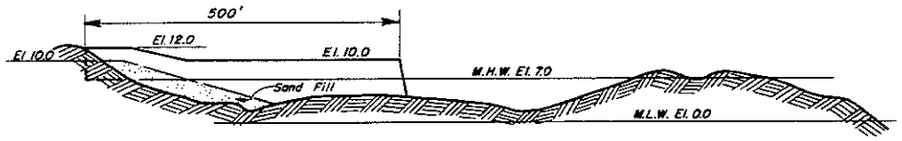
500'

PROPOSED GROINS

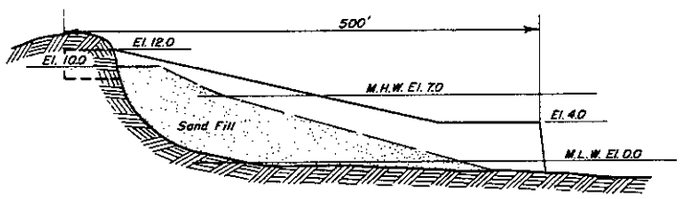
PROPOSED GROIN

PROPOSED TRAINING WALLS
(PROFILE OF EAST TRAINING WALL SHOWN ON SHEET 2.)

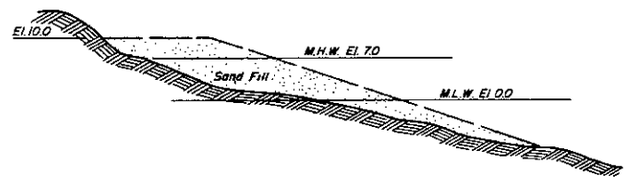
LONG ISLAND SOUND



GROIN PROFILE EAST END COMPO BEACH
SCALE IN FEET
HOR. 100 0 100 200
VERT. 10 0 10 20



GROIN PROFILE AT COMPO BEACH
SCALE IN FEET
HOR. 100 0 100 200
VERT. 10 0 10 20



PROFILE AT SHERWOOD POINT
SCALE IN FEET
HOR. 100 0 100 200
VERT. 10 0 10 20

NOTES

Shoreline is Mean High Water. The mean tidal range is 7.0 feet.

Shoreline and shore structures determined by 1948 survey.

Coordinates are on the Lambert Grid System for the State of Connecticut.

For additional construction details for shore structures see Plate 6.

CONNECTICUT BEACH EROSION CONTROL STUDY

PLANS OF IMPROVEMENT AREA I
ASH CREEK TO SAUGATUCK RIVER

IN 3 SHEETS SCALE IN FEET SHEET 3
500 0 500 1000

NEW ENGLAND DIVISION, BOSTON, MASS. JAN. 24, 1949

APPROVAL RECOMMENDED: Henry A. Whitesale
CHIEF, R & H OPERATIONS DIVISION

APPROVED:
LT. COL., C.E., ASST DIVISION ENGINEER

SUBMITTED: F. M. Rice
R & H PROJECTS AND REPORTS BRANCH

TRANSMITTED WITH REPORT DATED FEBRUARY 7, 1949.

DR. BY A.E.E.
TR. BY K.H.W.
CH. BY F.M.R.

FILE NO. B.E.C.I.14

PLATE 22

FIG. 1. JENNINGS BEACH. July 24, 1947. East end. Swift Ash Creek current and steep foreshore creates dangerous condition for bathers.

FIG. 2. JENNINGS BEACH. July 24, 1947. West end showing weekday patronage.

FIG. 3. FAIRFIELD BEACH. June 15, 1948. East of Shoal Point. Narrow beach in front of sea-walls.

FIG. 1. FAIRFIELD BEACH. June 15, 1948. Narrow beach in front of walls between Shoal Point and Pine Creek Point.

FIG. 2. FAIRFIELD BEACH. June 15, 1948. Westerly drift at groin and narrow beach in front of cottages east of Pine Creek Point.

FIG. 3. FAIRFIELD BEACH. June 15, 1948. Severe erosion condition west of Pine Creek Point.

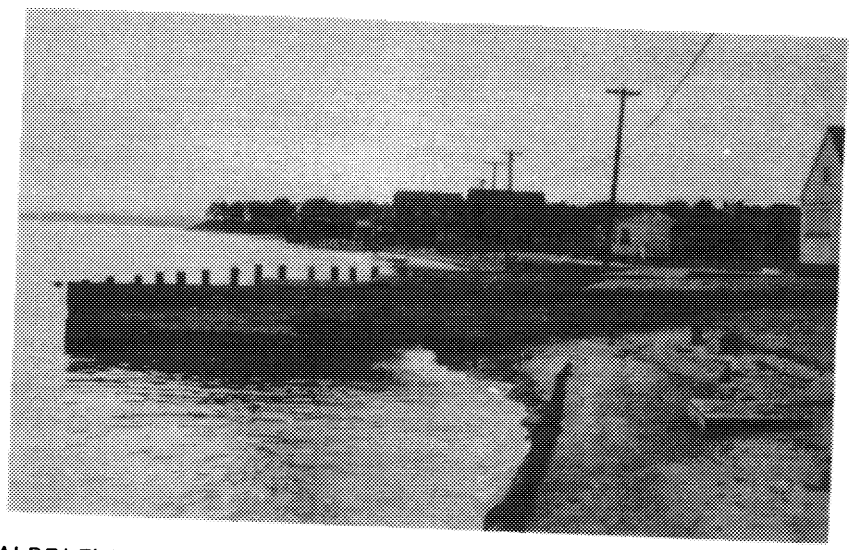


FIG. 1. FAIRFIELD BEACH. June 15, 1948. Erosion near end of spit west of Pine Creek Point.

FIG. 2. FAIRFIELD BEACH. September 3, 1947. Erosion at end of spit west of Pine Creek Point.

FIG. 3. KENSIE POINT. June 15, 1948. Eroding bank and fallen wall east side of Kensie Point.

FIG. 1. KENSIE POINT. June 15, 1948. Revetment, sea-wall and groins along west side of Kensie Point

FIG. 2. SASCO HILL BEACH. June 15, 1948. Shingle beach along east end of public beach.

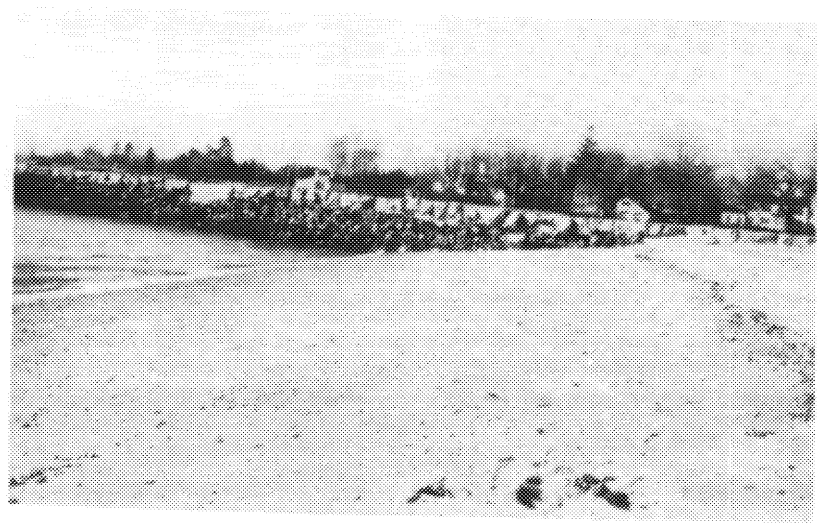


FIG. 3. SASCO HILL BEACH. December 6, 1948. Accumulation of sand at east side of Southport breakwater.

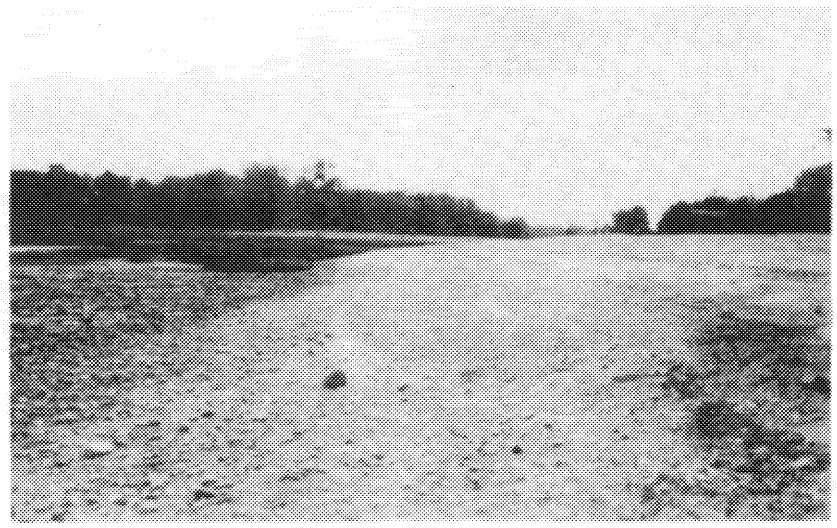


FIG. 1. SOUTHPORT BEACH. June 15, 1948. Shingle beach at east end of Southport Beach.

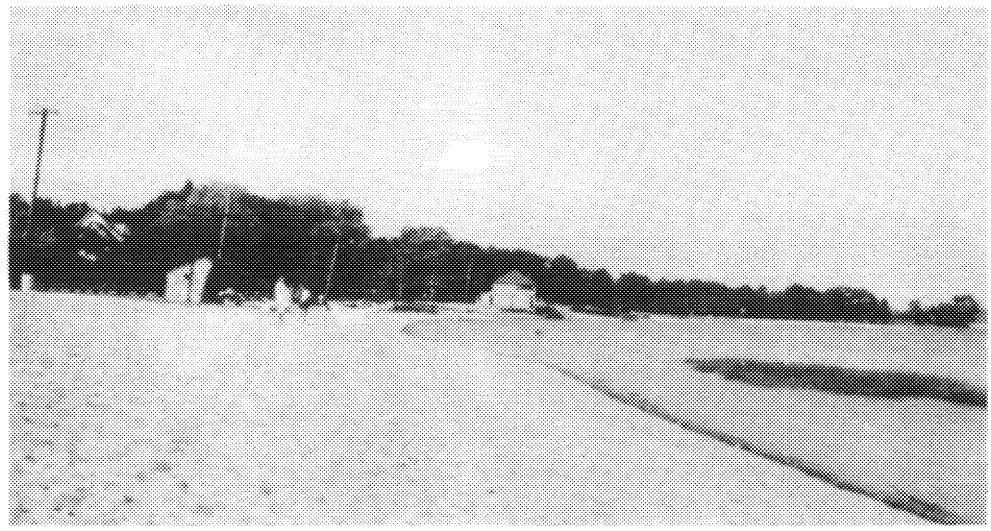


FIG. 2. SOUTHPORT BEACH. February 24, 1947. Looking east from west end of Southport Beach.

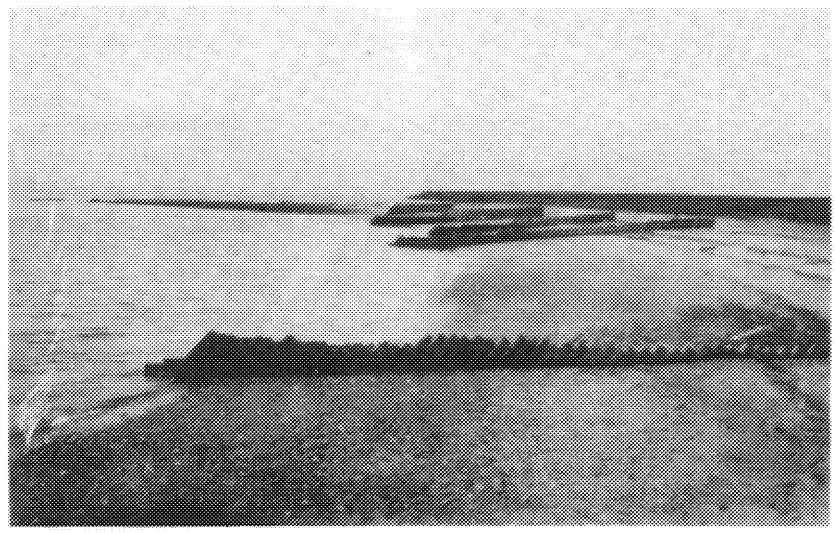


FIG. 3. GREEN FARMS. June 15, 1948. Groins holding 6" to 24" of westerly drift material east of Frost Point.

FIG. 1. GREEN FARMS. June 15, 1948. Groins and narrow beach in front of sea-walls west of Frost Point.

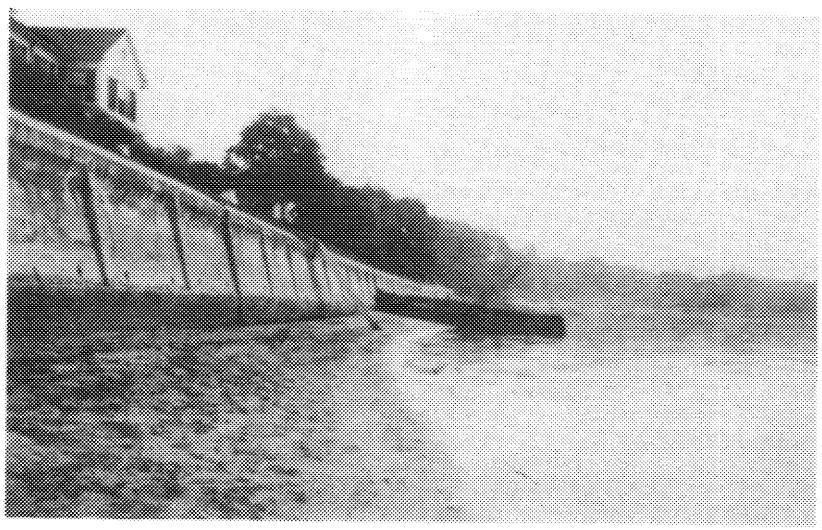


FIG. 2. GREEN FARMS. June 15, 1948. Footing of sea-wall exposed by erosion west of Frost Point.

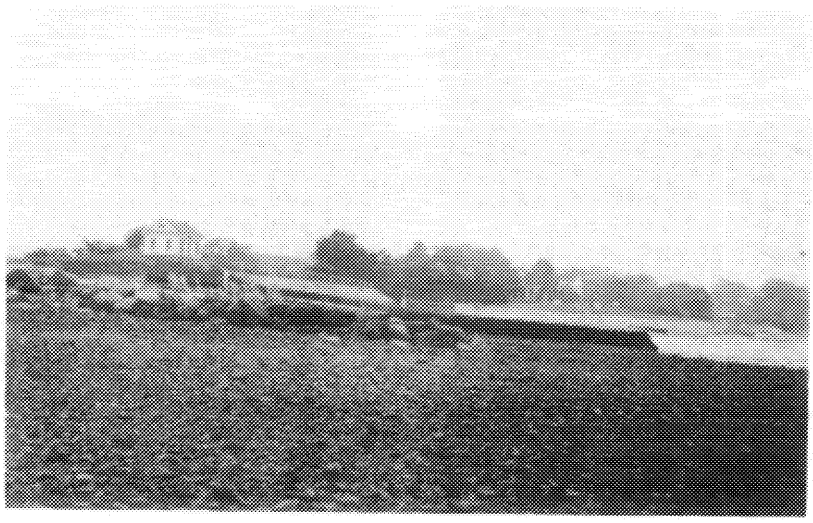


FIG. 3. BURIAL HILL. September 4, 1947. Shingle beach east of creek adjacent to and east of Sherwood Island Park.

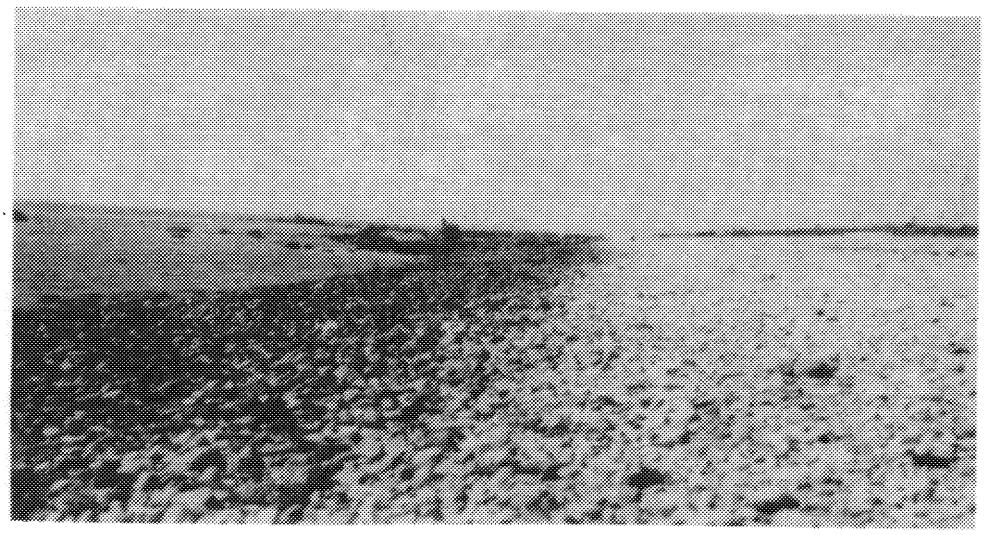


FIG. 1. SHERWOOD ISLAND PARK. July 25, 1947. Shingle beach east side of Sherwood Point.

FIG. 2. SHERWOOD ISLAND PARK. July 25, 1947. Shingle beach looking west from Sherwood Point.

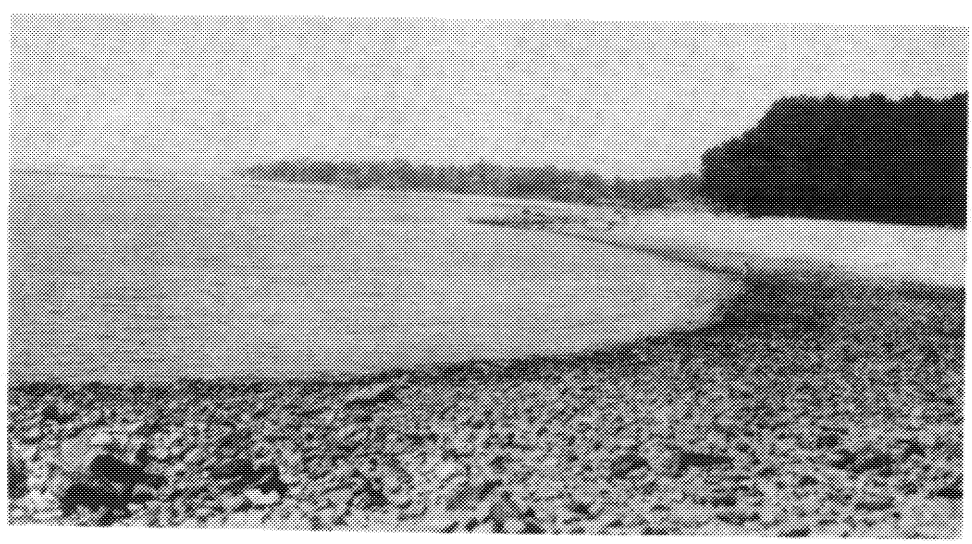


FIG. 3. SHERWOOD ISLAND PARK. July 25, 1947. Sandy backshore and shingle foreshore at west end of park beach.

FIG. 1. COMPO MILL ASSOCIATION BEACH. June 14, 1948. Groin holding shore at west end of Sherwood Island Park.

FIG. 2. COMPO MILL ASSOCIATION BEACH. June 14, 1948. Series of small concrete groins holding beach.

FIG. 3. COMPO BEACH. October 20, 1948. Newly built hydraulic fill beach west of Cedar Point.

FIG. 1. COMPO BEACH. October 20, 1948. Bank eroding behind newly constructed groin west of Cedar Point

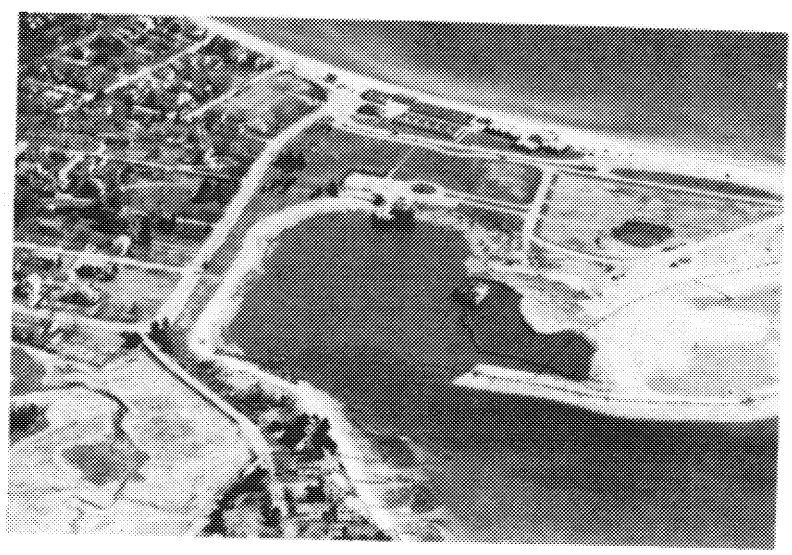


FIG. 2. COMPO BEACH. April 3, 1948. Dredging of basin in progress. Dash line represents approximate shore line before filling.

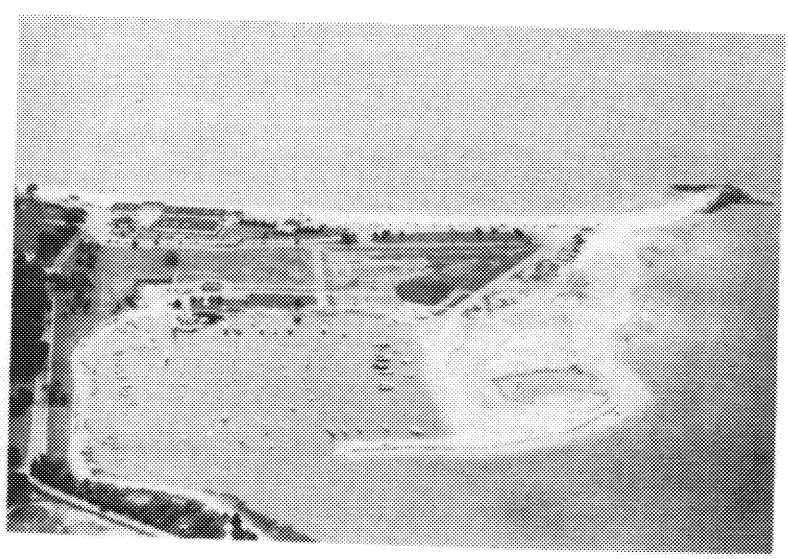


FIG. 3. COMPO BEACH. June 26, 1948. Basin completed. Bathing beach and bath houses in background.