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HURRICANE SURVEY



RECONNAISSANCE REPORT

FAIRFIELD CONNECTICUT



U.S. Army Engineer Division, New England
Corps of Engineers
Waltham, Mass.

ENGINEERING DIVISION WORKING COPY
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10 August 1960

28

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S Y L L A B U S

The Division Engineer finds that a serious problem of tidal flooding, due to hurricanes and other severe storms, exists in the town of Fairfield, Connecticut, particularly in the residential area between South Pine Creek Road and Ash Creek. The severity of the problem is indicated by the fact that three severe hurricanes and several great storms have struck the town in the past 22 years. The recurrence of the great hurricanes experienced in 1938 and 1954 would together cause total flood damages, at 1960 prices, of over \$2,000,000. The average annual loss from tidal flooding, for the entire town, amounts to \$265,000.

The Division Engineer further finds that dike protection for a major part of the town subject to tidal flooding, to a flood level of 12.8 feet msl or 2.7 feet above the record level of flooding experienced in 1938, is the best protective solution and can be economically justified. However, since local interests have indicated that support for dike protection to this height would be lacking and, further, that their present desire is for a lower degree of protection, below the 1938 record level of flooding, he does not recommend authorization of hurricane protection for Fairfield, Connecticut, at this time.

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM 54, MASS.

10 August 1960

SUBJECT: Reconnaissance Report on Hurricane Survey, Fairfield,
Connecticut

TO: Chief of Engineers
Department of the Army
Washington 25, D. C.
ATTENTION: ENG CW-X

AUTHORITY

1. This report is submitted in compliance with the provisions of Public Law 71, 84th Congress, First Session, approved 15 June 1955, and Section 204 of the Flood Control Act of 1954 (Public Law 780, 83d Congress). The Chief of Engineers, by first indorsement dated 10 February 1956) approved the Division Engineer's recommendation that studies in connection with these two authorizations be combined since both are concerned with hurricane tidal flooding in Fairfield, Connecticut.

SCOPE

2. This interim report presents the results of an investigation of the possibilities of providing protection against hurricane and other storm-induced tidal flooding in the town of Fairfield, Connecticut. It is one in a series of reports which, when completed, will constitute a survey of the entire coastal area of New England subject to tidal flooding occasioned by hurricanes.

This report includes a summary of data on experienced tidal flooding and tidal-flood damages, and descriptions of considered plans for reducing future losses through the construction of protective structures. Field work has consisted of flood damage investigations, topographic and hydrographic surveys, and some subsurface explorations in the areas of considered protection.

PRIOR REPORTS

3. HURRICANE REPORTS

There are no previous reports by the Corps of Engineers on the specific subject of hurricane protection for the town of Fairfield. Part Two, Chapter XXXIX (unpublished) of the report (Senate

Document No. 114, 85th Congress, First Session, 1957) on the "Land and Water Resources of the New England-New York Region", prepared by the New England-New York Inter-Agency Committee, pursuant to Presidential directive of October 9, 1950, includes a brief history of hurricane occurrences in New England, a description and summary of experienced losses in recent hurricanes, and a discussion of several methods of reducing damages.

4. NAVIGATION REPORTS

Southport Harbor in Fairfield, Connecticut, has been the subject of a number of navigation reports since 1827. The most recent report is River and Harbors Committee Document No. 36, 74th Congress, First Session, 1935.

5. BEACH EROSION CONTROL REPORTS

House Document No. 454, 81st Congress, Second Session, containing a Beach Erosion Control Study on Area 1, Ash Creek to Saugatuck River, Connecticut, recommends Federal participation in the construction of protective works at a number of locations along this area of the Connecticut coast, including three at Fairfield. The report also recommends the adoption by local interests of projects for the improvement of privately-owned shores in Fairfield.

DESCRIPTION

6. The town of Fairfield is located on the north shore of Long Island Sound, about 50 miles northeast of New York City, between the city of Bridgeport on the east and the town of Westport on the west. The town has a total waterfrontage along the Sound of about 4.5 miles. The mean range of tide at Fairfield is 6.9 feet, from 3.25 feet below to 3.65 feet above mean sea level. A high spring tide may reach an elevation of about 8.7 feet above mean low water (5.45 feet m.s.l.). The town is shown on standard quadrangle sheets of the U. S. Geological Survey at a scale of 1:31,680 and on quadrangles of the U. S. Army Map Service at a scale of 1:25,000; its shoreline is shown on U. S. Coast and Geodetic Survey Charts Nos. 220 and 1213.

ECONOMIC DEVELOPMENT

7. Fairfield has an estimated population of 45,000 which represents an increase of nearly 50 percent since 1950. The town is principally residential in character. Approximately 40 manufacturing plants, employing about 4,000 people, are located in the town. Most of the plants are small with 40 percent hiring less than 10 employees.

Recreation plays an important part in the economic life of the community. The principal recreational feature of the town rests in its fine beaches, particularly the three miles of beach extending from the mouth of Ash Creek west to Kensie Point. Located in this area are some 500 summer homes of which about 200 face directly on Long Island Sound. The town is served by a network of modern highways and the main line of the New Haven Railroad between New York and Boston.

EXPERIENCED TIDAL FLOODING

8. The record level of tidal flooding in Fairfield is 10.1 feet m.s.l. which was experienced during the hurricane of 21 September 1938 by reason of a 7.3-foot surge on top of a predicted gravitational tide of 2.8 feet m.s.l. at time of peak flooding. Tidal high-water elevations, predicted coincident astronomical tides, and storm surges in three major hurricanes and two other severe storms of recent times are tabulated in Table 1 below.

TABLE I

TIDAL - FLOOD DATA

Fairfield, Connecticut

<u>Date</u>	<u>Time of Peak (EST)</u>	<u>Highwater Elevation (feet msl)</u>	<u>Coincident Gravitational Tide (feet msl)</u>	<u>Storm Surge (feet)</u>
<u>Hurricanes</u>				
21 Sept 1938	7:35 PM	10.1	2.8	7.3
14 Sept 1944	11:20 PM	9.0	2.1	6.9
31 Aug 1954	12:35 PM	9.5	4.2	5.3
<u>Other Storms</u>				
25 Nov 1950	11:20 AM	9.0	3.7	5.3
8 Nov 1953	10:15 AM	8.8	3.6	5.2

STANDARD PROJECT HURRICANE

9. The basis for the standard project hurricane is a transposition of the September 1944 hurricane to a due northerly track, entirely over water, from Cape Hatteras to a point on the New England coast 49 nautical miles west of the eastern entrance to Long Island Sound. This transposed storm produces a surge at the entrance to the Sound equal to 13.4 feet or 1.4 times the 1938 surge of 9.5 feet. Routing the surge of 13.4 feet up the Sound gives a surge of 9.1 feet at Fairfield. The addition of a 9.1-foot surge on top of a high spring tide at 5.5 feet m.s.l. would give tidal-flooding to an elevation of 14.6 feet m.s.l.

DESIGN TIDAL-FLOOD LEVEL

10. The selected design tidal-flood level is 12.8 feet m.s.l. This elevation equals a project hurricane surge of 9.1 feet on top of mean high water at 3.7 feet m.s.l. Protection to this elevation, 2.7 feet above the 1938 level of flooding, would approximate the degree of protection that would provide a maximum excess of benefits over costs. It also represents protection against a future level of tidal flooding which has approximately one chance in 200 of occurring in any single year. It is considered to constitute a reasonable degree of protection that should be provided to the residential area of the town subject to the hazard of tidal flooding. The top of protective structures would be at an elevation of approximately 14.5 feet m.s.l. where subject to wave attack.

FLOOD DAMAGES

11. The hurricane of 21 September 1938 caused tidal flooding of approximately 1,800 acres in Fairfield; Hurricane "Carol", on 31 August 1954, the flooding of nearly 1,600 acres. Approximately 95 percent of the damages in 1938 and 1954, mainly residential in nature, were in the area between South Pine Creek Road and the town line at Ash Creek. The experienced flood damages in Hurricane "Carol" and the estimated damages that would be sustained upon the recurrence of the 1938 and 1954 hurricane tidal-flood stages and in the event of future flooding to an elevation of 12.8 feet m.s.l. in a design hurricane are summarized in Table 2 on the following page.

TABLE 2

TIDAL-FLOOD DAMAGESFairfield, Connecticut

<u>Hurricane</u>	<u>Flood Stage</u> (feet msl)	<u>Experienced Damages</u>	<u>Recurring Damages</u> (1960 prices)
21 Sept 1938	10.1	-	\$ 1,525,000
31 Aug 1954	9.5	\$608,000	700,000
Design	12.8	-	10,300,000

The flooded area in Fairfield and the distribution of experienced damages in 1954 are shown on Plate 1.

The annual losses for the entire town, from tidal flooding, at 1960 prices, are estimated at \$265,000.

EXISTING CORPS OF ENGINEERS' PROJECTS

12. HURRICANE PROTECTION

There is no existing Corps of Engineers' hurricane protection project for the prevention of tidal-flood damages in the town of Fairfield.

13. NAVIGATION

The existing navigation project for Southport Harbor provides for a stone breakwater about 1,320 feet long at the harbor mouth; a 1,350-foot dike along the east side of the harbor; a channel 9 feet deep at mean low water, to the upper end of the Golf Club wharf, 100 feet wide from Long Island Sound to opposite East Main Street, thence 400 to 175 feet wide; and an anchorage basin 6 feet deep at mean low water, 300 feet wide and 500 feet long, north of the Golf Club wharf. The existing project was completed in 1936.

14. BEACH EROSION CONTROL

The existing beach erosion control project at Fairfield provides for Federal participation in the amount of one-third of the first cost of construction of the following improvements:

a. Jennings Beach. An impermeable jetty, 800 feet long, extending southeasterly from the mouth of Ash Creek. This jetty was completed in 1951.

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

c. Southport Beach. Widening to a 100-foot width 700 feet of shore by the direct placement of sand, and construction of one impermeable groin, 400 feet long, at the west end of the improvement. The Sasco Hill and Southport Beach projects were completed in 1958. These projects are located along the western third of the Fairfield shorefront, west of the area of the Town susceptible to heavy tidal-flood damages.

15. NON-FEDERAL BEACH EROSION PROJECTS

House Document No. 454, 81st Congress, (see paragraph 5) recommends that consideration be given to the undertaking by non-Federal interests of several beach erosion control projects along the shore, in Fairfield between South Pine Creek Road and Ash Creek. This length of beach fronts the area where heavy damages have been experienced in past hurricanes. The recommended work includes:

a. Fairfield Beach. Widening to a 100-foot width, by direct placement of sand, about 3,400 feet of shore east of Shoal Point and 5,600 feet west, a total of 9,000 feet; and the construction of two groins, 400 and 500 feet long, east of Shoal Point, and five groins 350 to 450 feet long, west of Shoal Point.

b. Pine Creek Beach. Widening to a 100-foot width, by direct placement of sand, about 500 feet of shore west of the mouth of Pine Creek; and the construction of a training wall, 450 feet long, at the mouth of Pine Creek.

House Document No. 454, recognizing the unstable condition of the Pine Creek sand spit, west of Pine Creek Point and between Pine Creek and the Sound, recommends the removal of all structures on the spit and development of the abandoned area as a bathing beach, and the construction of a bulkhead to protect the shore area behind the spit if found to be necessary.

HURRICANE PROTECTION IMPROVEMENTS BY OTHERS

16. FEDERAL AND STATE IMPROVEMENTS

No improvements in the interest of minimizing hurricane tidal-flood damages in Fairfield have been undertaken by any other Federal agencies or by the State of Connecticut.

17. LOCAL IMPROVEMENTS

Several lengths of earth dike, totalling about 9,000 feet, have been constructed by the town along or near both banks of Pine Creek and the right bank of Ash Creek to provide some tidal-flood protection to the residential area between South Pine Creek Road and Ash Creek. The dikes have a top width varying from about two to eight feet and a top elevation of approximately 9.0 feet m.s.l. or about one foot below the 1938 flood level. The dikes tie into the existing sand dunes at the shore. The controlling elevation along the shore, which is also the controlling effective elevation of present protection, is approximately 8.0 feet m.s.l., at one location, with a number of locations ranging in elevation from 8.0 to 9.0 feet m.s.l.

The town has a regular planned program for the evacuation of danger areas by the public works, police, and fire departments in the event of tidal flooding. Further, with a view to minimizing future damages, the town has an ordinance requiring that the first floor of any new construction be at or above an elevation of 23.0 feet, Fairfield datum. This elevation is equivalent to 9.5 feet m.s.l. or the approximate level of tidal flooding experienced in 1954.

LOCAL DESIRES

18. During the course of the investigation a number of meetings have been held with representatives of both state and local governments, particularly with the Fairfield Flood and Erosion Control Board. The purposes of the meetings have been to ascertain the desires of local interests and to afford an opportunity for the exchange of ideas and comments on the investigation and the various plans of protection being considered. It was the opinion of local officials, in the early stages of the study, that the town should be provided with protection against a high level of flooding - to a flood stage of 14.6 feet m.s.l., equivalent to a standard project hurricane surge of 9.1 feet on top of a high spring tide at 5.5 feet m.s.l. - and that the protection should cover as large a part of the flooded area in the town as economically possible.

A public hearing was held in Fairfield on 25 June 1959 for the purpose of acquainting local interests with the results of the study and determining their views and opinions. The meeting was attended by about 750 persons including State and local officials and home owners in the problem area. At this hearing, considerable opposition to dike protection along the shore was expressed by waterfront property owners. Their objections were based principally on the contention that the protection would seriously interfere with their view and result in loss of breeze. The local Flood and Erosion Control Board presented a resolution that considered protection be limited to a top elevation of 12.5 feet m.s.l. This would be protection against a flood level of about 11.1 feet m.s.l. or a stage one foot above the 1938 level of flooding.

Subsequently the town officials have indicated that local support would be lacking for any plan calling for a high degree of protection, including protection against a flood level of 11.1 feet m.s.l. It is the present opinion of local interests that the town's need for protection can be met by the placement of sand fill or other protection, one to three feet high, in low areas along the beach east of Shoal Point. This would be protection to a flood stage at or slightly below the experienced level in 1938.

TIDAL-FLOOD PROBLEM

19. The damages caused by hurricanes and other severe storms result chiefly from (1) the salt-water flooding occasioned by the storm surge, (2) the action of storm-driven waves, (3) the fresh-water flooding resulting from heavy rains that may accompany the storm, and (4) the effect of high-velocity winds. This study has been limited to the problem of damages attributable to salt-water tidal flooding and wave action with the problem of fresh-water runoff being considered only to the extent that it may affect areas subject to tidal flooding.

Extreme high tides produced by hurricanes and other severe coastal storms enter the mouths of Ash and Pine Creeks at Fairfield, overflow the banks, and inundate properties on the banks and in the low-lying area between the two creeks. Hurricane tides also, at times, overtop the existing sand dunes or berm along the shore, particularly east of Shoal Point, and contribute to the salt-water flooding from the creeks. The problem at Fairfield is one of providing adequate tidal-flood protection to the extensive residential area between South Pine Creek Road and Ash Creek. This requires protective works to prevent damaging salt-water overflow from Ash and Pine Creeks and overflow of the sand dune or berm area along the shore.

CONSIDERED PROTECTION

20. Consideration was given to a number of plans that would provide needed tidal-flood protection to a major portion of the town. The protection, in general, consisted of earth-filled dikes with rock on the top and seaward slope and seeded topsoil on the landward slope. Where the protection follows the shore, provisions are included for the placement of sand fill, in the form of a berm 50 feet wide and with slopes of 1 on 20 and 1 on 30, which will serve to reduce the height of storm waves that will break on the dike.

The plan considered the most desirable, designated as Plan "C", is shown on Plate 2 accompanying this report. Protection under this plan starts at high ground near the intersection of South Pine Creek Road and Old Dam Road, runs easterly, about 4,500 feet, along Old Dam Road and across Pine Creek to the shorefront between Pine Creek Point and Shoal Point. It then continues along the shore for a distance of about 7,800 feet, around Shoal Point, to the foot of Beach Road. Here it turns inland for about 200 feet and then turns again and follows inshore of Jennings Beach and Ash Creek to high ground south of Riverside Drive, a distance of about 4,000 feet. Closure is completed by 1,800 feet of dike along the south bank of Turney Creek, from high ground on the north side of Riverside Drive to high ground near Turney Road, south of the Old Post Road.

Appurtenant structures in the plan include ramps and/or stop log structures at South Pine Creek Road, Old Dam Road, Fairfield Beach Road, and South Benson Road; a four-cell conduit, with 4.5-foot by 4.5-foot gates, at Pine Creek; a diversion structure and sluice gate in an existing sewer outfall west of Shoal Point; and a conduit, with one 4.5-foot by 4.5-foot gate, at the crossing of the creek on the north side of South Benson Road. Flow in the creek on the south side of Riverside Drive would be diverted to the conduit near South Benson Road.

Considered alternate alignments, shown on Plate 2, included (1) the extension of dike protection along the shore, across the mouth of Pine Creek, to high ground near the foot of South Pine Creek Road at Kensie Point, in lieu of the alignment along Old Dam Road; (2) dike protection along the right bank of Pine Creek in lieu of or to supplement protection along Old Dam Road; (3) an inshore alignment, 300 to 1,300 feet back from the shore, in lieu of the considered sand fill and dike protection along Fairfield Beach; and (4) alternate closures to high ground on the north in lieu of the south side of Turney Creek, at the east end of the protection.

The construction of a project along the alignment of Plan "C", affording protection to a flood level of 12.8 feet m.s.l., or 2.7 feet above the 1938 level of flooding, would cost a million and

a half or more dollars. The benefits that would be derived from the prevention of flood damages would be sufficient to justify the cost. The additional cost of providing protection for homes in the Pine Creek area, outside the protection afforded by dikes along the alignment of Plan "C", exceeds the additional benefits that would be obtained. Protection along an alignment inshore of Fairfield Beach would cost only a little less than Plan "C" protection along the shore but affords markedly less benefits. Preliminary estimates indicate that alternate closures to high ground in the Turney Creek area, at the east terminus of Plan "C" protection, have some merit.

Protection against a tidal-flood level of 12.8 feet m.s.l. is considered to approximate the minimum that should be provided to assure an adequate degree of protection to the 1,500 homes behind the considered dikes.

DISCUSSION

21. Residential areas in the town of Fairfield have experienced relatively heavy tidal-flood damages in recent hurricanes and other severe storms. The town, although not located on the open ocean, is subject to flooding from hurricane surges that travel up Long Island Sound from its eastern entrance off Montauk Point, Long Island. A recurring September 1938 hurricane would cause tidal-flood losses of over \$1,500,000; and a recurring August 1954 hurricane, losses of \$700,000. The need for protection is serious.

Dike protection for a major portion of the town east of South Pine Creek Road, against flooding to a stage of 12.8 feet m.s.l., is economically justified. This is protection to a level 2.7 feet above the record flood stage experienced in 1938 and approximates the minimum protection that should be provided for the 1,500 homes in the protected area.

The present desire of local interests is for some minor amount of additional protection along the shore east of Shoal Point to a flood level at or below that experienced in 1938. Town officials have indicated that any higher degree of protection would not receive local support. The degree of protection desired by local interests is considered to be inadequate in view of the large number of homes that are subject to flooding and the evacuation emergency that would arise in the event of future overtopping of low protection by tidal-flooding at or above the 1938 level.

CONCLUSIONS

22. It is concluded that the town of Fairfield, Connecticut, has sustained serious damages in the past from tidal flooding occasioned by hurricanes and other great storms and faces the continuing threat of similar damages in the future. It is further

concluded that there is justification for providing protection to a major portion of the town against tidal flooding to a stage of 12.8 feet m.s.l. through the construction of dikes and appurtenant works. The flood stage of 12.8 feet m.s.l., 2.7 feet above the record level of flooding experienced in 1938, approximates a minimum degree of protection that should be provided in view of the extensive area and large number of homes that would be deeply inundated in the event protective works were overtopped. Local interests, however, desire protection of a lesser degree and have indicated that there exists at this time a lack of public support and desire for protection against future tidal flooding to a stage at or above the 1938 record level of flooding.

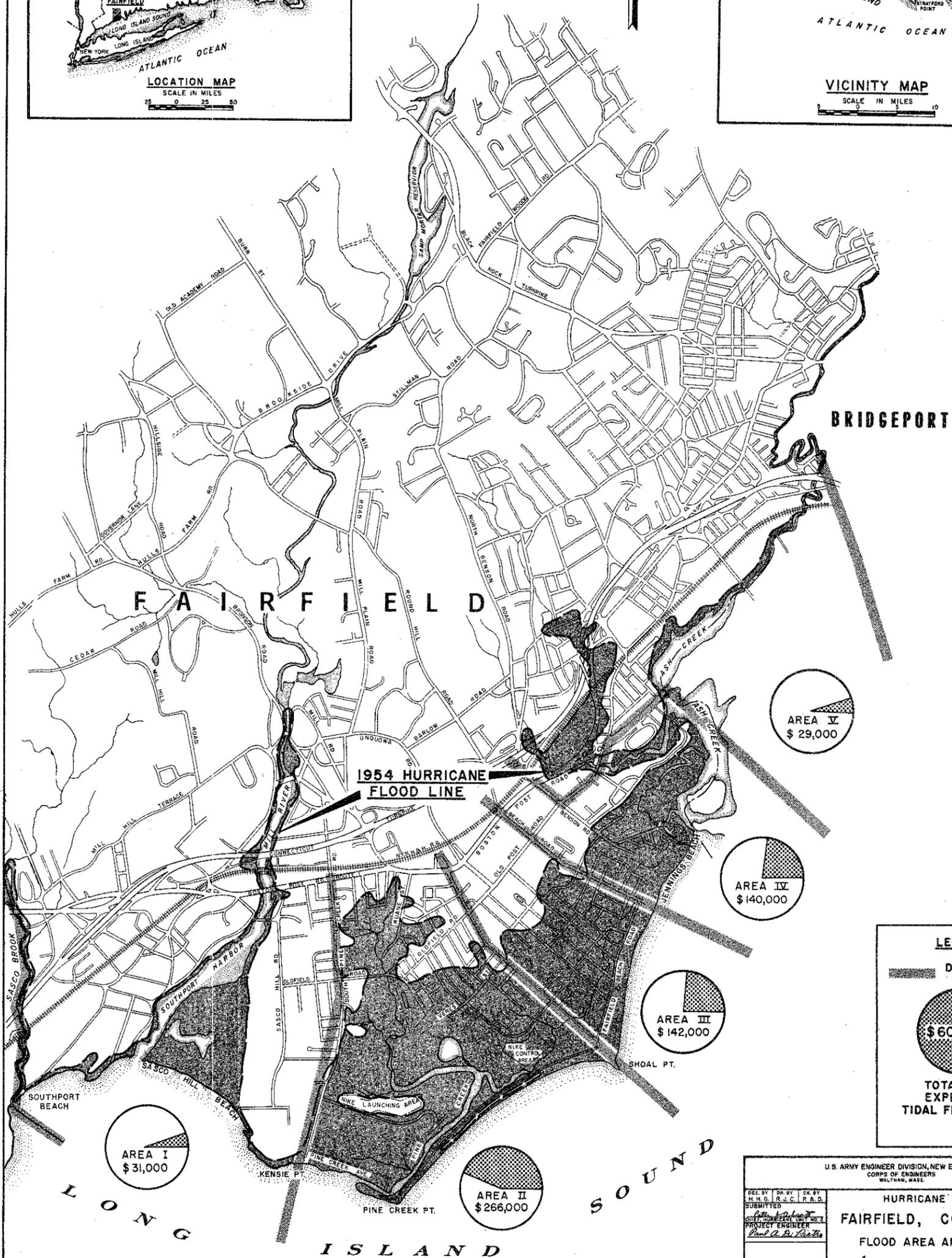
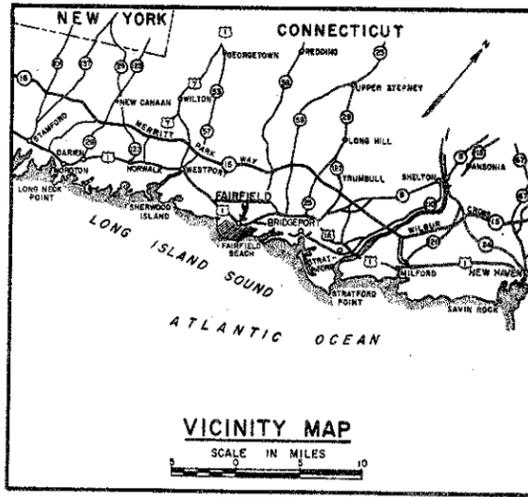
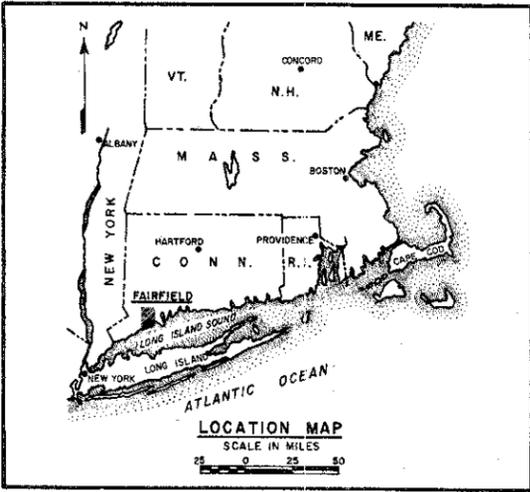
RECOMMENDATION

23. It is recommended that no hurricane protection for the town of Fairfield, Connecticut, be undertaken by the United States at this time.

ALDEN K. SIBLEY
Brigadier General, U. S. Army
Division Engineer

2 Incls

1. Plate 1 - Flood Area
and Damages-File No. FC-1-1000
2. Plate 2 - Considered Protection Plan "C"
File No. FC-1-1001



LEGEND

DAMAGE AREA OUTLINES

\$608,000

TOTAL 1954 EXPERIENCED TIDAL FLOOD LOSSES

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

HURRICANE SURVEY
FAIRFIELD, CONNECTICUT
FLOOD AREA AND DAMAGES

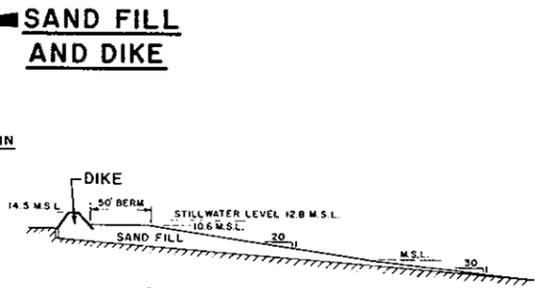
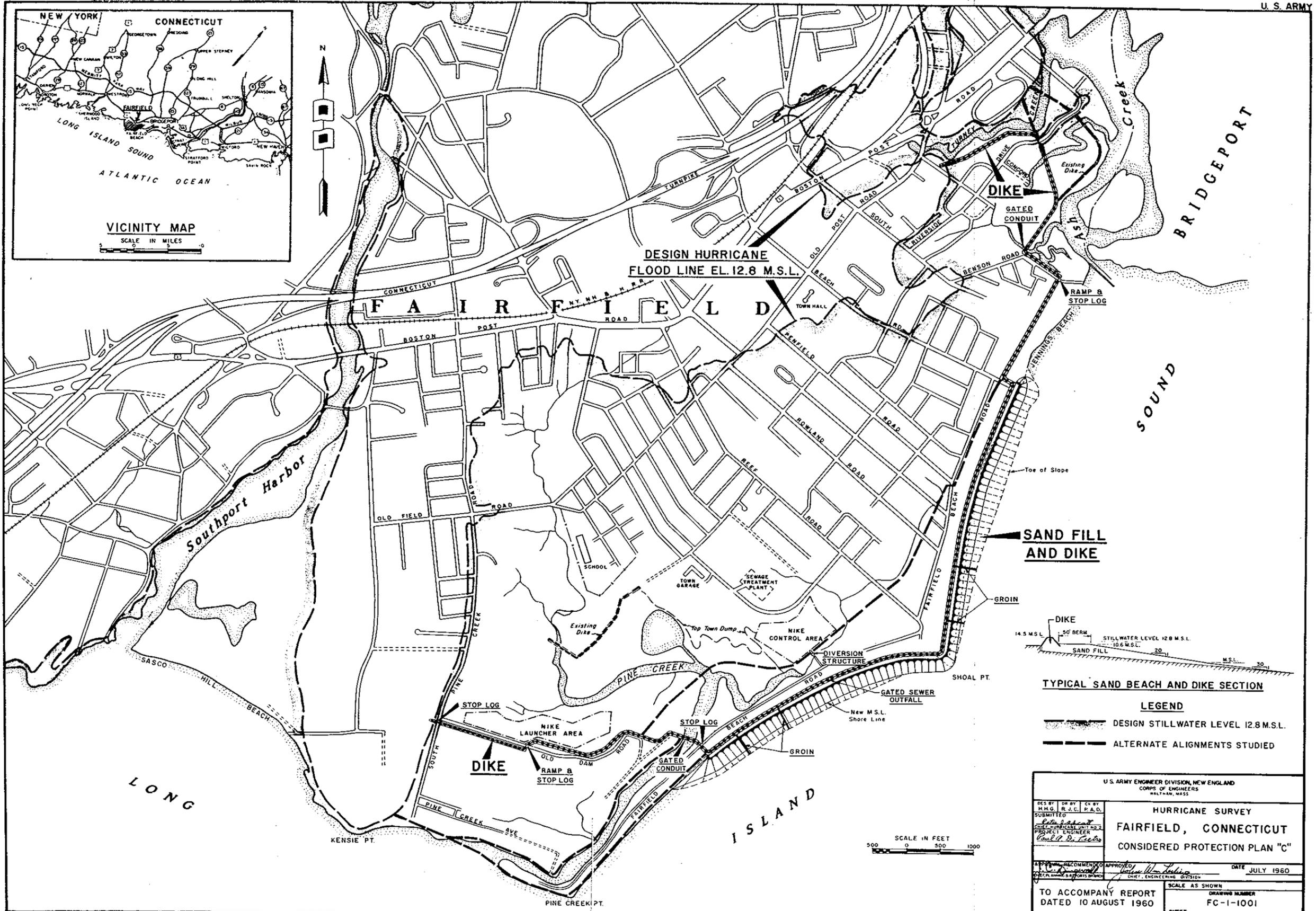
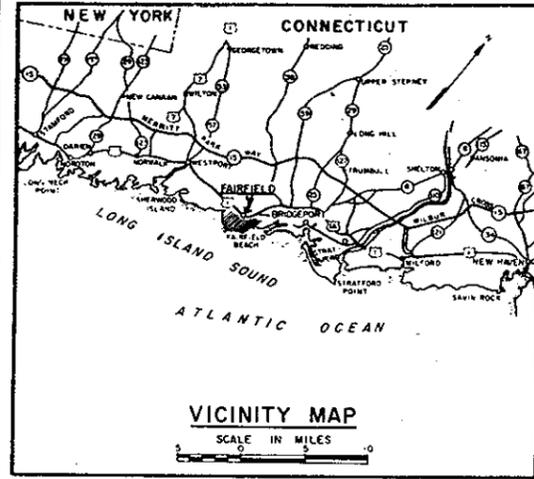
DATE: JULY 1960

TO ACCOMPANY REPORT DATED 10 AUGUST 1960

DRAWING NUMBER: FC-1-1000

SHEET





LEGEND
 --- DESIGN STILLWATER LEVEL 12.8 M.S.L.
 --- ALTERNATE ALIGNMENTS STUDIED

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.			
DES. BY M.H.G.	CHK. BY R.J.C.	CL. BY P.A.D.	DATE JULY 1960
SUBMITTED TO CHIEF OF ENGINEERS			
PROJECT ENGINEER Carl B. DeLoe			
APPROVED BY [Signature]			
TO ACCOMPANY REPORT DATED 10 AUGUST 1960			
SCALE AS SHOWN		DRAWING NUMBER FC-1-1001	
SHEET		PLATE 2	