Feasibility Report For Navigation Improvement
Including Environmental Impact Statement

Draft

Bridgeport Harbor & Vicinity, Ct. Navigation Study

US Army Corps
of Engineers
New England Division

SEPTEMBER 1983

BRIDGEPORT HARBOR, CONNECTICUT AND VICINITY

DRAFT FEASIBILITY REPORT
INLUDING THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

NAVIGATION STUDY ON IMPROVEMENTS TO
EXISTING FEDERAL DEEP DRAFT PROJECT
AT BRIDGEPORT MAIN HARBOR
AND MEDIUM DRAFT PROJECT
AT BLACK ROCK HARBOR

SEPTEMBER 1983

MAIN REPORT EXECUTIVE SUMMARY

BRIDGEPORT HARBOR, CT AND VICINITY

Bridgeport is the largest city in Connecticut and has the second largest port in the state, second only to New Haven. It is located 50 miles northeast of New York City and 20 miles west of New Haven, along the north shore of Long Island Sound in southwestern Connecticut. This highly industrialized city, with a 1980 population of nearly 143,000 serves as an oil and general cargo receiving center for western Connecticut and southwestern Massachusetts.

This Congressionally authorized study, initiated in October 1978, was executed to determine the engineering-economic feasibility and social-environmental acceptability of modifying the existing 35-foot-deep entrance channel and turning basin at Bridgeport, as well as consider other needs such as recreational boating improvements at Black Rock Harbor, the Pequonnock River, and Cedar, Burr, Ash and Johnsons Creeks. The study is concluded with this report.

The primary commercial navigation problems at Bridgeport Harbor are the need for additional channel depth and maneuvering area to handle the larger vessels now being used in the petroleum trade, and the need for attendant berthing improvements. Some lightering (partial offshore unloading) of larger tankers and cargo vessels to smaller vessels now occurs so that larger vessels can enter the harbor at high tide stages. Nearly 85 percent of the 3.2 million tons of waterborne commerce handled in 1981 consisted of petroleum products, of which nearly 24 percent was transhipped to six other Connecticut ports.

The principal recreational navigation problems are the lack of sufficient anchorage or mooring areas to meet the high local demand in the area of wet storage areas for recreational boats, and exposure of waterfront areas and boats at Black Rock Harbor to storm driven waves. Equal consideration was given to both structural and nonstructural measures in trying to meet the commercial and recreational navitation needs of the area.

The selected plan, the National Economic Development Plan, entails deepening the existing main ship channel to a depth of 42 feet at mean low water (while retaining the existing 400-foot channel width), enlarging the existing 18-acre turning basin to 28 acres and deepening to 42 feet, dredging a 28-acre, 6-foot-deep mooring basin at Burr and Cedar Creeks for use by recreational boats, designating an additional 10 acres (now exceeding 25 feet in depth) to restore the 25-foot main harbor anchorage to its full 23-acre dimension) and deauthorizing the two authorized, but unconstructed, breakwaters at the entrance to Black Rock Harbor, as they are no longer economically justified.

Burr & Cedar Creek anchorage already auth for construct.

This plan, which includes commensurate dredging at related terminal berthing areas, would require the removal of an estimated 2.9 million cubic yards of organic and inorganic silt, silty to gravelly sand, and clay. Clamshell mounted on barges are proposed for the dredging, and all materials would be transported by bottom dumping scows to the Central Long Island Sound Disposal Area, about 6 miles south of New Haven Harbor, for pointdumping. The proposed 8-month construction period is based on use of two large dredges to complete the main ship channel work and one smaller dredge to complete the Burr and Cedar Creeks mooring basin project. No dredging would be done during the warmer months (June through September) which are critical to the spawning of oysters.

Construction would be implemented by the Corps after Congressional authorization, funding and the completion of all local assurance requirements. The cost of the selected plan, based on October 1982 price levels, is estimated at $15,633,000, including $13,000 for the installation of additional navigation aids. Local and/or private interests would be entirely responsible for deepening the user berths at a cost currently estimated at $2,000,000. The estimated $1,260,000 dredging cost of the mooring basin at Burr and Cedar Creeks would be shared equally by the city and federal government. The dredging cost of the main harbor channel and turning basin improvements, presently estimated at $12,360,000, would be fully reimbursed by local interests under current Department of the Army policy. Previously, the full cost of commercial navigation projects was borne by the federal government under the traditional cost-sharing policies. Total annual maintenance cost of both project elements, including replacement and relocation of buoys as needed, is estimated at $149,000. It is anticipated maintenance dredging would be required on the order of every 10 years, based on an estimated shoaling rate of 24,000 cubic yards per year.

check cost data

Based on prospective use of both waterways, the selected plan is economically justified. Total annual charges of $1,472,000 when compared to annual project benefits of $5,810,000 yield a benefit-cost ratio of 4.0.

high jump in benefits 4.1 to 5.8 (BCR 2.8)

The main harbor improvements would permit more efficient use of the harbor through increased use of larger vessels and reduction of tidal delays, and result in long-term reduction of unit transportation costs through savings in waterborne transportation costs. The Burr and Cedar Creeks improvements would encourage increased use of the area by transcient recreational boats and by an estimated 200 new boats that could be expected to be added to the local fleet following project implementation.

The Division Engineer recommends, subject to certain local assurance requirements, that the foregoing plan of improvements be adopted for Bridgeport Harbor and Burr and Cedar Creeks, all located in Bridgeport, Connecticut.

DRAFT FEASIBILITY REPORT
BRIDGEPORT HARBOR AND VICINITY
CONNECTICUT

MAIN REPORT

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FEASIBILITY REPORT

BRIDGEPORT HARBOR AND VICINITY, CONNECTICUT

STUDY AUTHORITY

Concern over existing hazardous navigation conditions in the Bridgeport Harbor main channel and turning basin and other channels in the vicinity prompted local interests to request their Members of Congress to initiate a study of Bridgeport Harbor and vicinity. A navigation study was conducted by the Corps of Engineers in accordance a resolution adopted on 6 April 1977 at the request of Senators Abraham Ribicoff and Lowell P. Weicker, Jr., as follows:

"RESOLVED BY THE COMMITTEE OF PUBLIC WORKS OF THE UNITED STATES SENATE, that the Board of Engineers, for Rivers and Harbors be, and is hereby, requested to review the reports on Bridgeport Harbor, Connecticut, submitted in House Document No. 136, 85th Congress, 1st Session, with a view to determine the economic justification and environmental acceptability of providing navigation improvements for deep draft vessels, commercial fishing boats, recreational craft and related purposes in Bridgeport Harbor, including the harbor's tidal tributaries and nearby Black Rock Harbor, Cedar and Burr Creeks, and the tidal portion of Ash Creek."

STUDY PURPOSE AND SCOPE

This feasibility report presents the final response to the 1977 survey study resolution concerning the need for commercial navigation improvements at Bridgeport Harbor, the Pequonnock River, Black Rock Harbor and Cedar Creek and Ash Creek, all within or adjacent to the city of Bridgeport Connecticut.

Bridgeport, the largest city in Connecticut with a 1980 population of 142,546, is located midway between the cities of New Haven and Stamford along the north shore of Long Island Sound, about 50 miles northeast of New York City. The study area extends from the Ash Creek tidal arm of the Rooster River which marks the Fairfield-Bridgeport boundary on the west; Black Rock Harbor, Cedar Creek and Burr Creek in southwestern Bridgeport; Bridgeport Harbor, the tidal arm of the Pequonnock River and Yellow Mill Channel in southeastern Bridgeport; to the tidal arm of Johnsons Creek which marks the Bridgeport-Stratford boundary on the east, as shown in Figure 1.

Studies were made of the immediate and future regional needs for expansion of deep-draft navigation facilities at Bridgeport and Black Rock Harbors and for additional recreational boating facilities in the smaller waterways. All studies were made in the detail needed for plan selection and feasibility determination.

This report is presented in two parts. The main report contains a nontechnical discussion of problems, needs, and opportunities of the study area, followed by formulation, evaluation and screening of alternative plans, and assessment of their economic, social and environmental impacts. It concludes with selection of the final plan, a summary of coordination and public views, recommendations for implementation and an environmental impact statement (EIS).

The appendices support the main report with supplemental detailed data analyses needed by the technical reviewer in evaluating the selected plan and its capability for meeting existing and future navigation conditions.

EXISTING NAVIGATION PROJECT

The main harbor is serviced by a 3.6-mile-long entrance channel, 35 feet deep and 400 feet wide, extending from Long Island Sound past two rock breakwaters protecting the outer harbor; an 18-acre, 35-foot-deep turning basin at the east side of the head of the entrance channel; a 23-acre, 25-foot-deep anchorage immediately seaward of the turning basin; and a 1-mile-long inner channel, 35 feet deep and 300 to 600 feet wide extending to the Interstate 95 highway bridge.

Eastward of the turning basin, Johnson's Creek is serviced by a 15-foot-deep, 250-foot-wide channel in its lower reach and a 9-foot-deep, 100-foot-wide channel in the upper reach. Two small 9-foot-deep and 6-foot-deep anchorages lie at the west side of the head of the lower reach, and a 6-foot-deep anchorage lies at the head of the upper channel.

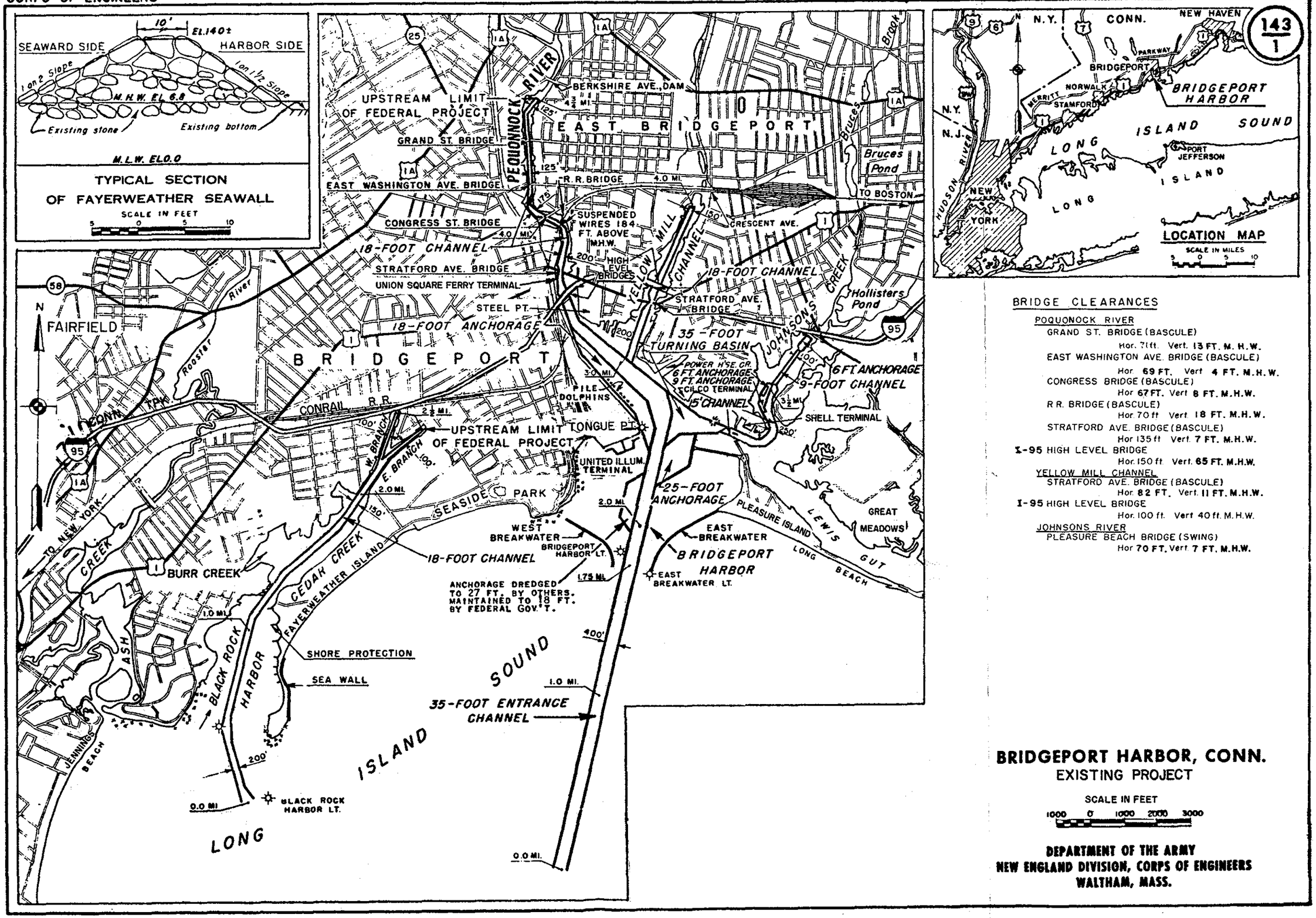
Midway along the east side of the inner main harbor, a 1-mile-long channel has been constructed in Yellow Mill Channel, 18 feet deep and 150 to 200 feet wide.

At the head of the inner harbor, a 1.3-mile-long channel has been dredged in the Pequonnock River, 18 feet deep and 200 feet wide at the lower end and 125 feet wide at the upper end.

In Black Rock Harbor, about 2 miles westward of the main harbor, a 2.4-mile-long channel, 18 feet deep and 200 feet wide extends from Long Island through the harbor to Cedar Creek, decreasing in width to 150 feet through the creek to two stub channels at the head of the creek.

NEEDS

City officials, acting through their congressional, delegation, requested the Corps of Engineers to study the feasibility of deepening the present 35-foot-deep main ship channel, deepening and enlarging the present 35-foot-deep maneuvering area, and providing breakwater protection and dredging improvements for commercial or recreational navigation in


SEAWARD SIDE
HARBOR SIDE
10'
EL.14.0±
1 on 2 Slope
1 on 1½ Slope
M.H.W. EL 6.8
Existing stone
Existing bottom
M.L.W. EL 0.0
TYPICAL SECTION OF FAYERWEATHER SEAWALL
SCALE IN FEET
UPSTREAM LIMIT OF FEDERAL PROJECT
GRAND ST. BRIDGE
EAST WASHINGTON AVE. BRIDGE
CONGRESS ST. BRIDGE
18-FOOT CHANNEL
STRATFORD AVE. BRIDGE
UNION SQUARE FERRY TERMINAL
STEEL PT.
18-FOOT ANCHORAGE
POQUONOCK RIVER
BERKSHIRE AVE., DAM
EAST BRIDGEPORT
R.R. BRIDGE
SUSPENDED WIRES 184 FT. ABOVE M.H.W.
HIGH LEVEL BRIDGES
YELLOW MILL CHANNEL
CRESCENT AVE.
18-FOOT CHANNEL
STRATFORD AVE. BRIDGE
JOHNSONS CREEK
Bruces Brook
Bruces Pond
TO BOSTON
Hollisters Pond
35-FOOT TURNING BASIN
POWER H'SE. CR.
6 FT. ANCHORAGE
9 FT. ANCHORAGE
CILCO TERMINAL
5' CHANNEL
6 FT. ANCHORAGE
9-FOOT CHANNEL
SHELL TERMINAL
FAIRFIELD
Rooster River
BRIDGEPORT
CONN. TPK.
CONRAIL R.R.
PILE DOLPHINS
UPSTREAM LIMIT OF FEDERAL PROJECT
TONGUE PT.
UNITED ILLUM. TERMINAL
W. BRANCH
E. BRANCH
SEASIDE PARK
25-FOOT ANCHORAGE
PLEASURE ISLAND
LEWIS GUT
GREAT MEADOWS
LONG BEACH
WEST BREAKWATER
BRIDGEPORT HARBOR LT.
EAST BREAKWATER
BRIDGEPORT HARBOR
EAST BREAKWATER LT.
18-FOOT CHANNEL
ANCHORAGE DREDGED TO 27 FT. BY OTHERS. MAINTAINED TO 18 FT. BY FEDERAL GOV'T.
TO NEW YORK
BURR CREEK
ASH CREEK
CEDAR CREEK
FAYERWEATHER ISLAND
BLACK ROCK HARBOR
SHORE PROTECTION
SEA WALL
JENNINGS BEACH
BLACK ROCK HARBOR LT.
35-FOOT ENTRANCE CHANNEL
LONG ISLAND SOUND
N.Y.
CONN.
NEW HAVEN
BRIDGEPORT
NORWALK
STAMFORD
MERRITT PARKWAY
BRIDGEPORT HARBOR
N.J.
HUDSON RIVER
NEW YORK
LONG ISLAND
PORT JEFFERSON
LOCATION MAP
SCALE IN MILES
143/1
BRIDGE CLEARANCES
POQUONOCK RIVER
GRAND ST. BRIDGE (BASCULE)
Hor. 71 ft. Vert. 13 FT. M.H.W.
EAST WASHINGTON AVE. BRIDGE (BASCULE)
Hor. 69 FT. Vert. 4 FT. M.H.W.
CONGRESS BRIDGE (BASCULE)
Hor. 67 FT. Vert. 8 FT. M.H.W.
R.R. BRIDGE (BASCULE)
Hor. 70 ft. Vert. 18 FT. M.H.W.
STRATFORD AVE. BRIDGE (BASCULE)
Hor. 135 ft. Vert. 7 FT. M.H.W.
I-95 HIGH LEVEL BRIDGE
Hor. 150 ft. Vert. 65 FT. M.H.W.
YELLOW MILL CHANNEL
STRATFORD AVE. BRIDGE (BASCULE)
Hor. 82 FT. Vert. 11 FT. M.H.W.
I-95 HIGH LEVEL BRIDGE
Hor. 100 ft. Vert. 40 ft. M.H.W.
JOHNSONS RIVER
PLEASURE BEACH BRIDGE (SWING)
Hor. 70 FT. Vert. 7 FT. M.H.W.
BRIDGEPORT HARBOR, CONN.
EXISTING PROJECT
SCALE IN FEET
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

five tributary waterways. Present 35-foot depths in the main harbor limit many world-class vessels to high-cost partial loads at Bridgeport Harbor, or require them to bypass the harbor entirely. While the size of visiting deep-draft vessels had been increasing during the 1960's and 1970's, the hazard of inadequate depths, particularly in the maneuvering area, has constrained the size of vessels visiting the harbor in recent years. This has impacted on shippers and terminal operators who strive to ship or receive commodities at the least cost per ton. In view of the world trend to larger vessels, some carriers visiting Bridgeport Harbor are partially loaded, which results in greater unit transportation costs that must be passed on to the consumers. Channel and maneuvering are modifications would improve navigation safety and permit more cost-efficient movement of the waterborne commerce.

City officials also indicated a need for deepening the access to the municipal dock at the head of the inner harbor, which is used as a terminus by the Bridgeport-Port Jefferson (NY) ferry. Because analysis determined that deepening of the berthing area was a local responsibility, the ferry company lessee is modifying the dock face so as to provide the 30-foot depth desired by local interests.

Recreational and city officials also indicated the need for recreational navigation improvements in Johnsons Creek, the Pequonnock River, Black Rock Harbor, Burr Creek and Ash Creek. In view of a large, unsatisfied demand for wet storage of recreational boats in the Bridgeport area, they requested that additional access channels, anchorages, mooring basins and public marina areas be provided in these smaller waterways. In addition, they stressed the need for breakwater protection at Black Rock Harbor so as to eliminate wave damages to boats and waterfront structures in Black Rock Harbor and Cedar Creek, and to provide protected anchorage for small craft in Black Rock Harbor.

PREVIOUS STUDIES

1. Navigation Studies

Bridgeport Harbor, its tributary waterways; Black Rock Harbor, Cedar and Burr Creeks about 2 miles to the westward; and Ash Creek about one-half mile further to the west have been the subject of 26 Corps of Engineers studies in the interest of navigation since 1827. A listing of these studies appears in Appendix 1, "Existing Conditions."

Federal improvement at Bridgeport Harbor began in 1836 when an 8-foot-deep channel was dredged over the outer bar. Further work through 1963 included two entrance channel breakwaters; successive dredging of the main channel to depths of 14, 20, 22, 25, 30 and 35 feet; an inner harbor turning basin with successive depths of 30 and 35 feet; 18-foot channels in the Pequonnock River and to Yellow Mill Pond; main harbor anchorages of 18 and 25 feet; and a 15-foot channel in Johnsons Creek, decreasing to 9 feet in the upper reach, plus a 9-foot small-boat anchorage and two 6-foot anchorages in the upper reach.

Federal work in Black Rock Harbor began in 1836-38 with construction of a seawall across a breach in the southern part of Fayerweather Island to protect a lighthouse and prevent harbor shoaling. Work continued in 1884-94 with dredging of a 6-foot-deep channel up Cedar Creek and construction of a 2600-foot-long breakwater (now buried by sand) connecting Fayerweather Island with the mainland. Work through 1931 entailed successive dredging of an 18-foot channel in Black Rock Harbor, Cedar Creek and its two stub channels at the head of the creek, plus a 9-foot channel in Burr Creek. Two breakwaters at the mouth of Black Rock Harbor and a 28-acre anchorage 6 feet deep in Burr and Cedar Creeks were authorized in 1958, but were never constructed as required local cash contributions were not forthcoming.

28 ac anchorage @ Burr & Cedar Creeks is already authorized

No federal navigation improvements have been made in Ash Creek along the Bridgeport-Fairfield boundary.

2. Beach Erosion Studies

A 1949 Corps report on Ash Creek, and Jennings Beach immediately to the westward in Fairfield, led to 1950 authorization of a federal project and 1951 construction of an 800-foot-long jetty by the state and town at the west side of the mouth of Ash Creek to protect Jennings Beach.

A 1952 Corps report on the shore erosion in Bridgeport and Stratford immediately to the eastward, led to 1954 authorization of a federal project and 1957 widening by the state of an 8800-foot-long beach at Seaside Park, which is located immediately west of Bridgeport Harbor.

3. Hurricane Protection Studies

As a result of Hurricanes "Carol" and "Edna" in August and September 1954, studies on hurricane protection measures along the southern New England coast resulted in 1965 authorization of Federal protection measures at Stratford Great Meadows, Lewis Gut and along the lower Housatonic River, which were subsequently deauthorized in 1977 because of lack of local support for the project.

A 1964 Corps report considered hurricane protection measures for the Pequonnock River and Seaside Park-Tongue Point sections of Bridgeport, but no plans were found to be economically justified.

4. Long Island Sound Regional Study

A joint federal-state (former) comprehensive report on the Long Island Sound region was submitted by the New England River Basins Commission to the Water Resources Council in July 1975, recommending a wide range of actions. Key items affecting the Bridgeport area would entail:

o Concentrating petroleum receipts at five ports along the sound - at Bridgeport, New Haven and New London, in Connecticut, and at Port Jefferson and Northville, on the north shore of Long Island, New York.

o Establishing a quasi-public corporation which would develop offshore oil-receiving terminals at Bridgeport, New Haven and Port Jefferson that would connect with inland fuel storage centers, and develop heated residual oil pipelines at Bridgeport and New Haven that would connect with powerplants at Devon and Middletown, Connecticut.

o Initiating harbor debris cleanup programs at Bridgeport, New Haven, Norwalk and Stamford, in Connecticut, and at Hempstead, New York.

o Creating artificial offshore islands from the deposition of dredged materials.

o Building public fishing piers at Bridgeport and a fish reef near the Bridgeport shore.

o Expansion of boating facilities (slips and dry storage) for 3300 boats at Black Rock Harbor, Bridgeport Inner Harbor and Johnsons Creek.

o Improving recreation by a shoreline purchase program that would include development of state parks at Pleasure and Long Beaches, with ferry service to Pleasure Beach.

o Artificial nourishment by the placement of sandfill at 12 Connecticut beaches, including Seaside and Pleasure Beaches.

o Studies by the Corps of seven Connecticut tidal-flood prone areas, including the Great Meadows industrial area near the Stratford-Bridgeport boundary and the Ash Creek area near the Fairfield-Bridgeport boundary, with emphasis on nonstructural measures.

5. New York-Connecticut Interim Plan for Disposal of Dredged Material in Long Island Sound

An interim plan, which resulted in an agreement between Connecticut and New York on the conditions under which open water disposal of dredged material will take place in Long Island Sound, was developed by the New England River Basins Commission in September 1981. The plan recommends continuation of carefully controlled and monitored open water disposal at three designated areas located near New Haven, Cornfield Point Shoals (Old Saybrook) and New London.

6. Final Programmatic Environmental Impact Statement for the Disposal of Dredged Materials in Long Island Sound

A programmatic EIS on disposal of dredged material in Long Island Sound was prepared by the Corps and released in June 1982. The report

projected future dredging and disposal needs in the region through 2035 based on forecasted consumption of petroleum products and coal for each port and market area. It assessed several open water disposal sites and generically discussed other alternatives such as upland disposal, containment, beach restoration, incineration and resource reclamation.

7. Final Environmental Impact Statement for the Designation of a Disposal Site for Dredged Material in Western Long Island Sound

A Final EIS on the designation of a disposal site for dredged material in Western Long Island Sound (WLIS III) was released by the Corps in February 1982. In response to the need for a regional open water disposal site in Western Long Island Sound, the Corps, in cooperation with the states of Connecticut and New York, proposed use of WLIS III, a site within Connecticut waters located 2.7 nautical miles south of Long Neck Point, Darien, Connecticut, and 2.7 nautical miles north of Lloyd Point, Huntington, Long Island, New York. The document evaluated the generic environmental impacts of site use compared with an alternative WLIS site proposed in the Programmatic EIS. A "Record of Decision" establishing site use was issued in March 1982.

8. Long Island Sound Dredged Material Containment Study

As a followup to the 1975 Long Island Sound Regional Study conducted by the New England River Basins Commission, the Corps is investigating the feasibility and impacts of using dredged materials to build artificial islands in Long Island Sound for recreation, conservation, marsh building, development and other purposes. The study has determined that rock dike containment facilities would be the least expensive design. It is estimated that approximately 60 million cubic yards of dredged material would need to be contained over a 50-year period, with 64 percent of the dredged material originating in the central coastal area.

The study has examined 140 public shorefront sites for dredged material containment, including the upper half of Yellow Mill Channel, Seaside Park and Fayerweather Island in Bridgeport. Detailed siting analyses were made of a Clinton Harbor marsh creation project and a Groton Black Ledge island creation project, both in Connecticut, so that cost, feasibility and impact data would be available for comparative purposes. Twelve additional sites will receive detailed analysis, two at New Haven Harbor, one near the breakwaters at the entrance to Bridgeport Harbor and nine at New York sites, mostly near the western end of the sound.

A final report is presently scheduled for completion late in 1984. The report may recommend several disposal alternatives, including containment and marsh creation.

EXISTING CONDITIONS

1. Completed Navigation Project

Bridgeport, the largest industrial center in the state, is located along the north shore of Long Island Sound, in Fairfield County, southwestern Connecticut, about 20 miles west of New Haven. The main harbor is situated in the southeastern section of the city, at the mouth of the 21-mile-long Pequonnock River. Three tributary waterways are located generally east of the inner harbor, Yellow Mill Pond Channel to the northeast, Johnsons Creek to the east and Lewis Gut to the southeast. As shown in Plate 1, Black Rock Harbor, a small harbor about 2 miles to the west in the southwestern section of the city, is part of the existing federal navigation project.

figure

Authorized as two separate projects in 1836, they were modified in 1871, 1875, 1878, 1882, 1884, 1888, 1892, 1894 and 1896. The two projects were combined and modified in 1899, and further modified in 1907, 1919, 1930, 1937, 1945, 1946 and 1958.

The main harbor work, completed in 1963, provided for the following:

redundant w/ page 2 description of the project

a. A main channel 35 feet deep at mean low water, 400 feet wide, extending about 3.6 miles from Long Island Sound to Tongue Point (at the west side of the inner harbor), widening to about 600 feet at the bend about 0.2 mile upstream opposite the Cilco Terminal, and narrowing to 300 feet at the Interstate 95 bridge about 1.0 mile upstream; and an 18-acre turning basin, 35 feet deep, south and southeast of the Cilco Terminal.

b. Two rubble mound breakwaters, one 3,823 feet long on the easterly side, and one 2,110 feet long on the westerly side of the entrance to the main harbor.

c. Two anchorage basins, one 25 feet deep and 23 acres in area, opposite Tongue Point and one 18 feet deep and 29 acres in area, adjoining the west side of the inner harbor channel west above Tongue Point.

d. Pequonnock River Channel, 18 feet deep, extending about 1.3 miles to a point about 500 feet below the dam at Berkshire Avenue; and narrowing in width from 300 feet at the Interstate 95 bridge, to 200 feet above the Stratford Avenue bridge, to 175 feet above the Congress Street bridge, to 125 feet above the East Washington Avenue bridge to the head of the channel.

200 or 300 feet at Interstate 95

e. Yellow Mill Pond Channel, 18 feet deep, and 200 feet wide at the entrance at Cooks Point, midway along the east side of the inner harbor channel, and narrowing to 150 feet over a distance of about 1 mile.

f. Johnsons Creek Channel, 15 feet deep and generally 200 feet wide for a distance of about 2800 feet from the eastern end of the 35-foot-deep turning basin, then 9 feet deep and 100 feet wide for a distance of about 1,100 feet to the vicinity of the Interstate 95 bridge.

g. Three anchorages along Johnsons Creek, one 9 feet deep over 2.4 acres at the west side of the head of the 15-foot channel, one 6 feet deep

over 0.6 acre at the northwest side of the first anchorage, and one 6 feet deep over 2 acres at the head of the 9 foot channel.

The Black Rock Harbor work, completed in 1931, provided for the following:

a. Construction and maintenance of shore protection on Fayerweather Island, including a seawall to close a breach between the north and south parts of the island.

b. Black Rock Harbor and Cedar Creek Channel, 18 feet deep and 200 feet wide in the entrance channel, 150 feet wide in Cedar Creek and 100 feet wide in the two branch channels at the head of the creek, extending about 2.4 miles from the 18-foot contour in Long Island Sound to the head of the two stub channels.

Total cost of the completed new work was $4,261,000 including local cash contributions of $148,000. The project is shown on U.S. Coast and Geodetic Charts 12369 and 220, on Plate 1 accompanying this report, and partially shown on the U.S. Geological Survey Bridgeport quadrangle map.

2. Authorized Project

In addition to the completed work discussed above, the project as authorized by Congress in 1958 provided for the following project features:

a. Two rubble mound breakwaters, authorized but not constructed, at the entrance to Black Rock Harbor, one 900 feet long on the easterly side of the harbor and one 650 feet long on the westerly side of the harbor.

b. A 28-acre, 6-foot-deep anchorage, authorized but not dredged, in Burr Creek and on each side of Cedar Creek adjacent to Burr Creek, and abandonment of a prior 7-foot channel in Burr Creek.

3. Topography

The coastal area of Connecticut lies within the Seaboard Lowland section of the New England physiographic province. The lowland is characterized by a seaward sloping area that is roughly planar. This lowland extends inland up to 20 miles and usually lies under elevation 500, National Geodetic Vertical Datum (NGVD) which is based on the mean sea level of 1929. Elevations in the project area along the coast range from tide level to 80 feet NGVD. Variations in erosion have shaped the local topography, including recent events such as relative sea level rise, which has modified the shoreline. The natural estuary at Bridgeport consists principally of the tidal arm of the Pequonnock River, plus the smaller tidal arms of Yellow Mill Channel and Johnsons Creek that receive the drainage of small, local brooks. Black Rock Harbor, which was partially enclosed by Fayerweather Island on the east, was further

enclosed by seawall and breakwater construction, assisted by natural accretion and extensive sandfill.

4. Geology

The bedrock of the region consists primarily of a middle to upper Ordovician sequence of metamorphic rocks. These rocks, primarily gneisses and schists, have been folded into a northeast-southwest trending overturned syncline. The rocks are generally well foliated, with the foliation dipping, on the average, between 40° and 85° to the northwest. The rocks underlying Bridgeport Harbor consist of interlayered muscovite schist and gneiss, quartz schist and amphibolite belonging the the Orange Formation. The rocks underlying Black Rock Harbor belong to the Hartland Group, and the units present consist of mica-quartz schist; interlayered mica-quartz schist and biotite gneiss; biotite plagioclase gneiss with interlayered schist, gneiss and amphibolite; and interlayered garnet-mica-quartz schist and gneiss.

In general, Pleistocene-age glacial deposits dominate the area, although recent deposits are dominant in the low-lying coastal and offshore areas. Glacial till in the area is a compact, nonsorted mixture of clay, silt, sand, gravel, cobbles and boulders deposited by glacial ice. It is found overlying bedrock and is generally exposed in areas of relatively high elevation. Areas along the coast are covered with beach and windblown sand and gravel. The area underlying Bridgeport Harbor is covered primarily by silty, gravelly sand and inorganic silt, with more recent silty sand and inorganic silt filling old stream channels and a very recent deposition of organic silt blanketing the area. The area underlying Black Rock Harbor is covered primarily by inorganic silt and silty sand overlying glacial till or bedrock, which was blanketed by a more recent deposition of silty sand and organic silt. Additional geological information is contained in Appendix 4, "Geotechnical Considerations."

5. Climate

Mild winters and summers are the rule for the Bridgeport area. Sea breezes off Long Island Sound tend to keep summer coastal temperatures 10° to 15° F cooler than further inland, and 5° to 10° F warmer during the winter months. Prevailing winds are from the west, with about equal duration from the southwest and northwest. Heavy fogs occur on an average of 30 days per year.

National Weather Service records since 1935 show a mean annual precipitation of nearly 44 inches, with average monthly precipitation ranging from 3 to 4 inches. Mean annual snowfall is about 27 inches. The mean annual temperature is 51° F. The maximum recorded temperature was 100° F and the minimum record temperature was -3° F.

6. Hydrology

The tide at Bridgeport is semidiurnal, consisting of two high tides and two low tides per lunar day. At Bridgeport Harbor, the tide has a mean range of 6.8 feet and a mean spring range of 7.7 feet (the latter occurring about twice each month near the times of the full and new moons). Near the outer harbor breakwaters the mean tide level is 3.4 feet above mean low water (MLW). The extreme low water level (during neap tides when the pull of the sun is at right angles to the pull of the moon) is minus 3.5 feet MLW. The maximum recorded storm surge level is 9.2 feet NGVD. The maximum tidal flood current is 0.7 knots between the breakwaters, and the maximum ebb current is 0.6 knots.

what is the relationship between data bases

At the entrance to Black Rock Harbor, the tide has a mean range of 6.9 feet, the spring range is 7.9 feet and the mean tide level is 3.4 feet above mean low water. Tidal currents and flood levels are similar to those at Bridgeport Harbor

7. Water Quality

The waters of Bridgeport Harbor, Black Rock Harbor and Ash Creek are classified "SC" by the Connecticut Department of Environmental Protection. This classification indicates a limited suitability for certain fish and wildlife, recreational, boating, certain industrial process and cooling, and good aesthetic value. "SC" water is not suitable for bathing and is considered unacceptable. The water quality goal is "SB" which would be suitable for bathing and offers excellent fish and wildlife habitat.

A major factor is the combined sewage overflows involving two secondary sewage treatment plants. One is located near the head of Power House Creek, north of the Cilco terminal at the east side of Bridgeport Inner Harbor. The other is located west of Cedar Creek and north of Burr

Table 1
Water Quality Parameters in Black Rock and Bridgeport Harbors

Parameters		Black Rock Harbor	Outer Harbor (Surface)	Outer Harbor (5ft from Bottom)	Inner Harbor (Surface)	Inner Harbor 5 ft from Bottom)	Pequonnock River (One Run) High Tide
Temperature C^{o}		22.1	22.3	19.1	23.6	19.3	26.0
pH		7.55	7.73	7.62	7.74	7.68	7.80
Nitrates	ppm	1.123	0.765	0.539	0.812	0.529	2.485
Free Ammonia	ppm	1.214	0.240	0.248	0.411	0.245	0.329
Dissolved Oxygen	mg/1	6.225	7.141	5.790	6.360	5.464	7.310
Biochemical Oxygen		6.364	1.226	0.944	1.565	0.872	2.040
Demand (BOD	mg/1						
Poly Phosphate	ppm	0.132	0.055	0.033	0.069	0.038	0.040
Ortho Phosphate	ppm	0.239	0.048	0.045	0.109	0.055	0.050
Total Phosphate	ppm	0.377	0.099	0.075	0.187	0.095	0.090
Fecal Coliform	x/100	1,878	418	136	2,131	247	270
Total Coliform	x/100	5,813	5,530	396	27,375	385	All Atypical Coliforms
$\frac{\text{Fecal Coliform}}{\text{Total Coliform}}$		0.240	0.103	0.085	0.145	0.145	None

Creek. Although both plants generally discharge within the secondary standards, the released nutrients, solids and coliform bacteria contribute to long-term degradation of both harbors.

Another major factor is the industrial discharges which occur in the area. Shorefront situated industries under permit are allowed to discharge effluents with limited deviations in temperature, pH, dissolved solids, metals, and oil and grease. The discharge of dissolved metals by some industries has been recently curtailed by the Connecticut Department of Environmental Protection.

Little water quality data currently exists for Black Rock or Bridgeport Harbors. Table 1, as published in the Corps' July 1982 Environmental Assessment for Maintenance Dredging of the Black Rock Harbor - Cedar Creek Federal Navigation Channel, summarizes water quality from a 1975 study by C.J. Verses, R.J. Chriss and W.T. Gnewuch and indicates that Bridgeport Inner Harbor is seriously degraded. Metal and organic concentrations from 1980 Corps data, including polychlorinated biphenyl (PCB), are shown in Table 2. Ongoing (1983) maintenance dredging in Black Rock Harbor is expected to result in improved water quality conditions.

Table 2
Metal and Organic Concentrations (1)
in Black Rock and Bridgeport Harbor Waters (2)

	Black Rock Harbor (3)	Bridgeport Harbor (4)	
Constituent		Inner	Outer
Oil and Grease	<1.0	3	1.3
Mercury	0.004	0.025	0.036
Lead	<0.005	<0.005	<0.005
Zinc	0.047	<0.005	<0.005
Arsenic	<0.002	<0.002	<0.002
Cadmium	0.006	0.005	<0.005
Chromium	<0.010	<0.01	<0.01
Copper	<0.0086	0.006	<0.005
Nickel	0.04	0.016	0.030
Vanadium	<0.025	0.025	<0.025
PCB's (ppb)	11(2)	18(1)	4.4(2)

(1) All concentrations are in parts per million (ppm) except where noted.
(2) Data from CE (1980).
(3) Average of 7 samples unless noted otherwise in parentheses.
(4) Average of 3 samples unless noted otherwise.

8. Aquatic Ecosystem

move to next page

The aquatic ecosystem is discussed in more detail in the EIS accompanying this report and in a subsequent section entitled, "Fisheries Resources". Recent benthic studies conducted for the Corps in 1981-82 by the Center for Environment and Man indicate that harbor sediments are primarily fine-grained materials (organic or sandy silt) in the inner harbors with concentrations of oils, grease and metals in the tributary channels, coarser (fine to medium grained sand) in the outer harbors, with coarse sand off Pleasure Beach, and predominantly silty and gravelly sand in the main entrance channel.

Benthic fauna are generally low in species diversity and density in the inner harbors, tributary channels and the inner sections of the outer harbor. Pollution-tolerant marine worms (polychaetes) and snails are present throughout the harbors. Mollusks (oysters and hard and soft shelled clams) and some crustaceans (blue crabs and lobsters) are present in the outer harbors.

Commonly observed fish species are the Atlantic silversides, striped killifish, bluefish, sea robin, Atlantic pipefish, white perch, striped bass, menhaden and smooth flounder.

The immediate coastal waters and the shallower waters of Ash Creek, Black Rock Harbor, Bridgeport Harbor and Lewis Gut are considered by the Connecticut Department of Environmental Protection as constituting the second most important waterfowl wintering area in the state. Black ducks, scaup, Canadian geese and mallards are frequently observed species.

9. Threatened and Endangered Species

There are no federally listed or state designated threatened, endangered or rare species residing in the area. Potential transients could entail the shortnose and Atlantic sturgeon, bald eagle, peregrin falcon, Ipswich sparrow and Cooper's hawk.

10. Historical-Archaeological Features

There are no recorded prehistoric archaeological sites within the project impact areas, and no historical sites would be impacted by the proposed dredging works.

EXISTING SOCIOECONOMIC CONDITIONS

The resources of a region to a large degree determine the status of its economic well-being and growth potential. A general understanding of these resources and development trends is helpful in identifying regional problems and needs and selecting appropriate solutions. Although the city of Bridgeport is one of nine communities in the Bridgeport Standard Metropolitan Statistical Area (SMSA), it has the greatest influence on

decisions concerning harbor improvements, and would be most affected by such improvements.

In addition to Bridgeport, which had a 1980 population of 142,546, the SMSA includes the town of Stratford (50,541) and the city of Milford (50,898) to the east, the city of Shelton (31,314) and the town of Derby (12,346) to the northeast, the town of Trumbull (32,989) and the town of Monroe (14,010) to the north, the town of Easton (5,962) to the northwest, and the town of Fairfield (54,849) to the west.

1. Population and Housing

Over the last 50 years, the population of the Bridgeport SMSA, consisting of 395,455 residents in 1980, has grown by nearly 78 percent. Bridgeport, with a 1980 population of 142,546 or 36 percent of the SMSA, was the only community that netted a decline over this period. This follows the trend of population migration from the central cities to the suburbs that has been typical of the Northeast. Between 1970 and 1980, however, Bridgeport, Fairfield and Derby contributed to a 2 percent decline in the SMSA population. Population trends for the SMSA communities are shown in Table 3.

Table 3
Population Trends, 1930-1980
Bridgeport SMSA
(By Census Year, Population and Percent Changed)

	Bridgeport		Derby		Easton		Fairfield		Milford	
1980	142,546	-8.9	12,346	-2.0	5,962	22.0	54,849	-2.9	50,898	0.6
1970	156,542	-0.1	12,599	3.8	4,885	43.4	56,487	22.3	50,558	21.4
1960	156,748	-1.2	12,132	18.3	3,407	57.4	46,183	51.5	41,662	55.1
1950	158,709	7.9	10,259	-0.3	2,165	71.6	30,489	44.3	26,870	63.5
1940	147,121	-	10,788	-	1,013	-	17,218	-	12,660	-

1930 data?

	Monroe		Shelton		Stratford		Trumbull		SMSA	
1980	14,010	16.3	31,314	15.3	50,541	1.5	32,989	5.1	395,455	-1.6
1970	12,047	88.2	27,165	49.3	49,775	10.6	31,394	54.1	401,752	14.7
1960	6,402	121.4	18,190	43.3	45,012	34.6	20,379	135.8	350,115	22.4
1950	2,892	67.4	12,694	15.7	33,428	48.0	8,641	63.2	286,147	20.8
1940	1,728	41.5	10,971	8.5	22,580	17.5	5,294	46.1	236,817	[6.4]
1930	1,221	-	10,113	-	19,212	-	3,624	-	222,565	

without 1930 data of above mean anything?

103 percent

The SMSA racial composition is predominantly white, accounting for nearly 87 percent of the total. Blacks make up 8.8 percent of the SMSA population, with nearly 86 percent residing in Bridgeport. Residents of Spanish origin account for 7.7 percent of the area population, with nearly 88 percent living in Bridgeport.

Table 4 shows the number of housing units in Bridgeport and the Bridgeport SMSA. From 1950 to 1980, housing units increased by 65.6 percent in the Bridgeport SMSA, and 18.7 percent in Bridgeport. Although population declined in the city of Bridgeport by 8.9 percent between 1970 qne 1980, the number of housing units increased 1.1 percent during that period.

Table 4
Housing Units, 1950-1980
Bridgeport and Bridgeport SMSA

Year	Bridgeport	Percent Change	Bridgeport SMSA	Percent Change
1980	55,291	1.1	143,172	11.3
1970	54,675	5.8	128,614	23.5
1960	51,654	10.9	104,117	20.4
1950	46,588	-	86,441	-

2. Economy and Employment

Manufacturing has traditionally been the core of the Bridgeport area economy. Following the development of the munitions industry early in the 19th century, brass products, electrical supplies and machine tools were major industries in the late 19th century. While ammunition and machine tools have remained important industries, the largest manufacturing industry today is ~~the~~ transportation equipment ~~industry~~ which came to the area during World War II.

However, since World War II, nonmanufacturing has shown steady growth. Table 5 shows the principal Bridgeport Labor Market Area (LMA) employment by industry.

The average 1981 labor force in the Bridgeport LMA, which contains the same nine communities as in the SMSA, constituted 12.1 percent (192,175) of the total labor force in the state (1,589,000). The LMA unemployment rate of 6.2 percent was equal to the state rate. Bridgeport's labor force equalled 70,722, of which 8.0 percent were unemployed. Derby had an unemployment rate of 8.5 percent, with other Bridgeport LMA communities ranging between 3.3 and 5.6 percent.

1981 data here and labor force 1986 and 1982 data do not agree! on next page

Table 5
Total 1982 Employment by Industry
Bridgeport Labor Market Area

Industry	Number	Percent
Manufacturing:		
Transp. Equipment	20,340	11.4
Electrical Equipment	10,530	5.9
Fabricated Metals	9,670	5.4
Other Machinery	8,960	5.0
Primary Metals	2,870	1.6
Printing & Publishing	2,520	1.4
Other Manufacturing	2,420	1.4
Stone, Clay & Glass	2,320	1.3
Rubber and Plastics	2,140	1.2
Apparel	1,820	1.0
Food	1,000	0.6
Services	47,060	26.4
Trade	37,290	20.9
Finance, Insur., Real Est.	8,720	4.9
Public Administration	8,250	4.6
Construction & Mining	5,940	3.3
Transportation	3,280	1.8
Communications & Utilities	2,980	1.7
TOTAL	178,110	100.0

3. Land Use

The nine communities in the Bridgeport SMSA have a total area of 136,882 cres. The largest communities are Monroe (22,060 acres), Shelton (20,105 cres), Fairfield (19,584 acres), Easton (18,112 acres), Trumbull (14,980 cres) and Milford (14,769 acres). Bridgeport is second smallest with 11,447 res. Residential land constitutes the largest single category, 31.5 percent, or 43,125 acres. Monroe has the most residential land (8,150 acres), followed by Fairfield (7,148 acres). Bridgeport has the largest proportion of its land in residential development, 38.5 percent or 4,413 acres. Easton and Monroe have the least percentages of their land (14.3 percent and 18.6 percent, respectively) in residential use.

52% is 11,471

Shelton with 52.5 percent of its land undeveloped (10,546 acres) and Monroe with 52.0 percent of its land (8,826 acres) undeveloped have the most vacant land in the SMSA. Bridgeport has the least undeveloped land (4.3 percent or 488 acres). Bridgeport accounts for 44 percent of the industrial acreage in the SMSA, with 1,152 acres. Milford has the most commercial acreage, 7.2 percent or 1,062 acres. Additional landuse information is presented in Appendix 4, "Social and Economic Impact Assessment."

4. Transportation

Nearly all waterborne commerce in the SMSA is handled through the port of Bridgeport, with extensive residual fuel oil and some sand, gravel and crushed rock handled on the lower Housatonic River about 3 miles east of Bridgeport. The area is served by extensive highway, rail and bus systems. Interstate 95 and Connecticut routes 8 and 25 enhance the potential of the port. Other highways serving the SMSA include U.S. 1 and Connecticut routes 15, 58, 108, 110, 111, 113, 121, 127, 135, 136, 137 and 162.

While most passenger service is provided by private automobile, daily passenger and freight service is provided by Conrail and Amtrack. Five transit companies provide regular bus service in Bridgeport, Fairfield, Stratford and Trumbull. Commercial and private aviation are serviced from Igor I. Sikorsky Memorial Airport in Stratford. Passenger and auto ferry service to Port Jefferson, on the north shore of Long Island, is provided at the Bridgeport Union Square Municipal Dock. Extensive freight service is provided by numerous trucking companies based at Bridgeport and other major cities.

5. Fisheries Resources

There are no commercial deep sea fishing vessels in Bridgeport Harbor. However, there is a small oyster fishing fleet and several charter fishing boats in the area. Extensive recreational fishing takes place from a long pier at the western end of Pleasure Beach, Seaside Beach and the western breakwater.

Long Island Sound is well suited for the production of clams and oysters. Nearly 30 percent of the 22,500 acres of oyster grounds administered by the Connecticut Shellfish Commission are leased beds off the shores of Fairfield, Bridgeport and Stratford. The nearly 50 oyster beds at Bridgeport, totalling 2,600 acres, are "seed beds" located generally seaward of the dredged basins and channels which act as silt traps. As Bridgeport bottom materials have high levels of pollutants, all oysters taken from polluted waters are considered "seed oysters" and must be transplanted to clean waters so that the oysters can pass clean warm water for 2 or more weeks through their systems and flush contaminants out.

Local oystermen report that an acre of ocean bottom off Bridgeport can, under extremely favorable conditions, produce 2,000 or more bushels of seed oysters, presently valued at roughly $6.00 per bushel. The total Bridgeport harvest in 1978, a recent peak year, was 78,000 bushels. Most of the Bridgeport seed oysters are transplanted to Norwalk, about 15 miles to the west, where they undergo depuration (cleansing).

6. Port Activities

The two harbors have 40 piers, wharves and docks, of which 20 handle dry cargo, 10 handle petroleum products, one services a ferry and nine service principally recreational boats. Major docks in the main harbor are Shell Oil (Buckley Brothers), Cilco (City Lumber Company), the city-owned Union Square Dock (which services the Long Island Ferry) and the Steel Point and Tongue Point Stations (owned and operated by the United Illuminating Company).

Eleven docks are located along Black Rock Harbor and its tributaries, 13 along Bridgeport main harbor, three along the Pequonnock River, four along Yellow Mill Channel and five along Johnsons Creek. Facilities at Ash Creek consist of a municipal marina immediately inside the entrance for Fairfield residents.

There is one repair facility at the east side of Bridgeport Inner Harbor with a marine railway that can handle vessels up to 120 feet in length. Two boatyards and five marinas have smallboat repair facilities. The nearest facilities for making major repairs or drydocking deep-draft vessels are located at the Port of New York or at New London Harbor in eastern Connecticut.

Renovation of the Union Square Dock at the head of the main channel is in progress, and expansion of ferry service to Port Jefferson, New York is planned. The Cilco Terminal Co. plans to expand its multipurpose terminal at the east side of the inner harbor, but is unable to obtain sufficient land at this time. A Free Trade Zone has been designated on municipal land at the north side of Burr Creek, but no water access is planned or desired as all access to this 3-acre site will be by truck.

7. Waterborne Commerce

• Bridgeport Harbor, New Haven Harbor (20 miles to the east) and New London Harbor (nearly 60 miles to the east) are the three deep-draft harbors in the state. Petroleum products are transshipped to three inland waterways and three smaller ports in the state. The port is second busiest harbor (to New Haven) in Connecticut and eighth largest in New England. It has shown a steady growth in tonnage since the 35-foot-deep channel was completed in 1963. Bridgeport ✓

Freight traffic through the port was 3,212,851 short tons in 1981, of which 85 percent consisted of petroleum products and crude petroleum. Principal commodities handled were imports of residual fuel oil, primary metal products, lumber, distillate fuel oil and nonmetallic minerals; coastwise receipts of gasoline, residual fuel oil, distillate fuel oil, crude petroleum and sand, gravel and crushed rock; coastwise shipments of residual fuel oil and distillate duel oil; local shipments of residual fuel oil and crude petroleum; and exports of paper waste and sugar. The Union Square Dock at the west side of the head of the main harbor provides major passenger and auto ferry services to Port Jefferson on the north shore of Long Island, New York. Table 6 shows comparative tonnage for the period between 1960 and 1981. Table 7 shows a breakdown of freight traffic in 1981 by specific commodities.

Table 6
Bridgeport Harbor Tonnage, 1960-1980

Year	Tons	Year	Tons
1960	2,090,396	1971	3,548,554
1961	2,312,586	1972	3,471,623
1962	2,518,424	1973	3,553,980
1963	2,445,928	1974	3,295,195
1964	2,349,442	1975	2,860,171
1965	2,458,938	1976	3,265,113
1966	2,489,475	1977	3,495,140
1967	2,985,583	1978	3,735,609
1968	3,436,096	1979	3,243,301
1969	3,847,560	1980	3,194,618
1970	3,843,722	1981	3,212,851

Table 7
Bridgeport Harbor Commodity Tonnages, 1981

Commodity	Total	Foreign Imports	Foreign Exports	Coastwise Receipts	Coastwise Shipments
Petroleum Products *	2,723,767	610,377		1705 510 ~~1,360,902~~	323,833
Primary Metal Products	408,661	408,661			
Lumber, Wood and Paper	31,015	30,516	499		
Sand, Gravel, Crushed Rock	22,743			22,743	
Nonmetallic Minerals	19,875	19,875			
Paper Waste and Scrap	5,108		5,108		
Sugar	1,433		1,433		
Machinery	67		1		
Cut Stone	52	52			
Fish and Shellfish	48	48			
Special Commodities	40	40			
Transportation	2	2		1,728,253	
TOTALS	3,212,851	1,069,635	7,043	1,490,688	323,833

* Also local shipments of 84,047 tons of residual and distillate fuel oils.

8. Vessel Traffic

Fully loaded 37,000 deadweight ton (DWT) vessels, having lengths of 660 feet and drafts of 35 feet, are the largest vessels that can enter Bridgeport's main harbor at this time. Larger vessels up to 765 feet long with DWT of 70,000 have, in past years, entered the harbor partially loaded. Because of insufficient depth in the maneuvering area needed to approach the Iluminating Company Company terminal, U.I. has has a voluntary, restrictive policy dating back to 1977 that no ships destined for U.I. would have a draft more than 32 feet. Some vessels have experienced difficulty in approaching the Cilco terminal because of inadequate deep water near the southern end of the existing maneuvering area. This has caused the need for occasional lightering of larger vessels. Most tankers that previously docked at the Shell Oil Company terminal at the southeastern end of the harbor, prior to that firm's shift to the use of barges, had no difficulty in reaching the terminal because of the favorable east-west elongation of the existing maneuvering. However, some minor shoaling has occurred in recent years at the south end of the maneuvering area. Figure 2 shows the locations of the main harbor terminals.

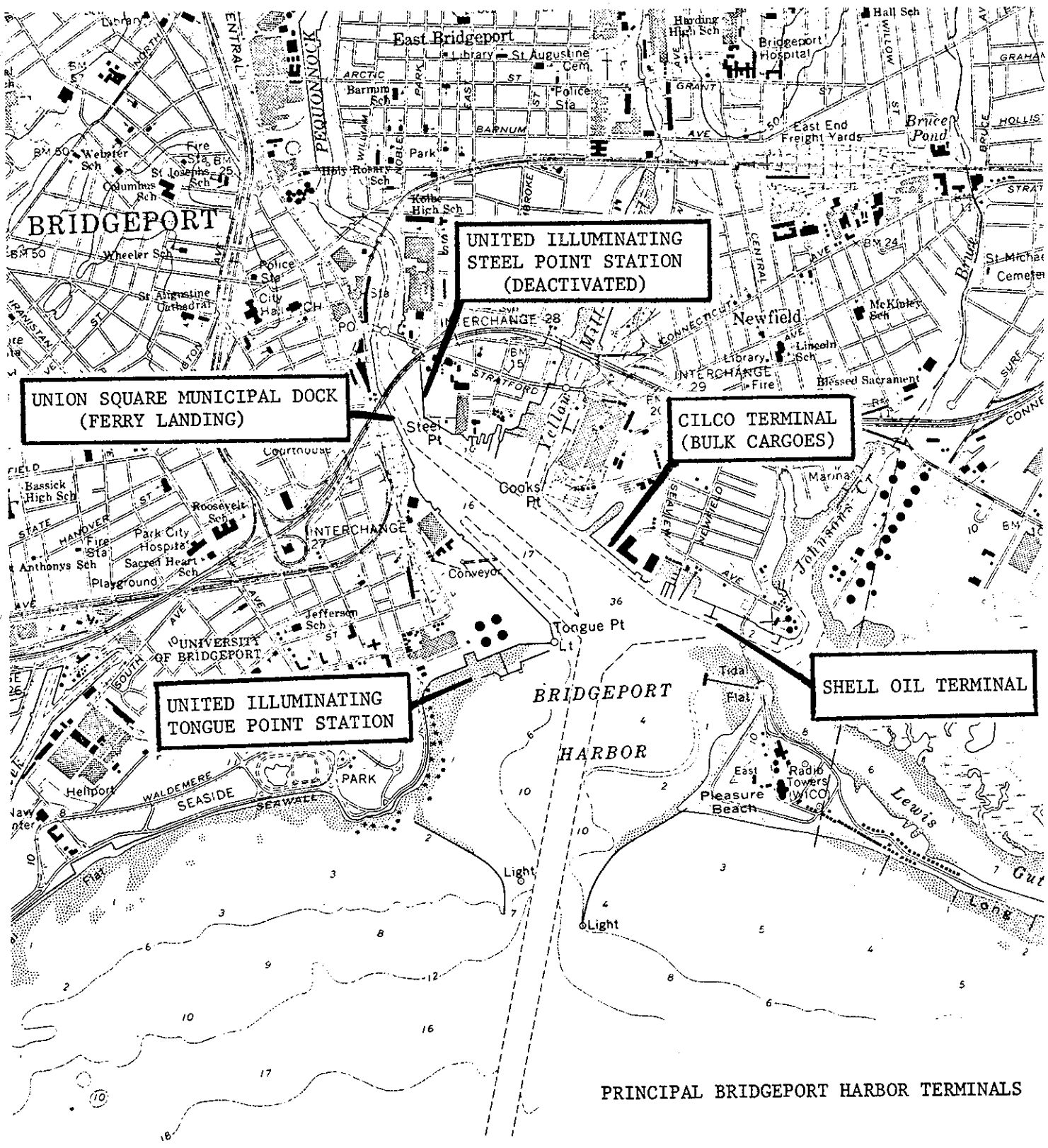
All large vessels entering the harbor are tug assisted. Due to insuffient deepwater maneuvering area, deep draft vessels are often required to wait for high tide before entering the harbor. As a result, many vessels using Bridgeport Harbor have been towed barge-type vessels in recent years with shallow drafts of 20 feet or less. A breakdown of trips and drafts of vessels involved in waterborne commerce at Bridgeport Harbor in 1981 is given in Table 8.

The trend in deep draft vessel usage is to increase the carrying capacity to take advantage of reduced transporation costs. Thus, the use of vessels with larger deadweight tonnage and deeper drafts will be increasing in the future. Without channel improvements, only shallower draft and partially full vessels will be able to use the harbor.

There is no specific data on the movements of recreational boats throughout the harbor areas. The following listing provides an approximate breakdown as to the numbers and locations of recreational boats based in the area.

Ash Creek	700	700
Black Rock Harbor	1,000	
Bridgeport Harbor and Pequonnock River		400
Johnsons Creek		500
Total Recreational Boats		2,600

Operational constraints for recreational boats are the lack of additional mooring or berthing areas, exposed harbor conditions at Black Rock Harbor and the 7-foot vertical clearance (at mean high water) of the Pleasure Beach swing bridge, when the bridge is in the closed position.



PRINCIPAL BRIDGEPORT HARBOR TERMINALS

FIGURE 2

Table 8
Bridgeport Harbor Vessel Traffic, 1981

Draft (Ft.)	Self-Propelled Cargo	Self-Propelled Tanker	Tug	Nonself Propelled Cargo	Nonself Propelled Tanker	Total
INBOUND						
34	1	8	-	-	-	9
33	6	-	-	-	-	6
32	14	3	-	-	-	17
31	5	1	-	-	-	6
30	6	-	-	-	2	8
29	10	1	-		11	22
28	7	2	1	1	1	9
27	4	2	-		1	7
26	11	-	-	-	3	14
25	4	3	-	-	1	8
24	4	-	-	-	2	6
23	7	1	-	-	6	14
22	4	-	-	-	-	4
21	7	-	-	-	5	12
20	3	-	-	-	4	7
19	4	-	-	-	3	7
18 and less	16	113	651	20	447	1,247
Total	113	134	651	20	485	1,408
OUTBOUND						
34	-	1	-	-	-	1
33	-	-	-	-	-	-
32	2	-	-	-	-	2
31	-	-	-	-	-	-
30	4	-	-	-	1	5
29	8	1	-	-	2	11
28	11	1	-	-	-	12
27	8	-	-	-	1	9
26	10	2	-	-	6	18
25	8	7	-	-	5	20
24	3	1	-	-	1	5
23	3	1	-	-	5	9
22	15	2	-	-	6	23
21	1	-	-	-	1	2
20	8	-	-	-	3	11
19	6	1	-	-	2	9
18 and less	24	115	667	13	452	1,271
Total	111	132	667	13	485	1,408

Cargo = dry cargo and passenger Tug - tugboat or towboat.

FUTURE CONDITION IF NO FEDERAL ACTION IS TAKEN

For Bridgeport and Black Rock Harbors, the without project condition would mean that the existing channels would be maintained with no additional improvements. Continued caution would be needed by ship pilots in guiding the 60 -plus largest ship passages each year, some consisting of partially loaded tankers that would draw 40 feet if fully loaded, to avoid accidents and possible oil spills.

If a federal program for improving general navigation facilities is not implemented, potential development and effectiveness of the port would be dampened. This could reduce the economic vitality of the port and the region that depends upon its services. As vessels in the foreign and U.S. fleets continue to increase in size and the older, smaller vessels are phased out of service, harbors with limited depths such as Bridgeport will be hard-pressed to attract ocean commerce. By 1995, more than 50 percent of all petroleum products are expected to be delivered in tankers. This condition could result in constriction of the market area served by the port and possible negative impact on industrial and waterfront expansion.

Shippers of petroleum products would have to lighter larger vessels on a regular basis. Transfer of petroleum from tankers to barges increases the potential for oil pollution incidents. While the amount spilled through lightering is unknown, the spillage rate has been estimated at one-half barrel per million barrels transferred. With continued use of larger tankers by the shipping industry and without channel improvement at Bridgeport, lightering activities could be expected to increase, further magnifying the present environmentally unsatisfactory situation.

In the short term, deliveries required to keep fuel oil and gasoline terminals along the tributary channels supplied are expected to continue. Three of the six terminals near the head of Cedar Creek, all serviced by barges, supply about 60 distributors with home heating oil. The single petroleum-barge terminal along the middle reach of the Pequonnock River receives about three million barrels of fuel oil annually. The large gasoline-fuel oil terminal along the east side of Johnsons Creek is serviced by four pipelines extending from the Shell Oil terminal located at the eastern end of the main harbor turning basin.

While it would be unreasonable to assume that all waterborne commerce at Bridgeport would ultimately be suspended in the long term, traffic would be limited primarily to smaller ships and barges, resulting in higher transportation costs. More and more ships would be forced to wait for favorable tides or wait for other ships to clear the entrance channel. These ship delays would lead to related economic losses. Larger vessels would be forced to lighter (offload) in Long Island Sound or be rerouted to other ports having deeper channels. In either case, transportation costs would rise, which would have to be passed on to consumers.

bad grammar

The demand for recreational boating, under the without--project condition, is expected to persist. Presently, there are long waiting lists for slips and moorings throughout the study area, and this demand could be expected to increase under the without-project condition.

WITH-PROJECT CONDITION why is this heading different than preceding one?

It is commonly recognized that many harbors have not been used to their full potential. Such is the case at Bridgeport, because of a variety of factors. While the size of deep-draft vessels had been increasing during the 1960's and 1970's, the hazard of inadequate deepwater maneuvering area has limited the size of fully loaded or partially loaded vessels visiting the harbor. Partial loading and lightering of vessels has been common, resulting in increased unit transportation costs.

Because of recent recession conditions, high interest rates and the present worldwide glut of oil, Bridgeport terminals have not been used to their highest potential. Due to the high cost of borrowing, oil and dry-cargo receivers have preferred to keep their inventories lower and order smaller loads of oil and other commodities. This condition is documented by a 10 percent increase in the number of vessels visiting Bridgeport in 1981, as compared with 1980 vessel trips, plus a noticeable decrease in the size of vessels visiting Bridgeport.

However, existing conditions will not necessarily continue for the next 5, 10 or 20 years. Because of continuing pressures to reduce shipping costs (costs per ton), more efficient use of the harbor may not be used to its maximum potential if channel deepening and maneuvering area improvements are made at Bridgeport, the fleet would shift over time to the use of larger vessels and more efficient use of harbor facilities.

re-work this section

Under long-term economic conditions, the shipping industry can be expected to operate with increased efficiency ~~toward~~ this minimizing unit transportation costs. The navigation plan selected for federal action at Bridgeport, the national economic development plan, would derive the greatest net economic benefits consistent with protecting the Nation's environment.

PLANNING CONSTRAINTS

1. Main Channel

There is a sizeable oyster industry off Bridgeport Harbor, and any dredging activities would have to be curtailed during the oyster spawning season from June through September each year to avoid serious damage to the oyster habitat and loss of income to the oyster industry.

Some of the bottom sediments, particularly in the upper harbor, appear to be polluted with organics and heavy metals. However, the extent of such sediments is small. During the offshore disposal of dredged materials in the proposed use of the Central Long Island Sound Regional Disposal Area, any partially polluted sediments would be capped by heavier, clean sandy material dredged from within the outer limits of the main ship channel.

Consideration of deepening the main channel upstream to the U.I. Steel Point powerplant was discontinued when it was learned that the Steel Point generating station was placed in a deactivated status. [Future deepening of the main channel upstream of the Yellow Mill Channel would require the removal and possible relocation of three submarine pipeline and one submarine cable immediately downstream of Steel Point (see Table 2 in Appendix 1).] evaluate cost of removing bridge

2. Pequonnock River

Early investigation of a request by local interests that a 100-boat marina be provided along the west bank of the lower reach of the Pequonnock River, a short distance upstream of the Stratford Avenue Bridge, determined that the proposed marina would encroach severly on the existing, federal channel limits because of the narrow width of the river. The marina could not be constructed unless the upsteam reaches of the channel were abandoned by congressional action. In view of extensive use of the upstream channel by petroleum barges and other potential users, the marina proposal was dropped from further consideration as local interests would have to provide affected upstream users with main harbor terminal facilities and connecting pipelines to their existing upstream storage tanks or to new storage tank locations.

3. Johnsons Creek

The existance of the 7-foot vertical clearance (at mean high water) at the Pleasure Beach swing bridge, when in a closed position across the lower reach of Johnsons Creek, serves as a constraint to additional recreational boats that could be based there. not planning constraint

COORDINATION

Key meetings included: top next page

bridge not "natural" condition

o 19 December 1978 - Public meeting at Bridgeport Central High School to determine the nature, extent and need for navigation improvements in the Bridgeport area, as well as local views on economic, social and environmental matters to be considered during the study.

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The New England Division is appreciative of the assistance received from individuals and local, municipal, state and federal authorities, particularly the following:

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- Mike Nicoh, Bridgeport Planning Department

(The results of public review of the draft report and final coordination on the final report will be added here.)

PROBLEMS AND OPPORTUNITIES

Information used to identify specific problems and needs was obtained from attendees at the public meeting held on 19 December 1978 at Bridgeport and from subsequent correspondence and workshop meetings with waterway users, organizations and individuals. The Bridgeport harbormaster, the New Haven-Bridgeport Pilots Association and waterfront owners have assisted in their suggested solutions to the problems.

1. Ash Creek

Shoal areas previously existed in the 60-foot-wide, 6-foot- deep entrance channel dredged by the town in the lower reach of Ash Creek. Tidal delays were experienced by deeper draft sailboats berthed at the municipally owned marina at the west side of the creek near the head of the entrance channel. This problem was resolved when a 9-foot-deep channel was dredged by the town in 1981 to obtain sand and gravel for highway purposes.

2. Black Rock Harbor

Black Rock Harbor has three major problems. Shoaling has occurred in the authorized 18-foot channel leading to Cedar Creek. This has required that 18-foot-draft tugboats, assisting oil barges to the upper reaches of Cedar Creek, slow down or stop because they scrape bottom or churn up silt at lower stages of the tide. This causes delays and maneuvering problems, as well as interruption of recreational boating activity in the lower harbor area during the sailing season. Approximately 1,000 pleasure boats moor along the Black Rock Channel during the summer months.

The fuel oil terminals in the upper reaches of Cedar Creek supply a large percentage of the homes and businesses in the Greater Bridgeport area. The deliveries required to keep these terminals supplied have been increasing and are expected to be more frequent in the future. The harbormaster has suggested deepening the channel to 22 feet, so as to allow tugs to pass safely through the channel with reasonable clearance for future siltation of the bottom.

A second major problem is the lack of protection in the outer harbor from wave action, particularly during storms generated across Long Island Sound. Damage to the boats moored in the harbor and shorefront facilities has run into thousands of dollars from severe storms. Local interests feel that breakwaters are needed at the entrance. This problem was studied in conjunction with the need for anchorage areas in Black Rock Harbor.

A third problem in the Black Rock Harbor area is the lack of sufficient anchorage. Cedar and Burr Creeks are well protected and would make fine mooring areas. A few smaller size boats anchor there now, but are grounded at low tide. Local interests would like to see mooring

basins in this area as the demand for recreational boating is very high and mooring space is needed.

Existing yacht clubs on the harbor have large sailing fleets, and their boats are encroaching on the existing channel. The yacht clubs have also expressed the need for anchorages on both sides of the channel in the lower Black Rock Harbor area.

3. Bridgeport Main Harbor

Bridgeport Harbor has two major problems - insufficient depth and insufficient turning basin area. Both problems are presently generated by the functions of the three largest terminals in the harbor, the United Illuminating (U.I.) Company Tongue Point powerplant, the Cilco cargo terminal and the Shell Oil terminal.

use consistent format

Channel depth. The present channel depth is limiting the size of vessels that can enter the port. Although 34-foot-draft vessels occasionally visit the Cilco and Shell Oil terminals, 32-foot-draft tankers are the largest vessels that visit the U.I. terminal. Some vessels have to wait up to 6 hours for favorable tides. While ship pilots try to take advantage of the channel, narrowing the effective channel width to 200 feet, which negates some of the favorable range of tide. Another controlling factor in safe passage of vessels is that U.S. -flag ships usually require a minimum clearance of 4 feet under the keel, while some foreign ships require a 6-foot clearance under the keel. Because of these conditions, some ships experience difficulty in navigating the 35-foot project, and others are forced to petroleum or dry-bulk cargos to smaller barges in Long Island Sound.

what's are you saying?

correct sentence

for 1 and 2 didn't use subheading as used here

U.S. flag and foreign fleets are increasing in vessel size. Over 80 percent of the Bridgeport petroleum tonnage is carried in foreign flag tankers, which tend to draw 2 or 3 more feet than U.S. tankers. Deepening of the channel would permit tankers in the 60-to 70,000 deadweight ton range, which draw between 40 and 43 feet, to use the port. In previous years, some tankers in this range have transited the channel with reduced loads.

Turning basin. At present, U.I. cannot accommodate large fully loaded tankers at their offloading facility at Tongue Point. Because of the existing 35-foot depth restriction in the channel and the existing turning basin is located inshore of Tongue Point, larger tankers must be scheduled to enter the harbor three quarters to half full, or with a loaded draft of only 32 feet. This causes problems with scheduling and requires more frequent tanker deliveries to supply the oil-fired generating station. Tankers preparing to dock at Tongue Point, which requires a sharp turn to port (left), have run aground on two occasions. Fortunately, neither incident resulted in an oil spill.

Larger cargo ships visiting the Cilco terminal, which must also make a

turn to port, also experience docking problems because of insufficient turning area and insufficient depth in the existing turning basin. Some shoaling has occured in the middle third of the turning basin, causing controlling depths of 32 feet. Shell oil has shifted in recent years to use of barges for transferring distillate fuel oil and gasoline from its Texas-New Jersey pipeline to its Bridgeport terminal, rather than by previous tanker shipments from Houston Texas. Harbor pilots have reported difficulties in maneuvering larger size vessels to the Cilco and U.I. terminals. Owners of both firms have requested that the turning basin be enlarged and deepened. With the world trend toward larger vessels, present problems will worsen. The New Haven-Bridgeport Harbor Pilots Association has requested that the existing 25-foot anchorage, which is located immediately south (or seaward) of the turning basin be made part of the turning basin. With this added area, larger vessels (70,000 DWT) in the 800-foot-long range could be handled with an acceptable degree of safety.

Another problem is inadequate depth at the city-owned Union Square Dock at the western head of the harbor. During recent visits by foreign sailing vessels and U.S. Navy and Coast Guard ships, the city secured a barge to the dock so that vessels could remain in deeper water near the channel, but still tie-up to the barge. The Mayor requested that 1.5-acre docking area be dredged so that future visiting vessels could tie-up directly to the dock.

4. Pequonnock River

Local interests requested that a 100-boat municipal marina be developed along the Jai Alai Fronton parking area in the lower reach of the river. No specific request for channel improvements was received from the Hoffman Fuel Company (Chevron), which operates the only active commercial terminal along the river, other than concern that their dock could be undermined if channel dredging should be proposed.

5. Yellow Mill Channel

Two requests were received concerning Yellow Mill Channel, one for removal of a sunken barge in front of the Move Yacht Club near the channel entrance, and the second for filling the upper channel with dredged material.

6. Johnsons Creek

Members of the Miamogue Yacht Club requested that a 3-acre anchorage be dredged for use by recreational boats in a small cove at the northwest side of the creek.

7. Other Needs

Other needs expressed included placement of suitable dredged materials on the beaches at Seaside Park and Pleasure Beach, extension of the main harbor west breakwater to the shore so that sportfishermen would not be stranded by rising tides, development of an offshore pipeline terminal for petroleum products, consideration of a narrower width for the main ship channel so that proposed deepening of the entrance channel would not impact on nearby oyster beds, cessation of any proposed dredging between 1 June and 1 October to minimize adverse impacts on productive oyster beds, and consideration of upland disposal areas (where appropriate) in lieu of deepwater disposal of dredged materials.

Heading?

delete this section (see cmts pg 28)

1. Main Channel

There is a sizeable oyster industry off Bridgeport Harbor, and any dredging activities would have to be curtailed during the oyster spawning season from June through September each year to avoid serious damage to the oyster habitat and loss of income to the oyster industry.

Some of the bottom sediments, particularly in the upper harbor, appear to be polluted with organics and heavy metals. However, the extent of such sediments is small. During the offshore disposal of dredged materials in the proposed use of the Central Long Island Sound Regional Disposal Area, any partially polluted sediments would be capped by heavier, clean sandy material dredged from within the outer limits of the main ship channel.

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The existence of the 7-foot vertical clearance (at mean high water) at the Pleasure Beach swing bridge, when in a closed position across the lower reach of Johnsons Creek, serves as a constraint to additional recreational boats that could be based there.

PLANNING OBJECTIVES

1. Federal Objective

The federal objective of water and related land resources project planning is to contribute to national economic development consistent with protecting the nation's environment. Federal planning should be responsive to state and local concerns. A plan recommending federal action should represent the alternative plan providing the greatest net economic benefits, unless there are overriding reasons for recommending another plan.

2. Regional and Local Objectives

The following planning objectives were established for the proposed 1990-2040 project period.

o Contribute to reduction in transportation costs for waterborne commerce.

o Contribute to efficient use of the harbor in conjunction with related socioeconomic needs of the region served by the port.

o Contribute to the improvement of recreational and environmental resources of the study area, where possible.

o Contribute to the safe navigation of commercial and recreational vessels, including reduction of potential marine accidents and petroleum spills.

o Minimize any impacts associated with dredging or disposal of dredged materials on indigenous fauna, especially existing oyster habitats.

o Maintain historical, archeological and cultural resources of the area.

o Enhance the human environment, where possible, including employment, tax base and the general quallity of life.

COORDINATION

Individual contacts, site visits, telephone conversations and/or correspondence contacts have been exchanged with all known interest groups in the area, as well as state and federal interests. Continuing coordination was maintained with the city planning office.

Key meetings included:

o 19 December 1978 - Public meeting at Bridgeport Central High School to determine the nature, extent and need for navigation improvements in the Bridgeport area, as well as local views on economic, social and environmental matters to be considered during the study.

delete

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(The results of public review of the draft report and final coordination on the final report will be added here.)

MANAGEMENT MEASURES

In order to formulate plans for meeting the needs for Bridgeport and Black Rock Harbors, all possible management measures were identified during the study process. Equal consideration was given to nonstructural and structural measures. The more promising individual managemtn measures were then developed into alternative plans.

The navigation problems in the Bridgeport area can be grouped into five "need" categories: channel depth in the main channel, Black Rock Harbor, Cedar Creek and Ash Creek; depth and area of main harbor turning basin; municipal marina at Pequonnock River; protected small-boat anchorages at Black Rock Harbor; and small-boat anchorages or mooring basins at Burr, Cedar and Johnson Creeks. Table 9 lists the management measures that were identified as possible ways to improve navigation in the area.

TABLE 9

Possible Management Measures

Nonstructural

1. Utilize Favorable Tides
2. Multiport Operations
3. Lightering (partial offshore transfers)
4. Utilize Other Ports
5. One-Way Traffic
6. Bypass Routes
7. Removal of Derelict Vessel
8. Stacking of Recreational Boats

Structural

1. Maintenance Dredging
2. Offshore Petroleum Products Terminal
3. Oil Pipelines
4. Marina Construction
5. Breakwater Construction or Extension
6. Improvement Dredging

ANALYSIS OF NONSTRUCTURAL MANAGEMENT MEASURES

1. Utilizing Favorable Tides

A common procedure at most ports is for ships to wait for high tides to allow deeper draft ships to move safely through channels that they could not navigate at low tide. Under current operating procedures, ship pilots are not taking full advantage of the tide ranges (6.7 feet mean tide at Bridgeport Harbor and 7.0 feet mean tide at Black Rock Harbor) and the use of favorable tides does not offer any further capability for improving port efficiency.

2. Multiport Operations

Multiport operations now play a small role in the receipt of petroleum products and general cargo to the Bridgeport market area, in that full loads are first brought to other North Atlantic ports and partial loads are then transhipped to Bridgeport or other ports where lesser depths are available. Shipment of Gulf Coast petroleum products by pipeline to New Jersey and transhipment by barge to Bridgeport is another form of multiport operation.

Substantial increases in multiport operations are not expected at Bridgeport for economic reasons, as expanded multiport operations would require that additional charges be paid at two or more ports rather than just at Bridgeport.

3. Lightering

The offloading or "lightering" of tankers and cargo ships now occurs at Bridgeport because of channel or berthing depth contraints. In some cases it permits a partially unloaded vessel to continue into the harbor to unload at the appropriate terminal at high stages of the tide. As noted earlier, the transfer of petroleum products increases the risk of oil spills. While lightering permits economies of scale through the use of newer, larger vessels, added expenses are incurred as in multiport operations. Because of these added expenses, potential adverse environmental impacts from oil spills and the current trend toward larger vessels, this alternative was dropped from further consideration as a significant alternative. However, the existing practice of lightering is expected to continue at Bridgeport in the absence of a federal improvement project, and could continue on a limited basis following implementation of an improved project.

4. Utilize Other Ports

Some diversion of traffic between Bridgeport, New Haven and other ports now occurs, whereby tankers call at one port and subsequent barge trips are made to the other port(s). Because Bridgeport has an established infrastructure of receiving and distributing facilities and the two existing oil-fired U.I. powerplants have extensive fuel oil requirements for plan consumption, capital and cost consideration dictate that Bridgeport remain a major petroleum port. Therefore, this measure was dropped from further consideration.

4. One-Way Traffic

In the interest of reducing future dredging impacts on nearby oyster beds, federal and state fish and wildlife officials requested that consideration be given to limiting commercial traffic in the main ship channel to one-way traffic so that channel widening would not be needed in the event that channel deepening is proposed. Typically, deepening a

channel by 5 feet results in the top width of the channel becoming 30 feet wider as the sideslopes of the channel tend to assume a 1 on 3 slope (1-foot vertical drop over a 3-foot horizontal distance) when a channel is dredged in ordinary materials such as at Bridgeport.

Past improvement and maintenance dredging operations have resulted in a channel bottom width generally well in excess of 400 feet, so that moderate channel deepening work would not disturb the sideslopes of the existing 35-foot-deep main ship channel. Oystermen indicated that few oysters exist along existing deepwater channel bottoms or sideslopes because of colder water temperatures in such areas.

One-way traffic is already in effect for the larger vessels now using the main harbor. Tankers having drafts of 36 feet and lengths of 660 feet now use the 400-foot-wide main channel during high tide stages. The New Haven-Bridgeport Pilots Association has requested that the authorized 400-foot channel width not be decreased, in the interest of safety and potential oil spills, as tankers in the 70,000 DWT range (765 feet in length, 108 feet in width and 40 feet in draft) would need the full 400-foot channel width to assure, safe, one-way passage for vessels up to this size. For these reasons, the one-way traffic alternative would not reduce the need for additional depth required for the larger vessels now using the harbor, and would not reduce the amount or extent of dredging needed to meet the needs of these larger vessels.

6. Bypass Routes

There are presently no alternative deepwater routes available to enable deeper draft vessels to enter the harbor. Therefore, there are no bypass routes that could be used to minimize the need for additional channel deepening, and this measure was dropped from further study.

7. Removal of Derelict Vessel

In response to a request by recreational boating interest for the removal of a sumken barge near the entrance to Yellow Mill Channel, it was determined that the sunken barge does not create a safety hazard as the barge is located well outside of existing channel limits. Removal would be a local responsibility.

8. Stacking of Recreational Boats

The use of multi-level open sheds and front-end fork lifts is being used at many harbors for "dry stacking" of recreational boats, where extensive vacant shorefront is available, in lieu of dredging anchorages, mooring basins, or slip areas. While some underutilized shorefront land is available for stacking recreational boats at Bridgeport and Black Rock Harbors, there is insufficient, undeveloped shorefront land available to meet the existing boating demand. Therefore, this alternative would not meet future boating activity needs.

ANALYSIS OF STRUCTURAL MANAGEMENT MEASURES

1. Maintenance Dredging

At times, significant shoaling can occur in an existing federal navigation channel prior to maintenance dredging being scheduled, funded and accomplished. In the interim period, local interest may feet that improvement dredging is needed to correct their navigation problems. Local interest requested that the authorized 18-foot-deep channel at Black Rock Harbor and Cedar Creek (which has shoaled to depths of 13 feet in a few sections of the channel and to 10 feet at the head of the eastern branch channel) be deepened to 22 feet. Deepening of the channel was found not to be economically justified for improvement dredging, as only a limited number of trips could be anticipated by vessels drawing more than 15 feet. Maintenance dredgilng of the Black Rock Harbor and Cedar Creek Channels to a depth of 17 feet plus 1 foot overdepth allowance (the maximum depth now economically justified by present usage) is expected to resolve the commercial navigation needs of the Cedar Creek terminals.

Maintenance dredging of the main ship entrance channel and the middle third of the turning basin to the authorized project depth of 35 feet plus 2 feet overdepth allowance would assist present usage, but would not meet the long-term needs of larger vessels expected to use the main harbor facilities.

2. Offshore Petroleum Products Terminal

As an alternative to additional deepening of the main ship channel, an offshore petroleum products terminal was considered about 3 miles south of Shoal Point in Fairfield (about 5 miles southwest of Bridgeport Harbor), in 56 feet of water in Long Island Sound. The terminal would be a double--berth fixed pier or a single-point mooring and would accommodate tankers up to 120,000 DWT. The terminal would include three concrete-coated submarine pipelines (with separate lines for residual, distillate and gasoline), each 3 miles long; intermediate storage tanks for 1.5 million gallons; a pumping and heating station (the latter to keep the residual fuel oil sufficiently heated for pumping); and 20 miles of underground pipelines to service all Bridgeport fuel terminals. The cost would exceed $119 million. Comparison of annual costs of $19.9 million with estimated annual benefits of $3.5 million derive an unfavorable benefit-cost ratio of 0.18. Consideration of an offshore terminal and connecting pipelines to service all of Bridgeport's and New Haven's petroleum needs also proved to be uneconomically justified. An offshore terminal system was dropped from further consideration for Bridgeport, as it was for New Haven in 1981, due to the high cost as compared with other alternatives. Also, an offshore petroleum terminal would not be able to meet the needs of the Cilco terminal and other dry-bulk terminals.

3. Oil Pipelines

Two oil pipeline routes to serve the Bridgeport gasoline and distillate fuel oil supply needs (1.1 million tons/year) were considered as alternatives to deepening the main ship channel. These alternatives did not include the pipeline movement of residual fuel oil, as much of the residual oil is imported. One alternative would consist of a 72-mile-long submarine pipeline from northeastern New Jersey at a cost of about $2 million per mile, for a total cost of $184,000. The other alternative would consist of a 72-mile-long land route from the Bayonne-Newark-Linden (NJ) area at a cost of about $1 million per mile, at a total cost of $92,000. Both alternatives were dropped from further consideration because of the high costs and anticipated rights-of-way acquisition problems. Comparison of the estimated annual costs of $30 million for the land route with the estimated annual benefits of $1.1 million produce a 0.04 benefit-cost ratio.

A third pipeline alternative was consisted that would meet the gasoline and distillate fuel oil supply needs of the coastal communities in New Haven and Fairfield Counties (CT) and Westchester County (NY). The estimated cost of a 95-mile-long underground pipeline is $122 million. Based on the movement of 15 million tons by pipeline annually, estimated annual costs of 59.3 million and estimated annual benefits of $24.7 million, the benefit-cost ration of the regional pipeline would be 0.42. It, too, was dropped from further consideration.

4. Marina Construction

As noted earlier, investigation of a request by local interests for a 100-boat marina municipal marina along the Pequonnock River determined that a marina would encroach so severly on the existing navigation channel, because of the narrow width of the river, that the proposal was dropped from further consideration.

5. Breakwater Construction or Extension

Construction of fixed or floating breakwaters at the entrance to Black Rock Harbor was considered in response to requests for measures to reduce stormwave damages in Black Rock Harbor and Cedar Creek and to provide protected small-boat anchorage areas in Black Rock Harbor. Fixed breakwaters were initially considered to be justified, and the alternative was carried forward for further study. Floating breakwaters were dropped from further study because of their inability to provide the needed wave reduction.

Extension of the main harbor west breakwater shoreward was studied as a measure to prevent people, especially those concentrating on sport fishing from the breakwater, from being cut off from the shore by rising tides. Potential benefits did not offset the costs of breakwater extension and resurfacing the breakwater for pedestrial use.

6. Improvement Dredging

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Deepening the existing 35-foot-deep main ship channel, deepening and enlarging the existing 35-foot-deep turning basin, and dredging small-boat anchorages or mooring basins in Black Rock Harbor and Burr, Cedar and Johnsons Creeks were found to be favorable alternatives and were carried forward for further study.

No needs or economic justification were ascertained to warrant channel improvements for commercial navigation in Black Rock Harbor-Cedar Creek (where maintenance dredging will meet projected needs), Yellow Mill Channel or Johnsons Creek. As noted previously, no recreational navigation improvements were found to be warranted to Ash Creek, Pequonnock River or Yellow Mill Channel.

Federal fish and wildlife officials had requested that consideration be given to placing suitable dredged material on the beaches at Seaside Park and Pleasure Beach or used for landfill so as to minimize the extent of disposal of dredged material in open water and to enhance existing beach or other onshore areas. The availability of suitable sand within the main channel outer limits was found to be too spotty to warrant the added disposal costs associated with pumping existing lenses of sand onto existing beaches.

Six possible upland fill areas and 11 containment areas (mostly shoreline water-occupied areas) were considered for onshore disposal of dredged materials. The largest sites included Yellow Mill Channel (upper half), Brewster Cove at Burr Creek, Power House Channel, a cove at Johnsons Creek, the city landfill at Fayerweather Island, the city-owned Foreign Trade Zone north of Burr Creek and the city incinerator plant area.

The Yellow Mill Channel and Brewster Cove sites would require expensive bulkheading or rock-faced diking, in excess of $3.5 million for both sites. City officials responded that the city could not afford the proposals. Some of the smaller sites could be reconsidered by local interests (at local cost) at a later date if improvement dredging is implemented. In all cases, open water disposal was determined to be the least expensive method of dredged material disposal.

PLAN FORMULATION RATIONALE

Selection of a specific plan for Bridgeport Harbor and vicinity is based on technical, economic and environmental criteria which would permit an objective appraisal of the impacts and feasibility of alternative solutions.

Technical criteria require that the optimum plan have facilities and dimensions adequate to accommodate expected user vessels and have adequate areas for maneuvering of vessels and development of associated shore facilities. Project dimensions should provide adequate separation from the shoreline so that dredging would not impact on shoreline stability or require shore protection measures.

Economic criteria require that tangible benefits exceed the economic costs and that the project scope provide maximum net benefits and minimize adverse impacts on existing, adjacent operations.

Environmental criteria require that the plan minimize alteration of intertidal areas, minimize volume of dredged material to reduce disposal problems, be environmentally and socially acceptable, incorporate measures to enhance and protect the environmental quality of the area, be aesthetically compatible if structures are involved, minimize both social and environmental impacts, and entail use of sources of expertise to identify endangered species of marine life or areas of historical significance.

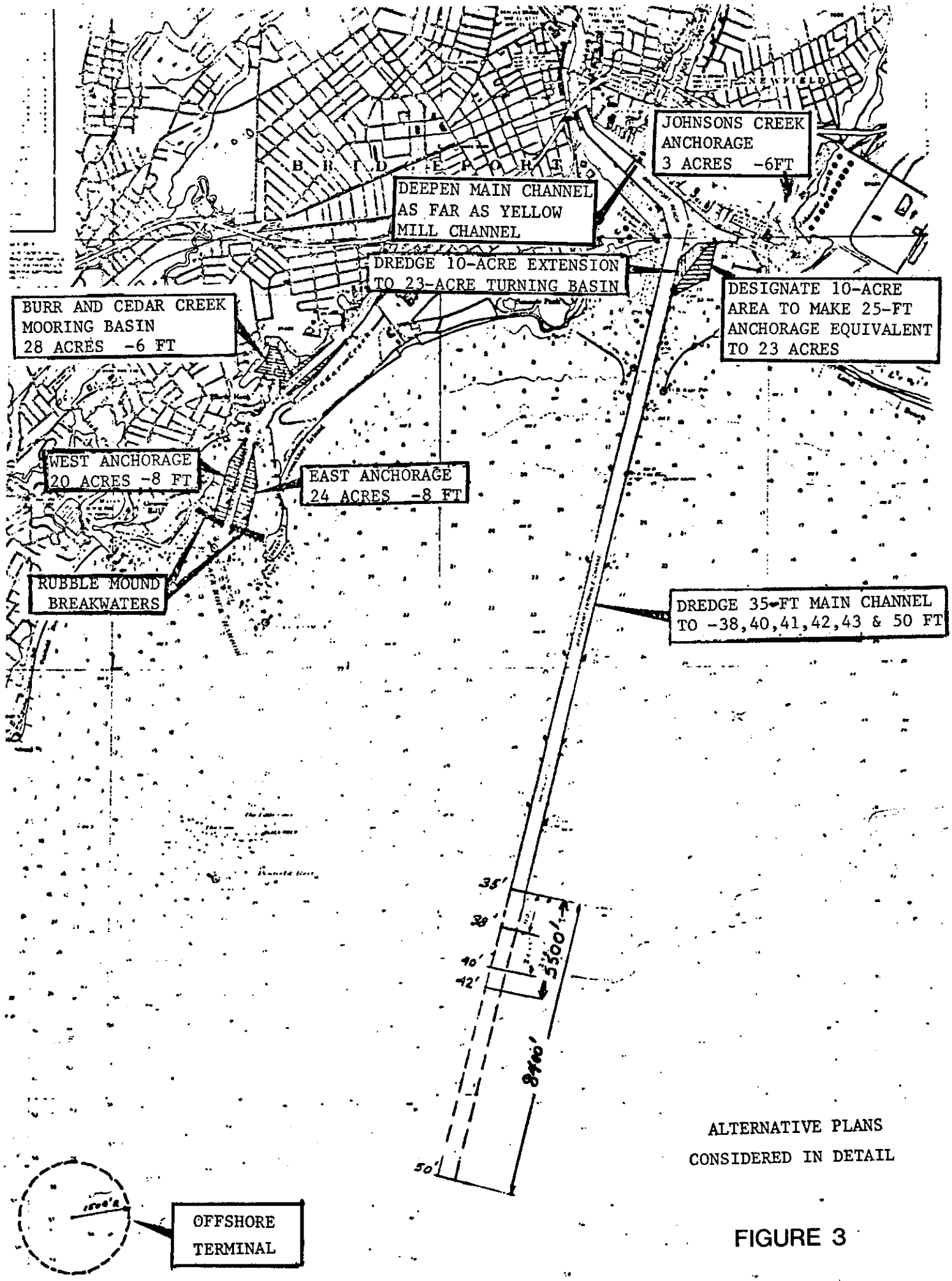
In view of the deactivation of the United Illuminating Steel Point powerplant and the unlikehood that a prospective industrial firm requiring deepwater access would occupy the site in the short-term, the confluence of the Yellow Mill Channel with the main ship channel was used as the upper limit for all channel deepening proposals for the main harbor.

DESCRIPTION OF ALTERNATIVE PLANS

Ten alternative structural plans were developed and studied in detail. They address to different degrees the need for more efficient access to the commercial terminals in Bridgeport Harbor, protection and anchorage for recreational boats in Black Rock Harbor, and anchorage or mooring areas for recreational boats in Burr, Cedar and Johnsons Creeks. These plans are shown on Figure 3. All plans call for disposal of dredged material in the Central Long Island Sound Regional Disposal Area, about 15 miles east of the Bridgeport main ship channel.

1. Plan A

Plan A entails improvement dredging to enlarge the existing 23-acre, 35-foot-deep turning basin opposite Tongue Point by deepening 10 acres at the northwestern side of the existing 25-foot-deep anchorage (immediately seaward of the turning basin) to 35 feet. This plan, as with six plans entailing channel deepening, calls for an additional 10 acres now having depths in excess of 25 feet (and located adjacent to the southeast side of the 25-foot anchorage area to be designated as part of the 25-foot anchorage. The need for this turning basin work is to provide increased maneuvering area for vessels visiting the U.I. Tongue Point and Cilco terminals, as they now experience difficulties in using the existing project. It requires the removal of 30,000 cubic yards of organic silt. No shellfish beds would be impacted by the dredging work.



ALTERNATIVE PLANS
CONSIDERED IN DETAIL

FIGURE 3

2. Plan B

Plan B involves deepening the existing 35-foot channel to 38 feet upstream to Yellow Mill Channel, deepening the existing turning basin to 38 feet, and enlarging the turning basin by deepening 10 acres of the existing 25-foot anchorage to 38 feet. This would permit larger tankers, barges and cargo vessels to reach all three major termlinals in the main harbor. It requires removal of 1,240,000 cubic yards of organic and inorganic silt, gravelly to silty sand, and clay, plus extension of the channel about 2,600 feet seaward.

3. Plan C

Plan C entails deepening the existing 35-foot channel to 40 feet upstream to Yellow Mill Channel, deepening the existing turning basin to 40 feet, and enlarging the turning basin by deepening 10 acres of the existing 25-foot anchorage to 40 feet. It requires extending the channel 4,100 feet seaward and removal of 1,710,000 cubic yards of inorganic and organic silts, silty to gravelly sands, and clay.

4. Plan D

Plan D calls for deepening the existing 35-foot channel to 41 feet upstream to Yellow Mill Channel, deepening the existing turning basin to 41 feet, and enlarging the turning basin by deepening 10 acres of the existing 25-foot anchorage to 41 feet. It entails removal of 2,000,000 cubic yards of organic and inorganic silts, silty to gravelly sands, and clay, as well as extension of the channel 4,600 feet seaward.

5. Plan E

Plan E consits of deepening the existing 35-foot channel to 42 feet upstream to Yellow Mill Channel, deepening the existing turning basin to 42 feet, and enlarging the turning basin by deepening 10 acres of the existing 25-foot anchorage to 42 feet. It would require removal of 2,620,000 cubic yards to organic and inorganic silts, silty to gravelly sands, and clay, plus extension of the channel 5,500 feet seaward.

6. Plan F

Plan F entails deepening the existing 35-foot channel to 43 feet upstream to Yellow Mill Channel, deepening the existing turning basin to 43 feet, and enlarging the turning basin by deepening 10 acres of the existing 25-foot anchorage to 43 feet. The plan requires removal of 3,080,000 cubic yards of organic and inorganic silts, silty to gravelly sands, and clay, as well as extension of the channel 6,000 seaward.

7. Plan G next page

Plan G calls for deepening the existing 35-foot channel to 50 feet upstream to Yellow Mill Channel, deepening the existing turning basin to 50 and enlarging the turning basin by deepening 10 acres of the existing 25-foot anchorage to 50 feet. The plan requires extending the channel 8,400 feet seaward and the removal of 6,340,000 cubic yards of organic and inorganic silts, silty to gravelly sands, and clay.

Plans B through G all entail retaining a 400-foot channel width. Because past overdredging of the channel width has occurred, oyster industry officials are concerned that additional top-of-slope oyster harvesting grounds would be lost if the existing 400-foot-wide channel is deepened. Although 4 to 5 acres of oyster grounds could be lost if excessive overdredging should occur with a 41-or-42-foot-deep channel, because the existing channel transects one-half mile of productive oyster beds, the dangers of an oil spill would increase significantly should a narrower channel width be imposed.

All of the larger tankers visiting Bridgeport Harbor, of which 80 percent are tankers in the 20,000 -to 50,000-DWT range, require exclusive one-way use of the existing channel for safe transit. The New Haven-Bridgeport Pilots Association has expressed concern that frequent groundings and attendant oil spills could be expected if the existing channel width is decreased. For this reason, a 400-foot channel width has been retained, so as to protect the overall environment of the area.

8. Plan H

Plan H entails dredging of a 6-foot deep mooring basin in Burr Creek and along the east side of Cedar Creek, opposite Burr Creek, in partial response to the large demand in the bridgeport area for recreational boating facilities. As this area adjacent to the existing municipal marina is well sheltered, a maximum of 28 acres was considered for dredging, in order not to encroach on the tidal flat in Brewster Cove at the southwest end of Burr Creek. The maximum area of 28 acres was selected in order to maximize benefits for recreational fleet. The plan involves removal of 165,000 cubic yards of organic silt that would be point-dumped at the Central Long Island Sound Regional Disposal Area and capped by clean sandy material obtained from the main ship channel improvement dredging. There are no shellfish beds in the proposed mooring basin area.

9. Plan I

Plan I entails construction of two breakwaters at the entrance to Black Rock Harbor and dredging a total of 44 acres along both sides of the Black Rock Harbor Channel behind the considered breakwaters, in order to provide additional protected anchorage for recreational boats. Three breakwater sites were evaluated based on 1980-81 studies conducted for the Corps (alternative breakwater studies by Vollmer Associates and Jason M. Cortell and Associates, and mathematical hydrodynamic modeling analyses by

where is supposed to be

the Center for Environmental and Man on the impacts of the considered breakwaters because floating breakwaters would not provide the necessary wave reduction.

Two quarry stone arms, 15 feet high at mean low water, were selected with a center opening for the existing 200-foot-wide entrance channel, which has a mean low water depth of 30 feet at the breakwater site. The inshore ends of both breakwater arms would begin at the mean low water line away from the shore to allow for tidal circulation. A 900-foot-long west arm, near the southern end of the Glover Hill peninsula, would have a top width of 7 feet and 4.5-foot-thick armor stone placed in two layers on a 1-foot vertical to 1.5-foot horizontal slope over a 2-foot-thick underlayer stone and a quarry-run stone core. A 975-foot-long east arm, near the southern end of Fayerweather Island, would have a top width of 6 feet and a 3.5-foot-thick armor stone placed over a similar foundation as the west arm. All organic silt in the foundation areas of the breakwaters would be removed and replaced by dumped sandfill prior to breakwater construction. Detailed design information on the breakwater and their foundation areas in contained in Appendix 2, "Engineering Design and Cost Estimates," and in Appendix 5, "Geotechnical Considerations."

Two anchorage areas, having various sizes and depths, were considered for the areas along both sides of the Black Rock Harbor Channel behind the considered breakwaters. A maximum of 44 acres was selected, 20 acres on the west side and 24 acres on the east side, allowing for existing residential, recreational and boating uses along the shores. A single maximum depth of 8 feet was selected, rather than a combination of depths, as the majority of the boats benefitted could be expected to require an 8-foot anchorage depth. The 20-acre west anchorage would require the removal of 47,000 cubic yards of silty sand, with a minimum environmental impact as the bottom is relatively free of oysters. The 24-acre east anchorage would require removal of 68,000 cubic yards of organic sandy silt, with a potential loss of 12 acres of oyster habitat which are expected to be worked in the near future.

10. Plan J

Plan J entails a 6-foot deep, 3-acre anchorage area in the small, unnamed cove at the northwest side of Johnsons Creek to provide additional space for the mooring or anchoraging of recreational boats. The plan would require the removal of 65,000 cubic yards of sandy silt. There are no shellfish beds in the considered anchorage basin area.

SCREENING OF ALTERNATIVE PLANS

Seven alternatives for improving commercial navigation facilities and three alternatives for improving recreational navigation facilities were screened for feasibility in satisfying the area's needs for navigation improvements in Bridgeport and Black Rock Harbors and their tributaries.

Local interests, at the 27 May 1982 public meeting held at the Miamogue Yacht Club along Johnsons Creek, recommended that the Corps of Engineers discontinue consideration of the 3-acre anchorage plan for Johnsons Creek. The recreational anchorage plan (Plan J) was dropped from further consideration as local yacht club members indicated that they would prefer to use floating slips near their yacht clubs rather than travel to remote moorings away from their yacht club facilities. They believe that full use of the anchorage would never be obtained.

Economic analysis during the final study phase detremined that immplementation of Plan I, the Black Rock Harbor breakwaters and anchorages, would result in the loss of 12 acres of seed oyster beds and cause an estimated loss of income to the oyster industry calculated on an annual basis at $115,200 (using an 80 percent optimum yield of 24,000 bushels of seed oysters having a present value of $6.00 per bushel). This caused the previously marginally justified plan to become uneconomical. The plan was dropped from further consideration after it was determined that modification of the plan to provide a single protected anchorage area would also not be economically justified.

The 28-acre mooring basin plan (Plan H) for Burr and Cedar Creeks remained economically justified and was selected for inclusion in the selected plan.

The economic justification of the alternative plans was determined by comparing the equivalent average annual costs of each alternative with the average annual benefits expected to accrue to each alternative. The economic analysis for each alternative selected for detailed study is contained in Appendix 3, "Economics". A detailed breakdown of estimated project costs is presented in Appendix 2, "Engineering, Design and Cost Estimates". Investment costs were also computed by adding the cost of interest during construction. Annual costs were calculated on the basis of a 50-year project life and an interest rate of 7-7/8 percent. They reflect periodic expenditures for maintenance dredging and maintenance or replacement of navigational aids (buoys).

Table 10 presents an economic summary of the 10 plans that received detailed analysis. Because maximum net benefits were determined to accrue in the 41-foot to 43-foot range for channel and turning basin deepening in the main harbor, there was no need for additional refinement of commercial navigation Plans A, B, C and G. As noted earlier, recreational navigation Plans I and J were dropped from further study. This left commercial navigation Plans D, E and F and recreational navigation Plan H to be carried on for final detailed study. None of the other management measures, such as nonstructural measures, offshore petroleum products terminal or oil pipeline routes proved to be economically justified, thus they were dropped from further consideration.

Table 10

Bridgeport and Black Rock Harbors

Economic Summary of Alternative Plans

Alternative Plan	Dredging Quantity	First Cost	Annual Benefits	Annual Costs	Net Benefits	Benefit-Cost Ratio
	(000 c.y.)	($000)	($000)	($000)	($000)	x / 1.0
A (35′) (Turning Basin)	30	233	90	22	68	4.1
B (38′) (Main Channel)	1,240	7,274	2,309	668	1,642	3.5
C (40′) (Main Channel)	1,710	9,830	4,568	916	3,652	5.0
D (41′) (Main Channel)	2,000	11,430	4,909	1,072	3,837	4.5
E (42′) (Main Channel)	2,620	14,370	5,384	1,342	4,042	4.0
F (43′) (Main Channel)	3,080	16,560	5,414	1,545	3,869	3.4
G (50′) (Main Channel)	6,340	30,615	6,491	2,976	3,515	2.2
H (Burr & Cedar Creeks)	165	1,263	426	130	296	3.3
I (Black Rock Harbor)	434 (plus stone)	10,070	814	1,080	-266	0.8
J (Johnsons Creek)	65	580	70	57	13	1.2

EVALUATION AND TRADE-OFF OF FINAL PLANS

1. Description of Final Plans

Three of the four plans (Plans D, E and F) selected for final evaluation and trade-off would enable larger commercial vessels to enter the main harbor.

Plan D entails deepening the existing 35-foot-deep channel to 41 feet (plus 2-foot overdepth allowance) over the existing width of 400 feet and length of 15,600 feet to Yellow Mill Channel, extending the channel 4,600 feet seaward for a total length of 3.8 miles, deepening the existing 23-acre, 35-foot-deep turning basin to 41 feet, and enlarging the turning basin by dredging 10 acres at the northwest side of the existing 25-foot-deep anchorage to 41 feet. It would require the removal of about 2,000,000 cubic yards of silt, sand and clay.

Plan E involves deepening the same project area to a depth of 42 feet (plus 2-foot overdepth allowance) and extending the 400-foot-wide channel 5,500 feet seaward for a total length of 4.0 miles. It would require the removal of an estimated 2,620,000 cubic yards of silt, sand and clay.

Plan F entails deepening the same project area to a depth of 43 feet (plus 2-foot overdepth allowance) and extending the 400-foot-wide channel 6,000 feet seaward for a total length of 4.1 miles. It would require the removal of an estimated 3,080,000 cubic yards of silt, sand and clay.

The fourth plan, Plan H, calls for recreational boating improvements upstream of Black Rock Harbor at Burr and Cedar Creeks. It provides for dredging 165,000 cubic yards of organic silt to a depth of 6 feet (plus 1-foot overdepth allowance) over 28 acres to form a mooring basin site in Burr Creek and along the east side of Cedar Creek, immediately opposite Burr Creek. Proposed dredged material disposal for all plans would be at the Central Long Island Sound Disposal Area. The proposed basin would provide mooring area for nearly 200 recreational boats, which could be serviced by the existing municipal marina at the north side of Burr Creek.

2. Dredging Impacts

Dredging has been evaluated on the assumption of using clamshell dredges mounted on barges, with deposition in bottom dumping scows for transport to the CLIS Area. Dredging would result in temporary increases in suspended sediments and removal of benthic organisms. Although a clamshell dredge grasps the bottom material in a cohesive mass, temporary turbidity could occur at Burr Creek and near the mouth of Yellow Mill Channel in the inner main harbor because of the presence of organic silty material in both areas. Materials in the main harbor and entrance channel are generally of a sandy nature, with some lenses of silts and clay, and any turbidity would be quickly dispersed into the water column. There are no shellfish beds or significant benthic organisms at Burr and Cedar

Creeks or in the inner main harbor because of the polluted and oxygen-depleted nature of the bottom materials in these areas. However, precautions would have to be taken to avoid overdredging of the sideslopes along the outer sections of the main entrance channel because of the existence of productive seed oyster beds seaward of the breakwaters. Excessive overdredging of the 400-foot wide channel width seaward of the breakwaters could result in an estimated loss of 4.6 acres of top-of-slope oyster harvesting grounds with the 41-, 42- and 43-foot channel plans.

Strict dredging controls would be needed particularly in the channel area seaward of the two existing breakwaters as the channel transects productive oyster beds in that area. Some precautions would also be needed near the outer end of the existing entrance channel and in the proposed channel extension area because of other oyster beds. Dredging would have to be completed prior to or suspended during the oyster spawning season from June through September to avoid serious damage to the oyster habitat and loss of income to oystermen. The loss of an estimated 4.6 acres of top-of-slopes oyster harvesting grounds was taken as the "worst possible case" for the 41-and 43-foot channel plans.

3. Disposal Impacts

Open water disposal at the CLIS Disposal Area is anticipated as construction of steel bulkhead or rock-faced dike containment structures were found to be too costly for further consideration. Point-dumping by bottom-dumping scows would be made at a specific site with CLIS Disposal Area following coordination with federal and state environmental agencies prior to project implementation. Because of possible contaminants in the organic silts dredged at Burr and Cedar Creeks and near Yellow Mill Channel, those areas would be dredged first (a standard dredging operations procedure) so the organic silty material could be capped with clean sandy material obtained from deepening the main channel outside the breakwaters. More detailed discussion of disposal impacts is contained in the draft Environmental Impact Statement accompanying this report.

4. Shoreline Impacts

None of the alternative plans would impact the adjacent shoreline.

5. Economic Impacts

The economic impacts of the final alternative plans were evaluated, as shown in Table 11, by determining the estimated costs, annual costs, annual benefits and possible annual losses to oystermen due to loss of income from possible overdredging of the main channel width seaward of the breakwaters. Benefits to the proposed commercial navigation plans are based on the determination that transportation cost savings would occur following project implementation (1990) due to efficiencies of scale resulting from the use of larger vessels visiting the United Illuminating and Cilco terminals. No benefits were taken for existing barge

operations, but conditions could change in future years should Shell Oil switch back to the use of tankers. All three plans would enable larger vessels to make fewer trips, thus decreasing traffic and improving safety. They would provide a beneficial impact on area income, tax base and creation of jobs by allowing Bridgeport Harbor to become more competitive with other areas. However, specific comparisons between channel plans would be small as shown by the small range of transportation savings (maximum of $315,000) between plans.

Benefits to the proposed mooring basin are based on the assumption that nearly 200 recreational boats would be added to the local fleet within 5 years of project implementation. Average annual benefits for all plans are based on a project life of 50 years commencing in 1990 and a discount rate of 7-7/8 percent. While it is recognized that many harbors have not been used to their full potential, under long-term conditions the shipping industry can be expected to operate with increased efficiency at Bridgeport Harbor, thereby minimizing unit transportation costs and passing at least some of the savings on to consumers. As shown by Table 10, the maximum net benefits ($4,042,000 annually) accrue to the 42-foot channel plan (Plan E), with slightly smaller net benefits ($3,759,000 and $3,727,000) accruing respectively to the 43-foot (Plan F) and 41-foot (Plan D) channel plans.

6. Social Impacts

Social impacts for Plans D, E and F relate primarily to safer passage by larger vessels and reduction of the threat of collision, groundings and potential oil spills Social impacts of Plan H are associated with increased recreational opportunity, based on a unit-day value of $12.00. Both economic and social benefits would accrue from economic additions to the local economy, including employment, income, tax base and income gains. Impacts during construction would be minimal as dredging activity and offshore disposal would be scheduled to avoid the oyster spawning period and the peak boating activity season, both June through September. Construction activities are estimated to require 8 months in both project element areas.

7. Mitigation Requirements

Strict dredging control (temporary buoys) would be developed to assure excessive overdredging of the main channel width would not occur in productive seed oyster beds seaward of the main channel breakwaters. Dredging specifications would include shifting the main channel alignment slightly eastward to avoid disturbing the existing sideslope along the west side of the channel where productive oyster beds now occur.

8. Navigation Impacts and Trade-Offs

Plan F would provide for greater ease and safety for newer, larger commercial vessels now in use or coming into use, than would either Plan D

or Plan E, because of greater channel depth, but the differences would be small. As world fleets continue to switch to newer, larger vessels and smaller vessels are phased out, the increased depths for all three channel plans would reduce transit time and permit added transportation savings through reductions in operating costs. Although Plan F provides the greatest savings ($5,304,000, after subtracting potential annual loss to the oyster industry), this is offset by larger annual costs ($203,000) for Plan F as compared with Plan E. As a result, Plan E, the 42-foot channel plan, provides the maximum net benefits using the standard economic analysis (variable tonnage and fleet compition conditions) or the two sensitivity analyses used in the benefit analysis (see Appendix 3, "Economics") - one holding the anticipated 1985 tonnage constant over the 1990-2040 analysis period and the other holding the anticipated 1990 feet compostion constant but allowing tonnage to change over the analysis period. The net benefits for the 41-foot channel plan (Plan D) are slightly smaller ($32,000) than the net benefits for the 42-foot channel plan (Plan F).

Plan E would require a 13 percent smaller project investment ($14,801,000) than Plan F ($17,057,000), as reflected by a larger Plan E benefit-cost ration (4.5 to 1) as compared with Plan F (4.0 to 1). Plan D would require an $11,773,000 project investment and have a higher benefit-cost ratio of 5.0 to 1. Plan E would require the dredging and disposal of 14,370,000 cubic yards, as compared with Plan D (11,430,000 cubic yards) or Plan F (16,560,000 cubic yards). Comparison of the impacts of the final alternative plans is shown in Table 12.

Table 11

Bridgeport and Black Rock Harbors

Evaluation of Final Plans

(Figures in thousands of cubic yards or thousands of dollars)

	41-Foot Channel	41-Foot Channel	43-Foot Channel	Mooring Basin
Dredging (c.y.)	2,000	2,620	3,080	165
Construction Cost	9,720	12,360	14,350	1,257
Private Berths	1,700	2,000	2,200	-
Navigation Aids	10	10	10	3
First Cost	11,430	14,370	16,560	1,260
Project Investment*	11,773	14,801	17,057	1,292
Total Benefits	4,909	5,384	5,414	426
Oyster Loss	110	110	110	-
Annual Benefits	4,799	5,274	5,304	296
Annual Costs	1,072	1,342	1,545	130
Net Benefits	3,727	4,042	3,759	296
Benefit-Cost Ration	4.5	4.0	3.4	3.3

*Includes interest during construction over 8-month period for all plans.

TABLE 12

Bridgeport and Black Rock Harbors

Comparison of Final Alternative Plans

	WITHOUT PROJECT CONDITION	PLAN D	PLAN E	PLAN F	PLAN H
PLAN DESCRIPTION	Main channel 35" deep and 400' wide. Turning basin 35' deep. No anchorage at Burr and Cedar Creeks.	Deepen main channel & enlarge turning basin to depth of 41".	Deepen main channel & enlarge turning basin to depth of 42'.	Deepen main channel & enlarge turning basin to depth of 43'.	Dredge 28-acre mooring basin 6' deep in Burr & Cedar Creeks.
IMPACT ASSESS.					
Economic					
First Cost	-	$11,430,000	$14,370,000	$16,560,000	$1,260,000
Annual Benefits*	-	4,799,000	5,384,000	5,304,000	426,000
Annual Charges	-	1,072,000	1,342,000	1,545,000	130,000
Net Benefits	-	3,727,000	4,042,000	3,759,000	296,000
B/C Ratio	-	4.5	4.0	3.4	3.3
Annual Loss to Oyster Industry	-	$ 110,000	$ 110,000	$ 110,000	-
Environmental					
Oyster Habitat Loss	-	4.6A	4.6A	4.6A	-
Effects on Shoreline	-	No Impact	No Impact	No Impact	No Impact
Wetlands Impacts	-	No Impact	No Impact	No Impact	No Impact
Effects on Basin Flushing	-	+1	+1	+1	+3
Reduce Oil Spill Threat	-	+2	+3	+3	-
Dredging Impacts on Water Quality	-	Minimal (-1)	Minimal (-1)	Minimal (-1)	Minimal (+1)
Disposal Impacts on Water Quality	-	-1	-1	-1	-1
Social					
Safety for Vessels	-	+2	+2	+3	
Employment & Growth		+2	+2	+2	+1
ACHIEVES PLANNING OBJECTIVES					
Full Utilization of Waterway		+2	+3	+3	+2
Increases Recreational Use	-	-	-	-	+2

IMPACT RATINGS (1-4) +1 = Minimum Positive Impact +4 = Maximum Positive Impact
-1 = Minimum Adverse Impact -4 = Maximum Adverse Impact

*After subtracting annual loss to oyster industry

SELECTION OF THE FINAL PLAN

1. Risks and Uncertainties

Commercial navigation benefits were derived on the basis of projected savings in the cost of transporting products to two primary users - the United Illuminating Company and the Cilco Terminal Company - with the implementation of channel and turning basin improvements in the main harbor. The current fleet mix serving both terminals is expected to change with project implementation through increased use of newer, larger vessels to obtain efficiencies of scale and reduced transportation costs. More efficient use of existing vessels would also occur due to reductions in tidal delays, lightering and multiport operations.

The U.S. Department of Energy forecasts that coal consumption in New England will grow by more than 34 million tons by 1995, because of expected implementation of coal conversion orders under the 1978 Powerplant and Industrial Fuel Use Act. It is premature to ascertain whether Bridgeport will be one of the ports where substantial increases in vessel receipts of coal may be expected.

While in past years five terminals in the main harbor were actively receiving or shipping oil, coal and dry bulk products, economic and shipping conditions have changed. The United Illuminating powerplant at Steel Point at the upper east side of the main harbor has been deactivated, and the site is not likely to attract a waterfront-dependent industry in the near future because of recent recession and high interest rate conditions. The Carpenter Specialty Steels Company immediately downstream is not expected to have deep-draft navigation needs in the near future.

Proposed expansion by the Cilco Terminal Company, the next terminal seaward, is contingent upon the availability of adjacent land for terminal expansion and improvement in worldwide recession conditions and high interest rates. The Shell Oil Company, the outermost terminal at the east side of the harbor which used to receive large tankers (up to 38-foot draft at high tide) from Houston, Texas, is unlikely to switch back to large tankers in the foreseeable future as they are now serviced by barges from New Jersey, which are supplied by a pipeline from Houston.

On the west side of the harbor, the United Illuminating Company has applied for a permit to convert Unit No. 2 at their Tongue Point powerplant to coal, which will include maintenance dredging at three berths, of which two are collier berths along the inner harbor side of Tongue Point. However, the powerplant is expected to be supplied principally by oil in the short-term.

The basic economic analysis for main harbor improvements at Bridgeport was predicted on 1977 projections that Venezulean oil imports at the U.I. Tongue Point terminal would increase until the early 1990's and then level off. Projections for the Cilco Terminal Company, which receives lumber, steel products and marble slabs/chips and ships scrap metal, suggested that a steady rise in cargos would continue following project implementation.

2. Sensitivity Analysis

Two sensitivity analyses were made in order to address risk and uncertainty in the benefit analysis. Approach or scenario No. 1 computed project benefits through holding tonnage (anticipated 1985 tonnage conditions) constant over the 50-year project life. This determination was based on the past constraint that the Cilco terminal needs additional storage capacity, and the firm has been unable to expand its terminal size because of competing demands for the limited land available seaward of Seaview Avenue.

Sensitivity analysis approach No. 2 entailed holding projected 1990 fleet mix characteristics and allowing tonnage to vary over the 50-year project life. Past trends in electrical energy conservation are expected to temper future industrial expansion energy demands and thus continue to act as a constraint on tonnage expansion.

Table 13, Sensitivity Analysis Comparison, shows that maximum net benefits accrue to the 42-foot channel plan (Plan E) under the standard economic approach and both of the two sensitivity analysis approaches.

Table 13

Bridgeport Harbor Main Channel
Sensitivity Analysis Comparison

Project Depth (ft)	Annual * Benefits ($000)	Annual Costs ($000)	Net Benefits ($000)	Benefit-Cost Ratio x : 1.0
Method 1 - Sensitivity Analysis No. 1 - Hold projected 1985 tonnage constant but fleet characteristics would vary over 1990-2040 period.				
41	4,001.6	1,072.0	2,929.6	3.7
42	4,281.0	1,342.0	2,939.0	3.2
43	4,434.6	1,545.0	2,889.6	2.9
Method 2 - Sensitivity Analysis No. 2 - Hold projected 1990 feet characteristics constant but tonnage would vary over 1990-2040 period.				
41	4,824.6	1,072.0	3,752.6	4.5
42	5,152.7	1,342.0	3,810.7	3.8
43	5,324.6	1,545.0	3,779.6	3.5

Method 3 - Traditional Economic Analysis - Tonnage and fleet characteristics would vary over time for 1990-2040 period.

41	4,909.6	1,072.0	3,837.6	4.5
42	5,384.1	1,342.0	4,042.1	4.0
43	5,414.6	1,545.0	3,869.6	3.4

* Reflect deduction of $110,400 for lost oyster industry income (annualized).

3. Rationale for the Selected Plan

The plan selected for implementation is the plan that would best meet the technical, economic and environmental objectives by meeting the area's needs, maximize net benefits, minimize adverse impacts and protect the environmental quality of the area. Plan E (the 42-foot channel and turning basin proposal) in Bridgeport Harbor and Plan H (the 28-acre Burr and Cedar Creeks mooring basin proposal) in the Black Rock Harbor headwater area have been selected to constitute the recommended plan for the following reasons:

a. Each plan element is incrementally justified, and each provides maximum net benefits. Each plan element provides maximum contributions to the national economic development, as well as minimizes the impacts on the project environment. Plan E provides the maximum net benefits for the Bridgeport Harbor area ($173,000 or 4 percent more than Plan F under the standard economic analysis). Plan H provides the maximum mooring basin area that could be developed for the Black Rock Harbor area without impacting on environmental, social or historic values of the Brewster Cove area to the southwest.

b. Each plan element meets the area's needs. While the 43-foot-draft proposal would provide a slightly greater margin of safety, Plan E (the 42-foot-draft proposal) would meet the needs of most deep-draft vessels expected to use the harbor. Most vessels would be in the 30- to 41-foot range based on 80 percent of present tonnage being carried in foreign flag tankers. Infrequent larger tankers in the 60- to 70,000-DWT range (loaded drafts of 43-44 feet) would be able to navigate the channel at normal high tide conditions. Plan H was the only recreational navigation proposal found to be warranted at this time.

c. Each plan element protects the environmental quality of the area through proposed use of clamshell dredges and special constraints on dredging operations and specific dredging season. Both plan elements would result in removal of organic silt near the heads of both harbors, which would be point-dumped and capped at the Central Long Island Sound Regional Disposal Area by heavier sandy material obtained from within the outer limits of the main ship channel.

THE SELECTED PLAN

1. Description

Plans D and H were selected as the combined plan for the Bridgeport Harbor - Black Rock Harbor project area that best solves the commercial and recreational navigation problems in the Bridgeport area. Its selection is supported by technical analysis and by local interests. The plan, as shown in Figure 4 which follows, consists of the following improvements:

- Deepening the existing 35-foot-deep main ship channel to a depth of 42 feet at mean low water (while retaining the existing 400-foot channel width;
- Enlarging the existing 35-foot-deep turning basin to 28 acres and deepening to 42 feet;
- Dredging a 28-acre, 6-foot-deep mooring basin at Burr and Cedar Creeks for nearly 200 recreational boats expected to be added to the existing fleet, as previously authorized by Congress in 1958;
- Designating an additional 10 acres (now exceeding 25 feet in depth) to restore the 25-foot anchorage to its full 23-acre dimension; and
- Deauthorizing the two unconstructed breakwaters, authorized by Congress in 1958, at the entrance to Black Rock Harbor, as they are no longer economically justified.

2. Design and Construction Considerations

The previous navigation improvements, completed in 1963, were designed for a 32,000-DWT design vessel with a draft of 34 feet. In subsequent years, some ships with drafts of 36 to 38 feet in the 40,000- to 45,000-DWT class entered the harbor at high tide conditions. However, since 1977, no ships destined for the United Illuminating terminal have had drafts more than 32 feet because of insufficient deepwater maneuvering area.

With the trend toward newer larger ships and the scrapping of smaller older ships, an increasing number of ships expected to visit Bridgeport in the coming years would, with project implementation, be in the 30- to 50,000-DWT class with loaded drafts of 34 to 42 feet (as 80 percent of present tonnage is being carried by foreign flag tankers which draw about 2 feet more than U.S. flag ships). Most of these ships could use the improved channel with a safe margin of clearance, with a few having to wait for high tides for safe passage.

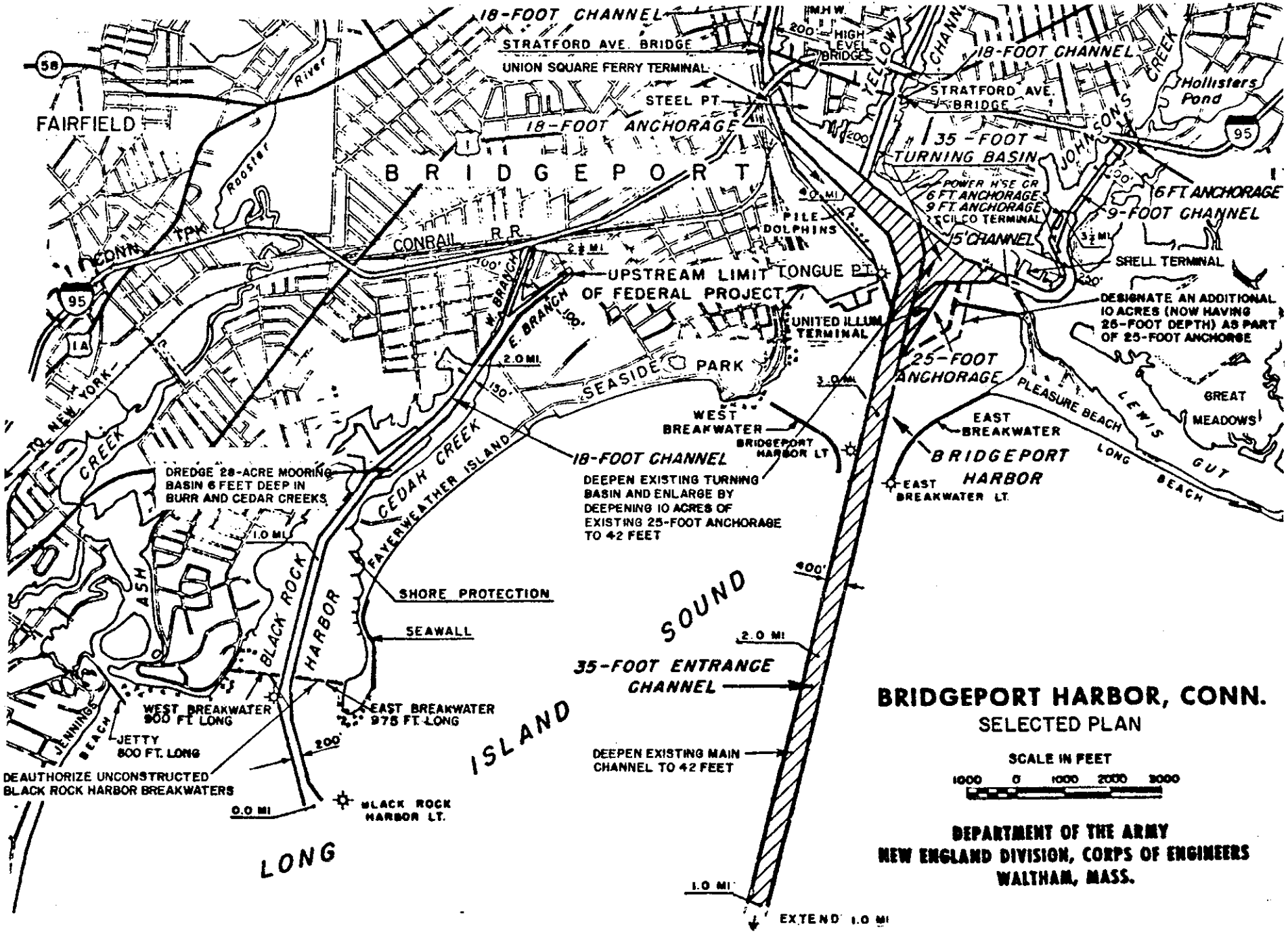

18-FOOT CHANNEL
STRATFORD AVE. BRIDGE
UNION SQUARE FERRY TERMINAL
STEEL PT.
18-FOOT ANCHORAGE
FAIRFIELD
58
River
Rooster
B R I D G E P O R T
CONN. TPK.
95
1A
TO NEW YORK
CONRAIL R.R.
UPSTREAM LIMIT OF FEDERAL PROJECT
TONGUE PT.
W. BRANCH
E. BRANCH
2.0 MI.
SEASIDE PARK
UNITED ILLUM. TERMINAL
PILE DOLPHINS
4.0 MI.
3.0 MI.
2½ MI.
M.H.W.
HIGH LEVEL BRIDGES
YELLOW CHANNEL
18-FOOT CHANNEL
STRATFORD AVE. BRIDGE
35-FOOT TURNING BASIN
JOHNSONS CREEK
Hollisters Pond
POWER H'SE CR
6 FT. ANCHORAGE
9 FT. ANCHORAGE
CILCO TERMINAL
6 FT. ANCHORAGE
9-FOOT CHANNEL
5' CHANNEL
3½ MI.
SHELL TERMINAL
DESIGNATE AN ADDITIONAL 10 ACRES (NOW HAVING 25-FOOT DEPTH) AS PART OF 25-FOOT ANCHORAGE
25-FOOT ANCHORAGE
PLEASURE BEACH
LONG BEACH
LEWIS GUT
GREAT MEADOWS
EAST BREAKWATER
BRIDGEPORT HARBOR
EAST BREAKWATER LT.
WEST BREAKWATER
BRIDGEPORT HARBOR LT.
18-FOOT CHANNEL
DEEPEN EXISTING TURNING BASIN AND ENLARGE BY DEEPENING 10 ACRES OF EXISTING 25-FOOT ANCHORAGE TO 42 FEET
DREDGE 28-ACRE MOORING BASIN 6 FEET DEEP IN BURR AND CEDAR CREEKS
CEDAR CREEK
FAYERWEATHER ISLAND
ASH CREEK
BLACK ROCK HARBOR
1.0 MI.
SHORE PROTECTION
SEAWALL
SOUND
400'
2.0 MI.
35-FOOT ENTRANCE CHANNEL
WEST BREAKWATER 900 FT. LONG
EAST BREAKWATER 975 FT. LONG
JETTY 800 FT. LONG
JENNINGS BEACH
200'
ISLAND
DEEPEN EXISTING MAIN CHANNEL TO 42 FEET
DEAUTHORIZE UNCONSTRUCTED BLACK ROCK HARBOR BREAKWATERS
0.0 MI.
BLACK ROCK HARBOR LT.
LONG
1.0 MI.
EXTEND 1.0 MI.
BRIDGEPORT HARBOR, CONN.
SELECTED PLAN
SCALE IN FEET
1000 0 1000 2000 3000
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

FIGURE 4

Construction activities are estimated to require 8 months, based on using two, large clamshell dredges for the main channel work and one, smaller clamshell dredge for the Burr and Cedar Creeks mooring basin work. Dredging specifications would include shifting the main channel alignment slightly eastward to avoid disturbing the existting sideslope along the west side of the channel where productive oyster beds now occur. Temporary buoys would be set to assure that excessive overdredging of the main channel width would not occur in the productive oyster bed areas along the channel, especially in the area immediately seaward of the west breakwater. The proposed dredging method would entail use of clamshell dredges mounted on barges, with dredged materials transported by bottom-dumping scows to the Central Long Island Sound Regional Disposal Area.

3. Operations and Maintenance Considerations

It is anticipated that only limited maintenance would be required, consisting of the removal of silt and sand. Maintenance dredging of the main ship channel would be expected to be infrequent, as no maintenance dredging of the existing 35-foot-deep project has been required, except in early 1983, since the existing project was completed in 1963. Infrequent maintenance dredging would be anticipated in the Burr and Cedar Creeks mooring basin area, as no federal dredging work has been done in the Black Rock Harbor area over the past 20 years, but some shoaling of the harbor has occurred in recent years. Based on an estimated annual shoaling rate of 24,000 cubic yards for both project elements, it is estimated that minor maintenance dredging would be required about every 10 years. The U.S. Coast Guard would maintain all navigational aids annually, and relocate or replace buoys as needed. The Central Long Island Sound Disposal Area has sufficient capacity to receive both the improvement and maintenance dredging materials from Bridgeport harbor and other harbors to the eastward, such as New Haven Harbor about 15 miles to the northeast.

4. Plan Accomplishments

The selected plan of improvement addresses the two major needs facing Bridgeport and Black Rock Harbors, namely accomodating larger commercial vessels and providing additional wet storage area for recreational boats. The plan meets the federal objective of providing the maximum net economic benefits and constitutes the National Economic Development plan. The selected plan meets all of the regional and local planning objectives, noted earlier in this report, and stresses specific areas where special precautions must be taken to minimize any impacts associated with dredging or disposal of dredged materials.

5. Economic, Environmental and Social Effects

The study has recognized the impacts of the selected plan on all resources, as discussed in the previous section, "Evaluation and Trade-Off of Final Plans," and in the draft Environmental Impact Statement that immediately follows this main report.

PLAN IMPLEMENTATION

1. Cost Allocation

The first cost of the selected general navigation facilities in Plan E (42-foot channel and turning basin), based on October 1982 price levels, is estimated at $13,620,000, excluding private berth improvements estimated at $2,000,000 and navigation aids estimated at $13,000. The estimated $1,260,000 dredging cost of the mooring basin at Burr and Cedar Creeks would be shared equally by the city and the federal government. The estimated $12,360,000 dredging cost of the main harbor channel and turning basin and improvements would be fully reimbursed by local interests under current Department of the Army policy. Previously, the full cost of general navigation facilities for commercial navigation was borne by the federal government under the traditional cost-sharing policies. Private shipping interests would be required to provide berthing depths commensurate with project depth, presently estimated at $2,000,000. The allocation of project costs is summarized in Table 14, Summary of Cost Apportionment, excluding the costs of navigation aids.

Table 14

Summary of Cost Apportionment

Present Department of the Army Cost-Sharing Policy

Type of Improvement

	Commercial	Recreational	Private	Totals
Federal	-	$630,000	-	$ 630,000
Non-Federal	$12,360,000	630,000	-	$12,990,000
Private	-	-	$2,000,000	$ 2,000,000
Totals	$12,360,000	$1,260,000	$2,000,000	$15,620,000

Traditional Cost-Sharing Policy

Type of Improvement

	Commercial	Recreational	Private	Totals
Federal	$12,360000	$630,000	-	$12,990,000
Non-Federal	-	630,000	-	630,000
Private	-	-	$2,000,000	$ 2,000,000
Totals	$12,360,000	$1,260,000	$2,000,000	$15,620,000

Cost-sharing policies are discussed in the next section, entitled "Division of Plan Responsibilites."

2. Division of Plan Responsibilities

Federal Responsibility. After Congressional authorization and funding, the Corps of Engineers would design and prepare detailed plans for the general navigation facilities. After receipt of local assurances including cost-sharing arrangements, the Corps of Engineers would construct the authorized improvements and the U.S. Coast Guard would provide the necessary aids to navigation. Future federal maintenance of the authorized project would be dependent upon future needs and the extent of future usage, i.e., the size and frequency of vessels using the project.

Non-Federal Responsibility. Local interests would provide all lands, easements and rights-of-way for implementation and maintenance of the project, and provide berth improvements commensurate with the project depth. Letters of assurance would be required from the State of Connecticut and the city of Bridgeport, including cost-sharing arrangements, indicating their willingness and ability to participate in the project and fulfill the conditions of local cooperation, as noted in the "Recommendations" section which follows.

On July 15, 1981, the Department of the Army, on behalf of the Adminstration, transmitted proposed legislation to Congress that would provide for full recovery of certain operation, maintenance and construction of rehabilitation costs for deep draft channels and ports with authorized depths greater than 14 feet. Under this proposed legislation, Corps of Engineers expenditures for the Bridgeport Harbor Deep Draft Navigation Project would be subject to recovery. Accordingly, non-federal interests would be required to reimburse the federal government for construction of navigation features of the recommended plan, and all subsequent expenditures for operation, maintenance and rehabilitation; except for expenditures assigned by the Secretary of the Army for national defense transportation requirements and to governmental vessels in noncommercial service.

The entire amount of the federal construction or rehabilitation expenditures to be reimbursed, including interest during construction and interest on the unpaid balance, would be reimbursed within the life of the project, but in no event to exceed 50 years after the date the project becomes available for use. The interest rate for reimbursement purposes would be determined by the Secretary of the Treasury based on the average market yields on outstanding obligations of the United States. Reimbursements for operation and maintenance would be made annually, and may be schueduled and periodically adjusted to result in the payment of actual operation and maintenance costs. The sponsoring public body would be authorized by the collection of fees for the use of the project by vessels in commercial waterway transportation.

Under the Department of the Army's innovative financing policy to get important harbor improvement projects moving again, local interests would be required to contribute $11,400,000 (75 percent of the commercial navigation improvement and 50 percent of the recreational navigation improvement) toward project construction and agree to subsequent reimbursement of $3,590,000 (25 percent of the commercial navigation improvement cost) over the economic life of the project (50 years).

3. Views of Sponsoring Agencies

Supporting letters have been received from the state of Connecticut and city of Bridgeport indicating intention to participate in the projecting pending the availability of resources. Additional views and letters will be obtained during public review of the draft report, including updated responses from the principal terminal operators.

RECOMMENDATIONS

I have reviewed and evaluated in light of the overall public interest, the information contained in this report, the environmental impact statement and other documents concerning deep draft navigation in Bridgeport Harbor and recreational navigation improvements in Burr and Cedar Creeks. I have considered the views of local, state and other federal officials, other agencies, organizations, harbor users, and other concerned members of the public. The possible consequences of constructing the selected plan, as well as each of the alternatives, were studied and evaluated for environmental effects, social effects, engineering considerations and economic factors. Special attention was given to attaining waterborne transportation savings and increasing the safety of deep draft navigation in the harbor.

Accordingly, I recommend that the existing navigation project for Bridgeport Harbor, as last modified by the 1956 River and Harbor Act, be modified, using cost-sharing and financing methods acceptable to the Department of the Army and the Congress of the United States, to provide for the implementation of a federal project for navigation, in accordance with the plan selected herein and with such further modifications thereto as in the discretion of the Chief of Engineers may be advisable.

This recommendation is made provided that, except as otherwise provided in these recommendations, the exact amount of nonfederal contributions shall be determined by the Chief of Engineers prior to project implementation, in accordance with the following requirements to which non-Federal interests must agree prior to implementation:

a. Provide, without cost to the United States, all lands, easements and rights-of-way necessary for implementation and later maintenance of the project and for aids to navigation, upon the request of the Chief of Engineers, including suitable areas determined by the Chief of Engineers. In the event that the Central Long Island Sound Regional Disposal Area is not available for the disposal of dredged material associated with improvement or maintenance dredging, providing suitable alternative disposal areas or sites determined by the Chief of Engineers to be in the general public interest for initial and later disposal of dredged material, and including necessary retaining dikes, bulkheads and embankments thereof, or the costs of such retaining works.

b. Hold and save the United States free from damages due to implementation and maintenance of the project, not including damages due to fault or negligence of the United States or its contractors;

c. Provide and maintain without cost to the United States adequate terminal and transfer facilities open to all on equal terms;

d. Provide and maintain without cost to the United States adequate depths in berthing areas serving the terminals;

e. Accomplish without cost to the United States all alterations and relocations of transportation facilities, storm drains, sewer outfalls, utilities, and other structures and improvements made necessary by the project;

f. Prohibit the erection of any structure within a distance to be determined by the Chief of Engineers from the bottom edge of the project channel, turning basin and mooring basin areas.

g. Reimburse the federal government in accordance with the Administration's July 15, 1981 proposed legislation for expenditures for the construction of the general navigation facilities of the recommended plan, and subsequent expenditures for operation, maintenance and rehabilitation; except for expenditures assigned by the Secretary of the Army for national defense transportation requirements.

Carl B. Sciple
Colonel, Corps of Engineers
Division Engineer

DRAFT ENVIRONMENTAL IMPACT STATEMENT

AND SECTION 404 EVALUATION

BRIDGEPORT HARBOR, CT AND VICINITY

DRAFT

ENVIRONMENTAL IMPACT STATEMENT

PROPOSED NAVIGATION

IMPROVEMENT PROJECT

BRIDGEPORT AND BLACK ROCK HARBORS
BRIDGEPORT, CONNECTICUT

NEW ENGLAND DIVISION
U.S. ARMY CORPS OF ENGINEERS

DRAFT
ENVIRONMENTAL IMPACT STATEMENT
AND 404(b) EVALUATION

PROPOSED PLAN FOR NAVIGATION
IMPROVEMENT PROJECT
BRIDGEPORT AND BLACK ROCK HARBORS
BRIDGEPORT, CONNECTICUT

The responsible lead agency is the U.S. Army Corps of Engineers, New England Division
The responsible cooperating agencies are the:
U.S. Fish and Wildlife Service
U.S. Environmental Protection Agency
National Marine Fisheries Service

ABSTRACT:

Bridgeport is the largest city in Connecticut and has the second largest port in the state, second only to New Haven. This highly industrialized city, with a 1980 population of nearly 143,000, serves as an oil and general cargo receiving center for western Connecticut and southeastern Massachusetts.

The primary commercial navigation problem at Bridgeport Harbor is the lack of adequate channel depth and maneuvering area to handle the larger vessels now being used, particularly in the petroleum trade.

The principal recreational navigation problem is the lack of sufficient anchorage or mooring areas to meet the high local demand in the area for wet storage areas for recreational boats.

The selected plan entails deepening the existing main ship channel to s depth of 42 feet at mean low water (while retaining the existing 400-foot channel width), enlarging the existing turning basin to 28 acres and deepening to 42 feet, dredging a 28-acre, 6-foot-deep mooring basin at Burr and Cedar Creeks for nearly 200 recreational boats expected to be added to the existing fleet, designating an additional 10 acres (now exceeding 25 feet in depth) to restore the 25-foot anchorage to its full 23-acre dimension) and deauthorizing the two authorized, but unconstructed, breakwaters at the entrance to Black Rock Harbor, as they are no longer economically justified because of oyster habitat loss associated with project implementation.

This plan, will require the removal of an estimated 2.9 million cubic yards of silt and sand. Clamshell dredges mounted on barges are proposed for the dredging, and all materials would be transported by bottom dumping scows to the Connecticut-approved Long Island Sound Central Disposal Site about 6 miles south of New Haven Harbor. The materials from the inner

Bridgeport Harbor and Burr Creek anchorage will be capped with coarser and clean sediments from the outer entrance channel. The total construction time would take 8 months using two dredges at Bridgeport and a third dredge at Burr Creek. The work will be accomplished concurrently and would be conducted only from October through May to minimize potential impacts to oyster beds in Black Rock Harbor and immediately outside Bridgeport Harbor.

Send your comments to the Division Engineer by April 1984.

If you would like further information on this statement, please contact:

Mr. Gib Chase
Impact Analysis Branch
New England Division, Army Corps Engineers
424 Trapelo Road
Waltham, MA 02254

SUMMARY

BRIDGEPORT AND BLACK ROCK HARBORS
PROPOSED NAVIGATION IMPROVEMENTS
BRIDGEPORT, CONNECTICUT

(X) Draft ( ) Final

Responsible Office: New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Mass. 02254

1. Name of Action. (X) Administrative ( ) Legislative

2. Description of Action. The proposed action is to deepen the existing 35-foot deep Bridgeport entrance channel, the inner harbor to Yellow Mill Channel (Plan E) and the turning basin to 42 feet. Deepening the entrance channel to 42 feet will necessitate lengthening it approximately 5,500 feet seaward. A section of the existing 25-foot deep anchorage would also be dredged to 42 feet to provide a 10-acre addition to the existing turning basin. In Black Rock Harbor a 28-acre anchorage area will be dredged to 6 feet deep (Plan H) in Burr and Cedar Creeks. It is proposed that the material be dredged by a mechanical bucket or clamshell dredge and placed into bottom dump scows for transportation for disposal at the designated Central Long Island Sound Regional Dump Ground off New Haven Harbor. The total amount of dredged material to be dredged from the Bridgeport Harbor entrance channel and the inner harbor amounts to approximately 2,620,000 cubic yards. An additional 120,000 cubic yards could result from the dredging of private berthing areas and 165,000 cubic yards would be dredged to create the 28 acres of anchorage at Cedar and Burr Creek.

3.a. Environmental Impacts. Deepening of the channels and turning basin in Bridgeport Harbor would provide an incentive for expanding docking facilities, transportation savings for the fleet and enhance navigation safety. The dredging of anchorage space at Cedar and Burr Creeks would provide additional moorings which are essential to maintaining the economic viability of the recreational boating in Black Rock Harbor.

Dredging operations would result in the removal and death of many of the organisms within the dredged channel, including most of the benthic infaunal community and a limited number of commercially important shellfish species. Water quality changes associated with dredging and disposal are primarily increased turbidity and reduced dissolved oxygen concentrations. These are predominantly short-term localized changes which are expected to have little effect on the biota. Water quality induced fish mortalities have not been observed, although studies show that fish that come in contact with the affected water may be subjected to

additional stress. Avoidance of these areas by fish may reduce the potential problems attributed to water quality changes.

Open water disposal at the Central Long Island Sound Regional Disposal Area would bury or stress existing benthic plant and animal life in the immediate vicinity of the disposal area and increase the contaminant loading of the sediments at the site. Construction time is estimated at 8 months pending employment of two dredges for the main channel and 10-acre enlargement of the turning basin and one smaller dredge for mooring basin at Burr Creek. Construction at both sites would be undertaken concurrently. The operations would be restricted to that period from October to May to minimize potential impacts to oyster resources.

b. Adverse Environmental Impacts. Dredging operations result in the removal and death of organisms residing in the dredged channel, including the benthic infaunal community and lobster. Many organisms residing at the open-water and shallow water container disposal sites, as well as on any new upland disposal sites would be killed or stressed by burial, turbidity and contaminant loading. Short-term, localized decreases in estuary and disposal site water quality are expected. Short-term, localized decreases in estuary water quality are expected.

4. Alternatives.

a. Structural. Consideration was given to dredging the existing entrance channel and inner channel and turning basin to depths of 38, 40, 42, and 50 feet below mean low water, respectively.

- Oil Pipelines
- Offshore Terminal

b. Nonstructural alternatives considered included:

- Utilization of Favorable Tides
- Multiport Operations
- Utilize Other Ports
- Additional Navigation Aids
- One-Way Traffic
- Use of Shallower Draft Vessels
- Bypass Route to Avoid Shoals

c. Dredging methods discussed include mechanical bucket and scow, hydraulic pipeline, and hopper dredge.

d. Disposal Options evaluated:

- Land Disposal
- Beach Nourishment and Dune Restoration
- In-Harbor Shallow-Water Diked Container Disposal Facilities

- Open-Water Disposal in Long Island Sound
- No Action

5. Coordination and Review of Drafters. Comments on the Draft Environmental Impact Statement are being requested from the following agencies:

Federal

Environmental Protection Agency, Boston, MA
Fish and Wildlife Service, Concord, NH
  Field Office and Region I Office, Newton Corner, MA
National Marine Fisheries Service, Gloucester, MA
U.S. Coast Guard, New Haven, CT
Department of Navy, Naval Support Facility, NY

State

Department of Environmental Protection, Hartford, CT
Coastal Area Management Office, Hartford, CT
Department of Transportation, Wethersfield, CT
Division of Aquaculture, Department of Agriculture, Milford, CT

Local

Mayor, City of Bridgeport, CT
First Selectmen, Town of Fairfield, CT
Manager, Town of Stratford, CT
Planning Board, City of Bridgeport, CT
New Haven-Bridgeport Pilots Assoc. Inc., Wallingford, CT
Greater Bridgeport Regional Planning Agency, Bridgeport, CT

Other

Barrier Island Coalition, Hamden, CT
United Illuminating Company, Bridgeport, CT
Bloom Bros. - Talmage Bros. Oyster Inc., Norwalk, CT
Long Island Oyster Farm, Inc., NY
Shell Oil Company, Bridgeport, CT
Cilco Terminal, Bridgeport, CT

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PROPOSED NAVIGATION IMPROVEMENTS
BRIDGEPORT HARBOR AND VICINITY, CONNECTICUT

I. Introduction and Project Description

1.01 Location and General Description. Bridgeport Harbor is on the north shore of Long Island Sound about 57 miles east of New York City and 20 miles west of New Haven and consists of two widely separated units. The main harbor and its branches serve the east and central portions of the city of Bridgeport, and Black Rock Harbor and its tributaries serve the western part.

1.02 The federally dredged channel extends about 3.5 miles from deep water in Long Island Sound north-northeastward between two converging breakwaters into the main harbor, and then into the three tributaries, Johnsons Creek, Yellow Mill Channel, and Pequonnock River. An additional channel, about 2 miles westward, extends about 2.4 miles through Black Rock Harbor to the heads of both branches of Cedar Creek, see Figure 1-1. The mean range of tide is 6.8 feet at Bridgeport Harbor and 6.9 feet at Black Rock Harbor. Waterborne commerce at Bridgeport consists mostly of petroleum products, metal shapes and products, nonmetallic minerals, sand, gravel, and scrap iron. Two oil-receiving piers, a general cargo dock and two small-boat rental and service facilities are located along the main waterfront. An inactive oil-receiving terminal, coal receiving dock, a ferry dock, a marina repair and marina facility, a yacht club, a marina, an inactive fish pier and a deactivated power plant terminal are located along the upper inner harbor.

1.03 Johnsons Creek, the easternmost tributary located northward of Pleasure Beach, is entered eastward of Tongue Point through a marked dredged channel leading to three anchorage basins, two on the west side, and one at the head of the creek. Two oil-receiving piers are on the lower creek, and two yacht clubs and a boatyard are on the upper creek.

1.04 Yellow Mill Channel, at the north-central side of the inner harbor is entered through a dredged channel that leads for about 0.8 mile north-northeastward from just above the first bend in the main channel to the head of the creek. Flats, largely bare at low water, are on both sides of the channel. Two commercial berths are located on the upper channel for barge traffic of sand, stone and scrap metal.

1.05 Pequonnock River, the most westerly of the tributaries, entering the inner harbor is easily followed by small craft, but larger vessels may need the assistance of a tug to get around the sharp bends. The river is entered through a dredged channel that leads northward from the main channel at Steel Point to the head of navigation just below the Berkshire Avenue Dam, about 1.1 miles above the entrance. An oil-receiving pier, a ferry dock, a marine repair facility, a marina, a yacht

club and an inactive fish pier are located along the lower river. An oil-receiving dock and several inactive commercial docks are located along the upper river.

1.06 Black Rock Harbor, about 2 miles west of the main harbor, is Bridgeport's main yacht harbor. There are two yacht clubs, two marinas, three launching ramps and a boatyard in the outer harbor and its two tributaries, Cedar and Burr Creeks. Six commercial berths are located near the head of Cedar Creek, principally for barge traffic of petroleum products and scrap metal.

1.07 Study Authorization. This study is being conducted in accordance with a Resolution made at the request of the Honorable Abraham Ribicoff and the Honorable Lowell P. Weicker, Jr., which is as follows:

> "RESOLVED BY THE COMMITTEE OF PUBLIC WORKS OF THE UNITED STATES SENATE, that the Board of Engineers, for Rivers and Harbors be, and is hereby requested to view the reports on Bridgeport Harbor Connecticut, submitted in House Document 136, 85th Congress, 1st Session, with a view to determine the economic justification and environmental acceptability of providing navigation improvements for deep draft vessels, commercial fishing boats, recreational craft and related purposes in Bridgeport Harbor, including the harbor's tidal tributaries and nearby Black Rock Harbor, Cedar Creek and Burr Creeks, and the tidal portion of Ash Creek." The resolution was adopted on April 6, 1977.

1.08 Prior Related Reports and Studies.

Acts	WORK AUTHORIZED	DOCUMENTS AND REPORTS
July 4, 1836	Fayerweather Island seawall	
Mar 3, 1899	Shore protection of Fayerweather Island	Annual Report, 1899, p. 1173.
Mar. 2, 1907	West breakwater and present project dimensions of east breakwater	H. Docs. 275 and 521 5th Cong., 2d sess.
Mar. 2, 1919	Present project depths of 18 and 12-foot anchorage basins	H. Doc. 898, 63d Cong. 2d sess

July 3, 1930	25-foot entrance channel, 25-foot anchorage and an 18-foot channel through Johnsons River, present project dimensions of channel through Pequonnock River, Yellow Mill Pond, Black Rock Harbor and Cedar Creek	H. Doc. 281, 71st Cong., 2d sess.
Aug. 26, 1937	25-foot channel through main harbor, and present project location and extent of 18- and 12-foot anchorage basins	H. Doc. 232, 75th Cong.
Mar. 2, 1945	30-foot channel; elimination of 12 foot anchorage	H. Doc. 819, 76th Cong., 3d sess.
July 24, 1946	30-foot turning basin and 15- and 9-foot channels in Johnsons River	H. Doc. 680, 79th Cong., 2d sess.
July 3, 1958	Present depth and extent of main channel, and turning basin south and southeast of Cilco Terminal; Black Rock Harbor breakwater; Burr and Cedar Creek anchorage; upper Johnsons River anchorage; lower Johnsons River anchorage.	H. Doc 136, 85th Cong.

1.09 Maintenance Dredging. Maintenance dredging is performed on an irregular basis to remove shoal material that has accumulated over the years in the Federal project. The scheduling of maintenance dredging is dependent on two factors: the rate of shoaling and the type of vessel utilizing the project. The latter factor also dictates the depth to which a project will be dredged. The depth might be less, but not more than the authorized depths. Improvement dredging involves new actions which would alter previously authorized dimensions of a project. The assumption can be made that the deepening of existing ports will require periodic dredging to maintain the desired channel dimensions.

1.10 Purpose and Need for Action.

The main harbor at Bridgeport has two major needs, a deeper channel and deeper turning basin to accommodate commercial shipping They are both generated by the presence of the three largest terminals in Bridgeport Harbor, which are owned by the United Illuminating Corporation (U.I.), Shell Oil Company, and the Cilco cargo terminal. United Illuminating is an electric generating utility company serving the Greater Bridgeport Area. U.I. and Shell have in recent years experienced difficulties in accommodating accommodate large fully loaded oil tankers or barges cannot

reach the U.I. and Shell offloading facilities at Tongue Point, and the point near the entrance to Johnsons River. Because of the existing 35-foot depth restriction in the channel and turning basin, larger tankers must be scheduled to enter the harbor 3/4 to 1/2 full, or with a loaded draft of about 32 feet. This causes problems with scheduling and requires more frequent tanker deliveries to supply the oil-fired generating stations, resulting in increased costs per unit of fuel. Some vessels have waited up to six hours to catch the incoming tide in order to make a safe passage. Ships preparing to dock at U.I. have run aground in the turning area on two different occasions. Fortunately neither of these incidents resulted in oil spills. Large cargo vessels also experience difficulties and delays in reaching the Cilco terminal.

1.11 In addition to the entrance channel depth restrictions, the size of the turning basin in the main harbor is also a problem. The turning basin is located at the bend in the main channel at the mouth of Johnsons River, and the harbor pilots have reported difficulty in maneuvering larger size vessels to the U.I., Cilco and Shell terminals. Owners of the first two firms have expressed their desire to have the basin enlarged. With the trend of using larger vessels in the harbor, the present problems are expected to worsen. A representative of the New Haven-Bridgeport Harbor Pilots Association suggested that the existing 25-foot anchorage be made part of the turning basin, and be deepened along with the main channel to 40 feet MLW. With this added area, larger vessels in the 600-800-foot range length could be handled with an acceptable degree of safety.

1.12 Pequonnock and Johnsons Rivers. Local interests initially felt there were insufficient recreational berthing facilities in the rivers and that the available water areas were not being fully utilized. However, presently there is no interest in anchorage improvements along either tributary channel.

1.13 Black Rock Harbor Area. Local interests expressed three major needs for the Black Rock Harbor area. The first was increased channel depth throughout the harbor and Cedar Creek. The authorized depth is 18 feet. However, because the channel has shoaled in recent years 18-foot draft tugboats, assisting oil barges to the upper reaches of Cedar Creek, have to slow down or stop because they scrape bottom and/or churn up silt at lower stages of the tide. This causes delays and maneuvering problems, as well as a interruption of recreational boating activity in the lower harbor area during the sailing season. It should be noted that in the summer months, approximately 1,000 pleasure boats are moored in Black Rock Harbor on both sides of the Federal channel.

1.14 The fuel oil terminals in the upper reaches of Cedar Creek supply approximately 60 fuel oil distributors with home heating oil. The deliveries required to keep these terminals supplied have been increasing, and they are expected to be more frequent in the future. The harbormaster has suggested maintenance of the existing 18-foot channel and deepening

the channel to 22 feet. Although there is presently insufficient economic justification to deepen the channel, maintenance of the existing channel is being scheduled.

1.15 The second major need identified is protection in the outer harbor from wave action, particularly during storms which are frequently generated across Long Island Sound. Damage to the boats moored in the harbor and shorefront facilities has run into thousands of dollars every time there is a severe storm. Local interests feel that rock breakwaters are needed at the entrance, but presently they are not economically justified.

1.16 The third concerned the need for sufficient and suitable anchorages in the Black Rock Harbor area. Cedar and Burr Creeks are well protected and would make fine anchorage areas. Local interests would like to see anchorages dredged in Cedar and Burr Creeks as the demand for recreational boating is very high and mooring space is needed.

1.17 Proposed Plan of Action

The recommended plan is as follows:

a. Bridgeport Harbor

(1) Dredge the existing 35-foot-deep Bridgeport entrance channel, the inner channel, and the turning basin to 40 feet. Deepening the entrance channel to 40 feet would necessitate lengthening it approximately 2,300 feet seaward.

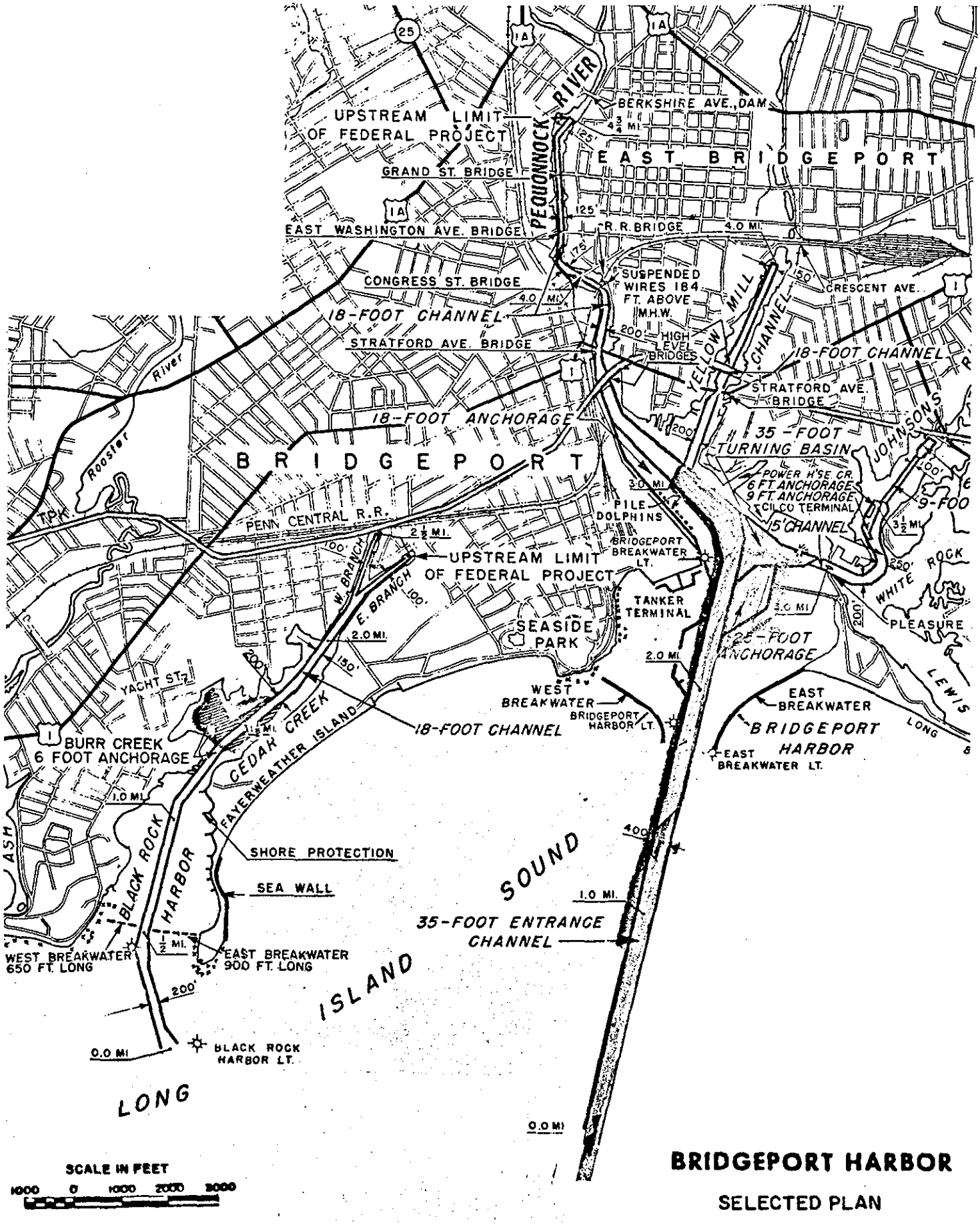
(2) Dredge a section of the existing 25-foot-deep anchorage to a depth of 40 feet so as to provide a 10-acre addition to the existing turning basin.

(3) Designation of an equivalent 10-acre area to the existing 25-foot-deep anchorage (no dredging required).

b. Black Rock Harbor Area

(1) Dredge a 28-acre anchorage area 6 feet deep in Cedar and Burr Creeks for recreational vessels.

1.18 Construction Methods. It is proposed that the material be dredged by a mechanical bucket or clamshell dredge and placed into bottom dump scows for transportation for disposal at the designated Central Long Island Sound Regional Dump Ground off New Haven Harbor. The total amount of dredged material to be dredged from the Bridgeport Harbor entrance channel and the inner harbor amounts to approximately 2,620,000 cubic yards. An additional 165,000 cubic yards would be dredged to create the 28 acres of anchorage at Cedar and Burr Creek.



BRIDGEPORT HARBOR

SELECTED PLAN

1.19 In order to gain the full benefits from the proposed project, private companies would need to dredge their berthing areas to 40 feet. Such measures could entail removal of 65,000 cubic yards at the United Illuminating Tongue Point dock, 59,000 at the U.S. Steel Point dock, 27,000 cubic yards at the Cilco dock (if feasible) and 4,000 cubic yards at the Shell Oil dock, with attendant structural modifications at the Cilco dock.

1.20 The estimated time period required to dredge the 40-foot main channel and anchorages at Burr and Cedar Creeks would be 8 to 16 months depending on whether one or three dredges are employed and assuming no dredging between 1 June and 30 September.

1.21 EVALUATION UNDER THE OCEAN DUMPING CRITERIA

1.22 Although Lond Island Sound is within the Territorial sea baseline, the criteria specified in the Ocean Dumping Act (U.S. EPA, 1977) must be applied to assess the potential impacts of this project pursuant to Section 4 of P.L. 572. The criteria specifiy certain restrictions and testing requirements to be applied when evaluating the acceptability of disposing dredged material in ocean waters or, in this case, Long Island Sound.

1.23 Subpart B of these regulations contain the specific guidelines to be considered in determining compliance. Part 227.5 prohibits the ocean dumping of high level radioactive wastes; materials used for warfare; insufficiently described materials; or persistent, inert substances that may interfere materially with legitimate uses of the ocean. The material to be dredged will be dumped within an area selected soley for that purpose and should not interfere with any other legitimate uses of the ocean.

1.24 Part 227.6 prohibits the ocean dumping of material containing mercury (Hg), cadmium (Cd), or organic halogens as well as their compounds, oil of any kind or form or known or suspected carcinogens, mutagens or teratogens in greater than trace amounts; trace amounts being that which causes no significant ecological impact. Sediments containing these constituents, however, may be disposed in ocean waters if it can be demonstrated, through special handling procedures and/or other studies, that the activity will not cause unacceptable ecological impacts.

1.25 Environmental testing performed on these sediments is discussed in sections 3.16 to 3.37 of this report. These data indicate that the inner harbor area is significantly contaminated with organics and heavy metals. The outer harbor sediment, however, is relatively uncontaminated coarse and fine grained material not significantly influenced by the various imputs of pollutants to the inner harbor. These sediments are similar to those existing at the proposed disposal site and therefore, are considered exempt from further testing under Part 227.13(b) of the criteria.

1.26 The inner harbor areas including the anchorage in Burr and Cedar Creeks are considered potentially degrading and may be disposed of in open water only if suitable mitigation and special handling procedures are employed.

1.27 It is proposed that these questionable sediments be dredged first and dumped at a specified point using a taut-moored buoy and then covered by the cleaner sediments from the outer harbor. This procedure has been successfully demonstrated to isolate and sequester contaminated sediments from the environment several times in the recent past. Such projects have been closely monitored via NED's Disposal Area Monitoring System (DAMOS). Further, this procedure has been endorsed by the U.S. EPA region I as satisfying the Ocean Dumping Criteria for handling questionable material.

1.28 Material dredged to improve private berths in the inner harbor area (estimated at 151,000 cubic yards) would be considered acceptable for disposal at the Central Long Island Sound Site if similar special handling procedures were implemented. These projects could be done concurrently with the proposed Federal project or if special handling procedures are not feasible, more comprehensive testing could be performed to determine the material's suitability for disposal without additional mitigation. Based on the above discussion, the proposed project has been judged in compliance with the applicable criteria.

II. Alternatives Including the Proposed Action

2.01 In accordance with the Council on Environmental Quality's (CEQ) recommended format, this section is is based upon the informational analyses presented in other sections of the EIS, particularly Sections 3 and 4, Affected Environment and Environmental Consequences, respectively, and the Formulation and Comparison of Detailed Plans in the Feasibility Report. All alternative navigation improvement plans considered in the feasibility report have been examined and evaluated in terms of their potential environmental effects or impacts. Detailed discussion will also be presented for various alternative dredging methods. Several disposal sites, open-water as well as subtidal, have been identified along with the possibility of utilizing some of the material for beach nourishment or dune restoration.

2.02 Dredging Alternatives Considered.

Bridgeport Harbor

A. Structural.

1. Dredging the existing entrance channel, turning basin and main channel to depths of:

38, 40, 42, and 50 feet below mean low water (MLW).

The selected plan is to dredge to -42 feet M.L.W. up to Yellow Mill Channel, plus allowing an additional 2-foot overdepth.

2. Dredge existing entrance channel, inner channel, (only to Yellow Mill Channel) and turning basin to:

38, 40, 42, and 50 feet below M.L.W.

This option was dropped because no oil or coal deliveries are being made at the now inactive U.I. Steel Point power plant, which has been placed in deactive reserve status.

3. Enlarging existing turning basin by deepening 10 acres of the existing 25-foot deep anchorage to depths of:

38, 40, 42, and 50 feet below M.L.W.

The selected plan is to dredge to -40 feet M.S.L. to provide more maneuvering area and designate an additional 10 acres (now having depths exceeding 25 feet) as anchorage.

4. Dredge the Union Square Municipal Dock ferry berthing area to:

35 feet below M.L.W.

This alternative, as requested by the City, was dropped because it cannot be economically justified incrementally. The city had requested to have this portion of the project dredged but this action would have to be accomplished at local costs.

5. Providing a public marina in the Pequonnock River and a 3-acre anchorage in Johnsons Creek to minus 6 feet with 1-foot overdredge allowance.

A 100-boat municipal marina in the Pequonnock River was dropped from further consideration when it was determined that a marina would encroach on the federal channel to the extent that the existing channel project would have to be abandoned.

Local interests stated at a May 1982 workshop at the Miamoque Yacht Club that the requested anchorage in Johnsons Creek would not be used because floating slips would be preferred and there is insufficient access along the shore of the inner cove for a public anchorage. The City requested in November 1982 that the alternative be dropped from further consideration.

Johnsons River

2.03 Dredge 3-acre anchorage in Johnsons River to minus 6 feet plus one foot overdepth allowance.

At a workshop held May 14, 1982 at the Miamoque Yacht Club, local interest stated that the proposed anchorage in Johnsons River was not needed as it would not be readily accessible to the yacht clubs and would probably not be used because there is no access along the shore of the inner cove. The attendees at the meeting indicated floating slips would be preferred. Since it was the city who had introduced this particular need, and requested its inclusion in the feasibility study, at the 1979 public meeting the NED had requested it reconsideration in light of the response of local interests. This alternative was eliminated from further consideration upon receipt of a November 1982 letter from the city requesting that the plan be dropped.

Black Rock Harbor

A. Structural.

1. Dredge existing 18-foot deep channel to minus 22 feet M.L.W.

2. Dredge Cedar and Burr Creek anchorages (28 acres) to minus 6 feet M.L.W. plus one-foot overdepth allowance.

3. Dredge outer harbor anchorages (20 acres and 24 acres) to minus 8 feet plus one foot overdepth allowance (behind breakwaters).

2.04 Black Rock Harbor. Dredging the existing 18-foot Cedar Creek-Black Rock Harbor channel to a depth of 22 feet was found to be unwarranted for the few commercial vessel trips recorded and could not be economically justified. Based on present usage, the Office of the Chief of Engineers approved 1983 maintenance dredging of the existing channel to a depth of 17 feet. Therefore, this improvement alternative was dropped from further consideration.

Fixed and floating breakwaters at the entrance to Black Rock Harbor were evaluated. Fixed breakwaters appeared to be more viable but were found in the final study stage not to be economically justified. Therefore, this breakwater alternative was dropped from further consideration. Floating breakwaters were dropped from further study due to their inability to provide the needed wave reduction within the harbor from the design storm, and the need for replacement about every 10 years.

Dredging of the anchorages at the mouth of the harbor, behind the proposed breakwaters and in the upper reaches of Burr and Cedar Creeks appeared to be needed and viable and were selected for further study. Dredging the Burr and Cedar Creeks 28-acre anchorage area was found to be economically justified. However, the 20-acre and 24-acre anchorage had to be dropped because of lack of necessary breakwater protection, when the two harbor entrance breakwaters were found not to be economically justified.

Bridgeport Harbor

2.05 a. Nonstructural. Intermediate nonstructural alternative analysis is as follows.

1. Utilize Favorable Tides. Deeper draft vessels already utilize favorable tides, however, they must also lighten their loads to reduce vessel draft so significant transportation savings cannot be realized. This alternative was dropped from further consideration.

2. Multiport Operations. Larger vessels bring full loads into New Jersey and New York ports, then transship partial loads to Long Island Sound ports of lesser depths such as Bridgeport, New Haven, Black Rock Harbor, Port Jefferson, etc. Multiport operations are already being utilized in Bridgeport and Black Rock Harbor to a large degree. Additional use appears to be uneconomical and further consideration of this alternative was dropped.

3. Utilize Other Ports. Bridgeport Harbor is the second largest port in Connecticut, handling one-sixth of the state's waterborne commerce. Petroleum and petroleum products are the major items of commerce. Dry bulk cargo is also handled in the port. Other neighboring ports are already crowded, especially New Haven Harbor, or are inadequate to handle the existing and/or future commerce. Therefore this alternative was not considered further.

4. Additional Navigation Aids - Placement of additional navigation buoys would be the Coast Guard's responsibility. This alternative addresses the safety factors associated with shoals or other navigation obstructions and not the use of harbor facilities by deeper draft vessels. Shoaling in the existing 35-foot channel and turning basin has not been serious. Discussions with the New Haven-Bridgeport Pilots Association indicates that the most critical need in Bridgeport in to remove a small amount of material from the western half of the 25-foot anchorage. This work is scheduled to be accomplished under operation of maintenance dredging in April 1983, therefore navigational aids will not be needed.

5. One-Way Traffic - While this alternative may provide an additional safety factor for the larger (600-800 ft.) vessels utilizing the harbor it would result in additional time delays and does not really relate to the study problem of whether the project justifies a deep-draft channel or not. One-way traffic is already in effect in the main channel for larger ship size ships and will not provide passage for deeper draft vessels.

6. Bypass Route to Avoid Shoals - Although there are minor shoals along both flanks of the main ship channel, there are no other routes available to enable deeper draft vessels to enter the harbor.

7. Use of Shallower Draft Vessels - The dimensions of any given navigation project dictate the maximum size vessel that can utilize the channel and anchorage facilities. The existing 35-foot main channel allows access to fully loaded 37,000 deadweight ton (DWT) vessels, having lengths 660 feet and drafts of 36 feet, the largest vessels which can enter Bridgeport's main harbor at this time. Larger vessels up to 800 feet long with DWT of 70,000 have entered the harbor partially loaded. The use of shallower draft vessels is not foreseen in the future pending continued maintenance of the existing project.

Black Rock Harbor

2.06 a. Nonstructural Alternative. In addition to the construction of a breakwater structure at Black Rock Harbor, nonstructural alternatives were considered as possible solutions to local needs and concerns. They are as follows:

- Construction of small-craft launching ramps at local cost.

- Dry stacking of small craft at local cost.

2.07 The nonstructual alternatives could eliminate the need for breakwater construction and dredging and disposal and would, therefore create minimal or less environmental effects than would result should the navigation improvement operations be carried out. The construction of launching ramps would generate potential increases in the number of recreational boats which subsequently would/ could result in the need for

more marine facilities for docking and maneuvering space which in turn would necessitate dredging and disposal of dredged materials. Adverse effects on water quality and subtidal habitat resulting from expansion of recreational boating would primarily be associated with construction activities, especially dredging and exhaust and fuel discharges from the boats. Most trailered boats are two small to use safely in the exposed waters of Long Island Sound.

2.08 Limited space on the immediate shoreline and access to the water are other factors which negate the "dry stacking" alternative. Small boat launching ramps were dropped from further consideration because of the lack of sites that would provide ample parking spaces along the waterway.

2.09 Alternative Methods of Dredging

The method of dredging is dependent upon the method of disposal chosen. If some combination of diked disposal or beach nourishment at nearby sites is chosen, then a hydraulic dredge (i.e., pipeline or hopper) would be used. If open-water disposal in the sound is selected, a mechanical dredge (i.e., bucket and scows) would be used.

2.10 Dredge Types - The most common dredging method utilized in New England is the mechanical bucket (i.e., clamshell or bucket) dredge and associated dump scow. The dredge itself is mounted on a flat-top barge and the material is then scooped from the bottom and deposited in a scow for transport to the disposal site. This dredge method is relatively slow and manueverability is quite restricted with a tugboat or spuds needed to position the dredge from one direction to another. Studies conducted during dredging in the Thames River and New Haven Harbor using this dredge type, in sediments characteristically similar to those in Bridgeport Harbor, indicated a 30-fold increase in suspended matter from 5 ppm (part per million) to 140 ppm in the immediate vicinity of the dredge (Bohlen 1976). Increased turbidity levels were found to be nearly undetectible 150-200 yards from an operating dredge, while most of the sediment was found to settle out in a band extending about 100 yards along either side of the dredge channel (Gordon, 1973; Bohlen, 1976). The areal distribution, density of suspended sediments, and time in suspension depends on grain size, water content, cohesiveness and currents. The experience of the dredge operator is also another variable when considering how much material would be lost in the water column.

2.11 With present dredging technology it is both feasible and practical to move large quantities of dredged material substantial distances by pipeline. A hydraulic pipeline dredge operates similar to a vacuum cleaner. A suction tube equipped with rotating cutter dislodges the sediments and swings side to side along the bottom at the desired depth. The suction provided by large pumps removes the sediments as a slurry along with four or five times as much water and this slurry is transported through the pipeline to the selected disposal sites. This

type of dredge method usually used for upland, diked and beach diposal operations cause less turbidity at the dredge site than the bucket dredge. Such an operation in effect would allow removal of the dredged material from a highly developed area to a more remote shoreline or inland location away from the harbor.

2.12 A hopper dredge is another form of hydraulic dredge minus the pipeline. Hopper dredges are seagoing vessels equipped with over-the-side drag arms with large suction grates on either side of the ship which are dragged along the bottom. The sediments are pumped aboard in a slurry and placed in hoppers within the vessel. The dredge then transports the material to the disposal site and releases it through bottom opening doors. The dredged material can either be dumped through hopper doors in the ship's bottom or pumped over the side through pipelines to shoreside diked reclamation areas or to eroded beaches. The draft and maximum dredging depths vary depending on the individual vessels design limits. Hopper dredges also have the capacity to pump material to disposal sites via pipelines. This type of dredge has been used frequently during the 1940's through 1960's in New Haven, Bridgeport, and lower Connecticut River. More recently (1979) a hopper dredge was employed to obtain sand at New Haven with which to cap polluted sediments from Stamford at the Central Long Island Sound Regional Disposal Site.

2.13 Both pipeline and hopper dredge with pumpout capabilities allow removal of dredged sediment from highly developed port areas to more remote shoreline or inland locations. The problem remains one of locating suitable repository for the transferred sediment. During the channel deepening at Bridgeport in 1961, the oyster industry insisted on the Corps utilizing a hopper dredge in order to minimize spillage and turbidity on the oyster beds in transporting the spoils to the disposal site.

2.14 Dredged Material Disposal Options

Each of the possible disposal alternatives would have some environmental impact, whether in the ocean, on land, or in diked disposal areas near the waterfront or marsh creation. The major concerns are potential for impacts on identified commercial marine resources and potential for addition to general low-level deterioration of the overall ocean resources.

The alternatives considered herein are: disposal of the dredged materials on land, specifically beaches; disposal in subtidal waters in the harbor; and container disposal facilities and disposal in Long Island Sound. Site descriptions and environmental implications for each follow:

2.15 Land Disposal. As described in Section III of this report, Class II "potentially degradable" dredge material and Class III dredge material are conditionally suitable for open water disposal or for disposal at land sites (except beaches) or in contained areas.

2.16 Potentially viable alternatives to the proposed action (open water disposal), include disposal of the dredged material from Bridgeport Harbor at land sites or in contained areas, provided that suitable sites are available and acceptable to the public.

2.17 There is very little land available in Bridgeport for land disposal of dredge materials. The landfill at Seaside Park only has a 1- to 1.5 year life, after which it will be closed. It is possible to place dredged materials at this site, however, this will increase the dimensions of the landfill (height, length, width). Disposing of dredgings in this manner may also create minor odor problems, but such odors may be less offensive than those presently experienced from the solid waste being dumped. It has also been suggested that some silt materials may be dredged and pumped behind the bulkhead off the west bank of Seaside Park. Further study is needed to determine the feasibility of utilizing the landfill area. There is an undocumented, informal plan to consider developing a corporate office park on this 30-45 acre site which could accommodate dredged material disposal for site development providing the material is suitable for construction.

2.18 A small amount of sediment could possibly be used to develop a proposed park which is now a junkyard adjacent to the harbor. The park, however, is quite small and could accommodate a minimal percentage of the operation's dredged sediment.

2.19 The city of Bridgeport is in the process of selling harborfront property to the Pequonnock Yacht Club, which presently leases it. The yacht club has proposed to fill in some marsh land at the site to expand its facilities. Dredged materials could be placed in this proposed fill area, however, bulkheading would be necessary. This 1-acre site could only accommodate a small amount of material.

2.20 There is an informal and tentative plan to expand the Cilco terminal site which is located on the east side of the harbor opposite Tongue Point. This preliminary plan has two options. Option 1 is the filling in of the east side sewage treatment plant gully to create 1-2 acres of city owned property. The second option is to fill an area east of the terminal to the Pleasure Beach Bridge to create a 5-10 acre site. This area, open water and mud flats, is used as marina space.

2.21 The final on-land disposal alternative involves the proposed deepwater port planned by RYKAR Corporation at Great Meadows. This plan calls for significant filling; however, like other proposals only preliminary planning has begun.

2.22 The Stratford Industrial Corporation (RYKAR) has filed plans with the Connecticut Department of Environmental Protection (DEP) to develop approximately 700 acres in the Great Meadows wetland area. Four hundred acres are now ready for development. RYKAR is willing to accept all the dredge materials pending the DEP action on its development plan.

RYKAR intends to develop this site into a deepwater terminal facility. This site was used as a stockpile for a prior harbor dredging project in which the materials were later used for construction fill on the Connecticut Turnpike nearby.

2.23 It appears there are several land disposal options that can be considered. However, specific plans by area concerns and the city of Bridgeport are very preliminary and their timing with respect to the dredging represent complicating factors. Further study of expanding the landfill site to take dredged material is warranted.

2.24 An additional, although theoretical alternative at this point in time, would be to use the dredged sediment in a marsh development project. More specific evaluation of the suitabilitly of the spoil for this use would have to be done. However, it is unlikely that suitable land can be found within economic proximity to the project due to the extensive development of and competing land uses in the local area.

2.25 Beach Disposal - Clean sand and gravel material could be used for beach nourishment and dune restoration at Seaside and Pleasure Beaches. Sand dunes at Pleasure Beach have been weathered down and could be reestablished by depositing sand to a height of 20 feet with a 3:1 slope for approximately a 2,000-foot stretch. This action could accommodate some 40,000 cubic yards of materials. Another 170,000 cubic yards of sand could be placed along 7,500 feet of shoreline at Seaside Park Beach. In both cases dredging would be accomplished by hydraulic dredge with the material being pumped through a pipeline to the desired location. Although the dredging impacts/effects would not be eliminated, this form of productive use of dredged sediments is considered less environmentally damaging than disposal in the open waters of the sound. Results of sediment profiles have revealed a rather high percentage of organic silts throughout the length of the channel. These are patches of silty sand or gravelly sand such as at station "J" in the outer channel, but it may be difficult to separate out these areas. At this time it appears that there would not be enough sediment suitable for beach or dune enhancement. Coarse sediment from the outer channel, however, could be used as foundation material for the breakwater construction at Black Rock Harbor.

2.26 In Harbor Containment Disposal - There appear to be several acceptable subtidal areas within Black Rock and Bridgeport Harbor which could accommodate dredged material. Some form of bulkheading or diking however, would be required to contain the materials.

2.27 The policy of the Corps concerning cost sharing for retaining structures (dikes) for dredged material areas as stated in Policy Issue No. 79-19 (30 Nov. 1979), is:

a. Retaining structures (dikes) will be provided by the Corps unless the authorizing documentation indicates explicitly that such

structures are a local responsibility except for cases where retaining structures become a new requirement for maintenance of the project for environmental reasons.

b. When retaining structures become a new requirement for environmental reasons, the Corps will:

(1) Recommend to the Secretary of the Army that draft legislation be submitted to the Congress to modify the local cooperation requirements to include retaining structures unless special circumstances justify a specific exception; and

(2) Continue to provide critical maintenance of the project including retaining structures) until the local cooperation requirements are modified by legislation.

2.28 Yellow Mill Channel is a man-made dredged channel. City officials have expressed an interest in deauthorizing the channel and are receptive of its filling and development of a "green" area - recreational park for neighboring low income housing. An area approximately 2,400 feet x 400 feet wide extended northward from the I-95 overpass and Crescent Avenue at its head could be diked and filled. Preliminary cost estimates for an earthern dike and storm drains have been computed by the Center for the Environment and Man CEM(65) under contract to the Corps. The dike would be constructed of impervious material hauled by truck from inland burrow pits. The structure would be 25 feet high which would rise 20 feet above mean low water. Construction of the dike would require 16,000 cubic yards of suitable material. It would be faced with 1-foot of riprap on both sides and the top could be capped with a hard-surface path suitable for cycling or jogging. Construction of the dike could be completed within a 3-month period. For safety purposes, a chain-link fence would be erected around the construction site. When dewatering is completed, the surface area of the disposal facility could be capped with clean sand and a layer of topsoil to form a recreation area. The total elevation would be essentially that of the present banks of the channel.

2.29 The unit cost of disposal at the Yellow Mill Channel Containment Facility would be less than dipsosal at the open water site withn 10 miles, in Long Island Sound and only a little more than half the cost of open ocean disposal. It must be kept in mind, however, that the materials to be dredged must be close to the containment facility, allowing hydraulic dredging and short distance pipeline transportation of material would be one of the controlling elements in the comparative cost analysis for construction of a containment facility in Yellow Mill Channel. Cost of construction of the earthen dike and filling the facility accounts for 28 percent of the total cost under the assumptions cited. The assumed cost of rerouting the storm drains is 29 percent of the total containment facility cost. Therefore, if the costs of storm drain rerouting are much higher (or lower) than assumed, the containment facility cost would change appreciably. A gravel dike with a rock revetment and including dredging

about 550,000 cubic yards and post-dredge covering and seeding would cost about $4,100,000.

2.30 For comparison purposes the overall costs of a steel bulkhead and hydraulically pumping about 550,000 cubic yards of dredged material into the site, as well as covering it with gravel and loam, is estimated at $4,400,000.* Other considerations not included in the estimate was the cost of purchasing riparian rights and the cost of surface drainage as previously mentioned.

2.31 The acreage of parks in the primary impact area is quite small and the addition of a large (17-acre) park in Yellow Mill Channel would provide an important recreational facility for residents of the inner city. The filling of the channel would prevent the continuing occurrence of drowning of children from the immediate area, as well as reduce rodent habitat. Yellow Mill Channel also contains high levels of PCB's and heavy metals which represent a source of contamination to the main harbor environs, commercial shellfish and finfish resources, and open waters of Long Island Sound immediately adjacent. Containment and burial of these materials are seen to benefit future water quality biological resources and aesthetics.

2.32 The following sumarizes the major impacts extracted from personal and telephone interviews, conducted by CEM[65] for the New England Division Corps of Engineers. Clarifying comments corresponding to some of the perceived major impacts are included parenthetically.

- There are several high-rise residences adjacent or near to the site, and the total population within a 1-mile radius is greater than 30,000.

- Construction should consider 100-year flood problems associated with extending the seven storm drains and an upstream source.

- Jacob Brothers Scrap Metal Company would no longer be able to send shipments by barge, and D'Addario Sand and Gravel is just below the proposed DMCF. (The extent of Jacob Brothers' present level of operation is not known.) Relocation of the plant could be investigated.

- Commercial establishments lining the east bank prevent access from that direction to a park that might be built on the completed containment facility. However, many other parks have the same limitation.

*These cost figures were not developed by CEM.

- Bridgeport's community services are facing serious cutbacks, and any recreational facility development might require Federal funding.

- Location of an Indian pottery ground adjacent to the site might require some specific mitigation. (The specific effects of the project have not yet been determined.)

- Construction noise during nights and summer would be objected to due to the high population density adjacent to the site. (No night work or dredging during the summer season is anticipated.)

- The need for a park in such a high-density region of Bridgeport could go a long way towards overcoming the adverse impacts associated with the project.

The concept of filling the upper end of Yellow Mill Channel and making it available for recreation received strong support from Bridgeport City agencies.

2.33 Environmentally, Yellow Mill Channel is a severely stressed water body. Results of the benthic sampling surveys in April and August[67] 1981 reveal that sediments consist of black highly organic and methanogenic muds. The April survey showed the area to be dominated by a single species of Capetellid worm. In August the entire channel was azoic and no animal life found. The habitat index value assigned in April ranged for a 1 to +3 and in August a -8. In areas of water quality the channel is characterized by high fecal and total coliform counts. Table 4-4 shows result of bulk chemical analyses from two cores taken in 1973 which showed high values for heavy metals including 4.4 and 5.4 ppm for mercury, 32 and 39 ppm for cadmium and 1.05 ppm for PCB's. A single sediment core obtained in 1980 revealed extremely high surficial concentrations of mercury, lead, zinc, and copper to be 11.6 ppm, 1,046 ppm, 109,998 ppm, and 42,333 ppm, respectively.

2.34 The channel has also been the recipient of PCB contamination for at least the past 20 years. Universal Manufacturers, Inc., has been identified as the primary source of the PCB pollution which resulted from the manufacture of capacitators during the period from 1956 through 1976. Delivery of the PCB's was by rail and accidential spills and subsequent runoff during offloading entered the system through the storm drain located at the head of the channel. In 1976 the EPA Laboratory at Lexington, Massachusetts, collected a single sediment sample from the upper reaches of the channel which exhibited PCB levels of 280 ppm (per communication between Mr. Gib Chase, ACOE and Mr. Ray Thompson, EPA, 9 June 1982).

2.35 Yellow Mill Channel, therefore, could be acting as a potential source of further contamination of PCB's as well as heavy metals to Bridgeport's main harbor entrance and open water immediately adjacent.

2.36 Burr Creek (Brewster Cove) is located on the western side of Black Rock Harbor and abutts the city playground. This playground area was also created from fill material. The cove comprises an area of approximately 7-8 acres. The inner portion of this cove known as Brewster Cove, which comprises an estimated 3.5 acres, could be diked and can accept up to 178,000 cubic yards of dredged material. The outer cove area serves as a small boat anchorage with municipal marina facilities at the northeastern side and boat yard facilities at the southeastern side. Sediment in the cove consists of anaerobic organic silts or sandy muds with high concentrations of methane gases. Species diversity or richness was found very low with only the polycheates worm Capitella capitata dominating in terms of numbers. The habitat value rating for this area is -8 to -10.(67) Based on the information at hand this area could be filled with minimal environmental damage because of its low resource value.

2.37 The total cost for erecting a steel bulkhead at Burr Creek inclusive of hydraulically pumping 165,000 cubic yards of fill, covering with gravel, loaming, seeding, and providing proper surface drainage is estimated as slightly over $3,000,000. This figure may be offset by the recreational and wildlife habitat use of the lands created. The cost for a gravel dike is estimated at $2,700,000.

2.38 Local interests, however, have recently petitioned the New England Division to dredge the Burr Creek Inlet and Brewster Cove for reasons of "health and property improvement." Opposition to the proposed filing of a portion of the cove was voiced at a public workshop held May 27, 1982. The cove is partially within the Black Rock Historic District but is alleged historic significance has yet to be confiremd by the State. Based on the foregoing it appears that this site is unavailable as a viable disposal option.

2.39 In a letter to the Corps dated 9 September 1982, the Mayor of Bridgeport has indicated that "The estimated $3,566,000+ minimum cost to the city plus the cost of purchasing riparian rights from abutting property owners; cost of surface runoff drainage, and other environmental cost to construct containment area at Yellow Mill and Burr Creek Cove cannot be borne by the city at this time. The approximately 26 acres of land created at these sites would be restricted to recreational parkland uses by the materials used and this could not be marketed for any activities that would provide the city with a return on its investment."

2.40 Power House Channel is a small man made channel approximately 600 feet long by 250 feet wide, located between the Cilco Terminal Wharf and Steel Company. The city of Bridgeport's municipal sewage treatment plant outfall pipe empties into this channel. In addition to the sewage effluent insults the waters are littered with scrap metal debris and other materials from the adjacent shore activities. The bottom sediments consist of black organic methanoganic muds high in heavy metals. Biologically the habitat value is considered extremely low and is ranked at -4.(67)

2.41 Fayerweather Island - A 52-acre container disposal facility could be constructed along the southeastern shore of Black Rock Harbor. A rock dike 3,800 feet long would extend from a point opposite Black Rock to the southern tip of the island (Fig. 2-1). This would make the Fayerweather Island peninsula approximately 1,000 feet wide through most of its length similar to its present landward end. In the late sixties the same area was cited for possible construction of a municipally operated marina and small boat anchorage (Harris, Inc. 1969).

2.42 Dike construction, dredging and material placement could be restricted to the period October through May, and no night work would be permitted at any time. The dike would be constructed in spring of the first year; filling could begin in the fall of the first year and would continue for two or more years. The dike would require 70,000 cubic yards of materials transported by truck from inland borrow pits.[65][66]

2.43 The disposal cost at the Fayerweather Island prototype dredge material containment facility would be less than either disposal in Long Island Sound or open ocean disposal. Such cost is based on the assumption of all fill material coming from local hydraulic dredging with temporary pipeline transport for distances up to three miles, thus including all of Bridgeport Harbor. The unit cost is also affected by the cost of dike construction and the assumption of a 1:1 slope (sheltered dike) and surfacing with one-foot of riprap on both sides.[66]

2.44 The potential final use of the site would be passive recreation and the area could be a refuge for birds and other coastal animals. Its final appearance would be very similar to existing vegetated areas. The most significant adverse impact would be the elimination of an active 30-40 acres of seed oyster growing habitat. Also, the use of the site as a continued disposal facility could impact plans for the enlargement of the anchorage area on this side of the harbor, but this could be partially offset somewhat by benefits derived by recreational use of the land created.

2.45 The following represents a list of potential perceived major social, economic, and environmental impacts identified in association with construction of a containment disposal facilitly at this site.[65]

- The boating hazards during construction would be potentially severe due to the large number of vessels that are moored in the harbor year-round. Accidents are rare but very serious. (No dredging from June through September is anticipated.)

- The entire site, currently owned by Flowers Oyster Company, would be affected, and many new oysters have recently been set; the entire site is affected.

- Trucks or loud machinery could not be operated at night past local ordinances unless special mufflers were used. (No night work is anticipated.)

- The extension could be seen as an opportunity to increase the size of the adjacent landfill, as opposed to renovating a resource recovery plant in the area. It could be strongly objected to on that ground. Including a provision that the completed disposal facility would be donated to Connecticut for non-landfill use would be a possible mitigation measure.

- There would be a marked reduction in panoramic view from across the harbor, and the dike should be made as low as is technically feasible. There would be about a 35 percent reduction at one-half mile viewing range assuming a 30-foot upper limit above horizon. (The facility would have essentially the same height as the present seawall connecting Fayerweather Island to the mainland.)

- An examination of potential increased siltation in the channel should be made due to the extended proximity of the site to the channel. (Circulation study of proposed breakwaters located at the mouth of the harbor indicated increased siltation is not expected. The containment facility would be designed and operated to prevent loss of disposal material.)

- Saint Mary's by the Sea, a residential area on the mainland side of Black Rock Harbor opposite Fayerweather Island, is considered to be the most exclusive in Bridgeport; many of the residences on the island are worth $300,000 and up.

In view of perceived significant adverse impacts, the site was dropped from further consideration as a possible containment facility.

2.46 Other Shallow Subtidal and Land Area

2.47 Other shallow subtidal and land areas that have been identified as possible disposal sites are listed below:

Beacon Street - Black Rock Harbor, privately-owned, could accommodate approximately 5,000 cubic yards of sand and gravel. Would require bulkhead or dikes and/or riprap.

Sea Bright Street - Located immediately south of Beacon Street site on city-owned property. Total capacity estimated is 20,000 cubic yards. Diking is required.

Trash Plant Creek - An area approximately 400 feet by 150 feet. Could accept some 33,000 cubic yards.

Incinerator Plant Area - Mostly upland and could use onsite fill for dikes. Could accommodate an estimated 75,000 cubic yards.

Fayerweather Island - southern section of city landfill area could use dredged materials to cover slopes of dump and then close dump. Could accommodate approximately 100,000 cubic yards.

Foreign Trade Zone - Could accept an estimated 75,000 cubic yards and would require diking.

Johnsons River Cove - An area 700 feet by 300 feet could be filled to a 12-foot depth. The site could accept 95,000 cubic yards and will require a diking. Dredging of the 3-acre anchorage originally identified as a need would have amounted to 65,000 c.y. of material. This alternative has been dropped from consideration for reasons cited in 2.02.

Pleasure Beach Pond - Located at the eastern side of Bridgeport Harbor is an area about 300 feet by 600 feet. The site could accept up to 40,000 cubic yards of clean sand and gravel.

2.48 Long Island Sound Dredged Material Containment Study

2.49 The New England Division is midway through a study to determine the feasibility of creating islands and containment structures within Long Island Sound with materials dredged from Connecticut rivers and harbors. Consideration will also be given to suitable materials other than dredged material.

2.50 Authority to conduct the study is contained in a Resolution of the Committee on Public Works and Transportation, U.S. House of Representatives, sponsored jointly by Congressmen Robert N. Giaimo, Stewart B. McKinney, and Christopher O. Dodd, and adopted 10 May 1977. The resolution reads as follows.

> "Resolved by the Committee on Public Works and Transportation of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors is hereby requested to review the reports on the Land and Water Resources of the New England - New York Region, published as Senate Document Numbered 14, Eighty-Fifth Congress, First Session, and other pertinent reports, with a view to determining the feasibility and impacts of the treatment and use of dredged materials to result from the continued maintenance anticipated improvements of Long Island Sound harbors, as well as from any newly created Federal harbors, to build artificial islands in Long Island Sound for recreation, conservation, marsh building, development, and other purposes. The study should also consider the utilization of dredged materials from other than Federal projects (i.e., State, Community

and Private), and the feasibility and acceptability of utilizing solid wastes other than dredged materials for Island building."

2.51 Over 300 sites have been screened to date. Prototype feasibility environmental studies were initiated at Clinton Harbor and Black Ledge, New London in August 1981. The Clinton Harbor site would represent a marsh creation or enhancement type project while Black Ledge represents an open-water island creation container facility. Yellow Mill Channel and Burr Creek would be representative of a shorezone containment area. Prototype analysis are contemplated for other sites during the coming year. One site identified by local interests for a possible containment facility is Penfield Reef whose description follows.

2.52 Island Creation

2.53 Penfield Bar and Reef. The town of Fairfield Conservation Commission has forwarded in conjunction with the Long Island Sound Dredge Disposal Container Study a proposal (letter, 22 March 1982) to create a dredged material disposal island at the Penfield Reef area. Historically, the Penfield Reef or shoal was an island varying from 50 to 200 acres depending on the tide. It developed a reasonable soil profile supporting beach grass, bayberry and scrub oak, allowing pasturage by cattle and sheep. Pasturing and removal of protecting riprap for ballast stone initiated erosion of the island which washed away in the late 19th century.

2.54 The site is within 1.5 miles of the Bridgeport and Black Rock Harbor channels and within 4 to 6 miles of the Southport and Housatonic River channels, respectively. The dredged spoil island would be approximately 70 acres in area, rising from -4 feet to +10 feet MSL, providing for an interior contained volume of about 1.6 million cubic yards of "contaminated" dredge spoil and surrounded by "clean" spoil, sweeping westerly on the old tombolo as a "sacrificial island" sand reservoir for littoral drift moving across the coastal beaches. The outer island would be a permanent improvement, protected by stone riprap and offering enhanced wildlife and recreational opportunities after reaching its design capacity. The connecting island would be of fluctuating size depending on current scour and periodic dredge spoil replenishment. A causeway could be built out from shore along the existing sand bar if needed or desired.

2.55 Today the area contains the spine of the old island as a distinct hazard to navigation. The area is closed to shellfishing, is adjacent to Fairfield's sanitary sewer outfall, and is in close proximity to both Black Rock and Bridgeport Harbors and the Penfield Reef cable area. The area has public access from the shore yet is isolated at all times. Shallow waters lie to the west while deep water to the east would permit off-loading of dredge spoil from barges. Water depths in the area and existing bottom topography would appear to favor an increase in

expansion of the facility well beyond the initial 70 acres, thus providing long-term (20 years) disposal usage. The project with proper diking in place would afford protection to the Fairfield Beach and Black Rock Harbor areas and associated recreational boating. The site is located near seed oyster grounds and an undetermined amount of bottom habitat could be lost if a container facility construction was undertaken. Conversely, it could also provide protection to the beds and allow a greater productivity than presently realized. A baseline biological survey consisting of benthic grab sampling and SCUBA transects was completed in September 1982. Additional biological sampling along with wave energy analysis and sediment transport studies was initiated in the summer of 1983. This information will be incorporated into the final detailed project report.

2.56 Open-Water Disposal in Long Island Sound

2.57 There are 19 previously used disposal sites within the Long Island Sound area. With the advent of NEPA and the Clean Water Act the concern for potential environmental impacts from disposal operations led to the reduction in the number of disposal sites. In accordance with Region I EPA policy, no new disposal sites will be considered except under exceptional circumstances (i.e., emergency operations) and when and where practical to reduce the number of existing disposal sites. Based on this philosophy, the Long Island Sound sites have been reduced to four interim approved sites. They are the New London site off the Thames River, Cornfield Shoals site off the Connecticut River, New Haven or the Central Long Island Sound site, and the recently selected Western Long Island Sound III site. These sites represent historic or previously used dump grounds. Undesignated ocean dumpsites, those not either interim approved or formally designated, will not be used (OCE, 16 Jan. 1981 policy guidance letter).

2.58 Operational considerations and recommendations for an open-water Long Island Sound Dumping Grounds Monitoring program has been outlined by the State of Connecticut and New York and the New England River Basin Commission in the LIS Interim Disposal Management Plan. For sites within the territorial baseline Section 404 of the Federal Water Pollution Control Act of 1972, as amended, will apply. Disposal sites within Long Island Sound, such as New Haven or Bridgeport, would come under the jurisdiction of this act. EPA has the final approval over the selection or designation of any disposal sites.

2.59 New Haven or Central LIS Dumping Grounds - General Environmental Setting

2.60 The Central Long Island Sound is an established regional disposal site in Long Island Sound identified by the New York-Connecticut Interim Plan (NERBC, 1980) and the Final Programmatic Environmental Impact Statement (CE, 1982). Approximately 5.7 million c.y. of dredged material has been deposited there since 1955. The dumping grounds is centered at approximately 41°-08'-45" north latitude and 72°-53'-15" west longitude,

about 6 nautical miles (NM) south of the entrance to New Haven Harbor, Connecticut.

2.61 The bottom substrate at the site is comprised of silts and clayey silts with less than 20 percent sand. Presumably most of the existing sediments have accumulated as a result of past disposal operations and are therefore not necessarily representative of natural sediments characterizing the central basin of the sound. The bottom is relatively featureless and slopes gently to the south and is an environment of net sediment deposition. Existing water depths range from 15 to 23 meters. Maximum tidal currents at the bottom are moderate (27-31 cm/sec) and wave induced currents are low.

2.62 Between October 1973 and March 1974, 1.5 million cubic yards of material from New Haven and Guilford Harbors were dumped at this site. This material formed a symmetrical mound at the center of the disposal site; the minimum depth of water above the pile was 15 to 15.5 meters. After the New Haven project was completed additional material from private projects under Federal permit was dumped at a buoyed point southwest of the original site. There was no spoil disposal at this site from 1975 until 1977. From March 1979 to June 1980, 470,000 c.y. of spoils from Stamford and New Haven Harbors were dumped at two points 0.5 nautical mile and 0.5 nautical mile south of the old disposal mound, north in 19.5 meters of water, respectively. In 1980-81 approximately 275,000 cubic yards (pay yardage) of dredged material was excavated from the Federal project in Norwalk Harbor and dumped at a site approximately 0.5 NM west of the central mound.

2.63 The Central Dump Grounds is currently the only State approved aquatic disposal site in Central Long Island Sound and has been the subject of extensive monitoring investigations. As such, this area has been judged to be suitable for Class I and Class II dredged material disposal and for Class III material disposal when capped by coarser and cleaner sediments.

2.64 Site A - Bridgeport East

2.65 Site A is three kilometers east of the discontinued Bridgeport dredged material disposal site located in the Central Long Island Sound approximately, 5 kilometers south of the Bridgeport/Pequonnock River Entrance Channel. The Bridgeport historic disposal site received almost 4 million cubic yards of dredged material between 1954 and 1977. This site was identified through the programmaic EIS and is discussed in more detail in that document.

2.66 The suitable site area, depicted in Figure 2-1 trends northwest-southeast and lies in water depths ranging from 16 to 24 meters. The bottom in the vicinity of the site slopes very gently and smoothly to the south. A shallow rocky area, known as Stratford Shoal Middle Ground, lies about 5 kilometers to the east. The site is along the

main approach for larger vessels to Bridgeport Harbor. The 15 meter draft clearance provided in computing the site capacity is adequate for this area (Silberman, 1980).

2.67 The sediments at Site A are silts and clayey silts with less than 20 percent sand fraction and the area appears to be one of natural sediment accumulation. Bottom tidal currents are in the range of 20-25 cm/sec.

2.68 The location southeast of the discontinued Bridgeport historic disposal site separates the selected site from the lobster fishery around the old Bridgeport site. The water depth range of 16 to 24 meters also provides for greater site capacity than would be found in the surrounding shallower local areas.

2.69 Besides the fisheries resources discussed below, and the ferry route which passes to the east of Site A, there is no other known significant conflicting use value for the site or areas immediately adjacent to it.

2.70 According to a study completed by Dames & Moore, Inc. under contract to the NED Corps, due to the muddy sediments and proximity to the old disposal site, most of the site is probably characterized by low species diversity. The benthic fauna occurring here probably are typical of those types which occur within the fine deep water sediments described in MAFC, 1974 (see also Section III.A.3.c). It is primarily a polychaetes-bivalve assemblage. "Cosmopolitan" species are those which find various habitats (i.e. temperature ranges, water quality requirements and bottom types) suitable for colonization. Their abundance, although not necessarily dominant, may be significant in different communities. Such typical "cosmopolitan" fauna occurring in many areas on different habitats within the sound would probably be found here, including several polychaetes, gastropods, and crustaceans. A bivalve was very abundant with about 1400 individuals collected in a single $0.1m^2$ grab (MAFC, 1974). Species diversity was low at this station. However, this was probably related to the large number of bivalves collected. The benthic species found at and near this canditate site can be found in MAFC (1974) and NOAA (1976).

2.71 The area around and including Site A is utilized by commercial fisherman for scup, flounder and fluke (USACOE, January, 1979). About 25 percent of the menhaden landings occur in the western Long Island Sound region (Connecticut DEP, 1979). A lobster fishing area can also be found about 0.5 km to the west of the site. Nearly 42 percent of the lobster landings of all the sound are taken in western Long Island Sound (Connecticut DEP, 1979). Recreational fishing occurs around the Stratford Shoal Middle Ground about 6 km to the east. Species such as bluefish, blackfish and sea robins are popular catch with the sportfishermen.

2.72 Bridgeport Historic Dump Grounds

2.73 This site is a rectangular shaped area 2 miles long by 1-mile wide and is located approximately 3 miles (4,800 meters) south of the Flashing "R2" Gong Buoy marking the Federal channel approach into Bridgeport Harbor. Water depth at the dump site ranges from 63 to 72 feet. The bottom sediments according to the C&GS navigation charts consists of muds probably as a direct result of the accumulation of previous disposal operations. This site was closed from 1972-1975 and was last utilized in 1961 and 1963 when the current 35-foot main channel was dredged and Johnsons Creek maintained, respectively. With the exception of Bed #849LIOF which is located 2,700 meters due north, all of the other commercial oyster grounds lie to the north and east of the dump ground beyond 3-mile distances.

2.74 No site specific research or monitoring programs have been undertaken at the discontinued Bridgeport dumping site so few data are available regarding the specific effects of disposal there. The reopening of this pristine or new site for dredge material disposal would necessitate the capping of contaminated sediments from Black Rock and Bridgeport Harbors and the initation of a monitoring program to document ecological and water quality effects. With any new disposal site such as this, the Connecticut Dept. of Health and Services and Division of Aquaculture would review the project operation plans and a shellfish sanitation closure zone may have to be established aorund the site to prohibit the harvest of shellfish.

2.75 Open water disposal at any of the aforementioned sites would preclude possible land use or wildlife habitat benefits if associated with shoreline or shallow water containment disposal facility.

Western LIS Site III

In March 1982 the Corps of Engineers NED in coordination with the State of Connecticut and New York to designated a regional disposal site in Western Long Island Sound (WLIS-III).

The WLIS III disposal site, centered at 49° 59.3 N and 73° 29.2 W is located within the triangle bordered by the Stamford disposal site on the west, the South Norwalk disposal site on the northeast and the Eaton's Neck disposal site on the east (Figure 2). It occupies an "east-west" oriented trench which ranges in depth from 115 feet in the valley to 80-90 feet along its upper sides. The general area is protected on the east by an extensive sandy ridge ranging from north of the Cable and Anchor Reef to Eaton's Neck on Long Island.

A description of the physical oceanography, water quality, sediments and impacts from use of this site are evaluated in detail in the final EIS issued February 1982.

2.76 Disposal Area Monitoring system - DAMOS

The Disposal Area Monitoring System (DAMOS) is the New England Division's response to increased environmental concern and responsibilities relative to the disposal of dredged material in open waters. Through the DAMOS program, the Corps monitors physical, chemical, and biological changes at the disposal sites and implements management practices to minimize any potential adverse impacts.

The results of DAMOS efforts to date indicate that the observed effects of disposal are restricted to the immediate area surrounding the disposal point and, after initial adjustments in the sediment surface occur, the dredged material remains stable. Biological impacts beyond the margins of the site have to date been undetectable.

2.77 Structural Alternatives for Construction of Breakwaters in Black Rock Harbor

2.78 Five alternative breakwater structures were considered for possible construction at the mouth of Black Rock Harbor. The types of breakwaters studied were:

(a) Rubblemound
(b) Steel Pile
(c) Cellular
(d) Composite
(e) Floating

2.79 Types (a) through (d) have been described in detail by Vollmer Associates (1981)[69]. The selected breakwater plan which reached the final consideration stage was the rubblemound type. Alternative breakwater types (b), (c), and (d) were rejected on the basis of high cost and/or difficulties with construction procedure. It was determined during the final study phase that a breakwater/anchorage plan inside the mouth of Black Rock Harbor was not economically justified.. Therefore, the option of breakwater construction was dropped from further consideration.

2.80 Floating Breakwaters. Construction of floating breakwaters could be considered for Black Rock Yacht Club, Naval Veterans Port Facility No. 5 and Fayerweather yacht clubs, however, the costs would be fully borne by local interests. Environmentally a floating breakwater would cause considerably less disturbance and alteration to the bottom habitat and could eliminate the need for dredging which is an inherent problem for disposal of dredged materials. The floating blocks as well as the anchor weight and cables would provide surfaces for the survival and growth of epibenthic fouling organisms, i.e., barnicles, hydroid mussels, ectoprocts, algae. This type of growth, while acceptable and even beneficial on the permanent rock breakwater, would serve to increase maintenance frequency and costs of the floating structures. The growth of these plant and animal communities would decrease the buoyancy which would greatly reduce the structure's capacity to disrupt wave energy.

2.81 Maintenance costs of this type of structure are very high, and its replacement would be required every 10 years. Another limitation is that a floating breakwater would only dissipate waves of 2-3 feet in height while the design wave of 4 feet was determined for Black Rock Harbor. The maintenance cost for floating breakwaters would be solely the responsibility of local interests.

2.82 Offshore Terminal. An offshore petroleum products terminal was considered in 56 feet of water, about 2 miles south of Penfield Reef, about 5 miles southwest of the Bridgeport Harbor. The terminal would be a double-berth fixed pier or a single-point mooring and accomodate tankers up to 120,000 DWT. A similar fixed-pier offshore terminal facility was considered for New Haven Harbor in the New Haven Harbor Feasibility Report, dated April 1981, in about the same depth of water. A similar structure for Bridgeport would cost about $119,000,000, including submarine pipelines and onshore support facilities. It was dropped from further consideration due ot the high cost, compared with other alternatives. The single-point mooring buoy concept was also dropped because of the anticipated high cost of the mooring, submarine pipelines and onshore suppport equipment.

2.83 Pipelines. Two pipeline routes were also considered in the New Haven Harbor Navigation Draft Feasibility Report. One was an all land route and the other was a part-submarine route from the New Jersey Refinery area. The land route would cost about $1,000,000 per mile and the submarine route in Long Island Sound would cost about $2,000,000 per mile. The estimated cost to bridge the pipeline to the Bridgeport area would be $92,000,000 for the land route and $184,000,000 for the underwater route. Due to the high cost, anticipated rights-of-way acquisition problems and the environmental considerations, this alternative was also dropped from further consideration.

2.84 From an environmental standpoint and habitat based approach, the construction of a single-point mooring terminal and/or pipeline system would eliminate the need for dredging and the attendant problem of disposal of dredged materials. This combined with the proper site selection and coordination of a pipeline route with commercial fishing interests would mitigate impacts to oyster grounds and water quality within the harbor and adjacent coastal waters.

2.85 No Action

2.86 If the channel deepening or enlargement of the manuevering area in Bridgeport is not undertaken, conditions would remain the same with the existing project dimensions determining the size of the vessel that can safey utilize the harbor. Access, therefore, would be restricted to vessels with 35-foot drafts. Larger vessels would continue to experience tidal delays.

2.87 Additional anchorage area and breakwater construction in Black Rock Harbor could provide several positive impacts including the reduction of periodic storm damage to moored boats and shoreline facilities, increased mooring area; enhancement of economic developent for local marina and possibly recreational benefits with the breakwaters providing fishing opportunities. Container disposal could also provide green space for recreational use and wildlife habitat. These benefits would of course not be realized as the Black Rock Harbor dredging and breakwater construction are no longer under consideration.

2.88 Negative effects or impacts that would be avoided if the proposed project action to the Bridgeport main harbor and Burr and Cedar Creeks is not approved are: decrease in water quality due to increased boating usage; loss of shellfish, namely seed oyster bottom habitat and the elimination of the inherent problems associated with the dredging and disposal of contaminated sediments.

III. Affected Environment

3.01 Present Level of Economic Activity. The city of Bridgeport covers approximately 17.5 square miles. Bridgeport is one of the key ports along the New England coast. The port is the second largest in the state, and handles nearly one-fifth of the state's waterborne commerce.(1) The main import is oil, while the maine export is iron and steel scrap. Bridgeport serves as one of the major oil distribution points on Long Island Sound.

3.02 Bridgeport's economic base has been traditionally oriented toward manufacturing, particularly in the defense industries. There has been a shift in the area towards more white collar jobs. As a result of decreased manufacturing activity, the area has experienced high unemployment.

3.03 Principal industries include the manufacture of firearms, brass goods, electrical appliances, airplanes, machine tools, plastics, wiring devices, aluminum and zinc castings, and valves.

3.04 The following chart notes the percentage of employees involved in each of the major industrial classifications (1982) in Bridgeport.(2)

TABLE 3-1
PERCENT OF EMPLOYEES 1982 - BRIDGEPORT, CONNECTICUT

Manufacturing	36.3
Services	26.4
Trade/Finance	25.8
Government/Education	4.6
Transportation/Communication	3.5
Construction	3.3

3.05 Marine Facilities - Commercial. Bridgeport Harbor serves important commercial and recreational navigation functions. The port also is the site of numerous recreational marinas which serve the needs of both Connecticut and Long Island Sound residents.

3.06 The 1981 freight traffic through the port exceeded 3,200,000 tons.(3) Principal commodities handled were petroleum, metals, nonmetallic minerals, lumber, and sand-gravel-crushed rock. Bridgeport has a major ferry operation at Union Square Dock, which provides passenger and auto service to Port Jefferson on the north shore of Long Island. The port's primary market areas are western Connecticut, southwestern Massachusetts and eastern New York.(4) Except for recession periods, Bridgeport has shown a steady growth in waterborne commerce since the 35-foot channel was completed in 1963.

3.07 The port has 29 waterfront facilities (nine inactive) to handle dry cargo. There are six deep draft terminals, of which the Cilco

Terminal on the east side of the inner harbor is the only general (all-purpose) cargo facility. The Cilco Terminal receives about 100 selfpropelled vessels per year, and has handled 400-500,000 tons per annum. The terminal also handles sea-train container traffic by barge.(6)

3.08 There are 10 fuel storage terminals (three inactive) in the port. The seven active terminals are Shell Oil, Hoffman Fuel, Sun Oil, United Illuminating, Inland Fuels, Crowley Fuel, and D'Addario Industries.(7) United Illuminating, Buckley Brothers (Shell subsidiary), and Hoffman Fuel are the major oil shippers for the port.(8) Shell Oil typically handles 950,000 tons/year in petroleum products. However, the Shell operation does considerable lightering of cargoes to Port Jefferson, New York; Fall River, Massachusette; and Sewaren, New Jersey. Although Shell has lost 2 feet of draft at their inner harbor facility due to shoaling,(9) the terminal can dock tankers with 35-foot draft at high water. Hoffman Fuel only handles barges in the 20,000-barrel range, with an annual traffic of 150-175 barges. Total petroleum product unloaded is approximately 3.5 million barrels.(10) United Illuminating received 6,563,460 barrels of oil in 1976. Thirty-five tankers and 16 barges were unloaded for the year. There is some transhipment of oil by U.I. to its New Haven plant from Bridgeport. Average tanker size at U.I. is 32-foot draft, 50,000 deadweight tons.(11) Most transhipped oil is carried by barge.

3.09 Water dependent commercial activites in the port area:

Ed Speers Boatyard
Fayerweather Boatyard
Black Rock Shipyard
Hitchock Gas Engine Repair Company
Fairfield Dock Company
Stratford Dory Company

It should be noted that the Hitchock Company is one of the largest boat repair companies in Fairfield County.

3.10 Marine Faciliites - Recreational. Bridgeport serves as an important center for recreational boating in Long Island Sound. The facilities in the port are crowded and there is a need for expansion. Most of the marinas and yacht clubs are located on the Black Rock Harbor Channel, Johnsons Creek, or the east side of Bridgeport Inner Harbor.

3.11 The following is a listing of private marinas in Bridgeport Harbor.(12)

Black Rock Yacht Club	Pequonnock Yacht Club
Naval Veterans Port 5 Assoc.	Parsell's Marine Sales
Fayerweather Yacht Club	Bill's Boat Basin
Cedar Boat Ways	Miamogue Yacht Club
Hitchock Gas Engine Co., Inc.	East End Yacht Club

The port also has the Bridgeport Municipal Marina at Burr Creek, a municipal trailer ramp at Seaside Park, a public use trailer ramp at Naval Veterans Port 5 Facility at Black Rock and an inactive fish pier at Steel Point.

3.12 It is clear that Bridgeport has considerable facilities to handle commercial and recreational boating. These facilities generate considerable tax revenue and related retail sales for the city. Commercial port operations are a critical element on the overall economic vitality of Bridgeport. Not only do port activities create jobs and pay taxes, the port attracts industries to the area which depend on waterborne commerce.

3.13 Existing Land Uses. Land use in the main harbor, in areas immediately adjacent to water, are predominantly industrial, utility-transportation, and recreational. Land use along Black Rock Channel is generally residential in nature with scattered areas having utility-transportation and industrial uses. Table 3-2 notes land use for the entire city of Bridgeport.

TABLE 3-2
LAND USE - PERCENT, 1980[13]
BRIDGEPORT, CONNECTICUT

Residential	38.5	Institutional	6.0
Streets	20.6	Commercial	4.9
Industrial	10.1	Vacant	4.3
Water	6.8	Utility/Transportation	2.2
Recreational	6.6	Agricultural	0

3.14 Land use on the west side of the inner harbor consists of wharves, light and heavy industry and a deactivated electrical powerplant site. The eastern side of the inner harbor has similar land uses to the western side; however, there are more residential and commercial activities present. Land use along the Pequonnock River consists of railroads, junkyards, gas storage, and industrial uses. Steel Point contains many wharves, light industry and an electric powerplant. Land use along Yellow Mill Channel is predominantly industrial, but a small park is located along the northwest shore. The entrance to Johnsons Creek is composed of Pleasure Beach - a park and Great Meadows tidal marshland. Great Meadows is a coastal wetland area of high ecological value. Land use farther up the creek is mostly oil handling facilities mixed with small craft anchorages and light industry.

3.15 Land use along Black Rock Channel is primarily residential with interspersed parks. Seaside Park runs the entire length of land separating Long Island Sound from Cedar Creek. A thin strip of land immediately fronting Cedar Creek and adjacent to the park is used for sanitary landfill. The northermost reaches of Cedar Creek are used by industrial firms and oil-receiving terminals.

3.16 Properties adjacent to the main harbor are presently zoned industrial. Seaside Park is unzoned. Lands along Black Rock Harbor are zoned primarily residential, with industrial zoning at the northern reach of the channel. A portion of Great Meadows is also zoned industrial.

3.17 It should be noted that there are major parks adjacent to Long Island Sound and the harbor channels. Seaside Park and Pleasure Beach, fronting the sound are important recreational sites for area residents. Attendance at these parks during the summer season exceeds 2 million people. Other parks adjacent to the water bodies include St. Mary's by the Sea, Seabright Avenue Lot, Wordin Park, Ellsworth Street Playground, and Waterview Park.

3.18 Water Quality Data

3.19 The waters of Black Rock and Bridgeport Harbors are currently classified "SC" by the State of Connecticut. This classification indicates a limited suitability for certain fish and wildlife, recreational, boating, certain industrial processes and cooling, and good aesthetic value. This classification is not suitable for bathing, and therefore is considered unacceptable. The water quality goal is "SB" which would be suitable for bathing and offers excellent fish and wildlife habitat.

3.20 The main reason for the classification is the combined sewage overflows involving two secondary sewage treatment plants in the area. One plant is located in Bridgeport Harbor and the other is in Black Rock Harbor. Although both plants generally discharge within the secondary standards, the released nutrients, solids and coliform bacteria contribute, impact at least, to the long-term degradation of both harbors.

TABLE 3-3

Parameter	Average Daily Quantity	Maximum Concentration	Average Daily Concentration
Chromium-Total	1.09 kg/day	3.0 mg/l	1.0 mg/l
Chromium-Hexavalent	0.11 kg/day	0.2 mg/l	0.1 mg/l
Copper	1.09 kg/day	3.0 mg/l	1.0 mg/l
Iron	2.18 kg/day	4.0 mg/l	2.0 mg/l
Nickel	1.09 kg/day	2.0 mg/l	1.0 mg/l
Zinc	5.45 kg/day	8.0 mg/l	5.0 mg/l
Cyanide-Amenable	0.11 kg/day	0.2 mg/l	0.1 mg/l
Total Suspended Solids	21.83 kg/day	30.0 mg/l	20.0 mg/l

3.21 An average daily flow to 228,000 gallons per day is authorized. After January 31, 1981, the average daily flow was reduced pending an engineering study. Concentrations of zinc also had to be reduced to a maximum concentration of 3.0 mg/l and an average daily concentration of 1.0 mg/l. The outfall is located at the end of South Street on the south bank of the creek.

3.22 The West Side Wastewater Treatment Plant has a design flow of 29 MGD, some fraction of which is discharged into the inner harbor each day. The outfall extends about 200 feet beyond mean low water and is submerged during all tidal conditions. It is located near the southeast corner of the treatment facility. The following conditions are contained in the NPDES Permit:

Parameter	Monthly Average Quantity	Monthly Average Concentration	Minimum Percentage Removal Efficiency
Biochemical Oxygen Demand	3406.5 kg/day	30 mg/l	85%
Suspended Solids	3406.5 kg/day	30 mg/l	85%

3.23 Nonpoint Discharge Sources

There are approximately 10 combined sewer overflow outfalls in Cedar Creek, which release storm water runoff from an area of approximately 1,050 acres into the creek. The area is heavily developed with industrial operations and residential housing. The opportunity exists for the introduction of a large variety of chemicals into the creek from surrounding parking areas, streets and highways and outside industrial activities. Untreated sewage also enters the creek during periods of heavy rain when the combined system exceeds its design capacity.

3.24 Nonpoint sources of discharge into Cedar Creek probably occur from erosion and runoff from the sanitary land-fill located on the south shore of the creek. Sanitary landfill is piled about 40-50 feet above sea level leaving rather steep banks where erosion could occur during periods of heavy precipitation.

3.25 Three marinas, a marina/boatyard and a yacht club are located in Bridgeport Inner Harbor, as are three terminals for offloading petroleum products. The petroleum offloading facilities and associated barge traffic are the most probable source of oils and tars found in sediments of the inner harbor.

3.26 Several publications are available which describe water quality in Bridgeport Harbor including reports by Normandeau Associates, Inc. in 1973[18], by Dr. Moran at Sacred Heart University in 1974[19] the Connecticut Department of Environmental Protection Water Compliance Unit in 1976,[20] Dr. Chung at the University of Bridgeport in 1976,[21] and Messrs. Verses, Chuss, and Onewachat, Sacred Heart University, published in 1976.[22]

3.27 The most recent water quality data collected by Messrs. Verses, Chuss and Gnewuch were obtained from a field program conducted in the summer of 1975.[22] Physical, chemical, and bacteriological data were gathered at eight stations in the Bridgeport Harbor area including locations in Black Rock Harbor, Ash Creek, Outer Harbor, Inner Harbor,

Pleasure Beach, Johnsons Creek, Yellow Mill River, and the Pequonnock River. The results are summarized in Table 2-3 as average concentrations computed for all tidal conditions. These results indicate that the Bridgeport Inner Harbor, Yellow Mill River and Johnsons Creek are severely degraded and that the Bridgeport Outer Harbor and Black Rock Harbor are moderately to severely degraded. At these locations "unusually high total fecal coliform counts as well as high concentrations of nitrate, ammonia, and phosphates[22] were observed.

3.28 Harbor Sediments. Sediment analysis data are available for the Bridgeport Harbor area from the U.S. Army Corps of Engineers,[24],[25] from the USGS,[20] and from Brannon, et al.[26]

3.29 Six borings were taken by the U.S. Army Corps of Engineers in November 1975 in Black Rock Harbor and Cedar Creek to analyze the sediment for chemical composition and grain size. A map locating the bore holes, the gradation curves from the size analysis, and tables describing the chemical composition of the sediment are found in Appendix A.

3.30 In 1973 the Corps of Engineers took thirteen borings in Bridgeport Harbor, two borings in Yellow Mill Channel and Johnsons Creek, and four borings in the Pequonnock River.

3.31 The USGS sampled bed materials in Bridgeport Harbor, Black Rock Harbor, and Cedar Creek in May 1975. Information on size analysis and chemical composition is found in Appendix A.

3.32 Brannon, et al., published sediment data on Bridgeport Harbor in 1976. This size analysis and chemical composition information is also found in Appendix A.

3.33 In Black Rock Harbor and Cedar Creek the Corps of Engineers analyses describe the sediment as predominantly black fine sandy organic silt with associated marine odors. The Corps of Engineers' samples taken in 1973 describe the sediment as either gray or black organic silt for Bridgeport Harbor, Yellow Mill Channel, Johnsons Creek, and the Pequonnock River. Samples taken by the USGS and Brannon, et al., also showed the sediment to be predominantly silt in the Bridgeport Harbor area.

3.34 In terms of chemical composition, the sediment in Bridgeport Harbor, including those in Black Rock Harbor and Cedar Creek, Yellow Mill Channel, Johnsons Creek, and the Pequonnock River, contain moderately high to high concentrations of potential pollutants, volatile solids, oil and grease, and metals.

3.35 Summary of the sediment data including vibracores obtained in 1980 and bioassay results are discussed in detail in Section 4 of this report.

TABLE 3-4

SUMMARY OF SEDIMENT ANALYSIS DATA
BRIDGEPORT HARBOR AREA

SEDIMENT CHARACTERISTICS	CORPS OF ENGINEERS DATA (1975)*						CORPS OF ENGINEERS DATA (1973)*																				USGS DATA (1975)				BRANNON, et al DATA FOR BRIDGEPORT HARBOR
	BLACKROCK HARBOR AND CEDAR CREEK						BRIDGEPORT HARBOR													YELLOW MILL CHANNEL		JOHNSONS CREEK		PEQUONNOCK RIVER				CEDAR CREEK	BLACKROCK HARBOR	BRIDGEPORT HARBOR		
	BE-1-76	BE-2-76	BE-3-76	BE-4-76	BE-5-86	BE-6-76	BE-9	BE-10	BE-11	BE-12	BE-13	BE-14	BE-15	BE-16	BE-17	BE-18	BE-19	BE-20	BE-21	BE-1	BE-2	BE-3	BE-4	BE-5	BE-6	BE-7	BE-8	01208863	01208864	01208860	01208861	
Percent Silt-Clay	78.7	81.8	96.6	96.8	64.6	No Data	77.4	90.1	91.3	56.4	80.5	67.8	93.2	82.2	95.7	76.3	96.3	97.4	98.3	98.2	94.0	64.4	93.0	83.0	30.6	35.7	3.4	41**	92**	73**	3**	95.5****
Percent Water	52.8	64.6	68.2	76.1	67.2	48.1	73.0	75.9	69.5	38.1	68.2	85.0	78.1	73.1	80.0	71.6	76.4	81.3	80.0	72.5	74.0	67.8	76.6	72.7	36.7	38.5	22.7	No Data				
Percent Volatile Solids (NED Method)	4.7	7.5	10.2	14.4	9.7	5.9	6.7	7.6	6.9	1.5	5.6	15.0	7.7	6.8	9.3	6.6	9.8	11.6	13.1	11.2	10.5	6.3	11.2	14.5	3.6	7.3	1.1	2.5***	12.0***	9.7***	.8***	No Data
Percent Oil & Grease (Hexane Extract)	.25	.45	.87	2.19	2.18	1.18	.35	.30	.46	.12	.46	4.33	.72	.61	No Data	.41	.63	.77	1.29	2.34	1.58	.61	1.17	3.12	.60	2.41	.08	.46	.33	.16	.05	No Data
Heavy Metals (ppm dry basis)																																
Hg	.46	.80	1.2	1.67	1.81	.49	.58	.79	.44	.17	.49	4.3	.82	.7	.79	.39	.97	.91	2.5	5.4	4.4	.8	1.1	2.5	.13	.55	.01	.8	.7	.4	0	No Data
Pb	127	198	314	586	427	481	119	116	118	45	302	881	265	297	400	84	136	230	100	1636	538	265	769	839	300	470	65	430	290	190	8	No Data
Zn	267	390	659	1507	488	886	549	316	328	116	415	1920	622	462	521	319	712	1067	440	1224	922	420	2118	1233	379	611	155	1500	830	350	29	1067
As	5.1	7.1	9.7	14.0	11.0	7.9	2.7	9.6	11.0	6.1	18.0	19.0	32.0	20.0	9.0	4.2	18.0	11.0	11.0	13.0	16.0	12.0	28.0	15.0	5.2	7.8	8.8	No Data				6.9
Cd	4.2	3.4	11.0	22.0	37.0	9.2	3.7	4.2	2.6	1.9	6.3	61.0	9.2	8.4	11.0	3.4	6.8	12.0	43.0	39.0	32.0	10.0	44.0	11.0	4.7	5.9	1.8	19	5	6	0	17.6
Cr	242	305	911	2260	671	414	280	300	353	84	415	2400	494	461	571	268	729	2134	530	No Data	1152	394	871	734	70	618	31	2000	1500	410	17	No Data
Cu	369	543	1004	2344	792	674	376	366	393	136	581	2268	768	594	670	310	805	2049	550	1384	1153	506	1161	2091	237	1544	145	1900	1400	500	41	203
Ni	59	79	138	242	152	96	96	116	92	71	106	280	165	119	150	134	127	231	120	292	268	93	290	161	63	81	39	130	78	35	1	No Data
V	64	85	126	167	122	77	103	133	92	39	126	160	128	149	120	85	136	171	60	335	169	74	154	161	44	65	36	No Data				
PCB (ppm dry weight)	No Data						.05	No Data				2.01	No Data								1.05	No Data										

* Surface samples
** Percent finer than 0.062 mm
*** Method of analysis not defined
**** Percent finer than 0.050 mm

3.36 Based on scoping meeting discussions with regulatory agencies and on the dredged material sediment classification scheme in the Interim Plan for the Disposal of Dredged Material in Long Island Sound (NERBC, 1980) it was agreed that the Bridgeport Harbor sediment including that for Black Rock Harbor and Cedar Creek, Yellow Mill Channel, Johnsons Creek, and the Pequonnock River is Class II "potentially degrading" or Class III.

3.37 "Class II sediments are relatively fine grained with moderate solids content.[27] They may be moderately enriched with potential pollutants, volatile solids, oil and grease, and metals. Class II sediments can be designated as either "nondegrading," "questionable," or "potentially degrading." Class II sediments should not be used for beach nourishment or landfill cover. They may be suitable for habitat creation projects but this might require capping with Class I material. Class II "potentially degrading" sediments should be capped by Class I or Class II "nondegrading" sediments at open water disposal sites. Class II sediment can be disposed of on land or contained.

3.38 "Class III sediments are fine-grained with low solids content. These materials are often highly enriched with potential pollutants, volatile solids, oil and grease, and metals.[27] For this reason Class III sediments may be judged "potentially degrading" or "potentially hazardous." Class III sediments should not be used for beach nourishment, landfill cover, or habitat creation projects. They may or may not be disposed at open water disposal sites. "Toxic" Class III sediments must be capped by Class I or Class II material if they are to be disposed at open water disposal sites. The Interim Plan states, however, that "land disposal and containment of Class III sediment will be given priority." Although the Federal Government is not necessarily bound by these guidelines the States have adopted them for preliminary evaluation purposes and they serve as the policy framework for dredging and disposal decisions.

3.39 Tidal Wetlands. Very few tidal wetland areas as defined by Connecticut Public Act 695 border Bridgeport or Black Rock Harbors. The only wetland area occurs in Fayerweather Island (Figure 2-1). However, significant salt marsh areas lie to the east in Statford and to the west in Fairfield. Lordship Marsh in Stratford's Great Meadows lies east of Johnsons Creek. Having been severely altered in the past, the area continguous to Johnsons Creek is not presently classified as a tidal wetland. Important salt marsh areas also occur on Ash Creek and Turney Creek west of Black Rock Harbor in Fairfield.

3.40 Wildlife - Mammals. Bridgeport and Black Rock Harbors are surrounded by industrial, commercial, residential areas, recreational parks and beaches that provide limited habitat for mammals. The Great Meadows provides the major habitat and cover in the area.

3.41 The areas immediately outside (seaward) of Bridgeport and Black Rock Harbors are major rafting areas, up to 10,000 scaup (*Aythya spp.*) and several thousand other ducks may be found.

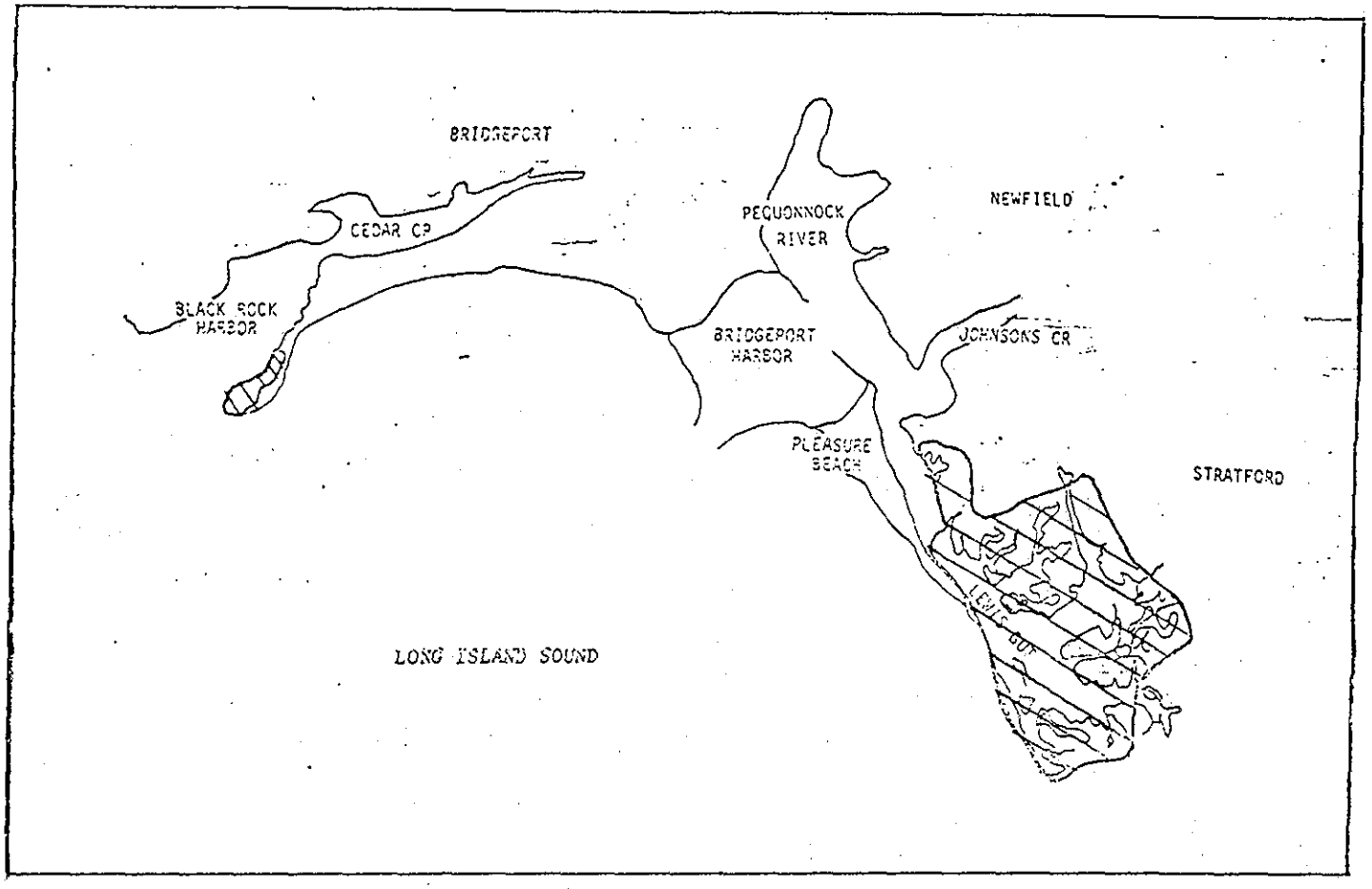


Figure 2-1: Tidal wetland areas delineated by the Connecticut wetlands survey.

3.42 The main feeding and congregating areas for overwintering ducks such as mallards, black ducks, scaup, goldeneye, American widgeon, white-winged scoter, bufflehead, oldsquaw and horned grebes are inside Lewis Gut during spring migration and severe storms, and outside Bridgeport and Black Rock Harbors.

3.43 The most abundant permanent residents of the area include black ducks, mallard ducks, great black backed gull, herring gull, and ring billed gull.[20]

3.44 No major bird breeding areas occur in Bridgeport and Black Rock Harbors and the immediate contiguous areas.

3.45 Shellfish. Bridgeport and Black Rock Harbors and areas near the harbor mouths have been among the best shellfish areas in the state.[30],[31] Extensive shellfish beds occur in inner and outer Bridgeport Harbor and near the mouth in Johnsons Creek (Figure 3-2). Although not shown on the map softshell clams (*Mya arenaria*) occur throughout Bridgeport Harbor but are most abundant in the intertidal flats west of the channel from Tongue Point to the breakwater.[18] Coarse sediments east of the channel and in the northern areas of the harbor limit the distribution snd abundance of the softshell clam. The abundance of oysters (*Crassostrea virginica*) has declined over the past several years, the last good set occurring in 1973. The Bridgeport area has historically been a good natural setting area for oysters.[37],[32] It is believed that the largest remaining oyster beds in Bridgeport Harbor occur along the western edge of the channel from Tongue Point to the western breakwater.

3.46 Bridgeport and Black Rock Harbors and the contiguous offshore waters are presently closed to shellfish harvesting for direct marketing and consumption.[33] Figure 4-2 shows the shellfish closure line and the location and extent of the present leased shellfish areas. Bloom Brothers, Inc., of Norwalk generally set out 30-40,000 bushels of shells annually for seed oysters.[32] Six permits to harvest seed oysters in Lewis Gut, Bridgeport Harbor, and the Bridgeport natural beds also occurred during 1976.(33) A commercial operation to harvest clams in Yellow Mill Channel took place a few years ago but now is defunct.[37]

3.47 Phytoplankton. The phytoplankton of Connecticut estuaries tend to be abundant in quantity, but limited as to the number of major species identified to date. Approximately 150 species have been found in Long Island Sound and its bays and estauries, but only 34 constitute major species. Only about 21 species are present 10-12 months of the year in sufficient abundance to consistently occur in samples.[54] The overwhelming dominant species in Connecticut estuaries is the diatom *Skeletonema costatum*. During unusually cold winters it yields dominance to the dinoflagellate, *Thalassioria nordenskioldii*, and in warm summers several other species may be more abundant.

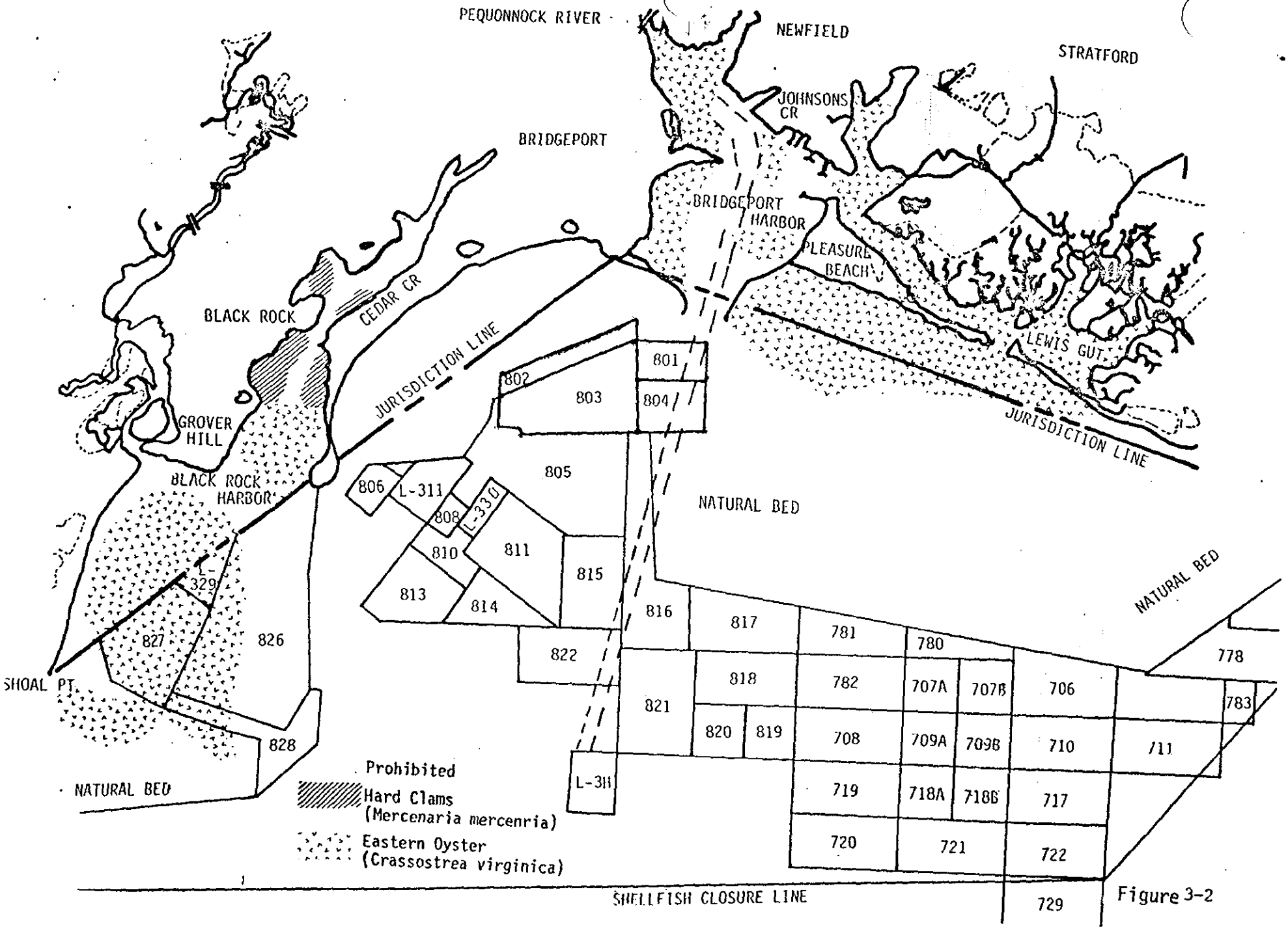

PEQUONNOCK RIVER
NEWFIELD
STRATFORD
JOHNSONS CR
BRIDGEPORT
BRIDGEPORT HARBOR
PLEASURE BEACH
LEWIS GUT
BLACK ROCK
CEDAR CR
JURISDICTION LINE
GROVER HILL
BLACK ROCK HARBOR
NATURAL BED
SHOAL PT
801
802
803
804
805
806
L-311
808
L-330
810
811
813
814
815
816
817
818
819
820
821
822
826
827
828
L-329
L-311
781
780
782
707A
707B
706
778
783
708
709A
709B
710
711
719
718A
718B
717
720
721
722
729
SHELLFISH CLOSURE LINE
Prohibited
Hard Clams
(Mercenaria mercenria)
Eastern Oyster
(Crassostrea virginica)

Figure 3-2

3.48 Limited phytoplankton sampling was conducted in Bridgeport Harbor as part of the Connecticut Biological Monitoring Program.[35] The species collected and their abundance are presented in Table 2-12. A total of 22 species were collected; Skeletonema costatum was the most abundant species, but coccoids as a group were more abundant.

3.49 Major blooms occur in Long Island Sound estuaries between January and March, smaller blooms occur during the spring and summer. Fall blooms occur in some estuaries that rival or exceed the winter diatom maximum.[34]

3.50 Finfish. Approximately 100 species of finfish have been found in Long Island Sound and its estuaries.[36] These species include wholly marine residents, regular seasonal visitors, occasional visitors, and estuarine forms. Estuarine areas such as Bridgeport and Black Rock Harbor experience seasonal influxes of juvenile marine species such as menhaden (Brevooria tyrannus) and bluefish (Pomatomus saltatrix) that utilize these waters as nursery areas. Menhaden appear in the estuaries during April while juvenile bluefish move inshore during late summer. Resident marine species that exhibit seasonal onshore-offshore movements may be found in the harbor areas. Scup (Stenotomns chrysops) move inshore during the early summer, Tautog (Tautogonitis) are seen inshore April to November, but move into deeper water during cold weather. Summer flounder (Paralichthys dentatus) and black seabass (Centropristes striatus) also move inshore during the summer. Regular seasonal visitors to the sound that may occur in the harbor areas include weakfish (Cynoscoin regalis), (late spring to fall), bluefish (May or June to the fall) and adult menhaden (April - November or December). Striped bass (Morone saxatilis) migrate north in the early spring and usually appear in the sound following the schools of menhaden. It is believed that a small population of striped bass overwinters in the sound.

3.51 Limited fisheries information for Bridgeport Harbor exists. As part of an ecological study of Bridgeport Harbor for United Illuminating Company (UI) a creel census and gill net and seine collections were made during July 1972.[18] Bluefish were reported to be very active in the UI unit #3 discharge. Successful fishermen had a catch per unit effort of 13.98 fish/hour. The most abundant species collected was the Atlantic silversides. This species was found in extremely high numbers in the UI unit #3 discharge. Striped bass were also collected in the UI unit #3 discharge.

TABLE 3-5
SPECIES LIST AND RELATIVE ABUNDANCE OF FISH COLLECTED DURING THE JULY 1972 BRIDGEPORT HARBOR FISHERY SURVEY[19]

SCIENTIFIC NAME	COMMON NAME	OCCURRENCE
Morone saxatilis	Striped bass	Infrequent
Pomatomus saltstrix	Bluefish	Common
Menidia menidia	Atlantic silversides	Abundant
Liopsetta putnami	Smooth flounder	Common
Brevoortia tyrannus	Menhaden	Infrequent
Cynoscion regalis	Weakfish	Infrequent
Stenotomus chrysops	Scup	Infrequent
Prionotus carolinus	Sea robin	Common
Fundulus majalis	Striped killifish	Abundant
Syngnathus fuscus	Atlantic pipefish	Common
Morone americanus	White perch	Common

3.52 The State of Connecticut conducted trawl collections in Bridgeport Harbor during 1974 and 1975 as part of a statewide monitoring program.[35] Three species were collected, alewife (Alosa pseudoharengus), bluefish and weakfish, all in extremely low numbers.

3.53 Although anadromous species such as alewife and American shad (Alosa sapidissimia) are not known to utilize the harbor areas for spawning or migration to spawning areas, these species have been observed in the area. American shad were observed stranded by the tide in a creek in Lordship Marsh.[37]

3.54 Benthic Invertebrates. The occurrence of benthic invertebrate populations in estuarine and coastal areas is generally related to bottom type, depth, and salinity. Populations can be defined in terms of the substrates they occupy. Mud-silt bottoms are predominantly inhabitated by organisms that burrow or habitat various kinds of tubes (infauna). On hard bottoms, coarse sand or rocky areas, organisms generally live on the exposed substrate, attached or under rocks and shells (epifauna). Another way of describing benthic fauna is in terms of communities. Certain groups of species occur together more or less consistently.

3.55 Water quality and sediment type appear to be the codeterminants of the occurrence, distribution and abundance of benthic invertebrates in Bridgeport Harbor.[18] The abundance of intertidal benthic invertebrates in general, principally polychaete worms and bivalve mollusks, is greatest on the tidal flats southwest of Tongue Point. The soft-shelled clam (Mya arenaria) is very abundant in this area (Table 2-6). Soft-shelled clams, Nemerteans (Proboscis worms) and polychaetes also occurred in the north and northeastern portions of the harbor, but in lesser abundance. The lowest abundance of intertidal benthos occurs in the eastern harbor areas near the eastern breakwater. This pattern of distribution and abundance appears related to substrate type which graded from medium grained sand in

the western harbor areas to predominantly coarse sand in the areas west of Pleasure Beach. There is also a greater abundance and diversity as one proceeds from high toward low intertidal zones.[18]

TABLE 3-6
TOTAL OBSERVED AND EXPECTED NUMBERS (IN PARENTHESES OF CLAMS (Mya)) ON FLATS AROUND BRIDGEPORT HARBOR[19]

SEASON	FLAT*	CLAMS OBSERVED 0-25 mm		CLAMS OBSERVED >25 mm	
WINTER	A	2	(20.88)	21	(2.12)
	B	205	(186.12)	0	(18.88)
SPRING	A	0	(26.62)	31	(4.38)
	B	486	(418.17)	1	(68.63)
	D	0	(41.22)	48	(6.78)
SUMMER	B	1197	(1101.10)	376	(471.90)
	C	0	(51.10)	73	(21.90)
	D	0	(44.80)	64	(19.20)

3.56 The snail Nassarius and polychaetes Spio setoss, Nereis succinea, Scolecolepides viridis and Ammotrypane aulogoster were generally present throughout the harbor.[18] Table 2-16 lists the seasonal occurrence of benthic invertebrate species found on intertidal flats.

3.57 The most abundant subtidal species are polychaete worms. Generally more species of benthic invertebrates are found at the lower harbor areas as opposed to the upper areas in the Pequonnock River. Table 2-17 and 2-18 lists species found in subtidal aress of Bridgeport Harbor during summer and fall sampling. Far fewer species were found during the fall.[18] Seasonally sparse benthic fauna were also noted in sampling conducted as part of the Connecticut Biological Monitoring Program.[35] The most abundant species were Nereis succinea, Ammotrypane aulngaster and Glycera americana.

3.58 The generally lower abundance and diversity in the upper harbor areas may be related to the pollution loads in the Pequonnock River and its sediments, but this view must be tempered with the fact that the outer harbor areas are inhabited by many marine species that do not occur upstream due to salinity preference. The invertebrate fauna of Black Rock Harbor should be similar to Bridgeport Harbor, especially near the harbor mouth. Difference in pollution loadings may cause some differences to occur in the upstream areas.

3.59 Benthic Surveys and Habitat Evaluation 1981

Biological sampling and analysis activities were conducted during April and August 1981 in Bridgeport Harbor, Black Rock Harbor and adjacent environments. Field sampling was divided into two periods - April and

August - to allow seasonal comprison of abundance and population structures of benthic communities as they relate to prevailing aerobic and anaerobic conditions. Fifty-nine individual stations were sampled in April, 45 of which were in Bridgeport Harbor and its asociated water bodies, Yellow Mill Channel and Johnsons Creek. The remaining 15 stations were located in Black Rock Harbor (Figure 4-3). The August sampling comprised of 54 samples at 41 stations with 25 stations located in the Bridgeport Harbor system and 16 stations in Black Rock Harbor.

3.60 A summary of the findings (CEM, 1981) are presented herein to facilitate the environmental assessment of potential impacts of the proposed dredging and breakwater construction.

3.61 Sediment Facies

The nature of benthic faunal communities in any area is determined by the integrated effects of both short- and long-term physical, chemical and biotic factors. Sediment type is one of the most important controlling factors for benthos distribution. Distribution of substratum type, in turn, is principally controlled by hydrodynamic conditions in the water overlying the bottom. Low energy areas with limited water movement allow finer silt-clay particles to settle out of the water column producing a mud sediment. Conversely, high energy environments keep these finer particles in suspension and resulting in a clean sand substratum. In typical harbors, the low energy situation is characteristic of inner harbor areas where wind-driven circulation is attenuated, and the high energy case is found in less protected outer harbor areas. This produces the observed pattern at both Black Rock and Bridgeport Harbors of mud sediment in the inner harbor giving way to sandy sediment in the outer harbor.

3.62 There is, however, nothing inherent in the nature of silt-clay facies which results in the severely impacted communities seen in these strata of both Black Rock and Bridgeport. In uncontaminated areas, notably in soft bottom areas of central Long Island Sound, these sediments support very diverse and productive communities. In a harbor situation, anthropogenic inputs of pollutants combined with the naturally elevated organic content of silt-clay sediments and the restricted circulation characteristics of dredged harbors produce conditions inimicable to the establishment of diverse stable communities. This situation is worsened in the summer by elevated temperatures which increase microbial decomposition processes while decreasing oxygen-carrying capacity of the water, leading to the bottom hypoxia (little oxygen) or anoxia (no oxygen) conditions which have been termed the "August Effect."

3.63 Chemical Parameters

3.64 The distribution of low pO_2 in bottom waters (hypoxic) and methanogenic sediments is shown in Figures 4-4 and 4-5. Most (62 percent) of the mid and inner Bridgeport Harbor stations in August fall within a

region of low bottom-water dissolved oxygen. The only apparent exception to this generalization is the narrow channel between the main harbor and the entrance to Johnsons Creek. Tidal flow-turbulence within this narrow channel apparently causes vertical water column mixing resulting in aerobic bottom water. The bottom sediments in this area consist of coarse shell deposits which are free of organic-rich muds, supporting the inference of high bottom-current velocities.

3.65 In April 1981, only 13 percent of the Bridgeport Harbor stations were designated as hypoxic. These four stations were limited to the Power House Channel and western end of Bridgeport Reach.

3.66 The extensive areal spreading of the hypoxic bottom water between April and August 1981 represents a pattern which has been observed in other Long Island Sound harbors. This is called the "August Effect" and it has been documented in New Haven Harbor since 1972. The "August Effect" describes hypoxic bottom water conditions which result from thermal stratification of the water column, limited surface mixing by wind-waves, and high bottom sediment BOD and COD. This phenomenon is not limited to August but is characteristic of late summer and early autumn.

3.67 In April, five stations were recognized as being methanogenic in Bridgeport Harbor; however, only one station was apparently methanogenic in August. The word "apparently" needs to be emphasized because the profile images only document methane gas pockets observed in the upper 20 cm of the bottom. Also, if an anoxic organic-rich mud is quasi-fluid, methane gas may escape soon after it is formed. In this case, gas pockets may not build up within the sediment. The appearance of large gas pockets at depth may result because the enclosing muds are of low permeability and, therefore, "capture" and store methane.

3.68 The harbor approach-channel stations (Figures 4-4 and 4-5) were all aerobic in both April and August. However, Station 4 was methanogenic in August while pore waters at all April stations were apparently free from methane.

3.69 All of the Black Rock Harbor stations were found to be anoxic or hypoxic in August except Stations 13 and 15, which are located in water 4 meters deep on a substratum which consist of clean aerobic sand. Station 25, located outside the mouth of the harbor, is also aerobic. The surfaces of stations in Burr Creek were found to be covered with an anaerobic microbial mat. In April, the seaward limit of low bottom water dissolved oxygen was located about 700 yards further inside of the harbor mouth than in August. Stations 6 and 16 were methanogenic in April but apparently were not storing methane in August. Station 1, sampled only in August, was the only station which showed evidence of methane in later summer.

3.70 <u>Habitat Indices</u>

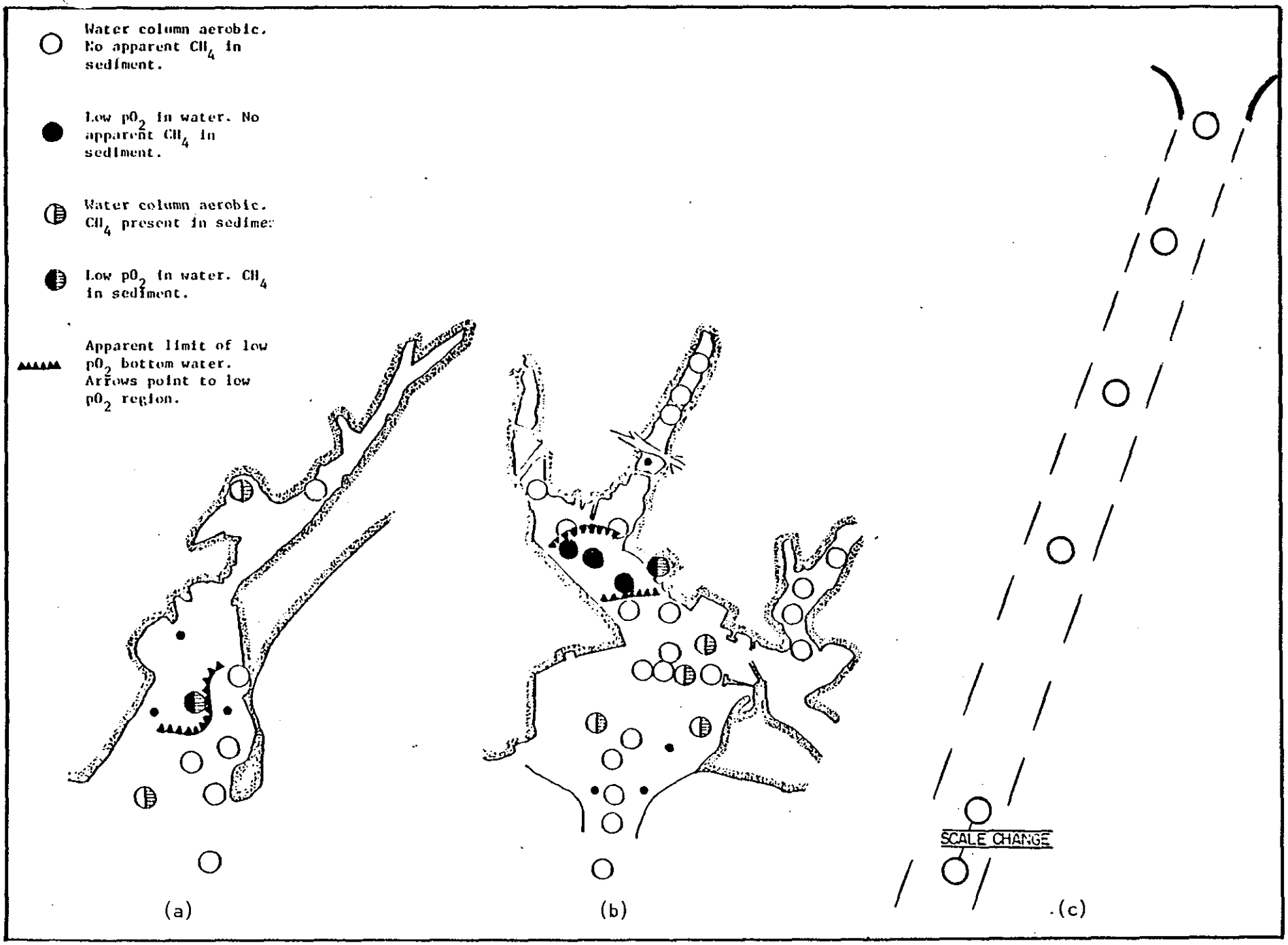


Figure 4-4 Chemical parameters, April 1981: (a) Black Rock Harbor; (b) Bridgeport Harbor; (c) approach channel.

3.71 An index of benthic habitat conditions (Figures 4-6 and 4-7) is developed based on data obtained from the sediment-interface photoimages and field notes. The index, which varies between +10 and -10, is arrived at by summing ranks or scores for value of redox potential discontinuity (RPD) depth or area, successional stage and presence or absence of CH_4 and O_1. The index is an estimation of the quality of the habitat--the ability of a benthic site to sustain a fauna over a long period of time (1 year). The habitat index is not intended to be an estimator of, nor a surrogate for, a faunal diversity index. Although the index is arrived at independently of detailed taxonomic analyses, it complements those data quite well.

3.72 Habitat indices show most August stations in the Bridgeport Inner Harbor to be ranked as -8 (anoxic and azoic). Many of these same stations, such as in Yellow Mill Channel, had positive indices in April 1981, but the August data more clearly reflect habitat conditions. In many of the -8 ranked August stations, one can observe worm tubes at the sediment surface. However, these appear to be relict, devoid of the polychaetes or oligochates which populated these stations in April.

3.73 The August habitat indices for the approach channel are comparable to those observed in April 1981. The onshore to offshore ranking increase in habitat indices is observed in both sampling periods. Habitat values between April and August in the approach channel are probably not significantly different.

3.74 For Black Rock Harbor, the habitat indices rank stations in the low oxygen areas as -8. Positive indices are limited to the shallow water sand bottoms (Stations 13 and 15) and Station 25 lying outside of the harbor mouth.

3.75 Species, Richness, Faunal Density and Species Diversity

3.76 In the soft bottom (inner harbor) areas at both Black Rock and Bridgeport, the synergistic effects of petrochemical contamination, chronic and acute hypoxia, and elevated turbidity preclude the estimate of a stable faunal community. The dynamic pattern of the benthos in these areas is characterized by periodic invasions of Stage 1 colonizing species (opportunists) who exploit unoccupied sediments during periods of decreased stress and develop dense monospecific populations only to suffer mass mortality when conditions deteriorate. Information generated is presented in graphical format for species richness (Figures 4-8 and 4-9), faunal density (Figures 4-10 and 4-11), and Shannon-Wiener diversity (Figures 4-12 and 4-13).

3.77 In Bridgeport Harbor, the approach channel area had near-normal faunal communities characteristic of oxygenated muds in many areas of Long Island Sound. Immediately inshore from the breakwaters, there was a heterogeneous area of mixed substrata supporting dense and diverse communities in some cases. Inshore of a line between Tongue Point and Pleasure

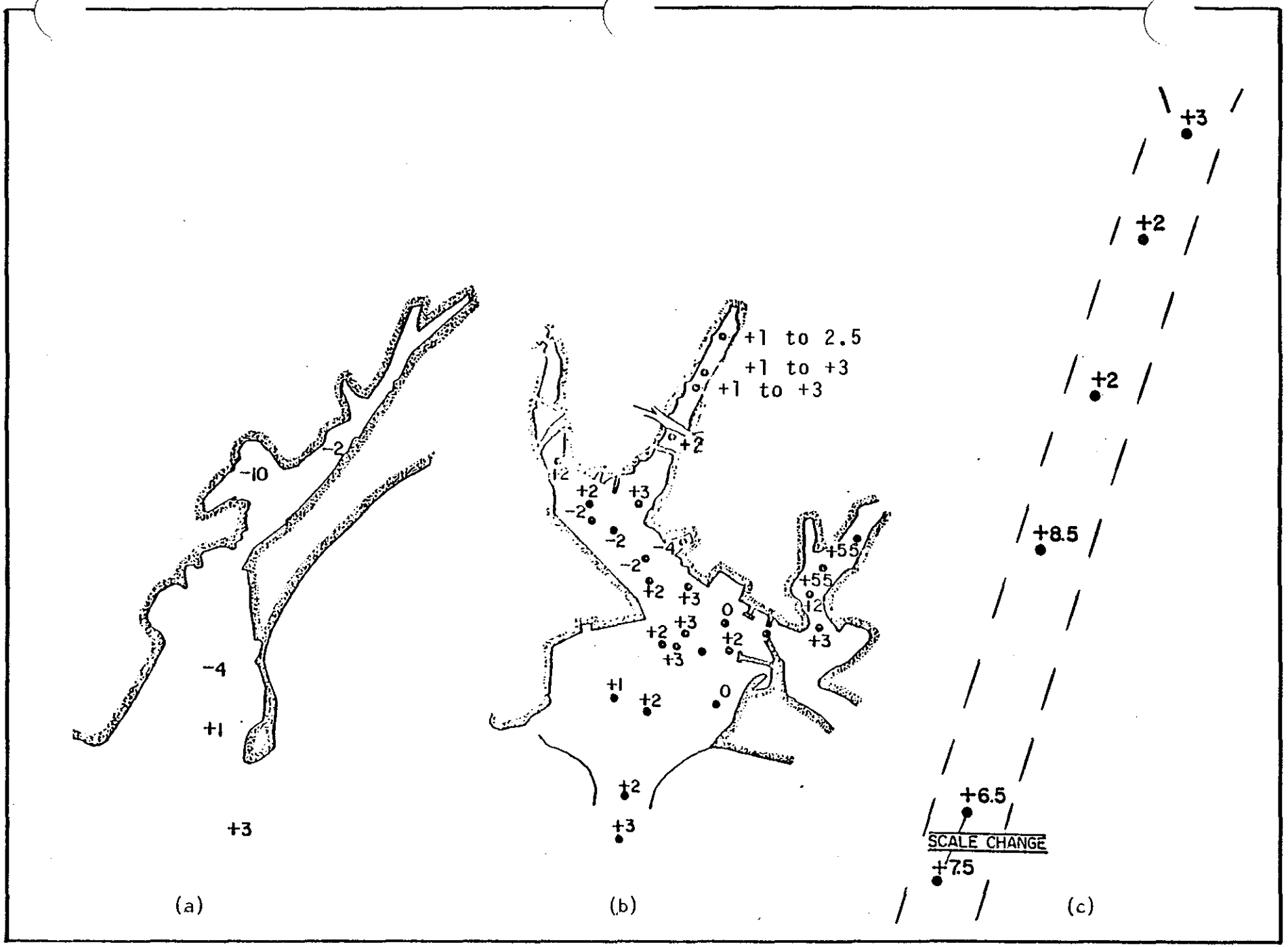


Figure 4-6 Habitat indices, April 1981: (a) Black Rock Harbor; (b) Bridgeport Harbor; (c) approach channel.

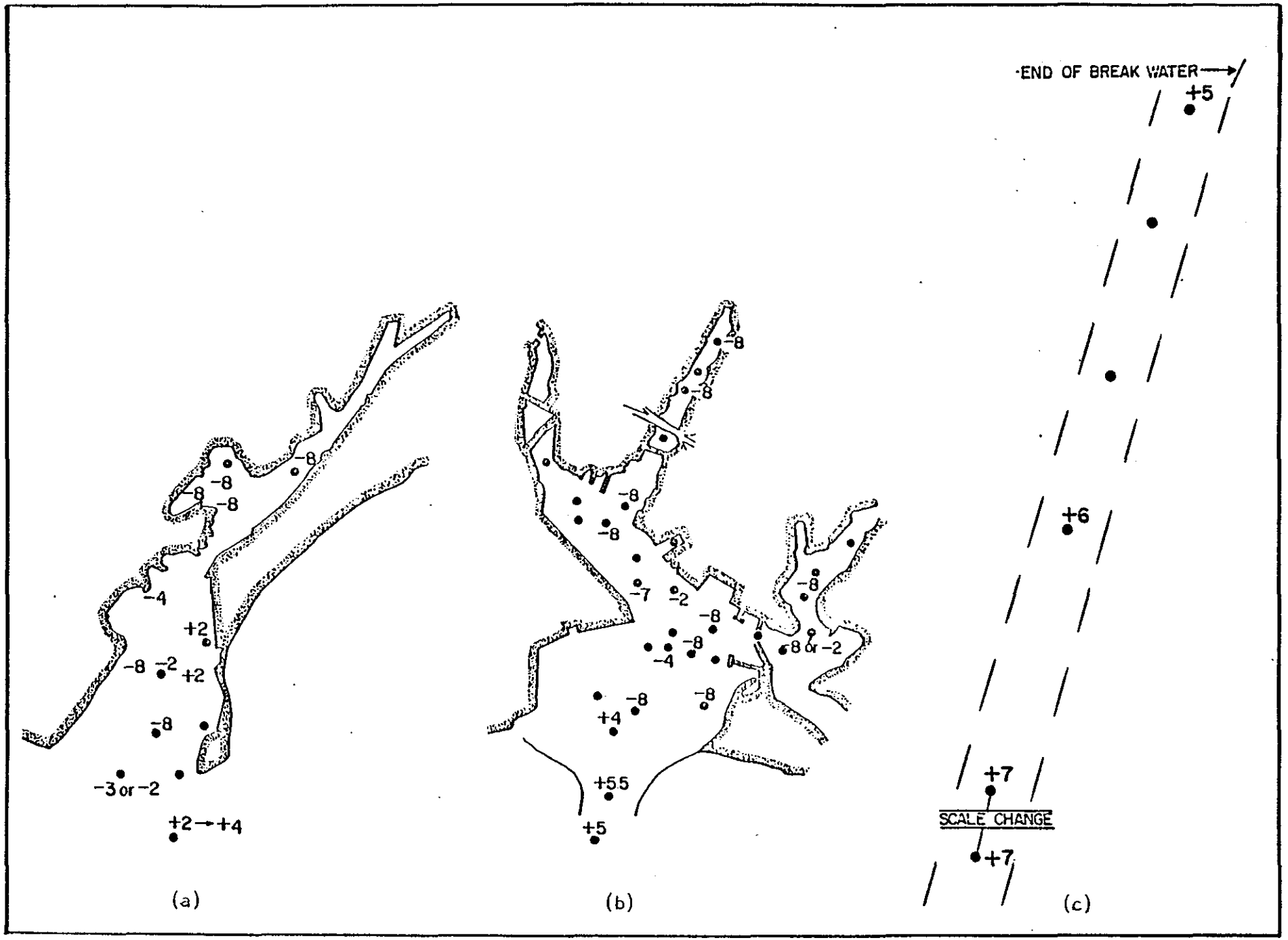


Figure 4-7 Habitat indices, August 1981: (a) Black Rock Harbor; (b) Bridgeport Harbor; (c) approach channel.

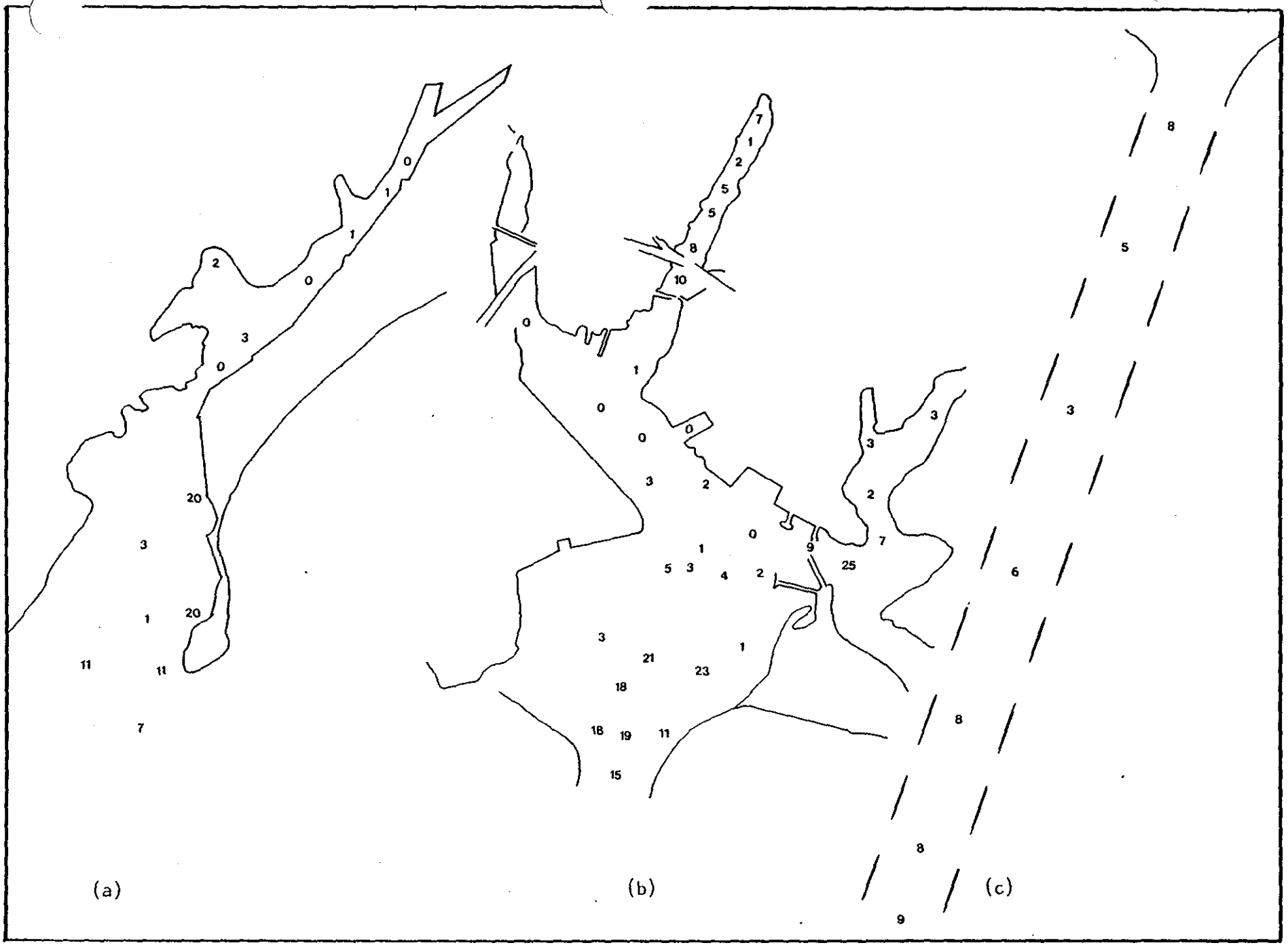


Figure 4-8 Species richness, April 1981: (a) Black Rock Harbor; (b) Bridgeport Harbor; (c) approach channel.

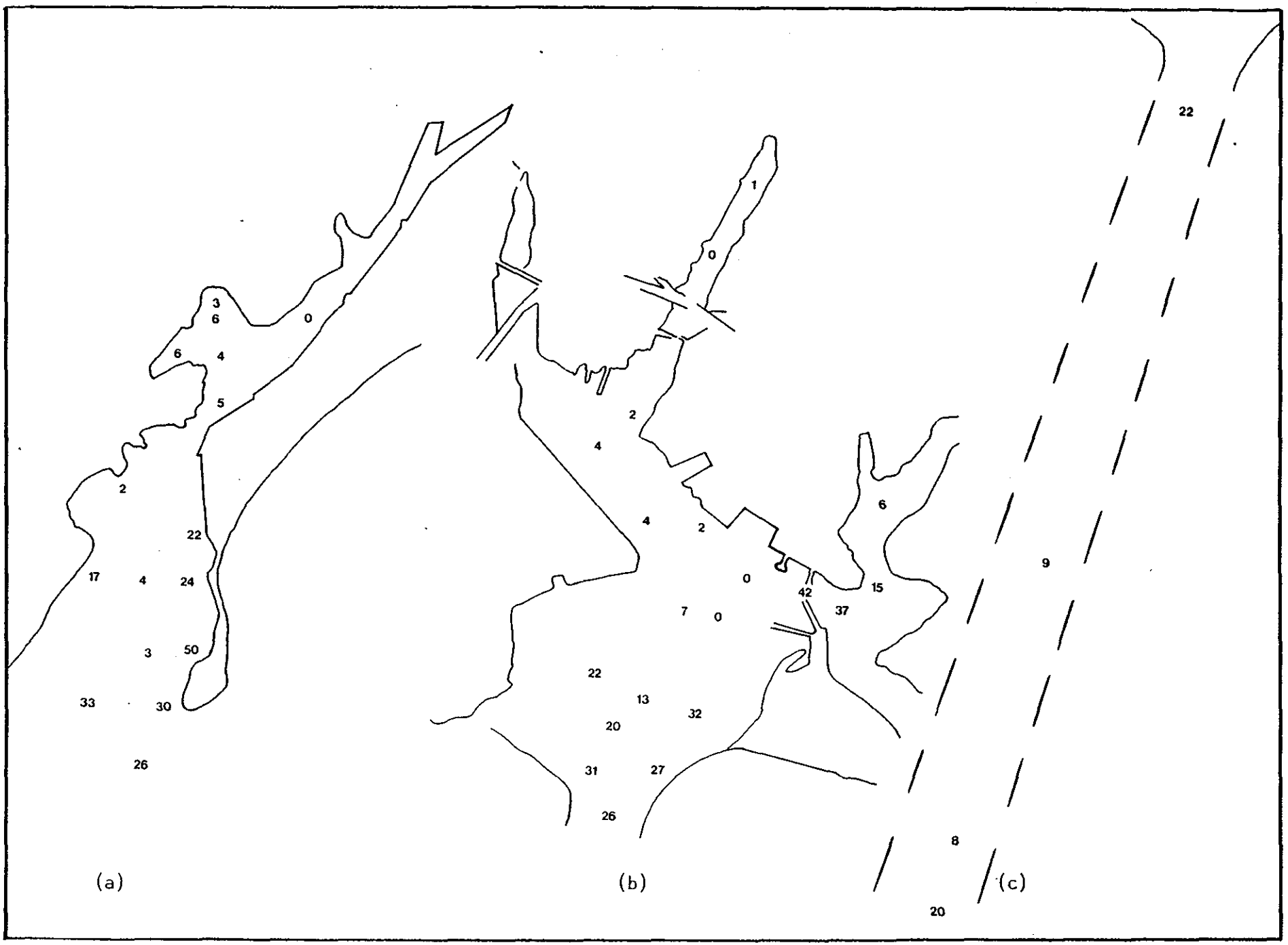


Figure 4-9 Species richness, August 1981: (a) Black Rock Harbor; (b) Bridgeport Harbor; (c) approach channel.

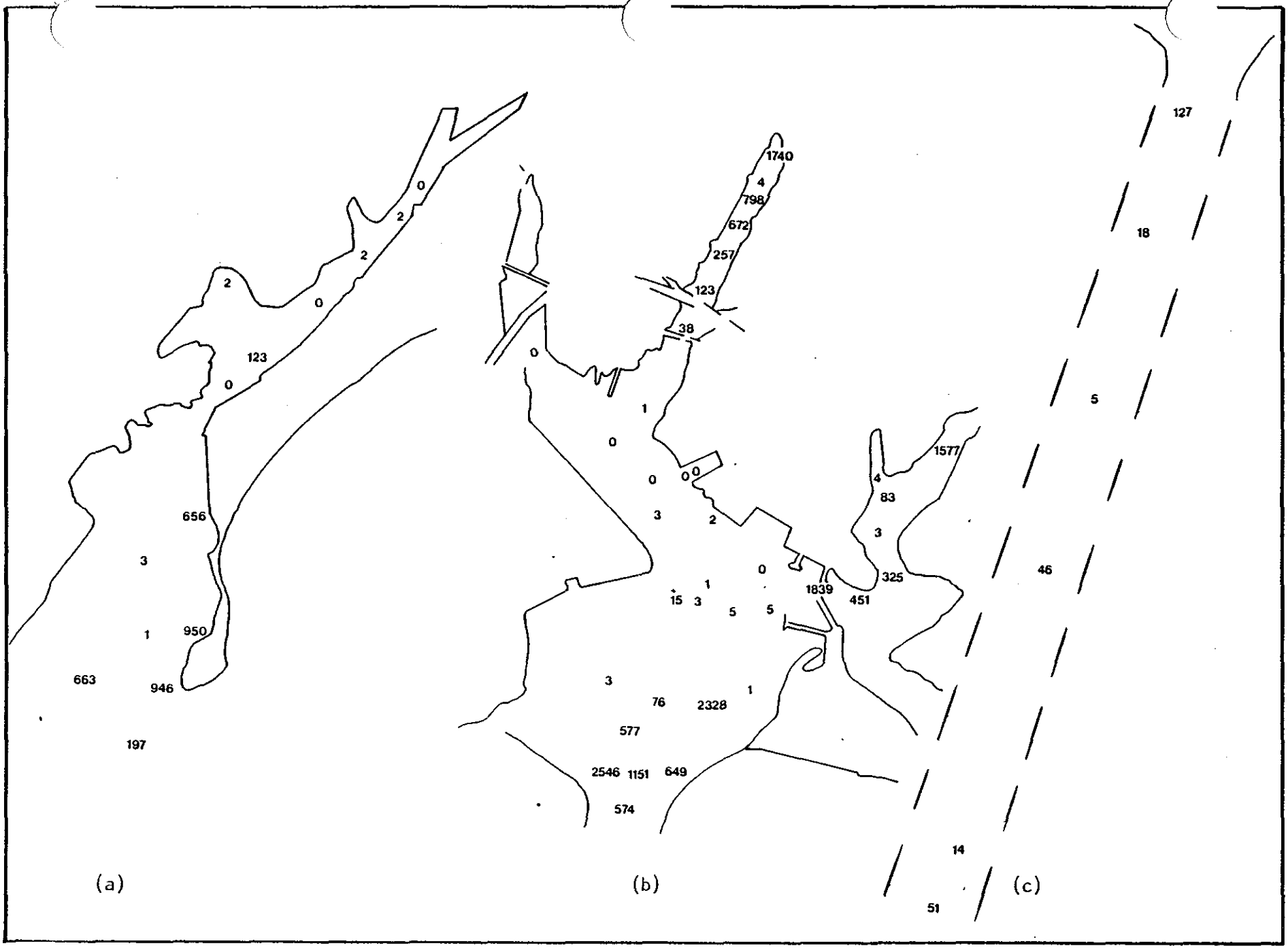


Figure 4-10 Faunal density (individuals/0.04m^2), April 1981: (a) Black Rock Harbor; (b) Bridgeport Harbor; (c) approach channel.

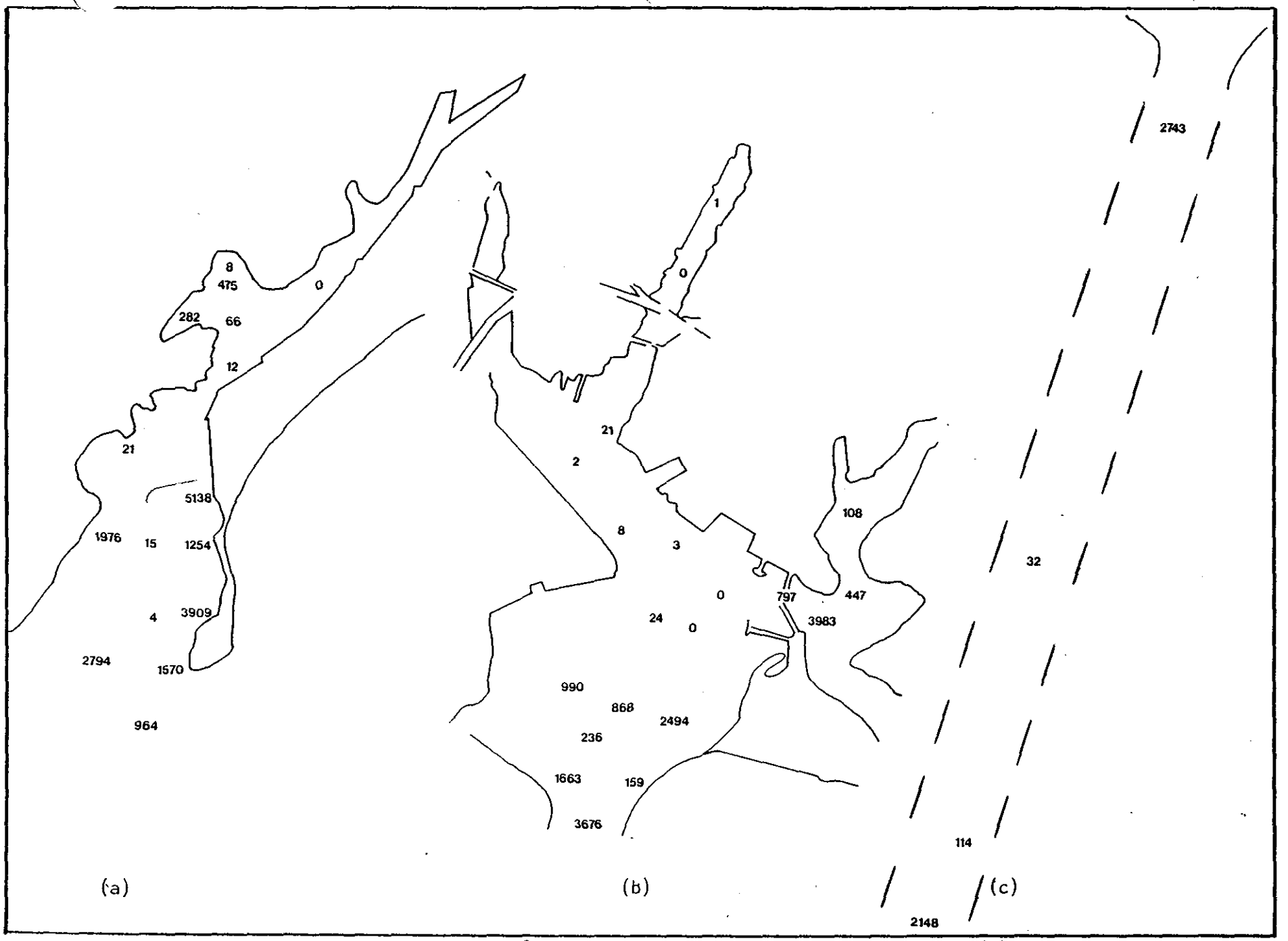


Figure 4-11 Faunal density (individuals/0.04m^2), August 1981: (a) Black Rock Harbor; (b) Bridgeport Harbor; (c) approach channel.

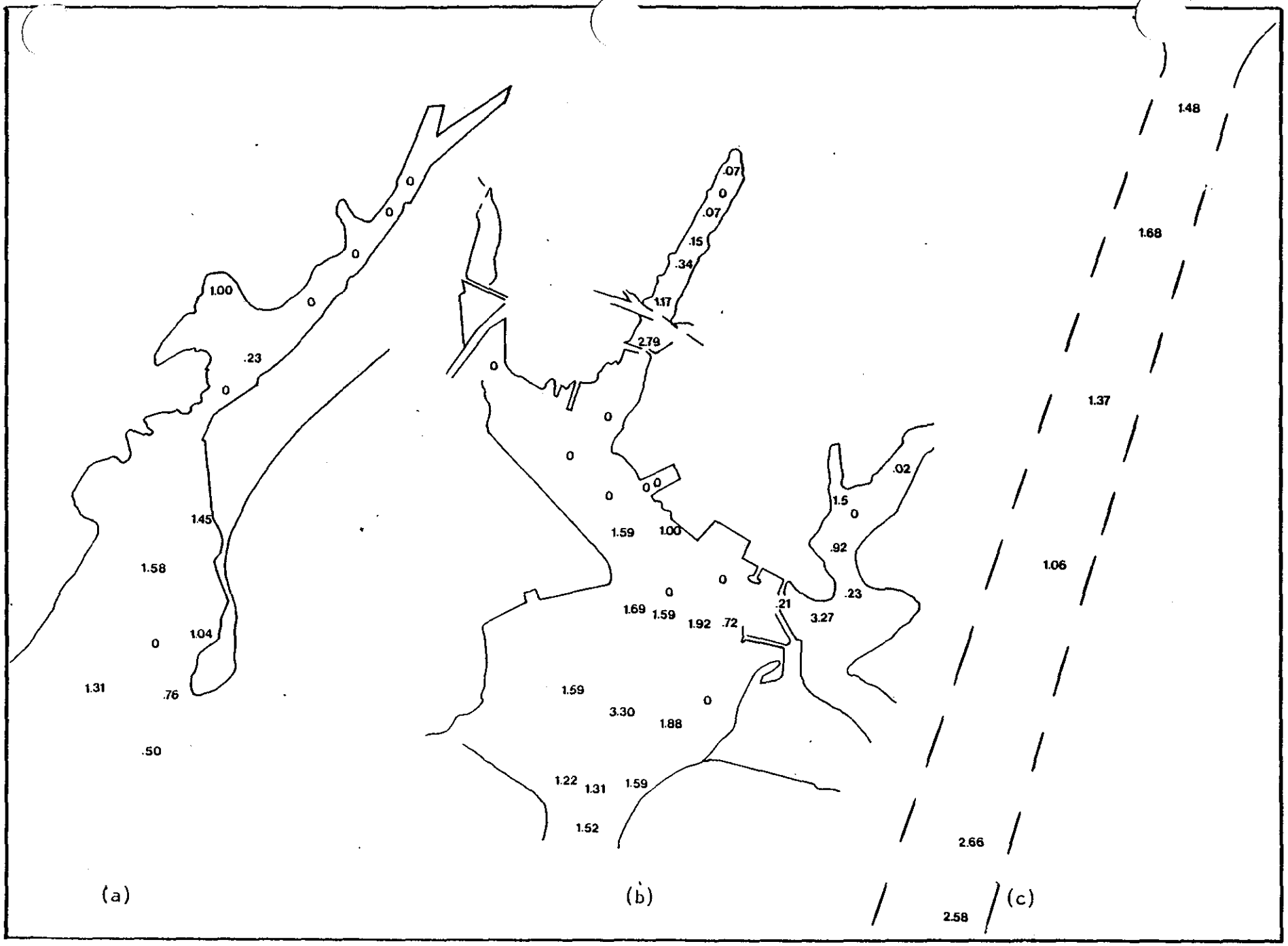


Figure 4-12 Shannon-Wiener diversity (H') values, April 1981: (a) Black Rock Harbor; (b) Bridgeport Harbor; (c) approach channel.

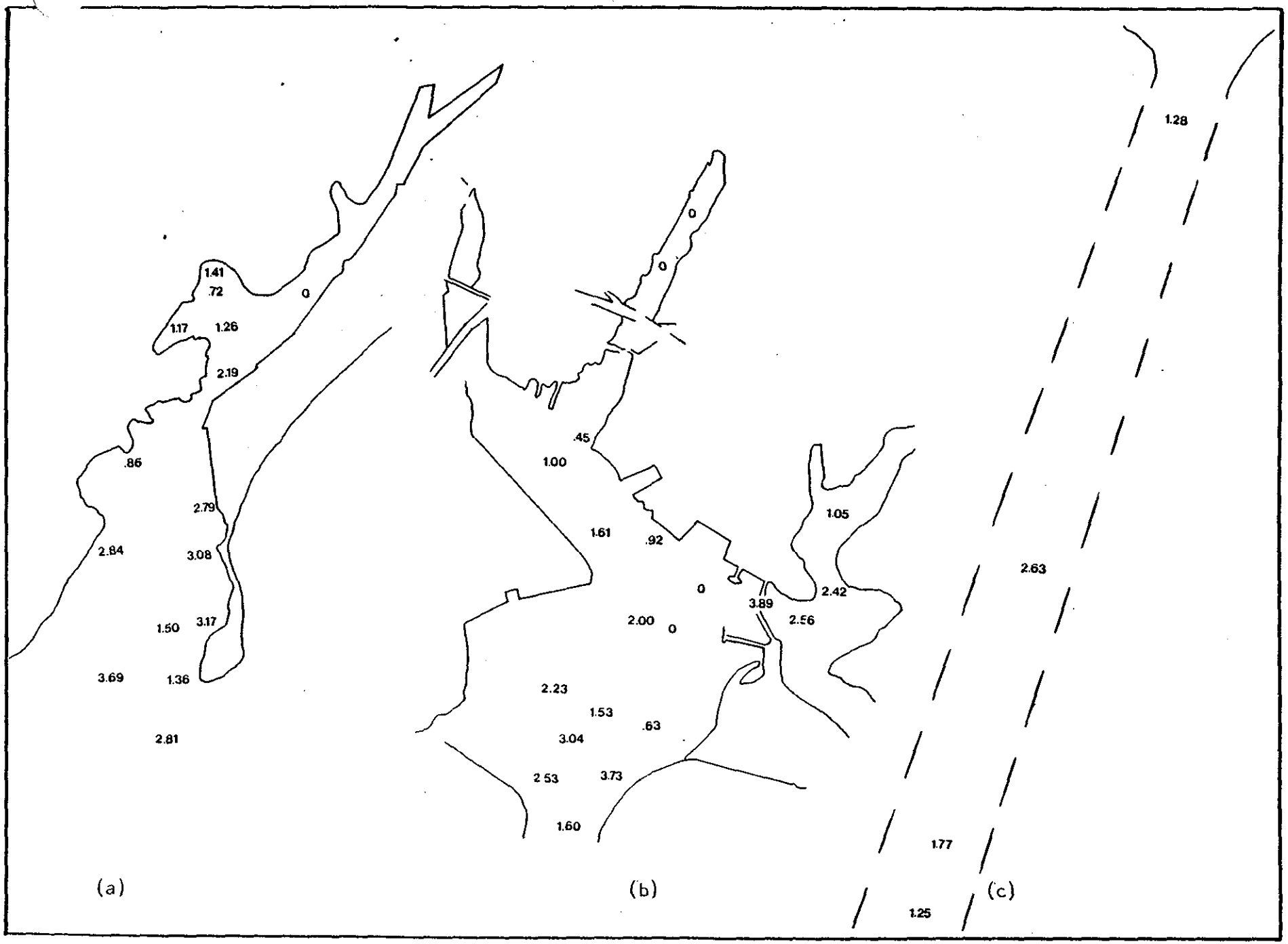


Figure 4-13 Shannon-Wiener diversity (H') values, August 1981: (a) Black Rock Harbor; (b) Bridgeport Harbor; (c) approach channel.

Beach, sediments were hypoxic muds with severely depauperate faunal communities. Much of this area, except for some stations near the mouth of Johnsons Creek where strong tidal currents prevent acute hypoxia from developing, was azoic and apparently heavily contaminated.

3.78 Yellow Mill Channel was the only area which appeared to change greatly between the two samplings. In April, a temporary unbalanced community dominated by Capitella had developed and gave the area the appearance of being less acutely stressed than the remainder of the inner harbor. In August, the entire channel was azoic, and it is believed August results more accurately portray the value of this area as a macrofaunal habitat.

3.79 The upper Black Rock Harbor area was devoid of macrofauna and appeared to be the most severely stressed area sampled in either harbor. Extreme petrochemical contamination here has resulted in a tar-like substratum. Between this area and the narrows at Black Rock, an area we have termed the "inner harbor," the substratum is silt-clay and the macrofaunal communities have depressed density and diversity. Many stations in the inner harbor were dominated by opportunistic species, particularly the polychaete Capitella capitata. Outer Black Rock Harbor contained faunal communities with near-normal density and diversity. Acute hypoxia appears to be prevented from developing in this area due to strong vertical mixing in the water column.

3.80 From the foregoing it is obvious that the Bridgeport and Black Rock Harbor environs are extremely stressed ecosystems. Evidence of environmental stress are manifested in the polluted sediments, low oxygen levels and low benthic species diversity and species number. The proposed dredging for Bridgeport Harbor and Burr and Cedar Creeks would result in the disruption of a total 245 acres of bottom habitat. The breakwater construction, although no longer proposed, would have eliminated or altered another 3 to 6 acres. With the exception of some shellfish resources, especially oysters, the impacts to resident biological population communities should be minimal.

3.81 The Connecticut Dept. of Commerce-Coastal Energy Impact Program is currently funding a quantitative natural resource inventory of the entire Long Island Sound Ecosystem (400 stations total) including benthos, and the information derived from this study will assist in future evaluations and dredging disposal activities.

3.82 Trends in the Utilization of Bridgeport Harbor and Black Rock Harbor. Bridgeport Harbor is one of the key oil handling ports within Long Island Sound. The amount of petroleum the port handles has averaged about 2.5 million tons since the project was completed in 1963. Dry cargo handling has also increased substantially with the expansion of the Cilco terminal. Since 1976, Cilco has been receiving container traffic from Seatrain. Activity at boatyards, marinas and yacht clubs has also shown sustained growth.

3.83 Recreational boating facilities in Black Rock Harbor and Johnsons Creek are quite crowded. There is definitely a need to permit expansion of such facilities or to establish local regulations that would restrict the size and number of boats permitted in a given area.

3.84 The shellfishing operations in the harbor area are improving. The area just outside the harbor near the channel is one of the main areas in Connecticut for oyster setting. Bloom Brothers set 30-40,000 bushels of oysters in 1976.[42]

3.85 Historical and Archaeological Features. Due to the fact that the dredging would only disturb water areas, no land-based historic sites should be affected. Should dredged material be disposed of onshore, the disposal sites should not adversely affect historic sites.

3.86 The East Bridgeport National Register District is located about 1 mile north of the main harbor.

In the Black Rock Harbor area:

- Marina Park National Register Historic District is located northeast of Seaside Park;

- Seaside Park appears to meet the eligibility criteria for the National Register of Historic Places;

- A submerged historic period pier footing exists inside the western entrance point of Black Rock Harbor opposite Grover Hill.

- A historic lighthouse exists at the southern end of Fayerweather Island, at the east side of the entrance to Black Rock Harbor.

3.87 The proposed navigation improvements would have no negative impacts on known historical or archaeological features.

IV. The Environmental Impact of the Proposed Action

4.01 Beneficial Impacts and Effects

4.02 Navigation improvements at Bridgeport Harbor would be an incentive for expansion of docking facilities in the Cilco Terminal area. Greater cargo would be handled and cargoes imported would be carried in larger vessels. Deepening of the main channel and turning basins and the anchorage area to 40 feet would result in a combined annualized substantial transportation savings for both oil-receiving and cargo terminals in the main harbor.

4.03 The Port of Bridgeport is one of the major job generators in the region. Not only do port activities directly use manpower, they attract water related industries to the harbor. Such activities in Bridgeport include marine repair, boatyards, shipyards, and pier construction firms. These related industries further stimulate the local economy. Should the channel be allowed to shoal further, these industries would be threatened.

4.04 Industrial firms are attracted to Bridgeport because of its excellent dry cargo handling facilities. Industrial firms utilize the port in shipping in raw materials and shipping out finished goods. Water transport of petroleum products and other types of materials and goods can significantly reduce transport costs. Such facilities depend on maintained channels, so that ship traffic can flow smoothly.

4.05 Bridgeport is one of Long Island Sound's major oil handling ports. The port serves as a distribution point for southwestern Connecticut and Long Island. Oil transport into the harbor has increased over the past decade. Oil handling facilities are presently limited by vessel draft, and must use small tankers. This size limit on tankers increases the unit cost of fuel. Oil tankers have experienced grounding in Bridgeport. Dredging would eliminate this problem and reduce the potential for oil spills.

4.06 The port especially the tributary waterways serves as an important recreational boating center. Marinas and yacht clubs offer outdoor recreational opportunities to the region's residents, and also generate wages, sales, and taxes for the city. Dredging would restore or improve boating activities in the area.

4.07 It should be noted that the central theme of Bridgeport redevelopment is greater utilization of the harbor, be it for industrial, commercial, residential, or recreational use. The city understands that improvement and maintainance of the channels will ensure the economic viability of renewal and redevelopment.

4.08 Environmental Effects and Potential Impacts. Dredging of Bridgeport Harbor may disrupt oil and dry cargo shipments. Oil tanker and

barge traffic increase in frequency during the winter months which is also the dredging season. Chevron Oil could experience serious problems if their channel is disrupted for any length of time during the winter, due to their limited storage facilities. United Illuminating's electric generating facilities must have uninterrupted supplies to meet residential as well as industrial/commercial demands.

4.09 There are major oyster beds in and adjacent to the Bridgeport channel. Dredging could damage these areas and inflict economic loss on the oyster franchise holders.

4.10 The dredging of 28 acres of anchorage space at Cedar and Burr Creeks would provide moorings for 203 additional vessels, reaching capacity within a 5-year period and leveling off thereafter. Net annual benefits derived from this expansion are calculated to be $296,000.

4.11 Dredging. Pending authorization and funding construction of the Bridgeport Harbor project element would take 8 months using two large 12-14 c.y. capacity dredges. Construction of the Burr and Cedar Creeks mooring basin, which would be dredged concurrently with the Bridgeport Harbor project element, would require approximately 8 months using a smaller 3-6 c.y. capacity third dredge. Work would be carried out only from October through May to minimize adverse impacts to oyster beds in Black Rock Harbor and immediately outside Bridgeport Outer Harbor.

Construction of the project elements would be accomplished by clamshell type dredge. An additional 2 feet of overdepth dredging would be allowed at Bridgeport Harbor (1 foot at Burr and Cedar Creeks) to account for dredging inaccuracies. Strict dredging controls would be needed along the main ship channel immediately seaward of the two existing breakwaters to assure that excessive overdredging of the 400-foot channel width did not occur, as productive top-of slope oyster harvesting grounds exist along both sides of the entrance channel. Dredged material would be transported in bottom-dumping scows and point-dumped at the Central Long Island Sound Disposal Area. The site has ample capacity to receive the proposed dredged material volume of nearly 2.9 million cubic yards.

The selected plan calls for materials from future maintenance dredging to also be placed at the Central Long Island Sound Disposal Area. It is estimated that additional maintenance dredging required would be about every 10 years (at an estimated annual shoaling rate of 24,000 cubic yards), as the two principal harbors in Bridgeport have experienced slightly less than half of the two percent shoaling rate typically experienced along the western Connecticut coast. The U.S. Coast Guard would maintain all navigation aids annually and relocate or replace buoys as needed.

4.12 Potential impacts of dredging operations on the water quality of Bridgeport Harbor are viewed as short term only causing increased turbidity, temporary dissolved oxygen reduction, temporary disturbance and

release to the water column of nutrients, heavy metals, oil, grease, and other potentially polluting materials in the sediment, and the release of hydrogen sulfide odors. The bottom topography would undergo a permanent change with deepening. The channel and anchorage area would serve as a permanent sink for fine sediment and organics.

4.13 The increased turbidity would be temporary and local to the dredging operation. The density of suspended solids would depend on the type of dredge employed. A study was performed by Yale University in New Haven Harbor[47] as part of the 1973 monitoring programs to measure the deposition of the dredge spoils lost during dredging operations. The sediment types of Bridgeport Harbor closely resemble those of New Haven, and the results of this report can be qualitatively apply to Bridgeport. A significant result of the study was that only 2.5 percent of the silt lifted by a clamshell bucket dredge was lost to the surrounding water column. At a lifting rate of 14 cubic yards per 1.5 minutes, the turbid plume left deposits of silt only 0.5 mm/day directly downstream of the dredge. At 800 yards downstream there was no trace of silt deposition. It was also observed that the deposition of silt within the harbor, after 100,000 cubic yards of material was dredged, was equivalent to that deposited by four winter storms.

4.14 Temporary dissolved oxygen reduction may occur in the surrounding waters during dredging due to the suspension of organic detritus, fecal pellets, and other natural organic compounds which are found in high concentrations in the Bridgeport Harbor sediments and are responsible for the elevated levels of COD and total carbon. The dissolved oxygen reduction would be short term and local to the dredging operation. The effects of reduced oxygen levels can be compounded, however, during periods of high water temperature and subsequent stratification of the water column.

4.15 As the sediment to be dredged is "potentially degrading" with moderately high to high levels of nutrients, heavy metals, oil and grease, and other potentially polluting materials such as PCB, these materials would be introduced into the water column during dredging. Such a release would add to the seasonal nutrient concentrations already in the water column. But along with the release of heavy metals, oil, grease, and other potentially polluting materials, this effect should be short term and persist only as long as the dredging operation. The release of hydrogen sulfide odors would be confined to the dredging and disposal operational areas.

4.16 The dredging operation could have both direct and indirect impacts on the biota. Dredging would remove and/or destroy sessile and some motile benthic invertebrates. Some of the more mobile and larger species may be able to leave the dredge site. A change in species composition of benthic communities previously inhabiting dredged areas can occur if the substrate type is altered. Resettling of suspended sediments can also cause substrate changes in areas adjacent to the dredged areas. The

area affected and extent of substrate change would depend on many factors such as the size of the sediment plume, nature of the suspended materials, currents, tides, and winds.

4.17 Sediment Analysis.

4.18 The sediments in project areas are derived from several sources. The coarser material has been generally deposited as glacial till during the recession of the last glacier. The fine sediments which overlie much of the glacial deposits are derived from the deposition of suspended fines from Long Island Sound, suspended solids from the sewage treatment plant and industrial effluents and suspended loads from the Pequonnock River (in the case of Bridgeport Harbor). Results of sediment sampling and testing in each harbor are described in detail below.

4.19 Bridgeport Harbor

4.20 During 1980, 11 vibracore sediment samples were obtained from the main navigation channel and anchorage basin at Bridgeport Harbor. The results of the bulk chemical sediment analysis of these cores are given in Table 3-1. An additional 12 short cores were obtained from Black Rock, Cedar Creek, Burr Creek Cove, Johnsons River, Yellow Mill Channel, and Power House Channel. The sample station locations are depicted in Figure 4-1. Results of bulk chemical testing from these areas are presented in Table 4-2. This sampling was performed specifically to evaluate the proposed navigation improvements.

4.21 Stations A and C in the upper reaches of the harbor (off Steel Point and Yellow Mill Channel) are characterized by organic silts with a high percentage of total carbon. The heavy metals, chromium, copper, nickel, zinc and lead at these two stations are present in concentrations whic place them in the Class III category. Cadmium concentrations for stations C, F and H are also at Class III level while stations A, E, I, L and M fall into Class II materials. Mercury concentrations for all 11 samples tested were at class I levels.

4.22 Parameter levels of sediments sampled from the 25-foot anchorage basin, with the exception of mercury, are also classified as Class III material. Oil and grease concentrations are also characteristically high for those stations within the inner harbor, and sediment samples were observed to passes a petroleum sheer and odor. Oil and grease levels, however, exhibit a rapid deline seaward of the breakwater.

4.23 Station I, just south of the entrance jetties is, characterized by black organic silt with associated high carbon and COD concentrations. Heavy metal levels for the most part are of Class I category but cadium values of 3 ppm (Class II) are shown to occur to a core depth of 3.5 meters. Cadmium levels of 5 ppm are also found at stations L and M associated with pockets of fine sediments.

TABLE 4-1

BRIDGEPORT HARBOR NAVIGATION IMPROVEMENT

BULK SEDIMENT ANALYSIS
OF SEDIMENT VIBRACORES
COLLECTED 1980

Station	% Solids	COD	Oil & Grease	Percent Total Carbon	Hg	Pb	Zn	As	Cd	Cr	Cu	Ni	S	V
A Off Steel Point	37.1	136,000	2,201	4.85	0.28	218	533	22	7	468	980	133	13	30
C Mouth YM Channel	30.4 (77.2)	107,000	2,547	4.18	0.11 (<0.1)	243 (<40)	443 (68)	13 (4.3)	14 (2)	408 (34)	540 (24)	156 (100)	<10 (11)	100 (<30)
E Off Cilco Terminal	71.1 (79.4)	11,700	937	0.44	<0.1	65 (42)	140 (95)	4.4 (2.5)	2 (3)	75 (17)	76 18	105 <40	<10 <10	50 <30
F 25-Foot Anchorage	30.6 (38.1) (73.7)	95,000	3,221	3.68	0.10 <.10	132 (115) (<40)	340 (408) (176)	19 (21) (6.5)	14 (11) (7)	278 (500) (83)	330 (620) (110)	82 (109) (68)	<10	30 (80) (50)
G Between Breakwater	Grey Med-Fine Sand to Organic Fine Sandy Silt to Med-Fine Sand with Hydrogen Sulfide Odors													
H	48	46,100	2,017	2.23	0.10	<40	213	6.8	8	213	210	90	<10	36
I	34.7 (58.9)	72,300	1,862	3.05	<0.1	59 (<40)	278 (104)	20 (9.3)	3 (3)	214 (54)	220 (31)	60 (<40)	<10	40 (<30)
J	78.2	7,290	270	0.26	<0.1	<40	121	4.3	<2	39	38	<40	<10	<30
K Seaward End Channel	51.4 (86.3) (78.6)	46,500	726	2.11	<0.1	57 (<40) (<40)	179 (78) (76)	11 (2.4) (3.1)	<2 2 6	120 <5 12	110 <10	<40 <40	<10 <10	60 <30
L	49.9 (66.0)	41,200	455	1.63	0.10 <0.1	<40 (<40)	198 (99)	11 (6.3)	5 4	69 (32)	62 <10	<40 <40	<10 <10	<30 <30
M	49.2	42,100	112	1.48	<0.1	<40	159	9.2	5	65	43	<40	<10	<30

NOTE: Concentration levels for all parameters are given in ppm unless otherwise noted. The first value shown is for surficial sediments to 2 feet in depth while additional values in parenthesis represent sediment core depths of 5-8 feet and 8-12 feet, respectively.

TABLE 4-2

BRIDGEPORT HARBOR
IMPROVEMENT NAVIGATION STUDY

BULK CHEMCIAL SEDIMENT ANALYSIS - 1980

Station Location	% Solids	Percent Total Carbon	COD	Oil & Grease	Hg	Pb	Zn	As	Cd	Cr	Cu	Ni	S	V
PE-1 Cedar Creek Channel Opp. Burr Creek	93 MF Sand	<0.10	1,472	967	7.2 (7.2)	<1.0 (17)	210 (8.5)	6.1 (<0.1)	0.4 (<0.1)	18 (11)	450 (6.7)	11 (11)	12.75 (2.65)	(<1.0) (<1.0)
PE-2 Burr Creek Anchorage	28/37 Org. Silt	2.54	169,680	14,840	5.3 (2.7) (1.9)	384 (412) (424)	196.7 (160) (120)	17.6 (16.8) (13.4)	11.2 (8.6) (4.0)	1,433 (789) (103)	283.3 (231) (174)	204 (120) (52)	29.6 (20.6) (15.2)	(<1.0) (<1.0) (<1.0)
PE-3 Burr Creek Cove	38/55 Org. Silt	2.54	10,500	5,140	4.6 (7.8)	144 (26)	67.9 (10.8)	3.8 (27.5)	59 (<0.1)	378 (25)	80.5 (2.9)	76 (5)	20.5 (65.6)	<1 <1
PE-4 Black Rock Harbor	64/55 Org. F-Sandy Silt	1.93	47,170	7,169	6.2 (9.3)	33 (11)	893.3 (18.3)	7.9 (9.3)	0.4 (<0.1)	56 (22)	483.3 (5.1)	23 (6)	2.7 (5.3)	<1 <1
PE-5 Off Black	44/59 Org. F-Sandy	3.44	98,700	6,111	7 (4.6)	299 (39)	2,111 (210)	13.5 (1.6)	9.2 (0.4)	867 (28)	249.6 (72)	84 (11)	21.1 (5.3)	<1 (<1)
GE-6 Black Rock Hbr. Anchorage	M-F Sand 79	-	21,420	<10	5.2	8.1	30.3	5.0	4.9	50	(53)	<1	-	<1
PE-7 Black Rock Anchorage	70/62 Silty M-F Sand	0.58	-	947	3.7 (2.0)	26 (9)	17.6 (8.9)	5.5 (10)	0.2 (<0.1)	56 (24)	12.1 (3.2)	<1 (<1)	30.4 (15.2)	<1 (<1)
PE-8 Johnson River	60/61 Org. F-Sandy	2.29	-	1,444	6.2 (2.8)	661 (483)	256.7 (296.7)	7.4 (6.9)	10.7 (20.3)	108 (1,267)	326.7 (296.6)	20 (208)	21 (51)	<1 (<1)
PE-9 Johnson River	61/53 Org. Silt	2.06	-	6.260	7.3 (2.6)	477 (503)	1,000 (172)	16.1 (9.1)	30 (40.9)	167 (481)	906.7 (141)	86 (73)	11.9 (4.6)	<1 (<1)
PE-10 Johnson River	43,43 Org. F-Sandy Silt	6.47	-	7,738	2.6 (2.0) (1.4)	33 (178) (296)	14 (60.3) (1045)	6.5 10.5) (14.6)	1.9 (1.9) (1.8)	46 (50.5) (72)	8.7 (36.9) (67.1)	<1 (<1) (<1)	178 (11.8) (46)	<1 <1 <1
PE-11 Yellow Mill Channel	31/51 Org. Silt	11.09	-	14,655	11.6 (4.9)	1,046 (78)	10,999 (48)	28.1 (14.8)	20.9 (3.4)	567 (81)	423.3 (63)	114 10	20.4 (30.4)	<1 (<1)
PE-12 Power House Channel	37.40 Org. Silt	7.43	-	21,500	10.2 (6.3)	1,237 (330)	396 (210)	9.4 (7.3)	1.99 (21.0)	1,920 (967)	186 (270)	359 (160)	47.5 (9.3)	<1 (<1)

NOTE: Values are expressed in ppm unless otherwise noted. The first value shown is for suficial sediments 0-0.25 feet, while those values in parenthesis represent core depths to 2 feet and 4-5 feet, respectively.

TABLE 4-3

COMPARISON OF ORGANIC AND TRACE METAL LEVELS WITH SEDIMENT TYPE DEPTH

BRIDGEPORT HARBOR

1973 & 1975

PARAMETERS TESTED	SUMMARY	MedGrainSize <0.06 Silt-Clays	MedGrainSize > 0.06 Sands-gravel	Sample Depth Less Than 1 FT	Sample Depth 1FT. or greater
% Vol Solids-EPA	1.66-22.18 9.24	6.92-22.18 10.67	1.66-8.15 3.71	1.66-22.18 9.38	6.92-9.79 8.19
-NED	1.11-15 7.84	5.6-15 9.12	1.11-7.33 3.15	1.11-15 7.84	
% Tot. Vol. Sol-EPA	1.56-37.60 14.97	11.10-37.60 17.25	1.56-13.60 6.60	15.6-37.60 14.97	
COD	14,600-370,000 140,639,28	100,000-370,000 162,636,36	14,600-125,000 59,983,33	14,600-370,000 140,639,28	
TKN	630-9,200 4,607.50	2,890-9,200 5,466.81	630-2,550 1,456,66	630-9,200 4,607,50	
Oil & Grease	810-43,300 9,353,92	3,030-43,300 10,284.09	810-24,100 5,943,33	810-43,300 9,353,92	
Mercury	0.007-11 1.41	0.32-11 1.62	0.007-0.59 0.27	0.007-5.4 1.20	0.26-11 1.85
Lead	14-1,636 320.69	23-1,636 354.81	14-470 133	40-1,636 338.11	14-1,013 284.82
Zinc	116-2,986 694.05	219-2,986 777.40	116-611 235.62	116-2,118 639.25	117-2,986 806.88
Arsenic	1.1-51 12.51	1.1-51 13.90	1.7-8.8 4.86	1.7-32 11.16	1.10-51 15.30
Cadmium	1.8-141 15.6	2.3-141 17.86	1.8-5.9 3.22	1.8-61 12.31	2.3-141 22.41
Chromium	31-3,525 687,24	51-3,528 773,11	31-756 236.37	31-3,528 637.66	51-3,162 783.47
Copper	82-9,300 1,008.55	82-9,300 1,101.81	134-1,544 495.62	134-9,300 990.28	82-2,287 1,046.17
Nickle	35-415 121.47	47-415 134.48	35-81 51.50	35-292 123.28	41-415 117.50
Vanadmium	21-335 109.80	35-335 122.52	21-65 39.87	21-335 110.08	35-249 109.23
% Total Carbon	1.17—6.26 3.51	3.42-6.26 4.40	1.17-1.43 1.30	1.17-6.26 3.34	4.54
% Hydrogen	0.25-1.24 0.73	0.72-1.24 0.91	0.25-0.29 0.27	0.25-1.24 0.69	0.93
% Nitrogen	0.0-0.6 0.29	0.25-0.60 0.40	0.0-0.05 0.025	0.00-0.60 0.29	0.33
PPM DDT	40-1,160 355	40-1,160 355		40-1,160 355	
PPb PCB's	80-2,010 1,200	80-2,010 1,200		80-2,010 1,200	

STATE INTERIM CLASSIFICATION OF MATERIALS TO BE DREDGED

BRIDGEPORT HARBOR		CLASS I	CLASS II	CLASS III
1.66-22.18 9.24		5	5-10	>10
1.11-15 7.84				
1.56-37.60 14.97				
14,600-370,000 140,639.28				
630-9,200 4,607.50				
810-43,300 9,353.92		< 5000	5000-10,000	> 10,000
0.007-11 1.41		< 0.5	0.5-1.5	> 1.5
14-1,636 320.69		< 100	100-200	> 200
116-2,986 694.05		< 200	200-400	> 400
1.1-51 12.51		< 10	10-20	> 20
1.8-141 15.61		< 5	5-10	> 10
31-3,528 687.24		< 100	100-300	> 300
82-9300 1,008.55		< 200	200-400	> 400
35-415 121.47		< 50	50-100	> 100
21-335 109.80		< 75	75-125	> 125
1.17-6.26 3.51				
0.25-1.24 0.73				
0.0-0.6 0.29				
40-1,160 355				
80-2,010 1,200				

4.24 Table 4-2 summarizes the test data for Black Rock, Burr Creek, and Cedar Creek. Channel and anchorage areas along with bulk values for Yellow Mill channel, and other tributaries within Bridgeport Harbor. The test results for these areas are representative of some of the highest recorded heavy metal levels especially zinc, lead, chromium, copper and nickel in the New England region and Northeast. These extremely high levels of heavy material may be attributed to the historical smelting and speciality metal manufacturing processes which abound in the harbor areas. Virtually all of the nine metals tested, with the exception of vanadium, are Class III materials. Mercury and cadmium values are also consistently high in the surficial sediments characteriing these particular environs.

4.25 Black Rock Harbor. Recent benthic surveys of Black Rock Harbor conducted under contract by the Corps of Engineers, New England Division indicate that Black Rock Harbor is primarily organic mud with coarser material (sand and silty sand) in the eastern portion of the outer harbor just upstream of Fayerweather Island and downstream of Buoy N "8". (CEM, 1982).

4.26 Sediment analyses of the harbor channel were accomplished in the years 1973, 1975, and 1979 by the Corps of Engineers, New England Division indicate the sample locations. Data for the sediment samples are tabulated in Tables 3, 4, and 5 for three sections of the Federal channel. The channel surface sediments are primarily composed of organic or sandy silt with a petroleum odor in the upper reaches of Cedar Creek and a typical salty marine odor in the lower reaches. In general, volatile solids, oil and grease, and metal levels are considered "high" at almost every sample site from the upper reaches of Cedar Creek and halfway downstream (just upstream of Buoy N "8"). The sediments seaward this area extending seaward to the channel entrance are significantly "cleaner" with only a few metals in the high category.

4.27 Bridgeport Harbor. Benthic studies conducted in Bridgeport Harbor have indicated that harbor sediments are primarily fine grained in the inner harbor and coarser grained in the outer harbor (CEM, 1982).

4.28 Analyses of the anchorage area sediments were done by the Corps of Engineers NED in 1973 (Site KE-15-73, Table 7). Sediments are primarily organic silt with some sand in the area. Chemical analyses of that site indicate that all metal levels are considered high when compared with Interim Plan Criteria (Table 3-3). Inasmuch as analyses of one sediment sample should not be considered as representative of the area to be dredged, thus analyses of two adjacent locations, PE-6-75 and PE-4-79, were included as supplemental data. Both sites were less contaminated than KE-15-73.

4.29 Evaluation of the Bioaccumulation Data:

4.30 The bioaccumulation tests for Black Rock Harbor data indicated that *Nereis* exhibited significant accumulation of PHC's, PCB's and DDT,

whereas Mercenaria accumulated PCB's and DDT. Both species are available as prey to predator marine organisms whereas only Mercenaria is directly consumed by man.

4.31 The accumulation of petroleum hydrocarbons by a deposit-feeder such as Nereis may be of little consequence to the ecosystem and to man. This accumulation would only be significant if PHC's are magnified to higher trophic levels within aquatic ecosystems. Such magnification has not been observed to occur in marine communities (Conner et al., 1979). Burns and Teal (1973) indicated the fish, a major predator of polychaetes, accumulate available PHC's primarily from the water column via their gills rather than from food sources. The observed accumulation, therefore, may be of minor consequence to the community near the discharge area. No release of oil and grease substances were detected in the elutriate tests (Table 10). These substances have a strong affinity for the sediments and probably would not cause any long-term effect at the disposal site.

4.32 Nereis also exhibited significant accumulation of PCB's and DDT. This occurred only in sample A from Black Rock Harbor. The observed accumulation of PCB's may be of little consequence to the disposal site community. Chytalo (1979) compared PCB concentrations in the tissues of the two polychaete species, Nepthys incisa and Pectinaria gouldii, with those of the inhabited sediments at three dredged material disposal sites in Long Island Sound. This may indicate long-term accumulation potential from disposal site sediments. The tissue levels (<1 part per billion (ppb)) were well below sediment concentrations (0.17 -0.48 ppm) although only a small number of worms were available for testing. Comparison of these values with tissue levels in predator fish led Chytalo to conclude that the polychaetes probably were not a significant "route" for the transfer of PCB's in the sediments to the estuarine food web. The values exhibited by Nereis in the bioaccumulation test are probably more related to accumulation from the water column. Accumulation of contaminants by the genus Nereis has been shown to be significantly higher (up to 1000x) from the water column than from the sediments (Ueda et al., 1976, 1977; and Beasley and Fowler, 1976). Disposal activities do cause temporary increases in PCB levels (Arimoto and Feng, 1980; Pavlou et al., 1978) These studies indicated levels do return to background levels after disposal activities cease. This temporary release into the water column may be responsible for the accumulation levels exhibited by Nereis. Thus, that level of accumulation would not be expected to occur over the long term and probably would be of little consequence to organisms near the discharge area.

4.33 The level of DDT accumulated by Nereis was 2 ppb. Because the concentrations are considered extremely low and occurred only at Site A, its impact on the disposal site is considered minor.

4.34 Mercenaria is a filter feeding organism that is directly consumed by man. Significant accumulation of PCB's were observed in test animals exposed to sediments from Site B at Black Rock Harbor. PCB's are

toxic to humans. Based on this fact, the Food and Drug Administration imposes action levels on consumable food such as shellfish. The action levels for PCB's are 5 ppm. This is almost 40 times the mean test values exhibited by Mercenaria; therefore, the clams are considered safe for human consumption. Thus, while the uptake is statistically significant, it may be quantitatively insignificant. Similarly, Mercenaria accumulated DDT from exposure to sediments from Site A in the harbor. The FDA action levels for shellfish are also 5 ppm. This is 700 times the mean test value observed in the clam tissues. It is also safe to consume and may be quantitatively insignificant.

4.35 The results of these bioaccumulation tests is based on two samples and includes sediments from both Black Rock Harbor and the anchorage off the Cilco Terminal in Bridgeport Harbor. This material has already been dredged and deposited at the Central LIS disposal site as part of the field verification study. Based on the above discussion, there is the potential for the disposal of sediments, if undertaken in waters of Long Island Sound, to cause some temporary accumulation in organisms in the vicinity of the disposal site. However, this accumulation is generally related to contaminants released or made available to the aquatic environment by disposal activities; therefore, it should only occur during the disposal period. Conversely, if the material is contained within a diked disposal facility such as was originally proposed for Yellow Mill Channel, then there would be no release or subsequent accumulation.

4.36 Elutriate Test Results

4.37 Elutriate tests were done on Black Rock Harbor, Burr Creek and Johnsons River sediments to determine potential release of contaminants substances showing potential release into the water column are ammonia nitrogen, phosphorous, cadmium, and PCB's. This test involves mixing the sediment samples with four parts seawater to simulate the discharge of hydraulic dredging. The mixture is shaken for 30 minutes and is allowed to settle for 1 hour. The filtered elutriate is then analyzed for sediment contaminants and compared with the water sample taken from the dredge site.

4.38 Elutriate tests were performed on sediments for three sample sites in Section "2" of Black Rock Harbor, PE-1-79, PE-2-79, and PE-5-79. These are included in the Environmental Assessment for Black Rock - Cedar Creek Federal Navigation Channel issued July 1982. The results at each of these stations indicate potential but small releases of sulfates, mercury and zinc. PCB analyses were not done on this section of the harbor channel. Elutriate testing of a downstream site, PE-3-79, indicates this substance would also be released into the water above the settled sediments. Releases of effluents from Burr Creek cove into the harbor would temporarily increase the concentration of PCB's contaminants in the harbor waters. Chemical analyses of the harbor waters EW-1-79, EW-2-75, EW-3-79, indicate that background and test mercury concentrations

slightly exceeded the instantaneous water quality standards, established by EPA (a1980), 0.037 ppm. Zinc concentrations were within the water quality standards of .058 ppm. No instantaneous standards have been established for PCB's. Levels should not exceed an average of 0.03 ppb over a 24-hour period. Acute toxicity occurs at 10 ppb. The background PCB concentration in the harbor water was 14 ppb. Tidal flushing of the harbor would dilute these released contaminants down to existing water quality conditions.

4.39 Adverse Impacts to Shellfish Resources

4.40 There are 2,576.4 acres of active commercial oyster grounds off Bridgeport and another 35.3 acres off Fairfield[70].

4.41 Bloom Bros.-Talmadge Bros. is one of three major commercial oyster companies operating in Long Island Sound. This company currently leases approximately 6,200 acres or 28% of the total oyster grounds in the State of Connecticut. The oyster beds at Bridgeport (and New Haven) are all "seed beds" and the oysters from this area, therefore, are not marketable or for direct consumption. A "seed oyster" is any oyster regardless of size that is found outside a certified groud. Certified grounds meet the Food and Drug Administration's water quality criteria of less than 70 MPN coliform bacteria per 100 ml. The seed oysters cultivated at Bridgeport are transplanted to Norwalk where they undergo depuration. This process consists of holding the oysters in certified waters for a minimum of 14 days at water temperatures of 50F. This temperature ensures that the animal will actively pump, thereby flushing any contaminants out of its system. Following this the oysters can be harvested for market.

4.42 The location of the commercial oyster beds at Bridgeport are shown in Figure 3-1. In addition, there are public shellfish grounds located inside the harbor and natural beds located west and east of the channel. Within the last year or two 10 boats have been working these coastal waters during October and November. It is reported that the harvest from those natural beds range from 900-1000 bushels per week or 40-45 bushel/day operation total for all 10 boats. Bloom & Talmadge Bros. are working some 849 acres at Bridgeport or about 33% of the total grounds. The entrance channel transects approximately 1/2 mile of these grounds and an area of specific concern are beds 801, 802, and 803 which have just been purchased from Radel and historically are highly productive.

4.43 Assuming a "worst case" situation whereby the dredging contractor performs excessive overdredging resulting in a widening of the channel from 400' to 420' (10' of overdredging on each side of the channel) estimates indicate a loss of approximately 4.6 acres of top-of-slope oyster harvesting grounds. This is thought to be a conservative estimate and probably does not depict the actual amount of excessive overdredging that would occur. The total of 4.6 acres represents that portion of the channel extending about 3 nautical miles seaward from the

flashing buoy off Tongue Point. An acre of oyster ground bottom is reported to produce an average of 2,000 bushels of seed oysters per acre (per comm. Jan. 1982, John Baker and Hillard Bloom). At $6.00/bushel for seed oysters this would amount to (4.6 x 2,000 - 9,200 bushells) $55,200. Since the beds are generally capable of catching more than one set in a given year, this dollar value may double or triple. A market bushel consists of roughly 240 oyster, 3-4 years of age. At the present market value of $42/bushel, the resource value would represent $386,400.

4.44 The considered breakwater construction and dredging of the 24-acre anchorage on the east side (Fayerweather Island) of Black Rock Harbor would have resulted in the following impacts:

- The potential oyster habitat loss for the 6 and 8-foot depth easterly anchorage to be 2.0 and 12.0 acres, respectively. No oyster habitat loss will occur in the westerly 28-acre anchorage or in the 20-acre anchorage in Cedar and Burr Creek although the dredging would disturb this benthic habitat and associated biota.

- Decrease circulation and flushing with a resulting increase in sedimentation which could effect the distribution and settlement of oyster larvae.

- Increased moorings and number of vessels which would render the area impossible to work (i.e., dredge the oysters).

4.45 The rejection of the plan to build the breakwaters and protected anchorages due to lack of economic, justification, eliminated the need for consideration of possible alternatives and/or mitigation measures, such as:

- Dredge and expand the anchorage on only the west side of the harbor so that all moorings would be located on one side.

- Build only the breakwater on the west side and realign for maximum protection.

- Relocate east breakwater seaward to tip of Fayerweather Island and align both structures in a more SW-NE direction.

- Have State and/or city purchase oyster grounds and write off area to navigation usage only.

4.46 As seen in the attached map, the entrance channel to Bridgeport Harbor transects at least six lease beds and the dredging could create turbid conditions that would inhibit spat settlement as well as reduce available bottom habitat. Slopes of the channel could provide suitble substrates for seed oysters, it would take several months or even years to stabilize. However, past maintenance dredging operations have resulted in a channel width in excess of 400 feet, and the proposed channel deepening work would only have minimal effects on the existing 35-feet deep channel.

4.47 The Connecticut Division of Aquaculture and commercial oyster representative (meeting with NED staff Jan 1982) has requested that the following alternatives and mitigation measures be considered:

- Dredge only on the east side of channel. This would reduce amount of alteration to Beds 801 and 804 and siltation to 802 and 803. This constraint can be included in the channel deepening specifications.

- Use of a hydraulic dredge plant (hopper dredge) would cause less turbidity and spillage then the conventional bucket dredged and scour. Use of a hopper dredge would also eliminate damage to the shellfish beds caused by the dredge barge and anchors. However, capping of the materials from the inner harbors and Black Rock Harbor will necessitate the use of a bucket dredge to maintain the cohesiveness of the sediment.

- Prohibit dredging or construction during the period 1 June through 31 September, to allow spawning and set of oysters. This constraint will be included in the dredging contract specifications.

- Pursue the alternative of creating an offshore mooring/discharge system. The fuel transport pipeline could be run to Fayerweather Island and along the beach in shallow water away from the commercial oyster beds. This option has been determined to be excessively expensive and not supported by local terminal owners.

4.48 Spawning activity of oysters is a critical condition for the industry and pertinent in the scheduling of the dredging operation. Setting of seed oysters during the spawning season occurs from June/July to late September. It is important that the oyster resources meet with a minimum of disturbance during this period, and use of oyster areas is prohibited during this time. It maybe concluded that dredging of Bridgeport Harbor channel and anchorage with its accompanying bottom disturbances would be least damaging if the operation were scheduled to commence in the fall.

4.49 It may be possible to remove some of the oysters to offshore water or other beds prior to any dredging. However, attempts to remove the oyster before the bottom becomes soft (following winter freeze) would result in severe damages. The companies maintaining oyster stocks in the project area do not utilize the entire acreage because they maintain a rotation system for seed oyster culture. The practice of mooring scows on the oyster beds will result in damages to some of the shellfish. Overflow of the scows could silt the immediate area very heavily which is also detrimental to the beds, particularly during the spawing season. Siltation of the beds before the oyster resources are removed could result in their destruction. Inadvertent short dumps or offsite dumping of dredging material by scows may have severe adverse effects on shellfish due to burial and siltation of the resources.

4.50 Oysters have been found to be remarkedly silt tolerant.[49], [50],[51] Dunnington (1968)[50] buried oysters under 3 inches of a sand/mud mixture at five temperatures. Those buried in summer temperatures survived for one week but all died within two weeks. Under winter temperature conditions (around 5°C) oysters lived for over five weeks with total mortality occurring after 10 weeks. Observations have shown that oysters survived 4-5 days when completely covered with sand, silt, or mud.[51] Hardshell and softshell clams are active burrowers and are relatively unaffected by temporarily increased turbidity and burial.[52],[53] Pumping activity usually ceases when suspended sediment levels are high but resumes when levels decline and they move up into the new layer. The eggs and larvae of oysters, clams, and finfish tend to be the most sensitive life stages. Loosanoff (1961)[54] found that 39 percent of oyster larvae completed development in a suspension of 2 gr of dry silt. Oyster sets exposed to silty runoff from onshore spoil disposal for a period of 16 to 48 hours sustained no mortality.[49] Dredge induced turbidity has only a marginal affect on spat settings.[50] Oyster sets within the channel limits would be destroyed but the survival of those nearby the dredge site would not likely be seriously impaired.

4.51 Finfish and the larger macro-invertebrates such as crabs can avoid unfavorable turbidity. But, larvae and juveniles may be less able to avoid the area and be more susceptible to turbidity effects and smothering.

4.52 Species composition of benthic communities may be altered due to decreased dissolved oxygen (DO) that can affect respiration. The decrease in DO is generally proportional to the BOD of the sediments and the length of time materials are suspended. The decrease in DO may span a period of 2 to 4 months if dredging is conducted during the summer months. However, since the dredging will be restricted to the period of Oct-May effects on the dissolved oxygen levels will be negligable.

4.53 Dredging may also release nutrients from the sediments to the water column. These nutrients could result in a phytoplankton bloom, but decreased light transmittance due to turbidity and the smothering of benthic algae would act to decrease photosynthesis. The effects of nutrients and turbidity on phytoplankton are usually temporary and entirely local. The areas affected by dredging and disposal are a small part of widely distributed populations.

4.54 It is possible that heavy metals in sediments could be released to the water column during dredging. But, the physical, chemical and biological processes involved are complex and poorly understood. Some evidence has been presented that heavy metals will not be released when anaerobic sediments are suspended but, rather, metals in the water column are stripped by adsorption to sediment particles.[55] Many marine organisms have been shown to concentrate heavy metals, especially filter feeders and organisms near the top of food chains. Oysters, hardshell clams, and softshell clams can accumulate heavy metals against a

concentration gradient.[56] Studies have shown a correlation between cadmium concentrations in tissues of fish species and the proportions of crustaceans in their diet.[56] Heavy metals are generally more toxic and damaging to the early life stages of aquatic organisms. Oyster larvae are known to be killed at low concentrations of mercury, copper, and zinc. Arsenic and chromium were found to be considerably less toxic.[57]

4.55 Effects on Hydraulics Circulation. The removal of sediment from Bridgeport Harbor would have no impact on tidal levels and little impact on tidal currents in the harbor.

4.56 Removal of sediments from the channels leading to and in Bridgeport Harbor might allow for better flushing of the upper reaches of the harbor. Increased flushing should improve water quality in these areas due to an increased exchange of water between Bridgeport Harbor and Long Island Sound. The removal of mud shoals and subsequent creation of a larger turning basin in the eastern portion of the harbor and associated channel deepening will provide an added degree of navigational safety and is not expected to cause any adverse effects to prevailing circulation patterns.

4.57 Disposal. As described in the Interim Plan for the Disposal of Dredged Materials in Long Island Sound[25] it is believed that "potentially degrading" Class II material or Class III material might result in harm to the aquatic system and in particular the marine bottom fauna, unless such sediment is properly capped by suitable Class I or Class II material after disposal. The New England Division, Corps of Engineers, has neither accepted nor rejected the New York/Connecticut plan and the discussion herein is merely to allow the reviewer to make a comparison of the sediment test results with the State standards. Short-term increases in turbidity, nutrient levels, heavy metals, and other potentially polluting materials and reductions in dissolved oxygen in the water column in the disposal area would occur during and shortly after the dumping operation, but these short-term changes are not necessarily considered significant. Potential long-term impacts at the Central Long Island Sound Regional Dredged Material Disposal Area include the minor erosion of the dredged material pile and the subsequent release of spoil material. Long-term disposal at a given area would result in a localized accumulation of heavy metal and oil and grease in sediments at the point source disposal site. However, subsequent capping with cleaner and coarser Class I or Class II sediments would tend to isolate this material from the water column.

4.58 The short-term turbid effects of dumping dredged material can be limited if the sediment is allowed to fall as a consolidated mass. Studies[58],[59],[60] have shown that when spoil with the consistency of cohesive particles of silt and clay like those in Bridgeport Harbor is released from a barge as a consolidated mass it will behave as a falling density current. Only 10% of the spoil is lost to a turbidity plume which is formed on the seabed after the impact of the mass on the seabed. The

turbidity cloud then laterally spreads and quickly (within a matter of hours) becomes diluted to ambient levels. The short-term impact of dredged material disposal is similar to the short-term impact of dredging in that there is a temporary localized increase in turbidity in the operational area. The effect is not considered significant.

4.59 Short-term increases in nutrient levels, heavy metals, and other potentially polluting materials introduced to the water column in the disposal area would be local to the disposal operation and these changes would be reduced by dilution. The effect is not considered significant. The same is true for dissolved oxygen reductions in the water column during off-loading of the barges.

4.60 Long-term potential impacts of disposal at the Central Long Island Sound Regional Dredged Material Disposal Area result from the potential erosion of the dump pile. Bathymetric surveys have been performed on previously dumped dredged materials in the dump site, which is contained within the Central Long Island Sound Disposal Area.[61] Data from this and continued monitoring under NED's Disposal Area Monitoring System (DAMOS) program have shown that the configuration of the dump pile has changed little over time. Initially, it appears that the water content of the pile decreases thus uniformly decreasing the size of the pile. Subsequently, the piles suffer from slight erosion and a small percentage of sediments appears to be redistributed to the surrounding seabed. In addition, as erosion occurs new portions of the pile are exposed to the water column with the potential for release of spoil pollutants to the water column. Not enough data has been collected for a long enough period to state conclusively how much erosion occurs but this does point to the potential for a long term (10-20 years) resuspension impact at the disposal site.

4.61 The effects on the biota of open water disposal are very similar to those of the dredging operation but burial may have a greater impact. The heavy metals in the disposal materials which enter the gut of benthic animals (excluding mollusks) are not highly concentrated over ambient levels and should not enter food chains.[57] Dumping grounds often attract mobile predators such as finfish and crustaceans. Lobsters and cancer crabs are attracted to spoil mounds for burrowing and feeding.

4.62 A definite, site specific evaluation of the suitability of these dredged materials for ocean dumping (including Long Island Sound) would have to be performed. This evaluation would have to include chemical and bioassay tests as described in the Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters, July, 1977. That document issued jointly by EPA/COE and an Amendment legislated in 1981 by Sen. Ambro, NY represents the current and comprehensive guidelines designed to fulfill requirements of Section 103 of P.L. 92-532, the Marine Protection, Research and Sanctuaries Act of 1972. However, these guidelines do have shortcomings in that they address only the acute lethal effects, namely the mortality of the chosen indicator species. In actual

disposal conditions, chronic effects on behavior, feeding and reproduction may be more significant to long-term species survival. The current EPA and Army Corps of Engineers "Field Verification Program" at Black Rock Harbor (Cedar Creek) is directed to the study of these long-term effects.

4.63 Consideration of the impacts on the local water quality created by dredging and local upland disposal are also required pursuant to the guidelines set forth in Sec. 101 and 404 of the FWPCA (P.L. 92-500). Runoff from the spoil if disposed on land near the river could cause a substantial increase in nutrients and heavy metals in waters of Bridgeport Harbor.

4.64 Consideration of any Long Island Sound disposal option would also have to address State requirements contained in the interim Dredged Material Disposal Management Plan and CAM Plan which is now finalized.

4.64 Mitigation Considerations.

4.65 The Army Corps would meet with area oil terminal operators to set up a dredging schedule which would cause the least disruption of supplies into the port during the winter months. Particular concern should be given to the potential disruption of oil barge traffic to the Chevron terminal.

4.66 The adverse effects on the shellfish, crustaceans and finfish residing in the Bridgeport and Black Rock Harbor areas could also be minimized or avoided by the timing of dredging. Dredging after the spawning period of hard clams, soft clams, and oysters would avoid stressing critical, sensitive early life stages. Oysters generally spawn in Long Island Sound 2 to 3 weeks after water temperatures reach 68-70°F. Spawning usually begins in late June to early August. Hard shell and soft shell clams generally spawn from midJune through August. Many resident finfish species move into shallow onshore waters during the spring and summer months. Crustaceans such as blue crabs and lobsters are also found inshore during the summer months. During the late summer and fall the resident species move offshore and the annual visitors generally migrate to warmer southern waters. Dredging in the fall (after October 1) would avoid disrupting spawning activities, stressing early life stages and impacting seasonal onshore migrants and populations of summer visitors. The disposal site is buoyed and point dumping will take place to facilitate capping. Monitoring of the disposal operations will be performed by the DAMOS program.

4.67 Rare and Endangered Species and Unique or Critical Habitats. The investigation of rare or endangered species was limited to species in danger of expiration in the State. This included species delineated as U.S. and State of Connecticut rare and endangered species.(39) thru (44) Species not frequently encountered in Connecticut because of limits of their range or narrowness of habitat were not considered. Unique and critical habitats considered were unusual natural areas and important habitats such as sites for breeding and nursery areas.

4.68 Although rare and endangered species have not been sighted in the area certain of these species can occur.[37,38,39] These include:

Shortnose sturgeon (Acipenser brevirostrum)
Atlantic sturgeon (A. oxyrhynchus)
Cooper's hawk (Accipiter cooperii)
Bald eagle (Haliaeetus leucocephalus)
American Peregrine falcon (Falco peregrinus anatum)
Ipswich sparrow (Passersilus sandwichensis princeps)

4.69 The Connecticut Audubon Society has notified the Corps that a nesting colony of least terns occupy the Long Beach area. This particular species may soon be classified as an endangered species, and this is the last known nesting site in Connecticut.

4.70 The National Marine Fisheries Service has stated (letter 17 March 1981) that the project is in the region inhabited by the threatened loggerhead sea turtle (Caretta caretta) and the endangered leatherback sea turtle (Dermochely s coriacea). Three endangered whale species; the finback whale (Balaenoptera physalus), the humpback whale (Megaptera novalangliae), and the right whale (Balaena glacialis) are also known to inhabit the area. However, disposal of dredged material either onshore or in an inshore area where food/prey organisms are not found would eliminate or minimize the effects of the project operations on these species.

4.71 Critical habitat identified in the Bridgeport area include the large salt marshes and barrier beach ecosystem associated with the Lewis Gut area, the Ash Creek estuary and wetlands complex and the unique environment afforded by Pleasure Beach which is close to the city.

4.72 Historical and Archaeological Features.

Should the Corps of Engineers schedule any dredging operation in the Pequonnock River, there could be an adverse impact on one of three historical canal boats that have been determined eligible for inclusion in the National Register of Historical Places. The Corps' procedures for the "Identification and Administration of Cultural Resources," (E.R. 1105-2-460), stipulate that in such a situation, it is necessary to comply with the Advisory Council's "Procedures for the Protection of Cultural and Historic Properties," (36 CFR 800).

4.73 In consultation with the State Historic Preservation Officer, the Criteria of Effect (36 CFR 800.8) must be applied to determine the nature and extent of the project's impact on the historic data. Upon a "Finding of Adverse Effect" (36 CFR 800.4 (e)) the Corps would then initiate procedures to mitigate the adverse impacts. Subsequent to preparation of a Preliminary Case Report, a Memorandum of Agreement between the Advisory Council, the State Historic Preservation Office and the Corps would be arranged. Mitigation of adverse impacts includes a wide variety of alternatives ranging from choosing an alternative plan for

the project in order to avoid the adverse impact, gathering in situ data of the property, or conducting a complete salvage of the data. A plan for mitigation would be arranged among the various State and Federal agencies and professionals. The present proposed improvement dredging would not extent into the area where the three canal boats are located.

4.75 The State Historic Preservation Officer (letter 2 Sept. 1981) has indicated that several prehistoric archaeological sites have existed in the immediate area of the harbor and proposed Black Rock Harbor. The East Bridgeport National Register Historic District, located to the north of the study area, would not be impacted by the proposed dredging work.

4.76 At Black Rock Harbor it was pointed out that the Marina Park National Register Historic District is located northeast of Seaside Park; Seaside Park appears to meet the eligibility criteria for the National Register of Historic Places; and a submerged historic archaeological site exists within the western side of Black Rock Harbor opposite Grover Hill. These areas would not be impacted by the proposed dredging work.

V. Public and Agency Involvement in the Planning Process

5.00 The proposed project plans are being coordinated with the major State and Federal regulatory agencies represented by the U.S. Environmental Protection Agency, U.S. Fish and Wildife Service, National Marine Fisheries Service, Connecticut Department of Environmental Protection and city officials.

5.01 A public meeting was held December 19, 1979, at which time local interests were provided the opportunity to express their views and recommendations. The meeting enabled the identification of the nature of and extent of navigation improvement desired and potential ecological problems of users. The documentation of this information is contained in the reconnaissance report issued April 1980. Several informational meetings were held 7 March and 19-20 May 1980, 21 December 1981 and 13 January 1982 with local officials and commercial oyster industry representatives to discuss project plans, alternatives, mitigation measures, and economics. An EIS prescoping meeting was held August 1982 and January 1983.

5.02 A draft EIS has been prepared in association with the preparation of the draft feasibility report, which will both be distributed for public review. A final EIS will be prepared following formal review of the final feasibility report and DEIS by the Board of Engineers for Rivers and Harbors, in Washington, D.C.

5.03 Questions or comments relevant to this Preliminary Environmental Assessment and Considerations should be directed to Mr. Gib Chase, Marine Resources Specialist, Impact Analysis Branch, New England Division, U.S. Army Corps of Engineers.

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SECTION 404 EVALUATION
PROPOSED NAVIGATION IMPROVEMENT DREDGING
BRIDGEPORT AND BLACK ROCK HARBORS, CONNECTICUT

1. References.

a. Section 404(b) of Public Law 92-500, Federal Water Pollution Control Act.

b. 40 CFR 230.4 - 230.5 dated 5 September 1974 AND 24 December 1980.

c. EC 1105-2-90, Appendix C, dated 10 October 1978 and revised 30 September 1980.

2. Proposed Project.

The selected plan of improvement consists of: deepening the existing 35-foot deep Bridgeport Harbor entrance channel, the inner channel and the turning basin to 42 feet. Deepening the entrance channel to 42 feet will necessitate lengthening it approximately 2,300 feet seaward. A section of the existing 25-foot deep anchorage would also be dredged to 42 feet to provide a 10-acre addition to the exiting turning basin. In Black Rock Harbor a 28-acre anchorage area will be dredged to 6 feet deep in Burr and Cedar Creeks. It is proposed that the material be dredged by a mechanical bucket or clamshell dredge and placed into bottom dump scows for transportation for disposal at the designated Central Long Island Sound Regional Dump Ground off New Haven Harbor. The total amount of dredged material to be dredged from the Bridgeport Harbor entrance channel and the inner harbor amounts to approximately 2,620,000 cubic yards. An additional 120,000 cubic yards could result from the dredging of private berthing areas and 165,000 cubic yards would be dredged to create the 28 acres of anchorage at Cedar and Burr Creek.

3. Project Authorization.

This study is being conducted in accordance with a Resolution made at the request of the Honorable Abraham Ribicoff and the Honorable Lowell P. Weicker, Jr., which is as follows:

> "RESOLVED BY THE COMMITTEE OF PUBLIC WORKS OF THE UNITED STATES SENATE, that the Board of Engineers, for Rivers and Harbors be, and is hereby requested to view the reports on Bridgeport Harbor Connecticut, submitted in House Document 136, 85th Congress, 1st Session, with a view to determine the economic justification and environmental acceptability of providing navigation improvements for deep draft vessels, commercial fishing boats, recreational craft and related purposed in Bridgeport Harbor, including the harbor's tidal tributaries and nearby Black Rock Harbor, Cedar Creek and Burr Creeks, and tidal portion of Ash Creek." The resolution was adopted on April 6, 1977.

4. Environmental Concerns.

Dredging operations result in the removal and death of many of the organisms within the dredged channel, including most of the benthic infaunal community and commercially important shellfish species. Water quality changes associated with dredging and disposal are primarily increased turbidity and reduced dissolved oxygen concentrations. These are predominantly short-term localized changes which are expected to have little effect on the biota. Water quality induced fish mortalities have not been observed, although studies show that fish that come in contact with the affected water may be subjected to additional stress. Avoidance of these areas by fish may reduce the potential problems attributed to water quality changes. Impacts of turbidity on benthic deposit feeders, filter feeders and finfish would be minimal and short term. The use of clamshell dredge will minimize exposuure of the sediments with the water column. The disposal of dredged sediments would bury any benthic organisms at the disposal areas. Recolonization of opportunistic species would occur soon after disposal is completed. No endangered or threatened species would be affected by the discharge activity.

230.4-1 PHYSICAL AND CHEMICAL BIOLOGICAL INTERACTIVE EFFECTS

(a) PHYSICAL EFFECTS

(1) Filling of Wetlands

The filling of wetlands is considered the most serious possible consequence of dredged material disposal. No filling of or disturbance to tidal saltmarsh wetlands is involved in the proposed Bridgeport and Cedar-Burr Creek dredging disposal operations.

(2) Effects on the Water Column

The dredging and disposal activities will result in the temporary increase in turbidity and suspended materials and minor short-term release of heavy materials, hydrocarbons and PCB's with the water column. These water quality effects are expected to be limited in areal extent of short duration. Full descriptions of these effects can be found in Section IV Environmental Consequences. Capping of the inner harbor contaminant laden silt-clay sediments at the disposal site will subtantially reduce release of toxic substances with the waters of Long Island Sound.

(3) Effects on Benthos

Benthic populations will be removed from the anchorage and channels in the area to be dredged. The communities to be disturbed in the Cedar-Burr Creek and inner Bridgeport Harbor area are impoverished and lack density. In the outer channel at Bridgeport most of the benthic infaunal community in a few oysters may be removed. In all cases however, the

communities to be disturbed are very resilient and the area is expected to recover rapidly.

(b) CHEMICAL-BIOLOGICAL INTERACTIVE EFFECTS

(1) Evaluation of Effects.

The material to be disposed of consists primarily of contaminated organic silt-clays which according to the NERBC and Conn-NY (NERBC, 1980) sediment classification system is Class III materials. In general volatile solids, oil and grease and metal levels are considered high at almost every sample site from the upper reaches of Cedar Creek and inner Bridgeport Harbor environs. Bioassay and bioaccumulation and elutriate tests have also been performed and evaluated. This Class III material is acceptable for disposal in Long Island Sound only if capped with cleaner and coarser Class I or II material. The proposed plan will

(2) Water Column Effects

Elutriate tests as required by this section indicate potential but small releases of sulfates, mercury, zinc and PCB's for Black Rock Harbor stations at Bridgeport inner harbor. Releases of effluents or resuspension of material during dredging at disposal operations would temporarily increase the concentration of these contaminates in the harbor and sound water, however tidal flushing of the harbor at current and water action at the year-water dump site is expected to dilute these contaminates down to existing water quality conditions.

(3) Effects on Benthos.

Ocean disposal will result in the smothering of the bottom benthic community and temporary disruption in the species population(s) functional activities and successional communities development stages.

230.4-2 WATER QUALITY CONSIDERATIONS

This section requires that the effects of the proposed dredging and disposal on applicable water quality standards be assessed. These effects, discussed in Section IV, are expected to be limited in severit and of short duration. Comparison of these anticipated effects to the water quality standards of Connecticut indicate that no permanent violation of standards is expected, nor does the action thwart the intention of existing water quality management plans.

230.5 SELECTION OF DISPOSAL SITE AND CONDITIONING OF DISCHARGES OF DREDGED OR FILL MATERIALS

(a) GENERAL CONSIDERATIONS AND OBJECTIVES

Consideration is to be given to the need for the action, the availability of alternative sites, and the effects of water quality standards. The need for the project is described fully in Section I. Alternative sites and methods of dredging and disposal are discussed in Section II. These discussions indicate that the proposed methods are equal or less damaging to the environment than are the alternatives.

(1) Avoid Disruption of Aquatic Ecosystems

As discussed in Section III, disruptions to aquatic ecosystems are expected to be limited in extent and recovery of the ecosystems is expected to be rapid.

(2) Avoid Disruption of Food Chains

No such effects are expected with the Bridgeport and Black Rock Harbor construction operations, including dredging and disposal.

(3) Avoid Disruption of Movement Patterns

The design and alignment of the breakwater will not conflict with the migratory movements of fish.

(4) Avoid Discharge in Wetlands

No discharge into wetlands is proposed.

(5) Avoid Discharge in Flood Retention Areas

No discharge into flood retention areas is proposed.

(6) Minimize Turbidity Levels

The proposed dredging and disposal plan which will utilize a clamshell budget dredge and point dumping with capping will minimize turbidity and suspended materials.

(7) Minimize Degradation of Aesthetics, Recreation and Economic Environment

The dredging and disposal operations, if undertaken, will be scheduled so as to minimize aesthetic and recreation effects by limiting conflict with recreational boating. The economic effects of the project are positive.

(8) Avoid Degradation of Water Quality

As discussed in Section III no serious or permanent effects to established water quality standards are expected.

(b) CONSIDERATIONS RELATING TO DEGRADATION OF WATER USES AT PROPOSED DISPOSAL SITE

(1) Municipal Water Supply Intakes

There are no intakes in the vicinity of the proposed construction site.

(2) Shellfish

The deepening of the Bridgeport channel would eliminate at maximum, approximately 2-4 acres of bottom shellfish habitat. The main shellfish beds located on either side of the channel will not be significantly altered.

(3) Fisheries

No adverse effects to fisheries will occur.

(4) Wildlife

Disposal of dredged materials, if at the open-water site in LIS will not result in the loss of upland habitat nor disturbance to wildlife.

(5) Recreation Activities

Fall or winter scheduling of dredging and disposal limits conflict with recreational boating activities and spawning of shellfish.

(6) Threatened and Endangered Species

No threatened or endangered species have been reported at the Bristol Harbor Site.

(7) Benthic Life

Temporary losses to the benthic community during dredging/disposal and breakwater construction will be rapidly made up through recolonization.

(8) Wetlands

No disposal in wetlands is proposed.

(9) Submerged Vegetation

Disposal at the sites being considered will not adversely affect aquatic vegetation.

5. Conclusions

a. An ecological evaluation as required by Section 404(b)(1) of the Clean Water Act has been made following the evaluation guidance in 40 CFR 230.4, in conjunction with the evaluation considerations in 40 CFR 230.5. Appropriate measures have been identified and incorporated in the proposed plan to minimize adverse effects on the aquatic environment as a result of the discharge. Consideration has been given to the need of the proposed activity, the availability of alternative sites and methods of disposal that are less damaging to the environment, and such water quality standards as are appropriate and applicable by law. Adverse impacts to the total marine ecosystem would be water oriented and water dependent. Construction during critical spawning periods and peak recreational boating would be avoided to minimize these impacts. A Public Notice with respect to the 404 Evaluation will be issued accompanying this document. Based on information presented in the 404 Evaluation and Environmental Assessment, I find that the project will not result in significant adverse impacts to the environment.

Carl B. Sciple
Colonel, Corps of Engineers
Division Engineer

APPENDIX 1

EXISTING PROJECT AREA CONDITIONS

BRIDGEPORT HARBOR, CT AND VICINITY

BRIDGEPORT HARBOR, CONNECTICUT

APPENDIX 1

EXISTING PROJECT AREA CONDITIONS

Appendix 1
Existing Project Area Conditions
Bridgeport Harbor, CT and Vicinity

This appendix serves as the first of seven supplements to the findings presented in the main report.

1. Existing Conditions

The immediate Bridgeport area has been the subject of 26 prior Corps of Engineers studies since 1827 in the interest of navigation. Improvements at Bridgeport Harbor and Black Rock Harbor were begun in 1836 as two separate projects. Both areas were combined into a single project area in 1899.

All work in the main harbor was completed in 1963, except for removal of rock in Yellow Mill Channel which was deauthorized by Congress in 1979.

All work in the Black Rock Harbor area was completed in 1931, except for the two breakwaters at the harbor entrance and a 28-acre anchorage 6 feet deep in Burr and Cedar Creeks that were never constructed, because required cash contributions were not forthcoming.

No federal navigation improvements have been made in Ash Creek along the Bridgeport-Fairfield boundary, or in Lewis Gut which joins Johnsons Creek at the Stratford-Bridgeport boundary.

A listing of prior navigation studies for the Bridgeport area is shown in Table 1.

2. Bridge and Utility Crossings

The main harbor is crossed by two pipelines and one submarine cable near the head of the inner harbor. These submarine utility lines would need to be removed and relocated in the event that further deepening is proposed near the head of the inner harbor.

Eight bridges, seven pipelines and 10 submarine cables cross the tributary waterways of Johnsons Creek, Yellow Mill Channel and the Pequonnock River. A listing of bridges, pipelines and submarine cables in the Bridgeport Harbor area is shown in Table 2.

Table 1
Previous Corps of Engineers Reports on Bridgeport (CT) Navigation Studies

	Preliminary Examinations		Survey or Feasibility Reports				Where Published					
	Report Date	Finding	Report Date	Estimated Proj. Cost	Finding	COE (1) Finding	House/ Senate	Number	Congress	Session	COE Ann.Rept. Year	COE Ann.Rept. Page
Ash Creek	Mar 2, 1936	Unfavorable				Unfavorable	Report not published.					
Black Rock Harbor			Feb 15, 1827	6,201			H	52	20	1		
			Jun 9, 1831	10,900								
	Nov 8, 1882	Favorable	Dec 12, 1883	80,000			S.Ex	*50	48	1	1884	666
			Oct 30, 1888	157,609	Favorable	Favorable					1889	741
			Oct 30, 1888	1,025,000	Favorable	Favorable					1889	741
Bridgeport Harbor			Sep 26, 1838	52,800								
			Dec 11, 1852	10,000								
			Jan 12, 1867									
			Jan 23, 1869		Unfavorable						1869	413
			Jan 12, 1871	72,000			H.Ex	60	41	3	1871	788
			Jan 12, 1871	566,922			H.Ex	60	41	3	1871	788
			Jul 1, 1874	126,050								
			Jul 14, 1879									
			Oct 28, 1895	90,000			H	*61	54	1	1896	803
			Aug 23, 1898	307,470	Favorable						1899	1173
			Jan 20, 1899	110,000			H	209	55	3	1899	1187
			Jan 20, 1899	65,000			H	209	55	3	1899	1187
	Nov 21, 1906	Favorable	Dec 18, 1906	560,000	Favorable	Favorable	H	275	50	2		
							H	*521	50	2		
	Sep 1, 1909	do	Feb 11, 1910	90,000	do	do	H	*751	61	2		
	Jan 6, 1911	Unfavorable				Unfavorable	H	*89	62	1		
	Nov 25, 1912	Favorable	Mar 19, 1914	175,300	Favorable	Favorable	H	*898	63	2		
	Jan 31, 1928	do	Jul 26, 1929	877,000	do		H	281	71	2		
			Jul 26, 1929	504,000		Favorable	H	281	71	2		
	Feb 26, 1936	do	Mar 10, 1937	192,500	Favorable	do	H	*232	75	1		
			Apr 9, 1940	529,000	do	do	H	*819	76	3		
			Apr 26, 1946	955,000		do	H	*680	79	2		
			Oct 19, 1956	2,076,000	(2)	do	H	*136	85	1		
Johnsons Creek	Nov 25, 1912	Favorable	Mar 19, 1914	19,800	Favorable	Favorable	H	*898	63	2		

(1) Chief of Engineers
(2) Plus $465,000 estimated cash contribution by local interests ($148,000 contributed)

* Included maps

TABLE 2

BRIDGE, CABLE AND PIPELINE CROSSINGS IN BRIDGEPORT HARBOR AREA

STRUCTURE	MILE (1)	DEPTH (2)	HORIZONTAL CLEARANCE	VERTICAL CLEARANCE
JOHNSONS CREEK				
Pleasure Beach bridge	2.90		70'	7' MHW
Four 12-inch pipelines (3)	3.30	15' MLW		
YELLOW MILL CHANNEL				
Stratford Ave. bascule bridge	3.45		82'	11' MHW
PEQUONNOCK RIVER				
Three 8-inch pipelines (4)	3.23	43' MLW		
One 69 KV cable (4)	3.29	38' MLW		
Interstate 95 fixed bridge	3.50		150'	65' MHW
Stratford Ave. bascule bridge	3.64		135'	7' MHW
Conrail bascule bridge	3.88		70'	18' MHW
Congress St. bascule bridge	4.00		67'	8' MHW
East Washington Ave. bascule bridge	4.25		69'	4' MHW
Grand St. bascule bridge	4.48		71'	13' MHW

(1) Mean range of tide is 6.7 feet
(2) Miles from outer end of main ship channel (which is 1.75 miles seaward of outer harbor breakwaters)
(3) Shell Oil Company
(4) United Illuminating Company

APPENDIX 2

ENGINEERING DESIGN AND COST ESTIMATES

BRIDGEPORT HARBOR, CT AND VICINITY

BRIDGEPORT HARBOR, CONNECTICUT

APPENDIX 2

ENGINEERING DESIGN AND

COST ESTIMATES

APPENDIX 2
ENGINEERING DESIGN AND COST ESTIMATES

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APPENDIX 2
ENGINEERING DESIGN AND COST ESTIMATES

INTRODUCTION. This report appendix presents engineering data to support selection of a recommended plan of improvement. For clarity the analysis is divided into two parts, Engineering Design and Cost Estimates.

SECTION A - ENGINEERING DESIGN

GENERAL. Modifications of general navigation facilities, considered here, are designed in accordance with criteria contained in U.S. Army Corps of Engineers, Committee on Tidal Hydraulics, Report Number 3, Evaluation of Present State of Knowledge of Factors Affecting Tidal Hydraulics and Related Phenomena.

DEEP DRAFT VESSEL ANALYSIS

Introduction. Tank ships have been for many years a critical element in the worldwide distribution of energy. The events of recent years have focused much attention on the tank ship and its importance to the lifestyle of people all over the world. As is the case here, virtually everyone in the south central region of Connecticut (population over 900,000) currently depends in large measure upon Bridgeport Harbor for ship delivery and handling of refined petroleum products and dry bulk commodities. The result of this analysis is a forecast of a range of ship sizes, especially tank ships, expected to serve Bridgeport Harbor over the economic life (1990-2040) of proposed navigation improvements.

The Merchant Fleet Forecast presented below was prepared using in large measure the Maritime Administration trade forecast (1). Principal findings resulting from an analysis of the forecast are presented below:

(1) U.S. Department of Commerce, Maritime Administration, Office of Commercial Development, Summary Report, May 1978.

A. World Fleet Serving U.S. Trade.

The number of vessels in the world fleet required to serve the U.S. foreign trade, which includes U.S. flag vessels, is projected to grow by only 379 vessels or about 2.5 percent between 1975 and 2000 (see Table 1). Because trade is projected to increase over 130 percent, the trend to larger and more efficient vessels is reflected by the growth in deadweight of nearly 90 percent and in annual capacity of about 145 percent.

Table 1

MERCHANT FLEET FORECAST SUMMARY
TOTAL SHIP REQUIRED TO SERVE THE U.S. - FOREIGN TRADE
(Vessels and Thousands of Deadweight Tons)

	1975	1980	1985	1990	1995	2000
			VESSELS			
General Cargo Ships	2,043	1,867	1,647	1,346	1,044	795
Partial Containerships	132	247	373	555	754	1,043
Full Containerships[1]	181	259	303	365	429	511
Barge Carriers	27	23	29	33	37	40
Neobulk Carriers	80	101	126	153	176	205
Dry Bulk Carriers	860	905	960	991	1,038	1,080
Combination Carriers	82	98	106	110	113	124
LNG Carriers	1	11	42	58	72	82
Tankers	643	805	772	748	710	548
Total	4,049	4,316	4,358	4,359	4,373	4,428
			DEADWEIGHT			
General Cargo Ships	18,241	18,228	16,634	14,496	11,754	9,387
Partial Containerships	1,387	3,011	4,950	7,860	11,468	16,365
Full Containerships[1]	2,766	4,198	5,086	6,307	8,058	10,180
Barge Carriers	1,015	896	1,160	1,336	1,520	1,721
Neobulk Carriers	1,730	2,193	2,779	3,487	4,289	5,428
Dry Bulk Carriers	26,278	28,340	31,692	34,691	39,482	46,550
Combination Carriers	5,837	7,275	8,463	9,631	11,128	13,090
LNG Carriers	32	608	2,394	3,316	5,000	6,185
Tankers	27,976	45,118	50,528	53,787	56,247	50,887
Total	85,262	109,867	123,686	134,911	148,946	159,793

[1]Includes Ro-Ro (roll on-roll off) vessels.

NOTE: Total may not add due to rounding.

New construction activity over the forecast period will be a function of two key factors: world trade growth and replacement requirements resulting from scrapped vessels. These factors combine during the forecast period in such a way that shipbuilding activity required to support U.S.-foregin trade is projected to decline substantially in the 1980s. This is consistent with the current shipbuilding outlook. However, in the 1990s the combination of trade growth and vessel retirements is expected to result in a significant rise in construction activities.

Specific findings regarding the world fleet include:

o In every ship type, increasingly larger vessels will be built. The largest increases occur in LNG carriers and tankers which increase in average size by 133 percent and 113 percent, respectively. The smallest increase, 14 percent, occurs in barge carriers. The average increase in deadweight per vessel for the whole fleet is 71 percent.

o There will be an increasing reliance upon more sophisticated liner type vessels in the future. During the next 25 years the number of partial containerships will increase nearly sevenfold while the number of full containerships will triple. The number of general cargo ships is projected to decrease over the same period by 60 percent.

B. U.S.-Flag Fleet.

The development of the U.S.-flag merchant fleet will depend on many factors such as management skills of U.S. flag vessel operators, capacity of U.S. shipyards, policies of the Maritime Administration, and Federal legislation. In the long run, a strong influence on the size of the U.S.-flag merchant fleet may be caused by an additional factor, the worldwide trends towards national flag preference. The Merchant Marine Act of 1970 provides for a subsidy program. While it cannot be determined with certainty what type of subsidy program will be enacted for the period 1990-2040 (economic life expectancy of this report"s improvement proposal), it appears reasonable to assume that the Federal Government will continue to provide the necessary support to the U.S. Merchant Marine.

Accordingly, if the forecast U.S.-flag share levels are achieved, the number of vessels in the fleet would increase by nearly 200. This equates to a 75 percent increase in the number of vessels in the fleet and a 108 percent increase in deadweight. New construction activity will also be high with s total requirement of 474 vessels or approximately 19 vessels aggregating 2 million deadweight tons per year between 1976 and 2000. A medium scenario forecast of U.S.-flag vessels is shown in Table 2.

Table 2

MERCHANT FLEET FORECAST SUMMARY
U.S.-FLAG VESSELS ENGAGED IN U.S.-FOREIGN TRADE

	1975	1980	1985	1990	1995	2000
			VESSELS			
General Cargo Ships	106	81	77	37	18	19
Partial Containerships	20	20	28	41	55	71
Full Containerships[1]	58	69	77	97	126	156
Barge Carriers	23	19	22	24	26	27
Neobulk Carriers	0	0	2	4	6	9
Dry Bulk Carriers	3	7	18	30	43	56
Combination Carriers	2	2	3	3	4	4
LNG Carriers	0	6	23	31	39	44
Tankers	38	48	48	53	56	56
Total	250	252	298	320	373	442
			DEADWEIGHT			
General Cargo Ships	1,402	1,057	1,021	513	249	269
Partial Containerships	265	269	389	569	769	999
Full Containerships[1]	1,112	1,353	1,568	1,966	2,600	3,228
Barge Carriers	839	720	866	954	1,051	1,149
Neobulk Carriers	6	6	34	76	134	224
Dry Bulk Carriers	91	255	623	1,041	1,575	2,330
Combination Carriers	172	171	223	283	318	350
LNG Carriers	0	346	1,325	1,786	2,673	3,265
Tankers	1,762	4,221	4,646	5,531	6,201	6,606
Total	5,650	8,398	10,695	12,719	15,570	18,420

[1]Includes Ro-Ro Vessels.

NOTE: Total may not add due to rounding.

Table 3

U.S. LIQUID BULK CARRIERS - ATLANTIC COAST DWT

DWT (000)	PERCENT OF TOTAL FLEET[2] 1975	1980	1985	1990	1992 2000
1-10	2	2	2	2	2 1
10-20	2	2	4	3	5 5
20-30	37	36	28	29	2925
30-50	42	41	37	36	3837
50-70	9	9	19	15	1415
70-125	7	9	9	8	5 5
125-175	0	0	1	7	712
175-225	0	0	1	3	5 7
225-300	0	0	0	2	2 1
300+	0	0	0	0	0 3
30-50 & Up Totals	58	59	65	59	5757

[2]Excerpted Data from "A Study of the Future Requirments for Ships That Will Be Engaged in the U.S. World Trade for Both the Short and Long Term" - 1976 - By Temple, Barker, and Slosne, Inc.

The above tabulation seems to be borne out somewhat by recent reports of the Sun Shipbuilding and Drydock Company. Excerpted data from the 1975 and 1976 reports show the average deadweight tonnage of the U.S. flag fleet increased from 22,100 DWT in 1966 to 36,200 DWT in 1975 to 39,900 DWT in 1976. The average DWT of U.S. flag vessels under construction or on order in 1976 was 119,432.

It should be noted, based on the Corps waterborne statistics for 1976, that 20 percent of the ships carrying petroleum products at Bridgeport Harbor were of foreign flag, which does reflect growth of the world tank fleet. Also, the dry bulk ships used for the import of lumber, the receipt of iron and steel shapes and products, and the export of iron and steel scrap are all of foreign flag. Similar to the liquid bulk ships, these dry bulk vessels are getting larger.

Accordingly, the above informstion does support that a U.S. flag fleet of larger liquid bulk carriers (30,000 to 50,000 DWT), will be available for use at Bridgeport Harbor. The forecast range in vessel sizes generally concurs with local views. Accordingly, it is our intention to design ship channel and turning basin dimensions to safely accommodate this U.S. flag fleet as representative of the future fleet expected to use Bridgeport Harbor.

Findings regarding the U.S.-flag fleet include:

o The U.S.-flag fleet reflects a substantially different profile than the world fleet. The differences are most apparent when viewed in the context of liner type vessels (general cargo, partial and full container, and barge carrying ships) snd non-liner type vessels (neobulk and dry bulk carriers, combination carriers, LNG carriers, and tankers). The number of these non-liner type vessels is projected to more than triple and on a eadweight basis to increase fivefold by the year 2000.

o U.S.-flag vessel new constructions are projected to increase over the forecast period. In the 1976-1980 time period, constructions were expected to average about 11 vessels per year. This figure will exceed 25 per year by 2000 if the projected U.S.-flag share is achieved.

o Summary Table 3 (U.S. Liquid Bulk Carriers - Atlantic Coast) presented below does show that by the year 2000, 37 percent of the vessel size range from 30,000 to 50,000 DWT are expected to be utilized in the liquid bulk trade for the Atlantic Coast. The average loaded draft of this range of tankers is about 37 feet. When 4 feet is added to this draft for under keel factors such as uneven loading, pitch and squat, it indicates a need for 41 feet of water at the design water level. The vessel sizes in the 20,000 to 30,000 DWT range have an average draft of 34 feet, thus requiring a water depth of 38 feet. The authorized channel depth in Bridgeport Harbor is 35 feet. The tabulation summary shows the 20,000 to 30,000 DWTs decreasing in use from 37 percent in 1975 to 25 percent in 2000; the 30,000 to 50,000 DWTs decreasing slightly in use from 42 percent in 1975 to 37 percent in 2000; while the use of 50,000 to 70,000 DWTs increases from 9 to 15 percent. Overall this appears to indicate that the larger U.S.-flag vessels will be available for use along the Atlantic Coast in the future.

C. Vessel Characteristics.

In recent years, the need for and use of proper vessel design characteristics in project formulation studies has become increasingly important. Although petroleum projections for the market area served by the port of New Haven are expected to decline in future years, tankers will continue to form an integral part of any proposed deep draft harbor improvement.

Past investigations have relied principally on typical vessel characteristics. Although considered representative of the average characteristics for various types of deep draft vessels comprising the world fleet, these data lacked statistical verification. With this in mind, the Corps' Mobile District Office (MDO) conducted an independent investigation of bulk carriers and tankers in the 1976 world fleet to ascertain whether more reliable data could be developed regarding physical characteristics and dimensions for deep draft vessels. Results of their investigation have been documented in a report entitled, "Statistical Analysis of Vessel Characteristics for Dry Bulk Carriers and Tankers in the 1975 World Fleet" dated 2 January 1977. Data contained in the report are

considered statistically reliable estimates of selected ship characteristics, including draft, tons per inch of immersion, deadweight tonnage, speed, length, breadth, and gross registered tonnage.

In the case of Bridgeport Harbor, proposed project dimensions have been based, in large measure, on the expected use of 30,000 to 50,000 DWT vessels, representing the average range of vessel sizes. The characterics of the range of tankers have been excerpted from Mobile District Office analysis and are shown on Table 4 below.

Table 4

CHARACTERISTICS OF TANKERS AND DRY BULK CARRIERS
ANTICIPATED TO USE BRIDGEPORT HARBOR

Vessel Size DWT-Range	Avg. DWT	Maximum Registered Draft (ft)	Average Length (Feet)	Average Beam (Feet)
27,500-32,500	30,000	34	616	83
32,500-37,500	35,000	36	639	87
37,500-42,500	40,000	37	660	91
42,500-47,500	45,000	38	679	94
47,500-52,500	50,000	40	698	98
52,400-57,400	55,000	41	715	101
57,500-60,000	60,000	42	732	104

D. Ship Generated Wave Effects on Harbor Shorefront.

Study indicates that the ship-generated waves are not the cause of erosion along the shorefront; waves generated by winds from the southerly directions are considered the prime cause of erosion. As further demonstrated by R.M. Sorenson,[1] "Ships moving at a speed of 6-10 knots in 37 to 42 feet of water generate maximum bow wave heights of 0.3-0.9 feet for pproximately 500-1000 feet. These wave heights would then begin to decay and finally dissipate if unobstructed, 1000 feet from the vessel." Energy in the form of waves generated by these passing vessels may dissipate on shore. However, it is considered too weak a force to adversely effect the shoreline and be the cause of shorefront erosion within the harbor.

GENERAL NAVIGATION CONDITIONS

Channel Depths. The design channel depth for the existing waterway and turning basin is based on the static loaded drafts of the range of

[1]Sorenson, Robert M., "Water Waves Produced by Ships," Journal of the Waterways, Harbors and Coastal Engineering Division of ASCE, 1973.

vessels expected to transit the waterway and consideration of the following factors required for safe vessel operation:

a. Clearance. A vessel must have sufficient water under the keel to allow for safe and efficient maneuvering when operated under its own propulsion. Two feet of clearance under keel are required for channels constructed in soft material. Where rock is present in the channel, an additional 2-foot clearance is provided for safety.

b. Squat and trim. A vessel in motion will squat or sink in the water, depending on: (1) the vessel speed, (2) distance between keel and channel bottom, (3) trim of the vessel, (4) cross-sectional area of the vessel, (5) whether the vessel is passing another large vessel, (6) location of the vessel relative to the channel centerline, and (7) general characteristics of the vessel. The trim of a vessel refers to the angle of the bottom of the vessel with respect to the water surface. Vessels are trimmed during loading so that a level keel can be established at a later period during the voyage as fuel and water are used. An allowance of 2 feet for squat and trim is used in this report.

c. Tidal phenomena. Vessels using Bridgeport Harbor are able to take advantage of a 6.2 foot mean range of tide throughout the year. However, computations were made using a 3-hour tidal advantage (about half tide) under design conditions.

d. Loss in buoyancy. The lower density of freshwater relative to saltwater results in s loss of buoyancy as a vessel moves from Long Island Sound into the harbor. The brackish transition zone from fresh to saltwater is located well above the head of the authorized 35-foot project. Therefore, no allowance is needed for vessels transiting the existing waterway.

e. Channel-bottom material. Numerous borings and probings have been obtained indicating mixtures of organic and inorganic silts, silty and gravelly sands, and clay overlying the entire ship channel and turning basin. Additional clearance for hard material (rock) was considered unnecessary in LIS approach channel and the harbor.

f. Wave action. Waves or swells are often present in Long Island Sound and harbor. Wave forces result in the vertical vessel motions of heave, pitch and roll, and must be considered in determining the necessary channel depth. The motion of heave raises and lowers the entire vessel with relation to the stillwater level. The motion of pitch alternately thrusts the bow and stern of the vessel above and below the stillwater level. The motion of roll alternately raises and lowers one side of the vessel with relation to the keel or bottom centerline of the vessel. While vessels navigating the channel do, on occasion, encounter waves of up to 4 feet in height, 128-foot in length and with a 5-second period, these wave characteristics have almost no effect on large ocean-going vessels. Hence, allowance for vessel pitch, roll and heave due to wave forces are considered unnecessary.

g. Summmary. Figure 1 illustrates the criteria used in determining channel depth for Bridgeport Harbor.

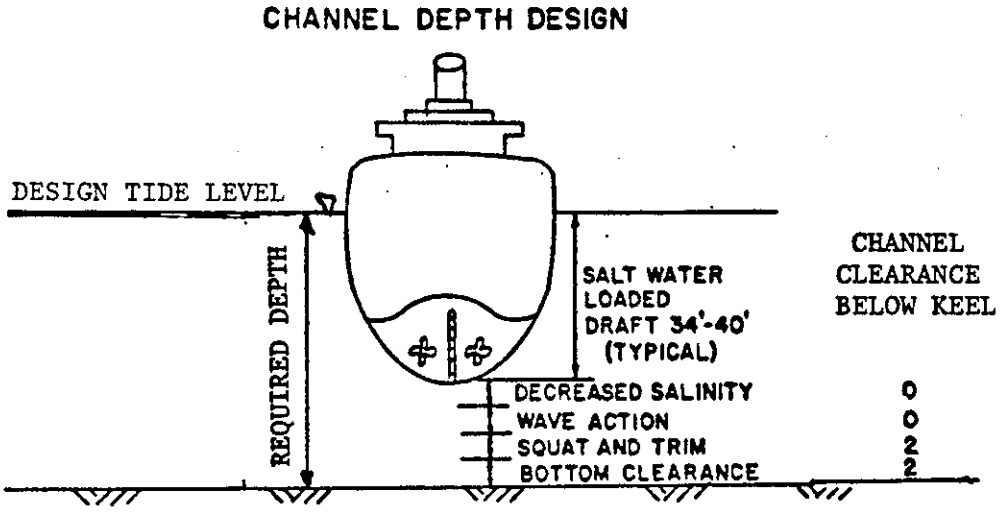
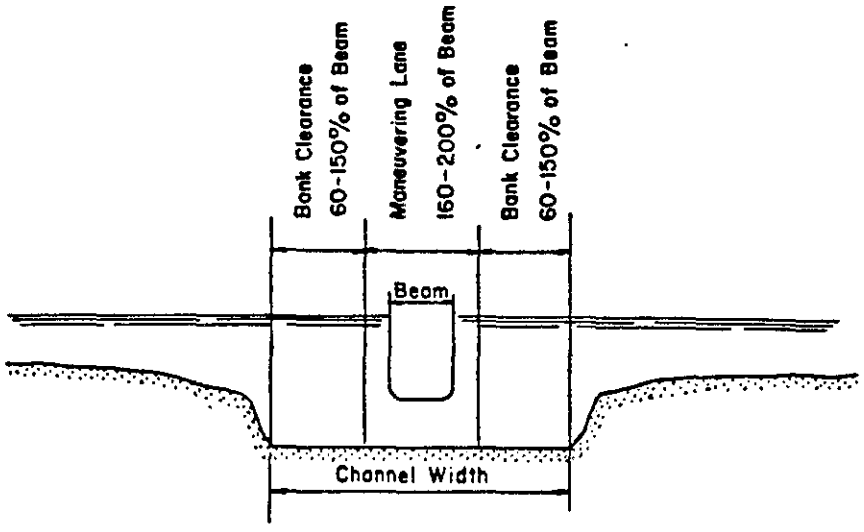


Figure 1

Channel Widths. The design width of the Bridgeport Harbor channels is based on the traffic density, beam and steering characteristics of vessels expected to transit the waterways and consideration of currents, wave conditions, winds, bends and general alignment. Channel widths are measured at the design channel depth (bottom width).

a. The selected channel width must be sufficient to allow adequate control of vessels using the waterway under expected conditions of ship speed, currents, channel alignment and traffic. The existing Bridgeport Harbor channel is considered unconfined; that is, the boundaries of the waterway are exterior to the channel boundaries and provide an open expanse of water beyond the channel. Of special concern, is the need to enlarge and deepen the existing turning basin within the harbor. In addition, it is recognized that vessel maneuverability is affected by the combined channel dimensions, depth and width; and therefore must be considered jointly in selecting the proper waterway dimensions.

DESIGN CRITERIA AND
ELEMENTS OF CHANNEL WIDTH



ONE-WAY TRAFFIC

Figure 2

b. A study of the harbor usage indicates that one-way traffic will be sufficient to accommodate the anticipated frequency of vessels throughout the life of the project without appreciable delays. The design channel width for one-way traffic is divided into three parts: a vessel maneuvering lane and bank-clearance lanes, one on either side of the vessel, between the outer edges of the maneuvering lane and adjacent channel bank. The criteria and elements used in determining channel widths needed to accommodate existing and expected vessels transiting the harbor are presented in Figure 2. The criteria include consideration of the following factors:

1. Size and speed of design vessels
2. Density of vessel traffic
3. Depth of channel
4. Current, velocity and direction
5. Vessel controllability on and off channel centerline
6. Pilot experience and capability
7. Channel uniformity

c. Computations. The maximum size vessel anticipated to frequently utilize channel improvements in Bridgeport Harbor under fully loaded conditions is 47,500 DWT and is selected as the design vessel. The characteristics are shown in Table 5.

Table 5
DESIGN VESSEL

Vessel Size DWT	Maximum Draft	Average Length	Average Beam
47,500	39 feet	700 feet	96 feet

Using a maximum draft of 39 feet for the 47,500-DWT design vessel, a 2-foot clearance allowance under the keel in soft material and a 2-foot clearance allowance for squat and trim, results in the need for a 43-foot channel depth. Because vessels are able to take advantage of a 6.7-foot mean range of tide at Bridgeport Harbor, a half tide condition (3.4 feet above mean low water) was established as a channel design condition. A channel depth of 40 feet at mean low water was selected as the design channel as this would provide a 43.4-foot depth of water at design stillwater level, which meets the need of a 47,500-DWT design vessel.

The manuvering lane of the channel width normally varies from 160 to 200 percent of the beam width, while the clearance varies from 60 to 150 percent of the beam of the design vessel. Because the vessels have a straight approach and are normally assisted by tug boats, they have good manuverability and controlled vessel speed. Therefore 175 percent and 120 percent of the beam width was selected for the manuverability lane and bank clearance, respectively. As a result, the design channel width is 398. Because the existing authorized entrance channel is 400 feet wide, there is no need to widen the channel. Interior channel horizontal dimensions will also remain the same. Table 6 summarizes the channel dimensions.

Table 6

PROPOSED CHANNEL DIMENSIONS

Location	Manuvering Lane (feet) (175%)	Bank Clearance (feet) (120%)	Total Channel Width (feet)
Entrance	168	115 x 2	398

Turning Basin. Representatives of the New Haven-Bridgeport Pilots Association and the United Illuminating Power Company requested that the existing turning basin be enlarged to the southward to reduce the risk of groundings and provide easier access to the tanker berth at Tongue Point. Some vessels of 70,000 DWT have delivered oil to UI, but they have had to

come in with only a part of their cargo and berthing time was difficult. Enlarging the existing turning basin to the south, from buoy N-2 to N-16, would add a triangular area of about 10 acres and provide a clearance of over 1.5 times the design vessel length for turning, including the width of the interior channel.

Anchorage. The existing 25-foot deep anchorage is 23 acres in area and is used only by smaller vessels because of the difference in depth between the anchorage and the adjacent 35-foot deep channel. Enlarging the turning basin to the south would eliminate 10 acres of the anchorage. However, the anchorage would be enlarged to the east and south, an equivalent 10-acres, thereby retaining the 23 acres of the anchorage. No dredging would be required as the equivalent area is already over 25 feet deep.

CONCLUSIONS

Based on the above design analysis, a ship channel 40 feet deep at mean low water and 400 feet wide and a 10-acre enlargement of the existing turning basin would be adequate to accommodate the design vessel anticipated to frequent Bridgeport Harbor during the life of the project, from 1990 to 2040.

Although the design depth of 40 feet at mean low water was selected for the design vessel, it is anticipated that larger vessels would also utilize the proposed channel improvements. It is common practice for ship captains and harbor pilots to take advantage of higher stages of the tide and light loading of vessels. Therefore, the theoretical size ship which could use the improvements is as shown in Table 7.

Table 7
THEORETICAL MAXIMUM VESSEL DRAFT

Channel Depth	40.0′	
Mean High Water	+ 6.8′	
Total High Water Depth	46.8′	
Light Load	+ 3.0′	
Theoretical Depth	49.8′	
Keel Clearance	- 4.0′	
Vessel Draft	45.8′	Say 46

THEORETICAL MAXIMUM VESSEL SIZE

Max. Draft (Feet)	Average Length (feet)	Average Beam (feet)	Vessel Range (DWT)	Average Size (DWT)
46	793	115	77,500-82,500	80,000

RECREATIONAL BOATING ANALYSIS

Introduction. The Bridgeport Harbor area is an important center for recreational boating. The numerous recreational marinas, yacht clubs and boatyards serve the needs of both Connecticut and Long Island Sound residents through the boating season from early May to mid-October.

There are 13 marinas, yacht clubs and boatyards within the city of Bridgeport. Four yacht clubs and the municipal marina are located on the mainland shore of Black Rock Harbor, Cedar and Burr Creeks. There are long waiting lists for slips and moorings at many of the yacht clubs, as they are presently filled to their limited capacity. Both powerboats and sailboats are accommodated, with the emphasis on powerboats.

Existing Fleet. The existing recreational boating fleet consists of outboards, inboards, stendrives, cruising sailboats and daysilers. No boats under 10 feet in length is considered part of the fleet. The majority of the boats are at yacht clubs and mooring areas. The locations and numbers of recreational boats are shown in Table 8.

Table 8
Recreational Boats

Location	Number
Black Rock Harbor	1,000
Bridgeport Harbor and Pequonnock River	375
Johnsons Creek	525
	1,900

The type and average characteristics of the existing recreational boating fleet are shown in Table 9.

Table 9
Existing Recreational Fleet

Type	Length	Beam	Draft
Outboards	10 - 20′	3′ - 9"	4" - 8"
	21 and Up	7′ - 6"	8" - 12"
Inboards	15 - 20′	7′ - 4"	1′ - 6"
	21 - 30′	8′ - 6"	2′ - 6"
	31 - 40′	12′ - 3"	3′ - 6"
	41 - 50′	13′ - 6"	4′ - 0"
	51 and Up	16′ - 6"	4 - 6"
Sterndrives	15 - 20′	7′ - 9"	1′ - 3"
	21 - 25′	8′ - 6"	1′ - 6"
	26 and Up	9′ - 10"	1′ - 11"
Cruising Sailboats	21 - 30′	6′ - 8"	3′ - 8"
	31 - 40′	10′ - 6"	4′ - 6"
	41 and Up	14′ - 0"	5′ - 9"
Day Sailers	16 - 20′	4′ - 8"	6′ - 12"
	21 - 25′	6′ - 6"	1′ - 6"
	26 and Up	8′ - 6"	2′ - 6"

Problems and Needs. The major boating problems are in Black Rock Harbor. The harbor is unprotected from storm waves originating in Long Island Sound. The existing anchorage areas and depths are inadequate to meet current and future recreational boating needs.

Prospective Fleet(s). The prospective fleets would consist of the types and sizes that now exist in Black Rock Harbor. However, since the energy crisis, the trend has been toward larger sailboats which have a draft of about 6 feet and require an anchorage depth of 8 feet. The prospective fleet in the upper reaches of the harbor, in Cedar and Burr Creeks, would require only an anchorage depth of 6 feet.

Anchorage Design. The 20- and 24-acre anchorages at the mouth of the harbor were designed for single-point moorings at a depth of 8 feet and one on three sideslopes. The 28-acre anchorage in Cedar and Burr Creeks was designed for single-point moorings at a depth of 6 feet and one on three sideslopes. The density is about 7 boats per acre. The locations and dimensions of the anchorages and mooring basins are shown in Table 10.

Table 10
Anchorage Design

Location	Area (acres)	Depth (feet)	Capacity (7-per acre)
Black Rock Harbor	20	8	140
	24	8	168
Cedar and Burr Creeks	28	6	196

Breakwater Design. A number of breakwater designs were studied. However, the rubble mound breakwater, detached from either side of the shoreline, was selected as being the most practical. The design, stillwater level 15.0 feet above mean low water, approximates the maximum recorded storm surge level of 15.3 feet above mean low water. A speed of 42 knots was taken as representative of the critical wind conditions in the area. Table 11 shows the freqeuncy of winds in the southeast to southwest quadrants.

Table 11
Frequency of Winds Greater than 22 Knots:
Southeast to Southwest Quadrant

	Wind Speed (Knots)					
	SSMO			NWS		
Direction	22-33	34-47	48+	22-33	34-47	48+
SE	2.0	*	*	3.0	#	#
SSE	2.0	*	#	1.3	#	#
S	0.7	*	#	0.4	6	#
SSW	1.0	*	#	0.3	12	#
SW	0.7	*	*	0.4	12	#

Return Frequency in Years

SSMO U.S. Naval Weather Service Command, Summary of Synoptic Meterological Observations, New York Area. Period of record = 60 years.

NWS U.S. National Weather Service, Bridgeport, Conn. Period of record available = 12 years.

* Percent frequency reported in SSMO is greater than 0.00 and less than 0.05. For the 60-year period of record, one to eight observations are possible with a return frequency of 7.4 to 60 years.

\# No observations.

Wave Height. The wave height and period were estimated for winds of 42 knots from the SE, SSE, S, SSW and SW using the Sverdrup-Munk-Bretschneider method. The forecast wave heights, periods and wave lengths are shown in Table 12.

Table 12
Estimated Deepwater Significant Wave
Height/Period and Length

Direction	Fetch Length (nautical miles)	Height (feet)	Period (sec.)	Length (feet)
SE	15	8.0	6.0	184
SSE	11	7.0	5.6	161
S	14	7.9	5.9	178
SSW	12	7.2	5.7	166
SW	15	8.0	6.0	184

Wind Speed: 42 Knots
Wave Length: $L_o = 5.12T^2$

Wave Refraction. The refraction of the deepwater waves was performed using standard graphical techniques and bathymetric contours of 6, 12, 18, 24, 30 and 60 feet. The results are shown in Table 13.

Table 13

Average Design Storm Wave Height, Shoaling and Refraction Coefficients at Entrance of Black Rock Harbor

(42 Knot Wind, Duration >2.2 Hours)

Direction	Water Depth (ft.)	Shoaling Coefficient K_S	West Half of Harbor Entrance Refraction Coefficient K_R	West Half of Harbor Entrance Wave Height (ft)	East Half of Harbor Entrance Refraction Coefficient K_R	East Half of Harbor Entrance Wave Height (ft)	Average For Harbor Entrance Refraction Coefficient K_R	Average For Harbor Entrance Wave Height (ft)
SW	13	0.97	0.36	2.8	0.34	2.6	0.35	2.7
	19	0.93	0.36	2.7	0.34	2.5	0.35	2.6
	25	0.92	0.36	2.7	0.34	2.5	0.35	2.6
SSW	13	0.96	0.54	3.8	0.55	3.8	0.55	3.8
	19	0.92	0.54	3.6	0.55	3.7	0.55	3.6
	25	0.91	0.54	3.6	0.55	3.6	0.55	3.6
S	13	0.97	0.36	2.8	0.48	3.6	0.42	3.2
	19	0.93	0.36	2.7	0.48	3.5	0.42	3.1
	25	0.91	0.36	2.6	0.48	3.5	0.42	3.0
SSE	13	0.95	0.75	5.0	0.52	3.4	0.65	4.3
	19	0.92	0.75	4.8	0.52	3.3	0.65	4.2
	25	0.91	0.75	4.8	0.52	3.3	0.65	4.2
SE	13	0.97	0.54	4.2	0.55	4.3	0.55	4.3
	19	0.93	0.54	4.1	0.55	4.1	0.55	4.1
	25	0.92	0.54	4.0	0.55	4.0	0.55	4.0

Alternative Breakwater Locations. Several alternative locations for the proposed breakwater were investigated and are shown in Plate 1. The selected location, W1-E1 is approximately that chosen by the Corps in their previous 1956 study and authorized by Congress in 1958. It offers protection for most of the harbor and nearly all of the proposed anchorage areas with relatively short breakwaters. Assuming that both halves of the breakwater would extend from the mean low water line to the edge of the entrance channel, the western (W1) breakwater would be 900 feet long at the eastern (E1) breakwater would be 975 feet long.

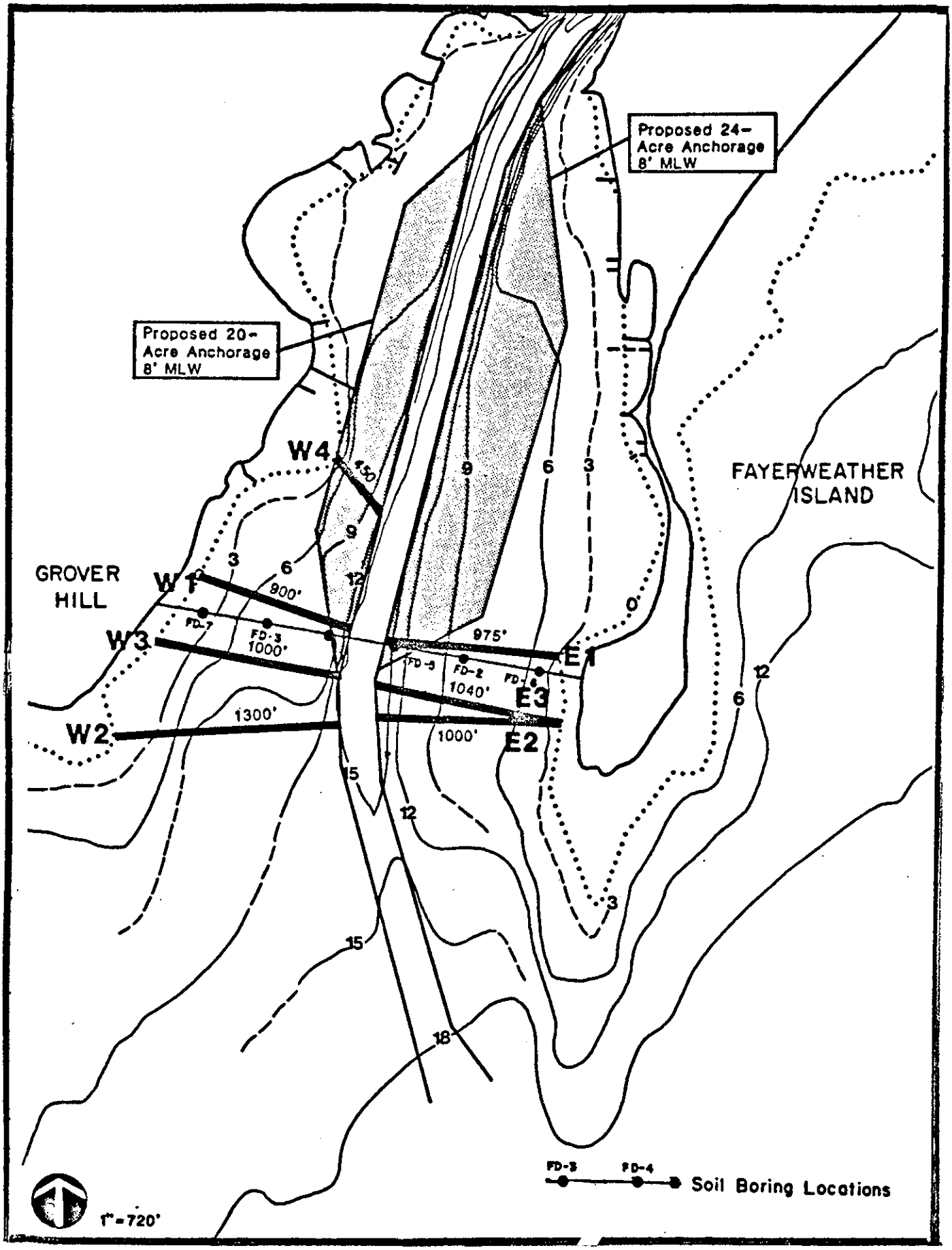
The design wave parameters were developed and used to determine the height, crest width, and slope of the breakwaters. The parameters are shown in Table 14.

Table 14
Design Wave Parameters

Breakwater	Deepwater Wave	Incident Wave
West 1	Direction: SSE	Angle 45°
	H_o : 7.0 ft.	H_s : 5.5 ft
	T : 5.6 sec	H_{10} : 6.5 ft
	L_o : 161 ft	L : 123 ft
East 1	Direction: SE	Angle 90°
	H_o : 8.0 ft.	H_s : 4.5 ft
	T : 6.0 sec	H_{10} : 5.5 ft
	L_o : 184 ft	L : 135 ft
East 2	Direction: SE	Angle 90°
	H_o : 8.0 ft.	H_s : 5.5 ft
	T : 6.0 sec	H_{10} : 6.5 ft
	L_o : 184 ft	L : 135 ft

H_o = Deepwater Wave Height
H_s = Significant Wave Height
H_{10} = Average of Highest 10 Percent Waves
T = Wave Period
L_o = Deepwater Wave Length
L = Shallow Water (Incident) Wave Length
Angle = Angle of Incident Wave Approach to Breakwater

The crest or top elevation of both breakwaters would be 15 feet above mean low water. Both the seaward and harbor slopes would be 1.5 horizontal on 1.0 vertical. The armor stone for the western arm would consist of 4.5 feet of two layers of 750- to 1250-pound stone; the bedding stone would consist of two layers of 70- to 130-pound stone, and the core stone would vary from 1 to 70 pounds.



Alternative Breakwater Study
BLACK ROCK HARBOR ENTRANCE
Bridgeport, Connecticut

ALTERNATIVE BREAKWATER LOCATIONS

PLATE 2-1

The armor stone for the eastern arm would consist of 3.5 feet of two layers of 400- to 700-pound stone. The bedding stone would consist of two layers of 40- to 70-pound stone, and the core stone would vary from 1 to 40 pounds.

Approximately 20 feet or organic silt would be removed under both breakwaters and replaced with dumped sandfill. The breakwater cross-sectional details are shown on Plate 2.

CONCLUSIONS

The 44 acres of anchorage behind the considered rock breakwaters in Black Rock Harbor and the 28-acre mooring basin in Cedar and Burr Creeks would provide safe mooring spaces for the existing and prospective recreational boating fleet. The breakwaters were determined during the final detailed study phase to be no longer economically justified and were dropped for further consideration.

SECTION B - COST ESTIMATES

INTRODUCTION. This part of the appendix presents information pertaining to estimates of first costs, investments, annual maintenance cost and annual charges pertaining to the considered structural alternatives for modifying the existing navigation project in Bridgeport Harbor and vicinity in the interest of commercial and recreational navigation.

PLAN DESCRIPTIONS. The descriptions of the alternative plans considered for commercial navigation improvements are as follows:

Plan A

Bridgeport Harbor

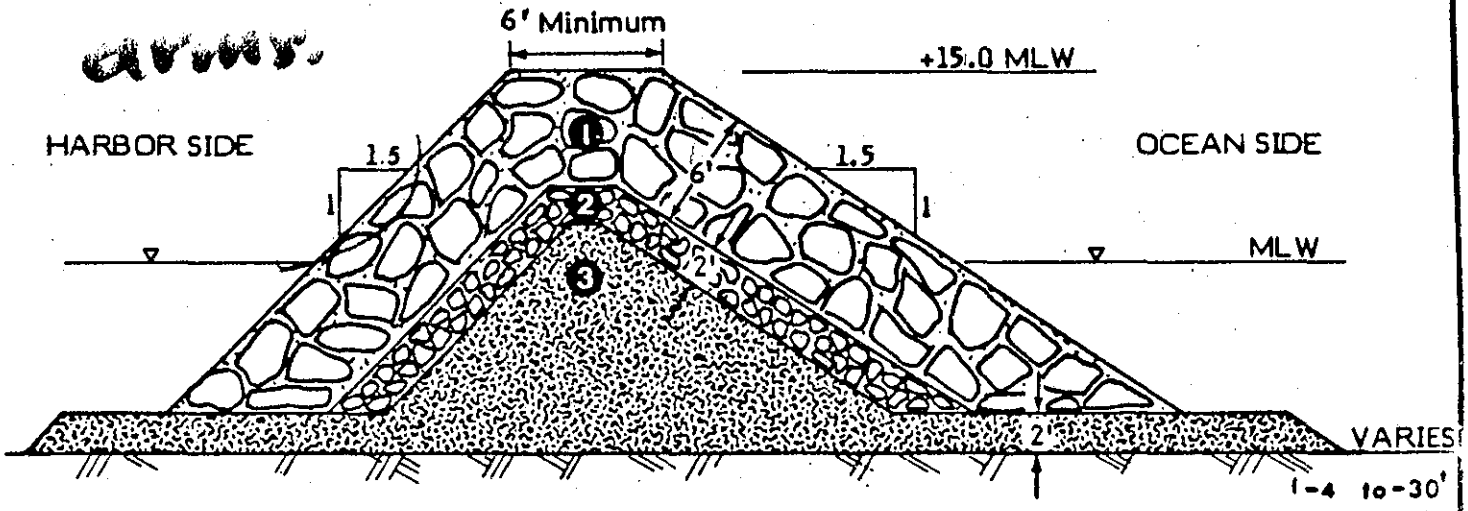
Enlarge the existing 23-acre, 35-foot-deep turning basin by deepening 10 acres at the northwestern side of the existing 25-foot-deep anchorage (immediately seaward of the turning basin) to 35 feet. An additional 10 acres (now having depths in excess of 25 feet) at the southeast side of the anchorage would be designated as part of the 25-foot anchorage.

Plan B

Bridgeport Harbor

Deepen the existing entrance channel, and turning basin and the inner harbor channel upstream to the Yellow Mill Channel to 38 feet MLW, enlarge the turning basin by deepening 10 acres of the 25-foot anchorage to 38 feet, and designate an additional 10 acres (now having 25-foot depth) as part of the 25-foot anchorage.

This plate is being revised to reflect actual dimensions selected for east and west breakwater arms.



TYPICAL CROSS SECTION WITH CREST ELEVATION 15.0' MLW

Scale 1" - 10'

MATERIALS: ❶ 2 Ton Stone Armor OR Concrete Armor Units (3.3')
❷ Filter Layer of 300# to 500# Stone (1.4' - 1.7')
❸ Core and Bedding of 1# to 30# Stone (2.5" - 8")

CREST ELEVATION: Crest Elevation may vary from 8' MLW to >15' MLW

Alternative Breakwater Study
BLACK ROCK HARBOR ENTRANCE
Bridgeport, Connecticut

RUBBLE MOUND BREAKWATER

PLATE 2-2

Plan C

Bridgeport Harbor

Deepen the existing entrance channel, inner harbor channel upstream to Yellow Mill Channel and turning basin to 40 feet MLW, enlarge the turning basin by deepening 10 acres of the 25-foot anchorage to 40 feet, and designate an additional 10 acres (now having 25-foot depth) as part of the 25-foot anchorage.

Plan D

Bridgeport Harbor

Deepen the existing entrance channel, inner harbor channel upstream to the Yellow Mill Channel and turning basin to 41 feet MLW, enlarge the turning basin by deepening 10 acres of the 25-foot anchorage to 41 feet, and designate an additional 10 acres (now having 25-foot depth) as part of the 25-foot anchorage.

Plan E

Bridgeport Harbor

Deepen the existing entrance channel, inner harbor channel upstream to the Yellow Mill Channel and turning basin to 42 feet MLW, enlarge the turning basin by deepening 10 acres of the 25-foot anchorage to 42 feet, and designate an additional 10 acres (now having 25-foot depth) as part of the 25-foot anchorage.

Plan F

Bridgeport Harbor

Deepen the existing entrance channel, inner harbor channel upstream to the Yellow Mill Channel and turning basin to 43 feet MLW, enlarge the turning basin by deepening 10 acres of the 25-foot anchorage to 43 feet, and designate an additional 10 acres (now having 25-foot depth) as part of the 25-foot anchorage.

Plan G

Bridgeport Harbor

Deepen the existing entrance channel, inner harbor channel upstream to the Yellow Mill Channel and turning basin to 50 feet MLW, enlarge the turning basin by deepening 10 acres of the 25-foot anchorage to 50 feet, and designate an additional 10 acres (new having 25-foot depth) as part of the 25-foot anchorage.

Plan H

Black Rock Harbor

Dredge a 6-foot-deep, 28-acre mooring basin in Burr Creek and along the east side of Cedar Creek, opposite Burr Creek, for the mooring of recreational boats.

Plan I

Black Rock Harbor

Construct two rubble mound breakwaters (900-foot-long western arm and 975-foot-long eastern arm) at the entrance to Black Rock Harbor and dredge two anchorage areas (20-acre western basin and 24-acre eastern basin, both 8 feet deep) behind the breakwaters. Both breakwater arms would begin at the MLW line away from the shore to allow for tidal circulation, and a 200-foot-wide center opening between the breakwaters would be provided to allow for the existing 18-foot-deep Black Rock Harbor Channel.

Johnsons Creek

Dredge a 6-foot-deep. 3-acre anchorage at the northwest side of Johnsons Creek for the mooring of recreational boats. City officials requested that the anchorage be droppped from consideration upon learning that the proposed moorings would not likely be fully used as yacht club members indicated that the moorings would be too remote from their yacht club facilities.

PLAN COSTS. The estimated costs for each of the alternative structural plans considered were based on October 1982 prices. Contingency for the breakwaters and the dredging was based on 25 percent. Contingencies for engineering and design and for administration and supervision varied from 3 to 6 percent, depending upon the size of each project element.

Dredging would be performed by clamshell-type dredges and material transported by scows about 15 miles southeastward to the Central Long Island Sound Disposal Area, where it would be point-dumped.

Component costs and quantities, first costs and annual charges for Plans A through I are shown in Tables 15 through 23.

TABLE 15
(35-Foot Channel)

Navigation Improvements of Bridgeport, Connecticut
Estimated Project Investment Including First Costs and Annual Charges

PLAN A

(Enlarge Existing 35-Foot-Deep Turning Basin by Deepening 10 Acres of Existing 25-Foot-Deep Anchorage to 35 Feet)

Feature		Amount
Dredging 30,000 c.y. @ $5.50/c.y.		$165,000
Contingencies (25%)		$ 42,000
Construction Cost		$207,000
Engineering & Design (5%)		$ 10,000
Supervision and Administration (6%)		$ 13,000
	Subtotal:	$230,000
Enlarging Private Berths		None
Navigation Aids		$ 2,500
TOTAL ESTIMATED FIRST COST		$232,500
Interest During Construction (1 month)		$ 1,500
Total Estimated Project Investment		$234,000

Annual Charges

Total Project Investment $234,000	
Interest & Amortization (7-7/8%, 50 yrs)	$19,000
Annual Maintenance (1% per year)	$ 3,000
TOTAL ANNUAL COST	$22,000

TABLE 16

Navigation Improvements at Bridgeport, Connecticut
Estimated Project Investment Including First Costs and Annual Charges

PLAN B
(38-Foot Channel)

(Deepening Existing 35-Foot Channel and Turning Basin to 38 Feet to Yellow Mill Channel and Enlarge Existing Turning Basin by Deepening 10 acres of Existing 25-Foot Anchorage to 38 Feet)

Feature		Amount
Dredging 1,240,000 c.y. @ $3,75/c.y.		$4,650,000
Contingencies (25%)		$1,160,000
Construction Cost		$5,810,000
Engineering and Design (4%)		$ 230,000
Supervision and Administration (4%)		$ 230,000
	Subtotal:	$6,270,000
Enlarging Private Berths		$1,000,000
Navigation Aids		$ 6,000
TOTAL ESTIMATED FIRST COST		$7,274,000
Interest During Construction (7 months)		$ 145,000
Total Estimated Project Investment		$7,421,000
Annual Charges		
Total Project Investment $7,421,000		
Interest & Amortization (7-7/8%, 50 yrs)		$598,000
Annual Maintenance (1% per year)		$ 70,000
TOTAL ANNUAL COST		$668,000

TABLE 17

Navigation Improvements at Bridgeport, Connecticut
Estimated Project Investment Including First Costs and Annual Charges

PLAN C
(40-Foot Channel)

(Deepen Existing Channel and Turning Basin to 40 Feet to Yellow Mill Channel and Enlarge Existing Turning Basin by Deepening 10 Acres of Existing 25-Foot Anchorage to 40 Feet)

Feature		Amount
Dredging 1,710,000 c.y. @ $3.65/c.y.		$6,240,000
Contingencies (25%)		$1,560,000
Construction Cost		$7,800,000
Engineering and Design (4%)		$ 310,000
Supervision and Administration (4%)		$ 310,000
	Subtotal:	$8,420,000
Enlarging Private Berths		$ 1,400,000
Navigation Aids		$ 10,000
TOTAL ESTIMATED FIRST COST		$ 9,830,000
Interest During Construction (8 months)		$ 295,000
Total Estimated Project Investment		$10,125,000
Annual Charges		
Total Project Investment $10,125,000		
Interest & Amortization (7-7/8%, 50 yrs)		$816,000
Annual Maintenance		$100,000
TOTAL ANNUAL COST		$916,000

TABLE 18

Navigation Improvements at Bridgeport, Connecticut
Estimated Project Investment Including First Costs and Annual Charges

PLAN D
(41-Foot Channel)

(Deepen Existing 35-Foot Channel and Turning Basin to 41 Feet to Yellow Mill Channel and Enlarge Existing Turning Basin by Deepening 10 Acres of Existing 25-Foot Anchorage to 41 Feet)

Feature		Amount
Dredging 2,000,000 c.y. @ $3.60/c.y.		$7,200,000
Contingencies (25%)		$1,800,000
Construction Cost		$9,000,000
Engineering and Design (4%)		$ 360,000
Supervision and Administration (4%)		$ 360,000
	Subtotal:	$9,720,000
Enlarging Private Berths		$ 1,700,000
Navigation Aids		$ 10,000
TOTAL ESTIMATED FIRST COST		$11,430,000
Interest During Construction (8 months)		$ 343,000
Total Estimated Project Investment		$11,773,000
Annual Charges		
Total Project Investment $11,773,000		
Interest & Amortization (7-7/8%, 50 yrs)		$ 949,000
Annual Maintenance (1% per year)		$ 123,000
TOTAL ANNUAL COST		$1,072,000

TABLE 19

Navigation Improvements at Bridgeport, Connecticut
Estimated Project Investment Including First Costs and Annual Charges

PLAN E
(42-Foot Channel)

(Deepen Existing 35-Foot Channel and Turning Basin to 42 Feet to Yellow Mill Channel and Enlarge Existing Turning Basin by Deepening 10 Acres of Existing 25-Foot Anchorage to 42 Feet)

Feature		Amount
Dredging 2,620,000 c.y. @ $3.50/c.y.		$9,170,000
Contingencies (25%)		$2,290,000
Construction Cost		$11,460,000
Engineering and Design (4%)		$ 450,000
Supervision and Administration (4%)		$ 450,000
	Subtotal:	$12,360,000
Enlarging Private Berths		$ 2,000,000
Navigation Aids		$ 10,000
TOTAL ESTIMATED FIRST COST		$14,370,000
Interest During Construction (8 months)		$ 431,000
Total Estimated Project Investment		$14,801,000
Annual Charges		
Total Project Investment $14,801,000		
Interest & Amortization (7-7/8%, 50 yrs)		$1,193,000
Annual Maintenance (1% per year)		$ 149,000
TOTAL ANNUAL COST		$1,342,000

TABLE 20

Navigation Improvements at Bridgeport, Connecticut
Estimated Project Investment Including First Costs and Annual Charges

PLAN F
(43-Foot Channel)

(Deepen Existing 35-Foot Channel and Turning Basin to 43 Feet to Yellow Mill Channel and Enlarge Existing Turning Basin by Deepening 10 Acres of Existing 25-Foot Anchorage to 43 Feet)

Feature		Amount
Dredging 3,080,000 c.y. @ $3.45/c.y.		$10,630,000
Contingencies (25%)		$ 2,660,000
Construction Cost		$13,290,000
Engineering and Design (4%)		$ 530,000
Supervision and Administration (4%)		$ 530,000
	Subtotal:	$14,350,000
Enlarging Private Berths		$ 2,200,000
Navigation Aids		$ 10,000
TOTAL ESTIMATED FIRST COST		$16,560,000
Interest During Construction (17 months)		$ 497,000
Total Estimated Project Investment		$17,057,000
Annual Charges		
Total Project Investment $17,057,000		
Interest & Amortization (7-7/8%, 50 yrs)		$1,374,000
Annual Maintenance (1% per year)		$ 171,000
TOTAL ANNUAL COST		$1,545,000

TABLE 21

Navigation Improvements at Bridgeport, Connecticut
Estimated Project Investment Including First Costs and Annual Charges

PLAN G
(50-Foot Channel)

(Deepen Existing 35-Foot Channel and Turning Basin to 50 Feet to Yellow Mill Channel and Enlarge Turning Basin by Deepening 10 Acres of Existing 25-Foot Anchorage to 50 Feet)

Feature	Amount
Dredging 6,340,000 c.y. @ $3.25/c.y.	$20,600,000
Contingencies (25%)	$ 5,150,000
Construction Cost	$25,750,000
Engineering and Design (3%)	$ 775,000
Supervision and Administration (3%)	$ 775,000
Subtotal:	$27,300,000
Enlarging Private Berths	$ 3,300,000
Navigation Aids	$ 15,000
TOTAL ESTIMATED FIRST COST	$30,615,000
Interest During Construction (20 months)	$ 2,435,000
Total Estimated Project Investment	$33,050,000
Annual Charges	
Total Project Investment $33,050,000	
Interest & Amoritization (7-7/8%, 50 yrs)	$2,663,000
Annual Maintenance (1% per year)	$ 313,000
TOTAL ANNUAL COST	$2,976,000

TABLE 22

Navigation Improvements at Bridgeport, Connecticut
Estimated Project Investment Including First Costs and Annual Charges

PLAN H
Burr and Cedar Creeks Mooring Basin
(Dredge 28-Acre Mooring Basin 6 Feet Deep)

Feature		Amount
Dredging 165,000 c.y. @ $5.50/c.y.		$ 908,000
Contingencies (25%)		$ 227,000
Construction Cost		$1,135,000
Engineering & Design (5%)		$ 57,000
Supervision and Administration (6%)		$ 68,000
	Subtotal:	$1,260,000
Enlarging Private Berths		None
Navigation Aids		$ 3,000
TOTAL ESTIMATED FIRST COST		$1,263,000
Interest During Construction (8 months)		$ 32,000
Total Estimated Project Investment		$1,295,000
Annual Charges		
Total Project Investment $1,295,000		
Interest & Amortization (7-7/8%, 50 yrs)		$104,000
Annual Maintenance (2% per year)		$ 26,000
TOTAL ANNUAL COST		$130,000

TABLE 23
Navigation at Bridgeport, Connecticut
Estimated Project Investment Including First Costs and Annual Charges

PLAN I
Black Rock Harbor Breakwaters and Anchorages

(Construct two entrance channel rock breakwaters and dredge 20-acre and 24-acre anchorages 8 feet deep)

Feature		Amount
Two Breakwaters		
Dredging and Disposal	319,000 c.y. @ $5.50	$1,750,000
Dumped Sandfill	253,000 c.y. @ $10.00	2,530,000
Armor Stone 750-1250#	17,000 ton @ $26.00	440,000
Armor Stone 400-700#	18,400 ton @ $25.00	460,000
Bedding Stone 40-70#	15,000 ton @ $18.00	360,000
Core Stone Chips	70,200 ton @ $18.00	1,260,000
		$6,800,000
Contingencies (25%)		$1,700,000
Construction Cost		$8,500,000
Engineering and Design (4%)		$ 350,000
Supervision and Administration (4%)		$ 350,000
	Subtotal:	$9,200,000
Two Anchorages		
Dredging and Disposal		
(a) 20-acre anchorage	47,000 c.y. @ $5.50	$260,000
(b) 24-acre anchorage	68,000 c.y. @ $5.50	$375,000
		$635,000
Contingencies (25%)		$160,000
Construction Cost		$795,000
Engineering and Design (4%)		$ 34,000
Supervision and Administration (4%)		$ 34,000
		$863,000
Navigation Aids		$ 7,000
	Subtotal:	$870,000
TOTAL ESTIMATED FIRST COST		$10,070,000
Interest During Construction (20 months)		$ 801,000
Total Estimated Project Investment		$10,871,000
Annual Charges		
Total Project Investment $10,871,000		
Interest & Amortization (7-7/8%, 50 yrs)		$ 876,000
Annual Maintenance (2% per year)		$ 204,000
TOTAL ANNUAL COST		$1,080,000

CONSTRUCTION

If this report is authorized and funds for its implementation are made available in a timely manner, construction of the Bridgeport Harbor project element would take 8 months using two large dredges. Construction of the Burr and Cedar Creeks mooring basin, which would be dredged concurrently with the Bridgeport Harbor project element, would require approximately 8 months using a smaller, third dredge. Work would be carried out only from October through May to minimize adverse impacts to oyster beds in Black Rock Harbor and immediately outside Bridgeport Outer Harbor.

Construction of the project elements would be accomplished by clamshell type dredge. An additional 2 feet of overdepth dredging would be allowed at Bridgeport Harbor (1 foot at Burr and Cedar Creeks) to account for dredging inaccuracies. Strict dredging controls would be needed along the main ship channel immediately seaward of the two existing breakwaters to assure that excessive overdredging of the 400-foot channel width did not occur, as productive top-of slope oyster harvesting grounds exist along both sides of the entrance channel. Dredged material would be transported in bottom-dumping scows and point-dumped at the Central Long Island Sound Disposal Area. The site has ample capacity to receive the proposed dredged material volume of nearly 2.9 million cubic yards.

OPERATION AND MAINTENANCE

The selected plan calls for materials from future maintenance dredging to be placed at the Central Long Island Sound Disposal Area. It is estimated that additional maintenance dredging required would be about every 10 years (at an estimated annual shoaling rate of 24,000 cubic yards), as the two principal harbors in Bridgeport have experienced slightly less than half of the two percent shoaling rate typically experienced along the western Connecticut coast. The U.S. Coast Guard would maintain all navigation aids annually and relocate or replace buoys as needed.

APPENDIX 3

ECONOMICS

BRIDGEPORT HARBOR, CT AND VICINITY

BRIDGEPORT HARBOR, CONNECTICUT

APPENDIX 3

ECONOMICS

APPENDIX 3
ECONOMICS
BRIDGEPORT HARBOR, CT AND VICINITY

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Methodology

The economic justification of the proposed improvements was determined by comparing the average annual benefits accruing to the project over its economic lifespan to the equivalent average annual costs. In general, the benefits should exceed the costs for the federal Government to participate in the project, but nonquantifiable environmental quality considerstions may also lead a plan to be recommended.

Benefits and costs are compared by putting them on an average annual basis using the interest and amortization rate of 7-7/8% currently applicable to federal projects. The economic life of the project is considered to be 50 years.

Costs

First costs have been estimated for the alternative plans of improvement. Investment costs were also computed by adding the cost of interest during construction. The estimate of annual costs is based on a 50-year project life and an interest rate of 7-7/8%. Annual costs include expenditures for annual maintenance dredging required for the incremental channel dimensions. Costs of reconstruction of bulkheads and dredging of private, deep-draft berths are also estimated and included in project costs. Annual costs are summarized in Table 1. A detailed breakdown of project costs is presented in Appendix 2, "Engineering Design and Cost Estimates."

redundant from

Benefits

The proposed project would accrue both deep draft navigation and recreational boating benefits. The navigation benefits would be derived from projected savings in the cost of transporting petroleum products on the improved waterway. They would arise through the use of larger vessels to obtain efficiencies of scale and reduced transportation costs. More efficient use of existing vessels would also occur due to reductions, in tidal delays, lightering and the necessity for multiport operations.

The considered dredging of 28 acres of mooring area at Burr and Cedar Creeks at the head of Black Rock Harbor, the construction of two breakwaters at the harbor's entrance and the dredging of 44 acres of anchorage behind them would result in recreational boating benefits. These benefits would arise from the provision of moorings for 456 additional recreational vessels.

Table 1A Bridgeport Harbor
Annual Costs

Main Ship Channel

Depth-38 Feet	
Investment Cost	$ 7,421,000
Interest and Amortization (7-7/8%, 50 years)	$ 598,000
Annual Maintenance	$ 70,000
TOTAL ANNUAL COSTS	$ 668,000
Depth-40 Feet	
Investment Costs	$10,125,000
Interest and Amortization (7-7/8%, 50 years)	$ 816,000
Annual Maintenance	$ 100,000
TOTAL ANNUAL COSTS	$ 916,000
Depth-41 Feet	
Investment Cost	$11,773,000
Interest and Amortization (7-7/8%, 50 years)	$ 949,000
Annual Maintenance	$ 123,000
TOTAL ANNUAL COSTS	$ 1,072,000
Depth-42 Feet	
Investment Costs	$14,801,000
Interest and Amortization (7-7/8%, 50 years)	$ 1,193,000
Annual Maintenance	$ 149,000
TOTAL ANNUAL COSTS	$ 1,342,000
Depth-43 Feet	
Investment Costs	$17,057,000
Interest and Amortization (7-7/8%, 50 years)	$ 1,374,000

Annual Maintenance	$ 171,000
TOTAL ANNUAL COSTS	$ 1,545,000
Depth-50 Feet	
Investment Costs	$33,050,000
Interest and Amortization (7-7/8%, 50 years)	$ 2,663,000
Annual Maintenance	$ 313,000
TOTAL ANNUAL COSTS	$ 2,976,000

Table 1B Black Rock Harbor
Annual Costs

Breakwater and Anchorages

Investment Cost	$10,871,000
Interest and Amortization (7-7/8%, 50 years)	876,000
Annual Maintenance (2% of construction cost)	$ 204,000
Annual Cost	$ 1,090,000

Table 1C Cedar and Burr Creeks
Annual Costs

Investment Cost	$ 1,295,000
Interest and Amortization (7-7/8%, 50 years)	104,000
Annual Maintenance (2% of construction cost)	26,000
Annual Cost	$ 130,000

Improved safety, though not directly quantifiable, would also be a significant benefit. The risk of collisions and/or groundings is partially dependent on the density of traffic. Deepening the channel would enable larger vessels to make fewer total trips, thus decreasing traffic and improving safety. The deepening would also allow vessels which currently must move within a few hours of high tide to use the waterway 24 hours a day, thereby reducing peak hour congestion.

The proposed deepening, by allowing for safer passage of ships and barges, would also result in a reduction in the risk of a major pollution incident occurring. By decreasing the need for existing vessels to engage in tanker-to-barge lightering operations, the proposed project would further minimize the potential for oil spills. The prevention of a pollution event involving oil or chemicals could mean saving millions of dollars in cleaning costs and lost income to the oyster industry. (Although the use of larger vessels would reduce the expected frequency of an oil spill, the expected magnitude of the spill could increase.)

Economic Study Area and Transportation Network

Bridgeport is located approximately 50 miles northeast of Metropolitan New York on Long Island Sound. The primary tributary area served by the harbor is southwestern Connecticut. A secondary tributary area extends to western Massachusetts, southeastern New York and southern Vermont.

All modes of public, private and commercial transportation generally used in the United States are available within the Bridgeport SMSA. The area is served by extensive highway and roadway systems including Interstate 95, State Highways 8, 15 and 25. Daily passenger and freight rail service is provided to cities throughout the northeast by Conrail and Amtrak. Sikorsky Memorial Airport, located in Bridgeport, provides facilities for both commercial and general aviation and five transit companies provide regularly scheduled bus service along routes in Bridgeport, Fairfield, Stratford, and a portion of Trumbull.

Other nearby transportation facilities include major ports and airports in Connecticut, Massachusetts, New York and New Jersey; a number of Interstate and State highways; and rail service connections to most of the Northeastern United States and portions of Canada. These transportation facilities afford the region an extensive market for goods and services within a one to two-day delivery area.

Transportation within the SMSA, is usually by private automobile, bus, train, or taxi. A small percentage of passenger transportation is provided by private aircraft, boats or ferry. Freight is primarily carried by truck, freighter or barge. Rail transport also accounts for a notable volume of freight within the region.

Type and Volumes of Commodity Flows

next page

Bridgeport is one of the 10 largest ports in New England, as shown in Table 2, and the second largest in Connecticut. Bridgeport facilities typically ship and receive about 3.5 million tons of waterborne commerce each year. A comparative statement of commerce for the 12-year period 1970-1981 appears in Table 3. An historical summary of commerce for that same period is presented in Table 4.

The primary commodity group is petroleum products and crude petroleum, which over the past 12 years averaged 85 percent of total waterborne commerce. (See Table 5).

Other major commodity groups are primary metal products, nonmetallic minerals, and sand, gravel and crushed rock.

Bridgeport waterborne commerce statistics for the period 1972-1981, as shown in Table 5, reveal a small decrease in oil receipts as a percentage of total receipts. The decrease in waterborne commerce from 1970-1980 was 16.9 percent, with a 0.6 percent increase in 1981. In 1971, 1528 inbound trips were recorded, of which 72 inbound vessels had drafts of 30 to 38 feet. Traffic by comparison in 1981, as shown in Table 6, dropped to 1403 inbound trips, of which only 46 inbound vessels had drafts of 30 to 34 feet because of changed conditions (economic recession, high interest rates, several shoals in maneuvering areas and some increase in the use of barges). A detailed listing of 1981 freight traffic by commodity is presented in Table 7.

Projections of Petroleum Product Shipments

In order to formulate plans for port maintenance and improvement, the New England Division of the U.S. Army Corps of Engineers retained Resource Planning Associates, Inc. (RPA) to project shipments of petroleum products through the 17 major ports in New England including Bridgeport Harbor in 1979. To carry out the study various forecasts of demand for petroleum products for the New England region as a whole were surveyed. The projections of the U.S. Department of Energy, Energy Information Administration (EIA) were selected as the most comprehensive and accurate estimates of the region's future use of six principal petroleum products: residual, distillate, gasoline, jet fuel, liquid gas and naptha. Using these projections and data developed on product consumption among the states in 1977, RPA estimated the amount of each fuel that will be shipped through each major port in 1985, 1990 and 1995.

RPA concluded that shipments of petroleum products through New England ports will decrease in the long run. After an increase in the short term, total volume will begin to decline. The most rapid declines in petroleum product consumption are anticipated to occur in the electric utilities and industrial sector, where residual and distillate fuels will be increasingly replaced by coal. Consumption in the residential, commercial and transportation sectors is expected to remain relatively constant over time.

The specific projections for the port of Bridgeport are presented in Table 8, RPA's projections end in 1995 due to the extremely unpredictable nature of the petroleum industry. Projected commerce was therefore held constant for the years following 1995. Discussions with United Illuminating in 1982, the major importer of residual fuel oil, however, indicated that there should be a slight increase from 19185 to 1990 after a decrease from 1980 to 11985 in residual receipts. These indications are based on a continuing use of oil and no coal conversions (see Table 18).

Table 2

Total Waterborne Commerce and Petroleum Commerce

in the Ten Largest New England Ports

(in Short Tons)

1981

Port	Total Tonnage	Petroleum Tonnage	Percent Petroleum
Boston, MA	20,306,450	18,325,575	90.2 86.4 w/o Mystic & Chelsea
Portland, ME	14,752,985	14,010,759	95.0
New Haven, CT	9,085,423	8,082,443	89.0
Chelsea River, MA (Incl in Boston)	7,513,060	7,055,630	93.9
Providence, RI	7,043,882	6,251,613	88.8
Mystic River, MA (Incl in Boston)	6,325,473	5,683,820	89.9
Fall River, MA	3,635,123	3,581,260	98.5
Bridgeport, CT	3,212,851	2,723,767	84.8
Portsmouth, NH	3,072,214	2,491,149	81.1
Connecticut River Below Hartford, CT	1,801,032	1,799,886	99.9

6467 917

Table 3

Comparative Statement of Commerce

Bridgeport Harbor, Connecticut

Year	Short Tons	Percent Increase/Decrease
1981	3,212,851	0.6
1980	3,194,618	-1.5
1979	3,243,301	-13.2
1978	3,735,609	6.9
1977	3,495,140	7.0
1976	3,265,113	14.2
1975	2,860,171	-13.2
1974	3,295,195	-7.3
1973	3,553,980	2.4
1972	3,471,623	-2.2
1971	3,548,554	-7.7
1970	3,843,722	None

Table 4

Historical Summary of Commerce*

Bridgeport Harbor, Connecticut

(Short Tons)

		Foreign		Domestic		
				Coastwise		
Year	Total	Imports	Exports	Receipts	Shipments	Local
1981	3,212,851	1,069,635	7,043	1,490,688	323,833	84,047
1980	3,194,618	1,059,640	34,109	1,663,537	422,532	14,800
1979	3,243,301	1,092,271	53,821	1,945,961	151,216	N.A.
1978	3,735,609	1,550,052	32,153	2,057,071	93,295	3,038
1977	3,495,140	1,228,664	42,956	2,107,875	112,500	3,145
1976	3,265,113	993,408	40,387	2,089,094	130,920	11,304
1975	2,860,171	748,268	48,343	1,963,251	67,183	33,118
1974	3,295,195	1,786,268	50,624	1,285,394	100,126	72,781
1973	3,553,980	1,741,783	81,343	1,484,367	111,473	135,014
1972	3,471,632	1,759,438	4,501	1,446,937	127,260	133,487
1971	3,548,554	1,658,285	38,977	1,530,043	279,272	41,973
1970	3,843,722	2,134,371	122,640	1,360,535	197,843	38,331

*Waterborne Commerce of the U.S. Waterways and Harbors, Atlantic Coast, Calendar Years 1970-1981, Department of the Army, Corps of Engineers.

Table 5
Bridgeport Harbor
Commodity Traffic, 1972-1981

Year	Leading Commodity	Leading Commodity Group	Percent of Total Commerce	Other Significant Commodities
1981	Foreign Residual Fuel Oil	Petroleum Products	85%	Iron & Steel, Crude Petroleum, Lead, Zinc, Lumber
1980	"	"	81%	Iron & Steel, Nonmetallic Minerals, Sand, Gravel, Crushed Rock
1979	"	"	81%	Iron & Steel, Sand, Gravel, Crushed Rock, Lead, Zinc
1978	"	"	92%	Iron & Steel, Sand, Gravel, Crushed Rock, Copper Alloys
1977	"	"	82%	Iron & Steel, Lead, Zinc, Nonmetallic Minerals
1976	"	"	89%	Iron & Steel, Lumber, Sand, Gravel, Crushed Rock
1975	"	"	88%	Iron & Steel, Sand, Gravel, Crushed Rock Lumber
1974	"	"	85%	Iron & Steel, Nonmetallic Minerals, Lumber

1973	"	"	86%	Iron & Steel, Limestone, Lumber
1972	"	"	89%	Iron & Steel, Nonmetallic Minerals, Limestone

Table 6
1981 Trips and Drafts of Vessels at Bridgeport Harbor, CT*

	Self Propelled Vessels			Non-Self Propelled Vessels		
Draft (Feet)	Passenger and Dry Cargo	Tanker	Towboat or Tugboat	Dry Cargo	Tanker	Total
INBOUND						
34	1	8	-	-	-	9
33	6	-	-	-	-	6
32	14	3	-	-	-	17
31	5	1	-	-	-	6
30	6	-	-	-	2	8
29	10	1	-	-	11	22
28	7	2	-	-	-	9
27	4	2	-	-	1	7
26	11	-	-	-	3	14
25	4	3	-	-	1	8
24	4	-	-	-	2	6
23	7	1	-	-	6	14
22	4	-	-	-	-	4
21	7	-	-	-	5	12
20	3	-	-	-	4	7
19	4	-	-	-	3	7
18 and Less	16	113	651	20	447	1,247
Total	113	134	651	20	485	1,403
OUTBOUND						
34	-	1	-	-	-	1
33	-	-	-	-	-	-
32	2	-	-	-	-	2
31	-	1	-	-	-	-
30	4	-	-	-	1	5
29	8	1	-	-	2	11
28	11	1	-	-	-	12
27	8	-	-	-	1	9
26	10	2	-	-	-6	18
25	8	7	-	-	5	20
24	3	1	-	-	1	5
23	3	1	-	-	5	9
22	15	2	-	-	6	23
21	1	-	-	-	1	2
20	8	-	-	-	3	11
19	6	-	-	-	2	9
18 and Less	24	115	667	13	452	1,271
Total	111	132	667	13	485	1,408

*Source: Waterborne Commerce of the United States - Calendar Year 1981

Table 7
Bridgeport Harbor, Connecticut*
Freight Traffic, 1981
(Short Tons)

	Commodity	Total	Imports	Foreign Exports	Domestic Coastwise Receipts	Domestic Coastwise Shipments	Local
	Total	3,212,851	1,069,675	7,043	1,728,253	323,833	84,047
0911	Fresh Fish, Except Shellfish	47	47	-	-	-	-
0912	Shellfish, Except Prepared	41	41	-	-	-	-
1311	Crude Petroleum	91,380	-	-	70,218	-	21,162
1442	Sand, Gravel, Crushed Rock	22,743	-	-	22,743	-	-
1499	Nonmetallic Minerals, Nec	19,875	19,875	-	-	-	-
2061	Sugar	1,433	-	1,433	-	-	-
2421	Lumber	26,820	26,820	-	-	-	-
2341	Veneer, Plywood, Worked Wood	3,584	3,584	-	-	-	-
2491	Wood Manufactures, Nec.	2	2	-	-	-	-
2631	Paper and Paperboard	608	109	499	-	-	-
2711	Printed Matter	1	1	-	-	-	-
2911	Gasoline	664,973	664,973	-	664,350	623	-
2914	Distillate Fuel Oil	395,066	20,501	-	364,608	7,686	2,271
2915	Residual Fuel Oil	1,572,348	589,976	-	606,334	315,524	60,614
3281	Cut Stone and Stone Products	52	52	-	-	-	-
3314	Iron and Steel Primary Forms	323	323	-	-	-	-
3315	Iron, Steel Shapes, Exc. Sheets	288,192	288,192	-	-	-	-
3316	Iron amd Steel Plates, Sheets	44	44	-	-	-	-
3317	Iron and Steel Pipe & Tube	20,967	20,967	-	-	-	-
3318	Ferroalloys	29,627	29,627	-	-	-	-
3319	Iron & Steel Products, Nec	573	573	-	-	-	-
3321	Nonferrous Metals, Nec	790	790	-	-	-	-
3322	Copper Alloys, Unworked	10,683	10,683	-	-	-	-
3323	Lead and Zinc, Unworked	56,662	56,622	-	-	-	-
3324	Aluminum and Alloys, Unworked	799	799	-	-	-	-
3411	Fabricated Metal Products	1	1	-	-	-	-
3511	Machinery, Except Electrical	66	66	-	-	-	-
3611	Electrical Mach. & Equip.	1	-	1	-	-	-
3711	Motor Vehicles	2	-	2	-	-	-
4024	Paper Waste and Scrap	5,108	-	5,108	-	-	-
4112	Commodities, Nec	40	-	40	-	-	-

*Source: Waterbourne Commerce of the United States - Calendar Year 1981

Table 8

Projected Petroleum Commerce for Deep-Draft Traffic in Bridgeport *

(thousands of short tons)

COMMODITY PETROLEUM PRODUCTS	ACTUAL 1977	ACTUAL 1980	BASE YEAR 1985	YEAR 5 1990	YEAR 10 1995	YEAR 20 2005	YEAR 30 2015	YEAR 40 2025	YEAR 50 2035
Residual	1,242	1,364	1,317	1,179	799				709
Distillate	567	273	731	625	591				591
Gasoline	958	687	825	811	848				848
Jet Fuel	4	4	5	5	5				5
Other (kerosene, lubricating oils, greases, asphalt, tar, pitches)	1	0							
TOTALS	2,772	2,328	2,878	2,620	2,243				2,243

* Resource Planning Associates, Inc. 1979.

The major assumptions which underlie the RPA projections are as follows:

Supply-Related Assumptions

1. Crude oil prices to be decontrolled by 1981.

2. Natural gas prices to producers will be eliminated by the terms of the Natural Gas Policy Act of 1978.

3. Imports of Canadian and Mexican natural gas and liquified natural gas will be limited.

4. The price of natural gas imports under new contracts will be tied to the world market price of oil.

5. The Alaskan Natural Gas Pipeline will be completed by 1985.

6. The Trans-Alaskan Pipeline will be expanded to a capacity of 1.6 million barrels of oil a day by 1985, and to 2.2 million barrels a day by 1990.

7. The PACTEX oil pipeline will be the only oil pipeline link connecting the West Coast to the midwestern and southeastern pipeline networks.*

delete instead of footnoting

8. Export of domestically produced crude oil will not be permitted.

Demand-Related Assumptions

1. Only the coal-fired electric power plants currently in planning stages will be operating in 1985.

2. Diesel cars and light-duty trucks will achieve 9.4 and 7.8 percent shares of their respective markets by 1985. Thereafter, these shares will remain constant.

* This project was cancelled.

Current Vessel Fleet and Operating Costs

Most ships calling on the Port of Bridgeport are in the 20,000-40,000 DWT category with drafts ranging from 30 to 34 feet. Some 50,000 DWT vessels which are lightered or carrying part cargo do use the port. The size of vessels using Bridgeport in the recent past is indicated by Table 9 which shows trips and drafts of vessels from 1970 to 1981. It can be seen that the total number of ships calling on Bridgeport decreased about 21 percent during this time period. Drafts of newer ships range from 37 to 39 feet, but only ships drawing up to 34 feet have visited the port in recent years because of changed economic or local harbor conditions. Data from the

U.S. Coast Guard and field interviews indicate that anywhere from 30 to 50 percent of the petroleum coming into Bridgeport arrives by way of barge, while remaining oil arrives by tankers. Typical vessel dimensions and vessel operating costs are provided in Tables 10 and 11, respectively.

Domestic and World Fleet Trends

The average capacity of vessels being built in recent years has become greater. Table 12 shows the world tanker fleet as of 1975. It can be seen that the ships at the larger end of the scale are generally the newer ones.

Analysis of tank ships on order or under construction as shown in Table 13 reveals that the majority of U.S. ships being built as of 1975 were over 60,000 DWT. A 1978 Coast Guard study projected that no new U.S. tankers 40,000 DWT and under were expected to be built in the foreseeable future. The reason, according to the study, is that anticipated construction and expansion of domestic oil pipelines will sharply reduce the need for smaller oil tankers.

Over 80 percent of the petroleum tonnage at Bridgeport is carried in foreign ships. Trends in vessel shipping, therefore, take on added significance. Projections of the U.S fleet-Atlantic Coast for 1975-2000 are presented in Table 13.

Future Fleet at Bridgeport

The sizes of the deep draft vessels currently in use at Bridgeport, when fully loaded, are in general the maximum allowable given the present depth restriction. Although world and U.S. shipping trends show a movement toward larger vessels, the utilization of larger ships at Bridgeport will in most cases not be practical due primarily to the 35-foot channel limitation. An historical record of inbound tankers classified by drafts appears in Table 9.

If the project is implemented, it will be feasible to use larger vessels. Terminal operators at Bridgeport indicate that storage capacity and berthing facilities are both adequate for vessels of slightly larger dimensions. Various shipping interests indicate that the maximum size vessel which would call on Bridgeport would be a 70- to 80,000-DWT ship, depending on the extent to which the main channel is improved. It is felt that utilization of vessels larger than that would generally not occur because storage capacity and dock facilities do not appear to be adequate for ships of this size. At this point in time, there are no firm commitments to expand and improve facilities for such ships.

Table 9

HISTORICAL RECORD OF TRIPS AND DRAFTS OF TANKERS
(Inbound Only)

Draft (ft.)	Number of Trips Per Year											
	1981	1980	1979	1978	1977	1976	1975	1974	1973	1972	1971	1970
38	-	-	-	-	-	-	-	-	-	2	1	-
37	-	-	-	5	-	-	-	1	3	1	1	1
36	-	-	-	5	-	-	-	1	3	1	1	1
35	-	5	8	-	11	3	4	5	7	15	6	8
34	8	2	4	5	17	7	11	13	12	20	14	19
33	-	-	5	3	10	5	11	20	18	19	18	18
32	3	7	4	10	3	7	3	12	5	6	8	7
31	1	2	3	5	2	4	2	9	10	3	6	11
30	-	2	4	3	5	3	6	6	8	4	5	6
29	1	2	3	4	4	4	3	6	4	1	5	2
28	2	2	4	3	2	8	3	3	6	1	-	7
27	2	2	-	-	3	2	5	3	2	2	4	7
26	-	2	3	-	5	3	-	2	4	1	2	6
25	3	2	4	3	-	1	1	-	4	3	3	3
24	-	2	-	1	1	-	2	2	2	-	3	2
23	1	-	-	-	-	2	2	-	2	-	1	1
22	-	-	1	-	-	1	-	-	-	1	1	-
21	-	-	1	1	-	-	-	-	-	1	1	-
20	-	-	1	-	-	-	-	1	-	-	-	1
19	-	-	2	-	1	-	-	-	-	-	-	-
18 and less	113	76	84	104	55	44	56	20	35	87	120	105
TOTAL	134	106	131	148	119	96	112	106	128	170	203	209

Source: Waterborne Commerce of the United States, 1970 - 1981

Table 10

Typical Vessel Dimensions of Vessel Fleet
By Type and Deadweight Tonnage

Type	DWT	Vessel Characteristics Length (ft.)	Beam	Draft, Loaded
U.S. Flag Tankers				
	20,000	529	77	32
	30,000	582	83	32
	40,000	703	87	34.5
	50,000	677	96	39.5
	60,000	775	106	41
	70,000	800	116	42
Foreign Flag Tankers				
	20,000	529	77	32
	30,000	580	86	34
	40,000	622	95	37
	50,000	680	106	41.5
	60,000	693	107	43.5
	70,000	785	110	43.5
		Gross Tons		
Barge (57,000 Barrel) Capacity	3,374	335	64	23

Source: U.S. Maritime Administration, barge companies

Table 11
Vessel Hourly Operating Costs* (Tankers)

Vessel Size DWT	Foreign Flag At Sea($)	Foreign Flag In Port($)	US Flag At Sea($)	US Flag In Port($)
25,000	1,078	715	1,900	1,540
35,000	1,145	783	2.060	1,700
50,000	1,369	913	2,410	1,960
60,000	1,430	984	2,680	2,090
70,000	1,700	1,060	2,810	2,170
80,000	1,800	1,110	2,930	2,240
90,000	1,900	1,160	3,070	2,340
120,000	2,090	1,320	3,430	2,660

* derived from January 1981 WRSC data

Table 12
World Tank Ship Fleet (100,000 DWT and Below)
December 31, 1975

Deadweight Tonnage (Thousands)	Number	Average Age Years	Months
Under 10	740	9	9
10 to 15	230	15	5
15 to 20	577	18	10
20 to 30	734	14	7
30 to 40	557	12	9
40 to 50	310	14	1
50 to 60	215	12	8
60 to 70	167	10	8
70 to 80	191	8	6
80 to 90	170	6	3
90 to 100	120	8	0

Table 13

Projections of U.S. Fleet-Atlantic Coast
(Liquid Bulk Carriers

DWT (000)	Percent of Total Fleet 1975	1980	1985	1990	1995	2000
1-10	2	2	2	2	2	1
10-20	2	2	4	3	5	5
20-30	37	36	28	29	29	25
30-50	42	41	37	36	38	37
50-70	9	9	19	15	14	15
70-125	7	9	9	8	5	5
125-175	0	0	1	7	7	12
175-225	0	0	1	3	5	7
225-300	0	0	0	2	2	1
300+	0	0	0	0	0	3

Source: "A study of the future requirements for ships that will be engaged in the U.S. World Trade for both the short and long term" - 1976- Temple, Barker, Sloane, Inc.

Table 14

DEADWEIGHT TONNAGE ANALYSIS OF TANK SHIPS ON ORDER OR UNDER CONSTRUCTION
AS OF DECEMBER 31, 1975
OCEAN-GOING VESSELS 2,000 GROSS TONS AND OVER

DEADWEIGHT TONNAGE IN THOUSANDS	COUNTRY OF CONSTRUCTION													
	UNITED STATES		DENMARK		FRANCE		WEST GERMANY		ITALY		JAPAN		NETHERLANDS	
	NO.	D.W.T.	NO.	D.W.T.	NO.	D.W.T.	NO.	D.W.T.	NO.	D.W.T.	NO.	D.W.T.	NO.	D.W.T.
UNDER 10	0	0	0	0	0	0	21	134,970	6	43,750	14	80,700	5	12,550
10 to 20	0	0	0	0	2	28,420	5	75,000	0	0	7	95,000	1	18,400
20 to 30	0	0	0	0	9	216,370	0	0	0	0	7	197,200	2	44,000
30 to 40	11	391,600	6	188,000	0	0	2	79,000	10	302,000	20	690,600	4	130,200
40 to 50	0	0	0	0	2	80,000	4	160,000	2	87,400	5	236,400	0	0
50 to 60	0	0	0	0	10	538,000	0	0	0	0	6	323,200	2	110,000
60 to 70	15	956,660	0	0	8	504,480	2	134,000	0	0	11	680,266	0	0
70 to 80	0	0	0	0	0	0	0	0	0	0	1	76,669	0	0
80 to 90	18	1,614,600	0	0	2	173,800	0	0	0	0	54	4,669,450	0	0
90 to 100	0	0	0	0	0	0	0	0	4	360,000	5	458,000	0	0
100 to 110	0	0	0	0	0	0	7	729,500	6	628,740	12	1,226,200	0	0
110 to 120	1	118,300	0	0	0	0	0	0	0	0	3	354,000	0	0
120 to 130	0	0	0	0	0	0	0	0	2	256,000	15	1,827,300	0	0
130 to 140	0	0	0	0	0	0	1	135,000	5	695,000	27	3,675,800	0	0
140 to 150	0	0	0	0	0	0	1	142,950	0	0	6	865,400	0	0
150 to 160	0	0	0	0	0	0	0	0	0	0	6	908,530	0	0
160 to 170	6	960,000	0	0	3	500,355	0	0	0	0	1	165,000	0	0
170 to 180	0	0	0	0	0	0	0	0	0	0	1	177,000	0	0
180 to 190	0	0	0	0	0	0	0	0	0	0	1	180,000	0	0
190 to 200	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200 to 210	0	0	0	0	0	0	0	0	0	0	0	0	0	0
210 to 220	2	450,000	0	0	0	0	0	0	0	0	0	0	0	0
220 to 230	0	0	0	0	0	0	0	0	0	0	5	1,139,900	2	456,600
230 to 240	0	0	0	0	0	0	4	958,500	0	0	13	3,041,699	0	0
240 to 250	0	0	0	0	1	240,000	0	0	0	0	2	486,000	0	0
250 to 260	0	0	0	0	0	0	0	0	6	1,518,000	16	4,071,100	0	0
260 to 270	4	1,060,000	0	0	0	0	0	0	0	0	26	6,871,070	0	0
270 to 280	0	0	0	0	4	1,100,200	0	0	0	0	21	5,767,600	0	0
280 to 290	0	0	0	0	0	0	0	0	0	0	0	0	0	0
290 to 300	0	0	0	0	0	0	0	0	0	0	0	0	0	0
300 to 310	0	0	2	618,000	0	0	0	0	0	0	2	607,100	0	0
310 to 320	0	0	0	0	0	0	2	633,500	0	0	0	0	2	636,000
320 to 330	0	0	0	0	1	328,000	2	640,000	0	0	0	0	0	0
330 to 340	0	0	2	660,000	0	0	0	0	0	0	0	0	0	0
340 to 350	0	0	0	0	0	0	0	0	0	0	0	0	0	0
350 to 360	0	0	0	0	0	0	0	0	0	0	0	0	0	0
360 to 370	0	0	0	0	0	0	0	0	0	0	6	2,164,800	0	0
370 to 380	0	0	0	0	0	0	0	0	0	0	1	370,000	0	0
380 to 390	0	0	0	0	0	0	4	1,520,000	0	0	1	380,000	0	0
390 to 400	3	1,172,310	0	0	0	0	0	0	0	0	1	394,800	0	0
OVER 400	0	0	2	993,600	4	2,200,000	0	0	0	0	37	15,513,050	0	0
TOTAL	60	6,723,470	12	2,459,600	46	5,909,625	55	5,342,420	41	3,890,890	333	57,693,834	18	1,407,750

Table 14 (cont'd)

DEADWEIGHT TONNAGE ANALYSIS OF TANK SHIPS ON ORDER OR UNDER CONSTRUCTION
AS OF DECEMBER 31, 1975
OCEAN-GOING VESSELS 2,000 GROSS TONS AND OVER

DEADWEIGHT TONNAGE IN THOUSANDS	COUNTRY OF CONSTRUCTION													
	NORWAY		SPAIN		SWEDEN		U.K.		U.S.S.R.		OTHER		TOTAL	
	NO.	D.W.T.	NO.	D.W.T.	NO.	D.W.T.	NO.	D.W.T.	NO.	D.W.T.	NO.	D.W.T.	NO.	D.W.T.
UNDER 10	13	81,861	10	41,750	7	31,000	4	13,060	0	0	10	69,399	90	509,040
10 to 20	7	84,400	0	0	6	67,100	1	17,100	5	81,500	19	297,600	53	764,520
20 to 30	4	103,250	0	0	0	0	0	0	0	0	25	644,050	47	1,204,870
30 to 40	16	498,400	2	70,000	13	398,400	11	345,367	0	0	31	1,020,980	126	4,114,547
40 to 50	0	0	0	0	0	0	0	0	3	148,200	11	476,000	27	1,188,000
50 to 60	7	387,050	0	0	4	220,000	7	391,160	0	0	7	388,500	43	2,357,910
60 to 70	2	120,000	0	0	0	0	2	132,000	0	0	3	185,000	43	2,712,406
70 to 80	0	0	0	0	0	0	0	0	0	0	0	0	1	76,669
80 to 90	0	0	0	0	0	0	0	0	0	0	3	243,980	77	6,701,830
90 to 100	0	0	0	0	0	0	0	0	0	0	33	3,214,260	42	4,032,260
100 to 110	0	0	0	0	0	0	0	0	0	0	2	218,860	27	2,803,300
110 to 120	0	0	0	0	0	0	7	784,000	0	0	2	233,000	13	1,489,300
120 to 130	0	0	0	0	5	633,000	0	0	0	0	10	1,220,000	32	3,936,300
130 to 140	1	131,500	9	1,170,000	9	1,222,950	1	132,039	0	0	0	0	53	7,162,289
140 to 150	0	0	0	0	3	420,000	3	426,000	0	0	0	0	13	1,854,350
150 to 160	0	0	0	0	14	2,156,000	0	0	4	600,000	14	2,102,400	38	5,766,930
160 to 170	0	0	0	0	0	0	0	0	0	0	0	0	10	1,625,355
170 to 180	0	0	6	1,032,000	0	0	0	0	0	0	0	0	7	1,209,000
180 to 190	0	0	0	0	0	0	0	0	0	0	0	0	1	180,000
190 to 200	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200 to 210	0	0	0	0	0	0	0	0	0	0	4	805,000	4	805,000
210 to 220	0	0	0	0	0	0	0	0	0	0	0	0	0	0
220 to 230	0	0	0	0	0	0	0	0	0	0	2	450,000	11	2,496,500
230 to 240	0	0	3	709,500	4	932,000	0	0	0	0	3	690,000	27	6,331,699
240 to 250	0	0	0	0	0	0	0	0	0	0	0	0	3	726,000
250 to 260	0	0	0	0	0	0	2	516,000	0	0	4	1,034,300	28	7,139,400
260 to 270	0	0	6	1,560,000	0	0	5	1,305,000	0	0	4	1,060,000	45	11,856,070
270 to 280	0	0	3	823,195	0	0	0	0	0	0	5	1,378,000	33	9,068,995
280 to 290	1	283,000	0	0	0	0	0	0	0	0	0	0	1	283,000
290 to 300	0	0	0	0	0	0	0	0	0	0	0	0	0	0
300 to 310	0	0	4	1,200,077	0	0	0	0	0	0	6	1,800,000	14	4,225,177
310 to 320	0	0	0	0	1	317,000	3	939,000	0	0	3	939,000	11	3,464,500
320 to 330	0	0	0	0	0	0	3	983,250	0	0	0	0	6	1,951,250
330 to 340	0	0	0	0	0	0	0	0	0	0	0	0	2	660,000
340 to 350	0	0	0	0	1	349,800	0	0	0	0	0	0	1	349,800
350 to 360	0	0	0	0	9	3,195,000	0	0	0	0	0	0	9	3,195,000
360 to 370	0	0	0	0	0	0	0	0	0	0	0	0	6	3,164,000
370 to 380	0	0	0	0	0	0	0	0	0	0	0	0	1	370,000
380 to 390	0	0	0	0	0	0	0	0	0	0	0	0	5	1,900,000
390 to 400	0	0	0	0	0	0	0	0	0	0	0	0	4	1,567,110
OVER 400	0	0	0	0	4	1,770,000	0	0	0	0	10	4,450,000	57	24,926,650
TOTAL	51	1,689,061	43	6,606,522	80	11,712,250	49	5,983,976	12	829,700	211	22,920,329	1011	133,169,827

Table 15A

Project Size Distribution of Tanker Fleet Transporting
Petroleum Products to United Illuminating

1985

Vessel Draft	Vessel DWT	Percentage of Tonnage for Selected Channel Depth 35	38	40	42	50
46.0	80,000					6
43.5	70,000				6**	6
41.5	60,000			5*	5	5
39.0	50,000	4*	12**	20	20	20
36.0	37,000	54	54	54	51	48
32.0	25,000	12	12	8	8	6
30.0	20,000	13	8	5	5	5
27.0	<20,000	17	14	8	5	4

1990

Vessel Draft	Vessel DWT	Percentage of Tonnage for Selected Channel Depth 35	38	40	42	50
46.0	80,000					5
43.5	70,000				5**	5
41.5	60,000			8*	8	8
39.0	50,000	3*	14*	24	24	24
36.0	37,000	55	50	48	45	45
32.0	25,000	12	14	8	7	5
30.0	20,000	13	9	5	5	3
27.0	<20,000	17	13	7	6	5

2000 - 2040

Vessel Draft	Vessel DWT	Percentage of Tonnage for Selected Channel Depth 35	38	40	42	50
46.0	80,000					5
43.5	70,000				5**	5
41.5	60,000			12*	12	12
39.0	50,000	3*	17*	34	24	24
36.0	37,000	55	50	38	45	45
32.0	25,000	12	14	5	5	3
30.0	20,000	14	7	4	4	1
27.0	<20,000	16	12	7	5	5

* lightloaded 3 ft.
** lightloaded 2 ft.
*** lightloaded 1 ft.

Table 15B

Projected Size Distribution of Dry Bulk Fleet
Transporting Products to and from Cilco Terminal

1985

Vessel Draft	Vessel DWT	Percentage of Tonnage for Selected Channel Depth 35	38	40	42	50
46	80,000					
41	60,000			10*	11**	11
38	50,000	9*	19	19	24	28
36	,35,000	13**	13	12	11	10
32	25,000	19	12	10	8	5
26	15,000	8	6	3	0	0
	<15,000	5	4	0	0	0
20	<15,000	46	46	46	46	46

1990

Vessel Draft	Vessel DWT	Percentage of Tonnage for Selected Channel Depth 35	38	40	42	50
46	80,000					12
41	60,000			11*	18**	18
38	50,000	8*	24	24	24	24
36	35,000	11*	11	10	8	0
32	25,000	20	12	8	4	0
26	15,000	10	4	1	0	0
	<15,000	5	3	0	0	0
20	<15,000 (Barges)	46	46	46	46	46

2000 - 2040

Vessel Draft	Vessel DWT	Percentage of Tonnage for Selected Channel Depth 35	38	40	42	50
46	80,000					11
41	60,000			15*	23**	23
38	50,000	7*	25	13	19	20
36	35,000	14**	14	18	9	0
32	25,000	20	10	8	3	0
26	15,000	8	2	0	0	0
	<15,000	5	3	0	0	0
20	<15,000 (Barges)	46	46	46	46	46

* lightloaded 3 ft.
** lightloaded 2 ft.
*** lightloaded 1 ft.

Also environmental problems would have to be overcome before expansion of storage capacity would be allowed. Another deterrent results from the fact the ships are sometimes partially unloaded at Bridgeport and sent to other ports in New York and New England. The facilities at these other ports may not be able to handle vessels with extreme widths and lengths.

Dredging the main entrance channel at Bridgeport Harbor would benefit two primary users - the United Illuminating Company (U.I.) and the Cilco Terminal Company. Oil is imported by U.I. for the generation of electric power at its Tongue Point plant along the main harbor. The Cilco wharf an active installation which receives lumber, steel products, marble slabs and chips, and exports scrap metal.

An analysis of the current fleet mix serving these terminals, review of shipbuilding trends and discussions with the terminal operators resulted in the derivation of the fleet projections shown in Table 15. It can be seen that the information obtained suggests that barges will continue to deliver petroleum products even with project implementation. It appears, however, that project implementation will result in a move away from barges toward larger tanker vessels, with the greatest portion of the shift being toward those in the 50,000 DWT range.

Cost of Commodity Movements

Typical computation of vessel voyage costs are shown in Table 16. The methodology used allows for consideration of multiport operations, light loading and tidal delays. Costs were developed using round-trip distances from the chief ports of origin. Costs for multiport operations were approximated by assuming an additional 200 miles travel cost.

Although some petroleum products are barged direct from New York-New Jersey refineries and to New York-New Jersey via pipelines and tankers, oil company representatives could not provide data on what proportion is delivered by each method. As project implementation is expected to alter this particular product flow, unit transportation costs for 20,000 DWT vessels and smaller were calculated from Venezula to Bridgeport to serve as a proxy for the cost of barge shipment to Bridgeport.

The unit transportation costs resulting from each prospective channel depth are shown in Table 17. Total transportation costs and savings for 1985, 1990 and 2000-2035 are shown in Table 18. The largest portion of savings come about due to efficiencies of scale resulting from the use of larger vessels. Savings also occur due to decreased tidal delays, light loading and mutiport operations for ships currently in use. It should be noted that at very deep channel depths, total mutiport operations may increase with Bridgeport as the first port of call.

Table 16
Calculation of Vessel Voyage Cost

Foreign - 25,000 DWT Vessel (Origin - Venezuela)

a.	Round Trip Distance	4,400 naut. mil	Tidal Delay: 35 ft. channel 32 ft. draft, 4 ft. clearance)
b.	Cruising time @ 16 knots vessel speed	275 hours	Tidal Height Required: 1 ft.
c.	Cost @ sea (275 hrs x $1078/hr)	$296,450	Transit time to dock: 1 hr.
d.	Cost in port (48 hrs x $7/5/hr)	$ 34,320	Maximum Delay Time (from Mean Tide Curve):
e.	Tidal Delay Costs (1 hr x $1078/hr)	$ 1,078	Average Delay =.75 hrs. $\frac{(4.3}{12.4} \times \frac{4.3)}{2}$ Say 1 hr
f.	Total Roundtrip Cost	$331,848	
g.	Cost Per Net Cargo Ton on a 35 ft channel:		

(1) Maximum loaded draft 32 ft.

(2) Required underkeel clearance 4 ft.

(3) Total required channel depth 36 ft.

(4) Existing channel depth 35 ft.

(5) Tidal allowance 6 ft.

(6) Total existing channel allowance 41 ft.

(7) Shut-out draft 0.

(8) Immersion factor 92.4 long tons/inch.

(9) Shut-out tonnage 0.

(10) Conversion factor 1 DWT=2240 lbs, 1.12 st = 1 DWT

(11) Total tonnage = 25,000 x 1.12 x .96 - $26,880

Cost per net cargo ton $\frac{\$331,848}{25,880}$ = $12,35/short ton

Table 16
Calculation of Vessel Voyage Cost (Cont'd)

Foreign - 50,000 DWT Vessel (Origin Venezuela)

a.	Round Trip Distance	4,400 naut. mi.
b.	Cruising time @ 16 knots vessel speed	275 hours
c.	Cost at sea (275 hrs X $1369/hr)	$396,475
d.	Cost in port (60 hrs X $913/hr)	$ 54,780
e.	Tidal Delay Costs (4 hrs X $1369/hr)	$ 5,476
f.	Total Roundtrip Cost	$436,731

Tidal Delay:

(35 ft. channel, 39 ft.draft, lightloaded 3' ship, 4 ft. clearance)
Tidal Height Required: 5 feet
Transit time to dock: 1 hr.
Maximum Delay Time (from Mean Tide Curve): 9 hours
Average Delay 4 hrs

$$\frac{(10 \times 10)}{12.4 \quad 2}$$

g. Cost Per Net Cargo Ton on a 35 ft channel:

(1) Maximum loaded draft 39 ft.

(2) Required underkeel clearance 4 ft.

(3) Total required channel depth 43 ft.

(4) Existing channel depth 35 ft.

(5) Tidal Allowance 6 ft.

(6) Total existing channel allowance 41 ft.

(7) Shut-out draft 0.

(8) Immersion factor 130 long tons/inch, 139.8 short tons/inch.

(9) Shut-out tonnage 0.

10) Conversion factor 1 DWT=2240 lbs, 1.12 st = 1 DWT.

(11) Total tonnage = 50,000 x 1.12 x .96 = 53,760.

(12) Total tonnage with vessel lightloaded 3 feet = 48,727.

Cost per net cargo ton $\frac{\$436,731}{48,727}$ = $8.96/short ton

Table 17

Unit Transportation Costs/Short Tons

Vessel Size (DWT)	Channel Depths (feet) 35	38	40	42	
Tankers					
80,000					6.53
70,000				7.59	7.06
60,000			7.82	7.07	7.01
50,000	8.96	8.61	8.07	8.05	8.02
37,000	9.24	9.16	9.12	9.12	9.12
25,000	12.35	12.31	12.31	12.31	12.31
20,000	14.92	14.92	14.92	14.92	14.92
<20,000	15.80	15.80	15.80	15.80	15.80
Dry Bulk					
80,000					9.28
60,000			12.67	11.45	11.37
50,000	11.93	10.83	10.78	10.74	10.74
35,000	15.02	13.79	13.74	13.74	13.74
25,000	16.25	16.21	16.21	16.21	16.21
15,000	22.87	22.87	22.87	22.87	22.87
<15,000	22.87	22.87	22.87	22.87	22.87
(barges)	1.85	1.85	1.85	1.85	1.85

Table 18A

Transportation Costs and Savings
United Illuminating

	Channel Depths				
	35 ft.	38 ft.	40 ft.	42 ft.	50 ft.
1985 - 1,320,000 Tons					
Total Costs ($000)	15,121.4	14,338.4	13,100.5	12,660.0	12,228.6
Total Savings ($000)		783.0	2,020.9	2,461.4	2,892.8
1990 - 1,590,000 Tons					
Total Costs ($000)	18,218.9	17,339.9	15,545.1	15,163.5	14,504.3
Total Savings ($000)		879.0	2,673.8	3,055.4	3,714.6
2000 - 2040 - 1,590,000 Tons					
Total Costs ($000)	18,218.9	17,024.9	15,051.1	14,733.3	14,084.2
		1,194.0	3,167.8	3,485.6	4,134.7

Table 18B
Transportation Costs and Savings
Cilco Terminal

	35 ft.	38 ft.	40 ft.	42 ft.	50 ft.
1985 - 570,000 Tons					
Total Costs ($000)	5,664.6	5,092.2	4,629.6	4,272.9	4.157.2
Total Savings ($000)		572.4	1,035.0	1,391.7	1,507.4
1990 - 660,000 Tons					
Total Costs ($000)	6,691.2	5,618.7	5,102.7	4,776.6	4,348.6
Total Savings ($000)		1,072.5	1,588.5	1,914.6	2,342.6
2000 - 2040 - 800,000 Tons					
Total Costs ($000)	6,691.2	6,602.9	6,338.3	5,798.4	5,307.9
Total Savings ($000)		1,406.7	1,671.3	2,211.2	2,701.7

Transportation

Benefits

Average annual transportation benefits - based on a project life of 50 years commencing in 1990 and a discount rate of 7 7/8 percent - are shown in Table 19. It has been assumed that no benefits would accrue to barge traffic using the harbor should project implementation occur. The barges currently in use have drafts fully capable of navigating the existing 35-foot channel.

Project Use With and Without Improvements

With petroleum product receipt projected to increase only moderately, it appears that total tonnage at Bridgeport Harbor would not substantially change over the project life. One uncertainty, however, is rising coal tonnage shipped to New England.

U.S. Department of Energy forecasts show that coal consumption in New England will grow by more than 34 million short tons between 1977 and 1995. This rapid increase is due to the expected implementation of coal conversion orders under the Powerplant and Industrial Fuel Use Act of 1978. This act requires that all major fuel burning installations (large industrial powerplants and electric utilities), with certain exceptions, convert to coal or other nonpetroleum fuels.

Representatives of public utility commissions, state energy offices and terminal operators confirm that most of the coal supplies needed to meet the increased demand will be transported by vessel. It is probable that coal will be shipped through ports that have adequate waterfront storage facilities and either a railwway siding or a major customer situated nearby. The level of traffic through certain New England ports will most likely increase substantially during the next twenty years.

Unfortunately, it is premature to ascertain whether or not Bridgeport will be one of these ports. Unlike many U.S. Gulf area ports which are already planning for and actually constructing additional facilities for coal transport, definite plans for Bridgeport have not yet been formulated. A projection on whether or not a deeper channel would benefit coal-carrying vessels will have to await finalization of plans by terminal operators, shipping interests and energy companies.

Table 19
Bridgeport Harbor Transportation Benefits*
($000)

Channel Depth	1985	1990	2000-2040	7 7/8% Average Annual Equivalent
38	1,355.4	1,951.5	2,600.7	2,420.0

40	3,055.9	4,262.3	4,839.1	4,678.6
42	3,853.1	4,970.0	5,696.8	5,494.5
50	4,400.2	6,057.2	6,836.4	6,601.7

*Assumed project operation base year is 1990. Total transportation savings are based on combined savings shown in Tables 18A and 18B.

Further discussion of commercial navigation benefits appears later in this appendix, following discussions of recreational boating benefits and potential negative benefits concerning possible oyster habitat loss and oyster industry loss of income.

Recreational Boating - Black Rock Harbor

The entrance to Black Rock Harbor is about 2 miles southwest of Bridgeport Harbor between Fayerweather Island and the mainland. The main harbor is about three-quarters nautical mile long and one-half nautical mile wide at the entrance.

The major problem arises from the susceptibility of Black Rock Harbor to rough wave conditions. Additionally, existing anchorage space and depth is inadequate to meet current and future recreational boating needs. A rock breakwater at the mouth of the harbor is desired to protect the existing and prospective recretional fleet and to stimulate the creation of additional anchorages areas.

Improvement alternatives include the constrution of a breakwater at the harbor's entrance, dredging Black Rock Harbor anchorages of 44 acres to a depth of 8 feet and dredging 28 acres of Cedar and Burr Creek anchorages to a depth of 6 feet.

The construction of the considered breakwater at the harbor entrance would benefit the recreational fleet by reducing or eliminating storm damages to existing vessels and docking facilities, by providing increased boating days to the existing fleet, encourage expansion of the fleet, and, by enhancing the safety of boaters throughout the general area by providing protection from storms. The unit-day value method for computing recreational boating benefits is chosen based on its simplicity, ease of application, ability to measure increases in efficiency and the fact that improvements at the site would result in less than a 500,000 user-day increase.

What does this figure represent? - break-even point?

Existing Recreational Boating Fleet

The city of Bridgeport has 13 marinas, yacht clubs and boatyards of which five (4 yacht clubs and one marina) are located on the mainland shore of Black Rock Harbor, Burr Creek and Cedar Creek.* It is estimated that more than half of these slips are in Black Rock Harbor. There are long waiting lists for wet storage at many existing marinas. Both powerboats and sailboats are accommodated in the marinas with the emphasis on

powerboats. Adding an estimated 500 boats at moorings produces a total existing fleet in Black Rock Harbor of roughly 1000 boats.

Damage Prevention Benefits

Black Rock Harbor is particularly susceptible to rough conditions during storms due to the exposure of the channel and marinas. The breakwater would accrue direct benefits through the prevention of damages that have resulted in the past and could be expected to continue in the future without the proposed protection. Interviews with members and officials of yacht clubs located in Black Rock Harbor resulted in an estimated average annual damage, which would be prevented by breakwater construction, of $90,000. Damages vary greatly from year to year, dependent upon the severity of weather conditions. In a typical storm, several boats will sustain damages totalling several thousand dollars each, while other storms may cause a single large cruising vessel valued at approximately $50,000 to break loose and be completely destroyed. In years of especially harsh summer storms, several boats have been completely destroyed and reported damages have ranged from $300,000 to $500,000.

Boat Use Days Per Season

The ideal number of days of use per season is based on a boating season in Connecticut extending from early May to mid-October, about 165 days. Based on observed practices and traffic at southern Connectcut marinas several assumptions have been made. Constraints of limited vacation time and inclement weather must be considered. It is estimated that each boat will only be used an average of 35 percent of the available season time or roughly 60 days. Actually, many of the larger boats with a longer range, particularly the cruising sailboats, take extended cruises and are absent from the harbor for periods of 2 to 14 days at a stretch. At the other end of the spectrum, smaller boats may be used less.

Unit Day Value

The unit day value is estimated in accordance with procedures contained in Appendix 3 to Subpart K of the WRC Manual. Recreational boating is considered to be "specialized recreation other than hunting and fishing." Point values were assigned for each criteria utilizing Table K-3-2.

*Boating Almanac, Vol. 2, Boating Alamanac Co., Inc. Severna Park, MD, 1981.

Criteria	Value
Recreation Experience	15
Availability of Opportunity	10
Carrying Capacity	11
Accessibility	15
Environmental Quality	15
Total	65

The rating points are converted to dollar values by utilizing the conversation table (Revised Table K-3-1 - FY 1983) found in the WRC FY 1983 Reference Handbook. Sixty-six points represents a unit day recreation value of $12.00.

Table 20

Table K-3 2 - Guidelines for Assigning Points for General Recreation

Criteria	Judgment Factors				
a) Recreation Experience	Two general activities 3/	Several general activities	Several general activities; one high quality value activity 4/	Several general activities; more than one high quality high activity	Numerous high quality value activities; some general activities
Total Points: 30					
Point Value:	0-4	5-10	11-16	17-23	24-30
b) Availability of Opportunity 7/	Several within 1 hr. travel time; a few within 30 min. travel time	Several within 1 hr. travel time; none within 30 min. travel time	One or two within 1 hr. travel time; none within 45 min. travel time	None within 1 hr. travel time	None within 2 hr. travel time
Total Points: 18					
Point Value:	0-3	4-6	7-10	11-14	15-18
c) Carrying Capacity 1/	Minimum facility development for public health and safety	Basic facilities to conduct activity(ies)	Adequate facilities to conduct without deterioration of the resource or activity experience	Optimum facilities to conduct activity at site potential	Ultimate facilities to achieve intent of selected alternative
Total Points: 14					
Point Value:	0-2	3-5	6-8	9-11	12-14
d) Accessibility	Limited access by any means to site or within site	Fair access poor quality roads to site; limited access within site	Fair access, fair road to site; fair access, good roads within site	Good access, good roads to site; fair access, good roads within site	Good access, high standard road to site; good access within site
Total Points: 18					
Point Value:	0-3	4-6	7-10	11-14	15-18
e) Environmental Quality	Low esthetic factors 5/ exist that significantly lower quality 6/	Average esthetic quality; factors exist that lower quality to minor degree	Above average esthetic quality; any limiting factors can be reasonably rectified	High esthetic quality; no factors exist that lower quality	Outstanding esthetic quality; no factors exist that lower quality
Total Points: 20					
Point Value:	0-2	3-6	7-10	11-15	16-20

1/ Value should be adjusted for overuse.
2/ Value for water-oriented activities should be adjusted if significant seasonal water level changes occur.
3/ General activities include those that are common to the region and that are usually of normal quality. This includes picnicking, camping, hiking, riding, cycling, and fishing and hunting of normal quality.
4/ High quality value activities include those that are not common to the region and/or Nation and that are usually of high quality.
5/ Major esthetic qualities to be considered include geology and topography, water, and vegetation.
6/ Factors to be considered in lowering quality include air and water pollution, pests, poor climate, and unsightly adjacent areas.
7/ Likelihood of success at fishing and hunting.
8/ Intensity of use for activity.

Table 21

Revised Table K-3-1 (FY 1983) Conversion of Points to Dollar Values

Activity Categories	POINT VALUES										
	0	10	20	30	40	50	60	70	80	90	100
General Recreation (Points from Table K-3 2)	1.60	1.90	2.10	2.40	3.00	3.40	3.70	3.90	4.30	4.60	4.80
General Fishing & Hunting (Points from Table K-3 2)	2.30	2.60	2.80	3.10	3.40	3.70	4.10	4.30	4.60	4.70	4.80
Specialized Fishing & Hunting (Points from Table K-3 2)	11.20	11.50	11.70	12.00	12.30	13.50	14.70	15.60	16.80	18.00	19.00
Specialized Recreation Other than Fishing & Hunting (Points from Table K-3 3)	6.50	6.90	7.40	8.00	8.50	9.60	10.60	12.80	14.90	17.00	19.00

Note: See 44 FR 72963-64 (published December 14, 1979) for Table K-3-2 and K-3-3.

Benefit Calculations

It is now established that the unit-day recreation value if $12.00/day, each boat is used an ideal average of 60 days per season and users per fleet are as follows (see Table 22,23 and 24):

Black Rock Harbor - Existing (200 boats)	780
Black Rock Harbor - Future	789
Black Rock Harbor - Transient	275

For the existing fleet at Black Rock Harbor it is necessary to estimate the recreation time foregone under the without/project condition and determine the impact with the project in place. Under existing conditions, it is estimated that 20 percent of the 60-day seasonal use is recreation time foregone due to rough waters. With the project in place, however, it is believed that boating could take place on these rough water days behind the breakwaters. Also, approximately 200 boats of the existing 1000 boat fleet are believed to be impacted in this manner. This benefit to the existing fleet is calculated below.

Recreational time foregone per year	=	12 days
Unit-day value for specialized recreation	=	$12.00
Recreator days in fleet (200 boats)	=	780
Total value of recreation time foregone (12 x $12.00 x 780)	=	$112,320

For the future fleet, the unit-day value method employed here measures the increase in the capacity projected for the recreation site based on project improvements. The benefit for the future fleet additions is calculated below.

Average amount of boating days per season	=	60
Recreator days in fleet	=	789
Unit-day value for specialized recreation	=	$12
Total value of new recreation	=	$568,080

Based on experience at other harbors, it is assumed that one-half the 200 expected new boats would be added to the existing fleet immediately at project completion and the other half would be added over a 5-year period (20 boats per year). The average annual benefit is computed below.

Immediate fleet expansion ($568,080/+ 2)	=	$284,040
Five-year expansion ($284,040 X .861135) AAEF 7 7/8%, g = 5, n = 50)	=	$244,600
Total		$528,640

Another category of recreational craft which would benefit from the proposed project is the transient fleet. These are cruising sailboats and inboards which take extended cruises from their permanent moorings and

stop at Black Rock Harbor. With the proposed project in place, it is expected that the harbor's attraction would increase markedly to transient vessels in western Long Island Sound. Not only would the harbor serve as a calm anchorage in normal weather, but it would also serve as a harbor of refuge in more violent weather. It is therefore anticipated that the transient fleet will average in the vicinity of 50 to 75 boats on any given day over the season, with even more in July and August. An average number of 60 is used in the derivation of the benefits below.

Average number of boating days per season	=	60
Recreator days in transient fleet	=	275
Unit-day value	=	$12
Total value of new recreation (60 x 275 x $12)	=	$198,000

In summary, total benefits expected to accrue to the proposed improvements at Black Rock Harbor are the following:

Damages Prevented		$ 90,000
Recreational Boating		$838,900
Existing	$112,300	
Future	528,600	
Transient	198,000	
Total		$928,900

Recreational Boating - Burr and Cedar Creeks

The proposed dredging of 28 acres of mooring area at Cedar and Burr Creeks at the head of Black Rock Harbor would provide moorings for 196 additional vessels. Benefits derived from this expansion are calculated as follows:

Average number of boating days per season	=	60
Recreator days in fleet (Table 4)	=	687
Unit-day value	=	$12
Total value of new recreation (60 x 687 x $12)	=	$494,640

Based on the location of the proposed mooring area and the other proposals for Black Rock Harbor, it is assumed that the 196 new boats would be added over a 5-year growth period. The average annual benefit is computed below.

$494,640 X .861134 (AAEF 7 7/8%) = $425,950.

Table 22
Black Rock Harbor
Existing Fleet

Type of Boat	Length	No. in Class	Average No. of Users per class	Total Users
Outboards	10-20	16	2	32
	21&up	4	3	12
Sterndrives	15-20	4	3	12
	21-25	12	4	48
	26&up	4	4	16
Inboards	15-20	4	2	8
	21-30	12	4	48
	31-40	20	5	100
	41-50	14	6	84
	51&up	6	6	36
Cruising Sailboats	21-30	20	3	60
	31-40	20	4	80
	41&up	12	5	60
Daysailers	16-20	12	2	24
	21-25	20	4	80
	26&up	20	4	80
Totals		200		780

Table 23
Black Rock Harbor
Future Additions

Type of Boat	Length	No. in Class	Average No. of Users per class	Total Users
Outboard	10-20	17	2	34
	21&up	4	3	12
Sterndrives	15-20	4	3	12
	21-25	8	4	32
	26&up	7	4	28
Inboards	15-20	4	2	8
	21-30	10	4	40
	31-40	22	5	110
	41-50	14	6	84
	51&up	6	6	36
Crusing Sailboats	21-30	15	3	45
	31-40	25	4	100
	41&up	12	5	60
Daysailers	16-20	10	2	20
	21-25	15	4	60
	26&up	27	4	108
Totals		200		789

Table 24
Black Rock Harbor
Transient Fleet
Additions

Type of Boat	Length	No. in Class	Average No. of Users per class	Total Users
Inboards	21-30	6	4	24
	31-40	8	5	40
	41-50	8	6	48
	51&up	5	6	30
Cruising Sailboats	21-30	5	3	15
	31-40	6	4	24
	41&up	6	5	30
Daysailers	21-25	8	4	32
	26&up	8	4	32
		60		275

Table 25
Cedar & Burr Creeks
New Fleet

Type of Boat	Length	No.in Class	Average No. of Users per class	Total Users
Outboards	10-14	5	2	10
	15-20	5	2	10
	21&up	10	3	30
Sterndrives	15-20	5	3	15
	21-25	10	4	40
	26&up	10	4	40
Inboards	15-20	5	2	10
	21-30	13	4	52
	31-40	11	5	55
	41-50	3	6	18
	51&up	2	6	12
Cruising Sailboats	15-20	5	2	10
	21-30	22	3	66
	31-40	22	4	88
	41&up	5	5	25
Daysailers	8-15	5	2	10
	16-20	18	2	36
	21-25	20	4	80
	26&up	20	4	80
Total		196		687

Negative Benefits

A major area of concern is how project implementation would affect the oyster industry at the project site. Without the improvements, conditions should remain unchanged. With the project, dredging operationgs could possibly affect the level of income attained by the oyster industry.

Connectiuct, as a coastal state, is prominently engaged in the development of oyster farming as a source of food and a profit making industry. The Connecticut Shellfish Commission administers approximately 22,500 acres of franchise oyster grounds off its shores, 2,600 of which are located off the city of Bridgeport. A total of nearly 6,450 acres of leased beds are off the shores of Fairfield, Bridgeport and Stratford. Though the oyster industry may be small relative to other industries in the state, indications are it is developing into a strong state resource. Seed oysters grown proximal to Bridgeport Harbor are considered to be the best in Long Island Sound and far superior to Chesapeake Bay oysters due to the quality of the water.

The oyster beds at Bridgeport are all "seed beds" and the oysters from this area therefore are not marketable for direct consumption. A "seed oyster" is any oyster, regardless of size, that is found outside a certified ground. Certified grounds meet the Food and Drug Administration's water quality criteria of less than 70 MPN coliform bacteria per 100 ml. The seed oysters cultivated at Bridgeport are transplanted to Norwalk, Connecticut and other locations where they undergo depuration. This process consists of holding the oysters in certified waters for a minimum of 15 days at a water temperature of $50^{o}F$. This temperature ensures that the animal will actively pump thereby flushing any contaminants out of its system. Following this the oysters can be harvested for market. A market bushel, now valued at $42, consists of roughly 240 oysters, 3-4 years of age.

An acre of ocean bottom in Bridgeport area is reported by local industry services to produce an average of 2,000 bushels of seed oysters per acre about 8 out of 10 years. At a current value of roughly $6.00 per bushel for seed oysters this would amount to $9,600 per acre per year ($6.00 x 2,000 x .80). Since the beds are generally capable of catching more than one set in a given year, this dollar value may be conservative.

Some factors which are detrimental to the success of oyster production are poor water quality, sparsity of food and alteration or elimination of habitat due to dredging and fill operations. Pollution in the rivers and harbors lowers the water quality and inhibits growth. Filling of tidal marshes reduces the levels of nutrients which act as a food source for oysters. Dredging could also cause a layer of silt to cover the oyster beds which, in turn, could prohibit spat settlement or if dense enough, death by suffication.

The existing entrance channel to Bridgeport Harbor transects approximately 1/2 mile of the oyster grounds at the 20-to 25-foot depth being worked by Talmadge Brothers, Inc. Oyster Company, one of the three major commercial oyster companies operating in Long Island Sound. Of specific concern are bed numbers 801, 802 and 803 which historically are highly productive and considered prime seed beds with a history of successful spat sets and high yields. While the average production is known to be 2,000 bushels per acre, these particular beds have been known to produce in excess of 5,000 bushels in some years. The location of these beds at Bridgeport is shown on the attahced map.

The other major area of oyster beds to be impacted by the proposed project is in Black Rock Harbor. The west side of the harbor has been reported as dead, but the east side was very productive in seed oysters at one time and amounts to about 40 acres. Talmadge Brothers has permission to harvest this area, but has not actively worked in the grounds in the last 3 to 4 years.

The original improvement project (1940's and 1960's) at Bridgeport eliminated oyster habitat from the inner harbor. Specifically, the deep basin, anchorages and channels serve as silt traps and accumulate fine sediments which are unsuitable for the settlement and growth of shellfish. Although the slopes of the channel could provide suitable substrata for seed oysters, it would take 2 to 4 years to stabilize. Even then the prop wake of deep draft vessels would suck any shellfish and oysters down into the channel proper where they would suffer physical damage or be smothered by silt. So now, oysters grow up to the edge of the main channel.

Dredging of the main entrance channel would unavoidably result in some damage to the regional oyster beds. Dredging the main channel to a depth of 40 feet plus a 2-foot overdepth would result in a total loss of approximately 2 acres of oyster harvesting grounds. This assumes that the area used for harvesting oysters is above the natural side slope of the channel. A "worst possible case" situation would be where the dredging contractor performs excessivbe overdredging resulting in a widening of the channel from 400 feet to 420 feet (10 feet by excessive overdredging on each side of the channel). Estimates assuming a 420-foot wide, 42-foot deep channel indicate a loss of approximately 4.6 acres of top-of-slope oyster harvesting grounds. This is considered a conservative estimate and probably does not depict the actual amount of excessive overdredging that would occur.

Dredging the easterly 24-acre anchorage in Black Rock Harbor results in a potential oyster habitat loss of 12 acres for the 8-foot depth option (2 acres if dredged to 6 feet). There would be no habitat loss in the westerly 20-acre anchorage or in the 28-acre mooring basin in Burr and Cedar Creeks. Industry sources feel that the mooring of recreational boats along the east side of the harbor is incompatible with the oyster ground industry. Not only would the proposed project decrease circulation

and flushing with a resulting increase in sedimentation which would affect the distribution and settlement of oyster larvae, but the increased moorings and number of vessels would render the area impossible to work (i.e., dredge the oysters).

Because of the economic uncertainties involved with estimating the value of oyster production, potential economic losses associated with the lost oyster habitat resulting from project implementation are questionable. First, if the lost production in the immediate project area can be compensate for by increased production in other acreage, there may be no net loss in production at all from a national point of view. Information from the January - February 1982 "Marine Resources Information 119" a publication of the University of Rhode Island Sea Grant Advisory Service indicates that other acreage is available.* The publication states that there are still plenty of room for expansion in the industry. This can be made possible by simply opening up the now closed beds. Thus, the lost production at Bridgeport could be compensated for by increasing production of "Closed" acreage and there would be n net loss in overall production natinally. Second if oyster production is indeed diminished, supply and demand comditions may dictate a rise in the price of the product, resulting in little or no change in oyster income, the real measure of project impact.

The argument to include in the economic analysis the value of lost oyster production has merit only if it is assumed that all beds are being used to full capacity. Then there would truly be a decline in production proportionate to the beds lost. Under such a situation, that is to say that there would be a permanent yearly loss of yield due to a finite supply of beds being worked to full capacity, the magnitude and valuation of the loss in income is still a matter of conjecture. The 2,000 bushels per acre yield, an overall average which may or may not apply to specific acreage under consideration, allows for "natural" fishing mortality.

Natural mortality- the loss of yield from the physical and biological workings of the life cycle - includes perturbations such as predation, turbidity and/or sedimentation, storms, lack of nutrients, extreme low water temperatures which prohibit or delay spawning and diseases. In addition, "man-induced" mortality such as coastal engineering activities, ships running aground, water pollution from petroleum and industrial wastes combine to reduce yields to as little as 1,000 bushels per acre.

However, for the purpose of this analysis, a worst case condition will be assumed - that all oyster beds are being used to full capacity and a decline in production would result from project implementation. Assumptions are as follows:

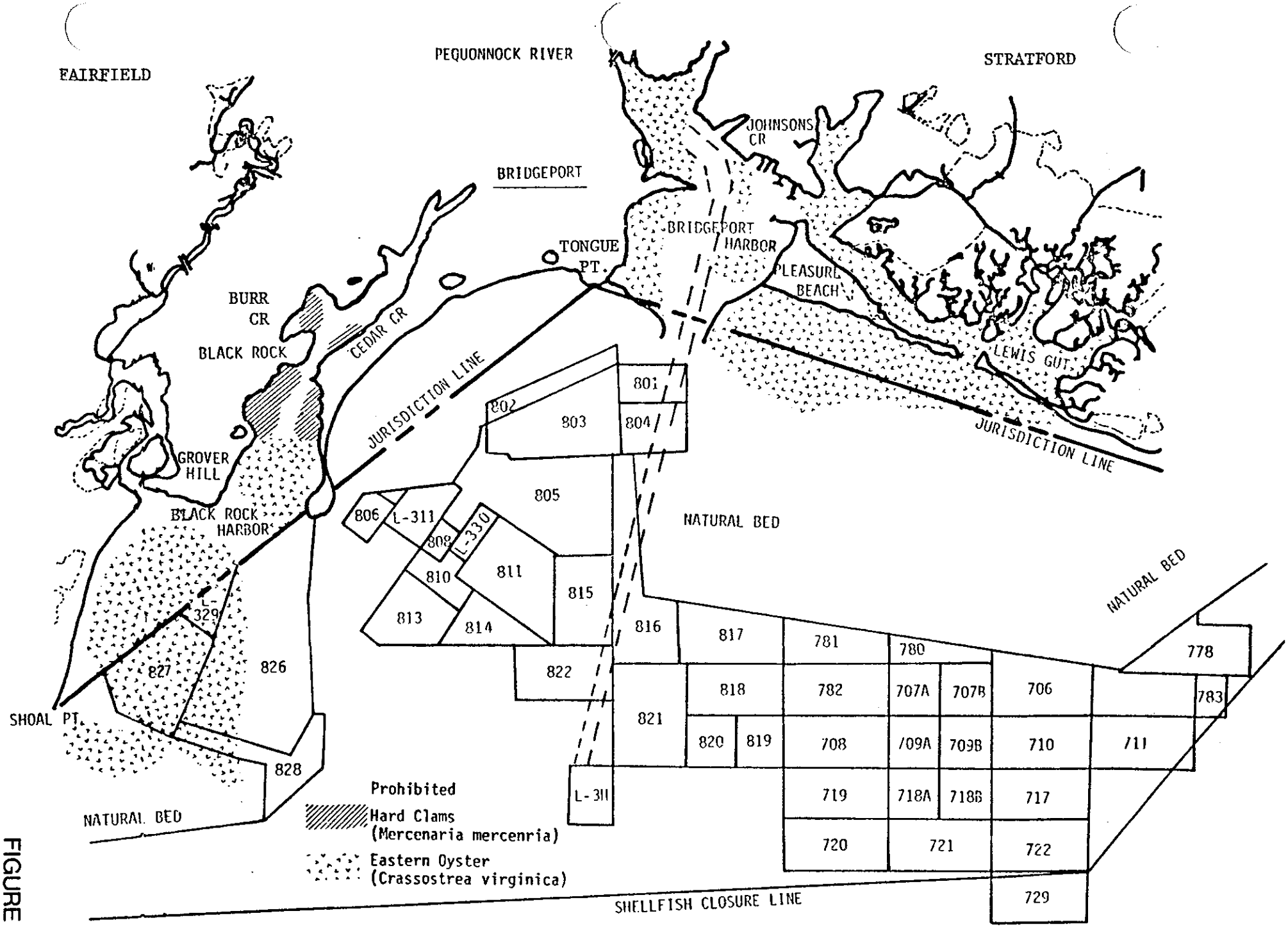
* University of Rhode Island Sea Grant Advisory Service, Marine Resources Information 119, January, February 1982, "Rejoice, Oyster Fanciers", pages 1-2, article by John Baker, Former Director Aquaculture Division, Connecticut Department of Agriculture.

(1) No "natural" or "man-induced" mortality.
(2) Beds numbered 801, 802 and 803 have an optimum yield of 5,000 bushels per acre, while those in Black Rock Harbor have a yield of 2,000 bushels per acre about 8 out of 10 years.
(3) Production declines proportionate to the loss of 4.6 acres in the main channel and 12 acres in Black Rock Harbor.
(4) The current value of seed oysters is approximately $6.00 per bushel.
(5) The east side of Black Rock Harbor would be farmed in the near future.

Annual losses in income are calculated below:

Main Channel (42-foot-depth) - 5,000 bushels x 4.6 acres x $6.00 per bushel x 80 percent equals $110,400.

Black Rock Harbor - 2,000 bushels x 12 acres x $6.00 per bushel x 80 percent equals $115,200.



SHELLFISH BEDS IN BRIDGEPORT, CT AREA

FIGURE 1

Economic Justification

To be considered economically justified, a project must have a benefit/cost ratio of one or greater. The ratios for the alternatives at Bridgeport - the main ship channel, Black Rock Harbor and Cedar and Burr Creek - are displayed in Table 26. For the main ship channel, net benefits are displayed for each dredging depth option. The option that maximizes net dollar benefits is the 42-foot channel depth.

Sensitivity Analysis

In order to address risk and uncertainty in the benefit analysis the following approaches were used as a basis to compute project benefits:

(1) Benefits are computed on the basis of anticipated 1985 tonnage only, not that projected for 1990-2040;

(2) Benefits are computed on the basis of tonnage over time using projected fleet characteristics at beginning of project life in 1990.

The transportation costs and savings for each of the above are displayed in Tables 27 and 28. Average annual transportation benefits - based on a project life of 50 years commencing in 1990 and a discount rate of 7-7/8 percent - are shown in Table 29 for each of the sensitivity approaches. Benefit/cost ratios and net benefits utilizing Approaches (1) and (2) are shown in Table 30.

Table 26
Economic Justification

Bridgeport Harbor
Main Ship Channel

Project Depth	Annual* Benefits	Annual Costs	BCR	Net Benefits
(ft)	($000)	($000)		($000)
38	2,309.6	668.0	3.5	1,641.6
40	4,568.2	916.0	5.0	3,652.2
42	5,384.1	1,342.0	4.0	4,042.1
50	6,491.3	2,976.0	2.2	3,515.3

Black Rock Harbor

Annual Benefits**	Annual Costs	BCR
813.7	1,080.0	0.75

Cedar and Burr Creeks

426.0	130.0	3.3

* Less lost oyster industry income of $110.4
** Less lost oyster industry income of $115.2

Table 27A
Sensitivity Analysis
Transportation Costs and Savings
Approach (1) - Tonnage Held Constant

United Illuminating-1,320,000 Tons

	35 ft.	38 ft.	40 ft.	42 ft.	50 ft.
1985					
Total Costs ($000)	15,121.4	14,338.4	13,100.5	12,550.0	12,228.6
Total Savings ($000)		783.0	2,020.9	2,461.4	2,892.8
1990					
Total Costs ($000)	15,125.1	14,395.4	12,905.4	12,588.6	12,041.3
Total Savings ($000)		729.7	2,219.7	2,536.5	3,083.8
2000 - 2040					
Total Costs ($000)	15,125.1	14,133.9	11,495.3	12,231.4	11,692.6
Total Savings ($000)		991.2	2,629.8	2,893.7	3,432.5

Table 27B
Sensitivity Analysis
Transportation Costs and Savings
Approach (1) - Tonnage Held Constant

Cilco - 570,000 Tons

	35 ft.	38 ft.	40 ft.	42 ft.	50 ft.
1985					
Total Costs ($000)	5,664.6	5,092.2	4,629.6	4,272.9	4,157.2
Total Savings ($000)		572.4	1,035.0	1,391.7	1,507.4
1990					
Total Costs ($000)	5,778.7	4,852.5	4,406.9	4,125.2	3,755.6
Total Savings ($000)		926.2	1,371.8	1,653.5	2,023.1
2000-2040					
Total Costs ($000)	5,706.8	4,704.6	4,516.1	4,131.4	3,781.9
Total Savings ($000)		1,002.2	1,190.7	1,575.4	1,924.9

Table 28A
Sensitivity Analysis
Transportation Costs and Savings
Approach (2) - Fleet Held at 1990 Make-up

United Illuminating - 1,590,000 Tons

1990 thru 2040

Channel Depths

	35 ft.	38 ft.	40 ft.	42 ft.	50 ft.
Total Costs ($000)	18,218.9	17,339.9	15,545.1	15,163.5	14,504.3
Total Savings ($000)		879.0	2,673.8	3,055.4	3,714.6

Table 28B
Sensitivity Analysis
Transportation Costs and Savings
Approach (2) - Fleet Held at 1990 Make-up

Cilco

1990 - 660,000 Tons

Channel Depths

	35 ft.	38 ft.	40 ft.	42 ft.	50 ft.
Total Costs ($000)	6,691.1	5,618.7	5,102.7	4,776.6	4,348.6
Total Savings ($000)		1,072.4	1,588.4	1,914.5	2,342.5
2000-2040 - 800,000 Tons					
Total Costs ($000)	8,110.5	6,810.5	6,185.1	5,789.8	5,271.0
Total Savings ($000)		1,300.0	1,925.4	2,320.7	2,839.5

Table 29
Sensitivity Analysis
Transportation Benefits
Main Ship Channel
Approach (1)
($000)

Channel Depth	1985	1990	2000-2040	Average Annual Equivalent
38	1,355.4	1,655.9	1,993.4	1,899.5
40	3,055.9	3,591.5	3,820.5	3,756.8
42	3,853.1	4,190.0	4,469.1	4,391.4
50	4,400.2	5,106.9	5,357.4	5,287.7
		Approach (2) ($000)		
38		1,951.5	2,179.0	2,115.7
40		4,262.3	4,599.2	4,505.4
42		4,970.0	5,376.1	5,263.1
50		6,057.2	6,554.1	6,415.8

Table 30
Sensitivity Analysis
Economic Justification
Main Ship Channel

Approach (1)

Project Depth	Annual* Benefits	Annual Costs	BCR	Net Benefits
(ft)	($000)	($000)		($000)
38	1,789.1	668.0	2.7	1,121.1
40	3,646.4	916.0	4.0	2,730.4
42	4,281.0	1,342.0	3.1	2,939.0
50	5,177.3	2,976.0	1.7	2,201.0

Approach (2)

38	2,005.3	668.0	3.0	1,337.3
40	4,395.0	916.0	4.8	3,479.0
42	5,152.7	1,342.0	3.8	3,810.0
50	6,305.4	2,976.0	2.1	3,329.4

* Less lost oyster industry income of $110.4

APPENDIX 4

SOCIAL AND ECONOMIC IMPACT ASSESSMENT

BRIDGEPORT HARBOR, CT AND VICINITY

BRIDGEPORT HARBOR, CONNECTICUT

APPENDIX 4

SOCIAL AND ECONOMIC IMPACT ASSESSMENT

Appendix 4
Social and Economic Impact Assessment
Bridgeport Harbor, CT and Vicinity

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APPENDIX 4
Social and Economic Impact Assessment
Bridgeport Harbor, CT and Vicinity

I. Introduction

This report appendix for navigation improvements in Bridgeport Harbor and vicinity is directed toward the social and economic elements of the study area and the effect a project would have on these elements.

The first section of this report describes the population, housing, employment, economic, and land use characteristics of the study area. Because of the regional nature of a harbor as large and intensely utilized as Bridgeport, the study area includes the entire Bridgeport Standard Metropolitan Statistical Area (SMSA). The Bridgeport SMSA consists of nine communities: Bridgeport, Derby, Easton, Fairfield, Milford, Monroe, Shelton, Stratford and Trumbull. Also included in the first section of the report are baseline descriptions of both Bridgeport Harbor and Black Rock Harbor. The second section describes the "most probable future" of the study area. The "without project" condition is as detailed as available data permits and is directed to specific areas within the study area that are likely to feel some impact from navigation improvements. The final section describes potential impacts of the possible navigation improvements.

II. Baseline Conditions

A. The Bridgeport SMSA

1. Population and Housing

Over the last 50 years, the population of the Bridgeport SMSA has grown by 77.6 percent. Bridgeport is the only community within the SMSA that netted a decline over this period. This follows the trend of population migration from the central cities to the suburbs that has been typical of the Northeast. Between 1970 and 1980 however, the population of the SMSA netted a decrease. Derby and Fairfield, as well as Bridgeport, contributed to this 2 percent decline. Those communities with the smallest populations in 1930, Easton, Monroe and Trumbull, showed the highest rates of growth over the last 50 years. All the population figures for the SMSA communities are provided in Table 1.

The racial composition of the SMSA's population is predominantly white, accounting for 86.9 percent of the total. Blacks make up 8.8 percent of the population of the study area with 85.8 percent residing in the City of Bridgeport. Residents of Spanish origin number 30,366, 7.7 percent of the population; 87.9 percent live in Bridgeport. Table 2 shows the breakdown by race for the SMSA and Bridgeport.

Table 1
Population Trends, 1930-1980
Bridgeport SMSA
(By Census Year, Population and Percent Change)

	Bridgeport		Derby		Easton		Fairfield		Milford	
1980	142,546	-8.9	12,346	-2.0	5,962	22.0	54,849	-2.9	50,898	0.6
1970	156,542	-0.1	12,599	3.8	4,885	43.4	56,487	22.3	50,558	21.4
1960	156,748	-1.2	12,132	18.3	3,407	57.4	46,183	51.5	41,662	55.1
1950	158,709	7.9	10,259	-0.3	2,165	71.6	30,489	44.3	26,870	63.5
1940	147,121	0.3	10,287	-4.6	1,262	24.6	21,135	22.7	16,439	29.8
1930	146,716	-	10,788	-	1,013	-	17,218	-	12,660	-

	Monroe		Shelton		Stratford		Trumbull		SMSA	
1980	14,010	16.3	31,314	15.3	50,541	1.5	32,989	5.1	395,455	-1.6
1970	12,047	88.2	27,165	49.3	49,775	10.6	31,394	54.1	401,752	14.7
1960	6,402	121.4	18,190	43.3	45,012	34.6	20,379	135.8	350,115	22.4
1950	2,892	67.4	12,694	15.7	33,428	48.0	8,641	63.2	286,147	20.8
1940	1,728	41.5	10,971	8.5	22,580	17.5	5,294	46.1	236,817	6.4
1930	1,221	-	10,113	-	19,212	-	3,624	-	222,565	-

TABLE 2

RACIAL COMPOSITION, 1980
BRIDGEPORT AND BRIDGEPORT SMSA

	Bridgeport		Bridgeport SMSA	
	Number	Percent	Number	Percent
White	98,195	68.9	343,541	86.9
Black	29,898	21.0	34,848	8.8
American Indian	289	0.2	537	0.1
Eskimo, Aleutian, Asian & Pacific Islander	778	0.5	1,995	0.5
Other	13,386	9.4	14,534	3.7
TOTAL:	142,546	100.0	395,455	100.0

Source: U.S. Census

Table 3 shows the number of housing units in the city of Bridgeport and the Bridgeport SMSA. From 1950 to 1980 the number of housing units in the Bridgeport SMSA increased 65.6 percent, and in Bridgeport 18.7. Whereas population and housing increase similarly in the SMSA, in Bridgeport an inverse relationship occurred; there was an increase in dwelling units during a period of slight population decline.

TABLE 3

Housing Units, 1950-1980
Bridgeport and the Bridgeport SMSA

Year	Bridgeport SMSA	Percent Change	Bridgeport	Percent Change
1950	86,441		46,588	
1960	104,117	20.4	51,654	10.9
1970	128,614	23.5	54,675	5.8
1980	143,172	11.3	55,291	1.1

2. Economy and Employment

Manufacturing has traditionally been the core of the Bridgeport area's economy. Employment in the manufacturing sector has fluctuated widely, reflecting defense dependency while nonmanufacturing has grown with the population. The presence of manufacturing dates back to the beginning of the 19th century when the munitions industry began. This was followed by the

brass, electrical supplies and machine tools industries in the 1880's. Both ammunition and machine tools have remained two of the most stable employers, although they are not the largest. The largest industry continues to be the transportation equipment industry which came to the area during World War II and in 1982 employed 31.5 percent of all manufacturing workers in the Bridgeport Labor Market Area, (LMA)*. Although manufacturing is forecasted to grow by 5 percent through 1993, its dominance in the area is declining. From a level of 40.1 percent of all nonagricultural employment in 1974, it has demonstrated a downward trend to represent only 36.3 percent of nonagricultural employment in 1982.

The decade of the seventies proved to be one of overall growth for the industrial sector in the Bridgeport LMA, with the increasing predomance of nonmanufacturing. Employment figures in several industries were inflated in 1970 due to the influence of the Vietnam War on defense-related industries with a subsequent dip in area employment at the conclusion of the conflict. The nationwide recession in 1974-1975 also affected area jobs. However, there has been a steady growth experienced by both the manufacturing and nonmanufacturing sectors since 1974. Table 4 shows the total employment by industry for the Bridgeport LMA in 1974 and 1982. The data reveals that in 1982 nonmanufacturing constituted 63.7 percent of total employment. Services account for the largest portion of the nonmanufacturing sector, 41.5 percent, followed by trade at 32.8 percent. Transportation equipment and electrical equipment were the greatest employers in the manufacturing sector.

As seen in Table 5, in 1981 the labor force in the LMA constituted 12.1 percent of the total labor force of the state. The unemployment rate for the LMA at 6.2 percent was equal to the rate for the state. Bridgeport's labor force totaled 70,722. Of this, 65,033 were employed yielding an unemployment rate of 8.0 percent. Bridgeport had the second highest rate of unemployment of all LMA communities following Derby with a rate of 8.5 percent.

3. Land Use

Land use data for the SMSA communities was obtained from the Greater Bridgeport Regional Planning Agency (GBRPA) for Bridgeport, Easton, Fairfield, Monroe, Stratford and Trumbull; from the Valley Regional Planning Agency (VRPA) for Derby and Shelton; and from the Connecticut Office of State Planning for Milford.

The largest community in the SMSA is Monroe with 22,060 acres; the smallest is Derby with 3,530 acres. Residential land constitutes the largest single category in the SMSA with the exception of vacant land.

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* The Bridgeport LMA includes the same communities as the SMSA.

TABLE 4

TOTAL EMPLOYMENT BY INDUSTRY

BRIDGEPORT LABOR MARKET AREA

Industry	1974 Number	1974 Percent	1982 Number	1982 Percent	Percent Change 1974-1982
Manufacturing	63,720	40.1	64,590	36.3	1.4
Food	1,550	1.0	1,000	0.6	-35.5
Apparel	2,360	1.5	1,820	1.0	-22.9
Printing & Publish	2,460	1.5	2,520	1.4	6.8
Rubber & Plastics	2,990	1.9	2,140	1.2	-28.4
Stone, Clay & Glass	2,840	1.8	2,320	1.3	-18.3
Primary Metals	4,690	3.0	2,870	1.6	-38.8
Fabricated Metals	9,000	5.7	9,670	5.4	7.4
Machinery (Except Elec.)	8,830	5.6	8,960	5.0	1.5
Elec. Equipment	9,340	5.9	10,530	5.9	12.7
Transp. Equip.	9,990	6.3	20,340	11.4	103.6
Other Manufact.	9,670	6.1	2,420	1.4	-75.0
Nonmanufacturing	95,090	59.9	113,520	63.7	19.4
Construction & Mining	7,760	4.9	5,940	3.3	-23.5
Transportation	3,540	2.2	3,280	1.8	-7.3
Communication & Utilities	3,420	2.2	2,980	1.7	-12.9
Trade	32,150	20.2	37,290	20.9	16.0
Finance, Ins., Real Estate	6,210	3.9	8,720	4.9	40.4
Services	35,960	22.6	47,060	26.4	30.9
Public Admin.	6,050	3.8	8,250	4.6	36.4
TOTAL:	158,810	100.0	178,110	100.0	12.2

TABLE 5

BRIDGEPORT LABOR MARKET AREA

LABOR FORCE (BY PLACE OF RESIDENCE)

ANNUAL AVERAGE

1980

AREA	LABOR FORCE	EMPLOYMENT	UNEMPLOYMENT	UNEMPLOYMENT RATE
Connecticut	1,616,000	1,521,000	95,000	5.9
Bridgeport LMA	198,886	186,930	11,956	6.0
Bridgeport	70,436	64,696	5,740	8.1
Derby	6,165	5,627	538	8.7
Easton	2,653	2,561	92	3.5
Fairfield	28,943	27,778	1,165	4.0
Milford	25,987	24,675	1,312	5.0
Monroe	7,021	6,711	310	4.4
Shelton	15,172	14,319	853	5.6
Stratford	25,564	24,282	1,282	5.0
Trumbull	16,947	16,282	665	3.9

Source: Annual Planning Information, Fiscal Year 1982, Bridgeport Labor Market Area

TABLE 6

LAND USE

BRIDGEPORT SMSA

Category	Bridgeport		Derby*		Easton		Fairfield		Milford**		Monroe		Shelton		Stratford		Trumbull		SMSA Total	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Residential	4,413	38.5	1,158	32.8	2,581	14.3	7,148	36.5	4,874	33.0	8,150	18.6	6,014	29.9	3,166	25.7	5,621	37.5	43,125	31.5
Commercial	566	4.9	125	3.5	5	0.0	302	1.6	1,062	7.2	135	0.8	131	0.6	317	2.6	160	1.1	2,803	2.0
Industrial	1,152	10.1	154	4.4	0	0	199	1.0	200	1.4	132	0.2	194	1.0	514	4.2	98	0.6	2,643	1.9
Recreational	755	6.6	51	1.4	415	2.3	2,175	11.1	1,114	7.5	539	3.2	137	0.7	1,164	9.5	1,450	9.7	7,800	5.7
Agriculture	0	0	154	4.4	1,495	8.3	478	2.4	0	0	901	5.3	1,892	9.4	94	0.7	289	1.9	5,303	3.9
Institutional	687	6.0	34	1.0	60	0.3	884	4.5	163	1.1	624	3.7	222	1.1	393	3.2	508	3.4	3,575	2.6
Water	755	6.8	331	9.4	791	4.4	458	2.3	0	0	160	0.9	969	4.8	980	8.0	160	1.1	4,624	3.4
Vacant	488	4.3	1,523	43.1	5,460	30.1	4,562	23.3	6,866	46.5	8,826	52.0	10,546	52.5	3,425	27.9	3,553	23.7	45,249	33.1
Utilities & Transportation	252	2.2	***		6,472	35.7	463	2.4	490	3.3	1,701	10.0	***		511	4.1	1,018	6.8	10,907	8.0
Street	2,359	20.6	***		833	4.6	2,915	14.9	***		892	5.3	***		1,731	14.1	2,123	14.2	10,853	7.9
TOTAL:	11,447	100.0	3,530	100.0	18,112	100.0	19,584	100.0	14,769	100.0	22,060	100.0	20,105	100.0	12,295	100.0	14,980	100.0	136,882	100.0

Source: Greater Bridgeport Regional Planning Agency, 1974

*Data from Valley Regional Planning Agency, 1978

**Data from the Connecticut Office of Planning, 1970

***These uses are incorporated into other categories

Residential uses total 43,125 acres, accounting for 31.5 percent of the SMSA's 136,882 acres. Monroe makes the largest contribution to the SMSA's residential acreage of 8,150 acres, followed by Fairfield contributing 7,148 acres. Easton and Monroe are the only communities with less than 25 percent of their acreage devoted to residential uses. Of the nine communities, Bridgeport has the largest proportion, 38.5 percent, of its area in residential development.

Monroe makes the largest contribution to the SMSA's vacant acreage, followed by Easton. Bridgeport has the least vacant land of the SMSA communities with 4.3 percent of its area lying vacant.

Bridgeport has the largest proportion of industrial acreage which accounts for 44 percent of such acreage in the SMSA. Commercial development which makes up 2.0 percent of the SMSA's acreage is greatest in Milford which has 7.2 percent of its acreage in commercial uses and accounts for 38 percent of the SMSA's.

Utility, transportation and streets make up significant portions of the SMSA communities. These and other land use data are presented in Table 6.

4. Transportation

The Bridgeport SMSA utilizes about all modes of public, private and commercial transportation. The area is served by extensive highway and roadway systems including Interstate 95 and State Highways 8, 15 and 25. Daily passenger and freight rail service is provided to cities throughout the Northeast by Conrail and Amtrak. Waterborne commerce is handled through the port of Bridgeport, second largest port in the state. Igor I. Sikorsky Memorial Airport, located in Stratford, provides facilities for both commercial and general aviation. Five transit companies provide regularly scheduled bus service along routes in Bridgeport, Fairfield, Stratford and a portion of Trumbull.

In addition to the transportation facilities directly serving the SMSA, other similar facilities are nearby. These include major ports and airports in Connecticut, Massachusetts, New York and New Jersey; a number of interstate and state highways; and rail service connections to most of the Northeastern United States and portions of Canada. These transportation facilities afford the region an extensive market for goods and services within a one to two day delivery area.

Within the SMSA, most passenger transportation is provided by private automobile. The remainder is by bus, train or taxi. A small percentage of passenger transportation is provided by private aircraft, boats or ferry. Freight is primarily carried by truck, freighter or barge. Rail transport also accounts for a notable volume of freight within the region.

B. The Port of Bridgeport

1. Waterborne Commerce

Table 7 contains information on the waterborne commerce at Bridgeport and Black Rock Harbors for the period 1970 through 1981.

TABLE 7

Comparative Statement of Commerce

Year	Tons	Percent Change from Previous Year
1970	3,843,722	
1971	3,548,554	-7.7
1972	3,471,623	-2.2
1973	3,553,980	2.4
1974	3,295,195	-7.3
1975	2,860,171	-13.2
1976	3,265,193	14.2
1977	3,495,140	7.0
1978	3,735,609	6.9
1979	3,243,301	-13.2
1980	3,194,618	-1.5
1981	3,212,851	0.6

Table 8 gives a summary of waterborne commerce for the year 1981 showing petroleum products, primary metal products, lumber-wood-paper products, and nonmetallic minerals as the principal commodities handled at the port. It can be seen that petroleum products constitute the bulk of the waterborne commerce at Bridgeport Harbor, comprising 85 percnet of the total commerce tonnage.

TABLE 8

FREIGHT TRAFFIC, 1981

BRIDGEPORT HARBOR

Commodity	Total	Foreign Imports	Foreign Exports	Domestic Coastwise Receipts	Domestic Coastwise Shipments	Local
Fish & Shellfish	48	48				
Sugar	1,433		1,433			
Sand, Gravel & Crushed Rock	22,743			22,743		
Nonmetallic Minerals (Except Fuels)	19,875	19,875				
Lumber, Wood & Paper	31,015	30,516	499			
Cut Stone	52	52				
Petroleum Products	2,723,767	610,377		1,360,902	323,833	84,047
Primary Metal Products	408,661	408,661				
Machinery	67	66	1			
Transportation	2		2			
Paper Waste & Scrap	5,108		5,108			
Special Items	40	40				
TOTALS	3,212,851	1,069,635	7,043	1,490,688	323,833	84,047

2. Harborside Development

a. Bridgeport Harbor

The Main Harbor includes the navigable portions of the Pequonnock River, the Yellow Mill Channel and Johnsons Creek. These three tributaries empty into the Inner Harbor which is separated from the Outer Harbor by Tongue Point on the West and Pleasure Beach on the east. The Outer Harbor extends from this point 3/4 mile south to converging breakwaters that protect the harbor from Long Island Sound. The main dredged 35-foot channel extends northward from Long Island Sound to the Inner Harbor and from there noth--westward to the mouth of the Pequonnock River.

A total of 21 piers, wharves, docks are located in the inner section of the Main Harbor and along the Yellow Mill Channel and the Pequonnock and Johnsons Rivers.

A total of 5 waterfront facilities are equipped to receive and/or ship petroleum products -- one of these provides bunkering for vessels; two of these are owned and operated by industries for the receipt of fuel oil for plant comsumption. One facility is used for the shipment of scrap metal, and two for the receipt of sand, stone, lumber, steel products, pumice, marble and shipping containers in feeder barge service -- one of these is also used for the shipment of scrap metal. One facility serves as a terminal for ferries operating between Bridgeport and Port Jefferson, Long Island, N.Y. and one is used for repairing small vessels. Eleven facilities were not being used at the time of the survey.

Three storage warehouses are available, having a total of almost 470,000 square feet of dry storage space.

Eight of the city's 13 marinas, yacht clubs and boatyards are located in Bridgeport Harbor. It is estimated that there are over 1,000 slips available within all of the city's marinas, with less than half of them available in Bridgeport Harbor. Many marinas report that they have extensive waiting lists for their wet storage spaces.

On the whole, there is little land available for development along the Bridgeport harborfront, as much of the land, although underutilized, is committed to existing users. Most of the land is devoted to activities not dependent on the water location. The majority of shore frontage is used for industrial purposes. Water related uses, such as marinas, parks and beaches, are underdeveloped with generally inadequate facilities.

b. Black Rock Harbor

The entrance to Black Rock Harbor is about 2 miles southwest of Bridgeport Harbor between Fayerweather Island and the mainland at Grover Hill. The main harbor is about 3/4 nautical mile long and 1/2 nautical mile wide at the entrance. Cedar Creek empties into the harbor head and extends northeast for about a mile and divides into short east and west

branches, both of which terminate south of Interstate 95. Burr Creek extends a short distance northward from the harbor head. A channel 18 feet deep extends from Long Island Sound the full length of Black Rock Harbor forking into Burr and Cedar Creeks. Apart from the dredged channel, the harbor and creeks are quite shallow, being under 10 feet.

A total of eight piers, wharves, and docks are located in the Cedar Creek extension of Black Rock Harbor. One facility is used for the shipment of scrap metal. Three are used for the receipt of petroleum products. One facility owned by Sikorsky Aircraft is used for the occasional receipt of helicopters to be repaired. Three were not being used when the survey was conducted.

Five of Bridgeport's 13 marinas, yacht clubs, and boatyards are located on the mainland shore of Black Rock Harbor, Burr Creek and Cedar Creek.

III. Without-Project Condition

A. Population Growth

Population projections based on the latest census figures are not yet available for the city of Bridgeport or the Greater Bridgeport region. (The region includes the SMSA communities except Derby, Milford and Shelton). The most recent projections which included projections for 1980 proved to overstate the region's growth, and suggested growth for Bridgeport rather than a decrease in population as occurred.

Overall, however, modest population growth in the six community region can be expected. Less growth is anticipated to occur in the three southern more urbanized communities than in the three northern communities, particularly in Monroe and Easton. With a smaller population per household, household formation is anticipated to occur more rapidly region-wide than population increase.

OBERS*, however, has provided some projections for the southern Connecticut area that includes the Bridgeport SMSA with the Stamford, Norwalk and Danbury SMSA's. In effect, this area covers most of Fairfield County. OBERS used employment and population changes between 1969 and 1978 as the historical base for its projections allowing for some shift in the region's share of the state's employment. The projections are provided in Table 9 below.

TABLE 9

OBERS Projections

Bridgeport, Stamford, Norwalk, Danbury SMSA's

Year	Population	Percent Change
1969**	780,867	
1978**	808,390	3.5
1985	849,800	5.1
1990	895,457	5.4
2000	931,704	4.0
2030	1,026,885	10.2

B. Future Growth

In terms of the economy the outlook for manufacturing is bright. Employment in manufacturing is expected to grow by more than 5 percent, 3,530 jobs, by 1987. The Bridgeport SMSA's future growth potential in manufacturing lies mainly in the transportation equipment industry. However, the share of the manufacturing section will decline to 36.0 percent of the area's industrial employment.

* Projections by Office of Business Economics (U.S. Dept.of Commerce) and Economic Research Service (U.S. Dept. of Agriculature)

** Historical

During the past decade nonmanufacturing has shown a greater and steadier increase. Employment in nonmanufacturing will increase by about 6.6 percent, 7,500 jobs, by 1987. Furthermore, the share of the nonmanufacturing sector will increase to 64.0 percent of the area's industrial employment. This increase is expected to take place in the trades and services. Construction and agricultural employment are expected to show declines in the coming years. Table 10 shows employment by industry for 1987 and the change between 1982 and 1987.

TABLE 10

Employment by Industry, 1987

Bridgeport Labor Market Area

Industry	1987 Number	1987 Percent	Percent Change 1982-1987
Manufacturing	68,120	36.0	5.5
Construction & Mining	6,030	3.2	1.5
Transportation	3,440	1.8	4.9
Communication & Utilities	3,030	1.6	1.7
Trade	38,070	20.2	2.1
Finance, Insurance & Real Estate	9,660	5.1	10.8
Services	51,740	27.3	9.9
Public Administration	9,050	4.8	9.7
Total	189,140	100.0	6.2

Future industrial growth is expected to occur in certain key areas in the Bridgeport SMSA. The most intensive growth in Bridgeport will take place in the southern section of the city along the Connecticut Turnpike and in the northern section of the city along Pequonnock River and around Success Lake. Other industrial development will be found along Route 110 in Stratford, Main Street and the Merritt Parkway in Trumbull, the Connecticut Turnpike in Fairfield and the northern region of Monroe.

Significant commercial development is expected to occur in all towns of the Bridgeport SMSA, excluding Easton. The most noteworthy commercial development will be found in Trumbull, Stratford and Fairfield. In Bridgeport, commercial expansion is planned for the downtown area.

Residential growth will most likely occur in all towns in the SMSA. Yet, more residential development will take place in the less dense communities on the outer edge of the region such as Monroe, Derby, Shelton, Easton and Fairfield. The core of the region, Bridgeport, Trumbull and Stratford, will not show significant increases in residential construction. In fact, Bridgeport, which is the most dense area and now showing a population decrease of 9 percent, will reveal the smallest increase in residential development.

C. Future Harbor Activity

1. Bridgeport Harbor

Demands on the harbor's resources are expected to continue increasing. Recreational boaters and commercial fishing interests will continue to seek out the limited mooring and docking space.

The Cilco Terminal at the northeast side of the inner harbor has been identified for potential port expansion. The terminal is utilizing about 88 percent of its current capacity and has 10 acres of open space and leases another 6 acres about a half mile away. Terminal expansion could be provided by bulkheading and filling in the water area between the existing terminal and the leased area. Presently, the land between the two areas is occupied by a number of homes; the water is occupied by a boat marina.

The waterfront has also become a critical element of Bridgeport's downtown revitalization plans. The city's revitalization plans for the central business district at the northwest side of the harbor are being integrated with harbor and waterfront development. The city hopes to take advantage of the waterfront's potential to draw shoppers into the downtown area and improve downtown business. Included in enhancing the attractiveness of the downtown are plans to refurnish the old railroad station as a gourmet market and convert a ferry boat into a high grade restaurant at the mouth of the river opposite the jai alai building.

2. Black Rock Harbor

The fuel oil terminals in the upper reaches and head of Cedar Creek currently supply about 60 fuel oil distributors with some home heating oil. A large percentage of homes and small businesses in the Greater Bridgeport area are supplied by these distributors. The deliveries required to keep the terminals supplied have been increasing and are expected to continue to do so.

The demand for recreational boating is expected to persist. However, the use of the municipally owned land near the north shore of Burr Creek as a foreign trade zone, may limit future recreational boat anchorage and increase commercial traffic. Anticipated barge traffic between the Resources Recovery Plant on Cedar Creek and the United Illuminating Plant may inhibit some recreational boating activities.

IV. With-Project Conditions

A. General

An analysis of 1979 and 1980 permit applications was performed by the Center for the Environment and Man, Inc. (CEM)* for the Corps of Engineers. Within this analysis, objections directed toward dredging/disposal activities were gathered. Dredging/disposal permits were issued for 23 Connecticut locations in 1979 and 1980. At 14 locations, some objection to the dredging/disposal activity was voiced; at the remaining 9 locations,

* J.C. Knopp et.al., CEM Report No. 4280-06-732, General Permit Study for the Six New England States, August 1981.

there were no objections. For the 23 sites, a total of 49 dredging/disposal permits were filed. Twenty of these were objected to. For the 20 permit applications receiving objections, 7 were objected to by agencies, 12 were objected to by the public, and 1 received objections from both agencies and the public. Agency objections to dredging/disposal projects included the following: wetland distrubance, disposal on tidal wetland, work during summer months. General public objections included: open water disposal, possible runoff, adverse aesthetic and environmental impacts, siltation. On many of these applications special conditions were imposed to accommodate various objections. Although no dredging/disposal permits were issued in Bridgeport Harbor during 1979 and 1980, the analysis provides some insight into the issues of greatest concern for dredging/disposal activity.

B. Dredging

Potential social and economic impacts have been considered during the progress of the study. Impacts that would occur during the construction phase, i.e., during dredging operations, as well as impacts associated with completion of the project, have been considered.

Impacts during construction are generally temporary and site-specific. The magnitude of these impacts is related to such things as the volume of material dredged, the nature of the dredging site (whether it is a heavily utilized commercial shipping channel or recreational boating anchorage), and the transportation associated with moving the dredged material to a disposal area. Because of their temporary nature, construction impacts generally are not significant. However,there are productive oyster beds in Bridgeport which may be disturbed during the dredging activities.

Impacts of particular concern during construction are potential shipping hazards, traffic problems, air and noise pollution, disruption of recreational opportunities, and displacement of usual site activities such as oyster farming.

These impacts are expected to be experienced to some extent with both the channel dredging in the Main Harbor and the anchorage creation and breakwater construction in Black Rock Harbor. The hinderance to traffic would be more commercially oriented, except that some disruption of recreational boating could occur if dredging is undertaken during the summer months in areas where oyster farms would not be impacted. Safety precautions would be taken and activities scheduled to minimize adverse effects.

The construction of a breakwater in Black Rock Harbor would introduce some land traffic problems if the material for the breakwater were transported by truck, increasing heavy truck travel on local roads. However, turnpike proximity would minimize these effects.

Post-construction impacts are experienced over the life of the project and may have regional as well as site specific implications. The occurrence of these impacts is related to changes in the utilization of the

project area. Long term impacts relevant to dredging in Bridgeport Harbor include reduced potential for boating accidents, reduced harbor traffic congestion, improvement of recreational opportunities, increased potential for existing activities, and some displacement of oyster farming activities.

A deeper channel and turning basin in Bridgeport Harbor would benefit the existing and future commercial and recreational fleets. Dredging in the main harbor would promote more efficient transportation of goods by allowing larger vessels to safely navigate the channel. Those vessels currently delayed during low tide periods would experience a transportation savings with elimination of the delays. A deeper channel would reduce the potential for groundings and spills. Enlarging the turning basin would increase the maneuverability for vessels that currently utilize the channel as well as those larger vessels that may use it in the future.

Dredging the main ship channel in Bridgeport Harbor would result in some damage to oyster farming activities that occur in the harbor. The economic and environmental costs associated with the loss of oyster habitat in Bridgeport is difficult to estimate. However, it is thought that there may be other beds in the area that are currently not being farmed that might compensate for those lost to dredging.

The placement of two breakwaters at the entrance to Black Rock Harbor would reduce storm damages to recreational boats and shoreline facilities. The breakwater would also increase the safety to boaters throughout the general area by providing protection during storms. Expansion of the fleet would be promoted by the creation of anchorage space approximating 44 acres. The new anchorage areas would alleviate the demand on the existing moorings. Increasing the channel depth in Black Rock Harbor would allow for safer passage of commercial traffic.

C. Disposal

A significant factor in the feasibility of dredging improvement is a suitable disposal site. The disposal issue raises environmental, social and public acceptability concerns as well as economic ones.

Utilization of the Central Long Island Sound Disposal Area is anticipated to have no significant social or economic effects. Transportation of the material would add to harbor traffic, but would be minor.

Other disposal sites addressed during earlier study stages involve placement of material on land and some involve the filling in of a creek or cove or an extension of the shoreline. These sites have capacities for material ranging from 5,000 cy to 200,000 cy.

Disposal impacts, like those related to dredging, may occur during both the construction phase and post-construction phase. The disposal site's location is influenced by transportation methods and routes, and site preparation would determine the extent of construction phase impacts. Important in land disposal sites are access routes and activities along these routes. Also a factor in land disposal is the need to dewater the material

before disposal. Transportation factors would probably not be as critical in ocean disposal or shorefront containment.

Post-construction phase impacts would be influenced mostly by final site use and the site's compatibility with surrounding activities. From a socioeconomic viewpoint, ocean disposal would prove to have the fewest impacts. Shorefront disposal and land disposal, however, could have significant impacts. Final use of a shorefront disposal site as a recreation area, as an example, may satisfy a very real need for the local population. Creation of a land disposal site in a residential area, however, could prove disruptive.

BRIDGEPORT IMPROVEMENT

HISTORICAL ARCHAEOLOGICAL

RESOURCES

Environmental Setting

There are no recorded prehistoric archaeological sites within the project impact area, although finds have been reported in Seaside Park and other nearby areas. As all proposed work would be within the present harbor, it is not anticipated that prehistoric resources would be affected by this project.

Black Rock Harbor was an active port in the 18th century, and was defended by a small battery during the Revolution. Until recently, this fort was believed to be under water, near the western shore of the harbor, but examination of period documents, including a map drawn at the time of a British attack, shows its location on the south side of Grover Hill. In the attack, noted above (July 7-8, 1779), many dwellings in Fairfield were burned, but the battery escaped damage. A new fort was built further up hill during the war of 1812.

Commercial use of the harbor continued in the 19th century, and a lighthouse was constructed on Fayerweather Island in 1847. Resort development began in the 1960's, accompanying the opening of Seaside Park. The structure formerly supposed to be the Revolutionary War battery appears to be a pier footing for a hotel built during this period. The harbor today reflects a continued mixture of residential, recreational, and industrial uses.

Seaside Park (including the Fayerweather Island Lighthouse) and the Black Rock Harbor Historic District, both on the National Register of Historic Places, border the east and west shores of Black Rock Harbor. The former area is a public park, dating from 1861 with late 19th and early 20th century additions, while the latter district contains several 18th and 19th century dwellings.

Impacts

As all projected work would be within the present harbor waters, no effect upon prehistoric archaeological resources is anticipated. Similarly, no effect upon significant historic archaelogical resources is anticipated. The only historic period feature within the project impact area is a rock structure near the western shore of Black Rock Harbor, which appears from its construction and location to be a late 19th century pier footing. As such, it has little historic or archaeological significance.

A visual effect upon the two adjacent historic districts might be anticipated from breakwater construction and possible disposal of some dredged material in Burr Creek Cove. However, the breakwaters considered would have been fairly unobtrusive structures, similar in appearance to seawalls now bordering the harbor, and the Burr Creek disposal site considered would have bordered only a small portion of the Black Rock Harbor Historic District behind dwellings and a modern playground. As both proposals are no longer under consideration, no effect is anticipated upon the districts.

APPENDIX 5

GEOTECHNICAL CONSIDERATIONS

BRIDGEPORT HARBOR, CT AND VICINITY

BRIDGEPORT HARBOR, CONNECTICUT

APPENDIX 5

GEOTECHNICAL CONSIDERATIONS

Appendix 5

Geotechnical Considerations

Bridgeport Harbor, CT and Vicinity

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Plates

Plate 1 - Soil Profile along Bridgeport Harbor Centerline

Plate 2 - Soil Profile along Proposed Alignment of Black Rock Harbor Breakwaters

Plate 3 - Sections: Black Rock Harbor Breakwaters

Appendix 5
Geotechnical Considerations
Bridgeport Harbor, CT and Vicinity

1. Topography. The coastal area of Connecticut lies within the Seaboard Lowland section of the New England physiographic province. The lowland is generally characterized by a seaward sloping area that is roughly planar. The lowland in Connecticut extends inland up to 20 miles and usually lies under elevation 500 feet NGVD. (1) National Geodetic Vertical Datum is the mean sea level of 1929. Elevations at the project area along the coast range from tide level to 80 feet NGVD. Only locally has different erosion significantly shaped the topography. Elsewhere, apparently because of pre-Cretaceous erosion to a surface of low relief and the deposition of extensive amounts of glacial drift, the bedrock geology has little elevational influence on topographic features. Recent events, including relative sea level rise, has somewhat modified the topography.

2. Geology. The bedrock in the region consists primarily of a middle to uppper Ordovician sequence of metamorphic rocks. These rocks, primarily gneisses and schists, have been folded into a NE-SW trending overturned syncline. The rocks are generally well-foliated, with the foliation dipping on the average between 40° and 85° to the northwest. Specifically, the rocks underlying Bridgeport Harbor consist of interlayered muscovite schist and gneiss, quartz schist and amphibolite belonging to the Orange Formation. The rocks underlying Black Rock Harbor belong to the Hartland Group, and the units present consist of mica-quartz schist; interlayered mica-quartz schist and biotite gneiss; biotite-quartz plagioclase gneiss with interlayered schist, gneiss and amphibolite; interlayered garnet-mica-quartz schist and gneiss.

In general, Pleistocene-age glacial deposits dominate the area although recent deposits are dominant in low-lying, coastal and offshore areas. Glacial till in the area is a compact, nonsorted mixture of clay, silt, sand, gravel, cobbles and boulders deposited by glacial ice. It is found overlying bedrock and is generally exposed in areas of relatively high elevation. Glacial outwash deposits, consisting mainly of stratified sand and gravel, grade into ice-contact stratified drift. These deposits are composed of sand, gravel, silt and clay and were deposited in streams and temporary lakes in close proximity to melting glacier ice. The stratified deposits generally overlie the till and are exposed in valleys, channels and low-lying areas. Recent deposits consist of alluvium, beach deposits, swamp and marsh sediments. The alluvium occurring in valleys and floodplains consists mainly of sand, silt and gravel. Swamp and marsh deposits, primarily silt, sand and clay mixed with organic matter, occur in poorly drained, low-lying areas. Areas along the coast are covered with beach and windblown sand and gravel. Specifically, the area underlying Bridgeport Harbor is covered primarily by silty, gravelly sand and inorganic silt, with more-recent silty sand and inorganic silt filling old stream channels and a very recent deposition of organic silt blanketing the area. The area underlying Black Rock Harbor is covered primarily by inorganic silt and silty sand overlying glacial till or bedrock. The area is blanketed by a more recent deposition of silty sand and organic silt.

Bottom sediment sample test results may be examined at the New England Division office of the U.S. Army Corps of Engineers, 424 Trapelo Road, Waltham, Massachusetts 02254, where they are on file with the Geotechnical Engineering Branch, Engineering Division.

3. Foundation Investigations. No field reconnaissance trips or foundation explorations were performed specifically for this study. Foundation explorations performed by the New England Division in 1954 and 1961 and environmental sampling explorations performed by the New England Division in 1980 were used in the analysis of Bridgeport Harbor. Foundation explorations performed by the New England Division in 1963 were used in the analysis of Black Rock Harbor. Locations of the explorations for each site are shown in Plates 1 and 2 respectively.

4. Foundation Conditions.

a. Bridgeport Harbor. The proposed plan at Bridgeport Harbor is to deepen the existing navigation channel from a mean low water depth of 35 feet to depths of 38,40,42 and 50 feet. A profile showing subsurface conditions along the centerline of the channel is depicted on Plate 1.

In general, 2 to 4 feet of organic, sandy silt, deposited since 1961 and containing 50 to 95 percent fines, covers the channel. Underlying this material to an undetermined depth is a silty and gravelly sand sequence containing 10 to 50 percent fines.

Throughout the area there is evidence of buried stream channels which existed at times of lower sea level. Referring to Plate 1, these channels are located approximately at distances of 2,200 feet, 7,200 feet, 10,800 feet and 20,200 feet from point A-A on Plate 1. These buried channels are approximately 15 feet deep and are filled with relatively fine materials consisting of inorganic, sandy silt with 65 to 80 percent fines, sandy silty clay with 90 percent fines, and more recent, organic sandy silt with 70 to 95 percent fines.

b. Black Rock Harbor. The proposed plan at Black Rock Harbor is to construct a breakwater to elevation 15.0 feet MLW on both sides of the existing 18-foot deep channel. A profile showing subsurface conditions along the centerline of the breakwater is depicted on Plate 2.

The surface material underlying the east leg of the breakwater is an organic, sandy silt containing 60 to 95 percent fines. This silt is approximately 15 feet thick between the shoreline and a line 700 feet offshore. At that point, it gradually thickens to over 30 feet under the channel. Underlying the silt, there is a 10 foot thick silty sand unit with 30 to 40 percent fines. This unit thins shoreward and eventually pinches out approximately 300 feet from shore. The basal unit, extending to an unknown depth, is an inorganic, sandy silt containing 60 to 80 percent fines.

The subsurface conditions at the west leg of the breakwater from the shore line to approximately 500 feet offshore are an average of 200

feet of silty sand overlying very compact till or, more likely, bedrock. Over the next 250 feet the top-of-rock profile drops 30 feet. The foundation conditions for this reach are as follows: 10 feet of silty sand with 30 to 40 percent fines, 5 to 30 feet of organic, sandy silt with 60 to 95 percent fines thickening toward the channel and 5 to 15 feet of silty sand overlying bedrock. In the area within 200 feet of the channel centerline, the silty sand overlies an undetermined thickness of inorganic, sandy silt with 60 to 80 percent fines.

5. Rubble Mound Breakwater Design

a. Foundation Assumptions and Recommendations. The organic silt layer layer covering most of the foundation area for the considered breakwater at Black Rock Harbor has inadequate bearing capacity to support the breakwater. The silty sand and inorganic silt deposits underlying theorganic silt are assumed to have adequate bearing capacity to support the breakwater without excessive settlements. These assumptions are based on existing limited subsurface information at the site. Foundation treatment would consist of removal of the inorganic silt layer and replacement with dumped sand fill as shown on the Foundation Treatment Section on Plate No. 3. In areas where no organic silt is present, the breakwater would be founded directly on the existing harbor bottom. The foundation design assumptions would be verified with a formal exploration and testing program during the design phase of this project.

b. Breakwater Slopes and Stone Sizes. The considered breakwater would consist of a rock core protected by underlayer stone and a double layer of armor stone. The weights of armor stone in structures were determined from the following formula for uniform size stone:

$$W = \frac{Wr\ H^3}{K_D(S_r - 1)^3\ \cot\theta}$$

where, W = weight of stone in pounds
Wr= unit weight of stone in pounds/cr. ft.
K_D= Stability coefficient: 3.5 for the trunk of structures subject to breaking waves
S_r= Specific gravity = Wr/Ww = $\frac{\text{Unit weight of stone}}{\text{Unit weight of water}}$
θ = Angle of slope to the horizontal
H = Wave height at structure

Side slopes of the breakwater would be 1.0 vertical on 1.5 horizontal. The west leg of the breakwater would be subjected to a maximum breaking wave of 4.5 feet.

The computed armor stone size for the west leg of the breakwater is 1,000 pounds, and would range from 750 pounds to 1,250 pounds with approximately 75 percent of the individual stones weighing more than 1,000 pounds. The thickness of the double armor stone layer would be approximately 4.5 feet. The 2-foot thick underlayer would contain stones ranging in size from 70 to 130 pounds with an average size of approximately 100 pounds. The rock core would consist of clean, quarry-run stone ranging in size from 1 to 70 pounds.

The computed armor stone size for the east leg of the breakwater is 550 pounds, and would range from 400 to 700 pounds with approximately 75 percent of the individual stones weighing more than 550 pounds. The thickness of the double armor stone layer would be approximately 3.5 feet. The 2-foot-thick underlayer would contain stones ranging in size from 40 to 70 pounds with an average size of approximately 55 pounds. The rock core would consist of clean, quarry-run stone ranging in size from 1 to 40 pounds.

c. Construction Considerations. It is envisioned that all construction materials would be delivered to the site by barge. After the excavation of organic silt from the foundation area is completed, sandfill would be placed by bottom-dump barge up to the existing harbor bottom. Core stone, underlayer stone and armor stone would be placed directly by crane operating from an equipment barge.

6. Construction Materials. Anticipated materials needed for the construction of the breakwater at Black Rock Harbor are 253,000 cy of dumpted sandfill, 17,000 tons of 750-to 1,250-pound armor stone, 18,400 tons of 400-to 700-pound armor stone; 8,500 tons of 70-to 130-pound underlayer stone, 6,500 tons of 40-pound to 70-pound underlayer stone and 70,200 tons of core stone. It is expected that all of the rock could be obtained from commercial suppliers within a 25-mile radius of the project site. It is expected that the required amount of sand could be obtained from within a 50-mile radius of the project. Based on discussions with local sand and gravel suppliers, it is doubtful that any one supplier could or would supply the anticipated quantity of sand.

APPENDIX 6

PUBLIC VIEWS AND RESPONSES

BRIDGEPORT HARBOR, CT AND VICINITY

APPENDIX 6

KEY CORRESPONDENCE

RECEIVED PRIOR TO ISSUANCE OF

DRAFT FEASIBILITY REPORT AND DEIS

BRIDGEPORT HARBOR, CT AND VICINITY

APPENDIX 6

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Colonel Carl B. Sciple
Division Engineer
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254

OCT 1 1982

Dear Colonel Sciple:

This planning aid letter is intended to assist your planning process for the Bridgeport Harbor Navigation Improvement feasibility study. The letter is issued under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

As we presently understand the alternative project plans, the contemplated navigation improvements would consist of deepening the main channel in Bridgeport up to the Union St. Dock, to 40 feet and enlarging and deepening the turning basin. Contemplated developments in Black Rock Harbor include two detached rubble mound breakwaters, construction of 20- and 24-acre anchorages to 8 feet and a 28-acre anchorage to 6 feet in Cedar and Burr Creek. The major construction activities associated with the various project alternatives include dredging dredge material disposal and rubble mound fill. The major problems associated with the dredging aspects of the proposals are loss of benthic habitat for oyster and hard clam resources of commercial importance and other benthic fauna important to finfish and avifauna resources and potential turbidity and/or sedimentation problems. Creation of dedicated anchorage areas in Black Rock Harbor will effectively cause a land use change from shellfish grounds and intertidal flats to boat mooring areas. Future conflicts between competing resource needs and/or utilization could be enhanced with the navigation proposals for Black Rock Harbor.

A variety of methods or alternative plans appear to be available to reduce construction impacts associated with the navigation improvements under consideration. Deep draft vessel utilization of the Federal channel in Bridgeport is on the order of one vessel every three to five days. Even if vessel traffic increased two or three fold, the main ship channel would only carry one deep draft vessel per day on the average. Based on this rate of use, it seems reasonable that the channel width could be reduced to 300 feet more or less which would eliminate the removal of oyster and quahog beds adjacent to the channel when it is deepened to 40 feet. Additionally, traffic control systems should be considered to regulate vessel movement if found necessary or desirable. Another measure or alternative plan that could be taken to minimize environmental impact would be for the commercial users to deepen their berthing areas to 40 feet and transit the channels at high tide. This option would provide for some of the economic advantages of a full 40-foot Federal channel while avoiding the adverse impacts of large scale dredging and disposal.

OCT 5 1982

A permanent alternative measure to minimize dredging and disposal impacts could be to develop an offshore unloading terminal. Since most of the cargo shipped into Bridgeport Harbor is petroleum, it would seem reasonable to develop an offshore unloading terminal capable of handling the largest class of transport vessels. Such a facility could conceivably serve both sides of Long Island Sound depending on its location. One of the long-term advantages of this alternate plan would be the elimination of subsequent channel deepening projects into Bridgeport Harbor to obtain the natural depths available in the Sound. The economic feasibility of this alternate should be based on the cost of developing the offshore terminal at a depth of 50 feet or greater vs the costs of developing the same depth capacity in Bridgeport Harbor. The physical capabilities of Bridgeport Harbor being able to accommodate this depth and appropriately sized vessels should be included in the analysis.

In Black Rock Harbor, some additional alternate plans we recommend for consideration are the use of comprehensive or storm damage insurance policies for boat owners using this area as an anchorage or mooring area. This alternate would not directly eliminate or reduce physical storm damages, but it would eliminate or greatly reduce the economic impact to individual boat owners in a manner similar to a comprehensive auto insurance policy. A second option that should be investigated is the feasibility of using dry storage to eliminate the need for dredging and dedicating anchorage areas in Black Rock Harbor. Both of these options would eliminate the adverse impacts to seed oyster habitat.

Information on the quality of dredge materials from Federal and non-Federal channels, berthing, anchorage and breakwater construction areas is necessary before disposal issues can be resolved. In addition to traditional bulk sediment data for parent and maintenance dredge material, bioassay, bioaccumulation and complete toxic scan analyses are needed for these sediments in the Federal and non-Federal channels, berthing, anchorage and breakwater construction areas. The quality of the dredge material will have a direct bearing on the acceptability of various uses and disposal locations.

Several potential disposal areas for clean sand exist near Bridgeport Harbor. These include Long, Pleasure, Seaside, Jennings and Fairfield Beaches. Precautions would need to be exercised to insure that sand placement did not adversely impact shellfish, finfish, avifauna and vegetative resources. These problems could be resolved by time of year restrictions and direct placement of sand on the beach between the beach grass or breakwall zone and mean tide level.

Potential upland disposal sites for suitable dredge material exist on the Jennings Beach parking lot, the Bridgeport landfill and adjacent upland areas to the east and west and the Pleasure Beach parking lot and adjacent upland areas.

We would not favor or recommend the use of intertidal flats, such as Burr Creek Cove, Penfield Reef or southern end of Fayerweather Island as disposal areas, because of the adverse impacts to finfish, shellfish, and avifauna resources. For similar reasons, we would recommend against the use of salt marsh areas for use as disposal sites.

Yellow Mill Channel within Bridgeport Harbor has potential for use as a dredge material disposal site. Water and sediment quality within this channel severely impact habitat suitability for benthic and finfish species. However, local residents do utilize the channel as a sports fishing area. During the summer, bluefish are occasionally observed chasing schools of forage fish in the channel. Yellow Mill Channel may also have potential for new recreational, commercial or industrial water dependent uses in the future as changes occur. As an example, Yellow Mill Channel should be considered as an alternate mooring or anchorage area for pleasure boats that propose to utilize Black Rock Harbor anchorages. The adverse impacts to fish and wildlife resources would be far less with the anchorage areas located in Yellow Mill Channel than if they are located in Black Rock Harbor because breakwater construction would be eliminated as would the dredging of productive oyster, hard clam and intertidal mudflat habitat. The major land use change and potential secondary impacts associated with the dedication of Black Rock Harbor as a small boat harbor and anchorage could be eliminated with the Yellow Mill Channel Alternate.

We have concerns with the proposal to construct breakwaters at the entrance to Black Rock Harbor in addition to the loss of shellfish habitat and land use changes. These concerns relate to changes in tidal flushing, circulation and mixing patterns that could result in detrimental water quality impairments above and beyond those that presently exist in portions of this small estuary. The potential to exacerbate these problems and promote conditions similar to New Bedford Harbor exist. We have similar concerns regarding sedimentation patterns in this estuary. The potential for Black Rock Harbor to accumulate fine grained and floculent sediments could increase if breakwaters are constructed. The results of these combined changes on the benthic community are of concern to us because the potential exists for the Black Rock system to favor pollution tolerant and/or transitory species.

The open water disposal alternate is the Central Long Island or New Haven Disposal site. Currently, this is the only approved open water disposal site in the central portion of Long Island Sound. Major impacts associated with disposal at this site include loss of benthic species where the dredge material is dumped, turbidity during the disposal operation and dispersion of contaminants into the marine environment. Specific impacts cannot be addressed without detailed chemical, physical, and biological test data on the maintenance and parent material to be dredged and, subsequently, disposed. Similar data would be needed for the specific dump site under consideration. Any future recolonization of the dump site by benthic fauna would depend on factors identified above.

If open water disposal is viewed as a viable option for uncontaminated dredge material, we recommend that an extensive effort be made to find areas in the sound that are containment areas, have relatively low benthic and finfish productivity or other ecological values, are not presently utilized by commercial

or recreational fishing interests, and other characteristics which would provide an opportunity to use dredge material in a beneficial manner in the marine environment.

We appreciate the opportunity to interact with your staff during the planning process for this navigation improvement study.

Sincerely yours,

Gordon E. Beckett

Gordon E. Beckett
Supervisor

OFFICE OF THE MAYOR
CITY OF BRIDGEPORT, CONNECTICUT
45 LYON TERRACE
BRIDGEPORT, CONNECTICUT 06604

LEONARD S. PAOLETTA
Mayor

December 27, 1982

Mr. Joseph L. Ignazio
Chief, Planning Division
Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Mass. 02254

Dear Mr. Ignazio:

The Corp of Engineers and the City of Bridgeport have for several years now been actively discussing the potential improvements to the navigable harbors of Bridgeport. One of Bridgeport's greatest assets is its shoreline with its many water-dependant activities for both recreational and commercial interests. The City acknowledges the Corp's proposed navigational improvements for Bridgeport Harbor and vicinity as a definite step forward in expanding the City's capabilities in the area of water-related uses.

It is the intention of the City of Bridgeport to participate in the recommended improvements contained in your study, assuming the availability of resources to fulfill the local match requirement. We are excited about your suggestions and support the continuation of the present study.

If at any time the City of Bridgeport can provide your office with any additional information, please do not hesitate to contact my office at (203) 576-7201.

Sincerely,

Leonard S. Paoletta

Leonard S. Paoletta, Mayor
City of Bridgeport

LSP/MPN/pv

OFFICE OF THE MAYOR
CITY OF BRIDGEPORT, CONNECTICUT
45 LYON TERRACE
BRIDGEPORT, CONNECTICUT 06604

LEONARD S. PAOLETTA
Mayor

November 22, 1982

Mr. Joseph L. Ignazio
Chief: Planning Division
Department of the Army
Corps of Engineers, NED
424 Trapelo Road
Waltham, Ma. 02254

Dear Mr. Ignazio:

At the Workshop Meeting on navigational improvements to Bridgeport Harbor, held at the Miamogue Yacht Club on May 27, 1982, the Commodore of the yacht club stated that the proposed 3-acre anchorage in Johnsons Creek would be located too far away from the Miamogue and East End yacht clubs. Both of these clubs, which are located on the creek, have indicated that the proposed anchorage would not be used by their members for this reason.

Acting upon the request of Mr. Steve Onysko, your Project Manager for the Bridgeport study, we took another look at the future needs and desires of local boating interests on Johnsons Creek. At this time, we can foresee no future need for this type of anchorage at this location. It is apparent from our discussions with the yacht clubs in this area that floating slips are preferable to remote moorings away from the club facilities. In addition, with no direct access to the proposed anchorage, only a limited number of recreational boaters would use the facility and thus, full capacity of the anchorage would probably never be attained.

Therefore, it is recommended at this time that the proposed 3-acre anchorage in Johnsons Creek be dropped from any alternative navigational improvement plan now under study.

If I can be of any further assistance in this matter, please let me know.

Sincerely,

Leonard S. Paoletta,
Mayor

LSP/pv

cc: Gilbert Zawadski - Harbormaster

OFFICE OF THE MAYOR
CITY OF BRIDGEPORT, CONNECTICUT
45 LYON TERRACE
BRIDGEPORT, CONNECTICUT 06604

LEONARD S. PAOLETTA
Mayor

September 9, 1982

Mr. Joseph L. Ignazio, Chief
Planning Division
Department of the Army
Corps of Engineers, New England Division
424 Trapelo Road
Waltham, Ma. 02254

Attention: NEDPL-C

Dear Sir:

In response to your letter of 27 August 1982 concerning the costs to construct containment areas for dredged materials at the Yellow Mill Channel and Burr Creek Cove sites, the City is in complete agreement with the Corps of Engineers in that this project cannot be economically justified at this time. The estimated $3,566,000+ minimum costs to the city plus the costs of purchasing riparian rights from abutting property owners; cost of surface runoff drainage, and other environmental costs could not possibly be bourne by the city at this time. The approximately 26 acres of land created at these sites would be restricted to recreational parkland uses by the nature of the materials used and thus could not be marketed for any activities that would provide the city with a return on its investment.

Regarding the ongoing feasibility study of potential navigational improvements in Bridgeport Harbor and vicinity, the city has been and will continue to closely follow the activities of the Corps as it progresses towards its finished report. At that time, the city will decide to what extent, if any, we will be involved in the implementation and economics of this project. The benefits to the City of Bridgeport of this project are obvious; the costs however may be prohibitive.

On behalf of the City of Bridgeport, let me express our appreciation for all the technical assistance and research that the Corps of Engineers has put into this project over the past several years. If at any time, we can supply any further information that the Corps may require, please don't hesitate to contact my office or our Director of Planning, Dr. James A. Crispino.

Sincerely,

Leonard S. Paoletta

Leonard S. Paoletta,
Mayor

LSP/MPN/pv

UI United Illuminating

General Offices: 80 Temple Street

P.O. Box 1564, New Haven, Conn. 06506-0901

January 4, 1983

Mr. Joseph L. Ignazio
Chief, Planning Division
Department of the Army
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254

RE: Your Letter Of November 5, 1982
Soliciting Interest In The Bridgeport Harbor And
Vicinity Feasibility Study For Navigational Improvements

Dear Mr. Ignazio:

The concept of deepening the Bridgeport Harbor navigational facilities to handle 40 foot draft marine traffic does not contain enough economic incentive for The United Illuminating Company to pursue an interest at this time.

The United Illuminating Company feels that, at this time, the existing 36 foot draft facilities and their continued maintenance provide sufficient capacity for our needs.

Since your project is scheduled for the late 1980s and since the value of deep drafts is difficult for UI to forecast, we certainly have a continuing interest in this plan and its development.

Your continuing efforts to keep us informed are greatly appreciated. Please continue this practice in the future.

Very truly yours,

John H. Salomon
Superintendent of Production

JHS/es

eneral Offices: 80 Temple Street

UI United Illuminating

P.O Box 1564, New Haven, Conn 06506-0901

January 22, 1982

Mr. Kevin B. McKelvey
Regional Economist
United States Army Corps of Engineers
424 Trapelo Road, Building 113N
Waltham, Massachusetts 02254

Dear Mr. McKelvey:

We offer the following comments to the questions reflected on the attachment to your letter dated January 4, 1982.

As I'm sure you are aware, it is extremely difficult to project terminal activities ten years into the future, but going out 50 years, particularly when a normal plant life is only 40 years, can be completely nebulous. Please view all of our comments in light of this, and the fact that we don't have the kind of details regarding vessels and vessel size that you are requesting under question (3).

c. Without the project, the terminal activities would necessitate a continued operation with barges, and "MR" tankers that have been lightered in order to meet the draft restriction. With the project, the most significant change that we can envision is the elimination of the need to lighter the tankers. Most fuel oil cargoes currently coming into the United States are shipped in "GP" "MR" and "LRI" size vessels which have drafts of 31' to 40'.
The deeper draft would obviously afford us certain advantages in negotiating future contracts by giving us the ability to procur a full contract cargo. In addition to increased flexibility, we could also realize potential fuel cost savings.

(1) Without the project, we don't foresee any change in the basic nature of the terminal's future operation.

(1) With the project, there is the potential to use the terminal for expanded fuel activities.
While certainly we don't have plans for expanded activities, it should be recognized, particularly when looking this far into the future, that events have a way of developing the need for changes in operation and if the potential is there, a company can profit from it.

While the future of coal conversions is uncertain, if they do materialize, the ability to handle self-unloading deep draft colliers could be a definite advantage.

(2) Do not anticipate changes under either scenario.

(3) a. GP, MR and LRI with and without project
b. Probably domestic
c. Dependent on future supplier
d. 19,000 to 45,000
e. 560' x 69' to 750' x 102'
f. 31' to 40'
g. 9' to 0' with project

(4) Demurrage, additional payroll costs, lightering costs, increased potential for spill, less flexibility regarding suppliers and potentially higher fuel costs, and increased potential for dock damages. We don't have enough information to be able to quantify the affect of the foregoing items at this time.

(5) It would certainly eliminate all of the items previously outlined but, again, we are not in a position to quantify those items.

a. Doubtful
b. Yes
c. Yes
d. Don't know
e. Yes
f. Probably
g. Yes

Regarding the tables, B-15 thru B-28, I have been unable to determine the source at UI that provides the input but I have reviewed the data regarding the number of vessels, draft in feet, DWT, and hours in port and have determined that these figures appear reasonable. We do not have access to the remaining data; i.e., rate at sea, rate in port, and hours at sea.

I must apologize for supplying very general answers to some specific questions but we do not have the details necessary to provide specific, quantitative answers.

Very truly yours,

Robert W. Lancio

R. W. Lancio
Manager, Fuel Supply and Operations Data

RWL/es

CILCO TERMINAL COMPANY, inc.

BRIDGEPORT, CONNECTICUT 06601

TERMINAL OPERATORS — STEVEDORES — STEAMSHIP AGENTS

MAIN OFFICE: 75 THIRD STREET
P.O. BOX 510
TERMINAL & OPERATIONS: 535 SEAVIEW AVENUE

PHONE: (203) 336-3841
TWX: 7104534028
TLX: 964343
CABLE ADDRESS: CILCO

January 19, 1983

Mr. Joseph L. Ignazio
Chief, Planning Division
Department of the Army
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, Mass. 02254

Attention: NEDPL-C

Dear Sir:

This is in response to your letter of November 3, 1982, in which you ask for a letter of continued interest in the dredging of the harbor at Bridgeport to 40 feet below mean low water. You further tell us that it is estimated that 27,000 cubic yards would need to be dredged at our terminal.

The construction of our terminal does not permit dredging below 35 feet. Any dredging below this would endanger the construction of our facility. We would not be involved in a deepening beyond 35 feet.

Sincerely yours,

CILCO TERMINAL COMPANY, INC.

Sidney S. Postol

Sidney S. Postol
Vice President

ssp/fm

SHELL OIL COMPANY
EAGLES NEST ROAD
P. O. BOX 4127
BRIDGEPORT, CONNECTICUT 06607

December 21, 1982

Joseph L. Ignazio
Chief, Planning Division
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, Mass. 02254

Dear Mr. Ignazio:

In reply to your letter of November 5, 1982 concerning a feasibility study for possible dredging of the Bridgeport Harbor we have reviewed our future needs in this area. At this time we wish to advise you that Shell Oil Co. has no interest in this project.

Very truly yours,

R.R. Johmann

R.R. Johmann
Plant Manager

NEW HAVEN - BRIDGEPORT PILOTS ASSOCIATION, INC.
23 Highland Drive, Wallingford, Conn. 06492
Serving New Haven and Bridgeport Harbors
Tel. ~~265-2167~~ Code 203
265-3673

August 24, 1982

Steven Onysko
Project Manager, CDB
Department of the Army
Corps of Engineers, NED
424 Trapelo Road
Waltham, MA 02254

Dear Mr. Onysko;

This letter is in response to our telephone conversation on Monday, August 16, 1982, concerning the proposed navigation improvements in Bridgeport, Connecticut.

The present entrance channel into Bridgeport Harbor is 35-feet deep at mean low water, and 400-feet wide. It can accomodate two-way traffic for vessels up to 10,000 DWT and one-way traffic for vessels larger than that size. Tankers in the 70,000 DWT range, 765-feet in length, 108-feet in width and 40-feet in draft, have transited the channel with a reduced load.

If the channel is deepened to 40-feet, tankers of up to 80,000 DWT, 795-feet in length, 115-feet in width and 45-feet in draft, could use the waterway at spring high water without increasing the present width of the channel. Although the entrance channel is a straight-in approach to the harbor, I would not recommend that it be decreased in width, as bank clearance for the anticipated larger size vessels would be inadequate and frequent groundings, as well as oil spills could be expected.

As in other ports, the vessel traffic in Bridgeport Harbor has decreased during the present economic slump. However, it is anticipated that the traffic will return to normal and then increase in the future.

If you have any questions or desire any further information in regards to the badly need navigation improvements in Bridgeport Harbor, please do not hesitate to let me know.

Sincerely,

Donald V. Monks

Captain Donald V. Monks
State and Federal Pilot

CF: James Crispino, Bridgeport
Director of Planning

Gilbert Zawadski, Bridgeport
Harbormaster

NEW HAVEN - BRIDGEPORT PILOTS ASSOCIATION, INC.
23 Highland Drive, Wallingford, Conn. 06492
Serving New Haven and Bridgeport Harbors
Tel. 265 2167 Code 203

March 19, 1980

Colonel W. E. Hodgson, Jr.
Acting Division Engineer
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Col. Hodgson,

Having attended a meeting at Bridgeport City Hall where your men presented a preliminary report on Bridgeport Harbor, I, on behalf of this Pilots Association, would like to pass on our support of the proposed project.

This association of Pilots has been in business in Bridgeport since it was opened up to deep draft vessels and we have seen it grow to the present level of about 400 ship passages a year. We were instrumental in having a better buoyage system put in the main channel for safer transit of ships.

At present we are requesting the removal of a shoal in the harbor for a safer maneuvering of ships.

Bridgeport is in the world market and in order to grow or even maintain its position it must deepen and widen the present channel as the size of ships being built today demand it. Twenty years ago 10,000 D.W.T. coal ships called on U.I. - now 70,000 D.W.T. tankers. They built their facility to accomodate it but the channel is not deep enough so they must come in part cargo.

Cilco Term and Shell Term docks now handle ships to the capacity or limitations of the channel.

I believe the jobs of thousands of people are related to the shipping in Bridgeport and to not go forth with this project would soon be a detriment to the regional economy.

We have recently supplied your office with the names and number of ship transits. If we can be of any further help on this project please call.

Sincerely,

Donald V. Monks

Captain Donald V. Monks
State and Federal Pilot

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