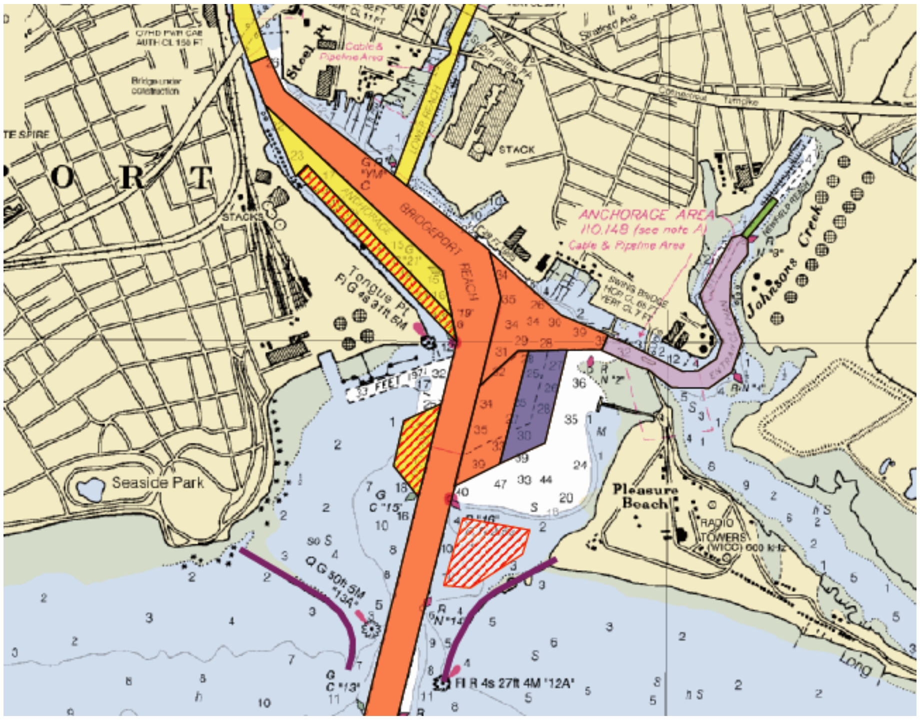
Draft Dredged Material Management Plan

Bridgeport Harbor
Bridgeport, Connecticut



US ARMY CORPS
OF ENGINEERS
New England District

February 2010

BRIDGEPORT HARBOR, CONNECTICUT
DREDGED MATERIAL MANAGEMENT PLAN

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DREDGED MATERIAL MANAGEMENT PLAN APPENDICES

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BRIDGEPORT HARBOR, CONNECTICUT
DREDGED MATERIALS MANAGEMENT PLAN

1. PURPOSE

The purpose of this decision document is to: 1) describe the existing conditions of the Bridgeport Harbor Federal Navigation Project and document the project features warranted for continued maintenance, 2) describe and document the selection of a dredged materials management plan, and 3) serve as a decision document supporting the Project Partnership Agreement (PPA) for the upcoming maintenance project

2. STUDY AREA

Bridgeport Harbor is located in southern Connecticut on the north shore of Long Island Sound in Fairfield County. The primary region served by the harbor is southwestern Connecticut; however, portions of western Massachusetts, southeastern New York and southern Vermont are also serviced by Bridgeport Harbor for various items of waterborne commerce.

Bridgeport Harbor is divided into outer and inner harbor. The outer harbor is entered from Long Island Sound between two converging breakwaters. It is about one-mile wide at the lower end, and extends north to mouth of the Pequonnock River entering from the northwest and Yellow Mill Creek Channel and Johnson's Creek from the northeast. That harbor includes the navigable portions of these waterways. The harbor is bounded on the east by Seaside Park and Tongue Point and on the west by Pleasure Beach. At the north end of the harbor is Steel Point.

3. AUTHORIZATION

The federal navigation project at Bridgeport Harbor was first adopted in 1836 and modified by subsequent authorizations by Congress to improve navigation. Authorized project features include entrance, main and branch tributary channels, anchorages, a turning basin, and two stone breakwaters at the entrance to the harbor. Current channel depths and navigation features were authorized in the River & Harbor Act of 1958. Since 1958 only two partial deauthorizations have been made. These were to deauthorize a portion of the Johnson Creek anchorage areas and to deauthorize a short strip along the eastern edge of the Yellow Mill Creek Channel. (WRDA 1997 and WRDA 2000, respectively.) . The complete list of authorizations is included in Appendix A along with a project construction and maintenance history.

4. PROJECT DESCRIPTION

The existing authorized Federal Navigation Project for Bridgeport Harbor consists of the following General Navigation Features, including the three tributary channels Johnson Creek, Yellow Mill Creek, and the Pequannock River. All depths noted are referenced to mean lower low water (MLLW and the 1983-2001 Tidal Epoch). Authorized depths are summarized in Table 1 and project features are shown in Figures 1 and 2.

General Navigation Project Features:

- Two rubblestone breakwaters separating the inner harbor from Long Island Sound.
- An entrance channel with an authorized depth of -35 feet and 400 feet wide extending from deep water in Long Island Sound to the breakwaters.
- An inner harbor channel -35 feet MLLW 600 to 300 feet wide extending about 1.7 miles from the breakwaters up-harbor to I-95.
- 35-foot MLLW turning basin at the east side of the head of the entrance channel;
- A 35-foot and 25-foot MLLW anchorage basin located east of the main channel and opposite Tongue Point.
- An 18-foot anchorage basin located west of the main channel and south of Tongue Point.
- An 18-foot inner anchorage and adjacent barge channel.
- In Johnson Creek a 15-foot MLLW by 250 foot wide channel at the lower end and a 9-foot deep by 100 foot wide channel in the upper reach. There is also a 6-foot deep anchorage at the head of the channel.
- In Yellow Mill Creek a 1-mile long channel 18 feet deep at MLLW by 150 to 200 feet wide.
- In the Pequannock River at the head of the inner harbor, a 1.1 mile-long channel 18 feet deep and 200 feet wide at the lower end to 125 feet wide at the upper end.

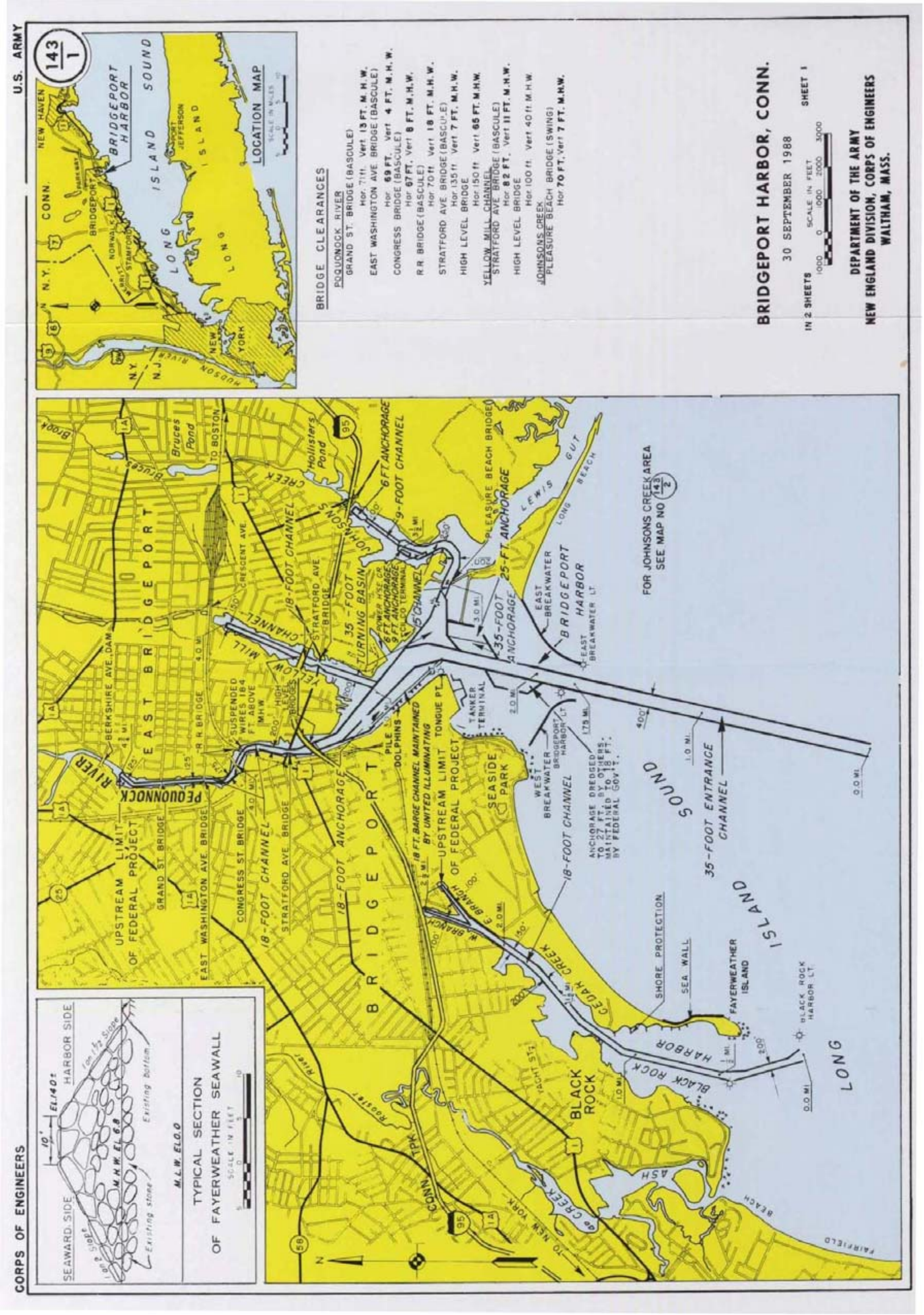
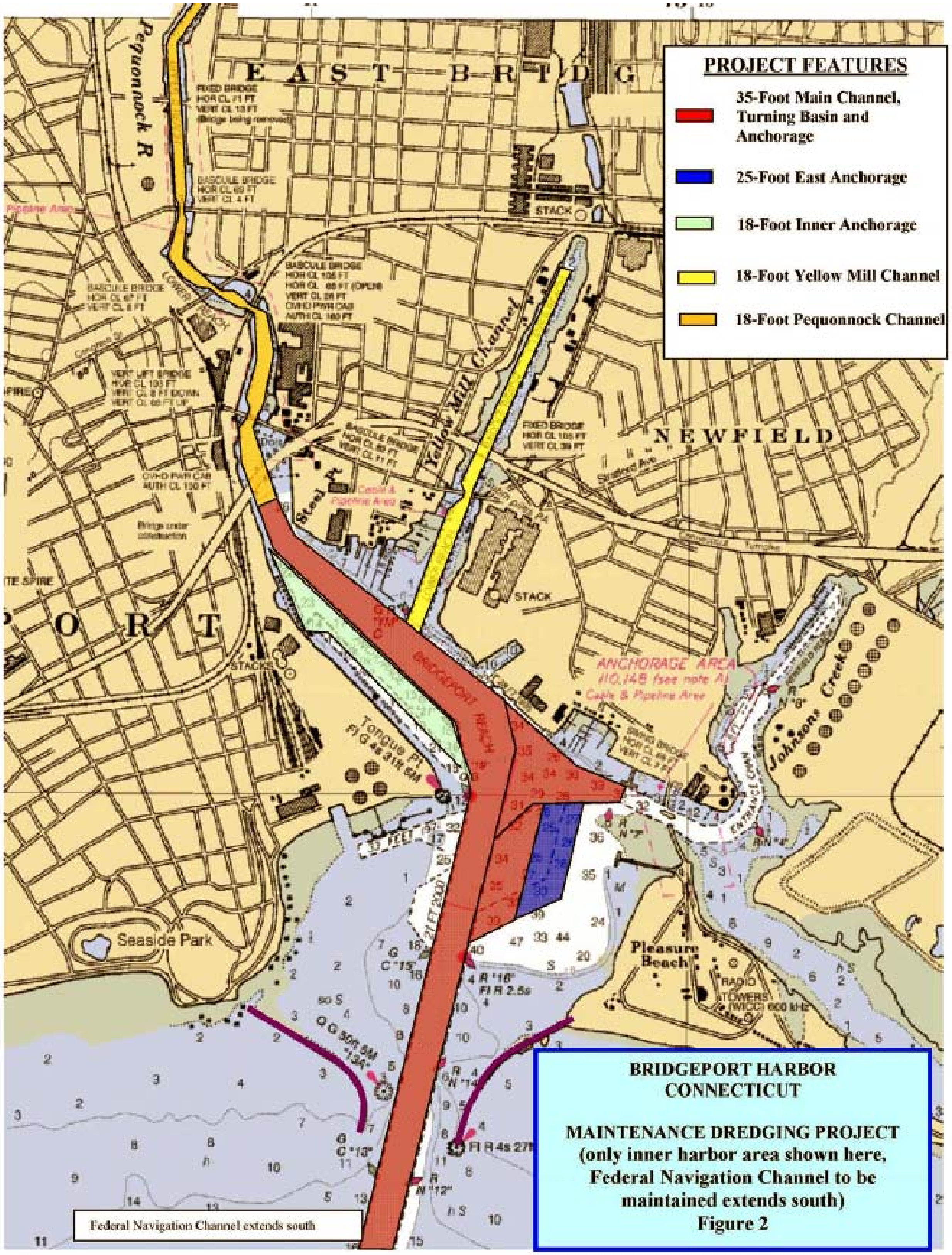


Figure 1. Project Map



BRIDGEPORT HARBOR CONNECTICUT

MAINTENANCE DREDGING PROJECT (only inner harbor area shown here, Federal Navigation Channel to be maintained extends south)

Figure 2

5. MAINTENANCE DREDGING NEED

Construction of the channel to -35 feet was completed in 1963. Since project completion the channel has shoaled to the extent that the controlling depth in the main channel is currently about -30 feet MLLW. Maintenance dredging of the project has been minimal since construction in the 1960's. However, at this time it is necessary to maintain the project to return the channel to the authorized depth to allow for continued deep draft navigation. Additional dredging within the 20 year evaluation period of this Dredged Material Management Plan is not anticipated once this maintenance project is completed.

Table 1. Authorized and Controlling Depths (MLLW)

Project Feature	Authorized Depth	~Current Controlling Depth *
Entrance Channel	35	30
Main Channel	35	30
Outer Anchorages	25&35	22&29
Turning Basin	35	29
Pequonnock	18	11
Yellow Mill	18	13
Johnsons Creek	15	12

* Depths are estimated based on the most recent survey (2006)

6. HARBOR SETTING

The City of Bridgeport is located 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 current population in Bridgeport is about 136,695 (2007) U.S. Census Bureau.. Bridgeport is accessible to the northeast region of the country as the Connecticut Turnpike I-95 passes directly through the city. The Merritt Parkway has a direction connection to the city via Route 25. The Conrail-Amtrak northeast corridor passes directly through Bridgeport connecting the City to the rest of the northeast.

Bridgeport was established in 1639 and incorporated in the 1830s. The harbor has been a working harbor with a Federal Navigation channel in place since 1836. The city known for its manufacturing activities and port facilities and the city was impacted in the early 1990s by the loss of its manufacturing base. In 1993 the City of Bridgeport created the Bridgeport Port Authority to manage and facilitate development of the waterfront and port.

Over time the waterfront has changed from heavy industrial use to a mix of industrial, commercial, and recreational uses. Land use along the western side of the harbor includes the PSEG fossil fuel electrical power generating facility at Tongue Point and the Bridgeport, CT to Port Jefferson, NY Ferry service terminal. Land use on the eastern side includes the Cilco terminal and the Bridgeport Regional Maritime Complex (developed on a former steel mill site) and the Derrektor ship yard. At the back of the harbor and the mouth of the Pequonnock River is the Steel Point peninsula, site of a former fossil fuel power generating station. This 52 acre site is planned for development as a mixed residential, commercial, and marina development. Figure 3 on the next page provides aerial views of Bridgeport Harbor.

7. ENVIRONMENTAL SETTING

Bridgeport Harbor is situated on the northern shore of Long Island Sound. Although the harbor area has been impacted by industrialization and urbanization it still provides viable habitat for shellfish, fish, and wildlife. Great Meadows is a significant tidal wetland and barrier beach complex located to the east of the harbor. The Pequonnock River discharges to the north end of the harbor.

The bottom of Bridgeport Harbor is covered with a black organic layer and below this are estuarine glacial deposits and bedrock. These estuarine deposits are primarily inter-bedded silts and fine sand. Silt with traces of clay layers inter-bedded in the silts and hard clay was identified in the channel at the north end of the harbor. The top layer of the estuarine deposits on the eastern side of the harbor is comprised of coarse sand and gravel. A mining operation in the northeast corner of the harbor has removed much of the coarse sand, creating deep pits in the harbor bottom that have mostly filled with silty shoal material. Bedrock occurs at relatively shallow depths along the west side of the Harbor. This is consistent with the suspected geological formation of the area which is believed to be a former river channel cut into bedrock. The valley is aligned with the Pequonnock River.

Shellfish beds are found in the harbor including eastern oysters and hard shell clams. The National Marine Fisheries Service has designated areas in and around Bridgeport as essential fish habitat (EFH) including habitat for winter flounder. There are efforts on the Pequonnock River to restore fish passage for alewife, blueback herring, sea-run brown trout, and American eel. .

No commercial shellfish species were noted in the intertidal benthic samples collected from the area beaches in Bridgeport Harbor. Although some juvenile lobsters may use the rocky tidal nearshore area near Seaside Beach as cover, and the adults may use the breakwaters for habitat, Bridgeport Harbor area is not considered a significant lobster habitat, according to the State. Leased oyster beds are located adjacent to the borrow pit and proposed access channel in Morris Cove.

More detailed information on natural resources in the study area is included in the Environmental Assessment

Bridgeport Inner Harbor

Steel Point

Entrance to Yellow Mill

Power House Creek

Figure 3. Bridgeport Harbor, Aerial Photographs, August 2006

8. TIDAL CONDITONS

In the study area, tides are semidiurnal with two low tides and two high tides occurring each day. The tide range varies in response to the relative position of the earth moon.. The tide at Bridgeport Harbor has a mean range of 6.8 feet and a mean spring range of 7.7 feet. Spring tides occur during the new and full moon time periods.

9. ECONOMICS

Shippers utilizing the Bridgeport Harbor channels currently experience navigation problems due to controlling depths reduced by shoaling. Terminals located around the harbor have been forced to operate inefficiently to cope with the reduction in channel capacity. Channel users have adopted techniques to deal with the problem. Techniques utilized are tidal assistance, light-loading vessels, and employing smaller vessels. These problems have been documented through conversations and correspondence with channel users. Channel users were surveyed by the Corps in the summer of 2003 and contacted again in 2008. Tonnage and vessel trips for the period 1992 through 2006 are provided in the Economic Appendix.

There are several terminals located on the channels that utilize the Bridgeport Harbor Federal Navigation Project. The facilities, general location and principal activity are listed in Table 2. Table 3 provides a history of recent Port tonnage.

Table 2. Bridgeport Harbor Terminals and Activities

Terminal	Channel	Activity
PSEG Power	Main Harbor	Receipt of Petroleum & Coal
Motiva	Main Harbor	Receipt of Petroleum Products
Municipal Waterfront Pier	Main Harbor	Passenger & Vehicular Ferries
Empty (Cilco)	Main Harbor	
Bridgeport Regional Maritime Complex	Main Harbor and Yellow Mill Channel	Container Barges
Anchorage	Main Harbor	Anchorage for Petroleum ships
O & G Industries	Yellow Mill Channel	Receipt of Sand & Stone
Hoffman Fuel	Pequonnock River	Receipt of Petroleum Products
CPW (Consumer's Petroleum)	Johnsons Creek	Receipt of Petroleum Products
Bridgeport United Recycling	Johnsons Creek	Receipt of recyclable Products

Logistec Corporation located at the Cilco Terminal, an importer of fruit products, recently left Bridgeport Harbor, but they would not have been a beneficiary of restoring the navigation project depth as existing depths were adequate to support the vessels for this activity.

The main thrust of the economic analysis was to incrementally compare transportation cost at the existing depth with greater depths down to the authorized depth. Controlling depths for both the with-project and without-project conditions (No Action) are held constant over the 20-year period of analysis.   Transportation cost is then evaluated in both the with project and without project condition to determine the transportation cost saving, or benefit, to maintenance dredging. This information is provided in the Economics Appendix.

Table 3. Tonnage and Total Trips for Bridgeport Harbor

Year	Tonnage (1,000 tons)	Trips
2006	5,389	22,911
2005	5,482	32,029
2004	5,671	21,813
2003	4,756	21,695
2002	4,607	27,376
2001	4,581	22,195
2000	4,255	22,217
1999	4,154	20,336
1998	4,626	10,514
1997	5,340	10,928
1996	4,862	10,711
1995	3,447	9,187
1994	3,054	9,652
1993	2,942	8,374
1992	2,948	7,789

Transportation costs were developed for each terminal in 1-foot increments, from the existing condition to the authorized condition. Transportation costs were developed based on vessel movements for the latest year available for the evaluation. Costs were developed on a per-ton basis and then applied to anticipated tonnage for each year of the study period. Separate cost estimates were obtained for domestic traffic and for foreign traffic. Within each of these cost estimates, it is assumed that destination–origin of traffic remains the same. The Army

Corps of Engineers Institute for Water Resources (IWR) vessel costs were used to estimate transportation costs. Each year, IWR publishes vessel-operating costs by flag, cargo type, and size of vessel.

The economic analysis demonstrated that significant transportation cost savings, or benefits, were apparent for project depths of -30 feet to -35 feet for the main channel (including the associated anchorages and turning basin) in Bridgeport Harbor and for the 18-foot Pequonnock River and Yellow Mill Creek channels. Economic analyses also demonstrated that there would be no transportation cost benefits associated with maintaining Johnsons Creek at the authorized depth of -15 feet.

The annual estimated transportation cost savings benefit to maintain the main channel is about 11.8 million dollars and $150,000 and $230,000 dollars respectively for Pequonnock River and Yellow Mill Creek. Based on the economic analyses, it is concluded that continued maintenance of Bridgeport Harbor including Pequonnock and Yellow Mill channels is economically warranted.

10. MAINTENANCE DREDGING QUANTITIES AND SUITABILITY

Maintenance dredging of Bridgeport Harbor to return the project to its authorized depths would require the removal of approximately 1,773,800 cubic yards (cy) of shoal material from the General Navigation Features of the project. (See Table 4.)

Table 4. Bridgeport Harbor Maintenance Material Dredging Quantities

		Required (cy)	Overdepth 2 feet (cy)	Total (cy)
Main Ship Channel	Suitable	302,500	363,100	665,600
Main Ship Channel	Unsuitable	399,000	188,000	587,000
Subtotal of Above		701,500	551,100	1,252,600
35' East Anchorage	Unsuitable	46,000	26,000	72,000
25' East Anchorage	Unsuitable	8,100	18,200	26,300
35' Turning Basin	Unsuitable	69,900	50,100	120,000
18' Inner Anchorage	Unsuitable	4,700	6,400	11,100

18' West Anchorage	Unsuitable	100	100	200
Subtotal of Above				229,600
18' Yellow Mill Creek	Unsuitable	93,500	33,400	126,900
18' Pequonnock River	Unsuitable	130,300	34,400	164,700
Subtotal of Above				291,600
Total Maintenance Dredging Material Suitable and Unsuitable Material				1,773,800

Approximately 665,600 cy of this material is suitable for unconfined open water disposal. These suitable materials are from the entrance channel. The remaining 1,108, 200 cy of material in the harbor is not suitable for open water disposal.

The suitability determination was made based on the physical and chemical characteristics of the material and biological testing, all conducted in compliance with the regulatory evaluation and testing requirements for unconfined open water disposal at the Central Long Island Sound Disposal Site (CLIS). The disposal of sediments from a federal navigation project below mean low water in Long Island Sound is regulated according to both Section 404 of the Clean Water Act and Section 103 of the Marine Protection Research and Sanctuaries Act (the Ocean Dumping Act. Details regarding the nature of the suitable and unsuitable materials, and the suitability determinations, are included in the Environmental Assessment.

11. PLAN FORMULATION

The objective of plan formulation was to develop a dredged material disposal plan that will allow for maintenance dredging of Bridgeport Harbor. Dredged Material Management plans are required to identify specific measures necessary to manage the volume of material likely to be dredged over the next 20 years. Corps project regulations require the disposal of dredged material in the least costly manner. (Engineer Regulation 1105-2-100, as amended)

Disposal is to be consistent with sound engineering practices and meet environmental standards including standards established by Section 404 of the Clean Water Act of 1972, as amended and Section 103 of the Marine Protection, Resources and Sanctuaries Act of 1972, as amended.

The Dredged Material Management Plan (DMMP) establishes the "Base Plan" for the disposal of the sediment dredged from Bridgeport Harbor. As explained above, the base plan (or Federal standard) is defined as the least costly, environmentally acceptable plan, consistent with sound engineering practices. In order to determine the base plan a full range of measures were considered including the beneficial use alternatives. Measures considered included:

- Confined Aquatic Disposal (CAD) and Confined Disposal Facility (CDF)
- Open Water Disposal
- Beneficial Uses
    - Beach Nourishment
    - Construction/Industrial Development
    - Habitat Creation
    - Borrow Pit Restoration
    - Use as cap material for CAD cells
    - Strip-Mine or Brownfield Reclamation
- Landfill Disposal
- Innovative Treatment

These measures are discussed below and were assessed for general construction feasibility, expected cost, and environmental acceptability to determine the viability of the measures. Measures were then combined into Dredged Material Management Plans.

A constraint on plan formulation was the nature of the material to be dredged from the Harbor. In general a significant portion of the material to be dredged did not meet the required Federal disposal requirements and was determined to be unsuitable for open water disposal. Suitability determination memorandums prepared for this study are contained in the Environmental Assessment

Confined Aquatic Disposal

Testing and evaluation of material to be dredged from Bridgeport Harbor determined that about 62 percent of the material is unsuitable for open water disposal. In other harbors in New England such as Boston, Providence, Hyannis and Norwalk Harbors, confined Aquatic Disposal (CAD) cells have proven to be a practicable alternative for material unsuitable for open water disposal. Construction of CAD cells is more expensive that open water disposal as this measure involves dredging the CAD cell in addition to project dredging. However, for material that is unsuitable for open water disposal CAD cell disposal is generally the next least-cost alternative.

CAD cells are deep underwater pits constructed beneath the harbor bottom. Unsuitable material from the FNP l maintenance can be placed in these pits. Once the dredged material is placed in the CAD cell, they are often capped with clean, typically harbor sediments to minimize any future exposure of the unsuitable material.

Detailed geotechnical investigations were conducted through out the Bridgeport Harbor to identify suitable location(s) for CAD cells within the harbor. Two sites were identified a South East CAD (SE CAD) cell site and a West CAD cell site. These sites are shown in Figure 4. The Geotechnical Appendix provides detailed information of the investigations conducted to locate these CAD cells. During the investigations other CAD cell sites within the harbor and below the navigations channel were considered and dropped due to shallow depth to bedrock and; significant depths of organic deposits. Thick silt deposits have accumulated in the depression where sand and gravel was previously mined and these deposits are unsuitable for disposal at the EPA designated Central Long Island Sound Disposal Site (CLIS). The identified SE CAD cell and West CAD cell locations will require additional geotechnical investigations during design.

The use of Confined Aquatic Disposal (CAD) cells within Bridgeport Harbor allows for placement of the material in an area near the dredging locations without significant exposure to the environment. There are natural oyster beds located in the general area of the CAD cells and these beds will be considered in the environmental review and permitting process as the beds will be impacted during CAD cell construction. Compensating post-construction restoration of the bed may be required.

The two CAD cell sites (the southeast CAD Cell and the West CAD cell) identified by the project team were retained for further consideration.

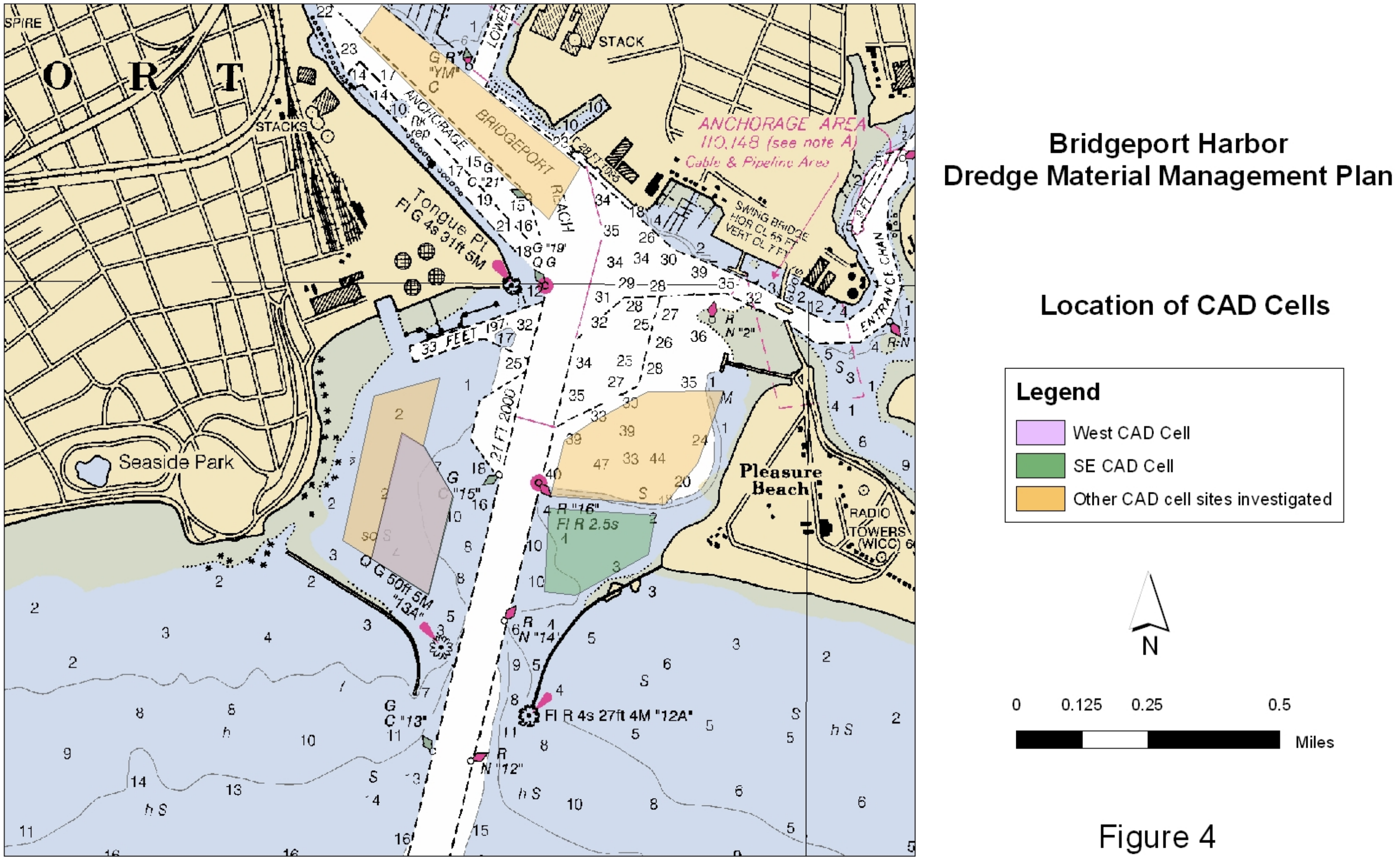

Bridgeport Harbor
Dredge Material Management Plan
Location of CAD Cells
Legend
West CAD Cell
SE CAD Cell
Other CAD cell sites investigated
N
0
0.125
0.25
0.5
Miles
Seaside Park
Pleasure Beach
Tongue Pt
Fl G 4s 31ft 5M
BRIDGEPORT REACH
ANCHORAGE AREA
110.148 (see note A)
Cable & Pipeline Area
SWING BRIDGE
HOR CL 55 FT
VERT CL 7 FT
ENTRANCE CHAN
STACK
STACKS
SPIRE
RADIO
TOWERS
(WICC)
33 FEET 1997
21 FT 2000
Fl R 4s 27ft 4M "12A"
Q G 50ft 5M "13A"
Fl R 2.5s
R "16"
G "15"
G "19"
C "21"
G "13"
N "12"
N "14"
N "2"
"YM"
O R T

Figure 4

Confined Disposal Facility

Another measure for placement of unsuitable material for ocean disposal is construction of a containment structure (Confined Disposal Facility). Two areas, Powerhouse Creek Canal and the upstream portion of Yellow Mill Creek were considered for construction of a CDF.

Powerhouse Creek is a small canal (150 feet wide by 580 feet long) located adjacent to the Bridgeport Regional Maritime Center. The canal entrance could be sealed off from the harbor with a steel sheet bulkhead and then filled with dredged material. An alternative to a bulkhead is a dike, but this would reduce the already limited capacity of the CDF. The CDF is estimated to store about 50,000 cy.

Planning level estimates of the CDF and dredging determined an approximate unit cost of $60/ cubic yard. This does not include the cost to move a sewer outfall (60 inch reinforced concrete pipe) which now empties into the upstream end of Powerhouse Creek Canal. The cost to relocate this outfall would further increase the unit cost of this measure. Due to the limited disposal capacity of the CDF and expected high cost this measure was dropped from further consideration.

Yellow Mill Channel is a feature of the Federal Navigation Project. The 18 feet deep channel ranges from 150 to 200 feet wide and is about 1-mile long. The west side is zoned light industrial. The east side of the channel has two small parks and two marinas and is zoned residential and light industrial. The channel is currently used for recreation boating with some industrial use. O&G Industries is located along the east side of the Yellow Mill Channel above I-95. Because of the channels navigation use, Yellow Mill Creek channel is also scheduled to be dredged.

Yellow Mill Creek drains an upland area of about 4.72 square miles and discharges to this channel. Two small waterbodies; Stilman Pond and Success Lake are included in the Yellow Mill Creek's drainage area. The 100-year discharge to the channel is a bout 1,400 cubic feet per second (cfs). A tidal flat/marsh is located where the creek discharges to the channel.

Consideration was given to creating a CDF along the shoreline upstream of the I-95 bridge in the upper channel. This would require a linear cellular bulkhead structure. Although the waterway averages about 300 feet wide in this area a portion of this width (at least 50 feet) must be reserved to convey flood flows. This leaves an area of about 200 feet wide that could be used for a CDF. The CDF could be about 2,400 feet in length and would hold about 300,000 cy. It would cost approximately $40/cy to construct the CDF for disposal.

Environmental resource agencies including CT DEP are not in favor of filling intertidal and subtidal habitat in Yellow Mill Creek to create a CDF. Due to the high cost of this measure and the environmental impacts this measure was dropped from further consideration.

Open Water Disposal

This measure involves disposal of dredged material at open water disposal sites that have been approved by State and Federal Regulatory agencies. This measure is typically the least cost measure for dredged material that has been determined suitable for open water disposal.

The open water disposal site near Bridgeport is the Central Long Island Sound Site (CLIS). Disposal at this site is permitted under the requirements of the Marine Protection, Research, and Sanctuaries Act of 1972, as amended (MPRSA) and under Section 404 of Clean Water Act. This site was approved by EPA in 2005 for continued use until 2013.

CLIS has been one of the most active disposal sites in the New England region. Since 1980, 6,301,000 cy of dredged material have been disposed of at the site. Sediments deposited at CLIS have been dredged from New Haven, Bridgeport, Stamford, and Norwalk Harbors, as well as other adjacent coastal areas. There is a long-term monitoring program in place under the New England District's Disposal Area Monitoring System program (DAMOS).

Analysis of sediment from Bridgeport Harbor indicated that material from the entrance channel and parent material from constructing the Southeast CAD cell and West CAD cells would be suitable for open water disposal. This measure would involve mechanical dredging of the material and transport by dump scow to the CLIS. This measure was retained for further consideration.

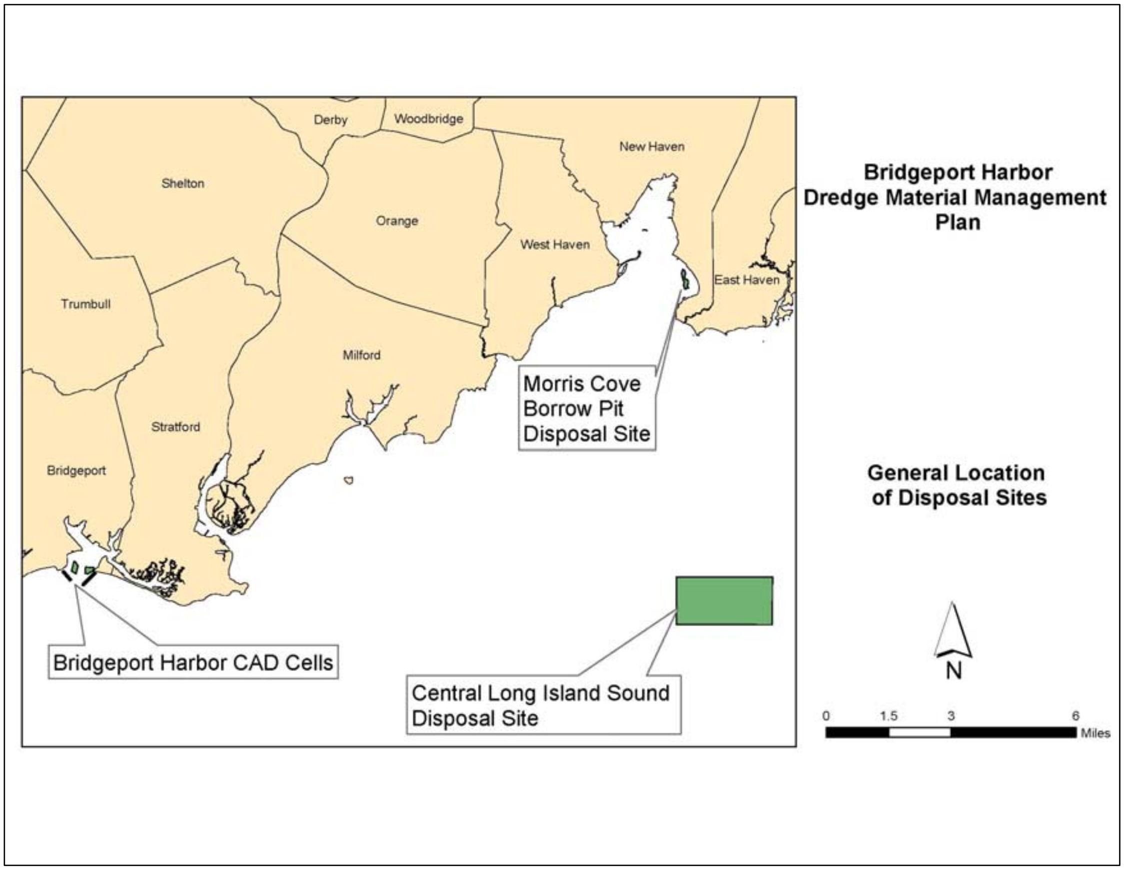


Figure 5. CLIS, Morris Cove, and CAD cells

Beneficial Use

The beneficial use of dredged material supports the idea that dredged material can be reused. Beneficial use is the preferred disposal method, when practicable and the least cost alternative. The practicability of beneficial use is determined by both the physical and chemical properties of the material.

Generally, in urban/industrial harbors contamination of dredged material from past land uses and industrial activities limits the practicability of beneficial use. Also where material is clean and relatively free from contaminants beneficial use may not be the most cost effective solution as it may require multi-handling, specialized facilities, and added transportation costs.

The Corps of Engineers has the authority under its Section 204 program to share in the added construction cost associated with beneficial use projects to reduce flood damages or improve ecological resources. Projects designed to reduce flood damages must demonstrate that the damages prevented exceed the added cost of construction.

The following beneficial uses[1] were considered for the material to be dredged for Bridgeport Harbor.

- Beach Nourishment
- Construction/Industrial Development
- Habitat Creation (wetland or island creation)
- Borrow Pit Restoration (fill for existing in-water borrow pits)
- CAP for CAD cells
- Upland Strip-Mine Reclamation

As the nature of the material to be dredged varies the general suitability of the material for beneficial use was considered. Table 5 displays the general suitability of the dredged material and the discussion following Table 5 focuses on the measures considered for disposal. More detailed information on the physical and chemical characteristics of the material can be found in the Appendix D (Geotechnical Investigations) and the Environmental Assessment, respectively.

The maintenance material from the harbor is organic silt and fine silty sand. The material from the inner harbor makes up a large portion of the material to be dredged. Due to past industrial practices around the harbor sediments contain urban and industrial pollutants that make it unsuitable for open water disposal.

In meeting with the Connecticut Department of Environmental Protection early in the study process it was determined that material unsuitable for open water disposal would also not meet soil criteria for upland placement without treatment. When the sediment is removed from the water and placed at an upland site it is considered as soil and contaminants levels are required to be below Connecticut Department of the Environment exposure criteria for soils. These exposure criteria have been established to prevent human and environmental health risks.

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[1] Beneficial uses can include many uses and a few other examples are remediation of landfills, restoration of mudflats, creation of artificial oyster or fisheries reef habitat, and enhancement or restoration of bird nesting or foraging habitat.

Table 5. Suitability of Material for Beneficial Use

	Material from Channel Entrance	Material from Harbor and Anchorages	Material from SE CAD Cell (1)	Material from West CAD Cell (1)
Suitable for beach nourishment	No; organic silt and fine grained materials.	No; organic silt and fine grained materials.	Yes; Sand and gravel to about 30ft. depth.	No; inter-bedded, organic silts, sands, and gravel . Shallow depths and limited volume.
Suitable for construction/ industrial development	No; organic silt limits use of material	No; organic silt limits use of materials	Yes; well graded coarse to fine sand and gravel to about 30ft. depth.	No; inter-bedded, organic silts, sands, and gravel. Shallow depths and limited volume.
Suitable for Habitat Creation	No; organic silt and fine grained materials	No; organic silt and fine grained materials	Yes, upper 30ft. suitable.	Marginal
Suitable to fill previous in-water borrow pits	Yes	Yes, if capped with clean material	Yes	Yes
Suitable Cap Material	Yes	No; unsuitable for open water disposal	Yes	Yes
Upland Strip Mine Reclamation	See discussion below	See discussion below	See discussion below	See discussion below
(1) Does not include the top 2 feet of the CAD cells which is not suitable for beneficial use.				

Beach Nourishment

Formerly, material from improvement dredging at Bridgeport was placed on area beaches. In 1962, a portion of the harbor was hydraulically dredged to deepen the main channel from 30 to

35 feet and material hydraulically dredged about 675,000 cy was placed at Long Beach and Pleasure Beach.

Analyses of physical characteristic of dredged material from Bridgeport Harbor determined that a portion of the material to be dredged to create the SE CAD cell might be used for Beach nourishment. The upper 30 feet of the SE CAD cell was well graded coarse to fine sand and is suitable for placement on area beaches. There are three area beaches within close proximity to Bridgeport Harbor. These are Seaside Park in Bridgeport, Pleasure Beach in Bridgeport, and Long Beach in Stratford.

Of these beaches Seaside Park has requested the Corps consider placing sand at this beach. Long Beach has piping plover habitat but could use some additional sand. Pleasure beach is beside the harbor and although close to the site does not appear to need sand nourishment. Seaside Park was selected for sand placement as there was local interest in placing sand in this location and littoral drift in the area is to the west and sand placed at Seaside Park would not be transported back into the navigation area. Placing sand at Seaside Park was retained for further consideration. The Seaside Park Beach is shown in Figure 6.

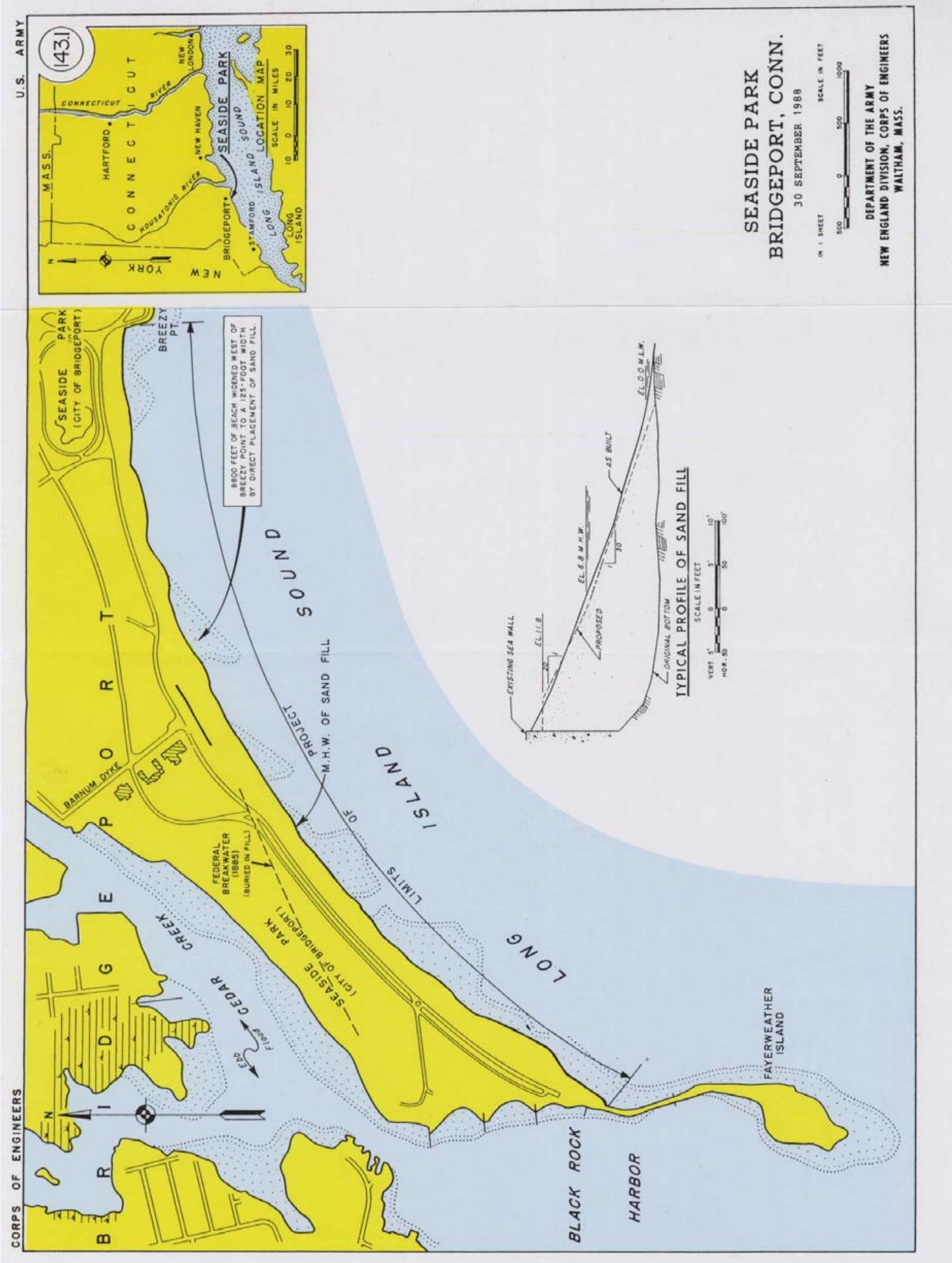


Figure 6. Seaside Park Beach

Construction/Industrial Development

In addition to the cost identified below the State of Connecticut charges a $4/cy fee for dredged material that is "mined" or used in some commercial fashion. An example would be for gravel extraction to be used for a highway embankment. The State does not charge a royalty for upland placement of the material in a CDF or upland site.

Stratford Development Company Site.

The Stratford Development Company was contacted in 2005 and again in 2008 to determine their interest in receiving dredged material from the harbor project for use in developing their site. The company has completed development of their west campus site. However, they still had a need for about 150,000 cy of fill material for their east campus site. After inquiry, it was determined that there may be a potential need for the sand and gravel material generated from construction of the SE CAD cell. Timing of the dredging would need to occur before the company begins construction on the site. Construction of the site is dependent on economic factors and a willing partner to develop the site. It is expected to take approximately 12 months to develop the site once an economic partner has been identified. The Company hopes to develop the site in the next 5 years.

The preferred method of transporting suitable material to this site is to use the mechanical dredge to load scows which would be transported to a shoreline location for offloading and dewatering prior to trucking to the disposal site. Dewatering of the material is expected to take only a few weeks. If a suitable shoreline site cannot be located then hydraulically dredging and pumping is another means to transport dredged material to this site. Since this site is located adjacent to wetlands, some form of containment and sediment control would be required. Cost for this measure includes hydraulic dredging at about $12/cy plus the cost of the dewatering area, estimated at $18/cy, for a disposal cost of about $30/cy.

As this measure will be more costly then open water disposal or beach placement this measure was removed from further consideration,

Steel Point.

Steel Point is about a 52-acre peninsula located at the mouth the Pequonnock River at the north end of the harbor. This is the site of a former fossil fuel power generating station.   The City of Bridgeport has acquired the 52 acres at the site from the former land owners. The City is in the process of selling the property to Bridgeport Landing Development LLC. The agreement for the development and acquisition was executed in November 28, 2007 between the City of Bridgeport and the Developer. (Telecom: Edward Lavernoich. City of Bridgeport, December 10, 2008). The Developer is planning a 1.5 billion dollar mixed use development with retail stores, restaurants, housing, offices, entertainment venues, a marina, a hotel, convention center, and waterfront park. The current economic climate has slowed the development at the site.

The Steel Point site might be used for the disposal of sand and gravel from the SE CAD cell if the Developer is interested in the material for use at the site. This would require constructing a dewatering area, unloading the material from the scows to the dewatering area, dewatering the material, decommissioning the dewatering area, and spreading material at site. It is estimated that this would cost about $38 per cy including mechanical dredging.

Steel Point was also considered as a temporary storage site for some of the unsuitable material from the CAD cell construction. This would require constructing a dewatering area, unloading the material from the scows to the dewatering area, dewatering the material, decommissioning the dewatering area, and spreading material at site or trucking material off site. It is estimated that this would cost about $50 cy (See Appendix B) not including upland disposal costs.. Disposing of material containing pollutants at Steel Point would have additional added costs include testing, permitting, and tighter controls on discharge water.

Due to the higher costs to dispose of material at Steel Point, this site was dropped from consideration.

Habitat Creation

Habitat creation includes using dredged material to build and restore wildlife habitat, especially wetlands or other water-based habitat (e.g., nesting islands and offshore reefs). Habitat restoration and/or creation were examined early in the study process. The use of dredged material to create bird habitat in the harbor or Long Island Sound was discussed with NMFS and CT DEP. Island creation could include creating small islands within existing open water areas just outside of the harbor, or larger efforts such as enlarging Faulkner Island by filling shallow inter-tidal areas. Both agencies had concerns regarding impacts to and displacement of aquatic habitat. CT DEP stated that this alternative would not be consistent with CZM policies, and NMFS opposed the creation of islands for bird habitat due to potential impacts to shellfish beds. This measure was dropped from further consideration.

In-Water Borrow Pit Restoration

Morris Cove.

There is a man made depression (borrow pit) in Morris Cove located in outer New Haven Harbor. This pit was created several decades ago when sand and gravel was mined for use as fill for the construction of Interstate Highway 95 through New Haven. The sediments were excavated, resulting in a submerged pit approximately 650 feet wide and 2,450 feet in length. Current water depths in the area range from about 9.8 feet over the ambient Morris Cove seafloor near the pit to about 29.5 feet within the deepest portion of the borrow pit.

This site has been utilized for open water disposal of suitable material. During January to May 2000, an estimated total of 18,574 cy of sediment dredged from the U.S. Coast Guard Base in New Haven, Connecticut, was placed in this old borrow pit in Morris Cove.

Studies of the site following the disposal including bathymetric and side-scan sonar data showed a clearly defined borrow pit boundary and good differentiation between softer sediments within the borrow pit and the coarser, more compact sediments that comprise its outer margin. The managed placement of approximately 600,000 cy of additional dredged material would fill the man-made depression and return the bottom of Morris Cove to a surface roughly even with the surrounding ambient bottom. (Reference: Monitoring Cruise at the Morris Cove Borrow Pit, May 2002, Report Published October 2003)

The National Marine Fisheries Service (NMFS) has identified Morris Cove as an important spawning and nursery area for a variety of commercially important fish species, including winter flounder. NMFS has expressed concern regarding the presence of the existing borrow pit within Morris Cove and the potential for reduced water exchange (flushing) to trap organic material within the bottom feature. As organic material within the borrow pit undergoes the process of decay, the quality of the bottom waters (dissolved oxygen, nutrient content, pH, etc.) will degrade sufficiently to result in poor habitat conditions for marine organisms. These conditions would be especially prevalent and have the most profound impacts during the summer months when dissolved oxygen concentrations tend to be lower due to the warmer water temperatures within New Haven Harbor and Long Island Sound (in excess of 20° C), as well as reduced surface mixing (i.e., gas exchange via short-period waves) relative to the remainder of the year.

Use of the pit for disposal of material from Bridgeport harbor would involve transporting material about 25 miles by dump scow to the site. This is about 5 miles further than disposal at CLIS. (See Figure 6) A access channel would likely be needed from the New Haven Channel to the Morris Cove borrow pit as the controlling water depths at MLLW are about 10ft. This site could be useful for some of the material not suitable for disposal at CLIS if capped with suitable material. Disposal at the Morris Cove borrow pit was retained for further consideration.

*Housatonic Rive*r.

Sand and gravel mining in the Housatonic River from the Route 15 bridge (Merritt Parkway) north to Derby created several holes that are 45-50 feet deep at low water. The authorized Federal channel depth in this reach of the waterway is –7 feet. These deep borrow pits have degraded the aquatic habitat of the river because of silt accumulation and anoxic conditions in these holes. Some areas also have a saltwater wedge at the bottom of the river that further reduces water quality and biological productivity. Filling the holes with dredged material would help restore aquatic resources. However, access to the site for dump scows that draw 13 to 15 feet would be impossible and require dredging a channel to the pits. Passage of the scows would also be constrained by the two (2) bridges with bascule spans that cross the river in the area. Due to the problematic logistics and anticipated high cost of accessing these pits, this measure was dropped from further consideration.

Use as Cap for CAD cells

Material that is suitable for open water disposal may be reused as a cap material for CAD cells or borrow pits that are utilized for the project. The potential to use suitable material dredged from the entrance channels and the CAD cells as a source of cap material was retained for further consideration.

Upland Strip Mine Reclamation

This measure would consist of transporting dredged material to assist in the reclamation of strip mines in regions in the northeast. The material must be blended with other material in order to produce a suitable growing substrate. A mine in Pennsylvania was identified in 2005 that was permitted to accept dredged material. This mine required testing prior to shipment of each 10,000 cy and each source would need to be approved by the Pennsylvania Department of Environmental Protection before it can be shipped to the site. Once at the site each shipment is to be mixed with material as directed and retested before placed in the mine pit. Initial estimates including transportation and handling placed the cost of at over $200 per cy. This measure was dropped from further consideration. Disposal at strip mines is an expensive and therefore not likely viable measure for dredged material from Bridgeport.

Landfills for Disposal of Material

Transporting the dredged material from Bridgeport Harbor to a managed landfill was considered. This disposal alternative would need to include the following components:

- identifying available waterfront locations for dewatering and re-handling the dredged material,
- practicabability of constructing these faculties,
- unloading of scows, drying of material, and loading of material into trucks,
- transport of material by truck to a landfill accepting dredged material,
- paying the tipping fee per load, if applicable, at the landfill.

Three landfills were identified that are permitted to accept dredged sediments for disposal (telecom, Bill Sigmund, CT DEP, Dec 2, 2008). The three landfills are located in the cities of Hartford, Windsor, and Manchester. Two of these landfills, Hartford and Windsor, will be closing in 2008 and 2009, respectively, and would not be available for this project. The other landfill in Manchester will be open until 2015. This landfill has remaining capacity for about 500,000 cy of material. It is not known how much of this capacity may already be under contract Tipping fees are $80/ton for dredged material.

Dewatering would be necessary prior to landfill disposal. For example, dewatering of 100,000 cy of material would require about a 20 acre area and a constructed berm to contain the material and dispose of the material three feet deep. Once the material is dewatered, it can be transported to the landfill. Five thousand (5,000) truck trips would be required to transport 100,000 cy of material, assuming a 20 cy capacity truck would be used to transport the material from the dewatering site to the landfill. The Manchester landfill is about 60 miles from Bridgeport Harbor.

Landfill disposal is estimated to cost about $125/cy (see calculation below) and will be more expensive than open water disposal (cost about $10/cy) or disposal in a confined aquatic disposal cell (cost about $15/cy). This option was dropped from further consideration due to the high cost.

Estimated Disposal Cost per Cubic Yard at the Manchester, Connecticut, Landfill

Handling and dewatering cost	$30/cy
Transport to landfill	$15/cy
Tipping fee (1)	$80/ton or $108/cy (based on 1.35 tons/ y)
TOTAL	$125/cy
(1) Tipping fee for the Manchester landfill, December 2008.	

Innovative Treatment of Dredged Material

One of the activities that must be performed in planning for dredging is to test to determine if the dredged material is suitable for ocean placement. The Bridgeport inner harbor shoal material, which is comprised mostly of silt was found to be unsuitable f or ocean placement. This type of material is also difficult to use in a beneficial manner. It is too silty for beach placement and not suitable for construction purposes because of the high percentage of fines. It may be applicable to use as a landscape material but the level of contaminants may significantly restrict its use to situations where it is “buried”.

In the past decade or so there have been several demonstration efforts where the maintenance material undergoes specific treatment processes to immobilize or reduce chemical concentrations to a level that may be acceptable for either open water placement or to be used in various beneficial manners. There are two specific technologies that seem promising in being able to treat the dredged material that will allow it to be used in a beneficial manner. One process involves thermal treatment where the resulting end product is a material that can mixed with Portland cement that will result in“blended cement” that can be used in construction. Another process washes the material under pressure and adds surfactants to clean the material. The end result of this process is a soil that can be mixed or amended with other material that can be used in landscaping.

In response to interest in potential treatment technologies for dredged material there is an on-going demonstration project known as the Long Island Sound Innovative Technology Demonstration Project (LIS Demo) which is being funded by the Corps of Engineers and the Bridgeport Port Authority. As part of this LIS Demo Project earlier efforts conducted by others were investigated as well as planned or on-going efforts were identified and reviewed. This review identified a demonstration project that was currently underway.

BioGenesis Washing BGW, LLC was conducting a full-scale demonstration project of the BioGenesisSM Sediment Washing Technology in the New York/New Jersey Harbor. The main purposes of the demonstration project were to determine the ability of the BioGenesisSM process to treat contaminated sediments to levels acceptable for beneficial use and to develop commercial scale operational and cost data.

The demonstration project was being conducted under contract to the New Jersey Department of Transportation, Office of Maritime Resources (NJDOT/OMR) under the State of New Jersey’s Sediment Decontamination Technology Demonstration Program in coordination with the U.S. Environmental Protection Agency (EPA) under the Water Resources Development Act (WRDA).

One of the goals of the demonstration project was to refine the projected capital and operating costs for a commercial-scale facility to be built in the New York/New Jersey Harbor region. For the purposes of the Lower Passaic River Focused Feasibility Study, treatment costs were estimated for several scenarios depending on the quantity of sediment to be dredged and delivered to a BioGenesisSM Sediment Washing Facility.

Based on discussions with the Lower Passaic River Restoration team, it was assumed that a dedicated facility would be required for the Lower Passaic River Restoration project, and that a site with offloading and storage facilities would be provided. The dredged material in the Lower

Passaic has very similar physical and chemical characteristics as the Bridgeport material and the cost estimate developed by Biogenesis is considered applicable to the treatment of Bridgeport material.

Three costing scenarios were considered:

- 50,000 cy project (to be dredged over the duration of the restoration project)
- 250,000 cy/year facility to be operated for 1 to 10 years
- 500,000 cy/year facility to be operated for 1 to 10 years

The cost for treatment of the material would vary depending on whether the treatment facility was developed for a single project or for multiple projects over a significant processing period such as 10 years. Since any treatment facility developed as a result of the DMMP for Bridgeport would be exclusively for that maintenance effort we have used the cost information for the period of time it would take to process the Bridgeport material. The unsuitable material in Bridgeport harbor would require a 500,000 cy per year processing facility that would operate for 2 years to treat the material. The treatment cost associated with a plant of this size for this period of time was $86.59/cy. If the plant only processed half of the material and operated for one year the cost was $101.89/cy. This option was dropped from further consideration due to the high cost.

12. ALTERNATIVE PLANS

Identified disposal measures for Bridgeport Harbor that appeared initially viable and cost-efficient were combined to create alternative plans for the least cost analysis in order to identify the Base Plan. Developed alternatives are listed below.

No Action and two alternative disposal plans were developed from the disposal measures considered for both suitable and unsuitable material from Bridgeport Harbor. These plans are outlined below and quantities are included in Table 6 and 7.

No Action

Under the No Action Alternative the Federal navigation channels in Bridgeport Harbor would not be dredged. Allowing existing conditions to persist and worsen will cause even more restrictions and delays to the commercial deep draft vessels. Without maintenance dredging to restore authorized depths, shippers will need to light load (not load to capacity to reduce draft) or lighter (transfer) their cargo in the outer harbor, thereby increasing transportation costs. Also shallower drafts in the harbor pose a safety risk to vessels utilizing the harbor. It is possible that a deeper draft vessel timing its entrances and exits in to the harbor based on tides could ground if it trips were timed improperly or unexpected delays occurred.

Plan A – CLIS, SE CAD Cell and Morris Cove Borrow Pit Disposal Site

Plan A includes a confined aquatic disposal cell constructed inside the Bridgeport Harbor breakwaters (SE CAD cell), the Morris Cove Borrow Pit disposal site in New Haven, Connecticut, and the Central Long Island Sound open water disposal site (CLIS). Plan A quantities are shown in Table 6 and maintenance dredging quantities include two foot of over depth.

- A portion of the suitable material from the entrance channel and the SE CAD cell will be used to cap the SE CAD cell and Morris Cove Pit, respectively. The remainder of the suitable material from the entrance channel and the SE CAD cell will go to open water disposal site at CLIS.

- Unsuitable Material from the top of the SE CAD cell and a portion of the Bridgeport dredging will be disposed of in Morris Cove. The remainder of the unsuitable material from dredging Bridgeport Harbor, Yellow Mill Channel, and Pequonnock River will be disposed of in the SE CAD cell.

Morris Cove Borrow Pit Disposal Site is a beneficial use alternative as filling the pit will eliminate anoxic water quality conditions that occur in the pit and provide 22 acres of restored benthic habitat in Morris Cove.

The SE CAD cell will be located inside Bridgeport Harbor just east of the channel and was found to contain sand and gravel to about 30 feet in depth similar to the area just north of this that was mined for materials for highway construction. More detailed information on the SE CAD cell is contained in the Geotechnical Appendix.

Plan A will be performed through mechanical dredging and will use dump scows to transport material to the CAD cell and disposal sites. CLIS is about 21 miles from Bridgeport Harbor and Morris Cove is about 25 miles. Plan A will require dredging into Morris Cove from the New Haven channel to allow access for dump scows. The access to Morris Cove is shown in Figure 7.

TABLE 6
BRIDGEPORT HARBOR, CONNECTICUT
DREDGING & DISPOSAL SEQUENCE AND VOLUMES

PLAN A - CLIS and SE CAD Cell and Morris Cove

	FEATURE & SEQUENCE	CY	TOTAL CY
MORRIS COVE	Dredge Scow Access Channel from New Haven Channel into Morris Cove and Place Material into Morris Cove Borrow Pit	37,800	287,800
	Dredge Unsuitable Material from Top of Bridgeport Southeast CAD Cell and Place in Morris Cove Borrow Pit	53,800	
	Dredge Portion of Unsuitable Material from Inner 35-Foot Main Channel and Place in Morris Cove Borrow Pit	196,200	
SOUTHEAST CAD CELL	Dredge Remainder of Suitable Sand Material to Create Southeast CAD Cell and Place at CLIS	400,000	1,001,300
	Dredge Remainder of Suitable Non-Sand Material to Create Southeast CAD Cell and Place at CLIS	601,300	
FILL SOUTHEAST CAD CELL	Dredge Remainder of Unsuitable 35-Foot Main Channel Material and Place in Southeast CAD Cell	390,800	912,000
	Dredged Unsuitable Material from 35-Foot Turning Basin and Place in Southeast CAD Cell	120,000	
	Dredged Unsuitable Material from 35-Foot East Anchorage and Place in Southeast CAD Cell	72,000	
	Dredged Unsuitable Material from 25-Foot Anchorage and Place in Southeast CAD Cell	26,300	
	Dredged Unsuitable Material from 18-Foot Barge Anchorage and Place in Southeast CAD Cell	11,100	
	Dredged Unsuitable Material from 18-Foot West Anchorage and Place in Southeast CAD Cell	200	
	Dredged Unsuitable Material from 18-Foot Yellowmill Channel and Place in Southeast CAD Cell	126,900	
	Dredged Unsuitable Material from 18-Foot Pequonnock River Channel and Place in Southeast CAD Cell	164,700	
ENTRANCE CHANNEL	Dredge Remainder of Suitable Material from 35-Foot Entrance Channel and Place at CLIS and CAP SE CAD and MorrisCove	815,600	815,600
	TOTAL		3,016,700
	Note: These calculations do not include local dredging of terminal berths.		

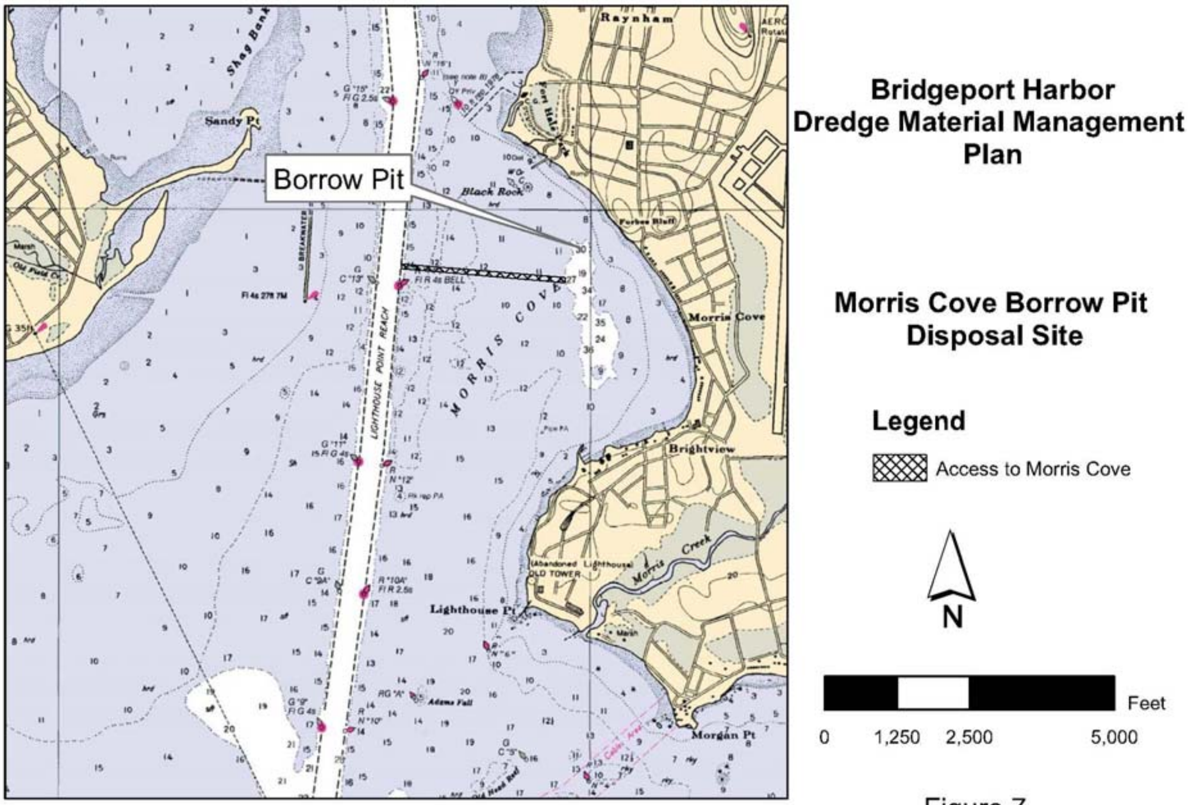

Borrow Pit
Shag Bank
Sandy Pt
Black Rock
Raynham
Forbes Bluff
Morris Cove
MORRIS COVE
LIGHTHOUSE POINT REACH
BREAKWATER
Old Field Cr
Marsh
Brightview
Morris Creek
(Abandoned Lighthouse) OLD TOWER
Lighthouse Pt
Adams Fall
Morgan Pt
Bridgeport Harbor
Dredge Material Management Plan
Morris Cove Borrow Pit Disposal Site
Legend
▨ Access to Morris Cove
N
Feet
0
1,250
2,500
5,000

Figure 7

Plan B – CLIS, SE CAD and West CAD

Plan B includes use of two confined aquatic disposal cells constructed inside the Bridgeport Harbor breakwaters (SE CAD cell and West CAD cell) and the open water disposal site (CLIS). Plan B quantities are shown in Table 7 and maintenance dredging includes two foot of over depth.

- A portion of the suitable material from the entrance channel will be used to cap the SE CAD Cell and the West CAD cell. The remained of the suitable material generated from dredging the entrance channel, the SE CAD cell and the West CAD cell will go to the open water disposal site at CLIS.

- Unsuitable Material from Bridgeport Harbor, Yellow Mill Creek and Pequonnock River will be disposed of in the SE CAD and West CAD cell. In order to construct these CAD cells a starter cell will be utilized within the footprint of the West CAD cell.

Plan B will be performed through mechanical dredging and will utilize dump scows to transport material to the CAD cells and CLIS. CLIS is about 21 miles from Bridgeport Harbor.

The starter cell will be constructed within the footprint of the West CAD cell and will involve temporary storage of unsuitable surface material removed during dredging of the starter cell on scows. This unsuitable material would be deposited into the completed starter cell along with the unsuitable surface material removed from the Southeast CAD Cell.

Water depths over the West CAD cell are shallow and in some locations only a few feet in depth at low tide. In addition, bedrock limits the depth of the West CAD cell. The estimated capacity of the West CAD cell for disposal of material is estimated primarily with data from geophysical investigations conducted by USGS in 2006 and one boring performed in 2006 by the U.S. Army Corps of Engineers, Baltimore District. If the West CAD cell is selected for disposal of unsuitable material more geotechnical investigation will be needed during design to confirm the capacity of the cell. If further geotechnical investigations result in a reduction in the estimated West CAD cell capacity, then this may impact the amount of maintenance dredging that could be performed.

TABLE 7
BRIDGEPORT HARBOR, CONNECTICUT
DREDGING & DISPOSAL SEQUENCE AND VOLUMES

PLAN B - CLIS, SE CAD Cell & West CAD Cell

	FEATURE & SEQUENCE	CY	TOTAL CY
CREATE STARTER CELL	Dredge Unsuitable Material from Upper 2 Feet of North End of West CAD Cell for Starter Cell and Hold Temporarily in Scows	22,000	
	Dredge Suitable Material from North End of West CAD Cell for Starter Cell and Place at CLIS	131,800	
	Place Unsuitrable Starter Cell Material from Temporary Scows into West CAD Starter Cell (22,000 cy)	-	153,800
COMPLETE SE CAD CELL	Dredge Unsuitable Material from Upper 2 Feet of Southeast CAD Cell and Place in West Starter Cell	53,800	
	Dredged Suitable Sand Material to Create Southeast CAD Cell and Place at CLIS	400,000	
	Dredged Suitable Non-Sand Material to Create Southeast CAD Cell and Place at CLIS	751,300	1,205,100
COMPLETE WEST CAD	Dredge Remaining Unsuitable Material from Upper 2 Feet of Southern End of West CAD Cell and Place in Southeast CAD Cell	45,500	
	Dredge Suitable Material from South End of West CAD Cell and Place at CLIS	401,600	447,100
FILL & CAP SOUTHEAST CAD CELL	Dredge Unsuitable 35-Foot Main Channel Material and Place in Southeast CAD Cell	587,000	
	Dredged Unsuitable Material from 35-Foot Turning Basin and Place in Southeast CAD Cell	120,000	
	Dredged Unsuitable Material from 35-Foot East Anchorage and Place in Southeast CAD Cell	72,000	
	Dredged Unsuitable Material from 25-Foot Anchorage and Place in Southeast CAD Cell	26,300	
	Dredge Portion of Suitable Material from 35-Foot Outer Entrance Channel and Place as 3-Foot Cap atop Southeast CAD Cell	73,200	878,500
FILL & CAP WEST CAD CELL	Dredged Unsuitable Material from 18-Foot Barge Anchorage and Place in West CAD Cell	11,100	
	Dredged Unsuitable Material from 18-Foot West Anchorage and Place in West CAD Cell	200	
	Dredged Unsuitable Material from 18-Foot Yellowmill Channel and Place in West CAD Cell	126,900	
	Dredged Unsuitable Material from 18-Foot Pequonnock River Channel and Place in West CAD Cell	164,700	
	Dredge Portion of Suitable Material from 35-Foot Outer Entrance Channel and Place as 3-Foot Cap atop West CAD Cell	94,800	397,700
ENTRANCE CHANNEL	Dredge Remainder of Suitable Material from 35-Foot Entrance Channel and Place at CLIS	497,600	497,600
	TOTAL		3,579,800
	Note: These calculations do not include local dredging of terminal berths.		

OPTION – Beach Nourishment at Seaside Park

An option (for either Plan A or Plan B) is to hydraulically dredge and pump the sand from the SE CAD cell to Seaside Park along the west shore of the outer harbor. Seaside Park is a public beach in Bridgeport, Connecticut about 8,000 feet long. The public beach facilities are maintained by the City of Bridgeport. The beach was previously nourished in 1957 by the State and City with partial reimbursement provided under a Federal Section 103 project and a requirement for non-Federal maintenance. The estimated quantity of sand for planning purposes that might be placed at Seaside Park is about 400,000 cy. This option will require mobilizing a hydraulic dredge in addition to the mechanical dredge required for the overall project construction.

13. CONSTRUCTION COST ESTIMATES FOR ALTERNATIVE PLANS

Construction cost estimates were prepared for both plan A and B and are presented in Tables 8 and 9. The cost estimates for the alternatives were prepared using the Corps of Engineers - Cost Engineering Dredge Estimating Program (CEDEP). Construction costs include dredging and disposal costs (dredges, dump scows, and tugs) equipment mobilization costs, crew costs and contractor's overhead, bond and profit. Dredging costs include consideration of bucket size, and cycle time and disposal includes consideration of haul distance. Costs were estimated at September 2008 price levels. A contingency of 20 percent has been applied to the construction cost estimate to account for actual variations in quantities and materials, potential weather impacts, bid competition and other factors affecting dredging production and costs.

14. PLAN COST COMPARISON

Plan A construction cost is estimated at $42.1 million and Plan B construction cost is estimated at $49.7 million, a difference of about $ 7.6 Million. Plan A is the least cost plan and was selected as the base plan.

An option with either plan would be to disposal of the sand from the SE CAD Cell at Seaside Park as beach nourishment. This would be more expensive than hauling the material to CLIS and is not part of the Base Plan. As no benefits were identified with this beach placement, the entire additional cost would need to be borne by the City or State if either desired to use the material in this manner.

The estimated costs for PLAN A and B are shown in Tables 8 and 9.

TABLE 8
BRIDGEPORT HARBOR, CONNECTICUT
COSTS AND COST ALLOCATION FOR ALTERNATIVE PLANS

PLAN A - SOUTHEAST CAD CELL PLUS MORRIS COVE	Project Cost Estimate			Percentage Allocation		Purpose Allocation		Non-Federal Share of DF Construction			Federal Share of GNF Plus Disposal Facilities	Non-Federal Post-Construction Reimbursement
	Quantity Cubic Yards	Unit Cost	Cost	Percentage of GNF or DF	Percentage of Total Cost	Maintenance Dredging of GNF	Disposal Facility Construction	Non-Federal Share of DF for ≤20-Foot	Non-Federal Share of DF for >20-Foot	Total Non-Federal Share of DF		
Mobilization/Demobilization		LS	$ 806,000			$452,000	$354,000	$8,000	$68,000	$76,000	$730,000	
Dredging and Disposal												
General Navigation Features >20-Foot Design Depth - Suitable				54.22%	30.42%							
Suitable Material from Outer Entrance Channel for 3-Foot Cap of SE CAD	73,200	$ 11.35	$ 831,000	4.49%	2.52%	$ 831,000					$ 831,000	
Suitable Material from Outer Entrance Channel for CAP Morris Cove and fill acces channel	187,800	$ 15.55	$ 2,920,000	15.77%	8.84%	$ 2,920,000					$ 2,920,000	
Suitable Material from Outer Entrance Channel to CLIS	404,600	$ 15.55	$ 6,292,000	33.97%	19.06%	$ 6,292,000					$ 6,292,000	
General Navigation Features >20-Foot Design Depth - Unsuitable				35.04%	19.66%							
Unsuitable Material from Inner 35-Foot Main Channel to Morris Cove	196,200	$ 14.73	$ 2,890,000	15.60%	8.75%	$ 2,890,000					$ 2,890,000	
Unsuitable Material from Inner 35-Foot Main Channel to SE CAD Cell	390,800	$ 5.91	$ 2,310,000	12.47%	7.00%	$ 2,310,000					$ 2,310,000	
Unsuitable Material from 35-Foot Turning Basin to SE CAD Cell	120,000	$ 5.91	$ 709,000	3.83%	2.15%	$ 709,000					$ 709,000	
Unsuitable Material from 35-Foot East Anchorage to SE CAD Cell	72,000	$ 5.91	$ 426,000	2.30%	1.29%	$ 426,000					$ 426,000	
Unsuitable Material from 25-Foot Anchorage to SE CAD Cell	26,300	$ 5.91	$ 155,000	0.84%	0.47%	$ 155,000					$ 155,000	
General Navigation Features ≤20-Foot Design Depth - Unsuitable				10.74%	6.02%							
Unsuitable Material from 18-Foot Yellow Mill Creek to SE CAD Cell	126,900	$ 6.84	$ 868,000	4.69%	2.63%	$ 868,000					$ 868,000	
Unsuitable Material from 18-Foot Pequonnock River to SE CAD Cell	164,700	$ 6.40	$ 1,054,000	5.69%	3.19%	$ 1,054,000					$ 1,054,000	
Unsuitable Material from 18-Foot Barge Anchorage to SE CAD Cell	11,100	$ 5.91	$ 66,000	0.36%	0.20%	$ 66,000					$ 66,000	
Unsuitable Material from 18-Foot West Anchorage to SE CAD Cell	200	$ 5.91	$ 1,000	0.01%	0.003%	$ 1,000					$ 1,000	
Subtotal - General Navigation Features	1,773,800	$ 10.44	$ 18,522,000	84.23%		$ 18,522,000					$ 18,522,000	
Disposal Features				100.00%	43.90%							
Material from access channel into Morris Cove	37,800	$ 15.70	$ 593,000	4.09%	1.80%		$ 593,000	$14,000	$113,000	$127,000	$ 466,000	
Strip Unsuitable Material (top 2') from SE CAD cell to Morris Cove	53,800	$ 15.97	$ 859,000	5.93%	2.60%		$ 859,000	$20,000	$164,000	$184,000	$ 675,000	
Suitable Sand Material from Southeast CAD Cell to CLIS	400,000	$ 10.91	$ 4,364,000	30.11%	13.22%		$ 4,364,000	$102,000	$835,000	$937,000	$ 3,427,000	
Suitable Non-Sand Material from Southeast CAD Cell to CLIS	751,300	$ 10.91	$ 8,197,000	56.56%	24.83%		$ 8,197,000	$192,000	$1,569,000	$1,761,000	$ 6,436,000	
Boulder & Debris Removal for Southeast CAD Cell (1200 cy est.)	1,200	$ 400.00	$ 480,000	3.31%	1.45%		$ 480,000	$11,000	$92,000	$103,000	$ 377,000	
Subtotal - Disposal Features (cy does not include 1200 cy boulders/debris)	1,242,900	$ 11.66	$ 14,493,000				$ 14,493,000	$ 339,000	$ 2,773,000	$ 3,112,000	$ 11,381,000	
Distribution Percentage						56.10%	43.90%					
Subtotal - GNF Plus Disposal Features	3,016,700	$ 10.94	$ 33,015,000		100.00%	$ 18,522,000	$ 14,493,000	$ 339,000	$ 2,773,000	$ 3,112,000	$ 29,903,000	
Contract Subtotal Including Mob/Demob			$ 33,821,000			$ 18,974,000	$ 14,847,000	$ 347,000	$ 2,841,000	$ 3,188,000	$ 30,633,000	
Contingencies	20%		$ 6,764,000			$ 3,795,000	$ 2,969,000	$ 69,000	$ 568,000	$ 637,000	$ 6,127,000	
Subtotal with Contingencies	3,016,700	$ 13.45	$ 40,585,000			$ 22,769,000	$ 17,816,000	$ 416,000	$ 3,409,000	$ 3,825,000	$ 36,760,000	
Planning, Engineering and Design (PED)			$ 660,000			$ 370,000	$ 290,000	$ 3,000	$ 25,000	$ 29,000	$ 631,000	
Construction S&A			$ 865,000			$ 485,000	$ 380,000	$ 4,000	$ 33,000	$ 37,000	$ 828,000	
Total First Cost			$ 42,110,000			$ 23,624,000	$ 18,486,000			$ 3,891,000	$ 38,219,000	$ 1,849,000
							$ 42,110,000				$ 42,110,000	

TABLE 9
BRIDGEPORT HARBOR, CONNECTICUT
COSTS AND COST ALLOCATION FOR ALTERNATIVE PLANS

PLAN B - WEST CAD CELL PLUS SOUTHEAST CAD CELL	Project Cost Estimate			Percentage Allocation		Purpose Allocation		Non-Federal Share of DF Construction			Federal Share of GNF Plus Disposal Facilities	Non-Federal Post-Construction Reimbursement
	Quantity Cubic Yards	Unit Cost	Cost	Percentage of GNF or DF Cost	Percentage of Total Cost	Maintenance Dredging of GNF	Disposal Facility Construction	Non-Federal Share of DF for ≤20-Foot	Non-Federal Share of DF for >20-Foot	Total Non-Federal Share of DF		
Mobilization/Demobilization		LS	$ 806,000			$348,000	$458,000	$13,000	$81,000	$94,000	$712,000	
Dredging and Disposal												
General Navigation Features >20-Foot Design Depth - Suitable				59.65%	25.77%							
Suitable Material from Outer Entrance Channel for 3-Foot Cap of SE CAD	73,200	$ 11.35	$ 831,000	4.92%	2.13%	$ 831,000					$ 831,000	
Suitable Material from Outer Entrance Channel for 3-Foot Cap of West CAD	94,800	$ 16.21	$ 1,537,000	9.10%	3.93%	$ 1,537,000					$ 1,537,000	
Suitable Material from Outer Entrance Channel to CLIS	497,600	$ 15.49	$ 7,708,000	45.63%	19.72%	$ 7,708,000					$ 7,708,000	
General Navigation Features >20-Foot Design Depth - Unsuitable				28.56%	12.34%							
Unsuitable Material from Inner 35-Foot Main Channel to SE CAD Cell	587,000	$ 5.99	$ 3,516,000	20.82%	8.99%	$ 3,516,000					$ 3,516,000	
Unsuitable Material from 35-Foot Turning Basin to SE CAD Cell	120,000	$ 5.99	$ 719,000	4.26%	1.84%	$ 719,000					$ 719,000	
Unsuitable Material from 35-Foot East Anchorage to SE CAD Cell	72,000	$ 5.99	$ 431,000	2.55%	1.10%	$ 431,000					$ 431,000	
Unsuitable Material from 25-Foot Anchorage to SE CAD Cell	26,300	$ 5.99	$ 158,000	0.94%	0.40%	$ 158,000					$ 158,000	
General Navigation Features ≤20-Foot Design Depth - Unsuitable				11.79%	5.09%							
Unsuitable Material from 18-Foot Yellow Mill Creek to West CAD Cell	126,900	$ 6.84	$ 868,000	5.14%	2.22%	$ 868,000					$ 868,000	
Unsuitable Material from 18-Foot Pequonnock River to West CAD Cell	164,700	$ 6.41	$ 1,056,000	6.25%	2.70%	$ 1,056,000					$ 1,056,000	
Unsuitable Material from 18-Foot Barge Anchorage to West CAD Cell	11,100	$ 5.99	$ 66,000	0.39%	0.17%	$ 66,000					$ 66,000	
Unsuitable Material from 18-Foot West Anchorage to West CAD Cell	200	$ 5.99	$ 1,000	0.01%	0.00%	$ 1,000					$ 1,000	
Subtotal - General Navigation Features	1,773,800	$ 9.52	$ 16,891,000	100.00%		$ 16,891,000					$ 16,891,000	
Disposal Features				100.00%	56.80%							
Strip Unsuitable Material (top 2') from West CAD Starter Cell to Scows	22,000	$ 13.56	$ 298,000	1.34%	0.76%		$ 298,000	$9,000	$53,000	$61,000	$ 237,000	
Suitable Material from West CAD Starter Cell to CLIS	131,800	$ 14.74	$ 1,943,000	8.75%	4.97%		$ 1,943,000	$57,000	$344,000	$401,000	$ 1,542,000	
Temporarily Store West CAD Starter Cell Material in Scows and Place in Starter Cell when Completed (Lump Sum Scow Rental)	LS	LS	$ 738,000	3.32%	1.89%		$ 738,000	$22,000	$131,000	$152,000	$ 586,000	
Strip Unsuitable Material (top 2') from SE CAD to West CAD Starter Cell	53,800	$ 13.02	$ 700,000	3.15%	1.79%		$ 700,000	$20,000	$124,000	$144,000	$ 556,000	
Suitable Sand Material from Southeast CAD Cell to CLIS	400,000	$ 10.91	$ 4,364,000	19.65%	11.16%		$ 4,364,000	$127,000	$772,000	$900,000	$ 3,464,000	
Suitable Non-Sand Material from Southeast CAD Cell to CLIS	751,300	$ 10.91	$ 8,197,000	36.91%	20.97%		$ 8,197,000	$239,000	$1,451,000	$1,690,000	$ 6,507,000	
Strip Unsuitable Material (top 2') from Southern West CAD Cell to SE CAD	45,500	$ 11.42	$ 520,000	2.34%	1.33%		$ 520,000	$15,000	$92,000	$107,000	$ 413,000	
Suitable Material from Southern West CAD Starter Cell to CLIS	401,600	$ 11.12	$ 4,466,000	20.11%	11.42%		$ 4,466,000	$130,000	$790,000	$921,000	$ 3,545,000	
Boulder & Debris Removal for Southeast CAD Cell	1,200	$ 400.00	$ 480,000	2.16%	1.23%		$ 480,000	$14,000	$85,000	$99,000	$ 381,000	
Boulder & Debris Removal for West CAD Cell	500	$ 400.00	$ 200,000	0.90%	0.51%		$ 200,000	$6,000	$35,000	$41,000	$ 159,000	
Oyster Lease Buy-Out for West CAD Cell Area	LS	LS	$ 100,000	0.45%	0.26%		$ 100,000	$3,000	$18,000	$21,000	$ 79,000	
Oyster Bed Restoration Mitigation for West CAD Cell Area	LS	LS	$ 200,000	0.90%	0.51%		$ 200,000	$6,000	$35,000	$41,000	$ 159,000	
Subtotal - Disposal Features	1,806,000	$ 12.30	$ 22,206,000	100.00%			$ 22,206,000	$648,000	$3,930,000	$4,578,000	$17,628,000	
Distribution Percentage						43.20%	56.80%					
Subtotal - GNF Plus Disposal Features	3,579,800	$ 10.92	$ 39,097,000		100.00%	$ 16,891,000	$ 22,206,000	$ 648,000	$ 3,930,000	$ 4,578,000	$ 34,519,000	
Contract Subtotal Including Mob/Demob			$ 39,903,000			$ 17,239,000	$ 22,664,000	$ 661,000	$ 4,011,000	$ 4,672,000	$ 35,231,000	
Contingencies	20%		$ 7,981,000			$ 3,448,000	$ 4,533,000	$ 132,000	$ 802,000	$ 934,000	$ 7,046,000	
Subtotal with Contingencies	3,579,800	$ 13.38	$ 47,884,000			$ 20,687,000	$ 27,197,000	$ 793,000	$ 4,813,000	$ 5,606,000	$ 42,277,000	$ 2,720,000
Planning, Engineering and Design (PED)			$ 844,000			$ 365,000	$ 479,000	$ 48,000	$ 11,000	$ 59,000	$ 785,000	$ 48,000
Construction S&APLAN			$ 943,000			$ 407,000	$ 536,000	$ 54,000	$ 12,000	$ 66,000	$ 877,000	$ 54,000
Total First Cost			$ 49,671,000 $ 49,670,000			$ 21,459,000	$ 28,212,000			$ 5,731,000	$ 43,939,000	$ 2,821,000

15. PROPOSED PLAN

The least cost plan and the base plan for disposing of dredged materials from Bridgeport Harbor is Plan A. This disposal plan is technically feasible and environmentally acceptable and is the lowest cost plan. Estimated quantities and costs for the proposed project are shown in Table 8.

The proposed plan (Plan A) includes construction of a CAD cell in Bridgeport Harbor for disposal of material not suitable for open water disposal at CLIS. This CAD cell would be located in the SE corner of the harbor (SE CAD Cell). It would be about 90 feet deep and have top area of about 16.3 acres. After unsuitable material from the maintenance dredging is placed in the CAD cell, it would be capped with clean material from the harbor entrance channel.

The existing borrow pit in Morris Cove in New Haven will be used to dispose of unsuitable material from the top of the SE CAD Cell and some harbor maintenance material and then would be capped with clean material. Use of the borrow pit will require approach dredging to improve access to the Pit. It is estimated that about 2,500 ft. of dredging would be necessary with an estimated volume of 37,800 cy. This material will go in the borrow pit.

The bulk of the suitable material from the maintenance dredging project and creation of the SE CAD cell will go to CLIS. This site is an EPA designated open water disposal site and is open until 2013.

Placing sand at Seaside Beach is more expensive than disposing of it at CLIS by about a dollar per cubic yard, plus mobilization cost of about $550,000, for a total of about $1 million. The beneficial use of placing sand on the beach could be considered as part of this Dredged Material Management Plan as an option if the City or State agreed to pay the incremental cost over disposal at CLIS.

An examination concluded it unlikely that Seaside Beach would qualify under the Corps Section 204 beneficial-use authority due to a lack of infrastructure that would potentially be protected by a beach nourishment project. If it were to be demonstrated that there was a justified project to placing sand on the beach (e.g. benefits due to storm damage reduction and environmental restoration greater than the annualized increase in project cost) then the local community would be eligible for cost sharing the increment at 35% non-Federal and 65% Federal under the Section 204 program. This would require a separate Corps study to better determine costs and potential benefits. However, based on information evaluated thus far, it is likely that the City or State be responsible for 100% of the incremental cost ($1 million) of placing sand at Seaside Beach.

16. ENVIRONMENTAL COMPLIANCE

The New England District of the Corps of Engineers has prepared an Environmental Assessment, Finding of No Significant Impact and a Section 404(b)(1) Evaluation and Statement of Findings. These documents will be provided for public review and comment prior to final approval of the DMMP. Findings of the Environmental Assessment are summarized below.

Endangered Species

No Federally threatened or endangered species listed by NOAA Fisheries Service are known to occur in Bridgeport Harbor or Morris Cove (letter dated July 9, 2008). There are no known occurrences of Federally threatened or endangered species listed by the U.S. Fish and Wildlife Service in the project area (email dated October 2, 2008). However, according to the U.S. Fish and Wildlife Service, the Seaside Park Beach disposal option, as described, will create suitable habitat conditions for the Federally-threatened piping plover (*Charadrius melodus*). The creation of new habitats for this species may be beneficial, provided that the General Piping Plover Dredged Disposal Conditions to Avoid Adversely Affecting Piping Plovers are implemented. If implemented, then the project is not likely to adversely affect the piping plover. If the management guidelines can not be implemented, then the project is likely to result in adverse affects to the plover and further consultation with the U.S. Fish and Wildlife Service is required.

Essential Fish Habitat

The 1996 amendments to the Magnuson-Stevens Fishery Conservation Management Act strengthen the ability of the National Marine Fisheries Service and the New England Fishery Management Council to protect and conserve the habitat of marine, estuarine, and anadromous finfish, mollusks, and crustaceans. This habitat is termed "essential fish habitat", and is broadly defined to include "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."

Of the managed species listed for Bridgeport Harbor, Morris Cove and CLIS, only the following species and their life stages are expected to be in the project area due to the depths, salinity, or substrate type. They are: red hake *Urophycis chuss* (eggs, larvae, juveniles, adults), winter flounder *Pseudopleuronectes americanus* (eggs, larvae, juveniles, adults), windowpane flounder *Scophthalmus aquosus* (eggs, larvae, juveniles, adults), bluefish *Pomatomus saltatrix* (juveniles, adults), Atlantic mackerel *Scomber scombrus* (eggs, larvae, juveniles, adults), summer flounder *Paralicthys dentatus* (juveniles), scup *Stenotomus chrysops* (eggs, larvae, juveniles, adults), black sea bass *Centropristus striata* (juveniles), Spanish mackerel *Scomberomorus maculatus* (juveniles), and sand tiger shark *Odontaspis taurus* (larvae).

Anadromous fish reported to transit Bridgeport Harbor to spawn in the Pequonnock River; are the alewives *Alosa pseudoharengus*, and, possibly, the blueback herring *Alosa aestivalis* (Johnson, pers. com). The migratory fish tautog *Tautoga onitis*, striped bass *Morone saxatilis*, scup *Stenotomus chrysops* may utilize the harbor for forage and cover.

There is negligible (little) potential for adverse effects, including cumulative effects, of the proposed action on Essential Fish Habitat for any of the managed species in the area as the project area is not optimal EFH for the majority of the above species due to unsuitable depth, temperature, salinity, or substrate. While there are both juvenile and adult fish species that might use the waters in the study area, these fish are mobile and would avoid areas of construction. If present, most of these species would only use the study area during the spring and summer, following warmer waters offshore in the winter. Eggs and larvae of windowpane flounder, scup and the larvae of winter flounder are planktonic (i.e. float in the water column) and would likely be unaffected by construction, as planktonic prey species.

The species and life stage that may be affected by the project is spawning winter flounder populations. Some winter flounder eggs were found in Bridgeport Harbor and also found in Morris Cove (Pereira, 1999). To avoid these impacts, dredging will not occur north of Tongue Point in Bridgeport Harbor between February and March and the dredge will use a closed bucket when dredging silt to reduce turbidity. Disposal at Morris Cove will also not occur during February and March. These windows have initially been coordinated with the resources agencies and coordination will continue as appropriate.

Measures to Minimize Environmental Impacts

The following measures were identified in the Environmental Assessment to minimize potential adverse impacts associated with dredging of Bridgeport Harbor:

a. Construction will be sequenced to minimize potential impacts to natural resources. Construction would start with deepening the access channel to Morris Cove borrow pit. In order to minimize impacts to leased shellfish beds in Morris Cove dredging of this channel will not occur from 31 May to 30 September. No dredging in the Main Channel would occur north of Tongue Point to the Stratford Avenue Bridge in Bridgeport Harbor from 1 February through 31 May to avoid winter flounder spawning. In addition the portions of the Main Channel above the confluence with Yellow Mill Creek would be restricted from dredging operations from 1 April to 30 June due to anadromous fish runs. The top layer of the footprint of the proposed Bridgeport CAD cell needs to be excavated prior to start of winter flounder spawning season (1 February). Removing the silty layer of the CAD cell prior to spawning season will allow dredging of the parent material being excavated to create the CAD cell without any impact to winter flounder. The entrance channel between Buoy No. 9 and the beginning of the breakwaters may be restricted from dredging activities from 31 May to 30 September to minimize impacts to shellfish beds nearby. Further review in underway to determine if this restriction is necessary. If an alternative CAD cell is constructed west of the Main Channel dredging may not occur there from 31 May to 30 September to protect nearby shellfish resources.

b. A closed bucket dredge will be used and no scow overflow will be allowed during silt dredging.

c. The unsuitable material placed in the CAD cell and the borrow pit will be capped with sufficient suitable cap material to isolate contaminants from the surrounding environment.

d. The channel created to access the Morris Cove Borrow pit may be filled in once the Morris Cove pit access is no longer required.

Cultural Resources

This report addresses proposed harbor maintenance dredging to restore the authorized project dimensions. Maintenance dredging will be confined to previously disturbed contexts and impacts to significant resources are not expected. However, to address concerns raised by the CT SHPO an archaeological remote sensing survey will be conducted near the Strafford Ave Bridge to investigate the reported presence of the historic canal boats submerged immediately south of the Bridge. Also to address concerns raised by the Mashantucket Pequot Tribal Historic Preservation Office a remote sensing survey will be conducted in previously undisturbed areas of the CAD cell to confirm that cultural resources do not exist in the CAD cell area. (see discussion below)

The Morris Cove Borrow Pit is a previously disturbed area and there will be no impacts here. Placement of Sand on Seaside Beach has occurred in the past and there will be no cultural resources impacted by placing sand on the beach, if that option is chosen.

The use of CLIS for disposal of suitable material will not have any effect on cultural resources as it is a previously utilized disposal area for dredging activities. Cultural resource concerns At CLIS were fully described in EPA's 2005 Site Designation Final EIS.

The dredged material disposal plan proposed in this report was coordinated with the Connecticut State Historic Preservation Officer and the Mashantucket Pequot and Mohegan Tribes by letters dated November 19, 2008 as part of the EA process. The State Historic Preservation office in a response letter dated December18, 2008, noted the presence of three historic canal boats submerged just south of Stratford Avenue Bridge near the Pequonnock River Channel. The SHPO recommends a survey of this area to identify the precise location of these boats to ensure they are not in the proposed dredging area. The Mashantucket Pequot in a letter dated December 8, 2008 recommended a survey of the harbor to identify any currently unknown cultural resources that may be in the work areas. Most of the work areas are in previously disturbed areas except for the area of the SE CAD cell.

17. ALTERNATIVE REVIEW BY REGIONAL DREDGING TEAM

When the US Environmental Protection Agency designated the Western Long Island Disposal Site (WLIS) and the Central Long Island Disposal Site (CLIS) in a June 2005 rulemaking, they imposed several restrictions or requirements on the use of the sites. One of these restrictions required the formation of a Long Island Sound Regional Dredging Team (LISRDT) that will review dredging projects to ensure that a thorough effort has been conducted to identify practicable alternatives and work to ensure their use as practical.

Although all regulatory agencies will retain their respective decision-making authority and time-frames for decision-making, the LISRDT provides guidance by which project proponents shall independently analyze the practicability of identified alternatives to open water disposal. Project proponents shall provide their completed alternatives analysis for review by the LISRDT during the application process. At the conclusion of the LISRDT's evaluation, the LISRDT chairperson will advise the Steering applicable regulatory agencies as to whether, in the LISRDT's opinion, the applicant or proponent has satisfactorily addressed the practicability of the alternative(s) with respect to the goals and objectives of the final rulemaking. Notwithstanding any review comments or recommendations of the LISRDT, all regulatory agencies will retain their respective decision-making authority and time frames for decision-making.

The LISRDT consist of representatives of the U.S. Environmental Protection Agency, the U.S. Army Corps of Engineers, the National Marine Fisheries Service, the Connecticut Department of Environmental Protection, the New York State Department of State, and the New York State Department of Environmental Conservation.

18. REAL ESTATE CONSIDERATIONS

The lands, easements and rights of way required for construction, operation and maintenance of the project lie below the ordinary high watermark of the navigable watercourse. Therefore, navigational servitude applies and will be invoked for the project. As a result, the non-Federal sponsor will not be required to furnish any lands, easements or rights of way for the project, and thus will not be entitled to any real estate credit.

19. FEDERAL AND NON-FEDERAL RESPONSIBILTIES

The Project Partnership Agreement will detail the specifics of responsibilities of both the U.S. Army Corps of Engineers and the Non-Federal Sponsor. The major functions that the Corps will provide for this project are as follows.

- Continued Project Management during Design and Construction
- Engineering & Design including pre-dredge and after-dredge surveys, additional geotechnical investigations during design, preparation of project Plans and Specifications, preparation of cost estimates, and any required Engineering during Construction.
- Contracting Services
- Construction Supervision and Administration
- Quality Assurance (Supervision and Inspection) of Construction Contracts
- Required Environmental Monitoring During Construction

The City of Bridgeport, Port Authority supports this project and has agreed to act as the Non-Federal Sponsor for the project including cost-sharing the construction of the CAD cells. The Port Authority will work with the Corps to secure the necessary state and local permits and approvals for construction of the CAD cells. The Corps of Engineers will obtain the Water Quality Certification under Section 401 of the Clean Water Act and a Coastal Zone Management consistency determination from the State of Connecticut.

20. COST ALLOCATION AND SHARING

Section 201 of the Water Resources Development Act (WRDA) of 1996 provides for cost sharing of dredged material disposal facilities as a General Navigation Feature (GNF) for those sites with construction award dates after October 12, 1996. Headquarters, U.S. Army Corps of

Engineers, released Policy Guidance Letter No. 47, dated April 3, 1998, to provide guidance on the implementation of laws relevant to cost-sharing Dredged Material Disposal Facility (DMDF) construction and operation. Much of the specific guidance can be found in paragraph 3 of Policy Guidance Letter (PGL) No. 47. The Non-Federal Sponsor is required to provide funds both during and after construction of the project, with the up-front funding determined according to the depth of the navigation project. The Sponsor's up-front share during construction is 10 percent of the cost of constructing a disposal facility for that portion of a project with depths not greater than 20 feet, and 25 percent for depths greater than 20 feet but not greater than 45 feet, and 50 percent for depths greater than 45 feet. Since the depth of the Bridgeport Harbor channels and anchorage varies the cost sharing also varies. The CAD Cell costs allocated to the 18-foot channels and anchorage will be shared 90 percent Federal and 10 percent Sponsor. The CAD Cell costs allocated to the 35-foot and 25-foot project features will be shared 75 percent Federal and 25 percent Sponsor.

Once construction is completed the non-Federal sponsor is required to pay an additional 10 percent of the cost of construction of the disposal facility over a period not to exceed 30 years. Table 8 above displays the projects costs for the base plan and the non-Federal sponsor share of this plan.

The Non-Federal sponsor will also provide the lands, easements, rights-of way and relocations (LERR) necessary for the disposal facility. Since the CAD cells are located in areas the below the mean high water elevation, provision of LERRs is not necessary, nor will the non-Federal sponsor be given cost sharing credit for LERR.

21. SPONSOR WILLINGENESS AND CAPABILTIY

The City of Bridgeport, Port Authority supports the ongoing Corps efforts to dredge the Bridgeport Federal Navigation Project (FNP). In a letter dated_______________, the Port Authority sent a letter to the New England District expressing full support for the project and providing assurance of the cooperation necessary for construction of the CAD cell for the disposal of the unsuitable materials. The support letter is contained in Appendix E, Correspondence.

22. RECOMENDATION

Based on the information and analyses contained in this Dredged Material Management Plan, it is recommended that dredged material resulting from the maintenance dredging of the Bridgeport Harbor Federal Navigation Project (FNP), including Yellow Mill Creek, and Pequonnock River, be disposed in a combination of sites including a confined aquatic disposal (CAD) cell to be constructed inside Bridgeport Harbor, the existing Morris Cove borrow pit in New Haven Harbor, and in open water at the existing EPA designated Central Long Island Sound Disposal Site (CLIS).

A portion of the material to be dredged to form the CAD cell is sand and gravel suitable for beneficial use that may be cost-effectively segregated from the other dredged material. Additional explorations to be conducted during design will determine if this is feasible. Local interests may wish to use that material for shore protection or other uses. However, as this is not a least cost option; and as no benefits have been identified for such uses, non-Federal interests would be required to pay any incremental cost over disposal of this material at the CLIS.

As part of this Dredged Material Management Plan consideration has been given to environmental acceptability, economic justification, and engineering feasibility. The proposed disposal plan for both suitable and unsuitable materials is the least cost, environmentally acceptable plan for disposal of dredged materials from the Bridgeport Harbor FNP. An Environmental Assessment and Finding of No Significant Impact have been prepared for the maintenance dredging confined disposal facility project.

The recommendations contained herein reflect the Corps policies governing formulation of projects and the information available at this time. They do not necessarily reflect program and budgeting priorities inherent in local and State programs, or the formulation of a national Civil Works water resources program. Consequently, the recommendations may be modified at higher levels within the Executive Branch before they are used to support funding. However, as appropriate, the non-Federal Sponsor will be advised of any modifications and will be afforded an opportunity to comment further.

In view of the above, I recommend that the Corps of Engineers enter into an agreement with the City of Bridgeport under Section 201 of the Water Resources Development Act of 1996 to cost-share in the construction of the dredged material disposal facilities identified in this report for the maintenance dredging of the Bridgeport Harbor FNP.

________________	____________________________
Date	PHILIP T. FEIR Colonel, Corps of Engineers District Engineer

APPENDIX A

AUTHORIZATIONS AND PROJECT HISTORY

Appendix A - List of Authorizations for Bridgeport Harbor

Authorization	Work Authorized & Constructed	Construction
Act of 1836	8-Foot MLW Channel 200 Feet Wide through Outer Bar and 100 Feet Wide through Inner Bar	1837 - Channel 60 Feet Wide
Act of 30 August 1852	Dredging through Both Bars to -8 Feet MLW by 200 Feet Wide Across the Entrance Bars. Dredged to 100 Feet Wide Across the Inner Bar and 60 Feet Wide Across the Outer Bar	Aug 1853 – June 1854 – Deepened to 13 Feet Across Outer Bar
River & Harbor Act of 3 March 1871	East Breakwater at Long Beach, Entrance Channel -12 Feet MLW by 100 Feet Wide Up to Stratford Avenue, with a Jetty Extending 3,000 LF Southwest from the Tip of Long Beach, East of the Channel + 11 Feet MLW	Channel - Summer 1871 – July 1875 to -9 Feet 12-Foot Channel – July 1875 – Dec 1881 East Jetty – Summer 1871 – FY 1873 – to 1,380 Feet Long
River & Harbor Act of 10 June 1872	Widening the 9-Foot Channel to 300 - 450 Feet Wide	May 1873 – Sept 1877
River & Harbor Act of 3 March 1875	Deepen –9 by 300-Foot Wide Channel to 12 Feet, Widened to 425 Feet in the Inner Harbor	July 1875 – Dec 1881
River & Harbor Act of 18 June 1878	Extension of the Channel above the Lower Bridge for 3,000 LF to the Horse-Railroad Bridge at -9 Feet MLW by 100 Feet Wide	Oct 1878 – Dec 1878
River & Harbor Act of 2 August 1882	Widening the 12-Foot Channel to 600 Feet to Create a Refuge Anchorage	Nov 1882 – March 1887
River & Harbor Act of 11 August 1888	Extension of the 9-Foot Poquonnock River Channel 100 Feet Wide Upstream of the Horse Railroad Bridge	May 1889 – Feb 1892 to Reduced Width
River & Harbor Act of 19 September 1890	West Stone Breakwater Extending from the Tongue ESE about 1,165 LF to the Inner Beacon +3 Feet MHW	June 1891 – Dec 1891
River & Harbor Act of 13 July 1892	Further Widening of the 12-Foot Inner Harbor Channel Westerly between the Inner Beacon and Naugatuck Wharf.	Nov 1892 – May 1893
River & Harbor Act of 17 August 1894	Deepening the Channel Across the Outer Bar to -15 Feet MLW by 100 Feet Wide	Nov 1894 – March 1896
River & Harbor Act of 3 June 1896	Channel -15 Feet MLW by 300 Feet Wide from Long Island Sound to the Inner Beacon, then 200 Feet Wide up to the Lower Bridge. The Act also Provided for a Channel in Yellow Mill Channel at -12 Feet MLW by 200 Feet Wide	15-Foot Channel Widening - Aug 1897 – June 1898 Yellowmill Channel –

	from the Main Harbor Channel up to the Causeway	Sept 1898 – Nov 1898
River & Harbor Act of 3 March 1899	Main Harbor: Channel -18 Feet MLW by 300 Feet Wide Across Outer Bar to Inner Beacon, 200 Feet Wide to Stratford Ave Bridge; a -18-Foot Anchorage West of the Channel above the Beacon, 500 by 2,000 Feet; 12-Foot Anchorage West of the Channel, 500 Feet by 1,500 Feet; a Second -12-Foot Anchorage East of the Channel to the Harbor Line. Pequonnock River: Channel 12 Feet by 100 Feet Wide for about 1 Mile up to Upper Bridges. Johnsons Creek: Channel -9 Feet by 100 Feet for about 3/4 Mile above the Main Channel. Yellow Mill Creek: Channel 12 Feet by 100 Feet from the Main Harbor to Head of Yellow Mill Cove.	Main Harbor – July 1900 – May 1907 Pequonnock River – FY 1901 – Dec 1904 Johnsons Creek – FY 1901 – May 1907 Yellowmill Channel – FY 1901 – May 1907
River & Harbor Act of 2 March 1907	Deepening the Main Entrance Channel and New East Outer Anchorage to -22 Feet, Yellow Mill Channel to -18 Feet, a New -12-Foot Northeast Anchorage, and Two Stone Breakwaters for Outer Harbor	East Breakwater – July 1907 – May 1908 West Breakwater – May 1908 – Sept 1908 22-Foot Harbor Areas April 1908 – Dec 1910 12-Foot Anchorage – July 1908 – Dec 1908 Yellowmill Channel – Not Constructed
River & Harbor Act of 25 June 1910	Extension of the 18-Foot Channel Upstream in Poquonnock River to 750 LF below the Head of the Channel. Plus Continued Maintenance of the Remaining 750-Foot Long Section of the 12 Foot Channel.	Oct 1910 – Feb 1911
River & Harbor Act of 2 March 1919	Widening and Shifting the 18-Foot Inner Main Channel South, Declaring the 18-Foot Anchorage, Widening the 12-Foot Anchorage West, Shifting the Yellowmill Channel West, and Johnsons River Channel 12 Feet by 125-175 Feet Wide to the First Turn, then 9 Feet by 100 Feet, Increased to 150 to 175 Feet at the Turns.	18-Foot Harbor – Jan 1920 – FY 1921 12-Foot Anchorage - FY 1924 - FY 1925 Yellowmill Channel – FY 1924 – FY 1925 Johnson Creek - Summer – Fall 1925
River & Harbor Act of 3 July 1930	Deepening the 22-Foot Main Entrance Channel and Anchorage to 25 Feet, Widen the 18-Foot Upper Harbor Channel to 300 Feet, Deepen and Widen the Upper Reach of the Poquonnock River Channel to 18 Feet, Deepen Yellowmill Channel to 18 Feet, Deepen the 12 and 9-Foot Johnsons River Channels to 18-Feet.	25-Foot Harbor – Dec 1932 – Sept 1933 Poquonnock River – June 1938 – Nov 1938 Yellowmill Channel – Nov 1932 – Dec 1932 Except Upstream Ledge Removal Johnson Creek - Never Constructed

River & Harbor Act of 26 August 1937	Deepening Main Channel in Inner Harbor to -25 Feet MLW up to Stratford Ave Bridge, and Realignment of the 18-Foot and 12-Foot Inner Harbor Anchorage Basins	25-Ft Inner Channel - Nov 1938 – June 1939
River & Harbor Act of 2 March 1945	30-Foot Main Harbor Channel, and Deauthorized the 12-Foot Anchorage	FY 1947 – Feb 1948
River & Harbor Act of 24 July 1946	Turning Basin -30 Feet MLW at Mouth of Johnsons River, Realign and Widen 30-Foot Main Channel from Power House Creek to Steel Point, Abandon the 18-Ft Johnsons River Channel, and Provide a 15-Ft Channel 200 Feet Wide Upriver to 1,700 Feet below the Dam, then at -9 Feet by 100 Feet Wide to 600 Feet below Dam	15-Ft Johnsons Creek - FY 1948 – Feb 1948 30-Foot Turning Basin FY 1948 – Feb 1948
River & Harbor Act of 3 July 1958	Main Ship Channel 35 Feet by 400 Feet from the Sound to Tongue Pt, Widen to 600 Feet at the Bend, Narrow to 300 Feet at the Pequonnock River Channel 800 Feet below the Stratford Avenue Bridge, an East Turning Basin 35 Feet Southeast of the Mouth of Johnsons River 200 to 1,800 Feet Wide and 1,500 Feet Long, and in Johnsons River 3 Anchorage Areas, (1) 6 Feet by 2-Acres at Head of 9-Ft Channel, (2) West of the 15-Ft Channel at -9 Feet by 2.4 Acres and (3) 6 Feet by 0.6 Acres.	35-Ft Channel & Basin Mar 1961 – June 1963 Johnsons Creek – Nov 1963 – Dec 1963
2 November 1979 House Doc. #96-157 4th Annual Deauth. Report, 26 June 1976	Deauthorizes the Uncompleted Portion of the 18-Foot Yellowmill Channel Consisting of Removal of Ledge from the Upper Reach as Authorized by the River and Harbor Act of 3 July 1930	Deauthorization
O&M Trade-off for Unconstructed West Outer Anchorage	Deepen 25-Foot East Outer Anchorage to –35 Feet MLW	Dec 1982 – June 1983
Water Resources Development Act of 25 September 1996	Deauthorized a 2-Acre 6-Foot Anchorage at the Head of Johnsons Creek from the Act of 1958. Also Deauthorized the Upstream Portion of the Federal Channel from the Act of 24 July 1946	Deauthorization
Water Resources Development Act of 17 August 1999	Deauthorized Two Anchorages on West Side of the Johnsons River Channel: 2.4 acre by 9 feet, and 0.6-acre by 6 feet deep, from the Act of 1958	Deauthorization
Water Resources Development Act of 8 November 2007, P.L. 110-114, Section 3181(a)(1)	Deauthorizes a Portion of the 18-Foot Yellow Mill Channel as Authorized by the Act of 3 July 1930.	Deauthorization

Appendix A - Bridgeport Harbor Dredging History

Year Authorized - Type of Work	**Project Segment**	**Dredged**	**Cubic Yards**
Improvement Dredging	8-foot by 60-foot wide Bar Entrance Channel	1838	Unknown
Improvement Dredging	8-Ft by 100-Ft Wide Entrance & Bar Channel	1853-1854	27,649
Improvement Dredging	14-Ft by 100-Ft Entrance & Harbor Channel	July 1871 - Dec 1871	24,494
Breakwater Construction	Stone East Breakwater	Fall 1871	na
Continue Improvement Dredging	9-Ft by 100-Ft Entrance & Harbor Channel	Apr 1873 - June 1873	28,303
Continue Breakwater Construction	Stone East Breakwater	FY 1873	na
Continue Improvement Dredging	9-Ft by 100-Ft Entrance & Harbor Channel	July 1873 - Jan 1874	165,751
Improvement Dredging	Widen Channel to 300 Ft (Outer) & 450 Ft	Sept 1874 - July 1875	145,343
Improvement Dredging	Channel Cut -12 Ft by 100 Ft	July 1875 - Dec 1875	100,264
Continue Improvement Dredging	Widen 9-Ft Inner Harbor Channel	July 1877 - Sept 1877	85,603
Improvement Dredging	9-Ft Lower Poquonnock R. Chan. to Horse RR	Oct 1878 - Dec 1878	71,345
Continue Improvement Dredging	Widen 12-Ft Entrance Channel to 300 Feet	April 1879 - May 1879	13,682
Continue Improvement Dredging	Widen 12-Ft Entrance Channel to 300 Feet	Sept 1879 - Dec 1879	89,417
Continue Improvement Dredging	Widen 12-Ft Entrance Channel to 300 Feet	Oct 1880 - June 1881	70,703
Improvement Dredging	Widen 12-Ft Chan. to 300 Ft, with 425-Ft Basin	Nov 1881 - Dec 1881	90,000
Improvement Dredging	Widen 12-Ft Inner Chan. to form 600-Ft Basin	Nov 1882 - Feb 1883	90,561
Continue Improvement Dredging	Continue 12-Ft by 600-Ft Basin	May 1885 - June 1885	59,352
Continue Improvement Dredging	Continue 12-Ft by 600-Ft Basin	Nov 1886 - May 1887	261,960
Maintenance Dredging	O&M of 12-Ft by 300-Ft Chan. at Inner Beacon	June 1888	14,000
Improvement Dredging	Extend 9-Ft Poquonnock R. Chan. above Bridge	FY 1889 - July 1889	45,000
Breakwater Construction	Inner Breakwater from Tongue to Inner Beacon	June 1891 - Dec 1891	na
Continue Improvement Dredging	Extend 9-Ft Poquonnock R. Chan. above Bridge	Dec 1891 - Feb 1892	30,000
Improvement Dredging	Expand 12-Ft Inner Basin to 770 Ft Wide	Nov 1892 - May 1893	190,132
Improvement Dredging	Entrance Channel -15 Feet by 100 Ft Wide	Nov 1894 - Mar 1895	48,458
"	"	Jan 1896 - Mar 1896	21,523
Continue Improvement Dredging	Entrance Channel -15 Feet by 300 Ft Wide	Aug 1897 - June 1898	137,700
Improvement Dredging	12-Ft Yellow Mill Channel, 200 ft Wide	Sept 1898 - Nov 1898	80,000
Improvement Dredging	18-Ft Main Channel and 12-Ft NE Basin	July 1900 - Sept 1900	257,783

Breakwater Improvement/Rehab	East Breakwater Repairs & Extension	July 1900 - Sept 1900	na
Improvement Dredging	18-Ft Main Channel Near Outer Beacon	Jan 1901 - June 1901	40,756
Improvement Dredging	12-Ft Pequonnock River Channel	Jan 1901 - June 1901	141,623
Improvement Dredging	9-Foot Johnsons River Channel - Lower End	Jan 1901 - June 1901	18,079
Improvement Dredging	18-Ft Main Channel in Inner Harbor	Apr 1902 - FY 1903	130,048
Improvement Dredging	18-Ft SW Anchorage, 500 x 2000 Feet	Apr 1902 - FY 1903	86,377
Continue Improvement Dredging	Lower 12-Ft Yellow Mill Channel, 200 ft Wide	July 1903 - May 1904	16,093
Improvement Dredging	9-Foot Johnsons River Channel - Upper End	July 1903 - May 1904	45,811
Improvement Dredging	12-Ft Pequonnock Chan. below New RR Bridge	FY 1903	2,295
Improvement Dredging	18-Ft Main Entrance Channel	FY1903 - May 1904	248,130
Improvement Dredging	12-Ft Pequonnock River Channel	July 1904 - Dec 1904	12,056
Improvement - Yellow Mill Channel	12-Foot Channel - Extension above Bridge	July 1904 - Dec 1905	101,235
Maintenance Dredging	12-Ft Pequonnock River Channel	November 1905	23,175
Improvement Dredging	12-Ft Pequonnock River Channel	July 1906 - May 1907	19,889
Improvement Dredging	9-Foot Johnsons River Channel - Upper End	July 1906 - May 1907	113,046
Improvement Dredging	12-Ft West Anchorage, 500 x 1500 Feet	July 1906 - May 1907	108,106
Improvement Dredging	18-Ft Main Entrance Channel	July 1906 - May 1907	37,366
Improvement Dredging	18-Ft SW Anchorage, 500 x 2000 Feet	July 1906 - May 1907	317,296
Maintenance Dredging	18-Ft SW Anchorage, 500 x 2000 Feet	Jan 1907 - May 1907	23,207
Maintenance Dredging	18-Ft Inner Main Channel	Jan 1907 - May 1907	57,446
Maintenance Dredging	12-Ft Pequonnock River Channel	Jan 1907 - May 1907	2,775
Maintenance Dredging	Lower 12-Ft Yellow Mill Channel at Bridge	April 1907	700
Breakwater Construction	East Breakwater Extension	July 1907 - May 1908	na
Breakwater Construction	West Outer Breakwater begun	May 1908 - FY 1909	na
Maintenance Dredging	18-Ft Inner Main Channel & Anchorage	August 1907	773
Continue Breakwater Construction	West Outer Breakwater Completed	July 1908 - Sept 1908	na
Improvement Dredging	12-Ft East Anchorage	July 1908 - Dec 1908	150,619
Improvement Dredging	22-Ft Main Entrance Channel	Apr 1909 - June 1910	425,359
Improvement Dredging	22-Ft East Outer Harbor Anchorage	July 1909 - Dec 1910	806,162
Improvement Dredging	18-Ft Pequonnock River Channel	Oct 1910 - Feb 1911	268,126
Maintenance Dredging	18-Ft Inner Main Channel	Nov 1911 - May 1912	22,151
Maintenance Dredging	18-Ft Inner SW Anchorage	Nov 1911 - May 1912	34,764
Maintenance Dredging	Lower 12-Ft Yellow Mill Channel	Nov 1911 - May 1912	8,932
Maintenance Dredging	Junction of Johnson Creek & East 12-Ft Anch.	Nov 1911 - May 1912	12,936
Maintenance Dredging	12-Ft Yellow Mill Channel - Both Reaches	July 1916 - Sept 1916	53,398
Lighthouse Relocation	Inner Beacon Moved Back for Channel Bend	Nov 1919 - Dec 1919	na
Improvement Dredging	18-Ft Inner Chan. Realign in West 12-Ft Anch.	Jan 1920 - FY 1921	291,100

Breakwater Maintenance	West Outer Breakwater Repaired	FY 1921	na
Maintenance Dredging	18-Ft Channel & Anchorage in Inner Harbor	Sept 1922 - FY1923	290,800
Maintenance & Improvmt Dredging	12-Ft Yellow Mill Channel - Shifted West 50 Ft	FY 1924	69,000
Maintenance Dredging	18-Ft Pequonnock River Channel	FY 1924	?
Improvement & Maint. Dredging	New 12-Ft North Anch. Extension, 300 Ft Wide	Fall 1924 - FY 1925	113,000
Improvement Dredging	12 Ft & Widened 9-Ft JohnsonsR.Channel	FY 1926	100,000
Maintenance Dredging	18-Ft Pequonnock River Channel	Oct 1928 - FY 1930	82,688
Improvement and Maintenance	18-Ft Yellowmill Channel	Nov 1932 - Dec 1932	424,165
Improvement	25-Foot Main Entrance Channel	Dec 1932 - Sept 1933	592,741
Improvement Dredging	25-Foot Outer East Anchorage	Dec 1932 - June 1933	367,168
Maintenance of Breakwaters	Repairs to Harbor Breakwaters	July 1935 - Aug 1935	na
Maintenance Dredging	Pequonnock River Channel	Nov 1936 - Jan 1937	79,936
Improvement Dredging	18-Ft Pequonnock River, Realign & Deepen	June 1938 - Nov 1938	65,829
Improvement Dredging	25-Foot Main Inner Channel	Nov 1938 - June 1939	940,879
Maintenance Dredging	18-Foot Yellow Mill Channel	Nov 1938 - Mar 1939	118,075
Maintenance of Breakwaters	Repairs to East Entrance Breakwater	Jan 1941 - Feb 1941	na
Maintenance/Realignment Dredging	18-Foot Inner Harbor Basin Areas	Aug 1941 - Dec 1941	121,974
Maintenance Dredging	25-Foot Outer East Anchorage	July 1943 - Nov 1943	126,247
Maintenance Dredging	25-Foot Main Inner Channel	Nov 1943 - Jan 1944	125,969
Maintenance Dredging	18-Foot Yellow Mill Channel	Mar & Jun - Dec 1944	48,668
Maintenance Dredging	12-ft & 9-Ft Johnson River Channels	June 1944 - Dec 1944	20,546
Maintenance Dredging	18-Ft Pequonnock River Channel	July 1944 - Dec 1944	48,841
Improvement Dredging	30-Foot Entrance Channel in Outer Harbor	June 1947	56,235
Improvement Dredging	30-Foot Main Channel & Basin and 15-Ft	July 1947 - Feb 1948	2,585,348
"	& Modified 9-Ft Johnsons River Channels	"	"
Maintenance Dredging	18-Foot Yellow Mill Channel	June 1952 - Aug 1952	55,010
Maintenance Dredging	30-Foot Entrance Channel	June 1956 - July 1956	500,665
Maintenance Dredging	30-Foot Inner Harbor Channel	Sept 1956 - Oct 1956	131,449
Maintenance Dredging	30-Foot Main Channel	Apr 1960 - May 1960	347,000
Improvement Dredging	35-Foot Entrance & Main Channel	Mar 1961 - June 1962	1,433,000
Improvement Dredging	35-Foot Main Channel & Turning Basin	Apr 1962 - Aug 1962	675,000
Grading & Fill for Stratford CDF	Grading of Diked Disposal Area	Jan 1963 - Mar 1963	94,600
Improvement RockRemoval	35-Foot Main Channel	May 1963 - June 1963	na
Improvement Dredging	9-Ft and Two 6-Ft Johnsons River Anchorages	Nov 1963 - Dec 1963	24,000
Improvement Dredging	Improvement Dredging to Deepen a Portion of the 25-Foot Anchorage to 35 ft.	Dec 1982 - June 1983	22,963

U.S. Army
Corps of Engineers
New England District

Appendix B-
Engineering and Design

Dredged Material Management Plan
Maintenance Dredging of Bridgeport Harbor

Prepared by the
Civil Engineering Section
Engineering and Planning Division
New England District

December 2009

Table of Contents

Dredged Material Management Plan
Maintenance Dredging Bridgeport Harbor

Introduction

Bridgeport Harbor is located on the northern shore of Long Island Sound at the mouth of the Pequonnock River. Tributaries include the Yellow Mill Creek and Johnson Creek which are located along the east side of the harbor. Black Rock Harbor is located approximately two miles to the west of Bridgeport Harbor.

Authorized Depth and Current Shoaling

The Federally authorized project at Bridgeport Harbor was authorized in 1836 and has been modified several times. The harbor contains the following features:

- A main ship channel extending from Long Island Sound to the inner harbor. From Long Island Sound to Tongue Point, the channel is 35 feet deep mean lower low water (MLLW; all depths referenced to minus MLLW and the 1983-2001 Tidal Epoch) and 400 feet wide. It widens to 600 feet at the northwest bend (opposite Cilco Terminal), then narrows to 300 feet at a point 800 feet before the Stratford Avenue bridge as it heads up the Pequonnock River. The deepening of the main ship channel to 35 feet was completed in 1963.
- A 1.1-mile-long, 18-foot-deep channel, 125 to 200 feet wide, extending from the vicinity of the Stratford Avenue Bridge, up the Pequonnock River, to a point 500 feet below the dam at Berkshire Avenue.
- Two breakwaters at the entrance to the main harbor. The easterly breakwater is 3,823 feet long, and the westerly breakwater has a length of 2,110 feet.
- Three anchorage basins inside the inner harbor. The first, 25 feet deep and 23 acres in area, lies opposite Tounge Point on the east side of the main ship channel (a small portion of this anchorage was dredged in 1983 to 33.5 feet to facilitate the movement of large commercial ships); the second, 18 feet deep and 29 acres in area, lies on the west side of the main channel, parallel to the shoreline, directly across from Yellow Mill Channel; the third basin is 18 feet deep (but maintained to 27 feet by others) is also located on the west side of the main ship channel and south of Tounge Point.
- A turning basin 35-foot deep and 18 acres in area located east of the main ship channel and south and southeast of Cilco Terminal.
- A 15-foot-deep channel, 200 feet wide, extending from the turning basin up Johnsons River to a point 1,700 feet below Hollisters Dam, where for 1,100 feet it becomes nine feet deep and 100 feet wide until terminating at the six-

foot-deep anchorage, two acres in area, at the head of the Johnsons River channel, near Hollisters Dam.

- A three-acre anchorage area midway up the Johnsons River channel, nine feet deep at the lower end and six feet deep at the upper end. *(This feature was deauthorized in WRDA 1999.)*
- A one-mile-long, 18-foot-deep channel, 150 to 200 feet wide, extending up Yellow Mill Pond Channel to a point about 370 feet from Crescent Avenue.

The project has not been dredged since the initial improvement work in 1963 with the exception of the deepening of a portion of the 25-foot anchorage in 1983. Survey results from November-December 2006 indicate controlling depths of about 30 feet in the 35-foot entrance channel and about 25 feet in the inner harbor 35-foot channel. The 25-foot anchorage has shoaled to about 22 feet, the 35-foot anchorage has shoaled to about 28 feet, the southwest 18-foot anchorage has maintained its depth, and the northwest 18-foot anchorage has shoaled to about 16 feet.

The 18-foot channel in the Yellow Mill River has shoaled to about 15 feet up to the Stratford Ave Bridge and to about 13 feet above the bridge. The 18-foot Pequonnock River has maintained its depth upstream to the Stratford Ave Bridge but then shoals to 17 feet upstream to the Congress Street Bridge and then progressively to 14 feet and then 11 feet to the head of navigation.

Maintenance Dredging Quantities

The main 35-foot channel, the 35-foot turning basin, and the anchorages within Bridgeport Harbor were surveyed in 2006. An earlier survey in 2004 by Ocean Surveys covered the main channel as well but also the Yellow Mill Channel and the Pequonnock River and is the most recent survey of those two channels. Quantities of material to be removed to restore the authorized channel depth were calculated by comparing the existing bottom surface to the template of the authorized channel. The results of these calculations are:

Channel	Required (cy)	Overdepth (cy)
Main Ship	701,500	551,100
35’ East Anchorage	46,000	26,000
25’ East Anchorage	8,100	18,200
35’ Turning Basin	69,900	50,100
18’ Anchorage	4,700	6,400
18’ West Anchorage	100	100
18’ Yellow Mill Channel	93,500	33,400
18’ Pequonnock River	130,300	3 4,400

Disposal

Because disposal of dredged material has become so difficult an effort is being made throughout the country to identify the type of material being dredged and the uses, if any, for this material. Samples of the material to be dredged were analyzed to determine its suitability for open water disposal if no other beneficial use could be found. In general, the older ports have had historical uses along the waterfront that have allowed various contaminates to enter the water column and settle out with sediments rendering these sediments not suitable for open water disposal . In general, materials to be dredged outside of the breakwaters were found suitable for open water disposal while those sediments inside of the breakwaters were found to be unsuitable for uncontrolled disposal in open water.

Thus, of the main ship channel 302,500 cy required and 363,100 cy of overdepth material is classified for open water disposal and the remaining 399,000 cy required and 188,000 cy of overdepth material must have some management for disposal. In addition the remaining 352,600 of required and 168,600 cy of overdepth from the other inner harbor channels and anchorages must also have some form of managed disposal.

Disposal Measures

As is common when writing a dredged material management plan, several alternative management schemes for handling the dredged material that tested unsuitable for open ocean disposal were examined and rejected. Among the measures rejected were upland disposal, beach nourishment, brownfields, bulkheads, habitat restoration, and strip mine reclamation.

Beach nourishment was an obvious alternative for maintenance material that mimics the characteristics of the beach material. Several geotechnical initiatives examined borings in the harbor but results indicated silt and clay quantities in excess of desirable. These investigations are covered in the Geotechnical Appendix.

Restoration of Brownfields, or disturbed urban sites typically formerly industrial in nature, are a potential beneficial use of dredged material. The difficulty with these sites is a matter of scale. It is usually not economical to transport dredged material to small, isolated sites. Another concern uncovered by an investigation by the Bridgeport Port Authority and quoted by Triton Inc a consultant for the PSEG Power Connecticut Bridgeport Harbor Station power plant concluded that the few Brownfield sites identified could not rely on timing of availability of the dredged material. Restoration of the sites requires a lengthy approval process and there is no easy method of tying a dredging schedule with it own permitting and environmental windows to a Brownfield restoration plan. One potential Brownfield identified was located adjacent to the inner harbor and may still have a role to play as an interim storage site. Steel Point between I-95 and the inner harbor opposite the PSEG power plant is slated for redevelopment but currently has been encountering difficulty making progress. This site may offer potential for limited short term storage of unsuitable materials removed from a CAD cell.

The use of a bulkhead at Powerhouse Creek was examined. Such a bulkhead could be built across the mouth of the “creek” (which is more of a dead end canal than creek) and was expected to have the capacity to store up to 50,000 cy. Preliminary design of a circular cell structure determined an approximate unit cost of $60.00 per cubic yard. In addition to the cost of the bulkhead a sewer outfall which now empties into Powerhouse Creek would need to be relocated thus increasing the unit cost. Use of a portion of the Yellow Mill channel upstream of the I-95 bridge for a bulkheaded confined disposal facility (CDF) was also examined. The unit cost for this alternative was $40.00 per cubic yard. Both of these alternatives were believed to be economically challenging considering the small amount of storage capacity for the expenditure.

Habitat restoration and/or creation were examined early in the study process.
The use of dredged material to create bird habitat in the harbor or Long Island Sound was discussed with NMFS and CT DEP. Island creation could include small islands within or just outside of the harbor, or larger efforts such as enlarging Faulkners Island by filling shallow areas to the west of the island. Larger islands outside of the harbor would require construction of a dike with stone revetment to contain dredged material. Both agencies had concerns regarding impacts to and displacement of aquatic habitat. CT DEP stated that this alternative would not be consistent with CZM policies, and NMFS opposes the creation of islands for bird habitat due to potential impacts to shellfish beds.

Landfill disposal was also considered. Initial discussions with the Connecticut Department of Environmental protection indicated that the landfill at Seaside Park in Bridgeport might be in need of fill material to shape the landfill cover. However, further discussions with this department determined that the landfill cover has been completed. A similar conclusion was drawn after contacting other nearby town landfills.

Disposal at strip mines is an expensive and therefore not likely viable measure for dredged material from Bridgeport. The material must be blended with other material in order to produce a suitable growing substrate. This measure would consist of shipping dredged material to assist in the reclamation of a strip mine. The Commonwealth of Pennsylvania, Department of Environmental Protection has authorized reclamation plans for Springdale Pit in Schuylkill County. The permit allows the use dredged sediment and other materials to reclaim one of Pennsylvania’s largest open mine pits. This measure would require rehandling the material ashore, dewatering and getting it to a rail line, loading onto rail cars, transportation to Pennsylvania, offloading and transfer to trucks, and transportation and placement at the mine. The dewatering of dredged material depending on the techniques employed can require significant landside resources. Primary among them is open space along the waterfront. It might be possible to utilize the vacant land at Steel Point initially but the duration of the project will likely conflict with development plans for that area. Discussions with the Bridgeport Port Authority determined that the owners intend to develop the property and they aren't interested in it being used as a disposal site. The major concern is the timing of harbor dredging would not coincide with site development and the cost of this option would exceed $200.00 per cy.

Upland Measures

The formerly used upland disposal site in Stratford, owned by the Stratford Development Company, is about 21 acres in size. This Company has indicated that it needs 2-3 feet of fill on this site at their east Campus site. The timing of disposal of dredged material and site development must be considered at this location. In addition, based on discussions with the CT DEP, unsuitable material would not meet the residential Remedial Standard Regulations (RSR) for placement at the site. Contaminated dredged material is considered a special waste, which requires upland disposal at a licensed, lined landfill. Suitable material, however, should meet the RSR. Additional testing is necessary to determine the type of material that could be disposed of at this location. The preferred method of moving suitable material to this site is to mechanically dredge the material, place into scows and transport to an offloading site which would allow for perhaps a month of dewatering before moving the material to the disposal site via truck. If an offload site can not be found then hydraulic dredging and pumping the material to the disposal site would be considered. However, this method would require containment dikes and much longer duration for dewatering on site potentially affecting site development.

The use of Steel Point for interim storage was investigated during the development of the final alternatives. It was anticipated that a small amount of unsuitable material from one of the proposed CAD cells would be stored at the site. However, to store about 60,000 cy a perimeter dike ten feet high with a crest width of ten feet was required to enclose a five acre site. It was estimated that such a dike would require about 28,000 cy of material suitable for dike construction, some sort of membrane to separate the dike material from the unsuitable material, a weir structure, and off-loading facilities and placement capabilities. This was estimated to cost upwards to $600,000. To off-load into the diked area was estimated at $8/cy and to remove the material when dewatered was estimated at another $12/cy. Thus for storing 60,000 temporarily the cost was about $30/cy and it was likely that additional expenditures would be encountered if the material had to be transported and disposed at an upland landfill. With the additional concern of availability of the site in doubt the use of Steel Point was dismissed.

Some of the material dredged from the harbor, either from the navigation features or material removed to form CAD cells (discussed below), may be suitable for placement (renourishment) at area beaches. Those within close proximity that could be considered include Seaside and Pleasure Beaches in Bridgeport, and Long Beach in Stratford. Fairfield Beach in Fairfield is also within a reasonable haul distance from the harbor. The main concern with beach nourishment was the high percentage of silt and fines that could wash offshore and create a plume affecting shellfish beds. Fine sands may be appropriate for dune restoration, with coarser material reserved for beach nourishment. Typically materials to be used for beach nourishment are considered undesirable if they contain more than 5-7% of fines or organics. The grain size analyses from the grab samples taken from the entrance channels, inner harbor, and potential CAD cell locations revealed percent fines to range from about 5-60% (see the geotechnical appendix). Also encountered was a layer of organics ranging in thickness from 7-26 feet. The conclusion was made that although lenses of usable material can be found in the potential CAD cell locations it would be uneconomical to employ a separate dredging plant to pump that material to the beach and scows could not be moved close enough to the shore to make nearshore disposal practical. The use of the material on the nearby beaches was examined in detail for the final alternatives. The thought was that although a separate hydraulic dredging plant would need to be mobilized the cost of pumping would be less that carrying the material to CLIS. This was not the case as the mobilization of the hydraulic dredge was estimated at $554,500 with a dredging unit cost of 12.71 as compared to the mechanical dredge unit cost plus transportation cost of $11.81.

Estimates of potential sand and gravel available for beach placement or upland construction projects in the South East CAD cell was made based on the few cores available. The amount of sand and gravel potential in the cell was estimated at 560,000cy for purposes of the analysis it was assumed that 400,000 cy may be placed on the beach. This material was located below a layer of fine material and could be expected to contain occasional lenses of fines throughout the 28 feet overall thickness. O&G industries was also contacted by Corps staff to investigate interest in this material. It also must be noted that likely this material will have a cost to a consumer as any additional cost incurred in offloading from the scow and landside offload facilities and transportation would have to be a non-Federal expense. There is also a $4.00/cy royalty fee that the state would collect on any material taken by private contractors.

Confined Aquatic Disposal Measures

A Confined Aquatic Disposal (CAD) cell is nothing more that a deep spot in the harbor bottom which can be filled with material and have a reasonable assurance that the material will stay where placed regardless of currents. A CAD cell can be constructed if no deep spots occur naturally and have been created for the disposal of dredged material in Boston, Providence, and Norwalk to name a few locations.

Several iterations of CAD cell locations were investigated for the Dredged Material Management Plan (DMMP) as the concept has achieved wide acceptance for disposal of material unsuitable for open water disposal.

Sites examined at Bridgeport were located in the inner harbor portion of the Federal 35-foot channel and turning basin, the area to the east of the entrance channel and south of the 25-foot anchorage (North East CAD), east of the entrance channel and north of the east breakwater (South East CAD), and west of the entrance channel and north of the west breakwater (West CAD). Figure B-1 shows the sites investigated and the two proposed CAD cell locations.

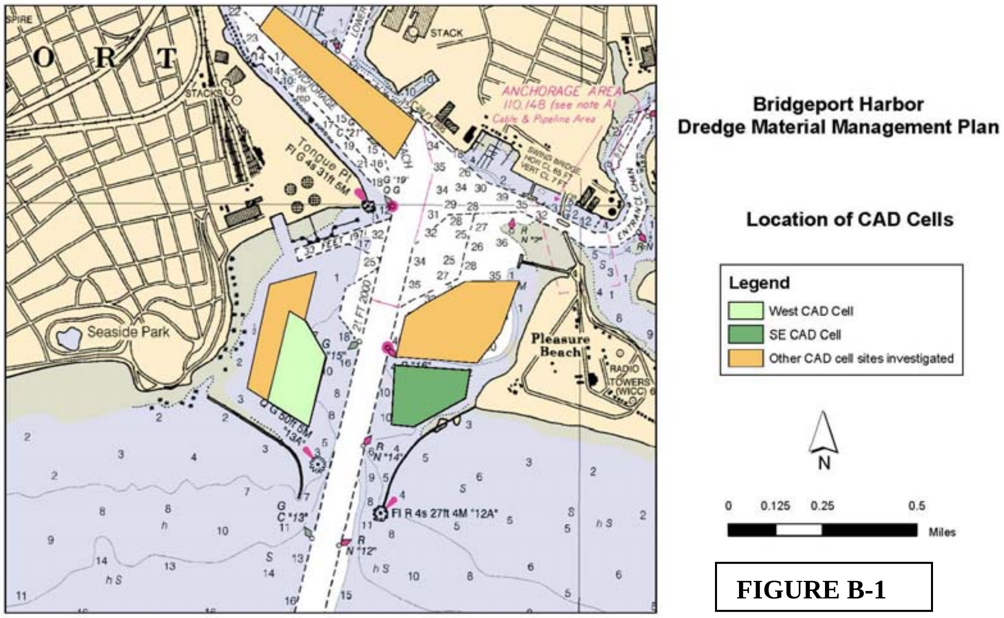


FIGURE B-1

Subsurface investigations were utilized to select the depth of the cells as well as a method to calculate the quantity of unsuitable material. The initial concept for multiple CAD cell applications is to “start small”. A hypothetical cell at the upper reaches of the 35-foot channel between the I-95 bridge and the submarine power cable between the PSEG power station and Steel Point looked at potential sizes of 300 x 600’, 250 x 500’, and 250 x 400’ before coming to the conclusion that one could not construct a series of cells in that location which would allow adequate storage for unsuitable material from subsequent cells in the inner harbor.

The apparent fruitlessness of developing CAD cells within the inner harbor led to the investigation of the area around the 25-foot anchorage east of the main ship channel. However, subsurface explorations confirmed that this area had been excavated by the state during the 1950s and subsequently filled back in with silty material. The silty material would likely be unsuitable for open water disposal so the construction of a CAD cell at this location was rejected.

With little space left inside of the breakwaters two additional sites were investigated for prospective CAD cells. The investigations consisted of collection of geophysical information by USGS and chemical and physical testing of cores by Battelle. There will be additional borings necessary to confirm the usefulness of the sites.

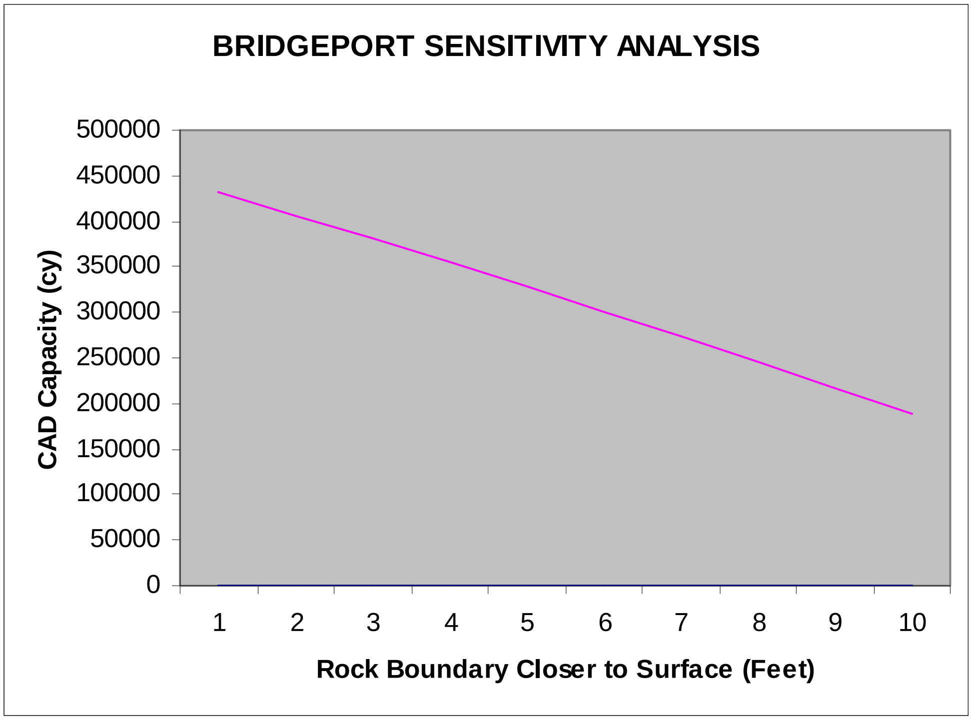
The site to the west of the main ship channel and south of the 18-foot anchorage, called the West CAD cell, showed bedrock sloping downward towards the channel. The site to the east of the main ship channel and south of the 25-foot anchorage, called the South East CAD cell, did not have the geophysical investigation and initially relied on nearby probes and a boring. Later subsurface investigations by Baltimore District drillers provided one boring and two probes and five additional vibracores.

The West CAD underwent six iterations of sizes before the final configuration was defined. The first cell layout did not have the benefit of the geophysical results and far overshot the boundaries of useable cell capacity based on the bedrock being so close to the surface on the northwest of the site. The second layout assumed a 3’ cap at elevation -10 down to -13 and a somewhat square shape but the capacity for unsuitable material was only about 267,000 cy and thus was too small. The third iteration used the same layout but the cap elevations were changed to -7 down to -10. The capacity for unsuitable was increased to 297,000 cy. The fourth layout pushed the west boundary 45’ towards the west and resulted in a jump in capacity to 331,000 cy. The fifth layout expanded the cell to the north with the capacity of 421,000 cy with the cap still at -7 down to -10. The final layout pushed the southern boundary of the cell 200 feet closer to the breakwater. The final capacity was 469,000 cy. For each of the layouts the capacity calculations were done using InRoads, a bedrock surface based on the geophysical data, and a bathymetric surface based on hydrographic surveys performed in August 2005.

The South East CAD cell saw three iterations of sizes. The first layout included an odd shape at the southern tip of the cell which was thought to be unable to be constructed. A simplified shape was examined with a depth of -80’, 1V on 3H side slopes, and a cap between -7 and -10 in the second trial. The final layout used a depth of -90’. Capacities increased from 1,024,000 for the second layout to 1,061,000 for the final. Surveys in November and December 2006 yielded slightly different quantities for the final layout at 1,065,000 cy.

Sensitivity Analysis for West CAD

The estimated capacity of the West CAD cell for disposal of material is estimated primarily with data from geophysical investigations conducted by USGS in 2006 and one boring performed in 2006 by the Corps of Engineers, Baltimore District. The rock surface under the CAD cell is estimated to vary from thirteen feet to greater than sixty feet beneath the mud line. There are abrupt changes in this estimated surface and the suggested pinnacles and valleys may or may not exist. Therefore, a sensitivity analysis was performed by raising the estimated rock surface upwards towards the mud line in one foot increments. Approximately 25,000 cy of CAD cell capacity is lost with each foot the rock surface is raised.



The lost of capacity in the West CAD cell can be broken into its two parts – the starter cell and the remaining portion of the CAD cell. The starter cell capacity needs to be at least 87,200 cy to safely accommodate the unsuitable material removed from the starter cell and temporarily stored in scows plus the unsuitable material to be removed from the Southeast CAD cell. The rock surface could be two feet closer to the mud line without jeopardizing this requirement.

If the rock surface is three feet closer to the mud line then something must change. If the intent is to have a single starter cell then the footprint of the starter cell must be enlarged. With the enlargement of the starter cell there will be more material to temporarily store in scows which may present a logistical problem. One way out of this might be to have two starter cells which when combined will have enough capacity for the unsuitable materials from both the starter cells and the Southeast CAD.

However, with the rise of the rock surface the overall West CAD cell capacity decreases and once below 348,300 cy something else must change. This condition would occur if the rock surface was a little over four feet closer to the mud line than currently estimated. One way to accommodate a loss in disposal capacity is to dredge less unsuitable material. This is achievable by reducing the permitted overdepth. The quantity estimates currently assumes a 2 foot overdepth for maintenance dredging but a one foot depth might be implemented by requiring precise control on dredging depths.

Morris Cove Borrow Pit Disposal Site

An October 2003 DAMOS (Disposal Area Monitoring System) report examined a potential disposal area for material dredged in Bridgeport. A small, man-made bottom depression, or borrow pit, located in Morris Cove in New Haven was created several decades ago when sand and gravel were mined for use as fill for the construction of Interstate Highway 95 through New Haven (See Figure B-2). The sediments were excavated along a north-northwest to south-southeast axis, resulting in a submerged pit approximately 650 feet wide and 2450 feet in length. Currently, water depths in the vicinity range from approximately 10 feet on the harbor substrate to 30 feet within the borrow pit. A large area of the pit has depths that are approximately 11 to 20 feet deeper than the surrounding harbor bottom, suggesting that the pit could contain a substantial amount of additional dredged material.

During January and May 2000, an estimated total of 18,500 cy of sediment dredged from the U.S. Coast Guard Base in East Haven, Connecticut, was placed in the borrow pit. The rationale for the placement of dredged sediments within the Morris Cove borrow pit was to begin the process of re-establishing flat, uniform bottom topography and promoting improved water quality within Morris Cove. The Morris Cove borrow pit has reportedly become a sink for organic detritus in New Haven Harbor. While the predominance of sandy substrate in the vicinity of the borrow pit is indicative of the influence of wave and tidal current energy acting on the bottom sediments, the borrow pit constitutes a distinct depression that may enhance deposition of fine-grained material. The pit’s distinct margins tend to limit the flow within the pit and the volume of water exchanged.

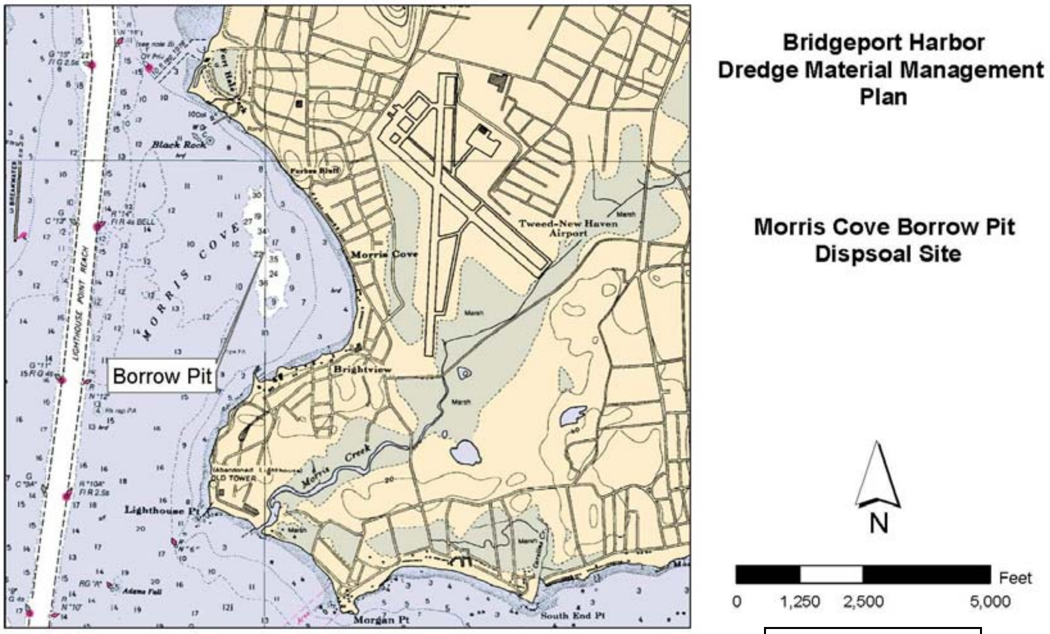


FIGURE B-2

The National Marine Fisheries Service (NMFS) has identified Morris Cove as an important spawning and nursery area for a variety of commercially important fish species, including winter flounder. NMFS has expressed concern regarding the presence of the borrow pit within Morris Cove and the potential for reduced water exchange (flushing) to trap organic material within the bottom feature. As organic material within the borrow pit undergoes the process of decay, the quality of the bottom waters (dissolved oxygen, nutrient content, pH, etc.) could degrade sufficiently to result in poor habitat conditions for marine organisms. These conditions would be especially prevalent and have the most profound impacts during the summer months when dissolved oxygen concentrations tend to be lower due to the warmer water temperatures within New Haven Harbor and Long Island Sound (in excess of 20° C), as well as reduced surface mixing (i.e., gas exchange via short-period waves) relative to the remainder of the year.

The capacity of the Morris Cove borrow pit for the potential deposition of dredged material in the future remains quite large. Approximately 610,000 cy of dredged material may be strategically placed within the pit to fill it to a depth of -11.5 feet MLLW, roughly even with the surrounding ambient bottom.

Alternative Plans

After review of the various measures examined for means of disposal of the material dredged from Bridgeport harbor two alternative plans were developed with an option for pumping sand to Seaside Beach.

Alternative Plan A

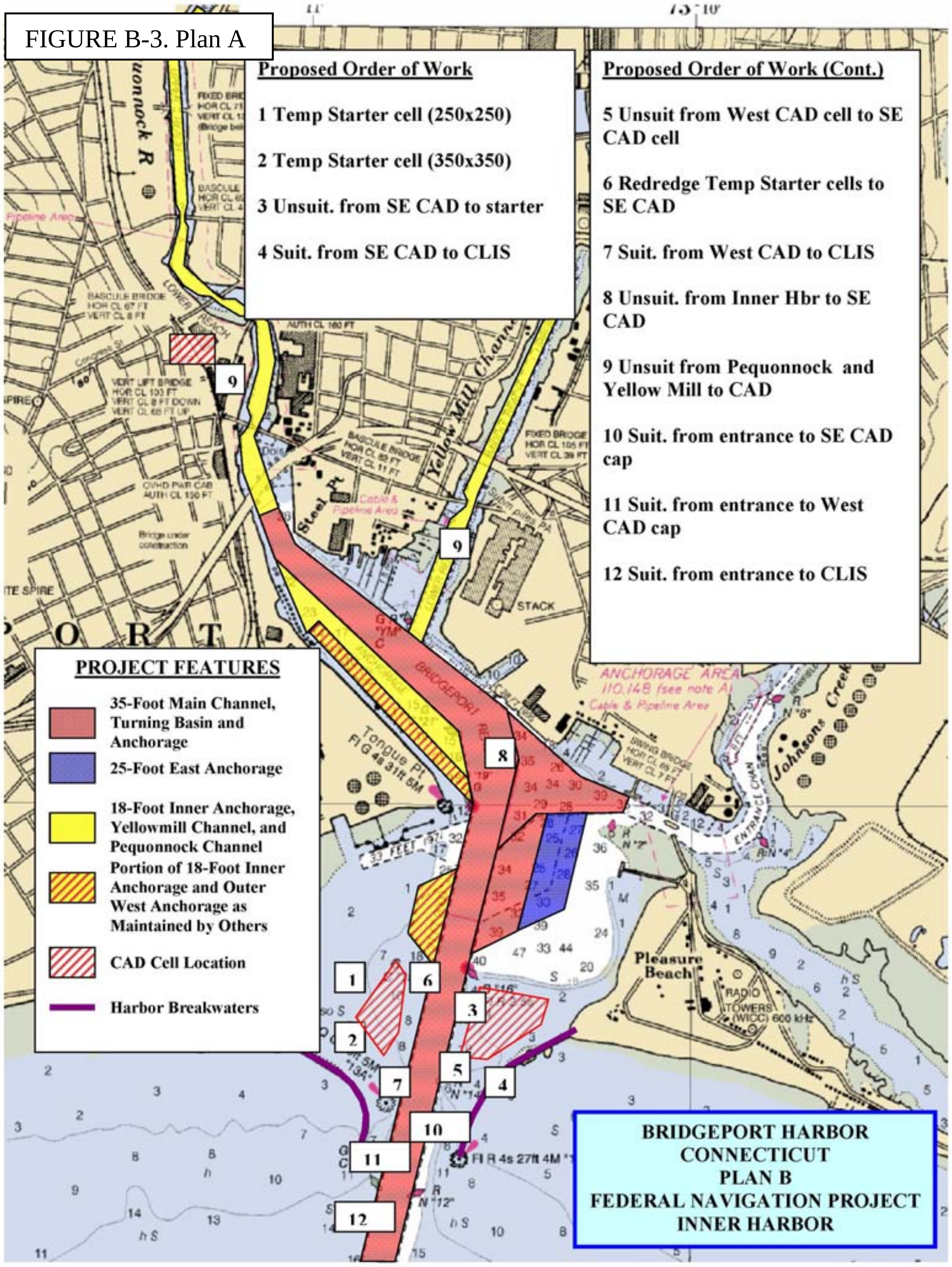
Disposal of 1,593,700 cy of suitable dredged material at CLIS and disposal of 1,162,000 cy of unsuitable dredged material at two locations – 250,000 cy at Morris Cove and 912,000 cy in the South East CAD cell.

Disposal of dredged material at Morris Cove is intended on restoring the current less than desirable environmental situation to one where the existing borrow pit is returned to bottom elevations compatible with surrounding harbor bottoms. The initial material disposed in the pit would be material unsuitable for open water disposal. This material would be contained within the borrow pit and then material suitable for open water disposal would be placed on top.

The contractor would be encouraged to initially remove material from the SE CAD cell, place it in a scow for transport to Morris Cove. It is not anticipated that an access channel into the South East CAD cell will be dredged. However, if one is dredged the material removed from this access channel will be disposed at Morris Cove. There must be consideration for access to the Morris Cove borrow pit with the scows being used by the contractor. It is anticipated that 37,000 cy of material would be removed from the access channel. This material will be disposed at the borrow pit. Once the contractor has removed the unsuitable material from the SE CAD cell (testing has confirmed the top two feet of material is unsuitable) additional unsuitable material from other areas within Bridgeport Harbor can be dredged and transported to Morris Cove.

The remaining material excavated from the CAD cell as well as the material from the entrance channel outside of the breakwaters will be transported to CLIS. The remaining material to be dredged within the harbor will be disposed at the SE CAD cell. A three foot cap of suitable material is anticipated to be required for closing the CAD cell. Material from the entrance channel will be used for this purpose.

FIGURE B-3. Plan A



Proposed Order of Work

1 Temp Starter cell (250x250)

2 Temp Starter cell (350x350)

3 Unsuit. from SE CAD to starter

4 Suit. from SE CAD to CLIS

Proposed Order of Work (Cont.)

5 Unsuit from West CAD cell to SE CAD cell

6 Redredge Temp Starter cells to SE CAD

7 Suit. from West CAD to CLIS

8 Unsuit. from Inner Hbr to SE CAD

9 Unsuit from Pequonnock and Yellow Mill to CAD

10 Suit. from entrance to SE CAD cap

11 Suit. from entrance to West CAD cap

12 Suit. from entrance to CLIS

Alternative Plan B

Disposal of 2,142,000 cy of suitable dredged material at CLIS and disposal of 1,220,700 cy of unsuitable dredged material at two CAD cells. (See Figure B-3)

The difference between this alternative and the previous is the initial storage of material unsuitable for open water disposal must be managed by dredging a starter CAD cell and storing the unsuitable material in scows while the remaining portion of the CAD cell is dredged and transported to CLIS. It is anticipated that the cell will be constructed in the north end of the West CAD cell and that access can be obtained at the north east portion of the cell. With the completion of the initial starter CAD cell there should be enough capacity to store the estimated 60,000 unsuitable material to be removed from the South East CAD cell as well as the material stored in scows.

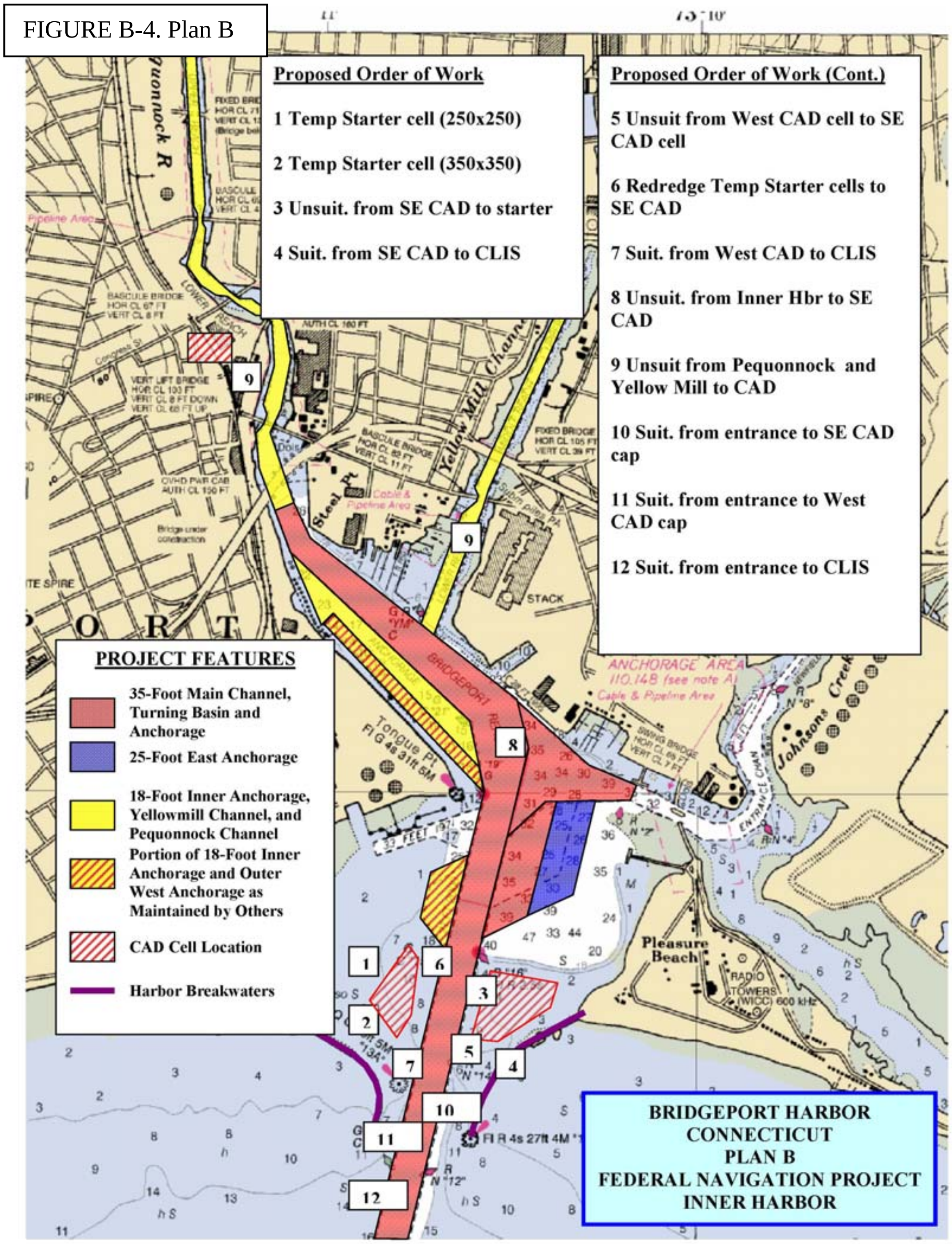
Once the South East CAD cell suitable material is transported to CLIS, the remainder of the West CAD cell can be dredged with unsuitable material being disposed at the South East CAD cell and the suitable material being disposed at CLIS. With two CAD cells completed the remaining unsuitable material from the harbor can be dredged and disposed in the cells and the entrance material can be disposed at CLIS with the exception of material needed for a cap on each cell.

Option Plan for either Alternative Plan A or Alternative Plan B

Federal participation in a project for beach erosion control at Seaside Park in Bridgeport was authorized by the River and Harbor Act in 1954 and completed in 1957. This provided for about 8,000 feet of widened beach by direct sandfill.

The limited subsurface information from the South East CAD cell indicates that about 400,000 cy of material to be dredged could satisfy beach fill requirements. Assuming the material would likely be hydraulically dredged and pumped to the beach instead of placing in scows for near shore disposal (oyster beds would be damaged) or pumped out (can’t get scow close enough to beach to be economical the costs were shown to be less expensive to dredge and haul to CLIS than dredge and pump to Seaside. This option could be added to either Alternative Plan A or Alternative Plan B if the local sponsor wished to pay the additional costs.

FIGURE B-4. Plan B



Proposed Order of Work

1 Temp Starter cell (250x250)

2 Temp Starter cell (350x350)

3 Unsuit. from SE CAD to starter

4 Suit. from SE CAD to CLIS

Proposed Order of Work (Cont.)

5 Unsuit from West CAD cell to SE CAD cell

6 Redredge Temp Starter cells to SE CAD

7 Suit. from West CAD to CLIS

8 Unsuit. from Inner Hbr to SE CAD

9 Unsuit from Pequonnock and Yellow Mill to CAD

10 Suit. from entrance to SE CAD cap

11 Suit. from entrance to West CAD cap

12 Suit. from entrance to CLIS

BRIDGEPORT HARBOR
CONNECTICUT
PLAN B
FEDERAL NAVIGATION PROJECT
INNER HARBOR

BRIDGEPORT HARBOR
BRIDGEPORT, CONNECTICUT

DREDGED MATERIAL MANAGEMENT PLAN

APPENDIX C

ECONOMIC EVALUATION

Department of the Army
New England District, Corps of Engineers
696 Virginia Road
Concord, MA 01742-2751

December 08

BRIDGEPORT HARBOR, CONNECTICUT

DREDGED MATERIAL MANAGEMENT PLAN
ECONOMIC APPENDIX

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ECONOMIC APPENDIX

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BRIDGEPORT HARBOR, CONNECTICUT
DREDGED MATERIAL MANAGEMENT PLAN ECONOMIC APPENDIX

Methodology

The purpose of this economic assessment is to evaluate the benefit of continued maintenance of the authorized project in Bridgeport Harbor over the next 20 years. Benefit classification is from the National Economic Development Account (NED). Regional economic benefit is not developed in this assessment. An interest rate of 4-5/8%, as specified in the Federal Register, is to be used by Federal agencies in the formulation and evaluation of water and land resource plans for the period 1 October 2008 to 30 September 2009. Project justification is established by the presence of significant economic benefits. All costs and benefits are stated at the current price level. The project economic evaluation period is 20 years. The analysis of cost and benefit follows standard U.S. Army Corps of Engineers procedures. The reference documents used in the benefit estimation process are ER 1105-2-100, 22 April 2000, Appendix E, Section II, Navigation, E-10, NED Benefit Evaluation Procedures: Transportation, Deep-Draft Navigation; EC-1165-200, Policy, National Harbors Program: Dredged Material Management Plans; and Policy Guidance Letter (PGL) No. 40, "Development and Financing of Dredged Material Management Studies".

"The Federal interest in continued O&M of an existing project for its navigation purpose is defined by that project of maximum scale and extent, within project authorization, for which continued maintenance is warranted in terms of vessel traffic and related factors." This quote was taken from EC 1165-2-200 referenced above. The project is considered economically feasible if annualized benefit divided by annualized cost is greater than or equal to one. Net benefit, or project benefit minus project cost, must be greater than or equal to zero.

Area Setting

Bridgeport is located in Southern Connecticut approximately 50 miles northeast of Metropolitan New York on Long Island Sound. The primary region served by the harbor is southwestern Connecticut, however, western Massachusetts, southeastern New York and southern Vermont are also serviced by Bridgeport Harbor.

Navigation Project

Bridgeport Harbor is a federal commercial project with a main navigation channel with an authorized depth of -35 feet MLLW and additional navigation channels in tributaries of varying depths. The project was completed in 1963 and the current authorized depths for the project are shown below. It is located at the mouth of the Pequonnock River and includes the Yellow Mill and Johnson Creek tributary channels. Black Rock Harbor, a small harbor about two miles to the west, is part of the existing federal navigation project. Black Rock Harbor separates into the east and west branches of Cedar Creek at its upper limit.

Navigation Problems

Since project completion the channel has shoaled to the extent that the controlling depth in the main channel is currently about -30 feet MLLW. Authorized depths and controlling depths used in the analysis for the main and tributary channels are

Channel	Authorized Depth	Current Controlling Depth
Main	35	30
Pequonnock	18	11
Yellow Mill	18	13
Johnsons Creek	15	12
Black Rock Harbor	18	15
Cedar Creek	18	15.

Shippers utilizing the channel are experiencing navigation problems due to the shoaling. Terminals located on the river have been forced to operate inefficiently to cope with the reduction in channel capacity. Channel users have adopted techniques to deal with the problem. Techniques utilized are tidal assistance, lightloading vessels, and employing smaller vessels. These problems have been documented through conversations and correspondence with channel users. Channel users were surveyed by the Corps in the summer of 2003 and contacted again in 2008. Tonnage and vessel trips for the period 1992 through 2006 are shown in Table C-1.

TABLE C-1

Tonnage and Total Trips for the Bridgeport Harbor

Year	Tonnage	Trips
	(000)	
2006	5,389	22,911
2005	5,482	32,029
2004	5,671	21,813
2003	4,756	21,695
2002	4,607	27,376
2001	4,581	22,195
2000	4,255	22,217
1999	4,154	20,336
1998	4,626	10,514
1997	5,340	10,928
1996	4,862	10,711
1995	3,447	9,187
1994	3,054	9,652
1993	2,942	8,374
1992	2,948	7,789

There are 14 terminals located in the channels that comprise the Bridgeport Harbor Navigation Project. Each facility, its location and its principal activity are listed in Table C-2. Logistic, an importer of fruit products, recently left the harbor, but they would not have been a beneficiary of restoring the navigation project dimensions.

TABLE C-2
Bridgeport Harbor Terminals and Activities (2004)

Terminal	Channel	Activity
PSEG Power Ct	Main Harbor	Receipt of Petroleum & Coal
Motiva	Main Harbor	Receipt of Petroleum Products
Municipal Waterfront Pier	Main Harbor	Passenger & Vehicular Ferries
Empty	Main Harbor	None
Anchorage	Main Harbor	Anchorage for Petroleum ships
HiHo Petroleum	West Branch	Receipt of Petroleum Products
Santa Fuel	East Branch	Receipt of Petroleum Products
O & G Industries	Cedar Creek	Receipt of Sand & Stone
O & G Industries	Yellow Mill Channel	Receipt of Sand & Stone
Hoffman Fuel	Pequonnock River	Receipt of Petroleum Products
Bridgeport Branch	Pequonnock River	Receipt of Petroleum Products
CPW	Johnsons Creek	Receipt of Petroleum Products
Bridgeport United Recycling	Johnsons Creek	Receipt of recyclable Products
Inland Fuels	Black Rock Harbor	Receipt of Petroleum Products
Black Rock Shipyard	Black Rock Harbor	Receipt of Petroleum Products

Waterborne Transportation Cost

Study Approach

Transportation costs were developed based on detailed movement data for Bridgeport Harbor provided by the Waterborne Commerce Statistical Center (WCSC). The detailed movement data includes information on port destination/origin, trip miles, volume of product carried, type of product carried, vessel identification, operating draft and other data. This file was then matched with a WCSC vessel file to obtain ship characteristics, such as design draft, beam, length, deadweight tonnage and other data. Data on foreign flag vessel movements were also obtained from the WCSC as well as domestic movements.

The augmented vessel movement data and vessel characteristic data is compiled for each terminal. Transportation cost for each vessel movement is calculated for each terminal and aggregated over all movements for that terminal. Hourly vessel operating costs by vessel size (DWT) developed by the Institute for Water Resources (IWR) are used to calculate movement cost. The IWR data also includes vessel operating speeds, immersion rates, and vessel dimensions. The types of costs developed are trip cost, delay cost, and lightering cost. Trip cost is developed using the time distance velocity relationship. The trip hours are multiplied by the hourly vessel operating cost to determine trip cost. Delay cost is associated with vessels waiting for higher tide stages and the time engaged in lightering. Lightering cost, other than delay, is the vessel operating cost (including labor) required for the lightering.

Shipper behavioral assumptions are built into the economic spreadsheet based on information provided by the terminals. Shippers may have different operating preferences with respect to lightloading vessels, lightering vessels, utilizing the tide, underkeel clearance, and channel depth required to shift tonnage to larger vessels. Each vessel movement into (and out of)the harbor is looked at with respect to depth required, depth available and shipper operating procedures. Only those vessels that are using the channel to its full capacity are subject to the operating inefficiencies discussed above. The spreadsheet is evaluated at the existing controlling depth for each vessel movement at each terminal. Separate calculations are made for domestic and foreign flag vessels. If depth required is less than the tidal range, tidal delay is calculated by the spreadsheet. If depth required is greater than the tidal range, the spreadsheet calculates lightering cost. Tidal delay is calculated using a tidal chart relating channel depth to time, depth required, and channel transit time. The average delay is then multiplied by the hourly vessel operating cost to determine tidal delay cost. Lightering cost is determined by using depth required, dispersion rates and hourly lightering cost. Lightloading is evaluated using dispersion rates.

The spreadsheet is then evaluated in one-foot increments from the existing condition to the authorized depth. This type of analysis is required by the guidance for development of dredged material management plans. For each projected channel depth; trip cost, delay cost and lightering cost are calculated for each vessel movement, foreign and domestic. All vessel movements are then aggregated for each terminal. A cost per ton is then developed at every depth for each terminal. This cost per ton can then be multiplied by projected tonnage to determine shipper's cost for each channel depth.

Tidal delay and lightering costs will change with each projected depth as long as the vessel needs more depth than is available in the channel. As vessel loads increase with additional depth, a given volume can be transported in fewer vessels. Reducing vessel trips lowers trip cost. In addition to loading existing vessels more efficiently shippers will have an incentive to shift tonnage to larger vessels. Larger vessels have greater operating costs, but because they carry proportionately more tonnage the cost per ton declines. Aggregate trip cost will decline for shippers as they substitute larger vessels for smaller, or load existing vessels more fully, and thereby reduce the number of vessel trips. The depth at which that they switch to larger vessels is entered onto the spreadsheet based on information provided by the shipper and judgment based on the economics of using larger vessels. Larger vessels would have to be used efficiently with few delays, and minor lightering and, or, lightloading requirements.

Although the main thrust of the analysis was to compare transportation cost at the existing depth with that at greater depths down to the authorized depth, transportation costs for depths above existing conditions were estimated. These are spreadsheet calculations that could be used to estimate transportation costs if the effects of channel shoaling were to be evaluated. However, typically transportation cost savings are measured as the difference in transportation costs between the with project condition (authorized depth) and without project condition (existing conditions). Controlling depths for both the with and without-project conditions are held constant over the 20-year period of analysis.   Transportation cost is then evaluated in both the with and without-project condition to determine the transportation cost saving, or benefit, to maintenance dredging.

The estimation of transportation costs involved thousands of arithmetical calculations that cannot be presented in the report. The spreadsheets also contain proprietary information provided to the WCSC by shippers that is unlawful to disclose as it could do financial harm to companies providing the data. For these reasons only summary data aggregated over all terminals is presented in the report.

Transportation Cost by Channel Depth

The method to determine National Economic Development (NED) benefit involves estimating the cost of transporting goods into and out of Bridgeport Harbor for the most likely with and without project future conditions. Transportation costs are estimated in one-foot increments from current conditions. The reduction in transportation cost for a given controlling depth is the gain, or reduction in transportation cost savings, of providing the project depth when compared with the transportation cost of the without project condition. The transportation saving would be the result of restoring a deeper channel for one-way traffic. A deeper channel would permit the use of larger vessels, as well as less tidal delay, lightering, and lightloading with existing vessels. This analysis did not address inefficiencies due to channel width, as there was no indication from channel users that width was a problem.

Transportation costs were developed for each terminal in 1-foot increments, from the existing condition to the authorized condition. Transportation costs were developed based on vessel movements for the latest year available for the evaluation. Costs were developed on a per-ton basis and then applied to anticipated tonnage for each year of the study period. Separate cost estimates were obtained for domestic traffic and for foreign traffic. Within each of these cost estimates, it is assumed that destination–origin of traffic remains the same. The Army Corps of Engineers Institute for Water Resources (IWR) vessel costs were used to estimate transportation costs. Each year, IWR publishes vessel-operating costs by flag, cargo type, and size of vessel.

Shippers were surveyed about their operating practices, future activity in Bridgeport Harbor, navigational problems currently being experienced, and their views on optimum channel dimensions. This information was coded into a spreadsheet along with vessel movement data obtained from WCSC and transportation costs were developed for both the with and without-project conditions. Total transportation cost at each depth was obtained by aggregating costs for each of the terminals.

Terminals were queried concerning continued operations, desired channel dimensions, tonnage received and shipped in 2002, size distribution of fleet under existing conditions and after maintenance, the extent of lightloading, lightering and tidal delay, the origin or destination of shipments before and after maintenance, the flag distribution of their fleet, and the extent of their multi-port operations. Based on shipper response and vessel movement data, both historical and projected, a spreadsheet was developed that estimated transportation costs for each terminal. Transportation costs for Bridgeport Harbor were obtained by aggregating the transportation cost for each terminal. Transportation cost savings represents only a portion of the advantages of maintenance dredging. Improved safety, reduction in environmental risk, and a more reliable oil delivery system are other advantages not addressed in this analysis.

Maintenance dredging of Bridgeport Harbor would reduce the transportation costs of delivering goods to this port. Tables C-3 through C-9 display estimates of shipping costs by channel depth. Trip cost refers to cost of transporting cargo from origin to destination. It is based on hourly vessel operating costs developed by IWR. Hourly cost is multiplied by the round-trip hours to determine trip cost.

The transportation costs displayed in Tables C-3 through C-9 were developed by channel user and aggregated. Each vessel movement was evaluated as to channel depth needed and channel depth available. If loaded draft plus under keel clearance exceeded depth available, tidal delay was calculated. The tidal delay computation involves translating tidal height required into hours through a tidal chart. Transit time to dock was then added to delay and an average delay calculated. The delay was then converted to dollars using the IWR vessel operating costs. Tidal delay was then summed over all vessel movements and divided by tons carried to arrive at a tidal delay cost per ton. This cost per ton was then multiplied by projected tonnage to determine tidal cost for a user at a given depth. The spreadsheet then changes the channel depth and recalculates tidal delay. This process is repeated down to the authorized channel depth.

For oil tankers, if required depth exceeds the tidal range of approximately three feet, then lightering cost was calculated for the vessel movement. Immersion factors (tons/ft) were then multiplied by required depth to determine tonnage needed to be lightered. A cost of $1.76 per ton obtained from oil terminals in a previous study conducted by the New England District for Boston Harborwas used to determine lightering cost. Delay cost was then calculated for the additional time in port due to the lightering operation. The lightering rate of tons per hour was inverted and multiplied by the number of tons lightered to determine the delay. This delay was then multiplied by vessel hourly cost to determine delay cost. Lightering cost and delay cost were then summed to determine total lightering cost. As with tidal delay, lightering costs were summed over all vessel movements and a lightering cost per ton determined. This cost per ton was then multiplied by projected tonnage to determine shipper lightering cost for a given depth.

Trip costs were determined by providing additional depth to lightloaded vessels and using dispersion rates to determine the additional tonnage that could be loaded onto vessels. This calculation was only done on vessel trips where the operating draft was 80 percent of the depth available in the channel. Trip costs were then summed over all vessel movements and divided by tons carried to determine trip cost per ton. Trip cost per ton was then multiplied by projected tonnage to determine trip cost per shipper. Another factor affecting trip cost is the decision by shippers to switch to larger vessels with increasing channel depth. As larger vessels are used and other vessels are loaded more efficiently it is possible to reduce the number of trips for a given tonnage. Thus, as shown in Tables C-3 through C-9 trip cost declines with increased channel capacity.

Table C-3 through Table C-9 can be used to show projected annual transportation cost savings associated with channel depths when compared to existing conditions. For the Main Channel, dredging to the authorized depth of -35 feet MLLW would decrease annual trip cost by $10,137,000; increase annual tidal delay cost by $15,600; and no lightering costs were incurred, for an annual total cost savings of $10,122,000. Trip cost declines as shippers load their vessels to greater depths and also take advantage of economies of scale by using larger vessels. The same quantity of goods is transported to and from Bridgeport, utilizing fewer vessels, thereby reducing annual trip cost.

The total cost for existing conditions of shipping goods into the main channel of Bridgeport Harbor with a channel depth of -29 feet MLLW is estimated to be $45,050,000 annually (see Table C-3). Tidal delay costs account for $15,000 of the total and lightering cost is not incurred and thus not calculated. In addition to tidal delay, the existing controlling depth in the main channel forces shippers to light load their vessels and to use smaller vessels that carry less cargo. Dredging the main channel is justified as it would reduce trip cost and tidal delay.

Table C-3.
Estimated Annual Transportation Cost by Channel Depth, Main Channel, ($000)

Channel Depth	Trip Cost	Tidal Delay Cost	Total Cost
25	55,986.7	88.6	56,075.4
26	55,166.3	61.5	55,227.8
27	53,694.1	37.4	53,731.5
28	46,766.3	15.8	46,782.1
29	45,034.3	15.3	45,049.6
30	42,864.9	27.9	42,892.9
31	41,224.1	33.3	41,257.5
32	39,036.4	39.0	39,075.4
33	37,762.5	30.9	37,793.4
34	36,395.2	30.9	36,426.0
35	34,897.3	30.9	34,928.1

The total cost for existing conditions of shipping goods into the Pequonnock River with controlling channel depth of -11 feet MLLW is estimated to be $606,000 annually (see Table C-4). Tidal delay costs account for $39,000. Restoring the authorized dimensions of the Pequonnock River is justified as it would reduce both trip cost and tidal delay.

Table C-4. Estimated Annual Transportation Cost by Channel Depth, Pequonnock River, ($000)

Channel Depth	Trip Cost	Tidal Delay Cost	Total Cost
8	705.8	42.8	748.6
9	566.5	92.3	658.8
10	566.5	53.8	620.3
11	566.5	39.2	605.7
12	551.7	37.6	589.3
13	536.3	35.5	571.8
14	487.2	33.8	520.9
15	471.8	32.0	503.8
16	457.7	30.8	488.5
17	457.7	30.8	488.5
18	457.7	21.6	479.3

The total cost for existing conditions of shipping goods into the Yellow Mill channel with controlling channel depth of -12 feet MLLW is estimated to be $1,596,000 annually (see Table C-5). Tidal delay costs account for $36,000. Dredging in Yellow Mill Channel is justified as it would reduce both trip cost and tidal delay.

Table C-5. Estimated Transportation Cost by Channel Depth, Yellow Mill Channel

Channel Depth	Trip Cost	Tidal Delay Cost	Total Cost
8	1,559.6	353.3	1,912.9
9	1,559.6	249.7	1,809.3
10	1,559.6	168.1	1,727.7
11	1,559.6	96.2	1,655.8
12	1,559.6	36.4	1,595.9
13	1,542.6	8.1	1,550.8
14	1,508.8	8.1	1,516.9
15	1,458.0	8.1	1,466.1
16	1,424.1	8.1	1,432.2
17	1,407.6	8.1	1,415.8
18	1,399.4	8.1	1,407.5

The total cost for existing conditions of shipping goods into Johnsons Creek with a controlling channel depth of -11 feet MLLW is estimated to be $16,000 annually (see Table C-6). There is no reduction in trip cost associated with deepening Johnsons Creek below nor are there any tidal delay or lightering costs incurred at the present controlling depth. Thus dredging Johnsons Creek was found not to be justified.

Table C-6. Estimated Transportation Cost by Channel Depth, Johnsons Creek

Channel Depth	Trip Cost	Tidal Delay Cost	Total Cost
8	15.7	0.0	15.7
9	15.7	0.0	15.7
10	15.7	0.0	15.7
11	15.7	0.0	15.7
12	15.7	0.0	15.7
13	15.7	0.0	15.7
14	15.7	0.0	15.7
15	15.7	0.0	15.7

The total cost for existing conditions of shipping goods into Black Rock Harbor with a controlling channel depth of -15 feet MLLW is estimated to be $445,000 annually (see Table C-7). Tidal delay costs account for $16,000. Trip cost would be reduced with deepening Black Rock Harbor justifying the dredging of the harbor.

Table C-7. Estimated Transportation Cost by Channel Depth, Black Rock Harbor, ($000)

Channel Depth	Trip Cost	Tidal Delay Cost	Total Cost
10	513.7	30.6	544.3
11	486.4	55.8	542.2
12	443.1	50.8	493.9
13	443.1	32.9	476.0
14	443.1	21.2	464.3
15	428.9	16.2	445.1
16	414.8	16.2	431.1
17	414.8	16.2	431.1
18	400.3	16.2	416.6

The total cost for existing conditions of shipping goods into Cedar Creek with a controlling channel depth of -15 feet MLLW is estimated to be $1,556,000 annually (see Table C-8). Tidal delay costs are estimated to be zero. At its existing controlling depth, there are no navigation problems in Cedar Creek to justify dredging at this time.

However, if the channel continues to shoal tidal delay will eventually increase beginning at a depth of -13 feet MLLW.

Table C-8. Estimated Transportation Cost by Channel Depth, Cedar Creek, ($000)

Channel Depth	Trip Cost	Tidal Delay Cost	Total Cost
10	1,555.9	172.1	1,728.0
11	1,555.9	92.5	1,648.4
12	1,555.9	30.6	1,586.5
13	1,555.9	6.3	1,562.2
14	1,555.9	0.0	1,555.9
15	1,555.9	0.0	1,555.9
16	1,555.9	0.0	1,555.9
17	1,555.9	0.0	1,555.9
18	1,555.9	0.0	1,555.9

The total cost for existing conditions of shipping goods into the east branch of Cedar Creek with a controlling channel depth of -15 feet MLLW is estimated to be $126,000 annually (see Table C-9). Tidal delay costs are estimated to be $4,000. Restoring the depth to -17 feet MLLW would reduce trip cost thereby justifying dredging in the east branch of Cedar Creek.

Table C-9. Estimated Transportation Cost by Channel Depth, East Branch, ($000)

Channel Depth	Trip Cost	Tidal Delay Cost	Total Cost
10	152.9	5.8	158.7
11	122.1	21.5	143.5
12	122.1	14.6	136.7
13	122.1	10.2	132.3
14	122.1	6.5	128.5
15	122.1	3.9	125.9
16	122.1	3.9	125.9
17	108.0	3.9	111.9
18	108.0	3.9	111.9

Vessel traffic is expected to grow annually at a rate of 1.9 % over the 20-year period of analysis. For the purpose of this study it is assumed that no further shoaling will take place in the without project condition. Transportation cost are developed by channel depth for both the without and with project conditions assuming no further shoaling over the 20-year study period.

Table C-10 displays the projected tonnage distribution carried by vessels of different sizes in the Main Channel, as measured by loaded draft. Separate distributions are developed for domestic (US) and foreign (F) vessels for each controlling depth evaluated. This distribution is used to estimate transportation costs.

Table C-10. Projected Fleet Size Distribution (Loaded Draft) by Channel Depth Main Channel

Flag	Channel Depth, ft	Less Than 30	30 to 35	35 to 40	40 to 44	Greater Than 44	Total
US	29	99.6%	0.4%	0.0%	0.0%	0.0%	100.0%
F	29	87.2%	12.8%	0.0%	0.0%	0.0%	100.0%
Total	29	97.4%	2.6%	0.0%	0.0%	0.0%	100.0%
US	30	97.7%	2.3%	0.0%	0.0%	0.0%	100.0%
F	30	79.6%	20.4%	0.0%	0.0%	0.0%	100.0%
Total	30	94.5%	5.5%	0.0%	0.0%	0.0%	100.0%
US	31	97.7%	0.4%	1.9%	0.0%	0.0%	100.0%
F	31	75.7%	13.3%	11.0%	0.0%	0.0%	100.0%
Total	31	93.8%	2.7%	3.5%	0.0%	0.0%	100.0%
US	32	94.6%	3.3%	2.0%	0.0%	0.0%	100.0%
F	32	65.2%	11.8%	23.0%	0.0%	0.0%	100.0%
Total	32	89.4%	4.8%	5.7%	0.0%	0.0%	100.0%
US	33	94.7%	4.5%	0.8%	0.0%	0.0%	100.0%
F	33	64.3%	10.6%	25.2%	0.0%	0.0%	100.0%
Total	33	89.2%	5.6%	5.2%	0.0%	0.0%	100.0%
US	34	94.6%	4.6%	0.8%	0.0%	0.0%	100.0%
F	34	63.2%	7.2%	26.1%	3.5%	0.0%	100.0%
Total	34	89.0%	5.1%	5.4%	0.6%	0.0%	100.0%
US	35	94.5%	4.2%	1.3%	0.0%	0.0%	100.0%
F	35	62.3%	7.4%	22.8%	7.5%	0.0%	100.0%
Total	35	88.7%	4.8%	5.2%	1.3%	0.0%	100.0%

In this analysis, there is no other independent influence on the vessel size distribution other than channel controlling depth. As eastern US ports continue to deepen their deep draft navigation channels, it is possible that the size distribution of the fleet servicing the eastern seaboard will increase, and as a result, it may become more difficult to find some of the smaller vessels that now service Bridgeport Harbor. As such, benefits estimated in this analysis form a lower bound on the range of transportation cost savings.

The fleet mix will change at different controlling depths. As channel depth increases, a given tonnage will be carried in fewer ships as shippers engage in less lightloading of vessels and switch to larger vessels. With maintenance dredging more tonnage will enter and, or, leave the port in larger vessels. As can be seen in Table C-10, the projected tonnage carried in vessels drawing less than 30 feet drops from 99.6 % to 88.7 % when the channel is restored to its authorized depth of –35 feet. Alternately, the percentage of tonnage carried in vessels drawing more than 30 feet rises from 0.4% to 11.3% when the main channel is restored to its authorized depth. Most shipments into Bridgeport Harbor are direct without stopping at other ports. Most neighboring ports have –35 to –40 feet available in their shipping channels. Thus, the depths at other ports are not expected to affect the fleet mix for Bridgeport Harbor and there is no need for a multi-port analysis. A multi-port analysis would be necessary if vessels served a route and fleet mix would be determined by the port(s) with minimum capacity. This is typical of containership traffic, but this situation does not apply to Bridgeport Harbor where the fleet mix consists mostly of oil tankers and barges.

Project Justification

The transportation costs for various controlling depths shown in Tables C-3 through C-9 were used to determine discounted annual transportation costs for both the with and without project conditions. With project conditions evaluated transportation costs with restored project depths from one foot below the existing controlling depth to the authorized project depth. Project benefit is defined as the difference in transportation costs between the with and without project conditions. It was assumed in the analysis that there would be no additional maintenance needed over the twenty-year period of analysis. The reduction in transportation costs between the with and without project conditions is the project benefit. Transportation cost is determined by multiplying cost per ton by tonnage. Thus, transportation cost will increase at the same rate as tonnage growth.

Annual benefits to channel dredging are shown below in Tables C-11 through C-17. These tables include the effect of tonnage growth on transportation cost. Previous tables displaying transportation costs did not include the effect of projected tonnage growth. The ten-year average annual growth rate of tonnage for New England ports was used to project transportation cost. Project cost savings, or benefits, are evaluated for project depths of -30 feet to -35 feet for the main channel in Bridgeport Harbor. Major beneficiaries include the main channel, Pequonnock River, and Yellow Mill River. Maintenance dredging in the main channel, Pequonnock River and the Yellow Mill River was found to be economically justified due to the presence of significant transportation cost savings. Black Rock Harbor also had benefits to restoring the authorized dimensions. The remaining Bridgeport tributaries were found to be not economically justified. Thus the continued maintenance of Bridgeport Harbor including some of the tributary channels is economically justified.

Table C-11. Annual Benefit, Main Channel ($000)

Project Depth (feet)	Without Project Transportation Cost	With Project Transportation Cost	Transport-ation Cost Reduced
30	52,370.7	49,862.9	2,507.8
31	52,370.7	47,961.2	4,409.5
32	52,370.7	45,423.9	6,946.8
33	52,370.7	43,933.1	8,437.6
34	52,370.7	42,343.2	10,027.5
35	52,370.7	40,601.3	11,769.4

Table C-12. Annual Benefit, Pequonnock River ($000)

Project Depth (feet)	Without Project Transportation Cost	With Project Transportation Cost	Transportation Cost Reduced
12	707.4	688.2	19.2
13	707.4	667.8	39.6
14	707.4	608.4	99.0
15	707.4	588.4	119.0
16	707.4	570.5	136.9
17	707.4	570.5	136.9
18	707.4	559.8	147.6

Table C-13. Annual Benefit, Yellow Mill Channel ($000)

Project Depth (feet)	Without Project Transportation Cost	With Project Transportation Cost	Transportation Cost Reduced
13	1,984.8	1,928.7	56.1
14	1,984.8	1,886.5	98.3
15	1,984.8	1,823.3	161.5
16	1,984.8	1,781.2	203.6
17	1,984.8	1,760.7	224.1
18	1,984.8	1,750.5	234.3

Table C-14. Annual Benefit, Johnsons Creek ($000)

Project Depth (feet)	Without Project Transportation Cost	With Project Transportation Cost	Transportation Cost Reduced
12	18.4	18.4	0.0
13	18.4	18.4	0.0
14	18.4	18.4	0.0
15	18.4	18.4	0.0

Table C-15. Annual Benefit, Black Rock Harbor ($000)

Project Depth (feet)	Without Project Transportation Cost	With Project Transportation Cost	Transportation Cost Reduced
16	519.8	503.4	16.4
17	519.8	503.4	16.4
18	519.8	486.5	33.3

Table C-16. Annual Benefit, Cedar Creek ($000)

Project Depth (feet)	Without Project Transportation Cost	With Project Transportation Cost	Transportation Cost Reduced
16	1,817.1	1,817.1	0.0
17	1,817.1	1,817.1	0.0
18	1,817.1	1,817.1	0.0

Table C-17. Annual Benefit, East Branch ($000)

Project Depth (feet)	Without Project Transportation Cost	With Project Transportation Cost	Transportation Cost Reduced
16	147.1	147.1	0.0
17	147.1	130.7	16.4
18	147.1	130.7	16.4

US Army Corps
of Engineers®
New England District

BRIDGEPORT HARBOR, BRIDGEPORT, CT
DREDGED MATERIAL MANAGEMENT PLAN (DMMP)

APPENDIX D
GEOTECHNICAL

SEPTEMBER 2008 as edited 2009

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GEOTECHNICAL

1. INTRODUCTION

The US Army Corps of Engineers New England District (NAE) conducted a series of subsurface investigations to evaluate the dredging and disposal of an estimated 1.2 million cubic yards of unsuitable maintenance dredging materials within the inner and outer portions of Bridgeport Harbor. The purpose of the subsurface explorations and sampling was to determine depth to bedrock and as well as engineering properties of subsurface materials. The data gathered from the explorations will aid in the preliminary design of the Confined Aqueous Disposal (CAD) Cells within the harbor. The CAD Cells will be sites used for disposal of materials dredged from other areas of the harbor that are not suitable for open water disposal. Other materials can be used for capping the CAD cells or transported to a designated area in Long Island Sound for deep water disposal.

A geotechnical exploration program at the north end of the harbor had previously been conducted for the construction of the I-95 bridge crossing over the Pequannock River. The borings identified the location of an historic river channel carved into the bedrock and showed shallow bedrock towards the western end of the bridge. Several environmental investigations utilizing vibracore techniques were used to collect samples to investigate the suitability of materials across the harbor, at proposed CAD cell locations, and along the outer Bridgeport channel. The results of analytical testing concluded that organic deposits from the bottom of the Harbor are unsuitable for disposal in Long Island Sound.

Subsurface explorations at Bridgeport consisting of 30 geotechnical probes and 8 soil borings were conducted during the time period from 6 October to 10 December 2003. Each boring retrieved sufficient samples of the subsurface soils for physical testing. The material testing and boring data gathered from this program was used to study engineering properties of the subsurface materials for the design and construction of an in-channel CAD cell. The subsurface conditions identified at the drilled locations within the harbor had thick deposits of unsuitable material and were not conducive for economical development of CAD cells. Seismic and resistivity geophysical investigations of the harbor with emphasis on the northern channel area and a section to the west of the navigational channel were conducted during the period from 7 to 14 April 2006 to look for alternative locations. Shallow bedrock conditions were detected in the western area, which do not provide sufficient volume to meet the total Bridgeport CAD disposal requirements. The southeast corner of the harbor previously had not been investigated because it was too small to accommodate the anticipated volume of unsuitable material. However, it appeared to have sufficient space to accommodate the potential volume of material which would not fit in the western CAD cell. In October 2006, two additional soil borings and two geotechnical probes were drilled in the western and southeastern sections of the Harbor. The subsurface investigations were used to confirm the geophysical data interpretations. The borings showed that the bedrock was shallower than it had been interpreted in the western CAD cell and that the depth to bedrock in the southeastern area of the harbor exceeds 100 feet below the mudline.

2. PROJECT DESCRIPTION

Bridgeport Harbor is located in Bridgeport Connecticut on the north shore of Long Island Sound at the mouth of the Pequonnock River and includes the Yellow Mill and Johnson Creek tributary channels. The authorized Bridgeport Harbor Federal Project consists of: a 35 foot main channel, 400 feet wide, extending from Long Island Sound to Tongue Point, then widening to approximately 600 feet a the bend opposite Cilco terminal, and then narrowing to 300 feet at the lower end of the Pequonnock River Channel at a point 800 feet below the Stratford Avenue Bridge.

The last maintenance dredging of Bridgeport harbor occurred in 1963. Since that time, shoaling of the channels has reduced the depth in the harbor from the authorized depths, limiting the operating drafts of vessels calling at Bridgeport. Some of the sediments in the harbor contain contaminants that render the dredged material unsuitable for ocean disposal. Due to this, maintenance of the Harbor has been deferred.

3. REGIONAL SETTING – GEOLOGY

The area of Connecticut was at one time a mountain that had been formed by continental collision. Nearly 180 million years ago as the Atlantic Ocean began to split apart, fracturing occurred, accompanied by volcanic activity which left lava to form the Hudson River Palisades. The lava cooled and became trapped by layers of sand and gravel into the area known as the Connecticut Valley. This area extends from Vermont, through Massachusetts and Connecticut, ending in Long island sound. The following description of the geology was primarily obtained from the US Geodetic Survey Report 2005-1162 for an oceanographic survey of the area in the vicinity of Bridgeport, CT (USGS 2005).

Schists, gneisses and phyllites of the Connecticut River valley synclinorium (Middle to Early Paleozoic Iapetos terrain) constitute the majority of outcrops along the north shore of Long Island Sound. The Bridgeport quadrangle is underlain by rocks of Paleozoic to Middle Mesozoic in age, present in the volcanic belt of the Western Highlands Province. The schists, metavolcanics and metasedimentary rock making up the bedrock presumably extend offshore and are partially overlain by rocks of the Hartford Basin. The Orange Formation is present northeast of Bridgeport Harbor and includes the Oronoque schist; gray to silver, medium to fine-grained schist and the Wepawaug Schist; medium to dark gray, medium to fine grained schist or phyllite. The Bridgeport syncline is west of Bridgeport Harbor; east of the Bridgeport Quandrangle, the majority of the bedrock underlying New Haven is the reddish poorly sorted New Haven Arkose. Presumably, these or similar formations extend offshore beneath the study area. Depth and thickness of these units varies greatly beneath the study area.

The bedrock across much of southern Connecticut is unconformably overlain by two tills, one of pre-Wisconsinan age, the Lake Chamberlain till, and one of late Wisconsinan age, the Hamden till. The younger till forms a thin (0-5 m), discontinuous mantle over nearly all of the higher land. However, no deposits associated with end moraines have been reported in the area south of

Bridgeport. The northward retreat of the late Wisconsinan ice sheet is marked in southeastern Connecticut by a succession of minor recessional moraines including the Madison, Hammonasset-Ledyard, Old Saybrook, and Mystic moraines.

Deltaic sediments and proximal and distal lacustrine fan facies deposited in glacial Lake Connecticut overlie both bedrock and glacial drift within the study area. This lake, which occupied most of the Long Island Sound basin, was formed when the ice front began to recede from the Harbor Hill-Roanoke Point-Charlestown moraine position and meltwater was impounded in the expanding, long, narrow basin between the moraine and the retreating ice to the north. The glaciolacustrine deposits of glacial Lake Connecticut and the underlying glacial drift are truncated by a regional unconformity. This unconformity is a composite product of the subaerial exposure, which occurred after glacial Lake Connecticut drained, and before the marine transgression, which took place starting 15 thousand years ago. Marine deposits, which occur in quiet-water areas throughout the Long Island Sound basin, overlie the unconformity and earlier deposits, and they record deposition during the postglacial Holocene eustatic rise of sea level.

The land west and east of Bridgeport Harbor has been artificially emplaced. East of the harbor, salt marsh deposits overlying fines are present in a protected inlet with low wave energy. Sand and gravel characterize the beach deposits, west of Point No Point (2 miles east of Bridgeport). The coastal surficial geology of the Bridgeport quadrangle is characterized by post glacial deposits composed of stacked coarser deposits overlying finer deposits. The sand varies in thickness; the fines are thinly bedded. This sequence represents distal glacial deltaic deposits overlying glacial lake bottom sediment.

Tidal and wind-driven currents have extensively reworked both the glacial and postglacial deposits south of Bridgeport.

The topography and slope of Bridgeport's shoreline areas is generally smooth or gently rolling. As a result of the dominant occurrence and erodibility of glacial outwash, composed primarily of sand and gravel, the onshore topography reflects the gentler slope of its parent material.

4. SUBSURFACE EXPLORATIONS

4.1. General. Explorations for dredging of the Bridgeport Harbor shipping channel were conducted in 1958 through 1962, The nature of the current subsurface conditions across the Bridgeport Harbor were primarily investigated by subsurface explorations conducted in 2003. Subsequently, additional investigations were conducted when these explorations failed to identify a suitable location to site a CAD cell. A chronological list describing exploration programs in Bridgeport Harbor follows:

4.1.1. Channel Dredging – 1958 through 1962

Fifty Seven test borings were drilled along the inner and outer Bridgeport Harbor channel. The outer channel begins at the breakwater and extends approximately 3 miles into Long Island Sound. The closest boring to the proposed CAD cells is FD-38, located approximately 250 feet northwest of the southeastern CAD cell. Gravelly sand and silty sand were encountered below -33.6 feet MLW in FD-38.

4.1.2. I-95 Bridge Reconstruction - 1996

Forty test borings, twenty seven on land and thirteen in Bridgeport Harbor, were drilled for Haley and Aldrich, Inc. (H&A) to explore subsurface conditions for the construction of the I-95 highway bridge in 1995. The land borings were drilled to depths of 8.2 m to 42.8 m; the water borings were drilled to depths of 7.6 m (25 ft) to 25.9 m (85 ft) below mud line. A summary of the test borings is presented on Table I.

The H&A report also refers to previous borings located along the bridge alignment and includes test borings drilled for the original bridge design completed in 1955 and design of the Union Square Dock Rehabilitation Project in 1992. Sixty-one test borings were drilled for the original bridge design. Boring depths ranged from 4.7 to 38.9 m. (15 to 128 ft) Five borings were drilled for the design of the Union Square Dock Project. Boring depths ranged from 3.4 to 19.5 m (11 to 64 ft) and are drilled in the area of the proposed Pier No. 10.

The subsurface conditions found on the west side of the harbor consist of fill, alluvium, and glacial till over relatively shallow bedrock. The subsurface conditions in the harbor and east of the harbor consist of fill, alluvium, organic deposits, glacial deposits, and glacial till over bedrock.

Alluvial sand deposits are the primary soil deposit. The alluvial sands are medium dense fine sand, with varying amounts of medium to coarse sand and silt. In the harbor these sands are loose and may be susceptible to liquefaction. Organic silt and fine sand deposits were encountered in the harbor area from about pier No. 9 to Pier No. 21. Thickness of the organic silt ranged from 1.5 to 11 m (5 to 36 ft) in thickness. Glacial deposits other than glacial till were confined predominately to the east side of the harbor area and ranged in thickness from 11.5 to 24.5 m (38 to 80 ft). The top of micaceous schist bedrock varies from El. -2.5m (-8.2 ft) at abutment No. 1 (near the western river bank) to El. -38.9m (- 127.6 ft) at Pier No. 16 (approximately 600 feet east of Pier 1). Refer to Haley and Aldrich (1996) for drilling logs and boring location plans.

4.1.3. ENSR Vibracore Sampling of Harbor Sediments – 1999

ENSR conducted vibracore sampling at twenty locations in the harbor and the outer entrance channels 21-23 August 1998 for the U.S. Army Corps of Engineers. The survey transect of Bridgeport Harbor was roughly 15,800 feet long, averaging 300 to 1600 feet wide(depending on area of designation: channel, turning basin, and anchorage area) with water depths ranging from -25 to -27 Mean Low Water (MLW).

Marine sediments were also collected from the Central Long Island Sound (CLIS) reference location for evaluating physical and chemical properties and determining benchmark values for biological testing. Analytical results were obtained from GeoTesting Express for grain size gradation curves. The locations of the vibracores are shown on Figure 2. Logs are available in the ENSR, 1999 report.

4.1.4. Battelle Vibracore Sampling of Harbor Sediments – 2001

On September 6 and 7, 2001, Bridgeport Harbor was sampled by Battelle Corporation for grain size and visual characterization. After the results of the grain size analysis were reviewed, Bridgeport harbor channel was then revisited for bulk sediment and water sampling. Collected soil samples were combined into 4 homogenized composites based on the results of the grain size and decisions made by the USACE. The four sites were B-D, E-H, I-K, and L-O. The locations of the sites are shown on Figure 3.

All sediment cores were taken to the depths specified in the survey report (Battelle, 2001). Silty sand was collected from 3 cores which are located in the outer channel. The furthest outlying core encountered sand at depths of 37 to 49 feet below MLW. Greenish black silty Clay was typically encountered in the other cores. Analytical analyses were conducted on composite samples of the materials encountered.

4.1.5. GEI Consultants Inc. - October 2003

Under GEI contract, Hardiman Co. and Associates, Inc. performed 30 geotechnical probes and 8 geotechnical borings in Bridgeport Harbor between October 6 and December 10, 2003. Probes were advanced to refusal, and borings were advanced to a depth of –100 ft Mean Lower Low Water (MLLW) or to refusal. Five feet of rock was cored to confirm bedrock when refusal was encountered above –100 ft MLLW in the borings. Geotechnical probes were started at mud line elevations ranging from about –16 feet to –45 feet MLLW. The probe penetration depths varied between 31 feet and 143.5 feet with an average value of about 70 feet. The soil conditions are estimated only at the probe locations. Field probe logs are contained in Attachment 1. Conditions between probes may differ significantly from those encountered at the probe locations. The locations of the probes are shown on Figure 4. A summary of as-drilled exploration locations is presented in Table 1.

The following procedures were used to perform the geotechnical probes and borings in 2003:

a) The drilling subcontractor advanced the borings using 3½-inch-diameter flush-jointed casing and drive-and-wash drilling techniques. GEI recorded the number of blows from a 300-pound hammer, dropping 30 inches needed to advance the casing 1 foot.

b) The drilling subcontractor performed continuous sampling from five feet below the mudline to just below the interface with the native sands. Below the silt/clay and native material interface, samples were taken at five-foot intervals to a depth of –100 ft MLLW or refusal, whichever occurred first. For this investigation, sample refusal was defined as 50 blows for less than 1 inch of penetration, or bouncing refusal. If refusal was encountered above –100 ft MLLW, five feet of rock core was taken to confirm bedrock in the borings.

c) Standard Penetration Test (SPT) samples were collected using a 1-3/8-inch inside diameter split-spoon sampler driven with a 140-pound safety hammer dropping

30 inches. Samples were collected within the organic silt/clay layer for environmental chemical testing. Woods Hole Group of Raynham, Massachusetts, performed the environmental and physical testing. Below the organic silt/clay and the native soils interface, samples were collected for physical testing.

d) Hardiman Co. and Associates, Inc. performed continuous environmental sample collection in the borings from 5 feet below the mud line to just below the interface with native sands. These samples taken through the organic layer were preserved and sent to Woods Hole Group in Raynham, Massachusetts for environmental testing. The results of the environmental chemical testing are not contained in this report.

4.1.6. Batelle Corporation Vibracore - Fall 2005

Eight vibracores were conducted in the lower harbor anchorage area in the fall of 2005. The vibracores extended 20 feet below the mudline. The locations of the vibracores are shown on as A through H. Thick silt/clay deposits were found in each of these vibracores . Several of the vibracores were terminated in Silty Sand. Vibracore “F” did not reach 20 feet having met refusal at 16 foot depth after penetrating a few feet of sand. Further investigation of the anchorage area was not done because of the thick organic deposits.

4.1.7. USGS Geophysical Investigation - April 2006

From April 7 to 14, 2006 continuous seismic profiling (CSP), continuous resistivity profiling (CRP), and magnetometer data were collected along seven profiles in Bridgeport harbor as shown on Figure 5. Profiles 4 and 5 were collected for the proposed northern CAD cell but were not interpreted.

A marine geophysical investigation was conducted to help characterize portions of the bottom and sub-bottom foundation materials and extent of bedrock in limited areas of materials in Bridgeport Harbor, Connecticut. The data collected will be used in the design of CAD Cells within the harbor to facilitate dredging of the harbor. Three water-based geophysical methods were used to evaluate the geometry and composition of subsurface materials. CSP methods provide the depth to water bottom, and when sufficient signal penetration can be achieved, delineate the depth to bedrock and subbottom materials. CRP methods were used to define the electrical properties of the shallow subbottom, and to possibly determine the distribution of conductive materials, such as clay, and resistive materials, such as sand and bedrock. Magnetometer data were used to identify conductive anomalies of anthropogenic sources, such as cables and metallic debris. These metallic targets might adversely affect CRP data and may be targets to avoid during construction of the CAD cells. All data were located using global positioning systems (GPS), and the GPS data were used for real-time navigation.

Interpretations of the CSP data were also tested for repeatability. In many of the CSP profiles, the same interpretations were obtained, but in a few profiles, the interpretations of the bedrock surface were not repeatable, indicating poor data quality and low confidence in the interpretation. In general, the data were fair to poor quality, as they were adversely affected by the waterbottom multiples.

These physical responses of the CRP, CSP, and magnetometer data are consistent with the conceptual model for the site, which is that the bedrock channel was incised or eroded into beneath the present day harbor. The channel appears to follow a north-northwest to south-southeast trend and is parallel on-line with the Pequannock River. In a limited number of places, the bedrock surface was observed in the CSP record, creating a discontinuous and sporadic image of the bedrock surface. The seismic record and corehole data indicate that under the channel, the depth to bedrock is as deep as 42.7 m (140 ft) below MLLW in the dredged part of the harbor. The bedrock channel shallows towards the shore, where bedrock outcrops have been mapped at land surface. The CSP and CRP indicate a high amount of relief on the bedrock surface, as well as along the water bottom.

Under the proposed southwestern CAD cell, the sediments are only marginally thick for the CAD cell, at about 8 to 15 m (26 to 49 ft) in depth. Some of the profiles show small diffractions in the unconsolidated sediments, but no large scale boulders were identified. Profile 1 runs southwest to northeast and profiles the subsurface beneath the proposed southwest CAD cell and the navigation channel. A reflector interpreted as bedrock was identified for 340 m (1100 ft) of the southwestern end of the profile. The seismic profile was not be continued over the last 140 m (460 ft) to the west because of insufficient water depth.

No bedrock reflectors were imaged under the proposed southeastern CAD cell, where core logs indicate the rock is as much as 30 m (98 ft) below MLLW.

4.1.8. Battelle Corporation Vibracores - April 2006

Vibracore samples and testing were conducted to determine if there are portions of the material that have the potential to be suitable for unconfined open water placement and to determine the location of the interface between the unsuitable sediment and clean parent materials. On April 18-19, 2006 a single core sample was taken at each of the 14 separate locations in Bridgeport Harbor, CT as shown on Figure 6 Upon collection all cores were capped, sealed, labeled and stored upright until processing could begin. Six of the cores were to target the specific depth range of -38 to -42 feet below MLLW for the CAD cell in the channel south of the I-95 bridge. The eight remaining cores were collected from the potential western CAD cell. These cores were collected to a depth of refusal, which ranged from 1 to 7 feet below the mud line. All cores were processed at Battelle’s Duxbury facility and analyzed for metals, and grain size.

Atterberg limit tests were conducted on selected samples from the cores. The results of the cores are provided in Table 4 of the Battelle report. Samples FAB-002 through FAB-013 represent the channel area and FAB-014 through FAB-028 represent the western CAD cell area. The Atterberg limit tests and sieve/hydrometer analyses confirm that the northern area is underlain by clay and the western area is primarily non-plastic sand and silt.

The northern end of the western CAD cell is mantled with loose sand and shell hash. The largest grain size is typically medium grained sand. Some of the sand is silty. At about 8 feet below the mudline, the soil transitions to a clayey material. The hydrogen sulfide odor observed indicates that this is likely an organic silt. Vibracores in the middle of the CAD cell penetrated between 7 and 11 feet of sand, and the vibracores in the southern end of the CAD cell penetrated only 2 to 5 feet of sand and gravel. The layer of silt on the top is very soft and required a significant amount of time to settle out of the water column.

4.1.9. Baltimore District US Army Corps of Engineers – September 2006

The US Army Corps of Engineer from Baltimore drilled two test borings and two soil probes during the period September 15 to 19, 2006 with a barge mounted CME 45 drill rig. Test boring FB-01 was drilled at the intersection of geophysical profiles 1 and 2 in the proposed western CAD cell. A total of 46.2 feet was drilled including 36.9 feet of overburden and 9.3 feet of rock core. The overburden was comprised of approximately 30 feet of loose silty fine sand underlain by dense coarse to fine sand and gravel. Very severely weathered schist was recovered in one split spoon sample from the interface between the overburden and the bedrock. The bedrock is hard, slightly weathered, moderately fractured, gray medium grained Schist. The spacing of discontinuities which typically dip moderately (35^o to 55^o) and parallel to foliation is close (2 to 12 inches). New drilling breaks along weaker sections of the schist are very close. A few of these breaks have been stained with iron indicating that they are open joints. The joints are generally planar, but moderately rough. One steep irregular joint was observed at the top of the core. A section 5 to 6 feet below the hard surface of the schist has been healed with quartz. The depth to rock confirmed the geophysical interpretation.

Test Boring FB-02 was drilled in the center of the proposed southeastern CAD cell. The boring penetrated 101.5 feet of overburden. The uppermost 30 feet are loose coarse to fine sand and trace of gravel. The top two samples include shell fragments. The mudline considered the top of the boring is overlain by a couple feet of very soft organic silt. The loose sand is underlain by approximately 20 feet of very soft slightly plastic fine sandy silt. The silt is underlain by more than 50 feet of medium dense silty fine sand. The boring was terminated without fully penetrating this stratum. Two additional probes were drilled in the southeastern CAD cell to refusal at depths of 135 and 155 feet. The locations of the borings and probes are shown on Figure 7.

4.1.10. USGS Geophysical Investigation of Southeast CAD Cell – October 2006

Investigation of the southeastern CAD cell was conducted utilizing 3 profiles (D, E, and F) during a secondary pilot investigation conducted October 10 to 11, 2006. Different sound source and receiver systems were used to improve the penetration and the quality of the data. The entrapped gas, however, adversely affected these data, too, and the depth to bedrock could not be determined. The location of the profiles are shown on Figure 6.

4.1.11. Battelle Corporation Vibracore investigation of the Southeastern CAD Cell October 2007

Core samples were collected at each of five stations using a vibracore. Hard compacted sand and gravel substantially limited penetration and recovery within the potential CAD cell location. As a result, the core lengths from this area are consistently shorter than the maximum targeted depth of five feet. Based on the sediment types present, the material represented in the cores is likely to represent the material from the sediment water interface to the depth of the core recovery (generally 2 feet).

4.2. Existing Subsurface Conditions

Overall, the subsurface conditions at Bridgeport Harbor is covered with a black organic silt layer that is underlain by estuarine glacial deposits and bedrock. These estuarine deposits are primarily interbedded silts and fine sand. Silt with traces of clay layers was found within this stratum in the harbor and hard clay was identified in the channel at the north of the harbor. The top layer of the estuarine deposits on the eastern side of the harbor is comprised of coarse sand and gravel. A mining operation for road construction in the northeast corner of the harbor has removed much of the coarse sand there. Glacial till has not been encountered in the borings or probes, however, a thin layer of weathered bedrock (schist) was identified.

The organic silt found in the deep anchorage and channel is 7 to 15 feet thick. In the shallow water to the west and to the southeast, the organics were typically less than 2 feet thick. The organics in the Main Shipping Channel CAD Cell locations range to 26 feet in thickness.

The geotechnical explorations were performed in water depths ranging from about 25 to 50 feet, depending on the time of exploration relative to the tide water level. Direct observations of the surrounding channel bottom were not possible from the barge deck because the water was too deep. The general subsurface conditions encountered at the boring locations are described below, starting at the mudline. The soil conditions are known only at the boring locations. Conditions between borings may vary significantly from those described below.

Organic Soil (OL/OH) – A layer of organic soil was encountered just below the mudline at all borings. This layer ranged in thickness from about 7 feet to 26 feet thick. The organic soil layer was comprised of generally homogeneous, low to medium plasticity soils, containing varying amounts of fine sand typically less than about 5%. The organic soil had a dark gray to black color and an organic odor. This layer did not support the weight of the drill casing.

Silt (ML) – All of the borings except FD-03-04 encountered a layer of gray silt. Borings FD-03-03, -06, -07, and -08 encountered the silt layer directly below the organic layer. Borings FD-03-01, -02, and -05 encountered the silt layer at depths below the sand and silty sand layers. Typically, this soil consisted primarily of low to non-plastic silt with between less than 5 and 20 percent fine sand. Much of the silt contained laminated layers, about 3 to 5 mm thick, of medium plasticity brown clay.

Poorly Graded Sand to Silty Sand (SP to SM) – All of the borings except boring FD-03-07 encountered a sand layer. The sand layer ranged from a poorly graded sand containing mostly fine sand and about 5% non-plastic fines to a silty sand containing primarily fine sand and up to about 40% non-plastic fines.

Poorly Graded Gravel with Sand (GP) – One of the borings, FD-03-06, encountered a thin layer of gravel. The soil layer contained both fine and coarse subangular gravel with about 25% fine to coarse sand.

Bedrock – Five borings (FD-03-02, -04, -06, -07, and -08) encountered bedrock above –100 feet MLLW at elevations ranging from about -55 to -91 MLLW. The bedrock was generally hard to very hard, unweathered to slightly weathered, fine to coarse grained, “pinstriped” schist and gneiss of the Orange Formation. On the western side of the harbor, FB-06-01 encountered bedrock at -46.2 feet MLLW.

Profiles. There is insufficient data available to provide profiles of the southeastern CAD cell or verify the geophysical profiles provided in the . Only one soil boring was done within each site. Drilling additional test borings at each location to better define the cross sections is recommended.

5. AT CAD CELL SITES

Geotechnical laboratory tests are currently being performed to classify and estimate the engineering properties of the soil samples collected from the test borings. The tests to be performed are grain size analyses (ASTM D422).

The US Army Corps of Engineer, New England Division performed 70 grain size analyses on the samples collected from the channel during the period 1958 to 1962. The analyses were used to correct the soil boring logs. Gravel, sand, and silt were identified.

Haley and Aldrich performed twenty-one grain size analyses (ASTM D422) on selected soil samples from the test borings at the I-95 bridge site. Grain size analyses were performed to confirm visual classification and aid in determining engineering properties. Other laboratory tests on soil from four undisturbed tube samples included moisture content, density, Atterberg Limits, index strength tests, and an unconsolidtated undrained triaxial test. Based on a single sample, the dark gray organic silt was non-plastic with a water content of 73.9% and shear strength of 0.043 tsf. The description of this sample is similar to the visual classification and depth of organic silt in geotechnical soil boring FB-06-02 in the southeastern CAD cell.

The Woods Hole Group performed physical testing, consisting of grain size analyses and Atterberg Limits on 25 of the environmental samples collected in 2003. Additionally, the Geotechnical Group, Inc. performed 16 grain-size analyses with hydrometers and 12 Atterberg Limits on the geotechnical samples collected in October – December 2003. Most of the samples tested by Woods Hole Group consisted of organic silt, with liquid limits ranging from 66 to 125 and plastic limits ranging from 37 to 67. The Atterberg limit tests indicated that all but two of the samples tested were noon-plastic silts (ML). One of the non-plastic samples tested indicated a silty clay (CL-ML) and the other was an elastic silt (MH). Water contents measured in the laboratory were dated 4 March 2004 and may not reflect in-situ conditions. In general the grain size analyses on the remaining samples indicate the soil varies between a silty sand and silt.

Ten grain size analyses were conducted on vibracore samples taken from the SE CAD cell in 2007. Five were from the unsuitable silt at the mudline, and five were obtained from depths of approximately 1 to 2 feet below the mudline. The materials immediately beneath the silt were sands and gravels classified by SP, GP, GW, SW-SM, and SM of the USCS classification system.

Grain size analyses were conducted for eight soil samples from the 2006 Test borings by GeoTesting Express in 2008. Three grain size analyses were conducted on the soil from the soil boring in the western CAD cell and five from the southeastern CAD cell. The resulting data matched the grain sizes for the samples collected in 1996 and 2003 with corresponding visual descriptions. The materials representing most of the soil profile were fine sand (SP) and silt (SM). Two samples from the top 30 feet were coarse sand and gravel (SP) and (GW). Sample 8 from FB06-02 was dark gray organic silt (ML). The results of the analyses are provided as Attachment 3.

Additional water contents (ASTM D2216), Atterberg Limits (ASTM D4318), and consolidated-undrained (CU') triaxial compression tests (ASTM D4767) are recommended if more soil samples are collected. The additional data should reduce uncertainty about the relative density of the materials. There is also concern about the weak organic soils ranging to 50 feet below the mud line. Laboratory test results for all the samples will be used to correct the final boring logs and will be summarized in the final plans and specifications.

6. CAD CELL DESIGN

DISCUSSION

Exploration Summary

Southeastern CAD cell:

The subsurface conditions for the southeastern CAD cell are identified in test boring FB-02 which is located near the middle of the CAD cell. The area is mantled by a thin layer of organic silt. The vibracore data (Battelle 2008) indicates that the mudline to the top of sediments is typically less than two feet thick. This material has been identified as unsuitable for diposal at CLIS. The soil profile generally matches what was found to the north in borings FD-03-02 and FD-03-03 except that at the boring locations to the south include an upper sand and gravel which was previously mined in the area to the north. The sand and gravel is underlain by organic silt, which in turn is underlain by silty fine sand.

Previous probes to the north and the geophysical investigation indicate that the former river valley is aligned with current Pequonnock River. These characteristics and topography are anticipated to continue southward across the entire proposed southeastern CAD cell. The depth to bedrock is typically more than 100 feet as was demonstrated by boring FB-02, and probes FP-01 and FP-02.

Inner Harbor Channel

Up to 26 feet of unsuitable material was detected in the channel. The thick deposits limit the net volume that can be obtained for a CAD cell. Therefore, alternative CAD locations were investigated.

Eastern CAD cell:

Thick silt deposits accumulated in the depression where sand and gravel was previously mined. Subsurface explorations FD-03, FD-02, and FP-12 are located in the vicinity of the proposed eastern CAD cell. The silt deposits are unsuitable for disposal in Long Island Sound. The thick deposits limit the net volume which could be gained by developing a CAD cell in this area. Therefore, alternative CAD locations were investigated.

Western CAD cell:

The depth to bedrock in the western CAD cell is the primary concern as shallow bedrock makes this location marginally acceptable for CAD cell construction. The bedrock surface typically dips easterly and ranges in depth from 25 to 60 feet below MLLW. Several bedrock outcrops or large boulders are exposed about 100 yards west of the shore line in Sea Side Park. The investigation of this CAD cell was conducted using geophysical methods. The seismic and resistivity profiles are discontinuous. The data was checked with a single boring done at the intersection of two profiles. The strength of the response interpreted as reflecting the bedrock surface was then adjusted to match the boring data. However, no additional data was collected to verify that the adjustment was universally correct. As a result, there is still uncertainty about the depth to bedrock. Based on the interpretation, the maximum depth of the CAD cell is 25 to 60 feet below MLLW. The average water depth is about 15 feet and shallow depths occur.

6.1. CAD Cell Excavation

Excavation of the western CAD cell

The geophysical data indicate a high amount of relief on the bedrock surface, as well as along the water bottom. Under the western CAD cell, the sediments are only marginally thick enough for a CAD cell, at about 8 to 15 meters in depth (MLLW). No large-scale boulders or boulder fields were identified.

The western CAD cell is underlain by bedrock ranging in depth to approximately 15 meters below MLLW towards the northern end. Geophysical Profile 2, which runs E-W across the northern end of the CAD cell, indicates the bedrock surface rises to approximately 10 meters at both the eastern and western edges of the CAD cell. Profile 3, which runs N-S interprets most of the bedrock surface under the middle and southern end of the CAD cell and is at a depth of about 5 meters below MLLW.

Elevation -16 in the northeast is a sufficient depth for access. However, the shallow depths across the cell will require planning for movement of scows and may require that the scows be partially loaded. Prop wash and tides will be significant concerns.

Based on previous dredging and CAD cell experience, the sidewalls of the CAD cell should be excavated at a slope of 1 Vertical to 3 Horizontal. This recommendation is based on the relative densities inferred from the N-value blow counts of the soil exploration programs done across the harbor. The slope of the sidewall can be adjusted if future soil testing specific to this location indicates it is necessary. Due to the shallow depths, changes in the sidewall slopes will have little impact on the volume of the CAD cell.

Excavation of the Southeastern CAD cell

The southeastern CAD cell is located in the old river channel where the bedrock surface is in excess of 100 feet below MLLW as demonstrated by soil Boring FB06-2 and two geophysical probes. No bedrock reflectors were identified during the geophysical investigation.

Removal of the 2 feet of unsuitable material should be done utilizing a 10-foot wide margin around the perimeter of the CAD cell. The black silt is only a couple feet thick, but is susceptible to movement by construction activity including prop wash. The area of egress for the barges to the cell should also be cleared of unsuitable materials. A 20 foot wide clean margin is recommended to provide a 1 vertical to 10 horizontal slope. During construction the depth of silt which has migrated into this margin can be monitored and re-cleared if necessary. Based on previous dredging and CAD cell experience, the sidewalls of the CAD cell should be excavated at a slope of 1 Vertical to 3 Horizontal. This recommendation is based on the relative densities inferred from the N-value blow counts of the soil exploration programs done across the harbor. The slope of the sidewall can be adjusted if future soil testing specific to this location indicates it is necessary. Due to the shallow depths, changes in the sidewall slopes will have little impact on the volume of the CAD cell.

The upper 30 feet of sand and gravel is material which could be used for controlled fill on various construction projects. The sieve results of this material indicate that it is a well graded coarse to fine sand. The sand has less than 5 percent fines at the locations tested and should drain well. This stratum corresponds to the depth of the Northeastern Anchorage which historically was mined for gravel. The lateral extent of this deposit is not clear. It is assumed that the deposit is continuous to the anchorage, but the extent to the south is unknown. It is constrained by the channel on the western side. The closest boring in the channel, FD-38, encountered five feet of gravelly sand . It is unknown whether the sand extends under Pleasure Beach. In 1962, 675,000 cubic yards of material were hydraulically dredged from the Bridgeport harbor channel and placed on Long Beach in Stratford, and Pleasure Beach in Bridgeport. However, the costs of multiple handling, lack of space for dewatering, inter-bedding of finer materials, and required production rates may reduce the economic value of the sand and gravel.

The N-values for the sand and gravel in FB06-02, range from 5 to 23. Typically material with N-values (blow counts per foot) less than 20 may be economically dredged. The dense material was located within the top ten feet of the gravel and is underlain by much looser material. Once the dense material is penetrated, the excavation will undermine the dense gravel facilitating excavation of the upper material. Dredging of the harbor channel was previously done using hydraulic methods. The dredged material was placed on Pleasure Beach and Long Beach.

The sand and gravel is underlain by approximately 20 feet of non-plastic to very slightly plastic organic silt. It is unknown whether the organic silt has uniform thickness across the CAD cell site. An undisturbed sample of the organic silt from the I-95 bridge site at a depth corresponding to the organic silt in the CAD cell had a water content of 74.9%. The high water content indicates that the saturated stratum has porosity in excess of 50%. This stratum is confined between the upper 30 feet of gravel and medium dense to dense glacio-lacustrine deposits below.

The interface with the upper gravel is gradational. The organic silt is soft with N-values between 3 and 5. Full recovery in the split spoon samples indicates that this material should be easily excavated. When the organic silt is no longer confined, some local slumping should be expected. Mixing with the overlying gravel will then stiffen the excavation's sloped surface.

The glacio-lacustrine materials are predominantly fine sand and silt. Red clay lenses ranging in thickness up to 3/8 inch thick were observed throughout the stratum. The amount of clay lenses increases with depth. The Dredging operations to the north did not penetrate this stratum. The area is represented by soil boring FD-03-02 which had glacio-lacustrine materials with N-values ranging from 17 to 34. The corresponding N-values from the center of the CAD cell in soil test boring FB06-02 ranged from 13 to 22.

Based on the previous construction information for the CAD cells and on past experience with similar type materials in other navigation dredging projects, a slope of 1V to 3H is recommended for the preliminary CAD cell sizing and design. Additional slope stability analysis is recommended after the material testing is complete to confirm the preliminary side slope for the CAD cells. It is assumed that the 1:3 slope will be conservative over some strata, but for ease of construction a single slope has been selected. The proposed CAD cells have a relatively thin mantle of organic silt which should not be significant because it is located at the mudline. However, a weak stratum of slightly plastic silt has been identified in the southeastern CAD cell. It may be possible to excavate a steeper slope below the silt It is recommended that after additional material testing is complete that the side slope be reviewed prior to development of plans and specifications.

Outer Harbor Channel

The outer channel is a potential borrow source for material needed to cap the CAD cells. The 1958 – 1962 test borings drilled in the harbor channel extended approximately 3 miles into the Long Island Sound outside of the Bridgeport Harbor breakwater. Vibra core explorations of this area were conducted in 1998. The 1998 Vibra-core data indicated that the organic silt extends at least 2 miles into the sound. The test borings encountered a surface layer of black organic silt extending 6000 feet out from the mouth of the breakwater. At 6000 feet from the breakwater, the thickness of the organics was 1 to 2 feet. It should be noted that current thickness could vary significantly from this 50 year old data. The organics are underlain by gray silty sand. The organics outside of the breakwater have been determined to be suitable material for disposal at CLIS or for capping the CAD cells within the inner harbor. However, if it is used for capping material over the CAD cells, it may be difficult to differentiate the boundary between future contaminated soil and the cap. The available data indicates that dredging from 2 miles and further out from the harbor would encounter more gray silty sand and minimize the amount of organic silts excavated.

7. CONCLUSIONS

After investigation of numerous locations across Bridgeport Harbor, the two locations shown on Figure 1 have been chosen as suitable for construction of CAD cells. Other areas were not chosen because of thick deposits of unsuitable material limited the net volume which could be derived at those locations. The southeastern CAD cell is the primary cell. It is located in the alluvial sediments filling a deep river valley. The southeastern CAD cell is constrained by the channel and breakwater. The back-slope of the sediments north of the breakwater is 1V to15H and should not be undercut by the CAD cell. An excavation slope not exceeding 1V to 3 H is recommended for the CAD cell. Based on soil boring penetration resistance data and previous dredging of the harbor, the soil from these CAD cells can be mechanically dredged and the uppermost 30 feet can be hydraulically dredged to the proposed dimensions. The materials from the proposed CAD cells are with the exception of a 2 foot surface layer at the mud line, suitable for disposal at CLIS. The uppermost 30 feet or thereabouts of suitable material is a sand and gravel deposit which is suitable for beach nourishment or controlled fill on construction projects. Similar material taken from the channel was previously used to nourish Long Beach, Pleasure Beach, and the beach at Sea Side Park. Erratic boulders may be encountered. However, any boulders at the site are apt to be near the bedrock surface and associated with the thin stratum of glacial till. Considering the proposed CAD cell shape and the depth of the river channel, problems with boulders are not anticipated.

The Western CAD cell can be mechanically dredged. It also is mantled with approximately 2 feet of unsuitable organic silt. The proposed western CAD cell is limited by an irregular bedrock surface which rises in a westerly direction. The shallow bedrock will limit the volume of the CAD cell. The geophysical data did not indicate boulders or bedrock pinnacles. However, the shallow water depths did not permit full coverage of the site. The soil suitable for reuse in the western CAD cell has not been shown to be sufficiently continuous to justify recovery. Unless future investigation reveals that there is sufficient salvageable material, disposal at CLIS is recommended for the spoils from this area.

Materials from the Southwestern CAD cell may be utilized for capping material for the western CAD cell.

8. RECOMMENDATIONS

Proposed Additional Investigations

An additional 4 test borings are recommended within the southeastern CAD cell to verify that the glacio-lacustrine silt and sand are loose enough to permit economical dredging. Data needed from the borings include the density of the glacio-lacustrine material, the thickness of the organic silt overlain by the sand and gravel, and that the depth to bedrock is in excess of 100 feet below MLLW. Two of these additional test borings should be conducted on the southern corners of the southeastern CAD cell to ensure that the boring, probes, and geophysical interpretations were correctly extrapolated across the CAD cell.

The validity of the geophysical interpretation of the depth to bedrock in the western CAD cell is unclear. A series of geotechnical probes should be drilled to map the shallow bedrock surface. Additionally, soil shear strength parameters should be measured from at least three locations within the CAD cell. The data can be obtained from in-situ testing or from soil borings samples. Existing soil samples are not suitable for this testing because they are disturbed samples. Additionally, the samples have dried and no longer represent subsurface conditions.

Drilling 6 to 8 probes to bedrock in the western CAD cell is recommended. Several of the additional points should coincide with the geophysical profiles as a further check of the bedrock surface interpretation. The other points should be located to verify bedrock depths at high points which could impact access within the CAD cell and the dredging sequence.

References

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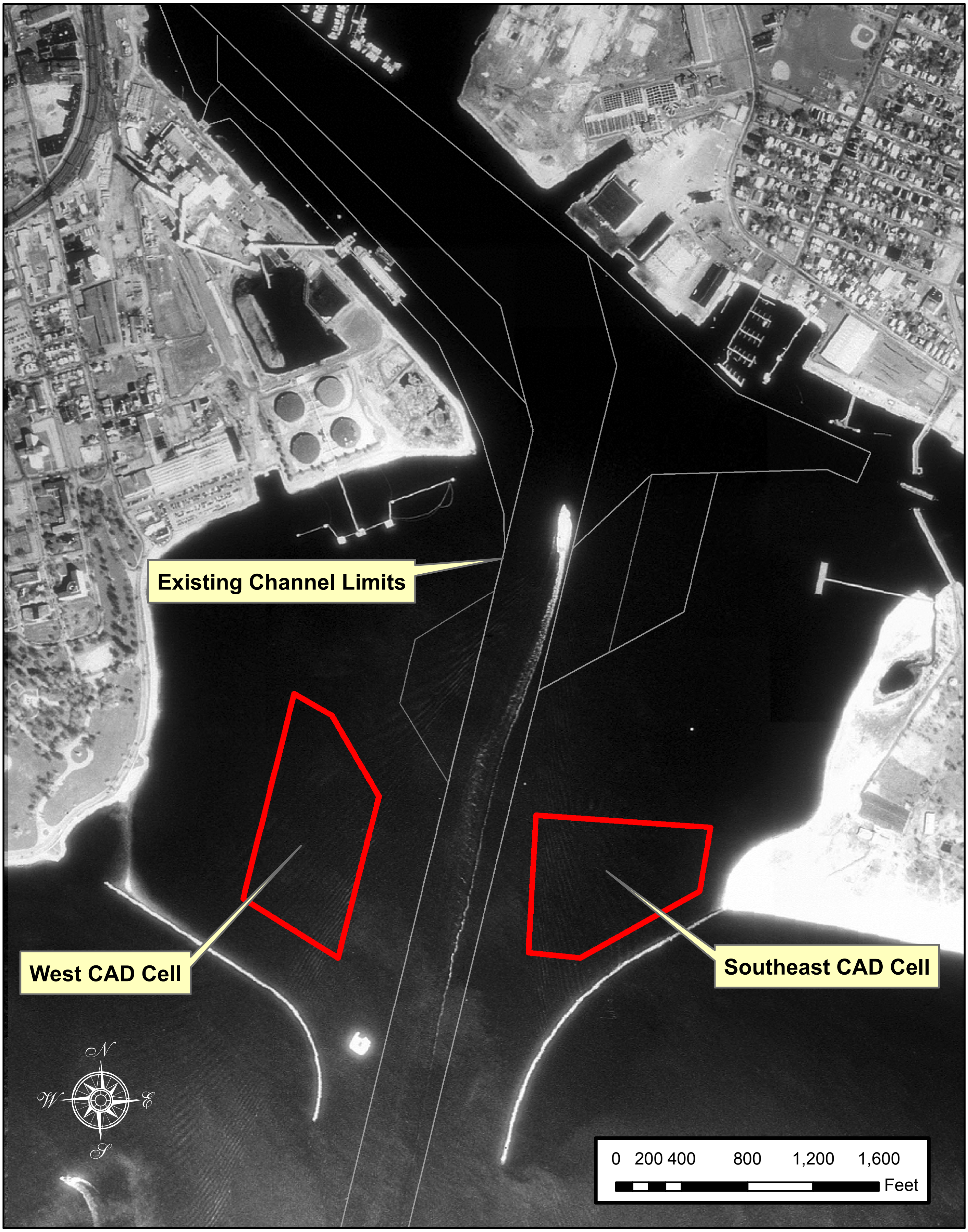
6. USACE, Bridgeport Harbor and Vicinity Reconnaissance Report Proposed Navigational Improvements, April 1980

7. USGS Report 2005-1162, Sidescan-Sonar Imagery and Surficial Geologic Interpretation of the Sea Floor off Bridgeport, CT, 2005.

8. USGS, Report 2007-5119, Marine Geophysical Investigation of Selected Sites in Bridgeport Harbor, Connecticut, 2006



Bridgeport Harbor CT
Proposed CAD Cell Locations

FIGURE 1

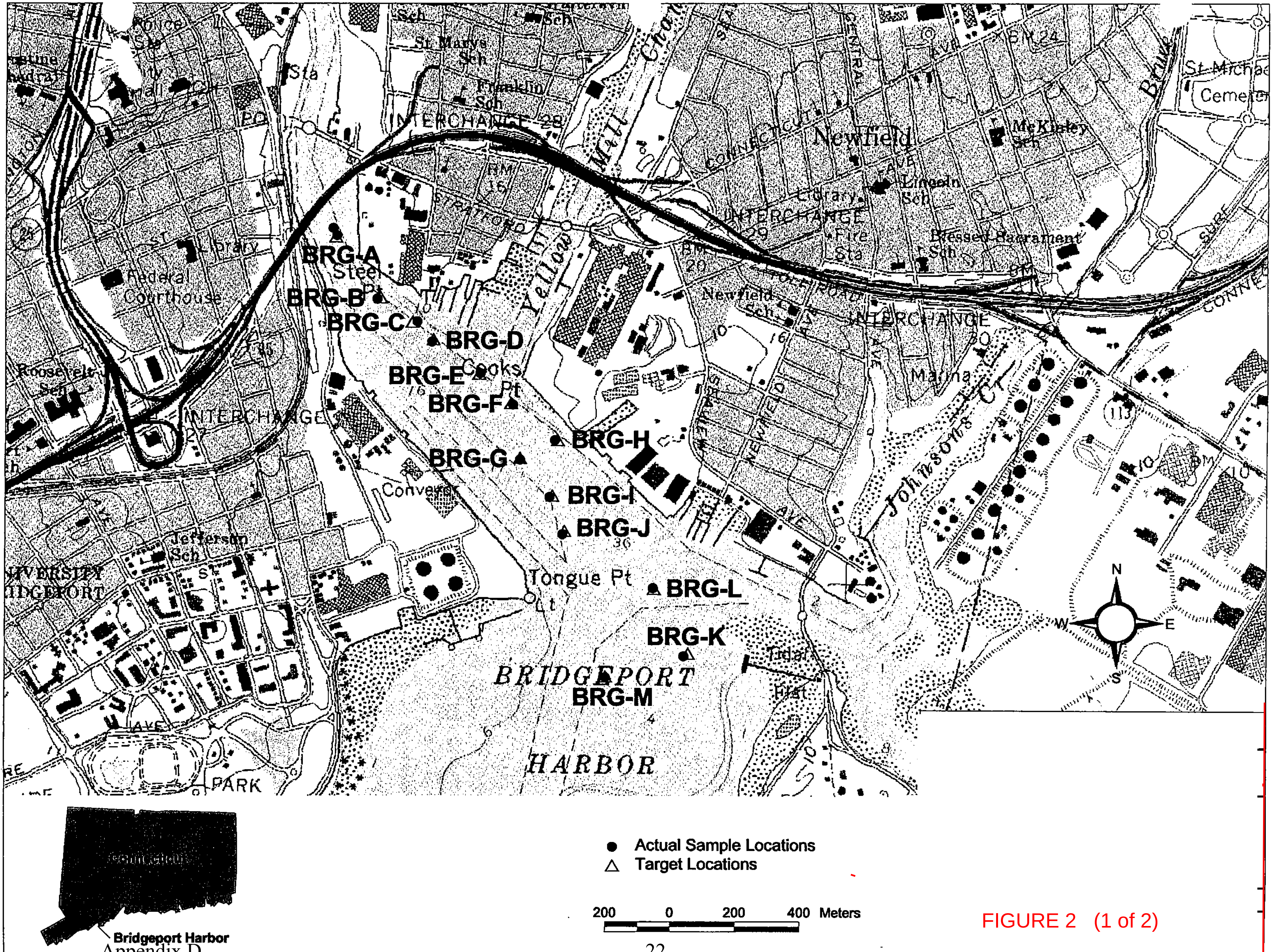


FIGURE 2 (1 of 2)

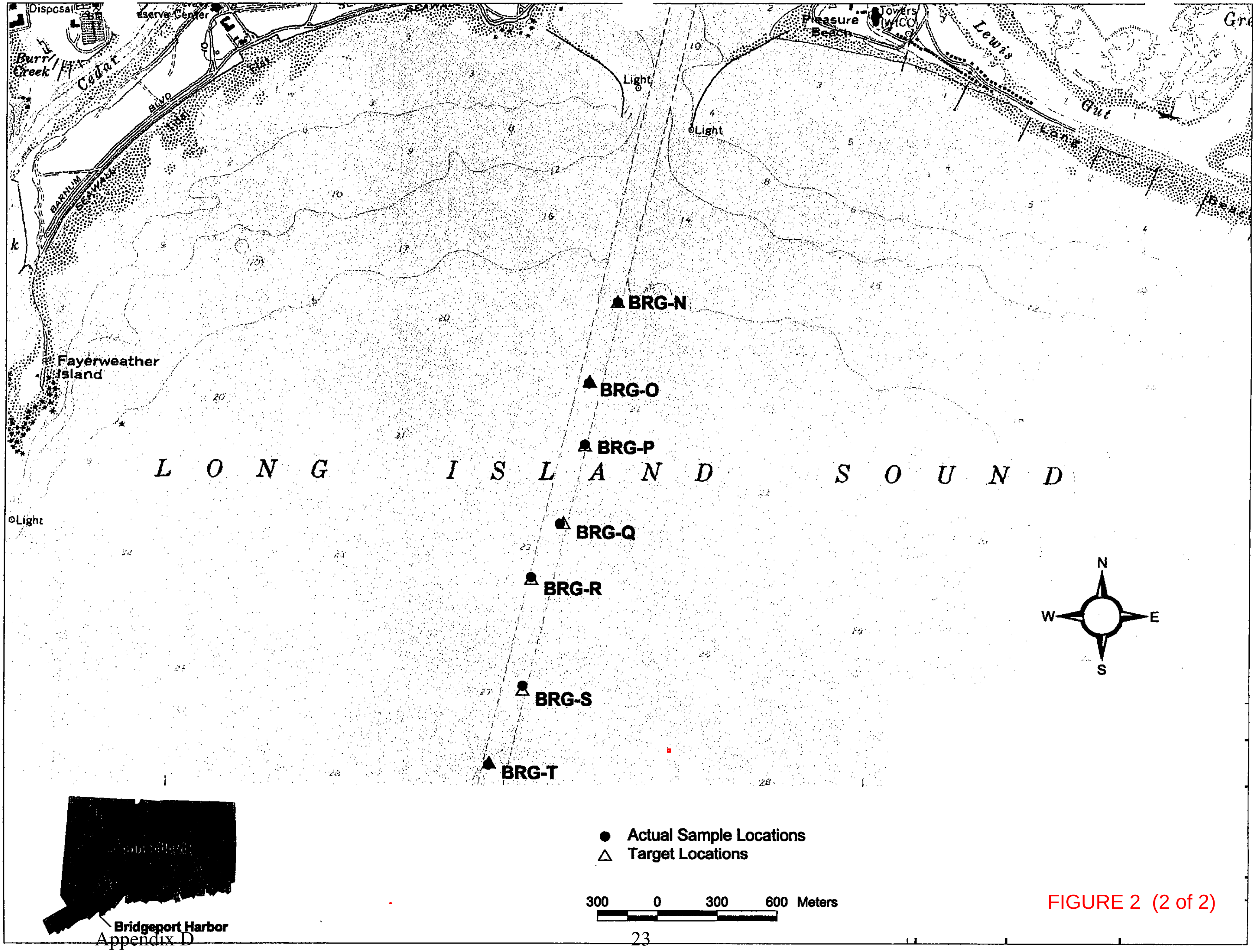
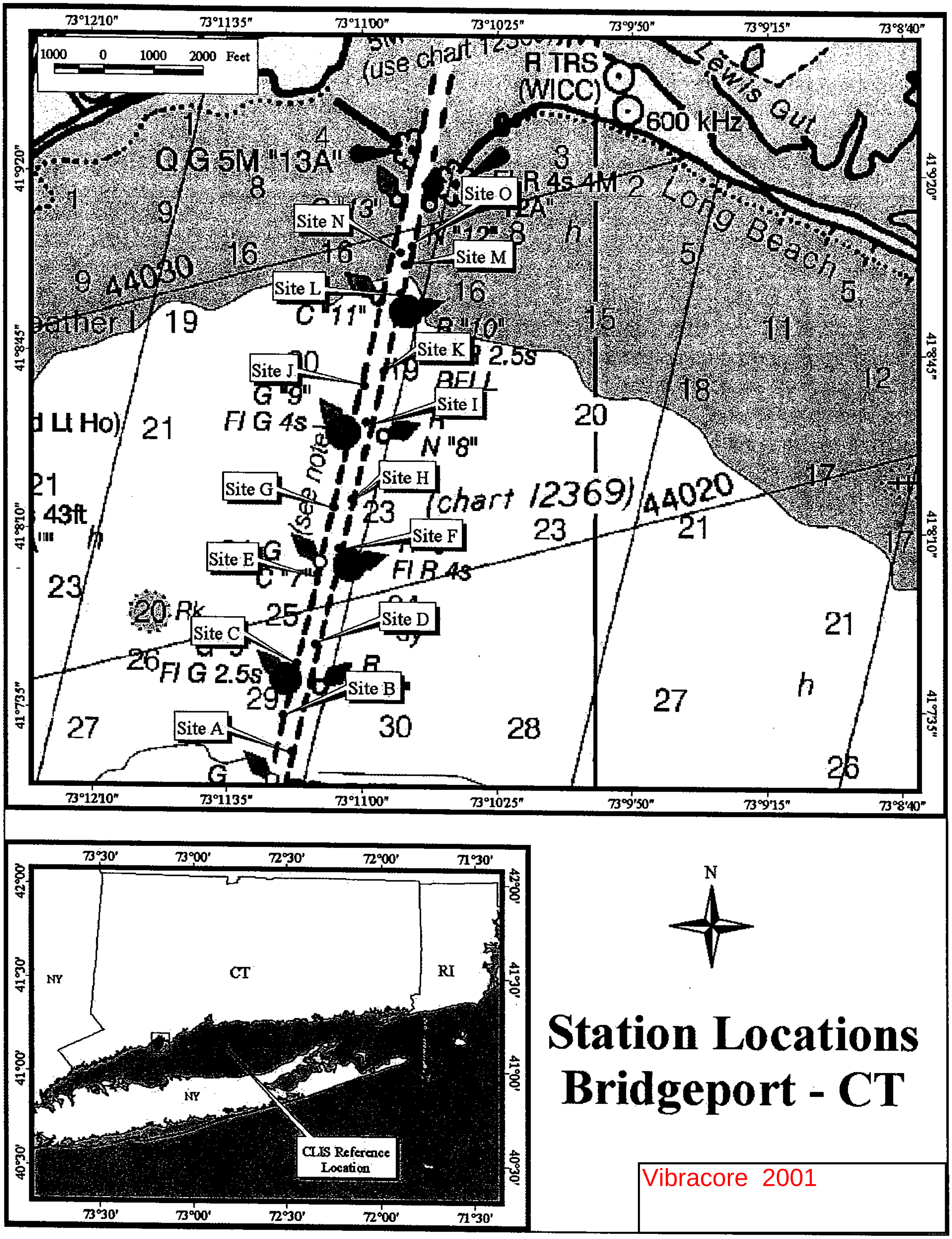


FIGURE 2 (2 of 2)



Vibracore 2001

Bridgeport Harbor Site Map with Sampling Locations.

FIGURE 3

Bridgeport Harbor Actual Probe and Boring Locations, 2003 Explorations

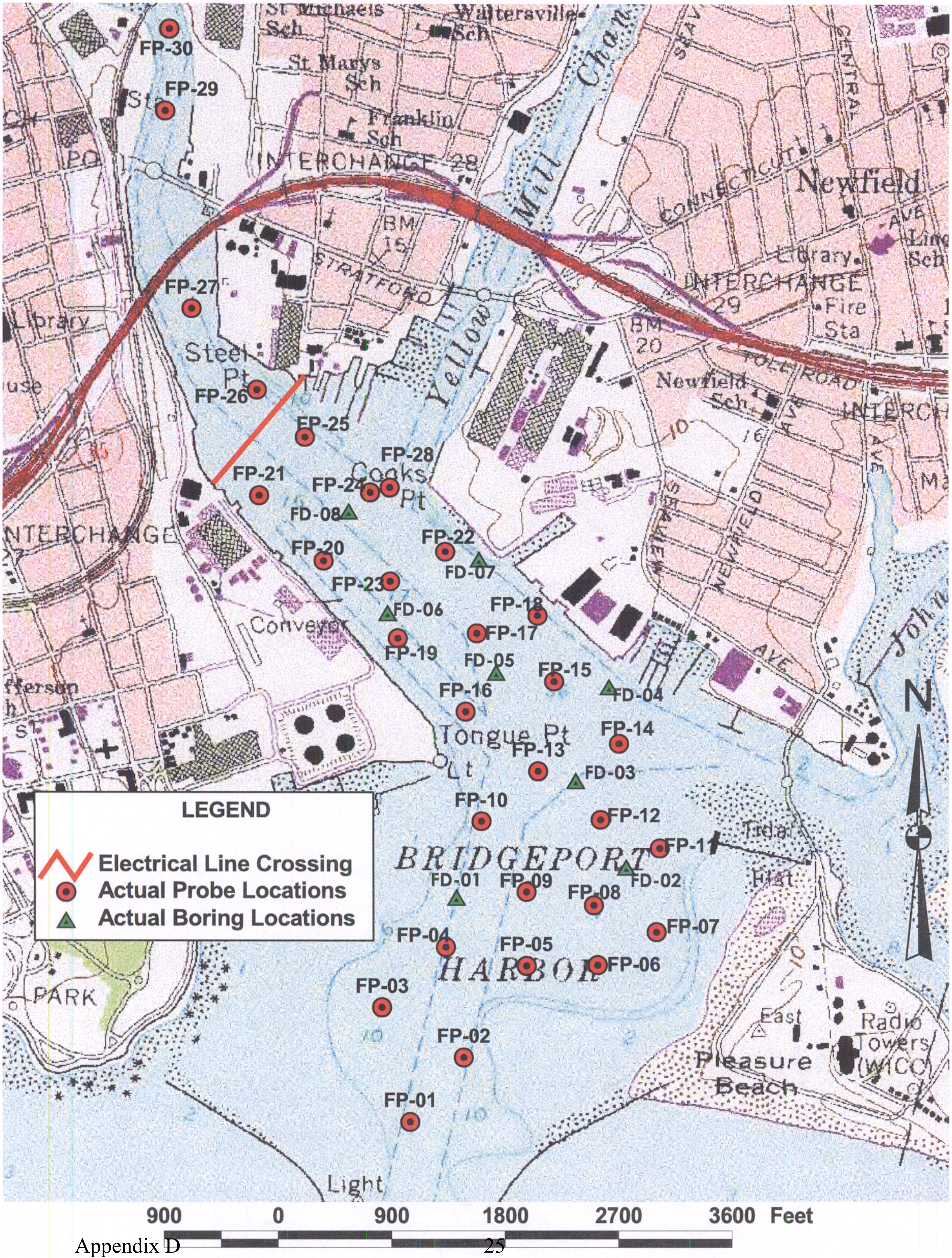
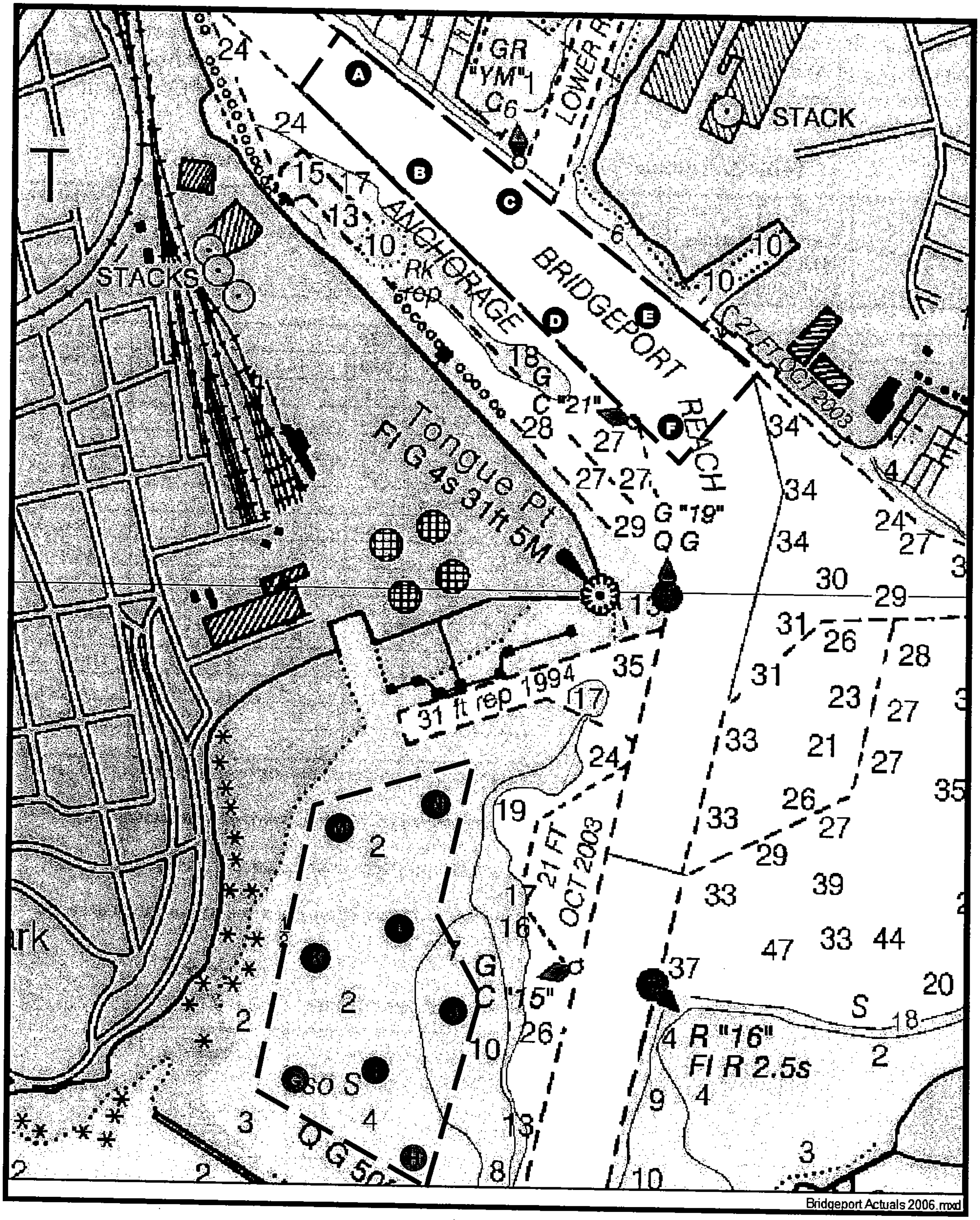
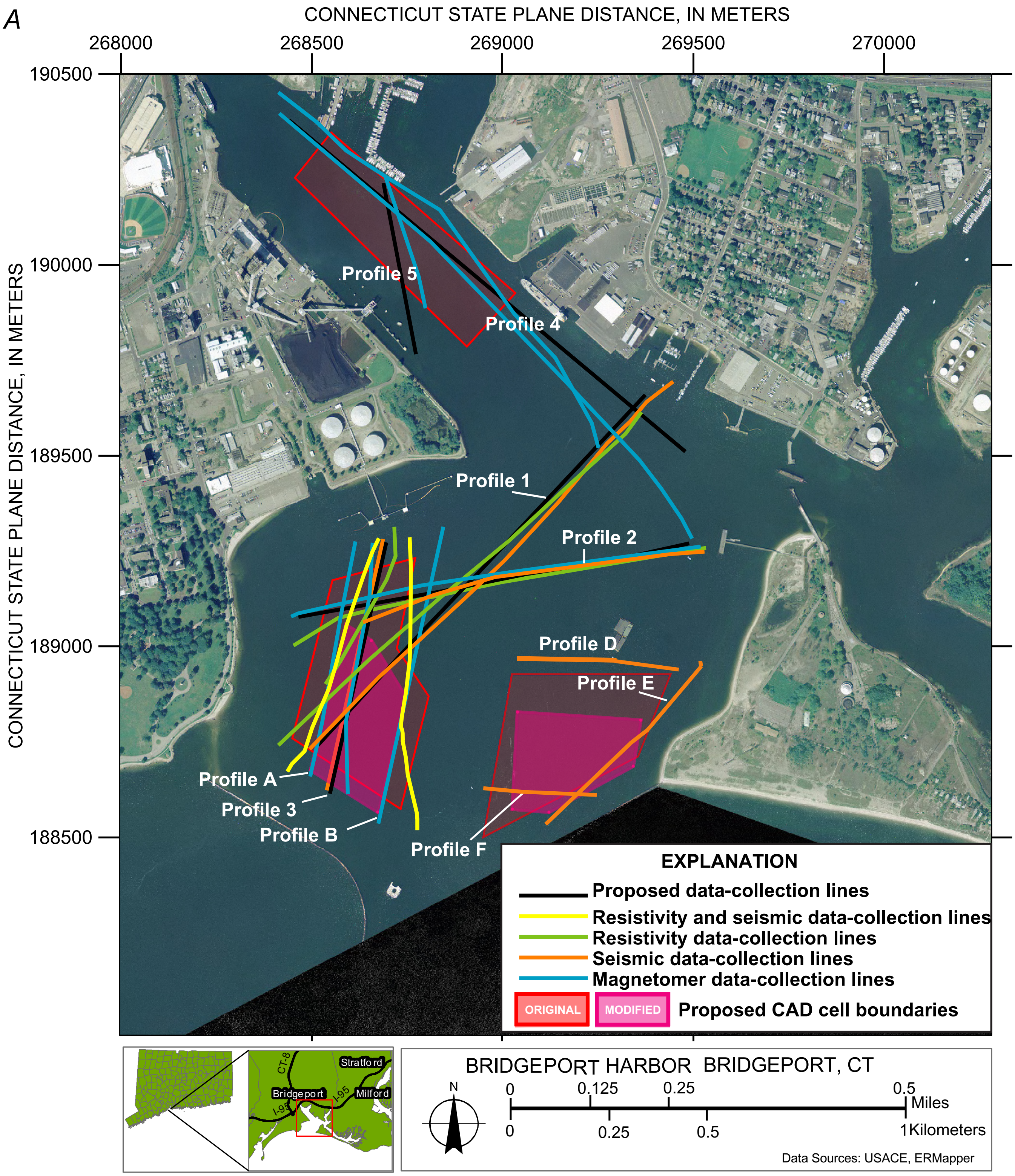


FIGURE 4



Vibracore 2005 **Sampling Locations within Bridgeport Harbor, CT.**

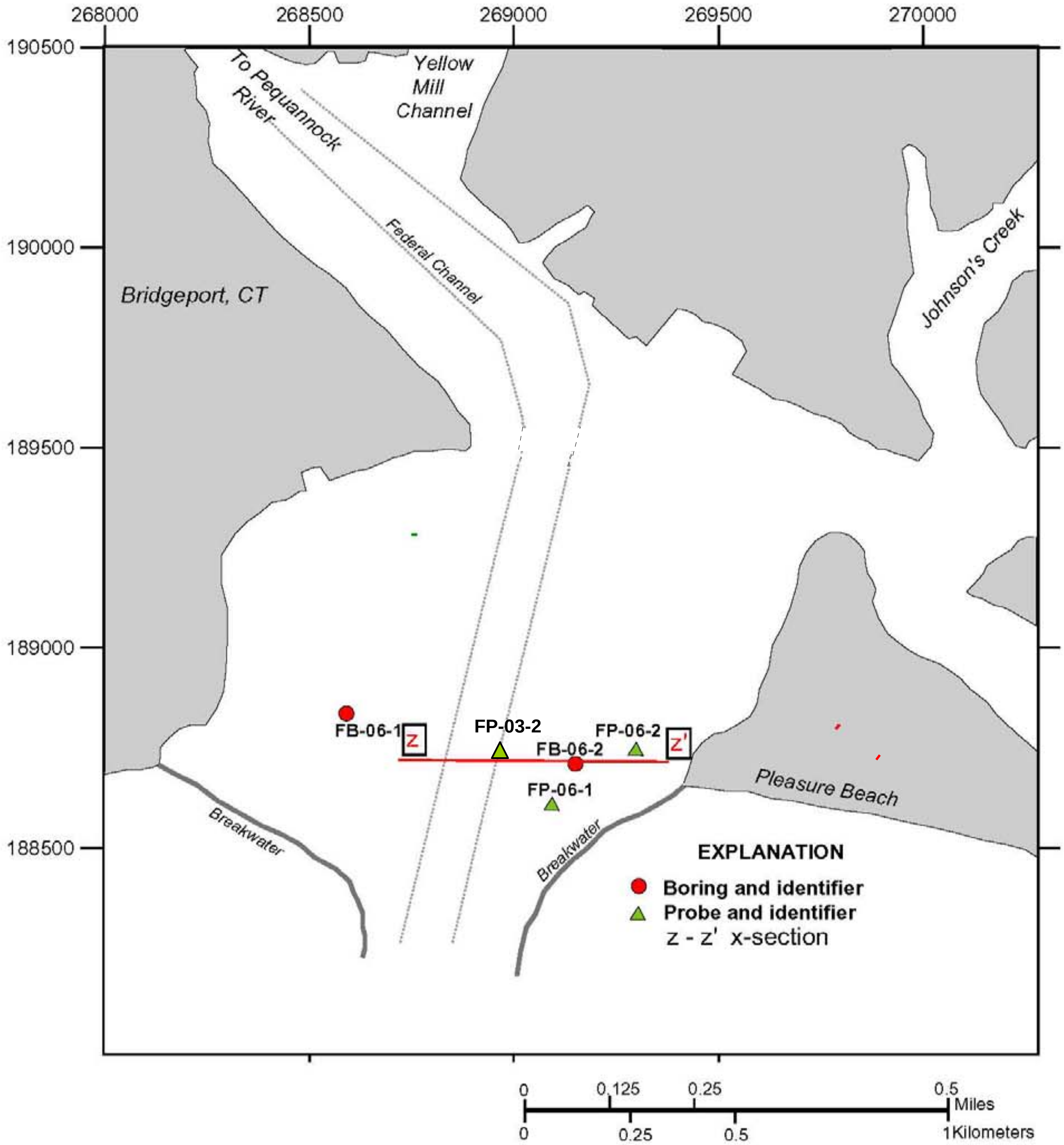
FIGURE 5



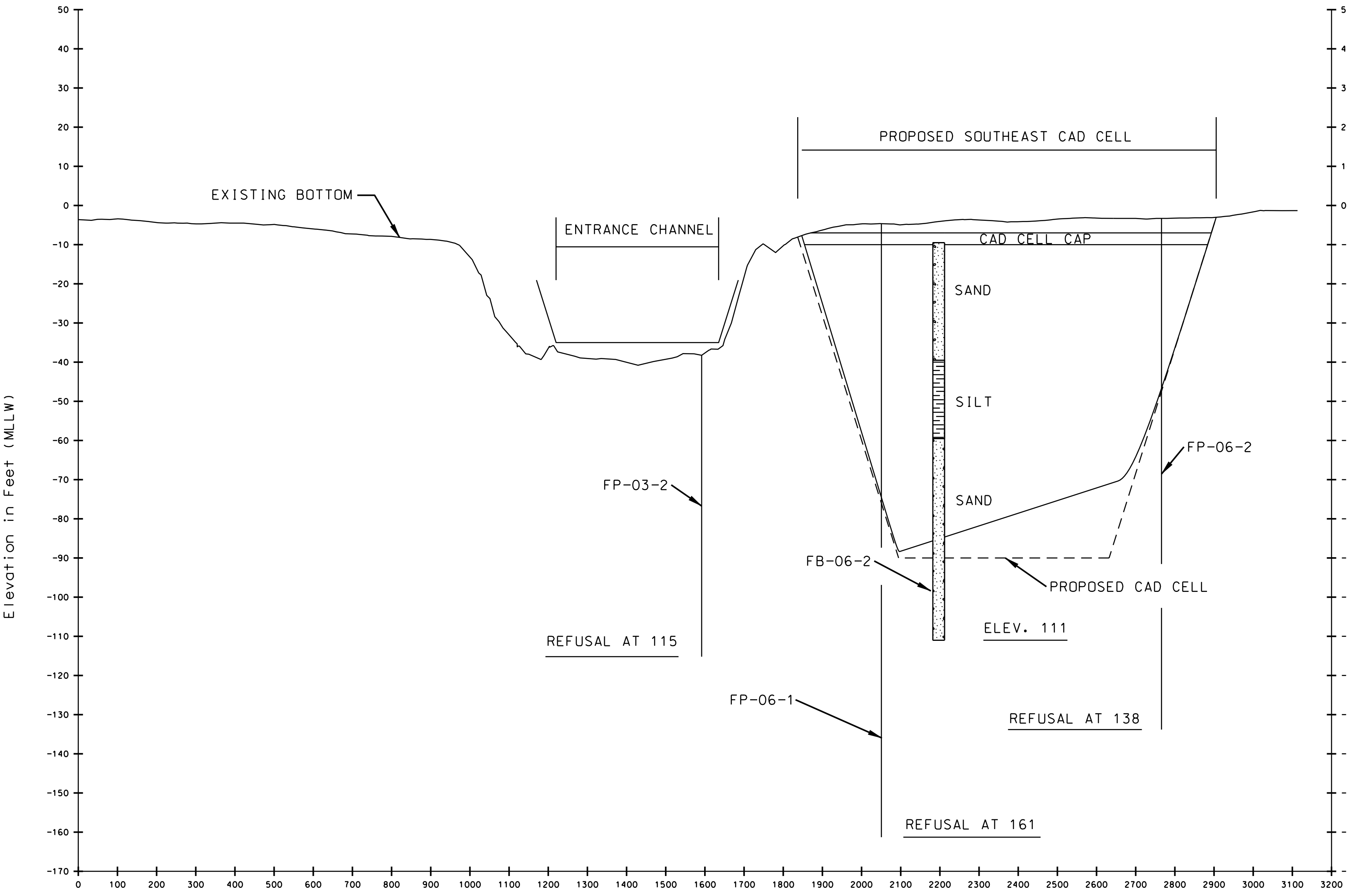
NAD 1983, Connecticut State Plane Coordinates, 2004 Aerial Photography from NOAA Coastal Services Center

Bridgeport Harbor, Bridgeport, Connecticut, showing profiles along which data were collected.

FIGURE 6



(*B*) Selected geophysical profiles, borings, and probe locations in Bridgeport Harbor, Bridgeport, Connecticut. All surveys for a single profile are shown in the same line color and the survey type is indicated by the line type. CRP is continuous resistivity profiling; CSP is continuous seismic profiling.



CROSS SECTION Z-Z' - SOUTHEAST CAD CELL

FIGURE 8

TABLE 1
Geotechnical Boring and Probe Data

Bridgeport Harbor
Dredged Material Management Plan (DMMP) Study
Bridgeport, Connecticut

	Exploration ID(1)		As-Drilled Location		Date	Start Time	End Time	Initial Water Elevation(3)	Barge Reference Elevation(3)(4)	Final Water Elevation(3)	Barge Reference(4) Elevation(3)	Depth Sampled (feet)	Mud Line		Bottom of Probe/Boring		Probe Penetration or Boring Soil Layer Thicknesses (feet)
			Northing (feet)(2)	Easting (feet)(2)									Depth(5) (feet)	Elevation(3)	Depth(5) (feet)	Elevation(3)	
Bridgeport Harbor Probes	1	FP-03-01	618741	881983	10/20/03	1220	1300	1.08	5.28	1.12	5.32	No samples	50.00	-44.72	92.9	-87.6	42.9
	2	FP-03-02	619252	882407	10/09/03	1025	1230	7.22	11.42	5.32	9.52	No samples	48.40	-36.99	124.7	-115.2	78.2
	3	FP-03-03	619652	881759	10/20/03	1015	1105	2.72	6.92	1.84	6.04	No samples	30.80	-23.89	72.6	-66.6	42.7
	4	FP-03-04	620135	882267	10/31/03	0910	1018	0.75	4.95	0.50	4.70	No samples	38.00	-33.06	107.3	-102.6	69.5
	5	FP-03-05	619979	882906	10/08/03	1410	1440	1.50	5.70	0.90	5.10	No samples	40.60	-34.90	100.4	-95.3	60.4
	6	FP-03-06	619991	883468	10/08/03	1205	1245	5.00	9.20	3.87	8.07	No samples	45.40	-36.20	120.0	-111.9	75.7
	7	FP-03-07	620254	883935	10/07/03	1400	1500	1.02	5.22	0.18	4.38	No samples	35.90	-30.68	110.4	-106.0	75.3
	8	FP-03-08	620464	883438	10/08/03	0935	1020	7.04	11.24	7.01	11.21	No samples	38.80	-27.56	118.7	-107.5	79.9
	9	FP-03-09	620572	882909	10/09/03	1435	1510	1.67	5.87	0.87	5.07	No samples	41.20	-35.33	107.9	-102.8	67.5
	10	FP-03-10	621138	882547	10/31/03	1200	1245	2.22	6.42	3.36	7.56	No samples	40.00	-33.58	130.7	-123.1	89.6
	11	FP-03-11	620926	883964	10/07/03	0950	1150	7.01	11.21	4.39	8.59	No samples	39.10	-27.89	136.2	-127.6	99.7
	12	FP-03-12	621155	883493	10/10/03	0945	1038	6.85	11.05	7.65	11.85	No samples	34.30	-23.26	132.8	-121.0	97.7
	13	FP-03-13	621545	883000	11/03/03	0925	1015	4.96	9.16	3.77	7.97	No samples	47.60	-38.45	129.2	-121.2	82.8
	14	FP-03-14	621764	883639	10/14/03	1125	1205	6.20	10.40	6.96	11.16	No samples	38.90	-28.51	92.7	-81.5	53.0
	15	FP-03-15	622264	883126	10/14/03	1335	1507	7.67	11.87	6.36	10.56	No samples	47.10	-35.23	148.2	-137.6	102.4
	16	FP-03-16	622021	882423	10/17/03	1000	1220	1.59	5.79	3.86	8.06	No samples	33.50	-27.71	177.8	-169.7	142.0
	17	FP-03-17	622644	882512	10/30/03	1418	1451	6.90	11.10	7.15	11.35	No samples	38.50	-27.40	106.2	-94.9	67.5
	18	FP-03-18	622792	882996	10/22/03	1300	1345	1.99	6.19	1.26	5.46	No samples	46.60	-40.41	125.7	-120.2	79.8
	19	FP-03-19	622609	881887	10/16/03	1215	1250	4.17	8.37	4.70	8.90	No samples	38.90	-30.53	70.4	-61.5	31.0
	20	FP-03-20	623234	881298	10/16/03	1335	1355	5.20	9.40	5.49	9.69	No samples	35.50	-26.10	71.4	-61.7	35.6
	21	FP-03-21	623765	880790	10/24/03	1215	1330	4.31	8.51	1.79	5.99	No samples	30.30	-21.79	87.0	-81.0	59.2
	22	FP-03-22	623310	882264	10/13/03	1120	1313	6.39	10.59	7.22	11.42	No samples	38.00	-27.41	146.5	-135.1	107.7
	23	FP-03-23	623065	881826	10/16/03	1005	1052	1.95	6.15	2.67	6.87	No samples	24.80	-18.65	83.7	-76.8	58.2
	24	FP-03-24	623785	881665	10/14/03	0920	1017	3.14	7.34	4.54	8.74	No samples	34.80	-27.46	102.9	-94.2	66.7
	25	FP-03-25	624229	881148	10/06/03	1130	1440	3.26	7.46	0.10	4.30	No samples	37.00	-29.54	96.5	-92.2	62.7
	26	FP-03-26	624608	880768	10/30/03	0935	1020	0.30	4.50	1.19	5.39	No samples	37.10	-32.60	77.2	-71.8	39.2
	27	FP-03-27	625263	880254	10/23/03	1015	1130	7.06	11.26	5.17	9.37	No samples	42.00	-30.74	102.2	-92.8	62.1
	28	FP-03-28	623820	881824	11/03/03	1200	1225	1.48	5.68	1.12	5.32	No samples	36.80	-31.12	93.0	-87.7	56.6
	29	FP-03-29	626838	880046	10/28/03	1100	1145	6.59	10.79	7.75	11.95	No samples	28.30	-17.51	78.6	-66.7	49.1
	30	FP-03-30	627493	880079	10/28/03	1248	1335	8.62	12.82	8.41	12.61	No samples	29.20	-16.38	80.6	-68.0	51.6

TABLE 1
Geotechnical Boring and Probe Data

Bridgeport Harbor
Dredged Material Management Plan (DMMP) Study
Bridgeport, Connecticut

	Exploration ID(1)		As-Drilled Location		Date	Start Time	End Time	Initial Water Elevation(3)	Barge Reference Elevation(3)(4)	Final Water Elevation(3)	Barge Reference(4) Elevation(3)	Depth Sampled (feet)	Mud Line		Bottom of Probe/Boring		Probe Penetration or Boring Soil Layer Thicknesses (feet)
			Northing (feet)(2)	Easting (feet)(2)									Depth(5) (feet)	Elevation(3)	Depth(5) (feet)	Elevation(3)	
Bridgeport Harbor Borings	1	FD-03-01	620525	882350	11/21/03	1000	1515	6.47	10.67	-0.30	3.91	0-27	44.00	-33.33	67.0	-100.3	26' - OL/OH; 11' - SP; 28' - ML; 2' - SM
		FD-03-01A	620535	882339	12/09/03	1100	1815	7.83	12.03	0.42	4.62	30-67					
	2	FD-03-02	620770	883694	11/04/03	1115	1415	4.10	8.30	1.35	5.55	0-17	36.00	-27.70	45.0(6)	-72.7	7' - OL/OH; 18' - SM; 15' - ML; 5' - BR
		FD-03-02A	620758	883688	11/05/03	1040	1545	6.04	10.24	0.90	5.10	20-42	39.00	-28.76			
		FD-03-02B	620757	883693	11/07/03	1045	1327	7.33	11.53	3.35	7.55	40-45	41.00	-29.48			
	3	FD-03-03	621466	883296	11/10/03	1100	1430	6.64	10.84	3.99	8.19	0-27	44.00	-33.16	67.0	-100.2	19' - OL/OH; 6' - ML; 20' - SM, SP-SM; 22' - ML
		FD-03-03A	621460	883298	11/11/03	0930	2040	4.63	8.83	2.36	6.56	30-67	44.10	-35.27			
	4	FD-03-04	622219	883559	11/12/03	1145	1623	6.93	11.13	3.42	7.62	0-27	44.00	-32.88	27.0(6)	-59.9	9' - OL/OH; 13' - SM; 5' - BR
	5	FD-03-05	622337	882666	12/05/03	1035	1430	5.99	10.19	0.81	5.01	0-22	40.40	-30.21	72.0	-102.2	26' - OL/OH; 20' - SP, SP-SM; 26' - ML
		FD-03-05A	622327	882663	12/10/03	1115	2228	7.68	11.88	5.89	10.09	25-72					
	6	FD-03-06	622809	881808	11/17/03	1030	1615	1.53	5.73	6.38	10.58	0-50.5	36.00	-30.27	50.5(6)	-80.8	15' - OL/OH; 15' - MH, ML; 5' - GP; 10.5' - SM, SP-SM; 5' - BR
	7	FD-03-07	623247	882528	11/18/03	1040	1530	1.68	5.88	4.71	8.91	0-37	33.60	-27.72	69.0(6)	-96.7	13' - OL/OH; 51' - ML; 5' - BR
		FD-03-07A	623247	882525	11/24/03	1115	1735	9.27	13.47	-0.44	3.76	40-69	42.00	-28.53			
	8	FD-03-08	623635	881499	11/25/03	1050	1535	7.89	12.09	2.69	6.89	0-27	43.00	-30.91	65.0(6)	-95.9	9' - OL/OH; 26' - ML; 25' - SP-SM, SP, SM; 5' - BR
		FD-03-08A	623621	881498	11/26/03	1100	1415	7.03	11.23	7.13	11.33	30-52					
		FD-03-08B	623629	881492	12/04/03	1045	1556	3.74	7.94	0.53	4.73	55-65	35.50	-27.57			

Notes:

(1) Some explorations required longer than one day to complete. Barge was relocated daily to the coordinates shown and the explorations resumed at the depths indicated.

(2) Coordinates are given in NAD83 CT state plane coordinate system.
GPS coordinates were post-processed and differentially corrected using the Acushnet, Massachusetts CORS.

(3) Elevations are in feet referenced to Mean Lower Low Water (MLLW).
Elevations were calculated using National Ocean Service (NOAA) water level data collected at 6 minute intervals from Station No. 8467150 in Bridgeport Harbor, Bridgeport, CT and published on the NOAA website. (http://co-ops.nos.noaa.gov)

(4) Freeboard was about 4.2 feet (Distance from water to Barge Reference Point).

(5) Probe and boring depths to the mud line were measured from the Barge Reference Point.
Depths to the bottom of probes were measured also from the Barge Reference Point.
Depths to the bottom of borings were measured relative to the mud line reference.

(6) Boring terminated with 5 feet of rock core.

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	**BORING LOG** PAGE 1 of 5 **FD-03-01**

GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

BORING LOCATION: see plan
TOTAL DEPTH (FT): 67
MUDLINE ELEVATION (FT): -33.2
VERT. DATUM: MLLW
NORTHING: 620525
EASTING: 882350
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 11/21/03
LOGGED BY: S. Hawkins
DATE END: 12/9/03

Borehole advanced using drive/wash techniques.
Casing advanced using a 300lb. Safety Hammer
SPT's advanced using a 140lb. Safety Hammer

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0	WOC								
	WOC								
	WOC								
	WOC								NOTE: No Sample Taken for top 5 feet.
	WOC								NOTE: Environmental samples collected from FD-01 (5-7) and FD-01 (7-9).
5	WOC	FD01 (5-7)	WOR	24	24				FD-01(5-7) (0-9"): ORGANIC SILT WITH SAND (OH); homogeneous, med. plasticity, ~21% fine to medium sand, dk. gray. (Note: Description based on lab gradation and Atterberg limit analyses.)
			WOR						
	WOC		WOR						FD-01(5-7) (9-10"): WELL-GRADED SAND (SW); homogeneous, <5% fines, olive-gray.
			WOR						
	WOC	FD01 (7-9)	WOR	24	20				FD-01(5-7) (10-24"): ORGANIC SOIL (OL/OH); homogeneous, med. plasticity, <5% f. sand, olive-gray.
			WOR						
	WOC		WOR						FD-01(7-9): ORGANIC SILT WITH SAND (OH); homogeneous, med. plasticity, ~17% f. sand, olive-gray. (Note: Description based on lab gradation and Atterberg limit analyses.)
			WOR						
	WOC								
10	WOC								
	WOC								

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

- ORGANIC SOIL
- SAND
- BEDROCK
- SILT
- GRAVEL

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	**BORING LOG**	
		PAGE 2 of 5	**FD-03-01**

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
	WOC								
	15								
	10								
15	25	S1	2	24	24				S1: ORGANIC SOIL (OL/OH); homogeneous, low-med. plasticity, <5% F. sand, organic odor, olive-gray.
			1						
	16								
			1/12"						
	14								
	14								
	14								
20	24	S2	4/24"	24	24				S2: ORGANIC SOIL (OL/OH); homogeneous, low-med. plasticity, contains shell fragments (~10-30mm), olive-gray.
	30								
	21								
	20								
	20								S3: (0-10") ORGANIC SOIL (OL/OH); heterogeneous, low-med. plasticity, ~50% shell fragments, organic odor, dark gray.
25	49	S3	WOR	24	24				S3: (10-14") Possible wood debris.
			35						S3: (14-18") SANDY SILT (ML); homogeneous, low plasticity, 30% f. sand, lt. gray/brown.
	63		25						
			29						S3: (18-24") POORLY GRADED SAND WITH GRAVEL (SP); ~70% med. to fine sand, ~25% coarse subrounded gravel, ~5% silt, lt. gray.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in. TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

- ORGANIC SOIL
- SAND
- BEDROCK
- SILT
- GRAVEL

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	BORING LOG PAGE 3 of 5 FD-03-01

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
	51							⁘	
	53							⁘	
	48							⁘	NOTE: Begin Day 2 drilling. (N620534, E882339)
30	70	S4	7	24	24			⁘	S4: POORLY GRADED SAND (SP); homogeneous, ~50% med. sand, ~35-45% fine sand, <5% silt, 1 piece of rounded gravel ~40mm, gray.
			10					⁘	
	51		15					⁘	
			16					⁘	
	48							⁘	
	43							⁘	
	33							⁘	
35	63	S5	8	24	24			⁘	S5: (0-23"); POORLY GRADED SAND WITH SILT (SP-SM); homogeneous, ~17% med. sand, ~73% fine sand, ~10% fines, 1 piece of rounded gravel ~40mm, gray. (Note: Description based on lab gradation and Atterberg limit analyses.)
			15					⁘	
	62		20					⁘	S5 (23-24"): SILT (ML); homogeneous, high plasticity, gray.
			19					⁘	
	68							☰	
	72							☰	
	63							☰	NOTE: Continue drilling open hole.
40	N/A	S6	7	24	24			☰	S6: SILT (ML); laminated with layers of ~2-5 mm thick brown clay, low- med. plasticity, <5% f. sand, med. dilatency, gray.
			7					☰	
	N/A		9					☰	
			13					☰	

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

⫼ - ORGANIC SOIL	⁘ - SAND	V V V - BEDROCK
☰ - SILT	▷◇ - GRAVEL	

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

BORING LOG
PAGE 4 of 5
FD-03-01

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
	N/A							▤	
	N/A								
	N/A								
45	N/A	S7	6	24	24				S7: SILT (ML); laminated with layers of ~2-5 mm thick brown clay, non-plastic, ~3% f. sand, med. dilatency, gray. (Note: Description based on lab gradation and Atterberg limit analyses.)
			8						
	N/A		9						
			13						
	N/A								
	N/A								
	N/A								
50	N/A	S8	ND*	24	24				S8: SILT (ML); laminated with layers of ~2-5 mm thick brown clay, low-med. plasticity, <5% f. sand, med. dilatency, gray. *NOTE: Sampler dropped from a height of ~5 feet above sampling location. (poor driller control)
			ND*						
	N/A		19						
			20						
	N/A								
	N/A								
	N/A								
55	N/A	S9	ND*	24	20				S9: Similar to S8. *NOTE: Sampler dropped from a height of ~15 feet above sampling location. (poor driller control)
			ND*						
	N/A		ND*						
			ND*						

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
░ - SAND
V - BEDROCK
▤ - SILT
▷ - GRAVEL

Φ GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	**BORING LOG** PAGE 5 of 5	**FD-03-01**

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
	N/A								
	N/A								
	N/A								
60	N/A	S10	ND*	24	12				S10: CLAYEY SILT (CL-ML); laminated with layers of ~2-5 mm thick brown clay, low plasticity, ~13% f. sand, rapid dilatency, gray. (Note: Description based on lab gradation and Atterberg limit analyses.) *NOTE: Sampler dropped from a height of ~15 feet above sampling location. (poor driller control)
			ND*						
	N/A		ND*						
			ND*						
	N/A								
	N/A								
	N/A								
65	N/A	S11	ND*	24	12				S11: SILTY SAND (SM); homogeneous, mostly fine sand, ~20-30% low plasticity fines, gray. *NOTE: Sampler dropped from a height of ~15 feet above sampling location. (poor driller control)
			ND*						
	N/A		ND*						
			ND*						End of Boring @ 67 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

- ORGANIC SOIL
- SAND
- BEDROCK
- SILT
- GRAVEL

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

BORING LOG
PAGE 1 of 4
FD-03-02

GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

BORING LOCATION: see plan
TOTAL DEPTH (FT): -45
MUDLINE ELEVATION (FT): -28.5
VERT. DATUM: MLLW
NORTHING: 620770
EASTING: 883694
HOR. DATUM: NAD 83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 11/4/03
LOGGED BY: S. Hawkins
DATE END: 11/7/03

Borehole advanced using drive/wash techniques.
Casing advanced using a 300lb. Safety Hammer
SPT's advanced using a 140lb. Safety Hammer

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0	WOC							▥	
	WOC							▥	
	WOC							▥	
	WOC							▥	NOTE: No samples taken for top 5 feet.
	WOC							▥	NOTE: Environmental samples collected from S1 and S2.
5	WOC	S1	WOR	24	24			▥	S1 (0-21"): ORGANIC SILT (OH); homogeneous, medium plastic, ~7% fine sand, fibrous, black. (Note: Description based on lab gradation and Atterberg limit analyses.)
			WOR					▥	
	WOC		5					▥	S1 (21-24"): SILTY SAND (SM); homogeneous, mostly fine sand, ~15% silt, rust lenses @ 12", sheen, brown.
			6					▥	
	WOC	S2	6	24	18			⁙	S2: SANDY SILT (ML); homogeneous, non-plastic, ~40% fine sand, gray/brown. (Note: Description based on lab gradation and Atterberg limit analyses.)
			8					⁙	
	WOC		11					⁙	
			15					⁙	
	WOC							⁙	
10	WOC	S3	9	24	8			⁙	S3: SILTY SAND (SM); homogeneous, ~56% fine sand, ~44% fines, gray/brown. (Note: Description based on lab gradation and Atterberg limit analyses.)
			16					⁙	
	10		8					⁙	
			8					⁙	

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in. TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE
ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⁙ - SAND
▽ - BEDROCK
☰ - SILT
▨ - GRAVEL

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	**BORING LOG** PAGE 2 of 4	**FD-03-02**

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
	17							⁙	
	25								
	31								
15	62	S4	8	24	24				S4: POORLY GRADED SAND W/SILT (SP-SM); homogeneous, ~90% fine sand, ~5-10% fines, brown.
			11						
	70		15						
			24						
	91								
	108								
	134								NOTE: Begin Day 2 Drilling. (N620757, E883688)
20	73	S5	10	24	24	0.6	0.6		S5: SANDY SILT (ML); homogeneous, low plasticity, 30-40% fine sand, brown/gray.
			14						
	85		14						
			15						
	100								
	128								
	105								NOTE: Begin drilling open hole.
25	N/A	S6	17	24	15	0.5	1.5	▤	S6: SILT (ML); homogeneous, low-med. plasticity, ~10% fine sand, gray.
			19						
	N/A		15						
			16						

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE
ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⁙ - SAND
∨ - BEDROCK
▤ - SILT
▨ - GRAVEL

Φ GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	BORING LOG PAGE 3 of 4	FD-03-02

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
	N/A							▤	
	N/A								
	N/A								
30	N/A	S7	5 6	24	20	0.25	1.2		S7: SILT (ML); homogeneous, laminated brown clay lenses ~3-5 mm thick, med. plasticity, 5-10% fine sand, gray.
	N/A		11 13						
	N/A								
	N/A								
	N/A								
35	N/A	S8	8 9	24	24	0.25, 0.75	1.0		S8: SILT (ML); homogeneous, laminated brown clay lenses ~3-5 mm thick, non-plastic, ~4% fine sand, gray. (Note: Description based on lab gradation and Atterberg limit analyses.)
	N/A		13 16						
	N/A								
	N/A								
	N/A								NOTE: Begin Day 3 Drilling. (N620757, E883693)
40	N/A	C1	3 min.	60	57			V V	C1: v. hard, unweathered, fine grained "pinstripe" SCHIST and GNEISS of the Orange Formation. RQD = 0.77. (Derby Hill Member)
	N/A		2 min.						

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⁘ - SAND
V V - BEDROCK
▤ - SILT
▨ - GRAVEL

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	BORING LOG PAGE 4 of 4	FD-03-02

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
	N/A	▮	2 min.					V V	
	N/A	▮	2 min.					V V	
	N/A	▮	2 min.					V V	End of boring @ 45 feet below mudline.
45									

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⁙ - SAND
V V - BEDROCK
▤ - SILT
◇ - GRAVEL

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	**BORING LOG** PAGE 1 of 5 **FD-03-03**

GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT) WATER	CASING	HOLE

BORING LOCATION: see plan
TOTAL DEPTH (FT): -67
MUDLINE ELEVATION (FT):-33.05
VERT. DATUM: MLLW
NORTHING: 621466
EASTING: 883296
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 11/10/03
LOGGED BY: S. Hawkins
DATE END: 11/11/03

Borehole advanced using drive/wash techniques. Casing advanced using a 300lb. Safety Hammer
SPT's advanced using a 140lb. Safety Hammer

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
0	WOC								
	WOC								
	WOC								NOTE: No samples taken for top 5 feet.
	WOC								
	WOC								NOTE: Environmental samples collected from samples S1 to S8.
5	WOC	S1	WOR	24	3				S1: ORGANIC SOIL (OL/OH); homogeneous, med. plasticity, <5% fine sand, organic odor, black.
			WOR						
	WOC		WOR						
			WOR						
	WOC	S2	WOR	24	17				S2: ORGANIC SILT (OH); homogeneous, medium plasticity, ~7% fine sand, black. (Note: Description based on lab gradation and Atterberg limit analyses.)
			WOR						
	WOC		WOR						
			WOR						
	WOC	S3	WOR	24	12				S3: similar to S2.
			WOR						
10	WOC		WOR						
			WOR						
	WOC	S4	WOR	24	12				S4: ORGANIC SILT (OH); homogeneous, medium plasticity, ~9% fine sand, black. (Note: Description based on lab gradation and Atterberg limit analyses.)
			WOR						

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⁘ - SAND
V - BEDROCK
▤ - SILT
▧ - GRAVEL

Φ GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

BORING LOG
PAGE 2 of 5
FD-03-03

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
	WOC		WOR					▥	
			WOR						
	WOC	S5	WOR	24	24				S5: ORGANIC SILT (OH); homogeneous, med. plasticity, <5% fine sand, organic odor, dk. gray.
			WOR						
	WOC		WOR						
			WOR						
15	WOC	S6	WOR	24	24				S6: ORGANIC SILT (OH); homogeneous, medium plasticity, ~6% fine sand, dark gray. (Note: Description based on lab gradation and Atterberg limit analyses.)
			WOR						
	WOC		WOR						
			WOR						
	12	S7	WOH	24	24			▤	S7 (0-20"): SILTY SAND (SM); homogeneous, mostly fine sand, ~47% non-plastic fines, black.
			WOH						S7 (20-24"): SILT WITH SAND (ML); homogeneous, low-med. plasticity, ~15-25% fine sand, gray.
	17		1/12"						
	21	S8	3	24	13				S8: SANDY SILT (ML); ~30& fine sand, gray. (Note: Description based on lab gradation and Atterberg limit analyses.)
			10						
20	22		11						
			15						
	53								
	48								
	56								
	70								NOTE: Begin Day 2 Drilling. (N621460, E883298)
25	88	S9	15	24	24	1.3	0.0	░	S9: SILT WITH SAND (ML); homogeneous, non-plastic, ~22% fine sand, brown. (Note: Description based on lab gradation and Atterberg limit analyses.)
			9						
	98		36						
			60						

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
░ - SAND
✓ - BEDROCK
▤ - SILT
△ - GRAVEL

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	**BORING LOG** PAGE 3 of 5	**FD-03-03**

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
	102							⁙	
	168							⁙	
	150							⁙	
30	87	S10	7 11	24	12			⁙	S10: SILTY SAND (SM); homogeneous, mostly fine sand, ~15-25% fines, brown.
	73		14 15					⁙	
	89							⁙	
	80							⁙	
	96							⁙	
35	43	S11	6 10	24	10			⁙	S11: SILTY SAND (SM); homogeneous, mostly fine sand, ~25-30% fines, <5%clay (at tip of spoon), gray.
	43		14 14					⁙	
	34							⁙	
	38							⁙	
	44							⁙	
40	36	S12	12 6	24	24			⁙	S12: POORLY GRADED SAND WITH SILT (SP-SM); homogeneous, ~90-95% fine sand, ~5-10% silt, gray.
	42		9 9					⁙	

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

ǀǀǀ - ORGANIC SOIL
⁙ - SAND
∨ - BEDROCK
☰ - SILT
▷ - GRAVEL

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	**BORING LOG** PAGE 4 of 5	**FD-03-03**

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
	52							∴	
	60							∴	
	79							∴	
45	N/A	S13	11	24	20	0.25	0.0	☰	S13: SILT (ML); homogeneous, non-plastic, lenses of red-brown clay ~3-5 mm thick, ~5% fine sand, gray. (Note: Description based on lab gradation and Atterberg limit analyses.)
			15					☰	
	89		23					☰	
			25					☰	
	79							☰	
	65							☰	
	140							☰	
50	130	S14	9	24	17			☰	S14: SILT WITH SAND (ML); homogeneous, low-med. plasticity, lenses of red-brown clay ~3-5 mm thick, ~15-20% fine sand, gray.
			14					☰	
	145		16					☰	
			22					☰	
	115							☰	
	143							☰	
	180							☰	
55	205	S15	10	24	18			☰	S15: similar to S14.
			17					☰	
	175		22					☰	
			36					☰	

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

ǀǀǀ - ORGANIC SOIL	∴ - SAND	V - BEDROCK
☰ - SILT	◁ - GRAVEL	

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

BORING LOG
PAGE 5 of 5
FD-03-03

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
	250							▤	
	272								
	266								NOTE: Begin open hole drilling.
60	N/A	S16	7	24	24				S16: SILT WITH SAND (ML); homogeneous, med. plasticity, lenses of red-brown clay ~3-5 mm thick, ~15-20% fine sand, gray.
			13						
	N/A		23						
			24						
	N/A								
	N/A								
	N/A								
65	N/A	S17	ND*	24	20				S17: similar to S16.
			ND*						*NOTE: Sampler dropped from a height of about 15 feet above the sampling location. (poor driller control)
	N/A		ND*						
			ND*						End of boring @ 67 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
░ - SAND
∨ - BEDROCK
▤ - SILT
▧ - GRAVEL

Φ GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

BORING LOG
PAGE 1 of 2
FD-03-04

GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

BORING LOCATION: see plan
TOTAL DEPTH (FT): -27
MUDLINE ELEVATION (FT): -33.62
VERT. DATUM: MLLW
NORTHING: 622219
EASTING: 883559
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 11/12/03
LOGGED BY: S. Hawkins
DATE END: 11/12/03

Borehole advanced using drive/wash techniques.
Casing advanced using a 300lb. Safety Hammer
SPT's advanced using a 140lb. Safety Hammer

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0	WOC							▥	
	WOC							▥	
	WOC							▥	NOTE: No samples taken for top 5 feet.
	WOC							▥	
	WOC							▥	NOTE: Environmental samples collected from sample FD-04 (7-9) to FD-04 (11-13).
5	WOC	FD04 (5-7)	WOR	24	0			▥	FD-04 (5-7): no recovery.
			WOR					▥	
	WOC		WOR					▥	
			WOR					▥	
	WOC	FD04 (7-9)	WOR	24	24			▥	FD-04 (7-9) (0-21"): ORGANIC SOIL (OL/OH); homogeneous, low-med. plasticity, organic odor, black.
			WOR					▥	FD-04 (7-9) (21-24"): SILTY SAND (SM); homogeneous, ~20% fines, lt. gray.
	WOC		WOR					▥	
			WOR					░	
	WOC	FD04 (9-11)	5	24	12			░	FD-04 (9-11): SANDY SILT (ML); heterogeneous, low plasticity, %48 fine sand, black/gray. (Note: Description based on lab gradation and Atterberg limit analyses.)
			4					░	
10	WOC		5					░	
			9					░	FD-04 (11-13) (0-12"): SILTY SAND (SM); homogeneous, mostly fine sand, ~43% non-plastic fines, lt. gray. (Note: Description based on lab gradation and Atterberg limit analyses.)
	WOC	FD04 (11-13)	12	24	15			░	
			13					░	FD-04 (11-13) (12-15"): SILTY SAND (SM); homogeneous, ~20% fines, brown.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE
ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
░ - SAND
∨ - BEDROCK
☰ - SILT
◇ - GRAVEL

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	**BORING LOG** PAGE 2 of 2 **FD-03-04**

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
	WOC		16 21					⁙	
	WOC							⁙	
	WOC							⁙	
15	15	S1	15 14	24	24			⁙	S1: SILTY SAND (SM); homogeneous, mostly fine sand, ~16% fines, lt. gray/brown. (Note: Description based on lab gradation and Atterberg limit analyses.)
	32		19 28					⁙	
	61							⁙	
	102							⁙	
	100							⁙	NOTE: Begin drilling open hole.
20	N/A	S2	11/4"	4	4			⁙	S2: SILTY SAND (SM); homogeneous, mostly fine to med. sand, 15-25% fines, brown.
	N/A							⁙	
	N/A	C1	4 min.	60	55			V V	C1: v. hard, slightly weathered, fine-coarse grained "pinstriped" SCHIST and GNEISS of the Orange Formation. RQD = 0.69. (Derby Hill Member)
	N/A		3 min.					V V	
	N/A		3 min.					V V	
25	N/A		4 min.					V V	
	N/A		5 min.					V V	End of boring @ 27 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

- ‖ - ORGANIC SOIL
- ⁙ - SAND
- V V - BEDROCK
- ☰ - SILT
- ▽ - GRAVEL

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	BORING LOG PAGE 1 of 5	FD-03-05

GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

BORING LOCATION: see plan
TOTAL DEPTH (FT): -72
MUDLINE ELEVATION (FT): -30.53
VERT. DATUM: MLLW
NORTHING: 622337
EASTING: 882666
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 12/05/03
LOGGED BY: S. Hawkins
DATE END: 12/10/03

Borehole advanced using drive/wash techniques. Casing advanced using a 300lb. Safety Hammer
SPT's advanced using a 140lb. Safety Hammer

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0	WOC								
	WOC								
	WOC								
									NOTE: No samples taken for the top 5 feet.
	WOC								
	WOC								NOTE: Environmental samples collected from FD-05 (5-7) to FD-05 (11-13).
5	WOC	FD05 (5-7)	WOR	24	15				FD-05 (5-7): ORGANIC SILT (OH); homogeneous, med. plasticity, ~10% mostly fine sand, organic odor, black. (Note: Descriptions based on lab gradation and Atterberg limit analyses.)
			WOR						
	WOC		WOR						
			WOR						
	WOC	FD05 (7-9)	WOR	24	17				FD-05 (7-9):similar to FD-05 (5-7).
			WOR						
	WOC		WOR						
			WOR						
	WOC	FD05 (9-11)	WOR	24	12				FD-05 (9-11): ORGANIC SILT (OH); homogeneous, lense of gray silt ~1/2" thick @9", med. plasticity, ~7% fine sand, organic odor, black. (Note: Descriptions based on lab gradation and Atterberg limit analyses.)
			WOR						
10	WOC		WOR						
			WOR						FD-05 (11-13) (0-9"): ORGANIC SOIL (OL/OH); homogeneous, low-med. plasticity, ~5-10% fine sand, organic odor, black. (Note: Descriptions based on lab gradation and Atterberg limit analyses.)
	WOC	FD05 (11--13)	WOR	24	24				
			WOR						FD-05 (11-13) (9-24"): ORGANIC SILT (OH); homogeneous, med. plasticity, ~10% fine sand, lt. gray.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE
ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⛆ - SAND
V - BEDROCK
☰ - SILT
◬ - GRAVEL

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

BORING LOG
PAGE 2 of 5
FD-03-05

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
	WOC		WOR WOR					▥	
	WOC							▥	
	WOC							▥	
15	WOC	S1	WOR WOR	24	8			▥	S1: ORGANIC SOIL (OL/OH); homogeneous, med.-high plasticity, <5% fine sand, organic odor, dk. gray.
	WOC		WOR WOR					▥	
	WOC							▥	
	WOC							▥	
	WOC							▥	
20	7	S2	WOR WOR	24	24	0.0	0.0	▥	S2: ORGANIC SOIL (OL/OH); homogeneous, med.-high plasticity, ~10-15% fine sand, no dilatency, organic odor, dk. gray.
	8		WOR WOR					▥	
	8							▥	
	10							▥	NOTE: Begin day 2 drilling. (N622327, E882663)
	14							▥	
25	30	S3	4 6	24	15			▥	S3 (0-6"): ORGANIC SOIL (OL/OH); homogeneous, med.-high plasticity, ~15% shell fragments, ~10% fine sand, dk. gray. S3 (6-10"): PEAT (PT); fibrous, possible wood debris, Dk. brown.
	14		6 9					░	S3 (10-11"): POORLY GRADED SAND (SP); mostly fine sand, <10% silt, gray. S3 (11-15"): SILTY SAND (SM); homogeneous, ~20-30% silt, med. plasticity, brown.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in. TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE
ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
░ - SAND
∨ - BEDROCK
☰ - SILT
▨ - GRAVEL

Φ GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	**BORING LOG** PAGE 3 of 5	**FD-03-05**

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
	22							⁙	
	24							⁙	
	26							⁙	
30	23	S4	8 5	24	15			⁙	S4 (0-6"): WELL GRADED SAND WITH GRAVEL (SW); homogeneous, mostly fine to coarse sand, ~30% rounded gravel, gray. S4 (6-15"): POORLY GRADED SAND WITH SILT (SP-SM); homogeneous, mostly fine sand, ~10-15% silt, lt. gray.
	13		5 6					⁙	
	18							⁙	
	25							⁙	
	37							⁙	
35	21	S5	8 9	24	24			⁙	S5: POORLY GRADED SAND (SP); homogeneous, mostly fine sand, ~5% silt, gray.
	18		13 11					⁙	
	30							⁙	
	27							⁙	
	53							⁙	
40	59	S6	8 8	24	24			⁙	S6: POORLY GRADED SAND (SP); homogeneous, mostly fine sand, ~5% low plasticity fines, gray.
	40		16 12					⁙	

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⁙ - SAND
∨ - BEDROCK
▤ - SILT
◬ - GRAVEL

Φ GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

BORING LOG
PAGE 4 of 5
FD-03-05

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
	38							⁘	
	29							⁘	
	50							⁘	
45	53	S7	7 8	24	24			⁘	S7 (0-12"): similar to S6.
	41		9 12					☰	S7 (12-24"): SILT (ML); homogeneous, low-med. plasticity, ~15% fine sand, rapid dilatency, gray.
	31							☰	
	29							☰	
	40							☰	
50	37	S8	7 8	24	24			☰	S8: SILT (ML); homogeneous, non-plastic, ~8% fine sand, rapid dilatency, gray. (Note: Descriptions based on lab gradation and Atterberg limit analyses.)
	37		8 10					☰	
	37							☰	
	43							☰	
	56							☰	
55	32	S9	4 4	24	18			☰	S9 (0-10"): SILT (ML); homogeneous, low-med. plasticity, ~5% fine sand, rapid dilatency, gray.
	28		8 14					☰	S9 (10-18"): SILT (ML); laminated brown clay layers 3-5 mm thick, med. plasticity, <5% fine sand, slow dilatency, gray.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

- ⫼ - ORGANIC SOIL
- ⁘ - SAND
- V - BEDROCK
- ☰ - SILT
- ▽ - GRAVEL

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

BORING LOG
PAGE 5 of 5
FD-03-05

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
	40								
	48								
	53								
60	N/A	S10	8	24	24				S10 (0-12"): POORLY GRADED SAND WITH SILT (SP-SM); homogeneous, mostly fine sand, ~10% fines, gray. S10 (12-24"): SILT (ML); laminated brown clay layers 3-5 mm thick, low-med. plasticity, ~5% fine sand, slow dilatency, gray.
			12						
	N/A		17			1.5	0.5		
			21						
	N/A								
	N/A								
	N/A								
65	N/A	S11	ND*	24	17	1.0	0.5		S11: SILT (ML); laminated brown clay layers 3-5 mm thick, non-plastic, ~5% fine sand, gray. (Note: Descriptions based on lab gradation and Atterberg limit analyses.) *NOTE: Sampler dropped from a height of about 60 feet above the sampling location. (poor driller control)
			ND*						
	N/A		ND*						
			ND*						
	N/A								
	N/A								
	N/A								
70	N/A	S12	ND*	24	15	0.0	0.0		S12: SILT (ML); laminated brown clay layers 3-5 mm thick, med. plasticity, ~5% fine sand, gray. *NOTE: Sampler droppd from a height of about 60 feet above the sampling location. (poor driller control)
			ND*						
	N/A		ND*						
			ND*						End of boring @ 72 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

- ORGANIC SOIL
- SAND
- BEDROCK
- SILT
- GRAVEL

Φ GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

BORING LOG
PAGE 1 of 4
FD-03-06

BORING LOCATION: see plan
TOTAL DEPTH (FT): -50.5
MUDLINE ELEVATION (FT): -30.23
VERT. DATUM: MLLW
NORTHING: 622809
EASTING: 881808
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 11/17/03
LOGGED BY: S. Hawkins
DATE END: 11/17/03

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

Borehole advanced using drive/wash techniques.
SPT's advanced using a 140lb. Safety Hammer
Casing advanced using a 300lb. Safety Hammer

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
0	WOC							▥	
	WOC							▥	
	WOC							▥	NOTE: No samples taken for top 5 feet.
	WOC							▥	
	WOC							▥	NOTE: Environmental samples collected from samples FD-06 (5-7) to FD-06 (9-11).
5	WOC	FD06 (5-7)	WOR	24	24			▥	FD-06 (5-7) (0-19"): SANDY ORGANIC SILT (OH); homogeneous, med. plasticity, ~35% fine sand, organic odor, black. (Note: Description based on lab gradation and Atterberg limit analyses.)
			WOR					▥	
	WOC		WOR					▥	FD-06 (5-7) (19-24"): ORGANIC CLAY (CL); med.-high plasticity, dk.gray.
			WOR					▥	
	WOC	FD06 (7-9)	WOR	24	18			▥	FD-06 (7-9): ORGANIC SILT (OH); med.-high plasticity, ~11% sand, dk.gray. (Note: Description based on lab gradation and Atterberg limit analyses.)
			WOR					▥	
	WOC		WOR					▥	
			WOR					▥	
	WOC	FD06 (9-11)	WOR	24	17			▥	FD-06 (9-11): ORGANIC SILT (OH); med.-high plasticity, ~13% sand, dk. gray. (Note: Description based on lab gradation and Atterberg limit analyses.)
			WOR					▥	
10	WOC		WOR					▥	
			WOR					▥	
	WOC							▥	

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
░ - SAND
∨ - BEDROCK
☰ - SILT
◇ - GRAVEL

Φ GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

BORING LOG
PAGE 2 of 4
FD-03-06

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
	WOC							▥	
	WOC							▥	
	WOC							▥	
15	WOC	S1	ND* ND*	84	24			▤	S1: SANDY ELASTIC SILT (MH); homogeneous, med. plasticity, ~35% fine sand, ~12% medium sand, olive gray. (Note: Description based on lab gradation and Atterberg limit analyses.) *NOTE: Sampler fell in hole and advanced to a depth of 22 feet.
	WOC		ND* ND*					▤	
	WOC							▤	
	WOC							▤	
	WOC							▤	
20	WOC							▤	
	WOC							▤	
	WOC							▤	
	WOC							▤	
	WOC							▤	
25	25	S2	12 11	24	10			▤	S2: GRAVELLY SILT WITH SAND (ML); heterogeneous, med. plasticity, ~20% sub-angular to sub-rounded gravel, ~10% fine sand, ~5% shell fragments, dk. gray.
	21		12 7					▤	

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL ⁘ - SAND V - BEDROCK
▤ - SILT ◇ - GRAVEL

Φ GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

BORING LOG
PAGE 3 of 4
FD-03-06

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION: TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
	17								
	21								
	22								
30	18	S3	7	24	5				S3: POORLY GRADED GRAVEL WITH SAND (GP); ~50% subangular coarse gravel (max size 40 mm), ~25% subangular fine gravel (max size 18 mm), ~20% coarse sand, ~5% fine to med. sand, gray.
			5						
	19		7						
			9						
	22								
	25								
	18								
35	20	S4	7	24	24	2.0	0.0		S4: NARROWLY GRADED SAND (SP); homogeneous, mostly fine sand, ~5% fines, gray.
			5						
	18		5						
			7						
	19								
	28								
	30								
40	18	S5	7	24	24	1.0	0.0		S5: SILTY SAND (SM); homogeneous, mostly fine sand, ~23% fines, gray. (Note: Description based on lab gradation and Atterberg limit analyses.)
			7						
	29		8						
			14						

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

- ORGANIC SOIL
- SAND
- BEDROCK
- SILT
- GRAVEL

Φ GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	**BORING LOG** PAGE 4 of 4 **FD-03-06**

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
	32							⁙	
	34							⁙	
	36							⁙	
45	N/A	S6	9	6	6	0.0	0.0	⁙	S6: NARROWLY GRADED SAND WITH SILT (SP-SM); homogeneous, mostly fine sand, ~5-10% fines, gray.
		C1	3 min.	60	60			V V	C1: hard, slightly weathered, fine-coarse grained, magnetite-rich, dark-greenish-black, SCHIST and GNEISS of the Orange Formation. RQD = 0.83. (Oronoque Member)
			2 min.					V V	
			2 min.					V V	
			2 min.					V V	
			2 min.					V V	
50								V V	End of Boring @ 50.5 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE
ND - NO DATA

STRATIGRAPHIC LEGEND

|||| - ORGANIC SOIL
⁙ - SAND
V V - BEDROCK
☰ - SILT
▷ - GRAVEL

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	**BORING LOG** PAGE 1 of 5	**FD-03-07**

GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

BORING LOCATION: see plan
TOTAL DEPTH (FT): -69
MUDLINE ELEVATION (FT): -27.14
VERT. DATUM: MLLW
NORTHING: 623247
EASTING: 882528
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 11/18/03
LOGGED BY: S. Hawkins
DATE END: 11/24/03

Borehole advanced using drive/wash techniques.
Casing advanced using a 300lb. Safety Hammer
SPT's advanced using a 140lb. Safety Hammer

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0	WOC							▥	
	WOC							▥	
	WOC							▥	
	WOC							▥	NOTE: No samples taken for top 5 feet.
	WOC							▥	NOTE: Environmental samples collected from samples FD-07 (5-7) to FD-07 (13-15).
5	WOC	FD07 (5-7)	WOR	24	16			▥	FD-07 (5-7): ORGANIC SILT (OH); homogeneous, med. plasticity, ~4% fine sand, organic odor, black. (Note: Description based on lab gradation and Atterberg limit analyses.)
			WOR					▥	
	WOC		WOR					▥	
			WOR					▥	
	WOC	FD07 (7-9)	WOR	24	16			▥	FD-07 (7-9): ORGANIC SILT WITH SAND (OH); homogeneous, medium plasticity, ~30% fine sand, black. (Note: Description based on lab gradation and Atterberg limit analyses.)
			WOR					▥	
	WOC		WOR					▥	
			WOR					▥	
	WOC	FD07 (9-11)	WOR	24	11			▥	FD-07 (9-11): ORGANIC SOIL (OH); homogeneous, med. plasticity, <5% fine sand, organic odor, black.
			WOR					▥	
10	WOC		WOR					▥	
			WOR					▥	FD-07 (11-13) (0-12"): SANDY ORGANIC SILT (OH); homogeneous, med. plasticity, ~42% mostly fine sand, black. (Note: Description based on lab gradation and Atterberg limit analyses.)
	WOC	FD07 (11-13)	WOR	24	17			▥	
			WOR					▤	FD-07 (11-13) (12-17"): SILT WITH SAND (ML); ~85% low -med. plasticity silt, ~15% fine sand, black.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
░ - SAND
▽ - BEDROCK
▤ - SILT
▨ - GRAVEL

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	BORING LOG PAGE 2 of 5	FD-03-07

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
	WOC		WOR						
			WOR						
	WOC	FD07 (13-15)	9	24	12				FD-07 (13-15) (0-6"): SILTY SAND (SM); mostly fine to medium sand, ~26% non-plastic fines, dk. gray/orange. (Note: Description based on lab gradation and Atterberg limit analyses.)
			8						
	WOC		11						FD-07 (13-15) (6-12"): SILT (ML); homogeneous, low-med. plasticity, <5% sand, yellowish-orange.
			11						
15	11								
	15								
	15								
	17								
	16								
20	9	S1	5	24	18				S1 (0-6"): SILT (ML); homogeneous, low plasticity, <5% fine sand, olive gray.
			7						
	9		8						S1 (6-18"): SILT (ML); homogeneous, low plasticity, 5-10% fine sand, lt. gray.
			9						
	13								
	16								
	18								
25	WOC	S2	7	24	16				S2 (0-5"): SILT WITH SAND (ML); homogeneous, low plasticity, ~20% fine sand, lt. gray.
			8						
	WOC		10						S2 (5-16"): SANDY SILT (ML); homogeneous, low plasticity, ~30% fine sand, gray with orange/brown oxidation stains.
			16						

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

- ORGANIC SOIL
- SAND
- BEDROCK
- SILT
- GRAVEL

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	**BORING LOG** PAGE 3 of 5 **FD-03-07**

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
	18								
	17								
	20								
30	WOC	S3	ND*	24	10				S3: SILT WITH SAND ML); homogeneous, non-plastic, ~15% fine sand, lt. gray. (Note: Description based on lab gradation and Atterberg limit analyses.)
			ND*						
	WOC		ND*						*NOTE: Sampler dropped from a height of about 40 feet above the sampling location. (poor driller control)
			ND*						
	18								
	17								
	20								
35	50	S4	5	24	17				S4: SILT (ML); homogeneous, low plasticity, ~5-10% fine sand, lt. gray.
			7						
	57		8						
			10						
	58								
	64								
	70								NOTE: Begin day 2 drilling. (N623247, E882525) Begin drilling open hole.
40	N/A	S5	7	24	24				S5: SILT (ML); laminated lenses of red/brown clay ~3-5 mm thick, med. plasticity, 5-10% fine sand,, slow to rapid dilatency, lt. gray.
			9						
	N/A		13						
			17						

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in. TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE
ND - NO DATA

STRATIGRAPHIC LEGEND

- ORGANIC SOIL
- SAND
- BEDROCK
- SILT
- GRAVEL

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

BORING LOG
PAGE 4 of 5
FD-03-07

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
	N/A								
	N/A								
	N/A								
45	N/A	S6	9 11	24	22				S6: similar to S5.
	N/A		13 22						
	N/A								
	N/A								
	N/A								
50	N/A	S7	3 6	24	11				S7: SILTY SAND (SM); mostly fine sand, ~30% low plasticity fines, lt. gray.
	N/A		8 9						
	N/A								
	N/A								
	N/A								
55	N/A	S8	ND* ND*	24	17				S8: SANDY SILT (ML); homogeneous, low plasticity, ~20-35% fine sand, lt. gray, contains a few lenses of brown clay. *NOTE: Sampler dropped from a height of about 10 feet above the sampling location and stopped at a depth of 56 feet below mudline. (poor driller control)
	N/A		12 17						

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in. TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE
ND - NO DATA

STRATIGRAPHIC LEGEND

- ORGANIC SOIL
- SAND
- BEDROCK
- SILT
- GRAVEL

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	BORING LOG PAGE 5 of 5	FD-03-07

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
	N/A							☰	
	N/A							☰	
	N/A							☰	
60	N/A	S9	7 12	24	15			☰	S9: SANDY SILT (ML); non-plastic, ~44% fine sand, rapid dilatency, lt. gray, contains a few pockets of brown clay. (Note: Description based on lab gradation and Atterberg limit analyses.)
	N/A		14 18					☰	
	N/A							☰	
	N/A							☰	NOTE: Roller bit refusal @ 64 feet.
	N/A	C1	3 min.	60	45			V V	C1: v. hard, slightly weathered, fine-grained, magnetite-rich, dark-greenish-black, SCHIST and GNEISS of the Orange Formation. RQD = 0.63. (Oronoque Member).
65	N/A		7 min.					V V	
	N/A		3 min.					V V	
	N/A		3 min.					V V	
	N/A		4 min.					V V	End of Boring @ 69 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE   ND - NO DATA

STRATIGRAPHIC LEGEND

- ⫼ - ORGANIC SOIL
- ⁘ - SAND
- V V - BEDROCK
- ☰ - SILT
- ◇ - GRAVEL

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

BORING LOG
PAGE 1 of 5
FD-03-08

BORING LOCATION: see plan
TOTAL DEPTH (FT): 65
MUDLINE ELEVATION (FT): -30.85
VERT. DATUM: MLLW
NORTHING: 623635
EASTING: 881499
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 11/25/03
LOGGED BY: S. Hawkins
DATE END: 12/4/03

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

Borehole advanced using drive/wash techniques.
SPT's advanced using a 140lb. Safety Hammer
Casing advanced using a 300lb. Safety Hammer

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0	WOC							▥	
	WOC							▥	
	WOC							▥	NOTE: No samples taken for top 5 feet.
	WOC							▥	
	WOC							▥	NOTE: Environmental samples collected from FD-08 (5-7) to FD-08 (9-11).
5	WOC	FD08 (5-7)	WOR WOR	24	17			▥	FD-08 (5-7): ORGANIC SILT (OH); homogeneous, med. plasticity, ~4% fine sand, organic odor, black. (Note: Description based on lab gradation and Atterberg limit analyses.)
	WOC		WOR WOR					▥	
	9	FD08 (7-9)	WOR WOR	24	24			▥	FD-08 (7-9) (0-22"): ORGANIC SILT (OH); homogeneous, medium plasticity, ~5% fine sand, black. (Note: Description based on lab gradation and Atterberg limit analyses.)
	27		WOR 5					▥	FD-08 (7-9) (22-24"): SILT WITH SAND (ML); low plasticity, 15-25% fine sand, lt. gray.
	31	FD08 (9-11)	12 12	24	15	0.5	1.0	≡	FD-08 (9-11): SILT WITH SAND (ML); low plasticity, 16% fine sand, slow dilatency, olive. (Note: Description based on lab gradation and Atterberg limit analyses.)
10	34		17 12					≡	
	36							≡	

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE
ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⁘ - SAND
V V - BEDROCK
≡ - SILT
◇ - GRAVEL

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	**BORING LOG** PAGE 2 of 5 **FD-03-08**

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
	42							▤	
	43							▤	
	48							▤	
15	36	S1	5	24	24	0.5	2.0	▤	S1: SILT WITH SAND (ML); low plasticity, ~15% fine sand, slow dilatency, lt. brown/orange.
			10					▤	
	25		15					▤	
			18					▤	
	32							▤	
	52							▤	
	47							▤	
20	N/A	S2	9	24	18	0.5		▤	S2: SILT (ML); laminated layers of red/brown clay ~3-5 mm thick, low-med. plasticity, <5% fine sand, rapid dilatency, lt. gray.
			9					▤	
	N/A		13					▤	
			14					▤	
	N/A							▤	
	N/A							▤	
	N/A							▤	
25	N/A	S3	5	24	24	0.0		▤	S3: SILT (ML); laminated layers of red/brown clay ~3-5 mm thick, non plastic, ~6% fine sand, rapid dilatency, lt. gray. (Note: Description based on lab gradation and Atterberg limit analyses.)
			9					▤	
	N/A		11					▤	
			15					▤	

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

- ▥ - ORGANIC SOIL
- ░ - SAND
- V V - BEDROCK
- ▤ - SILT
- ▨ - GRAVEL

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	BORING LOG PAGE 3 of 5	FD-03-08

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
	N/A							▤	NOTE: Begin day 2 drilling. (N623621, E881498)
	N/A							▤	
	N/A							▤	
30	N/A	S4	8 9	24	18	0.1		▤	S4: similar to S3.
	N/A		14 20					▤	
	N/A							▤	
	N/A							▤	
	N/A							▤	
35	N/A	S5	4 8	24	13			▤	S5: POORLY GRADED SAND WITH SILT (SP-SM); mostly fine sand, ~10-15% fines, lt. gray.
	N/A		9 12					▤	
	N/A							▤	
	N/A							▤	
	N/A							▤	
40	N/A	S6	7 9	24	13			⁘	S6: SILTY SAND (SM); mostly fine sand, ~25-30% med. plasticity fines, contains lenses of red/brown clay, gray.
	N/A		12 15					⁘	

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

⫼ - ORGANIC SOIL	⁘ - SAND	∨ - BEDROCK
▤ - SILT	◇ - GRAVEL	

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	**BORING LOG** PAGE 4 of 5	**FD-03-08**

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
	N/A							⁘	
	N/A								
	N/A								
45	N/A	S7	16	24	12				S7: POORLY GRADED SAND WITH SILT (SP); mostly fine sand, ~10-15% fines, lt. gray mottled with a few pockets of brown clay.
			18						
	N/A		20						
			23						
	N/A								
	N/A								
	N/A								
50	N/A	S8	9	24	14				S8: SILTY SAND (SM); homogeneous, ~57% fine sand, ~6% med. sand, ~37% non-plastic fines, contains pockets of brown clay, gray. (Note: Description based on lab gradation and Atterberg limit analyses.)
			11						
	N/A		15						
			19						
	N/A								NOTE: Begin day 3 drilling. (N623629, E881492)
	N/A								
	N/A								
55	N/A	S9	24	24	24	1.5	0.0		S9: SILTY SAND (SM); homogeneous, mostly fine sand, ~10-15% fines, lt. gray.
			32						
	N/A		45						
			45						

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE
ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL	⁘ - SAND	⋁ - BEDROCK
☰ - SILT	▷ - GRAVEL	

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	BORING LOG PAGE 5 of 5	FD-03-08

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
	N/A								
	N/A								
	N/A								
60	N/A	S10	7 min.	60	12				C1: highly fractured, v. hard, slightly-moderately weathered, fine-grained, magnetite-rich, dark-greenish-black, SCHIST and GNEISS of the Orange Formation. RQD = 0.07. (Oronoque Member)
	N/A		8 min.						
	N/A		8 min.						
	N/A		7 min.						
	N/A	C1	8 min.						End of boring @ 65 feet below mudline.
65									

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

- ORGANIC SOIL
- SAND
- BEDROCK
- SILT
- GRAVEL

Φ GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

PROBE LOG
PAGE 1 of 1
FP-03-01

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

PROBE LOCATION: see plan
TOTAL DEPTH (FT): 42.9
MUDLINE ELEVATION (FT): -44.72
VERT. DATUM: MLLW
NORTHING: 618741
EASTING: 881983
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 10/20/03; 1220
LOGGED BY: S. Hawkins
DATE END: 10/20/03; 1300

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0									50 feet of casing inserted to top of mudline.
5									
10									
15									
20									No change in drill reaction.
25									
30									
35									
40									92.9 feet of rod installed below the reference point. End of Probe @ 42.9 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in. TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE
ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⁙ - SAND
▿ - BEDROCK
▤ - SILT
△ - GRAVEL

Φ GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	**PROBE LOG** PAGE 1 of 1 **FP-03-02**

GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

PROBE LOCATION: see plan

TOTAL DEPTH (FT): 78.2

MUDLINE ELEVATION (FT): -36.99

VERT. DATUM: MLLW

NORTHING: 619252

EASTING: 882407

HOR. DATUM: NAD83

DRILLED BY: Hardiman Tom Hardiman

DATE START: 10/9/03; 1025

LOGGED BY: S. Hawkins

DATE END: 10/9/03; 1230

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0	WOC PUSH								70 feet of casing advanced from the reference point. Black organic material in water returns.
5									
10	PUSH								
15	PUSH								
20	PUSH								
25	PUSH								End of Casing @ 22.5 feet.
30									
35									
40									
45									
50									
55									
60									
65									Drilling more difficult from 65 feet to the end of the boring.
70									
75									124.7 feet of rod inserted below the barge reference point. End of probe at 78.2 feet. below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL	⛆ - SAND	⩔ - BEDROCK
☰ - SILT	⧋ - GRAVEL	

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

PROBE LOG
PAGE 1 of 1
FP-03-03

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

PROBE LOCATION: see plan
TOTAL DEPTH (FT): 42.7
MUDLINE ELEVATION (FT): -23.89
VERT. DATUM: MLLW
NORTHING: 619652
EASTING: 881759
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 10/20/03; 1015
LOGGED BY: S. Hawkins
DATE END: 10/20/03; 1105

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0									40 feet of casing inserted from the reference point.
5									Initial wash contained black sediment with organics. Slight organic odor. No sheen . Lost return after initial wash.
10									
15									
20									End of casing @ 9.2 feet.
25									No change in drill reaction.
30									
35									
40									72.6 feet of rod inserted below the barge reference point. End of probe @ 42.7 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in. TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⁘ - SAND
V - BEDROCK
▤ - SILT
◇ - GRAVEL

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

PROBE LOG
PAGE 1 of 1
FP-03-04

PROBE LOCATION: see plan
TOTAL DEPTH (FT): 69.5
MUDLINE ELEVATION (FT): -33.06
VERT. DATUM: MLLW
NORTHING: 620135
EASTING: 882267
HOR. DATUM: NAD83
DRILLED BY: Hardiman
Tom Hardiman
DATE START: 10/31/03; 0910
LOGGED BY: S. DiBartolo
DATE END: 10/31/03; 1018

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0									45 feet of casing advanced under WOC below the reference point.
5	WOC WOC WOC								44 feet of drill rods advanced under WOR below reference point.
10									
15									
20									No change in drill reaction.
25									
30									
35									
40									
45									
50									Red clay on drill rods after break down of rods on 60-foot rod section.
55									Drill rods advancing easily from ~70 to 100 feet below the reference point. (driller thinks probably silty sand or clay)
60									Increased resistance at 106.5 feet of rods below the barge reference point.
65									107.3 feet of rod inserted below the barge reference point. Bottom of probe @ 69.5 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in. TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE
ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⁘ - SAND
V - BEDROCK
☰ - SILT
▨ - GRAVEL

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	**PROBE LOG** PAGE 1 of 1 **FP-03-05**

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT) WATER	DEPTH (FT) CASING	DEPTH (FT) HOLE

PROBE LOCATION: see plan
TOTAL DEPTH (FT): 60.4
MUDLINE ELEVATION (FT): -34.9
VERT. DATUM: MLLW
NORTHING: 619979
EASTING: 882906
HOR. DATUM: NAD83
DRILLED BY: Hardiman
Tom Hardiman
DATE START: 10/8/03; 1410
LOGGED BY: S. Hawkins
DATE END: 10/8/03; 1440

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
0									55 feet of casing installed below the reference point.
5	WOC								
10	WOC								
15	WOC								
20									No change in drill reaction.
25									
30									
35									
40									
45									
50									
55									100.4 feet of rod installed below the barge reference elevation.
60									Bottom of probe @ 60.4 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE
ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
░ - SAND
∨ - BEDROCK
☰ - SILT
◇ - GRAVEL

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

PROBE LOG
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FP-03-06

GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

PROBE LOCATION: see plan
TOTAL DEPTH (FT): 75.7
MUDLINE ELEVATION (FT): -36.2
VERT. DATUM: MLLW
NORTHING: 619991
EASTING: 883468
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 10/8/03; 1205
LOGGED BY: S. Hawkins
DATE END: 10/8/03; 1245

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
0									55 feet of casing installed below the reference point.
5	WOC								
10	WOC								
15									
20									No change in drill reaction.
25									
30									
35									
40									
45									
50									
55									
60									
65									
70									120 feet of rod advanced below the reference elevation.
75									Bottom of probe @ 75.7 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL ⁘ - SAND ▽ - BEDROCK
☰ - SILT ◇ - GRAVEL

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	**PROBE LOG** PAGE 1 of 1 **FP-03-07**

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

PROBE LOCATION: see plan

TOTAL DEPTH (FT): 75.3

MUDLINE ELEVATION (FT): -30.68

VERT. DATUM: MLLW

NORTHING: 620254

EASTING: 883935

HOR. DATUM: NAD83

DRILLED BY: Hardiman Tom Hardiman

DATE START: 10/7/03; 1400

LOGGED BY: S. Hawkins

DATE END: 10/7/03; 1500

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0									55 feet of casing installed below the reference point.
5	WOC								
10	WOC								
15	WOC								
20	WOC								No change in drill reaction.
25									
30									
35									
40									
45									
50									
55									
60									
65									
70									110.4 feet of rod advanced below the reference elevation.
75									Bottom of probe @ 75.3 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL

░ - SAND

∨ - BEDROCK

☰ - SILT

▷ - GRAVEL

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

PROBE LOG
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FP-03-08

GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

PROBE LOCATION: see plan
TOTAL DEPTH (FT): 79.9
MUDLINE ELEVATION (FT): -27.56
VERT. DATUM: MLLW
NORTHING: 620464
EASTING: 883438
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 10/8/03; 0935
LOGGED BY: S. Hawkins
DATE END: 10/8/03; 1020

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0	WOC								55 feet of casing installed below the reference point.
5	WOC								
10	WOC								
15									
20									No change in drill reaction.
25									
30									
35									
40									
45									
50									
55									
60									
65									
70									
75									118.7 feet of rod advanced below the reference elevation. Bottom of probe @ 79.9 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⁘ - SAND
V - BEDROCK
☰ - SILT
◇ - GRAVEL

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

PROBE LOG
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FP-03-09

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

PROBE LOCATION: see plan
TOTAL DEPTH (FT): 67.5
MUDLINE ELEVATION (FT): -35.33
VERT. DATUM: MLLW
NORTHING: 620572
EASTING: 882909
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 10/9/03; 1435
LOGGED BY: S. Hawkins
DATE END: 10/9/03; 1510

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0									55 feet of casing installed below the reference point.
5	WOC								
10	WOC								
15	WOC								
20									No change in drill reaction.
25									
30									
35									
40									
45									
50									
55									
60									
65									107.9 feet of rod advanced below the reference elevation. Bottom of probe @ 67.5 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⁙ - SAND
V - BEDROCK
▤ - SILT
◬ - GRAVEL

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

PROBE LOG
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GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT) WATER	DEPTH (FT) CASING	DEPTH (FT) HOLE

PROBE LOCATION: see plan
TOTAL DEPTH (FT): 89.6
MUDLINE ELEVATION (FT): -33.58
VERT. DATUM: MLLW
NORTHING: 621138
EASTING: 882547
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 10/31/03; 1200
LOGGED BY: S. DiBartolo
DATE END: 10/31/03; 1245

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
0	WOC								45 feet of casing advanced under WOC below the reference point. 49 feet of drill rod advanced under WOR below reference point
5	WOC								
10									
15									
20									No change in drill reaction.
25									
30									
35									
40									
45									
50									Drill rods advanced easily from ~80 feet below reference point in something like sand or clay. (according to driller)
55									
60									
65									
70									
75									
80									
85									Drill rods advanced to refusal 103.7 feet below the barge reference point. Bottom of probe @ 89.6 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in. TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE
ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⛆ - SAND
▽ - BEDROCK
▤ - SILT
▨ - GRAVEL

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

PROBE LOG
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PROBE LOCATION: see plan
TOTAL DEPTH (FT): 99.7
MUDLINE ELEVATION (FT): -27.89
VERT. DATUM: MLLW
NORTHING: 620926
EASTING: 883964
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 10/7/03; 0950
LOGGED BY: S. Hawkins
DATE END: 10/7/03; 1150

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0									55 feet of casing advanced below the reference point.
5	WOC								
10	WOC								
15	WOC								
20									No change in drill reaction.
25									
30									
35									
40									
45									
50									
55									
60									
65									
70									
75									
80									
85									
90									
95									136.2 feet of drill rod advanced below the barge reference point. Bottom of probe @ 99.7 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in. TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⁘ - SAND
V - BEDROCK
▤ - SILT
◇ - GRAVEL

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

PROBE LOG
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GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

PROBE LOCATION: see plan
TOTAL DEPTH (FT): 97.7
MUDLINE ELEVATION (FT): -23.26
VERT. DATUM: MLLW
NORTHING: 621155
EASTING: 883493
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 10/10/03; 0945
LOGGED BY: S. Hawkins
DATE END: 10/10/03; 1038

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0									50 feet of casing advanced below the reference point.
	WOC								
5									
	WOC								
10									
	WOC								
15									
20									No change in drill reaction.
25									
30									
35									
40									
45									
50									
55									
60									
65									
70									
75									
80									
85									
90									
95									132.8 feet of drill rod advanced below the barge reference point. Bottom of probe @ 97.7 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in. TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE
ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
░ - SAND
▽ - BEDROCK
▤ - SILT
◇ - GRAVEL

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	PROBE LOG PAGE 1 of 1	FP-03-13

GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

PROBE LOCATION: see plan
TOTAL DEPTH (FT): 82.8
MUDLINE ELEVATION (FT): -38.45
VERT. DATUM: MLLW
NORTHING: 621545
EASTING: 883000
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 11/13/03; 0925
LOGGED BY: S. Hawkins
DATE END: 11/13/03; 1015

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
0									50 feet of casing advanced below the reference point.
5	WOC								
10									
15									
20									No change in drill reaction.
25									
30									
35									
40									
45									
50									
55									
60									
65									
70									
75									
80									129.2 feet of drill rod advanced below the barge reference point. Bottom of probe @ 82.8 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in. TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE
ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⁙ - SAND
∨ - BEDROCK
▤ - SILT
◇ - GRAVEL

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

PROBE LOG
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GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

PROBE LOCATION: see plan
TOTAL DEPTH (FT): 53
MUDLINE ELEVATION (FT): -28.51
VERT. DATUM: MLLW
NORTHING: 621764
EASTING: 883639
HOR. DATUM: NAD83
DRILLED BY: Hardiman
Tom Hardiman
DATE START: 10/14/03; 1125
LOGGED BY: S. Hawkins
DATE END: 10/14/03; 1205

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0									50 feet of casing advanced below the reference point.
5									
10									End of casing @ 11.1 feet.
15									
20									No change in drill reaction.
25									
30									
35									
40									
45									
50									92.7 feet of drill rod advanced below the barge reference point. Bottom of probe @ 53 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE
ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
░ - SAND
▨ - BEDROCK
☰ - SILT
◇ - GRAVEL

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

PROBE LOG
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PROBE LOCATION: see plan
TOTAL DEPTH (FT): 102.4
MUDLINE ELEVATION (FT): -35.23
VERT. DATUM: MLLW
NORTHING: 622264
EASTING: 883126
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 10/14/03; 1335
LOGGED BY: S. Hawkins
DATE END: 10/14/03; 1507

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0									
5	WOC								55 feet of casing advanced below the reference point.
10	WOC								End of casing @ 7.9 feet.
15									
20									No change in drill reaction.
25									
30									
35									
40									
45									
50									
55									
60									
65									
70									
75									
80									
85									
90									
95									
100									148.2 feet of drill rod inserted below the barge reference point. Bottom of probe @ 102.4feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
▒ - SAND
▽ - BEDROCK
▤ - SILT
▨ - GRAVEL

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	**PROBE LOG** PAGE 1 of 2 **FP-03-16**

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

PROBE LOCATION: see plan

TOTAL DEPTH (FT): 142.0

MUDLINE ELEVATION (FT): -27.71

VERT. DATUM: MLLW

NORTHING: 622021

EASTING: 882423

HOR. DATUM: NAD83

DRILLED BY: Hardiman Tom Hardiman

DATE START: 10/17/03; 1000

LOGGED BY: S. Hawkins

DATE END: 10/17/03; 1220

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0									
5	WOC								45 feet of casing advanced below the reference point. (Bottom 8 feet pushed)
10	PUSH								
15									End of casing @ 11.5 feet.
20									No change in drill reaction.
25									
30									
35									
40									
45									
50									
55									
60									
65									
70									
75									
80									
85									
90									
95									
100									

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL	⠿ - SAND	⩔ - BEDROCK
▤ - SILT	▨ - GRAVEL	

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	**BORING LOG** PAGE 2 of 2	**FP-03-16**

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
105									
110									
115									~115 feet - Drill rods bound up due to blowing sand. No other change in drill reaction.
120									
125									
130									
135									177.8 feet of drill rod inserted below the barge reference point.
140									Bottom of probe @ 142.0 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in. TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE
ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL	⁘ - SAND	∨ - BEDROCK
▤ - SILT	◇ - GRAVEL	

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

PROBE LOG
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GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

PROBE LOCATION: see plan
TOTAL DEPTH (FT): 67.5
MUDLINE ELEVATION (FT): -27.4
VERT. DATUM: MLLW
NORTHING: 622644
EASTING: 882512
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 10/30/03; 1418
LOGGED BY: S DiBartolo
DATE END: 10/30/03; 1451

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0	WOC								45 feet of casing advanced under WOC, below the reference point. 57 feet of drill rod advanced under WOR, below the barge reference point.
5	WOC								
10									
15									
20									No change in drill reaction.
25									
30									
35									
40									Drilling resistance encountered ~70 feet below reference point.
45									
50									
55									
60									
65									106.2 feet of drill rod inserted below the barge reference point. Bottom of probe @ 67.5 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

- ORGANIC SOIL
- SAND
- BEDROCK
- SILT
- GRAVEL

Φ GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

PROBE LOG
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PROBE LOCATION: see plan
TOTAL DEPTH (FT): 79.8
MUDLINE ELEVATION (FT): -40.41
VERT. DATUM: MLLW
NORTHING: 622792
EASTING: 882996
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 10/22/03; 1300
LOGGED BY: S. Hawkins
DATE END: 10/22/03; 1345

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0									50 feet of casing inserted below the reference point. Initial wash had black organic material with an organic odor and no sheen. Wash changed to brown fine sand before water returns were lost.
5	WOC								
10									
15									
20									No change in drill reaction.
25									
30									
35									
40									
45									
50									
55									
60									
65									
70									
75									125.7 feet of drill rod inserted below the barge reference point. Bottom of probe @ 79.8 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in. TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE
ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⛆ - SAND
⩔ - BEDROCK
▤ - SILT
▨ - GRAVEL

Φ GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

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PROBE LOCATION: see plan
TOTAL DEPTH (FT): 31.0
MUDLINE ELEVATION (FT): -30.53
VERT. DATUM: MLLW
NORTHING: 622609
EASTING: 881887
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 10/16/03; 1215
LOGGED BY: S. Hawkins
DATE END: 10/16/03; 1250

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0									40 feet of casing inserted below the reference point.
5	WOC								Initial wash contained black organic material with a slight organic odor and no sheen. Lost return water shortly after.
10									
15									No change in drill reaction.
20									
25									Drill resistance at ~26 feet. 70.4 feet of drill rod inserted below the barge reference point.
30									Bottom of probe @ 31 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in. TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⁙ - SAND
V V - BEDROCK
☰ - SILT
▨ - GRAVEL

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

PROBE LOG
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GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

PROBE LOCATION: see plan
TOTAL DEPTH (FT): 35.6
MUDLINE ELEVATION (FT): -26.1
VERT. DATUM: MLLW
NORTHING: 623234
EASTING: 881298
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 10/16/03; 1335
LOGGED BY: S. Hawkins
DATE END: 10/16/03; 1355

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
0									45 feet of casing inserted below the reference point.
5	WOC								Initial wash contained black organic sediment with an organic odor and no sheen. Lost rwater return.
10	WOC								End of casing at ~9.5 feet.
15									At ~10 feet, drill rig met resistance for ~5 feet.
20									No change in drill reaction.
25									
30									71.4 feet of drill rod inserted below the barge reference point.
35									Bottom of probe @ 35.6 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE
ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⁘ - SAND
∨ - BEDROCK
☰ - SILT
▨ - GRAVEL

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

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GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

PROBE LOCATION: see plan
TOTAL DEPTH (FT): 59.2
MUDLINE ELEVATION (FT): -21.79
VERT. DATUM: MLLW
NORTHING: 623765
EASTING: 880790
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 10/24/03; 1215
LOGGED BY: S. Hawkins
DATE END: 10/24/03; 1330

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0									45 feet of casing inserted below the reference point.
5	WOC								Wash contained black, fine sand and silt with organics, organic odor, and no sheen.
10	WOC								Wash contained gray fine sand and silt, no odor, no sand.
15	PUSH								End of casing at ~14.7 feet.
20									No change in drill reaction.
25									
30									
35									
40									
45									
50									Resistance @ ~52 feet for 1 foot.
55									87 feet of drill rod inserted below the barge reference point. Bottom of probe @ 59.2 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
▤ - SILT
░ - SAND
▧ - GRAVEL
▨ - BEDROCK

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

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GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT) WATER	DEPTH (FT) CASING	DEPTH (FT) HOLE

PROBE LOCATION: see plan
TOTAL DEPTH (FT): 107.7
MUDLINE ELEVATION (FT): -27.41
VERT. DATUM: MLLW
NORTHING: 623310
EASTING: 882264
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 10/13/03; 1120
LOGGED BY: S. Hawkins
DATE END: 10/13/03; 1313

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
0									55 feet of casing inserted below the reference point.
5	WOC								
10	WOC								
15	WOC								
20									End of casing at ~17 feet. No change in drill reaction.
25									
30									
35									
40									
45									
50									
55									
60									Blowing sand encountered. Bound up the drill rods.
65									
70									
75									
80									
85									
90									
95									
100									146.5 feet of drill rod inserted below the barge reference point.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in. TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE
ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
░ - SAND
▨ - BEDROCK
▤ - SILT
▧ - GRAVEL

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

BORING LOG
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DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
105									Bottom of probe @ 107.7 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⛆ - SAND
▽ - BEDROCK
☰ - SILT
◇ - GRAVEL

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

PROBE LOG
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GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

PROBE LOCATION: see plan
TOTAL DEPTH (FT): 58.2
MUDLINE ELEVATION (FT): -18.65
VERT. DATUM: MLLW
NORTHING: 623065
EASTING: 881826
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 10/16/03; 1005
LOGGED BY: S. Hawkins
DATE END: 10/16/03; 1052

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0	WOC								45 feet of casing inserted below the reference point. Initial wash contained black organics iwth organic odor. No visible sheen.
5	WOC								
10	WOC								Wash contained brown fine sand and silt. No odor or sheen.
15	PUSH								
20									Wash contained gray fine sand and silt. No odor or sheen. End of casing at ~20 feet.
25									
30									No change in drill reaction.
35									
40									
45									
50									
55									83.7 feet of drill rod inserted below the barge reference point. Bottom of probe @ 58.2 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in. TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE
ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⁙ - SAND
V - BEDROCK
▤ - SILT
▧ - GRAVEL

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	**PROBE LOG** PAGE 1 of 1 **FP-03-24**

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

PROBE LOCATION: see plan

TOTAL DEPTH (FT): 66.7

MUDLINE ELEVATION (FT): -27.46

VERT. DATUM: MLLW

NORTHING: 623785

EASTING: 881665

HOR. DATUM: NAD83

DRILLED BY: Hardiman Tom Hardiman

DATE START: 10/14/03; 0920

LOGGED BY: S. Hawkins

DATE END: 10/14/03; 1017

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0									50 feet of casing inserted below the reference point.
5	WOC								
10	WOC								
15	WOC								End of casing at ~15.2 feet.
20									No change in drill reaction.
25									
30									
35									
40									
45									
50									
55									
60									102.9 feet of drill rod inserted below the barge reference point.
65									Bottom of probe @ 66.7 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

- ORGANIC SOIL
- SAND
- BEDROCK
- SILT
- GRAVEL

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

PROBE LOG
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GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

PROBE LOCATION: see plan
TOTAL DEPTH (FT): 62.7
MUDLINE ELEVATION (FT): -29.54
VERT. DATUM: MLLW
NORTHING: 624229
EASTING: 881148
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 10/6/3; 1130
LOGGED BY: S. Hawkins
DATE END: 10/6/03; 1440

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0	WOC								47 feet of casing inserted below the reference point. Organics with organic sheen in return water. Black.
5									
10									
15									
20									No change in drill reaction.
25									
30									
35									
40									
45									
50									
55									96.5 feet of drill rod inserted below the barge reference point.
60									Bottom of probe @ 62.7 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
░ - SAND
V V - BEDROCK
▤ - SILT
▨ - GRAVEL

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

PROBE LOG
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FP-03-26

GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

PROBE LOCATION: see plan
TOTAL DEPTH (FT): 39.2
MUDLINE ELEVATION (FT): -32.60
VERT. DATUM: MLLW
NORTHING: 624608
EASTING: 880768
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 10/30/03; 0935
LOGGED BY: S. Hawkins
DATE END: 10/30/03; 1020

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
0									45 feet of casing inserted below the reference point.
5	WOC								
10	WOC								
15									
20									No change in drill reaction.
25									
30									
35									77.2 feet of drill rod inserted below the barge reference point. Bottom of probe @ 39.2 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⁙ - SAND
⩔ - BEDROCK
▤ - SILT
▧ - GRAVEL

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

PROBE LOG
PAGE 1 of 1
FP-03-27

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT) WATER	DEPTH (FT) CASING	DEPTH (FT) HOLE

PROBE LOCATION: see plan
TOTAL DEPTH (FT): 62.1
MUDLINE ELEVATION (FT): -30.74
VERT. DATUM: MLLW
NORTHING: 625263
EASTING: 880254
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 10/23/03; 1015
LOGGED BY: S. Hawkins
DATE END: 10/23/03; 1130

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION TYPE and NO.	SAMPLE INFORMATION BLOWS PER 6 IN.	SAMPLE INFORMATION PEN IN.	SAMPLE INFORMATION REC IN.	SAMPLE INFORMATION Qp (tsf)	SAMPLE INFORMATION Sv (tsf)	STRATA	SOIL / BEDROCK DESCRIPTION
0									50 feet of casing inserted below the reference point.
5	WOC								
10	WOC								End of casing @ ~7.9 feet.
15									
20									No change in drill reaction.
25									
30									
35									
40									
45									
50									
55									102.2 feet of drill rod inserted below the barge reference point.
60									Bottom of probe @ 62.1 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

- ▥ - ORGANIC SOIL
- ░ - SAND
- ▽ - BEDROCK
- ☰ - SILT
- ◇ - GRAVEL

GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

PROBE LOG
PAGE 1 of 1
FP-03-28

GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

PROBE LOCATION: see plan
TOTAL DEPTH (FT): 56.6
MUDLINE ELEVATION (FT): -31.12
VERT. DATUM: MLLW
NORTHING: 623820
EASTING: 881824
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 11/03/03; 1200
LOGGED BY: S. Hawkins
DATE END: 11/03/03; 1225

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0									50 feet of casing inserted below the reference point.
5	WOC								
10	WOC								
15	WOC								End of casing @ ~13.2 feet.
20									No change in drill reaction.
25									
30									
35									
40									
45									
50									93.0 feet of drill rod inserted below the barge reference point.
55									Bottom of probe @ 56.6 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in. TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⁘ - SAND
∨ - BEDROCK
☰ - SILT
◇ - GRAVEL

Φ GEI Consultants, Inc.

PROJECT NAME: Bridgeport Harbor
CITY/STATE: Bridgeport, CT
GEI PROJECT NUMBER: 032900

PROBE LOG
PAGE 1 of 1
FP-03-29

PROBE LOCATION: see plan
TOTAL DEPTH (FT): 49.1
MUDLINE ELEVATION (FT): -17.51
VERT. DATUM: MLLW
NORTHING: 626838
EASTING: 880046
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 10/28/03; 1100
LOGGED BY: S. Hawkins
DATE END: 10/28/03; 1145

GROUNDWATER INFORMATION

DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0									45 feet of casing inserted below the reference point.
5									
10									
15									
20									End of casing @ ~16.7 feet.
25									@ ~21.7 feet - Resistance in drilling for approximately 3 feet.
30									Resistance from stones/cobbles encountered through probe.
35									
40									
45									78.6 feet of drill rod inserted below the barge reference point. Bottom of probe @ 49.1 feet below mudline.

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in. TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⁙ - SAND
∨ - BEDROCK
☰ - SILT
▨ - GRAVEL

GEI Consultants, Inc.	PROJECT NAME: Bridgeport Harbor CITY/STATE: Bridgeport, CT GEI PROJECT NUMBER: 032900	PROBE LOG PAGE 1 of 1 **FP-03-30**

GROUNDWATER INFORMATION				
DATE	TIME	DEPTH (FT)		
		WATER	CASING	HOLE

PROBE LOCATION: see plan
TOTAL DEPTH (FT): 51.6
MUDLINE ELEVATION (FT): -16.38
VERT. DATUM: MLLW
NORTHING: 627493 EASTING: 880079
HOR. DATUM: NAD83
DRILLED BY: Hardiman Tom Hardiman
DATE START: 10/28/03; 1248
LOGGED BY: S. Hawkins
DATE END: 10/28/03; 1335

- 3.5" casing inserted into mudline
- N-4 rods with a 2-15/16 inch roller bit
- Rods advanced with downward hydraulic pressure, rotation, and jetting water through drill bit

DEPTH FT.	CASING BLOWS	SAMPLE INFORMATION						STRATA	SOIL / BEDROCK DESCRIPTION
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	Qp (tsf)	Sv (tsf)		
0									45 feet of casing inserted below the reference point.
5									
10									
15									End of casing @ ~15.8 feet. Resistance on stone/cobbles throughout probe.
20									
25									
30									
35									
40									
45									80.6 feet of drill rod inserted below the barge reference point. Bottom of probe @ 51.6 feet below mudline.
50									

BLOWS PER 6 in. - 140 LB. HAMMER FALLING 30 in.
TO DRIVE A 2.0 in. OD SPLIT SPOON SAMPLER
PEN - PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC - RECOVERY LENGTH OF SAMPLE
PID - PHOTOIONIZATION DETECTOR READING
Qp - POCKET PENETROMETER
Sv - SHEAR STRENGTH FROM TORVANE
ppm - PARTS PER MILLION
tsf - TONS PER SQUARE FOOT
S - 2 in. OD SPLIT SPOON SAMPLE
N/A - NOT APPLICABLE ND - NO DATA

STRATIGRAPHIC LEGEND

▥ - ORGANIC SOIL
⁘ - SAND
▽ - BEDROCK
▤ - SILT
◇ - GRAVEL

Hole No: FB06-1

DRILLING LOG

DIVISION **CENAB-EN-GGE**

INSTALLATION **Baltimore District**

SHEET **1** OF **2** SHEETS

1. PROJECT **Bridgeport Harbor**
2. LOCATION (Coordinates or Station) **Bridgeport, CT**
3. DRILLING AGENCY **Baltimore District**
4. HOLE NO. (As shown on drawing title and file number) **FB06-1**
5. NAME OF DRILLER **Albert McNamara**
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED DEG. FROM VERTICAL
7. THICKNESS OF OVERBURDEN **36.9'**
8. DEPTH DRILLED INTO ROCK **9.3'**
9. TOTAL DEPTH OF HOLE **46.2'**
10. SIZE AND TYPE OF BIT **4" casing w/ Advancer; 1 3/8" Split Spoon, HQ wireline**
11. DATUM FOR ELEVATION SHOWN (TBM or MSL) **See Remarks**
12. MANUFACTURER'S DESIGNATION OF DRILL **CME-45 on Jack-up Barge**
13. TOTAL NO. OF OVER-BURDEN SAMPLS TAKEN DISTURBED **9** UNDISTURBED **0**
14. TOTAL NO. OF CORE BOXES **1**
15. ELEVATION OF GROUND WATER
16. DATE HOLE STARTED **1230 Hrs. 15-Sep-06** COMPLETED **16-Sep-06**
17. ELEVATION TOP OF HOLE **See Remarks**
18. TOTAL CORE RECOVERY FOR BORING **93%** %
19. SIGNATURE OF INSPECTOR **Webster Shipley**

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f
			0.0-1.5 Sand, medium, wet, soft, tr shells, coarse, tr gravel to ¾", medium gray	**100%**	**J-1**
	2.0 4.0				
	6.0		**5.0-6.5 Sand, medium, wet, soft, with a little gravel, very coarse, medium to light gray**	**40%**	**J-2**
	8.0 10.0				
			10.0-11.5 Silty sand, fine, wet, soft, tr gravel, coarse, light brown	**73%**	**J-3**
	12.0 14.0				
	16.0		**15.0 Silty sand, fine, wet, soft, light brown 15.5-16.5**	**100%**	**J-4**
	18.0 20.0				
			20.0-21.5 Silt with a little clay, light brown	**87%**	**J-5**
	22.0 24.0				
	26.0		**25.0-26.5 Silt, wet, soft, with some sand, fine, light brown**	**87%**	**J-6**
	28.0 30.0				

REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g

Boring was drilled using 4" casing with casing advancer. Sampled using a standard 1 3/8" split spoon driven automatically by a 140 lb. hammer dropped 30". Coring with with HQ wireline using a 5' long split tube barrel.

Tides: 15-Sep-06
Bridgeport, CT Tide Gauge

Low	**0013**	**(0.7)**
High	**0615**	**6.2**
Low	**1224**	**(1.2)**
High	**1837**	**6.9**

Barge to Water: 13.4'
Water to Mud: 6.7'
Mud to Sediment: 1.2'
Barge to Sediment: 21.3'

Location Information:
Lat: 41 09 38.61802
Long: 73 10 52.42055
Elev of Top of Barge 11.970'

Jar #	Depth	Blow Count	Penetro-meter
J-1	0.0-1.5	3/9/17	NA
J-2	5.0-6.5	3/3/4	NA
J-3	10.0-11.5	5/5/11	NA
J-4	15.0-16.5	3/4/5	NA,1.5,2.0
J-5	20.0-21.5	3/4/8	NA,1.5,1.2
J-6	25.0-26.5	2/5/8	NA
J-7	30.0-31.5	7/18/19	NA
J-8	35.0-36.5	4/10/31	NA
J-9	36.0-36.9	10/ 100/.4	NA

			30.0-31.5 Sand, coarse to medium, wet, soft, with some gravel to ¾" grayish brown	**100%**	**J-7**	**BOH @ 46.2** **Groundwater Readings** **Encountered: Not Taken** **Completion: Not Taken** **After 24 Hrs: Not Taken**
	32.0					
	34.0					
	36.0		**35.0-36.5 Sand, coarse to medium, wet, soft, with some gravel to ¾", tr of decayed rock (schist) in shoe of spoon, grayish brown**	**100%**	**J-8**	PRELIMINARY INSPECTOR'S LOG CLASSIFICATION NOT FINAL
	38.0		**36.0 Decayed rock (schist), soft to hard, dull brownish gray**	**67%** **Run** **#1**	**J-9** **Box** **#1**	
	40.0		**Coring information located on 2nd page**	**86%**		

ENG FORM MAR 71 1836 PREVIOUS EDITIONS ARE OBSOLETE	PROJECT Bridgeport Harbor	HOLE NO. FB06-1

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE	Hole No. FB06-1
1. PROJECT Bridgeport Harbor Bridgeport, CT	2. INSTALLATION Baltimore District	SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY E	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			Schist, hard, medium to coarse grained, foliation is at ~60 to core axis	Run #1	Box #1	
	42.0 44.0 46.0		41.2-42.9 Schist, hard, medium to coarse grained, foliation is at ~60 to core axis 42.9-44.0 Quartz vein, massive, sugary, white to gray, banded with schist and gneiss. 44.0-46.2 41.2-42.9 Schist, hard, medium to coarse grained, foliation is at ~60 to core axis	Run #2 100%		
	48.0 50.0 52.0 54.0 56.0 58.0 60.0 62.0 64.0 66.0 68.0 70.0 72.0 74.0 76.0		Bottom of Hole 46.2’			

Coring:

Run	From	To	Cored	Rec	+/-	%	RQD
1	36.9	41.2	4.3	3.7	<.6)	86%	.4
2	41.2	46.2	5.0	5.0	0.0	100%	.26

Run 1: Fractures are irregular and uneven, open, fresh to weakly weathered and iron stained, mostly sub parallel to foliation but some are cross-cutting. Some of the fresh fractures are most likely mechanical breaks.

Fractures: 36.9-38.0 lost core and rubble,<.1’, 38.1, 38.4, 38.6, 38.3, 38.9, 39.4, 39.6, 40.0, 40.2, 40.5, rubble to 41.2

Run 2: Fractures are irregular and uneven, open, fresh to weakly weathered and iron stained, mostly sub parallel to foliation but some are cross-cutting. Some of the fresh fractures are most likely mechanical breaks.

Fractures: 41.2, 41.4, 41.6, 41.8, 42.3, 42.8, 42.9, 43.1, 43.2, 43.4, 43.6, 43.9, 44.1, 44.3, 44.6, 44.8, 45.1, 45.3, 45.4, 45.6, 45.8, rubble to bottom of run.

	78.0						
	80.0						
	82.0						PRELIMINARY INSPECTOR'S LOG CLASSIFICATION NOT FINAL
	84.0						
	86.0						
	88.0						

ENG FORM JUN 67 **1836- A** *(ER 1110-1-1801)*

PROJECT
Bridgeport Harbor
Bridgeport, CT

HOLE NO.
FB06-1

Hole No: FB06-02

DRILLING LOG	DIVISION **CENAB-EN-GGE**	INSTALLATION **Baltimore District**	SHEET **1** OF **3** SHEETS

1. PROJECT **Bridgeport Harbor**
2. LOCATION (Coordinates or Station) **Bridgeport, CT**
3. DRILLING AGENCY **Baltimore District**
4. HOLE NO. (As shown on drawing title and file number) **FB06-2**
5. NAME OF DRILLER **Albert McNamara**
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED DEG. FROM VERTICAL
7. THICKNESS OF OVERBURDEN **101.5'**
8. DEPTH DRILLED INTO ROCK **0.0'**
9. TOTAL DEPTH OF HOLE **101.5'**
10. SIZE AND TYPE OF BIT **4" casing w/ Advancer; 1 3/8" Split Spoon**
11. DATUM FOR ELEVATION SHOWN (TBM or MSL) **See Remarks**
12. MANUFACTURER'S DESIGNATION OF DRILL CME-45 on Jack-up Barge
13. TOTAL NO. OF OVER-BURDEN SAMPLS TAKEN DISTURBED **9** UNDISTURBED **0**
14. TOTAL NO. OF CORE BOXES **0**
15. ELEVATION OF GROUND WATER
16. DATE HOLE STARTED **1400 hrs. 16-Sep-06** COMPLETED **17-Sep-06**
17. ELEVATION TOP OF HOLE **See Remarks**
18. TOTAL CORE RECOVERY FOR BORING **-----** %
19. SIGNATURE OF INSPECTOR **Webster Shipley**

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f
			0.0-1.5 Sand, medium, wet,soft, tr shells, coarse,dark gray	**67%**	**J-1**
	2.0 4.0				
	6.0		**5.0-6.5 Gravelly sand, coarse to gravel, poorly sorted, wet, soft, tr silt, tr sand, fine, light gray**	**87%**	**J-2**
	8.0 10.0				
			10.0-11.5 Gravelly sand, coarse to gravel, poorly sorted, wet, soft, light gray	**33%**	**J-3**
	12.0 14.0				
	16.0		**15.0-16.5 Sand, medium to coarse, wet, soft, tr gravel, light gray**	**67%**	**J-4**
	18.0 20.0				
			20.0-21.5 Sand, coarse, wet, soft, with alittle sand, medium, tr silt, tr gravel, light gray	**100%**	**J-5**
	22.0 24.0				
	26.0		**25.0-26.5 Gravel, soft, wet, poorly sorted, with some sand, coarse to fine, light gray**	**33%**	**J-6**
	28.0 30.0				
			30.0-31.5 Silt, wet, soft, with a little clay, and sand, fine, medium gray	**100%**	**J-7**
	32.0 34.0				
	36.0		**35.0-36.5 Clay with some silt, wet, soft, medium gray**	**100%**	**J-8**
	38.0 40.0				

REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
g

Boring was drilled using 4" casing with casing advancer. Sampled using a standard 1 3/8" split spoon driven automatically by a 140 lb. hammer dropped 30".

Tides: 16-Sep-06
Bridgeport, CT Tide Gauge

Low	**0118**	**(0.9)**
High	**0720**	**6.2**
Low	**1330**	**(1.2)**
High	**1943**	**6.8**

Barge to Water: 12.7'
Water to Mud: 7.5'
Mud to Sediment: 1.2'
Barge to Sediment: 20.9'

Location Information:

Lat: 41 09 35.08180
Long: 73 10 28.71248
Elev of Top of Barge 11.396'

<u>Jar #</u>	<u>Depth</u>	Blow <u>Count</u>	Penetro-<u>meter</u>
J-1	0.0-1.5	5/3/4	NA
J-2	5.0-6.5	13/13/10	NA
J-3	10.0-11.5	4/6/2	NA
J-4	15.0-16.5	8/7/4	NA
J-5	20.0-21.5	3/2/1	NA
J-6	25.0-26.5	4/3/2	NA
J-7	30.0-31.5	1/2/2	.8,1.0,NA
J-8	35.0-36.5	W0H/2/1	.5,.8,.5
J-9	40.0-41.5	1/2/1	.8,.5,.8
J-10	45.0-46.5	1/2/1	.8,.5,.8
J-11	50.0-51.5	5/8/10	NA
J-12	55.0-56.5	6/7/10	NA
J-13	60.0-61.5	4/5/8	NA
J-14	65.0-66.5	4/5/9	NA
J-15	70.0-71.5	3/6/10	NA
J-16	75.0-76.5	4/9/13	NA
J-17	80.0-81.5	5/6/10	NA
J-18	85.0-86.5	3/5/8	NA
J-19	90.0-91.5	3/5/8	NA
J-20	95.0-96.5	2/6/9	NA,NA,1.2
J-21	100.0-101.5	4/6/11	NA

BOH @ 101.5

<u>Groundwater Readings</u>

Encountered: Not Taken
Completion: Not Taken
After 24 Hrs: Not Taken

PRELIMINARY
INSPECTOR'S LOG
CLASSIFICATION
NOT FINAL

ENG FORM MAR 71 1836 **PREVIOUS EDITIONS ARE OBSOLETE**

PROJECT
Bridgeport Harbor
Bridgeport, CT

HOLE NO.
FB06-2

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE	**Hole No. FB06-2**
1. PROJECT **Bridgeport Harbor Bridgeport, CT**	2. INSTALLATION **Baltimore District**	**SHEET 2** **OF 3 SHEETS**

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) D	% CORE RECOV-ERY E	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			40.0-41.5 Clay with tr silt, wet, soft, medium gray	**100%**	**J-9**	
	42.0 44.0					
	46.0		**45.0-46.5 Clay with tr silt, wet, soft, tr sand, coarse to gravel, medium gray**	**100%**	**J-10**	
	48.0					
	50.0		**50.0-51.5 Sand, fine, soft, wet, tr silt, medium gray**	**100%**	**J-11**	
	52.0 54.0					
	56.0		**55.0-56.5 Silt, wet, soft, with a little sand, fine to v fine, dull grayish brown**	**100%**	**J-12**	
	58.0					
	60.0		**60.0-61.5 Sandy silt, fine to v fine, wet, soft, light brown**	**80%**	**J-13**	
	62.0 64.0					
	66.0		**65.0-66.5 Silty sand, v fine, wet, soft, light brown**	**73%**	**J-14**	
	68.0					
	70.0		**70.0-71.5 Silty sand, v fine, wet, soft, light brown with tr of orangish brown**	**87%**	**J-15**	
	72.0 74.0					
	76.0		**75.0-76.5 Silty sand, v fine, wet, soft, light brown with tr of orangish brown**	**73%**	**J-16**	
	78.0					
	80.0		**80.0 Silty sand, v fine, wet, soft, light brown with tr of orangish brown**	**80%**	**J-17**	
	82.0 84.0		**80.5-81.5 Sand, v fine, wet, soft, with some silt, light gray**			
	86.0		**85.0-86.5 Silt, wet, soft, with some sand, v fine, tr clay, light gray**	**80%**	**J-18**	
	88.0					

PRELIMINARY
INSPECTOR'S LOG
CLASSIFICATION
NOT FINAL

ENG FORM JUN 67 1836- A *(ER 1110-1-1801)*	PROJECT **Bridgeport Harbor** **Bridgeport, CT**	HOLE NO. **FB06-2**

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE	**Hole No. FB06-2**
1. PROJECT **Bridgeport Harbor Bridgeport, CT**	2. INSTALLATION **Baltimore District**	**SHEET 3** **OF 3 SHEETS**

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY E	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	90.0		**90.0-91.5 Silt, wet, soft, tr sand, v fine, tr clay, light gray**	**100%**	**J-19**	
	92.0					
	94.0					
	96.0		**95.0-96.5 Silt, wet, soft, tr sand, v fine, tr to some at bottom of drive clay, light gray**	**100%**	**J-20**	
	98.0					
	100.0		**100.0-101.5 Silt, wet, soft, tr sand, v fine, some clay, light gray**	**80%**	**J-21**	
	102.0		**Bottom of Hole 101.5'** **No Refusal/No Top of Rock**			
	104.0					
	106.0					
	108.0					
	110.0					
	112.0					
	114.0					
	116.0					
	118.0					
	120.0					
	122.0					
	124.0					
	126.0					
	128.0					PRELIMINARY INSPECTOR'S LOG CLASSIFICATION NOT FINAL
	130.0					
	132.0					
	134.0					
	136.0					

ENG FORM JUN 67 **1836- A** *(ER 1110-1-1801)*

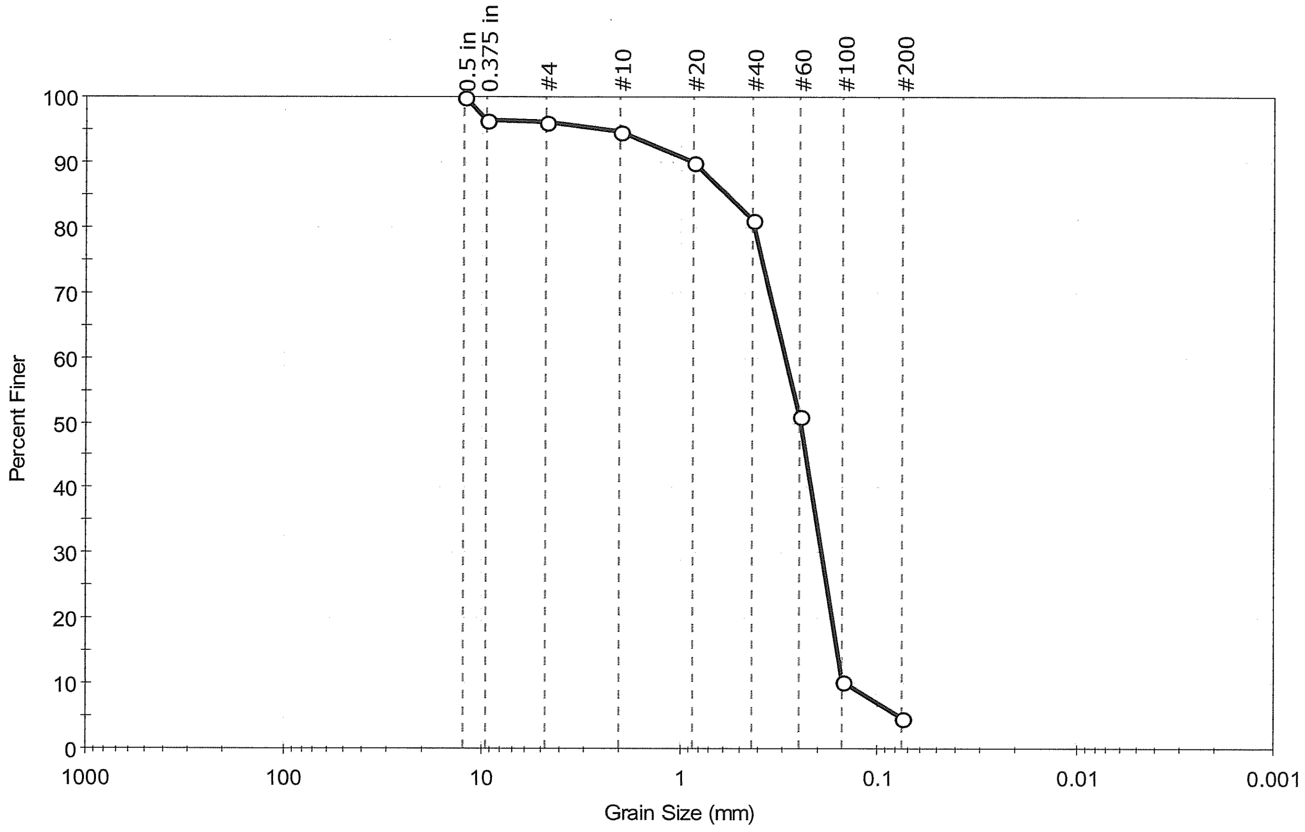
PROJECT
Bridgeport Harbor
Bridgeport, CT

HOLE NO.
FB06-2

GeoTesting express
a subsidiary of Geocomp Corporation

Client: US Army Corp of Engineers
Project: Bridgeport Harbor CAD Cells
Location:
Project No: GTX-8464
Boring ID: B6-1
Sample Type: jar
Tested By: ap
Sample ID:J-1
Test Date: 08/25/08
Checked By: jdt
Depth : 0-1.5 ft
Test Id: 137038
Test Comment: ---
Sample Description: Moist, olive brown sand
Sample Comment: ---

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	3.7	91.5	4.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	97		
#4	4.75	96		
#10	2.00	95		
#20	0.85	90		
#40	0.42	81		
#60	0.25	51		
#100	0.15	10		
#200	0.075	5		

Coefficients

D_{85} =0.5792 mm
D_{30} =0.1917 mm
D_{60} =0.2925 mm
D_{15} =0.1588 mm
D_{50} =0.2464 mm
D_{10} =0.1421 mm
C_u =2.058
C_c =0.884

Classification

ASTM Poorly graded sand (SP)

AASHTO Fine Sand (A-3 (0))

Sample/Test Description

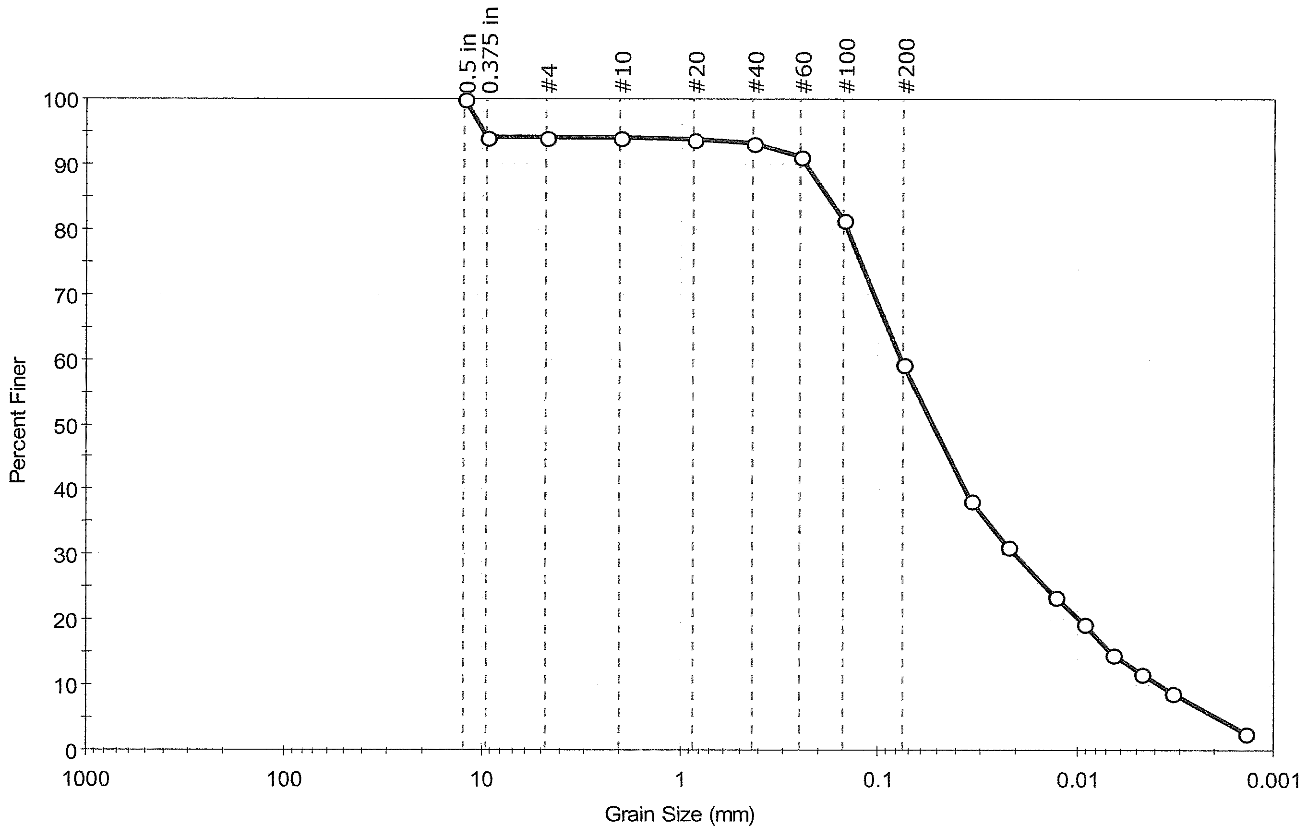
Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

GeoTesting express
a subsidiary of Geocomp Corporation

Client: US Army Corp of Engineers
Project: Bridgeport Harbor CAD Cells
Location:
Project No: GTX-8464
Boring ID: B6-1
Sample Type: jar
Tested By: ap
Sample ID:J-4
Test Date: 08/25/08
Checked By: jdt
Depth : 15.0-16.5 ft
Test Id: 137042
Test Comment: ---
Sample Description: Moist, dark yellowish brown sandy silt
Sample Comment: ---

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	5.9	34.9	59.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	94		
#4	4.75	94		
#10	2.00	94		
#20	0.85	94		
#40	0.42	93		
#60	0.25	91		
#100	0.15	82		
#200	0.075	59		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0339	38		
---	0.0220	31		
---	0.0130	24		
---	0.0092	19		
---	0.0066	15		
---	0.0047	12		
---	0.0033	9		
---	0.0014	3		

Coefficients

D_{85} =0.1807 mm	D_{30} =0.0202 mm
D_{60} =0.0770 mm	D_{15} =0.0067 mm
D_{50} =0.0530 mm	D_{10} =0.0038 mm
C_u =N/A	C_c =N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

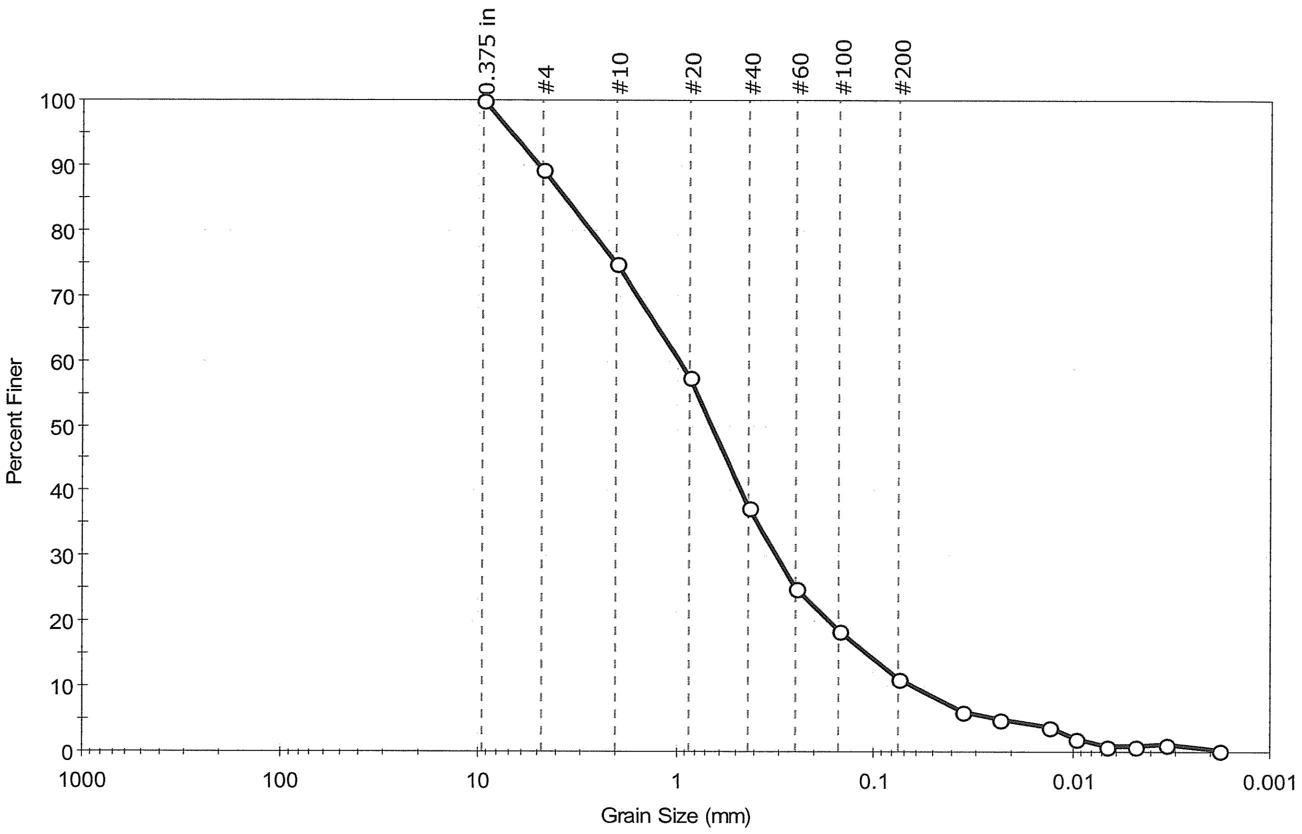
Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

GeoTesting express
a subsidiary of Geocomp Corporation

Client: US Army Corp of Engineers
Project: Bridgeport Harbor CAD Cells
Location:
Project No: GTX-8464
Boring ID: B6-1
Sample Type: jar
Tested By: ap
Sample ID: J-7
Test Date: 08/27/08
Checked By: jdt
Depth : 30.0-31.5 ft
Test Id: 137298
Test Comment: ---
Sample Description: Moist, dark yellowish sand with silt
Sample Comment: ---

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	10.7	78.1	11.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	89		
#10	2.00	75		
#20	0.85	57		
#40	0.42	37		
#60	0.25	25		
#100	0.15	19		
#200	0.075	11		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0360	6		
---	0.0236	5		
---	0.0131	4		
---	0.0095	2		
---	0.0068	1		
---	0.0048	1		
---	0.0033	1		
---	0.0018	0		

Coefficients

D_{85} =3.6672 mm
D_{30} =0.3077 mm
D_{60} =0.9609 mm
D_{15} =0.1076 mm
D_{50} =0.6560 mm
D_{10} =0.0631 mm
C_u =15.228
C_c =1.562

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description

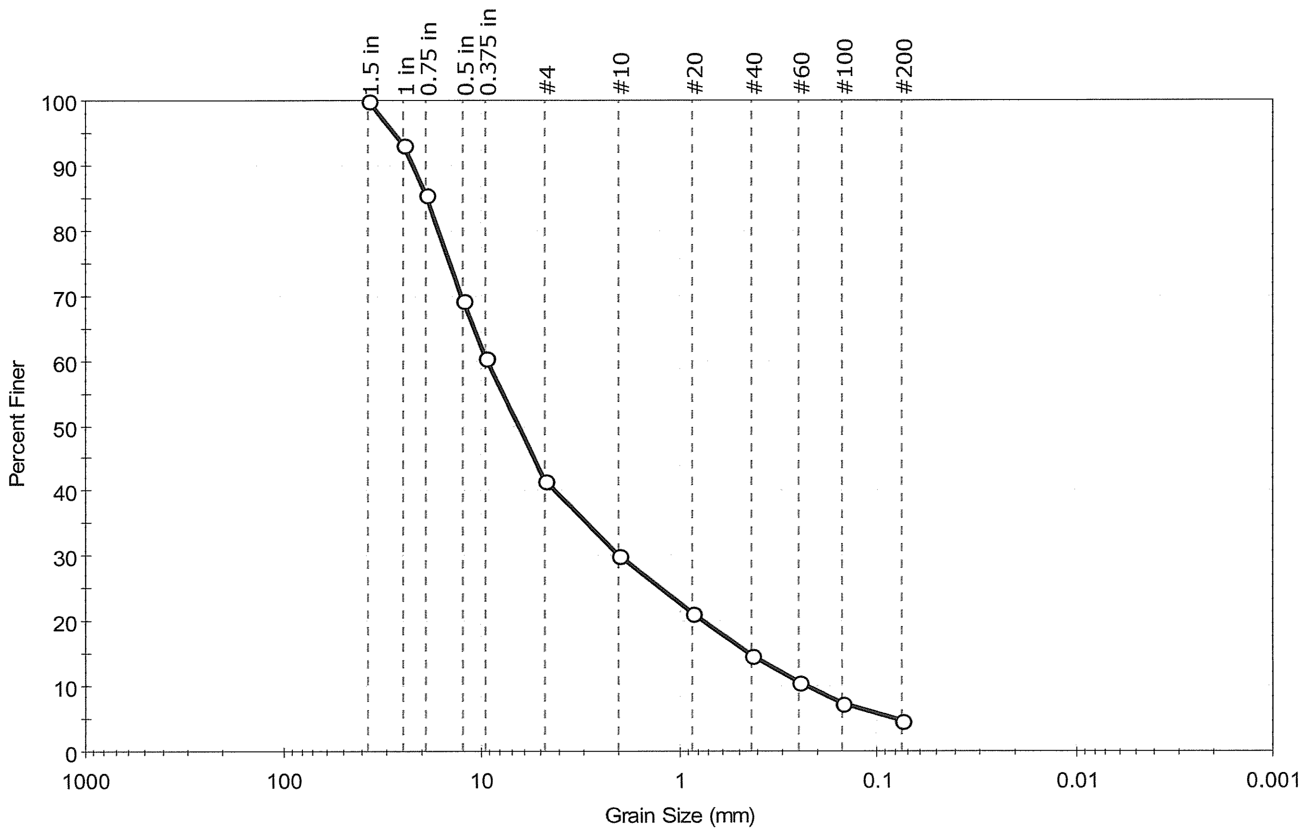
Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

GeoTesting express
a subsidiary of Geocomp Corporation

Client: US Army Corp of Engineers
Project: Bridgeport Harbor CAD Cells
Location:
Project No: GTX-8464
Boring ID: B6-2
Sample ID:J-2
Depth : 5.0-6.5ft
Sample Type: jar
Test Date: 08/25/08
Test Id: 137040
Tested By: ap
Checked By: jdt
Test Comment: ---
Sample Description: Moist, grayish brown gravel with sand
Sample Comment: ---

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	58.5	36.7	4.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	93		
0.75 in	19.00	86		
0.5 in	12.50	69		
0.375 in	9.50	60		
#4	4.75	42		
#10	2.00	30		
#20	0.85	21		
#40	0.42	15		
#60	0.25	11		
#100	0.15	7		
#200	0.075	5		

Coefficients

D_{85} =18.6837 mm
D_{30} =2.0066 mm
D_{60} =9.3784 mm
D_{15} =0.4402 mm
D_{50} =6.4838 mm
D_{10} =0.2225 mm
C_u =42.150
C_c =1.930

Classification

ASTM Well-graded gravel with sand (GW)

AASHTO Stone Fragments, Gravel and Sand (A-1-a (0))

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

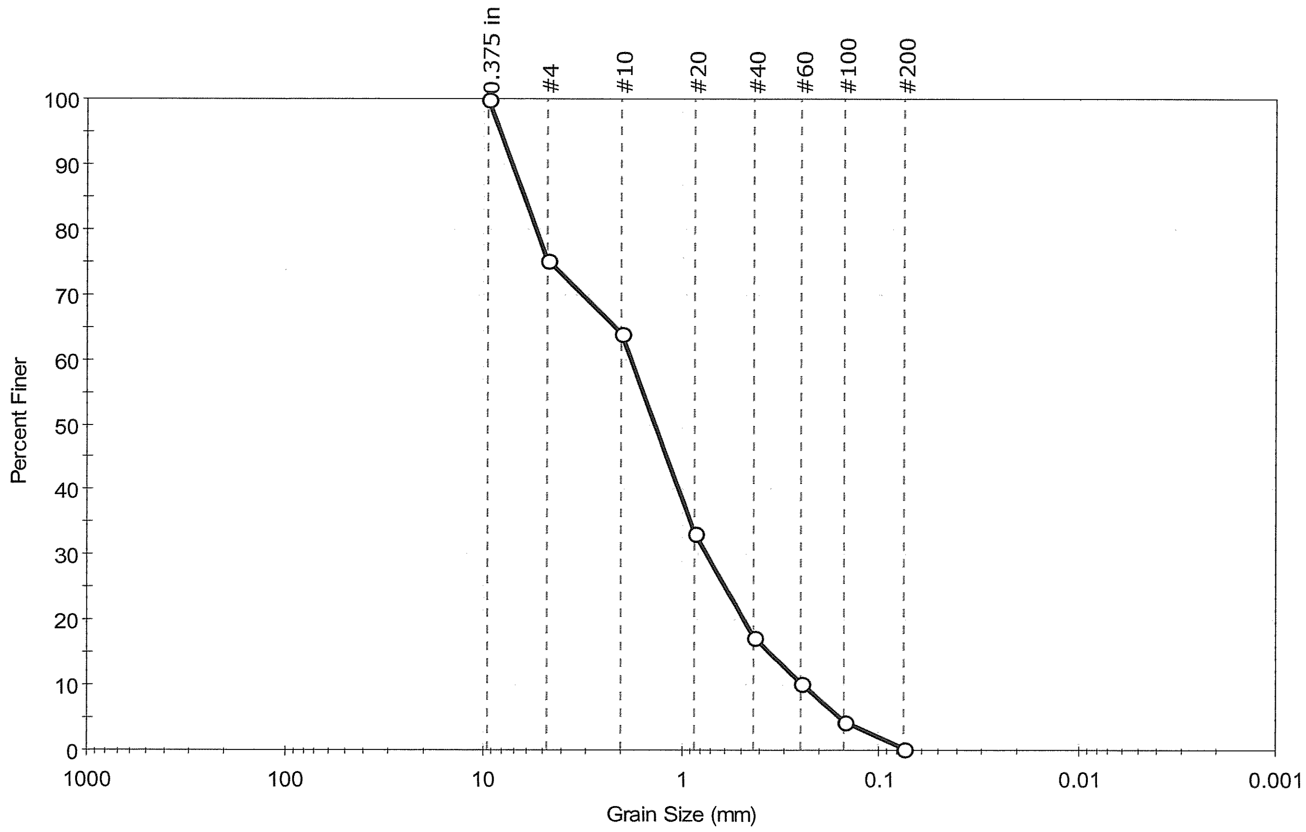
Sand/Gravel Hardness : HARD

GeoTesting express
a subsidiary of Geocomp Corporation

Client:	US Army Corp of Engineers				
Project:	Bridgeport Harbor CAD Cells				
Location:				Project No:	GTX-8464
Boring ID:	B6-2	Sample Type:	jar	Tested By:	ap
Sample ID:	J-5	Test Date:	08/25/08	Checked By:	jdt
Depth :	20.0-21.5 ft	Test Id:	137041		

Test Comment: ---
Sample Description: Moist, olive brown sand with gravel
Sample Comment: ---

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	24.8	74.9	0.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	75		
#10	2.00	64		
#20	0.85	33		
#40	0.42	17		
#60	0.25	10		
#100	0.15	5		
#200	0.075	0		

Coefficients

D_{85} =6.2551 mm	D_{30} =0.7350 mm
D_{60} =1.7921 mm	D_{15} =0.3551 mm
D_{50} =1.3546 mm	D_{10} =0.2420 mm
C_u =7.405	C_c =1.246

Classification

ASTM Well-graded sand with gravel (SW)

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

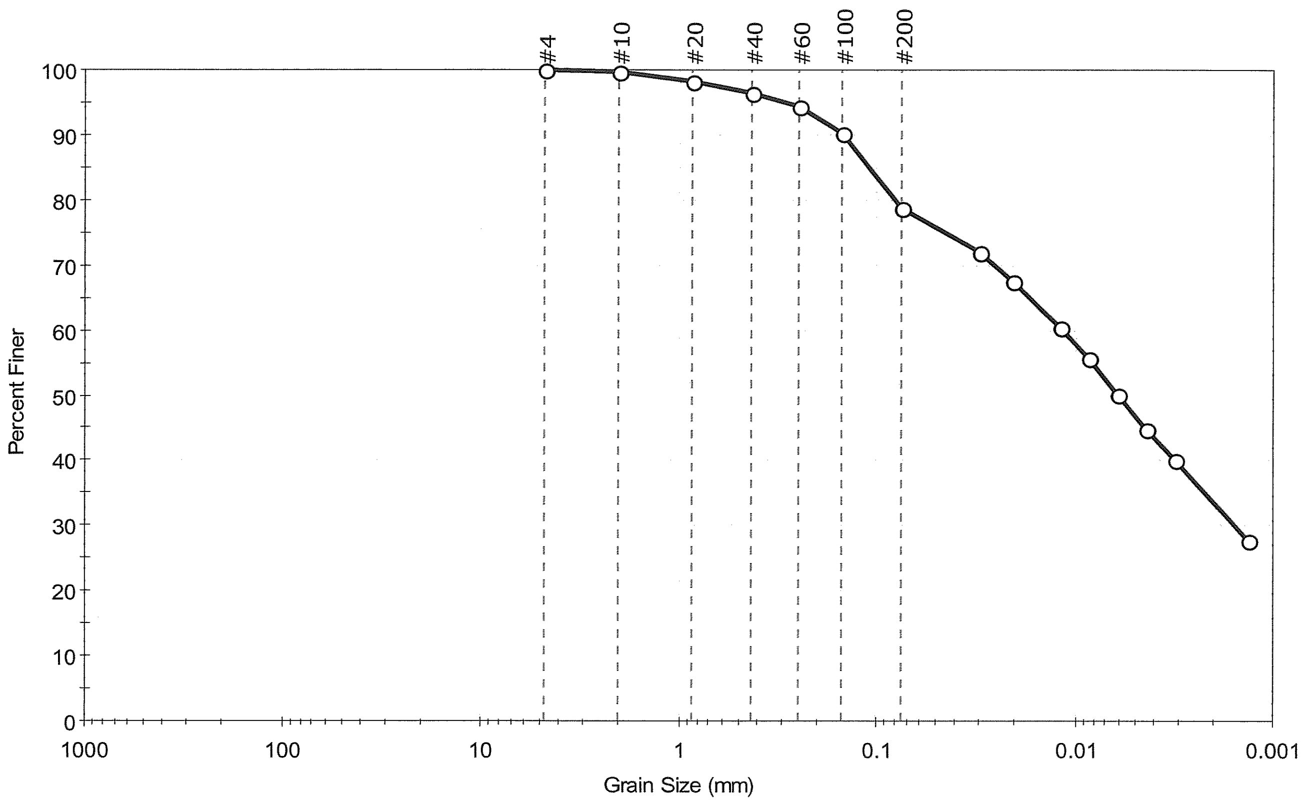
Sand/Gravel Hardness : HARD

GeoTesting
express
a subsidiary of Geocomp Corporation

Client:	US Army Corp of Engineers				
Project:	Bridgeport Harbor CAD Cells				
Location:				Project No:	GTX-8464
Boring ID:	B6-2	Sample Type:	jar	Tested By:	ap
Sample ID:	J-8	Test Date:	08/22/08	Checked By:	jdt
Depth :	35.0-36.5 ft	Test Id:	137043		

Test Comment: ---
Sample Description: Moist, dark olive gray silt with sand
Sample Comment: ---

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	21.3	78.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	98		
#40	0.42	96		
#60	0.25	94		
#100	0.15	90		
#200	0.075	79		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0302	72		
---	0.0206	67		
---	0.0120	61		
---	0.0085	56		
---	0.0061	50		
---	0.0044	45		
---	0.0031	40		
---	0.0013	28		

Coefficients

D_{85} =0.1096 mm
D_{30} =0.0016 mm
D_{60} =0.0115 mm
D_{15} =N/A
D_{50} =0.0061 mm
D_{10} =N/A
C_u =N/A
C_c =N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

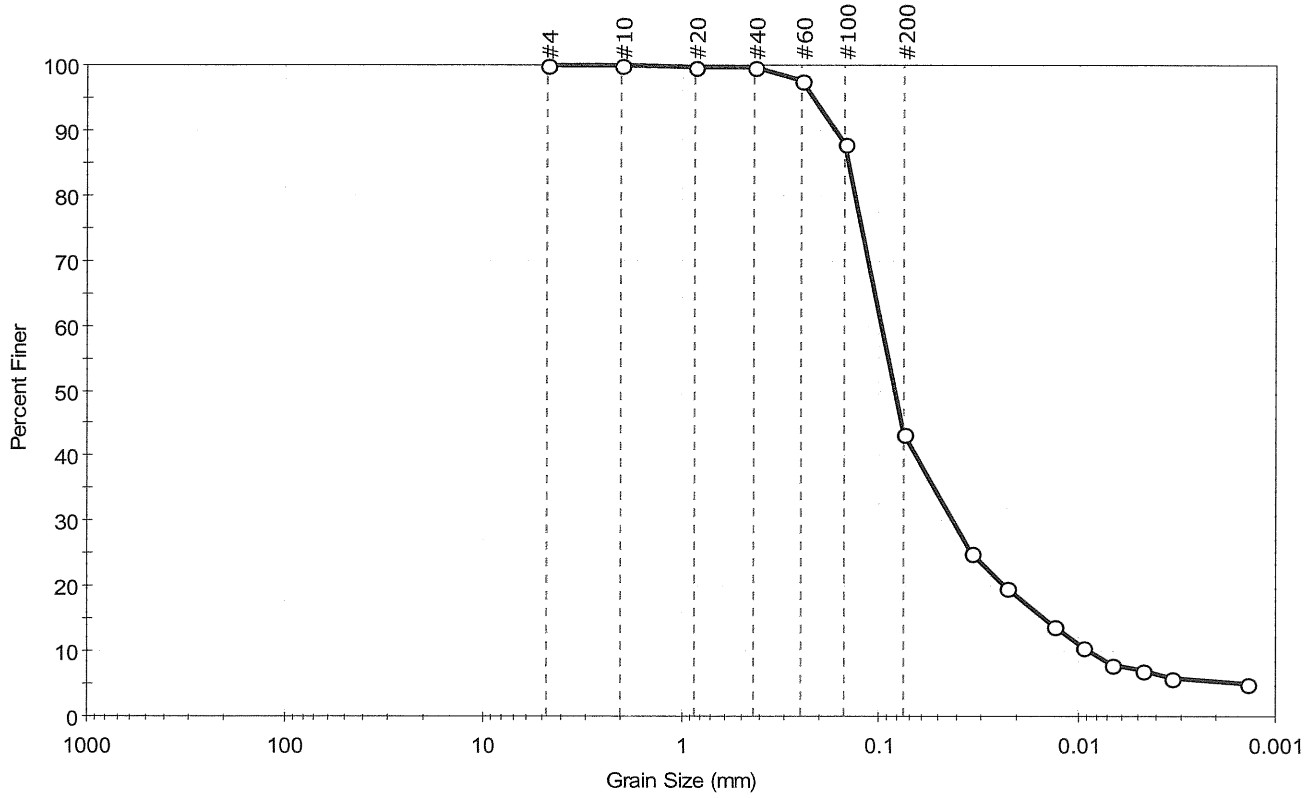
Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

GeoTesting express
a subsidiary of Geocomp Corporation

Client: US Army Corp of Engineers
Project: Bridgeport Harbor CAD Cells
Location:
Project No: GTX-8464
Boring ID: B6-2
Sample Type: jar
Tested By: ap
Sample ID:J-14
Test Date: 08/25/08
Checked By: jdt
Depth : 65.0-66.5 ft
Test Id: 137044
Test Comment: ---
Sample Description: Moist, olive brown silty sand
Sample Comment: ---

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	56.7	43.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	98		
#100	0.15	88		
#200	0.075	43		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0344	25		
---	0.0228	20		
---	0.0133	14		
---	0.0094	11		
---	0.0067	8		
---	0.0047	7		
---	0.0033	6		
---	0.0014	5		

Coefficients

D_{85} =0.1432 mm	D_{30} =0.0425 mm
D_{60} =0.0972 mm	D_{15} =0.0147 mm
D_{50} =0.0832 mm	D_{10} =0.0086 mm
C_u =N/A	C_c =N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

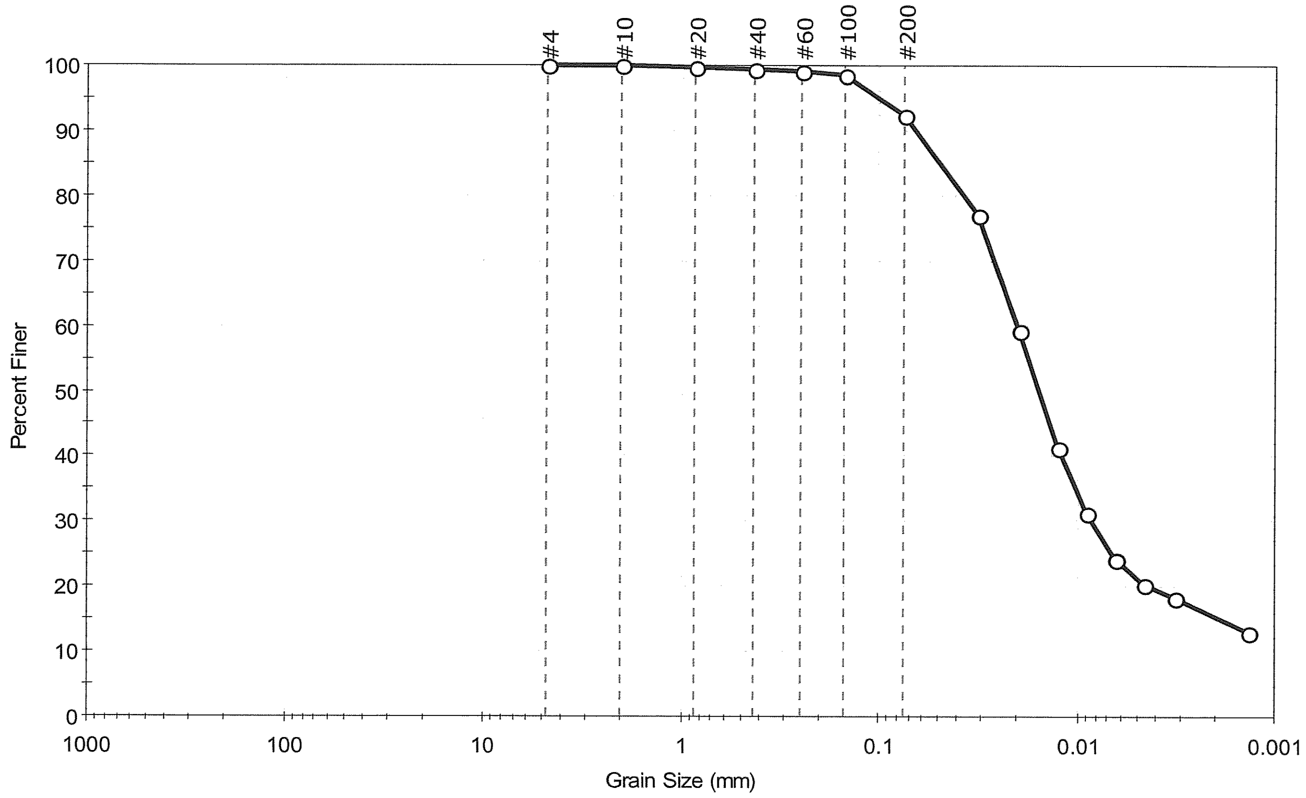
Sand/Gravel Hardness : HARD

GeoTesting express
a subsidiary of Geocomp Corporation

Client:	US Army Corp of Engineers				
Project:	Bridgeport Harbor CAD Cells				
Location:				Project No:	GTX-8464
Boring ID:	B6-2	Sample Type:	jar	Tested By:	ap
Sample ID:	J-19	Test Date:	08/25/08	Checked By:	jdt
Depth :	90.0-91.5 ft	Test Id:	137045		

Test Comment: ---
Sample Description: Moist, brown silt
Sample Comment: ---

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	7.6	92.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	99		
#60	0.25	99		
#100	0.15	98		
#200	0.075	92		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0317	77		
---	0.0195	59		
---	0.0124	41		
---	0.0090	31		
---	0.0064	24		
---	0.0046	20		
---	0.0032	18		
---	0.0014	13		

Coefficients

D_{85} =0.0497 mm	D_{30} =0.0085 mm
D_{60} =0.0200 mm	D_{15} =0.0019 mm
D_{50} =0.0155 mm	D_{10} =0.0009 mm
C_u =N/A	C_c =N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

APPENDIX E

CORRESPONDANCE

Connecticut Commission on Culture & Tourism

Historic Preservation and Museum Division

One Constitution Plaza
Second Floor
Hartford, Connecticut
06103

860.256.2800
860.256.2763 (f)

December 18, 2008

Mr. John R. Kennelly
Engineering/Planning Division
US Army Corps of Engineers
696 Virginia Road
Concord, MA 01742-2751

Subject: Bridgeport Harbor Federal Navigation Channels
Bridgeport, CT

Dear Mr. Kennelly:

The State Historic Preservation Office has reviewed the draft *Dredged Material Management Plan* prepared by the New England Division regarding the above-named project. This office notes that the *Elmer D. Dailey*, *Priscilla Dailey* and *Berkshire No. 7*, historic canal boats which are listed on the National Register of Historic Places, are submerged immediately south of the Stratford Avenue Bridge. Therefore, we recommend that a professional reconnaissance survey be undertaken to identify the precise location of these significant maritime vessels with regards to the Stratford Avenue navigation channel. All archaeological studies must be undertaken in accordance with our *Environmental Review Primer for Connecticut's Archaeological Resources.*

No project-related activities should be initiated until this office has had an opportunity to review and comment upon the recommended archaeological survey report.

We anticipate working with all interested parties in the expeditious furtherance of the proposed undertaking as well as in the professional management of Connecticut's maritime heritage.

For further information please contact Dr. David A. Poirier, Staff Archaeologist.

Sincerely,

David Bahlman

David Bahlman
Deputy State Historic Preservation Officer

cc: Dr. Nicholas Bellantoni/OSA
Ms. Kate Atwood/ACOE

CONNECTICUT
www.cultureandtourism.org

12-8-08

Mr. John R. Kennelly,
Chief of Planning
Department of The Army
New England Dist., Corps of Engineers
696 Virginia Rd.
Concord, MA 01742-2751

Re: DRAFT DREDGED MATERIAL MANAGEMENT PLAN (DMMP) & ENVIRONMENTAL ASSESSMENT FOR DREDGING AND DISPOSAL OF MATERIAL FROM THE BRIDGEFPORT HARBOR FEDERAL NAVIGATION CHANNELS IN BRIDGEPORT, CT

Dear Mr. Kennelly,

After reviewing the information provided, we have no knowledge of properties of religious and cultural importance to the Mashantucket Pequot Tribe. However, we recommend a Phase I Archaeological Survey be conducted to identify previously unknown properties of cultural and religious importance.
We would appreciate a copy of any work performed on this project.

Sincerely,

Kathleen Knowles

Kathleen Knowles,
Tribal Historic Preservation Officer
Mashantucket Pequot Tribe

MASHANTUCKET PEQUOT MUSEUM & RESEARCH CENTER

110 Pequot Trail, PO Box 3180
Mashantucket, CT 06338
Phone: 860 396 6800
Fax: 860 396 6850
www.pequotmuseum.org

-----Original Message-----
From: Anthony_Tur@fws.gov [mailto:Anthony_Tur@fws.gov]
Sent: Thursday, October 02, 2008 10:50 AM
To: Rogers, Catherine J NAE
Cc: Susi_vonOettingen@fws.gov
Subject: Bridgeport Harbor DMMP

Catherine,

There are no known occurences of federally listed species in the project are. However, the Seaside Park Beach disposal option, as described, will create suitable habitat conditions for the federally-threatened piping plover (Charadrius melodus). The creation of new habitats for this species may be beneficial, provide the General Piping Plover Dredge Disposal Conditions to Avoid Adversely Affecting Piping Plovers . If implemented, then the project is not likely to adversely affect the piping plover. If the management guidelines can not be implemented, then the project is likely to result in adverse affects to the plover and further consultation with this office is required.

2008 General Piping Plover Dredge Disposal Conditions to Avoid Adversely Affecting Piping Plovers

1. Any suitable piping plover habitat created by work performed under this authorization shall be managed in accordance with the U.S. Fish and Wildlife Service (U.S. FWS), Northeast Region, April 15, 1994 document titled, Guidelines for Managing Recreational Activities in Piping Plover Breeding Habitat on the U.S. Atlantic Coast to Avoid Take Under Section 9 of the Endangered Species Act ("Guidelines") for managing recreational beaches when federally listed piping plovers are present. See (http://www.fws.gov/northeast/newenglandfieldoffice/pdfs/Beach_management_guidelines.pdf).

2. Before work takes place, assurance of plover management must be provided to the U.S. FWS through a management plan implemented by the permittee or a signed management agreement between the permittee and a qualified entity. The U.S. FWS must approve the management plan. Permittees must contact Susi von Oettingen, U.S. FWS at (603) 223-2541, x22 or susi_vonOettingen@fws.gov for information on preparing a management agreement and its approval.

3. Beach nourishment in existing plover habitat should maintain a 10:1 slope and have no vegetation plantings.

4. Each year, before dredged material is placed in any site authorized under this permit a qualified piping plover monitor1 shall determine whether suitable piping plover nesting habitat exists at that site. If such habitat is present, it shall be posted with warning signs and/or

"symbolic fencing"2 before April 1 of each year and managed according to the Guidelines. (A qualified piping plover monitor is a person who has the skills, knowledge, and ability to conduct monitoring.)
(2"Symbolic fencing" refers to two strands of light-weight string, tied between posts to delineate at least a 50 meter radius around nests areas where pedestrians and vehicles should not
enter.)

5. Each year, a qualified monitor shall determine whether suitable
piping plover nesting habitat exists at disposal sites that have received dredged material under this authorization. If such habitat is present, it shall be posted with warning signs and/or "symbolic fencing" by April 1 of each year and managed according to Guidelines referenced above.

6. On suitable piping plover nesting habitat, all construction
activities are prohibited during the period March 30 to September 1 of each year, unless the U.S. FWS [Supervisor, New England Field Office, U.S. FWS, 70 Commercial Street, Suite 300, Concord, NH 03301, (603) 223-2541] is notified two weeks prior and:

a. A qualified monitor is in place by April 1 to document location and
activities of breeding plovers and to observe disposal activities relative to plover activities during the disposal period. In any calendar year pre-activity surveys shall begin one week prior to April 1 or one week prior to the commencement of any on-site project activity, whichever occurs first.
On at least four non-consecutive days the piping plover monitor shall survey the project area (including landing, staging, operation, sand-transport and beach nourishment areas) for the occurrence of territorial, courting or nesting piping plovers. Each day's monitoring shall consist of two separate surveys conducted during different times of the tidal cycle;

b. Dredge/disposal activities are located 100 meters or more from piping
plover territories and/or nests;

c. Plovers are monitored continuously during project activities and, if
it is determined that piping plovers are disturbed by the activity, (1) all work ceases immediately and (2) the U.S. FWS is notified immediately at (603)
223-2541 for further consultation. Piping plover monitoring field notes shall be provided to the U.S. FWS upon request. Piping plover monitoring is the process of observing and recording data on piping plover breeding activities without causing disturbance to the birds under observation.
Monitoring includes, but is not limited to, detecting and recording locations of territorial and courting adults, locating nests and incubating adults, locating broods, interpreting piping plover behaviors, and documenting observations in legible, complete field notes. Except to determine the number of eggs in a newly discovered

nest, monitoring is done using binoculars or spotting scopes from a distance of at least 50 meters;

d. If a crushed nest or a dead piping plover chick or adult is found,
the permittee immediately contacts the Division of Law Enforcement,
U.S. FWS, Office of Law Enforcement, 70 Everett Avenue, Suite 315,
Chelsea, MA 02150;
(617) 889-6616.

Thanks For Coordinating. In the future, please send your requests to us via the USPS.

Tony

Anthony Tur
Endangered Species Biologist
U.S. Fish and Wildlife Service
New England Field Office
70 Commercial Street, Suite 300
Concord, New Hampshire 03301

Phone (603) 223-2541 x.24
Anthony_Tur@fws.gov

http://www.fws.gov/northeast/newenglandfieldoffice/

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
One Blackburn Drive
Gloucester, MA 01930-2298

JUL -9 2008

Ms. Catherine Rogers
US Army Corps of Engineers
New England District
Engineering/Planning Division
Evaluation Branch
696 Virginia Road
Concord, MA 01742-2751

Re: Request for Information regarding fishery resources and endangered species within Bridgeport Harbor; Bridgeport Harbor Proposed Dredge Material Disposal Sites

Dear Ms. Rogers:

This letter is in response to your letter dated May 19, 2008 requesting information regarding the presence and distribution of Essential Fish Habitat (EFH), fishery resources, and protected resources within Bridgeport Harbor and Morris Cove, New Haven. Specifically, this request is in reference to the Bridgeport Harbor Proposed Dredge Material Disposal Sites. The Army Corps of Engineers (ACOE) has identified two potential locations within Bridgeport Harbor for the construction of a confined aquatic disposal (CAD) cell to dispose of material excavated from the Bridgeport Harbor federal navigation channel. Another potential site for dredge material disposal includes Morris Cove, New Haven. The National Marine Fisheries Service (NOAA Fisheries Service) provides the following information in an attempt to identify and address potential adverse impacts on NOAA trust resources within the project area.

Essential Fish Habitat

EFH has been designated for a number of federally managed species within the proposed work area of Bridgeport Harbor and Morris Cove. A complete list of species and life stages that have been designated for the proposed project location can be found on the NOAA Fisheries Service Habitat Conservation Division website at http://www.nero.noaa.gov/ro/doc/webintro.html

Among those species listed, particular attention should be focused on winter flounder (*Pseudopleuronectes americanus*) habitat that may be adversely affected by this project. Adult winter flounder utilize these areas for spawning and feeding, while eggs, larvae, and juveniles use the area for early life stage development. Suspended sediment deposition resulting from the proposed project can adversely affect winter flounder eggs and juvenile development. There is evidence that winter flounder spawn in waters surrounding Bridgeport and New Haven (Pereira et al. 1992; Nelson et al. 1991). Other federally managed species that have been identified within the project footprint should be evaluated for adverse effects resulting from the proposed project.

An existing borrow pit located within Morris Cove is also being proposed as a site for dredge material disposal. Water quality studies were conducted in Morris Cove by NOAA Fisheries Service staff from the Milford Laboratory in the summer of 2002. Data loggers measuring temperature, salinity, and dissolved oxygen were placed inside the dredged hole and immediately outside the hole. The data collected in August of 2002 show the conditions within the hole were anoxic, and dissolved oxygen levels were significantly higher immediately outside of this dredged area. This data suggest there could be benefits to marine resources by filling in this hole to grade so this area can function in a capacity similar to the surrounding fish habitat within Morris Cove.

EFH Assessment

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) and the Fish and Wildlife Coordination Act require federal agencies to consult with one another on projects such as this. Insofar as a project involves EFH, as this project does, this process is guided by the requirements of our EFH regulation at 50 CFR 600.905, which mandates the preparation of EFH assessments and generally outlines each agency's obligations in this consultation procedure.

The required contents of an EFH assessment include: 1) a description of the action; 2) an analysis of the potential adverse effects of the action on EFH and the managed species; 3) the ACOE's conclusions regarding the effects of the action on EFH; and 4) proposed mitigation, if applicable. Other information that should be contained in the EFH assessment, if appropriate, includes: 1) the results of on-site inspections to evaluate the habitat and site-specific effects; 2) the views of recognized experts on the habitat or the species that may be affected; 3) a review of pertinent literature and related information; and 4) an analysis of alternatives to the action that could avoid or minimize the adverse effects on EFH. Upon submittal of an EFH assessment, NOAA Fisheries Service will provide conservation recommendations for the proposed project, as necessary.

Fish and Wildlife Coordination Act

The substrate found within the project area also serves as habitat for benthic organisms, such as shellfish and other invertebrates living within and on the surface of the sediment. These organisms contribute to the productivity of the federally managed species by acting as a food source for both juvenile and adult life stages of finfish. Shellfish resources of concern within the project area include eastern oysters (*Crassostrea virginica).* According to Connecticut Department of Environmental Protection's (CTDEP) Bureau of Aquaculture, a valuable oyster bed is located inside Bridgeport Harbor, immediately west of the entrance channel, at the precise location of the proposed West CAD. Significant adverse impacts on shellfish resources would result from CAD cell construction in this location through direct impact (i.e., dredge) and by elevated levels of suspended sediment that can interfere with spawning success and feeding.

Connecticut state leased shellfish areas are located within Morris Cove and Bridgeport Harbor. Additional coordination with the CTDEP Bureau of Aquaculture should occur prior to the selection of any disposal areas. Pursuant to the Fish and Wildlife Coordination Act, recommendations will be provided in order to avoid and minimize adverse effects to the above referenced NOAA trust resources, as appropriate.

Endangered Species Act

No species listed by NOAA Fisheries Service under the Endangered Species Act (ESA) of 1973, as amended, are known to occur in the Bridgeport Harbor or Morris Cove proposed project areas. As such, no consultation pursuant to Section 7 of the ESA is necessary for the proposed project. Reinitiation of consultation is required and shall be requested by the Federal agency or by the Service, where discretionary Federal involvement or control over the action has been retained or is authorized by law, and: (a) if new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered in the consultation; (b) if the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the consultation; or (c) if a new species is listed or critical habitat designated that may be affected by the identified action. Should you have any questions regarding Section 7 consultation, please contact Julie Crocker in NOAA Fisheries Service's Protected Resources Division at (978)281-9300 x6530.

We appreciate the opportunity to provide these preliminary comments, and we look forward to receiving your EFH assessment for the proposed project. If you have questions regarding these comments, please contact Sue Tuxbury at 203-882-6544.

Sincerely,

Louis A. Chiarella

Louis A. Chiarella
New England Field Office Supervisor
for Habitat Conservation

cc: PRD – M. Colligan, J. Crocker
USEPA – M. Marsh
CTDEP – D. Carey
CTDEP – M. Johnson

References

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