Supplemental Environmental Impact Statement for the Designation of Dredged Material Disposal Site(s) in Eastern Long Island Sound, Connecticut and New York

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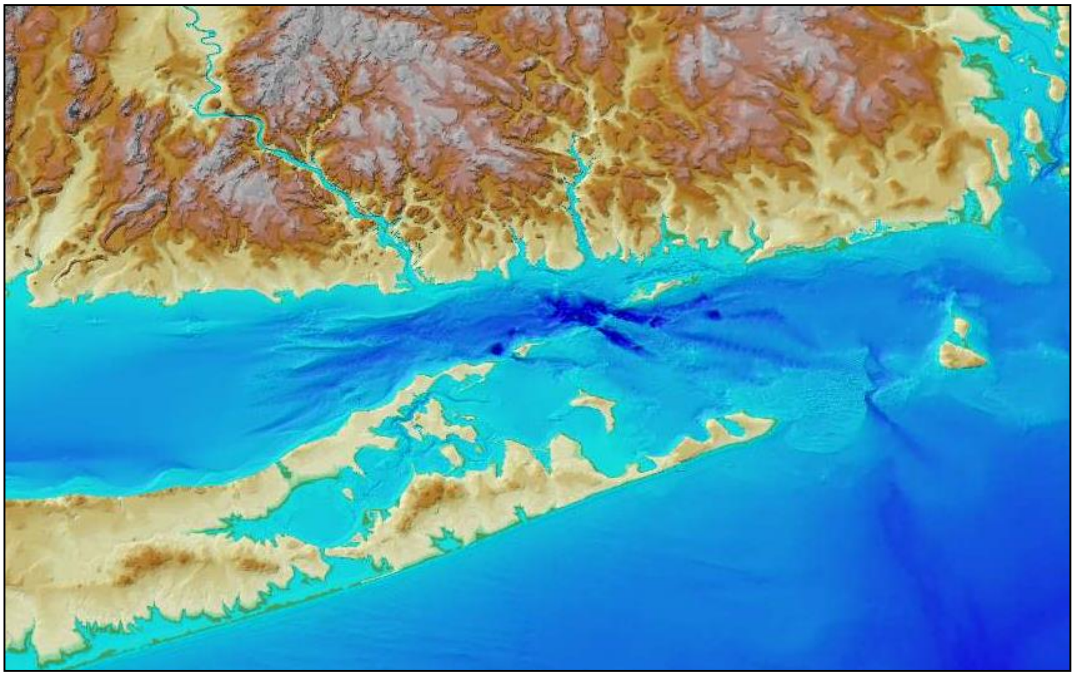

Prepared for: **United States Environmental Protection Agency**

Prepared by: **Louis Berger**

and

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April 2016

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SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT FOR THE DESIGNATION OF DREDGED MATERIAL DISPOSAL SITE(S) IN EASTERN LONG ISLAND SOUND, CONNECTICUT AND NEW YORK

DRAFT

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Foreword:

This Draft Supplemental Environmental Impact Statement (DSEIS) is prepared under NEPA by USEPA Region 1 using a third party contracting process. The Connecticut Department of Transportation is the funding agency. Region 1 reviewed the initial drafts prepared by Louis Berger and the University of Connecticut and, as necessary, directed revisions to the drafts from the contractors in order to produce this DEIS to be published for public review and comment. Cooperating agency representatives reviewed drafts of this document.

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Acronyms and Abbreviations

ACHP	Advisory Council on Historic Preservation
AIS	Automatic Identification System
aRDP	Apparent Redox Potential Discontinuity
AWOIS	Automatic Wreck and Obstruction Information System (a NOAA database)
BIS	Block Island Sound
BOEM	Bureau of Ocean Energy Management
CAA	Clean Air Act
CASE	Connecticut Academy of Science and Engineering
CCMA	Center for Coastal Monitoring and Assessment
CDIP	Coastal Data Information Program
C.F.R.	Code of Federal Regulations
CLDS	Central Long Island Sound Disposal Site (formerly abbreviated as CLIS)
CLIS	Central Long Island Sound (refers to the geographic region within the Sound)
cm	centimeter(s)
cm/s	centimeter per second
CO	Carbon monoxide
CPI	Consumer Price Index
CPUE	Catch per Unit Effort
CS	Cornfield Shoals
CSD	Cutter suction dredge
CSDS	Cornfield Shoals Disposal Site
CSO	Combined Sewer Overflow
CTDEEP	Connecticut Department of Energy and Environmental Protection
CTDOT	Connecticut Department of Transportation
CTDPH	Connecticut Department of Public Health
CT SHPO	Connecticut State Historic Preservation Office
cy	cubic yard(s)
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DAMOS	Disposal Area Monitoring System
DDT	Dichlorodiphenyltrichloroethane
DHS	Department of Homeland Security
DMMP	Dredged Material Management Plan

DO	Dissolved oxygen
DTM	Digital terrain model
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ELDS	Eastern Long Island Sound Disposal Site
ELIS	Eastern Long Island Sound
EMAP	Environmental Monitoring and Assessment Program
ENC	Electronic Navigational Charts (a NOAA database)
ERL	Effects Range – Low
ERM	Effect Range – Median
ESI	Environmental Sensitivity Index
FDA	Federal Drug Administration
FNP	Federal navigation project
FSEIS	Final Supplemental Environmental Impact Statement
ft	feet
ft/s	feet per second
FVCOM	Finite Volume Coastal Ocean Model (The model, nested within the University of Massachusetts-Dartmouth Regional Model, was used as the primary model for assessing the bottom stress, salinity, temperature, currents, waves, and horizontal circulation based on the data collected during the Physical Oceanographic study. The model is not commercially available.)
GHG	Greenhouse gas
GIS	Geographic Information System
GPS	Geographic Positioning System
GSP	Gross State Product
HAB	Harmful algal blooms
HMW	High molecular weight (applies to PAHs)
H_s	Significant wave height (measured in meters)
HP	horsepower
km	kilometer(s)
km^2	square kilometer(s)
km^3	cubic kilometer(s)
LIDAR	Light Detection and Ranging
LIS	Long Island Sound
LISICOS	Long Island Sound Integrated Coastal Observatory System
LISS	Long Island Sound Study

LISTS	Long Island Sound Trawl Survey
LNG	Liquefied Natural Gas
LPC	Limiting permissible concentration
LTFATE	Long-term FATE (USACE model that simulates long-term mound stability and sediment transport from dredged material disposal.)
LWRP	Local Waterfront Revitalization Program
LMW	Low molecular weight (applies to PAHs)
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
MARMAP	Marine Resources, Monitoring, Assessment and Prediction Program
MDMF	Massachusetts Division of Marine Fisheries
MRIP	Marine Recreational Information Program
µg/L	microgram/liter
MMPA	Marine Mammal Protection Act
µm	micrometer
mph	miles per hour
MPRSA	Marine Protection, Research, and Sanctuaries Act
m/s	meter(s)/second
n/a	Not available
NAAQS	National Ambient Air Quality Standards
NAD	North Atlantic Division, U.S. Army Corps of Engineers
NAD83	North American Datum of 1983
NAE	New England District, U.S. Army Corps of Engineers
NAN	New York District, U.S. Army Corps of Engineers
NB	Niantic Bay
NBDS	Niantic Bay Disposal Site
NCA	National Coastal Assessment (USEPA program)
NCCOS	National Centers for Coastal Ocean Science
NL	New London
nmi	nautical mile(s)
nmi^2	square nautical mile(s)
NEAMAP	North East Area Monitoring and Assessment Program
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act

NLDS	New London Disposal Site
NMFS	National Marine Fisheries Service
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NRHP	National Register of Historic Places
NROC	Northeast Regional Ocean Council
NS&T	National Status and Trends (NOAA benthic surveillance program)
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOS	New York State Department of State
NY SHPO	New York State Historic Preservation Office
O_3	Ozone
ODA	Ocean Dumping Act (see MPRSA)
ODMDS	Ocean (or ‘open-water’) dredged material disposal site
OPRHP	Office of Parks, Recreation and Historic Preservation
Pa	Pascal
PAH(s)	Polycyclic Aromatic Hydrocarbon(s)
PANYNJ	Port Authority of New York and New Jersey
PCB(s)	Polychlorinated Biphenyl(s)
PEIS	Programmatic Environmental Impact Statement
PM	Particulate matter
PO	Physical oceanography
POT	Peak-over-threshold
ppb	parts per billion
psu	practical salinity units
PV	Plan-view (photograph taken by a sediment profile system)
RHA	Rivers and Harbors Act
RICRMC	Rhode Island Coastal Resources Management Council
RIDEM	Rhode Island Department of Environmental Management
RIDFW	Rhode Island Division of Fish and Wildlife
RIDOH	Rhode Island Department of Health
RIEDC	Rhode Island Economic Development Corporation
RIGIS	Rhode Island Geographic Information System

RIM	Regional Implementation Manual
RIR	Rhode Island Region
RISDS	Rhode Island Sound Disposal Site (formerly abbreviated as RIDS in the literature)
RNC	Raster Navigational Chart
ROD	Record of Decision
RDP	Redox Potential Discontinuity
s	second(s)
SAIC	Science Application International Corporation
SAV	Submerged Aquatic Vegetation
SEIS	Supplemental Environmental Impact Statement
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan (plan by states to attain air quality standards)
SMMP	Site Management and Monitoring Plan
SPI	Sediment profile imaging
SO_2	Sulfur dioxide
SPP	Suspended particulate phase
STFATE	Short-Term FATE (USACE model simulating short-term effects in the water column during dredged material disposal)
SUNY	State University of New York
T	Dominant wave period (measured in seconds)
TMDL	Total maximum daily load
TOC	Total organic carbon
TSHD	Trailing suction hopper dredge
TRI	Toxics Release Inventory (publicly available USEPA database)
TSS	Total suspended solids
VOC	Volatile organic compound
UCONN	University of Connecticut
URI	University of Rhode Island
USACE	U.S. Army Corps of Engineers (abbreviated as ‘Corps’ in the CLIS/WLIS EIS [USEPA and USACE, 2004a])
U.S.C.	U.S. Code
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WLDS	Western Long Island Sound Disposal Site (formerly abbreviated as WLIS)

WLIS	Western Long Island Sound (refers to the geographic region within the Sound)
WHG	Woods Hole Group
ZSF	Zone of Siting Feasibility

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EXECUTIVE SUMMARY

Introduction and Background

The U.S. Environmental Protection Agency (USEPA) is considering designation of one or more open-water dredged material disposal sites in the eastern region of Long Island Sound, off the coasts of Connecticut and New York (Figure ES-1), consistent with the Marine Protection, Research, and Sanctuaries Act (MPRSA, also known as the Ocean Dumping Act), 33 U.S.C. §§ 1401 *et seq*. Disposal of dredged material in the waters of Long Island Sound from projects that are either federal actions or non-federal actions involving more than 25,000 cubic yards (19,114 cubic meters) of dredged material must comply with the requirements of MPRSA. See 33 U.S.C. § 1416(f).

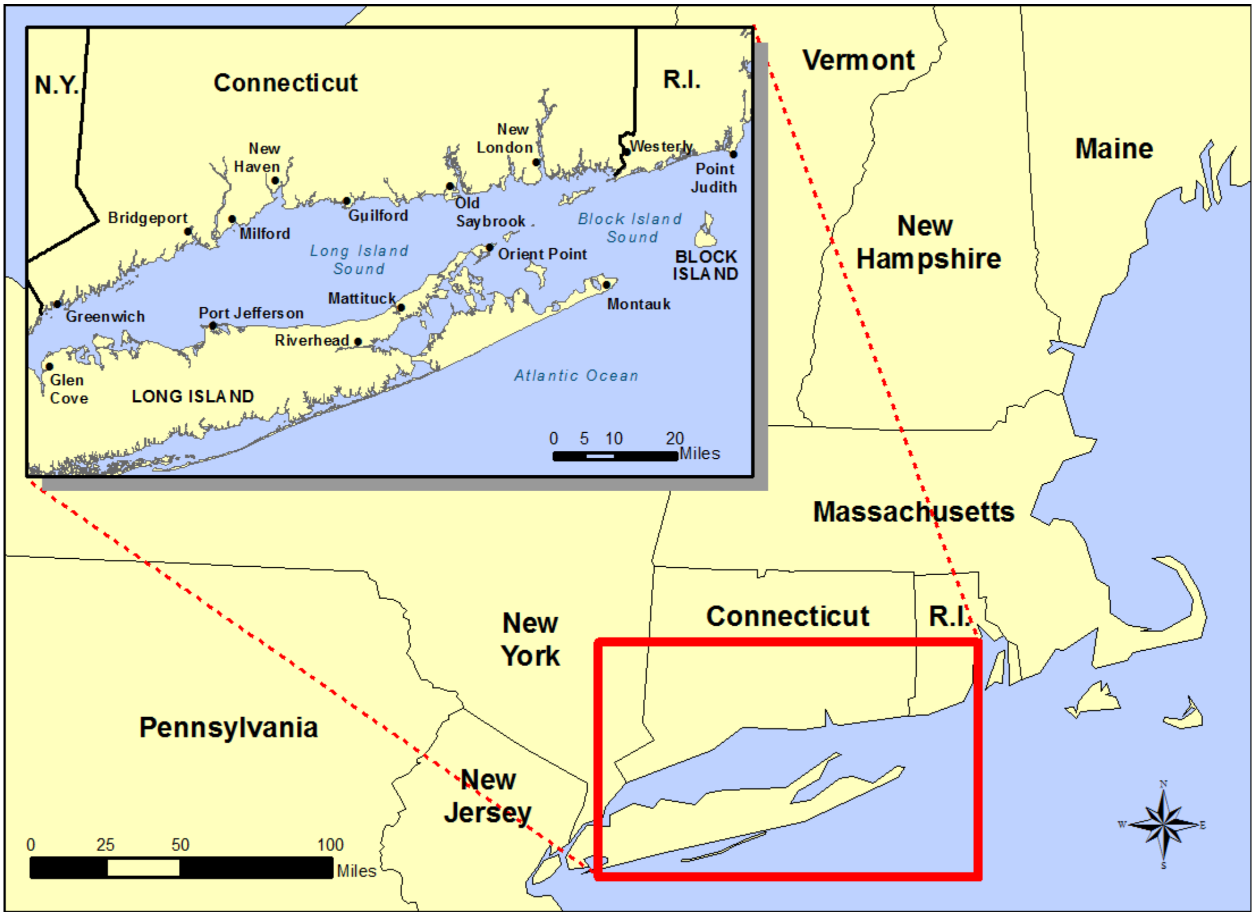

Figure ES-1. Location of Long Island Sound and Block Island Sound.

Through a site screening process that considered the five general and eleven specific criteria in the Ocean Dumping Act regulations as well as evaluation factors specific to Long Island Sound, USEPA has identified three potential alternative open-water dredged material disposal sites. Two of the sites have been used recently as disposal sites, and one site is an inactive historic disposal site. If designated, one or more of these sites could be used for disposal of material dredged from navigation projects and other sources from rivers, harbors, and coastal areas in Connecticut, New York and southwestern Rhode Island, if the material is found to be suitable for open-water disposal. USEPA's designation of an open-water disposal site does not authorize disposal of material from any particular source or project at any designated site. Such material may be dredged and disposed of only if authorized by the U.S. Army Corps of Engineers (USACE) under Section 404 of the Clean Water Act, 33 U.S.C. § 1344, Section 103 of the MPRSA, 33 U.S.C. § 1413, and/or Section 10 of the Rivers and Harbors Act, the latter of which statutes applies to the dredging itself (as opposed to the disposal), and other relevant provisions of law. In determining whether to authorize proposals to dispose of dredged material under Section 404 of the Clean Water Act and/or Section 103 of the MPRSA, the USACE applies environmental standards promulgated by USEPA under those statutory provisions.

USEPA is not legally required to subject its disposal site designations under the MPRSA to environmental review under the National Environmental Policy Act (NEPA), 42 U.S.C. §§ 4321 *et seq*., but has nonetheless conducted a NEPA review pursuant to the agency's "Statement of Policy for Voluntary Preparation of National Environmental Policy Act (NEPA) Documents" (63 Fed. Reg. 58045 – 58047). Thus, while not legally required to do so, USEPA has prepared this Supplemental Environmental Impact Statement (SEIS) to be consistent with USEPA's NEPA-implementing regulations at 40 C.F.R. Part 6, Subparts A through D, as appropriate, while also using regulations promulgated by the Council on Environmental Quality at 40 C.F.R. Parts 1500-1508 to provide additional guidance.

This Draft SEIS (DSEIS) is being published together with a Draft Site Management and Monitoring Plan (SMMP) for public review and comment. Comments may be provided in writing (by mail or email). In addition, during the public comment period, USEPA will hold public hearings during which interested parties may submit comments. Information regarding the locations, dates, and times of the public hearings will be provided in the *Federal Register,* included in public notices and press releases, sent by email to the existing mailing list, and be posted on USEPA's website:

https://www.epa.gov/ocean-dumping/dredged-material-management-long-island-sound#Eastern

Commenting on the DSEIS and SMMP

USEPA encourages comments on the DSEIS for the Designation of Dredged Material Disposal Sites in Eastern Long Island Sound. Comments may be submitted:

By mail to:
U.S. Environmental Protection Agency
New England Region One
5 Post Office Square, Suite 100 (OEP06-1)
Boston, MA 02109

By email to:
elis@epa.gov

Following consideration of the comments received, USEPA will issue a Final SEIS (FSEIS). The FSEIS will include written responses to comments received. Concurrent with the release of the DSEIS, a proposed rulemaking will be published in the *Federal Register* for public comment. Following issuance of the FSEIS, the USEPA will publish a final rulemaking in the *Federal Register.*

This action follows the designation of two disposal sites in western and central Long Island Sound, after the preparation of an Environmental Impact Statement (EIS) (USEPA and USACE, 2004a). The DSEIS for the eastern Long Island Sound builds on the analyses of this 2004 EIS.

Purpose and Need for Agency Action

The purpose of USEPA's action is to determine whether one or more environmentally sound open-water dredged material disposal sites should be authorized for future long-term use in the eastern Long Island Sound region and, if so, to designate the site or sites accordingly and consistent with applicable law. The need for this effort derives from the following facts: (1) there are currently no disposal sites designated for long-term use within the eastern Long Island Sound region, (2) the USACE has determined that over the next 30 years there are dredging and dredged material disposal/handling needs that exceed the available disposal/handling capacity in the eastern region of Long Island Sound, (3) the two currently used sites are authorized under short-term authority that will expire in December 2016, (4) periodic dredging and dredged material disposal is necessary to maintain safe navigation and marine commerce, and (5) MPRSA requires a USEPA designation for any long-term dredged material disposal site.

Alternatives

In 2012, USEPA developed a Zone of Siting Feasibility (ZSF) for open-water sites for this SEIS with the assistance of cooperating agencies (Figure ES-2). Within this ZSF, USEPA identified and evaluated a range of specific disposal site alternatives.

The ZSF encompasses eastern Long Island Sound and Block Island Sound between Mulberry Point (near Guilford, Connecticut) to Mattituck Point (New York) on the western end, and Montauk (New York) to Block Island to Point Judith (Rhode Island) on the southern and eastern end. This ZSF was delineated because it has the potential to yield a site or sites that could reasonably address the dredging needs of the eastern Long Island Sound region given that it includes areas within a reasonable haul distance for marinas, boatyards, commercial docks, and federal harbors and anchorages in this region.

This SEIS analyzes the No Action Alternative and the potential environmental impacts associated with three alternative open-water dredged material disposal sites (*i.e.*, the Cornfield Shoals, Niantic Bay, and New London disposal site alternatives; Figure ES-2). These three alternative sites were identified following an extensive site screening process during the initial phases of the SEIS. This screening process took into account the specific site designation criteria described in the MPRSA regulations (40 C.F.R. 228.5 and 40 C.F.R. 228.6). After applying various criteria, the three alternative sites were recommended for further analysis in the SEIS.

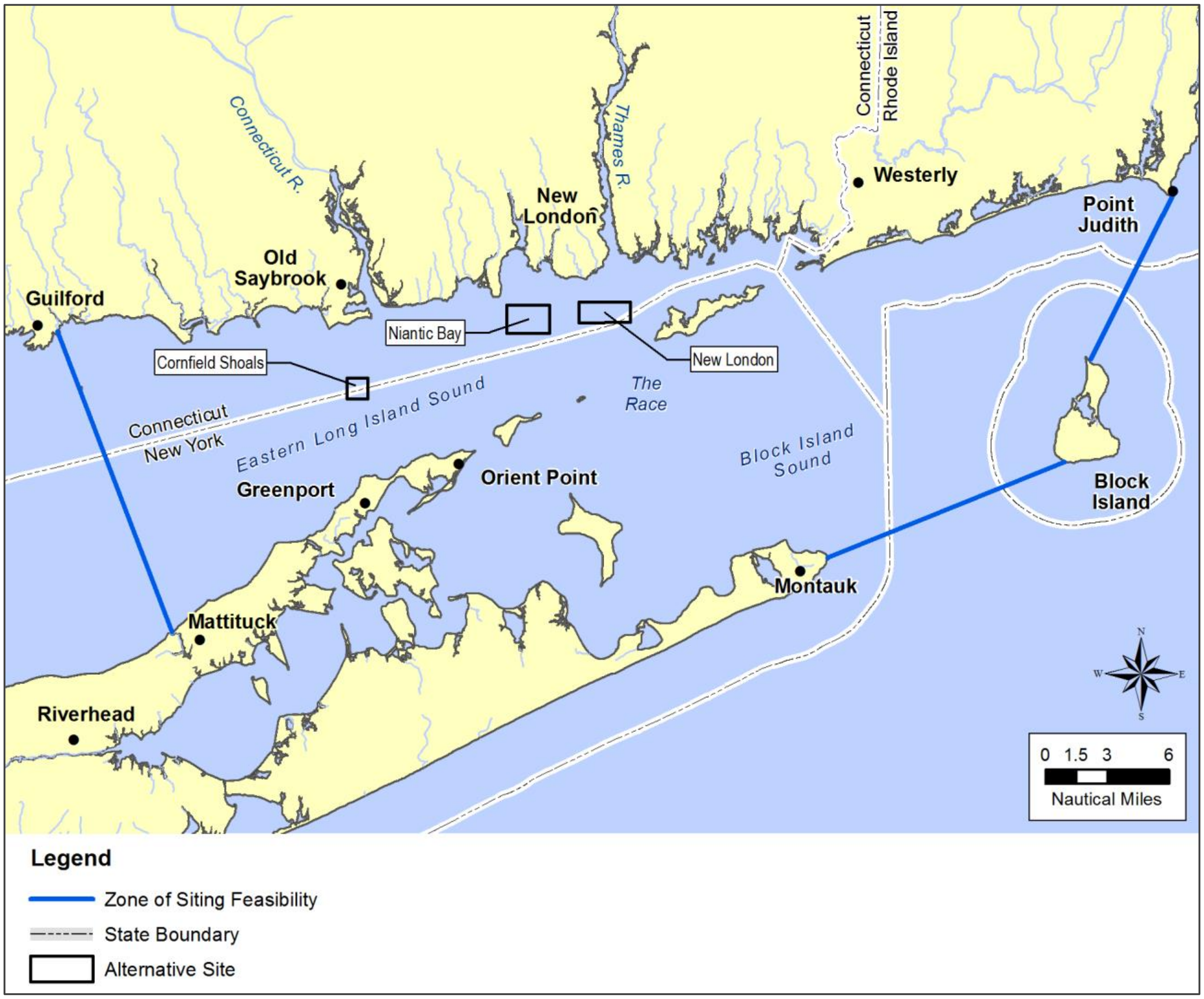

Figure ES-2. Zone of Siting Feasibility (Eastern Long Island Sound and Block Island Sound) and the three alternative open-water dredged material disposal sites evaluated in the SEIS.

The total estimated dredged material disposal needs for the eastern Long Island Sound region (*i.e.*, ports and harbors of Connecticut, New York, and southwestern Rhode Island, located within the ZSF) over the next 30 years are 22.6 million cubic yards (cy), or 17.3 million cubic meters (m^3). In order to identify disposal sites with the potential to handle this volume of dredged material, USEPA evaluated numerous sites within the ZSF. After screening out various sites, USEPA selected the following three alternative sites for more detailed evaluation: (1) The New London Alternative, which includes the existing NLDS and a 1.5 square nautical mile (nmi^2), or 5.1 square kilometer (km^2), area immediately to the west (Figure ES-3); (2) the Niantic Bay Alternative, which includes the area of the historic Niantic Bay Disposal Site (NBDS) and a 1.0 nmi^2 (3.4 km^2) area immediately to the east (Figure ES-4); and (3) the Cornfield Shoals Alternative, which has the same boundary as the active Cornfield Shoals Disposal Site (CSDS) (Figure ES-5). Each of these three Alternatives is described further below:

- ***New London Alternative.*** The New London Alternative is located to the south of the mouth of Thames River estuary. It has a total area of 2.5 nmi^2 (8.6 km^2). The closest upland points to the alternative site are Goshen Point, Connecticut, approximately 1.2 nautical miles (nmi), or 2.2 kilometers (km), to the north, and Fishers Island, New York, 1.4 nmi (2.6 km) to the southeast.

  The NLDS is an active open-water dredged material disposal site with an area of 1.0 nmi^2 (3.4 km^2). Water depths range from approximately 46 to 79 feet (14 to 24 m). Most of the site is located within Connecticut waters, with the remainder of the site located in New York State waters. A total of approximately 8.9 million cy (6.8 million m^3) of dredged material has been placed at this location since 1955. The dredged material mounds can rise up to 16 to 20 feet (5 to 6 m) above the surrounding seafloor. The sediments at the site are heterogeneous, but consist predominantly of fine sand and silt/clay. The NLDS is bisected by a 1,000-foot (300-m) wide submarine transit corridor that was established to minimize conflicts between disposal buoy positions and submarine traffic to and from the Submarine Base in Groton, Connecticut; disposal operations are monitored by the USACE to maintain a minimum water depth of 46 feet (14 m) within the corridor.

  The 1.5 nmi^2 (5.1 km^2) area immediately to the west of the NLDS is divided into "Site NL-Wa" and "Site NL-Wb". Site NL-Wa has an area of 1 nmi^2 (3.4 km^2). Water depths range from approximately 45 feet (14 m) in the north to 100 feet (30 m) in the south. Site NL-Wa consists of mostly sandy areas, but also contains an area of boulders and rocks in the northern part of the site. The water depth of parts of the boulder area is shallower than 59 feet (18 m). Site NL-Wb has an area of 0.5 nmi^2 (1.7 km^2). It consists of an extension of the sandy areas of Site NL-Wa. The southwestern corner of the site contains an area of bedrock and boulders. Overall, water depths at Site NL-Wb range from approximately 59 feet (18 m) in the north to 95 feet (28 m) in the south.

- ***Niantic Bay Alternative.*** The Niantic Bay Alternative is located to the south of Niantic Bay, between the Connecticut and Thames Rivers. It consists of the historic NBDS and Site NB-E immediately to the east (Figure ES-3) with a total area of 2.8 nmi^2 (9.5 km^2). The northern boundary of the Alternative is located approximately 0.6 nmi (1.1 km) from Black Point (southwestern corner of Niantic Bay) and 1.6 nmi (3.0 km) from Millstone Point in Waterford, Connecticut. The site is located entirely within Connecticut waters.

  The NBDS was used historically for dredged material disposal; between 1969 and 1972, a total of 176,000 cy (135,000 m^3) of dredged material was disposed at this location. The NBDS has an area of 1.8 nmi^2 (6.2 km^2). Water depths at the site range from approximately 60 to 130 feet (18 to 40 m). Sediments at the site consist of sand to the north and northwest and mostly gravelly sediment with patches of gravel in the remainder of the area. The site contains a boulder area in its north-central part and scour depressions in the south.

  The 1.0 nmi^2 (3.4 km^2) area immediately to the east of the NBDS is referred to as "Site NB-E". Water depths at Site NB-E range from 43 feet (13 m) in the north to 230 feet (70 m) in the southeast. Surface sediments at the site are generally similar to sediments at the NBDS. The southwestern corner of Site NB-E contains a bedrock and boulder area.

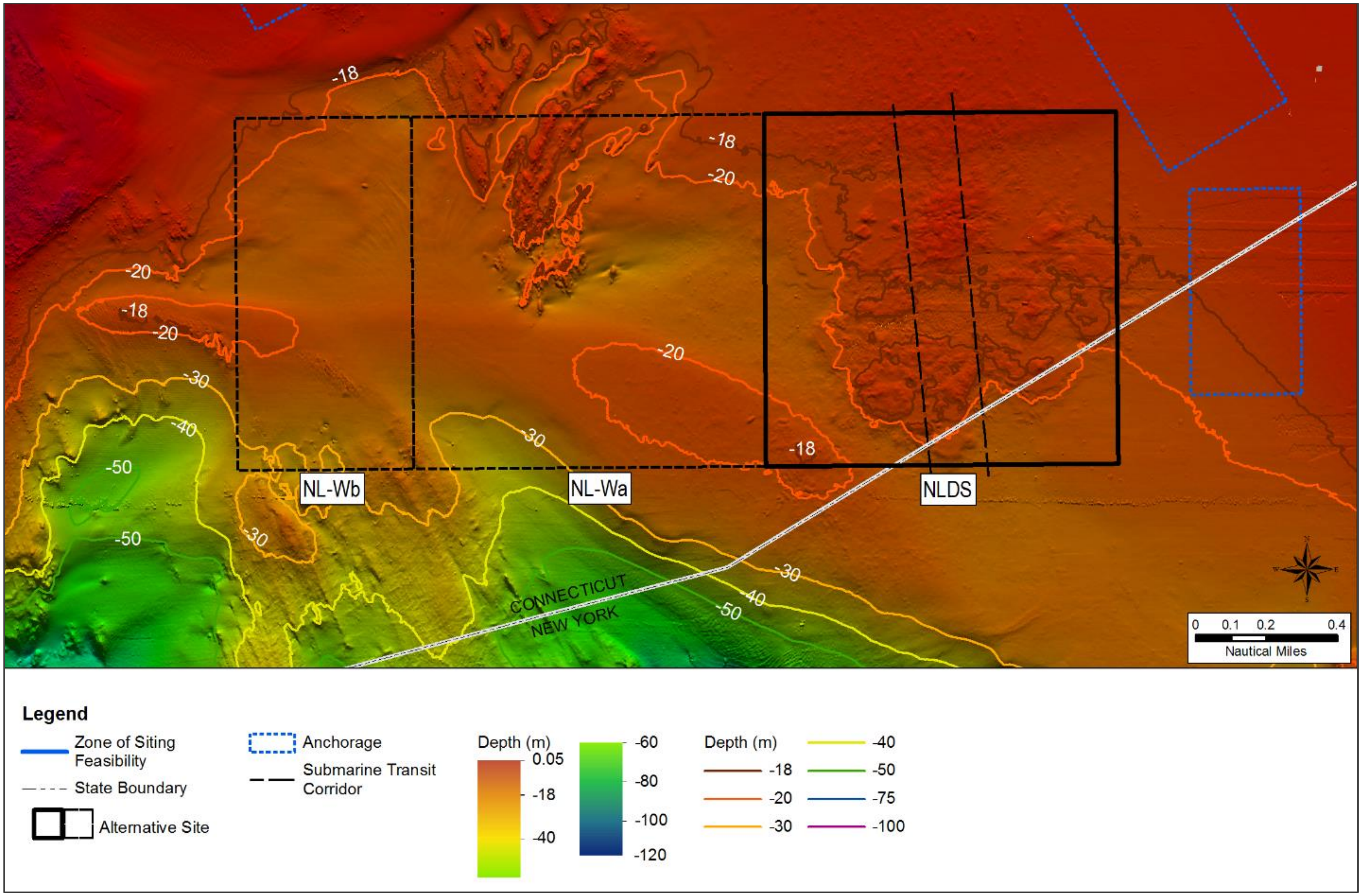

Figure ES-3. Location of the New London Alternative. The background represents water depth.

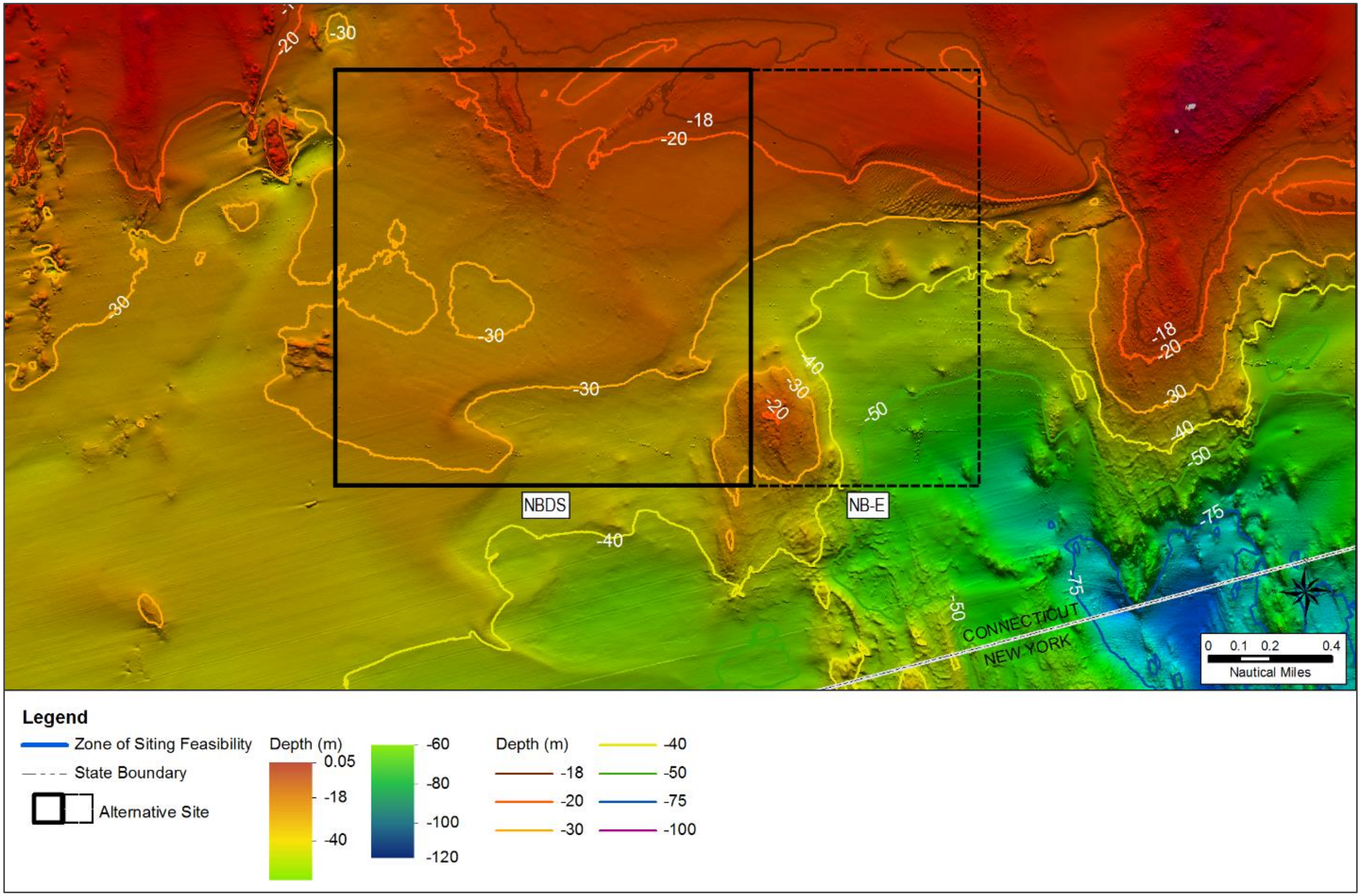

Figure ES-4. Location of the Niantic Bay Alternative. The background represents water depth.

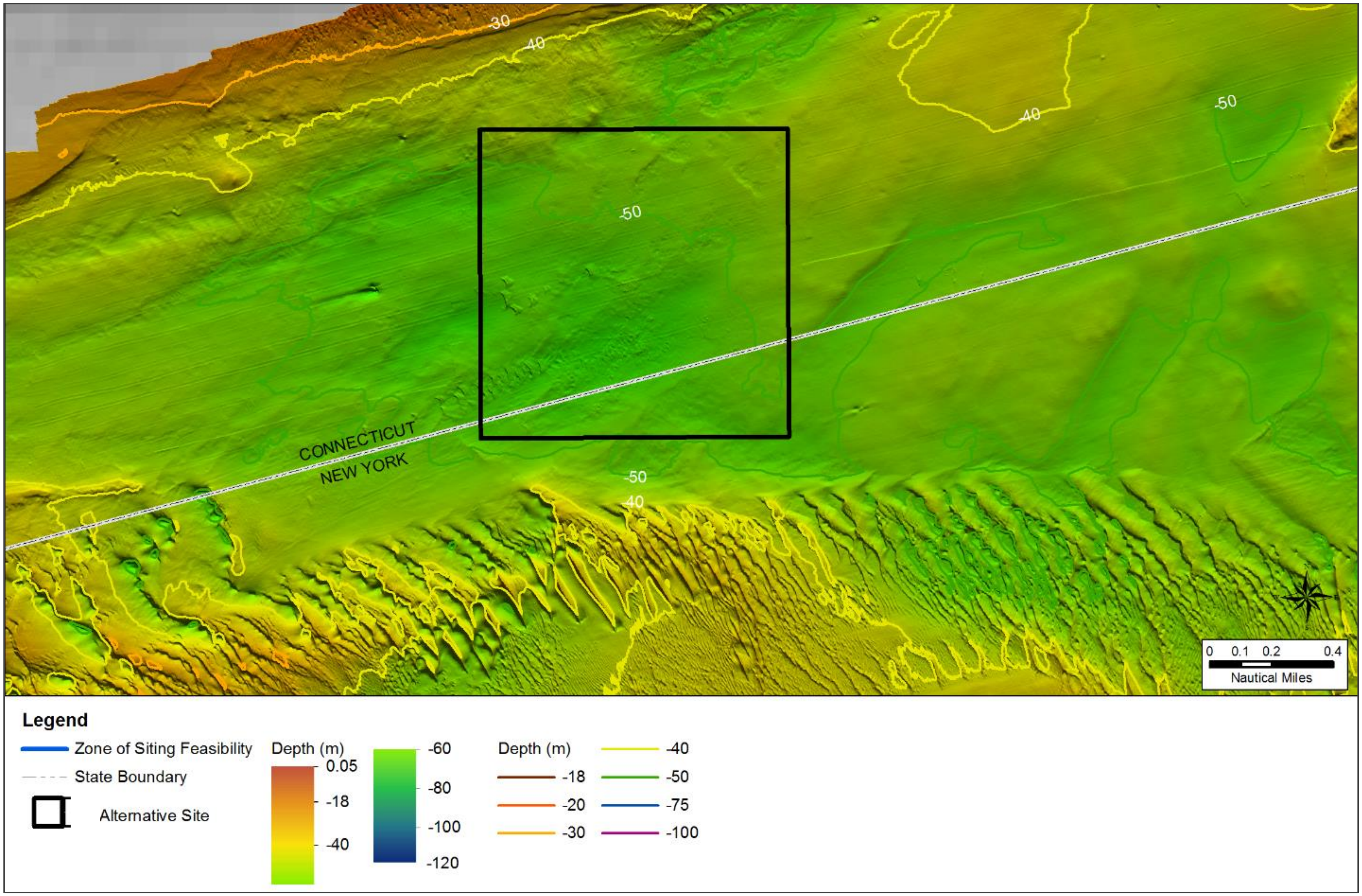

Figure ES-5. Location of the Cornfield Shoals Alternative. The background represents water depth.

- ***Cornfield Shoals Alternative.*** This Cornfield Shoals Alternative consists of the active CSDS, centrally located in eastern Long Island Sound. The center of the site is located 3.3 nmi (6.1 km) south of Cornfield Point in Old Saybrook, Connecticut. The site has an area of 1 by 1 nmi, or 1 nmi^2 (3.4 km^2), and is located mostly within Connecticut waters with the remainder of the site located in New York State waters. The water depth at the site is around 150 feet (50 m). Bottom currents at the site are directed generally in an east-west direction. The seafloor around the CSDS is relatively flat, with longitudinal ripples and other bedforms that suggests that sediments generally do not accumulate at the site. Surface sediments at the CSDS consist predominantly of sand with a smaller amount of silt/clay, as well as some gravel. The CSDS has received approximately 2.9 million cy (2.2 million m^3) since 1960.

In addition to the three alternative dredged material disposal sites, USEPA analyzed the No Action Alternative. In this case, under the No Action Alternative, the proposed action of designating one or more disposal sites would not take place. This provides a baseline against which the proposed action and other alternatives can be evaluated. Evaluation of the No Action Alternative involves assessing the environmental and socioeconomic effects that would result if the actions under consideration did not take place. These effects can then be assessed and compared with the effects of the proposed action and other "action" alternatives. In this case, the No Action Alternative is not to designate an open-water site or sites in the eastern region of Long Island Sound for the long-term disposal of dredged material from navigation projects and other sources from rivers, harbors, and coastal area in Connecticut, New York, and southwestern Rhode Island.

While it is impossible to be certain how dredging needs resulting from sediment accumulation in the eastern Long Island Sound region would be handled if no disposal sites are designated under MPRSA, several hypothetical scenarios might reasonably be considered. First, disposal site authorization for private projects involving less than 25,000 cy (19,114 m^3) of material would simply continue being evaluated on a project-specific basis under Section 404 of the Clean Water Act. Second, for projects subject to MPRSA (*i.e.,* either federal projects of any size or private projects involving greater than 25,000 cy of material), project proponents would need to pursue one of the following actions:

1. Utilize a short-term open-water site inside or outside of the ZSF that has been newly "selected" by the USACE and concurred with by USEPA under MPRSA.
2. Use an existing designated long-term open-water site outside of the ZSF.
3. Await designation of a new disposal site outside of the ZSF.
4. Develop or utilize appropriate upland or nearshore disposal or beneficial use alternatives.
5. Cancel the proposed dredging projects.

In accordance with NEPA, alternatives to open-water disposal were also considered during the overall SEIS process. These included ocean disposal outside of the eastern Long Island Sound region, development of dredged material containment facilities, beneficial uses of dredged material (such as beach nourishment and nearshore berms), upland disposal sites, dredged material treatment options, and transport of material outside of the eastern Long Island Sound region. None of these alternatives are capable of meeting the long-term regional dredged material disposal needs of the eastern Long Island Sound region. Therefore, potential open-water disposal sites were evaluated, suitable for accommodating the dredged material disposal needs for the region over the next 30 years.

Existing Conditions and Environmental Impacts at the Alternative Sites

The assessment of existing conditions in the ZSF was based on existing data and information, as well as SEIS-specific studies of the physical oceanographic characteristics, seafloor features, sediment chemistry, and biology. The following section describes the various environmental conditions in Long Island Sound and at the three alternative sites, and the potential environmental impacts that could occur as a result of dredged material disposal at these sites. A more detailed description of existing conditions in Block Island Sound is included in Chapter 4.

Physical Location and Setting

Long Island Sound is a 110-mile (177-km) long, semi-enclosed estuary located between the coastline of Connecticut and the northern coastline of Long Island, New York. The Connecticut–New York maritime state line runs east-west through the middle of Long Island Sound. Unlike most estuaries, Long Island Sound is connected to the ocean at both ends. The eastern end ("The Race") of Long Island Sound presents an open passage to the North Atlantic Ocean, while the ocean passage at the western end is more restricted, traveling through the Narrows, along the East River, and around the western tip of Long Island.

The Long Island Sound region is adjacent to one of the most densely populated and industrialized regions in North America. Cargo and petroleum products are shipped through Long Island Sound to and from the New York City area and several ferries traffic people and goods between Long Island and Connecticut. Three of the major rivers that empty into Long Island Sound (the Housatonic, Connecticut, and Thames Rivers) originate farther north in New England, effectively connecting Massachusetts, New Hampshire, and Vermont to Long Island Sound.

Sedimentation and Erosion

The transport, dispersion, and eventual fate of sediment in the marine environment depend upon the physical characteristics of the sediment and the structure and dynamics of the water column. The physical parameters that are important in the transport and dispersion of sediment include currents, waves, and the density structure of the water column. Currents directly affect the transport and dispersion of sediment. In shallow water, waves can resuspend sediments previously deposited on the seafloor. These resuspended sediments may then be transported by local currents. The density structure of the receiving water, relative to the density of the sediment, influences how long the sediment remains in the water column.

The disposal of dredged material at open-water sites results in the deposition of non-native sediments in a "footprint," or mound, at the disposal site. Over time, as currents move over this mound, hydraulic forces act on the sediment particles in the form of shear and lift. The response of the particles to these forces is related to current speed, particle size, shape, density, and any friction or cohesion exerted by adjacent sediment grains. At some point, the fluid exerts sufficient force to cause the grains to move and the sediment will be eroded from the bottom and suspended (or resuspended) into the water column for transport. The potential for erosion of dredged material deposited at each of the alternative disposal sites was examined using sediment transport models.

The three alternative sites differ with regard to sedimentation and erosion potential. The New London Alternative would largely be a containment site where dredged material would remain on the seafloor, similar to conditions at the existing NLDS. The Cornfield Shoals Alternative would be a dispersive site where dredged material disposed at the site would be eroded over time and transported predominantly toward the west. The Niantic Bay Alternative would include both a containment area and a dispersive area; any fine-grained sediment that was resuspended in the dispersive area would initially be transported in the dominant direction of tidal flows (*i.e.*, east-west) and dispersed in eastern Long Island Sound.

Sediment Quality

Sediment quality can impact the aquatic habitats available to marine organisms, including benthic organisms, and communities of fish and other types of organisms. In support of this SEIS, the sediment quality at the alternative sites was evaluated. Evaluated parameters included grain size, total organic carbon, metals, organic contaminants, and sediment toxicity.

The existing sediment quality differs to some extent among the three alternative sites. Sediments at the Cornfield Shoals and Niantic Bay Alternatives are coarser-grained on average and have lower total organic carbon concentrations than at the New London Alternative. The finer grain sizes and higher total organic carbon content at the New London Alternative are mainly a result of the dredged material disposal at the NLDS. Similarly, while overall contaminant concentrations at the three alternative sites were low or not detected, some compounds in a few samples at the NLDS exceeded National Oceanographic and Atmospheric Administration (NOAA) guideline values for sediment quality. However, comparisons of metals and organic compounds in sediments from the three alternative sites to the NOAA guideline values indicated that the sediments at the three alternative sites are unlikely to cause adverse biological effects.

For the purpose of future disposal activities, any dredged material proposed for disposal at one of the alternative disposal sites would be tested and evaluated in accordance with applicable regulations prior to disposal. Such dredged material would have to satisfy the sediment quality criteria of USEPA's ocean disposal regulations before it would be approved for open-water disposal. Therefore, adverse effects to sediment quality as a result of dredged material disposal are not likely at any of the alternative sites.

Water Quality

Temporary water quality impacts may be caused at the disposal sites by short-term changes in particle concentrations following dredged material disposal. These changes result in sporadic and temporary (less than a few hours) increases in suspended solids in the water column due to unconsolidated sediments that are stripped away from the sediment mass as it descends through the water column to the seafloor. The term "turbidity" is often used to refer to total suspended solids in the water column; however, turbidity is more correctly defined as an optical property of water referring to the blockage of light as it passes through water. Particles do not remain suspended in the water column indefinitely; they fall to the bottom at settling rates that depend upon their size and density. Suspended sediments present in the water column during and after disposal operations can potentially affect the feeding activities of fish and benthic organisms, and at extremely high concentrations can kill or injure fish and benthic organisms. Contaminants present in the dredged material disposal plume can also potentially be available to marine organisms.

Dredged material disposed in Long Island Sound consists of material ranging from fine sand to silt and clay (*e.g.*, USACE, 2015). While the bulk of the dredged material would settle to the bottom in the first few minutes after release, low concentrations of fine particles may persist for several hours in the water column, during which time they may be moved by the currents. To better define the potential impact of disposal on the water column and to compare the potential impacts across the alternative sites, a dredged material disposal model was applied at each of the alternative sites to predict disposal plume behavior. Specifically, the dispersion of dredged material in the water column after disposal was evaluated using the USACE Short-Term Fate (STFATE) model. Results of this modeling showed that, for disposal operations from a 3,000-cy scow, concentrations inside the site boundaries would decrease to below the limiting permissible concentration (LPC) within four hours after the release at all three alternative sites under various flow conditions. Concentrations would be below the LPC outside of the site boundaries at all times.

The amount of nutrients released from the descending dredged material into the water column is small relative to that associated with the receiving water at a well-mixed open-water disposal site. In addition, dredging removes organic and inorganic material from areas more vulnerable to eutrophication impairments. A concern in the past has been the potential of nutrient releases during dredged material disposal for stimulating harmful algal blooms (HABs) in the water column of Long Island Sound. However, the low nutrient load released into the water column during a disposal event, combined with the rapid dispersion of released nutrients by tidal flows in the comparatively open waters at disposal sites in Long Island Sound, results in a very low likelihood that nutrients in disposed dredged material contribute to triggering a HAB occurrence.

Benthic Invertebrates

The term "benthic community" refers to those invertebrate organisms (*e.g.*, shellfish, worms, etc.) that live on or within the bottom substrate. Benthic invertebrates represent an important biological community that interacts closely not only with other communities in the overlying water, but also with the physical environment. Benthic communities are particularly useful for evaluating the effects of physical disturbances because they are relatively immobile, providing a site-specific measure of impacts.

While habitat quality and species diversity are good at all three alternative sites, they are slightly higher at the NLDS of the New London Alternative. All alternative sites are dominated by arthropods; however, the sediment at the New London Alternative contains more tube-dwelling amphipods compared to sediment at the other two alternative sites, which have more barnacles and bivalves. Overall, the habitat quality at the alternative sites is considered typical of surrounding areas and the eastern basin of Long Island Sound. Additionally, the benthic communities at the active NLDS and CSDS show few effects of disturbance (including long-term effects from disposal activities).

The immediate impacts of dredged material disposal on the benthos would most likely be sudden reductions in infaunal abundances and species numbers, and, therefore, a reduction in species diversity. These impacts would be greatest near the central portion of the mound that forms during disposal. Available studies of the effects on benthic communities of disturbance (including dredged material disposal) indicate that the benthic habitats at a site would eventually be recolonized by a functioning infaunal community. Recolonization would mostly occur via migration from surrounding habitats or by the settling of the planktonic larvae of infaunal animals. Dredged material mounds with ongoing disposal activity at any given time within the three alternative sites would occupy less than 0.01% of the seafloor of eastern Long Island Sound. In summary, the potential for recolonization is high and similar among all alternative sites and long-term impacts would be minimal.

Finfish

Long Island Sound, a semi-enclosed estuary, is an important economic resource for both commercial and recreational/sport fisherman. Long Island Sound Trawl Surveys (LISTS), conducted by the Connecticut Department of Energy and Environmental Protection since 1984, have documented 105 finfish species in Long Island Sound. However, only a few of these species are considered year-round residents (*e.g.*, tautog). Most finfish species such as scup, bluefish, and striped bass migrate through the area in response to seasonal variations in water temperature, salinity, and access to spawning and nursery grounds in Long Island Sound. The overall abundance of finfishes and the species diversity in Long Island Sound has remained fairly stable since 1984. However, western and central Long Island Sound has shown significantly higher abundances compared to eastern Long Island Sound. This is likely a result of more extensive habitat with fine-grained sediments in western and central Long Island Sound that supports greater fish densities.

A trawl survey for the three alternative sites was conducted in June 2013. By far the most abundant finfish species present was scup; it also had the greatest biomass. The Cornfield Shoals Alternative had the highest species diversity, although it had by far the lowest abundance and finfish biomass compared to the other two Alternatives. While the New London Alternative had the highest finfish abundance, it had the lowest species diversity. Compared to surrounding areas, there was no significant difference between the abundance near and off of the three alternative sites for species of interest identified during the survey, namely scup, winter flounder, striped bass, bluefish, windowpane flounder, and striped sea robin.

Short-term impacts from dredged material disposal to finfish resources for all three alternative sites are minimal, consisting of local disruptions and some temporary loss of demersal species (*i.e.*, finfish that have an affinity to the seafloor). Most of the pelagic finfish species (*i.e.*, finfish that live in the open water with no affinity for the bottom or nearshore areas) that frequent the alternative sites would avoid disposal activities. Over time, recovery of the finfish resources to pre-disposal levels would be expected for all alternative sites. Thus, long-term impacts would not be expected.

Similarly, long-term impacts to Essential Fish Habitat (EFH) for all three alternative sites would be negligible. Impacts to early life stages would be minimized by the implementation of dredging and disposal restrictions during the environmentally sensitive period from generally June 1 to September 30, as well as other location-specific seasonal restrictions to protect shellfish and finfish populations during their spawning and/or migration seasons (although hopper dredges involved in nearshore placement of sandy dredged material do work through the summer months in New England, including in Long Island Sound). Consultation with the National Marine Fisheries Services (NMFS) is ongoing

Commercial and Recreational Shellfish

Certain species of shellfish comprise an important commercial and recreational fishery resource in nearshore areas of Long Island Sound. Important bivalve mollusk resources include the bay scallop, eastern oyster, hard clam, softshell clam, and surfclam. Lobster, longfin squid, horseshoe crab, channeled whelk, and knobbed whelk are also important resources. With the exception of lobster and longfin squid, commercially and recreationally important shellfish resources of Long Island Sound occur in shallow nearshore waters.

Of the commercial and recreational species, only longfin squid were present in the trawl survey at the alternative sites in any abundance. The other species were either not found to be present or had only a few individuals. Only five lobsters total were collected, all in the trawl near the New London Alternative. While the lobster abundance has always varied over time, the lobster population in Long Island Sound experienced unprecedented mortality in the fall of 1999, from which it has not recovered. Prior to 1999, lobsters were most abundant in western and central Long Island Sound. Since then, much of the remnant lobster population has been concentrated in deeper waters of central Long Island Sound and The Race.

There are potentially both short and long-term impacts to shellfish from the disposal of dredged material in eastern Long Island Sound. While these impacts can range from acute mortality associated with the burial of shellfish to the interrupted feeding and respiration by filter-feeding bivalves during periods of high turbidity, direct impacts to these organisms from the disposal of dredged material are generally limited to the footprint of the disposal mound.

The three alternative sites are located in deep water, away from shellfish beds. The general lack of species and overall low abundance of commercial and recreational shellfish at the alternative sites observed during the trawl survey indicates that impacts would be minimal and short-term, consisting mainly of direct burial and mortality of individuals that may be present at the time of disposal. Based on the relative abundances between the three alternative sites, it appears that impacts would be higher at the New London Alternative and lower at the Cornfield Shoals Alternative. However, because of the overall low abundance, none of the impacts would be expected to cause any measureable reduction in the population of any of the species potentially affected within eastern Long Island Sound.

Marine and Coastal Birds and Marine Mammals and Reptiles

The Atlantic coast supports a large number of resident and migratory marine and coastal birds. Dozens of marine and coastal birds migrate through Long Island Sound annually. In addition, Long Island Sound provides limited habitat for most marine mammals and reptiles. The species that are frequent or occasional visitors to the Sound and that may forage in the vicinity of the alternative sites include harbor porpoises, long-finned pilot whales, seals, and sea turtles.

Potential impacts to birds, marine mammals, and sea turtles could include temporarily reduced foraging opportunities during disposal activities and possible physical injury resulting from collisions with tugs and scows used to transport and place dredged materials. However, these impacts would be temporary with conditions rapidly returning to baseline conditions after a disposal event. Birds, marine mammals, or sea turtles foraging in the area would most likely move to a nearby location to resume foraging. Collisions with scows used during disposal activities are unlikely, because tugs and scows move slowly through the water, and most species would move out of the water to avoid a collision. Therefore, potential adverse impacts to these species or individuals would be minimal.

Endangered and Threatened Species

Atlantic and shortnose sturgeon could be seasonally present at the alternative sites, but they have not been frequently documented in Long Island Sound. Blueback herring, a Connecticut species of special concern, could also be seasonally present as they migrate through the area to their spawning grounds. Endangered and threatened birds may use the alternatives sites for flyover or occasional foraging habitat, but are not expected to be present for long periods of time. All three alternative sites evaluated are located in offshore open water. Listed whale species are only occasionally present in the waters of Long Island Sound and are therefore not likely to be present at the alternative sites with any regularity. Harbor porpoises are common throughout Long Island Sound and are present year-round, but would only be present at the alternative sites while transiting the area or for occasional foraging. Sea turtles may be present in Long Island Sound between May 1 and November 15 of any year and may transit or forage in any of the alternative sites. Considering the mobility and distribution patterns of endangered or threatened species, the likelihood of encounters is approximately the same at the three alternative sites.

Endangered and threatened species would therefore only be present at the sites on an occasional incidental basis. Species present at a disposal area while disposal activities occur could potentially be affected by temporary increases in suspended sediment concentrations in the water column. However, these species are highly mobile and would be able to avoid these areas, and any effects would likely be minimal. Loggerhead, leatherback and Kemp's ridley sea turtles are all benthic feeders and often feed at depths similar to those found at the disposal sites. Disposed dredged material would likely bury benthic prey species, especially near the center portion of the disposal mound. However, the loss of these sites as potential foraging areas would not be expected to substantially impact the prey base for sea turtles in the area. Generally, dredging is prohibited from June 1 to September 30 of any year to protect shellfish and finfish populations during their spawning season (except for nearshore placement of sandy dredged material, as stated above); these time-of-year restrictions would further reduce potential impacts on all listed species.

USEPA has determined that the designation of a disposal site will not result in adverse impacts to endangered or threatened species, species of concern, or marine protected areas, essential fish habitat. In addition, the USACE will coordinate with the NMFS and U.S. Fish and Wildlife Service (USFWS) for individual projects that are permitted to further ensure that impacts would not adversely impact any threatened or endangered species. Consultation with the NMFS and USFWS is ongoing.

Bioaccumulation

Due to the presence of anthropogenic pollution sources, contaminants in water or sediment are available to aquatic organisms through a variety of pathways, including direct uptake from the water column, direct contact or ingestion of sediments or sediment pore water, and ingestion of contaminated prey. Once in the tissues of aquatic organisms, these chemicals can pose a health threat both to the organism directly and to other organisms (*e.g.*, upper trophic level species, humans) that consume them. While bioaccumulation of a contaminant in an organism may or may not result in detrimental impacts to the organism, it can be an indicator that a population of the same or similar organisms, or of higher trophic-level organisms that prey on the contaminated organisms, or both, may be potentially at risk of impact.

Potential risks associated with the bioaccumulation of chemicals from sediments present at the alternative sites were evaluated by comparing contaminant concentrations in tissues to Federal Drug Administration Action/Tolerance Levels for an assessment of potential human health impacts, and to Ecological Effect Values for an assessment of ecological impacts. The species considered were those species for which tissue contaminant data from the NLDS and CSDS were available (American lobster, clam, worm, winter flounder, scup, and striped bass). In summary, the risk analysis shows that given existing conditions, potential risks to human health and ecological receptors associated with exposure to sediments at the alternative sites are low.

The placement of dredged material at any of the alternative sites could have potential impacts associated with bioaccumulation of contaminants in selected species from sediment exposure. Impacts would depend on the nature of dredged materials placed at an alternative site. Further, residence time of dredged materials placed at an alternative site governs the ability of biota to come into equilibrium with contaminants in the dredged material. However, dredged material management policies and procedures for open-water disposal, as well as sediment quality criteria limiting the materials that may be authorized for open-water disposal, are designed to screen out dredged materials that may pose a risk to human or ecological receptors.

To evaluate potential human health and ecological risks at the alternative sites, bioaccumulation test and USEPA risk model results were analyzed for four dredging projects that were (or might be) dredged and placed at one of the alternative sites. The four dredging projects with bioaccumulation data and USEPA risk model results were all located in Connecticut (Gales Ferry, New London, Westbrook, and Old Saybrook). The data indicate that there is low potential for any future incremental risk from management of dredged sediments at the alternative sites either in the long or short-term. There is little potential for cumulative risk because the individual risks associated with each project are not additive. As long as the individual dredging projects meet risk-based or concentration-based limits as required by the dredging program, the total number of such projects does not affect the risk at the alternative sites.

Socioeconomic Impacts

Long Island Sound is a region of social and economic importance with highly valuable resources. Potential socioeconomic impacts are those that relate to commercial and recreational fishing, shipping and navigation, recreational activities and beaches, parks and natural areas, historic and archaeological resources, and other human uses (military uses and mineral and energy development).

The potential impacts to commercial finfishing would be minimal because, among other reasons discussed above, the alternative sites are not prime finfish or shellfish habitats. Impacts to recreational fishing would be minimal as well and likely would not differ between the alternative sites. Commercial shipping and navigation would not be impacted, as the shallowest disposal depth permitted at a designated site would be 59 feet (18 m), and any interference during disposal operations would be mitigated through appropriate site management practices and notice to mariners. Disposal activities would not be expected to adversely impact the recreational activities, beaches, parks, and natural areas associated with any of the three alternative sites. There are no pipelines or cables located within the boundaries of any of the alternative sites.

The New London Alternative is the only site with a known exposed shipwreck located near the southern border of the site. Impact to the shipwreck would be avoided through appropriate site management, which includes a 164 feet (50 m) buffer zone around the shipwreck.

Air Quality and Noise

All five counties in the ZSF are part of moderate nonattainment areas for the 1997 ozone standard. Non-attainment zones are areas where the National Ambient Air Quality Standards have not been met. Ozone nonattainment zones are classified, in increasing degrees of severity, as follows: marginal, moderate, serious, severe, and extreme. New Haven, Middlesex and New London Counties (Connecticut) and Suffolk County (New York) are also marginal nonattainment areas for the stricter 2008 ozone standard.

Impacts to local air quality would consist mainly of exhaust fumes from tugs and other equipment used during operations. These minimal, short-term impacts would not be expected to differ between the alternative sites.

There are varying levels of background noise in and around Long Island Sound. Noise in the vicinity of navigation channels can include that generated by vessels, such as tugs and motorboats, and by dredges. Tugs would generate some minor noise while transporting the scows. Any minor noise impacts would be similar for the three alternative sites.

Cumulative Impacts

A cumulative impact on the environment is the impact that results from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. This type of assessment is important because significant cumulative impacts can result from several smaller actions that by themselves do not have significant impacts. The area of analysis for cumulative impacts is the entire Long Island Sound. Projects and activities that could interact with the proposed action to cause cumulative impacts on the resources of Long Island Sound include dredged material disposal events within the Sound, namely at the two designated Western and Central Long Island Sound Disposal Sites (WLDS, CLDS), and other, unrelated activities such as shipping, recreation, and fishing that occur on or near Long Island Sound.

Overall, any cumulative impacts from the proposed action on natural resources, as well as air quality and noise, would be imperceptible. Cumulative impacts to socioeconomic resources in the Long Island Sound region would be beneficial, as designation of dredged material disposal sites can facilitate that dredging of harbors and navigational channels, which would help keep harbors fully operational, thus avoiding a partial shift to truck traffic for some commercial goods.

Environmental Impacts of the No Action Alternative

Evaluation of the No Action Alternative involves assessing the environmental and socioeconomic effects that would result if the proposed action did not take place. These effects can then be assessed and compared with the effects of the proposed action and the other "action" alternatives.

Each of the No Action Alternative scenarios for projects subject to MPRSA presents a different set of consequences over the long-term. For Scenario 1 (utilize an alternative short-term open-water site either inside or outside of Long Island Sound that has been "selected" by the USACE and concurred with by USEPA under MPRSA), use of such sites is limited to no more than two five-year periods. Over the long-term, this approach would require the USACE to select sites as needed in the eastern Long Island Sound region or elsewhere. In contrast, USEPA's MPRSA regulations favor the continued use of historically utilized sites (see 40 C.F.R. § 228.5(e) that states that "EPA will, wherever feasible, designate ocean dumping sites … that have been historically used"). However, under this scenario, the two active disposal sites (NLDS and CSDS) would no longer be available, as the time limit for the use of these USACE-selected sites expires in December 2016. Moreover, to the extent that sites outside of the eastern Long Island Sound region were considered for selection by the USACE, the greater haul distances involved would increase the cost, duration, and ocean transport related impacts of each project. Depending on the distance from each dredging site to the particular disposal site, relying on sites selected outside the ZSF could potentially render some dredging projects infeasible. In addition, USACE-selected sites, unlike USEPA-designated sites, are not required to have SMMPs.

Under No Action Alternative Scenario 2 (use an already long-term designated site), the currently existing USEPA-designated disposal sites are located far from the eastern Long Island Sound region. The closest designated sites outside the ZSF are the Central Long Island Sound Disposal Site (CLDS) to the west and the Rhode Island Sound Disposal Site (RISDS) to the east. Reliance on these sites would greatly increase the transport distance and thus the costs of dredging projects in the eastern Long Island Sound region. This would likely render many dredging projects too expensive to conduct and needed dredging would not take place. Furthermore, the greater transport distance would increase the risk of spills and short dumps.

Regarding No Action Alternative Scenario 3 (await designation of a different disposal site outside of the ZSF), no other site outside of the ZSF is currently under consideration. A potential site would have to be located on the continental shelf of the Atlantic Ocean, to the southeast of Montauk. There would be no significant advantage to such a site for the major dredging centers of the ZSF, as travel distances to a continental shelf site would be similar or greater than to the designated CLDS or RISDS. On the other hand, risks for accidents due to larger waves in the open Atlantic Ocean would be considerably greater.

Regarding No Action Alternative Scenario 4 (develop and utilize appropriate land-based or beneficial use alternatives), neither New York, Connecticut, nor southwestern Rhode Island have available upland sites or beneficial use sites which would provide a reasonable, long-term alternative to an open-water disposal site designation. The Long Island Dredged Material Disposal Plan (LIS DMMP) study conducted by the USACE has investigated various potential upland and beneficial use alternatives, but did not identify alternatives with sufficient long-term capacity for the finer-grained dredged material common in the eastern Long Island Sound region. However, such alternatives may be suitable for some dredging projects, assuming the dredged material satisfies specific requirements such as grain size, chemistry, etc. Another consideration is the proximity of a beneficial use or land-based site to the dredging site, which would affect cost and duration of dredging projects, possibly rendering some projects infeasible.

No Action Alternative Scenario 5 (cancel proposed dredging projects) would have serious adverse effects on navigational safety and marine-dependent commerce. Shoaling in navigation channels could result in more marine accidents and spills and use of other transportation methods to move products. Adverse environmental ramifications would include traffic congestion and other impacts from increased truck traffic on the region’s highways and roads, as some of the cargo currently transported by sea would be transported on roads.

Conclusion

The initial site screening process led to the identification of three Action Alternative disposal sites (and several variations of those sites), as well as the No Action Alternative, for further evaluation in this document. The evaluation determined that any potential short-term, long-term, or cumulative impacts to the marine environment associated with the designation of any of the alternative sites would be minimal. Disposal site management and monitoring protocols for the preferred alternative are described in detail in the companion SMMP.

USEPA is proposing to designate a New London open-water dredged material disposal site alternative within eastern Long Island Sound. Specifically, the proposed New London site consists of a reduced area of the full New London Alternative, encompassing the western portion of the NLDS and of Sites NL-Wa and NL-Wb, and has a total area of 2 nmi by 1 nmi (3.7 km by 1.9

km). These areas have been combined and will be collectively referred to as the “Eastern Long Island Sound Disposal Site” (ELDS). The New London site satisfies the MPRSA site selection criteria and, when properly monitored and managed as described in the SMMP, use of this site will not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities. Furthermore, disposal at this site in a manner consistent with the restrictions imposed on the site with regard to disposal locations, time periods for disposal, and types of material to be disposed, as well as any other conditions consistent with the procedures and standards recommended by the LIS DMMP, would mitigate any potential adverse impacts to the environment to the greatest extent practicable. In addition, the New London Alternative (and therefore also the ELDS), as well as the Cornfield Shoals and Niantic Bay Alternatives, would avoid the substantial adverse socioeconomic impacts for the eastern Long Island Sound region that would be associated with the No Action Alternative.

The USEPA is interested in receiving public comment on this preferred alternative, as well as other options considered (see Section 5.8 of the DSEIS), to help inform its final determination.

Before any dredged material can be disposed of at any designated site, that material will first have to be tested according to applicable regulations and related national and regional guidance, and will have to satisfy the applicable legal requirements. As stated previously, non-federal dredging projects generating less than 25,000 cy (19,114 m^3) of dredged material are subject only to the requirements of CWA § 404, whereas non-federal dredging projects generating 25,000 cy or more of dredged material, and all federal projects, are subject to the requirements of both the MPRSA and CWA § 404.

CHAPTER 1 – INTRODUCTION

The U.S. Environmental Protection Agency (USEPA) is responsible for designating ocean disposal sites for various types of material, including sites for dredged material disposal, under Section 102(c) of the Marine Protection, Research, and Sanctuaries Act (MPRSA[1]) and the USEPA's Ocean Dumping Regulations (see 40 C.F.R. § 228.4). Under Section 103 of the MPRSA, the U.S. Army Corps of Engineers (USACE) is authorized to "select" ocean disposal sites for dredged material, but USACE-selected sites are limited to short-term use, whereas USEPA-designated sites may be used over the long-term. MPRSA § 103(b) provides that dredged material must be disposed of at USEPA-designated sites "to the maximum extent feasible," but when use of such a site is infeasible, then disposal at an alternative site selected by the USACE is allowed for a period of up to five years. The statute further provides that use of a site selected by the USACE may be extended for an additional five years if the specified criteria are met (see 33 U.S.C. §1413(b)(1) – (3)).

In general, the MPRSA applies to "ocean waters," as defined in Section 3(b) of the statute (see 33 U.S.C. § 1402(b)). This definition provides that "ocean waters" are those waters that lie *seaward* of the "baseline" from which the territorial sea is measured. The baseline extends roughly from Montauk Point, New York, north to Westerly, Rhode Island, and encloses the western-most area of Block Island Sound. The waters of Long Island Sound are not considered ocean waters under the MPRSA because they lie *landward* of the baseline. Dredged material disposal in waters landward of the baseline is generally governed by Section 404 of the Clean Water Act (CWA) (see 33 U.S.C. § 1344). Despite this basic division of statutory jurisdiction, the MPRSA also applies (in addition to CWA § 404) to the disposal of dredged material in the waters of Long Island Sound from certain types of projects because Section 106(f) of the MPRSA specifically provides that dredged material disposal in the waters of Long Island Sound from either federal projects or non-federal projects involving more than 25,000 cubic yards (cy; 19,114 cubic meters [m^3]) of dredged material must comply with the requirements of the MPRSA (see 33 U.S.C. § 1416(f)). As a result, dredged material from federal projects and from private projects involving more than 25,000 cubic yards of material can only be disposed of in Long Island Sound waters at either a disposal site designated by the USEPA under MPRSA § 102 or an active site selected by the USACE for short-term use under MPRSA § 103(b).

In 2005, USEPA designated the Western and Central Long Island Sound Disposal Sites (WLDS, CLDS)[2] under the MPRSA. This designation followed the preparation of an Environmental Impact Statement (EIS) (USEPA and USACE, 2004a) pursuant to the National Environmental Policy Act (NEPA). USEPA did not, however, designate any disposal sites in eastern Long Island Sound at that time. USEPA is now considering whether it should designate any dredged material disposal sites in eastern Long Island Sound.

There are two currently active dredged material disposal sites in eastern Long Island Sound, the New London and Cornfield Shoals Disposal Sites (NLDS, CSDS). These sites were selected by

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[1] The MPRSA is also known as the Ocean Dumping Act (ODA) of 1972; 33 U.S.C. §§1401 *et seq.*

[2] These two sites were previously abbreviated as WLIS and CLIS; these abbreviations were recently changed by the U.S. Army Corps of Engineers.

the USACE for short-term use under the MPRSA and were set to expire on October 5, 2011 for the NLDS and November 6, 2013 for the CSDS. On December 23, 2011, the availability of these sites for disposal was extended for five years (*i.e.*, until December 23, 2016 for both) by federal law (PL-112-74, Title I, Sec 116). In connection with the designation of the WLDS and CLDS, as is explained in more detail later in this chapter, in 2007, the USACE initiated development of a Dredged Material Management Plan for the Long Island Sound region (LIS DMMP). A review of reports prepared in support of the LIS DMMP (*i.e.*, the dredging needs report and alternatives reports) helped USEPA determine that the amount of dredged material expected to be collected over the next 30 years far surpasses the capacity of all of the possible alternatives to open-water disposal (see Chapters 2 and 3). In order to determine how to address this need for additional disposal capacity, USEPA has prepared this Draft Supplemental Environmental Impact Statement (DSEIS) to evaluate the possible designation of one or more ocean (or “open-water”) dredged material disposal sites (ODMDS) in eastern Long Island Sound and/or Block Island Sound, off the coasts of Connecticut, New York, and Rhode Island (Figure 1-1). It is “supplemental” because it utilizes data from, and builds analyses that were included in, the 2004 EIS that recommended designation of the WLDS and CLDS. This DSEIS was prepared under a third-party agreement in accordance with CEQ Regulation 40 C.F.R. § 1506.5(c); the Connecticut Department of Transportation (CTDOT) provided financial and contractual support for this study.

Although USEPA is considering designation of one or more disposal sites to facilitate the environmentally sound disposal of dredged material, USEPA recognizes that no site will be designated if none of the alternative sites under consideration satisfy the applicable law and regulations (*e.g.*, the MPRSA, 40 C.F.R. Part 228, the Endangered Species Act).

USEPA has identified three alternative open-water sites for potential designation as disposal sites for dredged material from rivers, harbors, and coastal areas in Connecticut, New York, and southwestern Rhode Island. Two of these identified sites include currently active dredged material disposal sites (*i.e.*, the NLDS and CSDS), and one site is a presently inactive “historic”[3] site. USEPA’s designation of a dredged material disposal site does not, however, authorize disposal of material from any particular source or project at that site (or any other site). Material may be dredged and disposed of only in accordance with an authorization from the USACE under Section 404 of the CWA, 33 U.S.C. § 1344, and/or Section 103 of the MPRSA, 33 U.S.C. § 1413, and Section 10 of the Rivers and Harbors Act (RHA), the latter of which applies to the dredging itself (as opposed to the disposal), and other applicable provisions of law. Dredged material may be disposed of at an ocean disposal site under the MPRSA only if the material is assessed and found to be suitable for ocean disposal. In other words, a USEPA disposal site designation only makes a site *available* for consideration as a potential open-water disposal option for proposed dredging projects. Disposal sites are designated by USEPA for long-term use and are subject to continuous monitoring and management to ensure that adverse environmental impacts do not occur.

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[3] “Historic” dredged material disposal sites refer to areas that were used historically for dredged material disposal.

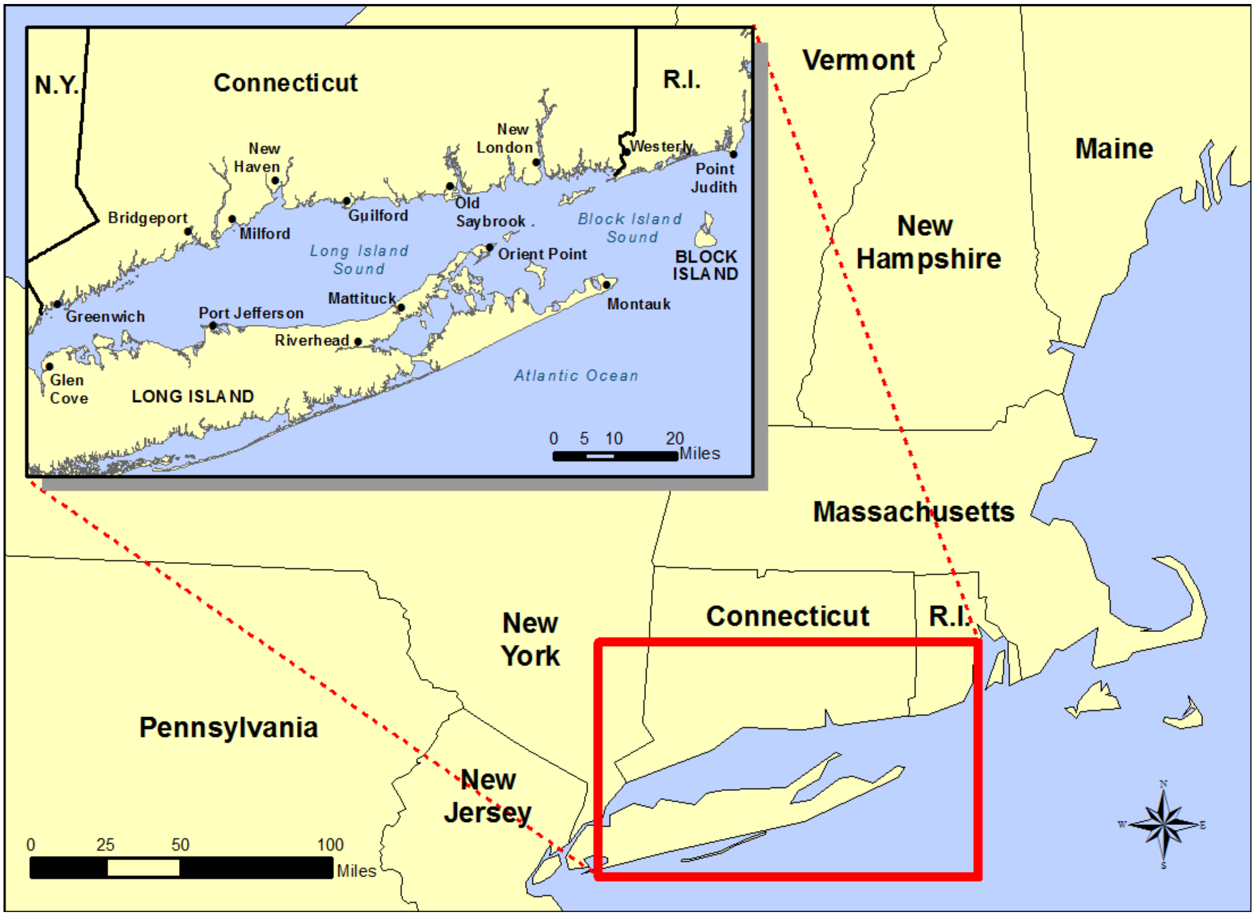

Figure 1-1. Location of Long Island Sound and Block Island Sound.

USEPA is not legally required to subject its disposal site designations under the MPRSA to environmental review under NEPA, 42 U.S.C. §§ 4321 *et seq*., but USEPA has nonetheless conducted a NEPA review pursuant to the agency's "Statement of Policy for Voluntary Preparation of National Environmental Policy Act (NEPA) Documents" 63 Fed. Reg. 58045 - 58047. USEPA has for many years voluntarily prepared NEPA reviews for its dredged material disposal site designations under the MPRSA as a matter of agency policy, and this action is consistent with that policy (see *Id*. at 58046). USEPA has explained that although "voluntary preparation of these [NEPA] documents in no way legally subjects the Agency to NEPA's requirements," USEPA will nevertheless "follow, as appropriate, procedures set out at 40 C.F.R. Part 6, Subparts A through D[4] *(see Id).* Thus, while not legally required to do so, USEPA has prepared this DSEIS in a manner consistent with USEPA's NEPA-implementing regulations at 40 C.F.R. Part 6, Subparts A through D, as appropriate, while also using regulations promulgated by the Council on Environmental Quality (CEQ) at 40 C.F.R. Parts 1500-1508 to provide additional guidance.

The USACE is participating in the development of this DSEIS as a cooperating agency for a number of important reasons. The USACE is responsible for issuing permits for the aquatic

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[4] See USEPA's website at *http://www.epa.gov/Compliance/nepa/epacompliance/index.html*.

disposal of dredged material under both Section 404 of the CWA, 33 U.S.C. § 1344, and Section 103 of the MPRSA, 33 U.S.C. § 1413. In addition, the USACE is responsible for implementing the federal dredging program for ensuring safe and reliable navigation in those project features (channels, anchorage areas, etc.) for which it has been delegated responsibility under its Civil Works Program. Although agencies and the public is contributing to the development of this DSEIS, all final decisions regarding any site designations will be made by USEPA. To take advantage of the expertise of other agencies, and to ensure compliance with all applicable legal requirements, USEPA is also closely coordinating with other federal agencies; state agencies from Connecticut, New York and Rhode Island; local governments; and Indian Tribal governments. Some of these entities are also participating as cooperating agencies (see 40 C.F.R. § 1508.5); the list of cooperating agencies is presented in Section 1.5.3 and also in Section 7.4. In addition, USEPA has held several meetings with members of the interested public to explain the process, gather information, and learn about concerns held by the public. These public outreach efforts are described in more detail in Chapter 7.

This DSEIS is now being circulated for review and comment by other federal agencies; state, local, and tribal agencies; and members of the public. Information regarding the DSEIS also will be posted on the USEPA website (*http://www.epa.gov/region1/eco/lisdreg/eisdocs.html*). Concurrent with the release of the DSEIS, a proposed rule (regulation) for site designation will be published in the *Federal Register* for public comment. Following consideration of the comments received by mail and at public meetings, the USEPA will issue a Final SEIS (FSEIS) that specifies USEPA's preferred alternative. At least 30 days after the issuance of the FSEIS, the USEPA will publish a Final Rule that will serve as its Record of Decision (ROD). The ROD, among other things, will state the agency's decision, identify all alternatives considered, and state whether all practical means to avoid or minimize environmental harm from the proposed action have been adopted (see 40 C.F.R. § 1505.2).

If a disposal site is designated by USEPA, that site cannot receive dredged material until disposal of that specific material has been authorized by the USACE. The USACE issues permits under MPRSA § 103(a) for dredged material disposal by parties other than the USACE, and issues federal "authorizations" under MPRSA § 103(e) for dredging and disposal activities by the USACE itself (see also 33 C.F.R. § 335.2). For either type of USACE approval, USEPA is given the opportunity to review and concur, concur with conditions, or non-concur with the USACE proposed permit (see 33 U.S.C. § 1413(c)). If USEPA concurs, the USACE can move ahead with its proposed action. If USEPA non-concurs, USACE cannot permit the disposal project. If USEPA concurs with conditions, USACE must include the conditions in its final permit for the disposal project.

The USACE actions are also subject to requirements for NEPA analysis and documentation, individual project evaluation under the CWA and MPRSA, and public participation in the decision process. The dredged material disposal evaluation process for any federal or non-federal dredging project requires consideration of a range of disposal alternatives, including open-water and non-open-water alternatives, as well as careful evaluation of the quality of the material to be disposed. Consideration of alternatives such as beneficial use, upland disposal, dredged material treatment and open-water disposal, are required on a project-specific basis. For alternatives, the "federal base plan" must be identified as the least costly environmentally acceptable alternative for the USACE to determine non-federal cost sharing requirements. USACE disposal determinations are made using USEPA guidelines and criteria (see 40 C.F.R. Parts 227 and 230) and are also subject to USEPA review and concurrence (see 33 U.S.C. § 1344(c) and § 1413(c)).

1.1 History of Dredging and Dredged Material Disposal in Long Island Sound and Block Island Sound

In order to facilitate safe navigation and marine commerce, dredged material from projects in Connecticut and New York rivers, harbors and coastal areas has been disposed of at open-water sites in Long Island Sound since at least the 1870s. While detailed records of dredging activities extend back to this time, disposal methods and sites for disposal projects were not systematically recorded until the 1950s; however, there is evidence of continuous use of some sites since 1941 (Fredette et al., 1992). From the 1950s through the early 1970s, about 19 open-water disposal sites were active in Long Island Sound (Dames and Moore, 1981). Since the early 1980s, dredged material has been placed predominantly at four disposal sites in Long Island Sound: WLDS, CLDS, CSDS, and NLDS. Based on information collected through the USACE Disposal Area Monitoring System (DAMOS) program and the LIS DMMP (USACE, 2014; USEPA, 2015a), as well as through the Oceanic Society (1982), an estimated 12 million cy (9 million m^3) of dredged material were disposed in eastern Long Island Sound between 1955 and 2013 (Table 1-1).

Table 1-1. Estimated Dredged Material Volumes Disposed at Sites in Eastern Long Island Sound (ELIS) and Block Island Sound (BIS) between 1955 and 2013

Disposal Site [1]	**Abbre-viation**	**Location**		**Status**		**Volume** (cy)	**Period**
		ELIS	BIS	Active	Historic		
Cornfield Shoals	CSDS	●		●		1,230,000 1,670,000	1960-1976 [2] 1982-2013 [3]
Clinton Harbor	CHDS	●			●	26,900	1965 [2]
Six Mile Reef	SIDS	●			●	n/a [4]	
Orient Point	OPDS	●			●	n/a [4]	
Niantic Bay	NBDS	●			●	176,000	1969-1972[2]
New London	NLDS	●		●		5,400,000 3,460,000	1955-1976 [32] 1981-2013 [3]
Block Island Sound	BIDS		●		●	n/a [4]	

[1] A map with locations of active and historic disposal sites is included in Appendix B of this DSEIS.

[2] Oceanic Society (1982)

[3] USACE (2014) and USEPA (2015a)

[4] n/a = Disposal volumes not available.

Since 1977, the USACE, USEPA, and the States of New York and Connecticut have evaluated and regulated the disposal of dredged material in Long Island Sound under the provisions of the CWA. Since 1972, federal activities and the activities of others carried out under federal permit have also been subject to review by the states under their applicable Coastal Zone Management programs. The number of actively used disposal sites in Long Island Sound was reduced to four open-water sites by the mid-1970s, with two of the sites now designated. At the same time, the USACE began a research and monitoring program that was named as the DAMOS program in 1979 that has been monitoring these four active disposal sites.

The USACE Civil Works Program is responsible for maintaining 55 federal navigation projects (FNP) along Long Island Sound and its adjacent waters (Table 1-2); these FNPs were studied under the LIS DMMP (USACE, 2015). These FNPs include navigation channels, anchorage areas, turning and maneuvering basins for vessels, breakwaters, jetties and other structures. The majority of these FNPs require periodic maintenance dredging to assure reliable navigable depth for vessel traffic. Three of these FNPs, all in New York, consist only of breakwaters and do not have any dredged features (Larchmont, Glen Cove and Sag Harbors); they therefore do not require maintenance dredging. Disposal of dredged material from maintenance of these FNPs, and from improvement of newly authorized federal civil works projects in the region, requires the same analysis as is required for disposal proposed by parties other than the USACE under permit from the USACE, including federal agencies and state, municipal, and private project proponents for projects involving more than 25,000 cubic yards of material.

1.2 Legal Requirements

The primary federal authorities that govern the disposal of dredged material in the United States are the CWA and the MPRSA. All dredged material disposal activities in Long Island Sound, whether from federal or non-federal projects of any size, are subject to the requirements of the CWA. In addition, all federal projects of any size and all non-federal projects disposing of greater than 25,000 cy (19,114 m^3) of dredged material in the Sound must comply with the requirements of the MPRSA. Some key provisions of these statutes are described in the following subsections.

1.2.1 Clean Water Act, Section 404

As stated above, CWA § 404, 33 U.S.C. § 1344, governs the disposal of dredged or fill material into waters landward of the baseline from which the territorial sea is measured (the “baseline”). The baseline generally follows the coastline, but may cut from a point of land across the mouth of bays, and other like bodies of water, to an opposite point of land, thus leaving potentially significant areas of coastal waters landward of the baseline. Indeed, all of the waters of Long Island Sound and the historic Block Island Sound disposal site lie landward of the baseline; however, the designated Rhode Island Sound disposal site (RISDS) does not. Under the CWA, disposal of dredged material into waters landward of the baseline must first be authorized by the USACE under CWA § 404 and must be conducted in compliance with the conditions of such an authorization.

Table 1-2. USACE authorized Federal Navigation Projects in the Long Island Sound Region

Connecticut		
Stonington Harbor	Duck Island Harbor	Southport Harbor
Mystic River and Harbor	Clinton Harbor	Westport Harbor
New London Harbor	Guilford Harbor	Norwalk Harbor
Thames River	Stony Creek Harbor	Wilson Point Harbor
Niantic Bay and Harbor	Branford Harbor	Fivemile River
Connecticut River (below Hartford)	New Haven Harbor	Westcott Cove
North Cove	West River	Stamford Harbor
Essex Cove Harbor	Milford Harbor	Mianus River
Eightmile River	Housatonic River	Greenwich Harbor
Wethersfield Cove	Bridgeport Harbor	
Patchogue River	Black Rock Harbor	
New York		
Port Chester Harbor	Little Neck Bay	Greenport Harbor
Milton Harbor	Hempstead Harbor	Peconic River
Larchmont Harbor	Glen Cove Harbor	Sag Harbor
Mamaroneck Harbor	Huntington Harbor	Lake Montauk Harbor
Echo Bay Harbor	Northport Harbor	Fishers Island Harbor
New Rochelle Harbor	Port Jefferson Harbor	
East Chester Creek	Mattituck Harbor	
Southern Rhode Island		
Block Island Harbor of Refuge	Pawcatuck River and Little Narragansett Bay (CT and RI)	Watch Hill Cove
Great Salt Pond		

Source: LIS DMMP (USACE, 2015)

In making its permit decisions and recommendations under its civil works program, the USACE applies the standards and criteria set forth in USEPA regulations commonly referred to as the "CWA §404(b)(1) Guidelines," which are promulgated at 40 C.F.R. Part 230 (see 33 U.S.C. § 1344(b)). The USACE also applies its own regulations promulgated at 33 C.F.R. Parts 320 to 338. In addition, other provisions of applicable law must also be satisfied (*e.g.*, state water quality standards for states receiving dredged material, applicable requirements of state coastal zone management plans, the Endangered Species Act). USACE permits and civil works decisions under CWA § 404 are subject to review, and concurrence, by USEPA. Section 1.2.4 describes the CWA Section 404 permit process in more detail.

1.2.2 Marine Protection, Research, and Sanctuaries Act

The MPRSA generally regulates dredged material disposal only in waters seaward of the baseline, which are referred to as "ocean waters" under the statute (see 33 U.S.C. § 1402(b)). These waters include the three-mile band extending seaward of the baseline, which is referred to as the "territorial sea," and beyond. (While not relevant for the present case, it is noted that CWA § 404 jurisdiction actually extends to the seaward edge of the territorial sea, thus overlapping with MPRSA jurisdiction within the territorial sea. USEPA regulations direct, however, that only the MPRSA program will be applied to regulate dredged material disposal in the territorial sea, while the CWA program will be applied to discharges of fill material in those waters (see 40 C.F.R. § 230.2(b)).

As stated in Section 1.2.1, the waters of Long Island Sound and the Block Island Sound disposal site lie landward of the baseline and, thus, would be expected to be subject to regulation under CWA § 404 and *not* the MPRSA. However, in 1980, the MPRSA was amended to add Section 106(f) to the statute (33 U.S.C. § 1416(f)). This provision is commonly referred to as the "Ambro Amendment," named after Congressman Jerome Ambro, who is said to have championed the provision. MPRSA § 106(f), 33 U.S.C. § 1416(f), was itself amended in 1990. As currently enacted, it reads as follows:

> *"In addition to other provisions of law and notwithstanding the specific exclusion relating to dredged material in the first sentence of this title, the dumping of dredged material in Long Island Sound from any Federal Project (or pursuant to Federal authorization) or from a dredging project by a non-Federal applicant exceeding 25,000 cy shall comply with the requirements of this subchapter."*

As a result of this provision, the disposal in Long Island Sound of dredged material from federal projects (both projects carried out under the USACE civil works program or the actions of other federal agencies), or from non-federal projects involving more than 25,000 cy (19,114 m^3) of material, must satisfy the requirements of both CWA § 404 and the MPRSA. Disposal from non-federal projects involving less than 25,000 cy of material, however, is subject only to CWA § 404.

Like the CWA, the MPRSA prohibits the disposal of dredged materials into waters under its jurisdiction unless conducted in compliance with a permit or authorization issued by the USACE (33 U.S.C. § 1411(a) and § 1413(a)). USACE dredged material disposal permits and authorizations are issued under MPRSA § 103, and may include conditions deemed necessary by the USACE related to the type of material to be disposed, time of disposal, and other matters (33 U.S.C. § 1413 and § 1414(a)). USEPA is responsible for review and permitting of any proposals to dispose anything other than dredged material into ocean waters (33 U.S.C. §§ 1412(a) and (b)). The USACE is to issue a permit, or authorize a project, only if it has determined that dredged material disposal "will not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities" (33 U.S.C. § 1413(a)). Similar to the CWA § 404 program, the USACE is to make MPRSA § 103 determinations utilizing the standards set forth in USEPA regulations (33 U.S.C. § 1413(b)). USEPA has promulgated its ocean dumping regulations pursuant to MPRSA § 102(a), 33 U.S.C. § 1412(a), at 40 C.F.R. Parts 220 to 229. USACE permit determinations and authorizations under the MPRSA are also subject to any applicable requirements of other laws (*e.g.*, the Endangered Species Act, the Coastal Zone Management Act). USACE permits and authorizations under MPRSA § 103 are further subject to USEPA review and concurrence. USEPA may concur, concur with conditions, or non-concur with regard to the permit or authorization proposed by the USACE (33 U.S.C. § 1413(c) and § 1414(a)). As with the CWA § 404 program, the USACE does not issue permits under MPRSA for USACE dredged material disposal projects under its civil works authority; rather, it "authorizes" its own disposal projects under the MPRSA by applying the same substantive and procedural requirements "in lieu of" the permit procedures (33 U.S.C. § 1413(e)). Such USACE authorizations for USACE projects are subject to the same USEPA review and concurrence process as those described above.

The USACE and USEPA are required to review and evaluate authorizations for dredged material disposal using criteria that include the following:

- Need for the proposed disposal.
- Effect of the disposal on human health and welfare, fisheries resources, plankton, fish, shellfish, wildlife, shorelines, beaches, and marine ecosystems.
- Persistence and permanence of the effects of the disposal.
- Effect of disposing of particular volumes and concentrations of such materials.
- Appropriate locations and methods for disposal or recycling the material, including land-based alternatives.
- Effect on other uses of the ocean.

Under CWA § 404, dredged material at a particular site is authorized on a project-specific basis, subject to the terms of the authorization. Under the MPRSA, however, the identification of sites for the potential disposal of dredged material is handled differently. MPRSA § 102(c) authorizes USEPA to "designate" sites for long-term use for dredged material disposal. Such long-term site designation by USEPA is conducted apart from the consideration of any particular project's dredged material. Material from particular projects is instead evaluated under the USACE permitting/authorization program under MPRSA § 103. (As stated above, however, material from non-federal projects involving less than 25,000 cy of dredged material are only evaluated under the CWA § 404 requirements.) USEPA designates disposal sites using its site designation criteria regulations promulgated at 40 C.F.R. Part 228. 33 U.S.C. § 1412(c)(1). USEPA designates both the sites and time periods for disposal, and can restrict site use, as necessary, to "mitigate adverse impact on the environment to the greatest extent practicable" (33 U.S.C. § 1412(c)(1)).

For each designated disposal site, USEPA and the USACE must develop a Site Management and Monitoring Plan (SMMP) that includes a baseline assessment of site conditions, a program for monitoring the site, special management conditions or practices to be implemented at the site to protect the environment, consideration of the quantity of material to be disposed of at the site and the presence of contaminants in the material, consideration of the anticipated use of the site over the long term, and a schedule for review and revision of the plan (33 U.S.C. § 1412(c)(3)). A designated disposal site may not be used until a SMMP has been developed for the site (33 U.S.C. § 1412(c)(4)).

In determining whether to authorize dredged material disposal under Section 103 of the MPRSA, the MPRSA directs the USACE to evaluate the "potential effect of a permit [or USACE project authorization] denial on navigation, economic and industrial development, and foreign and domestic commerce of the United States, [in order to] . . . make an independent determination as to the need for the dumping" (33 U.S.C. § 1413(b)). Related to this, the statute also directs the USACE to "make an independent determination as to the other possible methods of disposal and as to appropriate locations for the dumping." *Id.* With respect to locations for disposal, the statute requires the USACE to utilize USEPA-designated disposal sites to the "maximum extent feasible." *Id.* Where use of an USEPA-designated site is infeasible, however, the USACE is authorized to "select an alternative site." *Id.* Thus, USACE selection of an alternative site is conducted in conjunction with a specific project.

In considering "selection" of an alternative site, the USACE must use the same site selection criteria that USEPA uses in designating disposal sites (*i.e.*, 40 C.F.R. Part 228). *Id.* USACE selection of an alternative disposal site is also subject to USEPA review and concurrence. *Id.* While USEPA-designated disposal sites are specified for long-term use, and the statute does not specify a specific term of years to which such use must be limited, the statute places a specific time limit on the use of USACE-selected sites. MPRSA § 103(b) provides that "disposal at or in the vicinity of an alternative site shall be limited to a period of not greater than five years unless the site is subsequently designated [by the USEPA] . . .; except that an alternative site [selected by the USACE] may continue to be used for an additional period of time that shall not exceed five years if – (1) no feasible disposal site has been designated by the Administrator [of the USEPA]; (2) the continued use of the alternative site is necessary to maintain navigation and facilitate interstate or international commerce; and (3) the Administrator [of the USEPA] determines that the continued use of the site does not pose an unacceptable risk to human health, aquatic resources, or the environment" (33 U.S.C. § 1413(b)(1), (2) and (3)).

The time limits for use of a USACE-selected disposal site (*i.e.*, the five-year period, with potential for a five-year extension) were added to the MPRSA by an amendment to 33 U.S.C. § 103(b) made by Section 506(b) of the Water Resources Development Act of October 31, 1992 (WRDA92 – P.L. 102-580). There were no time limits prior to that date. Thus, USEPA and the USACE interpret Section 103(b) to mean that these time limits began to apply to USACE-selected sites used for disposal after the October 31, 1992, amendments to the statute. Furthermore, USEPA and the USACE interpret any second term of (up to) five years for use of a USACE-selected site to commence upon proper approval to extend the time for use of that site. Therefore, if there is a gap in time between the end of the first five-year term and the beginning of any second term, that time is not counted against the second term because it is the *use* of the site for disposal that is limited by the statute and the site is not being used during any such gap. The time period for any second term of use begins to run with the approval extending use of the site, thus ensuring that the site will not be used for disposal for any longer than ten years except for the case of NLDS and CSDS in which the sites were extended for an additional five-year period of time by Congress under the Consolidated Appropriations Act of 2012 (PL-112-74, Title I, Sec 116). Both existing open-water disposal sites in eastern Long Island Sound were selected by the USACE for short-term use under the MPRSA and were set to expire on October 5, 2011 for the NLDS and November 6, 2013 for the CSDS. On December 23, 2011, the availability of both sites for disposal was extended for five years until December 23, 2016.

The USACE also prepares dredged material management plans (DMMPs) on a project-specific basis (one or several projects combined) where a continued need for maintenance dredging is demonstrated and available disposal site capacity is determined insufficient to meet the project's needs for at least a 20-year period, for the quantity and quality of materials to be dredged. It should be noted that a USACE DMMP is different from the SMMP that must be prepared by USEPA in conjunction with the USACE for designated disposal sites under MPRSA § 102(c)(3).

1.2.3 Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) of 1972 establishes a national program to encourage coastal states to develop and implement coastal zone management plans, subject to the approval of the National Oceanic and Atmospheric Administration (NOAA). In response, Connecticut, New York, and Rhode Island, among other states, all developed Coastal Zone Management plans and programs that were federally approved under the CZMA. Section 307 of the CZMA, as amended, applies to federal agencies proposing or permitting activities within a state's coastal zone, or activities outside the coastal zone but with a reasonably foreseeable effect on a land or water use or natural resource of the coastal zone, to ensure that those activities are conducted in a manner which is consistent to the maximum extent practicable with the enforceable policies of approved state coastal management programs. As part of this SEIS process, the USEPA will prepare a federal determination of consistency with the applicable state-approved Coastal Zone Management programs.

Based on NYSDOS' CZMA review in 2007, the USACE started the development of the regional LIS DMMP (see Section 1.4.2 for details). The LIS DMMP is a separate document that recommends a base plan for USACE navigation projects and it has been prepared in conjunction with a separate Programmatic Environmental Impact Statement (PEIS). The draft document has been issued by the USACE in August 2015 for public review (USACE, 2015). This LIS DMMP is different than a project-specific DMMP.

1.2.4 USACE Permitting Process

A USACE permit or authorization is required for any discharge of dredged material into waters of the United States. To decide whether to permit or authorize the aquatic disposal of dredged material, the USACE applies technical and environmental criteria specified in USEPA regulations under the MPRSA and/or the CWA. Under both the CWA and the MPRSA, the USACE dredged material disposal permits and authorizations are subject to USEPA review and concurrence. The USACE also applies its own regulations promulgated at 33 C.F.R. Parts 320 to 338.

In order to ensure that dredged material disposal will not adversely affect human health, the aquatic environment, or uses of the aquatic environment, the USACE works cooperatively with federal and state regulatory and resource agencies throughout the permitting process. For example, the USACE solicits comments on dredged material disposal permits from the National Marine

Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), USEPA, and state agencies for those state(s) where disposal will take place or whose resources may otherwise be affected by the proposed action. Since the proposed alternative disposal sites in this case are located in Connecticut and New York waters, the Connecticut Department of Energy and Environmental Protection (CTDEEP, Office of Long Island Sound Programs) and New York State's Department of State (NYSDOS) may comment under their CZMA policy (see Section 1.2.3).

As mentioned above, one of the first steps in the permit application review process for both CWA and MPRSA projects is for the USACE, working with the state and federal resource agencies and the permit applicants, to develop sampling and analysis plans to determine the suitability of the dredged material for open-water disposal (unless the project meets exclusionary criteria). The applicants will perform sampling and analysis based on these plans. The USACE, USEPA, NMFS, and other interested federal agencies will review the results according to several testing protocols designed for regional and national use. As part of the permit process, the USACE reviews placement or disposal alternatives and makes a determination on the suitability of the material for disposal at a particular site; this determination is submitted to the USEPA and appropriate agency of the state where the disposal will take place for review and concurrence. National guidance for determining whether dredged material is acceptable for open-water disposal is provided in the Ocean Testing Manual (Green Book; USEPA and USACE, 1991) and in the Inland Testing Manual (USEPA and USACE, 1998). The Regional Implementation Manual, consistent with the Green Book and the Inland Testing Manual, provides specific testing and evaluation methods for dredged material projects at specific sites or groups of sites (USEPA and USACE, 2004c).

If the material is determined to be suitable for open-water disposal, the USACE will consider open-water disposal as one option in the analysis of disposal alternatives for its permit review. Other options considered for disposal (or management) of the material include any available options for beneficial use, upland disposal, and treatment. Under the CWA, material may be permitted for open-water disposal only if there is no practicable alternative location or method of disposal or beneficial reuse available that has less adverse environmental impact on the aquatic environment or a smaller potential risk to other parts of the environment (CWA § 404 (b)(1) Guidelines).

For a specific project involving the disposal of dredged material under MPRSA § 103, analysis of the USACE project or permit must demonstrate that no practical alternative location or method, including non-ocean alternatives, are available. For this reason, the USACE alternatives analysis evaluates available alternative locations and methods (ocean and non-ocean), beneficial use alternatives, as well as dredging and disposal costs. If other low impact or beneficial use alternatives are practicable, a MPRSA § 103 permit or authorization would not be issued. Further details are provided in the LIS DMMP (USACE, 2015).

Both improvement and maintenance dredging projects proposing disposal in open-water may also be reviewed under the USACE Connecticut State Programmatic General Permit (CTPGP), provided that the quantity of material to be dredged is less than 25,000 cy (19,114 m^3). The CTPGP offers an expedited review process with coordination and agreement of the federal and state agencies with resources of concern.

For projects involving quantities greater than 25,000 cy, or those projects that do not meet the terms and conditions of the CTPGP, proposals are reviewed under the standard individual permit process. This process involves a public notice and a review of the impacts and potential outcomes of the proposal. The sampling and analysis plans, and suitability determinations require the same level of detail regardless of the permitting process.

Ultimately, the decision to deny, approve, or place restrictions on a permit must be determined by utilizing the regulatory standard that the action must cause no "unacceptable adverse impact." As a result, federal and state agencies cooperatively set permit conditions by considering the range of potential impacts and the environmental, economic, and social conditions associated with the proposed activities.

Ensuring compliance with the CWA and MPRSA and their accompanying regulations is a joint responsibility of USEPA and the USACE. Discharging dredged material into waters covered by the CWA and/or the MPRSA without proper authorization from the USACE or in a manner inconsistent with the conditions of such an authorization would be a violation of the applicable statute. The USACE may revoke disposal permits or suspend them for a specified period of time if any conditions of the permit are violated. Moreover, USEPA may assess administrative penalties in response to such violations (see 33 U.S.C. § 1415). Furthermore, under certain circumstances, civil or criminal judicial actions may be brought by the federal government to enforce the CWA and MPRSA. Enforcement is an important site management tool because it serves to deter non-compliance with the requirements set out in a disposal permit.

1.3 Scope of the EIS

On October 16, 2012, USEPA issued a Notice of Intent (NOI) to prepare an SEIS to evaluate the potential designation of one or more ODMDS to serve the eastern Long Island Sound region (Connecticut, New York, and Rhode Island) under MPRSA Section 102 (64 Fed. Reg. 29865 (1999)). The NOI stated that the SEIS "will update and build on the analyses that were conducted for the 2004 Long Island Sound EIS," and would "evaluate the two current sites used in eastern Long Island Sound [CSDS, NLDS] as well as other sites for, and means of, disposal and management, including the no action alternative." Some of the alternatives to open-water disposal of dredged material are listed in Table 1-3; these are investigated in more detail as part of the LIS DMMP (see Section 1.4.2). The first public scoping meetings were held on November 14, 2012, in Connecticut and on January 9, 2013, in New York; see Section 1.5.1 for a list of additional public meetings held thereafter. Reports from these meetings are presented in Appendix A.

The Zone of Siting Feasibility (ZSF) refers to the area from which possible alternative open-water disposal sites were selected for further evaluation. The USEPA site designation guidance manual (USEPA, 1986) describes the factors that should be addressed in delineating the ZSF. Specifically, the USEPA recommends locating ODMDSs within an economically and operationally feasible radius of the point of dredging. Other considerations include navigational restrictions, political or other jurisdictional boundaries, distance to the edge of the continental shelf, the feasibility of surveillance and monitoring, and operational and transportation costs (Pequegnat et al., 1990).

Table 1-3. Alternatives to Open-Water Disposal of Dredged Material

Alternative	Description
Upland Disposal	Disposal of dredged material in any upland location for construction purposes, wildlife habitat, or recreational development.
Beach nourishment	Disposal of clean, sandy dredged material on existing beaches.
Nearshore berms	Nearshore placement off of beaches can result in sand eventually getting on the beach or reduce waves that reduce beach erosion.
Containment	Disposal of dredged material in a facility (*e.g.*, confined disposal facility [CDF] or Confined Aquatic Disposal [CAD] cells) designed to contain the material as part of an artificial island or to extend or bolster existing shoreline areas for purposes of construction, recreation, or habitat creation. Other containment facilities include Confined Aquatic Disposal [CAD] cells).
Treatment Technologies	Example: The combustion of dredged material to reduce its volume and volatile organic compounds.
Resource Reclamation	Use of dredged material as a soil enhancer for landscaping, agricultural purposes, or construction material.

In 2012, USEPA developed the ZSF for open-water sites for this SEIS with the assistance of cooperating agencies. The ZSF includes the following boundaries (Figure 1-2):

- *West:* Line drawn between Mulberry Point, Connecticut (near Guilford, Connecticut) to Mattituck Point, New York. This boundary abuts the eastern boundary of the ZSF for the 2004 CLIS/WLIS EIS.
- *South:* Line drawn between Montauk, New York, to Block Island, Rhode Island.
- *East:* Line drawn between Block Island to Point Judith, Rhode Island.
- The shorelines of the States of Connecticut, New York, and Rhode Island, connecting the lines listed above.

Once the ZSF was delineated, USEPA identified and evaluated a range of potential disposal site alternatives found within the ZSF (see Chapter 3 for site screening methodology). The suitability of these alternative sites has been evaluated using the five general and eleven specific criteria for disposal site designation, as spelled out in USEPA regulations (40 C.F.R. § 228.5 and § 228.6). The ZSF includes the two currently active dredged material disposal sites in the region (*i.e.*, CSDS and NLDS). These two sites are analyzed in the DSEIS along with one additional alternative site; locations of these three sites are shown in Figure 3-1 in Chapter 3.

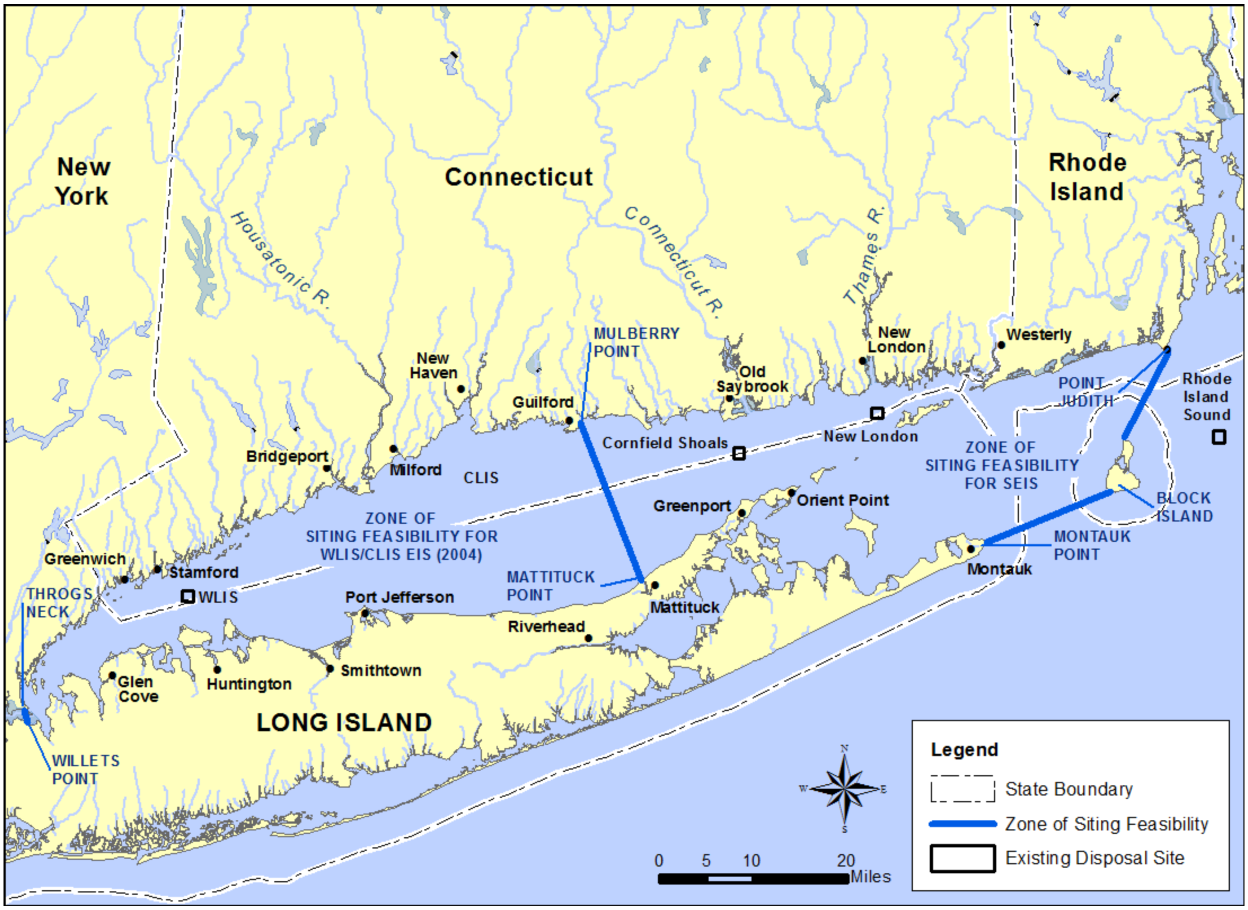

Figure 1-2. Zone of Site Feasibility (ZSF) for the eastern Long Island Sound region, as well as ZSF for the 2004 EIS for the Western and Central Long Island Sound Disposal Sites (USEPA and USACE, 2004a).

1.4 Other Relevant Documents

1.4.1 NEPA Documents

The following NEPA documents were prepared in the past by the USACE and/or USEPA concerning the disposal of dredged material in the waters of Long Island Sound, including the area of the current ZSF:

- **Final Programmatic Environmental Impact Statement (PEIS) for the Disposal of Dredged Material in the Long Island Sound Region** (USACE, 1982a): The USACE prepared this PEIS as a result of a 1976 agreement with the Natural Resources Defense Council. It evaluated seven proposed disposal sites in Long Island Sound and identified generic impacts associated with a range of disposal alternatives for dredged materials. This document also sought to provide an informational basis upon which future NEPA documents could be developed for site-specific projects in the Long Island Sound region. The PEIS concluded that open-water, upland, containment, beach restoration, incineration, and resource reclamation were all viable alternatives and that the most appropriate alternative for disposal would be determined on a case-by-case project-specific basis depending on the conditions prevalent at the time a project was proposed. The PEIS also found that three of the seven sites in Long Island Sound were the least environmentally damaging and practicable alternative open-water disposal sites. These three sites were the CLDS, CSDS, and NLDS.

- **Final Environmental Impact Statement for the Designation of Dredged Material Disposal Sites in Central and Western Long Island Sound, Connecticut and New York** (USEPA and USACE, 2004a): As described above, this 2004 EIS was prepared for the designation of the WLDS and CLDS in western and central Long Island Sound. It includes information that pertains to the entire Long Island Sound; this information was incorporated into the DSEIS, as relevant. The DSEIS for the eastern Long Island Sound region builds on the analyses of this 2004 EIS.

- **Rhode Island Region Long-term Dredged Material Disposal Site Evaluation Project** (USEPA and USACE, 2004b): This EIS was prepared for USEPA's designation of the RISDS in Rhode Island Sound offshore of Rhode Island. This action was necessary to provide a long-term site for the current and future disposal of dredged material from Rhode Island, southeastern Massachusetts, and surrounding harbors (referred to as the 'Rhode Island Region', or RIR). The ZSF for this RIR EIS included the eastern portion of Block Island Sound.

1.4.2 Long Island Sound Dredged Material Management Plan

On June 3, 2005, the USEPA promulgated final regulations to designate the WLDS and CLDS. In an effort to assuage concerns about the potential impact of dredged material disposal on Long Island Sound water quality and fisheries habitat, these site designations included certain restrictions on use of the sites. These restrictions are described in the site designation regulations and are intended to reduce or eliminate the disposal of dredged material in Long Island Sound.

One of these restrictions, at 40 C.F.R. § 228.15(b)(4)(vi)(C), links continued use of the sites to the completion of the regional LIS DMMP within eight years of the publication of the rule (by June 3, 2013). A DMMP is a comprehensive planning process and decision-making tool to address the management of dredged material for a specific harbor or navigation project, group of related projects, or geographic area.

Due to the initial delays in starting the project, the USACE was unable to meet the original deadline for the LIS DMMP of June 2013, so on June 10, 2013, USEPA extended the deadline for the completion of the LIS DMMP to April 30, 2015, with a letter countersigned by the USACE, NYSDOS, and CTDEEP, as required by 40 C.F.R. § 228.15(b)(4)(vi)(D). On April 28, 2015, pursuant to the designation rule (40 C.F.R. § 228.15(b)(4)(v) and (vi)(E) and 40 C.F.R. § 228.15(b)(5)(v) and (vi)), USEPA extended the deadline for completion of the LIS DMMP to April 30, 2016. The USACE issued the Draft LIS DMMP for public review in August 2015 (USACE, 2015).

The LIS DMMP consists of an in-depth analysis of all potential dredged material management alternatives with the goal to reduce or eliminate open water disposal. These alternatives include open-water placement, beneficial use, upland placement, and innovative treatment technologies, which could be used by dredging proponents in developing alternatives for consideration in the review of dredged material projects in the Long Island Sound vicinity. The USACE New England District is the lead agency developing the LIS DMMP, in cooperation with the USEPA (Regions 1 and 2), NOAA, NYSDOS, New York State Department of Environmental Conservation (NYSDEC), CTDEEP, CTDOT, and the Rhode Island Coastal Zone Management Council (RICRMC).

The study area for the LIS DMMP encompasses all of Long Island Sound and Block Island Sound (thus the eastern part of the DMMP study area overlaps with the ZSF for the DSEIS). As part of the DMMP, several studies were conducted that were utilized in this DSEIS. These studies include a dredging needs survey designed to estimate the future quantities of material to be dredged over the 30-year planning horizon (see Section 2.3), an environmental data literature search (WHG, 2010a), and a thorough evaluation of alternatives to open-water disposal (see summary in Section 3.2).

The LIS DMMP (USACE, 2015) includes a PEIS to evaluate the overall impacts of various alternatives identified in the LIS DMMP for management of dredged material in the Long Island Sound region. Some alternative disposal methods may be implemented on the basis of the PEIS, while others may require additional analysis and documentation at the project level including NEPA documents to be prepared by the USACE and other federal agencies.

1.5 Public Involvement

This section describes the formal scoping process, other public and agency meetings that have been held regarding this DSEIS, and future opportunities for public involvement.

1.5.1 Public Scoping

In addition to the NOI to prepare an SEIS for the designation of disposal site(s) in eastern Long Island Sound published in the *Federal Register* on October 16, 2012 (FR Doc. 2012–25398), USEPA published news releases on its website informing the public of the NOI and announcing the two initial public scoping meetings. Two formal scoping meetings were conducted in Groton, Connecticut (November 14, 2012), and in Riverhead, New York (January 9, 2013), to ensure that interested communities, groups, and individuals had the opportunity to provide input on the scope of the environmental review, including the scope of the alternatives and impact analyses. The first New York meeting was originally scheduled for November 15 in Port Jefferson but was rescheduled due to Superstorm Sandy recovery efforts to better facilitate participation from New York residents affected by the storm. These meetings provided a forum for the public to ask questions and express concerns regarding dredged material disposal, and to comment on the need for the project.

In general, the public comments raised the following issues:

- ***Regulatory Issues:*** Compliance with MPRSA, the Clean Water Act and other laws and regulations; consistency with the Coastal Zone Management Act.
- ***Concerns for Human Health and the Natural Environment:*** Contamination of fish and fish habitat, contamination of benthic organisms and habitats; impacts on species diversity; health impacts of consumption of contaminated seafood; dispersion of contaminants in Long Island Sound; need for additional field studies.
- ***Socioeconomic Issues:*** Cost of disposal at sites outside of eastern Long Island Sound; economic impacts on coastal communities, including access to open water; recreational boating impacts; effects on navigation and waterborne commerce; transport distance for barges; groundings of submarines; air quality impacts from barge traffic.
- ***NEPA Documentation and Analysis Issues:*** Consideration given to other dredged material disposal options through the LIS DMMP process, including beneficial use options.

Additional public scoping meetings were held on the following dates:

- ***June 25 (Riverhead, NY) and June 26 (Groton, CT), 2013:*** The focus of this set of meetings was to describe the process and results of the preliminary screening within the ZSF.
- ***December 8 (Riverhead, NY) and December 9 (New London, CT), 2014:*** The focus of this set of meetings was to present an update on the screening process, and in particular the findings of the physical oceanography study.

USEPA considered all comments it received and has used these comments in preparing the analysis presented in this DSEIS. The comments and issues raised during the scoping period are described in the reports for each public meeting (Appendix A, Public Involvement).

1.5.2 Public Webinar

In addition to the formal scoping process, USEPA held one public webinar on April 3, 2014, in response to a request at the June 2013 public meeting in Riverhead, NY. The purpose of the webinar was to provide information about dredged material management in general and the permitting process specific to the Long Island Sound region. The webinar was attended by 49 individuals.

1.5.3 Cooperating Agency Group

The USEPA also formed a Cooperating Agency Group for the development of this DSEIS. This group includes representatives from USEPA Regions 1 and 2, USACE New England and New York Districts, NMFS, CTDEEP, CTDOT, NYSDEC, NYSDOS, and the RICRMC. The purpose of the Cooperating Agency Group has been to review and provide feedback during the preparation of the SEIS. Meetings and webinars were held to further refine the scope and steps of the SEIS, provide project status, and discuss the screening of potential disposal sites.

1.5.4 Future Opportunities for Public Involvement

This DSEIS and SMMP are being released on USEPA's website (see web link in Table 1-4) for a 60-day public comment period. Comments on the DSEIS may be provided in writing (by mail, email, or on USEPA's website). In addition, during the public comment period, the USEPA will hold public hearings at which interested parties may make oral comments or submit written comments. Information regarding the locations, dates, and times of the public hearings will be provided in the *Federal Register*, included in public notices and press releases, and distributed using the existing mailing list. This information will also be posted on the USEPA website.

Table 1-4. Contact Information for Comments on the DSEIS and Draft SMMP

Mode	Contact
Mail	U.S. EPA - New England Region 1 5 Post Office Square, Suite 100 (Mail code OEP06-1)Boston, MA 02109-3912
Website	*www.epa.gov/region1/eco/lisdreg*
Email	elis@epa.gov

1.5.5 EPA Rulemaking Process

Concurrent with the release of the DSEIS, a proposed rulemaking will be published in the *Federal Register* for public comment. Following issuance of the Final SEIS (FSEIS), the USEPA will publish a final rulemaking in the *Federal Register* pertaining to the potential designation of a dredged material disposal site(s) in eastern Long Island Sound.

1.6 Structure of the DSEIS

This DSEIS is structured to lead the reader through the investigation and decision-making process for site designation. It consists of an Executive Summary, nine chapters of information and analysis, a public involvement appendix containing correspondence and documents from the public involvement program, seven technical appendices, and a draft SMMP for the site(s) recommended for possible designation.

- ***Chapter 1 – Introduction:*** This chapter provides an introduction to the issues involved in the DSEIS; the history of dredging and disposal in the ZSF; the statutory, regulatory, and legal framework in which the study was conducted; an overview of the scoping process and public involvement program; and a description of the remaining steps in the process. This introduction provides the necessary background information for an understanding of the purpose and need for the proposed action set forth in Chapter 2.

- ***Chapter 2 – Purpose and Need for Agency Action:*** This chapter describes the need for alternative means of disposing of or otherwise managing dredged material from the many federal and non-federal dredging projects that occur in the rivers and harbors within the ZSF. This chapter also discusses the purpose of investigating open-water disposal options, and alternatives to open-water disposal, so that long-term practical means of meeting the dredging needs of the eastern Long Island Sound region can be identified.

- ***Chapter 3 – Alternatives:*** This chapter describes the process for identifying long-term open-water disposal options for the eastern Long Island Sound region. It provides a general overview of the potential sites evaluated throughout the SEIS process, non-open-water disposal options, and the "No Action" alternative (*i.e.*, the option of not designating any disposal sites in eastern Long Island Sound). The currently preferred alternative(s) are described at the end of Chapter 3 to provide the reader with a focus for understanding the technical evaluations presented in Chapters 4 and 5, and to facilitate public comment on the particular alternative(s), along with other alternatives.

- ***Chapter 4 – Affected Environment:*** This chapter describes the environmental conditions in which the anticipated impacts of any designation action will be addressed and evaluated. This information and evaluation draws from numerous preexisting sources (federal, state, academic and private) as well as the investigations undertaken specifically in support of the SEIS, to describe the environment and uses of the ZSF, and the baseline setting in which the remaining analysis took place.

- ***Chapter 5 – Environmental Consequences:*** This chapter presents the identification and evaluation of the environmental consequences, or the anticipated impacts, of site designation in the ZSF and surrounding areas. It evaluates the impacts to water quality, the benthic community, fish and shellfish, endangered species, and other ecological impacts. This chapter also evaluates the socioeconomic impacts to fisheries, navigation, recreation, cultural resources, and other human uses of the ZSF. These evaluations provide the technical rationale for the alternative sites analysis and recommendation for the preferred alternative presented in Chapter 3.

- ***Chapter 6 – Compliance/Consistency with Environmental Laws, Regulations and Programs:*** This chapter contains a list of statutes, regulations, executive orders, and other policies that potentially apply to the actions evaluated in this DSEIS. NEPA requires that supporting documents describe the proposed action's compliance with applicable laws, regulations and other federal authorities. The list shows which authorities apply to a dredged material disposal site designation in the ZSF.

- ***Chapter 7 – Public Involvement:*** This chapter describes the public involvement program undertaken by the USEPA for this DSEIS. This program is presented in greater detail in Appendix A (Public Involvement). This effort consisted of a formal scoping process, public meetings and webinars, cooperating agency meetings, and a general solicitation of public comments on individual studies and the overall effort throughout the SEIS process. Chapters 3 to 5 incorporate the concerns and issues raised by the public, cooperating agencies and other agencies, and interested groups during this process assisted in framing the scope of investigations conducted for the DSEIS.

- ***Chapters 8 and 9:*** Chapter 8 lists references consulted in preparation of the DSEIS. Chapter 9 contains a list of preparers of the DSEIS.
- ***Appendices.*** The technical appendixes consist of detailed documents supporting the discussions, evaluations, and recommendations in the DSEIS:
  - Appendix A – Public Involvement
  - Appendix B – Analysis of Alternative Open-Water Dredged Material Disposal Sites
  - Appendix C – Physical Oceanography of Eastern Long Island Sound Region
  - Appendix D – Side-Scan Sonar Data Processing and Mosaicking; Eastern Long Island Sound
  - Appendix E – Biological Characterization of the Eastern Long Island Sound Dredged Material Disposal Sites
  - Appendix F – Data Summary Report of the New London Disposal Site and Vicinity Sediment Profile and Plan-View Imaging Survey
  - Appendix G – Physical and Chemical Properties of Sediments in Eastern Long Island Sound
  - Appendix H – Essential Fish Habitat Assessment
  - Appendix I – Site Management and Monitoring Plan

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CHAPTER 2 – PURPOSE AND NEED FOR AGENCY ACTION

Dredging is periodically needed in the river, tributaries, and harbors of Long Island Sound and Block Island Sound. Dredged material must be managed in an environmentally sound manner, which could include disposal at open-water sites. This DSEIS evaluates alternative means for such disposal, focusing on the potential designation of dredged material disposal sites in eastern Long Island Sound and Block Island Sound for long-term use. Consistent with USEPA's voluntary NEPA review policy, as discussed in Chapter 1, USEPA has developed this DSEIS to aid in this consideration (see also 40 C.F.R. § 228.6(b)).

The purpose of USEPA's action is to determine whether one or more open-water dredged material disposal sites can and should be authorized for future long-term use in eastern Long Island Sound and/or in Block Island Sound and, if so, to designate the site or sites in a manner consistent with applicable law.

The need of USEPA's action derives from the following facts: (1) there are currently no disposal sites designated for long-term use within eastern Long island Sound or Block Island Sound; (2) the currently used sites (NLDS and CSDS) are authorized under short-term authority and are scheduled to close on December 23, 2016 (as extended by Congress on December 23, 2011); (3) periodic dredging and dredged material disposal is necessary to maintain safe navigation and marine commerce; and (4) the MPRSA's requirements authorize USEPA to designate appropriate long-term dredged material disposal sites. At the same time, designating a site does not serve to authorize any particular dredged material for disposal. Any proposal to dispose of material at a designated site in Long Island Sound still must undergo careful review and obtain authorization from the USACE and USEPA under the standards and requirements of the CWA and MPRSA.

The legal, environmental and navigation/commerce aspects of the purpose and need for USEPA's action are discussed below.

2.1 Legal

The legal framework applicable to dredged material disposal in Long Island Sound and Block Island Sound is described in detail in Chapter 1 and is discussed here only as it relates to the purpose and need for USEPA's present effort. MPRSA § 106(f) states that the disposal of dredged material in Long Island Sound from either federal projects or non-federal projects involving more than 25,000 cy (19,114 m^3) of material must comply with the requirements of the MPRSA. The MPRSA also applies to any dredged material disposal in Block Island Sound because those waters are "ocean waters" under the MPRSA. While the USACE can "select" disposal sites for short-term use under MPRSA § 103 (*i.e.,* for a term of up to five years with the potential for an extension of up to five years), only USEPA can "designate" a disposal site for long-term use.

Unless USEPA designates sites for dredged material disposal in the ZSF, dredged material from projects covered by MPRSA would require alternative disposal options after the expiration date of December 23, 2016, for the existing USACE-selected sites. The closest designated open-water disposal sites outside the ZSF are the CLDS and RISDS. Due to their distance from the eastern

Long Island Sound area, the use the CLDS or RISDS would be expensive, pose substantial logistical difficulties, and have a greater risk of spills due to the greater distances that would have to be travelled.

2.2 Environmental

USEPA designation of a long-term dredged material disposal site(s) would offer several possible environmental advantages. First, as mentioned above, when use of a site under the USACE site selection authority is due to expire, designation by USEPA is the only way to authorize continued use of that site, even if the site is environmentally suitable or even environmentally preferable to all other sites. Given that the USACE selection of the NLDS and CSDS expires in December 2016, USEPA's site designation studies were designed to determine whether or not these or any other sites should be designated for continued long-term use.

When considering designation of a disposal site, USEPA must consider previously used disposal sites or areas. Active or historically used sites are given preference in the evaluation (40 C.F.R. § 228.5(e)). On January 8, 2013, the Cooperating Agency Group agreed to apply this general preference in the screening of potential sites; it also follows the approach used for site screening during the 2004 CLIS/WLIS EIS (USACE, 2002a).

Congress has directed that the disposal of dredged material should take place at USEPA-designated sites, rather than USACE-selected sites, when USEPA-designated sites are available (see MPRSA § 103(b)). Thus, Congress has identified a preference for use of USEPA-designated sites. The DSEIS is conducted to determine whether one or more such sites should be made available in the eastern Long Island Sound region.

Another possible benefit that could result from this effort is that if a disposal site were designated, a SMMP would be developed for that site consistent with MPRSA § 102(c)(3). Future environmental benefits could result from such enhanced site management.

As mentioned above, in addition to evaluating existing open-water disposal sites, USEPA reviewed alternatives to open-water disposal based on findings in the LIS DMMP; these alternatives are described in Chapter 3.

2.3 Navigation and Marine Commerce

Periodic dredging of harbors and channels and, therefore, dredged material management, are essential for ensuring safe navigation and facilitating marine commerce. This is because the natural processes of erosion and siltation result in sediment accumulation in federal navigation channels, harbors, port facilities, marinas, and other important areas of our water bodies. Unsafe navigational conditions not only threaten public health and safety, but also pose an environmental threat from an increased risk of spills from vessels involved in accidents. Navigation safety is a regulatory requirement for such agencies as the USCG and the USACE.

Economic considerations also contribute to the need for dredging (and the environmentally sound management of dredged material). There are a large number of important navigation-dependent businesses and industries in eastern Long Island Sound and Block Island Sound, ranging from shipping (especially the movement of petroleum fuels and the shipping of bulk materials), businesses related to recreational boating, marine transportation, commercial and recreational fishing, interstate ferries operations, and military navigation, such as that associated with the U.S. Naval Submarine Base in New London. These businesses and industries contribute substantially to the region's economic output, the gross state product (GSP) of the bordering states and tax revenue (Table 2-1). These businesses also employ thousands of people. Continued access to harbors, berths, and mooring areas is vital to ensuring the continued economic health of these industries, and to preserving the ability of the region to import fuels, bulk supplies, and other commodities at competitive prices. More detailed information regarding the economic importance of these industries is contained in Section 4.14. In addition, preserving navigation channels, marinas, harbors, berthing areas, and other marine resources, improves the quality of life for residents and visitors to the eastern Long Island Sound region by facilitating recreational boating and associated activities such fishing and sightseeing.

Maintaining these marine areas (*i.e.*, navigation channels, harbors, berthing areas) are also important for homeland security and public safety and they support the operation of the U.S. Naval Submarine Base and USCG facilities in the region as well other governmental entities that operate on the waters of Long Island Sound.

Table 2-1. Regional Economic Significance of Navigation-Dependent Activities (2009 dollars)

Region[1]	**Annual Output** (millions)	**Gross State Product** (millions)	**Employment**	**Annual Tax Revenues** (millions)
Rhode Island	$13	$4.7	88	$1.4
Eastern Connecticut	$4,364	$2,705	30,325	$702
Eastern Long Island	$391	$199	2,385	$63
Total ZSF (sum)	**$4,768**	**$2,909**	**32,798**	**$766**

[1] The analysis is based on data in WHG (2010c) (see Section 4.14 in Chapter 4 for details).

As part of the LIS DMMP, the dredging needs for the Long Island Sound region were investigated in 2009 (Battelle, 2009a), and updated in 2015 (Table 2-2). The study area for the needs assessment included all of Long Island Sound, the New York State portion of Block Island Sound (including Peconic Bay and Gardiners Bay), and Block Island. Aside from Block Island, communities in Rhode Island within the study area consisted only of the Town of Westerly in Washington County; other Washington County towns also bordering the SEIS ZSF (Charlestown, South Kingstown, and Narragansett) were not included in the USACE assessment.

The USACE used a planning horizon of 30 years (2015-2045) to estimate the quantities of dredged material expected from all harbors, ports, and other navigation-dependent facilities. The study consolidated the geographical areas of dredging needs into logical groupings referred to as "dredging centers." Dredging needs data were separated into three categories:

- *USACE Federal Navigation Projects:* Estimates from the USACE (New England and New York Districts) for federal dredging projects.
- *Other (non-USACE) Federal Facilities:* Survey responses for facilities such as the U.S. Coast Guard (including the Maritime Academy) and the U.S. Navy.
- *Non-Federal Facilities:* Survey responses for facilities from state, municipal or other public, or private facilities.

Table 2-2 presents the total estimated dredging needs for the 2015-2045 planning horizon. These estimates include maintenance dredging as well as improvement dredging (to the extent that information was available). The total estimated dredging needs for the eastern Long Island Sound region consist of 22.6 million cy (17.2 m^3):

- *Maintenance vs. improvement dredging needs:* Approximately 90% (20.2 million cy [15.5 million m^3]) of the total estimated dredging needs consists of maintenance dredging with the remaining 10% (2.3 million cy [1.8 million m^3]) consisting of improvement dredging.
- *Types of dredged material:* Approximately 60% (13.5 million cy [10.3 million m^3]) consists of fine-grained dredged material, and 40% (9.1 million cy [6.9 million m3]) of the total estimated dredging needs consist of sand (Table 2-3).

The dredging needs for the dredging centers are presented spatially in Figure 2-1. The size of each circle in the figure is proportional to the total volume of dredged material (*i.e.,* maintenance and improvement) projected through 2045 for USACE navigation projects, other federal facilities, and non-federal facilities. Most important are maintenance dredging of larger federal navigation projects, chiefly in the areas of Clinton/Westbrook, Connecticut River, and New London/Thames River. Maintenance dredging is necessary to maintain channel depths authorized by Congress to permit continued navigation. Many of the private facilities also are dependent on predictable access to their facilities via federal channels maintained to their authorized depths. Thus, the projected dredging volumes for the ZSF include a mix of large and small federal navigation projects, many small private dredging projects (marinas, boatyards, and harbors), and a few large private projects.

Dredged material included in the dredging needs estimate (Table 2-2) are anticipated to be suitable for unconfined open-water disposal, although some of this material could prove to be unacceptable for unconfined open-water disposal after project-specific testing and evaluation. The coarser-grained dredged materials (*i.e.,* the 40% sand portion of total dredging needs volume) may prove to be better suited for beneficial use alternatives (such as for beach nourishment or nearshore berm construction). Other types of material, in accordance with state and local policy, could be directed to upland alternatives (such as to brownfield sites or as fill for construction sites), if such options are available. The practicability of these beneficial use and upland disposal options, including environmental impact and risk, engineering feasibility and disposal cost, is part of the alternatives analysis for any dredging project. Additional options are discussed in Chapter 3.

Table 2-2. Maintenance and Improvement Dredging Needs of Dredging Centers, 2015-2045: All Dredged Materials *(Estimate)*

30-year Dredging Needs (cubic yards) [1]		**Maintenance**				**Improvement**				
Dredging Center [2]	**State**	**USACE Federal Navigation Projects**	**Other Federal Facilities**	**Non-Federal Facilities**	**Subtotal**	**USACE Federal Navigation Projects**	**Other Federal Facilities**	**Non-Federal Facilities**	**Subtotal**	**TOTAL**
All Dredged Material (Sand and Suitable Fine-grained Material combined)										
Guilford/Branford	CT	557,700		331,000	**888,700**			150,800	**150,800**	**1,039,500**
Clinton/Westbrook	CT	2,232,900		607,300	**2,840,200**			202,000	**202,000**	**3,042,200**
Connecticut River	CT	4,391,300		1,203,000	**5,594,300**			225,400	**225,400**	**5,819,700**
Niantic Area	CT	18,000		226,500	**244,500**			255,900	**255,900**	**500,400**
New London	CT	4,519,800	189,000	622,700	**5,331,500**		350,000	172,000	**522,000**	**5,853,500**
Fishers Island Sound/ Little Narragansett Bay	CT/ RI	450,000		583,700	**1,033,700**	450,000		147,100	**597,100**	**1,630,800**
Fishers Island	NY	12,000		47,200	**59,200**			6,000	**6,000**	**65,200**
Montauk	NY	193,200		341,600	**534,800**			75,000	**75,000**	**609,800**
Shelter Island/Gardiners Bay	NY	3,200	20,000	1,385,900	**1,409,100**			303,700	**303,700**	**1,712,800**
Great & Little Peconic Bays	NY	13,300		2,121,500	**2,134,800**			500	**500**	**2,135,300**
Suffolk County North Shore	NY	113,200		61,400	**174,600**					**174,600**
Totals		**12,504,600**	**209,000**	**7,531,800**	**20,245,400**	**450,000**	**350,000**	**1,538,400**	**2,338,400**	**22,583,800**

[1] For cubic meters, multiply by 0.765.

[2] The two dredging centers (1) Block Island and (2) South-Central and Southeast Washington County, located in the ZSF in Rhode Island are not included as these dredging centers are within reach of the Rhode Island Sound Disposal Site.

Source: USACE (2015)

Table 2-3. Maintenance and Improvement Dredging Needs of Dredging Centers, 2015-2045: Sand and Fine-grained Material *(Estimate)*

30-year Dredging Needs (cubic yards)		**Maintenance**				**Improvement**				**TOTAL**
Dredging Center [2]	**State**	**USACE Federal Nav. Projects**	**Other Federal Facilities**	**Non-Federal Facilities**	**Subtotal**	**USACE Federal Nav. Projects**	**Other Federal Facilities**	**Non-Federal Facilities**	**Subtotal**	
Sand										
Guilford/Branford	CT	13,600			**13,600**					**13,600**
Clinton/Westbrook	CT	2,144,400			**2,144,400**					**2,144,400**
Connecticut River	CT	2,570,400		601,500	**3,171,900**			112,700	**112,700**	**3,284,600**
Niantic Area	CT	9,500		113,200	**122,700**					**122,700**
New London	CT									
Fishers Island Sound/Little Narrag. Bay	CT/RI	77,300			**77,300**					**77,300**
Fishers Island	NY									
Montauk	NY	193,200		341,600	**534,800**			75,000	**75,000**	**609,800**
Shelter Island/Gardiners Bay	NY	3,200	20,000	1,108,700	**1,131,900**			243,000	**243,000**	**1,374,000**
Great & Little Peconic Bays	NY			1,272,900	**1,272,900**			300	**300**	**1,273,200**
Suffolk County North Shore	NY	113,200		61,400	**174,600**					**174,600**
Totals		**5,124,800**	**20,000**	**3,499,300**	**8,644,100**			**431,000**	**431,000**	**9,075,100**
Fine-grained Material										
Guilford/Branford	CT	544,100		331,000	**875,100**			150,800	**150,800**	**1,025,900**
Clinton/Westbrook	CT	88,500		607,300	**695,800**			202,000	**202,000**	**897,800**
Connecticut River	CT	1,820,900		601,500	**2,422,400**			112,700	**112,700**	**2,535,100**
Niantic Area	CT	8,500		113,300	**121,800**			255,900	**255,900**	**377,700**
New London	CT	4,519,800	189,000	622,700	**5,331,500**		350,000	172,000	**522,000**	**5,853,500**
Fishers Island Sound/Little Narrag. Bay	CT/RI	372,700		583,700	**956,400**	450,000		147,100	**597,100**	**1,553,500**
Fishers Island	NY	12,000		47,200	**59,200**			6,000	**6,000**	**65,200**
Montauk	NY									
Shelter Island/Gardiners Bay	NY			277,200	**277,200**			60,700	**60,700**	**337,900**
Great & Little Peconic Bays	NY	13,300		848,600	**861,900**			200	**200**	**862,100**
Suffolk County North Shore	NY									
Totals		**7,379,800**	**189,000**	**4,032,500**	**11,601,300**	**450,000**	**350,000**	**1,107,400**	**1,907,400**	**13,508,700**
All Dredged Material		**12,504,600**	**209,000**	**7,531,800**	**20,245,400**	**450,000**	**350,000**	**1,538,400**	**2,338,400**	**22,583,800**

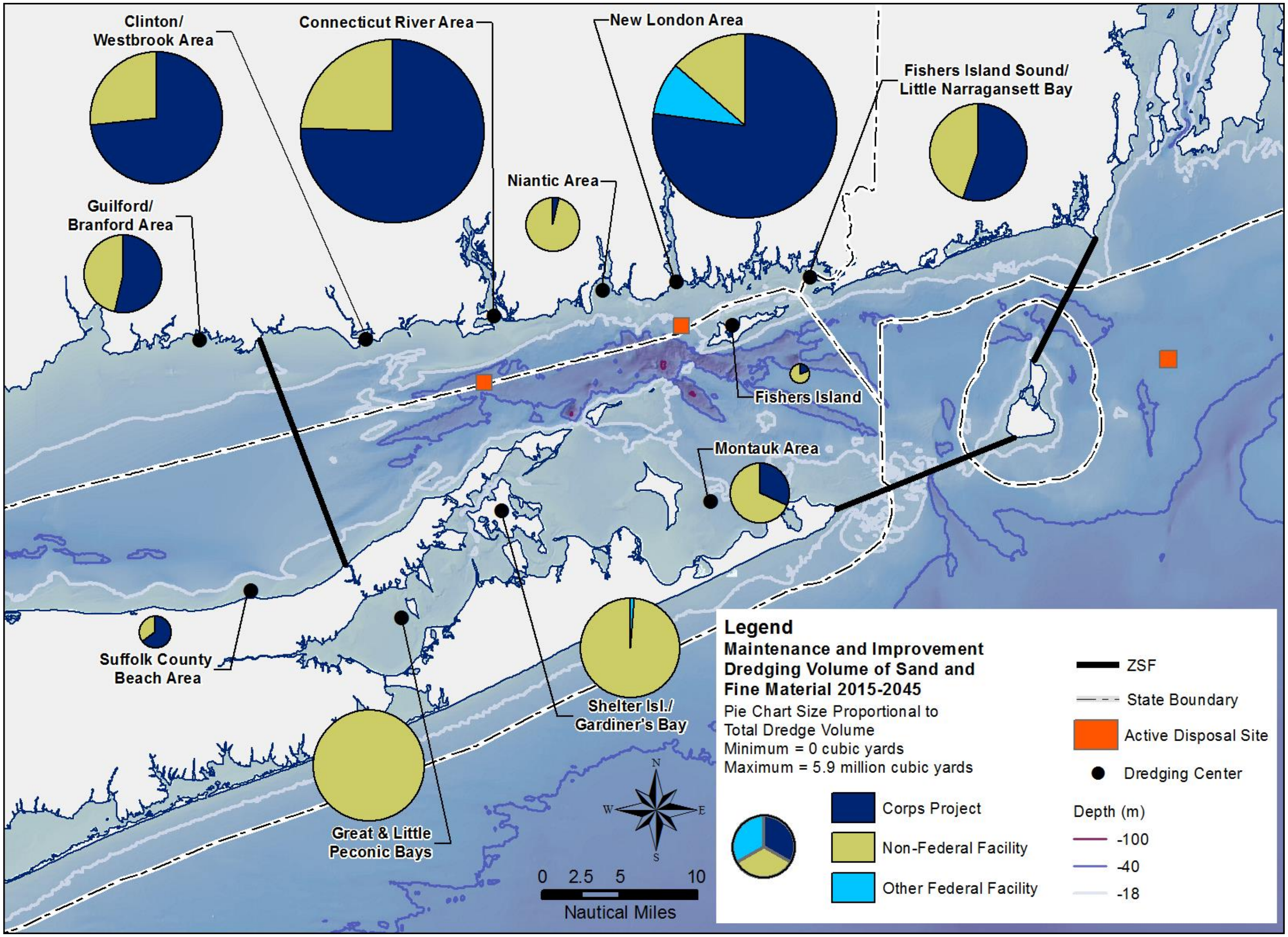

Figure 2-1. Maintenance and improvement dredging needs of dredging centers, 2015-2045 (Data source: USACE, 2015).

As stated above, USEPA's designation of an ODMDS does not authorize the disposal of material from any particular project or harbor. Designation only makes a site available for consideration as an open-water disposal option for each proposed dredging project in the area.

This information in total indicates a substantial need for dredged material disposal capacity in the ZSF over the next 30 years (*i.e.*, up to year 2045). Considering the expiration of the current USACE-selected sites, USEPA's site designation studies were designed to investigate whether one or more disposal sites should be designated for long-term use to address this disposal need.

CHAPTER 3 – ALTERNATIVES

The purpose of this SEIS is to determine whether one or more environmentally sound open-water dredged material disposal sites can be designated for future long-term use in eastern Long Island Sound. The USEPA is responsible for designating ocean disposal sites for various types of material, including sites for dredged material disposal, under Section 102(c) of the MPRSA and USEPA's Ocean Dumping Regulations (see 40 C.F.R. § 228.4). The need for dredging, and for dredged material disposal sites, for Connecticut, New York (Long Island), and western Rhode Island was determined by the USACE in 2012 and revised in 2015 (Figure 2-1 and Table 2-2).

This chapter provides an overview of the alternatives evaluated throughout the SEIS process in accordance with NEPA. The evaluation incorporates information and study reports prepared by the USACE during the drafting of the LIS DMMP. In addition to open-water disposal at sites within the eastern Long Island Sound region, alternatives evaluated for this DSEIS included other open-water alternatives, alternatives to open-water disposal, and the "No Action Alternative". Alternatives to open-water disposal include upland alternatives; beneficial uses such as beach nourishment, nearshore berms, and redevelopment; containment facilities; and treatment technologies. As described in detail below, this evaluation determined that none of these alternatives to open-water disposal, individually or collectively, would meet the long-term regional dredged material disposal needs of the eastern Long Island Sound region. Therefore, while alternatives to open-water disposal will continue to be evaluated and utilized when feasible on a project-specific basis, they were not evaluated further in subsequent chapters of the DSEIS.

Chapter 3 also describes the screening process used to evaluate alternative open-water dredged material disposal sites within the eastern Long Island Sound region. The screening process applied evaluation criteria of the MPRSA and a tiered approach for the selection of alternative sites. This evaluation initially identified 11 sites that were subsequently narrowed down to three sites (in agreement with cooperating agencies). These three sites (from east to west) are as follows (Figure 3-1); they are described in more detail in Section 3.4.3:

- New London Alternative
- Niantic Bay Alternative
- Cornfield Shoals Alternative.

In summary, Chapter 3 reviews dredged material disposal permitting (Section 3.1), discusses the initial screening for alternatives to open-water disposal in the ZSF (Section 3.2), summarizes different scenarios under the No Action Alternative (Section 3.3), and discusses the initial screening for open-water alternatives sites within the ZSF (Section 3.4). Section 3.5 summarizes this chapter.

The subsequent two chapters of the DSEIS evaluate the three alternative sites (in addition to the No Action Alternative) in further detail. Specifically, Chapter 4 (Affected Environment) describes the natural and socioeconomic environment of these sites. Chapter 5 (Environmental Consequences) describes environmental consequences if one or more of these alternatives are selected.

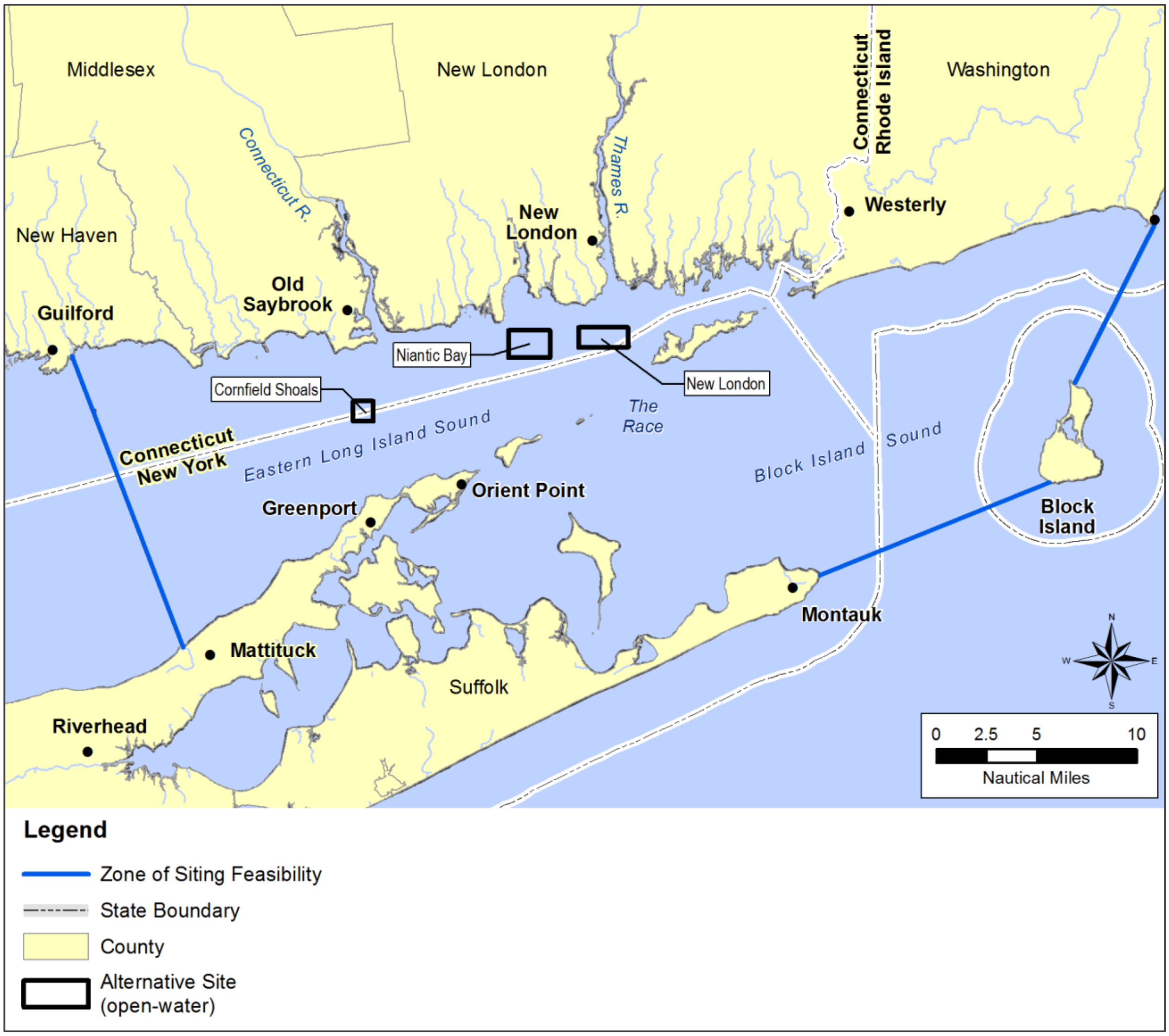

Figure 3-1. Zone of Siting Feasibility (Eastern Long Island Sound and Block Island Sound) and the three alternative open-water dredged material disposal sites evaluated in this DSEIS.

3.1 Dredged Material Disposal Permitting

The dredging needs volumes for the eastern Long Island Sound region, described in Chapter 2, are an estimate of the future needs for disposal of dredged material. The designation of a disposal site(s) does not imply that all of the dredged material generated over the 30-year planning period would be disposed at the site(s). All individual dredging projects are evaluated through the USACE permitting process. The requirements of MPRSA, the Ocean Dumping Regulations and the Regional Implementation Manual (RIM) (USEPA and USACE, 2004c) are followed for dredged material testing and evaluation. These procedures are described in detail in the Site Management and Monitoring Plan (Appendix I).

Dredged material found through physical testing to consist of clean sand, gravel, rock or geological parent material, such as glacial tills and marine clays, is often considered for beneficial use (see Section 3.2). For materials with low concentrations of contaminants, or where the project proponents wish to maintain the option of open-water disposal and other uses, the sediment is subjected to further tests aimed at predicting the biological response to exposure to contaminated sediment during different phases of the disposal process. These tests are generally described as bioassay (toxicity) tests, and bioaccumulation (tissue uptake of contaminants) tests.

Toxicity tests consist of exposing test organisms to the dredged material and comparing survivability rates to those of organisms exposed to reference and control materials. Where the dredged material exhibits greater toxicity to benthic test species than the reference sediments (using statistical tests and nationally developed interpretation guidance), project proponents may elect to forgo any further cost of testing for suitability for open-water disposal and seek alternative disposal methods. Otherwise, material that exhibits toxicity comparable to the reference sediments shall undergo bioaccumulation testing before any determination on suitability for open-water disposal can be made. In general terms, bioaccumulation involves a long exposure of test organisms to the sediment followed by analysis of their tissues to determine the potential for uptake of contaminants from the dredged material. The test results are evaluated to determine the risk of exposure to ecological and human health. Dredged material that is determined through these testing protocols to not pose an unacceptable risk to human or ecological health is deemed suitable for ocean disposal; these findings may be accompanied by disposal management requirements, such as limitations on disposal rates to maximize dilution. Dredged materials that are tested and do not meet the ocean disposal criteria are not permitted to be disposed of at MPRSA designated sites.

In addition, the specific regulatory requirements in Long Island Sound (*i.e.,* the dual application of MPRSA and the CWA) result in different regulation of dredged materials depending on the proponent and size of the proposed dredging project (see discussion in Section 1.2.2 on the Ambro Amendment). Non-Federal projects seeking to dispose of 25,000 cy (19,114 m^3) of dredged material or less are not subject to the requirements of MPRSA. Materials from these smaller dredging projects that exhibit potential for adverse impacts may sometimes still be disposed in open-water under the CWA with proper disposal management.

3.2 Initial Screening Process — Alternatives to Open-Water Disposal in Eastern Long Island Sound and Block Island Sound

Early in the process of identifying potential ODMDSs, the USEPA reviewed a wide range of dredged material disposal alternatives to disposal in waters of eastern Long Island Sound and Block Island Sound (*i.e.,* within the ZSF). Dredging centers are centralized areas established for the purpose of quantifying dredging and disposal needs. There are 27 dredging centers in Connecticut and New York along Long Island Sound. For example, the New London dredging center consists of the Connecticut shoreline from Mumford Point through New London Harbor to Goshen Point and the Thames River up to Norwich, Connecticut. This area includes the New London Harbor and Thames River (Groton to Norwich) federal navigation projects and the communities of Ledyard, Preston, New London, Groton, Montville, and Norwich, Connecticut.

Other Federal facilities in this dredging center are the New London Naval Submarine Base, U.S. Coast Guard Academy, and U.S. Coast Guard Station in New London.

The review was based in part on the findings set forth in the USACE LIS DMMP. Specifically, the LIS DMMP evaluated various non-open-water dredged material placement options, including upland and beneficial use sites (Battelle, 2009b, 2011; WHG, 2010b), nearshore berm sites (WHG 2012a), and dredged material containment facilities (WHG, 2012b). The study area for the LIS DMMP encompasses all of Connecticut, southeastern New York State, and southwestern Rhode Island (Figure 3-2). The eastern portion of the LIS DMMP overlaps with the ZSF for this SEIS. Also included in this level of screening was open-water disposal in other parts of Long Island Sound and locations outside of the ZSF.

The absence of a designated site would necessitate using these other alternatives, or a curtailment in dredging activity for projects in the eastern Long Island Sound region subject to MPRSA (non-Federal projects over 25,000 cy [19,114 m^3] and all Federal projects.

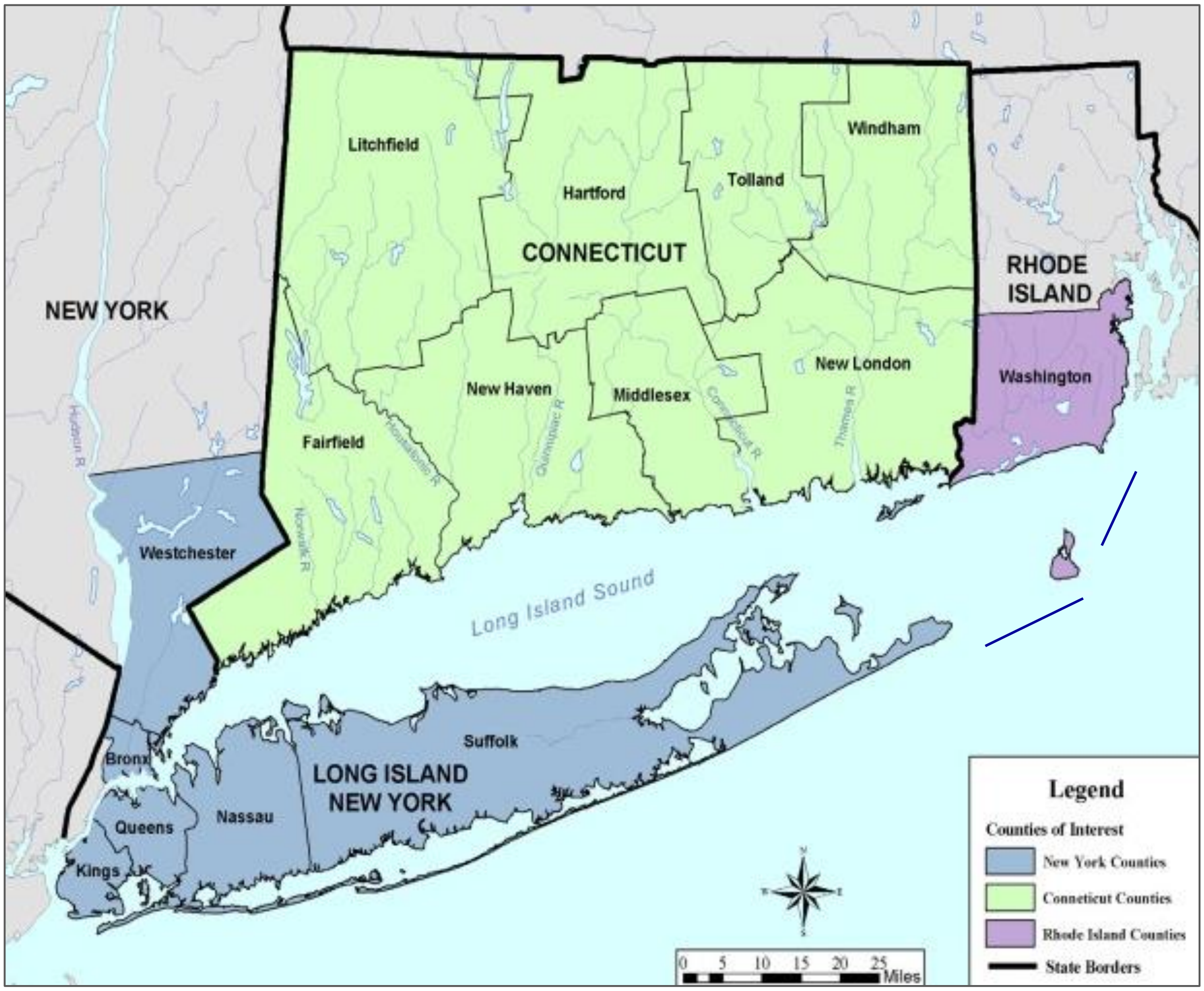

Figure 3-2. Study area for the Long Island Sound DMMP (Source: Battelle, 2009b).

3.2.1 Open-Water Disposal Alternatives in Long Island Sound and Block Island Sound

Outside of the ZSF, there are two designated disposal sites in central and western Long Island Sound:

- *Central Long Island Sound Disposal Site (CLDS):* This site is located approximately 5.6 nmi (10.4 km) south of South End Point, East Haven, Connecticut and over 10 nmi (18.5 km) north of Shoreham Beach, New York. The site covers a rectangular area of 3.2 nmi^2 (11 km^2), centered at 41˚08.950'N and 72˚52.950'W (NAD83), and has a water depth of 56 to 77 feet (17 to 24 m). Sediments at the CLDS consist predominantly of fine silt and clay. The site is located in an area of sediment accumulation due to generally low current velocities (USEPA and USACE, 2004a). This site receives most of the dredged material in the Long Island Sound region. The distance to the New London dredging center is approximately 35 nmi (65 km).

- *Western Long Island Sound Disposal Site (WLDS):* This site is located approximately 2 nmi (4 km) north of Lloyd Point, New York and 2.8 nmi (5.1 km) south of Long Neck Point, Noroton, Connecticut. The site has an area of 1.6 nmi^2 (5.4 km^2) centered at 40°59.500'N, 73°28.950'W (NAD 83), and a water depth of 79 to 118 feet (24 to 36 m). Sediments at the site also consist predominantly of fine silt and clay, and the site is also located in an area of sediment accumulation due to generally low current velocities (USEPA and USACE, 2004a). The distance to the New London dredging center is approximately 70 nmi (130 km).

Other sites in Long Island Sound could be selected for use by the USACE pursuant to MPRSA § 103(b) after sufficient analysis, if use of an EPA-designated site is infeasible. Site selection requires evaluation of the proposed site relative to the MPRSA criteria in a manner similar to site designation, as described in Section 1.2.2. USACE sites are available for five years, with the possibility under certain circumstances of extending use of the site by an additional five years (see Chapter 1). The two existing USACE-selected sites listed above are not eligible for re-selection after December 2016. Without designation of new disposal sites there will be no long-term regional solution within the eastern portion of Long Island Sound to meet the needs for dredged material disposal of this region. The use of the CLDS or the WLDS would add considerable cost to the disposal of dredged material, possibly rendering some projects infeasible.

3.2.2 Ocean Disposal Alternatives outside Long Island Sound and Block Island Sound

The nearest designated ocean disposal sites outside of Long Island Sound and Block Island Sound are the Rhode Island Sound Disposal Site (RISDS) to the east and the Historic Area Remediation Site (HARS) to the west:

- *Rhode Island Sound Disposal Site (RISDS):* This site was designated in December 2004, following the preparation of an EIS (USEPA and USACE, 2004b). The site is located approximately 11 nmi (21 km) south of the entrance to Narragansett Bay, and 7.5 nmi (14 km) east of the northern tip of Block Island. The site has an area of 1 nmi^2 (3.4 km^2) and is centered at 41°13.85'N, 71°22.82'W (NAD 83). It is situated within the Separation Zone for the Narragansett Bay inbound and outbound traffic lanes and lies within a depression on the seafloor. Water depths at the site range from 115 to 128 feet (35 to 39 m).

The distance to the New London dredging center is approximately 34 nmi (63 km), and tugs and scows would need to cross The Race, which has strong tidal currents. While the RISDS is a feasible alternative for Rhode Island dredging centers (such as for Point Judith and Block Island), it does not offer a long-term cost-effective solution for disposal of dredged material from the eastern Long Island Sound region (see discussion of disposal costs in Section 5.3).

- *Historic Area Remediation Site (HARS):* This site has an area of 16 nmi^2 (55 km^2) located approximately 3.5 nmi (6.5 km) east of Highlands, New Jersey, and 7.7 nmi (14 km) south of Rockaway, Long Island. The site has a water depth of 39 to 138 feet (12 to 42 m) and is available for disposal of material that meets the definition of remediation material for this ocean site. The HARS site is located at a significant distance from the harbors in the ELIS ZSF. For example, the distance to the New London dredging center is approximately 120 nmi (220 km), and is accessible either by navigating through Long Island Sound and along the East River in New York, or through Block Island Sound and then the Atlantic Ocean. The HARS does not provide a long-term solution for disposal.

The MPRSA also requires consideration of the outer continental shelf or continental slope for designation of ocean disposal sites. The continental shelf extends about 60 nmi (110 km) seaward from Montauk Point, New York, outside of Block Island Sound. A site located on the continental slope would result in a hauling distance of approximately 80 nmi (150 km) from New London. Even a site closer inshore on the continental shelf, perhaps as close as 10 nmi (18 km) to the southeast of Montauk, would result in a hauling distance of 30 nmi (55 km) from New London. Distances from other large dredging centers in the ZSF would be even greater. There is no designated site beyond the continental shelf; therefore, traveling beyond the continental shelf does not offer a long-term disposal option.

As described further in Section 5.3, the significant distances associated with hauling dredged material outside of the ZSF make those locations unacceptable as long-term solutions for dredged material disposal. Greater distance to the disposal site equates to more haul miles per dredging project. Increased miles per project increases the likelihood of interaction between disposal tows and other navigation (including shipping, fishing, and military uses), as well as between tows and marine life, including federally-listed species. Disposal tows are more likely to encounter endangered species such as sea turtles and whales outside of Long Island Sound than on tows to sites within the ZSF. Increased haul miles also equals more fuel burned per tow haul, increased air emissions, and increased potential for accidents and fuel spills, all more critical in the winter months when most dredging typically occurs.

3.2.3 Upland Disposal Alternatives

Upland disposal alternatives consist primarily of sanitary landfills, redevelopment sites, and concrete and asphalt plants; as well as project-specific options such as use as structural fill for development of commercial or public lands, remediation of brownfield sites, reclamation of sand

and gravel pits, or fill for large-scale landscaping applications. As part of the LIS DMMP, the USACE inventoried all available upland alternatives to open-water disposal of dredged material in the Long Island Sound region. The information for the report was collected by updating a database initially developed in 2004 (USEPA, 2004), through searches on the web, by contacting site owners, and by preparing a preliminary characterization of existing uses, size, potential to accept dredged material, special conditions, and costs for use. The effort resulted in a site inventory of 157 upland sites that could potentially accept dredged material within the entire LIS DMMP study area, and 22 dewatering sites (Battelle, 2009b). The inventory was analyzed further for use by Federal navigation projects (WHG, 2010b) and smaller non-Federal projects (Battelle, 2011). Upland alternatives identified in the eastern Long Island Sound region consist of the following:

- *Landfills:* The inventory identified three landfills that were located in Hartford, Manchester, and Windsor, Connecticut. However, the landfills in Hartford and Windsor have since been closed. The Manchester landfill is the only landfill with the potential to accept contaminated dredged sediment; this would require a special application for a Special Waste Disposal Authorization under CTDEEP regulations.

- *Redevelopment Site:* The single redevelopment site identified by WHG (2010b) is Plum Island, located to the east of Orient Point on Long Island, New York (Figure 3-3). The Plum Island Animal Disease Center, currently owned by the Department of Homeland Security (DHS) is expected to move from the island. Redevelopment of the land may allow for use of dredged material. A beach/berm area, located on the south side of the island, has been nourished in the past with material from maintenance dredging in the harbor. The potential capacity for beach nourishment at Plum Island was estimated at up to 56,100 cy (43,900 m^3) (Table 3-1). Plum Island may also be preserved in its natural state which could change redevelopment plans and use of dredged material for beach nourishment.

- *Concrete and Asphalt Plants:* Three plants expressed an interest in receiving dredged material, particularly clean sand or gravel:
    - Bistrian Materials, Inc. (three facilities located in East Hampton and Montauk, NY): Need for 5 to 10 million cy (3.8 to 7.6 m^3).
    - Corazzini Asphalt Inc. (located in Cutchogue, NY): Need for 10,000 cy/yr (7.6 m^3/yr).
    - Killingly Asphalt products, LLC (Hot-Mix Asphalt Plant, located in Dayville, CT): Needed volume unspecified.

Tipping and/or user fees may be charged to accept dredged material.

Transport to upland locations often requires prior dewatering of the dredged material. Dewatering sites should preferably be close to shore for logistical and cost reasons. WHG (2010b) identified two potentially feasible dewatering sites within the ZSF. These sites were the P&W Railroad Co. site in Norwich (CT) and the Mattituck Agricultural Fields in Mattituck (NY) (Figure 3-3). However, the site in Norwich has a limited fill volume of only 17,500 cy (13,400 m^3), which would prevent it from being used by larger dredging projects. Using the potential dewatering site in

Mattituck would likely be cost-prohibitive if the dewatered sediment would subsequently be transported to an upland site other than on Long Island for final disposal. Local interests including the Town of Southold have expressed objection to using any agricultural zoned lands in their community for dredged material dewatering and processing.

In summary, upland disposal options, individually or collectively, do not provide a long-term disposal alternative for all of the dredged material expected to be generated in the eastern Long Island Sound region. However, dredged material permit applicants are still required to investigate alternatives to open-water disposal on a project-specific basis, including upland disposal options. Such upland disposal options could be available and appropriate for material on a project-specific basis. Details of the various options are discussed in the LIS DMMP (USACE, 2015).

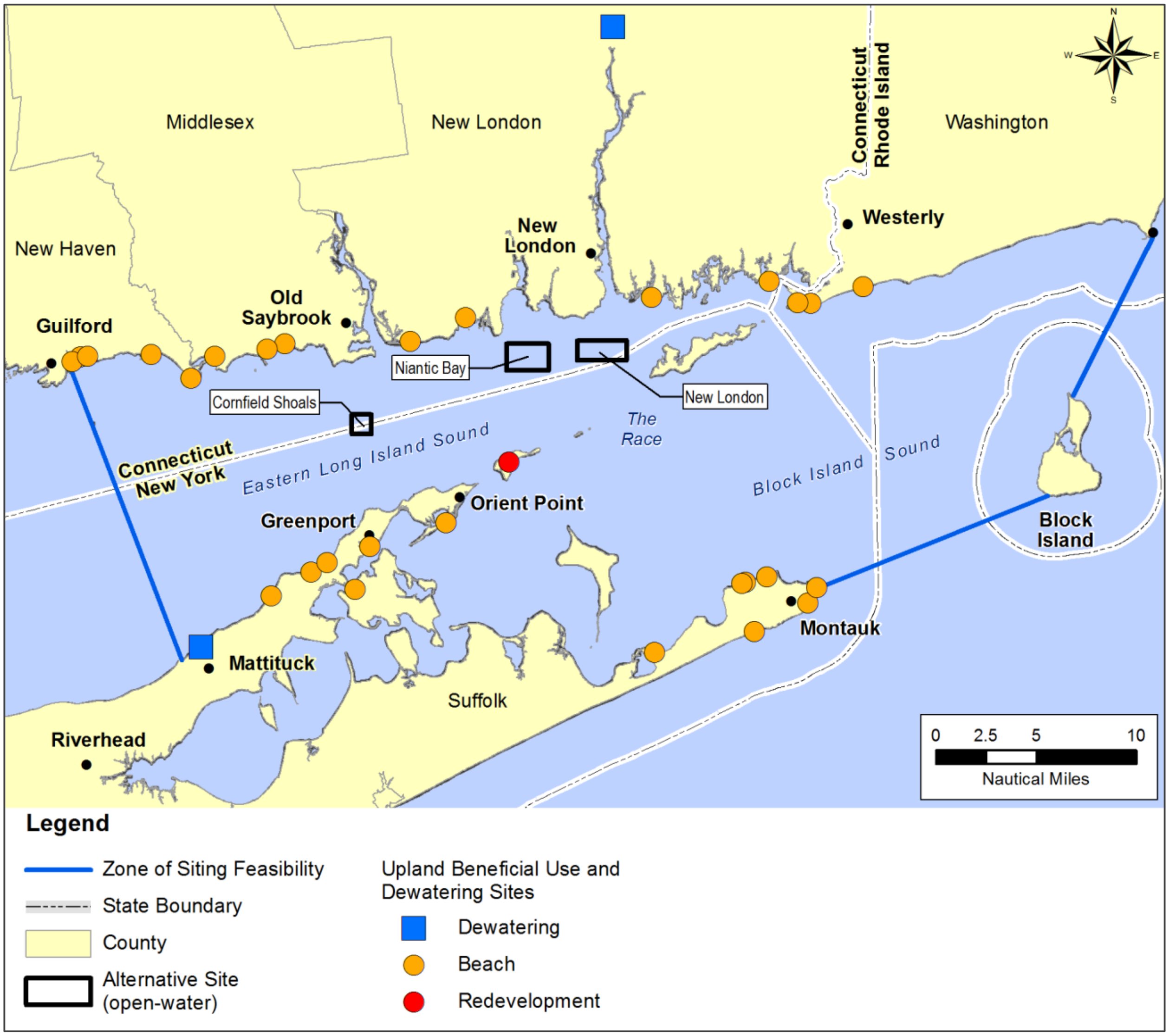

Figure 3-3. Potential upland, beneficial use, and dewatering sites, identified by the LIS DMMP (WHG, 2010b).

Table 3-1. Summary of 26 Potential Beach Nourishment Sites for Federal Navigation Projects (identified by the LIS DMMP)

Site ID[1]	**Town**	**Site Name**	**Type** [4]	**Nourishment Volume**[5] (cy)		**Average Grain Size**
					+35%	
New York						
177	E. Hampton	Shadmoor State Park	S	20,100	27,100	Medium sand
178	E. Hampton	Camp Hero State Park	S	76,900	103,800	Cobble to coarse sand
179	E. Hampton	Montauk Point State Park	S	147,300	198,900	Cobble to coarse sand
446	E. Hampton	Theodore Roosevelt County Park	C	427,400	577,000	Medium to fine sand
121[2]	E. Hampton	Gin Beach	T	9,000	12,200	Medium sand
453	E. Hampton	Lake Montauk Harbor	F	400,000[3]	400,000[3]	Medium to fine sand
173	E. Hampton	Hither Hills State Park	S	319,600	431,500	Coarse sand
111	Shelter Isl.	Crescent Beach	T	23,900	32,200	Coarse to medium sand
79[2]	Southold	Gull Pond Beach (N.E. Klipp Pk.)	T	14,400	19,500	Coarse sand
180	Orient	Orient Beach State Park	S	119,900	161,800	Medium sand
437	Southold	Plum Island	R	41,600	56,100	Sand
454East	Southold	Hashamomuck Cove - Rd 48	F	162,800	219,800	Coarse sand
76	Southold	Southold Town Beach	T	23,200	31,300	Coarse sand
454West	Southold	Hashamomuck Cove - Kenney's B.	F	50,700	68,500	Coarse sand
455/82[2]	Mattituck	Matt. Harbor 111 / Bailie's Beach	T	100,000[3]	100,000[3]	Medium sand
Subtotals / Range				*1,936,800*	*2,439,700*	*Cobble to fine sand*
Connecticut						
339[2]	Guilford	Jacobs Beach	T	6,400	8,600	Medium to fine sand
457	Madison	East Wharf Beach	F	4,300	5,700	Coarse to medium sand
365	Madison	Hammonasset State Park	F	562,700[3]	562,700[3]	Medium sand
343	Clinton	Clinton Town Beach	T	1,200	1,600	Coarse to medium sand
348	Old Lyme	White Sands Beach	T	1,700	2,300	Fine sand
367	East Lyme	Rocky Neck State Park	S	10,400	14,100	Fine sand
368	Groton	Bluff Point State Park	S	131,200	177,100	Coarse sand
480	Stonington	DuBois Beach	T	3,300	4,500	Medium to fine sand
Subtotals / Range				*721,200*	*776,600*	*Coarse to medium sand*
Rhode Island						
382[2]	Westerly	Napatree Point Beach	T	68,100	91,900	Medium to fine sand
381[2]	Westerly	Watch Hill Beach	T	22,600	30,500	
384	Westerly	Misquamicut State Beach	F	32,000	43,200	
Subtotals / Range				*122,700*	*165,600*	*Medium to fine sand*
Totals /Range (all States)				**2,780,700**	**3,381,900**	**Cobble to fine sand**

[1] Source: WHG (2010b); site IDs were generated by the USACE for the LIS DMMP.

[2] Beaches within 2 miles (3.2 km) of Federal navigation projects potentially generating beach-compatible sand.

[3] Nourishment volume in WHG (2010b) obtained from USACE or CTDEEP engineering design.

[4] Type: F=Federal shore protection; S=State beach; C=County beach; T=Town beach; R=Redevelopment project

3.2.4 Nearshore Beneficial Use Alternatives

Nearshore beneficial use alternatives include beach nourishment; nearshore bars/berms; and other uses such as marsh creation, bottom habitat development, and along-shore fill in support of waterfront development. Nearshore beneficial uses also include coastal resiliency projects intended to mitigate anticipated impacts from sea level rise and extreme storms. Nearshore beneficial use sites may be used multiple times during the USACE planning period of 30 years.

Beach Nourishment. The most common form of beneficial use is beach nourishment using suitable sandy dredged materials on beaches adjacent to the harbor being dredged. Several times each year, projects of this nature are undertaken in New England waters. This method of placement is commonly used for the maintenance of entrance channels and beaches for the harbors of Nassau and Suffolk Counties on Long Island, and to a lesser extent for Connecticut harbors, using a hydraulic pipeline dredge to pump materials directly onto the receiving beach. For most projects this requires a receiving beach within about one mile of the dredging site. Entrance channels at Connecticut harbors such as Milford, Clinton, Westbrook, Little Narragansett Bay, Southport, and the Housatonic River have all used direct beach placement in past dredging projects.

- *Beach Nourishment Sites for Federal Navigation Projects.* WHG (2010b) evaluated the potential for beach nourishment for various beaches using dredged material based on site visits, interviews with site operators, and review of aerial photographs. These sites included public beaches within 2 miles (3.2 km) of Federal navigation projects, Federal Shore Protection or Coastal Storm Damage Reduction projects, and other State-owned beaches that indicated a need for material. Municipal beaches located greater than 2 miles (3.2 km) from the Federal navigation projects were not considered due to the high costs and logistical issues associated with pumping dredged material more than 2 miles from the dredging sites.

  A total of 26 potential beach nourishment sites were identified within the SEIS ZSF (Figure 3-3; Table 3-1). The predominant grain sizes at these sites are coarse and medium sand; some sites also have fine sand and cobble. WHG (2010b) provided conservative capacity estimates for beach nourishment, as well as estimates with volumes increased by 35% that consider additional capacities on the upper beach face above the berm or in dune areas along the landward edge of the beach. The total capacity at beach nourishment sites ranged from approximately 2.8 million to 3.4 million cy (2.1 million to 2.6 million m^3) over 30-years. About 2.4 million cy (72%) of the maximum capacity was located along beaches in New York, 777,000 cy (23%) was located in Connecticut, and 166,000 (5%) was located in southwestern Rhode Island.

- *Beach Nourishment Sites for Smaller Non-Federal Projects*. Battelle (2011) evaluated additional municipal beaches for potential use for smaller non-Federal projects. Many coastal communities within the Long Island Sound region expressed interest in dredged material for rebuilding beaches and dunes if the material meets site-specific requirements, such as chemical composition, grain size, and other characteristics compatible with the naturally occurring beach material. Within the ZSF, eleven beach communities indicated a need for material; the potential capacities for these sites ranged from 148,000 to >241,000 cy (113,000 to >184,000 m^3) over 30 years (Table 3-2). Other beach communities that did not respond to the phone interview could allow for an additional capacity of 1.7 million cy (1.3 million m^3); about 1.4 million cy (85%) of this additional capacity would be located along municipal beaches in New York, 32,000 cy (2%) would be located in Connecticut, and 212,000 cy (13%) would be located in southwestern Rhode Island.

It is noted that all beach nourishment volumes in Tables 3-1 and 3-2 assume one-time nourishment; however, individual beaches may be nourished several times over the 30-year planning period; therefore the total potential beach nourishment volume over a 30-year period is somewhat greater than shown in these two tables.

Table 3-2. Summary of 11 Additional Municipal and County-owned Beaches for non-Federal Dredging Projects (identified by the LIS DMMP)

Site ID[1]	**Town**	**Site Name**	**Type**[2]	**Nourishment Volume**[3] (cy)		**Material accepted/needed**
				3-foot depth	**5-foot depth**	
New York						
74	Southold	McCabe's Beach	M	4,000	6,000	Clean sand
75	Southold	Kenney' Beach	M	9,000	15,000	
76	Southold	Town Beach	M	11,000	18,000	
Subtotals				*24,000*	*39,000*	
Connecticut						
340	Madison	East Wharf Beach	M	4,000	n/a	Fine-grained clean fill
341	Madison	West Wharf Beach	M	2,000	n/a	
342	Madison	Surf Club Beach	M	11,000	19,000	
354	Waterford	Kiddie Beach	M	1,000	n/a	Clean sand
355	Waterford	Pleasure Beach	M	9,000	15,000	
356	Waterford	Waterford Beach Park	M	19,000	31,000	
Subtotals				*46,000*	*>72,000*	
Rhode Island						
379	Westerly	Westerly Town Beach	M	8,000	13,000	Sand
380	Westerly	Wuskenau (New Town) Beach	M	70,000	117,000	
Subtotals				*78,000*	*130,000*	
Totals /Range (all States)				**148,000**	**>241,000**	

[1] Source: Battelle (2011); site IDs were generated by the USACE for the LIS DMMP.
[2] Type: M=Municipal

There is a long history of using dredged material for beach nourishment in Long Island Sound. For example, between 2005 and 2013, a total of 2.3 million cy (1.8 million m^3) of dredged material was generated in all of Long Island Sound. Of that total, approximately 191,000 cy (146,000 m^3), or 7%, was used beneficially for beach nourishment (*e.g.*, USEPA, 2014, and earlier reports). It is expected that 9.1 million cy (6.9 million m^3) of sand will be dredged in the eastern Long Island Sound ZSF over the next 30 years, which corresponds to approximately 40% of the total volume of dredged material generated (see Table 2-3). A considerable portion may be used for beach nourishment, although not all of the eroding shore areas will be proximate to dredging sites; prioritizing placement will be a matter of cost, needs at the sites, and the cost-sharing capability and willingness of non-federal sponsors (USACE, 2015).

Nearshore Berms. Nearshore berms are created by placing clean sandy material into the nearshore littoral bar system off beaches. This material is commonly placed by hopper dredges (rather than by pipelines) which allows for berm creation at a greater distance from the dredging site. Berms would be constructed in water depths of approximately 15 feet (4.5 m); their length would vary depending on the configuration of individual beaches. Nearshore berm sites are locations where the placement of dredged material could act as feeder berms or as stable (or wave-dampening) berms for adjacent beaches. Berms are transient structures that allow for their repeated reconstruction after a period of erosion.

- *Feeder Berms:* Sand is placed adjacent to a beach. These berms add sediment to the littoral system to nourish the adjacent beach. This process may reduce nearshore wave energy and reduce shoreline erosion.

- *Stable Berms:* Stable berms typically last longer than feeder berms. They are constructed in deeper water or in low-energy environments. This process may reduce nearshore wave energy along the shoreline, reduce shoreline erosion, and enhance habitat for fisheries.

WHG (2012a) identified a total of 18 potential nearshore berm sites within the ZSF (Figure 3-4; Table 3-3). The grain size ranged at these sites ranged from fine sand to cobble. Berms would be up to 3 feet (1 m) high and 200 feet (60 m) wide at the crest. The total capacity at the nearshore berm sites is approximately 1.9 million cy (1.4 million m^3). About 70% of this capacity is located along beaches in New York, 18% is located in Connecticut, and 12% is located in southwestern Rhode Island. These estimates do not include the possibility of repeated reconstruction of berms at these sites over the years, thus the total capacity over 30 year is likely somewhat greater.

The LIS DMMP considered potential conflicting uses and other issues associated with berm sites (Table 3-4). Prior to each site use, a more detailed assessment is conducted as part of the project permitting and review process. Potential conflicts and issues may include disturbance, modification of habitat, shellfish, marine mammals, coastal structures, and recreational areas.

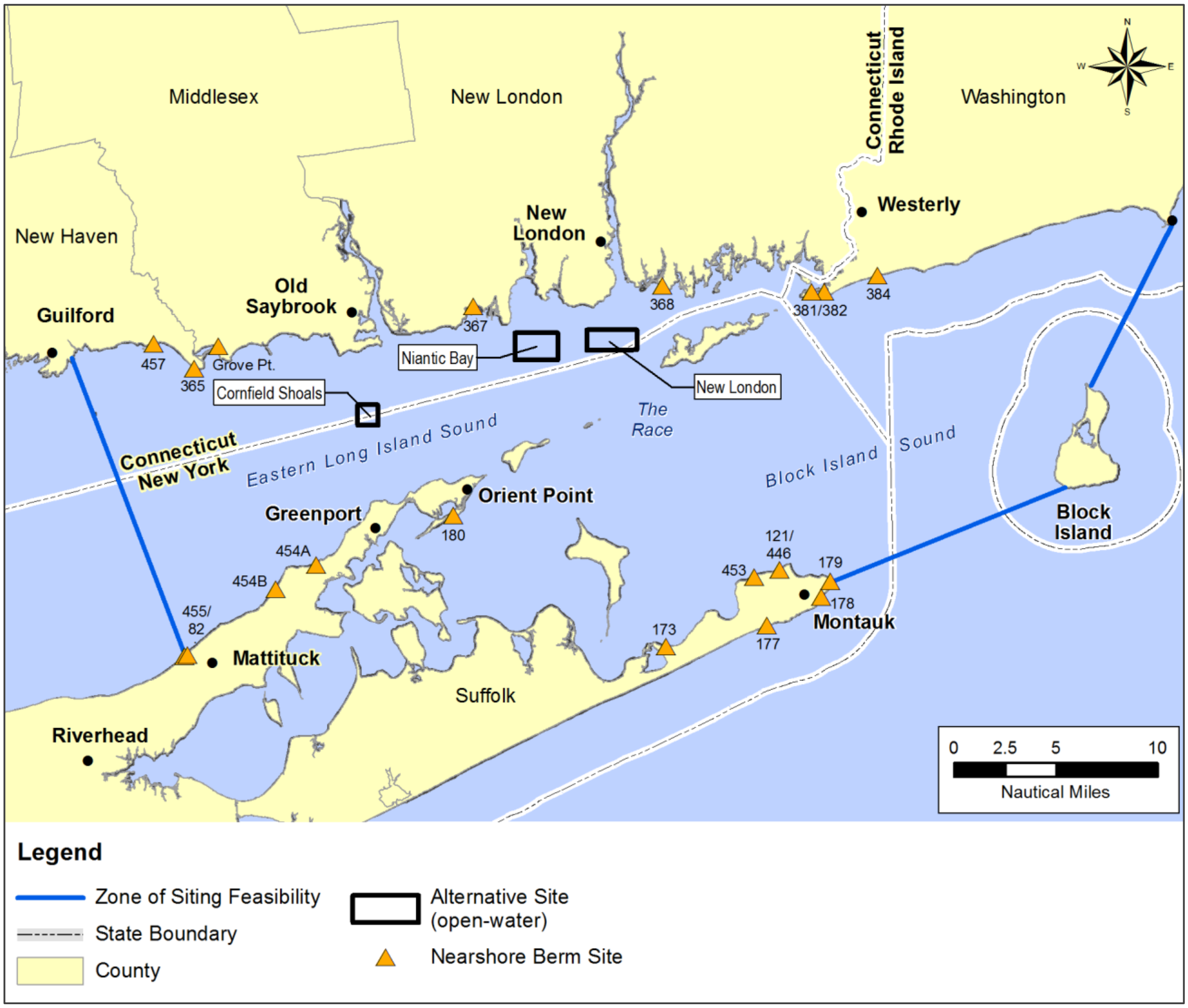

Figure 3-4. Potential dredged material nearshore berm sites, identified by the LIS DMMP (WHG, 2012a).

Table 3-3. Summary of 17 Potential Nearshore Berm Sites (identified by the LIS DMMP)

Site ID[1]	**Site Name**	**Berm Length** (ft)	**Berm Volume** [2] (cy)	**Average Grain Size**
New York				
177	Shadmoor State Park	1,477	33,700	Medium sand
178	Camp Hero State Park	3,703	84,332	Cobble to coarse sand
179	Montauk Point State Park	5,760	131,119	Cobble to coarse sand
121/446	Gin Beach & Theodore Roosevelt County Park	8,892	202,358	Medium to fine sand
453	Lake Montauk Harbor	4,618	105,144	Medium to fine sand
173	Hither Hills State Park	12,132	276,053	Coarse sand
180	Orient Beach State Park	8,968	204,086	Medium sand
454A	Hashamomuck Cove – County Road 48	6,815	155,115	Coarse sand
454B	Hashamomuck Cove – Kenney's Beach	3,196	72,800	Coarse sand
455/82	Mattituck Harbor 111 / Bailie's Beach	1,540	35,133	Medium sand
Subtotals / Range		*57,101*	*1,299,840*	*Cobble to fine sand*
Connecticut				
457	East Wharf Beach	379	8,726	Coarse to medium sand
365	Hammonasset State Park	6,151	140,012	Medium sand
n/a	Grove Point Beach	2,757	62,814	Medium sand
367	Rocky Neck State Park	2,131	48,576	Medium sand
368	Bluff Point State Park	3,173	72,277	Coarse sand
Subtotals / Range		*14,591*	*332,405*	*Coarse to medium sand*
Rhode Island				
381, 382	Watch Hill Beach / Napatree Point Beach	6,806	154,911	Medium to fine sand
384	Misquamicut State Beach	3,093	70,457	Medium to fine sand
Subtotals / Range		*9,899*	*225,368*	Medium to fine sand
Totals /Range (all States)		**81,591**	**1,857,613**	**Cobble to fine sand**

[1] Source: WHG (2012a); site IDs were generated by the USACE for the LIS DMMP.

[2] Volumes assume one-time use. However, berms may be created multiple times during the USACE planning period of 30 years.

Habitat Restoration Sites. USACE (2015) identified Sandy Point in Little Narragansett Bay on the Rhode Island/Connecticut border as a potential marsh creation site. Use of dredged material at the site would involve filling the shallow water in the lee of the existing barrier island to create substrate for salt marsh development. The site has a fill capacity of approximately 500,000 cy (382,000 m^3). USACE (2015) further stated that Rhode Island has been experimenting recently with thin-layer marsh placement by discharge from a small pipeline dredge. This option may be available for small local dredging projects.

Table 3-4. Summary of Potential Conflicting Uses and Other Issues for Nearshore Berm Sites (identified by the LIS DMMP)

Site ID[1]	**Site**	**Cultural Resources**			**Environmental Resources**									**Infrastructure Resources**									**Physical Resources**			
		Shipwrecks	Historic Districts	Archaeological Sites	Wetlands	Federal & State Listed Species	Shellfish	Federally Managed Species [2]	SAV	Marine Protected Areas	Birds	Marine Mammals	Terrestrial Wildlife	Mooring Areas	Navig. Channels & Shipping	Ports	Coastal Structures	Cable/power/utility crossings	Recreational Areas	Commercial & Industrial Facil.	Aquaculture	Dredged Mat. Disposal Sites	Sediments	Littoral Drift	Currents	Waves
New York																										
177	Shadmoor State Park					●	●	●		●	●	●							●					●		●
178	Camp Hero State Park					●	●	●		●	●	●							●					●		●
179	Montauk Point State Park	●			●	●	●	●			●	●					●	●	●				●			●
121/446	Gin Beach & Th. Roosevelt County Park				●	●	●	●				●												●		●
453	Lake Montauk Harbor	●		●	●	●	●	●	●			●							●							●
173	Hither Hills State Park				●	●	●	●		●		●							●		●		●	●		●
180	Orient Beach State Park				●	●	●	●	●	●	●	●					●		●		●		●	●		●
454A	Hashamomuck Cove – County Road 48	●				●	●	●			●	●					●		●					●		●
454B	Hashamomuck Cove – Kenney's Beach				●	●	●	●			●	●					●		●					●		●
455/82	Mattituck Harbor 111 / Bailie's Beach				●	●	●	●			●	●														●
Connecticut																										
457	East Wharf Beach					●	●	●				●					●									●
365	Hammonasset State Park					●	●	●		●	●	●					●		●			●	●	●		●
n/a	Grove Point Beach	●				●	●	●				●											●		●	
367	Rocky Neck State Park					●	●	●	●		●	●					●		●				●			●
368	Bluff Point State Park	●				●	●	●	●	●		●							●					●		●
Rhode Island																										
381, 382	Watch Hill Beach / Napatree Pt Beach	●	●			●	●	●				●					●	●	●					●		●
384	Misquamicut State Beach	●				●	●	●				●					●		●					●		●

[1] Source: WHG (2012a); site IDs were generated by the USACE for the LIS DMMP.

[2] Pursuant to the Magnuson-Stevens Fishery Conservation and Management Act.

3.2.5 Dredged Material Containment Facilities

Other nearshore alternatives include confined disposal facilities (CDFs) and confined aquatic disposal (CAD) cells. These two types of containment facilities are not considered beneficial use facilities. Both types of facilities are discussed further below.

Confined Disposal Facilities (CDFs). CDFs consist of a diked containment covering sufficient area to provide either a limited fill capacity for a single port or dredging project, or a regional disposal capacity for multiple ports or projects. Creation and use of CDFs entails substantial costs for dredging projects and their local sponsors due to the need to construct and maintain armored dikes, rehandling berths, internal distribution and drainage, and drying management, as well as long-term operation of the facility. In addition to potential environmental impacts, the use and value of adjacent properties would also be affected. Affected resources may consist, for example, of shellfish beds, eelgrass beds, and beaches. CDFs generally require a sheltered location to minimize the degree of protection and to thereby limit the costs for dikes for storm protection. There are two different types of CDFs:

- *Shoreline CDFs:* Shoreline CDFs are constructed in shallow coastal water adjacent to shore. The facilities contain dredged material through retention dikes or other structures. Dikes are constructed to an elevation above sea level to limit exposure to waves and tidal flows and to restrict water exchange between the CDFs and the surrounding waters. Examples of small shoreline CDFs in the eastern Long Island Sound region are Pilots Point Marina in Westbrook, CT (filled), and Cedar Island Marina in Clinton, CT (still usable).

- *Island CDFs:* Island CDFs are similar in concept to shoreline CDFs, but they are constructed in deeper waters, generally between 1 and 4 nmi (2 to 8 km) from shore. These CDFs need to be surrounded on all sides by retaining dikes to isolate dredged material from the surrounding waters and to restrict water exchange. Examples of island CDFs along the east coast of the United States include Hart Miller Island and Poplar Island, both in Chesapeake Bay, and Craney Island in Norfolk Harbor.

WHG (2012b) identified five potential locations for the potential development of CDFs within the ELIS ZSF, all within waters of the State of Connecticut (Figure 3-5; Table 3-5). Four of these sites are island CDFs; one site is a shoreline CDF. The total capacity at these five possible CDF sites is approximately 30 million cy (24 million m^3).

Identified sites are described below (from west to east). Aside from WHG (2012b), further details are provided in earlier studies (USACE, 1985a; 1985b).

- *Falkner Island:* This potential island CDF site would be located approximately 3.5 nmi (6.5 km) south of Guilford Harbor, Connecticut. The CDF would connect Falkner Island to Goose Island with a rock retaining dike in up to 32 feet (10 m) of water. This site would have a capacity of 17 million cy (13 million m^3) and a footprint of 240 acres (0.97 km^2).

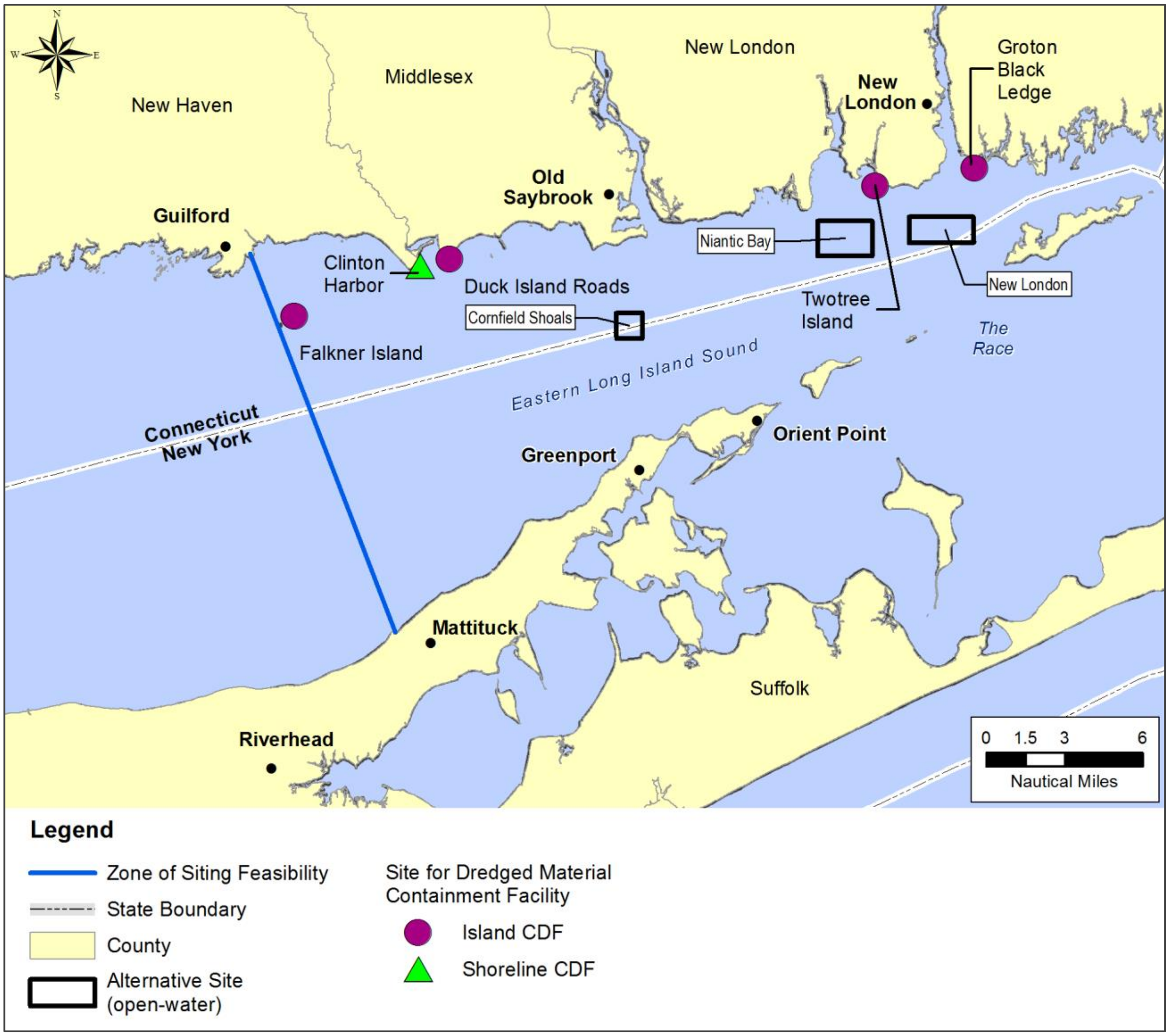

Figure 3-5. Site for potential dredged material containment facilities, identified by the LIS DMMP (WHG, 2012a).

Table 3-5. Potential Containment Facilities (identified by the LIS DMMP)

Site ID[1]	Type	Site Name	Footprint		Capacity
			acres	km^2	cy
N	Island CDF	Falkner Island	240	0.97	17,180,000
O	Shoreline CDF	Clinton Harbor	100	0.41	700,000
P	Island CDF	Duck Island Roads	48	0.19	1,610,000
Q	Island CDF	Twotree Island	80	0.32	3,400,000
R	Island CDF	Groton Black Ledge	125	0.51	7,500,000
Totals (all sites)			**593**	**2.40**	**30,390,000**

[1] Source: WHG (2012b); site IDs were generated by the USACE for the LIS DMMP.

- *Clinton Harbor:* This potential shoreline CDF site would create a salt marsh habitat adjacent to the Clinton Harbor federal navigation channel along the southern shoreline of Cedar Island and the eastern shoreline of Willard Island (Hammonasset Beach State Park). Two thirds of its footprint of 100 acres (0.41 km^2) would consist of created tidal wetlands. This site has would have a capacity of 700,000 cy (535,000 m^3).

- *Duck Island Roads:* This potential island CDF site would be located approximately 0.2 nmi (0.4 km) south of Kelsey Point in Clinton, Connecticut, and bounded by the southern tip of Stone Island, East Ledge, and the Kelsey Point breakwater. The site is triangular in shape and is located in 8 to 30 feet (2.5 to 9.2 m) of water. It would have a capacity of 1.6 million cy (1.2 million m^3) and a footprint of 48 acres (0.19 km^2).

- *Twotree Island:* This potential island CDF site would be located approximately 0.65 nmi 1.2 km) southeast of Millstone Power Plant in Waterford, Connecticut, surrounding the existing Twotree Island. Construction may consist of building a rock retaining dike around the existing island in 10 to 15 feet (3 to 5 m) of water. This site would have a capacity of approximately 3.4 million cy (2.6 million m^3) and a footprint of 80 acres (0.32 km^2).

- *Groton Black Ledge:* This potential island CDF site would be located adjacent to the New London Harbor navigation channel approximately 1 nmi (2 km) seaward of the entrance to New London harbor and south of Avery Point in Groton, Connecticut. The site is a rocky shoal with water depths shallower than 18 feet (5.5 m). A small part of the shoal is exposed at low tide. Its design volume is approximately 7.5 million cy (5.7 million m^3) and a footprint of 125 acres (0.51 km^2).

The availability of any CDF is evaluated based on considerations such as costs, logistics, and scheduling. The LIS DMMP also considered potential conflicting uses and other issues associated with CDFs; a more detailed assessment would be conducted as part of the project permitting and review process for any actual proposal to install a CDF. Potential conflicts and issues may pertain to species habitat, shellfish, marine mammals, coastal structures, and recreational areas (Table 3-6).

Confined Aquatic Disposal (CAD) Cells. CAD cells are either existing natural deep depressions on the seafloor or in river channels, or man-made depressions such as borrow pits or newly-excavated pits for the purpose of placing dredged material. CAD cells are typically sized and designed to accommodate specific volumes of material from individual projects. Dredged material placed into CAD cells is also typically capped with coarser-grained material. CAD cells are generally constructed in water depths of 5 to 100 feet (1.5 to 30 m) in areas of low to moderate energy. If cells are constructed beneath navigation channels, their finished elevation must also account for future dredging depths, including long-range plans for future port improvement, as the finished elevation of the cell will restrict navigation depths.

Table 3-6. Summary of Potential Conflicting Uses and Other Issues for Containment Facilities (identified by the LIS DMMP)

Site ID1	**Site**	**Cultural Resources**			**Environmental Resources**									**Infrastructure Resources**									**Physical Resources**			
		Shipwrecks	Historic Districts	Archaeological Sites	Wetlands	Federal & State Listed Species[2]	Shellfish	Federally Managed Species [2]	SAV	Marine Protected Areas	Birds	Marine Mammals	Terrestrial Wildlife	Mooring Areas	Navig. Channels & Shipping	Ports	Coastal Structures	Cable/power/utility crossings	Recreational Areas	Commercial & Industrial Facil.	Aquaculture	Dredged Mat. Disposal Sites	Sediments	Littoral Drift	Currents	Waves
N	Falkner Island	●				●		●		●	●	●											●			●
O	Clinton Harbor		●		●	●	●	●	●		●	●			●				●				●	●	●	●
P	Duck Island Roads		●			●		●			●	●					●					●	●	●	●	●
Q	Twotree Island	●	●		●	●		●	●		●	●					●		●				●	●		●
R	Groton Black Ledge	●	●	●		●		●	●	●	●	●			●		●	●	●				●	●	●	●

[1] Source: WHG (2012a); site IDs were generated by the USACE for the LIS DMMP.

[2] Pursuant to the Magnuson-Stevens Fishery Conservation and Management Act.

While CAD cells could be constructed to accommodate material deemed suitable for open-water disposal, construction of CAD cells themselves generates dredged material requiring disposal. Therefore, CAD cells are typically confined to disposal of contaminated materials and are designed, as needed, on a project-specific basis and located in waters subject to regulation under CWA § 404 (see 40 C.F.R. § 230.72). The high costs of CAD cells relative to other disposal options make them practicable only for contaminated materials that are unsuitable for other means of disposal. For those reasons, CAD cells do not represent a long-term regional disposal option for the eastern Long Island Sound region.

3.2.6 Upland Disposal outside the Eastern Long Island Sound Region

Upland disposal in other states located outside of the eastern Long Island Sound region would consist of transport (by truck or rail) of dredged material over long distances. Prior to transportation, dredged material would require dewatering and rehandling; such space is limited as determined by the LIS DMMP (see Section 3.1.3). Long-distance landside transportation would also increase environmental (air quality) and social (traffic) impacts. While for some types of dredged material upland disposal is the only available option, the high costs of upland transport are not feasible for most applicants for dredging projects.

3.2.7 Treatment Technologies

A review of treatment technologies by the USACE Engineer Research and Development Center (ERDC) concluded that, while all treatment technologies reviewed resulted in some degree of contaminant reduction, the subset of treatments that are potentially cost-effective for treatment of dredged material to enable beneficial use is relatively small (Estes and McGrath, 2014). The authors further concluded that high treatment efficiency is generally too costly for management of dredged material from navigation projects. A review of treatment technologies in the LIS DMMP resulted at similar findings (USACE, 2015).

Despite advances in the development of treatment technologies, the high cost and low throughput processing rate generally make such options impractical for large dredging projects at this time. A treatment processing methodology that handles only a few hundred cubic yards a day cannot work in tandem with dredging equipment that generates several thousand cubic yards a day. Further, once treated, the material must be rehandled and hauled away to an upland disposal site, or transported and further processed for use in a commercial application. The costs and throughput rates for such alternatives make them impractical for use in this evaluation as long-term regional disposal alternatives for dredged materials suitable for other less costly means of disposal.

3.2.8 Summary of Initial Screening Process – Alternatives to Open-Water Disposal in Eastern Long Island Sound and Block Island Sound

Several alternatives to open-water disposal were reviewed to accommodate a significant portion of the total of 22.6 million cy (17.3 m^3) of dredged material (consisting of approximately 40% sand and 60% fine-grained material) estimated for the eastern Long Island Sound region between 2015 and 2045 (see Tables 2-2. and 2-3). These alternatives are potentially available for consideration on a project-specific basis. However, the initial screening process determined that there are no alternatives to open-water disposal available that could meet the cumulative long-term disposal needs of the eastern Long Island Sound region. One habitat restoration site (Sandy Point in Little Narragansett Bay) was identified with a capacity of 500,000 cy (382,000 m^3). Other nearshore beneficial use sites (beach nourishment, nearshore berms), as well as concrete/asphalt plants, largely require coarser grain sizes than those of most dredged materials generated by dredging centers in the region. Sufficient upland disposal options are not available. Treatment technologies are also considered costly and apply only to contaminated sediments, which is a small percentage of the overall volume of dredged material. Open-water sites outside the eastern Long Island Sound region would result in costly transportation. Although sufficient capacity could be created, island and shoreline CDFs are costly to construct and maintain and may also have environmental impacts. Over the long term, CDFs may become viable options as part of coastal resiliency efforts, assuming there would be significant cost-sharing from the federal government, state governments, and/or the municipalities that would benefit from such options.

3.3 No Action Alternative

NEPA requires that an EIS evaluate the “No Action Alternative” (see 40 C.F.R. 1502.14(d)). In cases involving Federal decisions on proposals for projects, “no action” means the proposed activity would not take place. In this case, the No Action Alternative to the proposed action is to not designate one or several ODMDSs.

All dredged material disposal permits will continue to be evaluated on a project-specific basis. If no disposal sites are designated, project proponents would need to pursue one or more of the following actions:

- *Scenario 1:* Utilize a short-term ODMDS either inside or outside of the ZSF that has been newly “selected” by the USACE and concurred with by the USEPA under MPRSA §103 (see Section 1.2.2 for details on the selection process)
- *Scenario 2:* Use an existing designated long-term ODMDS outside of the ZSF.
- *Scenario 3:* Await designation of a new disposal site outside of the ZSF.
- *Scenario 4:* Develop or utilize appropriate upland or nearshore disposal or beneficial use alternatives.
- *Scenario 5:* Cancel proposed dredging projects.

Environmental consequences associated with each scenario of the No Action Alternative are evaluated in Section 5.4 within Chapter 5.

3.4 Initial Screening Process — Open-Water Alternative Sites in Eastern Long Island Sound and Block Island Sound

The next step undertaken in the process of screening possible dredged material disposal options within the ZSF of eastern Long Island Sound and Block Island Sound was a review of possible open-water alternatives.

3.4.1 Zone of Siting Feasibility for Open-Water Alternative Sites

The USEPA site designation guidance manual (USEPA, 1986) describes the considerations that should be addressed to define a ZSF (see Section 1.3 and Figure 1-2). USEPA (1986) recommends locating ODMDSs within an economically and operationally feasible radius from the point of dredging. Other considerations include navigational restrictions, political or other jurisdictional boundaries, distance to the edge of the continental shelf, the feasibility of surveillance and monitoring, and operational and transportation costs (Pequegnat et al., 1990; USEPA and USACE, 2004d).

The harbors and inlets of Long Island Sound and Block Island Sound are shallow depositional areas that require periodic dredging to maintain their recreational and commercial use. The overall size of both water bodies results in a wide range of haul distances and navigational limitations with respect to dredging project sites. In addition, several factors limit the dredging schedule, including environmental windows, seasonal conditions, and the availability of equipment suitable for dredging Federal projects, marinas, and harbors (USACE, 2001).

A longer travel time increases costs for the crew, equipment, and fuel. In some cases, sites located farther from the point of dredging also demand the use of larger equipment suited for open ocean travel, which further increases the disposal costs. Many dredging projects throughout the eastern Long Island Sound region, including some Federal and non-Federal projects over 25,000 cy (19,114 m^3), are in shallow non-navigable areas where large ocean- suitable tugs and barges cannot be operated. (These barges are commonly referred to as “scows”; this term will be used hereafter.) In addition, dredging of many projects in the region is conducted by regional contractors that have small scows and tugs designed for short distance disposal.

Using the same threshold that was used in the CLIS/WLIS EIS (USEPA and USACE, 2004a), candidate disposal sites more than 25 nmi (46 km) from a dredging center in the eastern Long Island Sound region were determined to be neither economically nor operationally feasible. These candidate sites include those on or beyond the continental shelf break (located approximately 60 nmi [110 km] southeast of Montauk Point).

3.4.2 Screening Process for Open-Water Alternatives Sites

The USEPA, in accordance with NEPA, worked with Federal and State agencies to identify specific potential disposal sites within the ZSF. Because NLDS and CSDS are currently active dredged material disposal sites within the ZSF, they were included among the alternative sites considered in this DSEIS. The USEPA followed MPRSA to facilitate the identification of alternative sites that are sufficiently removed from ecologically sensitive or incompatible use areas to avoid or minimize potential impacts on these areas.

The five general and eleven specific criteria in 40 C.F.R. 228.5 and 40 C.F.R. 228.6 (Table 3-7) guided the process used to identify alternative sites.

Table 3-7. Required Considerations in the Evaluation and Designation of Ocean Dredged Material Disposal Sites (40 C.F.R. 228.5 and 228.6)

<table>
<tr><th colspan="2">Sec. 228.5 General criteria for the selection of sites</th></tr>
<tr><td colspan="2">(a) The dumping of dredged material into the ocean will be permitted only at sites or in areas selected to minimize the interference of disposal activities with other activities in the marine environment, particularly avoiding areas of existing fisheries or shellfisheries, and regions of heavy commercial or recreational navigation.</td></tr>
<tr><td colspan="2">(b) Locations and boundaries of disposal sites will be so chosen that temporary perturbations in water quality or other environmental conditions during initial mixing caused by disposal operations anywhere within the site can be expected to be reduced to normal ambient seawater levels or to undetectable contaminant concentrations of effects before reaching any beach, shoreline, marine sanctuary, or known geographically limited fishery or shellfishery.</td></tr>
<tr><td colspan="2">(c) If at any time during or after disposal site evaluation studies, it is determined that existing disposal sites presently approved on an interim basis for ocean dumping do not meet the criteria for site selection set forth in Section 228.5 through 228.6, the use of such sites will be terminated as soon as suitable alternate disposal sites can be designated.</td></tr>
<tr><td colspan="2">(d) The sizes of ocean disposal sites will be limited in order to localize for identification and control any immediate adverse impacts and permit the implementation of effective monitoring and surveillance programs to prevent adverse long-range impacts. The size, configuration, and location of any disposal site will be determined as a part of the disposal site evaluation or designation site study.</td></tr>
<tr><td colspan="2">(e) USEPA will, wherever feasible, designate ocean dumping sites beyond the edge of the Continental shelf and other such sites that have been historically used.</td></tr>
<tr><th colspan="2">Sec. 228.6 Specific criteria for site selection</th></tr>
<tr><td colspan="2">(a) In the selection of disposal sites, in addition to other necessary or appropriate factors determined by the Administrator, the following factors will be considered:</td></tr>
<tr><td>(1)</td><td>Geographical position, depth of water, bottom topography and distance from coast;</td></tr>
<tr><td>(2)</td><td>Location in relation to breeding, spawning, nursery, feeding or passage areas of living resources in adult or juvenile phases;</td></tr>
<tr><td>(3)</td><td>Location in relation to beaches and other amenity areas;</td></tr>
<tr><td>(4)</td><td>Types and quantities of wastes (dredged material) proposed to be disposed of, and proposed methods of release, including methods of packaging the waste (dredged material), if any;</td></tr>
<tr><td>(5)</td><td>Feasibility of surveillance and monitoring;</td></tr>
<tr><td>(6)</td><td>Dispersal, horizontal transport and vertical mixing characteristics of the area, including prevailing current direction and velocity, if any;</td></tr>
<tr><td>(7)</td><td>Existence and effects of current and previous discharges and dumping in the area (including cumulative effects);</td></tr>
<tr><td>(8)</td><td>Interference with shipping, fishing, recreation, mineral extraction, desalination, fish and shellfish culture, areas of special scientific importance and other legitimate uses of the ocean;</td></tr>
<tr><td>(9)</td><td>The existing water quality and ecology of the site as determined by available data or by trend assessment or baseline surveys;</td></tr>
<tr><td>(10)</td><td>Potentiality for development or recruitment of nuisance species in the disposal site;</td></tr>
<tr><td>(11)</td><td>Existence at or in close proximity to the site of any significant natural or cultural features of historical importance.</td></tr>
<tr><td colspan="2">(b) The results of a disposal site evaluation and/or designation study based on the criteria stated in paragraphs (1) – (11) will be presented in support of the site designation promulgation as an environmental assessment of the impact of the use of the site for disposal, and will be used in the preparation of an environmental impact statement for each site where such a statement is required by USEPA policy. By publication of a notice in accordance with this Part 228, an environmental impact statement, in draft form, will be made available for public comment not later than the time of publication of the site designation as proposed rulemaking, and a final EIS will be made available at the time of final rulemaking.</td></tr>
</table>

To facilitate the selection of alternative disposal sites for the ZSF, these general and specific criteria were applied as follows:

- *Tier 1 screening:* Identification of areas within the ZSF that are not acceptable for locating an ODMDS(s) designated under the MPRSA.
- *Tier 2 screening:* Identification of specific areas for potentially siting an ODMDS(s), for further evaluation in the SEIS.

Site screening and potential alternative sites were discussed during the Cooperating Agency meetings and webinars in 2013 (January 8, May 20, and June 18) and in 2014 (September 5). Participating agencies included USEPA Regions 1 and 2, the USACE, NMFS, CTDOT, CTDEEP, NYSDEC, NYSDOS, and RICRMC. The site screening process was based on data and information from the USACE; States of Connecticut, New York and Rhode Island; the USGS and NOAA; and other organizations. Findings from several field studies conducted for this project (Appendices C to G) were also considered. Details of the screening process for alternative open-water sites within the ZSF are presented in Appendix B.

3.4.2.1 Tier 1 Screening of Open-Water Sites

Tier 1 screening identified areas that are not acceptable for locating an ODMDS, thereby reducing the area considered for Tier 2 screening. For site screening purposes, New York, Connecticut, and western Rhode Island State waters were considered equally [40 C.F.R. 228.6(a)(1)]. Lesser weight was given to eastern Block Island Sound due to long travel distances of greater than 25 nmi (46 km) from major dredging centers in the eastern Long Island Sound region and due to close proximity of some of Rhode Island's communities to the RISDS to the east of Block Island. Other considerations used in the Tier 1 screening were as follows:

- *Stability and Feasibility* [40 C.F.R. 228.5(b), 228.6(a)(1), 228.6(a)(6)]: Dredged material disposal sites include "containment" sites[1] and "dispersive" sites[2]. The active NLDS is a containment site; the CSDS is a dispersive site. As stated in the NOI, both currently active disposal sites would be considered in the SEIS along with other alternative site(s). For Tier 1 screening purposes, water depth was used as a surrogate for sediment stability, following the approach used in the CLIS/WLIS EIS (USEPA and USACE, 2004a). Specifically, waters shallower than 59 feet (18 m) were eliminated from consideration because wave and storm driven bottom currents in these shallow waters of Long Island Sound were considered strong enough to resuspend bottom sediments.

  The estimated future dredging needs for communities in the eastern Long Island Sound region (Table 2-2) and available site capacities were additional factors for considering

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[1] Containment areas have physical and geological features that restrict movement of bottom sediments from the area to surrounding areas. Containment areas would, for example, include topographical depressions in the seafloor or other locations where peak bottom current velocities are too low to resuspend sediment.

[2] Dispersive areas have physical and hydrodynamic conditions that tend to disseminate materials from the disposal area to surrounding areas over time. Dispersive areas would have peak bottom current velocities capable of resuspending sediments and carrying them beyond the disposal area.

site(s) in containment areas versus dispersive areas. This consideration included the type of sediment to be dredged and disposed. The majority of sediment from the ZSF would consist of finer-grained material from harbors. Disposal of this type of sediment at containment sites would allow for easier site management and monitoring.

- *Areas with Conflicting Uses* [40 C.F.R. 228.5(b), 228.6(a)(3), 228.6(a)(8)]: Disposal areas would not be sited near beaches, State or Federal Reserve areas, artificial reefs, or other conservation areas. Pipeline and cable areas would be avoided. A minimum 200-foot (60-m) buffer zone around each pipeline and cable was assumed during the screening.

- *Shellfish and Shellfishing Resource Areas* [40 C.F.R. 228.5(a), 228.6(a)(8)]: Shellfish resource areas would not be considered for alternative sites. This included shellfish beds as well as approved shellfishing zones.

- *Valuable Marine Habitats* [40 C.F.R. 228.5(a), 228.6(a)(2)]: Benthic sediment texture and seafloor morphology were considered to describe marine habitats. Large areas with hard-bottoms (rock outcrops and boulder fields) were considered more valuable marine habitats because they provide topographic relief important to living resources. Unusual seafloor morphology and tidal conditions may result in turbulent marine deepwater habitats and shoals and scoured areas, such as in The Race, Plum Gut (the area between Plum Island and Orient Point), and Montauk Point Shoals. These three areas are designated as Significant Coastal Fish and Wildlife Habitats (NYSDOS, 2002; 2005a; 2005b) and were screened out during Tier 1.

- *Interference with Navigation* [40 C.F.R. 228.5(a)]: Interference with commercial and recreational navigation was considered but determined minimal given the open water conditions in the ZSF and the generally short time duration that dredged material transport scows would be present at a site during sediment disposal.

Tier 1 screening considerations are summarized in Figure 3-6 with sediment texture as background. The areas removed from consideration are shaded in black (water depth shallower than 59 feet [18 m], reefs, shellfish beds, and valuable marine habitats), solid brown (cables, cable areas, pipelines), and cross-hatched brown (approved shellfishing zones). The remaining areas, not screened out under Tier 1, were considered further under Tier 2.

3.4.2.2 Tier 2 Screening of Open-Water Sites

Tier 2 screening evaluated the areas remaining after the Tier 1 screening to identify specific alternative disposal site(s) within the ZSF for further, more detailed evaluation in the SEIS. The primary factors used during Tier 2 screening were as follows:

- *Active and Historic Disposal Sites* [40 C.F.R. 228.5(e)]: There are two active disposal sites and seven historic sites in the ZSF. Preference was given to these active and historic disposal sites for selecting alternative sites, although the two historic disposal sites within

Fishers Island Sound (North Dumpling and Stonington) were not considered as their water depths are too shallow.

- *Minimize Impacts to Archaeological Resources* [40 C.F.R. 228.5(a)(11)]: There are several shipwrecks within the ZSF. For site screening, information was gathered from NOAA's Automated Wreck and Obstruction Information System (AWOIS), which provides a historical record of selected wrecks and obstructions including a brief history and descriptive details.

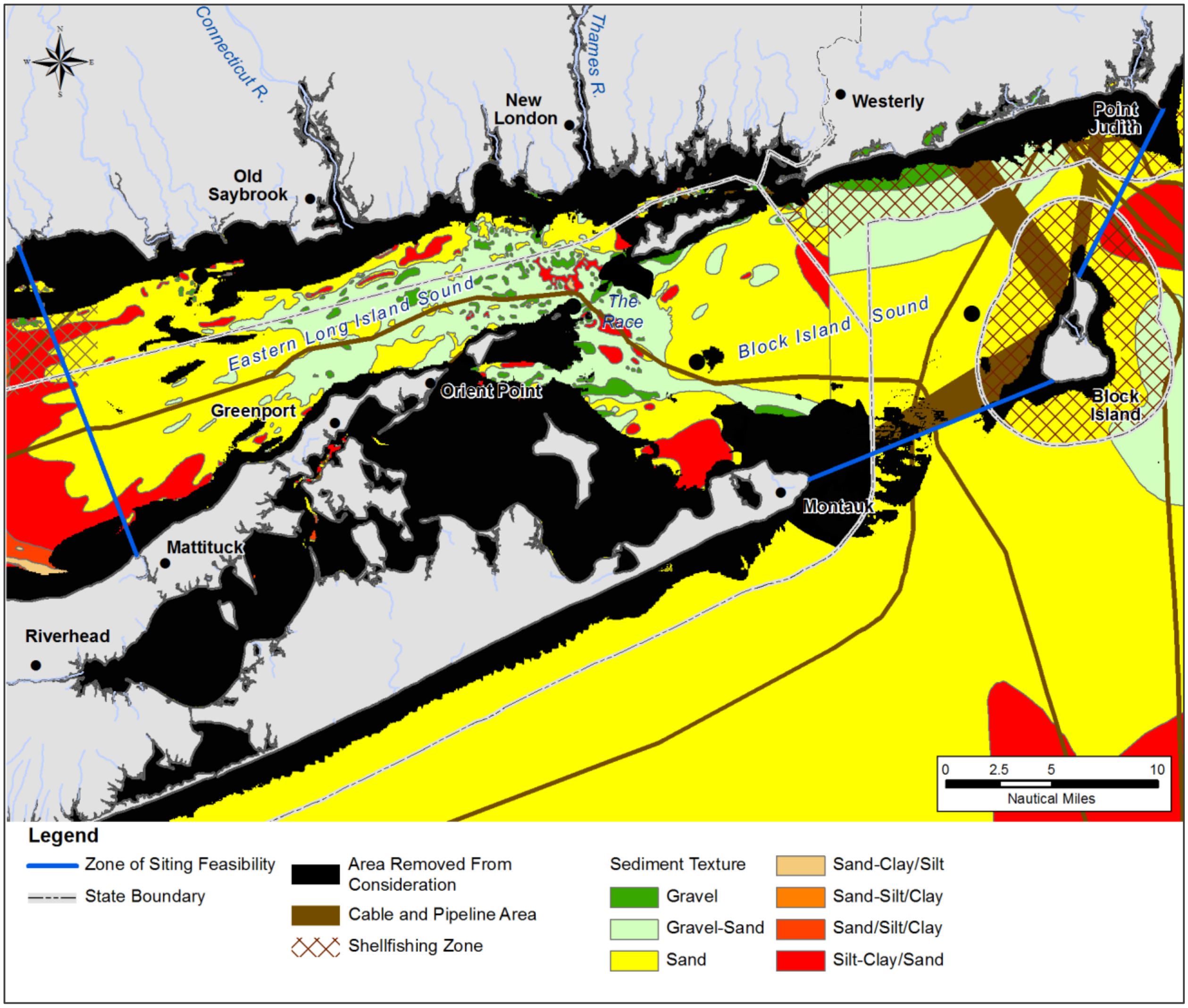


Figure 3-6. Summary of Tier 1 screening considerations. The background consists of sediment texture (Poppe et al., 2000). It is noted that the sediment grain size data come from different USGS data sets for Block Island Sound.

- *Minimize Impact to Fish Habitats and Fish Concentrations* [40 C.F.R. 228.5(a), 228.6(a)(8), 228.6(a)(9)]: The screening included fish habitat and fish concentration data from CTDEEP's monitoring program, conducted since 1984 (*e.g.*, Gottschall and Pacileo, 2014), as well as fisheries resource information in Tetra Tech (2014). The type and morphology of the seafloor for fish habitat value were also considered.

- *Minimize Impact to Living Resources (Breeding, Spawning, Nursery, Feeding, and Passage Areas)* [40 C.F.R. 228.6(a)(2)]: Living resources were evaluated by reviewing biological data as well as the seafloor morphology as an indication of the habitat.

- *Minimize Impacts to Benthic Community* [40 C.F.R. 228.6(a)(6)]: Maintaining continuity of benthic community type and habitat was considered (*e.g.*, disposal of sediment types generally similar to the types that exist on the seafloor), if possible.

- *Consideration of Site Characteristics* [40 C.F.R. 228.6(a)(6)]: The physical and chemical characteristics of the surface sediments were considered.

- *Site Dimension* [40 C.F.R. 228.6(a)(4)]: Alternative sites were evaluated based on the need and capacity using a minimum area of 1 nmi^2 (3.4 km^2), and adequate capacity to accommodate the dredged material disposal needs over the next 30 years.

- *Surveillance and Monitoring* [40 C.F.R. 228.5(d), 228.6(a)(5)]: The feasibility of monitoring and assessment is affected by the seafloor morphology and physical oceanographic conditions. This consideration used the USGS/NOAA seafloor morphology data (*e.g.*, Poppe et al., 2011, 2014), sidescan sonar information (WHG, 2014), and the tidal current information from the physical oceanography study (O'Donnell et al., 2015a).

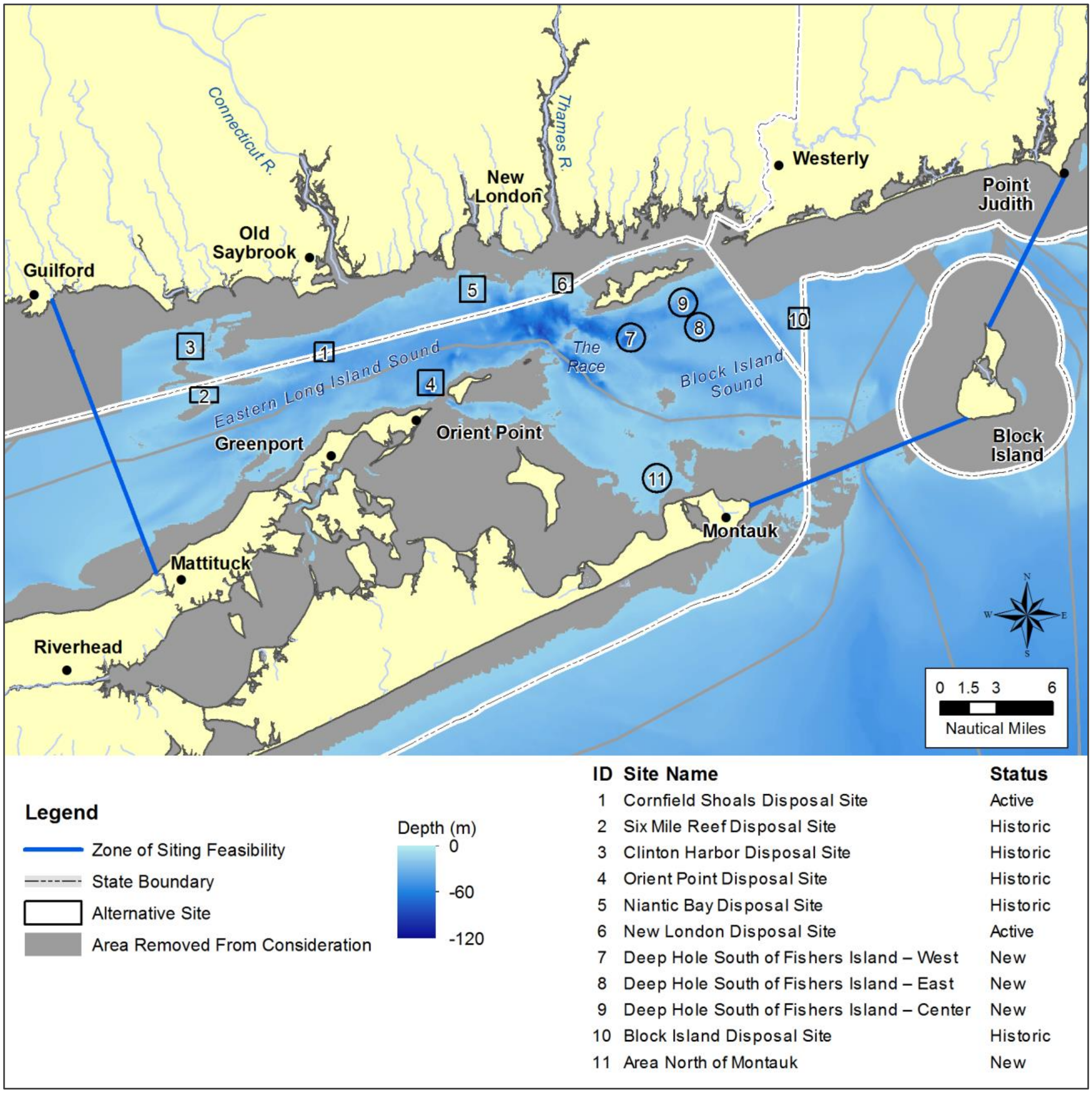
- *Interference with Other Uses* [40 C.F.R. 228.6(a)(8)]: Other uses considered included renewable energy generation potential (wind, wave, and tidal energy).

Another factor considered under Tier 2 screening was travel distance for tugs and scows from dredging centers as higher costs for disposal could prohibit dredging of some public or private shore facilities.

3.4.2.3 Initial Identified Sites

Based on the results of the Tier 1 and 2 screening, eleven initial sites were identified. These sites included the two active disposal sites, five areas that were historically used for dredged material disposal, and four areas not previously used for disposal (Figure 3-7).

These eleven sites were introduced to the Cooperating Agency Group during a webinar on May 20, 2013. Additional information from the literature was reviewed and data were collected in the field to reduce the number of potentially suitable sites further for more detailed evaluation in the SEIS. Specifically, out of these eleven sites the following eight sites were screened out:



ID	Site Name	Status
1	Cornfield Shoals Disposal Site	Active
2	Six Mile Reef Disposal Site	Historic
3	Clinton Harbor Disposal Site	Historic
4	Orient Point Disposal Site	Historic
5	Niantic Bay Disposal Site	Historic
6	New London Disposal Site	Active
7	Deep Hole South of Fishers Island – West	New
8	Deep Hole South of Fishers Island – East	New
9	Deep Hole South of Fishers Island – Center	New
10	Block Island Disposal Site	Historic
11	Area North of Montauk	New

Figure 3-7. Locations of eleven initial sites identified during Tier 1 and Tier 2 screening.

- *Six Mile Reef Disposal Site (Site 2):* This historic site is located in an area of large sedimentary bedforms on the seafloor. Shifting sands in the area are likely to reduce water depths at the site over time [40 C.F.R. 228.6 (a)(1)], complicating management of the site [40 C.F.R. 228.5 (d)].

- *Clinton Harbor Disposal Site (Site 3):* The hardbottom substrate in the eastern portion of this site suggests valuable benthic and fishing habitat [40 C.F.R. 228.6 (a)(2)] and the site contains four shipwrecks (NOAA, 2013a) [40 C.F.R. 228.6 (a)(11)]. In addition, as for the Six Mile Reef Disposal Site, sediment transport with shifting bedforms may complicate management of the site [40 C.F.R. 228.5 (d)].

- *Orient Point Disposal Site (Site 4):* This historic site is located close to shore [40 C.F.R. 228.5(b)] as well as close to Plum Gut in an area with diverse marine resources [40 C.F.R. 228.5(a), 228.6(a)(1) 228.6(a)(2)] and active recreational fishing [40 C.F.R. 228.6(a)(8)]. Plum Gut was designated as a Significant Coastal and Fish and Wildlife Habitat in 1987 (NYSDOS, 2005a).

- *Deep Hole south of Fishers Island – West (Site 7):* This bathymetric depression on the seafloor is an extension of The Race, which is a significant marine habitat with strong tidal currents. The Race was designated as a Significant Coastal and Fish and Wildlife Habitat in 1987 (NYSDOS, 2005b).

- *Deep Hole south of Fishers Island – East (Site 8):* Sediments within this bathymetric depression on the seafloor are scoured out intermittently by currents (McMullen et al., 2015). In addition, erosional walls with rip-up clasts to the north and east of the hole suggest higher habitat quality than the surrounding area in Block Island Sound.

- *Deep Hole south of Fishers Island – Center (Site 9):* Similar to Site 8, sediments within this bathymetric depression on the seafloor are scoured out intermittently by currents (McMullen, et al., 2015). In addition, the site is comparatively small.

- *Block Island Disposal Site (Site 10):* This historic disposal site is located at a comparatively long distance from the dredging centers in the eastern Long Island Sound region. The distance from the New London dredging center, for example, is approximately 20 nmi (37 km), and greater from many other major dredging centers in the eastern Long Island Sound.

- *Area north of Montauk (Site 11):* The site is located close to shore [40 C.F.R. 228.5(b)] and close to the Montauk Point shoals potentially impacting marine resources [40 C.F.R. 228.5(a), 228.6(a)(1), 228.6(a)(2)] and recreational fishing [40 C.F.R. 228.6(a)(8)]. Montauk Point Shoals was designated as a Significant Coastal and Fish and Wildlife Habitat in 1987 (NYSDOS, 2002). The site is also located far from major dredging centers. The distance from the New London dredging center, for example, is approximately 16 nmi (30 km), and greater from many other major dredging centers in the eastern Long Island Sound.

After applying the Tier 1 and Tier 2 screens, three alternatives sites were recommended for further analysis in the SEIS (New London, Niantic Bay, and Cornfield Shoals) (Figure 3-8). In order to accommodate the dredged material disposal needs for the eastern Long Island Sound region over for the next 30 years (which includes 13.5 million cy [10.3 million m^3] of fine-grained material; see Table 2-2 in Chapter 2), the recommended New London Alternative includes the area of the active NLDS as well as two areas immediately to the west (referred to as "Site NL-Wa" and "Site NL-Wb"). The Niantic Bay Alternative includes the area of the historic NBDS and an area immediately to the east (referred to as "Site NB-E"). The Cornfield Shoals Alternative is identical to the active CSDS.

For the New London Alternative, Sites NL-Wa/b were added for consideration in the SEIS to increase the limited remaining capacity of the NLDS. The current water volume at the NLDS between a water depth of 59 feet (18 m) and the sediment surface is approximately 4.5 million cy (3.4 million m^3), based on USGS/NOAA bathymetric data from 2005 and accounting for the disposal of 390,000 cy (300,000 m^3) of dredged material at the NLDS between 2006 and 2013. (Note that the capacity for the disposal of dredged material at the site is lower than the water volume because mounds are sloped; mounds also have uneven surfaces that may and thus a "filled" site would have multiple areas remaining with water depths greater than 59 feet [18 m]).

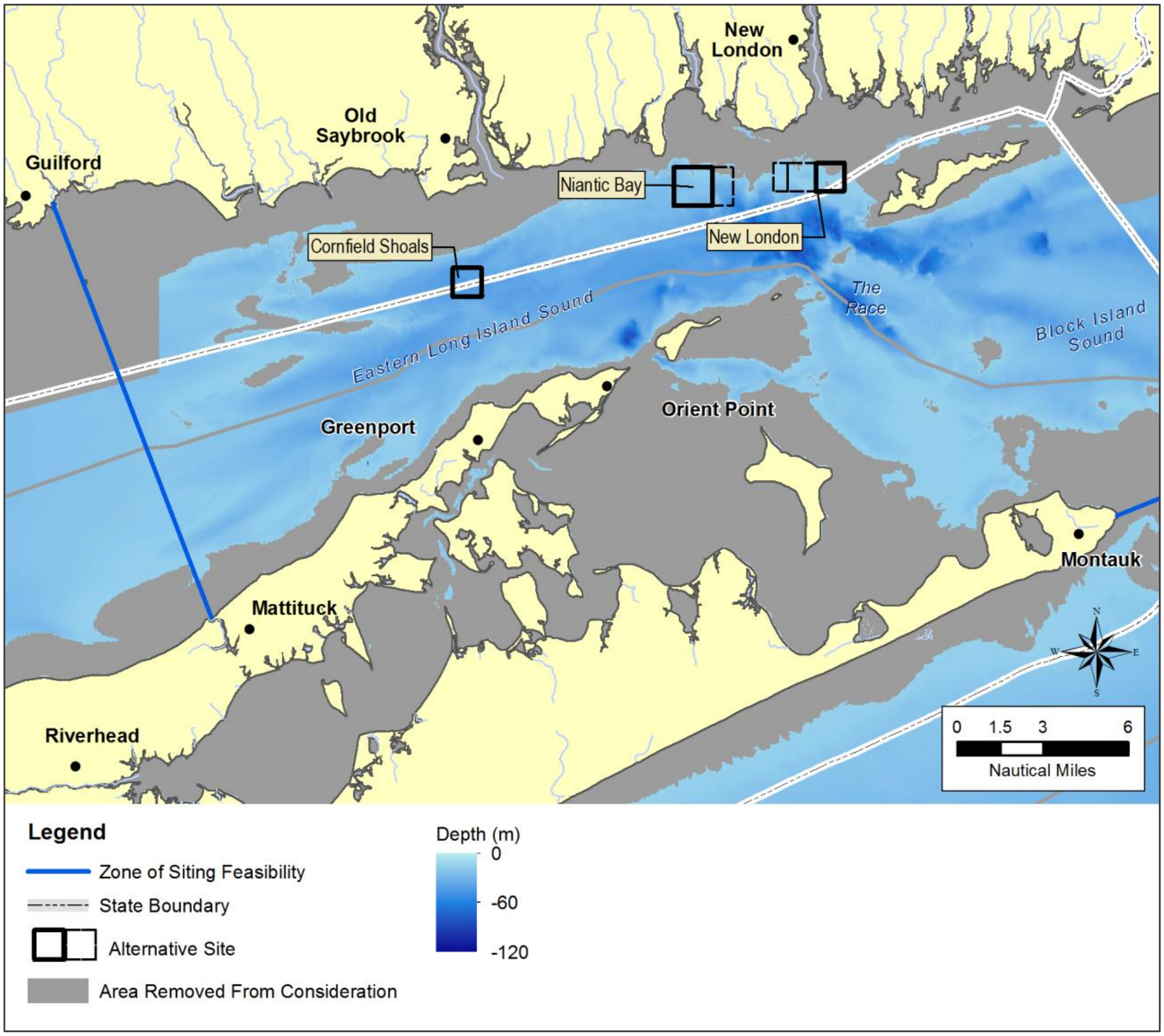


Figure 3-8. Results after Tier 1 and Tier 2 site screening for alternative open-water dredged material sites.

With the addition of Sites NL-Wa/b, the capacity at the New London Alternative would be sufficient to accommodate the dredged material disposal needs for the next 30 years. The water volume for Site NL-Wa below a water depth of 59 m (18 m) is approximately 14 million cy (11 million m^3), excluding a boulder zone in its north-central part (as discussed further below). The water volume for Site NL-Wb below a water depth of 59 m (18 m) is approximately 10 million cy (8 million m^3). Bottom stress[3] analysis indicates that the NLDS, Site NL-Wa, and most of Site NL-Wb would be containment areas for cohesive fine-grained dredged material (see Section 5.5.1 for more detailed discussion).

For the Niantic Bay Alternative, Site NB-E was added for consideration in the SEIS to increase the capacity for sediment containment under this Alternative. Bottom stress analysis indicates that most of the Niantic Bay Alternative would be a dispersive site, except for the northeastern part of the NBDS and the northern half of Site NB-E, which would function as containment areas for cohesive fine-grained dredged material due to lower bottom stress. The water volume below a water depth of 59 feet (18 m) for Site NB-E in the zone of lower bottom stress is approximately 24 million cy (18 million m^3). As noted above, the capacity for dredged material disposal would be lower than this volume due to topographic constraints of individual disposal mounds.

3.4.3 Open-Water Alternative Sites

This section provides an overview of the three alternative sites analyzed in this DSEIS.

3.4.3.1 New London Alternative

The New London Alternative is located to the south of the mouth of Thames River estuary (Figure 3-9). As stated above, the site consists of the active NLDS, and Sites NL-Wa and NL-Wb immediately to the west of the NLDS. The closest upland points to the New London Alternative are Goshen Point, Connecticut, approximately 1.2 nmi (2.2 km) to the north, and Fishers Island, New York, approximately 1.4 nmi (2.6 km) to the southeast.

- ***NLDS:*** This active open-water dredged material disposal site was selected by the USACE using their site selection authority. The use of the site was then further extended by Public Law on December 23, 2011 (PL-112-74, Title I, Sec 116). The NLDS is centered 3.1 nmi (5.4 km) south of Eastern Point in Groton, Connecticut. The site is a 1 nmi square area (3.4 km^2) centered at 41°16.306' N, 72°04.571' W (NAD83); corner coordinates are presented in Table 3-8. Water depths range from approximately 46 to 79 feet (14 to 24 m). Most of the site is located within Connecticut waters, with the southeast corner located in New York State waters. The NLDS has been used for dredged material disposal since at least 1955 (SAIC, 2001b). A total of approximately 3.5 million cy (2.6 million m^3) of dredged material have been placed at this location since 1982 (USEPA, 2015a). In addition, approximately 5.4 million cy (4.1 million m^3) were disposed at the NLDS between 1955 and 1976 (Oceanic Society, 1982, which cited the CTDEEP and NYSDEC as sources for the dredged material

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[3] Bottom stress is the force acting on the surface sediments on the seafloor, potentially resuspending sediment if the bottom stress is high enough. This force is primarily a function of the strength of the waves and currents.

disposal information). The disposed dredged materials result in an uneven seafloor; disposal mounds can rise 16 to 20 feet (5 to 6 m) above the surrounding seafloor.

The USGS mapped the sediment at the NLDS as predominantly sand; in the northernmost part of the site, sediments were mapped as gravelly sediment (Poppe et al., 2000). NUSC (1979) described the sediment at the site as generally fine sand. Much of the surface sediment at the site consists of placed dredged material. Sediment sampled by the DAMOS program at locations approximately 0.5 nmi (1 km) to the east and west of the NLDS consisted of silt/clay and very fine silty sand (AECOM, 2009), which may reflect pre-disposal sediment textures at the NLDS.

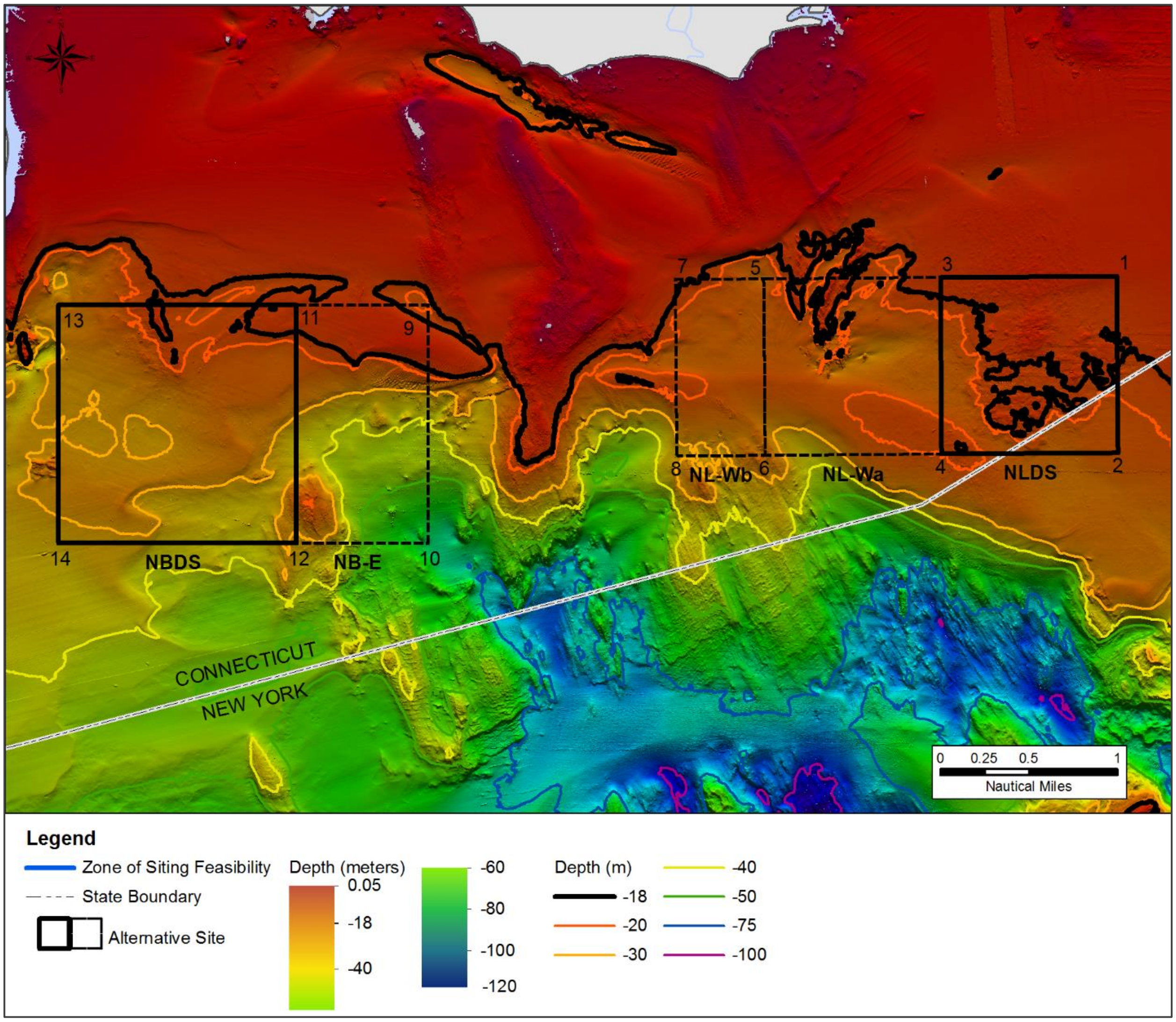

Figure 3-9. Locations of the New London and Niantic Bay Alternatives. Corner points or coordinates are presented in Table 3-8.

Table 3-8. Coordinates of the three Alternative Sites

Alternative Site	Corners Points[1]	Latitude	Longitude
New London	1	41° 16.81’ N	72° 03.91‘ W
	2	41° 15.81‘ N	72° 03.91‘ W
	3	41° 16.81‘ N	72° 05.23‘ W
	4	41° 15.81‘ N	72° 05.23‘ W
	5	41° 16.81’ N	72° 06.56‘ W
	6	41° 15.81‘ N	72° 06.56‘ W
	7	41° 16.81‘ N	72° 07.22‘ W
	8	41° 15.81‘ N	72° 07.22‘ W
Niantic Bay	9	41° 16.68‘ N	72° 09.08‘ W
	10	41° 15.33‘ N	72° 09.08‘ W
	11	41° 16.68‘ N	72° 10.08‘ W
	12	41° 15.33‘ N	72° 10.08‘ W
	13	41° 16.68‘ N	72° 11.87‘ W
	14	41° 15.33‘ N	72° 11.87‘ W
Cornfield Shoals	15	41° 13.19‘ N	72° 20.83‘ W
	16	41° 12.19‘ N	72° 20.83‘ W
	17	41° 13.19‘ N	72° 22.15‘ W
	18	41° 12.19‘ N	72° 22.15’ W

[1] See Figures 3-9 and 3-10 for the location of the corner points.

- ***Site NL-Wa:*** Site NL-Wa also has an area of 1 nmi^2 (3.4 km^2). Water depths range from approximately 45 feet (14 m) in the north to 100 feet (30 m) in the south. The site consists of mostly sandy areas, but also an area of boulders and rocks in the northern part of the site (WHG, 2014). This boulder area may be a lag deposit of a glacial moraine. The water depth in parts of the boulder area is shallower than 59 feet (18 m).

- ***Site NL-Wb:*** Site NL-Wb has an area of 0.5 nmi^2 (1.7 km^2). The site consists of an extension of the sandy areas of Site NL-Wa. Bartlett Reef is located approximately 0.5 nmi (0.9 km) to the west of the western boundary of the site. The southwestern corner of Site NL-Wb contains an area of bedrock and boulders (WHG, 2014); this area is an extension of a larger area with a similar substrate further to the south. The bedrock appears as parallel ridges of dipping layered rock that can be correlated to bedrock on shore (Poppe et al., 2011). The bedrock area within Site NL-Wb also contains some sand waves (WHG, 2014). Overall, water depths at the entire site range from approximately 59 feet (18 m) in the north to 95 feet (28 m) in the south.

3.4.3.2 Niantic Bay Alternative

The Niantic Bay Alternative is located to the south of Niantic Bay, between the Connecticut and Thames Rivers (Figure 3-9). It consists of the historic NBDS and Site NB-E immediately to the east. The northern edge of the alternative site is located approximately 0.6 nmi (1.1 km) from Black Point (southwestern corner of Niantic Bay) and 1.6 nmi (3.0 km) from Millstone (southeastern corner of Niantic Bay). The site is located entirely within Connecticut waters.

- ***NBDS:*** The NBDS was used historically for the disposal of dredged materials between 1969 and 1972 when a total of 176,000 cy (135,000 m^3) of dredged material was disposed at this location (Oceanic Society, 1982), but is not an active disposal site. Water depths at the site range from approximately 60 to 130 feet (18 to 40 m). Sediments at the site consist of sand to the north and northwest and mostly gravelly sediment with patches of gravel in the remainder of the area (Poppe, 2000). The site contains a boulder area in the north-central part of the site (Poppe et al., 1998) and scour depressions in the south. The southeastern corner of the site abuts a bedrock area (Poppe et al., 2013). The historic NBDS has an area of approximately 1.8 nmi^2 (6.2 km^2); corner coordinates are included in Table 3-8.

- ***Site NB-E:*** Water depths at Site NB-E range from 43 feet (13 m) in the north to 230 feet (70 m) in the southeast. Surface sediments at the site are generally similar to sediments at the NBDS. The southwestern corner of Site NB-E contains a bedrock area, which is an extension of an exposed area of dipping bedrock layers to the south of the site. Site NB-E has an area of 1.0 nmi^2 (3.4 km^2). Bartlett Reef, a bedrock shoal, is located approximately 0.5 nmi (1 km) to the east of the site.

3.4.3.3 Cornfield Shoals Alternative

The Cornfield Shoals Alternative consists entirely of the active CSDS, located in a central location of eastern Long Island Sound, approximately 3.3 nmi (6.1 km) south of Cornfield Point in Old Saybrook, Connecticut (Figure 3-10). The site has an area of 1 nmi^2 (3.4 km^2) centered at 41°12.686' N, 72°21.491' W (NAD83); corner coordinates are included in Table 3-8. The water depth is approximately 150 feet (46 m). The larger portion of the site is located within Connecticut waters with the remainder of the site located in New York State waters.

Bottom currents generally flow in an ENE-WSW direction. The seafloor around the CSDS is relatively flat, with longitudinal ripples and other bedforms that suggest that this area is sediment-starved; the site is classified as erosional/non-depositional in Poppe et al. (2013). Surface sediments at the CSDS consist predominantly of gravel and gravelly sediment. Gravelly sediment consists of a mixture of 50 to 90% sand, silt and clay; the remaining fraction consists of gravel (*e.g.*, Poppe et al., 2000).

An estimated 1.2 million cy (0.95 million m^3) were disposed at the site between 1960 and 1976 (Oceanic Society, 1982), and additional 1.7 million cy (1.3 million m^3) between 1982 and 2013 (USEPA, 2015a).

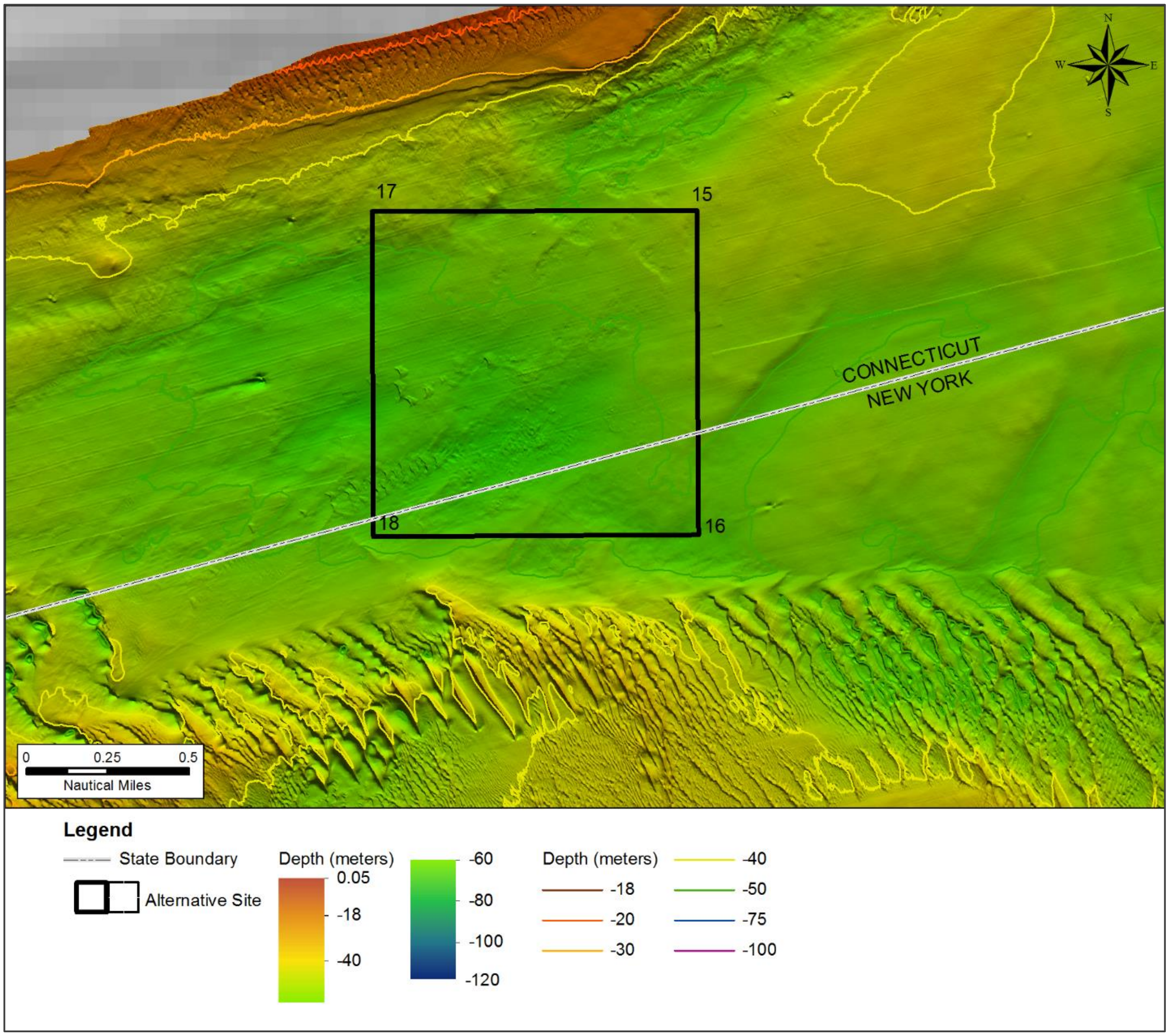

Figure 3-10. Location of the Cornfield Shoals Alternative. Corner points or coordinates are presented in Table 3-8.

3.5 Summary of Alternatives Analysis

Multiple alternative disposal options were considered to identify one or several suitable long-term regional disposal alternatives that would satisfy the need for dredged material disposal in the eastern Long Island Sound region. It was determined that upland options, beneficial use options, and treatment technologies are not suitable for satisfying this need for a variety of reasons, including a lack of capacity. Confined disposal facilities, which could be designed to have sufficient capacity, are expensive to construct and maintain; furthermore, due to the need to construct them in shallow waters, these facilities may have considerable environmental impacts. The closest currently available designated ODMDSs (*i.e.*, the CLDS and RISDS) are at a considerable distance from the eastern Long Island Sound region, resulting in higher fuel consumption during transport and thus higher disposal costs for dredging projects in the region. Open-water disposal within the ZSF is considered the most cost-effective approach to dredged material disposal for dredging centers in the eastern Long Island Sound.

The initial site screening process led to the identification of three alternative sites (New London, Niantic Bay, and Cornfield Shoals) for further evaluation with respect to MPRSA site selection criteria, in addition to the No Action Alternative. For the New London Alternative, two additional areas (*i.e.*, Sites NL-Wa and NL-Wb) immediately to the west of the active NLDS were included in the SEIS evaluation to accommodate the volume of dredged material projected for disposal over the next 30 years. Similarly, for the Niantic Bay Alternative an area immediately to the east of the historic NBDS (*i.e.*, Site NB-E) was included in the evaluation as part of this area exhibits lower bottom stress conditions than the NBDS.

Baseline conditions for these three Alternatives are presented in Chapter 4 (Affected Environment). Impacts from these alternative sites, as well as the No Action Alternative, are evaluated in detail in Chapter 5.

CHAPTER 4 – AFFECTED ENVIRONMENT

This chapter provides a description of the environment of eastern Long Island Sound and Block Island Sound, with focus on the existing environment within and around the three alternative sites (New London, Niantic Bay, and Cornfield Shoals). Both natural environmental and socioeconomic resources are potentially affected by dredged material disposal at these sites. The description of these resources in Chapter 4 provides the basis for the analysis of environmental consequences in Chapter 5.

Specifically, Chapter 4 describes the key physical, biological, and socioeconomic resources, as relevant to the five general and eleven specific MPRSA site selection criteria and other factors raised by the public during scoping meetings. Sections in this chapter consist of the following:

- Physical setting (Section 4.1)
- Bathymetry (water depth) (Section 4.2)
- Geological setting and geomorphology (bathymetric features on the seafloor) (Section 4.3)
- Meteorology (atmospheric conditions) (Section 4.4)
- Physical oceanography (physical conditions and processes within the ocean, especially the motions and physical properties of ocean waters) (Section 4.5)
- Sediment quality (sediment grain size and chemistry) (Section 4.6)
- Water quality (physical parameters such as turbidity, dissolved oxygen, and chemical composition) (Section 4.7)
- Biological resources, including benthic organisms, plankton, finfish and shellfish, federally- or state-listed threatened and endangered species, and bioaccumulation (Sections 4.8 to 4.14)
- Socioeconomic environment, including commercial and recreational fisheries, commercial navigation, recreational activities and beaches, parks and natural areas, and historical and archaeological resources (Section 4.15)
- Air quality and noise (Section 4.16).

These topics are described for the overall environment of Long Island Sound (with emphasis on eastern Long Island Sound) and Block Island Sound, followed by a description and evaluation of the existing conditions specific to the three alternative sites, as appropriate for specific resources. The descriptions and evaluations are based on existing data and information, as well as several studies conducted for the SEIS. These studies included a physical oceanographic field survey and modeling study (O'Donnell, 2014; 2015a; 2015b), a sidescan sonar survey of the seafloor (WHG, 2014), a biological characterization study (Tetra Tech, 2014), a sediment imaging survey of the seafloor habitat (Carey and Bellagamba Fucile, 2015), and a sediment chemistry survey (Louis Berger and UCONN, 2015). Reports of these studies are attached to this DSEIS as Appendices C to G, respectively.

4.1 Physical Setting

This section describes the physical setting of Long Island Sound, Block Island Sound, and the three alternative sites analyzed in this SEIS.

4.1.1 Long Island Sound

Long Island Sound is a 96-nmi (177-km) long, semi-enclosed estuary located between the coastline of Connecticut and the northern coastline of Long Island, New York (Figure 4-1). The border between the two states runs east-west through the middle of Long Island Sound. The Sound is connected to the Atlantic Ocean at both ends. Its eastern end (*i.e.*, Plum Gut near Orient Point, The Race west of Fishers Island, and Wicopessett Passage east of Fishers Island) presents an open passage to the ocean, while the passage to the ocean at the western end is partially restricted by the Narrows and the East River. The Race and Plum Gut have been designated as Significant Coastal and Fish and Wildlife Habitats (NYSDOS, 2005a; 2005b). The eastern Long Island Sound portion of the ZSF has a surface area of approximately 250 nmi^2 (860 km^2), not including Fisher Island Sound.

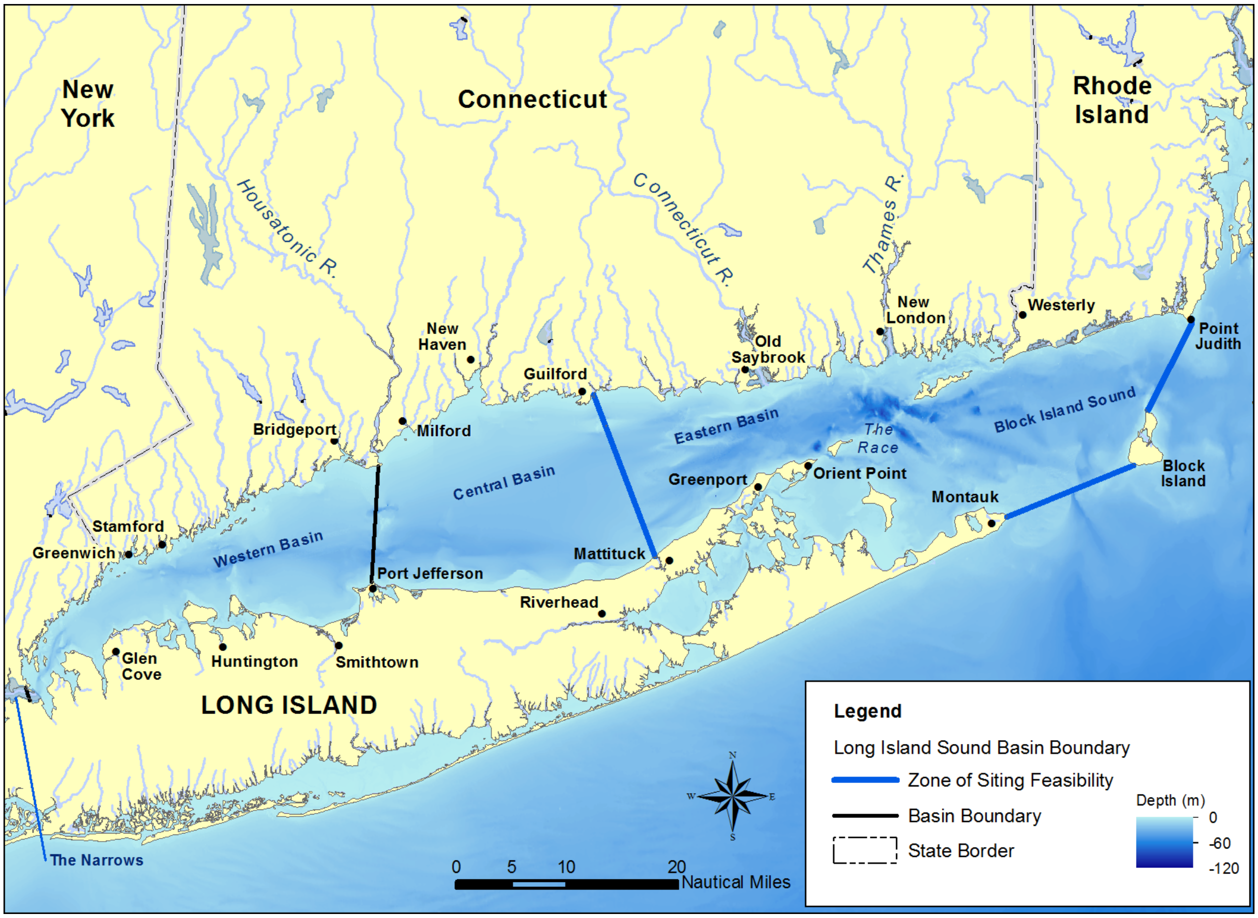

Figure 4-1. Physical setting of Long Island Sound and Block Island Sound (Source of water depth data: NOAA, 2012).

Long Island Sound can be divided into three basins defined by submarine geological features: the western, central, and eastern basins (Fig. 4-1). The western basin extends from the Narrows (between Throgs Neck and Willets Point, New York) to the Stratford Shoal (between Stratford Point [near Bridgeport, Connecticut] and Port Jefferson, New York). The central basin extends from the Stratford Shoal to the Mattituck Sill (between Mulberry Point [near Guilford, Connecticut] and Mattituck Point, New York). The eastern basin extends from the Mattituck Sill to The Race at the eastern end of Long Island Sound. This SEIS is focused on the eastern basin; all three alternative sites are located within it. The western and central basins were analyzed in the EIS for the designation of the WLDS and CLDS (USEPA and USACE, 2004a).

All of Connecticut's southern coast borders Long Island Sound. Connecticut has a population of approximately 3.6 million (2014 census) with the highest population density being found in communities along western and central Long Island Sound, and in the greater Hartford area. Long Island stretches eastward from New York City to Montauk over a distance of 118 miles (190 km) and has a maximum width of 23 miles (37 km). It has a population of approximately 8 million (2014 census); the population density is highest in Nassau County in the west and less dense in Suffolk County in the east. Aside from residential use, the coastal communities in Connecticut are more industrialized whereas the land use in eastern Long Island includes farms and vineyards. Multiple beaches are found along the coasts of both states. Three of the major rivers that empty into Long Island Sound (the Housatonic, Connecticut, and Thames) originate farther north in New England, effectively connecting Massachusetts, New Hampshire, and Vermont to Long Island Sound.

Located at the eastern end of Long Island Sound is Fishers Island. The island is about 7 miles (11 km) long and 1 mile (1.6 km) wide. It is separated from the mainland (Towns of Groton and Stonington) by Fishers Island Sound. Fishers Island Sound has a width of approximately 1.7 nmi (3 km). Water enters Fisher Island Sound both on its eastern end (from Block Island Sound), and on its western end (from eastern Long Island Sound).

In addition to Fishers Island, there are several smaller islands in eastern Long Island Sound which include Plum Island, Great and Little Gull Island, Twotree Island, and Faulkner Island. Plum Island is about 3 miles (4.8 km) long and 1-mile (1.6 km) wide at its widest point. The island is the site of the Plum Island Animal Disease Center established by the United States Department of Agriculture (USDA) in 1954. Great Gull Island is a 17-acre (6.9-ha) island located to the east of Plum Island. Great Gull Island is owned by the American Museum of Natural History that is restoring the island's ecosystem. Little Gull Island is a small island, located approximately 0.4 miles (0.6 km) northeast of Great Gull Island. Much of the rocky island is occupied by the Little Gull Island Lighthouse. Twotree Island is a small bare island located 0.8 nmi (1.5 km) to the southeast of Millstone Point in Waterford, Connecticut. The island is approximately 400 feet (120 m) long and is surrounded by shoals. Faulkner Island is a 2.9-acre (1.2 ha) crescent-shaped island located about 3 nmi (5.5 km) off the coast of Guilford, Connecticut. The island is part of the Stewart B. McKinney National Wildlife Refuge.

4.1.2 Block Island Sound

Block Island Sound is a semi-enclosed coastal body of water, approximately 28 nmi (52 km) long and 12 nmi (22 km) wide (Figure 4-1). Corner points of Block Island Sound in a clockwise direction are Point Judith, Rhode Island; Block Island, Rhode Island; Montauk, New York; Gardiners Island, New York; Orient Point, New York; Fishers Island, New York; and the southern shore of Washington County, Rhode Island.

The population living in communities surrounding Block Island Sound is small compared to the population surrounding Long Island Sound. There are approximately 77,100 residents in Rhode Island's southern four towns that border Block Island Sound: Narragansett (15,900), South Kingstown (30,600), Charlestown (7,800), and Westerly (22,800) (2010 census). Other communities surrounding Block Island Sound include Block Island (approximately 1,000 residents), the Town of Montauk, New York (approximately 3,000 residents), and Fishers Island (less than 300 residents) (2010 census).

Block Island is located approximately 8 nmi (15 km) south of the coast of Rhode Island and 12 nmi (23 km) east of Montauk Point, New York. The roughly pear-shaped island is 5.6 miles (9.0 km) long and up to 3.5 miles (5.6 km) wide. The largest community is New Shoreham on the eastern side of the island.

Gardiners Island is located along the western edge of Block Island Sound. The island is 6 miles (9.7 km) long and 3 miles (4.8 km) wide. The island has been owned by the Gardiner family for nearly 400 years.

4.1.3 New London Alternative

As described in Section 3.4.3, the New London Alternative includes the active New London dredged material disposal site (NLDS), currently used for dredged material disposal, and two areas to the west of the NLDS (Sites NL-Wa and NL-Wb). These two areas would provide additional capacity for accommodating the needs for dredged material disposal over the next 30 years (see Section 3.4.2.3).

The NLDS is located to the south of the mouth of Thames River. Specifically, the site is located approximately 1.6 nmi (3.0 km) to the southeast of Goshen Point, Connecticut, and 1.4 nmi (2.6 km) west of Fishers Island, New York. It has a square area of 1 nmi^2 (3.4 km^2) centered at 41°16.306' N, 72°04.571' W (NAD83) (USACE, 2014).

Site NL-Wa is located immediately adjacent to the NLDS. It also has a square area of 1 nmi^2 (3.4 km^2) centered at 41°16.306' N, 72°05.898' W (NAD83). Site NL-Wb is a 0.5 nmi^2 (1.7 km^2) rectangular area that extends 0.5 nmi (0.9 km) from east to west, and 1 nmi (1.8 km) from north to south. It is centered at 41°16.306' N, 72°06.892' W (NAD83). Sites NL-Wa/b are located 1.2 nmi (2.2 km) to the south of Goshen Point.

4.1.4 Niantic Bay Alternative

The Niantic Bay Alternative includes the historically used Niantic Bay dredged material disposal site (NBDS) and an area east of the NBDS (Site NB-E). The NBDS has a square area of 1.33 nmi^2 (2.5 km^2). It is located to the south of Niantic Bay, centered at 41°16.000' N, 72°11.000' W (NAD83), and was used for dredged material disposal between 1969 and 1972 (Oceanic Society, 1982); it is not an active disposal site at this time. The NBDS is located approximately 0.6 nmi (1.1 km) to the southeast of Black Point, Connecticut.

Site NB-E is located immediately adjacent to the NBDS. It is a 1.0 nmi^2 (1.8 km^2) rectangular area that extends 0.75 nmi (1.4 km) from east to west, and 1.35 nmi (2.5 km) from north to south. It is centered at 41°16.000' N, 72°09.584' W (NAD83). The site is located approximately 1.5 nmi (2.8 km) to the south of Millstone Point in Waterford, Connecticut; 0.65 nmi (1.2 km) to the west of Bartlett Reef (a mostly submerged shoal), and 1 nmi (1.8 km) to the south of Twotree Island.

4.1.5 Cornfield Shoals Alternative

The Cornfield Shoals Alternative is the active CSDS. The site has a square area of 1 nmi^2 (3.4 km^2) centered at 41°12.686' N, 72°21.491' W (NAD83) (USACE, 2014). The boundary of the site is located 2.6 nmi (4.8 km) south of Cornfield Point in Old Saybrook, Connecticut, and approximately 4.0 nmi (7.4 km) north of Rocky Point in East Marion, New York. The CSDS is located approximately 13 nmi (24 km) to the west of the active NLDS.

4.2 Bathymetry (Water Depth)

Bathymetry affects issues such as the behavior of tidal currents, erosion of the seabed from waves, and the storage capacity for dredged material. This section describes the bathymetry of Long Island Sound, Block Island Sound, and the three alternative sites. Information on the bathymetry for Fishers Island Sound is included in the section for Long Island Sound.

The analysis in this SEIS used primarily bathymetric data collected by the USGS in cooperation with NOAA between 2004 and 2009. Based on these data, these agencies produced detailed maps of the seafloor in Long Island Sound and Block Island Sound (*e.g.*, Poppe et al., 2011; 2012; 2014). The USGS/NOAA data were acquired primarily by multibeam echo-sounders[1] mounted underneath the ship's hull. The bathymetry in shallower nearshore waters in the vicinity of New London and Niantic Bay was surveyed in 2004 using hydrographic Light Detection and Ranging (LIDAR[2]) technology (Poppe et al., 2010). The multibeam and LIDAR data from individual surveys were integrated into a single data set that covers much of eastern Long Island Sound and Block Island Sound (Figures 4-2 and 4-3). The processed data show the topographic variability of the seafloor as well as sedimentary structures on the seafloor that provide information about sediment transport processes. A more detailed analysis of sediment transport in eastern Long Island Sound region was conducted as part of a physical oceanographic study for this SEIS (see Appendix C).

Other bathymetric data considered in this SEIS include data collected by the DAMOS program at the two active disposal sites, the NLDS and CSDS (*e.g.,* ENSR, 2005; AECOM, 2009).

4.2.1 Long Island Sound

The bottom topography in Long Island Sound is characterized by the three broad relatively flat basins bounded by shoal complexes, described in Section 4.1.1. Compared to western and central Long Island Sound, eastern Long Island Sound is comparatively deep. Much of the seafloor in eastern Long Island Sound consists of an east-west trending depression with depths ranging from 100 to 200 feet (30 to 60 meters). The bottom topography is irregular due to submerged reefs and shoals, exposed bedrock, and scoured areas (Figure 4-3). Depressions in Long Island Sound formed as a result of erosion of sediment by tidal currents. Shoals are either areas of sediment deposition (such as the Mattituck Sill), or glacial deposits of rocks and boulders.

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[1] The multibeam echosounding data were primarily collected with hull-mounted RESON SeaBat 8101 and 8125 shallow-water systems aboard launches, and a RESON 7125 system aboard the NOAA ship *Thomas Jefferson*.

[2] LIDAR technology measures elevation or depth by analyzing the reflection of pulses of laser light off an object. It is typically mounted on aircraft and can measure elevations on land as well as in water bodies to depths up to 164 feet (50 m) depending on water clarity. Bathymetric LIDAR is particularly useful in shallow waters and in areas with complex and rugged coastlines where surface vessels cannot operate efficiently or safely.

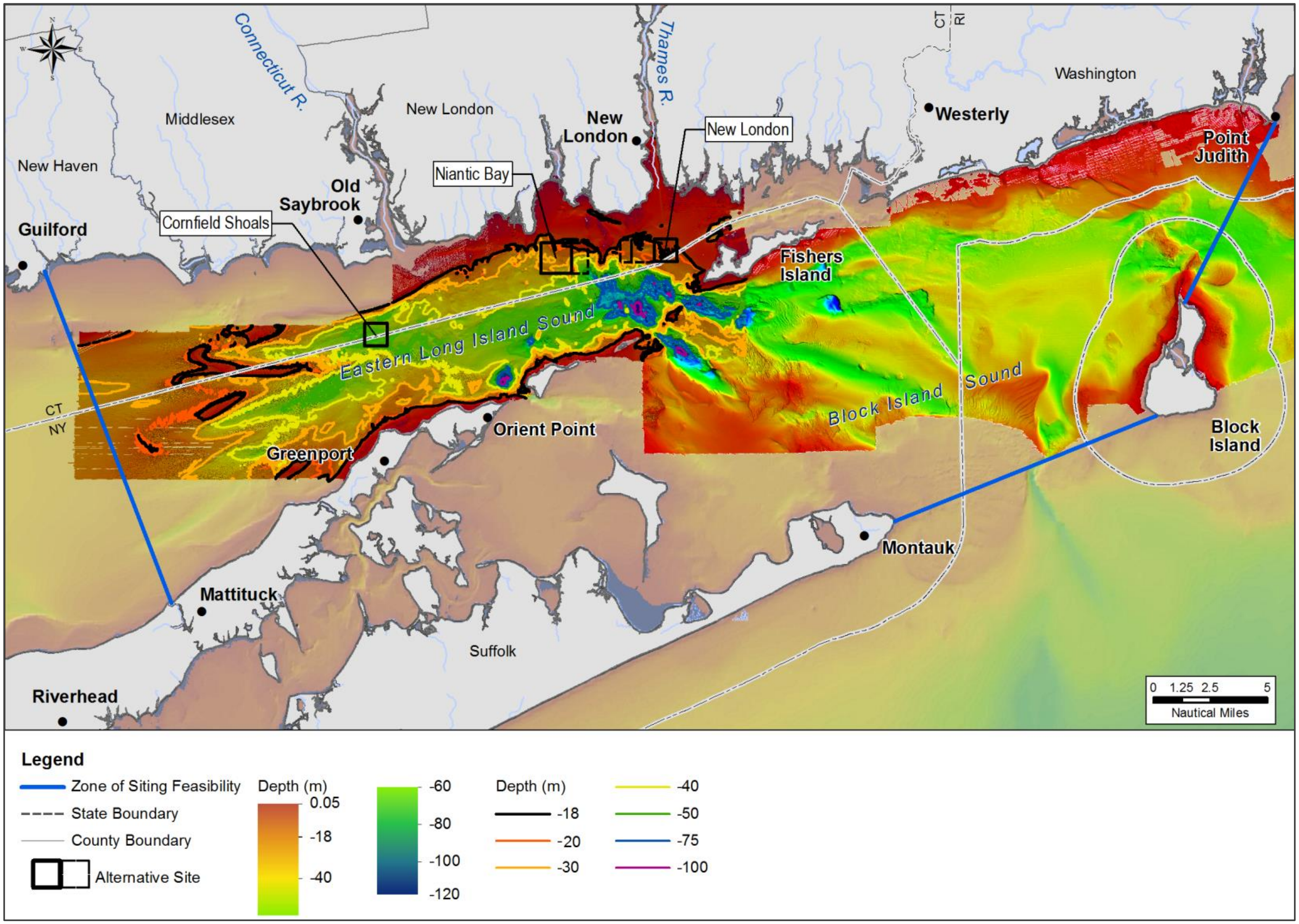


Figure 4-2. Bathymetry of eastern Long Island Sound and Block Island Sound, based on USGS/NOAA data from surveys between 2004 and 2009 (brighter colors) and other NOAA bathymetric data (lighter colors).

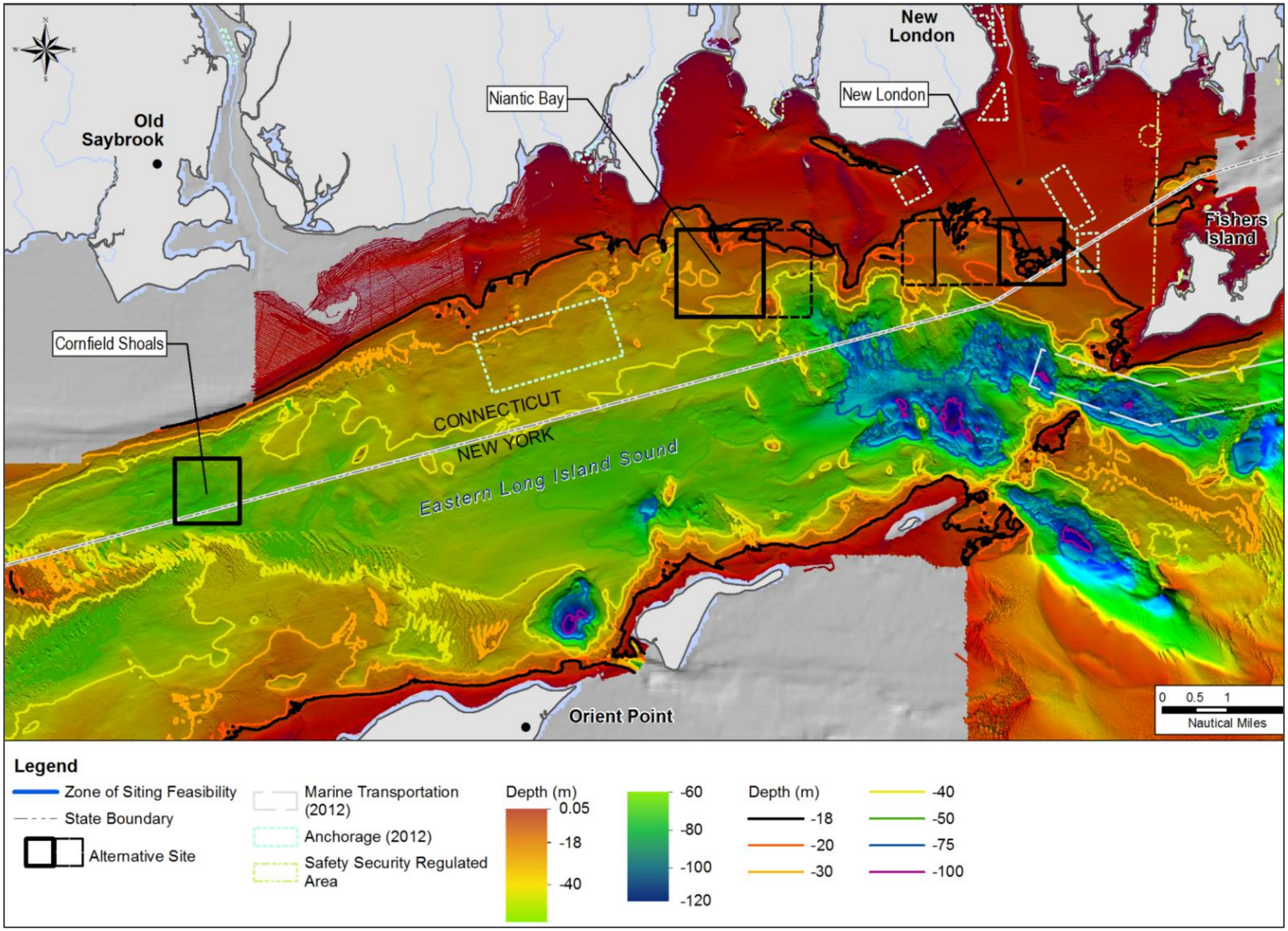


Figure 4-3. Enlarged view of bathymetry of eastern Long Island Sound. USGS/NOAA bathymetry data are not available in gray areas.

Eastern Long Island Sound increasingly narrows and deepens toward the east and has stronger tidal currents that scoured the seafloor. Water enters Long Island Sound from Block Island Sound through two deep elongate depressions (The Race), located between Fishers Island and Little Gull Island. These depressions reach a maximum water depth of approximately 330 feet (101 m) on the Long Island Sound side.

Another depression exists just to the northwest of Plum Gut, the passage between Orient Point and Plum Island, scoured out by tidal currents. This near-circular shaped depression reaches a water depth of approximately 340 feet (104 m).

In the west, eastern Long Island Sound is bounded by the shallow Mattituck Sill, the shoal that extends between Westbrook, Connecticut, and Mattituck, New York. The Mattituck Sill is approximately 1.5 to 6.5 nmi (3 to 12 km) wide and lies at a water depth of approximately 43 to 80 feet (13 to 24 m) (Whitney et al., 2014).

Along the coast, eastern Long Island Sound is shallow, particularly along Connecticut's shoreline. Fishers Island Sound to the east of Long Island Sound is also comparatively shallow. Although the maximum water depth is 104 feet (32 m), most of Fishers Island Sound is shallower than 59 feet (18 m), which was used as the minimum water depth during Tier 1 site screening (see Section 3.4.2.1).

4.2.2 Block Island Sound

Compared to Long Island Sound, the Block Island Sound is fairly flat with water depths of approximately 100 feet (30 m), gradually shoaling in the north along the Rhode Island coast. However, Block Island Sound contains several topographic features.

The western part of Block Island Sound includes several broad channels between the Atlantic Ocean and The Race in the northwestern corner of Block Island Sound. The Race and the channels are scoured by tidal waters flowing in and out of Long Island Sound. These channels contain three deep depressions (or "holes"), all located south of Fishers Island. These holes range in maximum depths from approximately 240 to 330 feet (73 to 101 m); they were considered during the site screening process (see Section 3.4.2.3 for additional information). The maximum depth of The Race on the Block Island Sound side is 340 feet (104 m).

The southern part of Block Island Sound between Montauk Point and Block Island consists of a shoal area that is bisected by a narrow channel in its center. The western part of the shoal area, Montauk Point Shoals, is a broad platform with water depths of between approximately 30 and 60 feet (9 and 18 m). The eastern part of the shoal area, Southwest Ledge, located southwest of Block Island, has water depths of between approximately 20 and 50 feet (6 and 15 m). The narrow channel separating these two shoal areas reaches a water depth of up to 200 feet (61 m).

4.2.3 New London Alternative

The seafloor at the active NLDS slopes down toward the south; depths range from 46 feet (14 m) in the center of the site to 79 feet (24 m) at its southern boundary. The site has well-defined dredged material mounds, shown in regular bathymetric surveys by the DAMOS program (*e.g.*, AECOM 2009; 2012) and by the USGS/NOAA bathymetric survey (Figure 4-4). The seafloor surface of the northern half and part of the southern half of the NLDS is irregular due to the presence of distinct dredged material disposal mounds. In areas without mounds (*i.e.*, near the westernmost and southeastern parts of the site), the seafloor is comparatively flat. The seafloor of most of Site NL-Wa is also comparatively flat, with water depths predominantly between 60 and 80 feet (18 and 30 m). However, the seafloor is shallower and more irregular in the boulder area in the north-central part of the site, where water depths range from approximately 45 to 66 feet (14 to 20 m). Near the southern boundary of Site NL-Wa the seafloor slopes down to water depths of approximately 137 feet (42 m). The seafloor at Site NL-Wb is similar to the flat part of Site NL-Wa. Water depths range from approximately 60 to 80 feet (18 to 30 m), with depths increasing to 95 feet (30 m) at its southern end.

4.2.4 Niantic Bay Alternative

The seafloor at the NBDS slopes down toward the south (Figure 4-5). Water depths range from approximately 50 feet (15 m) in the north to 120 feet (37 m) in the south. Depths vary slightly in the boulder and bedrock areas in the north-central part and the southeastern corner of the site where depths are more irregular. Sidescan sonar images (WHG, 2014) and USGS/NOAA bathymetry data (Figure 4-5) do not show any topographic features indicative of dredged material disposal. The seafloor at Site NB-E also slopes down toward the south, but to a greater extent. Water depths range from approximately 43 feet (13 m) in the north to 230 feet (70 m) in the southeast. The water depth of the bedrock/boulder area in the southwestern corner of Site NB-E is 60 feet (18 m) at its shallow point.

4.2.5 Cornfield Shoals Alternative

The seafloor at the CSDS is comparatively flat. Water depths at the CSDS range from 151 to 187 feet (46 to 57 m) (Figure 4-6). The USACE has monitored the site periodically since 1978 as part of DAMOS program. Well-defined dredged material mounds were not detected by bathymetric surveys performed in 1978, 1987, and 1990, 1992, 1994, and 2004 (NUSC, 1979; SAIC, 1994, 1996a, 1996b; ENSR, 2005), although the sediment survey in 1990 detected fine-grained dredged material near the center of the site. Only some remnants of dredged material were identified by the 2009 USGS/NOAA bathymetric survey data with the largest mound extending 3.7 feet (1.1 m) above the surrounding seafloor (Poppe et al., 2013). A broad field of sand waves extends in an east-west direction to the south of the CSDS.

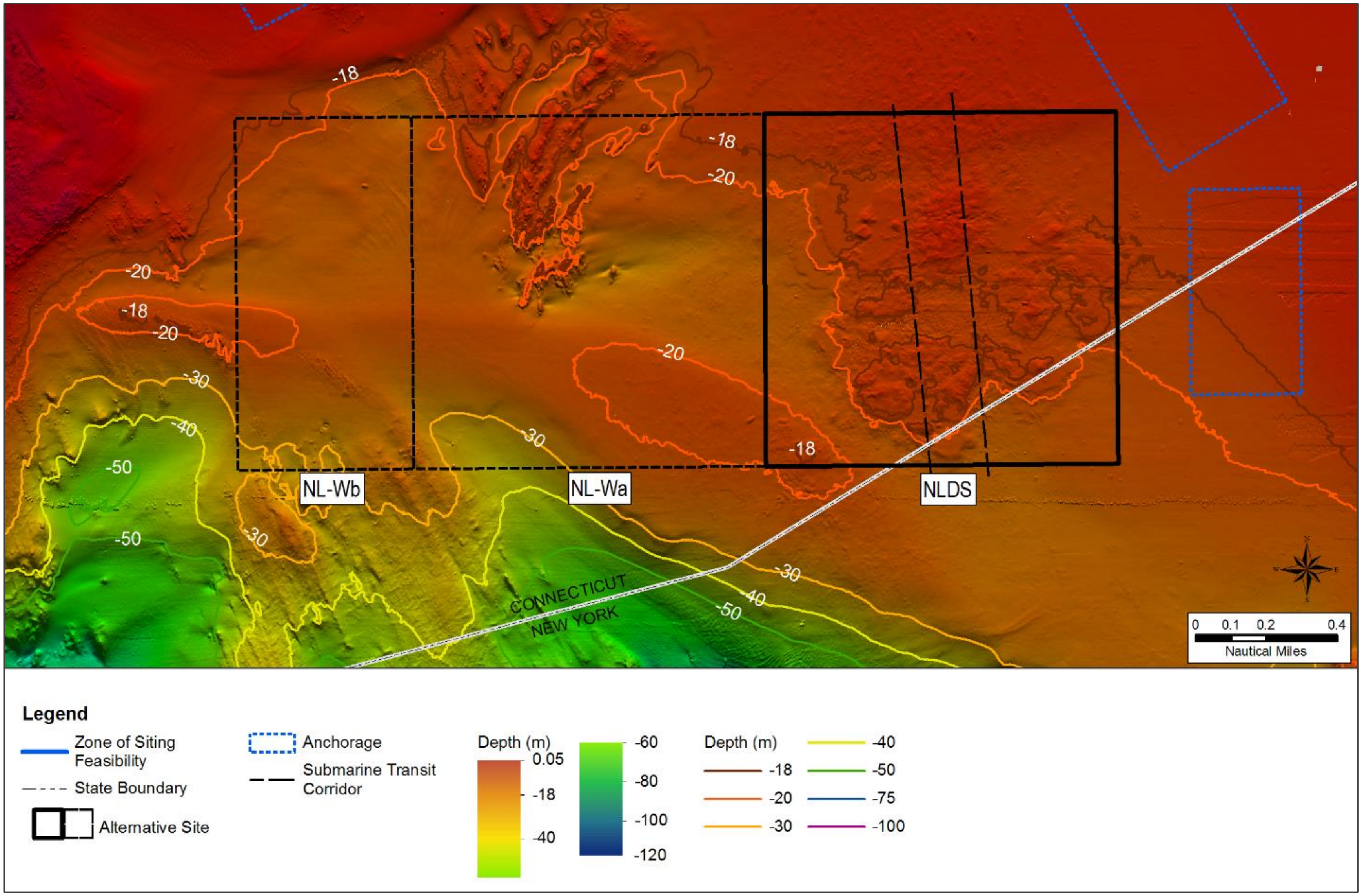


Figure 4-4. Bathymetry of the New London Alternative, based on USGS/NOAA data collected between 2004 and 2009 (Poppe et al., 2011).

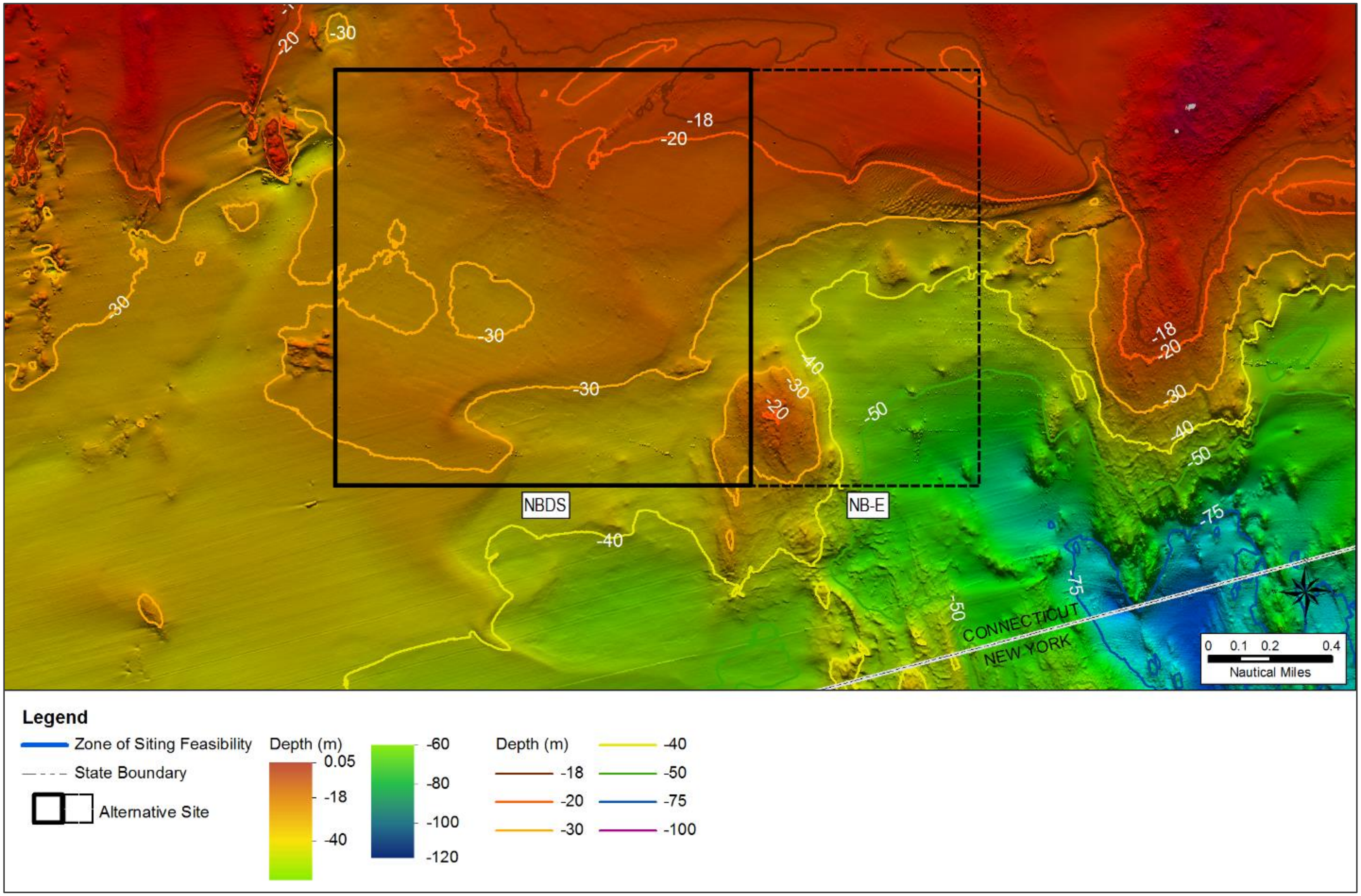


Figure 4-5. Bathymetry at the Niantic Bay Alternative, based on USGS/NOAA data collected between 2004 and 2009 (Poppe et al., 2011).

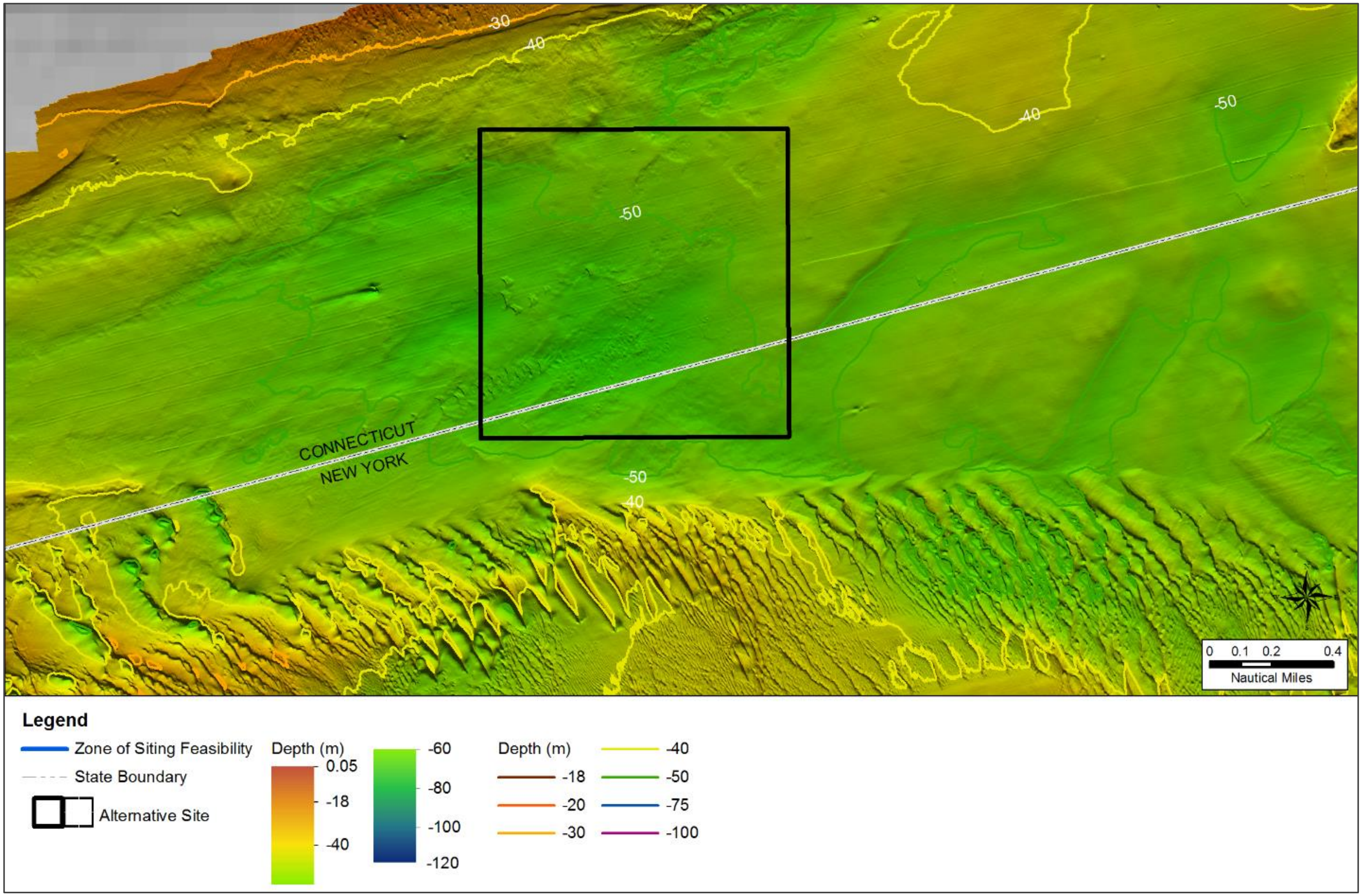


Figure 4-6. Bathymetry at the Cornfield Shoals Alternative, based on USGS/NOAA data collected between 2004 and 2009 (Poppe et al., 2011).

4.3 Geological Setting and Geomorphology

This section describes the geological setting and geomorphology of Long Island Sound, Block Island Sound, and the three alternative sites. Additional information was available through the USGS/NOAA bathymetric data, sediment samples, and bottom photographs (*e.g.*, Poppe et al., 2011; 2012; 2014). The site-specific discussion also incorporates results of field studies conducted in support of this SEIS, including the sidescan sonar survey (WHG, 2014), sediment investigations (Tetra Tech, 2014; Louis Berger and UCONN, 2015), and seafloor habitat investigations by the DAMOS program (Carey and Bellagamba Fucile, 2015); reports of these studies are provided in Appendices D to G.

The geomorphology of eastern Long Island Sound and Block Island Sound was formed during the Quaternary Period, which was dominated by glacial advances and retreats followed by submergence of the region due to sea level rise (*e.g.*, Lewis, 2014). The area was glaciated during two advances in the late Wisconsin glaciation. The first advance (24,000-20,000 years before the present [BP]) resulted in a long terminal moraine extending from Nantucket to central Long Island, which includes the now submerged shoals between Montauk and Block Island. The second advance (18,000 years BP) resulted in a terminal moraine between Point Judith and the north shore of Long Island, including Fishers Island, Great and Little Gull Islands, and Plum Island (Larson, 1982). Glaciolacustrine and marine deltaic deposits at the eastern end of Long Island Sound were subsequently eroded, sorted and transported westward (Knebel and Poppe, 2000; Lewis and DiGiacomo-Cohen, 2000), which resulted in the current geomorphology of the region.

4.3.1 Long Island Sound

The present-day geomorphology in Long Island Sound is characterized by the three broad and relatively flat basins separated by shoals in the western and central part of the Sound, as described above. In addition, in eastern Long Island Sound, the USGS/NOAA bathymetry data revealed detailed geological and geomorphological features such as bedrock outcrops, boulder deposits of submerged moraines, sand-wave fields, and scour depressions that reflect the effects of tidal currents (Poppe et al., 2011, and references therein):

- *Bedrock outcrops and glacial moraines:* Tidal- and storm-driven currents over the past 15,000 years have removed or winnowed much of the sediment that once filled the area and exposed bedrock outcrops and produced lag deposits of boulders in the northeastern part of eastern Long Island Sound (*e.g.*, Bartlett Reef) and along its shallow edge along the Long Island shoreline.
- *Scour:* Constricted tidal flow has resulted in high-energy sedimentary environments dominated by processes associated with erosion and non-deposition and have produced large scour depressions adjacent to The Race and at the northern entrance to Plum Gut. Sedimentary features include also gravel armors on the seafloor.
- *Sand waves:* Sedimentary environments in the western part of the eastern Long Island Sound are dominated by coarse bedload transport and by sands and gravelly sands as the predominant sediment types. Common bedforms include fields of sand waves and large

ripples ("megaripples"). Sand waves are higher than 3 feet (1 m); megaripples are 0.7 to 3 feet (0.2 to 1 m) high. Sand waves and megaripples are best developed where constrictions for tidal flows widen, energy levels drop, and processes that characterize the sedimentary environments change from those dominated by erosion and nondeposition to those associated with coarse-bedload transport. The geometry of the sand waves indicates net sediment transport toward the west and southwest.

- *Gravel pavement:* Parts of the seafloor in eastern Long Island Sound is relatively flat and featureless, as strong tidal currents prevent the deposition of marine sediments and erode the finer grain size fractions in the sediments. This process leaves exposed lag deposits of gravel and gravelly sand that armor the seafloor. Larger sessile benthic organisms were not observed on these gravel pavements, suggesting periodic mobilization of the gravel.

4.3.2 Block Island Sound

As for Long Island Sound, retreating glaciers resulted in thick deposits of fine-grained sediments between the moraines and the melting glacier in the area now occupied by Block Island Sound (*e.g.*, Bertoni et al., 1977; Needell and Lewis, 1985; Poppe et al., 2006). Surface sediments across much of Block Island Sound consist of sand (Poppe et al., 2012), except in high-energy sedimentary environments where surface sediments are dominated by boulders and gravel. Coarser-grained sediments are more common in the western part of Block Island Sound between Fishers Island and Gardiners Island, around Montauk Point, and to the north near the coast of Rhode Island (Poppe et al., 2000). Sedimentary bedforms in sandy areas of Block Island Sound include sand waves and megaripples such as in the western part of Block Island Sound near The Race and in southeastern Block Island Sound near Block Channel (Poppe et al., 2014).

4.3.3 New London Alternative

Surface sediments at the NLDS consist of natural sediment and disposed dredged materials. Dominant grain sizes vary from sand to silt and clay at various locations within the site (see Section 4.6 for details). The rough, hummocky topography of the NLDS indicates that disposed dredged material remains on site, as also reflected in bathymetry surveys as part of the DAMOS program (*e.g.*, AECOM, 2009). Site NL-Wa consists of mostly sandy areas, but also an area of boulders to the north. The boulder area is relatively concentrated, with boulders and rocks varying in size (WHG, 2014). Site NL-Wb consists of an almost uniformly sandy area. The southeastern part contains the northernmost extent of an area of exposed ice-sculpted bedrock. As described in Poppe et al. (2011), the bedrock reflects parallel ridges of layered rock that can be correlated to bedrock on shore. The bedrock area contains some boulders and sand waves (WHG, 2014).

Bartlett Reef is located approximately 0.75 nmi (1.4 km) to the west of Site NL-Wb. The reef extends to the south as a submerged sand ridge, with the crest of the ridge deepening toward the south.

4.3.4 Niantic Bay Alternative

Sediments at the site consist of mostly sand (see Section 4.6 for details). There is a boulder area in the north-central part of the NBDS (Poppe et al., 1998; WHG, 2014) and a broad scour depression in the south (Figure 4-5). The southwestern corner of Site NB-E contains a bedrock area.

4.3.5 Cornfield Shoals Alternative

Surface sediments at the CSDS consist predominantly of sand (see Section 4.6 for details). Bottom currents are directed in an east-west direction. This direction is consistent with the orientation of the shallow Long Sand Shoal, located approximately 0.5 nmi (1 km) to the north of the alternative site, and 2 nmi (3.5 km) to the south the mouth of the Connecticut River. The elongate shoal is 6 nmi (11 km) long and up to about 1,500 feet (450 m) wide, with a minimum water depth over the shoal of approximately 8 feet (2.4 m) (Williams, 1981). This shoal forms a constriction that accelerates and focuses currents in an east-west direction. Crescent-shaped dunes ("barchan dunes") near the center of the CSDS (Figure 4-7) also indicate a net sediment transport direction to the west.

Between 1994 and 2004, approximately 438,000 cy (335,000 m^3) of dredged material was placed at the center of CSDS (ENSR, 2005). A comparison of the data from 1994 and 2004 bathymetric surveys, performed under the DAMOS program, indicated that limited sediment accretion of less than 3.1 feet (1 m) in thickness was present to the west of the disposal location and limited erosion was observed to the east. ENSR considered the sediment erosion and accretion pattern and the lack of a distinct mound at CSDS consistent with the dispersive nature of this site and the dominant east-west transport orientation.

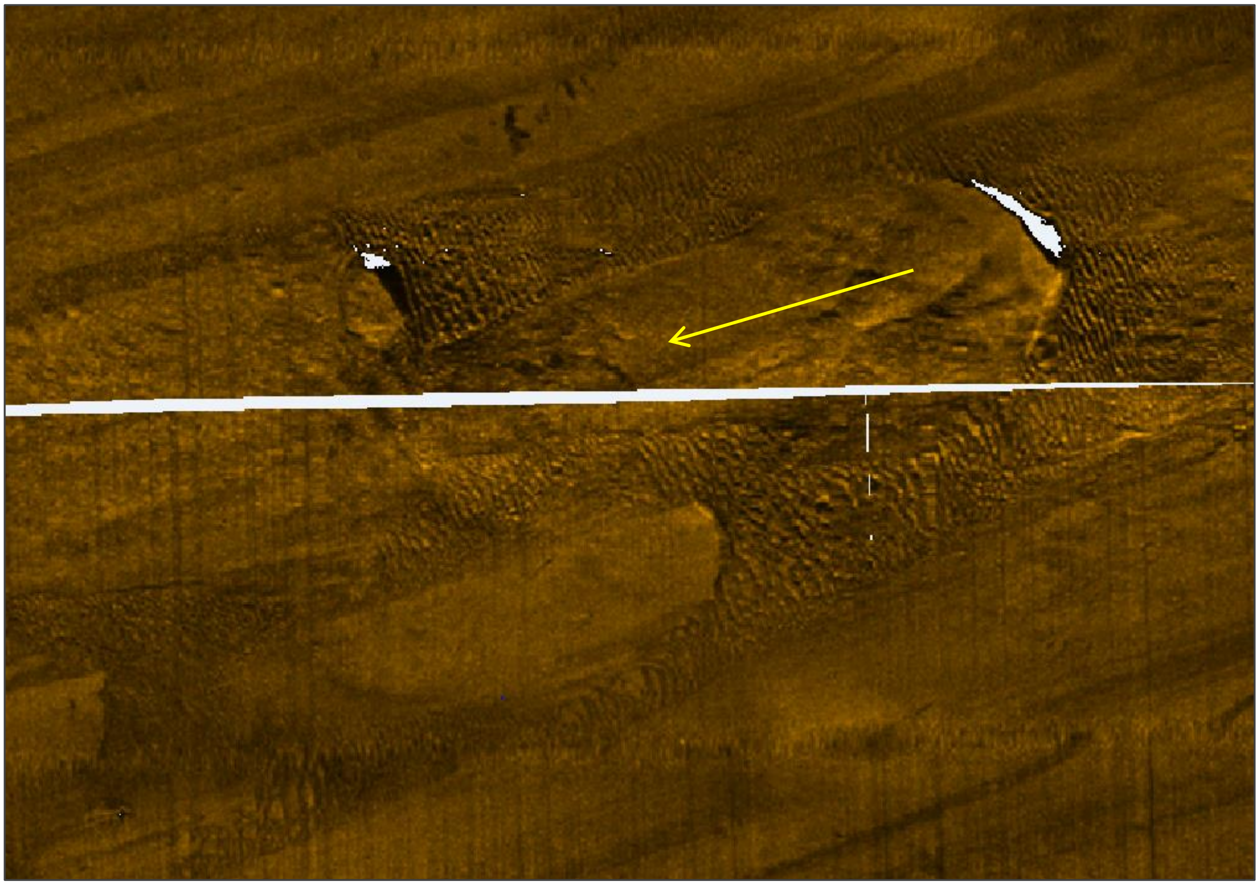


Figure 4-7. Sidescan sonar image of crescent-shaped dunes at the CSDS (*i.e.*, the Cornfield Shoals Alternative) (data obtained by USEPA [WHG, 2014]). The shape of the dunes indicates sediment transport to the west. The length of the arrow represents a distance of approximately 300 feet (92 m).

4.4 Meteorology

The transport and dispersion of sediment in the marine environment depend upon the physical characteristics of the sediment and the structure and dynamics of the water column. The physical parameters that are important in the transport and dispersion of sediment include currents, waves, and the density structure of the water column. Currents directly affect the transport and dispersion of sediment. In shallow water, waves can resuspend sediments previously deposited on the seafloor. These resuspended sediments may then be transported by local currents. The magnitude and pattern of currents are determined by wind, tidal forces, and the distributions of salinity and temperature, which determine the water density. The density structure of seawater relative to the density of the sediment affects the rate of settling of sediment out of the water column to the seafloor. Together, these characteristics of the ocean (waves, density structure, and currents) are commonly termed the physical oceanography (PO).

This section describes the meteorological conditions for the ZSF. Long-term meteorological data were used to describe the seasonal cycles and characteristics of extreme events that occur in the region. Data considered included the following sources:

- Sikorsky Airfield in Bridgeport, Connecticut, archived by the National Climatic Data Center. These data sets include air temperature and hourly measurement of wind at 26 feet (8 m) above ground level since January 1943, a 72-year long record. In addition, long-term records of air temperature were obtained from the Berkeley Earth archive for New London, Connecticut (a 140-year record) (Rohde et al., 2013).

- UCONN buoy “CLIS” located in Central Long Island Sound with the NOAA designation 44037 (Figure 4-8); wind observations are made at 10 feet (3 m) above the sea surface. Data were available for the period from February 2004 to December 2014 at hourly intervals.

- NOAA buoy 44017, located approximately 23 nmi (42 km) to the south southwest of Montauk Point, New York (Figure 4-8); wind observations are made at 16 feet (5 m) above the sea surface. Data were available for the period from September 2002 to December 2014, with a data gap from September 2011 to January 2013.

Long-term data were also compared to meteorological conditions observed during the field program of the physical oceanographic study (Appendix C-1). Part of the field program was designed to resolve the seasonal variability in river discharge and wind conditions in the region. Data were collected during three seasonal field observation periods, referred to hereafter as “campaigns” (Table 4-1).

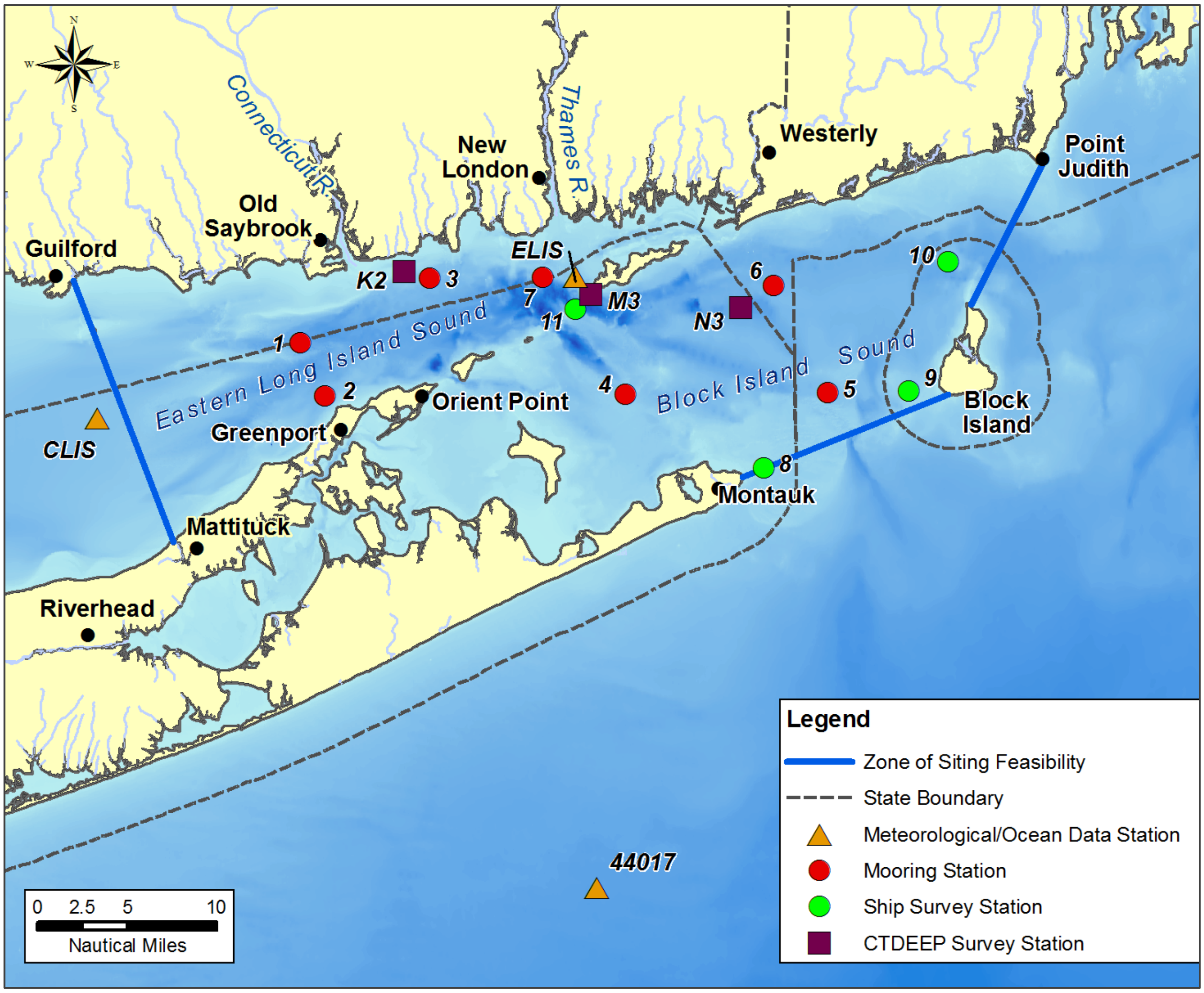


Figure 4-8. Station locations of meteorological/ocean buoys, as well as mooring and ship survey stations used during the field program for the physical oceanographic study and water quality stations sampled by CTDEEP (see discussion in Section 4.5).

Table 4-1. Seasonal Field Observation Periods ("Campaigns")

Campaign	Season	Interval	Conditions	
			River Discharge	Wind
1	Spring	Mar. 12 – May 17, 2013 (*66 days)*	High	High
2	Summer	Jun. 11 – Aug. 8, 2013 *(58 days)*	Low	Low
3	Winter	Nov. 20, 2013 – Jan. 16, 2014 *(57 days)*	Low	High

Source: O'Donnell et al., 2014 (see Appendix C-1)

4.4.1 Air Temperature

The climate in the Long Island Sound and Block Island Sound is typical of the northeastern United States, with hot summers and cold, stormy winters. The annual cycle of air and water temperature is larger than in many other parts of the world. Maximum monthly average air temperatures based on 140 years of observations occur in July at 22 to 23°C (72 to 73°F); minimum monthly average temperatures occur in January or February in the range −2.5 to 0°C (28 to 32°F) (Figure 4-9).

Air temperatures during the physical oceanography study were typical for the region. Specifically, the air temperatures during the spring campaign were almost exactly average conditions. During the summer campaign, June and August air temperatures were close to average conditions while July temperatures were warmer by approximately 2°C (4°F). Air temperatures during the winter campaign were slightly warmer than average.

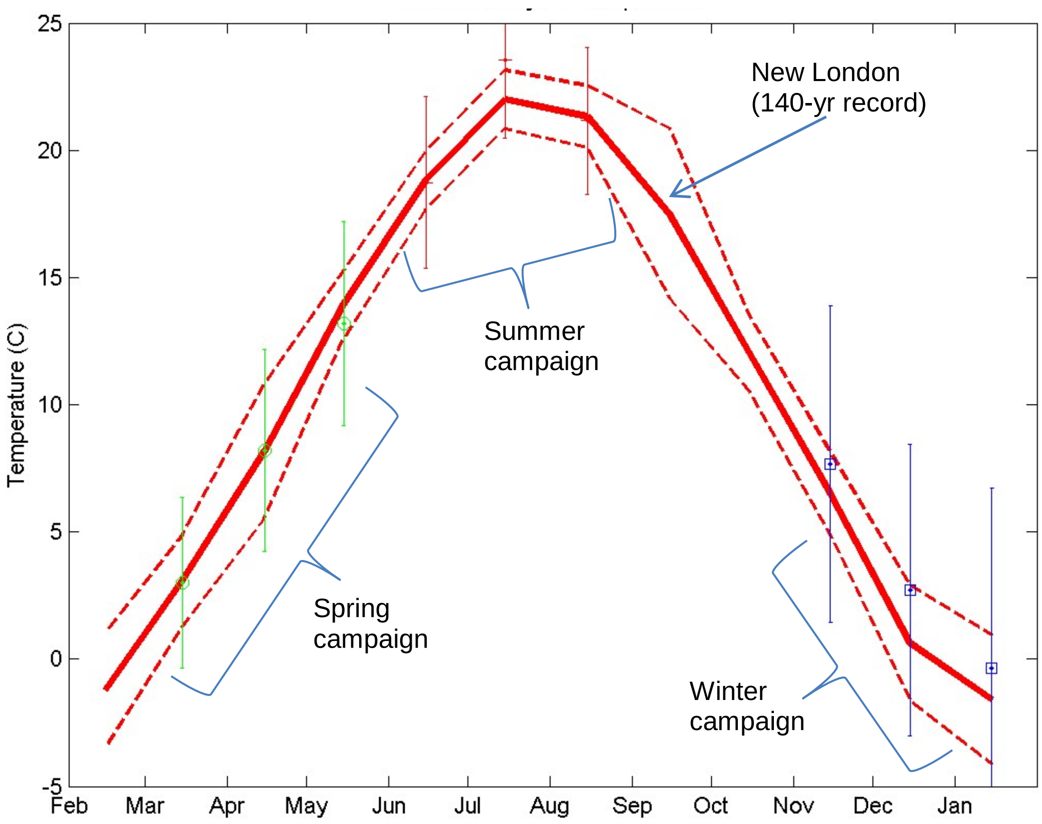


Figure 4-9. Monthly average air temperature in New London (includes ± 1 standard deviation interval shown in red dashed lines). Superimposed are monthly air temperatures (average and standard deviation) during the three seasonal campaigns of the 2013/14 physical oceanography study. (Data sources: Rohde et al., 2013; National Climate Data Center at *ftp://ftp.ncdc.noaa.gov*).

4.4.2 Wind

The wind exerts a stress (a force per unit area) along the surface of the ocean that greatly influences circulation, generation of waves, and the rate of vertical mixing. Consequently, wind can influence sediment resuspension. Long Island Sound and Block Island Sound lie in the latitude band where westerly winds predominate but there is a distinct seasonality to the wind patterns (Isemer and Hasse, 1985). Using all long-term land station data archived by the National Climate Data Center, Klink (1999) showed that the monthly mean surface wind velocity in southern New England were directed to the southeast in winter and to the northeast in summer with much lower speeds. However, the magnitude of the monthly mean surface wind speeds are much smaller than these speeds that occur during energetic wind events that can drive significant circulation.

Wind conditions during the three campaigns of the 2013/14 PO study were compared to the 72 year-long record from Bridgeport Airport (Figures 4-10 to 4-12). Winds in spring are seldom in excess of 10 m/s (22 mph). When storms occur, winds are generally from the east or the northwest. In the summer, wind speeds are seldom in excess of 7.5 m/s (17 mph) and are generally from the southwest (Figure 4-11). During the winter, westerly winds are most frequent. However, when wind speeds are in excess of 10 m/s (22 mph), winds are from the west or northwest. Wind conditions during the three PO study campaigns were similar to the long-term average conditions at the Bridgeport Airport.

Wind conditions during the PO field program in 2013/14 PO study were also compared to the over-water meteorological measurement at NOAA buoy 44017 located on the continental shelf to the southeast of Montauk, New York (Figure 4-8). Overall, wind directions at this buoy were consistent with directions observed at Bridgeport Airport, but wind speeds were higher during all seasons.

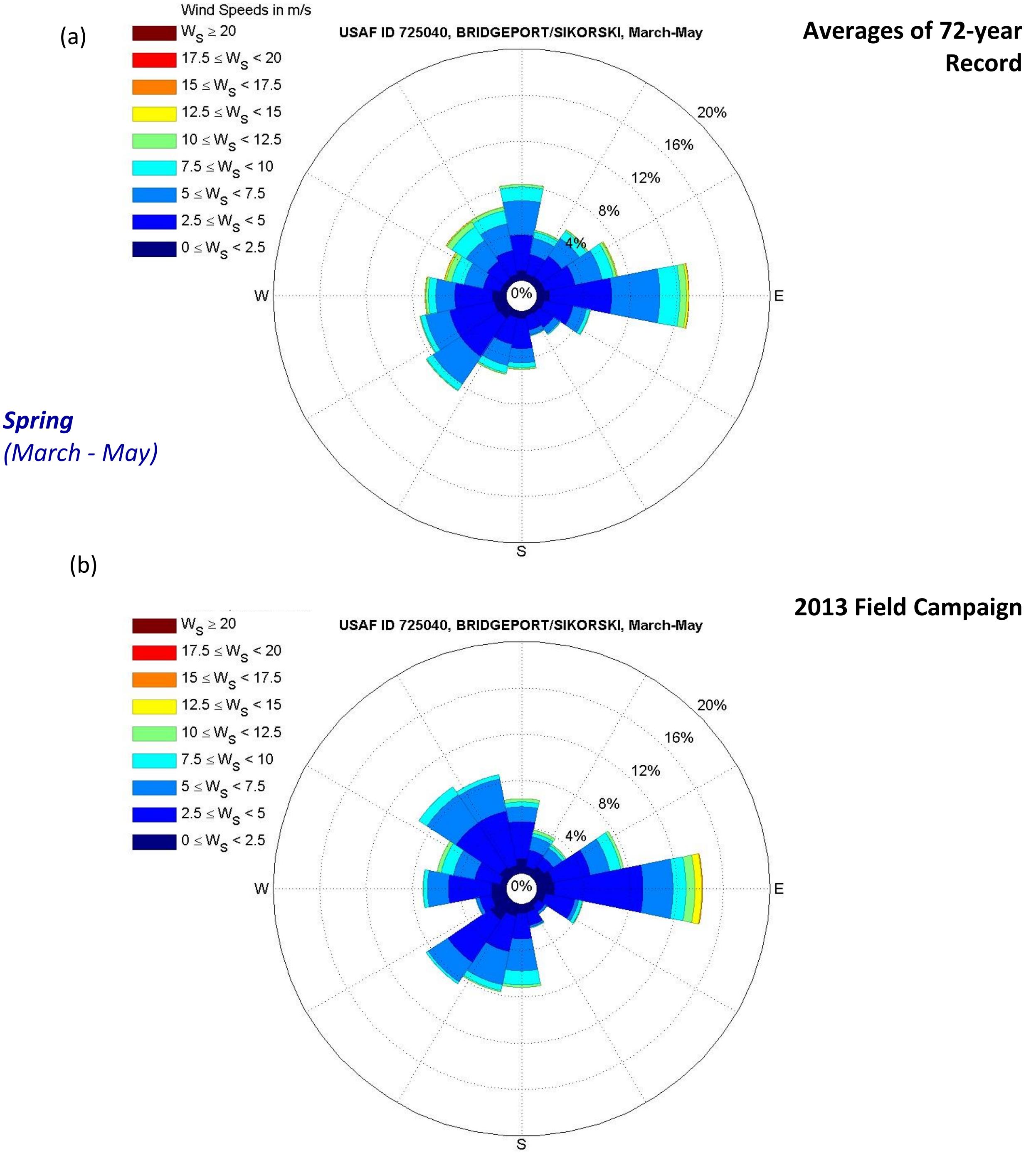
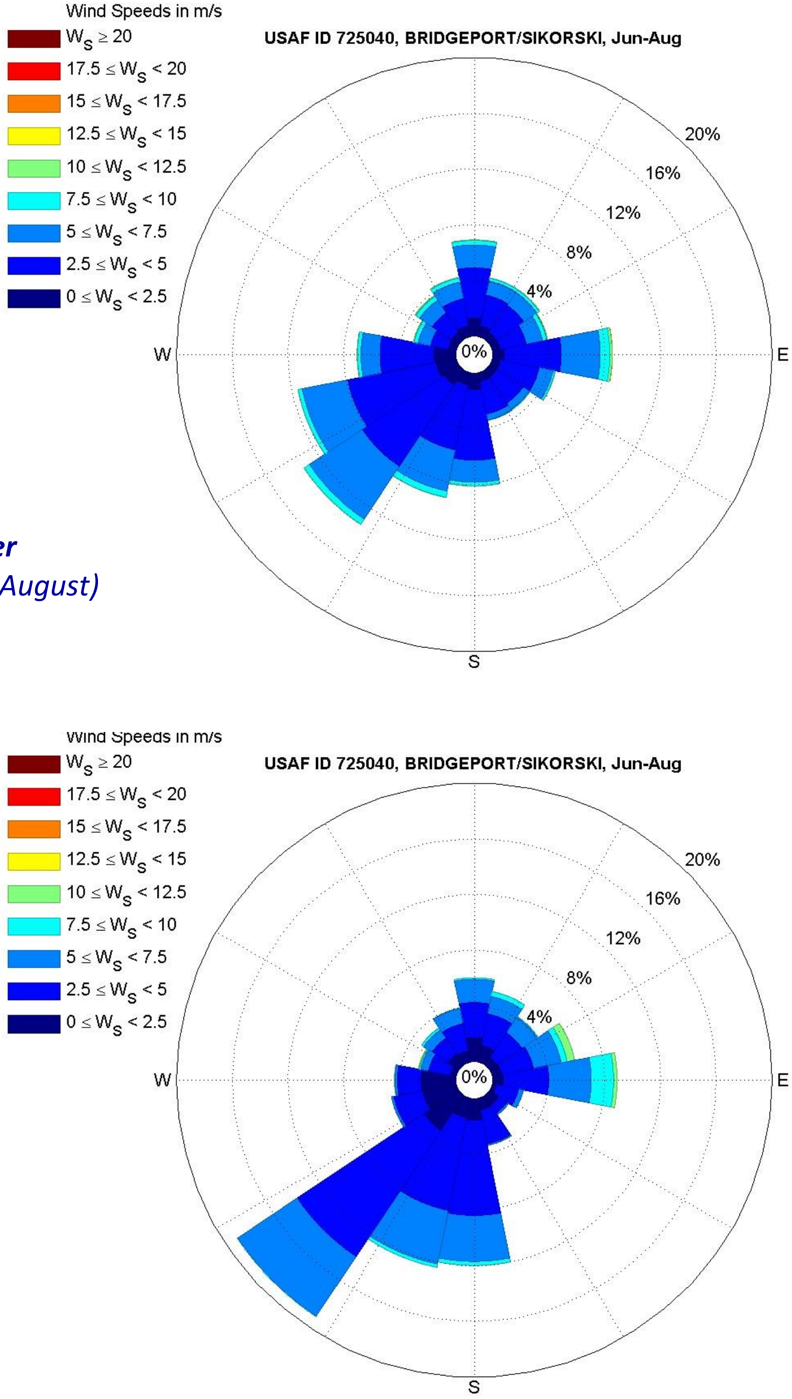


Figure 4-10. Average wind speed and direction at the airport in Bridgeport, Connecticut, during spring (March-May) for (a) the entire 1943 to 2014 record, and (b) for the spring campaign in 2013. The radial extent of the 16 sectors shows the fraction (%) of the observations in which the wind was blowing *from*. The width and color of the rings in each direction represent the fraction of specific wind speeds.

(a)

Averages of 72-year Record



Summer
(June - August)

(b)

2013 Field Campaign

Figure 4-11. Average wind speed and direction at the airport in Bridgeport, Connecticut, during summer (June-August) for (a) the entire 1943 to 2014 record, and (b) for the summer campaign in 2013. The radial extent of the 16 sectors shows the fraction (%) of the observations in which the wind was blowing *from*. The width and color of the rings in each direction represent the fraction of specific wind speeds.

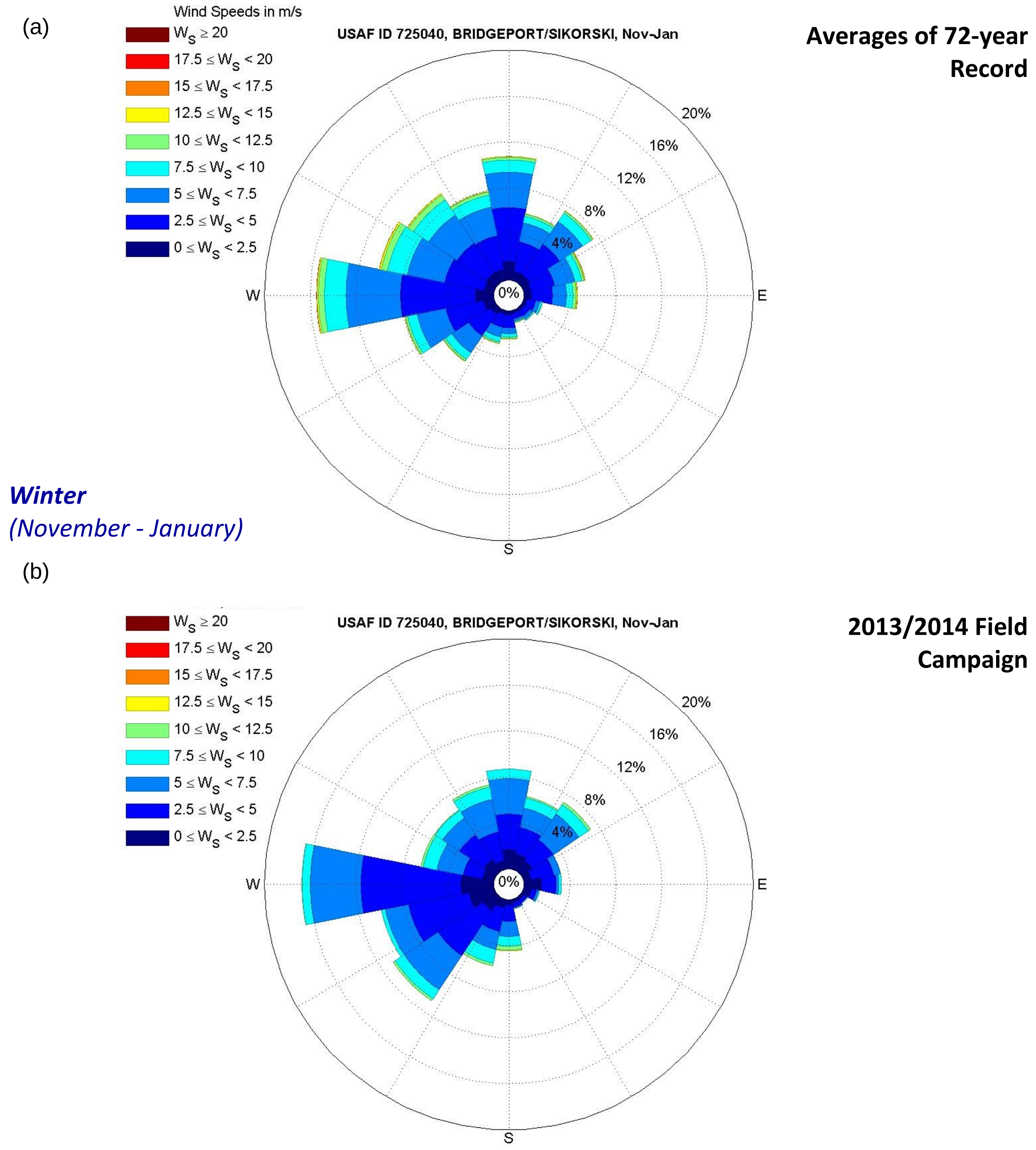


Figure 4-12. Average wind speed and direction at the airport in Bridgeport, Connecticut, during winter (November-January) for (a) the entire 1943 to 2014 record, and (b) for the winter campaign in 2013/14. The radial extent of the 16 sectors shows the fraction (%) of the observations in which the wind was blowing *from*. The width and color of the rings in each direction represent the fraction of specific wind speeds.

4.5 Physical Oceanography

This section describes the physical oceanography of Long Island Sound, Block Island Sound, and the three alternative sites. The description is based on the comprehensive review of the physical oceanography of the Long Island Sound (O'Donnell, 2013) and the summary of conditions in Block Island Sound (Codiga and Ullman, 2010a; 2010b), and (b) the results of the extensive physical oceanography study conducted for this SEIS (Appendix C).

4.5.1 Long Island Sound and Block Island Sound

4.5.1.1 Waves

Waves in Long Island Sound and Block Island Sound are both generated locally by winds and propagated into the Block Island Sound from the Atlantic Ocean. Waves are manifested by surface undulations and sub-surface water parcel orbital motions. The dimensions of the sub-surface orbits and the velocities of the motions vary with wave height and period. They are strongest near the surface and diminish with depth. The motion penetrates deeper in long period waves. The mathematical theory that explains these patterns of motion is well developed and tested. In shallow waters, near-bottom orbital motions can be strong enough to provide enough energy to resuspend bottom sediments. Once suspended, particles may be transported by currents. Therefore, it is important to characterize the statistics of the occurrence of waves in the ZSF.

As part of the physical oceanography study for the SEIS, significant wave heights were recorded at seven mooring stations during three seasonal observation campaigns (Table 4-1; station locations are included in Figure 4-8). Figure 4-13 shows the seasonal time-series of the significant wave heights at the four mooring stations in eastern Long Island Sound (Stations 1, 2, 3, and 7) together with wave measurements at the CLIS buoy. The mean of the measurements in each campaign are indicated by the dashed horizontal lines. The time-series have a high correlation across the region suggesting that the significant wave height in the deeper waters of eastern Long Island Sound is homogeneous. By comparison, Block Island Sound is influenced by waves generated in the Atlantic Ocean, which have larger amplitudes and longer periods.

The data in eastern Long Island Sound reveal that the mean significant wave heights are largest in the winter; maximum wave heights in winter reached approximately 8 feet (2.5 m). These observations are consistent with the 11-year long record from the CLIS buoy located slightly to the west of eastern Long Island Sound. The maximum monthly average significant wave heights at the CLIS buoy occur during the winter as well (Figure 4-14).

Examination of the significant wave height time-series, however, shows that the maximum hourly significant wave heights occur in the late summer and early fall when tropical cyclones influence the winds in southern New England. In recent years, the largest wave heights occurred on August 28-30, 2011 (Tropical Storm Irene[3]) and October 28-31, 2012 (Superstorm Sandy). The significant

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[3] Tropical Storm Irene consisted of the remnants of Hurricane Irene. See Section 4.7 for more details about Irene.

wave heights during these storms peaked at 13 feet (4 m) at the CLIS buoy. The wave periods[4] during these unusual storms are important to sediment transport because the depth to which wave motions extend increases with the wave period. During winter storms the dominant wave periods reach up to 5 or 6 seconds (s) in Long Island Sound; during Tropical Storm Irene and Superstorm Sandy, longer wave periods were observed with values reaching 8 s at the CLIS buoy. These wave periods are too short to substantially modify the potential for sediment erosion (or "bottom stress") in regions of water depth of approximately 66 feet (20 m) (see discussion of bottom stress in Section 4.5.1.2).

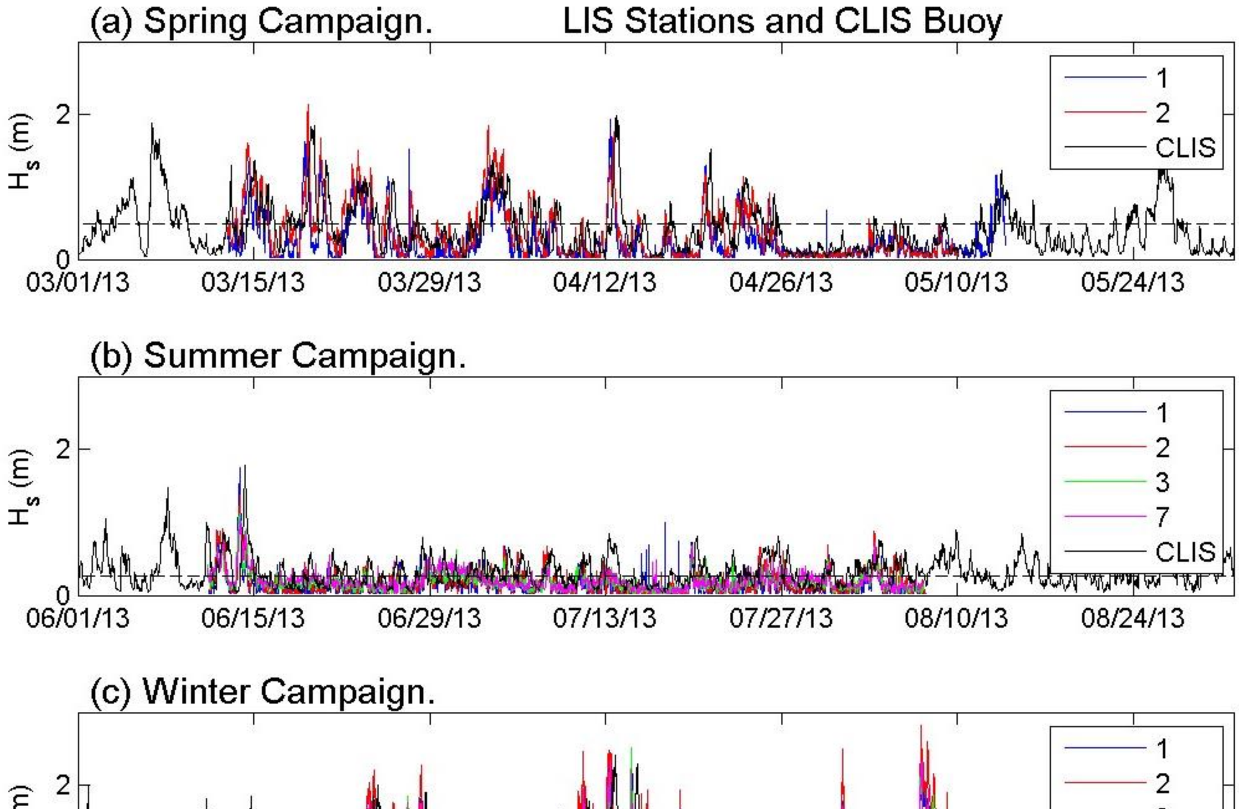

Figure 4-13. Time-series of the significant wave heights (H_s) observed in eastern Long Island Sound during (a) March-May of 2013; (b) June-August of 2013; and (c) November-January of 2013-14. Dashed horizontal lines indicate mean wave heights. Included are also wave heights at the CLIS buoy. Station locations are shown in Figure 4-8.

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[4] A wave period is the time (T) it takes for a complete cycle of a wave to pass a given point in the ocean. As the frequency of a wave increases, the period of the wave decreases.

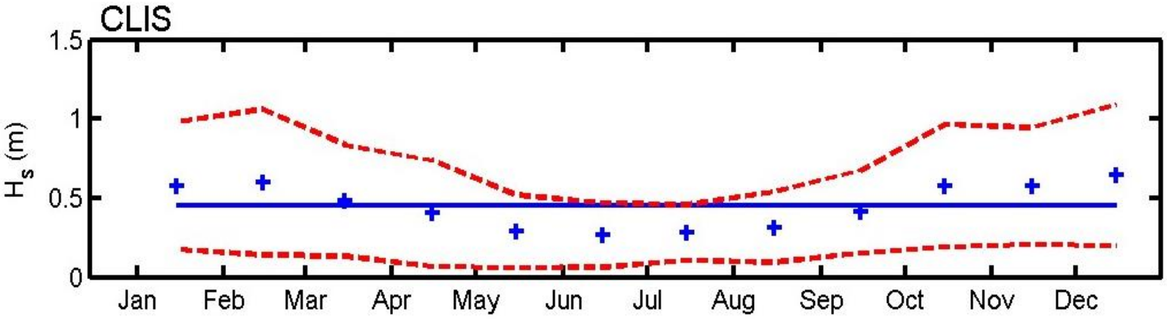

Figure 4-14. Seasonal variation of the significant wave heights (H_S) at the CLIS buoy in Long Island Sound. The '+' symbols show the averages by month; the dashed red lines show the 68 percentile envelope of the observations. The solid blue lines represent the mean of the monthly averages.

To characterize the amplitudes of the largest waves that are likely in the region and to understand the significance of the Superstorm Sandy conditions for Long Island Sound, established methods of extreme value (or return interval) analysis were employed. All approaches assume that the available data characterize the frequency distribution of the significant wave height values. The applied method, the "peak-over-threshold method", allows data to be considered from more than one severe storm each year; this approach maximizes the utility of the limited data available. Using the CLIS buoy data, the 10, 25, 50 and 100-year return wave heights are calculated (Table 4-2). With wave heights reaching 13 feet (4 m), Superstorm Sandy was a 30 year event. The largest waves observed during the PO study (8 feet [2.5 m]) had a return interval of approximately 1 year.

Table 4-2. Return Interval of Significant Wave Heights in Long Island Sound

Return Interval	**Significant Wave Height**	
years	feet	m
10	11.1	3.4
25	12.7	3.9
50	14.1	4.3
100	15.7	4.8

4.5.1.2 Currents and Bottom Stress

Currents in Long Island Sound and Block Island Sound, as in most of the ocean, are driven by three distinct processes: tides, density variations, and wind. Since the pattern and magnitude of the currents influence the stability of bottom sediments and the distribution of particles, a hydrodynamic simulation of the region (a numerical model) was implemented as part of the PO study for this SEIS (Appendix C-2).

Tidal currents near the coast are driven by the rise and fall of the sea level in the Atlantic Ocean which occurs in response to the gravitational forces of the moon and sun. These water level changes in the Atlantic Ocean force the tidal currents within Block Island Sound and Long Island Sound. Throughout southern New England, the influence of the moon on the tidal forcing is the most significant effect and it generates an oscillation with a period of 12.4 hours. Since this is approximately twice a day, this component of the total motion is termed the "M_2" tidal constituent.

The tidal current has oscillatory components in both the east and the north directions; therefore, water parcels tend to move in elliptical paths with varying dimensions and orientations. Figure 4-15 shows tidal current ellipses measured and simulated during the PO study. Longer ellipses indicate faster currents and magnitudes. The orientation of the tidal current ellipses generally trends east-west along the axis of Long Island Sound and the currents are stronger at the eastern end, near The Race. In Block Island Sound, the tidal currents are generally directed toward and away from the ocean through the gap between Montauk Point and Block Island, and there is a substantial reduction of the amplitudes away from this gap in the direction of the Atlantic Ocean.

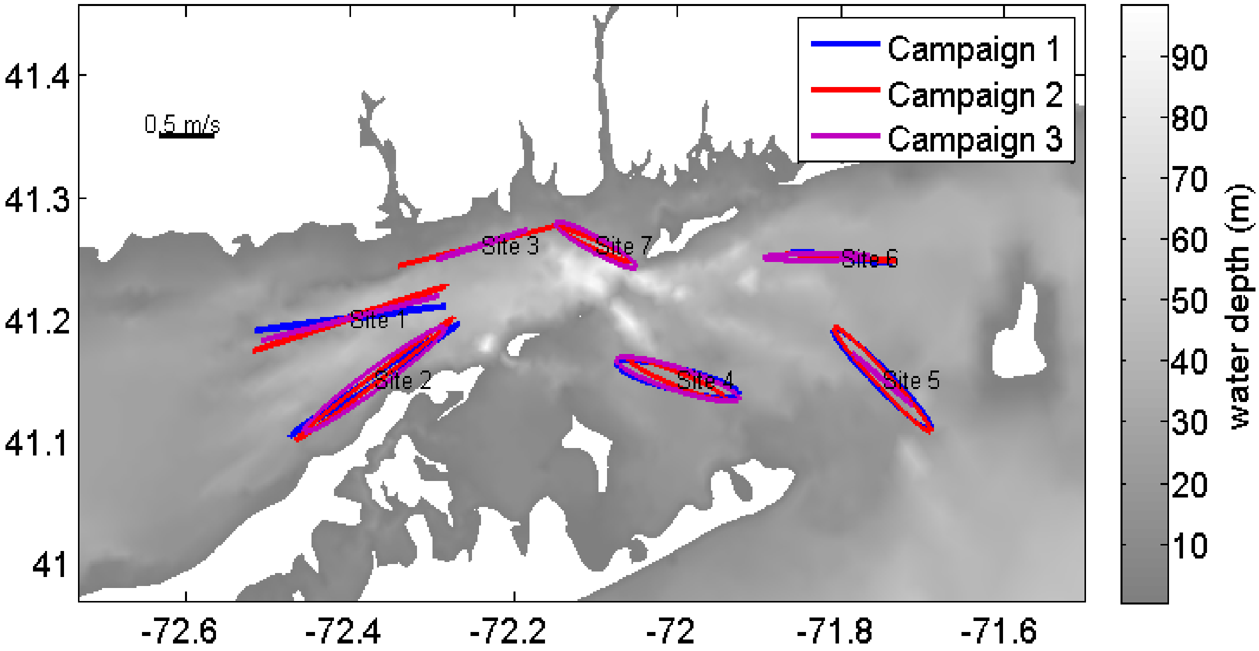

Figure 4-15. M_2 ellipses for depth-averaged velocities from measurements obtained during the spring (blue), summer (red), and winter (purple) campaigns at the seven mooring stations.

The magnitude of the tides also varies vertically throughout the water column with stronger currents occurring near the surface. Peak near-surface tidal currents through The Race are typically 3.9 ft/s (1.2 m/s) and can exceed 5.3 ft/s (1.6 m/s) during spring tides. Westward from The Race, tidal current velocities decrease rapidly as Long Island Sound widens. Tidal currents in the western and central basins are typically only 0.7 to 1.0 ft/s (0.2 to 0.3 m/s). The tidal currents through The Race lead to the rise and fall of the sea surface as water moves into and out of Long Island Sound, and M_2 tidal height amplitudes increase from 2.6 feet (0.8 m) in eastern Long Island Sound to 6.6 feet (2.0 m) in the western Sound (Ianniello, 1981).

Near-bottom currents are most significant to sediment stability since they are in direct contact with sediments on the seabed. These currents are strongest in eastern Long Island Sound, with peak near-bottom velocities of 2.0 to 2.3 ft/s (0.6 to 0.7 m/s) during spring tides. Near-bottom currents weaken toward western Long Island Sound to only 0.7 ft/s (0.2 m/s).

Purely oscillatory tidal currents create no net flow (*i.e.*, they have a mean of zero), but when there are spatial variations in the currents or when the flow interacts with features on the bottom or shoreline, a mean flow (or residual current) remains. This can cause net transport and dispersion of materials. In addition, a gravitationally driven circulation arises from density gradients along Long Island Sound created by the freshwater from rivers. This results in a net flow into Long Island Sound near the bottom and a net flow out of the Sound near the surface. Although these mean flows are much weaker than tidal currents, they are important since they result in the net transport of water masses and fine particles (Signell et al., 2000; O'Donnell, 2013).

An example of the pattern of the mean near-bottom and surface flows in the ZSF in the winter of 2013 is shown in Figure 4-16, as predicted by the model. The mean near-bottom flow in the deeper areas of Block Island Sound was directed westward through The Race into Long Island Sound. The mean flow direction in Fishers Island Sound was also westward. High current velocities occurred near The Race where the flow is constricted. The mean near-bottom flow in Long Island Sound was westward in the deeper areas but was eastward in the shallower areas near the shores of Connecticut and Long Island. The mean near-surface flow was eastward out of Long Island Sound and then southeastward toward the Atlantic Ocean in Block Island Sound. Near-bottom mean flow velocities in the ZSF ranged between 2 and 4 inches/second (5 and 10 cm/s) (Figure 4-17) and were consistent with the patterns predicted by the model. Differences in the near-bottom flow between seasons were mainly in the direction of the currents.

The flow of bottom currents across the seafloor causes turbulent shear stress (referred to as "bottom stress") which exerts a force on the surface sediments; this stress is measured in Pascal (Pa). The distribution and variation of the bottom stress in the ZSF was simulated and directly measured at the seven stations occupied during the PO study. The model and observations were in close agreement.

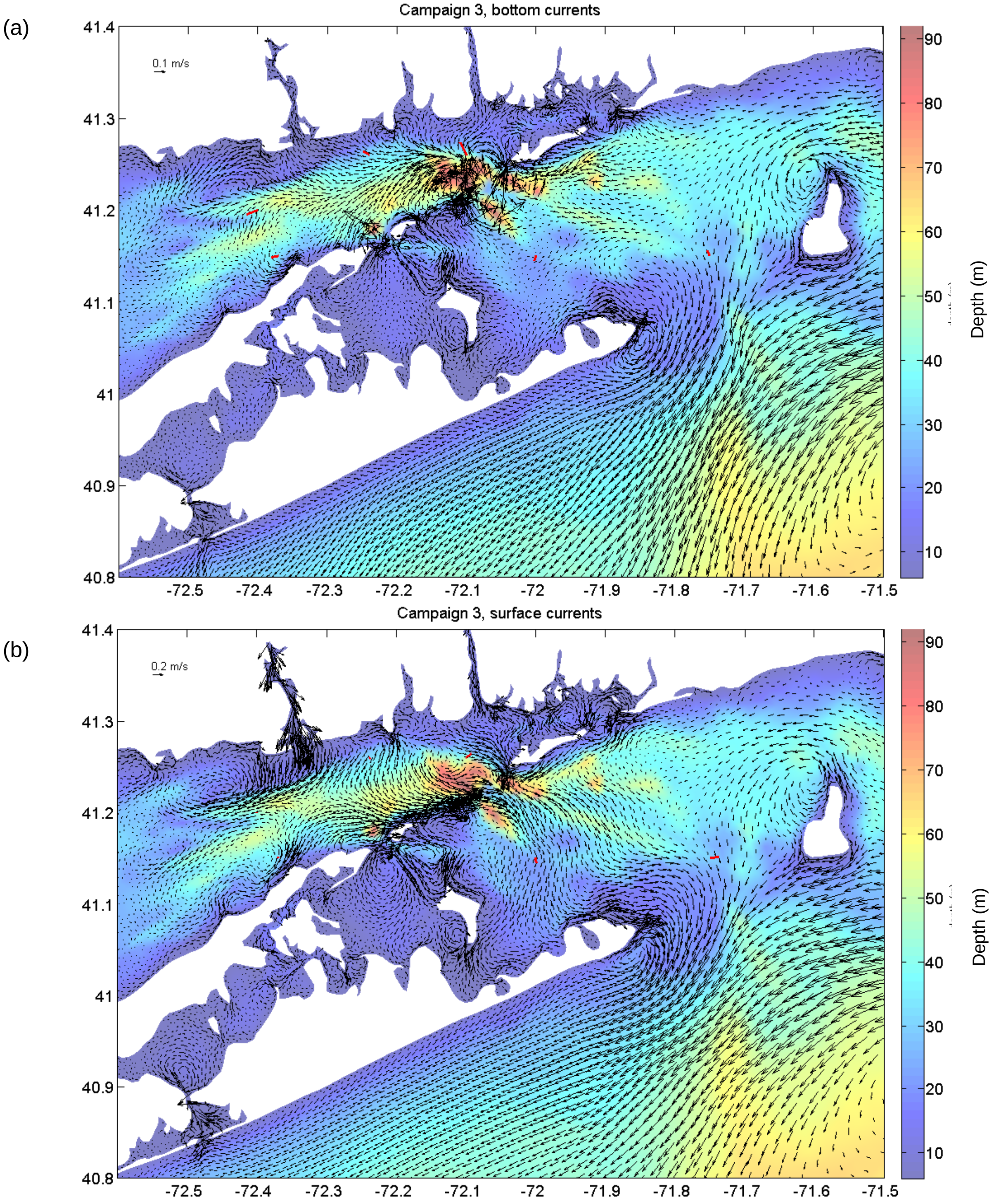

Figure 4-16. (a) Time-averaged near-bottom current vectors estimated for the winter of 2013. (b) Corresponding near-surface mean flow. It is noted that the scales for current velocity magnitudes are different (shown in the upper left corner of the two graphs). The background color represents water depths.

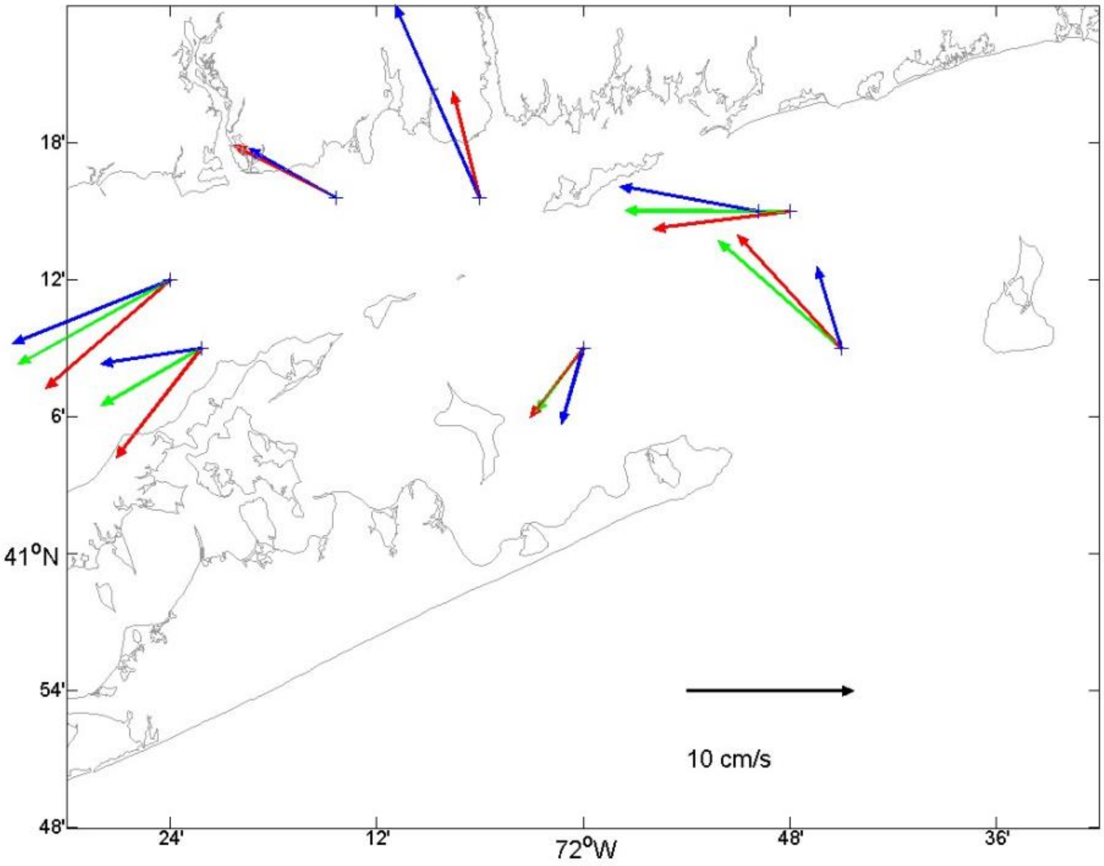

Figure 4-17. Mean near-bottom flow velocities at 2 feet (0.6 m) above the seafloor for the campaigns in the spring (green), summer (red), and winter (blue) in 2013/14.

The wind and density driven flow can modulate the pattern and magnitudes of the bottom stress. To determine the pattern of maximum values that arise, a maximum stress was selected that occurs at each location during the simulation period of 2013 (Figure 4-18). The region immediately to the south of the Thames River mouth is the largest area of low maximum bottom stress in eastern Long Island Sound. In Block Island Sound, the areas of lowest maximum bottom stresses are located to the west of Block Island and between Montauk and Gardiners Island. High bottom stresses extend throughout much of the eastern part of eastern Long Island Sound and around Montauk Shoals.

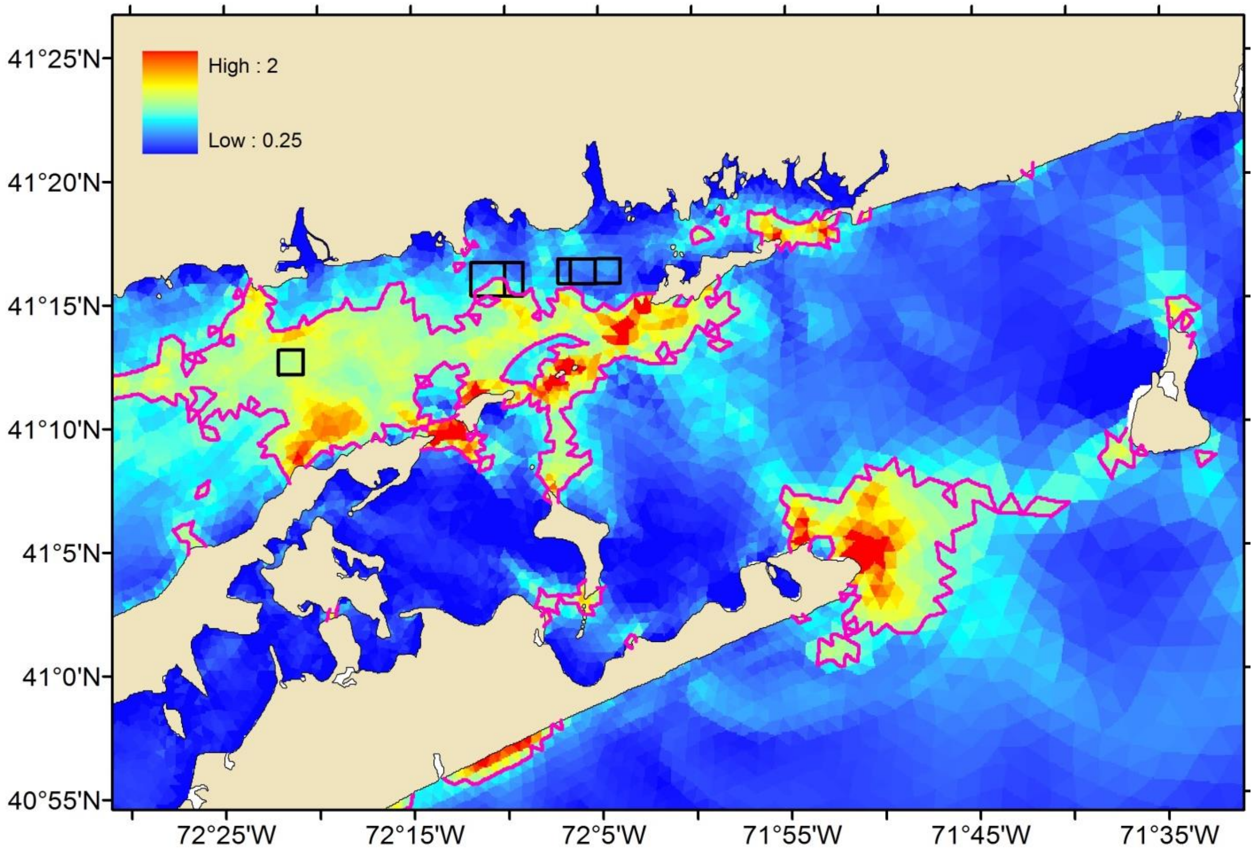

Figure 4-18. Maximum bottom stresses within the ZSF during 2013. The magenta contour line reflects bottom stress of 1.0 Pascal.

4.5.1.3 Water Temperature and Salinity

In seawater, temperature and salinity determine the water density and that influences circulation patterns and sediment settling rates. Both temperature and salinity vary by season, mainly as a consequence of solar insolation, and precipitation and river flow patterns. However, the exchange of water with the adjacent shelf also has an influence. The waters on the southern New England continental shelf originate in the Canadian Arctic and flow from the northeast to the southwest (Chapman and Beardsley, 1989). Salinity and temperature data have been collected in the Long Island Sound since 1988 by a CTDEEP program summarized by Kaputa and Olsen (2000) that includes Stations K2, M3 and N3 in the ZSF (see station locations in Figure 4-8.)

Figure 4-19a shows monthly average temperatures computed from over 10 years of ship-based measurements by CTDEEP at Station K2 (located approximately in the center of eastern Long Island Sound) and Station M3 (located in The Race). Minimum near-bottom temperatures occur in March and maximum temperatures in September. Maximum thermal stratification occurs in July. The temperatures at Station K2, located further to the west, are slightly higher than at Station M3 throughout most of the summer (June-August). Bottom water temperatures at both Stations

M3 and K2 are significantly warmer than at Station N3 during the summer. Commencing in November, the vertical temperature difference disappears as the water destratifies, and eastern Long Island Sound becomes well-mixed until May.

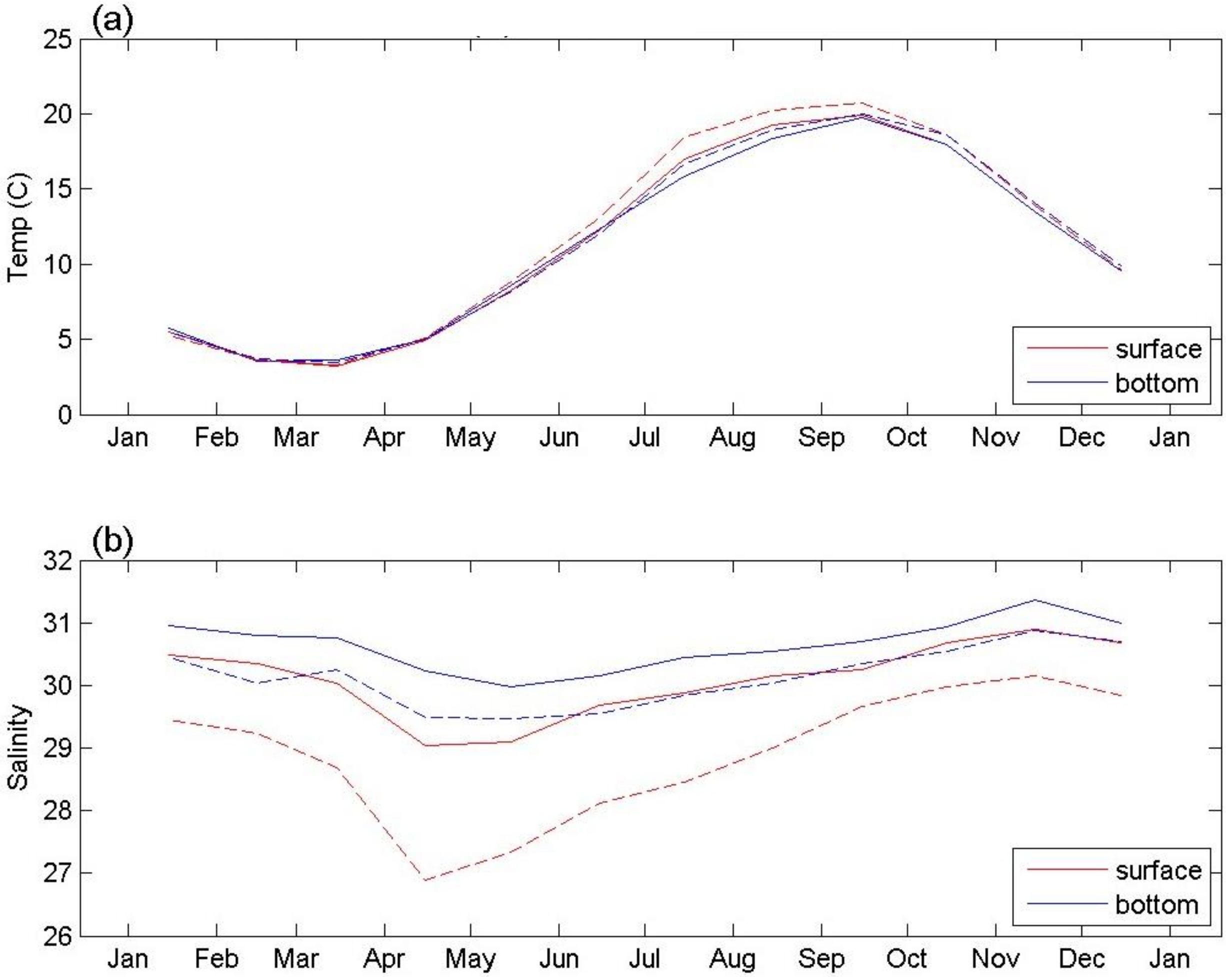

Figure 4-19. Monthly (a) mean temperature and (b) mean salinity (in psu) in surface and bottom waters in Long Island Sound at CTDEEP Stations K2 (dashed lines) and M3 (solid lines) (Source of data: Kaputa and Olsen, 2000).

The temperature observations obtained during the 2013/14 PO study showed a similar annual variation to that of the CTDEEP data. However, throughout the ZSF the summer observations were comparable to the warmest years and the winter observations comparable to the coldest years.

Spatial variations of bottom temperatures in eastern Long Island Sound during the PO study were minor. Water entering from Block Island Sound was slightly cooler than in Long Island Sound throughout the summer (June-August). The southern side of the Long Island Sound had the warmest bottom temperatures in the summer; this station was located in a region where a summertime eastward flow carries water from the warmer central basin of Long Island Sound toward The Race. In the winter, this condition reversed and the coldest temperatures were recorded at PO study Station 2.

Like most coastal areas, the ZSF has salinity gradients resulting from the mixing of freshwater from rivers and streams with salt water from the ocean. Freshwater is lower in density than seawater and, therefore, tends to float above it and spreads horizontally away from the source. Some mixing occurs due to the relative motion of the water masses and due to wind and tidal currents. Consequently, the salinity of the surface water increases with distance from freshwater sources.

The annual cycle of the near-surface and near-bottom salinity in eastern Long Island Sound is shown in Figure 4-19b. The average monthly salinity at Station M3, near The Race, is higher than at Station K2, both at the surface and the bottom, with the highest salinities occurring in November. The difference between the surface and bottom salinities reflects the vertical stratification at the two stations. Although weaker during the winter, salinity stratification in Long Island Sound persists year-round and results in density-driven currents that affect all of Long Island Sound. The degree of salinity stratification at Station K2 (to the west of Station M3) is approximately twice that at Station M3. The differences between the salinities at these two stations reflect the magnitude of the horizontal salinity gradients in eastern Long Island Sound that drives the mean flow through The Race. The bottom salinity at Station K2 is approximately 1 psu lower than the bottom salinity at Station M3 throughout the year and it appears that this longitudinal gradient in bottom salinity is insensitive to the seasonal fluctuations in the freshwater runoff. Monthly surface salinities at Station K2 range from approximately 27 psu in April to 30 psu in November; this seasonal variability in salinity is likely a consequence of the seasonal variation in the flow of the Connecticut River (Gay et al., 2004). The salinity observations obtained at PO study Station 3, located closest to CTDEEP Station K2, were consistent with the mean monthly salinity at that station suggesting that the conditions during the 2013/14 PO study were typical.

During the PO study, the highest near-bottom salinity in Long Island Sound occurred consistently at Station 7, near The Race, where the inflow from Block Island Sound is most influential. The lowest salinity values were measured consistently at Station 2 even though it was located on the southern side of Long Island Sound furthest from the mouth of the Connecticut River; these low salinity values are consistent with a circulation pattern that transports freshwater at the surface west from the Connecticut River to central Long Island Sound and then eastward along the north shore of Long Island past Station 2.

In summary, there is a persistent vertical gradient in salinity in Long Island Sound and, consequently, a persistent vertical density gradient. The gradient is enhanced by the increased river discharge in the spring and by warming of surface waters in the summer. Horizontal gradients are also substantial in Long Island Sound and these influence the circulation in complex ways. The 2013/14 PO study was used to test model predictions of the patterns and magnitudes of the circulation and bottom stress. Comparison of the measurements of temperature and salinity obtained by the PO study to the data of the CTDEEP program show that the PO study captured typical hydrographic conditions.

4.5.2 Physical Oceanography at the Alternative Sites

The analysis of model and field observations demonstrates that since the water depth and wind conditions at the three alternative sites in eastern Long Island Sound are very similar. The wave conditions are similar as well. However, the complex bathymetry results in different current conditions. The model-predicted tidal ellipses of near-bottom currents at the three alternative sites in eastern Long Island Sound are shown in Figure 4-20. The tidal ellipses are scaled to show how far the water moves over a tidal cycle. Figure 4-20 also shows the mean near-bottom currents at each location in red. The tidal ellipses represent the oscillatory portion of the current while the red lines show the persistent average or net drift. The results shown in Figure 4-20 are summarized in Table 4-3. The tidal amplitude at the New London site is the smallest. As discussed above, the mean flow (shown in red) can affect maximum bottom stresses and create asymmetry between the flood and ebb stress magnitudes.

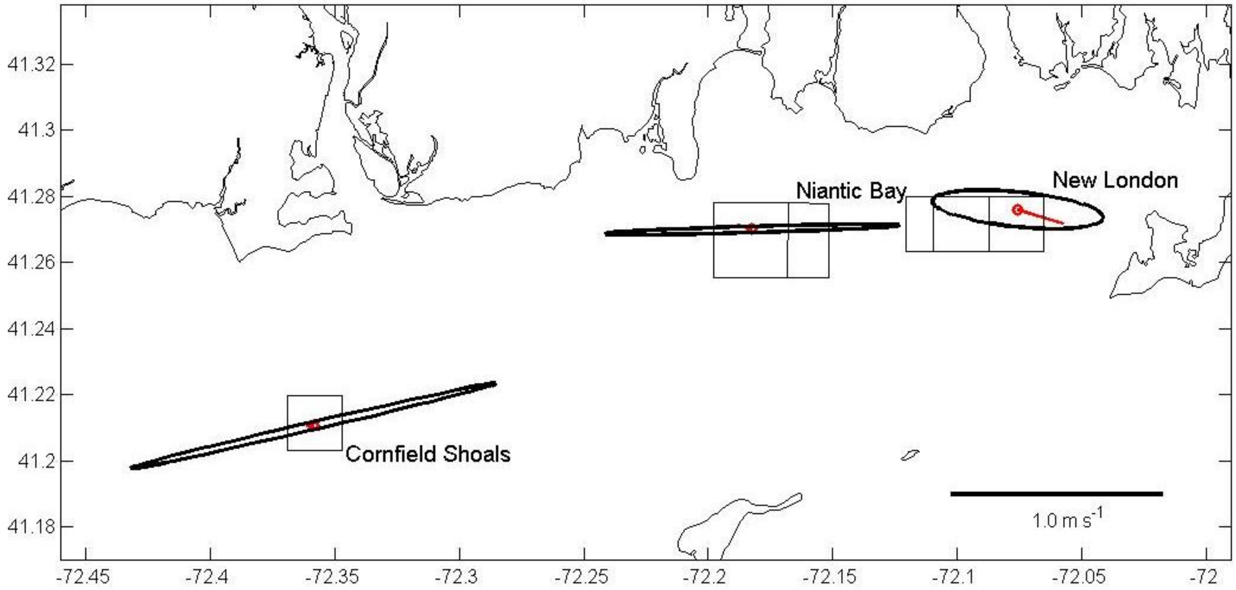

Figure 4-20. Near-bottom (1 m) semidiurnal M_2 tidal currents at the New London, Niantic Bay, and Cornfield Shoals Alternatives. The ellipses show the amplitude and directions of the M_2 tide scaled by the M_2 tidal excursion distances. The red lines show the magnitudes and directions of the mean near-bottom currents at the three sites scaled by the M_2 excursion time.

Table 4-3. Depth-averaged and Near-bottom M_2 Tidal Currents (amplitudes and directions) and Near-bottom Mean Currents (magnitudes and directions) at the three Alternative Sites

Alternative	**Depth-averaged M_2 Tidal Currents**		**Near-bottom M_2 Tidal Currents**		**Mean Near-bottom Currents**	
	Amplitudes (m/s)	**Direction**[1] (*true)	**Amplitudes** (m/s)	**Direction**[1] (*true)	**Magnitudes** (m/s)	**Direction**[1] (*true)
New London	0.40	95.7	0.23	96.8	0.07	108.8
Niantic Bay	0.69	88.3	0.35	85.4	0.06	292.6
Cornfield Shoals	0.88	76.9	0.44	68.2	0.03	265.6

[1] Directions are based on 360 degrees, clockwise from true north.

As part of the PO study, the bottom stress was simulated for conditions during Superstorm Sandy (October 28-31, 2012). This storm produced the largest significant wave height ever observed in Long Island Sound (13 feet [4 m]). The extreme value analysis for significant wave heights for summer-fall conditions suggests that this wave height would occur once every 30 years (Table 4-2). The maximum sustained (15-minute average) wind speed of 46 knots (23.6 m/s) occurred on October 29, 2012 during the superstorm.

The wind generates sea level anomalies (or surges) in Long Island Sound and these are detected by water level sensors or tide gages. Records from these gauges are long and thus statistics of anomalous events are more robust. These records are also valuable because the magnitude of the sea level anomaly correlates with the magnitudes of non-tidal currents. Since long records of currents in the ZSF do not exist, the sea level anomalies provide the only possible guidance for the return interval of the current anomaly. The analysis of sea level measurements indicate that the best estimate of the return interval for surges like the one that occurred during Superstorm Sandy is 25 years. However, the magnitude is also equivalent to the lower limit of the uncertainty range of the 100-year return interval. Thus, based on the observed surge, Superstorm Sandy should be considered characteristic of a 25- to 100-year event.

4.5.2.1 New London Alternative

The maximum bottom stress values in the vicinity of the New London Alternative during 2013 are shown in Figure 4-21. The 0.75 Pa contour is shown in magenta to separate areas of low stress from higher stress. The New London Alternative is located in an area of lower stress. Maximum stress values at the NLDS and at Site NL-Wa were 0.64 Pa. Maximum stress values at Site NL-Wb were below 0.75 Pa, with the exception of the southeastern corner of the site, located in an area of bedrock where the bottom stress reached a value of 0.76 Pa.

The relatively low maximum bottom stresses at the NLDS is consistent with the observations of the DAMOS program, which compared bathymetric surveys data from before and after a large storm that occurred on October 16, 2002; the study concluded that there was little motion of dredged sediments due to this significant storm (SAIC, 2003). Low bottom stress is also consistent with the hummocky topography of the NLDS which indicates that surface sediments are not reworked by currents (see Figure 4-4).

Figure 4-22 shows the pattern of maximum bottom stresses during the period from October 2012 through January 2014 that includes the simulation of Superstorm Sandy. The pattern of maximum stresses simulated for this period (that includes Superstorm Sandy) was similar to the pattern of maximum stresses for 2013 shown in Figure 4-21 (that excludes Superstorm Sandy), particularly in deeper water (that includes the New London Alternative). Differences were only simulated for the shallower coastal waters, where maximum stresses are higher as a result of the superstorm.

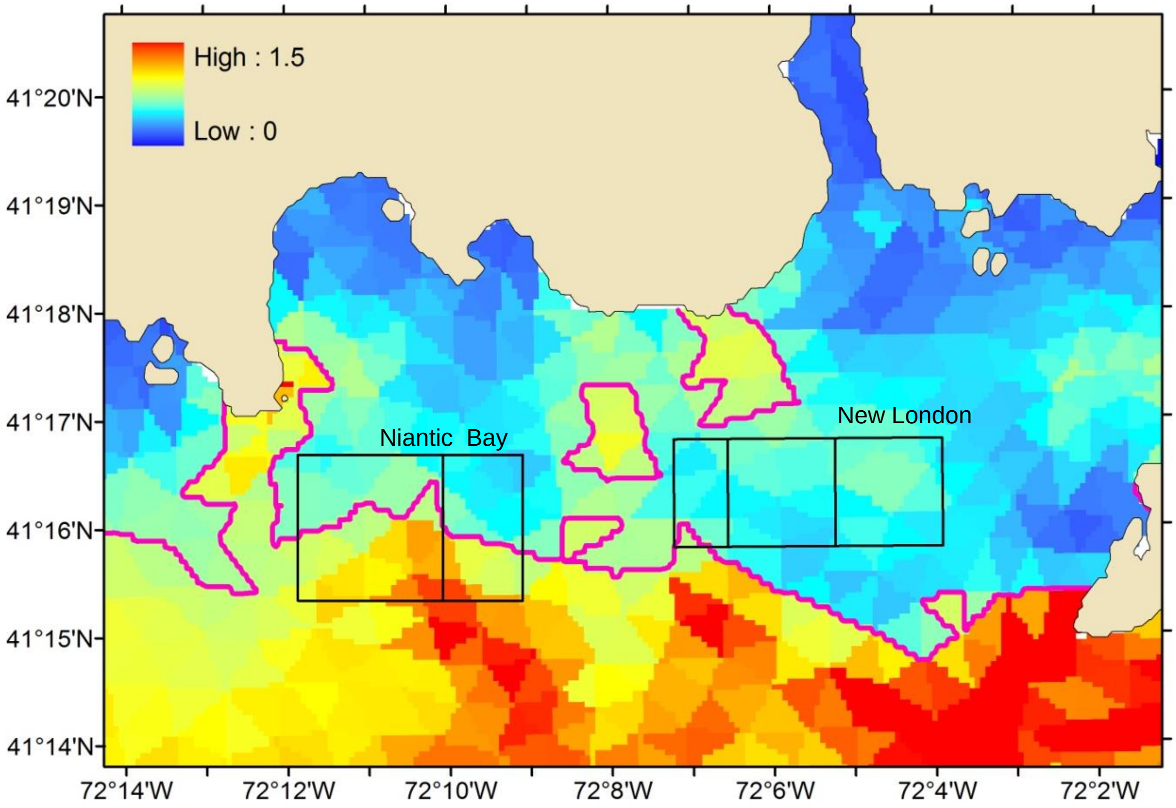

Figure 4-21. Maximum bottom stress (in Pascal) in the vicinity of the New London and Niantic Bay Alternatives for 2013. The magenta line represents the 0.75 Pascal contour.

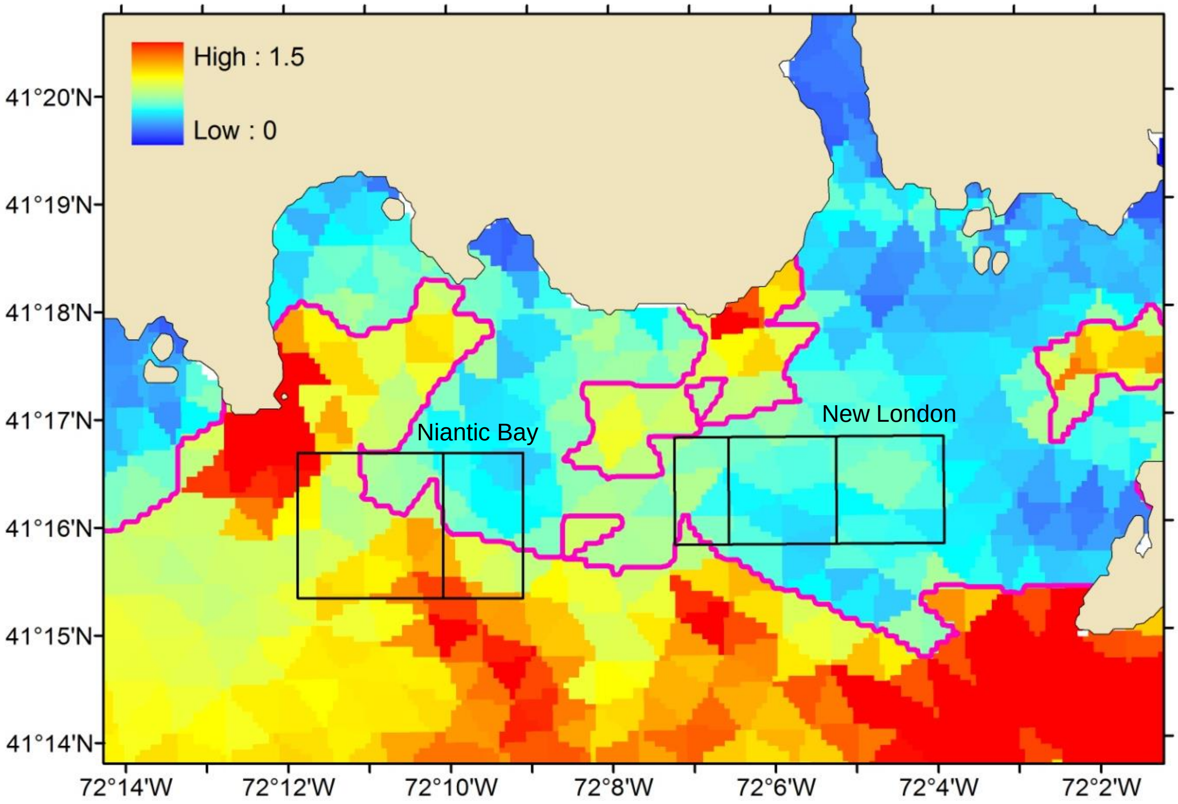

Figure 4-22. Maximum bottom stress in the vicinity of the New London and Niantic Bay Alternatives for the period from October 2012 to January 2014 that includes Superstorm Sandy. The magenta line represents the 0.75 Pascal contour.

The patterns of the near-bottom and near-surface mean flows computed for the winter simulation are shown in Figure 4-23. The near-surface mean flow vectors at the New London Alternative are directed to the southeast at approximately 10 cm/s (Figure 4-23a). The bottom flow is directed to the northeast at approximately the same velocity (Figure 4-23b). Similar patterns of flow occur in the spring and summer. As discussed in Section 4.5.1.2, the mean flow influences the maximum stress patterns and creates asymmetry in the stress magnitudes encountered during ebb and flood tides. Although the long-term movement of sediment is influenced by the pattern of the long-term mean current, the mean flow structure by itself does not describe the trajectory of particles released in the water. Because this region shows high variability in the mean flow, tidal currents will move particles into regions with different mean flows, resulting in complex particle pathways.

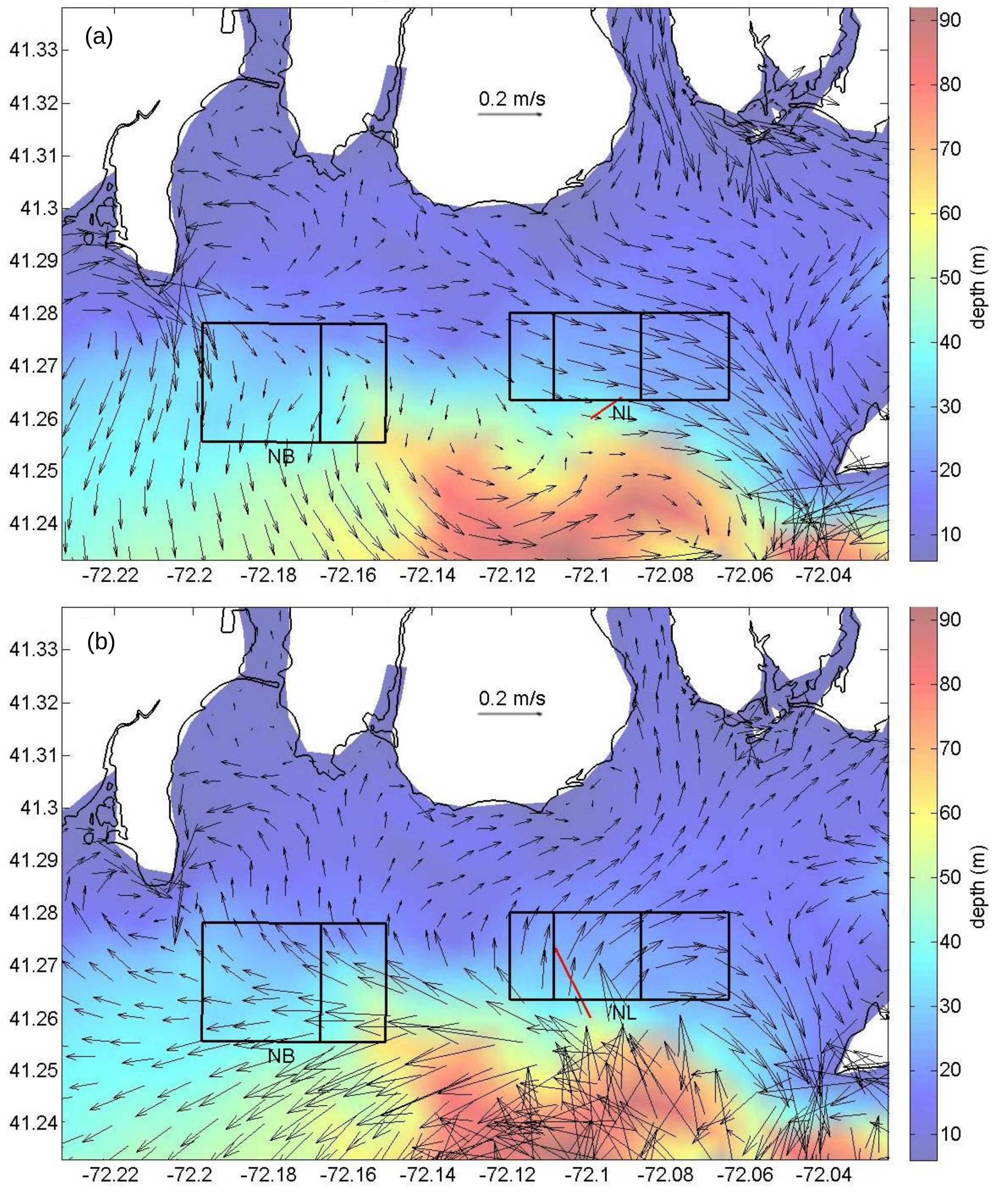

Figure 4-23. Bathymetry and simulated mean flow vectors in the eastern part of eastern Long Island Sound during the winter campaign. (a) Near-surface flow. (b) Near-bottom flow. The red arrows show the mean flow estimated from measurements at PO study Station 7.

4.5.2.2 Niantic Bay Alternative

At the Niantic Bay Alternative, there is considerable spatial variation in the magnitude of the maximum stress computed for 2013 (Figure 4-21). The bottom stress in the northern part of Site NB-E is approximately 0.5 to 0.6 Pa, similar to the bottom stress at the New London Alternative. However, in the southern and western parts of the Niantic Bay Alternative, the bottom stress is in excess of 0.75 Pa.

The potential effect of a severe storm on the bottom stress is demonstrated in Figure 4-22. This figure shows the maximum bottom stresses during the period from October 2012 through January 2014 that includes the simulation of Superstorm Sandy. Due to the storm, the maximum bottom stresses are substantially higher in the northeastern part of the NBDS. The maximum bottom stresses in other parts of the Niantic Bay Alternative remain similar to those without the Superstorm Sandy simulation; this includes the lower maximum bottom stresses in the northern part of Site NB-E.

The mean near-surface currents for the period of the winter campaign in the vicinity of the Niantic Bay Alternative are directed offshore to the south at approximately 10 cm/s (Figure 4-23a). At the near-bottom, the currents are of similar magnitude but directed to the west (Figure 4-23b).

4.5.2.3 Cornfield Shoals Alternative

The distribution of the maximum bottom stresses in the simulation of 2013 in the vicinity of the Cornfield Shoals Alternative is shown in Figure 4-24. The bottom stresses throughout this site is high, in excess of 1.0 Pa.

The maximum bottom stresses at the Cornfield Shoals Alternative did not increase during Superstorm Sandy (Figure 4-25). However, the maximum bottom stresses during the superstorm increased in shallow waters along the coast (including at the mouth of the Connecticut River).

Both the mean near-surface and near-bottom currents in the area of the Cornfield Shoals Alternative for the period of the winter campaign are directed westward with a magnitude of approximately 10 cm/s (Figure 4-26).

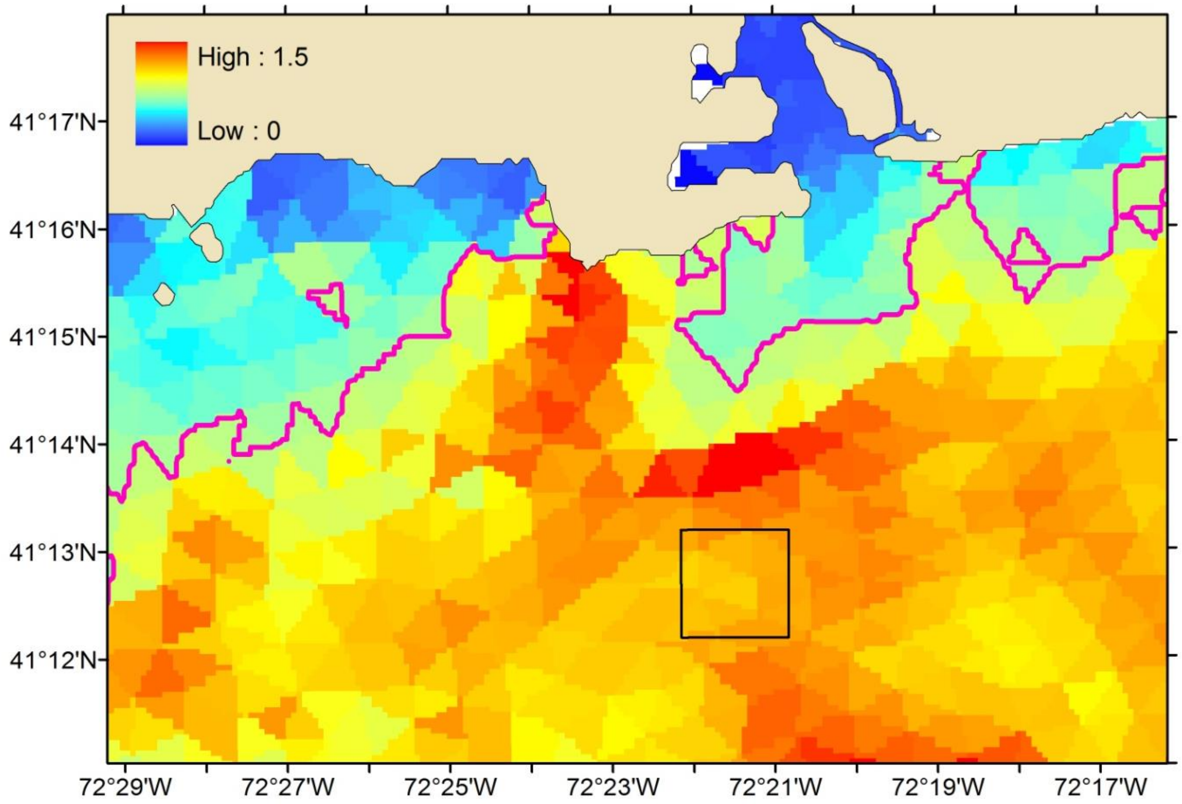

Figure 4-24. Maximum bottom stress in the vicinity of the Cornfield Shoals Alternative for 2013. The magenta line represents the 0.75 Pascal contour.

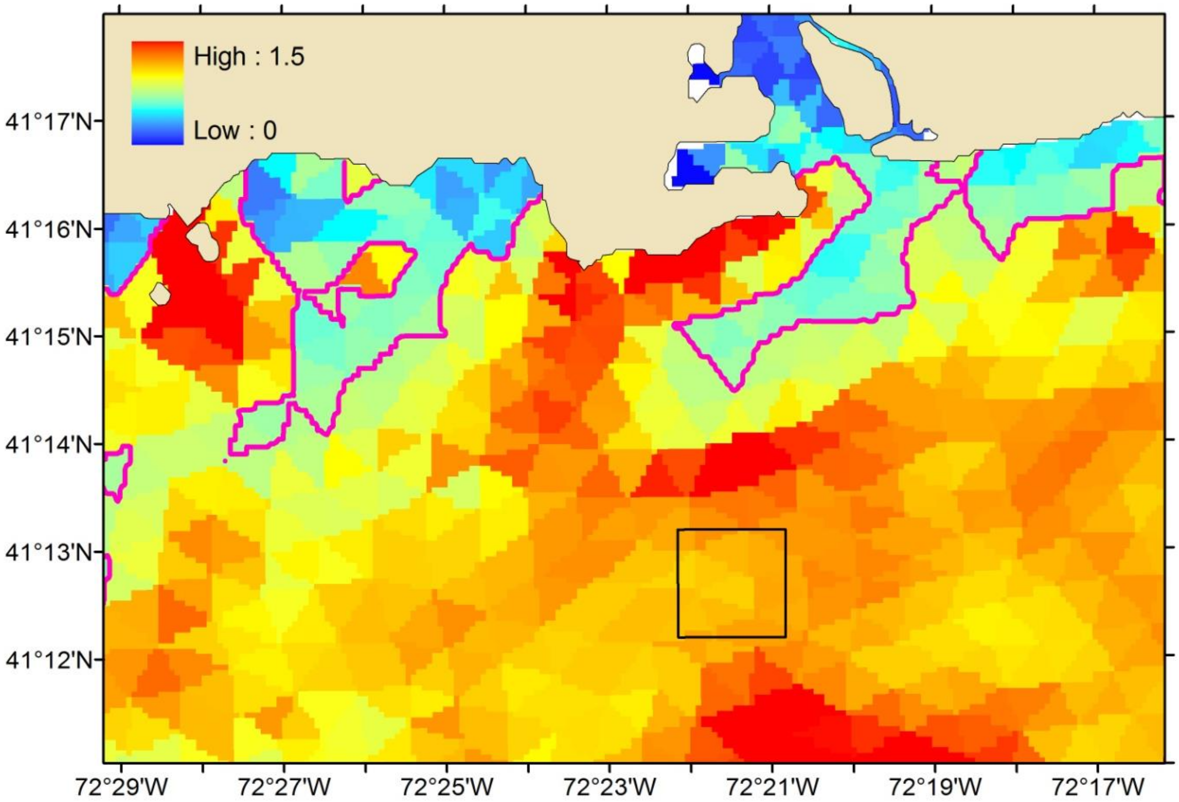

Figure 4-25. Maximum bottom stress in the vicinity of the Cornfield Shoals Alternative for the period from October 2012 to January 2014 that includes Superstorm Sandy. The magenta line represents the 0.75 Pascal contour.

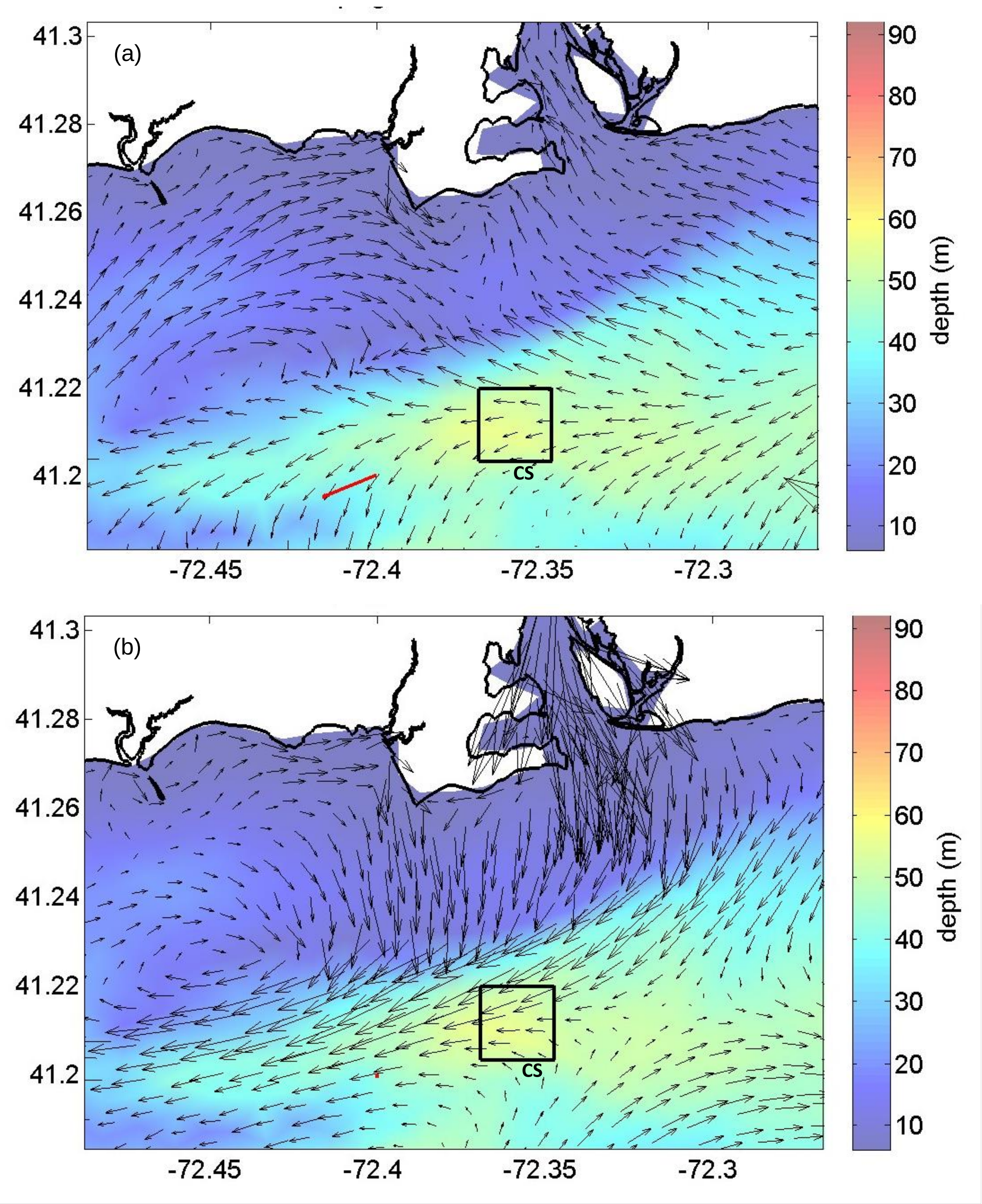

Figure 4-26. Bathymetry and simulated mean flow vectors near the mouth of the Connecticut River and Cornfield Shoals Alternative during the winter campaign. (a) Near-surface flow. (b) Near-bottom flow. The red arrows show the mean flow estimated from measurements at PO study Station 1.

4.5.3 Physical Oceanography Summary

The physical oceanography in the ZSF is strongly influenced by tidal flows. Conditions during the PO study for this SEIS were considered typical for this area. Specifically, salinity and temperature in the ZSF were consistent with the long-term average seasonal cycles although bottom temperatures and salinities were slightly higher than usual during the field campaign periods. The character of the winds and waves were also consistent with typical seasonal patterns. The bottom stresses simulated during the PO study were consistent with observations of bottom stresses made during the field campaigns and allow for the discrimination of areas with high stress from areas of low stress. The maximum bottom stresses that occur during different seasons were similar since bottom stresses are mainly driven by tidal currents.

The influence of severe storms was characterized, using Superstorm Sandy as an example. Comparing data for wave heights, wind speed, and sea level surge to data from other storms indicates that Superstorm Sandy was a 25- to 100-year event.

Based on the analysis of the data and model results, the New London Alternative has the lowest maximum current speeds of the three alternative sites. The Cornfield Shoals Alternative has the highest maximum current speeds. The magnitudes of the maximum bottom stress at the three alternative sites are related to the current speeds. The New London Alternative has the lowest maximum bottom stress. The Cornfield Shoals Alternative has the highest maximum bottom stress of any of the three sites. Maximum bottom stress conditions at the Niantic Bay Alternative are more complex. While the northeastern part of the Niantic Bay Alternative has low maximum bottom stress (similar to the New London Alternative), the southern and western portion of the site has higher stress.

4.6 Sediment Quality

This section describes the sediment quality (grain size, total organic carbon [TOC], metals, organic compounds, and sediment toxicity) of Long Island Sound, Block Island Sound, and the three alternative sites. Sediment quality can affect the aquatic habitats available to benthic and fish communities. The regional sediment quality was based on several studies such as Knebel and Poppe (2000), Mecray and Buchholtz ten Brink (2000), and Varekamp et al. (2014). In addition, three surveys were conducted for the three alternatives sites in support of the SEIS; Table 4-4 lists the station locations and parameters analyzed by these studies:

- *2015 Sediment Chemistry Survey:* The survey was conducted within and off-site of the three alternative sites between February 24 and 27, 2015 (Louis Berger and UCONN, 2015; see Appendix G). Surface sediment samples were collected at a total of 35 stations using a Smith McIntyre grab sampler (Figures 4-27 and 4-28). All samples were analyzed for grain size, TOC, metals, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and pesticides.

- *2013 Benthic Survey:* In July 2013, Tetra Tech (2014; see Appendix E) investigated 45 stations for sediment and benthic parameters within and off-site of the three alternative sites as part of a biological characterization. Samples were collected with a Van Veen grab sampler with a surface area of 0.1 m^2. Sediment quality analyses included grain size, TOC, and toxicity. In addition, samples were analyzed for the benthic infauna (see Section 4.9). Station locations are shown in Figure 4-38 and 4-39 in Section 4.9; the location of the toxicity samples are also included in Figures 4-27 and 4-28.

- *2014 SPI/PV (Sediment-profile and plan-view imaging) Survey*: As part of the DAMOS program, the USACE conducted a sediment-profile imaging (SPI) and plan-view underwater camera photography (PV) survey, referred to as SPI/PV survey, to provide physical characterization of sediments and evaluate benthic habitat conditions at the NLDS and NBDS and off-site areas (Carey and Bellagamba Fucile, 2015; see Appendix F). A total of 60 stations were sampled. A more detailed discussion of this survey is provided in Section 4.9, which also include a map of the station locations (see Figure 4-40).

Other site-specific information considered included DAMOS studies (*e.g.,* ENSR, 2005; AECOM, 2009; 2010; 2012) and a sidescan sonar study (WHG, 2014; see Appendix D).

Sediment quality data discussed distinguish between samples from within the active or historic sites, and from other areas:

- *Active or historic site:* Samples from within the active sites (*i.e.,* NLDS, CSDS) or from within the historic site (NBDS).
- *NL-Wa, NL-Wb, NB-E:* These stations were within the footprints of the New London and Niantic Bay Alternatives, but outside of the active NLDS and the historically used NBDS, respectively. These stations were used to assess conditions within the New London and

Niantic Bay Alternatives, but to assess potential off-site effects from the active NLDS and historically used NBDS, respectively.

- *Off-site stations east or west of the three alternative sites:* These stations were outside of the boundaries for the three alternatives sites. The stations were used to evaluate the sediment quality at locations off-site the active NLDS and CSDS, and the historically used NBDS

Some of the stations at Site NL-Wa and at off-site locations are regularly being used as reference stations by the DAMOS program for monitoring conditions at the two active disposal sites (*e.g.*, AECOM, 2009; ENSR, 2005).

Table 4-4. Summary of Sampling Stations from the 2015 Sediment Chemistry Survey, 2013 Benthic Survey, and 2014 SPI/PV Survey

Site	**2015 Sediment Chemistry Survey**	**2013 Benthic Survey**			**2014 SPI/PV Survey**
		Grain Size and TOC	**Toxicity**	**Benthic Infauna**	
New London Alternative					
NLDS	8	6	1	6	6
NL-Wa	4	11	-	11	14
NL-Wb	3	-	-	-	4
Off-site - east of NLDS	3	-	-	-	8
Off-site –south and west of New London Alternative	-	6	1	6	8
Total stations	18	23	2	23	40
Niantic Bay Alternative					
NBDS	5	8	1	8	11
NB-E	3	7	-	7	4
Off-site – east of NB-E	2	2	-	2	5
Off-site – west of NBDS	1	2	-	2	-
Total stations	11	19	1	19	20
Cornfield Shoals Alternative					
CSDS	4	1	1	1	-
Off-site – west of CSDS	1	2	-	2	-
Total stations	5	3	1	3	-
Total stations – all sites	**35**	**45**	**4**	**45**	**60**

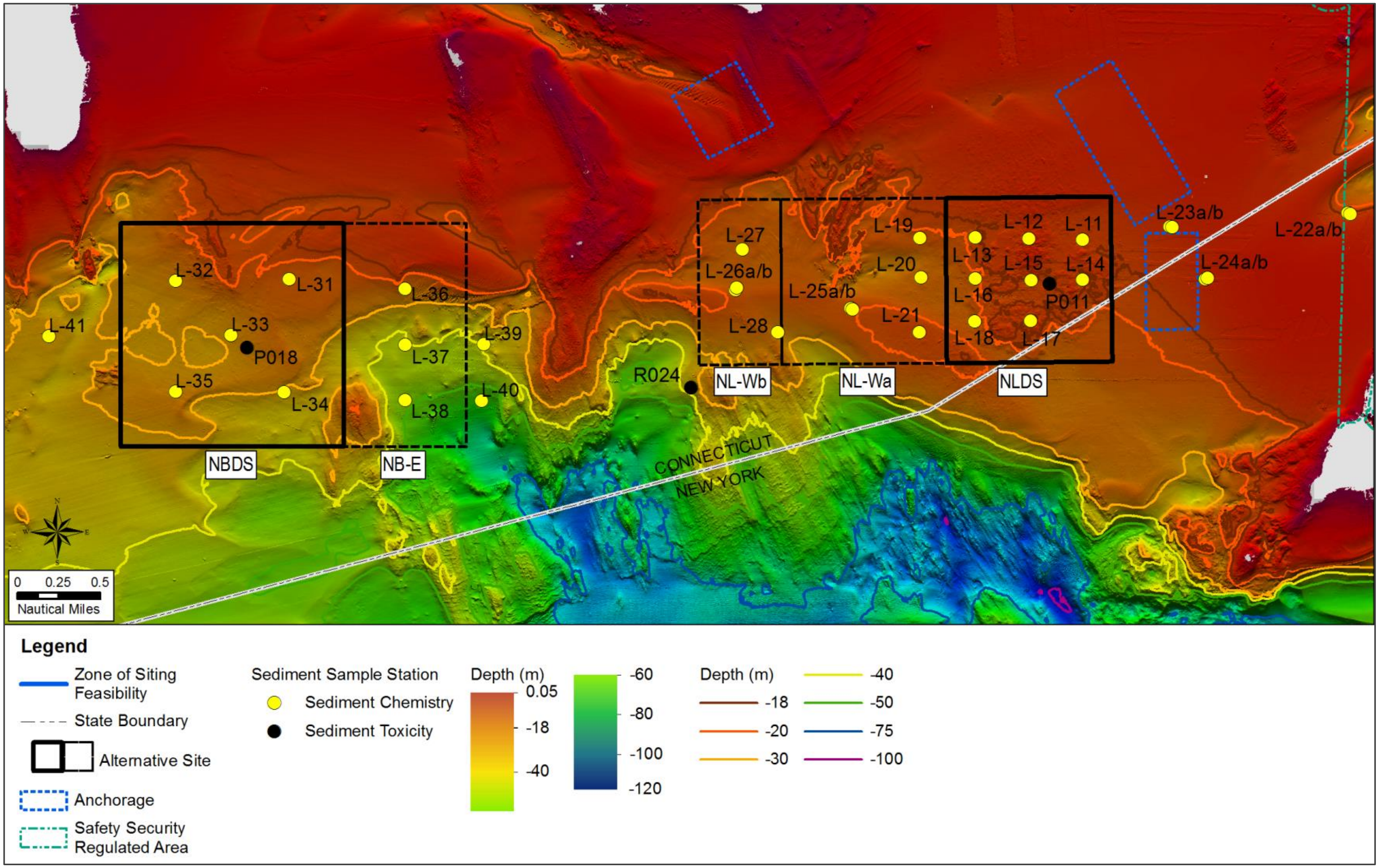

Figure 4-27. Sampling stations during the 2015 sediment chemistry survey at and near the New London and Niantic Bay Alternatives (Louis Berger and UConn, 2015). Shown also are three sediment toxicity sampling stations from the 2013 benthic survey (Tetra Tech, 2014).

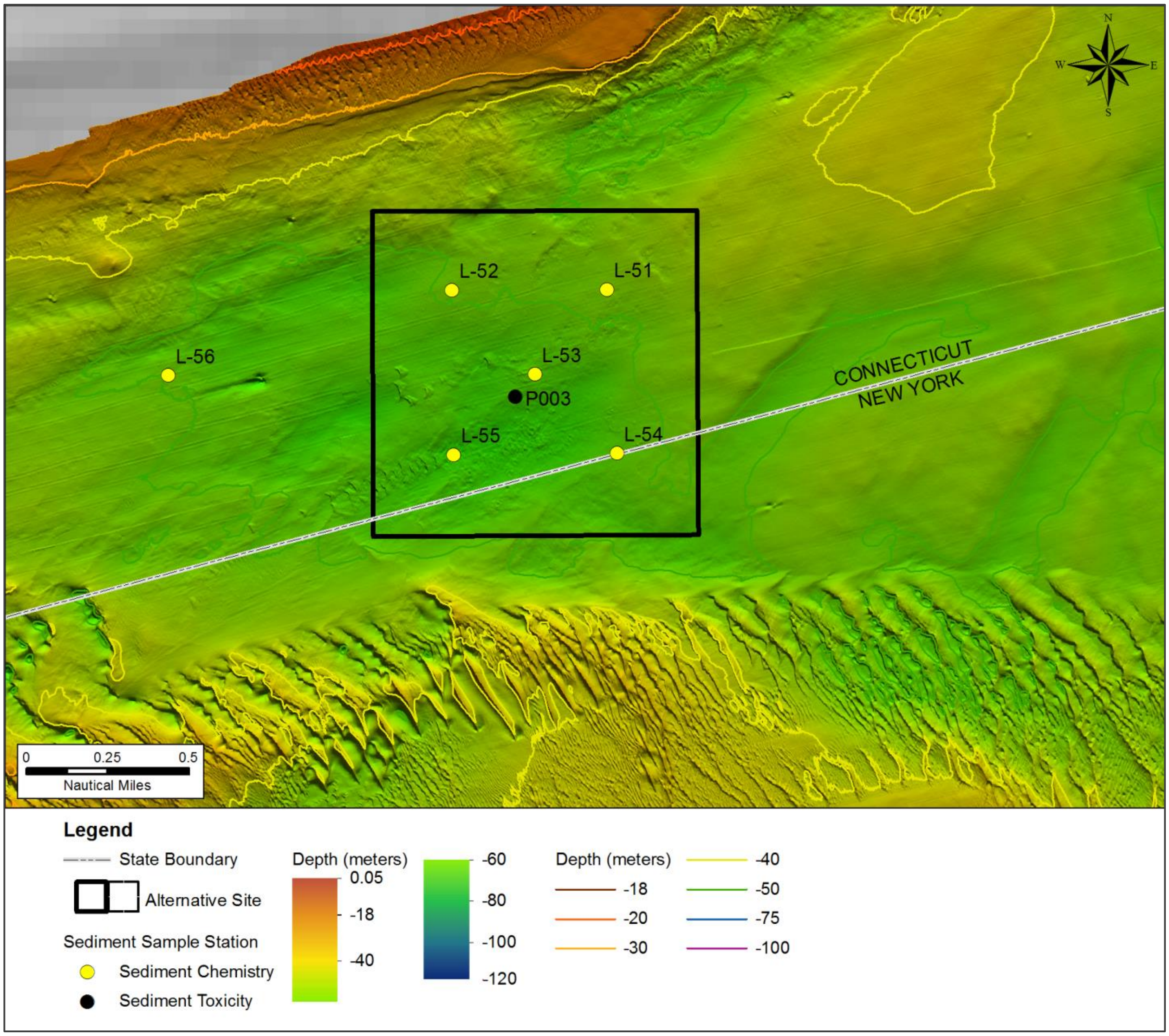

Figure 4-28. Sampling stations during the 2015 sediment chemistry survey at and near the Cornfield Shoals Alternative (Louis Berger and UConn, 2015). Shown also is sediment toxicity sampling station from the 2013 benthic survey (Tetra Tech, 2014**).**

Analytical results for metals and organic compounds can be compared to Effects Range Low (ERL) and Effects Range Median (ERM) values, developed by NOAA as a screening tool to estimate the relative degree of contamination (Long et al., 1995; Buchman, 1999). However, these guideline values should not be used to infer causality because of the inherent variability and uncertainty of the approach. These values are based upon data primarily of marine sediment chemistry paired with sediment toxicity bioassay data (USEPA, 2015b). To calculate an ERL value for a given analyte, concentration data obtained from studies are ranked from lowest (least toxic) to highest (more toxic) concentrations. The ERL value is indicative of concentrations below which adverse biological effects rarely occur. The ERM value is indicative of concentrations above which adverse biological effects frequently occur.

4.6.1 Long Island Sound

The Long Island Sound region is densely populated and industrialized, particularly in the New York City area and along Connecticut's coastal region. Contaminants may be released to Long Island Sound from numerous point and non-point sources, including wastewater and water treatment plants, industrial facilities, stormwater runoff from urban areas, agricultural runoff, and atmospheric inputs. Although improvements in industrial practices over the last decades have in many cases reduced the load of contaminants to Long Island Sound, some residual historical contamination remains, particularly in industrialized harbors and nearshore areas.

Grain Size and Total Organic Carbon. Grain size and TOC are important physical characteristics of the sediment environment. They are relevant for the suitability of the sediment as habitat for benthic organisms, and may control the fate, transport, and uptake of contaminants. Sediment grain size is related to the hydrodynamic environment in which the sediments are found, with coarser-grained deposits found in nearshore and higher-energy environments and finer-grained deposits found in deeper, lower energy environments.

The grain size distribution in surface sediments of the eastern Long Island Sound is shown in Figure 4-29. Data were compiled and mapped by the USGS (Poppe et al., 2000). The USGS interpolated this sediment grain size map from individual surface grab samples; thus, the resolution is a function of the density of actual samples collected in any given area. Additional samples collected up to 2005 and stored on the USGS database (McMullen et al., 2005) are superimposed as circles; the USGS has not updated their map from year 2000 with the newer sediment data.

The sedimentary environments in Long Island Sound reflect the dominant hydrodynamic forces acting on the sediment (see Section 4.5, Physical Oceanography). Generally, areas with high bottom current velocities (such as the area around The Race) are areas of erosion; the substrate of these areas typically consists of coarser-grained sediment (sand and gravel) or bedrock. Finer-grained sediment particles transported into these areas remain suspended in the water column until they encounter areas in Long Island Sound with slower tidal current velocities where they can settle out. Hence, bottom sediments in Long Island Sound are increasingly fine-grained with decreasing current velocities. Knebel and Poppe (2000) identified four sedimentary environments based on grain size distribution and current velocities and defined them as follows (Figure 4-30): "Erosion or Non-deposition", where boulder fields to gravelly coarse-to-medium sands are present; "Coarse-grained Bedload Transport", characterized by coarse-to-fine sand with small amounts of mud; "Sediment Sorting and Reworking", characterized by heterogeneous sands and muds; and "Fine-grained Deposition", characterized by bottom sediments that are muds and muddy, fine sands. The substrate of eastern Long Island Sound includes three of these sedimentary environments. The substrate of central and western Long Island Sound consists mostly of the Fine-grained Deposition sedimentary environment.

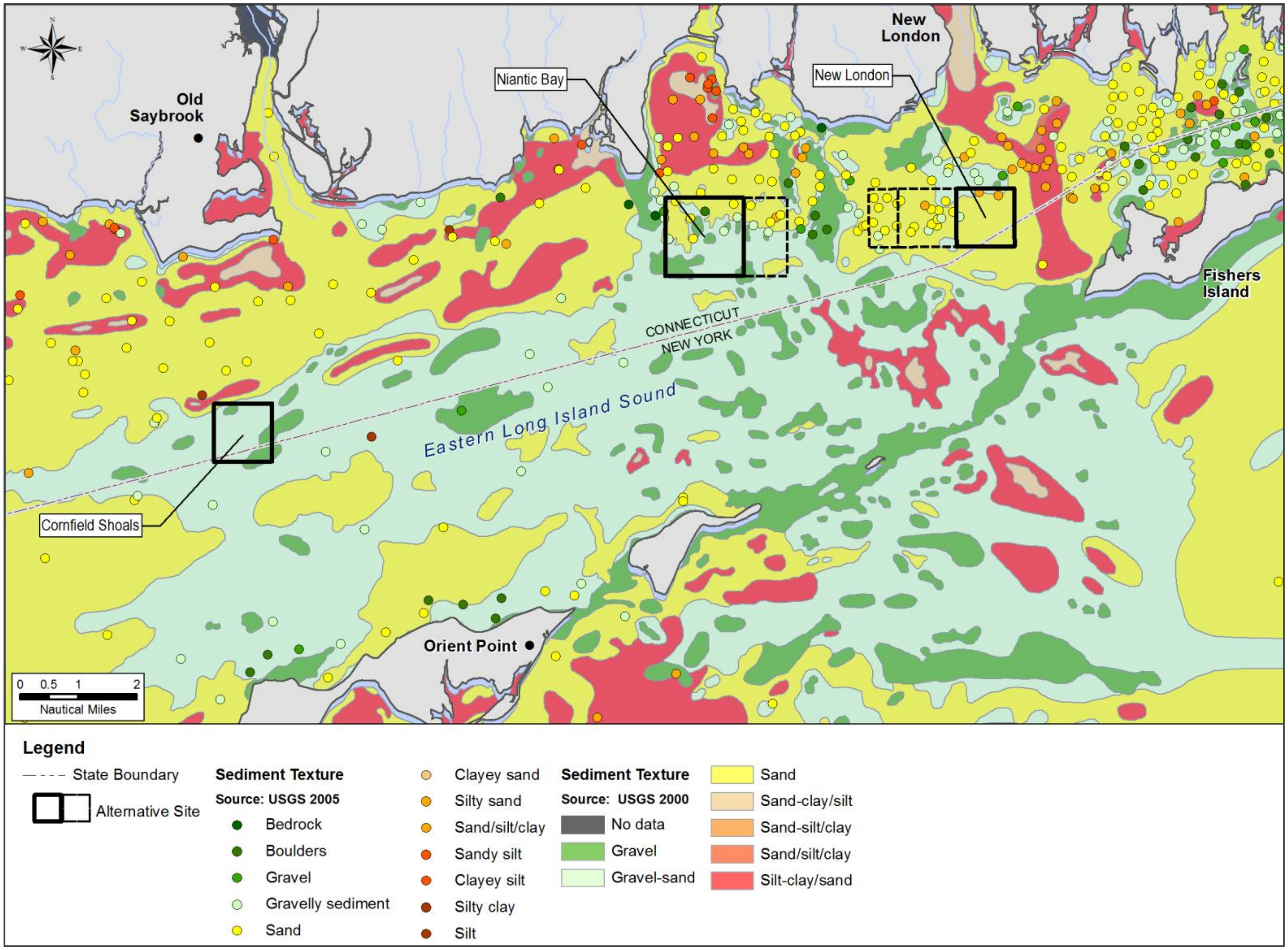

Figure 4-29. Grain size of surface sediments in eastern Long Island Sound (USGS data sources: Poppe et al., 2000; McMullen et al., 2005).

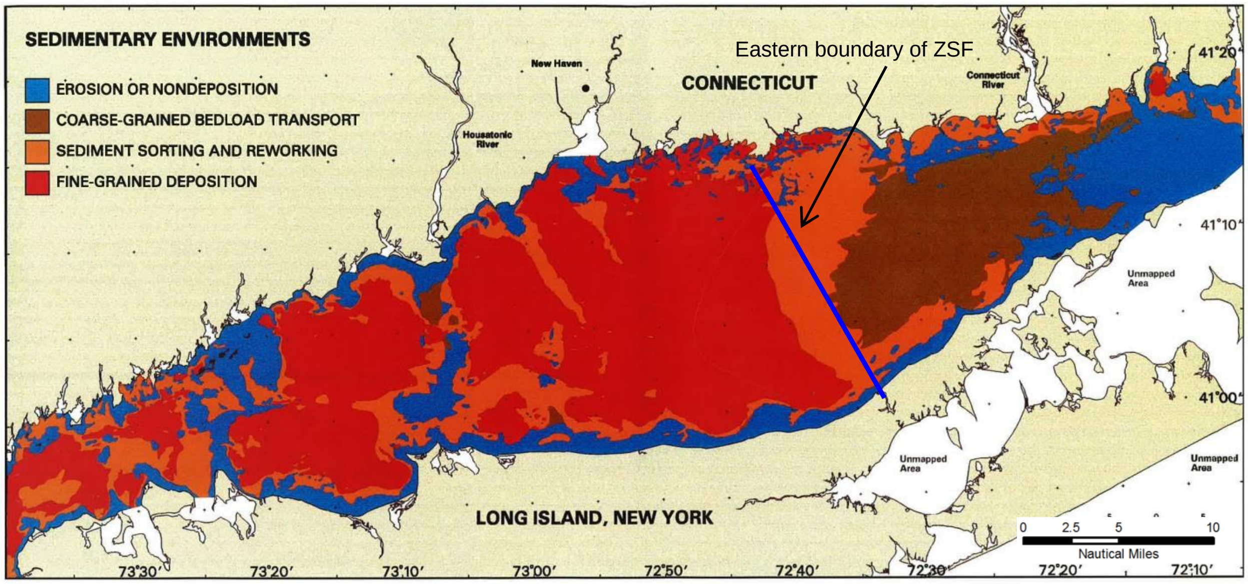

Figure 4-30. Sedimentary environments in Long Island Sound (Source: Knebel and Poppe, 2000).

Total organic carbon is a measure of the total amount of organic material in sediment. The TOC concentration influences many physical, chemical, and biological processes, including the availability of sediment contaminants to marine organisms. The TOC concentration in Long Island Sound sediments increases with decreasing grain size, with an average of more than 1.9% dry weight in sandy clay/silt and less than 0.4% in sand (Poppe et al., 2000). Consistent with the grain size distribution in Long Island Sound, the TOC concentrations increase toward the west and from the shallow margins to the deeper parts of the Long Island Sound basin. The TOC concentration in eastern Long Island Sound sediments in the area between Bartlett Reef and Mattituck Sill is less than 0.5% in most areas (Poppe et al., 2000).

Metals. Regional studies of metals in Long Island Sound sediments have found that concentrations generally increase from east to west (*e.g.*, Brownawell et al., 1991; Mecray and Buchholtz ten Brink, 2000; Mitch and Anisfeld, 2010; Varekamp et al., 2014). The higher concentrations of most metals are a result of more abundant urban and industrial sources. Mecray and Buchholtz ten Brink (2000) observed a strong correlation between metal concentrations and fine grain sizes in Long Island Sound sediment.

Table 4-5 presents the mean metal concentrations in Long Island Sound sediments, as well as the mean concentrations specific to the four sedimentary environments within Long Island Sound identified by Knebel and Poppe (2000) (Figure 4-30). None of the metal concentrations exceeded the respective ERM values. Of the four sedimentary environments listed by the USGS, concentrations for chromium, copper, lead, mercury, and nickel exceeded the ERL values in the Fine-grained Deposition environment found in the western and central Long Island Sound. Copper and nickel exceeded the ERL value in the Sediment Sorting and Reworking sedimentary environment found predominantly between central and eastern Long Island Sound. All other metal concentrations were below the ERL value.

Table 4-5. Mean Metal Concentrations in Long Island Sound Sediments

	Silver	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
	mg/kg dry weight							
Long Island Sound - Mean	0.27	0.16	67.9	**39.1**	36.1	0.12	**24.8**	103
Mean concentrations for all of Long Island Sound by Sedimentary Environment								
1. Erosional or non-deposition	0.09	0.08	36.3	13.8	23.6	0.06	15.5	53
2. Coarse-grained bedload transport	0.02	0.02	30.0	3.2	16.4	0.04	15.9	40
3. Sediment sorting and reworking	0.21	0.14	59.9	**35.0**	33.2	0.09	**21.7**	90
4. Fine-grained deposition	0.44	0.25	**93.3**	**59.5**	**47.7**	**0.18**	**32.2**	146
Ecological Effects Values								
ERL	1.0	1.2	81	34	46.7	0.15	20.9	150
ERM	3.7	9.6	370	270	218	0.71	51.6	410

Bold concentrations exceed the ERL value. (None of the measured concentrations exceed the ERM value.)
n/a Not available.

Concentrations of lead, copper, zinc, and mercury in Long Island Sound have been found to be higher in the upper approximate 12 inches (30 cm) of sediment than at depth, reflecting the effects of industrialization starting in the early to mid-1800s (Cochran et al., 1991; Varekamp et al., 2014). Since around 1980, metal concentrations in the sediment have decreased due to better environmental regulations with more stringent testing protocols, water quality standards, and permitting requirements, and due to programs such as the Long Island Sound Study (see Section 4.7.1).

Organic Compounds. Data on the distribution of organic compounds in the sediment in Long Island Sound are limited. The USGS compiled a data base of Long Island Sound sediment properties and contaminant levels for the period of 1975 to 2000 (Mecray et al., 2003). Similar to metal concentrations, the average concentrations for PAHs and PCBs decrease from west to east throughout Long Island Sound.

Sediment Toxicity. To evaluate the potential toxicity of sediments to aquatic organisms, laboratory tests are conducted in which representative organisms are exposed to sediments collected from the sample location. A review of the literature indicated that NOAA and USEPA monitoring programs are the primary sources of sediment toxicity monitoring data in Long Island Sound.

NOAA's National Status and Trends (NS&T) Benthic Surveillance Program conducted a survey of sediment toxicity in the coastal bays that surround Long Island Sound. In general, toxicity was more prevalent in the sediments of western and central Long Island Sound than in the sediments of eastern Long Island Sound (Figure 4-31). Results of whole-sediment assays (10-day *Ampelisca abdita*) from offshore areas reported by Wolfe et al. (1994) indicate that toxicity is generally absent from the body of Long Island Sound. These data are included in the presentation of USEPA monitoring data that follows.

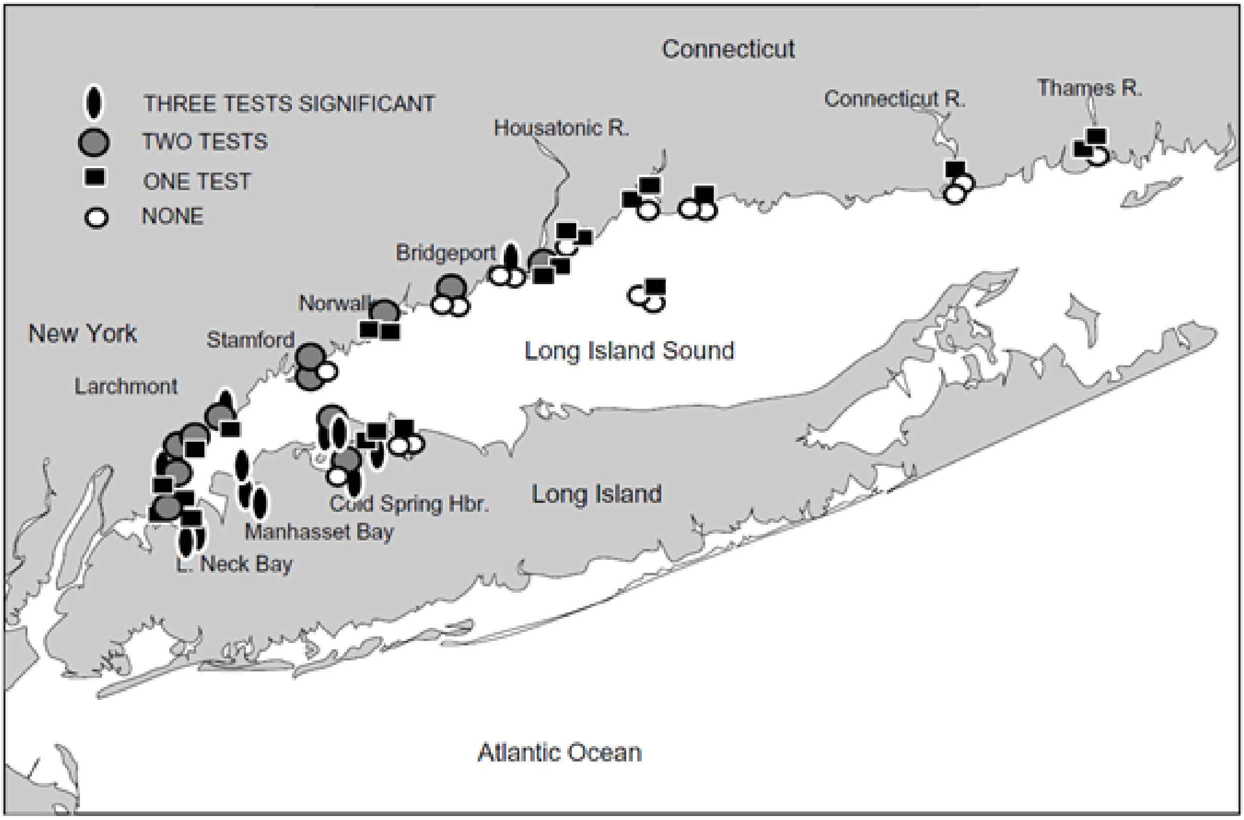

Figure 4-31. Toxicity of surface sediments measured by NOAA at sampling locations in Long Island Sound evaluated by 10-day *Ampelisca abdita*, 48-hour *Mulinia lateralis*, and Microtox^{TM} (Source: Wolfe et al., 1994).

USEPA's Environmental Monitoring and Assessment Program (EMAP) monitored and assessed the status and trends of national ecological resources from 1990 to 2006. Field work for this program included the collection of sediments for evaluating potential toxicity. The EMAP National Coastal Database (USEPA, 2010) houses these historical monitoring data. Between 1990 and 2006, 360 sediment toxicity tests (10-day *Ampelisca abdita* whole sediment amphipod survival) were conducted on the sediments of Long Island Sound, its coastal bays, and contributing rivers. These data are included in the following data sets: EMAP Virginian Province, R-EMAP Region 2, and National Coastal Assessment (Northeast). Of the 360 *Ampelisca abdita* sediment toxicity tests conducted on the sediments of Long Island Sound, its coastal bays, and contributing rivers, only 33 samples from 32 stations (Figure 4-32) exhibited biologically significant toxicity (defined as less than 80% mean survival relative to control *and* significant difference from control).

Nineteen out of the 32 stations exhibiting toxicity were located in bays and harbors, supporting the general conclusions in Wolfe et al. (1994) and Varekamp et al. (2014) that toxicity is primarily found in coastal (inshore) sediments rather than in the (offshore) body of Long Island Sound. Eleven of the 32 stations exhibiting toxicity exhibited no toxicity at a subsequent sampling date, indicating temporal variability in sediment toxicity within Long Island Sound. Within the ZSF, there were only four open-water stations that exhibited sediment toxicity. None of these stations were located within the three alternative sites.

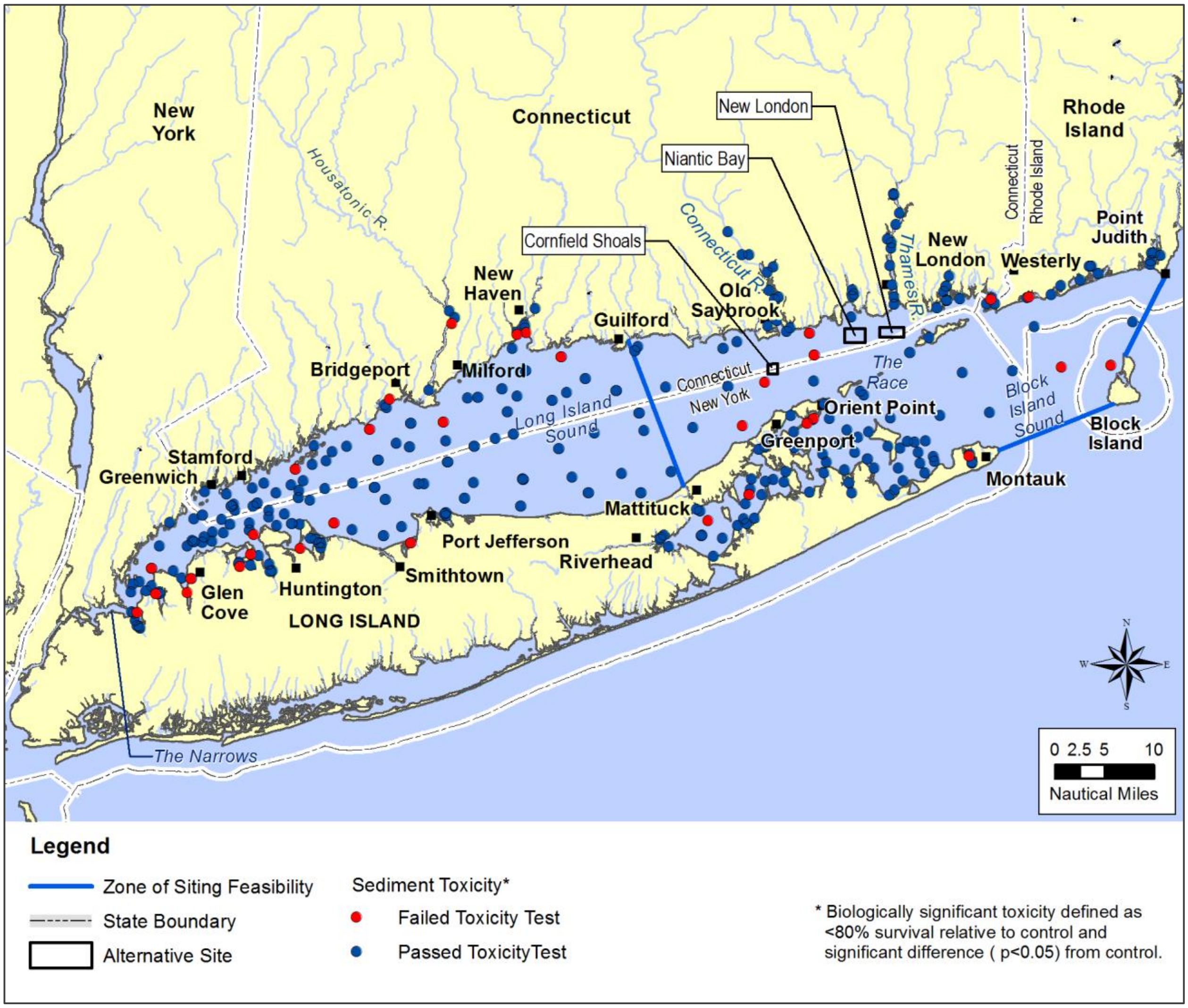

Figure 4-32. Toxicity of surface sediments collected in open waters, coastal bays, and contributing rivers of Long Island Sound and Block Island Sound from the EMAP National Coastal Database (Source: USEPA, 2010).

4.6.2 Block Island Sound

The sediment characteristics of Block Island Sound were studied extensively by Savard (1966), the U.S. Department of Navy (1973), and Poppe et al., (2012; 2014). The predominant sediment texture across much of Block Island Sound is sand (Figures 3-6 and 4-29). Shallow areas and areas with tidal restrictions contain coarse- to medium-grained sand with less than 1% silt and clay (Poppe et al., 2012). The shallow ridge between Montauk Point and Block Island, the ridge and shallow areas north of Block Island, and the deep channels in the western part of Block Island Sound are covered predominantly by gravel and sandy gravel. Surface sediments in the protected shallows of Napeague Bay (located east of Gardiners Island) and on the plain in the east-central area of Block Island Sound consist predominantly of silty sand with fractions of silt and clay. Sediments in the east-central area are also poorly sorted as well as heavily bioturbated containing abundant burrows and worm tubes; the sea-floor sedimentary environment in this area is characterized by the processes associated with deposition.

4.6.3 Sediment Quality at the Alternative Sites

The sediment quality at the three alternative sites was evaluated using existing data and data collected during three surveys summarized in Table 4-4. Complete descriptions of these surveys and the results obtained are provided in Appendices E to G.

Grain Size and Total Organic Carbon.

- ***New London Alternative:*** The predominant grain size within the New London Alternative was sand, although sediments were on average finer-grained within the NLDS (due to the disposed dredged material) than at areas outside of the NLDS. Specifically, at the NLDS, the mean sand content was 53%, while the mean sand content at areas outside the NLDS ranged from 72% to 85% (Table 4-6). The mean silt and clay content at the NLDS was 39%, which was approximately 2.5 times higher than the mean silt and clay content at all other areas outside the NLDS (mean of 18%). The highest silt and clay content was measured at Station L-18 (78%), which was located in the area of the NLDS that received most of the dredged material in the previous decade (AECOM, 2009).

  The predominant sediment grain size observed during the 2014 SPI/PV survey throughout most of the New London Alternative was a fine sand layer overlying silt and clay. The grain size in the off-site area to the east of the NLDS was predominantly very fine sand. These grain sizes were consistent with findings by a more extensive SPI/PV survey conducted in 2007 at the NLDS and at off-site reference stations (AECOM, 2009); they were also consistent with the findings of the 2015 sediment chemistry survey.

  The TOC concentrations at stations within and around the New London Alternative were similar to the pattern observed in the grain size data. The mean TOC concentration measured at the NLDS was 2.4%, which was about 2.5 times higher than the mean concentrations at all the other areas (mean of 0.9%). The highest TOC concentration was measured at Station L-18 with 3.5%.

Table 4-6. Mean Grain Size and TOC Content in Sediments at the three Alternative Sites

Site	2015 Sediment Chemistry Survey				2013 Benthic Survey				2014 SPI/PV Survey
	Gravel	Sand	Silt and Clay	Total Organic Carbon	Gravel	Sand	Silt and Clay	Total Organic Carbon	Predominant Grain Size
	Percent				Percent				
New London Alternative									
NLDS	9.4	54.7	35.9	1.7	7.3	50.6	42.1	3.0	Fine sand, overlying silt+clay
NL-Wa	2.2	85.2	12.6	0.5	6.3	79.7	14.0	1.3	
NL-Wb	2.2	82.9	15.0	1.0	n/a				Fine sand
Off-site – east of NLDS	0.4	71.8	27.8	0.4	n/a				Very fine sand
Niantic Bay Alternative									
NBDS	9.1	82.1	8.8	0.8	17.4	77.6	5.0	0.6	Medium+fine sand
NB-E	8.0	80.2	11.8	0.8	21.2	70.0	8.8	0.9	Medium+fine sand, overlying silt+clay
Off-site – east of NB-E	5.5	79.2	15.4	1.6	17.6	72.9	9.5	1.0	
Off-site – west of NBDS	7.5	82.8	9.7	0.6	27.0	68.9	4.2	0.5	n/a
Cornfield Shoals Alternative									
CSDS	14.6	77.2	8.3	0.4	23.7	71.3	5.0	0.6	n/a
Off-site – west of CSDS	13.2	50.9	35.9	0.3	20.2	75.9	4.0	0.5	

n/a Not available

The most recent assessments of physical and chemical characteristics at the NLDS by the DAMOS program were conducted at the Seawolf Mound in 2006 and 2010 (AECOM, 2010; 2012). In the 2010 survey, sediments in the upper 1.7 feet (50 cm) contained 55 to 90% silt and clay, and 1.2 to 2.1% TOC, which was consistent with previous surveys at the mound.

- ***Niantic Bay Alternative:*** The predominant grain size within and off-site of the Niantic Bay Alternative was sand, with means ranging from 69% to 83% (Table 4-6). The silt and clay concentrations were low, with means ranging from 4% to 15%. None of the individual samples had a silt and clay content higher than 16%.

  Similarly, the predominant sediment grain size observed during the 2014 SPI/PV survey at the NBDS ranged from fine sand in the north to medium sand in the south. The sediment grain size at Site NB-E as well in the off-site area to the east of Site NB-E was medium and fine sand overlying silt and clay.

The TOC concentrations at stations in the Niantic Bay Alternative were generally below 1%, with the exception of two stations to the east of Site NB-E (Stations L-39 and L-40); the mean TOC concentration of these two stations was 1.5%.

- ***Cornfield Shoals Alternative:*** Similar to the Niantic Bay Alternative, the predominant grain size within the CSDS and in the off-site area was also sand (Table 4-6). The measured silt and clay content varied between the 2013 benthic survey and the 2015 sediment chemistry survey. At the center of the CSDS, the 2013 benthic survey measured a silt and clay content of 5% (Station P003); the 2015 sediment chemistry survey measured a silt and clay content of 28% (Station L-51).

  The TOC concentrations in the center of the CSDS were 0.6% during the 2013 survey and 1.0% during the 2015 survey; the higher concentration in 2015 is consistent with the finer grain sizes measured in that sample. Sediment samples (2015 survey) from the perimeter within the CSDS as well as samples from the off-site area had TOC concentrations of less than 0.5%.

Metals. Metal concentrations in surface sediment samples collected from the three alternative sites during the 2015 sediment chemistry survey are summarized in Table 4-7. The distributions at the alternative sites were as follows:

- ***New London Alternative:*** None of the metal concentrations at individual stations exceeded the ERM values. Only two stations exceeded the ERL value for copper (37 mg/kg); specifically, the copper concentrations at Stations L-13 and L-16 were 45 mg/kg and 41 mg/kg, respectively. Mean metals concentrations were approximately twice as high at the NLDS as at Sites NL-Wa and NL-Wb, although none of the mean metal concentrations for those sites exceeded the ERL values. Metal concentrations at the three stations from the eastern part of Site NL-Wa (Stations L-19 to L-21), located just to the west of the NLDS, had lower concentrations than Stations L-13 and L-16 (located within the NLDS), suggesting that dredged material is contained within the NLDS. Stability of the sediment at the disposal mounds is also evidenced by the DAMOS program surveys; the 2006 assessment of surface sediments at the Seawolf Mound found metals concentrations that were similar across the mound and that were consistent with pre-dredge characterization of the disposed material (AECOM, 2010).

- ***Niantic Bay Alternative:*** None of the metal concentrations at any of the 2015 survey stations exceeded the ERM or ERL values. Concentrations were consistently low.

- ***Cornfield Shoals Alternative:*** None of the metal concentrations at any of the 2015 survey stations exceeded the ERM or ERL values. Metal concentrations in the center of the CSDS at Station L-53 were higher than at the other four stations within the CSDS, possibly reflecting disposed dredged material in the center. This observation is consistent with the higher silt and clay content at Station L-53 (28%), compared to the low silt and clay content at the four other CSDS stations (mean of 3.5%). Metal concentrations at the off-site station, located 0.6 nmi (1.1 km) to the west of the CSDS, were similar to concentrations at the center of the CSDS.

Table 4-7. 2015 Metal Concentrations in Sediments from the three Alternative Sites

Site	**Total Metals – Mean Concentration** (mg/kg dry weight)							
	Arsenic	**Cadmium**	**Chromium**	**Copper**	**Lead**	**Mercury**	**Nickel**	**Zinc**
New London Alternative								
NLDS	3.76	0.10	15.6	18.3	14.1	0.04	9.81	50.9
NL-Wa	2.02	0.03	7.0	4.0	5.4	0.02	4.20	19.5
NL-Wb	2.72	0.05	8.5	4.6	6.0	--	5.18	27.7
Off-site – east of NLDS	2.36	0.07	10.9	7.0	7.2	0.02	6.20	31.3
Niantic Bay Alternative								
NBDS	2.31	--	5.3	2.9	4.1	--	3.80	17.9
NB-E	2.90	--	7.7	4.3	5.2	--	4.66	24.3
Off-site – east of NB-E	3.04	--	7.3	3.3	5.5	--	4.90	24.6
Off-site – west of NBDS	3.06	0.03	6.1	3.4	4.2	--	4.08	20.2
Cornfield Shoals Alternative								
CSDS	2.55	0.04	7.0	5.8	5.1	0.02	5.90	25.1
Off-site – west of CSDS	5.22	0.06	18.4	14.7	8.1	--	18.60	47.4
Ecological Effects Values and Natural Background								
ERL	8.2	1.2	81	37	46.7	0.15	20.9	150
ERM	70	9.6	370	270	218	0.71	51.6	410
Natural background[1]	n/a	0.18	59	8	23	n/a	25	68

[1] Natural background values were determined from Long Island Sound sediments that reflect pre-anthropogenic conditions (Mecray and Buchholtz ten Brink, 2000).

n/a = not available -- indicates no detection

Organic Compounds – PAHs. PAHs were detected at 23 stations (out of 35 stations), and summarized in Table 4-8 as mean and maximum concentrations for specific areas. The 16 analyzed PAHs were divided into low molecular weight (LMW) PAHs and high molecular weight (HMW) PAHs because there are separate ERL and ERM values developed for these categories, based on their different toxicities. None of the individual samples exceeded the ERM value for any compound. None of the mean LMW, HMW, or total PAH concentrations exceeded the respective ERL value for any of the various areas of the three alternative sites. Only one sample (Station L-13) exceeded the ERL value for LMW, HMW, and total PAHs (this sample is discussed further below). For the New London Alternative, the mean total PAH concentrations were higher at the NLDS. For the Cornfield Shoals Alternative, total PAH concentrations were higher at the CSDS (due to the sample from Station L-53 in the center) than at the off-site station to the west.

Table 4-8. 2015 Polycyclic Aromatic Hydrocarbons (PAHs) in Sediments at the three Alternative Sites

Site	**PAH Concentration** (µg/kg dry weight)					
	Low Molecular Weight PAH	**High Molecular Weight PAH**	**Total PAH**	**Low Molecular Weight PAH**	**High Molecular Weight PAH**	**Total PAH**
	Mean Concentration			**Maximum Concentration**		
New London Alternative						
NLDS	287	1,050	1,338	**2,116**	**6,587**	**8,703**
NL-Wa	19	241	260	58	590	648
NL-Wb	5	46	51	13	180	190
Off-site – east of NLDS	34	327	361	112	473	585
Niantic Bay Alternative						
NBDS	3	25	27	13	110	110
NB-E	23	225	248	68	648	715
Off-site – east of NB-E	--	20	20	--	25	25
Off-site – west of NBDS	--	--	--	--	--	--
Cornfield Shoals Alternative						
CSDS	14	125	139	68	626	694
Off-site – west of CSDS	--	19	19	--	19	19
Ecological Effects Guideline Values						
ERL	552	1,700	4,022	552	1,700	4,022
ERM	3,160	9,600	44,792	3,160	9,600	44,792

Bold values exceed the ERL values. Dashes indicate that no PAH compounds were detected in the samples.

The most recent assessment of PAHs at the Seawolf Mound at the NLDS was conducted by the DAMOS program through the collection of 16 vibracores in 2010 (AECOM, 2012). The 2010 survey results indicated that PAH concentrations in the surface sediment (upper 1.7 feet [0.5 m]) were similar across the Seawolf Mound stations and were consistent with pre-dredge characterization of the capping material. Only one sample had a HMW PAH concentration slightly above the ERL value, but the total PAH concentrations of all individual stations was below the ERL value.

Sample L-13 collected during the 2015 sediment chemistry survey was located at the Seawolf Mound. The sample had a total PAH concentration of 8,703 µg/kg, exceeding the ERL of 4,022 µg/kg (*i.e.*, the sample represents the maximum PAH concentration at the NLDS in Table 4-8). Higher total PAH concentrations measured in Sample L-13 (as compared to the DAMOS 2010 survey) may be a result of heterogeneity and small-scale spatial variability in the sediments of the Seawolf Mound. One of the 2010 DAMOS stations was located in the same area, about 400 feet (120 m) to the northeast of Station L-13; this DAMOS station had a total PAH concentration of 1,140 µg/kg, below the ERL value (AECOM, 2012).

Organic Compounds – Pesticides. The surface sediment collected during the 2015 sediment chemistry survey was analyzed for 19 pesticides. Pesticides were only detected above the analytical reporting limit at six stations (4 stations at the NLDS, one station at the off-site area to the east of the New London Alternative, and one station at the CSDS). None of the detected concentrations exceeded the ERM values. Only two NLDS samples slightly exceeded ERL values: in Sample L-13, the concentration for the sum of DDD, DDE, and DDT of 1.70 µg/kg slightly exceeded the ERL value of 1.58 µg/kg; in Sample L-17, the DDT concentration of 1.48 µg/kg slightly exceeded the ERL value of 1 µg/kg.

Organic Compounds – PCBs. The surface sediment collected during the 2015 sediment chemistry survey was analyzed for 22 PCB congeners[5]. PCBs were only detected above the analytical reporting limit at three stations (two at the NLDS, and one at the CSDS). None of the detected concentrations exceeded the ERM value for total PCBs. Only the total PCB concentration in Sample L-17 (55.9 µg/kg), located at the NLDS, exceeded the ERL value (22.7 µg/kg).

Sediment Toxicity. Toxicity testing conducted in 2013 (Tetra Tech, 2014) indicated no potential toxicity at the alternative sites. Specifically, 10-day whole sediment toxicity tests on samples from the three alternative sites resulted in high mean survival rates (Table 4-9), and there was no significant difference in the survival at any alternative site with respect to the off-site reference or laboratory controls.

Table 4-9. Mean Survival Rates in 10-day Sediment Toxicity Tests

Sample Locations	**Station Number** [1]	**Mean Survival Rate** (percent)	
		Leptocheirus plumulosus	*Americamysis bahia*
NLDS	P011	96	82
NBDS	P018	99	92
CSDS	P003	98	92
Off-site reference station	R024	94	88

[1] See Figures 4-27 and 4-28 for station locations.

Source: Tetra Tech, 2014

The toxicity test conducted during the 2013 benthic survey used two species as required by the Regional Implementation Manual (USEPA and USACE, 2004c) – a marine amphipod (*Leptocheirus plumulosus*) and the mysid shrimp (*Americamysis bahia*). Toxicity sampling stations are shown in Figures 4-27 and 4-28. Because average replicate survival rates in the

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[5] A PCB congener is a single, unique well-defined chemical compound in the PCB category. The name of a congener specifies the total number of chlorine substituents and the position of each chlorine.

alternative site tests were high and not significantly different from reference or laboratory control survival, it is concluded that the sediments at the three alternative sites are not toxic to benthic organisms. This conclusion is based on the results of toxicity tests on one composite sample from each alternative site, and relies on the assumption that chemical and physical conditions at each alternative site are relatively consistent. While the comparison of sediment chemistry to ERL and ERM values support extending this "not toxic" conclusion to the entire extent of both the NBDS and CSDS, the various ERL exceedances at three stations in NLDS introduces some uncertainty to the conclusion that all NLDS sediments are not toxic. However, the literature suggests that the ERL value cannot be used as an indicator of sediment toxicity (O'Connor, 2004); therefore, the conclusion that the alternative site sediments are not toxic is justified.

4.6.4 Sediment Quality Summary

The predominant mean grain size throughout the three alternative sites was sand, although grain sizes at individual stations were finer-grained and more variable at the NLDS, reflecting the disposal of dredged material. The TOC content was below 1% in most samples from the three alternative sites, with generally higher concentrations at the NLDS. Metal and organic compound concentrations at the three alternative sites were low with only a few samples exceeding ERL values. Specifically, metal concentrations exceeded the ERL value for copper at two NLDS stations; PAH concentrations exceeded ERL values at one NLDS station; pesticide concentrations exceeded the ERL value for DDT and the sum of DDD, DDE, and DDT at two NLDS stations; and PCB concentrations exceeded the ERL value for total PCBs at one NLDS station. None of the concentrations exceeded the ERM value.

Available data for the Long Island Sound region indicate that sediments in the open waters of Long Island Sound are generally not toxic to benthic organisms. The toxicity tests during the 2013 benthic survey demonstrated that contaminants and physical conditions at the alternative sites do not elicit a toxic response to exposed organisms. These direct observations, combined with the comparisons of sediment chemistry to ERL and ERM values, support the conclusion that sediments at the alternative sites are generally not toxic.

4.7 Water Quality

This section describes the water quality (turbidity, nutrients, dissolved oxygen, pathogens, metals, and organic compounds) in the water column of Long Island Sound and Block Island Sound, and are summarized for the three alternative sites. This evaluation relies on information collected during several regional studies, and information recently synthesized in Varekamp et al. (2014). Additional water quality information was collected during the physical oceanography study for this SEIS (Appendix C-1).

4.7.1 Long Island Sound

The water quality in Long Island Sound is strongly affected by runoff and discharges from its urban surroundings. The watershed of Long Island Sound has an area of approximately 16,250 square miles (42,070 km^2; LISS, 2014b, Figure 4-33). Contaminant loading and the resulting environmental impacts are closely related to the total population surrounding Long Island Sound. However, environmental regulations and other programs have reduced the contaminant loading for many toxic and inorganic chemicals and nutrients over the last several decades (*e.g.*, Varekamp et al., 2014; LISS, 2014c).

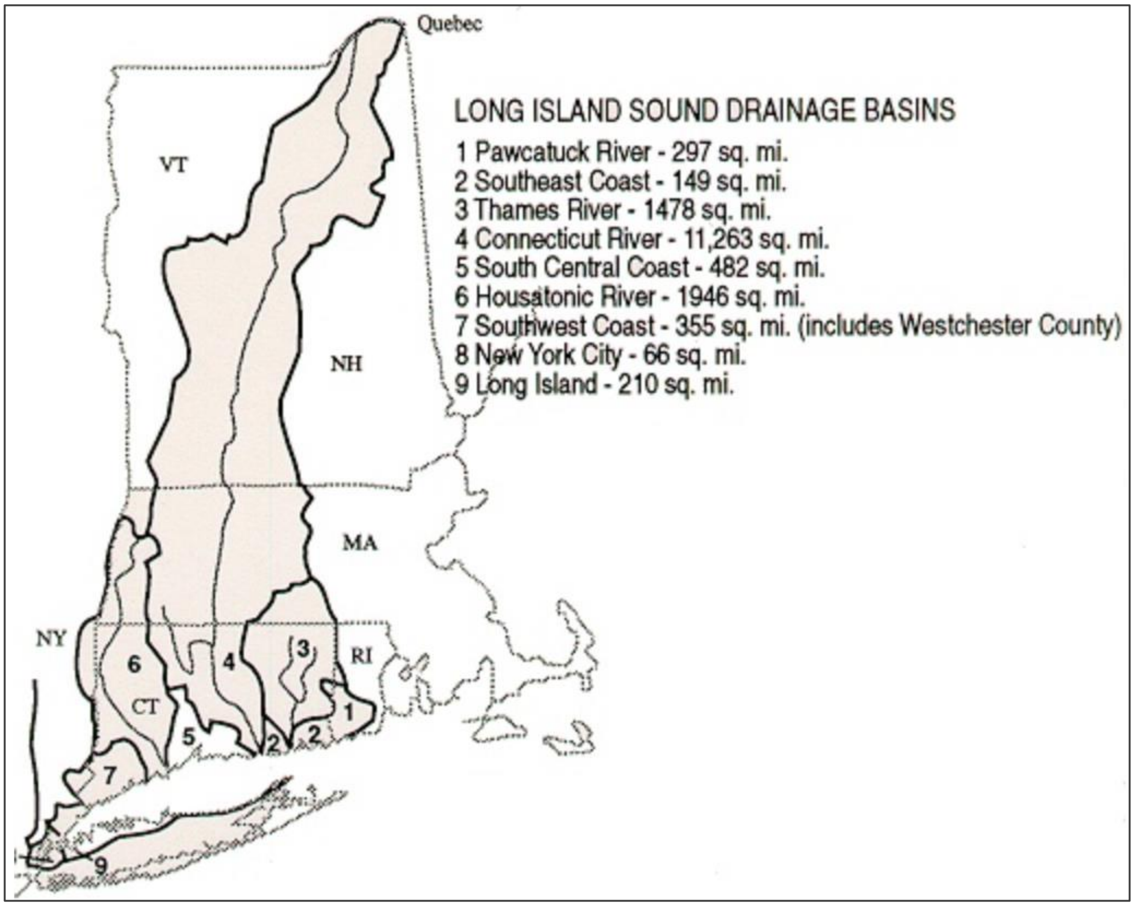

Figure 4-33. Long Island Sound drainage basin (Source: LISS, 2014b).

The three largest rivers draining into Long Island Sound are, from east to west, the Thames River, Connecticut River, and Housatonic River:

- *Thames River:* The Thames River combines the input of the Quinebaug, Shetucket, and Yantic Rivers. It enters the eastern Long Island Sound between New London and Groton, Connecticut. Covering 9% of the drainage area to the entire Long Island Sound, it discharges on average 2,200 cfs (62 m^3/s) (Gay et al., 2004).

- *Connecticut River:* It enters the eastern Long Island Sound between Old Saybrook and Old Lyme, Connecticut. Covering approximately 75% of the total drainage area of all major rivers draining to the Long Island Sound, it discharges on average 19,300 cfs (545 m^3/s).

- *Housatonic River:* It enters the central Long Island Sound between Stratford and Milford, Connecticut. Its drainage area covers 12% of the total drainage area to the Sound. Its average discharge rate is 3,500 cfs (98 m^3/s).

In 1985, the Long Island Sound Study (LISS, 2014d), became one of the 28 estuaries in the USEPA National Estuary Program. The LISS developed a comprehensive management plan for improved management of the Sound. Key water quality issues identified by the LISS include low dissolved oxygen, toxic contamination, pathogen contamination, floatable debris, the health of living organisms, and land use and development. Since 1991, the CTDEEP has performed an intensive year-round water quality monitoring program in Long Island Sound on behalf of the LISS. Surface and bottom waters are monitored for water temperature, salinity, dissolved and particulate silica, dissolved and particulate nitrogen, dissolved oxygen, chlorophyll *a*, and total suspended solids. Sampling occurs monthly from October through May at 17 stations (CTDEEP, 2014a). Bi-weekly hypoxia surveys start in mid-June and end in September with up to 48 stations being sampled during each survey.

Except for selected coastal areas, waters in Long Island Sound are classified as SA waters. The best uses of Class SA waters are shellfishing for market purposes, primary and secondary contact recreation, and fishing. These waters shall also be suitable for fish propagation and survival. As required by the Clean Water Act (Section 303), the States of Connecticut and New York have adopted dissolved oxygen (DO) water quality standards for coastal and marine surface waters. The states have set criteria or water quality goals for water resources depending upon the water's class and/or designated use(s). Water quality standards for New York and Connecticut require a chronic DO concentrations of not less than 4.8 mg/L for defined periods of time and an acute DO concentration never less than 3.0 mg/L (NYSDEC, 2015c; CTDEEP, 2014b) for protection of habitat for marine fish, other aquatic life and wildlife; shellfish harvesting for human consumption; recreation; industrial water supply; and navigation. In 1998 the States of New York and Connecticut agreed to nitrogen reduction targets of nearly 60%, subsequently adopted as part of a Total Maximum Daily Load (TMDL) plan completed in December 2000 (NYSDEC and CTDEEP, 2000). There are no turbidity limits for the State of Connecticut, provided that all reasonable controls and Best Management Practices are used to control turbidity and none exceeding levels necessary to protect and maintain all designated uses. For the State of New York, turbidity shall not increase to levels that would cause a substantial visible contrast to natural conditions.

Following is a summary of relevant water quality parameters: turbidity, nutrients, dissolved oxygen, pathogens, and metal and organic compounds. Temperature and salinity are discussed in Section 4.5.1.3 above.

Turbidity. The main sources for turbidity in the water column are plankton blooms in the surface waters, suspended sediment entering Long Island Sound by rivers, and sediment that was resuspended at the seafloor. Organic and inorganic particulate matter present in the water column is measured as total suspended solids (TSS) or as turbidity. The higher the concentrations of particulate matter, the higher the turbidity. Turbid water interferes with recreational use and aesthetic enjoyment of water. Higher turbidity also lowers water transparency, increasing light extinction (a measure of the penetration of light through water) and reducing the depth of the euphotic zone. This decreases primary production and decreases food for aquatic organisms.

Turbidity measurements are made in the spring and summer, the most productive seasons in Long Island Sound. CTDEEP has been monitoring turbidity indirectly by measuring water clarity (using a Secchi disk) since June 2000 (CTDEEP, 2013). The average Secchi depth in Long Island Sound is 7.5 feet (2.3 m).

<u>Suspended sediment</u>: Turbidity is also affected by suspended sediment inflows. The annual inflow of suspended sediment to Long Island Sound from primarily rivers (but also from direct urban and agricultural runoff and discharges from sewage treatment plants) was estimated with 0.93 million metric tons per year, with an additional 0.7 metric tons per year entering Long Island Sound from the coastal ocean, mainly through The Race (Farrow et al., 1986; Rhoads 1994). This total mass of 1.6 million metric tons per year converts to a volume of 1.1 million cy/yr (using a bulk density of 1.5 g/cm^3).

Sediment loading from land sources may be higher during storms, as for example during Tropical Storm Irene. Irene was initially a hurricane but was downgraded to a tropical storm on August 28, 2011 as it was passing the Chesapeake Bay region. Tropical Storm Irene passed directly over the northeastern United States between August 28 and 29, 2011. The storm resulted in about 6 to 8 inches (15 to 20 cm) of rainfall within the Connecticut River watershed and major flooding of the Connecticut River. Flooding during the storm was particularly severe within the upland tributaries of the Connecticut River. In addition, the Connecticut River runs through a landscape that was once submerged under glacial Lake Hitchcock that contained fine-grained sediment, resulting in high suspended sediment loads in the river and a large plume in Long Island Sound (Figure 4-34). Over the 3 days of peak flooding from August 29 to September 1, 2011, approximately 1.2 million metric tons of sediment were transported through the low-lying reaches of the Connecticut River. Suspended sediment concentrations reached a peak of over 800 mg/L on August 31, 2011 (Yellen et al., 2014). Upon entering Long Island Sound, the net transport direction of the suspended sediment plume was to the west (consistent with physical oceanographic conditions described in Section 4.5). Figure 4-34 also shows dispersion of suspended sediment in an easterly direction toward The Race and as far as Montauk Point in Block Island Sound. The satellite image was taken two to three days after the runoff peak thus the area had experienced several tidal cycles with water flowing into and out of Long Island Sound.

Figure 4-34. NASA image of suspended sediment in the Connecticut River and in Long Island Sound after Tropical Storm Irene (Source: Landsat satellite image acquired on September 2, 2011; NASA, 2014).

The larger portion of the suspended sediment entering Long Island Sound settles in the western and central basin rather than in the eastern basin (Bokuniewicz, 1988). In addition to the suspended sediment that is transported into Long Island Sound, the bottom sediments in the central and western basins are resuspended and redeposited regularly by tidal flows (Rhoads et al., 1984; Knebel and Poppe, 2000). The resuspended and redeposited sediment volume appears to be substantially greater than the volume of suspended sediment entering Long Island Sound. Using sediment trap data obtained by McCall (1977), Rhoads (1994) calculated that 1 billion metric tons of fine sediment was resuspended annually in Long Island Sound, or approximately 1,000 times the annual inflow of suspended sediment. Resuspension rates may be higher during storms but as stated by Lopez et al. (2014), there is little evidence that storm events are a major source of disturbance in Long Island Sound except in shallow nearshore habitats. This observation is consistent with results of the physical oceanographic modeling performed for this SEIS (see Section 4.5).

Nutrients. Nutrients include the organic and inorganic forms of nitrogen, phosphorus, and silica, which exist in aquatic environments primarily in dissolved or particulate form. In Long Island Sound, nitrogen is the primary limiting nutrient for algal growth (Gobler et al., 2006), *i.e.*, if this nutrient is absent, algal growth is reduced. Sources of nitrogen to Long Island Sound include municipal and industrial wastewater treatment plants, combined sewer overflows, nonpoint sources (runoff from land use activities), and atmospheric deposition directly to water surfaces. Point sources contribute the bulk of the total nitrogen load that reaches Long Island Sound, providing approximately 39,000 tons/yr in 1990 (NYSDEC and CTDEEP, 2000). The predominant nitrogen point sources were wastewater treatment plants with 38,000 tons/yr; other point sources consisted of combined sewer overflows (900 tons/yr). Nitrogen loading from non-point sources contributed an additional 14,400 tons/yr. Point source loading of nitrogen to Long Island Sound has decreased by a factor of approximately 2.5 since 1990 (LISS, 2014d) as a result of the increase in federal, state and local regulations, and the development of the LISS.

Total phosphorus loads also declined, likely due to improvements in wastewater treatment in the Sound’s watershed. The total phosphorus load from the Connecticut River declined from 1,780 tons/yr in 1974 to 922 tons/yr in 2008 (Varekamp et al., 2014), a reduction of 48%.

Dissolved silica is an essential nutrient required by some organisms such as diatoms. The primary source of the silica is weathered rock (Varekamp et al., 2014) with only limited influence by anthropogenic activities. The combined annual inflow of silica from the Connecticut and Housatonic Rivers is estimated at 1.5 million tons/yr; the wastewater treatment plant inflow of silica is estimated at only approximately 1% of the riverine inflow (Boon, 2008).

Dissolved Oxygen. Dissolved oxygen is an important gauge of water quality and indicates the ability of the water body to support a well-balanced aquatic faunal community. In estuaries, DO concentrations can range from saturation (*i.e.*, the highest amount of DO which the water can hold at equilibrium) to 0 mg/L (anoxia). Saturation varies with water temperature and salinity, but is about 7.5 mg/L when the water temperature is 22°C (72°F), a typical summer temperature in Long Island Sound. Hypoxia, or low DO concentrations, has been identified as the major problem in western Long Island Sound since 1986. LISS has defined the onset of hypoxia as 3 mg/L, although there may be adverse effects to organisms even above this concentration depending upon the length of exposure (CTDEEP, 2013).

Hypoxia in the bottom waters of Long Island Sound is caused primarily by die-off of plankton. Excessive plankton blooms have been attributed to nitrogen loads from wastewater treatment plant discharges, combined sewer overflows (CSOs), and stormwater and urban runoff (NYSDEC, 2011).

Natural variations in weather and physical factors have affected the size of the hypoxic area, the duration of the event, and variability in DO concentrations. Long Island Sound hypoxic events last from 35 to 80 days. They start as early as mid-June and can end mid to late September. Hypoxia steadily develops through the summer as bacteria consume the supply of dead plankton descending to bottom waters, and propagates from near the East River in an easterly direction reaching well into central Long Island Sound. DO is restored to bottom waters during the fall turnover when oxygen-rich surface water is mixed downwards. In eastern Long Island Sound, the frequency of hypoxic events is very low (Figure 4-35). During the most extensive hypoxic event in 1994, only western and central Long Island Sound was affected (Figure 4-36). It is noted that hypoxic events occur during the summer months, while dredging and disposal occur during the fall and winter.

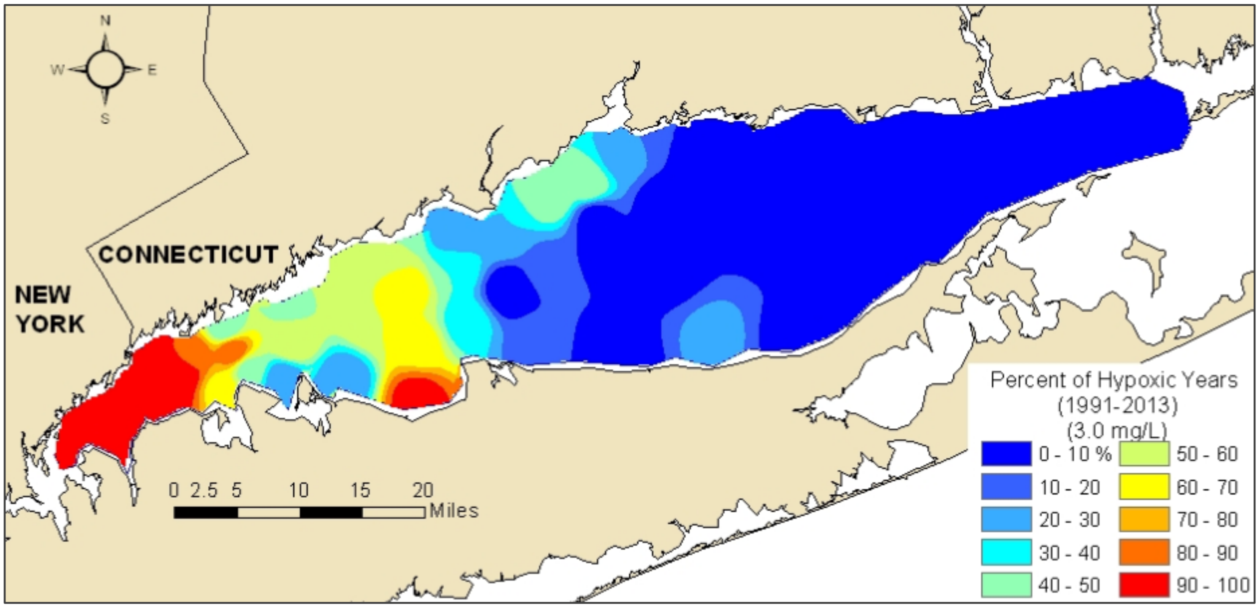

Figure 4-35. Frequency of hypoxia events in Long Island Sound bottom waters (Source: LISS, 2014c).

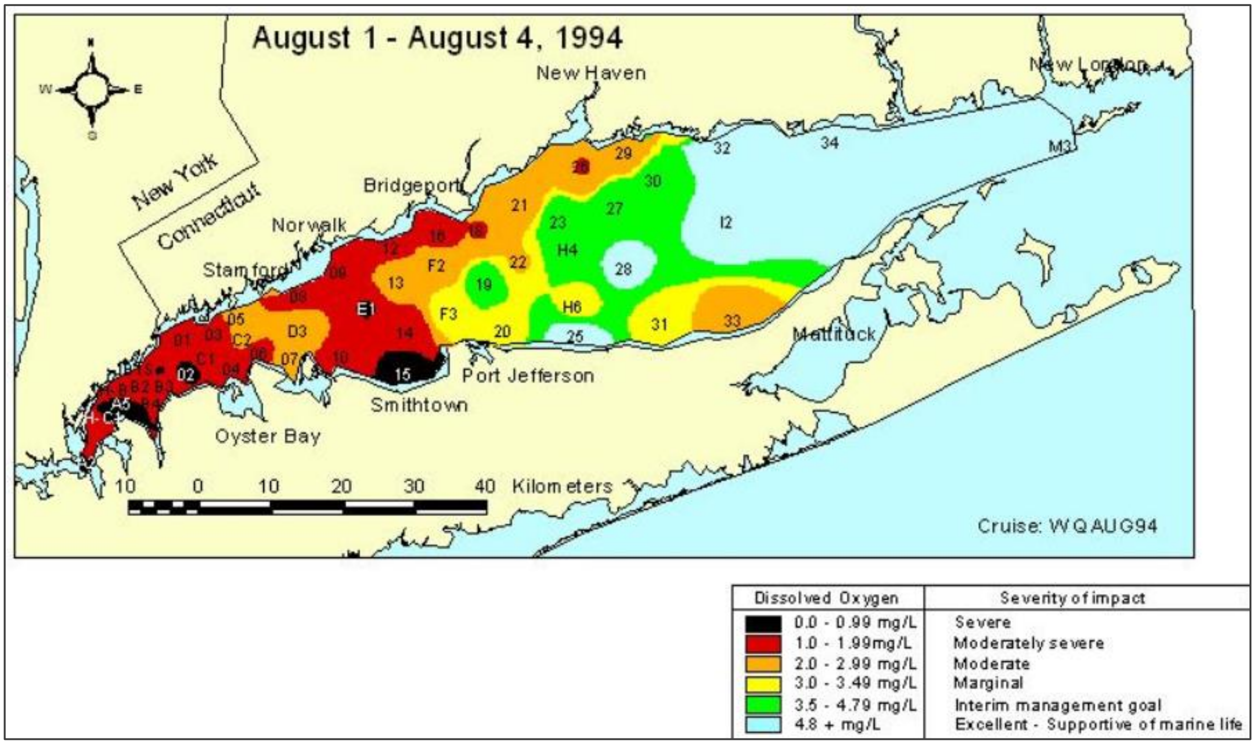

Figure 4-36. Dissolved oxygen concentrations in bottom waters of Long Island Sound during the most extensive hypoxia event observed, August 1 to 4, 1994 (Source: LISS, 2014c).

Pathogens. Pathogens are bacteria and viruses that, when ingested or contacted by humans, cause illnesses or diseases, such as gastroenteritis, cholera, typhoid fever, salmonella, or hepatitis A. Pathogens that concentrate in the fecal waste of infected humans or warm-blooded animals enter Long Island Sound through both point and nonpoint pathways. Specific sources of pathogens include improperly treated or untreated sewage discharges from combined sewer overflows, sewage treatment plant breakdowns, stormwater runoff, waterfowl and animal wastes, septic systems, inadequately treated sewage discharges from boats, and illegal connections to storm drain systems. There are no practical tests for pathogens in the environment, and coliform bacteria (*i.e.*, total coliform bacteria, fecal coliform bacteria) are often used as surrogates. Long Island Sound is not tested for coliform bacteria; rather, waters near beaches or other recreational areas and near shellfish beds are most often tested for these bacteria. Generally, the Sound's beaches are safe for swimming, although health departments will close beaches when monitoring data indicate contamination, or preemptively after a rainstorms at beaches known to be susceptible to contamination (LISS, 2014d). Similarly, commercial and recreationally-approved shellfish areas are monitored regularly for potential contamination from pathogens for the protection of human health.

Metals and Organic Compounds. Metals and organic compounds (PAHs, pesticides, PCBs) in the water column are most often found at trace levels. Primary sources of metals and organic compounds in Long Island Sound are discharges from sources of the surrounding watershed. The USEPA collected and analyzed water from the CLDS in January 2000 and the CSDS in September

2001 (USACE, 2002b; USACE, 2002c; respectively) as part of testing to determine the suitability of sediment dredged from harbors in Connecticut for disposal. The data from these analyses were provided in the WLIS/CLIS EIS (USEPA and USACE, 2004a), and are presented in Table 4-10, in addition to the current Connecticut and New York surface water quality standards. (The data from the CLDS are included since the CSDS is a dispersive site, with net transport of materials to the west toward central Long Island Sound.)

These 2000/2001 analyses show that all ambient metals levels at the CLDS and CSDS were below current applicable water quality standards. Pesticides, PCBs, and PAHs were either not detected or were also below applicable water quality standards, although for some of these compounds, the method detection limits (*i.e.*, the minimum concentration reliably quantified by the analytical method in the laboratory) were above the water quality standards. Data from the eastern part of eastern Long Island Sound are not available; however, the waters of this area are more frequently exchanged with Block Island Sound water than water in the central parts of Long Island Sound. Concentrations of organic compounds are expected to be low in Block Island Sound water, resembling more closely the water chemistry of the open Atlantic Ocean.

Table 4-10. Contaminant Concentrations in Water from the Central Long Island Sound and Cornfield Shoals Disposal Sites (2000/2001)

Parameter	**Central Long Island Sound Disposal Site** (µg/L)	**Cornfield Shoals Disposal Site** (µg/L)	**State Water Quality Standards**	
			CTDEEP (µg/L)	**NYSDEC** (µg/L)
Metals				
Arsenic	1.65	1.13	36	63
Cadmium	0.044	0.031	8.8	7.7
Chromium	0.31	0.33	50	54
Copper	1.48	0.9	3.1	3.4
Mercury	0.0012	0.0009	0.94	0.0026
Nickel	0.66	0.55	8.2	8.2
Lead	0.16	0.15	8.1	8
Zinc	1.65	1.59	81	66
Polycyclic Aromatic Hydrocarbons (PAHs)				
Naphthalene	0.007	n/a	20,513	n/a
2-Methylnaphthalene	0.003		---	
1-Methylnaphthalene	0.002		---	
2,6-Dimethylnaphthalene	0.002		---	
Biphenyl	0.001		---	
Acenaphthylene	0.002		49.2	
Acenaphthene	<0.01		6.1	
Fluorene	0.0009		49.2	
Phenanthrene	0.002		49.2	
Anthracene	<0.01		49.17	
1-Methylphenanthrene	<0.01		---	

Table 4-10. Contaminant Concentrations in Water from the Central Long Island Sound and Cornfield Shoals Disposal Sites (2000/2001)

Parameter	**Central Long Island Sound Disposal Site** (µg/L)	**Cornfield Shoals Disposal Site** (µg/L)	**State Water Quality Standards**	
			CTDEEP (µg/L)	**NYSDEC** (µg/L)
Fluoranthene	0.001	n/a	1.28	n/a
Pyrene	0.001		49.17	
Benzo(a)anthracene	<0.01		0.018	
Chrysene	<0.01		0.018	
Benzo(b)fluoranthene	<0.01		0.018	
Benzo(k)fluoranthene	<0.01		0.018	
Benzo(e)pyrene	0.0008		---	
Benzo(a)pyrene	<0.01		0.018	
Perylene	<0.01		---	
Indeno(1,2,3-c,d)pyrene	<0.01		0.018	
Dibenz(a,h)anthracene	<0.01		0.010	
Benzo(g,h,i)perylene	<0.01		4.92	
Pesticides				
4,4 DDD	<0.0015	<0.0015	---	0.00005
4,4 DDE	<0.0015	<0.0015	---	0.000007
4,4 DDT	<0.0015	<0.0015	0.001	0.00001
Aldrin	<0.0015	<0.0015	0.0005	0.001
a-BHC	<0.0015	<0.0015	0.0049	0.002
b-BHC	<0.0015	<0.0015	0.017	0.007
d-BHC	<0.0015	<0.0015	---	0.008
g-BHC	<0.0015	<0.0015	0.063	0.008
a Chlordane	<0.0015	<0.0015	0.004	0.00002
g-Chlordane	<0.0015	<0.0015	---	---
Dieldrin	<0.0015	<0.0015	0.0019	0.0000006
Endosulfan I	<0.0015	<0.0015	0.0087	0.001
Endosulfan II	<0.0015	<0.0015	0.0087	---
Endosulfan sulfate	0.00186	<0.0015	89	---
Endrin	<0.0015	<0.0015	0.0023	0.036
Endrin aldehyde	<0.0015	<0.0015	0.30	---
Endrin ketone	<0.0015	<0.0015	---	---
Heptachlor	<0.0015	<0.0015	0.0036	0.0002
Heptachlor epoxide	<0.0015	<0.0015	0.0036	0.0003
Methoxychlor	0.00655	0.0045	---	0.03
Toxaphene	<0.02	<0.02	0.0002	0.005
Total PCBs				
Total PCBs	<0.0015	<0.0015	0.03	0.00012

Non-detected values are marked with a "<" and the method detection limit.

The low concentrations of metals in Long Island Sound (Table 4-10) are consistent with findings by Mitch and Anisfeld (2010) who synthesized available water quality data and information for the Sound from various sources; they concluded that all dissolved metal concentrations throughout the Sound were well below the CTDEEP water quality standards. Furthermore, toxic releases from industrial facilities within the watershed of Long Island Sound have continued to decrease substantially, as shown by LISS (2014c) (Figure 4-37).

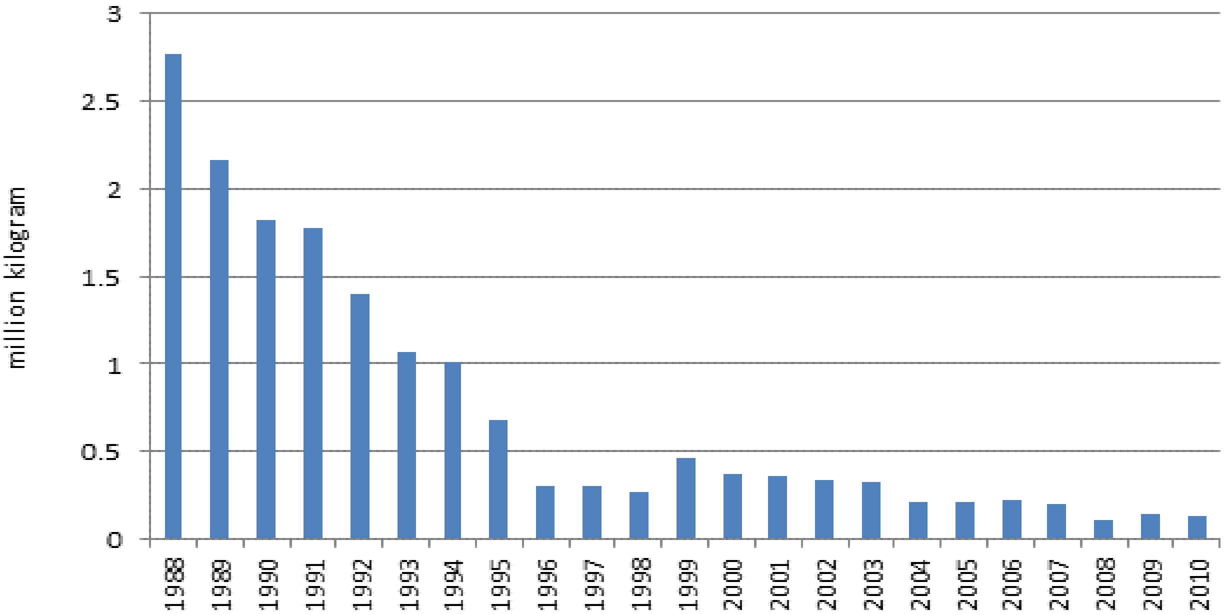

Figure 4-37. Surface water discharges of the sum of industrial chemicals listed in the Toxics Release Inventory (TRI) for Connecticut and New York (Source: LISS, 2014c).

4.7.2 Block Island Sound

The influence of freshwater to the water quality in Block Island Sound is very low, due to the absence of major rivers entering the Sound. As a result, its hydrography and water quality more closely resemble ocean conditions. The analysis relies on information collected by RICRMC (2010). Suspended sediment concentrations are lower in Block Island Sound than in Long Island Sound due to the absence of major rivers. Phosphate concentrations in Block Island Sound are highest in fall and winter. They decline rapidly in spring during phytoplankton blooms, resulting in minimum concentrations in late spring and early summer. Dissolved oxygen concentrations in Block Island Sound are high and well above the criteria for marine waters, which is likely a result of the open exchange of water with the Atlantic Ocean. The coastal zone surrounding Block Island Sound is not industrially developed, and therefore discharges of wastewater entering Block Island Sound are limited.

4.7.3 Water Quality at Alternatives Sites and Summary

The vigorous circulation in the eastern basin of Long Island Sound ensures that the water properties are rapidly mixed in both the horizontal and vertical dimensions. Consequently, measurements of water quality parameters (salinity, temperature, turbidity, dissolved oxygen etc.) show only subtle variations. The temporal variability associated with seasonal cycles in runoff and biological productivity are a much more substantial factor that affect the water quality in eastern Long Island Sound. The water quality at the three alternative sites is therefore considered to be similar.

The water column in the Sound is well-mixed from fall through late spring, but increased freshwater runoff and increasing water temperatures cause buoyant, warmer water to become layered over more dense, colder water during the summer and early fall. Hypoxic events, prevalent in the summer in the western and central Long Island Sound, do not extend to eastern Long Island Sound and the three alternative sites. Water column concentrations of contaminants measured at the Cornfield Shoals and at the Central Long Island Sound were low or not detected. Similar low concentrations are expected at the three alternative sites considering the rapid tidal mixing in the eastern Long Island Sound.

4.8 Plankton

Plankton are small, free-floating, or weakly swimming organisms that drift through the water column. Despite their small size and short life spans, plankton form the base of most of the ocean's food chains and have key ecosystem roles in the distribution, transfer, and recycling of nutrients and minerals. Although some forms can independently swim hundreds of meters vertically in a single day, the horizontal position of plankton is primarily controlled by the surrounding currents.

Plankton can be divided into two major groups, phytoplankton and zooplankton.

- *Phytoplankton:* Phytoplankton consists of single-celled plants, which are the major contributor to primary production in the sea. There are two major groups of phytoplankton, fast-growing diatoms, which are not capable of propelling themselves through the water, and dinoflagellates, which can migrate vertically in the water column in response to light.

- *Zooplankton:* The zooplankton community is comprised of microscopic animals that consume primarily phytoplankton, converting them into protein that then fuels the higher trophic levels of the food web in the marine ecosystem. Zooplanktonic organisms (zooplankters) include animals that spend their entire life span in the plankton community (holoplankton) and some that are part of the planktonic community for only specific life stages (meroplankton). For example, the meroplankton includes the larval forms of many species of invertebrates and fish. Important zooplankton include unicellular (foraminifera, radiolaria) and multicellular animals (copepods).

Both plankton groups, as well as harmful algal blooms, are discussed below for Long Island Sound and Block Island Sound.

4.8.1 Long Island Sound

The plankton community in Long Island Sound appears to be consistent with that expected for the mid to north Atlantic (*e.g.*, Capriulo and Carpenter, 1983; Anderson and Taylor, 2001; Capriulo et al., 2002). Seasonal stratification, water temperature, nutrient concentrations, and light availability all factor into the distribution and abundance of the phytoplankton and zooplankton communities.

Phytoplankton. The occurrence and intensity of seasonal phytoplankton blooms in early spring, summer, and fall varies from year to year. Algal blooms occur when environmental factors stimulate phytoplankton growth to levels greater than that removed by cell death and grazing. Phytoplankton organisms ("phytoplankters") are typically evenly distributed throughout the water column before the onset of seasonal stratification. When the water column is stratified, nutrients are locked below the pycnocline (the density gradient set up by the differences in temperature and salinity between the surface and bottom layers), and phytoplankton populations decline as the nutrients they require are used up and not replenished. Summer blooms may occur if increased tidal mixing during new moon phases (Peterson, 1983) or disturbance of bottom waters by storms (Anderson and Taylor, 2001) break down the stratification barrier and release nutrients into the photic zone (the zone within which light penetrates and photosynthesis occurs).

Earlier studies observed a major phytoplankton peak in the spring and a lower peak in the fall (*e.g.*, Conover, 1956; Sun et al., 1994). However, during 2002 to 2010, the largest peak occurred during the summer, based on CTDEEP monitoring data (Lopez et al., 2014). Diatoms contributed over half of the total biomass in the 2002 to 2010 period, followed by dinoflagellates with 11%. There was no discernable trend in species richness from west to east in the Sound, although the phytoplankton abundance (measured as the number of cells per liter of water) was highest in the high-nutrient and lower-salinity waters of western Long Island Sound, as also observed by others (*e.g.*, Capriulo et al., 2002). The nutrient gradient in the Sound reflects the strong human population gradient along its shores from west to east.

Zooplankton. Zooplankton include metazooplankton (organisms larger than 200 µm) and microzooplankton (organisms between 35 and 200 µm in size). Overall, the seasonal patterns in metazooplankton abundances and species composition over the last 60 years seem to be relatively unchanged in Long Island Sound (Lopez et al., 2014). Specifically, peak abundances during the periods 1952-1953, 2002-2004, and 2008-2009 occurred between April and June of each year; minimum abundances occurred between December and February.

Routinely reported taxa have included the following: Arthropoda (copepods, mysids, crab larvae, amphipods, barnacle nauplii, and cladocerans); Annelida (polychaete larvae); Mollusca (gastropod and bivalve larvae); Echinodermata (sea star larvae); Chordata (*Oikopleura* sp.); Bryozoa; and Chaetognatha (*e.g.*, the arrow worm, *Sagitta elegans*) (Lopez et al., 2014). Copepods accounted for 80 to 90% of the abundances (Dam and McManus, 2009). The seasonal metazooplankton cycles are dominated by the copepods *Acartia hudsonica*, *Temora longicornis,* and *Pseudocalanus* sp. in winter and spring, and by the copepods *Acartia tonsa*, *Paracalanus crassirostris,* and *Oithona similis* in the summer and fall (Peterson, 1986).

As for phytoplankton, there is a distinct decreasing gradient in mesozooplankton biomass and abundances from west to east in Long Island Sound. Based on 2002 to 2009 data from the CTDEEP zooplankton monitoring program (Dam and McManus, 2009), the mean annual total mesozooplankton abundance is 4 and 3 times higher in western and central Long Island Sound, respectively, as compared to eastern Long Island Sound. Lopez et al. (2014) suggested that the parallel gradients between phytoplankton and zooplankton indicate that the metazooplankton distribution is primarily food-limited; eutrophication in the western Long Island Sound does not appear to adversely affect this zooplankton community.

Smaller animals are also an important component of the overall zooplankton community in the Sound. The most common microzooplankton include ciliates, and heterotrophic nanoflagellates and dinoflagellates (Lopez et al., 2014). Capriulo and Carpenter (1980; 1983) studied the abundance and feeding biology of microzooplankton in Long Island Sound. Capriulo and Carpenter (1983) concluded that tintinnids, a ciliate, by virtue of their high abundances and ingestion rates, were important herbivores in Long Island Sound. The authors emphasized, however, that because tintinnids feed more efficiently on small phytoplankton, they did not directly compete with copepods, which are significant grazers on larger organisms. The CTDEEP monitoring program reported that abundance of ciliates peaked broadly from spring through summer, but varied greatly spatially and temporally.

Harmful Algal Blooms. An algal bloom is a rapid increase in the population of algae in an aquatic system. Harmful algal blooms (HABs) are blooms of a single species of phytoplankton that result in adverse impacts to other organisms via production of natural toxins, mechanical damage, depletion of oxygen, or by other means. HABs may impact the natural resources (invertebrates, fish, bird, and mammal mortality) or socio-economic resources (shellfish-poisoning in human consumers, economic losses to coastal communities from commercial fisheries and tourism). This includes impacts to the Sound's molluscan shellfish fishery, chiefly consisting of wild caught hard clams and bottom-cultivated eastern oysters *(Crassostrea virginica).*

HABs are sometimes referred to as "red tide", "brown tide" or "green tide", depending on the coloration of the water by the particular plankton species causing the bloom. Not all of these "tides" are harmful. HABs have occurred annually in some embayments of Long Island Sound (Lopez et al., 2014). Causes for HABs are not well understood, in part because there are many different species of algae that can form HABs, each with different environmental requirements for optimal growth. Anthropogenic nutrient enrichment has been proposed as a principal cause (Davidson et al., 2014). For example, experiments suggested that the red tide blooms of the dinoflagellate *Alexandrium fundyense* (which have emerged in the Northport-Huntington Bay complex along the northern shore of Long Island since 2006) appear to be supported by wastewater-derived nitrogen (Gobler and Hattenrath-Lehman, 2011). Other factors may be local hydrodynamic conditions such as poor flushing.

4.8.2 Block Island Sound

Phytoplankton. Riley (1952) studied the phytoplankton distribution in Block Island Sound and found that nine genera constituted 98% of the total number of phytoplankton cells (*Skeletonema costatum*, *Chaetoceros* spp., *Leptocylindricus* spp., *Thalassiosira* spp., *Thallasionema nitzschioides*, *Nitzschia* spp., *Asterionella japonica*, *Rhizosolenia* spp., and *Guinardia flaccida*). He observed a phytoplankton minimum in mid-winter and mid-spring, a bloom in spring, and smaller blooms during the summer, which is generally similar to seasonality in Long Island Sound. The New York Ocean Science Laboratory, located in Montauk, New York, initiated a survey of the physical and chemical characteristics of Block Island Sound (Hollman, 1976; Staker and Bruno, 1977). The diatom species *Thalassiosira nordenskioldii* was numerically dominant in the samples, but the diatom species *Skeletonema costatum* and dinoflagellate species *Ceratium tripos* presented a larger biomass in the community. Very little phytoplankton data has been collected in Block Island Sound since the 1970's. Primary production and chlorophyll *a* concentrations reflect fairly consistent peaks during late fall and early spring, with a distinct and significant fall bloom.

Zooplankton. As in Long Island Sound, the most dominant zooplankton species in Block Island Sound are copepods with a seasonal average of 73% of the total zooplankton population. As reported in RICRMC (2010), data collected between 1978 and 2007 by the Marine Resources, Monitoring, Assessment and Prediction Program (MARMAP) suggest that the dominant zooplankton species have not shifted over the last 60 years.

Harmful Algal Blooms. RICRMC (2010) reported that HABs have not been reported in its study area, which included the eastern Block Island Sound. However, the authors stated that considering the presence of potentially harmful species and the warming climate, the area is not immune to HABs.

4.8.3 Plankton at the Alternative Sites and Summary

Site-specific information is not available to describe the communities at each alternative site. However, considering the lack of mobility of planktonic species (*i.e.*, they drift along in tidal currents), the plankton communities at each of the alternative sites are expected to be similar to those described for Long Island Sound, and the primary factors controlling fluctuations in these populations are seasonal stratification of the water column and nutrient supply.

4.9 Benthic Invertebrates

This section describes the benthic invertebrates of Long Island Sound, Block Island Sound, and the three alternative sites. Benthic invertebrates are organisms (*e.g.*, worms) that live on or within the bottom substrate. They represent an important biological community that interacts closely not only with other communities in the overlying water (Steimle et al., 1994), but also with the physical environment. Benthic communities are used as biological indicators for evaluating the effects of physical disturbances because they are relatively immobile, sensitive to physical disturbance, and tests are relatively inexpensive. The benthic community is typically studied by collecting a grab sample of a discrete portion of the sediment. The sediment is then evaluated to determine the number and type of organisms present. Abundance calculations of the benthic infauna are extrapolated to numbers per unit area by dividing the number of organisms in the sample by the surface area sampled.

Information about the condition of the Long Island Sound benthos was described in the CLIS/WLIS EIS (USEPA and USACE, 2004a). Information about the benthic communities at the three alternative sites was derived primarily from two field studies conducted in support of this SEIS: the 2013 benthic survey and the 2014 SPI/PV survey (Appendices E and F). The sediment quality component of these two studies was described in Section 4.6; the biological component is described below.

2013 Benthic Survey. In July 2013, Tetra Tech (2014) investigated 45 sites for benthic parameters within and off-site of the three alternative sites (Table 4-4; Figures 4-38 and 4-39). Samples were collected with a Van Veen grab sampler with a surface area of 0.1 m^2. Benthic invertebrate data were compared to the following ecological parameters that are among the more common ones used by marine ecologists to characterize communities:

- *Abundance (or Total Individuals):* Represents the number of infaunal organisms identified in a defined sample size or area. The actual number of organisms counted is often extrapolated to the number of organisms per square meter.
- *Species Richness (R):* Represents the number of species identified in the sample.
- *Shannon-Wiener Diversity (H'):* A measure of species diversity that estimates the uncertainty associated with predicting the species identity of an organism randomly selected from a sample. H′ is 0 when there is only one species in the sample and is at a maximum when all species in the sample have the same number of individuals. Generally, maximum H′ values for marine infaunal communities are between 6.0 and 7.0 for very diverse tropical communities. Maximum values for southern New England communities are <5.0. This index is used by the DAMOS program for the management of dredged material disposal sites.
- *Pielou's Evenness (J'):* A measure of the distribution of the abundance of the organisms in a sample among the species in that sample. The index ranges from 0 to 1 and is at the maximum value when all species in the sample have the same number of individuals.

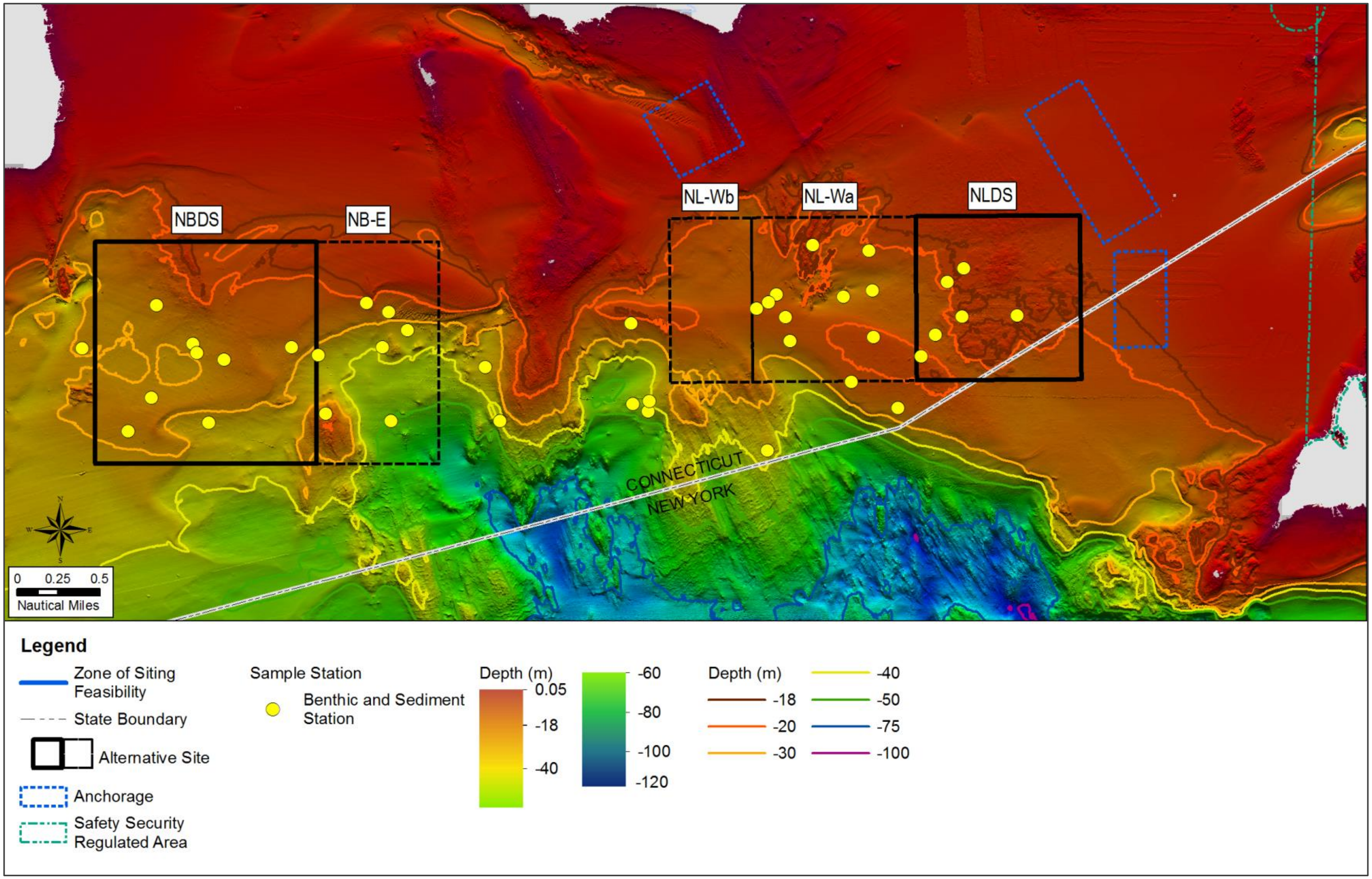

Figure 4-38. Sampling stations during the 2013 benthic survey at and near the New London and Niantic Bay Alternatives.

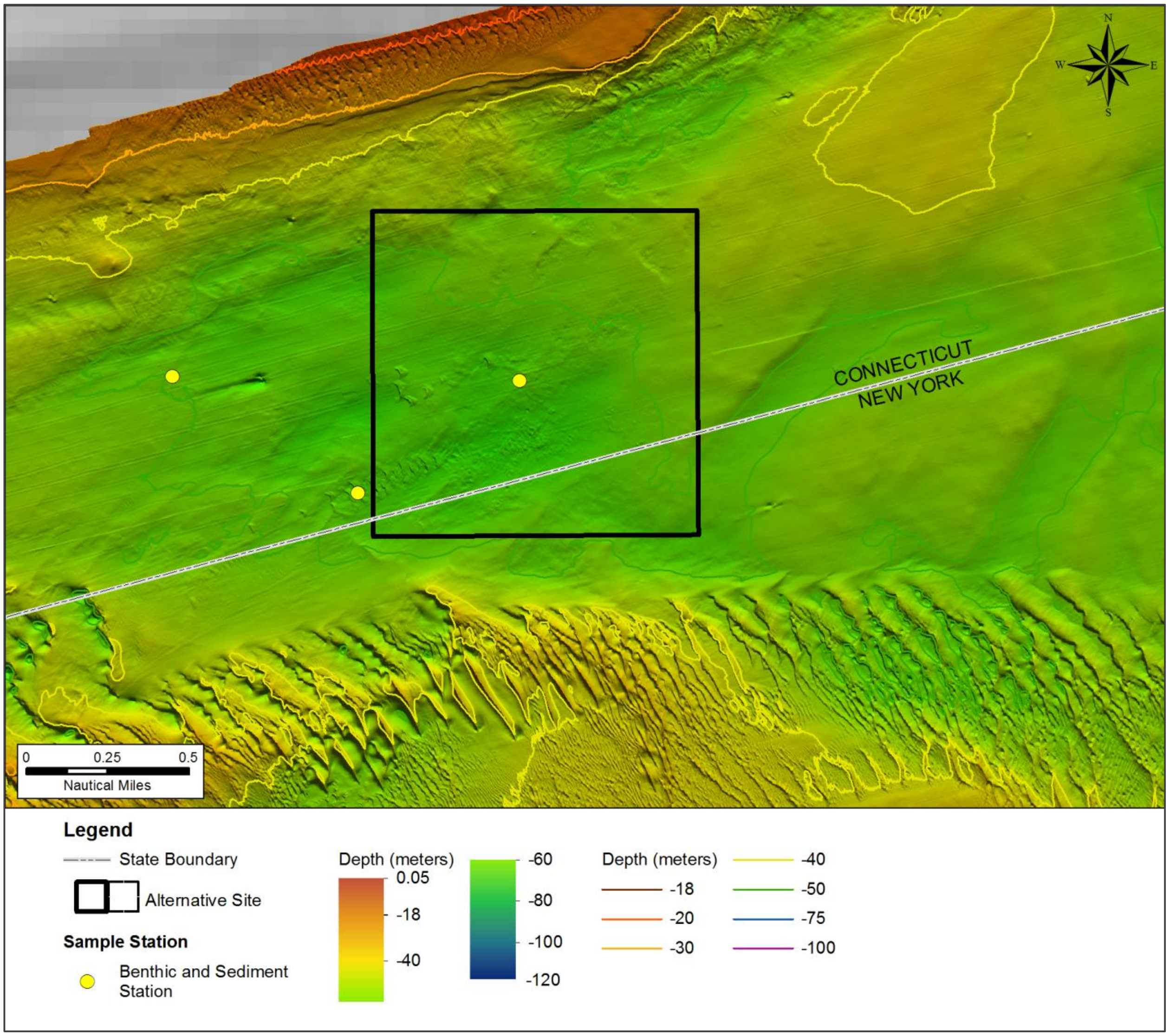

Figure 4-39. Sampling stations during the 2013 benthic survey at and near the Cornfield Shoals Alternative.

2014 SPI/PV Survey. The USACE conducted a sediment-profile imaging (SPI) and plan-view underwater camera photography (PV) survey to provide physical characterization of sediments and evaluate benthic habitat conditions (Carey and Bellagamba Fucile, 2015). The 2014 SPI/PV survey obtained images at 60 stations within and around the New London and Niantic Bay Alternatives (Table 4-4; Figure 4-40).

SPI images record the vertical section of the seafloor captured via the deployment of a 35-mm camera housed on top of a wedge-shaped prism that penetrates several centimeters into the bottom sediments. The prism has a clear faceplate at the front with a mirror placed at a 45° angle at the back to reflect the image from the faceplate to the camera lens above.

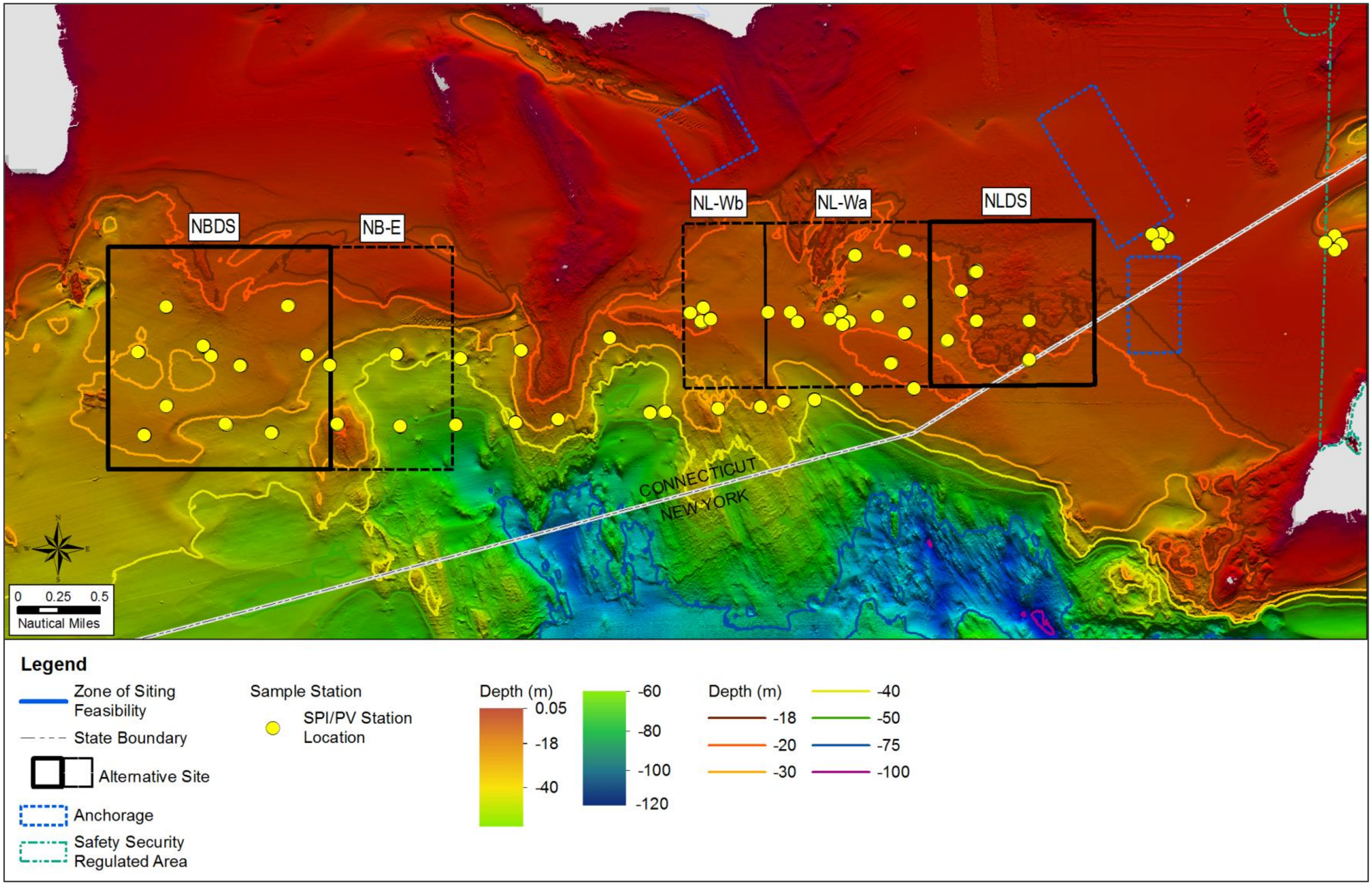

Figure 4-40. Sampling stations during the 2014 SPI/PV survey at and in the vicinity of the New London and Niantic Bay Alternatives.

The use of SPI cameras is a common technique for evaluating benthic habitats and has been used since the 1970's. One of the purposes of the approach is to provide photographic documentation of the relationship between infaunal organisms and their sedimentary habitat. When interpreting SPI images, there are several specific features that are particularly useful in evaluating the quality of the habitat and health of the benthic community:

- *Sediment Grain Size:* Grain size is determined by comparison of site-specific images with a set of standard images for which mean grain size has been determined in the laboratory. Grain size was described in Section 4.6.3.

- *Apparent Redox Potential Discontinuity (aRPD) Depth:* This depth reflects the boundary between oxidized and anoxic sediments. It is called the apparent RPD (aRPD) because it is a visual estimate based on differences in the reflectivity or color of oxidized and anoxic sediments and is not an actual measurement of the RPD depth. The depth of the aRPD increases as the amount of sediment movement by infaunal organisms (called bioturbation) increases thereby carrying oxygen to greater depths in the sediment. Habitats considered to be of good quality have relatively high (greater than 2 cm) aRPD depths.

- *Infaunal Community Successional Stage:* This stage is based on the hypothesis that after a disturbance, infaunal organisms will recolonize a habitat in a predictable sequence leading from the early colonizing stage to the final climax community.

    - <u>Stage I</u>: The community is classified as Stage I if it is comprised primarily of dense assemblages of small polychaete worms that move into an area soon after disturbance (species are characterized by small size, short life spans, and high population growth rates).
    - <u>Stage II</u>: Transitional stage between the colonizing and climax communities; it consists of tube-dwelling amphipods such as *Ampelisca* spp.
    - <u>Stage III</u>: Represents the mature, climax community comprised of polychaete worms (*e.g.*, maldanid worms) that feed in deeper parts of the sediment and deposit waste material near the sediment surface (species are characterized by larger size, longer life spans, and lower population growth rates).

    In practice, analysis often detects the presence of more than one stage in an image with the resulting data being classified as "Stage I on III" or "Stage II on III". As an example, Figure 4-41 shows representative SPI images obtained over the Seawolf disposal mound in the NLDS, reflecting the three different stages of faunal recolonization (Valente and Fredette, 2003).

Plan-view (PV) images refer to photographs taken with an underwater camera that is looking straight down onto the seafloor surface. The PV image complements the SPI image of the cross-section of the upper sediment column.

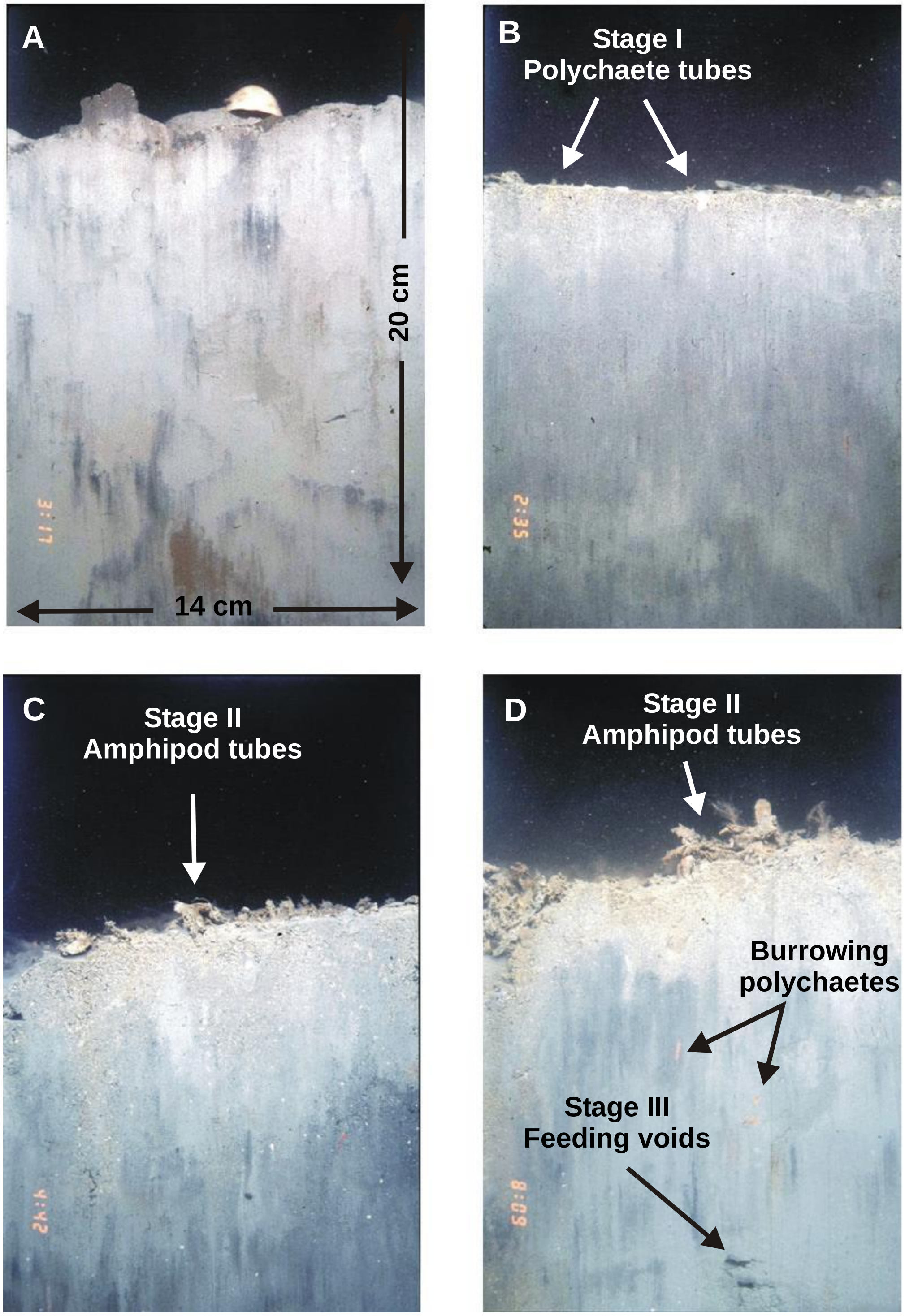

Figure 4-41. Example of SPI images and successional stages; these images were obtained over the Seawolf disposal mound at the New London Disposal Site. (A) Cohesive grey clay, (B) Small polychaete tubes at the sediment surface = Stage I; (C) Tube-dwelling amphipods at the sediment surface = Stage II; (D) Example of Stage II on III (Source: Valente and Fredette, 2003).

4.9.1 Long Island Sound

Benthic habitats in Long Island Sound vary due to differences in sediment grain size and bottom currents in the three basins of the Sound. An extensive survey of the benthos in Long Island Sound was undertaken in 1972 with samples collected at 142 stations (Reid, 1979; Reid et al., 1979). Three main infaunal assemblages were defined. A shallow-water, sandy-sediment based assemblage occurred on a narrow strip of seafloor along the southern margin of Long Island Sound and was characterized by the polychaete worms *Nephtys picta* and *Aricidea catherinae*, the clams *Spisula solidissima* and *Tellina agilis*, and the amphipod *Ampelisca vadorum*. A muddy assemblage comprised of the polychaete worms *Nephtys incisa, Mediomastus ambiseta*, and *Polydora cornuta* (previously known as *P. ligni*), the clams *Nucula annulata* and *Yoldia limatula*, and the amphipod *Ampelisca abdita* occupied a considerable expanse of the flat seafloor in the western and central basins. The third group consisted of a transitional shallow-water fauna occupying sandy muds primarily along the Connecticut shore comprised of the polychaetes *Polydora cornuta*, *Streblospio benedicti*, and *Tharyx acutus*, the clams *Tellina agilis* and *Ensis directus*, and the amphipods *Ampelisca abdita* and *A. vadorum*.

Another extensive survey of the benthic communities in the Long Island Sound was conducted by Pellegrino and Hubbard (1983). Many of 413 stations were located in the western half of Long Island Sound in Connecticut's waters. As in the 1972 survey (Reid, 1979; Reid et al., 1979), the primary communities in western and central Long Island Sound were characterized primarily by *Nephtys incisa* and *Nucula annulata*, but also included another small clam *(Mulinia lateralis)*. The occurrence of *M. lateralis* as a predominant member of these regions is noteworthy because it is considered an opportunistic species (Williams et al., 1986) and its populations are often very transient in Long Island Sound (Levinton, 1970).

Several types of benthic communities were found in more hydrologically dynamic areas with coarser sediments. A community type dominated by several polychaetes including *Asbellides oculata* and *Siophanes bonbyx* and the bivalve *Tellina agilis* was found in the transition between the eastern and central basins. Also found in the sandy sedimentary environments of the eastern basin was a community dominated by the polychaetes *Cirratulis grandis*, *C. cirratus*, *Prionospio heterobranchia*, *P. tenuis*, and the amphipod *Aeginnia longicornis*. All of the studies of benthic communities within Long Island Sound show a gradient in both species richness and community structure along the west to east axis of the Sound, with relatively low species richness in the western basin and greater species richness in the eastern basin, with a transition between the two occurring in the central basin (Lopez et al., 2014).

Zajac (1998) and Zajac et al. (2000) examined variations within the infaunal communities of Long Island Sound at various spatial scales by reanalyzing a subset (*i.e.*, the 35 most abundant species) of the data from Pellegrino and Hubbard (1983). They found that the benthic communities inhabiting Long Island Sound were highly variable and could be grouped into more than a dozen assemblages. Zajac et al. (2000) concluded that the benthic communities in Long Island Sound are limited in their extent by the particular adaptations of the species, limiting them to the various hydrographic and sediment regimes encountered. From work conducted in eastern Long Island Sound, Zajac et al. (2003) also studied how infaunal populations respond to benthoscape structure (*i.e.*, benthic landscapes). They showed that infaunal populations exhibit complex and spatially varying patterns of abundance in relation to benthoscape structure, and that mesoscale (1-2 km^2 to tens of m^2) variations in seafloor habitat/patch structure (*e.g.*, dredged material disposal mounds) may be important in determining the complexity and spatial patterns. They also showed that transition zones between benthoscapes can affect the distribution and dynamics of infaunal populations and communities.

4.9.2 Block Island Sound

The dominant benthic species found in Block Island Sound include several amphipods, the bivalves *Nucula*, *Mytilus*, and *Arctica* and several polychaete species, including *Prionospio steenstrupia*, *Nephtys incise*, and *Clymenella torquata*. The relative dominance of these species varies with geographic location, sediment type, and organic content. Primary constituents of the infaunal communities in silt and silty-sand sediments are the amphipods *Ampelisca agassizi* and *A. vadorum* and the nut clam *Nucula annulata.* A mix of amphipods and polychaetes, which often vary seasonally, are the infauna found within the coarse sand and gravel sediments throughout Block Island Sound. Overall, the amphipod *Ampelisca* has dominated the fauna for at least the last 50 years, suggesting that the benthic community has been fairly stable over that timeframe (RICRMC, 2010).

4.9.3 New London Alternative

The 2013 benthic survey samples contained a mean of 615 benthic invertebrate individuals at the NLDS and 399 individuals at Site NL-Wa (Table 4-11; none of the stations were located within Site NL-Wb). Other ecological parameters were also higher at the NLDS compared to Site NL-Wa, but not substantially. At the NLDS, the total number of species found in each sample ranged from 60 to 100, with a total species richness of 208. The mean diversity index was 3.30, and the mean evenness was moderately high at 0.75. At Site NL-Wa, the total number of species found was less than at the NLDS, with a total species richness at the site of 172. The mean diversity index at Site NL-Wa was 2.76, and the mean evenness was less than at the NLDS, but was still moderate at 0.69.

The three phyla with the highest number of individuals sampled at both the NLDS and Site NL-Wa were Arthropoda, Annelida, and Mollusca, composing approximately 99% of the infaunal composition at both locations (Table 4-12). In terms of individual species, the five most abundant benthic species sampled at NLDS were the amphipods (phylum: Arthropoda) *Ampelisca* sp. (833 individuals) and *Ampelisca vadorum* (580 individuals), and the polychaetes (phylum: Annelida) *Ampharete cf. lindstroem* (275 individuals), *Monticellina baptisteae* (223 individuals), and *Cirratulidae* spp. (203 individuals). Together they accounted for approximately 43% of the infauna identified. At Site NL-Wa, the four most abundant species, each totaling over 300 individuals, were the amphipods (phylum: Arthropoda) *Ampelisca* sp. (1,015 individuals), *Ampelisca verrilli* (447 individuals), *Ampelisca vadorum* (334 individuals), and the bivalve (phylum: Mollusca) *Angulus agilis* (338 individuals). Together these species accounted for approximately 49% of the infauna collected.

Table 4-11. Ecological Parameters of Benthic Infauna for the three Alternative Sites (2013 Benthic Survey)

Site	No. of Samples	Statistics	Total Individuals	Species Richness (R)	Diversity Index (H')	Pielou's Evenness (J')
New London Alternative						
NLDS	8[1]	Minimum	259	60	2.84	0.68
		Maximum	875	100	3.80	0.83
		Mean	**615**		**3.30**	**0.75**
		Total Species Richness		**208**		
NL-Wa	11	Minimum	187	33	1.32	0.38
		Maximum	703	91	3.46	0.85
		Mean	**399**		**2.76**	**0.69**
		Total Species Richness		**172**		
Off-site	6	Minimum	59	21	2.33	0.53
		Maximum	1,874	78	3.23	0.88
		Mean	**762**		**2.83**	**0.71**
		Total Species Richness		**154**		
Niantic Bay Alternative						
NBDS	10[1]	Minimum	134	30	1.99	0.55
		Maximum	837	86	3.73	0.86
		Mean	**528**		**2.93**	**0.71**
		Total Species Richness		**196**		
NB-E	7	Minimum	52	12	1.60	0.58
		Maximum	721	71	3.65	0.89
		Mean	**361**		**2.82**	**0.72**
		Total Species Richness		**171**		
Off-site	3	Minimum	135	32	2.17	0.56
		Maximum	3,905	104	2.87	0.83
		Mean	**1,479**		**2.55**	**0.65**
		Total Species Richness		**129**		
Cornfield Shoals Alternative						
CSDS	3[1]	Minimum	537	62	2.10	0.51
		Maximum	879	71	3.25	0.76
		Mean	**693**		**2.85**	**0.68**
		Total Species Richness		**115**		
Off-site	2	Minimum	134	33	2.39	0.57
		Maximum	2,121	66	2.65	0.77
		Mean	**1,128**		**2.52**	**0.67**
		Total Species Richness		**84**		

[1] Includes triplicate sample at one station.

Source: Tetra Tech, 2014

Table 4-12. Abundance of Individuals by Phyla for NLDS and NL-Wa (2013 Benthic Survey)

Phylum	New London Alternative				Niantic Bay Alternative				Cornfield Shoals Alternative	
	NLDS		NL-Wa		NBDS		NB-E			
	Total Individuals	Percent of Individuals	Total Individuals	Percent of Individuals	Total Individuals	Percent of Individuals	Total Individuals	Percent of Individuals	Total Individuals	Percent of Individuals
Arthropoda	2,215	45.0	2,192	50.0	1,980	37.5	1,028	40.8	745	35.8
Annelida	2,039	41.4	1,284	29.3	1,413	26.8	947	37.6	618	29.7
Mollusca	611	12.4	839	19.1	1,735	32.9	499	19.8	656	31.5
Nemertea	33	0.67	15	0.34	54	1.02	17	0.67	55	2.64
Echinodermata	22	0.45	55	1.25	90	1.71	23	0.91	3	0.14
Cnidaria	-	-	-	-	2	0.04	3	0.12	3	0.14
Sipuncula	1	0.02	-	-	3	0.06	2	0.08	-	-
Platyhelminthes	-	-	-	-	-	-	-	-	1	0.05
Phoronida	-	-	1	0.02	-	-	-	-	-	-
Chordata	-	-	-	-	1	0.02	-	-	-	-
Number of Samples	8		11		10		7		3	

Source: Tetra Tech, 2014

The ecological parameters and phyla data indicate that, overall, both the NLDS and Site NL-Wa had relatively good species diversity and were not dominated by just a few species. The data from within the NLDS and Site NL-Wa were consistent with observations at off-site locations outside of the New London Alternative, although the species richness was slightly lower at off-site stations (Table 4-11).

During the 2014 SPI/PV survey, all of the stations at the NLDS and Site NL-Wa that could be measured (at some stations a lack of camera penetration prevented the identification of the successional stage) showed evidence of Stage III succession except for the two westernmost stations at Site NL-Wa. Sediments at the NLDS were heavily bioturbated with numerous burrows and evidence of subsurface feeding. The stations were classified as either Stage I on III, Stage II on III, or Stage III. The shell lag and pebbles on the substrate had encrusting and attached epifauna on them suggesting a fairly stable substrate. The aRPDs at the NLDS ranged from 1.9 to 4.7 cm with a mean of 3.1 cm, indicating good habitat quality. At Site NL-Wa, the aRPDs was at least 2.8 cm at the various stations, also indicating good habitat quality. Conditions were similar at Site WL-Wb; sediments from all four stations were bioturbated with some evidence of subsurface feeding, and the shell lag and pebbles also had encrusting and attached epifauna, suggesting a fairly stable substrate. Due to the dense shell layer, only one sample at Site NL-Wb was deep enough to determine an aRPD value; it was 2.9 cm, indicating good habitat quality. All stations at Site NL-Wb exhibited Stage II succession.

The biological conditions at the off-site stations to the east of the NLDS were similar to the NLDS in that they all had evidence of Stage III succession and good habitat quality. Sediments from all eight stations sampled within the two off-site areas had burrows, bioturbation, and deep aRPDs, and the stations had showed evidence of Stage III succession. The four off-site stations located 0.4 nmi (0.7 km) to the east of the NLDS (*i.e.*, Stations NE-REF) had large burrow openings and polychaetes visible below the sediment. The four off-site stations located 1.5 nmi (2.8 km) to the east from the NLDS (*i.e.*, Stations NLON-REF) had evidence of two polychaetes typical of Stage III succession. These organisms were *Saccoglossus kowaleswski* as evidenced by its distinctive fecal coil on the surface, and *Chaetopterus variopedatus* as evidenced by its thick parchment tube in the sediment through which it pumps water. The aRPD at Stations NE-REF ranged from 2.5 to 6.8 cm with a mean of 4.6 cm. At Stations NLON-REF, the aRPD ranged from 2.2 to 4.6 cm with a mean of 3.6 cm. These depths are indications of good habitat quality.

4.9.4 Niantic Bay Alternative

The 2013 benthic survey samples contained a mean of 528 benthic invertebrate individuals at the NBDS and 361 individuals at Site NB-E (Table 4-11). The total number of species and the species diversity were slightly higher at the NBDS than at Site NB-E. At the NBDS, the total number of species found in each sample ranged from 30 to 86, with a total species richness of 196. At Site NB-E, the total number of species found in each sample ranged from 12 to 71, with a total species richness of 171. The two additional ecological parameters (diversity index and evenness) were similar at the NBDS and at Site NB-E.

Similar to the New London Alternative, the three phyla with the highest number of individuals sampled at the NBDS and Site NB-E were Arthropoda, Annelida, and Mollusca, composing 97% and 98% of the infaunal composition, respectively (Table 4-12). The four most abundant individual benthic species sampled at the NBDS, each numbering over 300 individuals, were the bivalve (phylum: Mollusca) *Crassinella lunulata* (567 individuals), the amphipod (phylum: Arthropoda) *Ampelisca vadorum* (561 individuals), the barnacle (phylum: Arthropoda) *Sessillia* spp. (467 individuals) and the mussel (phylum: Mollusca) *Mytilus edulis* (314 individuals). Together they accounted for approximately 36% of the infauna identified. At Site NB-E the four most abundant individual species found were the barnacle (phylum: Mollusca) *Sessillia* spp. (516 individuals), the bivalve (phylum: Mollusca) *Crassinella lunulata* (185 individuals), the amphipod (phylum: Arthropoda) *Ampelisca vadorum* (163 individuals), and the polychaete worm (phylum: Annelida) *Ampharete cf. lindstroemi* (155 individuals). These were the only species to number over 100 individuals and together they accounted for approximately 40% of the infauna collected.

The ecological parameters and phyla data indicate that, overall, species diversity was relatively good and fairly consistent across both the NBDS and Site NB-E, and neither site was dominated by just a few species. The species diversity at the NBDS and Site NB-E was greater than at off-site locations, although there were only three off-site samples (Table 4-11).

The amphipod *Ampelisca vadorum* found during the 2013 benthic survey at both the NBDS and at Site NB-E is indicative of Stage II succession, which is consistent with the successional stages observed during the 2014 SPI/PV survey. Only two SPI/PV survey stations at the NBDS and Site NB-E had evidence of Stage III succession, while the other 13 stations were classified as Stage II. Stage II conditions are typical of most areas with coarser-grained sediments. The aRPDs were indeterminate at six of the eleven stations at the NBDS and at one of the four NB-E stations. The aRPD at other five stations at the NBDS ranged from 1.7 to 6.0 cm (mean of 3.1 cm); the aRPD measured at other three NB-E stations ranged from 3.1 cm to 4.9 cm (mean of 4.2 cm). These aRPDs indicate good habitat quality at both sites.

4.9.5 Cornfield Shoals Alternative

The 2013 benthic survey samples contained a mean of 693 benthic invertebrate individuals in the three samples collected at the station in the center of the CSDS (Table 4-11). The total number of species found in each sample ranged from 62 to 71, with a total species richness of 115. The mean diversity index was 2.85, while the mean evenness was moderately high at 0.68.

Similar to the New London and Niantic Bay Alternatives, the three phyla with the highest number of individuals sampled at the CSDS were Arthropoda, Annelida, and Mollusca composing approximately 97% of the infaunal composition (Table 4-12). The five most abundant benthic species sampled at the CSDS, each numbering over 100 individuals, were the bivalve mussel (phylum: Mollusca) *Mytilus edulis* (215); the amphipod (phylum: Arthropoda) *Corophiidae* spp. (193),although only collected in one sample; the bivalve clam (phylum: Mollusca) *Anadara transversa* (162); and the polychaetes (phylum: Annelida) *Sabellaria vulgaris* (111) and *Euclymeninae spp.*(101). Together they accounted for 38% of the fauna identified.

The ecological parameters and phyla data indicate that species diversity was fairly good at the CSDS, and that it was not dominated by just a few species. Although the number of samples was small, species diversity at the CSDS was slightly greater than at nearby off-site locations. While successional stages were not identified for the CSDS, the amphipod *Corophiidae* spp. is classified as a Stage I/II amphipod.

4.9.6 Benthic Invertebrates Summary

While habitat quality and species diversity was good at all of the alternative sites, it was slightly higher at the NLDS of the New London Alternative, as reflected by the highest values for species richness, diversity, and evenness, as well as by the second highest infaunal abundance. Sites NL-Wa, NL-Wb, and NB-E were all similar to each other, and while the CSDS had the highest abundance of infauna, it had the lowest species richness and evenness indexes. All alternative sites were dominated by arthropods; however, the sediment at the New London Alternative (NLDS, NL-Wa, NL-Wb) contained more tube-dwelling amphipods compared to sediment at the other two alternative sites, which had more barnacles and bivalves. The New London Alternative also had more Stage III communities.

Overall, the habitat quality at the alternative sites is considered typical of surrounding areas and the eastern basin of Long Island Sound. Additionally, the benthic communities (*i.e.,* successional stage) at the active NLDS and CSDS showed little effects of disturbance (including long-term effects from disposal activities).

4.10 Finfish Resources

The Long Island Sound region is home to numerous fish species that are an important resource for commercial and recreational/sport fishermen. This section describes the fish resources of Long Island Sound, Block Island Sound, and the three alternative sites.

Information about the finfish species found in Long Island Sound is derived primarily from the CTDEEP Long Island Sound Trawl Survey (LISTS), for which 2013 is the latest data set (Gottschall and Pacileo, 2014), and various summaries of the long-term LISTS data sets (Gottschall et al., 2000; Lopez et al., 2014; USEPA and USACE, 2004a). CTDEEP has been conducting LISTSs annually since 1984 to provide fishery-independent monitoring of important recreational species in Long Island Sound. The survey is conducted each spring (April-June) and fall (September-October), with 40 stations sampled monthly for a total of 200 stations annually. The LISTSs cover both Connecticut and New York State waters. New York State relies on Connecticut's trawl survey data and does not itself collect fishing data systematically (Tetra Tech, 2014).

4.10.1 Long Island Sound

Trawl surveys have documented 105 finfish species in Long Island Sound; however, only a few of them are considered year-round residents (*e.g.*, tautog) (Gottschall et al., 2000; Gottschall and Pacileo, 2014). Most finfish species such as scup, bluefish, and striped bass migrate through the area in response to seasonal variations in water temperature, salinity, and access to spawning and nursery grounds in Long Island Sound.

Finfish species captured in Long Island Sound during LISTS between 1984 and 2013 are presented in Table 4-13 and include both demersal species (*i.e.*, finfish that have an affinity to the seafloor) and pelagic species (*i.e.*, finfish that live in the open water with no affinity for the bottom or nearshore areas). Finfish abundance and distribution show several patterns. The overall abundance of finfishes (Figure 4-42) and the species diversity (Figure 4-43) has remained fairly stable since 1984. However, western and central Long Island Sound have shown significantly higher abundances compared to eastern Long Island Sound, based on CTDEEP data from 1984 to 2012 (Figure 4-44). This is likely a result of more extensive mud habitat in western and central Long Island Sound that supports greater fish densities (USEPA and USACE, 2004a). Particularly, the shallow mud and transitional substrates adjacent to the western and central basins in Long Island Sound have the highest average catch per unit effort (CPUE). The central basin contained sampling stations with the highest species richness, particularly in transitional and muddy habitats, although this richness was observed to decrease during the spring (note that there are no LISTSs in winter). Based on data in Gottschall et al. (2000), species richness was far less variable between habitat areas, and the only notable pattern was decreased richness in eastern Long Island Sound.

Table 4-13. Finfish Species collected during Long Island Sound Trawl Surveys, 1984-2013

Common Name	Scientific Name
African pompano	*Alectis ciliaris*
Alewife herring	*Alosa pseudoharengus*
American eel	*Anguilla rostrata*
American plaice	*Hippoglossoides platessoides*
American sand lance	*Ammodytes americanus*
American shad	*Alosa sapidissima*
Atlantic bonito	*Sarda sarda*
Atlantic cod	*Gadus morhua*
Atlantic croaker	*Mircopogonias undulatus*
Atlantic herring	*Clupea harengus*
Atlantic mackerel	*Scomber scombrus*
Atlantic menhaden	*Brevoortia tyrannus*
Atlantic salmon	*Salmo salar*
Atlantic silverside	*Menidia menidia*
Atlantic sturgeon	*Acipenser oxyrhynchus*
Atlantic tomcod	*Microgadus tomcod*
Banded rudderfish	*Seriola zonata*
Barndoor skate	*Dipturus laevis*
Bay anchovy	*Anchoa mitchilli*
Bigeye	*Priacanthus arenatus*
Bigeye scad	*Selar crumenophthalmus*
Black sea bass	*Centropristes striata*
Blueback herring	*Alosa aestivalis*
Bluerunner	*Caranx crysos*
Bluefish	*Pomatomus saltatrix*
Bullnose ray	*Myliobatis freminvillei*
Butterfish	*Peprilus triacanthus*
Clearnose skate	*Raja eglanteria*
Conger eel	*Conger oceanicus*
Crevalle jack	*Caranx hippos*
Cunner	*Tautogolabrus adspersus*
Dwarf goatfish	*Upeneus parvus*
Fawn cusk-eel	*Lepophidium profundorum*
Feather blenny	*Hypsoblennius hentz*
Fourbeard rockling	*Enchelyopus cimbrius*
Fourspot flounder	*Paralichthys oblongus*
Gizzard shad	*Dorosoma cepedianum*

Table 4-13. Finfish Species collected during Long Island Sound Trawl Surveys, 1984-2013

Common Name	Scientific Name
Goosefish	*Lophius americanus*
Gray triggerfish	*Balistes capriscus*
Grubby	*Myoxocephalus aeneus*
Haddock	*Melanogrammus aeglefinus*
Harvestfish	*Peprilus paru*
Hickory shad	*Alosa mediocris*
Hogchoker	*Trinectes maculatus*
Inshore lizardfish	*Synodus foetens*
Little skate	*Leucoraja erinacea*
Longhorn sculpin	*Myoxocephalus octodecemspinosus*
Lookdown	*Selene vomer*
Lumpfish	*Cyclopterus lumpus*
Mackerel scad	*Decapterus macarellus*
Moonfish	*Selene setapinnis*
Naked goby	*Gobiosoma bosci*
Northern kingfish	*Menticirrhus saxatilis*
Northern pipefish	*Syngnathus fuscus*
Northern puffer	*Sphoeroides maculatus*
Northern sea robin	*Prionotus carolinus*
Northern sennet	*Sphyraena borealis*
Northern startgazer	*Astroscopus guttatus*
Ocean pout	*Macrozoarces americanus*
Orange filefish	*Aluterus schoepfi*
Oyster toadfish	*Opsanus tau*
Pinfish	*Lagodon rhomboides*
Planehead filefish	*Monacanthus hispidus*
Pollock	*Pollachius virens*
Rainbow smelt	*Osmerus mordax*
Red cornetfish	*Fistularia petimba*
Red goatfish	*Mullus auratus*
Red hake	*Urophycis chuss*
Rock gunnel	*Pholis gunnellus*
Rough scad	*Trachurus lathami*
Roughtail stingray	*Dasyatis centroura*
Round herring	*Etrumeus teres*
Round scad	*Decapterus punctatus*
Sandbar shark (brown)	*Carcharhinus plumbeus*

Table 4-13. Finfish Species collected during Long Island Sound Trawl Surveys, 1984-2013

Common Name	Scientific Name
Sea lamprey	*Petromyzon marinus*
Scup	*Stenotomus chrysops*
Sea raven	*Hemitripterus americanus*
Sea snail	*Liparis atlanticus*
Seahorse	*Hippocampus* sp.
Sharksucker	*Echeneis naucrates*
Short bigeye	*Pristigenys alta*
Silver hake	*Merluccius bilinearis*
Silver perch	*Bairdiella chrysoura*
Smallmouth flounder	*Etropus microstomus*
Smooth dogfish	*Mustelus canis*
Snapper glasseye	*Priacanthus cruentatus*
Spanish mackerel	*Scomberomorus maculatus*
Spiny dogfish	*Squalus acanthius*
Spot	*Leioxtomus xanthurus*
Spotted hake	*Urophycis regia*
Striped anchovy	*Anchoa hepsetus*
Striped bass	*Morone saxatilis*
Striped burrfish	*Chilomycterus schoepfi*
Striped cusk-eel	*Ophidion marginatum*
Striped sea robin	*Prionotus evolans*
Summer flounder	*Paralichthys dentatus*
Tautog	*Tautoga onitis*
Weakfish	*Cynoscion regalis*
White mullet	*Mugil curema*
White perch	*Morone Americana*
Windowpane flounder	*Scophthalmus aquosus*
Winter flounder	*Pseudopleuronectes americanus*
Winter skate	*Leucoraja ocellata*
Yellow jack	*Caranx bartholomaei*
Yellowtail flounder	*Pleuronectes ferrugineus*

Source: Gottschall and Pacileo, 2014

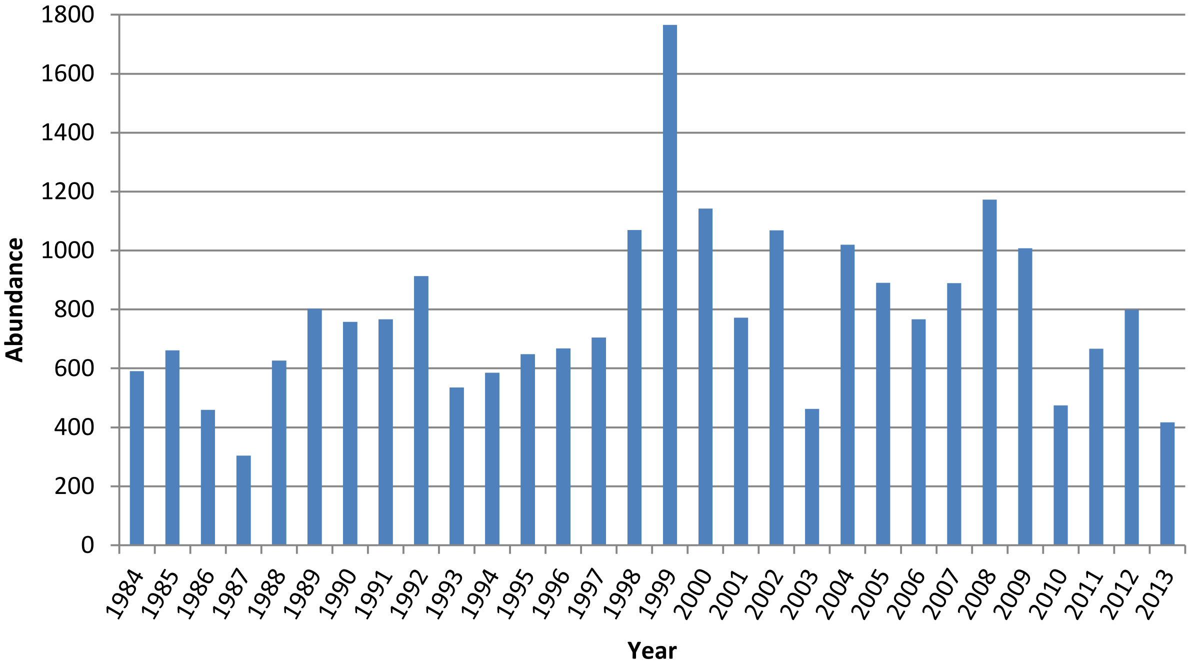

Figure 4-42. Mean abundance of finfish per tow during the CTDEEP Long Island Sound Trawl Surveys from 1984 through 2013 (Source: Gottschall and Pacileo, 2014).

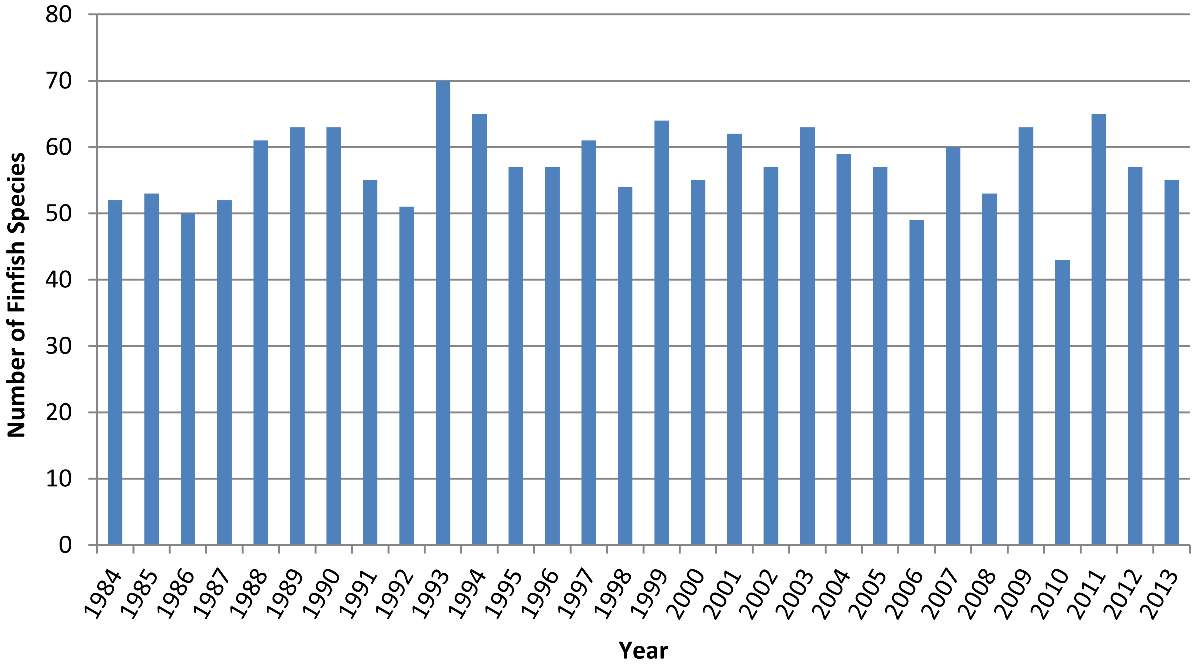

Figure 4-43. Number of finfish species observed annually during the CTDEEP Long Island Sound Trawl Surveys from 1984 through 2013 (Source: Gottschall and Pacileo, 2014).

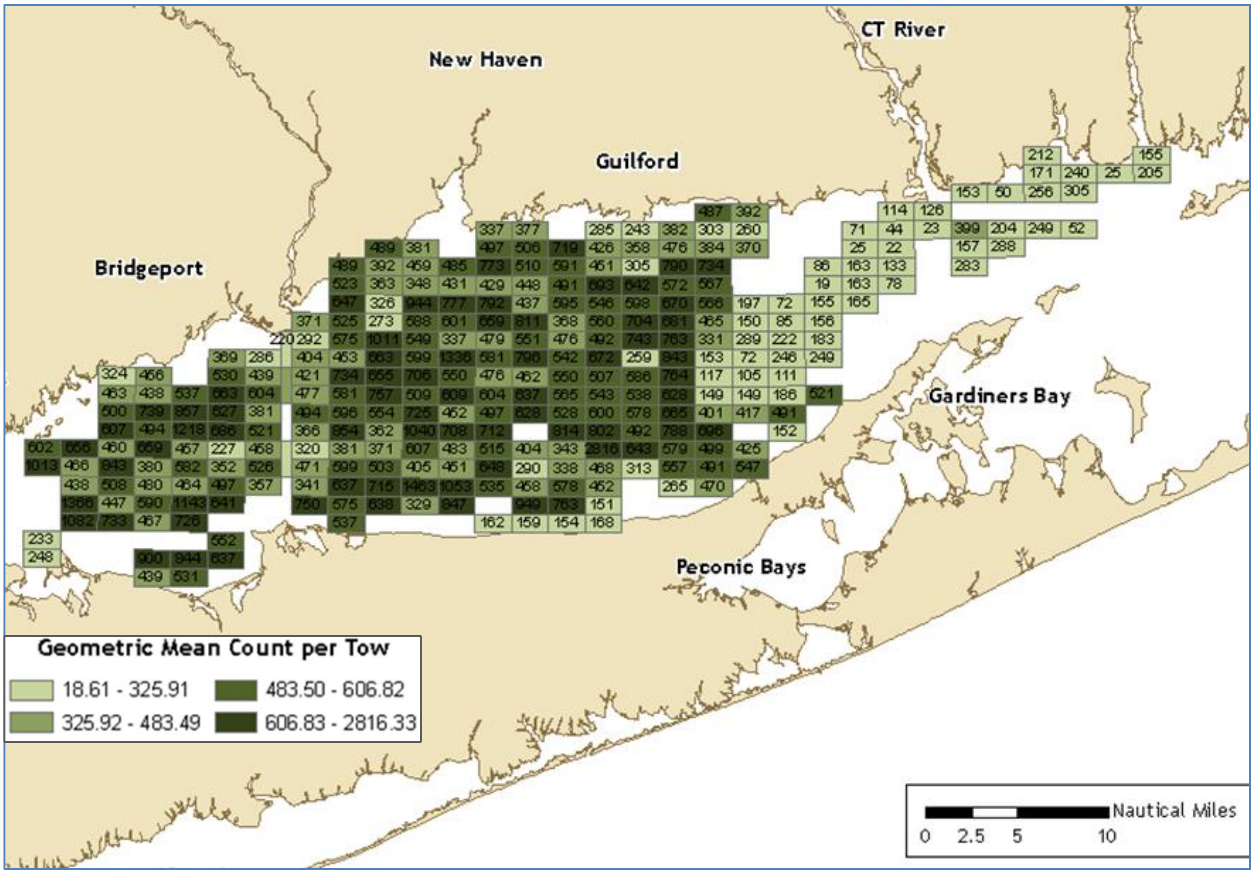

Figure 4-44. Mean finfish abundance per tow by location during the CTDEEP Long Island Sound Trawl Surveys, 1984-2012 (Source: CTDEEP, unpublished data, August 2013).

Seasonal patterns observed among commercial and recreational finfish species in Long Island Sound are as follows:

- Spring months are characterized by warming water temperatures and migration of finfish species into the Sound. Demersal species dominate all habitats at this time and are particularly abundant on fine-grained habitats in April and May (Gottschall et al., 2000). Between 1984 and 2008, the most abundant species (including common invertebrate species) captured in spring, in terms of CPUE, included winter flounder, windowpane flounder, scup, American lobster, butterfish, little skate, long-finned squid, Atlantic herring, fourspot flounder and red hake (Lopez et al., 2014). Of these species, only scup and butterfish showed increasing trends in abundance over time. Winter flounder, windowpane flounder, little skate, fourspot flounder, and red hake showed decreasing trends.

- Fall months in Long Island Sound are characterized by cooling water temperatures and migration of many species out of the Sound. Overall, catch is much higher and dominated by pelagic species that are caught more frequently over mud and transitional habitats than over sand (Gottschall et al., 2000). The most abundant species (in terms of CPUE) captured

> in the fall between 1984 and 2008 comprised butterfish, scup, long-finned squid, weakfish, bluefish, bay anchovy, windowpane flounder, winter flounder, and little skate. Of these, butterfish, weakfish, and anchovy showed significant increases in abundance over time, while significant decreases were observed in abundance for windowpane flounder and winter flounder (Lopez et al., 2014).

These species-specific abundance trends noted by Lopez et al. (2014) for the LISTS data sets from 1984 to 2008 are consistent with the overall trend during the entire LISTS period (1984-2013), which showed that the average number of warm water species captured in the spring and fall trawl surveys has increased while the average number of cold water species has decreased, especially in the spring, but also in the fall surveys (Gottschall and Pacileo, 2014).

The CLIS/WLIS EIS (USEPA and USACE, 2004a) summarized the food, habitat, and distribution of some of the predominant finfish species captured during the LISTS (1984-2003), including their preferred prey, the habitat type in which they were typically found during the surveys, and their common abundance and distribution within the open waters of Long Island Sound, including eastern Long Island Sound (Table 4-14). Finfish were grouped in the table by habitat categories, distinguishing those that are typically found in sandy, muddy, or hard substrate, or a variety of habitat types. The table further provides information on seasonal distribution.

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), as amended by the Sustainable Fisheries Act (SFA) of 1996 (Public Law 104-267), sets forth a mandate for the NMFS, regional Fishery Management Councils, and other federal agencies to identify, conserve, and enhance essential fish habitat (EFH) for those commercially and recreationally important fish species that are federally regulated. EFH is defined as "those waters and substrates necessary to fish for spawning, breeding, feeding or growth to maturity" (16 U.S.C. 1802(10)) (NOAA, 2004). The overall goal of the Magnuson-Stevens Act is to ensure that EFH is not adversely impacted by fishing or other human activities, including dredged material disposal, and to further the enhancement of these habitats, thereby protecting both ecosystem health and the fisheries industries. The Magnuson-Stevens Act requires consultation among NMFS and federal agencies in achieving these goals. Table 4-15 identifies the species for which EFH has been designated at the three alternative site. To comply with the Magnuson-Stevens Act, the effect of the proposed action on the EFH for these species was assessed (Appendix H).

Table 4-14. Food, Habitat, and Distribution of the Finfish Species Present in Long Island Sound

Fish Species	**Prey Characterization**	***Prey Habitat***	**Seasonal Distribution in Long Island Sound**	**Abundance and Distribution in Long Island Sound**
Multi-Habitat Fish				
American shad *(Alosa sapidissima)*	Benthic invertebrates (*e.g.*, crustaceans) small fish, fish eggs, variety of zooplankton	Water column	Most common in June.	Shallow water. Typically found along the Connecticut coast rather than in open waters of Long Island Sound. Spawn over freshwater, gravel or mud substrates.
Atlantic cod *(Gadus morhua)*	Fish, benthic invertebrates (*e.g.*, clams, crabs, mussels, polychaetes, echinoderms)	Sand, gravel, water column	Rare in Long Island Sound.	Rare in Long Island Sound.
Fourspot flounder *(Paralichthys oblongus)*	Benthic invertebrates (*e.g.*, arthropods, mollusks, shrimp, crabs) and fish	Near-bottom water column	Most common in spring and fall.	Typically found along the coastlines. Prefer muddy sediments but can be found in sandy areas as well.
Red hake *(Urophycis chuss)*	Benthic invertebrates (*e.g.*, shrimp, worms, crabs), zooplankton (copepods), fish	Sand, mud	Most common in spring and fall.	Typically found along the coastlines. Prefer muddy sediments but can be found in sandy areas as well.
Silver hake *(Merluccius bilinearis)*	Fish, benthic invertebrates, squid	Sand, water column	Adults were most abundant in April and May. Juveniles were most abundant in the summer and fall.	Highest catches are within the Long Island Sound disposal areas and on Stratford Shoal.
Windowpane flounder *(Scophthalmus aquosus)*	Plankton (planktonic shrimp), benthic invertebrates (*e.g.*, epibenthic shrimp)	Sandy environments	Most abundant from April to June. Juveniles dominate the summer and fall catches. Adults dominate April and May.	Highest catch numbers are in the western and central basins, especially over muddy and transitional sediments.
Winter flounder *(Pseudopleuronectes americanus)*	Benthic invertebrates (small crabs, worms, bivalves)	Mud and sand	More abundant in open water in spring than in fall.	Highest spring catches were in central basin over mud and transitional sediments. Highest fall catches were in shallow areas of the western and central basins.

Table 4-14. Food, Habitat, and Distribution of the Finfish Species Present in Long Island Sound

Fish Species	**Prey Characterization**	***Prey Habitat***	**Seasonal Distribution in Long Island Sound**	**Abundance and Distribution in Long Island Sound**
Sandy Habitat Fish				
Hogchoker (*Trinectes maculatus)*	Benthic invertebrates (crustaceans, polychaetes, shrimp)	Sand, mud	Most abundant in spring.	Uniformly dispersed in western and central basins, never deeper than 88 feet (31 m). High early summer abundance along Long Island shoreline between Shoreham and Eaton's Neck. In July, high catches moved to Connecticut shoreline.
Northern sea robin *(Prionotus carolinus)*	Benthic invertebrates (crabs, worms, epibenthic shrimp), fish	Mud, sand, water column	Slightly more abundant in spring.	Most abundant along the Mattituck Sill in sandy and transitional habitats as well as in deep waters of the western basin.
Scup *(Stenotomus chrysops)*	Benthic invertebrates (crustaceans, worms, mollusks), vegetable debris	Sand, rock	Most abundant during spring and fall, with adults dominating catches in April-June and juveniles dominating in fall.	Found over transitional or sandy bottoms in depths > 60 feet (18 m). Largest numbers occur south of Milford, Connecticut, around the mouth of the Thames River, and in Niantic Bay.
Smooth dogfish *(Mustelus canis)*	Benthic invertebrates (decapod crustaceans, bivalves), squid, fish	Sand	Abundance is higher in the fall than in the spring.	In fall, highest numbers are recorded in deep eastern basin areas as well as in shallower areas of the western and central basins. In spring, species prefers transitional habitats in western and central basins.
Striped sea robin *(Pronotus evolans)*	Benthic invertebrates (crabs, epibenthic shrimp)	Mud, sand	Abundance is higher in fall than in spring.	Primarily found in the western and central basins.
Summer flounder *(Paralicthys dentatus)*	Benthic invertebrates (rock crabs, shrimp, bivalves, polychaete worms), fish (esp. scup), squid	Sand, near-bottom water column	Juveniles--most abundant in spring and fall, with numbers dropping off in summer.	Abundant along Connecticut shoreline between Guilford and New Haven, as well as near the mouth of the Connecticut River, in Niantic Bay, and near Mattituck, New York

Table 4-14. Food, Habitat, and Distribution of the Finfish Species Present in Long Island Sound

Fish Species	**Prey Characterization**	***Prey Habitat***	**Seasonal Distribution in Long Island Sound**	**Abundance and Distribution in Long Island Sound**
Muddy Habitat Fish				
Atlantic sturgeon *(Acipenser oxyrinchus oxyrinchus)*	Benthic invertebrates, gastropods, shrimp, sand lance	Mud, transitional sediments	Most abundant during September and October.	Highest numbers found in central basin in > 88 feet (31 m) of water. Large numbers found in the eastern basin esp. around the mouth of the Connecticut River in < 30 feet (11 m) of water.
Fourbeard rockling *(Enchelyopuss cimbrius)*	Bivalves (esp. Yoldia sp.), polychaetes, decapod crustaceans	Mud, sand	Seasonal distribution not very varied, although slightly more caught in spring compared to fall.	Typically caught in deep muddy or transitional habitats in the Western Basin.
Hard Substrate Habitat Fish				
Black sea bass *(Centropristis striata)*	Benthic invertebrates (crabs, mussels), squid	Sand, water column, rocky and transitional sediments	Highest abundances reported between April and June.	Found in shallow, nearshore areas in the central basin.
Cunner *(Tautogolabrus adspersus)*	Benthic invertebrates (mussels, worms, epibenthic shrimp)	Rocks, sand	Very few individuals caught in fall.	Majority of catches occur in western basin in shallow mud/deep transitional habitats.
Tautog *(Tautoga onitis)*	Benthic invertebrates (mussels, crabs, sand dollars)	Rocks, sand	Most tautog are caught in spring. Overall abundance peaks in May-July, drops off, then peaks again in early fall.	Abundance peaked along Connecticut shoreline between New Haven and Norwalk, north of Hempstead, New York, and off of Eaton's Neck, Connecticut.
Pelagic Habitat Fish				
Alewife *(Alosa pseudoharengus)*	Fish, polychaete (cyclopoid copepods, cladocerans)	Water column, sandy bottoms	Most abundant in April, usually in >60 feet (18 m) of water.	Mouths of Norwalk and Saugatuck Rivers were important habitats. Typically found over muddy, sandy, or transitional sediments.
Atlantic herring *(Clupea harengus)*	Plankton (copepods), euphasids, pterodpods	Water column, sandy bottoms	Most abundant in spring.	Particularly abundant in shallow areas of western and central basins.

Table 4-14. Food, Habitat, and Distribution of the Finfish Species Present in Long Island Sound

Fish Species	**Prey Characterization**	***Prey Habitat***	**Seasonal Distribution in Long Island Sound**	**Abundance and Distribution in Long Island Sound**
Atlantic mackerel *(Scomber scombrus)*	Plankton (copepods, amphipods), shrimp, pelagic mollusks (squid)	Water column	Highest numbers caught in April and June.	Not abundant in Long Island Sound.
Atlantic menhaden *(Brevoortia tyrannus)*	Zooplankton, phytoplankton, diatoms	Water column	Largest abundances caught between April and September.	During summer months, largest numbers are caught near New Haven Harbor in <90 feet (27 m) of water. In fall, the largest numbers are caught along the shoreline between Norwalk and Guilford, Connecticut.
Bluefish *(Pomatomus saltatrix)*	Fish, shrimp, squid, benthic invertebrates (crabs, annelid worms), squid, shrimp	Water column, sandy bottoms, rocky and transitional sediments	Most frequently caught between July and October. No bluefish were caught during winter months.	Numbers peak on Connecticut side of Long Island Sound in midsummer and throughout entire Sound in September.
Butterfish *(Peprilus tracantus)*	Plankton (copepods), small fish, benthic invertebrates (polychaete worms, amphipods, crabs, bivalves)	Water column, sandy bottoms	Most abundant in early fall.	In early fall, found in large numbers around Stratford Shoal and within central basin.
Striped bass *(Morone saxatilis)*	Fish, shrimp, squid, benthic invertebrates (crabs, clams)	Water column, rocky and transitional sediments	Most common in May and November, with abundances dropping in summer.	Commonly found along Connecticut shorelines (esp. near mouths of Connecticut and Housatonic Rivers) and Long Island shorelines (usually in <60 feet (18 m) of water).
Weakfish *(Cynoscion regalis)*	Fish, shrimp, squid, benthic invertebrates (crabs, clams)	Water column, rocky and transitional sediments	Most abundant in fall.	In spring, adults are commonly found along Mattituck Sill and both Connecticut and New York coastlines. In fall, the central basin coastline of Long Island has the highest abundance.

Table 4-15. Designated Essential Fish Habitat by Life Stage occurring at one or more of the Alternative Sites

Common Name	Scientific Name	Eggs	Larvae	Juvenile	Adult
Atlantic salmon	*Salmo salar*			●	●
Atlantic sea herring	*Clupea harengus*			●	●
Bluefin tuna	*Thunnus thynnus*				●
Bluefish	*Pomatomus saltatrix*			●	●
Cobia	*Rachycentron canadum*	●	●	●	●
Dusky shark	*Carcharhinus obscurus*			●	
King mackerel	*Scomberomorus cavalla*	●	●	●	●
Little skate	*Leucoraja erinacea*			●	●
Pollock	*Pollachius virens*			●	●
Red hake	*Urophycis chuss*	●	●	●	●
Sand tiger shark	*Carcharias taurus*		●		
Spanish mackerel	*Scomberomorus maculatus*	●	●	●	●
Windowpane flounder	*Scophthalmus aquosus*	●	●	●	●
Winter flounder	*Pseudopleuronectes americanus*	●	●	●	●
Winter skate	*Leucoraja ocellata*			●	●

Source: NOAA, 2014b

4.10.2 Block Island Sound

Block Island Sound contains a diverse and dynamic fish community. Malek et al. (2010) found a strong relationship between the complexity of benthic habitats within Block Island Sound and the diversity of demersal fish communities, where more complex habitats support greater fish diversity. The authors also found that benthic habitats in deep water support a larger, more evenly distributed community of small fish, while benthic habitats in shallow water support a smaller, more diverse community of larger fish.

Similar to Long Island Sound, most finfish species in Block Island Sound are seasonal migrants rather than resident species (RICRMC, 2010). Pelagic species such as striped bass, bluefish, butterfish, and weakfish, are generally seasonal migrants, arriving in the spring and leaving during the fall, while the few resident species are demersal species such as the winter flounder, little skate, and winter skate. Also similar to Long Island Sound, the fish community within Block Island Sound has undergone a recent shift in species with an increase in warm water species and a corresponding decrease in cold water species. This shift is also reflected in the fact that Block Island Sound, which was once dominated by demersal species, is now dominated by pelagic species. These shifts are not only being experienced in commercially important species, but are also occurring in species of non-commercial value.

4.10.3 Finfish Resources at the Alternative Sites and Summary

Trawl data for the three alternative sites were collected as part of the LISTS on June 10-12, 2013. Specifically, the survey conducted three trawls near the alternative sites (Trawls 1, 3, 6) and three trawls at locations off-site (Trawls 2, 4, and 5) (Figure 4-45). Trawls are not collected by CTDEEP within active disposal sites to avoid potential disturbance of the dredged material by the bottom trawl (USEPA and USACE, 2004a); therefore, CTDEEP selected trawl locations that were considered sufficiently representative of the alternative sites, considering that finfishes are highly mobile. To be consistent with previous Long Island Sound studies at these sites (including LISTS reports), scup, winter flounder, striped bass, and blue fish were chosen as primary species of interest, and the windowpane flounder and striped sea robin were considered secondary species of interest. Data are discussed in Tetra Tech (2014; see Appendix E) and summarized below.

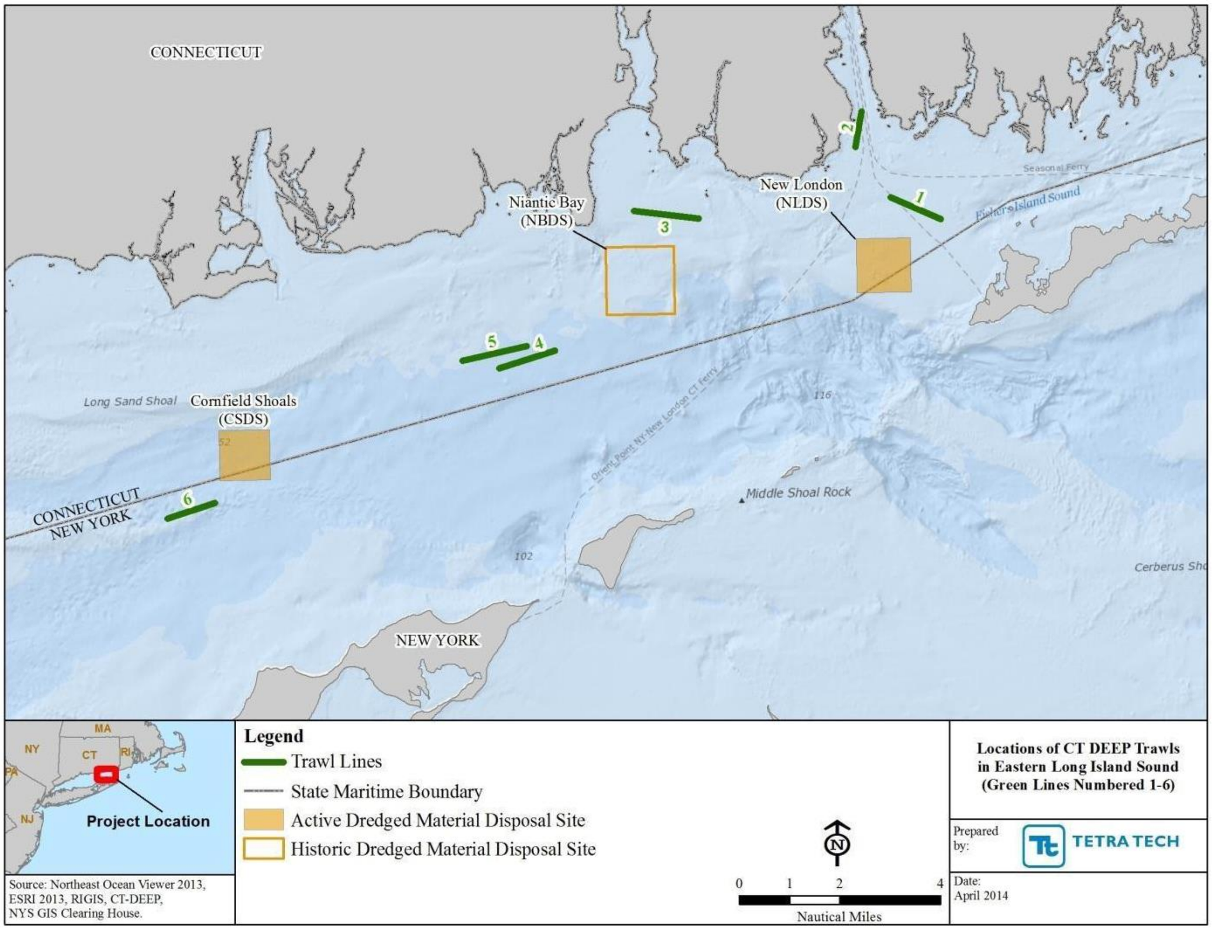

Figure 4-45. Locations of CTDEEP trawls in eastern Long Island Sound (Source: Tetra Tech, 2014).

Trawls near the three Alternative Sites: Data on species occurrence, abundance, and biomass (*i.e.*, weight) from the trawls are presented in Table 4-16. Of the three trawls collected, Trawl 1 near the New London Alternative had the highest number of individuals. Specifically, there were twice as many individuals near the New London Alternative than near the Niantic Bay Alternative, and twelve times as many individuals as near the Cornfield Shoals Alternative. The greatest biomass was found near the Niantic Bay Alternative. Trawl 6 near the Cornfield Shoals Alternative had the lowest abundance and biomass of fish; however, it had the highest species diversity, with 11 different species captured, compared to 5 species near the New London Alternative and 8 species near the Niantic Bay Alternative.

By far the most abundant finfish species present near the three alternative sites was scup (1,137 individuals); it also had the greatest biomass. This species was dominant near the New London and Niantic Bay Alternatives by abundance at 59% and 76% of the catch, and by weight at 55% and 60%, respectively, but only made up 18% of the catch and 8.4% of the biomass near CSDS. Little skate was the next most abundant species (30 individuals), but it was found mostly in the Cornfield Shoals Alternative trawl (19 fish compared to 10 fish at New London and 1 fish at Niantic Bay). It made up more than 35% of the catch and was the most abundant species by weight at Cornfield Shoals. Winter flounder had a relatively low abundance; the highest proportion of biomass was 3.2% near the New London Alternative. Striped bass was absent near the New London Alternative, and only one individual was caught each near the Niantic Bay and Cornfield Shoals Alternatives. Bluefish was only caught near the Cornfield Shoals Alternative (one individual, which made up 3.6% of the catch weight). Other species, such as the striped sea robin and windowpane flounder, were also only caught near the Cornfield Shoals Alternative. Two striped sea robin comprised 1.3% of the biomass, and 11 windowpane flounder made up 4.1% of the catch by weight.

Trawls conducted off–site of Alternative Sites: In addition to the three trawls conducted near the three alternative sites, three trawls were made in off-site areas for the purpose of comparison (Figure 4-45). They are Trawls 2, 4 and 5. Overall, Trawl 5 had the highest abundance and biomass of finfish, even when compared to all six trawls. The most abundant fish caught at the off-site areas was scup and its numbers were fairly comparable across all three trawls. It was the most dominant species in Trawls 2 and 4, composing 46% and 42% in each trawl, respectively. It also constituted the greatest biomass in those two trawls, 30% and 27% of the catch, respectively. The northern sea robin was the next most abundant finfish caught even though none were found in Trawl 2. It composed 31% of Trawl 4 and 42% of Trawl 5. Although few in number (16), smooth dogfish constituted the greatest biomass for Trawl 5, composing 28% of the catch weight (Table 4-17). For other species, striped bass was only present in one trawl (Trawl 2), and bluefish were not present in any of the trawls. Winter flounder abundance was relatively consistent among trawls, making up between 2.1 and 2.6% of total biomass.

Table 4-16. Catch Composition of Trawls near the New London, Niantic Bay, and Cornfield Shoals Alternative Sites

Common Name	**Scientific Name**	**New London** (Trawl 1)				**Niantic Bay** (Trawl 3)				**Cornfield Shoals** (Trawl 6)			
		Count	% Com-position	Weight (kg)	% Com-position	Count	% Com-position	Weight (kg)	% Com-position	Count	% Com-position	Weight (kg)	% Com-position
Scup[1]	*Stenotomus chrysops*	676	59.2	61.6	55.0	444	76.2	76.4	59.5	17	18.3	4.5	8.4
Striped bass[1]	*Morone saxatilis*	--	--	--	--	1	0.2	3.2	2.5	1	1.1	3.4	6.4
Winter flounder[1]	*Pseudopleuronectes americanus*	13	1.1	3.6	3.2	2	0.3	0.4	0.3	1	1.1	0.3	0.6
Bluefish[1]	*Pomatomus saltatrix*	--	--	--	--	--	--	--	--	1	1.1	1.9	3.6
Striped sea robin[2]	*Prionotus evolans*	--	--	--	--	--	--	--	--	2	2.2	0.7	1.3
Windowpane flounder[2]	*Scophthalmus aquosus*	--	--	--	--	--	--	--	--	11	11.8	2.2	4.1
Asian red algae	*Heterosiphonia japonica*	n/a[3]	--	8.8	7.9	n/a[3]	--	23.9	18.6	n/a[3]	--	0.2	0.4
Longfin squid	*Loligo pealeii*	433	37.9	22.3	19.9	130	22.3	4.9	3.8	5	5.4	0.3	0.6
Winter skate	*Leucoraja ocellata*	--	--	--	--	--	--	--	--	17	18.3	19	35.6
Little skate	*Leucoraja erinacea*	10	0.9	5.2	4.6	1	0.2	0.4	0.3	19	20.4	12	22.5
Spider crab	*Libinia emarginata*	n/a[3]	--	5.9	5.3	n/a[3]	--	3.4	2.6	n/a[3]	--	0.2	0.4
Kelp	*Laminaria* spp.	n/a[3]	--	0.6	0.5	n/a[3]	--	7	5.5	--	--	--	--
Smooth dogfish	*Mustelus canis*	--	--	--	--	--	--	--	--	2	2.2	5.6	10.5
Tautog	*Tautoga onitis*	1	0.1	1.8	1.6	2	0.3	2.4	1.9	--	--	--	--
Mixed algae species	*Algae* spp.	n/a[3]	--	0.7	0.6	n/a[3]	--	2.9	2.3	n/a[3]	--	0.1	0.2
Northern sea robin	*Prionotus carolinus*	--	--	--	--	--	--	--	--	15	16.1	2.2	4.1
Boring sponge	*Cliona celata*	--	--	--	--	n/a[3]	--	1.5	1.2	--	--	--	--
American lobster	*Homarus americanus*	5	0.4	1.2	1.1	--	--	--	--	--	--	--	--
Summer flounder	*Paralichthys dentatus*	--	--	--	--	1	0.2	0.9	0.7	--	--	--	--
Ulva	*Ulva lactuca*	n/a[3]	--	0.1	0.1	n/a[3]	--	0.7	0.5	n/a[3]	--	0.1	0.2
Fourspot flounder	*Paralichthys oblongus*	--	--	--	--	--	--	--	--	2	2.2	0.4	0.8
Butterfish	*Peprilus triacanthus*	3	0.3	0.1	0.1	1	0.2	0.1	0.1	--	--	--	--
Bay anchovy	*Anchoa mitchilli*	--	--	--	--	1	0.2	0.1	0.1	--	--	--	--
Squid eggs	*Loligo pealeii eggs*	--	--	--	--	n/a[3]	--	0.1	0.1	--	--	--	--
Rock crab	*Cancer irroratus*	--	--	--	--	n/a[3]	--	0.1	0.1	--	--	--	--
Flat claw hermit crab	*Pagurus pollicaris*	--	--	--	--	--	--	--	--	n/a[3]	--	0.1	0.2
Rockweed, fucus	*Fucus* spp.	--	--	--	--	--	--	--	--	n/a[3]	--	0.1	0.2
	Total	**1,141**	**100**	**112**	**100**	**583**	**100**	**128**	**93**	**100**	**53**	**100**	**100**

[1] Primary species of interest. [2] Secondary species of interest. [3] Counts not obtained, only weights.

Source: Tetra Tech, 2014

Table 4-17. Catch Composition of Trawls Off-Site from the New London, Niantic Bay, and Cornfield Shoals Alternative Sites

Common Name	Scientific Name	**Off New London** (Trawl 2)				**Off Niantic Bay** (Trawl 4)				**Off Cornfield Shoals** (Trawl 5)			
		Count	% Com-position	Weight (kg)	% Com-position	Count	% Com-position	Weight (kg)	% Com-position	Count	% Com-position	Weight (kg)	% Com-position
Scup[1]	*Stenotomus chrysops*	165	46.3	16	29.7	292	42.4	32.9	26.7	209	24.8	20.5	11.6
Striped bass[1]	*Morone saxatilis*	1	0.3	8.7	16.1	--	--	--	--	--		--	--
Winter flounder[1]	*Pseudopleuronectes americanus*	3	0.8	1.4	2.6	10	1.5	3.2	2.6	13	1.5	3.7	2.1
Windowpane flounder[2]	*Scophthalmus aquosus*	1	0.3	0.4	0.7	14	2.0	3	2.4	62	7.3	12.7	7.2
Striped sea robin[2]	*Prionotus evolans*	1	0.3	0.5	0.9	4	0.6	0.8	0.6	1	0.1	0.3	0.2
Smooth dogfish	*Mustelus canis*	--	--	--	--	6	0.9	16.8	13.6	16	1.9	49.5	28.0
Northern sea robin	*Prionotus carolinus*	--	--	--	--	214	31.1	14.6	11.9	351	41.6	26.3	14.9
Little skate	*Leucoraja erinacea*	2	0.6	1.3	2.4	36	5.2	19.7	16.0	35	4.1	16.8	9.5
Spiny dogfish	*Squalus acanthias*	--	--	--	--	1	0.1	3.9	3.2	5	0.6	21.4	12.1
Winter skate	*Leucoraja ocellata*	--	--	--	--	10	1.5	11.9	9.7	5	0.6	5.1	2.9
Longfin squid	*Loligo pealeii*	147	41.3	6	11.1	59	8.6	4.3	3.5	78	9.2	4.8	2.7
Asian red algae	*Heterosiphonia japonica*	n/a[3]	--	7.8	14.5	n/a[3]	--	5	4.1	n/a[3]		1.2	0.7
Summer flounder	*Paralichthys dentatus*	6	1.7	3.4	6.3	1	0.1	0.8	0.6	3	0.4	5.9	3.3
Black sea bass	*Centropristis striata*	3	0.8	0.5	0.9	14	2.0	2	1.6	15	1.8	2.4	1.4
Spider crab	*Libinia emarginata*	n/a[3]	--	2	3.7	n/a[3]	--	0.7	0.6	--		--	--
Fourspot flounder	*Paralichthys oblongus*	--	--	--	--	11	1.6	1.8	1.5	6	0.7	0.9	0.5
Kelp	*Laminaria* spp.	n/a[3]	--	2.3	4.3	n/a[3]	--	0.3	0.2	n/a[3]		0.1	0.1
Clearnose skate	*Raja eglanteria*	--	--	--	--	--	--	--	--	1	0.1	1.9	1.1
Bluecrab	*Callinectes sapidus*	8	2.2	1.4	2.6	--	--	--	--	--		--	--
Silver hake	*Merluccius bilinearis*	--	--	--	--	10	1.5	0.7	0.6	9	1.1	0.7	0.4
Spot	*Leiostomus xanthurus*	--	--	--	--	--	--	--	--	20	2.4	1.4	0.8
Mixed algae species	*Algae* spp.	n/a[3]	--	0.8	1.5	--	--	--	--	n/a[3]		0.2	0.1
Spotted hake	*Urophycis regia*	--	--	--	--	4	0.6	0.2	0.2	14	1.7	0.6	0.3
American lobster	*Homarus americanus*	2	0.6	0.6	1.1	--	--	--	--	--		--	--
Ulva	*Ulva lactuca*	n/a[3]	--	0.2	0.4	n/a[3]	--	0.3	0.2	n/a[3]		0.1	0.1
Flat claw hermit crab	*Pagurus pollicaris*	--	--	--	--	n/a[3]	--	0.1	0.1	n/a[3]		0.2	0.1
Lion's mane jellyfish	*Cyanea capillata*	4	1.1	0.2	0.4	--	--	--	--	--		--	--
Red hake	*Urophycis chuss*	--	--	--	--	2	0.3	0.1	0.1	1	0.1	0.1	0.1

Table 4-17. Catch Composition of Trawls Off-Site from the New London, Niantic Bay, and Cornfield Shoals Alternative Sites

Common Name	**Scientific Name**	**Off New London** (Trawl 2)				**Off Niantic Bay** (Trawl 4)				**Off Cornfield Shoals** (Trawl 5)			
		Count	% Com-position	Weight (kg)	% Com-position	Count	% Com-position	Weight (kg)	% Com-position	Count	% Com-position	Weight (kg)	% Com-position
Bay anchovy	*Anchoa mitchilli*	9	2.5	0.1	0.2	--	--	--	--	--		--	--
Butterfish	*Peprilus triacanthus*	3	0.8	0.1	0.2	--	--	--	--	--		--	--
Atlantic herring	*Clupea harengus*	1	0.3	0.1	0.2	--	--	--	--	--		--	--
Common slipper shell	*Crepidula fornicata*	n/a[3]	--	0.1	0.2	--	--	--	--	--		--	--
Rock crab	*Cancer irroratus*	--	--	--	--	n/a[3]	--	0.1	0.1	--		--	--
Moon snail egg case	*Naticidae* spp.	--	--	--	--	--	--	--	--	n/a[3]		0.1	0.1
	Total	**356**	**100**	**54**	**100**	**688**	**100**	**123**	**100**	**844**	**100**	**177**	**100**

[1] Primary species of interest. [2] Secondary species of interest. [3] Not available. Counts not obtained, only weights.

Source: Tetra Tech, 2014

Comparison with near-site and off-site Data: The overall abundance of species was about the same between the alternative sites and the off-site locations (1,817 near-site; 1,888 off-site). However, biomass was higher in off-site trawls, although that was likely a result of the high occurrence of smooth dogfish in one trawl. The statistical analysis of abundance (using a two-tailed, equal variance t-test with a significance level of 0.05), showed no significant difference in overall abundance for species of interest collected near and off of alternative sites (all P values were greater than 0.323; Table 4-18). Additionally, abundance, as estimated by CPUE, did not differ between sites located near and off of alternative sites (Table 4-19).

Table 4-18. Average Composition of Finfish Species of Interest from Trawls for Alternative Sites

Species of Interest		Average Percent Composition		P-value
		Near-site	Off-site	
Primary	Scup	41.0	22.7	0.348
	Winter flounder	1.4	2.4	0.323
	Striped bass	4.4	16.1	0.692
	Bluefish	3.6	0.0	0.374
Secondary	Windowpane flounder	4.1	3.5	0.430
	Striped sea robin	1.3	0.6	0.783

Source: Tetra Tech, 2014

Table 4-19. Average Catch per Unit Effort for Finfish Species of Interest for Alternative Sites

Species of Interest		Average Catch per Unit Effort (CPUE)		P-value
		Near-site	Off-site	
Primary	Scup	8.19	7.40	0.919
	Winter flounder	0.18	0.29	0.530
	Striped bass	0.02	0.01	0.519
	Bluefish	0.01	0.00	0.374
Secondary	Windowpane flounder	0.12	0.86	0.309
	Striped sea robin	0.02	0.07	0.329

Source: Tetra Tech, 2014

In summary, among the three alternative sites, the Cornfield Shoals Alternative had the highest species diversity with 11 species captured in the trawl survey,although it had by far the lowest abundance and finfish biomass compared to the other two alternative sites. While the New London Alternative had the highest finfish abundance, it had the lowest species diversity. Compared to surrounding areas, there was no significant difference between the abundance or CPUE near and off of the three alternative sites for species of interest identified during the survey, namely scup, winter flounder, striped bass, bluefish, windowpane flounder, and striped sea robin.

4.11 Commercial and Recreational Shellfish Resources

Several species of shellfish comprise important commercial and recreational fishery resources; this section provides a summary of the distribution of these species for both Long Island Sound, Block Island Sound, and for the three alternative sites. Shellfish resources in Long Island Sound were described in the CLIS/WLIS EIS (USEPA and USACE, 2004a) based primarily on the LISTS data collected from 1984 to 2000. These data were updated with LISTS data up to 2013 (Gottschall and Pacileo, 2014). In addition, data and information from the biological characterization study (Appendix E) were used to evaluate populations of shellfish specific to the three alternative sites.

4.11.1 Long Island Sound

Important commercial or recreational bivalve mollusk resources within Long Island Sound include the bay scallop (*Argopecten irradians*), eastern oyster (*Crassostrea virginica*), northern quahog/hard clam (*Mercenaria mercenaria*), softshell clam (*Mya arenaria*), and surf clam (*Spisula solidissima*). Lobster *(Homarus americanus),* longfin squid *(Loligo pealeii),* horseshoe crab *(Limulus polyphemus),* channeled whelk *(Busycon canaliculatum),* and knobbed whelk *(Busycon carica)* are also important resources. With the exception of lobster and longfin squid, commercially and recreationally important shellfish resources of Long Island Sound occur in shallow nearshore waters.

Harvesting of shellfish is regulated by state and local authorities based on lease agreements, stock assessments, management goals, and health regulations. Most of these regulations are based on conditions in shallow nearshore waters, although there is a large area of the far western Long Island Sound that is closed to shellfishing. Many of Connecticut's shellfish classification areas extend into the middle of Long Island Sound (Figure 4-46); classifications consist of the following:

- *Approved:* A growing area that is safe for the direct marketing or consumption of shellfish.
- *Conditionally Approved:* Area that is safe for the direct, marketing or consumption of shellfish when a sanitary survey finds that the area can remain in the open status for a reasonable period of time.
- *Conditionally Restricted:* Area where a sanitary survey has found that the area meets the criteria for "Restricted" classification when the area is in the open status, and meets the criteria for "Prohibited" classification when the area is in the closed status.
- *Restricted:* Area where harvested shellstock is relayed to "Approved" or "Conditionally Approved" waters for natural cleansing or depuration. Depuration IS the process of reducing the pathogenic organisms that may be present in shellstock by using a controlled aquatic environment as the treatment process.
- *Prohibited:* Shellfish may not be harvested from these areas except for seed oystering or depletion of the areas.

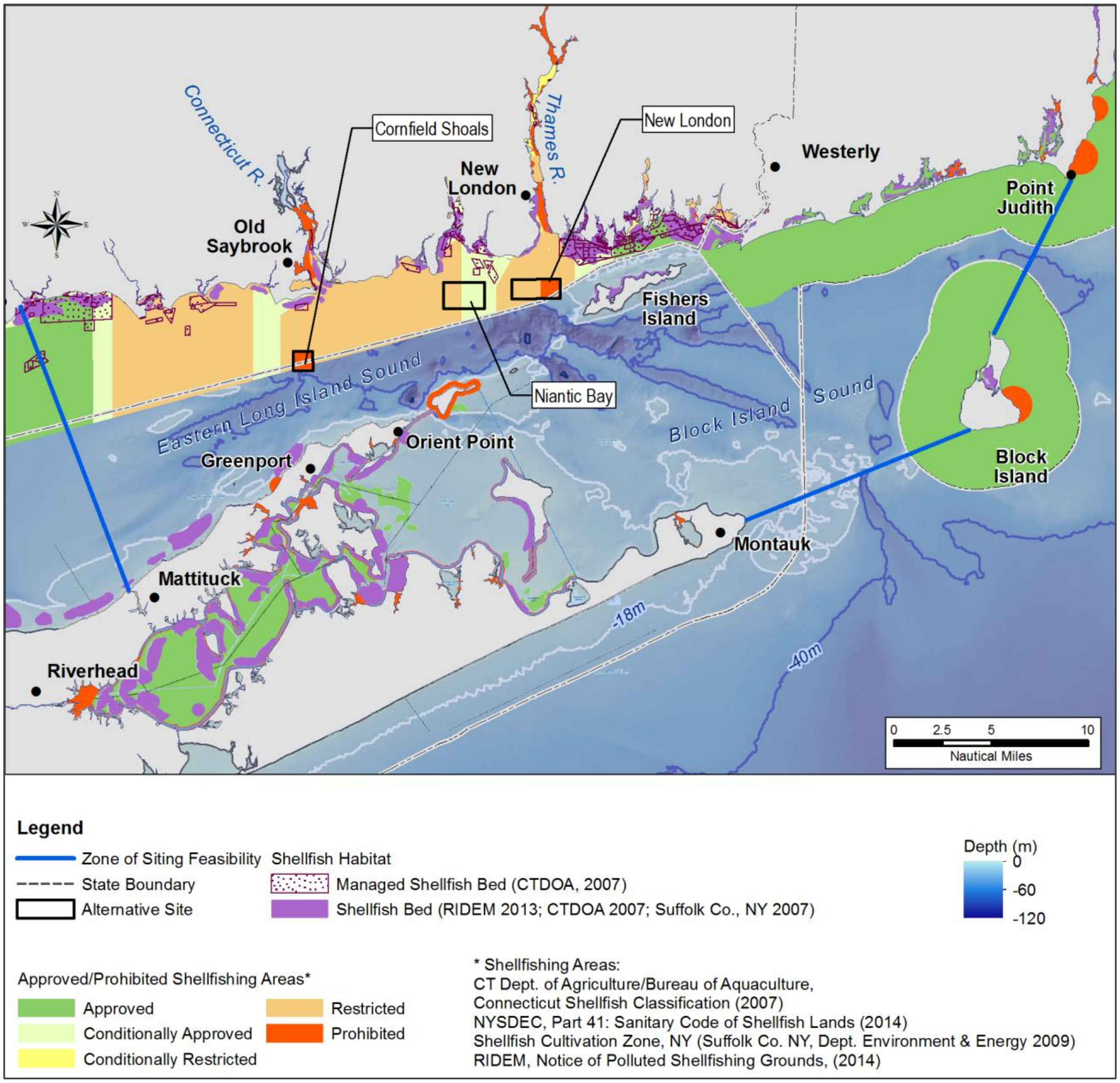

Figure 4-46. Shellfish beds and shellfishing areas in eastern Long Island Sound and Block Island Sound (Data sources: GIS data bases from states and from Suffolk County, New York).

Table 4-20 summarizes the location and habitats of the Long Island Sound shellfish species that could be present in or near the alternative sites, including their preferred prey, habitat type in which they are typically found, and their common abundance and distribution within Long Island Sound.

Table 4-20. Food, Habitat, and Distribution of the Predominant Shellfish Species present in Long Island Sound

Species	**Habitat**	**Preferred Food**	**Distribution in Long Island Sound**
American lobster *(Homarus americanus)*	Rocky coastal areas; muddy habitats for burrowing; offshore canyons	Fish, crustaceans, echinoderms, polychaetes	Deeper waters of central basin and The Race in the eastern basin.
Longfin squid *(Loligo pealeii)*	Primarily pelagic	Fish, crustaceans, squid larvae	Most common throughout Long Island Sound in the summer and fall. Higher abundances in eastern basin of Long Island Sound during migrations. High abundances in western basin during summer.
Horseshoe crab (*Limulus polyphemus*)	Differs depending on the stage: Eggs - laid on coastal beaches. Juveniles - offshore on sandy tidal flats. Adult - deeper in ocean.	Worms, clams	Throughout Long Island Sound. Stable or increasing population in western Long Island Sound in both NY and CT waters. Population declining in eastern Long Island Sound since 1995 in both NY and CT waters.
Eastern oyster *(Crassostrea virginica)*	Attached to natural or artificial hard substrates	Filter feed for phytoplankton, zooplankton, bacteria, detritus	CT waters: Occur in nearshore waters, including in eastern Long Island Sound. Low to high abundance in parts of western and central basins. NY waters: Low abundance in coastal embayments in western basin; medium abundance nearshore in central basin.
Northern quahog/ hard clam *(Mercenaria mercenaria)*	Sandy or muddy sediments	Filter feed for phytoplankton, zooplankton, bacteria, detritus	CT waters: Occur up to 2.1 nmi (4 km) offshore and in water less than 49 feet (15 m) deep, including eastern Long Island Sound. NY waters: Abundant close to shore in part of the western basin and most of the central and eastern basins.
Softshell clam *(Mya arenaria)*	Prefer multi-habitats, including clay, mud, sand, and gravel	Filter feed for phytoplankton, zooplankton, bacteria, detritus	CT waters: Medium abundance at a few sites in the western and central basins, otherwise low in relative abundance. NY waters: Abundant only in nearshore waters in western basin. Medium abundance in central basin.
Surfclam (*Spisula solidissima)*	Shallow, subtidal areas with coarse sediments	Filter feed for phytoplankton, zooplankton, bacteria, detritus	CT waters: More common in the eastern basin than the western basin. NY waters: Occur in medium abundance along north shore of Long Island.

Table 4-20. Food, Habitat, and Distribution of the Predominant Shellfish Species present in Long Island Sound

Species	Habitat	Preferred Food	Distribution in Long Island Sound
Bay scallop *(Argopecten irradians)*	Subtidal zone, eelgrass beds, sandy and muddy bottoms, and offshore in shallow to moderately deep water, such as bays and harbors.	Filter feed for phytoplankton, zooplankton, bacteria, detritus	Primarily found in the eastern part of Long Island Sound. Best production is found in estuarine embayments.
Channeled whelk *(Busycon canaliculatum)*	Shallow, intertidal to continental slope; sandy or muddy sediments	Carnivore feeding on dead fish, gastropods, annelids, and bivalves	Throughout Long Island Sound
Knobbed whelk *(Busycon carica)*	Shallow, intertidal to continental slope; sandy or muddy sediments	Carnivore feeding on dead fish, gastropods, annelids, and bivalves	Throughout Long Island Sound

Sources: American lobster distribution: Lopez et al. (2014); Horseshoe crab: LISS (2015b); Bay scallops: Fay et al. (1983) and Hammerson (2004); Surf clam: Hammerson (2004); other sources: USEPA and USACE (2004a; 2004b).

American Lobster. The American lobster occurs from Cape Hatteras to Labrador and is found in habitats ranging from shallow coastal waters to subtidal areas with depths of up to 2,300 feet (700 m). Lobsters live primarily in rocky areas of coastal waters, but may be abundant in muddy areas in which they can burrow. Small lobsters in coastal waters do not travel long distances, although larger individuals may do so (Idoine, 2000). Within Long Island Sound, studies have shown that most lobsters remain within about a 5.5-nmi (10-km) radius of their capture site (Balcom and Howell, 2006). Offshore, lobster populations are usually found near submarine canyons at the edge of the continental shelf. In contrast to inshore lobsters, those living offshore often migrate considerably, traveling as far as 160 nmi (300 km).

Female lobsters mate after molting and carry the fertilized eggs under the abdomen until the larvae hatch about eight months later. Eggs hatch in late spring or early summer and the planktonic larvae pass through four developmental stages before metamorphosing into postlarvae and settling to the bottom (Idoine, 2000). Lobsters require five to eight years to attain legal size in Long Island Sound. Lobsters feed on a variety of foods including fish and other benthic invertebrates including crabs, sea stars, worms, and sea urchins. Predators primarily include fish and predation is likely more intense on juvenile stages than on mature adults.

Based on the CTDEEP LISTS data, lobsters were most abundant on muddy substrates and occurred throughout Long Island Sound in all seasons during the study period 1984 to 2000 (USEPA and USACE, 2004a). Plots of the catch data indicated that the lobster catch was particularly high in western Long Island Sound, accounting for 50 to 60% of the harvest in Long Island Sound (CTDEEP, 2000). After reaching peak abundances in 1997 (over 19 lobsters per tow in the fall survey) and 1998 (over 18 lobsters per tow in the spring survey), spring and fall mean catch values have fallen steadily throughout Long Island Sound to record lows in 2013, with only an average of 0.44 lobsters per tow during the spring 2013 survey and an average of 0.16 lobsters per tow during the fall 2013 survey (Gottschall and Pacileo, 2014). While the lobster abundance has always varied over time, the lobster population in Long Island Sound experienced unprecedented mortality in the fall of 1999 from which it has not recovered. There was no single major contributing factor to the die-off, rather multiple factors such as warmer water temperatures, low dissolved oxygen levels, and exposure to elevated levels of bottom water sulfide and ammonium contributed to the physiological stress of the lobsters to a point where their immune system could not cope with the rapidly changing conditions (Balcom and Howell, 2006; Lopez et al., 2014). Prior to 1999, lobsters were most abundant in western and central Long Island Sound. Since then, much of the remnant lobster population has been concentrated in deeper waters of central Long Island Sound and The Race (Lopez et al., 2014).

Longfin Squid. The longfin squid is a highly mobile pelagic macroinvertebrate that occurs in the Atlantic Ocean from Newfoundland to the Caribbean (Cargnelli et al., 1999). During the annual migrations, squid move offshore in late autumn and inshore in spring and early summer. As inshore waters begin to warm, squid move shoreward and populations become concentrated in inshore waters such as Long Island Sound during the summer. These inshore waters are important nursery areas as eggs are laid on the benthic substrates in late spring and early summer. Cargnelli et al. (1999) reported that juveniles were the most abundant life stage in May, but were the least abundant stage in winter. Hatfield and Cadrin (2002) described Long Island Sound as a persistent spawning area for longfin squid from May to July; the pelagic larvae live near the surface of inshore waters upon hatching. This patterns is consistent with the LISTS data collected from 1984 to 2013 with squid being more common in Long Island Sound in summer and fall than in winter and spring (Gottschall and Pacileo, 2014).

Horseshoe Crab. The horseshoe crab ranges from Nova Scotia to Mexico and uses both estuarine and continental shelf habitats. While it lives year-round in Long Island Sound, it is most abundant from New Jersey to Virginia with Delaware Bay supporting the largest spawning population (ASMFC, 2015). They feed on worms and bivalves. Adults are exclusively subtidal except during spawning. They prefer depths of less than 90 feet (30 meters), and migrate inshore to intertidal sandy beaches to spawn in spring. Spawning generally occurs on protected sandy beaches from March through July with a peak in May and June. Horseshoe crab eggs are an important energy source for migratory birds and at least 11 species of shorebirds time their northward migration with their spawning season (Mattei and Beekey, 2008). Shoal water and shallow water areas of bays are important nursery areas as juveniles spend their first two years on intertidal sand flats. Deepwater areas are used by larger juveniles and adults to forage for food. Horseshoe crabs are important commercially as they are used for bait in the conch and eel fishery and their blood is used by the biomedical industry. Horseshoe crabs are generally harvested nearshore during their spawning season. The Atlantic States Marine Fisheries Commission implements state quotas. The New York quota is 366,272 while the Connecticut quota is 48,689; rarely are these quotas met though (Eyler et al., 2014). Within Long Island Sound, the horseshoe crab population has been stable or increasing in western Long Island Sound in both New York and Connecticut waters, while the population has been declining in eastern Long Island Sound since 1995 in both New York and Connecticut waters.

Eastern Oyster. The eastern oyster ranges from the Newfoundland to the Gulf of Mexico. Oysters filter feed on planktonic organisms. Oyster farming constitutes an important industry in Connecticut; oysters are harvested commercially both by individuals and businesses that lease shellfish beds. Oyster farmers use several culture methods to raise oysters on leased parcels of Long Island Sound floor. The farming method requires that the oysters be grown in relatively shallow waters close to shore. Due to successful oyster culture practices, oystering experienced resurgence in the 1980s and 1990s. However, after peaking in 1992, the large commercial oyster industry declined due to MSX, a parasitic disease. Oyster harvests began to rebound again in 2006 due in part to efforts to restore and protect oyster habitats. Since 2011, Connecticut oyster harvesting data have not been available, but resource managers believe that harvests are continuing to rise (LISS, 2015a). The New York fishery along Long Island Sound is much smaller than that in Connecticut, but from 2012 to 2014, New York’s oyster harvest increased by more than 370%, in part due to increased aquaculture production (LISS, 2015a).

Clams. The northern quahog/hard clam (*Mercenaria mercenaria*), softshell clam (*Mya arenaria*), and surf clam all occur in soft-bottom habitats. The primary fishery areas for harvestable clams are shallow waters on leased or franchised bottoms of Long Island Sound (Getchis, 2006). Softshell clams are harvested in muddy shallow embayments and hard clams are harvested in deeper nearshore areas. Surf clam harvesting areas are located in nearshore waters along the northern shore of Long Island between Port Jefferson and Mattituck.

Bay Scallops. The bay scallop ranges from the north shore of Cape Cod, Massachusetts, to Laguna Madre, Texas. Their distribution is entirely nearshore, less than 2.6 nmi (4.8 km) from shore (Fay et al., 1983). The availability of appropriate substrates for settlement, attachment, and filter feeding is essential, and beds of eelgrass and other seagrasses growing on sand substrates are preferred. They are more prevalent in eastern Long Island Sound where eelgrass is abundant (Hammerson, 2004).

Channeled and Knobbed Whelks. The channeled whelk and knobbed whelk are generally found in the colder waters of southern New England, including Long Island Sound. These species may be found in various bottom habitat types, but are most common on sandy bottoms in shallow waters (less than 60 feet [18 m]). They are commonly distributed from intertidal regions to the continental slope. Whelks are voracious carnivores, feeding on gastropods, annelids, and bivalves, as well as dead fish, and are relatively mobile (Davis and Sisson, 1988). The channeled whelk, which grows up to 7 inches (18 cm) long, occurs from intertidal habitats to those just below low-tide level. Channeled whelks are abundant in the shallow bays of southern New England and in Long Island Sound. This species is primarily nocturnal during warmer months, diurnal and nocturnal in the spring and fall, and primarily diurnal in winter. Channeled whelks lay eggs only in spring.

The knobbed whelk, which grows up to 8 to 9 inches (20 to 23 cm) long, occurs along the coast from Massachusetts to northern Florida. This species migrates to the deeper offshore waters during the extreme weather conditions prevalent during the summer and winter months, returning to shallow waters of nearshore mud flats during the spring and fall months (GDNR, 2007). While on mud flats, whelks prey on oysters, clams, and other marine bivalves. Mating and egg-laying occur during the spring and fall migrations.

4.11.2 Block Island Sound

American lobster, longfin squid, and Atlantic sea scallop are important commercial and recreational shellfish species in Block Island Sound (RICRMC, 2010). Lobsters are found both nearshore and offshore in Rhode Island and Block Island Sound. Lobsters will migrate into Narragansett Bay and other inshore areas during the summer, and return to the offshore areas, including Block Island Sound, during the fall. Both, longfin squid and Atlantic sea scallop are harvested commercially in Block Island Sound year-round. Quahogs, channeled whelk, and knobbed whelk are harvested primarily within Narragansett Bay and not offshore.

A commercial fishery has developed within the Peconic Bay and Gardiners Bay in New York, with nearly 30,000 acres of shellfish cultivation zones. These bays provide shellfishing for oysters, hard clams, and bay scallops (Suffolk County, 2007; 2009).

4.11.3 New London Alternative

As stated above, since 1999, lobster abundance has sharply declined throughout all of Long Island Sound in LISTS (Gottschall and Pacileo, 2014). Only five lobsters total were collected in the three trawls near the three alternative sites, and all five lobsters were collected in the trawl near the New London Alternative (Tetra Tech, 2014). The two lobsters collected in off-site trawls were also collected near the New London Alternative.

Longfin squid were most abundant in the single LISTS tow near the New London Alternative in June 2013. They numbered 433 (*i.e.,* 433 squid per tow) and composed 38% of the catch (Table 4-16). This was much higher than the average abundance of 1.47 squid per tow during the spring 2013 (April – June) LISTS for all of Long Island Sound, as well as the 4.84 squid per tow for all LISTS data from 1986 to 2013 (no counts were made in 1984 and 1985) (Gottschall and Pacileo, 2014). Although squid are commonly encountered throughout Long Island Sound in late spring, during the period from 1986 to 1994, Gottschall et al. (2000) noted that in addition to being most abundant east of Stratford Shoal, particularly in depths greater than 59 feet (18 m) on transitional and sand bottom in the central basin, they were also concentrated in Niantic Bay.

During the 2013 benthic survey, only two surf clams were collected at the NLDS and one was collected at Site NL-Wa; no other commercially harvested clam species, eastern oyster, or bay scallop occurred in benthic samples at the New London Alternative. Horseshoe crabs and whelks were also not collected (benthic or trawl surveys).

4.11.4 Niantic Bay Alternative

No lobsters were collected in the 2013 trawl near this alternative site. However, the NBDS site contains a boulder area in the north-central part of the site and abuts a bedrock area in the southeastern corner, and Site NB-E contains a bedrock area in the southwestern corner of the site. These structured habitats could provide suitable habitat for lobsters.

Longfin squid was abundant in the trawl; it numbered 130 and composed 22% of the catch (table 4-16). Similar to the New London Alternative, this was much higher than the average abundance of 1.47 squid per tow during the spring 2013 (April – June) LISTS for all of Long Island Sound (Gottschall and Pacileo, 2014). As mentioned above under the New London Alternative, Gottschall et al. (2000) noted that during the spring LISTS from 1986 to 1994 Niantic Bay was an area of high concentration for longfin squid.

Two hard clams were collected during the 2013 benthic survey at Site NB-E and five surf clams were collected at the NBDS site; no other commercially harvested clam species, eastern oyster, or bay scallop were collected. Horseshoe crabs and whelks were also not collected (benthic or trawl surveys).

4.11.5 Cornfield Shoals Alternative

No lobsters were collected in the 2013 trawl survey. Longfin squid were substantially less abundant near this site as compared to the other two alternative sites, with only five individuals caught and comprising 5.4% of the catch (Table 4-16). However, this number was still higher than the average abundance of 1.47 squid per tow during the spring 2013 LISTS. The 2013 benthic survey did not observe any commercially harvested clam species, eastern oyster, or the bay scallop at the Cornfield Shoals Alternative. Horseshoe crabs and whelks were also not collected (benthic or trawl surveys).

4.11.6 Shellfish Summary

Of the commercial and recreationally species discussed, only longfin squid were present at the alternative sites in any abundance. The other species were either not found to be present or only had a few individuals. For longfin squid, during the 2013 trawl survey all three alternative sites had a higher average abundance per tow than the LISTS for the rest of Long Island Sound. Abundance at the three sites showed a decreasing trend toward the west, with the highest abundance in the trawl near the New London Alternative and the lowest abundance near the Cornfield Shoals Alternative.

4.12 Marine and Coastal Birds, Marine Mammals, and Marine Reptiles

Section 4.12 describes the marine and coastal birds, marine mammals, and marine reptiles of Long Island Sound and Block Island Sound which may occur at any of the three alternative sites. Species designated as "endangered," "threatened," or "species of special concern" at the federal or state levels are discussed separately in Section 4.13.

4.12.1 Marine and Coastal Birds

The Atlantic Coast of North America supports a large number of resident and migratory marine and coastal birds. Long Island Sound and Block Island Sound provide important foraging, nesting, and breeding habitat for both resident and migratory birds (LISS, 2010; USGS, 2013; CRESLI, 2015a). Both Sounds are within the Atlantic Flyway, which is one of the important avian migratory routes, extending from the Canadian Arctic to the Caribbean, and Central and South America (Audubon, 2011).

4.12.1.1 Long Island Sound

Long Island Sound is utilized by a wide diversity of marine and coastal birds including both migratory and resident species. Avian species found in Long Island Sound have a preference for one or more of the three main habitat types found in the Sound: open water, coastal beaches and mudflats, and tidal marshes (Lopez et al., 2014). Open-water bird species found in Long Island Sound include waterfowl, colonial water birds, and pelagic species. Shorebirds and raptors may occasionally use open-water habitats for foraging or as fly-over during migrations, but are not likely to be present in offshore waters with any regularity. Table 4-21 provides information about bird species known to occur in Long Island Sound; these species may be present at the alternative sites.

Waterfowl. Waterfowl species include ducks, loons, and grebes. These species are common during non-breeding periods but are rarely present during the summer months (Lopez et al., 2014). Most waterfowl species breed in inland habitats but forage in open-water habitats. Sea ducks, such as greater scaup, are known to occur in Long Island Sound in flocks as large as several thousand, especially during winter. Large flocks of white-winged scoter and brant are also common in Long Island Sound during migrations. Also present, but less common in Long Island Sound, are red-throated loons and horned grebes. These species are more commonly present near the coasts of Long Island Sound seasonally from fall until spring. Dabbling ducks such as mallards, widgeons, and pintails, feed in calm, shallow waters and would not be likely to occur in the deeper open waters of eastern Long Island Sound (Stokes and Stokes, 1996).

Colonial Water Birds. Colonial water birds are a large and diverse group consisting of species such as gulls, terns, skimmers, cormorants, wading birds, and other water birds. These species build colonies of nests along the shoreline. Some colonial water birds spend substantial time foraging offshore.

Table 4-21. Marine and Coastal Birds Potentially Occurring in Offshore Open Waters of Eastern Long Island Sound

Common Name	Scientific Name	Preferred Habitat	Seasonal Presence	Use of offshore, open-water areas
Waterfowl				
American coot	*Fulica americana*	Bays, marshes, estuaries	Resident	Rare
American wigeon	*Anas americana*	Bays, marshes, estuaries	Winter	Rare
Barrow’s goldeneye	*Bucephala islandica*	Bays, estuaries	Winter	Rare
Black scoter	*Melanitta nigra*	Seashore, ocean	Winter	Occasional
Brant	*Branta bernicla*	Seashore, estuaries	Winter	Rare
Bufflehead	*Bucephala albeola*	Rivers, bays, estuaries	Winter	Rare
Canada goose	*Branta canadensis*	Bays	Resident	Rare
Canvasback	*Aythya valisineria*	Bays, estuaries	Winter	Rare
Common eider	*Somateria mollissima*	Rocky shorelines, shoals	Winter	Rare
Common goldeneye	*Bucephala clangula*	Rocky shorelines	Winter	Rare
Eurasian wigeon	*Anas penelope*	Shallow coastal estuaries, bays	Winter	Rare
Greater scaup	*Aythya marila*	Bays, estuaries	Winter	Occasional
Green-winged teal	*Anas crecca*	Bays	Winter	Rare
Harlequin duck	*Histrionicus histrionicus*	Rocky shorelines, coastal waters	Winter	Rare
Horned grebe	*Podiceps auritus*	Seashore, coastal waters	Winter	Rare
King eider	*Somateria spectablilis*	Seashore, ocean	Winter	Occasional
Lesser scaup	*Aythya affinis*	Bays, estuaries	Winter	Occasional
Long-tailed duck	*Clangula hyemalis*	Seashore, ocean	Winter	Occasional
Mute swan	*Cygnus olor*	Coastal lagoons, bays	Resident	Rare
Northern pintail	*Anas acuta*	Coastal lagoons, marshes	Summer	Rare
Northern shoveler	*Anas clypeata*	Bays	Summer	Rare
Oldsquaw	*Clangula hyemalis*	Ocean	Winter	Occasional
Red-breasted merganser	*Mergus serrator*	Seashore, bays	Winter	Rare
Redhead	*Aythya Americana*	Bays, estuaries	Winter	Rare
Red-necked grebe	*Podiceps grisegena*	Seashore, coastal lagoons	Winter	Rare
Red-throated loon	*Gavia stellate*	Seashore, bays, estuaries, ocean	Winter	Rare
Ring-neck duck	*Aythya collaris*	Bays	Winter	Rare
Ruddy duck	*Oxyura jamaicensis*	Seashore, bays	Winter	Rare
Snow goose	*Chen caerulescens*	Bays, marshes	Winter	Rare
Surf scoter	*Melanitta perspicillata*	Bays, ocean	Winter	Rare
Tufted duck	*Aythya fuligula*	Bays, estuaries	Winter	Rare
White-winged scoter	*Melanitta deglandi*	Bays, ocean	Winter	Occasional

Table 4-21. Marine and Coastal Birds Potentially Occurring in Offshore Open Waters of Eastern Long Island Sound

Common Name	Scientific Name	Preferred Habitat	Seasonal Presence	Use of offshore, open-water areas
Colonial Water Birds				
Black-headed gull	*Larus ridibundus*	Seashore, bays, estuaries	Winter	Rare
Bonaparte's gull	*Larus Philadelphia*	Seashore, estuaries, ocean	Spring	Occasional
Double-crested cormorant	*Phalacrocorax auritus*	Seashore, bays, estuaries	Resident	Occasional
Glaucous gull	*Larus hyperboreus*	Seashore	Winter	Rare
Great Black-backed gull	*Larus marinus*	Seashore, ocean	Resident	Occasional
Great cormorant	*Phalacrocorax carbo*	Seashore, ocean	Winter	Rare
Herring gull	*Larus argentatus*	Seashore, ocean	Resident	Occasional
Iceland gull	*Larus glaucoides*	Seashore, estuaries, ocean	Winter	Occasional
Laughing gull	*Larus atricilla*	Seashore, estuaries, ocean	Winter	Occasional
Ring-billed gull	*Larus delawarensis*	Seashore, estuaries, ocean	Spring	Rare
Pelagic Species				
Northern gannet	*Morus bassanus*	Seashore, ocean	Spring	Common
Razorbill	*Alca torda*	Seashore, ocean	Winter	Common
Wilson's storm-petrel	*Oceanites oceanicus*	Seashore, ocean	Summer	Common

Sources: Stokes and Stokes, 1996; USEPA and USACE, 2004a; LISS, 2010; Lopez et al., 2014; CRESLI, 2015a

Gulls occur year-round in Long Island Sound although abundance and diversity peak from fall to spring (Lopez et al., 2014). Large flocks consisting of thousands of ring-billed, herring, and Bonaparte's gulls congregate annually from late March to early April in Long Island Sound. These flocks often spend considerable time foraging in the productive offshore waters of Long Island Sound in preparation for their next migration. Ring-billed and laughing gulls are the most common summer gull species. Several species of terns are also common during the summer months. Cormorants occur year-round in eastern Long Island Sound and breeding populations appear to be growing. Cormorants often forage for fish in offshore waters. However, their unique feather physiology limits their ability to spend long periods of time in offshore waters before returning to dry resting areas.

Wading birds such as egrets and herons also nest in colonies on beaches and islands in Long Island Sound. However, these species forage in marsh and estuarine habitat, rarely, if ever, venturing offshore (LISS, 2015c). Therefore, these species are not likely to be present at any of the alternative sites.

Pelagic Species. Pelagic water birds are species which spend most of their lives on the open ocean, rarely venturing to land except to breed. Pelagic bird species found in Long Island Sound include gannets, razorbills, and petrels (LISS, 2010; Lopez et al., 2014; CRESLI, 2015a). These non-breeding visitors can be seen in eastern Long Island Sound during the spring and summer months, but are among the less common species.

Raptors. All raptor species occurring in Long Island Sound are protected at the federal or state level and are included in Section 4.13.

4.12.1.2 Block Island Sound

Avian surveys of Rhode Island waters, including Block Island Sound, were conducted in 2009 and 2010 (Paton et al., 2010). These surveys concluded that the most common species which utilized offshore open-water habitats included waterfowl such as loons, grebes, and seaducks, and colonial water birds such gulls and terns. Pelagic species such as gannets, razorbills, and petrels were also relatively common. A strong seasonal component was observed for many species, with waterfowl primarily occurring during winter months, and gulls occurring in large numbers during spring and summer, but being most abundant in offshore waters during fall. Although rarely present offshore, coastal nesting birds benefit from the 69-acre (0.28-km^2) Block Island National Wildlife Refuge, which encompasses approximately 12 miles (19.3 km) of westward-facing coastline at the northern tip of Block Island, Rhode Island.

4.12.1.3 Marine and Coastal Birds at the Alternative Sites and Summary

All three alternative sites are located in offshore open-water areas and are unlikely to support coastal species. However, these sites could provide foraging habitat for some species of waterfowl and colonial water birds as well as resting opportunities for migratory species.

4.12.2 Marine Mammals

All marine mammals in U.S. waters are protected under the Marine Mammal Protection Act (MMPA) of 1972. The MMPA prohibits, with certain exceptions, the take of marine mammals in U.S. waters, where “take” is defined as “to hunt harass, capture, or kill any marine mammal,” or to attempt to do so. Species granted additional protection at the federal and state levels include blue whale, finback whale, humpback whale, North Atlantic right whale, sei whale, sperm whale, and harbor porpoise; they are described in Section 4.13, Endangered and Threatened Species.

4.12.2.1 Long Island Sound

Long Island Sound provides year-round and seasonal habitat for a variety of marine mammals (Lopez et al., 2014). Marine mammal species found in eastern Long Island Sound consist of cetaceans and pinnipeds. Cetaceans include dolphins, porpoises and whales. All pinnipeds found in eastern Long Island Sound are seals (CRESLI, 2015b).

Whales. Many whale species are common throughout the North Atlantic. Long Island Sound does not have any resident whale populations, but whales may occasionally enter the waters of eastern Long Island Sound during seasonal migrations or to feed (Lopez et al., 2014), and therefore, could be present at one or more of the three alternative sites. Two species of whales that are not listed as endangered or threatened that potentially occur in Long Island Sound include long-finned pilot whales (*Globicephala melas*) and minke whales (*Balaenoptera acutorostrata*). A third whale, the beluga whale *(Delphinapterus leucas),* is not normally known to the waters of the eastern United States, but an extremely rare sighting of three beluga whales in Long Island Sound occurred in May 2015. (Endangered and threatened whales are discussed in Section 4.13.1.)

Long-finned pilot whales are a moderate-sized whale species reaching lengths of up to 25 feet (7.6 m). This species is characterized by dark skin, almost black, with a gray underside, and a large bulbous head. The North Atlantic longfin pilot whale population extends along the east coast of North America from the Gulf of St. Lawrence, south to North Carolina. In the winter and spring, they are more likely to occur in offshore oceanic waters, but are more commonly present in inshore coastal waters during summer and fall as they follow fish and other prey migrations (NMFS, 2014a).

Minke whales reach lengths of up to 35 feet (12 m) and are characterized by their sleek body shape and black skin with a white underside. Distribution of minke whales includes most oceanic waters of the northern hemisphere, but in the Atlantic they occur from the Arctic to the Caribbean. Although minke whales spend much of their life offshore, they frequently enter bays and estuaries in coastal waters (NMFS, 2014b).

Beluga whales are a small, white-toothed whale averaging 13 feet (4 m) in length, but may reach 16 feet (5 m). This species is distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere and are not residents of the waters off the eastern United States (Allen and Angliss, 2014; NOAA Fisheries, 2016). However, in an extremely rare event, three beluga whales were sighted in Long Island Sound in May 2015. It is surmised that they originated from a population in the Saint Lawrence River in Canada and followed an abundance of prey to Long Island Sound (Long Island Press, 2015).

Dolphins and Porpoises. Bottlenose dolphins (*Tursiops truncatus*), common dolphins (*Delphinus delphis*), and Atlantic white-sided dolphins (*Lagenorhynchus acutus*) may be encountered in Long Island Sound throughout the year (Lopez et al., 2014).

Both bottlenose and common dolphins are present throughout the Atlantic Ocean from Nova Scotia to Venezuela. Both species travel in herds, sometimes with hundreds of animals. The primary distinguishing difference between the two species is size. Bottlenose dolphins reach lengths of up to 12 feet (3.6 m) while common dolphins typically have a length of approximately 8 feet (2.4 m) (Audubon, 1995). These species often forage in inshore waters including coastal bays and estuaries, and occur with somewhat regular frequency in Long Island Sound (Lopez et al., 2014). Atlantic white-sided dolphins (*Lagenorhynchus acutus*) range from Greenland to Virginia (Audubon, 1995) and have also been reported to occur throughout Long Island Sound (ISE, 2003).

On rare occasions Risso's dolphins (*Grampus griseus*) have also been reported in eastern Long Island Sound (Kenney and Vigness-Raposa, 2010). Risso's dolphins are primarily offshore species. They are similar in appearance to bottlenose dolphins, and share the same home range in the Atlantic Ocean from Nova Scotia to Venezuela (Audubon, 1995).

Pinnipeds. Pinnipeds are the most common marine mammals in Long Island Sound. Four species of seals comprise the pinnipeds commonly encountered: harbor seals (*Phoca vitulina*), harp seals (*Pagophilus groenlandicus*), gray seals (*Halichoerus grypus*), and hooded seals (*Cystophora cristata*) (Riverhead Foundation, 2015).

Harbor seals are commonly found in Maine and eastern Canada during the spring and summer, and often move southward to Long Island Sound during the winter. These seals feed primarily on schooling fish, crustaceans, and other marine invertebrates and are known to haul out on sandy or rocky areas.

Harp seals are primarily found in the North Atlantic from Newfoundland to Northern Russia, but make extensive migrations (traveling up to 1,600 miles) throughout the year. They move northward in spring and summer to feed on schooling fish, crustaceans, and other marine invertebrates. Harp seals are commonly found in Long Island Sound during winter months and have been reported as far south as Virginia.

Gray seals are found only in waters of the western North Atlantic. The majority of the gray seal population is found in eastern Canada, but the population extends to southern New England, including Long Island Sound. They primarily feed on schooling fish, such as herring, mackerel, flounder, cod, and salmon, as well as squid, octopus, crustaceans, and even seabirds.

The breeding range of hooded seals is limited to the central and western North Atlantic. Juveniles may migrate extensively from this area during the non-breeding season. Hooded seals are commonly found in Long Island Sound during winter months and feed on schooling fish, crustaceans, and other marine invertebrates.

4.12.2.2 Block Island Sound

Kenney and Vigness-Raposa (2010) compiled a review of occurrences of marine mammals and sea turtles in or near Block Island Sound based on sighting, stranding, and bycatch data from various sources. A total of 36 marine mammal species were identified,although 18 of the species were considered to be rare visitors to the Sound. Finback whales were the most commonly reported whale species in Block Island Sound and common inshore species included dolphins and seals, as also reported for Long Island Sound. Within Block Island Sound, Montauk Point Shoals is an important migratory corridor for marine mammals, and the rocky areas off of Montauk Point are regularly used as haulouts during the winter by harbor seals and grey seals (NYSDOS, 2002). Similar to species reported for Long Island Sound, other common marine mammals occurring in Block Island Sound include common and bottlenose dolphins and harbor, harp, gray, and hooded seals.

4.12.2.3 Marine Mammals at the Alternative Sites and Summary

Whales, dolphins, and porpoises spend time in open-water habitats and may be present at any of the proposed alternative sites. Long-finned pilot whales and minke whales may be present at the alternative sites on occasion, but are transient in nature. These species are most likely present during summer and fall months when migratory prey fish species are present. Dolphins and porpoises may be present in Long Island Sound year-round, with the most common species consisting of bottlenose, common, and Atlantic white-sided dolphins. Four species of seals are common throughout Long Island Sound and Block Island Sound, but are more often present along shorelines, islands, or outcroppings. Pinnipeds are the most common group of marine mammals in Long Island Sound and are most abundant during the winter months. None of the three alternative sites are known to serve as spawning grounds for marine mammals.

4.12.3 Marine Reptiles

All marine reptile species occurring in Long Island Sound are listed as federally endangered or threatened and are described in Section 4.13.

4.13 Endangered and Threatened Species

Endangered and threatened species include those listed as "endangered" or "threatened" at the federal level under the Endangered Species Act (ESA) of 1973, 16 U.S.C. §§ 1531 *et seq*., and those species, which are given separate designations as "endangered," "threatened," or "species of special concern" under individual state laws. An endangered species is one whose overall survival in a particular region or locality is in jeopardy because of loss or change in habitat, overall exploitation by humans, predation, adverse interspecies competition, or disease.

ESA Section 7 requires federal agencies to ensure that any actions authorized, funded, or carried out by the agency do not jeopardize the continued existence of a federally-listed threatened or endangered species, or result in the destruction or adverse modification of the designated critical habitat of a federally-listed species.

4.13.1 Long Island Sound

Table 4-22 lists the special-status species known to occur within Long Island Sound and Block Island Sound, along with their federal- and state-level designation statuses in Connecticut, New York, and Rhode Island. Special-status species known to occur in the region include fishes, birds, marine mammals, and reptiles.

Finfish. Two federally-listed endangered finfish species, Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) and shortnose sturgeon (*Acipenser brevirostrum*), and one species of special concern in Connecticut state waters, blueback herring (*Alosa aestivalis*), are known to occur in Long Island Sound.

Atlantic and shortnose sturgeon are anadromous species that spawn in freshwater habitats in spring and early summer in the northeast and mid-Atlantic region (NMFS, 2014c; 2014d). For Atlantic sturgeon, the closest spawning areas to Long Island Sound are the Hudson River and the St. Lawrence River (NMFS, 2014c). Atlantic sturgeon have been reported throughout Long Island Sound, but would most likely occur in transit during spawning migrations (CTDEEP, 2015b). In addition to its federal endangered status, Atlantic sturgeon are listed as a threatened species in Connecticut state waters. Shortnose sturgeon occur in the lower Connecticut River from the Holyoke Pool to Long Island Sound (NMFS, 2014d). It is possible that shortnose sturgeon utilize portions of Long Island Sound for foraging or transit, although it is rarely encountered (NMFS, 1998). In addition to its federal endangered status, shortnose sturgeon are listed as endangered at the state level in Connecticut and New York.

Blueback herring is an anadromous schooling species which occurs throughout the western Atlantic Ocean from Nova Scotia to Florida. Blueback herring arrive in estuaries to spawn from May to June of each year and may be seasonally present in Long Island Sound (NYSDEC, 2015b). This species is only protected in Connecticut state waters; it is not listed federally or by the States of New York and Rhode Island.

Table 4-22. Marine and Coastal Endangered and Threatened Species in Long Island Sound and Block Island Sound

Common Name	**Scientific Name**	**Status**			
		Federal	**CT**	**NY**	**RI**
Finfish					
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	E	T		
Blueback herring	*Alosa aestivalis*		SC		
Shortnose sturgeon	*Acipenser brevirostrum*	E	E	E	
Birds					
Acadian flycatcher	*Empidonax virescens*				SC
Adler flycatcher	*Empidonax alnorum*		SC		
American bittern	*Botaurus lentiginosus*		E	SC	E
American oystercatcher	*Haematopus palliatus*		T		SC
Bald eagle	*Haliaeetus leucocephalus*		T	T	
Black-crowned night heron	*Egretta thula*				SC
Black rail	*Laterallus jamaicensis*		E	E	
Black skimmer	*Rynchops niger*			SC	
Blue-winged teal	*Anas discors*		T		SC
Cattle egret	*Bubulcus ibis*				SC
Clapper rail	*Raullus longirostris*				SC
Common loon	*Gavia immer*		SC	SC	
Common moorhen	*Gallinula chloropus*		E		
Common nighthawk	*Chordeiles minor*			SC	SC
Common tern	*Sterna hirundo*		SC		
Cooper’s hawk	*Accipiter cooperii*				SC
Glossy ibis	*Plegadis falcinellus*		SC		SC
Grasshopper sparrow	*Ammodramus savannarum*		E		
Great egret	*Ardea alba*		T		SC
Great blue heron	*Ardea albus*				SC
Green-winged teal	*Anas crecca*				SC
Horned lark	*Eremophila alpestris*			SC	
King rail	*Rallus elegans*		E	T	C
Least bittern	*Ixobrychus exilis*		T		T
Least tern	*Sternula antillarum*		T	T	T
Little blue heron	*Egretta caerulea*		SC		SC
Northern goshawk	*Accipiter gentilis*				SC
Northern harrier	*Circus cyaneus*			T	SC
Osprey	*Pandion haliaetus*			SC	SC
Peregrine falcon	*Falco peregrinus*		T	E	E

Table 4-22. Marine and Coastal Endangered and Threatened Species in Long Island Sound and Block Island Sound

Common Name	Scientific Name	Status			
		Federal	CT	NY	RI
Pied-billed grebe	*Podilymbus podiceps*		E	T	E
Piping plover	*Charadrius melodus*	T	T	E	
Red knot	*Calidris canutus rufa*	T			
Roseate tern	*Sterna dougallii dougallii*	E	E	E	
Saltmarsh sharp-tailed	*Ammodramus caudacutus*		SC		
Seaside sparrow	*Ammodramus maritimus*		T	SC	
Snowy egret	*Egretta thula*		T		SC
Sora	*Porzana carolina*				C
Upland sandpiper	*Bartramia longicauda*			T	E
Whip-poor-will	*Caprimulgus vociferous*		SC	SC	
Willet	*Catoptrophorus semipalmatus*				SC
Yellow-breasted chat	*Icteria virens*		E	SC	
Yellow-crowned night heron	*Nyctanassa violacea*		SC		SC
Marine Mammals					
Blue whale	*Balaenoptera musculus*	E		E	
Finback whale	*Balaenoptera physalus*	E		E	
Humpback whale	*Megaptera novaeangliae*	E		E	
North Atlantic right whale	*Megaptera novaeangliae*	E		E	
Sei whale	*Balaenoptera borealis*	E		E	
Sperm whale	*Physeter catodon*	E		E	
Harbor porpoise	*Phocoena phocoena*			SC	
Marine Reptiles					
Green sea turtle	*Chelonia mydas*	T	T	T	
Hawksbill sea turtle	*Eretmochelys imbricata*	E		E	
Kemp's Ridley sea turtle	*Lepidochelys kempii*	E	E	E	
Leatherback sea turtle	*Dermochelys coriacea*	E	E	E	
Loggerhead sea turtle	*Caretta caretta*	T	T	T	

E = Endangered; T = Threatened; SC = Species of Special Concern

Sources: CTDEEP (2015a); Enser (2006); NYSDEC (2015a); USFWS (2015a,b,c,d,e)

Birds. Thirty-three endangered or threatened coastal and marine bird species are known to occur in coastal counties of New York and Connecticut and may occur within Long Island Sound. Waterfowl, raptors, and some colonial water bird species may occasionally use the open waters of Long Island Sound for foraging or flyover, but none of the listed species are likely to be present at the proposed alternative sites for extended periods of time or with any regularity, and are therefore not discussed further.

Marine Mammals. Seven endangered or threatened marine mammal species are known to occur in Long Island Sound. Six of the species are whales and one is a porpoise. Endangered or threatened whales known to occur in Long Island Sound include the blue whale (*Balaenoptera musculus*), finback whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), North Atlantic right whale (*Megaptera novaeangliae*), sei whale (*Balaenoptera borealis*), and sperm whale (*Physeter catodon*). All six whale species are federally endangered and are also listed as endangered at the state level in New York. The harbor porpoise (*Phocoena phocoena*) is the only non-whale endangered or threatened marine mammal known to occur in Long Island Sound and is listed as a species of special concern in New York state waters.

Long Island Sound does not have any resident whale populations, but whales may enter the waters of Long Island Sound to feed during seasonal migrations (Lopez et al., 2014; NYSDOS, 2002). Kenney and Vigness-Raposa (2010) compiled a review of occurrences of marine mammals and sea turtles in or near Block Island Sound, including portions of eastern Long Island Sound, based on sighting, stranding, and bycatch data from various sources. This review concluded that finback and humpback whales were the most commonly reported whale sightings and may be present year-round throughout continental shelf waters. Sei whales and sperm whales are also known to occur regularly in eastern Long Island Sound. North Atlantic right whales are occasionally reported in eastern Long Island Sound, but are typically only present in transit during spring and fall migrations (Kenney and Vigness-Raposa, 2010; DiGiovanni and DePerte, 2005). Harbor porpoises are regularly present throughout Long Island Sound.

Marine Reptiles. Five species of sea turtles are known to occur in Long Island Sound: green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricata*), Kemp's ridley sea turtle (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), and loggerhead sea turtle (*Caretta caretta*). Use of Long Island Sound by turtles appears to be related to the availability of prey, annual migration patterns, and age. The coastal waters of New York, especially Montauk Point Shoals and Plum Gut, provide an important habitat for juvenile Kemp’s Ridley, green, and loggerhead turtles and adult-sized leatherbacks (NYSDOS, 2002; 2005a). Hawksbill turtles are only an incidental visitor to Long Island Sound, therefore Long Island Sound is not considered important habitat to the hawksbill sea turtle (CRESLI, 2015c).

The Kemp’s ridley sea turtle is listed as endangered at the federal level as well as the state level in both Connecticut and New York. This turtle is found mainly in the Gulf of Mexico; however, juveniles migrate north along the Atlantic seaboard during the summer and can be found in Long Island Sound. Most of the turtles that visit Long Island Sound are juveniles (NMFS, 1988). In Long Island Sound, where crustaceans represent more than 80% of their diet, nearly all feeding takes place on or near the bottom in shallow water (Morreale and Standora, 1992; 1993). Young Kemp’s ridley’s consume several species of crabs, including spider crabs, lady crabs, and rock crabs.

The loggerhead sea turtle is listed as threatened at the federal level as well as the state level in both Connecticut and New York. It is the most common and seasonally abundant turtle in inshore coastal waters of the Atlantic (NMFS and USFWS, 1991). Sub-adult loggerhead turtles migrate northward in the spring and become abundant in coastal waters off New York where they are encountered in Long Island Sound during the summer (Henwood, 1987; Keinath et al., 1987; Morreale et al., 1989; Shoop and Kenney, 1992). The dominant prey of the loggerhead turtle is the spider crab, but other crabs (*e.g.*, horseshoe, green, and portunid) are consumed as well (Sadove and Cardinale, 1993).

The leatherback turtle is listed as endangered at the federal level as well as the state level in both Connecticut and New York, and is the largest of the sea turtle species. Leatherback turtles are the second most common turtle along the eastern seaboard of the United States. Long Island Sound supports one of the largest populations along the Atlantic coast during the summer and early fall (Lazell, 1980; Shoop and Kenney, 1992). During the summer, they move into fairly shallow coastal waters (but rarely into bays), apparently following their preferred jellyfish prey.

The green sea turtle is listed as threatened at the federal level as well as the state level in both Connecticut and New York. During the summer, small numbers of green turtles may venture as far north as the New York Bight and New England, where some become cold–stunned each year by falling water temperatures in the fall and winter (Burke et al., 1992; Morreale et al., 1992). Sub-adult green turtles are occasionally observed in the late summer feeding on seagrass beds in the Chesapeake Bay (Barnard et al., 1989) and along the shores of Long Island (Burke et al., 1992).

The hawksbill sea turtle is listed as endangered at the federal level and at the state level in New York. In United States territorial waters, hawksbills occur along the Gulf of Mexico coast, along the Atlantic coast of Florida, and in the Caribbean. Like most sea turtles, hatchling hawksbills are pelagic for a period of one to several years. When the juveniles reach a carapace length of about 8 to 10 inches (20 to 25 cm) they return to coastal waters to feed and grow as sub-adults (NMFS, 2001). There have been a few reports of hawksbills in the western Atlantic Ocean as far north as Cape Cod (Bleakney, 1965; Lazell, 1980).

4.13.2 Block Island Sound

Due the proximity and similarity of habitat between Block Island Sound and Long Island Sound, particularly eastern Long Island Sound, marine mammal species known to occur in both locations are likely similar. Occurrences of North Atlantic right whales, humpback whales, and finback whales are relatively common in Block Island Sound during seasonal migrations (Kenney and Vigness-Raposa, 2010). All of the sea turtle species described above are also known to occur in Block Island Sound and may forage in or transit the area during seasonal migrations. Frequency and distribution of avian species, particularly those which utilize offshore open-water habitats, does not differ greatly between Long Island Sound and Block Island Sound (CRESLI, 2015a; Paton et al., 2010).

4.13.3 Endangered and Threatened Species at the Alternative Sites and Summary

Atlantic and shortnose sturgeon could be seasonally present at the alternative sites, but they have not been frequently documented in Long Island Sound. Blueback herring could also be seasonally present as they migrate through the area to their spawning grounds. Endangered and threatened birds may use the alternatives sites for flyover or occasional foraging habitat, but are not expected to be present for long periods of time. All three alternative sites evaluated are located in offshore open water. All of the listed whale species described above are only occasionally present in the waters of Long Island Sound (NOAA, 2004) and are therefore not likely to be present at the alternative sites with any regularity. Harbor porpoises are common throughout Long Island Sound and are present year-round, but would only be present at the alternative sites while transiting the area or for occasional foraging. Sea turtles may be present in Long Island Sound between May 1 and November 15 of any year (NOAA, 2004) and may transit or forage in any of the alternative sites. Considering the mobility and distribution patterns of endangered or threatened species, the likelihood of encounters is approximately the same at the three alternative sites.

4.14 Bioaccumulation

Where anthropogenic pollution sources are present, contaminants in water or sediment are available to aquatic organisms through a variety of pathways, including direct uptake from the water column, direct contact or ingestion of sediments or sediment porewater, and ingestion of contaminated prey. Once in the tissues of aquatic organisms, these chemicals can pose a health threat both to the organism directly and to other organisms (*e.g.*, upper trophic level species, humans) that consume them. While bioaccumulation of a contaminant by an organism may or may not result in detrimental impacts to the organism, it can be an indicator that a population of the same or similar organisms, or of higher trophic-level organisms that prey on the contaminated organisms, or both, may be potentially at risk of impact. This section, based on WHG (2015), provides a summary of contaminants in the tissues of representative organisms from Long Island Sound, compares Long Island Sound wide (LIS-wide) data to the alternative sites, and evaluates potential human health and ecological risks from exposure to LIS-wide tissues and alternative site tissues.

Potential risks associated with the bioaccumulation of chemicals from sediments at the alternative sites were evaluated by comparing contaminant concentrations in tissues to Federal Drug Administration (FDA) Action/Tolerance Levels for an assessment of potential human health impacts (FDA, 2011), and to Ecological Effect Values for an assessment of ecological impacts. Ecological Effects Values represent tissue contaminant concentrations believed to be safe for aquatic organisms, generally derived from the final chronic value of USEPA water quality criteria (as suggested by Lee et al., 1989). The FDA Action/Tolerance Levels and Ecological Effect Values are commonly used by USEPA and USACE in the dredging program to assess risk. This evaluation considers that tissue contaminant concentrations that do not exceed FDA Action/Tolerance Levels or Ecological Effect Values do not result in a potential human health or ecological risk.

The species considered in this analysis were those species for which tissue contaminant data from the NLDS and CSDS were available:

- American Lobster (*Homarus americanus*): Muscle tissue contaminant concentrations and hepatopancreas tissue contaminant concentrations for this species were obtained from samples collected at the NLDS and CSDS.

- Clam (*Pitar morrhuana*): Tissue contaminant concentrations for this species were obtained from samples collected at the NLDS.

- Worm (*Nephtys incisa*): Tissue contaminant concentrations for this species were obtained from samples collected at the NLDS.

- Winter Flounder (*Pseudopleuronectes americanus*): Fillet tissue contaminant concentrations for this species were obtained from samples collected at the NLDS and CSDS.

- Scup (*Stenotomus chrysops*): Fillet tissue contaminant concentrations for this species were obtained from samples collected at the NLDS and CSDS.

- Striped Bass (*Morone saxatilis*): Fillet tissue contaminant concentrations for this species were obtained from samples collected at the NLDS.

The data for this analysis were obtained from four studies. The 2004 CLIS/WLIS EIS (USEPA and USACE, 2004a) provided tissue contaminant concentrations to characterize bioaccumulation at alternative sites (including the NLDS and CSDS) and at other sites representative of LIS-wide conditions. The organisms sampled included winter flounder, scup, striped bass, lobster, clam, and worm; measured contaminants included PAHs, PCBs, pesticides, and metals. The USEPA National Coastal Assessment (USEPA, 2010) provided tissue contaminant concentrations to characterize LIS-wide conditions. The organisms sampled included winter flounder, scup, striped bass, and lobster (muscle only); measured contaminants included PCBs, pesticides, and metals. A survey by NYSDEC and CTDEEP (Skinner et al., 2009) provided tissue contaminant concentrations to characterize LIS-wide conditions. The organisms sampled included striped bass and lobster (hepatopancreas only); measured contaminants included PCBs and mercury. The NOAA National Status & Trends Mussel Watch Program (NOAA, 2013d) provided recent measured tissue contaminant concentrations to characterize LIS-wide conditions. The organisms sampled included blue mussel, considered an analogue for alternative site clams (*Pitar*); measured contaminants included PCBs, PAHs, pesticides, and metals. Figure 4-47 shows the station locations from the various programs.

Table 4-23 lists all metals and organic compounds analyzed by the USEPA and USACE (2004a) at the NLDS and CSDS. Contaminants considered further in this analysis were those that were detected in tissues at the alternative sites and that also have either a human health endpoint expressed as a tissue contaminant concentration (FDA Action/Tolerance Level) or an Ecological Effects Value also expressed as a tissue contaminant concentration.

4.14.1 Long Island Sound and the Alternative Sites

Human Health Risks. FDA Action/Tolerance Levels are non-binding recommendations established by FDA for contaminants in the edible portion of fish; the various levels represent limits "at or above which FDA will take legal action to remove products from the market" because they are deemed to be injurious to human health. Table 4-24 presents the comparison of the average concentrations of the contaminants in finfish and lobster tissue from the various data sources.

Several average measured tissue contaminant concentrations at the alternative sites were higher than average concentrations reported in various LIS-wide measurement programs (total PCBs in winter flounder tissue at NLDS; total PCBs in scup tissue at NLDS and CSDS; chlordanes in scup tissue at CSDS; total DDT in scup tissue at NLDS and CSDS; dieldrin in scup tissue at NLDS and CSDS; mercury in winter flounder tissue at NLDS; mercury in scup tissue at NLDS and CSDS; mercury in striped bass tissue at NLDS; mercury in lobster muscle at NLDS and CSDS; mercury in lobster hepatopancreas at CSDS). However, none of the detected contaminants in finfish fillets, lobster muscle, or lobster hepatopancreas from LIS-wide data sets or the alternative sites exceeded any of their respective FDA Action/Tolerance Levels.

Although the average alternative site tissue concentrations of some contaminants were slightly higher than LIS-wide averages, the evaluation demonstrated that none exceeded FDA Action/Tolerance Levels.

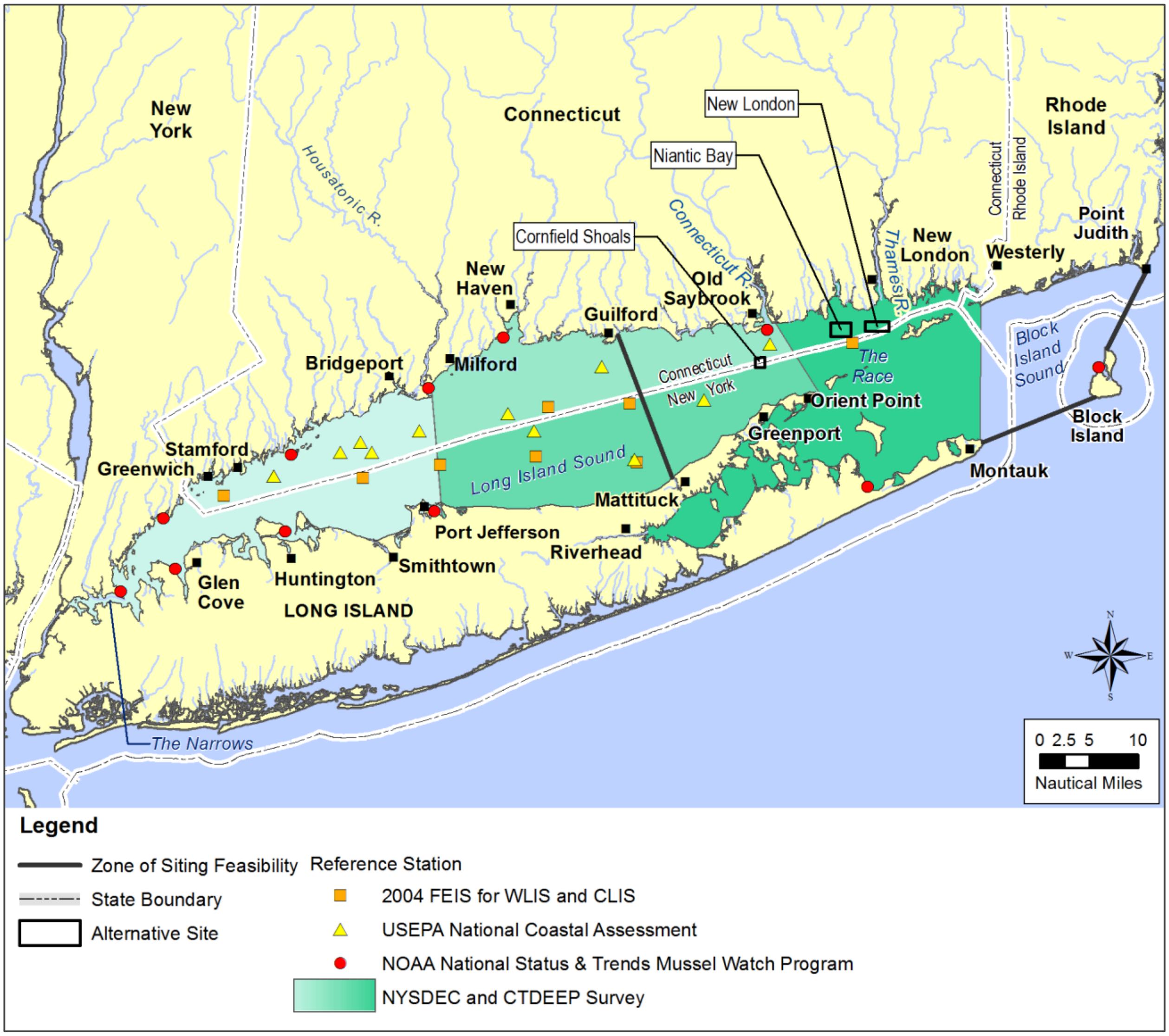

Figure 4-47. Stations of various sampling programs used in the analysis of bioaccumulation (Sources: USEPA and USACE, 2004a; USEPA, 2010; Skinner et al., 2009; NOAA, 2013d). The different shades of green reflect the four NYSDEC and CTDEEP survey sampling areas.

Table 4-23. Tissue Contaminants analyzed at the NLDS and CSDS in 2002

Contaminant	Detected in tissue at NLDS or CSDS?	Ecological Effects Value	FDA Action/ Tolerance Level
Metals			
Arsenic	Y	●	
Beryllium	Y		
Cadmium	Y	●	
Chromium	Y	●	
Copper	Y	●	
Lead	Y	●	
Mercury	Y	●	●
Nickel	Y	●	
Selenium	Y		
Silver	Y	●	
Zinc	Y	●	
PAHs			
Acenaphthene	Y		
Acenaphthylene	Y		
Anthracene	Y	●	
Benzo(a)anthracene	Y		
Benzo(a)pyrene	Y	●	
Benzo(b)fluoranthene	Y		
Benzo(e)pyrene	Y		
Benzo(g,h,i)perylene	Y		
Benzo(k)fluoranthene	Y		
Chrysene	Y		
Dibenz(a,h)anthracene	Y		
Fluoranthene	Y		
Fluorene	Y		
Indeno(1,2,3-c,d)pyrene	Y		
Naphthalene	Y		
Phenanthrene	Y		
Pyrene	Y		
Total PAH	Y	●	

Contaminant	Detected in tissue at NLDS or CSDS?	Ecological Effects Value	FDA Action/ Tolerance Level
PCBs			
Total PCBs	Y	●	●
Pesticides			
Aldrin	N		●
alpha-BHC	N		
beta-BHC	N		
delta-BHC	N		
gamma-BHC	N		
alpha-Chlordane	Y		
gamma-Chlordane	Y		
Chlordanes	Y	●	
Dieldrin	Y	●	●
Endosulfan I	N		
Endosulfan II	N		
Endosulfan sulfate	N		
Heptachlor	N		●
Heptachlor epoxide	N		●
Methoxychlor	N		
Toxaphene	N		
4,4’-DDD	Y		
4,4’-DDE	Y		
4,4’-DDT	Y		
2,4’-DDD	N		
2,4’-DDE	N		
2,4’-DDT	N		
Total DDT	Y	●	●

Source: Appendix H-5 of USEPA and USACE (2004a).

Table 4-24. Comparison of Lobster and Finfish Edible Tissue Contaminant Concentrations to FDA Action/Tolerance Levels

Analyte	**FDA Human Health Action / Tolerance Levels**	**Winter Flounder Fillet**				**Scup Fillet**				**Striped Bass Fillet**		**Lobster Muscle**				**Lobster Hepatopancreas**			
		ELIS Alternatives		**WLIS/CLIS Reference**	**National Coastal Assessment**	**ELIS Alternatives**		**WLIS/CLIS Reference**	**National Coastal Assessment**	**ELIS Alternatives**	**NYSDEC-CTDEEP Survey**	**ELIS Alternatives**		**WLIS/CLIS Reference**	**National Coastal Assessment**	**ELIS Alternatives**		**WLIS/CLIS Reference**	**NYSDEC-CTDEEP Survey**
		NLDS	**CSDS**	**LIS**	**LIS**	**NLDS**	**CSDS**	**LIS**	**LIS**	**NLDS**	**LIS**	**NLDS**	**CSDS**	**LIS**	**LIS**	**NLDS**	**CSDS**	**LIS**	**LIS**
Metals *(mg/kg wet weight)*																			
Mercury	1	**0.022**	0.015	0.020	n/a	**0.07**	**0.086**	0.061	0.029	**0.48**	0.37	**0.11**	**0.24**	0.070	0.064	0.075	**0.12**	0.079	0.073
Pesticides *(µg/kg wet weight)*																			
Chlordanes	300	0.98	1.1	1.0	2.2	0.64	**1.2**	0.72	2 U	2.4	n/a	0.042	0.058	0.098	2 U	3.6	1.1	4.8	n/a
Total DDT	5,000	6.7	4.6	5.8	11.9	**12**	**15**	10	8.8	20	n/a	0.76	1.0	1.1	5.0	113	80	127	n/a
Dieldrin	300	0.6	0.49	0.67	3.8	**2.2**	**2.9**	2.1	1 U	0.85	n/a	0.34	0.46	0.56	1 U	9.2	4.8	11.0	n/a
Total PCBs *(µg/kg wet weight)*																			
Total PCB	2,000	**90.6**	57.6	76.5	56.0	**134**	**184**	130	60.5	326	333	10.5	16.2	14.1	27.4	1,514	1,419	1,698	1,310

U = Undetected; value represents Method Detection Limit by the laboratory.

1.2 Bolded values indicated that the average tissue contaminant concentration measured at an alternative site were higher than the corresponding average values reported in LIS-wide programs.

Note: None of the average tissue concentration measured at an alternative site exceeded its corresponding FDA Action/Tolerance Level.

Ecological Risks. The ecological risk assessment was based on the Ecological Effects Values. These values, typically derived from the final chronic value of USEPA water quality criteria, are tissue concentrations (body burdens) of various contaminants deemed to be "safe" for aquatic organisms. Table 4-25 presents the comparison of the average contaminant concentrations in lobster, clam, and worm tissue from various measurement programs.

Several of the measured or estimated average contaminant concentrations in invertebrate tissue (LIS-wide and at the alternative sites) exceeded their respective Ecological Effects Value. Measured worm tissue from the CLIS reference area exceeded the Ecological Effects Value for cadmium. Estimated whole body lobster tissue from the NLDS, CSDS, and LIS-wide samples exceeded the Ecological Effects Value for copper. Estimated whole body lobster tissue from CSDS and measured worm tissue from the CLIS-reference area exceeded the Ecological Effects Value for mercury. Estimated whole body lobster tissue from the CSDS and LIS-wide exceeded the Ecological Effects Value for silver.

Several of the measured or estimated average contaminant concentrations in invertebrate tissue at the alternative sites were higher than the average concentrations in LIS-wide programs. Total PAH, total PCBs, chlordanes, total DDT, dieldrin, arsenic, chromium, copper, nickel, and zinc were higher in measured worm tissue from the NLDS than in measured worm tissue LIS-wide. Silver was higher in measured clam tissue from the NLDS than in measured clam tissue LIS-wide. Arsenic and mercury were higher in estimated whole body lobster tissue from the NLDS and CSDS than in estimated whole body lobster tissue LIS-wide. Cadmium, copper, silver, and zinc were higher in estimated whole body lobster tissue from the CSDS than in estimated whole body lobster tissue LIS-wide.

In most instances, the average metals concentrations at the alternative sites were only slightly higher than the average LIS-wide concentrations with the exception of arsenic. Nickel was elevated in worm tissue at NLDS, but well below the Ecological Effects Value.

Average concentrations of copper, mercury, and silver in estimated whole body lobster at the CSDS were elevated above LIS-wide levels, and were above the Ecological Effects Values. The ranges of estimated whole body lobster concentrations for copper and silver were similar between CSDS and LIS-wide samples. Mercury is a highly biomagnifiable contaminant which is widely distributed in urban estuaries, and the concentration did not significantly exceed the Ecological Effects Value.

These analyses indicate that several contaminant concentrations in invertebrate tissue exceeded their respective Ecological Effects Values at alternative sites and in LIS-wide areas. The lobster tissue concentrations of various contaminants at the NLDS and CSDS were slightly higher relative to the tissue concentrations measured LIS-wide. Worm tissue concentrations measured at the NLDS were elevated above the LIS-wide tissue concentrations, but did not exceed the Ecological Effects Values.

Table 4-25. Comparison of Benthic Tissue Contaminant Concentrations to Ecological Effects Values

Analyte	**Ecological Effects Values**	**Lobster** (Whole body est.)			**Clam**		**Mussel**	**Worm**	
		ELIS Alternatives		**WLIS/CLIS Reference**	**ELIS Alternative**	**CLIS Reference**	**NS&T Mussel Watch**	**ELIS Alternatives**	**CLIS Reference**
		NLDS	**CSDS**	**LIS**	**NLDS**	**LIS**	**LIS**	**NLDS**	**LIS**
Metals *(mg/kg wet weight)*									
Arsenic	12.6	**6.7**	**6.6**	5.4	1.1	1.1	1.4	**4.6**	0.030
Cadmium	3	0.53	**0.92**	0.69	0.11	0.14	0.30	0.15	4.0
Chromium	11.8	0.21 U	0.21 U	0.21U	0.22	0.45	0.40	**0.18**	0.13
Copper	9.6	59	82	85	1.2	2.1	3.4	**1.6**	0.15
Lead	11.9	**0.018**	0.0037	0.017	0.47	0.70	0.80	0.45	2.3
Mercury	0.2	**0.10**	**0.23**	0.093	0.0075	0.010	0.030	0.0048	0.37
Nickel	3.8	0.079	0.082	0.088	0.97	1.2	0.70	**0.48**	0.010
Silver	1.5	1.2	**1.8**	1.7	**0.32**	0.15	0.010	0.028	0.59
Zinc	1,517	18	**28**	23	12	14	23	**19**	18
PAHs *(µg/kg wet weight)*									
Anthracene	3,750	0.25	0.32	-	0.43	-	3.6	0.85	-
Benzo(a)pyrene	8,000	2.2	0.47	-	0.46	-	4.8	1.6	-
Total PAH	10,000	**39**	13	34	23	42	290	**49**	25
Total PCBs (µg/kg wet weight)									
Total PCB	4,000	146	143	166	12	22	65	**46**	30
Pesticides (µg/kg wet weight)									
Chlordanes	64	0.37	0.16	0.52	0.35	0.27	4.9	**0.51**	0.18
Total DDT	3,000	11	8.2	12	0.75	1.5	8.4	**3.9**	2.2
Dieldrin	4.37	1.1	0.85	1.5	0.15	0.20	0.80	**0.32**	0.30

U = Undetected; value represents MDL by the laboratory.

82	Highlighted data cells indicate that the average tissue contaminant concentration measured at an alternative site exceeded its corresponding Ecological Effects Value.
6.1	Bolded values indicate that the average tissue contaminant concentration measured at an alternative site were higher than the corresponding average values reported in LIS-wide programs.

4.14.2 Bioaccumulation Summary

All measured finfish and lobster tissue concentrations were below available FDA Action/Tolerance Levels for all contaminants that were detected at the NLDS (part of the New London Alternative) and the CSDS (*i.e.*, Cornfield Shoals Alternative) indicating low probability of a human health risk. Advisories from the Connecticut Department of Health limit consumption of higher trophic level fish (striped bass and bluefish).

The measured (clam and worm tissue) and estimated (lobster) whole body concentrations of contaminants obtained from organisms collected at the NLDS and CSDS did not exceed their respective Ecological Effect Values except for copper in lobsters at both NLDS and CSDS, and mercury and silver at CSDS.

In summary, the risk analysis using FDA Action/Tolerance and Ecological Effect Values shows that potential risks to human health and ecological receptors associated with exposure to sediments at the alternative sites, given existing conditions, are low.

4.15 Socioeconomic Environment

This section describes the socioeconomic environment (commercial and recreational fisheries, shipping and navigation, recreational activities and beaches, parks and natural areas, historical and archaeological resources, and other human uses) of the ZSF. Each of these socioeconomic resources was evaluated for the Long Island Sound region and the three alternative sites, as appropriate.

Public and private business activities, including the business aspects of recreational fishing and boating, contribute to the regional economy by creating jobs and producing goods and services from business activities. Business output represents the value of industry production. The value added by maritime-related industries contributes directly to the Gross State Product (GSP), which is a measure of the size of a state economy. In addition to direct employment and output, business activities generate indirect and induced economic contributions. Indirect economic contributions result from businesses purchasing goods and services from other businesses as inputs to their own production. Induced economic contributions result from employees spending their wages and salaries on various household expenditures.

An analysis of the economic contributions of navigation-dependent activity in the Long Island Sound region was conducted by the USACE in June 2010 as part of the LIS DMMP (WHG, 2010c). The study area included all of Long Island Sound and Block Island Sound from New York City to Point Judith, Rhode Island. The navigation-dependent activities examined were marine transportation (including commercial shipping, water transportation and shipbuilding), commercial fishing, recreational boating, ferry-dependent tourism, and the U.S. Navy Submarine Base in New London. Baseline data on direct employment, payrolls, and business expenditures were obtained primarily from public data sources and previous studies and surveys. After establishing the level of direct employment and expenditures for each industry category, the study used a regional input-output model to determine the indirect and induced contributions of navigation-dependent activities.

These WHG (2010c) estimates were produced for the several sub-regions defined by county. For the analysis in this SEIS, this information was adjusted as follows to reflect the boundaries of the ZSF:

- *Rhode Island:* Westerly and Little Narragansett Bay are the only portions of Washington County included. (These communities are included as dredged material could be disposed of at a designated site in eastern Long Island Sound.)

- *Eastern Connecticut:* New London County, Middlesex County plus the portion of New Haven County from Guilford Harbor to the east, including the Connecticut River.

- *Eastern Long Island, New York:* North shore of Suffolk County from Mattituck Harbor and Peconic and Gardiners Bays between Orient Point and Montauk, including the fishing fleet and marinas in Montauk Lake. Not included were Port Jefferson on the north shore of Long Island and Shinnecock Bay on the south shore as they are located outside of the ZSF.

In the cases of commercial shipping and the U.S. Navy Submarine Base in Groton, Connecticut, the activities and the resulting economic contributions for the ZSF can be separated from the broader contributions on the larger Long Island Sound region based on the location of specific facilities within the study area. For other activities such as commercial fishing and recreational boating, much of the relevant data are most readily available only at the state or county level, which makes separating the economic contributions on eastern Long Island Sound from the larger region somewhat more difficult. However, WHG (2010c) allocated the economic contributions of fishing and recreational boating by port and waterway, so it was possible to extract the findings for the ZSF.

Table 4-26 provides a summary of the economic measures for annual output, GSP, employment, and annual tax revenues. The majority of the economic contributions in the eastern Long Island Sound region occur in the Eastern Connecticut sub-region. The New London/Groton area is the largest population and employment center. Only a small part of Rhode Island is included in the ZSF, and the easternmost part of Suffolk County, New York, is sparsely populated compared to other parts of Long Island. However, Eastern Long Island is a popular destination for tourism and recreation, and this is reflected by the importance of recreational boating in this sub-region (as discussed further below).

Table 4-26. Estimated Regional Economic Contributions (2009 dollars)

Adjusted Sub-region	**Annual Output** (millions)	**Gross State Product** (millions)	**Employment**	**Annual Tax Revenues** (millions)
Rhode Island	$13	$4.7	88	$1.4
Eastern Connecticut	$4,364	$2,705	30,325	$702
Eastern Long Island	$391	$199	2,385	$63
Total ZSF (sum)	**$4,768**	**$2,909**	**32,798**	**$766**

Table 4-27 lists the economic contributions (stated in GSP) of each industry sector as they were allocated to the adjusted sub-regions for the ZSF.

- *Marine Transportation:* Marine transportation activity was allocated to waterways within the ZSF based on the level of inbound freight cargo measured in short tons. The waterways are New London Harbor, Thames River, and the Connecticut River below the City of Hartford. The regional economic contribution for marine transportation allocated to these waterways, stated in terms of GSP, was $1.38 billion.

  The two most significant employment and economic generators in the ZSF are the General Dynamics Electric Boat shipyard and the U.S. Navy Submarine Base, both located in New London/Groton. Electric Boat was planning to expand its Connecticut operations from 8,700 employees to 8,900 (Connecticut Governor Dannel Malloy, 2014). The Submarine Base is responsible for approximately 10,000 jobs in the region (WHG, 2010c). In the economic analysis, shipbuilding and repair activities at Electric Boat are included as part of the marine transportation sector, while the U.S. Navy Submarine Base is categorized as a separate sector.

- *Commercial Fishing:* The economic contribution of commercial fishing activity was allocated to waterways and ports based on the ex-vessel landings value of finfish and shellfish. The regional GSP contributions were $200,000 for Rhode Island, $22 million for eastern Connecticut, and $35 million for eastern Long Island, New York, for a total of $57 million. The small amount for Rhode Island reflects the fact that only the Port of Westerly and the waterways of Pawcatuck River, Little Narragansett Bay, and Watch Hill Cove are included in the analysis.

- *Recreational Boating:* For recreational boating activity (which includes recreational fishing), WHG (2010c) allocated economic contributions to specific waterways based on the number of slips and moorings in each waterway. The regional economic GSP contribution was $4.5 million for Rhode Island, $362 million for eastern Connecticut, and $127 million for eastern Long Island, for a total of $494 million.

- *Ferry-based Tourism:* The economic activity generated by ferry-based tourism was allocated to waterways within the full Long Island Sound area using annual passenger trips as a proxy for economic activity. This results in an estimate of $37.5 million in GSP that is produced by ferry-related tourism within the ZSF.

- *U.S. Navy Submarine Base:* All of the economic contributions of the Submarine Base on the Thames River in Groton were allocated to the Thames River waterway. The economic contribution to the GSP was $944,000.

Table 4-27. Gross State Product (GSP) Estimates for ZSF by Industry Sector

Adjusted Sub-region[1]	**Marine Transportation** (millions)	**Commercial Fishing** (millions)	**Recreational Boating** (millions)	**Ferry-Based Tourism** (millions)	**U.S. Navy Submarine Base**	**Total all Industry Sectors** (millions)	**Percent of Total GSP**
Rhode Island	$0	$0.2	$4.5	$0		$4.7	0.2%
Eastern Connecticut	$1,377	$21.6	$362.3	$0.27	$944.2	$2,705.4	93.0%
Eastern Long Island	$0	$35.1	$127.0	$37.2		$199.3	6.8%
Total ZSF	**$1,377**	**$56.9**	**$493.8**	**$37.5**	**$944.2**	**$2,909.4**	**100%**
Percent of Total GSP	47.3%	2.0%	17.0%	1.3%	32.4%	100%	

[1] The analysis is based on data in WHG (2010c), adjusted to reflect the boundaries of the ZSF.

On an industry sector basis, marine transportation in the ZSF accounts for 47% of the GSP contributed by all navigation-dependent industries (Table 4-27). The Submarine Base accounts for 32%. Recreational boating accounts for 17% of the contribution to GSP. Within the Eastern Long Island sub-region, recreational boating is an important component of the economy, contributing 64% of the GSP generated by navigation-dependent industries. Specific industry sectors are discussed in more detail below.

4.15.1 Commercial and Recreational Fisheries

Commercial and recreational fisheries of Long Island Sound are valuable resources to the States of Connecticut, New York, and Rhode Island. The following section describes economic aspects of commercial and recreational fishing practices in the ZSF.

Commercial Fisheries. Commercial fishing in Long Island Sound targets both finfish and shellfish. The value of the commercial fishery includes two factors: revenue generated by the sale of fish landings and revenues generated by those markets that supply and are supplied by the industry. These two factors combined provide an estimate of the total value of commercial fishing in Long Island Sound. Revenues generated by industries that supply and are supplied by the commercial fishing activities include upland activities such as the sale of fishing gear, petroleum products, and food; production of vessels; and non-fishing related activities such as the services provided by marinas.

Information on commercial fishing activities and fish landings is most readily available at the state level from the NMFS. While data for the States of New York and Rhode Island are included in this analysis, data for Connecticut are viewed to be most representative of fishing activities for Long Island Sound, since the entire Connecticut coastline borders Long Island Sound. While New York and Rhode Island represent important components of Long Island Sound’s fishing industry, a significant portion of the state-wide data come from the Atlantic Ocean, Block Island Sound, Narragansett Bay and other areas outside Long Island Sound. State-wide data for Connecticut is also particularly relevant because the majority of Connecticut fish landings occur in New London County. For example, for years 2012 and 2013 combined, New London County accounted for 96% of Connecticut’s commercial fish landings by weight and 95% of the state total by value (ACCSP, 2014).

The NMFS includes four ports within the ZSF in its list of 2013 commercial fish ports ranked by dollar value of the catch (NMFS, 2014e). These four ports were Montauk, New York, Stonington, Connecticut, New London, Connecticut and Greenport, New York. Together, they landed 20.9 million pounds of fish with a value of $31.8 million in 2013. However, while Montauk is located within the ZSF, its landings originate mostly from Block Island Sound and the Atlantic Ocean rather than eastern Long Island Sound.

The size and value of commercial fish landings in Connecticut have declined over the 10-year period from 2004 to 2013, while the landings in New York and Rhode Island have been more stable (Table 4-28). In fact, in both New York and Rhode Island, the value of the fish catch in 2013 was higher than in 2004, while in Connecticut, the 2013 value was less than half that of 2004.

However, as explained above, Connecticut data are considered more representative of commercial fishing activity in eastern Long Island Sound.

Table 4-28. Annual Commercial Fish Landings, All Species Combined

Year	Connecticut		New York		Rhode Island	
	Pounds (millions)	**Dollar Value** (millions)	**Pounds** (millions)	**Dollar Value** (millions)	**Pounds** (millions)	**Dollar Value** (millions)
2004	18.1	33.4	34.5	46.9	115.0	77.6
2005	13.6	37.6	38.2	56.4	97.6	91.4
2006	11.7	36.9	33.3	58.5	113.0	99.4
2007	10.0	42.1	35.8	60.3	75.3	72.3
2008	7.1	17.2	34.2	57.5	72.0	66.1
2009	6.7	15.0	34.3	48.9	84.0	61.7
2010	6.7	17.6	33.4	49.6	77.5	62.7
2011	7.1	19.7	27.1	37.6	76.7	75.5
2012	8.7	20.6	30.1	39.3	83.3	80.8
2013	8.0	14.6	33.0	56.0	90.0	86.4

Source: NMFS, 2014e

Table 4-29 lists the most significant commercial fish species for each state in terms of value and weight. The predominant species measured by value in each state is a shellfish. Specifically, nearly half of the value of the commercial catch in Connecticut came from sea scallops in 2013, but this can be attributed to their high value of more than $11 per pound. On the basis of catch weight, sea scallops accounted for only 8% of Connecticut’s catch. The most significant species by weight in Connecticut were silver hake, scup (porgy), and squid.

The northern quahog, or hard clam, was the dominant species ranked by dollar value in New York in 2013. This may be due in part to the use of aquaculture in Peconic and Gardiners Bays. A 2002 report stated that nearly 90% of the annual hard clam production and over 90% of the annual oyster production in Peconic Bay came from aquaculture activities (Suffolk County, 2002). In terms of catch weight, squid, scup, and other clams (not northern quahogs) were the most important species for New York.

Table 4-29. Fish and Shellfish Species Distribution by Value of Catch, 2013

Fish/Shellfish Species	**State-wide Catch Weight** (pounds)	**State-wide Catch Value** (dollars)	**Percent of Total Catch Value**
New York			
Northern quahog	1,932,000	$ 13,475,000	24.0
Squid	4,828,000	$ 5,976,000	10.7
Golden tilefish	1,466,000	$ 4,673,000	8.3
Eastern oyster	204,000	$ 4,149,000	7.4
Flounder (various species)	1,338,000	$ 3,636,000	6.4
Striped bass	824,000	$ 3,394,000	6.0
Other clam species	3,596,000	$ 3,301,000	5.9
Scallop (sea and bay)	288,000	$ 3,076,000	5.5
Scup	4,578,000	$ 2,970,000	5.3
Silver hake	2,380,000	$ 1,909,000	3.4
Goosefish	1,426,000	$ 1,625,000	2.9
Other species	10,173,000	$ 7,849,000	14.2
Total Catch Value	**33,033,000**	**$ 56,033,000**	100%
Connecticut			
Sea scallop	640,000	$ 7,219,000	49.0
Silver hake	1,647,000	$ 1,301,000	8.9
Squid	1,098,000	$ 1,257,000	8.6
Flounder (various species)	426,000	$ 1,086,000	7.4
Goosefish	967,000	$ 1,022,000	7.0
Scup	1,195,000	$ 705,000	4.8
Other species	1,984,000	$ 2,042,000	14.3
Total Catch Value	**7,957,000**	**$ 14,632,000**	100%
Rhode Island			
Sea scallop	1,648,000	$ 18,658,000	21.6
Squid	12,587,000	$ 13,172,000	15.2
American lobster	2,156,000	$ 9,732,000	11.3
Flounder (various species)	3,565,000	$ 8,885,000	10.3
Northern quahog	818,000	$ 5,033,000	5.8
Atlantic herring	27,881,000	$ 4,782,000	5.5
Crabs (various species)	4,787,000	$ 4,787,000	5.5
Eastern oyster	173,000	$ 4,265,000	4.9
Scup	7,357,000	$ 3,669,000	4.2
Goosefish	2,825,000	$ 2,733,000	3.2
Other species	26,216,000	$ 10,703,000	12.5
Total Catch Value	**90,013,000**	**$ 86,419,000**	100%

Source: NMFS, 2014e

Lobster catch in Long Island Sound has declined significantly since the die-off began in 1999. The NMFS reports lobster landings in Connecticut of approximately 127,000 pounds with a value of $577,000 in 2009, compared to 647,000 pounds and a value of $3.17 million in 2004, and 2.9 million pounds and a value of $9.8 million in 1996 (NMFS, 2014e). The Atlantic States Marine Fisheries Commission has placed restrictions on commercial lobster fishing in Long Island Sound, including a three-month moratorium on all lobster fishing in 2013.

Tetra Tech (2014) conducted a fishing activity survey for finfish and shellfish. The survey was offered in several formats (web, phone, social media, hardcopy) and made available to individuals and various user groups with multiple members. Respondents listed summer flounder and striped bass as important target species within the ZSF (Table 4-30).

Table 4-30. Targeted Fish and Shellfish Species in the ZSF based on Fishing Activity Survey

Target Species	**Relative Fishing Effort** (percent)		
	Commercial	**Charter/Party**	**Recreational**
Summer flounder	18	15	28
Striped bass	11	29	28
Bluefish	5	14	14
Tautog	18	14	11
Scup	11	12	7
Black sea bass	13	8	3
False albacore	--	--	2
All other local fish	5	5	<1
Mollusks	3	--	2
Weakfish	--	--	1
Lobster	--	2	1
Squid	5	--	--
Blowfish (pufferfish)	--	--	<1
Kingfish	--	--	<1
Shark	--	--	<1
Spanish mackerel	--	--	<1
Winter flounder	--	--	<1
Tilefish	--	2	--
Tuna	--	2	--
Butterfish	3	--	--
Whiting/silver hake	3	--	--
Atlantic herring	3	--	--
Atlantic mackerel	3	--	--

Source: Tetra Tech, 2014

Alternative Sites. Commercial fishing for each alternative site is as follows, based on the fishing activity survey by Tetra Tech (2014):

- **New London Alternative:** Only one of the commercial respondent to the fishing activity survey fished near the NLDS occasionally or regularly; other respondents either did not know or did not fish at dredged material disposal sites. The NLDS is classified as a prohibited shellfishing area in the State of Connecticut.
- **Niantic Bay Alternative:** The site was not mentioned by commercial respondents.
- **Cornfield Shoals Alternative:** None of the respondents to the survey fished near the CSDS. The site is a classified as a prohibited shellfishing area in the State of Connecticut.

Though the data are limited, the CTDEEP trawl data collected for this SEIS (see Section 4.10.3) indicated that of the species most often targeted by commercial fisherman (Table 4-30; greater than 10% relative fishing effort) only scup was found abundantly near any of the alternative sites (New London and Niantic Bay Alternatives). This may explain in part why few respondents indicated they fish at the alternative sites.

Recreational Fisheries. Recreational fishing is an important activity in Long Island Sound and nearby areas, including Block Island Sound and the Atlantic Ocean, which are more accessible to certain communities such as Montauk, New York. A large portion of the recreational fishing activity occurs between the spring and fall months when weather and water temperatures are most favorable (Tetra Tech, 2014). During these months, offshore angling is concentrated around ledges, shoals, banks, and other places where habitat and depth changes induce fish to congregate.

Fishing in the ZSF may be done from shore or from boats, and the analysis of recreational boating indicates that fishing is the most common type of recreational boating activity (Connelly et al., 2004). In addition to private boats, communities offer numerous charter boats that are available to small groups of fishermen and larger party boats that offer fishing trips to individuals who are not part of a group.

The NMFS Marine Recreational Information Program (MRIP) provides state-wide estimates of recreational fishing "effort" and catch data. Effort is in terms of angler trips and can be stratified by fishing area (ocean greater or less than 3 miles offshore and inland) and by the fishing mode. The number of angler trips for the three states in the ZSF in 2013 is shown in Table 4-31. These data are state-wide, so they are not limited to the ZSF, although they do represent ocean fishing areas and not inland lakes or waterways. While the data are not exclusively focused on the ZSF, they still provide an indication of the overall level of fishing activity and the relative importance of recreational boating and shore fishing modes. Each fishing mode contributes to the regional economy in different ways and to different degrees. While shore-based fishing does not depend on dredging to maintain harbor channels, dredging is important for many recreational fishing boats.

Table 4-31. Angler Trips in Open Water by Fishing Mode and State, 2013

Mode	Connecticut		New York		Rhode Island	
	Angler Trips	Percent	Angler Trips	Percent	Angler Trips	Percent
Shore	3,314	1.4	412,783	34.5	285,704	55.8
Party Boat	109	0.1	104,402	8.7	16,930	3.3
Charter Boat	3,817	1.6	112,638	9.4	14,857	2.9
Private/Rental Boat	229,300	96.9	568,162	47.4	194,864	38.0
Total – All Modes	**236,540**	100%	**1,197,985**	100%	**512,355**	100%

Source: NMFS, 2014e

The types of fish caught by recreational fishermen are more consistent among the three states than for the commercial catch. Bluefish and striped bass are the predominant species in all of the states, followed by scup and summer flounder. Together, these four species represent 89% of the recreational catch in Connecticut, 86% in New York and 77% in Rhode Island (Table 4-32).

Table 4-32. Annual Recreational Fish Landings by State for Most Significant Species

Species	Connecticut		New York		Rhode Island	
	Pounds (million)	**Percent of Total**	**Pounds** (million)	**Percent of Total**	**Pounds** (million)	**Percent of Total**
Bluefish	4.19	44	3.68	24	1.38	19
Striped Bass	2.29	24	6.82	44	3.0	41
Scup	1.10	12	1.11	7	0.89	12
Summer Flounder	0.89	9	1.69	11	0.34	5
Others	1.01	11	2.28	14	1.63	23
Total - All Species	**9.48**	100%	**15.60**	100%	**7.25**	100%

Source: NMFS, 2014e

Recreational fishing activities in Long Island Sound and Block Island Sound have long supported the local socioeconomic framework of many coastal towns and cities throughout the area. This includes direct money spent on fishing gear, bait, and charter/party boats by both in-state and out-of-state fishermen, and the indirect money out-of-state anglers spend on food, lodging, and shopping while in-state, among others. Expenditure patterns are reviewed in greater detail in Section 4.15.3, Recreational Activities and Beaches, which covers recreational boating.

Alternative Sites. Recreational fishing for each alternative site is as follows, based on the fishing activity survey by Tetra Tech (2014):

- **New London Alternative:** Some of the respondents occasionally fished near the NLDS for finfish. The NLDS is classified as a prohibited shellfishing area in the State of Connecticut.
- **Niantic Bay Alternative:** The site was not mentioned by respondents.
- **Cornfield Shoals Alternative:** None of the respondents to the survey fished near CSDS. The site is a classified as a prohibited shellfishing area in the State of Connecticut.

As also applies to commercial fishing (Section 4.15.1), the CTDEEP trawl data indicated that none of the species most often targeted by recreational fishermen were found to be abundant at any of the alternative sites. This may explain, in part, why few respondents indicated they fish at the alternative sites.

4.15.2 Commercial Navigation

The navigation routes and traffic density of commercial shipping in the ZSF are shown below in Figure 4-48. Much of the traffic occurs in an east-west direction, through the center of Long Island Sound and along the northern part of Block Island Sound. Some of the vessel traffic passes through the ZSF to access ports in central or western Long Island Sound.

Navigation-dependent activities are important to the economies of New York and Connecticut. These industries require dredging and the affordable disposal of dredged material for their continued economic vitality.

The only major commercial cargo port within the ZSF is in New London, Connecticut. In 2012, New London was the smallest of Connecticut's ports in terms of cargo volume (USACE, 2012). Specifically, that year, New London handled 438,000 tons of foreign and domestic freight traffic, representing 4.2% of the 10.3 million tons total for deepwater commercial ports in Connecticut. The other Connecticut ports are located to the west, outside the ZSF. In 2012, New Haven accounted for 75.6% of the state's waterborne cargo tonnage, Bridgeport had 15.4% and the Port of Stamford captured 4.8% of the state total.

New London's cargo tonnage has declined over the last decade, particularly since 2009, after a period of relative stability at around 1.5 million tons from 2003 to 2006. The shipments are primarily domestic, with foreign cargo representing 28% and domestic 72% in 2012. The cargo is also concentrated in three commodity groups: petroleum and petroleum products (55%), primary iron and steel products (21%), and primary non-ferrous metal products (7%).

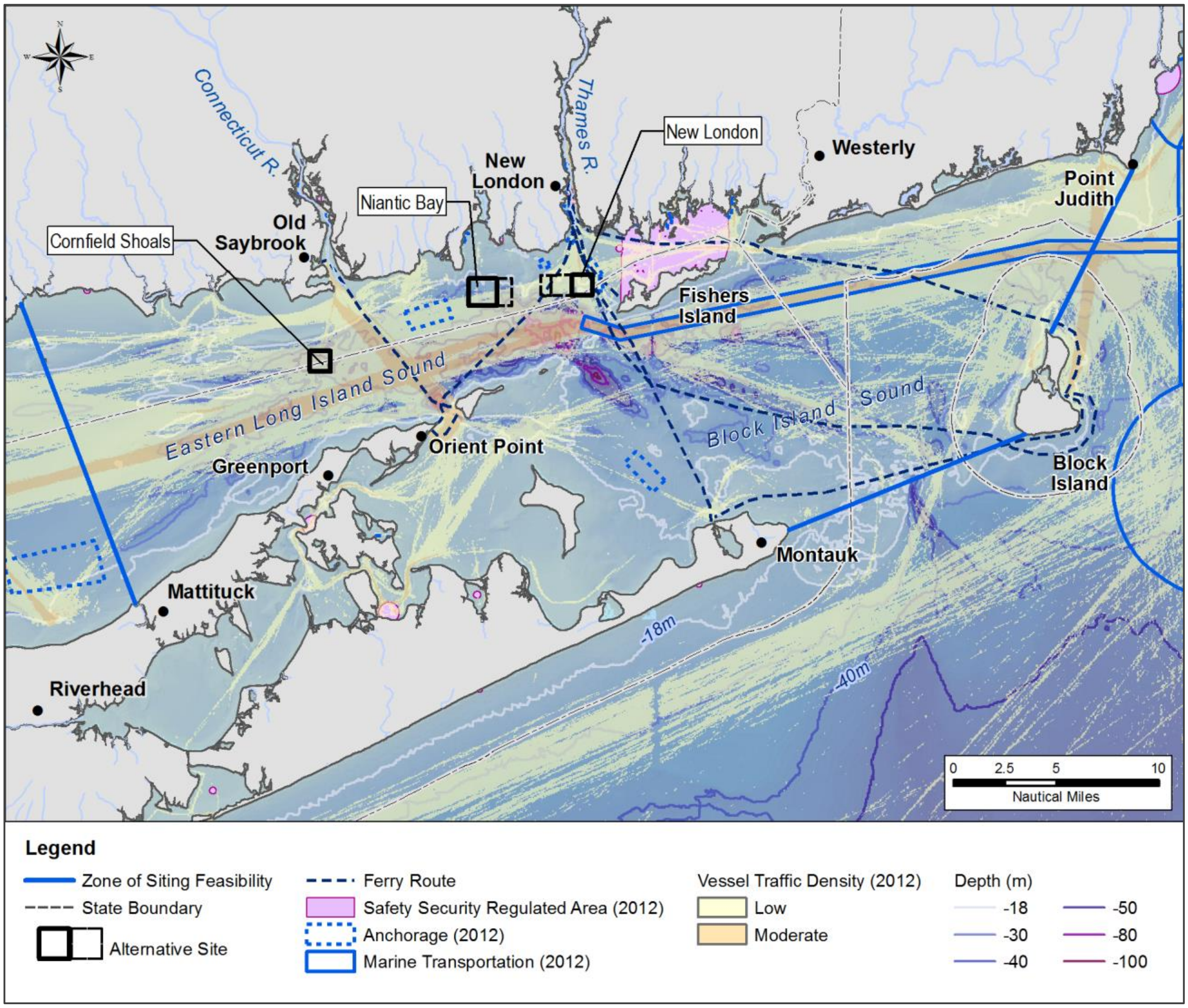

Figure 4-48. Marine transportation routes, anchorage areas, and density of commercial vessel traffic (Data Sources: U.S. Coast Guard, 2012, and NOAA GIS data base).

In their report on waterborne cargo including trips and drafts, USACE (2012) reported a total of 6,727 vessel and barge trips to and from New London harbor. Nearly all of these trips (*i.e.*, 6,684 trips) were domestic, while only 43 trips had foreign registrations. The majority of vessels (*i.e.*, 6,689 vessels) also reported relatively shallow drafts of 18 feet (5.5 m) or less. Only 38 vessels or barges reported drafts of 20 to 33 feet (5.5 to 10 m).

The federal channel in New London Harbor has an authorized depth (under the USACE civil works program) of 33 feet (10 m) up to the Railroad Bridge, and then 25 feet (7.6 m) in the Thames River up to Norwich. Branch channels, maneuvering areas and anchorages of 23 feet (7 m) are provided along the New London waterfront, and 15 feet (4.6 m) in Shaw's Cove. The U.S. Navy has deepened the main channel from the Sound through the harbor to the railroad bridge to 40 feet (12.2 m), and then upriver to the Submarine Base in Groton to 39 and 36 feet (11.9 and 11.0 m).

The USACE and the Navy jointly maintain the 40- and 39-foot depths. The U.S. Navy helps maintain the deeper channel because of the presence of the U.S. Navy Submarine Base in Groton, on the east side of the river approximately 2.5 nmi (4.6 km) north of New London. The head of navigation on the Thames River is at Norwich, approximately 10 nmi (18 km) upriver from New London. Freight traffic on the Thames River has consisted primarily of coal and petroleum products (Table 4-33).

Table 4-33. Thames River and Connecticut River Freight Traffic, 2008-2012

Year	**Freight Traffic** (short tons)	
	Thames River	**Connecticut River**
2008	844,000	32,000
2009	712,000	20,000
2010	689,000	14,000
2011	134,000	0
2012	73,000	0

Sources: USACE, 2008, 2009, 2010a, 2011a, 2012

Historically there has been a small amount of commercial cargo on the Connecticut River south of Hartford, consisting primarily of petroleum products and chemicals, but there has been no waterborne commerce on this waterway recently. The Connecticut River is navigable with a federal channel authorized at a 15-foot (4.6-m) depth for 45 miles (72 km) from the river mouth at Long Island Sound to Hartford. This depth is suitable for relatively small coastal barges, but not for most oceangoing vessels. NOAA (2015a) reports that the Connecticut River has more than 20 piers and wharves, but the only remaining commercial docks in Hartford are a bulk fuel facility at the Hartford Electric Light Company power plant and a barge unloading facility for the Hartford Gas Company. Freight traffic on the Connecticut River is considerable less than on the Thames River.

The NLDS is bisected by a 1,000-feet (300-m) wide submarine transit corridor that was established to minimize conflicts between disposal buoy positions and submarine traffic to and from the Submarine Base in Groton, Connecticut (see Figure 4-4). Mounds under the transit corridor have been managed to maintain a minimum water depth of 46 feet (14 m) (USACE, 2001c).

Cargo Facilities. The CTDOT owns two major pier structures in the Port of New London: the Admiral Harold E. Shear State Pier (State Pier) and the Long Dock (also known as the Central Vermont Railroad Pier) (Moffatt & Nichol, 2012). The State Pier is operated by Logistec U.S.A. Inc., and is used for receipt and shipment of general cargo, copper, zinc, steel and wood products. It is approximately 1,000 feet (300 m) long and 200 feet (61 m) wide, with water depths of 35 feet (10.7 m) at the eastern berth and 30 feet (9.1 m) at the western berth. The Long Dock has some structural deficiencies and is limited in berthing and utilization. It can be used for berthing of barges, but is primarily used by shallow draft fishing vessels.

There are a number of private terminals with piers in New London and further up the Thames River that are used primarily for receipt of petroleum and other liquid bulk products, as well as some dry bulk products, such as coal:

- Amerada Hess Corp. operates a pier on the east side of the river for receipt and shipment of petroleum products, receipt of molasses and for bunkering vessels.
- Pfizer has a plant in Groton located south of the General Dynamics Electric Boat shipyard. This facility has a 360-foot (110-m) long berth with a water depth alongside of 20 feet (6.1 m), which is used for the receipt of fuel oil for plant consumption.
- Dow Chemical Co. has a facility for the receipt of liquid chemicals at Allyn Point in the Town of Gales Ferry, about 5 nmi (9.3 km) upriver from New London.
- DDLC Energy, a heating oil supplier, receives petroleum products by barge at a facility at Horton Point in the Town of Uncasville, with a 225-foot (69-m) long pier with a water depth of 13 to 14 feet (4.0 to 4.3 m).
- NRG operates a power plant in the Town of Montville that has a dock for receipt of petroleum products and coal. Moffatt & Nichol (2012) reports that this dock is 350 feet (107 m) long with a water depth alongside of 19 feet (5.8 m).

Shipbuilding and Repair. General Dynamics Electric Boat is one of two large contractors that have built nuclear submarines for the U.S. Navy. The other one is Newport News Shipbuilding of Virginia. Navy orders for submarine construction have generally been divided evenly between the two contractors. The Electric Boat shipyard is located on the east side of the river in the Town of Groton. It continues to provide maintenance and repairs to submarines and other Navy ships, and it is one of the largest employers in Connecticut.

The Thames Shipyard in New London has two drydocks with new-building and maintenance capabilities for all types of commercial vessels. One of the drydocks has a capacity for ships up to 400 feet (122 m) in length and 10,000 tons displacement, while the other can serve ships up to 150 feet (46 m) and 1,000 tons. This facility provides shipbuilding/repair and maintenance services for the Cross Sound Ferry and maintenance for other regional ferry services. Thames Shipyard has provided maintenance support for the U.S. Navy Submarine Base in Groton and the Electric Boat shipyard, as well as maintaining New London’s tug fleet.

Ferries. The Cross Sound Ferry provides a passenger and vehicle ferry service between New London and Orient Point, New York, on the eastern north fork of Long Island. The company operates a fleet of seven vehicle-passenger ferries and one high-speed passenger-only ferry. In New London, the ferry pier is located in the downtown area just below the state piers.

The Block Island Express provides passenger-only service to Block Island, Rhode Island from the same New London location.

Viking Fleet Interstate Fast Ferry also operates a limited schedule of passenger-only trips between New London and Montauk, using the Cross Sound Ferry dock in New London. Viking Fleet is based in Montauk and its passenger ferry schedule connects Montauk with several destinations during the summer season, including New London, Block Island, and Martha's Vineyard (Massachusetts).

The Fishers Island Ferry District operates a service with two vessels connecting New London with Fishers Island. There is also a ferry connection to Plum Island, New York, from Old Saybrook or from Orient Point.

Military. The U.S. Coast Guard Academy is located on the west side of the Thames River about 1 nmi (1.8 km) north of the center of New London. The Academy has a 410-foot (125-m) long pier that is the home berth of the *USCGC Eagle*, a sailing vessel used as a training cutter for future officers of the U.S. Coast Guard. Water depths along the pier were reported in 2005 as 30 to 34 feet (9 to 10 m) (NOAA, 2015a).

The U.S. Navy Submarine Base is on the east side of the Thames River about 2.5 nmi (4.6 km) upriver from New London. It has 10 piers with the capacity to berth 18 submarines. It serves as home port for 15 attack submarines. The base occupies approximately 500 acres (2 km^2) and has over 400 buildings, with the housing and support facilities for 10,000 active duty and civilian workers and their families.

Alternative Sites. Commercial navigation at each alternative site is as follows (Figure 4-48):

- **New London Alternative:** Vessels approaching New London from the open ocean will pass through The Race between Fishers Island and Little Gull Island. Turning to the north, vessels would then pass near the center or over the western portion of the alternative site, well away from the anchorage areas. Submarines presumably use the 1,000-feet (300-m) submarine transit corridor crossing the center of the NLDS. The ferries between New London and Orient Point, New York approach the mouth of the Thames River from the southwest and cross over Sites NL-Wa or NL-Wb.

- **Niantic Bay Alternative:** Vessels accessing New London and the Thames River from the Atlantic Ocean or from Orient Point would pass well to the east of the Niantic Bay Alternative. Most commercial shipping traffic between eastern Long Island Sound and ports in central and western Long Island Sound passes south of the Niantic Bay site.

- **Cornfield Shoals Alternative:** The site is located to the north of the prevalent shipping route along the central axis of Long Island Sound and to the west of the route between Old Saybrook and Orient Point.

4.15.3 Recreational Activities and Beaches

Recreational activities are plentiful in the ZSF and include swimming, diving, and sunbathing. Diving is also a popular activity in Long Island Sound and takes place in the sheltered waters of the Sound around reefs and in areas where clearer water can be found (USACE, 1981; WHG, 2010c). A 1990 study (reported in LISS, 2015d) estimated the direct and indirect effects from water-dependent uses in all of Long Island Sound with $5.2 billion (Table 4-34). Direct effects pertain to recreational expenditures made by the activity participant, such as for restaurants, lodging, transportation, and the purchase of equipment. Indirect effects pertain to the multiplier (or "ripple effect") on the economy. Although the data are older, they still demonstrate the significance of water-dependent recreational uses to the economy of communities surrounding Long Island Sound, with recreational boating being the predominant component. This section describes recreational boating and beaches in the eastern Long Island Sound region; recreational fishing in the ZSF was addressed in Section 4.15.1.

Table 4-34. Value of Main Water-dependent Recreational Uses of Long Island Sound

Water-Dependent Use	Direct Effect	Indirect Effect	Total
	(in millions; 1990 dollars)		
Recreational Boating	$99	$3,223	$3,322
Swimming	$182	$661	$843
Recreational Fishing	$22	$1,043	$1,065
Total	**$303**	**$4,927**	**$5,230**

Source: Prepared in 1990 by Dr. Marilyn Altobello, University of Connecticut, as reported in LISS (2015d).

Recreational Boating. Recreational boating includes vessels engaged in sport fishing, sailing, motoring, and ferry activity. Other recreational navigation includes single-day and multi-day trips on both sail and motor operated vessels that most often occur during the months of May through September. There are approximately 150 marinas surrounding Long Island Sound, about evenly split between Connecticut and New York (Sail-the-Net, 2015).

WHG (2010c) allocated the regional economic impact of recreational boating activity within Long Island Sound to individual waterways on the basis of the number of marina slips and moorings located in each waterway. An analysis of this data produces an estimate of 15,500 slips and moorings within the ZSF. Of this total, approximately 450 slips are located in western Rhode Island, 11,350 in eastern Connecticut and 3,700 in eastern Long Island. Based on boat registrations data available for Connecticut (CTDEEP, 2012) and on boating data for the State of New York (Connelly et al., 2004), it is estimated that approximately the same number of (mostly smaller) recreational boats are trailered to boat launches (rather than permanently moored during the boating season).

On the Connecticut coast, the major activity centers for boating and recreational fishing in the ZSF are located in harbors and tributaries in Guilford, Clinton/Westbrook, the Connecticut River, Niantic, New London and the Thames River, and Fishers Island Sound/Little Narragansett Bay. The Fishers Island Sound/Little Narragansett Bay area includes harbors on Fishers Island, New York and along the Pawcatuck River up to Westerly, Rhode Island. In Block Island Sound, the major activity centers for boating and recreational fishing are located in harbors in Montauk Lake, Orient Point, Greenport and Fishers Island, New York. Recreational boating (Figure 4-49) occurs closer to shore than commercial navigation. The density of recreational boating is higher in more populated areas and along larger waterways and corridors that connect coastal communities.

Beaches. Beaches are located throughout eastern Long Island Sound along the shores of Connecticut and New York. Beaches are listed in Table 4-35 and mapped on Figure 4-50; additional beaches are located in state parks (see Section 4.15.4).

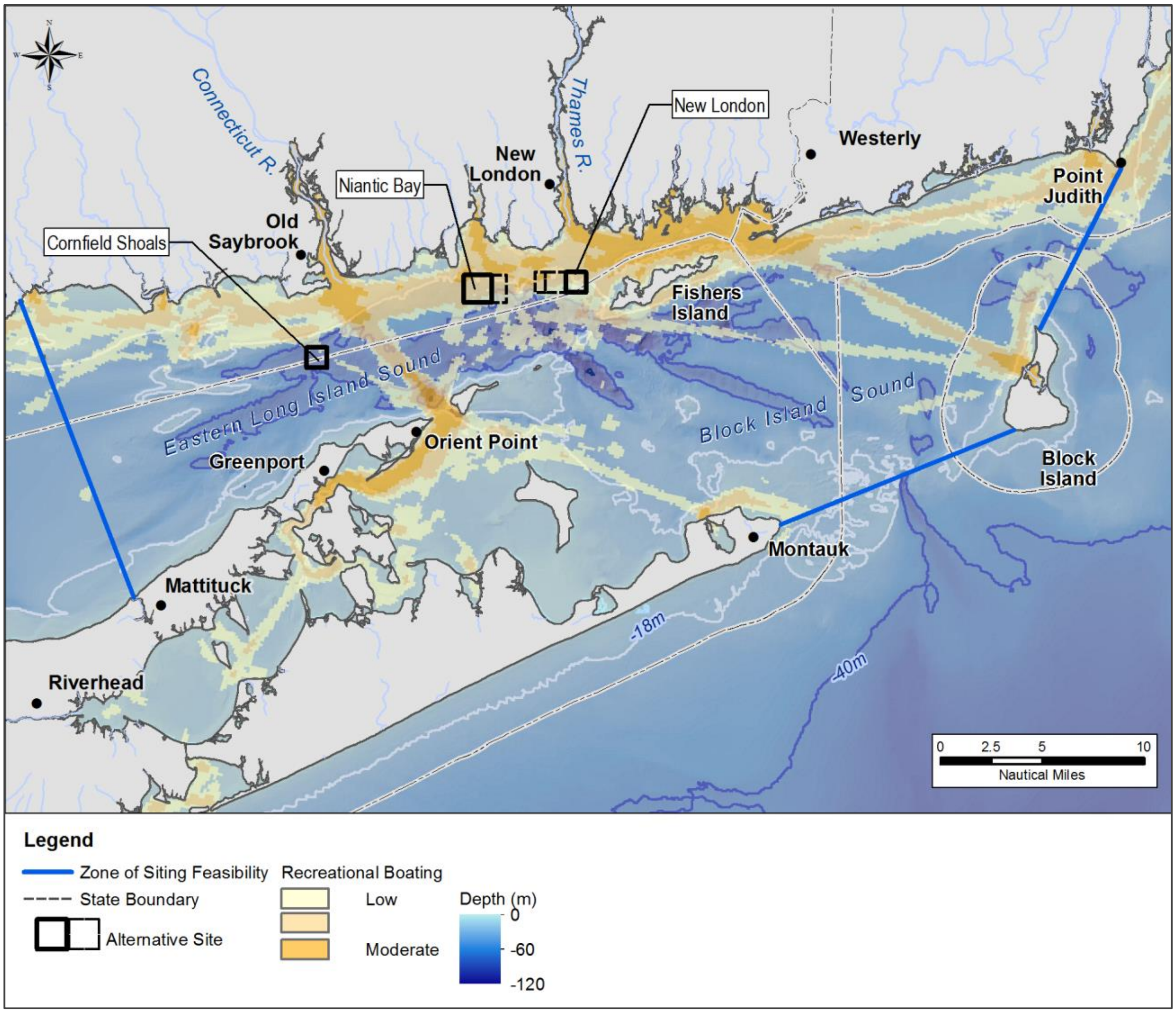

Figure 4-49. Recreational boating density (Data sources: State GIS data bases [CTDEEP, 2014c; NYSDOS, 2013; RIGIS, 2011]; NROC, 2012).

Table 4-35. State and Town Beaches in Eastern Long Island Sound

(Federal and State Parks and Areas of Special Concern are provided in Table 4-36)

ID[1]	Name	Location	Closest Alternative Site
Connecticut			
1	Clinton Town Beach	Clinton	Cornfield Shoals
2	Esker Point Beach	Groton	New London
3	Guilford Point Beach	Guilford	Cornfield Shoals
4	Jacobs Beach	Guilford	Cornfield Shoals
5	Shell Beach	Guilford	Cornfield Shoals
6	East Wharf Beach	Madison	Cornfield Shoals
7	Green Harbor Beach	New London	New London
8	White Sands Beach	Old Lyme	Cornfield Shoals
9	Harvey's Beach	Old Saybrook	Cornfield Shoals
10	Old Saybrook Town Beach	Old Saybrook	Cornfield Shoals
11	DuBois Beach	Stonington	New London
12	White Beach	Stonington	New London
13	Pleasure Beach	Waterford	Niantic Bay
14	Middle Beach	Westbrook	Cornfield Shoals
15	West Beach	Westbrook	Cornfield Shoals
16	Westbrook Town Beach	Westbrook	Cornfield Shoals
New York State			
17	Fishers Island Beaches	Fishers Island	New London
18	Bailie's Beach	Mattituck	Cornfield Shoals
19	Breakwater Park Beach	Mattituck	Cornfield Shoals
20	Town Beach	Southold	Cornfield Shoals

[1] ID of beach as used in Figure 4-50.

Sources: CTDEEP (1997, 2004, 2010, 2011); NYSDEC (2013); Suffolk County (2011); WHG (2012a)

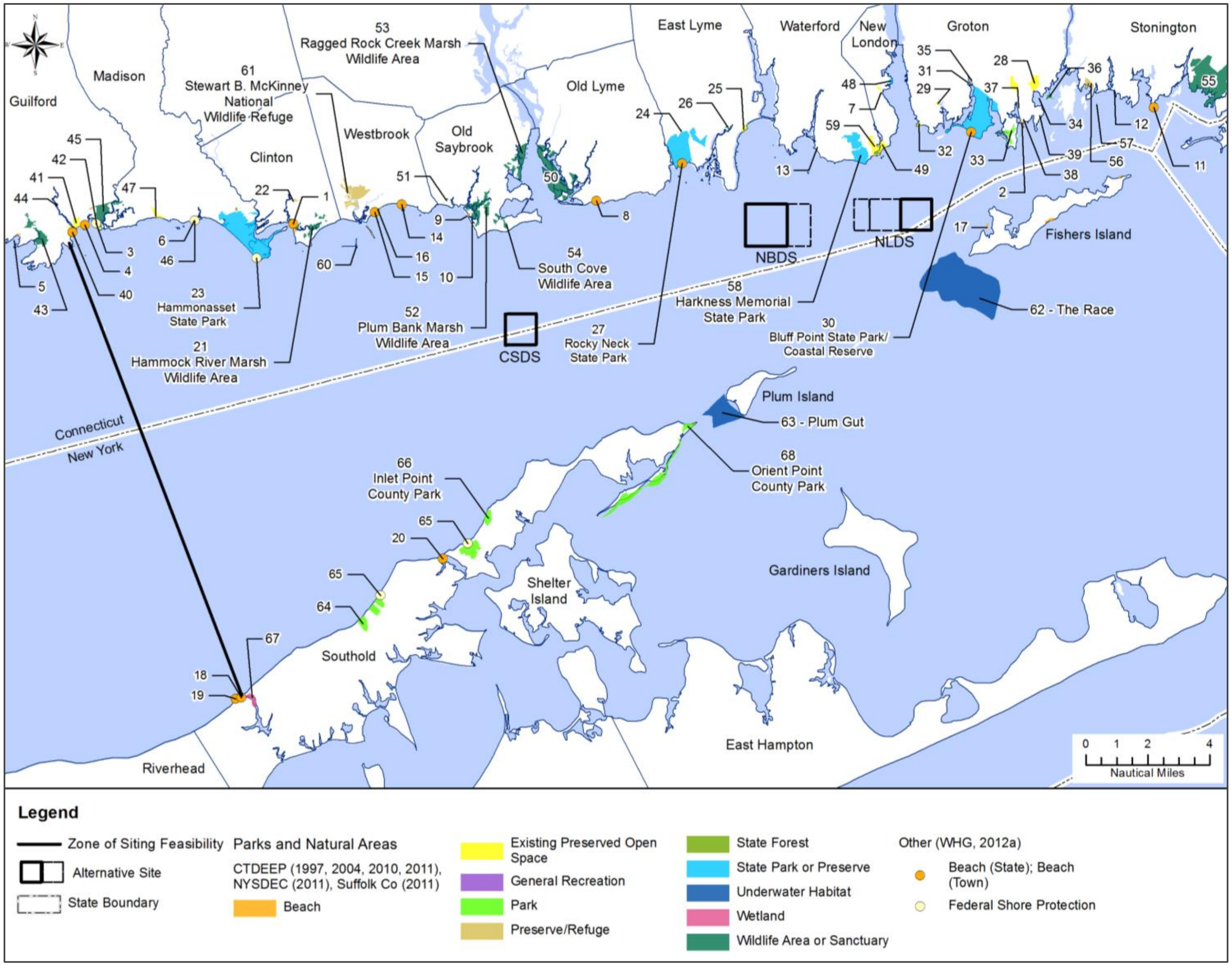

Figure 4-50. State and town beaches, federal and state parks and areas of special concern in eastern Long Island Sound.

Alternative Sites. Recreational activities and beaches near the three Alternatives are as follows*:*

- **New London Alternative:** The closest beaches to the New London Alternative are located along the western shore of Fishers Island at a distance of approximately 1.7 nmi (3.2 km) and in New London (Green Harbor Beach) at a distance of 3.6 nmi (6.7 km). Thames River and Fishers Island Sound to the northeast of the site are two of the more heavily trafficked boating areas in the eastern Long Island Sound region (Figure 4-49).

- **Niantic Bay Alternative:** The closest beach in Connecticut is located in Waterford (Pleasure Beach) at a distance of approximately 1.7 nmi (3.2 km). The closest beach in New York State is located along the western shore of Fishers Island at a distance of approximately 5.6 nmi (10.4 km). The recreational boating density at the Niantic Bay Alternative appears to be similar to the density the New London Alternative (Figure 4-49).

- **Cornfield Shoals Alternative:** Beaches in Connecticut closest to the Cornfield Shoals Alternative are located in Old Saybrook (Harvey's Beach) at a distance of approximately 3.4 nmi (6.3 km), and in Westbrook (Middle Beach) at a distance of 4.8 nmi (8.9 km). The closest beach in New York State is the Southold Town Beach at a distance of approximately 7.1 nmi (13.2 km). Recreational boating in this part of eastern Long Island Sound is concentrated along a corridor between the mouth of the Connecticut River and Orient Point on Long Island (Figure 4-49). The density of recreational boating at the Cornfields Shoals Alternative is comparatively low.

4.15.4 Parks and Natural Areas

Areas of special concern in eastern Long Island Sound include national wildlife refuges, state parks, county and city lands, and wildlife management and conservation areas. These areas are listed in Table 4-36 and included in Figure 4-50 above.

State parks in Connecticut are located throughout the eastern Long Island Sound and can be found in Clinton, East Lyme, Groton, Madison, New London and Waterford. Connecticut is also home to the USFWS' Stewart B. McKinney National Wildlife Refuge that includes holdings along the coast of southern Connecticut from Norwalk to Westbrook. Other parks in Connecticut include Bluff Point Coastal Reserve in Groton, Rock Neck State Park in East Lyme, Hammonasset Beach and Preserve in Clinton and Madison, and Harkness Memorial State Park in Waterford. Wildlife management areas and preserves can be found in Clinton, East Lyme, Groton, Guilford, Madison, Old Lyme, Old Saybrook, Stonington, and Westbrook.

In New York State, Jamesport State Park is located in Riverhead. Several county parks are located in Southold, including Goldsmith Inlet, Inlet Point, and Orient Point. The Federal Shore Protection project at Mattituck Harbor and the area currently under study for a storm damage reduction project at Hashamomuck Cove are also located in the Town of Southold.

Table 4-36. Federal and State Parks and Areas of Special Concern in Eastern Long Island Sound

ID[1]	Name	Location	Closest Alternative Site
Connecticut			
21	Hammock River Marsh Wildlife Area	Clinton	Cornfield Shoals
22	Lar Fagan Sanctuary	Clinton	Cornfield Shoals
23	Hammonasset State Park/Preserve	Clinton/Madison	Cornfield Shoals
24	Bride Brook Wildlife Sanctuary	East Lyme	Niantic Bay
25	McCook Point Park	East Lyme	Niantic Bay
26	Pattagansett River Marsh Wildlife Area	East Lyme	Niantic Bay
27	Rocky Neck State Park	East Lyme	Niantic Bay
28	Beebe Pond Park	Groton	New London
29	Birch Plain Creek Open Space (City of Groton)	Groton	New London
30	Bluff Point State Park/Coastal Reserve	Groton	New London
31	Burrows Park	Groton	New London
32	Eastern Point Beach	Groton	New London
33	Groton Long Point	Groton	New London
34	Penny Island Wildlife Area	Groton	New London
35	Poquonnock River Bank	Groton	New London
36	Six Penny Island Wildlife Area	Groton	New London
37	Tanglewood Open Space	Groton	New London
38	Tidal Marsh (Marsh Road)	Groton	New London
39	Town Waterfront	Groton	New London
44	Chaffinch Island Park	Guilford	Cornfield Shoals
41	Chittenden Park	Guilford	Cornfield Shoals
42	Grass Island	Guilford	Cornfield Shoals
43	Great Harbor Wildlife Area	Guilford	Cornfield Shoals
44	West River Marsh Wildlife Area	Guilford	Cornfield Shoals
45	East River Marsh Wildlife Area	Guilford/Madison	Cornfield Shoals
46	Federal Shore Protection	Madison	Cornfield Shoals
47	West Wharf Beach & Surf Club	Madison	Cornfield Shoals
48	Fort Trumbull State Park	New London	New London
49	Ocean Beach Park	New London	New London
50	Great Island Wildlife Area	Old Lyme	Cornfield Shoals
51	Hager Creek Marsh Wildlife Area	Old Saybrook	Cornfield Shoals
52	Plum Bank Marsh Wildlife Area	Old Saybrook	Cornfield Shoals
53	Ragged Rock Creek Marsh Wildlife Area	Old Saybrook	Cornfield Shoals
54	South Cove Wildlife Area	Old Saybrook	Cornfield Shoals
55	Barn Island Wildlife Area	Stonington	New London
56	Cottrell Marsh Preserve	Stonington	New London
57	Lydia's Island - Wilcox Preserve	Stonington	New London
58	Harkness Memorial State Park	Waterford	New London

Table 4-36. Federal and State Parks and Areas of Special Concern in Eastern Long Island Sound

ID[1]	Name	Location	Closest Alternative Site
59	Waterford Beach Park	Waterford	New London
60	Duck Island Wildlife Area	Westbrook	Cornfield Shoals
61	Stewart B. McKinney National Wildlife Refuge	Westbrook	Cornfield Shoals
New York State			
62	The Race	Fishers Island	Niantic Bay
63	Plum Gut	Orient Point	Niantic Bay
64	Goldsmith Inlet County Park	Southold	Cornfield Shoals
65	Hashamomuck Cove	Southold	Cornfield Shoals
66	Inlet Point County Park	Southold	Cornfield Shoals
67	Mattituck Harbor/Inlet Wetland	Southold	Cornfield Shoals
68	Orient Point County Park	Southold	Cornfield Shoals

[1] ID of area as used in Figure 4-50.

Sources: CTDEEP (1997, 2004, 2010, 2011); NYSDEC (2013); Suffolk County (2011); WHG (2012a)

Alternative Sites. Areas of special concern in proximity to the three alternative sites include the following:

- **New London Alternative:** Areas of special concern nearest to the New London Alternative are the Harkness Memorial State Park at a distance of approximately 1.1 nmi (2.0 km) and the Bluff Point State Park and Coastal Reserve at a distance of 2.4 nmi (4.4 km); both parks are located in Connecticut. In addition, the area is located close to The Race, which was designated by the NYSDOS in 1987 as a Significant Coastal and Fish and Wildlife Habitat. The closest distance between this designated area and the New London Alternative is approximately 0.9 nmi (1.7 km).

- **Niantic Bay Alternative:** Areas of special concern located in Connecticut nearest to the Niantic Bay Alternative are the Rocky Neck State Park at a distance of approximately 2.5 nmi (4.6 km). The distance from the alternative site to Plum Island in New York State is 4.9 nmi (9.1 km); the distance to The Race in New York is 3.8 nmi (7.0 km).

- **Cornfield Shoals Alternative:** Areas of special concern located in Connecticut nearest to the Cornfield Shoals Alternative are the Plum Bank Marsh Wildlife Area and Great Island Wildlife Area in Connecticut, and Orient Point County Park and Inlet Point County Park in New York. The Plum Bank Marsh Wildlife Area is the closest preserve at a distance of approximately 3.9 nmi (7.2 km) to the Cornfield Shoals Alternative. The closest park in New York State is the Inlet Point County Park at a distance of approximately 5.2 nmi (9.6 km).

4.15.5 Historical and Archaeological Resources

Historical and archaeological resources are protected under the National Historic Preservation Act (NHPA) of 1966 [54 U.S.C. § 300101 *et seq*.]. Under the NHPA, federal agencies must consider the effects of their undertakings on historic properties and cultural resources. Historic properties are defined as resources that are eligible for listing on the National Register of Historic Places (NRHP). The criteria for eligibility are listed in 36 C.F.R. 60.4 and include (a) association with significant events in history; (b) association with the lives of persons significant in the past; (c) embodiment of distinctive characteristics of type, period, or construction; and (d) sites or places that have yielded or are likely to yield important information (ACHP, 2012). The historic preservation review process, NHPA Section 106, is outlined in regulations the Advisory Council on Historic Preservation (ACHP) issued in 36 C.F.R. Part 800 *et seq*.

Historical and archaeological resources in the ZSF and in the vicinity of the three alternative sites were assessed based on database searches and a sidescan sonar survey:

- *NOAA:* The Automated Wrecks and Obstructions Information System (AWOIS) and Electronic Navigational Charts (ENC) databases contain all wrecks and obstructions identified by NOAA (NOAA, 2013a; 2015b). NOAA created these databases for different purposes, and as a result, not all wrecks are listed on both databases. In addition, the position and features for a particular wreck found on both NOAA databases may not necessarily agree. The wrecks in the ENC database are not numbered, and are referenced only by location. For the entire ZSF, only the NOAA AWOIS database was accessed (Figure 4-51). The NOAA AWOIS database also includes "obstructions" which typically consist of submerged rocks and boulders rather than historical and archaeological resources. Both NOAA databases were accessed for an area that included the footprint of the three alternative sites and a 0.5-nmi (0.9-km) wide zone surrounding each of the three alternative sites.

- *Connecticut State Historic Preservation Office (CT SHPO):* The Connecticut SHPO was consulted regarding known submerged resources in and within 0.5 nmi (0.9 km) of the alternative sites. The CT SHPO database also includes a number of obstructions that are recorded in the AWOIS database in addition to known shipwrecks. These obstructions were included in the CT SHPO spatial analysis to determine if spatial patterns were present in the data or if some could have been the cause of shipwrecks (Heritage Consultants, 2007). The AWOIS and CT SHPO databases use different record numbers for listed wrecks.

- *New York State Office of Parks, Recreation and Historic Preservation (NY OPRHP):* The NY OPRHP, which acts as the NY SHPO, was consulted regarding known submerged resources in and around the alternative sites that are partially located in New York State.

An archaeological survey was also conducted by the LIS DMMP (USACE and PAL, 2010). However, the survey was limited to an area of 0.5 miles (0.8 km) from shore, which was outside of the three alternative sites.

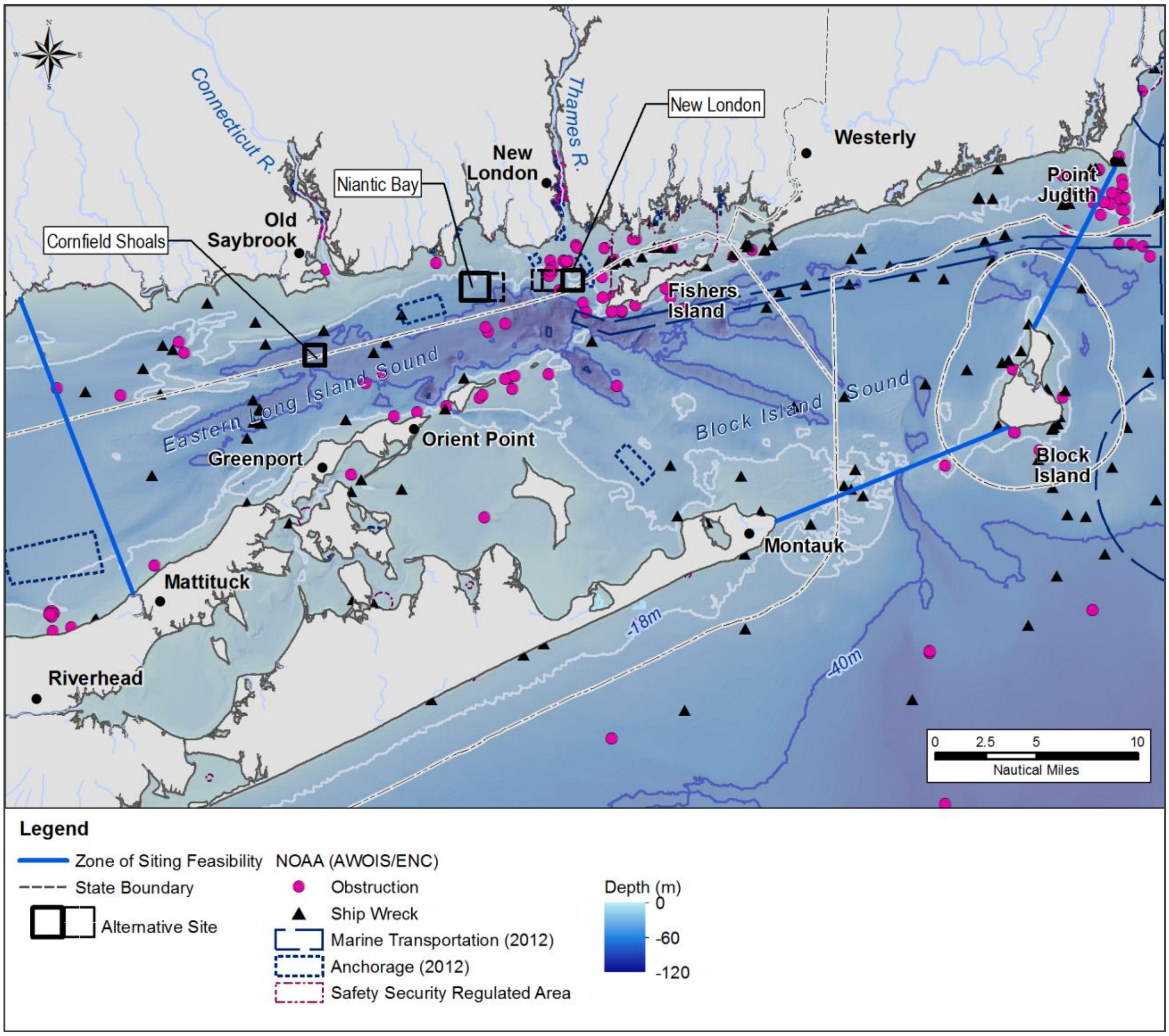

Figure 4-51. Shipwrecks and obstructions (Data source: NOAA, 2013a).

Sidescan Sonar Survey. WHG (2014) provided analysis, interpretation, and reporting of sidescan sonar data collected at 28 sites throughout the ZSF between 2007 and 2012 (the study report is included as Appendix D). The purpose of the analysis was to characterize the geology, morphology, shipwrecks, or other structures on the seafloor in the surveyed areas. Of the total of 28 individual sidescan sonar survey areas, four survey areas covered most of the New London Alternative, six survey areas covered most of the Niantic Bay Alternative, and one survey area covered the Cornfield Shoals Alternative. Only the northernmost parts of the Niantic Bay and New London Alternatives were not covered by the sidescan sonar survey; those parts are mostly shallower than 59 feet (18 m) in water depth.

Sidescan sonar is a useful tool for evaluating seafloor properties. An acoustic pulse emitted by the sonar equipment reflects back to receivers, and that information is processed to produce an image of the seafloor. WHG (2014) analyzed the sidescan sonar files to create a mosaic for each of the 28 surveyed areas. The single mosaic was then used for detailed characterization of each survey area. Within these mosaics, targets were classified according to categories approved by the USEPA. These categories were based on the marine geology and site-specific history. Targets that could not be positively identified according to specific geological, navigational, and other categories were classified as "unidentified/other." The category relevant to historical and archaeological resources was the category of "wreck." Wrecks were defined by WHG (2014) as "plotted on NOAA navigation charts; observed as an irregular reflector on the seafloor, often oblong with high backscatter."

Alternative Sites. Historical and archaeological resources within and surrounding the three alternative sites are summarized in Table 4-37 and shown in Figure 4-52. There were a total of three wrecks recorded in the databases in the searched areas. Only one of these wrecks is recorded in all three databases; the other two wrecks are recorded only in the ENC database. The survey area of the sidescan sonar survey covered the location of two of these three wrecks recorded in the databases. The third wreck, located in the 0.5-nmi (0.9-km) perimeter outside of the Cornfield Shoals Alternative was not covered by the sidescan sonar survey. The sidescan sonar survey identified one additional wreck that is not recorded in the databases. Consultation with the NY OPRHP revealed that there are no submerged vessels or historic resources within those portions of the alternative sites that are located in New York State waters (applies to the NLDS and CSDS) (Daria Merwin, NY OPRHP, email, March, 26, 2015).

- **New London Alternative:** There is one documented submerged wreck within the area of the entire New London Alternative, but no submerged wrecks in the surrounding 0.5-nmi (0.9-km) perimeter. The submerged wreck is located within Site NL-Wa (marked as T-22 in Figure 4-52) and is recorded in all databases. This wreck is an unknown vessel in 57 feet (18 m) of water and has been classified by NOAA (2015b) as "submerged/dangerous." In NOAA cartographic terminology, "wrecks are designated visible, dangerous, or non-dangerous according to whether they are above tidal datum, less than, or more than 20 m (66 feet) below tidal datum, respectively;" wrecks below the tidal datum are classified as "submerged" (NOAA, 2014a). No other information regarding this wreck (*e.g.*, age, vessel type) is available.

  There are three "obstructions" within the boulder area of Site NL-Wa. The AWOIS database lists these obstructions as rocks in water depths of 45 to 48 feet (14 to 15 m). A fourth obstruction is located on the southern boundary of Site NL-Wa. It is located at a water depth of 59 feet (18 m), and was confirmed by a private diver to be a buoy with lighting hardware removed according to the AWOIS database (NOAA, 2015b).

Table 4-37. Shipwrecks at and within 0.5 nmi of the three Alternative Sites

ID (on Fig. 4-52)	Database			Sidescan Survey	Database Record No. / Sidescan Target Number	Recorded Coordinates		Comments / Location for each Alternative
	NOAA		CT SHPO			Latitude (NAD 83)	Longitude (NAD 83)	
	AWOIS	ENC						
New London Alternative								
T-22	●				11913	41°15.936'N	72°05.292'W	Type of wreck unknown. Wreck is located inside Site NL-Wa, and within 0.1 nmi to the west of the NLDS.
		●			Unnumbered			
			●		1354			
				●	NLDNACT-T0022	41°15.930'N	72°05.280'W	
Niantic Bay Alternative								
T-44/ T-12		●			Unnumbered	41°15.276'N	72°11.982'W	The type of wreck is unknown. It is located outside of NBDS, about 0.2 nmi to the southwest.
				●	ELIS14-T0044	41°15.276'N	72°11.946'W	Several strong linear contacts at right angles. Appears to be the same wreck as wreck in ENC database.
				●	FISEHOLE6-T0012	41°15.282'N	72°11.970'W	Appears to be the same wreck as wreck in ELIS14-T0044 survey area, and as wreck in ENC database.
T-89				●	ELIS14-T0089	41°14.658'N	72°11.208'W	Semi-rectangular sonar contact. Evidence of right angles in shape. Shape, size and symmetry suggest possible shipwreck. Located about 0.5 nmi to the south of the NBDS.
Cornfield Shoals Alternative								
No ID[1]		●			Unnumbered	41°13.542'N	72°20.454'W	The type of wreck is unknown. It is located outside of the CSDS, about 0.4 nmi to the northeast.

[1] This wreck does not have an ID number. A separate graphic was not prepared for this wreck location.

Data sources: WHG, 2014; NOAA, 2015b; CT SHPO, 2015

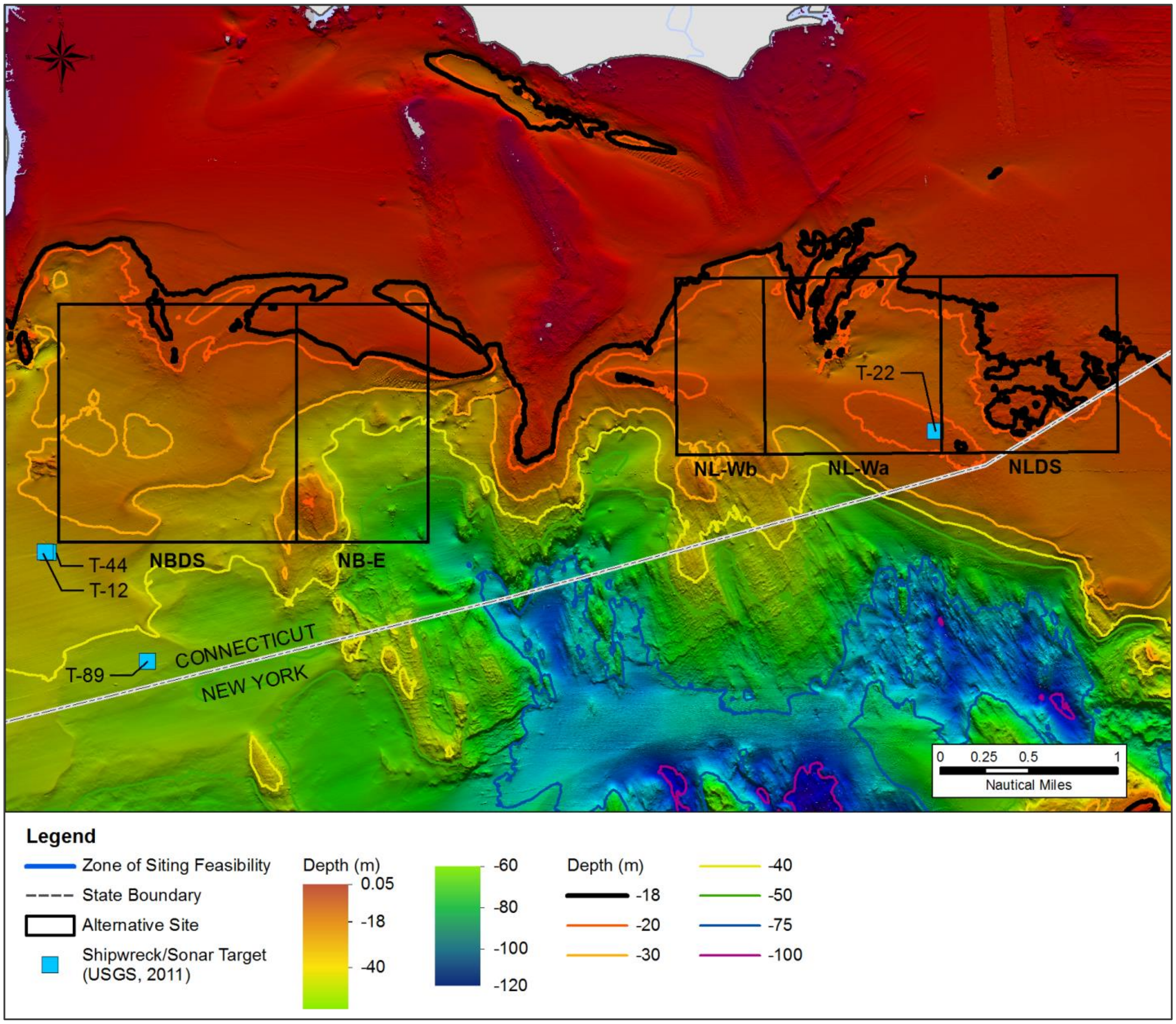

Figure 4-52. Shipwrecks identified in databases and through a sidescan sonar survey. (Sources: NOAA, 2015b; CT SHPO, 2015; WHG, 2014).

- **Niantic Bay Alternative:** There are no submerged wrecks within the entire Niantic Bay Alternative, but two submerged wrecks in the surrounding 0.5-nmi (0.9-km) perimeter. Specifically, the sidescan sonar survey identified three wrecks to the south and west of the southwestern corner of the NBDS. Two of these wrecks, T-44 and T-12, appear to be the same object; they were recorded as part of separate, but overlapping survey areas. Based on the recorded coordinates, these two wrecks are located only 115 feet (35 m) in distance from one another, and no other wrecks are nearby in either survey area. There is a wreck at this location recorded in the ENC database (but not in the AWOIS or CT SHPO databases). Unlike the AWOIS database, wrecks listed in the ENC database are unnumbered, so no other designation is available to refer to this resource. The charted wreck is classified by NOAA as "submerged/non-dangerous;" no other information is available.

The additional wreck (T-89) identified by the sidescan sonar survey does not appear to correspond to any wrecks recorded in the three databases, and no additional information is available.

- **Cornfield Shoals Alternative:** There are no known submerged wrecks within the Cornfield Shoals Alternative recorded in any of the databases or identified by the sidescan sonar survey. However, the ENC database records include a wreck approximately 0.5 nmi (0.9 km) to the northeast of the northeastern corner of the CSDS. No additional information is available about this wreck.

4.15.6 Other Human Uses

Other human uses include military use, mineral and energy development, and renewable energy development potential.

Military Use. The largest active military sites are the U.S. Navy Submarine Base in Groton, Connecticut, and the U.S. Coast Guard Academy in New London, Connecticut. The U.S. Coast Guard also maintains stations at various locations around Long Island Sound that have search and rescue capabilities and may provide lookout, communication, and/or patrol functions to assist vessels in distress. Within the ZSF, Coast Guard stations are located at Fort Trumbull in New London (Connecticut), at the east end of Fishers Island (New York; manned during summer months only), and at Montauk Point in Montauk Harbor (New York) (NOAA, 2015a). The Connecticut Military Department also operates the Camp Niantic National Guard facility, including a regional training center, in Niantic, Connecticut.

Mineral and Energy Development. The Millstone Nuclear Power Plant, operated by Dominion Resources, is located in the town of Waterford, Connecticut, and uses Niantic Bay as a source of coolant water.

Other energy resources in the ZSF include pipelines and electrical cables (Figure 4-53). Data on these resources (as well as on telephone cables) were obtained from the websites for Northeast Ocean Data (NOD, 2013) and NOAA's National Ocean Service (NOAA, 2013b). Information on cables was also reviewed using the Eastern Interconnection States' Planning Council mapping tool (EISPC, 2013), which includes transmission line data for underground transmission lines above 220 kV. In addition, targeted inquiries were made, as explained further below, to obtain up-to-date information on "cable areas" shown on current NOAA charts.

As shown on Figure 4-53, pipelines are limited to a few locations near the coast. Cables or cable areas include the following, from west to east:

- *MCI Telecommunications Corporation cable:* The fiber-optic telecommunications cable was installed in 1996 between Madison, Connecticut, and Rocky Point, Long Island.

- *Fiber-optic Link Around the Globe (FLAG) Atlantic-1 North cable:* This transatlantic communications cable was completed in 2001. It runs parallel to the long axis of Long Island Sound within New York State waters.

- *Cable areas between Fishers Island and the mainland:* Active utility cables extend from Groton Long Point to the West Harbor area of Fishers Island; the cables are owned by the Fishers Island Electric Corporation. The company does not have cables within the "cable area" marked on the NOAA chart between Avery Point and Silver Eel Cove on the western end of Fishers Island (Mr. Chris Finan, Fishers Island Electric Corporation, personal communication, January 30, 2014). However, there may be inactive cables within this corridor; in a letter from November 14, 1935, the War Department asked the U.S. Coast and Geodetic Survey to add a cable to widen a then already existing cable area for a new "military communications cable."
- *Cable areas between Fishers Island and Great Gull Island:* NOAA charts show two arc-shaped cable areas between Great Gull Island and Fishers Island. The northern arc-shaped cable area was added by NOAA after a request by the War Department to the Secretary of Commerce on March 7, 1940; the area contained a cable between Fort Wright on Fishers Island and Fort Michie on Great Gull Island. Only remnants of these forts exist today. It is not known if this cable was removed, but it does not appear to be active. Information on the southern arc-shaped cable area was not located but, if still in the ground, the cable is expected to be inactive as well. Great Gull Island is presently owned by the American Museum of Natural History. There are no utility cables that connect Great Gull Island to the mainland (Helen Hays, Great Gull Island Project, personal communication, January 30, 2013).

- *Little Gull Island:* Little Gull Island has an active light, maintained by the Coast Guard. The building is powered by solar panels. There is no active power cable going to the island (Thomas Popham, Coast Guard, Aids to Navigation Team Long Island Sound, personal communication, January 30, 2014). The lighthouse and the island were sold to Mr. Fred Plum in October 2012. There are no utility lines leading to this island (Mr. Fred Plum, email communication, January 31, 2014).

- *Fishers Island to Race Rock:* In a letter, dated December 10, 1957, the USACE asked the U.S. Coast and Geodetic Survey to add a new cable area between Silver Eel Pond on Fishers Island to Race Rock off the southwestern tip of Fishers Island to their charts. This area may contain utility cables for the lighthouse.

- *Cable area south of Fishers Island:* The cable area to the south of Fishers Island is marked "Cable Area (Hydrophones)" on NOAA charts. This area was used for hydrophone testing during World War II. Hydrophones and related infrastructure have since been removed (Roderick Rocky, Naval Undersea Warfare Center, personal communication February 12, 2014).

- *Cables in and around Block Island Sound:* Cables areas also exist between Montauk and Block Island, and between Block Island and Washington County in Rhode Island. In addition, several communications cables extend from the Rhode Island coast toward the continental shelf.

None of these cables or cable areas pass through the three alternative sites.

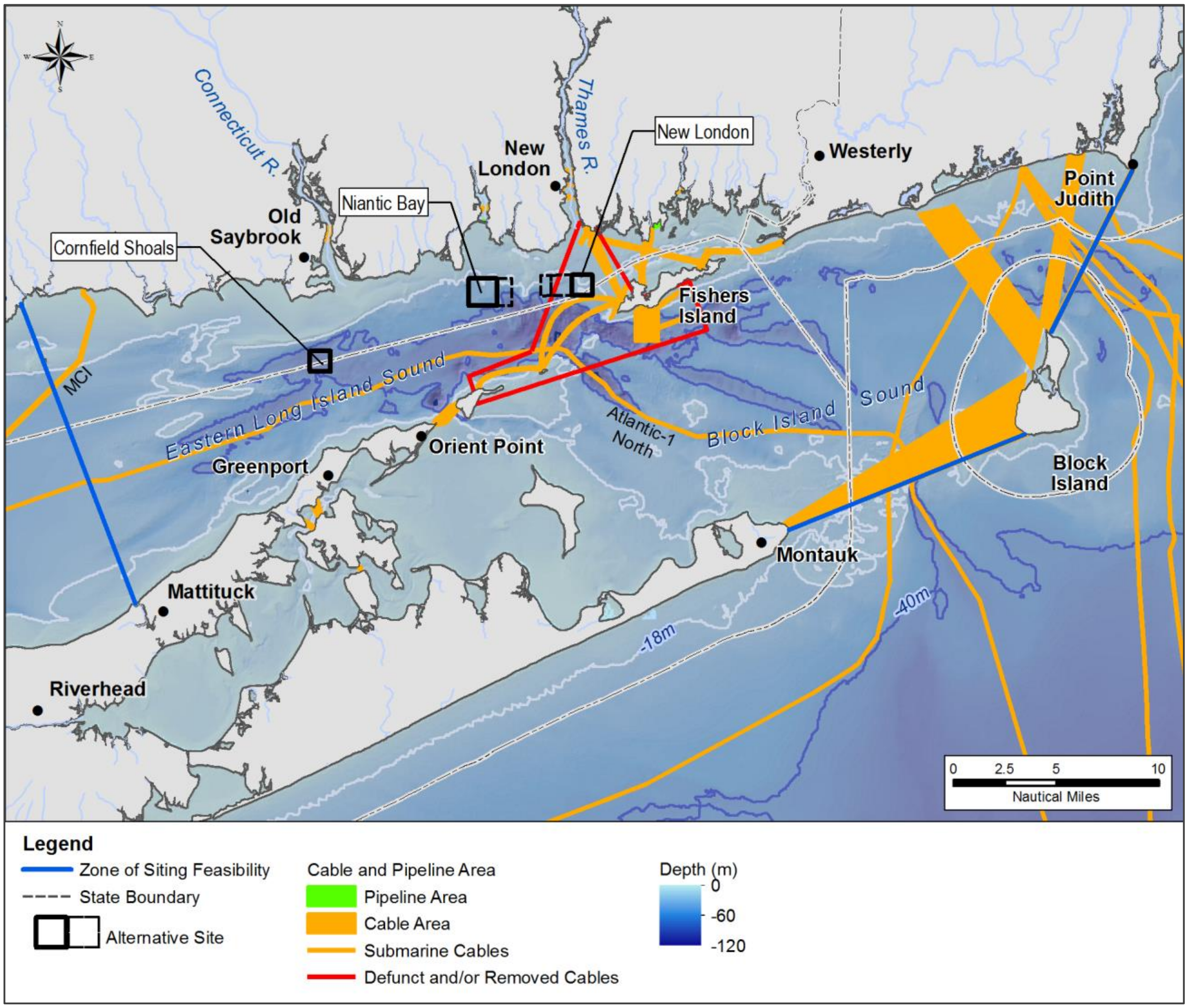

Figure 4-53. Utilities (pipelines, cables, and cable areas) (Data sources: NOD, 2013; NOAA, 2013b; EISPC, 2013). Cable areas within the red polygon near Fishers Island appear on current NOAA charts; however, inquiries indicate that either most of those no longer contain cables, or cables are no longer in use.

Renewable Energy. Other human uses of the waters in the ZSF include renewable energy generation potential. Overall the potential for renewable energy generation is low, as follows:

- *Wind energy:* Most of eastern Long Island Sound is classified by the U.S. Department of Energy (USDOE) as Wind Power Class 3 or 4; Block Island Sound is classified mostly as Class 4 or 5 (Figure 4-54). For reference, the planned offshore wind farm project currently under construction south of Block Island is located within a Class 6 area.

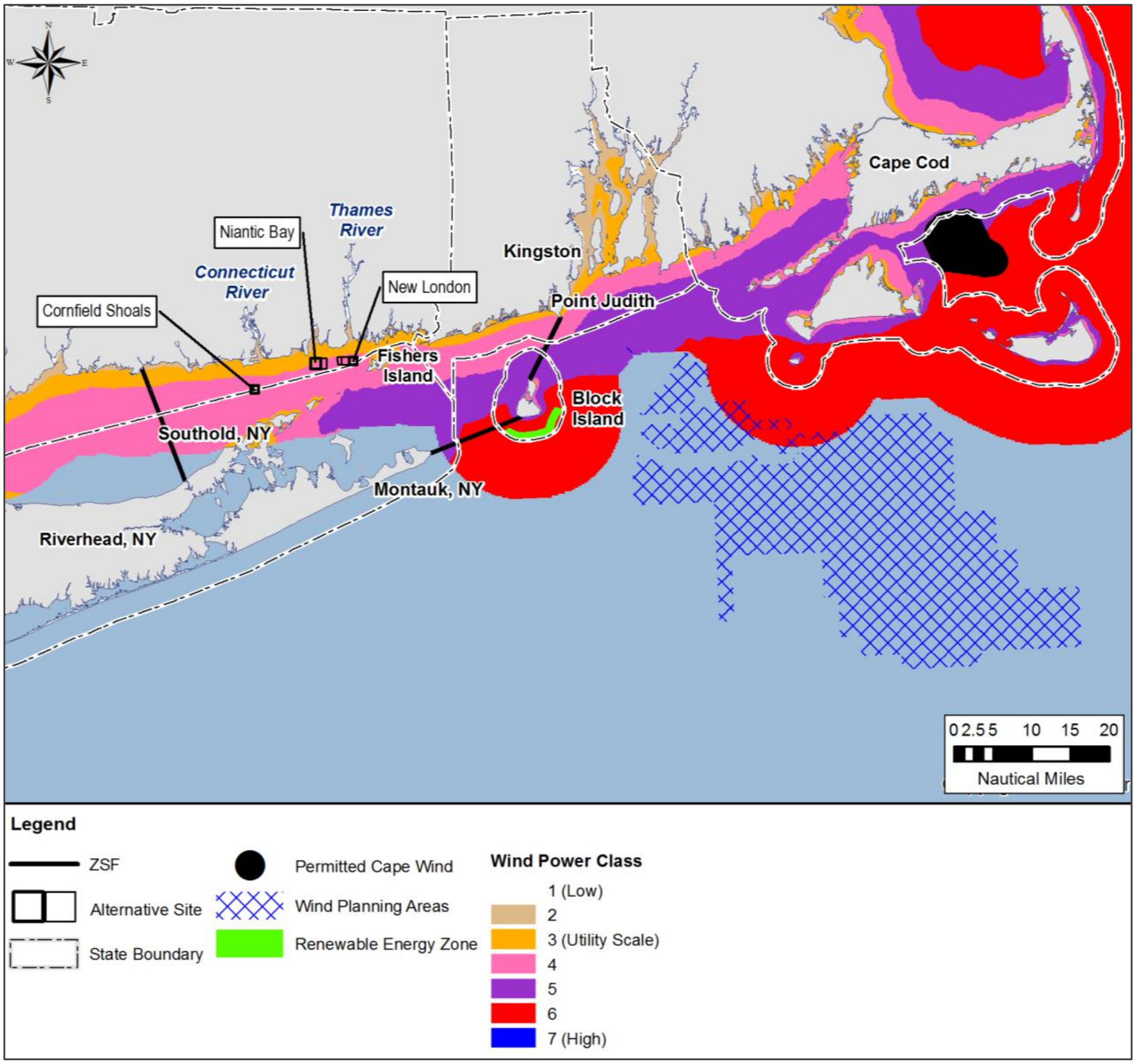

Figure 4-54. Wind energy potential in Long Island Sound, Block Island Sound, and their greater vicinity (Data source: NREL, 2013).

- *Wave energy:* All locations in the ZSF have lower wave energy potential than the nearby wide-open continental shelf of the Atlantic Ocean (Figure 4-55). The wave power density is expected to be lower in eastern Long Island Sound than in Block Island Sound due the more protected nature of eastern Long Island Sound.

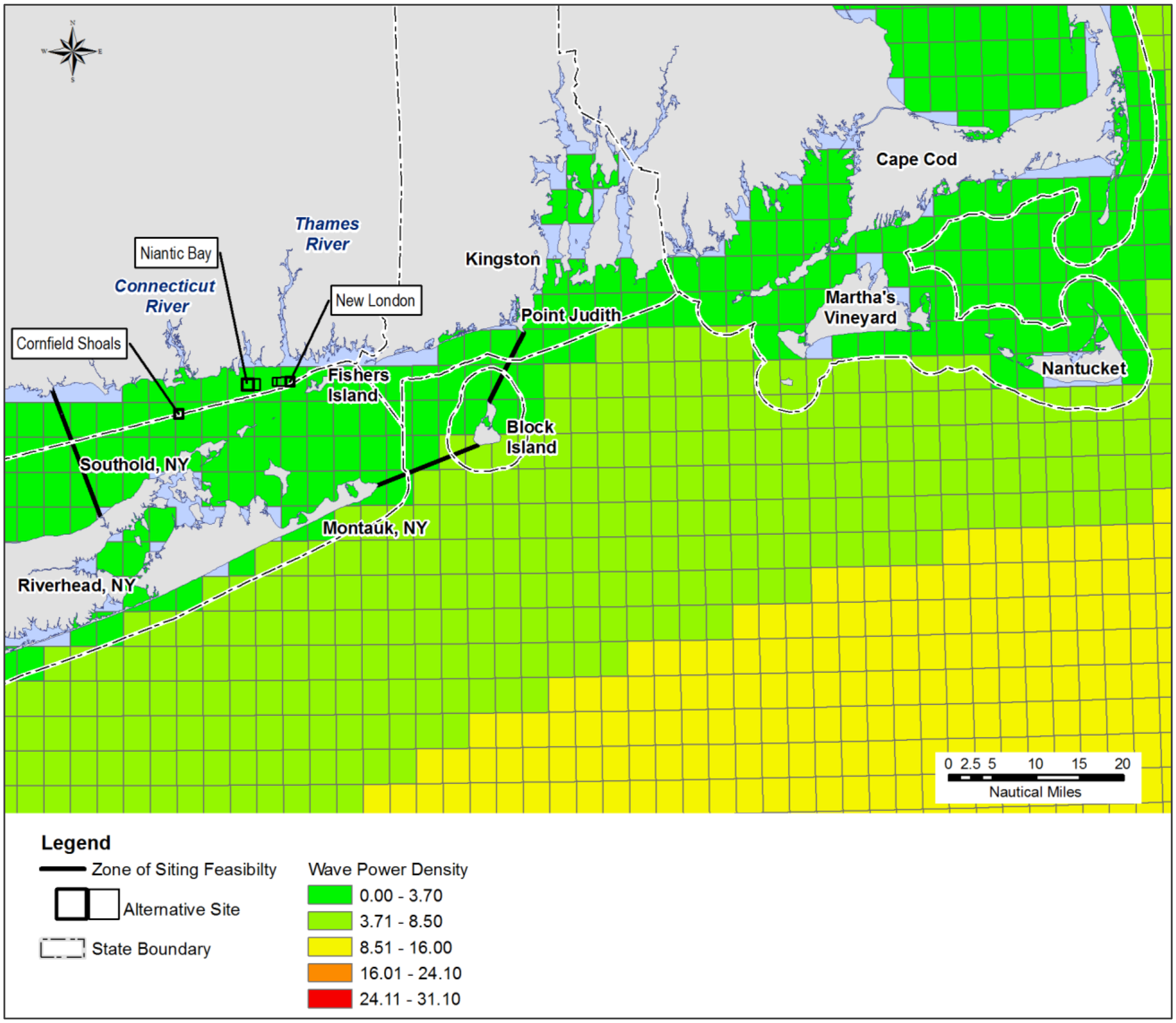

Figure 4-55. Wave energy potential in Long Island Sound, Block Island Sound, and their greater vicinity, expressed as wave power density (Data source: NOAA, 2013c).

- *Tidal energy:* The tidal energy potential, measured as mean kinetic power density, coincides with tidal current velocities. The tidal energy potential is highest in The Race, in Plum Gut, and at Montauk Point Shoals (Figure 4-56).

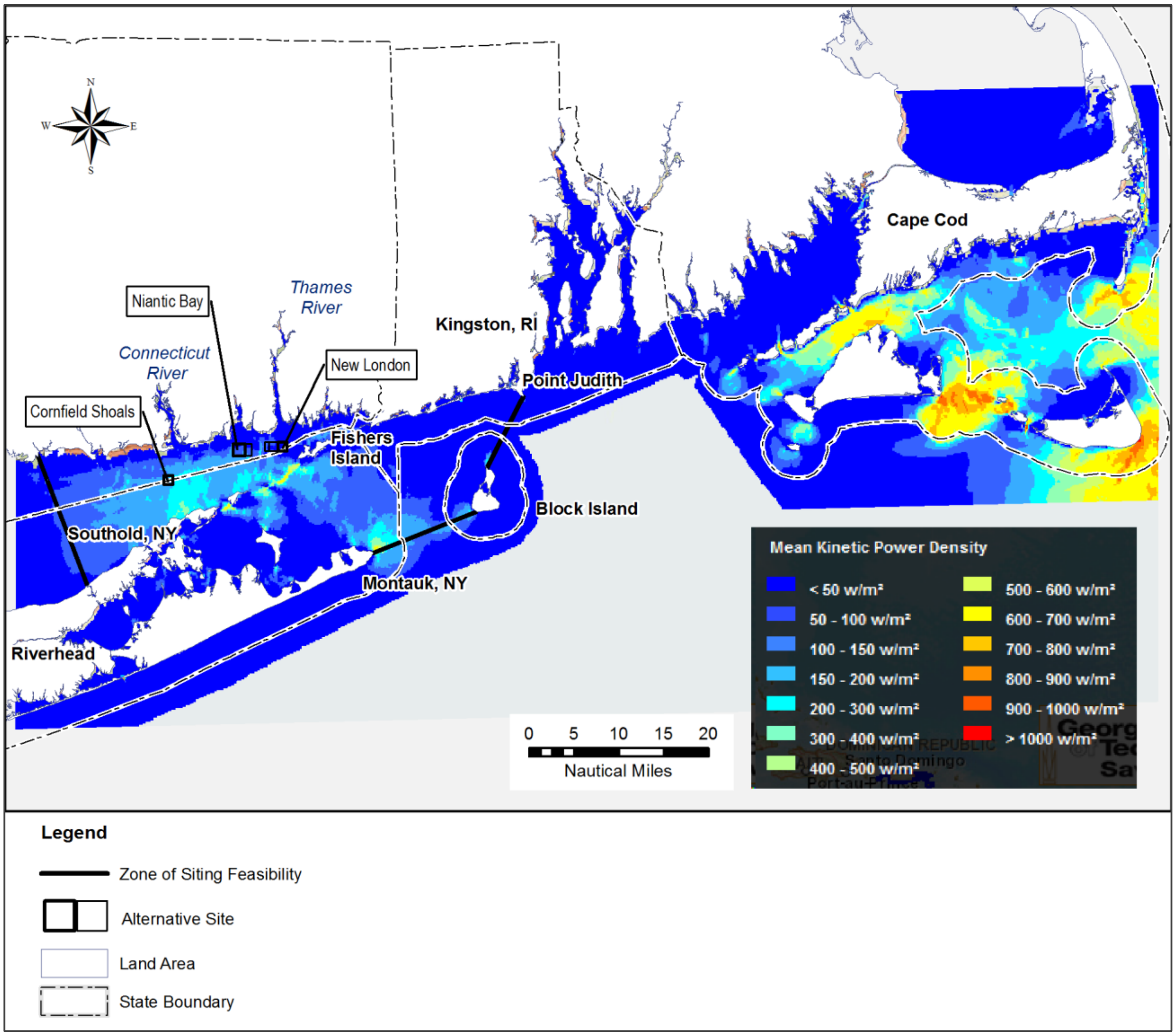

Figure 4-56. Tidal energy potential in Long Island Sound, Block Island Sound, and their greater vicinity, expressed as mean kinetic power density (Data source: Georgia Tech, 2013).

4.16 Air Quality and Noise

4.16.1 Air Quality

The Clean Air Act (CAA) and its amendments led to the creation of National Ambient Air Quality Standards (NAAQS) by the USEPA for six criteria air pollutants: carbon monoxide (CO), sulfur dioxide (SO_2), ozone (O_3), particulate matter (PM), nitrogen dioxide (NO_2), and lead.

Areas that do not meet the NAAQS are classified as nonattainment areas for that pollutant. Areas that are not designated nonattainment for a pollutant are designated attainment and/or unclassifiable. State implementation plans are designed to bring nonattainment areas into compliance with the NAAQS as well as maintain an areas' attainment designation. These plans can include the establishment of emissions "budgets" or the maximum emissions allowed for different source categories to ensure the air quality standards would be met. Former nonattainment areas currently meeting the NAAQS are designated maintenance areas and must have maintenance plans for 20 years.

Table 4-38 summarizes the attainment status of the counties within the ZSF. All five counties are part of moderate nonattainment areas for the 1997 ozone standard. Ozone non-attainment zones are classified, in increasing degrees of severity, as follows: marginal, moderate, serious, severe, and extreme. New Haven, Middlesex and New London Counties (Connecticut) and Suffolk County (New York) are also marginal nonattainment areas for the stricter 2008 ozone standard**.**

New Haven County is a maintenance area for CO. Portions of Middlesex County are maintenance areas for CO, but emissions associated with dredging would occur outside the specific towns designated as within the maintenance area. Suffolk County is part of a maintenance area for the 1997 and 2006 PM2.5 (*i.e.,* particulate matter less than 2.5 micrometers in diameter) NAAQS. The other counties in the ZSF are considered in attainment for PM2.5. All five counties are attainment areas for lead, nitrogen dioxide, PM10 (*i.e.,* particulate matter less than 10 micrometers in diameter), and sulfur dioxide.

Ozone is formed through reactions of nitrogen oxides (NO_x) and volatile organic compounds (VOCs) in the presence of sunlight (*e.g.*, operation of gasoline and diesel-powered construction equipment, including dredges, barges, and dump trucks). The States of Connecticut, New York and Rhode Island have all adopted State Implementation Plans (SIPs) that include regulations to reduce emissions of the ozone precursor pollutants VOC and NOx (USEPA, 2015e; NYSDEC, 2015d). The SIPs include attainment demonstrations addressing how the NAAQS will be achieved or continue to be achieved into the future. For PM2.5, New York has an approved maintenance plan that has allowed Suffolk County to be redesignated from nonattainment to maintenance.

Table 4-38. Clean Air Act Attainment by County and State

Air Pollutant	New Haven County, CT	Middlesex County, CT	New London County, CT	Suffolk County, NY	Washington County, RI
Carbon monoxide	Maintenance	Maintenance (Portion of County[1])	Attainment	Attainment	Attainment
Lead	Attainment				
Nitrogen dioxide	Attainment				
Ozone	Nonattainment (1997 NAAQS- moderate, 2008 NAAQS- marginal)				Nonattainment (1997 NAAQS- moderate)
PM2.5	Maintenance (1997 and 2006 NAAQS)	Attainment	Attainment	Maintenance (1997 and 2006 NAAQS)	Attainment
PM10	Attainment				
Sulfur dioxide	Attainment				

Source: USEPA, 2015c

[1] Maintenance area is limited to the Town of Cromwell, Durham, East Hampton, Haddam, East Haddam, Middlefield, and Portland, and the City of Middleton.

4.16.2 Noise

There are varying levels of background noise in and around Long Island Sound and Block Island Sound. Noise associated with federal navigation channels can be generated by vessels, such as tugs and motorboats, and by dredges. Noise created in the navigation channel will often be far from shore and not noticeable to people on the land. Such noise may be noticeable, however, in areas where the channel is located close to the shoreline.

Non-federal dredging sites consist primarily of recreational marinas, private access channels, and terminals (such as for fuel deliveries, fishing vessels, or ferries). Background noise levels at marinas are moderate. Noise levels at terminals are generally somewhat higher than at the marinas due to the industrial nature of the terminals and their location in urban areas.

Background noise levels vary at potential disposal sites. The alternative sites consist of very quiet areas in open water. Noise is limited to occasional commercial or recreational vessels passing through the sites.

CHAPTER 5 – ENVIRONMENTAL CONSEQUENCES

This chapter considers the environmental and socioeconomic consequences that may result either from not designating an open-water disposal site (*i.e.*, No Action Alternative) or from designating one or more of the three open-water alternative sites considered in the eastern Long Island Sound region (*i.e.*, Action Alternatives), and decides on a preferred alternative. The chapter starts with an overview of dredged material disposal processes and potential environmental consequences (Sections 5.1 and 5.2). Thereafter, costs for dredged material disposal for dredging centers in the eastern Long Island Sound region under various alternatives are evaluated (Section 5.3). The environmental consequences of the No Action and Action Alternatives (evaluated in Sections 5.4 and 5.5, respectively) are summarized and compared in Section 5.6 relative to the MPRSA criteria. Section 5.7 addresses cumulative impacts associated with the three alternative sites within Long Island Sound. Section 5.8 summarizes the preferred alternative(s).

5.1 Open-Water Disposal Processes

Dredging and dredged material disposal in Long Island Sound has typically been accomplished using a bucket dredge to fill split-hull or pocket scows for transport to the disposal site or by using hopper dredges. Scows vary in size with capacities for dredged material of up to several thousand cubic yards. Most dredging projects in eastern Long Island Sound would be expected to use scows with a capacity of 3,000 cy (2,300 m^3) or less (W. Frank Bohlen, University of Connecticut, and Joe Salvatore, Connecticut Department of Transportation, May 2015, personal communications).

To assess the potential impact of dredged material disposal, it is important to understand the nature and characteristics of dredged material during individual disposal events. The dredged material disposal process has been extensively studied and is well understood, and this knowledge forms the basis for the approaches to managing dredged material disposal sites. Several factors influence the behavior of the descending plume of dredged material, including the physical properties of the sediment (*e.g.*, unconsolidated sediment particles versus clumps of material), water depth, water column stratification, and the speed and direction of currents. Due to its density, most of the descending dredged material settles to the bottom.

In general, the behavior of the descending plume follows three phases (Figure 5-1):

- ***Convective Descent***. This phase consists of the period immediately following release from the bottom of the scow where the material descends through the water column under the influence of gravity, generally maintaining its identity as a single plume (Brandsma and Divoky, 1976). During its descent, the area occupied by the plume expands as water is entrained. Kraus (1991) found that plumes resulting from the disposal of up to 5,000 cy (3,820 m^3) of sediment in waters up to 66 feet (20 m) deep spread 328 to 656 feet (100 to 200 m) around the original discharge point. The suspended sediment concentration is reduced due to dilution. The duration of this phase depends on the depth of the water, lasting only seconds to minutes in relatively shallow areas. Field and laboratory studies indicate that approximately 1-5% of the sediment discharged from a scow remains in the water column following the convective descent phase (Ruggaber and Adams, 2000; Tavolaro, 1984; USACE, 1986).

- ***Dynamic Collapse***. This phase occurs when the descending plume impacts the bottom and diffuses horizontally due to its own momentum. In areas with deep stratified water columns (*i.e.*, several hundreds to thousands of feet deep, much deeper than any area of Long Island Sound), this process is complicated by the fact that the plume may reach a depth of neutral buoyancy before hitting the seafloor. In those situations, the plume's downward vertical momentum tends to make it overshoot the neutral buoyant depth, creating a vertical oscillation, and increasing turbidity and dispersion. However, in relatively shallow water depths, such as in Long Island Sound, dredged material plumes experience dynamic collapse by impacting the bottom regardless of the water stratification because their initial momentum is too great to be overcome by the plume buoyancy.

- ***Passive Diffusion***. Passive diffusion refers to the transport and diffusion of the disposed material by the ambient, oceanographic conditions (currents and turbulence) rather than the dynamics of the plume body. This dispersion and transport of the suspended sediments may last for several hours depending on the specific gravity and particle size of the sediment. Numerous field studies (see Section 5.2.1 for further details) have confirmed that plumes are transient, short-term (*i.e.*, hours in duration) features of dredged material disposal from scows (Dragos and Lewis, 1993; Dragos and Peven, 1994; SAIC, 1988).

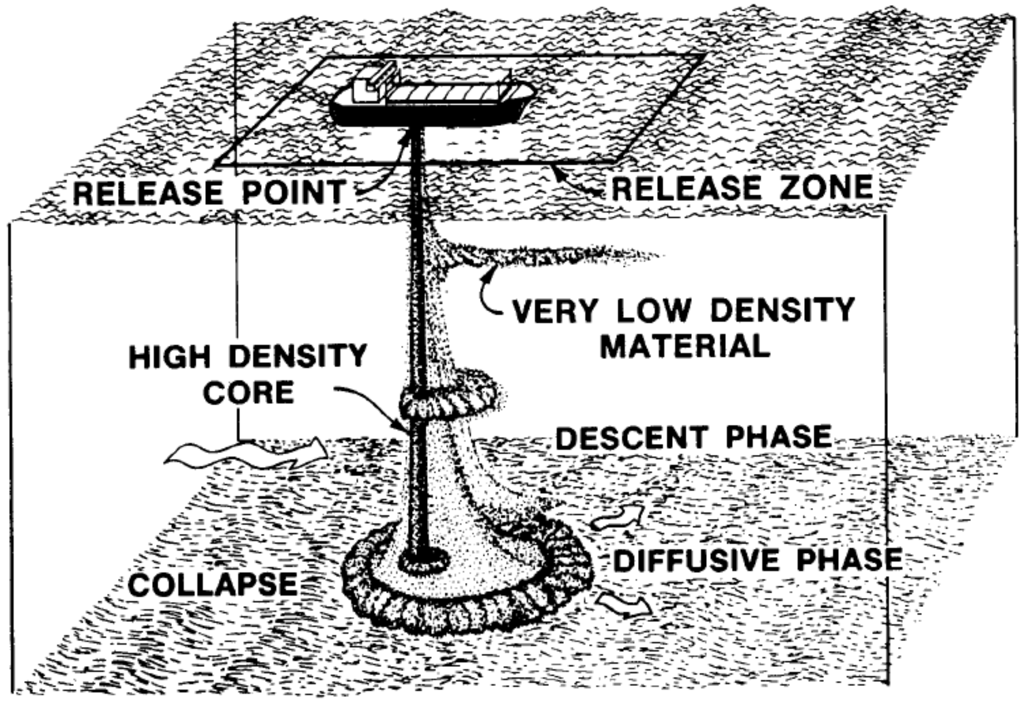

Figure 5-1. Schematic drawing of transport processes during open-water dredged material disposal (in USACE, 1986, adapted from Pequegnat et al. 1981).

The scale of the dredged material release depicted in Figure 5-1 would translate to a site located in deep water relative to the size of the scow at the surface. For the shallower sites in Long Island Sound presented in this report, the released dredged material is expected to transition from convective descent directly to dynamic collapse with limited potential for release to the water column.

Disposal in the marine environment exposes the deposited dredged material to currents, which have the potential to carry the material elsewhere in the surrounding aquatic environment. There are two ways that this transport may occur. During the disposal operation, the portion of the dredged material that is released (a fraction of any fine silt and clay particles present) may remain in the water column as a turbid plume for several hours where it will drift with the current. Additionally, once deposited on the seafloor, the sediment is exposed to tidal and wave generated currents, which, if sufficiently strong, may resuspend the sediment, with subsequent transport along the seafloor or within the water column. Dredged material disposal sites are generally selected in areas with no or minimal resuspension potential.

5.2 Overview of Environmental Consequences

Physical, chemical, and biological effects of dredged material disposal at open-water sites in the natural environment were evaluated to describe the impacts of disposal. Reported effects of disposing dredged material at open-water sites include direct, indirect, and cumulative impacts, both short-term and long-term (*e.g.*, Wright, 1978; USACE, 1981; USACE, 1982a; USACE, 1982b; Fredette et al., 1993; Fredette and French, 2004; Germano et al., 2011; Lopez et al., 2014). These and other studies described below considered both short-term and long-term impacts, as well as those occurring within and outside of disposal site boundaries. Based on these data, the primary effects of dredged material disposal were identified as:

- Physical, chemical, and biological impacts within the water column;
- Topographic changes to the seafloor and impacts to biological communities within the site;
- Erosion and transport of deposited dredged material mounds; and
- Bioaccumulation of contaminants.

These effects and potential impacts are described in the following four subsections.

5.2.1 Water Column

Impacts to the water column resulting from the disposal of dredged material are temporary, due to the rapid descent of the material and the relatively large volume of the receiving waterbody within which the suspended fraction of the disposed dredged material is diluted. Impacts are also spatially limited to the region of the disposal site due to the relatively small cross-sectional area of the descending material (*i.e.*, the convective phase). The intermittent nature of the disposal operations, short time period that material stays in the water column, and rapid dilution and settling further limit such effects. Some entrainment of organisms (*e.g.*, phytoplankton, zooplankton, and larval stages of fish and invertebrates) may occur during the descent of the dredged material; however, the number of organisms affected would be small compared to the size of the overall community at the site and within Long Island Sound. Impacts of the descending sediment plume on pelagic fish, reptiles, and mammals are thought to be minor because those organisms are mobile enough to avoid the descending material, and can burrow out from beneath a modest thickness of deposited material. Wright (1978) indicated that avoidance of disposal plumes by fish was noted in early dredged material studies conducted under the USACE Dredged Material Research Program.

The primary impacts to the water column are associated with the residual particles that remain suspended after the plume has reached the seafloor. Suspended sediments have been associated with mechanical damage to respiratory surfaces of fish, which may increase the chances of mortality (LaSalle et al., 1991; O'Connor, 1991; Saila et al., 1971), though impacts depend largely on the species, lifestage present, suspended sediment concentration, and duration of exposure (Kjelland et al., 2015). In general, finfish are less likely to experience mortality from suspended sediments because of their ability to move away from or out of an area of higher concentration to an area of lower concentration compared; the mortality is higher for sessile or less mobile species. In addition, residual turbidity caused by suspended sediments changes the light penetration, and may result in reduced photosynthesis of aquatic plants. However, impacts such as these are limited in time and space due to the short time needed for dredged material to reach the bottom (Kraus, 1991; Dragos and Lewis, 1993; Dragos and Peven, 1994).

The frequency of disposal operations may influence the potential for water quality impacts at the disposal site. For example, if the frequency of disposal is high, the potential for disposal within residual suspended sediment in the water column increases, resulting in slower dilution of the suspended fraction of the disposed dredged material. There is less potential for this type of impact when the disposal frequency is low. Careful site management can be used to mitigate such potential impacts.

Other potential effects on the water column from dredged material disposal may include the release of nutrients or contaminants from sediments during the descent phase. Nutrients and contaminants in sediments are generally bound to the particulate organic particles. However, various levels of nutrients and contaminants, if any, occur in the pore water (*i.e.*, water within the sediments) depending on the physical and chemical properties of the sediment. Under some circumstances, nutrient and contaminant levels in pore waters may exceed levels found in the overlying water column. However, the total amount of nutrients associated with the sediment pore waters of a 3000-cy scow load of dredged material is small relative to that associated with the receiving water at an open-water disposal site, and only a small portion of these chemicals are released during the disposal process. Jones and Lee (1981), who examined the significance of dredging and dredged material disposal as a source of nitrogen and phosphorus for estuarine waters, concluded that dredged sediment-associated nutrients will rarely have an adverse effect on water quality because the disposal events are short-lived, there is typically fairly rapid dilution of the disposed sediment, and, relative to the dilution, nutrient release is small. Furthermore, the incremental addition of nutrients or contaminants from dredged material disposal relative to other sources such as rivers, treatment facilities, and nonpoint sources is believed to be insignificant. USACE (1982a; 1982b) studied impacts in Long Island Sound from dredged material disposal, but was unable to identify specific cumulative effects of dredged material disposal due to “complex and interrelated environmental factors” that made it impossible to separate the influence of dredged material disposal from other possible sources of impact.

A concern in the past has been the potential of nutrient releases during dredged material disposal for stimulating harmful algal blooms (HABs) in the water column of Long Island Sound. The primary cause for HABs is thought to be increased nutrient loading (Gobler and Hattenrath-Lehman, 2011; Davidson et al., 2014). HABs have been occurring in some of the embayments along Long Island Sound. However, the low nutrient load released into the water column during a disposal event, combined with the rapid dispersion of released nutrients by tidal flows in the comparatively open waters at disposal sites in Long Island Sound, results in a very low likelihood that nutrients in disposed dredged material contribute to triggering a HAB occurrence. A detailed study of phosphorus loading in western Lake Erie found that open-lake disposal of dredged material has no measurable impact on HABs in the lake, both from releases during the disposal event, and from long-term releases from the disposed material either by resuspension and desorption or by pore diffusion (Ecology and Environment and LimnoTech, 2014). Phosphorus is the limiting nutrient in Lake Erie (Lake Erie Nutrient Science Task Group, 2009), whereas primary production in Long Island Sound is largely nitrogen-limited (Gobler et al., 2006).

5.2.2 Topography

The overlap of multiple dredged material disposal events ultimately builds discernable mounds within a disposal site, altering the topography of the area. While changes associated with single events are likely to be negligible, the cumulative impact could be more substantial. The bulk of the released dredged material forms a mound on the seafloor that typically has a diameter between 50 and 300 m, depending primarily on water depth, dredged material type and volume, and sea surface topography (Lopez et al., 2014). Studies from Long Island Sound show that the footprint of a scow load of dredged sediment discharged in 100 feet (30 m) of water may spread over the seafloor in an area approximately 400 feet (120 m) in diameter. As multiple disposal events occur, accumulations that range from several inches to several feet in height are built above the original seafloor. The impacts associated with these changes could be both physical and biological.

Physical Impacts. One physical impact due to changes in topography is the alteration of local bottom water currents within a site. These alterations are not known to interfere with regional flow patterns and transport within a system. Another physical impact is a change in water depth above the dredged material disposal site. However, each site is actively managed to control the number and elevation of mounds created to avoid interferences with shipping and navigation.

Numerous studies have investigated the stability of disposal mounds on the seafloor (*e.g.*, SAIC, 1979; SAIC, 2001a; SAIC 2001b; SAIC, 2001c; ENSR, 2007; AECOM, 2009). Several longer-term processes can reduce mound height or modify the mound topography, including physical and biological processes that smooth the roughness of the mound (Rhoads, 1994). The most prevalent process occurring right after disposal is reconsolidation of the sediment due to the weight of the material in the mound. As a result of this settling process, the water trapped in the dredged material is expelled, reducing the total volume and height of the mound.

In some situations, bottom currents may transport and redistribute materials from the mound surface. The amount of transport and redistribution depends on the sediment texture (grain size), sediment cohesiveness, and current strength. Biological processes such as colonization (including burrowing) and foraging by megafauna also act to smooth the mound’s surface and change its topography. These physical and biological processes also modify the nature of the surface sediments on the mounds over time. Studies have demonstrated that the storms and currents may remove (winnow) fine-grained surface sediments from dredged material mounds, leaving behind coarse sediments (Pratt et al., 1973; SAIC, 1979). Such winnowing eventually reaches an equilibrium distribution that reflects the critical erosion velocity at the site.

Storms such as hurricanes or Nor’easters can potentially affect mound stability at shallow coastal disposal sites. Such storms may cause erosion by increasing the bottom stress induced by waves and currents. Storm intensity, including wind direction, speed and duration, determines the wave field characteristics (amplitude and wavelength). However, aside from waves and currents, potential erosion is a function of water depth, sediment type, and sediment structure. Rhoads (1994) examined the loss of material from mounds at the CLDS using bathymetric methods following the passage of Hurricane Gloria in 1985, and found no significant loss of material from the historic mounds; the study noted possible changes of only 0.4 or 0.8 inches (1 or 2 cm) in mound height based on data from sediment profile images. Such information is often used to establish the minimum water depth for disposal sites.

Studies over the past 35 years, including those of the DAMOS program, have documented the general stability of dredged material mounds by recording bathymetry before and after active disposal operations, and periodically thereafter. High precision bathymetry studies at the NLDS have detailed changes in the topography of the site as disposal occurs and have repeatedly documented that the bathymetry or topography of historic mounds are not changing (*e.g.*, AECOM, 2009). Some mounds at the site are several decades old.

Biological Impacts. One of the key biological impacts due to changes in topography is the burial of organisms in the disposal area. Those species that are not able to avoid the descending dredged material plume or burrow through the deposited material may be eliminated from the site following multiple disposal events. Such burial would be problematic if the buried organisms constituted a significant shellfishery or a spatially limited, unique community or population within the water body. This type of impact can be avoided, however, by identification and avoidance of any such resources during disposal site designation or selection.

Burial of organisms may occur at sites where dredged material is deposited. Some organisms possess the ability to move through the sediment layer deposited on them and others do not. Vertical migration of organisms through the deposited sediments is influenced by a number of factors, including an organism's life cycle stage, sediment type, sediment depth, burial duration, temperature, and adaptive features such as an organism's ability to burrow and to survive low oxygen conditions. Maurer et al. (1986) indicate that major taxa such as mollusks (clams), crustaceans (*e.g.*, crabs, lobsters), and polychaetes (worms) respond differently to burial. Sediment type (*e.g.*, mud, sand, and mixtures of mud and sand) greatly influences the ability of buried organisms to migrate through the sediment to their normal depths of habitation. As a result, the type of material disposed may influence the level of survival and the rate of recovery of the site, as well as the diversity of the community that recolonizes the area, particularly if the sediment characteristics are very different from the native sediment at the site.

Also important are the life habits of organisms inhabiting the disposal site, such as feeding type (*e.g.*, epifaunal suspension feeders, deep burrowing siphonate suspension feeders, infaunal non-siphonate suspension feeders, burrowing siphonate feeders). Those organisms that burrow deeply into sediments tend to be able to survive greater burial depths, often up to 20 inches (50 cm), and are more likely to survive a burial event. Other types of feeders may survive only a few inches of burial (0.4 to 4 inches [1 to 10 cm]). Large decapod crustaceans (*i.e.*, cancer crabs, shrimp species, lobster) are able to penetrate deeply into the sediment, which provides them with mechanisms that enable them to survive some burial.

Biological impacts could also include those to the benthic community and local food web caused by changes in the physical properties of the substrate if deposited dredged material (*e.g.*, sand, mud, clays, and rock) alters the habitat type. Dredged material disposal could result in physical changes to the sediment properties of the site (*e.g.*, sediment texture and particulate organic matter). Such changes could be an outcome of the actual disposal (*e.g.*, mud on sand or sand on mud or intermediate sediment texture) or could result from alteration in the sediment texture through erosion. If such changes occurred, they would then define the type of habitat available for benthic organisms to colonize and, thus, the types of organisms and benthic community that would be able to live and thrive on the mounds. This, in turn, could influence the use of the disposal site by higher trophic levels and potentially affect the response of various species to the mound, including those of recreational or commercial importance.

Sediments disturbed by natural processes or dredged material disposal operations may be recolonized by aquatic organisms through several mechanisms. As summarized in Maurer et al. (1986) recolonization mechanisms may include (1) emigration of adults from undisturbed areas, (2) seasonal reproduction and larval recruitment from undisturbed areas, (3) vertical migration through the sediments, and (4) nocturnal swimming. Each mechanism can influence the rate of recolonization as it may depend on natural reproductive cycles and active or passive transport to the affected sediments. The relative importance of the above recolonization mechanisms to site recovery is specific to the conditions in the site, communities in adjacent sediments, and the life cycle of the various organisms.

The recolonization and rate of dredged material disposal mound recovery follows a systematic progression described by Rhoads and Germano (1982, 1986). This successional progression forms the basis for evaluation of benthic community recovery on dredged material mounds in the Northeast, including Long Island Sound, and is amenable to rapid assessment using sediment profiling camera systems. The successional process is categorized as proceeding from Stage I (pioneering assemblages) through Stage II (infaunal deposit feeders) to Stage III assemblages (typically head-down deposit feeding organisms) (see also Section 4.9). DAMOS and other programs have repeatedly documented rapid recolonization of mound surfaces with infaunal assemblages typical of the sediments surrounding the disposal site. For example, monitoring at the NLDS (SAIC, 2001a; SAIC, 2001b; SAIC, 2001c; SAIC, 2004; AECOM, 2009) shows the impact to an infaunal community is confined to the deposition footprint of the mound and that a gradient in benthic assemblages and communities exists across a mound within 1-2 years of disposal. Initial mound recolonization is very rapid (months) and proceeds from Stage I to Stage II/Stage III assemblages within a few years. These studies also documented that the recovery of the mound apex, which is the most disturbed area, tends to be slower than at the mound apron, where deposited sediments are thinner and physical disruption of the seafloor lower. Mounds that have been in place at the NLDS for several years consistently support mature benthic assemblages that are similar to reference areas outside of the disposal site and are stable over time (*e.g.,* SAIC, 2001c; AECOM, 2009).

In summary, over time, sediments within disposal sites recover and develop biological communities that are healthy and able to support species typically found in the ambient surroundings. There is no evidence of long-term effects on benthic processes or habitat conditions (Fredette and French, 2004; Germano et al., 2011).

5.2.3 Erosion

Erosion may result in movement of the deposited sediments away from the point of impact with the seafloor, and if extensive enough, out of the disposal site. Factors influencing erosion include water depth, the duration, and intensity of storms, magnitude of local currents (*e.g.*, tidal currents), mound configuration, bottom topography, and sediment characteristics. Human activities that alter the bottom topography, such as trawling, may also influence erosion.

Storms occur intermittently and may impart energy to the seafloor, causing deposited particles to lift into the water column. Erosion caused by storms depends greatly on the water depth; intensity, duration and direction of winds; and the type of material on the mound (sand, silt, etc.). Erosion caused by this process may resuspend and transport a few inches of sediments, although the amount resuspended and transported is site- and storm-specific. Understanding the potential for erosion based on storm frequency and intensity is a critical aspect of dredged material site designation and site management strategies (*i.e.*, not allowing mounds to build higher than the critical erosion depth for a site). Sites located in water depths below the critical erosion depth potential are typically not affected by major storms (see Appendix C-2).

The second erosion process is related to the normal movement of bottom water due to tidal and other local currents. Erosion associated with these currents is periodic and generally less intense than that experienced during storms. Current velocity, mound configuration, and sediment type greatly influence the amount of erosion that occurs. This type of erosion may winnow fine-grained sediments (silt and clays) from the deposited material leaving behind material that is coarser and less susceptible to erosion and transport from the mound. The biological community associated with the sediments also influences whether erosion can occur (*e.g.*, organisms may loosen the sediments allowing easier resuspension or form mats that restrict the ability of the currents to lift the sediments).

The interplay between erosion and benthic organisms may also affect higher trophic levels (a feeding stratum in the food chain) by providing more or less prey at a given location or prey that is more or less suitable for a variety of species. Over time, and in the absence of major physical disturbances, this interplay would establish or reestablish biological communities on the mounds as described previously. The time frame for the changes in these benthic communities has been extensively studied on dredged material mounds. Thus, mound erosion has three elements that relate to indirect impact of dredged material disposal: (1) recovery of benthic communities following disposal, (2) habitat changes on the mound through time, and (3) influence of these changes on the food web including commercial and recreational fisheries in and near a site over time.

Limiting the probability of large-scale erosion and transport of mounds within and from the disposal site is an important consideration when designating a site. However, some erosion and winnowing of the surface sediments (upper 0.8 to 1.6 inches [2 to 4 cm]) is a normal response due to tidal and long-term currents. It may provide positive attributes such as armoring of the surface against further erosion and creating microhabitats within the disposal site that provide greater variability in benthic habitat, leading to continued, if not greater, utilization of the area by fish and shellfish.

5.2.4 Bioaccumulation

Bioaccumulation is defined as the uptake and retention of contaminants (*e.g.*, metals and organic compounds) into the tissues of organisms from all possible external sources (Brungs and Mount, 1978; Spacie and Hamelink, 1985). While bioaccumulation of a contaminant by an organism may or may not result in detrimental impacts to that organism, it can be an indicator that the population, similar organisms, and higher trophic-level organisms that prey on the contaminated organisms may be potentially at risk of adverse impacts. Understanding pathways by which contaminants may potentially bioaccumulate is essential for evaluating the effects of dredged material disposal. This includes cumulative impact of historical dredged material as well as other disposal activities and other contaminant sources to a region.

There are five major pathways for contaminant entry into organisms: (1) water, (2) particles (detrital or resuspended), (3) sediment, (4) contact with interstitial pore water of the sediments, and (5) grazing (herbivorous or carnivorous). The importance of each pathway depends in large measure on the life history of the organism and bioavailability of the contaminant. For example, benthic infaunal and epifaunal organisms are in close and immediate contact with bottom sediments and are more likely to be exposed to contaminants through contact with or consumption of sediment and pore-water. For these organisms, feeding mode (*i.e.*, filter or deposit) would also influence the initial entry pathway and dictate the exposure to and assimilation of contaminants.

Demersal species that live on the bottom may be exposed through sediment and food pathways depending on their trophic level (*e.g.*, primary or secondary carnivores). These organisms are more motile than benthic infauna and can encounter varying levels of contaminants through different prey species and feeding ranges.

Further removed from the sediment environment that contains most of the bioaccumulative contaminants are the pelagic organisms. Pelagic organisms generally prey on other pelagic organisms. Thus, these organisms are primarily exposed to contaminants present in the water column and their water-column food. Additionally, because many pelagic fish move across large coastal areas, they may be exposed to widely different types and levels of contaminants throughout their life cycle.

Grazing occurs at all trophic levels. Herbivorous organisms graze on primary producers (*e.g.*, plankton) and plant detritus. These primary consumers include zooplankton and filter feeding benthic species (*e.g.*, bivalves) and secondary consumers such as whales. Small and large fish and crustaceans graze on zooplankton and benthic infauna and are in turn consumed by other fish. The highest trophic level includes carnivorous fish, some marine mammals, and humans.

In aquatic environments, contaminants are bioavailable only if they are in a form that can be transferred into an organism, usually through its skin, gill epithelium, gut epithelium, or other cell membranes (Newman and Jagoe, 1994). Nearly always, contaminants in solution in the water are more bioavailable than those bound to sediment particles or present in food (Neff, 1984). Most bioaccumulative contaminants of concern (*e.g.*, PCBs, DDTs, dioxins, mercury) dissolve in water at only low concentrations, if at all, and are strongly bound to sediment particles. Some of these sediment particles enter the water column by natural processes such as river outflow or are resuspended by currents and storm events. Others are resuspended by human activity (*e.g.*, dredged material disposal events, fish trawling, and underwater mining).

For bioaccumulation to occur, the rate of uptake must be greater than the rate of loss (excretion) of the contaminant from the organism. Highly soluble contaminants often occur in bioavailable forms in the environment and rapidly penetrate the tissues of aquatic organisms. However, at sublethal concentrations, these contaminants are not retained and are lost just as rapidly from the tissues by diffusion, active transport, or metabolic modification. As a result, their concentrations in tissues are equal to or lower than their concentrations in the water or sediment. For other contaminants, organisms' metabolic processes regulate contaminant levels independent of ambient concentrations (Chapman et al., 1996). This is especially true for many metals. Other chemicals (*e.g.*, some PAHs) may be taken up rapidly, but are transformed and excreted rapidly and, therefore, are not bioaccumulated.

A component of bioaccumulation is biomagnification. Biomagnification is the transfer of a chemical through trophic levels resulting in elevated concentrations with increasing trophic levels (Connell, 1989; Gobas et al., 1993). Studies have shown that very few chemicals biomagnify in aquatic environments (*e.g.*, LeBlanc, 1995). Even though higher trophic levels have higher contaminant concentrations relative to lower trophic levels, the increase can be explained in many cases by the relative increase in lipid content as trophic level increases or by decreased chemical elimination efficiencies of higher trophic level organisms (LeBlanc, 1995).

Although bioaccumulation is a naturally occurring process within the aquatic environment, the placement of dredged material at a disposal site could alter the conditions controlling bioaccumulation (*e.g.*, chemical concentrations, grain size, TOC), which would result in a localized change in the rate of uptake and possible risks of associated adverse health effects. As summarized by Fredette and French (2004), Arimoto and Feng (1983) and Gentile et al. (1984), it has been demonstrated that some dredged material may result in short-term, spatially limited increases in the bioavailability of compounds at or near dredged material mounds, although these studies did not find adverse impacts to organisms from dredged material disposal. This highlights the importance of current practices to assess dredged materials proposed for open-water disposal to prevent dredged material disposal from causing problems with regard to bioaccumulation of contaminants by marine organisms.

5.3 Costs for Disposal of Dredged Material

The LIS DMMP prepared by the USACE (2015) included a forecast of dredging needs and a comprehensive analysis of dredging and disposal costs for dredging centers (waterways, harbors and marine facilities) throughout Long Island Sound. The cost analysis covered a variety of dredging methods, placement alternatives and distances from the dredging project site to the dredged material disposal site. The analysis also considered the type of dredged material and whether it was suitable for placement along beaches (beach nourishment) or other beneficial uses. The total estimated dredging needs for the eastern Long Island Sound region over the 30-year planning horizon (2015-2045) are 22.6 million cy (17.3 million m^3), including 9.1 million cy (6.9 million m^3) sand, and 13.5 million cy (10.3 million m^3) fine-grained material. Dredging needs by dredging center are presented in Tables 2-2 and 2-3 in Chapter 2.

5.3.1 Dredging Cost Categories

Costs associated with any specific dredging project are dependent on many factors, including the volume of material to be dredged; the physical and chemical characteristics of the dredged material; the project depth and design; the dredging technique and equipment to be used; the location, capacity and characteristics of the dredged material disposal site; and the methods for transportation of the dredged material for the disposal site. Some of these factors may also affect the efficiency and schedule of the dredging project, which may impact the selection of the most appropriate disposal alternative.

For each type of dredging project, six cost categories were identified by USACE (2015):

- Contract costs of dredging;
- Design efforts;
- Sampling and testing;
- Coordination and permitting;
- Air quality mitigation; and
- Project contingency.

These cost categories included subcomponents of both a fixed and variable cost nature. For example, for the contract cost of dredging, mobilization and demobilization of major equipment are largely fixed costs, while the operating costs of the equipment during the actual dredging activity are variable costs that are based on the volume of material to be dredged.

Contract Costs of Dredging. The contract costs represent the costs charged by the dredging contractor for the implementation of a dredging project, including excavation, transportation and deposition of the dredged material at the selected disposal site. USACE (2015) analyzed three dredging methods (mechanical, hopper, and hydraulic/pipeline). With each type of dredging method, different size dredges were evaluated based on the volume of dredged material.

- *Mechanical Dredging:* Mechanical dredging is usually conducted with clamshell dredging buckets that are repeatedly lowered to the bottom of the dredging location to dig up the bottom material which is then lifted and placed on a scow. The filled scow then takes the material to the disposal site. The equipment is less specialized than for the two other dredging methods described below. Mechanical dredging may be appropriate for smaller projects, since the fixed costs for mobilization and demobilization are lower and do not need to be spread across a large volume of dredged material.

- *Trailing Suction Hopper Dredge (TSHD):* A TSHD pumps dredged material from the channel to its own storage hopper and can then travel to the disposal site when the hopper is full. A TSHD may dispose material mechanically by gravity at an open water site, or if it has pump-out capability, it can pump the material either overboard at an open-water site, or by pipeline to a beach nourishment site or a confined disposal facility (CDF).

- *Pipeline Dredging:* Pipeline dredging, usually with a cutter suction dredge (CSD), has high mobilization costs, but once installed at the site, it can be highly efficient for pumping dredged material over short distances. However, hydraulic pumping and disposal involves mixing the dredged material with large quantities of water, so dewatering and rehandling of material after it has dried can add significantly to the costs of disposing material at upland sites. The CSD is fixed at the site with temporary pilings during dredging, so it moves the dredged material only as far as it can pump. This pumping may be to the disposal site with a pipeline, or material can be pumped onto scows that are then towed to a more distant disposal site.

The contract costs are the cost category that is most directly influenced by the distance to the disposal site.

Design. The design costs of the project vary with its size and complexity. Use of a CDF for dredged material disposal may increase the complexity of the project design, so for dredging projects of the same size, one that uses a CDF may have a higher design cost than one that uses an existing open-water site. Although design costs are influenced more by size and complexity than by the distance from the project site to the disposal site, for estimating purposes, USACE (2015) assumed that design costs are 8% of the contract costs. Thus, the estimated design costs are directly related to estimated contract costs and are consequently influenced by the same variables as the contract costs.

Sampling and Testing. The selection of suitable disposal options for dredged material requires physical and chemical characterization of the material to be dredged, as described in Chapter 1. If the dredged material is to be disposed at an open-water disposal site, it also may be subject to toxicity and bioassay testing. Sampling and testing costs increase with large increases in the volume of material to be dredged. These costs can also vary based on the type of disposal site, with more testing required for environmentally sensitive options. Sampling and testing costs do not vary significantly as a result of the distance to the disposal site.

Coordination and Permitting. This cost category includes efforts for the following:

- Biological resource studies (*e.g.*, benthos, eelgrass, shellfish, fish, etc.);
- Cultural resource studies;
- Preparation of a NEPA document (*e.g.*, Environmental Assessment, EIS);

- Coordination with federal, state, and local resource agencies; and
- Preparation of federal, state, and local permitting documents.

These coordination and permitting costs may vary somewhat with the size of the dredging project, but they are generally not dependent on the type of dredging or the dredged material disposal alternative.

Air Quality Mitigation. The USAID (2015) cost analysis incorporated the results of a related study performed for the USACE (AECOM, 2014) to predict the air emissions from activities associated with dredging in the states surrounding Long Island Sound. Various scenarios were developed and air quality models were run to predict air emissions and cost estimates for air mitigation related to dredging projects in Long Island Sound. The air emissions calculated included equipment used to perform the dredging as well as any equipment needed as part of the project. Costs for air quality mitigation were added to the cost estimates only where the estimated direct and/or indirect air emissions exceeded a minimum regulatory threshold. For most of the dredging methods and disposal options evaluated, the USACE (2015) cost matrices list zero air quality mitigation costs for projects of 250,000 cy or less.

Contingency. A project contingency of 20% of the contract costs was added by USACE (2015) to the overall project costs to account for uncertainties. It is therefore not an independent cost category, but instead an increase in the contract cost estimate.

5.3.2 Dredging Cost Estimates

USACE (2015) considered several disposal options (open-water, nearshore, beach nourishment, marsh creation, CAD cell, upland, and an island CDF). The cost analysis also considered 15 project volumes ranging from 1,000 to 4,000,000 cy (765 to 3,060,000 m^3). The analysis further included nine disposal distances, based on statute miles for comparison between all alternatives (note: 1 statute mile = 0.87 nmi): 1 mile, 2 miles, 5 miles, 10 miles, 20 miles, 30 miles, 50 miles, 60 miles, and 120 miles. The disposal distances vary with the type of dredge and the disposal method used.

The cost estimates are summarized in Tables 5-1 to 5-4. While USACE (2015) lists costs for each of the cost categories separately for each alternative, the summary in the tables below shows only the total costs for each alternative. Four project sizes were included (26,000 cy, 100,000 cy, 500,000 cy and 1,000,000 cy) which are considered a representative range. Costs are shown as total costs per project and as unit costs per cy. In the cost tables, mechanical dredging is represented in the columns labeled “bucket”; the use of a TSHD is represented in columns labeled both “hopper” and “pump-off.”

For most of the analyzed disposal alternatives, the costs of disposal are strongly related to the distance between the project site and the disposal site. The costs per cy of disposal projects decrease with larger dredging projects due to economies of scale and fixed mobilization and demobilization costs that can be spread over a greater number of units (cy). Costs also reflect rehandling of material for those alternatives not involving in-water disposal.

Table 5-1. Dredging Cost Estimates for Open-water or Nearshore Disposal

Cubic Yards Dredged	**Open-water or Nearshore Disposal - Haul Distances**								
	≤ 5 miles		**10 miles**		**20 miles**		**30 miles**	**60 miles**	**120 miles**
	Bucket	Hopper	Bucket	Hopper	Bucket	Hopper	Bucket		
Total Costs (in million dollars)									
26,000	$1.4	$1.2	$1.2	$1.4	$1.3	$1.9	$1.6	$2.2	$4.0
100,000	$2.5	$2.5	$2.9	$3.4	$3.4	$5.2	$4.1	$6.1	$10.7
500,000	$14.5	$6.5	$15.1	$8.8	$16.4	$13.4	$19.1	$25.3	$38.6
1,000,000	$26.9	$10.7	$27.9	$15.8	$30.1	$24.1	$32.5	$41.5	$60.2
Costs per CY									
26,000	$55.73	$46.66	$46.91	$55.64	$49.45	$73.61	$62.58	$86.32	$154.50
100,000	$24.70	$25.31	$29.14	$34.18	$33.73	$52.28	$41.09	$61.07	$107.19
500,000	$28.98	$13.02	$30.27	$17.62	$32.87	$26.74	$38.16	$50.56	$77.18
1,000,000	$26.88	$10.71	$27.94	$15.81	$30.05	$24.15	$32.47	$41.53	$60.24

Table 5-2. Dredging Cost Estimates for Beneficial Use Alternatives

Cubic Yards Dredged	**Beach Nourishment - Direct Placement**		**Beach Nourishment – Pump-off Placement**				**Marsh Creation**		**CAD Cell** (Creation & Disposal	
	≤ 1 miles	**2 miles**	**5 miles**	**10 miles**	**20 miles**	**50 miles**	**< 2 miles**		**2 miles**	**5 miles**
	Pipeline		Pump-off from Hopper				Bucket	Pipe-line	Bucket	
Total Costs (in million dollars)										
26,000	$0.95	$1.1	$1.6	$1.9	$2.4	$2.8	$3.3	$2.2	$2.6	$2.6
100,000	$2.3	$2.6	$4.0	$5.2	$6.2	$7.1	$12.7	$6.8	$7.2	$7.8
500,000	$7.2	$8.8	$12.9	$15.7	$14.6	$22.8	$67.4	$29.6	$33.0	$33.4
1,000,000	n/a						$133.1	$58.4	$63.4	$64.1
Costs per CY										
26,000	$36.45	$43.68	$59.93	$71.81	$90.80	$106.96	$126.48	$85.52	$100.62	$99.55
100,000	$23.22	$26.19	$40.15	$51.95	$62.07	$71.30	$126.53	$67.54	$71.77	$77.51
500,000	$14.47	$17.65	$25.82	$31.49	$29.22	$45.62	$134.73	$59.20	$66.05	$66.89
1,000,000	n/a						$133.08	$58.49	$63.41	$64.07

Table 5-3. Dredging Cost Estimates for Upland Disposal Alternatives

Cubic Yards Dredged	**Confined or Unconfined Upland Dewatering and Disposal** (including Cost of Rehandling ashore, and Trucking Where Needed)									
	0-2 miles No Haul		**5 miles**		**10 miles**		**20 miles**	**30 miles**	**60 miles**	**Railroad to Pennsylvania Mines**
	Bucket	Pipe-line	Bucket	Pipe-line	Bucket	Pipe-line	Bucket			
Total Costs (in million dollars)										
26,000	$1.0	$1.3	$1.3	$1.6	$1.6	$1.7	$1.8	$2.1	$3.0	$4.8
100,000	$3.1	$3.2	$6.1	$5.9	$6.8	$6.6	$7.6	$8.7	$10.2	$24.5
500,000	$19.1	$10.2	$30.8	$24.9	$35.1	$28.5	$38.2	$46.4	$58.8	$115.1
1,000,000	$36.4	$19.6	$66.4	$48.9	$74.9	$55.5	$84.7	$97.3	$120.0	$229.3
Costs per CY										
26,000	$38.03	$48.16	$48.51	$63.32	$60.11	$66.06	$68.85	$81.69	$116.82	$184.45
100,000	$31.49	$31.53	$60.90	$58.96	$68.22	$65.60	$75.82	$87.27	$102.05	$244.94
500,000	$38.15	$20.38	$61.54	$49.85	$70.18	$57.05	$76.32	$92.70	$117.66	$230.17
1,000,000	$36.41	$19.57	$66.45	$48.87	$74.90	$55.51	$84.65	$97.25	$119.98	$229.32

Table 5-4. Dredging Cost Estimates for Island CDF Alternatives

Cubic Yards Dredged	**Island Confined Disposal Facilities** (referred to as Containment Island Placement in USACE, 2015)									
	0-2 miles		**10 miles**		**20 miles**		**30 miles**		**60 miles**	
	Bucket	Pipeline	Bucket	Pump-off (Hopper)	Bucket	Pump-off (Hopper)	Bucket	Pump-off (Hopper)	Bucket	Pump-off (Hopper)
Total Costs (in million dollars)										
26,000	$3.2	$3.0	$3.3	$4.2	$3.9	$5.3	$3.8	$6.1	$4.6	$8.8
100,000	$11.2	$9.7	$11.5	$14.0	$12.7	$18.0	$13.2	$21.3	$16.5	$31.7
500,000	$57.2	$44.3	$58.2	$55.5	$59.8	$66.4	$62.7	$67.2	$71.6	$85.3
1,000,000	$112.7	$87.8	$114.4	$102.5	$116.5	$120.4	$118.9	$132.8	$134.3	$170.1
Costs per CY										
6,000	$124.30	$115.16	$125.55	$163.10	$148.21	$202.71	$147.76	$235.70	$178.57	$339.89
100,000	$112.46	$97.13	$115.48	$139.60	$126.80	$179.52	$131.84	$212.54	$165.07	$316.79
500,000	$114.41	$88.56	$116.47	$111.01	$119.63	$132.81	$125.31	$134.40	$143.12	$170.65
1,000,000	$112.68	$87.83	$114.36	$102.48	$116.48	$120.35	$118.89	$132.82	$134.27	$170.06

Overall, disposal costs are lowest for open-water or nearshore disposal. For very short distances, beach nourishment has lower costs than open-water/nearshore alternatives for all of the project sizes, but open-water/nearshore disposal has the cost advantage once the distance exceeds five miles. (Beach nourishment would not be available for fine-grained dredged material.) In the case of a 26,000 cy project, upland disposal at a short distance (0-2 miles with no haul) using a bucket (*i.e.*, mechanical dredging) has a cost of $38.03 per cy, which is lower than the open-water alternatives of 5 miles or less, but slightly higher than the $36.45 per cy cost for beach nourishment direct disposal by pipeline at a distance of one mile or less. No-haul upland disposal consists of placing sediment directly along the shore (bucket dredge) or piping it directly onto land to its final disposal site. Disposal at an island CDF has substantially higher disposal costs that other alternatives.

In summary, open-water disposal sites are the lowest cost alternatives in most cases, and these costs are strongly related to distance. Table 5-5 shows the distances between major harbors in the eastern Long Island Sound region and selected open-water disposal sites (NLDS, CSDS, CLDS, and RISDS). In highlighting the closest disposal site for each harbor, this table suggests what is likely the lowest cost open-water disposal alternative for each harbor.

Table 5-5. Distances between Selected Harbors and Open-water Disposal Sites

Navigation Project or Harbor	**New London Disposal Site**	**Cornfield Shoals Disposal Site**	**Central Long Island Sound Disposal Site**	**Rhode Island Sound Disposal Site**	**New London Disposal Site**	**Cornfield Shoals Disposal Site**	**Central Long Island Sound Disposal Site**	**Rhode Island Sound Disposal Site**
	miles				nautical miles			
Watch Hill Cove, RI	11.3	23.6	46.7	31.2	9.8	20.5	40.6	27.1
Little Narrag. Bay & Pawcatuck River (CT/RI)	14.7	27.0	50.2	34.6	12.8	23.5	43.6	30.1
Stonington Harbor, CT	9.1	21.4	44.5	29.0	7.9	18.6	38.7	25.2
Mystic Harbor	7.9	20.3	43.4	33.5	6.9	17.6	37.7	29.1
New London Harbor	5.3	16.8	39.9	51.2	4.6	14.6	34.7	44.5
Niantic Bay	6.7	11.2	34.3	52.6	5.8	9.7	29.8	45.7
Connecticut River - Saybrook Bar Entrance	12.4	3.5	25.6	50.4	10.8	3.0	22.2	43.8
Connecticut River - Essex Harbor	17.7	8.7	30.7	55.7	15.4	7.6	26.7	48.4
Clinton - Duck Island Harbor	17.8	6.3	19.3	53.3	15.5	5.5	16.8	46.3
Guilford Harbor	27.6	15.3	13.2	62.3	24.0	13.3	11.5	54.1
Mattituck Harbor, NY	27.4	16.3	17.8	60.5	23.8	14.2	15.5	52.6
Plum Gut Harbor (USDA)	8.7	7.4	29.7	40.5	7.6	6.4	25.8	35.2
Hay Harbor, Fishers Island	4.5	16.8	39.9	31.8	3.9	14.6	34.7	27.6

Distances flagged in grey mark the closest site.
Source: Appendix E-3 (USACE, 2003a) of 2004 CLIS/WLIS EIS

5.4 Impacts Associated with the No Action Alternative

As discussed in Section 3.3, NEPA requires an EIS to include an evaluation of the No Action Alternative. Evaluation of the No Action Alternative involves assessing the environmental and socioeconomic effects that would result if the proposed action did not take place. These effects can then be assessed and compared with the effects of the proposed Action Alternatives.

The No Action Alternative to the proposed action would consist of not designating any open-water site(s) in the eastern Long Island Sound region. As a result, several scenarios might reasonably be expected to occur. First, disposal site authorization for private projects involving less than 25,000 cy of material would simply continue being evaluated on a project-specific basis under CWA § 404. Second, for projects subject to MPRSA § 106(f) (*i.e.*, either federal projects or private projects involving greater than 25,000 cy of material), project proponents would need to pursue one or more of the following five scenarios, each of which pose different impacts over the long-term:

- **Scenario 1: *Utilize a short-term open-water site either inside or outside of the ZSF that has been newly "selected" by the USACE and concurred with by USEPA under MPRSA § 103.*** The use of such sites is limited to no more than two five-year periods, as explained in Chapter 1. Over the long-term, this approach would require the USACE to select sites as needed in the eastern Long Island Sound region, or elsewhere, thus spreading any environmental effects geographically. This would be contrary to the MPRSA principle, as discussed above, which favors the continued use of historically used sites. However, under this scenario, the two active sites (NLDS and CSDS) would no longer be available. Moreover, to the extent that sites outside of the eastern Long Island Sound region were considered for selection by the USACE, the greater haul distances involved would increase the cost and duration of each project. Depending on the distance from each dredging site to the particular disposal site, relying on sites selected outside the ZSF could potentially render some dredging projects infeasible. The increased haul distances would also increase the risk of accidents from larger waves and stronger tidal currents in The Race (if the disposal site is located outside the more protected Long Island Sound), increase project air emissions, and require greater fuel consumption. In addition, USACE-selected sites, unlike USEPA-designated sites, are not required to have Site Management and Monitoring Plans.

- **Scenario 2: *Use an existing designated long-term disposal site outside of the ZSF.*** The closest existing USEPA-designated disposal sites consist of the CLDS in central Long Island Sound to the west and RISDS in Rhode Island Sound to the east. These sites are both located at a considerable distance from the main dredging centers in the eastern Long Island Sound region. Reliance on such sites would increase the cost, duration, air emissions, and transportation safety risk of dredged material disposal projects from the eastern Long Island Sound region. This scenario could potentially render some dredging projects too expensive to conduct. Additionally, this scenario also uses up available disposal capacity at such designated sites.

- **Scenario 3:** ***Await designation of a new disposal site outside of the ZSF.*** No other site designation in the greater vicinity outside of the ZSF is currently under consideration by the USEPA. A potential site would have to be located on the continental shelf of the Atlantic Ocean, to the southeast of Montauk; travel distances to a continental shelf site would be similar or greater than to the designated CLDS or RISDS. Aside from higher transportation costs and air emissions, the risk of accidents due to larger waves, strong tidal currents in The Race, and other ship traffic are considerably greater.

- **Scenario 4:** ***Develop and utilize appropriate land-based or beneficial use alternatives.*** Neither New York, Connecticut, nor southwestern Rhode Island has available upland sites or beneficial use sites that would provide a reasonable, long-term alternative to an open-water site designation. The LIS DMMP has investigated various potential upland and beneficial use alternatives, but did not identify alternatives with sufficient capacity to meet the long-term dredged material disposal needs of the eastern Long Island Sound region (see Section 3.2). However, such alternatives may be suitable for some dredging projects, particularly for sandy dredged material, and, if so, will be strongly encouraged to be used. Another consideration is location of the disposal site relative to the dredging site, which affects cost and duration of dredging projects. Travel costs to disposal sites increase with distance from the dredging location.

- **Scenario 5:** ***Cancel the proposed dredging projects.*** This scenario would ultimately have adverse effects on navigational safety and marine-dependent commerce and recreation. It could also have adverse environmental ramifications if shoaling in navigation channels resulted in more marine accidents and spills and forced use of other transportation methods to move products, aside from potential traffic congestion and other impacts from increased truck traffic on the region's highways and roads. Rather than risk increased accidents and spills in unmaintained channels, marine shipping companies would more likely switch to smaller and less efficient vessels or shift their services to other ports outside the region with adequate depths. In the latter case, cargo now carried by ship would instead be shifted to less efficient land-based transportation.

Finally, it is noted that the SEIS is designed to assess alternatives to meet the overall, long-term dredging needs of the eastern Long Island Sound region. Disposal alternatives for individual projects would continue to be evaluated on a project-specific basis, and beneficial uses would be strongly encouraged when available.

Impacts that might arise from the various No Action Alternative Scenarios 1, 2, 4, and 5 are discussed in more detail below; Scenario 3 was not evaluated further as a site outside of the ZSF is not considered for potential designation. For all types of impacts associated with Scenario 1 (*i.e.*, new sites are selected either within or outside of Long Island Sound), the level of impact would vary depending on the number of sites selected and the volume of dredged material disposed. For this scenario, the existing conditions at the selected sites would first need to be assessed for a more detailed understanding of impacts.

5.4.1 Sedimentation and Erosion

The No Action Alternative Scenario 1 (new sites within or outside of ZSF) would have the potential for adverse environmental impacts because the new locations selected are likely to be areas where disposal has not previously occurred, although impacts would likely be minimized through appropriate investigations prior to site selection. Under Scenario 2 (use of a designated site), effects on sedimentation and erosion would reflect conditions at the chosen designated site; at the CLDS and RISDS effects would be minor or less with proper site management. Under Scenario 4 (land-based or beneficial use alternatives), beneficial use alternatives (*i.e.*, beach nourishment, nearshore berms) may offset coastal erosion effects from global sea level rise and protect coastal resources. There would be no sedimentation and erosion impacts for land-based alternatives. There would also be no impacts to eastern Long Island Sound under Scenario 5 (cancellation of projects), although sediment would eventually fill harbors and channels.

5.4.2 Sediment Quality

The No Action Alternative Scenario 1 (new sites within or outside of ZSF) may result in increased wider dispersion of dredged material, depending on local physical oceanographic conditions. Under Scenario 2 (use of a designated site), dredged material from the eastern Long Island Sound would likely have similar physical properties as dredged material disposed at the CLDS and RISDS from other regions. Under both Scenarios 1 and 2, as well as under Scenario 4 (land-based or beneficial use alternatives), environmental impacts to physical and chemical quality of the sediment would be minimized through required testing and site management. There would be no impacts to sediment quality under Scenario 5 (cancellation of projects).

5.4.3 Water Quality

As described in Section 5.2.1, impacts of open-water disposal on water quality are short-term in duration and minor in nature. The No Action Alternative Scenario 1 (new sites within or outside of ZSF) may result in increased dispersion of suspended sediment, depending on local physical oceanographic conditions. As for sediment quality, environmental impacts to water quality would be minimized through required testing and site management (see also discussion on water quality impacts from open-water dredged material disposal in Section 5.5.3). Under Scenario 2 (use of a designated site), impacts on water quality at the CLDS and RISDS would be minor or less, also through proper site management. Under Scenario 4 (land-based or beneficial use alternatives), there is a potential for impacts from surface water runoff and groundwater infiltration during the dewatering process and at upland placement sites, although risk would be minimized as a result of appropriate site protection and management measures. There would be no impacts under Scenario 5 (cancellation of projects).

5.4.4 Benthic Invertebrates

The No Action Alternative Scenario 1 (new sites within or outside of ZSF) would result in impacts to benthic invertebrates from the direct burial of species, similar to the Action Alternatives. The magnitude of the impacts would depend on the local benthic habitat, the species present at the selected site, and the physical oceanographic conditions that would determine the extent of dispersion of suspended sediment. Areas where Stage I and Stage II communities are dominant would experience slightly less impacts than areas where Stage III communities are established since Stage I and Stage II communities recolonize areas after disturbances more quickly than Stage III communities. Under Scenario 2 (use of a designated site), impacts to benthic invertebrates at the CLDS and RISDS would be minimal and short-term; there would be no long-term impacts. Under Scenario 4 (land-based or beneficial use alternatives), there would be no impacts for upland sites, but impacts to benthic invertebrates may occur for nearshore berm sites. There would be no impacts under Scenario 5 (cancellation of projects).

5.4.5 Fish

The No Action Alternative Scenario 1 (new sites within or outside of ZSF) may result in potential impacts to fish resources, depending on the species present, local habitat conditions, and the dispersion of suspended sediment. Impacts would range from mortality associated with burial of demersal species (though most fish would be able to avoid the descending plume of dredged material) to temporary displacement from the site. Other potential impacts include turbidity affecting feeding behavior, either adversely or beneficially depending on the species' mechanism for foraging as well as inhibiting effective respiration. Impacts, however, would be limited to the disposal area. Under Scenario 2 (use of a designated site), impacts to fish at the CLDS and RISDS would be minor and short-term, consisting primarily of localized, limited habitat disruptions; mortality from the burial of demersal species, turbidity affecting feeding behavior, either adversely or beneficially depending on the species' mechanism for foraging, as well as inhibiting effective respiration. There would be no long-term impacts. Under Scenario 4 (land-based or beneficial use alternatives), impacts could occur at upland sites that are close to nearshore fishing grounds or at nearshore berm sites where suspended sediment could increase local turbidity and impact fish species. Under Scenario 5 (cancellation of project), there would be no impacts on fish since dredged material disposal activities would not occur.

5.4.6 Commercial and Recreational Shellfish

The No Action Alternative Scenario 1 (new sites within or outside of ZSF) may result in potential impacts to shellfish resources, depending on the species present, local habitat conditions, and the physical oceanographic conditions that would determine the extent of dispersion of suspended sediment. Impacts would range from mortality associated with burial of species to temporary displacement from the site. Other potential impacts include turbidity affecting feeding and respiration. However, impacts would be limited to the disposal area. Under Scenario 2 (use of a designated site), impacts to shellfish at the CLDS and RISDS would be minor and short-term; there would be no long-term impacts. Under Scenario 4 (land-based or beneficial use alternatives), impacts to shellfish or horseshoe crabs would not be expected unless the upland site is close to nearshore shellfishing grounds where runoff from the site could adversely impact shellfish from increased sedimentation and turbidity. Under Scenario 5 (cancellation of project), there would be no impacts on shellfish resources since dredged material disposal activities would not occur.

5.4.7 Marine and Coastal Birds, Marine Mammals, and Marine Reptiles

The No Action Alternative Scenario 1 (new sites within or outside of ZSF) may result in potential impacts to marine and coastal birds, and marine mammals and reptiles depending on the species present. Impacts may include reduced foraging opportunities during disposal activities and possible physical injury to marine mammals and reptiles resulting from collisions with tugs/scows used to transport and place dredged materials. However, impacts to species would be minimal as ship strikes are extremely rare. For example, annual mortality from ship strikes for the entire Gulf of Maine stock of humpback whales for the period 2001-2005 was 1.4; and for the US/Nova Scotia stock of fin whales, the annual ship strike mortality was 1.6 (Kenney and Vigness-Raposa, 2010). Under Scenario 2 (use of a designated site), impacts to marine and coastal birds, and marine mammals and reptiles at the CLDS and RISDS would be minimal. Under Scenario 4 (land-based or beneficial use alternatives), there could be potential impacts to marine birds, mammals, and reptiles at nearshore berm sites, and impacts to coastal birds at beach nourishment and upland sites. Regardless of which disposal scenario is selected (*i.e.*, Scenarios 1 through 4), consultation with NMFS and USFWS would be necessary to assess potential impacts to these species. Under Scenario 5 (cancellation of project), there would be no impacts on marine and coastal birds, and marine mammals and reptiles since dredged material disposal activities would not occur.

5.4.8 Endangered and Threatened Species

Under No Action Scenario 1 (new sites within or outside of ZSF) the potential impacts on endangered or threatened species would depend on site-specific conditions and the species that may be present at each site. Under Scenario 2 (use of a designated site), impacts to endangered and threatened species at the CLDS and RISDS would be minimal. Under Scenario 4 (land-based or beneficial use alternatives), there could be potential impacts to marine related endangered and threatened species at nearshore berm sites, and impacts to terrestrial endangered and threatened species at beach nourishment and upland sites. Regardless of the disposal scenario chosen (*i.e.*, Scenarios 1 through 4), consultation with NMFS and USFWS would be necessary to assess, and if necessary, avoid or mitigate potential impacts to any endangered or threatened species that may occur at the disposal sites. Under Scenario 5 (cancellation of project), there would be no impacts on endangered and threatened species since dredged material disposal activities would not occur.

5.4.9 Bioaccumulation

All dredged material would undergo testing for its suitability for disposal, which should result in dredged material that poses a bioaccumulation threat being prohibited from open-water disposal. The No Action Alternative Scenario 1 (new sites within or outside of ZSF) may result in the potential for bioaccumulation over a broader area; however, the magnitude of this potential bioaccumulation would still be constrained by the limits imposed by the bioaccumulation testing requirements of the dredging program. Under Scenario 2 (use of a designated site) the potential for adverse environmental impacts from bioaccumulation at the CLDS and RISDS is very low based on over 30 years of monitoring those sites. Under Scenario 4 (land-based or beneficial use alternatives), there might be a higher potential for bioaccumulation to marine or terrestrial species depending on the location of the site. Under Scenario 5 (cancellation of project), there would be no impacts from bioaccumulation since dredged material disposal activities would not occur.

5.4.10 Socioeconomic Resources

5.4.10.1 Commercial Fishing

Commercial fishing activities in the ZSF could be impacted in two ways: dredging activities and disposal could directly affect the marine environment at disposal sites, and the potential postponement or cancellation of dredging projects could result in shallower channel and berth depths that would affect vessel access to ports and harbors. Short-term socioeconomic impacts to commercial fishing activities could occur under No Action Alternative Scenario 1 (new sites within or outside of ZSF) due to disruption of fishing activities at locations previously unused for disposal. However, impacts would be minimized due to restrictions prohibiting dredging from generally June 1 to September 30 of any year that have been developed and imposed by state fishery resource experts primarily to protect spawning and/or migrating fish and shellfish populations. Scenarios 2 and 4 (use of a designated site; land-based or beneficial use alternatives) may result in socioeconomic impacts to commercial fishing activities as higher disposal costs could result in cancellation or delays of dredging projects.

Under Scenario 5 (cancellation of projects), adverse socioeconomic impacts would be expected to commercial fishing activities depending on the homeport of the individual vessels. The lack of dredging and resultant shoaling in specific harbors could result in potential groundings, collisions, tidal delays, and spoilage of catch and lost fishing days. Over the long term, reduced channel and harbor depths could lead some fishermen to relocate to another port, which could in turn result in increased operating costs. Some fishermen might be forced to leave the industry as costs increase and profitability drops. Commercial fishing within the ZSF, which includes finfishing, shellfishing, and aquaculture, was estimated to contribute $56.9 million to the Gross State Product ($35 million for New York, $22 million for Connecticut and $0.2 million for the small portion of Rhode Island within the ZSF) in year 2007, used for the analysis in WHG (2001c) (see Table 4-27 in Chapter 4).

For deep harbors and channels, such as those in New London and the Thames River that serve commercial vessels and other large ships such as Navy submarines, there would be no or limited impact on fishing vessels in the short or medium-term. This is because the large vessels have much deeper drafts than fishing vessels, so even if dredging projects are cancelled, it would be many years before a channel dredged to 35 or 40-foot (11 or 12-m) depths would silt up to a point where it would affect commercial fishing vessels that have drafts of less than 15 feet (4.6 m).

5.4.10.2 Recreational Fishing

Short-term socioeconomic impacts to recreational fishing activities would occur under the No Action Alternative Scenario 1 (new sites within or outside of ZSF) due to disruption of fishing activities at locations previously unused for disposal. Impacts would be minimized due to restrictions prohibiting most dredging activities from generally June 1 to September 30 of any year that have been developed and imposed by state fishery resource experts primarily to protect shellfish and finfish populations (although hopper dredges involved in nearshore placement of sandy dredged material do work through the summer months in New England, including in Long Island Sound). Most recreational boating and fishing takes place in the summer months, so recreational fishing and dredging have nearly opposite peak seasons; this offset minimizes conflicts between the two activities.

Under Scenarios 2 and 4 (use of designated site; land-based or beneficial use alternatives), socioeconomic impacts could also occur if projects are cancelled due to higher disposal costs. In addition, under Scenario 4, impacts could occur if the selected land-based site is close to nearshore shellfish beds or fishing grounds. Under Scenario 5 (cancellation of projects), adverse socioeconomic impacts may occur because of reduced harbor and channel depths, but to a lesser extent than for commercial fishing because of the diversity of vessel types and drafts. This impact also depends on the homeport of the individual vessels. Recreational boating, including sportfishing was estimated to contribute $494 million to Gross State Product in the ZSF in 2007 (see Table 4-27 in Chapter 4).

5.4.10.3 Shipping and Navigation

The socioeconomic impacts to shipping and navigation under No Action Alternative Scenario 1 (new sites within or outside of ZSF) would generally remain unchanged since it is likely that dredging activities at various sites would be managed as to not interfere with shipping and navigation traffic. Under Scenarios 2 and 5 (use of a designated site; cancellation of projects), adverse socioeconomic impacts to shipping and navigation would be expected. Specifically, higher transport costs for dredged material would lead to a reduction in dredging activity (Scenario 2); cancellation of projects would render some port facilities unusable for certain types of vessels and port activities (Scenario 5). Under Scenario 4 (land-based or beneficial use alternatives), socioeconomic impacts would also increase since dredged materials would now have to be rehandled and transported by land increasing cost, air emissions, and traffic. In addition, the limited number of suitable upland and beneficial use sites to accommodate the dredging needs of the region might also result in reduced dredging of harbors and channels.

With shoaling of channels and anchorages of these harbors, the average controlling depths would decrease, and depth-related restrictions on navigation access to these harbors would increase. The potential for collisions and groundings would increase. Restricted vessel operations at commercial ports would cause some businesses to close or shift to other ports within and outside of the eastern Long Island Sound region, or use means of reducing draft, such as shifting to cargo barges, lightering of cargo, or light loading at the point of origin. All of these actions would increase the cost of waterborne transport and some might require substitution of land-based transport, mainly trucks, to move the goods.

Reduced navigation access at smaller harbors would limit recreational opportunity and fishing time, and over time would contribute to a reduction in vessel size and drafts of the fleets using these harbors. At some point it is likely that increased costs for harbor maintenance would trigger a re-examination of the role of public funding of harbor maintenance for economically marginal harbors, both small and large. In addition, all federal dredging projects, and non-federal projects greater than 25,000 cy (19,114 m^3) (such as the dredging of large marinas, major state and municipal facilities, or deep-draft berths), would be less likely to occur without an affordable disposal site.

Dredging and disposal for non-federal projects up to 25,000 cy (19,114 m^3) would likely continue to occur as they do currently, since the restrictions on disposal of dredged material due to MPRSA only apply to those projects over 25,000 cy (19,114 m^3). However, these smaller, non-federal projects could still be impacted under the No Action Alternative because of the dependence of these users on the federal channels that provide them access. With less frequent or curtailed maintenance of the federal channels, the private facilities along those channels would find maintenance dredging less viable, since the controlling depths could be less in the access channels than in their berths or slip space. For example, over time a marina may see its customer base converted to smaller craft as average channel controlling depths decline with less frequent channel dredging, regardless of how frequent the marina’s slip areas are dredged.

In the 2001 dredging needs survey (USACE, 2001) and in the 2013-2014 public scoping meetings for the SEIS, marina owners expressed concern that they would face economic hardship without an affordable, environmentally sound, designated site to dispose of their dredged material. An updated survey of navigation-dependent facility owners was conducted as part of the 2009 dredging needs study for the LIS DMMP (Battelle, 2009a). While the study focused on dredging needs, its questionnaire also addressed possible economic impacts on local facilities if dredging did not occur. Battelle (2009a) summarized that most facility owners raised concerns over the dredging and disposal costs and the need for dredging in federal channels near their facilities. There were also comments that indicated that a lack of dredging would reduce the number, size, and types of vessels that can access the facilities. Respondents to the Battelle survey further considered the lack of dredging as having a negative impact on the economic viability of their facilities; several facilities contacted by Battelle were in the process of being sold or closing because the current owners could afford to dredge. The earlier survey (USACE, 2001) indicated that owners of private facilities such as small marinas have a lower threshold of perceived affordability, while large deep-draft facility managers likely have the higher operating revenues needed to support somewhat higher maintenance costs for dredging. However, for many navigation-dependent industries, without a nearby open-water site, disposal of fine-grained dredged material at more distant sites under Scenario 2 (*i.e.*, CLDS and RISDS) could be considered unaffordable, with estimated costs of \$63 to \$86 per cy for a 26,000 cy project for haul distances of 30 to 60 miles (26 to 52 nmi; 48 to 97 km) (Table 5-1). For beach nourishment alternatives (for sand only), costs range from \$60 to \$107 when direct placement by pipeline is not available. Costs would be even higher for alternatives such as marsh creation, CAD cell creation and placement, or island CDF alternatives (Tables 5-2 to 5-4). As discussed in the cost analysis contained in Section 5.3, nearly all of the alternatives to open-water disposal would result in substantially higher disposal costs to some private, municipal, and federal dredging projects in the ZSF, particularly for fine-grained material that cannot be used for beach nourishment.

The current level of navigation-dependent economic activity around the eastern Long Island Sound region would likely decrease if dredging projects are postponed or cancelled because a designated site within the ZSF is not available. In this case, harbors would shoal in and the depth of channels, anchorage areas, berths, and mooring areas would be reduced because maintenance dredging is performed less frequently or not at all. The estimated $2.3 billion in Gross State Product produced by the direct, indirect, and induced impacts of the commercial navigation and the U.S. Navy Submarine Base in New London would be threatened, and a portion of the estimated 30,325 jobs and $702 million in tax revenues for eastern Connecticut would be threatened as well. It should be noted that the U.S. Navy currently takes responsibility for dredging of the Thames River because of the importance of deep draft access to the Submarine Base in New London and thus requires a suitable and affordable disposal alternative to maintain the existing channel system. Depending on shoaling rates, the deferral of dredging in the Thames River would at some point make the Submarine Base inaccessible to submarines, which have a maximum draft of 36 feet (11 m). This would consequently limit the use of the facility as a submarine base and significantly reduce the $944 million that the base is estimated to contribute to the regional economy (WHG, 2010c).

5.4.10.4 Recreational Activities and Beaches

Under No Action Alternative Scenario 1 (new sites within or outside of ZSF), the socioeconomic impacts to recreational activities and beaches would depend on the location of the sites. Under Scenarios 2 and 5 (use of a designated site; cancellation of projects), impacts to most recreational activities and beaches would be minimal with the exception of recreational boating, which could be significant in specific harbors. Recreational boating is very popular in Long Island Sound. (Potential effects on recreational fishing are discussed farther above.) Shoaling of access channels and facilities would result in reduced boat use and thus reduced recreational opportunities, leading to reduced revenues for marinas, other service providers, and destination ports. This effect would be multiplied throughout the local and regional economies as the reduced revenues lead these businesses to spend less on payrolls, supplies and services. Under Scenario 4 (land-based or beneficial use alternatives), socioeconomic impacts to recreational activities and beaches would not be expected unless the upland disposal site is located nearby. Nearshore berm and beach nourishment projects could cause short-term adverse impacts but would have beneficial impacts over the longer term.

5.4.10.5 Parks and Natural Areas

Under No Action Alternative Scenario 1 (new sites within or outside of ZSF), the socioeconomic impacts to parks and natural areas would depend on the location of the sites. Under Scenarios 2 and 5 (use of a designated site; cancellation of projects), impacts to parks and natural areas would be minimal. The only exceptions would be areas accessible only by boat, and areas that shoal and require dredging. It would be expected that the majority of these types of areas are small and require less than 25,000 cy to maintain access, and thus would have access to open-water sites under CWA §404. Under Scenario 4 (land-based or beneficial use alternatives), socioeconomic impacts to parks and natural areas would not be expected unless the upland disposal site is located nearby. Beneficial impacts may result from the placement of dredged material along beaches of coastal parks or natural areas in areas of erosion or as protection from storm surge and sea level rise.

5.4.10.6 Historic and Archaeological Resources

The socioeconomic impacts to historic and archaeological resources under No Action Alternative Scenario 1 (new sites within or outside of ZSF) would depend on the location of the sites and resources within it. Regardless of disposal option selected, coordination with State and Tribal Historic Preservation Offices would be required, and potential site investigations may be needed. Under Scenario 2 (use of a designated site), there would be no impacts at the CLDS and RISDS as historic and archaeological resources were not identified at the sites. Under Scenario 4 (land-based or beneficial use alternatives), historic and archeological resources would also not be impacted in open waters, although there could be impacts of such resources at upland disposal sites. Under Scenario 5 (cancellation of projects), historic and archaeological resources in open waters would not be impacted.

5.4.10.7 Other Human Uses

Other human uses refer to issues such as military exercises or operations, cable and pipeline crossings, and renewable energy development. There would be no impacts under Scenario 2 (use of a designated site). Under Scenario 1 (new sites within or outside of ZSF) and Scenario 4, socioeconomic impacts to other human uses would depend on the location of the sites and human uses within it. However, disposal activities would avoid transporting material through any military use areas to avoid any conflicts, and there would be no cable and pipeline routes within a selected site. Under Scenario 5 (cancellation of projects), potential impacts to other human uses would occur as a result of reduced vessel access to Long Island Sound and Block Island Sound associated with shoaling harbors and channels.

5.4.11 Air Quality and Noise

5.4.11.1 Air Quality

Air emissions and odors are generated during dredging operations and the transportation of dredged material to the disposal location. These activities would need to comply with Connecticut Air Pollution Control Regulations, Vehicle Emission Standards, and Fugitive Dust Regulations to minimize impacts (CTDEEP, 2015c).

Air emissions and odors under No Action Alternative Scenario 1 (new sites within or outside of ZSF) would be expected to be similar to air emissions from Action Alternatives. Under Scenario 2 (use of a designated site), air emissions would be higher as a direct result of the increased hauling distance for the dredged material, as well as using large scows with more powerful tug boats. Under Scenario 5 (cancellation of projects), some impacts from air emissions may occur locally as a result of shifts in utilization of harbor areas due to shoaling.

Under Scenario 4 (land-based or beneficial use alternatives), it is possible that air emissions would increase due to emissions resulting from equipment (*i.e.*, pumps, trucks) needed to transfer material from scows to dewatering sites and then to the final disposal site(s). Trucks hauling the material to the site would emit pollutants, including NO_x and PM2.5. Transportation to the furthest disposal sites would generate the most air pollutants and consume the most fuel. Pollutants would be also be generated by heavy construction equipment during disposal on land. Land-based alternatives may include a dewatering site prior to final disposal. During transport of dredged material from the dredging site to the dewatering site, tugs, trucks, and other equipment used in this process, would generate minor amounts of air pollutants. Odor impacts may also occur during the transportation of the dredged material, as well as in the vicinity of dewatering and final disposal sites, depending on the specific handling of the materials; environmental consequences would be site-specific.

5.4.11.2 Noise

Noise is generated during transportation of dredged material to the disposal location. Noise levels under No Action Alternative Scenarios 1 and 2 (new sites within or outside of ZSF; use of a designated site) would not be expected to be substantially different from background noise levels in the area. Under Scenario 4 (land-based or beneficial use alternatives), noise impacts might occur from truck traffic transporting the dredged material to upland disposal facilities. Under Scenario 5 (cancellation of projects), some impacts from noise may occur locally as a result of shifts in utilization of harbor areas due to shoaling.

5.5 Impacts Associated with the Action Alternatives

This section addresses the potential physical, biological, and socioeconomic impacts that could result from dredged material disposal at each of the three alternative sites. Potential concerns analyzed include the possibility of sedimentation and erosion of material following disposal, as well as the potential impacts of disposal on sediment quality; water quality; benthos, fish and shellfish, marine and coastal birds, marine mammals and reptiles, and endangered and threatened species; contaminant levels in selected species; commercial and recreational fishing; shipping and navigation; recreational activities and beaches; parks and natural areas; historic and archeological resources; and other human uses. This section is structured into subsections that address each of these potential impact categories.

5.5.1 Sedimentation and Erosion

As discussed in Section 5.2, the disposal of dredged material at open-ocean sites results in the deposition of non-native sediments in a mound at the disposal site. Over time, as currents move over this mound, hydraulic forces act on the sediment particles in the form of shear and lift. The response of the particles to these forces is determined by current speed, particle size, shape, density, and any friction or cohesion exerted by adjacent sediment grains. At higher speeds, the fluid may exert sufficient force to cause the grains to move so that sediment is eroded from the bottom and suspended (or resuspended) into the water column for transport.

The stability of dredged materials at the three alternative sites was assessed using two approaches:

- *FVCOM Model:* The first approach was based on the principle that bottom sediment is mobilized when the shear stress on the bottom (*i.e.*, ”bottom stress”) exerted by motion in the overlying water exceeds a threshold value (*i.e.*, the critical bottom stress) that is determined by the physical and biogeochemical conditions of the sediment. Simulations with the FVCOM model are presented in detail in Appendix C-2.

- *LTFATE Model:* The second approach was based on the erosion and transport model LTFATE, which was developed by the USACE to simulate the behavior of dredged material deposited on the seafloor (Scheffner et al., 1995; Scheffner, 1996). LTFATE was intended for classifying disposal sites as either dispersive sites or containment sites (see definition in Section 3.4.2.1) by evaluating the potential migration of disposed dredged material. LTFATE simulates the effects of the water’s motion using linear wave theory (Dean and Dalrymple, 1991) and a combined wave and current bottom stress formulation similar to that of Grant and Madsen (1986). Using mean current data or circulation model predictions, these theories yield an estimate of bottom stress. The rates of erosion and the consequent evolution of the morphology of sediment mounds are predicted by LTFATE if the vertical critical bottom stress in the sediment column is known.

  The simulation of sediment transport in LTFATE has evolved through two versions. Version 1 (Scheffner et al. 1995; Scheffner 1996) computed sand transport as the combined effect of both bed and suspended load. Version 2 represented these processes separately

> and was employed by Battelle (2004) as part of the studies for the designation of the RISDS, although the author found the model to be unstable in some circumstances. Recently, LTFATE version 2 has been withdrawn by the USACE and is being replaced with Multi-Block LTFATE (MB-LTFATE), which is a sophisticated hydrodynamic and sediment transport modeling system. Development and documentation of this system is ongoing. Therefore, the stability of the disposal mounds over time was simulated using LTFATE version 1; results are described in Appendix C-3.

Both approaches are based on the magnitude of the bottom stress and the expected physical characteristics of the dredged material that is deposited on the bottom. However, the analysis of sedimentation and erosion in this SEIS emphasized the results of the FVCOM bottom stress calculations because the stress simulations in FVCOM have received more critical evaluation than those computed by LTFATE, the mound motion predicted by LTFATE was inconsistent with DAMOS monitoring of mounds at the NLDS, and the determination of critical bottom stress as the threshold for erosion (used for classifying the three alternative sites) is clearer.

Critical Bottom Stress. In sediments with particle sizes less than 0.063 mm in diameter (*i.e.*, silt and clay), the stabilizing influence of inter-particle electrochemical interactions are at least as important as the gravitational forces in resisting the drag and lift forces exerted by water motion on bed sediments. Consequently, the critical bottom stress above which sediment begins to move is higher when very small sediment particles are present. The work of Righetti and Lucarelli (2007) and Lick et al. (2004) suggests that for coarse silt and fine sand (0.03 to 0.13 mm), a critical bottom stress of 0.54 to 1.06 Pa would be appropriate.

There is also considerable other evidence that supports substantially higher critical bottom stress in complex marine sediments. Van Ledden et al. (2004) described the principal effects of silt/clay on the critical erosion stress threshold for sand-silt/clay mixtures and demonstrated that the mixture exhibited significant cohesion when the silt/clay fraction exceeded 5-10% of the sediment mass. Grabowski et al. (2011) provided a comprehensive review and summarized the significance of the particle size distribution, bulk density, water content, organic matter concentration, the type of the clay particles, temperature, salinity, pH, metal concentration, and the feeding ecology of the benthic community; the authors concluded that these effects can increase the critical bottom stress for cohesive sediments by factors of between 10^2 and 10^3 over that for non-cohesive sediments. Consolidation and seasonal cycles in temperature and salinity cause temporal variation at the seabed and further complicate the determination of the critical bottom stress. Thompson et al. (2013) deployed a benthic annular flume in the North Sea to measure the critical bottom stress and obtained results at sites with mean sediment grain sizes of 0.063 mm and 0.071 mm. Their measurements suggested that the critical bottom stress ranged from 0.66 to 1.27 Pa, in broad agreement with the theory and lab experiments of Lick et al. (2004) and Righetti and Lucarelli (2007). Reports on the application of LTFATE (USACE, 1998; Battelle, 2004) prescribed the vertical structure of the critical bottom stress at sites in Rhode Island Sound and the Gulf of Maine to be low at the surface of the seafloor but to rise quickly to 0.96 Pa a few centimeters below the sediment surface. In summary, available information suggests that the cohesive sediment mixtures with various grain sizes have a high critical bottom stress.

Most of the dredged material disposed of in eastern Long Island Sound consists of mixtures of particles in the range 0.01-0.06 mm, *i.e.*, silt and clay to very fine sand (SAIC, 1995). The Righetti and Lucarelli (2007) predictions for the critical bottom stress in these types of grain sizes are in the range of 1.35 to 2.81 Pa. The field observations of Thompson et al. (2013) at sites with mean sediment grain sizes of 0.063 mm and 0.071 mm suggested that the critical bottom stress ranged from 0.66 to 1.27 Pa. This is slightly lower that the model prediction obtained by Righetti and Lucarelli (2007). To assess the erosion potential of disposed dredged material at the alternative sites, the analysis in this SEIS adopted a critical bottom stress value of 0.75 Pa as the threshold to classify alternative sites, since it is at the lower end of the range of values found in the literature for cohesive sediment mixtures. Specifically, sites where the maximum bottom stress exceeds this threshold value are considered dispersive sites; sites where the maximum bottom stress is below this threshold value are considered containment sites.

FVCOM Bottom Stress Simulations. The maximum bottom stresses that occur in the ZSF were estimated based on a model that simulated the circulation and hydrography and included all physical oceanography (PO) study data collected during various seasons throughout the year (*i.e.*, from all observation campaigns) (Appendices C-1 and C-2). The bottom stresses estimated for individual campaign periods were validated using field observations. Figure 4-18 shows the maximum bottom stresses in the ZSF predicted during 2013. Bottom stresses during other campaign periods are included in Appendix C-2. Bottom stresses are highest in areas of high flows (such as in The Race and around Montauk Point) and lowest in comparatively protected areas (such as around Gardiners Bay and west of Block Island). Bottom stress simulations using FVCOM for the three alternative sites are discussed below.

5.5.1.1 New London Alternative

The maximum bottom stress values within the New London Alternative during 2013 are below the 0.75 Pa threshold for erosion (Figure 4-21). Specifically, the maximum bottom stress values at the NLDS and Site NL-Wa are 0.64 Pa. Maximum bottom stress values at Site NL-Wb are also below 0.75 Pa, with the exception of the southwestern corner of the site, located in an area of bedrock and boulders, where the maximum bottom stress is 0.76 Pa.

The relatively low maximum bottom stresses at the NLDS are consistent with the observations by the DAMOS program which compared pre-storm and post-storm bathymetric surveys and concluded that there was little movement of the dredged sediments due to a major storm (SAIC, 2003). Low bottom stress is also consistent with the hummocky topography of the NLDS (Figure 4-4), which indicates that surface sediments are not reworked by storms and tidal currents. This was also observed by other DAMOS site surveys (*e.g.*, SAIC, 2004; AECOM, 2009).

The distribution of maximum bottom stresses that occurred during Superstorm Sandy (October 28-31, 2012) was computed to assess conditions during an unusually large event. This storm produced the largest significant wave heights ever observed in Long Island Sound, and wind speeds of 46 knots (23.6 m/s) were observed. The pattern of maximum stresses simulated for the period including Superstorm Sandy (Figure 4-22) is similar to the pattern of maximum stresses for 2013 shown in Figure 4-21. During Superstorm Sandy, there were a few areas in eastern Long Island

Sound where higher maximum stresses occurred, but in deeper water (including in the area of the New London Alternative, there were no major changes in the maximum stress values.

These results indicate that the New London Alternative is a containment site; disposed dredged material would remain at the site, with the possible exception of the southwestern corner of Site NL-Wb.

5.5.1.2 Niantic Bay Alternative

At the Niantic Bay Alternative, there is considerable spatial variation in the magnitude of the maximum bottom stress computed for 2013 (Figure 4-21). The bottom stress in the northern part of Site NB-E is in the range of 0.5 to 0.6 Pa, and is similar to the bottom stresses at the New London Alternative. However, in the southern and western parts of the Niantic Bay Alternative, the stress is in excess of 0.75 Pa.

The potential effect of a severe storm on the bottom stress is demonstrated in Figure 4-22, which shows the maximum bottom stresses during the period from October 2012 through January 2014 which includes the simulation of Superstorm Sandy. This storm results in substantially higher maximum bottom stresses in the northwestern part of the Niantic Bay Alternative. The maximum bottom stresses in other parts of the Niantic Bay Alternative remain similar to those without the Superstorm Sandy simulation (Figure 4-21).

These results indicate that the northeastern portion of the Niantic Bay Alternative is a containment area (see Figure 4-22). The remaining portion of the Niantic Bay Alternative is considered a dispersive area. Simulations of the transport of materials using FVCOM shows that fine sediments eroded and suspended from the dispersive portion of the Niantic Bay Alternative would be rapidly diluted and dispersed in the water column of eastern Long Island Sound.

5.5.1.3 Cornfield Shoals Alternative

Based on the simulation of 2013, the maximum bottom stresses in the vicinity of the Cornfield Shoals Alternative are high throughout this site, exceeding 1.0 Pa (Figure 4-24). Maximum bottom stresses did not increase during Superstorm Sandy (Figure 4-25) at this site. Instead, it appears that the transient wind-forced current was in the opposite direction to the mean and tidal current during the storm and this led to a bottom stress reduction.

The relatively high maximum bottom stresses at the CSDS are consistent with the observations by the DAMOS program (*e.g.*, ENSR, 2005, and references therein). They are also consistent with observations of the bottom topography made through the USGS/NOAA bathymetric survey (Figure 4-6) and through a sidescan sonar survey (Figure 4-7). While there are indications of dredged material in the bottom sediments and of diffuse mounds within the CSDS (see Section 4.2.5), none of these surveys identified mounds that would account for the nearly 3 million cy (2.3 million m^3) of dredged material disposed at the CSDS since 1960.

These results indicate that the Cornfield Shoals Alternative is a dispersive site. Dredged material eroded from the site would initially be transported predominantly in an east-west direction by the tidal flow. Eroded and suspended sediment would be dispersed in the water column of Long Island Sound; the net (long-term) flow direction of eroded sediments would be to the west, as shown through physical oceanographic modeling and the shape of sand dunes on the seafloor (Figure 4-7).

5.5.1.4 Summary for Sedimentation and Erosion

The three alternative sites differ with regard to sedimentation and erosion of disposed cohesive dredged materials. The New London Alternative would largely be a containment site where dredged material would remain on the seafloor, similar to conditions at the existing NLDS. The Cornfield Shoals Alternative would be a dispersive site where dredged material disposed at the site would be eroded over time and transported predominantly toward the west, similar to conditions at the existing CSDS. The Niantic Bay Alternative would include both a containment area and a dispersive area; any sediment that was resuspended within the dispersive area would initially be transported in the dominant direction of tidal flows (*i.e.,* east-west) and dispersed in eastern Long Island Sound.

5.5.2 Sediment Quality

The existing sediment quality differs to some extent between the three alternative sites. Sediments at the Cornfield Shoals and Niantic Bay Alternatives are coarser-grained on average and have lower TOC concentrations than at the New London Alternative. The finer grain sizes and higher TOC content at the New London Alternative are mainly a result of the dredged material disposal at the NLDS. Similarly, while overall contaminant concentrations at the three alternative sites were low or not detected, a few samples at the NLDS exceeded the NOAA ERL guideline values for specific compounds. Comparisons of metals and organic compounds in sediments from the three alternative sites to the NOAA guideline values (ERLs and ERMs) indicated that the sediments at the three alternative sites are unlikely to be toxic. Further, laboratory toxicity test data demonstrated that sediments from each site are not acutely toxic to *Leptocheirus plumulosus* or *Americamysis bahia*.

For the purpose of future disposal activities, any dredged material proposed for disposal at one of the alternative disposal sites would be tested and evaluated in accordance with applicable regulations, as described in Chapter 1, prior to disposal. Such dredged material would have to satisfy the sediment quality criteria of USEPA's ocean disposal regulations before it would be approved for open-water disposal. Therefore, adverse effects to sediment quality as a result of dredged material disposal are not likely at any of the alternative sites.

5.5.3 Water Quality

Water quality impacts at the disposal sites could be caused by short-term changes in particle concentrations in the water column following disposal. Such changes, if any, would involve only sporadic and temporary (<few hours) increases in suspended solids in the water column due to

unconsolidated sediments that are stripped away from the descending sediment mass as it travels through the water column to the seafloor. A detailed discussion of dredged material disposal plume behavior is presented in Section 5.1.

Grains of sediment and other particulate material present in the water column are measured as total suspended solids (TSS), reported as milligrams of solids per liter of water (mg/L). As discussed in Section 4.7.1, the term "turbidity" is often used when referring to suspended solids in the water column; however, turbidity is an optical property of water referring to the blockage of light as it passes through water. Particles do not remain suspended in the water column indefinitely; they settle to the seafloor at rates that depend upon their size and density. Suspended sediments present in the water column during and after disposal operations could affect the feeding activities of fish and benthic organisms and at extremely high concentrations could kill or injure fish and benthic organisms. Contaminants present in the dredged material disposal plume could also be available to marine organisms.

Most of the dredged material disposed in Long Island Sound consists of very fine sand to silt and clay (Rhoads, 1994). As discussed in Section 5.1, while the bulk of the dredged material would settle to the seafloor in the first few minutes after release, low concentrations of fine particles may persist for several hours in the water column, during which time they may be moved by the currents. The maximum amount of sediment that may be released to the water column by a disposal event was estimated by Rhoads (1994) and Tavolaro (1984) at 1-5% of the dredged material (dry mass). Dragos and Lewis (1993) and others demonstrated that the plume was detectable following disposal events at the New York Mud Dump Site in the New York Bight (water depth approximately 92 feet [28 m]) for only a few hours.

Dilution Criterion. The USACE routinely employs suspended particulate phase (SPP) (*i.e.*, elutriate) toxicity tests to evaluate the suitability of dredged material for ocean disposal by assessing the sensitivity of indicator organisms to eluted contaminants. These elutriate tests determine the dilution required of sediment samples to reach elutriate levels fatal to 50% of the indicator organisms (*i.e.*, LC_{50}). The "Green Book" – *Evaluation of Dredged Material Proposed for Ocean Disposal: Testing Manual* (USEPA and USACE, 1991) – sets a limiting permissible concentration (LPC) of 1/100th of the elutriate LC_{50} concentration, which may not be exceeded after the period of initial mixing (4 hours after disposal) anywhere within the designated disposal site or at any time outside the disposal site.

This analysis adapts the procedures set forth by the "Green Book" for project-specific evaluation to provide an estimate of an appropriately conservative LC_{50} value to use for evaluating the three alternative sites. The approach is similar to that used in the CLIS/WLIS EIS (USEPA and USACE, 2004a). The approach for calculating the LPC for the three alternatives sites was as follows:

- *Date Sources:* The most recent available elutriate tests from harbors with dredging needs in eastern Long Island Sound were used, consisting of the following (Figure 5-2):
    1. Guilford Harbor Federal Navigation Project, Guilford, CT (USACE, 2000)
    2. Clinton Harbor Federal Navigation Project, Clinton, CT (USACE, 2010b)

3. Patchogue River Federal Navigation Project, Westbrook, CT (USACE, 2011b)
4. North Cove Federal Navigation Project, Old Saybrook, CT (USACE, 2003b)
5. Americas Styrenics, LLC. – Thames River at Allyn's Point, Gales Ferry, Connecticut (Americas Styrenics, 2014).

- *Species evaluated:* The analysis used data from these projects for all species tested for each project. The species included *Americamysis bahia* (a shrimp-like crustacean in the order Mysida, the opossum shrimp), *Menidia beryllina* (a brackish/marine fish in the order Atheriniformes, the inland silverside), and *Arbacia punctulata* (the purple-spined sea urchin).

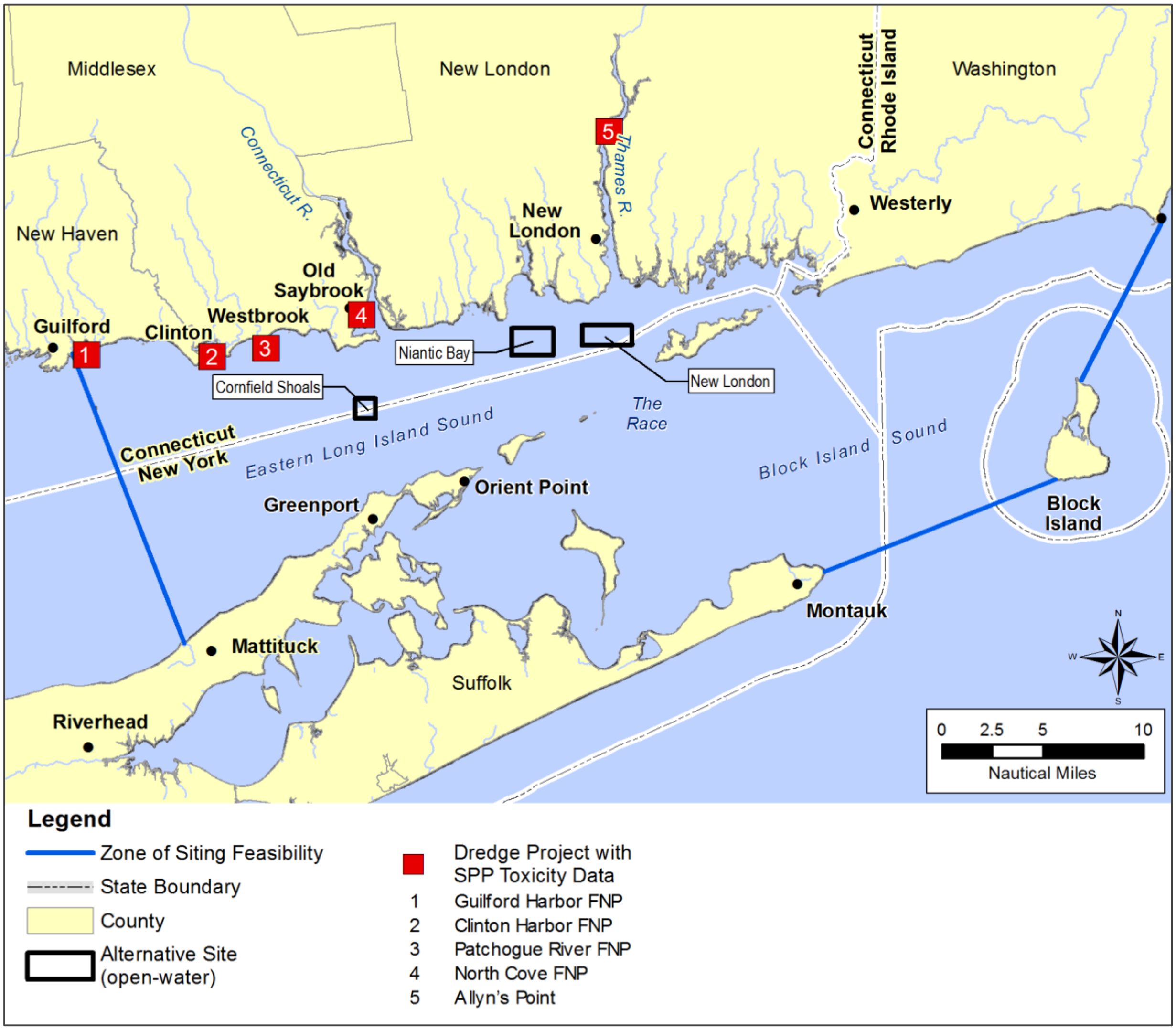

Figure 5-2. Location of harbors with suspended phase toxicity test results from sediments (four federal navigation projects [FNP] and one private project) (Sources: USACE, 2000, 2003b, 2010b, 2011b; Americas Styrenics, 2014).

- *Determination of the LPC Value:* All these data were tabulated from low to high LC_{50} values (Table 5-6). The lowest (most toxic) 10% of LC_{50} values were then averaged. The average LC_{50} value was divided by 100 to determine the LPC to meet the requirements of the "Green Book". The five lowest (most toxic) LC_{50} values ranged from 15.7% to 35.5%, with an average of 25%. Therefore, the LPC for the eastern Long Island Sound alternative sites is 0.25%.

Table 5-6. Suspended Phase Toxicity Test Results from Harbors with Dredging Needs along Eastern Long Island Sound from 2000 to 2014

Project	**Location**	**Year**[1]	**Species**			**Sample** [2]	**LC_{50}** [3]
			A. punctulata	*M. beryllina*	*A. bahia*		
North Cove	Old Saybrook	2003	●			NCC 3-16	15.7%
Clinton Harbor	Clinton	2010	●			Comp G/H	17.7%
North Cove	Old Saybrook	2003	●			NCC 1-2	22.1%
Guilford Harbor	Guilford	2000	●			GH-FGH-COMP	33.7%
Guilford Harbor	Guilford	2000	●			GH-ABC-COMP	35.5%
Allyn's Point / Thames R.	Gales Ferry	2014		●		Turning Basin dilute with CLIS	39.5%
Allyn's Point / Thames R.	Gales Ferry	2014		●		Turning Basin dilute with NLDS	41.1%
Guilford Harbor	Guilford	2000	●			GH-IJK-COMP	43.9%
Clinton Harbor	Clinton	2010	●			Comp I/J	47.8%
Allyn's Point / Thames R.	Gales Ferry	2014		●		Ship Berth dilute with CLIS	50.1%
Allyn's Point / Thames R.	Gales Ferry	2014		●		Ship Berth dilute with NLDS	52.9%
Guilford Harbor	Guilford	2000		●		GH-IJK-COMP	69.7%
Allyn's Point / Thames R.	Gales Ferry	2014			●	Turning Basin dilute with CLIS	73.5%
Guilford Harbor	Guilford	2000		●		GH-ABC-COMP	73.5%
Patchogue River	Westport	2011		●		Core FGHI	78.9%
Allyn's Point / Thames R.	Gales Ferry	2014	●			Turning Basin dilute with CLIS	100%
Allyn's Point / Thames R.	Gales Ferry	2014			●	Ship Berth dilute with CLIS	100%
Allyn's Point / Thames R.	Gales Ferry	2014	●			Ship Berth dilute with CLIS	100%
Allyn's Point / Thames R.	Gales Ferry	2014			●	Turning Basin dilute with NLDS	100%
Allyn's Point / Thames R.	Gales Ferry	2014	●			Turning Basin dilute with NLDS	100%
Allyn's Point / Thames R.	Gales Ferry	2014			●	Ship Berth dilute with NLDS	100%
Allyn's Point / Thames R.	Gales Ferry	2014	●			Ship Berth dilute with NLDS	100%
Guilford Harbor	Guilford	2000			●	GH-ABC-COMP	100%
Guilford Harbor	Guilford	2000			●	GH-FGH-COMP	100%
Guilford Harbor	Guilford	2000			●	GH-IJK-COMP	100%
Guilford Harbor	Guilford	2000		●		GH-FGH-COMP	100%

Table 5-6. Suspended Phase Toxicity Test Results from Harbors with Dredging Needs along Eastern Long Island Sound from 2000 to 2014

Project	Location	Year[1]	Species			Sample [2]	LC_{50} [3]
			A. punctulata	*M. beryllina*	*A. bahia*		
Clinton Harbor	Clinton	2010			●	Comp G/H	100%
Clinton Harbor	Clinton	2010			●	Comp I/J	100%
Clinton Harbor	Clinton	2010			●	Comp K/L/M	100%
Clinton Harbor	Clinton	2010		●		Comp G/H	100%
Clinton Harbor	Clinton	2010		●		Comp I/J	100%
Clinton Harbor	Clinton	2010		●		Comp K/L/M	100%
Clinton Harbor	Clinton	2010	●			Comp K/L/M	100%
North Cove	Old Saybrook	2003			●	NCC 1-2	100%
North Cove	Old Saybrook	2003			●	NCC 3-16	100%
North Cove	Old Saybrook	2003		●		NCC 1-2	100%
North Cove	Old Saybrook	2003		●		NCC 3-16	100%
Patchogue River	Westport	2011			●	Core ABC	100%
Patchogue River	Westport	2011			●	Core DE	100%
Patchogue River	Westport	2011			●	Core FGHI	100%
Patchogue River	Westport	2011			●	Core JKL	100%
Patchogue River	Westport	2011			●	Core MNO	100%
Patchogue River	Westport	2011		●		Core ABC	100%
Patchogue River	Westport	2011		●		Core DE	100%
Patchogue River	Westport	2011		●		Core JKL	100%
Patchogue River	Westport	2011		●		Core MNO	100%

[1] Sources: Americas Styrenics, 2014; USACE, 2000; USACE, 2003b; USACE, 2010b; USACE, 2011b. The year in the column corresponds to the year in the source.

[2] Sample name as specified in the original study.

[3] Tabulated from low to high LC_{50} values. The first five rows represent the lowest 10% of these values.

Dilution Modeling. The potential impact of dredged material disposal on the water column at the three alternative sites was evaluated using the USACE Short-Term Fate (STFATE) dredged material disposal model to predict disposal plume behavior and dilution (Appendix C-3), and then these results were compared to the LPC. STFATE was developed to model plume behavior including physical mixing, transport, settling and contaminant dilution in and around disposal sites during the first few hours after the release of dredged material. The model is described in detail by Brandsma and Divoky (1976) and Koh and Chang (1973). STFATE models both the dispersion of sediment and the associated elutriate. The disposed sediment is considered to be a mixture of sand, silt, clay and clumps fractions, each of which have characteristic densities and settling velocities. Clumps are large, compacted, highly cohesive parcels of sand, silt and clay that have been mechanically dredged from the bottom of estuaries or harbors. The behavior of the plume is modeled mathematically in the same manner as a dense liquid (since the concentration of discharged dredged material in the plume is usually low) by applying conservation of mass, momentum, buoyancy, and particle settling velocities. The model is applied on a project-specific basis and the results are used to establish conditions for disposal management.

STFATE requires information on water depths, current velocity, disposed sediment characteristics, and disposal operation parameters. The ambient stratification was chosen to represent the largest values in the region. The modeling results of the PO study (Appendix C-2) were used to determine the range of site-specific currents that might be encountered during disposal operations at the three alternative sites. The depth-averaged currents in the ZSF are tidal and the amplitude of the principal constituent (the twice daily M_2) varies with the phase of the moon. Simulations were conducted with currents equal to the annual mean amplitude (referred to as "mean flow" hereafter) and the mean maximum daily amplitude (referred to as "high flow" hereafter) for each alternative site. Water depths were set to a uniform depth representative of the site. Because a stratified water column may cause greater loss of material during the descent phase, the most conservative ("worst") case was modeled and a density profile representing maximum stratification was used (*i.e.*, a surface density of 1.023 g/cm^3 and a bottom layer density of 1.026 g/cm^3). It was also assumed that water from the dredging site would be slightly fresher (less saline) than water at the disposal site and a density of 1.015 g/cm^3 was used to represent the water in the dredged material. The disposal operation parameters, including volume of dredged material and scow dimensions, were based on information from typical barge configurations and sizes previously used in Long Island Sound.

Grain size distributions used during the STFATE modeling for eastern Long Island Sound were based on sediment samples collected from harbors in New Haven, Norwalk, and Guilford for the 2004 CLIS/WLIS EIS (USEPA and USACE, 2004a). Specifically, the average grain size distribution of the sampled sediments consisted of a mix of 10% sand, 76% silt, and 14% clay. The same distributions were used for the STFATE modeling in the 2004 Rhode Island Region EIS (USEPA and USACE, 2004b). Field experience shows that the mechanical (*i.e.*, clamshell) dredging operations (commonly used to dredge sediments) result in a significant portion of the cohesive sediment remaining as clumps within the scow and during disposal. During the STFATE modeling for the 2004 CLIS/WLIS EIS, mixes of 40% and 60% clumps were used, although modeling determined that the percent volume of clumps used in the simulations did not significantly affect the results in the ranges simulated. Thus, the percentage of clumps used in the modeling for eastern Long Island Sound was 45%. The water fraction of the sediments was set to 70.6%.

A 3,000 cy release from a scow at the center of each site was modeled; this represents the largest capacity that is likely to be used in eastern Long Island Sound dredging operations (W. Frank Bohlen, University of Connecticut, and Joe Salvatore, Connecticut Department of Transportation, May 2015, personal communication). Results of the STFATE modeling for each alternative site are summarized in Table 5-7 and discussed for each alternative site below. The analysis allows for several options of the final site dimensions of the New London and Niantic Bay Alternatives (see further discussion in Section 5.8.3). For each of these options, the water depths and currents would be similar and the settlement of sediment would consequently be similar as well. However, the dimensions of the site affect the dissolved and particulate elutriate concentrations that are transported out of the site boundaries.

Table 5-7. STFATE Dilution Modeling Results for various Site Dimension Options for the three Alternatives Sites

Alternative Site (with various Site Dimension Options)	**Scow Volume** (cy)	**Maximum Dilution within Site after 4h** [1]		**Maximum Dilution outside Site** [1]	
		at Mean Flow	**at High Flow** [2]	**at Mean Flow**	**at High Flow** [2]
New London Alternative					
Full site (NLDS + NL-Wa/b; area: 2.5 x 1 nmi)	3,000	0.08%	0.08%	0.00%	0.18%
2 x 1 nmi Area [3] (NLDS [western 50%] + NL-Wa/b)	3,000	0.08%	0.08%	0.03%	0.25%
1.5 x 1 nmi Area (NL-Wa/b)	3,000	0.08%	0.08%	0.12%	**0.28%**
Niantic Bay Alternative					
Full site (NBDS + NB-E; area: 2.08 x 1.33 nmi)	3,000	0.07%	0.07%	0.09%	0.24%
2 x 1 nmi Area (northern 75% of NB Alternative)	3,000	0.07%	0.07%	0.09%	0.25%
1 x 1 nmi Area (anchored in NE corner of NB Alternative)	3,000	0.07%	0.07%	0.15%	**0.37%**
Cornfield Shoals Alternative					
Full site (CSDS; area: 1 x 1 nmi)	3,000	0.05%	0.05%	0.15%	0.15%

[1] Note: The limiting permissible criterion (LPC) is 0.25%. **Bold** values indicate exceedance of the LPC.

[2] High Flow = Mean Daily Maximum Flow.

[3] The 2 x 1 nmi Area of the New London Alternative is also referred to as the "Eastern Long Island Sound Disposal Site" (ELDS), starting in Section 5.8.1.

Longer-term Transport Modeling. To establish the direction of transport, and the rate of dilution of the dissolved materials and very fine suspended sediments that may remain in the water after disposal operations, the circulation model (FVCOM, described in Section 5.5.1) was employed. FVCOM includes a module that simulates the evolution of a tracer (or solute) using the same well-calibrated velocity and turbulent mixing rates that were employed in the simulation of heat, salt and stress. The initial concentration distribution of the tracer must be specified. The simulations assumed that the concentration at all depths in the cell closest to the center of each alternative disposal site to the concentration that would occur if the water volume contained in one scow of dredged material was mixed uniformly into the volume of the model cell. The model then computed the evolution of the concentration. At any time, the computed concentration, divided by the initial concentration, provides an estimate of the effective dilution of the contaminants during the transport process. The initial tracer concentrations at the New London, Niantic Bay, and Cornfield Shoals Alternatives are then 2.94×10^{-5}, 2.44×10^{-5}, and 1.32×10^{-5}, respectively.

The trajectory of material released at a point in an estuary is sensitive to the phase of the tide at the time of release. To take this into account, releases were simulated at each alternative site at low slack water, maximum flood, high slack water, and maximum ebb. The concentrations of these four conditions were then averaged; since the range of concentrations is large, a geometric mean was used to provide a typical concentration from the set of model outputs with releases at different tidal phases.

For all alternative sites, the highest contaminant concentrations occur immediately following the release, so the areas with the highest concentrations are those reached in the first few hours. Accordingly, the coastline points exposed to the highest concentrations are those nearest to the release point. The concentrations at example locations are discussed in the following sections. The cloud of material from disposal operations at each alternative site was found to spread rapidly across eastern Long Island Sound, diluted over time by the tidal circulation. After 12 hours the clouds from all three alternative sites were similar and covered much of eastern Long Island Sound with a diluted concentration in the range of 10^{-7}. Note that this value reflects the initial dilutions within the site (in the range of 10^{-5}), diluted further by a factor of approximately 100.

5.5.3.1 New London Alternative

The STFATE predictions of the distribution of the disposed sediment on the seabed show that it is contained within the alternative site and the mound is elongated along the axis of the current. Under mean flow conditions the maximum mound height after disposal from a 3,000 cy scow would be 0.21 feet (6.4 cm); under high flow conditions the maximum height would be 0.18 feet (5.5 cm). STFATE predictions for the amount of material reaching the seafloor show that under both mean and high flow conditions, 99-100% of the sand, silt, and clumps in the scow would reach the seafloor. Most of the clay also reaches the seafloor. Specifically, 83% of the clay is predicted to reach the seafloor during operations under high flow conditions, and 96% of it would reach the seafloor under mean flow conditions.

The STFATE simulations further show that the maximum relative concentration in the water column within the New London Alternative falls below 0.25% within 120 minutes of release of dredged material from the scow. After four hours, the maximum concentrations would be 0.08% for both mean and high flow conditions (Table 5-7). The maximum concentrations outside the alternative site depend on which site dimensions are used. For the smallest site dimension evaluated (NL-Wa/b), concentrations outside the site would exceed the 0.25% LPC after 80 minutes under high flow conditions. Concentrations outside of the site would not exceed the LPC under either high or mean flow conditions for the two larger site dimensions options that were considered during the modeling.

The FVCOM-based longer-term evolution of the concentrations resulting from releases at the site at low slack, maximum flood, high slack and maximum ebb at representative coastal locations in Connecticut and on Fishers Island are shown in Figures 5-3 and 5-4. At the red and turquoise locations along Connecticut's coast, the concentrations would peak at approximately 50 hours after a release of dredged material and would reach levels of 2×10^{-7} and 3×10^{-7} (Figure 5-3a). These levels would be equivalent to further dilution of the initial concentration by a factor of approximately 100. After 150 hours, the concentrations would have been diluted further to less than 1×10^{-7}. The concentrations at the other three locations along Connecticut's coast would not reach the 1×10^{-7} level. At the western end of Fishers Island (green location in Figure 5-4), the peak concentration would reach 10×10^{-7} a few hours after the release (Figure 5-4a) as the ebb tide transports fluid from the area of the alternative site through The Race. This would correspond to further dilution of the initial concentration by approximately a factor of 10. The concentration would then rapidly decrease to levels similar to those predicted for locations along the Connecticut coast and elsewhere on Fishers Island. At locations on the shore of Long Island, the predicted concentration evolution (not shown) would not exceed 0.6×10^{-7}.

In summary, the STFATE simulations indicate that disposal operations at the New London Alternative would not exceed the LPC except for the smallest site option (1.5 x 1 nmi Area) under high flow conditions. The maximum concentration at representative coastal locations examined show that the highest values would occur at the western end of Fishers Island. These conditions would occur for only a few hours after release on maximum ebb. However, maximum concentrations would be diluted further outside of the alternative site by at least a factor of approximately 10 at the western tip of Fishers Island and a factor of 100 at other coastal locations, after initial dilution within the alternative site.

5.5.3.2 Niantic Bay Alternative

The maximum thickness of the sediment that is predicted to accumulate on the seabed from a 3,000 cy disposal operation is 0.11 feet (3.4 cm) under mean flow conditions and 0.09 feet (2.7 cm) under high flow conditions. Under both flow conditions, STFATE predicts that the material on the seafloor would be contained within the alternative site and that the mound would be elongated along the axis of the current. Also under both flow conditions, 100% of the sand and the clumps in the scow would reach the seafloor. Almost all (99%) of the silt would reach the seafloor. However, all of the clay (not bound in clumps) would remain in the water column during operations at high flow conditions; 11% of it would remain in suspension under mean flow conditions.

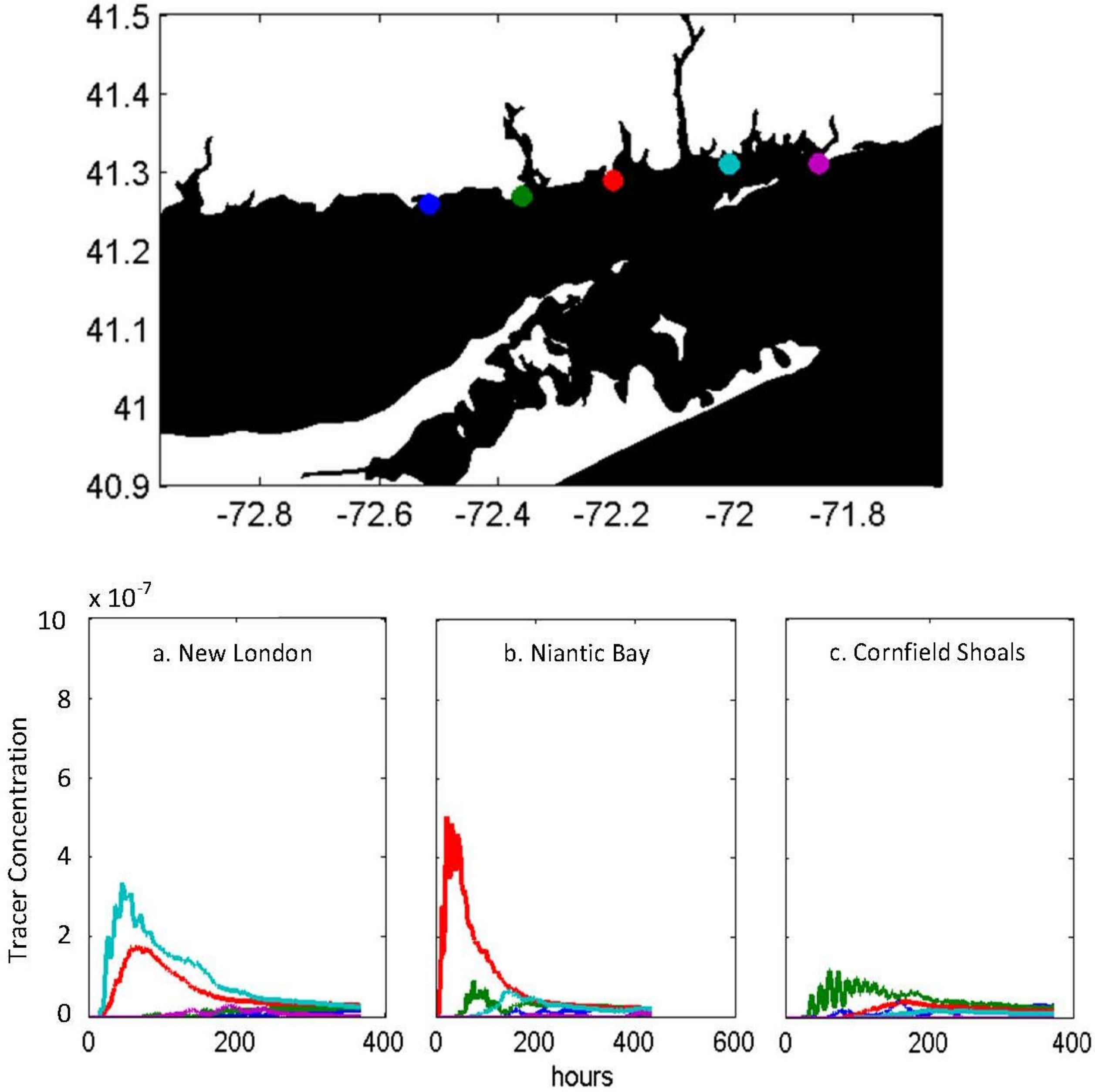

Figure 5-3. Evolution of tracer concentrations for releases from the three alternative sites for five locations along the coast of Connecticut. In each time-series, the colors correspond to the locations on the map.

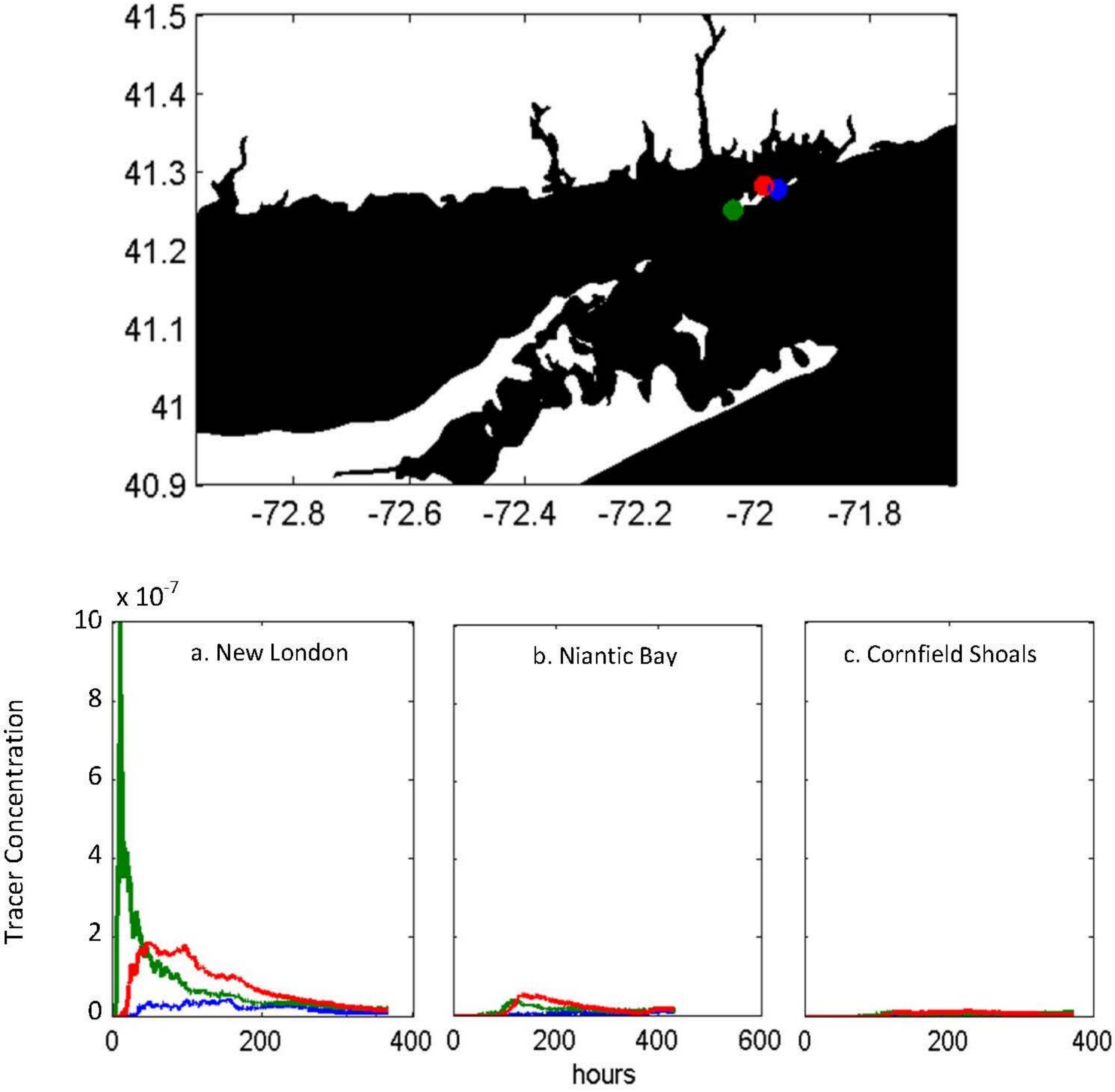

Figure 5-4. Evolution of tracer concentrations for releases from the three alternative sites for three locations along the coast of Fishers Island. In each time-series, the colors correspond to the locations on the map.

The STFATE simulations further show that the maximum relative concentration in the water column within the Niantic Bay Alternative would fall below 0.25% within 80 minutes of release of the dredged material from a 3,000-cy scow. After four hours, the maximum concentrations would be 0.07% for both mean flow and maximum daily flow conditions (Table 5-7). The maximum concentrations outside the site would depend on selected site dimensions. For the smallest site dimension (1 x 1 nmi Area), concentrations outside the site would exceed the 0.25% LPC after 55 minutes under high flow conditions. Concentrations outside the site would not exceed the LPC under either high or mean flow conditions for the larger site dimensions.

The FVCOM-based longer-term evolution of the concentrations resulting from releases at the Niantic Bay Alternative at low slack, maximum flood, high slack and maximum ebb at representative coastal locations in Connecticut and on Fishers Island are shown in Figures 5-3 and 5-4. At the red location along Connecticut's coast, the concentration would peak at approximately 50 hours after the release of dredged material and reach a level of 5 x 10^{-7} (Figure 5-3b). This level is equivalent to further dilution of the initial concentration by almost a factor of 100. After 150 hours, the concentration would decrease to a level of less than 1 x 10^{-7}. The concentrations at the other locations would not reach the 1 x 10^{-7} level. At any of the locations on Fishers Island, the concentrations would not reach the 1 x 10^{-7} level either (Figure 5-4b), and at locations on the shore of Long Island the predicted concentration evolution (not shown) would be less than 0.6 x 10^{-7}.

In summary, the STFATE simulations indicate that disposal operations at the Niantic Bay Alternative would not exceed the LPC except for the smallest site dimension option evaluated (1 x 1 nmi Area) under high flow conditions. The maximum concentration at the representative coastal locations examined show that the highest values would occur on the Connecticut shore near the alternative site. However, maximum concentrations would be diluted further outside of the alternative site by at least a factor of approximately 100, after initial dilution within the site.

5.5.3.3 Cornfield Shoals Alternative

Under both mean and high flow conditions, the STFATE model results show that the dredged material on the seafloor would be contained within the Cornfield Shoals Alternative and that the mound would be elongated along the axis of the current. Under mean flow conditions, the maximum mound height after disposal by a 3,000 cy scow would be 0.15 feet (4.6 cm). Under high flow conditions, the maximum mound height would be 0.14 feet (4.3 cm). Under both flow conditions, 100% of the sand and the clumps in the scow would reach the seafloor. Almost all (95-97%) of the silt would reach the seafloor. However, the majority of the clay (not bound in clumps) is predicted to remain in suspension in the water column under high flow conditions; under mean flow conditions, 22% of the clay particles would remain in suspension.

The STFATE simulations further show that the maximum relative concentration of elutriate in the water column within the Cornfield Shoals Alternative would fall below 1% of the scow concentration within five minutes of release of the dredged material from the scow, and then would fall to 0.2% within 50 minutes of release under mean flow conditions. After two hours, the maximum concentrations would be below 0.10% under both flow conditions. After four hours, the maximum concentrations would be 0.05% for both flow conditions (Table 5-7). Outside of the site, the maximum concentration would be 0.15% under both flow conditions.

The FVCOM-based longer-term evolution of the geometric mean of the concentrations resulting from releases at the Cornfield Shoals Alternative at low slack, maximum flood, high slack and maximum ebb at representative coastal locations in Connecticut and on Fishers Island are shown in Figures 5-3 and 5-4. At all locations, the concentrations would not exceed a level of 1×10^{-7} (Figures 5-3c and 5-4c) This would correspond to further dilution from the initial concentration at the alternative site by a factor of approximately 100. At locations on the shore of Long Island the concentration evolution (not shown) would be less than 0.6×10^{-7}.

In summary, the STFATE simulations indicate that disposal operations at the Cornfield Shoals Alternative would not exceed the LPC. The maximum concentration at the representative coastal locations examined show that the highest values occur on the Connecticut shore closest to the alternative site. However, maximum concentrations would be diluted further outside of the alternative site by at least a factor of approximately 100, after initial dilution within the site.

5.5.3.4 Summary for Water Quality

The STFATE model was developed to simulate short-term fate of dredged material when released from scows and hoppers at an open-water disposal site. The dredged material is assumed to consist of pore-water (elutriate) and a mixture of sediment types. The fractions of sand, clay and cohesive clumps vary between sites. When material is released near the surface during disposal operations, the sediment fractions sink at different rates and the model predicts the distribution on the bottom and the concentration of the fine and dissolved material in the water column.

STFATE simulations of disposal operations at the three alternative sites demonstrate that for releases at the centers of these sites, the mounds of sediment on the seafloor would be located within the disposal site. All of the clump and sand portions and almost all of the silt would be deposited under all conditions within the three sites. Only the clay portions would partially remain in suspension at various rates at all three sites.

STFATE was also used to simulate the dilution of dredged material elutriate (a mixture of water and sediment) in the water column as a consequence of the sediment disposal at the three potential disposal sites at both mean flow and high flow conditions. These simulations showed that, for disposal operations from a 3,000-cy scow, concentrations inside the site boundaries would decrease to below the LPC of 0.25% well within four hours after the release at all three alternative sites. For alternative sites other than the options with the smallest dimensions for the Niantic Bay and New London Alternatives, concentrations would be below the LPC outside of the site boundaries.

For the smallest site dimension option for the Niantic Bay Alternative (1 x 1 nmi Area), the LPC would be exceeded outside the site during high flow conditions. Likewise, for smallest site dimension option for the New London Alternative (1.5 x 1 nmi Area), the concentrations outside the site would exceed the LPC during high flow conditions. During mean flow conditions, none of the various site dimension options considered would exceed the LPC outside the site.

Exceedance of the LPC could occur if anomalously large currents occurred during operations, disposal operations occurred near the edge of the alternative site under unsuitable current conditions, or larger barges than anticipated were employed. These possibilities can be eliminated by (1) limiting the disposal event to times other than high flow conditions, (2) positioning the release point according to the ambient current, and (3) limiting the scow size.

The longer-term (greater than 100 hours from release) transport and dilution of material in the water column after disposal operations show maximum concentrations in the range of 10^{-7} at locations on the coast of Connecticut, and Fishers Island and the North Fork of Long Island. These values reflect further dilution by a factor of approximately 100 from initial dilution at the site. An exception exists at the west coast of Fishers Island where releases from the New London Alternative would result in the maximum concentrations of 10^{-6}, *i.e.*, further dilution by a factor of approximately 10 after initial dilution within the alternative site.

5.5.4 Benthic Invertebrates

The disposal of dredged material has a variety of direct and short-term impacts on the benthic community including dislodging or burying animals and impacting them through suspended sediments. The descending dredged material plume may dislodge small surface dwelling animals (*e.g.*, some amphipod and polychaete species) and transport them some distance along the bottom as the plume collapses. Increased suspended sediment levels could affect respiration and feeding, although disturbed conditions would be relatively short-lived due to the small amount of material that remains in the water column (1-5%) (Ruggaber and Adams, 2000; Tavolaro, 1984; USACE, 1986), the short time period that material stays in the water column, and rapid dilution.

The primary direct impact of dredged material disposal to the benthic community is likely to be associated with burial of some organisms and changes in topography. As described in Section 5.2.2, topographic changes occur primarily by the building of mounds as the disposed material reaches the seafloor. As this occurs, benthic animals remaining under the descending plume would be buried. This burial would likely lead to mortality or damage of many of the animals directly, but the overall impact to the community depends on the depth of burial, the sediment grain size, burial duration, temperature, and adaptive features such as an organism's ability to burrow through sediment and to survive low oxygen conditions. Strong burrowing deposit feeders can escape from four inches (10 cm) or more of burial, but attached epifaunal suspension feeders cannot survive more than 0.4 inches of burial (1 cm) (Lopez et al., 2014). For example, Kranz (1974) found that nut clams (*Nucula annulata*) could successfully emerge after burial by 20 inches (50 cm) of their native sediment (mud), but could not recover after being buried by 16 inches (40 cm) of fine sand. Many polychaete worms actively burrow through the sediment and are thus predisposed to recovery from burial. Some tube-dwelling worms may even reach the surface simply by extending their tubes. Impacts are greatest near the center portion of the mound as it is usually sufficiently thick to bury all organisms that cannot move out of the way (Germano et al., 1994). With increasing distance from the center of the disposal mound, the layer of material becomes thinner, lessening the impact as some species are increasingly able to burrow to the surface.

Because pre-existing species may be buried, the nature of the community present immediately after disposal could be determined by the animals, including non-native invasive species, that were present in the dredged material and that were able to survive the process of dredging, transport to the site, and disposal. However, the likelihood of surviving this process is not known with any degree of certainty, and regarding invasive species, prior studies of disposal mounds on the seafloor (*e.g.*, Fredette and French, 2004; ENSR, 2005; AECOM, 2009; AECOM, 2012; Carey and Bellagamba Fucile, 2015) have not indicated that colonization of disposal mounds by non-native invasive species is an issue. Therefore, for at least a short period of time immediately after disposal, the community is likely to be effectively eliminated, at least under the center of the mound, or be comprised of different species.

The impacts to the benthos are usually temporary, as the native community either burrows to the surface or recolonizes the area. As summarized by Maurer et al. (1986) recolonization mechanisms may include: (1) emigration of adults from undisturbed areas, (2) seasonal reproduction and larval recruitment from undisturbed areas, (3) vertical migration through the sediments, and (4) nocturnal swimming. Each mechanism can influence the rate of recolonization as it may depend on natural reproductive cycles and active (*e.g.*, migration) or passive (*e.g.*, drifting) transport to the affected sediments. The relative importance of the recolonization mechanisms to site recovery is specific to the condition of the site, communities in adjacent sediments, and the life cycle of the various organisms.

The recolonization and rate of recovery of a dredged material disposal mound follows a systematic progression described by Rhoads and Germano (1982; 1986). The successional process is categorized as proceeding from a Stage I community (which can occur within weeks to months after a disturbance) consisting of surface dwelling opportunistic species characterized by small size, short life spans, and high population growth rates, such as small tube dwelling polychaetes, to a Stage III climax community composed of species characterized by a larger size, longer life spans, and lower population growth. These species are typically head-down deposit feeding organisms, such as maldanid polychaetes. The Stage III community can take months or years to develop. Stage II communities occur in the transition between Stage I and Stage III and are typically infaunal deposit feeders such as the amphipod *Ampelisca vadorum*. Given the timeline for recovery, impacts to areas containing Stage I and Stage II communities would be less than those containing Stage III communities since they would return to pre-disturbance conditions more quickly.

Despite the obvious impact of burying and altering the makeup of the existing benthic fauna, Rhoads and Germano (1982; 1986) and Germano et al. (1994) also note that recolonization of benthic infauna following the disposal of dredged material by opportunistic Stage I species can temporarily increase the productivity at the disposal site. Long-term or cumulative effects to the benthos may also result. The rate at which the community returns depends on many factors. The first consideration is the texture of the deposited material as discussed in Section 5.2.2. Any substantial change in texture reduces the chances that the community present after disposal would be similar to that present before disposal. Chronic disturbance from repeated disposal may also prevent Stage III communities from re-establishing (Germano et al., 1994).

Because of variability in texture and grain size of the dredged material, as well as the biological factors mentioned above (*e.g.,* ability to burrow through sediment and to survive low oxygen conditions), the specific benthic community structure that would inhabit the alternative sites shortly after disposal activity ends would vary. However, studies by the DAMOS program have shown that the infaunal community at dredged material disposal mounds does eventually begin to resemble nearby, unimpacted areas, as described in Section 5.2.2. Thus, mounds that have been in place at the NLDS for several years consistently support mature benthic assemblages (Stage III communities), and apparent Redox Potential Discontinuity (aRPD) depths that are similar to reference areas outside of the disposal site are stable over time (AECOM, 2009; Carey and Bellagamba Fucile, 2015 [Appendix F]). Advanced stages of recolonization with extensive burrowing and feeding voids present were also found to occur at a NLDS mound eight months after the last recorded disposal activity, although the aRPD depths were significantly shallower than the reference areas.

5.5.4.1 New London Alternative

The benthic community within the New London Alternative (NLDS, Site NL-Wa, and Site NL-Wb) is primarily made up of the three major taxonomic groups: Annelida, Arthropoda, and Mollusca. Many species belonging to these groups have shown remarkable abilities to burrow up through deposited dredged material, although mortalities would increase with increasing depth of burial (Maurer et al., 1981a; 1981b; 1982). The New London Alternative also contains Stage III communities.

Short-term impacts include reductions in abundance and diversity of benthic organisms at a disposal location within the alternative site. However, long-term impacts would be minimal as surveys of mounds at the NLDS have shown that the benthic community readily recolonizes, with Stage I/II communities well established as soon as eight months after a disposal event and with historic mounds showing Stage III communities. In addition, surveys show that all benthic communities are similar to those found at off-site reference stations.

The north-central portion of Site NL-Wa contains an area of boulders. Part of this area lies at depths less than 59 feet (18 m). Disposal of dredged material would be excluded from this area due its shallow depths and higher habitat value. Given the comparatively low bottom stress in the area surrounding the boulder area, it is unlikely that sediments would be resuspended from any nearby disposal mounds and transported to the boulder area where they could potentially impact the benthic community.

In addition to a dominant substrate of sand, Site NL-Wb contains a bedrock/boulder area in the southwestern corner of the site. This substrate may support attached epifauna that would be susceptible to adverse impacts from burial and sedimentation. This area would also be excluded from disposal to minimize impacts.

5.5.4.2 Niantic Bay Alternative

The benthic community at the Niantic Bay Alternative (NBDS and Site NB-E) is also primarily made up of the three major taxonomic groups Annelida, Arthropoda, and Mollusca that include many species with remarkable abilities to burrow up through deposited dredged material. Because the current community assemblages at the NBDS and Site NB-E are similar, the impacts of disposal activity in terms of burying benthic species, and the sudden change in community type during and immediately after disposal, would likely be similar between the two sites of the Niantic Bay Alternative. As with the New London Alternative, short-term impacts for the Niantic Bay Alternative would include reductions in abundance and diversity of benthic organisms at specific disposal locations. However, long-term impacts would be minimal due to rapid recolonization.

The NBDS contains a boulder area in its north-central part; Site NB-E contains a bedrock/boulder area in its southwestern corner and abuts a bedrock/boulder area in its southeastern corner. These substrates likely support attached epifauna that would be susceptible to adverse impacts from burial and sedimentation. These areas would be excluded from disposal to minimize impacts.

5.5.4.3 Cornfield Shoals Alternative

The benthic community at the Cornfield Shoals Alternative is also comprised primarily of the three major taxonomic groups Annelida, Arthropoda, and Mollusca that include many species with remarkable abilities to burrow up through deposited dredged material. As with the other alternatives, short-term impacts from dredged material disposal at this site would include reductions in abundance and diversity of benthic organisms at disposal locations within the Cornfield Shoals Alternative. However, long-term impacts would be minimal due to rapid recolonization.

5.5.4.4 Summary for Benthic Invertebrates

The immediate impacts of dredged material disposal on the benthos would most likely be sudden reductions in infaunal abundances and species numbers, and, therefore, a reduction in species diversity. These impacts would be greatest near the central portion of the mound that forms during disposal. Because the New London Alternative contained more Stage III communities that take a longer time to recover from disturbance, short-term impacts would likely be slightly greater at the New London Alternative than at the Niantic Bay Alternative or Cornfield Shoals Alternative where few Stage III communities were found. Studies of the effects of disturbance (including dredged material disposal) indicate that the benthic habitats at a site would eventually be recolonized by a functioning infaunal community, although it may not be exactly the same as the one present before disposal, and with the influx of Stage I opportunistic species the productivity of the site may temporarily increase. Recolonization would mostly occur via migration from surrounding habitats or by the settling of the planktonic larvae of infaunal animals. Dredged material mounds with ongoing disposal activity at any given time within the three alternative sites would occupy below 0.01% of the seafloor of eastern Long Island Sound, which has an area of approximately 250 nmi^2 (860 km^2). In summary, the potential for recolonization is high and similar between all alternative sites and long-term impacts would be minimal.

5.5.5 Fish

Potential short- and long-term impacts to finfish from the disposal of dredged material could range from acute mortality associated with the burial of fish to the temporary displacement of fish during periods of high turbidity. However, direct impacts to these organisms would be limited to the footprint of the disposal mound.

The most immediate potential impact to fish would be burial by the descending dredged material. Because of their mobility, many fish would be able to avoid injury, although it is unlikely that all fish would escape unharmed. For example, in response to the descending material, demersal species such as flounder and tautog may seek refuge in or near the substrate, or simply may not move quickly enough or far enough away to avoid being buried. Additionally, early life stages of fish, which are less motile than adult fish, may also be buried. Considering (1) the small footprint of a typical dredged material disposal event compared to the similar available habitat throughout Long Island Sound, , and (2) that the alternative sites are not significant spawning or nursing areas based on trawl data, the direct impact of burial would not cause sufficient mortality to adversely affect the overall populations of any species.

Immediately following a disposal event, increased TSS concentrations in the water column may be of potential concern for finfish in the disposal area, creating a direct impact for some species and life stages and an indirect impact for others. However, impacts would be temporary since the amount of suspended material that remains in suspension is small and quickly becomes dispersed and diluted to ambient levels (1-4 hours) (Bohlen et al., 1996). Suspended sediment may physically injure adult and juvenile finfish by lacerating the protective gill covering, and irritating or clogging the gill system (O’Connor, 1991). Damage to the gills of finfish may inhibit the effective exchange of oxygen, thereby impairing respiration and increasing the chances of mortality (LaSalle et al., 1991). The impacts of increased TSS to finfish depend largely on the life stage present during disposal. While adult and juvenile finfish are capable of leaving a disposal area that has stressfully high TSS levels, egg and larval stages of finfish have little or no control over their mobility. As a result, younger life stages present at a disposal site may experience higher rates of TSS-associated impacts.

Elevated TSS levels may also alter certain finfish behaviors, such as migration, spawning, foraging, schooling, and predator evasion (O’Connor, 1991). The consequences of these altered behaviors are considered an indirect impact. Fish species that migrate through Long Island Sound during early spring, such as fourspot flounder, striped sea robin and windowpane flounder, may avoid disposal areas temporarily during periods of high turbidity. Following these turbid periods, finfish may be drawn back to the disposal site by irregularities in the substrate and the presence of new material containing infaunal organisms and other forage (discussed further below).

Direct impacts to fish species from burial and elevated TSS levels would be reduced by restricting dredging during certain times of year to protect different life stages of finfish and shellfish species.

Generally, the States of Connecticut and New York restrict dredging from June 1 to September 30 to protect shellfish and finfish populations during their spawning season. With this restriction on dredging activities, over 90% of disposal activities occur outside of this timeframe (October 1 to May 31) (NOAA, 2004). Additional restrictions between February and June may be imposed on a case-by-case basis to protect spawning winter flounder and their eggs, and/or the migration of anadromous fish to freshwater spawning grounds, based on recommendations by state or federal fishery biologists during the USACE permit review. Other site-specific restrictions may apply for endangered species if they are present. As a result, disturbance to the migration or spawning of fish species at the disposal sites during these critical periods are usually avoided.

Potential long-term impact to the fish community associated with the disposal of dredged material include the potential alteration of the community as the result of changes to habitat and food resources. It is likely that most finfish would leave the area during a disposal event to escape the associated turbidity. This departure from the area would be temporary and, once disposal activities had ceased and the turbidity diminished, the finfish would likely return to the region to forage. As described in Section 5.5.4, however, it may take time for the benthic community to reestablish following a disposal event, reducing the foraging opportunities for finfish in the area until the benthic recolonization process is well under way. Once the placed sediment mound stabilizes, the surface of the newly deposited sediment tends to attract high settlement densities of benthic epifauna. This may indirectly benefit fish species in the short-term due to a temporary increase in productivity at the disposal site, which in turn would provide increased prey for demersal fish species that feed on the benthic fauna (Rhoads and Germano, 1982, 1986; Germano et al., 1994; Rhoads and Carey, 1997; Lopez et al., 2014). It is not expected that disposal of dredged material would alter long-term habitat conditions at any of the alternative sites. Sediments permitted for disposal are likely to be of similar textural characteristics to the existing bottoms, although with higher organic matter content. Recolonization and bioturbation of the surface of the disposal mound and deposition of ambient sediments would bring the mound surface into equilibrium with the surrounding habitat within six months to one year after a disposal activity, as discussed in Section 5.5.4.

The changes in bottom topography associated with dredged material disposal would not be expected to cause measurable impacts to aquatic life at any of the alternative sites. Disposal mounds in Long Island Sound typically have a thickness of 1.5 to 14 feet (0.5 to 4.3 m), a diameter of 300 to 1,150 feet (91 to 351 m) built up from multiple disposal events, and gradual slopes at angles of less than 3% (USEPA and USACE, 2004a). These dimensions would not prevent pelagic species from reentering the area when disposal operations are completed, nor would most demersal organisms avoid recolonizing an area with new and distinct contouring. Some larval demersal fish such as windowpane flounder, winter flounder, or summer flounder might prefer an undisturbed silt or sand habitat for refuge and actively avoid fresh dredged material due to the presence of relief and difficulty of concealment in the absence of a loose sediment layer. This potential displacement of refuge would be limited to a period of one to two years after which the surface characteristics of the shallow mounds are difficult to distinguish from ambient conditions in terms of surface texture and small scale relief.

While some finfish species may delay returning to the site because of the change in benthic community, others may be attracted to the high density of colonizing species and disturbed sediments (Clarke and Kasal, 1994; Lopez et al. 2014). Scientific studies on this subject have been limited, but those that have been conducted suggest that demersal fish species are likely to recolonize an area in which the topographic features have been modified (Clarke et al., 1988). Another study suggested that the minor changes in currents resulting from the new contouring might attract prey species such as polychaetes and mysid shrimp, thus attracting larger predators such as finfish (Clarke and Kasal, 1994). To evaluate the relative value of benthic food sources to fish resources, the Benthic Resources Assessment Technique (BRAT) was developed (SAIC, 1989). The technique has demonstrated that early successional assemblages established on dredged material disposal mounds have higher fisheries value in biomass and higher potential usage by benthic feeding fishes (particularly juveniles) than nearby reference areas. In addition to demersal species, Reine et al. (2012) found that dredged material disposal mounds may attract mid-water species such as anchovies, planktivores that would feed on plankton accumulating in the eddies that result from the interruption of bottom currents by artificial reefs (*i.e.*, disposal mounds).

All three alternative sites occur in areas for which EFH has been designated for species and their life stages (eggs, larvae, juveniles, adults). Combined, EFH has been designated for a total of 15 species across the three sites, although no one alternative site contains EFH for all 15 species. The proposed action would result in long-term negligible adverse impacts to EFH. Impacts to EFH would be temporary and localized, with conditions quickly returning to baseline after each dredged material disposal event. Although temporary, these impacts would take place on a recurring basis for the foreseeable future, constituting a long-term impact. Impacts to EFH would include temporary increases in turbidity, sedimentation, and nutrient availability, as well as a temporary decrease in prey abundance due to burial of benthic prey items, followed by a temporary increase in prey abundance during site recolonization. Increased turbidity immediately following dredged material disposal events could temporarily reduce foraging ability due to decreased visibility in the water column. Most fish would avoid impacts by leaving the area during disturbance events, but would return to the area shortly thereafter. Therefore, any short-term adverse impact is anticipated to be minimal. Demersal species and less mobile species or life stages may be more susceptible to direct mortality due to burial. Impacts to early life stages would be minimized by the implementation of dredging restrictions during the environmentally sensitive period from June 1 to September 30, as well as other location-specific seasonal restrictions to protect shellfish and finfish populations during their spawning and/or migration seasons. A complete detailed assessment of impacts on EFH from the proposed action is included as Appendix H and consultation with NMFS is ongoing.

5.5.5.1 New London Alternative

Available information about fish populations in and near the New London Alternative (NLDS, Site NL-Wa, and Site NL-Wb) indicates that the potential for adverse impacts associated with dredged material disposal at the sites would be minimal. The annual Long Island Sound Trawl Survey (LISTS) conducted by CTDEEP since 1984 indicates that CPUE values are much lower in eastern Long Island Sound than in the central and western Long Island Sound (Figure 4-44 in

Section 4.10). The trawl survey conducted in June 2013 in support of this SEIS also found that CPUE did not differ in areas near the alternative sites and areas further away, although the species composition differed slightly. Most of the fish caught in the 2013 survey were demersal species, and comprising 59% of the catch, scup was by far the most dominant species. Demersal species are the most likely to be impacted by burial and the disruption of forage habitat. The primary pelagic species at the New London Alternative, Atlantic butterfish and squid, would be most affected by water-column impacts that interrupt feeding on pelagic prey. However, these species would most likely be able to avoid the descending dredged material plume.

Site NL-Wa contains an area of boulders in the north-central portion of the site that partially lies at depths less than 59 feet (18 m) (Figure 4-4). Many species, such as tautog, prefer structured habit. Therefore, it is likely that this boulder area provides preferred habitat for some species of fish. However, fish using this habitat would likely not experience any adverse impacts from the proposed action as disposal of dredged material would be excluded from this area due its shallow depth and higher habitat value. In addition, given the comparatively low bottom stress at the alternative site, it is unlikely that disposed dredged material would be resuspended from nearby disposal mounds and transported to the boulder area.

Site NL-Wb also contains a bedrock/boulder area in the southwestern corner of the site (Figure 4-4; WHG, 2014). This substrate may also support fish species that like structured habitat. To minimize impacts to species using this habitat the area would be excluded from disposal activities.

The overall impacts to fish populations by dredged material disposal at the New London Alternative would be minimal and short-term and would be unchanged from the present conditions at the NLDS. Impacts would consist primarily of localized, limited habitat and migration disruption. Habitat disruption would be partially offset by increased topographic relief and recolonization by benthic food sources. Additionally, the direct impacts of death and burial in the New London Alternative are not expected to cause any measureable reduction in the population of any of the species potentially affected within the eastern Long Island Sound.

Within the New London Alternative, EFH has been designated for Atlantic salmon (juveniles and adults), Atlantic sea herring (adults), bluefish (juveniles and adults), cobia (all life stages), dusky shark (juveniles), king mackerel (all life stages), red hake (adults), sand tiger shark (larvae), and Spanish mackerel (all life stages). As indicated above, any long-term adverse impacts to EFH would be negligible (Appendix H).

5.5.5.2 Niantic Bay Alternative

Similar to the New London Alternative, information available about fish populations in and near the Niantic Bay Alternative (NBDS and Site NB-E) indicates that the potential for adverse impacts associated with dredged material disposal at the sites would be minimal. LISTS sampling conducted since 1984 indicates that CPUE values are much lower in eastern Long Island Sound than in central and western Long Island Sound (Figure 4-44 in Section 4.10). The June 2013 LISTS found that the CPUE did not differ between the areas near the alternative site and areas further away, although the number of fish caught was 50% lower than at the New London

Alternative. Similar to the New London Alternative, most of the fish caught in the 2013 survey were demersal species, and scup was the most dominant species at 76% of the catch. Demersal species are most likely to be impacted by burial and the disruption of forage habitat. The primary pelagic species at the Niantic Bay Alternative, squid, would be most affected by water-column impacts that interrupt feeding on pelagic prey. However, this and other pelagic species would most likely be able to avoid the descending dredged material plume.

In addition to the dominant substrate of sand, the NBDS site contains a boulder area in the north-central part of the site; Site NB-E contains a bedrock/boulder area in the southwestern corner of the site. These habitats likely support fish species that benefit from structured substrate, such as the tautog. These areas would be excluded from disposal to minimize impacts.

Overall, impacts to fish populations by dredged material disposal at the Niantic Bay Alternative would be minimal and short-term. Impacts would consist primarily of localized, limited habitat and migration disruption. Habitat disruption would be partially offset by increased topographic relief and recolonization by benthic food sources. Additionally, the direct impacts of death and burial in the Niantic Bay Alternative would not cause any measureable reduction in the population of any of the species potentially affected within eastern Long Island Sound.

Within the Niantic Bay Alternative, EFH has been designated for Atlantic salmon (juveniles and adults), Atlantic sea herring (juveniles and adults), bluefin tuna (adults: NB-E only), bluefish (juveniles and adults), cobia (all life stages), dusky shark (juveniles: NB-E only), king mackerel (all life stages), little skate (juveniles and adults), pollock (juveniles and adults), red hake (all life stages), sand tiger shark (larvae: NB-E only), Spanish mackerel (all life stages), windowpane flounder (all life stages), winter flounder (all life stages), and winter skate (juveniles and adults). As indicated above, long-term impacts to EFH would be negligible (Appendix H).

5.5.5.3 Cornfield Shoals Alternative

Information available about fish populations in and near the Cornfield Shoals Alternative indicates that the potential for adverse impacts associated with dredged material disposal at the site would be minimal and likely less than those at either the New London or Niantic Bay Alternatives. LISTS sampling conducted since 1984 indicates that the CPUE values are much lower in eastern Long Island Sound than in central and western Long Island Sound (Figure 4-44 in Section 4.10). The June 2013 LISTS found that the CPUE did not differ between the alternative site and surrounding areas, although the number of fish caught was much lower than that at either the New London or Niantic Bay Alternatives. Most of the fish caught in the 2013 survey were demersal species with five species (scup, windowpane flounder, winter skate, little skate, and northern sea robin) ranging each from 12% to 20% of the catch by abundance. These demersal species would be most likely to be impacted by burial and the temporary disruption of forage habitat. The pelagic species, although very few were caught near the Cornfield Shoals Alternative (*i.e.*, only one striped bass, one bluefish, and five squid) would potentially be most affected by water-column impacts that interrupt feeding on pelagic prey. However, these and other pelagic species would likely be able to avoid the descending dredged material plume.

Overall, impacts to fish populations by dredged material disposal at the Cornfield Shoals Alternative would be minimal and short-term and, due to its less abundant fish population, impacts would be less than those at the other two alternative sites. Impacts would consist primarily of localized, limited habitat and migration disruption. Habitat disruption would be partially offset by increased topographic relief and recolonization by benthic food sources. Additionally, the direct impacts of death and burial in the Cornfield Shoals Alternative would not cause any measureable reduction in the population of any of the species potentially affected within eastern Long Island Sound.

EFH has been designated within the Cornfield Shoals Alternative for Atlantic salmon (juveniles and adults), Atlantic sea herring (juveniles and adults), bluefish (juveniles and adults), cobia (all life stages), king mackerel (all life stages), little skate (juveniles and adults), pollock (juveniles and adults), red hake (all life stages), Spanish mackerel (all life stages), windowpane flounder (all life stages), and winter skate (juveniles and adults). As indicated above, long-term impacts to EFH would be negligible (Appendix H).

5.5.5.4 Summary for Fish

As indicated by long-term trawl data, eastern Long Island Sound appears to have a substantially lower fish abundance compared to the western and central Long Island Sound. Based on 2013 site-specific trawl data, finfish resources appear to be lower at the Cornfield Shoals Alternative as compared to the other two alternative sites. Overall, short-term impacts to finfish resources for all three alternative sites are minimal, consisting of local disruptions and some temporary loss of demersal species. Most of the pelagic finfish species that frequent the alternative sites would avoid disposal activities. Over time, recovery of the finfish resources to pre-disposal levels would be expected for all alternative sites, thus long-term impacts would not be expected. Similarly, long-term impacts to EFH for all three alternative sites would be negligible.

5.5.6 Commercial and Recreational Shellfish

Dredged material disposal may result in localized short- and long-term impacts to shellfish. Longfin squid and planktonic life stages of species may get enveloped by the descending plume of dredged material and suffer mortality or injury. These impacts would be more prevalent on planktonic life stages which are much less mobile than the squid. Most squid would likely be able to escape the descending plume, although some may still be enveloped and impacted by it. Overall impacts to species though would be negligible due to the infrequent nature of the disposal activities and the localized nature of them. The main impact would be direct burial and mortality of species within the footprint of a disposal mound.

Depending on the thickness of the layer of dredged material deposited at a site, the frequency of subsequent disposal events, and the sediment type or composition, some species would be more likely to recover from burial than others. Rhoads and Carey (1997) discussed the recovery potential for benthic animals from disposal of dredged material, and concluded that depths at the center of the mound are sufficiently thick (greater than 36 inches [1 m]) to cause mortality of all buried species. However, as one moves away from the center of the mound and sediment thicknesses become less than or equal to 12 inches (30 cm) some species would be able to survive by burrowing upward to the new sediment-water interface, and still further from the center where thicknesses are less than or equal to four inches (10 cm) thick, most species would be able to survive by burrowing upward. Species such as clams can move up and down in the sediment column and can burrow upward in the sediment. For example, adult northern quahogs can escape after being buried by four to 20 inches (10 to 50 cm) of sediment if the material is not very compact (Pratt et al., 1992). Lobsters can also burrow in sediments in the depth range of four to eight inches (10 to 20 cm) (Rhoads and Carey, 1997). Thus, these species would likely be able to survive burial if it occurs far enough away from the center of the mound. However, species such as the oyster and bay scallop, as well as newly settled larval stages of shellfish species are generally immobile filter feeders, and in the case of the oyster and new settled larval stages are attached to the benthos (sediment, shells, rocks etc.). These species and life stages are more vulnerable and tend to suffer high mortality when buried rapidly with sediment thicker than four inches (10 cm). Whelks would also be susceptible to burial.

Immediately following a disposal event, increased TSS concentrations may also be of potential concern for shellfish in the disposal area. In particular, increased TSS levels in the water column may interrupt feeding and respiration by filter feeding bivalves, with eggs and larval stages likely more susceptible. However, these impacts would only be temporary since the amount of sediment that remains in suspension during the disposal process is small and quickly becomes dispersed and diluted to ambient levels. Impacts to eggs and larval stages would also be minimized by timeframe restrictions placed on dredging activities, and hence disposal activities. Generally, the States of Connecticut and New York restrict dredging from June 1 to September 30 to protect shellfish and finfish populations during their spawning season, as previously described. Dredged material disposal activities may also impact shellfish species by altering the community as a result of changes to habitat. Physical changes to the sediment characteristics (*e.g.*, grain size or organic content) may affect the survival of residents or the recruitment of larval stages settling out of the water column by altering their preferred substrate. The winnowing of the finer sediments from the disposal mounds after the initial disposal event could also cause impacts. As the finer sediments winnow away, any newly settled larvae or adults that have burrowed into or affixed themselves to the surface layer of sediment might be swept away from the area or exposed to a greater predation risk.

In 2005, the effect of dredged material disposal on lobster populations was studied by Valente et al. (2007) at the RISDS during a three-month study (August, September, November) as part of the DAMOS program, along with two off-site reference areas not used for dredged material disposal. The RISDS and the reference areas had been studied during the same three months in 1999 prior to designation of the site as a disposal site. The study by Valente et al. (2007) occurred just seven months after the disposal of large volumes of dredged material from the Providence River project at the RISDS from April 2003 to January 2005, therefore allowing for an assessment of whether or not dredged material disposal impacts local lobster populations. The study found that, from 1999 to 2005, the average abundance of lobsters had decreased both at the RISDS and the two reference areas, which was reflective of the overall trend of steadily declining numbers of both juvenile and adult lobster throughout southern New England since the 1990's. Over the three-month study in 2005, a total of 309 lobsters were captured at the RISDS. Although this number was lower than at the two reference areas (549 and 373), of significance was the observation that from 1999 to 2005, the lobster population at the RISDS did not experience any changes that were unusually strong or anomalous compared to population changes at the two reference sites. The lobster population decreased in this six-year period by approximately 40% at the RISDS, and by 40% and 30% at the two reference sites. The authors noted that since the findings of the study provided evidence that lobster populations at and near the disposal site were not suffering long-term adverse impacts from the disposal activities.

5.5.6.1 New London Alternative

Commercial and recreational shellfish species found at or near the New London Alternative consisted of squid, surf clam, and lobster; oyster, bay scallop, hard clam, softshell clam, horseshoe crab, and whelks were not found (see Section 4.11.3).

While longfin squid were fairly numerous near the alternative site during the 2013 trawl survey, impacts to this pelagic species would be limited to some individuals possibly being enveloped by the descending plume of material and being injured or buried. It is likely, though, that most individuals would be able to evade the descending plume. While longfin squid eggs are present in the summer months and attached to benthic material, restrictions on dredging activities in the summer would minimize impacts.

Both surf clam and the lobster were found in very low numbers with only two surf clams captured during the 2013 benthic survey and five lobsters captured during the 2013 trawl survey. Surf clams could be impacted by disposal activities, although the low observed abundance indicates that any impacts would be experienced by only few individuals. Lobsters could also be buried by the disposal activities, although considering the low observed abundance during the trawl survey as well as the findings by the lobster study at the RISDS (Valente et al., 2007), disposal operations would not be expected to adversely impact the overall lobster population at the New London Alternative over the long-term.

Site NL-Wa contains an area of boulders in the north-central portion of the site. While this is habitat preferred by lobsters, disposal of dredged material would be excluded from this area due its shallow depth and higher habitat value. Additionally, given the comparatively low bottom stress in the area surrounding the boulder area, it is unlikely that sediments would be resuspended from any nearby disposal mounds and transported to the boulder area to potentially impact the lobster habitat.

Site NL-Wb contains a bedrock/boulder area in the southwestern corner of the site which also is likely preferred habitat for lobsters. While any lobsters using this habitat would be susceptible to adverse impacts from burial, this area would be excluded from disposal to minimize impacts.

Overall, impacts to the commercial and recreational shellfish populations by dredged material disposal at the New London Alternative would be minimal and short-term and would be unchanged from the present conditions at the NLDS site.

5.5.6.2 Niantic Bay Alternative

Commercial and recreational shellfish species found at or near the Niantic Bay Alternative consisted of squid, surf clam, and hard clam; lobster, oyster, bay scallop, softshell clam, horseshoe crab, and whelks were not found (see Section 4.11.4).

Though longfin squid were numerous near the Niantic Bay Alternative during the 2013 trawl survey, impacts to this pelagic species would be limited to some individuals possibly being enveloped by the descending plume of material and being injured or buried. It is likely, though, that most individuals would be able to evade the descending plume. In addition, restrictions on dredging activities in the summer would minimize impacts to squid eggs. Only two hard clams and five surf clams were captured during the 2013 benthic survey, indicating that any impacts from disposal activities would be experienced by relatively few, if any, representatives of these species at the site.

Although no lobsters were captured during the 2013 trawl survey, the boulder area in the north-central part of the NBDS and the bedrock/boulder area in the southwestern corner of Site NB-E have habitat type preferred by lobsters because it provides protection. Although no lobsters were found at the NBDS these areas would be excluded from disposal to minimize potential impacts to lobster habitat.

Located to the northeast of the Niantic Bay Alternative is a grouping of four managed shellfish beds (Figure 4-46 in Section 4.11). Considering that the northeastern portion of the Niantic Bay Alternative (*i.e.*, the area closest to the designated shellfish beds) is a containment area (due to lower bottom stress), and considering the rapid dispersion and dilution of suspended dredged material in the water column after disposal, impact to these shellfish beds would not be expected.

Overall, impacts to commercial and recreational shellfish populations by dredged material disposal at the Niantic Bay Alternative would be minimal and short-term.

5.5.6.3 Cornfield Shoals Alternative

Commercial and recreational shellfish species found at or near the Cornfield Shoals Alternative consisted only of squid; horseshoe crab, lobster, or other shellfish species were not found (see Section 4.11.5).

Compared to the New London and Niantic Bay Alternatives, longfin squid were captured near the Cornfield Shoals Alternative in relatively small numbers during the 2013 trawl survey. Impacts to this pelagic species would be limited to some individuals possibly being enveloped by the descending plume of material and being injured or buried. It is likely, though, that most individuals would be able to evade the descending plume. While longfin squid eggs are present in the summer months and attached to benthic material, restrictions on dredging activities in the summer would minimize impacts.

Cornfield Shoals is characterized as a dispersive site. Out of concern that material from Cornfield Shoals may be transported toward oyster beds located to the north of the site, specifically north of Long Sand Shoal, a series of surveys were conducted in 1991, 1992, 1994, and 2004 that showed the dispersion at the CSDS was oriented along an east-west axis and would not impact those shellfish beds (ENSR, 2005; Wiley, 1996). Predominant east-west transport at the alternative site is consistent with the findings of the physical oceanography study for this SEIS.

Overall, impacts to commercial and recreational shellfish populations by dredged material disposal at the Cornfield Shoals Alternative would be minimal and short-term and less than those at the other two alternative sites due to the less abundant population of shellfish at the site.

5.5.6.4 Summary for Commercial and Recreational Shellfish

In Long Island Sound, shellfish beds, as well as open-water shellfishing and aquaculture activities (see Section 5.5.10.1), exist primarily in nearshore areas. The three alternative sites are located in deep water away from shellfish beds.

The general lack of species and overall low abundance of commercial and recreational shellfish at the alternative sites indicates that impacts would be minimal and short-term, consisting mainly of direct burial and mortality of individuals that may be present at the time of disposal. Based on the relative abundances between the three alternative sites, it appears that impacts would be higher at the New London Alternative and lower at the Cornfield Shoals Alternative. However, because of the overall low abundance, none of the impacts would be expected to cause any measureable reduction in the population of any of the species potentially affected within eastern Long Island Sound.

5.5.7 Marine and Coastal Birds, Marine Mammals, and Marine Reptiles

The use of the three alternative sites by marine and coastal birds, marine mammals, and marine reptiles is possible, but would likely be limited in frequency and duration of visits. The occasional presence of these species may occur, especially while transiting the area during seasonal migrations. Birds, whales, dolphins, seals, and sea turtles may occasionally use the open waters for foraging habitat.

Potential impacts to birds, marine mammals, and sea turtles could include temporarily reduced foraging opportunities during disposal activities and possible physical injury resulting from collisions with tugs/scows used to transport and place dredged materials. Foraging opportunities could be temporarily reduced due to pulses of turbidity and disturbances to prey species at the proposed sites. However, these impacts would be temporary with conditions rapidly returning to baseline conditions after a disposal event. Birds, marine mammals, or sea turtles foraging in the area would most likely move to a nearby location to resume foraging. Collisions with scows used during disposal activities are unlikely, because tug and scow move slowly through the water and most species would move out of the water to avoid a collision. The rare occurrence of ship strikes is indicated by an annual mortality rate of 1.4 for humpback whales in the entire Gulf of Maine for the period 2001-2005, and a mortality rate of 1.6 for fin whales in the United States and Nova

Scotia, Canada (Kenney and Vigness-Raposa, 2010). Therefore, potential adverse impacts to these species or individuals would be minimal.

5.5.8 Endangered and Threatened Species

Due to proximity and similarity of offshore open-water habitat between the three alternative sites, the likelihood of occurrences of endangered or threatened species is the same at each site. Endangered and threatened whales and birds would only be present at the sites on an occasional incidental basis. Atlantic and shortnose sturgeon could be seasonally present in Long Island Sound, but have not been frequently documented and if present, would likely avoid the area due to the disturbance caused during disposal activities. Green, Kemp’s ridley, leatherback, and loggerhead sea turtles may transit or forage in parts of Long Island Sound between May 1 and November 15 of each year and could be present at the alternative sites. Sea turtles that are present at a disposal area while disposal activities occur may be affected by temporary increases in suspended sediment concentration in the water column. However, turtles are highly mobile and would be able to avoid these areas, and any effects would likely be minimal. Loggerhead, leatherback and Kemp's ridley sea turtles are all benthic feeders and often feed at depths similar to those found at the disposal sites. Disposed dredged materials would likely bury and kill benthic prey species, especially near the center portion of the disposal mound. However, the loss of these sites as potential foraging areas would not be expected to substantially impact the prey base for sea turtles in the area, as sea turtles are highly mobile and able to find other areas with suitable forage. As such, indirect effects on sea turtles from the disposal of dredged material would be minimal.

States, including Connecticut and New York, restrict dredging during certain times of year to protect species that are vulnerable to impacts from dredging. Generally, dredging is prohibited from June 1 to September 30 of any year to protect shellfish and finfish populations during their spawning season. Additional restrictions between February and June may be imposed on a case-by-case basis to protect endangered and threatened species where they may be present, according to recommendations by state or federal biologists during the USACE permit review. These time-of-year restrictions would further reduce potential impacts on all listed species. Sea turtles would particularly be protected because they are not expected to be in Long Island Sound between November 16 and April 30 (NOAA, 2004) when the majority of dredging and disposal activities would be expected to take place. Therefore, implementing the proposed action of designating one or more sites as a dredged material disposal site would not be expected to adversely impact any of the endangered or threatened species that may occur at the alternative sites.

Section 7 of the ESA requires consultation with NMFS and USFWS to adequately address potential impacts to threatened and endangered species that may occur at the proposed dredged material disposal alternative sites from any proposal to dispose dredged material. USEPA has determined that the designation of a disposal site will not result in adverse impacts to threatened or endangered species, species of concern, marine protected areas, or essential fish habitat. In addition, the USACE would coordinate with the NMFS and USFWS for individual permitted projects to further ensure that impacts would not adversely impact any threatened or endangered species. Consultation with NMFS and USFWS is ongoing.

5.5.9 Bioaccumulation

The placement of dredged material at any of the alternative sites could have potential impacts associated with bioaccumulation of contaminants in selected species from sediment exposure. Impacts would depend on the nature of dredged materials placed at an alternative site. Further, residence time of dredged materials placed at an alternative site governs the ability of biota to come into equilibrium with contaminants in the dredged material. However, dredged material management policies and procedures for open-water disposal (USEPA and USACE, 2004c), as well as sediment quality criteria limiting materials that may be authorized for open-water disposal (40 C.F.R. Part 227), are designed to screen out dredged materials that may pose a risk to human or ecological receptors.

To generate a conservative estimate of potential future tissue concentrations at the alternative sites and evaluate potential human health and ecological risks, this analysis (WHG, 2015) relied on bioaccumulation test and USEPA risk model results provided by USEPA and USACE for four dredging projects that were (or might be) dredged and placed at one of the alternative sites. This approach is considered conservative because: (1) future conditions and in-situ bioaccumulation at any alternative site is contingent on the mixture of native and placed sediments at the site, not solely on recent dredged materials which have undergone bioaccumulation testing, and (2) the tiered approach of the Regional Implementation Manual (USEPA and USACE, 2004c) dictates that other less contaminated dredged material may be disposed at an ocean disposal site, and only sediments that do not pass the initial tiered sediment testing approach receive Tier IV bioaccumulation testing and risk assessment.

The four dredging projects with bioaccumulation data and USEPA risk model results provided by USEPA and USACE were:

- Americas Styrenics (Gales Ferry, Connecticut);
- U.S. Coast Guard Academy (New London, Connecticut);
- Patchogue River Federal Navigation Project (Westbrook, Connecticut); and
- North Cove Federal Navigation Project (Old Saybrook, Connecticut)

The Americas Styrenics (2014) data included worm *(Nereis virens)* and clam *(Macoma nasuta)* bioaccumulation testing and comparisons to risk-based tissue concentrations. With the exception of lead in clams, bioaccumulation tissue results were either non-detect or not significantly different from reference area bioaccumulation tissue. No bioaccumulation tissue exceeded FDA Action/Tolerance Levels for protection of human health. Only dieldrin and endosulfans in worm tissue exceeded ecological effects values, although these pesticides were not significantly different from the reference area tissue results. Therefore, disposal of Americas Styrenics dredged materials at an alternative site would not be expected to pose any incremental risk to human health or ecological receptors.

The U.S. Coast Guard Academy (2013) data included worm *(Nereis virens)* and clam *(Macoma nasuta)* and clam bioaccumulation testing and risk modeling. No bioaccumulation tissue exceeded FDA Action/Tolerance Levels for protection of human health. USEPA human health risk model results indicated potential non-carcinogenic and carcinogenic risks from exposure to arsenic through the food chain, but also calculated potential non-carcinogenic and carcinogenic risks from exposure to arsenic in reference area bioaccumulation tissue. Therefore, disposal of U.S. Coast Guard Academy dredged materials at an alternative site would not be expected to pose any incremental risk to human health or ecological receptors.

The Patchogue River Federal Navigation Project (USACE, 2011b) data included worm (*Nereis virens*) and clam (*Macoma nasuta*) bioaccumulation testing and risk modeling. With the exception of PAHs and total PCBs in worms, and arsenic, cadmium, chromium, copper, lead, nickel, and PAHs in clams, bioaccumulation tissue results were either non-detect or not significantly different from reference area bioaccumulation tissue. No bioaccumulation tissue exceeded FDA Action/Tolerance Levels for protection of human health. No bioaccumulation tissue exceeded Ecological Effects Values. USEPA human health risk model results indicated no potential non-carcinogenic risks from exposure through the food chain. USEPA human health risk model results indicated levels of risk (less than 10^{-4} to 10^{-6}). Since this carcinogenic risk screen used conservative exposure assumptions, USACE review concluded Patchogue River dredged materials did not have the potential for significant undesirable effects.

The North Cove Federal Navigation Project (USACE, 2003b) data included worm *(Nereis virens)* and clam *(Macoma nasuta)* bioaccumulation testing and risk modeling. With the exception of PAHs and total PCBs in worms, and copper, lead, PAHs and total PCBs in clams, bioaccumulation tissue results were either non-detect or not significantly different from reference area bioaccumulation tissue. No bioaccumulation tissue exceeded FDA Action/Tolerance Levels for protection of human health. No bioaccumulation tissue exceeded Ecological Effects Values. USEPA human health risk model results indicated no potential non-carcinogenic risks from exposure through the food chain. USEPA human health risk model results indicated acceptable levels of risk (less than 10^{-4} to 10^{-6}). Since this carcinogenic risk screen used conservative exposure assumptions, USACE review concluded North Cove dredged materials were unlikely to have the potential for significant undesirable effects.

In summary, the data provided by USEPA and USACE indicate that there is low potential for any future incremental risk from management of dredged sediments at the alternative sites either in the long or short term. There is little potential for cumulative risk because the individual risks associated with each project are not additive. As long as the individual projects meet risk-based or concentration-based limits as required by the dredging program, the total number of such projects does not affect the risk at the alternative sites.

5.5.10 Socioeconomic Resources

As shown in Section 4.15, Long Island Sound is a region of social and economic importance with highly valuable resources. Because the three alternative sites share the same socioeconomic environment, socioeconomic impacts are similar.

5.5.10.1 Commercial Fishing

Commercial fishing activities occur throughout Long Island Sound, including in areas at or near the three alternative sites in eastern Long Island Sound. However, the alternative sites do not provide ideal habitat for the most common commercial species, and they further represent only a small area in the context of the entire eastern Long Island Sound fisheries resource.

Commercial fishing may be affected by dredged material disposal through interference with fishing methods or changes to the resource itself. For example, disposal may result in a restriction on the amount of time that the site is available for commercial fishing activities because fishermen do not want to risk loss of gear during times of active disposal. These impacts would not occur during the summer months, as dredging is generally restricted from June 1 to September 30 for protecting critical life stages of shellfish and finfish.

In Long Island Sound, open-water shellfishing and aquaculture activities, including oyster propagation and harvesting, occur primarily in nearshore areas. The three alternative sites are located in deep water away from shellfish beds. Shellfishing and aquaculture would not be impacted by disposal at any of the alternative sites because the disposal of dredged material is managed, as described in Section 5.5.3.

- ***Commercial Fishing at the New London Alternative:*** The finfish abundance is lower in eastern Long Island Sound than in central and western Long Island Sound. The primary target species in eastern Long Island Sound are summer flounder and tautog. Summer flounder inhabit shallow coastal and estuarine waters during warmer months and move offshore to the outer continental shelf in colder months (NOAA, 2015c); trawl data indicate few summer flounder inhabit the alternative sites. Tautog are attracted to structures such as reefs. With the exception of the boulder area in the north-central part of the New London Alternative (an area which, as discussed above, would not be used for dredged material disposal), the majority of the site has a relatively smooth and sandy bottom, which is not an ideal habitat for the target species, so there is relatively little commercial fishing activity at the site. As discussed in Sections 5.5.5.1 and 5.5.6.1, impacts from dredged material disposal activities on both commercial finfish and shellfish species that may be present at the New London Alternative would be minimal with no measureable reduction in the population of any targeted species within eastern Long Island Sound. Therefore, impacts to commercial fishing would be minimal.

- ***Commercial Fishing at the Niantic Bay Alternative:*** Commercial fish trawling is not known to occur at the site**,** and as discussed in Section 5.5.5.2, impacts to finfish species would be minimal and temporary and would not cause any measureable reduction in the population of any commercially targeted species within eastern Long Island Sound. Long-term impacts to commercial finfishing would not be expected at this site. With regards to commercial shellfishing, the western and central portion of the historic NBDS is zoned by the State of Connecticut as "Conditionally Restricted" for shellfishing, while the eastern part of the NBDS and Area NB-E are zoned "Conditionally Approved." However, as discussed in Section 5.5.6.2, impacts to commercial shellfish species would be minimal as no oysters, bay scallops, soft shell clams, or whelks were collected at the site, and only two hard clams and five surf clams were collected. The site is also located away from nearshore areas where most commercial shellfish beds are located. Therefore, impacts to commercial fishing would be minimal.

- ***Commercial Fishing at the Cornfield Shoals Alternative:*** As discussed in Section 5.5.5.3 and 5.5.6.3, impacts to finfish and shellfish species would be minimal and likely less than those for the New London and Niantic Bay Alternatives due to the less abundant population of commercially targeted finfish species at the site. Further, shellfish resources in coastal waters outside of the site would not be impacted due to rapid dilution and dispersion of dredged material in the water column after disposal (see Section 5.5.3). Therefore, impacts to commercial fishing would be minimal.

5.5.10.2 Recreational Fishing

Recreational fishing in Long Island Sound most frequently occurs from spring to fall (USACE, 1991), and reefs and areas of high relief are major fishing locations for recreational fishermen. Although the seafloor has some topographic relief in the boulder areas of the NBDS and Site NL-Wa, as well as in the disposal area of the NLDS, much of the seafloor at the three alternative sites is comparatively flat. Areas of high relief on the seafloor (such as Bartlett Reef) are located at least 0.5 nmi (1 km) from any alternative site. Recreational fishing in areas outside of the three alternative sites would not be impacted by disposal because the transport of dredged material is managed, as described in Section 5.5.3. Furthermore, dredging is generally restricted from June 1 to September 30 to protect critical life stages of shellfish and finfish; this period coincides with the primary recreational fishing season. Based on this information, impacts to recreational fishing at the three alternative sites would be minimal.

5.5.10.3 Shipping and Navigation

The impacts of dredged material disposal on shipping and navigation would be limited and manageable at each of the three alternative sites. As explained in Section 4.15.2, dredging operations involve the presence of dredging equipment in the channels and harbors that are being dredged, and scows carrying dredged material travel between these harbors and channels and the disposal sites. The disposal sites are all located outside of currently designated shipping lanes, although the New London Alternative is close to the entrance channel for the Thames River, and the submarine transit corridor crosses the center of the NLDS. Scows carrying dredged material may cross shipping lanes as they move to and from the disposal sites. In particular, if scows transport material from dredging projects in eastern Long Island, they would likely cross the route of the Orient Point-New London ferry. However, these potential traffic conflicts would be of short duration due to the limited dredging season and the moderate volumes of dredged material that need to be transported from some of the smaller harbors.

The minor impacts of additional tug/scow traffic within eastern Long Island Sound would be more than balanced out by the benefits of additional dredged material disposal capacity. The designation of one or more of the three alternative sites would result in the continued availability of affordable disposal of dredged material in the eastern Long Island Sound region, which would be beneficial for the navigation-dependent industries and other navigation-dependent economic activity.

5.5.10.4 Recreational Activities and Beaches

Recreational beaches in the vicinity of the three alternative sites would be unaffected by the use of any of the alternative sites for the disposal of dredged material due to the distance between the proposed sites and the shore. None of the sites is closer than 1.7 nmi (3.2 km) to public beaches in both Connecticut and New York. Therefore, impacts on recreational beach activities such as sunbathing or swimming would not be expected. Furthermore, impacts would be limited further due to restrictions prohibiting dredging from generally June 1 to September 30 of any year.

5.5.10.5 Parks and Natural Areas

Areas of special concern such as parks and other natural areas in Connecticut and New York are not likely to be affected by the use of any of the alternative sites. Over the long term, dredged materials would be expected to be contained within the New London Alternative and part of the Niantic Bay Alternative. The closest area of special concern from the New London Alternative is The Race at a distance of approximately 0.9 nmi (1.7 km). On balance, dredged material mobilized from the Cornfield Shoals Alternative and the dispersive part of the Niantic Bay Alternative would be expected to be transported westward toward central Long Island Sound over time. The closest area of special concern to the Niantic Bay Alternative is Rocky Neck State Park at a distance of approximately 2.5 nmi (4.6 km). The closest area of special concern to the Cornfield Shoals Alternative is the Plum Bank Marsh Wildlife Area at a distance of approximately 3.9 nmi (7.2 km). None of these areas of special concern would likely be affected by dredged material disposal at any of the three alternative sites because of their distance from the sites and the site management controls in place that would prevent contaminants or bioaccumulative materials from being disposed of at one of the sites.

5.5.10.6 Historic and Archaeological Resources

Potential impacts to a submerged shipwreck from disposal activity could occur in one of two ways: (1) direct impact of the mass of disposed dredged material as it is released from a scow positioned directly above the wreck, and (2) accumulation of fine sediment particles that settle out of the water column onto the resource from the suspended sediment plume of disposed dredged material. If a shipwreck is of historical significance, the direct impact would likely be adverse, resulting in physical damage to the shipwreck, including loss of physical integrity. The second type of impact from disposal nearby would result in gentle settling of fine sediment onto a shipwreck, which could, over time cover it but the sediment would not likely accumulate quickly enough to cause physical damage.

As discussed in Section 4.15.5, a review of submerged vessel reports in the NOAA and CT SHPO shipwreck databases indicate that there are three charted shipwrecks within 0.5 nmi (0.9 km) of the alternative sites. One of these charted shipwrecks is located within Site NL-Wa of the New London Alternative; this wreck was also identified by the sidescan sonar survey (WHG, 2014).

The sidescan sonar survey identified two additional wrecks within the 0.5-nm (0.9-km) perimeter outside of the Niantic Bay Alternative. None of these known shipwrecks are currently considered to be of historical significance. Consultation with the New York Office of Parks, Recreation and Historic Preservation (OPRHP; acts as the NY SHPO) revealed that there are no submerged vessels or historic resources within those portions of the New London and Cornfield Shoals Alternatives that are located in New York State waters.

For the charted shipwreck located in the southeastern corner of Site NL-Wa, further coordination with CT SHPO could include adding an avoidance buffer zone around the shipwreck to avoid impacts from the disposal of dredged material. There is currently no standard avoidance buffer for submerged historical and archaeological resources that has been adopted by any federal agency or accepted as a widespread practice, and buffers or exclusion zones have been implemented on a case-by-case basis (Research Planning et al., 2004). Generally, these buffers have been negotiated between federal agencies and the SHPOs. CT SHPO does not have an official policy or guidelines regarding avoidance buffers on submerged archeological resources. During a phone conversation to inquire if any guidelines or expectations had been developed by the CT SHPO or buffers that had been applied on previous projects, CT SHPO responded that these are determined on a case-by-case basis, but in the absence of additional site-specific information, a minimum avoidance distance of 100 feet (30 m) would be expected (Cathy Labadia, Archaeologist, CT SHPO, personal communication, March 2, 2015). In `the past, the NY OPRHP has recommended an avoidance zone around a potentially eligible submerged resource of 197 feet (60 m) beyond the limits of the resource (Research Planning et al., 2004). Currently, the NY OPRHP recommends a minimum buffer of 131 to 164 feet (40 to 50 m) for submerged historical and archaeological resources in freshwater contexts (Chris Sabick, Champlain Maritime Museum, personal communication, February 27, 2015). The management and monitoring of the shipwreck is described in the SMMP (Appendix I).

In summary, there are no historic and archaeological resources within the Niantic Bay and Cornfield Shoals Alternatives. The New London Alternative contains a shipwreck near its southern boundary; impacts would be minimized through by establishing a 164 feet (50 m) avoidance buffer surrounding the shipwreck and appropriate site management, which accommodates both the minimum buffer of 30 m expected by the CT SHPO, and the 40-50 m minimum buffer applied by the NY OPRHP.

5.5.10.7 Other Human Uses

The only military use at or near any of the three alternative sites is the submarine transit corridor across the NLDS. There are no energy resources located at or in the immediate vicinity of the three alternative sites, and none of the three sites have unique renewable energy potential. Therefore, there would be no impacts to these actual or potential uses.

5.5.10.8 Summary for Socioeconomic Resources

The potential impacts to commercial finfishing would be minimal because the alternative sites are not prime finfish or shellfish habitats. Impacts to recreational fishing would be minimal as well and likely would not differ between the alternative sites. Commercial shipping and navigation would not be impacted as the shallowest disposal depth permitted at a designated site would be 59 feet (18 m), and any interference during disposal operations would be mitigated through appropriate site management practices and notice to mariners. Disposal activities are not expected to adversely impact the recreational activities, beaches, parks, and natural areas associated with any of the three alternative sites. There are no pipelines or cables located within the boundaries of any of the alternative sites.

The New London Alternative is the only site with a known exposed shipwreck located at the southern border of the site. Not enough information exists to determine if the wreck is eligible for the NRHP. Nevertheless, impact to the wreck would be avoided through appropriate site management.

5.5.11 Air Quality and Noise

5.5.11.1 Air Quality

The designation of one or more disposal sites in eastern Long Island Sound would have no direct impacts on the emissions of criteria pollutants or air quality. Compliance with General Conformity would be addressed on a project-specific basis as part of the USACE permitting process for each dredged material disposal project. It is expected that most disposal projects would not exceed the de minimis thresholds and thus would not require General Conformity determinations.

Potential annual emissions from dredging and tugboat operations to move dredged material to a disposal site were estimated for comparison to the General Conformity de minimis thresholds. As described in Chapter 2, the total volume of fine-grained dredged material over the 30-year planning horizon is estimated as 13.4 million cubic yards. Assuming that: (1) all fine-grained dredged material is deposited at one or more designated open-water dredged material disposal sites in eastern Long Island Sound, (2) all material is deposited by 3,000 cy scows, and (3) the average travel time per round-trip by the tug/scow is 6 hours, then the average number of hours of operation per year by the tug/scow for the disposal of dredged material in eastern Long Island Sound would be approximately 1,000 hours.

Dredging emissions were quantified based on the emissions per cubic yard of material from an air emissions inventory at the Port of Oakland (ENVIRON, 2013). The study identifies dredging emissions separately from disposal emissions. For dredging emissions, the Port of Oakland study assumed the following dredging equipment: a clamshell dredge with two diesel engines, a dredge tender with two diesel engines, and a survey boat with two diesel engines. For disposal emissions, the study assumed a 650 horsepower (HP) diesel tugboat. The source of the tugboat engine emissions factor was an emissions inventory study conducted for the Port Authority of New York and New Jersey (PANYNJ) (Starcrest, 2012). To ensure tugboat emissions were assessed conservatively, a load factor of 100% was used (engine operating at maximum power during all hours of operation). A more realistic load factor cited in the PANYNJ study for towboats and pushboats would be 68%.

Table 5-8 summarizes the results of the emissions analysis. Total emissions from dredging and disposal activities would be well below the General Conformity de minimis impact thresholds; however, as noted previously, the designation of disposal site(s) is not subject to General Conformity and compliance would need to be demonstrated at project-specific basis. Furthermore, the geographic location of the emissions in open water away from populated areas would serve to further preclude the possibility of impacts to air quality at a local level.

Table 5-8. Potential Annual Emissions from Dredging and Disposal Activities in the Eastern Long Island Sound Region

	CO	**VOC**	**NOx**	**PM10**	**PM2.5**	**SO_2**
	tons					
Dredging Emissions	2.43	0.61	7.27	0.30	0.28	0.01
Disposal Emissions	0.76	0.27	6.84	0.37	0.36	0.14
Total	**3.19**	**0.87**	**14.10**	**0.67**	**0.65**	**0.15**
General Conformity de minimis impact thresholds	100	50	100	100	100	100

For comparisons with upland disposal alternatives, each load from a 3,000-cy scow may be equivalent to approximately 150 trucks (depending on truck size used). Disposal at upland sites would likely generate higher emissions than disposal at the three open-water alternative sites in eastern Long Island Sound. Total truck disposal emissions would depend on variables such as travel distance to the disposal site and the level of road congestion. Travel distances would likely be long, as suitable upland sites in the region are very limited (see Section 3.2.3). Emissions would include the engine exhaust emissions of diesel trucks, tire and brake wear particulate emissions, fugitive dust generated by the truck traffic on roads, and dust generated by unloading/material handling at the land-based disposal site.

Greenhouse Gas Emissions. Based on the methodology discussed above for air quality, annual greenhouse gas emissions from dredging and disposal activity were quantified. The total emissions are expressed in terms of CO_2-equivalent (CO_2e), a metric that takes into account the global warming potential/heat trapping properties of various greenhouse gases relative to CO_2. Dredging emissions would total 873 tons of CO_2e per year and disposal emissions would total 384 tons per year. The combined emissions from dredging and disposal would be 1,257 tons per year, which would be well below the 25,000 tons per year level that Draft CEQ Guidance suggests should prompt consideration of a detailed quantitative greenhouse gas analysis for NEPA purposes (CEQ, 2014). Utilization of the three alternative sites (New London, Niantic Bay, and Cornfield Shoals) would present the lowest greenhouse gas (GHG) emissions for disposal compared to No Action Alternative, as those other alternatives would involve more GHG-producing transportation and disposal activity. Reduction of GHG emissions promotes climate resilience (*e.g.*, resilience to rising sea levels). As discussed above, given the limited availability of suitable upland sites, upland disposal would be expected to require substantially longer trips (and hence higher emissions of greenhouse gases) than required on average for disposal at the three open-water alternative sites.

Odors. The designation of potential open-water dredged material sites would comply with Connecticut Air Pollution Control Regulations that address odors (CTDEEP, 2015c). New York State does not have regulations to address specific nuisance odors, although specific pollutants that may contribute to odor issues are regulated (such as hydrogen sulfide) (NYSDEC, 2015e). It is not expected that odors in the dredged material would be noticed during dredging, although this would depend on the type of dredge used, air temperature, direction of the wind, and proximity of the dredge and scow to populated areas. Dredged material disposal at the three alternative sites would occur far enough from populated areas that any potential odors would mix sufficiently with ambient air to prevent objectionable odors on land.

5.5.11.2 Noise

Dredging operations and transportation of dredged material produce noise similar to noise created by other diesel equipment. The specific amount of noise produced would depend on the type of equipment used by the dredging contractor. It is expected that the degree of noise produced by the designation of any of the three alternative sites in eastern Long Island Sound would not be substantially different from background noise levels in the area.

5.5.11.3 Summary of Air Quality and Noise

Impacts to local air quality would consist mainly of exhaust fumes from tugs and other equipment used during operations. These minimal, short-term impacts would not be expected to differ between alternative sites. Tugs would generate some minor noise while transporting the scows. Any minor noise impacts should be similar for the three alternative sites.

5.6 Comparison of Alternatives with MPRSA Criteria

This section summarizes the impacts for the various resources associated with the three alternative sites and the No Action Alternative, as relevant to the five general (40 C.F.R. Section 228.5) and 11 specific (40 C.F.R. Section 228.6(a)) MPRSA site selection criteria.

Based on the information presented in Chapter 4, there are similarities between the three alternative sites for a number of resources; therefore, several of the site selection criteria were found to not discriminate (*i.e.*, were considered equal) between the alternative sites. Those criteria that were not used to discriminate between the alternative sites (*i.e.*, non-discriminatory) are discussed in Section 5.6.1. In addition, as indicated in Table 5-9, some impacts were identified that could be mitigated through site management actions; related MPRSA criteria are discussed in Section 5.6.2. Section 5.6.3 provides a discussion of the discriminatory site selection criteria. The No Action Alternative is compared to the three alternative sites in Section 5.6.4. Section 5.7 assesses potential cumulative impacts for the three Action Alternatives.

Based on the comparison of the alternative sites with MPRSA criteria and the cumulative impact assessment, the preferred alternative, which is defined as the alternative that provides the greatest practicable net benefit with the least environmental and socioeconomic impact, is determined in Section 5.8.

Table 5-9. Summary of Impacts for Action and No Action Alternatives

Impacts (Reference to MPRSA Criteria, 40 C.F.R)	Action Alternatives			**No Action Alternative**
	New London	**Niantic Bay**	**Cornfield Shoals**	
Water Depth	46 to 95 feet (14 to 28 m)	60 to 230 feet (18 to 70 m)	151 to 187 feet (46 to 57 m)	Not applicable.
Sedimentation and Erosion [228.6(a)(7)] *Note:* A maximum bottom stress of 0.75 Pascal (Pa) is considered the critical stress for sediment erosion from the seafloor.	The maximum bottom stress throughout the site is below 0.75 Pa, with the exception of a small area in the southwestern corner of Site NL-Wb where the bottom stress is 0.76 Pa. Dredged material disposed at the site would be contained.	The maximum bottom stress is below 0.75 Pa in the northeastern portion of the site, and above 0.75 Pa in the central, western and southern portion of the site. Dredged material disposed in the northeastern part of the site would be contained. In the remaining part of the site, fine fractions of the disposed dredged material disposed would be suspended and dispersed over time in eastern Long Island Sound, initially in the dominant direction of tidal flows (*i.e.*, east-west). Coarse sediment would remain at the bottom and mix with natural sediments.	The maximum bottom stress throughout the site is above 1.0 Pa. Fine fractions of the dredged material disposed at the site would be suspended and dispersed in Long Island Sound, after transport initially in a westerly direction. Coarse sediment would remain at the bottom and mix with natural sediments.	*Scenarios 1 and 4:* Impacts would depend on location of other open-water sites or coastal beneficial use alternative. No impacts to land-based alternatives. Beneficial use alternatives (nearshore berms; beach nourishment) may offset effects from global sea level rise. *Scenario 2:* Impacts would pertain to conditions at the selected designated site; at the CLDS and RISDS impacts would be minor or less with proper site management. *Scenario 5:* No impact.
	Containment Site	**Partial Containment and Partial Dispersive Site**	**Dispersive Site**	**Minor to No Impact**

Table 5-9. Summary of Impacts for Action and No Action Alternatives

Impacts (Reference to MPRSA Criteria, 40 C.F.R)	**Action Alternatives**			**No Action Alternative**
	New London	**Niantic Bay**	**Cornfield Shoals**	
Water Column (Transport) and Water Quality [228.6(a)(6)] and [228.5(b); 228.6(a)(9)] *Note:* STFATE model used to assess compliance with dilution requirements. Simulations used characteristic scow size and dredged material composition. Depths, stratification, and current velocities for each site were specified based on the PO study. Simulations for mean and high (worst case) tidal flow conditions were conducted and recent elutriate test data for projects in eastern Long Island Sound dredging project were used.	For disposal operations at mean flows as well as at high flows (*i.e.*, flows at maximum tidal amplitude), there would be short-term effects within the site, although effects would be in compliance with requirements. Outside the alternative site, discharges generally would also be compliant both at mean and high flow conditions. * These simulations represent worst-case conditions. Potential water quality impacts would be prevented further through proper site management practices.			*Scenarios 1 and 4:* Impacts depend on location of other open-water sites or coastal beneficial use alternatives. Potential for impacts to land-based alternatives from surface water runoff and groundwater infiltration, although risk would be minimized due to site protection and management measures. *Scenario 2:* Impacts at the CLDS and RISDS impacts would be minor or less with proper site management. *Scenario 5:* No impact.
	* Should smaller site dimensions for the Niantic Bay or New London Alternatives be chosen, the LPC at high flows would be exceeded outside the site for a 1x1 nmi site within the Niantic Bay Alternative or a 1.5x1 nmi site (Sites NL-Wa/b) within the New London Alternative. The LPC would not be exceeded at mean flow conditions, however. Thus, water quality impacts could also be avoided for these site dimension options with appropriate site management practices.			
	Minimal Short-term Impact (assuming use of proper site management practices) **No Long-term Impact.**			**Minor to No Impact.**

Table 5-9. Summary of Impacts for Action and No Action Alternatives

Impacts (Reference to MPRSA Criteria, 40 C.F.R)	**Action Alternatives**			**No Action Alternative**
	New London	**Niantic Bay**	**Cornfield Shoals**	
Sediment Quality [228.6(a)(4)]	Contaminants were either not detected or at low concentrations (*i.e.*, both at the site and off-site reference areas outside the site). A few detected concentrations exceeded the NOAA ERL guideline values; all detected concentrations were below the NOAA ERM guideline values considered adverse to organisms.	Contaminants were either not detected or at very low concentrations (*i.e.*, both at the site and off-site reference areas outside the site. All detected concentrations were below the NOAA ERL guideline values and the NOAA ERM guideline values considered adverse to organisms.		*Scenarios 1, 2, and 4:* Impacts would depend on location of other open-water sites, or beneficial use and land-based alternatives. Required testing to screen out unacceptable materials, and site management would minimize human health risks and exposure of organisms to unacceptable contaminant levels. *Scenario 5:* No impact.
	Toxicity testing with two test organisms indicated no site-related toxicity relative to laboratory controls or to reference areas. Required testing to screen out unacceptable materials, and site management would minimize exposure of organisms to unacceptable contaminant levels.			
	No Impact			**Minimal to No Impact**
Plankton and Larval Forms [228.6(a)(2); 228.6(a)(9); 228.6(a)(10)]	Small, short-term entrainment losses. No major cumulative impact.			*Scenarios 1, 2, and 4:* Similar to minimal impacts for Action Alternatives. *Scenario 5:* No impact.
	Minimal Impact			**Minimal to No Impact**

Table 5-9. Summary of Impacts for Action and No Action Alternatives

Impacts (Reference to MPRSA Criteria, 40 C.F.R)	**Action Alternatives**			**No Action Alternative**
	New London	**Niantic Bay**	**Cornfield Shoals**	
Benthos [228.6(a)(2); 228.6(a)(9); 228.6(a)(10)]	Short-term reductions in abundance and diversity within the site due to burial, but productivity may increase temporarily with influx of Stage I colonizers. Minimal to no long-term impacts as recolonization to levels similar to predisposal would occur within months to several years.			*Scenarios 1 and 4:* Impacts would depend on location of other open-water sites or coastal beneficial use alternative. Impacts may occur for nearshore berm or CDF alternatives. No impacts to land-based alternatives. *Scenario 2:* Similar to Action Alternatives, impacts to benthic invertebrates at the CLDS and RISDS would be minimal and short-term, and there would be no long-term impacts. *Scenario 5:* No impact.
	With more existing Stage III communities than present at the other two alternative sites, short-term impacts would be slightly greater and recovery to predisposal community structure would likely take longer than for the other two alternative sites.	Short-term impacts and long-term recovery time would be slightly less than at New London Alternative based on the amount of existing Stage III communities.		
	Exclusion of boulder area in north-central part of Site NL-Wa and the bedrock/boulder area in southwestern corner of Site NL-Wb would avoid impacts to epifauna.	Exclusion of the boulder area in north-central part of the NBDS and the bedrock/boulder area in southwestern corner of Site NB-E would avoid impacts to epifauna	No impacts to epifauna in boulder or bedrock areas as no habitat of this type exists.	
	Minor Short-term Impact. Minimal Long-term Impact.			**Impact / No Impact**

Table 5-9. Summary of Impacts for Action and No Action Alternatives

Impacts (Reference to MPRSA Criteria, 40 C.F.R)	**Action Alternatives**			**No Action Alternative**
	New London	**Niantic Bay**	**Cornfield Shoals**	
Fish, Lobster, and Other Invertebrates [228.6(a)(2); 228.6(a)(9); 228.6(a)(10)] *(EFH consultation with the NMFS is ongoing)*	Short-term local disruption of forage habitat and potential loss of demersal finfish and benthic species during disposal due to burial, but no long-term impacts on populations. . Impacts to EFH would be minimal. Increased topographic relief and recolonization by benthic food sources would partially offset some of the habitat disruption impacts.			*Scenario 1:* Impacts would be similar to Action Alternatives from direct mortality of demersal species through burial, turbidity affecting feeding behavior (both adverse and beneficial feeding mechanism), and temporary displacement. Impacts would be confined to disposal area, but would depend on local conditions. *Scenario 2:* Impacts at the CLDS and RISDS would be minimal and short-term; there would be no long-term impacts. *Scenario 4:* No impacts unless a selected upland site is close to nearshore fishing or shellfishing grounds where eroded sediment in runoff could increase turbidity and impact species. *Scenario 5:* No impact.
	Mitigation (*i.e.*, avoidance of area) would result in no impacts to species inhabiting structured habitat of boulder area in north-central part of Site NL-Wa and of bedrock/boulder area in southwestern corner of Site NL-Wb.	Mitigation (*i.e.*, avoidance of area) would result in no impacts to species inhabiting the boulder area in north-central part of NBDS and in bedrock/boulder area in southwestern corner of Site NB-E.	Overall impacts would be less than New London and Niantic Bay due to fewer species existing in this area.	
	Minimal Impact			**Impact / No Impact**

Table 5-9. Summary of Impacts for Action and No Action Alternatives

Impacts (Reference to MPRSA Criteria, 40 C.F.R)	**Action Alternatives**			**No Action Alternative**
	New London	**Niantic Bay**	**Cornfield Shoals**	
Marine and Coastal Birds, Marine Mammals, Marine Reptiles [228.6(a)(2)]	These species are occasional visitors to the alternative sites, but do not rely on them for critical habitat. Impacts would be temporary and very limited, involving potential disruption of foraging habitat during and in the immediate vicinity of the disposal events.			*Scenario 1:* Impacts would be similar to Action Alternatives but would be very limited in nature. Possible reduced foraging in area during disposal activities, and possible (though unlikely) collision with scows. *Scenario 2:* Impacts at the CLDS and RISDS would be minimal. *Scenario 4:* Potential impacts to marine and coastal birds, and marine mammals and reptiles, would depend on the selected site. *Scenario 5:* No impact.
	Minimal Impact			**Impact / No Impact**
Endangered and Threatened Species [228.6(a)(2)] *(Section 7 ESA consultation with the NMFS and USFWS is ongoing)*	These species are occasional visitors to the sites, but do not rely on them for critical habitat. Impacts would be temporary and very limited, involving potential disruption of foraging habitat during and in the immediate vicinity of the disposal events. Time of year restrictions on dredging activities (*e.g.*, generally from June 1 to September 30), and hence disposal activities, would further reduce any potential impacts.			*Scenario 1:* Impacts would depend on site-specific conditions and the species that may be present. *Scenario 2:* Impacts at the CLDS and RISDS would be minimal. *Scenario 4:* Potential impacts to marine species at nearshore berm sites, and terrestrial species at beach nourishment and upland sites. *Scenario 5:* No impact.
	Minimal Impact			**Impact / No Impact**

Table 5-9. Summary of Impacts for Action and No Action Alternatives

Impacts (Reference to MPRSA Criteria, 40 C.F.R)	**Action Alternatives**			**No Action Alternative**
	New London	**Niantic Bay**	**Cornfield Shoals**	
Bioaccumulation Potential [228.6(a)(9)]	Disposal of material deemed suitable for open-water disposal under the ocean disposal regulations is not expected to change the present low risk levels in organisms in or near the site.			*Scenario 1:* Impact would depend on location of other open-water sites, but likely acceptable, similar to Action Alternatives. *Scenario 2:* Impacts at the CLDS and RISDS would be very low. *Scenario 4:* Impacts depend on location and type of upland or beneficial use alternative. *Scenario 5:* No impact.
	No Impact			**Impact / No Impact**

Table 5-9. Summary of Impacts for Action and No Action Alternatives

Impacts (Reference to MPRSA Criteria, 40 C.F.R)	**Action Alternatives**			**No Action Alternative**
	New London	**Niantic Bay**	**Cornfield Shoals**	
Commercial and Recreational Fishing [228.5(a) and 228.6(a)(8)]	Site does not provide ideal habitat for targeted commercial and recreational fisheries and few target species have been found at the site; therefore, impacts would be minimal.	Site does not provide ideal habitat for targeted commercial and recreational fisheries and few target species have been found at the site.		*Scenario 1:* Potential impacts from disruption of fishing activities at previously unused areas for disposal, but impacts would be minimized due to dredging restrictions from June 1 to September 30 for protection of critical life stages of shellfish and finfish. *Scenario 2:* Potential socioeconomic impacts if higher disposal costs result in delays or cancellation of dredging projects due to resultant shoaling in harbors and channels. *Scenario 4:* Potential socioeconomic impacts if higher disposal costs result in delays or cancellation of dredging projects. Potential impacts to recreational fishing if selected disposal sites are close to nearshore shellfish beds or fishing grounds. *Scenarios 5:* Impacts potentially significant due to reduction in dredging of harbors and channels and resultant shoaling.
		The northern portion of Site NB-E and the northeastern corner of the NBDS are containment areas, and while the rest of the alternative site is considered a dispersive area. Dispersion would occur along the principal east-west axis for tidal flows and would not impact shellfish beds to the north and northeast of Site NB-E. Therefore, any impacts to commercial and recreational fishing would be minimal.	Dispersion of dredged material would occur along the east-west axis and would not impact oyster shellfish beds to the north. Therefore, any impacts to commercial and recreational fishing would be minimal.	
	Time of year restrictions on dredging and disposal activities (*e.g.*, June 1 to September 30) for protecting critical life stages of shellfish and finfish would further minimize any potential impacts.			
	Minimal Impact			**Major to Minimal Impact**

Table 5-9. Summary of Impacts for Action and No Action Alternatives

Impacts (Reference to MPRSA Criteria, 40 C.F.R)	**Action Alternatives**			**No Action Alternative**
	New London	**Niantic Bay**	**Cornfield Shoals**	
Shipping, Navigation [228.5(a) and 228.6(a)(8)]	Minimal interferences that could be mitigated through site management practices and notice to mariners.			*Scenario 1:* Minimal impact. *Scenarios 2, 4, and 5:* Impacts expected due to possible reduction in dredging of harbors and channels and resultant shoaling. These impacts would be substantial particularly under Scenario 5.
	The submarine transit corridor crosses the center of the NLDS. However, the minimum targeted water depths for dredged material disposal (*i.e.*, 59 feet [18m]) is greater than the depth of the shipping channel in the Thames River (*i.e.*, 40 feet [12 m]).			
	Minor Impact	**Minimal Impact**	**Minimal Impact**	**Major to Minimal Impact**
Beaches and Swimming [228.5(b) and 228.6(a)(3)]	No impact; distances are too long for impacts to these areas. Suspended sediment from disposal of dredged material and from erosion at the seafloor by storms and tidal currents would be rapidly diluted and dispersed in the water column. Furthermore, impacts would be limited further due to restrictions prohibiting dredging from generally June 1 to September 30 of any year.			*Scenario 1:* Impacts would depend on the location of the sites. *Scenarios 2 and 5:* No impacts. *Scenario 4:* Impacts (both beneficial and adverse) depend on location and type of beneficial use or upland alternative.
	No Impact			**Adverse and Beneficial Impact / No Impact**

Table 5-9. Summary of Impacts for Action and No Action Alternatives

Impacts (Reference to MPRSA Criteria, 40 C.F.R)	**Action Alternatives**			**No Action Alternative**
	New London	**Niantic Bay**	**Cornfield Shoals**	
Parks / Sanctuaries / Natural Areas / Research Preserves [228.5(b) and 228.6(a)(8)]	None of these entities exist within or near any of the sites.			*Scenario 1:* Impacts would depend on the location of the sites. *Scenarios 2 and 5:* No impacts. *Scenario 4:* Impacts (both beneficial and adverse) depend on location and type of beneficial use or upland alternative. Potential beneficial impacts from beach nourishment at coastal parks, etc.
	No Impact			**Adverse and Beneficial Impact / No Impact**
Historic/ Archaeological Resources [228.6(a)(11)]	One wreck identified near southern border of the site. Not enough information exists to determine if the wreck is eligible for the NRHP.	No impact; no confirmed wrecks in site.		*Scenarios 1 and 4:* Impacts would depend on location of site. *Scenarios 2 and 5:* No impact.
	Impact (but could be managed through an avoidance buffer zone)	**No Impact**	**No Impact**	**Impact / No Impact**
Other Human Uses [228.5(a) and 228.6(a)(8)]	No military activity within the site. No cables or pipelines within the site. No unique renewal energy potential at the site. Interference with recreation such as boating and other human uses would not be expected.			*Scenarios 1 and 4:* Impacts would depend on location of site. *Scenario 2:* No impact. *Scenario 5:* Potential impacts due to reduced access to the open water as a results of shoaling harbors.
	No Impact			**No Impact**

Table 5-9. Summary of Impacts for Action and No Action Alternatives

Impacts (Reference to MPRSA Criteria, 40 C.F.R)	**Action Alternatives**			**No Action Alternative**
	New London	**Niantic Bay**	**Cornfield Shoals**	
Use of previous dredged material disposal [228.6(a)(7)]	Actively used (40% of the area of the alternative site). Site is actively used; site has been monitored extensively with no known adverse impacts attributable to its use. Management studies provide a long history and thus value for continuing dredged material research.	Historically used (approximately two thirds of the area of the alternative site). No evidence of adverse impacts in or from the site since closure. Sediment quality is similar to adjacent areas.	Actively used (100% of the area of the alternative site). Site is actively used. Site has been monitored extensively with no known adverse impacts attributable to its use. Management studies provide a long history and thus value for dredged material research at dispersive sites.	*Scenarios 1 and 4:* Likely new sites, where applicable. *Scenario 2:* Active designated sites. *Scenario 5:* No impact.
	No Impact	**No Impact**	**No Impact**	**Impact / No Impact**
Air Quality and Noise (NEPA requirement)	Minimal adverse air quality or noise impacts.			*Scenarios 1 and 2:* No impact. *Scenarios 4 and 5:* Potentially significant increase in land-based transport and associated emissions depending on alternatives selected to move material and on the volume of dredged material transported and disposed.
	Minimal Impact			**Impact / No Impact**

Table 5-9. Summary of Impacts for Action and No Action Alternatives

Impacts (Reference to MPRSA Criteria, 40 C.F.R)	Action Alternatives			No Action Alternative
	New London	**Niantic Bay**	**Cornfield Shoals**	
Economic Impacts [228.5(a) and 228.6(a)(8)]	Dredging and disposal costs of $11 to $56 per cy for harbors within 4.3 to 8.7 nmi (5 to 10 miles; 8 to 16 km) of the alternative sites. The lower costs are for a large (1,000,000 cy) project within 4.3 nmi, and higher costs are for a small (26,000 cy) project 8.7 nmi from the disposal site.			Depending on Scenario, substantial impacts to regional waterborne commerce, recreational use, and economy of the eastern Long Island Sound region. Reduction in depths of navigable waterways and harbors due to deferred maintenance dredging could cause some marinas to close and lead larger ships to avoid commercial harbors that do not maintain authorized depths. This would reduce the contributions of these maritime-related industries to the regional economy. Recreational boating is estimated to contribute $494 million and marine transportation is estimated to contribute $1.4 billion to the regional economy. Beneficial use and upland placement alternatives can involve substantially higher costs, particularly for small projects, except for those with pipeline or pump-off placement of material at small distances. Costs for beneficial use beach nourishment alternatives range from $14 to $107 per cy depending on volume and distance. Costs for marsh creation range from $58 to $135 per cy.
	Lowest cost for harbors in vicinity of New London; highest cost for harbors in western part of eastern Long Island Sound.	Lower cost for harbors in vicinity of New London; higher cost for harbors in western part of eastern Long Island Sound.	Lowest cost for harbors near mouth of Connecticut River; highest cost for harbors surrounding Fishers Island Sound.	
	No Impact	**No Impact**	**No Impact**	**Impact**

Note: MPRSA criteria 228.5(c), 228.5(d), 228.5(e), 228.6(a)(4), and 228.6(a)(5) were addressed during the site screening process. See Appendix B.

5.6.1 Non-Discriminating Criteria and Use Conflicts

Three of the MPRSA general site selection criteria (40 C.F.R. 228.5) and four specific site selection criteria (40 C.F.R. 228.6) that were addressed during the site selection process or the alternative site evaluation in Chapter 4 did not discriminate substantially for the choice of an alternative.

1. *228.5(c): If at any time during or after disposal site evaluation studies, it is determined that existing disposal sites presently approved on an interim basis for ocean dumping do not meet the criteria for site selection set forth in Section 228.5 through 228.6, the use of such sites will be terminated as soon as suitable alternate disposal sites can be designated.*

   General criterion 228.5(c) is relevant only to existing and historic sites and is related to site terminations if the site is not meeting the Section 228.5 and 228.5(a) criteria. The three alternative sites that were evaluated were generally consistent with this criterion and therefore were all retained in the alternatives analysis. It is noted that the New London Alternative includes the existing NLDS and an area to the west, not previously used for dredged material disposal (*i.e.*, Sites NL-Wa and NL-Wb). Similarly, the Niantic Bay Alternative includes the historic NBDS and an area to the east, not previously used for dredged material disposal (*i.e.*, Site NB-E). Not designating all (or part) of the existing NLDS and/or CSDS would terminate their use for dredged material disposal after December 23, 2016.

2. *228.5(d): The sizes of ocean disposal sites will be limited in order to localize for identification and control any immediate adverse impacts and permit the implementation of effective monitoring and surveillance programs to prevent adverse long-range impacts. The size, configuration, and location of any disposal site will be determined as a part of the disposal site evaluation or designation site study.*

   General criterion 228.5(d) limits the size of disposal sites to enable identification and control of immediate impact and to enable effective monitoring and surveillance programs. The long history of dredged material site monitoring in New England (*i.e.*, the DAMOS program) and specifically at active and historic dredged material disposal sites within Long Island Sound provides ample evidence that these surveillance and monitoring programs are effective at determining physical, chemical, and biological impacts regardless of the alternative site chosen. The disposal sites were also investigated by the USEPA within the last ten years as part of sidescan sonar surveys in eastern Long Island Sound (Appendix D). Thus, the assessment required by criterion 228.6(a)(5) indicates that monitoring and surveillance are neither limiting nor discriminatory with respect to the alternative sites evaluated. Moreover, having sites located relatively close to shore and near ports provides for more cost-effective surveys than those further from shore, thus there are no cost reasons, contingent on available federal budgets, that would favor one alternative site over another.

3. *228.5(e): USEPA will, wherever feasible, designate ocean dumping sites beyond the edge of the Continental shelf and other such sites that have been historically used.*

   General criterion 228.5(e) states that USEPA will, wherever feasible, designate ocean dumping sites beyond the edge of the continental shelf. However, as discussed in Section 3.4.1, sites beyond the edge of the continental shelf were determined not feasible to meet long-term regional dredged material disposal needs and were eliminated. All three evaluated alternative sites, or significant portions thereof, have been historically used for dredged material disposal. The only exception would be site dimension option NL-Wa/b of the New London Alternative, which has not been historically used.

4. *228.6(a)(4): Types and quantities of wastes (dredged material) proposed to be disposed of, and proposed methods of release, including methods of packaging the waste (dredged material), if any.*

   Specific criterion 228.6(a)(4) addresses the types and quantities of waste considered for disposal at a site. Only dredged material found suitable for disposal in the marine environment would be placed at any of the alternative sites. Therefore, there is no available information to discriminate between the alternative sites on the basis of the types and quantities of material. Similarly there is no information that would discriminate between the sites on the basis of the disposal method, which is predominantly via hopper dredge or scows. However, CSDS has received coarser dredged material historically.

5. *228.6(a)(5): Feasibility of surveillance and monitoring.*

   Specific criterion 228.6(a)(5) was written to ensure that any site chosen can be surveyed and monitored properly to avoid unanticipated impacts at a site. All three alternative sites could be surveyed and monitored properly.

6. *228.6(a)(10): Potentiality for development or recruitment of nuisance species in the disposal site.*

   The contribution of dredged material to nutrient loading in Long Island Sound would be very small and would not be expected to contribute to conditions that could lead to the development of harmful algal blooms (see Section 5.2.1). The primary sources of nutrients entering Long Island Sound are atmospheric deposition, domestic and industrial wastewater flows, fertilizer releases, and urban runoff (Varekamp et al., 2014). It is also unlikely that non-native invasive species, (*e.g.,* some species of tunicates) would colonize the disposal sites. The range of depths at the three alternatives sites are not so dissimilar that they would have different potential to attract and support invasive species. Further, the different bottom types located in the three sites (boulders, gravel, sand, silt) are not likely to have substantially different potential for the types of invasive species anticipated in Long Island Sound. Invasive species could originate from the dredged material itself, or colonize the newly disturbed sites from surrounding areas. The likelihood of species surviving the process of dredging, transport to the site, and disposal is not known with any degree of certainty; however, prior studies of disposal mounds on the seafloor (*e.g.*, Fredette and French, 2004; ENSR, 2005; AECOM, 2009; AECOM, 2012; Carey and Bellagamba Fucile, 2015) have not indicated that colonization of disposal mounds by non-native invasive species is an issue. Thus, there are no dissimilarities between the alternative sites that allow preference of one alternative site over the others under this criterion.

7. *228.6(a)(7): Existence and effects of current and previous discharges and dumping in the area (including cumulative effects).*

Impacts from current and past disposal activities were assessed at each of the alternative sites considered in this SEIS. All three alternative sites have been used in the past for disposal of dredged material. Changes in bathymetry were observed at the NLDS, as dredged material disposed in the past is contained within the site. At the CSDS, dredged material is dispersed; only remnants of dredged material disposal mounds are observed on the seafloor. At the historically-used NBDS, available data do not show remaining signs of past dredged material disposal operations. However, both the NLDS and CSDS have been used for more than 50 years for dredged material disposal, while the Niantic Bay site was used only for a short period about 45 years ago (see Table 1-1).
Differences between the alternative sites exist with regard to mound retention due to different hydrodynamic conditions. Dredged material would be retained as mounds at the New London Alternative, dispersed at the Cornfield Shoals Alternative, and both retained (northeast area) and dispersed (remainder of the site) at the Niantic Bay Alternative.

Although there is a short-term loss of benthic infauna species under the footprint of the dredged material mounds during disposal, benthic communities recover as demonstrated consistently by the DAMOS program (*e.g.*, AECOM, 2009). Nutrient and contaminant releases during dredged material disposal would be very small (see Section 5.2.1) and similar at all three sites; elutriate discharges would be rapidly diluted in the water column (see Section 5.5.3).

Contaminants in the sediment of the NLDS and CSDS were either not detected or detected at low concentrations *(i.e.,* both at the site and reference areas outside the site). A few detected concentrations exceeded the NOAA ERL guideline values, but all detected concentrations were below the NOAA ERM guideline values considered adverse to organisms. Previous discharges do not appear to have affected sediment toxicity, based on a comparison of site results to laboratory controls and off-site reference area results. Contaminants were measured either below the Ecological Effects Values or within the range observed LIS-wide. The exception was mercury in estimated lobster whole body tissue at CSDS, although the concentration did not significantly exceed the guideline value for aquatic organisms (*i.e.,* the estimated tissue concentration was only 15% greater than the guideline value); however, the mercury concentration at the CSDS was similar to the concentration at the reference areas in western and central Long Island Sound (see Table 14-24 in Section 4.14.1). Contaminants in tissues were also below FDA Action/Tolerance Levels for human health.

In summary, the evaluation did not find sufficient reason to choose one of the alternative sites over the others on the basis of current or past disposal activities.

5.6.2 Mitigatable Discriminating Criteria and Use Conflicts

Two of the MPRSA general site selection criteria (40 C.F.R. 228.5) and five specific site selection criteria (40 C.F.R. 228.6) that were addressed during the site selection process or the alternative site evaluation in Chapter 4 were considered to be fully or partially discriminatory to the choice of an alternative. Specifically, several of the MPRSA criteria are multifaceted, addressing various issues. Some of these issues were considered nondiscriminatory and did not reveal any major differences between the alternative sites. Other issues raised by these multifaceted criteria, however, were considered discriminatory. For those discriminatory criteria, mitigation actions were considered to determine if one or more of the alternative sites would be preferable.

1. *228.5(a): The dumping of dredged material into the ocean will be permitted only at sites or in areas selected to minimize the interference of disposal activities with other activities in the marine environment, particularly avoiding areas of existing fisheries or shellfisheries, and regions of heavy commercial or recreational navigation.*

   228.6(a)(8): Interference with shipping, fishing, recreation, mineral extraction, desalination, fish and shellfish culture, areas of special scientific importance and other legitimate uses of the ocean.

   None of the alternative sites are located near a desalination plant or areas of mineral extraction. The use of these sites for dredged material disposal also would not interfere with aquaculture operations or any other competing, legitimate uses of eastern Long Island Sound. Available data indicate that there are no significant shellfisheries or commercial/recreational fishing at the three alternative sites, and dredging restrictions that generally occur from June 1 to September 30 for protecting critical life stages of shellfish and finfish would minimize potential interference during this timeframe, which encompasses a large portion of the fishing season.

   The site screening described in Chapter 3 carried forward only those sites that were not located in concentrated areas of heavy commercial or recreational navigation, although all three alternative sites are subject to intermittent vessel passage throughout the year. The only difference between the alternative sites is the identified submarine transit corridor that was established across the NLDS (part of the New London Alternative) to minimize conflicts between disposal buoy positions and submarine and other deep-draft traffic to and from the Submarine Base in Groton, Connecticut. Disposal operations are monitored by the USACE to maintain a minimum water depth of 46 feet (14 m) within the corridor.

   The entire Cornfield Shoals Alternative and most of the New London and Niantic Bay Alternative are deeper than 59 feet (18 m) deep. Small areas within the Niantic Bay and New London Alternatives are shallower than 59 feet (18 m) due to natural conditions (both alternative sites) or due to dredged material disposal in the past (New London Alternative only). These shallower areas would be exempt from further dredged material disposal, as the mound height would be restricted to at least 59 feet (18 m) below the water surface. The availability of modern navigational and bathymetric equipment would minimize the risk of exceeding the allowable dredged material mound height. In addition, disposal operations would be conducted under permit and with full notification to mariners of the locations of disposal coordinates and activities. Thus, interference with shipping could be mitigated. Also, the imposition of dredging windows eliminates the potential for interference with recreational vessels from the late spring into fall. Therefore, no grounding or interference with navigation and shipping would be expected.

2. *228.5(b): Locations and boundaries of disposal sites will be so chosen that temporary perturbations in water quality or other environmental conditions during initial mixing caused by disposal operations anywhere within the site can be expected to be reduced to normal ambient seawater levels or to undetectable contaminant concentrations of effects before reaching any beach, shoreline, marine sanctuary, or known geographically limited fishery or shellfishery.*

   228.6(a)(3): Location in relation to beaches and other amenity areas.

   The movement of the water column due to tides and storms is predominantly east and west at the Cornfield Shoals Alternative. At the Niantic Bay and New London Alternative, the predominant direction of currents is also along an east-west axis, but currents have a lower amplitude and are more variable in direction than at the Cornfield Shoals Alternative. Material dissolved or suspended in the water column at all three alternative sites would move initially east and west on the first day and would rapidly be diluted by dispersed.

   The simulation of short-term water quality impacts with the STFATE model (see Section 5.5.3) suggests that disposal operations at all three alternative sites would be expected to meet the limiting permissible concentrations (LPC) within four hours of disposal. The LPC outside the site boundaries would also be met at all three alternative sites during all flow conditions. Exceptions might occur, should smaller site dimensions for the Niantic Bay or New London Alternatives be chosen (see Section 5.8.3). The smallest site dimensions analyzed for water quality impacts in this SEIS consisted of a 1 x 1 nmi Area for the Niantic Bay Alternative, and a 1.5 x 1 nmi Area (Sites NL-Wa/b) for the New London Alternative. For these dimensions, the LPC would be exceeded outside the site at high flow conditions (*i.e*., flows with maximum tidal amplitude), but not at mean flow conditions. Water quality impacts would be avoided with proper site management practices.

   Water column impacts at any of the sites are not anticipated since the effects would be short-term and any plumes during disposal would rapidly dilute to ambient conditions. Consequently, it is unlikely that detectable amounts of dredged material would be transported to any beach and amenity areas; the beach closest to any of the alternative sites is located at least 1.7 nmi (3.2 km) away. Similarly, there are no known fisheries or shellfisheries at or adjacent to any of the three alternative sites. The closest area of special concern to any of the three alternative sites is The Race, a designated Significant Coastal and Fish and Wildlife Habitat, located at a distance of 0.9 nmi (1.7 km) from the New London Alternative; impacts to The Race would also not be expected. Therefore, and because proper site management practices would avoid impacts, this evaluation does not substantially discriminate between the three alternative sites.

3. *228.6(a)(2): Location in relation to breeding, spawning, nursery, feeding or passage areas of living resources in adult or juvenile phases.*

   228.6(a)(9): The existing water quality and ecology of the site as determined by available data or by trend assessment or baseline surveys.

   Impacts on water quality are described under the criteria above. With regard to ecological impacts (including breeding, spawning, nursery, feeding or passage areas of living resources in adult or juvenile phases), long-term Long Island Sound trawl data presented in this SEIS indicate that eastern Long Island Sound appears to have a lower fish abundance compared to western and central Long Island Sound. Based on limited site-specific trawl data, finfish resources appear to be lower at the Cornfield Shoals Alternative than at the New London and Niantic Bay Alternatives, suggesting that the Cornfield Shoals Alternative would be the more desirable location for disposal activities. The existence of boulder and bedrock areas within both the New London and Niantic Bay Alternatives, which likely support fish species that benefit from structured substrate, also suggests that Cornfield Shoals would be the more desirable location for disposal events under these two MPRSA criteria. However, part of the north-central boulder areas at the two alternative sites are shallower than 59 feet (18 m) and disposal would be excluded from dredged material disposal. Deeper parts of the boulder and bedrock areas would also be excluded from disposal events to avoid potential impacts in these areas. Therefore, with these site management measures, impacts across all three alternative sites would be expected to be similar, consisting of limited local habitat and migration disruptions and the slight potential for loss of non-migratory species due to direct burial during disposal events. Also, based on data from the New London Alternative, a portion of which is currently active for the disposal of dredged material, the recovery of finfish resources to pre-disposal levels would be expected for all alternative sites with no measureable reduction in the population of any of the species potentially affected within eastern Long Island Sound. Additionally, impacts to EFH at all three alternative sites are expected to be negligible.

   Similar to finfish resources, data presented in this SEIS indicate that the Cornfield Shoals Alternative contains the least shellfish resources, again suggesting it would be the more desirable location for dredged material disposal. However, all three alternative sites exhibited a general lack of species and abundance of commercial and recreational shellfish; therefore, impacts across all three sites would be similar, consisting mainly of direct burial and mortality of individuals that may be present at the time of disposal. Due to the overall low abundance, none of the impacts at any of the three alternative sites would be expected to cause any measureable reduction in population of any of the species potentially affected within eastern Long Island Sound.

Evidence presented in this SEIS shows that the benthic habitat quality was highest at the New London Alternative for species richness, diversity, and evenness. It was second highest for infaunal abundance. The higher diversity and abundance at this alternative site may be related to the disruption and recolonization following recent disposal activities at the NLDS. However, this is not considered a reason to prefer one alternative site compared to another as diversity was overall fairly similar and relatively high for all three alternative sites. Additionally, disposal of dredged material at the alternative sites would not be expected to have a direct or long-term adverse impact to the living resources in eastern Long Island Sound. Although short-term loss of benthic infauna species under the footprint of the dredged material mounds would occur at each alterative site, these communities would recover quickly as demonstrated consistently by the DAMOS program.

4. *228.6(a)(11): Existence at or in close proximity to the site of any significant natural or cultural features of historical importance.*

   Natural or cultural features of known significance were not found within the Niantic Bay and Cornfield Shoals Alternatives. At the New London Alternative, a shipwreck is located in the southeastern corner of Site NL-Wa, and is of unknown age. Not enough information is available to determine if avoidance would be required as available information about the shipwreck is insufficient to assess whether it is eligible for listing on the NRHP. Impacts would be minimized through by establishing a 164 feet (50 m) avoidance buffer surrounding the shipwreck and appropriate site management until and unless significance can be determined.

   No other natural or cultural features of historic importance have been identified within the three alternative sites. Potential prehistoric sites have either likely been buried by natural sedimentation have been eroded over time.

5.6.3 Discriminating Criteria and Use Conflicts

Two MPRSA criteria remain for discrimination between the alternative sites. These specific site selection criteria [Sections 228.6(a)(1) and 228.6(a)(6)] contain similar factors such as the water depth at the site, physical oceanographic conditions, and sediment transport characteristics. Therefore, these two criteria as considered together in this section.

1. *228.6(a)(1): Geographical position, depth of water, bottom topography and distance from coast;*

   228.6(a)(6): Dispersal, horizontal transport and vertical mixing characteristics of the area, including prevailing current direction and velocity, if any.

   The geographic position of the alternative sites varies. While the New London and Niantic Bay Alternatives are located closer to shore, the Cornfield Shoals Alternative is located in the middle of eastern Long Island Sound. Oceanographic currents are strongest at the Cornfield Shoals Alternative and weakest at the New London Alternative. Tidal currents are more unidirectional (east-west) at the Cornfield Shoals Alternative than at the New London Alternative. Water depths are greatest at the Cornfield Shoals Alternative, averaging around 165 feet (50 m), and shallowest at the New London site where they mostly range between 60 and 80 feet (18 to 30 m). Conditions at the Niantic Bay Alternative are more variable, with shallowest water depths and slower currents in the northwest, and greater water depths and faster currents in the south of the site.

Field measurements and sediment transport modeling during the PO study, as well as long-term observations by the USACE DAMOS program, revealed distinct differences in sediment mobility (or bottom stress, as defined during the PO study) at the three alternative sites. Bottom stress is largely a function of waves and tidal or storm-driven currents acting on the seafloor. Depending on factors such as particle size, shape, density, and any friction or cohesion between particles, sediment would be eroded from the bottom and suspended (or resuspended) into the water column for transport once the bottom stress exceeds a critical threshold for erosion. For the New London Alternative, disposed dredged material would be contained on-site since the maximum bottom stress expected at the site would be below the bottom stress required to erode the disposed dredged material. This is supported by DAMOS observations of disposal mounds at the NLDS. For the Cornfield Shoals Alternative, the maximum bottom stress exceeds the stress needed for erosion of dredged material. DAMOS observed that there are no distinct disposal mounds at the CSDS from the dredged material that was disposed over several decades. Thus, this site would be a dispersive site. For the Niantic Bay Alternative, conditions would be variable with a containment area in the northeast, and a dispersive area in the center and southwest (see Section 4.5.2.2). See additional discussion in Section 5.8.1.3 below.

5.7 Cumulative Impacts

The Council on Environmental Quality regulations implementing NEPA require federal agencies to consider the cumulative impacts of a proposal (40 C.F.R. 1508.25(c)). A cumulative impact to the environment is the impact that results from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions (40 C.F.R. 1508.7). This type of an assessment is important because significant cumulative impacts could result from several smaller actions that by themselves do not have significant impacts.

In general, with respect to the disposal of dredged material at designated sites, cumulative impacts could occur as a result of multiple disposal events at the same designated site; however, these types of cumulative impacts have already taken into consideration as part of the overall analysis for each resource topic discussed above in Chapter 5 with regards to the three alternative sites. In other words, the analysis presented in Chapter 5 under each resource topic does not consider the impacts of just one disposal event, but the totality of dredging needs over the next 30 years, which would entail many disposal events. In addition, the condition of the three alternative sites in light of past disposal activities was also considered. Therefore, these types of cumulative impacts as they relate to each of the three alternative sites are not considered separately here as cumulative impacts.

The area of analysis for cumulative impacts is the entire Long Island Sound. Projects and activities that could interact with the proposed action to cause cumulative impacts on the resources of Long Island Sound, and that are considered in this analysis, include dredged material disposal events within the Sound, namely at the two designated dredged material disposal sites within western and central Long Island Sound (WLDS and CLDS), and other, unrelated activities such as shipping, recreation, and fishing that occur on or near Long Island Sound.

Sediment Quality. Dredged material from the dispersive alternative sites in eastern Long Island Sound (*i.e.*, the Cornfield Shoals Alternative and part of the Niantic Bay Alternative) would be resuspended over time by strong tidal flows and storms. On balance, the larger portion of resuspended dredged material would be transported westward toward deeper areas of central Long Island Sound where particles would be expected to partially settle. Considering the physical and chemical characteristics of the sediment in Long Island Sound and of the dredged material to be disposed, and considering the sediment transport processes with extensive dispersion throughout the water column, impacts to sediment quality in other parts of Long Island Sound would be minimal. In addition, transported volumes of resuspended dredged material would be well below the volume of sediment that is resuspended naturally in Long Island Sound during strong tidal flows and storms. Additional dredged material would not be eroded and dispersed in the water column of Long Island Sound from the WLDS and CLDS since they are containment sites.

Water Quality. Similar to the nature of impacts within eastern Long Island Sound resulting from the proposed action, the disposal of dredged material at the WLDS and CLDS could potentially have short-term impacts to the water column from the release of suspended dredged material. However, as would be the case for disposal at alternative sites in eastern Long Island Sound, the suspended material would rapidly dilute and disperse in the water column. Therefore, cumulative impacts to the water quality in Long Island Sound from the disposal at the eastern Long Island Sound alternative sites would not be expected. Dredging and disposal were not listed as potential sources in the nitrogen TMDL for Long Island Sound that was developed as a management tool to decrease nutrient loading and improve dissolved oxygen concentrations (NYSDEC and CTDEEP, 2000). Instead, the primary sources of nutrients, sediment, metals, and organic compounds entering and affecting the water quality in Long Island Sound are point sources such as municipal and industrial wastewater discharges, nonpoint source runoff, and atmospheric deposition (see Section 4.7.1).

Benthic Invertebrates. Similar to the nature of impacts within eastern Long Island Sound resulting from the proposed action, impacts to benthic invertebrates from disposing of dredged material at the WLDS and CLDS result in short-term reductions in abundance and diversity of benthic species at those sites. However, also similar to the nature of impacts in eastern Long Island Sound under the proposed action, recovery to levels similar to predisposal are expected to occur within months to several years. Given the relatively small geographic area of all of the existing and potential disposal sites (WLDS/CLDS and New London, Niantic Bay, and Cornfield Shoals, respectively) compared to the entirety of Long Island Sound, cumulative impacts on the benthic community within Long Island Sound would be imperceptible and not significant.

Fish. Similar to the nature of impacts within eastern Long Island Sound resulting from the proposed action, impacts to fish species from disposing of dredged material at the WLDS and CLDS consist of short-term local habitat and migration disruptions and the slight potential for loss of non-migratory species due to direct burial during disposal events. The majority of species at these sites are migratory and recovery to predisposal event levels are expected. While commercial and recreational fishing within Long Island Sound impacts a number of fish resources through the removal of adult species and disturbance to bottom habitat through trawling practices, these endeavors are highly regulated so as to not significantly impact species populations. Although cumulative impacts would occur to fish species through the loss of individuals and disruption of habitat, impacts would be expected to be insignificant and the contribution of the proposed action to these cumulative impacts would be imperceptible.

Commercial and Recreational Shellfish. Similar to the nature of the impacts within eastern Long Island Sound resulting from the proposed action, impacts to shellfish species from disposing of dredged material at the WLDS and CLDS likely consist of short- and long-term impacts from mortality or injury of squid and planktonic life stages of species that may get enveloped by descending plumes of dredged material during disposal events, by the direct burial and mortality of species within the footprint of a disposal mound, and through the interruption of feeding and respiration by filter feeding bivalves due to increased suspended sediment concentrations in the water column immediately following a disposal event. However, some species of shellfish can move up and down in the substrate and survive some burial by sediment. Additionally, dredging windows are implemented by Connecticut and New York to protect different life stages of shellfish, helping to minimize impacts. While commercial and recreational shellfishing within Long Island Sound impacts a number of shellfish resources through the removal of adult shellfish, these endeavors are highly regulated so as to not significantly impact species populations and oftentimes local shellfish programs will “seed” shellfish beds. Although cumulative impacts would occur to shellfish species through the loss of individuals and disruption of habitat, impacts would likely not be significant and the contribution of the proposed action to these cumulative impacts would be imperceptible.

Marine and Coastal Birds, Marine Mammals, and Reptiles. Birds, marine mammals, and marine reptiles are occasional visitors to the WLDS and CLDS, but do not rely on them for critical habitat. Similar to the proposed action in eastern Long Island Sound, impacts at these two sites are considered temporary and very limited, involving potential disruption of foraging habitat during and in the immediate vicinity of disposal events. Commercial fishing may also result in temporary and limited disruption of foraging habitat. Overall, cumulative impacts from the proposed action would likely be imperceptible. The limited time of year for disposal activities at all the sites in Long Island Sound minimizes the potential for impacts with the species.

Endangered and Threatened Species. Similar to the sites in eastern Long Island Sound under the proposed action, endangered and threatened species (whales, birds, and sea turtles) are occasional visitors to the WLDS and CLDS, but do not rely on them for critical habitat. Some species of sea turtles are benthic feeders and may lose some benthic prey species as a result of disposal activities; however, restrictions on dredging during the summer months, which is when sea turtles are present in Long Island Sound, would minimize any impacts. Fishing activities may also temporarily disrupt foraging or migratory behaviors. Overall, any cumulative impacts from the proposed action on endangered and threatened species would likely be insignificant and imperceptible.

Bioaccumulation. Bioaccumulation is defined as the uptake and retention of contaminants into tissues of organisms from all possible external sources. While bioaccumulation of a contaminant by an organism may or may not result in detrimental impacts to that organism, it can be an indicator that the population, similar organisms, and higher tropic-level organisms that prey on the contaminated organisms may be potentially at risk of adverse impacts. However, as long as materials for disposal are deemed acceptable under the ocean disposal regulations, there should be no cumulative effect on bioaccumulation in Long Island Sound beyond that which currently exists. Evaluation and management of dredged material is designed to minimize this effect. Sediments found to be associated with elevated risks are either not accepted for open-water disposal or may be managed through procedures that ensure that the material is isolated from the marine environment and would not pose a potential for unacceptable adverse effects due to bioaccumulation.

Socioeconomic Resources. Open-water dredged material disposal for ports and harbors in western and central Long Island Sound was provided by the designation of the WLDS and CSDS. Maintaining appropriate operational water depths in ports and harbor infrastructure in eastern Long Island Sound through appropriate dredging would have socioeconomic benefits for the entire Long Island Sound regions, as ports and harbors remain connected allowing for the cost-effective shipping of goods. As a result, additional transportation by trucks (resulting from the No Action Alternative) would be avoided, and along with it further emissions and congestion of roads and highways (particularly Interstate 95) in the region. Therefore, overall, cumulative impacts from the proposed action would be considered beneficial for the Long Island Sound region.

Air Quality and Noise. Air quality and noise impacts from all disposal activities in Long Island Sound also would be localized and minimal; hence, there would be no cumulative air quality and noise impacts to the Sound.

5.8 Preferred Alternative and Rationale for Preference

The initial site screening process led to the identification of three Action Alternative disposal sites (and several variations of those sites), in addition to the No Action Alternative, for further evaluation with respect to the MPRSA site selection criteria. As described earlier in this chapter, USEPA determined that any potential short-term, long-term, or cumulative impacts to the marine environment associated with the designation of any of the alternative sites would be minimal. USEPA further determined that any potential impacts associated with dredged material disposal at these sites could be mitigated through proper site management. Disposal site management and monitoring protocols for the preferred alternative are described in detail in the companion SMMP.

5.8.1 Open-Water Action Alternatives

5.8.1.1 Site Dimension Options

The three open-water Alternatives vary in size. The New London Alternative has an area of 2.5 nmi^2 (8.6 km^2) with a length (east-west) of 2.5 nmi (4.6 km) and a width (north-south) of 1.0 nmi (1.9 km). The Niantic Bay Alternative has an area of 2.8 nmi^2 (9.6 km^2) with a length of 2.08 nmi (3.9 km) and a width of 1.33 nmi (2.5 km). The Cornfield Shoals Alternative has a square area of 1 nmi^2 (3.4 km^2) with a length and width of 1 nmi (1.9 km). Reduced site dimensions within the full area of the New London and Niantic Bay Alternatives were also considered for purposes of site management, as described below and illustrated in Figure 5-5 and Table 5-10. Since the analyses in this SEIS encompassed the entire area of each Alternative, the analyses are also applicable to any reduced site dimensions potentially selected for site management reasons. For the Cornfield Shoals Alternative, adjustments to the site dimension analyzed in this SEIS are not recommended for consideration. Since the site is dispersive, expanding the dimensions of the site would not add any capacity for the disposal of dredged material.

- *New London Alternative:* The site dimensions of the full New London Alternative could be reduced to a 2 x 1 nmi Area by shifting the eastern boundary of the full Alternative to the middle of the NLDS. This would reduce the area of the full New London Alternative by 20% (*i.e.*, by 0.5 nmi^2 [2.4 km^2]). As the eastern half of the NLDS is fairly shallow as a result of past dredged material disposal, the loss in disposal capacity in the 2 x 1 nmi Area would be small compared to the capacity of the full New London Alternative. Specifically, the water volume of the eastern half of the NLDS below a water depth of 59 feet (18 m) is 2 million cy (1.5 million m^3); for the entire New London Alternative, the water volume below 59 feet (18 m) is 29 million cy (22 million m^3). Reducing the site dimensions to 2 nmi^2 (6.9 km^2) would reduce the area to be managed by the USACE through its DAMOS program. In addition, under this site dimension option, only the western part of the submarine transit corridor would remain within the disposal site. Water depths within most of the remaining part of the submarine transit corridor are shallower than 59 feet (18 m), prohibiting dredged material disposal as well. Potential disposal in any remaining deeper portions of the submarine transit corridor would be managed through site management, as is done currently.

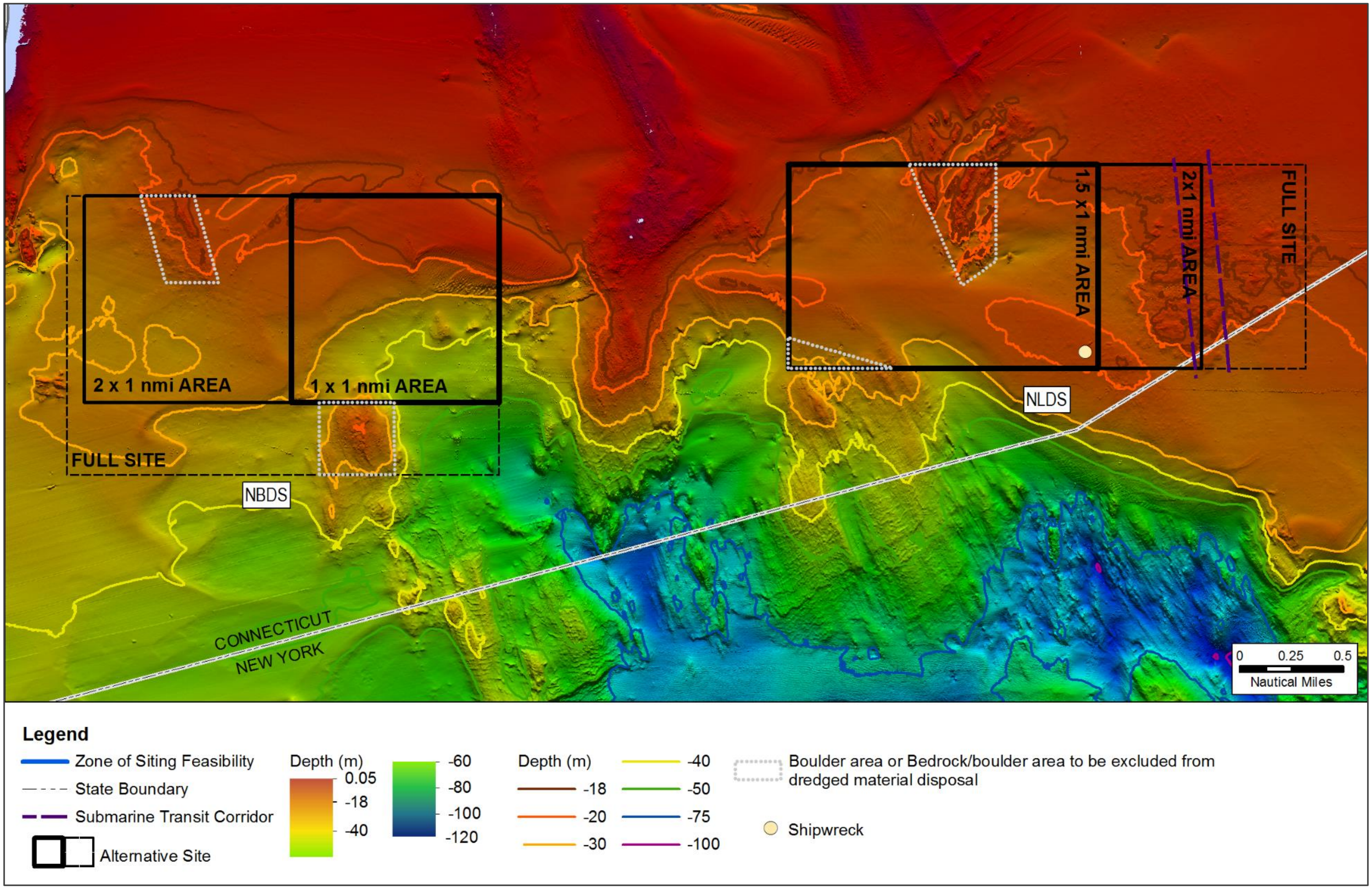

Figure 5-5. Site dimension options for the New London and Niantic Bay Alternatives.

Table 5-10. Characteristics of Alternative Sites and Site Dimension Options

Alterna-tive Site	Site Dimension Option	Description	Surface Area		Water Volume below 59 feet (18 m) [1]	
			nmi²	km²	Million cy	Million m³
New London	*Full site* (area: 2.5 x 1 nmi)	NLDS + Sites NL-Wa/b	2.5	8.6	29	22
	2x1 nmi Area (ELDS [3])	NLDS (western 50%) + Sites NL-Wa/b	2.0	6.9	27	21
	1.5 x 1 nmi Area	Sites NL-Wa/b	1.5	5.1	24	18
Niantic Bay	*Full site* (area: 2.08 x 1.33 nmi)	NBDS + Site NB-E	2.8	9.5	27 [2]	21 [2]
	2 x 1 nmi Area	Northern 72% of the Niantic Bay Alternative, anchored in its northeastern corner	2.0	6.9	27 [2]	21 [2]
	1 x 1 nmi Area	Anchored in northeastern corner of the Niantic Bay Alternative)	1.0	3.4	24 [2]	18 [2]
Cornfield Shoals	*Full site* (area: 1 x 1 nmi)	CSDS	1.0	3.4	No limit – dispersive site	

[1] Note: The dredged material disposal capacity at the site is smaller than the water volume below 59 feet (18 m) due to factors such as slopes of disposal mounds and the buffer between the site boundary and the toe of mounds.

[2] The listed value is an estimate of the water volume below 59 feet (18 m) for the containment portion of the site. It does not include the dispersive portion of the site. With the dispersive portion of the site included, the capacity for dredged material disposal for the site would have no limit.

[3] The 2 x 1 nmi Area is also referred to hereafter as the "Eastern Long Island Sound Disposal Site (ELDS)."

Another site dimension option for the New London Alternative that could be considered is the 1.5 x 1 nmi Area, consisting of Sites NL-Wa and NL-Wb only. The water volume below a water depth of 59 feet (18 m) in this area is approximately 24 million cy (18 million m^3), excluding the boulder area in the north-central area of Site NL-Wa.

- *Niantic Bay Alternative:* The site dimensions of the full Niantic Bay Alternative could be reduced to a 2 x 1 nmi Area by shifting the southern boundary of the full Alternative by 0.33 nmi (0.6 km) to the north and the western boundary by 0.08 nmi (0.15 km) to the east. These shifts would reduce the area of the full Niantic Bay Alternative by approximately 28% (*i.e.*, by 0.77 nmi^2 [2.6 km^2]). This reduction in area would not affect the containment portion of the Niantic Bay Alternative, which is located in the northeastern part of the site. This reduction in area would only affect the dispersive portion of the site. However, since typical dredged material is predicted to be dispersed outside of this alternative site, the reduction in size of the dispersive area would not reduce the overall capacity for dredged material disposal within the 2 x 1 nmi Area. However, reducing the site dimensions of the Niantic Bay Alternative would reduce the area that would need to be managed. In addition, a shift of the southern boundary to the north would keep the site away from the bedrock/boulder area located in the southwestern corner of Site NB-E.

Another site dimension option for the Niantic Bay Alternative that could be considered is the 1 x 1 nmi Area. This site dimension option would extend 1 nmi (1.9 km) to the west and 1 nmi (1.9 km) to the south from the northeastern coordinate point of the full Niantic Bay Alternative.

5.8.1.2 Additional Measures for Consideration for Action Alternatives

The following additional measures are considered for the New London and Niantic Bay Alternatives:

- *Boulder Areas:* Boulder areas are located in the north-central portions of Site NL-Wa (part of the New London Alternative) and of the NBDS (part of the Niantic Bay Alternative). Boulder areas likely have higher habitat value for finfish and benthic organisms than the surrounding sandy bottoms. In addition, the maximum bottom stress in the boulder area of the Niantic Bay Alternative is greater than 0.75 Pa, *i.e.*, the boulder area is within the dispersive area of the site. For these reasons the boulder areas would be excluded from dredged material disposal. Parts of both boulder areas are also shallower than 59 feet (18 m) and would not receive dredged material for that reason alone.

- *Bedrock/boulder Areas:* Bedrock/boulder areas are located in the southwestern corners of Site NL-Wb (part of the New London Alternative) and of Site NB-E (part of the Niantic Bay Alternative). These areas also may have higher habitat value than surrounding sandy bottoms. In addition, the maximum bottom stress in the two bedrock/boulder areas is higher than 0.75 Pa; it is only slightly higher in the bedrock/boulder area of the New London Alternative (0.76 Pa) but substantially higher in the bedrock/boulder area of the Niantic Bay Alternative (>1 Pa). For these reasons, the bedrock/boulder areas would be considered for exclusion from dredged material disposal.

- *Shipwreck at Site NL-Wa:* There is a documented submerged wreck in the southeastern corner of Site NL-Wa of the New London Alternative. This wreck is an unknown vessel in 57 feet (18 m) of water and is of unknown age. As discussed in Section 5.5.10.6, providing for an avoidance buffer around the charted wreck location would result in no impact to this shipwreck. Based on communication with the CT SHPO in Connecticut and information on practices by the NY OPRHP (the SHPO for New York State) (see Section 5.5.10.6), an avoidance buffer of 164 feet (50 m) is recommended to minimize impacts. However, not enough information is available to determine if avoidance would be required. Under Section 106 of the NHPA, avoidance of adverse effects is only necessary if a property or resource is listed, or is eligible for listing, on the National Register of Historic Places (NRHP). An investigation of this site could be conducted to determine if the wreck site is eligible for listing on the NRHP. If it is not eligible, the avoidance buffer could be removed for the New London Alternative.

5.8.1.3 Preferred Alternative

Having considered all of the relevant information and the MPRSA site selection criteria, USEPA is proposing as its preferred Alternative the designation of a site that encompasses the western portion of the existing New London Disposal Site (NLDS), along with an adjacent area immediately west of the NLDS (*i.e.,* Sites NL-Wa and NL-Wb with an area of 1.5 x 1 nmi). These areas have been combined and are collectively referred to hereafter as the "Eastern Long Island Sound Disposal Site" (ELDS) (Figure 5-6).

USEPA is proposing to designate the ELDS for several reasons. First, unlike the other two Alternatives (*i.e.,* the Cornfield Shoals and portions of the Niantic Bay Alternatives), the ELDS is a containment site, which would support effective management and monitoring. Second, the NLDS has been used for dredged material disposal for over 30 years, and monitoring of the site has determined that past and present management practices have been successful in minimizing short-term, long-term, and cumulative impacts to water quality and benthic habitat. Third, designating the ELDS, which includes a portion of the NLDS, would be consistent with USEPA's ocean disposal regulations, which indicate a preference for designating disposal sites in areas that have been used in the past, rather than new, relatively undisturbed areas (40 C.F.R. 228.5(e)). Finally, the capacity of the ELDS is approximately 27 million cy (based on water volume below 59 feet [18 m]), which would be sufficient to meet the dredging needs of the eastern Long Island Sound region for the next 30 years and beyond.

Alternatively, USEPA could designate an ELDS that includes only the 1.5 x 1 nmi Area immediately to the west of the NLDS (*i.e.*, NL-Wa and NL-Wb), and excludes the eastern and western portions of the existing NLDS. Such a site would still provide approximately 24 million cy of capacity, based on water volume below 59 feet (18 m), while eliminating an area that has been used historically for dredged material disposal. USEPA is interested in receiving public comment on these options to help inform its final determination.

While USEPA is currently proposing the designation of the ELDS as its preferred option, USEPA also concludes, based on the analysis in this SEIS, that two other Action Alternatives, Niantic Bay and Cornfield Shoals, could also potentially be designated in addition to, or instead of, the ELDS. The Niantic Bay Alternative, located just to the northwest of the existing New London Disposal Site, contains an area that was historically used (*i.e.*, the NBDS), which is a criterion in the regulations. It also has a capacity of up to 27 million cy (based on water volume below 59 feet [18 m]), which is sufficient to meet the dredging needs of the eastern Long Island Sound region. However, the Niantic Bay site is predominately a transitional area, with a containment area in the northeastern corner, with the remainder of the site being dispersive. USEPA is not recommending this site as a preferred alternative at this time. Still, USEPA will continue to consider the site and is interested in receiving public comments concerning whether USEPA should designate all or any part of it as an open-water disposal site.

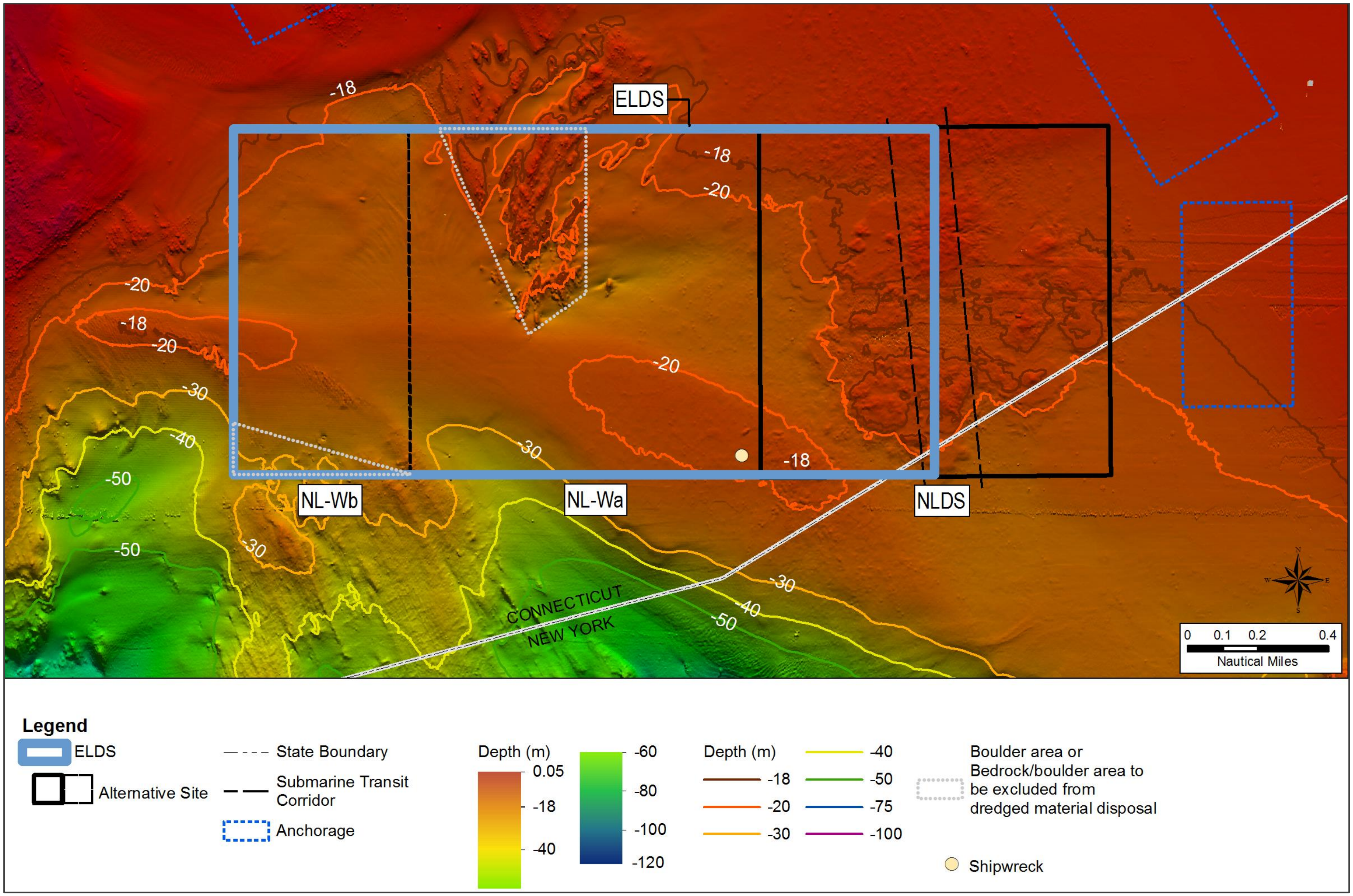

Figure 5-6. Location of the Eastern Long Island Sound Disposal Site (ELDS), the Preferred Alternative.

USEPA does not currently recommend designating *both* the New London and Niantic Bay Alternatives since these two sites are located comparatively close to each other and, as a result, designating both would not provide significant savings in average travel time for tugs/scows. Moreover, each alternative site, by itself, has sufficient capacity for the 30-year planning horizon, and designating just one of these two sites would limit site management costs. That said, USEPA is also interested in receiving public comments concerning the option of designating both of these sites.

The Cornfield Shoals Alternative, located in the western part of eastern Long Island Sound, has been used for dredged material disposal for over 30 years. This site is located in a highly dispersive environment. As a result, the site has historically been used for the disposal of coarser-grained dredged material. Monitoring of the site has determined that past and present management practices have been successful in minimizing short-term, long-term, and cumulative impacts to water quality and benthic habitat from dredged material disposal. Designation of this site in addition to one of the other Action Alternatives would provide a disposal site on both ends of eastern Long Island Sound, which could reduce travel time for tugs/scows for dredged material appropriate for disposal at the CSDS. This, in turn, could reduce costs and further minimize any risks of spills or short dumps. Due to the high energy and dispersive nature of the area, the site has unlimited capacity, but because of its highly dispersive characteristics, disposal at the site would be restricted to only certain types of sediments, such as sand, consistent with past practice.

Despite these considerations, USEPA does not currently recommend designating the Cornfield Shoals site. Given the site’s dispersive characteristics, USEPA concludes that the Cornfield Shoals site would not be appropriate to designate as the sole disposal site in eastern Long Island Sound. See 40 C.F.R. § 228.6(a)(5) and (6). Furthermore, USEPA is not proposing to designate the Cornfield Shoals site even as a limited complement to one or more other sites because of the growing opportunities for sand and other dredged sediments to be beneficially used, such as for beach nourishment. Designating the Cornfield Shoals site could potentially reduce the incentive to coordinate a dredging project that will generate sediments with a potential beneficial use. In light of these considerations, USEPA is not currently recommending this site as a preferred alternative in this SEIS but is taking comments on the option of designating this site as an alternative complement to one or more of the other Action Alternatives.

The primary differentiating features of the three Alternatives are water depth, and dispersal and horizontal transport characteristics. As a result of these differences in physical factors, the three alternative sites also differ with regard to sedimentation and erosion of disposed cohesive dredged materials. The proposed ELDS is a containment site where dredged material would remain on the seafloor, similar to conditions at the existing NLDS. The Cornfield Shoals Alternative is a dispersive site where dredged material disposed at the site would be eroded over time, dispersed in the water column, and then be transported predominantly toward the west, similar to conditions at the existing CSDS. The Niantic Bay Alternative contains both a containment area and a dispersive area. Dredged material disposed in the dispersive area would be eroded over time, dispersed in the water column, and then be transported predominantly toward the west.

USEPA regulations (40 C.F.R. 228.5(e)) indicate that it is preferable to designate disposal sites in areas that have been used in the past, rather than to locate sites in new, relatively undisturbed areas. As proposed, the ELDS includes a portion of the existing NLDS and an area immediately adjacent to the NLDS and, to that extent, the ELDS satisfies this criterion. USEPA is proposing to expand the site beyond the boundaries of the existing NLDS to include additional containment disposal capacity. While the Cornfield Shoals Alternative consists of the existing CSDS, this does not provide strong support for designating the site given that it is a dispersive site and dredged sediments would largely not remain at the site. The Niantic Bay Alternative includes the historically used NBDS, but also includes additional areas that become increasingly dispersive. Given that the ELDS provides the best containment characteristics of the three sites, it would be the easiest to manage and monitor to prevent potential adverse impacts to the marine environment. As a result, USEPA is currently proposing to designate the ELDS.

The evaluation in this SEIS determines that any potential long-term or cumulative impacts to the marine environment associated with of any of the three Alternatives would be minimal with proper site management; there would be only minor short-term impacts associated with the sites. (See Sections 5.6 and 5.7.)

Monitoring of the NLDS and CSDS has verified that past and present management practices have been successful in minimizing the short-term and long-term adverse impacts to water quality and benthic habitat. Disposal site management and monitoring plans for the ELDS preferred alternative are described in detail in the SMMP (Appendix I).

5.8.2 No Action Alternative

Based on the analysis in Section 5.4 and the summary in Table 5-9, the No Action Alternative is not a preferred alternative. As discussed in Chapter 3, for dredging projects subject to MPRSA § 106(f), project proponents would need to find other suitable disposal alternatives.

While it is impossible to be certain of how dredging needs resulting from sediment build-up in the eastern Long Island Sound region would be handled if no disposal sites are designated, several hypothetical scenarios might reasonably be considered. First, disposal site authorization for private projects involving less than 25,000 cy (19,114 m^3) of material would simply continue being evaluated on a project-specific basis under CWA § 404. Second, for projects subject to MPRSA § 106(f) (*i.e.*, either federal projects or private projects involving greater than 25,000 cy [19,114 m^3] of material), project proponents would need to pursue one or more of the following actions:

- *Scenario 1: Utilize a short-term alternative open-water site either inside or outside of the eastern Long Island Sound region that has been "selected" by the USACE and concurred with by USEPA under MPRSA § 103.* This scenario could have a greater environmental impact than the Action Alternatives if it resulted in multiple sites being selected and dredged materials being dispersed over a greater area of the eastern Long Island Sound region. In addition, USACE-selected sites, unlike USEPA-designated sites, are not required to have Site Management and Monitoring Plans.

- *Scenario 2: Use an existing designated long-term open-water site outside of the eastern Long Island Sound region (such as CLDS or RISDS).* This scenario would have socioeconomic impacts as a result of higher disposal costs due to the greater travel distance, and potential environmental impacts since the greater distances provide more chances for accidents such as a scow capsizing in rough seas. Additionally, this scenario uses up available disposal capacity at such designated sites.

- *Scenario 3: Await designation of a new disposal site outside of eastern Long Island Sound and Block Island Sound*. The closest location outside of the two Sounds would be the continental shelf, southeast of Montauk, New York. Such a designation is currently not under consideration, as the transport distance to the continental shelf would be similar or greater than to the designated CLDS or RISDS.

- *Scenario 4: Develop and utilize appropriate land-based disposal or beneficial use alternatives.* Multiple upland and beneficial use options were investigated in the LIS DMMP (USACE, 2015; Battelle, 2015) and summarized in Chapter 3 of this SEIS. Upland and beneficial use disposal alternatives would be investigated and utilized whenever feasible on a project-specific basis as part of the assessment of the "need" for open-water disposal that is done for each disposal permit. However, the upland disposal capacity is very limited, and beneficial use alternatives (beach nourishment, nearshore berms) don't provide sufficient capacity either to accommodate the long-term dredged material needs of the region. Other options would be expensive to construct (*e.g.*, confined disposal facilities).

- *Scenario 5: Cancel proposed dredging projects.* This scenario would severely compromise navigational safety and marine commerce. This scenario could also result in vessels running aground and leaking oil and other hazardous materials, thus posing a serious environmental risk.

Under most of the scenarios of the No Action Alternative, transportation and disposal costs for dredged material that is not suitable for beach nourishment or nearshore berms would be substantially higher than with the use of the New London, Niantic Bay or Cornfield Shoals open-water alternative sites. Longer transportation on both the sea and land would result in more noise and higher emissions of air pollutants and greenhouse gases, and localized environmental impacts at multiple sites. Overall, it is predicted that reduced dredging would adversely affect socioeconomic resources, such as commercial and recreational fishing and shipping and navigation, such that substantial adverse impact to the economies of Connecticut and New York would result. If a reduction in the maintenance dredging effort resulted in a significant reduction in depths of navigation channels and harbors, small marinas and fishing harbors could be forced to close, and larger harbors could see the diversion of deep draft vessels to other ports outside the region. This would in turn reduce the contribution of these navigation-dependent industries to the regional economy. The regional economic contribution of these industry sectors has been estimated to included approximately 33,000 jobs, a total industry output of $4.8 billion, and a Gross State Product of $2.9 billion (see Tables 4-26 and 4-27 in Chapter 4).

5.8.3 Summary of the Preferred Alternative

USEPA is proposing to designate the ELDS Alternative (consisting of the western portion of the NLDS and Sites NL-Wa and NL-Wb) in eastern Long Island Sound. The ELDS satisfies the MPRSA site selection criteria and, properly monitored and managed as described in the SMMP, use of this site would not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities. Furthermore, disposal at this site in a manner consistent with the restrictions imposed on the site with regard to disposal locations, time periods for disposal, and types of material to be disposed, as well as any other conditions consistent with the procedures and standards recommended by the LIS DMMP, would mitigate any potential adverse impacts to the environment to the greatest extent practicable.

Before any dredged material could be disposed of at any designated site, that material would first be tested according to applicable regulations and related national and regional guidance and would have to satisfy the applicable legal requirements. As discussed elsewhere in this SEIS, non-federal dredging projects generating no more than 25,000 cy of dredged material are subject only to the requirements of CWA §404, whereas non-federal dredging projects generating more than 25,000 cy of dredged material, and all federal projects, are subject to the requirements of both the MPRSA and CWA § 404.

In addition, the New London Alternative (and therefore also the ELDS) would avoid the substantial adverse socioeconomic impacts for the eastern Long Island Sound region that would be associated with the No Action Alternative.

CHAPTER 6 – COMPLIANCE WITH FEDERAL ENVIRONMENTAL STATUTES AND EXECUTIVE ORDERS/MEMORANDUM

This chapter describes the federal laws, regulations, and programs that are relevant to the designation of open-water dredged material disposal sites in the eastern Long Island Sound region. Chapter 1, Section 1.2, also addresses the legal requirements of the CWA and the MPRSA.

Federal Statutes

1. American Indian Religious Freedom Act of 1978, 42 U.S.C. 1996.

Compliance: Coordination with the Indian tribes potentially affected by the proposed action occurred during the development of this SEIS to avoid interference with their rights to traditional religious practices. Coordination by USEPA with the tribes is ongoing.

2. Clean Air Act, as amended, 42 U.S.C. 7401 *et seq*.

Compliance: The "general conformity" requirements of Section 176(c)(1) of the Clean Air Act, 42 U.S.C. § 7506(c)(1), may apply to the designation of a dredged material disposal site. The designation of dredging disposal sites will not directly cause any emissions. Future dredging projects will result in emissions; however, the timing and extent of future dredging projects is not reasonably foreseeable and emissions from future projects do not meet the definition of "indirect emissions" under General Conformity. At this time, individual future dredging projects that are proposed will require evaluation under General Conformity prior to approval by USACE. Most dredging projects will result in emissions below the applicable de minimis thresholds and thus will not be required to prepare General Conformity Determinations (40 C.F.R. § 93.153).

3. Clean Water Act, as amended, 33 U.S.C. 1251 *et seq*.

Compliance: The Clean Water Act does not apply specifically to a USEPA designation of a long-term dredged material disposal site under the MPRSA. However, future federal and non-federal projects involving the open-water disposal in Long Island Sound of dredged material will require both a Section 404 permit as well as a State Water Quality Certification pursuant to Section 401 of CWA.

4. Coastal Zone Management Act of 1972, as amended, 16 U.S.C. 1431 *et seq*.

Compliance: A CZM consistency determination will be provided to the NYSDOS and CTDEEP for review and concurrence with the finding that the proposed action is "consistent to the maximum extent practicable with the enforceable policies of [the] approved State CZM programs" 16 U.S.C. § 1456 (c)(1)(A).

5. Endangered Species Act of 1973, as amended, 16 U.S.C. 1531 *et seq*.

Compliance: Consultation has been initiated with both NMFS and USFWS to determine whether there are any threatened or endangered species, or critical habitat that could be directly or indirectly affected by the project. Compliance with Section 7 of the ESA will be met through either informal or formal consultation, resulting in concurrence from the Services. New York and Connecticut are also being consulted with to determine if any state-listed species may be affected by the project.

6. Estuary Protection Act, 16 U.S.C. 1221 *et seq*.

Compliance: Estuaries were considered as part of the evaluation of alternatives in this SEIS. In addition, this project is being coordinated with the National Estuary Program for Long Island Sound.

7. Fish and Wildlife Coordination Act, as amended, 16 U.S.C. 661 *et seq*.

Compliance: The NMFS, the USFWS, and the fish and wildlife agencies of Connecticut and New York are being consulted, and their recommendations, when possible, will be incorporated into the final action.

8. Magnuson-Stevens Fishery Conservation and Management Act, as amended, 16 U.S.C. 1801 *et seq*.

Compliance: An Essential Fish Habitat assessment in compliance with the Act has been prepared. USEPA is coordinating with the NMFS and will incorporate conservation recommendations from NMFS in its final action or explain why it has not done so.

9. Marine Mammal Protection Act of 1972, 16 U.S.C. 1361.

Compliance: This action is being coordinated with the NMFS and the USFWS to determine whether any marine mammals under their respective jurisdictions may be affected by the project.

10. Marine Protection, Research, and Sanctuaries Act of 1972, as amended, 33 U.S.C. 1401 *et seq*.

Compliance: Pursuant to MPRSA § 102, USEPA promulgated criteria (40 C.F.R. Part 228) to guide the selection of open-water disposal sites. These criteria were followed in evaluating the potential designation of open-water disposal sites. The requirements of this Act are discussed more fully in Chapter 1 of this SEIS.

11. Migratory Bird Treaty Act of 1918, 16 U.S.C. 703–712.

Compliance: This SEIS evaluated the potential adverse impacts to marine and coastal bird species, including migratory species, and determined that the proposed action is unlikely to impact migratory birds.

12. National Environmental Policy Act of 1969, as amended, 42 U.S.C. 4321 *et seq*.

Compliance: As discussed in Chapter 1, Section 511(c) of the CWA exempts the USEPA's designation of dredged material disposal sites under the MPRSA from environmental review under NEPA. However, USEPA prepared this SEIS pursuant to its voluntary NEPA Policy, "Statement of Policy for Voluntary Preparation of National Environmental Policy Act (NEPA) Documents." 63 *Fed. Reg*. 58045 - 58047.

13. National Historic Preservation Act of 1966, 16 U.S.C. 470.

Compliance: The project was coordinated with the State Historic Preservation Offices in Connecticut and New York and it was determined that no known historic property would be affected by the proposed project. USEPA is also coordinating with Federal Historic Preservation Officers and interested Indian tribes regarding possible effects on historic/archaeological resources.

14. Native American Graves Protection and Repatriation Act (NAGPRA), 25 U.S.C. 3002.

Compliance: This statute was considered and it was determined that it should not be triggered by this action because (a) no Native American human remains or objects will be disturbed or disinterred during this action, which involves designating open-water sites for potential future disposal of dredged material, and (b) this action will not take place on either federal or Indian lands.

15. Preservation of Historic and Archaeological Data Act of 1974, 16 U.S.C. 469.

Compliance**:** The chance of this action leading to future damage to resources covered by this Act was considered and there is no expectation that this project will damage archaeological, historic, scientific, or prehistoric data. USEPA will preserve relevant studies and reports produced by this action. If there is an unexpected discovery of data covered by this act, USEPA will notify the National Park Service Departmental Consulting Archaeologist.

Executive Orders

1. Executive Order 11593, Protection and Enhancement of the Cultural Environment, 13 May 1971.

Compliance: This Order has been incorporated into the National Historic Preservation Act of 1980. USEPA coordination with the State Historic Preservation Offices in the States of Connecticut and New York signifies compliance with this Order.

2. Executive Order 13175, Consultation and Coordination with Indian Tribal Governments, 6 November 2000.

Compliance: Coordination with the Indian Tribal Governments with an interest in the study area signifies compliance. USEPA coordination with the tribes is ongoing.

3. **Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, 11 February 1994.**

Compliance**:** This SEIS has evaluated the potential adverse risks to human health this project poses to minority and low income populations and found that there are no expected disproportionately high and adverse health or environmental effects to these populations.

4. **Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks, 21 April 1997.**

Compliance: This SEIS has evaluated the potential adverse risks to children's health and found that there are no expected disproportionately high, adverse health or safety threats to children from this action.

5. **Executive Order 12962, Recreational Fisheries, 9 June 1995.**

Compliance: This SEIS has considered the goals of this Executive Order and the project is not expected to have disproportionately high or adverse effects on recreational fisheries.

6. **Executive Order 13158, Marine Protected Areas.**

Compliance: USEPA considered the location of any "marine protected areas" during the evaluation of the project alternatives. The action will avoid harm to natural and cultural resources protected by any designated marine protected areas.

7. **Executive Order 12088, Federal Compliance with Pollution Control Standards.**

Compliance: USEPA has determined that the designation of the preferred disposal sites is in compliance with this Executive Order.

8. **Executive Order 13514, Federal Leadership in Environmental, Energy, and Economic Performance.**

Compliance: Executive Order 13514 establishes greenhouse gas reduction targets and strategies for federal agencies. Many of the policies in the executive order pertain to buildings, waste reduction strategies and use of fuel-efficient vehicles that are not directly relevant to designation of dredged material disposal sites. In general terms, alternatives that require shorter haul distances of dredged materials to their ultimate disposal site will result in lower greenhouse gas emissions and be relatively more consistent with the executive order than other alternatives.

9. **Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds**

Compliance: This SEIS has considered the goals of this Executive Order and has determined that the proposed action is unlikely to impact migratory birds.

10. Executive Order 13112, Invasive Species

Compliance: This Executive Order requires agencies to prevent the introduction of invasive species and provide for their control. The proposed action of designating a long-term dredged material disposal site(s) would not introduce any invasive species and therefore is consistent with the Executive Order. Future authorizations of specific dredging and dredged material disposal projects will require authorization and a permit issued by the USACE. These actions would also need to be consistent with the Executive Order, unless the USACE has determined and made public its determination that (1) the benefits of such actions clearly outweigh the potential harm caused by invasive species, and that (2) all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions.

11. Executive Order Executive Order 13653 Preparing the United States for the Impacts of Climate Change

Compliance: This Executive Order requires federal agencies to identify and support smarter, more climate-resilient investments by states, local communities, and tribes, including by providing incentives through agency guidance and grants. In general, disposal alternatives that incorporate elements that promote climate-resilience (e.g., to rising sea levels) are relatively more consistent with the Executive Order than other alternatives.

Executive Memorandum

1. White House Memorandum, Government-to-Government Relations with Indian Tribes, 29 April 1994.

Compliance: Coordination with the federally-recognized Indian Tribes signifies compliance. USEPA coordination with the tribes is ongoing.

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CHAPTER 7 – PUBLIC INVOLVEMENT

As stated in Chapter 1, this SEIS is being prepared consistent with the requirements of Section 102 of NEPA (42 U.S.C. § 4332) and USEPA's voluntary NEPA compliance policy.

Federal regulations that guide compliance with NEPA by the USEPA (40 C.F.R. Parts 6 and 25), the USACE (33 C.F.R. Part 230), and the CEQ (40 C.F.R. 1500 *et seq.*) are more explicit in than NEPA requirements for public involvement throughout the EIS process.

This SEIS also addresses requirements of the MPRSA and the CWA, both of which include provisions for public involvement, and other federal agency policies and agreements established over the history of dredged material management in Long Island Sound.

The Long Island Sound region has a long and rich history of public involvement and participation in environmental decision-making. In keeping with this tradition, and to satisfy the numerous statutory and regulatory requirements to which this proposed action is subject, USEPA has conducted an extensive public involvement program throughout the development of the SEIS. The program included establishing a Cooperating Agency group comprised of stakeholders from the eastern Long Island Sound region, as well as six public meetings that provided the public with relevant information on the SEIS process, the results of studies conducted in support of the SEIS and gave the public an opportunity to provide input on the process and issues considered in the NEPA document. In addition, USEPA conducted an educational webinar on the dredging and disposal process in LIS. The following sections describe in detail the elements of the USEPA public involvement program.

7.1 Major Public Involvement Activities

7.1.1 Notice of Intent and Public Announcements

On October 16, 2012, the USEPA published a Notice of Intent (NOI) to prepare a SEIS to evaluate the potential designation of one or more open-water dredged material disposal sites (ODMDS) to serve the eastern Long Island Sound region (Connecticut, New York, and Rhode Island) under MPRSA Section 102 (64 *Fed. Reg*. 29865 (1999)). The NOI stated that the SEIS would evaluate the two existing dredged material disposal sites used in eastern Long Island Sound (CSDS, NLDS), as well as other sites and the No Action alternative. In addition to outlining the project, the NOI gave notification of the public scoping meetings (described below).

The SEIS ELIS mailing list (see Section 7.3) was used to send out the following notices:

- October 24, 2012: Publication of NOI public meeting announcement
- November 7, 2012: Postponement of November 15, 2012 public meeting in New York State due to Superstorm Sandy
- November 29, 2012: New date for New York State public meeting
- January 3, 2013: New York State public meeting reminder

June 4, 2013:	Public meeting announcements
March 17, 2014:	Webinar announcement
March 31, 2014:	Webinar reminder
April 2, 2014:	Webinar agenda and connection information (only sent to the 71 webinar registrants – see Section 7.1.3)
April 8, 2014:	Follow-up from webinar with link to Workshop page (only sent to the 71 webinar registrants – see Section 7.1.3)
November 18, 2014:	Public meeting announcements

Press releases were sent out for the following announcements:

November 8, 2012:	NOI announcement and postponement of New York State meeting
January 4, 2013:	Announcement of new date for New York State public meeting

7.1.2 Public Meetings

A total of six public meetings have been held during the period of the DSEIS preparation:

- ***Public Meetings 1 and 2: Scoping.*** Scoping is the process by which federal agencies responsible for the development of an EIS determine the scope of the project, including the range of alternative actions that may also meet the purpose of and need for the proposed action; the projected spatial extent and range of potential impacts resulting from the proposed and alternative actions; and the studies necessary to determine the extent of potential impacts resulting from these actions.

  Public scoping meetings were held on November 9, 2012, in Groton, CT, and on January 9, 2013, in Riverhead, NY, to ensure that interested communities, groups, and individuals had the opportunity to provide input on the scope of the document, including alternatives and impact analyses. Specifically, these meetings provided a forum for the public to ask questions, to express their concerns regarding dredged material disposal, and to comment on the need for the project. USEPA requested written comments from federal, state, and local governments, industry, nongovernmental organizations, and the public on the need for action, the range of alternatives considered, and the potential impacts of the alternatives. As summarized in Section 1.5.1, comments received by USEPA pertained to regulatory issues, concerns for the natural environments, socioeconomic issues, and NEPA documentation and analysis issues. A total of 76 people attended these two public meetings. The comment period started on November 9, 2012, and ended January 31, 2013.

- ***Public Meetings 3 and 4: Screening Process.*** These meetings were held on June 25, 2013, in Riverhead, NY, and on June 26, 2013, in Groton, CT, to present the process and first results of the screening for alternative dredged material disposal sites within the ZSF. The attendees were able to ask questions and make comments during these meetings, but there was no official comment period. A total of 75 people attended these two public meetings.

- ***Public Meetings 5 and 6: Physical Oceanography Study.*** These meetings were held on December 8, 2014, in Riverhead, NY, and on December 9, 2014, in New London, CT, to present the findings of the physical oceanography study that was performed by the University of Connecticut within the ZSF for this SEIS. In addition, the USEPA presented an update of the SEIS process. The attendees were able to ask questions and make comments during the meetings, but there was no official comment period. A total of 61 people attended these two public meetings.

Reports of each set of public meetings were prepared and are provided in Appendix A – Public Involvement.

7.1.3 Public Webinar

USEPA held one public webinar in response to a request made during Public Meeting 3 on June 25, 2013. The webinar was announced by using the mailing list (see Section 7.3). This 3-hour long webinar was held on April 3, 2014 to provide information to the public regarding dredged material management and the permitting process specific to the Long Island Sound region. The webinar consisted of the following two 1-hour long presentations:

- *Dredging and Dredged Material Management*, presented by Patricia Pechko, USEPA Region 2: This session provided a general overview of dredging definitions, legal jurisdiction, equipment, best practices, and placement options.

- *Dredging Permit Process, Testing, and Dredged Material Disposal,* presented by Patricia Pechko, USEPA Region 2, and Jeannie Brochi, USEPA Region 1: This session provided a general overview of the review and permitting process, and emphasized sample planning, risk pathways and toxicity testing.

Each presentation was followed by 30 minutes of discussion. At the beginning of the webinar, Ms. Brochi noted that the session was a general informational session not specific to the ELIS SEIS or the LIS DMMP, and therefore there would be no comment period. Both sessions were geared toward a public audience. The sessions were recorded and subsequently posted on USEPA's website. There were 71 registrants to the webinar; 49 attended the webinar.

7.1.4 Cooperating Agency Group

USEPA formed a Cooperating Agency Group for the development of this SEIS. This group includes representatives from USEPA Region 1 and Region 2 offices, the USACE New England North Atlantic Division and New York Districts, NMFS, CTDEEP, CTDOT, NYSDEC, NYSDOS, and the RICRMC (addresses are provided in Section 7.4 below). Agencies that were not interested in an active participation but desired further coordination are on a coordinating agency list and include the U.S. Navy, USCG, and tribes from Connecticut, New York, and Rhode Island.

The purpose of the Cooperating Agency Group has been to review and provide feedback during the development and preparation of the SEIS. Meetings and webinars were held to further refine the scope and steps of the SEIS, provide project status, and get feedback on reports, studies, and site screening.

Four meetings were held with the Cooperating Agency Group as follows:

- ***Meeting 1: January 8, 2013 – Meeting at CTDOT's headquarter in Newington, Connecticut.*** The goal of this meeting was to review the ZSF, preliminary site screening, and the plan for the physical oceanographic study, in preparation for the SEIS. The USEPA presented an overview of the SEIS process. Battelle discussed the initial site screening process and reviewed individual screening criteria under the MPRSA as they applied to the ZSF. UCONN then presented existing physical oceanographic data for the ZSF and the planned approach for the physical oceanography study to address data gaps through field data collection and modeling. The presentations were followed by discussion.

- ***Meeting 2: May 20, 2013 – Webinar.*** The goal of this webinar was to provide updates on the site screening and the physical oceanographic study. Louis Berger presented the status of the site screening process at the time, incorporating new data obtained since the previous Cooperating Agency Group meeting. The presentation included a discussion of eleven potential alternative sites selected based on this initial screening. Thereafter, UCONN presented an update of the field observation and modeling plan for the physical oceanography study. The presentations were followed by discussion.

- ***Meeting 3: June 18, 2013 – Webinar.*** The goal of this meeting was to review comments made on the presentation of Cooperating Agency Group Meeting 2, and to discuss the upcoming Public Meetings 3 and 4. Specifically, the USEPA had received comments from NYSDOS, USACE New England District, and USEPA Region 2. Comments were integrated in revised GIS-based screening maps. The revised information was discussed.

- ***Meeting 4: September 5, 2014 – Webinar.*** The goal of this meeting was to present the results of UCONN's Physical Oceanography study in preparation for the eastern Long Island Sound region SEIS. UCONN presented the approach and findings of the field data collection and modeling effort. The presentation was followed by discussion.

Minutes of the four Cooperating Agency Group meetings, including the presentations, are provided in Appendix A – Public Involvement.

7.2 Public Involvement and Coordination Activities – DSEIS

As described in Section 1.5.4, this DSEIS is being published together with a Draft Site Management and Monitoring Plans (SMMP) on USEPA's website. These documents are circulated for public review and comment. Comments on the DSEIS and draft rulemaking for the Designation of Dredged Material Disposal Site(s) in the eastern Long Island Sound region may be provided in writing. In addition, during the public comment period, the USEPA will hold public meetings in which interested parties may submit comments. Information regarding the locations, dates, and times of the public hearings will be provided in the *Federal Register*, included in public notices and press releases, and mailed to the existing mailing list. This information is also posted on the USEPA website (see Section 7.3).

In accordance with the USEPA Policy on Consultation and Coordination with Indian Tribes, USEPA coordinated and requested interest in Consultation in July 2015.

7.3 Distribution

There were various avenues used to distribute information to the public. These included, but were not limited to the following: a website, mailing lists for emails and hardcopy mail, and the media. The DSEIS is also being transmitted electronically; the email notification with the link to the website was sent to state and federal cooperating agency representatives, Connecticut and New York congressional leaders, and stakeholders who participated in meetings and are on the USEPA email distribution list. The FSEIS will be distributed similarly.

A description of these avenues for distribution and of the information distributed during the development of this SEIS is provided below.

- ***Website.*** USEPA developed a public website where all reports, meeting notes, and any documentation develop during this SEIS process have been posted. The address of this website is as follows: *https://www.epa.gov/ocean-dumping/dredged-material-management-long-island-sound#Eastern*

- ***Mailing Lists.*** The mailing list for the eastern Long Island Sound SEIS consists of approximately 230 email addresses and 11 mailing addresses. The mailing list was set up in a manner similar to the mailing list that was originally developed in 1999 for the WLIS/CLIS EIS (USEPA and USACE, 2004a). The original list had seven different categories: general notification; marine interests including marina owners, marine industries, dredging companies, and consultants; press; state and federal agencies and Tribes; stakeholders or people who had contacted USEPA or the USACE; local cities and towns; and people who commented early in the process. This original mailing list was gathered in 1999 from various sources such as websites, state and federal agency mailing lists, environmental mailing lists, the Long Island Sound Study (LISS) mailing list, industry mailing lists, and others. The mailing list is available upon request by emailing *ELIS@epa.gov*.

- ***Press Releases.*** Press releases were sent out for the NOI announcement and postponement of New York State meeting (November 8, 2012), and for the announcement of new date for New York State public meeting (January 4, 2013).

7.4 List of Cooperating Agencies

Federal	
US Army Corps of Engineers New England District 696 Virginia Road Concord, MA 01742	US Army Corps of Engineers New York District 26 Federal Plaza New York, NY 10278
NOAA/National Marine Fisheries Service Milford Lab 212 Rogers Avenue Milford, CT 06460	U.S. Army Corps of Engineers North Atlantic Division 302 General Lee Avenue Brooklyn, NY 11252
States	
Connecticut Department of Transportation Joe Salvatore 2800 Berlin Turnpike Newington, CT 06131	Connecticut Department of Energy and Environmental Protection 79 Elm Street Hartford, CT 06106
New York State Department of State One Commerce Plaza 99 Washington Ave Albany, NY 12231-0001	New York State Department of Conservation Region 1 Office Stony Brook University 50 Circle Road Stony Brook, NY 11790
Rhode Island Coastal Resources Management Council 4808 Tower Hill Rd # 116 Wakefield, RI 02879	

7.5 Contractor Attendees of Cooperating Agency Group Meetings

University of Connecticut Department of Marine Sciences 1080 Shennecossett Road Groton, CT 06340	Louis Berger 117 Kendrick Street Suite 400 Needham, MA 02494
Battelle 141 Longwater Place Norwell, MA 02061	

7.6 List of Federal and State Agencies Coordinated with during Development of this SEIS

This list contains federal and state agencies that were coordinated with during the preparation of the SEIS, in addition to the Cooperating Agencies listed in Section 7.4.

Federal	
U.S. Fish and Wildlife Service Regional Office 5 300 Westgate Center Drive Hadley, MA 01035-9589	NOAA National Marine Fisheries Service Greater Atlantic Regional Fisheries Office 55 Great Republic Drive Gloucester, MA 01930-2276
Tribes	
Eastern Pequot Tribe 391 Norwich-Westerly Road P.O. Box 208 North Stonington, CT 06359	Mashantucket Pequot Tribal Nation 2 Matts Path PO Box 3060 Mashantucket, CT 06338-3060
Mohegan Tribe 13 Crow Hill Road Uncasville, CT 06382	Narragansett Indian Tribe 4375-B South County Trail P.O. Box 268 Charlestown, RI 02813
Paucatuck Eastern Pequot Tribal Office 393 Gold Star Highway Groton, CT 06340	Shinnecock Indian Nation Tribal Office PO Box 5006 Southampton, NY 11969
States	
New York State Department of Environmental Conservation 625 Broadway Albany, NY 12233	NY State Parks, Recreation, and Historic Preservation New York State Historic Preservation Office Peebles Island Resource Center P.O. Box 189 Waterford, NY 12188-0189
Connecticut State Historic Preservation Office One Constitution Plaza Hartford, CT , 06103	
Other Federal Agencies	
U.S. Coast Guard Group/MSO Long Island Sound 120 Woodward Avenue New Haven, CT 06512	Naval Submarine Base New London Environmental Department 1 Crystal Lake Road Groton CT 06349
U.S. Geological Survey Woods Hole Science Center 384 Woods Hole Road Quissett Campus Woods Hole, MA 02540	Naval Undersea Warfare Center NUWC Division Newport 1176 Howell ST Newport, RI 02841

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CHAPTER 8 – REFERENCES

Note: For agencies or organizations that are listed in abbreviated form, the full names are provided in brackets following the abbreviation the first time an agency or organization is listed.

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CHAPTER 9 -LIST OF PREPARERS

Preparers of the SEIS are listed below in alphabetical order.

Amy Atamian: Senior GIS Analyst, Louis Berger

Education: M.S. in Information Engineering, New York University (formerly Polytechnic University); B.F.A. in Painting and Drawing, Pratt Institute; Certificate in Cartography and Remote Sensing, Pace University

Experience: Ms. Atamian is a Certified GIS Professional with over 30 years of experience in the environmental field. She has led various types of GIS projects, including watershed assessment, contaminant migration/risk ranking, field data collection, criticality modeling, and decision support for utility capital planning, and effective cartographic design.

Role in Preparing the SEIS: Ms. Atamian was responsible for data assembly and preparation of mapping presented in the SEIS.

Steve Bedford: Principal Architectural Historian, Cultural Resources, Louis Berger

Education: Ph.D. in Art History and Archaeology from Columbia University; M.Phil. in American and Renaissance Architecture, Columbia University; M.A. in Art History, Columbia University; B.Arch., Rensselaer Polytechnic Institute; B.S. in Building Sciences, Rensselaer Polytechnic Institute.

Experience: With over 30 years of experience, Dr. Bedford serves as Principal Architectural Historian which includes being responsible for quality assurance and quality control for documents produced by members of the cultural resources practice at Louis Berger. He also has conducted and produced survey and register reports, assembled historic documentation, and prepared technical reports including NEPA and CEPA documents.

Role in Preparing the SEIS: Dr. Bedford prepared sections related to marine archaeology.

Jean Brochi: Biologist, USEPA New England

Education: M.A. in Biology, Harvard University; B.S. Biology, Suffolk University.

Experience: Ms. Brochi has over 15 years of experience in dredged material management, quality control, sediment chemistry, estuary program.

Role in Preparing the SEIS: Ms. Brochi acted as the USEPA Project Manager and technical and regulatory reviewer for the SEIS, and presenter at public meetings and hearings.

Alejandro Cifuentes-Lorenzen: Post-doctoral Fellow, University of Connecticut

Education: Ph.D. in Physical Oceanography from the University of Connecticut; M.S. in Chemical Engineering and B.S. in Environmental Engineering from Universidad Tecnica Federico Santa Maria, Valparaiso, Chile.

Experience: Dr. Cifuentes-Lorenzen's background is in air-sea interaction and the effects of waves on the turbulent exchange of heat and momentum to and from the ocean. His most recent research has focused on wave field statistics and modeling in the coastal zone.

Role in Preparing the SEIS: Dr. Cifuentes-Lorenzen was responsible for the analysis and interpretation of the wave data, coupling of the wave dynamics model component with FVCOM, and validation of the model results with field observations.

Melville Cote: Chief, Ocean and Coastal Protection Section, USEPA New England

Education: M.A. in Environmental Policy, Tufts University; B.A. Journalism/ Communications, Tufts University

Experience: Mr. Coté has been with the USEPA, Region 1, for 25 years, including serving as Senior Regional Program Manager for the Long Island Sound Study National Estuary Program and the Connecticut Nonpoint Source Program from 1993-2002, Manager of the Water Quality Unit from 2002 to 2014, and Chief of the Ocean and Coastal Protection Section from 2002 to present. His section administers the National Estuary Program for the six "member" estuaries in New England, the Regional dredged material management and ocean disposal programs, and other marine water quality programs. Mr. Coté also serves on the New England Regional Dredging Team, the Northeast Regional Ocean Council, the Gulf of Maine Council, and the board of the Northeastern Regional Association of Coastal Ocean Observing Systems, as well as other assorted regional committees and workgroups.

Role in Preparing the SEIS: Mr. Coté acted as a technical and regulatory reviewer for the SEIS, and presenter at public meetings and hearings.

Jerry Cura: Marine Biologist, Woods Hole Group

Education: Ph.D. in Biological Oceanography, University of Maine; M.S. Biology, Northeastern University; B.A. Biology, College of the Holy Cross

Experience: Dr. Cura has 38 years of experience in ecological risk assessment at marine and freshwater sites. He has been conducting studies on the potential effects of various contaminants in coastal environments and in various harbors, as well as studies concerning the ecology of marine organisms in salt marshes, estuaries, and in the offshore waters throughout New England. He has developed guidance for conducting risk assessments at marine dredging sites for the USACE and he chaired the International Navigation Association's workgroup that developed international guidance. Dr. Cura has published over 30 peer-reviewed book chapters, technical papers, journal articles, and conference proceedings in the areas of marine biology, risk assessment, environmental decision making, marine ecology, and dredged material disposal evaluation methods.

Role in Preparing the SEIS: Dr. Cura was responsible for sections pertaining to toxicity of the dredged material and bioaccumulation of marine organisms on the seafloor and in the water column.

Joe Dalrymple: Biologist/Environmental Scientist, Louis Berger

Education: M.S. in Marine Science, University of South Alabama; B.S. in Marine Biology and B.S. in Environmental Science, University of North Carolina, Wilmington

Experience: Mr. Dalrymple has 6 years of experience, with a background in marine biology and coastal ecology. He has assisted in the preparation of numerous NEPA documents. He has also prepared Essential Fish Habitat assessments, assisted in the development of management plans, and conducted various field investigations.

Role in Preparing the SEIS: Mr. Dalrymple prepared the Essential Fish Habitat sections and appendix of the SEIS.

Joseph Famely: Environmental Scientist, Woods Hole Group

Education: M.E.M. in Urban Ecology and Environmental Design, Yale School of Forestry and Environmental Studies; B.A. in Environmental Studies and Psychology, Bowdoin College

Experience: Mr. Famely has 15 years of experience in ecological risk assessment at marine and freshwater sites and supporting the development of environmental impact statements and dredged material management plans. His sediment experience includes planning and conducting field studies, evaluation and estimation of toxicity and bioaccumulation using literature-derived benchmarks and models, food chain modeling, and evaluation of alternatives for beneficial reuse of dredged material.

Role in Preparing the SEIS: Mr. Famely contributed to sections pertaining to toxicity of the dredged material and bioaccumulation of marine organisms on the seafloor and in the water column.

Phyllis Feinmark: Chief, Water and General Law Branch, Office of Regional Counsel, USEPA Region 2

Education: J.D. from George Washington University National Law Center; B.A from Johns Hopkins University

Experience: Ms. Feinmark has over 30 years of experience in the field of water law and regulation. She has advised and represented the USEPA Region 2 dredged material program for nearly 25 years on matters relating to dredged material management as well as ocean disposal and regulation.

Role in Preparing the SEIS: Ms. Feinmark provided technical and regulatory review of the SEIS.

Thomas Fredette: Biologist, USACE New England District

Education: Ph.D. and M.A. from the College of William & Mary, Virginia Institute of Marine Science; B.S. University of Massachusetts, North Dartmouth.

Experience: Dr. Fredette has more than 20 years of experience in marine science, focusing on benthic ecology, marine environmental monitoring, dredged material management, and contaminated sediment management.

Role in Preparing the SEIS: Mr. Fredette acted as a technical and regulatory reviewer for the SEIS.

Ken Goldstein: Senior Vice President, Louis Berger

Education: M.A. in Physical and Environmental Systems Analysis (Geomorphology, Hydrologic and Hydrogeologic Systems); B.A., Environmental (Geologic Sciences and Physical Geography)

Experience: Mr. Goldstein has over 33 years of experience in site remediation, watershed management, planning and protection and ecosystems restoration. He has served as lead project scientist, program manager, technical director or technical reviewer on more than 300 remediation projects.

Role in Preparing the SEIS: Mr. Goldstein was the Principal-in-Charge for Louis Berger's contribution to the SEIS.

Dell Gould: Principal Field Director, Cultural Resources, Louis Berger

Education: B.A. in Anthropology, West Virginia University; Graduate Studies in Geoscience, University of Iowa

Experience: Mr. Gould has over 20 years of experience in conducting cultural resource studies at all levels of investigation. He has contributed to several EISs for a variety of projects, including projects in New York as well as mainland and coastal environments in Massachusetts.

Role in Preparing the SEIS: Mr. Gould assisted with the preparation of the cultural resources sections of the SEIS.

Alicia Grimaldi, Physical Scientist, USEPA New England

Education: B.S. in Earth, Environment, and Oceanographic Sciences (Geology/Hydrology), University of Massachusetts, Boston

Experience: Ms. Grimaldi is part of the Ocean & Coastal Protection Unit at USEPA Region 1. In addition to working in the dredging program, she is the aquatic nuisance species coordinator, works in the beach monitoring program, and conducts GIS analyses. She previously worked in the Air Quality Monitoring Unit at USEPA Region 1.

Role in Preparing the SEIS:. Managed the public mailing list and database and contributed to the public outreach program.

Mark Habel: Geologist, USACE New England District

Education: J.D., Suffolk University Law School; B.S. in Geology, Northeastern University

Experience: Over 37 years of experience in coastal geology, navigation project design, evaluation and construction, civil works planning and feasibility studies, and project management. Mr. Habel acted as the USACE Project Manager for the 1998-2004 Long Island Sound Site Designation EIS.

Role in Preparing the SEIS: Mr. Habel acted as the USACE Project Manager for the Long Island Sound study effort. He contributed to the preparation and editing of the Introduction, Purpose and Need, No Action and Alternatives sections of the SEIS.

Bernward Hay: Principal Environmental Scientist, Louis Berger

Education: Ph.D. in Oceanography (Marine Geology), Massachusetts Institute of Technology & Woods Hole Oceanographic Institution Joint Program; M.S. in Geological Sciences, Cornell University; Pre-diploma in Geology, University of Göttingen, Germany

Experience: Dr. Hay has 28 years of experience conducting investigations of water quality and sediment issues in coastal environments. He has been involved in multiple Environmental Impact Statements and related studies. He has conducted research about particle settling in marine environments.

Role in Preparing the SEIS: Dr. Hay acted as the Louis Berger Project Manager for the preparation of the SEIS. He was also the marine geologist for this project, prepared Public Meeting reports and the Sediment Chemistry report, and provided review of technical documents.

Rachel Horwitz: Postdoctoral Fellow, University of Connecticut

Education: Ph.D. in Physical Oceanography from the Massachusetts Institute of Technology / Woods Hole Oceanographic Institute Joint Program in Oceanography and Applied Ocean Science & Engineering; B.A. in Mathematics from Williams College.

Experience: A physical oceanographer with a background in both field measurements and numerical modeling, Dr. Horwitz has 9 years of experience in coastal data analysis.

Role in Preparing the SEIS: Dr. Horwitz prepared sections related to the processing of acoustic Doppler current profiler data, model dye experiments, and presentations of moored instrument data, model data, and data-model comparisons.

Kay Howard-Strobel: Research Associate, University of Connecticut

Education: M.A. in Marine Science (Marine Geology concentration), College of William and Mary; B.S. in Geology and Biology, University of Mary Washington.

Experience: Ms. Howard-Strobel has over 25 years of experience in managing and conducting a broad range of oceanographic field surveys in coastal environments.

Role in Preparing the SEIS: Ms. Howard-Strobel prepared sections related to the field sampling and data collection campaigns, as well as the data processing and sediment analysis for the SEIS.

Carlton Hunt: Research Leader, Battelle

Education: Ph.D. in Chemical/Geochemical Oceanography from the University of Connecticut; M.S. in Chemical Oceanography from the University of Connecticut; B.A. in Chemistry from Doane College

Experience: Dr. Hunt is a chemical oceanographer with broad experience in estuarine and coastal marine ecosystems. During the past 35 years, he has conducted and supervised projects involving the transport, fate, effects, and bioaccumulation of contaminants and water quality impacts of nutrients in diverse coastal systems including Long Island Sound, Narragansett Bay, Massachusetts Bay, New York Harbor, and New York Bight, and the Northwest Atlantic Ocean. He supported the preparation of Central and Western Long Island Sound EIS for designation of ocean disposal sites, as well as other EISs that support dredged material site designations in the New York Bight, offshore of Rhode Island, and southeastern Massachusetts.

Role in Preparing the SEIS: Dr. Hunt presented the ZSF and site screening methodology conducted for the Central and Western Long Island Sound EIS prepared in 2004 and how a similar approach would apply to Eastern Long Island Sound.

Stephanie Lamster: Life Scientist, USEPA Region 2

Education: M.A. in Conservation Biology, Columbia University; M.P.A. in Environmental Policy, Columbia University; B.A. in Environmental Science, Barnard College

Experience: Ms. Lamster has 11 years of experience in environmental protection, six of which have been as a NEPA reviewer and the Endangered Species Act Coordinator at USEPA.

Role in Preparing the SEIS: Ms. Lamstser provided technical and regulatory review of the SEIS document and NEPA compliance.

Ben Lieberman: Senior Port Planner, Louis Berger / independent consultant

Education: M.S. in Urban and Regional Planning, University of Wisconsin, Madison; B.S. in Psychology, University of Maryland, College Park

Experience: Mr. Lieberman joined Louis Berger in 2009, after more than 20 years of port management experience with the Maryland Port Administration (MPA) in Baltimore, MD. He is experienced in port system and strategic planning, analysis of trade flows, competitive port analyses and market evaluations, as well as strategic-level development of port terminal layout and operations. At the MPA, as Manager of Market Planning and Assistant Director of Strategic Planning, Mr. Lieberman was responsible for analysis of cargo markets and global trade flow trends, assessment of competing ports' infrastructure development and evaluation of trends in ship construction and deployment. He worked with the USACE on the benefit/cost analysis for the deepening of the Chesapeake and Delaware Canal. Mr. Lieberman participated as an independent consultant after April 2015.

Role in Preparing the SEIS: Mr. Lieberman prepared the socioeconomic sections for the SEIS, related to economics, navigation, and disposal costs.

Grant McCardell: Post-doctoral Research Fellow, University of Connecticut

Education: Ph.D. in Oceanography (Physical Oceanography), University of Connecticut; M.S.C.I.S., Boston University; B.A., Princeton University

Experience: Dr. McCardell has 24 year of experience in computer modeling and simulation. He has been involved in several USEPA water quality studies of Long Island Sound.

Role in Preparing the SEIS: Dr. McCardell participated in the implementation, calibration, and evaluation of the computer models used in the physical oceanography study for the SEIS. He also presented at some of the Public Meetings and contributed to the physical oceanography study for the SEIS.

Lynn McLeod: Environmental Scientist, Battelle

Education: M.A. in Organizational Communications from Marist College, B.S. (Honors) in Environmental Science from Marist College

Experience: Over 25 years of experience in environmental science, including work on biological and environmental assessments, environmental impact statements, monitoring plan development, and conduct of peer reviews. Ms. McLeod was the Project Manager in charge of developing the Environmental Impact Statement for the Designation of Dredged Material Disposal Sites in Central and Western Long Island Sound, Connecticut and New York, was a task manager on the Providence River and Harbor Maintenance Dredging Project Final EIS, and assisted in the preparation of the Historic Area Remediation Site Supplemental EIS.

Role in Preparing the SEIS: Ms. McLeod prepared a presentation regarding the ZSF and site screening conducted for the Central and Western Long Island Sound EIS prepared in 2004 and how a similar approach would apply to Eastern Long Island Sound.

James O'Donnell: Professor of Marine Sciences, Executive Director of the Connecticut Institute for Resilience and Climate Adaptation, University of Connecticut

Education: Ph.D. in Oceanography, University of Delaware; M.S. Marine Sciences, University of Delaware; B.S. in Applied Physics, University of Strathclyde, Scotland

Experience: Dr. O'Donnell has more than 30 years of experience in conducting oceanographic research. A marine scientist specializing in physical oceanography studies, he has managed teams for a wide range of coastal studies involving field investigations and computer modeling. His research centers on understanding and predicting the processes that control the transport of material in the coastal ocean. Much of his work has been conducted in Long Island Sound and Block Island Sound.

Role in Preparing the SEIS: Dr. O'Donnell was the Project Manager for the UCONN Team and the lead scientist for the physical oceanography study for the SEIS. He also prepared summary sections on physical oceanographic processes for the SEIS document.

Doug Pabst: Team Leader, USEPA Region 2, Dredged Material Management Team

Education: M.S. in Marine Environmental Science, State University of New York at Stony Brook

Experience: Mr. Pabst has 28 years of experience in ocean monitoring, ocean dumping, and dredged material management.

Role in Preparing the SEIS: Mr. Pabst provided technical and regulatory reviewer for the SEIS.

Patricia Pechko: Environmental Scientist, Dredged Material Management Team, USEPA Region 2

Education: B.S. in Marine Science (concentration in Oceanography), Stockton University

Experience: Ms. Pechko has 28 years of experience in dredged material management, ocean disposal and regulation and 3 years of experience in hazardous waste management.

Role in Preparing the SEIS: Ms. Pechko provided technical and regulatory reviewer for the SEIS.

Joseph Salvatore: Dredge Coordinator, Project Management, Connecticut Department of Transportation

Education: B.S. Construction Management, Central Connecticut State University

Experience: Mr. Salvatore oversees and manages the Maritime Program for the State of Connecticut. He promotes and supports Port Infrastructure Development of Connecticut's ports and harbors.

Role in Preparing the SEIS: Contract manager for CTDOT.

Spence Smith: Marine Biologist, Louis Berger

Education: M.A. in Biology (with Marine Biology concentration) from the Boston University; B.S. in Zoology from Duke University

Experience: Mr. Smith is a marine and environmental scientist with background in marine, coastal, biological, fisheries, water quality, and regulatory compliance assessments; threatened and endangered species impact analyses; and federal and state permitting. He has been involved in preparing and reviewing over 50 environmental assessments and EISs in accordance with the NEPA and Center for Environmental Quality regulations implementing NEPA. His experience also includes preparing Essential Fish Habitat and Fish and Wildlife Coordination Act assessments; and Coastal Zone Management Act consistency determinations.

Role in Preparing the SEIS: Mr. Smith prepared sections related to marine biology and provided NEPA review.

Leo Tidd: Air and Noise Specialist, Louis Berger

Education: M.P.A., Environmental Science and Policy, Columbia University; B.S., Environmental Studies, SUNY College of Environmental Science and Forestry

Experience: Mr. Tidd has 8 years of experience in air quality and noise modeling and analyses, and an understanding of NEPA and Clean Air Act regulatory requirements. His air quality experience includes analyses for transportation and building facility projects, conformity determinations, greenhouse gas emissions inventories, and air quality screening analyses.

Role in Preparing the SEIS: Mr. Tidd prepared sections related to air quality and noise for the SEIS.

Niek Veraart: Vice President, Environmental Planning, Louis Berger

Education: M.S. in Regional Planning and Land Planning, Wageningen University, Netherlands; B.S. in Land Planning and Landscape Architecture, Wageningen University, Netherlands

Experience: Mr. Veraart has 25 years of experience in environmental analysis and environmental review under NEPA and state statutes. These include environmental review for USACE permitting actions and projects including the New England District and the New York District.

Role in Preparing the SEIS: Mr. Veraart was the quality assurance staff for regulatory compliance review and public participation review. He also assisted with the NEPA public outreach component.

Len Warner: Director, Louis Berger

Education: B.S.E. in Aerospace Engineering, University of Michigan

Experience: Mr. Warner is an engineer and project manager with 25 years of experience designing and implementing remedial investigations and feasibility studies for contaminated sediment sites. At Louis Berger, Mr. Warner leads geochemical data evaluation and interpretation efforts for environmental projects.

Role in Preparing the SEIS: Mr. Warner coordinated the preparation of the Work Plan and Quality Assurance Project Plan for the physical oceanography study by the University of Connecticut and provided technical review.

George Wisker: Environmental Analyst 3, Connecticut Department. of Energy and Environmental Protection

Education: B.S. in Marine Science, Southampton College of Long Island University; M.S. in Geology, University of Delaware

Experience: Mr. Wisker has 30 years of experience in environmental analysis and regulatory review of dredging projects, beach restoration and coastal structures projects.

Role in Preparing the SEIS: Provided technical and regulatory review of the SEIS document.

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