Essential Fish Habitat (EFH) Assessment
New Bedford/Fairhaven Harbor
Massachusetts
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Prepared for:
Massachusetts Office of Coastal Zone Management
251 Causeway Street, Suite 900
Boston, MA 02114-2119

Prepared by:
Maguire Group Inc.
225 Foxborough Boulevard
Foxborough, MA 02035
508-543-1700

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

The following acronyms and abbreviations are used in this assessment:

ATC	Adjacent to Channel
BHNIP	Boston Harbor Navigation Improvement Project
BMPs	Best Management Practices
BOS	Batelle Oceanic Sciences
CBP	Chesapeake Bay Program
^oC	degrees Celsius
CAD	Confined Aquatic Disposal
CDF	Confined Disposal Facility
CFR	Code of Federal Regulations
cm	centimeters
CMR	Code of Massachusetts Regulation
cm/s	centimeters/second
CPUE	Catch per Unit Effort
cy	cubic yards
CWA	Clean Water Act
DO	Dissolved Oxygen
DEP	Department of Environmental Protection
DMMP	Dredged Material Management Plan
EEZ	Exclusive Economic Zone
EIR	Environmental Impact Review
EFH	Essential Fish Habitat
ENF	Environmental Notification Form
EOEA	Executive Office of Environmental Affairs
^oF	degrees Fahrenheit
ft	feet
ft^2	square feet
FMCs	Fisheries Management Councils
GSMFC	Gulf States Marine Fisheries Management Commission
HAPC	Habitat Areas of Particular Concern
in	inches
m	meter
m^2	square meters
MACZM	Massachusetts Coastal Zone Management
MADMF	Massachusetts Division of Marine Fisheries
MAFMC	Mid-Atlantic Fisheries Management Council
MARMAP	Marine Resources Monitoring, Assessment and Prediction
MBDS	Massachusetts Bay Disposal Site
MEPA	Massachusetts Environmental Policy Act
MIT	Massachusetts Institute of Technology
MLW	Mean Low Water
MPRSA	Marine Protection, Research and Sanctuaries Act

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

NAI	Normandeau Associates Incorporated
NBHTC	New Bedford Harbor Trustees Council
NED	New England Division
NEFMC	New England Fisheries Management Council
NERBC	New England River Basin Commission
NERO	Northeast Regional Office
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NYD	New York District
OD	Overdredge
OHRM	Other Regulated Material
OMR	Office of Maritime Resources
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
pH	-log of hydrogen ion concentration
ppt ($^{o}/_{oo}$)	parts per thousand
RCRA	Resource Conservation and Recovery Act
SAV	Submerged Aquatic Vegetation
TAC	Technical Advisory Committee
TH	Tidal Habitat
TSS	Total Suspended Solids
UDM	Unsuitable Dredged Material
UMASS	University of Massachusetts
USACE	United States Army Corp of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
WADFW	Washington State Division of Fish and Wildlife
YOY	Young of Year
ZSF	Zone of Siting Feasibility

1.0 INTRODUCTION

The Magnuson Fisheries Conservation and Management Act of 1976 (the Act) was passed in order to promote sustainable fish conservation and management. Under the Act, the National Marine Fisheries Service (NMFS) was granted legislative authority for fisheries regulation in the United States within a jurisdictional area located between three miles to 200 miles offshore, depending on geographical location. NMFS is an agency within the National Oceanic and Atmospheric Administration (NOAA) within the United States Department of Commerce (American Oceans, 2001). The NMFS was also granted legislative authority to establish eight regional fishery management councils that would be responsible for the proper management and harvest of fish and shellfish resources within these waters. Measures to ensure the proper management and harvest of fish and shellfish resources within these waters are outlined in Fisheries Management Plans prepared by the eight councils for their respective geographic regions. New Bedford/Fairhaven Harbor, Massachusetts lies within the management jurisdiction of the New England Fisheries Management Council (NEFMC).

Recognizing that many marine fisheries are dependent on nearshore and estuarine environments for at least part of their life cycles, the Act was reauthorized , and changed extensively via amendments in 1996 (P.L. 104-297). The amendments, among other things, aimed to stress the importance of habitat protection to healthy fisheries. The authority of the NMFS and their councils was strengthened by the reauthorization in order to promote more effective habitat management and protection of marine fisheries. The marine environments important to marine fisheries are referred to as essential fish habitat (EFH) in the Act and are defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." To delineate EFH, coastal littoral and continental shelf waters are first mapped by the regional Fisheries Management Councils (FMCs) and superimposed with ten minute by ten-minute (10′x10′) square coordinate grids. Then survey data, gray literature, peer review literature, and reviews by academic and government fisheries experts were all used by the management councils to determine if these 10′x10′ grids support essential fish habitat for federally managed species. Both the NEFMC and the Mid-Atlantic Fisheries Management Council (MAFMC) have designated EFH in New Bedford/Fairhaven waters.

1.1 PROPOSED ACTION

This EFH assessment was conducted to supplement the Environmental Impact Review (EIR) prepared for the New Bedford/Fairhaven Harbor Dredged Material Management Plan (DMMP), in New Bedford/Fairhaven, Massachusetts. An Environmental Notification Form (ENF) was noticed in the *Environmental Monitor* for the New Bedford/Fairhaven Harbor DMMP on June 10, 1998, by Massachusetts Office of Coastal Zone Management (MACZM), the project proponent. The location of New Bedford/Fairhaven Harbor is shown in Figure 1-1. The Executive Office of Environmental Affairs (EOEA) file number for the New Bedford/Fairhaven Harbor DMMP is 11669.

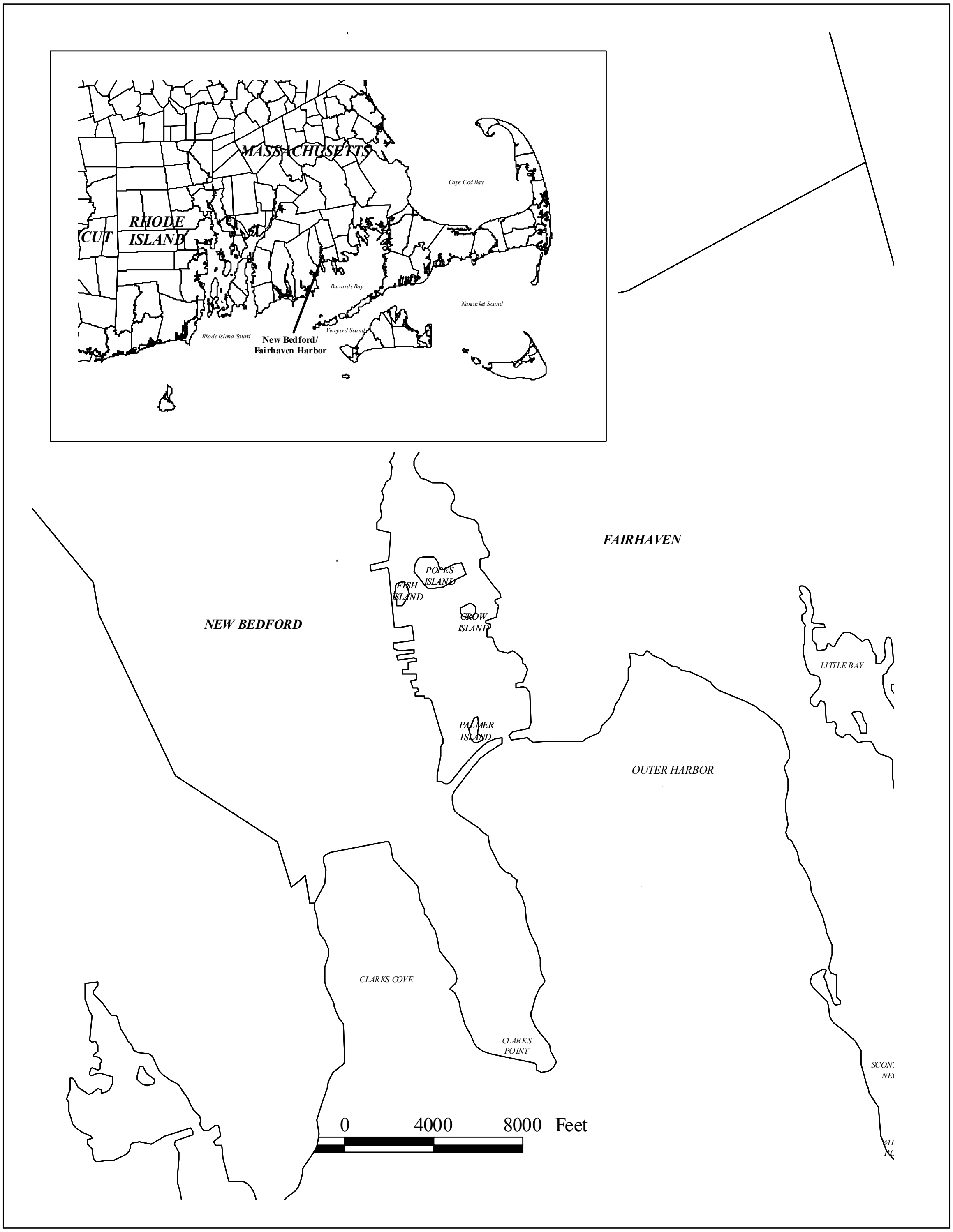

Figure 1-1. Project Area Location

The DMMP EIR included an analysis of alternative upland and aquatic dredged material disposal sites and alternative technologies to treat sediments that are unsuitable for unconfined open water disposal ("unsuitable dredged material" or "UDM") for eventual disposal or beneficial reuse. The EIR identified two (2) proposed preferred alternatives for UDM disposal, the Pope's Island North and Channel Inner Sites (Figure 1-2).

The New Bedford/Fairhaven Harbor DMMP provides a mechanism for balancing existing and future needs for the disposal of UDM associated with proposed harbor development projects while maintaining existing environmental resources. The framework established in the New Bedford/Fairhaven Harbor DMMP provides technical information in support of the harbor management goals of the City of New Bedford and Town of Fairhaven and the sound management of the Commonwealth's environmental and maritime economic resources.

1.2 PURPOSE AND NEED

New Bedford/Fairhaven Harbor lies within an area designated as EFH for the New England Groundfish Management Plans. The delineation of this EFH area is depicted in Figure 1-3.

1.2.1 Purpose

The purpose of this EFH Assessment is to address the potential impact to finfish and shellfish resources from implementation of the DMMP for New Bedford/Fairhaven Harbor. The DMMP addresses disposal of UDM over the next ten (10) years. The lack of practicable, cost-effective methods for the disposal of dredged material unsuitable for unconfined ocean disposal in an environmentally sound and cost-effective manner has been a long-standing obstacle to the successful completion of dredging projects in New Bedford/Fairhaven Harbor and other harbors throughout the Commonwealth.

1.2.2 Dredging Need

Based on dredging records collected in the Massachusetts Navigation and Dredging Management Study that was completed by the United States Army Corps of Engineers (USACE) for the State of Massachusetts (USACE, 1995), a total of 7,028,465 cubic yards of material have been dredged from New Bedford/Fairhaven Harbor. Much of this volume was dredged prior to the initial creation of the federal navigation channels and the construction of the hurricane barrier in 1966. No major dredging has occurred since that time, except for dredging in the upper estuary as part of the Superfund remediation project. The potential volume of sediment to be dredged from New Bedford/Fairhaven Harbor over the next ten years has been estimated through surveys conducted by the USACE (1996) and Maguire (1997) to be 960,000 cubic yards (cy). This included the dredging needs of federal, state, local and private parties with channels, turning basins, or marinas within the harbor. Due to sediment quality concerns (Section 2.1.4), the entire volume of sediment was estimated to be unsuitable for open water disposal and thus considered UDM.

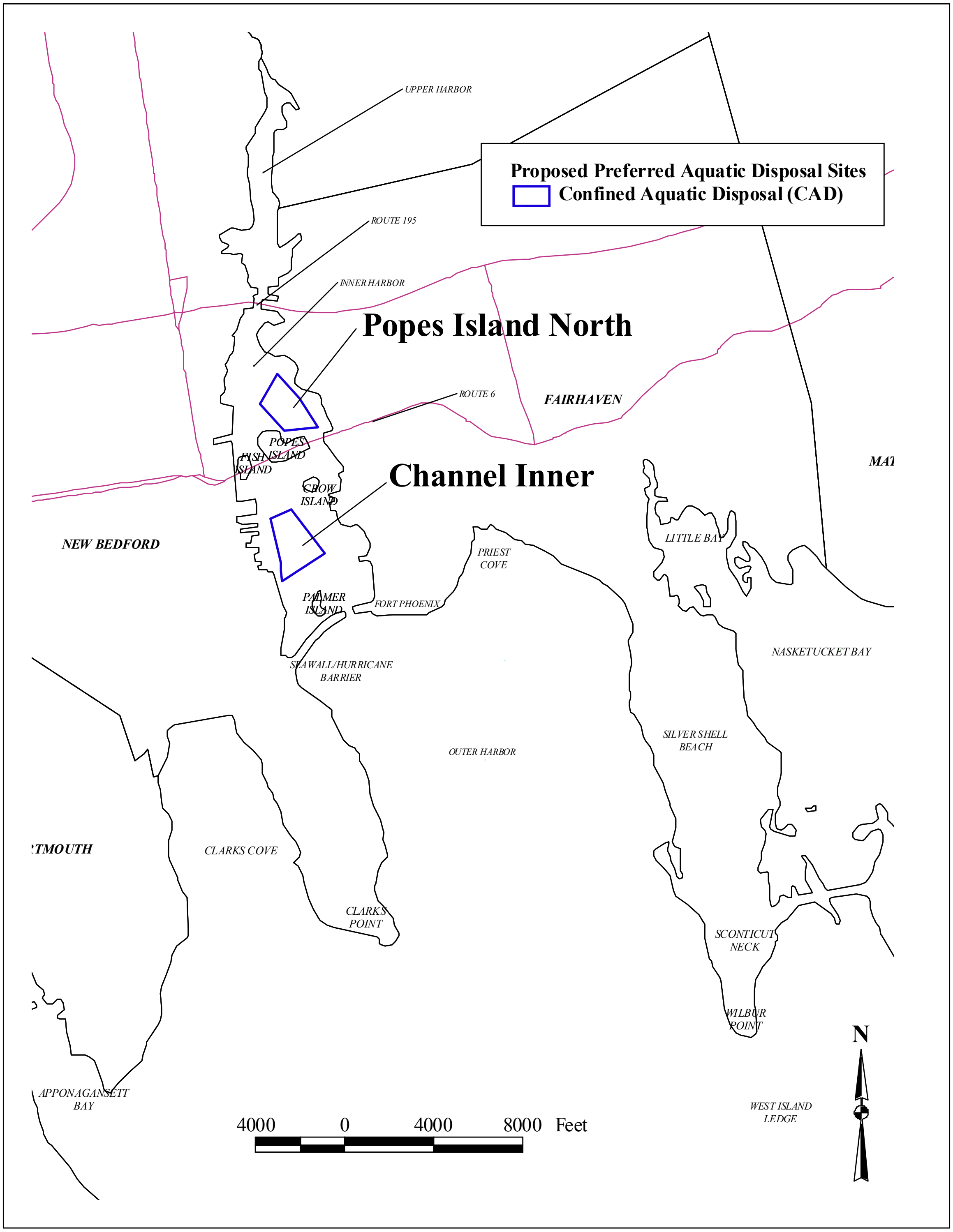

Figure 1-2. Location of Preferred Alternative CAD Cell Disposal Areas

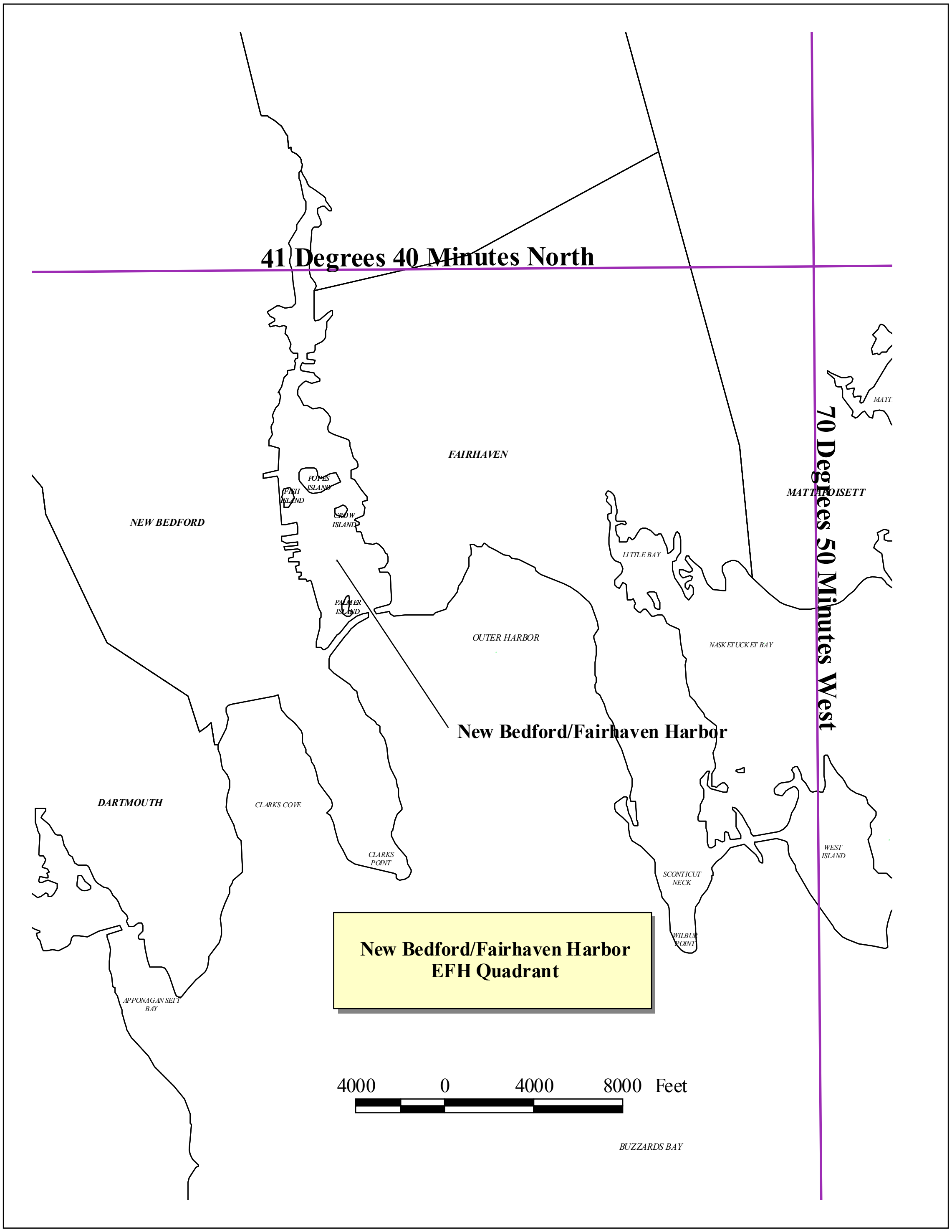

Figure 1-3. EFH Delineation Area Inclusive of New Bedford/Fairhaven Harbor

Table 1-1: Dredged material volumes (cy) for New Bedford/Fairhaven Harbor for next ten years

Baseline Dredging Demand	Suitable Dredged Material[1]	Unsuitable Dredged Material[2]
960,000	0	960,000

[1] Suitable for disposal at MBDS
[2] Not suitable for disposal at MBDS

1.3 BACKGROUND

1.3.1 Assessment of Alternative Disposal Sites

Universe of Sites

Possible geographical locations to implement upland and aquatic disposal alternatives for UDM were investigated within upland and aquatic Zone of Siting Feasibility (ZSF) defined for the New Bedford/Fairhaven Harbor DMMP. The logistical basis for each ZSF established a reasonable search area to develop the universe of potential disposal locations. A description of the development of the upland and aquatic universe of sites considered for the New Bedford/Fairhaven Harbor DMMP is provided in the EIR. Further successive detailed screening was conducted after a universe of disposal sites were identified.

The Upland ZSF for New Bedford/Fairhaven was defined based on a reasonable transit distance from a practicable landside dewatering facility location to the disposal area and return trip in one day via conventional trucking means.

The Aquatic ZSF for New Bedford/Fairhaven was defined based on reasonable transit distances from the dredging projects, local jurisdictional boundaries, and evaluation of restricted use areas such as marine sanctuaries. Based on the transit distance criteria, the Aquatic ZSF was defined as a line was drawn from Wilbur Point to Clarks Point across the outer harbor. At the request of several federal regulatory agencies, the ZSF was expanded to the southwest to include an area off Clarks Point because this is a potentially degraded area due to the presence of wastewater treatment outfalls. Federal resource agencies then requested that a nearby historic disposal site, West Island Ledge, be included as well.

Within the expanded Aquatic ZSF, a total universe of 17 sites was identified. Potential sites were identified by defining areas with suitable bathymetric depressions and/or indications of a depositional area (i.e., containment areas not susceptible to storm wave currents) and existing navigational projects.

Screening Process

The goal of the DMMP screening process was to identify the most appropriate sites for the disposal of UDM. There were no numerical thresholds that identified the "best" site; rather, the DMMP screening process was a relational comparison among potential sites and types by which a determination was made regarding which site is "better" than another. Therefore, the screening process was designed to assess a wide range of potential sites and then, through sequential analysis, continually narrow the list until only the most appropriate sites remained. The most appropriate sites were determined to be those that meet local, state, and federal permitting standards, are consistent with New Bedford/Fairhaven's harbor planning objectives and are capable of being implemented at reasonable cost.

The DMMP screening process consisted of three primary steps:

- Initial screen for feasibility, which resulted in the identification of numerous "Candidate Sites",

- Application of site exclusionary screening criteria to the Candidate sites, resulting in the narrowing of Candidate Sites to Potential Alternatives,

- The Application of discretionary criteria to the Potential Alternatives resulting in the narrowing of the Potential Alternatives to Proposed Preferred Alternatives; and

- Review of the Proposed Preferred Alternatives by local, state, and federal officials resulting in the identification of Preferred Alternatives.

Upland Sites

No upland sites survived the screening process due to the following reasons:

- There is no dewatering site available for the temporary stockpiling and dewatering of UDM. A dewatering site is a mandatory element of the upland disposal process.

- The lowest cost for upland disposal is $62/cy. This is more costly than aquatic disposal. In addition, the $62/cy cost would be for disposal of only about 6% of the entire UDM volume.

Massachusetts DEP regulations and policies for handling of dredged material, and landfill siting, engineering, and operations are very restrictive. The likelihood for obtaining a permit to site a new landfill, or activate a closed landfill is low and even if a site were to become permitted, it would take 5-7 years to achieve all the necessary approvals. While a large-scale facility sited on that schedule could potentially accommodate the outyear dredging projects, the 5-7 year permitting schedule does not accommodate the 0-5 year dredging need.

Aquatic Sites

Two general types of aquatic disposal sites were evaluated for the New Bedford/Fairhaven Harbor DMMP: confined aquatic disposal (CAD) and confined disposal facilities (CDF). A CAD is an underwater site where UDM is deposited and then covered (capped) with a layer of clean material to isolate UDM from the environment. A CDF is an aquatic site that is typically an extension of land with constructed walls on the three remaining sides. There are three general types of CADs evaluated in this DEIR:

- Confined aquatic disposal/over dredge (CAD/OD) site: an existing navigation channel is over dredged to a depth sufficient to accommodate both a volume of UDM and a cap of clean material without interfering with navigation.

- Open water CAD site: CAD cell is constructed on the ocean bottom, or UDM is deposited in an existing depression in the ocean floor .

- Adjacent to channel (ATC) site: a CAD cell constructed in an area immediately adjacent to a navigation channel, where the ocean bottom may be previously disturbed or degraded due to the proximity of the navigation channel and channel dredging activities.

- Confined disposal facility (CDF): a CDF site is constructed by building a wall seaward of an existing land feature and backfilling behind the confinement wall with dredged material. Typical end-use of such facilities includes port expansion and open space land creation.

- Tidal Habitat (TH): a TH site is a CDF that allows tidal influx, via culverts, over a contained area of dredged material. TH sites can be designed to create mudflat or coastal wetland.

The multi-step siting process was used to identify and screen aquatic disposal sites for UDM to be generated from New Bedford/Fairhaven Harbor dredging projects. A total universe of seventeen (17) disposal sites within the New Bedford/Fairhaven expanded Aquatic Zone of Siting Feasibility (ZSF) were subjected to a preliminary physical screening, including criteria based on size (or capacity), water depth, confinement potential, location and navigational restrictions. The revised Aquatic ZSF was defined by a line originating at Clarks Point in the City of New Bedford, running southwesterly to Bents ledge, thence southeasterly to North Ledge, thence easterly to Henrietta Rock, then northeasterly to Angelica Rock, and finally northeasterly to Wilbur Point in the Town of Fairhaven. Aquatic disposal sites further away would place an unreasonable operational cost on projects within the harbor. Additionally, the former dredged material disposal site known as “West Island Ledge Dumping Ground” was also investigated.

Exclusionary criteria, aimed at eliminating sites based on regulatory prohibition, were applied to the 17 candidate sites. The specific criteria are explained in Section 4.8.2.1 of the EIR. None of the candidate sites failed the exclusionary criteria, therefore all 17-candidate disposal sites were carried forward as potential alternatives. The 17 potential sites were then evaluated using discretionary criteria. The discretionary criteria are used to compare and contrast among sites. They include physical, biological, socioeconomic, historical/archaeological, and cost considerations.

1.3.2 Identification of the Preferred Alternative

After evaluating and screening the physical, biological, jurisdictional, economic and other factors for the universe of aquatic disposal sites, the Inner Channel and Popes Island North CADs sites were selected as proposed preferred aquatic disposal areas. These sites (either alone or in combination) have the potential to accommodate the baseline dredging demand volume of UDM identified for New Bedford/Fairhaven Harbors. Both sites also lie within areas where expected impacts would only be of a temporary nature, posing minimal potential for long-term environmental impacts.

Currently, it is envisioned that a disposal subcell would be open for one dredging season within a five-year window. The dredging window, as specified by DMF and DEP, is usually from late fall to spring and is designed to avoid the sensitive life stages of important fish and shellfish species. Therefore, excavation of the cells, placement of the UDM within the cells, and capping of the cells would likely occur within a period of less than six (6) months. The five-year duration of each phase is intended to provide ample notice of availability of a disposal facility, providing facilities an opportunity to secure the necessary permits and funding to conduct dredging projects. This planned opening of a disposal facility on a regular basis should also provide opportunities for coordinating various harbor projects.

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2.0 DESCRIPTION OF THE STUDY AREA

New Bedford/Fairhaven Harbor is located on the northern shore of the Buzzards Bay coast and borders the communities of Fairhaven to the east, and New Bedford to the west. It is approximately 56 miles south of Boston and 11 miles east of Fall River Massachusetts. New Bedford/Fairhaven Harbor is a coastal embayment with a mean tidal range of approximately 3.3 feet or 1 meter (Howes and Goehringer, 1996). The Acushnet River is the most significant freshwater inflow to the harbor. It forms the border between New Bedford to the west and Fairhaven to the east. Other smaller tidal streams fed by fresh water intermittent and perennial tributaries drain into either the Acushnet River or New Bedford/Fairhaven Harbor.

The limit of the harbor lies at an imaginary line that extends from Clarks Point in New Bedford, east to Wilbur Point in Fairhaven. New Bedford/Fairhaven Harbor is divided into three separate regions: the Upper Harbor, the Lower Harbor (together referred to as the Inner Harbor) and the Outer Harbor. There are also distinct smaller coves and embayments around its perimeter. Beginning from the mouth of the Harbor and proceeding upstream, the following distinct regions of the harbor are delineated: The Outer Harbor region extends from the harbor mouth, north (upstream) to the hurricane barrier seawall that extends from Fort Phoenix Beach in Fairhaven west to New Bedford, just south of Palmer Island. From the seawall north to the I-195 Bridge lies the Lower harbor segment. From I-195 Bridge upstream lies the Upper Harbor segment.

Distinct areas of the harbor include the following: Proceeding north from the mouth of the harbor along the western shore lays the community of Clarks Point. North of the seawall along the western shore of the Acushnet River lie commercial wharves within the City of New Bedford. Some of the more notable wharves (proceeding from north to south) include the New Bedford Gas and Edison Light Company wharf, Homer’s Wharf, the State Pier, Pier 3, and Pier 4. Continuing upstream (north), Fish Island lies under Route 6 and the New Bedford/Fairhaven Bridge in the Lower Harbor. To the east of Fish Island lies Popes Island Marine Park, which also lies beneath the New Bedford/Fairhaven Bridge. Continuing clockwise, and proceeding south along the eastern shore of the Acushnet River lies, first, Delano Wharf, then Kelly, Union, and Railroad wharves, north of the seawall. Just east of the seawall on the eastern side of the southern limits of the Lower Harbor in Fairhaven lies the Fort Phoenix Beach State Reservation. East of Fort Phoenix lies the community of Harbor View on the west side of Priests Cove, a small embayment on the north shore of the Outer Harbor in Fairhaven. East of Priests Cove lies the Community of Pope Beach. Continuing south and counterclockwise along the western shore of the Outer Harbor lies Silver Shell Beach within the community of Sconticut Neck, a peninsula that extends southward from the middle of Fairhaven’s southern shore. South of Silver Shell Beach lies a small unnamed tidal cove embayment and salt marsh. Further south lies the limits of Sconticut neck at Wilbur Point (Refer to Figure 1-2 – Page 1-4).

The main federal navigation channel leading into New Bedford/Fairhaven Harbor (the Entrance Channel) is authorized to a depth of 30 feet (Figure 2-1). It begins at a location just south of the Butler Flats Lighthouse in the Outer Harbor and continues northwesterly through the break in the seawall and into the Lower Harbor. The main navigation channel splits into two channels once inside the hurricane barrier. One channel provides access to the New Bedford Commercial Wharves (the New Bedford Reach) and the other (the Fairhaven Reach) provides access to the Fairhaven Wharves on the east side of the Lower Harbor. The New Bedford Reach terminates at an area between New Bedford Harbor to the west and Popes Island to the east. A turning basin authorized to a depth of 30 feet lies at the terminus of the New Bedford Reach. A maneuvering area lies adjacent to the west side of the New Bedford Reach between the commercial wharves and the reach (Figure 2-2).

The smaller Fairhaven tributary channel services the commercial wharves along the eastern shore of the Lower Harbor segment in Fairhaven. The Fairhaven Channel has an authorized depth of 15 feet adjacent to a 25-foot anchorage area within the Lower Harbor. This fifteen-foot channel extends northeasterly between Crow's Island and Fairhaven. In the vicinity of Old South Wharf, the authorized depth of the Fairhaven reach changes from fifteen to ten feet.

The Upper and Lower segments of the Inner Harbor contains several marinas, a significant recreational fleet, harborside historical attractions, and various commercial fishing fleets and fish processing/cold storage facilities. Land usage along the western shore of the Outer Harbor contains a mixture of residential commercial and industrial uses. Land usage along the eastern shore of the Outer Harbor is predominantly residential.

2.1 DESCRIPTION OF THE DMMP DISPOSAL SITES

2.1.1 Hydrography

The circulation of water in coastal embayments such as New Bedford/Fairhaven Harbor is influenced by a complex combination of forces produced by basin morphology, tidal fluctuations, wind, and density gradients. Although general data regarding circulation conditions and sediment transport within the harbor has been collected (see below), no data exist describing the actual site-specific sediment transport and circulation patterns within each Proposed Preferred Aquatic Disposal sites and their proximity. Factors affecting potential sediment transport at this site are dependent on disposal site design.

Detailed site-specific information is required to project the fate of UDM placed at this location. At present, understanding of the magnitude and seasonal/spatial components of these physical forces is insufficient to quantify the long-term stability of UDM at the preferred disposal sites. Detailed, *in situ* measurements of tides, circulation, and patterns of sediment resuspension will be evaluated at each Proposed Preferred Aquatic Disposal site. This includes deployment of a tide gauge; current meters, and other devices in order to provide a vertical profile of flows, bottom shear stress, and wave height. An optional

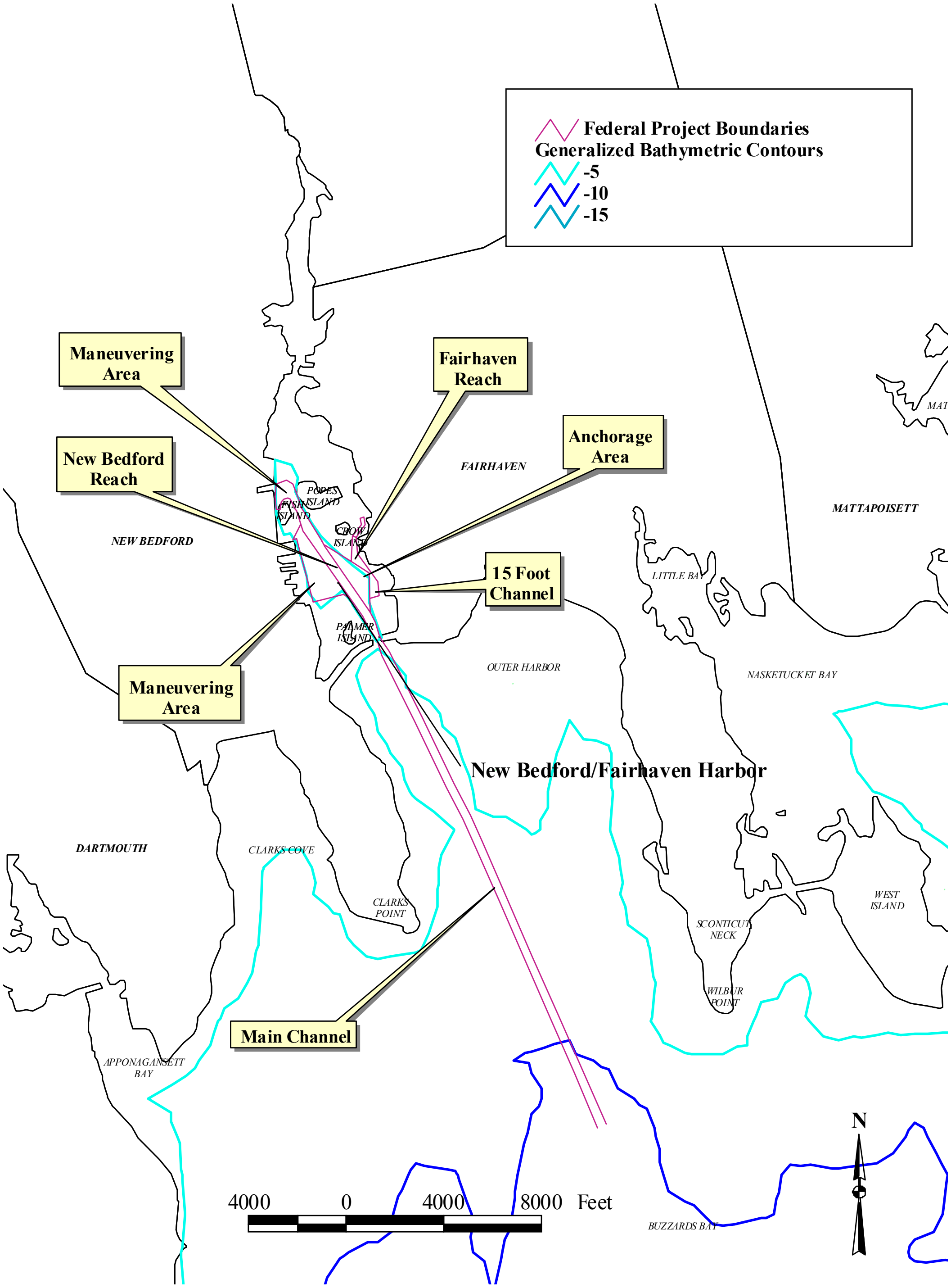

Figure 2-1 Navigation Channels and Maneuvering Areas Within New Bedford/Fairhaven Harbor

backscatter (OBS) meter will be used to determine the relationship between wave heights, water currents, and sediment resuspension.

Nevertheless, the general sediment transport and circulation conditions within the vicinity of the Proposed Preferred Aquatic Disposal sites can be assessed using the existing available information to quantitatively determine the suitability of the proposed sites. Circulation patterns within New Bedford/Fairhaven Harbor are primarily driven by meteorological events and mixed semi-diurnal tidal currents (EBASCO, 1991; Howes and Goerhinger, 1996; NBHTC, 1996). In the Upper Harbor, the mean tidal amplitude within the harbor is approximately 3.7 feet (1.1 m). Spring tide range is reported to be 4.6 feet (1.4m). In the Outer Harbor, the tidal range is reported to be from 1.41 ft (0.43m) to 5.05 ft (1.54m) with a mean of 4.65 ft (1.42 m)(ACOE, 1990). Flushing of the harbor was determined to take 2 days under winter conditions, and 8 days under summer conditions (Bellmer, 1988). Table 2-1 shows the effects during various time segments of the average tidal cycle.

Local embayment and channel restrictions produce faster currents. Examples of these locations include: within the opening in the hurricane barrier, within the vicinity of Popes Island, and within the vicinity of the Coggeshall Street Bridge. At the Coggeshall Street Bridge, the average ebb tide velocity is 0.7 knots, however currents as fast as 3.5 knots have been recorded here during ebb tide (USACE, 1990).

Meteorological forcing and storm-driven events may have a strong influence on sediment resuspension in the region. Despite the prevailing northwesterly winds blowing across Buzzards Bay during the winter, sediment resuspension is most prominent during episodic northeasterly storm events. These storms blow along the long axis of Buzzards Bay and during ebb tides can produce a reversal of bottom currents traveling northeast and upward to replace the waters driven southwest and out of the bay. In addition, the irregular bathymetry of Buzzards Bay causes eddies to form at the mouth of the bay, thereby affecting the transport or export of re-suspended sediment out of the Bay. During spring and summer, winds are typically from the southwest and west, waves are smaller and weaker, and resuspension is less likely (Howes and Goerhinger, 1996).

New Bedford/Fairhaven Harbor, however, is oriented to the south, which makes it less susceptible to the more erosive storms and waves originating from the northeast throughout the winter. Therefore, local winds and other conditions may have a more significant effect on sediment resuspension within New Bedford/Fairhaven Harbor. Generally, water enters New Bedford /Fairhaven Harbor at lower depths, while water exiting the harbor does so at upper depths. This generalized flow can be strongly influenced by local wind conditions as surface shear can be strong enough to stall upper water column movements. Tidal effects are more pronounced at the Harbor’s boundary with Buzzards Bay. Shoreward of this boundary, wind driven flows drive vertical mixing (Howes and Goerhinger, 1996).

Table 2-1: Current Velocity and Direction within New Bedford/Fairhaven Harbors during Various Segments of the Diurnal Tide

Tidal Segment	Time (hrs)	Current Velocity and Direction	Effect Distance
Flood	0	At beginning of tidal cycle 0.2 - 0.3 knot currents traveling northeasterly, enter the Outer Harbor	weak tides in Upper and Lower Harbor
	1-2	0.3 knot currents entering lower harbor	extending north into Upper Harbor
	3-4	maximum flood current velocity of 0.3 knots reached	extends north to I-195 bridge in Upper Harbor
	5-6	water level in estuary reaching maximum capacity; currents weaken.	0.3 knots still present in Outer Harbor
High Tide	6	current speeds, direction minimal	throughout
Ebb Tide	6-7	0.3-0.4 knot currents flow southeasterly in Outer Harbor	weak currents are present in the Inner Harbor
	7-11	Ebb tide begins to strengthen and reach 0.3 knots flowing south/southeasterly	as far north as I-195 bridge
Low Tide	>11	Currents diminish until next cycle	throughout

Source: NBHTC, 1996

2.1.2 Bathymetry

Water depth varies with location within the two sites. Generally, the Popes Island north site exhibits water depths of ten feet or less. The more southerly Channel Inner site exhibits water depths in the range of 25 to 35 feet as measured from mean sea level (MGI, 2001).

2.1.3 Sediment Characteristics

The draft geotechnical investigation and sediment engineering property evaluation conducted on the two DMMP CAD cell sites (MGI, 2001) revealed similar geologic stratigraphy, from mudline down to bedrock at the two proposed CAD sites. Surficial organic sediments composed of organic silt and peat of recent (Holocene Era) geological deposits comprise the uppermost layers. Cross-bedded silts, sands, sands and gravels, and generally undifferentiated glacial drift deposits of Pleistocene Age origin underlie this layer. This layer is further underlain by deposits of generally dense, bouldery, ice-contact, and glacial till also of Pleistocene Age. The ice-contact glacial till is underlain by gneissic granite (Alaskite) bedrock, which is surficially fractured, and fresh to slightly weathered. Bedrock lies at 65-80 feet below the mud line at the Popes Island CAD cell, and 20 – 30 feet below the mud line at the Channel inner CAD cell. Geologically recent marine organic deposits are typical of regionally near-shore areas protected from wave action and tidal currents. These deposits were laid down post-sea level rise after the retreat of the Pleistocene Age glaciers. Regionally, the surficial, nearshore, organic sediment deposits are typically found to be less than approximately 20-feet in thickness.

The cross-bedded Glacial Drift deposits, which make up the bulk of the sediment stratigraphy, include typically moraine and out-wash granular sediments laid-down in complex stratigraphy by glacial melt streams. In nearby Buzzards Bay, these deposits are observed in excess of 100-feet in thickness. The regionally dense, relatively thin, undifferentiated and bouldery glacial till deposits mantle bedrock and are the result of direct ice contact deposition. Bedrock within the New Bedford/Fairhaven Harbor study areas is observed to be very hard, surficially fractured, granitic rock. Examination of project boring core samples reveal numerous quartz intrusions and a slightly weathered to fresh condition (MGI, 2001). Figure 2-2 depicts the sediment characteristics and stratigraphy of the CAD Cell sites.

2.1.4 Water and Sediment Quality

Prior to a 1989 Superfund Pilot Study and Evaluation of Dredging and Dredged Material Disposal, the United States Army Corps of Engineers (1990) conducted pre-operational sampling and water quality characterization of the New Bedford/Fairhaven Harbor on nine separate days between 9 July 1987 and 23 June 1988. This sampling effort was conducted in order to determine existing ranges of physical, chemical, and biological response variables that occur in the harbor. Mean salinity, as measured from the Coggeshall Street Bridge, ranged from 24 - 30 parts per thousand ($^{\circ}/_{00}$) during the diurnal tidal cycle; results that are comparable to those obtained during the finfish sampling (NAI, 1999). The upper end of the salinity range is very close to the average salinity concentration reported for inshore waters (Gosner, 1978), while the lower range reflects the limited freshwater input of the Acushnet River to New Bedford/Fairhaven Harbor. Temperature as measured from the same location was found to range from 18.5 ^{o}C to 23.5 ^{o}C. Total Suspended Solids (TSS) was measured at two stations within the Harbor. At the first location, the Coggeshall Street Bridge, TSS ranged from 6.4 - 8.3 mg/l during ebb tide, and 6.8 - 10.2 mg/l during flood tide. At the second location, the Hurricane Barrier, TSS ranged from 4.4 - 7.9 mg/l during ebb tide, and 6.6 - 7.8 mg/l during flood tide. These values are within the range reported by Batelle Ocean Sciences (BOS) (1991) of less than 10 mg/l under normal conditions. During storm events, TSS concentrations can reach 40 mg/l. Currents were measured at 10 to 50 cm/sec (0.19 to 0.97 knots). The tidal range was found to be 5.2 feet (1.6 m) (USACE, 1990).

Insert file: Sec 2_NBSchematic Strat.pdf (Figure 2-2a)

Insert file: Sec 2_NBSchematic Strat.pdf (Figure 2-2b)

Insert file: Sec 2_NBSchematic Strat.pdf (Figure 2-2c)

During finfish sampling within the Harbor, dissolved oxygen was reported to be at saturation from January to May. It ranged from a low of 7.9 mg/l (measured at one station located northeast of Crow Island in the Lower Harbor) in October to 13.5 mg/l (measured at another station located within the middle of the Lower Harbor) in February.

Turbidity is reportedly 1 - 1.5x greater in bottom waters than in surface waters with the greatest values typically measured one hour after maximum flood velocity. Suspended sediment is generally lowest within the Harbor during winter and highest during early spring through early summer (BOS, 1991). This is attributed to freshwater inflow, since suspended sediments are typically highest during spring, due to seasonal increases in precipitation and resultant runoff. Exceptionally high turbidities can also be expected from suspended sediment in areas relatively exposed to tidal or storm induced wave energy.

In order to evaluate the quality of potential sediment to be dredged from New Bedford/Fairhaven Harbor, a preliminary determination of its suitability for open ocean disposal was conducted as part of the DMMP. The preliminary determination was based upon a comparison of sediment chemistry results from samples taken within proposed New Bedford/Fairhaven dredging projects with results from Massachusetts Bay Disposal Site (MBDS) reference sites and other sediment guidelines such as those developed by NOAA and the New England River Basins Commission (NERBC).

Based on a review of sediment chemistry data available from the harbor, it is assumed that all sediments from New Bedford/Fairhaven would be unsuitable for ocean disposal at MBDS (Table 1-1). For instance, sediments in the Lower Harbor channel and near Fish Island contain elevated concentrations of metals, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and dioxins/furans that would likely render them unsuitable for ocean disposal. Sediments in the Fairhaven channel and in the Outer Harbor channel contain considerably less contamination. However, these contaminants are still present in measurable quantities. Therefore, to be conservative, they were also assumed to be unsuitable for ocean disposal. Given the assumptions of the baseline dredging demand, it is estimated that approximately 960,000 cy of sediment to be dredged from New Bedford/Fairhaven Harbor over the next ten years would be UDM.

Additionally, the sediments contain bioaccumulative contaminants that would render them undesirable for beneficial habitat reuse. Beach nourishment is impracticable because the sediments are fine-grained, not coarse-grained (sand) that is required for beach replenishment. The silty nature of the sediments is suitable for salt marsh or mud flat creation, however the presence of highly bioaccumulative contaminants in the sediments, particularly PCBs, dioxins and furans, could cause negative biological effects if organisms are exposed to this substrate in the intertidal zone. Therefore, the use of the material in habitat creation projects was not considered further.

PCBs are the main pollutant of concern in New Bedford/Fairhaven Harbor. Sediment concentrations are among the highest encountered in any United States waterway. The focus of the Superfund project is the remediation of PCBs in the upper and lower harbor areas. In the lower harbor, sediments containing PCBs in excess of 50 ppm are slated for cleanup. All samples composited for the DMMP dredged material had PCB concentrations below the Superfund target cleanup levels, and therefore were only considered unsuitable for open ocean disposal.

2.1.5 Habitat Areas of Particular Concern

No Habitat Areas of Particular Concern (HAPC) are located within the project areas. HAPC are described by NOAA as “subsets of EFH which are rare, particularly susceptible to human-induced degradation, especially ecologically important or located in an environmentally stressed area” (NOAA, 1998).

2.2 FISHERIES RESOURCES OF THE PROJECT AREA

All of New Bedford/Fairhaven Harbor is designated as EFH. The harbor provides EFH for at least one life stage for 20 managed species listed by the NEFMC. Data collected by NMFS for EFH areas is presented in tabular summaries, which correspond to ten-minute by ten-minute squares of latitude and longitude. The tabular data summary presented for this square is presented in Table 2-2. A notation “X” within the table indicates that the EFH has been designated within the square for a given species and life stage. A notation “n/a”, if it appears in one or more life stage columns, denotes that that particular life stage does not occur for that particular species.

Distribution of the managed species is a function of three major interdependent components: physical, chemical, and biological. Variation of any or all of these components may affect the distribution of the managed species within the harbor. This EFH Assessment was prepared based on the known specific habitat requirements for each life history stage of the listed managed species for the two EFH areas which include New Bedford/Fairhaven Harbor and the tidally influenced portion of the Acushnet River, and knowledge of potential pending and future projects within the harbor that may impact these managed species.

2.2.1 Federally Managed Fish of New Bedford/Fairhaven Harbor

New Bedford/Fairhaven Harbor is home to a number of fish species and other marine life (Howes and Goerhinger, 1996; USEPA, 1996; NAI, 1999). Fish species include both commercial and recreational species, both bottom dwelling and free-swimming water column species, and both resident and migratory species. Ecologically, the harbor functions both as an ocean embayment and estuarine environment. Compared to classic estuaries, which receive large freshwater inputs, New Bedford/Fairhaven Harbor does not have a major freshwater drainage entering the harbor. The Acushnet River is the largest freshwater drainage entering the harbor. The harbor’s smaller coves and the Acushnet River, provide spawning and nursery potential for a number of the harbor’s fish.

Table 2-2: New Bedford/Fairhaven Harbor EFH Designated Species

<u>10'x 10' Square Coordinates:</u>

Boundary	*North*	*East*	*South*	*West*
Coordinate	41° 40.0' N	70° 50.0' W	41° 30.0' N	71° 00.0' W

<u>Square Description (i.e. habitat, landmarks, coastline markers):</u> Waters within Buzzards Bay within the Atlantic Ocean within the square affecting the following: south of Dartmouth, MA., New Bedford, MA., and Fairhaven, MA., from Sconticut Neck and the western part of West Island to Slocum Neck and Barneys Joy Point in Dartmouth, MA. Also affected are: Wilkes Ledge Mishaum Pt., Round Hill Pt., Smith Neck, Dumpling Rocks, Negro Ledge, Great Ledge, Phinney Rock, Pawn Rock, White Rock, Hussey Rock, Apponagansett Bay, Ricketson Pt. in South Dartmouth, MA., Apponagansett, MA., Clarks Cove, Clarks Pt., in Fairhaven, MA., Butler Flats, Mosher Ledge, Wilbur Pt. on Sconticut Neck, Bents Ledge, Middle Ledge, and West Ledge. These waters are also within western Nasketucket Bay, east of Sconticut Neck and north of West I., and within New Bedford Harbor.

Species	*Eggs*	*Larvae*	*Juveniles*	*Adults*
Atlantic cod *(Gadus morhua)*	X	X	X	X
haddock *(Melanogrammus aeglefinus)*	X	X		
pollock *(Pollachius virens)*				
whiting *(Merluccius bilinearis)*				
offshore hake *(Merluccius albidus)*				
Red hake *(Urophycis chuss)*		X	X	X
white hake *(Urophycis tenuis)*				
redfish *(Sebastes fasciatus)*	n/a			
witch flounder *(Glyptocephalus cynoglossus)*				
winter flounder *(Pleuronectes americanus)*	X	X	X	X
yellowtail flounder *(Pleuronectes ferruginea)*				
windowpane flounder *(Scopthalmus aquosus)*	X	X	X	X
American plaice *(Hippoglossoides platessoides)*			X	X
ocean pout *(Macrozoarces americanus)*				
Atlantic halibut *(Hippoglossus hippoglossus)*				
Atlantic sea scallop *(Placopecten magellanicus)*				
Atlantic sea herring *(Clupea harengus)*			X	X
monkfish *(Lophius americanus)*				
bluefish *(Pomatomus saltatrix)*			X	X
long finned squid *(Loligo pealei)*	n/a	n/a	X	X
short finned squid *(Illex illecebrosus)*	n/a	n/a		
Atlantic butterfish *(Peprilus triacanthus)*	X	X	X	X

Species	***Eggs***	***Larvae***	***Juveniles***	***Adults***
Atlantic mackerel *(Scomber scombrus)*	X	X	X	X
summer flounder *(Paralicthys dentatus)*	X	X	X	X
scup *(Stenotomus chrysops)*	X	X	X	X
black sea bass *(Centropristus striata)*	n/a	X	X	X
surf clam *(Spisula solidissima)*	n/a	n/a	X	X
ocean quahog *(Artica islandica)*	n/a	n/a		
spiny dogfish *(Squalus acanthias)*	n/a	n/a		
tilefish *(Lopholatilus chamaeleonticeps)*				
king mackerel *(Scomberomorus cavalla)*	X	X	X	X
Spanish mackerel *(Scomberomorus maculatus)*	X	X	X	X
cobia *(Rachycentron canadum)*	X	X	X	X
sandbar shark *(Charcharinus plumbeus)*				X
bluefin tuna *(Thunnus thynnus)*			X	

Source: NMFS, 2001

2.2.2 New Bedford/Fairhaven Harbor Finfish Community

A study consisting of seine and trawl samples were conducted in New Bedford/Fairhaven Harbor waters between 1998 and 1999 by Normandeau Associates Inc (NAI). For each seine and trawl sample, all fish were identified to species, counted, then measured for biomass in grams and total length to the nearest mm. Exceptionally large catches were estimated through volumetric sub-sampling, in which a minimum of twenty fish were measured. Ages of the fish were estimated based on their lengths. Catch data was analyzed by descriptive statistics, including mean, range, and percent composition, to characterize seasonal and geographic features of the fish community in New Bedford/Fairhaven Harbor.

Seine Survey

Nearshore sampling locations consisted of a 50-foot seine with a 3/16 delta mesh, positioned parallel to shore in approximately 1 m of water and then directly hauled to shore covering a rectangular area. One seine sample was collected at each of the three sampling areas (Figure 2-4). Station NS1 was located in the south end of New Bedford near the ferry dock landing, while station NS2 was located to the east of Fort Phoenix on a shallow sandy beach. Station NS3 was located on the northeast side of Crow Island in the Inner Harbor between the two Proposed Alternative CAD cell sites. The resources were calculated as a Catch Per Unit Effort (CPUE) based on the number of fish per haul.

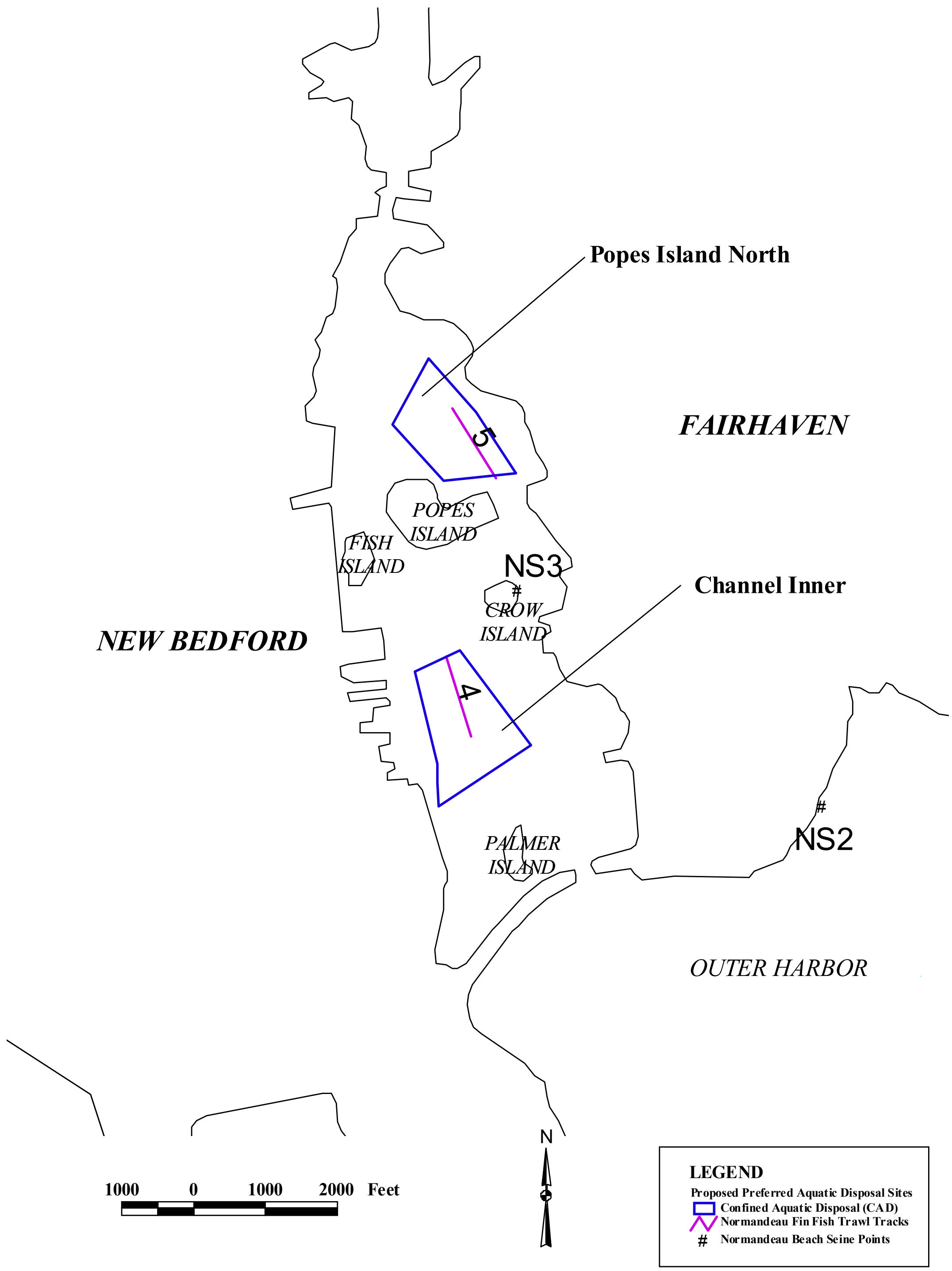

Figure 2-3. NAI (1999) Finfish Sampling Locations in the Inner Harbor

Beach seine hauls attempted to cover equal distance, but hauls were not standardized to haul length.

Seine catches in New Bedford harbor were, at times, dominated by large catches of a few species. On a few sampling dates no fish were caught (January and February), due to fish moving to deeper waters. The most numerous fish captured by the seine was Atlantic silversides (*Menidia menidia*), accounting for 44 % of the total catch at all seine-sampling locations. Striped killifish (*Fundulus majalis*) comprised 16%, mummichog (*Fundulus heteroclitus*) 9%, cunner (*Tautogolabrus adspersus*) 7%, and winter flounder (*Psuedo*pleuronectes *americanus*) 6% of the fishes captured in nearshore New Bedford Harbor (Table 2-3). Inner Harbor data is represented by Station NS3.

Table 2-3: Percent of fish caught in seine samples taken in New Bedford Harbor from June 1998 through May 1999.

Species	**Station NS1 %**	**Station NS2 %**	**Station NS3 % (Inner Harbor)**	**All Stations Combined (NS1-4) %**
Atlantic silverside (*Menidia menidia*)	45.2	33.4	54.1	43.6
Striped killifish (*Fundulus majalis*)	11.1	19.1	14.0	16.0
Cunner (*Tautogolabrus adspersus*)	--	10.2	5.8	7.5
Mummichog (*Fundulus heteroclitus*)	--	17.9	--	8.7
Atlantic menhaden (*Brevoortia tyrannus*)	11.2	--	--	--
Black sea bass (*Centropristus stiata*)	--	6.8	--	--
Winter flounder (*Psuedo*pleuronectes *americanus*)	--	--	11.7	6.3
Northern kingfish (*Menticirrhus saxatilis*)	--	--	3.2	--
Northern puffer (*Sphoeroides testudineus*)	6.3	--	--	--
Bluefish (*Pomatomus saltatrix*)	9.3	--	--	--
Other species	17	12.6	11.2	17.9
Total	100.1	100	100	100

Notes: -- = not determined for that species due to absence or extremely low abundance (If present, included in numbers tallied as part of other species category)
Some totals do not equal 100% because of rounding.

CPUE of Atlantic silversides generally rose throughout the summer to a peak in abundance in August, primarily due to an increase in the capture of Young of Year (YOY, annual fry) fish. The CPUE started to decrease in December, no fish were caught in January and February, and began to increase thereafter. Striped killifish, which ranked second in CPUE, were most abundant, appearing in seine samples from July through December. Most of the captured striped killifish comprised of YOY fish (less than 40 mm) collected in September hauls. Mummichog ranked third in overall CPUE and was most common at sampling station NS2. The CPUE for mummichog peaked in August and were most common at sampling station NS2, which is in close proximity to a salt marsh. Mummichog is a common shore-zone fish in the Atlantic coast estuaries, and flooded salt marsh and mud flats are important habitats for foraging (Haplin1997; Javonillo 1997). At sampling station NS1 a large CPUE was documented for Atlantic menhaden (*Brevoortia tyrannus*) during the August sampling occasion.

Station NS2 yielded the largest geometric mean of CPUE for all three stations followed by NS1 and the lowest yielding station, NS3. On average the other species categories accounted for approximately 18 % of the catch. This category included such fish as black sea bass (*Centropristus stiata*), northern kingfish (*Menticirrhus saxatilis*), winter flounder and northern puffer (*Sphoeroides nephelus*). Based on the captured fish length, most of the species were considered YOY fish.

Trawl Survey

Deeper water sampling was conducted with a 30-foot trawl made of 2-inch stretch mesh in the body and 1-inch stretch mesh in the cod end with a 1/4-inch liner. Each trawl was towed for approximately 400 m. When a 400 m tow length was not achieved, the length and catch was standardized by the following mathematical equation:

$$CPUE_{s,t} = (CATCH_{s,t}/TOW_t)\ 400$$

Where: $CPUE_{s,t}$ = Catch per unit effort for species S in Sample T
$CATCH_{s,t}$ = Catch of species S in sample T
TOW_t = Tow length in m of sample T

The trawl catches characterized the fish community of depths from 6.5 to 33 feet (2 to 10 meters), within New Bedford Harbor. Trawl sampling locations are identified as NT1 through NT5 as shown in Figure 2-4. Sampling location NT1 was in outer harbor South End at a depth of 23 to 26 feet (7 to 8 meters). Station NT2 was also located in the Outer Harbor but north of the lighthouse at a depth of 16.5 to 20 feet (5 to 6 meters). Sampling station NT3 was located in the Outer Harbor, but on the eastern side, at depths ranging from 23 to 26 feet (7 to 8 meters). Station NT4 was located in the Inner Harbor, to the east of the New Bedford docks, at depths between 26 and 29.5 feet (8 to 9 meters). Lastly, station NT5 was also located in the Inner Harbor, north of Popes Island at depths between 6.5 to almost 10 feet (2 to 3 meters).

Generally, the observations of the trawl catches were scup representing 23% of CPUE, cunner 21%, winter flounder 13%, black sea bass 9%, and northern pipefish 6% (Table 2-4). On a few occasions single large catches of a less abundant species affected the total annual catch statistics. Other species caught in substantial quantities were Atlantic herring (March, stations NT1 & NT4) and Atlantic silversides (December & March - station NT2, March - station NT3).

Monthly CPUE steadily increased from May, peaked in August, and then decreased to a seasonal low in February as water temperatures decreased and the fish moved to deeper water. Highest CPUE occurred in August with scup dominating the catch. Recruitment of young-of-the-year (YOY) of scup, cunner and black sea bass influenced the samples and reflected the seasonality of the deeper-water fish community.

Station NT1 ranked second among the five stations in CPUE, and the sample consisted mainly of scup (Table 2-4). Black sea bass, cunner, northern pipefish and Atlantic herring comprised the remainder of the sample. However, these species were substantially less abundant than scup. The CPUE peaked in August and again rose significantly in March due to a large catch of Atlantic herring. CPUE were low during the months of November through February and no fish were caught in November. YOY fish of Atlantic herring, scup, cunner and butterfish were present in the catches for most of the sampling events from March through October.

Table 2-4: Percent of fish caught in trawl samples taken in New Bedford Harbor from June 1998 through May 1999.

Species	**% of Catch Per Station**					
	NT1	**NT2**	**NT3**	**NT4** (Channel Inner)	**NT5** (Popes I.)	**combined (NT1-5)**
Atlantic herring (*Clupea harengus*)	8.6	--	--	12.6	--	--
Atlantic silversides (*Menidia menidia*)	--	10.3	8.7	--	8.1	--
Bay anchovy (*Anchoa mitchilli*)	--	--	--	--	6.5	--
Black sea bass (*Centropristus striata*)	11.3	7.1	13.1	--	--	9.1
Atlantic butterfish (*Peprilus triacanthus*)	8.6	--	--	--	--	--
Cunner (*Tautogolabrus adspersus*)	10.7	34.0	30.1	18.2	--	20.8
Northern pipefish (*Syngnathus fuscus*)	--	4.6	--	13.4	--	6.0

Seaboard goby (*Gobiosoma ginsburgi*)	--	--	--	--	9.5	--
Scup (*Stenotomus chysops*)	35.3	25.3	26.8	17.3	--	23.4
Windowpane flounder (*Scopthalmus aquosus*)	--	--	--	--	5.7	--
Winter flounder (*Pseudopleuronectes americanus*)	--	--	6.2	11.5	52.5	12.5
Other species	25.5	18.7	15.3	27.1	17.8	28.2
Total	100	100	100.2	100.1	100.1	100

Notes: -- = not determined for that species due to absence or extremely low abundance (If present, included in numbers tallied as part of other species category) Some totals do not equal 100.0% because of rounding.

Sampling station NT2, north of the lighthouse in the south end outer New Bedford harbor, ranked third among CPUE per station. The most common fish captured was cunner, with significant total catch yields from scup, Atlantic silversides, black sea bass, and northern pipefish. CPUE peaked in August at this sampling station due to the large numbers of scup, cunner and black sea bass. The CPUE decreased through October and few fish were caught in November. The CPUE was low through November to February, when no fish were caught. A significantly large catch of Atlantic silversides occurred in March and the CPUE steadily increased through July. Observed in the catches at this station were large amounts of *Codium spp.* and other red and green filamentous algae.

At sampling location NT3, which was located in the east side of outer New Bedford harbor, the CPUE ranked fourth among the five stations. Here again, the catches were dominated by the cunner, scup, black sea bass, Atlantic silversides and winter flounder. Cunner was captured in every sampling event except during September. Young-of-Year fishes for the scup, cunner (except September), and black sea bass were observed in catches from June through October. Atlantic silversides were caught in January and March and the catch consisted of both YOY and yearlings. Winter flounder were captured in September and March trough May, and catches comprised of both one year and older fish.

Station NT4 is located in the Inner Harbor within the boundaries of the Channel Inner CAD cell site, east of the New Bedford Docks. This station was highest in CPUE for all stations. The high ranking was in part related to the large captures of Atlantic herring in March. Cunner was captured in each sampling event occurring April through November. The highest CPUE occurred in September, at this location, decreasing to near zero catches in February and increasing in March through August. YOY fish for cunner, scup, Atlantic herring, and winter flounder were all recruited during many sampling efforts. Interestingly, the distribution of the species was fairly consistent and equal with no one species consistently dominating the catches. For the five species listed, the percentage of catch per species ranged between 11.5 % to 18.2 % and the other species category equaling 27.1%.

Sampling station NT5 was located in the Inner Harbor within the boundaries of the Popes Island CAD cell site. This station consistently yielded the lowest CPUE of all sampling stations. The catches consisted of winter flounder (52%), followed by seaboard goby, *Gobiosoma ginsburgi* (9.5 %), Atlantic silverside (8%), bay anchovy, *Anchoa mitchilli*, (6.5 %), windowpane flounder, *Scopthalmus aquosus*, (5.75%) and other species comprised the remainder.

Diadromous Fish Activity

Alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), striped bass (*Morone saxatilis*), rainbow smelt (*Osmerus mordax*), white perches (*Morone americana*) are diadromous in the Buzzards Bay area. The Acushnet River supports an annual anadromous fish run of Alewife, which spawn in Sawmill pond, generally beginning in March/April and continues into June (Howes and Goehringer, 1996). Other anadromous and diadromous species known to utilize Buzzards Bay waters are the Blueback herring, and rainbow smelts

Anadromous fish are those that migrate from the sea to breed in fresh water. Diadromous fish are fish that partake in regular, periodic (typically seasonal), and obligatory movements between fresh and marine water habitats. These movements are further classified into one of three categories: anadromy, catadromy, and amphidromy, defined below by Matthews (1998):

- Anadromy: the periodic and obligatory migration of fish from marine waters into fresh water to spawn. Examples in the New Bedford/Fairhaven Harbor icthyofaunal community would be the rainbow smelt, blueback herring, alewife and striped bass.

- Catadromy: the periodic and obligatory migration of fish from fresh water into marine waters to spawn. An example in the New Bedford/Fairhaven Harbor icthyofaunal community would be the American eel.

- Amphidromy: the periodic movement of immature or juvenile fish between fresh and marine waters. Winter flounder, which tolerate a wide range of salinity from fresh water to seawater salinities (Pereira, 1999), would be an example of an amphidromous fish species known to inhabit the New Bedford/Fairhaven Harbor icthyofaunal community.

Recent finfish sampling in New Bedford/Fairhaven Harbor has provided current data on diadromous fish activity within the New Bedford/Fairhaven Harbor/Acushnet River estuary (NAI, 1999). Alewife was found to appear in trawl samples collected from the harbor in September, but was absent in other months. Trawl sampling also revealed that significant rainbow smelt runs occur in the harbor in the early spring and then again in summer, with peak densities occurring in March and July. White perch were found to occur in New Bedford/Fairhaven Harbor waters solely in March. American shad and blueback herring were not caught in either seine or trawl samples collected from New Bedford Harbor during NAI finfish sampling efforts (NAI, 1999). The restoration of alewife and blue back herring runs in the Acushnet River Estuary has been identified as a priority by the NOAA Fisheries, Restoration Center (Turek, personal communication).

Alewife are anadromous non-residents of the Buzzards Bay waters. They return each year with regularity and are important both as a recreational and commercial resource. This finfish resource has a substantial number of early laws and regulations in the Commonwealth of Massachusetts statutes designed to protect the fishery. The alewives return to their freshwater spawning grounds beginning in late April to early May. The young typically spend their early stages in the ponds and as early as July migrate out to the estuaries to spend their first year (Cooper, 1961). The diet of the alewife mainly consists of copepods, shrimp, eggs and larvae (Howes and Goehringer, 1996). The mean catch per unit effort (catch per haul) for alewife captured during finfish trawl sampling within New Bedford/ Fairhaven Harbor was greatest in September (NAI, 1999).

Blueback herring are closely related to alewife and sometimes mistaken for alewife. Like their kin, they are also anadromous, usually entering the brackish estuarine waters by mid-May to spawn. The blueback or river herring tend to be more salinity tolerant and do not depend on the freshwater nursery habitat as much as alewives (Chittenden, 1972; Clayton et al., 1978). The diet of the blueback herring consists of copepods, pelagic shrimp, fish eggs and larvae (Howes and Goehringer, 1996). Both the alewives and the blueback herring are an important prey source for many other fish including EFH species that occur in the New Bedford/Fairhaven quadrant, such as bluefish (Bowman et al., 2000).

<u>Nursery Potential</u>

Certain intertidal and subtidal habitats are favorable for finfish nurseries in that they provide areas for cover, feeding, and development. For instance, salt marsh (intertidal) and subtidal eelgrass (*Zostera marina*) habitats provide nursery habitat for numerous fish species. Certain other benthic substrate conditions outside of salt marsh or eelgrass areas can also be good nursery habitat. Therefore, the presence of these habitats to the finfish resources of New Bedford/Fairhaven Harbor is discussed below. Using the sediment profile imagery data collected for this project, the nursery potential of the Proposed Preferred Sites is evaluated as well.

The various subtidal and intertidal habitats with nursery potential are an import part of the ecology for New Bedford/Fairhaven Harbor and other communities within Buzzards Bay. These habitats generally occur around the perimeter of the embayment although in some areas they have been dramatically altered or eliminated by development. New Bedford/Fairhaven Harbor has the smallest amount of salt marsh area due to the large-scale development and the physical structure of the harbor (Howes and Goehringer, 1996). Therefore, the remaining intertidal and subtidal benthic substrates identified as having a high nursery potential, are important resource areas to the harbor's finfish community.

Both resident and non-resident species inhabit these areas and represent an important element in the ecological web of both the harbor and Buzzards Bay. Most resident fish species spend their entire life within these habitats and, therefore, within the waters of New Bedford/Fairhaven Harbor. Non-resident adult species enter these habitats to spawn, and juveniles of other species use these habitats only as nursery grounds. Typical resident species include the Atlantic silverside, which generally live for only one year, but those that do survive migration to deeper warm waters in the winter, return to nearshore nursery areas to spawn in the spring. Three species of killifish are typical residents of the salt marsh. These fish usually winter in the lower sandier areas of the marsh. Spawning generally occurs between April and October. Mummichogs are also residents, typically these fish will live several years and winter by burrowing or clinging to the bottom of creeks and marsh pools and generally in more brackish waters in the upper reaches of the marsh system (Howes and Goehringer, 1996). Resident species may susceptible to impacts associated with UDM management since they may be exposed to UDM activities for a long duration, and throughout various stages of their life cycles. Exposure to contaminated sediment during larval and juvenile development may have health implications for the species during later life stages.

Non-resident species include bay anchovy, sheepshead minnow, striped mullet (*Mugil cephalus*), northern pipefish, butterfish, black sea bass, cunner, American eel (*Anguilla rostrata*), and sand lance (*Ammodytes americanus*). Non-resident species growth rate in the salt marsh is almost 10 times the rate of the residents. An investigation of the gut contents of residents and non-residents were consistent with the observed growth rates. The non-resident species maintained a higher feeding rate and consumed a higher percentage of animal foods than residents (Howes and Goehringer, 1996).

Although non-residents may spend less time within the estuaries, they may not necessarily be less susceptible to impacts associated with UDM management. Their higher feeding rates and higher percentage consumption of animal foods may make them more susceptible to toxic effects of sediment contaminants. As developing larvae or juveniles in a nursery, they may be highly susceptible to certain toxicants. This exposure also represents a pathway of UDM management impact to areas outside of the harbor, should these fish leave the estuarine nursery for offshore adult habitats.

Utilizing the information from the DMMP Seine and Trawl Surveys (NAI, 1999), REMOTS® survey (Valente, 1999), and other literature, the potential value for the Preferred Aquatic Disposal Sites as a nursery for finfish and large invertebrates was assessed. UDM disposal is more likely to affect sensitive larval and juvenile stages of fish and invertebrates, so the protection of areas with high nursery potential is important. Nursery potential in the area of the Preferred Alternatives was estimated during data collection for the DMMP EIR. Nursery potential was estimated using the method described by Wilbur (1999), using data on habitat complexity and presence of juvenile fish.

All New Bedford Harbor candidate aquatic disposal sites were determined to have moderate to high nursery potential for juvenile fish. Beach seine and open water trawl sampling conducted within New Bedford Harbor (NAI, 1999) revealed that many areas of the harbor are important finfish nursery areas. For instance, the Inner Harbor was found to be an important nursery area for winter flounder, while deeper water areas of the Outer Harbor were found to provide nursery for scup, cunner, and black sea bass.

Spawning

Spawning is an essential life history activity of all marine and estuarine organisms. Specific habitat conditions are required to induce spawning and support successful reproduction and development. Spawning occurs over a wide range of substrates depending on the species. These substrates include, but are not limited to, silty sand, sand, gravel, cobble, boulder, shellbeds, eelgrass, etc. Spawning periods and conditions for the most common fish and invertebrates are widely known and many local surveys have identified important habitat associations that appear to be essential to induce spawning and for the reproduction and development of fishes and invertebrates after spawning.

Based on habitat associations and regional distribution of spawning activity, several demersal finfish species may locate suitable environmental conditions for spawning within Massachusetts' ports, estuaries and/or open water (Wilbur, 2000). Some of the more abundant fish known to spawn within New Bedford/Fairhaven harbor include Atlantic silversides, striped killifish, cunner, mummichog, northern pipefish, ocean pout, winter flounder, Atlantic butterfish, and Atlantic mackerel. Abundant shellfish known to spawn in the harbor include Atlantic rock crab (*Cancer irroratus*), Green crab (*Carcinus maenus*), blue mussel (*Mytilus edulis*), softshell clam (*Mya arenaria*), Northern quahog (*Mercenaria mercenaria*), and Green sea urchin (*Stronglyocentrotus droebachiensis*). Blueback herring, alewife, and rainbow smelt spawn in upstream waters in the Acushnet River and pass through the harbor en route to spawning grounds from offshore wintering areas. Winter flounder, and Atlantic butterfish can also spawn in offshore waters. Table 2-5 lists the dominant fish and invertebrate species and their known spawning seasons in New Bedford/Fairhaven Harbor and adjacent waters.

Within the season, spawning can be spatially variable in Massachusetts' coastal waters due to presence or absence of specific habitat requirements that are required for spawning (e.g., temperature, salinity, depth, substrate, etc,). Spawning potential can be better predicted in a given location based on presence or absence of these special spawning habitat requirements. Table 2-6 lists the special habitat requirements for spawning of managed fish species known to occur within New Bedford/Fairhaven Harbor.

Table 2-5: Spawning Seasons for Common Nearshore Invertebrates and Fish Species of Buzzards Bay, including New Bedford/Fairhaven Harbor

Common Name	Spawning Season
Invertebrates	
American lobster (*Homarus americanus*)	April - May[1]
Atlantic rock crab (*Cancer irroratus*)	July - October[1]
Green crab (*Carcinus maenus*)	June - October[1]
Blue mussel (*Mytilus edulis*)	April - October[1]
Softshell clam (*Mya arenaria*)	March - July[1]
Northern quahog (*Mercenaria mercenaria*)	June - August[1]
Green sea urchin (*Stronglyocentrotus droebachiensis*)	February - April[1]
Finfish	
Winter flounder (*Pseudopleuronectes americanus*)	February - June[1]
Butterfish (*Peprilus triacanthus*)	spring and summer[2]
Rainbow smelt (*Osmerus mordax*)	March - May[1]
Striped bass (*Morone saxatilis*)	June - July[1]
Alewife (*Alosa pseudoharengus*)	April - May[1]
Blueback herring (*Alosa aestivalis*)	April - July[1]

Source: [1] Howes and Goerhinger, 1996
[2] NMFS/NERO, www.nero.nmfs.gov/ro/doc/efhtables.pdf

Table 2-6: Spawning Requirements for some Common Managed Inshore Fish and Invertebrate Species known to Spawn in New Bedford/Fairhaven Harbor.

Species Name	Temp. (^{O}C)	Salinity (□)	Depth (m)	Substrate
Winter flounder (*Pleuronectes americanus*)	<10	10 - 32	0.3 - 4.5 (inshore)	sand, muddy sand, mud, gravel
Atlantic butterfish (*Peprilus triacanthus*)	11 - 17	25 - 33	0 - 1829	pelagic waters
Atlantic mackerel (*Scomber scombrus*)	5 - 23	18 - >30 (peak >30)	0 - 15	pelagic waters
Scup (*Stenotomus chyrsops*)	13 - 23	13 - 23	<30	pelagic waters in estuaries
Black sea bass (*Centropristis striata*)	n/a	n/a	0 - 200	upper water column

Source: NMFS/NERO, www.nero.nmfs.gov/ro/doc/efhtables.pdf

3.0 ESSENTIAL FISH HABITAT DESCRIPTIONS

Information on habitat requirements for the listed EFH species of the 10-minute x 10 minute EFH Quadrant is discussed in this section. This information was synthesized from various publications from NOAA, NMFS and the NEFMC. The information provided herein presents the special habitat requirements only for the specific life cycles stages of the EFH species listed for the EFH quadrant. It should be noted that it is possible during dispersal, disturbance events, or as a result of other stimuli in the environment, for these listed EFH species to be found in habitats that deviate from those listed here. Therefore, the reader should note that potential seasonal and spatial variability of the conditions associated with these species is possible and should be expected.

3.1 ATLANTIC COD (*Gadus morhua*)

Atlantic cod is an economically important member of the family Gadidae. This fish ranges in North America from southern Greenland and southeast Baffin Island, south to Cape Hatteras, and North Carolina (winter) (Robins and Ray, 1986). In southern New England, Atlantic cod are common only in winter and spring in shallow waters under 12 m (40') deep, but are common year round in deeper water (Weiss, 1995). The New Bedford/Fairhaven Harbor Quadrant provides EFH for Atlantic cod eggs, larvae, juveniles and adults.

Eggs
Viable eggs are reportedly found in harbor waters with a salinity range of greater than 32 to 33°/$_{00}$ and temperatures below 63°F (12°C). Eggs are observed beginning in the fall, with peak densities occurring in the following winter and spring (NEFMC, 1998; Fahay et al., 1999a).

Larvae
Cod larvae are typically pelagic. They can be found in near-shore waters at depths between 98 and 230 feet (30 and 70 meters) when sea surface temperatures are below 50ºF (10ºC) and salinity ranges from 32 to 33°/$_{00}$. Larvae are most often observed in the spring (NEFMC, 1998; Fahay et al., 1999a).

Juveniles
Atlantic cod juveniles are found in bottom habitats dominated by cobble or gravel substrates. Juveniles require water temperatures below 68°F (20°C), prefer water depths from 82 to 246 feet (25 to 75 meters) and salinity of 30 to 35°/$_{00}$ (NEFMC, 1998; Fahay et al., 1999a).

Adults
Atlantic cod adults are typically found in bottom habitats dominated by cobble, gravel or rock substrates but also occupy sand or shell areas (NEFMC, 1998). Adults prefer water temperatures below 10ºC (50ºF), depths from 10 to 150 m (33 to 492 ft) and tolerate a wide range of salinities. Most cod are observed spawning during the fall, winter and early spring (NEFMC, 1998; Fahay et al., 1999a).

3.2 HADDOCK (*Melanogrammus aeglefinus*)

In North America, haddock (family Gadidae) range from northern Newfoundland south to Cape Hatteras, NC (Robins and Ray, 1986). Haddock is an important species to the New Bedford Harbor commercial fishery industry. The New Bedford/Fairhaven Harbor Quadrant is designated EFH for eggs and larvae haddock.

Eggs
Eggs of this species are found in the greatest abundance in surface waters where temperatures are below 50°F (10^{o}C), at water depths between 164 and 295 feet (50 and 90 meters) and in salinity ranging from 34 to 36°/$_{00}$ (NEFMC, 1998). Eggs occur between March to May with the greatest densities occurring in April (Cargnelli, et al., 1999a).

Larvae
Larvae are found in surface waters where temperatures are below 57ºF (14^{o}C), water depths are between 98 and 295 feet (30 and 90 meters) and salinity ranges from 34 to 36°/$_{00}$ (NEFMC, 1998; Cargnelli et al., 1999a).

3.3 RED HAKE (*Urophycis chuss*)

Red hake, a commercially harvested species of the family Gadidae, ranges in North America from southern Labrador to North Carolina (Robins and Ray, 1986). The New Bedford/Fairhaven Harbor Quadrant is designated EFH for larvae, juveniles, and adults of this species.

Larvae
Larvae are found in pelagic waters. They prefer sea surface temperatures below 19^{o}C (66ºF), water depths less than 200 m (656 ft), and a salinity of greater than 0.5°/$_{00}$. They appear from May through December with peak densities recorded for the months of September and October (Steimle et al., 1999a).

Juveniles
Juvenile red hake seek out bottom habitat with shell fragment or live sea scallop bed substrates. Juveniles prefer water temperatures below 16^{o}C (61ºF), water depths less than 100 m (328 ft), and a salinity range from 31 to 33°/$_{00}$. Juveniles tend to avoid shallow waters warmer than 22^{o}C (71^{o}F). Juveniles remain pelagic until they reach a size of 25-30 millimeters (mm) total length (TL), after which they seek out sheltered areas. Juveniles are present along coastal regions from spring to fall (NEFMC, 1998; Steimle et al., 1999a).

Adults
Adult red hake seek out bottom habitats, especially depressions with a substrate of sand and mud in areas where water temperatures are below 12^{o}C (54ºF). They prefer depths of 10 to 130 m (33 to 427 ft) and salinities between 33 and 34°/$_{00}$. Adults spawn in the depressions of sand and mud when water temperatures are less than 10^{o}C (50ºF), at depths of less than 100 m (328 ft) and in areas where salinity falls to less than 25°/$_{00}$.

Spawning typically occurs during the months from May to November, with peak spawning activity occurring in June and July (NEFMC, 1998; Steimle et al., 1999a).

3.4 WINTER FLOUNDER (*Pleuronectes americanus*)

Winter flounder is a right-eye flounder (family Pleuronectidae) that ranges in North America from Labrador, south to Georgia (Robins and Ray, 1986). The New Bedford/Fairhaven Harbor Quadrant is designated EFH for winter flounder eggs, larvae, juveniles, and adults.

Eggs
Winter flounder eggs are found in bottom habitats with sand, mud, and gravel where water temperatures are less than 10°C (50°F), salinities range between 10 and 30°/$_{00}$, and water depths are less than 5 m (16 ft). Spawning areas occur where hydrodynamics function to keep the hatched larvae from being dispersed. Winter flounder seem to time their hatching to the advent of favorable environmental conditions (Pereira, et. al., 1999).

Larvae
Larvae inhabit open water and benthic habitats in areas where sea surface water temperatures are less than 15°C (59°F) and salinities range from 4 to 30°/$_{00}$. Within inshore waters such as the New Bedford Harbor, they are typically found in waters less than 6 m (17 ft) deep. Larvae are often observed from March to July with peaks in April and May (NEFMC, 1998; Pereira, et. al., 1999).

Juveniles
Juvenile winter flounder are found in bottom habitats with a substrate of mud or fine-grained sand. They are generally found in waters from 0.1 to 10 m (0.3 to 33 ft) deep, water temperatures below 28°C (82°F), and salinities between 5 and 33°/$_{00}$. Young of the year (YOY) flounder (i.e., those less than one year old) spend much of their first year in very shallow inshore waters (NMFS, 1999; Pereira, et. al., 1999).

Adults
Adults are also found in bottom habitats with sand, gravel, and mud substrates. The habitat is usually less than 6 m (17 ft) deep, with temperatures below 15°C (59°F), and salinities between 5.5 and 36°/$_{00}$ (NEFMC, 1998).

3.5 WINDOWPANE FLOUNDER (*Scopthalmus aquosus*)

Windowpane flounder is a left-eye flounder (family Bothidae) ranging in North America from the Gulf of Saint Lawrence, south to northern Florida (Robins and Ray, 1986). This species is very common throughout southern New England (Weiss, 1995). The New Bedford/Fairhaven Harbor Quadrant is designated EFH for eggs, larvae, juveniles and adults of this species.

Eggs

Eggs of the windowpane flounder are found in surface waters with temperatures less than 20°C (68°F), and at water depths less than 70 m (230 ft). Eggs appear from February to November with peak densities occurring in July and August (NEFMC, 1998; Chang et al., 1999).

Larvae

Larvae inhabit pelagic waters where sea surface temperatures are less than 20°C (68°F) and water depths are less than 70 m (230 ft). Larvae appear from February to November, with peak densities occurring in July and into August (NEFMC, 1998; Chang et al., 1999).

Juveniles

Juveniles inhabit benthic areas with mud or fine-grained sand substrates; water temperatures are below 25°C (77°F), and depths ranging from 1 to 100 m (3 to 328 ft). They tolerate a wide range of salinity, between 5.5 and 36°/$_{00}$ (NEFMC, 1998; Chang et al., 1999).

Adults

Adults inhabit benthic areas with mud or fine-grained sand substrates where water temperatures are below 27°C (80°F), and depths range from 1 to 75 m (3 to 246 ft). Adults also tolerate a wide range of salinity, between 5.5 and 36°/$_{00}$. Spawning conditions are met when water temperatures are below 21°C (70°F), water depths are between 1 and 75 m (3 and 246 ft) and salinity is between 5.5 and 36°/$_{00}$. Spawning normally occurs from February to December (NEFMC, 1998; Chang et al., 1999).

3.6 AMERICAN PLAICE (*Hippoglossoides platessoides*)

American plaice is a right-eye flounder (family Pleuronectidae) that ranges in North America from southern Labrador and Greenland, south to Rhode Island (Robins and Ray, 1986). American plaice is common in the Gulf of Maine waters over 40 m (125') deep and colder than 13°C (55°F), however they rarely stray into shallow estuarine waters (Weiss, 1995). The New Bedford/Fairhaven Harbor Quadrant is a designated EFH for American plaice juveniles and adults.

Juveniles

American plaice juveniles are found in bottom sediments ranging from fine–grained to sand or gravel substrates. Juveniles require water temperatures below 63°F (17°C). They prefer water depths between 148 and 492 feet (45 and 150 meters) but tolerate a wide range of salinities (NEFMC, 1998; Johnson et al., 1999).

Adults

American plaice adults are also found in bottom sediments ranging from fine–grained to sand or gravel substrates. Adults prefer water temperatures below 63°F (17°C) and water depths between 148 and 574 feet (45 and 175 meters). They tolerate a wide range of salinities. Beginning in March, adults move shoreward to spawn in water depths of less than 295 feet (90 meters). Spawning continues through June (NEFMC, 1998; Johnson et al., 1999).

3.7 ATLANTIC SEA HERRING (*Clupea harengus*)

Atlantic sea herring is an economically important member of the family Clupeidae. This fish ranges in North America from Greenland and northern Labrador, south to North Carolina (Robins and Ray, 1986). The New Bedford/Fairhaven Harbor Quadrant is designated EFH for juveniles and adult Atlantic sea herring.

Juveniles
Atlantic sea herring juveniles frequent open waters and bottom habitats with temperatures below 10°C (50ºF). They prefer water depths from 15 and 135 m (49 to 443 ft) and a salinity range of 26 to 32°/$_{00}$ (NEFMC, 1998; Reid et al., 1999).

Adults
Atlantic sea herring adults are found in open waters and bottom habitats. They generally prefer water temperatures below 10°C (50°F), inhabit water depths from 20 to 130 m (66 to 427 ft), and prefer salinities above 28°/$_{00}$. Atlantic herring adults use bottom habitats with gravel, sand, cobble or shell fragment substrate for spawning. Patches of aquatic macrophytes are also used. Spawning typically occurs in water depths between 20 and 80 m (66 and 263 ft) and in salinities ranging from 32 to 33°/$_{00}$. Spawning occurs from July through November in areas of well-mixed water with tidal currents between 1.5 and 3.0 knots (NEFMC, 1998). Adults are present in smaller numbers in the spring and fall, and are typically not observed during the summer (Reid, et al., 1999).

3.8 BLUEFISH (*Pomatomus saltatrix*)

Bluefish (family Pomatomidae) is an important commercial and sport fish ranging from Nova Scotia, Canada, south to Argentina (Robins and Ray, 1986). In southern New England, young "snapper" bluefish are very common near-shore and in estuaries, while the larger bluefish are common offshore (Weiss, 1995). The New Bedford/Fairhaven Harbor Quadrant is designated as EFH for bluefish juveniles and adults.

Juveniles
All major estuaries from Penobscot Bay, Maine south to St. Johns River in Florida is considered EFH for bluefish juveniles. Juvenile bluefish prefer estuaries or shallow water with temperatures between 15 and 30°C (59 and 86°F). Typical salinities of waters frequented by this species range from 23 to 33°/$_{00}$. Preferred substrates include sand, mud, silt, and clay (Fahay et al., 1999b).

Adults
Adult bluefish are most common in near-shore open waters with temperatures ranging from 15 to 25°C (59 to 77°F), and with seawater salinities. Adults are highly migratory, appearing in New Bedford/Fairhaven Harbor from May through October, after which

they migrate southward, returning to warmer waters. They reportedly prefer salinities greater than 25°/₀₀ (Fahay et al., 1999b). Most fish collected in the New Bedford Harbor area are juveniles with some adults. The peak abundance for adults is summer through fall (NAI, 1999).

3.9 LONG-FINNED SQUID (*Loligo pealei*)

In North America, long-finned squid (family Loliginidae) ranges from southern Maine to the Caribbean, with greatest abundance from Cape Ann south to Cape Cod. This species is of great economic importance as a bait source and for consumption overseas in Italian fish markets (Gosner, 1978). New Bedford/Fairhaven Harbor Quadrant is designated EFH for the juvenile and adult life stages of this species.

Juveniles

Juveniles (pre-recruits) are found in greatest abundance in open water ranging in depth from shore to 700 feet (213 meters) deep, and in temperatures from 39 to 81°F (4 to 27ºC) (Cargnelli et al., 1999b; NMFS, 2001).

Adults

Adults (recruits) are found in greatest abundance in open water ranging in depth from shore to 1,000 feet (305 meters) deep, and prefer the same temperature range as juveniles (Cargnelli et al., 1999b).

3.10 ATLANTIC BUTTERFISH (*Peprilus triacanthus*)

This species is a commercially important member of the family Stromateidae, a family comprised largely of coastal and oceanic warm-water fish (Robins and Ray, 1986). These fish migrate shoreward in the spring. By summer, they can be found in loose schools inhabiting waters from sheltered bays, seaward to the edge of the mid-Atlantic shelf to depths of 200 m (656 ft). They then return to deeper and more southerly waters in the fall, as water temperatures again decrease (Cross, et al., 1999). New Bedford/Fairhaven Harbor Quadrant provides EFH for eggs, larvae, juveniles, and adults of this species.

Eggs

Inshore, butterfish eggs are collected from mixing, seawater, or both salinity areas of estuaries. Egg densities are greatest in water temperatures between 52 and 63 °F. Eggs may be collected from shore to a depth of 1,829 m (6000 ft) (Cross, et al., 1999; NMFS/NERO, 2001).

Larvae

Larvae inhabit the upper layer of open waters, usually associated with floating cover such as cnidarians or *Sargassum* weed. They become more abundant at night near the water surface than during the day, suggesting a diel vertical migration behavior pattern (Kendall and Naplin, 1981). Larvae are reported from waters within their range at temperatures between 4.4 and 27.9°C (40 and 82°F), but prefer temperatures of between 9 and 19°C (48 and 66°F). They are found in mixing zone and seawater salinities (Cross, et al., 1999; NMFS/NERO, 2001). Larvae are most frequently observed in July and August, with abundance sharply declining by the end of September.

Juveniles
Juvenile butterfish inhabit open waters from the surface to depth on the continental shelf. Juveniles typically occupy a vertical range in the water column of 10 to 330 m (33 to 1,082 ft). These fish are commonly observed in coastal bays and estuaries, and other inshore areas. Frequent sightings in the surf zone have also been documented. Juvenile butterfish can tolerate a wide range of salinity (3.0 to 37.4°/$_{00}$), hence their sightings in estuaries, bays and in offshore waters. In previous sampling studies, the greatest numbers of fish collected were at sampling depths of 120 m (393 ft). The schools can be found over sandy to muddy substrates and prefer a temperature range from 4.4 to 29.7ºC (40 to 85ºF). However, their survival rate is reduced when the temperature falls below 10ºC (50ºF). Juveniles are generally present from spring through fall (Cross, et al., 1999).

Adults
Inshore, butterfish eggs are collected from mixing, seawater, or both salinity areas of estuaries. Egg densities are greatest in water temperatures between 11 to 17 ºC (52 and 63 ^{o}F). Generally adult butterfish inhabit water columns between 10 to 366m (33 to 1200 ft) and are typically found in water with temperatures from 37 –82 ºF (Cross, et al., 1999; NMFS/NERO, 2001).

3.11 ATLANTIC MACKEREL (*Scomber scombrus*)

Atlantic mackerel (family Scombridae) range in North America from southern Labrador to Cape Hatteras (Robins and Ray, 1986) and is very common in southern New England waters (Weiss, 1995). The New Bedford/Fairhaven Harbor Quadrant is designated EFH for eggs, larvae, juveniles, and adults of Atlantic mackerel.

Eggs
Eggs of the Atlantic mackerel are found in both near-shore and offshore waters. In near-shore waters they are typically found in mixing water salinity (between 0.5 and 25°/$_{00}$) to seawater salinity (greater than 25°/$_{00}$) and at depths between zero and 50 feet (zero and 15 meters). Eggs require temperatures between 41 and 73^{o}F (5 and 23ºC) (Studholme, et al., 1999).

Larvae
Larvae of the Atlantic mackerel are found in both near-shore and offshore waters. In near-shore waters such as New Bedford Harbor they are typically found within mixing water salinity (between 0.5 and 25°/$_{00}$) to seawater salinity (greater than 25°/$_{00}$) range, at depths of 33 to 425 feet (10 to 130 meters), and at temperatures between 43 and 72^{o}F (6 and 22ºC) (Studholme, et al., 1999; NMFS, 2001).

Juveniles
Atlantic mackerel juveniles are found in both near-shore and offshore waters. In near-shore waters, such as New Bedford Harbor, they are typically found in mixing water to seawater salinities, at depths ranging from zero to 320 m (zero to 1,050 ft) and

temperatures between 4ºC and 22ºC (39 and 72°F) (Studholme, et al., 1999; NMFS, 2001). Juveniles tend to peak in density from May through August, with numbers declining sharply thereafter.

Adults
Adults are found in both near-shore and offshore waters. In near-shore waters, such as New Bedford Harbor, they are typically found in mixing water and seawater salinities, at depths ranging from zero to 381 m (zero to 1,250 ft) and at temperatures between 4ºC and 16ºC (39 and 61°F) (Studholme, et al., 1999; NMFS, 2001). Adult mackerel are present during the late winter to early spring, after which they migrate to deeper open water. A brief return of adults may occur in late fall.

3.12 SUMMER FLOUNDER (*Paralicthys dentatus*)

Summer Flounder is a left-eye flounder (family Bothidae) that ranges in North America from Maine and (rarely) Nova Scotia, south to northern Florida (Robins and Ray, 1986). This species is common in southern New England from mid-spring through mid-fall (Weiss, 1995). The New Bedford/Fairhaven Harbor Quadrant is designated EFH for eggs, larvae, juveniles, and adults of this species.

Eggs
Summer flounder eggs occur from October to May. Depth of occurrence is dependent on season. In the fall eggs are typically found from 30-70 m (98 – 230 feet). In the winter, eggs are typically found in greatest abundance at 110m (361 feet) (Packer, et al., 1999).

Larvae
Larvae are typically found to be most abundant 19 to 83 km (11.8 to 51.6 mi) from shore in water column depths from 10 to 70 m (33 to 230 ft). The larvae proceed to migrate inshore, seeking coastal and estuarine nursery areas to start and complete metamorphosis. Temperature appears to have a significant bearing on the duration of metamorphosis. Mortality occurs when the water temperature reaches 2 to 4ºC (35 to 39ºF). The transforming larvae are sensitive to the types of predators present and modify their burying behavior accordingly (Packer, et al., 1999). Peak existence of summer flounder larvae occurs from October through January (Packer, et al., 1999; NMFS/NERO, 2001).

Juveniles
The preferred habitat substrate of juveniles is sand. Estuarine marsh creeks, tidal flats and channels with depths of 0.5 to 1.5 m (1.6 to 4.9 ft) are preferred habitat areas for summer flounder. Increased temperature directly relates to a short metamorphic period. Juveniles experience a higher mortality when temperatures fall below 4ºC (39ºF) (Packer, et al., 1999).

Adults
Adults prefer bottom habitats of both inshore (warmer months) and offshore (colder months) waters to depths of 152 m (500 ft). They tolerate both the mixing water and seawater salinities (Packer, et al., 1999). Stands of submerged aquatic vegetation, sea grasses, and macroalgae are recognized as HAPC for this species by NMFS (2001).

3.13 SCUP (*Stenotomus chrysops*)

This species is a member of the family Sparidae. It is found from Nova Scotia, south to Florida (Robins and Ray, 1986). In southern New England, scup is very common in bays and sounds (Weiss, 1995). The New Bedford/Fairhaven Harbor Quadrant is designated EFH for eggs, larvae, juveniles and adults of this species.

Eggs

EFH for Scup eggs is described as estuaries where scup eggs were identified as common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. Scup eggs typically appear from May through August in southern New England. They reach there greatest density in estuarine waters with temperatures between 55 and 73 ^{o}F and in salinities > 15 $°/_{00}$ (Steimle et al., 1999b; NMFS/NERO).

Larvae

EFH for Scup larvae is described as estuaries where scup were identified as common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. Scup larvae reach their greatest densities from May through September, in inshore waters with temperatures between 55 and 73 ^{o}F and salinities > 15 $°/_{00}$ (Steimle et al., 1999b; NMFS/NERO).

Juveniles

Juvenile scup are found in estuaries and bays with sand, mud, mussel, and eelgrass bed substrates. They generally require water above 16ºC (61°F) and salinities greater than 15$°/_{00}$ (Steimle et al., 1999b).

Adults

Adult scup are also found in estuaries with mixing to seawater salinity ranges and temperatures above 16ºC (61°F). They prefer depths of 2-38 m (6.6 – 125 ft) and are generally found in areas with fine to silty sand, mud, mussel beds, rock, artificial reefs, wrecks, and other structures (Steimle et al., 1999b).

3.14 BLACK SEA BASS (*Centropristis striata*)

Black sea bass (family Serranidae) range in North America from Maine to northeastern Florida, and the eastern Gulf of Mexico (Robins and Ray, 1986). New Bedford/Fairhaven Harbor Quadrant is designated EFH for black sea bass larvae, juveniles and adults.

Larvae

Black sea bass frequent coastal areas and marine parts of estuaries at depths less than 100 m (328 feet) within a salinity range of 30 to 35$°/_{00}$, and in water with temperatures between 11 and 26ºC (52 – 79 °F). After transformation into juveniles, black sea bass become demersal and seek out structured substrate (Steimle et al., 1999c; NMFS, 2001).

Juveniles
Winter juveniles and YOY fish migrate from the Middle Atlantic Bight to the Gulf of Maine and then into estuaries upon further development. Juvenile habitat ranges from estuarine to coastal waters, and from the water surface to a depth of 38 m (125 ft). Juvenile sea bass may be found around the edges of salt marshes and channels. Substrate most likely inhabited by the black sea bass consists of rough bottom in and amongst shellfish, sponge, eelgrass beds, near-shore shell patches, or man-made objects (Steimle, et al., 1999c).

Adults
Adults are typically found within inshore waters of mixing water to seawater salinities. The adults prefer rock jetties and rocky bottom substrate areas, but may also be found in sand and shell fragment substrates. These fish enter near-shore waters in greatest abundance from May through October. They require a minimum water temperature of 6ºC (43^{o}F) (Steimle, et al., 1999c).

3.15 SURF CLAM (*Spisula solidissima*)

The surf clam, family Mactridae, is a major commercial commodity; accounting for a majority of the clam crop in this country (Gosner, et al., 1978). In southern New England, these clams are harvested for chowder and other food products (Weiss, 1995). Surf Clams are usually found from Nova Scotia south to South Carolina. In southern New England, surf clams are common offshore in sand (Weiss, 1995). New Bedford/Fairhaven Harbor Quadrant provides EFH for surf clam juveniles and adults.

Juveniles
Juvenile surf clams are found in well-sorted, medium and fine-grained sands and in waters with temperatures less than 77°F (25ºC). They are typically found in water with a salinity of 28°/$_{00}$ or higher (Steimle et al., 1999c).

Adults
Adults are found in medium sized sands and prefer temperatures between 59 and 86°F (15 and 30ºC). Adults can survive in salinities as low as 12.5°/$_{00}$ but are more commonly found in salinities above 28°/$_{00}$ (Steimle et al., 1999c; NMFS/NERO, 2001).

3.16 KING MACKEREL (*Scomberomorus cavalla*)

King mackerel (family Scombridae) range in North America from Massachusetts and the northern Gulf of Mexico south to southern Brazil. It is an important food and game fish typically caught by trolling over deep water (Robins and Ray, 1986). New Bedford/Fairhaven Harbor Quadrant is designated EFH for king mackerel eggs, larvae, juveniles, and adults. EFH for all life stages of this federally managed species is defined as “sandy shoals of capes and offshore bars, high profile rocky bottom and barrier island ocean-side waters, from the surf to the shelf break zone, but from the Gulf Stream shoreward”. *Sargassum* also provides EFH for this species, as do all coastal inlets and all state-designated nursery habitats known to support coastal migratory species. King mackerel are typically found in waters with salinities >30°/00, and temperatures >20°C (68°F) (NMFS/NERO, 2001).

3.17 SPANISH MACKEREL (*Scomberomorus maculatus*)

Spanish mackerel (family Scombridae) range in North America from Cape Cod, south to southern Florida and the Gulf of Mexico. However, it is reportedly rare north of the Chesapeake Bay (Robins and Ray, 1986). Like other Scombrids, it is a popular food and game fish. It typically enters shallow bays and can be caught by bridge fisherman (Robins and Ray, 1986). The New Bedford/Fairhaven Harbor Quadrant is designated EFH for Spanish mackerel eggs, larvae, juveniles, and adults. EFH for all life stages of this federally managed species is the same as that defined for king mackerel. Spanish mackerel are typically found in water with salinities greater than 30°/00, and temperatures greater than 20°C (68°F), preferably between 21 and 31°C (70 and 88°F), and rarely below 18°C (64°F). Spanish mackerel spawn off the coast between late spring and late summer (NMFS/NERO, 2001).

3.18 COBIA (*Rachycentron canadum*)

Most closely related to remoras and jacks, cobia are the only extant member of the family Rachycentridae. They range from Massachusetts south to Argentina and are valued as food and game fish (Robins and Ray, 1986). The New Bedford/Fairhaven Harbor Quadrant is designated EFH for all life stages of cobia eggs, larvae, juveniles, and adults. Areas designated as essential fish habitat for cobia are the same as for king and Spanish mackerel. Additionally, the Gulf Stream is designated EFH for cobia since it is essential to the dispersal of coastal migratory pelagic larvae of this species. Cobia are typically found in waters with salinities greater than 30°/00, and temperatures greater than 20°C (68°F) (NMFS/NERO, 2001).

3.19 SANDBAR SHARK (*Charcharhinus plumbeus*)

A member of the requiem sharks (family Carcharhinidae), the sandbar shark inhabits the western Atlantic from Massachusetts to southern Brazil (Robins and Ray, 1986). In southern New England, sandbar sharks are not common in estuarine waters (Weiss, 1995). The New Bedford/Fairhaven Harbor Quadrant is designated EFH for sandbar shark adults.

Adults

Adult Sandbar sharks inhabit shallow, muddy, coastal waters to the 50 m (165 ft) isobath from Nantucket, Massachusetts, south to Miami Florida. They also inhabit waters surrounding peninsular Florida, west to the Florida panhandle at water temperatures up to 30ºC (85°F), and saline portions of Florida Bay (NMFS/NERO, 2001). This species is known to migrate south in winter to wintering grounds from North Carolina, south to Florida and the Caribbean Sea.

3.20 BLUEFIN TUNA (*Thunnus thynnus*)

A member of the family Scombridae, and renown as a food and game fish, bluefin tuna range from southern Labrador, Canada south to northern Brazil (Robins and Ray, 1986). The New Bedford/Fairhaven Harbor Quadrant is designated EFH for bluefin juvenile stages.

Juveniles
EFH for bluefin juveniles is essentially all coastal pelagic surface waters that exceed temperatures of 12°C (52ºF) and lie between the 25 and 200 m (82 and 656 ft) isobaths from Cape Ann, MA, south to Cape Hatteras, NC (NMFS/NERO, 2001).

4.0 ANALYSIS OF DREDGING IMPACTS TO FISH AND EFH

Dredging and dredged material disposal, if not conducted properly with adequate planning and proper engineering controls, may adversely affect fish and fish habitat. Potential dredging areas identified in the DMMP include shipping berths, turning basins, and entrance channels as well as the federal navigational channels within the New Bedford/Fairhaven Harbor.

Potential adverse effects to fish and fish habitat related to typical dredging projects include the following: destruction of benthic habitat, the impairment of water quality and the direct (e.g., toxicological) and indirect (e.g., habitat alteration) effects on the fish and their prey species. Table 4-1 lists the impacts or effects of human-induced alterations on food source, water quality, habitat structure, flow regime and biotic interactions. The extent of the effect depends on hydrologic processes, sediment texture and composition, chemical content of the sediment and pore water matrices, and the behavior or life stage of the receptor species.

4.1 IMPAIRMENT OF WATER QUALITY

Water quality impacts from dredging and dredge disposal include physical, chemical and biological impacts. Changes in water quality have concurrent impacts to the system which effect fish and EFH in various ways (Table 4-1). The impacts to the water quality that are to be expected during dredging and dredged material disposal will be temporary and diminish with the cessation of dredging and disposal. Changes to the water turbidity, pH, and dissolved oxygen (DO) are expected both during the actual dredging activity within the Harbor, and during disposal activity within the CAD cells. However using proper controls, these impacts will be minimized and the anticipated changes to the water quality of the marine system will return to pre-project conditions once the project is completed. No appreciable or permanent changes to the salinity regime, tidal cycle, or current patterns are anticipated.

4.1.1 Physical Impairment

Physical impairment of the water column due to dredging and dredge disposal occurs from changes in dissolved oxygen, salinity, pH, oxidation-reduction state, and turbidity with a resultant decrease in light penetration. The degree of change or alteration of the water columns physical component depends on various physical and chemical parameters (e.g., pH, oxidation-reduction potential, sediment size, organic matter content, concentration of reactive iron and manganese, etc.).

The water column proximal to the dredging operation will experience temporary physical impairment due to increased turbidity during dredging. Likewise, the water column proximal to the disposal area will also be impacted by increased turbidity during disposal. The temporary water quality impacts that can be expected include the release of dissolved hydrogen sulfides into the water column, as well as an increase in Total Suspended Solids (TSS) loads. A concurrent decrease in DO would be anticipated in response to the

Table 4-1 Impact of Human-Induced Alterations to Various Ecological Attributes

Ecological Attribute	Impact of Human-Induced Alterations
1. Food (energy) source -type, amount, and particle size of organic material entering a tidal stream or tributary from the riparian zone vs. primary production in the stream -seasonal pattern of available energy -primary production of the basin	-decreased coarse particulate organic matter to estuary -increased fine particulate organic matter to estuary -increased algal production in basin -shifts in feeding guilds
2. Water Quality -temperature -turbidity -dissolved oxygen -nutrients (primarily nitrogen and phosphorus) -organic and inorganic chemicals -heavy metals and other toxic substances -pH -salinity	-expanded temperature extremes -increased turbidity -altered diurnal cycle of dissolved oxygen -increased nutrients (especially soluble nitrogen and phosphorus) -increased suspended solids -increased toxics -altered salinity
3. Habitat Structure -substrate type -water depth and current tidal velocity -spawning, nursery, and hiding places -diversity/complexity (pools, riffles, woody debris in tidal streams; SAV, shell beds, sand wave ripples, structures, reefs, wrecks, etc. in basin -basin size and shape	-decreased stability of substrate, banks and shoreline due to erosion and sedimentation -more uniform water depth -reduced habitat heterogeneity -decreased channel sinuosity of tidal or tributary streams -reduced habitat areas due to shortened channel, removed structures or debris -decreased instream cover and riparian vegetation
4. Flow Regime -water volume -temporal distribution of floods, low flows, tides	-altered flow extremes (both magnitude and frequency of high and low flows) -increased maximum flow velocity -decreased minimum flow velocity -reduced diversity of microhabitat velocities -fewer protected sites
5. Biotic Interactions -competition -predation -disease -parasitism -mutualism -introduction of non-native organisms	-increased frequency of diseased fish -altered primary and secondary production -altered trophic structure -altered decomposition rates and timing -disruption of seasonal rhythms -shifts in species composition and relative abundance -shifts in invertebrate functional groups (e.g. filler feeders vs. suspension feeders) -shifts in trophic guilds (e.g. increased omnivores and decreased piscivores) -increased frequency of fish hybridization -increased frequency of exotic species

Source: Adapted to marine systems from Karr (1991) and other sources.

increased TSS. The magnitude of TSS released or generated during dredging can be minimized using best management practices such as the deployment of appropriate dredging equipment and techniques. The areal extent of impact will be minimized by avoiding dredging during days of adverse weather and resultant increased wave and current velocities. The temporary impacts to the water column associated with turbidity will cease following completion of the maintenance dredging.

4.1.2 Chemical Impairment

Chemical impairment of the water column produced by dredging and dredge disposal is caused by release of various chemical contaminants that may occur within the sediment. Such contaminants typically include heavy metals, organochlorine compounds, polyaromatic hydrocarbons, total petroleum hydrocarbon, pesticides, and other anthropogenic compounds or materials. These compounds are introduced into the harbor sediment via a variety of sources including but not limited to surface runoff (non-point sources), municipal wastewater treatment effluent, industrial discharge, accidental and incidental oil and chemical spills, illegal discharges, etc. Depending on basin characteristics, and composition of the receiving matrix (i.e., sediment) concentrations of the chemicals can be greatest at the point of discharge or away (e.g., downcurrent) from the discharge.

The following contaminants occur in the material to be dredged from the harbor at varying detectable concentrations: polyaromatic hydrocarbons (PAH_S), polychlorinated biphenyls (PCBs), heavy metals, and dioxins/furans. Many of these compounds are ubiquitous in sediments of multi-use estuaries. At elevated concentrations, exposure of fish to these chemicals in the water column or sediment matrices can cause various acute and chronic toxicological effects (Suter and Rosen, 1988). The various contaminant classes and some of their known toxicological effects on fish are presented in Appendix A.

The concentrations of the chemicals detected in the sediment of the project area, are not considered hazardous, and therefore their handling and disposal as hazardous waste in accordance with 40 CFR 260-268 is neither necessary nor required by law.

4.1.3 Biological Impairment

Microorganisms such as bacteria, viruses, and plankton cause biological impairment of water quality. Biological impairment can occur when introduction of dredge materials into the water column kills submerged aquatic vegetation and macroalgae (either through direct smothering or via impaired light penetration) leading to higher rates of bacterial decomposition and a resultant increase in bacterial oxygen demand. Disposal of materials contaminated by wastewater treatment effluent, failing sewer pipes, or failing individual subsurface sanitary disposal systems may introduce disease-causing organisms (i.e. bacteria and viruses) into the water column and into the biota proximal to the disposal site. Pathogens, alone (i.e., without accompanying sediment), are typically rapidly assimilated or neutralized by the estuarine system. Aside from potential serious human health impacts, they typically pose little impact to the biota of the system (Wilson, 1988).

Pathogens may exist within the water column of the New Bedford/Fairhaven Harbor, which is closed to harvest for direct sale of shellfish without depuration. Disposal of UDM at the CAD sites is unlikely to cause irreversible impact to marine resources due to pathogenic impairment since the area is not used for shellfishing.

4.2 DESTRUCTION OF BENTHIC HABITAT

Dredging and dredge disposal may result in the destruction of benthic habitat either by direct removal of the benthic substrate by the dredging operation itself, or via disposal of dredged material onto the benthic habitat at the disposal site. Either operation may result in the change in substrate composition, rendering the formerly suitable benthic substrate unsuitable for certain benthic organisms or disrupting existing ecological processes or interactions between resident benthic and water column communities.

Changes to the bathymetry of both the dredged areas (due to the removal of sediment) and the disposal site (due to excavation of the sediment from the CAD cells) will occur. The existing bathymetry of the dredged federal navigation channels would return to their authorized federal navigation depths (Section 2.0). The elevation at the disposal site would be capped at an elevation less than the surrounding sediment elevation. This would allow natural sedimentation rates to fill the recessed CAD cap (USACE/EPA, 1997). Resultant impact to the EFH species that inhabit these areas will vary based on the mobility, life history, and behavior of the species. For instance, sessile and slow moving invertebrate species and taxa would be removed via dredging during construction of the CAD sites, and early recolonizing benthic invertebrates would be covered over during UDM disposal at the CAD sites. Highly mobile species and taxa such as adult pelagic fish would likely avoid the disturbance areas.

Sediment texture would undergo a series of changes. Native sediments would be removed, exposing deeper till layers. The disposal of UDM would result in placement of unconsolidated material back into the CAD cell and final capping would change the surficial sediment layers to sand. The recessed cap would begin to accumulate organic material settling out of the water column. The sand cap would slowly, over time, accumulate a layer of smaller fraction sediment such as silts, clays and organic matter.

4.2.1 Direct Removal of Benthic Substrate

Direct removal of suitable benthic substrate via dredging typically impacts EFH by removing prey species (e.g., benthic organisms) or food species (e.g., macroalgae), removal of suitable cover or settlement structure (e.g., shell beds, SAV) or by destruction of spawning areas. Re-colonization of the newly exposed substrate after dredging is a factor not only of site-specific basin characteristics (e.g., wave or tidal energy, bathymetry, etc.) but also of substrate requirements of the larvae of recolonizing species (Rhoads and Germano, 1982). Dredge or disposal areas that continue to be disturbed after UDM management activities have ceased (e.g. such as areas within dredged channels and shipping maneuvering areas) may not return to pre-disturbance conditions or may not progress beyond the initial re-colonization seral stage community (Kaplan, et al, 1975).

Removal of benthic sediment through dredging homogenizes the bottom substrate, reduces structural complexity and may release hydrogen sulfide; all factors that tend to discourage recruitment of benthic invertebrates, which in turn, are the food of many demersal fish. This impact is of even greater significance in areas where organisms with special microhabitat requirements that have now been removed via dredging, formerly dominated the benthos. Even small structures or inconsistencies in the sea floor are exploited by various species of benthic invertebrates or demersal fish species. Examples of these smaller structures include sand ripples; thalassinid crustacean mounds; sea cucumber fecal deposits; pits left by feeding elasmobranchs and crabs; submerged aquatic vegetation blades; urchin spines, kelp holdfasts and stipes; sponge, sea pen and bryozoan colonies; annelid worm, amphipod crustacean, vermetid gastropod, and cerianthid anemone tubes (Norse and Watling, 1999). Regardless of the sizes of the structure, structural complexity provides smaller species with living space, increased food abundance, and refuge from predation. Certain species of demersal fish prefer one substrate over another for fishing or spawning. For instance, red hake are known to exploit the downcurrent side of sand wave crests catching prey items by surprise as they are carried by bottom currents over the sand wave (Norse and Watling, 1999). Black sea bass occupy areas around the base of boulders and rock reefs. As a general rule, both prey and fish species diversity increases with habitat complexity, therefore, the more structurally complex the marine habitat the greater the organism diversity. This is illustrated in the diverse communities that form among the structurally complex coral reef (Kaplan, 1982) and rocky intertidal zone (Hughes, 1986) communities.

4.2.2 Disposal of Material Onto Benthic Substrate

Disposal of the material directly onto the substrate may impact EFH by burying food sources, changing microhabitat requirements, destruction of spawning areas, and changing basin hydrology and bathymetry. In addition, the disposal of the material into the water column above the benthic substrate could impact the physical, chemical, and biological suitability of the water column within the EFH (Section 4.1). Re-colonization of dredged material disposal areas typically follow successive and progressive steps ecologically similar to the re-vegetation and re-colonization successional phases of clear-cut or burned terrestrial systems. Opportunistic organisms with high reproductive rates typically characterize the initial communities that form on dredged materials. Slower growing specialists with lower reproductive rates and narrower niche requirements eventually replace these organisms. Eventually over time, the community on the re-colonized surface will begin to succeed toward pre-disturbance levels of diversity (Rhoads and Germano, 1982; 1986).

4.3 DIRECT AND INDIRECT EFFECTS ON ORGANISMS

Dredging and dredged material disposal can cause adverse direct impact (e.g., via toxicity) and indirect impact (e.g., disruption of ecosystem attributes) to marine organisms.

4.3.1 Direct Effects

Direct effects caused by disposal of the dredge materials include behavioral impairment (e.g., inhibition of migration patterns), destruction of eggs or spawning areas, physical impairment (e.g., turbidity-induced clogged gills resulting in suffocation, or abrasion of sensitive epithelial tissue), or physiological impairment due to acute or chronic toxicity to contaminants within the dredge sediments (Appendix A).

Some physical impairment of resident fish species within the bay would be expected. Pelagic fish are more likely to avoid the turbidity plumes and leave that portion of the bay in which the sediment plumes lies. Anadromous fish may either be temporarily impacted by the sediment plume as they pass through it to freshwater spawning areas, or they may avoid returning to their spawning areas altogether, potentially effecting their reproductive success for the season. Dredging during winter months may directly impact hibernating marine organisms that may have buried into the soft sediment of the bay.

4.3.2 Indirect Effects

Ecological impacts of dredging, if implemented without the proper controls and planning, can affect various ecological attributes of the system, including energy flow, habitat structure, and biotic interactions.

Energy Flow
Food sources enter the system based on organic material input and via primary productivity by phytoplankton, algae, emergent or submerged aquatic vegetation. Phytoplankton productivity is a major source of primary food-energy for temperate zone estuaries (Day et al., 1989). These organisms have metabolic pathways that convert light energy into biological energy with the resultant fixation of carbon dioxide and the production of oxygen and carbohydrates. Phytoplankton production typically exhibits spring and fall maxima, with the highest rates typically occurring during annual water temperature maxima. These seasonal patterns are usually a result of various environmental factors including salinity, turbidity, nutrients, turbulence, and depth.

Energy from phytoplankton production is transported to primary consumers such as zooplankton and benthic marine invertebrates. These primary consumers, in turn, provide prey for secondary consumers and higher trophic level organisms. Disruption in seasonal patterns of salinity, turbidity, nutrients, turbulence, and depth can impact phytoplankton productivity and therefore the flow of energy from primary producers to higher trophic level consumers. Many organisms have evolved migration patterns and spawning activity to coincide or correspond with increased inputs of energy into the system. Disruption in these energy flow patterns could, therefore, disrupt these aspects of the organism's life cycle.

Habitat Structure

Habitat structural attributes vary with water depth, current and tidal velocity, basin size and shape, and the diversity or complexity of substrate types. Examples of the diverse sediment types typically found in marine and estuarine environments include, but are not limited to, the presence or absence of depressions, sediment wave ripples, woody debris, submerged aquatic vegetation, shell beds, structures, reefs, and wrecks. Potential dredging and dredge material disposal activities can alter these structural attributes resulting in dramatic change or homogenization of habitat structure by decreasing the stability of the substrate, creating a more uniform water depth, reducing habitat heterogeneity, reducing habitat area, and decreasing availability of cover.

Biotic Interactions

Indirect effects on fish and EFH are produced by dredging and dredge disposal through disruption of the symbiotic associations and ecological principles that govern the fish community (i.e. predator - prey relationships or other symbiotic relationships). Predator - prey relationships can be locally disrupted by direct impact to the prey organism's population. Prey species are impacted by direct coverage of the organism during dredge disposal, impact to egg settlement rate (either through removal of suitable substrate or via release of hydrogen sulfide), destruction of prey species habitat, or otherwise impacting predator or prey species fecundity, survivorship, recruitment, or colonization rates. The degree or complexity of symbiotic interactions among many fish species is not completely understood; therefore impacts to one species may have unknown or currently unobserved impacts to others.

Additionally, animals that have been stressed by the various negative impacts associated with dredging and dredge disposal can succumb to parasitism, disease, predation, intense competition or other stresses. The loss of one species in an obligatory mutualistic relationship will result in the demise of the other. Finally, the interbasin transfer of sediment may aid in the spread of non-native species. These exotic species may add additional predation or competition pressure on the native organisms, and may also introduce exotic diseases from which the native organisms may have little natural resistance.

The abundance and local distribution of prey species for EFH designated fish, may directly and indirectly be impacted during dredging and dredged material disposal. Many of the EFH designated fish species prey on benthic marine organisms living in or on the sediment. Direct impact to these prey species will occur during the dredging and disposal process activities via removal at the dredge site and burying at the disposal site, respectively. Indirect impact will occur using the same temporary changes in the water quality as discussed in Section 4.1, such as impact from TSS concentrations (which could result in local depletion of DO), and the release of hydrogen sulfide (which may discourage settlement of many sessile, benthic invertebrate prey species). A loss of prey (e.g., lower trophic level) species may degrade the habitat value of EFH for higher trophic level fish by depleting the food sources of those fish. The prey of each of the EFH species and their various life stages are presented in Table 4-2.

However, the anticipated impact to the prey species is considered temporary, as the benthic community will eventually return to pre-impact conditions over time. The return to pre-impact conditions will not occur immediately, but rather in phases as various invertebrates re-colonize disturbance areas in successive stages over a temporal scale (Rhoads and Germano, 1982, 1986; Zajac and Whitlach, 1982). Therefore, the anticipated impact to the prey species that occur within the area of the CAD cells is considered temporary, as the benthic community will succeed toward pre-impact conditions over time, following cessation of UDM management activities. However a return to pre-disturbance conditions will not occur immediately, but rather in phases, as various invertebrates re-colonize disturbance areas at different rates (Kaplan et al., 1975; Rhodes and Germano, 1982, 1986; Gallagher and Keay, 1998).

Table 4-2 Essential Fish Habitat Species and their Respective Prey

Species	Life Stage	Likely Prey Species in Project Area	Source
Atlantic cod (*Gadus morhua*)	Larvae	Copepods	Fahay et al., 1999a
	Juvenile	Small zooplankton, capelin, crustaceans, polychaetes	
	Adult	Herring, haddock, redfish, plaice, codling, shrimp	
haddock *(Melanogrammus aeglefinuss)*	Larvae	Invertebrate eggs, copepods, phytoplankton	Cargnelli, et al., 1999a
red hake (*Urophycis chuss*)	Larvae	Copepods, microcrustaceans	Steimle et al., 1999a
	Juvenile	Mostly crustaceans such as Crangon, but also amphipods and polychaetes	
	Adult	Fish and Crustaceans	
winter flounder (*Pleuronectes americanus*)	Larvae	Nauplii, invertebrate eggs, protozoans, polychaetes	Pereira et al., 1999
	Juvenile	Sand dollar, bivalve siphons, polychaetes, amphipods,	
	Adult	Amphipods, polychaetes, bivalves or siphons, capelin eggs, crustaceans	
windowpane flounder (*Scophthalmus aquosus*)	Larvae	Copepods and other zooplankton	Chang et al., 1999
	Juvenile	Polychaetes and small crustaceans such as mysids	
	Adult	Polychaetes, mysids, decapods, shrimp, hake, and tomcod	
American plaice (*Hippoglossoides platessoides*)	Juvenile	Small crustaceans, polychaetes, cumaceans	Johnson et al., 1999
	Adults	Echinoderms, sand dollars, sea urchins, brittle stars	
Atlantic sea herring (*Clupea harengus*)	Juveniles	Selective opportunistic feeders, mostly copepods	Reid et al., 1999
	Adult	Euphausiid, chaetognaths, and copepods	

Species	Life Stage	Likely Prey Species in Project Area	Source
bluefish (*Pomatomus saltatrix*)	Juvenile	Crustaceans, fish, and polychaetes	Fahay et al., 1999b
	Adult	Sight feed on other fish such as silversides, spot, weakfish. Also eat shrimp, crabs, and worms	
long-finned squid *(Loligo pealei)*	Juvenile	Plankton, copepods, cuphausiids, arrow worms, crabs, polychaetes, shrimp	Cargnelli et al., 1999b
	Adult	Clupeids, myctophids, squid larvae/juveniles, silver hake, mackerel, herring, menhaden, sand lance, bay anchovy, menhaden, weakfish, silversides	
Atlantic butterfish (*Peprillus triacanthus*)	Larvae	Undetermined	Cross et al., 1999
	Juvenile	Copepods, squid, amphipods, decapods, coelenterates, polychaetes, small fish, ctenophores	
	Adult	Copepods, squid, amphipods, decapods, coelenterates, polychaetes, small fish, ctenophores	
Atlantic mackerel (*Scomber scombrus*)	Larvae	Copepods, fish larvae: yellowtail flounder, silver hake, redfish	Studholme et al., 1999
	Juvenile	Small crustaceans, such as copepods, euphausiids, amphipods, mysid, shrimp, and decapod larvae	
	Adult	Similar to juvenile but with selection of larger fish such as, euphausiid, pandalid, and crangonid shrimp	
summer flounder (*Paralicthys dentatus*)	Larvae	Polychaete tentacles, harpactacoid copepods, and clams siphons	Packer et al., 1999
	Juvenile	Crustaceans, polychaetes, and invertebrate parts	
	Adult	Invertebrates, shrimp, weakfish, mysids, anchovies, squid, Atlantic silversides, herring, and hermit crabs	
scup (*Stenotomus chrysops*)	Larvae	Zooplankton	Steimle et al., 1999b
	Juvenile	Small benthic invertebrates, fish eggs and larvae	
	Adult	Benthic and near bottom invertebrates and small fish	
black sea bass (*Centropristus striata*)	Larvae	Zooplankton	Steimle et al., 1999c
	Juvenile	Small epibenthic invertebrates such as crustaceans	
	Adult	Benthic, near-bottom invertebrates, and small fish	
surf clam *(Spisula solidissima)*	Juvenile	Planktotrophic	Cargnelli et al., 1999c
	Adult	Planktivorous siphon feeders, ciliates, diatoms	

Species	**Life Stage**	**Likely Prey Species in Project Area**	**Source**
king mackerel (*Scomberomorus cavalla*)	Larvae	Larval fish, especially carangids, clupeids, and engraulids; also some crustaceans	GSMFC, 2001
	Juvenile	Small fish such as anchovies, shad, sardines	
	Adult	Jacks and herrings; also squid and shrimp	
Spanish mackerel (*Scomberomorus maculatus*)	Larvae	Larval fish, especially carangids, clupeids, and engraulids; also some crustaceans	GSMFC, 2001
	Juvenile	Small fish, shrimp and squid	
	Adult	Jacks and herrings; also squid and shrimp	
cobia (*Rachycentron canadum*)	Larvae	Wild zooplankton, dominated by copepods	GSMFC, 2001
	Juvenile	Carnivorous fish, shrimp, and squid	
	Adult	Crustaceans and fishes, primarily crabs	
sandbar shark (*Charcharinus plumbeus*)	Adult	Finfish, rays, benthic fauna, seabirds, sea turtles	CBP, 2001
bluefin tuna (*Thunnus thynnus*)	Juvenile	Schooling fish, including gar, herring, mackerel, snappers, and blues, as well as squid.	

5.0 INDIRECT AND CUMULATIVE IMPACTS

Much of the land area surrounding New Bedford Harbor is developed with multiple land uses which support a variety of uses including industrial, commercial, institutional, residential, and open space. The various land uses within the watershed might ultimately contribute to human-induced alterations to the various ecological attributes of the marine system. The impact of these human induced alterations are comparable to those presented in Table 4-1 (Section 4.0 – Analysis of Dredging Impacts to Fish and EFH). A discussion of the various fishing and non-fishing activities and their effects on marine EFH and EFH designated species is provided below.

5.1 Fishing Activities and their Potential Effects on Marine EFH

The Act requires the NEFMC to minimize adverse effects on the EFH from fishing, to the extent practicable. Fishing activities may have an adverse impact to New Bedford Harbor EFH if the activities cause physical, chemical, or biological alterations to the EFH, cause the loss or injury to the prey species or their habitat, or alter predator-prey cycles or other biotic interactions. Impacts to EFH via fishing can occur on both a commercial and recreational level. Commercial impacts include over-harvesting, disruption of biotic interactions (e.g. predator-prey relationships), and gear impacts to benthic habitat. Recreation impacts involve disruption of benthic habitat via digging during over-exploitation of bait species (Wilson, 1988).

5.1.1 Over-harvesting

Of the 20 species for which the project area and the disposal area are designated as EFH, the NEFMC has identified nine non-pelagic species whose populations are either overexploited (i.e. formerly or currently harvested at unsustainable yields) or are currently approaching an over-exploited status (Table 4-1). In some management areas, emergency amendments to existing commercial and recreational harvest regulations may be enacted on an annual basis to protect further impact to extant populations from over-harvesting. The status of yet other species or stocks of other species may be currently undetermined. Additional data, when it becomes available, may reveal still other species that may be currently overexploited.

Over-harvesting of offshore areas may impact EFH of New Bedford/Fairhaven Harbor by removal of EFH designated species and their prey (refer to Section 4.1.2), or via the destruction of complex benthic habitats which would normally support these species, a portion of which might normally disperse into New Bedford/Fairhaven Harbor from off-shore areas. A review of mid-Atlantic fisheries records from 1890 to 1990 by McHugh (1993) revealed that 33 major fisheries species in the mid-Atlantic region, reached a peak in commercial landings, followed by declines to very low levels, with groups of species peaking in successive decades. However, total landings in commercial fish (minus menhaden) remained relatively stable as fisherman shifted from one species or group of species to the next following as a response to these successive declines. McHugh (1993) included overfishing as one of the reasons for the successive declines exhibited by the various groups of mid-Atlantic fisheries. The proposed action would have no impact to total landings of harvested fish since the proposed action would occur in areas closed to commercial fishing and would not interfere with fishing schedules or the deployment of the various fishing gear within the bay.

Table 5-1 Status of Select Fisheries Involving non-pelagic EFH Species

Species	NMFS Fishery Status
Atlantic cod *(Gadus morhua)*	Overfished
Haddock (*Melanogrammus aeglefinus*)	Status in question
Red hake *(Urophycis chuss)*	Overfished
Winter flounder *(Pleuronectes americanus)*	Overfished
Windowpane flounder *(Scopthalmus aquosus)*	Overfished
American Plaice (*Hippoglossoides platessoides*)	Overfished
Atlantic sea herring *(Clupea harengus)*	Not overfished
Bluefish *(Pomatomus saltatrix)*	Undetermined; commonly exhibits population fluctuations
Long-finned squid *(Loligo pealei)*	Almost fully exploited
Atlantic butterfish *(Peprillus triacanthus)*	Neither currently overfished nor approaching an overfished condition
Atlantic mackerel *(Scomber scombrus)*	Not overfished
Summer flounder *(Paralicthys dentatus)*	Overfished
Scup *(Stenotomus chrysops)*	Overfished
Black sea bass *(Centropristus striata)*	Overfished in Mid-Atlantic Bight stocks, no information for New England Stocks
Surf Clam (*Spisula solidissima*)	Neither currently overfished nor approaching an overfished condition

Source: NMFS, EFH Source Documents (Note: table excludes pelagic species)

5.1.2 Harvest or Impact to Prey Species

Over-harvesting of lower trophic level (prey) species may degrade the habitat value of EFH for higher trophic level (predatory) fish by depleting the food sources of the predatory fish. Pauly et al. (1998) identified a worldwide trend in increasing harvest of lower trophic level fish. They caution that continued harvest of lower trophic level fish species may lead to a collapse in the food webs that support higher trophic level fish, including many that are EFH species. The prey of various life stages of EFH species designated for the project and disposal areas was presented in Table 4-2 (Section 4.0). Some direct impact to prey species is anticipated through substrate removal and resultant turbidity as discussed in Section 4.0.

5.1.3 Gear Effects

The potential adverse effects that gear may cause on fish and EFH depend on the specifics of the fishery and the type of gear employed. For example, there are many different types or configurations of trawl gear including those that are deployed along the bottom or near the bottom, those that are used for mid-water and still others that use varying configurations of the net. Nets alone may vary in mesh size. Furthermore, the use of the gear may be restricted in certain areas such as shipping lanes, turning basins, mooring areas and so forth. Seasonal restrictions may also apply to certain gear used. The two most important impact categories caused by fishing include direct injury to fish and injury to fish habitat.

5.1.3.1 Injury to Fish

Gill nets can damage fish either via compressing their gills leading to suffocation or via gill injury while struggling in the net (WADFW, 1997). For instance, recent experiments with salmonids in Washington State, demonstrated that one out of five Coho and one out of ten Chinook salmon caught in tangle nets would be injured to the point where they could not reasonably be expected to survive if released.

Certain fish species individuals and their populations may be negatively impacted via commercial by-catch. As defined in the Act, (Sec. 104-297), the term "bycatch" means:

> *"...fish which are harvested in a fishery, but which are not sold or kept for personal use, and includes economic discards and regulatory discards. Such term does not include fish released alive under a recreational catch and release fishery management program."*

"Economic discards" refers to:

> *"Fish which are the target of a fishery, but which are not retained because they are of an undesirable size, sex, or quality, or for other economic reasons" (Sec. 104-297).*

The term "regulatory discards" means:

> *"Fish harvested in a fishery which fisherman are required by regulation to discard whenever caught, or are required by regulation to retain but not sell" (Sec 104-297).*

By-catch can result in the injury or removal of non-targeted fish species during commercial harvest operations of the targeted fish species. For instance, the use of gill nets near the bottom while fishing for flatfish may result in the capture of other demersal fish such as cod. Typically, injury to the by-catch occurs as external trauma via handling of the gear, or via internal trauma due to changes in pressure as gear is hauled up quickly from the bottom using mechanical means. Efforts are underway in the northeast to improve commercial fishing gear to improve selectivity of target fish and reduce by-catch while maintaining utility of the gear (MADMF, 2001). The anticipated temporary increase in turbidity generated by the proposed action could have an additive negative effect on the health of recovering fish previously injured by fishing gear.

5.1.3.2 Injury to Fish Habitat

The degree of impact caused by mobile fishing gear on the marine substrate is dependent upon the benthic composition. However, substrate types can be negatively impacted by gear that drags along the bottom substrate. Generally speaking, the more complex the bottom habitat, the more negative impact to the benthic habitat that could potentially be incurred. Boulder and rock reef areas can be raked by bottom trawls that could potentially overturn boulders, thereby killing the sessile invertebrates that have colonized the rock surfaces. These sessile creatures include sponges, cnidarians, bryozoans, echinoderms, etc., which are prey species for a number of EFH fish (Table 4-2 – Section 4.3)).

On smaller textured substrates such as cobbles, pebbles, sands, and mud, impacts incurred by use of bottom dragging trawls typically result in a loss of substrate complexity via a homogenization of substrate types (Eckelbarger, 2001). The homogenization of bottom substrates impacts EFH because it results in the reduction of the habitats suitability to larval recruits of the exploited fish species or it discourages settlement of sessile invertebrate prey species. Recent studies have shown that any benthic structure has value in increasing survival time and total number of young cod when young are subjected to predation (Lindholm, et al., 1999).

Trawls through soft bottom sediments such as mud can destroy invertebrate burrows, killing the inhabitants. This results in reducing bioturbation rates and thus sediment aeration producing areas that may have shallow to no aerobic surface layers. Disturbance of sediments with shallow to no aerobic surface layers can result in the release of hydrogen sulfide to the water column, which may discourage settlement of benthic, invertebrate larvae. The negative impact that gear may have on a fishery are greater if the gear disturbs or destroys special habitat areas known to take many years to form such as kelp beds, Submerged Aquatic Vegetation (SAV) beds (Stephan, 2000), or coral reefs (Kaplan, 1982). Many researchers attribute fishing with mobile fishing gear as the leading factor in disturbance to the seabed resulting in the reduction in complexity of benthic habitats and a concurrent decrease in the diversity of the benthos (McHugh 1993; Auster and Langton, 1999; Norse and Watling, 1999).

Commercial fishing for various groundfish and mollusks employing a number of gear techniques (such as trawling, purse seining, gill netting, pound netting, hook and line, traps, and hydraulic dredge) occur within waters of the adjacent Buzzards Bay and surrounding environs. No commercial fishing is allowed in New Bedford/Fairhaven Inner Harbor and no commercial fishing is allowed within the New Bedford/Fairhaven Outer Harbor navigation channels. However, areas of the Outer New Bedford/Fairhaven Harbor and adjacent Buzzards Bay support various demersal and pelagic commercial and recreational finfish and shellfish fisheries.

Direct impact to fish habitat is anticipated through substrate removal at the CAD sites, as discussed in Section 4.0. This temporary impact could have an additive effect to current fisheries related impacts associated with New Bedford/Fairhaven Harbor

5.2 Non-Fishing Activities and their Potential Effects on Marine EFH

Non-fishing activities that may impact EFH include those projects, actions or procedures that may:

- Alter sediment inputs to the estuary;
- Alter water flows, quantities, cycling, physical or chemical characteristics;
- Impact soil through compaction, or other changes in permeability;
- Alter riparian, or estuarine vegetation;
- Reduce or alter the stability of coastal landforms;
- Alter estuarine wetlands and wetlands along tributary waters;
- Alter predator species richness and abundance;
- Alter the amount or types of nutrients or prey;
- Alter estuarine or marine habitat (including water quality, vegetation, structure, or conveyances);
- Introduce or transfer exotic organisms and disease;
- Disturb nursery or spawning areas;
- Create a barrier or hazard to fish migration; and;
- Discharge pollutants, nutrients, or contaminants.

Any on-shore activity that disturbs or alters the watershed around the harbor (e.g. land clearing, urbanization, stream relocation, etc) has the potential to impact EFH directly (e.g. via pollutant or sediment inputs) or indirectly by altering watershed processes that affect tributary streams, salt marsh wetlands, shorelines and estuaries. This is typically the case as these alterations tend to be of such magnitude, scale, or duration as to surpass those produced by natural disturbances, or they exceed limits of the natural recovery processes in which the ichthyofauna have adapted. The potential impacts to the major components of the marine environment caused by human induced alterations in the landscape were presented in Table 4-1 (Section 4.0).

5.2.1 Wetland/Estuarine Alteration

Wetlands associated with the marine and estuarine environment are valuable habitat types relative to fish and EFH. These habitats are the transition areas between the upland and the open water communities. They provide a food rich environment for productive foraging (Levington, 1982), they are used as physiological transition zones between fresh and salt water environments (Schmidt-Nielsen, 1983), they offer refuge to juveniles and prey species from predators, and it is here where the transfer of energy from the upland to open water environments occurs (Day et al., 1989).

Changes to the systems may occur through tideland conversion, exogenous material (i.e. material originating outside the system) input, runoff and sedimentation induced turbidity, physical disruption (e.g., noise, turbulence, obstructions), shading by structures and vessels, SAV control, water diversion, and the introduction of non-native species. Alteration of the watershed can result in changes to the pollutant quantities and concentrations, organic matter concentrations, or physical parameters of the water column (i.e., temperature, dissolved oxygen, salinity, pH, light penetration). The alteration of these parameters may negatively impact the wetland/estuarine communities.

Alteration of the wetland and estuarine systems can cause a reduction or loss of juvenile or prey species rearing habitats, exposure of fish to pollutants, exposure of fish species to mammalian and avian predators, and alteration in the timing of life history stages or events. Vegetated wetlands associated with the estuarine and marine environment include intertidal mudflats, submerged aquatic vegetation beds, and emergent (intertidal) salt marsh. These communities typically are productive interfaces between the upland and open water environments. Estuarine aquatic bed lies proximal to the project area. Examples of the other communities can be found to the east of the project area on the eastern shore side of New Bedford/Fairhaven Harbor, and upstream (north) of the project area (Figure 5-1).

Estuarine submerged aquatic vegetation beds, composed largely of eelgrass (*Zostera marinus*), historically occurred within the New Bedford/Fairhaven Harbor but have all but disappeared (Howes and Goerhinger, 1992). The disappearance of eelgrass followed a general decline in Europe and North America in the decade between 1935-1945, and was attributed to "wasting disease" a phenomenon thought to have been caused by a general increase in summer temperatures (Day et al., 1989). Like other areas of the northeast, these aquatic beds are now most likely dominated by marine algae such as sea lettuce (*Ulva lactuca*), spaghetti grass (*Codium fragile*) and the red algae *Gracilaria spp*. or vascular plants such as widgeon grass (Tiner, 1985; Metzler and Tiner, 1992). SAV beds are especially high value to fish habitat since they provide strategic cover for juvenile diadromous fish.

Of the 20 EFH fish species listed for the project and disposal areas, five can be considered estuarine dependent. Estuarine dependent fish are those species of fish, which require estuarine habitats for some, if not all, of their life cycle. Among the 20 EFH fish species listed for the project areas, Day et al., (1989) listed the summer flounder, winter flounder, scup, and the black sea bass as estuarine dependent species. Typically, the primary estuarine habitats such as tidal creeks, salt marshes, and sea grass beds are used as nursery areas by many marine fish. These nursery areas are sought out by larval and juvenile life stages of the estuarine dependent fish, since not only do the estuaries tend to provide relative safety or protection from predators, but they also supply an abundant food source (through detrital food chains) with reduced competition at critical trophic levels (Day et. al., 1989). Typically, these species are adapted to survive in a dynamic environment subject to frequent environmental fluctuations. However, prolonged or permanent alterations of the physiochemical parameters of their environment (e.g., temperature, salinity, turbidity, dissolved oxygen) due to human-induced impact can be detrimental to the fish that reside in these estuarine habitats (Newcome and Jensen, 1996) or pass through them (Gibson, 1987).

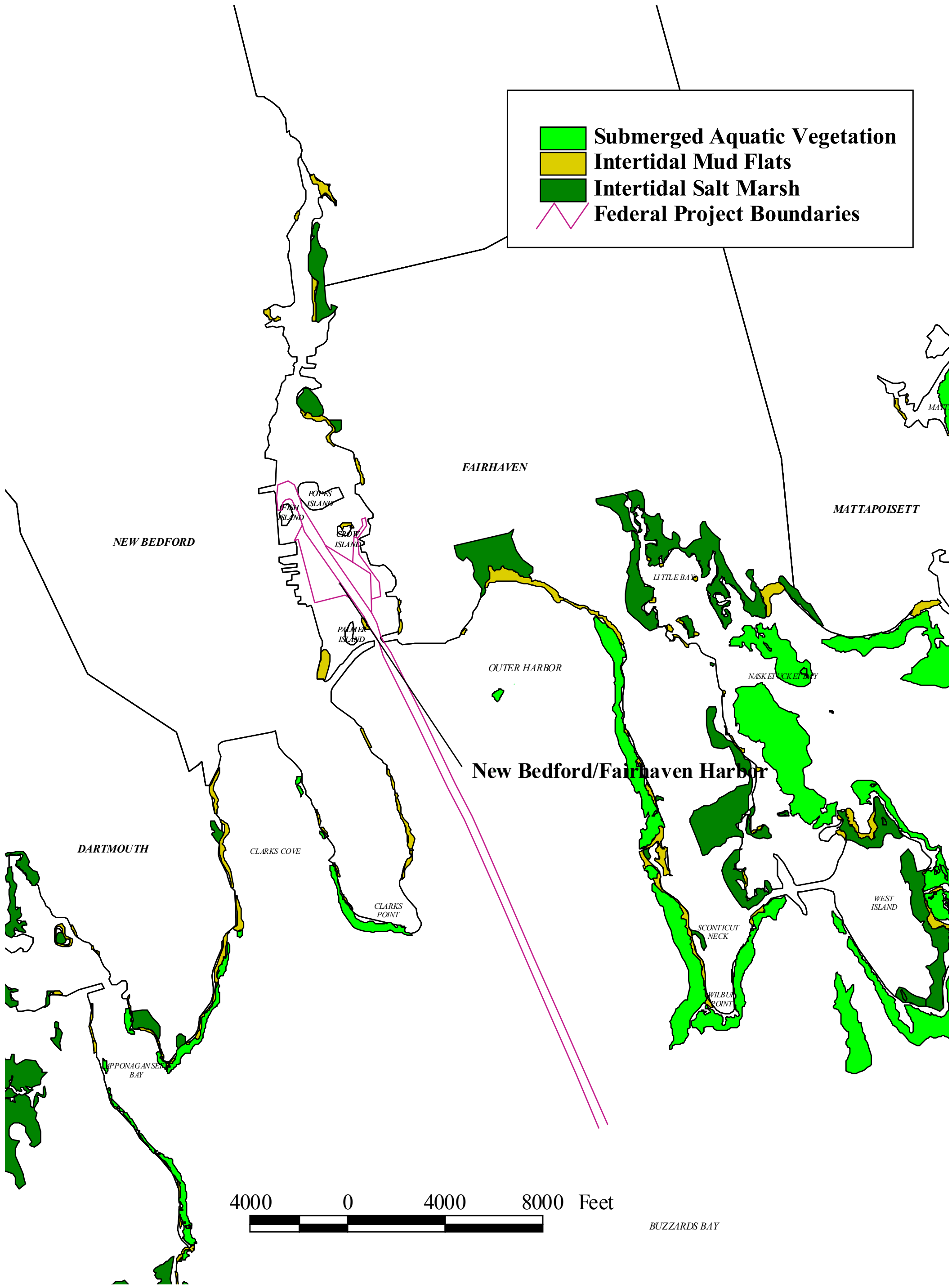

Figure 5-1. Marine Wetlands of New Bedford/Fairhaven Harbor and Proximity

Temporary disturbance generated by the proposed action could indirectly impact the five estuarine-dependent EFH fish species and additional anadromous fish (many of which are prey for EFH species) by generating turbidity in the bay, preventing or confounding movement of these species between the Acushnet River Estuary and more distal seawater offshore. This impact can have an additive negative effect on the ichthyofauna is coincident with other turbidity generating activities in the bay.

5.2.2 Aquaculture

Shellfish farming and depuration is an example of a common aquaculture activity in the northeast. Shellfish farming typically requires the dumping of shell spawn into appropriate waters. Harvesting requires raking and other disturbances to the benthic environment. These practices can cause the destruction of SAV beds; increased erosion of areas formerly stabilized by SAV; increased turbidity; loss of habitat complexity, juvenile refugia, or substrate; reduction in primary productivity; and increased wave energy resulting in juvenile displacement or strandings. The proposed action would not result in changes to aquacultural practices and therefore, would not negatively impact EFH species or their habitats.

The proposed preferred aquatic disposal sites do not contain any active commercial shellfish beds due to their proximity to contaminated water or sediment, or due to their proximity to navigation lanes. However suitable shellfish habitat exists within or proximal to both sites. The southwestern corner of the New Bedford Channel Inner site overlaps approximately 11 acres of the northeastern corner of the MDMF-designated "Shellfish Contaminated Relay Area No. 1" (Figure 5-2). This designated area contains suitable quahog, soft shell calm and oyster habitat. This portion of Shellfish Contaminated Relay Area No. 1 would receive direct impacts from construction of the CAD cell and disposal of UDM at the CAD cell. However, it will be a temporary loss of shellfish habitat. Given that re-colonization of disposal mounds is influenced, at least in part, by the benthos of the surrounding area and the larvae in the water column (Maurer et al., 1982a,b; Rhoads et al., 1978), quahog and soft shell clam are expected to re-colonize the area. This re-colonization rate, however, is expected to occur in stages (Stages I, II, III) and higher trophic level benthos such as most bivalve mollusks are typically part of the Stage II, II/III assemblage (Rhoads et al., 1978). Stage I organisms will re-colonize first, followed by succession to Stage II and Stage III. Monitoring will be needed to track the progress of recovery. Providing seed stock to the area could speed recovery.

5.2.3 Construction/Urbanization

Construction and general urbanization activities include road-building, land-clearing for development, excavation for utilities, etc. These activities typically result in a greater impervious upland surface area due to development of areas that formerly contained natural vegetation as the predominant land coverage. Increased urbanization is directly proportional to an increase in interception of precipitation producing greater runoff of untreated stormwater. Urbanization typically reduces habitat complexity, alters tidal

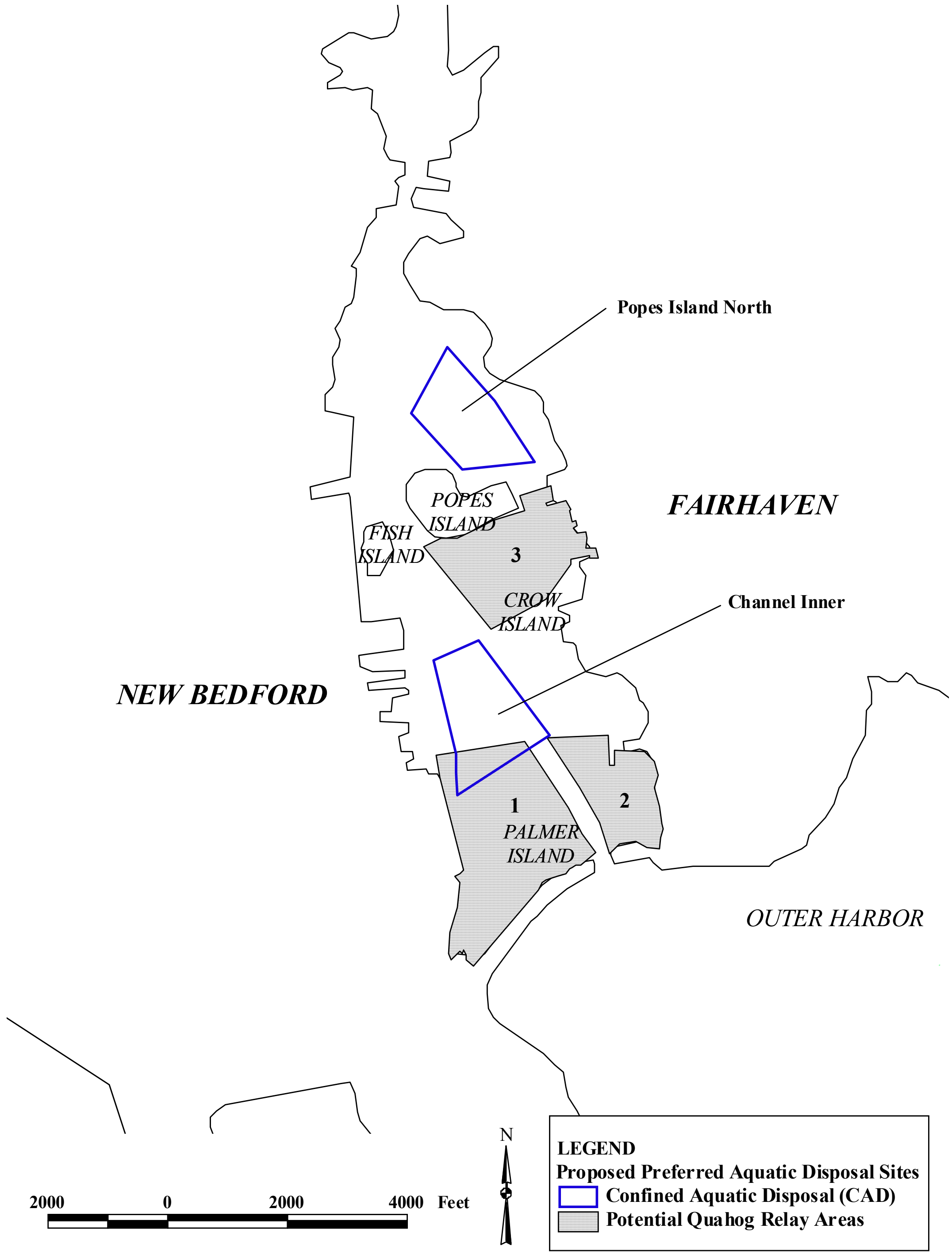

Figure 5-2. Potential Quahog Relay Areas in New Bedford/Fairhaven Inner Harbor

streams through channelization, decreases channel stability, and impairs water quality. It results in the increase of frequency and magnitude of flood events, and accelerated runoff rates result in lower stream flows during drier months by disrupting groundwater retention times. This typically impacts fish with extended freshwater larval or juvenile rearing stages of their life history. The net effect of urbanization is disruption of the hydrologic processes by increasing peak flows and decreasing low flows (CTDEP, 1995) Disturbance to sediments as a result of the proposed action would result in direct impact to EFH as discussed in Section 4.0.

5.2.4 Oil and Hazardous/Regulated Material Handling, Processing, Transport, Disposal.

Various exogenous chemicals have historically been or currently are transported by railroad, shipping, and roadways within the harbor and its watershed. These chemicals, when released through controlled loss, leakage, seepage, spills or deliberate disposal (either permitted or un-permitted), may enter the marine and estuarine ecosystems resulting in various acute and chronic toxicity responses to fish and their prey species. These substances and chemicals may be generated by various residential, commercial, industrial, municipal, institutional or military land uses. The various classes of chemicals are presented in Table 5-2.

The proposed action would result in safer oil, hazardous, or other regulated material (OHRM) handling, and transport within New Bedford Harbor since navigation channels would be maintained via dredging, resulting in safer shipping operations by reducing risk of navigation accidents that could result in the uncontrolled loss, spillage or release of this material in the harbor and adjacent waters.

Table 5-2. Various Classes of Exogenous Materials, Typical Representative Contaminants and Likely Contaminant Sources.

Contaminant Class	Typical Contaminants	Anthropogenic Contaminant Sources
Inorganic contaminants	Nutrients	Agricultural runoff, wastewater treatment plant discharges, excessive or improper fertilization
	Heavy metals	Atmospheric deposition, industrial discharge, wastewater discharges, leaching from treated wood used for in-water construction, flaking from defective painted surfaces
Organic contaminants	Petroleum compounds	Road and pavement surface water runoff, leaking aboveground and underground storage tanks, bilge and ballast water pump-outs, roadway oiling, tanker transfers and commercial ship fillings, other releases (accidental spills)
	Volatile organic compounds	Industrial, commercial discharges, chemical spills
	Insecticides, herbicides, fungicides, other biocides	Residential lawns and gardens, agricultural areas, nurseries, golf-courses, wood treatment facilities and treated wood structures
	Polyaromatic hydrocarbons	Roadway oiling, atmospheric deposition from fossil fuel combustion

Contaminant Class	Typical Contaminants	Anthropogenic Contaminant Sources
	PCBs	Industrial discharges, electrical transformers, flaking from defective painted surfaces
Biological Wastes	Sewage and sewage treatment wastewater	Municipal wastewater treatment plants, sewer pipelines, failing subsurface disposal systems, disposal lagoons and cess pools, marine facility dumping
	Animal wastes	Animal lots, feed lots
Radionucleides	Low-level radioactive waste	Biomedical wastes, chemical spills

Table created from multiple reference sources

5.2.5 Introduction/Spread of Invasive, Non-Native Species

The introduction of non-native invasive plants and animals to surface waters occurs either deliberately (e.g., to enhance sport fishing or to control aquatic weeds) or without knowledge or intent through various water-related activities, such as bilge or ballast water pump-outs, dumping of live bait and associated seaweed packing, aquaculture escapes, interbasin transfers of sediment and other material, and other inadvertent releases. Exotic species that have established themselves historically have done so to the detriment of native species. This detriment occurs as a result of competition, predation, hybridization or inhibition of reproduction, environmental modification (e.g., alteration of food webs), introduction of new parasites or pathogens, or a combination of these things.

The New Bedford/Fairhaven CAD cells would only receive sediment generated within the harbor itself, eliminating the risk of invasive species introduction via interbasin transfer of dredged materials. However, various species of non-native marine organisms representing a diverse array of taxa have become established in other harbors of the northeast such (e.g., the Hudson-Raritan Bay) via the discharge of ballast from ships that have visited foreign ports or ports outside of the faunal region. Therefore, New Bedford/Fairhaven Harbor will remain susceptible to potential future introductions of non-native species by other means.

5.2.6 Marina/Dock Construction

Impacts typically generated during dock or bulkhead construction, expansion, replacement or demolition activities typically occur as construction/ urbanization impacts discussed in Section 4.2.4 (i.e., removal of vegetation, turbidity and sedimentation, increased surface water runoff, etc.). However, the structures themselves introduce exogenous chemicals into the marine environment, the effects of which may not yet be totally understood, especially on a chronic toxicity level. Historically, wooden structures were treated with creosote or pentachlorophenol to prevent decomposition and decay by marine organisms. These structures have been implicated in the release of persistent polynuclear aromatic hydrocarbons into the aquatic environment. These substances have been phased out of production and have been replaced with chromated copper and copper-zinc arsenates, a class of compounds which may have their own toxicological concerns associated with their use due to potential release of toxic heavy metals over time. In fact, some studies suggest that copper-zinc arsenates may have higher acute toxicity than each of the individual metal toxicities (Walker, 1998). Toxicological effects of these exogenous chemicals span the gambit of those outlined in Appendix A.

No new marina and dock construction in New Bedford/Fairhaven Harbor is proposed for CAD cell operation and UDM management. UDM disposal would occur at the CAD cells via split hull scows independent of any in-water structures. Some marina/dock construction may result as an indirect effect of having an available disposal site for UDM, since some marinas may take the opportunity to maintenance dredge their access channels, thereby allowing bigger boats access to their facilities and requiring upgrades to existing marina facilities.

5.2.7 Removal of In-water Structures

Removal of in-water structures such as, reefs, rock ledges, jetties, vertical bulkhead or seawalls, and even wrecks could impact fish and EFH. This action is sometimes necessary to maintain safe navigation channels. The removal of navigational obstructions such as derelict pilings, dilapidated wharves, and shipwrecks and other long established structures, reefs, rock ledges, jetties, and bulkhead walls, could remove productive marine communities living within, on, or in association with the given structure. It acts to reduce habitat complexity, remove shelter, breeding, and feeding substrates. Typically, removal of these structures produces turbidity, may subject land areas to erosion, and may alter flows in embayments and tidal creeks. Removal of woody debris also removes a source of detrital nutrients for wood boring marine organisms. Norse and Watling (1999) cite various studies that have shown that the removal of structures and the reduction of habitat structural complexity have resulted in the favoring of sand-loving fish species and the loss of some commercially important species such as grouper and cod. No in-water structures have been identified within the CAD cells, therefore no removal of these structures would be required for CAD cell construction and operation.

5.2.8 Road-building and Maintenance

Impacts to fish and EFH from road building and maintenance are similar to those associated with urbanization/construction impacts (refer to Section 4.2.4). Typically, the major effects to wetland systems due to road building and maintenance projects are disruption/alteration of hydrologic regime, sediment loading and direct wetland removal (Mitsch and Gosselink, 1993). No new road construction would occur as a result of the proposed action.

5.2.9 Shipping Operations

Shipping operations are an integral part of the economic vitality of the harbor. New Bedford/Fairhaven Harbor serves as homeport for commercial fishing fleets, destination port for commercial barges and container shipping, and a terminal for passenger ferries.

In addition, the harbor has been developed with marinas and mooring areas that support, recreational fishing party boats, and many pleasure crafts. Shipping related activities that impact fish and EFH include oily bilge water/ballast water discharge, oil release from shipping accidents, ship wakes, and ship-induced wave energy. Release of oily wastewater into the water column can produce the same toxicological, behavioral, and developmental effects as outlined in Appendix A. Wave energy and wakes generated by shipping operations can produce erosion of beach sediment, displacement of juveniles and larval fishes and can cause juvenile strandings when waves over-wash rocks, jetties and beach areas. Changes to shipping operations in the form of increased activity, could occur as an indirect result of the proposed action. Identification of CAD disposal sites may result in increased maintenance of shipping channels allowing for better service of larger commercial ships.

5.2.10 Wastewater/Pollutant Discharge

Wastewater discharge to surface waters occurs via direct discharges (point sources) such as sewage treatment plants, power-generating facilities, and industrial effluents, or via non-discrete surface runoff (non-point sources), such as agricultural runoff, runoff from over-fertilized lawns and gardens, and runoff from parking lots and roadways. Other pollutant discharge can occur via atmospheric deposition, accidental release or spills, and via intentional discharge or disposal such as via pump-outs of oily bilge water or via the disposal of unsuitable dredge or fill materials. Pollutant discharges can also occur from the seepage of contaminated groundwater into the harbor from landside contaminated sites.

Wastewater/pollutant discharges can impact fish and EFH via acute and chronic toxicity to various pollutants (Appendix A), via turbidity effects (discussed in Section 4.0) and via depletion or reduction of dissolved oxygen in the water column or benthic sediment. Implementation of the proposed action could reduce the risk of spills associated with shipping accidents, since maintenance of the navigation channels (made possible by establishing UDM disposal sites) would allow safer operation of ships in the harbor. However the disposal of UDM represents a temporary and controlled source of pollutant discharge since disposal of the UDM into the CAD cell produces a sediment plume that is in direct contact with the overlying water column. However, after cessation of the UDM management activity, the CAD site would be capped, thereby eliminating the pathway of contaminated sediment exposure to the overlying water column.

5.2.11 Habitat Restoration

Habitat restoration projects usually occur as a result of wetland mitigation requirements in response to impacts from other projects such as new roadway or bridge construction. However habitat restoration sites typically fail to replicate the value of the originally impacted habitat for the following reasons (Hammer, 1992):

- Inaccurate assessment of physical processes governing the system;
- Inadequate knowledge of the habitat's community ecology;

- Inadequate assessment of the original cause of habitat degradation;
- Ineffective restoration efforts;
- The lack of pristine reference sites proximal to the restoration area;
- Failure to set appropriate monitoring or performance standards;
- Focus on benefit to a single species rather than the community; and
- Focus on mitigating losses rather than on preventing loss.

No habitat restoration projects are included as part of the proposed action. Mitigation of direct, potential indirect, and cumulative impacts would be achieved through conformance to required permits and approvals, development and adherence to a disposal site monitoring plan, and implementation of CAD cell best management practices (discussed in Section 6.0).

6.0 MITIGATION

Barring anthropogenic disturbances, the four main factors influencing fish habitat preference within a marine environment are temperature, salinity, depth and substrate. Although the EFH designation quadrants list 20 species within the 10' x 10' coordinate EFH quadrants applicable to the project area, variations in environmental factors typically prevent these species from being uniformly distributed throughout the quadrant's aerial coverage.

Therefore, to accurately assess impacts to the EFH listed species, the temperature, salinity, depth, and substrate of the marine environment within the aerial extent of the project limits as well as within influence of the project limits (e.g., down current, or adjacent, etc.) were considered when assessing impact to EFH species. Table 6-1 is provided as a summation of the EFH species habitat requirements presented previously in Section 3.0 (Data gaps in Table 6-1, denoted as "⊗", reflect areas where more research may be currently needed). The information provided in Table 6-1 was used as a screening tool to determine which species may likely occur within the thermal, salinity, and depth ranges of the proposed project area.

Table 6-1. Summary of Temperature, Salinity, Depth and Substrate Requirements of Fish Species Listed for the Project Ares EFH Quadrants.

Species	Life History Stages	Temperature (°C)	Salinity (ppt)	Depth (meters)	Habitat
Atlantic Cod	Eggs	<12	32-33	<110	surface waters
	Larvae	<10	32-33	30-70	pelagic waters
	Juvenile	<20	30-35	25-75	cobble or gravel
	Adult	<10	⊗	10-150	cobble, gravel, rock
Haddock	Eggs	<10	34-36	50-90	surface waters
	Larvae	<14	34-36	30-90	surface waters
Red Hake	Larvae	<19	>0.5	<200	none (water column)
	Juveniles	<16	31-33	<100	shell fragment or live sea scallop bed
	Adults	<12	33-34	10-130	sand and mud
Winter Flounder	Eggs	<10	10 – 30	<5	sand, mud, gravel
	Larvae	<15	4-30	<6	⊗
	Juveniles	<28	5-33	0.1-10	mud, fine sand
	Adults	<15	5.5-36	<6	sand, mud, gravel
Windowpane Flounder	Eggs	<20	⊗	<70	⊗
	Larvae	<20	⊗	<70	⊗
	juveniles	<25	5.5-36	1-100	mud or fine sand
	adults	<27	5.5-36	1-75	mud or fine sand
American Plaice	Juveniles	<17	34-20	45-175	fine-grained sediments, sand, gravel

Species	Life History Stages	Temperature (°C)	Salinity (ppt)	Depth (meters)	Habitat
	adults	<17	32	<90	all substrate types
Atlantic Sea Herring	juveniles	<10	26-32	15-135	⊗
	adults	<10	>28	20-130	sand, gravel, cobble, shell fragment
Bluefish	juveniles	15-30	23-33	shallow	sand, silt, mud, clay
	adults	15-25	>25	⊗	⊗
Atlantic Butterfish	larvae	4.4-27.9	0.5-25	near surface	associated with floating cover
	juveniles	4.4-29.7	3-37.4	10-330	sand and mud
	adults	4.4-26	3.8-33	10-420	⊗
Long-finned Squid	juveniles	10-26	31.5-34.0	upper 10	none (water column)
	Adults	4-28	⊗	0-305	pelagic waters
Atlantic Butterfish	Eggs	11-17	25-33	0-1829	pelagic waters
	Larvae	9-19	6.4-37	10-1829	pelagic waters
	Juveniles	3-28	3-37	10-365	pelagic waters some over sandy and muddy substrates
	adults	3-28	4-26	10-365	pelagic waters over sandy, sandy-silt and muddy substrates
Atlantic Mackerel	Eggs	5-23	18->30	0-15	pelagic waters
	Larvae	6-22	>30	10-130	pelagic waters
	juveniles	4-22	0.5->25	0-320	⊗
	adults	4-16	0.5->25	0-381	sand and mud
Summer Flounder	eggs	⊗	⊗	winter: 110 fall: 30-70 spring: 9-30	pelagic waters
	larvae	>4	>25	10-70	none (water column)
	juveniles	>4	0.5-25	0.5-1.5	sand
	adults	⊗	0.5->25	up to 152	submerged aquatic vegetation
Scup	eggs	13-23	>15	<30	pelagic waters in estuary
	larvae	13-23	>15	<20	pelagic waters in estuary
	juveniles	>16	>15	⊗	sand, mud, mussel, eelgrass
	adults	>16	0.5->25	<30	⊗

Species	Life History Stages	Temperature (°C)	Salinity (ppt)	Depth (meters)	Habitat
Black Sea Bass	larvae	11-26	30-35	<100	near coastal areas into marine parts of estuaries; become demersal setting to structured beds
	juveniles	⊗	⊗	surface-38	rough bottom
	adults	>6	0.5->25	⊗	rocky
Surf Clam	juveniles	16-26	⊗	8-66	⊗
	adults	16-26	≈28	8-66	med. to coarse sand and gravel; silty sand
King Mackerel	all life stages	>20	>30	surf to shelf break zone	sandy shoals and high profile, rocky bottoms
Spanish Mackerel	all life stages	>20	>30	surf to shelf break zone	sandy shoals and high profile, rocky bottoms
Cobia	all life stages	>20	>30	surf to shelf break zone	sandy shoals and high profile, rocky bottoms, *sargassum* and seagrass beds
Sandbar Shark	adults	30	high	coastal waters to 200	none (water column)
Bluefin Tuna	juveniles	>12	≥25	25-200 m isobaths	none (water column)

Source: NOAA, NMFS and MAFMC
⊗ = Information not available

The dredging activities conducted for the project area are likely to have some temporary impacts on EFH species in New Bedford/Fairhaven Harbor. Generally speaking, eggs and larvae are the more vulnerable life cycle stage to dredging related impacts than juveniles or adults due to the relative immobility of the former two life stages when compared to the latter two (i.e., juveniles and adults can avoid dredging and disposal-related disturbance by leaving the impact area) (USACE-NED, 2001).

Not all fish species will incur the same degree of impact. For instance, demersal fish species such as flounders are more susceptible to impacts than pelagic species since most dredging related disturbance occurs near the bottom (USACE-NED, 2001). Those species with demersal eggs such as winter flounder are highly susceptible to impacts of dredging than those with pelagic (planktonic) eggs suspended within the water column. The eggs and larvae of species with demersal eggs may be killed from exposure to elevated concentrations of suspended solids and associated water quality impacts. While adult and juvenile demersal and pelagic fish can avoid a sediment plume produced by dredging, small larval fish (and juvenile fish of species that reside on the bottom following metamorphosis from their larval stage) are less able to swim away from impact areas.

Avoidance and mitigation measures would be implemented to reduce potential impact of the proposed action on fisheries resources. Avoidance and mitigation strategies specific to the identified work areas are discussed below.

6.1 CONFORMANCE TO REQUIRED PERMITS AND APPROVALS

Development of either of the preferred alternative disposal sites will require permits and approvals from local, state and federal regulatory agencies. Table 6-2 provides a listing of the required permits and approvals for each of the proposed preferred alternatives. A complete analysis of the permitting requirements and specific regulatory standards for each of the permitting and approval programs is included in the DEIR. Ongoing coordination with the USEPA and USACE will also explore potential beneficial use of clean material (i.e., material dredged at the CAD cell sites to create UDM capacity) for potential use in harbor-wide wetlands restoration projects.

6.2 DEVELOPMENT AND ADHERENCE TO DISPOSAL SITE MONITORING PLAN

A disposal site management and monitoring plan (management plan) will be developed by a Technical Advisory Committee (TAC) composed of local, state, and federal interests. The purpose of a management plan is to determine the specific actions and responsibilities necessary to ensure that disposal site use protects human and environmental health and resources. A management plan addresses where, when, and how a disposal site can be used, what kind of short and long-term monitoring will be required, and establishes who is responsible for every aspect of site use, management, and monitoring. The management plan will also determine what kind of material can be safely disposed of, and what testing may be necessary to determine the nature of the material proposed for disposal.

Table 6-2: Potential Local, State and Federal Permits and Approvals Required for Aquatic UDM Management

JURISDICTION	PERMIT/ APPROVAL	AGENCY	AQUATIC DISPOSAL
			CAD Cells
	Section 10 ***Permit*** - Review of projects in navigable waters of the United States	Corps of Engineers	Y
	Section 103 ***Permit*** - Approves transport of suitable dredged material to ocean disposal site	Corps of Engineers	Y
FEDERAL	***Section 404 Permit*** - Determines compliance with guidelines for discharges of dredged or fill materials into waters of the United States	Corps of Engineers	Y

	MCZM Consistency Concurrence - Evaluation of a project□s consistency with MCZM□s policies and management principles	MA Coastal Zone Management	Y
	MEPA Certification on DEIR and FEIR - Decisions of Secretary of Environmental Affairs on DEIR and FEIR and compliance with MEPA	MA Environmental Policy Act	Y
STATE	***Chapter 91 License*** - Approves structures/activities below mean low water mark	DEP: Division of Wetlands & Waterways	Y
	Water Quality Certification - Controls impacts to water quality and determines compliance with state water quality standards	DEP: Division of Wetlands & Waterways	Y
LOCAL	***Wetlands Order of Conditions*** - Protection of Wetland Resource Area and compliance with WPA performance standards.	Local Conservation Commissions	Y

Notes: Concurrence required for construction and operation of dewatering site. Structural or use changes associated with harbor-side dewatering may require approval.

MCZM anticipates that comments from the City and Town on this DEIR will recommend the appropriate local membership for the TAC. For the recent dredging project in Boston Harbor, the management plan was developed by a TAC composed of a core group of City representatives, state and federal agencies, scientists from UMASS and MIT, and environmental interest groups, and was open to any members of the public who wished to participate. The DEIR suggested a similar strategy for New Bedford/Fairhaven Harbor.

It is important to note that (1) the final, approved management plan would be the basis for the local, state and federal permits required for use of the disposal sites; and (2) no final approval for any disposal sites would occur until a management plan is developed, presented for public comment in the FEIR, and approved by city (i.e., New Bedford), town (i.e., Fairhaven), state and federal regulatory agencies.

6.3 CAD CELL BEST MANAGEMENT PRACTICES

MCZM has developed Draft Best Management Practices (BMPs) for CAD of UDM in New Bedford/Fairhaven Harbor based on the experiences and data from the Boston Harbor Navigation Improvement Project (BHNIP). The Draft BMPs are included in Appendix L. The BMPs have been developed to meet state and federal water quality criteria and standards under CWA s. 404, 314 CMR 9.00, other applicable regulations. The Draft CAD BMPs have been developed with input and participation of applicable state and federal agencies.

The BMPs are designed to be effective regulatory tools, where effective means:

- Appropriately protective of resources and uses;
- Cost-effective;
- Yield unambiguous results to the maximum extent practicable;
- Contribute directly to performance review (decision-making); and
- Applicable by non-specialist regulatory agency staff.

6.4 SITE-SPECIFIC ENVIRONMENTAL DATA

The expected impacts of the proposed preferred alternative disposal sites were evaluated in the DEIR based upon the following: harbor specific information gathered during the DMMP process; previous studies of New Bedford/Fairhaven Harbor and the Buzzards Bay region; studies done at other New England ports (e.g. Boston Harbor) and disposal sites; and laboratory studies of the effects of dredging and related activities. While the selection of the preferred alternative in this DEIR is supported by the above data, the DEIR recognizes that additional site-specific information is needed to complete the MEPA process and subsequent federal and state permitting. Additional site-specific efforts that could be undertaken in support of continuing the MEPA and/or permitting processes for further development of final CAD cell design concepts include the following:

- Additional Geotechnical borings to confirm bedrock depth and side slope stability;
- Macrobenthic sampling and identification;
- Current meter measurements and basic water column chemistry;
- Dredging and disposal event modeling and hydrodynamic analysis;
- Underwater archaeological surveys; and
- Physical and chemical analysis of subcell surficial sediments.

7.0 CONCLUSIONS

The proposed action could result in local, temporary impact to EFH for at least one federally managed fisheries resource, and various prey organisms of other EFH species. Potential impacts generated by the proposed actions include localized impairment to water quality, destruction of benthic habitat, and direct effects to EFH species and other marine organisms. Indirect effects to EFH species and other marine organisms within the area may occur due to the alterations of energy flow, habitat structure, and biotic interaction. The most significant impact to fisheries resources due to the proposed action could occur within the Inner Harbor. Certain fisheries resources within the Inner Harbor were identified as particularly sensitive to UDM management and resultant turbidity-induced impacts due to their demersal egg and larval stages, or due to their migration or hibernation habits.

The fisheries resources within New Bedford/Fairhaven Harbor identified as particularly susceptible to dredging and turbidity induced impacts include the winter flounder and anadromous fish. Winter flounder eggs are demersal and attach to benthic substrate and, therefore, are susceptible to removal via dredging and via smothering during the re-settlement of sediment from the water column. Winter flounder begin spawning once water temperatures reach 8-9^{o}C. Peak spawning occurs in February and larvae remain proximal to their nursery areas through June.

Anadromous fish runs between Buzzards Bay and the Acushnet River begin in the early spring with rainbow smelt returning first. Alewife and blueback herring follow in April. Restoration of anadromous fish runs in the Acushnet River Estuary has been identified as a priority by NOAA-Fisheries, Restoration Center (J. Turek, NOAA Fisheries, personal communication). Therefore, to avoid these critical time periods UDM management activities should not commence until June.

Impacts associated with UDM disposal are considered temporary and reversible. Potential turbidity-induced impacts to the water column are expected to be comparable to the magnitude of natural events incurred during seasonal storms and peak discharges from the Acushnet River. The duration of increased turbidity of the water column during dredged sediment disposal activity at the CAD cells is estimated to be less than one hour. Therefore, water column turbidity should return to pre-disposal conditions. Avoiding disposal during peak flood and ebb tides could minimize turbidity transport.

Other water quality parameters (such as DO, chlorophyll *a* concentration, nutrients, and contaminant concentrations) are predicted to cause minimal temporal changes to the water column and, therefore, are not expected to have a permanent adverse impact to EFH species.

No historical evidence has been presented that directly links sediment disposal at other aquatic disposal sites to increased fish mortality. The fish communities in the area of other aquatic disposal sites continues to thrive and no apparent adverse effect on the local or regional biota due to sediment disposal has been established (USACE-NYD, in press).

Impact to motile marine life, especially finfish species, due to injury from sediments descending through the water column would be minimized by various factors similar to those described for the Historic Area Remediation Site in the New York Bight. These factors include: regulating disposal to a relatively small contact area (i.e., subcell), sequential placement of the sediment within a pre-determined grid, and increased chance of finfish flight caused by vessels operating within the relatively shallow waters of the Inner Harbor (USACE-NYD, in press).

Local disruptions to the predator/prey cycle within the Inner Harbor may occur during discharge of the sediment since many EFH species are known to feed on organisms inhabiting the harbor, especially benthic invertebrates that have colonized the sediment within the CAD cells. Many of the EFH species and certain motile invertebrate prey species will flee the disposal area during release of the sediment. Other prey species such as sessile invertebrates (e.g., shellfish, and colonial invertebrates) would be buried. Some invertebrates are capable of digging themselves out once covered by sediment, whereas others would be eliminated via suffocation. Recolonization of the sediment surface would occur following cessation of dumping within the CAD cell. Those EFH species that feed on pelagic and planktonic organisms would most likely experience minimal disruption to their feeding (USACE-NYD, in press).

Based on the results of this EFH assessment, impact to susceptible federally managed (EFH) fish species from the proposed action appears to be limited to winter flounder. However the potential impact area would be minimal in comparison to the more prime and less disturbed habitat available to this fish elsewhere in the region, since the density of winter flounder within the project area is expected to be low due to routine disturbance by vessel traffic serviced by the urban harbor. Impact to prey species such as anadromous fish could also occur but would be minimized by avoidance of dredging during sensitive life cycle habits (e.g., migration). Other prey species such as sessile benthic marine invertebrates would be directly impacted by removal of sediment from the project area, and disposal of the sediment at the CAD cells. However, this impact would only be temporary as adjacent source populations are expected to re-colonize the disturbance areas. Other mitigation techniques outlined in Section 6.0 would further reduce the potential impact of dredging and disposal.

As a result of this EFH assessment dredging should be avoided from February 1 to June 1 in any given calendar year. Refraining from UDM management during this time period will avoid potential impacts to winter flounder spawning, larval stages in the nursery and will avoid impact to spring anadromous fish runs.

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- Atlantic Surf Clam (*Spisula solidissima*)
- Black sea bass (*Centropristis striata*)

- Bluefin tuna (*Thunnus thynnus*)
- Bluefish (*Pomatomus saltatrix*)
- Atlantic butterfish (*Peprilus triacanthus*)
- Cobia (*Rachycentron canadum*)
- King mackerel (*Scomberomorus cavalla*)
- Long-finned squid (*Loligo pealeii*)
- Sandbar shark (*Charcharhinus plumbeus*)
- Spanish mackerel (*Scomberomorus maculatus*)
- Summer Flounder (*Paralichthys dentatus*)
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Appendix A. Various Contaminant Classes and some of their Toxic Effects to Fish and Shellfish

Contaminant Class	Contaminant type	Reproductive effects	Behavioral Effects	Growth	Physiological	Cellular/ Molecular
Chlorinated compounds	Chlorine Polychlorinated Alkanes (or chlorinated paraffins) PCA's		- Inhibited spawning - Avoidance - Diminished or no startle response, loss of equilibrium (Cooley et al., 2001)	Develop dark coloration (Cooley et al., 2001)	- Reduction in filtration rate, foot activity index and byssus thread production in mussels (Rajagopal, et al., 1997) - Liver lesions - Inflammation (Cooley et al., 2001)	- Membrane disruption - Increase in Hepatic aryl hydrocarbon hydroxylase activity - Hepatocyte necrosis - Glycogen/lipid depletion (Cooley et al., 2001)
Petroleum products	Oil Gasoline Diesel	- Premature/delayed hatching in eggs - Alteration in reproductive schedules or behavior - Disruption of egg respiration - Reduced resistance to environmental stress which can contribute to reproductive failure. (Freedman, 1989)	- Alterations in: • Feeding • Migration • Reproduction • Swimming activity • Schooling behavior (Freedman, 1989) - Avoidance	- Fin erosion - Gill and epithelial hyperplasia - Enlarged liver - Reduced growth (Freedman, 1989) - Cartilage dysplasia - Abnormal branching and fusion of lamallea. (Spies, et al., 1996)	- Change in heart and respiration rates (Walker et al., 1998) - Impaired endocrine system - Suppression of immune system (Freedman, 1989) - Aneurysms - Histopathological lesions on the liver kidney and gills (Spies, et al., 1996)	- Cellular abnormalities - Blood changes - Membrane disruption (Freedman, 1989)
Pesticides/ Herbicides	Organophosphate	Estrogen disruption (Freedman, 1989)	Avoidance			- Depressed brain enzyme function (acetylcholinesterase) (Freedman, 1989) - Serine esterase inhibition in the brain, muscle, gill, liver and plasma. (Straus and Chambers, 1995)
Pesticides/ Herbicides	Organochlorine (e.g., endosulfan, DDT)	- Decreased fertility and fecundity. - Early oocyte loss. (O'Connor, 1993)		- Alterations to the histoarchitecture of the heptopancreas and gills. - Thickening of basal laminae - Abnormal gill tips (Bhavan and Geraldine, 2000)	- Hemocytic infiltration of the interstitial sinuses, - Necrosis of the tubules of the heptopancreas - Accumulation of hemocytes in the hemocoelic space - Swelling and fusion of the lamellae, hyperplastic, necrotic and clavate-globule lamellae of the gills. (Bhavan and Geraldine, 2000)	- Depressed brain enzyme function (acetylcholinesterase) (Freedman, 1989) - Increased micronuclei frequency - Alterations in the absorption, storage and secretion of the heptopancreas - Alterations in respiration, osmotic and andionic regulations of the gills (O'Connor, 1993)
Pesticides/ Herbicides	Carbamate	Males less likely to approach females		- Decreased hatching size - Abnormal spine development	- Decreased heart rate throughput embryonic development. - Tail lesions	
Pesticides/ Herbicides	Pyrethrins	- Reduces/inhibits male responses to female priming pheromone in Atlantic salmon. - Reduced number of fertilized eggs (Moore and Waring, 2001)			Impacts the pheromonal mediated endocrine system in mature male Atlantic salmon (Moore and Waring, 2001)	
Aromatics	In General	Inhibits ovarian development	- General behavioral responses impaired or impacted (Freedman, 1989) - Avoidance	Neoplasms in bivalve mollusks (Walker et al., 1998) and flatfishes (O'Connor, 1993)	- Suppression of immune system response (Freedman, 1989) - Skin lesions - Liver disorders (McMahon, 2001)	Damage to liver DNA (Freedman, 1989; O'Connor, 1993)

Appendix A (Continued). Various Contaminant Classes and some of their Toxic Effects to Fish and Shellfish

Contaminant Class	Contaminant type	Reproductive effects	Behavioral Effects	Growth	Physiological	Cellular/ Molecular
Metals	In General	Imposex in whelks and other *Nucella* spp. (Walker, 1998)		Delayed growth and development in larval and embryonic clams	- Elevated body – burden - Change in enzyme function due to change in enzyme configuration (Freedman, 1989)	- Antagonistic competition of other cation uptake (Walker, 1998) - DNA damage due to: • metal binding, • disruption of transcription; • inability to produce specific proteins (esp. enzymes) - Changes in heamoglobin concentrations and hematocrit values - Changes in red and white blood cell numbers - Changes in plasma and protein concentrations
	Chromium		Avoidance		- Aenemic conditions occur resulting in decreased oxygen utilization and hypoxia - Osmoregulation is influenced - Metabolism is decreased. (VanVuren and Nussey, 2001)	- Increases in mean corpuscular volume and delta-aminolevulinic dehydratase activity - Decreases in blood pH (VanVuren and Nussey, 2001)
	Copper					Changes in: • Ammonia levels • antibody titters • glucose concentrations • plasma salt levels • protein concentrations • haematocrit values • hemoglobin concentrations • white and red blood cell counts (VanVuren and Nussey, 2001)
	Mercury	Reduced gonadosomatic index and testicular atrophy (Friedman et al., 1996)		Reduction in fish length/weight (Friedman et al., 1996)	Impairs immune function (Friedman et al., 1996)	Suppresses plasma cortisol (Friedman et al., 1996)
	Manganese	High fish egg mortalities (VanVuren and Nussey, 2001)			Gill damage occurs resulting in: • internal hypoxia • reduced oxygen utilization • impaired osmoregulation • altered metabolic processes (VanVuren and Nussey, 2001)	- Changes in mean corpuscular volume - Increases in delta-aminolevulinic dehydrase and glucose-6-phosphates dehydrogenase activities - Decreases in plasma sodium and protein concentrations - Increase in plasma potassium, calcium, chlorides, glucose and lactate (VanVuren and Nussey, 2001)
	Lead				- Anemia - Lowering of blood sugar due to damage of the kidney tubules or depression of gluconeogenesis in the liver. (VanVuren and Nussey, 2001)	- Inhibition of heamoglobin synthesis and delta-aminolevulinic dehydrase activity. - Stimulation of alkaline phosphatase but inhibition of some enzymes involved in energy metabolism. - Disturbed ion balance, - Significant and persistent hypoglycaemia - Increases in blood lactate, mean corpuscular volume and cholesterol levels in circulating blood and tissues. (VanVuren and Nussey, 2001)
	Zinc	Egg production is reduced (VanVuren and Nussey, 2001)	- Increase in agnostic behavior by dormant individuals. (VanVuren and Nussey, 2001) - Three successive responses of fish to Zinc poisoning: • surfacing, • overturn and • immobilization of gill opercula	Gill damage	- Interference with the respiratory surface causing historical gill damage, impaired oxygen consumption. - Increased mucous production, coughing frequency, and ventilatory aberrations. - Reduced heart rate - Suppression of immune response	- Fall in arterial-blood oxygen tension, - Decrease in blood pH (acidosis), - Reduction in oxygen available to tissues (hypoxia) - Changes in: • Blood lactate concentration • Leucocrit and cortisol levels • Delta-aminolevulic dehydrase activity • Liver and serum proteins • Blood glucose concentration • Ammonia levels

Appendix A (Continued). **Various Contaminant Classes and some of their Toxic Effects to Fish and Shellfish**

Contaminant Class	Contaminant type	Reproductive effects	Behavioral Effects	Growth	Physiological	Cellular/ Molecular
Surfactants	e.g. Nonyl-phenol	Decreased spermatogenesis (LeGac et al., 2001)	Inhibited gonadal development (LeGac et al., 2001)		Increase in blood plasma vitellogenin in juvenile or mature male trout (LeGac et al., 2001).	- Disrupts germ cell membrane receptivity to peptide Hormones (LeGac et al., 2001) - Endocrine disrupting effects on sex steroid production
	Polychlorinated Biphenyls (PCB's)	- Birth defects - Reduced spawning success (Holm et al., 1998)		Neoplasms (McMahon, 2001)	Fin erosion (McMahon, 2001)	- Increased micronuclei frequency (O'Connor, 2001) - Lipid accumulation in liver (Holm et al., 1998)
	Polyaromatic Hydrocarbons (PAH's)	High concentrations are acutely toxic to flatfish eggs		Hepatic neoplasms (O'Connor, 2001)		
	Fluorescent Aromatic Hydrocarbons (FAC's)	Disrupts vitellogenesis in female fish				Decreases levels of endogenous estradiol in female fish possibly resulting from depressed ovarian steroidogenesis. (O'Connor, 2001)
Sulfides				Discourages planktonic larval settlement of invertebrates	Various adverse effects to physiological functions (Teodora, 1992)	Adversely effects enzymes, oxygen transport proteins and cellular structure (Teodora, 1992)
Viruses				Neoplasms (Walker et al., 1998)		
Nutrients			- Lethargy, - Gulping of surficial air. - Inhibited consumption of phytoplankton; - Avoidance		- Hypoxia - Increased occurrence of BT algae	Increases in haematocrit as a result of swelling of red blood cells and/or fluid loss to the tissue with a subsequent decrease in plasma volume.

APPENDIX B
EFH ASSESSMENT WORKSHEET (05/14/01 v.)

PROJECT NAME: New Bedford/Fairhaven Harbor DMMP EIR
DATE: March 2002
PROJECT NO.: EOES No. 11669
LOCATION: New Bedford/Fairhaven Harbor, MA
PREPARER: MACZM

Step 1. Generate the species list from the EFH website for the geographic area of interest. Use the species list as part of the initial screening process to determine if EFH occurs in the vicinity of the proposed action. Attach that list to the worksheet because it will be used in later steps. Make a preliminary determination on the need to conduct an EFH Consultation.

1. INITIAL CONSIDERATIONS		
EFH Designations	YES	NO
Is action located in or adjacent to EFH?	X	
Is EFH designated for eggs?	X	
Is EFH designated for larvae?	X	
Is EFH designated for juveniles?	X	
Is EFH designated for adults?	X	
Is there Habitat Areas of Particular Concern (HAPC) at or near project site?		X
Does action have the potential to adversely affect EFH for any life stages checked above to any degree? If no, consultation is not required. If yes, consultation is required –-complete remainder of worksheet.	X	

Step 2. In order to assess impacts, it is critical to know the habitat characteristics of the site before the activity is undertaken. Use existing information, to the extent possible, in answering these questions. Please note that, there may be circumstances in which new information must be collected to appropriately characterize the site and assess impacts.

2. SITE CHARACTERISTICS	
Site Characteristics	**Description**
Is the site intertidal/sub-tidal/water column?	Sub-tidal
What are the sediment characteristics?	Section 2.1.3 (page 2-5)
Is there HAPC at the site, if so what type, size, characteristics?	No
Is there submerged aquatic vegetation (SAV) at or adjacent to project site? If so describe aerial extent.	No
What is typical salinity and temperature regime/range?	Section 2.1.4 (page 2-6)
What is the normal frequency of site disturbance, both natural and man-made?	Annual natural disturbance (i.e. storms, peak discharge). Disposal cell would remain open for one dredging season within a five year window
What is the area of proposed impact (work footprint & far afield)?	CAD Cell Footprints Pope's Island North Cell = approx. 60 ac; Channel Inner Cell = approx. 40 ac.

Step 3. This section is used to describe the anticipated impacts from the proposed action on the physical/chemical/biological environment at the project site and areas adjacent to the site that may be affected.

3. DESCRIPTION OF IMPACTS			
Impacts	**Yes**	**No**	**Description**
Nature and duration of activity(s)			Maintenance Dredging-Disposal of material at HARS-approx. 4 week duration – Section 2.2.1(page 2-2)
Will benthic community be disturbed?	X		Section 4.2 (page 4-4 – 4-5)
Will SAV be impacted?		X	
Will sediments be altered and/or sedimentation rates changed?	X		Existing surficial sediments and underlying strata will be removed to design depth and replaced with disposed UDM. Upon capacity of CAD site, UDM will be capped with clean sand to a recessed elevation in comparison to surrounding sediment (Section 4.2 - Page 4-4)
Will turbidity increase?	X		Temporary increase in turbidity will occur during dredge and disposal activity – Section 4.1.1 (page 4-1)
Will water depth change?	X		The proposed project would maintenance dredging to return shipping lanes, turning basin and pier berths to authorized federal navigation/operating depths – Section 2.0 (page 2-1 - 2-2)
Will contaminants be released into sediments or water column?	X		Varying concentrations of certain contaminants have historically been detected in project area sediments – Section 4.1.2 (page 4-2)
Will tidal flow, currents or wave patterns be altered?		X	
Will ambient salinity or temperature regime change?		X	
Will water quality be altered?	X		Proposed action may result in temporary but reversible physical and chemical impact to water column – Section 4.1 (page 4-1 – 4-4)

Step 4. This section is used to evaluate the consequences of the proposed action on the functions and values of EFH as well as the vulnerability of the EFH species and their life stages. Identify which species from the EFH species list (generated in Step 1) will be adversely impacted from the action. Assessment of EFH impacts should be based upon the site characteristics identified in Step 2 and the nature of the impacts described in Step 3. The Guide to EFH Descriptions on the website should be used during this assessment to determine the ecological parameters/preferences associated with each species listed and the potential impact to those parameters.

4. EFH ASSESSMENT			
Functions and Values	**Yes**	**No**	**Describe habitat type, species and life stages to be adversely impacted**
Will functions and values of EFH be impacted for:			
Spawning	X		With proposed avoidance/ mitigation strategies, impact to spawning winter flounder, their eggs and larvae would be negligible – Section 6.1 (pages 6-4 – 6-5)
Nursery	X		Reversible impacts may temporarily impair nursery habitat functions and values
Forage	X		Various finfish species could temporarily lose a source of forage from removal of benthic marine invertebrates from the project area – Section 4.2.1 (page 4-4)
Shelter		X	
Will impacts be temporary or permanent?			With proposed mitigation, impact to regional fisheries will be temporary and reversible
Will compensatory mitigation be used?		X	Planning, avoidance strategies, monitoring, and implementation of Best Management Practices are proposed – Section 6.0